Electronic Measuring Instruments

2019

Since 1895

Anritsu

Electronic Measuring Instruments

Optical Measuring Instruments

- Network Master Pro
  - OTDR Module
- Network Master
  - µOTDR Module
  - Optical Channel Analyzer Module
- ACCESS Master
- Coherent OTDR
- Card OTDR
- OTDR Module
- Optical Loss Tester/Light Source/Optical Power Meter
- Optical Spectrum Analyzer
- Video Inspection Probe Series
  - Autofocus Video Inspection Probe
  - Video Inspection Probe
- Optical Fiber Identifiers
- Visual Fault Locator
- Bare Fiber Adapter

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Bit Error Rate Tester (BERT)/Oscilloscope

- Signal Quality Analyzer-R
- Signal Quality Analyzer
- 56G/64G bit/s MUX/DEMUX
- 4Tap Emphasis
- BERTWave

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IP/Network Measuring Instruments

- Network Master Pro
  - 10G Multirate Module
  - 100G Multirate Module
  - High Performance GPS Disciplined Oscillator
  - CPRI RF Module
- Network Master Flex
  - 10G Multirate Module
  - 100G Multirate Module
  - 40/100G Advanced Module
- Network Master
  - Gigabit Ethernet Modules

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Mobile/Wireless Communications Measuring Instruments

- Radio Communication Test Station
- Signalling Testers
- Rapid Test Designer (RTD)
- 5G NR Mobile Device Test Platform
- LTE-Advanced Mobile Device Test Platform
- LTE-Advanced RF Conformance Test System
- Simple Conformance Test System
- Radio Communication Analyzers
- ACE RNX Channel Emulator
- Spider
- Universal Wireless Test Set
- Shield Box
- Vector Signal Generator
- Handheld Direction Finding System
- Mobile Interference Hunting System
- Cell Master
- BTS Master High Performance Handheld Base Station Analyzer
- Bluetooth Test Set
- Wireless Connectivity Test Set
- PIM Master
- TRX NEON Signal Mapper

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Signal Analyzers/Spectrum Analyzers

- Signal Analyzers
- High Performance Waveguide Mixer
- V2X 802.11p Message Evaluation Software
- Spectrum Master High Performance Handheld Spectrum Analyzer
- Spectrum Master Ultraportable Spectrum Analyzer
- Spectrum Master Compact Handheld Spectrum Analyzer
- Remote RF Signal Monitoring
- Remote Spectrum Monitor
- Spectrum Monitoring System

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Vector Network Analyzers

- VectorStar
  - Broadband Vector Network Analyzers
  - Vector Network Analyzers
  - Microwave Vector Network Analyzer
- ShockLine
  - 1-Port Vector Network Analyzers
  - Compact USB Vector Network Analyzers
  - Economy Vector Network Analyzers
  - Performance Vector Network Analyzers
  - 2-Port Calibration Unit
  - 2-Port and 4-Port Calibration Units
- VNA Masters
- LMR Master
- Site Masters
- Microwave Site Master
- VNA Calibration Kits
- VNA Verification Kits
- O/E Calibration Module

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Signal Generators

- RF/Microwave Signal Generators
- Analog Signal Generator

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RF Microwave Measuring Instruments

- Power Meters
- Wideband Peak Power Meters
- Inline Peak Power Sensor
- USB Power Sensors
- Microwave Universal USB Power Sensors
- Microwave CW USB Power Sensor
- mmWave Power Analyzer

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Components

- RF Fuse Holder
- Fuse Element
- Fixed Attenuators for High Power Measurement
- Four-port Junction Pad
- 2Way/4Way Low Amplitude Error Divider
- Resistive Power Tap
- Precision RF & Microwave Components
- H-Field Isotropic Antenna
- E-Field Isotropic Antenna
- Low Reflection 4-Way Power Divider
- 2:1 Multiplexer
- 1:2 Demultiplexer
- T-Flip Flop
- Differential Branch Amplifier
- 28 Gbaud Quad Linear EA Driver

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Peripheral Equipment

- Coaxial Cords, Adapters
- F-series Cabinets

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Optical Devices

- 1.31/1.55 µm LD Module
- 1.48 µm LD Module
- 1.4 µm FBG LD Module
- 1.48 µm Cylindrical Module
- 1.31/1.55/1.65 µm SLD Module
- 1.3 µm SOA Module

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Anritsu, as a cutting-edge company in the ICT services industry, is operating its test and measurement business globally to support the building of the next generation of networks.

In the information and telecommunications field, the utilization of Internet of Things (IoT) services is progressing. In addition, the standardization of the 5G system has advanced, and efforts to start commercial service from 2019 to 2020 are full-scale.

Since its establishment in 1895, Anritsu has blazed the trail as a pioneer of information communication and consistently contributed to creating new values. In the 5G/IoT fields, we have further improved measurement technology and enhanced our customer support which we have been cultivating throughout the mobile broadband forefront, while delivering optimal Time To Market solutions.

The slogan that represents these efforts is the Anritsu Group brand statement: "envision: ensure". This message conveys our strong thoughts of sharing the dream of social change with our customers and continuing the challenge to realize it.

Anritsu is proud to contribute to the new innovation of society, with over 120 years of technological advances and the know-how that we have amassed in collaboration with our customers.

Headquarters

Corporate Information

Headquarters

Anritsu Corporation
5-1-1 Onna, Atsugi-shi, Kanagawa 243-8555, Japan

First founded as Sekisan-sha in 1895.

Established as Anritsu Electric Corporation on March 17, 1931.

Paid-up capital: 19,064 million yen (as of March 31, 2018)

Sales volume: 85,967 million yen (consolidated)
(Year ended March 31, 2018)

Employees: 3,717 (consolidated) (as of March 31, 2018)
844 (non-consolidated) (as of March 31, 2018)

Sales Network

Anritsu Company (United States)
Anritsu Electronics Ltd. (Canada)
Anritsu Eletrônica Ltda. (Brazil)
Anritsu Company S.A. de C.V. (Mexico)
Anritsu EMEA Ltd. (United Kingdom)
Anritsu S.A. (France)
Anritsu GmbH (Germany)
Anritsu S.r.l. (Italy)
Anritsu AB (Sweden/Finland)
Anritsu EMEA Ltd. Representation Office in Russia (Russia)
Anritsu EMEA Ltd. Representation Office in Spain (Spain)
Anritsu EMEA Ltd. Dubai Liaison Office (United Arab Emirates)
Anritsu (China) Co., Ltd. (P.R. China, Shanghai)
Anritsu Company Ltd. (P.R. China, Hong Kong)
Anritsu Corporation (Japan)
Anritsu Company Inc. (Taiwan)
Anritsu Corporation, Ltd. (Korea)
Anritsu Pte. Ltd. (Singapore)
Anritsu India Private Limited (India)
Anritsu Pty. Ltd. (Australia)

R&D and Manufacturing

Anritsu Corporation (Japan)
Tohoku Anritsu Co. Ltd. (Japan)
Anritsu Company (United States)
Azimuth Systems, Inc. (United States)
Anritsu Ltd. (United Kingdom)
Anritsu A/S (Denmark)
Anritsu Solutions S.r.l. (Italy)
Anritsu Solutions S.R.L. (Romania)
Anritsu Solutions SK, s.r.o. (Slovakia)
Anritsu Philippines, Inc.(Philippines)

ISO9001/14001

Electronic Measurement Instruments products contained in this catalogue are manufactured under a quality management system and environment management system in conformance to the ISO international standards.

Factory Location	Standards	Certificate Number	Registration Date	Certification Body
Atsugi, Japan	ISO9001	JQA-0316	Nov. 15, 1993	Japan Quality Assurance Organization (JQA)
	ISO14001	JQA-EM0210	Aug. 28, 1998	
Tohoku, Japan	ISO9001	JQA-0316	Nov. 15, 1993	
	ISO14001	JQA-EM0210	Aug. 28, 1998	
U.S.A.	ISO9001	13013	Apr. 27, 1995	National Quality Assurance, U.S.A.
	ISO14001	EN12275	Mar. 29, 2007	

Quality and Reliability Assurance for Products

Planning Stage

Management resources are focused on measuring instruments related to growing fields such as mobile Internet, WDM and digital broadcasting, system solutions, and device businesses. New products are planned to provide solutions whenever required by customers.

Design Stage

To realize a design with high-safety and high-reliability, several levels of design assessments are performed. Power consumption is reduced from the viewpoint of environment considerations, starting with evaluation of specifications, legal regulations and parts used. Evaluations are also implemented for improving the recycling ratio, and the design quality is improved.

Anritsu utilizes a design process that targets customer satisfaction.

Evaluation Stage

In addition to safety, reliability and environment considerations of test models for new products, functions and performance are verified by an operating environmental conditions test and operability, uncertainty, maintainability and flexibility of design are evaluated fully. After passing these tests, the products can be commercialized.

Manufacturing and Inspection Stages

Based on our policy, “post-processing is the customer,” the product is manufactured by experienced employees according to the workmanship standards. In the adjustment and inspection stage, automatic measurement is promoted. An expert will be in charge of the adjustment if high-skilled adjustment is required.

After Sold

In each service department, traceability assurance by calibrations based on high-technical capabilities, as well as rapid repair and preventive maintenance are performed.

Parts Standardization and Improving Activities for Quality and Reliability

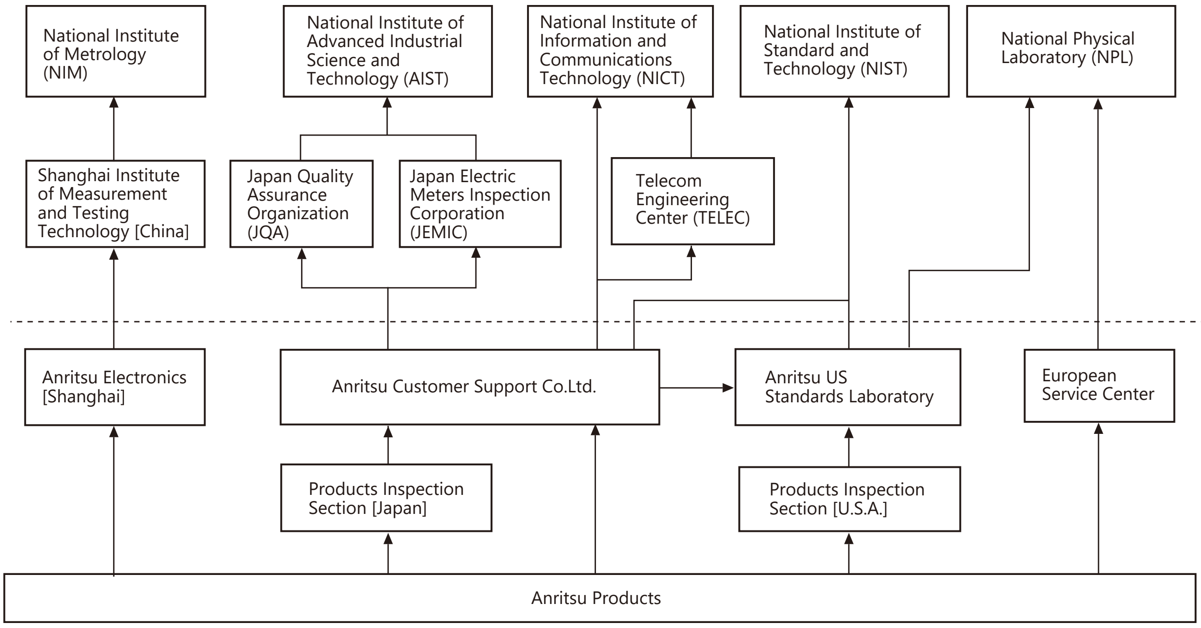
For parts generally used in each measuring instrument, quality improvement and standardization are actively promoted.

All field data is analyzed, arranged and completely made known to each department while required actions are taken for reliability improvement. In addition, failure rate, MTBF observation and parts failure rate are calculated based on this information.

Traceability Assurance

As defined in the International vocabulary of metrology – Basic and general concepts and associated terms (VIM)-JCGM 200: 2008, property of a measurement result whereby the result can be related to a reference, usually national or international standards, through a documented unbroken chain of calibrations. Anritsu system to ensure traceability is shown below.

Traceability System



Standard Products

All measuring instruments appearing in this catalog are standard products. For information on non-standard instruments please contact us.

New Products

Identifies products introduced in the period from November 2017 to October 2018.

Excellent Eco Product

Products conformed to environment-friendly criteria uniquely set by ourselves is called “Excellent Eco Product.”
For the details of the mark and environment-friendly criteria, please refer to Anritsu Corporation home page.

Specification Changes

We reserve the right to discontinue any item without notice and to change specifications at any time without incurring any obligation to incorporate new features in instruments or parts previously sold.

Numerical Values Used in This Catalog

All numerical values are expressed according to the following units:

- Output Voltage of Signal Generator
  The output voltage expressed in a unit of dB or dBμ is calibrated in terms of e.m.f. (open circuit output voltage). 1 μV is equal to 0 dB or 0 dBμ.
- Input Power of Level Meter
  The input power is expressed in a unit of dBm which is terminated by nominal impedance. 0 dBm is equal to 1 mW.
  Even if the input power is applied to the “high” impedance input terminal, the indicated value is calibrated as mentioned above.
- Power Supply Voltage
  Any rated voltage between 100 V and 240 V is available. Normal operation can be obtained within ±10% of each rated voltage (however, maximum permissible operating voltage is 250 V).
- Ambient Temperature, Rated Range of Use
  “Ambient temperature, rated range of use” in the specifications represents the range of ambient temperature, which guarantees values given in specifications.
- External Dimensions
  External dimensions are indicated in width, height, and depth in millimeters, and do not include controls, fittings, or stands.

About Exchanged Parts when Adding Options, Upgrade and Making Repairs

As a rule, exchanged parts are not returned to customers; Anritsu handles disposal of exchanged parts.

Accessories

Two types of accessories are available: Supplied and Optional.
All instruments include the cost of supplied accessories, including fuses and one operation (or instruction) manual in English. The cost of optional accessories, however, is not included and, therefore, the optional accessories will be supplied only on request.

Measuring Cords

The measuring cord in the accessory column is indicated in the sequence of Connector · Cord · Connector.
A type S connector is compatible to a type N.

Exchanged Parts when Adding Options and Making Repairs

As a rule, exchanged parts are not returned to customers; Anritsu handles disposal of exchanged parts.

Technical Publications

In this catalog you will notice that an outline of usage, noteworthy points, and standards have been prepared. If further information is required please contact us directly. We will be happy to send you the technical publications of your choice.

Windows XP

Microsoft stopped releasing Windows XP security updates on April 8, 2014 in line with its termination of the extended support Windows XP security update program. Some Anritsu products use the embedded Windows XP program, but these products can still be used in accordance with the description of the usage conditions in the Instruction Manual without problems even after the end of the extended support program. Contact our sales agents for more details about products supporting OS updates.

CE and RoHS Non-compliant Products

The following products in this catalog are not compliant with European CE and RoHS regulations.
Moreover, even RoHS-compliant standalone products may sometimes be non-compliant depending on usage in combination with other ordered products and models. Consult our business section for more details.
Additionally, contact our business section regarding CE and RoHS compliance of application parts and accessories.

RoHS Non-compliant Products	
BIT ERROR RATE TESTER (BERT)/OSCILLOSCOPE	
4Tap Emphasis	MP1825B
MOBILE/WIRELESS COMMUNICATIONS MEASURING INSTRUMENTS	
Shield Box	MA8120E
Spider	SPI-100 Series
VECTOR NETWORK ANALYZERS	
SIGNAL GENERATORS	
RF/Microwave Signal Generator	MG3690C
RF MICROWAVE MEASURING INSTRUMENTS	
Power Meters	ML2430A Series
Wideband Peak Power Meter	ML2480B Series
Wideband Peak Power Meter	ML2490A Series
Precision RF & Microwave Components	RF/µWave Components
Some Options are not RoHS compliant	
MOBILE/WIRELESS COMMUNICATIONS MEASURING INSTRUMENTS	
Signalling Tester	MD8475A/MD8475B
LTE-Advanced Mobile Device Test Platform	ME7834LA
LTE-Advanced RF Conformance Test System	ME7873LA
Radio Communication Analyzer	MT8820C
Radio Communication Analyzer	MT8821C

Order by Model Number

When ordering, please specify the model number and name of the instrument desired, for example, "MD8475A Signalling Tester."
To prevent misunderstandings, include all necessary specifications and specific instructions in your order. That is to say, include all special options or features such as special color, nonstandard power line voltage, etc. To expedite your order we suggest that you contact us directly.

Shipment

Generally, instruments will be shipped within two months of receipt of your order. In the case of "Build-to order products" mentioned in the footnotes, shipment may take from 4 to 7 months. Every endeavor will be made to maintain delivery dates, but no liability is accepted for loss, damage, or delay of instruments, for reasons which are out of our control.

Terms

Unless previous terms have been arranged, we will use one of the following:

- Full payment in advance of shipment
- Sight draft against an irrevocable confirmed letter of credit

Quotations and Pro Forma Invoices

FOB, CIF, C&F, etc., quotations, and pro forma invoices are available on request. The instrument price includes a packing charge.

Inspection Surcharge

An inspection surcharge is applied to all orders requiring inspection by government agencies or individually appointed inspectors at our factory.

Special Products Build-to-order

Requests for remodeling standard products for special use will be accepted, but only after detailed discussions.

Returning Instrument for Repairs

When returning the instrument to Anritsu for repairs, the following suggestions will help us return it to you in the shortest possible time:

- Send complete instructions about what you would like done to the instrument.
- If possible, include the "symptoms" or "defects."
- Indicate the return address and, if different, the address to be used for billing purposes.

All repairs and recalibrations are carried out at our factory.

Extension Service

The normal warranty term is one year, but may be extended to three or five years as an option when purchasing equipment.
For three or five years extension service, please ask your local Anritsu Field Office or Sales Representative for price and availability.

- Windows® is a registered trademark of Microsoft Corporation in the USA and other countries.
- Pentium® is a registered trademarks of Intel Corporation or its subsidiaries in the USA and other countries.
- LTE logo is a trademark of the European Telecommunications Standards Institute (ETSI).
- WiMAX® is a trademark or registered trademark of WiMAX Forum.
- CDMA2000® is a registered trademark of the Telecommunications Industry Association (TIA-USA).
- Bluetooth® and related logomarks are owned by Bluetooth SIG, Inc. and are used by Anritsu under license.
- LabWindows and LabVIEW are registered trademarks of National Instruments.
- MATLAB® is a registered trademark of The MathWorks, Inc.
- Other companies, product names and service names are registered trademarks of their respective companies.

WARRANTY

All other expressed warranties are disclaimed and all implied warranties for this product, including the warranties of merchantability and fitness for a particular purpose, are limited in duration to a period of one year from the date of delivery. In no event shall all Anritsu group be liable to the customer for any damages, including lost profits, or other incidental or consequential damages arising out of the use or inability to use this product.

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OPTICAL MEASURING INSTRUMENTS

BIT ERROR RATE TESTER (BERT)/OSCILLOSCOPE

IP/NETWORK MEASURING INSTRUMENTS

MOBILE/WIRELESS COMMUNICATIONS MEASURING INSTRUMENTS

SIGNAL ANALYZERS/SPECTRUM ANALYZERS

VECTOR NETWORK ANALYZERS

SIGNAL GENERATORS

RF MICROWAVE MEASURING INSTRUMENTS

COMPONENTS

PERIPHERAL EQUIPMENT

OPTICAL DEVICES

The All-in-one Supports the Various Needs of Fiber I&M

ACCESS Master

MT9085 Series

1.31/1.55/1.49/1.625/1.65 µm (SMF), 0.85/1.3 µm (MMF)

The ACCESS Master MT9085 series is a compact handheld all-in-one tester for performing OTDR tests, optical loss/power measurements, and optical fiber end-face inspections. It has a wide variety of applications, ranging from installation and maintenance (I&M) of trunk fibers (Core, Metro, Access, Mobile Fronthaul, Mobile Backhaul) to troubleshooting Access networks, such as breaks in drop cables.
As well as keeping the intuitive operability of previous models using hard keys and rotary knob, the MT9085 has been upgraded with a wide, 8-inch color LCD touchscreen. The Fiber Visualizer function has also been taken to the next stage with at-a-glance confirmation of the optical fiber transmission path.

(For further information see page 43)

All-in-One 5G Signaling and RF Tests

Radio Communication Test Station

MT8000A

5G NR is a new communications standard intended to increase communications speed and capacity to more than 100 times that of the current LTE standard. It is required to support advances in wireless communications technologies, such as greatly expanded communications bandwidth and use of mmWave, which is not supported by earlier mobile communications.
Anritsu is releasing its new MT8000A solution supporting 5G NR RF measurements and Protocol tests needed to support advances in communications technologies in line with the development of 5G NR.

(For further information see page 174)

Frequency Selectable mmWave Power Analyzer

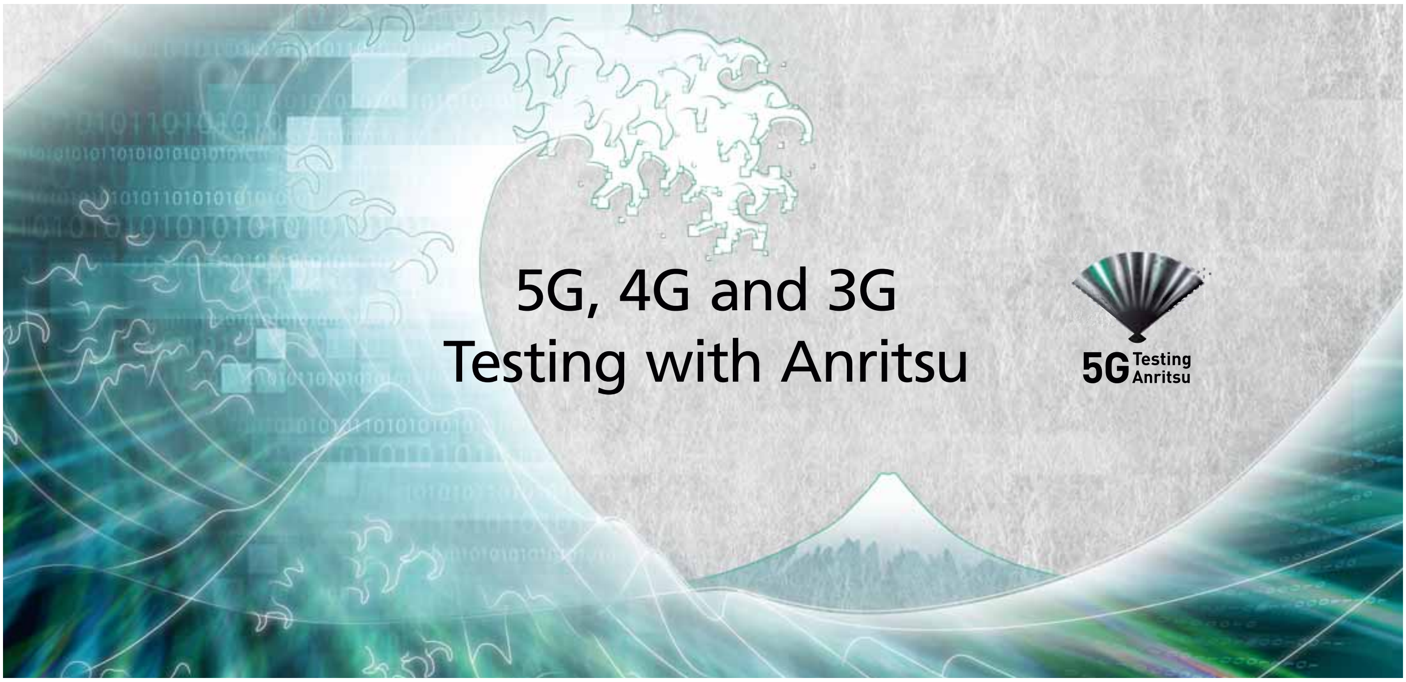
mmWave Power Analyzer

MA24510A

9 kHz to 110 GHz

Power Master is an ultraportable, USB-powered mmWave power analyzer that enables simple, numeric, frequency-based measurement of RF power from 9 kHz to 110 GHz and as low as –90 dBm. Traditional power meters are broadband and have limited power ranges, so engineers and technicians are using spectrum analyzers that include many unneeded features, cost hundreds of thousands of dollars, and take up half the test bench just to make simple, frequency-based RF amplitude measurements. The Power Master MA24510A enables those measurements in a USB-powered device slightly bigger than a smartphone and at a fraction of the price of a spectrum analyzer.

(For further information see page 931)



Anritsu continues,

Timely, optimum, high-quality measurement solutions

Extensive lineup and experience from Wireless to Wired leading to 3G, 4G to 5G

Measurement solution corresponding to the utilization of 5G technology such as IoT, Automotive

We will contribute to customer's 5G product development and future innovation of network.

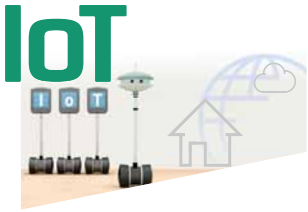
5G Innovation

The appearance of fifth-generation (5G) mobile systems using different technologies than previous 3G and 4G (LTE) systems, such as inclusion of both wireless and wired technologies, is driving large network (social infrastructure) innovations.
These 5G innovations are spreading into industrial fields with accelerating development of self-driving vehicles and the "connected car" in the automotive world. IoT (internet of things) using these 5G innovations is spreading with feasibility and prototype testing in various fields, including automotive, medical, security, construction (remote sensing), and entertainment.

With the start of 5G applications various new services are appearing, causing increased data traffic volumes that are adversely impacting not only wireless access but are also spreading to base stations, transmission equipment, and data centers.

With a wealth of experience in wireless to wired technologies, Anritsu is ideally positioned to assist with tailored measurement solutions for every field, including 5G, IoT, automotive, data center, and more.

Please visit https://www.anritsu.com/test-measurement/technologies/5g-everything-connected for details.



Introduction to Products for 5G

R&D : Research and Development **QA** : Quality Assurance **Mfg** : Manufacturing Test **I&M** : Installation and Maintenance

Radio Communication Test Station MT8000A

R&D

The Radio Communication Test Station MT8000A is an all-in-one tester simulating a 5G base station and supports sub-6 GHz to millimeter Wave (mmWave) including Band n41 as well as RF protocol tests. Combined use with an RF converter and Over The Air (OTA) chamber offers powerful support for development of 5G chipsets and mobile terminals at the various frequencies selected by 5G operators worldwide.

(For further information see page 174)

5G NR Mobile Device Test Platform ME7834NR

R&D **QA**

The 5G NR Mobile Device Test Platform ME7834NR is the test platform for 3GPP based Protocol Conformance Tests (PCT) and Carrier Acceptance Testing (CAT) of mobile devices incorporating Multiple Radio Access Technologies (RAT).
The ME7834NR covers the 5G frequency bands defined by 3GPP including sub-6 GHz and mmWave when combined with an OTA chamber and RF converter.

(For further information see page 190)

Spectrum Analyzer/Signal Analyzer MS2850A

R&D **QA** **Mfg**

The Spectrum Analyzer/Signal Analyzer MS2850A supports evaluation of TRx characteristics at R&D of 5G NR (sub-6 GHz, mmWave) devices. It is also for researching new applications and base stations using 5G NR. It includes a built-in vector signal analyzer covering a frequency range of 9 kHz to 32 GHz/44.5 GHz with a maximum analysis bandwidth of 1 GHz. The high-speed, large-capacity digitizer function coupled with optional modulation analysis function combine to offer a high-performance, multifunction, benchtop signal analyzer with excellent cost-performance ratio for both R&D and manufacturing applications.

(For further information see page 447)

Spectrum Analyzer/Signal Analyzer MS269xA

R&D **QA** **Mfg**

The Spectrum Analyzer/Signal Analyzer MS269xA series supports evaluation of the TRx characteristics at R&D of sub-6 GHz band 5G NR chipsets, communications modules, smartphones, and other radio equipment. The series is also for researching new applications using 5G NR. The MS269xA includes a built-in vector signal analyzer using wideband FFT analysis up to 125 MHz as well as other optional modulation analysis, vector signal generator and BER measurement functions in an all-in-one, high-performance, multifunction, benchtop signal analyzer.

(For further information see page 414)

Vector Signal Generator MG3710A

R&D **Mfg**

The Vector Signal Generator MG3710A is a high-general-purpose signal generator with excellent RF performance and baseband functions for outputting modulation signals required by communications systems, including 5G NR (sub-6 GHz), LTE, etc. It has a 2-waveform addition function for tests combining wanted and interference/AWGN waveforms, as well as an optional 2nd RF output.

(For further information see page 332)

Universal Wireless Test Set MT8870A

Mfg

The Universal Wireless Test Set MT8870A is targeted at mass-production line applications for manufacturing 5G NR sub-6 GHz smartphones, tablets, communications modules, IoT devices, etc. Up to four TRx test modules can be installed for simultaneous parallel measurement of various technologies including LTE, NB-IoT, Cat-M, V2X, WLAN, Bluetooth, and of course the latest 5G NR.

(For further information see page 289)

Vector Network Analyzer ShockLine™ Series

R&D

The ShockLine™ series features a full line of compact, low-cost, vector network analyzers (VNA) for measuring the S-parameters and performing time-domain analyses of 5G mmWave components and devices.

(For further information see pages 699, 705, 717, 729, 746)

Network Master Pro MT1000A

I&M

The Network Master Pro MT1000A is a portable handheld tester for evaluating the transmission quality of different communications networks operating at speeds from 10 Mbps to 100 Gbps. The all-in-one design supports 5G base-station interface eCPRI/RoE throughput and delay measurements as well as high-accuracy time synchronization tests.

(For further information see page 138)

BERTWave™ MP2110A

Mfg

The all-in-one BERTWave MP2110A is for BER measurement and Eye pattern analysis of eCPRI/RoE optical modules used by 5G networks. Simultaneous measurement and analysis help increase work efficiency while the built-in sampling oscilloscope supporting NRZ to 53-Gbaud PAM signals enables Eye pattern analysis of bit rates ranging from CPRI to eCPRI/RoE.

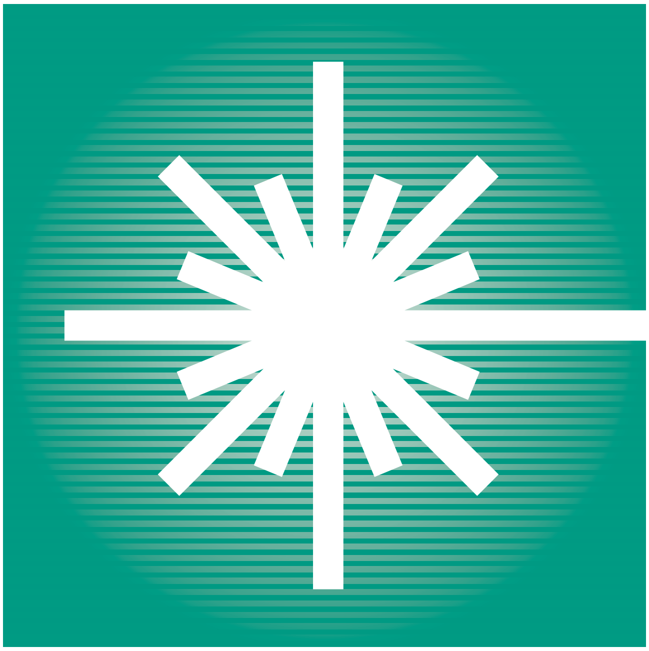
(For further information see page 122)

ACCESS Master MT9085 Series

I&M

The ACCESS Master MT9085 Series is a compact, portable optical-fiber tester with built-in OTDR and optical power and loss measurement functions for efficient I&M of optical fiber lines between 5G base stations, data centers, etc.

(For further information see page 43)



OPTICAL MEASURING INSTRUMENTS

Selection Guide

Application / Model/Name		Optical Power		Light Source Wavelength		Loss			Optical Identification		Optical Return Loss Measurement	Fiber Evaluation		Laser Diode Testing	Others	Remarks
		Low Level	Medium/High Level	Spectrum	Wavelength	High-loss	High Accuracy	Loss-wavelength	Identification	Loss		Fault Location	Splice Loss			
Light Source/ Handheld Power Meter	CMA5 Series	✓	✓			✓	✓	✓	✓	✓						0.85 µm to 1.625 µm
Optical Spectrum Analyzer	MS9740A	✓	✓	✓	✓	✓		✓						✓		0.6 µm to 1.75 µm
OTDR Module	MW9077A/A1/A2/B						✓		✓	✓	✓	✓	✓			1.31/1.55/1.625 µm (SM)
	MW9087B/D						✓		✓	✓	✓	✓	✓			1.55/1.65 µm
ACCESS Master	MT9085A/B/C		✓				✓		✓	✓	✓	✓	✓			0.85/1.3 µm (MM), 1.31/1.49/1.55/1.625/1.65 µm (SM)
Coherent OTDR	MW90010A						✓		✓	✓	✓	✓	✓			1535.03 nm to 1565.08 nm
Network Master Pro	MU100020A/MU100021A/ MU100022A		✓				✓		✓	✓	✓	✓	✓			0.85/1.3 µm (MM), 1.31/1.55/1.625 µm (SM)
Network Master	MU909014/15		✓				✓		✓	✓	✓	✓	✓			1.31/1.55/1.625/1.65 µm
	MU909020A		✓		✓										✓	CWDM network analyzer
Optical Fiber Identifier	FI700 Series								✓							0.8 µm to 1.7 µm
Visual Fault Locator	VFL650								✓							635 nm
Video Inspection Probe	G0382A/G0306B														✓	

Optical Connector Options for Anritsu Optical Measuring Instruments

A variety of optical connectors are used with optical fibers.

Specify the option number, model name, and number of the optical connector from the table below according to the type of optical connector you use. If no specification is made, an FC-type connector will be supplied.

For combinations marked with "✓" symbols in the table, the required instrument can be supplied according to the order.

For connectors without "✓" symbols or which do not appear in the table, consult your sales representative. For measuring equipment with more than one control panel, specify only the connector connected to the measured fiber. Be sure to consult us before ordering, particularly for optical connectors for single-mode fibers, to avoid trouble with connectors not fitting.

Optical connectors may be designed for either flat-polished or PC-polished ends. Some measuring instruments use connectors only for PC-polished ends; consult the literature on the instrument before specifying the connector option.

Model/Name		Connector Option Number						
		25	26	37	38	39	40	43
		FC-APC key width 2.0 mm*1	SC-APC*1	FC	ST	DIN 47256	SC	HMS-10/A (SM)*2
Light Source/Optical Power Meter	CMA5 Series	For connector and product numbers, please refer to individual product page.						
Optical Spectrum Analyzer	MS9740A			✓*3	✓*3	✓*3	✓*3	
OTDR Module	MW9077A/A1/A2/B	✓	✓	✓*2	✓*2	✓*2	✓*2	✓*2
	MW9087B/D			✓*3	✓*3	✓*3	✓*3	✓*3
ACCESS Master	MT9085A/B/C	✓	✓	✓*3	✓*3	✓*3	✓*3	
Network Master Pro	MU100020A/MU100021A/ MU100022A	✓	✓	✓*3		✓*3	✓*3	
Network Master	MU909014/15			✓*3		✓*3	✓*3	
	MU909020A	✓	✓	✓*3			✓*3	
Coherent OTDR	MW90010A			✓*3	✓*3	✓*3	✓*3	✓*3

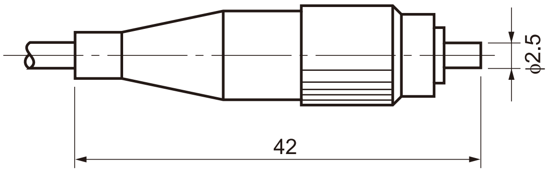
*1: Ferrule type; APC (angled PC)
*2: Ferrule type; PC
*3: Ferrule type; PC (user replaceable and cleanable)

No marking: Ferrule type; Flat and PC.

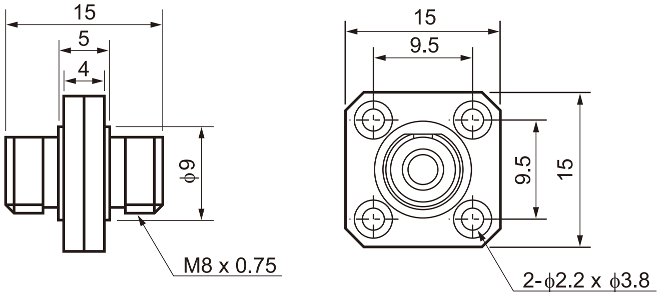
Unit in mm

Option 25: FC-APC key width 2.0 mm (angled convex)
Option 37: FC (flat, convex)

Plug

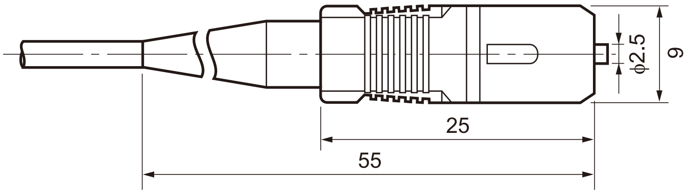


Adapter

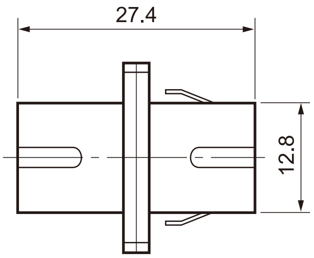


Option 26: SC-APC (angled convex)
Option 40: SC (flat, convex: PC)

Plug

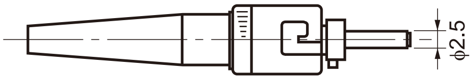


Adapter

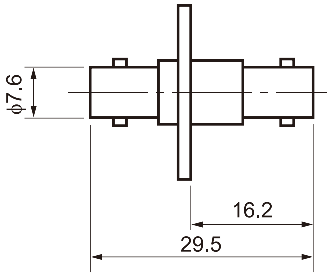


Option 38: ST (flat, convex: PC)

Plug

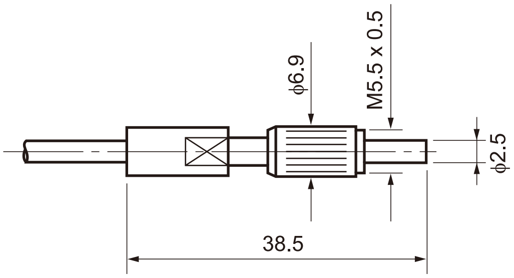


Adapter

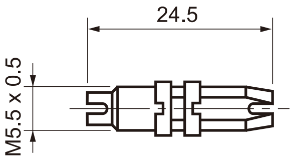


Option 39: DIN 47256 (flat, convex: PC)

Plug



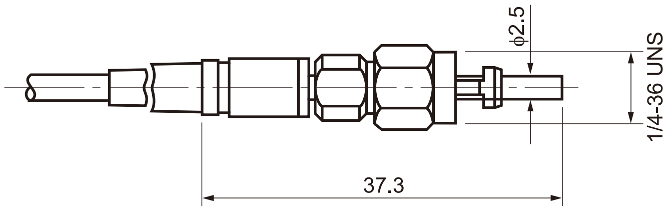
Adapter



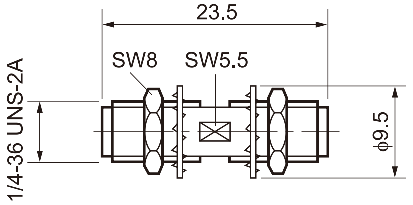
Unit in mm

Option 43: HMS-10/A (SM, convex: PC)

Plug



Adapter



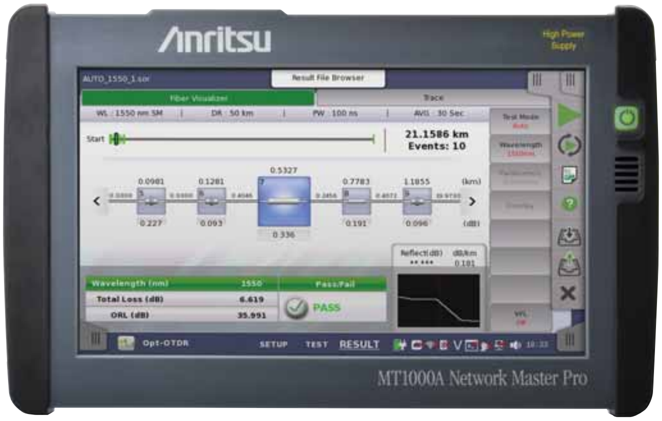
Network Master™ Series

MT1000A Network Master Pro
MU100020A/MU100021A/MU100022A OTDR Module

1310/1550 nm SMF, 1310/1550/850/1300 nm SMF/MMF, 1310/1550/1625 nm SMF

Remote Control
Ethernet | USB

For Mobile Network I&M



Network Master Pro   FiberVisualizer

The worldwide spread of mobile devices, such as smartphones and tablets using SNS, video streaming, etc., is causing an explosive increase in data traffic volumes. Mobile network base stations have various configurations; as well as shifting towards using smaller remote radio head (RRH) installations, optical fiber fault-finding and transport quality tests are required as the network environment evolves.
Installing the Transport Module MU100010A (10G Multirate)/MU100011A (100G Multirate) and OTDR Module MU100020A/MU100021A/MU100022A in the Network Master Pro MT1000A supports all-in-one optical-fiber fault finding and transport quality tests.
Using the MU100020A/MU100021A/MU100022A, scratched or dirty connectors at fiber cable connections can be detected as fault locations from the excessive optical reflections to support fault finding and troubleshooting of Mobile optical networks. Additionally, work efficiency is greatly improved using the Fiber Visualizer function supporting Easy-to-Use/Easy-to-Report testing.

Network Master Pro MT1000A Series

- All-in-One Optical/Transport Tester Install OTDR Module and 10G/100G Multirate Module in one main frame
- Easy-to-Use Intuitive GUI Menus
- Compact Lightweight Design for Onsite Testing
- Modular Design for Maximized Investment Efficiency

Key Applications

Mobile Network I&M

Mobile Fronthaul and Backhaul Optical Loss and Reflection Attenuation Measurements

- Supports hybrid SM fiber (1310/1550/1625 nm), MM fiber (850 nm/1300 nm) models
- All-in-one OTDR, light source, optical power meter, visible light source (option)
- High-accuracy event detection
- CPRI/OBSAI measurement with simultaneously installed Multirate Module MU100010A/MU100011A

Easy-to-Use, Easy-to-Report

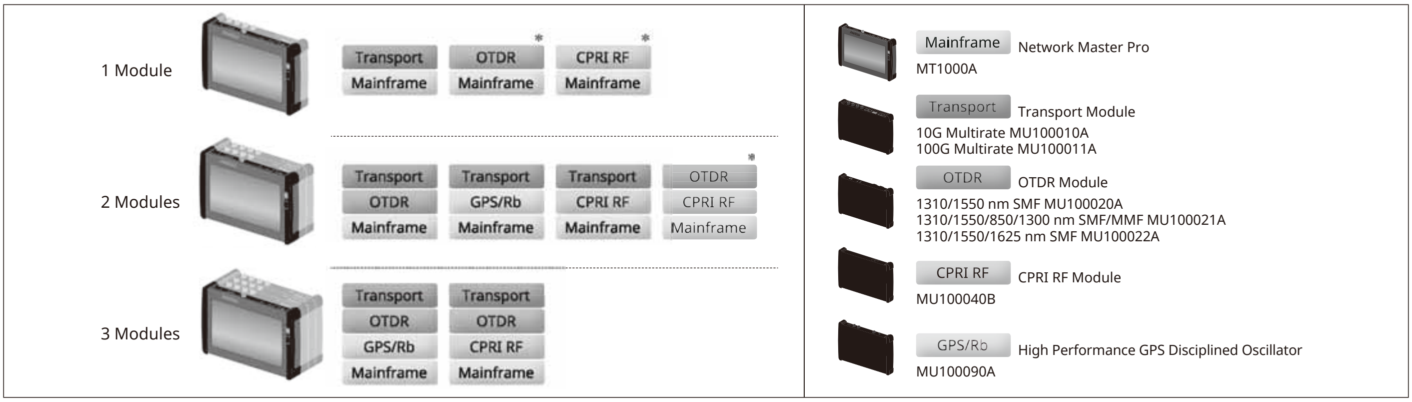
- Graphical summary and Pass/Fail evaluation display using Fiber Visualizer function
- OTDR simple test mode operation using touch panel
- One-touch button PDF report output

Core and Metro Network Long Range I&M

- Measures Trunk Fibers of 100 km or more and PON Networks with up to 1×128 Splitters
- Supports three SM fiber (1310 nm/1550 nm) models (Standard, Enhanced, High-Performance)
- Supporting Construction using Multi-core Fiber Cables
- Supports other Mobile network applications

Network Master Pro MT1000A Module Line up

Any modular combination as shown in a figure.



*: Required if the transport modules is not used rear cover (B0720A).

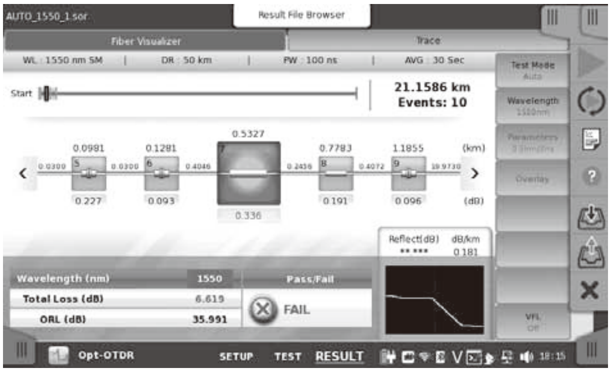
All-in-One

Network I&M is supported by installing the MU100020A/MU100021A/MU100022A and MU100010A/MU100011A in the MT1000A.
The OTDR Module lineup includes the MU100021A for OTDR measurements of both SM and MM fibers in high demand by the Mobile network I&M, plus the MU100020A/MU100022A for OTDR measurements of SM fiber used by PON networks and long- range measurements in Core/Metro networks.

With 10G/100G Multirate Module and OTDR Module

Easy-to-Use GUI

The MT1000A GUI design simulates onsite operations to help increase evaluation efficiency at network installation and to speed-up fault troubleshooting and isolation. Additionally, the intuitive user interface operations also help cut training time.



AUTO_1550_1.sor

WL : 1550 nm SM | DR : 50 km | PW : 100 ns | AVG : 30 Sec

21.1586 km
Events: 10

Reflect(dB) **.*** dB/km 0.181

Wavelength (nm)	1550
Total Loss (dB)	6.619
ORL (dB)	35.991

Pass/Fail: FAIL

Easy-to-Read and Easy-to-Use 9-inch High-Resolution Touch Screen

The large 9-inch high-resolution, full-color, touch screen is easy to use and displays easy-to-read measurement results, helping improve onsite work efficiency.

Portable

All test functions required for network verification are built into the compact MT1000A cabinet for easy, all-in-one onsite support of most communications standards; the standard soft carry bag accessory is also ideal for carrying the MT1000A onsite.

Long Battery Life

Since AC power is not commonly available onsite, the MT1000A can run for up to 6 hours (with OTDR Module) on just one battery charge. And the optional car 12 Vdc adapter offers in-vehicle charging, helping facilitate uninterrupted work when moving between sites.

All-in-One Functions Required by Physical Layer I&M Tests

The MU100020A/MU100021A/MU100022A built-in light source and power meter functions can be used for optical loss tests in addition to OTDR tests. An optional (Option 002) visible light source can be installed as well.
Moreover, the presence of scratches and dirt on the fiber end face can be checked using the Video Inspection Probe (VIP).

*: Separately sold Video Inspection Probe (External G0382A/G0306B)

G0382A

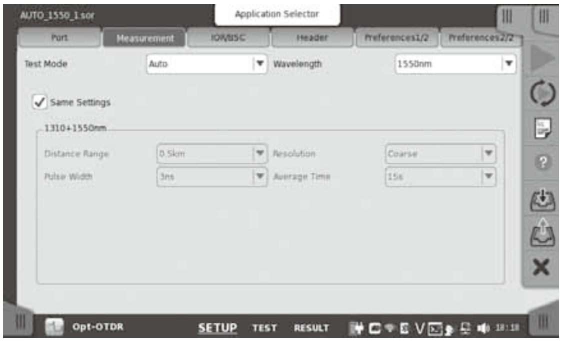
G0306B

OTDR Module Applications

Generally, depending on the optical fiber measurement environment, OTDR measurements require multiple settings such as distance range, pulse width, measurement time, etc., making work difficult for technicians who do not generally use an OTDR. When performing Pass/Fail evaluation of an optical network for a report, a simple intuitive GUI is key to improving work efficiency.
The MU100020A/MU100021A/MU100022A emphasizes easy-to-understand operability using four application measurement modes: Standard OTDR Measurement, FTTA Measurement, Construction Mode and OLTS Measurement.

Standard OTDR Measurements

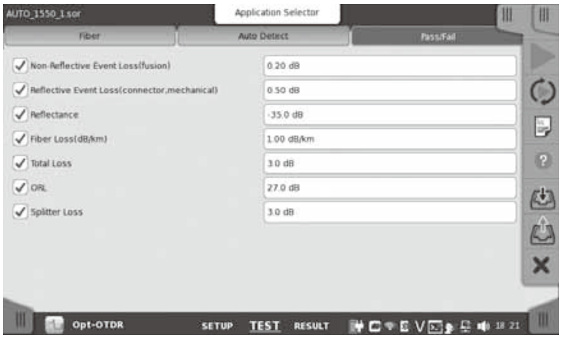
Graphical Display Based on Three-Window Operation: SETUP/TEST/RESULT



Test Mode: Auto
Wavelength: 1550nm
☑ Same Settings
1310+1550nm
Distance Range: 0.5km
Resolution: Coarse
Pulse Width: 3ns
Average Time: 15s

SETUP

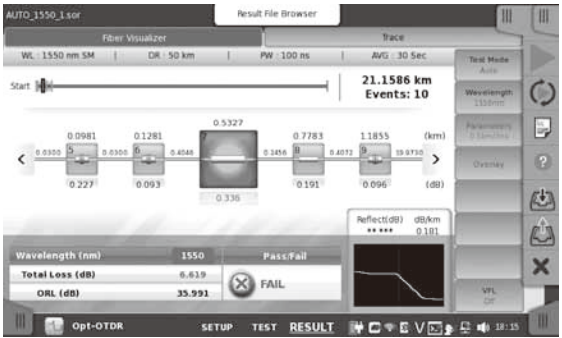
This sets the measurement wavelength.
Other conditions, such as distance range, measurement time, etc., are measured at the Auto setting conditions.



☑ Non-Reflective Event Loss(fusion): 0.20 dB
☑ Reflective Event Loss(connector,mechanical): 0.50 dB
☑ Reflectance: -35.0 dB
☑ Fiber Loss(dB/km): 1.00 dB/km
☑ Total Loss: 3.0 dB
☑ ORL: 27.0 dB
☑ Splitter Loss: 3.0 dB

TEST

This sets the detection conditions for optical fiber connectors and splices as well as the Pass/Fail evaluation threshold values, and starts measurement.



WL : 1550 nm SM | DR : 50 km | PW : 100 ns | AVG : 30 Sec

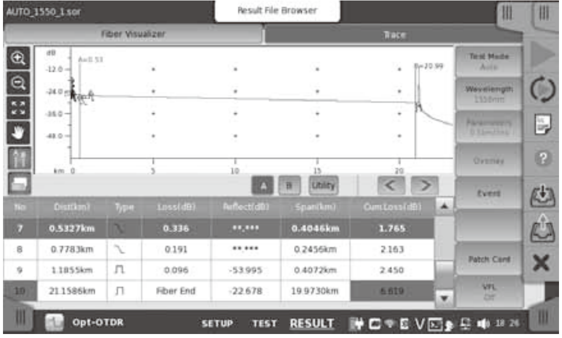
21.1586 km
Events: 10

Wavelength (nm)	1550	Pass/Fail
Total Loss (dB)	6.619	☒ FAIL
ORL (dB)	35.991	

One-Button Screen Switch

RESULT

This displays the Pass/Fail evaluation results for each event graphically at the Fiber Visualizer screen.
Additionally, waveform analysis is supported by switching to the Trace screen.

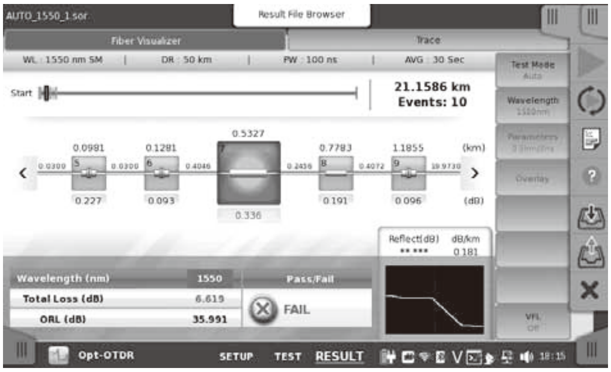


No	Dist(km)	Type	Loss(dB)	Reflect(dB)	Span(km)	Cum.Loss(dB)
7	0.5327km	⟍	0.336	**.***	0.4046km	1.765
8	0.7783km	⟍	0.191	**.***	0.2456km	2.163
9	1.1855km	⎍	0.096	-53.995	0.4072km	2.450
10	21.1586km	⎍	Fiber End	-22.678	19.9730km	6.619

The measured data are output as a PDF report by an easy one-button operation.

Easy Pass/Fail Evaluation Using Fiber Visualizer

The OTDR measurement results are displayed as a trace showing the optical fiber length, losses and size of reflections, as well as an easy-to-view summary of the analysis results on the Fiber Visualizer screen.



WL : 1550 nm SM | DR : 50 km | PW : 100 ns | AVG : 30 Sec

21.1586 km
Events: 10

Wavelength (nm)	1550
Total Loss (dB)	6.619
ORL (dB)	35.991

Pass/Fail: FAIL

Reflect(dB) **.*** dB/km 0.181

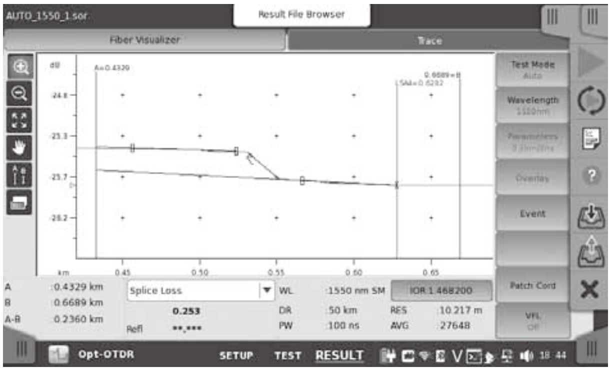
Fiber Visualizer Screen

- Event icons showing characteristics of each connector, splice, and far end
- Pass/Fail evaluations based on user-settable threshold values

The user can set any threshold value for each event. If the Pass/Fail evaluation settings prescribed in the engineering manual are set beforehand, the measured optical fiber loss status can be easily distinguished visually at the same time as measurement ends.

Intuitive Manual Waveform Analysis Using Touch Panel Operation

Using the Trace screen, it is also possible to perform manual analysis while moving the cursor on the captured waveform. Since the MT1000A has a touch panel, the optical fiber length, loss, and reflection attenuation can be analyzed manually using intuitive direct operations on the waveform.

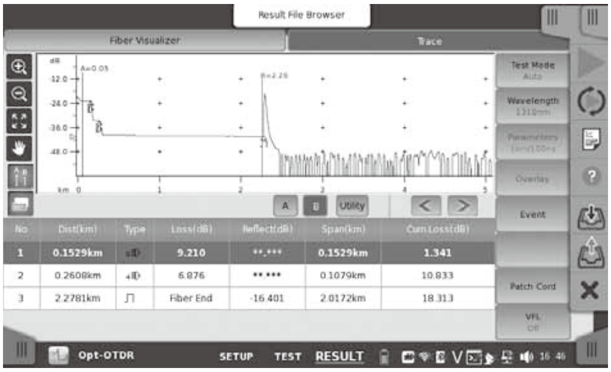


A 0.4329 km
B 0.6689 km
A-B 0.2360 km
Splice Loss 0.253
Refl **.***
WL 1550 nm SM
DR 50 km
PW 100 ns
IOR 1.468200
RES 10.217 m
AVG 27648

Manual Analysis Screen

Supports Long-Distance Optical Fibers and PON Network Measurements with 1 × 128 Splitters

OTDR measurements of long optical fibers exceeding 100 km as well as PON networks including many splitters require an OTDR with high dynamic-range performance.
With its high dynamic range of 46 dB (typ.), the MU100020A/MU100022A is ideal for evaluating Core/Metro/Access optical fiber networks.

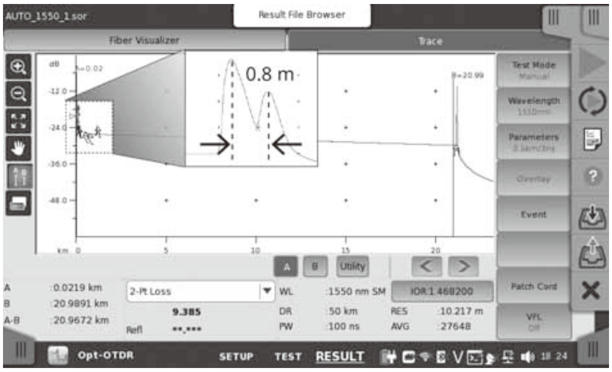


No	Dist(km)	Type	Loss(dB)	Reflect(dB)	Span(km)	Cum.Loss(dB)
1	0.1529km		9.210	**.***	0.1529km	1.341
2	0.2608km		6.876	**.***	0.1079km	10.833
3	2.2781km	⎍	Fiber End	-16.401	2.0172km	18.313

PON Measurement Screen

Various Functions and Performance for Precision OTDR Measurements

- 0.8-m Event Dead Zone
  Events can be detected with a dead zone of just 0.8 m (typ.). This is ideal for measurements in a mixed environment including short optical fibers, such as patch cords.



A 0.0219 km
B 20.9891 km
A-B 20.9672 km
2-Pt Loss 9.385
Refl **.***
WL 1550 nm SM
DR 50 km
PW 100 ns
IOR 1.468200
RES 10.217 m
AVG 27648

0.8-m Event Dead Zone

- 250,001 Sampling Points Max.
  Up to 250,001 sampling points are supported, offering a minimum resolution of 2 cm, and a resolution of 2 m for a distance range of 300 km.

- Optical Communications/Connection Check Functions
  If an optical data signal is being input to the OTDR from an external source, the optical fiber connection status will be poor, making it impossible to perform accurate measurement and analysis. When an optical data signal is detected at the start of OTDR measurement using these functions, the optical fiber connection status is evaluated as poor, a warning is displayed, and measurement is stopped.

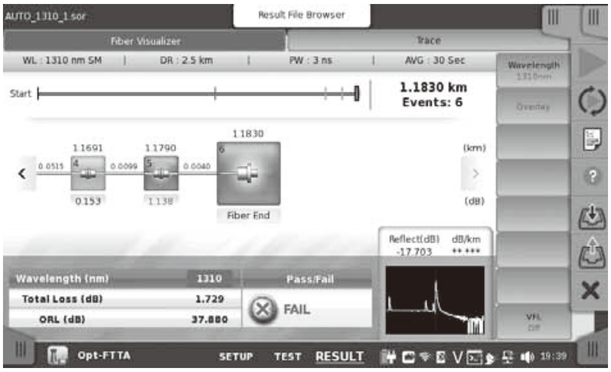
- Supports OTDR Data Sharing Format
  The measured waveform and analysis results data from the Fiber Visualizer and waveform screens are saved in the same common OTDR format described in the Telcordia SR-4731 (issue 2) standards. Not only can saved data be read by the "NETWORKS" Analysis Software running on a PC.
  *: The PC Analysis Software does not support the Fiber Visualizer function.

- Macro Bend Detection/Analysis
  Macro bends can be detected and analyzed by comparing two waveform (1310/1550/1625 nm) measurements using wavelength bend characteristics, permitting confirmation of bending faults in optical fibers, which is a difficult evaluation using measurement only one wavelength.

- Multi-waveform Measurement and Display Functions
  This is very convenient for comparison with saved waveform data captured at network commissioning as well as for comparison with abnormal waveform data, such as that captured at macro bend measurements.

FTTA Measurements

Comparatively short optical fibers of around several hundred meters in length are usually installed at the Mobile fronthaul FTTA. In this type of measurement environment, measurements made by different operators under different conditions commonly have inconsistency problems at later data processing.
At FTTA measurement, the optical fiber installation measurement conditions are fixed previously, so measurements are always made under the same conditions.
Like the OTDR measurement function, each measurement result can be analyzed at the Trace and Fiber Visualizer screens.



WL : 1310 nm SM | DR : 2.5 km | PW : 3 ns | AVG : 30 Sec

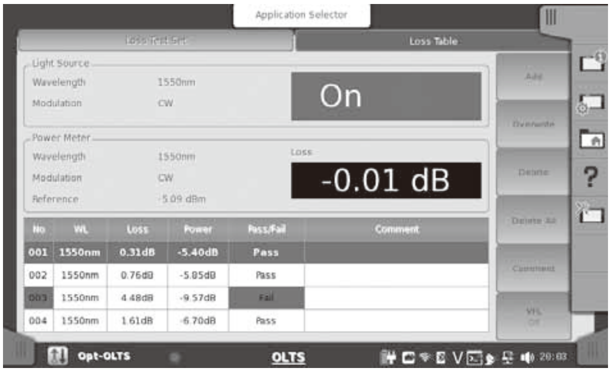
1.1830 km
Events: 6

Wavelength (nm)	1310	Pass/Fail
Total Loss (dB)	1.729	FAIL
ORL (dB)	37.880	

FTTA Measurements

OLTS Measurements

At measurement of the optical fiber, the first basic measurement is loss measurement using a light source and power meter. With a built-in light source and power meter as standard, the MU100020A/MU100021A/MU100022A can be used as an optical loss test set (OLTS).
In addition, measurement results can be managed at the Loss Table for Pass/Fail evaluation of individual data based on set threshold values.



Light Source
Wavelength 1550nm
Modulation CW
On

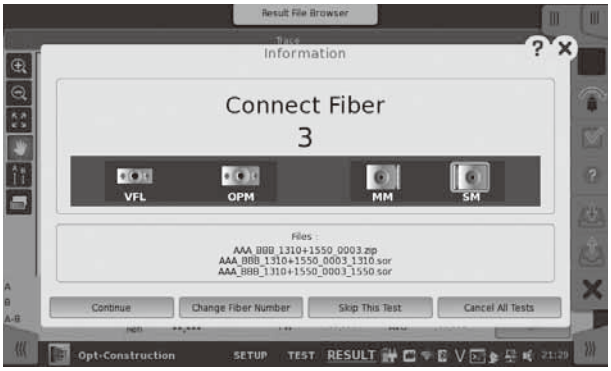
Power Meter
Wavelength 1550nm
Modulation CW
Reference -5.09 dBm
Loss -0.01 dB

No	WL	Loss	Power	Pass/Fail	Comment
001	1550nm	0.31dB	-5.40dB	Pass	
002	1550nm	0.76dB	-5.85dB	Pass	
003	1550nm	4.48dB	-9.57dB	Fail	
004	1550nm	1.61dB	-6.70dB	Pass	

OLTS Measurement Loss Table

Construction Mode

The "Construction Mode" simplifies installation work and is especially useful when pulling multi-core fiber cables. Work mistakes are eliminated by automated operation using pre-settings, such as project data (number of fibers, file names, etc.) and measurement conditions, to facilitate efficient measurement of multi-core fiber cables.



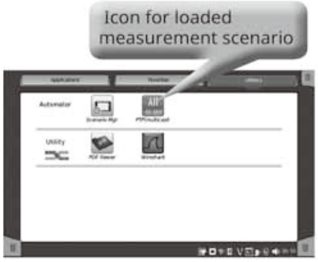
Connect Fiber
3

Files :
AAA_BBB_1310+1550_0003.zip
AAA_BBB_1310+1550_0003_1310.sor
AAA_BBB_1310+1550_0003_1550.sor

Construction Mode

Value of Offering Automatic Measurement Solutions

Simplifies multiple testing work, shortens on-site test time, and eliminates human operation errors. Supports simultaneous multiple tests. Download free editing software (MX100003A) to create scenarios without need for programing skills.



Automation Test Select

SEEK (Scenario Edit Environment Kit)
MX100003A

Specifications

MT1000A + MU100020A/MU100021A/MU100022A

Display		9-inch active TFT display (800 × 480 pixels) and touch screen
Supported Languages		User selectable (English, Japanese, Simplified Chinese, Russian, French, Spanish, Finnish, Korean, German)
USB Data Interface		MT1000A operates as host: USB 2.0 type A (2 ports), MT1000A operates as device: USB 2.0 type Mini-B (1 port)
Ethernet Interface		Ethernet 10M/100M/1000M, Connector: RJ45
WLAN Interface*		IEEE 802.11 b/g/n
Bluetooth Interface*		Bluetooth 2.1 +EDR
Audio Interface		For connection of head set, Connector: 3.5-mm diameter jack
AUX Connector		For connection of optional G0325A GPS receiver
Built-in Loudspeaker		Monitors speech of voice channel, Output level: user-controlled from user Interface
Ext. Clock Input		For connection of external clock signals: SETS (E1: 2.048 Mbps), BITS (DS1: 1.544 Mbps) or 2.048 MHz TTL signal in accordance with ITU-T G.703, 10 MHz, Connector: BNC
Dimensions and Mass		MU100020A/MU100021A/MU100022A: 257.6 (W) × 163 (H) × 25 (D) mm (without rear panel), ≤0.8 kg with MT1000A: 257.6 (W) × 163 (H) × 84.3 (D) mm, 2.7 kg including battery (G0310A) with MT1000A/MU100010A: 257.6 (W) × 163 (H) × 102.2 (D) mm, 3.5 kg including battery (G0310A)
Mains Adapter		Input: 100 V(ac) to 240 V(ac), 50 Hz/60 Hz Output: 18 V(dc), 3.62 A (max.) Power Consumption: ≤65 W With MT1000A-006 Input: 100 V(ac) to 240 V(ac), 50 Hz/60 Hz Output: 18 V(dc), 6.6 A (max.) Power Consumption: ≤120 W
Battery		10.8 V rechargeable and replaceable intelligent Li-ion battery Operating time: 6.0 h (with MU100020A/MU100021A/MU100022A), Telcordia GR-196-CORE Issue2, September 2010, 25°C
Environmental Conditions		Operating Temperature: 0° to +50°C, ≤85%RH (non-condensing) (with MU100020A/MU100021A/MU100022A) Charging Temperature: 0° to +50°C, ≤85%RH (non-condensing) Storage Temperature: –30° to +60°C, ≤90%RH (non-condensing) (without battery or AC adapter, with MU100020A/MU100021A/MU100022A) –20° to +50°C, ≤90%RH (non-condensing) (with battery and AC adapter, with MU100020A/MU100021A/MU100022A)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

*: Available for certified countries and regions including USA, Canada, Japan and EU countries. Please visit the Anritsu web site for updated information.

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MU100020A/MU100021A/MU100022A OTDR Module Common Specifications

IOR Setting	1.300000 to 1.700000 (0.000001 steps)
Units	km, m, kft, ft, mi
Sampling Points	Up to 250,001
Sampling Resolution	0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 40 m
Loss measurement accuracy (linearity)	±0.05 dB/dB or ±0.1 dB (whichever is greater)
Reflectance Accuracy	Single mode: ±2 dB, Multimode: ±4 dB
Distance Accuracy	±1 m ±3 × measurement distance × 10^{-5} ± marker resolution (excluding IOR uncertainty)
Distance Range (IOR = 1.50000)	Single mode: 0.5, 1, 2.5, 5, 10, 25, 50, 100, 200, 300 km Multimode: 0.5, 1, 2.5, 5, 10, 25, 50, 100 km
Realtime Sweep Time	≤0.2 sec. (Test Mode: Manual, Distance Range: 50 km, Resolution: Coarse)
Testing Modes	Standard OTDR application: Selectable automatic or manual set-up, Fiber Visualizer, Trace analysis, Light source, Power meter, Visual fault locator (Optional) FTTA application: Automatic set-up, Fiber Visualizer, Trace analysis, Light source, Power meter, Visual fault locator (Optional) Construction application: OTDR Measurement, Auto Save, Multi-core fiber measurements, Power meter, Visual fault locator (Optional) OLTS application: Power meter and Light source, Loss Table, Visual fault locator (Optional)
Fiber Event Analysis	Fiber condition setup: Patch-cord setup (Launch/Receive), Splitter Setup (Up to 128 branch) User defined Auto detect threshold: Event loss (Reflective and non-reflective), Reflectance, Fiber end, Macro bend detect ON/OFF, Splitter detect: Up to 128 branch User defined PASS/FAIL thresholds: Non-reflective event loss (fusion), Reflective event loss (connector, mechanical), Reflectance, Fiber loss (dB/km), Total loss, ORL, Splitter loss (Up to 128 branch)
OTDR Trace Format	Telcordia universal. SOR, issue 2 (SR-4731)
Other Functions	Loss modes: Splice loss, 2-pt loss, 2-pt LSA, dB/km loss, dB/km LSA, ORL Averaging modes: Timed (5, 10, 15, 30 sec, 1, 2, 3, 5, 10 min.) Live Fiber detect : Verifies presence of communication light in optical fiber Connection check: Automatic check of OTDR to FUT connection quality Remote Operation, Both-End Measurement

MU100020A OTDR Module

Options	Wavelength*1	Fiber Type	Pulse Width	Dynamic Range*2, *3	Deadzone (Fresnel)*4 (IOR = 1.500000)	Deadzone (Backscatter)*5 (IOR = 1.500000)
MU100020A-020	1310 nm/1550 nm ±25 nm	Single Mode Fiber (SMF) 10 µm/125 µm ITU-T G.652	3, 10, 20, 50, 100, 200, 500, 1000, 2000, 4000, 10000, 20000 ns	39 dB/37.5 dB*6	≤80 cm (typ.)	≤3.8 m/4.3 m
MU100020A-021				42 dB/41 dB*6		
MU100020A-022				46 dB/46 dB*6 25 dB/25 dB*6 (Pulse width: 100 ns)		

MU100021A OTDR Module

Options	Wavelength*1	Fiber Type	Pulse Width	Dynamic Range*2, *3	Deadzone (Fresnel)*4 (IOR = 1.500000)	Deadzone (Backscatter)*5 (IOR = 1.500000)
MU100021A-021	1310 nm/1550 nm ±25 nm 850 nm/1300 nm ±30 nm	Single Mode Fiber (SMF) 10 µm/125 µm ITU-T G.652 GI Fiber 62.5 µm/125 µm*7	SMF: Same as MU100020A 1300 nm (MMF): 3, 10, 20, 50, 100, 200, 500, 1000, 2000, 4000 ns 850 nm (MMF): 3, 10, 20, 50, 100, 200, 500 ns	42 dB/41 dB*6 29 dB/28 dB*6	≤80 cm (typ.)	≤3.8 m/4.3 m ≤4.0 m/5.0 m

MU100022A OTDR Module

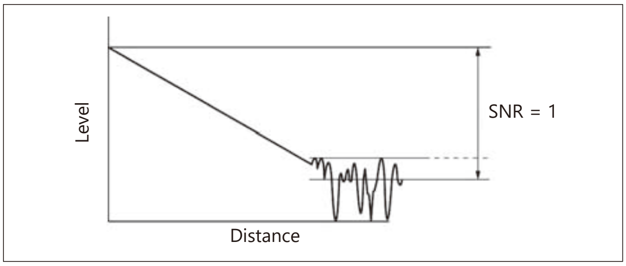
Options	Wavelength*1	Fiber Type	Pulse Width	Dynamic Range*2, *3	Deadzone (Fresnel)*4 (IOR = 1.500000)	Deadzone (Backscatter)*5 (IOR = 1.500000)
MU100022A-022	1310/1550/1625 nm ±25 nm	Single Mode Fiber (SMF) 10 µm/125 µm ITU-T G.652	3, 10, 20, 50, 100, 200, 500, 1000, 2000, 4000, 10000, 20000 ns	46/46/44 dB*6 25/25/23 dB*6 (Pulse width: 100 ns)	≤80 cm (typ.)	≤3.8/4.3/4.8 m

Laser Safety*8	IEC 60825-1: 2007 CLASS 1M: 21 CFR1040.10 Excludes deviations caused by conformance to Laser Notice No. 50 dated June 24, 2007

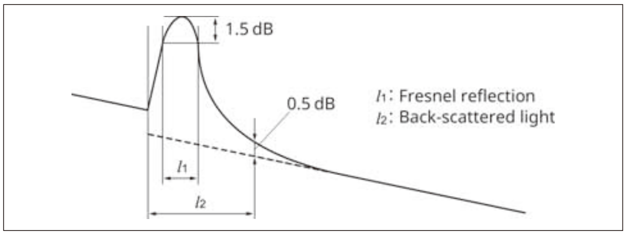
*1: 25°C, Pulse width: 1 µs (1310/1550/1625 nm), 100 ns (850 nm/1300 nm), Except for when charging the battery.

*2: Pulse widths: 20 µs (1310/1550/1625 nm), 500 ns/4 µs (850 nm/1300 nm)
Distance range: 100 km (1310 nm/1550 nm), 25 km (850 nm/1300 nm)
Averaging: 180 sec., SNR = 1, 25°C
Except for when charging the battery.

*3: Dynamic range (one-way back-scattered light), SNR = 1: The level difference between the RMS noise level and the level where near end back-scattering occurs.



*4: Pulse width: 3 ns, Return loss: 40 dB, 25°C (Refer to the figure below) Except for when charging the battery.



*5: Pulse width 10 ns, return loss 55 dB, Deviation ±0.5 dB, 25° ±5°C

*6: Typical. Subtract 1 dB for guarantee

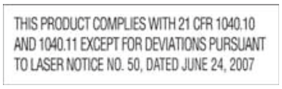
*7: At measurement of 50 µm/125 µm MM Fiber, the dynamic range drops by about 3.0 dB

*8: Safety measures for laser products
This product complies with optical safety standards in IEC 60825-1, 21CFR1040.10 and 1040.11; the following descriptive labels are affixed to the product.

IEC 60825-1 2007
INVISIBLE LASER RADIATION
DO NOT VIEW DIRECTLY WITH
OPTICAL INSTRUMENTS

(MAX OUTPUT POWER)	(PULSE DURATION)	(WAVELENGTH)
4mW	CW	850nm
150mW	≤500ns	850nm
150mW	≤20µs	1300 to 1400nm

CLASS 1M LASER PRODUCT



THIS PRODUCT COMPLIES WITH 21 CFR 1040.10
AND 1040.11 EXCEPT FOR DEVIATIONS PURSUANT
TO LASER NOTICE NO. 50, DATED JUNE 24, 2007

Light Source Specifications

Standard on all models

Stabilized Light Source (through OTDR port)			
Options	MU100020A	MU100021A	MU100022A
Wavelength*1	1310 nm/1550 nm ±30 nm	1310 nm/1550 nm ±30 nm 850 nm/1300 nm ±30 nm	1310/1550/1625 nm ±30 nm
Spectral Width*1	≤5 nm (1310 nm) ≤10 nm (850/1300/1550/1625 nm)		
Fiber Type	Single Mode Fiber (SMF) 10 µm/125 µm ITU-T G.652	Single Mode Fiber (SMF) 10 µm/125 µm ITU-T G.652 GI Fiber 62.5 µm/125 µm	Single Mode Fiber (SMF) 10 µm/125 µm ITU-T G.652
Optical Connector	Same as OTDR		
Output Power*1	–5 ±1.5 dBm		
Output Stability*2	≤0.1 dB (1310/1550/1625 nm)		
Modes of Operation	CW, 270 Hz, 1 kHz, 2 kHz		
Warm up time	10 min.		
Laser Safety	Same as OTDR		

Power Meter Specifications

Standard on all models

Standard Power Meter (Dedicated port)	
Fiber Type	Single Mode (SMF) 10 µm/125 µm ITU-T G.652, GI Fiber 62.5 µm/125 µm
Wavelength Range	800 nm to 1700 nm
Setting Wavelengths	1310, 1490, 1550, 1625, 1650, 850, 1300 nm
Measurement Range	–67 to +6 dBm (CW, 1550 nm, –60 to +3 dBm @850 nm) –70 to +3 dBm (Modulation, 1550 nm, –63 to 0 dBm @850 nm)
Optical Connector	2.5 mm/1.25 mm Universal
Accuracy*3	±5% (–10 dBm, 1310 nm/1550 nm, CW, 25°C, Using Master FC fiber and 2.5 mm universal connector) ±10% (–10 dBm, 850 nm, CW, 25°C, Using Master FC fiber and 2.5 mm universal connector)
Modes of Operation	CW, 270 Hz, 1 kHz, 2 kHz

Visible Light Source (Option 002)	
Central Wavelength	650 nm ±15 nm (at 25°C)
Optical Output	0 ±3 dBm (CW, 25°C)
Output Optical Fiber	10 µm/125 µm, SMF (ITU-T G.652)
Optical Connector	2.5 mm universal
Output Function	OFF, CW, Blink
Laser Safety*4	IEC 60825-1: 2007 CLASS 3R 21CFR1040.10 and 1040.11 Excludes deviations caused by conformance to Laser Notice No. 50 dated June 24, 2007

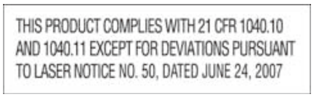
*1: CW, 25°C

*2: CW, –10° to +50°C (±1°C) difference between max/min. values over 1 minute, SM fiber 2 m, when an optical power meter with 40 dB or greater return loss is used (SM),after warming up.

*3: After zero offset

*4: Safety measures for laser products
This option complies with optical safety standards in IEC 60825-1, 21CFR1040.10 and 1040.11; the following descriptive labels are affixed to the product

⚠ IEC 60825-1:2007
VISIBLE LASER RADIATION
AVOID DIRECT EYE EXPOSURE
(MAX OUTPUT POWER) (PULSE DURATION) (WAVELENGTH)
5mW CW 650±15nm
CLASS 3R LASER PRODUCT



THIS PRODUCT COMPLIES WITH 21 CFR 1040.10
AND 1040.11 EXCEPT FOR DEVIATIONS PURSUANT
TO LASER NOTICE NO. 50, DATED JUNE 24, 2007

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

1) Mainframe

Model/Order No.	Name	
MT1000A	Network Master Pro	
	Standard Accessories	
MT1000A-006*1	High Power Supply:	Installed
	Line Cord*2:	1 pc
B0745A	Softcase:	1 pc
B0728A*3	Rear Panel kit:	1 pc
G0385A*4	High Power AC Adaptor:	1 pc
G0310A	Li-ion Battery:	1 pc
Z1746A	Stylus:	1 pc
Z1747A*5	Carrying Strap:	1 pc
Z1748A*6	Handle:	1 pc
Z1817A*7	Utilities ROM:	1 pc
	Main Frame Option	
MT1000A-003*8	Connectivity for WLAN/Bluetooth	
MT1000A-005*9	AUX I/O	

*1: The presence of the MT1000A-006 option can be recognized at the top right of the front panel. To retrofit to the already shipped item, please contact us.

Without MT1000A-006

With in MT1000A-006

*2: One line cord is attached to the area to shipment.
*3: Set of B0720A (Rear Cover) and B0732A (Screw Kit). Please refer to next page "Module Configuration" for details.
*4: The MT1000A with MT1000A-006 can be used. Use the AC adapter when using the MT1000A without MT1000A-006 installed.
*5: Shoulder strap for MT1000A.
*6: Hand strap for MT1000A.
*7: This DVD includes PDF files and formatting tools of each product's instruction manual (such as W3933AE, W3810AE, W3736AE, W3946AE).
*8: Available for certified countries and regions including USA, Canada, Japan and EU countries. Please visit the Anritsu web site for updated information.
*9: MT1000A-005 is required for MU100090A. To retrofit to the already shipped item, please contact us.

2) Select OTDR Module

Select the OTDR module configuration according to the procedures in items 2-1) and 2-2) below.

2-1) Select Base Module

Select one of the following models.

Model/Order No.*10	Name	
MU100020A	OTDR Module (1310/1550 nm SMF)	
MU100021A	OTDR Module (1310/1550/850/1300 nm SMF/MMF)	
MU100022A	OTDR Module (1310/1550/1625 nm SMF)	
	Standard Accessories	
J1693A	Universal Connector 2.5 mm for OPM:	1 pc
J1694A	Universal Connector 1.25 mm for OPM:	1 pc
W3811AE	Quick Reference Guide:	1 pc

*10: Factory installed option only and cannot be retrofitted.

2-2) Select Dynamic Range Type

Select one of the following models.

Model/Order No.*11	Name
MU100020A-020	Standard Dynamic Range (1310/1550 nm: 39/37.5 dB)
MU100020A-021	Enhanced Dynamic Range (1310/1550 nm: 42/41 dB)
MU100020A-022	High-Performance Dynamic Range (1310/1550 nm: 46/46 dB)
MU100021A-021	Enhanced Dynamic Range (1310/1550/850/1300 nm: 42/41/29/28 dB)
MU100022A-022	High-Performance Dynamic Range (1310/1550/1625 nm: 46/46/44 dB)

*11: Factory installed option only and cannot be retrofitted.

3) Select Connector Types

Select a module polish type and connector adapter according to the procedures in items 3-1) and 3-2).

3-1) Polish Types

Specify one connector polish type.

Model/Order No.*12	Name
MU100020A-010	UPC Polish
MU100020A-011*13	APC Polish
MU100021A-010	UPC Polish
MU100021A-011*13	APC Polish
MU100022A-010	UPC Polish
MU100022A-011*13	APC Polish

*12: Factory installed option only and cannot be retrofitted.
*13: Used by SM port. An APC connector cannot be specified for the MM port, which uses a UPC connector.

3-2) Select Connector Adapter type

Specify one type of connector adapter.

Model/Order No.	Name
	For UPC Polish with Option 010
MU100020A-037*14	FC Connector
MU100020A-039*14	DIN 47256 Connector
MU100020A-040*14	SC Connector
MU100021A-037*15	FC Connector
MU100021A-039*15	DIN 47256 Connector
MU100021A-040*15	SC Connector
MU100022A-037*14	FC Connector
MU100022A-039*14	DIN 47256 Connector
MU100022A-040*14	SC Connector
	For APC Polish with Option 011
MU100020A-025*14	FC Connector key width 2.0 mm
MU100020A-026*14	SC Connector
MU100021A-025*16	FC Connector key width 2.0 mm
MU100021A-026*17	SC Connector
MU100022A-025*14	FC Connector key width 2.0 mm
MU100022A-026*14	SC Connector

*14: One specified connector adapter supplied free of charge.
*15: One each of same connector adapter for SM port and MM port supplied free of charge. Cannot specify different connector adapters for each port.
*16: One connector adapter for SM port supplied free of charge. One connector adapter equivalent to Option 37 (FC/UPC) for MM port supplied free of charge.
*17: One specified connector adapter for SM port supplied free of charge. One connector adapter equivalent to Option 40 (SC/UPC) for MM port supplied free of charge.

4) VFL

Model/Order No.*18	Name
MU100020A-002*19	Visual Fault Locator
MU100021A-002*19	Visual Fault Locator
MU100022A-002*19	Visual Fault Locator

*18: Factory installed option only and cannot be retrofitted.
*19: Installs dedicated port for visible light source; 2.5 mm universal light receiver type (connector adapter not required). J1335A required to connect 1.25 mm fiber.

5) Replacement Adapters

Model/Order No.	MU100020A/MU100022A	MU100021A	
	For UPC Polish		
	SM port	SM port	MM port
J0617B (FC/UPC)	✓	✓	✓
J0618E (DIN/UPC)	✓	✓	✓
J0619B (SC/UPC)	✓	✓	✓
	For APC Polish		
	SM port	SM port	MM port
J0739A (FC/APC)	✓	✓	N/A
J1697A (SC/APC)	✓	✓	N/A

6) Select Accessories & Replacement Items

Model/Order No.	Name	Description
For MT1000A Mainframe		
B0691B	Hard Case	Up to two installed modules
G0324A	Battery Charger	
J1569B	Car 12 Vdc Adapter	
G0382A	Autofocus Video Inspection Probe	Fixed x400 magnification (USB Autofocus type). For visually verifying fiber end-face condition using MT1000A Utility application
G0306B	Video Inspection Probe (X400)	Fixed x400 magnification (USB Standard type). For visually verifying fiber end-face condition using MT1000A Utility application
G0309A	AC Adapter	Use the AC Adapter when using the MT1000A without MT1000A-006 installed
B0720A	Rear Cover	MT1000A Rear Cover
B0728A	Rear Panel Kit	Rear Panel and Screw kit (Same as Standard accessory)
B0729A	Screw 1U	1 unit screw set (Total 4 pcs)
B0730A	Screw 2U	2 units screw set (Total 4 pcs)
B0731A	Screw 3U	3 units screw set (Total 4 pcs)
B0732A	Screw Kit	1U, 2U, 3U screw set (Total 12 pcs)
For MU100020A/MU100021A/MU100022A OTDR Modules		
W3810AE	MT1000A MU100020A Network Master Pro Operation Manual	Printed Matter
J1335A	MU/LC Connector Adapter	Converts ferrule connector diameter from 2.5 mm → 1.25 mm for visible light source (Option 002)
J1530A	SC Plug-in Converter (UPC(P)-APC(J))	SC/UPC → SC/APC Adapter
J1531A	SC Plug-in Converter (APC(P)-UPC(J))	SC/APC → SC/UPC Adapter
J1532A	FC Plug-in Converter (UPC(P)-APC(J))	FC/UPC → FC/APC Adapter
J1533A	FC Plug-in Converter (APC(P)-UPC(J))	FC/APC → FC/UPC Adapter
J1534A	LC-SC Plug-in Converter (for SM, SC(P)-LC(J))	SC/UPC → LC/UPC Adapter for SM fiber
J1535A	LC-SC Plug-in Converter (for MM, SC(P)-LC(J))	SC/UPC → LC/UPC Adapter for MM fiber
NETWORKS	PC Emulation Software for Data Analysis and Reporting	
J1579A	Optical cable SM LC/PC to LC/PC 3 m	
J1581A	Optical cable MM LC/PC to LC/PC 3 meter	
J1575A	Optical cable SM LC/PC to FC/PC 3 m	
J1571A	Optical cable SM LC/PC to SC/PC 3 m	

7) Maintenance Service

Model/Order No.	Description
MT1000A-ES210	2 Years Extended Warranty Service
MT1000A-ES310	3 Years Extended Warranty Service
MT1000A-ES510	5 Years Extended Warranty Service
MU100020A-ES210	2 Years Extended Warranty Service
MU100020A-ES310	3 Years Extended Warranty Service
MU100020A-ES510	5 Years Extended Warranty Service
MU100021A-ES210	2 Years Extended Warranty Service
MU100021A-ES310	3 Years Extended Warranty Service
MU100021A-ES510	5 Years Extended Warranty Service
MU100022A-ES210	2 Years Extended Warranty Service
MU100022A-ES310	3 Years Extended Warranty Service
MU100022A-ES510	5 Years Extended Warranty Service

Example of Ordering Configuration

1)	MT1000A	Network Master Pro
2-1)	MU100020A	OTDR Module (1310/1550 nm SMF)
2-2)	MU100020A-020	Standard Dynamic Range
3-1)	MU100020A-010	UPC Connector
3-2)	MU100020A-037	FC Connector

1)	MT1000A	Network Master Pro
2-1)	MU100021A	OTDR Module (1310/1550/850/1300 nm SMF/MMF)
2-2)	MU100021A-021	Enhanced Dynamic Range
3-1)	MU100021A-011	APC Connector
3-2)	MU100021A-025	FC Connector key width 2.0 mm
4)	MU100021A-002	Visual Fault Locator Option
5)	J0619B	Replaceable Optical Connector (SC)

- One must be specified from items 1), 2-1), 2-2), 3-1), and 3-2), but specification from 1) is not required if the MT1000A main frame is not required.
- When the MU100020A is specified in item 2-1), select from the MU100020A options for models for item 2-2) and later.

MT9090A Mainframe
MU909014A1/B/B1/C/C6, MU909015A6/B/B1/C/C6 μOTDR Module™

Field Optical Testing Redefined

Network Master FiberVisualizer

MT9090A with MU909014/15 Overview

There are many handheld OTDRs on the market that appear to be a good value until they are put into action and the user quickly finds out that they lack the performance needed to install and maintain today's networks.

The new μOTDR Module series MU909014/15 for the Network Master MT9090A platform from Anritsu finally addresses this need by providing all of the features and performance required for installation and maintenance of optical fibers in a compact, modular test set. The MT9090A represents an unmatched level of value and ease of use, while not compromising performance. Data sampling of 2 centimeters, dead zones of 0.8-meter and dynamic range up to 38 dB ensure accurate and complete fiber evaluation of any network type – premise to access, metro to core...including PON-based FTTx networks featuring up to a 1 × 64 split.

The MT9090A with MU909014/15 module represents a new era in optical fiber testing!

Key Features

- Tri-wavelength OTDR for both installation and maintenance (1310 nm/1550 nm plus filtered 1650 nm or 1625 nm)
- Built-in PON Power Meter, Loss Test Set and Light Source functions
- High-end OTDR performance in a pocket-size package with unique battery operation
- "Fiber Visualizer" mode simplifies operation, no OTDR knowledge needed
- Complete PON testing through splitters up to 1 × 64
- Bluetooth, WLAN and Ethernet connectivity*

*: These features use an USB Ethernet converter, USB WLAN dongle, or USB Bluetooth dongle.

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A Truly Revolutionary OTDR

Introducing the first handheld OTDR that does not compromise performance – the new μOTDR from Anritsu. With performance that rivals traditional OTDRs that are four times the size and more than double the price, the Network Master MT9090A μOTDR has created a new class of test instruments. It features 2 cm resolution for accurate mapping of events, dead zones of 0.8-meter (2.6-feet) and a dynamic range of up to 38 dB – enough to test over 150 km (90+ miles).

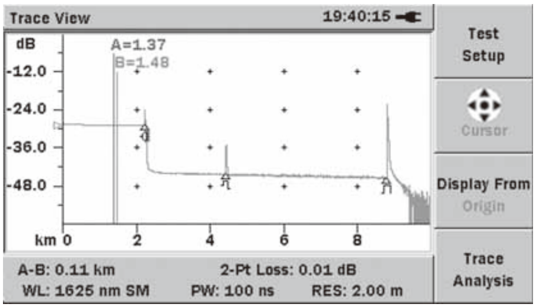
The MT9090A μOTDR also takes portability to a new level by being the first handheld OTDR that truly fits in the palm of your hand.

Complete Testing Tool - Premise to Core

With a dynamic range of up to 38 dB, the μOTDR evolves far beyond the premise/access applications that other handheld OTDRs service. Metro links can be tested with lower pulsewidths which provides greater detail and better resolution while long haul fibers up to 175 km (108 miles) can also be completely evaluated.

FTTx and PON Ready

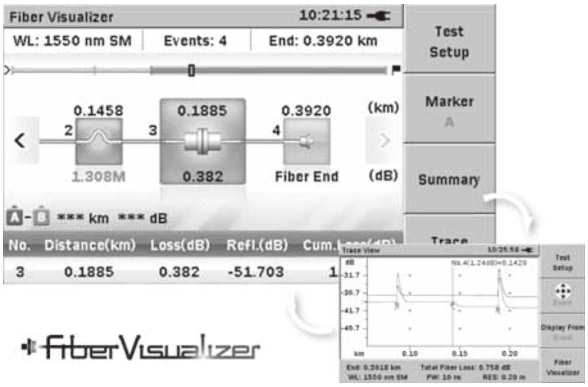
With splitter-based fiber-to-the-x (FTTx) deployments becoming more popular, the need for test equipment to thoroughly test and maintain them has risen. The μOTDR series features the ability to test up to a 1 × 64 split completely from end-to-end and with high resolution.



A-B: 0.11 km
2-Pt Loss: 0.01 dB
WL: 1625 nm SM
PW: 100 ns
RES: 2.00 m

Easy Operation and Analysis

"Fiber Visualizer" is a new fault location function designed to simplify the entire testing process. Fiber Visualizer automatically selects the testing parameters to ensure the correct setup and provides a simple, graphical summary of the fiber under test within seconds.
A comprehensive PDF report can then be customized and generated, completing the testing process.



Fiber Visualizer 10:21:15

WL: 1550 nm SM | Events: 4 | End: 0.3920 km

No.	Distance(km)	Loss(dB)	Refl.(dB)
3	0.1885	0.382	-51.703

0.8-m Dead Zone for Short Fiber Analysis

With 0.8-meter dead zones, the MT9090A is perfect for evaluating central office, FTTx and intra building cables.

Fast Real Time Sweeping

The MT9090A µOTDR features real-time updates as quickly as 0.25 seconds. This is useful for connector and splice optimizations as well as verifications of parameter selection.

Portable

The MT9090A µOTDR takes portability to a whole new level. With dimensions of just 19 cm × 9.6 cm × 4.8 cm (7.5" × 3.8" × 1.9") and a weight of only 700 g (1.54 lbs.), the µOTDR is the smallest and lightest OTDR on the market. With its lightweight design and user friendly dimensions, the MT9090A is perfect for the outside plant environment and can easily be managed with one hand.
The standard soft case with shoulder strap further increases portability when traveling from the truck to the testing site.

Bluetooth, WLAN and Ethernet Connectivity

The Bluetooth feature enables you to share files between the µOTDR series and a PC. The WLAN and Ethernet features enable you to share files as well as use the remote GUI feature. You can connect the µOTDR and PC, and control the µOTDR series from a browser.

Modular Design

The MT9090A features a modular design allowing modules to be easily changed in the field. Users can interchange different OTDR modules or perform other optical network testing such as optical channel analysis with the available CWDM channel analyzer module or 10/100/1000 MB Ethernet testing on optical or electrical links. Operation is quite similar between modules so the user is immediately familiar with operation.

4.3-inch Wide Screen Display for Easy Viewing

The high resolution, full color, 4.3-inch wide screen display is the perfect format for viewing OTDR results. It also provides excellent readability both indoors and outdoors.

Integrated Launch Fiber

To further simplify testing, the MU909014/15 series is the only handheld OTDR that features an integrated launch cable. A ten meter (30-feet) fiber is built-in so initial fiber connections can be verified without the need for additional patchcords or launch fibers.

Reliable. Capable.

When buying products, you tend to choose ones that are innovative and from established companies.
When you need to install and maintain optical networks, this should also apply. With over 50 years of combined OTDR design, Anritsu, which now includes NetTest, delivers the features that matter.
Having been in the test and measurement business for a long time, we understand the importance of performance, portability, reliability, easy operation and of course price.

Event Table with User Defined Thresholds

PASS/FAIL thresholds for key acceptance criteria such as splice loss, reflectance and total span loss can be set in the MT9090A allowing technicians to easily assess a fiber's condition. Failing values are clearly highlighted in the event table alerting technicians of potential problems.

Unique Battery Operation

Since AC power is not always available where you need it, especially at fiber pedestals, the MT9090A typically provides 8 hours of testing on a single charge. This coupled with an optional car cigarette lighter cord guarantees the MT9090A is ready when you are. µOTDR supports widely available NiMH and Alkaline batteries for truly unique battery operation.

Quick Startup

The MT9090A is ready for measurement in under 15 seconds so productive work can start immediately.

Video Inspection Probe Support

When equipped with the optional connector video inspection probe (G0306B), the µOTDR becomes a powerful tool for evaluating connector cleanliness and quality. The G0306B can reduce issues by verifying the condition and cleanliness of connector end faces during the installation phase.
The G0306B has added a Pass/Fail analysis function to the conventional VIP.
This new function inspects the state of the connector end using video. It can automatically inspect the end of the optical connector for defects and scratches (The automatic pass/fail determination is made in accordance with the IEC61300-3-35 standard.)
You can also create a PDF report on the µOTDR series.

VIP 15:59:16

Core: PASS
Cladding: FAIL
Adhesive: PASS
Contact: FAIL
FAIL

Press Start for Live Image

Screen Capture Function

Screen shots are sometimes useful for adding to reports so the MT9090A features the ability to save screen shots as Bitmap images.

Functions for FTTx

One µOTDR module supports FTTx installation and maintenance (PON Power Meter, Loss Test Set, Light Source) in addition to µOTDR functions. (See page 35 for details.)

Installation and Maintenance Simplified

Since the MT9090A is designed for technicians of any level, its hardware and user interface are optimized for simplicity. A customizable testing sequence and “Full Auto” mode automates testing and guides novice users. Specialized maintenance wavelengths are also available to eliminate equipment damage and transmission interruptions.

Installation Simplified

The MU909014/15 µOTDR Module series provides easy and accurate verification of fiber installations at 1310 nm, 1490 nm and 1550 nm to ensure your network is ready for any transmission type. The user simply connects the fiber, selects “Full Auto” and presses “Start” - all settings are automatically selected to ensure accurate and constant results for any skill level. Upon completion, all key fiber characteristics are displayed within seconds. Experienced users can also “fine tune” all testing parameters and make manual measurements.

Step 1 – Connect fiber and Power on

Step 2 – Select “Full Auto” and Press “Start”

All testing parameters are automatically selected.

Test Setup 19:34:06

1650 nm SM

☑ Full Auto ☑ PON (ONU to OLT)

Range: Auto

Resolution: Medium

Pulsewidth: Auto

Averaging: Auto

☑ Apply to All Wavelength

IOR: 1.4682

BSC: -81.50

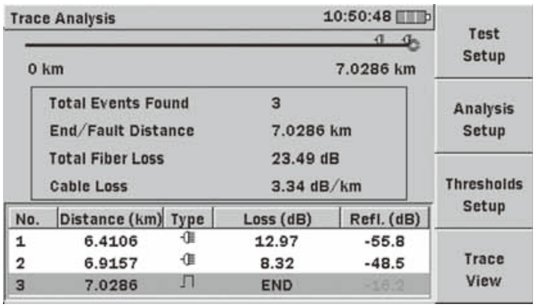
Loss Mode: Event

1650 nm

*: The screen items depend on the selected module.

Step 3 – Read Results

Test results including all splices and connectors, as well as total fiber length and loss are shown in an easy to read table.



Trace Analysis 10:50:48

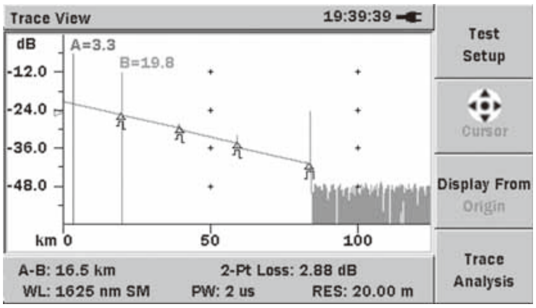
0 km 7.0286 km

Total Events Found	3
End/Fault Distance	7.0286 km
Total Fiber Loss	23.49 dB
Cable Loss	3.34 dB/km

No.	Distance (km)	Type	Loss (dB)	Refl. (dB)
1	6.4106		12.97	-55.8
2	6.9157		8.32	-48.5
3	7.0286		END	-16.2

Step 4 – View Trace

View trace if desired to see the complete fiber trace and make any manual measurements.



Trace View 19:39:39

A-B: 16.5 km

2-Pt Loss: 2.88 dB

WL: 1625 nm SM

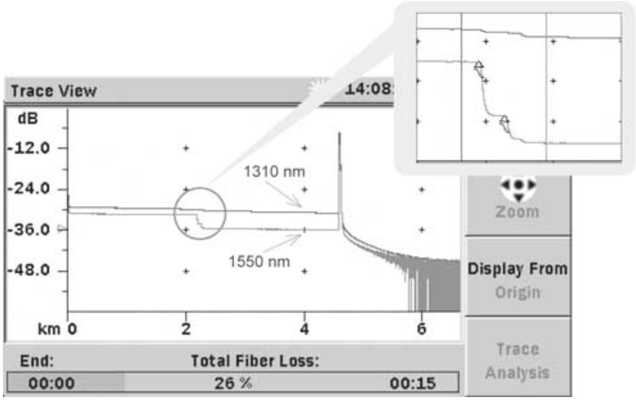
PW: 2 us

RES: 20.00 m

Maintenance Simplified

Being able to test active fibers is a key requirement for network maintenance since multiple users often share portions of the network and taking them all out of service is not an option. To address this need, special modules are available in the MT9090A µOTDR series. 1650 nm is recommended by the ITU-T L.41 for active maintenance since it features 100 nm of isolation from the nearest 1550 nm transmission wavelength. The 1650 nm OTDR also features an integrated filter to block transmissions from damaging the OTDR. 1625 nm is also available and can be used for in-service testing or as an “extra” test to verify installation for stresses such as macrobends.

- Added Macro Bending analysis function
  The µOTDR series finds macro bending points by comparing data from two traces: one 1310 nm and the other 1550 nm.



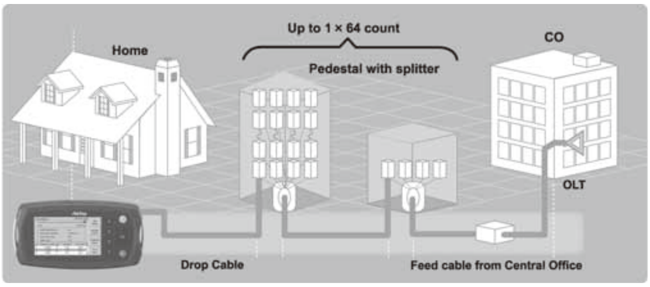
Trace View 14:08

End: 00:00

Total Fiber Loss: 26 % 00:15

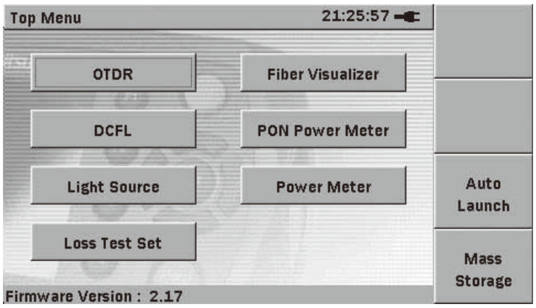
Network Documentation Simplified

- Simple Data Storage
  With internal data storage plus support for external USB memory devices, the MT9090A is more than capable. Add to this auto file saving and naming for easy, error-free documenting of your network.
- Common OTDR Data Format
  The MT9090A supports the universal Telcordia SR-4731 format making it compatible with not only legacy Anritsu and NetTest products, but with many other vendors data.
- Free and Simple Software Upgrades
  Firmware upgrades are easily performed via USB and available from the Anritsu website for registered users or through Anritsu customer support.



All-in-one FTTx Installation and Maintenance Functions

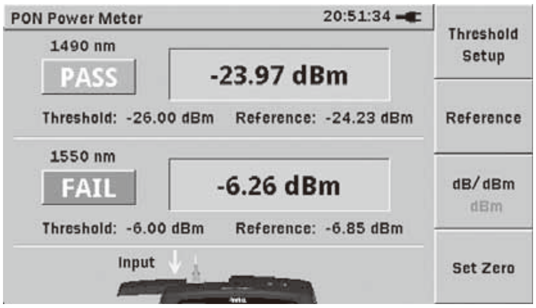
There are three types of µOTDR module: single wavelength (1625 nm or 1650 nm) for the FTTx maintenance market including Metro networks, dual wavelength (1310 nm/1550 nm) for the installation market, and triple wavelength for both these markets.
These all-in-one µOTDR modules support every function required at fiber installation and maintenance, as well as OTDR functions.
The PON Power Meter and Power Meter are ideal for loss measurements required for quality measurements and basic fault tests.


Top Menu 21:25:57

Firmware Version : 2.17

PON Power Meter (1490 nm/1550 nm)

Generally, PON communications use three wavelengths: 1310 nm, 1490 nm, and 1550 nm. Data (1490 nm) and video (1550 nm) signals are sent to subscribers through one optical fiber but a general-purpose optical power meter cannot separate the two wavelengths, making it difficult to locate faults using optical level measurements.
The PON Power Meter can identify and measure the two 1490 nm and 1550 nm signals to support PASS/FAIL evaluations based on a set threshold and reference value. Additionally, power measurements and µOTDR tests are quick and easy without changing the optical fiber because the PON Power Meter port is shared with the µOTDR function.


PON Power Meter 20:51:34

1490 nm PASS -23.97 dBm

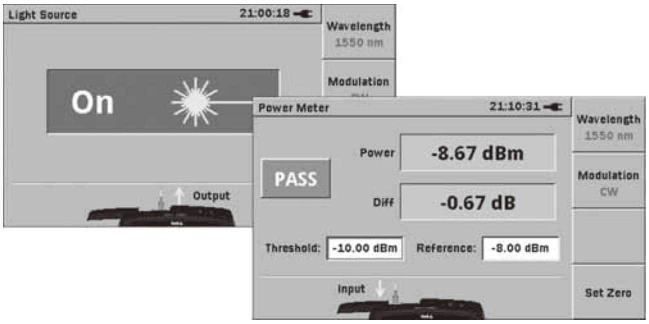
Threshold: -26.00 dBm Reference: -24.23 dBm

1550 nm FAIL -6.26 dBm

Threshold: -6.00 dBm Reference: -6.85 dBm

Light Source/Power Meter

The µOTDR module can be used as a light source to identify an optical fiber and measure the loss by connecting an optical fiber identifier and optical power meter at the other end of the fiber. Since all wavelengths are shared by one µOTDR port, the fiber identification, loss, and µOTDR measurements can all be performed as a single task without changing the fiber connection. Both modulation (270 Hz, 1 kHz, 2 kHz) and CW signals are supported.
The simple power meter function is ideal for checking optical levels to confirm a fault occurrence using total received power. Setting a threshold and reference value makes PASS/FAIL evaluation easy too. In addition, power measurements and µOTDR tests are quick and easy without changing the optical fiber, because the Power Meter port is shared with the µOTDR.


Light Source 21:00:18

On

Power Meter 21:10:31

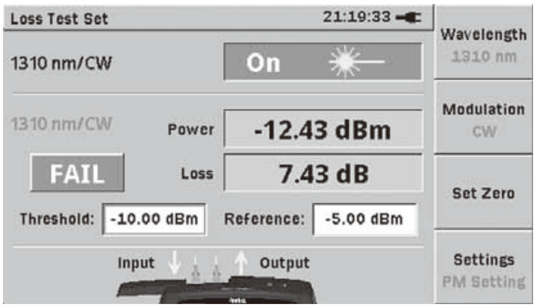
PASS Power -8.67 dBm

Diff -0.67 dB

Threshold: -10.00 dBm Reference: -8.00 dBm

Loss Test Set

Combining the µOTDR module light source with the Power Meter supports use as a Loss Test Set.
The loss at both 1310 nm and 1550 nm can be measured with one µOTDR by looping-back the optical fiber. And both modulation (270 Hz, 1 kHz, 2 kHz) and CW signals are supported. Just setting the threshold and reference value makes PASS/FAIL evaluation easy.


Loss Test Set 21:19:33

1310 nm/CW On

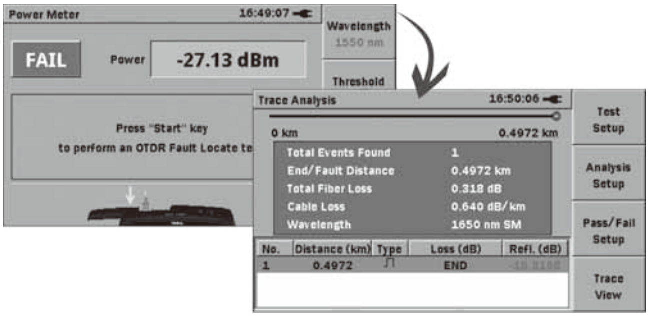
1310 nm/CW Power -12.43 dBm

FAIL Loss 7.43 dB

Threshold: -10.00 dBm Reference: -5.00 dBm

DCFL Function

The Drop Cable Fault Locate (DCFL) mode is a useful function to investigate faults occurring in a drop cable. It consists of the Power Meter function and OTDR function, so you are not required to switch measuring instruments or applications.


Power Meter 16:49:07

FAIL Power -27.13 dBm

Press "Start" key to perform an OTDR Fault Locate te

Trace Analysis 16:50:06

0 km 0.4972 km

Total Events Found 1
End/Fault Distance 0.4972 km
Total Fiber Loss 0.318 dB
Cable Loss 0.640 dB/km
Wavelength 1650 nm SM

No.	Distance (km)	Type	Loss (dB)	Refl. (dB)
1	0.4972		END	[illegible]

Visible Laser Diode

The optional visible red LD light source makes it easy to spot faults in splices and connectors and well as to manage fibers.

*: The PON Power Meter, Light Source, Power Meter, Loss Test Set, and Visible Laser Diode functions have different menus, depending on the selected module. See the Ordering Information for details.
*: The Visible Laser Diode is operated from the µOTDR and Power Meter menus.
*: The screen items depend on the selected module.

Specifications

Mainframe MT9090A

Dimensions and Mass	190 (W) × 96 (H) × 48 (D) mm (7.5” × 3.8” × 1.9”) (including Mainframe and Module) <700 g (1.54 lbs.) (including Mainframe, Module and Standard battery)
Display	4.3-inch TFT Color LCD (480 × 272 pixels, Transmissive)
Interface	USB 1.1, Type A × 1 (memory), Type B × 1 (USB mass storage)

µOTDR Module Common (MU909014C/C6, MU909015C/C6, MU909014A1/B/B1 and MU909015B/B1, MU909015A6)

Fiber Type		10 µm/125 µm SMF (ITU-T G.652)
Optical Connector		FC, SC, DIN adapter are changeable
Distance Range		0.5, 1, 2.5, 5, 10, 25, 50, 75, 125, 250 km (IOR = 1.500000)
Pulse Width		5, 10, 20, 50, 100, 200, 500 ns, 1, 2, 5, 10, 20 µs
Linearity		Which ever is greater ±0.05 dB/dB or ±0.1 dB
Return Loss Measurement Accuracy*1		±2 dB
Distance Measurement Accuracy		±1 m ±3 × Measurement distance × 10^{-5} ±Marker resolution (excluding IOR uncertainty)
Data Storage		Internal memory: 40 MB (<1,000 traces) External (USB Memory): 1 GB (<30,000 traces)
IOR Setting		1.3000 to 1.7000 (0.0001 steps)
Units		km, m, kft, ft, mi
Other Functions		Integrated launch fiber: 10 m (30 ft) Connection check: Automatic check of OTDR to FUT connection quality Live fiber detect: Verifies presence of communication light in fiber Real time sweep: <1 sec (typ.) Macro bend analysis (without single-wavelength model) Bluetooth, WLAN and Ethernet connectivity “Fiber Visualizer (FV)” function “DCFL” function (differs with selected module) Password protect function Video inspection probe (Option)
Language		User selectable (English, Simplified Chinese, Traditional Chinese, Korean, Japanese, French, German, Italian, Spanish, Polish, Portuguese, Finnish, Danish, Swedish, Spanish (Latin America), Russian and Dutch)
Power Supply		9 V(dc), 100 V(ac) to 240 V(ac), Allowable Input voltage range: 90 V(ac) to 264 V(ac), 50 Hz/60 Hz
Fiber Event Analysis		Automatic, Displayed in table format based on user defined PASS/FAIL thresholds
Loss Measurement Modes		2-point loss, Splice loss, dB/km Loss LSA, ORL, Event
OTDR Trace Format		Telcordia universal (.SOR) issue 2 (SR-4731)
Battery		NiMH (Standard battery), NiMH (AA Type), Alkaline Dry Battery (AA Type)*2 Operating time (Standard battery): 8 hours (typ.)*3, Telcordia GR-196-CORE Issue2, September 2010 Recharging time: <4 hours (typ.)*4
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

µOTDR Module MU909014C/C6 and MU909015C/C6

Model Name		MU909015C/C6-057 MU909015C/C6-067	MU909015C/C6-058 MU909015C/C6-068	MU909015C/C6-059 MU909015C/C6-069	MU909014C/C6-057 MU909014C/C6-067	MU909014C/C6-058 MU909014C/C6-068
Center Wavelength*5		1310/1550 ±20 nm*6 1625 ±15 nm	1310/1550 ±20 nm*6 1650 ±15 nm	1310/1490/1550 ±20 nm*6	1310/1550 ±20 nm*6 1625 ±15 nm	1310/1550 ±20 nm*6 1650 ±15 nm
Dynamic Range*7, *8	PW = 20 µs	38 dB/37 dB/35 dB*9, *10	38 dB/37 dB/35 dB*9, *10	36 dB/35 dB/35 dB	32.5 dB/31 dB/32.5 dB*9, *11	32.5 dB/31 dB/32.5 dB*9, *11
	PW = 500 ns	27 dB/26 dB/25 dB*9, *10	27 dB/26 dB/24 dB*9, *10	25 dB/24 dB/24 dB	24.5 dB/23 dB/24 dB*9, *11	24.5 dB/23 dB/24 dB*9, *11
Dead Zone*12 (IOR = 1.500000)		Fresnel: ≤0.8 m (typ.) Backscatter: ≤4.0 m (1310 nm, typ.), ≤4.5 m (1490/1550/1625/1650 nm, typ.)				
Number of Sampling Points*13		<250,001 pts (Course: <7,501 pts, Medium: <20,001 pts, Fine: <250,001 pts)				
Sampling Resolution		2 cm (min.)				
Testing Modes		OTDR (Full automatic, Manual, Real time), Power Meter, [Video Inspection Probe (Option)] [PON Power Meter, Loss Test Set, Light Source (MU909015C6, MU909014C6)]				
Power Meter		Please refer to the spec “Power Meter”				
PON Power Meter (only for MU909015C6/14C6)		Please refer to the spec “PON Power Meter”				
Light Source (only for MU909015C6/14C6)		Please refer to the spec “Light Source”				
Loss Test Set (only for MU909015C6/14C6)		Please refer to the spec “Loss Test Set”				
Environment		Temperature and Humidity Operating: –10° to +50°C, <95% (no condensation) Storage: –30° to +70°C, <95% (no condensation) Vibration: MIL-T-28800E Class 3, Dust and Drip proof: IP51				
Laser Safety*14		IEC Pub 60825-1: 2007 Class 1M, 21CFR1040.10				

µOTDR Module MU909014A1/B/B1 and MU909015B/B1

Model name		MU909015B/B1-056 MU909015B/B1-066	MU909014B/B1-056 MU909014B/B1-066	MU909014A1-053 MU909014A1-063	MU909014A1-054 MU909014A1-064
Center Wavelength*5		1310/1550 ±20 nm*6		1625 ±15 nm	1650 ±15 nm
Dynamic Range*7, *8	PW = 20 µs	37 dB/36 dB	32.5 dB/31 dB	32.5 dB*9, *11	
	PW = 500 ns	28 dB/26 dB	24.5 dB/23 dB	24.5 dB*9, *11	24 dB*9, *11
Dead Zone*12 (IOR = 1.500000)		Fresnel: ≤1 m Backscatter: ≤5 m			
Number of Sampling Points*13		<125,001 pts (Course: <6,251 pts, Medium: <25,001 pts, Fine: <125,001 pts)			
Sampling Resolution		5 cm (min.)			
Testing Modes		OTDR (Full automatic, Manual, Real time), Power Meter, [Visible Fault Locator (Option)], [Video Inspection Prove (Option)]			
Power Meter (only for MU909014B/B1/15B/15B1)		Please refer to the spec "Power Meter"		Not applicable	
Visible Fault Locator (only for MU909014A1/B1/15B1)		Connector: 2.5 mm universal Wavelength: 650 ±15 nm (CW, +25°C) Output power: 0 ±3 dBm (CW, +25°C) Modulation: CW, 1 Hz			
Environment		Temperature and Humidity Operating: –5° to +40°C, <80% (no condensation) Storage: –20° to +60°C, <80% (no condensation) Vibration: MIL-T-28800E Class 3, Dust and Drip proof: IP51			
Laser Safety*14		IEC Pub 60825-1: 2007 Class 1, IEC Pub 60825-1: 2007 Class 1M, IEC Pub 60825-1: 2007 Class 3R (VLD Option), 21CFR1040.10			

µOTDR Module MU909015A6

Model Name		MU909015A6-053 MU909015A6-063	MU909015A6-054 MU909015A6-064
Center Wavelength*5		1625 ±15 nm	1650 ±15 nm
Dynamic Range*7, *8	PW = 20 µs	35 dB*9, *10	
	PW = 500 ns	25 dB*9, *10	24 dB*9, *10
Dead Zone*12 (IOR = 1.500000)		Fresnel: ≤0.8 m (typ.) Backscatter: ≤4.5 m (typ.)	
Number of Sampling Points*13		<250,001 pts (Course: <7,501 pts, Medium: <20,001 pts, Fine: <250,001 pts)	
Sampling Resolution		2 cm (min.)	
Testing Modes		OTDR (Full automatic, Manual, Real time), Power Meter, [Video Inspection Probe (Option)] [PON Power Meter, Light Source]	
Power Meter		Please refer to the spec "Power Meter"	
PON Power Meter		Please refer to the spec "PON Power Meter"	
Light Source		Please refer to the spec "Light Source"	
Environment		Temperature and Humidity Operating: –10° to +50°C, <95% (no condensation) Storage: –30° to +70°C, <95% (no condensation) Vibration: MIL-T-28800E Class 3, Dust and Drip proof: IP51	
Laser Safety*14		IEC Pub 60825-1: 2007 Class 1, 21CFR1040.10	

*1: Design assurance. Distance range: 25 km, Pulse width: 2 µs, 20 km open the fiber-end. BSC: –78.5 (1310 nm), –80.1 (1490 nm), –81.5 (1550 nm), –82.5 (1625 nm/1650 nm)

*2: All specifications are guaranteed by standard battery.

*3: Back light low, Sweeping halted, +25°C

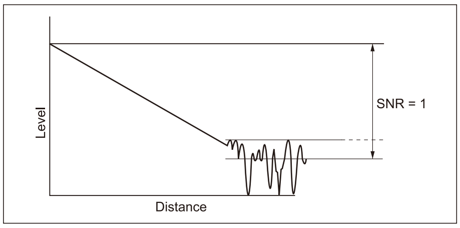
*4: +10 to +30°C, Power off

*5: At +25°C, 1 µs, except charging battery

*6: Typical value, ±25 nm is Guaranteed

*7: Typical value, Distance range: 125 km, Averaging: 180 sec, SNR = 1, +25°C, Except while charging battery, Subtract 1 dB for guarantee

*8: Dynamic range (one-way back-scattered light)
SNR = 1: The level difference between the RMS nose level and the level where near end back-scattering occurs.

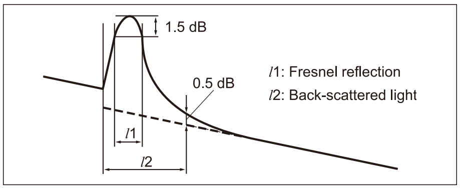


*9: 1490 nm/1550 nm cut filter included (1625 nm or 1650 nm port)

*10: Specified without background light (1625 nm, 1650 nm)

*11: In service Signal is –20 dBm (CW) at 1310 nm/1550 nm

*12: Return Loss 45 dB, +25°C
Fresnel: PW = 5 ns, 1.5 dB down from the peak of Fresnel
Backscatter: PW = 5 ns, Deviation ±0.5 dB



*13: Either medium and fine density value is selected depends on distance range

*14: Safety measures for laser products
This option complies with optical safety standards, in Class1, 1M, 3R of IEC 60825-1; the following descriptive labels are affixed to the product.

Light Source Function

Models	MU909015C6/14C6, MU909015A6
Wavelength*15	1310/1550 ±25 nm (MU909015C6/14C6) 1490 ±25 nm (MU909015C6-059, MU909015C6-069) 1625 ±25 nm (MU909015C6/14C6-057, MU909015A6-053, MU909015C6/14C6-067, MU909015A6-063) 1650 ±25 nm (MU909015C6/14C6-058, MU909015A6-054, MU909015C6/14C6-068, MU909015A6-064)
Fiber Type	10 µm/125 µm SMF (ITU-T G.652)
Output Port	Shared with OTDR port
Output Power*15, *16	–5 ±1.5 dBm
Output Stability*17	≤0.2 dB
Modes of Operation	CW, 270 Hz, 1 kHz, 2 kHz
Laser Safety	Same as OTDR

Power Meter Function

Models	MU909015C6/14C6, MU909015A6	MU909015C/14C	MU909015B/B1, MU909014B/B1
Setting Wavelength	1310/1490/1550/1625/1650 nm	1310/1490/1550 nm	1310/1490/1550/1625/1650 nm
Fiber Type	10 µm/125 µm SMF (ITU-T G.652)		
Measurement Range*18	–50 to +26 dBm (CW) –40 to +13 dBm (270 Hz, 1 kHz, 2 kHz)	–50 to –5 dBm (CW)	
Measurement Port	Shared with OTDR port 1625 nm or 1650 nm OTDR port Dedicated port (Options 059 and 069)	Shared with OTDR port 1310 nm/1550 nm OTDR port (Except options 059 and 069) 1310 nm/1490 nm/1550 nm OTDR port (Options 059 and 069)	
Measurement Accuracy*19	±0.5 dB		
Modes of Operation	CW, 270 Hz, 1 kHz, 2 kHz	CW	

PON Power Meter Function (1490 nm/1550 nm)

Models	MU909015C6/14C6, MU909015A6
Wavelength	1490 nm/1550 nm
Fiber Type	10 µm/125 µm SMF (ITU-T G.652)
Measurement Range	–50 to +13 dBm (1490 nm, CW) –50 to +26 dBm (1550 nm, CW)
Measurement Port	Shared with OTDR port (1625 nm or 1650 nm) Dedicated port (Options 059 and 069)
Measurement Accuracy*20	±0.5 dB
Isolation*21	1490 nm: >35 dB, 1550 nm: >50 dB

Loss Test Set Function

Models	MU909015C6/14C6
Fiber Type	10 µm/125 µm SMF (ITU-T G.652)
Measurement Port	Light Source: Shared with OTDR port 1310 nm/1550 nm OTDR port (Except options 059 and 069) 1310 nm/1490 nm/1550 nm OTDR port (Options 059 and 069) Power Meter: Shared with OTDR port 1625 nm or 1650 nm OTDR port (Except options 059 and 069) Dedicated port (Options 059 and 069)
Light Source	
Wavelength	1310 ±25 nm, 1550 ±25 nm (Except options 059 and 069) 1310 ±25 nm, 1490 ±25 nm, 1550 ±25 nm (Options 059 and 069)
Output Power*15, *16	–5 ±1.5 dBm (CW, 25°C)
Output Stability*17	≤0.2 dB
Modes of Operation	CW, 270 Hz, 1 kHz, 2 kHz
Laser Safety	Same as OTDR
Power Meter	
Setting Wavelength	1310/1490/1550/1625/1650 nm
Measurement Range*18	–50 to +26 dBm (CW) –40 to +13 dBm (270 Hz, 1 kHz, 2 kHz)
Measurement Accuracy*19	±0.5 dB
Modes of Operation	CW, 270 Hz, 1 kHz, 2 kHz

*15: At +25°C, CW
*16: Fiber length 2 m, after the warm-up.
*17: Wavelength 1310 nm/1550 nm, CW, ±1°C at one point within –10° to +50°C, deference between the largest value and shortest value for one minute, single mode fiber 2 m, when the optical power meter with return loss of 40 dB or more is used. After the warm-up time (10 minutes) passed.
*18: At 1550 nm
*19: 1310 nm/1490 nm/1550 nm, CW, –20 dBm, +25°C, on master connector fiber (FC) use, after zero offset execution.
*20: 1490 nm/1550 nm, CW, –20 dBm, +25°C, on master connector fiber (FC) use, after zero offset execution.
*21: Design assurance.

Ordering information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Select Mainframe

Includes battery pack, AC charger/adapter, standard soft case, strap and protector.

Model/Order No.	Description
MT9090A	Mainframe
	Standard Accessories
G0202A	Replacement NiMH Battery Pack
G0203A	Replacement AC Charger/Adapter
B0601B	For MT9090A with/without Protector. This soft case is standard accessory for MT9090A main frame.
Z1023A	Replacement Strap
B0663A	Protector

Select Base Module

Model/Order No.	Description
MU909014A1*1	μOTDR (Single wavelength, 30 dB class OTDR with VLD)
MU909015A6*2	μOTDR (Single wavelength, 35 dB class OTDR with PM, PON-PM and LS)
MU909014B*1	μOTDR (2-wavelength, 30 dB class OTDR)
MU909014B1*1	μOTDR (2-wavelength, 30 dB class OTDR with VLD)
MU909015B*1	μOTDR (2-wavelength, 35 dB class OTDR)
MU909015B1*1	μOTDR (2-wavelength, 35 dB class OTDR with VLD)
MU909014C*4	μOTDR (3-wavelength, 30 dB class OTDR)
MU909014C6*4	μOTDR (3-wavelength, 30 dB class OTDR with PM, PON-PM, LTS and LS)
MU909015C*3, *4	μOTDR (3-wavelength, 35 dB class OTDR)
MU909015C6*4, *5	μOTDR (3-wavelength, 35 dB class OTDR with PM, PON-PM, LTS and LS)

*1: One OTDR port (any of 1310 nm/1550 nm, 1625 nm, 1650 nm) and visible light source (option) (Fig. 1)
*2: One OTDR port (1625 nm or 1650 nm) (Fig. 2)
*3: One OTDR port (1310 nm/1490 nm/1550 nm; Options 059 and 069) (Fig. 2)
*4: Two OTDR ports (1310 nm/1550 nm, and 1625 nm or 1650 nm; Except options 059 and 069) (Fig. 3)
*5: One OTDR port and dedicated power meter port (1310 nm/1490 nm/1550 nm, and power meter; Options 059 and 069) (Fig. 3)


Fig. 1


Fig. 2

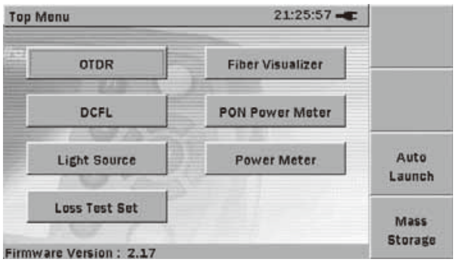

Fig. 3

Select Module, Connector Interface and Testing Options

Includes operation manual and quick reference guide.

Model/Order No.		Description	PM	PON-PM	LTS	LS*7	VLD*8	FV	DCFL
UPC type	APC type	Installation and Maintenance Models							
MU909014C-057	MU909014C-067	μOTDR (1310/1550/1625 nm, 32.5/31/32.5 dB)	✓*1					✓	
MU909014C-058	MU909014C-068	μOTDR (1310/1550/1650 nm, 32.5/31/32.5 dB)	✓*1					✓	
MU909015C-057	MU909015C-067	μOTDR (1310/1550/1625 nm, 38/37/35 dB)	✓*1					✓	
MU909015C-058	MU909015C-068	μOTDR (1310/1550/1650 nm, 38/37/35 dB)	✓*1					✓	
MU909015C-059	MU909015C-069	μOTDR (1310/1490/1550 nm, 36/35/35 dB)	✓*1					✓	
MU909014C6-057	MU909014C6-067	μOTDR (1310/1550/1625 nm, 32.5/31/32.5 dB)	✓*1	✓*3	✓*5	✓		✓	✓
MU909014C6-058	MU909014C6-068	μOTDR (1310/1550/1650 nm, 32.5/31/32.5 dB)	✓*1	✓*3	✓*5	✓		✓	✓
MU909015C6-057	MU909015C6-067	μOTDR (1310/1550/1625 nm, 38/37/35 dB)	✓*1	✓*3	✓*5	✓		✓	✓
MU909015C6-058	MU909015C6-068	μOTDR (1310/1550/1650 nm, 38/37/35 dB)	✓*1	✓*3	✓*5	✓		✓	✓
MU909015C6-059	MU909015C6-069	μOTDR (1310/1490/1550 nm, 36/35/35 dB)	✓*2	✓*4	✓*6	✓		✓	
UPC type	APC type	General Purpose Models							
MU909014B-056	MU909014B-066	μOTDR (1310/1550 nm, 32.5/31 dB)	✓*1					✓	
MU909014B1-056	MU909014B1-066	μOTDR (1310/1550 nm, 32.5/31 dB)	✓*1				✓	✓	
MU909015B-056	MU909015B-066	μOTDR (1310/1550 nm, 37/36 dB)	✓*1					✓	
MU909015B1-056	MU909015B1-066	μOTDR (1310/1550 nm, 37/36 dB)	✓*1				✓	✓	
UPC type	APC type	Maintenance Models							
MU909014A1-053	MU909014A1-063	μOTDR (1625 nm, 32.5 dB)					✓	✓	
MU909014A1-054	MU909014A1-064	μOTDR (1650 nm, 32.5 dB)					✓	✓	
MU909015A6-053	MU909015A6-063	μOTDR (1625 nm, 35 dB)	✓*1	✓*3		✓		✓	✓
MU909015A6-054	MU909015A6-064	μOTDR (1650 nm, 35 dB)	✓*1	✓*3		✓		✓	✓

*1: PM (Power Meter) function shared with OTDR port.
*2: Dedicated PM port.
*3: PON-PM (PON Power Meter) shared with 1625 nm or 1650 nm OTDR port. Identifies and measures 1490 nm and 1550 nm wavelengths.
*4: Dedicated PON-PM port. Identifies and measures 1490 nm and 1550 nm wavelengths.
*5: LTS (Loss Test Set) function for measuring 1310/1550 nm wavelengths. Light source shared with 1310/1550 nm OTDR port. Power meter shared with 1625 nm or 1650 nm OTDR port.
*6: LTS function for measuring 1310/1490/1550 nm wavelengths. Light source shared with 1310/1490/1550 nm OTDR port. Power meter is dedicated port.
*7: LS (Stabilized Light Source) shared with OTDR port for each wavelength.
*8: VLD (Visible Laser Diode) function with visible light source port operated from OTDR or Power Meter.



Firmware Version : 2.17

Top Menu differs with selected module

Select Connector Adapter

Adapter included at no charge – must be added as a separate line item.

Model/Order No.	Description
MU909014A/B/C-025 MU909015A/B/C-025	FC-APC Connector key width 2.0 mm (APC: Models -063, 064, 066, 067, 068, and 069)
MU909014A/B/C-026 MU909015A/B/C-026	SC-APC Connector (APC: Models -063, 064, 066, 067, 068, and 069)
MU909014A/B/C-037 MU909015A/B/C-037	FC Connector (UPC: Models -053, 054, 056, 057, 058, and 059)
MU909014A/B/C-039 MU909015A/B/C-039	DIN 47256 Connector (UPC: Models -053, 054, 056, 057, 058, and 059)
MU909014A/B/C-040 MU909015A/B/C-040	SC Connector (UPC: Models -053, 054, 056, 057, 058, and 059)

Select Accessories

Must be added as separate line items.

Model/Order No.	Description
Z1580A*1	Protector & Soft Case
B0663A*2	Protector
G0203A	AC Adapter (for Replacement)
G0202A	NiMH battery pack (for Replacement)
B0602B	Deluxe Soft Case (for MT9090A)
B0601B	Standard Soft Case
B0600B	Hard Case (for MT9090A)
Z1023A	Strap
J1402A	Car Plug Cord
J1530A	SC Plug-in Converter (UPC(P)-APC(J))
J1531A	SC Plug-in Converter (APC(P)-UPC(J))
J1532A	FC Plug-in Converter (UPC(P)-APC(J))
J1533A	FC Plug-in Converter (APC(P)-UPC(J))
J1534A	LC-SC Plug-in Converter (for SM, SC(P)-LC(J))
J1535A	LC-SC Plug-in Converter (for MM, SC(P)-LC(J))
W3585AE	Quick Reference Guide (English, Printed)
W3586AE	Operation Manual (English, Printed)
Z1579A	Operation Manual (English and Japanese, Electronic (CD-R))
G0306B	Video Inspection Probe (× 400)
NETWORKS	PC Emulation Software for Data Analysis and Reporting

*1: The protector (B0663A) and standard soft case (B0601B) from a set.
The protector includes a shoulder strap.

*2: The shoulder strap can be used to hang the instrument around the neck while working.

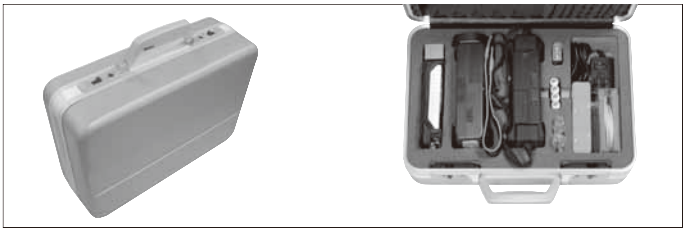
Replacement Adaptors

Must be added as separate line items.

Model/Order No.	Description
J0617B	FC (UPC: Models -053, -054, -056, -057, -058)
J0618E	DIN (UPC: Models -053, -054, -056, -057, -058)
J0619B	Replaceable Optical Connector SC (UPC: Models -053, -054, -056, -057, -058) (APC: Models -063, -064, -066, -067, -068)
J0739A	FC (APC: Models -063, -064, -066, -067, -068)
J1602A	Replaceable optical connector (SC) Phosphor bronze
J1603A	Replaceable optical connector (FC) Phosphor bronze

Standard Soft Case B0601B
This standard accessory accommodates the mainframe with fitted protector.

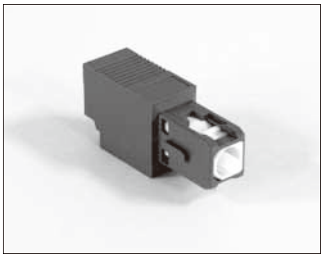
Deluxe Soft Case B0602B
Full Network Master operation without removal from the case. Provides excellent protection for use in hash conditions.
This does not accommodate the mainframe if the protector is fitted.



Hard Case B0600B
This accommodates two mainframes (with or without fitted protector), accessories (light source or power meter, backup battery, fiber cleaner, etc.).

Mainframe with Protector

Protector B0663A (Standard accessory)
The mainframe with fitted protector.



J1530A to J1535A
Plug-in Converter
(The photo shows the J1534A)

G0306B
Video Inspection Probe
(× 400)

MT9090A Mainframe
MU909020A Optical Channel Analyzer Module

All 18 CWDM channels

Optical CWDM Channel Monitoring

Network Master

The Network Master Optical Channel Analyzer (OCA) is a low price CWDM analyzer designed to measure and monitor power and wavelength over the 18 CWDM channels. This small, rugged and easy to use instrument is the ideal and essential mate of each technician for installation, maintenance and troubleshooting of CWDM access networks. Providing fast and reliable measurements in every environment, this modular device is a low cost alternative to more complex OSA for the emerging CWDM market.

Reliable Measurements at a Glance

Starting in less than 30 seconds and reaching stability after a warm-up time inferior to 5 minutes, the OCA is instantaneously operational to monitor CWDM networks.
Light, compact, with no moving part and battery operation, it is ideal for field applications.
Its friendly software interface, with comprehensive graph and table displays of wavelength and power levels and drifts, with pass and fail indicators, makes it easy to use for any skill level, reducing the need for training.
The OCA module is fully compliant with ITU-T G.695 and G.694.2 standards, comes with a universal optical connector, easy to clean by the operator, and is interchangeable with other Network Master modules, without the use of special tools and without requiring calibration.

Specifications

Mainframe MT9090A

Dimensions and Mass	190 (W) × 96 (H) × 48 (D) mm (7.5” × 3.8” × 1.9”) (Mainframe and Module) <800 g (<2 lbs.) (including mainframe, module and battery)
Display	4.3-inch TFT-LCD (480 × 272, with backlight, transparent type)
Interface	USB 1.1, Type A × 1 (memory), Type B × 1 (USB mass storage)

Optical Channel Analyzer Module MU909020A

Number of Channels	All 18 CWDM channels, compliant to ITU-T G.694.2
Channel Pass Band	±6.5 nm, compliant to ITU-T G.695
Channel Wavelength Accuracy	±1 nm*2
Power Range per Channel	–40 to +10 dBm
Channel Power Accuracy	±0.5 dB*1
Channel Power Linearity	±0.3 dB*2
Total Power Accuracy	±0.5 dB*1
Total Power Linearity	±0.3 dB*2
Maximum Total Safe Power	+17 dBm
Maximum Channel Safe Power	+13 dBm
Instrument Repeatability	±0.2 dB*1
Channel Imbalance (Adjacent Channels)	≥12 dB*2, *3
Polarization Dependant Loss	±0.3 dB
Power Supply	9 V(dc), 100 V(ac) to 240 V(ac)
Battery	NiMH, Operating time: 4 hours (typ.)*4, Recharge time: <3 hours (typ.)*5, Operation possible with 4 × AA alkaline: operating time depends on batteries type

Continued on next page

Environmental Conditions		Operating: 0° to +50°C[*6], <80% (non-condensing)[*7], Storage: –20° to +60°C
		Vibration: MIL-T-28800E Class 3, Dust and Drip proof: IP 51
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

*1: Measured at –10 dBm
*2: Signal from –35 to +10 dBm
*3: for wavelengths spacing >15 nm. Channel imbalance >15 dB for wavelengths spacing >20 nm
*4: Backlight low
*5: +10° to +30°C, Power OFF
*6: Specifications are guaranteed from +10° to +40°C. Operation possible from 0° to +50°C.
*7: +10° to +30°C (During Recharging battery, Power OFF)

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Select Mainframe

Includes battery pack, AC charger/adapter, standard soft case, strap and protector

Model/Order No.	Description
MT9090A	Mainframe (with color LCD)

Select Base Module

Includes operation manual on CD

Model/Order No.	Description
MU909020A	Optical Channel Analyzer Module

Select Connector Interface

Model/Order No.	Description
MU909020A-050	OCA with UPC Optical Connector
MU909020A-060	OCA with APC Optical Connector

Select Connector Adapter

One adapter included at no charge – must be added as a separate line item.

Model/Order No.	Description
MU909020A-037	FC Connector (UPC: Model -050 only)
MU909020A-040	SC Connector (UPC: Model -050 only)
MU909020A-025	FC-APC Connector key width 2.0 mm (APC: Model -060 only)
MU909020A-026	SC-APC Connector (APC: Model -060 only)

Select Accessories

Must be added as separate line items.

Model/Order No.	Description
G0203A	AC adaptor (Replacement)
G0202A	NiMH Battery Pack (Replacement)
Z1580A[*1]	Protector & Soft Case
B0663A[*2]	Protector
B0600B	Hard Case
B0601B	Standard Soft Case
B0602A	Deluxe Soft Case (for MT9090A)
Z1023A	Strap
CD005568	Hardcopy MT9090A/MU909020A Operation manual
CD005780	Hardcopy MT9090A/MU909020A Quick Reference Guide
MU909020A-ES210	2 years Extended Warranty Service (total 2 years warranty)
MU909020A-ES310	3 years Extended Warranty Service (total 3 years warranty)

*1: The protector (B0663A) and standard soft case (B0601B) from a set. The protector includes a shoulder strap.
*2: The shoulder strap can be used to hang the instrument around the neck while working.

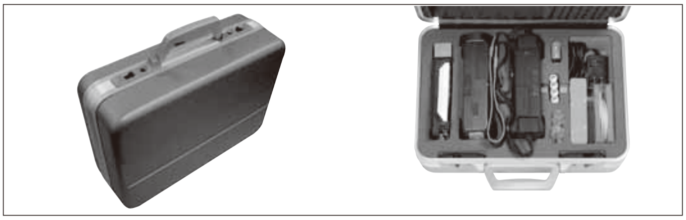
Replacement Adaptors

Must be added as separate line items.

Model/Order No.	Description
J0617B	FC (UPC: Models -050)
J0619B	SC (UPC or APC: all models)
J0739A	FC (APC: Model -060 only)

Standard Soft Case B0601B
This standard accessory accommodates the mainframe with fitted protector.

Deluxe Soft Case B0602A
Full Network Master operation without removal from the case.
Provides excellent protection for use in hash conditions.
This does not accommodate the mainframe if the protector is fitted.



Hard Case B0600B
This accommodates two mainframes (with or without fitted protector), accessories (light source or power meter, backup battery, fiber cleaner, etc.).

Mainframe with Protector

Protector B0663A (Standard accessory)

ACCESS Master

MT9085 Series

1.31/1.55/1.49/1.625/1.65 µm (SMF), 0.85/1.3 µm (MMF)

For Fiber Installation and Maintenance

NEW

The ACCESS Master MT9085 series is a compact handheld all-in-one tester for performing OTDR tests, optical loss/power measurements, and optical fiber end-face inspections. It has a wide variety of applications, ranging from installation and maintenance (I&M) of trunk fibers (Core, Metro, Access, Mobile Fronthaul, Mobile Backhaul) to troubleshooting Access networks, such as breaks in drop cables.

8-inch
Wide Touch Screen

Hard keys
Easy Operation

The easy to use rotary knob and hard keys support efficient manual waveform analysis.

Easy Analysis
Fiber Visualizer

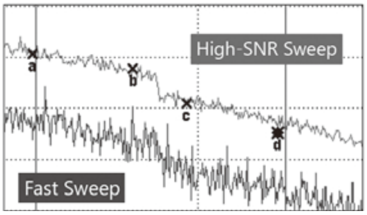
Fiber events, such as splices, connectors, splitters, etc., are displayed as schematic icons along with loss and reflectance Pass/Fail evaluation results for at-a-glance confirmation.

FiberVisualizer

Fast Realtime Sweep Mode with High SNR

Supports Various Measurement Environments

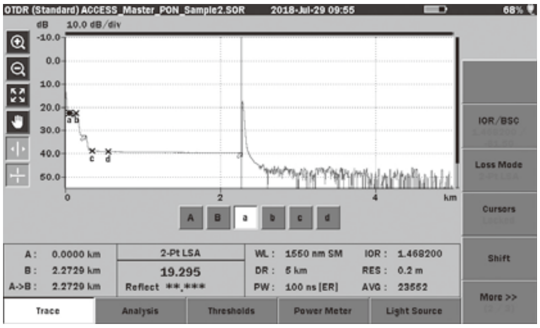
Realtime measurement, fast sweeping is useful for position identification by bending the fiber, while high-SNR sweeping makes it easy to view the waveform. These two sweep modes can be applied in various measurement environments.



Up to 1 × 128 Branches

Identify events for each splitter and branch information

Multiple PON splitters can be identified using high-quality waveforms, and events at each splitter are Pass/Fail evaluated based on preset threshold values.



OTDR (Standard) ACCESS_Master_PON_Sample2.SOR 2018-Jul-29 09:55 68%

A : 0.0000 km
B : 2.2729 km
A->B : 2.2729 km

2-Pt LSA
19.295
Reflect **.***

WL : 1550 nm SM
DR : 5 km
PW : 100 ns [ER]
IOR : 1.468200
RES : 0.2 m
AVG : 23552

Accurate Event Detection and Loss Measurement

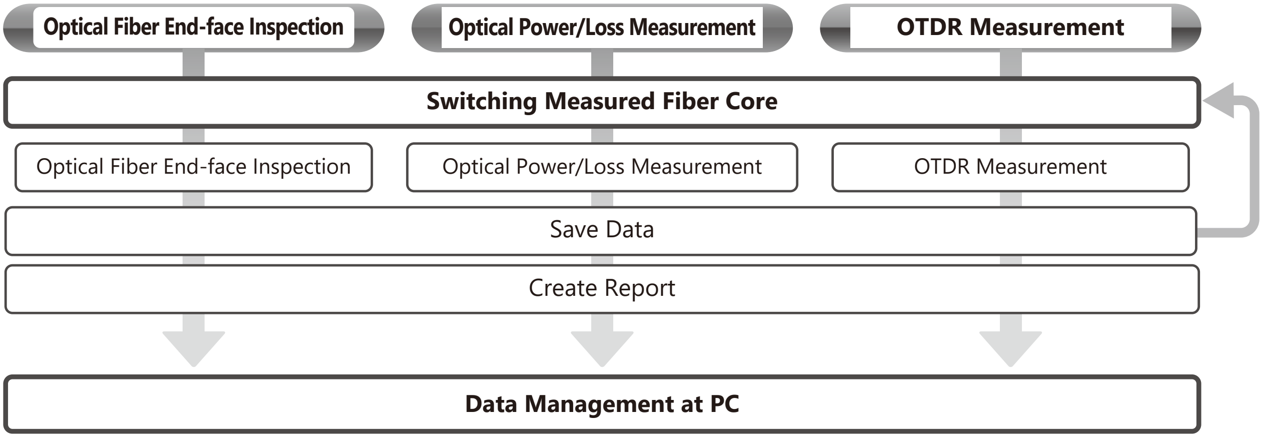
Multi-pulse measurement is supported with a 46-dB max. dynamic range and a dead zone of 0.8 m.

Measurement of both short fibers of a few meters to long fibers of more than 100 km is supported. Multi-pulse measurements enable accurate loss and reflection measurements between events separated by short distances.

Basic Applications

Optical Fiber Path Evaluation process

Multiple test are completed when evaluating optical fiber which include, fiber end-face inspection, and optical power/optical loss and OTDR measurements. these test can all be executed using a single MT9085 series unit (require built-in options and external hardware options).
In addition, data file saved for each measurement can be transferred over WLAN or Bluetooth network connection for further management and processing using dedicated PC tools.

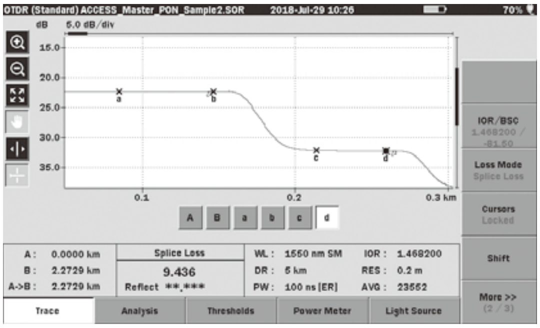


OTDR Measurement

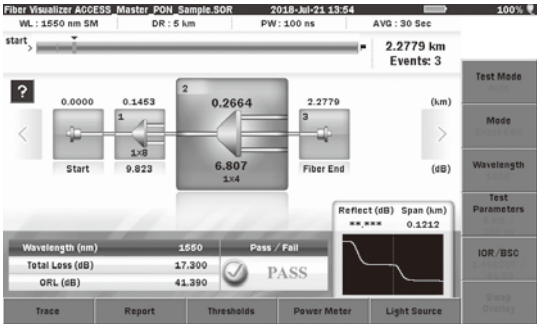
OTDR measurement is a basic function of the MT9085 series. The models in the series support different wavelengths matching the measurement environment. The Fiber Visualizer function displays fiber events as schematic icons for at-a-glance confirmation of splices and connectors along the fiber length with automatic Pass/Fail evaluation of fiber loss and reflectance. Moreover, manual analysis of loss and reflectance using a combination of the rotary knob, hard keys and marker operations assures the same easy operability as previous ACCESS Master series. The excellent waveform quality supports both PON measurements as well as realtime short to long-distance fiber measurements.

MT9085 Series OTDR Product Line

Option	Wavelength	Dynamic Range	Feature
MT9085C-053	1310/1550 nm SM	46/46 dB	General-purpose model for installation and maintenance (I&M)
MT9085C-057	1310/1550/1625 nm SM	46/46/44 dB	Model for effective wavelength maintenance using macrobend analysis
MT9085B-053	1310/1550 nm SM	42/41 dB	General-purpose model for installation and I&M
MT9085B-055	1310/1550 nm, 1650nm SM	41/41 dB, 35 dB	Model with built-in filters for live circuit maintenance
MT9085B-056	1310/1490/1550 nm SM	42/41/41 dB	Model for FTTx/PON I&M
MT9085B-057	1310/1550/1625 nm SM	40/39/38 dB	Model for effective wavelength maintenance using macrobend analysis
MT9085B-058	1310/1490/1550/1625 nm SM	42/41/41/40 dB	Model for FTTx/PON I&M; supports sectioned evaluation of CWDM wavelength band
MT9085B-063	1310/1550 nm SM 850/1300 nm MM	42/41 dB, 29/28 dB	All-in-one model for SMF and MMF I&M
MT9085A-053	1310/1550 nm SM	39/37.5 dB	General-purpose model for installation and I&M
MT9085A-057	1310/1550/1625 nm SM	37/35.5/32.5 dB	Model for effective wavelength maintenance using macrobend analysis
MT9085A-063	1310/1550 nm SM 850/1300 nm MM	39/37.5 dB, 29/28 dB	All-in-one model for SMF and MMF I&M



A : 0.0000 km
B : 2.2729 km
A->B : 2.2729 km
Splice Loss 9.436
Reflect **.***
WL : 1550 nm SM
DR : 5 km
PW : 100 ns [ER]
IOR : 1.468200
RES : 0.2 m
AVG : 23552



WL : 1550 nm SM
DR : 5 km
PW : 100 ns
AVG : 30 Sec
2.2779 km
Events: 3

Reflect (dB) **.***
Span (km) 0.1212

Wavelength (nm)	1550
Total Loss (dB)	17.300
ORL (dB)	41.390

Pass / Fail: PASS

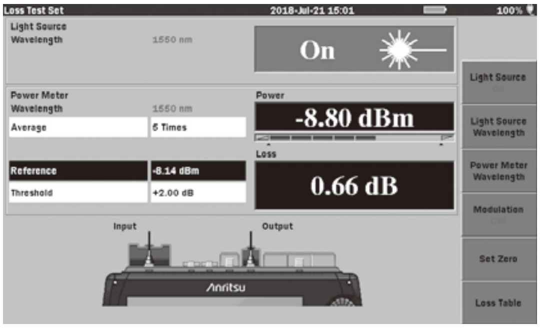
Optical Power/Loss Measurement

Optical power and loss measurement is a key basic function for confirming the optical fiber installation condition and fault status.
The OTDR measurement module functions as a light source outputting laser light. The optical power meter function built into a dedicated port option supports optical loss measurements (OLTS) using one tester.

MT9085 Series Optical Power Meter (Option) Product Line

These are specified as OTDR module options.

Option	Outline	Measurement Range
MT9085A/B/C-004	SMF Optical Power Meter	–50 to +23 dBm
MT9085A/B/C-005	SMF High Input Optical Power Meter	–43 to +30 dBm
MT9085A/B/C-007	SMF/MMF Optical Power Meter	–67 to +6 dBm


Loss Test Set 2018-Jul-21 15:01 100%

Light Source Wavelength 1550 nm

On

Power Meter Wavelength 1550 nm

Average 5 Times

Reference -8.14 dBm

Threshold +2.00 dB

Power -8.80 dBm

Loss 0.66 dB

CMA5 Series: Light Source/Optical Power Meter

The CMA5 series is an optical power meter and optical loss tester for optical power and loss measurements.
For more details, see the separate catalog for the CMA5 series.

Visual Light Source Test

The visual light source is used when monitoring light leaking from the optical fiber core at fiber breaks.

MT9085 Series Visual Light Source (Option) Product Line

It is specified as an OTDR module option.

Option	Outline
MT9085A/B/C-002	Visual Fault Locator

Optical Fiber End-face Inspection

Scratches and dirt on the ferrule end face of connectors is a main cause of signal transmission loss and reflections, which severely degrade transmission quality. Moreover, the optical fiber end face requires inspection and cleaning to assure accurate OTDR and optical power/loss measurements.
Using the MT9085 series in combination with the Video Inspection Probe G0306B external option (sold separately) supports end-face inspections.

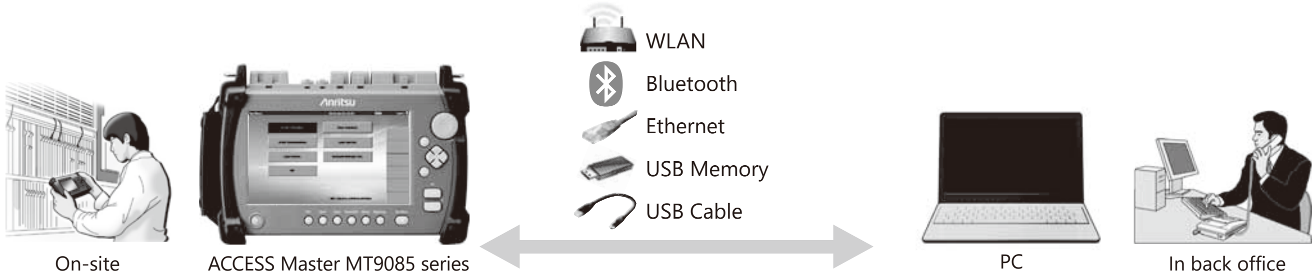
Video Inspection Probe (External Attachment Option) Product Line

Option	Outline
G0306B	Video Inspection Probe

Saving Data Files and Creating Reports

On-site measurement data captured using the MT9085 series can be saved in each original measurement application data file format as well as in various other formats, including PDF reports. Moreover, these data can be shared with a PC via interfaces such as WLAN, Bluetooth, USB Memory, etc., for further waveform analysis and reporting at the PC using dedicated software tools based on the on-site captured original data files.

* Communications over WLAN and Bluetooth require a USB dongle adapter. Files can also be shared via Ethernet, USB memory, and USB cable.



MT9085 Series Measured Data Save Methods

	Original Data Files	Screen Capture	.csv File	PDF Report Output
OTDR	✓	✓		✓
OLTS		✓	✓	
VIP	✓	✓		✓

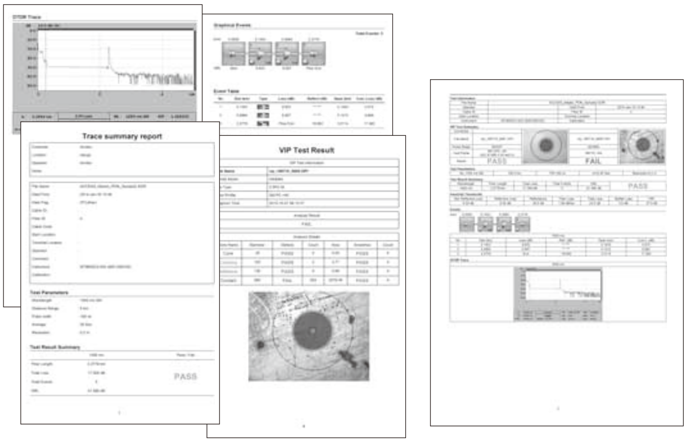
Windows PC Analysis Tools

OTDR	NETWORKS • Waveform analysis of original data file (.sor) saved by MT9085 • Report creation
VIP	Connector Master MX900030A • Analysis of loaded data file (.vipi) originally saved by MT9085 + G0306B

Managing Measured Data

Each OTDR, OLTS, and VIP data set measured on-site using the MT9085 series can be saved as the original data file or as a .csv file. The screen capture function is useful when wanting to keep a simple record of the measured data. Saving is easy using the shortcut key at the bottom of the screen.

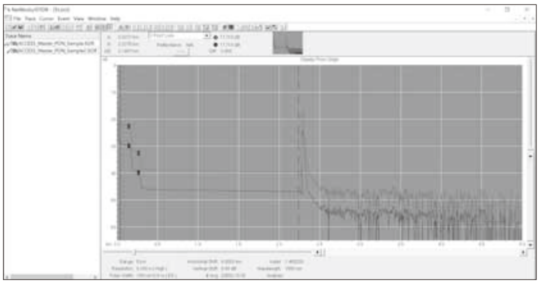
At OTDR and VIP measurement, saving the file in the original data format (.sor, .vipi) is useful for further waveform data analysis back at the office either by reloading the data onto the MT9085 series or onto a PC. Moreover, in addition to creating a PDF report, reports combining the OTDR and VIP measurements results can also be created.



PDF Report Output

Waveform analysis and report creation for on-site OTDR measurement data results (.sor) on a PC can be performed using the dedicated Analysis Software NETWORKS (sold separately).

Similarly, VIP measurement data can also be analyzed on a PC using the dedicated Connector Master MX900030A software.



Waveform Analysis and Report Creation using NETWORKS

External Data File Transmission and Communications Control

In addition to transferring data files from the MT9085 series to a PC using either USB memory or a USB cable, data can also be transferred using WLAN and Bluetooth networks (requires external USB WLAN adapter). Communications over either WLAN or Ethernet interface can be controlled remotely using a Web browser GUI or remote commands. (Ethernet connection requires an external USB-Ethernet conversion cable.)

Remote GUI Control by Web Browser

Specifications

ACCESS Master MT9085A/B/C Common

Dimensions and Mass	Without Protector	Dimensions: 270 (W) × 165 (H) × 61 (D) mm, 10.6 × 6.5 × 2.4 inches
		Mass: 1.6 kg without battery, 1.9 kg including battery
	With Protector (option 010)	Dimensions: 284 (W) × 200 (H) × 77 (D) mm, 11.2 × 7.9 × 3 inches
		Mass: 2.6 kg including battery
Display	8-inch touch screen TFT-Color LCD	
Interface	USB 2.0: Type A × 3 (memory), USB1.1: MicroB × 1 (USB mass storage) * USB power supply is 500 mA	
Wireless Interface	WLAN/Bluetooth * via USB adapter connected to USB port	
Data Storage	Internal memory: 1 GB (up to 50,000 traces), External memory (USB): up to 32 GB	
Power Supply	12 V(dc), 100 V(ac) to 240 V(ac), Allowable input voltage range: 90 V to 264 V, 50 Hz/60 Hz	
Battery	Type: Lithium ion Operating Time*1: 12 hours, Telcordia GR-196-CORE Issue 2, September 2010 Recharge Time: <5 hours (power off)	
Power Consumption	20 W max (recharging), 4 W standard (low backlight, sweep stopped)	
Power Saving Functions	Backlight off: Disable/1 to 99 minutes Auto shutdown: Disable/1 to 99 minutes	
Vertical Scale	0.1, 0.2, 0.5, 1.0, 2.0, 5.0, 10.0 dB/div	
IOR Setting	1.300000 to 1.700000 (0.000001 steps)	
Units	km, m, kft, ft, mi	
Languages	User selectable (English, Simplified Chinese, Traditional Chinese, French, German, Italian, Korean, Portuguese, Russian, Spanish, Swedish and Japanese)	
Sampling Points*2	Up to 150,001	
Sampling Resolution	0.05 m to 60 m	
Reflectance Accuracy	Single mode: ±2 dB (When measuring the non-connected end of an approximately 25 km length fiber, Distance range: 50 km, Pulse width: 2 µs) Multimode: ±4 dB (When measuring the non-connected end of an approximately 4.5 km length fiber, Distance range: 10 km, Pulse width: 100 ns)	
Distance Accuracy	±1 m ±3 × measurement distance × 10^{-5} ± marker resolution (excluding IOR uncertainty)	
Loss Measurement Accuracy (Linearity)	±0.05 dB/dB or ±0.1 dB (whichever is greater)	
Distance Range	Single mode: 0.5, 1, 2.5, 5, 10, 25, 50, 100, 200, 300 km Multimode: 0.5, 1, 2.5, 5, 10, 25, 50, 100 km	
Testing Modes	Fiber Visualizer: Provides end/break location, end to end loss, fiber length, easy graphical summary, PDF report, Standard OTDR: User selectable automatic or manual set-up Construction OTDR: Automated, multi-wavelength testing Light source: Stabilized Light source (CW, 270 Hz, 1 kHz, 2 kHz output) Loss test set (optional): Power meter and Light source Connector Video Inspection Probe (optional) Visual fault locator (optional): Visible red light for fiber identification and troubleshooting	
Fiber Event Analysis	Auto or manual operation, displayed in table format User defined Pass/Fail thresholds: Reflective and non-reflective events: 0.01 to 9.99 dB (0.01-dB steps) Reflectance: 70.0 to 20.0 dB (0.1-dB steps) Fiber end/break: 1 to 99 dB (1-dB steps) Number of detected events: up to 99 Macrobend detection	
OTDR Trace Format	Telcordia universal. SOR, issue 2 (SR-4731)	
Other Functions	Real time sweep*3: 0.15 sec. Loss modes: 2-point loss, dB/km, 2-point LSA, splice loss, ORL Averaging modes: Timed (1 to 3600 s) Live Fiber detect: Verifies presence of communication light in optical fiber Connection check: Automatic check of OTDR to FUT connection quality Trace overlay and comparison, Template function, USB keyboard support, Remote control, Remote GUI Password protection feature	
Environmental Conditions	Operating temperature and humidity: –10° to +50°C, <80% (non-condensing) Storage temperature and humidity: –20° to +60°C, <80% (non-condensing) Vibration: Conforming to MIL-T-28800E Class 3 Dust proof: MIL-T-28800E (Dust Exposure) Class 2 Drip proof: IP51 (IEC 60529), JIS C 0920 TYPE I complied Shock: MIL-T-28800E Style A (46 cm height , 8 corners, 6 faces ; 14 drops in total, power off), Bump: IEC 60068-2-27, JIS C60068-2-27, Shock-on-desk: MIL-T-28800E(45° angle or 100 mm lifted edge, 4 drops in total , power on)	
CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN61010-1 RoHS: 2011/65/EU, EN50581	

*1: Typical, backlight Low, sweeping halted at 25˚C
*2: Either high density value is selected depending on distance range
*3: Resolution: Low Density

OTDR

MT9085C

Options	HR/ER Mode*4	Wavelength*5	Fiber Type	Pulse width	Dynamic Range*6, *7	Dead Zone (Fresnel)*8 (IOR = 1.500000)	Dead Zone (Backscatter)*9 (IOR = 1.500000)
MT9085C-053	✓	1310/1550 nm ±25 nm	Single Mode (SMF) 10/125 µm ITU-T G.652	3, 10, 20, 30, 50, 100, 200, 500, 1000, 2000, 4000, 10000, 20000 ns	46/46 dB*11 25/25 dB*10 (Pulse width: 100 ns)	≤1 m, 0.8 m (typ.)	≤3.8/4.3 m
MT9085C-057	✓	1310/1550/1625 nm ±25 nm			46/46/44 dB*11 25/25/23 dB*10 (Pulse width: 100 ns)		≤3.8/4.3/4.8 m

MT9085B

Options	HR/ER Mode*4	Wavelength*5	Fiber Type	Pulse width	Dynamic Range*6, *7, *13	Dead Zone (Fresnel)*8 (IOR = 1.500000)	Dead Zone (Backscatter)*9 (IOR = 1.500000)
MT9085B-053	✓	1310/1550 nm ±25 nm	Single Mode (SMF) 10/125 µm ITU-T G.652	3, 10, 20, 30, 50, 100, 200, 500, 1000, 2000, 4000, 10000, 20000 ns	42/41 dB*11	≤1 m 0.8 m (typ.)	≤5/5.5 m
MT9085B-055	✓	1310/1550 nm ±25 nm, 1645 nm to 1655 nm			42/41/35 dB*11		≤5/5.5/6.5 m
MT9085B-056	✓	1310/1490/1550 nm ±25 nm			42/41/41 dB*11		≤6/6.5/6.5 m
MT9085B-057	✓	1310/1550/1625 nm ±25 nm			40/39/38 dB*11		≤6/6.5/7.5 m
MT9085B-058	✓	1310/1490/1550/1625 nm ±25 nm			42/41/41/40 dB*11		≤7/7.5/7.5/8.5 m
MT9085B-063	✓	1310/1550 nm ±25 nm, 850/1300 nm ±30 nm	HYBRID (SMF/MMF)*12	SMF: above MMF: 3, 10, 20, 30, 50, 100, 200, 500, 1000, 2000, 4000 ns 850 nm: Does not support 1000, 2000, 4000 ns	42/41 dB*11 29/28 dB*11		≤5/5.5 m, ≤4/5 m (3/4 m typ.)

MT9085A

Options	HR/ER Mode*4	Wavelength*5	Fiber Type	Pulse width	Dynamic Range*6, *7	Dead Zone (Fresnel)*8 (IOR = 1.500000)	Dead Zone (Backscatter)*9 (IOR = 1.500000)
MT9085A-053	✓	1310/1550 nm ±25 nm	Single Mode (SMF) 10/125 µm ITU-T G.652	3, 10, 20, 30, 50, 100, 200, 500, 1000, 2000, 4000, 10000, 20000 ns	39/37.5 dB*11	≤1 m 0.8 m (typ.)	≤5/5.5 m
MT9085A-057	✓	1310/1550/1625 nm ±25 nm			37/35.5/32.5 dB*11		≤6/6.5/7.5 m
MT9085A-063	✓	1310/1550 nm ±25 nm, 850/1300 nm ±30 nm	HYBRID (SMF/MMF)*12	SMF: above MMF: 3, 10, 20, 30, 50, 100, 200, 500, 1000, 2000, 4000 ns 850 nm: Does not support 1000, 2000, 4000 ns	39/37.5 dB*11 29/28 dB*11		≤5/5.5 m, ≤4/5 m (3/4 m typ.)

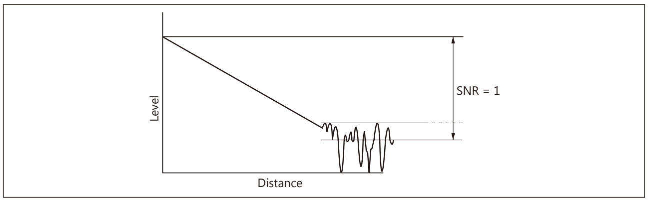
Laser Safety*14	IEC 60825-1:2007 CLASS 1M: option 053, 055, 056, 057, 058, 063 21CFR1040.10 Excludes deviations caused by conformance to Laser Notice No. 50 dated June 24, 2007

*4: HR: High Resolution mode for Short dead zone.
ER: Enhanced Range mode for PON measurement.

*5: 25°C, Pulse width: 1 µs (all except 850 nm, 1300 nm), 850 nm/1300 nm: 100 ns

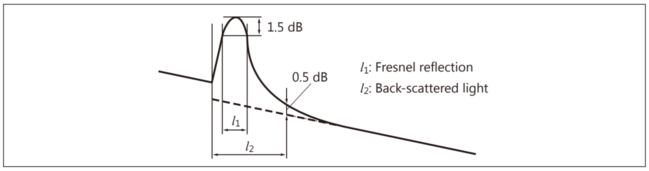
*6: Pulse widths: 20 µs (Options 053, 055, 056, 057, 058, 063, 1310 nm/1550 nm) at Distance range: 100 km
Pulse width: 4 µs (Option 063, 1300 nm) at Distance range: 25 km
Pulse width: 500 ns (Option 063, 850 nm) at Distance range: 25 km
Averaging: 180 sec., SNR = 1, 25°C

*7: Dynamic range (one-way back-scattered light), SNR = 1: The level difference between the RMS noise level and the level where near end back-scattering occurs.



*8: Pulse width: 3 ns (Options 053, 055, 056, 057, 058, 063.)
Return loss: 40 dB, 25˚C (Refer to the figure below)

*9: Pulse width 10 ns, return loss 55 dB, Deviation ±0.5 dB, 25°C
(Options 053, 055, 056, 057, 058, 063. All except 850 nm/1300 nm)
Pulse width 3 ns, return loss 40 dB, Deviation ±0.5 dB, 25°C
(Option 063, 850 nm/1300 nm)



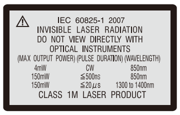
*10: Pulse width: 100 ns (ER Mode), Distance range: 100 km
Averaging: 180 sec., SNR = 1, 25°C

*11: Typical. Subtract 1 dB for guarantee

*12: At measurement of 50 µm/125 µm MM Fiber, the dynamic range drops by about 3.0 dB

*13: At 1650 nm: With background light, 1310/1550 nm, –19 dBm CW light

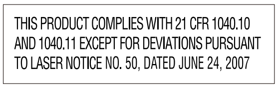
*14: Safety measures for laser products
This product complies with optical safety standards in IEC 60825-1, 21CFR1040.10 and 1040.11; the following descriptive labels are affixed to the product.



IEC 60825-1 2007
INVISIBLE LASER RADIATION
DO NOT VIEW DIRECTLY WITH
OPTICAL INSTRUMENTS

(MAX OUTPUT POWER)	(PULSE DURATION)	(WAVELENGTH)
4mW	CW	850nm
150mW	≦500ns	850nm
150mW	≦20µs	1300 to 1400nm

CLASS 1M LASER PRODUCT



THIS PRODUCT COMPLIES WITH 21 CFR 1040.10
AND 1040.11 EXCEPT FOR DEVIATIONS PURSUANT
TO LASER NOTICE NO. 50, DATED JUNE 24, 2007

Light Source Specifications – Standard on all models*15	
Stabilized Light Source (through OTDR port)	
Wavelength*17	Same as OTDR
Spectral Width*17	≤5 nm (1310 nm) ≤10 nm (850/1300/1490/1550/1625 nm) ≤3 nm (1650 nm)
Wavelength Accuracy*17	850/1300/1310/1490/1550/1625 nm: ±30 nm 1650 nm: ±5 nm
Fiber Type	Same as OTDR
Optical Connector	Same as OTDR
Output Power*17	–5 ±1.5 dBm
Output Stability*18	≤0.1 dB
Modes of Operation*19	CW, 270 Hz, 1 kHz, 2 kHz
Laser Safety	Same as OTDR

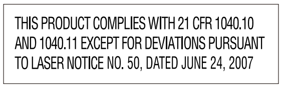
Power Meter Specifications – Standard on all models*15	
Standard Integrated Power Meter*16 (through OTDR port)	
Maximum Input	+10 dBm
Measurement Range	–50 to –5 dBm
Fiber Type	Same as OTDR
Optical Connector	Same as OTDR
Accuracy*20	±6.5%
Setting Wavelengths	1310, 1550, 1625, 1650 nm (Options 053, 055, 057, 063) 1310, 1490, 1550, 1625 nm (Options 056, 058)
Features	Store reference, loss table

Loss Test Set Specifications – Optional on all Models*17, *18			
Power meters (004, 005 and 007)			
Option	MT9085A/B/C-007	MT9085A/B/C-004	MT9085A/B/C-005
Fiber Type	Single Mode: 10 μm/125 μm (G.652), Multimode: 62.5 μm/125 μm	Single Mode: 10 μm/125 μm (G.652) *PC only for UPC connector	Single Mode: 10 μm/125 μm (G.652)
Measurement Range*21	–67 to +6 dBm*22 (CW, 1310 nm)	–50 to +23 dBm (CW, 1550 nm)	–43 to +30 dBm (CW, 1550 nm)
Wavelength Range	800 nm to 1700 nm	1200 nm to 1700 nm	
Setting Wavelengths	850, 1300, 1310, 1383, 1490, 1550, 1625, 1650 nm	1310, 1383, 1490, 1550, 1625, 1650 nm	
Optical Connector	Universal – uses LP-XX adapters	Universal – uses JXXXX adapters (same as OTDR)	Universal – uses MA9005B adapters
Accuracy	±5% (1310 nm/1550 nm)*23, ±0.5 dB (850 nm)*23	±5% (1310 nm/1550 nm)*24	
Reflectance	—	≥36 dB*25	—
Modulation	CW, 270 Hz, 1 kHz, 2 kHz		
Features	Save reference, loss table		
Environmental	Operating temperature and humidity: 0° to +50°C, <80% (non-condensing)		

Visual light Source (Option 002)	
Central Wavelength	650 nm ±15 nm (at 25˚C)
Optical Output	0 ±3 dBm (CW)
Output Optical Fiber	10 μm/125 μm, SMF (ITU-T G.652)
Optical Connector	2.5 mm universal
Laser Safety*26	IEC 60825-1: 2007 CLASS 3R 21CFR1040.10 and 1040.11 Excludes deviations caused by conformance to Laser Notice No. 50 dated June 24, 2007
Environmental	Operating temperature and humidity: 0° to +50°C, <80% (non-condensing)

*15: Some models do not support power meter (See next page)
*16: If Opttion 004, 005 or 007 is ordered, the standard integrated power meter is not available
*17: CW, 25°C
*18: CW, –10° to 50°C (±1°C) difference between max/min. values over 1 minute, SM fiber 2 m
*19: Modulation +1.5% with 10 minute warm up
*20: CW input, –20 dBm at 1550 nm, 23°C ±2 Using Master FC connector
*21: Peak power, subtract 3 dB for modulated tones
*22: –60 to +3 dBm (Option 007 @850 nm)
*23: CW, at –10 dBm (1310/1550 nm), At –10 dBm (850 nm), 25°C, Using Master FC connector After zero offset
*24: CW, at 0 dBm (1310/1550 nm), 25°C, Using Master FC connector, After zero offset
*25: Using SM fiber (ITU-T G.652). Reflectance: ≥45 dB
*26: Safety measures for laser products
This option complies with optical safety standards in IEC 60825-1, 21CFR1040.10 and 1040.11; the following descriptive labels are affixed to the product.


⚠ IEC 60825-1:2007
VISIBLE LASER RADIATION
AVOID DIRECT EYE EXPOSURE
(MAX OUTPUT POWER) (PULSE DURATION) (WAVELENGTH)
5mW CW 650±15nm
CLASS 3R LASER PRODUCT


THIS PRODUCT COMPLIES WITH 21 CFR 1040.10
AND 1040.11 EXCEPT FOR DEVIATIONS PURSUANT
TO LASER NOTICE NO. 50, DATED JUNE 24, 2007

Standard Light Source and Power Meter Built-in

LS: MT9085A/B/C standard built-in stabilized Light Source, OPM: MT9085A/B/C standard built-in Optical Power Meter

Options	Optical Port	LS	OPM
MT9085A/B/C-053	1310/1550 nm SM	✓	✓
MT9085B-055	1310/1550 nm SM	✓	✓
	1650 nm SM	✓	✓
MT9085B-056	1310/1490/1550 nm SM	✓	✓
MT9085A/B/C-057	1310/1550/1625 nm SM	✓	✓
MT9085B-058	1310/1490/1550/1625 nm SM	✓	✓
MT9085A/B-063	850/1300 nm MM	✓	—
	1310/1550 nm SM	✓	✓

Battery Pack: Z0921A

Battery	Lithium Ion secondary battery
Voltage, Capacity	11.1 V, 4200 mAh
Dimensions and Mass	53 (W) × 19 (H) × 215 (D) mm, 330 g (typ.)
Environmental Conditions	Charging: +5° to +30°C, ≤80% RH
	Discharging: –20° to +60°C, ≤80% RH
	Storage: –20° to +50°C, ≤80% RH

AC Adapter: Z1625A

Rated AC Input	100 V(ac) to 240 V(ac), 50 Hz/60 Hz
Rated DC Output	12 V(dc), 5 A
Environmental Conditions	Operating: 0° to +45°C, 20 to 80% RH
	Storage: –20° to +70°C, 10 to 90% RH

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

1) Specify at least one main unit.

Model/Order No.	Name
	Main Unit
MT9085C	ACCESS Master High Performance Dynamic Range
MT9085B	ACCESS Master Enhanced Dynamic Range
MT9085A	ACCESS Master Standard Dynamic Range
	Standard Accessories
Z1991A*1	ACCESS Master Operation Manual CD: 1 pc
W3974AE	MT9085 Series Quick Guide: 1 pc
Z1625A*2	AC adapter: 1 pc
	Line cord: 1 pc
Z0921A	Battery Pack: 1 pc

2) Specify at least one module option (wavelength).

Model/Order No.	Name
	Module Option (OTDR)*3
	High Performance Model
MT9085C-053	SMF 1.31/1.55 µm OTDR
MT9085C-057	SMF 1.31/1.55/1.625 µm OTDR
	Enhanced Model
MT9085B-053	SMF 1.31/1.55 µm OTDR
MT9085B-055	SMF 1.31/1.55/1.65 µm OTDR
MT9085B-056	SMF 1.31/1.49/1.55 µm OTDR
MT9085B-057	SMF 1.31/1.55/1.625 µm OTDR
MT9085B-058	SMF 1.31/1.49/1.55/1.625 µm OTDR
MT9085B-063	MMF 0.85/1.3 µm & SMF 1.31/1.55 µm OTDR
	Standard Model
MT9085A-053	SMF 1.31/1.55 µm OTDR
MT9085A-057	SMF 1.31/1.55/1.625 µm OTDR
MT9085A-063	MMF 0.85/1.3 µm & SMF 1.31/1.55 µm OTDR

3) Specify at least one optical connector.

Model/Order No.*5	Name
	Option (Connector)
MT9085x-025*3	FC-APC Connector Key width 2.0 mm
MT9085x-026*3	SC-APC Connector
MT9085x-037*4	FC Connector
MT9085x-038*4	ST Connector
MT9085x-039*4	DIN 47256 Connector
MT9085x-040*4	SC Connector

4) Choose from the following options.

Model/Order No.*5	Name
	Option (Visual light Source)
MT9085x-002	Visual Fault Locator
	Option (Power Meter)*6
MT9085x-004	SMF Optical Power Meter
MT9085x-005	SMF High Power Optical Power Meter
MT9085x-007	SMF/MMF Optical Power Meter
	Option (Others)
MT9085x-010*7	Protector

*1: Stores operation manual and quick guide

*2: Power cord (J0979) supplied at separate purchase

*3: Can only connect APC-type optical fiber

*4: Cannot only connect APC-type optical fiber

*5: Specify A, B, or C at "x"

*6: Same optical connector or connector adapter supplied as type specified for optical pulse tester

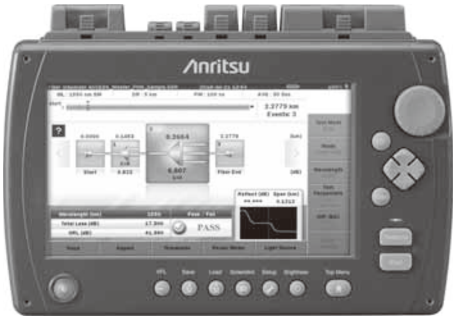
*7: Front Protector B0584A cover supplied with belt as standard

Example of Ordering Configuration

1) MT9085B	ACCESS Master Enhanced Dynamic Range
2) MT9085B-053	SMF 1.31/1.55µm OTDR
3) MT9085B-040	SC Connector
4) MT9085B-002	Visual Fault Locator
4) MT9085B-007	SMF/MMF Optical Power Meter
4) MT9085B-010	Protector

- Requires one each for items 1) to 3)
  When specifying Model B, select from B-type options for items 2) to 4).
- 3) When specifying SC connector at 3), SC connector will be used at power meter in item 4).

With Protector (Option)
(The Protector Cover B0584A is supplied with a carrying strap as standard.)



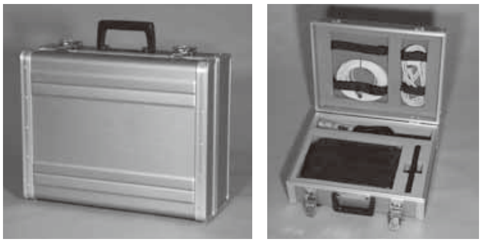
Without Protector

5) Choose from the following when specifying application parts, peripherals, consumables, etc.

Model/Order No.	Name	Description
	Application Parts	
W3971AE	MT9085 Series Operation Manual	Printed. Electronic version included on accessory CD Z1991A.
W3972AE	MT9085 Series SCPI Remote Control Operation Manual	Printed. Electronic version included on accessory CD Z1991A.
B0745A	Softcase	
B0582A	Soft carrying case	With shoulder strap. Can also accommodate main unit with fitted Option 010 Protector
B0583A	Hard transit case	Dimensions 420 (W) × 330 (H) × 148(D) mm
B0549	HARD CARRYING CASE	
B0584A	Front cover	Option 010 Protector cover only
Z0921A	Battery Pack	Li-ion Secondary battery, 11.1 V(dc), 4200 mAh
Z1632A	Battery Charger	Li-ion battery charger
J1295	CAR PLUG CORD	
J0617B	Replaceable optical connector (FC-PC)	For OTDR port, For option power meter port (MT9085A/B/C)
J0618D	Replaceable optical connector (ST)	For OTDR port, For option power meter port (MT9085A/B/C)
J0618E	Replaceable optical connector (DIN)	For OTDR port, For option power meter port (MT9085A/B/C)
J0618F	Replaceable optical connector (HMS-10/A)	For OTDR port, For option power meter port (MT9085A/B/C)
J0619B	Replaceable optical connector (SC-PC)	For OTDR port, For option power meter port (MT9085A/B/C)
J0739A	Replaceable optical connector (FC-APC)	For OTDR port (MT9085A/B/C)
J1697A	Replaceable optical connector (SC-APC)	For OTDR port (MT9085A/B/C)
J0057	OPTICAL ADAPTER FC TYPE	FC-FC connector (JJ adapter)
J1335A	MU/LC connector adapter	Ferrule connection adapter 1.25 mm → 2.5 mm for visual light source (Option 002 only)
MA9005B-37	FOR FC CONNECTOR	For option power meter port (MT9085A/B/C-005)
MA9005B-38	FOR ST CONNECTOR	For option power meter port (MT9085A/B/C-005)
MA9005B-39	FOR DIN CONNECTOR	For option power meter port (MT9085A/B/C-005)
MA9005B-40	FOR SC CONNECTOR	For option power meter port (MT9085A/B/C-005)
LP-FC	FC-PC POWER METER ADAPTER	For option power meter port (MT9085A/B/C-007)
LP-ST	ST-PC POWER METER ADAPTER	For option power meter port (MT9085A/B/C-007)
LP-SC	SC-PC POWER METER ADAPTER	For option power meter port (MT9085A/B/C-007)
LP-DIN	DIN-PC POWER METER ADAPTER	For option power meter port (MT9085A/B/C-007)
J1530A	SC PLUG IN CONVERTER (UPC(P)-APC(J))	Converts main unit SC/UPC connector to SC/APC
J1531A	SC PLUG IN CONVERTER (APC(P)-UPC(J))	Converts main unit SC/APC connector to SC/UPC
J1532A	FC PLUG IN CONVERTER (UPC(P)-APC(J))	Converts main unit FC/UPC connector to FC/APC
J1533A	FC PLUG IN CONVERTER (APC(P)-UPC(J))	Converts main unit FC/APC connector to FC/UPC
J1534A	LC-SC Plug-in Converter (for SM, SC(P)-LC(J))	Converts main unit SC connector to LC (SMF only)
J1535A	LC-SC Plug-in Converter (for MM, SC(P)-LC(J))	Converts main unit SC connector to LC (MMF 62.5/125 μm only)
Z0914A	Ferrule cleaner	1 pc
Z0915A	Replacement reel for ferrule cleaner	6 pcs for Z0914A
Z0284	Adapter Cleaner	Stick type (200 pcs/set)
G0306B	Video Inspection Probe	× 400 magnification fixed. Displays fiber end-face condition on ACCESS Master screen and performs Pass/Fail evaluation Also supports end-face evaluation on PC running MX900030A software downloaded from Anritsu web site.
J1480A	USB-Ethernet converter	For remote GUI connection
	PC Software	
NETWORKS	NETWORKS	Microsoft Windows 10 (32 bit, 64 bit), Windows 8/8.1 (32 bit, 64 bit), Windows 7 (32 bit), Windows XP SP3 (currently Ver. 5.00 at September 2018)


Softcase (B0745A)

Soft Carrying Case (B0582A)


Hard Carrying Case (B0583A)-Attache style


Hard Carrying Case
(B0549)


J1530A to J1535A
Plug-in Converter
(The photo shows the J1534A)


Battery Pack (Z0921A)


CAR PLUG CORD (J1295)

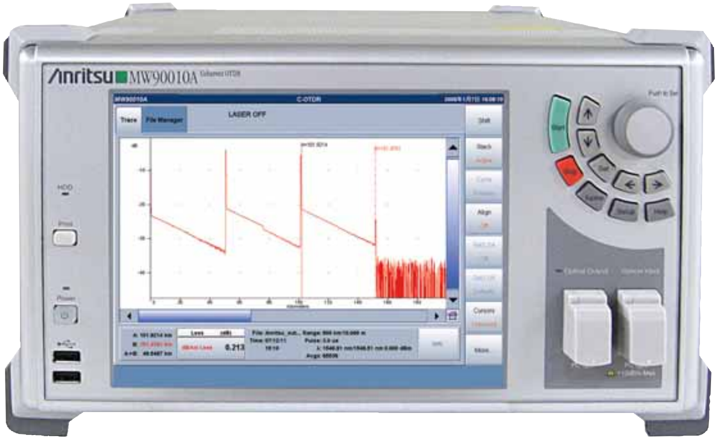
Video Inspection Probe (× 400)
(G0306B)

Coherent OTDR

MW90010A

Remote Control
Ethernet

Measure Submarine Cables up to 12,000 km Long with 10 m Resolution



The Coherent OTDR (C-OTDR) MW90010A is a measuring instrument for detecting faults in ultra-long optical submarine cables of up to 12,000 km including multiple repeaters (EDFAs). It is the ideal solution for evaluating new cables at service deployment as well as for troubleshooting in-service faults.

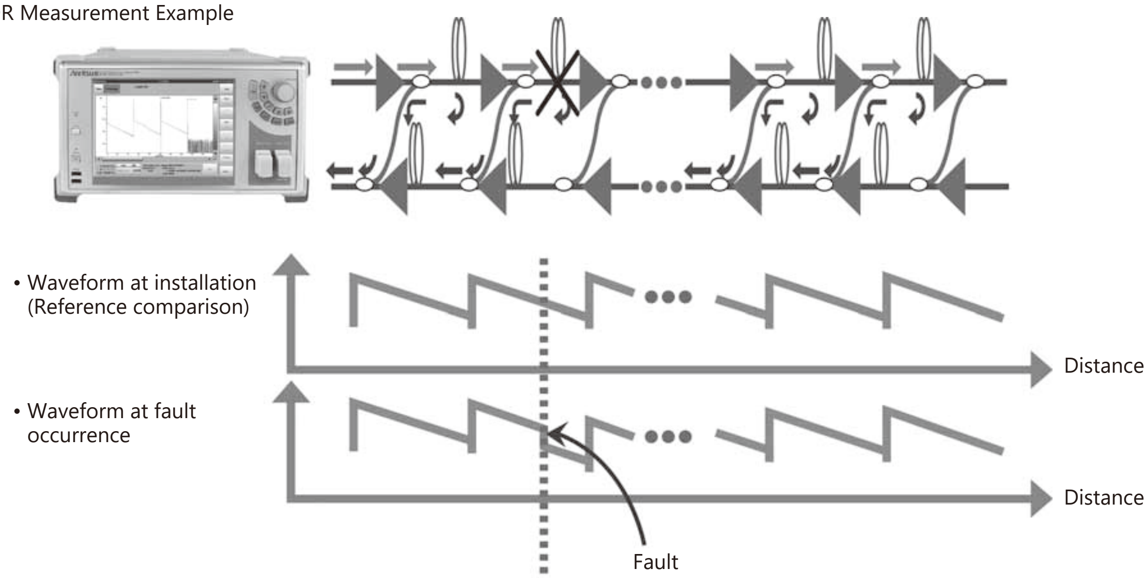
Ultra-long optical submarine cables use optical amplifiers to boost signals. Successful OTDR measurement through the repeaters requires configuring a backscatter detection system using up and down links. The MW90010A can measure the backscatter light through all repeaters by using coherent detection. As a result, it can display every fault condition, such as optical loss between repeaters, bending loss, distances, breaks, etc., on-screen for waveform data analysis.

Features

- Fault detection with 10 m distance resolution
- Compact and lightweight all-in-one design for on-site portability [320 (W) × 177 (H) × 451 (D) mm, 17 kg Max.]
- Simple and easy touch-panel operation for easy first-time use by any operator
- Wide dynamic range supporting fault detection and troubleshooting of submarine cables with repeaters at 80 km or wider intervals
- Built-in tunable light source with high wavelength accuracy of ±0.2 nm for wavelength setting range of 1535.03 nm to 1565.08 nm
- Adjustable output power from 0 to +13 dBm

Application

C-OTDR Measurement Example



Measure Submarine Cables up to 12,000 km Long with 10 m Resolution

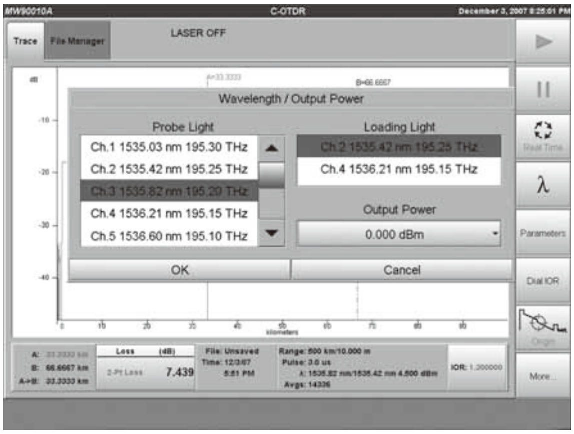
The MW90010A can capture data from up to 1.2 million points on the horizontal axis at a fixed resolution of 10 m with no dependency on measured distance. As a result, faults can be located with very high resolution even in fibers longer than 10,000 km.

Lightweight and Compact

In comparison to previous optical submarine cable measuring equipment, the MW90010A is less than half the weight (17 kg max.) and size. The all-in-one design incorporates a tunable light source for easy on-site portability and troubleshooting.

Excellent GUI

Every stage from setting parameters to starting measurement is made easy using the touch-screen. The rotary knob and keypad can be used for operation too. The easy-to-use design coupled with standard interfaces for USB memory, USB mouse, keyboard, and VGA OUT, makes measurement simple even for novice OTDR operators.



Wavelength / Output Power

Probe Light

- Ch.1 1535.03 nm 195.30 THz
- Ch.2 1535.42 nm 195.25 THz
- Ch.3 1535.82 nm 195.20 THz
- Ch.4 1536.21 nm 195.15 THz
- Ch.5 1536.60 nm 195.10 THz

Loading Light

- Ch.2 1535.42 nm 195.25 THz
- Ch.4 1536.21 nm 195.15 THz

Output Power: 0.000 dBm

A: 33.3333 km
B: 66.6667 km
A↔B: 33.3333 km

Loss (dB) 2-Pt Loss 7.439

File: Unsaved
Time: 12/3/07 5:51 PM

Range: 500 km/10.000 m
Pulse: 3.0 us
λ: 1535.82 nm/1535.42 nm 4.500 dBm
Avgs: 14336

IOR: 1.200000

Remote Operation Function

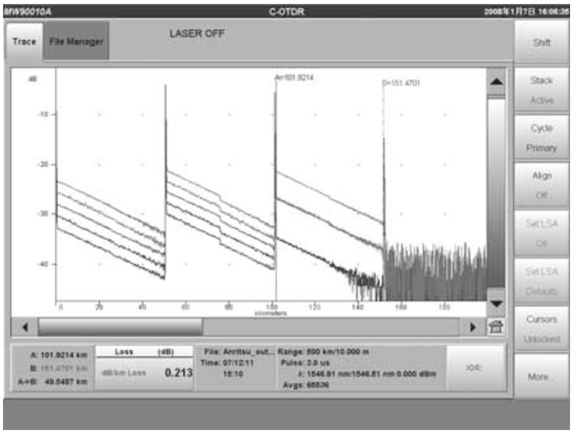
The MW90010A has a built-in VNC server. When the MW90010A (server) is connected over Ethernet to a PC (client) running either a Windows or Linux OS, the MW90010A GUI can be remotely controlled from the PC to transfer files between the server and client.

Wide Dynamic Range

Typical optical submarine cables are designed with repeaters every 50 km to 60 km but the high resolution of the MW90010A easily supports fiber loss measurement of these systems as well as fault location of cables with repeaters spaced at more than 80 km.

Simultaneous Display of 8 Waveforms (max.)

Installation and maintenance of optical submarine cables requires comparison of current waveform data with data at cable installation to monitor aging changes. The MW90010A makes this comparison easy because it can display up to 8 waveforms simultaneously, allowing faults to be seen at glance by comparing the install waveform with the fault waveform on one screen.



A: 101.9214 km
B: 151.4701 km
A↔B: 49.5487 km

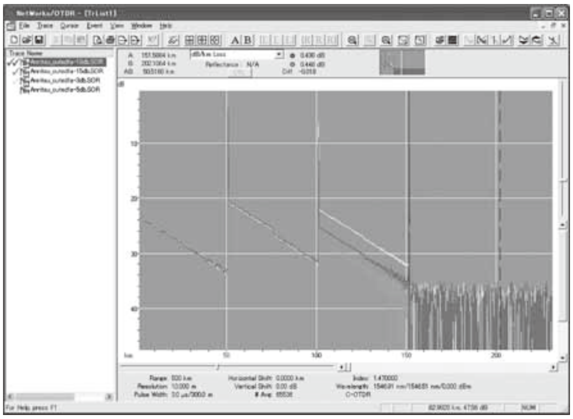
Loss (dB) dB/km Loss 0.213

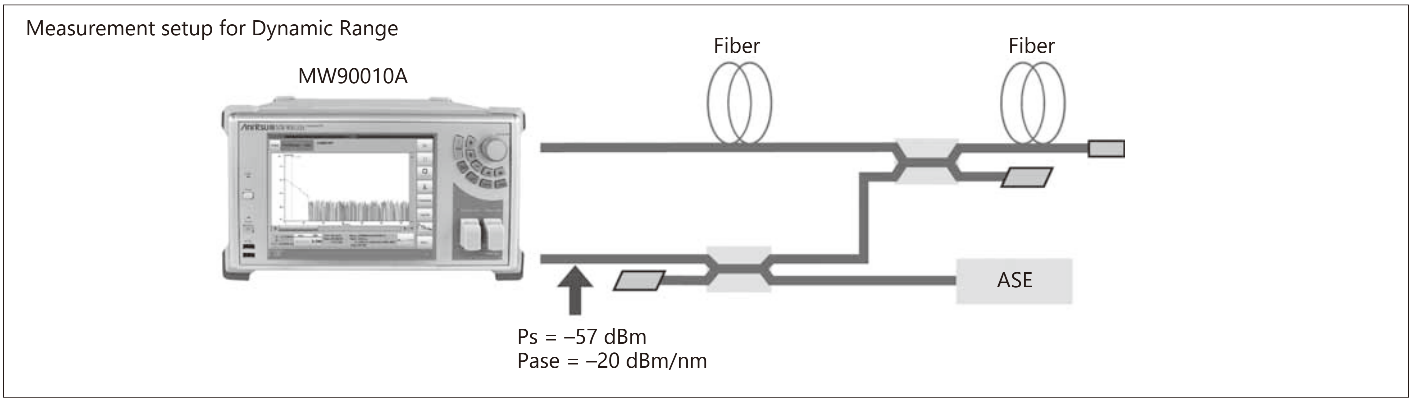
File: Anritsu_out...
Time: 07:12:11 16:10

Range: 500 km/10.000 m
Pulse: 3.0 us
λ: 1546.91 nm/1546.81 nm 0.000 dBm
Avgs: 65536

Waveform Analysis using Emulation Software

Waveform data measured and saved by the MW90010A can be analyzed on a PC running a Windows OS using the optional NETWORKS (version 4.1 or newer) emulation software (sold separately).





Specifications

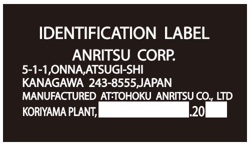
Coherent OTDR MW90010A

Fiber Under Test		ITU-T G.653 (DSF)
Optical Connector		FC, SC, DIN, HSM-10/A, ST (Replaceable, PC type)
Wavelength (Probe Light)		1535.03 nm to 1565.08 nm (ITU-T Grid, Wavelength in vacuum setting with 50 GHz steps)
Wavelength Accuracy		±0.2 nm (+20° to +30°C)
Warm-up Time		30 minutes (+20° to +30°C)
Loading Light Source (Dummy)		" wavelength of probe light " +50 GHz or –50 GHz The loading wavelength can be selectable at +50 GHz or –50 GHz of the probe (OTDR) wavelength.
Pulse Width		3, 10, 30, 60, 100 µs
Optical Output Power		0 to +13 dBm, 0.5 dB steps
Dynamic Range (one way, S/N=1) (See the block diagram on previous page)		>17 dB Measurement Conditions: Pulse width: 10 µs, Average times: 2^{16}, Distance range: 1000 km, Smoothing: On, Ps: –57 dBm @ Pin[*1] Pase: –20 dBm/nm @ Pin[*1]
Dead Zone		0.5 km (Pulse width: 3 µs)
Distance Measurement Accuracy		±10 m ±0.5 × 10^{-6} × measurement value (m) This does not include optical fiber refraction index (IOR) based uncertainty.
Vertical Scale		0.02, 0.05, 0.1, 0.2, 0.5, 1.0, 2.0, 5.0, 10.0 dB/div
Distance Range		100 km, 500 km to 12,000 km (in 500 km steps)
Sampling Resolution (IOR = 1.500000)		10 m
Measurement Time		15 minutes (Distance range: 1000 km, Average times: 2^{16})
Average Times		2^{8} to 2^{24}
Ior Settings		1.300000 to 1.700000 (0.000001 steps)
Monitor Output		–25 to –15 dBm (for OTDR Wavelength Monitor)
Other Functions		• Real Time Measurement • Multiple Trace Display (8 Waveforms max.) • Zoom & Shift • Loss Calculation Splice Loss, 2Pt Loss, 2Pt LSA, dB/ km Loss, dB/km LSA, 2Pt & dB/km, 2Pt & dB/km LSA • File Save formats GR-196, SR4731 • USB Memory support • Internal Memory (2.8 GB) • Print External printer, Hard copy (file: PDF) • Distance Unit miles, feet, kilofeet, meters, kilometers • File Utility File: Copy, Paste, Delete Folder: Create new • Help function • Remote Control Function (Option)
Display		8.4 inch, XGA (1024 × 768) color LCD with touch panel
Interface		USB (2 ports, REV1.1), Mouse (USB), Keyboard (PS/2), VGA
Power Supply		100 V(ac) to 120 V(ac)/200 V(ac) to 240 V(ac), 50 Hz to 60 Hz, ≤300 VA
Dimensions and Mass		320 (W) × 177 (H) × 451 (D) mm, <17 kg
Environmental Conditions		Temperature: +10° to +35°C (operating), –10° to +50°C (storage) Humidity: <85% RH Vibration: Conforms to MIL-STD-810D
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581
Laser Safety Level[*2]		IEC 60825-1: 2007 CLASS 1M: Optical Output Port CLASS 1: Monitor Port 21CFR1040.10 Excludes deviations caused by conformance to Laser Notice No. 50 dated June 24, 2007

*1: Ps: Maximum backscatter level at the input [dBm]
Pase: ASE level at the input [dBm]

*2: Safety measures for laser products
This product complies with optical safety standards in 21CFR1040.10 and IEC 60825-1; the following descriptive labels are affixed to the product.

⚠ IEC 60825-1:2007
INVISIBLE LASER RADIATION
DO NOT VIEW DIRECTLY WITH
OPTICAL INSTRUMENTS
(MAX OUTPUT POWER) (PULSE DURATION) (WAVELENGTH)
50mW CW 1530-1570nm
CLASS 1M LASER PRODUCT



IDENTIFICATION LABEL
ANRITSU CORP.
5-1-1,ONNA,ATSUGI-SHI
KANAGAWA 243-8555,JAPAN
MANUFACTURED AT:TOHOKU ANRITSU CO., LTD
KORIYAMA PLANT, .20

⚠ IEC 60825-1:2007
CLASS 1 LASER PRODUCT

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main Frame
MW90010A	Coherent OTDR
	Standard Accessories
	Power Cord: 1 pc
W3030AE	MW90010A Operation Manual (CD-R): 1 copy
	Options
MW90010A-001	Remote Control Function
MW90010A-002*1	OS Upgrade to WES2009
MW90010A-101	Remote Control Function Retrofit
MW90010A-102*2	OS Upgrade to WES2009 Retrofit
	Options (Optical Connector)
MW90010A-037*3	FC Connector
MW90010A-038*3	ST Connector
MW90010A-039*3	DIN 47256 Connector
MW90010A-040*3	SC Connector
MW90010A-043*3	HMS-10/A Diamond Connector
	Application Parts
NETWORKS	Emulation Software (Version 4.1 or newer)
B0335C	Carrying Case
B0604A	Rack Mount Kit
J0617B	Replaceable Optical Connector (FC-PC)
J1409A	Replaceable Optical Connector (ST)
J1410A	Replaceable Optical Connector (DIN)
J1411A	Replaceable Optical Connector (SC)
J1412A	Replaceable Optical Connector (HMS-10/A)
J0057	Optical Adapter FC type
J0635*4	Optical Fiber Cord with FC-PC at both ends (SM, with FC-PC at both ends)
J0952A	FC · PC-FC · APC(SG)-1M-SM
Z0914A	Ferrule Cleaner
Z0915A	Replacement Reel for Ferrule Cleaner (6 pcs/set)
Z0284	Adapter Cleaner (Stick type, 200 pcs/set)
W3024AE	MW90010A Operation Manual (Printed version)
Z0397A*5	FC Adapter Cap
Z0412A*5	DIN Adapter Cap
Z0413A*5	SC Adapter Cap
Z0414A*5	HMS-10 Adapter Cap

*1: Please be sure to specify.

*2: Factory (in Japan) option.

*3: Required option
Specify the optical connector type. The same type of connector will be supplied for the optical output port, optical input port, and optical monitor port.

*4: Specify the optical fiber length as A, B or C (A: 1 m, B: 2 m, C: 3 m)

*5: Monitor Output Port optical connector cap. Specify exchangeable optical connectors (J1409A, J1410A, J1411A, J1412A and J0617B) as a pair.

Card OTDR

MW9087B/D

Remote Control
Ethernet

Suitable Solution for all Optical Fiber Networks (PON Network, Core Network and so on...)

Card OTDR MW9087B/D is a suitable solution for monitoring the optical fiber networks. Recently, the optical fiber monitoring business is expanding from Long distance fiber (Core network) to PON network (Access network). MW9087B/D is supplied a solution for all kinds optical networks with “Small”, “High performance”.

Features

- Suitable size to install to RFTS system (B5 size)
- High performance to test the PON network (possible to test up to 1 × 128, High resolution, Short dead zone)
- High performance to test the long fiber (High dynamic range up to 50 dB)
- High speed data transfer (100BASE-T Ethernet Interface)

Specifications

Model No.	MW9087B	MW9087D
Wavelength*1	1645 nm to 1655 nm*7	1550 ±25 nm
Pulse Peak Power	≤+15 dBm	—
Measurement Fiber	10/125 µm SM fiber (ITU-T G.652)	
Optical Connector	SC/PC replaceable	
Dynamic Range*2, *3	41 dB	50 dB
Dead Zone (Fresnel)*4	≤0.5 m	≤1.0 m
Dead Zone (Back Scatter)*5	≤6.5 m	≤4.3 m
LD Type	DFB-LD	FP-LD
In-service Cut Filter	Mounted	Not mounted
Pulse Width	3, 10, 20, 50, 100, 200, 500 ns 1, 2, 4, 10, 20 µs	
Distance Range	1, 2.5, 5, 10, 25, 50, 100, 200, 300 km (IOR = 1.500000)	
Sampling Resolution	0.05 m to 60 m (IOR = 1.500000)	
Distance Measurement Accuracy	±1 m ±3 × Meas. distance × 10^{-5} ±Sampling Resolution (Uncertainty with fiber’s index of refraction is excluded.)	
Loss Minimum Unit	0.001 dB	
Linearity (Loss Measurement Accuracy)	±0.05 dB/dB or ±0.1 dB (Whichever is greater)	
Sampling Points	Coarse: 5,001 Medium: 20,001 or 25,001 Fine: 100,001, 125,001 or 150,001	
IOR Setting	1.000000 to 1.999999 (0.000001 step)	
Averaging Time (Averaging Count)	1 to 9999 times or 1 to 9999 seconds (settable range)	
Auto Measurement*6	Measurement item: Total loss, Distance of each event, Splice loss, Return loss, or Reflectance Threshold Splice loss: 0.01 to 9.99 dB (0.01 dB step) Reflectance: –60 to –20 dB (0.1 dB step) Far end: 1 to 99 dB (1 dB step) Number of detected events: Up to 99 events Automatic setting: Distance range, pulse width, and averaging count (period)	

Continued on next page

Manual Measurement		Measurement item: 2-point loss, 2-point LSA, dB/km loss, splice loss, return loss or level difference
Other Function		Partial sampling function Remote control function High dynamic range mode added (pulse width: 50 ns to 2 µs)
Interface		Ethernet: RJ45 Ethernet 10BASE-T/100BASE-Tx Auto negotiation supported Ethernet Full Duplex/Half Duplex supported USB 1.1: Type B × 1*8
LED Interface		Option
Power		12 Vdc ±10%
Power Consumption		≤20 W
Dimensions		165 (H) × 50 (W) × 270 (D) mm (not including projection portion)
Mass		≤1.5 kg
Temperature/Humidity		Operating temperature and humidity: 0 to +50°C, ≤95% (no condensation) Storage temperature and humidity: –20 to +60°C, ≤95%
Laser Safety*9		IEC 60825-1: 2007 Class 1 (MW9087B) IEC 60825-1: 2007 Class 1M (MW9087D)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

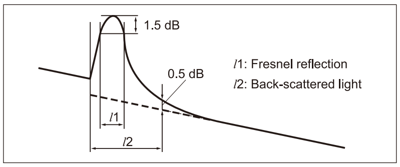
*1: Pulse width: 1 µs at +25°C

*2: SNR = 1, +25°C, Pulse width 20 µs.
Distance range: 100 km, Average: 180 seconds, +25°C.
With background light, 1310/1550 nm –19 dBm Continuous light (MW9087B)
Standard/High dynamic range mode added (pulse width 50 ns to 20 µs)

*3: Typical. Subtract 1 dB for guarantee.

*4: *l*1 in the below figure.
Return loss: 40 dB, +25°C, IOR = 1.500000, Pulse width 3 ns.

*5: *l*2 in the below figure.
Return loss: 55 dB, +25°C, IOR = 1.500000, Pulse width 10 ns.



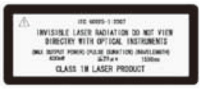
*6: Automatic measurement is an auxiliary function to facilitate measurement operations, and does not assure any detected results. As there may be a case of miss detection, be sure to check waveform data as well for final judgment of measured results.

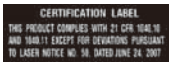
*7: Wavelength range at peak value [Spectrum peak value] –20 dB

*8: Interface for IP address setup.
The specified driver installation is required for connection.

*9: Safety measures for laser products
This option complies with optical safety standards in Class 1, 1M of IEC 60825-1; the following descriptive labels are affixed to the product.


IEC 60825-1 2007
CLASS 1 LASER PRODUCT


IEC 60825-1 2007
INVISIBLE LASER RADIATION DO NOT VIEW
DIRECTRY WITH OPTICAL INSTRUMENTS
CLASS 1M LASER PRODUCT


CERTIFICATION LABEL
THIS PRODUCT COMPLIES WITH 21 CFR 1040.10
AND 1040.11 EXCEPT FOR DEVIATIONS PURSUANT
TO LASER NOTICE NO. 50, DATED JUNE 24, 2007

Front View (When installed LED Interface Option)

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Mainframe
MW9087B	Card OTDR (1650 nm, 40 dB class DR)
MW9087D	Card OTDR (1550 nm, 50 dB class DR)
	Standard Accessories
W3543AE	MW9087 Series Operation Manual
	Option
MW9087B/D-001	LED Interface
	Options (Optical Connector)
MW9087B/D-037	FC Connector
MW9087B/D-038	ST Connector
MW9087B/D-039	DIN47256 Connector
MW9087B/D-040	SC Connector
MW9087B/D-043	HMS-10/A DIAMOND Connector

OTDR Module

MW9077A/A1/A2/B

1.31 µm (SM)/1.55 µm (SM)/1.625 µm (SM)

Remote Control
Ethernet

Compact and High-performance OTDR Module for Optical Fiber Monitoring Systems

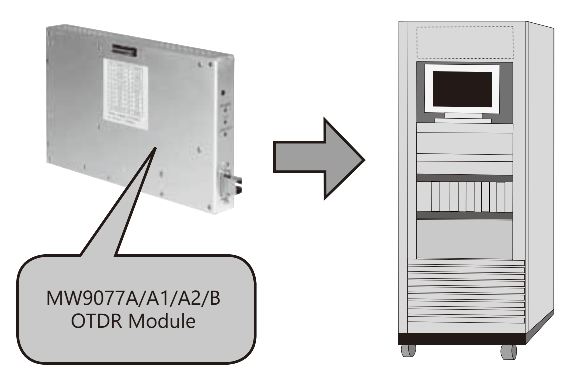
The OTDR Module MW9077A/A1/A2/B is ideal for monitoring optical fiber systems. In recent years, optical-fiber monitoring is being used in many fields including maintenance of optical-communications networks as well as security sensors, flood sensors and disaster-prevention systems, etc. The MW9077A/A1/A2/B offers a compact and high-performance solution for optical fiber applications.

Features

- Compact A5-size for monitoring optical fiber systems
- Wide operating temperature range (–5° to +55°C)
- Fast data transmission by Ethernet interface

Compact A5-size for Monitoring Optical Fiber Systems

Space is an important factor in designing a monitoring systems. Factors such as functions, performance, and module size favor use of compact modules.
Furthermore, using a compact module helps reduce the size of the whole system, reading to system-wide cost reductions. The compact MW9077A/A1/A2/B is less than A5-size [200 (W) × 130 (H) × 25 (D) mm]. Even systems with severe space limitations can use this module.

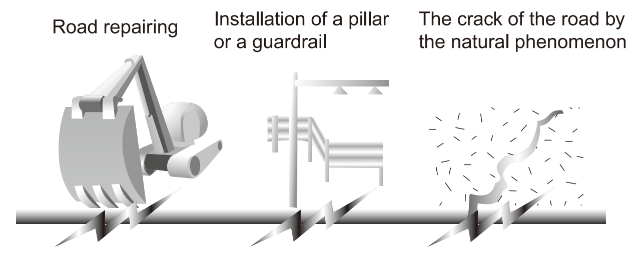


Wide Operating Temperature Range

The system operating temperature is affected by various environmental factors, such as installation location, and monitored objects.
In addition, the heat that the system generates itself influences the operation temperature. As a result, temperature of the monitoring system must also be monitored to assure reliability.
The MW9077A/A1 dynamic range is stable from –5° to +55°C, supporting its use in a wide range of temperature environments (MW9077A2/B is stable to +25°C).

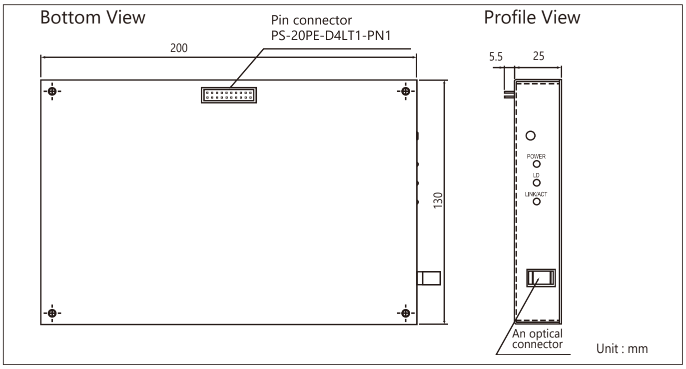
Fast Data Transmission over Ethernet Interface

Optical fibers are monitored for various reasons. For example, to assess long-term changes in optical fiber, the system checks the fiber every several hours using an OTDR. In other cases, such as when there is a network fault, the system checks the fiber immediately using an OTDR to find the fiber break. On the other hand, monitoring is always performed to detect changes in the loss of an optical fiber.
The MW9077A/A1/A2/B can perform trace sweep at intervals of about 1 second with smoothing by averaging. The Ethernet interface transmits waveform data to a controller at high speeds, making fiber monitoring much easier.

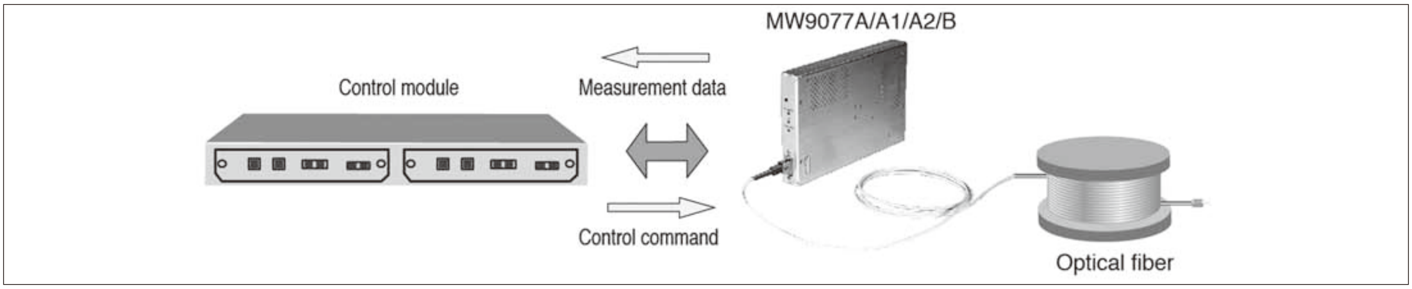


Fast and Precision Operation from Controller

The MW9077A/A1/A2/B has a 10BASE-T compatible Ethernet interface for control over an Ethernet network. (The IP address is set using RS-232C.) A comprehensive set of commands is built-in, including commands for setting measurement conditions, transferring measured data to the controller, along with a full range of file formats, making it easy to match settings with the monitored fiber.



Appearance of MW9077A/A1/A2/B



Specifications

Model		MW9077A	MW9077A1	MW9077A2*1	MW9077B
Wavelength*2		1310 nm ±25 nm	1550 nm ±25 nm	1625 nm ±25 nm	1310 nm/1550 nm ±25 nm
Fiber Under Test		10 μm/125 μm single-mode optical fiber (ITU-T G.652)			
Distance Range		1, 2.5, 5, 10, 25, 50, 100, 200, 250, 400 km			
Pulse Width		10 ns ±30%, 30 ns ±25%, 100 ns ±10%, 300 ns ±10%, 1 μs ±10%, 3 μs ±10%, 10 μs ±10%, 20 μs ±10%			
Dynamic Range		41 dB (+25°C, Pulse width 20 μs) 39 dB at –5° to +55°C (S/N = 1)	40 dB (+25°C, Pulse width 20 μs) 38 dB at –5° to +55°C (S/N = 1)	37 dB (+25°C, Pulse width 20 μs) (S/N = 1)	39 dB (1.31 μm, +25°C, Pulse width 20 μs)*3 38 dB (1.55 μm, +25°C, Pulse width 20 μs)*3 (S/N = 1)
Dead Zone (Back Scattered Light)*4		≤20 m			
Dead Zone (Fresnel Reflection)*5		≤5 m (typ. 2 m)			
Sampling Resolution*6		0.05 m to 80 m			
Number of Sampling Points		Normal: 5001 or 6251, Fine: 20001 or 25001			
IOR		1.400000 to 1.699999 (in 0.000001 steps)			
Distance Measurement Accuracy		±1 m ±3 × Measurement distance × 10^{-5} ± Sampling resolution			
Loss Measurement Accuracy (Linearity)		±0.05 dB/dB or ±0.1 dB (whichever is greater)			
Return Loss Measurement Accuracy		±2 dB			
Automatic Measurement*7		Measurement items: Total loss, Each event distance, Connection loss, Return loss or Reflectance Threshold values: Connection loss: 0.01 to 9.99 dB (in 0.01 dB steps) Reflectance: –14 to –70 dB (in 0.1-dB steps), Fiber end: 1 to 99 dB (in 1-dB steps) Number of detected events: Up to 99 Automatic setting: Distance range, Pulse width, Averaging count (time)			
Manual Measurement		Measurement items: Transmission loss and distance between 2 points, Connection loss, Reflectance			
Other Functions		Relative distance setting (zero offset cursor), Calendar clock (without backup), Distance unit: m (Fixed)			
Laser Safety		IEC 60825-1: 2007: CLASS 1 21CFR1040.10 Excludes deviations caused by conformance to Laser Notice No. 50 dated June 24, 2007			
Power Supply		+12 V(dc) ±1 V, 1.5 A Max.			
Interface		Ethernet interface*8: 10Base with 20 pin connector Serial interface: RS-232C: 115.2 kbps (The IP address is set using RS-232C)			
Dimensions and Mass		200 (W) × 130 (H) × 25 (D) mm, ≤0.6 kg			
Environmental Conditions		Operating temperature and humidity: –5° to +55°C, ≤95% (no condensation) (MW9077A/A1/B) –5° to +50°C, ≤85% (no condensation) (MW9077A2) Storage temperature: –40° to +70°C			
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2			
	LVD	2014/35/EU, EN61010-1			
	RoHS	2011/65/EU, EN50581			

*1: When an optical pulse from the MW9077A2 (1.625 µm) is input (in-service monitoring) into an optical fiber used for communications at 1.55 µm, the optical communications signal is affected by Ramman amplification. Take care when using this setup.
*2: At 25°C, Pulse width: 1 µs
*3: The dynamic range specification at a pulse width of 3 µs is shown below 26.5 dB (1.31 µm, +25°C), 25.5 dB (1.55 µm, +25°C), (S/N = 1)
*4: At pulse width 10 ns
*5: At pulse width 10 ns, Return loss: 35 dB (MW9077A/A1/A2), 40 dB (MW9077B)
*6: IOR = 1.500000
*7: Automatic measurement function: Automatic measurement results are not guaranteed. There is a possibility to miss detection of event.
Please check each result at on your own.
*8: Signal exchange with 10BASE-T

Note: This product outputs the pulse light of a high peak power. When this product is used in the state where it connected with transmission equipment, attaching a wavelength filter etc. should take care about the input of too much OTDR pulse light to Receiver. There is a possibility of damaging Receiver of transmission equipment.

Safety Measures for Laser Products
This product complies with optical safety standards in 21CFR1040.10 and IEC 60825-1; the following descriptive labels are affixed to the product.

⚠ IEC 60825-1:2007
CLASS 1 LASER PRODUCT

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main Frame
MW9077A*1	OTDR Module (Wavelength 1.31 µm)
MW9077A1*1	OTDR Module (Wavelength 1.55 µm)
MW9077A2*1	OTDR Module (Wavelength 1.625 µm)
MW9077B*1	OTDR Module (Wavelength 1.31 µm/1.55 µm)
	Standard Accessory
W2254AE*2	MW9077A/A1 Operation Manual: 1 copy
	Options
MW9077A-01	1550 nm Filter (Factory option, 1550 nm cut filter inside)
MW9077A/A1/A2/B-25*3	FC-APC Connector (Factory option, Fixed)
MW9077A/A1/A2/B-26*3	SC-APC Connector (Factory option, Fixed)
MW9077A/A1/A2/B-37*3	FC Connector (Factory option, Fixed)
MW9077A/A1/A2/B-38*3	ST Connector (Factory option, Fixed)
MW9077A/A1/A2/B-39*3	DIN Connector (Factory option, Fixed)
MW9077A/A1/A2/B-43*3	HMS-10/A Connector (Factory option, Fixed)

*1: In the case of purchase, Please concluded a sales contract.
*2: A new table is attached at purchase of the MW9077A2/B.
*3: Standard connector for specified option. If not specified, SC connector (Fixed) supplied as standard.

Optical Loss Tester/Light Source/Optical Power Meter

CMA5 Series

Optical Loss Tester/Light Source 850, 1300, 1310, 1550 nm/Optical Power Meter 850, 1300, 1310, 1490, 1550, 1625 nm

Compact and Lightweight for Optical Fiber Installation and Maintenance

The CMA5 series (Optical Loss Tester/Light Source/Optical Power Meter) measures optical loss and power for optical fiber I&M.
The CMA5 series are compact and lightweight, its excellent cost performance and simple operation with the required minimum number of functions make it ideal for onsite I&M. Service engineers can choose from three models — optical loss tester, optical source, and optical power meter — to match the onsite application.

Features

Optical Loss Tester

- All-in-one light source and optical power meter supporting SM (1310 nm/1550 nm) and MM (850 nm/1300 nm) fiber
- Compact and lightweight (300 g)
- Measures +23 dBm max. optical power*1
- 20 hours of battery (dry cell) operation*2
- Useful fiber identification modulation function (270 Hz, 1 kHz, 2 kHz and CW)

*1: SM type (CATV model) only
*2: With 9-V alkaline batteries using optical source and optical power meter

Light Source

- Supports MM model (850 nm/1300 nm), SM model (1310 nm/1550 nm)
- Lightweight at only 250 g
- 16 hours of continuous running with 9 V alkaline battery
- Light source for fiber identification (270 Hz, 1 kHz, 2 kHz and CW)

Optical Power Meter

- Lightweight at only 250 g
- 40 hours of continuous running with 9 V alkaline battery
- Measures up to +23 dBm optical power*3

*3: CATV model

Specifications

Optical Loss Tester

Optical Loss Tester*	
SM Model	1310 nm/1550 nm (Power Meter: Standard)
	1310 nm/1550 nm (Power Meter: CATV)
MM Model	850 nm/1300 nm

*: One 9 V alkaline battery as standard. No AC adapter.

Model/Order No.	5LT35	5LT35C	5LT83
Light Source Port			
Supported Optical Fiber	10 µm/125 µm SM fiber, PC-polished		62.5 µm/125 µm MM fiber, PC-polished
Emitter Type	LD		
Wavelength	1310 nm/1550 nm ±20 nm		850 nm/1300 nm ±20 nm
Output Power	≥–7 dBm		≥–7 dBm*1
Source Line Width (FWHNM)	≤5 nm		
Modulation Output	CW, 270 Hz, 1 kHz, 2 kHz (±2%)		
Stability	±0.05 dB/15 minutes		
	±0.10 dB/8 hours (1310 nm/1550 nm) ±0.15 dB/8 hours (850 nm/1300 nm)		
Connector Type	FC/PC, SC/PC, ST/PC (user replaceable)		
Optical Power Meter Port			
Supported Optical Fiber	SM (10 µm/125 µm) MM (50 µm/125 µm, 62.5 µm/125 µm)		
Detector Type	InGaAs		
Calibrated Wavelength	850, 1300, 1310, 1490, 1550, 1625 nm		
Measurement Range*2	–60 to +5 dBm –50 to +10 dBm (850 nm)	–40 to +23 dBm	–60 to +5 dBm –5 to +10 dBm (850 nm)
Accuracy*2	±0.2 dB @ –10 dBm (±0.5 dB @ 850 nm)		
Linearity*2	±0.2 dB		±0.5 dB
Display Resolution	0.01 dB		
Auto-Zero Setting	Supported		
Warm-up Time	60 s		
Connector Type	FC, SC, ST (user replaceable)		
General Specifications			
Input Power	9 V (9 V alkaline battery)		
AC Adapter (Option)	Input: 100 V to 240 V, 50 Hz to 60 Hz Output: 7.5 V		
Battery Operation	40 hours min. (Optical Power Meter) 20 hours min. (Optical Power Meter & Light Source)		
Auto Off Function	5 minutes		
Others	Reference setting function, Loop loss testing function		
Operating Temperature Range	–10° to +50°C		
Storage Temperature Range	–25° to +60°C		
Relative Humidity	0 to 95% (no condensation)		

Continued on next page

Model/Order No.		5LT35	5LT35C	5LT83
Dimensions		75 (W) × 145 (H) × 25 (D) mm (excl. rubber cover)		
Mass		300 g (0.66 lbs) or less (excl. rubber cover and 9 V alkaline battery)		
Warranty		3 years		
Laser Safety*3		IEC 60825-1: 2007 CLASS1, 21CFR 1040.10 Excludes deviations caused by conformance to Laser Notice No. 50 dated June 24, 2007		
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2		
	LVD	2014/35/EU, EN61010-1		
	RoHS	2011/65/EU, EN50581		

Specifications assured at 25°C (±3°C)

∗1: If a 50 µm/125 µm MM fiber is connected to the optical output port, the rated output power (≥–7 dBm) can not be obtained due to differences in core diameter, NA, and fiber excitation condition. The optical output power can drop by about 2 to 10 dB from the rated output power.

∗2: When GI fiber (62.5 µm/125 µm) is connected to optical power meter port.

∗3: Safety measures for laser products
This product complies with optical safety standards in 21CFR1040.10 and IEC60825-1; the following descriptive labels are affixed to the product.

IEC 60825-1: 2007
CLASS 1 LASER PRODUCT

THIS PRODUCT COMPLIES WITH 21 CFR 1040. 10 AND 1040. 11 EXCEPT FOR DEVIATIONS PURSUANT TO LASER NOTICE NO. 50, DATED JUNE 24, 2007

Light Source

Light Source*	
SM Model	1310 nm/1550 nm
MM Model	850 nm/1300 nm

∗: One 9 V alkaline battery as standard. No AC adapter.

Model/Order No.		5L83	5L35
Emitter Type		LD	
Wavelength		850/1300 ±20 nm	1310/1550 ±20 nm
Output Power*1		–7 dBm*2 (62.5 µm/ 125 µm MM fiber)	–7 dBm (SM fiber)
Source Line Width (FWHM)		<5 nm	
Modulation Output		CW, 270 Hz, 1 kHz, 2 kHz	
Stability (8 hours)		±0.1 dB (25°C)	
Connector Type		FC, ST, SC (User replaceable)	
Battery Operation Time		16 h (9 V alkaline battery)	
Input Power		9 V (9 V alkaline battery)	
AC Adapter (Option)		Input: 100 V to 240 V, 50 Hz to 60 Hz Output: 7.5 V	
Operating Temperature Range		–10° to +50°C	
Storage Temperature Range		–25° to +60°C	
Relative Humidity		0 to 95% (no condensation)	
Dimensions		75 (W) × 145 (H) × 25 (D) mm (excl. rubber cover)	
Mass		250 g	
Warranty		3 years	
Laser Safety*3		IEC 60825-1: 2007 CLASS 1 21CFR 1040.10 Excludes deviations caused by conformance to Laser Notice No. 50 dated June 24, 2007	
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2	
	LVD	2014/35/EU, EN61010-1	
	RoHS	2011/65/EU, EN50581	

∗1: Typical (25°C)

∗2: If a 50 µm/125 µm MM fiber is connected to the optical output port, the rated output power (≥–7 dBm) can not be obtained due to differences in core diameter, NA, and fiber excitation condition. The optical output power can drop by about 2 to 10 dB from the rated output power.

∗3: Safety measures for laser products
This product complies with optical safety standards in 21CFR1040.10 and IEC 60825-1; the following descriptive labels are affixed to the product.

IEC 60825-1: 2007
CLASS 1 LASER PRODUCT

THIS PRODUCT COMPLIES WITH 21 CFR 1040. 10 AND 1040. 11 EXCEPT FOR DEVIATIONS PURSUANT TO LASER NOTICE NO. 50, DATED JUNE 24, 2007

Optical Power Meter

Optical Power Meter* (Calibrated for 850, 1300, 1310, 1490, 1550, and 1625 nm)	
Standard Model	–60 to +10 dBm
CATV Model	–50 to +23 dBm

∗: One 9 V alkaline battery as standard. No AC adapter.

Model/Order No.		5P100	5P100C
Connector Type		FC, SC, ST (User replaceable)	
Fiber Type		MM, SM	
Detector Type		InGaAs	
Calibrated Wavelength		850/1300/1310/1490/1550/1625 nm	
Measurement Range		–60 to +10 dBm –50 to +10 dBm (850 nm)	–50 to +23 dBm
Accuracy*1		±0.2 dB, ±0.5 dB (850 nm)	
Linearity*2		±0.2 dB @ 1310/1550 nm (–60 to +5 dBm) ±0.5 dB @ 850 nm (–50 to +5 dBm)	±0.2 dB @ 1310/1550 nm (–40 to +23 dBm) ±0.5 dB @ 850 nm (–40 to +23 dBm)
Display Resolution		0.01 dB	
Modulation Detection		2 kHz modulation	
Display		4-digit, 7-segment display LCD	
Others		Reference setting function, battery level display, automatic power OFF	
Battery Operation Time		40 hours min. (9 V alkaline battery)	
Input Power		9 V (one alkaline battery)	
AC Adapter (Option)		Input: 100 V to 240 V, 50 Hz to 60 Hz Output: 7.5 V	
Operating Temperature Range		–10° to +50°C	
Storage Temperature Range		–25° to +60°C	
Relative Humidity		0 to 95% (no condensation)	
Dimensions		75 (W) × 145 (H) × 25 (D) mm (excl. rubber cover)	
Mass		250 g	
Warranty		3 years	
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2	
	LVD	2014/35/EU, EN61010-1	
	RoHS	2011/65/EU, EN50581	

∗1: –10 dBm, 25°C (typ.)

∗2: 25°C

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Optical Loss Tester

Model/Order No.	Description
	Main Frame
5LT35-YY*	Optical Loss Tester 1310 nm/1550 nm (Standard Power Meter)
5LT35C-YY*	Optical Loss Tester 1310 nm/1550 nm (CATV Power Meter)
5LT83-YY*	Optical Loss Tester 850 nm/1300 nm (Standard Power Meter)
	Standard Accessories CMA5 Optical Loss Tester Operation Manual: 1 pc Rubber Protective Cover: 1 pc 9 V Alkaline Battery: 1 pc
	Accessories
GN-3HH-CASE	Hard Case (for two CMA5 series)
CMA5-POUCH-A	Carrying Pouch/Shoulder Strap
CMA5-BAT	9 V Alkaline Battery
Z1525A	AC Adapter (CMA5)
CMA5-AD-LS-FC	FC Connector Adapter (Light Source Port)
CMA5-AD-LS-SC	SC Connector Adapter (Light Source Port)
CMA5-AD-LS-ST	ST Connector Adapter (Light Source Port)
CMA5-AD-LS-ALL3	Connector Adapter (FC, SC and ST)
CMA5-AD-PM-FC	FC Connector Adapter (Power Meter Port)
CMA5-AD-PM-SC	SC Connector Adapter (Power Meter Port)
CMA5-AD-PM-ST	ST Connector Adapter (Power Meter Port)
CMA5-AD-PM-ALL3	Connector Adapter (FC, SC and ST)
J1530A	SC Plug-in Converter (UPC(P)-APC(J))
J1532A	FC Plug-in Converter (UPC(P)-APC(J))
J1534A	LC-SC Plug-in Converter (for SM, SC(P)-LC(J))
J1535A	LC-SC Plug-in Converter (for MM, SC(P)-LC(J)) *62.5 µm/125 µm type

*: Specify one connector adapter at YY (FU = FC/PC, SU = SC/PC, TU = ST/PC).

The specified connector adapter is fitted at each optical source and power meter connector.

Light Source

Model/Order No.	Description
	Main Frame
5L35-YY*	Light Source: 1310 nm/1550 nm (Dual wavelength for SM fiber)
5L83-YY*	Light Source: 850 nm/1300 nm (Four wavelength for MM fiber)
	Standard Accessories CMA5 Operation Manual: 1 pc Rubber Protective Cover: 1 pc 9 V Alkaline Battery: 1 pc
	Accessories
GN-3HH-CASE	Hard Case (for two CMA5 series)
CMA5-POUCH-A	Carrying Pouch/Shoulder Strap
CMA5-BAT	9 V Alkaline Battery
Z1525A	AC Adapter (CMA5)
CMA5-AD-LS-FC	FC Connector Adapter
CMA5-AD-LS-SC	SC Connector Adapter
CMA5-AD-LS-ST	ST Connector Adapter
CMA5-AD-LS-ALL3	Connector Adapter (FC, SC and ST)

*: Specify one connector adapter for YY.
FU = FC/PC, SU = SC/PC, TU = ST/PC, FA = FC/APC, SA = SC/APC
(FA = FC/APC and SA = SC/APC cannot be selected for 5L83-YY.)

Optical Power Meter

Model/Order No.	Description
	Main Frame
5P100-YY*	Optical Power Meter (Standard): –60 to +10 dBm
5P100C-YY*	Optical Power Meter (CATV): –50 to +23 dBm
	Standard Accessories CMA5 Operation Manual: 1 pc Rubber Protective Cover: 1 pc 9 V Alkaline Battery: 1 pc
	Accessories
GN-3HH-CASE	Hard Case (for two CMA5 series)
CMA5-POUCH-A	Carrying Pouch/Shoulder Strap
CMA5-BAT	9 V Alkaline Battery
Z1525A	AC Adapter (CMA5)
CMA5-AD-PM-FC	FC Connector Adapter
CMA5-AD-PM-SC	SC Connector Adapter
CMA5-AD-PM-ST	ST Connector Adapter
CMA5-AD-PM-ALL3	Connector Adapter (FC, SC and ST)

*: Specify one of FC, SC or ST connector adaptor for YY.

MS9740A

600 nm to 1750 nm

Remote Control
GPIB OPTION | **Ethernet**

Improved Production Efficiency, Reduces Measurement and Inspection Times

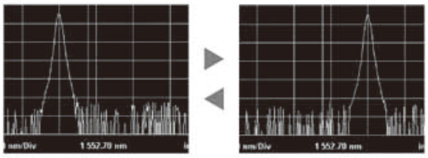
Excellent Eco Product

Reduce the manufacturing costs is a key issue for vendors of active optical devices. Measuring instruments for device evaluation are expected to increase productivity by shortening inspection times.
The Optical Spectrum Analyzer MS9740A reduces the total time from waveform sweeping to data transfer to external control equipment and supports simple analysis procedures, offering excellent cost performance and better productivity.

Reduces the Time from Waveform Sweeping to Data Transfer by 80% Compared to Previous Models

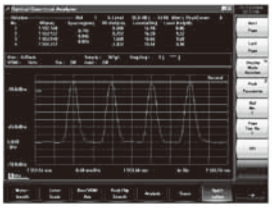
Waveform Sweeping **Spectrum Measurement at 0.2 s/5 nm Sweeping**

High-speed waveform sweeping and range processing support spectrum measurement at 0.2 s/5 nm.



The spectrum change and variation in noise level can be monitored and the waveform light source can be switched.

Analysis **Nine Analysis Menus**

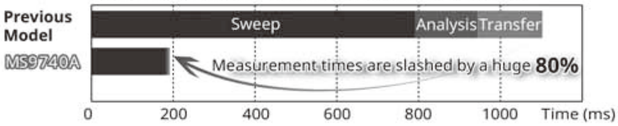


- LD-Module
- DFB-LD
- FP-LD
- LED
- PMD
- WDM
- Opt.Amp
- Opt.Amp (Multi-channel)
- WDM Filter

Data Transfer **Instant Data Transfer**

Data is transferred at high speed from waveform sweeping to external controller equipment.

GPIB Interface, SMSR Measurement (DFB-LD), VBW=10 kHz, Resolution 0.1 nm, Sweep width 5 nm, Sampling Point 501



Ideal Solution for Active Optical Device Evaluation

This all-in-one unit has the performance and functions for evaluating all active optical devices, including SFP, XFP, and SFP+ modules, as well as optical transceivers and VCSEL and DFB optical sources. Evaluation results, such as center wavelength, level, spectrum, SMSR, OSNR, etc., are displayed on one screen. Combination with a Bit Error Rate Tester (BERT) supports spectrum analysis of optical transceiver outputs and WDM signals.

- Wavelength sweep time <0.2 s
- Built-in application for optical active device evaluation (LD module test)
- Option for multimode measurements (Multimode fiber interface (50/62.5 µm) option MS9740A-009)
- Supports LC connector using conversion adapter
- All-in-one function (MM mode) supporting SM and MM fiber*

*: The Multimode fiber interface (50/62.5 µm) option MS9740A-009 is designed for multimode connections to the optical input section; it supports measurements with high optical sensitivity and high sweep speeds when using a MM fiber with a core diameter of 62.5 µm and a NA of ≤0.275. Although the MS9740A-009 option can also be used to measure SM fiber, some features are different from the standard MS9740A model.
For details refer to the MS9740A and MS9740A-009 specifications.

Supports High Resolution and Wide Dynamic Range Required for WDM Signal Evaluation

The wide dynamic range and high resolution support OSNR analysis of WDM signals, etc.

- Dynamic range >58 dB (at 0.4 nm from peak wavelength)
- –90 dBm lowest optical sensitivity
- 30 pm minimum resolution
- ±20 pm wavelength accuracy (C/L band, at wavelength calibration using wavelength calibration light source)
- Supports signal level integration function supporting modulation signals
- Accurate noise position estimation using noise fitting function
- Supports optical axis alignment, wavelength calibration, effective resolution calibration functions

Easy to View and Easy to Use with Large 8.4” Display, Full Interface Line-up, and Storage Functions

Increasing the screen to 8.4 inches makes operation much easier than previous generations, while dedicated front-panel function keys simplify procedures like setting wavelength sweep width, resolution, measurement sensitivity, markers, etc., supporting intuitive operation.
Built-in Ethernet (TCP/IP) and GPIB (option) interfaces support transfer of measurement screen capture files to an external PC at remote operation. In addition, the large internal memory can save up to 1000 measurement files. Files can also be exchanged between the main unit and PC via the USB port.
The embedded Windows OS simplifies measurement menu selection and parameter setting with familiar PC-like mouse operations.

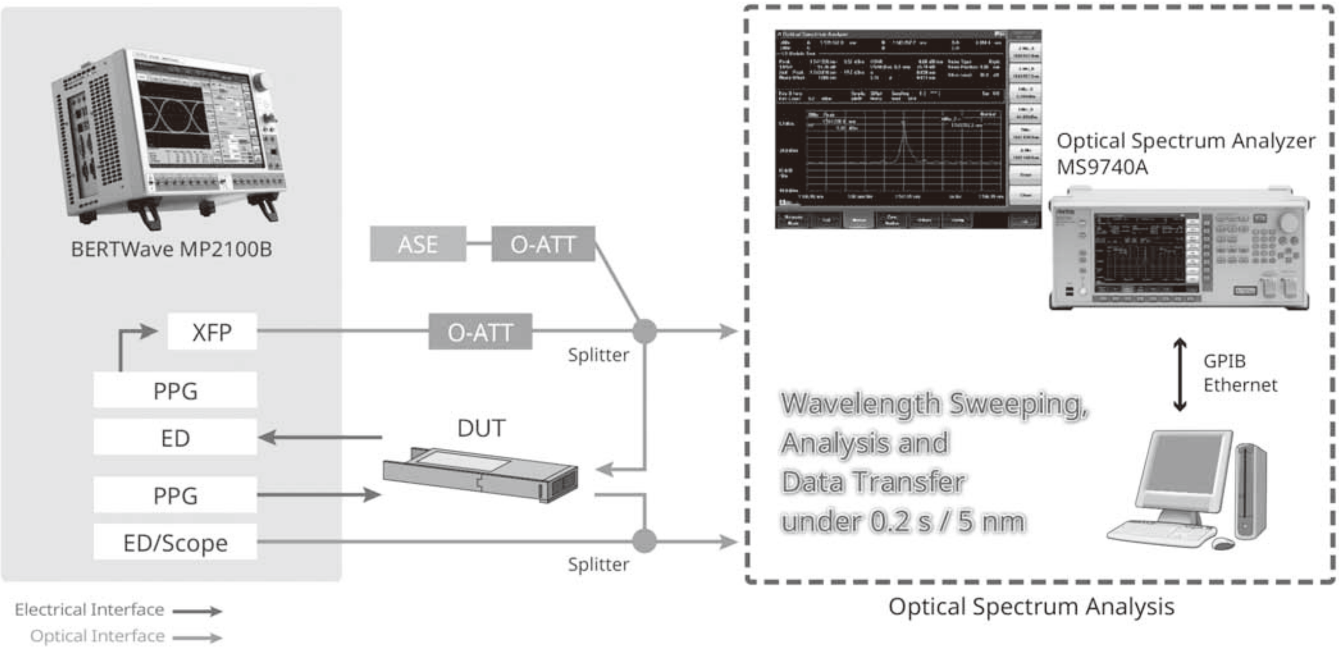
- 8.4-inch large LCD
- Ethernet, GPIB (Option) external interface
- USB storage function

Windows® is a registered trademark of Microsoft Corporation in the USA and other countries.

Compact and Low Power Consumption

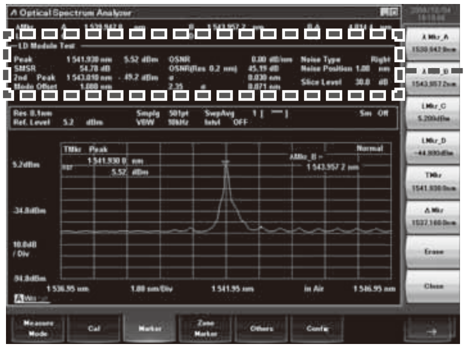
Weighing in at under 15 kg, the MS9740A is the world’s lightest bench-top spectrum analyzer (at October 2011). Consuming under 75 VA, or less than half its predecessors, it’s also eco-friendly too. And not only does it save power, it’s quiet as well, making it the ideal bench-top companion.

Example of Optical Transceiver Measurement



LD Module Test Analysis

This application measures test items such as center wavelength, optical level, OSNR, etc., required for LD module tests, and displays the results on one screen. The center wavelength, optical level, OSNR (per nm), side mode suppression ratio (SMSR) and 20 dB down spectrum width of LD modules can be measured. The center wavelength and spectrum half-width (FWHM) of FP-LDs or VCSELs are measured using the RMS method. Both SM and MM fibers are supported by one unit, helping cut equipment costs.



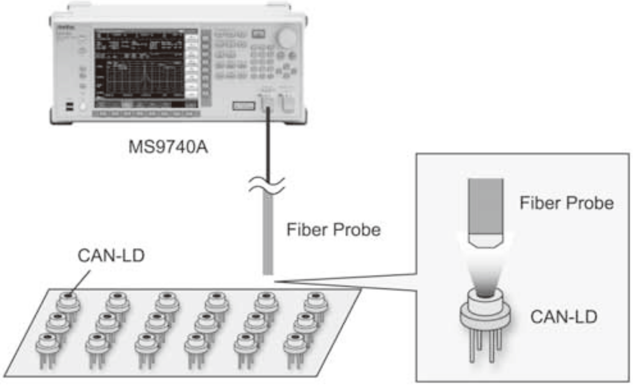
LD Module Test

LD Module Test Items

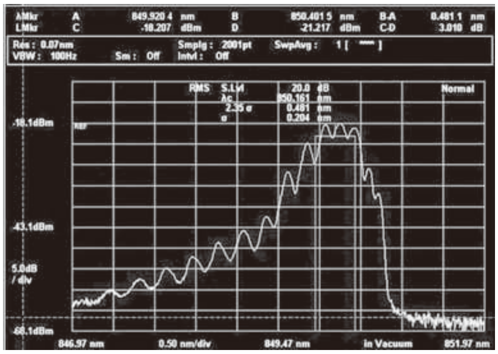
- Center wavelength, Level
- OSNR (actual measured value)
- OSNR (noise level per nm)
  *: OSNR noise level specified from Higher, Left, Right, (L+R)/2 or distance from peak wavelength
- SMSR
- Side mode peak wavelength, Level
- Spectrum width (n dB, RMS method, Standard deviation)

Optical Chip and CAN Device Evaluation

Evaluation systems for optical Chip and CAN devices must support efficient measurements of multiple devices and two key factors are short evaluation time as well as fast optical axis alignment time for each device. For example, irrespective of the LD type, optical axis alignment using MM fiber for receiving radiated light in a short time with good efficiency requires a lot of time consuming work. In this case, the optical spectrum analyzer finally receiving this light must also have the lowest possible connection loss and excellent high-speed sweep performance for waveform analysis.
The Multimode fiber interface (50/62.5 µm) option MS9740A-009 is ideal for evaluating optical devices mainly using this type of MM fiber.
The MS9740A-009 optical receiver section is optimized for MM fiber connections. Since extremely accurate sensitivity settings (VBW) are supported, MM fiber connection loss is kept to a minimum and the characteristics of multiple devices can be evaluated efficiently because the optimum sensitivity for level and SMSR measurements as well as high-speed sweeping conditions are both assured. In addition, the MS9740A has high resolution even in the short wavelength band, and offers optimized applications for VCSEL, etc., evaluations.



Example of Device Characteristics Evaluation



850 nm VCSEL Spectrum Measurement Example

The wavelength sweep time changes according to the VBW and measurement wavelength range; the relationship is shown in the following table.

Relationship between VBW, Sweep Speed, and Minimum Optical Reception Sensitivity*1

VBW	10 Hz	100 Hz	200 Hz	1 kHz	2 kHz	10 kHz	100 kHz	1 MHz
Sweep Speed (typ.)*2	32 s	3.5 s	2 s	0.5 s	0.3 s	0.2 s	0.2 s	0.2 s
Min. Optical Reception Sensitivity*3	–90 dBm	–80 dBm	–76 dBm	–70 dBm	–66 dBm	–60 dBm	–50 dBm	–40 dBm

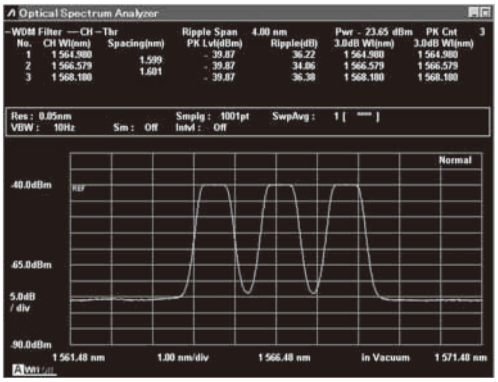
*1: Reference value and not guaranteed.
*2: Center wavelength: 1200 nm, Span: 200 nm, No. of samples: 501, Normal dynamic range, Point Avg. 1, No optical input, Sweep start to end
*3: Wavelength range: 1250 nm to 1600 nm, Resolution: >0.07 nm, Optical attenuator OFF, Sweep Avg. 10, SM fiber is used, 5° to 30°C

WDM Filter Measurement Application

Fast evaluation of optical devices requires short inspection times using high-efficiency measuring equipment. The MS9740 adds a new WDM Filter analysis function supporting group display for optical bandpass filters, such as WSS and WDM Filter devices.

Transmittance Evaluation

The WDM Filter analysis function supports efficient evaluation of optical bandpass filter transmittance characteristics.



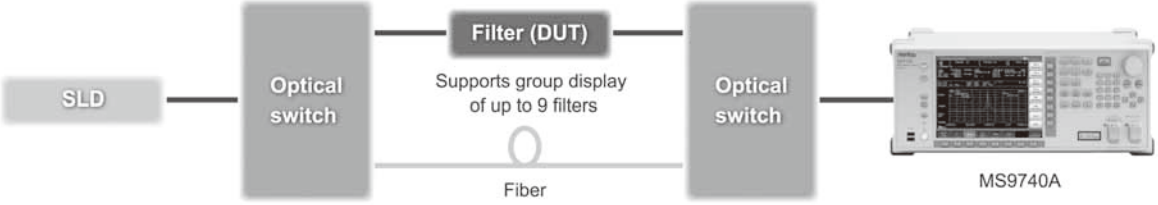
```
Optical Spectrum Analyzer
-WDM Filter  —CH –Thr           Ripple Span   4.00 nm         Pwr  - 23.65 dBm   PK Cnt     3
 No.   CH Wl(nm)   Spacing(nm)    PK Lvl(dBm)      Ripple(dB)   3.0dB Wl(nm)    3.0dB Wl(nm)
  1    1 564.980                     - 39.87          36.22     1 564.980       1 564.980
                      1.599
  2    1 566.579                     - 39.87          34.06     1 566.579       1 566.579
                      1.601
  3    1 568.180                     - 39.87          36.38     1 568.180       1 568.180

 Res :  0.05nm                   Smplg :  1001pt    SwpAvg :    1 [  **** ]
 VBW :   10Hz         Sm :  Off  Intvl :    Off
```

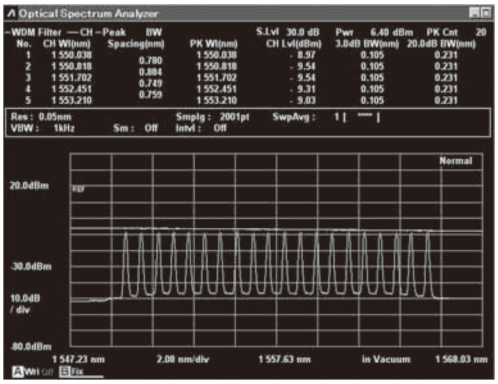
WDM Filter Function Measurements

- Signal Level
- Peak Signal No.
- Signal Wavelength
- Spacing (Wavelength)
- Pass Band
- Ripple

Insertion Loss Evaluation

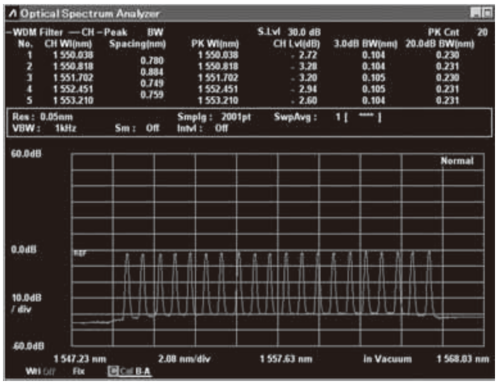


Filters, such as optical bandpass filters, are evaluated by finding the difference in the measured results when the filter (DUT) is inserted and not inserted. The MS9740A Trace Mode function supports measurement using optical switches to measure DUT insertion loss by inter-waveform processing, saving the results in one file and displaying up to 10 waveforms simultaneously on one screen.



```
Optical Spectrum Analyzer
-WDM Filter  —CH –Peak     BW               S.Lvl  30.0 dB    Pwr    6.40 dBm    PK Cnt     20
 No.   CH Wl(nm)   Spacing(nm)   PK Wl(nm)    CH Lvl(dBm)   3.0dB BW(nm)  20.0dB BW(nm)
  1    1 550.038                 1 550.038       - 8.97        0.105          0.231
                     0.780
  2    1 550.818                 1 550.818       - 9.54        0.105          0.231
                     0.884
  3    1 551.702                 1 551.702       - 9.54        0.105          0.231
                     0.749
  4    1 552.451                 1 552.451       - 9.31        0.105          0.231
                     0.759
  5    1 553.210                 1 553.210       - 9.03        0.105          0.231
 Res :  0.05nm                   Smplg :  2001pt    SwpAvg :    1 [  **** ]
 VBW :    1kHz        Sm :  Off  Intvl :    Off
```

Waveform of Wideband Light Source Before and After Insertion to Optical Bandpass Filter



```
Optical Spectrum Analyzer
-WDM Filter  —CH –Peak     BW               S.Lvl  30.0 dB                       PK Cnt     20
 No.   CH Wl(nm)   Spacing(nm)   PK Wl(nm)     CH Lvl(dB)   3.0dB BW(nm)  20.0dB BW(nm)
  1    1 550.038                 1 550.038       - 2.72        0.104          0.230
                     0.780
  2    1 550.818                 1 550.818       - 3.28        0.104          0.231
                     0.884
  3    1 551.702                 1 551.702       - 3.20        0.105          0.230
                     0.749
  4    1 552.451                 1 552.451       - 2.94        0.105          0.231
                     0.759
  5    1 553.210                 1 553.210       - 2.60        0.104          0.231
 Res :  0.05nm                   Smplg :  2001pt    SwpAvg :    1 [  **** ]
 VBW :    1kHz        Sm :  Off  Intvl :    Off
```

Filter Analysis by Waveform Difference Comparison

SM/MM Fiber Support

At optical device evaluation and measurement, it is important to suppress the effect of reflections at the optical input section. The MS9740A achieves a reflection attenuation of 35 dB max. using a fiber input structure for high-accuracy spectrum measurement.
The MS9740A-009* option also supports connection of SM fiber.

*: The Multimode fiber interface (50/62.5 µm) option MS9740A-009 is designed for multimode connections to the optical input section; it supports measurements with high optical sensitivity and high sweep speeds when using a MM fiber with a core diameter of 62.5 µm and an NA of ≤0.275.
Although the MS9740A-009 option can also be used to measure SM fiber, some features are different from the standard MS9740A model.
For details refer to the MS9740A and MS9740A-009 specifications.

Various Functions, Easy Operability

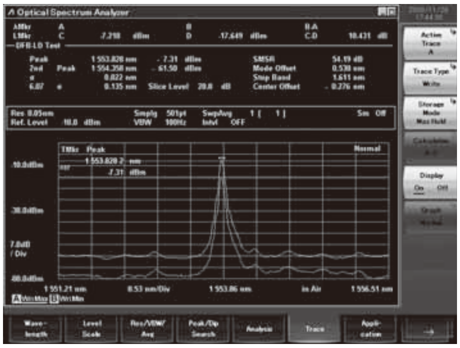
Supports 9 Application Modes

The MS9740A supports eight application measurement modes (DFB-LD, FP-LD, LED, PMD, Opt. Amp, Opt. Amp (Multi-channel), WDM, LD Module, WDM Filter) for measurement targets.
For example, at evaluation of LD characteristics, analysis items and methods can be tailored to the spectrum, such as a Single longitudinal mode laser (DFB-LD) spectrum, Multiple longitudinal mode laser (FP-LD), wideband LED, etc. Furthermore, analysis of each wavelength channel required by WDM signals is supported too. Combining test items into a menu supports easy batch measurement.

Application Name	Test Items
DFB-LD	Spectrum analysis of single longitudinal mode laser
FP-LD	Spectrum analysis of multiple longitudinal mode laser
LED	Spectrum analysis of wideband light source
PMD	PMD characteristics evaluation of optical fiber
Opt. Amp/Opt. Amp (Multi-channel)	Evaluation of fiber amp (EDFA) gain and NF characteristics
WDM	Spectrum evaluation of WDM for up to 300 wavelengths (channels)
LD Module	Evaluation of optical transceiver characteristics
WDM Filter	Evaluation of optical band pass Filter

Various Trace Displays

In addition to the normal waveform displays, the MS9740A has a full range of flexible display modes including Max Hold for displaying peak levels at continuous sweeping, Min Hold for displaying dip level at continuous sweeping, Calculate for computing differences between traces, etc.
The Overlap function superimposes all swept waveforms on one screen. It is ideal for checking the wavelengths of optical sources and long-term level drift.



Max Hold, Min Hold Display Function

These display functions are convenient for confirming maximum and minimum levels at continuous sweeping.

Modulated and Pulse Light Measurements

Measurement of modulated and pulsed optical signals requires synchronization with modulation. The trigger input connector on the rear panel of the MS9740A supports input of an external trigger synchronized to the internally modulated light, supporting measurement without data loss.

Wavelength Calibration Function for Accurate Measurements and Analysis

Assuring reliable measurement and analysis requires measurement with the best accuracy and resolution, which in turn requires automatic alignment of the internal optical axis, wavelength calibration with an external light source, and resolution calibration.
A wavelength accuracy of ±20 pm is assured by calibrating the wavelength using the Light Source For Wavelength Calibration (MS9740A-002) after automatic optical axis alignment. In addition, the MS9740A has a function for automatically calibrating wavelength if the ambient temperature and pressure change, based on the first calibration data. Calibration of effective resolution is important when measuring the noise level of a continuous spectrum, such as EDFA ASE, LDs, etc.

Item	Calibration
Automatic Optical Axis Alignment	Satisfy wavelength accuracy, level accuracy and dynamic range specifications
Wavelength Calibration	Calibrate wavelength using external light source and light source for wavelength calibration
Actual Resolution Calibration	Calibrate Actual resolution for accurate noise level measurement

Remote Control via Ethernet and GPIB Interfaces

Remote control is supported over either the Ethernet or GPIB (option) interfaces, slashing the time from measurement start at the MS9740A to data capture at an external PC via the GPIB interface by 80% compared to previous measurement systems.

Backward Compatibility with MS9710/MS9780 Series Remote Commands

Support for almost all remote commands used by the previous MS9710 and MS9780 series of instruments assures smooth backwards compatibility and easy future-proof migration to newer instruments.

Remote Tool Package

The MS9740A Remote Tools Package supports easy creation of remote command sequences software.
The Remote Tools Package includes the quick-start guide, sample programs, C# class library, and LabVIEW driver.

Sample Programs:	MS9740A control program created using Visual Basic
C# Class Library:	DLL using NET framework
LabVIEW Driver:	NI LabVIEW 7.1 driver

Specification

Optical Spectrum Analyzer MS9740A

Supported Optical Fiber		SM fiber (ITU-T G.652), 50 µm/125 µm GI fiber*1, PC Connector (reflection attenuation 40 dB or more)
Optical Connector		User replaceable: FC, SC, ST, DIN (All connectors are PC polished.)
Wavelength Measurement Range		600 nm to 1750 nm
Wavelength Accuracy*2		±20 pm (1520 nm to 1620 nm, Resolution: 0.03 nm to 0.2 nm), ±100 pm (1520 nm to 1620 nm, Resolution: 0.5 nm, 1.0 nm)*3
		±300 pm (600 nm to 1520 nm), ±200 pm (1520 nm to 1570 nm), ±300 pm (1570 nm to 1750 nm)*4
Wavelength Stability*2		≤±5 pm (1 min, smoothing: 11 pt, at center wavelength of half maximum, Using SM fiber)
Wavelength Linearity*2		±20 pm (1520 nm to 1620 nm)
Setting Resolution		0.03, 0.05, 0.07, 0.1, 0.2, 0.5, 1.0 nm (0.03 nm, 0.05 nm only 1550 nm band and room temperature)
Resolution Accuracy*2, *5		±7% (Resolution: 0.1 nm), ±3% (Resolution: 0.2 nm), ±2.2% (Resolution: 0.5 nm) [1520 nm to 1620 nm]
		±30% (Resolution: 0.1 nm), ±15% (Resolution: 0.2 nm), ±7% (Resolution: 0.5 nm) [600 nm to 1520 nm, 1620 nm to 1750 nm]
Measurement Range*2		–65 to +10 dBm (600 nm to 1000 nm), –85 to +10 dBm (1000 nm to 1250 nm), –90 to +10 dBm (1250 nm to 1600 nm), –85 to +10 dBm (1600 nm to 1650 nm), –65 to +10 dBm (1650 nm to 1700 nm), –55 to +10 dBm (1700 nm to 1750 nm) [5° to 30°C, VBW: 10 Hz, Sweep average: 10, Resolution: 0.07 nm to 1.0 nm, using SM fiber, Optical Att: Off]
		–60 to +10 dBm (600 nm to 1000 nm), –80 to +10 dBm (1000 nm to 1250 nm), –85 to +10 dBm (1250 nm to 1600 nm), –80 to +10 dBm (1600 nm to 1650 nm), –60 to +10 dBm (1650 nm to 1700 nm), –50 to +10 dBm (1700 nm to 1750 nm) [30° to 45°C, VBW: 10 Hz, Sweep average: 10, Resolution: 0.07 nm to 1.0 nm, using SM fiber, Optical Att: Off]
		–70 to +23 dBm (1100 nm to 1600 nm), [5° to 30°C, VBW: 10 Hz, Sweep average: 10, Resolution: 0.07 nm to 1.0 nm, using SM fiber, Optical Att: On]
		–65 to +23 dBm (1100 nm to 1600 nm), [30° to 45°C, VBW: 10 Hz, Sweep average: 10, Resolution: 0.07 nm to 1.0 nm, using SM fiber, Optical Att: On]
Level Accuracy*2, *6		±0.4 dB (Wavelength: 1310 nm, 1550 nm, Input: –10 dBm, Resolution: 0.1 nm to 1.0 nm)
Level Stability*2		±0.02 dB (1 min, Wavelength: 1550 nm, Input: –23 dBm, Resolution: 0.1 nm to 1.0 nm, no polarization fluctuation)
Level Linearity*2		±0.05 dB (Wavelength: 1550 nm, Input: –50 to 0 dBm, Optical Att: Off) ±0.05 dB (Wavelength: 1550 nm, Input: –30 to +20 dBm, Optical Att: On)
Level Flatness*2, *7		±0.1 dB (Wavelength: 1520 nm to 1620 nm, Resolution: 0.5 nm, Optical Att: Off)
Polarization Dependency*2		±0.05 dB (Wavelength: 1550 nm/1600 nm), ±0.1 dB (Wavelength: 1300 nm), [Resolution: 0.5 nm, 1.0 nm]
Dynamic Range*2		High dynamic range: 70 dB (1 nm from peak wavelength), 60 dB (0.4 nm from peak wavelength), 42 dB (0.2 nm from peak wavelength) Normal dynamic range: 62 dB (1 nm from peak wavelength), 58 dB (0.4 nm from peak wavelength), 42 dB (0.2 nm from peak wavelength) [Wavelength: 1550 nm, Resolution: 0.05 nm, Optical Att: Off, 20° to 30°C]
Optical Return Loss*2		≥35 dB (Using SM fiber with wavelength of 1300 nm and 1550 nm)
Sweep		Sweep width: 0.2 nm to 1200 nm, 0 nm
		Sweep speed: ≤0.2 s (span: 5 nm, Resolution: 0.1 nm), ≤0.3 s (span: 500 nm) [VBW: 10 kHz, Normal dynamic range, center 1550 nm (span: 5 nm), 1200 nm (span: 500 nm), sweep start to stop, no optical input, sampling point: ≤501]
Display		800 × 600 dots, 8.4 inch SVGA color LCD
Function		Measurement functions: Auto Measure, Optical pulse measurement (External trigger), Power monitor Display functions: Normalized, Max Hold, Min Hold, Overlap, Value in Air/Vacuum, Effective Resolution, Multi fiber mode Analysis functions:Wavelength Subtraction, Marker, Wavelength Analysis (Threshold, ndB-Loss, Envelope, RMS, SMSR, Spectrum Power), Light Source Evaluation (FP-LD, DFB-LD, LED, LD Module), Optical AMP NF Evaluation, PMD Measurement, WDM Signal Evaluation, WDM Filter Analysis Calibration functions: Auto Align, Wavelength cal., Level offset, Wavelength offset Memory function: Display measurement data to memory A to J (10 waveforms) Interfaces: Ethernet, GPIB (Option) Input/Output function I/O: Save and read files to USB memory Input: External trigger terminal (0 to 0.8 V/2 V to 5 V, high impedance) Output: Measured data text file output, measurement screen file (BMP, PNG) output, VGA output
Operating Conditions		Operating temperature: +5° to +45°C, Storage temperature: –20° to +60°C, Relative humidity: 0 to 90% (no condensation)
Power Supply		100 V(ac) to 120 V(ac)/200 V(ac) to 240 V(ac), 50 Hz to 60 Hz, ≤75 VA
Dimensions and Mass		426 (W) × 177 (H) × 350 (D) mm (excluding projections), ≤15.0 kg (without options)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581
Remote Control Interfaces		Ethernet, GPIB (MS9740A-001)*8

*1: The connection loss when connecting 50 µm/125 µm multimode optical fiber degrades the minimum light reception sensitivity.
The MS9740A has an MM mode function to correct correction loss when connecting 50 µm/125 µm multimode optical fiber and to display the level.
The optical loss level is corrected when the MM mode is On. It corrects the level by 14 dB (sum).
Level display errors occur if light is input under other excitation conditions.

*2: Using SM fiber (ITU-T G.652), after 2 hours of warm-up (The Repeat sweeping performed at span 100 nm or more and VBW 10 kHz or more during the warm-up operation), after Auto Align, at stable room temperature

*3: Built-in MS9740A-002, after WI cal (ref) wavelength calibration execution, at stable room temperature

*4: After WI cal (Ext) wavelength calibration execution by external light source, such as Single Longitudinal mode laser (DFB-LD)

*5: Effective resolution, after Res-cal, using SM fiber

*6: Using master FC connector, 23° ±5°C

*7: 10° to 30°C

*8: When controlling the MS9740A remotely using the Ethernet port, a VISA*9 driver must be installed in the PC controller. We recommend using NI-VISA™*10 from National Instruments™ (NI hereafter) as the VISA driver.
Although a license is generally required to use NI-VISA™, the licensed NI-VISA™ driver is provided free-of-charge for use when performing remote control (Note) of a MS9740A unit in which the MS9740A-001 GPIB option has been installed.

The NI-VISA™ driver can be downloaded from the NI website at:
http://sine.ni.com/psp/app/doc/p/id/psp-411

Be sure to comply with the NI license agreement for the usage and license scope.
Be sure to uninstall the NI-VISA™ driver when disposing of the MS9740A or transferring it to a third party, etc., or when ceasing to use NI-VISA™.

(Notes)
Although the NI-VISA™ driver itself can be downloaded free-of-charge from the web, an implementation license is required for legal reasons if some requirements are not met. (Check the NI web page for the detailed requirements.)
If these requirements are not met, permission is not granted to use NI hardware and software and an NI implementation license must be purchased.
However, since the MS9740A-001 GPIB option incorporates NI hardware (GPIB ASIC), the NI-VISA™ driver can be used free-of-charge.

Glossary of Terms:

*9: VISA: Virtual Instrument Software Architecture
I/O software specification for remote control of measuring instruments using interfaces such as GPIB, Ethernet, USB, etc.

*10: NI-VISA™
World de facto standard I/O software interface developed by NI and standardized by the VXI Plug&Play Alliance.

Trademarks:
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Multimode fiber interface (50/62.5 µm) (MS9740A-009)

Supported Optical Fiber		SM fiber (ITU-T G.652), 50 µm/125 µm GI fiber*1, 62.5 µm/125 µm GI fiber*1, PC Connector SM (ITU-T G.652), GI (50 µm/125 µm): reflection attenuation 40 dB or more, GI (62.5 µm/125 µm): reflection attenuation 38 dB or more
Optical Connector		User replaceable: FC, SC, ST, DIN (All connectors are PC polished.)
Wavelength Measurement Range		600 nm to 1750 nm
Wavelength Accuracy*2		±50 pm (1530 nm to 1570 nm)*3, ±100 pm (1530 nm to 1570 nm)*4 ±300 pm (600 nm to 1750 nm)*5
Wavelength Stability*2		±5 pm (1 min, smoothing: 11 pt, at center wavelength of half maximum, Using SM fiber)
Setting Resolution		0.07, 0.1, 0.2, 0.5, 1.0 nm
Resolution Accuracy*2		±30% (Resolution: 0.1 nm), ±15% (Resolution: 0.2 nm), ±7% (Resolution: 0.5 nm) After Res-cal, using SM fiber, 633/1310/1550 nm
Measurement Range*2		–65 to +10 dBm (600 nm to 1000 nm), –85 to +10 dBm (1000 nm to 1250 nm), –90 to +10 dBm (1250 nm to 1600 nm), –75 to +10 dBm (1600 nm to 1700 nm), –55 to +10 dBm (1700 nm to 1750 nm) [5° to 30°C, VBW: 10 Hz, Sweep average: 10, Resolution: 0.07 nm to 1.0 nm, using SM fiber, Optical Att: Off] –60 to +10 dBm (600 nm to 1000 nm), –80 to +10 dBm (1000 nm to 1250 nm), –85 to +10 dBm (1250 nm to 1600 nm), –70 to +10 dBm (1600 nm to 1700 nm), –50 to +10 dBm (1700 nm to 1750 nm) [30° to 45°C, VBW: 10 Hz, Sweep average: 10, Resolution: 0.07 nm to 1.0 nm, using SM fiber, Optical Att: Off] –70 to +23 dBm (1100 nm to 1600 nm), [5° to 30°C, VBW: 10 Hz, Sweep average: 10, Resolution: 0.07 nm to 1.0 nm, using SM fiber, Optical Att: On] –65 to +23 dBm (1100 nm to 1600 nm), [30° to 45°C, VBW: 10 Hz, Sweep average: 10, Resolution: 0.07 nm to 1.0 nm, using SM fiber, Optical Att: On]
Level Accuracy*2		±0.6 dB (Wavelength: 1310 nm, 1550 nm, Input: –10 dBm, Resolution: 0.2 nm to 1.0 nm, using SM fiber, using master FC connector, 23 ±5°C)
Level Stability*2		±0.1 dB (1 min, Wavelength: 1550 nm, Input: –23 dBm, Resolution: 0.2 nm to 1.0 nm, no polarization fluctuation, using SM fiber, at stable room temperature)
Level Linearity*2		±0.1 dB (Wavelength: 1550 nm, Input: –50 to 0 dBm, using SM fiber, Optical Att: Off) ±0.1 dB (Wavelength: 1550 nm, Input: –30 to +20 dBm, using SM fiber, Optical Att: On)
Dynamic Range*2		High dynamic range: 70 dB (1 nm from peak wavelength, 20° to 30°C), 60 dB (0.5 nm from peak wavelength, 20° to 30°C) 65 dB (1 nm from peak wavelength, 5° to 45°C), 55 dB (0.5 nm from peak wavelength, 5° to 45°C) Normal dynamic range: 62 dB (1 nm from peak wavelength, 20° to 30°C), 58 dB (0.5 nm from peak wavelength, 20° to 30°C) 57 dB (1 nm from peak wavelength, 5° to 45°C), 53 dB (0.5 nm from peak wavelength, 5° to 45°C) [Wavelength: 1550 nm, Resolution: 0.07 nm, using SM fiber, Optical Att: Off]
Optical Return Loss*2		32 dB (Wavelength: 1310 nm, 1550 nm, using SM fiber, Optical Att: Off)
Sweep*2		Sweep width: 0.2 nm to 1200 nm, 0 nm Sweep speed: ≤0.2 s (span: 5 nm, Resolution: 0.1 nm), ≤0.3 s (span: 500 nm) [VBW: 10 kHz, Normal dynamic range, center 1550 nm (span: 5 nm), 1200 nm (span: 500 nm), sweep start to stop, no optical input, sampling point: ≤501]
Display		800 × 600 dots, 8.4 inch SVGA color LCD
Function		Measurement functions: Auto Measure, Optical pulse measurement (External trigger), Power monitor Display functions: Normalized, Max Hold, Min Hold, Overlap, Value in Air/Vacuum, Effective Resolution, Multi fiber mode Analysis functions:Wavelength Subtraction, Marker, Wavelength Analysis (Threshold, ndB-Loss, Envelope, RMS, SMSR, Spectrum Power), Light Source Evaluation (FP-LD, DFB-LD, LED, LD Module), Optical AMP NF Evaluation, PMD Measurement, WDM Signal Evaluation, WDM Filter Analysis Calibration functions: Auto Align, Wavelength cal., Level offset, Wavelength offset Memory function: Display measurement data to memory A to J (10 waveforms) Interfaces: Ethernet, GPIB (Option) Input/Output function I/O: Save and read files to USB memory Input: External trigger terminal (0 to 0.8 V/2 V to 5 V, high impedance) Output: Measured data text file output, measurement screen file (BMP, PNG) output, VGA output
Operating Conditions		Operating temperature: +5° to +45°C, Storage temperature: –20° to +60°C, Relative humidity: 0 to 90% (no condensation)
Power Supply		100 V(ac) to 120 V(ac)/200 V(ac) to 240 V(ac), 50 Hz to 60 Hz, ≤75 VA
Dimensions and Mass		426 (W) × 177 (H) × 350 (D) mm (excluding projections), ≤15.0 kg (without options)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

*1: The NA is 0.2 for 50 µm/125 µm GI fiber and 0.275 for 62.5 µm/125 µm GI fiber.

*2: Warm-up the instrument for at least 2 hours before measurement by performing repeated sweeping at span ≥100 nm, VBW = 10 kHz. Perform waveform calibration after auto-optical alignment (Wl Cal) and keep the instrument at the same temperature unless stated otherwise. Use either SM fiber (ITU-T G.652) or GI fiber (50 µm/125 µm) with a return loss of >40 dB, or GI fiber (62.5 µm/125 µm) with a return loss of >38 dB.

*3: Built-in MS9740A-002, after Wl Cal (Ref), with SM fiber and resolution at 0.07 nm to 0.2 nm

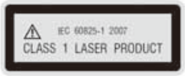
*4: Built-in MS9740A-002, after Wl Cal (Ref), with SM fiber and resolution at 0.5 nm/1.0 nm

*5: After Wl cal (Ext) wavelength calibration execution by external light source, such as DFB-LD, using SM fiber or GI fiber (50 µm/125 µm or 62.5 µm/125 µm)

Light Source For Wavelength Calibration MS9740A-002

Supported Optical Fiber	SM fiber (ITU-T G.652)
Optical Connector	User replaceable: FC, SC, ST, DIN (All connectors are PC polished.)
Output Level	–40 dBm/nm (Reference wavelength, 10° to 30°C, Wavelength:1550 nm ±20 nm, Resolution:1 nm)
Output Level Stability	±0.04 dB (10 minutes after power-on, Wavelength:1550 nm, Resolution:1 nm, VBW:100 Hz, Point Avg.:20, Measurement time:1 minute)
Laser Safety*	Class 1 (IEC 60825-1:2007)

*: Safety measures for laser products. This option complies with optical safety standards in Class 1 of IEC 60825-1; The following descriptive labels are affixed to the product.



Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

(1) Specify the mainframe

Model/Order No.	Name
	Main Frame
MS9740A	Optical Spectrum Analyzer
	Standard Accessories
Z1353A*1	MS9740A Operation Manual (CD): 1 pc
	Power Cord: 1 pc

(2) Specify one optical connector

Model/Order No.	Name
	Options (Optical Connector)*2
MS9740A-037	FC Connector
MS9740A-038	ST Connector
MS9740A-039	DIN 47256 Connector
MS9740A-040	SC Connector

(3) Select an option from the list

Model/Order No.	Name
	Options (Interface)
MS9740A-001	GPIB Interface
MS9740A-101	GPIB Interface Retrofit
	Options (Light Source for Wavelength Calibration)*3, *4
MS9740A-002	Light Source For Wavelength Calibration
MS9740A-102	Light Source For Wavelength Calibration Retrofit
	Option (Multimode Fiber Interface)*5, *6
MS9740A-009	Multimode fiber interface (50/62.5 µm)

(4) Select the optional accessories, peripherals and consumables from the list

Model/Order No.	Name
	Application Parts
W3328AE	MS9740A Optical Spectrum Analyzer Operation Manual (Printed)
W3329AE	MS9740A Optical Spectrum Analyzer Remote Control Operation Manual (Printed)
W3696AE	MS9740A Optical Spectrum Analyzer Remote Control Operation Manual (Printed)
J0617B	Replaceable Optical Connector (FC-PC)*7
J0618D	Replaceable Optical Connector (ST)*7
J0618E	Replaceable Optical Connector (DIN)*7
J0619B	Replaceable Optical Connector (SC)*7
J1530A	SC Plug-in Converter (UPC(P)-APC(J))
J1532A	FC Plug-in Converter (UPC(P)-APC(J))
J0635A	FC · PC-FC · PC-1M-SM (Optical Fiber Cord, 1.0 m)
J0635B	FC · PC-FC · PC-2M-SM (Optical Fiber Cord, 2.0 m)
J0635C	FC · PC-FC · PC-3M-SM (Optical Fiber Cord, 3.0 m)
J0660A	SC · PC-SC · PC-1M-SM (Optical Fiber Cord, 1.0 m)
J0660B	SC · PC-SC · PC-2M-SM (Optical Fiber Cord, 2.0 m)
J0660C	SC · PC-SC · PC-3M-SM (Optical Fiber Cord, 3.0 m)
J0893A	FC · PC-FC · PC-1M-GI (Optical Fiber Cord, 1.0 m)
J0893B	FC · PC-FC · PC-2M-GI (Optical Fiber Cord, 2.0 m)
J0839A	SC · PC-SC · PC-1M-GI (Optical Fiber Cord, 1.0 m)
J0839B	SC · PC-SC · PC-2M-GI (Optical Fiber Cord, 2.0 m)
J1534A	LC-SC Plug-in Converter (for SM, SC(P)-LC(J))
Z0914A	Ferrule Cleaner
Z0915A	Replacement Reel for Ferrule Cleaner
Z0284	Adapter Cleaner (Stick Type)
B0640C*8	Carrying Case
B0671A*9	Front Cover for 1MW4U
B0641A	Rack Mount Kit
J0008	GPIB Cable, 2.0 m
Z0541A	USB Mouse
Z0975A	Keyboard (USB)
	Single Mode Attenuator
G0350F	Programmable Optical Attenuator (SM9, FC/UPC)
G0350S	Programmable Optical Attenuator (SM9, SC/UPC)
G0351F	Programmable Optical Attenuator (SM9, FC/UPC, Power Monitor)
G0351S	Programmable Optical Attenuator (SM9, SC/UPC, Power Monitor)
	Multi Mode Attenuator
G0352F	Programmable Optical Attenuator (GI50, FC/UPC)
G0352S	Programmable Optical Attenuator (GI50, SC/UPC)
G0353F	Programmable Optical Attenuator (GI50, FC/UPC, Power Monitor)
G0353S	Programmable Optical Attenuator (GI50, SC/UPC, Power Monitor)
G0354F	Programmable Optical Attenuator (GI62.5, FC/UPC)
G0354S	Programmable Optical Attenuator (GI62.5, SC/UPC)
G0355F	Programmable Optical Attenuator (GI62.5, FC/UPC, Power Monitor)
G0355S	Programmable Optical Attenuator (GI62.5, SC/UPC, Power Monitor)
	Single Mode Switch
G0344F	Optical Switch (1×4, SM9, FC/UPC)
G0344S	Optical Switch (1×4, SM9, SC/UPC)
G0345F	Optical Switch (1×16, SM9, FC/UPC)
G0345S	Optical Switch (1×16, SM9, SC/UPC)
	Multi Mode Switch
G0346F	Optical Switch (1×4, GI50, FC/UPC)
G0346S	Optical Switch (1×4, GI50, SC/UPC)
G0347F	Optical Switch (1×4, GI62.5, FC/UPC)
G0347S	Optical Switch (1×4, GI62.5, SC/UPC)
G0348F	Optical Switch (2×4, GI50, FC/UPC)
G0348S	Optical Switch (2×4, GI50, SC/UPC)
G0349F	Optical Switch (2×4, GI62.5, FC/UPC)
G0349S	Optical Switch (2×4, GI62.5, SC/UPC)

*1: CD contains Operation Manual for Main Frame and Remote Control.

*2: One free specified optical connector for optical input port.

*3: When Light Source For Wavelength Calibration option selected, one more connector specified in (2) supplied free.

*4: Executing wavelength calibration with this option secures ±20 pm (1520 nm to 1620 nm, without MS9740A-009) accuracy. The MS9740A supports wavelength calibration with the external light source, such as DFB-LD, but this option assures higher accuracy. Refer to the specifications for details.

*5: Factory option and Retrofit not supported.

*6: MS9740A Optical Spectrum Analyzer standard not guaranteed. Refer to Multimode fiber interface (50/62.5 µm) Option MS9740A-009 Standard.

*7: Exchangeable-type optical connectors for optical input port and wavelength calibration light source output port.

*8: The Carrying Case includes a Front Panel Protective Cover (B0671A).

*9: Old type carrying case cannot be used (B0640B).

Ordering Configuration 1

(1)	MS9740A	Optical Spectrum Analyzer
(2)	MS9740A-040	SC Connector
(3)	MS9740A-001	GPIB Interface
(3)	MS9740A-002	Light Source For Wavelength Calibration
(4)	J0617B	Optical Connector Adapter (FC) × 2 pcs

- When ordering the main frame, specify model name (1) and one connector from (2).
- Two SC connectors specified in (2) supplied free when Light Source For Wavelength Calibration option selected in (3).

Ordering Configuration 2

(1)	MS9740A	Optical Spectrum Analyzer
(2)	MS9740A-037	FC Connector
(3)	MS9740A-002	Light Source For Wavelength Calibration
(3)	MS9740A-009	Multimode fiber interface (50/62.5 µm)

- When ordering the main frame, specify model name (1) and one connector from (2).
- Two FC connectors specified in (2) supplied free when Light Source For Wavelength Calibration option selected in (3).
- When MS9740A-009 specified with (3): specifications based on Multimode fiber interface (50/62.5 µm) Option MS9740A-009.

Video Inspection Probe Series

G0382A Autofocus Video Inspection Probe
G0306B Video Inspection Probe

Optical Connector End Face Inspection

Scratches and stains to optic fiber ferrule endfaces are often said to have a negative impact on transmission quality.
When the external optical fiberscope (G0382A USB Autofocus type, G0306B USB Standard type: sold separately) is connected, scratches and dirt on the optical connector endface can be confirmed visually.
The Video Inspection Probe can be connected to the Network Master Pro MT1000A, Network Master Flex MT1100A, ACCESS Master MT9083x2 Series, µOTDR MU909014x/15x Anritsu products and PC.

Products Support

	G0382A	G0306B
Network Master Pro MT1000A	✓	✓
Network Master Flex MT1100A	✓	✓
ACCESS Master MT9083x2 Series	NA	✓
µOTDR MU909014x/15x	NA	✓
Autofocus VIP Software (For PC) MX900031A	✓	NA
Connector Master (For PC) MX900030A	NA	✓

Features

	G0382A	G0306B
	USB Autofocus type. Based on Auto Operation.	USB Standard type. Based on Manual Operation.
Automatic Focus Adjustment	✓	NA
Automatic Fiber Image Centering	✓	NA
Automatic Image Capture	✓	NA ✓ (MT1000A/MT1100A)*
Pass/Fail Analysis on Screen	✓	✓
Pass/Fail LED Indicator	✓	NA

*: It is available to MT1000A/MT1100A VIP application only.

Specifications

G0382A

Magnification	400 times with 7″ monitor
Resolution	1.0 µm/pixel
Focus	Automatic
Power	2 W
Interface	USB 2.0
Dimensions	182 (W) × 25 (H) × 48 (D) mm
Mass	152 g
Operation Temperature	–10° to +50°C
Storage Temperature	–40° to +70°C
Vibration/Shock proof	MIL-T-28800E (Class3)
CE	EMC: 2014/30/EU, EN61326-1 RoHS: 2011/65/EU, EN50581
RCM	Australia, New Zealand: AS/NZS 4417:2012

G0306B

Items	Parameter
Interface	USB 2.0 (Compatible USB 1.1)
Display Resolution	640*480
Resolution	<1 µm
Field of View	0.365*0.273 mm
Focus Mode	Manual
Operating Voltage	5 ± 0.2 V
Operating Temperature	–10° to +55°C
Storage Temperature	–20° to +60°C
Dimensions	31 (W) × 46.5 (H) × 165 (D) mm
Mass	150 g
Cable Length	1.5 m
CE	EMC: 2014/30/EU, EN61326-1 RoHS: 2011/65/EU, EN50581
RCM	Australia, New Zealand: AS/NZS 4417:2012

Ordering information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

G0382A

Model/Order No.	Name
	Main Frame
G0382A	Autofocus Video Inspection Probe
	Standard Accessories
H0383A	1.25PC-M (1.25 mm PC Universal)
H0382A	2.5PC-M (2.5 mm PC Universal)
H0387A	2.5APC-M (2.5 mm APC Universal)
H0385A	LC-PC-F (LC PC Bulk)
H0386A	FC-PC-F (FC PC Bulk)
H0384A	SC-PC-F (SC PC Bulk)
H0398A	SC-APC-F (SC APC Bulk)
	Quick Reference Guide
	Application Parts
H0388A	1.25APC-M (1.25 mm APC Universal)
H0395A	FC-APC-F (FC APC Bulk)
H0393A	LC-PC-F-L (LC PC Long Bulk)
H0394A	LC-APC-F-L (LC APC Long Bulk)
H0396A	ST-PC-F (ST PC Bulk)
H0397A	MU-PC-F (MU PC Bulk)
H0390A	E2000-PC-F (E2000 PC Bulk)
H0392A*	MPO-PC/APC-F (MPO PC/APC Bulk)

Operation Manual and Autofocus VIP Software (For PC) MX900031A can be downloaded from Anritsu public Web site.

*: It is not available to Autofocus and Pass/Fail functions operation.

G0306B

Model/Order No.	Name
	Main Frame
G0306B	Video Inspection Probe
	Standard Accessories
H0361A	1.25PC-M (1.25 mm PC Universal)
H0360A	2.5PC-M (2.5 mm PC Universal)
H0362A	2.5APC-M (2.5 mm APC Universal)
H0363A	LC-PC-F (LC PC Bulk)
H0364A	FC-PC-F (FC PC Bulk)
H0365A	SC-PC-F (SC PC Bulk)
H0366A	SC-APC-F (SC APC Bulk)
	Operation Manual (Printed)
	Application Parts
H0372A	E2000-PC-F (E2000 PC Bulk)
H0373A	FC-APC-F (FC APC Bulk)
H0374A	MU-PC-F (MU PC Bulk)
H0375A	ST-PC-F (ST PC Bulk)
H0376A	1.25APC-M (1.25 mm APC Universal)
H0380A	LC65-PC-F (65 degree LP PC Bulk)

Connector Master (For PC analysis) MX900030A can be downloaded from Anritsu public Web site.

Optical Fiber Identifiers

FI700 Series

Single-hand Operation and Wide Detection Range

The FI700 Series of Optical Fiber Identifiers is the safe, economical and non-destructive way to identify active lit optical fibers. These rugged units use local detection technology, which employs a macro-bend method, eliminating the need to open the fiber at the splice point for identification.
All models detect continuous wave, live optical transmission and low frequency modulated tones at 270 Hz, 1 kHz, and 2 kHz. The presence of traffic, the direction of the transmission and modulated tones on the fiber are indicated by LEDs.

Optical Specifications

Model	FI710	FI720	FI720C
Insertion Loss	<0.5 dB*		
Spectral Response	800 nm to 1700 nm		
Optical Tone Receiver	270 Hz, 1 kHz and 2 kHz		
Maximum Range	–40 to 0 dBm	–40 to 0 dBm; ±2.0 dBm	–20 to +20 dBm; ±2.0 dBm
Relative Power	No	Yes	
Fiber Stress	None; Macro-bending		

*: Mean Detectable Signal Power for single-mode fiber at 1310 nm.

Fiber Compatibility	Dual Window Single-mode	8 µm to 10 µm diameter
	Coating Diameter	250 µm diameter
	Coating	High refractive index acrylate
Optical Characteristics		Using Corning 1528
Minimum Fiber Slack		0.75 µm required for detection

General Specifications

Power Supply		One 9 volt Alkaline battery
Operation		Approximately 10,000 readings
Temperature Range		Operating: –20° to +50°C (–4° to 122° F) Storage: –40° to +60°C (–40° to 140° F)
Humidity		≤90%, non-condensing
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581
Dimensions		4.2 (W) × 19.1 (H) × 2.5 (D) cm (1.3 × 7.5 × 1.0 inches)
Mass		≤0.2 kg (7.5 oz)

In addition, the FI720 models measure the fiber's relative power and displays the reading on a two-digit, seven-segment LED. This allows for measurement of power loss through a splice or connector.

Features and Benefits

- Detection of modulated tones; 270 Hz, 1 kHz, 2 kHz
- Single-hand operation
- Light weight (≤0.2 kg/7.5 oz.)
- Interchangeable head for ribbon, jacketed and coated fiber allows virtually any fiber to be identified
- Detects all light source and loss test set modulation frequencies

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

A Fiber Identifier is a non-intrusive tool used to determine if a fiber has traffic on it prior to breaking the connection and interrupting service. All Fiber Identifiers operate on a 9-volt battery and include a 3 mm, 900 µm, ribbon adapter, manual, and carry case.

Model Numbers

FI710: Basic Optical Fiber Identifier
FI720: Optical Fiber Identifier with relative power reading
FI720C: High Power (CATV) Optical Fiber Identifier

Fiber Identifier Accessories

TD-30418	250 µm buffered fiber adapter
TD-30419	900 µm buffered fiber adapter
TD-30420	3 mm fiber adapter
TD-34788	2 mm adapter
TD-30421	Replacement leather pouch for Fiber Identifier

Visual Fault Locator

VFL650

Compact and Cost-effective Design

Now you can easily isolate high losses and faults in optical fiber cable with the Visual Fault Locator VFL650. This handheld, visible laser source emits a bright beam of red light into a fiber, allowing you to see a break as a glowing or blinking red light. Two versions are available: one with a universal port for 2.5 mm ferrule connectors (FC, SC, ST, E2000, DIN), and one which includes an adapter that allows use with 1.25 mm ferrule connectors as well (LC, MU).

Key Features and Benefits

- Both CW and pulsed mode are available
- Lightweight (≤60 g)
- 40 hours continuous operation
- Cost effective solution

Optical Specifications

Emitter Type	Laser Diode
Wavelength (nm)	635 nm
CW Output Power	>–3 dBm (500 µW) into a single mode or multi mode fiber
Modulation Modes	CW or Pulsed (2 Hz to 3 Hz)
Range	>5 km
Power Supply	Two AAA alkaline batteries
Fiber Type	Multimode or Single-mode
Temperature Range	–10° to +50°C
CE RoHS	2011/65/EU, EN50581
Dimensions	Length: 168 mm, Diameter: 12 mm, Weight: ≤60 g
Laser Safety*	IEC 60825-1: 2007 Class 2 21CFR1040.10, 1040.11 Excludes deviations caused by conformance to Laser Notice No. 50 dated June 24, 2007

*: Safety measures for laser products
This product complies with optical safety standards in 21CFR1040.10, 1040.11 and IEC 60825-1; the following descriptive labels are affixed to the product.

LASER RADIATION
DO NOT STARE INTO THE BEAM
λ=635nm , P < 1mW
CLASS 2 LASER PRODUCT
IEC 60825-1:2007

CERTIFICATION LABEL
THIS PRODUCT COMPLIES WITH 21 CFR 1040.10
AND 1040.11 EXCEPT FOR DEVIATIONS PURSUANT
TO LASER NOTICE NO. 50, DATED JUNE 24, 2007

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

A Visual Fault Locator is a "red" light that allows users visually see the light in the fiber. This is a useful tool to aid in fiber identification and troubleshooting for macro bends and near end fiber breaks.

Model Number

VFL-650-250: VFL compatible with all 2.5 mm connectors
VFL-650-UNI: VFL adaptable to all 2.5 mm and 1.25 mm connectors
VFL-650-ADPT: VFL 2.5 mm to 1.25 mm adapter (only)
VFL-650-ADPT is not RoHS compliant

Bare Fiber Adapter

FiberConnect

Coupling Unterminated Fiber or Optical Components to Test Equipment

The FiberConnect is the ultimate time saving solution for coupling unterminated fiber or optical components to test equipment.
By allowing the user to perform optical measurements without terminating, which requires additional equipment and procedures, test time can be significantly reduced over 50% compared to other methods.
The low loss and highly repeatable connection made using the FiberConnect is similar to that of connectorized fiber.

Optical Specifications

Fiber Type Single-mode	9 µm/125 µm
Multimode	62.5 µm/125 µm or 50 µm/125 µm
Pigtail Length	1 m
Insertion Loss	<0.6 dB (typ.)
Number of Insertions	2000 (min.)
Back Reflectance	<–50 dB

General Specifications

Temperature Range	Operating: –10° to +50°C (14° to 122°F) Storage: –40° to +60°C (–40° to 140°F)
Connector Types	FC, ST, SC, D4, E2000, LC, DIN
Weight (With Cable)	≤90 g (3.2 oz)
Unit Size (with suction cup)	35 (W) × 32 (H) × 35 (D) mm (1.375 × 1.25 × 1.375 inches)
Case Size	240 (W) × 80 (H) × 200 (D) mm (9.5 × 3.5 × 8 inches)

Ordering Information

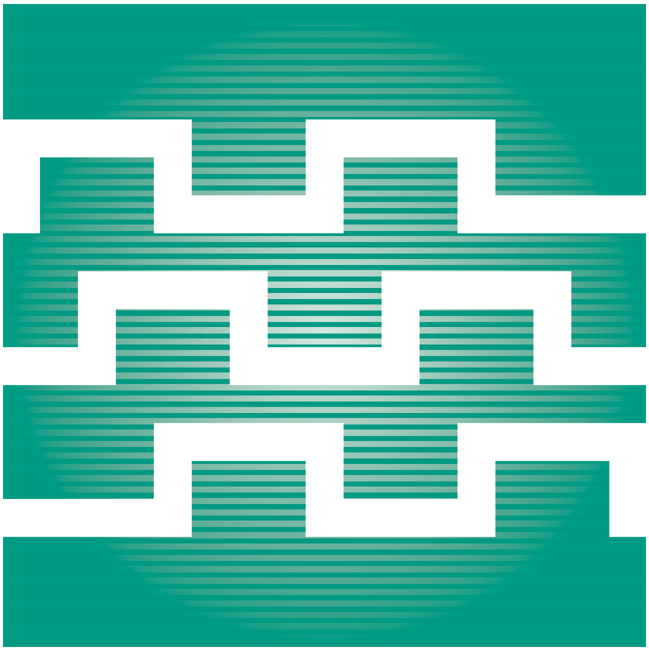
Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

FiberConnect-X-XXX
X = 1: Single-mode 9 µm/125 µm
X = 2: Multimode 62.5 µm/125 µm
X = 3: Multimode 50 µm/125 µm

XXX=Connector and polish
UFC = Ultra FC
USC = Ultra SC
UST = Ultra ST
AFC = Angled FC (single mode only)
ASC = Angled SC (single mode only)

Package Includes

- FiberConnect
- Maintenance kit
- Magnetic stand
- Manual
- Cleaning brush
- Carrying case
- Index matching oil
- Spare pigtail
- 90 days warranty



BIT ERROR RATE TESTER (BERT)/ OSCILLOSCOPE

Selection Guide

Model Application	MP1900A Signal Quality Analyzer-R	MP1800A Series Signal Quality Analyzer	MP1825B 4Tap Emphasis	MP1861A 56G/64G bit/s MUX	MP1862A 56G/64G bit/s DEMUX	MP2110A BERTWave	MP2100B BERTWave
10 Gbit/s Optical Module Test		✓					✓
10 GE-PON Optical Module Test		✓					✓
40 Gbit/s Optical Module Test		✓					✓
100 GbE Optical Module Test	✓	✓				✓	
400 Gbit/s Optical Module Test	✓			✓	✓	✓	
Active Optical Cable (AOC) Test	✓	✓				✓	✓
16G, 32G FC/InfiniBand FDR (14G), EDR (26G)	✓	✓	✓			✓	
28G/32G bit/s Interconnect Test	✓	✓	✓			✓	
56G/64G bit/s Interconnect Test	✓			✓	✓		
PCI Express Receiver Test	✓						
USB 3.1 Receiver Test	✓	✓					
Thunderbolt 3 Receiver Test	✓	✓					

Signal Quality Analyzer-R

MP1900A

Remote Control
GPIB | LAN

Support 400 GbE and PCIe Gen4/5

Excellent Eco Product

SQA-R

Due to the explosive growth of data traffic resulting from the popularity of smartphones and mobile terminals, network interfaces are transitioning to faster 200 GbE/400 GbE standards, and PCI bus interface speeds now exceed 10G. In addition, the equipment and chipsets using these interfaces support multi-channels and multi-protocols. The MP1900A is a high-performance BERT with excellent expandability for supporting Physical layer evaluations of these high-speed interfaces. The all-in-one design is ideal for early stage R&D evaluations of all interfaces covering next-generation Ethernet networks to bus interconnects.

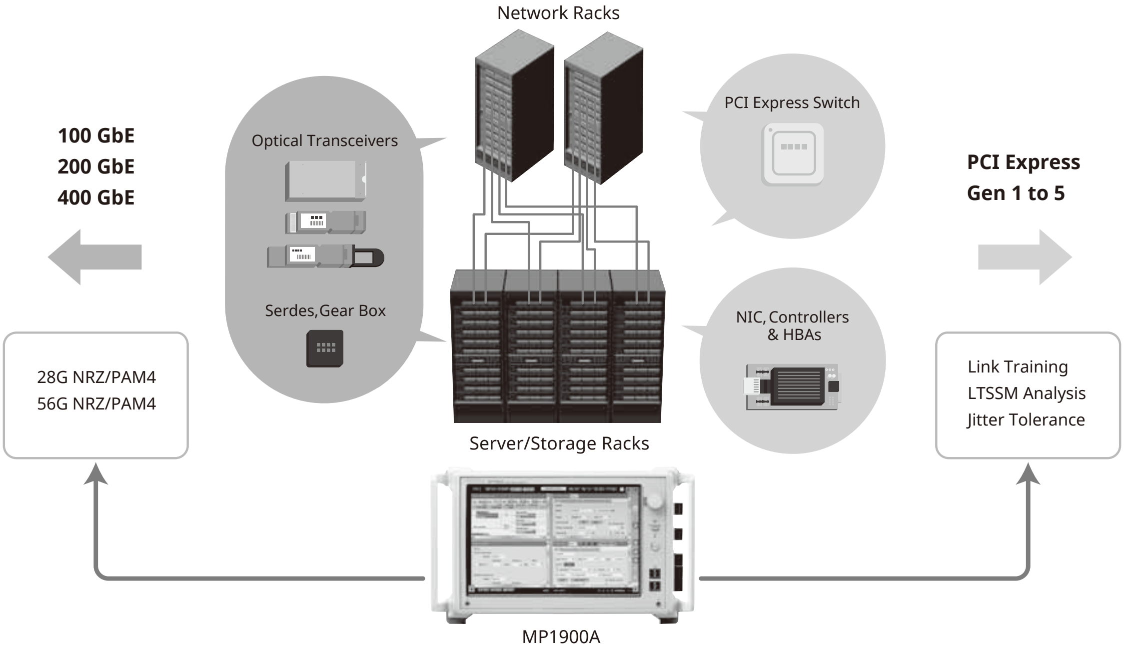
Wide Application Support

100 GbE/200 GbE/400 GbE, CEI-25G/28G/56G/112G, InfiniBand EDR/HDR, Fibre Channel
PCI Express Gen1 to 5, Thunderbolt 3, USB3.1 Gen1/2
Optical module, SERDES, AOC, High-speed Interconnect

Excellent Expandability

All-in-One Support for Evaluating Next-Generation NRZ/PAM4 Network Interfaces and High-Speed Serial Buses

The Signal Quality Analyzer–R MP1900A is a modular Bit Error Rate Tester (BERT) supporting equipment external interfaces, such as next-generation Ethernet, by installing a pulse pattern generator (PPG) for outputting high-quality multi-channel NRZ/PAM4 signals over a wide bandwidth of 2.4 Gbit/s to 32.1 Gbit/s, a high-sensitivity input error detector (ED), Jitter modulation sources for Jitter Tolerance tests, etc.
Additionally, optional noise generation and 10Tap Emphasis functions can be installed for Voltage Noise Tolerance tests, etc., and installing the High-Speed Serial Data Test Software MX183000A software enables efficient design evaluation for increasingly faster PCIe, USB, and Thunderbolt receivers.

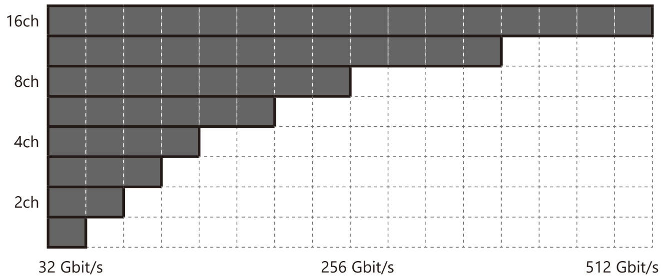


Easy Flexibility for Multi-Channel Measurements at Various Transmission Rates and Formats

400 GbE is the standard for the next generation of large-capacity transmissions but it is still unknown how much further data traffic will grow. To cope with this data traffic growth, in addition to speeding-up NRZ signals and introducing multi-channel signalling, introduction of PAM4-format signals is also progressing. To facilitate this change to multi-channels and the new PAM4 signals, the MP1900A series is an 8-slot modular instrument that can be easily customized by selecting and adding required function modules. This flexible expandability supporting the latest communications methods ensures both efficient R&D investment and the fastest time to market.

SI PPG/ED Module Expandability

- NRZ Solution (Max. 32 Gbit/s at 1ch)

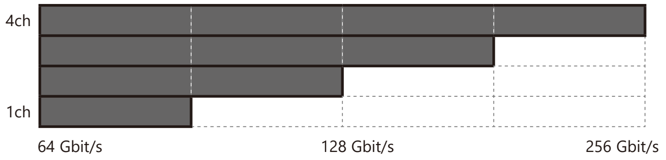


- PAM4 Solution (Max. 32Gbaud at 1ch)

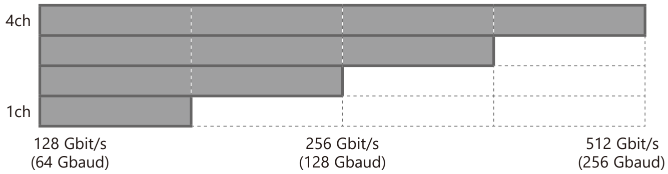
Low-cost expandability to 32G PAM4 BER measurement is supported by using the 32 Gbaud Power PAM4 Converter G0375A, and 32 Gbaud PAM4 Decoder with CTLE G0376A.

PAM4 PPG/ED Expandability*1

- NRZ Solution (Max. 64 Gbit/s at 1ch)



- PAM4 Solution (Max. 64 Gbaud at 1ch)



*: ED (<32.1G), 2ch to 4ch support in future

In addition to installing PPG, ED, and noise-generation modules in the 8-slot main unit, existing modules for the previous MP1800A series can also be installed. The 21G/32G bit/s SI PPG/ED modules support selection of both one and two channels, enabling up to 16-channel measurement for both the PPG and ED. The PAM4 PPG and ED modules can be installed simultaneously to support up to a 4ch PPG and 4ch ED in a one channel per module configuration. Moreover, the pattern for each channel can be synchronized, providing an ideal solution for evaluating DAC, MUX and DEMUX devices as well as for crosstalk and skew tolerance tests.

*: Refer to the MP1900A Selection Guide for details of the supported multi-channel configurations and module combinations.
Consult our business sales representative for use of other module configurations not described in the MP1900A Selection Guide.

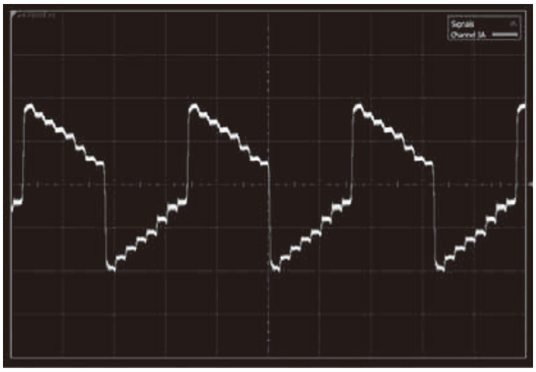
Signal Integrity Evaluation

Strengthened Signal Integrity Evaluations in Addition to New SI PPG, SI ED and Noise Generator Modules

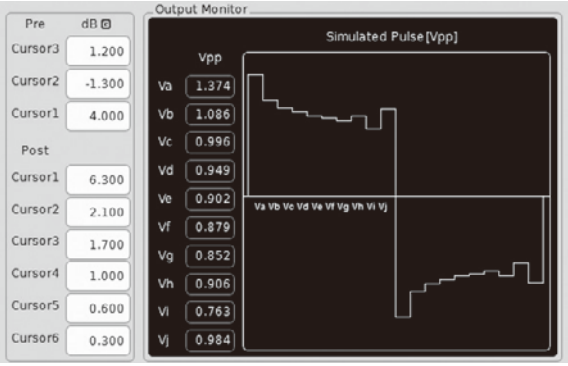
Emphasis and equalizer functions are built-in to correct transmission path losses and assure signal integrity as signals become faster and as high-speed devices use lower signal levels to help reduce power consumption.

10Tap Emphasis

The 10Tap Emphasis option installed in the transmission-side21G/32 Gbit/s SI PPG MU195020A can accurately replay simulated waveforms for various devices and channels (corrected for loss after passage through channel) to help improve design efficiency.



Waveform adjustment using 10Tap Emphasis Function



Pre	dB
Cursor3	1.200
Cursor2	-1.300
Cursor1	4.000
Post	
Cursor1	6.300
Cursor2	2.100
Cursor3	1.700
Cursor4	1.000
Cursor5	0.600
Cursor6	0.300

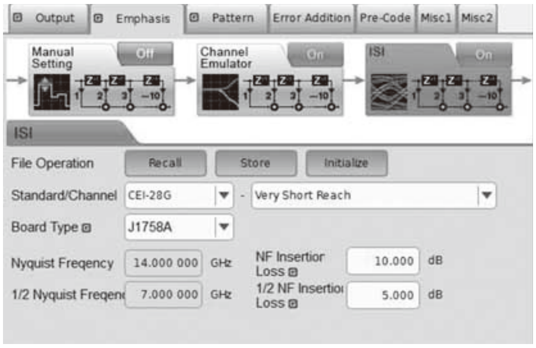
Output Monitor

	Vpp
Va	1.374
Vb	1.086
Vc	0.996
Vd	0.949
Ve	0.902
Vf	0.879
Vg	0.852
Vh	0.906
Vi	0.763
Vj	0.984

Emphasis Setting Screen Example

Additionally, the Variable ISI (option) can generate a signal with simulated Loss between the Tx and Rx channels of high-speed devices by setting the channel Loss for the frequencies defined in CEI-28 G/25G and the S-parameter information, and can also easily output a Loss-corrected waveforms. As a result, channel-Loss dependent high-speed device performance tests can be run easily with good reproducibility without needing to prototype multiple channel boards, helping cut development time.

* For Variable ISI (option), use either in combination with ISI Board J1758A (select J1758A) or in combination with external channel board (select Not Specified).



Standard/Channel CEI-28G - Very Short Reach

Board Type J1758A

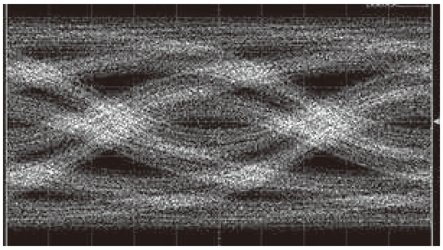
Nyquist Freqency 14.000 000 GHz

1/2 Nyquist Freqen 7.000 000 GHz

NF Insertior Loss 10.000 dB

1/2 NF Insertio Loss 5.000 dB

ISI Setting Screen Example



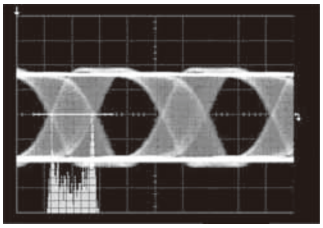
ISI, CEI-28G, 14 dB Loss waveform (typical)

Multi-band CTLE

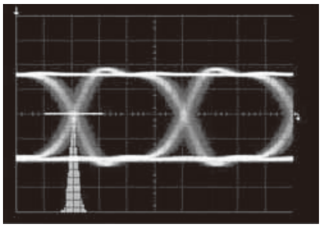
Installing the CTLE option supporting multi-band input signals of 28, 16, and 8 Gbit/s at the receive-side of the 21G/32G bit/s SI ED MU195040A permits BER measurements even when the Eye is closed by transmission path losses. Since this CTLE function is a hardware equalizer rather than the software emulator, it supports evaluation of TRx BER performance under near-to-live conditions, such as BER evaluation of test signals, and comparison of DUT BER measurement results.

Jitter/Noise Addition

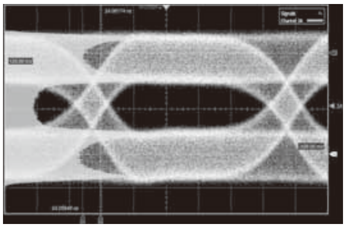
To perform DUT receiver stressed input tolerance tests, the BER is measured under the worst conditions using a stressed signal with added jitter and voltage noise. Using the MP1900A series with the Jitter Modulation Source MU181500B, Jitter Tolerance Test MX183000A-PL001 software, and Noise Generator MU195050A for adding CM/DM/White Noise supports receiver tolerance tests in conformance with the various interface standards. The MP1900A series offers strong support for receiver stressed input tolerance tests by generating high-quality signals before jitter and noise addition as well as for adding high-linearity jitter and noise.



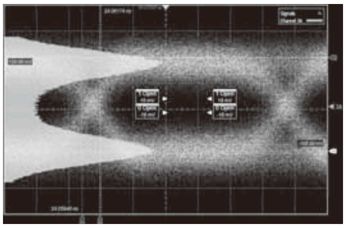
Sinusoidal Jitter (SJ)



Random Jitter (RJ)



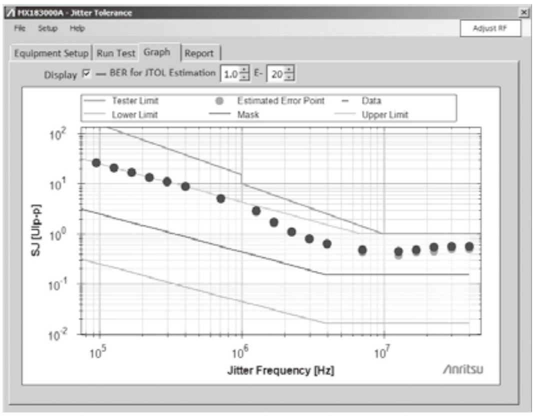
CM/DM Noise



White Noise

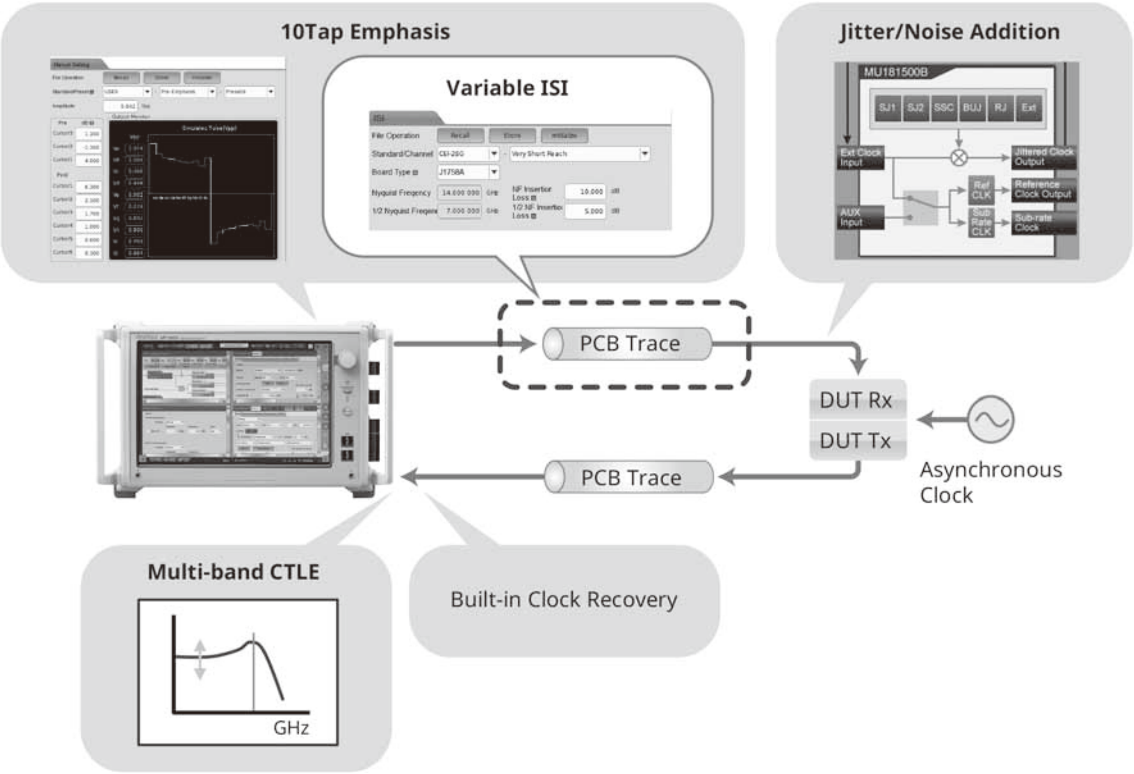
Jitter Tolerance Test Function (MX183000A-PL001)

- High-versatility Jitter Tolerance measurements
- PHY Device Jitter Tolerance tests by impressing SJ/RJ/BUJ
- Standards-compliant Mask measurements
- Fast measurement times using low error rate estimation function, such as 1E–12 and 1E–15
- Tolerance measurements versus device characteristics using four Binary, Upward, Downward, Binary + Linear methods



Display ☑ — BER for JTOL Estimation 1.0 E- 20

Low Error Rate Estimation BER Measurements

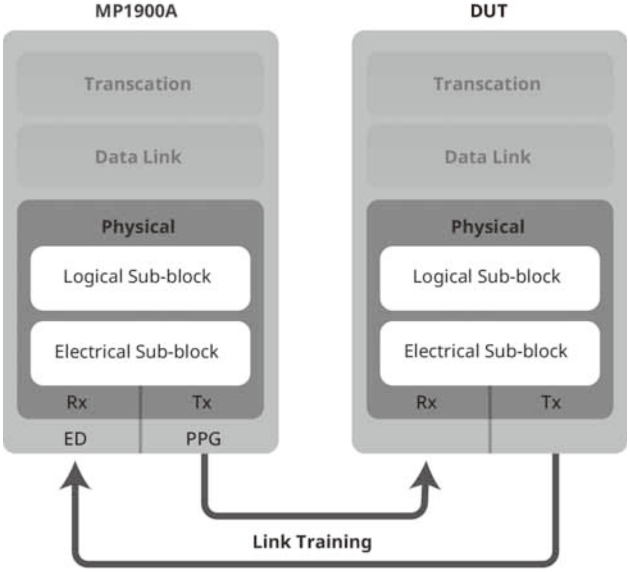


Link Training

The PCI Express and 10 Gbit/s USB3.1 standards require PHY layer tests such as Jitter Tolerance tests on an established Link to assure interconnectivity between the host and device. Additionally, it is necessary to determine whether the cause is a physical or logical fault at a Link fault.
The MP1900A PCI Express/USB functions have Protocol Awareness with a Link Training function required for evaluating the PHY layer as well as an analysis function for detecting each LTSSM state transition to help troubleshoot faults.
These all-in-one functions facilitate efficient PHY layer evaluation of PCIe Gen1 to Gen5* and USB3.1 receivers through inspection and fault troubleshooting.
Moreover, combination with the Jitter Tolerance Measurement function (MX183000 A-PL001) supports consistent receiver tests of high-speed serial interfaces.

LTSSM: Link Training Status State Machine

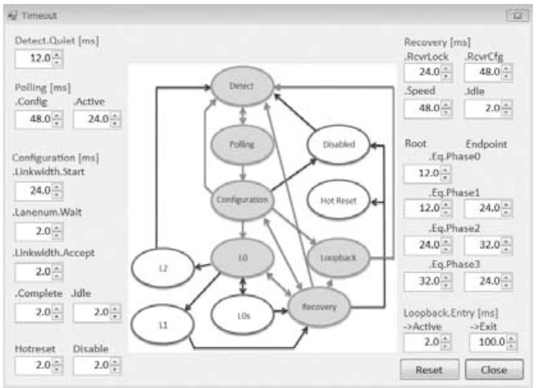
*: Anritsu is an active member of PCI-SIG and is fully engaged in helping establish new PCI Express specifications. Anritsu provides PCI Express Gen5 pattern generation tools to PCI-SIG members to support future PCIe Gen5 implementation. Contact our sales representative for more details.



Supports physical layer measurements of add-in cards and system boards

- Tx/Rx Link Equalization Response Test
- Rx Link Equalization Test
- Receiver Jitter Tolerance Test

PCI Express Link Training (MX183000A-PL021)



Detect.Quiet [ms] 12.0

Polling [ms]
.Config 48.0
.Active 24.0

Configuration [ms]
.Linkwidth.Start 24.0
.Lanenum.Wait 2.0
.Linkwidth.Accept 2.0
.Complete 2.0
.Idle 2.0

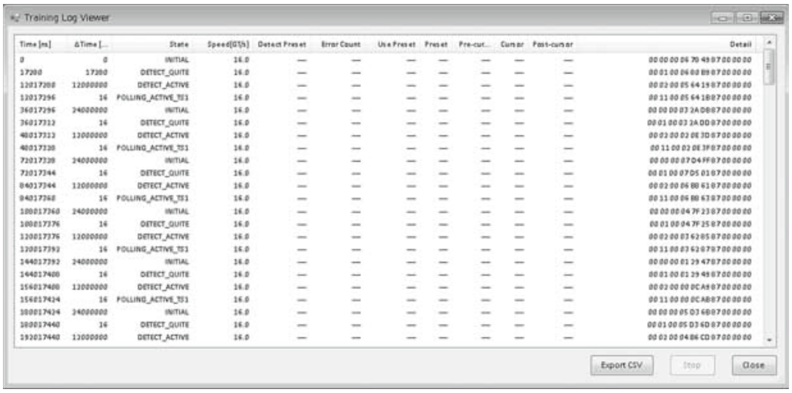
Hotreset 2.0
Disable 2.0

Recovery [ms]
.RcvrLock 24.0
.RcvrCfg 48.0
.Speed 48.0
.Idle 2.0

Root / Endpoint
.Eq.Phase0 12.0
.Eq.Phase1 12.0 / 24.0
.Eq.Phase2 24.0 / 32.0
.Eq.Phase3 32.0 / 24.0

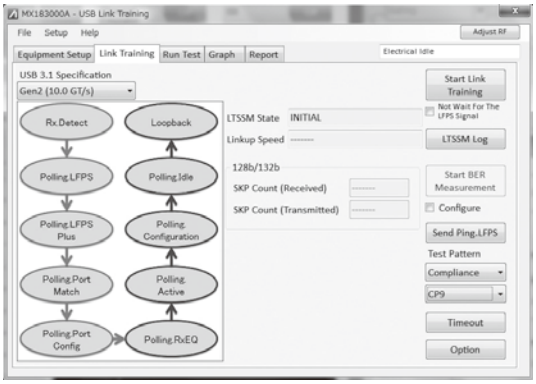
Loopback.Entry [ms]
->Active 2.0
->Exit 100.0

PCIe Link Training State Transition



LTSSM Log of each LTSSM State Transition

USB Link Training (MX183000A-PL022)



Electrical Idle

USB 3.1 Specification: Gen2 (10.0 GT/s)

☐ Not Wait For The LFPS Signal

LTSSM State: INITIAL

Linkup Speed: --------

128b/132b

SKP Count (Received): --------

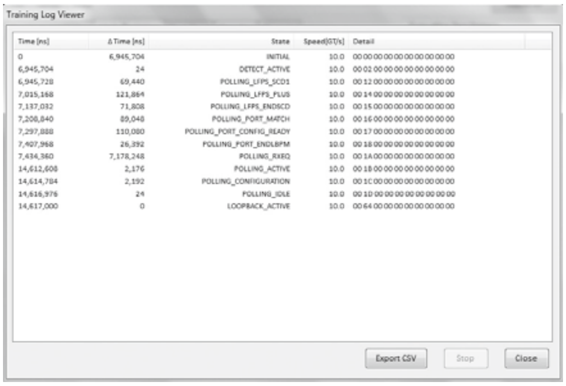
SKP Count (Transmitted): --------

☐ Configure

Test Pattern: Compliance

CP9

USB Link Training State Transition



Time [ns]	Δ Time [ns]	State	Speed[GT/s]	Detail
0	6,945,704	INITIAL	10.0	00 00 00 00 00 00 00 00 00 00 00
6,945,704	24	DETECT_ACTIVE	10.0	00 02 00 00 00 00 00 00 00 00 00
6,945,728	69,440	POLLING_LFPS_SCD1	10.0	00 12 00 00 00 00 00 00 00 00 00
7,015,168	121,864	POLLING_LFPS_PLUS	10.0	00 14 00 00 00 00 00 00 00 00 00
7,137,032	71,808	POLLING_LFPS_ENDSCD	10.0	00 15 00 00 00 00 00 00 00 00 00
7,208,840	89,048	POLLING_PORT_MATCH	10.0	00 16 00 00 00 00 00 00 00 00 00
7,297,888	110,080	POLLING_PORT_CONFIG_READY	10.0	00 17 00 00 00 00 00 00 00 00 00
7,407,968	26,392	POLLING_PORT_ENDLBPM	10.0	00 18 00 00 00 00 00 00 00 00 00
7,434,360	7,178,248	POLLING_RXEQ	10.0	00 1A 00 00 00 00 00 00 00 00 00
14,612,608	2,176	POLLING_ACTIVE	10.0	00 1B 00 00 00 00 00 00 00 00 00
14,614,784	2,192	POLLING_CONFIGURATION	10.0	00 1C 00 00 00 00 00 00 00 00 00
14,616,976	24	POLLING_IDLE	10.0	00 1D 00 00 00 00 00 00 00 00 00
14,617,000	0	LOOPBACK_ACTIVE	10.0	00 64 00 00 00 00 00 00 00 00 00

LTSSM Log of each LTSSM State Transition

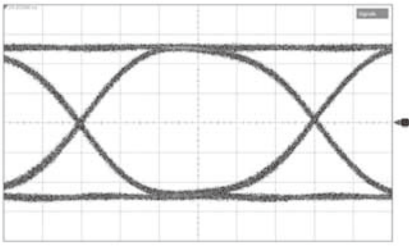
High Waveform Quality and High Sensitivity

Low-Noise, High-Quality BERT with Low Intrinsic Jitter Output, High Sensitivity and Wideband Input

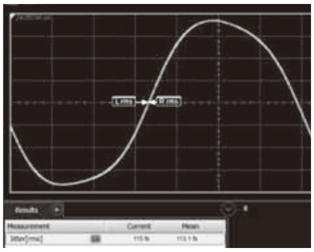
Assuring DUT design margins has become an important issue as transmission rates have become faster and PAM4 Signal formats have been introduced. Designers require more accurate evaluations to confirm that adequate margins are maintained. As a result, the impact of uncertainty elements, such as noise and Intrinsic Jitter characteristics of measuring instruments, on results can no longer being ignored. These newly developed best-of-class PPG with lowest-level Intrinsic Jitter and high-sensitivity ED can measure DUT guaranteed margins more accurately to help improve R&D efficiency.

Low Intrinsic Jitter Data Output PPG

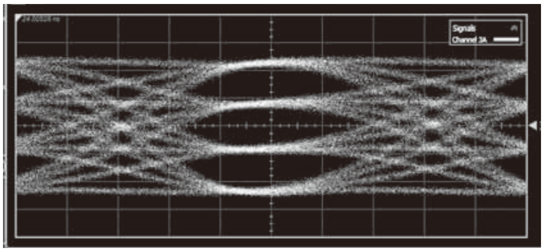
The MU195020A PPG has an Intrinsic Jitter of just 115 fs rms. As a result, it can generate PAM4 waveforms for wide Eye openings.



28.1 Gbit/s PRBS $2^{31} - 1$
Typical Output Waveform



Low intrinsic RJ 115 fs rms

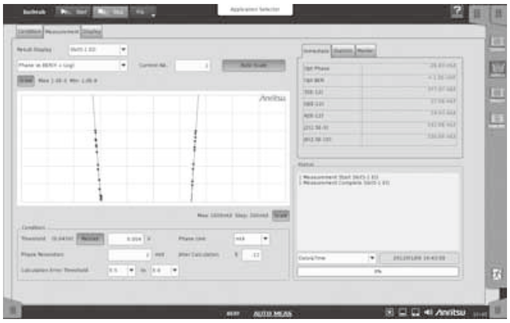


28 Gbaud QPRBS13 Typical Output Waveform
(Output after G0375A remote head)

High-Sensitivity, Wideband Input ED

The assured ED input analog bandwidth is 40 GHz. This bandwidth supports evaluation of Eye margin characteristics with high reproducibility even at input of small signals.

Example of Eye Contour Measurement at Input of Small 50 mVp-p Signal



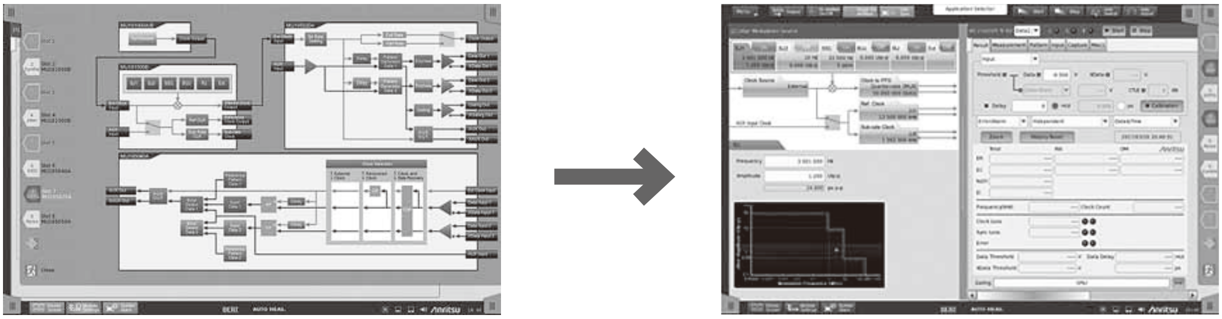
Bathtub Measurement Example

Easy to Use Operability

Improved Operability with New System View, User Interface, and Multi-windows

The MP1900A features easy intuitive operability based on a redesigned GUI and large 12.1-inch touch-panel LCD. Fast mistake-free settings help shorten measurement times.

The newly developed system view displays system functions as easy-to-understand blocks, supporting smooth settings and easy operation of each module.

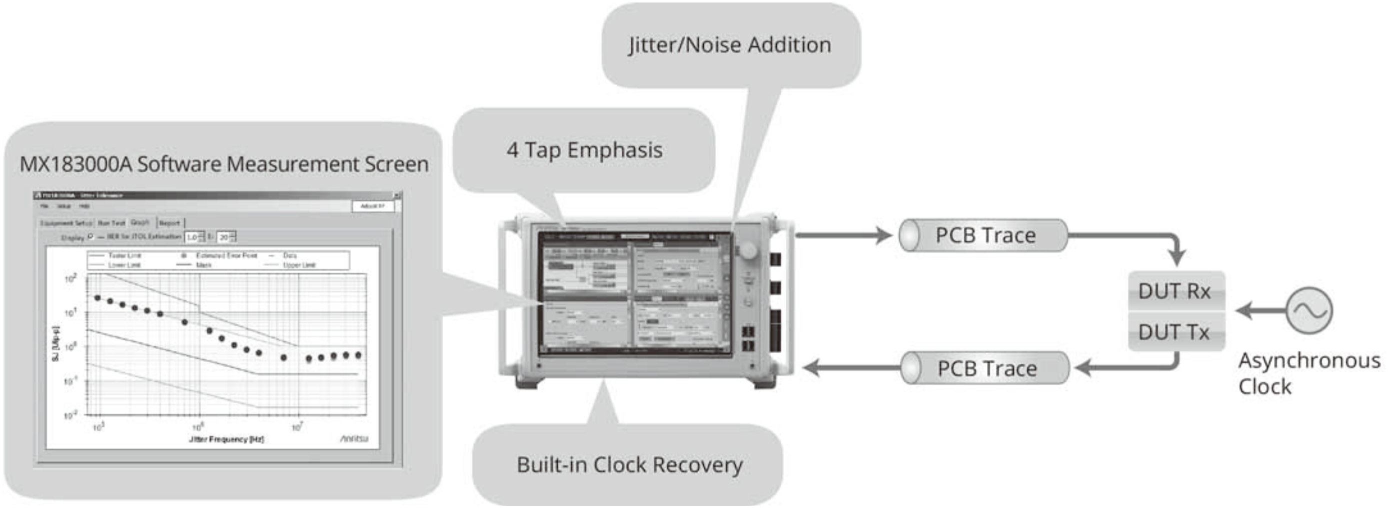


Four split screens help improve the efficiency of multi-channel measurements.

The Help function displays the remote commands corresponding to GUI operations, which simplifies automated system configurations.

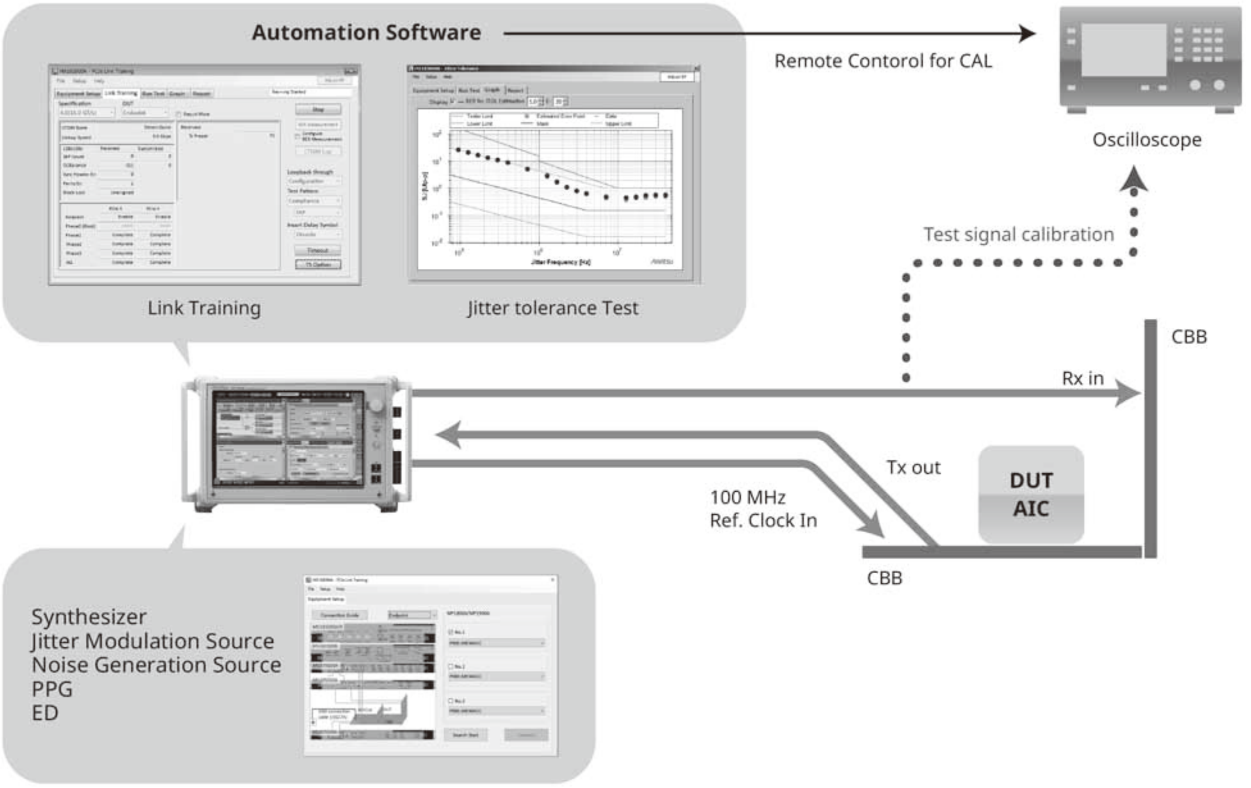
Application Examples

PAM4 Signal Jitter Tolerance Test using One MP1900A



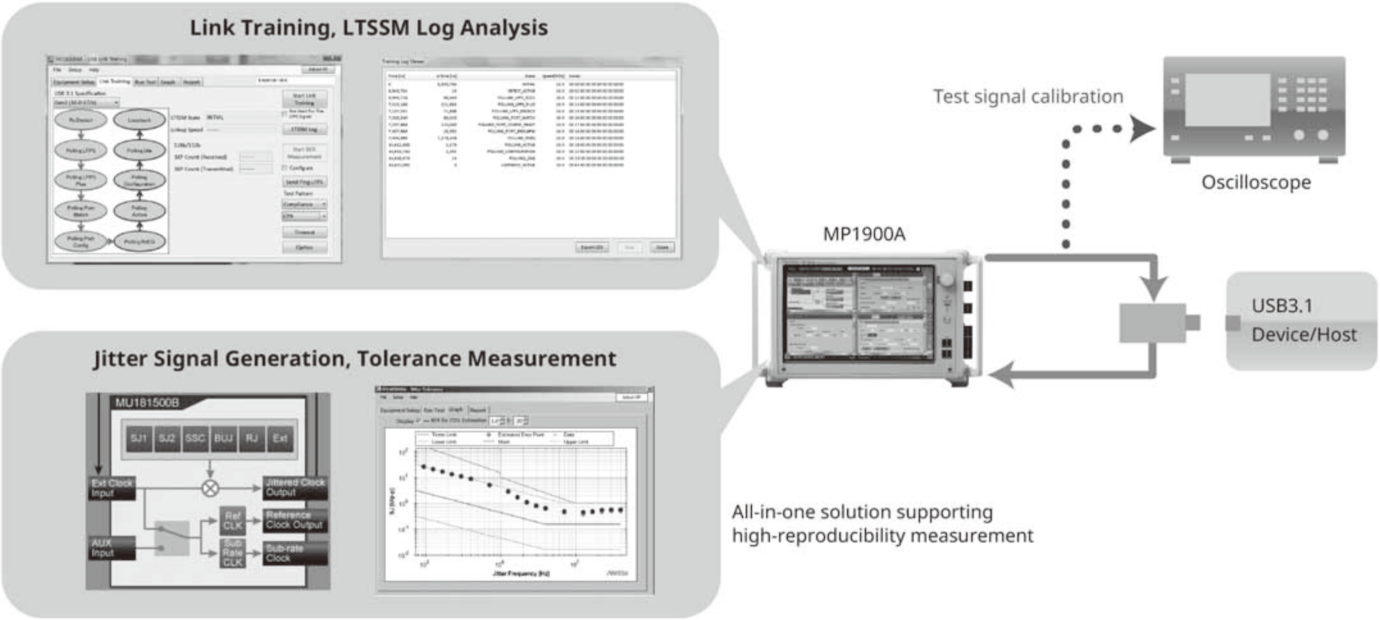
Required Items
- PAM4 BER measurement
- Jitter Tolerance Test

PCIe Gen4 Receiver Test Solution



Required Items
- Link Training function
- Jitter Tolerance Test
- Emphasis Effect Validation
- Supports Common/Separate Clock Architecture

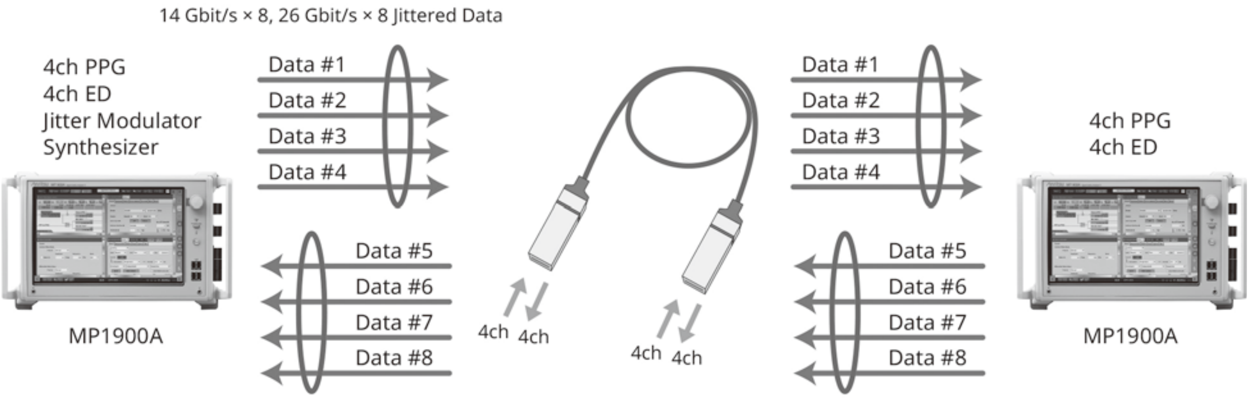
USB Receiver Test Solution



Required Functions

- Loopback State Setting Function
- Jitter Tolerance Function
- Automatic Receiver Test Function
- Link Training Function

InfiniBand EDR (25.78G) AOC Evaluation



Required Test Items

- 8ch (4ch two ways) simultaneous BER measurement
- Crosstalk Test
- Jitter Tolerance Test
- Bathtub Jitter and Eye Diagram Analysis

Specifications

Signal Quality Analyzer-R MP1900A

LCD		12.1” WXGA 1280 × 800
Remote Interface		GPIB, LAN
Module Slots		8
External Equipment Interface		USB × 6, VGA × 1, HDMI × 1
OS		Window Embedded Standard 7
Power Supply		100 V(ac) to 120 V(ac), 200 V(ac) to 240 V(ac), 50 Hz to 60 Hz Power consumption: 1350 VA max.
Dimensions and Mass		340 (W) × 222.5 (H) × 451 (D) mm, 20 kg (excluding modules)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

21G/32G bit/s SI PPG MU195020A

Operation Bit Rate	2.4 Gbit/s to 21 Gbit/s or 32.1 Gbit/s
Number of Channels	1 or 2
Output Amplitude	0.1 Vp-p to 1.3 Vp-p (Single-end) 0.2 Vp-p to 2.6 Vp-p (Differential)
Emphasis	10Tap
Channel Emulator	Normal: Emulates Insertion Loss using S-parameter data Inverse: Performs De-Emphasis compensation for S-parameter Insertion Loss S-Parameter file: S2P,S4P
ISI	Emulates ISI output using CEI-28G/25G Nyquist frequency loss setting Supports loss control in combination with ISI Board J1758A accessory Insertion Loss setting: 1.5 to 25 dB, 0.01 dB step, Nyquist frequency 0 to 25 dB, 0.01 dB step, 1/2 Nyquist frequency
Tr/Tf (20 to 80%)	12 ps (typ.)
Random Jitter	115 fs rms (typ.)
PCIe, USB Link Training	Supported (MX183000A-PL021, MX183000A-PL022)
I/O Connectors	K (f)

21G/32G bit/s SI ED MU195040A

Operation Bit Rate	2.4 Gbit/s to 21 Gbit/s or 32.1 Gbit/s
Number of Channels	1 or 2
Input Attitude	0.05 Vp-p to 1.0 Vp-p (Single-End) 0.1 Vp-p to 2.0 Vp-p (Differential)
Input Sensitivity	15 mV (Eye Height 28.1 Gbit/s, NRZ) 30 mV/Eye (Eye Height 28.1 Gbaud, PRBS15, PAM4)
CTLE	Peak Frequency: 14, 8, 4 GHz Gain: 0 to –12 dB
Clock Recovery	Yes, supports SSC
PCIe, USB Link Training	Supported (MX183000A-PL021, MX183000A-PL022)
I/O Connectors	K (f)

PAM4 PPG MU196020A

Operation Rate (PAM4/NRZ)	PAM4: 2.4 to 32.1 Gbaud, 58.2 Gbaud, or 64.2 Gbaud NRZ: 2.4 to 32.1 Gbit/s, or 58.2 Gbit/s, or 64.2 Gbit/s Upper limit as option selections
No. of Channels	1
Output Amplitude	70 mVp- to 800 mVp-p (Single-end) 140 mVp- to 1600 mVp-p (Differential)
Offset	–2 V to +3.3 V
PAM4 3Eye Independently Variable	20 to 50% (PAM4 Amplitude 0/3 level = 100%)
Emphasis	4 Tap, –20 to +20 dB
PAM4 Pattern	SSPRQ, PRBS13Q, PRBS31Q, etc.
PAM4 Pattern Error Addition	Error on MSB, Error on LSB, Error on LSB&MSB
Tr/Tf (20 to 80%)	8.5 ps (typ., NRZ)
Random Jitter	170 fs rms (typ., NRZ)
I/O Connector	V (f)

PAM4 ED MU196040A

Operation Rate (PAM4/NRZ)	PAM4: 2.4 to 32.1 Gbaud NRZ: 2.4 Gbit/s to 32.1 Gbit/s
No. of Channels	1
Input Amplitude	PAM4: 300 mVp-p to 1000 mVp-p NRZ: 50 mVp-p to 1000 mVp-p
Input Sensitivity	PAM4: 23 mV (typ., PRBS31, Eye height for each Eye, 26.5625 Gbaud) NRZ: 23 mV (typ., PRBS31)
Stressed Margin	BER < 1E–12*
Clock Recovery	Yes (25.5G to 32.1G)
PAM4 Pattern	SSPRQ, PRBS13Q, PRBS31Q, etc.
PAM4 Counter	MSB/LSB, Symbol 0 to 3
I/O Connector	K (f)

*: At PAM4 Stressed waveform input refer to CEI-56G-VSR

Noise Generator MU195050A

Number of Channels	2
Insertion Loss	–3 dB
CMI: Common Mode Noise	0.1 GHz to 6 GHz: Sinusoidal wave
DMI: Differential Mode Noise	2 GHz to 10 GHz: Sinusoidal wave
White Noise	10 MHz to 10 GHz
Crest Factor	>5

12.5 GHz 4 Port Synthesizer MU181000B

Clock Output	Number of Output: 4 Frequency Range: 0.1 GHz to 12.5 GHz, Steps: 1 kHz/1 MHz Level: 0.4 Vp-p to 1 Vp-p (AC) Connector: SMA (f), Termination: 50Ω/GND
10 MHz Input	Frequency: 10 MHz ±10 ppm Level: 0.5 Vp-p to 2.0 Vp-p Connector: BNC, Termination: 50Ω/GND
10 MHz Output	Level: 1.0 Vp-p ±30% (AC) Connector: BNC, Termination: 50Ω/GND

SSC Extension MU181000B-002

100 MHz Reference Signal Input (SSC)	Outputs either 100 MHz with phase deviation x25, x50, or x80 frequency-multiplied clock from Clock Output connector Supports PCI Express Host Reflclk input Modulation Frequency: 30 kHz to 33 kHz Level: 0.15 Vp-p to 1.3 Vp-p (AC) Connector: BNC

Jitter Modulation Source MU181500B

External Clock Input	Frequency Range: 0.800 000 GHz to 15.000 000 GHz Amplitude: 0.4 Vp-p to 1.0 Vp-p Connector: SMA (f), Termination: 50Ω/AC Coupling
Jittered Clock Output	Number of Output: 2 Amplitude: 0.4 Vp-p to 1.0 Vp-p Connector: SMA (f), Termination: 50Ω/AC Coupling
SJ1	Modulation Frequency: 10 Hz to 250 MHz Amplitude: 0 to 2000 UI @Modulation Frequency 10 kHz to 100 kHz 0 to 1 UI @Modulation Frequency 10 MHz to 250 MHz (Different depending on the operating bit rate)
Built-in SJ2	Modulation Frequency: 33 kHz, 87 MHz, 100 MHz, 210 MHz
Spread Spectrum Clocking (SSC)	Modulation Frequency: 28 kHz to 37 kHz Deviation: 0 to 7000 ppm
Random Jitter (RJ)	Bandwidth: 10 kHz to 1 GHz Amplitude: 0 to 0.5 UI (Different depending on the operating frequency)
Bounded Uncorrelated Jitter (BUJ)	PRBS Pattern Length: $2^n - 1$ (n = 7, 9, 11, 15, 23, or 31) BUJ Rate: 0.1 Gbit/s to 3.2 Gbit/s, 4.9 Gbit/s to 6.25 Gbit/s, 9.8 Gbit/s to 12.5 Gbit/s Filter Type (LPF 3 dB Bandwidth): 50, 100, 200, 300, 500 MHz, Through Amplitude: 0 to 0.5 UI (Different depending on the operating frequency)
External Jitter	Bandwidth: 10 kHz to 1 GHz

* Refer to the MP1900A Data Sheet for detailed specifications.

* Refer to the MP1800A Brochure about the other modules.

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

MP1900A

Model/Order No.	Name	
	Main Frame	
MP1900A	Signal Quality Analyzer-R	
	Standard Accessories	
G0342A	ESD DISCHARGER:	1
J1211	POWER CORD. 3M:	1
J1627A	GND connection cable:	1
P0031A	USB Memory:	1
Z0306A	Wrist Strap:	1
	Maintenance Service	
MP1900A-ES310	Three Years Extended Warranty Service	
MP1900A-ES510	Five Years Extended Warranty Service	

MU195020A

Model/Order No.	Name	
	Module	
MU195020A	21G/32G bit/s SI PPG	
	Standard Accessories	
J1632A	Terminator:	5
J1341A	Open:	2
J1359A	Coaxial Adapter (K-P, K-J, SMA):	1
J1717A	COAXIAL ADAPTOR (SMA-P, SMA-J):	6
	Option	
MU195020A-001	32G bit/s Extension	
MU195020A-010	1ch Data Output	
MU195020A-020	2ch Data Output	
MU195020A-011	1ch 10Tap Emphasis	
MU195020A-021	2ch 10Tap Emphasis	
MU195020A-030	1ch Data Delay	
MU195020A-031	2ch Data Delay	
MU195020A-040	1ch Variable ISI	
MU195020A-041	2ch Variable ISI	
	Retrofit Options	
MU195020A-101	32G bit/s Extension Retrofit	
MU195020A-120	2ch Data Output Retrofit	
MU195020A-111	1ch 10Tap Emphasis Retrofit	
MU195020A-121	2ch 10Tap Emphasis Retrofit	
MU195020A-130	1ch Data Delay Retrofit	
MU195020A-131	2ch Data Delay Retrofit	
MU195020A-140	1ch Variable ISI Retrofit	
MU195020A-141	2ch Variable ISI Retrofit	
	When Option 010/110 Installed	
J1632A	Terminator:	2
J1359A	Coaxial Adapter (K-P, K-J, SMA):	2
	When Option 020/120 Installed	
J1632A	Terminator:	4
J1359A	Coaxial Adapter (K-P, K-J, SMA):	4
	Maintenance Service	
MU195020A-ES310	Three Years Extended Warranty Service	
MU195020A-ES510	Five Years Extended Warranty Service	

MU195040A

Model/Order No.	Name	
	Module	
MU195040A	21G/32G bit/s SI ED	
	Standard Accessories	
J1632A	Terminator:	2
J1341A	Open:	1
J1717A	COAXIAL ADAPTOR (SMA-P, SMA-J):	4
	Option	
MU195040A-001	32G bit/s Extension	
MU195040A-010	1ch ED	
MU195040A-020	2ch ED	
MU195040A-011	1ch CTLE	
MU195040A-021	2ch CTLE	
MU195040A-022	Clock Recovery	
	Retrofit Options	
MU195040A-101	32G bit/s Extension Retrofit	
MU195040A-120	2ch ED Retrofit	
MU195040A-111	1ch CTLE Retrofit	
MU195040A-121	2ch CTLE Retrofit	
MU195040A-122	Clock Recovery Retrofit	
	When Option 010/110 Installed	
J1341A	Open:	3
J1359A	Coaxial Adapter (K-P, K-J, SMA):	2
41KC-6	Fixed Attenuator 6 dB:	2
	When Option 020/120 Installed	
J1341A	Open:	5
J1359A	Coaxial Adapter (K-P, K-J, SMA):	4
41KC-6	Fixed Attenuator 6 dB:	4
	Maintenance Service	
MU195040A-ES310	Three Years Extended Warranty Service	
MU195040A-ES510	Five Years Extended Warranty Service	

MU196020A

Model/Order No.	Name	
	Module	
MU196020A	PAM4 PPG	
	Standard Accessories	
J1632A	TERMINATOR:	4
V210	TERMINATOR (V):	2
J1341A	OPEN:	2
J1359A	COAXIAL ADAPTOR (K-P.K-J,SMA):	1
J1717A	COAXIAL ADAPTOR (SMA-P.SMA-J):	5
	Option	
MU196020A-001	32G baud	
MU196020A-002	58G baud	
MU196020A-003	64G baud	
MU196020A-011	4Tap Emphasis	
MU196020A-030	Data Delay	
	Retrofit Options	
MU196020A-112	32G to 58G baud Extension Retrofit	
MU196020A-113	32G to 64G baud Retrofit	
MU196020A-123	58G to 64G baud Retrofit	
MU196020A-111	4Tap Emphasis Retrofit	
MU196020A-130	Data Delay Retrofit	
	Maintenance Service	
MU196020A-ES310	Three Years Extended Warranty Service	
MU196020A-ES510	Five Years Extended Warranty Service	

MU196040A

Model/Order No.	Name	
	Module	
MU196040A	PAM4 ED	
	Standard Accessories	
J1632A	TERMINATOR:	2
J1341A	OPEN:	2
J1359A	COAXIAL ADAPTOR (K-P.K-J,SMA):	1
J1717A	COAXIAL ADAPTOR (SMA-P.SMA-J):	3
	Option	
MU196040A-001	32.1G baud Decoder	
MU196040A-022	25.5G to 32.1G baud Clock Recovery	
MU196040A-041	SER Measurement	
	Retrofit Options	
MU196040A-122	25.5G to 32.1G baud Clock Recovery Retrofit	
MU196040A-141	SER Measurement Retrofit	
	Standard Accessories for MU196040A-x001	
J1341A	Open:	2
J1359A	COAXIAL ADAPTOR (K-P.K-J,SMA):	2
	Maintenance Service	
MU196040A-ES310	Three Years Extended Warranty Service	
MU196040A-ES510	Five Years Extended Warranty Service	

MU195050A

Model/Order No.	Name	
	Module	
MU195050A	Noise Generator	
	Standard Accessories	
J1632A	Terminator:	4
J1359A	Coaxial Adapter (K-P, K-J, SMA):	4
J1717A	COAXIAL ADAPTOR (SMA-P, SMA-J):	2
J1341A	Open:	6
J1746A	Skew Match Pair Semrigid Cable (K connector, Data Input1):	1 set
J1747A	Skew Match Pair Semrigid Cable (K connector, Data Input2):	1 set
	Option	
MU195050A-001	White Noise	
	Retrofit Option	
MU195050A-101	White Noise Retrofit	
	Maintenance Service	
MU195050A-ES310	Three Years Extended Warranty Service	
MU195050A-ES510	Five Years Extended Warranty Service	

MU181000B*1

Model/Order No.	Name	
	Module	
MU181000B	12.5 GHz 4port Synthesizer	
	Standard Accessories	
J1624A	Coaxial Cable 0.3 m (SMA, DC to 18 GHz):	4 pcs
	Option	
MU181000B-001	Jitter Modulation	
MU181000B-002	SSC Extension	
	Retrofit Option	
MU181000B-101	Jitter Modulation Retrofit	
MU181000B-102	SSC Extension Retrofit	
	Maintenance Service	
MU181000B-ES310	Three Years Extended Warranty Service	
MU181000B-ES510	Five Years Extended Warranty Service	

MU181500B*1

Model/Order No.	Name	
	Module	
MU181500B	Jitter Modulation Source	
	Standard Accessories	
J1624A	Coaxial Cable 0.3 m (SMA, DC to 18 GHz):	1 pc
J1508A	BNC-SMA Connector Cable (30 cm):	2 pcs
J1137	Terminator:	6 pcs
J1341A	Open:	2 pcs
Z0897A	MP1800A Manual CD:	1 pc
Z0918A	MX180000A Software CD:	1 pc
	Maintenance Service	
MU181500B-ES310	Three Years Extended Warranty Service	
MU181500B-ES510	Five Years Extended Warranty Service	

*1:Other MP1800A-series modules will be supported one-by-one in future. Refer to the selection guide for details.

MU183020A

Model/Order No.	Name	
	Module	
MU183020A	28G/32G bit/s PPG	
	Standard Accessories	
J1137	Terminator:	3 pcs
J1359A	Coaxial Adaptor (K-P, K-J, SMA):	1 pc
J1341A	Open:	1 pc
J0541E	6 dB Fixed Attenuator:	1 pc
Z0897A	MP1800A Manual CD:	1 pc
Z0918A	MX180000A Software CD:	1 pc
	Options	
MU183020A-001	32G bit/s Extension	
MU183020A-012	1ch 2 V Data Output	
MU183020A-013	1ch 3.5 V Data Output	
MU183020A-022	2ch 2 V Data Output	
MU183020A-023	2ch 3.5 V Data Output	
MU183020A-030	1ch Data Delay	
MU183020A-031	2ch Data Delay	
	Retrofit Options	
MU183020A-101	32G bit/s Extension Retrofit	
MU183020A-112	1ch 2 V Data Output Retrofit	
MU183020A-113	1ch 3.5 V Data Output Retrofit	
MU183020A-122	2ch 2 V Data Output Retrofit	
MU183020A-123	2ch 3.5 V Data Output Retrofit	
MU183020A-130	1ch Data Delay Retrofit	
MU183020A-131	2ch Data Delay Retrofit	
	Standard Accessories for MU183020A-x12, x13	
J1137	Terminator:	2 pcs
J1359A	Coaxial Adaptor (K-P, K-J, SMA):	2 pcs
	Standard Accessories for MU183020A-x22, x23	
J1137	Terminator:	4 pcs
J1359A	Coaxial Adaptor (K-P, K-J, SMA):	4 pcs
	Maintenance Service	
MU183020A-ES310	Three Years Extended Warranty Service	
MU183020A-ES510	Five Years Extended Warranty Service	

MU183040B

Model/Order No.	Name	
	Module	
MU183040B	28G/32G bit/s High Sensitivity ED	
	Standard Accessories	
J1137	Terminator:	2 pcs
J1341A	Open:	1 pc
Z0897A	MP1800A Manual CD:	1 pc
Z0918A	MX180000A Software CD:	1 pc
	Options	
MU183040B-001	32 Gbit/s Extension	
MU183040B-010	1ch ED	
MU183040B-020	2ch ED	
MU183040B-022	2.4G to 28.1G bit/s Clock Recovery	
MU183040B-023	25.5G to 32.1G bit/s Clock Recovery	
	Retrofit Options	
MU183040B-101	32 Gbit/s Extension Retrofit	
MU183040B-110	1ch ED Retrofit	
MU183040B-120	2ch ED Retrofit	
MU183040B-122	2.4G to 28.1G bit/s Clock Recover Retrofit	
MU183040B-123	25.5G to 32.1G bit/s Clock Recovery Retrofit	
	Standard Accessories for MU183040B-x10	
J1341A	Open:	2 pcs
J1359A	Coaxial Adaptor (K-P, K-J, SMA):	2 pcs
41KC-6	Precision Fixed Attenuator 6 dB:	2 pcs
	Standard Accessories for MU183040B-x20	
J1341A	Open:	4 pcs
J1359A	Coaxial Adaptor (K-P, K-J, SMA):	4 pcs
41KC-6	Precision Fixed Attenuator 6 dB:	4 pcs
	Maintenance Service	
MU183040B-ES310	Three Years Extended Warranty Service	
MU183040B-ES510	Five Years Extended Warranty Service	

G0374A*2

Model/Order No.	Name
	Main Frame
G0374A	64Gbaud PAM4 DAC
	Standard Accessories
J1611A	Coaxial Cable (1.3 m, K connector): 1 pc
J1741A	Electrical Length Specified Coaxial Cable (0.8 m, K Connector): 4 pc
V210	Coaxial Terminator: 1 pc
J0017F	POWER CORD, 2.6M: 1 pc
G0342A	ESD DISCHARGER: 1 pc

G0375A*2

Model/Order No.	Name
	Main Frame
G0375A	32 Gbaud Power PAM4 Converter
	Standard Accessories
J1741A	Electrical Length Specified Coaxial Cable (0.8 m, K Connector): 4 pc
J1475A	USB Cable: 1 pc

G0376A*2

Model/Order No.	Name
	Main Frame
G0376A	32 Gbaud PAM4 Decoder with CTLE
	Standard Accessories
J1728A	Electrical Length Specified Coaxial Cable (0.4 m, K connector): 2 pc
J1475A	USB Cable: 1 pc

*2: The warranty period shall be 1 year under normal use.
Repair by exchange for new during the warranty period shall be limited to one instance.
Repair using new spare parts shall be charged after the warranty period has expired.
Moreover, Anritsu Corporation will deem this warranty void when:

- When new spare parts can no longer be easily obtained when more than 5 years have elapsed after manufacture.

Software

Model/Order No.	Name
MX183000A	High-Speed Serial Data Test Software
MX183000A-PL001	Jitter Tolerance Test
MX183000A-PL011	PCIe Link Sequence
MX183000A-PL021	PCIe Link Training
MX183000A-PL022	USB Link Training

On Using VISA*3

The National Instruments™ (NI hereafter) NI-VISA*4 software must be installed to use the MX183000A (this product hereafter). We recommend using NI-VISA saved on the product USB memory stick. Customers may only use NI-VISA saved on the product memory stick. NI-VISA on the memory stick may not be used for other applications with other products.
When uninstalling this product from the controller PC, etc., also uninstall NI-VISA from the USB memory.

*3: Abbreviation for Virtual Instrument Software Architecture. This is I/O software for remote control of measuring instruments via GPIB, Ethernet and USB interfaces.

*4: NI-VISA was developed by National Instruments for VXI Plug&Play Alliance standards compliant I/O interfaces.
National Instruments™, NI™, and NI-VISA™ are registered trademarks of National Instruments Corporation.

Optional Accessories

Model/Order No.	Name
34VFK50	Fixed Adapter (V-F, K-M)
34VKF50	Fixed Adapter (V-M. K-F)
41KC-3	Fixed Attenuator 3 dB
41KC-6	Fixed Attenuator 6 dB
41KC-10	Fixed Attenuator 10 dB
41KC-20	Fixed Attenuator 20 dB
41V-3	Fixed Attenuator 3 dB
41V-6	Fixed Attenuator 6 dB
41V-10	Fixed Attenuator 10 dB
41V-20	Fixed Attenuator 20 dB
B0576A	Blank Panel
B0736A	Front Cover (For MP1900A)
B0737A	Carrying Case (For MP1900A, with G0736A)
B0738A	Rack Mount Kit (For MP1900A)
G0361A	64 Gbaud 2-bit DAC with MUX
G0374A	64 Gbaud PAM4 DAC
G0375A	32 Gbaud Power PAM4 Converter
G0376A	32 Gbaud PAM4 Decoder with CTLE
J0008	GPIB CABLE, 2.0 m
J1342A	COAXIAL CABLE 0.8 m (APC3.5 connector)
J1359A	Coaxial Adapter (K-P, K-J, SMA)
J1439A	Coaxial cable (0.8 m, K connector)
J1449A	Measurement kit (J1324A × 2, J1439A × 2, J1625A × 1)
J1510A	Pick OFF Tee (K)
J1550A	Coaxial skew match cable (0.8 m, APC3.5 connector)
J1551A	Coaxial skew match cable (0.8 m, K connector)
J1624A	COAXIAL CABLE 0.3 m (18 GHz and SMA)
J1625A	Coaxial Cable 1 m (18 GHz, SMA)
J1632A	Terminator
J1678A	ESD Protection Adapter-K
J1679A	ESD Protection Adapter-V
J1728A	Electrical Length Specified Coaxial Cable (0.4 m, K connector)
J1735A	Combiner (G0375A PAM4 for non-linear output)
J1741A	Electrical Length Specified Coaxial Cable (0.8 m, K Connector)
J1742A	Electrical Length Specified Coaxial Cable (0.84 m, K Connector, G0375A PAM4 for non-linear output)
J1748A	Power Splitter (1.5 GHz to 18 GHz, SMA, using MU195020A × 4 to MU181500B connection)
J1758A	ISI Board
J1789A	Electrical Length Specified Coaxial Cable (0.4 m, V connector)
J1790A	Electrical Length Specified Coaxial Cable (0.8 m, V connector)
J1792A	Skew match pair semirigid cable (V-K connector, Data Input1)
J1793A	Pick OFF Tee (V)
K240C	Precision Power Divider
MZ1834A/B	4PAM Converter
V210	TERMINATOR (V)
V240C	Fixed Power divider
W3911AE	MP1900A Operation Manual
W3913AE	MX190000A Operation Manual
W3915AE	MU195020/40/50A Operation Manual
W3976AE	MU196020/40A OPERATION MANUAL
Z0541A	USB Mouse
Z0917A	Shielded LAN Cable, 5 m
Z1746A	Stylus
Z1953A	Gigabit Ethernet Switch (5 Port)
Z1964A	Torque Wrench (Right Angle)

Signal Quality Analyzer

MP1800A Series

Remote Control
GPIB OPTION | **Ethernet** OPTION

Small and Flexible Cost-efficient BER Test Solution

Excellent Eco Product

Signal Quality Analyzer MP1800A is a modular BERT with plug-in modules;

- Pulse Pattern Generator (PPG) supporting high quality output and high amplitude signals
- Error Detector (ED) with high input sensitivity supporting signal analysis, such as Bathtub and Eye Diagram measurements
- Jitter Modulation Source (JMS) for generating various types of jitter, such as SJ/RJ/BUJ/SSC, and supporting Jitter Tolerance tests

MP1800A supports physical layers testing for optical modules and high speed devices up to 64.2 Gbit/s. Combined use with the 56G/64G bit/s MUX MP1861A and 56G/64G bit/s DEMUX MP1862A supports BER tests up to 64.2 Gbit/s. Additionally, combining the 4Tap Emphasis MP1825B supporting up to 32.1 Gbit/s with the PAM4 Converter MZ1834A/B, PAM8 Converter MZ1838A, 32Gbaud Power PAM4 Converter G0375A, and 32Gbaud PAM4 Decoder with CTLE G0376A supports PAM signal generation and BER measurement, while tracking using the 64Gbaud PAM4 DAC G0374A adds strong support for signal integrity tests, including PAM signal generation.

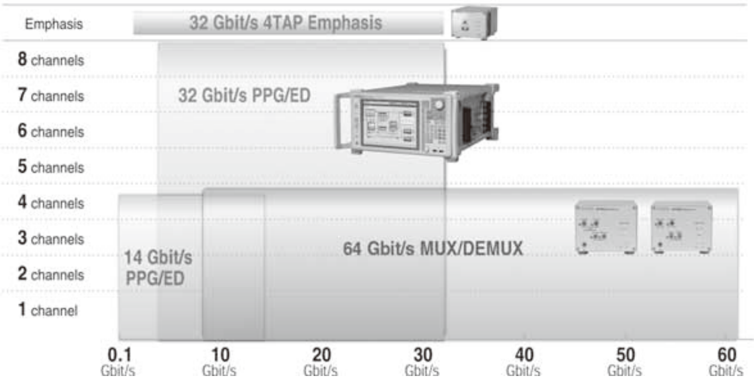
Features

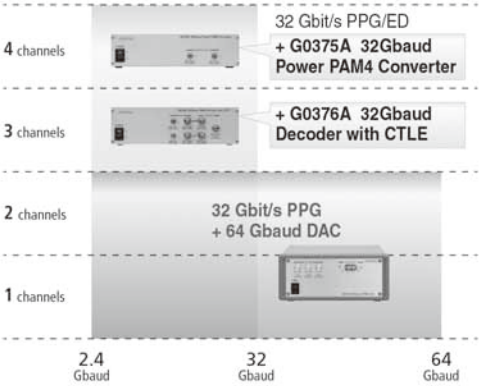
Wide Bandwidth 0.1 Gbit/s to 32.1 Gbit/s, 8 Gbit/s to 64.2 Gbit/s

Bit rates from 0.1 Gbit/s to 32.1 Gbit/s are supported, depending on the selected module. Furthermore, PAM signals can be generated by combining the MZ1834A/B, MZ1838A, and G0375A, while adding the G0376A supports PAM signal BER measurements. Combination with the 56G/64G MUX/DEMUX supports bit rates up to 64.2 Gbit/s. Additionally, PAM4 signals up to 64.2 Gbaud can be generated when used in combination with the 64Gbaud PAM4 DAC G0374A.

- 32 Gbit/s PPG/ED Module
  - 2.4 Gbit/s to 32.1 Gbit/s:
    - MU183020A/21A, MU183040B/41B (Option-001)
  - 2.4 Gbit/s to 28.1 Gbit/s:
    - MU183020A/21A, MU183040B/41B
- 14 Gbit/s PPG/ED Module
  - 0.1 Gbit/s to 14.1 Gbit/s:
    - MU181020B, MU181040B (Option-002/005)
  - 0.1 Gbit/s to 14 Gbit/s:
    - MU181020B, MU181040B (Option-002)
- 56/64G MUX/DEMUX
  - 8 Gbit/s to 56.2 Gbit/s: MP1861A, MP1862A
  - 8 Gbit/s to 64.2 Gbit/s: MP1861A, MP1862A (Option-001)
  - DC to 64 Gbaud: G0374A

Synchronous operation of up to four MP1800A units generates 32G × 32ch (32G PPG module) and 64G × 16ch (64G MUX) signals.

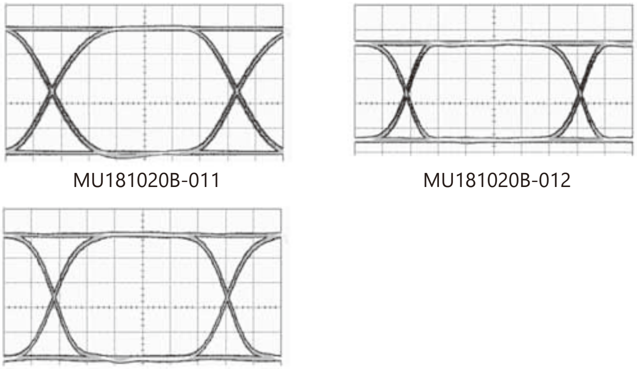




Low-jitter High-quality Waveforms

The combination of low-jitter, high-quality output waveform, and high-amplitude output PPG modules can be tailored to the application.

- Low Jitter: 8 ps p-p (MU181020B-012)
- High Amplitude: 0.5 Vp-p to 3.5 Vp-p (MU181020B-013)



MU181020B-011

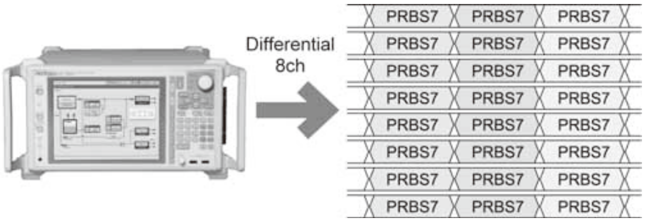
MU181020B-012

MU181020B-013

10 Gbit/s, PRBS31, Maximum amplitude

Synchronization up to 8ch

Due to the modular platform design, the PPG/ED modules can be configured with various other modules to configure custom systems. The number of channels per 28G/32G PPG/ED module can be selected from 1, 2, or 4 and PPG/ED modules can be installed to support up to 8ch. Moreover, since each channel pattern can be synchronized, D/A converters, MUX/DEMUX, crosstalk, and skew tolerance can be evaluated.



*: For details about possible module combinations, see the Option Selection Guide for the MP1800A series.

High Input Sensitivity 28/32 Gbit/s ED

28 G/32 Gbit/s High Sensitivity ED MU183040B/MU183041B extends the performance of the earlier A-type ED to offer world's best Rx sensitivity* with the world's fastest Auto Adjust* (auto-align of threshold level and phase points).
The MU183040B/41B supports simultaneous multichannel measurements of low-amplitude, low Eye Opening DUTs such as Highs Speed Back Plane devices and Active Optical Cable (AOC) to achieve more-accurate, ideal signal quality analysis.

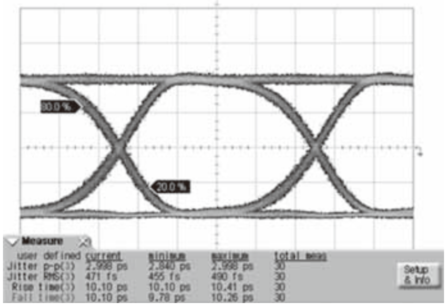
Eye Amplitude Sensitivity:
15 mVp-p (typ.) (28.1 Gbit/s, Single-end)
≤25 mVp-p (28.1 Gbit/s, Single-end)
Eye Height Sensitivity:
10 mVp-p (typ.) (28.1 Gbit/s, Single-end)

* As of September, 2013

Low-jitter, High-quality Waveform 28/32 Gbit/s PPG

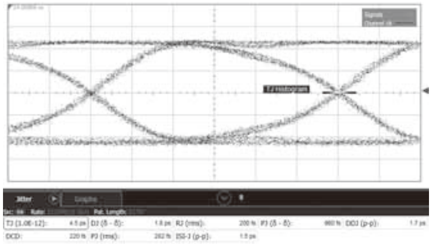
The PPG module supports low-jitter and high-quality waveforms. The output amplitude can be customized to application needs.

Low-jitter: RJ 300 fs rms (typ.)
Total RMS Jitter 700 fs rms (typ.)
High amplitude: 0.5 Vp-p to 3.5 Vp-p
[MU183020A-013/023, MU183021A-013]



user defined	current	minimum	maximum	total meas
Jitter p-p(3)	2.998 ps	2.840 ps	2.998 ps	30
Jitter RMS(3)	471 fs	455 fs	490 fs	30
Rise time(3)	10.10 ps	10.10 ps	10.41 ps	30
Fall time(3)	10.10 ps	9.78 ps	10.26 ps	30

Output Waveform at 28 Gbit/s, 3.5 Vp-p (MU183020A-013) using Sampling oscilloscope with 70 GHz bandwidth



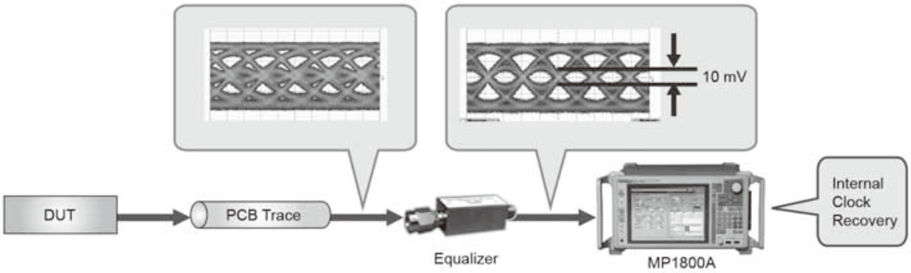
28 Gbit/s, PPG Intrinsic TJ (1E-12) = 4.5 psp-p, RJ rms = 200 fs
Nominal measured data.
Using Sampling Oscilloscope with 50 GHz bandwidth and <100 fs rms intrinsic jitter.

Passive Equalizer

In high speed serial transmission such as 28 Gbit/s, transmission losses of printed-circuits boards causes the Eye Opening to become narrower. The Passive Linear Equalizers J1621A and J1622A can be connected to the ED to compensate for PCB trace losses and improve the Eye Opening. Combination with the High Sensitivity ED MU183040B/MU183041B supports Jitter Tolerance tests of PHY devices with a narrow Eye Opening.

Clock Recovery

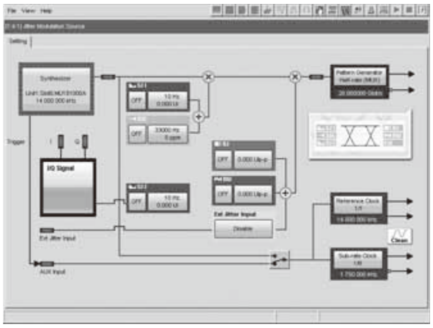
Internal Clock Recovery option can be installed in to MU183040B/MU183041B. Physical layer (PHY) devices, such as SERDES, sometimes have different Tx and Rx Clock systems and Clock Recovery is required at the Error Detector for jitter tolerance tests. Additionally, since transmission using Multi-Mode Fiber (MMF) causes generation of jitter and wander components in the Rx module, Clock Recovery at the Error Detector is similarly required.
Installing this Clock Recovery option supports stress jitter tolerance tests of PHY devices with different Tx and Rx clocks, BER measurements of AOC devices, and simultaneous multichannel measurements, offering even more accurate and ideal signal integrity analyses.



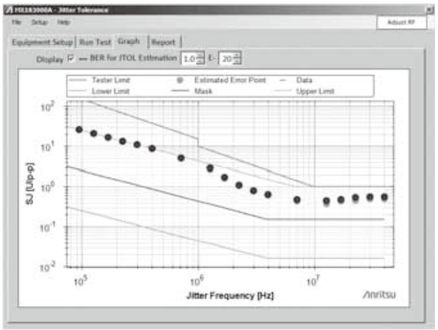
SJ, RJ, BUJ, SSC and Half Period Jitter (F/2 Jitter) Generation

The Jitter Modulation Source MU181500B generates wide-amplitude SJ up to 1 UI at a Jitter Frequency of 250 MHz and a maximum 2000 UI, ensuring sufficient margin for receiver Jitter Tolerance tests. Additionally, the Intrinsic Jitter of 275 fs rms (nom.)* is extremely low, not only when Jitter modulation is OFF but also when 0 UI is set at Jitter modulation ON, ensuring accurate measurements even at low Jitter amplitudes.
The combination of low intrinsic jitter waveform with excellent jitter transparency supports high-accuracy Jitter Tolerance tests. Moreover, simultaneous injection of RJ, BUJ and SSC as well as dual SJ for two-tone supports various Jitter Tolerance tests. Additionally, the High-Speed Serial Data Test Software MX183000A supports multi-mask tables as well as easy mask editing to support next-generation standards.

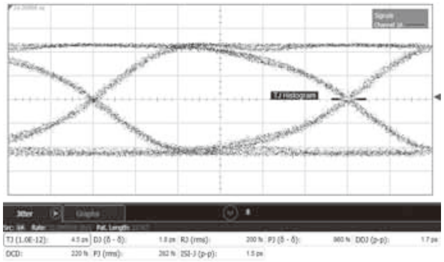
*: Phase noise measurement with using Spectrum Analyzer and 1010...repetition signal.



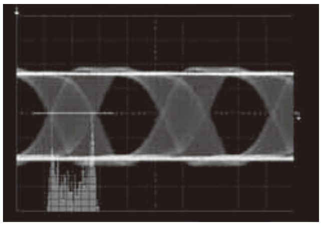
Jitter Modulation Source MU181500B Setting Screen



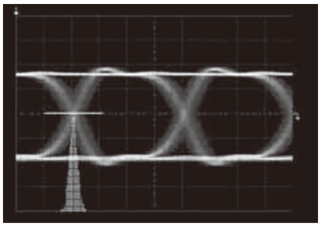
High-Speed Serial Data Test Software MX183000A Measurement Screen



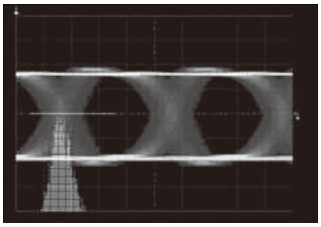
28 Gbit/s, PPG Intrinsic RJ rms
Using Sampling oscilloscope with 50 GHz bandwidth and <100 fs rms intrinsic jitter



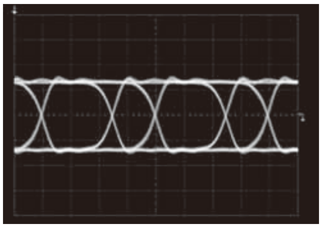
Sinusoidal Jitter (SJ)



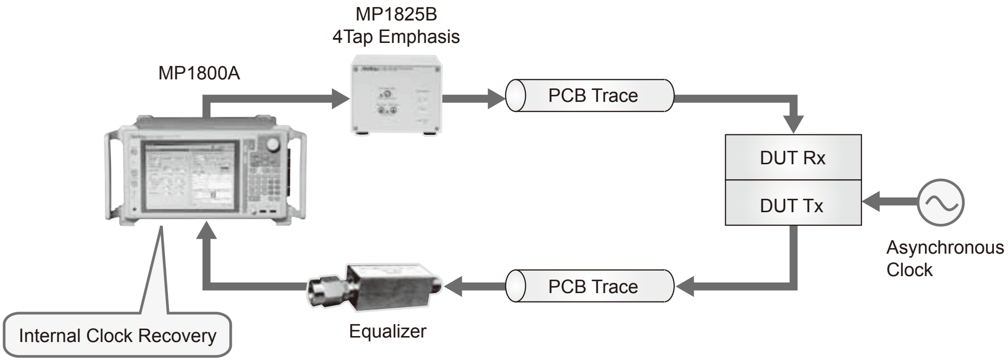
Random Jitter (RJ)



Bounded Uncorrelated Jitter (BUJ)

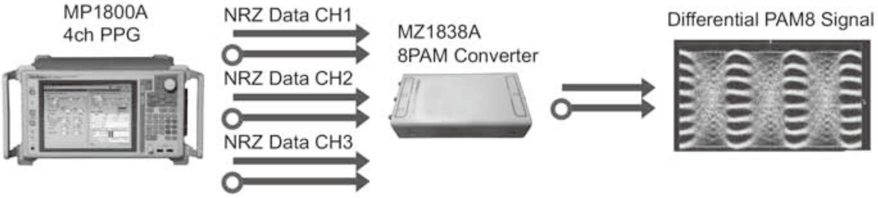


Half Period Jitter (F/2 Jitter)



PAM4/PAM8 Signal Generation

Combining the Anritsu 4PAM Converter MZ1834A/B, 8PAM Converter MZ1838A and 32Gbaud Power PAM4 Converter G0375A with the Signal Quality Analyzer MP1800A supports generation of both PAM4 and PAM8 signals for R&D High Speed Back Plane and 400 GbE R&D. The MP1800A high-quality NRZ waveform and wideband passive PAM converter generate high-quality PAM signals with assured S/N.



In addition, combining the MP1800A and 32Gbaud Power PAM4 Converter G0375A supports output of high-amplitude PAM4 signals and independent 3 Eye level control.

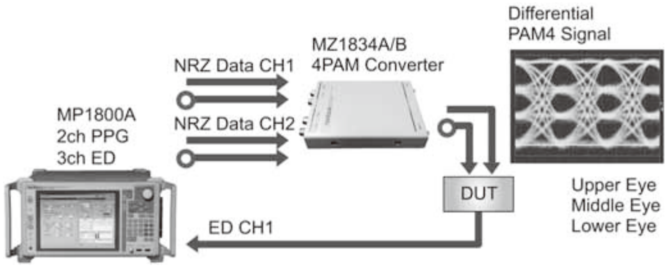
- High-amplitude PAM 4ch output
- Wideband 32.1-Gbaud rate
- High quality and low Jitter
- PAM4 Linearity control

True BER Measurement of 32Gbaud PAM4 Signal

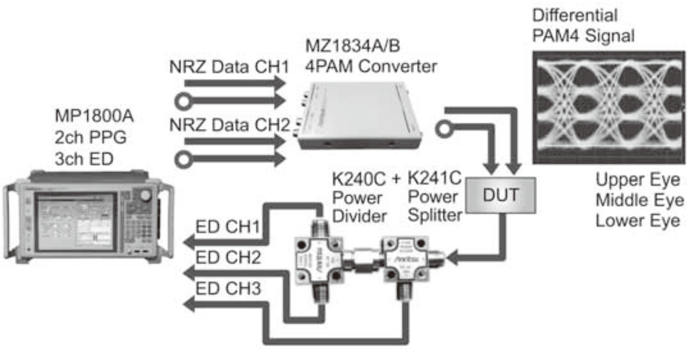
BER measurement of PAM4 signals requires accurate measurement of bit error rates in each of three Eye patterns using a 3-ch Error Detector (ED). However, each Eye data pattern must be a programmable pattern due to differences in regular PRBS. Moreover, since 2-bit data is split between three Eye patterns, errors may be counted twice by mistake at simple error measurements for each Eye, so the true BER cannot be measured.
The BER of the three Eye patterns of a PAM4 data signal can be measured simultaneously by combining the Power Divider K240C and Power Splitter K241C with the High-Sensitivity ED MU18304xB. Additionally, the True BER of PAM4 signals can be measured using both the MP1800A long-memory programmable pattern function and the error mask function for removing unwanted errors.
In addition, the standard built-in functions support separate BER measurements for each of the Top/Middle/Bottom Eye parts, repeated Auto Search and BER measurements using ED 1ch, and calculation and display of PAM4 total BER results from measured results.
Moreover, versatile automatic measurement functions* enable easy and efficient testing.

- Auto Search function automatically detects each decision point (both the amplitude and phase) of Upper, Middle and Lower Eye.
- Simultaneous Bathtub Jitter measurement for PAM 3Eyes
- Eye Margin, Eye Diagram and Q-value measurement

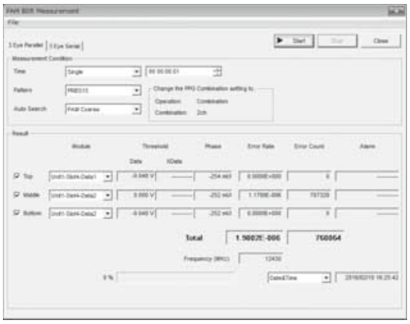
*: MP1800A Software Version 7.9 or later.
Eye Height >50 mV at the input of ED is required for PAM4 automatic measurement function.



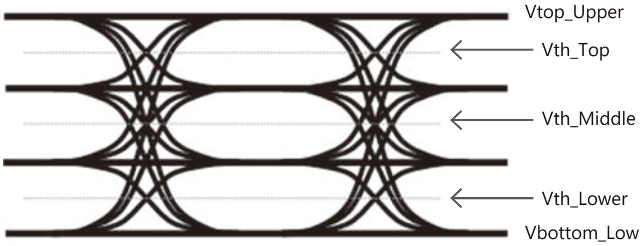
PAM4 Total BER Measurement



True BER Measurement at PAM4 signal



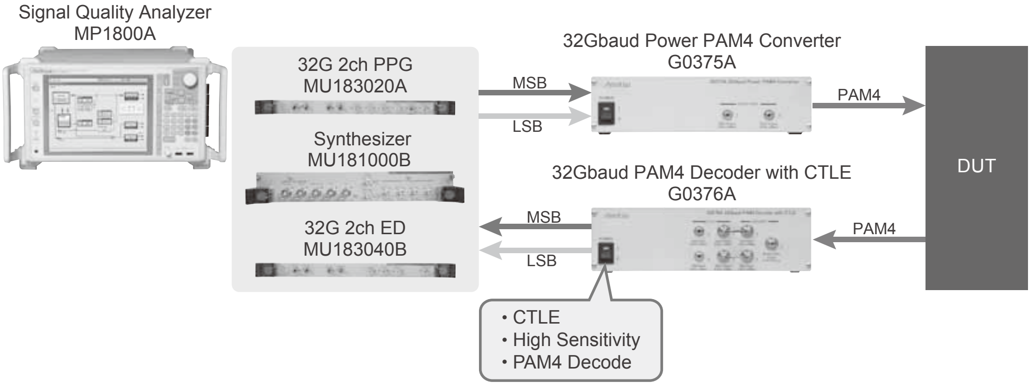
PAM4 Total BER Measurement Screen



Sampling Measurement of PAM4 Signal at 1ch ED

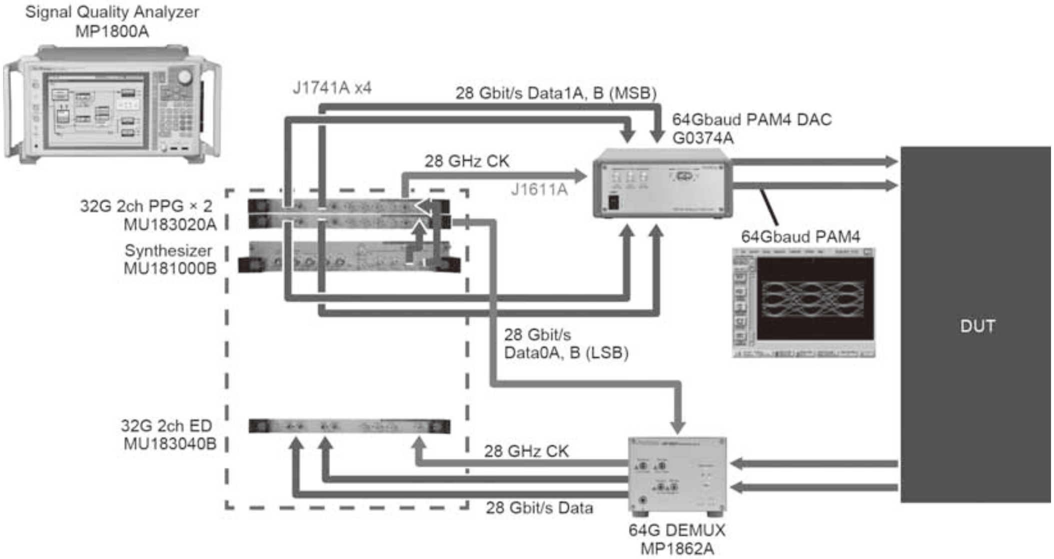
Moreover, the MSB and LSB can be measured separately, and the BER can be measured in real-time using the high input sensitivity of the 32Gbaud PAM4 Decoder with CTLE G0376A and PAM4 Decode function.

- Baud Rate of 10 to 32.1 Gbaud
- High Input Sensitivity of 40 mV typ. (per Eye, Single-end, G0376A Data input)
- Continuously Variable CTLE Gain of –12 to 0 dB for PAM4 BER Measurement after Adjustment of Eye Opening
- Real-time PAM4 BER Measurement using PAM4 Decoder + 2ch Error Detector
- CDR function (with MU183040B-022)
- Compact Remote Head for Close DUT Measurement (Remote Control between G0376A and MP1800A)



64Gbaud PAM4 BER Measurements

The G0374A 64Gbaud PAM4 DAC has two built-in 64G 2:1 multiplexers for generating 64-Gbaud PAM4 signals simply by using a 32-Gbit/s NRZ signal source (PPG). The compact, all-in-one G0374A connects to the DUT using a Remote Head with short cable to minimize loss and provide high-quality waveform PAM4 signals.
Moreover, BER measurements of PAM4 signals up to 56Gbaud are supported by combining the 56G/64G bit/s DEMUX MP1862A and 32G ED.



High Input Sensitivity & Wide Phase Margin

Using the high-input sensitivity ED Rx function supports direct input and evaluation of low-amplitude data.

- Input Sensitivity
  MU181040B-002: 10 mVp-p (typ.)
- Phase Margin
  MU181040B-002: 60 ps (typ.) (12.5 Gbit/s)

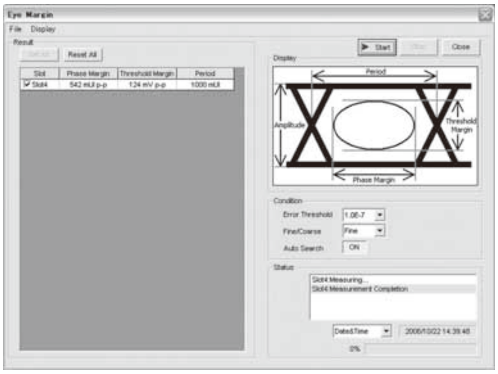
Burst Measurement

The following application evaluations using burst signals are supported.

- E-PON, G-PON, 10GE-PON Upstream Test
- Optical Loop Test
- Transmission Test using Quantum Noise Technology

Eye Margin

For confirming DATA threshold and phase margins.



Slot	Phase Margin	Threshold Margin	Period
☑ Slot4	542 mUI p-p	124 mV p-p	1000 mUI

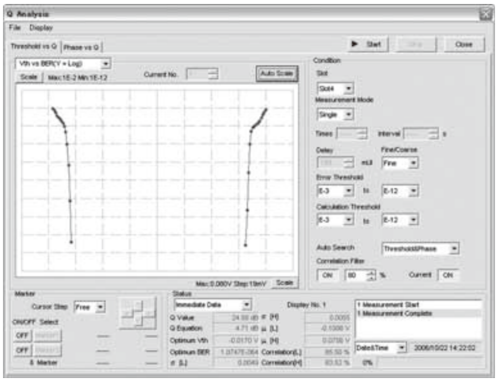
Error Threshold: 1.0E-7
Fine/Coarse: Fine
Auto Search: ON

Slot4 Measuring...
Slot4 Measurement Completion

Date&Time: 2006/10/22 14:39:48
0%

Q Measurement

Calculates Q value from bit error rate using change in threshold value. Can be used to check change in Q value for clock phase.



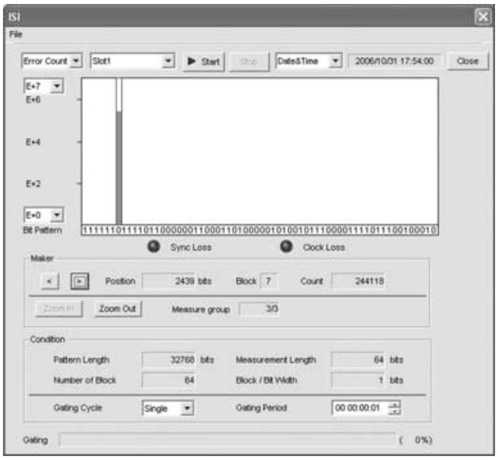
Slot: Slot4
Measurement Mode: Single
Times
Interval s
Delay mUI
Fine/Coarse: Fine
Error Threshold: E-3 to E-12
Calculation Threshold: E-3 to E-12
Auto Search: Threshold&Phase
Correlation Filter: ON 80 %
Current: ON

1 Measurement Start
1 Measurement Complete

Date&Time: 2006/10/22 14:22:02
0%

Bit Error Analysis using ISI

Used to confirm bit error rate in each specified block or bit position and for bit error rate correlation with inter-symbol interference.



Error Count
Slot1
Date&Time: 2006/10/31 17:54:00

Bit Pattern: 1111110111101100000011000110100000101001011100001111011100100010

Position: 2439 bits
Block: 7
Count: 244118
Measure group: 3/3

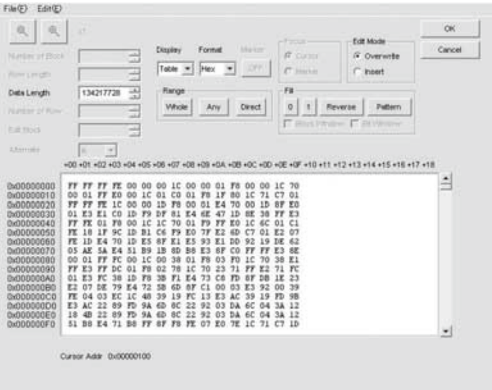
Pattern Length: 32768 bits
Measurement Length: 64 bits
Number of Block: 64
Block / Bit Width: 1 bits
Gating Cycle: Single
Gating Period: 00 00:00:01

Gating (0%)

*: Functions and specifications are different according to the module.
Refer to the Specification and Brochure for each module.

Versatile Pattern Generation

- Pseudorandom patterns (PRBS)
  Because all PRBS rates required by the standards are supported up to PRBS2^{31} – 1, all BER are supported.
  2^n – 1 (n = 7, 9, 10, 11, 15, 20, 23, 31)
- Zero Substitution Pattern
  All 0 s and All 1 s patterns can be added to PRBS patterns for performing CDR tolerance tests.
  2^n, 2^n – 1 (n = 7, 9, 10, 11, 15, 20, 23)
- Data Pattern
  Patterns required by each application can be created with flexibility.
  128 Mbits max. (Steps: 1-bit)
- Alternate Pattern
  Two patterns (A and B) can be set and the A/B pattern can be output at any timing.
- Mixed Pattern
  A mixed data and PRBS pattern can be output. At creation of SDH/SONET frames, adding a PRBS2^{31} – 1, etc., pattern to the payload allows setting of a continuous pattern across frames.
- Sequence Pattern
  A variety of programmable patterns can be output in any sequence and combining various patterns offers effective support for applications requiring sequence processing.
- PAM4 Pattern
  J03A, J03B, Linearity test pattern, SSPR, PRQS 10, 13, PRBS 13Q, Gray PRBS 13Q



Data Length 134217728

Display: Table

Format: Hex

Edit Mode: ● Overwrite ○ Insert

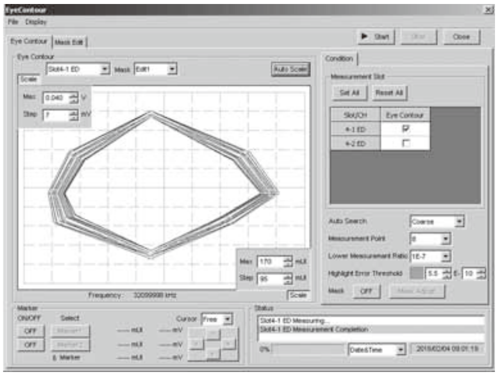
```
            +00 +01 +02 +03 +04 +05 +06 +07 +08 +09 +0A +0B +0C +0D +0E +0F +10 +11 +12 +13 +14 +15 +16 +17 +18
0x00000000  FF FF FF FE 00 00 00 1C 00 00 01 F8 00 00 1C 70
0x00000010  00 01 FF E0 00 1C 01 C0 01 F8 1F 80 1C 71 C7 01
0x00000020  FF FF FE 1C 00 00 1D F8 00 01 E4 70 00 1D 8F E0
0x00000030  01 E3 E1 C0 1D F9 DF 81 E4 6E 47 1D 8E 38 FF E3
0x00000040  FF FE 01 F8 00 1C 1C 70 01 F9 FF E0 1C 6C 01 C1
0x00000050  FE 18 1F 9C 1D B1 C6 F9 E0 7F E2 6D C7 01 E2 07
0x00000060  FE 1D E4 70 1D E5 8F E1 E5 93 E1 DD 92 19 DE 62
0x00000070  05 AE 5A E4 51 B9 1B 8D B8 E3 8F C0 FF FF E3 8E
0x00000080  00 01 FF FC 00 1C 00 38 01 F8 03 F0 1C 70 38 E1
0x00000090  FF E3 FF DC 01 F8 02 78 1C 70 23 71 FF E2 71 FC
0x000000A0  01 E3 FC 38 1D F8 3B F1 E4 73 C8 FD 8F DB 1E 23
0x000000B0  E2 07 DE 79 E4 72 5B 6D 8F C1 00 03 E3 92 00 39
0x000000C0  FE 04 03 EC 1C 48 39 19 FC 13 E3 AC 39 19 FD 9B
0x000000D0  E3 AC 22 89 FD 9A 6D 8C 22 92 03 DA 6C 04 3A 12
0x000000E0  18 4B 22 89 FD 9A 6D 8C 22 92 03 DA 6C 04 3A 12
0x000000F0  51 B8 E4 71 B8 FF 8F F8 FE 07 E0 7E 1C 71 C7 1D
```

Cursor Addr 0x00000100

Data Pattern Setting Screen

Eye Contour Function

Contours can be estimated quickly up to BER 1E-20 based on the Bathtub estimate.
Any of the Upper/Middle/Lower part of the Eye of either NRZ or PAM4 signals can be specified and measured.



Slot4-1 ED; Mask: Edit1

Max 0.040 V; Step 7 mV

Slot/CH	Eye Contour
4-1 ED	☑
4-2 ED	☐

Auto Search: Coarse

Measurement Point: 8

Lower Measurement Ratio: 1E-7

Highlight Error Threshold: 5.5 E- 10

Mask: OFF

Max 170 mUI; Step 95 mUI

Frequency: 32099999 kHz

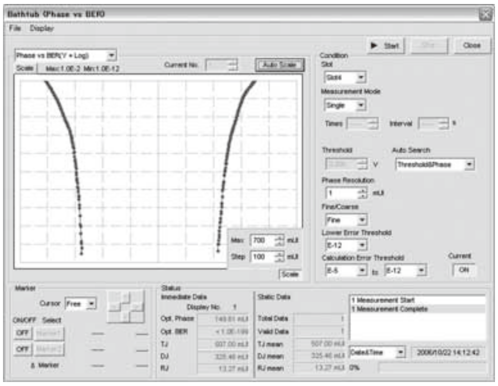
Cursor: Free

Slot4-1 ED Measuring...
Slot4-1 ED Measurement Completion

0% Date&Time 2016/02/04 09:01:19

Bathtub

Performs optimum bit error rate based on changes in bit error rate relative to phase. And performs jitter analysis (TJ, DJ, RJ).



Phase vs BER(Y = Log)

Scale: Max:1.0E-2 Min:1.0E-12

Current No.

Slot: Slot4

Measurement Mode: Single

Threshold: V; Auto Search: Threshold&Phase

Phase Resolution: 1 mUI

Fine/Coarse: Fine

Lower Error Threshold: E-12

Calculation Error Threshold: E-6 to E-12

Current: ON

Max 700 mUI; Step 100 mUI

Cursor: Free

Display No. 1

Opt. Phase	143.81 mUI	Total Data	1
Opt. BER	< 1.0E-199	Valid Data	1
TJ	507.00 mUI	TJ mean	507.00 mUI
DJ	325.46 mUI	DJ mean	325.46 mUI
RJ	13.27 mUI	RJ mean	13.27 mUI

1 Measurement Start
1 Measurement Complete

0% Date&Time 2006/10/22 14:12:42

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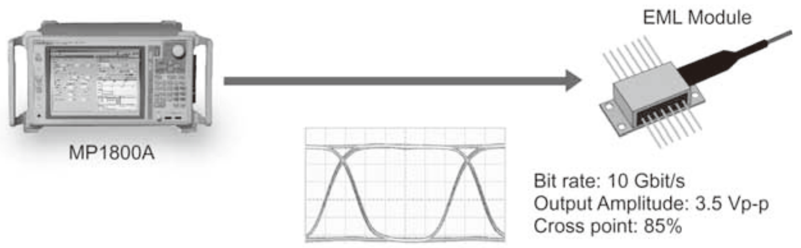
*: Functions and specifications are different according to the module.
Refer to the Specification and Brochure for each module.

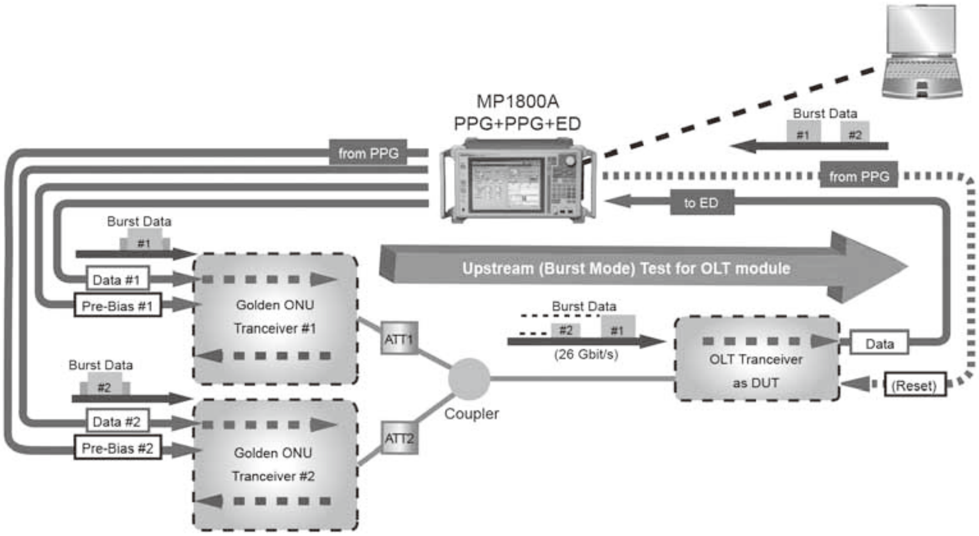
Applications

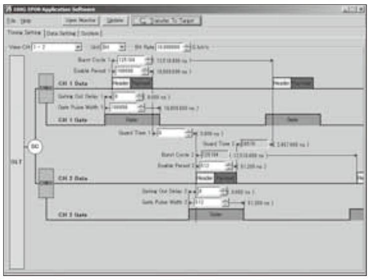
Application 1: EA/EML Module Evaluation



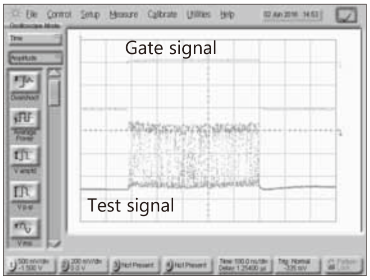
Direct driving of EML and EA module using 3.5 Vp-p high-amplitude waveform
Wide cross point adjustment function: 20 to 90% [MU181020B-013]

Application 2: 25G/100G PON OLT Module Inspection





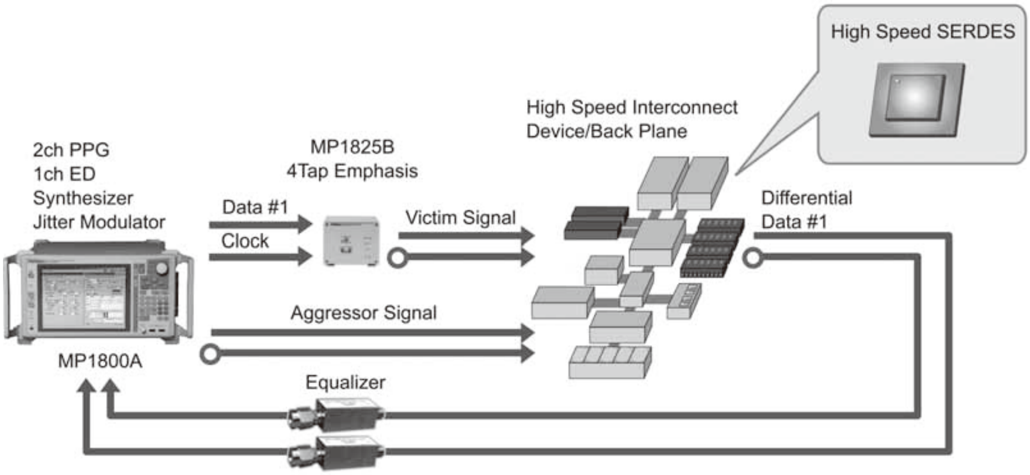
Example of control screen



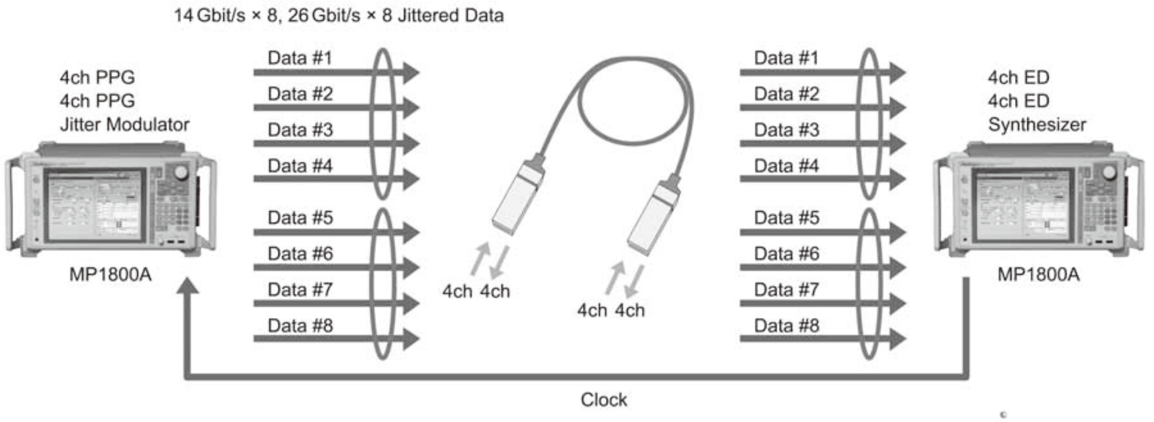
Reference burst signals

The PON OLT Upstream test can be performed using one MP1800A and 100G EPON Application Software MX180014A

Application 3: 32 Gbit/s Band Ultrafast Interconnect Evaluation



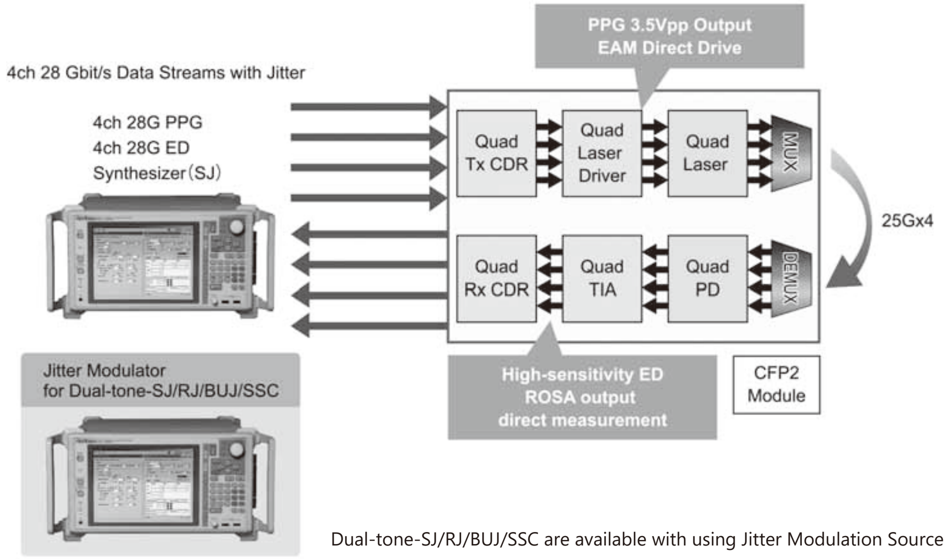
Application 4: AOC (Active Optical Cable) Evaluation



INFINIBAND™
TRADE ASSOCIATION MEMBER

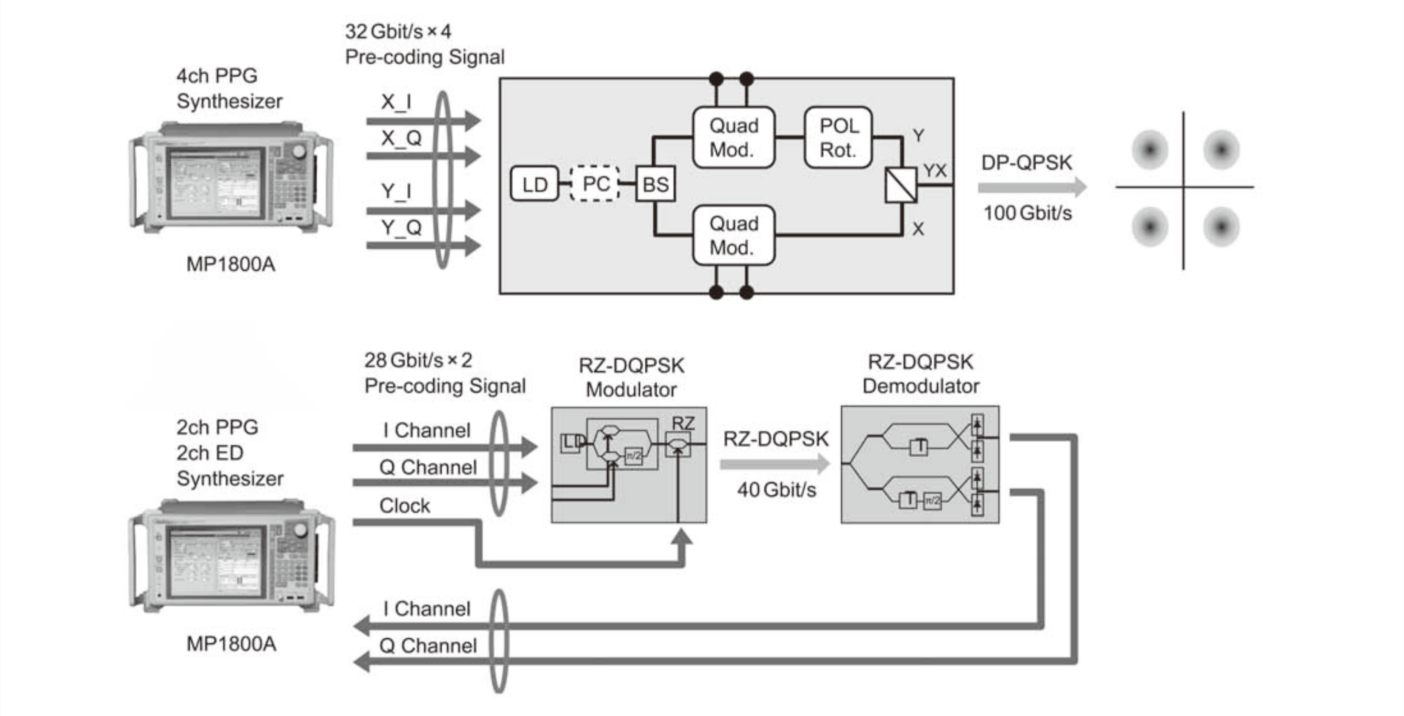
Anritsu MP1800A is recognized to test equipment for IBTA Integrators' List.

Application 5: 100 GbE/400 GbE Devices CFP2/CFP4/CFP8 Evaluation



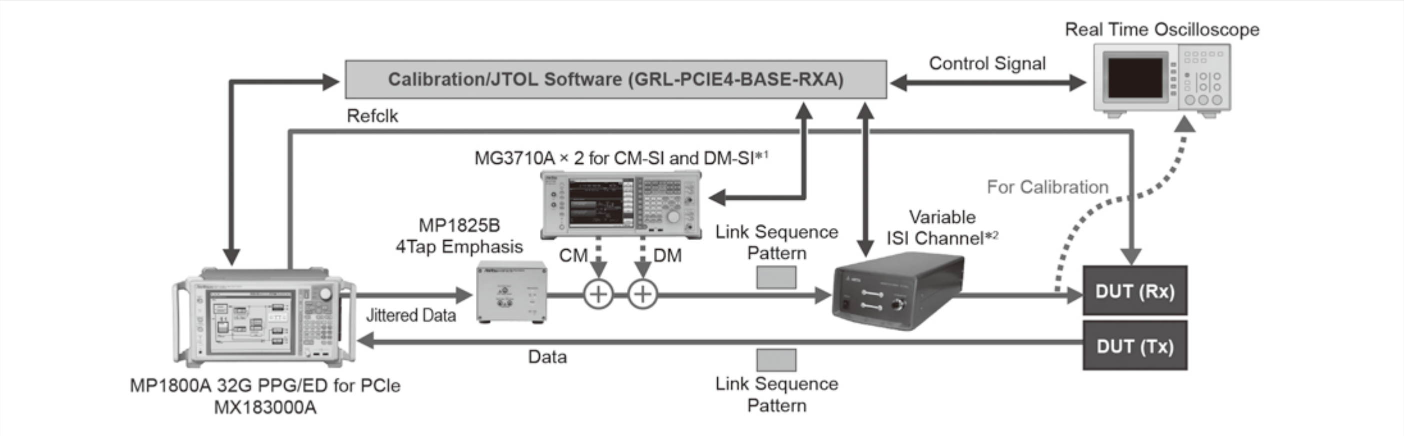
Dual-tone-SJ/RJ/BUJ/SSC are available with using Jitter Modulation Source MU181500B.

Application 6: 100 Gbit/s Band DP-QPSK and 40 Gbit/s Band DQPSK Evaluation



Pre-coding signal generator synchronized between channels
Optical output waveform optimization using cross-point adjustment
Timing control and skew control between channels
Modulator input level tolerance

PCI Express Device Evaluation Setup



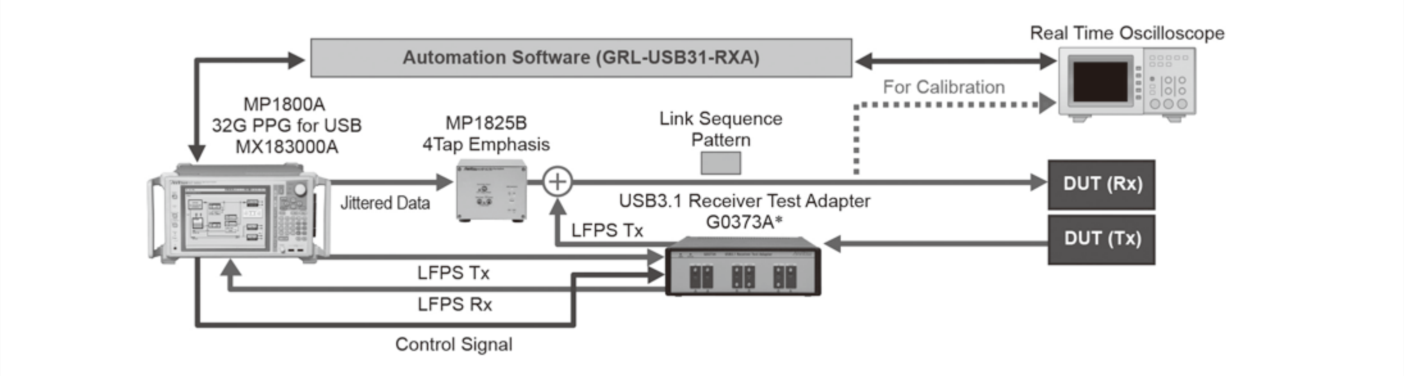
Required Functions

- Loopback State Setting Function
- Jitter Tolerance Function
- Automatic Receiver Test Function

*1: The MG3710A is used at common mode noise and differential mode noise loads.
*2: The Variable ISI Channel is used at the ISI (Inter Symbol Interference) load test.

* The GRL-PCIE4-BASE-RXA software is a Granite River Labs product.

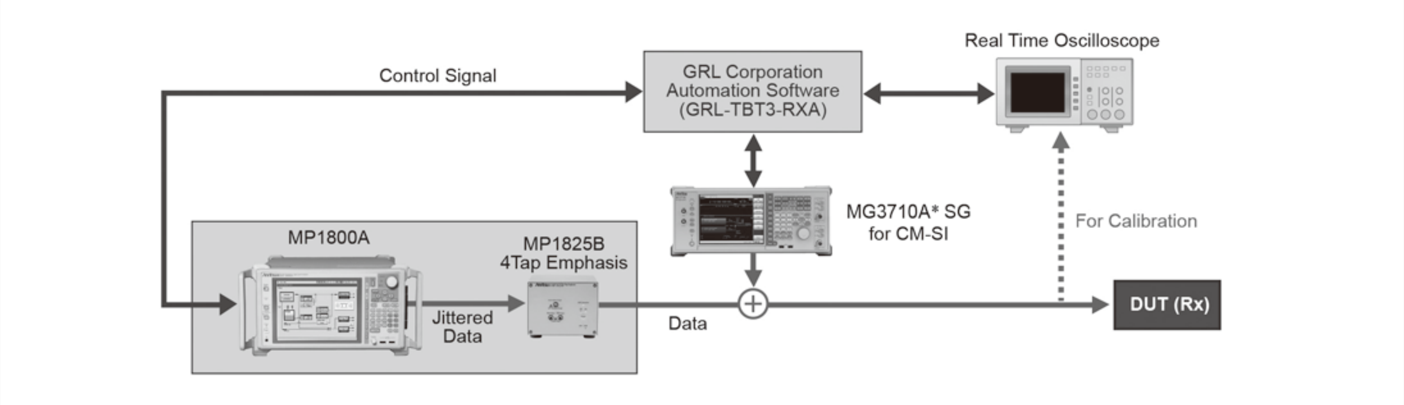
USB Device Evaluation Setup



Required Functions
- Loopback State Setting Function
- Jitter Tolerance Function
- Automatic Receiver Test Function

*: G0373A is used for LFPS (Low Frequency Periodic Signal) generation and BER measurement.

Thunderbolt Device Evaluation Setup



Required Functions
- 20 Gbit/s PPG
- Stressed Signal Calibration Function
- Jitter Tolerance Function

*: The MG3710A is used at common mode noise loads.

* The GRL-PCIE4-BASE-RXA and GRL-TBT3-RXA software are Granite River Labs products.

Anritsu MP1800A is recognized to recommended test equipment for Thunderbolt Compliance Test.

Specifications

Signal Quality Analyzer MP1800A

LCD Display		8.4-inch Color TFT, 800 × 600 pixels
Peripheral Interface		VGA out (SVGA), USB 1.1 (3 Ports)
Remote Interface		GPIB [MP1800A-001], LAN (2 ports) [MP1800A-002]
Options		4-slot PPG and/or ED [MP1800A-015]
Power Supply		100 V(ac) to 120 V(ac)/200 V(ac) to 240 V(ac) [auto-switching between 100 V(ac)/200 V(ac)], 47.5 Hz to 63 Hz
Power Consumption		≤600 VA
Operating Temperature		5° to 40°C
Dimensions and Mass		320 (W) × 177 (H) × 450 mm (D), ≤13 kg (without modules)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Signal Quality Analyzer MP1800A

Model/Order No.	Name
	Main frame
MP1800A	Signal Quality Analyzer
	Standard accessories
	Power Cord: 1 pc
Z0306A	Wrist Strap: 1 pc
Z0541A	USB Mouse: 1 pc
B0329G	Front Cover for 3/4MW 4U: 1 pc
G0342A	ESD Discharger: 1 pc
J1627A	GND Connection Cable: 1 pc
B0574A	MP1800A Protect Cover: 1 pc
MX180000A	Signal Quality Analyzer Control Software: 1 pc
Z0897A	MP1800A Manual CD: 1 pc
	Options
MP1800A-001	GPIB
MP1800A-002	LAN
MP1800A-007	OS Upgrade to Windows7
MP1800A-015	4-Slot for PPG and/or ED
MP1800A-032	32 Gbit/s PPG and/or ED Support
	Retrofit options
MP1800A-101	GPIB Retrofit
MP1800A-102	LAN Retrofit
MP1800A-107	OS Upgrade to Windows7 Retrofit
MP1800A-132	32 Gbit/s PPG and/or ED Support Retrofit
	Calibration service
MP1800A-190	25G Calibration of PPG and MUX Retrofit
	Maintenance service
MP1800A-ES310	Three Years Extended Warranty Service
MP1800A-ES510	Five Years Extended Warranty Service

12.5 GHz 4port Synthesizer MU181000B

Model/Order No.	Name
	Unit/Module
MU181000B	12.5 GHz 4port Synthesizer
	Standard accessories
J1349A	Coaxial Cable 0.3 m (SMA, DC to 18 GHz): 4 pcs
	Option
MU181000B-001	Jitter Modulation
	Retrofit option
MU181000B-101	Jitter Modulation Retrofit
	Maintenance service
MU181000B-ES310	Three Years Extended Warranty Service
MU181000B-ES510	Five Years Extended Warranty Service

Jitter Modulation Source MU181500B

Model/Order No.	Name
	Unit/Module
MU181500B	Jitter Modulation Source
	Standard accessories
J1349A	Coaxial Cable 0.3 m (SMA, DC to 18 GHz): 1 pc
J1508A	BNC-SMA Connector Cable (30 cm): 2 pcs
J1137	Terminator: 6 pcs
J1341A	Open: 2 pcs
Z0897A	MP1800A Manual CD: 1 pc
Z0918A	MX180000A Software CD: 1 pc
	Maintenance service
MU181500B-ES310	Three Years Extended Warranty Service
MU181500B-ES510	Five Years Extended Warranty Service

14 GHz Clock Distributor MU181800B

Model/Order No.	Name
	Unit/Module
MU181800B	14 GHz Clock Distributor
	Option
MU181800B-005	14.1 GHz Extension
	Retrofit option
MU181800B-105	14.1 GHz Extension Retrofit
	Maintenance service
MU181800B-ES310	Three Years Extended Warranty Service
MU181800B-ES510	Five Years Extended Warranty Service

14 Gbit/s PPG MU181020B

Model/Order No.	Name
	Unit/Module
MU181020B*1	14 Gbit/s PPG
	Standard accessories
J1137	Terminator (50Ω): 3 pcs
J1341A	Open: 1 pc
	Options
MU181020B-002	0.1 to 14 Gbit/s
MU181020B-005	14.1 Gbit/s Extension
MU181020B-011	Variable Data Output (0.25 to 2.5 Vp-p)
MU181020B-012	High Performance Data Output (0.05 to 2.0 Vp-p)
MU181020B-013	Variable Data Output (0.5 to 3.5 Vp-p)
MU181020B-030	Variable Data Delay
	Retrofit options
MU181020B-105	14.1 Gbit/s Extension Retrofit
MU181020B-111	Variable Data Output (0.25 to 2.5 Vp-p) Retrofit
MU181020B-112	High Performance Data Output (0.05 to 2.0 Vp-p) Retrofit
MU181020B-113	Variable Data Output (0.5 to 3.5 Vp-p) Retrofit
MU181020B-130	Variable Data Delay Retrofit
	Standard accessories for MU181020B-011/111
J1359A	Coaxial Adapter (K-P, K-J, SMA): 2 pcs
	Standard accessories for MU181020B-012/112
J1359A	Coaxial Adapter (K-P, K-J, SMA): 2 pcs
	Standard accessories for MU181020B-013/113
J1359A	Coaxial Adapter (K-P, K-J, SMA): 2 pcs
	Maintenance service
MU181020B-ES310	Three Years Extended Warranty Service
MU181020B-ES510	Five Years Extended Warranty Service

*1: MU181020B is not RoHS compliant.

14 Gbit/s ED MU181040B

Model/Order No.	Name
	Unit/Module
MU181040B*2	14 Gbit/s ED
	Options
MU181040B-002	0.1 to 14 Gbit/s
MU181040B-005	14.1 Gbit/s Extension
MU181040B-020	Clock Recovery
MU181040B-030	Variable Clock Delay
	Retrofit options
MU181040B-105	14.1 Gbit/s Extension Retrofit
MU181040B-120	Clock Recovery Retrofit
MU181040B-130	Variable Clock Delay Retrofit
	Standard accessories for MU181040B-002
J1341A	Open: 3 pcs
J1359A	Coaxial Adapter (K-P, K-J, SMA): 2 pcs
J1137	Terminator (50Ω): 2 pcs
	Standard accessories for MU181040B-020/120
J1137	Terminator (50Ω): 1 pc
	Maintenance service
MU181040B-ES310	Three Years Extended Warranty Service
MU181040B-ES510	Five Years Extended Warranty Service

*2: MU181040B is not RoHS compliant.

28G/32G bit/s PPG MU183020A

Model/Order No.	Name	
	Unit/Module	
MU183020A	28G/32G bit/s PPG	
	Standard accessories	
J1137	Terminator:	3 pcs
J1359A	Coaxial Adaptor (K-P, K-J, SMA):	1 pc
J1341A	Open:	1 pc
J0541E	6 dB Fixed Attenuator:	1 pc
Z0897A	MP1800A Manual CD:	1 pc
Z0918A	MX180000A Software CD:	1 pc
	Options	
MU183020A-001	32G bit/s Extension	
MU183020A-012	1ch 2 V Data Output	
MU183020A-013	1ch 3.5 V Data Output	
MU183020A-022	2ch 2 V Data Output	
MU183020A-023	2ch 3.5 V Data Output	
MU183020A-030	1ch Data Delay	
MU183020A-031	2ch Data Delay	
	Retrofit options	
MU183020A-101	32G bit/s Extension Retrofit	
MU183020A-112	1ch 2 V Data Output Retrofit	
MU183020A-113	1ch 3.5 V Data Output Retrofit	
MU183020A-122	2ch 2 V Data Output Retrofit	
MU183020A-123	2ch 3.5 V Data Output Retrofit	
MU183020A-130	1ch Data Delay Retrofit	
MU183020A-131	2ch Data Delay Retrofit	
	Standard accessories for MU183020A-x12, x13	
J1137	Terminator:	2 pcs
J1359A	Coaxial Adaptor (K-P, K-J, SMA):	2 pcs
	Standard accessories for MU183020A-x22, x23	
J1137	Terminator:	4 pcs
J1359A	Coaxial Adaptor (K-P, K-J, SMA):	4 pcs
	Maintenance service	
MU183020A-ES310	Three Years Extended Warranty Service	
MU183020A-ES510	Five Years Extended Warranty Service	

28G/32G bit/s High Sensitivity ED MU183040B

Model/Order No.	Name	
	Unit/Module	
MU183040B	28G/32G bit/s High Sensitivity ED	
	Standard accessories	
J1137	Terminator:	2 pcs
J1341A	Open:	1 pc
Z0897A	MP1800A Manual CD:	1 pc
Z0918A	MX180000A Software CD:	1 pc
	Options	
MU183040B-001	32 Gbit/s Extension	
MU183040B-010	1ch ED	
MU183040B-020	2ch ED	
MU183040B-022	2.4G to 28.1G bit/s Clock Recovery	
MU183040B-023	25.5G to 32.1G bit/s Clock Recovery	
	Retrofit options	
MU183040B-101	32 Gbit/s Extension Retrofit	
MU183040B-110	1ch ED Retrofit	
MU183040B-120	2ch ED Retrofit	
MU183040B-122	2.4G to 28.1G bit/s Clock Recover Retrofit	
MU183040B-123	25.5G to 32.1G bit/s Clock Recovery Retrofit	
	Standard accessories for MU183040B-x10	
J1341A	Open:	2 pcs
J1359A	Coaxial Adaptor (K-P, K-J, SMA):	2 pcs
41KC-6	Precision Fixed Attenuator 6 dB:	2 pcs
	Standard accessories for MU183040B-x20	
J1341A	Open:	4 pcs
J1359A	Coaxial Adaptor (K-P, K-J, SMA):	4 pcs
41KC-6	Precision Fixed Attenuator 6 dB:	4 pcs
	Maintenance service	
MU183040B-ES310	Three Years Extended Warranty Service	
MU183040B-ES510	Five Years Extended Warranty Service	

28G/32G bit/s 4ch PPG MU183021A

Model/Order No.	Name	
	Unit/Module	
MU183021A	28G/32G bit/s 4ch PPG	
	Standard accessories	
J1137	Terminator:	3 pcs
J1359A	Coaxial Adaptor (K-P, K-J, SMA):	1 pc
J1341A	Open:	1 pc
J0541E	6 dB Fixed Attenuator:	1 pc
Z0897A	MP1800A Manual CD:	1 pc
Z0918A	MX180000A Software CD:	1 pc
	Options	
MU183021A-001	32G bit/s Extension	
MU183021A-012	4ch 2.0 V Data Output	
MU183021A-013	4ch 3.5 V Data Output	
MU183021A-030	4ch Data Delay	
	Retrofit options	
MU183021A-101	32G bit/s Extension Retrofit	
MU183021A-112	4ch 2.0 V Data Output Retrofit	
MU183021A-113	4ch 3.5 V Data Output Retrofit	
MU183021A-130	4ch Data Delay Retrofit	
	Standard accessories for MU183021A-x12, x13	
J1137	Terminator:	8 pcs
J1359A	Coaxial Adaptor (K-P, K-J, SMA):	8 pcs
	Maintenance service	
MU183021A-ES310	Three Years Extended Warranty Service	
MU183021A-ES510	Five Years Extended Warranty Service	

28G/32G bit/s 4ch High Sensitivity ED MU183041B

Model/Order No.	Name	
	Unit/Module	
MU183041B	28G/32G bit/s 4ch High Sensitivity ED	
	Standard accessories	
J1137	Terminator:	3 pcs
J1341A	Open:	9 pcs
J1359A	Coaxial Adaptor (K-P, K-J, SMA):	8 pcs
41KC-6	Precision Fixed Attenuator 6 dB:	8 pcs
Z0897A	MP1800A Manual CD:	1 pc
Z0918A	MX180000A Software CD:	1 pc
	Option	
MU183041B-001	32 Gbit/s Extension	
MU183041B-022	2.4G to 28.1G bit/s Clock Recovery	
MU183041B-023	25.5G to 32.1G bit/s Clock Recovery	
	Retrofit option	
MU183041B-101	32 Gbit/s Extension Retrofit	
MU183041B-122	2.4G to 28.1G bit/s Clock Recovery Retrofit	
MU183041B-123	25.5G to 32.1G bit/s Clock Recovery Retrofit	
	Maintenance service	
MU183041B-ES310	Three Years Extended Warranty Service	
MU183041B-ES510	Five Years Extended Warranty Service	

4PAM Converter MZ1834A

Model/Order No.	Name	
	Main frame	
MZ1834A	4PAM Converter	
	Standard accessories	
J1359A	Coaxial Adaptor (K-P, K-J, SMA):	2 pcs
Z0897A	MP1800A Manual CD:	1 pc

4PAM Converter MZ1834B

Model/Order No.	Name	
	Main frame	
MZ1834B	4PAM Converter	
	Standard accessories	
J1359A	Coaxial Adaptor (K-P, K-J, SMA):	2 pcs
Z0897A	MP1800A Manual CD:	1 pc

8PAM Converter MZ1838A

Model/Order No.	Name
	Main frame
MZ1838A	8PAM Converter
	Standard accessories
J1359A	Coaxial Adaptor (K-P, K-J, SMA): 2 pcs
Z0897A	MP1800A Manual CD: 1 pc

Data Signal Combiner MZ1854A

Model/Order No.	Name
	Main frame
MZ1854A	Data Signal Combiner
	Standard accessories
Z0897A	MP1800A Manual CD

Software

Model/Order No.	Name
MX180000A	Signal Quality Analyzer Control Software
MX180001A	SDH/SONET Pattern Editor
MX180003A	GbE/10 GbE Pattern Editor
MX180004A	PON Application Software
MX180005A	Jitter Application Software
MX181500A	Jitter/Noise Tolerance Test Software
MX183000A*3	High-Speed Serial Data Test Software
MX183000A-PL001	Jitter Tolerance Test
MX183000A-PL011	PCIe Link Sequence
MX183000A-PL012	USB Link Sequence

*3: MP1800A is shipped with MX183000A installed.

Before Using VISA*4

For Those Who Use MP1800A

To use the High-Speed Serial Data Test Software MX183000A (hereafter MX183000A), you are required to install National Instruments™ (hereafter NI™) NI-VISA™*5 on the PC controller.
We recommend using NI-VISA™ provided in the USB memory stick that contains MX183000A.
You are allowed to use NI-VISA™ contained in the USB memory stick only for the purpose of using it for MX183000A. Use of NI-VISA™ for any other product or purpose is prohibited.
When uninstalling MX183000A from the PC controller, uninstall NI-VISA™ that was installed from the USB memory stick as well.

*4: Virtual Instrument Software Architecture I/O software specification for remote control of measuring instruments using interfaces such as GPIB, Ethernet, USB, etc.

*5: World de facto standard I/O software interface developed by NI and standardized by the VXI Plug&Play Alliance.

National Instruments™, NI™, NI-VISA™ and National Instruments Corporation are all trademarks of National Instruments Corporation.

Optional Accessories

Model/Order No.	Name
J1621A	Passive Equalizer 3 dB
J1622A	Passive Equalizer 6 dB
J0008	GPIB Cable 2 m
J1137	Terminator (50 Ω)
J1341A	Open
J1342A	Coaxial Cable 0.8 m (APC-3.5, DC to 27.5 GHz)
J1349A	Coaxial Cable 0.3 m (SMA, DC to 18 GHz)
J1439A	Coaxial Cable 0.8 m (K connector, DC to 40 GHz)
J1620A	Coaxial Cable (0.9 m, K connector)
J1550A	Coaxial Skew Match Cable (0.8 m, APC3.5, DC to 27.5 GHz, Skew <3 ps, pair cable)
J1551A	Coaxial Skew Match Cable (0.8 m, K connector, DC to 40 GHz, Skew <3 ps, pair cable)
J1611A	Coaxial Cable (1.3 m, K connector, DC to 40 GHz)
J1615A	Coaxial Cable Set (PPG-Emphasis, for jitter tolerance measurement, 2 pcs)
J1618A	Coaxial Cable Set (Jitter-2chPPG-2chEmphasis, for jitter tolerance measurement, 6 pcs)
J1359A	Coaxial Adapter (K-P, K-J, SMA)
J1360A	Measurement Kit <J1342A × 2, J1625A × 1>
J1449A	Measurement Kit (K connector) <J1439A × 2, J1342A × 2, J1625A × 1>
J1678A	ESD Protection Adapter-K
J1679A	ESD Protection Adapter-V
J1600A	Skew Match Pair Cable (0.2 m, V connector)
J1656A	Coaxial Cable Set (MP1861A – MP1862A)
J1646A	Passive Equalizer 6 dB (V connector)
Z0897A	MP1800A Manual CD
Z0917A	Shielded LAN Cable, 5 m (CAT5, Straight)
Z0918A	MX180000A Software CD
B0588A	Rack Mount Kit (MP1800A)
B0576A	Blank Panel
B0566A	MP1800A Hard Carrying Case (MP1800A)
W2745AE	MP1800A Operation Manual
W2747AE	MP1800A Installation Guide
W2746AE	MT1810A Operation Manual
W2748AE	MT1810A Installation Guide
W2750AE	MU181000A/B Operation Manual
W2752AE	MU181020B Operation Manual
W2753AE	MU181040B Operation Manual
W3481AE	MU181500B Operation Manual
W2751AE	MU181800A/B Operation Manual
W3594AE	MU183020A/MU183021A Operation Manual
W2749AE	MX180000A Operation Manual
W2799AE	MX180000A Remote Control Operation Manual
W2884AE	MX180001A Operation Manual
W2886AE	MX180003A Operation Manual
W2887AE	MX180004A Operation Manual
W2926AE	MX180005A Operation Manual
W3480AE	MX181500A Operation Manual
W3813AE	MX183000A Operation Manual
41KC-3	Precision Fixed Attenuator 3 dB
41KC-6	Precision Fixed Attenuator 6 dB
41KC-10	Precision Fixed Attenuator 10 dB
41KC-20	Precision Fixed Attenuator 20 dB
K240C	Precision Power Divider
K241C	Precision Power Splitter
Z0306A	Wrist Strap
P0047A	Frequency Doublers
Z1340A	13 GHz BPF
G0361A	64Gbaud 2-bit DAC with MUX
J1398A	N-SMA ADAPTOR
J1508A	BNC-SMA Connector Cable (30 cm)
J1510A	Pick OFF Tee
J1627A	GND Connection Cable
J1624A	Coaxial Cable 0.3 m (SMA Connector)
J1625A	Coaxial Cable 1 m (SMA Connector)
J1632A	Terminator (SMA)
J1715A	Coaxial Skew Match Cable (0.1M, SMP-J,SMA-J)
K220B	Coaxial Adapter
K261	DC Block
K250	Bias T
Z1927A	USB Measurement Kit
J1721A	USB Measurement Component Set
J1722A	PCIe Measurement Component Set
J1723A	TBT Measurement Component Set
J1724A	Compliance Test Component Set
J1735A	Combiner
J1728A	Electrical Length Specified Coaxial Cable (0.4 m, K connector)
J1741A	Electrical Length Specified Coaxial Cable (0.8 m, K Connector)
J1742A	Electrical Length Specified Coaxial Cable (0.84 m, K Connector)
G0373A*6	USB3.1 Receiver Test Adapter
G0374A*6	64Gbaud PAM4 DAC

*6: The warranty period shall be 1 year under normal use.
Repair by exchange for new during the warranty period shall be limited to one instance.
Repair using new spare parts shall be charged after the warranty period has expired.

Moreover, Anritsu Corporation will deem this warranty void when:

- When new spare parts can no longer be easily obtained when more than 5 years have elapsed after manufacture.

56G/64G bit/s MUX, 56G/64G bit/s DEMUX

MP1861A/MP1862A

Developing 400 GbE and CEI-56G

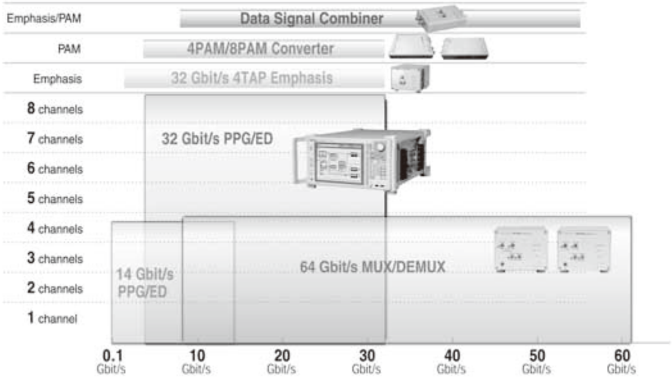
MP1861A

MP1862A

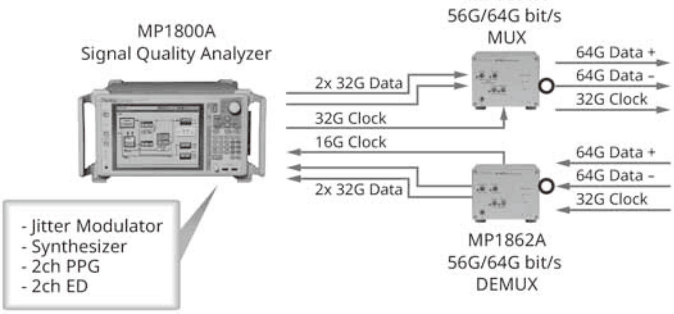
Traffic volumes at data centers are exploding due to the rapid spread of cloud computing services. To increase transmission speeds, standards for new high-speed interfaces like 400 GbE and CEI-56G are being investigated. Assuring signal integrity of PHY devices like SERDES used by these high-speed interfaces is a key requirement in speed increases. Linking the MUX MP1861A and DEMUX MP1862A with the Signal Quality Analyzer MP1800A with installed 32G PPG/ED and Jitter Modulation Source option supports generation of NRZ Data signals at up to 64.2 Gbit/s, BER measurements and Jitter Tolerance measurements. New standards such as CEI-56G are also supported by Jitter Tolerance measurements of jitter components such as Dual Tone SJ (two different frequencies), RJ, BUJ, SSC, and Half Period Jitter (Even/Odd Jitter) as well as Bathtub Jitter measurements. With its built-in Jitter Tolerance Software for Emphasis and PAM signal generation and Equalizer for correcting the Eye opening, Anritsu’s MP1800A is the ideal total solution for signal integrity evaluation.

Multichannel BER and Jitter Measurements using Modular Configuration

The modular configuration is easily customized for 32G multichannel, PAM, Emphasis and 56G/64G serial/multichannel signal analyses and measurements supporting 100G/400G R&D required by new IEEE and OIF standards, helping cut future equipment investment costs.



Synchronous operation of up to four MP1800A units generates 64G × 16ch signals.

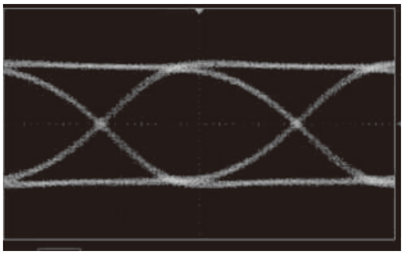


Supports 64G signal quality evaluations using one MP1800A and MUX/DEMUX.

Low-Jitter and High-Quality Waveform MUX

The MUX MP1861A outputs low-jitter, high-quality waveforms. Various output amplitude options can be selected to match the application.

Low Jitter: RJ = 200 fs rms (typ.)
Amplitude: 0.5 Vp-p to 2.5 Vp-p (≤56.2 Gbit/s, MP1861A-011)
1.0 Vp-p to 2.5 Vp-p (>56.2 Gbit/s, MP1861A-011)
0.5 Vp-p to 3.5 Vp-p (≤56.2 Gbit/s, MP1861A-013)
1.0 Vp-p to 3.5 Vp-p (>56.2 Gbit/s, MP1861A-013)



Output Waveform at 50 Gbit/s and 3.5 Vp-p (MP1861A-013)

High-Sensitivity DEMUX

The DEMUX MP1862A has high sensitivity to support various applications up to 64 Gbit/s.

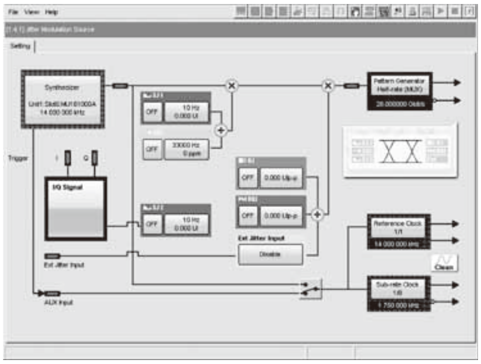
Sensitivity: 25 mV (typ.)
≤40 mV (Eye Height, PRBS31, Single-ended, 56.2 Gbit/s)

SJ, RJ, BUJ, SSC and Half Period Jitter (F/2 Jitter) Generation

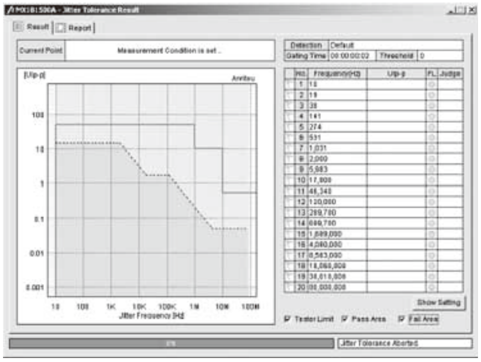
The Jitter Modulator MU181500B generates wide-amplitude SJ up to 0.55 UI at a Jitter Frequency of 250 MHz and a maximum 2000 UI, ensuring sufficient margin for receiver Jitter Tolerance tests. Additionally, the Intrinsic Jitter of 275 fs rms (nominal)* is extremely low, not only when Jitter modulation is OFF but also when 0 UI is set at Jitter modulation ON, ensuring accurate measurements even at low Jitter amplitudes.

The combination of low intrinsic jitter waveform with excellent jitter transparency supports high-accuracy Jitter Tolerance tests. Moreover, simultaneous injection of RJ, BUJ and SSC as well as dual SJ for two-tone supports various Jitter Tolerance tests. Additionally, the Jitter/Noise Tolerance Test Software MX181500A supports multi-mask tables as well as easy mask editing to support next-generation standards.

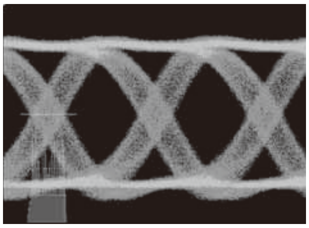
*: Phase noise measurement with using Spectrum Analyzer and 1010... repetition signal.



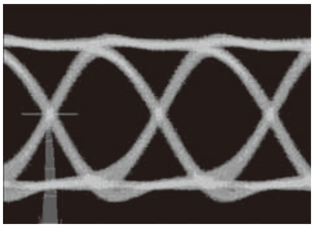
Jitter Modulation Source MU181500B
Setting Screen



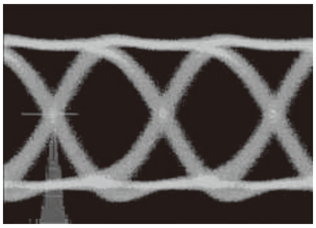
Jitter/Noise Tolerance Test Software MX181500A
Setting Screen



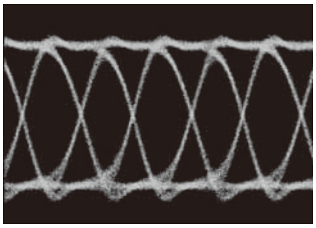
Sinusoidal Jitter (SJ)



Random Jitter (RJ)



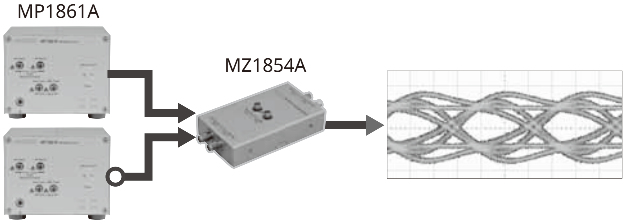
Bounded Uncorrelated Jitter (BUJ)



Half Period Jitter (F/2 Jitter)

Emphasis Signal Generation

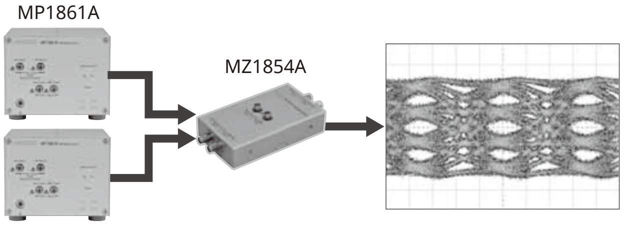
Linking two MUXes MP1861A using the Data Signal Combiner MZ1854A supports generation of a 2Tap Emphasis signal at up to 57.8 Gbit/s. Since the MP1800A external Remote Head can get close to the DUT, the effect of cable losses is minimized to assure high signal quality is maintained. Accurate Jitter Tolerance tests are possible using the pre-Emphasis signal supporting transmission path loss required by CEI-56G.



Generation using 2ch Sync,
1-bit delay and inverse addition Emphasis waveform

PAM4 Signal Generation

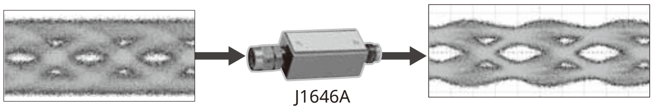
Linking two MUXes MP1861A using the Data Signal Combiner MZ1854A supports generation of PAM4 signals up to 56.2 Gbaud.
Using the MP1861A high-quality NRZ waveform with a wideband passive combiner supports generation of the PAM signals required for R&D into high-speed backplanes and high-speed optical modulation.



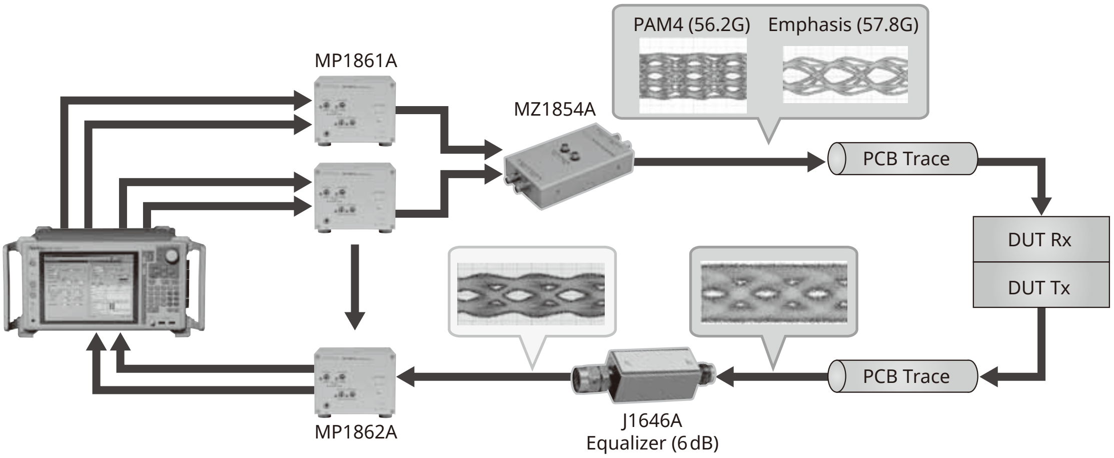
PAM4 Waveform generation using 2 ch Sync,
any bit delay and addition

Passive Equalizer

High-speed serial transmissions such as 56 Gbit/s suffer from a closed Eye opening due to losses in the transmission path. Inserting the Passive Equalizer J1646A upstream of the DEMUX MP1862A compensates for transmission path losses and restores the Eye opening. Combination with the high-sensitivity DEMUX MP1862A supports BER measurements and Jitter Tolerance tests of PHY devices with a closed Eye opening.



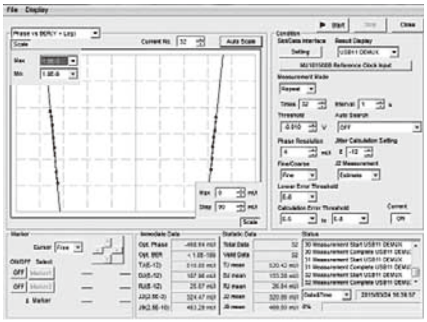
Eye Opening using Passive Equalizer



Measurement System using MP1861A, MP1862A, MZ1854A and J1646A

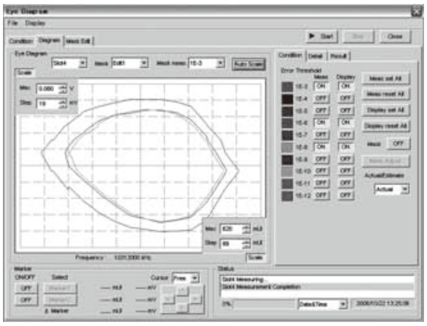
Bathtub Jitter

Measures optimum bit error rate based on changes in bit error rate relative to phase margin and performs jitter analysis (TJ, DJ, RJ).



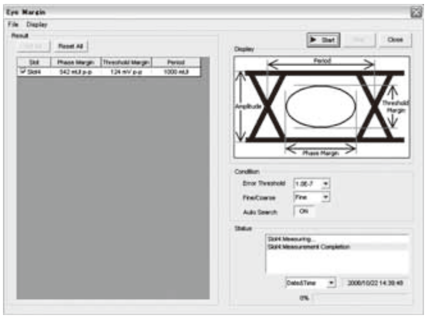
Eye Diagram

Captures bit error rate contours linking specified bit error rate points.



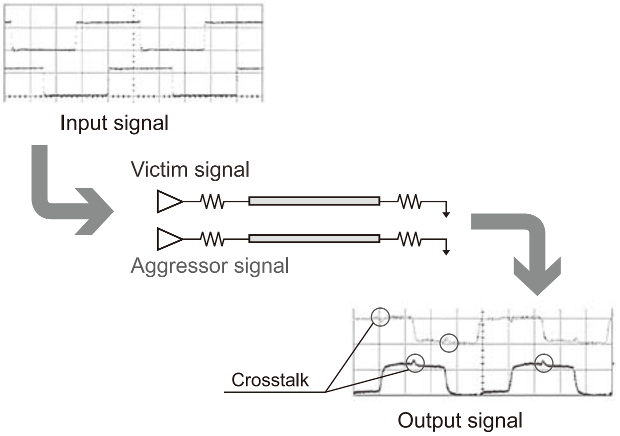
Eye Margin

Confirms Data threshold and phase margins.



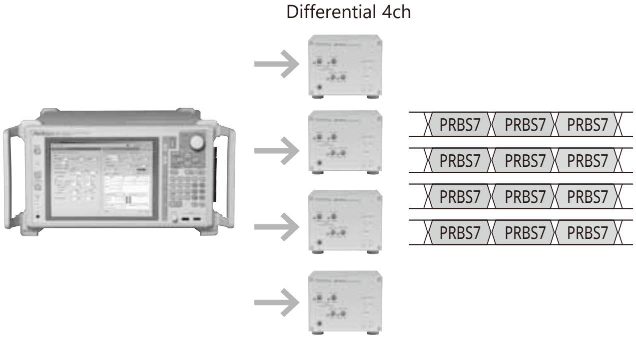
Crosstalk Tests

Independently controls phase for each channel using built-in PPG Data Delay option to examine DUT crosstalk characteristics with excellent accuracy in 4-mUI steps.



Up to 4ch Sync

Using an external MUX and DEMUX supports syncing for up to 4ch by connecting to the PPG and ED modules installed in the MP1800A. D/A converter, crosstalk and skew tolerance tests are all supported.

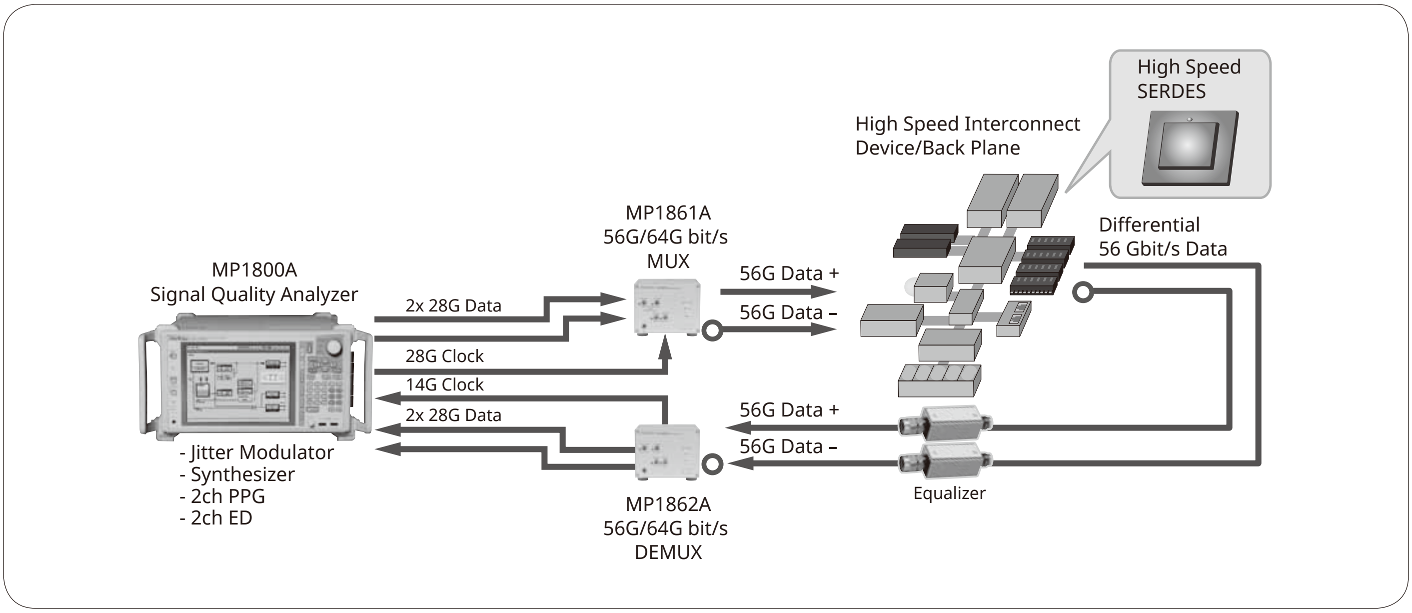


Versatile Pattern Generation

- Pseudorandom Patterns (PRBS)
  All PRBS patterns required by standards are supported up to PRBS $2^{31} – 1$.
  $2^n – 1$ (n = 7, 9, 10, 11, 15, 20, 23, 31)
- Zero Substitution Pattern
  Consecutive 0 s and 1 s patterns can be added to PRBS patterns for Clock Data Recovery (CDR) tolerance tests.
  2^n, $2^n – 1$ (n = 7, 9, 10, 11, 15, 20, 23)
- Data Pattern
  Patterns required by each application, such as CJTPAT, CJPAT, K28.5 and PAM4 PRBS can be created flexibly.
  512 Mbits/ch max. (Steps: 2 bit)
- Mixed Pattern
  A mixed data and PRBS pattern can be output. At creation of SONET/SDH frames, adding a PRBS$2^{31} – 1$, etc., pattern to the payload supports setting of a continuous pattern across frames.
- Burst Signals
  Application evaluation using burst signals, such as optical loop test and transmission test using quantum noise technology are supported.

Applications

Measuring 56-Gbit/s Band High-Speed Semiconductor Chips



Test Requirements
- 56 Gbit/s BER Measurements
- Jitter Tolerance Measurements
- Input Sensitivity Test
- Bathtub Jitter Measurements

56 Gbit/s BER Measurements

The bit rates of high-performance servers, switch backplanes, etc., are becoming increasingly faster while consuming less power. Evaluation of signal integrity is important for evaluating dropping input/output amplitudes of semiconductor chips such as SERDES and CDR to reduce power consumption. The signal output of these low-amplitude devices can be received securely using the high-sensitivity performance 25 mV (typ.) of the DEMUX MP1862A.

Input Sensitivity Tests

With a wide tuning range of 0.5 Vp-p to 3.5 Vp-p max., the MUX MP1861A supports device input sensitivity tests (when 56 Gbit MP1861A-013 installed.) The MP1861A incorporates a 6-dB ATT as standard for use over a range of 0.25 Vp-p to 1.75 Vp-p.
Anritsu recommends using a 6-dB ATT to prevent risk of damage from EOS (Electric Over Stress).

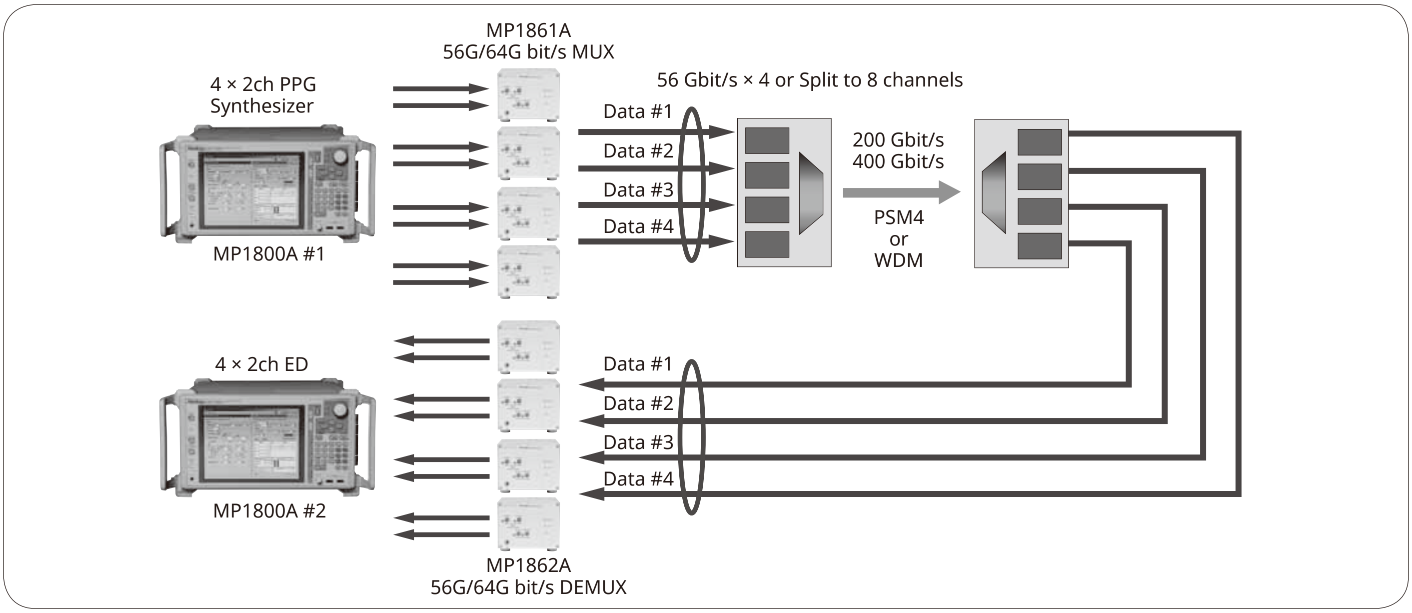
Jitter Tolerance Tests

Installing the Jitter Modulation Source MU181500B in the MP1800A supports independent and simultaneous injection of Dual SJ (two types), RJ, BUJ, and SSC jitter components for Jitter Tolerance tests meeting various standards, such as CEI-56G, etc.

Bathtub Jitter Measurement

Standards such as CEI-56G specify device output Jitter Tolerance values. Bathtub Jitter measurement analyzes the device Total Jitter (TJ) and RJ and DJ components from changes in the bit error rate with phase. It also calculates the optimum bit error rate.
A clean Clock reference signal is required by the DEMUX and ED at Bathtub Jitter measurement. The MP1862A supports Bathtub Jitter measurement using a clean Clock with jitter addition.

Evaluating 400 GbE Transmitters



Test Requirements
- 4ch Simultaneous BER Measurement
- Optimized Optical Output Waveform using Crosspoint Adjustment
- Lane Timing and Skew Control
- Input Sensitivity Tests

Evaluating 400 GbE and 56G × 4 Lane Systems

By using a MUX/DEMUX supporting bit rates up to 56 Gbit/s, it is possible to evaluate 400 GbE EML and optical modules using 4ch synchronous operation now being investigated by IEEE 802.3 bs.

Ideal Signal Quality for EML Evaluations

With a tunable output function of up to 3.5 Vp-p, EMLs can be driven directly. The amplitude and crosspoint can be adjusted easily on the screen to shorten evaluation times and offer high-reliability evaluations.

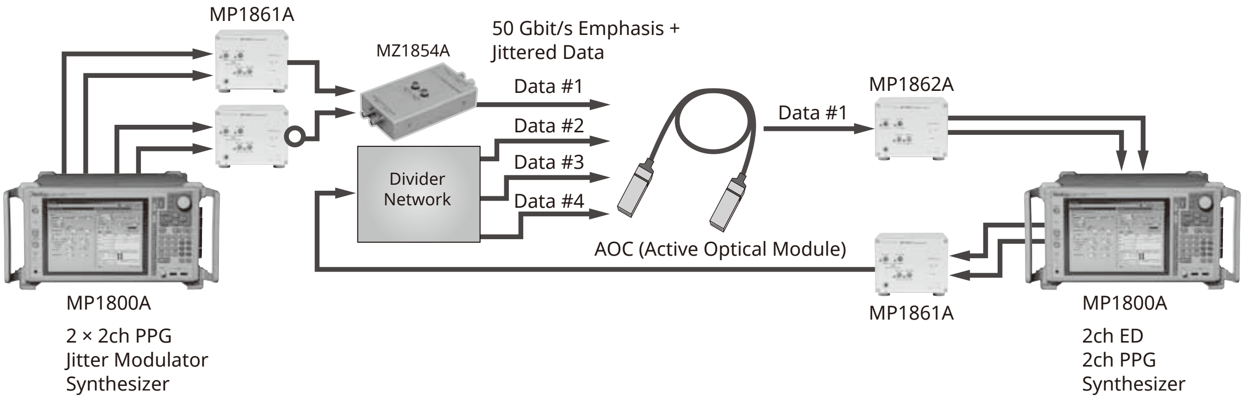
Confirming Skew and Crosstalk Effects

Applications using 56-Gbit/s class signals require both theoretical and practical verifications. Since the MP1800A supports pattern synchronization and has a phase tuning function, it is the ideal instrument for easy examination of Rx device skew tolerance, crosstalk effects, etc.

Built-in High-Sensitivity Auto-Search Function

The built-in DEMUX MP1862A Auto Search function supports auto-tuning of the Data and Clock phase difference as well as optimization of the voltage threshold value.
It is possible to easy operation for optical receiver sensitivity tests.

AOC/Backplane Device Stress Jitter Tolerance Test



Test Requirements
- Emphasis Signal Generation
- Crosstalk Test
- Jitter Tolerance Test
- Bathtub Jitter and Eye Diagram Analyses

Generating Emphasis
Emphasis signals can be generated using the MP1861A 2ch synchronization function and Data Signal Combiner MZ1854A to compensate for transmission path losses at the electrical interface of Active Optical Cables (AOC) and Backplane devices and recover the Eye opening.

Jitter Tolerance Tests
The Jitter Modulation Source MU181500B injects SJ (two types), RJ, BUJ, and SSC simultaneously or independently for Jitter Tolerance tests meeting various standards.

Confirming Crosstalk Effects
Processing of 56-Gbit/s class signals requires both theoretical and practical verification. With its pattern synchronization and independent phase tuning function for each channel, the MP1800A makes it easy to examine AOC and Backplane crosstalk effects, etc.

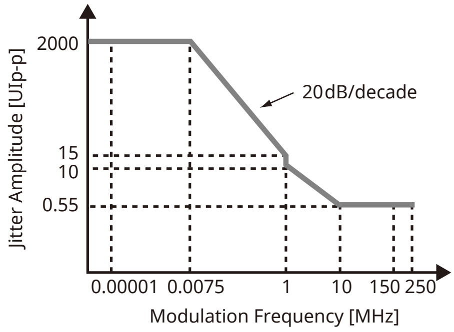
Bathtub and Eye Diagram Analyses
Bathtub Jitter analysis (TJ, RJ, DJ components) is performed using the Clock Delay function of the built-in ED. Even low bit-error rates, such as 1E-12 and 1E-15, can be estimated quickly from changes in the bit error rate with phase.

Specifications

56G/64G bit/s MUX MP1861A

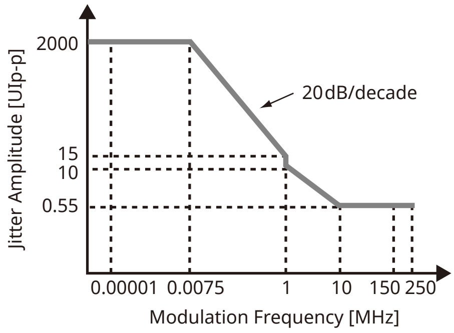
Operational Bit-rate Range	8 Gbit/s to 56.2 Gbit/s 8 Gbit/s to 64.2 Gbit/s (with Option 01 installed)
External Clock Input (Half-rate Clock Input)	Number of Input: 1 Frequency: 4 GHz to 28.1 GHz 4 GHz to 32.1 GHz (with Option 01 installed) Amplitude: 0.3 Vp-p to 1.0 Vp-p Termination: 50Ω/AC Coupling Connector: K (f)
Data Input	Number of Input: 2 (Data Input1, Data Input2) Input level: 0/–0.7 V (H: –0.15 to +0.05, L: –0.85 to –0.55) Termination: 50Ω/GND Connector: K (f)
1/2 Clock Output	Number of Output: 1 Frequency: 2 GHz to 14.05 GHz 2 GHz to 16.05 GHz (with Option 01 installed) Output amplitude: 0.3 Vp-p to 1.0 Vp-p Termination: 50Ω/AC Coupling Connector: SMA (f)
Clock Output 1, 2	Number of Output: 2 (Clock Output1, Clock Output2) Frequency: 4 GHz to 28.1 GHz 4 GHz to 32.1 GHz (with Option 01 installed) Output amplitude: 0.4 Vp-p to 1.0 Vp-p Termination: 50Ω/AC Coupling Connector: K (f)

Continued on next page

<table>
<tr><td colspan="2">Buffered Clock Output</td><td colspan="2">Number of Output: 1
Frequency: 4 GHz to 28.1 GHz
4 GHz to 32.1 GHz (with Option 01 installed)
Output amplitude: 0.2 Vp-p to 1.0 Vp-p
Termination: 50Ω/AC Coupling
Connector: K (f)</td></tr>
<tr><td colspan="2">Delayed Clock Output</td><td colspan="2">Number of Output: 1
Frequency: 4 GHz to 28.1 GHz
4 GHz to 32.1 GHz (with Option 01 installed)
Output amplitude: 0.2 Vp-p to 1.0 Vp-p
Termination: 50Ω/AC Coupling
Connector: K (f)</td></tr>
<tr><td colspan="2">MUX Clock Input</td><td colspan="2">Number of Input: 1
Frequency: 4 GHz to 28.1 GHz
4 GHz to 32.1 GHz (with Option 01 installed)
Amplitude: 0.2 Vp-p to 1.0 Vp-p
Termination: 50Ω/AC Coupling
Connector: K (f)</td></tr>
<tr><td colspan="2" rowspan="4">Data Output*1</td><td>Option x11</td><td>Option x13</td></tr>
<tr><td colspan="2">Number of Output: 2 (Data Output/$\overline{\text{Data}}$ Output)</td></tr>
<tr><td>Amplitude: 0.5 Vp-p to 2.5 Vp-p/2 mV Step (@≤56.2 Gbit/s)
1.0 Vp-p to 2.5 Vp-p/2 mV Step (@>56.2 Gbit/s)</td><td>Amplitude: 0.5 Vp-p to 3.5 Vp-p/2 mV Step (@≤56.2 Gbit/s)
1.0 Vp-p to 3.5 Vp-p/2 mV Step (@>56.2 Gbit/s)</td></tr>
<tr><td colspan="2">Setting Error: ±50 mV ±17% of Amplitude*2, *3, *4
Offset: –2.0 to +3.3 Voh/1-mV Step, min.: –4.0 Vol
Setting Error: ±65 mV ±10% of Offset (Vth) ± (Output amplitude setting error/2)
Current Limit: Source 100 mA/Sink 100 mA
Crosspoint: 45 to 55%/0.1% Step (≤56.2 Gbit/s)
>56.2 Gbit/s, with MP1861A-x 01 installed: Since >50% is not assured, displays Overload
Tr/Tf: Typ. 8 ps (20 to 80%)*2, *3, *4
Half Period Jitter: –20 to 20/1 Step
Jitter (rms): 450 fs typ., ≤550 fs*2, *4, *5
650 fs typ.*3, *4, *5
Random Jitter (rms): 200 fs typ.*2, *4, *5
Waveform Distortion (0-peak): ±25 mV ±10% of Amplitude typ.*2, *3, *4, *6
ON/OFF Output Switch Function
Termination: AC/DC switchable, 50Ω/GND, –2 V, +1.3 V (at DC selection)
Connector: V (f)</td></tr>
<tr><td colspan="2">Jitter Tolerance</td><td colspan="2">56.2 Gbit/s, 64.2 Gbit/s (with Option 01 installed), at PRBS2^{31} – 1, Mark ratio 1/2,
Crosspoint 50%, MP1861A – MP1862A Loopback, Temperature: +20° to +30°C
56.2 Gbit/s up to 250 MHz modulation frequency; 64.2 Gbit/s up to 150 MHz modulation frequency

 </td></tr>
<tr><td colspan="2">Variable Data Delay</td><td colspan="2">Variable Phase Range: –64000 mUI to +64000 mUI/4 mUI Step
Phase Setting Error: ±50 mUIp-p typ.*5</td></tr>
<tr><td colspan="2">Control Interface</td><td colspan="2">USB 2.0 or 1.1 Type B × 1</td></tr>
<tr><td colspan="2">Channel Setting</td><td colspan="2">1ch to 4ch Selectable</td></tr>
<tr><td colspan="2">Power Supply (AC adapter)</td><td colspan="2">Input Voltage: 100 V(ac) to 240 V(ac)*7
Input Frequency: 50 Hz to 60 Hz
Output power: 19 V(dc), 7.9 A (max.)</td></tr>
<tr><td colspan="2">Power Consumption</td><td colspan="2">19 V(dc), 4 A</td></tr>
<tr><td colspan="2">Dimensions and Mass</td><td colspan="2">120 (W) × 90.9 (H) × 140 (D) mm (Excluding protrusions), ≤5 kg</td></tr>
<tr><td colspan="2">Temperature</td><td colspan="2">Operation: +15° to +35°C (with options installed)
Storage: –20° to +60°C</td></tr>
<tr><td rowspan="3">CE</td><td>EMC</td><td colspan="2">2014/30/EU, EN61326-1, EN61000-3-2</td></tr>
<tr><td>LVD</td><td colspan="2">2014/35/EU, EN61010-1</td></tr>
<tr><td>RoHS</td><td colspan="2">2011/65/EU, EN50581</td></tr>
</table>

*1: Unless otherwise described, at PRBS2^{31} – 1, Mark Ratio 1/2. Values observed using coaxial cable J1655A and 70-GHz band sampling oscilloscope
*2: At 56.2 Gbit/s
*3: 64.2 Gbit/s (with MP1861A Option x01 installed)
*4: Crosspoint: 50%
*5: Jitter Standard values when oscilloscope intrinsic jitter ≤200 fs
*6: Output Amplitude: 2.5 Vp-p
*7: Operation voltage: +10% and –15% of specified voltage

56G/64G bit/s DEMUX MP1862A

Operational Bit-rate Range	8 Gbit/s to 56.2 Gbit/s 8 Gbit/s to 64.2 Gbit/s (with Option 01 installed)
External Clock Input (Half-rate Clock Input)	Number of Input: 1 Frequency: 4 GHz to 28.1 GHz 4 GHz to 32.1 GHz (with Option 01 installed) Amplitude: 0.3 Vp-p to 1.0 Vp-p Termination: 50Ω/AC Coupling Connector: K (f)
Data Output	Number of Output: 2 (Data Output1, Data Output2) Output Level: 0/–0.4 V (H: –0.1 to +0.1, L: –0.6 to –0.3) Termination: 50Ω/GND Connector: K (f)
1/2 Clock Output	Number of Output: 1 Frequency: 2 GHz to 14.05 GHz 2 GHz to 16.05 GHz (with Option 01 installed) Output amplitude: 0.3 Vp-p to 1.0 Vp-p Termination: 50Ω/AC Coupling Connector: SMA (f)
Clock Output	Number of Output: 1 Frequency: 4 GHz to 28.1 GHz 4 GHz to 32.1 GHz (with Option 01 installed) Output amplitude: 0.4 Vp-p to 1.0 Vp-p Termination: 50Ω/AC Coupling Connector: K (f)
Buffered Clock Output	Number of Output: 1 Frequency: 4 GHz to 28.1 GHz 4 GHz to 32.1 GHz (with Option 01 installed) Output amplitude: 0.2 Vp-p to 1.0 Vp-p Termination: 50Ω/AC Coupling Connector: K (f)
Delayed Clock Output	Number of Output: 1 Frequency: 4 GHz to 28.1 GHz 4 GHz to 32.1 GHz (with Option 01 installed) Output amplitude: 0.2 Vp-p to 1.0 Vp-p Termination: 50Ω/AC Coupling Connector: K (f)
DEMUX Clock Input	Number of Input: 1 Frequency: 4 GHz to 28.1 GHz 4 GHz to 32.1 GHz (with Option 01 installed) Amplitude: 0.2 Vp-p to 1.0 Vp-p Termination: 50Ω/AC Coupling Connector: K (f)
Data Input	Number of Input: 2 (Data Input/$\overline{\text{Data}}$ Input), Differential Amplifier: Single-ended, 50Ω, Differential 50Ω, Differential 100Ω selectable Data, XData selectable Tracking, Independent, Alternate selectable At Alternate setting: Data-XData, XData-Data selectable (Absolute value of Data, XData Threshold Difference: 3.0 V max.) Input Data Format: NRZ Amplitude: 0.125 Vp-p to 1.0 Vp-p$^{*1, *2}$ Threshold Voltage: –3.5 V to +3.3 V/1-mV step (independently settable Data, selectable. Absolute value of Data, XData Threshold Difference: 3.0 V max.) Input Sensitivity: 25 mV typ., ≤40 mV$^{*1, *3, *4, *5}$ 30 mV typ.$^{*1, *4, *5, *6}$ Phase Margin: 200° typ.$^{*3, *6, *7}$ Termination: 50Ω/GND, Variable Termination Voltage: –2.5 V to +3.5 V/0.01-V step at Variable setting Connector: V (f)
Jitter Tolerance	56.2 Gbit/s, 64.2 Gbit/s (with Option 01 installed), PRBS 2^{31} – 1, Mark ratio 1/2, Crosspoint 50%, MP1861A – MP1862A Loopback, Temperature: +20° to +30°C 56.2 Gbit/s up to 250 MHz modulation frequency; 64.2 Gbit/s up to 150 MHz modulation frequency 

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Variable Clock Phase		Variable Phase Range: –1000 mUI to +1000 mUI/4 mUI Step Phase Setting Error: ±50 mUIp-p typ.[*8]
Automatic Measurement		Auto Search, Eye Margin, Eye Diagram, Bathtub
BER Measurement Result Display		With indication screens
Control Interface		USB 2.0 or 1.1 Type B × 1
Channel Setting		1ch to 4ch Selectable
Power Supply (AC adapter)		Input Voltage: 100 V(ac) to 240 V(ac)[*9] Input Frequency: 50 Hz to 60 Hz Output power: 19 V(dc), 7.9 A (max.)
Power Consumption		19 V(dc), 4 A
Dimensions and Mass		120 (W) × 90.9 (H) × 140 (D) mm (Excluding protrusions), ≤5 kg
Temperature		Operation: +15° to +35°C (with options installed) Storage: –20° to +60°C
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

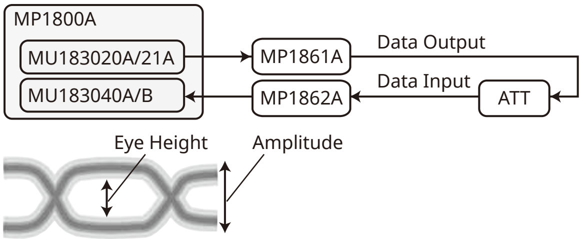
*1: At single-ended, 50Ω

*2: Amplitude range using Auto Search and Auto Measurement functions. Sensitivity at minimum error-free input amplitude.

*3: At 56.2 Gbit/s

*4: At PRBS 2^{31} – 1, Mark Ratio 1 /2, +20° to +30°C, using coaxial cable J1656A

*5: Standard at Eye Height. Using the measurement system shown in the following diagram (output amplitude monitored using sampling oscilloscope with bandwidth of better than 70 GHz and intrinsic jitter of less than 200 fs), Eye Height (total measurement count of 30) is the value of the amplitude measured by the oscilloscope when the BER becomes 1E-9 when the amplitude is decreased using the MP1861A + ATT.



*6: 64.2 Gbit/s (with MP1862A Option x01 installed)

*7: Standard with Tx intrinsic jitter component deducted

*8: Jitter standard value when oscilloscope intrinsic jitter ≤200 fs

*9: Operation voltage: +10% and –15% of specified voltage

Data Signal Combiner MZ1854A

Data Output	Number of Output: 2 (Data, XData) Output Amplitude[*1]: 0.238 Vp-p to 0.594 Vp-p (with using MP1861A-011) 0.238 Vp-p to 0.832 Vp-p (with using MP1861A-013) Connector: V (f)
Data Input	Number of Input: 4 (Data1, XData1, Data2, XData2) Input Amplitude: 0.5 Vp-p to 3.5 Vp-p Connector: V (m)
Insertion Loss	–16 dBm (nominal)[*2]
General	Temperature Operation: +15° to +35°C Storage: –20° to +60°C Dimensions and Mass: 60.2 (W) × 104.7 (H) × 23.5 (D) mm (Excluding protrusions), ≤2 kg

*1: Level 0 to 3

*2: Data_n input to Data output

Passive Equalizer 6 dB (V connector) J1646A

Frequency Range	DC to 28 GHz (56 Gbit/s band)
Slope	6.0 dB ±1.0 dB
Insertion Loss	At 28 GHz ≤2.8 dB
Return Loss	11 dB (min.)
General	Connector: V Impedance: 50Ω Dimensions: 44 (W) × 12 (H) × 11 (D) mm

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

56G/64G bit/s MUX MP1861A

Model/Order No.	Name	
	Main frame	
MP1861A	56G/64G bit/s MUX	
	Standard accessories	
J1658A	Coaxial Skew Match Pair Cable (1.3 m, K Connector):	1 set
J1652A	Coaxial Cable (0.5 m, K Connector):	1 pc
J1654A	U Link Cable B:	1 pc
J1363A	Protection Cap:	2 pcs
41V-6	Precision Fixed Attenuator 6 dB:	2 pcs
J1632A	Terminator:	4 pcs
J1341A	Open:	3 pcs
J1655A	Semi-rigid Cable (0.2 m, V):	1 pc
J1475A	USB Cable:	1 pc
Z1312A	AC Adapter:	1 pc
G0342A	ESD Discharger:	1 pc
J0017	Power Cord, 2.5 m:	1 pc
Z0897A	MP1800A Manual CD:	1 pc
Z0918A	MX180000A Software CD:	1 pc
	Options	
MP1861A-001	64G bit/s Extension	
MP1861A-011	Variable Data Output (0.5 to 2.5 Vp-p)	
MP1861A-013	Variable Data Output (0.5 to 3.5 Vp-p)	
MP1861A-030	Variable Data Delay	
	Retrofit options	
MP1861A-101	64G bit/s Extension Retrofit	
MP1861A-111	Variable Data Output (0.5 to 2.5 Vp-p) Retrofit	
MP1861A-113	Variable Data Output (0.5 to 3.5 Vp-p) Retrofit	
MP1861A-130	Variable Data Delay Retrofit	
	Optional accessories	
J1600A	Skew Match Pair Cable (0.2 m, V connector)	
J1656A	Coaxial Cable Set (MP1861A – MP1862A)	
J1646A	Passive Equalizer 6 dB (V connector)	
	Maintenance service	
MP1861A-ES310	Three Years Extended Warranty Service	
MP1861A-ES510	Five Years Extended Warranty Service	

56G/64G bit/s DEMUX MP1862A

Model/Order No.	Name	
	Main frame	
MP1862A	56G/64G bit/s DEMUX	
	Standard accessories	
J1657A	Coaxial Cable (1.3 m, K Connector):	2 pcs
J1668A	Coaxial Cable (0.8 m, K connector):	1 pc
J1654A	U Link Cable B:	1 pc
J1363A	Protection Cap:	2 pcs
41V-6	Precision Fixed Attenuator 6 dB:	2 pcs
J1632A	Terminator:	5 pcs
J1341A	Open:	1 pc
J1475A	USB Cable:	1 pc
Z1312A	AC Adapter:	1 pc
G0342A	ESD Discharger:	1 pc
J0017	Power Cord, 2.5 m:	1 pc
Z0897A	MP1800A Manual CD:	1 pc
Z0918A	MX180000A Software CD:	1 pc
	Options	
MP1862A-001	64G bit/s Extension	
	Retrofit options	
MP1862A-101	64G bit/s Extension Retrofit	
	Optional accessories	
J1600A	Skew Match Pair Cable (0.2 m, V connector)	
J1656A	Coaxial Cable Set (MP1861A – MP1862A)	
J1646A	Passive Equalizer 6 dB (V connector)	
	Maintenance service	
MP1862A-ES310	Three Years Extended Warranty Service	
MP1862A-ES510	Five Years Extended Warranty Service	

Data Signal Combiner MZ1854A

Model/Order No.	Name
	Main frame
MZ1854A	Data Signal Combiner
	Standard accessories
Z0897A	MP1800A Manual CD

Software

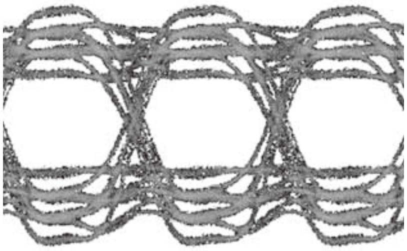
Model/Order No.	Name
MX181500A	Jitter/Noise Tolerance Test Software

4Tap Emphasis

MP1825B

Characteristics Evaluation for Interconnect Serial Interface with 32.1 Gbit/s 4 Taps Pre-emphasis Signals

The passage of signals through printed-circuit board (PCB) wiring causes signal level attenuation and quality degradation, resulting in a closed Eye diagram. Since it is impossible to transfer high-speed signals through PCBs without attenuation, many interconnect interfaces use pre-emphasis technology to maintain the Eye opening by correcting the level attenuation.
The 4Tap Emphasis MP1825B is a 4 taps pre-emphasis converter for bit rates up to 32.1 Gbit/s; it supports easy changes to the pre-emphasis waveform amplitude, offset, amplitude of each tap, etc., for effective evaluation of the characteristics of high-speed interfaces, such as PCI Express, USB, and Backplane Ethernet requiring pre-emphasis signals, as well as InfiniBand 26G-IB-EDR, CEI-28G-VSR, 32G FC, etc..



Target Applications

CEI-28G-SR/VSR, InfiniBand FDR (14G)/EDR (26G), PCI Express, 100 GbE (100GBASE-CR4, KR4)

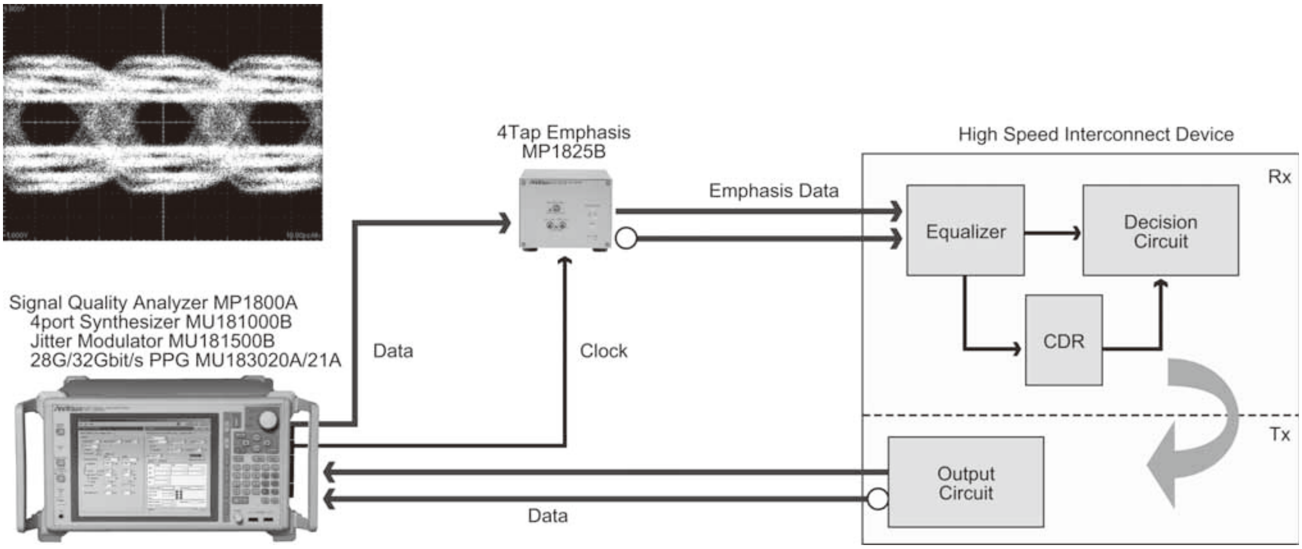
Features

- Pre-emphasis up to 4 Taps
  Generates 2 and 3 taps pre-emphasis signals required for various standards and supports up to 4 taps. Since each tap can be changed independently, the effect of adding pre-emphasis can be confirmed accurately.
- Jitter Transparent
  Supports accurate jitter tolerance tests due to transparent input data and clock jitter.
- Compact Remote Head
  Shorter cable to DUT minimizes cable effects and assures high signal quality.
- Supports Two Ranges of Bit Rates
  Choice of two configurations tailored to application, supporting 1 Gbit/s to 14.1 Gbit/s (MP1825B-001, 005) and 1 Gbit/s to 32.1 Gbit/s (MP1825B-002, 006).
- Use as Front End for Other Makers' BERTs and Customers' Devices
  Independent operation via USB control can generate pre-emphasis signals using other makers' devices as signal source to maximize efficiency of customers' investment in signal sources.

Applications

BER Measurements and Jitter Tolerance Tests of Receivers using Pre-emphasis Signals

The MP1825B supports up to 4 taps at pre-emphasis ratio required by the various standards. Using pre-emphasis signals creates an interconnect standards-compliant measurement system supporting reliable BER measurements and jitter tolerance tests.

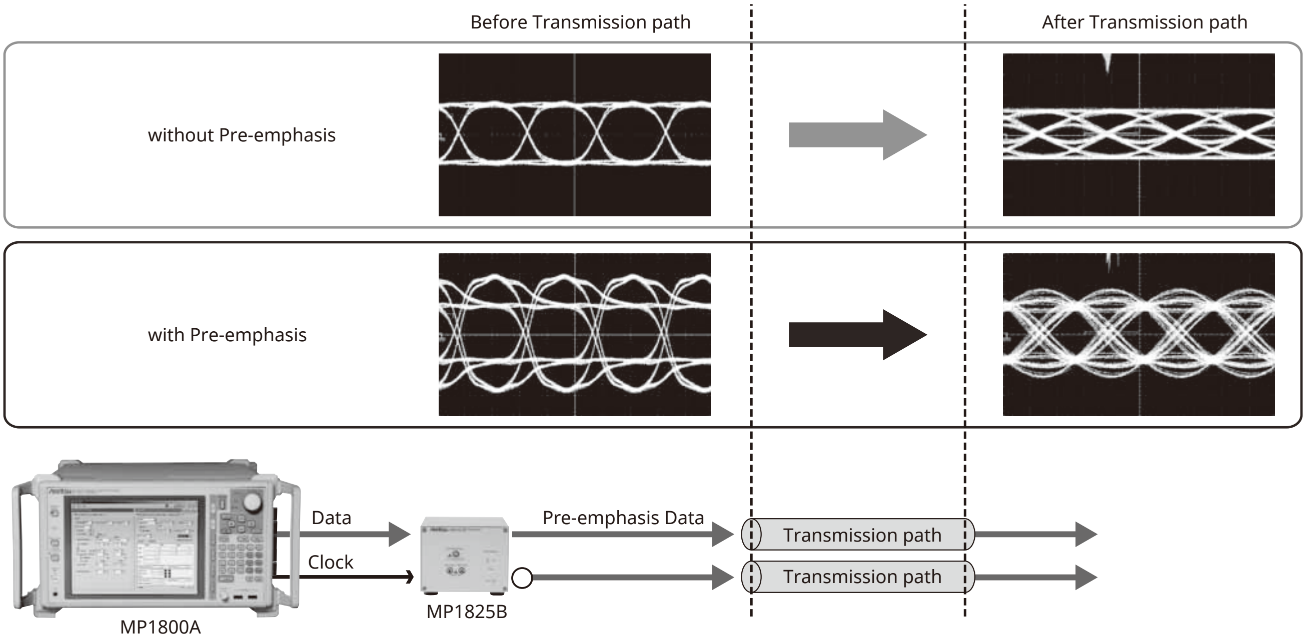


Jitter Tolerance Test Configuration using Pre-emphasis Signals

Frequency doubler I/O is used when the 28 Gbit/s option MP1825B-002 is installed. Half-rate clock operation is supported at bit rates of 8 Gbit/s to 28.1 Gbit/s. The doubler circuit operation frequency is up to 28.1 GHz even when the 32.1 Gbit/s Extension MP1825B-006 is installed.
Bit rates of 28.1 Gbit/s to 32.1 Gbit/s require full-rate clock input.

Optimized Pre-emphasis

The pre-emphasis signal minimizes signal attenuation in the transmission path. Because the MP1825B can change the emphasis ratio for each tap individually, the optimum pre-emphasis for the transmission path is confirmed easily.

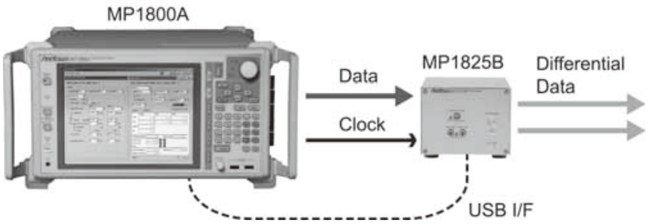


Optimized Pre-emphasis Effect

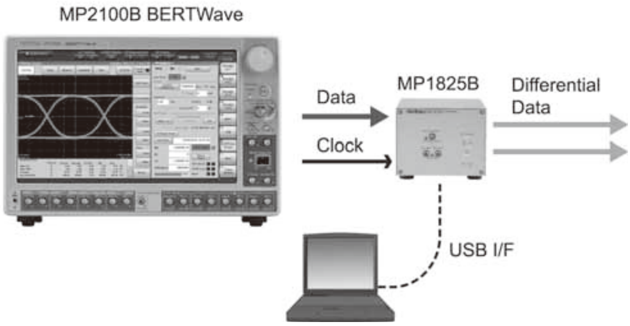
Setup

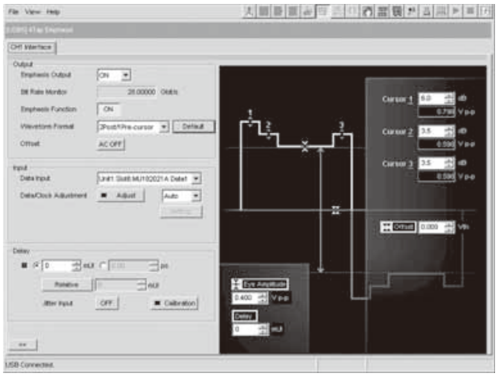
Using the Signal Quality Analyzer MP1800A as a signal source enables the Signal Quality Analyzer Control Software MX180000A installed in the MP1800A to control both MP1825B and MP1800A. When using signal sources other than the MP1800A, the MP1825B can be controlled independently via the USB interface from a PC with MX180000A installed.

Using MP1800A as signal source



Using other product as signal source





Output
Emphasis Output: ON
Bit Rate Monitor: 28.00000 Gbit/s
Emphasis Function: ON
Waveform Format: 3Post/1Pre-cursor
Offset: AC OFF

Input
Data Input: Unit1 Slot6:MU183021A Data1
Data/Clock Adjustment: Adjust, Auto

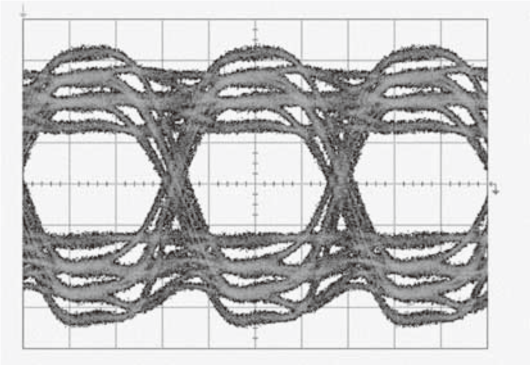
Delay: 0 mUI
Jitter Input: OFF

Cursor 1: 6.0 dB, 0.798 Vp-p
Cursor 2: 3.5 dB, 0.598 Vp-p
Cursor 3: 3.5 dB, 0.598 Vp-p
Offset: 0.000 Vth
Eye Amplitude: 0.400 Vp-p
Delay: 0 mUI

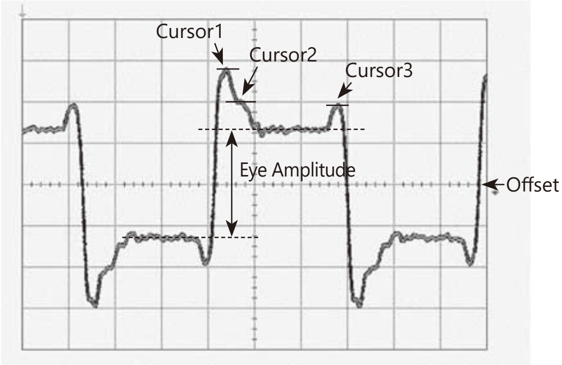
USB Connected.

4Tap Emphasis MP1825B Setting Screen

Waveform



Test Pattern: PRBS31



Test Pattern: FF00

Setting: 28.1 Gbit/s, Eye Amplitude: 0.5 Vp-p, Offset: 0 Vth, Cursor1: 6 dB, Cursor2: 3.5 dB, Cursor3: 3.5 dB

Selection Guide

No.	Main Frame	Bit Rate	Data Delay
1	4Tap Emphasis MP1825B	MP1825B-001 14 Gbit/s Operation	
2			MP1825B-003 14 Gbit/s Variable Data Delay
3		MP1825B-001 14 Gbit/s Operation MP1825B-005 14.1 Gbit/s Extension	
4			MP1825B-003 14 Gbit/s Variable Data Delay
5		MP1825B-002 28 Gbit/s Operation	
6			MP1825B-004 28 Gbit/s Variable Data Delay
7		MP1825B-002 28 Gbit/s Operation MP1825B-006 32.1 Gbit/s Extension	

4Tap Emphasis MP1825B
Converts input signals to pre-emphasis signals and outputs signals.

14 Gbit/s Operation MP1825B-001
Covers bit rate from 1 Gbit/s to 14.05 Gbit/s. Select either MP1825B-001 or MP1825B-002.

28 Gbit/s Operation MP1825B-002
Covers bit rate from 1 Gbit/s to 28.1 Gbit/s. Select either MP1825B-001 or MP1825B-002.

14 Gbit/s Variable Data Delay MP1825B-003
Phase shifts input data and input clock. Select this option to input ideal phase when data and clock phase shift function not available at signal source.
* Requires MP1825B-001.

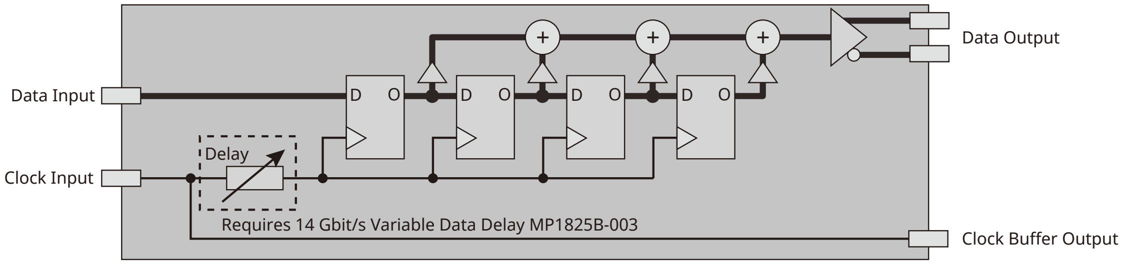
28 Gbit/s Variable Data Delay MP1825B-004
Phase shift input data and input clock. Select this option to input ideal phase when data and clock phase shift function not available at signal source.
* Requires MP1825B-002.

14.1 Gbit/s Extension MP1825B-005
Extends bit rate from 1 Gbit/s to 14.1 Gbit/s.
* Requires MP1825B-001.

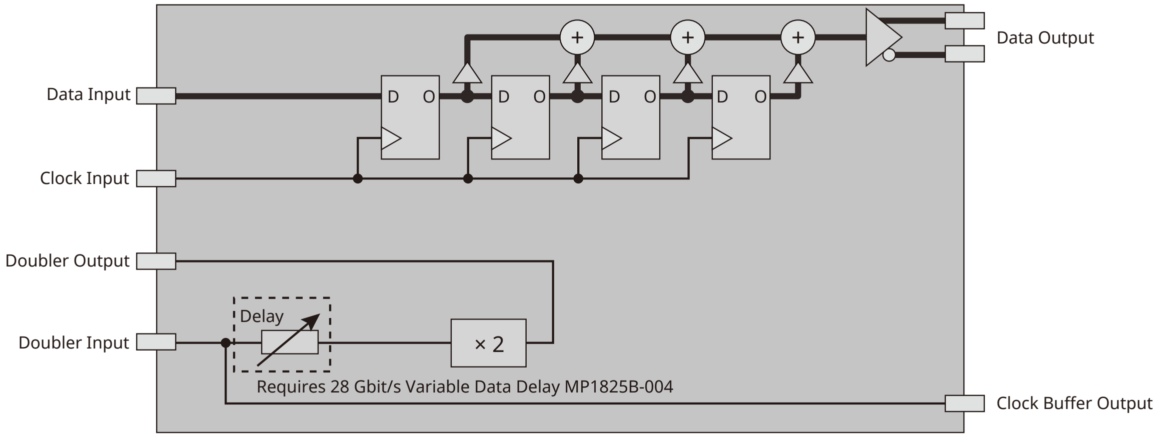
32.1 Gbit/s Extension MP1825B-006
Extends bit rate from 1 Gbit/s to 32.1 Gbit/s.
* Requires MP1825B-002.

Block Diagrams

4Tap Emphasis MP1825B with 14 Gbit/s Operation MP1825B-001



4Tap Emphasis MP1825B with 28 Gbit/s Operation MP1825B-002



Even when the 32.1 Gbit/s Extension MP1825B-006 is installed, the upper limit of the 28 Gbit/s Variable Data Delay MP1825B-004 operation range is 28.1 Gbit/s. The Data/Clock phase between the 28G/32Gbit/s PPG MU183020A/21A and MP1825B is auto-adjusted by the Data Delay option MU183020A/21A-030/031 function.

Specifications

Bit Rate	1 Gbit/s to 14.05 Gbit/s [MP1825B-001] 1 Gbit/s to 14.1 Gbit/s [MP1825B-001, 005] 1 Gbit/s to 28.1 Gbit/s [MP1825B-002, when not using Doubler Input/Output] 1 Gbit/s to 32.1 Gbit/s [MP1825B-002, 006, when not using Doubler Input/Output] 8 Gbit/s to 28.1 Gbit/s [MP1825B-002, when using Doubler Input/Output]
Data Output*[1]	Number of output: 2 (Data/xData) Emphasis setting: a) 2post-cursor, 1pre-cursor b) 3post-cursor c) 1post-cursor, 1pre-cursor d) 2post-cursor e) 1post-cursor f) Rev. 3post-cursor Peak voltage: 100 mVp-p to 1.5 Vp-p (Single-ended) Eye amplitude: 100 mVp-p to 1.0 Vp-p (Single-ended), Steps: 2 mVp-p Offset: –1.0 Vth to +1.0 Vth, Steps: 1 mV Total jitter*[2]: 8 ps p-p (typ.) Tr/Tf*[3]: 20 ps (typ.), ≤25 ps (20 to 80%) [MP1825B-001] 12 ps (typ.), ≤16 ps (20 to 80%) [MP1825B-002] Cursor1 emphasis: –20 to +20 dB, 20log (Eye Amplitude/Cursor1), Steps: 0.1 dB Cursor2 emphasis: –20 to +20 dB, 20log (Eye Amplitude/Cursor2), Steps: 0.1 dB Cursor3 emphasis: –20 to +20 dB, 20log (Eye Amplitude/Cursor3), Steps: 0.1 dB On/Off function: Supported Connector: K (f), Termination: 50Ω/AC coupling
Data Input	Amplitude: 0.4 Vp-p to 1.2 Vp-p Connector: SMA (f) [MP1825B-001], K (f) [MP1825B-002], Termination: 50Ω/GND
Clock Input	Frequency range: 1 GHz to 14.05 GHz [MP1825B-001] 1 GHz to 14.1 GHz [MP1825B-001, 005] 1 GHz to 28.1 GHz [MP1825B-002] 1 GHz to 32.1 GHz [MP1825B-002, 006] Amplitude: 0.25 Vp-p to 1.0 Vp-p Connector: SMA (f) [MP1825B-001], K (f) [MP1825B-002], Termination: 50 Ω/AC coupling
Clock Buffer Output	Frequency range: 1 GHz to 14.05 GHz [MP1825B-001] 1 GHz to 14.1 GHz [MP1825B-001, 005] 4 GHz to 14.05 GHz [MP1825B-002] Amplitude: 0.4 Vp-p (min.), 1.0 Vp-p (max.) (Fixed) Connector: SMA (f), Termination: 50Ω/AC coupling
Doubler Input [MP1825B-002]	Frequency range: 4 GHz to 14.05 GHz Amplitude: 0.25 Vp-p to 1.2 Vp-p Connector: SMA (f), Termination: 50 Ω/AC coupling
Doubler Output [MP1825B-002]	Amplitude: 0.4 Vp-p (min.), 1.0 Vp-p (max.) (Fixed) Connector: K (f), Termination: 50Ω/AC coupling
Variable Data Delay [MP1825B-003 or MP1825B-004]	Phase variable range: –1000 mUI to +1000 mUI Accuracy: 50 mUIp-p (typ.)
General Specification	Channel switch: CH1/CH2 (Rear panel switch) Operation interface: USB 2.0 or 1.1 Type B Power supply: 100 V(ac) to 120 V(ac)/200 V(ac) to 240 V(ac), 50 Hz/60 Hz Power consumption: ≤100 W Dimensions: 120 (W) × 90.9 (H) × 140 (D) mm Mass: ≤5 kg Operating temperature: 15° to 35°C EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN61010-1

*1: Measured at PRBS $2^{31} - 1$, Mark ratio 1/2 with 50 GHz sampling oscilloscope
*2: Measured at 14.05 Gbit/s or 28.1 Gbit/s (with MP1825B-002) with the sampling oscilloscope, intrinsic jitter should be less than 200 fs (rms)
*3: Emphasis function: Off

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No	Name	
	Main frame	
MP1825B	4Tap Emphasis	
	Standard accessories	
J1137	Terminator:	3 pcs
J1341A	Open:	2 pcs
J1359A*[1]	Coaxial Adaptor (K-P, K-J, SMA compatible):	2 pcs/3 pcs
J1507A*[2]	Semirigid Cable:	1 pc
J1475A	USB Cable:	1 pc
Z1312A	AC Adaptor:	1 pc
	Power Cord:	1 pc
Z0897A	MP1800A Manual CD:	1 pc
Z0918A	MX180000A Software CD:	1 pc

*1: MP1825B-001: 2 pcs, MP1825B-002: 3 pcs
*2: Select MP1825B-002
*3: For jitter tolerance measurement, 2 pcs

Model/Order No	Name
	Options
MP1825B-001	14 Gbit/s Operation
MP1825B-002	28 Gbit/s Operation
MP1825B-003	14 Gbit/s Variable Data Delay
MP1825B-004	28 Gbit/s Variable Data Delay
MP1825B-005	14.1 Gbit/s Extension
MP1825B-006	32.1 Gbit/s Extension
MP1825B-103	14 Gbit/s Variable Data Delay Retrofit
MP1825B-104	28 Gbit/s Variable Data Delay Retrofit
MP1825B-105	14.1 Gbit/s Extension Retrofit
MP1825B-106	32.1 Gbit/s Extension Retrofit
	Optional accessories
J1342A	Coaxial Cable 0.8 m (APC-3.5, DC to 27.5 GHz)
J1439A	Coaxial Cable (0.8 m, K Connector) (DC to 40 GHz)
J1615A*[3]	Coaxial Cable Set (PPG-Emphasis)
W3482AE	MP1825B Operation Manual
	Maintenance service
MP1825B-ES310	Extended Three Years Warranty Service
MP1825B-ES510	Extended Five Years Warranty Service

BERTWave™

MP2110A

Remote Control
GPIB | **Ethernet**

Development and Manufacturing of Multi-channel Optical Modules for 100G/200G/400G

Excellent Eco Product

BERTWave

Data traffic volumes are exploding with the spread of fixed-rate video streaming and cloud services.
As a result, there is a need for optical interfaces for transmission equipment supporting speeds of more than 10 Gbit/s as 100 GbE and even 200 GbE and 400 GbE networks are deployed. However, there are increasing requests for less-expensive optical interfaces due to major problems with how to increase line productivity and cut costs.
The BERTWave MP2110A is an all-in-one instrument with built-in BERT (Bit Error Rate Tester) and Sampling Oscilloscope (Eye pattern analysis) designed for manufacturing inspection of 100, 200, and 400G optical modules. It helps increase line productivity and cuts costs.

All In One	All-in-one max. 4ch 28.2 Gbit/s BERT + max. 2ch sampling oscilloscope
Low Cost	Integrated BERT and sampling oscilloscope reduce instrument capital costs
250 ksamples/s	Captures 1 million samples in about 5 seconds
-15 dBm Sensitivity	Measures optical signals attenuated by peripherals such as optical switches
NRZ/ PAM4 Analysis	Easy, fast and high-sensitivity analysis of PAM4 signals including TDECQ with support for clock recovery

Shorter Measurement Times

High-speed Sampling Oscilloscope
(250 ksamples/s)

Multi-channel Measurement
(4ch BERT and 2ch Sampling Oscilloscope)

More Accurate Performance

Sampling Oscilloscope
  Bandwidth
    Optical: 35 GHz (SMF), 25 GHz (MMF)
    Electrical: 40 GHz
  High Sensitivity: –15 dBm (typ., SMF)
  Low-Jitter: 200 fs rms (typ.)

BERT
  Low-Jitter PPG: 600 fs rms (typ.)
  High-Sensitivity ED: 25 mV (typ.)

Built-in PC for Stable Operation

Efficient Measurement Systems

Easy configuration of flexible measurement system using All-in-one and discrete instruments

Slashes instrument capital costs by up to about 50% depending on selected configuration

Easy measurement system configuration using sample program

Both NRZ and PAM4 signals are supported, and there is a built-in Clock Recovery Unit for Sampling Oscilloscope.

Target Applications:

  Evaluating PHY layer performance of optical transceiver modules, cables and component devices

Transmission Paths:
  Ethernet, eCPRI/RoE, CPRI, SDH/SONET, OTN, InfiniBand, Fibre Channel

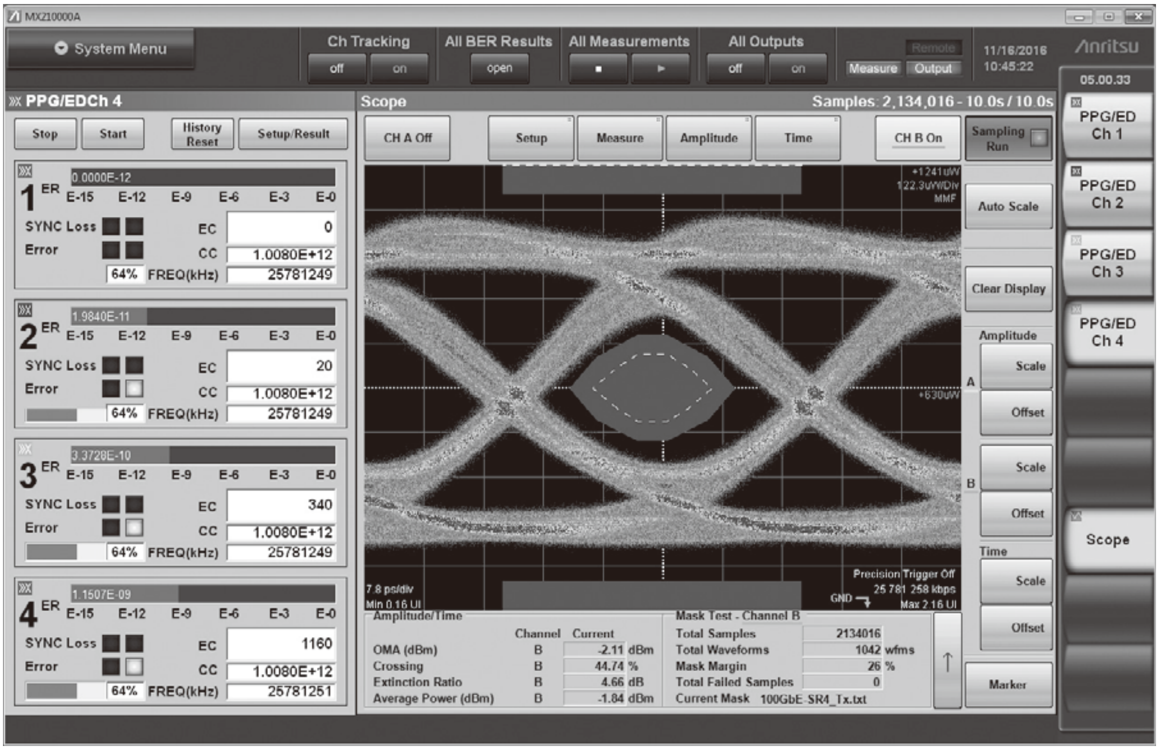
Optical Transceiver Modules:
  SFP28, QSFP28, CFP2/4/8, SFP56, QSFP56, OSFP, QSFP-DD

Cables:
  Active Optical Cables (AOC), Direct Attach Cables (DAC)

Devices:
  TOSA, ROSA, High-Speed Optical Engine, PHY, Driver ICs

Reduces Measurement Times

With a BERT and sampling oscilloscope in one box, measurement results can be captured all at once along with simultaneous Eye pattern display. As a result, all the measurement results needed to evaluate multi-channel optical modules and devices can be seen at a glance, reducing measurement times by large margins.



Samples: 2,134,016 - 10.0s / 10.0s

	ER	SYNC Loss	Error	EC	CC		FREQ(kHz)
1	0.0000E-12	■ ■	■ ■	0	1.0080E+12	64%	25781249
2	1.9840E-11	■ ■	■ □	20	1.0080E+12	64%	25781249
3	3.3728E-10	■ ■	■ □	340	1.0080E+12	64%	25781249
4	1.1507E-09	■ ■	■ □	1160	1.0080E+12	64%	25781251

7.8 ps/div
Min 0.16 UI
Precision Trigger Off
25 781 258 kbps
Max 2.16 UI

Amplitude/Time

	Channel	Current
OMA (dBm)	B	-2.11 dBm
Crossing	B	44.74 %
Extinction Ratio	B	4.66 dB
Average Power (dBm)	B	-1.84 dBm

Mask Test - Channel B

Total Samples	2134016
Total Waveforms	1042 wfms
Mask Margin	26 %
Total Failed Samples	0
Current Mask	100GbE-SR4_Tx.txt

The All-in-one BERT and sampling oscilloscope makes it easy to configure and control the measurement system and supports simultaneous BER measurements and Eye pattern analysis. It reduces measurement times by 40% compared to systems using a combination of stand-alone instruments.
Moreover, the expanded 4ch BERTS can measure errors simultaneously for all channels of QSFP28 modules. Eliminating the need to switch channels also helps reduce measurement times.

Poor Efficiency, Long Time

No Switching Necessary, Simple Measurement System

Furthermore, the MP2110A retains the simple settings and easy-to-use user interface of all models in the BERTWave series; in addition compatibility with MP2100B remote commands assures trouble-free instrument upgrades.
Additionally, the stable operation resulting from the built-in PC guarantees performance irrespective of the operation environment.

High-Speed Sampling and Fast Mask Margin Tests

The BERTWave MP2110A supports high-speed sampling at 250 ksamples/s for up to 2ch simultaneously. The built-in as standard automatic Mask Margin test function can complete capture of 1 million samples of a 25-Gbit/s signal in about 5 seconds, slashing Eye pattern analysis times by 65% compared to conventional instruments.

15:39:40
Samples: 0 / 1,000,000

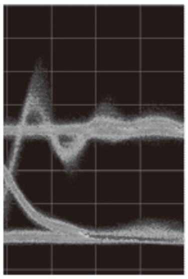
15:39:45
Samples: 1,007,616 / 1,000,000

Sampling Oscilloscope

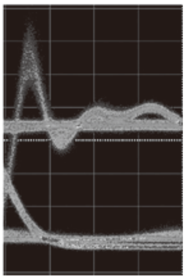
The MP2110A sampling oscilloscope has all the performance necessary for measuring optical modules such as 100 GbE, OTU4, etc., and optical devices used by optical modules.

- Bandwidth:
  Optical: 35 GHz (SMF), 25 GHz (MMF)
  Electrical: 40 GHz
- High Sensitivity: –15 dBm (typ., SMF)
- Low Noise: 3.4 µW (typ. SMF)
- Low-Jitter: 200 fs rms (typ.)

In comparison to conventional instruments, the wideband O/E draws accurate patterns of the characteristics of directly driven optical signals and optical modules for long-distance transmissions.

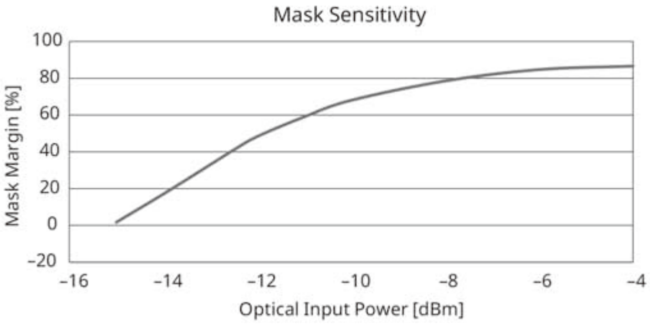


Conventional Instrument
(Filter Off)



MP2110A
(Filter Off)

The low-noise and high-sensitivity O/E plus low-jitter trigger support more accurate measurements of narrow Eye openings of PAM4 signals as well as attenuated signals passing through optical switches, etc., helping improve production-line yields.

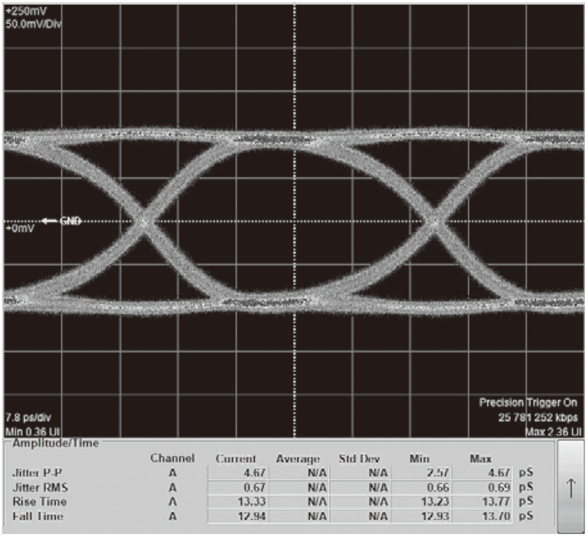


* Estimated optical power when Mask Margin (Hit Count 0) reaches 0%
(calculated from optical noise)

BERT

The MP2110A PPG has a low data Jitter of 600 fs rms (typ.) for accurate measurement of the characteristics of optical modules, optical devices, etc. Additionally, the 25 mV (typ.) ED supports BER measurement of low-amplitude signals resulting from transmission path losses, helping improve DUT yields.

Typical PPG Waveform



	Channel	Current	Average	Std Dev	Min	Max	
Jitter P-P	A	4.67	N/A	N/A	2.57	4.67	pS
Jitter RMS	A	0.67	N/A	N/A	0.66	0.69	pS
Rise Time	A	13.33	N/A	N/A	13.23	13.77	pS
Fall Time	A	12.94	N/A	N/A	12.93	13.70	pS

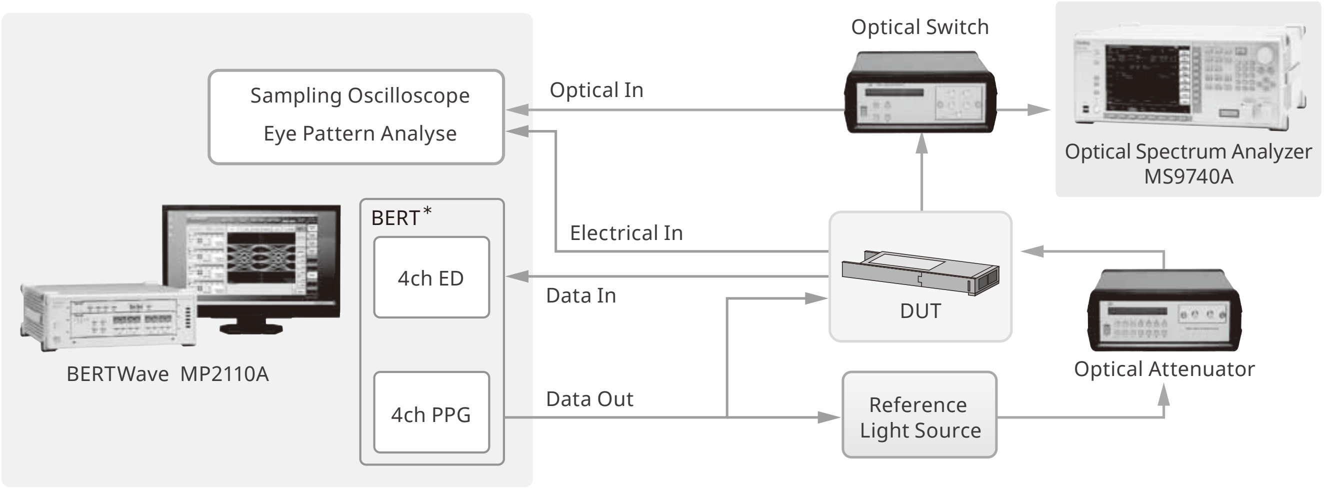
25.78125 Gbit/s Electrical Loopback Waveform
(at PRBS 31, 200 mV Amplitude, and Precision Trigger Option On)

In the standard configuration, the MP2110A BERT operates at bit rates of 24.3 Gbit/s to 28.2 Gbit/s. This range can be extended optionally to support bit rates of 9.5 Gbit/s to 14.2 Gbit/s, enabling use for various applications including 10 GbE and 100 GbE.

PPG/ED Supported Bit Rates	Application Example
24.3 Gbit/s to 28.2 Gbit/s	32G Fibre Channel, CPRI (Option 10), InfiniBand EDR, 100 GbE, 100 GbE FEC, OTU4
9.5 Gbit/s to 14.2 Gbit/s (Option 093)	InfiniBand FDR/QDR, Fibre Channel (16G, 10G, 10G FEC), 10 GbE (WAN, LAN), 40 GbE (4 × 10 Gbit/s), CPRI (Option 8, 9), OC-192/STM-64, OC-192/STM-64 FEC (G.975), OTU1e, OTU2, OTU2e

Application Examples

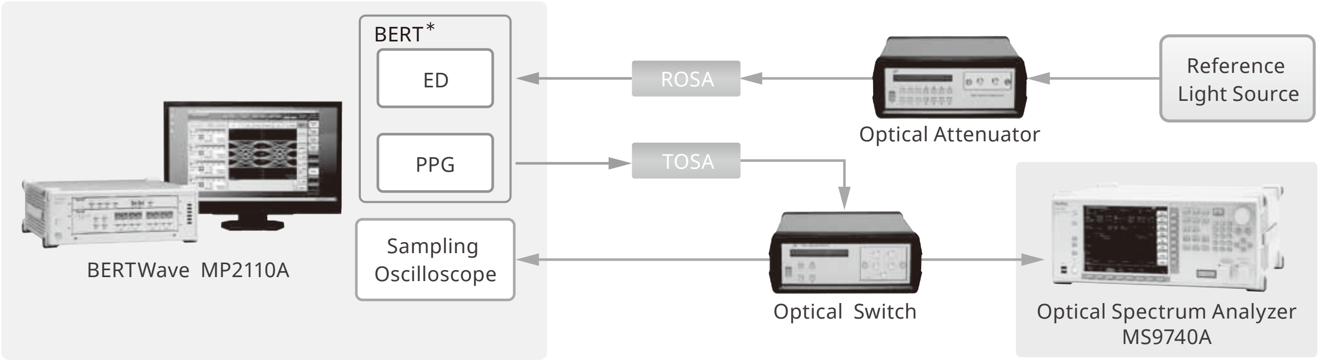
Multi-channel Optical Module Evaluation



Required Test Items

- Rx Electrical Signal Eye Pattern Analysis (NRZ: Mask Margin, Jitter, Tr/Tf, etc.)
- Tx Optical Signal Eye Pattern Analysis
  (Optical Power, NRZ: Mask Margin, Jitter, Tr/Tf, Extinction Ratio, PAM4: TDECQ, Outer OMA/Extinction Ratio, Linearity etc.)
- Rx Signal Rx Sensitivity Test (BER Measurement)

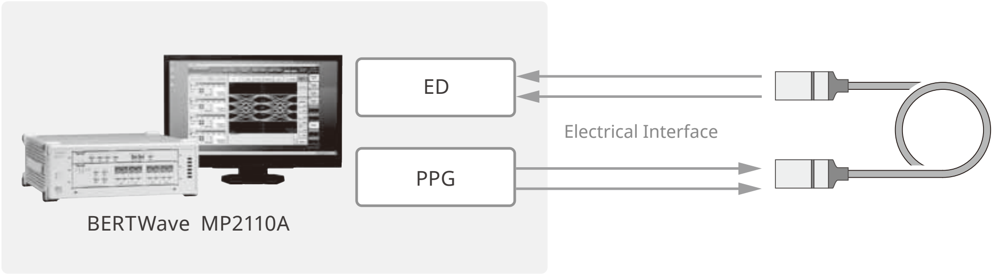
TOSA/ROSA Evaluation



Required Test Items

- Tx Optical Signal Eye Pattern Analysis
  (Optical Power, NRZ: Mask Margin, Jitter, Tr/Tf, Extinction Ratio, PAM4: TDECQ, Outer OMA/Extinction Ratio, Linearity etc.)
- Rx Signal Rx Sensitivity Test (BER Measurement)

Active Optical Cables (AOC)/Direct Attach Cables (DAC) Evaluation



Required Test Items

- 4ch Simultaneous BER Measurement (Crosstalk Test)
- Differential Electrical Signal Eye Pattern Analysis
- Differential Electrical Signal Jitter Analysis

Specifications

Common

Operating System		Windows Embedded Standard 7
Internal Storage Devices		SSD (60 GB or more)
Input and Output		HDMI, Display Port USB2.0 × 6 (Front), USB3.0 × 4 (Rear) Ethernet × 2 (10/100/1000BASE-T) GPIB
Remote Control		Ethernet, GPIB
Power Voltage		100 V(ac) to 240 V(ac), 50 Hz/60 Hz
Power Consumption		300 VA max.
Operating Temperature		+5° to +40°C
Storage Temperature		–20° to +60°C
Dimensions		422 (W) × 142.5 (H) × 389.4 (D) mm (excluding projections)
Mass		11 kg max.
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

BERT

Operation Bit Rates		24.3 Gbit/s to 28.2 Gbit/s 9.5 Gbit/s to 14.2 Gbit/s (Option 093)
Number of Channels		1, 2, 4 (Differential)
Connector		K (f)
Output	Amplitude	0.1 Vp-p to 0.8 Vp-p (Single-end) 0.2 Vp-p to 1.6 Vp-p (Differential)
	Jitter	600 fs rms (typ.)
	Tr/Tf (20 to 80%)	15 ps (typ.)
Input	Amplitude	0.05 Vp-p to 0.8 Vp-p
	Sensitivity	25 mVp-p (typ.)
Test Pattern		PRBS7, PRBS9, PRBS15, PRBS23, PRBS31 1/2 Clock Pattern, 1/16 Clock Pattern (Output Only)

Sampling Oscilloscope

Optical Channel	Wavelength Range	SMF: 860 nm to 1650 nm, MMF: 800 nm to 860 nm
	Bandwidth	SMF: 35 GHz, MMF: 25 GHz (typ.)
	RMS Noise	SMF: 3.4 μW, MMF: 6.7 μW (typ.)
	Eye Mask Sensitivity*	SMF: –15 dBm, MMF: –12 dBm (typ.)
	Reference Receiver Filter (NRZ)	Built-in: 100 GbE, 100 GbE FEC, OTU4, 32GFC
Electrical Channel	Bandwidth	40 GHz (typ.)
	RMS Noise	1.5 mV (typ.)
Jitter		400 fs rms (typ.), 200 fs rms (typ., Precision Trigger MP2110A-024 On)
Sampling Rate		250 ksamples/s (nominal)
Clock Recovery (Option)		NRZ/PAM4, 25.5 Gbaud to 28.2 Gbaud

*: Estimated optical power when Mask Margin (Hit Count 0) reaches 0% (calculated from optical noise).

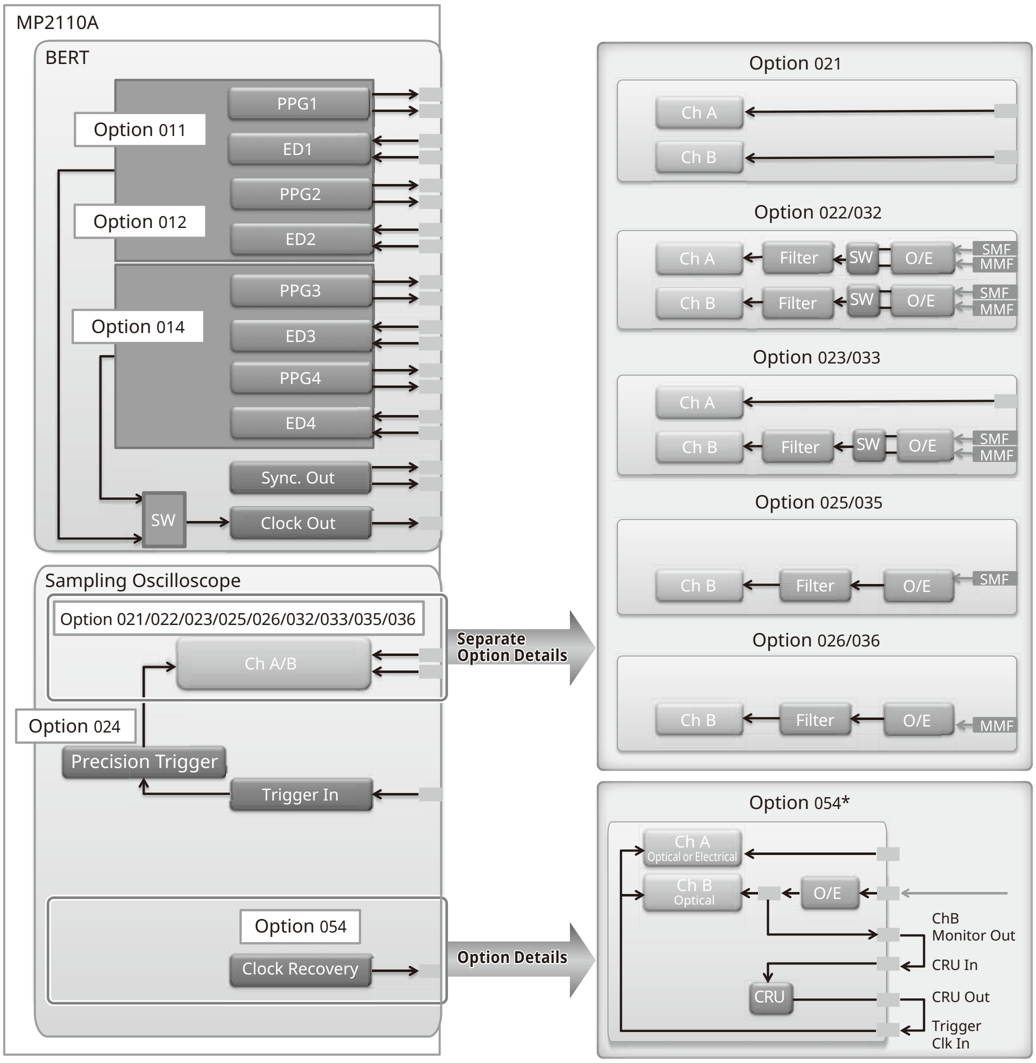
Selection Guide

Either a BERT or a sampling oscilloscope, or both a BERT and a sampling oscilloscope can be selected for the MP2110A.
Select by referring to the following table and block diagram.

Function			Selection/Option Addition
BERT	Select any one	1ch	MP2110A-011
		2ch	MP2110A-012
		4ch	MP2110A-014
	Select as addition	PPG/ED Bit Rate Extension Adds bit rates of 9.5 Gbit/s to 14.2 Gbit/s to standard range of 24.3 Gbit/s to 28.2 Gbit/s.	MP2110A-093
Sampling Oscilloscope	Select any one	Differential Electrical	MP2110A-021
		Optical 2ch*1	MP2110A-022 or MP2110A-032*2
		E/O*1	MP2110A-023 or MP2110A-033*2
		1ch SMF Optical*1	MP2110A-025 or MP2110A-035*2
		1ch MMF Optical*1	MP2110A-026 or MP2110A-036*2
	Select as addition	Precision Trigger Supports high-accuracy jitter measurement	MP2110A-024
		Clock Recovery (Electrical/Optical) Recovers Clock from input data signal	MP2110A-054
		PAM4 Analysis Software Supports PAM4 signal analysis	MP2110A-095
		Jitter Analysis Software Supports NRZ signal Jitter analysis	MP2110A-096

*1: The Single Mode (SMF) supports optical signals of 860 nm to 1650 nm; the Multi Mode (MMF) supports optical signals of 800 nm to 890 nm.
*2: Option 02x and Option 03x have different optical channel reference receiver characteristics (Bessel filter approximation characteristics).
Option 03x is adjusted for a smooth roll-off characteristic at the low-frequency side.

Block Diagram



*: Optical channel: The clock in the optical signal input to Ch B is recovered. Use the accessory U-link coaxial cable to make the connection.
Electrical channel: Split the signal using the Pick-off tee and input to CRU In. There is no Monitor Out connector when Ch B is an electrical channel.

Ordering Information

When making a contract, determine the configuration by referencing the selection guide and specify the type, model, name, and quantity.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main frame
MP2110A	BERTWave
	Standard accessories
	Power Cord
J1627A	GND Connection Cable: 1
	MX210000A BERTWave Control Software CD-ROM: 1
	Options
MP2110A-011	1ch BERT
MP2110A-012	2ch BERT
MP2110A-014	4ch BERT
MP2110A-021	Dual Electrical Scope
MP2110A-022	Dual Optical Scope
MP2110A-023	Optical and Single-ended Electrical Scope
MP2110A-024	Precision Trigger
MP2110A-025	Optical Scope for Singlemode
MP2110A-026	Optical Scope for Multimode
MP2110A-032	Dual Optical Scope Baseband Flat
MP2110A-033	Optical and Single-ended Electrical Scope Baseband Flat
MP2110A-035	Optical Scope for Singlemode Baseband Flat
MP2110A-036	Optical Scope for Multimode Baseband Flat
MP2110A-054	Clock Recovery (Electrical/Optical)
MP2110A-093	PPG/ED Bit Rate Extension
MP2110A-095	PAM4 Analysis Software
MP2110A-096	Jitter Analysis Software
	Retrofit options
MP2110A-111	1ch BERT Retrofit
MP2110A-112	2ch BERT Retrofit
MP2110A-114	4ch BERT Retrofit
MP2110A-121	Dual Electrical Scope Retrofit
MP2110A-122	Dual Optical Scope Retrofit
MP2110A-123	Optical and Single-ended Electrical Scope Retrofit
MP2110A-124	Precision Trigger Retrofit
MP2110A-125	Optical Scope for Singlemode Retrofit
MP2110A-126	Optical Scope for Multimode Retrofit
MP2110A-132	Dual Optical Scope Baseband Flat Retrofit
MP2110A-133	Optical and Single-ended Electrical Scope Baseband Flat Retrofit
MP2110A-135	Optical Scope for Singlemode Baseband Flat Retrofit
MP2110A-136	Optical Scope for Multimode Baseband Flat Retrofit
MP2110A-154	Clock Recovery (Electrical/Optical) Retrofit
MP2110A-193	PPG/ED Bit Rate Extension Retrofit
MP2110A-195	PAM4 Analysis Software Retrofit*
MP2110A-395	PAM4 Analysis Software Retrofit*
MP2110A-196	Jitter Analysis Software Retrofit
MP2110A-396	Jitter Analysis Software Retrofit
	Standard accessories MP2110A-011
J1632A	Terminator: 3
J1341A	Open: 5
	Standard accessories MP2110A-012
J1632A	Terminator: 5
J1341A	Open: 7
	Standard accessories MP2110A-014
J1632A	Terminator: 9
J1341A	Open: 11
	Standard accessories MP2110A-021
J1341A	Open: 3
	Standard accessories MP2110A-022/032
J0617B	Replaceable Optical Connector (FC-PC): 4
Z0397A	FC ADAPTER CAP: 4
J1341A	Open: 1
	Standard accessories MP2110A-023/033
J0617B	Replaceable Optical Connector (FC-PC): 2
Z0397A	FC ADAPTER CAP: 2
J1341A	Open: 2

Model/Order No.	Name
	Standard accessories MP2110A-025/035
J0617B	Replaceable Optical Connector (FC-PC): 1
Z0397A	FC ADAPTER CAP: 1
J1341A	Open: 1
	Standard accessories MP2110A-026/036
J0617B	Replaceable Optical Connector (FC-PC): 1
Z0397A	FC ADAPTER CAP: 1
J1341A	Open: 1
	Standard accessories MP2110A-054
J1632A	Terminator: 1
J1341A	Open: 2
J1763A	U Link Coaxial Cable (K): 1
J1764A	U Link Coaxial Cable (SMA): 1
	Maintenance service
MP2110A-ES310	3 Years Extended Warranty Service
MP2110A-ES510	5 Years Extended Warranty Service
	Optional accessories
B0734A	Carrying Case
B0735A	Rack Mount Kit
G0342A	ESD DISCHARGER
G0364A	100G LR4 1310 nm QSFP28
G0366A	100G SR4 850 nm QSFP28
J0617B	Replaceable Optical Connector (FC-PC)
J0618D	Replaceable Optical Connector (ST)
J0618E	Replaceable Optical Connector (DIN)
J0619B	Replaceable Optical Connector (SC)
J0635A	FC · PC-FC · PC-1M-SM
J0660A	SC · PC-SC · PC-1M-SM
J0839A	SC · PC-SC · PC-1M-GI
J0893A	FC · PC-FC · PC-1M-GI
J1632A	Terminator
J1139A	FC · PC-LC · PC-1M-SM
J1341A	Open (Coaxial connector cover)
J1342A	Coaxial Cable 0.8 m
J1343A	Coaxial Cable 1 m
J1344A	LC/PC-LC/PC-1M-SM
J1345A	SC/PC-LC/PC-1M-SM
J1346A	LC/PC-LC/PC-1M-GI (62.5/125)
J1347A	FC/PC-LC/PC-1M-GI (62.5/125)
J1348A	SC/PC-LC/PC-1M-GI (62.5/125)
J1349A	Coaxial Cable 0.3 m
J1359A	Coaxial Adaptor (K-P · K-J, SMA compatible)
J1439A	Coaxial Cable (0.8 m, K connector)
J1763A	U Link Coaxial Cable (K)
J1764A	U Link Coaxial Cable (SMA)
J1510A	Pick OFF Tee
J1519A	Optical Fiber Cord (MM, 12FIBER, MPO,3M)
J1551A	Coaxial Skew Match Cable (0.8 m, K connector)
J1681A	MPO Loopback Cable
J1682A	MPO to FC convert cable
W3831AE	MP2110A BERTWave Operation Manual
W3773AE	BERTWave Series Remote Control Operation Manual
Z0306A	List Wrap
Z0397A	FC ADAPTER CAP
Z0541A	USB Mouse
Z0914A	Ferrule Cleaner
Z0915A	Replacement Reel for Ferrule Cleaner
Z1944A	LCD Monitor
Z1952A	HDMI to VGA Adapter

*: About PAM4 Analysis Software Retrofit is sometimes, depending on the serial number, the customer can perform the retrofit, but sometimes return to the factory may be necessary. Contact your sales representative for more details.

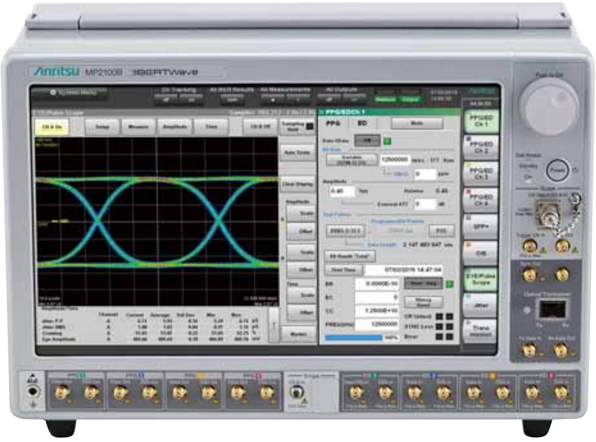
BERTWave™

MP2100B

Remote Control
GPIB OPTION | **Ethernet**

Development and Manufacturing of Multi-channel Optical Modules for 10G/40G

Excellent Eco Product



BERTWave

The spread of cloud computing is increasing demand for optical modules used in data centers.
In particular, SFP+ modules for 10 GbE and QSFP+ modules for 40 GbE (10 Gbit/s × 4) are in high demand.
The all-in-one BERTWave MP2100B has a built-in BERT (Bit Error Rate Tester) and sampling oscilloscope for running simultaneous BER tests and Eye Pattern analyses required for developing and manufacturing modules.
The number of BERT channels can be expanded to four, all supporting simultaneous BER measurements. Additionally, the high sampling speed reduces the Eye Pattern measurement time.
multi channel optical modules, such as QSFP+, can be measured more efficiently using the MP2100B.

All in One	Built-in BERT and Scope	1 ps rms Jitter	Pulse Pattern Generator (PPG) Jitter: 1 ps rms
4ch BERT	Built-in 1ch to 4ch 12.5 Gbit/s BERT	10 mVp-p Sensitivity	Error Detector (ED) Sensitivity: 10 mVp-p

Short Measurement Times

Simultaneous 4ch BERT and Eye Pattern Measurements
Simultaneous 4ch BER Measurements
High-Speed Eye Mask Tests
High-Speed BER Tests

Full-Featured Analysis Functions

Wideband Operation Frequency
Electrical and Optical Interfaces
Jitter Analysis
Clock Recovery

Cost-Effective Investment

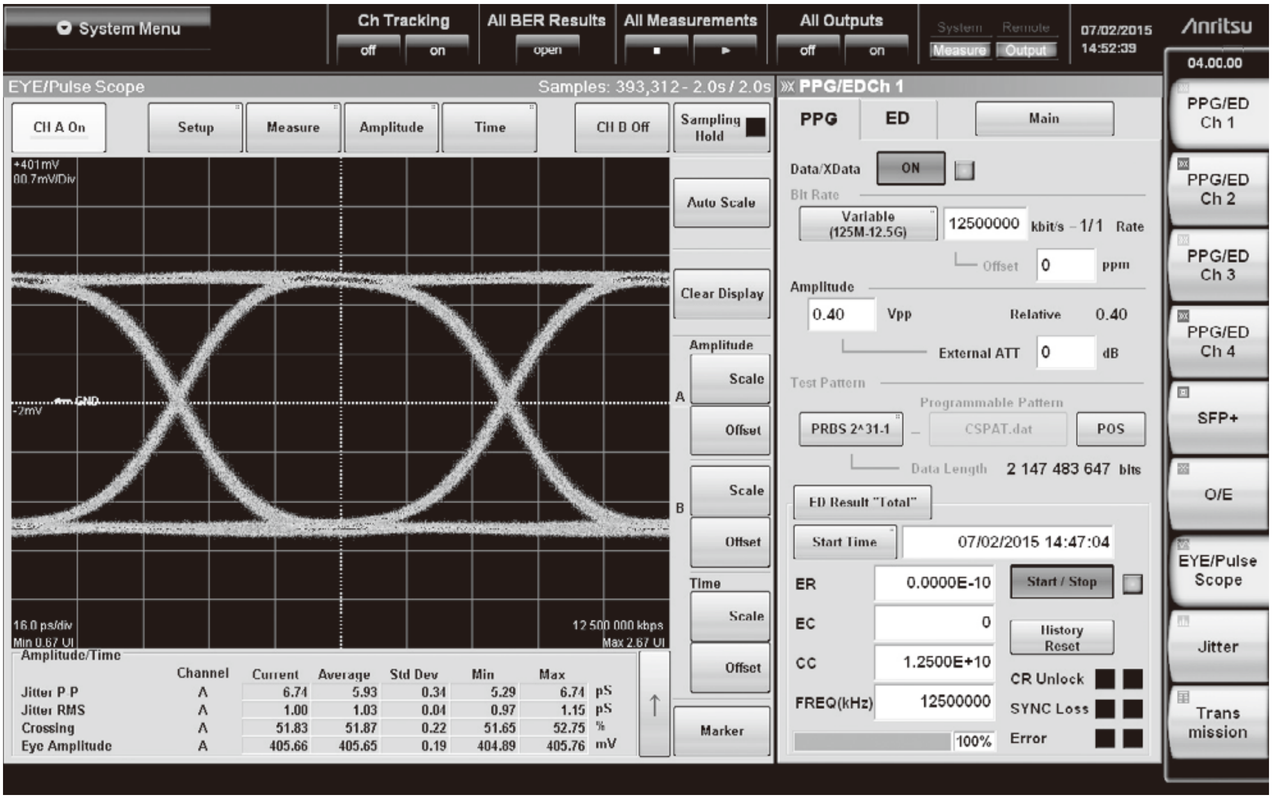
Flexible Measurement System Configuration
Multi-channel BERT

Supported Applications

- InfiniBand (SDR, DDR, QDR),
  Fibre Channel (1G, 2G, 4G, 8G, 10G, 10G FEC)
- 1 GbE, 2 GbE, 10 GbE (WAN, LAN), XAUI (3.125 Gbit/s),
  40 GbE (10 Gbit/s × 4)
- CPRI (× 1, × 2, × 4, × 5, × 8, × 10),
  OBSAI (RP3, RP3 × 2, RP3 × 4, RP3 × 8)
- OC-3 to OC-192/STM-1 to STM-64, OC-192/STM-64 FEC (ITU-T G.975),
  OTU-1, OTU-2, OTU-1e, OTU-2e
- CFP, CXP, QSFP/QSFP+, SFP/SFP+, XFP, Active Optical Cable (AOC),
  TOSA/ROSA

All-in-One 4ch BER Measurements and Eye Pattern Analyses

Increasing the number of channels can greatly shorten measurement times for QFSP+ modules that might otherwise require long measurement times.



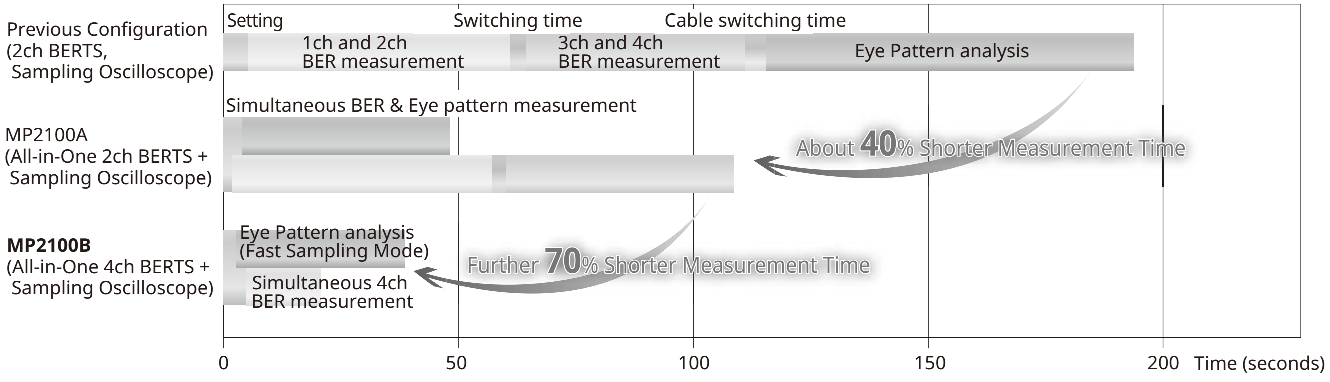
Amplitude/Time

	Channel	Current	Average	Std Dev	Min	Max	
Jitter P-P	A	6.74	5.93	0.34	5.29	6.74	pS
Jitter RMS	A	1.00	1.03	0.04	0.97	1.15	pS
Crossing	A	51.83	51.87	0.22	51.65	52.75	%
Eye Amplitude	A	405.66	405.65	0.19	404.89	405.76	mV

Data/XData ON
Bit Rate Variable (125M-12.5G) 12500000 kbit/s – 1/1 Rate
Offset 0 ppm
Amplitude 0.40 Vpp Relative 0.40
External ATT 0 dB
Test Pattern PRBS 2^31-1 – Programmable Pattern CSPAT.dat POS
Data Length 2 147 483 647 bits
ED Result "Total"
Start Time 07/02/2015 14:47:04
ER 0.0000E-10
EC 0
CC 1.2500E+10
FREQ(kHz) 12500000
100%
Start / Stop
History Reset
CR Unlock ■ ■
SYNC Loss ■ ■
Error ■ ■

The all-in-one sampling oscilloscope with integrated BERT simplifies measurement system configuration and control to support simultaneous BER measurement and EYE pattern analysis, cutting measurement times by about 40% in comparison to combinations of separate instruments. Furthermore, the BERTS expandability to 4ch supports simultaneous error measurement for all QSFP+ module channels, cutting measurement times by a further 70% because time-wasting channel switching operation is eliminated.

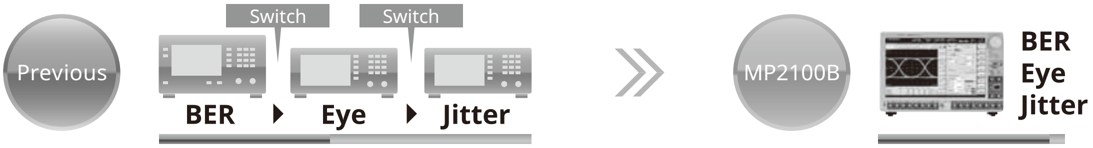
Comparison of 40 Gbit/s (10 Gbit/s × 4ch) QSFP+ BER Measurement Times



Capture BER for 3 points for each of 1E-3, 1E-5, 1E-7, 1E-8, 1E-9, and 1E-10 for 4ch × 10 Gbit/s
Compare to the waveform of 1 Msample

Flexible Measurement System Configurations

Conventional measurement systems use a BERT as the signal source and a sampling oscilloscope for Eye pattern analysis in separate cabinets, which is complex. Incorporating the BERT and sampling oscilloscope into one MP2100B set offers an easy to configure measurement system.

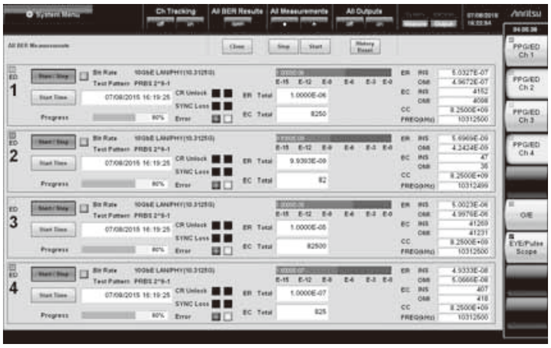


Low Efficiency and Time Consuming

Simple Measurement System with No Switching

High-Speed BER Tests

The MP2100B uses a BERT Channel ranking function to support batch setting and measurement of up to 4ch. Additionally, it has a built-in standard function for batch capture of measurement results. As a result, it greatly shortens 40 GbE (10 Gbit/s × 4) QSFP+ BER measurement times. Moreover, capturing BER measurement results in 10-ms units, reduces measurement times too.



Fast Sampling Mode/High-Speed Eye Pattern Analysis

A new Fast Sampling Mode is built into the MP2100B as a standard function. As well as offering the same high-speed 100 ksample/s sampling speed as legacy models, the new Fast Sampling Mode increases sampling speed 150 ksample/s for 1.5 time faster Eye pattern analysis.

Wideband Operating Frequency

The built-in PPG and ED operate at 1/N bit rates over the range of 8.5 Gbit/s to 11.32 Gbit/s as standard. Installing option 092 supports all bit rates ranging from 125 Mbit/s to 12.5 Gbit/s used by various applications such as STM-1, 10GFC, etc., in one set.

Examples of Supported Bit Rates and Applications (with Option 092)

PPG/ED Supported Bit Rates	Application Example
125 Mbit/s to 12.5Gbit/s	InfiniBand (SDR, DDR, QDR), Fibre Channel (1G, 2G, 4G, 8G, 10G, 10G FEC), GbE, 2 GbE, 10 GbE (WAN, LAN), XAUI (3.125G), 40 GbE (10 Gbit/s × 4), CPRI (×1, ×2, ×4, ×5, ×8, ×10), OBSAI (RP3, RP3 ×2, RP3 ×4, RP3 ×8), OC-3/STM-1, OC-12/STM-4, OC-24, OC-48/STM-16, OC-192/STM-64, OC-192/STM-64 FEC (G.975), OTU-1, OTU-2, OTU-1e, OTU-2e, SFP, SFP+, XFP, Active Optical Cable (AOC), QSFP/QSFP+, CFP, CXP, TOSA/ROSA

Examples of Supported Bit Rates and Applications (without Option 092)

PPG/ED Supported Bit Rates	Application Example	
8.5 Gbit/s to 11.32 Gbit/s	• 8GFC • 10GFC • 10GFC FEC • OTU-2 • OTU-2e	• 10 GbE • 40 GbE (10 Gbit/s × 4) • 10 GbE FEC • OC-192/STM-64 • OC-192/STM-64 FEC • OTU-1e
4.25 Gbit/s to 5.66 Gbit/s	• 4GFC	
2.125 Gbit/s to 2.83 Gbit/s	• 2GFC • InfiniBand	• 2 GbE • OC-48/STM-16 • OTU-1
1.0625 Gbit/s to 1.415 Gbit/s	• 1 GbE • 1GFC	
0.53125 Gbit/s to 0.7075 Gbit/s	• OC-12/STM-4	
0.265625 Gbit/s to 0.35375 Gbit/s		
0.132812 Gbit/s to 0.176875 Gbit/s	• OC-3/STM-1	

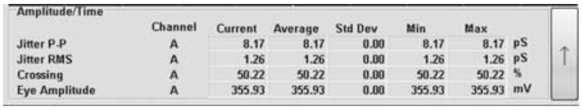
Clock Recovery Function

- ED Clock Recovery Function (Standard Function)
  BER Analysis is supported by inputting the Data signal without requiring an external Clock.
- Eye/Pulse Scope Clock Recovery Function (Option 053, 054, 055)
  Frequency range: 8.5 Gbit/s to 12.5 GHz, 0.1 Gbit/s to 2.7 GHz

This function can be used for evaluating optical characteristics such as long-distance transmission equipment without Clock output.

Time and Amplitude Tests

Supported measurements include 0 level, 1 level, SNR, Eye closure ratio, Eye amplitude, Eye height, Eye width, Jitter p-p, Jitter RMS, Extinction ratio, Rise time, Fall time, Duty cycle distortion, Average power, OMA, etc.



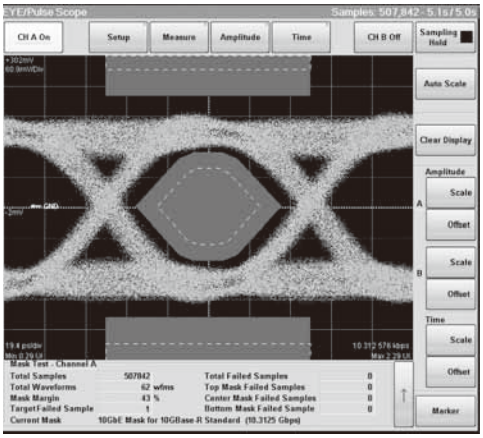
Amplitude/Time

	Channel	Current	Average	Std Dev	Min	Max	
Jitter P-P	A	8.17	8.17	0.00	8.17	8.17	pS
Jitter RMS	A	1.26	1.26	0.00	1.26	1.26	pS
Crossing	A	50.22	50.22	0.00	50.22	50.22	%
Eye Amplitude	A	355.93	355.93	0.00	355.93	355.93	mV

Eye Mask/Mask Margin Test

Testing is simple because Mask Margin tests are performed automatically. Furthermore, since the time required for Mask Margin tests is only about one second, line productivity is improved because standards-compliant measurements are performed at high speed in a shorter time.

- Automatic measurement within one second
- Real-time margin measurements
- Selectable Count and Rate at Mask Hit

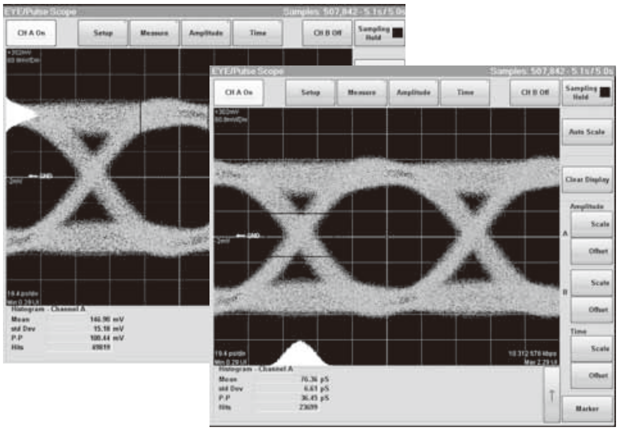


Mask Test - Channel A

Total Samples	507842	Total Failed Samples	0
Total Waveforms	62 wfms	Top Mask Failed Samples	0
Mask Margin	43 %	Center Mask Failed Samples	0
Target Failed Sample	1	Bottom Mask Failed Sample	0
Current Mask	10GbE Mask for 10GBase-R Standard (10.3125 Gbps)		

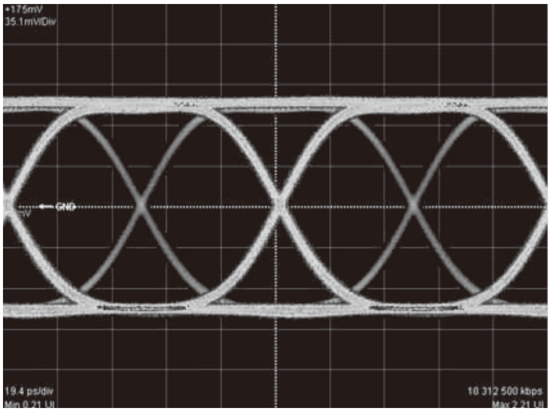
Histograms

Troubleshooting is made easier because waveform data component analysis can be performed using the mean, standard error, and scatter within the set data distribution.



Reference Trace Function

Saving measured waveform data for reference enables comparison of current data with previous data.



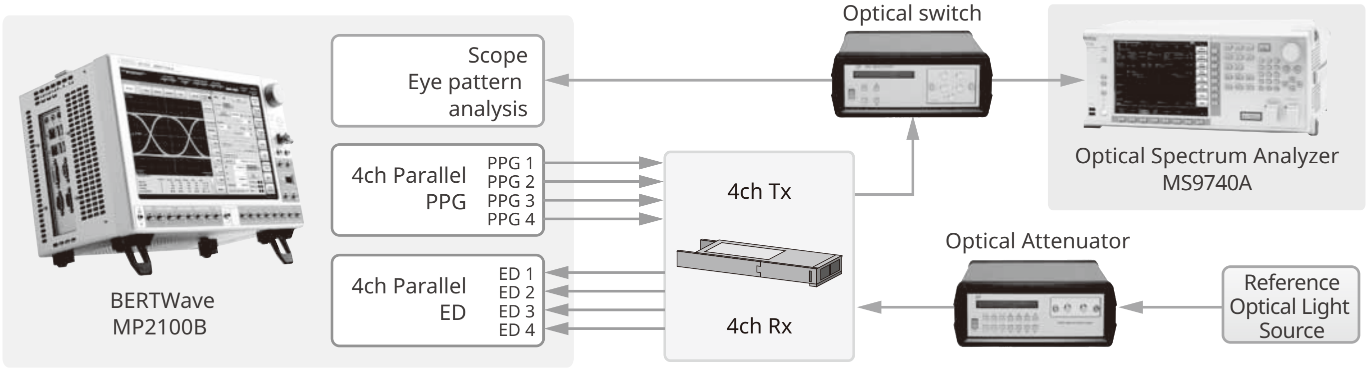
Simple Operation, High Durability, Eco-friendly Design

Improved Operability
- Easy-to-read, 12.1” wide display
- Easy touch-panel operation

Improved Reliability
- Uses flash disk
  Data loss is prevented using flash disk.

Compact, Eco-friendly Design
- Compact 18-cm deep design
- Dimensions: 341 (W) × 221.5 (H) × 180 (D) mm
- Lightweight (7 kg max.)

40 Gbit/s QSFP+ (10 Gbit/s × 4) Measurement



40 Gbit/s QSFP + Measurement Items

Transmitter
- Eye Pattern Measurements
  Tr/Tf, Jitter, Mask Margin, etc.
- Average Output Power
- OMA
- Extinction Ratio

Receiver
- BER Curve

Shorter Test Times with Simultaneous BER and Waveform Measurements

Multichannel optical modules such as QSFP+ are being deployed in data centers to cope with the explosive increase in data traffic. With a built-in 4ch BERT, the MP2100B supports simultaneous measurement of all QSFP+ channels. Moreover, since it has both a built-in BERT and oscilloscope, it can be used to monitor waveforms while also performing BER measurements, helping nearly halve test times.

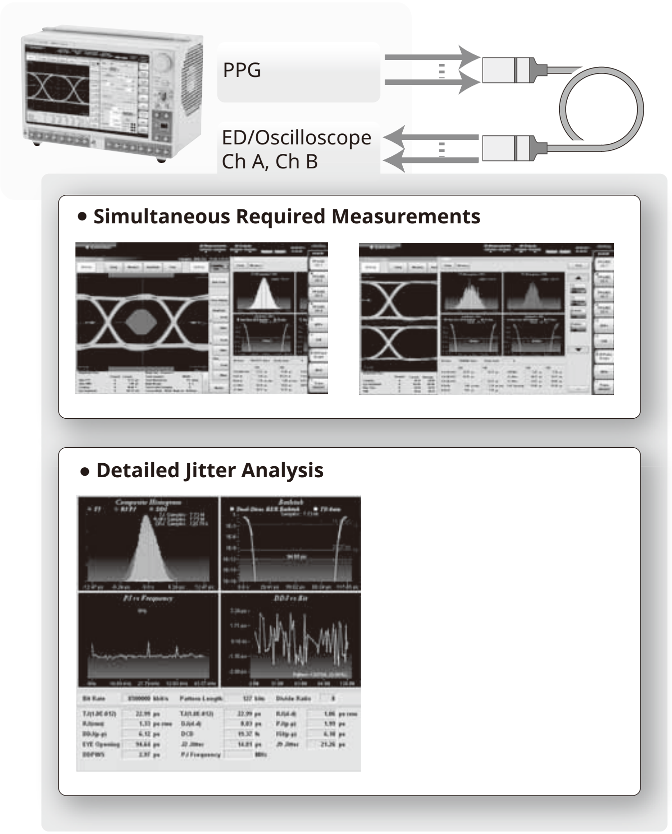
Shorter Analysis Times using Automatic Waveform Measurements

Key parameters, such as Tr/Tf and Jitter, for clearly understanding waveform performance can be measured automatically.
Mask Margin Pass/Fail evaluations are displayed along with Margin data such as bit errors and rates.
These automated measurement functions play a major role in cutting monitored waveform quality-analysis time.

Higher Yields due to High-Quality PPG and High-Sensitivity ED

Accurate testing of DUT characteristics must avoid degrading the DUT characteristics due to the measuring instrument performance.
The MP2100B PPG can output a high-quality signal with a Tr/Tf of 24 ps and a Jitter of 1 ps. In addition, the ED has a high input sensitivity of 10 mVp-p min.
This excellent performance helps improve DUT yields.

AOC (Active Optical Cable) Measurement



AOC (Active Optical Cable) Measurement Items

- BER
- Eye Pattern
  Tr/Tf, Jitter, Mask Margin, etc.
- Jitter Analysis

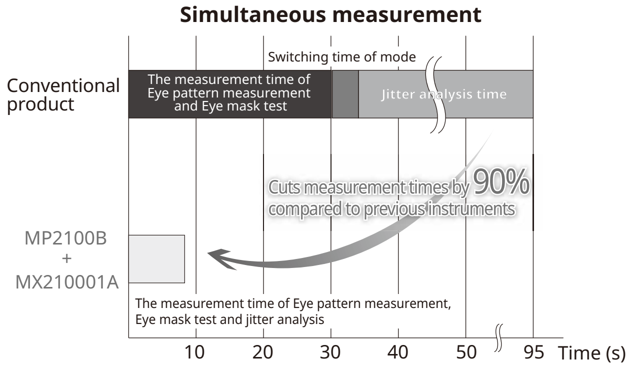
Shorter Test Time using Multichannel BER Measurement

Since the MP2100B has a built-in 4ch BERT it can measure the BER of all four AOC lanes at once, helping cut test times.

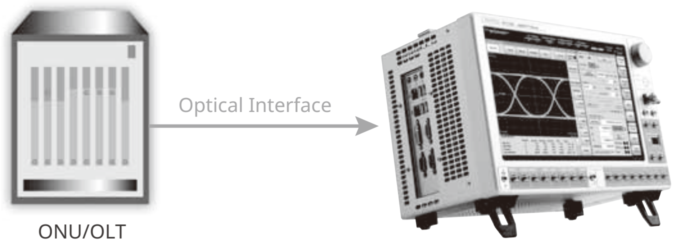
Shorter Test Time using High-Speed Jitter Analysis Function

AOC are not evaluated using just the Eye pattern — Jitter analysis is also required.
Using the Jitter Analysis Software MX210001A in combination with the MP2100B supports simultaneous Jitter analysis, Eye Pattern, and Eye Mask tests, helping cut test times.

Simultaneous Eye Pattern and Eye Mask, Jitter Analysis Measurements



PON Device BOB (BOSA On Board) Evaluations



PON Transmission Equipment Measurement Items

- Eye Pattern
  Tr/Tf, Jitter, Mask Margin, etc.

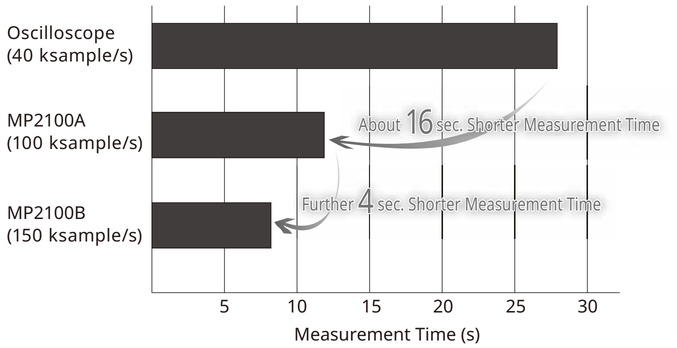
Simple Test System using Clock Recovery

Commonly, transmission equipment does not output a trigger signal, but since the MP2100B has a built-in Clock Recovery option, a waveform monitoring system can be configured using only the MP2100B.

Shorter Test Time using High-Speed Mask Margin Measurement

The MP2100B has a new Fast Sampling Mode built-in as standard. It increases the sampling speed from 100 ksample/s to 150 ksample/s, helping shorten test times by increasing the Eye pattern screen drawing speed.

Difference in Eye Mask Screen Drawing Time due Sampling Speed



Specifications

Common

Display		12.1 inch (1280 × 800) Touch Panel
Operating System		Windows Embedded Standard 2009
Internal Storage Devices		Flash Memory (8 GB or more)
Input and Output		VGA, DVI USB 2.0 × 4 Ethernet × 2 (10/100/1000BASE-T) GPIB
Remote Control		Ethernet, GPIB (Option)
Power Voltage		100 V(ac) to 120 V(ac)/200 V(ac) to 240 V(ac), 50 Hz/60 Hz
Power Consumption		300 VA max.
Operating Temperature		+5° to +40°C
Storage Temperature		–20° to +60°C
Dimensions		341 (W) × 221.5 (H) × 180 (D) mm (excluding projections)
Mass		7 kg max. (with option 012 and 021)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

BERT

Operation Bit Rates		125 Mbit/s to 12.5 Gbit/s
Number of Channels		1, 2, 4 (Differential)
Connector		SMA
Output	Amplitude	0.1 Vp-p to 0.8 Vp-p (Single-end) 0.2 Vp-p to 1.6 Vp-p (Differential)
	Jitter	1 ps rms (typ.)
	Tr/Tf (20 to 80%)	24 ps (typ.)
Input	Amplitude	0.05 Vp-p to 0.8 Vp-p
	Sensitivity	10 mVp-p (typ.)
Test Pattern		PRBS7, PRBS9, PRBS15, PRBS23, PRBS31 1.3 Mbits Programmable

Sampling Oscilloscope

Optical Channel	Wavelength Range	750 nm to 1650 nm
	Bandwidth	9 GHz (typ.)
	RMS Noise	SMF: 1.3 µW, MMF: 2.4 µW (typ.)
	Eye Mask Sensitivity	–15 dBm (typ.)
	Reference Receiver Filter (Option)	OC-3/STM-1, OC-12/STM-4, CPRI, 1GFC, 1 GbE, OC-24, CPRIx2, CPRIx4, OC-48/STM-16, 2 GbE, InfiniBand Optical, 2GFC, OTU-1, CPRIx5, 10GBASE-LX4, 10GFC-LX4, 4GFC, InfiniBand Opticalx2, CPRIx8, CPRIx10, XAUI Opticalx2, 8GFC, 10 GbE WAN, 10 GbE LAN/PHY, OC-192/STM-64, InfiniBand Opticalx4, 10GFC, G975 FEC, OTU-2, 10 GbE FEC, 10GFC FEC
Electrical Channel	Bandwidth	25 GHz (typ.)
	RMS Noise	0.5 mV (typ.)
Jitter		0.85 ps rms (typ.)
Sampling Rate		150 ksamples/s (nominal)
Clock Recovery (Option)		0.1 GHz to 2.7 GHz, 8.5 GHz to 12.5 GHz

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main frame
MP2100B	BERTWave
	Standard accessories
	Power Cord: 1
	BERTWave Control Software (CD-ROM, Operation manual): 1
	Option
MP2100B-011	1CH BERT
MP2100B-012	2CH BERT
MP2100B-014	4CH BERT
MP2100B-021	Dual Electrical Scope
MP2100B-023	Optical and Single-ended Electrical Scope
MP2100B-030	GPIB
MP2100B-037	FC Connector
MP2100B-040	SC Connector
MP2100B-051	SFP+ Slot
MP2100B-053	Clock Recovery (External Input)
MP2100B-054	Clock Recovery (Optical Data)
MP2100B-055	Clock Recovery (with BER Measurement)
MP2100B-063	High Rate Filter Bank
MP2100B-065	Low Rate Filter Bank
MP2100B-069	Multi Rate Filter Bank
MP2100B-070	LPF for 156M (L)
MP2100B-071	LPF for 622M (L)
MP2100B-072	LPF for 1.0G (L)
MP2100B-073	LPF for 1.2G (L)
MP2100B-075	LPF for 2.5G (L)
MP2100B-076	LPF for 2.1G (H)
MP2100B-078	LPF for 2.6G (H)
MP2100B-079	LPF for 3.1G (H)
MP2100B-080	LPF for 4.2G (H)
MP2100B-081	LPF for 5.0G (H)
MP2100B-082	LPF for 6.2G (H)
MP2100B-086	LPF for Multi 10G (8.5G to 11.3G) (H)
MP2100B-087	Filter Bank Set (622M/1.2G/2.5G/4.2G/6.2G/Multi 10G)
MP2100B-088	Filter Bank Set (4.2G/5.0G/6.2G/ Multi 10G)
MP2100B-089	Filter Bank Set (156M/622M/1.2G/2.5G)
MP2100B-092	PPG/ED Bit Rate Extension for 125M to 12.5G
	Retrofit option
MP2100B-111	1CH BERT Retrofit
MP2100B-112	2CH BERT Retrofit
MP2100B-114	4CH BERT Retrofit
MP2100B-121	Dual Electrical Scope Retrofit
MP2100B-123	Optical and Single-ended Electrical Scope Retrofit
MP2100B-130	GPIB Retrofit
MP2100B-151	SFP+ Slot Retrofit
MP2100B-153	Clock Recovery (External Input) Retrofit
MP2100B-154	Clock Recovery (Optical Data) Retrofit
MP2100B-155	Clock Recovery (with BER Measurement) Retrofit
MP2100B-176	LPF for 2.1G (H) Retrofit
MP2100B-178	LPF for 2.6G (H) Retrofit
MP2100B-179	LPF for 3.1G (H) Retrofit
MP2100B-180	LPF for 4.2G (H) Retrofit
MP2100B-181	LPF for 5.0G (H) Retrofit
MP2100B-182	LPF for 6.2G (H) Retrofit
MP2100B-186	LPF for Multi 10G (8.5G to 11.3G) (H) Retrofit
MP2100B-187	Filter Bank Set (622M/1.2G/2.5G/4.2G/6.2G/Multi 10G) Retrofit
MP2100B-188	Filter Bank Set (4.2G/5.0G/6.2G/ Multi 10G) Retrofit
MP2100B-189	Filter Bank Set (156M/622M/1.2G/2.5G) Retrofit
MP2100B-192	PPG/ED Bit Rate Extension for 125M to 12.5G Retrofit
	Standard accessories (MP2100B-x11)
	Terminator: 2
	Open (Coaxial connector cover): 5
	Standard accessories (MP2100B-x12)
	Terminator: 4
	Open (Coaxial connector cover): 7
	Standard accessories (MP2100B-x14)
	Terminator: 8
	Open (Coaxial connector cover): 11

Model/Order No.	Name
	Standard accessories (MP2100B-x21)
	Open (Coaxial connector cover): 3
	Coaxial Adaptor (K-P · K-J, SMA compatible): 2
	Standard accessories (MP2100B-x23)
	Open (Coaxial connector cover): 2
	Coaxial Adaptor (K-P · K-J, SMA compatible): 1
	Standard accessories (MP2100B-x51)
	Open (Coaxial connector cover): 2
	Standard accessories (MP2100B-x53)
	Open (Coaxial connector cover): 2
	Standard accessories (MP2100B-x54)
	Open (Coaxial connector cover): 1
	Standard accessories (MP2100B-x55)
	Open (Coaxial connector cover): 1
	Maintenance Service
MP2100B-ES310	3 Years Extended Warranty Service
MP2100B-ES510	5 Years Extended Warranty Service
	Optional accessories
J1137	Terminator
J1341A	Open (Coaxial connector cover)
J1359A	Coaxial Adaptor (K-P · K-J, SMA compatible)
J1349A	Coaxial Cable 0.3 m
J1342A	Coaxial Cable 0.8 m
J1625A	Coaxial Cable 1 m (SMA connector)
G0238A	SFP+ SR 850 nm
G0239A	SFP+ LR 1310 nm
G0177A	850 nm SFP module (1.062 to 4.25 Gbit/s)
G0178A	1310 nm SFP Module (0.155 to 2.67 Gbit/s)
G0179A	1550 nm SFP Module (0.155 to 2.67 Gbit/s)
J1344A	LC/PC-LC/PC-1M-SM
J1139A	FC · PC-LC · PC-1M-SM
J1345A	SC/PC-LC/PC-1M-SM
J1346A	LC/PC-LC/PC-1M-GI (62.5/125)
J1347A	FC/PC-LC/PC-1M-GI (62.5/125)
J1348A	SC/PC-LC/PC-1M-GI (62.5/125)
J1510A	Pick OFF Tee
J0617B	Replaceable Optical Connector (FC-PC)
J0618D	Replaceable Optical Connector (ST)
J0618E	Replaceable Optical Connector (DIN)
J0619B	Replaceable Optical Connector (SC)
B0716A	Carrying Case
J1512A	7.5 GHz Passive Probe Set
B0650A	Rack Mount Kit
J1519A	Optical Fiber Cord (MM, 12FIBER, MPO,3M)
J1680A	4Channel CWDM MUX or DEMUX
J1681A	MPO Loopback Cable
J1682A	MPO to FC convert cable
G0334A	40G LR4 1310 nm QSFP+
G0359A	40G SR4 850 nm QSFP+
W3772AE	MP2100B BERTWave Operation Manual
W3773AE	BERTWave Series Remote Control Operation Manual
Z0306A	Wrist Strap
J1627A	GND Connection Cable
G0342A	ESD Discharger
Z0914A	Ferrule Cleaner
Z0915A	Replacement Reel for Ferrule Cleaner
	Software
MX210001A	Jitter Analysis Software
MX210002A	Transmission Analysis Software

IP/NETWORK MEASURING INSTRUMENTS

Selection Guide

Interface

Model Interface	MT1000A/ MU100010A	MT1000A/ MU100011A	MT1000A/ MU100040B	MT1100A	MT9090A/ MU909060Ax
10M/100M/Gigabit Ethernet	✓	✓		✓	✓
10 Gigabit Ethernet	✓	✓		✓	
25 Gigabit Ethernet		✓			
40 Gigabit Ethernet		✓		✓	
100 Gigabit Ethernet		✓		✓	
OTU1, OTU2	✓	✓		✓	
OTU1e, 2e, 1f, 2f	✓	✓		✓	
OTU3, 3e1, 3e2, 4		✓		✓	
STM-1, 4, 16, 64/OC-3, 12, 48, 192	✓	✓		✓	
STM-256/OC-768				✓	
eCPRI/RoE (IEEE1914.3)	✓	✓		✓	
CPRI Option 1, 2, 3, 4, 5, 6, 7, 8	✓	✓	✓	✓	
OBSAI 1X, 2X, 3X, 4X, 8X	✓	✓		✓	
DS1, DS3, E1, E3, E4	✓			✓	
1G, 2G, 4G, 8G, 10G FC	✓	✓		✓	
16G FC		✓			

Measurement Functions

Model Measurement Functions		MT1000A/ MU100010A	MT1000A/ MU100011A	MT1000A/ MU100040B	MT1100A	MT9090A/ MU909060Ax
Ethernet	Packet Capture	✓	✓		✓	
	Protocol Decoding	✓	✓		✓	
	Protocol Emulation	✓	✓		✓	
	RFC 2544 Automatic Test	✓	✓		✓	✓
	Y.1564 Automatic Test	✓	✓		✓	✓
	RFC 6349 Automatic Test	✓	✓		✓	
	Through Mode	✓	✓		✓	✓
	Traffic Monitor	✓	✓		✓	✓
	Full Wire Rate Transmission	✓	✓		✓	✓
	Packet BER Measurement	✓	✓		✓	✓
	Latency	✓	✓		✓	✓
	SyncE	✓	✓		✓	
	IEEE 1588 v2	✓	✓		✓	
OTN/SDH/SONET	OTN Frame	✓	✓		✓	
	SDH/SONET Frame	✓	✓		✓	
	Tandem Connection Pattern G.707	✓	✓		✓	
	Automatic Protection Switch	✓	✓		✓	
	PDH Mapping	✓	✓		✓	
	DSn Mapping	✓	✓		✓	
	GMP Mapping	✓	✓		✓	
	Through Mode	✓	✓		✓	
	Optical Power Measurements	✓	✓		✓	
	Frequency Offset	✓	✓		✓	
	Client Signal Test over OTN	✓	✓		✓	
Mobile xHaul/ eCPRI/ RoE (IEEE1914.3)	Full Wire Rate Transmission	✓	✓		✓	
	Packet BER Measurement	✓	✓		✓	
	Latency	✓	✓		✓	
	SyncE	✓	✓		✓	
	IEEE 1588 v2	✓	✓		✓	
Mobile xHaul/ CPRI	BERT	✓	✓		✓	
	Error/Alarm Transmission	✓	✓		✓	
	Passive Link Confirmation Test	✓	✓		✓	
	APS	✓	✓		✓	
	Pass Through	✓	✓		✓	
	Spectrum			✓		
	Spectrogram			✓		
Mobile xHaul/ OBSAI	BERT	✓	✓		✓	
	Error/Alarm Transmission	✓	✓		✓	
	APS	✓	✓		✓	
PDH/DSn	Frequency Measurements	✓			✓	
	Error Measurement (G.821, etc.)	✓			✓	
Fibre Channel	BERT	✓	✓		✓	
	Performance Test	✓	✓		✓	
	Reflector	✓	✓		✓	
Remote Control	GUI	✓	✓		✓	✓
	Command	✓	✓		✓	

Network Master Series

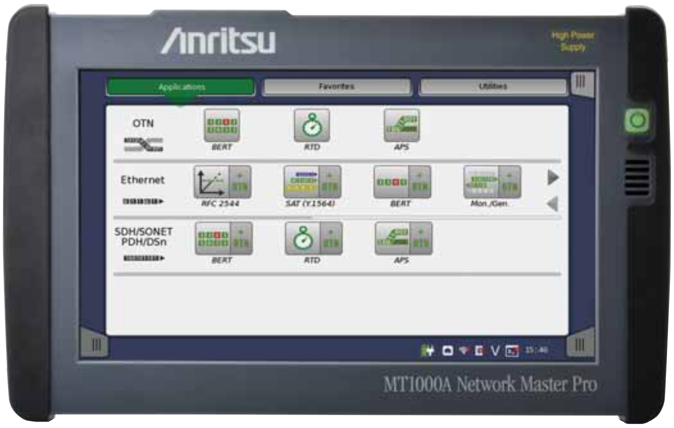
MT1000A Network Master Pro

MU100010A 10G Multirate Module
MU100011A 100G Multirate Module
MU100090A High Performance GPS Disciplined Oscillator

Remote Control
WLAN | Bluetooth | Ethernet | USB

Redefining Transport Testing

Excellent Eco Product



Network Master Pro

Networks continue to evolve as standards for transport tests, such as Ethernet, OTN, SDH/SONET, eCPRI/RoE/CPRI/OBSAI, PTP, Fibre Channel, etc., become more diverse, and speeds increase with development of 100G/25G Ethernet and 16G Fibre Channel.
With an easily configured modular design to support changing network standards and an easy-to-use GUI, the Network Master Pro MT1000A is perfect for rapid I&M of wide-area networks.

All in One | I&M | Easy to use

- All transport network field tests in one tester
- Easy-to-read 9-inch touch screen in easy-to-use compact B5-size tester
- Higher work efficiency with multiple tests using one-button automated measurement tools

One Button Testing

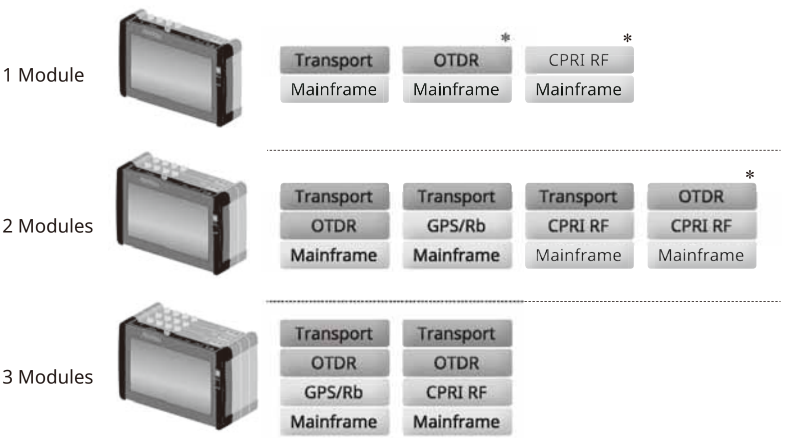
The MT1000A has automatic test functions for simple and efficient network commissioning. These MT1000A automated test functions run scenario files created in advance on a PC to perform tests automatically using preset measurement items, procedures, and pass/fail evaluation conditions. Since the scenario also handles report creation, evaluation and results, inexperienced workers can run accurate tests without operation mistakes and re-tests.

Setting Test Equipment: Manual
Executing Test: Manual
Evaluating Results: Based on data

Setting Test Equipment: Not necessary
Executing Test: Not necessary
Evaluating Results: Not necessary

Network Master Pro MT1000A Module Line up

Any modular combination as shown in a figure.



Mainframe Network Master Pro
MT1000A

Transport Transport Module
10G Multirate MU100010A
100G Multirate MU100011A

OTDR OTDR Module
1310/1550 nm SMF MU100020A
1310/1550/850/1300 nm SMF/MMF MU100021A
1310/1550/1625 nm SMF MU100022A

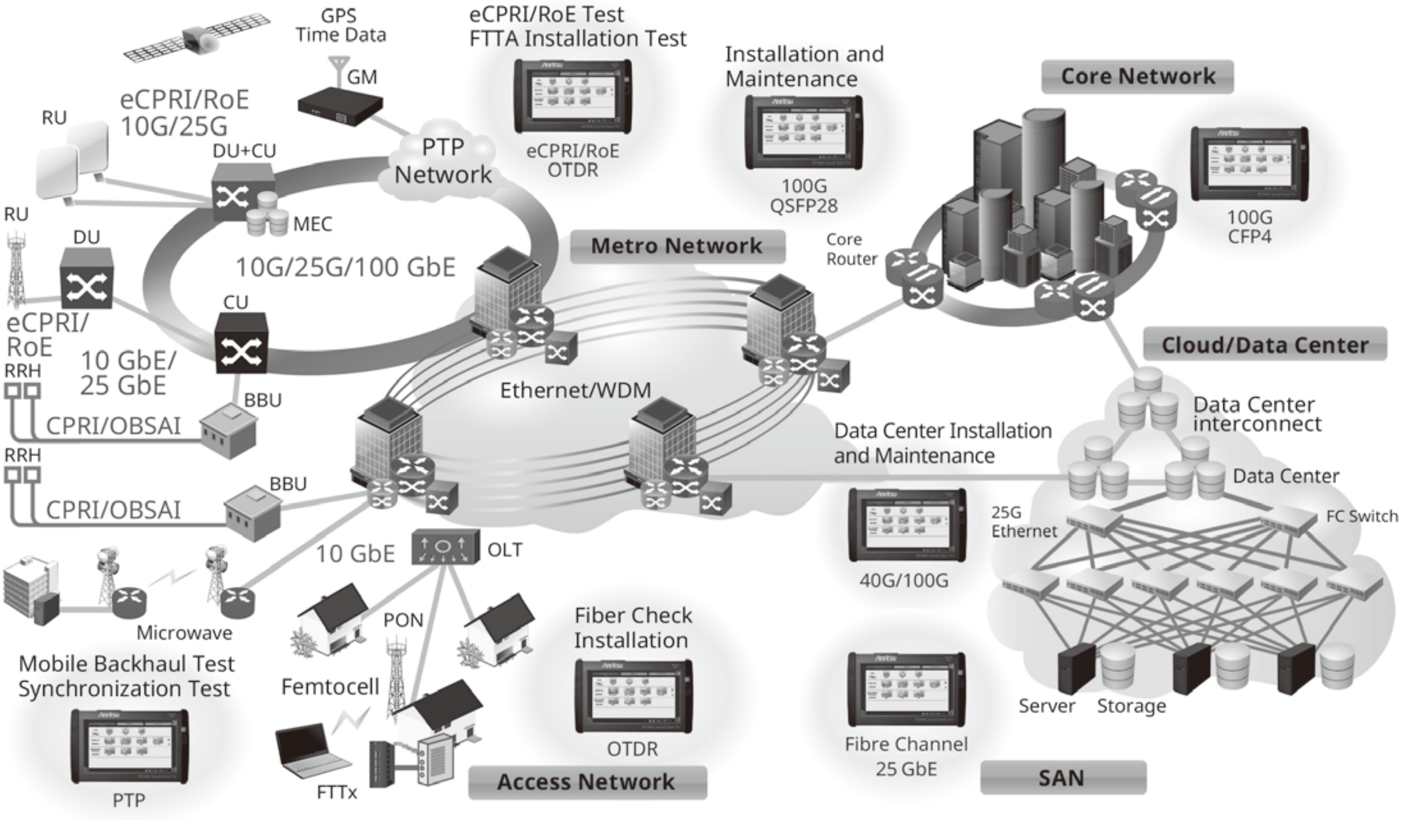
CPRI RF CPRI RF Module
MU100040B

GPS/Rb High Performance GPS Disciplined Oscillator
MU100090A

*: Required if the transport modules is not used rear cover (B0720A).

I&M Support for All Networks

The Network Master supports all types of network I&M.

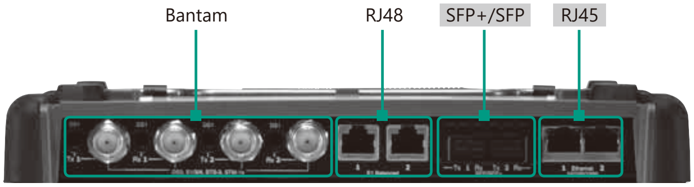


The modular design of the Network Master Pro MT1000A platform makes it easy to support I&M for different network configurations. Combining it with the 10G Multirate Module MU100010A offers the necessary functions for I&M of networks at speeds from 1.5 Mbps to 10 Gbps. Combining with the 100G Multirate Module MU100011A, it supports more interface standards than any other handheld transport tester on the market such as CFP4/QSFP28, QSFP+, SFP28 (25GbE), SFP+SFP and RJ45.
Coupled with a compact easy-to-use design and long battery operation, plus a large 9” easy-to-see color touch screen, remote GUI operation via Internet connection, and more, the MT1000A is a key factor in increasing I&M test work efficiency.
Furthermore, options for each test function can be selected and added as necessary to match the work schedule, helping cut initial capital costs.

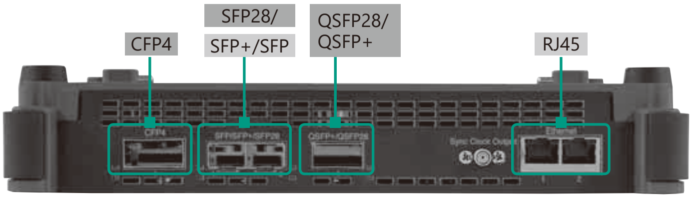
Interface*	Ethernet	OTN	SDH/SONET	Fibre Channel	CPRI/OBSAI	PDH/DSn
CFP4	100 GbE	OTU4	—	—	—	—
QSFP28	100 GbE	OTU4	—	—	—	—
QSFP+	40 GbE	OTU3	—	—	—	—
SFP28	25 GbE	—	—	—	—	—
SFP/SFP+	GbE/10 GbE	OTU1x/OTU2x	STM1-64/ OC3-192	1G/2G/4G/8G/10G FC 16G FC	CPRI 1/2/3/4/5/6/7/8 OBSAI 1x/2x/4x/8x	—
RJ45	10/100/1000M	—	—	—	—	—
RJ48	—	—	—	—	—	E1
BNC	—	—	STM-1e/STS-3	—	—	E1/E3/E4/DS3
Bantam	—	—	—	—	—	DS1

☐ : MU100010A Only   : MU100011A Only ▨ : Both MU100010A & MU100011A Supported

*: The interface depends on the module. For details, refer to the following.



10G Multirate Module MU100010A



100G Multirate Module MU100011A

Ethernet Application

Network operators are introducing new carrier-class technologies, such as VLAN, Q-in-Q, Ethernet OAM, MPLS, PBB, MPLS-TP, etc., to their Ethernet service menus, increasing test complexity and test time for field technicians.
The MU100010A/MU100011A Ethernet test functions provide strong support for commissioning and troubleshooting Ethernet networks up to 100G speeds, including connectivity and band tests, QoS tests, and service-related tests.

Ethernet Test: End-to-End

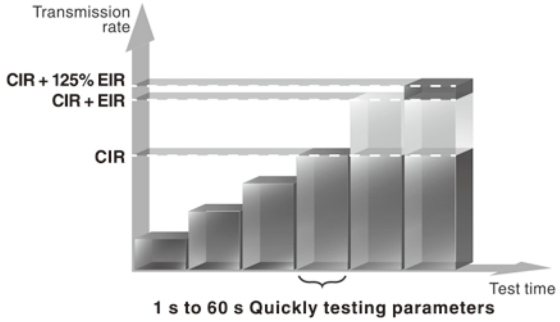
WDM Test

Ethernet Service Activation Test (Y.1564)

With the ability to simultaneously test multiple traffic streams, ITU-T Y.1564 is a new test methodology when deploying Ethernet networks. Today's common RFC 2544 standard completes tests one at the time and does not run all traffic streams simultaneously. ITU-T Y.1564 has the following two test phases.

Service Configuration Test:

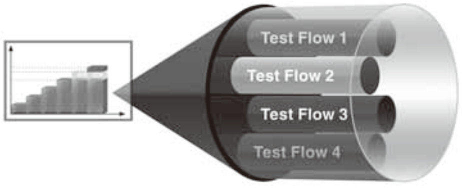
This section is completed quickly, within seconds per stream.
It confirms the end-to-end configuration while quickly checking the Information Rate (IR), Frame Transfer Delay (FTD), Frame Delay Variation (FDV), Frame Loss Ratio (FLR), Committed Burst Size (CBS) and Excess Burst Size (EBS) sequentially for all configured traffic streams.



Y.1564 Service Configuration Test

Service Performance Test:

This section is completed based on the M.2110 standard for 15 minutes, 2 hours, 24 hours, or a user-selectable period.
It transmits all configured traffic streams simultaneously at the CIR, confirming that all traffic can traverse the network under full load while checking IR, FTD, FDV, FLR and Availability (AVAIL).

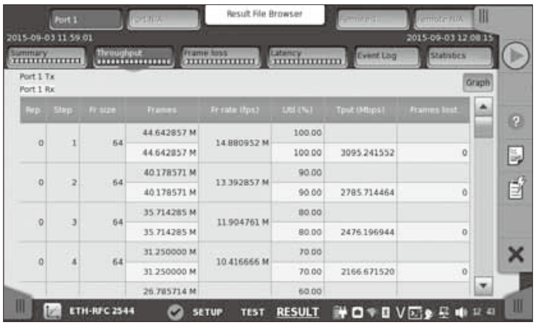


Y.1564 Service Performance Test

Simultaneous testing in the Service Performance Test section greatly reduces the total test time compared to RFC 2544.

RFC 2544 Test

RFC 2544 testing of Throughput, Frame Loss, Latency, Packet Jitter and Burstability is straightforward with the MU100010A/MU100011A.
It automates the procedure while still allowing thorough test configuration. For full information on performance at both line sides, the end-to-end test mode allows two MT1000A testers to work together in a local–remote configuration where the user controls both testers and reads results from both locally. Easy to understand tabular screens and bar graph presentations simplifies reading of results. Attractive looking reports can be generated for presentation to end-customers.

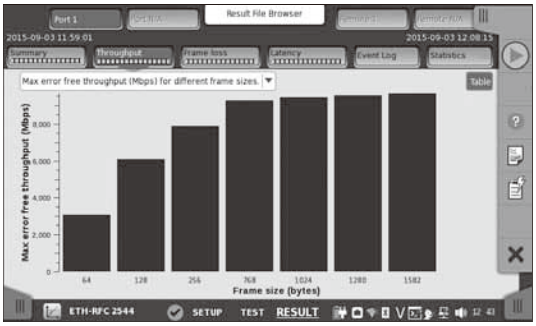


2015-09-03 11:59:01
2015-09-03 12:08:15

Port 1 Tx
Port 1 Rx

Rep	Step	Fr size	Frames	Fr rate (fps)	Util (%)	Tput (Mbps)	Frames lost
0	1	64	44.642857 M	14.880952 M	100.00		
			44.642857 M		100.00	3095.241552	0
0	2	64	40.178571 M	13.392857 M	90.00		
			40.178571 M		90.00	2785.714464	0
0	3	64	35.714285 M	11.904761 M	80.00		
			35.714285 M		80.00	2476.196944	0
0	4	64	31.250000 M	10.416666 M	70.00		
			31.250000 M		70.00	2166.671520	0
			26.785714 M		60.00		

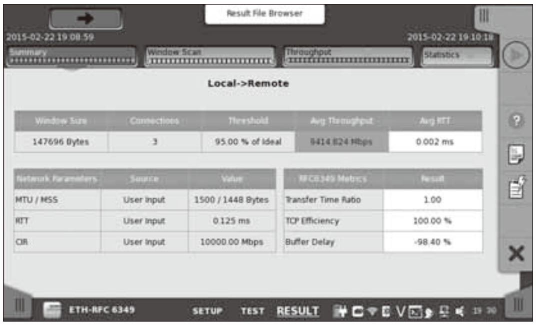
Throughput Summary



Throughput Graph

TCP Throughput (RFC 6349, iPerf) [Option]

Normally, IP network operators test their communications equipment in accordance with the RFC 2544 and ITU-T Y.1564 standards, but even when the test results are good, sometimes the expected end-to-end data throughput is not achieved. Although data communications use the TCP protocol for guaranteed data transfers, sometimes throughput drops as a result of network delays, poor circuit quality, etc.
The RFC 6349 standard regulates the test methods for assuring operator throughput over the TCP layer, and the MU100010A/MU100011A modules with built-in TCP throughput option support TCP throughput evaluation and testing in accordance with the RFC 6349 standard. The iperf client function for testing TCP throughput is also supported.



2015-02-22 19:08:59
2015-02-22 19:10:18

Local->Remote

Window Size	Connections	Threshold	Avg Throughput	Avg RTT
147696 Bytes	3	95.00 % of Ideal	9414.824 Mbps	0.002 ms

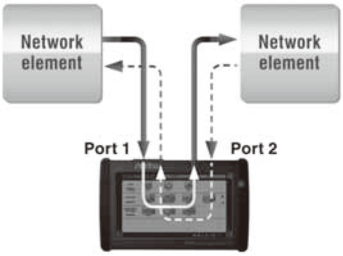
Network Parameters	Source	Value
MTU / MSS	User Input	1500 / 1448 Bytes
RTT	User Input	0.125 ms
CIR	User Input	10000.00 Mbps

RFC6349 Metrics	Result
Transfer Time Ratio	1.00
TCP Efficiency	100.00 %
Buffer Delay	-98.40 %

Test Result

Pass-through Mode

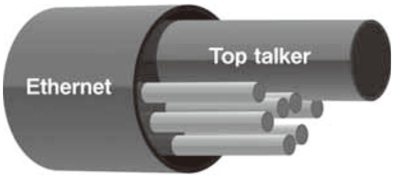
Configuring the MU100010A/MU100011A to Pass-through mode supports detailed troubleshooting, especially in bi-directional networks requiring traffic monitoring from both ends.



Pass-through monitoring by inserting MT1000A in network

IP Channel Statistics – Multiflow Counters

Up to 230 flows can be selected and filtered by MAC and IP Source/Destination addresses, VLAN and MPLS to monitor selected streams and display detailed information. This allows the user to identify error streams, top talkers, and network attacks, as well as troubleshoot network issues more deeply.



One-way Delay Measurement Using Two MT1000A Units

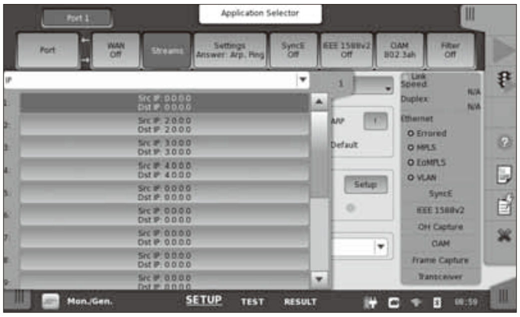
One-way delay can be measured with high accuracy using two MT1000A/MU100011A units at a distant location with installed MU100090A.

Ethernet OAM

To improve the performance of Ethernet-based networks and provide Carrier Class service, many network providers have enhanced their systems with Ethernet OAM (Operation, Administration and Maintenance), supporting the ability to detect network faults and measure performance. Ethernet OAM is defined by three standards covering different network sections.
The ITU-T Y.1731 and IEEE 802.1ag standards are similar and support end-to-end network functionality, while the IEEE 802.3 (previously IEEE 802.3ah) standard supports first (or last) mile functionality.
The MU100010A/MU100011A tests the network using all supported OAM functions.

Ethernet Multistream

The MU100010A/MU100011A Ethernet Multistream function allows simulation and testing of a congested network's ability to prioritize high-priority traffic over low-priority traffic. The user can set different priorities for up to 16 streams per port to measure how frame loss affects network performance.
The Multistream function displays clear information on Packet Jitter and Latency per stream, helping troubleshoot problematic issues for VoIP services, etc.



1: Src IP: 0.0.0.0 Dst IP: 0.0.0.0
2: Src IP: 2.0.0.0 Dst IP: 2.0.0.0
3: Src IP: 3.0.0.0 Dst IP: 3.0.0.0
4: Src IP: 4.0.0.0 Dst IP: 4.0.0.0
5: Src IP: 0.0.0.0 Dst IP: 0.0.0.0
6: Src IP: 0.0.0.0 Dst IP: 0.0.0.0
7: Src IP: 0.0.0.0 Dst IP: 0.0.0.0
8: Src IP: 0.0.0.0 Dst IP: 0.0.0.0
9: Src IP: 0.0.0.0 Dst IP: 0.0.0.0

Multi Stream Setting

Stacked VLAN

Stacked VLAN (Q-in-Q) is used increasingly by several types of Ethernet-based networks, allowing operators to split traffic from different customers on one line or to shape traffic by priority.
The MU100010A/MU100011A supports up to 8 levels of VLAN tags, offering a powerful network test tool.

MPLS and MPLS-TP

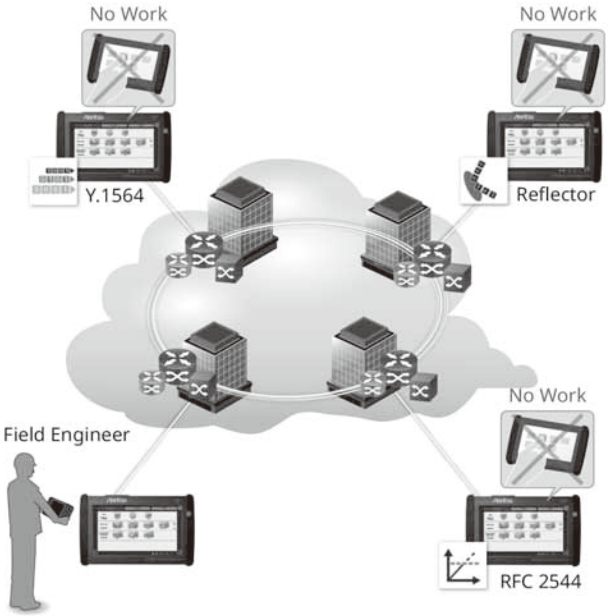
Multi-Protocol Label Switching (MPLS) supports efficient traffic routing on packet-based networks. MPLS – Transport Profile (MPLS-TP) technology is based on standard MPLS and aims to give service providers reliable connection-oriented packet-based transport over the network. MPLS-TP offers service providers QoS, end-to-end Carrier Class OAM, and protection switching. With its ability to insert up to 8 levels of MPLS labels, the MU100010A/MU100011A is a powerful tool for testing MPLS and MPLS-TP networks including OAM functions.

	Port 1	
Pause	0	0
VLAN	0	0
MPLS	0	0
EoMPLS	0	0
MiM	0	
VLAN Max Level	0	
MPLS Max Level	0	
MPLS Min Level	N/A	

Protocol Counter

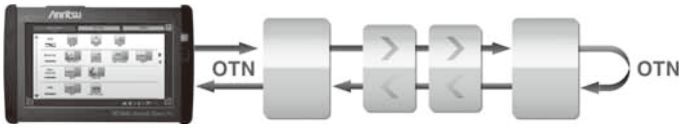
In-Band Test

Usually at least two field technicians must be dispatched for end-to-end testing, but using the MU100010A/MU100011A in-band measurement function to control the remote MT1000A from the local MT1000A via the test network, cuts the number of required field technicians and increases work efficiency.



OTN Application

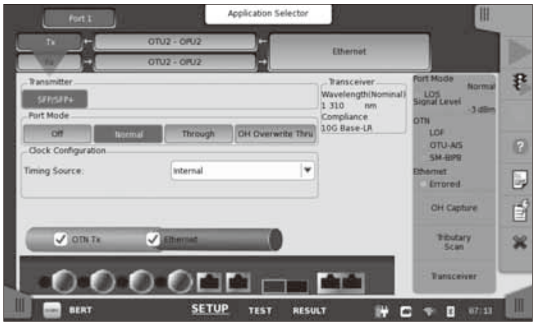
OTN carries client signals, but current OTN field testers only support OTN testing at the OTN line rate with bulk test signals. This means that problems in the carried client signals are invisible when testing an in-service OTN system.
Using the MU100010A/MU100011A, OTN lines can be tested at the client signal level with signals like Ethernet, CPRI, Fibre Channel and SDH/SONET, because the OTN mapping function is mandatory for modern OTN transponders. The MT1000A can also test OTN lines at the line rate with bulk signals.
The user can identify problems at all levels in the OTN signal, solving OTN issues efficiently, reducing system downtime, and reducing operating expenses for network operators.



Looping-back test signal from MT1000A at far end supports easy OTN line quality tests

Out-of-service OTN Error and Alarm Statistics

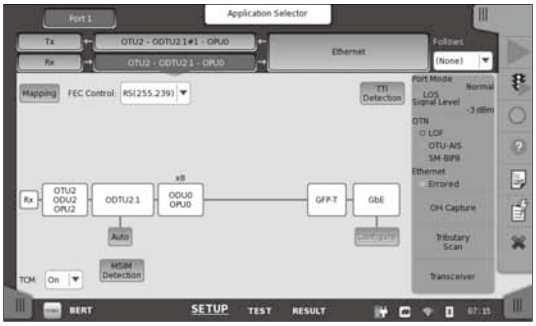
The MU100010A/MU100011A supports powerful statistical measurements for BER tests as well as OTN level alarms and errors for installing/commissioning and troubleshooting out-of-service OTN lines. G.8201 or M.2401 error-performance parameters are calculated during measurement. Stress testing of network elements is supported by inserting errors and alarms, and adjusting overhead bytes in the signal transmitted by the instrument.



Error/Alarm Setting

Testing Ethernet, CPRI, Fibre Channel, or SDH/SONET Client Signals Mapped onto OTN Signal (Part of ODU Multiplexing Option)

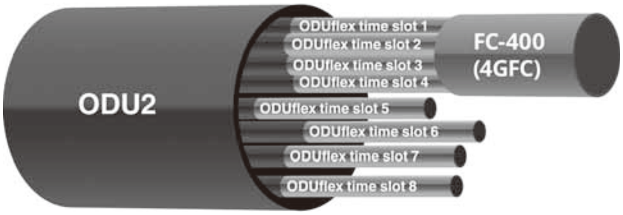
The MU100010A/MU100011A tests OTN links carrying Ethernet, CPRI, Fibre Channel or SDH/SONET client signals, allowing the operator to test embedded client signals.
For example, an RFC 2544 or Y.1564 test can be performed with an Ethernet signal carried over the OTN signal, allowing the service engineer to run tests emulating the real-world requirements of end users.



OTN Mapping Setting

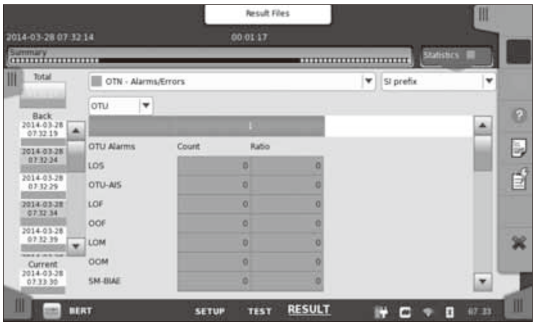
ODUflex Test (with ODU Flex Option)

ODUflex is a new feature of OTN supporting flexible allocation of client-signal bandwidth to make best use of OTN capacity.
The MU100010A/MU100011A with ODU Flex option supports ODUflex tests, allowing operators to verify this new technology on their networks.



ODU Flex Option divides capacity of ODU2 into eight 1.25G ODUflex time slots.
In the above example, an FC-400 (4GFC) Fibre Channel signal occupies four ODUflex time slots.

OTN Statistics Summary



OTU Level Statistics

ITU-T O.182-compliant FEC Test

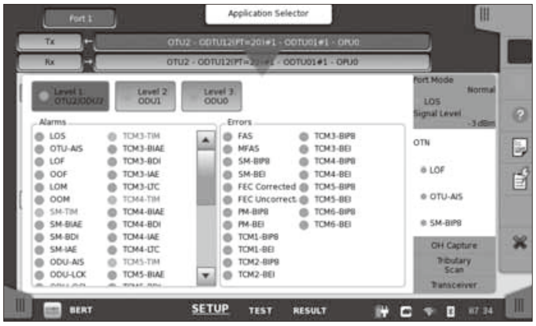
Anritsu proposed the FEC performance tests using Poisson-distributed random errors adopted by ITU-T Recommendation O.182.
This method supports reproducible and accurate FEC error correction tests by generating truly random signal errors.
High-speed networks cannot be tested accurately without using the ITU-T O.182 Poisson error distribution.


Alarms/Errors/Others: Port 1, OTN
Category: FEC Test
Error Item: 0.182 Poisson
Insertion Mode: Rate 1.0 E-9
Exclude FAS (>2.0E-3): ● Off ○ On

FEC Error Insertion

OTN Tributary Scan

The tributary scan feature supports quick inspection of the OTN signal by examining it for major problems and highlighting them in an easy-to-understand manner.

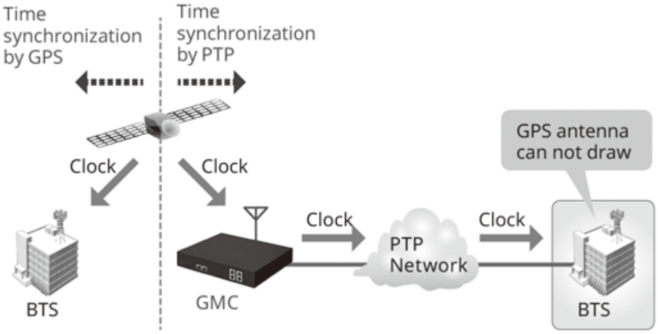


OTU Alarms and Errors View

OTU Header Capture

Mobile Backhaul Application

Mobile backhaul networks use IEEE 1588 v2 and synchronous Ethernet (SyncE) technologies. Since in-office base stations generate wireless signals based on a synchronizing signal distributed by the mobile backhaul, any mobile backhaul synchronization fault severely degrades the mobile radio performance. As a result, mobile operators must test that the SyncE and IEEE 1588 v2 technologies are functioning correctly.



Synchronous Ethernet test

The MU100010A/MU100011A support SyncE and IEEE 1588 v2 (G.8265.1 and G.8275.1) protocol tests and analyses for monitoring SSM messages, and effectively troubleshooting and analyzing network faults, such as interoperability issues caused by abnormal vendor clock devices.

Time/Phase Synchronization Accuracy Tests

Mobile backhaul is starting construction of IEEE 1588 v2 (G.8275.1)-compliant time and phase-synchronized networks.
The High Performance GPS Disciplined Oscillator MU100090A option measures the time and phase synchronization with high accuracy as a max|TE| (absolute Time Error), cTE (Constant Time Error), and dTE (Dynamic Time Error) matrix.
Combining it with the MU100010A/MU100011A adds pass/fail evaluation tests for commissioning time and phase-synchronized networks.


Local Clock
State: SLAVE
Offset: 0 ns
Mean path delay: 5 ns
Sync timeout

Parent Clock
Identity: 00:00:91:FF:FE:E1:02:0E
Port number: 1

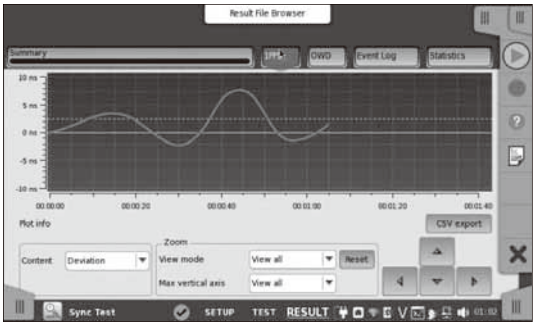
Foreign Master
00:00:91:FF:FE:E1:02:0E
Port number: 1
Announce count: 13

Wall Clock
UTC: N/A
Current: 2016-02-22 18:44:33
UTC offset: N/A

Grandmaster Clock
Identity: 00:00:91:FF:FE:E1:02:0E
Class: 255
Accuracy: Within 1us (0x23)
Variance ann/est: 1.00E-12 / N/A
Variance Raw: 0x5824
Priority 1/2: 12 / 9
Steps removed: 0x00
Time source: GPS (0x20)

Link Speed: 1 Gbps
Duplex: FDX

Status of IEEE 1588 v2 Slave Clock


Content: Deviation
View mode: View all
Max vertical axis: View all

Phase Confirmation using MU100090A

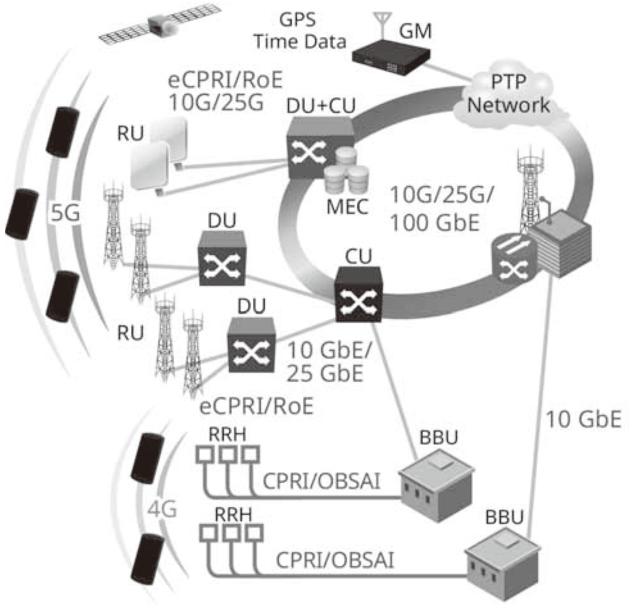
Mobile Fronthaul Application

Operators are supporting the explosive spread of smartphones and tablets by increasing the bandwidth of mobile communications networks, in turn driving a complete change in mobile

So far, mobile front haul has been split into the Base Band Unit (BBU) and Remote Radio Head (RRU) with speed increased and ease of connected supported by using multiple antennas.

However, in addition to faster speeds, the key requirements for next-generation 5G mobile are higher reliability, lower latency, and multiple simultaneous user connections. As a result, mobile front haul requires:

- Change of interface between BBU and RRH from CPRI/OBSAI to eCPRI/RoE (IEEE1914.3)
- Improved time synchronization accuracy
- Large decreases in latency.



eCPRI/RoE (IEEE1914.3) Test

- BER tests using either eCPRI or RoE frame
- One and two-way latency time measurements*
- Phase/Time synchronization accuracy tests
  - Time synchronization test using IEEE 1588 v2 1 pps TE supporting 1G/10G/25G Ethernet

CPRI Test

- BER tests
- Various error and alarm tests
- Return Time Delay (RTD) tests
- Perform pass-through monitoring and CPRI APS measurements
- Client signal mapped to OTN.

OBSAI Test

- BER tests
- Various error and alarms tests
- Returen Time Delay (RTD)
- Perform OBSAI APS measurements

*: Requires MU100011A for high-resolution measurement; requires two MT1000A/MU100011A/MU100090A units for measurement at distant location

Fibre Channel Application

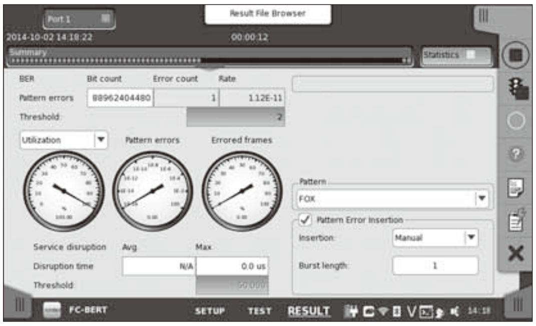
Many operators need to support Fibre Channel links in Storage Area Networks (SAN) together with other transport technologies like OTN, Ethernet, and SDH/SONET. Having one tool for all technologies is important for efficient testing. The multi-protocol MU100010A/MU100011A with Fibre Channel option is the perfect tool for deploying Fibre Channel with support for testing links at rates up to 10 Gbps and it also supports other technologies like OTN, Ethernet, CPRI/OBSAI, SDH/SONET and PDH/DSn. The all-in-one MT1000A gives the user less equipment to maintain and learn, helping reduce operating expenses.

Latency

High latency is a problem for many applications, including SAN, and network operators and service providers urgently need a tool like the MU100010A/MU100011A with Fibre Channel option to test latency on Fibre Channel lines and equipment.

Fibre Channel BER Tests

The MU100010A/MU100011A with Fibre Channel option supports BER tests to measure the performance of Fibre Channel lines and equipment. Service disruption measurement is also supported.



2014-10-02 14:18:22

00:00:12

BER	Bit count	Error count	Rate
Pattern errors	88962404480	1	1.12E-11
Threshold:			2

Service disruption	Avg	Max
Disruption time	N/A	0.0 us
Threshold:		50.000

Pattern: FOX

☑ Pattern Error Insertion

Insertion: Manual

Burst length: 1

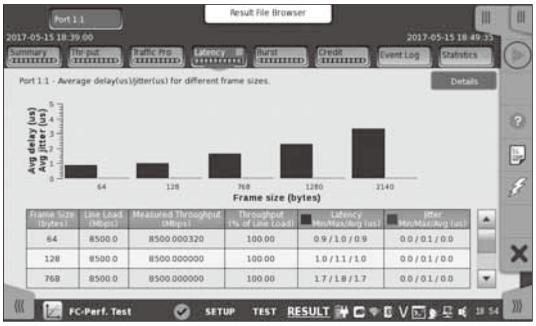
FC BER Test

Performance Tests

Fibre Channel achieves frame-loss-free transmissions using buffer-credit-based flow control. On the other hand, throughput rates drop due to the wasted wait times if the buffer size is small compared to the network transmission delay time.

The MU100010A/MU100011A measures the buffer size needed to achieve the required throughput and can play a key role in the following aspects of network I&M.

- Adjusting local parameters at commissioning testing
- Troubleshooting whether buffer size setting or network settings are causing lower throughput than the network design specification



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2017-05-15 18:49:35

Port 1:1 - Average delay(us)/jitter(us) for different frame sizes.

Frame Size (bytes)	Line Load (Mbps)	Measured Throughput (Mbps)	Throughput (% of Line Load)	■ Latency Min/Max/Avg (us)	■ Jitter Min/Max/Avg (us)
64	8500.0	8500.000320	100.00	0.9 / 1.0 / 0.9	0.0 / 0.1 / 0.0
128	8500.0	8500.000000	100.00	1.0 / 1.1 / 1.0	0.0 / 0.1 / 0.0
768	8500.0	8500.000000	100.00	1.7 / 1.8 / 1.7	0.0 / 0.1 / 0.0

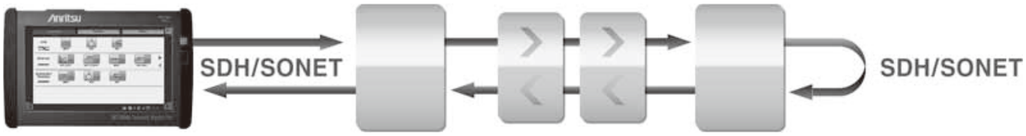
FC Performance Test

SDH/SONET, PDH/DSn Application

Legacy technologies in transport networks can't just be eliminated because of the huge capital investment, but keeping legacy technologies operational can require several testers.
With its SDH/SONET and PDH/DSn test options, the MU100010A/MU100011A is a powerful and easy-to-use tool for testing SDH/SONET up to STM-64/OC-192. PDH/DSn systems (E1, E3, E4, DS1 and DS3) can be tested directly or embedded into SDH/SONET. The MT1000A can support new and legacy technologies, leaving the user less equipment to maintain and learn, and reducing operating expenses.

SDH/SONET and PDH/DSn test features include:

- Powerful testing of SDH (STM-64, STM-16, STM-4, STM-1), SONET (OC-192, OC-48, OC-12, OC-3, STS-3) systems and embedded PDH (E1, E3, E4) and DSn (DS1, DS3) systems
- Powerful testing of PDH (E1, E3, E4) and DSn (DS1, DS3) systems
- Simultaneous bi-directional monitoring of SDH/SONET and PDH/DSn lines
- SDH/SONET mapping and de-mapping of PDH/DSn signals
- Comprehensive error and alarm statistics
- SDH/SONET overhead byte testing and monitoring
- SDH/SONET tributary scan
- SDH/SONET pointer event generation and monitoring
- SDH/SONET and PDH/DSn delay measurements
- Analysis of service disruption with APS application

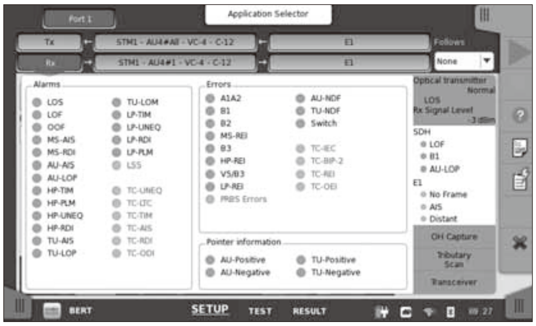


Looping-back test signal from MT1000A at far end supports SDH/SONET line quality tests

SDH/SONET Installing and Commissioning Testing

The MU100010A/MU100011A has powerful statistical measurements for BER testing at installing/commissioning and troubleshooting out-of-service SDH/SONET lines. Statistics are also collected for in-service analysis of line transmission-error performance together with information on pointer operations. G.826, G.828, G.829, or M.2100 error-performance parameters are calculated and the measurement result is highlighted by easy-to-understand color coding. Errors, alarms, pointer operations and overhead byte changes can be inserted into the transmitted signal for stress testing.

Bi-directional in-service monitoring of SDH/SONET lines



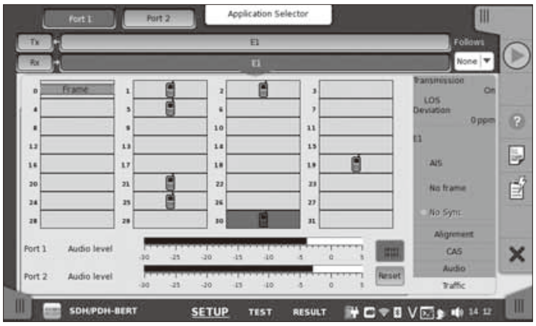
Quick overview of errors and alarms for both sides of SDH/SONET line

Speeds-up SDH/SONET Troubleshooting

The MU100010A/MU100011A monitor function speeds-up troubleshooting by providing key information on the monitored system, including line alarms and errors, input frequency and deviation, optical input level and overhead bytes. Information is also available on embedded PDH/DSn signals.

PDH (E1, E3, E4) and DSn (DS1, DS3) Testing

The MU100010A/MU100011A has powerful statistical measurements for BER testing at installing/commissioning and troubleshooting out-of-service PDH/DSn lines. Statistics are also collected for in-service analysis of line transmission-error performance of PDH/DSn lines, and G.826 or M.2100 error-performance parameters are calculated. Furthermore, PDH/DSn signals can be mapped to the SDH/SONET signal.



Monitor 64 kbps traffic channels on bidirectional E1 line with MU100010A/MU100011A traffic display

Optical Modules Selection Guide

<table>
<tr><th>MU110010A</th><th>MU110011A</th><th>Model/ Order No.</th><th>Name</th><th>Form Factor</th><th>100 Meg Ethernet</th><th>156 Meg STM-1</th><th>614 Meg CPRI</th><th>622 Meg STM-4</th><th>768 Meg OBSAI</th><th>1GFC</th><th>1.23 Gig CPRI</th><th>1.25 Gig Ethernet</th><th>1.54 Gig OBSAI</th><th>2GFC</th><th>2.46 Gig CPRI</th><th>2.488 Gig STM-16</th><th>2.67 Gig OTU1</th><th>3.07 Gig CPRI OBSAI</th><th>4GFC</th><th>4.92 Gig CPRI</th><th>6.14 Gig CPRI OBSAI</th><th>8GFC</th><th>9.83 Gig CPRI</th><th>9.95 Gig STM-64</th><th>10.1 Gig CPRI</th><th>10.3 Gig Ethernet</th><th>10GFC</th><th>10.7 Gig OTU2</th><th>11.05 Gig OTU1e</th><th>11.09 Gig OTU2e</th><th>11.27 Gig OTU1f</th><th>11.3 Gig OTU2f</th><th>16GFC</th><th>25G Ethernet</th><th>40G Ethernet</th><th>40G OTN</th><th>100G Ethernet</th><th>100G OTN</th></tr>
<tr><td>✓</td><td>✓</td><td>G0332A</td><td>100M FX 1310 nm MM SFP</td><td>SFP</td><td colspan="2">1310 nm, MM, 2 km</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td></td><td>✓</td><td>G0366A</td><td>100G SR4 850 nm QSFP28</td><td>QSFP28</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>850 nm, MM, 0.1 km</td><td></td></tr>
<tr><td></td><td>✓</td><td>G0364A</td><td>100G LR4 1310 nm QSFP28</td><td>QSFP28</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>1310 nm, SM, 10 km</td><td></td></tr>
<tr><td></td><td>✓</td><td>G0365A</td><td>100G LR4 Dual Rate 1310 nm QSFP28</td><td>QSFP28</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2">1310 nm, SM, 10 km</td></tr>
<tr><td></td><td>✓</td><td>G0369A</td><td>100G LR4 Dual Rate 1310 nm CFP4</td><td>CFP4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2">1310 nm, SM, 10 km</td></tr>
</table>

Network Master Pro MT1000A Mainframe Specifications

User Interfaces	
Display	9-inch active TFT display (800 × 480 pixels) and touch screen
Supported Languages	English, Chinese, Japanese, French, Russian, Spanish, Finnish, Korean, German

Service Interfaces	
USB Data Interface	MT1000A operates as host: USB 2.0 type A (2 ports) MT1000A operates as device: USB 2.0 type Mini-B (1 port)
Ethernet Interface	Ethernet 10M/100M/1000M, Connector: RJ45
WLAN Interface*[1]	IEEE 802.11 b/g/n
Bluetooth Interface*[1]	Bluetooth 2.1 +EDR

*1: Available for certified countries and regions including USA, Canada, Japan and EU countries. Please visit the Anritsu web site for updated information.
The Bluetooth® mark and logos are registered trademarks of Bluetooth SIG, Inc.

Other Interfaces	
Audio Interface	For connection of CTIA Standard head set Connector: 3.5-mm diameter jack
AUX Connector	For connection of optional G0325A GPS receiver With MT1000A-005: For connection of Optional MU100090A
Built-in Loudspeaker	Monitors speech of voice channel Output level: user-controlled from user Interface
Internal Clock	Accuracy: ±4.6 ppm or less, STRATUM3 compliant
Ext. Clock Input	For connection of external clock signals: SETS (E1: 2.048 Mbps), BITS (DS1: 1.544 Mbps) or 2.048 MHz TTL signal in accordance with ITU-T G.703, 10 MHz Connector: BNC (50Ω)

Miscellaneous		
Battery		10.8 V rechargeable and replaceable intelligent Li-ion battery Operating time: 1.5 hours (typ., in case of 100 GbE) Charging time: 6 hours (Max.) Remaining capacity indication: %
Mains Adapter		Input: 100 V(ac) to 240 V(ac), 50 Hz/60 Hz Output: 18 V(dc), 3.62 A (max.) Power Consumption: ≤65 W With MT1000A-006*[2] Input: 100 V(ac) to 240 V(ac), 50 Hz/60 Hz Output: 18 V(dc), 6.6 A (max.) Power Consumption: ≤120 W
Dimensions and Mass		257 (W) × 164 (H) × 82 (D) mm (excluding projections, MT1000A + MU100010A) 257 (W) × 164 (H) × 89 (D) mm (excluding projections, MT1000A + MU100011A) 2.7 kg (including MT1000A, MU100010A and battery) 2.7 kg (including MT1000A, MU100011A and battery)
Environmental		Temperature Operating : 0° to +50°C (non-condensing) Charging: 0° to +40°C (non-condensing) Storage: –30° to +60°C (non-condensing, without battery or AC adapter) –20° to +50°C (non-condensing, with battery and AC adapter) Humidity Operating: ≤85% RH (non-condensing) Storage and Transportation: ≤90% RH (non-condensing, without battery and AC adapter) Storage and Transportation: ≤85% RH (non-condensing, with battery and AC adapter)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581
Laser Safety*[3]		IEC 60825-1:2007 Class 1M CFP4: 100GBASE-SR4 QSFP28: 100GBASE-SR4 QSFP+: 40GBASE-SR4 SFP28: 25GBASE-SR IEC 60825-1:2007 Class 1 CFP4: 100GBASE-LR4 QSFP28: 100GBASE-LR4 QSFP+: 40GBASE-LR4 SFP28: 25GBASE-LR SFP+: 1000BASE-SX/LX/ZX, 10GBASE-LR/ER/ZR SFP: 4G FC (SX), 4G FC (LX), 4G FC (EX), OC-48 LR-1/STM L-16.1, OC-48 LR-2/STM L-16.2, 100BASE-FX/LX FDA 21CFR1040.10 and 1040.11*[4]

*2: MT1000A-006 is required for MU100011A.

*3: Safety measures for laser products
This product complies with optical safety standards in 21CFR1040.10, 1040.11 and IEC 60825-1; the following descriptive labels are affixed to the product.

*4: Excludes deviations caused by conformance to Laser Notice No. 50 dated June 24, 2007

IEC 60825-1:2007
INVISIBLE LASER RADIATION
DO NOT VIEW DIRECTLY
WITH OPTICAL INSTRUMENTS
(MAX OUTPUT POWER) (PULSE DURATION) (WAVELENGTH)
7.8mW CW 840 to 860nm
CLASS 1M LASER PRODUCT

THIS PRODUCT COMPLIES WITH 21 CFR 1040.10
AND 1040.11 EXCEPT FOR DEVIATIONS PURSUANT
TO LASER NOTICE NO. 50, DATED JUNE 24, 2007

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Mainframe

Model/Order No.	Name	
MT1000A	Network Master Pro	
	Standard Accessories	
MT1000A-006*1	High Power Supply:	Installed
	Line Cord*2:	1 pc
B0745A	Softcase:	1 pc
B0728A*3	Rear Panel kit:	1 pc
G0385A*4	High Power AC Adaptor:	1 pc
G0310A	Li-ion Battery:	1 pc
Z1746A	Stylus:	1 pc
Z1747A*5	Carrying Strap:	1 pc
Z1748A*6	Handle:	1 pc
Z1817A*7	Utilities ROM:	1 pc
	Options	
MT1000A-003*8	Connectivity for WLAN/Bluetooth	
MT1000A-005*9	AUX I/O	
	Optional Accessories	
B0691B*10	Hard Case	
B0720A	Rear Panel	
B0729A*11	Screw 1U	
B0730A*11	Screw 2U	
B0731A*11	Screw 3U	
B0732A*12	Screw Kit	
G0382A*13	Autofocus Video Inspection Probe	
G0306B*13	Video Inspection Probe	
G0309A*4	AC Adapter	
G0324A	Battery Charger	
G0325A	GPS Receiver	
J1569B	Car 12 Vdc Adapter	
J1667A*14	GPIB–USB Converter	
Z1821A*15	Utilities in USB Stick	

*1: The presence of the MT1000A-006 option can be recognized at the top right of the front panel. To retrofit to the already shipped item, please contact us.

Without MT1000A-006

With in MT1000A-006

*2: One line cord is attached to the area to shipment.
*3: Composed of B0720A, B0729A, B0730A and B0731A. Refer to Module Composition for the module combination.
*4: The MT1000A with MT1000A-006 can be used. Use the AC adapter when using the MT1000A without MT1000A-006 installed.
*5: Shoulder strap for MT1000A.
*6: Hand strap for MT1000A.
*7: This DVD includes PDF files and formatting tools of each product's instruction manual (such as W3933AE, W3810AE, W3736AE, W3946AE).
*8: Available for certified countries and regions including USA, Canada, Japan and EU countries. Please visit the Anritsu web site for updated information.
*9: MT1000A-005 is required for MU100090A. To retrofit to the already shipped item, please contact us.
*10: Can use module 1 to 2 in combination
*11: Includes 4 bolts of same length
*12: Includes B0729A, B0730A and B0731A
*13: This fiberscope uses the VIP function in the MT1000A Utility menu. Different tip types are used by the G0382A and G0306B.

G0382A

G0306B

*14: J1667A is required for SCPI remote control via GPIB
*15: Include MT1000A Operation Manual and the Remote Script Manual.

Softcase B0745A (Standard Accessory)

This bag with shoulder strap can hold the MT1000A with up to three installed modules.

Hard Case B0691B

This strong plastic case can hold the MT1000A with up to two installed modules.
462 (W) × 372 (H) × 207 (D) mm

Transport Module

10G Multirate Module MU100010A

Model/Order No.	Name	
MU100010A	10G Multirate Module	
	Standard Accessories	
W3935AE	MT1000A Transport Module Quick Reference Guide:	1 pc
B0692A*16	ESD Box (for optical modules):	1 pc

*16: Up to four SFP+/SFPs can be stored.

Options*17

Model/Order No.	Name
	Low Rate
MU100010A-001*18	Up to 2.7G Dual Channel
	Ethernet
MU100010A-011	Ethernet 10G Single Channel
MU100010A-012	Ethernet 10G Dual Channel
MU100010A-020*19	TCP Throughput
	OTN
MU100010A-051	OTN 10G Single Channel
MU100010A-052	OTN 10G Dual Channel
MU100010A-061*20	ODU Multiplexing
MU100010A-062*20	ODU Flex
	CPRI/OBSAI
MU100010A-071	CPRI/OBSAI Up to 5G Dual Channel
MU100010A-072	CPRI/OBSAI 6G to 10G Single Channel
MU100010A-073	CPRI/OBSAI 6G to 10G Dual Channel
	Fiber Channel
MU100010A-002	FC 1G 2G 4G Dual Channel
MU100010A-091	FC 8G 10G Single Channel
MU100010A-092	FC 8G 10G Dual Channel
	SDH/SONET
MU100010A-081	STM-64 OC-192 Single Channel
MU100010A-082	STM-64 OC-192 Dual Channel

*17: This option can be retrofitted.
The Model/Order No. of retrofit option is "-3** ".
Example
As a retrofit, MU100010A-001 Up to 2.7G Dual Channel becomes MU100010A-301 Up to 2.7G Dual Channel Retrofit. In addition, specify one of the following media along with the required option.

Model/Order No.	Name
Z1849A	DVD-ROM for Retrofit Options
Z1850A	USB Stick for Retrofit Options

*18: Includes OTN (OTU1), Ethernet (10 Mbps, 100 Mbps, 1 Gbps), SDH up to STM-16, SONET up to OC-48, PDH (E1, E3, E4), and DSn (DS1, DS3)
*19: Requires that at least one of the following options is installed: MU100010A-001, MU100010A-011, MU100010A-012
*20: Requires that at least one of the following options is installed: MU100010A-001, MU100010A-051, MU100010A-052

100G Multirate Module MU100011A

Model/Order No.	Name
MU100011A[*1]	100G Multirate Module
	Standard Accessories
W3935AE	MT1000A Transport Module Quick Reference Guide: 1 pc

*1: MT1000A-006 is required for MU100011A.

Options

Model/Order No.	Name
	Standard
MU100011A-001[*2]	Up to 10G Single Channel
MU100011A-003[*2]	Up to 10G Dual Channel
	Ethernet
MU100011A-013	Ethernet 40G Single Channel
MU100011A-015	Ethernet 100G Single Channel
MU100011A-017	Ethernet 25G Single Channel
MU100011A-020[*3]	TCP Throughput
MU100011A-023[*4]	RS-FEC for 100GBASE-SR4
	OTN
MU100011A-053	OTN 40G Single Channel
MU100011A-055	OTN 100G Single Channel
MU100011A-062[*5]	ODU Flex
MU100011A-063[*5]	ODU Multiplexing/Multi Stage
	Fibre Channel
MU100011A-004	Up to 10G FC Single Channel
MU100011A-005	Up to 10G FC Dual Channel
MU100011A-091	FC 16G Single Channel
	CPRI/OBSAI
MU100011A-071	CPRI/OBSAI Up to 10G Single Channel
MU100011A-072	CPRI/OBSAI Up to 10G Dual Channel
	SDH/SONET
MU100011A-083[*6]	STM-256/OC-768 Client Signal

*2: Only one of these option can be installed.
Included OTN(OTU1, OTU1e, OTU1f, OTU2, OTU2e, OTU2f), Ethernet up to 10 Gbps, SDH up to STM-64 and SONET up to OC-192.

*3: Requires that at least one of the following option is installed:
MU100011A-001, MU100011A-003

*4: Requires to MU100011A-015

*5: Requires that at least one of the following option is installed:
MU100011A-001, MU100011A-003, MU100011A-053, MU100011A-055

*6: MU100011A does not have a physical interface of the option.
The option is required for client signal mapped in the OTN.

High Performance GPS Disciplined Oscillator MU100090A

Model/Order No.	Name
MU100090A[*7]	High Performance GPS Disciplined Oscillator
	Standard Accessories
J1705A	AUX Conversion Adaptor
J1706A	GPS Antenna
J1710A	BNC Cable (20 cm) × 2

*7: Excellent Eco Product non-compliant.
MT1000A-005 is required for MU100090A.

Optional Accessories for Transport Module

Model/Order No.	Name
	Operation Manuals
W3933AE	MT1000A Transport Module Operation Manual
W3736AE	MT1000A/MT1100A Remote Scripting Operation Manual
	Optical Module
G0332A	100M FX 1310 nm MM SFP
G0319A	Up to 2.7G 1310 nm 15 km SFP
G0320A	Up to 2.7G 1310 nm 40 km SFP
G0321A	Up to 2.7G 1550 nm 80 km SFP
G0328A	1G/2G/4G FC 850 nm SFP
G0322A	1G/2G/4G FC 1310 nm SFP
G0323A	1G/2G/4G FC 1550 nm SFP
G0315A	10G LR/LW 1310 nm SFP+
G0316A	10G ER/EW 1550 nm 40 km SFP+
G0318A	10G ZR/ZW 1550 nm 80 km SFP+
G0329A	10G LR 1310 nm SFP+
G0356A	8G FC/10G SR 850 nm SFP+
G0386A	16GFC SR 850 nm SFP+
G0387A	16GFC LR 1310 nm SFP+
G0388A	25G SR 850 nm SFP28
G0389A	25G LR 1310 nm SFP28
G0359A	40G SR4 850 nm QSFP+
G0334A	40G LR4 1310 nm QSFP+
G0366A	100G SR4 850 nm QSFP28
G0364A	100G LR4 1310 nm QSFP28
G0365A	100G LR4 Dual Rate 1310 nm QSFP28
G0369A	100G LR4 Dual Rate 1310 nm CFP4
	Cables
J1571A	Optical Cable SM LC/PC to SC/PC 3 m
J1575A	Optical Cable SM LC/PC to FC/PC 3 m
J1579A	Optical Cable SM LC/PC to LC/PC 3 m
J1581A	Optical Cable MM LC/PC to LC/PC 3 m
J1583A	Optical Attenuator 10 dB LC/PC to LC/PC
J1584A	RJ45 Cable 3 m
J1585A[*8]	RJ48 to Crocodile Clips Cable 3 m
J1586A[*8]	RJ48 to Crocodile Clips Cable 20 dB ATT 3 m
J1588A[*9]	BNC Cable 2.5 m
J1589A[*9]	BNC to 1.6/5.6 Cable 2.5 m
J1591A[*8]	RJ48 to Two 3-pin Banana Plug Cable 2.5 m
J1597A[*8]	RJ48 Balanced PDH Cable Crossed 3 m
J1598A[*10]	Bantam Cable 3 m
J1710A[*11]	BNC Cable 0.2 m
J0127B[*11]	COAXIAL CORD, 2.0 M

*8: E1 interface cable.

*9: E1, E3, E4, DS3, STM-1e, STS-3 interface cable. Impedance: 75Ω

*10: DS1 interface cable.

*11: 50Ω impedance cable for MU100090A and main-frame external clock input connector

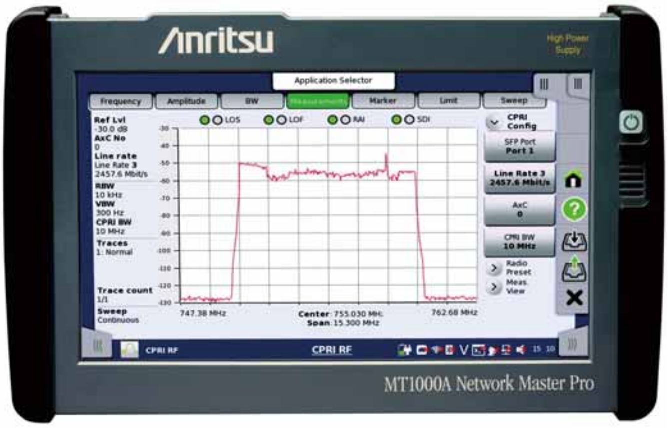
Maintenance Service

Model/Order No.	Name
MT1000A-ES210	2 Years Extended Warranty Service
MT1000A-ES310	3 Years Extended Warranty Service
MT1000A-ES510	5 Years Extended Warranty Service
MU100010A-ES210	2 Years Extended Warranty Service
MU100010A-ES310	3 Years Extended Warranty Service
MU100010A-ES510	5 Years Extended Warranty Service
MU100011A-ES210	2 Years Extended Warranty Service
MU100011A-ES310	3 Years Extended Warranty Service
MU100011A-ES510	5 Years Extended Warranty Service
MU100090A-ES210	2 Years Extended Warranty Service
MU100090A-ES310	3 Years Extended Warranty Service
MU100090A-ES510	5 Years Extended Warranty Service

MT1000A Network Master Pro
MU100040B CPRI RF Module

Remote Control
USB

Handheld, Battery-powered Network Tester



The MT1000A Network Master Pro is a handheld, battery-powered tester designed to facilitate the installation and maintenance of cellular networks. CPRI RF measurements are configured and displayed on the 9-inch color touch screen. The MU100040B CPRI RF module for the MT1000A Network Master Pro adds CPRI RF measurements to Anritsu's transport and fiber test platform.
The modular design of the MT1000A means that it can be configured just for CPRI measurements or combined with the 10G transport module and OTDR module to create the most comprehensive and versatile fiber and transport tester available.

Key Features

- Displays LTE spectrum of ALU/Nokia, Ericsson and Huawei CPRI radios
- Fast update rate to capture intermittent interferers
- Spectrum pan and zoom for detailed analysis of interferers
- Spectrogram display captures and holds data for intermittent interferers
- Two SFP slots for simultaneous uplink and downlink testing
- SFP data reading and display
- Layer 2 alarm monitoring and display
- Auto configuration of CPRI parameters
- Modular design for use with MT1000A OTDR and 10G transport test modules
- Battery powered for field use

MT1000A/MU100040B Specifications

Network Master Pro MT1000A Mainframe

User Interfaces	Display	9-inch active TFT display (800 × 480 pixels) and touch screen
	Supported Languages	English
Service Interfaces	USB Data Interface	MT1000A operates as host: USB 2.0 type A (2 ports) MT1000A operates as device: USB 2.0 type Mini-B (1 port)
	Ethernet Interface	Ethernet 10M/100M/1000M, Connector: RJ45
	WLAN Interface*1	IEEE 802.11 b/g/n
	Bluetooth Interface*1	Bluetooth 2.1 +EDR
Other Interfaces	Audio Interface	For connection of CTIA Standard head set Connector: 3.5 mm diameter jack
	AUX Connector	For connection of optional G0325A GPS receiver With MT1000A-005: For connection of optional MU100090A
	Built-in Loudspeaker	Monitors voice channel Output level: user-controlled from user interface
	Ext. Clock Input	For connection of external clock signals: SETS (E1: 2.048 Mbps), BITS (DS1: 1.544 Mbps) or 2.048 MHz TTL signal in accordance with ITU-T G.703, 10 MHz Connector: BNC

Continued on next page

Miscellaneous	Battery	10.8 V rechargeable and replaceable intelligent Li-ion battery Operating time: 4 hours (typical) Charging time: 3 to 6 hours (typical) Remaining capacity indication: %
	Mains Adapter	Input: 100 VAC to 240 VAC, 50 Hz/60 Hz Output: 18 VDC, 3.62 A (max) Power Consumption: ≤65 W With MT1000A-0062 Input: 100 VAC to 240 VAC, 50 Hz/60 Hz Output: 18 VDC, 6.6 A (max) Power Consumption: ≤120 W
	Dimensions and Mass	255 (W) × 164 (H) × 80 (D) mm ≤2.6 kg (including MT1000A, MU100040B and battery)
Environmental	Temperature	Operating: 0° to +45°C (non-condensing) with MU100040B Charging: 0° to +40°C (non-condensing) Storage: –30° to +60°C (non-condensing, without battery or AC adapter) –20° to +50°C (non-condensing, with battery and AC adapter)
	Humidity	Operating: ≤85% RH (non-condensing) Storage and Transportation: ≤90% RH (non-condensing)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU
Laser Safety*2		IEC 60825-1: 2007 CLASS 1, 21CFR1040.10, and 1040.11*3 (MU100040B with optical modules)

*1: Available for certified countries and regions including USA, Canada, Japan and all EU countries.
Please visit www.anritsu.com for updated information.
*2: Required for MU100011A (100G Multirate Module).
*3: Safety measures for laser products. This product complies with optical safety standards in 21CFR1040.10, 1040.11, and IEC 60825-1.
The descriptive labels are affixed to the product.
*4: Excludes deviations caused by conformance to Laser Notice No. 50 dated June 24, 2007.

CPRI LTE RF Measurements (Option 1)

Measurements (CPRI RF measurements support LTE technology)	Spectrum	LTE Uplink and Downlink
	Spectrogram	LTE Uplink and Downlink
	Layer 2 Alarms	Signal Loss, LOS, LOF, LSS, Remote LOS, Remote LOF, RAI, SDI, Reset
	SFP Data	Reads device information
	Optical Power	Reads Tx/Rx Optical Power from SFP
Setup Parameters	Frequency	Center, Span
	Amplitude	Reference Level (RL), Scale
	Bandwidth	BW, Auto RBW, VBW, Auto VBW, VBW/Average Type, RBW/VBW, Span/RBW
	Measurements	CPRI Spectrum, Spectrogram, Layer 2 Alarms, SFP Data (SFP Info/Compliance Info)
	CPRI Configure	Line Rate, AxC Container #, CPRI BW, Radio Presets
	Radio Presets	Ericsson (Uplink/Downlink), Alcatel (Uplink/Downlink), Huawei (Uplink/Downlink), Advanced
	Advanced	IQ Bit Width, Number of Reserve Bits, Aggregation (On/Off)
Sweep Functions	Sweep	Single/Continuous
Trace Functions	Traces	Up to three Traces (1, 2, 3), Blank, Hold/View, Active
	Trace 1 Operations	Normal, Max Hold, Min Hold, Average (2 to 512 averages)
	Trace 2 Operations	Max Hold, Min Hold
	Trace 3 Operations	Max Hold, Min Hold
Marker Functions	Markers	Markers 1 to 6, Marker Table (On/Off), All Markers Off
	Marker Auto-Position	Peak Search, Next Peak (Right/Left), Marker Frequency to Center, Fine Tune Marker Control (Right/Left)
	Marker Table	1 to 6 markers frequency and amplitude
Limit Line Functions	Limit Lines	Upper/Limit, On/Off, Move, Limit Alarm
	Limit Line Move	By dB
Bandwidth	Resolution Bandwidth (RBW)	10 Hz to 3 MHz in 1-3-10 sequence ±10% (–3 dB bandwidth point) typical
	Video Bandwidth (VBW)	10 Hz to 3 MHz in 1-3-10 sequence ±10 % (–3 dB bandwidth) typical
	Line Bit Rate	Line bit rate 1: 614.4 Mbit/s Line bit rate 2: 1228.8 Mbit/s Line bit rate 3: 2457.6 Mbit/s Line bit rate 4: 3072.0 Mbit/s Line bit rate 5: 4915.2 Mbit/s Line bit rate 6: 6144.0 Mbit/s Line bit rate 7: 9830.4 Mbit/s
CPRI Parameters	IQ Sample Width	10, 12, 15, 16 bits
	Bandwidth	5, 10, 15, 20 MHz
	Aggregation	On/Off
CPRI Interfaces Two SFP (small form factor pluggable) optical transceiver ports.	SFP 4.25G	850 nm
	SFP+ 8G-FC/10G-SR	850 nm
	SFP 2.7G	1310 nm
	SFP+ 10G-LR	1310 nm
	SFP 3.07 Gbps	1310 nm
	SFP 3.7 Gbps	850 nm
	SFP+ 10.5 Gbps	1310 nm
	SFP+ 10.5 Gbps	850 nm

CPRI Base Band Unit Emulation ALu-Nokia LTE (Option 10)

Measurements	
BBU Test	Initialization; RRH information (Manufacturer, Model Number, Serial Number, Frequency Range, Output Power, Firmware, SFP) Location
SFP Data	Reads SFP information installed in RRH
CPRI Alarms	LOS, LOF, RAI, SDI status lights
RF Measurements	
RRH Antenna VSWR/Return Loss	While RRH is transmitting; Pass/Fail Limit
Uplink Spectrum While RRH is transmitting; Uplink	Markers, Limit Lines, Max., Min. Traces, RBW/VBW, Pan & Zoom
Uplink Spectrogram While RRH is transmitting; Uplink	Markers, Limit Lines, Max., Min. Traces, RBW/VBW, Pan & Zoom
RF Transmission	
Test Models	LTE test model waveforms Test models: E-Tm1.1, E-Tm1.2, E-Tm2, E-Tm3.1, E-Tm3.2, E-Tm3.3 Bandwidths: 5 MHz, 10 MHz, 15 MHz, 20 MHz
Single Carrier Over CPRI	Adjust transmit power and center frequency of RRH
Waveform Manager	Manages waveforms for transmission
GPS Receiver	
GPS data	Number of Tracked Satellites, Latitude, Longitude, Altitude, Fix available Yes/No, Almanac, Antenna and Receiver Status, Antenna Voltage, Current
GPS Lock Accuracy	± 5.0 × 10^{-8}, 3 minutes after satellite lock, 0° to 50 °C ambient temperature
Connector	SMA, female
Supplied Antenna	2000-1760-R GPS Antenna, SMA (m), 25 dB gain, 2.5 VDC to 3.7 VDC

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Mainframe
MT1000A	Network Master Pro
	Standard Accessories
MT1000A-006*1	High Power Supply
B0690A	Soft Case
B0728A	Rear Panel and Screw Kit
G0310A	Li-ion Battery
G0385A	High Power AC Adapter
J1565A*2	Line Cord USA
J1594A*2	Line Cord Japan
J1566A*2	Line Cord Europe
J1567A*2	Line Cord UK
J1568A*2	Line Cord Australia
J1596A*2	Line Cord Korea
Z1746A	Stylus
Z1747A*3	Shoulder Strap
Z1748A*4	Handgrip
	Options
MT1000A-003*5	Connectivity for WLAN/Bluetooth
MT1000A-005*6	AUX I/O
	CPRI RF Module
MU100040B	CPRI RF Module (requires Option 1)
	Option
MU100040B-001	Option 1, CPRI LTE RF Measurements
MU100040B-010	Option 10, CPRI Base Band Unit Emulation ALu-Nokia LTE
	Accessories (included with Option 10)
	2000-1760-R GPS Antenna, SMA (m), 25 dB gain, 2.5 VDC to 3.7 VDC
	Optional CPRI Accessories
67-12-R	80/20 Optical Tap; Single Mode/Multi Mode
67-13-R	80/20 Optical Tap; Single Mode
67-14-R	50/50 Optical Tap; Single Mode/Multi Mode
67-15-R	50/50 Optical Tap; Single Mode
68-5-R	SFP (Optical Module), 4.25G, 850 nm, 500 m
68-6-R	SFP+ (Optical Module), 8G FC/10G SR 850 nm
68-7-R	SFP (Optical Module), 2.7G, 1310 nm, 15 km
68-8-R	SFP+ (Optical Module), 10G LR, 1310 nm
68-9-R	SFP (Optical Module), 3.07Gbps SFP, 1310 nm
68-10-R	SFP (Optical Module), 3.7Gbps SFP, 850 nm
68-11-R	SFP (Optical Module), 10.5Gbps SFP+, 1310 nm
68-12-R	SFP (Optical Module), 10.5Gbps SFP+, 850 nm
68-16-R	SFP (Optical Module), 9.83Gbps SFP+, 1310 nm
2100-29-R	Fiber Optic Cable, 3 m, LC/UPC, Single Mode (SM), Simplex
2100-30-R	Fiber Optic Cable,10 m, LC-SC, Multi Mode (MM), Simplex
2100-31-R	Fiber Optic Cable, 3 m, LC/UPC, Single Mode (SM), Duplex
971-14-R	Ferrule Cleaner, 2.5 mm SC
971-15-R	Ferrule Cleaner, 1.25 mm LC
971-16	Fiber Ferrule Cleaner
808-16-R	3m, DUPLEX, MM, LC-LC
808-17-R	3m, SIMPLEX, MM, LC-LC
2000-1849-R	ESD Box

Model/Order No.	Name
	Miscellaneous Accessories
760-286-R	Compact Transit Case with Wheels and Handle 55.6 × 35.5 × 22.9 cm (22" × 14" × 9")
G0309A	AC Adapter
G0324A	Battery Charger
J1569A	Car 12 VDC Adapter
J1667A*1	GPIB–USB Converter
	Operation Manuals
10580-00423	MT1000A/MU100040B Network Master Pro Operation Manual
	Maintenance Service
MT1000A-ES210	2 Years Extended Warranty Service
MT1000A-ES310	3 Years Extended Warranty Service
MT1000A-ES510	5 Years Extended Warranty Service
MU100040B-ES210	2 Years Extended Warranty Service
MU100040B-ES310	3 Years Extended Warranty Service
MU100040B-ES510	5 Years Extended Warranty Service

*1: Required for MU100011A (100G Multirate Module).
*2: One of the power line cords is supplied with the MT1000A.
*3: This strap is mounted on the MT1000A.
*4: This handgrip is mounted on the MT1000A.
*5: Available for certified countries and regions including USA.
*6: Required to carry MU100090A. Contact Anritsu to retrofit your instrument.

Network Master Series

MT1100A Network Master Flex

MU110010A 10G Multirate Module
MU110011A 100G Multirate Module
MU110013A 40/100G Advanced Module

Remote Control
WLAN OPTION | Bluetooth OPTION | Ethernet | USB

All-in-one Support for R&D, Manufacturing and I&M of 100 Gbps Core and Metro Networks

Network Master Flex

Today’s core and metro communications networks are implementing 100 GigE and OTN technologies rapidly to provide sufficient bandwidth supporting the explosive increase in mobile communications data. These high-bit-rate networks demand very high reliability due to the large data volumes and variety of client signals in use.
Consequently, every stage from R&D through to manufacturing, installation, and maintenance, requires precision testing and verification of network equipment and transport devices.
The all-in-one Network Master Flex MT1100A supports the communications network technologies.
Selecting and installing up to two modules from a range of three module options supports all-in-one R&D, manufacturing, installation and maintenance tests of network and transport equipment operating at bit rates from 1.5 Mbps to 100 Gbps. The large, 12.1-inch color LCD touch panel with easy-to-use GUI plus remote operation of a full range of test functions over an Internet connection greatly improves test efficiency and helps cut costs.

All in One | 100G 4ports | OTN flex mapping

All-in-one Transport Tester
- Supports testing from 1.5 Mbps to 100 Gbps
- Support for various transport tests

Supports Up to 400 Gbps (100G × 4)
- Install any two modules from choice of three module options
- Test up to four independent 100 Gbps ports simultaneously to increase manufacturing efficiency for 100 Gbps transport equipment
- Support 400 Gbps (100G × 4) R&D by simulating client signals

OTN Flexible Mapping
- Various OTN mappings up to 100 Gbps
- Supports both multi-stage mappings and ODUflex
- Supports mapped client-signal tests

Main Applications

R&D
- Research and development of 400 Gbps networks and transport equipment

Manufacturing
- Quality and assurance tests of 100 Gbps transport equipment

Commissioning
- Verification of Service Level Agreement (SLA) at commissioning of 1.5 Mbps to 100 Gbps lines

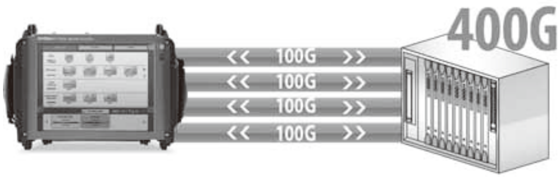
Maintenance
- Troubleshooting 1.5 Mbps to 100 Gbps line faults

R&D for 400 Gbps Networks

R&D into faster 400 Gbps networks is being driven by the explosive growth in smartphone mobile data traffic.
The MT1100A can send and receive a variety of 100G × 4 client signals, offering support for R&D of 400 Gbps networks and transport equipment.

Features
- Transport testers supporting simultaneous installation of four independent 100 Gbps ports
- Multiple users can log in one MT1100A via PC and operate each port independently using the dedicated remote GUI operation software.
- Each 100 Gbps port supports 40 GigE/100 GigE and OTU4/OTU3/OTU3e1/OTU3e2 interfaces
- Detailed client-signal analysis using Ethernet frame capture
- Support various OTN mappings including ODUflex
- FEC Performance tests using ITU-T O.182 recommended Poisson-distribution error insertion
- Display test results for four ports on one screen

Recommended modules: MU110013A × 2



Higher 100 Gbps Transport Equipment Manufacturing Efficiency

Manufacturing of 100 Gbps WDM, switches and optical transceiver modules are being. With all the functions needed for testing transport equipment, the 4-port, all-in-one MT1100A with automatic testing using SCPI commands is the ideal platform for maximizing equipment investment through higher test efficiency and lower cost per port.

Features
- Supports OTN, Ethernet, eCPRI/RoE (IEEE1914.3)/CPRI/OBSAI, Fibre Channel, SDH/SONET and PDH/DSn at bit rates from 1.5 Mbps to 100 Gbps using combination of modules
- RFC 2544-based transmission equipment performance tests
- Color display of threshold settings and Pass/Fail evaluation results
- Optical transceiver modules analysis using MDIO analysis and VOD, Pre-emphasis, Rx equalizer control.
- Various high speed interfaces support
  CFP2, CXP, QSFP+, CFP4, QSFP28
  (CFP4, QSFP28 are adaptor required)
- Automatic repeat testing using SCPI remote commands via Ethernet, WLAN or GPIB
- Multiple users can log in one MT1100A via PC and operate each port independently using the dedicated remote GUI operation software.

Recommended modules: MU110013A × 2 (for four 40 Gbps/100 Gbps ports)

Quick Network Commissioning Tests

Efficient and accurate network commissioning tests in a limited time window are a key issue for network operators. With its all-in-one support for transport tests, including OTN, eCPRI/RoE (IEEE1914.3)/CPRI/OBSAI, SyncE, PTP (IEEE 1588 v2), ITU-T Y.1564, RFC 6349 etc., plus simultaneous multiple-line tests using two ports, the MT1100A helps cut costs by slashing test times.

Features
- All-in-one support for network commissioning transport tests up to 100 Gbps
- Large, 12.1-inch touch-panel GUI with battery operation
- Frame loopback using remote-controlled MT1100A as Ethernet reflector
- One-way latency tests using operation at Master side at remote control Master/Slave setup
- Time synchronization for the SyncE and IEEE 1588 v2 one-way latency tests is supported using the GPS antenna (option)
- Support Mobile fronthaul deployment and maintenance by eCPRI/RoE/CPRI/OBSAI test
- Network performance check at the end users site by TCP throughput testing with RFC 6349 or iPerf.
- Remote operation over VNC for operations-center support of on-site engineers
- Remote boot-up, operation, file transfer, firmware update
- Halved measurement times using simultaneous 2-port, multi-line testing

Recommended modules: MU110011A

Fast and Flexible Troubleshooting

Today's data centers have a mix of interfaces ranging from old legacy network equipment to the 100 Gbps core networks. With excellent built-in troubleshooting functions as well as dual ports for simultaneous two-way monitoring, the MT1100A locates problems quickly.

Features
- Dual ports supporting bit rates from 1.5 Mbps to 100 Gbps for two-way monitoring and equipment insertion tests
- Top talker, network attack, and fast error-frame capture using IP Channel Statistics (up to 10 Gbps)
- Ethernet frame capture and Wireshark analysis
- Live line monitoring at Through testing
- Battery operation for fast on-site troubleshooting anywhere
- Long-term monitoring using remote operation over VNC or the dedicated remote GUI operation software

Recommended modules: MU110010A + MU110013A
(two ports for 1.5 Mbps to 100 Gbps ports)

Wireshark® is a registered trademark of the Wireshark Foundation.

Comprehensive OTN Testing for Core and Metro Networks Installation and Maintenance

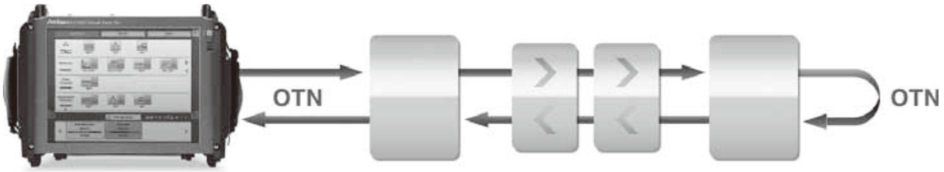
OTN carries client signals, but current OTN transport testers only support OTN testing at the OTN line rate with bulk test signals. This means that problems in the carried client signals are invisible when testing an in-service OTN system.
Using the MT1100A, OTN lines can be tested at the client signal level with signals like Ethernet, CPRI, Fibre Channel and SDH/SONET, because the OTN mapping function is mandatory for modern OTN transponders. The MT1100A can also test OTN lines at the line rate with bulk signals.
The user can identify problems at all levels in the OTN signal, solving OTN issues efficiently, reducing system downtime, and reducing operating expenses for network operators.

OTN Testing with Client Signals

The MT1100A is a powerful and full toolset for testing OTN signals. It supports complete Bit Error Rate (BER) tests with bulk signals at the OTN level as well as tests all the way to the Ethernet, Fibre Channel and SDH/SONET client signals mapped onto the OTN signal.

OTN tests features include:

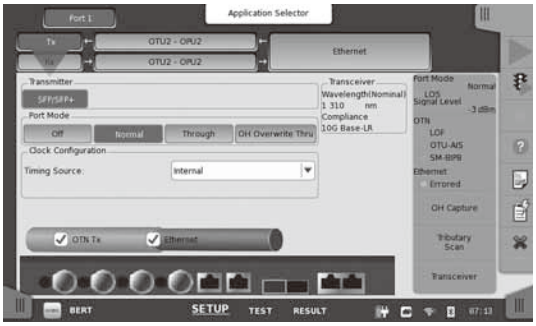
- Supports OTU4, OTU3, OTU3e1, OTU3e2, OTU2, OTU2e, OTU2f, OTU1, OTU1e, OTU1f
- Supports multi-stage mapping and ODUflex
- OTN tests with bulk signals (PRBS, Null or User pattern) at OTN level
- Comprehensive OTN error and alarm statistics
- OTN error performance measurement in accordance with G.8201 or M.2401
- ITU-T O.182-compliant FEC test
- Test of Ethernet, CPRI, Fibre Channel or SDH/SONET client signals mapped onto OTN signal
- Delay measurement
- OTN header edit and capture
- OTN TCM monitoring and generation
- Service disruption analysis using APS application
- OTN tributary scan (up to 10 Gbps)
- Full flexibility to monitor insert/overwrite client overhead and payload within OTN signal



Looping-back test signal from MT1100A at far end supports easy OTN line quality tests

Out-of-service OTN Error and Alarm Statistics

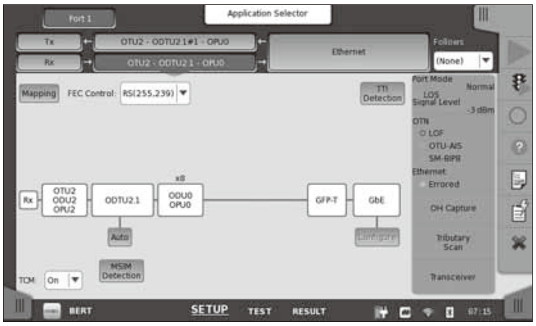
The MT1100A supports powerful statistical measurements for BER tests as well as OTN level alarms and errors for installing/commissioning and troubleshooting out-of-service OTN lines. G.8201 or M.2401 error-performance parameters are calculated during measurement. Stress testing of network elements is supported by inserting errors and alarms, and adjusting overhead bytes in the signal transmitted by the instrument.


Tx ← OTU2 - OPU2 ← Ethernet
Rx → OTU2 - OPU2 → Ethernet
Transmitter: SFP/SFP+
Port Mode: Normal
Timing Source: Internal
Transceiver
Wavelength(Nominal) 1 310 nm
Compliance 10G Base-LR
Port Mode Normal
LOS Signal Level -3 dBm
☑ OTN Tx ☑ Ethernet

OTN Mapping Setting

Testing Ethernet, CPRI, Fibre Channel, or SDH/SONET Client Signals Mapped onto OTN Signal (Part of ODU Multiplexing Option)

The MT1100A tests OTN links carrying Ethernet, CPRI, or SDH/SONET client signals, allowing the operator to test embedded client signals.
For example, an RFC 2544 or Y.1564 test can be performed with an Ethernet signal carried over the OTN signal, allowing the service engineer to run tests emulating the real-world requirements of end users.

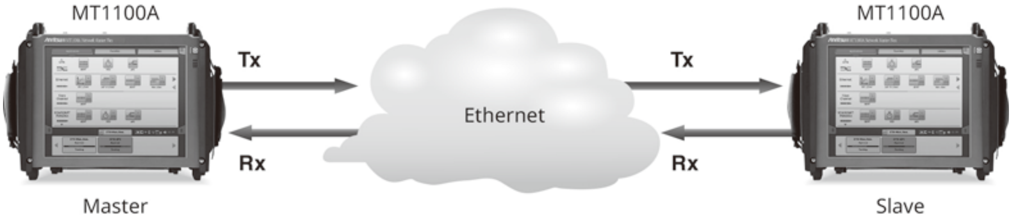

Tx ← OTU2 - ODTU2.1#1 - OPU0 ← Ethernet
Rx → OTU2 - ODTU2.1 - OPU0 → Ethernet
Follows: (None)
FEC Control: RS(255,239)
TCM: On
Port Mode Normal
LOS Signal Level -3 dBm

OTN Frame Setting

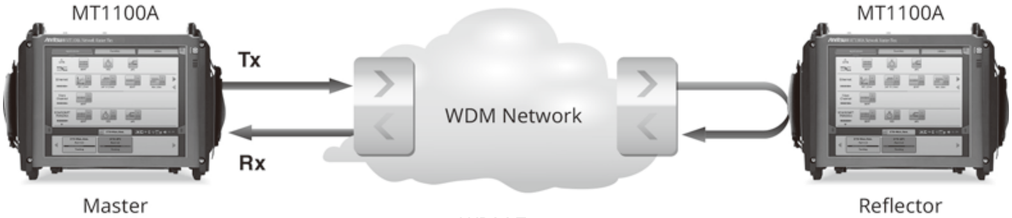
Carrier Ethernet Installation and Troubleshooting

Ethernet technology is used by many applications today, including Carrier Class Ethernet, VLAN, Q-in-Q, Ethernet OAM and MPLS and, recently, PBB and MPLS-TP. Network operators must handle all these technologies, leading to long and complex test procedures.

The MT1100A with Ethernet option is a comprehensive solution for easy testing, installing, and faster troubleshooting of Ethernet lines up to 100 Gbps using functions for verifying bandwidth, and testing connectivity, Quality of Service (QoS), and service availability, cutting additional truck rolls, tech support calls, and customer churn to improve operating expenses.



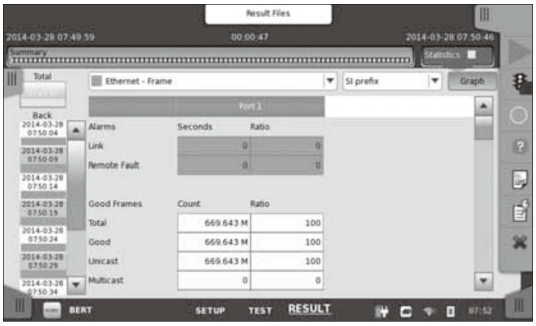
Ethernet Test: End-to-End



WDM Test

Ethernet test features include:

- Supports 100 Gbps, 40 Gbps, 10 Gbps, 1 Gbps, 100 Mbps, and 10 Mbps Ethernet tests
- Supports 100 Gbps RS-FEC test
- Traffic generation up to full line rate
- Support for IPv4 and IPv6
- Ethernet Service Activation Test (Y.1564)
- Automated RFC 2544 tests of Throughput, Frame Loss, Latency or Packet Jitter, Burstability
- TCP Throughput (RFC 6349, iPerf) [Option] (up to 10 Gbps)
- BER tests – include Frame Loss and Sequence Error tests
- Service disruption measurements
- Comprehensive statistics
- Filters – to extract relevant parts of traffic
- Thresholds – to highlight abnormalities
- Simultaneous monitoring in both line directions
- IP Channel Statistics to identify error streams, top talkers, network attacks (up to 10 Gbps)
- Ethernet OAM tests
- 10G WAN-PHY tests
- Synchronous Ethernet test (up to 10 Gbps)
- Ethernet Multistream
- Stacked VLAN (Q-in-Q)
- MPLS tests
- MPLS-TP and PBB tests
- Ping/Traceroute
- Frame capture for protocol analysis with Wireshark
- Electrical cable tests and optical signal level displays



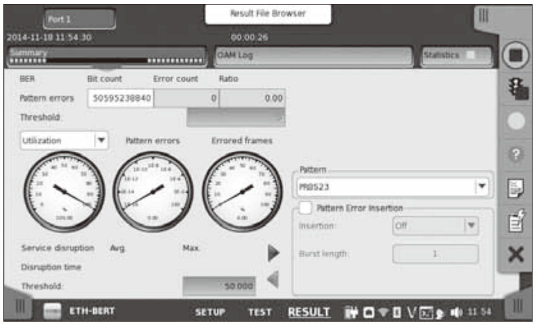
2014-03-28 07:49:59 00:00:47 2014-03-28 07:50:46

Ethernet - Frame
SI prefix

Alarms	Seconds	Ratio
Link	0	0
Remote Fault	0	0

Good Frames	Count	Ratio
Total	669.643 M	100
Good	669.643 M	100
Unicast	669.643 M	100
Multicast	0	0

Ethernet Statistics



2014-11-18 11:54:30 00:00:26

BER	Bit count	Error count	Ratio
Pattern errors	50595238840	0	0.00
Threshold			

Pattern: PRBS23
Insertion: Off
Burst length: 1

Service disruption Avg. Max.
Disruption time
Threshold: 50.000

Ethernet BER Tests Statistics Summary

2014-03-28 07:49:59 00:00:47 2014-03-28 07:50:46

Ethernet - BERT
SI prefix

BERT	Count	Ratio
Pattern bit count	91071430592	
Pattern errors	3	3.29412e-09
Seq. Errors	0	
Seq. Sync. Lost	0	
Frame loss	0	
Frame loss secs.	0	

Service disruption Seconds Count

Ethernet BER Tests Results

100 GigE RS-FEC Test

Forward Error Correction (FEC) is a technology for preventing errors when sending and receiving data. It assigns redundancy to the Tx data beforehand so any errors in the data occurring during transmission can be detected and corrected at the receiver side. FEC helps keep the average data throughput high by preventing the need to resend data. The MT1100A can send and receive* FEC signals supported by 100GBASE-SR4, and 100GBASE-ER4-lite (FEC Code: RS (528, 514, 7,10)) to help evaluate network equipment and facilitate RS-FEC communications.

*: Enabled for CFP2 and QSFP28 optical-module settings.

Mobile Backhaul Installation and Verification (Up to 10 Gbps)

Synchronous Ethernet is an essential technology in mobile backhaul networks and faults in Synchronous Ethernet seriously jeopardize the performance of mobile networks and can cause system downtime. Consequently, mobile operators need a test tool to verify the correct functioning of Synchronous Ethernet.

The Synchronous Ethernet test function of the MT1100A supports comprehensive testing and analysis of both Synchronous Ethernet technologies: SyncE and PTP (IEEE 1588 v2).

The user can quickly identify problems at all levels in Synchronous Ethernet, solving issues quickly, reducing system downtime and customer churn, and improving operating expenses for mobile operators. (up to 10 Gbps)

Local Clock
State: SLAVE
Offset 0 ns
Mean path delay 5 ns
Sync timeout

Parent Clock
Identity 00:00:91:FF:FE:E1:02:0E
Port number 1

Foreign Master
00:00:91:FF:FE:E1:02:0E
Port number 1
Announce count 13

Wall Clock
UTC N/A
Current 2016-02-22 18:44:33
UTC offset N/A

Grandmaster Clock
Identity 00:00:91:FF:FE:E1:02:0E
Class 255
Accuracy Within 1us (0x23)
Variance ann/est. 1.00E-12 / N/A
Variance Raw 0x5824
Priority 1/2 12 / 9
Steps removed 0x00
Time source GPS (0x20)

Link Speed: 1 Gbps
Duplex: FDX
Ethernet Traffic
○ MPLS frame
○ MPLS-TP frame
○ VLAN frame

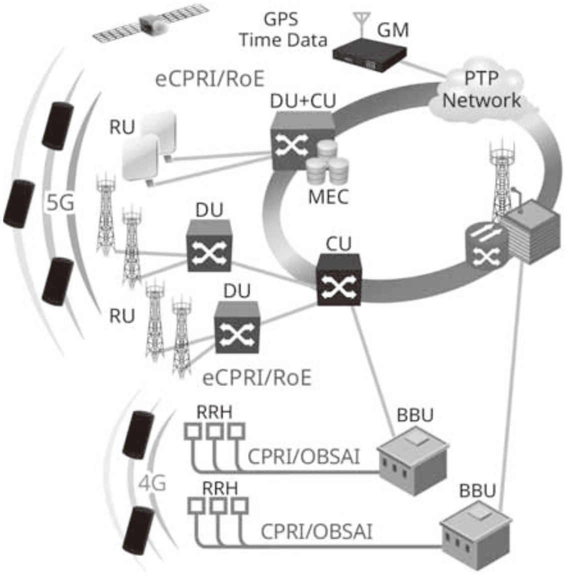
Status of IEEE 1588 v2 Slave Clock

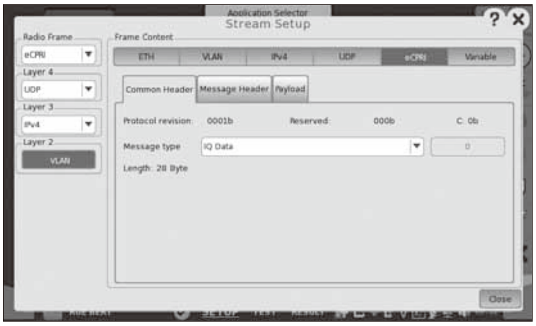
Mobile Fronthaul Installation and Verification (Up to 10 Gbps)

The spread of smartphones, tablets, etc., is driving use of wider bandwidths for mobile communications.

Until now, the mobile-backhaul Base Band Unit (BBU) and Remote Radio Head (RRH) have been connected via a general-purpose interface, such as the Common Public Radio Interface (CPRI) and the Open Base Station Architecture Initiative (OBSAI), with use of multiple antennas supporting better connectivity and faster speeds.

Future 5G mobile networks are deploying new eCPRI/IEEE 1914.3 (RoE: Radio over Ethernet) interfaces. In addition to supporting conventional CPRI/OBSAI, the MT1100A has built-in eCPRI/RoE (IEEE1914.3) interfaces and supports BER tests, various error and alarm tests, return time delay (RTD) tests, Link status displays, and Pass-through monitoring.





Radio Frame
eCPRI
Layer 4
UDP
Layer 3
IPv4
Layer 2
VLAN

Frame Content
Protocol revision: 0001b Reserved: 000b C: 0b
Message type IQ Data 0
Length: 28 Byte

eCPRI Frame Setting

2015-02-26 01:12:41 00:01:28

CPRI - Alarms/Errors
SI prefix

Back
2015-02-26 01:12:46
2015-02-26 01:12:51
2015-02-26 01:12:56
2015-02-26 01:13:01
2015-02-26 01:13:06
Current
2015-02-26 01:14:07

	Port 1	
RemoteLOF	0	0.00
RAI	0	0.00
SDI	0	0.00
Reset	0	0.00
Errors	Count	Ratio
LCV	0	0.00
K30.7	0	0.00
Pattern error	3	5.68E-11

CPRI/OBSAI BER Test

Storage Area Networking (SAN) Testing (Up to 10 Gbps)

Many operators need to support Fibre Channel links in Storage Area Networks (SAN) together with other transport technologies like OTN, Ethernet, and SDH/SONET. Having one tool for all technologies is important for efficient testing. The multi-protocol MT1100A with Fibre Channel option is the perfect tool for deploying Fibre Channel with support for testing links at rates up to 10 Gbps and it also supports other technologies like OTN, Ethernet, eCPRI/RoE/CPRI/OBSAI, SDH/SONET and PDH/DSn. The all-in-one MT1100A gives the user less equipment to maintain and learn, helping reduce operating expenses.

Fibre Channel test features include:

- 1GFC, 2GFC, 4GFC, 8GFC, and 10GFC tests
- Optional mapping to OTN
- Latency measurement
- BER tests including service disruption measurement
- Line alarm and error monitor
- Normal or Reflector mode

Latency

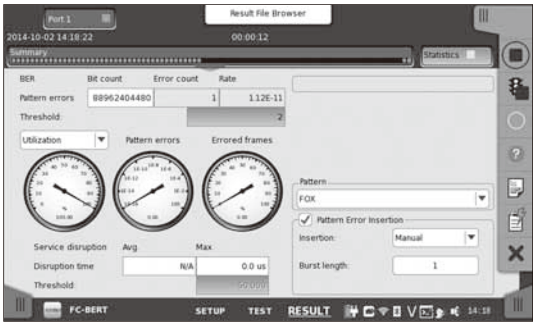
High latency is a problem for many applications, including SAN, and network operators and service providers urgently need a tool like the MT1100A with Fibre Channel option to test latency on Fibre Channel lines and equipment.

Fibre Channel BER Tests

The MT1100A with Fibre Channel option supports BER tests to measure the performance of Fibre Channel lines and equipment. Service disruption measurement is also supported.

Performance Tests

Fibre Channel achieves frame-loss-free transmissions using buffer credit-based flow control. On the other hand, throughput rates drop due to the wasted wait times if the buffer size is small compared to the network transmission delay time.
The MT1100A measures the buffer size needed to achieve the required throughput.



2014-10-02 14:18:22
00:00:12

BER	Bit count	Error count	Rate
Pattern errors	88962404480	1	1.12E-11
Threshold			2

Service disruption	Avg	Max
Disruption time	N/A	0.0 us
Threshold		50.000

Pattern: FOX
☑ Pattern Error Insertion
Insertion: Manual
Burst length: 1

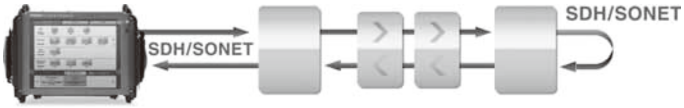
Fibre Channel BER Tests

Quick and Easy Tests of SDH/SONET and PDH/DSn Networks

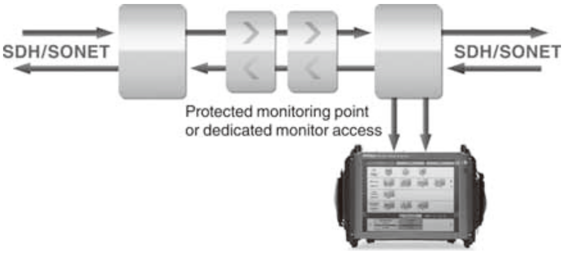
Legacy technologies in transport networks can't just be eliminated because of the huge capital investment, but keeping legacy technologies operational can require several testers.
With its SDH/SONET and PDH/DSn test options, the MT1100A is a powerful and easy-to-use tool for testing SDH/SONET up to STM-64/OC-192. PDH/DSn systems (E1, E3, E4, DS1 and DS3) can be tested directly or embedded into SDH/SONET. The MT1100A can support new and legacy technologies, leaving the user less equipment to maintain and learn, and reducing operating expenses.

SDH/SONET and PDH/DSn test features include:

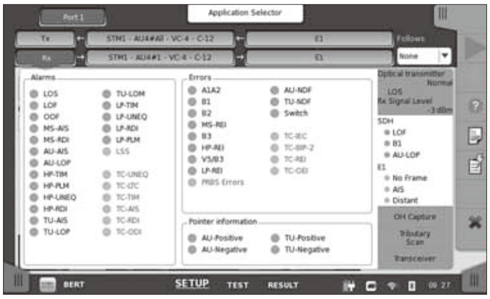
- Powerful testing of SDH (STM-256, STM-64, STM-16, STM-4, STM-1), SONET (OC-768, OC-192, OC-48, OC-12, OC-3, STS-3) systems and embedded PDH (E1, E3, E4) and DSn (DS1, DS3) systems
- Powerful testing of PDH (E1, E3, E4) and DSn (DS1, DS3) systems
- Simultaneous bi-directional monitoring of SDH/SONET and PDH/DSn lines
- SDH/SONET mapping and de-mapping of PDH/DSn signals
- Comprehensive error and alarm statistics
- SDH/SONET overhead byte testing and monitoring
- SDH/SONET tributary scan
- SDH/SONET pointer event generation and monitoring
- SDH/SONET and PDH/DSn delay measurements
- Analysis of service disruption with APS application



Looping-back test signal from MT1100A at far end supports SDH/SONET line quality tests

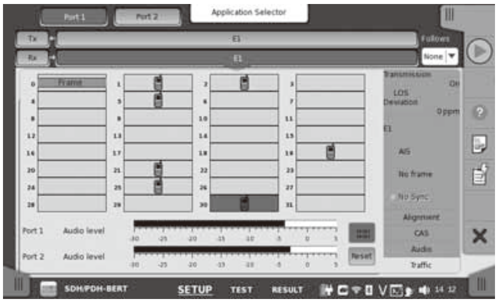


Bi-directional in-service monitoring of SDH/SONET lines



Tx: STM1 - AU4#All - VC-4 - C-12 ← E1
Rx: STM1 - AU4#1 - VC-4 - C-12 → E1
Follows: None
Optical transmitter: Normal
LOS
Rx Signal Level: -3 dBm

Quick overview of errors and alarms for both sides of SDH/SONET line



Tx: E1
Rx: E1
Follows: None
Transmission: On
LOS
Deviation: 0 ppm

Monitor 64 kbps traffic channels on bidirectional E1 line with MT1100A traffic display

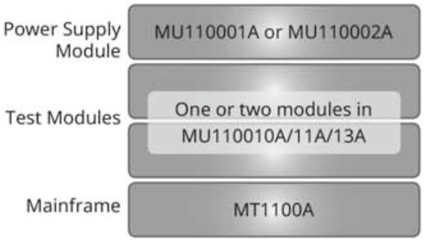
Optical Transceivers Interface List

MU110010A	MU110011A	MU110013A	Model/ Order No.	Name	Form Factor	100 Meg Ethernet	156 Meg STM-1	614 Meg CPRI	622 Meg STM-4	768 Meg OBSAI	1 Gig FC	1.23 Gig CPRI	1.25 Gig Ethernet	1.54 Gig OBSAI	2 Gig FC	2.46 Gig CPRI	2.488 Gig STM-16	2.67 Gig OTU1	3.07 Gig CPRI OBSAI	4 Gig FC	4.92 Gig CPRI	6.14 Gig CPRI OBSAI	8 Gig FC	9.83 Gig CPRI	9.95 Gig STM-64	10.1 Gig CPRI	10.3 Gig Ethernet	10.5 Gig FC	10.7 Gig OTU2	11.05 Gig OTU1e	11.09 Gig OTU2e	11.27 Gig OTU1f	11.3 Gig OTU2f	40G SDH/SONET	40G Ethernet	40G OTN	100G Ethernet	100G OTN
✓	✓		G0332A	100M FX 1310 nm MM SFP	SFP	1310 nm, MM, 2 km	▨																															
✓	✓		G0329A	10G LR 1310 nm SFP+	SFP+								1310 nm, SM, 10 km	▨	▨	▨			▨	▨	▨	▨	▨	▨		▨	▨	▨		▨	▨	▨						
✓	✓		G0315A	10G LR/LW 1310 nm SFP+	SFP+																		1310 nm, SM, 10 km	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨					
✓	✓		G0316A	10G ER/EW 1550 nm 40 km SFP+	SFP+																		1550 nm, SM, 40 km	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨					
✓	✓		G0318A	10G ZR/ZW 1550 nm 80 km SFP+	SFP+																		1550 nm, SM, 80 km	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨					
✓	✓		G0319A	Up to 2.7G 1310 nm 15 km SFP	SFP		1310 nm, SM, 15 km	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨																				
✓	✓		G0320A	Up to 2.7G 1310 nm 40 km SFP	SFP		1310 nm, SM, 40 km	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨																				
✓	✓		G0321A	Up to 2.7G 1550 nm 80 km SFP	SFP		1550 nm, SM, 80 km	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨																				
✓	✓		G0328A	1G/2G/4G FC 850 nm SFP	SFP						850 nm, MM, 0.5 km	▨	▨	▨	▨	▨				▨																		
✓	✓		G0322A	1G/2G/4G FC 1310 nm SFP	SFP						1310 nm, SM, 10 km	▨	▨	▨	▨	▨				▨																		
✓	✓		G0323A	1G/2G/4G FC 1550 nm SFP	SFP						1550 nm, SM, 40 km	▨	▨	▨	▨	▨				▨																		
✓	✓		G0356A	8G FC/10G SR 850 nm SFP+	SFP+																		850 nm, MM, 0.3 km	▨		▨	▨	▨										
	✓	✓	G0359A	40G SR4 850 nm QSFP+	QSFP+																														850 nm, MM, 0.5 km	▨		
	✓	✓	G0334A	40G LR4 1310 nm QSFP+	QSFP+																														1310 nm, SM, 10 km	▨		
	✓		G0335A	40G LR4 1310 nm CFP	CFP																													1310 nm, SM, 10 km	▨	▨		
	✓		G0336A	40G FR 1550 nm CFP	CFP																													1550 nm, SM, 2 km	▨	▨		
	✓		G0337A	100G LR4 1310 nm CFP	CFP																																1310 nm, SM, 10 km	▨
		✓	G0338A	100G LR4 1310 nm CFP2	CFP2																																1310 nm, SM, 10 km	▨
		✓	G0339A	100G 850 nm CXP	CXP																																850 nm, MM, 0.1 km	
		✓	G0366A	100G BASE-SR4 QSFP28	QSFP28																																850 nm, MM, 0.1 km	
		✓	G0364A	100G BASE-LR4 QSFP28	QSFP28																																1310 nm, SM, 10 km	
		✓	G0365A	100G LR4 Dual Rate 1310 nm QSFP28	QSFP28																																1310 nm, SM, 10 km	▨
		✓	G0369A	100G LR4 Dual Rate 1310 nm CFP4	CFP4																																1310 nm, SM, 10 km	▨

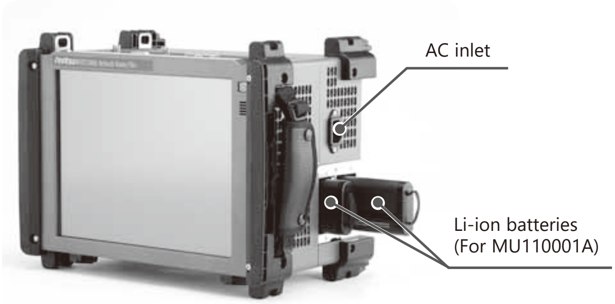
Configuration Guide

Mainframe and Modules

Product Number	Product Name	Description
MT1100A	Network Master Flex	Network Master Flex Mainframe
MU110001A	Battery and AC Power Supply Module	Power supply module for MT1100A Includes G0237A × 2 (Battery), Z1862A (Hexagon wrench)
MU110002A	AC only High Power Supply Module	High power supply module for MT1100A Includes Z1862A (Hexagon wrench)
MU110010A	10G Multirate Module	SFP/SFP+: 2, RJ45: 2, BNC (Tx/Rx): 2, RJ48: 2, Mini-bantam (Tx/Rx): 2
MU110011A	100G Multirate Module	CFP: 1, QSFP+: 2, SFP/SFP+: 2, RJ45: 2
MU110013A	40/100G Advanced Module	CFP2: 2, CXP: 2, QSFP+: 2, CFP4: 2 (with J1665A), QSFP28: 2 (with J1756A)



One mainframe, one or two test modules and one power supply module can be combined flexibly for various applications.



MT1100A + MU110001A + MU110011A
Overview

Power Supply Modules and Test Modules Combination

Battery and AC Power Supply Module MU110001A

		Module 2			
		No Module	MU110010A	MU110011A	MU110013A
Module 1	MU110010A	✓	✓	✓	✓
	MU110011A	✓	✓	—	—
	MU110013A	✓	✓	—	—

AC only High Power Supply Module MU110002A

		Module 2			
		No Module	MU110010A	MU110011A	MU110013A
Module 1	MU110010A	✓	✓	✓	✓
	MU110011A	✓	✓	✓	✓
	MU110013A	✓	✓	✓	✓

✓: Available —: Not Available

Test Modules and Maximum Operating Ports

Protocol	PDH/DSn	OTU1	100 Mbps to 1 Gbps Ethernet	STM-16/OC-48	1GFC to 4GFC	OTU2/1e/ 2e/1f/2f	10 Gbps Ethernet	STM-64/OC-192	8GFC to 10GFC	OBSAI1 X to 4 X	CPRI Option 1 to 8	OTU3/3e1/3e2	40 Gbps Ethernet	STM-256/OC-768	OTU4	100 Gbps Ethernet
MU110010A	2 ports	2 ports				2 ports										
MU110011A		2 ports				2 ports						2 ports*1		1 port		
MU110013A												2 ports		*2	2 ports	

*1: Up to two ports in two QSFP+ and one CFP can be operated simultaneously.
*2: MU110013A does not have a STM-256/OC-768 physical interface.
MU110013A-083/084 are the options for STM-256/OC-768 client signals mapped in the OTN.

Specifications

Network Master Flex MT1100A Mainframe

User Interfaces	
Display	12.1-inch active matrix TFT display (800 × 600 pixels) and touch screen
Supported Languages	English, Chinese, Japanese, French, Russian, Spanish, Finnish, Korean, German

Service Interfaces	
USB Interface	MT1100A operates as host: USB 2.0 type A (2 ports) MT1100A operates as device: USB 2.0 type Mini-B (1 port)
Ethernet Interface	Ethernet 10M/100M/1000M, Connector: RJ45
WLAN Interface*	IEEE 802.11 b/g/n
Bluetooth Interface*	Bluetooth 2.1 + EDR

*: Available for certified countries and regions including USA, Canada, Japan and EU countries. Please visit the Anritsu web site for updated information.
The Bluetooth® mark and logos are registered trademarks of Bluetooth SIG, Inc.

Other Interfaces	
Unit synchronization Input	(Not used)
Unit Synchronization Output	(Not used)
Audio Interface	For connection of CTIA Standard head set Connector: 3.5-mm diameter jack
AUX Connector	For connection of G0325A GPS receiver
Built-in Loudspeaker	Monitors speech of voice channel Output level: user-controlled from user Interface
Ext. Clock Input	For connection of external clock signals: SETS (E1: 2.048 Mbps), BITS (DS1: 1.544 Mbps),or 2.048 MHz TTL signal in accordance with ITU-T G.703, 10 MHz Connector: BNC

Miscellaneous		
Dimensions and Mass		320 (W) × 225 (H) × 46 (D) mm (excluding projections), ≤2.5 kg
Environmental		Temperature and Humidity Operating: 0° to +40°C, ≤80% RH (non-condensing) Storage: −20° to +60°C, ≤80% RH (non-condensing)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

Battery and AC Power Supply Module MU110001A

Battery		14.4 V rechargeable and replaceable intelligent Li-ion battery Operation time: 1 hour (typ.) (with MU110011A, 100 Gbps Ethernet operation) Charging time: 6 hours (typ.) (25°C) Remaining capacity indication:%
Power Supply		100 V(ac) to 240 V(ac), 50 Hz/60 Hz 380 VA (max.)
Dimensions and Mass		320 (W) × 225 (H) × 82 (D) mm (excluding projections), ≤3.0 kg (without battery)
Environmental		Temperature and Humidity Operating: 0° to +40°C, ≤80% RH (non-condensing) Storage: −20° to +60°C, ≤80% RH (non-condensing, without battery) −20° to +50°C, ≤80% RH (non-condensing, with battery)
Module Combination		1 module: Un limited 2 modules: MU110010A + MU110010A MU110010A + MU110011A MU110010A + MU110013A
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

AC only High Power Supply Module MU110002A

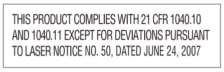
Power Supply		100 V(ac) to 240 V(ac), 50 Hz/60 Hz 700 VA (max.)
Dimensions and Mass		320 (W) × 225 (H) × 72 (D) mm (excluding projections), ≤3.0 kg
Environmental		Temperature and Humidity Operating: 0° to +40°C, ≤80% RH (non-condensing) Storage: −20° to +60°C, ≤80% RH (non-condensing)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

10G Multirate Module MU110010A

Test Port/Reference Standard		SFP/SFP+: 2 ports • SFF-8431, SFF-8472 compliant, IEEE 802.3ae-2002, IEEE 802.3-2008 compliant RJ45: 2 ports • IEEE 802.3-2008 10BASE-T, 100BASE-TX, 1000BASE-T compliant • Auto MDI-X • 10 Mbps/100 Mbps full/half duplex, 1000 Mbps full duplex BNC: 2 ports • ITU-T G.703 compliant RJ48: 2 ports • ITU-T G.703 compliant RTT Bantam: 2 ports • ANSI DS1.102 compliant
Tx Ref. Clock Output		Frequency : Selectable from 1/16, or 1/64 against the bit rate. (Available only when one of SFP ports is selected) Level : 250 mVp-p (min.), 550 mVp-p (max.) Termination : 50Ω/AC (Single ended) Connector : SMA
Dimensions and Mass		320 (W) × 225 (H) × 37 (D) mm, ≤1.4 kg
Environmental		Temperature and Humidity • Operating : 0° to +40°C, ≤80% RH (non-condensing) • Storage : –20° to +60°C, ≤80% RH (non-condensing)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581
Laser Safety*2		IEC 60825-1: 2007 CLASS 1 21CFR1040.10 and 1040.11*1

*1: Excludes deviations caused by conformance to Laser Notice No. 50 dated June 24, 2007
*2: Safety measures for laser products
This product complies with optical safety standards in 21CFR1040.10, 1040.11 and IEC 60825-1; the following descriptive labels are affixed to the product.


⚠ IEC 60825-1:2007
CLASS 1 LASER PRODUCT

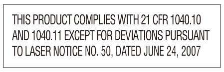

THIS PRODUCT COMPLIES WITH 21 CFR 1040.10
AND 1040.11 EXCEPT FOR DEVIATIONS PURSUANT
TO LASER NOTICE NO. 50, DATED JUNE 24, 2007

100G Multirate Module MU110011A

Test Port/Reference Standard		CFP: 1 port • CFP MSA Hardware Specification, Rev. 1.4 compliant • CFP MSA Management Interface Specification V2.2 R06a compliant (Not supported to MSA 100GLH) • IEEE 802.3ba-2010 compliant QSFP+: 2 ports • SFF-8436, SFF-8472 compliant • IEEE 802.3ba-2010 compliant SFP/SFP+: 2 ports • SFF-8431, SFF-8472 compliant • IEEE 802.3ae-2002, IEEE 802.3-2008 compliant RJ45: 2 ports • IEEE 802.3-2008 10BASE-T, 100BASE-TX, 1000BASE-T compliant • Auto MDI-X • 10 Mbps/100 Mbps full/half duplex, 1000 Mbps full duplex
Tx Ref. Clock Output		Frequency: Select 1/16 or 1/64 for bit rates of 10G or less. Select 1/16 or 1/64 for each lane rate for XLAUI and OTL3.4 of 40G. Select 1/16 or 1/64 for each lane rate for CAUI and OTL4.19 of 100G. (RJ45 port cannot be selected) Level: 250 mVp-p (min.), 550 mVp-p (max.) Termination: 50Ω/AC (Single ended) Connector: SMA
Dimensions and Mass		320 (W) × 225 (H) × 60 (D) mm, ≤3.0 kg
Environmental		Temperature and Humidity • Operating : 0° to +40°C, ≤80% RH (non-condensing) • Storage : –20° to +60°C, ≤80% RH (non-condensing)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581
Laser Safety*2		IEC 60825-1: 2007 CLASS 1 21CFR1040.10 and 1040.11*1 CFP : 100GBASE-LR4, 40GBASE-LR4, 40GBASE-FR QSFP+ : 40GBASE-LR4 SFP : 4GFC(SX), 4GFC(LX), 4GFC(EX), OC-48 LR-1/STM L-16.1, OC-48 LR-2/STM L-16.2, 100BASE-FX, 100BASE-LX SFP+ : 1000BASE-SX/LX/ZX, 10GBASE-LR, 10GBASE-ER, 10GBASE-ZR IEC 60825-1: 2007 CLASS 1M 21CFR1040.10 and 1040.11*1 CFP : 100G BASE-SR10 QSFP+ : 40GBASE-SR4

*1: Excludes deviations caused by conformance to Laser Notice No. 50 dated June 24, 2007
*2: Safety measures for laser products
This product complies with optical safety standards in 21CFR1040.10, 1040.11 and IEC 60825-1; the following descriptive labels are affixed to the product.


⚠ IEC 60825-1:2007
INVISIBLE LASER RADIATION
DO NOT VIEW DIRECTLY
WITH OPTICAL INSTRUMENTS
(MAX OUTPUT POWER) (PULSE DURATION) (WAVELENGTH)
6.5mW CW 840 to 860nm
CLASS 1M LASER PRODUCT


THIS PRODUCT COMPLIES WITH 21 CFR 1040.10
AND 1040.11 EXCEPT FOR DEVIATIONS PURSUANT
TO LASER NOTICE NO. 50, DATED JUNE 24, 2007

40/100G Advanced Module MU110013A

Test Port/Reference Standard		CFP2: 2 ports • CFP MSA CFP2 Hardware Specification, Rev. 1.0 compliant • CFP MSA Management Interface Specification V2.2 R06a compliant (Not supported to MSA 100GLH) • IEEE 802.3ba-2010 compliant CXP: 2 ports • InfiniBand Architecture 1.2.1 Annex A6: CXP compliant • SFF-8642, IEEE 802.3ba-2010 compliant QSFP+: 2 ports • SFF-8436, SFF-8472 compliant • IEEE 802.3ba-2010 compliant
Tx Ref. Clock Output		Frequency Select 1/16 or 1/64 for each lane rate of XX. 40 GigE : XLAUI OTU3, OTU3e1, OTU3e2 : OTL3.4 100 GigE : CAUI OTU4 : OTL4.10 Level: 250 mVp-p (min.), 550 mVp-p (max.) Termination: 50Ω/AC (Single ended) Connector: SMA
Sync Clock Output		Frequency Select 1/8 or 1/16 against the bit rate of the data lane for CFP2 port. 100 GigE : CAUI4 OTU4 : OTL 4.4 Level: 150 mVp-p (min.), 650 mVp-p (max.) Termination: 50Ω/AC (Single ended) Connector: SMA
Dimensions and Mass		320 (W) × 225 (H) × 60 (D) mm, ≤3.0 kg
Environmental		Temperature and Humidity • Operating : 0° to +40°C, ≤80% RH (non-condensing) • Storage : –20° to +60°C, ≤80% RH (non-condensing)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581
Laser Safety[*2]		IEC 60825-1: 2007 CLASS 1 21CFR1040.10 and 1040.11[*1] QSFP+ : 40G BASE-LR4 CFP2 : 100G BASE-LR4 CFP4 : 100G BASE-LR4 QSFP28 : 100G BASE-LR4 IEC 60825-1: 2007 CLASS 1M 21CFR1040.10 and 1040.11[*1] QSFP+ : 40G BASE-SR4 CXP : 100G BASE-SR10 QSFP28 : 100G BASE-SR4

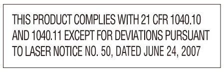
*1: Excludes deviations caused by conformance to Laser Notice No. 50 dated June 24, 2007

*2: Safety measures for laser products
This product complies with optical safety standards in 21CFR1040.10, 1040.11 and IEC 60825-1; the following descriptive labels are affixed to the product.

⚠ IEC 60825-1:2007
INVISIBLE LASER RADIATION
DO NOT VIEW DIRECTLY
WITH OPTICAL INSTRUMENTS

(MAX OUTPUT POWER)	(PULSE DURATION)	(WAVELENGTH)
7.8mW	CW	840 to 860nm

CLASS 1M LASER PRODUCT



THIS PRODUCT COMPLIES WITH 21 CFR 1040.10
AND 1040.11 EXCEPT FOR DEVIATIONS PURSUANT
TO LASER NOTICE NO. 50, DATED JUNE 24, 2007

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

1. Mainframe

Model/Order No.	Name
Mainframe	
MT1100A	Network Master Flex
Standard accessories for MT1100A	
Z1746A	Stylus
Z1870A	Utilities ROM
W3734AE	MT1100A Quick Reference Guide (English)
W3734AW	MT1100A Quick Reference Guide (Japanese)
Z1861A	Carrying Strap
Z1862A	Module Combination Kit
B0699A	Soft Case
Option	
MT1100A-003*1	Connectivity for WLAN/Bluetooth

*1: Please visit the Anritsu web site for updated information.

2. Power Supply Module

Model/Order No.	Name
MU110001A*2	Battery and AC Power Supply Module
MU110002A*2	AC only High Power Supply Module
Standard accessories for MU110001A	
G0327A*3	Li-ion Battery: 2 pcs

*2: Select MU110001A or MU110002A.
When installing two test modules in an MT1100A mainframe, one module must be an MU110010A to select MU110001A, battery powered power module.

*3: MU110001A requires two G0327A.

3. Measurement Module*4

Model/Order No.	Name
MU110010A	10G Multirate Module
MU110011A	100G Multirate Module
MU110013A	40/100G Advanced Module

*4: One or two modules of MU110010A/11A/13A can be installed in one mainframe.

4. Protocol Options*5, *6

MU110010A

Model/Order No.	Name
Ethernet	
MU110010A-001	Up to 2.7G Dual Channel
MU110010A-011	Ethernet 10G Single Channel
MU110010A-012	Ethernet 10G Dual Channel
MU110010A-020	TCP Throughput
CPRI/OBSAI	
MU110010A-071	CPRI/OBSAI Up to 5G Dual Channel
MU110010A-072	CPRI/OBSAI 6G to 10G Single Channel
MU110010A-073	CPRI/OBSAI 6G to 10G Dual Channel
OTN	
MU110010A-001	Up to 2.7G Dual Channel
MU110010A-051	OTN 10G Single Channel
MU110010A-052	OTN 10G Dual Channel
MU110010A-061	ODU Multiplexing
MU110010A-062	ODU Flex
SDH/SONET	
MU110010A-001	Up to 2.7G Dual Channel
MU110010A-081	STM-64 OC-192 Single Channel
MU110010A-082	STM-64 OC-192 Dual Channel
Fibre Channel	
MU110010A-002	FC 1G 2G 4G Dual Channel
MU110010A-091	FC 8G 10G Single Channel
MU110010A-092	FC 8G 10G Dual Channel

*5: "channel" means physical port or client signal test mapped in OTN.
Refer to data sheet for OTN and client signals.

*6: These options can be retrofitted.
The Model/Order No. of retrofit options is "-3**".
Example
MU110010A-001 Up to 2.7G Dual Channel becomes MU110010A-301 Up to 2.7G Dual Channel Retrofit. In addition, specify one of the following media along with the required option.

Model/Order No.	Name
Z1849A	DVD-ROM for Retrofit Options
Z1850A	USB Stick for Retrofit Options

MU110011A

Model/Order No.	Name
Ethernet	
MU110011A-001	Up to 10G Single Channel
MU110011A-003	Up to 10G Dual Channel
MU110011A-013	Ethernet 40G Single Channel
MU110011A-014	Ethernet 40G Dual Channel
MU110011A-015	Ethernet 100G Single Channel
MU110011A-020	TCP Throughput
CPRI/OBSAI	
MU110011A-071	CPRI/OBSAI Up to 10G Single Channel
MU110011A-072	CPRI/OBSAI Up to 10G Dual Channel
OTN	
MU110011A-001	Up to 10G Single Channel
MU110011A-003	Up to 10G Dual Channel
MU110011A-053	OTN 40G Single Channel
MU110011A-054	OTN 40G Dual Channel
MU110011A-055	OTN 100G Single Channel
MU110011A-061	ODU Multiplexing
MU110011A-062	ODU Flex
MU110011A-063*7	40G/100G ODU Multi Stage
SDH/SONET	
MU110011A-001	Up to 10G Single Channel
MU110011A-003	Up to 10G Dual Channel
MU110011A-083	STM-256 OC-768 Single Channel
MU110011A-084	STM-256 OC-768 Dual Channel
Fibre Channel	
MU110011A-005	Up to 10G FC Single Channel
MU110011A-004	Up to 10G FC Dual Channel

MU110013A

Model/Order No.	Name
Ethernet	
MU110013A-001*8	Up to 10G Single Channel
MU110013A-003*8	Up to 10G Dual Channel
MU110013A-013	Ethernet 40G Single Channel
MU110013A-014	Ethernet 40G Dual Channel
MU110013A-015	Ethernet 100G Single Channel
MU110013A-016	Ethernet 100G Dual Channel
MU110013A-023*9	RS-FEC for 100GBASE-SR4
CPRI/OBSAI	
MU110013A-071*8	CPRI Up to 10G Single Channel
MU110013A-072*8	CPRI Up to 10G Dual Channel
OTN	
MU110013A-001*8	Up to 10G Single Channel
MU110013A-003*8	Up to 10G Dual Channel
MU110013A-053	OTN 40G Single Channel
MU110013A-054	OTN 40G Dual Channel
MU110013A-055	OTN 100G Single Channel
MU110013A-056	OTN 100G Dual Channel
MU110013A-062	ODU Flex
MU110013A-063	40G/100G ODU Multi Stage
SDH/SONET	
MU110013A-001*8	Up to 10G Single Channel
MU110013A-003*8	Up to 10G Dual Channel
MU110013A-083*8	STM-256 OC-768 Single Channel
MU110013A-084*8	STM-256 OC-768 Dual Channel
Fibre Channel	
MU110013A-005*8	Up to 10G FC Single Channel
MU110013A-004*8	Up to 10G FC Dual Channel
Device Test	
MU110013A-008	4 × 25G/28G BERT

*7: These options including MU11001xA-061 function.

*8: MU110013A does not have a physical interface of these options.
These options are required for the client signal mapped in the OTN.
Refer to the OTN mapping pages on the datasheet.

*9: Required to MU110013A-015 or MU110013A-016.

5. Optional Accessories

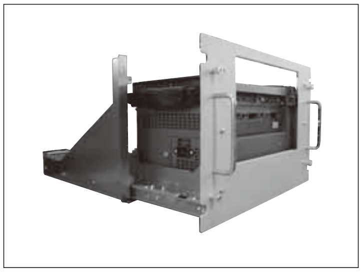
Model/Order No.	Name
Optical modules	
G0332A	100M FX 1310 nm MM SFP
G0329A	10G LR 1310 nm SFP+
G0315A	10G LR/LW 1310 nm SFP+
G0316A	10G ER/EW 1550 nm 40 km SFP+
G0318A	10G ZR/ZW 1550 nm 80 km SFP+
G0319A	Up to 2.7G 1310 nm 15 km SFP
G0320A	Up to 2.7G 1310 nm 40 km SFP
G0321A	Up to 2.7G 1550 nm 80 km SFP
G0328A	1G/2G/4G FC 850 nm SFP
G0322A	1G/2G/4G FC 1310 nm SFP
G0323A	1G/2G/4G FC 1550 nm SFP
G0356A	8G FC/10G SR 850 nm SFP+
G0359A	40G SR4 850 nm QSFP+
G0334A	40G LR4 1310 nm QSFP+
G0335A	40G LR4 1310 nm CFP
G0336A	40G FR 1550 nm CFP
G0337A	100G LR4 1310 nm CFP
G0338A	100G LR4 1310 nm CFP2
G0339A	100G 850 nm CXP
G0366A	100G BASE-SR4 QSFP28
G0364A	100G BASE-LR4 QSFP28
G0365A	100G LR4 Dual Rate 1310 nm QSFP28
G0369A	100G LR4 Dual Rate 1310 nm CFP4
Mainframe optional accessories	
B0717A	Hard Case
Z1860A	Battery Charger
G0325A	GPS Receiver
Z1871A	Utilities in USB Stick
B0692A*10	ESD Box
G0382A	Autofocus Video Inspection Probe
G0306B	Video Inspection Probe
J1667A*11	GPIB-USB Converter
B0705A	Rack Mount Kit
Interface convertor for optical module	
J1756A*12	CFP2-QSFP28 Adaptor
Cables	
J1571A	Optical Cable SM LC/PC to SC/PC 3 m
J1575A	Optical Cable SM LC/PC to FC/PC 3 m
J1579A	Optical Cable SM LC/PC to LC/PC 3 m
J1581A	Optical Cable MM LC/PC to LC/PC 3 m
J1583A	Optical Attenuator 10 dB LC/PC to LC/PC
J1584A	RJ45 Cable 3 m
J1585A	RJ48 to Crocodile Clips Cable 3 m
J1586A	RJ48 to Crocodile Clips Cable 20 dB ATT 3 m
J1588A	BNC Cable 2.5 m
J1589A	BNC to 1.6/5.6 Cable 2.5 m
J1591A	RJ48 to Two 3-pin Banana Plug Cable 2.5 m
J1597A	RJ48 Balanced PDH Cable Crossed 3 m
J1598A	Bantam Cable 3 m
J0775D	Coaxial Cord, 2.0 m (75Ω)
Manuals	
W3735AE	MT1100A Operation Manual (English)
W3735AW	MT1100A Operation Manual (Japanese)
W3736AE	MT1000A/MT1100A Remote Scripting Operation Manual (English)
W3736AW	MT1000A/MT1100A Remote Scripting Operation Manual (Japanese)

*10: Up to 4 SFP+/SFPs can be stored.
*11: J1667A is required for SCPI remote control via GPIB.
*12: CFP2 Interface.

6. Extended Warranties

Model/Order No.	Name
MT1100A-ES210	2 Years Extended Warranty Service
MT1100A-ES310	3 Years Extended Warranty Service
MT1100A-ES510	5 Years Extended Warranty Service
MU110001A-ES210	2 Years Extended Warranty Service
MU110001A-ES310	3 Years Extended Warranty Service
MU110001A-ES510	5 Years Extended Warranty Service
MU110002A-ES210	2 Years Extended Warranty Service
MU110002A-ES310	3 Years Extended Warranty Service
MU110002A-ES510	5 Years Extended Warranty Service
MU110010A-ES210	2 Years Extended Warranty Service
MU110010A-ES310	3 Years Extended Warranty Service
MU110010A-ES510	5 Years Extended Warranty Service
MU110011A-ES210	2 Years Extended Warranty Service
MU110011A-ES310	3 Years Extended Warranty Service
MU110011A-ES510	5 Years Extended Warranty Service
MU110013A-ES210	2 Years Extended Warranty Service
MU110013A-ES310	3 Years Extended Warranty Service
MU110013A-ES510	5 Years Extended Warranty Service


Hard case B0717A


Rack Mount Kit B0705A

MT9090A Mainframe
MU909060A1/A2/A3 Gigabit Ethernet Modules

Remote Control
Ethernet
OPTION

Gigabit Ethernet Testing Redefined!

Network Master

MT9090A with MU909060A1/A2/A3 Overview

The Ethernet technology is widely deployed, and used for carrier class Ethernet and Mobile backhaul. Therefore easy testing of Ethernet links is very important. When outfitted with the Gigabit Ethernet Module, the very compact battery-powered, easy-to-use Anritsu Network Master is a comprehensive solution for Gigabit Ethernet testing and for installation and troubleshooting Ethernet communication lines. The instrument gives the user facilities for easy bandwidth verification, connectivity testing and service availability verification. The small size and low weight of the instrument makes it very easy to carry around for the field technician working with the Ethernet lines and despite the small size the instrument is equipped with a large display. The user can easily read and interpret information from the tested lines off the large color display with easy-to-understand colors and graphical symbols.
And the graphical user interface makes it a simple task to configure and operate the instrument.

Key Features

- RJ45 and SFP optical interface are selectable for two ports
- Newly released ITU-T standard for End-to-End Ethernet testing ITU-T Y.1564 testing, simultaneously testing of multiple traffic streams emulating real world networks
- Stacked VLAN (Q-in-Q), MPLS, IPv4, IPv6 supported
- Test Automator simplify operation and ensure proper set-up
- Ping, Traceroute, Ramp data generation, RFC 2544 testing
- Upstream/Downstream individual and simultaneous testing with End-to-End RFC 2544
- Service Disruption Time measurement for VoIP and IPTV
- Shorter testing time of multiple port networks by utilizing MT9090-ports
- Optical power level check and electrical cable test for physical layer testing
- In-band pass through and bidirectional monitoring using two ports
- Channel Stats for identifying error streams, top talkers, network attacks
- PDF and CSV report generation for documentation of test results
- Modular platform ensures maximum return on investment
- Compact and lightweight design for maximum portability in the field

Designed for Field Operations

The Network Master Gigabit Ethernet tester (MT9090A with MU909060A) is purpose built for testing Ethernet links in the field. Its hardware and user interface are optimized for simplicity, making it easy to use for any skill level, and it is rugged enough to function in harsh environments.

Quick Startup

The Network Master Gigabit Ethernet tester is ready for measurement in about 15 seconds so productive work can start immediately.

Long Battery Life

Since AC power is not always available where you need it, the Network Master Gigabit Ethernet tester provides up to 3 hours of testing on a single charge, depending on configuration and setup. This coupled with an optional car cigarette lighter cord guarantees the instrument is ready when you are.

Portable

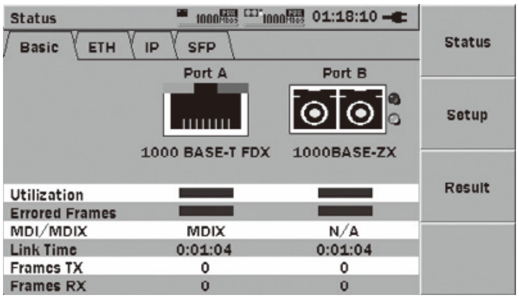
With its lightweight design and user friendly dimensions, the Network Master Gigabit Ethernet tester is perfect for the outside plant environment and can easily be managed with one hand.
The standard softcase with shoulder strap further increases portability when traveling from the truck to the testing site.

Rugged

With no fans or vents to allow dust and moisture to enter the unit, the Network Master Gigabit Ethernet tester was designed for the challenging outside plant environment.
The protector included as standard equipment absorbs the shock to the tester.

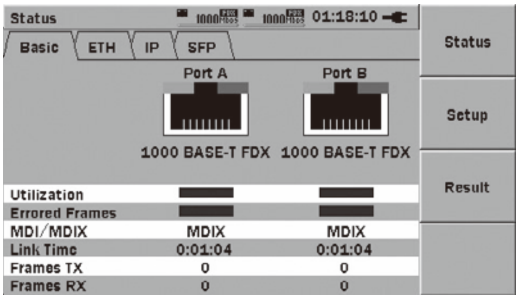
4.3-inch Wide Screen Display for Easy Viewing

The high resolution, full color, 4.3-inch wide screen display is the perfect format for viewing Ethernet measurement results. It also provides excellent readability both indoors and outdoors.


Status 01:18:10

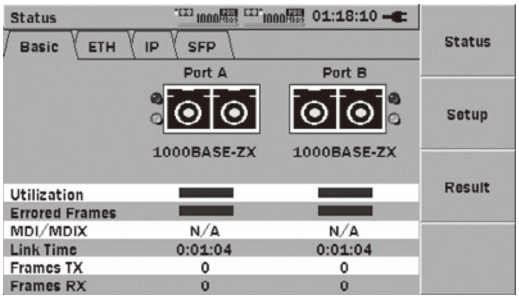
	Port A	Port B
	1000 BASE-T FDX	1000BASE-ZX
Utilization		
Errored Frames		
MDI/MDIX	MDIX	N/A
Link Time	0:01:04	0:01:04
Frames TX	0	0
Frames RX	0	0

MU909060A1


Status 01:18:10

	Port A	Port B
	1000 BASE-T FDX	1000 BASE-T FDX
Utilization		
Errored Frames		
MDI/MDIX	MDIX	MDIX
Link Time	0:01:04	0:01:04
Frames TX	0	0
Frames RX	0	0

MU909060A2


Status 01:18:10

	Port A	Port B
	1000BASE-ZX	1000BASE-ZX
Utilization		
Errored Frames		
MDI/MDIX	N/A	N/A
Link Time	0:01:04	0:01:04
Frames TX	0	0
Frames RX	0	0

MU909060A3

No Experience Required

The expertise is built into the Network Master Gigabit Ethernet tester. With its Test Automator and PASS/FAIL indicators the instrument makes it easy to test and troubleshoot Ethernet connections.

Designed for Network Activation

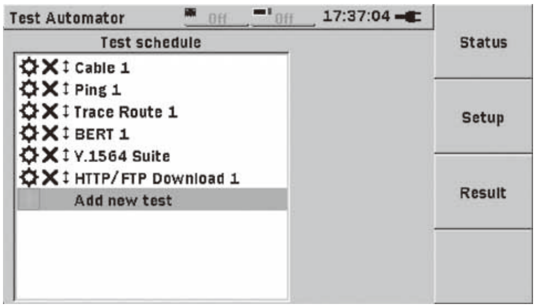
For installation, commissioning and QoS verification the Network Master Gigabit Ethernet tester provides powerful and flexible traffic generation capabilities, allowing you to easily test the network under various conditions, including generation of VLAN tagged traffic. The instrument also provides facilities for BER testing of the lines, performance statistics and QoS statistics.

Single end test with Loopback or Using a Ethernet Reflector,
Two ports simultaneous testing for multiple ports installation.

Bidirectional performance test with End-to-End RFC 2544,
Two ports simultaneous testing for multiple ports installation.

Installation and Maintenance Simplified

Since the Network Master Gigabit Ethernet tester is purposely built for easy testing of Ethernet links in the field, its hardware and user interface are optimized for simplicity. The instrument is easy to setup using its keys and screen. The user can also store setups relevant for a given application and via a USB port distribute the setup to other instruments with the Gigabit Ethernet tester. A Test Automator is provided making it easy to set up a sequence of tests.


Test Automator Off Off 17:37:04

Test schedule

- Cable 1
- Ping 1
- Trace Route 1
- BERT 1
- Y.1564 Suite
- HTTP/FTP Download 1
- Add new test

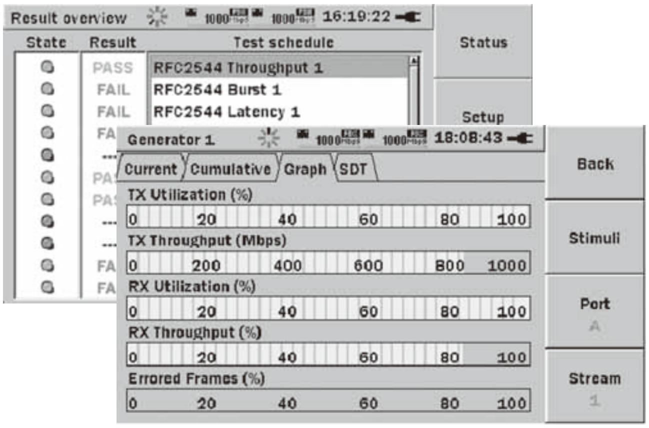
The Test Automator makes it easy to set up a sequence of tests

Report Generation

With the powerful and flexible report generator you can create .pdf or .csv files for selected measurement results. With these files you can provide professional documentation of test results to your customers.

Pass/Fail Indication, Graphical Display

The result can be checked not only value but also PASS/FAIL indicator and graphical display.



Result overview 16:19:22

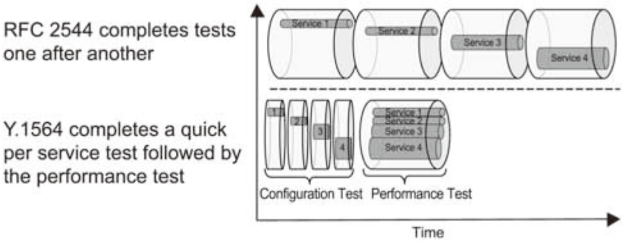
State	Result	Test schedule
	PASS	RFC2544 Throughput 1
	FAIL	RFC2544 Burst 1
	FAIL	RFC2544 Latency 1

Y.1564 Test Option

ITU-T Y.1564 is a new test methodology for bring Ethernet networks into service, simultaneously completing multiple traffic streams. RFC 2544 commonly use today completes tests in a serial manner never running all traffic streams at the same time. ITU-T Y.1564 completes this testing in two phases:

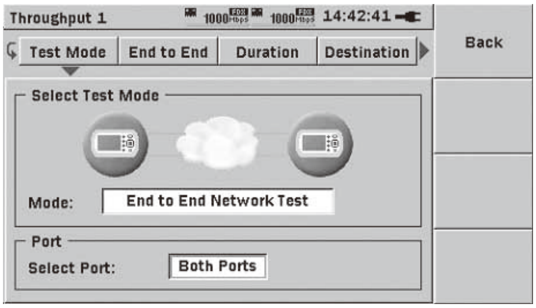
- Service Configuration Test, confirms the end to end configuration while quickly checking the Information Rate (IR), Frame Delay Variation (FDV), Frame Loss Ratio (FLR), Frame Loss Ration at the Service Acceptance Criteria (FLRSAC), Committed Burst Size (CBS) and Excess Burst Size (EBS) sequentially for all configured traffic streams.
- Service Performance Test transmits all configured traffic streams simultaneously at the CIR confirming all traffic is able to transverse the network under full load while checking the following IR, FDV, FLR and Availability (AVAIL).

This two phase approach reduces total testing time.



RFC 2544 Test Option

With the RFC 2544 test option, testing of throughput and frame loss, latency, packet jitter and burstability is straightforward.
The Network Master Gigabit Ethernet tester automates the testing procedure while still allowing you to configure the test to be as thorough as needed.
To get full information on the performance of both sides of a line, the end-to-end test mode allows two Network Master Gigabit Ethernet tester to work together in a master-slave setup whereby the user can control both units and inspect the results of the test from both units on the master instrument.



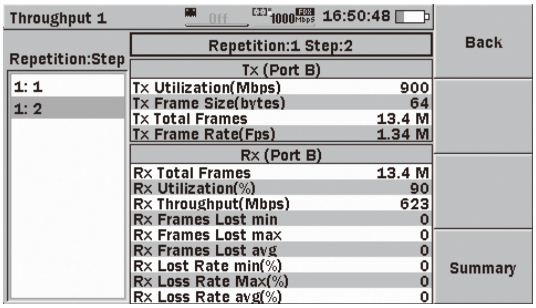
Throughput 1 14:42:41

Select Test Mode

Mode: End to End Network Test

Port

Select Port: Both Ports



Throughput 1 Off 1000 FDX Mbps 16:50:48

Repetition:Step

1: 1
1: 2

Repetition:1 Step:2

Tx (Port B)	
Tx Utilization(Mbps)	900
Tx Frame Size(bytes)	64
Tx Total Frames	13.4 M
Tx Frame Rate(Fps)	1.34 M

Rx (Port B)	
Rx Total Frames	13.4 M
Rx Utilization(%)	90
Rx Throughput(Mbps)	623
Rx Frames Lost min	0
Rx Frames Lost max	0
Rx Frames Lost avg	0
Rx Lost Rate min(%)	0
Rx Loss Rate Max(%)	0
Rx Loss Rate avg(%)	0

Multistream Option

The Ethernet Multistream option for the Network Master Gigabit Ethernet tester allows testing a congested networks ability to transport high priority traffic rather than lower priority traffic.
The user can activate up to 8 streams with different priority settings on the Ethernet line and detect how they are affected by frame loss through the network.

Simplifying Maintenance and Troubleshooting

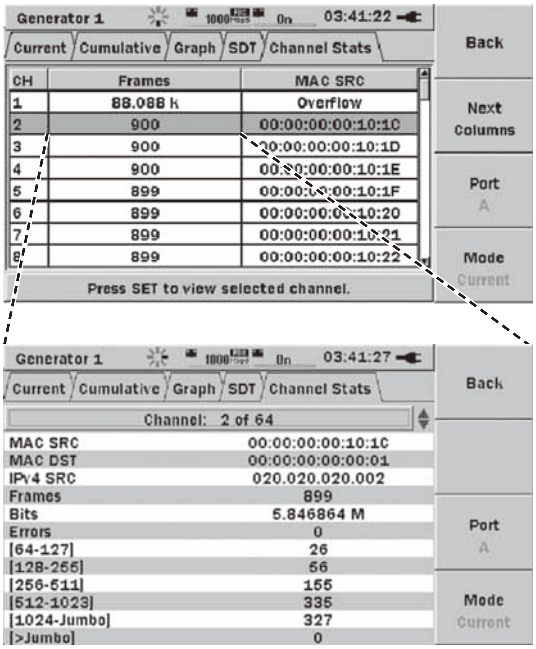
The Network Master Gigabit Ethernet tester has maintenance and troubleshooting application in 800 g pocketable package.

Pass through monitoring by inserting the tester in a network.
Tx and Rx of two ports are used for this application.

Bidirectional monitoring by dividing both signals and put them into the tester. Two Rxs are used for this application.

Channel Stats (Option)

Up to 63 streams can be selected by the filter of Source/Destination addresses, VLAN, MPLS. Those streams can be monitored and displayed in detailed information. It's useful to identify the error streams, top talkers and network attack.



CH	Frames	MAC SRC
1	88.088 k	Overflow
2	900	00:00:00:00:10:1C
3	900	00:00:00:00:10:1D
4	900	00:00:00:00:10:1E
5	899	00:00:00:00:10:1F
6	899	00:00:00:00:10:20
7	899	00:00:00:00:10:21
8	899	00:00:00:00:10:22

Press SET to view selected channel.

Channel: 2 of 64

MAC SRC	00:00:00:00:10:1C
MAC DST	00:00:00:00:00:01
IPv4 SRC	020.020.020.002
Frames	899
Bits	5.846864 M
Errors	0
[64-127]	26
[128-255]	56
[256-511]	155
[512-1023]	335
[1024-Jumbo]	327
[>Jumbo]	0

Simultaneous Two Ports Monitoring

Network Master Gigabit Ethernet tester has two ports and they can be used simultaneously. It saves the test time for multiple ports deployment. It is possible to support identification of issues in the network by pass through monitoring and bidirectional monitoring.

Remote GUI Option

Network Master Gigabit Ethernet tester can be operated remotely from the far end operation center using a Web browser. USB-Ethernet Converter (option) connects the Network Master Gigabit Ethernet tester with Ethernet for remote control.

Specifications

The specification table below applies to the Network Master Mainframe equipped with the Gigabit Ethernet Module.

Ethernet Interfaces	Interfaces	• Electrical interfaces: 10/100/1000 Mbps RJ45 (10BASE-T, 100BASE-TX, 1000BASE-T) • Optical interfaces: 100 or 1000 Mbps LC connector (100BASE-FX, 100BASE-LX, 1000BASE-SX, 1000BASE-LX or 1000BASE-ZX)			
	Interface Configurations	• MU909060A1: Gigabit Ethernet Module with one SFP port and 1 electrical RJ45 port. One optical module can be installed • MU909060A2: Gigabit Ethernet Module with 2 electrical RJ45 ports. • MU909060A3: Gigabit Ethernet Module with two SFP ports. Two electrical or optical modules can be installed			
	Duplex Modes	Full duplex. Electrical 10 Mbps/100 Mbps also half duplex			
	Test Configurations	Monitor/Generate, Pass through, Reflector			
Optical Modules*1	Description	Min. input sensitivity and wavelength		Output power and wavelength	
	1000BASE-SX 850 nm Multimode	–17 dBm	770 nm to 860 nm	–9.5 to –1.5 dBm	830 nm to 860 nm
	1000BASE-LX 1310 nm Singlemode	–20 dBm	1260 nm to 1580 nm	–10 to –3 dBm	1285 nm to 1343 nm
	1000BASE-ZX 1550 nm Singlemode	–22 dBm	1260 nm to 1580 nm	–3 to +5 dBm	1480 nm to 1580 nm
	100BASE-FX 1310 nm Multimode	–31 dBm	1260 nm to 1570 nm	–20 to –14 dBm	1270 nm to 1335 nm
	100BASE-LX 1310 nm Singlemode	–28 dBm	1260 nm to 1570 nm	–15 to –8 dBm	1261 nm to 1360 nm
Generate	Supported Encapsulations	EtherType II (DIX v.2), IEEE 802.3 with 802.2 (LLC1), IEEE 802.3 with SNAP			
	Traffic Generation/Monitor	• Variable line rate traffic generation, up to full line rate • Traffic shaping: Constant, Burst, Ramped • Frame sizes can be set to Constant, Stepped or Random length • Configurable MAC/IP source and destination addresses (supports IPv4 and IPv6), UDP/TCP address and DSCP/TOS byte • Request IP source address from a DHCP server (On/Off) • Adjustable frame size from 46 bytes to 10000 bytes • User defined up to 3 level VLAN ID and VLAN priority (Option) • User defined up to 3 level MPLS label (Option) • User defined traffic mix of unicast and broadcast frames • Generate and respond to pause frames • Answer incoming ARP request (On/Off) • MAC/IP address swapping (reflector configuration) Test Result Current/Cumulative: Total frame, Total bit, Utilization, Throughput, Broadcast frame, Error frame, Frame loss, Frame loss rate Graph: Tx utilization, Tx throughput, Rx utilization, Rx throughput, Error frame Service Disruption Time: Min., Max., Average, Count, Total time, Total SDT (%), Last frame received (interval) timestamp Channel Stats: Total frame, Total bit, Error, Frame size distribution of up to 63 filtered streams			

Continued on next page

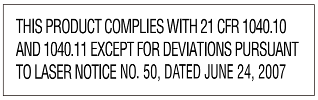
Measurements	Status		Link status, Signal and Frames present (utilization), Errored frames, Rx/Tx frame count, Link time, Remote fault, Speed, Full/Half duplex, MDI/MDIX, Interface type, Link partner abilities (Pause capable and Asymmetric pause capable), Local clock (1000 Mbps), DHCP lease time, Optical level for optical interfaces
	Frame Statistics		Link status, Signal and Frames present (utilization), Error frames, Rx/Tx frame count, Link time, Remote fault, Speed, Full/Half duplex, MDI/MDIX, Interface type, Link partner abilities (Pause capable and Asymmetric pause capable), Local clock (1000 Mbps), DHCP lease time, Optical level for optical interfaces
	Event Log		The instrument logs major events during a test with a 1 sec. resolution time stamp. Logged events include: Link/No link and Test Start/Stop
	Report Generation		Generation of test result reports as pdf-files. The report may be customized with a user logo and comments.
Dedicated Tests	Electrical Cable Test (MU909060A1/A2)		• Detection of MDI/MDIX mode, Link speed and status, Cable status and distance to fault (if any), Polarity. For 1000 Mbps also skew • Pin mapping: Tx/Rx for 10/100 Mbps, DA, DB, DC, DD for 1000 Mbps
	BER Test		Generation and detection of test patterns. Count of errors in received test pattern. Pattern generation: Unframed, Framed with IP header or Framed with IP and TCP/UDP header Test patterns supported: FOX, all 0, all 1, 0101, PING, PRBS 9, PRBS 11, PRBS 15, PRBS 20, PRBS 23, PRBS 29, PRBS 31, HF test pattern, CRPAT, JTPAT, SPAT Detection of sequence errors and loss of sequence synchronization.
	Ping Test		For connectivity and configuration check • Round Trip Time (RTT) • Supports IPv4 and IPv6 addressing • Answer incoming Ping requests (On/Off)
	Traceroute Test		Setup: Number of Attempts, Max number of hops, Number of ping each host, Timeout Result: Number of hop, Host IP address, Number of Received/Lost replies, Min/Max/Average time
	ITU-T Y.1564 Test (Option)		Test mode: Single Ended test, Switch/Router test, End-to-End test Configuration Test: Up to 32 services, Up to 6 steps with CBS, EBS Test result: Pass/Fail, IR (Information Rate), FL (Frame Loss), FTD (Frame Transfer Delay), FDV (Frame Delay Variation) Service Performance Test: Up to 32 services Test result: Pass/Fail, IR (Information Rate), FL (Frame Loss), FTD (Frame Transfer Delay), FDV (Frame Delay Variation), AVAIL (Availability), UN-AVAIL (Unavailable seconds), SEQ ERR (Sequence Errors) Test report: Y.1564 Appendix II compliant (CSV or PDF) Parameters: Configurable with MT9090A's Test Automator or the standalone PC application (MX909060A)
	RFC 2544 Installation and Commissioning Tests (Option)		Single ended network test and Switch/Router test modes: Throughput and utilization, Frame loss, Latency, Packet jitter, Back-to-back frames (burstability) End-to-End network test mode (two Network Master Gigabit Ethernet testers in a master-slave setup): Throughput and utilization, Frame loss, Back-to-back frames (burstability) Router latency test mode: IP ping based latency, IP ping based packet jitter
	Multistream Test (Option)		Number of streams: Up to 8 streams can be activated on the Ethernet line available information per stream: Frame loss count/rate, Frames and bytes received, Frames and bytes transmitted
	HTTP/FTP Test		Test mode: HTTP, FTP Setup: Target directory, Download file name, Authentication Result: Received/Total file size, Min/Max/Average throughput
	Reflector Delay		Maximum internal delay when instrument is in reflector configuration: 2.44 μs (1000 Mbps), 5.16 μs (100 Mbps), 31.93 μs (10 Mbps)
General	Internal Memory		Internal memory for storage of results, setups and screen shots: 40 MB
	Stored Configurations		The user can save a number of configuration files for later recall. The configuration files can be transferred to other instruments via the instruments USB port.
	Test Automator		The user can create a macro to run several tests in sequence. The user can also load, save, import and export test macros
	Service Interface		Two USB 1.1 (One type A for USB memory stick, One type B for USB mass storage)
	Display		4.3-inch color LCD (480 × 272 pixels), with LED back light, transmissive
	Language		English, Japanese, Chinese (Simplified, Traditional), Spanish, German, Korean, French, Italian, Portuguese
	Battery		Dedicated battery pack or 4 AA Ni-MH Operating time: Up to 3 hours, depending on configuration and test setup Charging time: 4 hours while power off (typ.), Temperature: +10° to +30°C Indicator for battery level in display when the unit is turned on
	Power Supply		AC adapter: 9 V(dc), 100 V(ac) to 240 V(ac), Frequency: 50 Hz/60 Hz
	Dimensions and Mass		MT9090A: 190 (W) × 96 (H) × 18 (D) mm, <200 g MU909060A1/A2/A3: 190 (W) × 96 (H) × 30 (D) mm, <600 g
	Environmental		Operational Temperature Range: 0° to +40°C, Humidity ≤85%, No condensation Storage Temperature Range: −25° to +60°C, Humidity ≤80%, No condensation Vibration: IEC 60 068-2-6 Fc and IEC 60 068-2-64 Fh, Dust and Drip proof: IP 51
	CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
		LVD	2014/35/EU, EN61010-1
		RoHS	2011/65/EU, EN50581
	Laser Safety*3		IEC 60825-1: 2007 CLASS 1 21CFR1040.10*2: MU909060A1/A3 with optical modules

*1: Correct functioning can only be guaranteed with optical modules from Anritsu for the Network Master Gigabit Ethernet tester.
Modules with extended temperature range (up to +85°C) must be used.

*2: Excludes deviations caused by conformance to Laser Notice No. 50 dated June 24, 2007

*3: Safety measures for laser products
This product complies with optical safety standards in 21CFR1040.10 and IEC 60825-1; the following descriptive labels are affixed to the product.

IEC 60825-1:2007
CLASS 1 LASER PRODUCT



THIS PRODUCT COMPLIES WITH 21 CFR 1040.10
AND 1040.11 EXCEPT FOR DEVIATIONS PURSUANT
TO LASER NOTICE NO. 50, DATED JUNE 24, 2007

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Select Mainframe

Model/Order No.	Description
MT9090A	Mainframe (with color LCD)
	Standard accessories
G0203A	AC Adapter
G0202A	NiMH Battery Pack
Z1023A	Strap
B0601B	Standard Soft Case
B0663A*1	Protector

*1: The shoulder strap can be used to hang the instrument around the neck while working.

Select Base Model

Model/Order No.	Description
MU909060A1	Gigabit Ethernet Module (with one SFP slot and one RJ-45 port)
MU909060A2	Gigabit Ethernet Module (with two RJ-45 ports)
MU909060A3	Gigabit Ethernet Module (with two SFP slots)
	Standard accessories
W3173AE	Gigabit Ethernet Tester Quick Start Guide
Z1234A	Network Master Gigabit Ethernet Tester CD

Select Module Option

One module can be installed in MU909060A1.
Two modules can be installed in MU909060A3

Model/Order No.	Description
G0240A	1000 Mbps SX SFP [850 nm multimode, LC connector (optical)]
G0241A	1000 Mbps LX SFP [1310 nm single mode, LC connector (optical)]
G0242A	1000 Mbps ZX SFP [1550 nm single mode, LC connector (optical)]
G0243A	100 Mbps FX SFP [1310 nm multimode, LC connector (optical)]
G0244A	100 Mbps LX SFP [1310 nm single mode, LC connector (optical)]
G0246A	10/100/1000 Mbps RJ-45 SFP (electrical)

Select Software Option

Model/Order No.	Description
MU909060A1-001	RFC 2544 Test (for MU909060A1)
MU909060A2-001	RFC 2544 Test (for MU909060A2)
MU909060A3-001	RFC 2544 Test (for MU909060A3)
MU909060A1-002	Multistream (for MU909060A1)
MU909060A2-002	Multistream (for MU909060A2)
MU909060A3-002	Multistream (for MU909060A3)
MU909060A1-003	Stacked VLAN (for MU909060A1)
MU909060A2-003	Stacked VLAN (for MU909060A2)
MU909060A3-003	Stacked VLAN (for MU909060A3)
MU909060A1-004	MPLS (for MU909060A1)
MU909060A2-004	MPLS (for MU909060A2)
MU909060A3-004	MPLS (for MU909060A3)
MU909060A1-005*2	Remote GUI (for MU909060A1)
MU909060A2-005*2	Remote GUI (for MU909060A2)
MU909060A3-005*2	Remote GUI (for MU909060A3)
MU909060A1-006	Channel Stats (for MU909060A1)
MU909060A2-006	Channel Stats (for MU909060A2)
MU909060A3-006	Channel Stats (for MU909060A3)
MU909060A1-007	Y.1564 Test (for MU909060A1)
MU909060A2-007	Y.1564 Test (for MU909060A2)
MU909060A3-007	Y.1564 Test (for MU909060A3)

Select Accessories

Must be added as separate line items

Model/Order No.	Description
Z1580A*3	Protector & Soft Case
B0600B	Hard Case
B0602B	Deluxe Soft Case (for MT9090A)
J1402A	Car Plug Cord
W3166AE	MU909060A1/A2/A3 Operation Manual (Hardcopy – English version)
J1480A*4	USB-Ethernet Converter

*2: Requires J1480A USB-Ethernet Converter (sold separately)
*3: The protector (B0663A) and standard soft case (B0601B) from a set. The protector includes a shoulder strap.
*4: Requires MU909060Ax-y05 Remote GUI (sold separately)

Warranty Service

Model/Order No.	Description
MT9090A-ES210	2 Years Extended Warranty Service (for MT9090A)
MT9090A-ES310	3 Years Extended Warranty Service (for MT9090A)
MU909060A1-ES210	2 Years Extended Warranty Service (for MU909060A1)
MU909060A2-ES210	2 Years Extended Warranty Service (for MU909060A2)
MU909060A3-ES210	2 Years Extended Warranty Service (for MU909060A3)
MU909060A1-ES310	3 Years Extended Warranty Service (for MU909060A1)
MU909060A2-ES310	3 Years Extended Warranty Service (for MU909060A2)
MU909060A3-ES310	3 Years Extended Warranty Service (for MU909060A3)

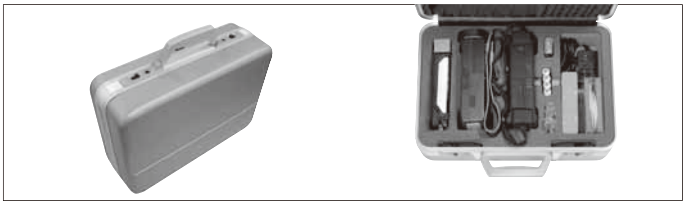
Installed Software Option (Retrofit)

The following software options can be field installed by the customer in already purchased Network Master Gigabit Ethernet testers.

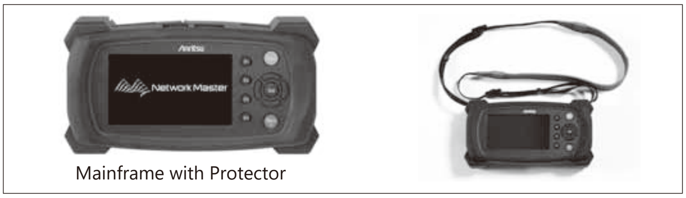
Model/Order No.	Description
MU909060A1-301	RFC 2544 Test Retrofit (for MU909060A1)
MU909060A2-301	RFC 2544 Test Retrofit (for MU909060A2)
MU909060A3-301	RFC 2544 Test Retrofit (for MU909060A3)
MU909060A1-302	Multistream Retrofit (for MU909060A1)
MU909060A2-302	Multistream Retrofit (for MU909060A2)
MU909060A3-302	Multistream Retrofit (for MU909060A3)
MU909060A1-303	Stacked VLAN Retrofit (for MU909060A1)
MU909060A2-303	Stacked VLAN Retrofit (for MU909060A2)
MU909060A3-303	Stacked VLAN Retrofit (for MU909060A3)
MU909060A1-304	MPLS Retrofit (for MU909060A1)
MU909060A2-304	MPLS Retrofit (for MU909060A2)
MU909060A3-304	MPLS Retrofit (for MU909060A3)
MU909060A1-305*2	Remote GUI Retrofit (for MU909060A1)
MU909060A2-305*2	Remote GUI Retrofit (for MU909060A2)
MU909060A3-305*2	Remote GUI Retrofit (for MU909060A3)
MU909060A1-306	Channel Stats Retrofit (for MU909060A1)
MU909060A2-306	Channel Stats Retrofit (for MU909060A2)
MU909060A3-306	Channel Stats Retrofit (for MU909060A3)
MU909060A1-307	Y.1564 Test Retrofit (for MU909060A1)
MU909060A2-307	Y.1564 Test Retrofit (for MU909060A2)
MU909060A3-307	Y.1564 Test Retrofit (for MU909060A3)

Standard Soft Case B0601B
This standard accessory accommodates the mainframe with fitted protector.

Deluxe Soft Case B0602B
Full Network Master operation without removal from the case.
Provides excellent protection for use in hash conditions.
This does not accommodate the mainframe if the protector is fitted.



Hard Case B0600B
This accommodates two mainframes (with or without fitted protector), accessories (light source or power meter, backup battery, fiber cleaner, etc.).



Mainframe with Protector

Protector B0663A (Standard accessory)

MOBILE/WIRELESS COMMUNICATIONS MEASURING INSTRUMENTS

Mobile Communication Measurement Equipment

(example of an application; various other types of measurement equipment are also available)

Anritsu Model	Mobile Communication System																										Mobile Equipment			Base Station		
	5G	LTE-Advanced	LTE FDD	LTE TDD	Cat-M	NB-IoT	W-CDMA	HSDPA	HSUPA	HSPA Evolution	CDMA2000 1X	1xEV-DO	GSM/GPRS	EGPRS	TD-SCDMA	Advanced PHS	W-LAN (11a/b/g/n)	W-LAN (11ac)	W-LAN (11ax)	W-LAN (11j)	W-LAN (11p)	Mobile WiMAX	Bluetooth	ISDB-T	DVB-T/H	CPRI	R&D	Manufacture	Maintenance/Service	R&D	Manufacture	Construction/Service
MT8000A Radio Communication Test Station	✓																															
MD8430A Signalling Tester		✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓													✓					
MX786201A Rapid Test Designer (RTD)		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓													✓					
ME7834NR 5G NR Mobile Device Test Platform	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓*1												✓					
ME7834LA LTE-Advanced Mobile Device Test Platform		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓*1												✓					
ME7873LA LTE-Advanced RF Conformance Test System		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓*1	✓*1	✓*1		✓*1												✓					
ME7800L Simple Conformance Test System		✓	✓	✓	✓	✓																					✓					
MD8475A/MD8475B Signalling Tester		✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓												✓					
MT8821C Radio Communication Analyzer		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓												✓					
MT8820C Radio Communication Analyzer		✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓											✓	✓	✓			
ACE-RNX ACE RNX Channel Emulator	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓					✓					✓			✓		
SPI-100 Series Spider		✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓					✓				✓					
MT8870A Universal Wireless Test Set	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓			✓				
MG3710A Vector Signal Generator	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	
MS2690A/MS2691A/MS2692A Signal Analyzer	✓	✓	✓	✓*2		✓	✓	✓	✓	✓	✓*2	✓*2	✓	✓	✓		✓	✓		✓	✓			✓		✓	✓	✓		✓	✓	✓
MS2850A Signal Analyzer	✓	✓	✓	✓			✓	✓	✓	✓			✓	✓	✓												✓	✓	✓	✓	✓	✓
MS2840A Signal Analyzer																											✓*3			✓*3		
MS2830A Signal Analyzer		✓	✓	✓*2			✓	✓	✓	✓	✓*2	✓*2	✓	✓	✓		✓	✓		✓	✓		✓	✓			✓	✓	✓		✓	✓
MS2720T Spectrum Master							✓				✓	✓	✓		✓																✓	✓
MS2712E/MS2713E Spectrum Master							✓	✓			✓	✓	✓		✓									✓	✓						✓	✓
MT8212E/MT8213E Cell Master		✓	✓	✓			✓	✓			✓	✓	✓		✓							✓		✓	✓							✓
MT8220T BTS Master		✓	✓	✓			✓	✓			✓	✓	✓		✓							✓										✓
MT8852B Bluetooth Test Set																							✓				✓	✓				
MT8862A Wireless Connectivity Test Set																	✓	✓									✓	✓				
MA8100A TRX NEON Signal Mapper		✓	✓	✓			✓	✓			✓	✓	✓		✓							✓										✓

*1: Measurement items for InterRAT Handover are available.
*2: Downlink/Forward link only
*3: Available for Spectrum measurement without modulation analysis.

Radio Communication Test Station

MT8000A

Remote Control
Ethernet

All-in-One 5G Signaling and RF Tests

NEW

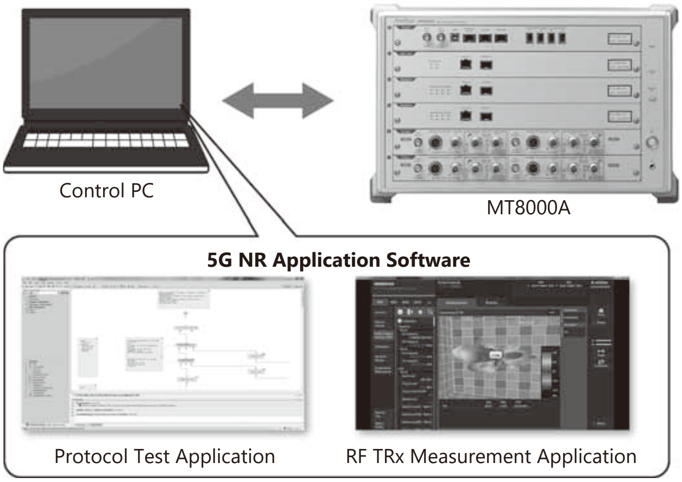
Expandability Supporting 5G

5G NR is a new communications standard intended to increase communications speed and capacity to more than 100 times that of the current LTE standard. It is required to support advances in wireless communications technologies, such as greatly expanded communications bandwidth and use of mmWave, which is not supported by earlier mobile communications.
Anritsu is releasing its new MT8000A solution supporting 5G NR RF Tx measurements and Protocol tests needed to support advances in communications technologies in line with the development of 5G NR.

Three Features of 5G Test Platform MT8000A

1. Support for Various Test Requirements

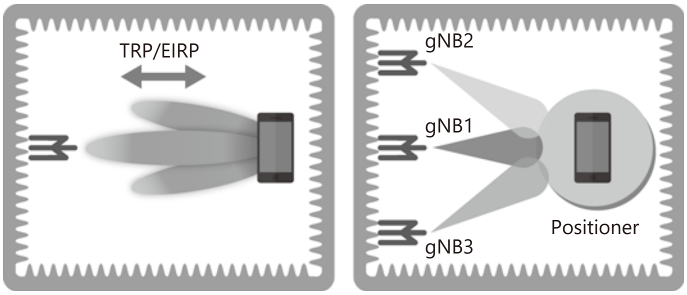
MT8000A supports both Non-signalling/Signalling RF TRx measurements as well as Protocol tests on all-in-one hardware by switching applications. The leading-edge design with flexibility and scalability uses a modular architecture; in addition to supporting high-order 4×4 MIMO and 8 Carrier Aggregation (8CA) by implementing eMBB (Enhanced Mobile Broadband), the MT8000A offers a flexible test environment for future new applications covering a wide application area by supporting new 5G test needs, including URLLC (Ultra-Reliable and Low Latency Communications) and mMTC (massive Machine Type Communications).



RF TRx Measurement and Protocol Test Environment Image

2. Support for 5G mm-Wave Bands

5G NR requires not only expanded sub-6GHz band test but also the new mmWave band test that is not used by earlier mobile communications. The main mm-Wave evaluation such as RF TRx measurements based on TRP/EIRP characteristics and handover test with Beam Management require OTA environment. MT8000A supports sub-6GHz including band n41. Moreover combining the MT8000A with the RF Chamber MA8171A supports evaluation of 5G NR terminals in an OTA environment.



RF TRP/EIRP Measurement
Beam Management Test

Example of Millimeter-wave Band RF/Protocol Test in Combination with RF Chamber

Example of supported band

Band	n41 (2.5 GHz)	n78-79 (3.5 GHz/4.5 GHz)	n257 (28 GHz)	n260 (39 GHz)
	✓	✓	✓	✓

*: Please enquire about other supported bands.

3. Early Support for NSA/SA Test Environments

The MT8000A is Anritsu's market-leading NSA test solution (for Non-Standalone, 5G NR and LTE network architectures), but it is also a timely solution (for SA Standalone, and 5G NR-only architectures) expected to be introduced in future markets. In addition, customer can utilize Anritsu LTE measurement solutions such as stable LTE test environment and existing test scenario resource, and easy to configure a 5G-LTE coupled test environment.

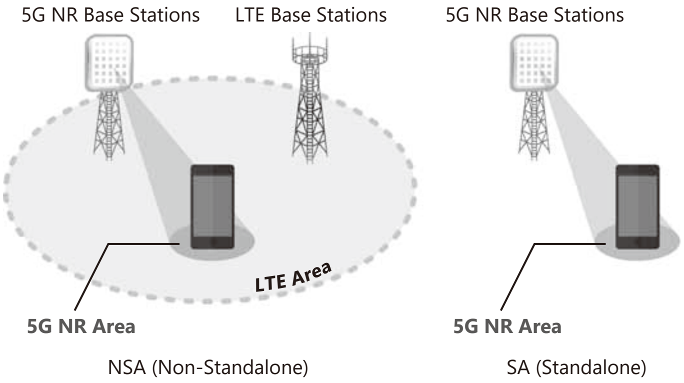


Image of 5G NR NSA/SA Configuration

Specifications

Dimensions		426 (W) × 265 (H) × 578 (D) mm (excluding projections)
Mass		≤50 kg (with all options)
Environmental Conditions		Operating: +5° to +40°C (no condensation) Storage: –20° to +71°C (no condensation)
Power Supply		100 V (ac) to 120 V (ac)/200 V (ac) to 240 V (ac), 50 Hz/60 Hz ≤1500 VA
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

Please contact us for other detailed specifications.

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Model/Order No.	Name	
	Main Frame	
MT8000A	Radio Communication Test Station	
	Standard Accessories	
J1211	POWER CORD.3M:	1 pc
J1440A	LAN Cable :	1 pc
W3955AE	MT8000A Radio Communication Test Station Operation Manual:	1 pc
MX800000A	Platform Software	
	Options	
MT8000A-001	Control Module	
MT8000A-009	Multi-box Data connection	
MT8000A-011	Baseband Module	
MT8000A-012	Data Test Module	
MT8000A-020	RF Base Module	
MT8000A-021	0.4 GHz-6 GHz RF Sub Module	
MT8000A-022	3 GHz-12 GHz RF Sub Module	
MT8000A-023	Extend RF 2.4 GHz - 3 GHz	
	Please inquire about other options.	
	Converter	
MA80001A	28 GHz RF Converter	
MA80002A	39 GHz RF Converter	
	OTA Items	
MA8171A	RF Chamber	
MA8174A	Position Controller	
MA8175A	Positioner	
	Software Options	
MX800010A	NR TDD Measurement Software	
MX800030A	NR Protocol Platform Software	
MX800050A	Rapid Test Designer Platform (RTD)	
	Support Service	
MX800010A-SS101	5G NR RF Measurement Support Service (Per Year)	
MX800050A-SS100	RTD Support Service (Per Year)	
	Application Parts	
	Please inquire details.	

For details, please contact our sales department.

Signalling Tester

MD8430A

Remote Control
Ethernet

Early Support for Developing LTE-Advanced Pro (CA/MTC) Chipsets and Mobile UEs

LTE-Advanced Pro is faster than LTE/LTE-Advanced and becoming effect radio communications network.
The Signalling Tester MD8430A is a key LTE-Advanced Pro base station simulator for developing LTE/LTE-Advanced/LTE-Advanced Pro-compliant chipsets and mobile UEs.
Using its extensive experience in 3G markets, Anritsu has developed the MD8430A as a powerful LTE-Advanced Pro protocol R&D test solution to help developers bring LTE/LTE-Advanced/LTE-Advanced Pro terminals to market as fast as possible.

Key Features

- Support LTE-Advanced Pro testing with 6CCs Carrier Aggregation (CA) and less
- Early support 3GPP LTE-Advanced FDD/TDD Release 12
  - TDD-FDD joint operation including CA
  - DL 256QAM
  - LTE MTC (Machine Type Communication)
- One MD8430A support CA handover, 4×4 MIMO, 8×4 MIMO, etc.
- Available to testing of full digital fading
- Support DL 2 Gbps, UL 300 Mbps data throughput
- Inter-RAT tests making effective use of previous MD8480C (UTRAN/GERAN), and MD8475A (CDMA2000) hardware investments
- Optimized investment from first R&D to protocol conformance testing
- Full development and analysis toolset cuts L1, L2 and L3 scenario development time and costs
- Support UMTS Release 10, HSPA Evolution, GSM/GPRS/EGPRS

Main Applications

- Coding/Decoding tests (RF/Baseband)
- Protocol sequence tests
- Throughout and stress tests (Performance test)
- Intra-RAT/Inter-RAT performance tests
- LTE Pre-conformance/Conformance tests
- Network interoperability tests
- LTE network operator acceptance tests (CAT)
- Troubleshooting field test problems
- UE QC inspection
- W-CDMA/HSPA protocol sequence tests

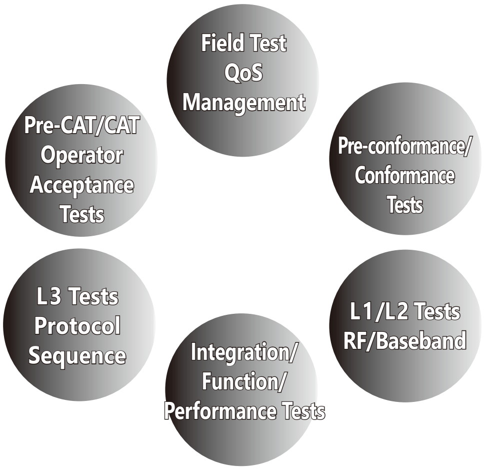
Main Test Functions

- LTE-Advanced Intra-RAT CA handover test (Hard handover)
- LTE ↔ UTRAN/GERAN Inter-RAT handover test
- eMBMS test
- Digital baseband slow clock test
- Protocol sequence analysis (Log analysis)
- Throughput monitoring
- UE scheduling function (Time/MCS/Lowest RB/RB)
- H-ARQ Test (ACK/NACK/DTX)
- VoLTE test (SPS, TTI Bundling, DRX, RoHC, CA+VoLTE)
- W-CDMA/HSPA handover test
- Dual Connectivity
- Licensed Assisted Access (LAA)
- Cellular Internet of Things (C-IoT) Test (Cat-M/NB-IoT)

Basic Functions (LTE-Advanced)

- Transmit downlink (DL) signal (Up to 6 GHz)
- Receive uplink (UL) signal (Up to 6 GHz)
- Call processing
- Transmit power Control (TPC)
- Baseband interface
- DL 2×2/4×2 MIMO (Test Model: ETM)
  DL 4×4/8×2/8×4 MIMO (Test Model: ETM)
  UL 2×2 MIMO (Test Model: ETM)
- CA 2CCs/3CCs/4CCs/5CCs/6CCs (Test Model: ETM)
- Ciphering (option)

See Specifications of "Signalling Tester MD8430A models" for detail..



Supports Newest UE Categories

The MD8430A follows UE categories defined on 3GPP specifications, and will support new future categories.
UE category table: 3GPP TS 36.306 V14.5.0 (2017-12)

☐ : MD8430A supported　▨ : MD8430A not supported

UE Category (DL)

UE Category	Maximum number of DL-SCH transport block bits received within a TTI	Maximum number of bits of a DL-SCH transport block received within a TTI	Total number of soft channel bits	Maximum number of supported layers for spatial multiplexing in DL
Category 1	10296	10296	250368	1
Category 2	51024	51024	1237248	2
Category 3	102048	75376	1237248	2
Category 4	150752	75376	1827072	2
Category 5	299552	149776	3667200	4
Category 6	301504	149776 (4 layers, 64QAM) 75376 (2 layers, 64QAM)	3654144	2 or 4
Category 7	301504	149776 (4 layers, 64QAM) 75376 (2 layers, 64QAM)	3654144	2 or 4
Category 8	2998560	299856	35982720	8
Category 9	452256	149776 (4 layers, 64QAM) 75376 (2 layers, 64QAM)	5481216	2 or 4
Category 10	452256	149776 (4 layers, 64QAM) 75376 (2 layers, 64QAM)	5481216	2 or 4
Category 11	603008	149776 (4 layers, 64QAM) 195816 (4 layers, 256QAM) 75376 (2 layers, 64QAM) 97896 (2 layers, 256QAM)	7308288	2 or 4
Category 12	603008	149776 (4 layers, 64QAM) 195816 (4 layers, 256QAM) 75376 (2 layers, 64QAM) 97896 (2 layers, 256QAM)	7308288	2 or 4

UE Category (UL)

UE Category	Maximum number of UL-SCH transport block bits transmitted within a TTI	Maximum number of bits of an UL-SCH transport block transmitted within a TTI	Support for 64QAM in UL
Category 1	5160	5160	No
Category 2	25456	25456	No
Category 3	51024	51024	No
Category 4	51024	51024	No
Category 5	75376	75376	Yes
Category 6	51024	51024	No
Category 7	102048	51024	No
Category 8	1497760	149776	Yes
Category 9	51024	51024	No
Category 10	102048	51024	No
Category 11	51024	51024	No
Category 12	102048	51024	No

UE DL Category

UE DL Category	Maximum number of DL-SCH transport block bits received within a TTI	Maximum number of bits of a DL-SCH transport block received within a TTI	Total number of soft channel bits	Maximum number of supported layers for spatial multiplexing in DL
DL Category M1	1000	1000	25344	1
DL Category M2	4008	4008	73152	1
DL Category 0	1000	1000	25344	1
DL Category 1bis	10296	10296	250368	1
DL Category 4	150752	75376	1827072	2
DL Category 6	301504	149776 (4 layers, 64QAM) 75376 (2 layers, 64QAM)	3654144	2 or 4
DL Category 7	301504	149776 (4 layers, 64QAM) 75376 (2 layers, 64QAM)	3654144	2 or 4
DL Category 9	452256	149776 (4 layers, 64QAM) 75376 (2 layers, 64QAM)	5481216	2 or 4
DL Category 10	452256	149776 (4 layers, 64QAM) 75376 (2 layers, 64QAM)	5481216	2 or 4
DL Category 11	603008	149776 (4 layers, 64QAM) 195816 (4 layers, 256QAM) 75376 (2 layers, 64QAM) 97896 (2 layers, 256QAM)	7308288	2 or 4
DL Category 12	603008	149776 (4 layers, 64QAM) 195816 (4 layers, 256QAM) 75376 (2 layers, 64QAM) 97896 (2 layers, 256QAM)	7308288	2 or 4
DL Category 13	391632	195816 (4 layers, 256QAM) 97896 (2 layers, 256QAM)	3654144	2 or 4
DL Category 14	3916560	391656 (8 layers, 256QAM)	47431680	8
DL Category 15	749856-807744	149776 (4 layers, 64QAM) 195816 (4 layers, 256QAM, if alternativeTBS-Index-r14 is not supported) 201936 (4 layers, 256QAM, if alternativeTBS-Index-r14 is supported) 75376 (2 layers, 64QAM) 97896 (2 layers, 256QAM, if alternativeTBS-Index-r14 is not supported) 100752 (2 layers, 256QAM, if alternativeTBS-Index-r14 is supported)	9744384	2 or 4
DL Category 16	978960-1051360	149776 (4 layers, 64QAM) 195816 (4 layers, 256QAM, if alternativeTBS-Index-r14 is not supported) 201936 (4 layers, 256QAM, if alternativeTBS-Index-r14 is supported) 75376 (2 layers, 64QAM) 97896 (2 layers, 256QAM, if alternativeTBS-Index-r14 is not supported) 100752 (2 layers, 256QAM, if alternativeTBS-Index-r14 is supported)	12789504	2 or 4
DL Category 17	25065984	391656 (8 layers, 256QAM)	303562752	8
DL Category 18	1174752-1211616	[299856 (8 layers, 64QAM) 391656 (8 layers, 256QAM)] 149776 (4 layers, 64QAM) 195816 (4 layers, 256QAM, if alternativeTBS-Index-r14 is not supported) 201936 (4 layers, 256QAM, if alternativeTBS-Index-r14 is supported) 75376 (2 layers, 64QAM) 97896 (2 layers, 256QAM, if alternativeTBS-Index-r14 is not supported) 100752 (2 layers, 256QAM, if alternativeTBS-Index-r14 is supported)	14616576	2 or 4 [or 8]
DL Category 19	1566336-1658272	[299856 (8 layers, 64QAM) 391656 (8 layers, 256QAM)] 149776 (4 layers, 64QAM) 195816 (4 layers, 256QAM, if alternativeTBS-Index-r14 is not supported) 201936 (4 layers, 256QAM, if alternativeTBS-Index-r14 is supported) 75376 (2 layers, 64QAM) 97896 (2 layers, 256QAM, if alternativeTBS-Index-r14 is not supported) 201936 (4 layers, 256QAM, if alternativeTBS-Index-r14 is supported)	19488768	2 or 4 [or 8]
DL Category 20	1948064 - 2019360	[299856 (8 layers, 64QAM) 391656 (8 layers, 256QAM)] 149776 (4 layers, 64QAM) 195816 (4 layers, 256QAM, if alternativeTBS-Index-r14 is not supported) 201936 (4 layers, 256QAM, if alternativeTBS-Index-r14 is supported) 75376 (2 layers, 64QAM) 97896 (2 layers, 256QAM, if alternativeTBS-Index-r14 is not supported) 100752 (2 layers, 256QAM, if alternativeTBS-Index-r14 is supported)	24360960	2 or 4 [or 8]

UE UL Category

UE UL Category	Maximum number of UL-SCH transport block bits transmitted within a TTI	Maximum number of bits of an UL-SCH transport block transmitted within a TTI	Support for 64QAM in UL	Support for 256QAM in UL
UL Category M1	1000 or 2984	1000 or 2984	No	No
UL Category M2	6968	6968	No	No
UL Category 0	1000	1000	No	No
UL Category 1 bis	5160	5160	No	No
UL Category 3	51024	51024	No	No
UL Category 5	75376	75376	Yes	No
UL Category 7	102048	51024	No	No
UL Category 8	1497760	149776	Yes	No
UL Category 13	150752	75376	Yes	No
UL Category 14	9585664	149776	Yes	No
UL Category 15	226128	75376	Yes	No
UL Category 16	105528	105528	Yes	Yes
UL Category 17	2119360	211936	Yes	Yes
UL Category 18	211056	105528	Yes	Yes
UL Category 19	13563904	211936	Yes	Yes
UL Category 20	316584	105528	Yes	Yes
UL Category 21	301504	75376	Yes	No

NB-IoT (DL)

UE Category	Maximum number of DL-SCH transport block bits received within a TTI	Maximum number of bits of a DL-SCH transport block received within a TTI	Total number of soft channel bits
Category NB1	680	680	2112
Category NB2	2536	2536	6400

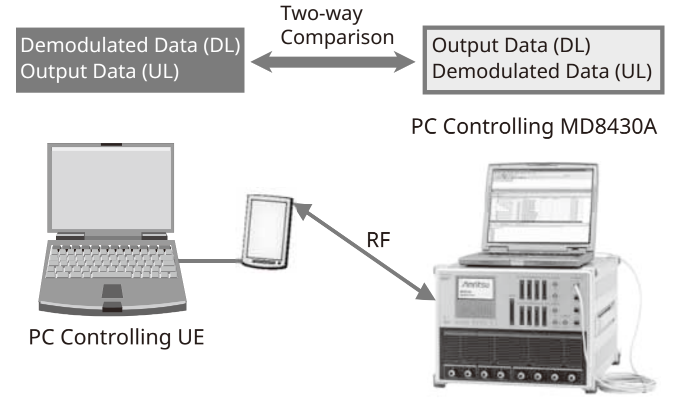
NB-IoT (UL)

UE Category	Maximum number of UL-SCH transport block bits transmitted within a TTI	Maximum number of bits of an UL-SCH transport block transmitted within a TTI
Category NB1	1000	1000
Category NB2	2536	2536

For Developing LTE-Advanced Pro Chipsets and Mobile UEs RF/Baseband Tests

Coding/Decoding Test

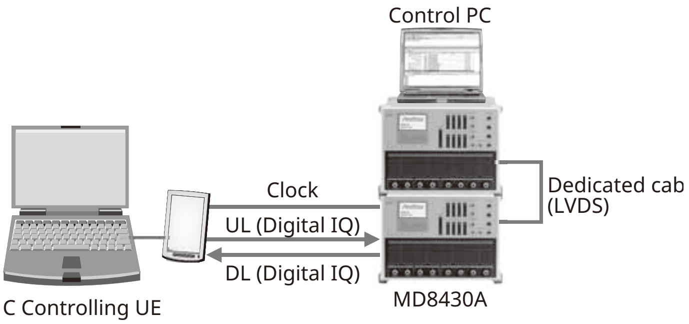
Coding/Decoding tests of LTE-Advanced Pro terminals are performed by making the RF connections shown in the following diagram.



Coding/Decoding Test Example (RF, Non-call-processing Test)

The MD8430A supports digital baseband I/O as standard functions. Using the baseband interface offers high-reproducibility coding/decoding tests free from the RF section, supporting stable evaluation of LTE chipset baseband performance.

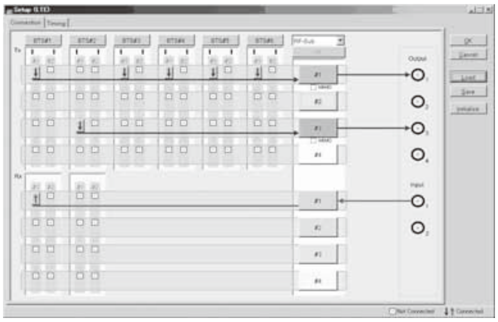
Moreover, LTE coding/decoding tests are supported because the baseband chip can be evaluated using a slower clock than the clock frequency. And connecting the second MD8430A fading function to the digital baseband interface supports slow clock evaluations in a fading environment, which are difficult to perform with an RF fading simulator.



Slow Clock Test Setup (Digital Baseband, Fading)

Easy MIMO Test Configuration Settings

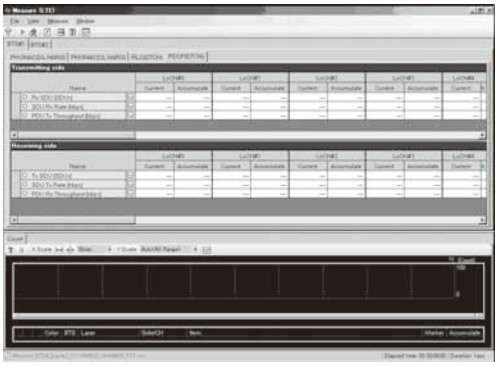
The MD8430A has 8 main and sub RF connectors as well as 8 digital IQ connectors as standard equipment for use with the MX843010A/E LTE Control Software to easily configure and monitor various settings, including RF parameters, channel power, MIMO, fading, connector selections, frame timing, BTS cell selections, etc.



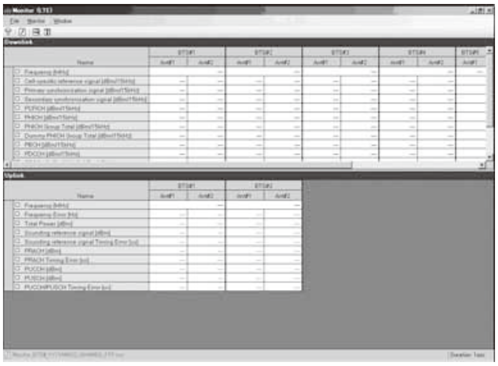
Setup Screen Example

Fully Versatile L1/L2 Monitoring Functions

The MX843010A/E software supports LTE development by processing large volumes of low-layer data at very high speeds using a full line of versatile power monitoring, throughput monitoring and log analysis functions. The Measure (Counter) functions can monitor Layer 1/2 (L1/L2) throughputs in real time by counting parameter values such as ACK/NACK/DTX/CQI.



Measurement (Counter and Throughput) Screens



Monitor Screen Example

Complete LTE-Advanced Pro Protocol Test Environment

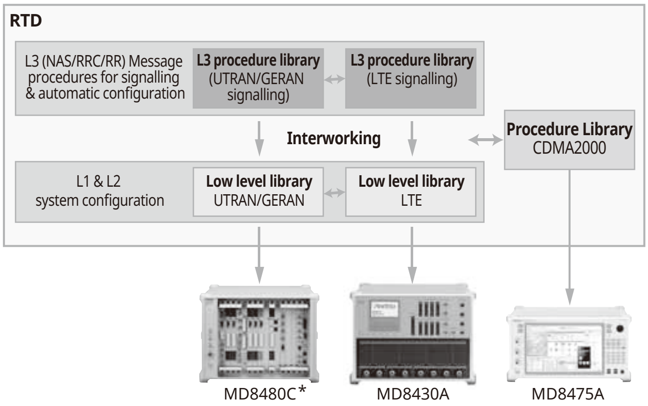
Intelligent Test Creation

The Rapid Test Designer (RTD) MX786201A software tools gives users power to create tests that cannot be done with traditional language based tools. RTD Supports L1/L2/L3 testing using Lower Layer Configuration library and Layer 3 procedure library of UE development. Moreover, each procedure auto-sets the connection with the lower Layers (L1/L2) based on full compliance with the 3GPP standards. RTD can simulater LTE ↔ UMTS Inter-RAT and LTE ↔ CDMA2000 Interworking by connecting MD8480C and/or MD8475A.

The Reference Library test cases provides a reference to build the customized test cases and libraries with ease.

Cuts Test Case Development Time

The RTD GUI offers intuitive test case creation by linking procedures with parameters, such as network conditions and message data, at easy-to-understand setting screens, quickly increasing the number of working test cases.
In addition, the Built-in Analyzer function checks for programming errors prior to testing, which can start immediately without recompiling after editing and changing settings.

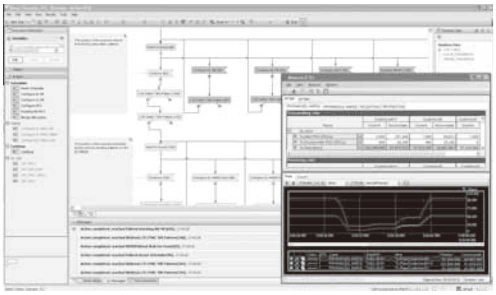


RTD Procedure Block

*: MD8430A can be used on UMTS/GSM test in place of MD8480C.

Flexibility in Testing & Analysis

When the test finishes the execution, the RTD provides a preliminary judgment against predetermined criteria. This avoids the need to study complex message sequences and can show a test outcome explained in a local language. The Integrated protocol analyzer with RTD supports very detailed Message Sequence Analysis and provides a facility to export the Protocol Test logs in to HTML format which can be viewed at any PC with a Browser without a RTD license.



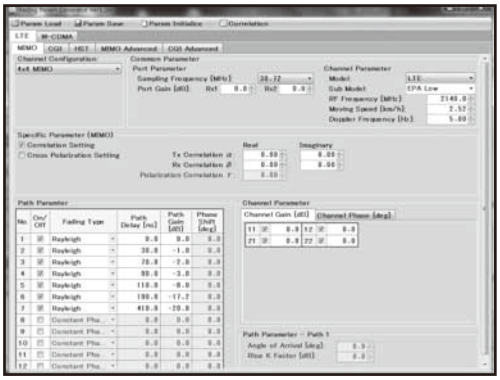
Test Execution Screen (RTD)

Log Analysis Screen (RTD)

Efficient UE Integration and Performance Tests

Testing Throughput for Various Conditions

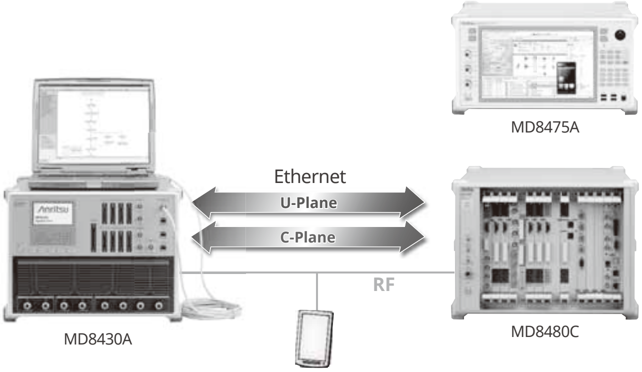
The MD8430A supports the latest UE categories with download speeds of 2 Gbps and uploads speeds of 300 Mbps.
The bundled sample scenarios make it easy to change parameters such as bandwidth, scheduling, HARQ, etc., for testing LTE throughputs under various conditions.
In addition, combination with second MD8430A fading function supporting LTE MIMO via the dedicated digital interface simplifies complex power control procedures for easy throughput testing in a fading environment with simple test setup.



Fading Setting Screen (MF6900A Fading Simulator)

Handover Tests Optimizing Hardware Investment

The MD8430A supports up to six cells (Four active cells) allowing handover tests between two LTE BTS with one tester. In addition, LTE-UTRAN/GERAN Inter-RAT handover tests are supported by connecting the W-CDMA Signalling Tester MD8480C. And the MD8480C is not limited to the globally dominant W-CDMA technology but also supports the HSPA/HSPA Evolution and GSM/GPRS/EGPRS technologies.
When combined with the Signalling Tester MD8475A, CDMA2000 Interworking tests are supported too, maximizing support for both worldwide communications technologies and investment in hardware.



LTE-UTRAN/GERAN Handover Test Setup

Specifications of Signalling Tester MD8430A Model (ETM)

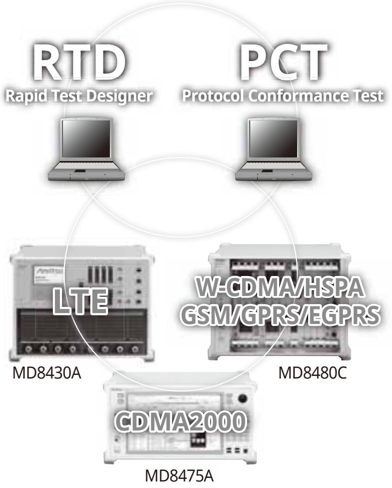
Model/Name	MD8430A-035 LTE Enhanced Test Model (ETM)
Interface	RF, Digital IQ, Baseband Fading*1
Frequency Band	Max. 20 MHz
UE Category	Category 1, 2, 3, 4, 5, 6, 7, 9*2, 10*2, 11*2, 12*2 DL Category M1, 0, 1 bis, 4, 6, 7, 9*2, 10*2, 11*2, 12*2, 13*2, 15*2, 16*2, 18*2, 19*2, 20*2 UL Category M1, 0, 1 bis, 3, 5, 7, 13, 15, 20 NB Category NB1
Max. Data Rate (DL)	1 Gbps (PHY: 2 Gbps)
Max. Data Rate (UL)	300 Mbps
MIMO	2 × 2 MIMO 4 × 2 MIMO 4 × 4 MIMO*3 8 × 2 MIMO 8 × 4 MIMO*4
Max. No. of Base Station	Active + adjacent BTS: 8*5 (Max. Active BTS: 6)
Hard Handover (including at MIMO)	Available*6
Carrier Aggregation: No. of Component Carriers (DL)*7	6*8, *9, *10
Carrier Aggregation: No. of Component Carriers (UL)*7	3*11

*1: Requires MD8430A-067 and two MD8430A sets for Baseband Fading. (ETM & ETM or ETM & BTM)
*2: Requires two MD8430A sets. (ETM & ETM or ETM & BTM)
*3: Requires MD8430A-075.
*4: Requires MD8430A-076.
*5: Requires two MD8430A sets. (ETM & ETM).
*6: For inter-frequency handover with Carrier Aggregation, requires two MD8430A sets. (ETM & ETM or ETM & BTM)
*7: Requires MD8430A-085.
*8: DL 4 CA operation requires MD8430A-088, DL 5 CA operation requires MD8430A-089, and DL 6 CA operation requires MD8430A-044.
*9: For 3 CA MIMO and 4 CA MIMO, requires two MD8430A sets. (ETM & ETM or ETM & BTM)
*10: For DL 5 CA MIMO and 6 CA MIMO, requires two MD8430A sets (only ETM 2 sets configuration)
*11: UL 3 CA operation requires MD8430A-045.

Powerful Platform for Both Conformance and Operator Acceptance Tests

Optimized Hardware Investment

The MD8430A supports to design for early chipset and mobile UE, function tests, and performance tests ranging from carrier acceptance tests to protocol conformance tests as well as retrofit upgrades between models allows developers to tailor their hardware investment to current needs with future flexible upgrade options.
The Protocol Conformance Test Toolkit (PCT) with MD8430A and GCF/PTCRB approved TTCN test package provide an optimum environment for LTE protocol conformance testing. Hence, a Single Hardware Platform that extends its usage from Platform development to Conformance Testing and Operater Acceptance Test.



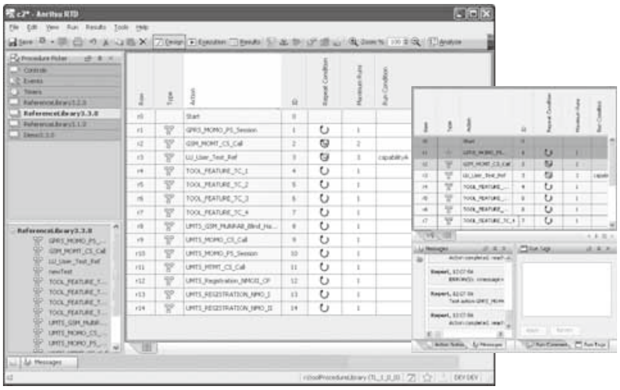
Full Line of Versatile L3 Analysis Tools

Instant Firmware Switching

Because the MD8430A saves up to ten firmware versions, the right firmware is selected easily at startup. There is no need to install/uninstall firmware when executing a test case that determines the firmware version.

Powerful Automated Testing

The RTD software supporting the UE control interface makes it easy to setup automated test systems. Furthermore, multiple test cases can be executed continuously and test reports generated automatically, and many functions, including repeat testing under different conditions with multiple settings, can be automated, offering carriers, etc., an ideal turnkey solution for acceptance testing.



Example of Test Case Campaign

Easy Test Case Maintenance

Test cases created by the RTD software can be updated easily when new 3GPP standard evolves, reducing the need for re-editing. In addition, guaranteed test case compatibility even when the MD8430A firmware version is changed removes the need to recompile, etc., resulting in greatly reduced costs for maintaining test cases to support regression testing when rolling out new terminals and performing pre-IOT to assure compatibility with network equipment worldwide.

Test Models/Options/Software

Test Models

Basic Test Model (BTM)	MD8430A-025
M2M Test Model (MTM)	MD8430A-027
LTE Enhanced Test Model (ETM)	MD8430A-035

Choose one of the above three models.

*: Please refer to Specifications of Signalling Tester MD8430A Models.

Test Model Upgrade

Required option when upgrading to higher order model.

Upgrade from Function Test Model (FTM)

LTE FTM to ETM Upgrade Kit	Z1670A
LTE FTM to ETM Upgrade Kit (FO)	Z1789A

Upgrade from Standard Test Model (STM)

LTE STM to ETM Upgrade Kit	Z1671A
LTE STM to ETM Upgrade Kit (FO)	Z1790A

Upgrade from Performance Test Model (STM)

LTE PTM to ETM Upgrade Kit	Z1672A
LTE PTM to ETM Upgrade Kit (FO)	Z1791A

Upgrade from Basic Test Model

LTE BTM to ETM Upgrade Kit	Z1873A
LTE BTM to MTM Upgrade Kit	Z1976A

Upgrade from M2M Test Model

LTE MTM to ETM Upgrade Kit	Z1977A

Options

Extended Frequency Range to 3.8 GHz MD8430A-002

Required software option when extending maximum frequency of MD8430A (Tx/Rx) to 3.8 GHz.

Extended Frequency Range to 3.8 GHz Hardware MD8430A-003

Required hardware option when extending maximum frequency of MD8430A (Tx/Rx) to 3.8 GHz.

Enhanced DL Frequency Bandwidth Option MD8430A-004

Required software option when extending downlink frequency bandwidth of MD8430A (Tx) to 60 MHz.

Extended Frequency Range to 3.8 GHz Hardware 2 MD8430A-005

Required hardware option when extending maximum frequency of MD8430A (Tx/Rx) to 3.8 GHz. (Test Model: BTM, ETM)

Extended Frequency Range to 6 GHz MD8430A-006

Required software option when extending maximum frequency of MD8430A (Tx/Rx) to 6 GHz.

Extended Frequency Range to 6 GHz Hardware MD8430A-007

Required hardware option when extending maximum frequency of MD8430A (Tx/Rx) to 6 GHz.

LTE DL 6 Carrier Aggregation Option MD8430A-044

Option for adding Carrier Aggregation (CA) function supporting transmission of up to six component carriers on downlink.

LTE UL 3 Carrier Aggregation Option MD8430A-045

Option for adding Carrier Aggregation (CA) function supporting reception of up to three component carriers on uplink.

W-CDMA Fading Option MD8430A-052

Required software option when W-CDMA fading testing.

SCME Fading Option MD8430A-053

Required software option when SCME fading testing.

LTE 2×2 MIMO Fading Option MD8430A-055

Required software option when LTE 2×2 MIMO fading testing.

LTE 4×2 MIMO Fading Option MD8430A-056

Required software option when LTE 4×2 MIMO fading testing.

LTE 4×4 MIMO Fading Option MD8430A-057

Required software option when LTE 4×4 MIMO fading testing.

LTE 8×2 MIMO Fading Option MD8430A-058

Required software option when LTE 8×2 MIMO fading testing.

LTE 8×4 MIMO Fading Option MD8430A-059

Required software option when LTE 8×4 MIMO fading testing.

LTE FDD Option MD8430A-060

Required option when simulating 3GPP LTE FDD.

LTE TDD Option MD8430A-061

Required option when simulating TD-LTE.

LTE Enhanced MTC Option MD8430A-062

Required option when simulating LTE eMTC.

Narrow Band IoT Option MD8430A-063

Required option when simulating NB-IoT.

W-CDMA Option MD8430A-065

Required option when simulating W-CDMA.

GSM Option MD8430A-066

Required option when simulating GSM.

RF/Fading Driver Option MD8430A-067

Required software option when extending RF for MD8430A-025 BTM and executing the fading function. (MD8430A-055, 056, 057, 058)

HSPA Multi Carrier Option MD8430A-070

Required option when HSPA multi carrier testing.

W-CDMA/GSM Ciphering Option MD8430A-071

Option for adding ciphering function for W-CDMA, GSM and GPRS. Supporting KASUMI and SNOW 3G to W-CDMA. A5/1, A5/2, A5/3 and A5/4 to GSM. GEA1, GEA2, GEA3 and GEA4 to GPRS.

LTE Licensed Assisted Access (LAA) Option MD8430A-072

Required software option for executing LTE Licensed Assisted Access function.

LTE Dual Connectivity Option MD8430A-073

Required software option for executing Dual Connectivity function.

LTE DL 4×4 MIMO Option MD8430A-075

Required software option when LTE 4×4 MIMO testing.

LTE DL 8×4 MIMO Option MD8430A-076

Required software option when LTE 8×4 MIMO testing.

LTE UL 2×2 MIMO Option MD8430A-078

Required software option when LTE UL 2×2 MIMO testing.

LTE UL 256QAM Option MD8430A-079

Required software option when LTE UL 256QAM testing.

LTE Ciphering Option MD8430A-080

Option for adding ciphering function supporting EEA0, EEA1, and EEA2 (TS 33.401, TS 36.323) algorithms to LTE.

LTE ROHC Option MD8430A-081

Option for adding LTE ROHC function supporting RTP/UDP/IP (RFC3095, RFC4815), UDP/IP (RFC3095, RFC4815), ESP/IP (RFC3095, RFC4815), and IP (RFC3843, RFC4815).
Required this option for VoLTE testing.

LTE MBMS Option MD8430A-082

Option for adding LTE MBMS function supporting (P) MCH Transmission Scheduling, MCCH Message Transmission, MSI MAC control element Transmission and MTCH Message Transmission described in 3GPP (TS 36.211, TS36.221).

LTE ZUC Ciphering Option MD8430A-083

Option for adding ciphering function supporting EEA3 and EIA3 (TS 33.401, TS 35.221) algorithms to LTE.

LTE Carrier Aggregation Option MD8430A-085

Option for adding Carrier Aggregation (CA) function supporting transmission of up to two component carriers on downlink.

Ciphering Option MD8430A-086

Option for adding ciphering function supporting EEA0, EEA1, EEA2, EEA3 and EIA3 (TS 33.401, TS 35.221, TS 36.323) algorithms to LTE.

LTE CoMP Option MD8430A-087

Required software option when 3GPP Release 11 CoMP feature.
It is available to test Dynamic Point Selection.

LTE DL 4 Carrier Aggregation Option MD8430A-088

Option for adding Carrier Aggregation (CA) function supporting transmission of up to four component carriers on downlink.

LTE DL 5 Carrier Aggregation Option MD8430A-089

Option for adding Carrier Aggregation (CA) function supporting transmission of up to five component carriers on downlink.

Application Products

Signalling Tester MD8475A

Base Station Simulator supporting CDMA2000 Multiple Sector/Carrier or 1xEV-DO Rev.A. Realizes Inter-working tests between LTE and CDMA2000 by controlling MD8430A and MD8475A simultaneously from Rapid Test Designer (RTD) MX786201A.

W-CDMA Signalling Tester MD8480C

Base Station Simulator supporting HSPA Evolution based on the 3GPP Release 8 specification, W-CDMA and GSM. Realizes Inter-RAT handover tests between LTE and UTRAN/GERAN by controlling MD8430A and MD8480C from Rapid Test Designer (RTD) MX786201A.

CDMA2000® is a registered trademark of the Telecommunications Industry Association (TIA-USA).

Software

LTE Control Software MX843010A

Software for simulating L1 and L2 with test cases in C.

LTE Control Software MX843010E

Software for simulating L1 and L2 with test case in C.
(Test Model: ETM)

W-CDMA/GSM Control Software MX843070E

Software for simulating L1 and L2 with test cases in C.
(Test Model: W-CDMA/GSM)

Rapid Test Designer (RTD) MX786201A

Software for simulating L1 to L3 with test cases described by GUI for automating testing, analyzing test cases and creating reports.

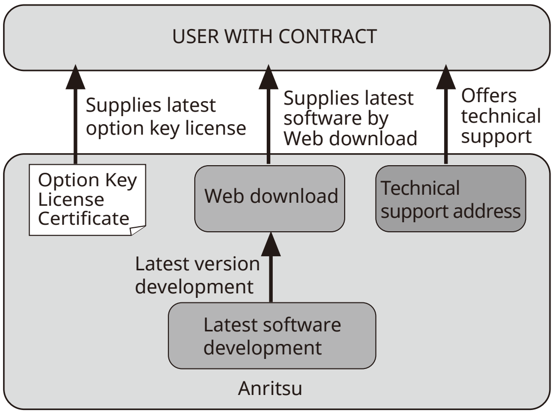
Software Maintenance Contract

Service Provided

- Contract for adding/revising software functions in line with 3GPP revisions
- Technical support for troubleshooting user problems

Annual Support Service (1 year)

Option providing 1 year of service support for MD8430A test functions including web downloads of latest software and technical enquiries. Services depend on option configuration.



MD8430A Support Services

MD8430A Support (FDD)	
1 Year Support Service LTE FDD (ETM)	MD8430A-SS135
MD8430A Support (TDD)	
1 Year Support Service LTE TDD (ETM)	MD8430A-SS136
MD8430A Support (W-CDMA/GSM)	
1 Year Support Service W-CDMA/GSM	MD8430A-SS170
MD8430A Support (LTE eMTC)	
1 Year Support Service for LTE eMTC	MD8430A-SS171
MD8430A Support (NB-IoT)	
1 Year Support Service for NB-IoT	MD8430A-SS172
LTE Control Software Support MX843010A	
1 Year Support Service	MX843010A-SS120
LTE Control Software Support MX843010E	
1 Year Support Service (Test Model: ETM)	MX843010E-SS120

Specifications

Signalling Tester MD8430A

Reference Oscillator	Reference Frequency	10 MHz
	Activation Characteristics	$\pm 5 \times 10^{-7}$ (2 minutes after turning on the power) $\pm 5 \times 10^{-8}$ (5 minutes after turning on the power) At 25°C, Based on the frequency 24 hours after turning on the power
	Aging Rate	$\pm 1 \times 10^{-8}$/day (Specification per day, based on the frequency 48 hours after turning on the power) $\pm 1 \times 10^{-7}$/year (Specification per day, based on the frequency 10 days after turning on the power)
	Temperature Characteristics	$\pm 2 \times 10^{-8}$ (0° to 45°C) Based on the frequency at 25°C
	External Reference Input	Frequency: 10 MHz Operating range: ±1 ppm Input level: –15 dBm ≤ level ≤ +20 dBm (50Ω, AC coupling) Connector: BNC-J, 50Ω (nominal)
	Internal Reference Output	Frequency adjusted at shipment: 10 MHz ±0.02 ppm Output level: ≥0 dBm (50Ω, AC coupling) Connector: BNC-J, 50Ω (nominal)
Transmission Signal	Maximum Output Level	Main connector: –40 dBm (Maximum setting level at Main connector: –20 dBm) Sub connector: 0 dBm
	Level Accuracy	±1.5 dB (350 MHz ≤ Frequency ≤ 3800 MHz) ±2.0 dB (3800 MHz < Frequency ≤ 6000 MHz) Main connector: –113 dBm ≤ Level ≤ –40 dBm Sub connector: –113 dBm ≤ Level ≤ 0 dBm After calibration, 18° to 28°C, for calibration CW
	Frequency	LTE: 350 MHz to 3.0 GHz, 350 MHz to 3.8 GHz (with MD8430A-002), 350 MHz to 6.0 GHz (with MD8430A-006) W-CDMA: 400 MHz to 3.0 GHz, 400 MHz to 3.8 GHz (with MD8430A-002/006) GSM: 400 MHz to 2.0 GHz Setting resolution: 100 kHz

Continued on next page

Transmission Signal	Access Method	LTE: OFDMA, W-CDMA: CDMA, GSM: TDMA
	Modulation Method	LTE: QPSK, 16QAM, 64QAM, 256QAM W-CDMA: QPSK, 16QAM, 64QAM GSM: GMSK, 8PSK
	Modulation Accuracy	LTE: ≤2%, Sub output: 0 dBm, LTE (OFDM, 64QAM, 20 MHz band) W-CDMA: ≤3.5%, Sub output: 0 dBm, W-CDMA (transmitting CPICH, ICH) GSM: ≤1.5deg., Sub output: 0 dBm, GMSK ≤3.5%, Sub output: 0 dBm, 8PSK * At 18° to 28°C
Received Signal	Input Level	Setting demodulation range Based on the value set for the reference power QPSK: –28 to +15 dB 16QAM: –21 to +15 dB 64QAM: –15 to +15 dB (Input signal: EVM ≤1%, BER ≤1 × 10^{-12}, 20 MHz band, SC-FDMA) Main connector input: Reference Power setting range: −20 to +20 dBm However, within the input level range from −30 to +35 dBm Sub connector input: Reference power setting range: –35 to +5 dBm However, within the input level range from −45 to +20 dBm
	Level Accuracy	Main connector: ±3.0 dB Sub connector: ±3.0 dB At 18° to 28°C, for calibration CW, within the Main input level range from −30 to +35 dBm, the Sub input level range from −45 to +20 dBm, and the reference power range of ±15 dB
	Frequency	LTE: 350 MHz to 3.0 GHz, 350 MHz to 3.8 GHz (with MD8430A-002), 350 MHz to 6.0 GHz (with MD8430A-006) W-CDMA: 400 MHz to 3.0 GHz, 400 MHz to 3.8 GHz (with MD8430A-002/006) GSM: 400 MHz to 2.0 GHz (setting resolution: 100 kHz)
	Access Method	LTE: SC-FDMA, W-CDMA: CDMA, GSM: TDMA
	Modulation Method	LTE: QPSK, 16QAM, 64QAM, 256QAM W-CDMA: BPSK, 4PAM GSM: GMSK, 8PSK
	Synchronization Acquirable Range	LTE: ±100 µs (PRACH), ±30 µs (PUSCH) W-CDMA: ±100 chips (PRACH), ±100 chips (DPCCH) GSM: 0 to 63 symbols (SACCH)
RF Connector	Main	Connector: N-J, 50Ω (nom.) VSWR:≤1.3 (Frequency Range: ≥350 MHz to ≤3800 MHz) ≤1.4 (Frequency Range: >3800 MHz to ≤6000 MHz)
	Sub (Downlink)	Connector: N-J, 50Ω (nom.) VSWR:≤1.5 (Frequency Range: ≥350 MHz to ≤3800 MHz) ≤1.6 (Frequency Range: >3800 MHz to ≤6000 MHz)
	Sub (Uplink)	Connector: N-J, 50Ω (nom.) VSWR:≤1.5 (Frequency Range: ≥350 MHz to ≤3800 MHz) ≤1.6 (Frequency Range: >3800 MHz to ≤6000 MHz)
Front Panel Interface	Digital IQ I/F	DX20 connector (50 pin) × 8 Digital IQ signal, IQ: 16 bit
	Monitor I/F	DX20 connector (80 pin), 3.3 V-CMOS level Connection with the Monitor board (G0091)
	Sync Out	BNC connector, 3.3 V-CMOS level Internal Sync Start signal output
	Sync In	BNC connector, 3.3 V-CMOS level External Sync Start signal input
	Clock Out	BNC connector, 3.3 V-CMOS level Internal Clock signal output
	Clock In	BNC connector, 3.3 V-CMOS level, 10 kHz to 30.72 MHz External Clock signal input
MF6900A Interface	Sync Out	Without MD8430A-008/108/208: BNC connector × 3, 3.3 V-CMOS level With MD8430A-008/108/208: BNC connector × 2, 3.3 V-CMOS level Connection with the MF6900A (Sync Start signal)
	Port	Without MD8430A-008/108/208: HIB-B16LFYGA connector × 6, LVDS level With MD8430A-008/108/208: HIB-B16LFYGA connector × 2 (Digital IQ: 2ports/connector), LVDS level HIB-B16LFYGA connector × 4 (Digital IQ: 8ports/connector), LVDS level Connection with the MF6900A (Digital IQ signal)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581
Temperature	Operating	0° to +45°C, ≤90% RH (no condensation) 0° to +40°C, ≤90% RH (no condensation) (with Enhanced Hardware)
	Storage	–20° to +60°C, ≤85% RH (no condensation)
Power Supply	Voltage	100 V(ac) to 120 V(ac)/200 V(ac) to 240 V(ac) (Automatic switching system)
	Frequency	50 Hz/60 Hz (Automatically changeover system)
	Power Consumption	≤1200 VA
Dimensions and Mass	Dimensions	426 (W) × 310 (H) × 500 (D) mm
	Mass	≤40 kg

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name	
	LTE Basic Test Model	
MD8430A	Signalling Tester	
MD8430A-005	Extended Frequency Range to 3.8 GHz Hardware 2	
MD8430A-025	Basic Test Model (BTM)	
	M2M Test Model	
MD8430A	Signalling Tester	
MD8430A-005	Extended Frequency Range to 3.8 GHz Hardware 2	
MD8430A-027	M2M Test Model (MTM)	
	LTE Enhanced Test Model	
MD8430A	Signalling Tester	
MD8430A-005	Extended Frequency Range to 3.8 GHz Hardware 2	
MD8430A-035	LTE Enhanced Test Model (ETM)	
	Standard Accessories	
	CD-ROM (Operation Manual and Maintenance Software):	1 pc
J1440A	LAN Cable:	2 pcs
J1211	Power Cord, 3.0 m (15 A):	1 pc
J0127A	Coaxial Cord, 1.0 m (BNC-P · RG58A/U · BNC-P):	1 pc
J0576B	Coaxial Cord, 1.0 m (N-P · 5D-2W · N-P):	2 pcs
J1398A	N-SMA Adaptor:	6 units
G0091	Monitor Board:	1 pc
J1005	Monitor Cable 80:	1 pc
J1459A	Digital IQ Cable (50 cm):	1 pc
	Options	
MD8430A-002	Extended Frequency Range to 3.8 GHz	
MD8430A-004	Enhanced DL Frequency Bandwidth Option	
MD8430A-006	Extended Frequency Range to 6 GHz	
MD8430A-044	LTE DL 6 Carrier Aggregation Option	
MD8430A-045	LTE UL 3 Carrier Aggregation Option	
MD8430A-052	W-CDMA Fading Option	
MD8430A-053	SCME Fading Option	
MD8430A-055	LTE 2×2 MIMO Fading Option	
MD8430A-056	LTE 4×2 MIMO Fading Option	
MD8430A-057	LTE 4×4 MIMO Fading Option	
MD8430A-058	LTE 8×2 MIMO Fading Option	
MD8430A-059	LTE 8×4 MIMO Fading Option	
MD8430A-060	LTE FDD Option	
MD8430A-061	LTE TDD Option	
MD8430A-062	LTE Enhanced MTC Option	
MD8430A-063	Narrow Band IoT Option	
MD8430A-065	W-CDMA Option	
MD8430A-066	GSM Option	
MD8430A-067	RF/Fading Driver Option	
MD8430A-070	HSPA Multi Carrier Option	
MD8430A-071	W-CDMA/GSM Ciphering Option	
MD8430A-072	LTE Licensed Assisted Access (LAA) Option	
MD8430A-073	LTE Dual Connectivity Option	
MD8430A-075	LTE DL 4×4 MIMO Option	
MD8430A-076	LTE DL 8×4 MIMO Option	
MD8430A-078	LTE UL 2×2 MIMO Option	
MD8430A-079	LTE UL 256QAM Option	
MD8430A-080	LTE Ciphering Option	
MD8430A-081	LTE ROHC Option	
MD8430A-082	LTE MBMS Option	
MD8430A-083	LTE ZUC Ciphering Option	
MD8430A-085	LTE Carrier Aggregation Option	
MD8430A-086	Ciphering Option	
MD8430A-087	LTE CoMP Option	
MD8430A-088	LTE DL 4 Carrier Aggregation Option	
MD8430A-089	LTE DL 5 Carrier Aggregation Option	
MD8430A-103	Extended Frequency Range to 3.8 GHz Hardware Retrofit (for Asia, Oceania)	
MD8430A-107	Extended Frequency Range 3 GHz to 6 GHz Hardware Retrofit (for Asia, Oceania)	
MD8430A-117	Extended Frequency Range 3.8 GHz to 6 GHz Hardware Retrofit (for Asia, Oceania)	
MD8430A-203	Extended Frequency Range to 3.8 GHz Hardware Retrofit (FO)	
MD8430A-207	Extended Frequency Range 3 GHz to 6 GHz Hardware Retrofit (FO)	
MD8430A-217	Extended Frequency Range 3.8 GHz to 6 GHz Hardware Retrofit (FO)	

Model/Order No.	Name
	Software Options
MX843010A	LTE Control Software
MX843010E	LTE Control Software
MX843070E	W-CDMA/GSM Control Software
MX786201A	Rapid Test Designer (RTD)
	Main frame Support Service
	[FDD]
MD8430A-SS125	1 Year Support Service for LTE FDD (BTM)
MD8430A-SS135	1 Year Support Service for LTE FDD (ETM)
	[TDD]
MD8430A-SS126	1 Year Support Service for LTE TDD (BTM)
MD8430A-SS136	1 Year Support Service for LTE TDD (ETM)
	[W-CDMA/GSM]
MD8430A-SS170	1 Year Support Service for W-CDMA/GSM
	[LTE eMTC]
MD8430A-SS171	1 Year Support Service for LTE eMTC
	[NB-IoT]
MD8430A-SS172	1 Year Support Service for NB-IoT
	LTE Control Software Support Service
MX843010A-SS120	1 Year Support Service
MX843010E-SS120	1 Year Support Service
	Upgrade Options
Z1670A	LTE FTM to ETM Upgrade Kit
Z1789A	LTE FTM to ETM Upgrade Kit (FO)
Z1671A	LTE STM to ETM Upgrade Kit
Z1790A	LTE STM to ETM Upgrade Kit (FO)
Z1672A	LTE PTM to ETM Upgrade Kit
Z1791A	LTE PTM to ETM Upgrade Kit (FO)
Z1873A	LTE BTM to ETM Upgrade Kit
Z1976A	LTE BTM to MTM Upgrade Kit
Z1977A	LTE MTM to ETM Upgrade Kit
	Application Products
MD8475A	Signalling Tester
MD8480C	W-CDMA Signalling Tester
MN8150A	RF Combiner Unit
J1416A	LVDS CABLE
J1609A	Signal Divider

: A PC[1] running Microsoft Visual C++ 2008 Express Edition, Microsoft Visual C++ 2010 Express Edition or Microsoft Visual Studio Express 2012 is required to use the MD8430A.
It must be supplied by the customer.

*1: The PC controller for the MD8430A must meet or exceed the following specifications:
OS: Windows 7 (64 bit) or later
CPU: Intel Core i5 processer 2.6 GHz or more
RAM: 4 GB or more
NIC: 1000 BASE-T

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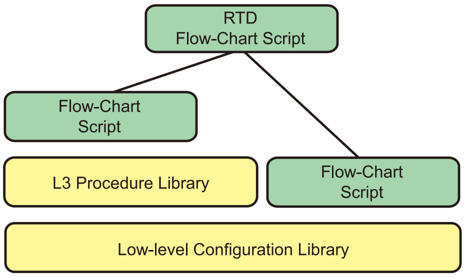
Rapid Test Designer (RTD)

MX786201A



- Faster Test Development
- Easier Test Maintenance
- Automatic Simulator Configuration
- Less Specific Protocol Knowledge Required

The Rapid Test Designer (RTD) MX786201A is a revolutionary tool which speeds up the testing of UMTS and LTE terminals significantly by greatly simplifying the way in which tests are created, executed and analyzed. RTD has a mature customer base of 3G installations using the W-CDMA Signalling Tester MD8480C and is able to provide a cost effective solution to migrate over to LTE with the LTE Signalling Tester MD8430A. This combination makes a comprehensive and flexible solution for the most powerful protocol development system for next generation wireless terminals.
The RTD is already established as a proven multi-standard graphical flow chart tool for many organizations. MD8480C has now become a reference as an essential part of test systems reflected by its extensive use in all aspect of the 3G terminal development cycle including R&D, integration, regression, conformance, acceptance and validation. It has the ability to create almost limitless network simulations and is complimented by the MD8430A for LTE and MD8475A for TD-SCDMA.
The RTD is the fastest and most efficient way to ensure that modern terminal behaviour can be comprehensively exercised. Its ability to simulate network scenarios with actual network settings takes it beyond conformance testing and into real world situations.
Network Operators are making use of the RTD's intelligent test tools to ensure that terminals behave correctly on their networks. Terminal development teams simulate conditions in networks that may be thousands of miles away and may not yet support the new functionality present in new handsets hence saving time and money.
Finally, the RTD provides one click, instant execution with no test case build or compilation phase necessary to enable very effective and efficient development of test case libraries for a wide variety of purposes:

- Acceptance Testing
- Integration Testing
- Generating Variants
- Application Testing
- Regression Testing
- Pre-conformance Testing
- Prototyping Testing
- Hardware and Software Integration
- Software Development

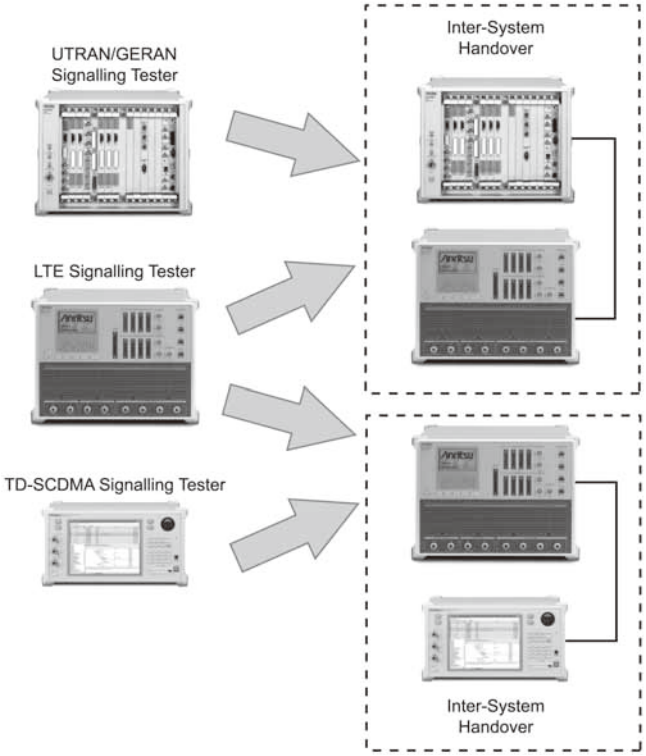
Terminal Development from R&D to Conformance and Beyond

R&D teams will spend thousands of hours developing, integrating and proving their terminal designs. The RTD provides LTE design teams with procedures that test low level configuration as well as L3 protocol. Individually the procedure libraries provide tools for teams at different parts of the design process. By combining and merging them, very detailed proving and integration of designs is possible.
As specifications evolve, the RTD provides a roadmap that reflects the fast moving needs of the developers.
As a consequence increased dependence upon regression testing to ensure changes do not affect the designs. RTD provides all the tools for immediate test definition, analysis and execution.

Time to Market

With competition being so great and staff movement an issue, teams cannot afford to add time to development of new products. The RTD provides an intuitive interface that is easy to learn and provides flexible and informative feedback to the operator.
This allows developers to accelerate the learning curve for new technology and the tools needed for successful designs.

RTD Supports
GSM
GPRS
E-GPRS
UMTS
HSPA Evolution
TD-SCDMA
LTE
LTE-Advanced



Key Facts

- Development environment for layer 1 to layer 3 signalling
- Integration test packages and software tools for developing LTE terminals
- Extensive procedure library with preconfigured messages and signalling
- Integration of legacy scenarios
- One button upgrade process for existing tests

Regression Testing

Regression testing needs to be performed as new software is introduced into networks. RTD makes it possible to modify test scripts simply by applying a new set of network parameters or making a change to a reference that can populate a suite of tests. The test suite can then be run overnight or unattended, presenting the operator with an executive summary to enable software stability trends to be mapped.

Maintaining Tests

Wireless terminal developers will build up large libraries of tests for ongoing development and regression testing of their designs. The RTD has the ability to update these libraries using the latest 3GPP Release automatically, saving many hours of test re-creation and debugging.

Beyond Conformance

Although conformance tests prove adherence to specifications, they play little part in simulating “real world” conditions where consideration to interfering signals and user plane data is involved. The RTD makes test scenarios easy to create and then iterate as there is no lengthy compilation stage and tests may be adjusted at run time if required.

Roaming and Network Selection

With multi-mode capability, terminals will have complex algorithms that select preferred networks and still maintain acceptable performance. Revenue streams will be threatened if UEs do not behave correctly and Network Operators will exercise them to ensure the best possible behaviour on their network configurations. RTD provides this type of testing which will be crucial to terminal selection - and rejection.

Simulating Live Network Conditions

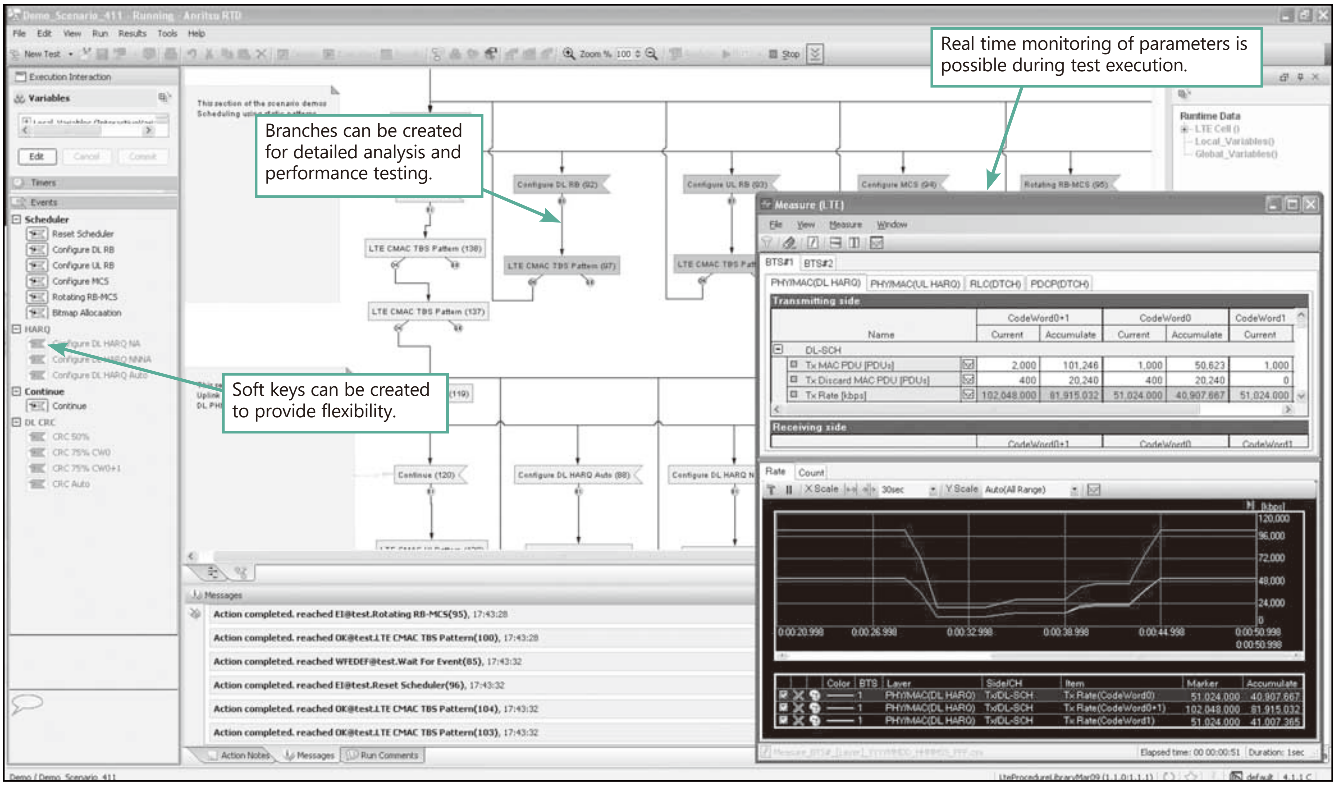
Traditionally protocol and RF tests have been kept separate.
In order to reduce test times there is a trend to combine fading with protocol tests. The RTD provides a convenient way to add digital baseband fading by using the Signalling Tester MD8430A to the system.

LTE-Advanced Carrier Aggregation

LTE Technology is reaching the limits of spectral efficiency (the bit rate possible in a given bandwidth), so the ever increasing user demand requires more bandwidth. The problem is that few locations have large blocks of suitable contiguous spectrum available. The 3GPP Release 10 LTE-Advanced standards have been developed to address the twin challenges of increasing data usage and spectrum congestion.
Carrier Aggregation combines multiple LTE carriers at the physical layer to provide increased bandwidth. The component carriers may reside in non-contiguous frequencies, enabling increased bandwidth even in regions with fragmented spectrum allocation.
LTE-Advanced chipset and device makers will find themselves faced with the combined challenges of time to market, technical complexity and budget constraints. RTD addresses these challenges because it is consistently the first solution to support the early test requirements for new technologies, provides visibility of device behaviour at each layer of the protocol stack, and delivers Carrier Aggregation functions as a cost-effective software only upgrade.

Why a Graphical Flow Chart?

The RTD's unique flowchart display provides a more natural way of creating scenarios and observing test flow and outcomes.
Debugging is especially straightforward as tests can be run and iterative changes made. Because there is no compilation phase, tests can be run immediately and aborted if the wrong path is taken. With well annotated tests, sharing and consolidation is possible and productive.



Real time monitoring of parameters is possible during test execution.

Branches can be created for detailed analysis and performance testing.

Soft keys can be created to provide flexibility.

Transmitting side

Name	CodeWord0+1 Current	CodeWord0+1 Accumulate	CodeWord0 Current	CodeWord0 Accumulate	CodeWord1 Current
DL-SCH					
Tx MAC PDU [PDUs]	2,000	101,246	1,000	50,623	1,000
Tx Discard MAC PDU [PDUs]	400	20,240	400	20,240	0
Tx Rate [kbps]	102,048,000	81,915,032	51,024,000	40,907,667	51,024,000

Color	BTS	Layer	Side/CH	Item	Marker	Accumulate
	1	PHY/MAC(DL HARQ)	Tx/DL-SCH	Tx Rate(CodeWord0)	51,024,000	40,907,667
	1	PHY/MAC(DL HARQ)	Tx/DL-SCH	Tx Rate(CodeWord0+1)	102,048,000	81,915,032
	1	PHY/MAC(DL HARQ)	Tx/DL-SCH	Tx Rate(CodeWord1)	51,024,000	41,007,365

Messages

```
Action completed. reached EI@test.Rotating RB-MCS(95), 17:43:28
Action completed. reached OK@test.LTE CMAC TBS Pattern(100), 17:43:28
Action completed. reached WFEDEF@test.Wait For Event(85), 17:43:32
Action completed. reached EI@test.Reset Scheduler(96), 17:43:32
Action completed. reached OK@test.LTE CMAC TBS Pattern(104), 17:43:32
Action completed. reached OK@test.LTE CMAC TBS Pattern(103), 17:43:32
```

Acceptance Testing for Network Operators

With finite bandwidth and ever more traffic generated, the biggest challenge is for network operators to optimize their networks and ensure that terminals obey the rules they set. LTE attempts to make more efficient use of the spectrum available but still needs to inter-work with legacy systems. There are also regional variations and network specific requirements that terminals will be expected to conform to. Load balancing may be important to make best use of network resources and although aesthetics and applications may define a terminal's popularity, the behaviour under specific conditions needs to be tested to ensure a reliable and friendly user experience.

Cell Selection and Re-selection

The compromise between battery life and continuous caretaking activities will always challenge terminal designers. Thousands of hours of field trials may still not be able to identify why a terminal fails to maintain service on a preferred network.
Many conditions can only be reliably exercised using a simulation of network conditions in the laboratory. The RTD has the ability to use network logs and create tests that closely resemble the field environment. Iteration of the test is then straightforward to discover and rectify the problem.

Application Testing

As we move to an all packet delivery network, data throughput and integrity is becoming more important.
Scenarios with a variety of radio bearers and configurations are possible with RTD, proving that data is not lost during handovers and reselection. As traffic builds up and volume driven state transitions occur the user needs to remain connected.
Simultaneous applications are now commonplace, so interaction and priority between services needs simulating.
Where high value applications such as financial transactions take place handovers or link failures may be serious. Gaming and social networking may seem less important to test, but is proving to be a differentiator for a young and influential market.

Roaming Partners

Simulation of foreign networks using the RTD's many advanced features allows a convenient way to test roaming between networks with different configurations/parameters and even different ways of implementing procedures. Today the cost of sending engineering teams to perform network testing over many weeks can be a very significant portion of a Network Operator's proving budget.

New Network Services

Most Networks will not allow new terminals onto their live service without some proving. RTD provides a way to test new terminals and also new services that may be ready to be deployed. Future functionality and applications can be proved in a controlled way using a system simulator and problems resolved ahead of deployment.

Stress Testing

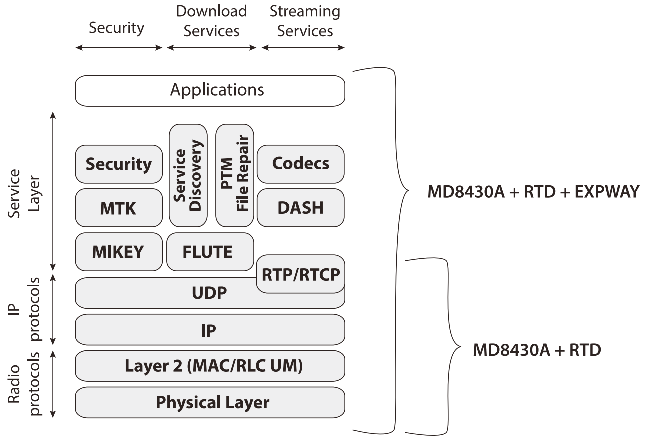
Terminal stress testing can be automated and run overnight using RTD. With the ability to make thousands of reselections, calls, hand-overs etc. Tests that exercise the extremes and limits of the terminal provide quantitive and qualitative data for terminal selection.

RTD for eMBMS Testing

The evolved Multimedia Multicast Broadcast Service (eMBMS) enables the efficient delivery of media content simultaneously to a high number of subscribers. Operators are upgrading their networks to utilize eMBMS technology in order to keep up with the demand for services such as mobile TV.

Devices not only have to implement support for additional radio channels and protocols, but also need to implement a service layer to communicate with additional core network elements for eMBMS. The most important of these is the Broadcast Multicast Service Center (BM-SC).

Anritsu partners with Expway – the leading supplier of BM-SC technology components, top deliver a complete end-to-end eMBMS test solution consisting of the MD8430A Signaling Tester, RTD software and a BM-SC adapted for test purposes. This provides a complete lab simulation to test not only LTE Layer 1 and Layer 2 operation, but also the eMBMS service layer and interactions between the radio modem and the eMBMS middleware.



RTD Top Features

Edit
- Intuitive editing means faster test development
- Easier test maintenance
- Automatic simulator configuration
- Code re-use

Analyze
- Detailed protocol analysis
- Parameter changes can be made at RunTime
- Real time control can be achieved within tests

Automate
- Campaigns created using graphical interface
- Reports generated
- Export to other databases

Regression
- Tests and entire archives can be updated to the latest 3GPP release using a single command
- Backup generated and archived automatically for regression tests

Control
- AT commands can be included in all tests
- Automation of tests using campaigns or from a host system using CLI

Future
- MD8480C proven in 3G development and testing
- MD8430A proven in LTE testing
- GSM/GPRS/E-GPRS/HSPA/HSPA Evo/LTE FDD/LTE TDD

Automation

The RTD provides many ways that test execution can be made more efficient using remote control, terminal control and campaign management tools.

Remote Control Interface MX787401A-012

The RTD may be controlled using remote commands and integrated into a total test system. The RTD is compatible with a number of remote commands that allow Tests to be RUN, ANALYZED, etc. In this mode the RTD works as a slave to an existing test system where existing equipment and data is controlled and collected.

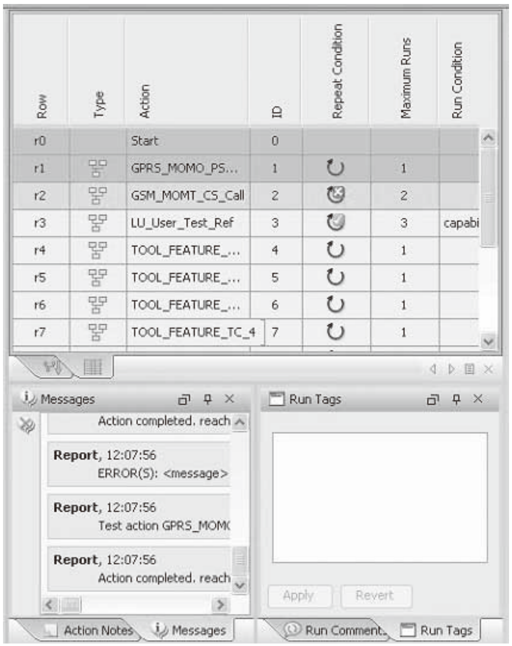
Signalling Application Tool for Terminal Automation MX787401A-013

The RTD provides proxy control of the AT command set to the terminal through the RTD Test Cases. It enables automated testing to be achieved through a serial port on the control PC. The system maybe configured to map the AT/MMI commands to match those supported by the terminal. Prompts on the screen can be suppressed when automation is used. In general automated testing can be carried out via the use of the AT command set [3GPP TS 27.007].

Signalling Application Tool for Test Sequencing MX787401A-014

The RTD includes a campaign management tool. This provides the user with the ability to create test runs that can be run remotely without the need for any further control equipment. Tests can be repeated depending on rules set by the user. Results are generated in a tabular form and can be exported to form part of a formal report.

A campaign may be used to run an entire suite of conformance tests, or inter-operability tests, or any other large grouping of tests. Rules may be set to run all tests and then retest those that fail, making best use of time.



Row	Type	Action	ID	Repeat Condition	Maximum Runs	Run Condition
r0		Start	0			
r1		GPRS_MOMO_PS...	1	↻	1	
r2		GSM_MOMT_CS_Call	2	↻	2	
r3		LU_User_Test_Ref	3	↻	3	capabi
r4		TOOL_FEATURE_...	4	↻	1	
r5		TOOL_FEATURE_...	5	↻	1	
r6		TOOL_FEATURE_...	6	↻	1	
r7		TOOL_FEATURE_TC_4	7	↻	1	

Action completed. reach

Report, 12:07:56
ERROR(S): <message>

Report, 12:07:56
Test action GPRS_MOM(

Report, 12:07:56
Action completed. reach

The Total System Solution

For some, the RTD will be a new concept and we aim to provide the tools and support to make the experience productive and logical.

Using the RTD

An RTD test is constructed and edited using a graphical environment, which supports procedures, loops, delays and interactive dialogs. Compared to traditional "C" and "TTCN" based languages this GUI provides fast and simple test creation. Typically a test that may have taken several days to create may be created in hours using the RTD.

Reference Tests

These reference tests are samples of commonly used functions to act as templates for the user. They allow Network specific parameters to be added manually or by means of a "catalogue" function. Packages of other test cases are also available on request.

Test Execution Engine

RTD tests are run immediately after they have been checked for simple errors, without a compile or build cycle.

Test Criteria Editor

The test operative may use this tool to automatically make objective decisions on whether the right actions have been made by the UE. Criteria may be changed post testing and applied to existing results. This avoids the need to re-run the tests.

Detailed Test Log Analyzer

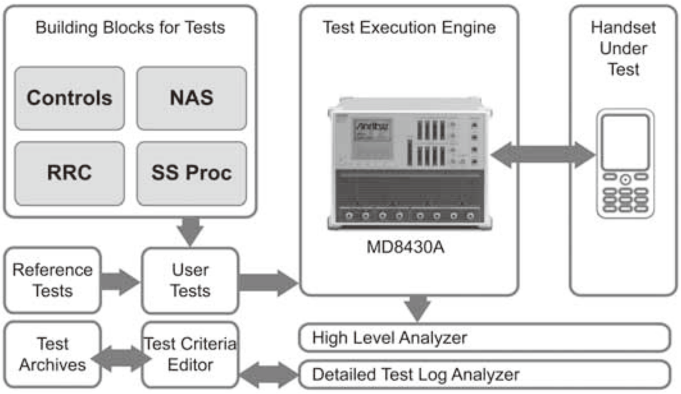
The protocol log analyzer, which maintains the same look and feel as other Anritsu products, is provided to examine the message sequences that are produced by the terminal under test.

Procedure Libraries

Procedures are the building blocks from which all tests are created. The RTD Procedures can be selected from a palette and added to the Test simply by dragging onto the edit page. Compound procedures can be created to allow frequently used scripts to be added in a single action, further simplifying test creation.

These procedures are configured using parameters, which can be changed at three levels :

1) Parameter sets held in catalogues can be selected to parameterise groups of procedures rapidly.
2) The user can edit individual parameters after they have been selected from catalogue components, overriding values if they wish to. These parameters are used to populate the actual protocol messages sent by the procedure.
3) The expert user can edit the individual messages sent by the procedure, if needed, overriding any parameters previously selected or changed.



Ordering Information

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Model/Order No.	Name
	Main Frame
MX786201A	Rapid Test Designer (RTD)
Z1591A	USB Dongle (Protocol)
	Options
MX786201A-025	eMBMS BM-SC Procedure Library
MX786201A-027	RTD IMS Signalling Library
MX786201A-028	Layer 1/Layer 2 Statistics Monitor (LTE)
MX786201A-031	RTD Layer 3 Procedure Library (LTE)
MX786201A-038	Low-level Configuration Library for RTD (LTE)
MX786201A-40	Ciphering
MX786201A-041	RTD Layer 3 Procedure Library (UTRAN/GERAN)
MX786201A-45	RTD Test Creation and Editing Tools
MX786201A-46	RTD Run Time Engine
MX786201A-048	Low-level Configuration Library (UTRAN/GERAN)
MX786201A-052	Dual Cell Capability (Run-time Option)
MX786201A-056	Dual-cell to Multi-cell Upgrade (Run Time Option)
	Tools Options
MX787401A	Set of Signalling Application Support Tools
MX787401A-011	Protocol Analyzer (RTD)
MX787401A-012	Remote Control Interface
MX787401A-013	Signalling Application Tool for Terminal Automation
MX787401A-014	Signalling Application Tool for Test Sequencing
MX787401A-017	IMS Audio calls on RTD PC (AMR codec)
MX787401A-018	IMS over 3G
MX787401A-019	IMS over WiFi
MX787401A-020	IMS RCS
MX787401A-033	Protocol Analyzer 3- Real Time Log Capture Tool
MX787401A-062	Interface Driver for MF6900A (Fading Simulator)
MX787401A-065	RTD Fading Library
MX787401A-066	RTD Fading Library (Higher Order MIMO)
MX787401A-070	RTD Fading Library (UTRAN)
MX787401A-076	RTD Fading Library (SCME)
	Framework Options
MX787201A	Multi-RAT Framework for Signalling Testing Applications
MX787201A-012	Enabler for Multiple Signalling Testers
MX787201A-013	LTE UL 2×2 MIMO FRAMEWORK
MX787201A-021	GERAN Framework for Signalling Testing Applications
MX787201A-023	Framework UTRAN Core (Incl. HSPA)
MX787201A-026	Framework HSPA Evo (Rel-8)
MX787201A-027	LTE Core FRAMEWORK for Signalling Testing Applications
MX787201A-028	LTE FDD Framework for Signalling Testing Applications
MX787201A-029	Framework LTE TDD Option
MX787201A-030	LTE Advanced Carrier Aggregation Framework
MX787201A-031	Framework C2K Core (Can be ordered only for ME7834L CAT)
MX787201A-032	UTRAN LCR TDD Framework Core (Incl. HSPA)
MX787201A-035	LTE Framework Technology MD8430 ETM Driver
MX787201A-036	LTE-A 3 Carrier Aggregation Framework
MX787201A-037	UTRAN Framework MC-HSDPA (REL-10)
MX787201A-038	LTE DL 4×4 MIMO Framework
MX787201A-039	LTE CoMP Framework
MX787201A-041	LTE-A 4 Carrier Aggregation Framework
MX787201A-042	LTE DL 8×4 MIMO FRAMEWORK
MX787201A-043	LTE Dual Connectivity Framework
MX787201A-045	LTE-A 5 Carrier Aggregation Framework
MX787201A-047	LTE Unlicensed 6 GHz Framework
MX787201A-048	Extended DL Frequency Bandwidth Framework
MX787201A-050	LTE Licensed Assisted Access (LAA) Framework
MX787201A-051	Floating (Server based) License
MX787201A-053	LTE Enhanced MTC Framework
MX787201A-054	Narrow band IoT Framework
MX787201A-056	LTE-A 6 Carrier Aggregation Framework
MX787201A-057	LTE-A UL 3 Carrier Aggregation Framework
	Options for eMBMS
MX787460A	eMBMS BM-SC Server
MX787460A-SS120	MX787460A 1 Year Support Service
MX787460A-SS020	MX787460A 1 Month Support Service
Z1896A	Additional PC for RTD eMBMS (With Monitor)
Z1897A	eMBMS USB Dongle
	Update & Maintenance
MX786201A-20	Software Update and Maintenance Contract
MX787201A-SS100	Maintenance for Technology Framework
MX787401A-SS100	Maintenance for Software Tools
	Additional Accessories
Z1320D	Standard PC for RTD (with monitor)
P0055D6	RTD Standard UICC Pack -4FF
P0055D7	RTD Standard UICC Pack -3FF

5G NR Mobile Device Test Platform

ME7834NR

Remote Control
Ethernet

Supporting Protocol Test for 5G NR Mobile Devices

NEW

Anritsu has been working on Conformance Test developments from the start of 3G communications until today's upcoming 5G services, and continues providing solutions meeting customers' expectations. Based on our long experience, we deliver timely, trusted solutions incorporating state-of-the-art technology to customers.

All-in-One 5G NR Support for Protocol Conformance Test and Carrier Acceptance Test

The 5G NR Mobile Device Test Platform ME7834NR is for 3GPP- based Protocol Conformance Tests (PCT) and Carrier Acceptance Tests (CAT) of mobile devices incorporating Multiple Radio Access Technologies (RAT). The ME7834NR supports 5G New Radio (NR) Technology in both Standalone (SA) and Non-Standalone (NSA) modes, as well as LTE, LTE-Advanced (LTE-A), LTE-A Pro, and W-CDMA.

Supports 3GPP-Defined Bands from Sub-6 GHz to mmWave

The ME7834NR covers the 3GPP 5G frequency bands including sub-6 GHz and mmWave when combined with Anritsu's new OTA Chamber MA8171A and RF converters.

Upgrade Current ME7834 System for 5G

The ME7834NR provides a smooth transition to 5G while still supporting LTE, LTE-A, LTE-A Pro and legacy W-CDMA technologies. Existing customers can upgrade to 5G while capitalizing on a proven LTE-A test environment and staying abreast of the latest technology evolution.

Adds Support for 3GPP Main Carrier Acceptance Tests

Protocol Conformance Tests continue to follow the 3GPP standards, and the Global Certification Forum (GCF)/PCS Type Certification Review Board (PTCRB) have approved the various test cases for the ME7834NR as a GCF/PTCRB recommended platform.
The Carrier Acceptance Tests support acceptance inspection by major 5G operators worldwide.

Comprehensive Support System

To assure effective use, each subscription package includes comprehensive after-sales support offering:

- Latest software updates matching latest changes to 3GPP standards
- Consultation and technical support for troubleshooting test problems

These after-sales services assure smooth support for customers' business development.

Specifications

Dimensions
570 (W) × 1980 (H) × 797 (D) mm
(1 rack, excluding projections)

Mass
≤650 kg (Full system configuration)

Temperature Range
Operating: 15° to 30°C (With rack, 30-cm space at back and sides, no condensation)
Storage: 0° to 30°C (No condensation)

Power Supply
Voltage: 100 Vac to 120 Vac/200 Vac to 240 Vac
Frequency: 50 Hz/60 Hz
Power consumption: ≤8500 VA (Full system configuration)

CE
EMC: 2014/30/EU, EN61326-1, EN61000-3-2
LVD: 2014/35/EU, EN61010-1
RoHS: 2011/65/EU, EN50581

Test Standards
Protocol Conformance Test (PCT)
3GPP TS 38.523-1 (5G NR)
3GPP TS 36.523-1 (LTE)
3GPP TS 34.123-1 (UMTS)

Carrier Acceptance Test (CAT)
Complies with standard of each supported carrier

Contact your Anritsu sales representative for detailed electrical characteristics, specifications, supported test cases, and carriers.

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Model/Order No.	Name
ME7834NR	**Main Frame** 5G NR Mobile Device Test Platform
MN8142B MT8000A MD8430A	**Configuration Items** RF Combiner Unit Radio Communication Test Station Signalling Tester Consult us for other configurations.
	Options **Converters** **OTA Measurement Hardware** **Software Options** **Support Services** **Application Parts** Consult us for details.

Contact your Anritsu sales representative for detailed ordering information.

LTE-Advanced Mobile Device Test Platform

ME7834LA

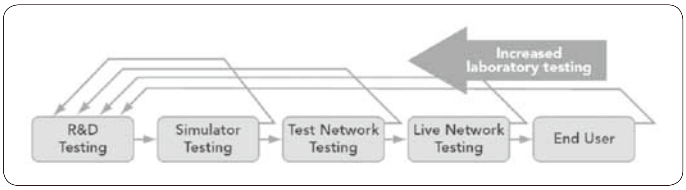
Remote Control
Ethernet

GCF/PTCRB, and Carrier Approved Test System for Mobile Protocol Testing

The ME7834LA is a configurable system that provides flexible protocol test solutions throughout the lifecycle of modern wireless terminals. ME7834LA systems are able to address applications in development and conformance and evolve to provide advanced system simulation. Anritsu led the way with 3G/LTE mobile development programs. It is now delivering intelligent test solutions to LTE-Advanced development teams that need to accelerate their designs to stay competitive.

Protocol Test Solutions

- 2G/3G/LTE/LTE-Advanced
- 4×4 MIMO, 3CC CA/4CC CA/5CC CA
- Development
- Conformance
- Carrier Acceptance



Reduce Costs by finding errors earlier in the process

ME7834LA for Conformance Testing to Meet Evolving Specifications

The Global Certification Forum (GCF) and the PCS Type Certification Review Board (PTCRB) include the ME7834LA as an approved platform to provide test coverage for GERAN, UTRAN, HSPA+, LTE and LTE-Advanced technologies.
The ME7834LA is registered as GCF TP119 and tracks TS 36.523 for LTE and TS 34.123 for UTRAN. It has met critical deadlines set by the industry for test platform approval. The system may also be configured to meet tests mandated by several network operators.

ME7834LA for Acceptance Testing for Carriers

Carriers are making use of the intelligent test tools to ensure that terminals behave correctly on their networks. Terminal development teams simulate conditions in networks that may be thousands of miles away and may not yet support the updated functionality present in new handsets.
The tests are created and validated with the RTD to take advantage of the graphical layout. This makes it straight forward to visualize test flow and hence verify and debug the terminals behavior.
These tests are validated against stringent requirements before they are provided as a commercial test package.
Test packages that keep pace with network requirements Anritsu are able to provide and support a number of carrier specific tests.
(Note: some test packages may need to be obtained directly from carriers)
ME7834LA users now have the ability to purchase carrier acceptance test packages outright or subscribe to them on an annual basis to suit their fiscal needs.

Other

MD8475A with CDMA2000 option and MD8480C are not RoHS compliant.
Please contact our sales representative for more details.

Specifications

Input and Output Connector		N-type, 50Ω
Max. Input Level		+33 dBm
Frequency Range		450 MHz to 6 GHz
Temperature Range		15° to 35°C (operating), 0° to 50°C (storage)*1
Power Supply (Rating)		Select either 100 V(ac) to 120 V(ac) or 200 V(ac) to 240 V(ac), 50 Hz/60 Hz ≤5000 VA (Full system configuration)
Dimensions		1140 (W) × 1980 (H) × 797 (D) mm*2 (Full system configuration)
Mass		≤650 kg*3 (Full system configuration)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

*1: Ambient temperature

Basic calibration at acceptance inspection must meet this requirement.

Use in air-conditioned room recommended for stable measurement.

*2: Topple prevention

Secure using hooks at rack top recommended.

*3: Mass/Floor Loads

The installation location must be able to safely bear the above floor loads plus 100 kg for basic calibration equipment at acceptance inspection.

LTE-Advanced RF Conformance Test System

ME7873LA

Remote Control
Ethernet

RF/RRM Conformance Test System Supporting Most and First GCF/PTCRB Approved TCs

Supporting Most and First GCF*[1]/PTCRB*[2] Approved Test Cases*[3]

This GCF/PTCRB-compatible test platform targets the most and first Test Cases approved at quarterly GCF/PTCRB meetings.
It uses the Signalling Tester MD8430A as a LTE base station simulator, and is configured from various test instruments and dedicated software.
It supports RF/RRM tests while communicating with LTE mobile terminals.

LTE-Advanced RF Conformance Test System ME7873LA

This system is for testing the RF TRx characteristics, performance requirements, and RRM performance of FDD/TDD LTE mobile terminals in compliance with the requirements of 3GPP TS 36.521-1 Chapter 6 (Transmitter Characteristics), Chapter 7 (Receiver Characteristics), Chapter 8 (Performance Requirement), Chapter 9 (Reporting of Channel State Information), Chapter 10 (MBMS Performance) and TS 36.521-3 RRM*[4] including LTE → GSM/UMTS/CDMA2000/TD-SCDMA Inter-RAT tests. TS 34.121-1 UMTS → LTE and TS 34.122 TD-SCDMA → LTE Inter-RAT tests are also supported.
Moreover, UMTS 3GPP TS 34.121-1 tests are supported.*[5]

Supports Mobile Terminal Carrier Acceptance Tests

This single, multi-purpose platform supports acceptance tests mainly for North American operators, as well as 3GPP RF/RRM conformance tests.

*1: GCF (Global Certification Forum):
Certifies conformance to standards for mobile terminals and test systems. Composed mainly of operators, mobile terminal vendors and chipset vendors and performs certification for frequency bands used in Europe.
*2: PTCRB (PCS Type Certification Review Board):
A similar test system certification organization to GCF composed mainly of N. American carriers and UE vendors and performing conformance certification for frequency bands used in N. America.
*3: As of June, 2018.
*4: RRM: Radio Resource Management
5: In principle, defined by GCF Work Item[6] and targeting measurement items certified by GCF/PTCRB.
(Contact your Anritsu sales representative for timing of supported items and option configurations.)
*6: Work Item:
Name of function test items selected by GCF for mobile terminal approval.

Supports Global Mobile Terminals

Worldwide Frequency Bands

Not only are GCF/PTCRB-approved Bands planned for use in Europe and North America fully supported, but the following bands defined by 3GPP are also supported too.
Unlisted bands can be supported by request.

Operating Band	UL Frequencies (MHz)	DL Frequencies (MHz)
1	1920 to 1980	2110 to 2170
2	1850 to 1910	1930 to 1990
3	1710 to 1785	1805 to 1880
4	1710 to 1755	2110 to 2155
5	824 to 849	869 to 894
6	830 to 840	875 to 885
7	2500 to 2570	2620 to 2690
8	880 to 915	925 to 960
9	1749.9 to 1784.9	1844.9 to 1879.9
10	1710 to 1770	2110 to 2170
11	1427.9 to 1447.9	1475.9 to 1495.9
12	698 to 716	728 to 746
13	777 to 787	746 to 756
14	788 to 798	758 to 768
17	704 to 716	734 to 746
18	815 to 830	860 to 875
19	830 to 845	875 to 890
20	832 to 862	791 to 821
21	1447.9 to 1462.9	1495.9 to 1510.9
24	1626.5 to 1660.5	1525 to 1559
25	1850 to 1915	1930 to 1995
26	814 to 849	859 to 894
27	807 to 824	852 to 869
28	703 to 748	758 to 803
29	N/A	717 to 728
30	2305 to 2315	2350 to 2360
31	452.5 to 457.5	462.4 to 467.5
32	N/A	1452 to 1496
33	1900 to 1920	1900 to 1920
34	2010 to 2025	2010 to 2025
35	1850 to 1910	1850 to 1910
36	1930 to 1990	1930 to 1990
37	1910 to 1930	1910 to 1930
38	2570 to 2620	2570 to 2620

Continued on next page

Operating Band	UL Frequencies (MHz)	DL Frequencies (MHz)
39	1880 to 1920	1880 to 1920
40	2300 to 2400	2300 to 2400
41	2496 to 2690	2496 to 2690
42	3400 to 3600	3400 to 3600
46	5150 to 5925	5150 to 5925
66	1710 to 1780	2110 to 2200
71	663 to 698	617 to 652

Focus on Improving Test Efficiency, Measurement Stability and Reliability

Continuous Testing of Multiple Terminals

Since the standard system configuration has four RF interfaces, it can test up to four terminals continuously. Fully automated testing of multiple terminals is supported by DC power supply and serial control line auto-switching.

Control via Networks

The PC server in the rack can be operated remotely over a network. Measurement progress can be monitored remotely and measurement sequences can be created and edited, allowing tests to be run while working elsewhere.

Easy Control of External Devices

The system software has built-in functions for controlling the DC power supply* and temperature chamber* in the same way as selecting test items. Using these standard functions makes automation easy.

*: Users must provide the DC power supply and temperature chamber.
Refer to the ordering information for recommended models.

Radio Equipment Derective (RED) compliant Test Items (option)

This option is fully compliant with the European ETSI-defined RED RF TRx test items. Anritsu launched this European-test-house approved option ahead of market competitors.
Simple operation supports easy RED compliant tests like normal test items.

Improve Reliability using Correction Function

System measurement stability and reliability are improved by the following three calibration and correction methods:

1. Basic calibration at acceptance inspection
2. Auto-calibration at work start
3. Individual measurement correction

Individual measurement correction immediately before measurement eliminates temperature-related drift and greatly improves the reliability of measurements.
In addition, Anritsu engineers perform basic calibration when installing the system at acceptance inspection, eliminating the need for operators to perform this complex calibration and correction work.

Detailed Support System

An Anritsu Support Service contract keeps the system operating at peak performance, maximizing return on investment, minimizing downtime, and keeping work on schedule.

- Latest software updates matching the latest changes to the 3GPP standards
- Information on 3GPP trends, consultation and technical support for troubleshooting test problems
- Free hardware repair and maintenance with a back-up loan unit

Specifications

LTE-Advanced RF Conformance Test System ME7873LA

Input and Output Connector		N-type, 50Ω
Max. Input Level		+35 dBm
Reference Oscillator		MS2692A (with option-001 Rubidium Reference Oscillator) as standard External oscillator signal input available (Frequency: 10 MHz, Connector: BNC)
Frequency Range		Defined by 3GPP E-UTRA Operating Band 1 to 14, 17 to 21, 24 to 42, 66, 71
Temperature Range		15° to 35°C (operating), 0° to 50°C (storage)*1
Power Supply (Rating)		Select either 100 V(ac) to 120 V(ac) or 200 V(ac) to 240 V(ac), 50 Hz/60 Hz ≤7700 VA*2 (Full system configuration)
Dimensions		1710 (W) × 1980 (H) × 797 (D) mm*3 (Full system configuration)
Mass		≤830 kg*4 (Full system configuration)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

*1: Ambient temperature
Basic calibration at acceptance inspection must meet this requirement.
Use in air-conditioned room recommended for stable measurement.
*2: Power consumption
Sufficient power (600 VA) for basic calibration at acceptance inspection as well as for ME7873LA must be supplied.
*3: Topple prevention
Secure using hooks at rack top recommended.
*4: Mass/Floor Loads
The installation location must be able to safely bear the above floor loads plus 100 kg for basic calibration equipment at acceptance inspection.

Supported Test Standards

The system design is based on the following standards:

3GPP TS 36.521-1	E-UTRA UE Conformance Specification Radio Transmission and Reception Part 1: Conformance Testing
3GPP TS 36.521-3	E-UTRA UE Conformance Specification Radio Transmission and Reception Part 3: RRM Conformance Testing
3GPP TS 34.121-1	User Equipment (UE) conformance specification; Radio transmission and reception (FDD); Part 1: Conformance specification

Release 8, 9, 10, 11, 12 and 13 of above standards is also supported. Contact our sales representative for detailed of the supported versions.

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main frame
ME7873LA	LTE-Advanced RF Conformance Test System
	Configuration items
MN7462E	RF Front End
MN7463E	Combining Unit
MN7446A	Filter Unit
MN7446B1	Filter Block
MN7446C	Filter Block2
MN7447A	LTE Uplink Signal Filter
MN7448A	Uplink Signal Filter
MA24218A	Universal USB Power Sensor
MS2692A	Signal Analyzer
MD8430A	Signalling Tester
MG3710A	Vector Signal Generator
MG3692C*1	2 GHz - 20 GHz Signal Generator
G0379B	APSIN20G-RM-AZI Signal Generator
MD8475A*2	Signalling Tester
Z1396D	User Operation PC
Z1397D	User Operation PC
Z1392C	Server PC
	Standard accessory
	ME7873LA Operation Manual (CD-ROM): 1 set
	Options
ME7873LA-001	Common Kit
ME7873LA-002	Antenna Extension
ME7873LA-005	Additional Rack
ME7873LA-011	SS1 Accessory
ME7873LA-012	SS2 Accessory
ME7873LA-013	SS3 Accessory
ME7873LA-014	SS4 Accessory
ME7873LA-017	SS7 Accessory
ME7873LA-021	VSG1 Accessory
ME7873LA-022	VSG2 Accessory
ME7873LA-023	CWSG1 Accessory
ME7873LA-051	Spurious Filter
ME7873LA-052	Spurious Filter2
ME7873LA-064	SS4 Accessory (Fading)
MX787301LA	4Rx Capability
MX787301LA-001	3GPP 4Rx TC Capability
MX787310LA	W-CDMA Test Software
MX787310LA-001	TRX Test Cases
MX787310LA-002	Performance Test Cases
MX787310LA-003	RRM Test Cases
MX787310LA-004	W-CDMA to GSM Test Cases
MX787310LA-005	W-CDMA Test Case for China
MX787311LA	FDD LTE Test Software
MX787311LA-001	TRX Test Cases
MX787311LA-002	Performance Test Cases
MX787311LA-003	RRM Test Cases
MX787311LA-004	LTE to W-CDMA/GSM Test Cases
MX787311LA-005	LTE to C2K Test Cases
MX787311LA-007	Sustained Data Throughput Test Cases
MX787311LA-011	TRX Test Cases for UL64QAM
MX787311LA-012	Rel-9 eMBMS Performance Test Cases
MX787311LA-021	TRX Test Cases for HPUE
MX787311LA-022	Rel-10 eICIC Performance Test Cases
MX787311LA-023	Rel-10 eICIC RRM Test Cases
MX787311LA-032	Rel-11 feICIC Performance Test Cases
MX787311LA-033	Rel-11 feICIC RRM Test Cases
MX787311LA-042	eDL-MIMO Performance Test Cases
MX787311LA-043	Rel-10 Enhancement RRM Test Cases
MX787311LA-044	Rel-10 Enhancement LTE to WCDMA Test Cases
MX787311LA-047	Rel-10 Enhancement Performance Test Cases
MX787311LA-052	Enhanced Performance Type A Test Cases
MX787311LA-062	DL CoMP Performance Test Cases
MX787311LA-071	TRX Test Cases with 4Rx antenna
MX787311LA-072	Performance Test Cases with 4Rx (3-4 Layer)
MX787311LA-073	RRM Test Cases with 4Rx
MX787311LA-078	Performance Test Cases with 4Rx (1-2 Layer)
MX787311LA-079	SDR and CQI Test Cases with 4Rx (3-4 Layer)
MX787311LA-081	DL256QAM TRX Test Cases
MX787311LA-087	DL256QAM Performance Test Cases
MX787311LA-095	RF Test Case for China
MX787361LA	TD-LTE Test Software
MX787361LA-001	TRX Test Cases
MX787361LA-002	Performance Test Cases
MX787361LA-003	RRM Test Cases
MX787361LA-004	LTE to W-CDMA/GSM Test Cases
MX787361LA-005	LTE to TD-SCDMA Test Cases
MX787361LA-007	Sustained Data Throughput Test Cases

Model/Order No.	Name
MX787361LA-011	TRX Test Cases for UL64QAM
MX787361LA-012	Rel-9 eMBMS Performance Test Cases
MX787361LA-013	Rel-9 FDD/TDD Dual Mode Test Cases
MX787361LA-015	LTE to TD-SCDMA Test Cases2
MX787361LA-021	TRX Test Cases for HPUE
MX787361LA-022	Rel-10 eICIC Performance Test Cases
MX787361LA-023	Rel-10 eICIC RRM Test Cases
MX787361LA-032	Rel-11 feICIC Performance Test Cases
MX787361LA-033	Rel-11 feICIC RRM Test Cases
MX787361LA-042	eDL-MIMO Performance Test Cases
MX787361LA-043	Rel-10 Enhancement RRM Test Cases
MX787361LA-047	Rel-10 Enhancement Performance Test Cases
MX787361LA-052	Enhanced Performance Type A Test Cases
MX787361LA-071	TRX Test Cases with 4Rx antenna
MX787361LA-072	Performance Test Cases with 4Rx (3-4 Layer)
MX787361LA-073	RRM Test Cases with 4Rx
MX787361LA-079	SDR and CQI Test Cases with 4Rx (3-4 Layer)
MX787361LA-081	DL256QAM TRX Test Cases
MX787361LA-087	DL256QAM Performance Test Cases
MX787361LA-095	RF Test Case for China
MX787361LA-096	RRM Test Case for China
MX787312LA	FDD CA Test Software
MX787312LA-001	TRX Test Cases
MX787312LA-002	Performance Test Cases
MX787312LA-003	RRM Test Cases
MX787312LA-004	LTE to W-CDMA Test Cases
MX787312LA-007	Sustained Data Throughput Test Cases
MX787312LA-011	TRX Test Cases CO
MX787312LA-012	Performance Test Cases CO
MX787312LA-017	Sustained Data Throughput Test Cases CO
MX787312LA-021	TRX Test Cases CO/U
MX787312LA-031	TRX Test Cases NC
MX787312LA-032	Performance Test Cases NC
MX787312LA-033	RRM Test Cases NC
MX787312LA-034	LTE to W-CDMA Test Cases NC
MX787312LA-037	Sustained Data Throughput Test Cases NC
MX787312LA-041	TRX Test Cases CO/U for UL64QAM
MX787312LA-081	DL256QAM TRX Test Cases
MX787312LA-087	DL256QAM Performance Test Cases
MX787362LA	TD-LTE CA Test Software
MX787362LA-001	TRX Test Cases
MX787362LA-002	Performance Test Cases
MX787362LA-003	RRM Test Cases
MX787362LA-005	LTE to TD-SCDMA Test Cases
MX787362LA-007	Sustained Data Throughput Test Cases
MX787362LA-011	TRX Test Cases CO
MX787362LA-012	Performance Test Cases CO
MX787362LA-017	Sustained Data Throughput Test Cases CO
MX787362LA-021	TRX Test Cases CO/U
MX787362LA-031	TRX Test Cases NC
MX787362LA-032	Performance Test Cases NC
MX787362LA-033	RRM Test Cases NC
MX787362LA-037	Sustained Data Throughput Test Cases NC
MX787362LA-041	TRX Test Cases CO/U for UL64QAM
MX787362LA-043	RRM Test Cases2
MX787362LA-081	DL256QAM TRX Test Cases
MX787362LA-087	DL256QAM Performance Test Cases
MX787313LA	FDD 3CA Test Software
MX787313LA-001	TRX Test Cases
MX787313LA-002	Performance Test Cases
MX787313LA-003	RRM Test Cases
MX787313LA-007	Sustained Data Throughput Test Cases
MX787313LA-011	TRX Test Cases 1B
MX787313LA-012	Performance Test Cases 1B
MX787313LA-013	RRM Test Cases 1B
MX787313LA-017	Sustained Data Throughput Test Cases 1B
MX787313LA-031	TRX Test Cases 2B
MX787313LA-032	Performance Test Cases 2B
MX787313LA-033	RRM Test Cases 2B
MX787313LA-037	Sustained Data Throughput Test Cases 2B
MX787313LA-081	DL256QAM TRX Test Cases
MX787313LA-087	DL256QAM Performance Test Cases
MX787363LA	TD-LTE 3CA Test Software
MX787363LA-011	TRX Test Cases 1B
MX787363LA-012	Performance Test Cases 1B
MX787363LA-013	RRM Test Cases 1B
MX787363LA-017	Sustained Data Throughput Test Cases 1B
MX787363LA-031	TRX Test Cases 2B
MX787363LA-032	Performance Test Cases 2B
MX787363LA-033	RRM Test Cases 2B

Continued on next page

Model/Order No.	Name
MX787363LA-037	Sustained Data Throughput Test Cases 2B
MX787363LA-081	DL256QAM TRX Test Cases
MX787363LA-087	DL256QAM Performance Test Cases
MX787314LA	FDD 4CA Test Software
MX787314LA-001	TRX Test Cases
MX787314LA-002	Performance Test Cases
MX787314LA-003	RRM Test Cases
MX787315LA	FDD 5CA Test Software
MX787315LA-001	TRX Test Cases
MX787322LA	FDD-TDD 2CA Test Software
MX787322LA-001	TRX Test Cases
MX787322LA-002	Performance Test Cases
MX787322LA-003	RRM Test Cases
MX787322LA-007	Sustained Data Throughput Test Cases
MX787322LA-011	TRX Test Cases for TDD PCell
MX787322LA-012	Performance Test Cases for TDD PCell
MX787322LA-013	RRM Test Cases for TDD PCell
MX787322LA-017	SDT Test Cases for TDD PCell
MX787322LA-081	DL256QAM TRX Test Cases
MX787322LA-087	DL256QAM Performance Test Cases
MX787323LA	FDD-TDD 3CA Test Software
MX787323LA-001	TRX Test Cases
MX787323LA-002	Performance Test Cases
MX787323LA-003	RRM Test Cases
MX787323LA-007	Sustained Data Throughput Test Cases
MX787323LA-031	TRX Test Cases 2B
MX787323LA-032	Performance Test Cases 2B
MX787323LA-033	RRM Test Cases 2B
MX787323LA-037	Sustained Data Throughput Test Cases 2B
MX787323LA-071	TRX Test Cases with 4Rx antenna
MX787323LA-081	DL256QAM TRX Test Cases
MX787323LA-085	DL256QAM TRX Test Cases with 4Rx antenna
MX787323LA-087	DL256QAM Performance Test Cases
MX787324LA	FDD-TDD 4CA Test Software
MX787324LA-001	TRX Test Cases
MX787324LA-002	Performance Test Cases
MX787324LA-003	RRM Test Cases
MX787325LA	FDD-TDD 5CA Test Software
MX787325LA-001	TRX Test Cases
MX787330LA	LAA Test Software
MX787330LA-001	LAA RX Test Cases
MX787330LA-002	LAA Performance Test Cases
MX787330LA-003	LAA RRM Test Cases
MX787371LA	HD-FDD CAT-M1 Test Software
MX787371LA-001	TRx Test Cases
MX787371LA-002	Performance Test Cases
MX787371LA-003	RRM Test Cases
MX787376LA	HD-FDD NB-IoT Test Software
MX787376LA-001	TRX Test Cases
MX787376LA-002	Performance Test Cases
MX787376LA-003	RRM Test Cases
MX787340LA	Supplementary Test Software for Vzw
MX787340LA-001	Band4 Supplementary TRx Test Cases
MX787340LA-002	Band4 Supplementary Performance Test Cases
MX787340LA-003	Band2 Supplementary TRx Test Cases
MX787340LA-004	Band2 Supplementary Performance Test Cases
MX787340LA-005	Band13 Supplementary RF Test Cases
MX787340LA-006	Band13 Supplementary RRM Test Cases
MX787340LA-009	InterBand RRM Test Cases
MX787340LA-011	Band5 Supplementary TRx Test Cases
MX787340LA-012	Band13 Supplementary RRM feICIC Test Cases
MX787340LA-013	InterBand RRM feICIC Test Cases
MX787340LA-014	Band66 Supplementary TRx Test Cases
MX787340LA-015	Band66 Supplementary Performance Test Cases
MX787340LA-016	Band5 InterBand RRM Test Cases1
MX787340LA-018	DL256QAM Supplementary RF Test Cases
MX787340LA-020	InterBand RRM Test Cases2
MX787340LA-021	Band5 InterBand RRM Test Cases2
MX787341LA	Supplementary Test Software for AT&T
MX787341LA-001	R1 Supplementary RF Test Cases
MX787341LA-002	R1 Supplementary Performance Test Cases
MX787341LA-003	R61 RRM Test Cases1
MX787341LA-004	R64 CA TRX Test Cases1
MX787341LA-005	R61 CA RRM Test Cases1
MX787341LA-006	R64 3CA RF Test Cases1
MX787341LA-007	R61 3CA RRM Test Cases1
MX787341LA-008	R64 3CA RF Test Cases2
MX787341LA-009	R61 RRM Test Cases2
MX787341LA-010	R61 CA RRM Test Cases2
MX787341LA-013	R64 4CA RF Test Cases
MX787341LA-014	R1 RF Test Cases with 4Rx
MX787343LA	Supplementary Test Software for T-Mobile
MX787343LA-001	RF Supplementary Test Cases1
MX787343LA-002	RF CA Supplementary Test Cases1
MX787343LA-003	RF Supplementary Test Cases2
MX787343LA-004	RF Supplementary Test Cases3
MX787343LA-005	RF Supplementary Test Cases4
MX787350LA	R&TTE Test Software
MX787350LA-002	LTE Test Cases
MX787350LA-003	LTE TDD Test Cases
MX787350LA-004	LTE 2CA Test Cases
MX787350LA-005	LTE TDD 2CA Test Cases
MX787350LA-006	LTE Multi-Cluster Test Cases
MX787350LA-007	LTE TDD Multi-Cluster Test Cases
MX787351LA	TRCC Test Software
MX787351LA-001	W-CDMA Test Cases
MX787300LA	Platform Functionality
MX787300LA-001	Band 1 Capability
MX787300LA-002	Band 2 Capability
MX787300LA-003	Band 3 Capability
MX787300LA-004	Band 4 Capability
MX787300LA-005	Band 5 Capability
MX787300LA-006	Band 6 Capability
MX787300LA-007	Band 7 Capability
MX787300LA-008	Band 8 Capability
MX787300LA-009	Band 9 Capability
MX787300LA-010	Band 10 Capability
MX787300LA-011	Band 11 Capability
MX787300LA-012	Band 12 Capability
MX787300LA-013	Band 13 Capability
MX787300LA-014	Band 14 Capability
MX787300LA-017	Band 17 Capability
MX787300LA-018	Band 18 Capability
MX787300LA-019	Band 19 Capability
MX787300LA-020	Band 20 Capability
MX787300LA-021	Band 21 Capability
MX787300LA-024	Band 24 Capability
MX787300LA-025	Band 25 Capability
MX787300LA-026	Band 26 Capability
MX787300LA-027	Band 27 Capability
MX787300LA-028	Band 28 Capability
MX787300LA-029	Band 29 Capability
MX787300LA-030	Band 30 Capability
MX787300LA-031	Band 31 Capability
MX787300LA-032	Band 32 Capability
MX787300LA-033	Band 33 Capability
MX787300LA-034	Band 34 Capability
MX787300LA-035	Band 35 Capability
MX787300LA-036	Band 36 Capability
MX787300LA-037	Band 37 Capability
MX787300LA-038	Band 38 Capability
MX787300LA-039	Band 39 Capability
MX787300LA-040	Band 40 Capability
MX787300LA-041	Band 41 Capability
MX787300LA-042	Band 42 Capability
MX787300LA-046	Band 46 Capability
MX787300LA-066	Band 66 Capability
MX787300LA-071	Band 71 Capability

*1: MG3692C is not RoHS compliant.

*2: MD8475A with CDMA2000 option is not RoHS compliant.
Contact your Anritsu sales representative for details.

In addition to the above-described accessories, the following items are required to use the ME7873LA.

DC Power Supply

One of the following models is required when controlling the power supply using the ME7873LA.

Model	Name	pcs	Manufacturer
N6700C	Main frame	1	Keysight Technologies Inc.
N6732B	8 V, 6.25 A, 50 W DC Power Module*1	4	
N6709C	Low-Profile MPS Mainframe Rack Mount Kit	1	
2306-PJ	Dual-Channel Battery/ Charger Simulator with 500 mA Range	2*2	Keithley Instruments Inc.

*1: Up to four modules are required according to connected mobiles.
Filler Panel Kit N6708A is required if the number of DC power modules are less than four.
At rack mounting, the maximum current is 2 A. To draw more than 2 A of current, use a separate cable to supply DC to the terminal. However, since this will prevent rack mounting, decide on the installation location for the DC power supply in advance.
When using other DC power module, ask the power supply manufacturer for details.

*2: Two sets of the 2306-PJ are required when testing up to four mobiles continuously.

Temperature Chamber

One of the following equipments is required to control the temperature chamber from the ME7873LA.

Model	Name	Manufacturer
SH-241*1	Temperature & Humidity Chamber	ESPEC Corp.
SH-242*1		
VT4002*2	EMC Shielding with Temperature	Votsch Industrietechnik GmbH
105*1	Benchtop Temperature Chamber	TestEquity LLC
107*1		
115*1	Temperature Chamber	

*1: GPIB Cable (Double-Shield, 2 m) is required to control this chamber automatically.

*2: USB-RS232C Converter Cable (2 m) is required to control this chamber automatically.

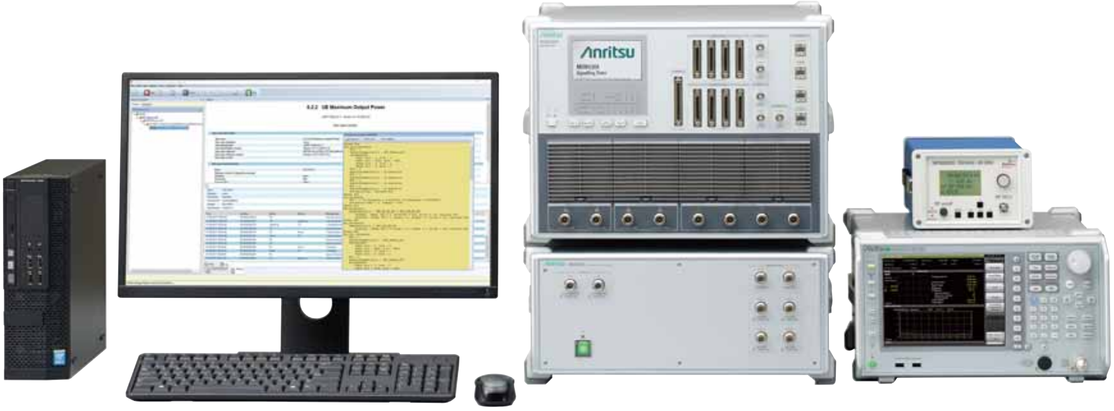
Contact your Anritsu sales representative for details.

Simple Conformance Test System

ME7800L

Remote Control
Ethernet

The First Step in Future Communications



Partners with Anritsu Conformance Test System

Anritsu's Simple Conformance Test System ME7800L is the ideal system for introducing RF and Protocol Conformance tests of 3GPP-compliant LTE mobile terminals. It covers all the basic LTE test items and also supports evolving communications standards.
Both RF/Performance/RRM tests and protocol tests can be selected and introduced as necessary and work efficiency is maximized by the full range of built-in functions for every stage, ranging from assuring network quality to developing mobile terminals.
The series top-of-the-line LTE-Advanced RF Conformance Test System has won more LTE-Advanced-related certifications than any other company and Anritsu promises to bring the benefits of its long experience in conformance test systems to customers meeting the challenges of verification.

All-in-One RF and Conformance Tests

Using one Signalling Tester MD8430A as a base station simulator with installed RF/RRM and protocol test software supports both RF/RRM and protocol conformance tests.

Support for Spurious Tests

Even the base model in the product line supports the spurious test required at RF measurement.

Compliance with 3GPP Standards include Latest IoT Tests

In addition to RF/RRM and protocol tests, the ME7800L continuously tracks new 3GPP standards include the latest Cat-M and NB-IoT tests to maintain compliance.
Refer to the Specifications section for the supported tests.

GCF*[1]/PTCRB*[2] Approved Conformance Tests

The Simple Conformance Test System ME7800L is a GCF/PTCRB approved test platform with RF/RRM and protocol test cases certified*[3] by GCF/PTCRB.

*1: Abbreviation for Global Certification Forum, an organization certifying mobile equipment and test platform standards compliance. GCF is composed of operators, mobile equipment and chipset makers and certifies standards compliance for the frequency bands used principally in Europe.

*2: Abbreviation for PCS Type Certification Review Board, an organization like the GCF mobile equipment and test platform standards compliance.
Unlike GCF, its main target is frequency bands used principally in N. America.

*3: Registered as GCF Test Platform (TP) 160.

Support for Regional Frequency Bands

In addition to the GCF/PTCRB-certified bands used principally in Europe and N. America, 3GPP-defined bands are also supported.
We also plan increasing support for other bands, depending on market requirements.
Refer to the standards page for the frequency bands.

Easy Control of Peripheral Equipment

A function for controlling the DC power supply and constant temperature chamber required by RF/RRM tests is built-in as standard. Control is easy and performed in the same manner as selecting test items for simple automated testing.

*: The DC power supply and constant temperature chamber must be supplied by the customer. Refer to the ordering information page for recommended models.

Calibration/Correction Functions for Higher Reliability

The following built-in calibration and correction functions improve measurement stability and reliability:

- Factory shipping basic correction
- Start-up auto-calibration
- Correction at each measurement

Since measurement correction is performed immediately before measurement, temperature-related changes in the measurement system are eliminated to greatly improve the measured value reliability.
Moreover, factory shipping basic correction eliminates the need for customers to perform complex operations, such as daily calibration and correction.

Excellent Support System

Various support packages provide after-purchase services to help ensure this system is used at its highest efficiency.
They include:

- Software updates assuring full compliance with new 3GPP standards
- Technical support consultations for troubleshooting testing problems

These versatile services help ensure efficient and effective testing work.

Specifications

Connector

TRx port: N-J, 50Ω, Maximum input +35 dBm
Rx port: N-J, 50Ω, Maximum input +30 dBm

Reference Oscillator

10 MHz Buffered Output of MD8430A as standard
External oscillator signal input available
(Frequency: 10 MHz, Connector: BNC)

Temperature Range

Operating: 15° to 35°C
Storage: 0° to 50°C

Power Supply

Power voltage: 100 V (ac) to 120 V (ac)/200 V (ac) to 240 V (ac)
Frequency: 50 Hz/60 Hz
Power consumption: ≤2500 VA

EU Standards (CE Marking)

EMC: 2014/30/EU, EN61326-1, EN61000-3-2
LVD: 2014/35/EU, EN61010-1
RoHS: 2011/65/EU, EN50581

Supported Test Standards

Both RF/RRM and Protocol Testing support Release 8, 9 and 10 (only 2 Downlink Carrier Aggregation) and Release 13 (IoT only) of below standards.

RF/RRM Testing

3GPP TS 36.521-1
E-UTRA UE Conformance Specification Radio Transmission and Reception Part1: Conformance Testing
3GPP TS 36.521-3
E-UTRA UE Conformance Specification Radio Transmission and Reception Part3: RRM Conformance Testing

Protocol Testing

3GPP TS 36.523-1
Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); User Equipment (UE) conformance specification; Part 1: Protocol conformance specification
3GPP TS34.229-1
Internet Protocol (IP) multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); User Equipment (UE) conformance specification; Part 1: Protocol conformance specification

Frequency Range

Operating Band	UL Frequencies (MHz)	DL Frequencies (MHz)
1	1920 to 1980	2110 to 2170
2	1850 to 1910	1930 to 1990
3	1710 to 1785	1805 to 1880
4	1710 to 1755	2110 to 2155
5	824 to 849	869 to 894
7	2500 to 2570	2620 to 2690
8	880 to 915	925 to 960
9	1749.9 to 1784.9	1844.9 to 1879.9
10	1710 to 1770	2110 to 2170
11	1427.9 to 1447.9	1475.9 to 1495.9
12	698 to 716	728 to 746
13	777 to 787	746 to 756
14	788 to 798	758 to 768
17	704 to 716	734 to 746
18	815 to 830	860 to 875
19	830 to 845	875 to 890
20	832 to 862	791 to 821
21	1447.9 to 1462.9	1495.9 to 1510.9
24	1626.5 to 1660.5	1525 to 1559
25	1850 to 1915	1930 to 1995
26	814 to 849	859 to 894
27	807 to 824	852 to 869
28	703 to 748	758 to 803
29	N/A	717 to 728
30	2305 to 2315	2350 to 2360
31	452.5 to 457.5	462.4 to 467.5
32	N/A	1452 to 1496
33	1900 to 1920	1900 to 1920
34	2010 to 2025	2010 to 2025
35	1850 to 1910	1850 to 1910
36	1930 to 1990	1930 to 1990
37	1910 to 1930	1910 to 1930
38	2570 to 2620	2570 to 2620
39	1880 to 1920	1880 to 1920
40	2300 to 2400	2300 to 2400
41	2496 to 2690	2496 to 2690
42	3400 to 3600	3400 to 3600
66	1710 to 1780	2110 to 2200
71	663 to 698	617 to 652

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main frame
ME7800L	Simple Conformance Test System
	Configuration items
MN8160A	Combiner Unit
Z1938A	Standard PC for SimpleCT (with monitor)
ME7800L-AK000	Accessory Kit for ME7800L
MD8430A	Signalling Tester
MS2692A	Signal Analyzer
MA24218A	Microwave Universal USB Power Sensor (10 MHz-18 GHz)
G0378B	APSIN20 G-HC-AZ1 Signal Generator
	Standard accessory
	ME7800L Operation Manual (CD-ROM) 1 set
	Options
ME7800L-001	LTE Protocol Test Package
ME7800L-011	IoT Protocol Test Package
ME7800L-051	LTE RF/RRM Test Package
ME7800L-061	IoT RF/RRM Test Package

The following DC power supplies and temperature chamber used for the RF tests can be controlled by the ME7800L.

DC Power Supply

The DC power supply to the mobile can be controlled.

Model	Name	pcs	Manufacturer
N6700C	Main frame	1	Keysight Technologies Inc.
N6732B*1	8 V, 6.25 A, 50 W DC Power Module	1	
N6708A	Filler Panel Kit	1	
2306-PJ	Dual-Channel Battery/Charger Simulator with 500 mA Range	1	Keithley Instruments Inc.

*1: When using DC power modules other than the N6732B, the customer must confirm whether the power supply can be installed in the N6700C main unit.

Temperature Chamber

The temperature chamber can be controlled for the mobile temperature test.

Model	Name	Manufacturer
SH-241*2	Bench-Top Type Temperature & Humidity Chamber	Espec Corp.
SH-242*2		
VT4002*3	EMC Shielding with Temperature	Votsch Industrietechnik GmbH
105*2	Benchtop Temperature Chamber	TestEquity LLC
107*2		
115*2	Temperature Chamber	

*2: GPIB cable is required to control this chamber automatically.
*3: USB-RS232C converter cable is required to control this chamber automatically.

MD8475A/MD8475B

Total Smartphone Application Testing

Excellent Eco Product

SmartStudio

All-in-One Support for LTE and Other Communications Systems

All the world's main communications technologies, such as triple-system LTE/W-CDMA/GSM/GPRS mobiles and TD-LTE/TD-SCDMA/GSM as well as LTE/CDMA2000 hybrids, can be tested using the all-in-one MD8475A/MD8475B. (Requires installation of optional units and software for each systems).

Scenario-less Smartphone Tests using SmartStudio

Unlike earlier base station simulators requiring time-consuming creation of complex scenarios, the SmartStudio MX847570A/MX847570B interactive user interface eliminates the need to create scenarios, smoothing UE testing.

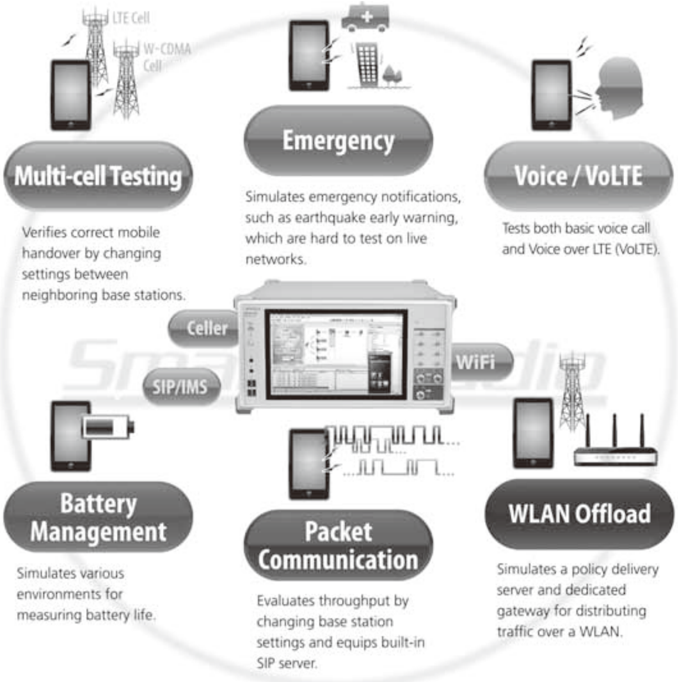
SmartStudio

Verifying Existing Smartphone Functions using SmartStudio Manager

Smartphone development requires verification of existing functions. Testing of items that have already been tested many times over, such as voice tests and SMS sending/receiving, are automated using SmartStudio Manager MX847503A to improve development efficiency.

Supports Versatile Smartphone Tests

Complex tests of multifunction smartphones are supported by the all-in-one MD8475A/MD8475B with interactive SmartStudio interface.

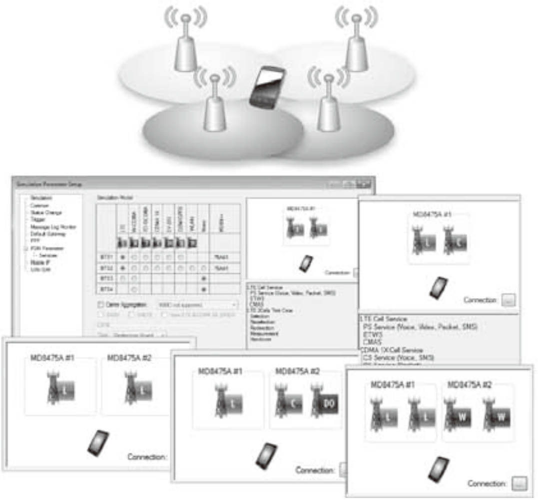


Configuring Multi-cell Test Environment

Performing UE tests between communications systems (handover tests) usually requires set-up of several measuring instruments and creation of complex scenarios. SmartStudio eliminates these problems by providing a simple test environment for fast and efficient testing.

Multi System Configuration

Roaming and power consumption tests of UEs require multi-cell connections. The MD8475A supports dual-RF tests. And MD8475B supports up to 8RF tests.
The SmartStudio GUI makes it easy to set multi-system test environments, especially for the latest Carrier Aggregation (CA) wireless standards.



Multi-cell Test Configurations

Tests of UEs moving between cells take the Selection, Redirection, Handover, and other conditions into consideration, depending on the UE and base station conditions. SmartStudio can register these UE and base station conditions, including the RF power, as a test case, making it quick and easy to evaluate UE behaviors and reproduce failures. Test cases are also useful for general UE evaluations when reproducing Handover failures.

Small-cell Switching Tests

Macrocell, small-cell, and femtocell base stations are being installed to provide wide coverage for people moving freely between base stations; SmartStudio provides easy test sequences for preferential capture of small-cells.

2-cell Testing Support by SmartStudio (MD8475A)

✓: Supported

Cell 2 Cell 1	LTE FDD/TDD	W-CDMA/HSPA/ HSPA Evolution/ DC-HSDPA	GSM/GPRS/ EGPRS	CDMA2000 1X	CDMA2000 1xEV-DO	TD-SCDMA/ TD-HSPA	WLAN
LTE FDD/TDD	✓*1,*2	✓	✓	✓*3	✓*3	✓	✓*4
W-CDMA/HSPA/HSPA Evolution/DC-HSDPA	✓	✓	✓	—	—	—	✓*4
GSM/GPRS/EGPRS	✓	✓	✓	—	—	✓	✓*4
CDMA2000 1X	✓*3	—	—	—	✓	—	✓*4
CDMA2000 1xEV-DO	✓*3	—	—	✓	—	—	✓*4
TD-SCDMA/TD-HSPA	✓	—	✓	—	—	✓	✓*4
WLAN	✓*4	✓*4	✓*4	✓*4	✓*4	✓*4	✓*4

*1: Two MD8475A units are required for MIMO connection.
*2: LTE-FDD/TDD Joint CA test is not supported.
*3: A hybrid mode test environment for LTE-CDMA2000 1X-CDMA2000 1xEV-DO can be configured using two MD8475A units.
*4: The WLAN Offload test requires a separate WLAN access point.

2-cell Testing Support by SmartStudio (MD8475B)

✓: Supported

Cell 2 Cell 1	LTE FDD/TDD	W-CDMA/HSPA/ HSPA Evolution/ DC-HSDPA	GSM/GPRS/ EGPRS	CDMA2000 1X	CDMA2000 1xEV-DO	TD-SCDMA/ TD-HSPA*2	WLAN
LTE FDD/TDD	✓	✓	✓	✓	✓	✓	✓*
W-CDMA/HSPA/HSPA Evolution/DC-HSDPA	✓	✓	✓	—	—	—	✓*
GSM/GPRS/EGPRS	✓	✓	✓	—	—	✓	✓*
CDMA2000 1X	✓	—	—	—	✓	—	✓*
CDMA2000 1xEV-DO	✓	—	—	✓	—	—	✓*
TD-SCDMA/TD-HSPA*	✓	—	✓	—	—	✓	✓*
WLAN	✓*	✓*	✓*	✓*	✓*	✓*	—

*: The WLAN Offload test requires a separate WLAN access point.

Multi-cell Testing Support by SmartStudio (MD8475B)

Cell 1	Cell 2	Cell 3	Cell 4
LTE	LTE	LTE	—
LTE	LTE	W-CDMA	—
LTE	LTE	GSM	—
LTE	LTE	TD-SCDMA	—
LTE	CDMA2000 1X	CDMA2000 1xEV-DO	—
LTE	LTE	CDMA2000 1X or CDMA2000 1xEV-DO	—
LTE	LTE	LTE	LTE

Carrier Aggregation Tests

The MD8475A/MD8475B supports LTE CA 2CC/3CC/4CC/5CC for throughput performance tests of UEs, such as smartphones using high-speed data networks.

	MD8475A	MD8475B
Configuration		
Operation Software	SmartStudio	
Required CA Option	MX847550A-040	MX847550B-040 MX847550B-041 (3CC) MX847550B-042 (4CC) MX847550B-043 (5CC) MX847570B-051
RF	1TX/1RX (standard), 2TX/2RX (option)	4TX/2RX (standard), 8TX/4RX (option)
Support for DL CA	2CC SISO 2CC MIMO (2×2)*	2CC SISO 2CC MIMO (2×2) 2CC MIMO (4×4) 3CC SISO 3CC MIMO (2×2) 3CC MIMO (4×4) 4CC SISO 4CC MIMO (2×2) 4CC MIMO (4×4) 5CC MIMO (4×4)
UE Category	Cat.4, Cat.6	Cat.4, Cat.6, Cat.9, Cat.11, Cat.16, Cat.18, Cat.19

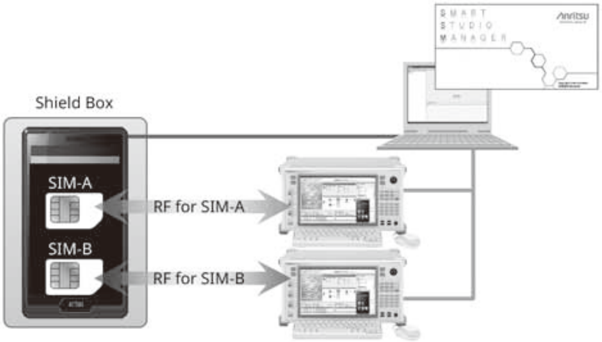
*: Two MD8475A units are required.

SIM Connectivity Test

Dual SIM Dual Standby (DSDS) and Dual SIM Dual Active (DSDA) tests of dual-SIM UE can be performed using two sets of MD8475A/MD8475B. Additionally, Single SIM Dual Standby (SSDS) and Single SIM Dual Active (SSDA) of single-SIM UE can be performed using one MD8475A/ MD8475B. These test environments can be fully automated using SmartStudio Manager.

Test Example:

The power consumption and throughput of a dual-SIM UE can be confirmed while the UE is making a voice call using SIM1 and transferring packet data using SIM2.



Simple Throughput Test Environment (MD8475B)

Throughput testing until now

- It needs to be adjusted for each application about radio layer settings and server settings.
- Performance depends on the PC specification and the load of Ethernet.

Throughput testing using MD8475B

- Single GUI supports to adjust for each application about radio layer settings and server settings.
- Performance is independent from PC specification and the load of Ethernet.

For the transmission and reception of the UE, use iPerf application which is widely used for throughput testing.

Data Packet Communications

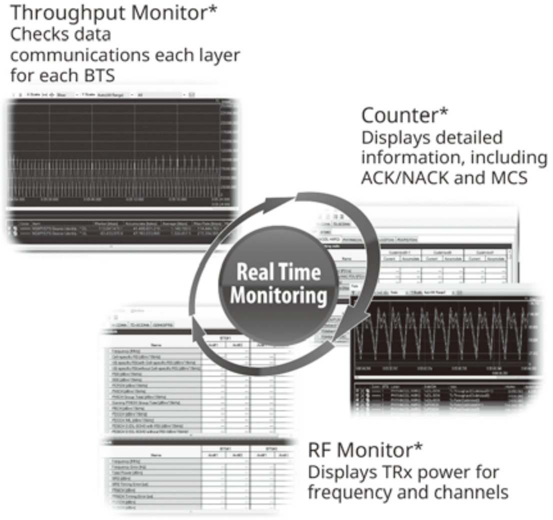
Data packet communication environments are complex, but SmartStudio makes it easy to resolve troublesome packet bottlenecks, shortening evaluation times.

Versatile Server Environment

Because the MD8475A/MD8475B pre-installs Windows 7, commercial application servers can be easily installed.

Status Evaluation

A full line of function tools can be used to check communication status, including throughput, ACK/NACK counts, and RF monitoring. Simultaneous checking of multiple layers allows quick troubleshooting during data communications.



Throughput Monitor*
Checks data communications each layer for each BTS

Counter*
Displays detailed information, including ACK/NACK and MCS

RF Monitor*
Displays TRx power for frequency and channels

*: Not supported for CDMA2000.

Genuine Application Test Environment

Connecting the MD8475A/MD8475B to the Internet supports Web application tests using UEs under development to verify actual in-use power consumption and throughput before market release.

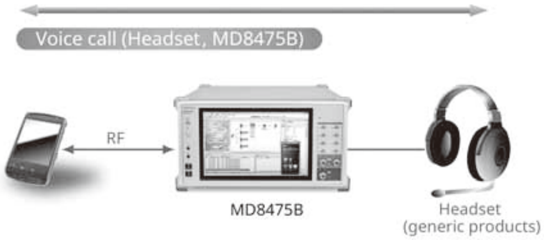
Voice Call Evaluation Environment

The need for voice-call evaluations has not changed even with the spread of LTE services. However, some voice-call test items, such as the access barred condition and emergency calls, are not easily evaluated on live networks. SmartStudio supports comprehensive evaluation of UE under high-load conditions, such as testing of simultaneous voice calls and other functions.

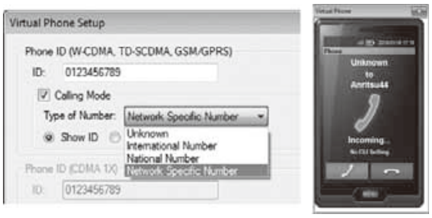
3G/2G Voice Calling Test

Just making voice settings using SmartStudio is all that is necessary for voice tests with the MD8475A/MD8475B.

- Multimedia Interface Software MX847508B



- Setting Roaming and Registering Address Book
  When performing incoming-call tests of W-CDMA/GSM UE, SmartStudio can display any of 'Public', 'National', 'International', and 'Unknown' on the UE. Additionally, when the incoming call number matches a preregistered number in the address book, the name associated with the number is displayed.



Virtual Phone Setup

Phone ID (W-CDMA, TD-SCDMA, GSM/GPRS)

ID: 0123456789

☑ Calling Mode

Type of Number: Network Specific Number

● Show ID ○

Phone ID (CDMA 1X)

ID: 0123456789

*: Not supported for LTE/CDMA2000.

- Setting Identify Type
  When performing incoming call tests of W-CDMA/GSM UEs, either IMSI or TMSI can be chosen for the UE Caller ID using Paging.

Voice over LTE Tests

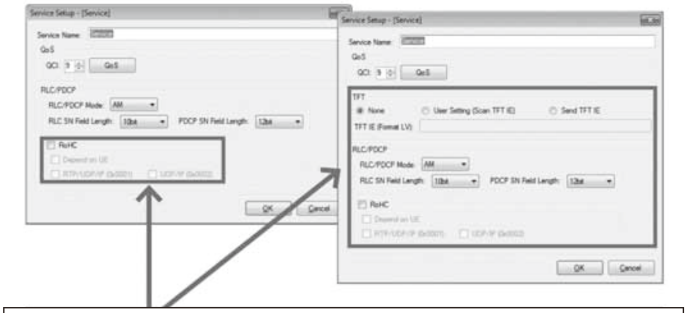
Since LTE uses the data network, Voice over LTE (VoLTE) communications also use the data network; SmartStudio simplifies VoLTE tests.

- Loopback Tests of VoLTE/Video

  The SmartStudio CSCF function supports VoLTE tests (AMR/W-AMR Codec, etc.) in the loopback mode.

  In addition to an IMS server, VoLTE tests require a variety of LTE settings about multi-PDN. Not only does SmartStudio support multi-PDN*[1], but it it also supports packet filter and QoS settings. Additionally, loopback audio data can be changed using the RTP function.

  At VoLTE loopback testing, as well as looping voice data sent to the terminal from the network back from the terminal, the voice data can be changed to the MUTE status or to a fixed pattern to perform communications quality tests and battery consumption measurements requiring good reproducibility.*[2]



Service Setup - [Service]

Service Name:

QoS

QCI: 9

RLC/PDCP

RLC/PDCP Mode: AM

RLC SN Field Length: 10bit

PDCP SN Field Length: 12bit

☐ RoHC

☐ Depend on UE

☐ RTP/UDP/IP (0x0001) ☐ UDP/IP (0x0002)

Service Setup - [Service]

Service Name:

QoS

QCI: 9

TFT

● None ○ User Setting (Scan TFT IE) ○ Send TFT IE

TFT IE (Format LV)

RLC/PDCP

RLC/PDCP Mode: AM

RLC SN Field Length: 10bit

PDCP SN Field Length: 12bit

☐ RoHC

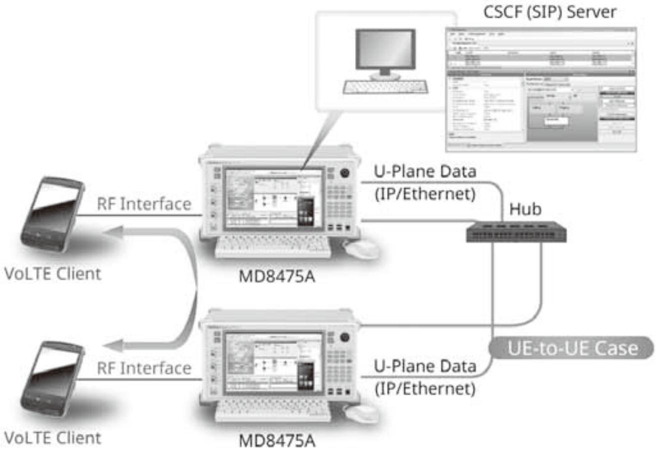
☐ Depend on UE

☐ RTP/UDP/IP (0x0001) ☐ UDP/IP (0x0002)

Sets RoHC*[3] and TFT filter at Default Bearer and Dedicated Bearer

- End-to-End Tests of VoLTE and Video Call

  Voice over LTE can be tested between two LTE UEs in both directions using two MD8475A units to benchmark and evaluate calls between actual UEs.



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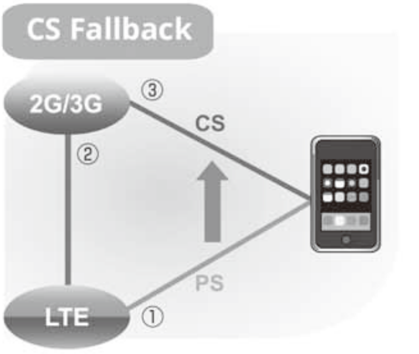
*1: GSM and TD-SCDMA are not supported.

*2: Requires MX847570A-086 or MX847570B-086.

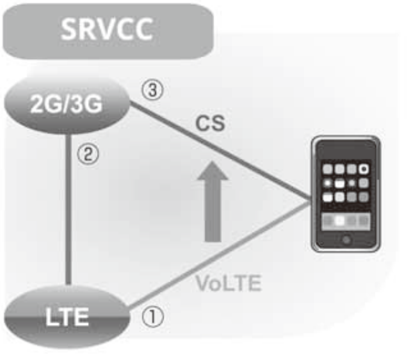
*3: RoHC settings require the MX847550A-060 or MX847550B-060 option.
The RTP/VDP/IP (0x0001) and UDP/IP RoHC (0x0002) profiles are supported.

Testing Voice Calls from LTE to 3G/2G

A variety of technologies are used when a UE moves between systems from an LTE to 3G/2G cell. Configuring a 2-cell test environment using SmartStudio supports LTE and 2G/3G system voice call tests such as CS Fallback and SV-LTE (Simultaneous Voice and LTE).



① LTE: Communications by PS
② Receive call by CS and notify UE of incoming call via LTE from 2G/3G system
③ Connect voice call by CS



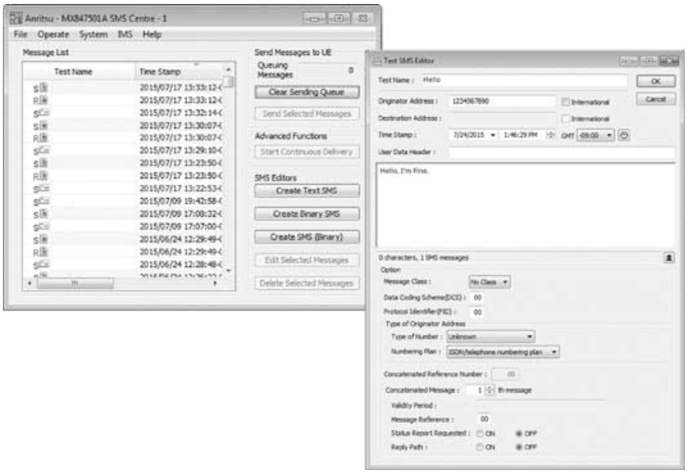
① LTE: Calling over VoLTE
② Transfer 3G/2G information from base station before moving between systems
③ Continue voice call without interruption

SMS Tests

SMS and MMS are popular messaging services used worldwide. Exchanges between UEs as well as the number of verification items are both increasing because more direct control of UE is being attempted now.

Sending/Receiving SMS Text Messages

SmartStudio has a dedicated SMS server supporting sending and receiving of SMS messages at any PS or CS network setting. Multiple SMS messages can be preregistered for continuous sending and CBS messages can be sent too.



Queuing Messages 0

	Test Name	Time Stamp
S		2015/07/17 13:33:12
R		2015/07/17 13:33:12
S		2015/07/17 13:32:14
S		2015/07/17 13:30:07
R		2015/07/17 13:30:07
S		2015/07/17 13:29:10
S		2015/07/17 13:23:50
R		2015/07/17 13:23:50
S		2015/07/17 13:22:53
S		2015/07/09 19:42:58
S		2015/07/09 17:08:32
S		2015/07/09 17:07:00
S		2015/06/24 12:29:49
R		2015/06/24 12:29:49
S		2015/06/24 12:28:48

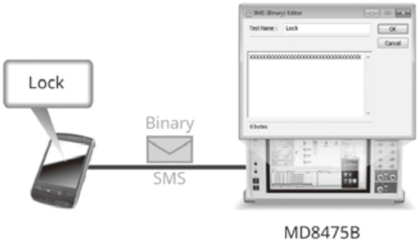
Test Name : Hello
Originator Address : 1234567890 ☐ International
Destination Address : ☐ International
Time Stamp : 7/24/2015 1:46:29 PM GMT -09:00
User Data Header :

Hello, I'm Fine.

0 characters, 1 SMS messages
Option
Message Class : No Class
Data Coding Scheme(DCS) : 00
Protocol Identifier(PID) : 00
Type of Originator Address
Type of Number : Unknown
Numbering Plan : ISDN/telephone numbering plan
Concatenated Reference Number : 00
Concatenated Message : 1 th message
Validity Period :
Message Reference : 00
Status Report Requested : ○ ON ● OFF
Reply Path : ○ ON ● OFF

Sending Binary SMS

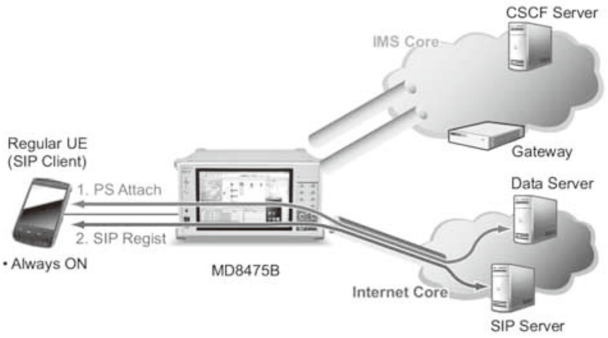
The MD8475A/MD8475B can send binary messages as SMS supporting remote control of the UE. Additionally, general evaluations, such as behavior when receiving an SMS during a voice call, can be evaluated to help prevent problems occurring in the field.



IMS Service Tests

SmartStudio has a built-in standard server environment for running IMS server functions for easy service tests, including VoLTE, SMS over IMS, etc.

- SIP Registration of a Non-IMS UE

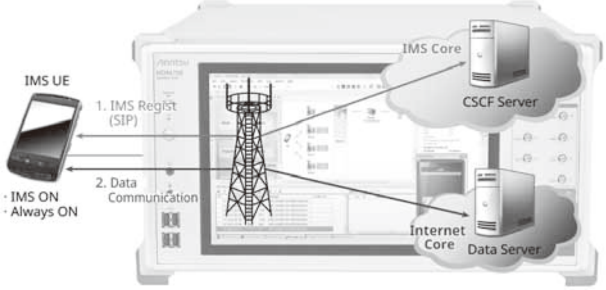


Typical Connection Procedure

1. PS Attach: Connect to Data server.
   → Get address using DNS, etc.
2. SIP Registration:
   → Depends on application.

⇒ One PDN is required.

- SIP Registration of an IMS UE



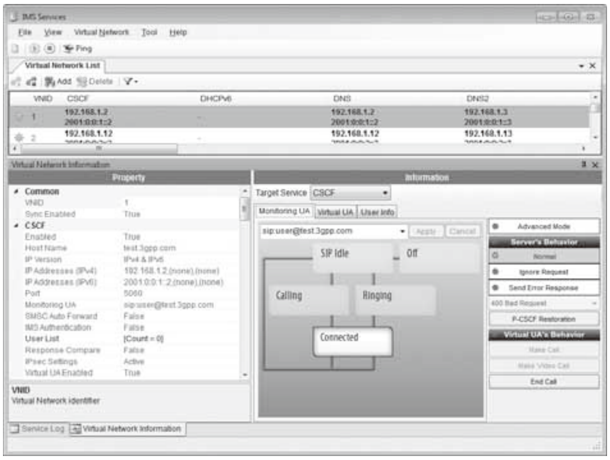
Typical Connection Procedure

1. IMS Registration: Connect to CSCF server using SIP.
2. Data Communication: Connect to Data server.

⇒ Consequently, two or more PDN required.

Standard IMS Server Function

- CSCF (Call Session Control Function)
  Supports standard server function for VoLTE and SMS over IMS tests as well as voice data loopback function. IPsec is supported too.
- DHCPv6 (Dynamic Host Configuration Protocol v6)
  Allocates IPv6 address and notifies DNS/SIP server address to network node.
- DNS (Domain Name System)
  Operates as DNS cache server.
- NDP (Neighbor Discovery Protocol)
  Supports function to transmit RA (Router Advertisement) and periodically transmit RA to RS (Router Solicitation).
- NTP (Network Time Protocol)
  The UE and MD8475A times are synchronized by sending time data in response to an NTP request.
- PSAP (Public Safety Answering Point)
  The UA (User Agent) and voice data loopback function support PSAP simulation for running IMS Emergency tests.
- XCAP (XML Configuration Access Protocol)
  This function supports updating, referencing, and deleting of XML format file data (XCAP documents).



VNID	CSCF	DHCPv6	DNS	DNS2
1	192.168.1.2 2001:0:0:1::2	-	192.168.1.2 2001:0:0:1::2	192.168.1.3 2001:0:0:1::3
2	192.168.1.12	-	192.168.1.12	192.168.1.13

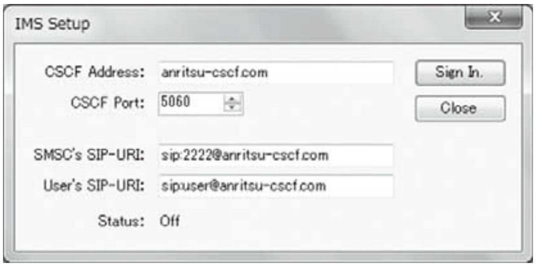
Common
VNID: 1
Sync Enabled: True
CSCF
Enabled: True
Host Name: test.3gpp.com
IP Version: IPv4 & IPv6
IP Addresses (IPv4): 192.168.1.2,(none),(none)
IP Addresses (IPv6): 2001:0:0:1::2,(none),(none)
Port: 5060
Monitoring UA: sip:user@test.3gpp.com
SMSC Auto Forward: False
IMS Authentication: False
User List: [Count = 0]
Response Compare: False
IPsec Settings: Active
Virtual UA Enabled: True

VNID
Virtual Network identifier

Target Service: CSCF
sip:user@test.3gpp.com
400 Bad Request

SMS over IMS Setting

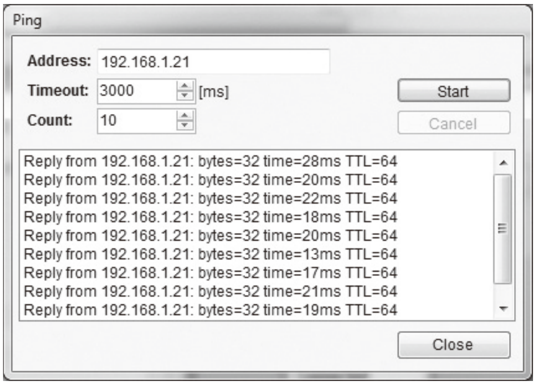
UE can register with CSCF server, and can transmit and receive SMS over IMS.



CSCF Address: anritsu-cscf.com
CSCF Port: 5060
SMSC's SIP-URI: sip:2222@anritsu-cscf.com
User's SIP-URI: sip:user@anritsu-cscf.com
Status: Off

Ping Sending Function

The Ping sending function is used to verify the connection of the device under test to the network.



Address: 192.168.1.21
Timeout: 3000 [ms]
Count: 10

```
Reply from 192.168.1.21: bytes=32 time=28ms TTL=64
Reply from 192.168.1.21: bytes=32 time=20ms TTL=64
Reply from 192.168.1.21: bytes=32 time=22ms TTL=64
Reply from 192.168.1.21: bytes=32 time=18ms TTL=64
Reply from 192.168.1.21: bytes=32 time=20ms TTL=64
Reply from 192.168.1.21: bytes=32 time=13ms TTL=64
Reply from 192.168.1.21: bytes=32 time=17ms TTL=64
Reply from 192.168.1.21: bytes=32 time=21ms TTL=64
Reply from 192.168.1.21: bytes=32 time=19ms TTL=64
```

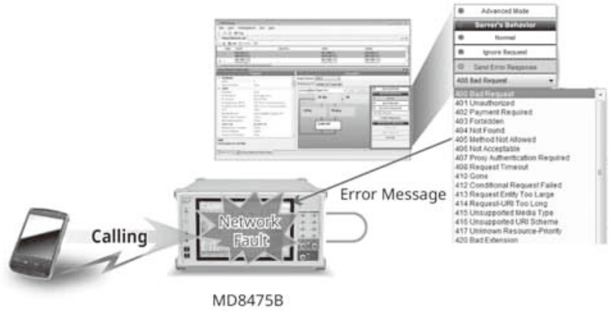
IMS Options

Extended CSCF Option MX847570A-080/MX847570B-080

Various conditions can be set for VoLTE/Video quasi-normal and abnormal tests. Moreover, VoLTE call and hang-up sequences can both be confirmed from SmartStudio. In addition, VoLTE/Video audio codec switchover tests are supported as well.

- Virtual UA Calling/Release
  VoLTE calling from the SmartStudio simulated UE (Virtual UA) is supported. In addition, any Virtual UA response can be set.

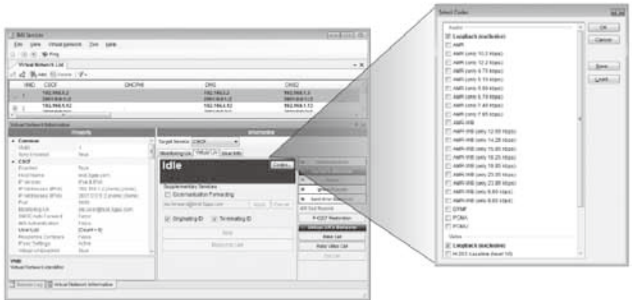
- Network Fault
  The occurrence of a server or network fault can be created.



- Message Blocking
  Ignore and Reply responses to specific messages can be changed arbitrarily.

- Multi-P-CSCF Settings
  Up to three types of P-CSCF addresses can be notified to UE by one PDN to confirm correct UE operation for multiple addresses.

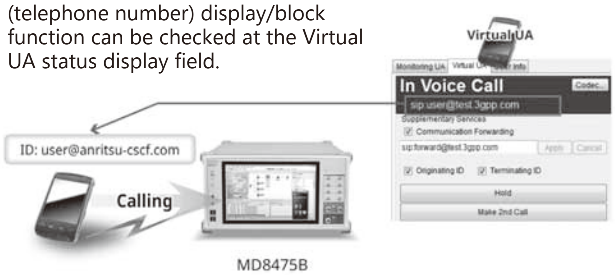
- Voice Codec Switchover
  Any codec can be sent from the MD8475A/MD8475B to the UE, and switchover tests, such as VoLTE → Video, are supported too.



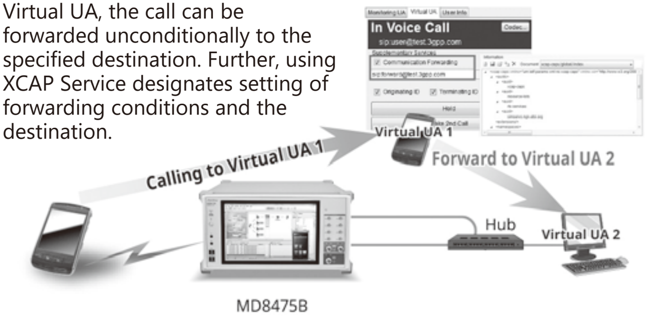
IMS Supplementary Service Option MX847570A-081/MX847570B-081

This option adds functions for simulating VoLTE/Video caller ID, call transfer and call hold. Various CSCF and XCAP service settings as well as supplementary service functions can be set.

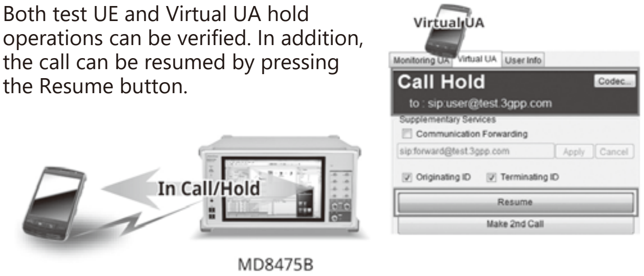
- Caller ID Display ON/OFF Function
  After a call from the test UE, the caller ID (telephone number) display/block function can be checked at the Virtual UA status display field.



- Forwarding Function
  At calling from the test UE to the Virtual UA, the call can be forwarded unconditionally to the specified destination. Further, using XCAP Service designates setting of forwarding conditions and the destination.



- Call Hold/Resume Function
  Both test UE and Virtual UA hold operations can be verified. In addition, the call can be resumed by pressing the Resume button.



- VoLTE Conference Test
  The 3GPP TS 24.605 defined VoLTE Conference Call functions can be tested.

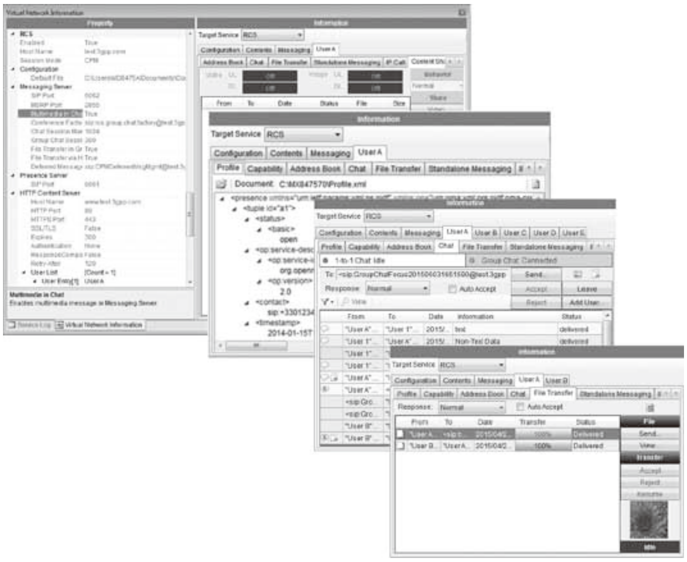
3GPP TS 24.605	
4.5.2.1.1	User joining a conference
4.5.2.1.2	User inviting another user to a conference
4.5.2.1.3	User leaving a conference
4.5.2.1.4	User creating a conference
4.5.2.1.5	Subscription for the conference event package
4.5.2.2.1	Conference focus
4.5.2.2.2	Conference notification service
4.5.2.7	Actions at the destination UE
4.6.1	Communication HOLD (HOLD)
4.6.3	Terminating Identification Restriction (TIR)
4.6.5	Originating Identification Restriction (OIR)

RCS Basic Option MX847570A-083/MX847570B-083

Rich Communication Suite (RCS) is the next evolutionary step in deploying existing simple voice and messaging (SMS, MMS) services with "rich" communications.
Installing this software supports RCS defined tests of Instant Messaging (IM), Address Book, and Contents sharing.

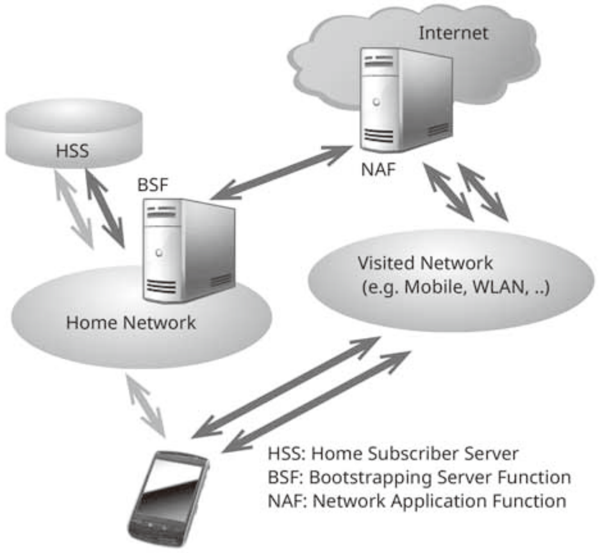
Item	Note
Configuration & Registration	HTTP (S) based support
Capability Discovery	
Standalone Messaging	
1-to-1 Chat	
Group Chat	
File Transfer	
Content Sharing	
Social Presence Information	Geolocation service not supported
IP Voice Call	IR.92 based support Interaction with other RCS services not supported
IP Video Call (IR.94)	IR.94 based support

RCS Service Image



GBA Authentication Option MX847570A-084/MX847570B-084

The software option references the 3GPP GBA Authentication algorithm to simulate the authentication procedure required when connecting to the Internet via networks other than Home Networks.



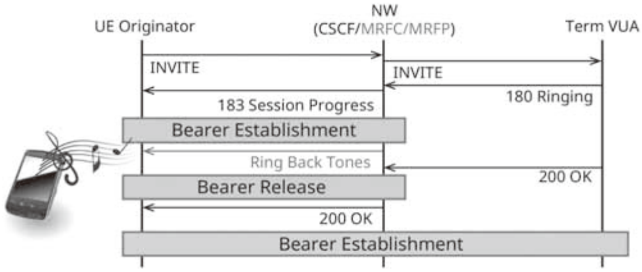
HSS: Home Subscriber Server
BSF: Bootstrapping Server Function
NAF: Network Application Function

IMS Early Media Option MX847570A-085/MX847570B-085

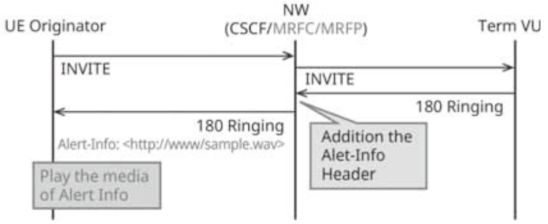
The software option simulates the IMS Early Media sequence.
It supports MRFC, MRFP, etc., nodes and can authenticate service functions such as customized ringtones from the network side.

NRBT: Function for recovering RBT (ring back tone) from network rather than from UE

The recovery status (recovery possible/not possible/recovering/stopped) for each session is displayed on the Information screen.

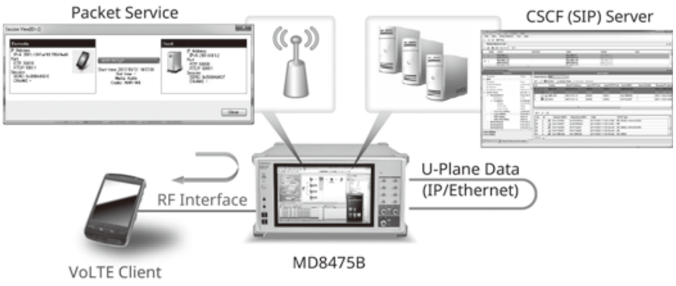


Alert-Info: Provides substitute ring back tone using Alert-Info, one of the Early Media switching function



RTP Frame Control Option MX847570A-086/MX847570B-086

This software controls the media data (RTP packets) during VoLTE communications. In addition to the MUTE condition and Fixed pattern, the data itself can be delayed; it can be used to configure the static stage required at audio evaluation and battery consumption measurement.

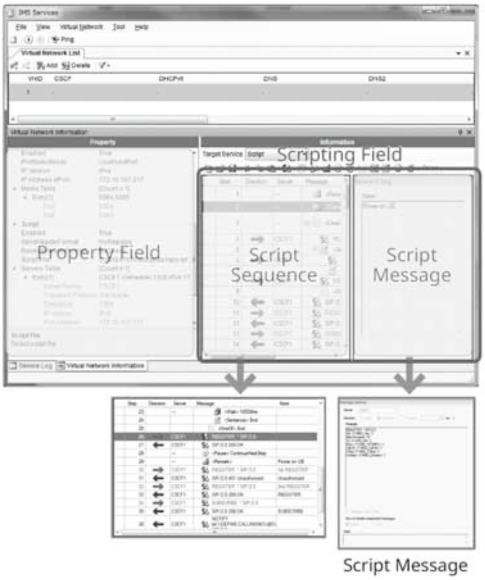


IMS Script Basic Option MX847570A-060/MX847570B-060
XCAP Script Option MX847570A-061/MX847570B-061

The software option can be used to edit and create SIP messages/XCAP messages using a ladder sequence to simulate the CSCF server/XCAP server behavior. Not only can configure a test environment from the service designing specification stage, but also user-specific tests, such as quasi-normal and abnormal conditions, can also be tested to easily support every test requirement.

Property Field:
Network parameters such as IP address are set here.

Scripting Field:
Sequence messages between the UE and CSCF are edited and executed here.



IMS Options (MD8475A/MD8475B)

✓: Supported

Section	Function	Outline	GUI Option							Scripting Option*2	
			MX847570A MX847570B	MX847570A-080 MX847570B-080	MX847570A-081 MX847570B-081	MX847570A-083 MX847570B-083	MX847570A-084 MX847570B-084	MX847570A-085 MX847570B-085	MX847570A-086 MX847570B-086	MX847570A-060 MX847570B-060	MX847570A-061 MX847570B-061
General	SIP REGIST Test	Function for verifying CSCF server Bind/Unbind operation	✓	—	—	—	—	—	—	✓	—
	IPsec	Function for on/off of IPsec (3DES, AES).	✓	—	—	—	—	—	—	✓	—
	DNS Server	Function for resolving address using DNS	✓	—	—	—	—	—	—	—	—
	NTP Server	Function for synchronizing time using NTP	✓	—	—	—	—	—	—	—	—
	PSAP Server	Function for looping-back voice for IMS Emergency	✓	—	—	—	—	—	—	✓	—
	X-CAP Server	Function for verifying service using XML file	✓	—	—	—	—	—	—	—	✓
	BSF Server	Function for verifying GBA	—	—	—	—	✓	—	—	—	—
	No Server (Network) Response Test	Function for verifying operation when no response due to error at server or network	—	✓	—	—	—	—	—	✓	✓
	Server Error Test	Function for verifying operation when error response received from server due to the error at server	—	✓	—	—	—	—	—	✓	✓
	Multi P-CSCF	Function for reporting up to three P-CSCF servers to UE	—	✓	—	—	—	—	—	—	—
VoLTE/ Video Telephony	Calling Sequence Test	Function for verifying call sequence from UE	✓	—	—	—	—	—	—	✓	—
	Incoming Call Sequence Test	Function for verifying call sequence to UE	—	✓*1	—	—	—	—	—	✓	—
	Voice Loopback Test	Function for looping-back and sending uplink voice data to verify call at UE side	✓	—	—	—	—	—	—	✓	—
	Voice Loopback Test (fixed pattern)	Function for configuring the static stage required at audio evaluation and battery consumption measurement	✓	—	—	—	—	—	✓	—	—
	Early media Test	Function for verifying early media sequence and Ring Back Tone	—	—	—	—	—	✓	—	—	—
	Disconnection (from UE) Sequence Test	Function for verifying disconnection sequence from UE	✓	—	—	—	—	—	—	✓	—
	Disconnection (from NW) Sequence Test	Function for verifying disconnection sequence from network	—	✓*1	—	—	—	—	—	✓	—
	Called Party Busy Test	Function for verifying operation when called party busy	—	✓	—	—	—	—	—	✓	—
	Called Party Not Found Test	Function for verifying operation when called party not found	—	✓	—	—	—	—	—	✓	—
	Called Party No Response Test	Function for verifying operation when no response from called party	—	✓	—	—	—	—	—	✓	—
	Codec Selection	Function for confirming VoLTE/VT traffic with any codec; also performs loopback	—	✓	—	—	—	—	—	✓	—
	VoLTE/Video Telephony Upgrade/Downgrade	Switches VoLTE/Video Telephony during call	—	✓	—	—	—	—	—	✓	—
	Call ID Display/Block	TS 24.607 verifies IMS test UE caller ID display ON/OFF	—	—	✓	—	—	—	—	✓	✓
	Incoming Call ID Display/Block	TS 24.608 verifies IMS test UE incoming caller ID display ON/OFF	—	—	✓	—	—	—	—	✓	✓
	Call Forwarding, Holding, Catchphone	Function for simulating TS 24.604, TS 24.610, TS 24.615 call forwarding, call holding, and catchphone functions	—	—	✓	—	—	—	—	—	✓
	VoLTE Conference Environment	Function for verifying TS 24.605 VoLTE Conference related tests (Event message, HOLD, etc.)	—	—	✓	—	—	—	—	✓	✓
	Message Waiting Indication	Function for notifying users of voice mail services about arriving voice mail	—	—	✓	—	—	—	—	✓	✓
RCS	Configuration	Function for creating and updating UE configuration data using XML file	—	—	—	✓	—	—	—	—	—
	Presence	Function for referring UE configuration data using XML file	—	—	—	✓	—	—	—	—	—
	Instant Messaging	Function for sending and receiving Instant Message using XML file	—	—	—	✓	—	—	—	—	—
	RCS Address Book	Function for registering and saving UE contacts using RCS	—	—	—	✓	—	—	—	—	—
	1 to 1 Chat (CPM)	Function for 1 to 1 chat by connecting with CPM mode	—	—	—	✓	—	—	—	—	—
	Group Chat	Function for multi party chat (Maximum 5 users)	—	—	—	✓	—	—	—	—	—
	File Transfer	Function for sending and receiving same files between users	—	—	—	✓	—	—	—	—	—
	Contents Sharing	Function for sharing same files between users	—	—	—	✓	—	—	—	—	—
SMS over IMS	SMS Message Send Test	Function for verifying UE SMS message sending	✓	—	—	—	—	—	—	✓	✓
	SMS Message Receive Test	Function for verifying UE SMS message receiving	✓	—	—	—	—	—	—	✓	✓
IPv6 Addressing	IP Address Allocation Test (RA)	Function for verifying IP address setting at RA receiving	✓	—	—	—	—	—	—	—	—
	IP Address Allocation Test (DHCPv6)	Function for verifying IP address setting allocated from DHCPv6 server	✓	—	—	—	—	—	—	—	—
VoLTE Emergency Call	VoLTE Emergency Call (Voice)	Function for verifying IP VoLTE Emergency Call	—	✓	—	—	—	—	—	—	—

*1: This option is unnecessary when a separate network-side UE is prepared.
*2: The user must create the test message script.

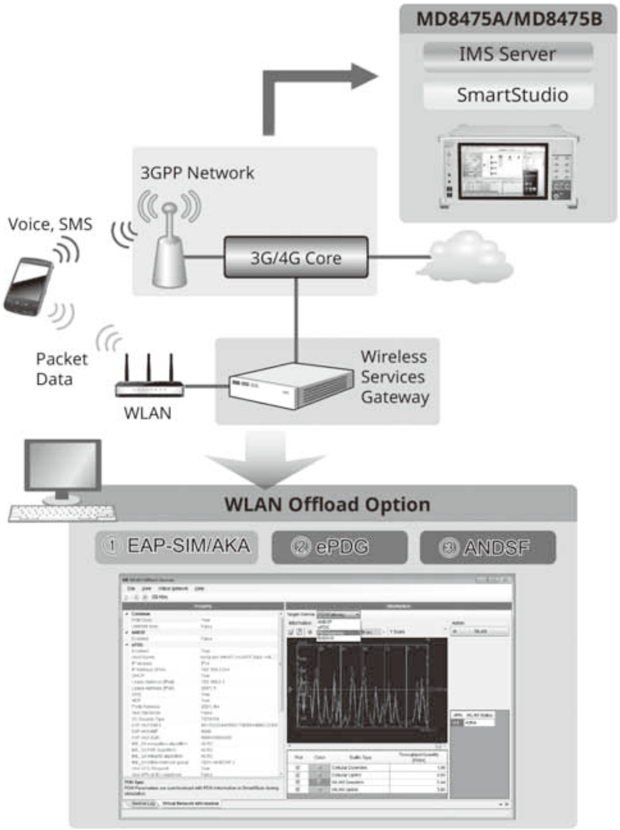
New Services

New network services are being deployed at an increasing rate, requiring more-and-more tests for UEs supporting such new services.
The MD8475A/MD8475B makes it easy to support new mobile test environments.

WLAN Offload Tests

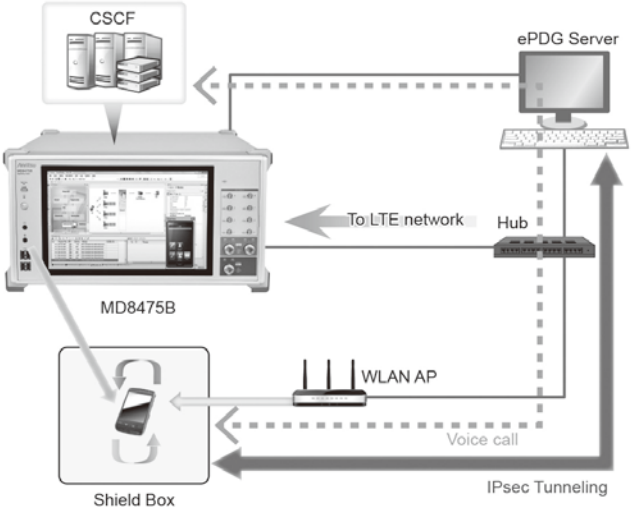
Offloading data traffic to WLAN networks is being deployed as a technology for preventing traffic congestion on mobile networks. The MD8475A/MD8475B supports a WLAN data offload test environment.

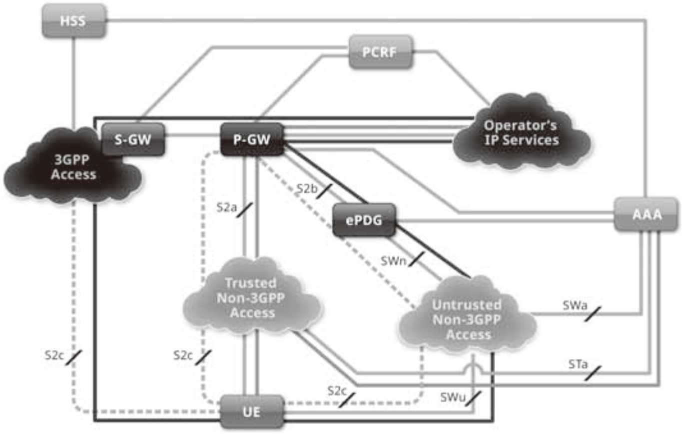
- WLAN Offload Basic Option MX847570A-070/MX847570B-070
  The software option provides functions for forwarding packets between the UE and networks with both Trusted non-3GPP Access and Untrusted non-3GPP Access authentication functions, as well as for monitoring packets graphically.
- ePDG Option MX847570A-071/MX847570B-071
  The software option supports the IKEv2 key exchange procedure and IPsec communications functions for Untrusted non-3GPP Access network authentication.
- ANDSF Option MX847570A-072/MX847570B-072
  The software option supports the function for setting and distributing the system selection policy between 3GPP and WLAN (distributes Policy and Discovery Information according to request from UE, and receives Location and Profile reports from UE).
- Extended ePDG Option MX847570A-073/MX847570B-073
  The software option supports configuration of an ePDG status fault test environment for inserting errors into the ePDG sequence, setting timeouts, etc. Additionally, this option can be used to support Fast Re-Authentication (EAP-SIM/EAP-AKA) tests without the need to generate UE-side authentication keys.



Wi-Fi Calling Evaluation Environment

Wi-Fi Calling is a function for making voice calls and sending/receiving SMS over WLAN. Using this function, voice calls can be made using the telephone number registered inside the SIM card. Combining the MD8475A/MD8475B with the WLAN option supports verification of Wi-Fi Calling voice calls as well as handover tests from VoLTE to Wi-Fi Calling and vice versa.



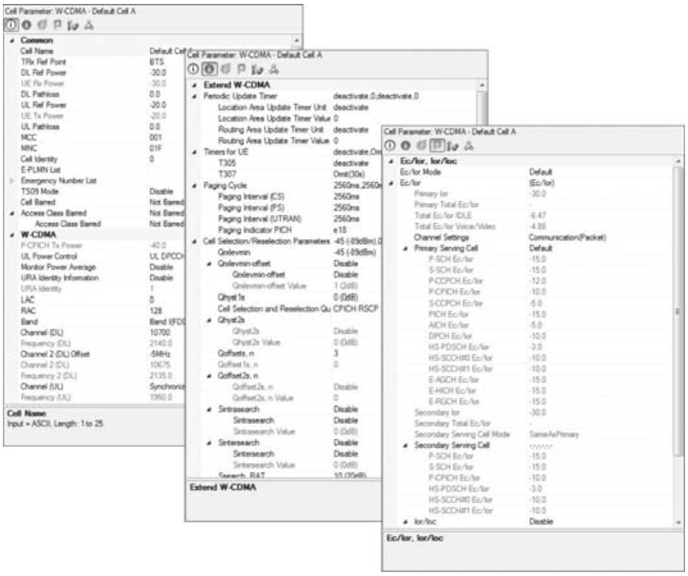


Power Consumption Test

SmartStudio supports detailed settings such as changes to the UE RF output and stopping packet communications.

Base Station Settings

Any messages, such as Paging Cycle, UL TPC, etc., can be sent to the UE*.
Support W-CDMA CPC, Ec/lor, etc.



Cell Parameter: W-CDMA - Default Cell A

Common	
Cell Name	Default Cell
TRx Ref Point	BTS
DL Ref Power	-30.0
UE Rx Power	-30.0
DL Pathloss	0.0
UL Ref Power	-20.0
UE Tx Power	-20.0
UL Pathloss	0.0
MCC	001
MNC	01F
Cell Identity	0
E-PLMN List	
Emergency Number List	
T509 Mode	Disable
Cell Barred	Not Barred
Access Class Barred	Not Barred
Access Class Barred	Not Barred
W-CDMA	
P-CPICH Tx Power	-40.0
UL Power Control	UL DPCCH
Monitor Power Average	Disable
URA Identity Information	Disable
URA Identity	1
LAC	0
RAC	128
Band	Band I(FDD
Channel (DL)	10700
Frequency (DL)	2140.0
Channel 2 (DL) Offset	-5MHz
Channel 2 (DL)	10675
Frequency 2 (DL)	2135.0
Channel (UL)	Synchroniz
Frequency (UL)	1950.0

Cell Name
Input = ASCII, Length: 1 to 25

Cell Parameter: W-CDMA - Default Cell A

Extend W-CDMA	
Periodic Update Timer	deactivate,0,deactivate,0
Location Area Update Timer Unit	deactivate
Location Area Update Timer Value	0
Routing Area Update Timer Unit	deactivate
Routing Area Update Timer Value	0
Timers for UE	deactivate,Om
T305	deactivate
T307	Omit(30s)
Paging Cycle	2560ms,2560
Paging Interval (CS)	2560ms
Paging Interval (PS)	2560ms
Paging Interval (UTRAN)	2560ms
Paging Indicator PICH	e18
Cell Selection/Reselection Parameters	-45 (-89dBm),0
Qrxlevmin	-45 (-89dBm)
Qrxlevmin-offset	Disable
Qrxlevmin-offset	Disable
Qrxlevmin-offset Value	1 (2dB)
Qhyst1s	0 (0dB)
Cell Selection and Reselection Qu	CPICH RSCP
Qhyst2s	
Qhyst2s	Disable
Qhyst2s Value	0 (0dB)
Qoffsets, n	3
Qoffset1s, n	0
Qoffset2s, n	
Qoffset2s, n	Disable
Qoffset2s, n Value	0
Sintrasearch	Disable
Sintrasearch	Disable
Sintrasearch Value	0 (0dB)
Sintersearch	Disable
Sintersearch	Disable
Sintersearch Value	0 (0dB)
Ssearch, RAT	10 (20dB)

Extend W-CDMA

Cell Parameter: W-CDMA - Default Cell A

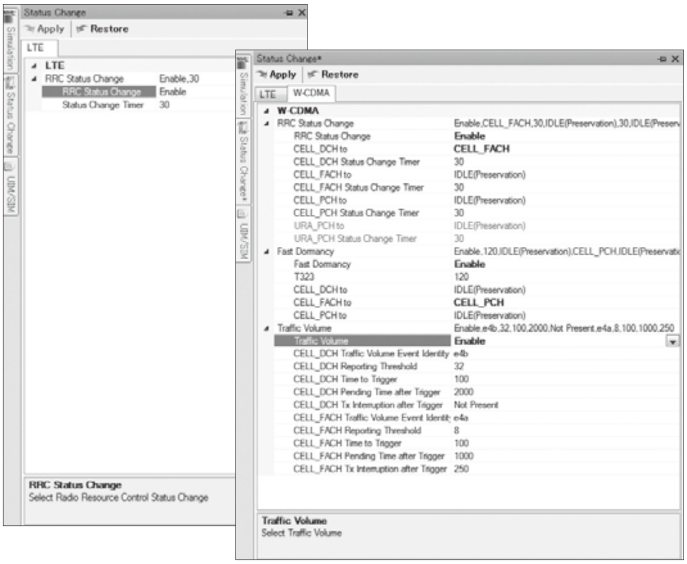
Ec/lor, lor/loc	
Ec/lor Mode	Default
Ec/lor	(Ec/lor)
Primary lor	-30.0
Primary Total Ec/lor	-
Total Ec/lor IDLE	-6.47
Total Ec/lor Voice/Video	-4.88
Channel Settings	Communication(Packet)
Primary Serving Cell	Default
P-SCH Ec/lor	-15.0
S-SCH Ec/lor	-15.0
P-CCPCH Ec/lor	-12.0
P-CPICH Ec/lor	-10.0
S-CCPCH Ec/lor	-5.0
PICH Ec/lor	-15.0
AICH Ec/lor	-5.0
DPCH Ec/lor	-10.0
HS-PDSCH Ec/lor	-3.0
HS-SCCH#0 Ec/lor	-10.0
HS-SCCH#1 Ec/lor	-10.0
E-AGCH Ec/lor	-15.0
E-HICH Ec/lor	-15.0
E-RGCH Ec/lor	-15.0
Secondary lor	-30.0
Secondary Total Ec/lor	-
Secondary Serving Cell Mode	SameAsPrimary
Secondary Serving Cell	,,,,,,
P-SCH Ec/lor	-15.0
S-SCH Ec/lor	-15.0
P-CPICH Ec/lor	-10.0
HS-PDSCH Ec/lor	-3.0
HS-SCCH#0 Ec/lor	-10.0
HS-SCCH#1 Ec/lor	-10.0
lor/loc	Disable

Ec/lor, lor/loc

*: The settable items differ by the systems.

Packets Communication State (RRC State Change) Settings

When packets stop passing over the network during data packet communications, the Cell Status can be transitioned at a specific timing to switch the UE to any RRC State. This is useful for configuring a test environment simulating a real network when testing battery life.



LTE	
RRC Status Change	Enable,30
RRC Status Change	Enable
Status Change Timer	30

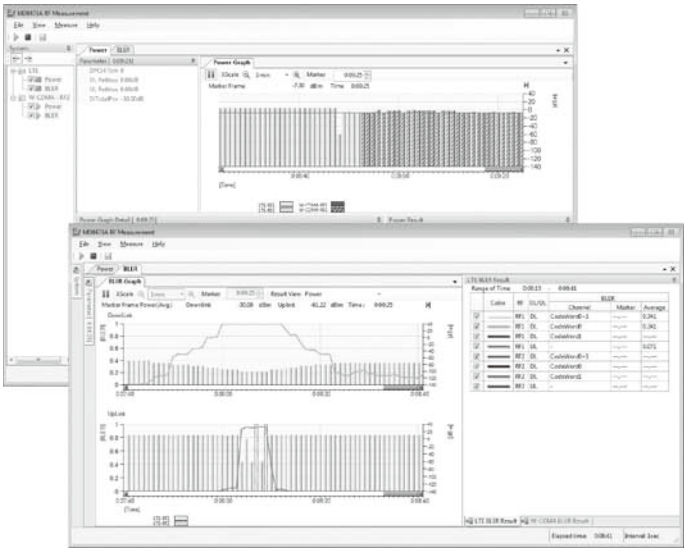
RRC Status Change
Select Radio Resource Control Status Change

W-CDMA	
RRC Status Change	Enable,CELL_FACH,30,IDLE(Preservation),30,IDLE(Preserv
RRC Status Change	**Enable**
CELL_DCH to	**CELL_FACH**
CELL_DCH Status Change Timer	30
CELL_FACH to	IDLE(Preservation)
CELL_FACH Status Change Timer	30
CELL_PCH to	IDLE(Preservation)
CELL_PCH Status Change Timer	30
URA_PCH to	IDLE(Preservation)
URA_PCH Status Change Timer	30
Fast Domancy	Enable,120,IDLE(Preservation),CELL_PCH,IDLE(Preservatio
Fast Domancy	**Enable**
T323	120
CELL_DCH to	IDLE(Preservation)
CELL_FACH to	**CELL_PCH**
CELL_PCH to	IDLE(Preservation)
Traffic Volume	Enable,e4b,32,100,2000,Not Present,e4a,8,100,1000,250
Traffic Volume	**Enable**
CELL_DCH Traffic Volume Event Identity	e4b
CELL_DCH Reporting Threshold	32
CELL_DCH Time to Trigger	100
CELL_DCH Pending Time after Trigger	2000
CELL_DCH Tx Interruption after Trigger	Not Present
CELL_FACH Traffic Volume Event Identit	e4a
CELL_FACH Reporting Threshold	8
CELL_FACH Time to Trigger	100
CELL_FACH Pending Time after Trigger	1000
CELL_FACH Tx Interruption after Trigger	250

Traffic Volume
Select Traffic Volume

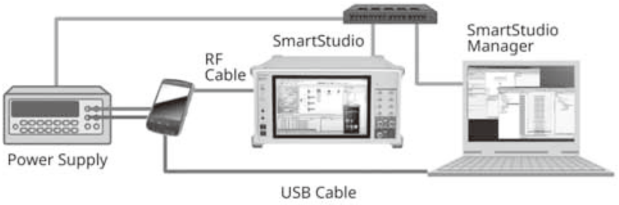
Check UE Tx RF Power

- RF Measurement MX847506A
  Quick TRX Diagnosis MX847506B
    Adding RF Measurement supports verification of UE Tx RF power.
    A UE power consumption test environment can be configured easily by combined use with SmartStudio base station settings from the UE. Further, BLER can be verified using graphical or tabulated data.



Power Consumption Test using SmartStudio Manager

The SmartStudio Manager software MX847503A is bundled with test cases for measuring the UE power consumption. In addition, the MX847503A can also control peripheral devices simultaneously, shortening the time required for configuring UE test environments.



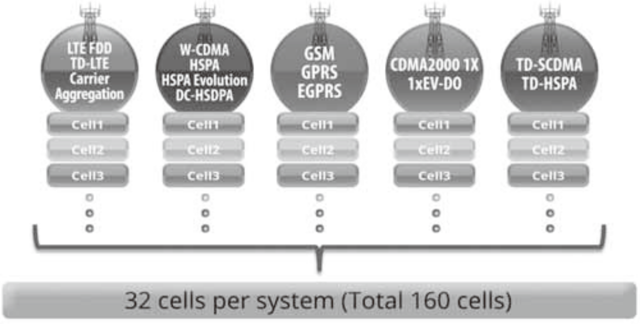
Flexible Base Station Settings

Base station settings are essential for testing UE connections. Not only does SmartStudio support frequency band and Tx and Rx power settings, it can also be set to behave as a real base station.

Setting Base Station Parameters

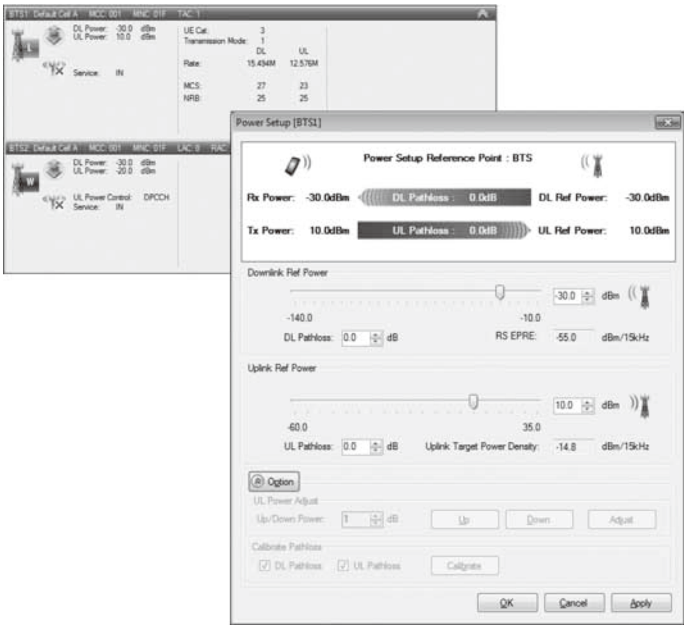
Cell Parameter Settings

Up to 32 base station parameters can be saved in one file to prevent setting errors and assure fast, smooth testing when making slight changes to frequency and bandwidth before retesting.



Base Station Power Settings

The Tx/Rx power of the base station can be changed during testing to simulate Out-of-Service tests by stopping RF on Smartstudio.



BTS1 Default Cell A MCC 001 MNC 01F TAC 1
DL Power: -30.0 dBm
UL Power: 10.0 dBm
Service: IN
UE Cat: 3
Transmission Mode: 1

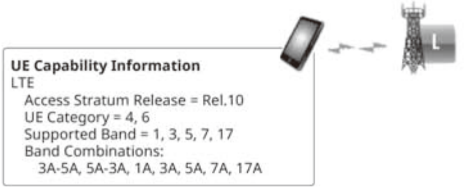
	DL	UL
Rate:	15.494M	12.576M
MCS:	27	23
NRB:	25	25

BTS2 Default Cell A MCC 001 MNC 01F LAC 0 RAC
DL Power: -30.0 dBm
UL Power: -20.0 dBm
UL Power Control: DPCCH
Service: IN

Power Setup [BTS1]
Power Setup Reference Point : BTS
Rx Power: -30.0dBm DL Pathloss : 0.0dB DL Ref Power: -30.0dBm
Tx Power: 10.0dBm UL Pathloss : 0.0dB UL Ref Power: 10.0dBm
Downlink Ref Power
-30.0 dBm
-140.0 -10.0
DL Pathloss: 0.0 dB RS EPRE: -55.0 dBm/15kHz
Uplink Ref Power
10.0 dBm
-60.0 35.0
UL Pathloss: 0.0 dB Uplink Target Power Density: -14.8 dBm/15kHz

At-a-Glance Confirmation of UE Performance

Moving the mouse cursor over the SmartStudio UE icon displays a summary of the UE capability information for easy confirmation of the categories, bands, etc., supported by the UE under test.

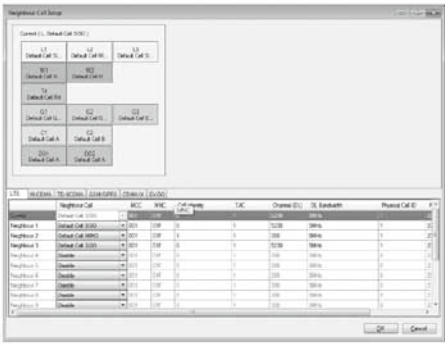


UE Capability Information
LTE
Access Stratum Release = Rel.10
UE Category = 4, 6
Supported Band = 1, 3, 5, 7, 17
Band Combinations:
3A-5A, 5A-3A, 1A, 3A, 5A, 7A, 17A

System	Information Element	Example
LTE	Access Stratum Release	Rel.12
	UE Category	4, 6, 9
	Supported Band	1, 2, 3, 4
	Band Combination	1A-2A, 3C
	Band Combination (Rel.11)	1A-2A, 3C
W-CDMA	Access Stratum Release	Rel.10
	HSDPA Category (Rel.7/Rel.8)	10 (14/24)
	HSUPA Category	6
	Supported Band	I, II
TD-SCDMA	Access Stratum Release	Rel.9
	HSDPA Category	15
	HSUPA Category	6
	Supported Band	a, f
GSM/GPRS	GPRS Multislot Class	12
	EGPRS Multislot Class	12
	Supported Band	GSM E

Setting Neighbor Cells

Neighbor cells can be set to display the mix of multiple cells for a UE graphically.

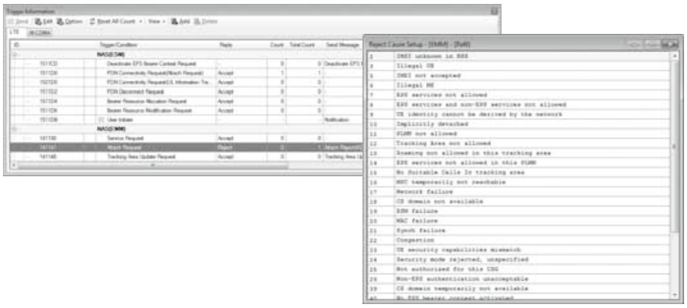


Creating Environment for Difficult Tests on Live Network

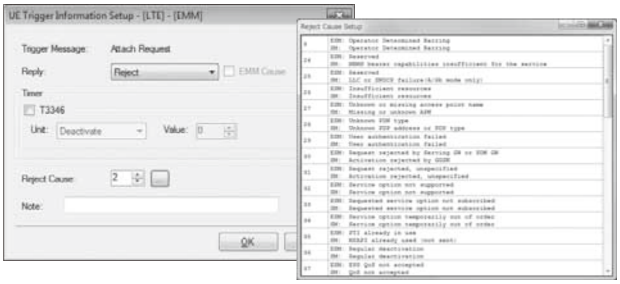
Some UE tests cannot be run on a commercial live network and are difficult on a test network.
SmartStudio makes it easy to support these tests.

Reject Tests

- Attach Reject/Ignore
  By setting specific messages, UE connection request can be rejected when the UE tries to connect the base station.
  In addition, the base station ignores messages from the UE by setting 'Ignore', enabling confirmation of the UE behavior when messages are ignored.



- APN Reject
  By setting specific messages, UE connection request can be rejected when the UE connects to the network.

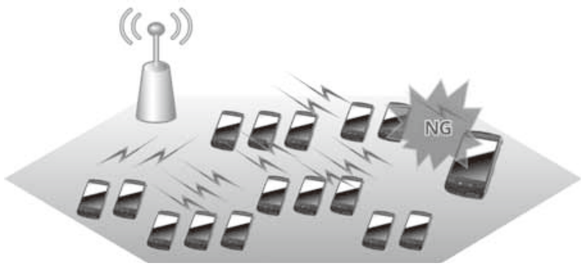


UE Trigger Information Setup - [LTE] - [EMM]
Trigger Message: Attach Request
Reply: Reject ☐ EMM Cause
Timer
☐ T3346
Unit: Deactivate Value: 0
Reject Cause: 2
Note:

Barred Call and Emergency Call Tests

- Access Class Control
  Sometimes, carriers limit access at events where there are too many people trying to call at once or during abnormally busy times like New Year. SmartStudio can configure an access control test environment, which is difficult to do on a live network.
- Emergency Call Test
  Obviously, emergency calls cannot be tested on a live network but this is an essential test that must be performed. SmartStudio offers emergency call test settings and execution.

System	Control Method	Operation
W-CDMA/ GSM	Not Barred	No Access Control
	Barred	Call barring for all communications
	Emergency	Call barring for communications except emergency call
CDMA2000/ EV-DO	PSIST	Call barring for 1xEV-DO
	ACCT	Call barring for ACCT1X

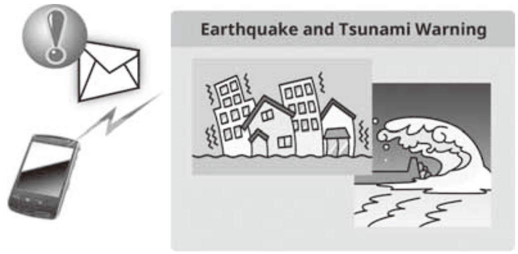


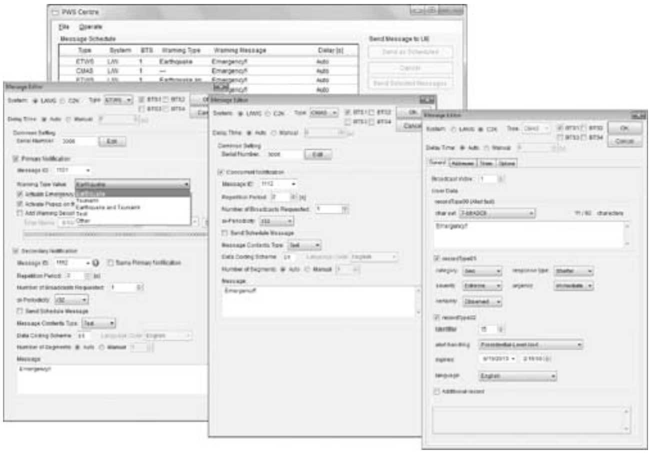
Emergency Alerts Tests

Using the built-in SmartStudio PWS center function supports sending of emergency alerts like earthquake and tsunami warnings to the UE*. ETWS/CMAS messages can be sent at any timing simply by selecting created/edited messages.

- ETWS (Earthquake and Tsunami Warning System used in Japan)
- CMAS (Commercial Mobile Alert System) North American Federal and state government system for sending standard-format text and audio messages to TV broadcast stations

*: Supports LTE/W-CDMA/CDMA2000/GSM.



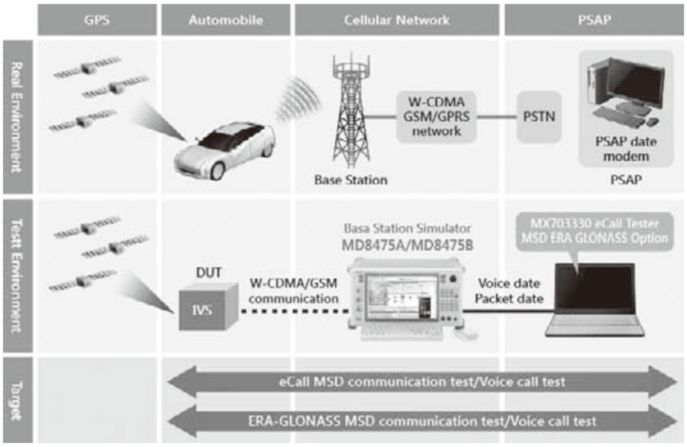


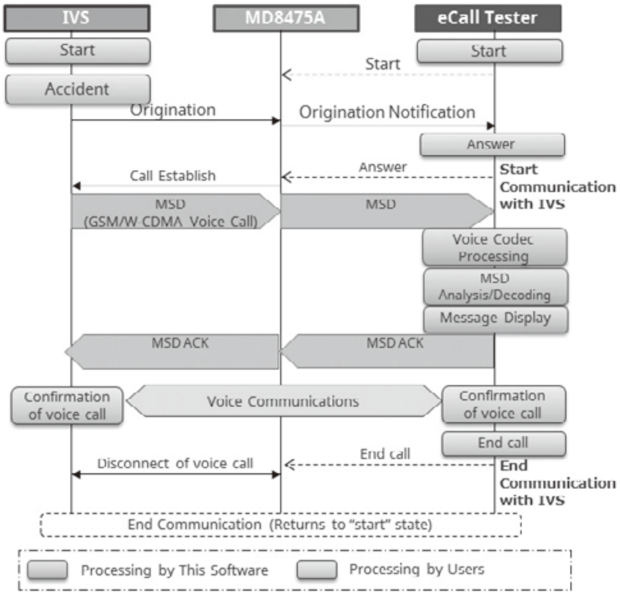
Configuring eCall Compliance to Application Test Environments

This solution makes it easy to configure an environment for emulating the eCall emergency rescue information system for automatically transmitting traffic accident information, including accident location, as well as for making voice calls to an emergency assistance Public Safety Answering Point (PSAP). Since emergency calls cannot be tested on live communications networks, combining the Signalling Tester MD8475A/B and eCall Tester MX703330E software is the perfect answer to testing IVS (In Vehicle System) communications functions.

eCall Tester MX703330E

The MX703330E emulates the eCall system IVS and PSAP communications sequence. It supports quasi-normal test of MSD timeout that are hard to simulate on a live network, as well as comparison of reference MSD (expected) and received data.





Features

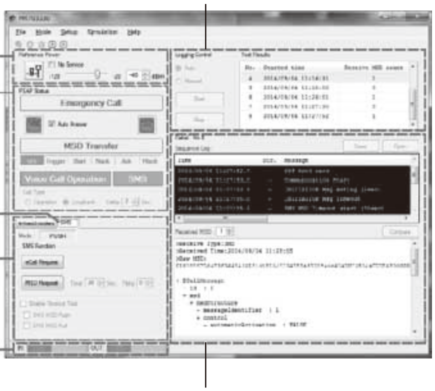
- EN16454-compliant
- Implements communications sequence tests between IVS and PSAP
- Trace-displays status of eCall communications (MSD-Voice) and MSD communications (in-band modem)
- Displays in-band modem sequence and MSD decode data (conversion to meaningful data) execution results and outputs as data file
- Sets reference MSD (expected values) and displays results of comparison with received MSD
- Simulates base station operation in eCall Tester background, making specialist mobile protocol knowledge unnecessary for eCall evaluation
- Performs external control of eCall tester using SmartStudio Manager automation tool to perform PSAP operations

EU eCall Compliance Test

European Commission regulation (EU) 2017/79 approved sale of new M1 and N1 category in-vehicle eCall equipment from 31 March 2018. eCall is an emergency rescue information system for automatically transmitting traffic accident information, including accident location, as well as for making voice calls to an emergency assistance centre, or Public Safety Answering Point (PSAP).

The eCall Tester with EN 16454 PSAP server function supports configuration of the type-certification test environment. Additionally, the interactive GUI simplifies parameter changes, while display of real-time MSD analysis data improves the efficiency of pre-compliance testing, including debugging.

* M1 Category: Passenger vehicles with driver and 8 or less seats
N1 Category: Trucks up to 3.5 tonnes max. load weight



Received MSD Lists

Set DL-Reference Power

PSAP Status
Off Hook: Makes call with IVS unit via SmartStudio
On HooK: Terminates call with IVS unit via SmartStudio

ERA-GLONASS Option
SMS function tab

MSD Condition and Settings
MSD Pull: Transmission to signal PSAP modem (pull mode)
Manual Reset: Force idle
Enable Timeout Test: Timeout setting

Audio Level Meter: Input/Output

MSD Result (sequence and decode)
Save: MSD result save at XML file

eCall Application Testing

Some IVS have requirements for both calling and Telematics functions while driving. Figure shows the handover between base stations during driving.

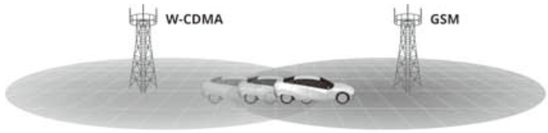
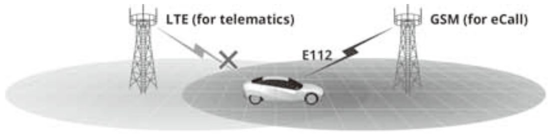


Figure shows the situation when the IVS switches from a 4G network connection used by Telematics services during driving to a 2G/3G network connection for eCall functions when an accident occurs. To emulate this type of test environment, the MD8475A and eCall Tester software perform the handover and CS Fallback switching tests in combination with the eCall function test.

Requires Multi-Cell Option MX703330E-061.



One-touch handover test settings save time and eliminate user worries. The following cells are supported.

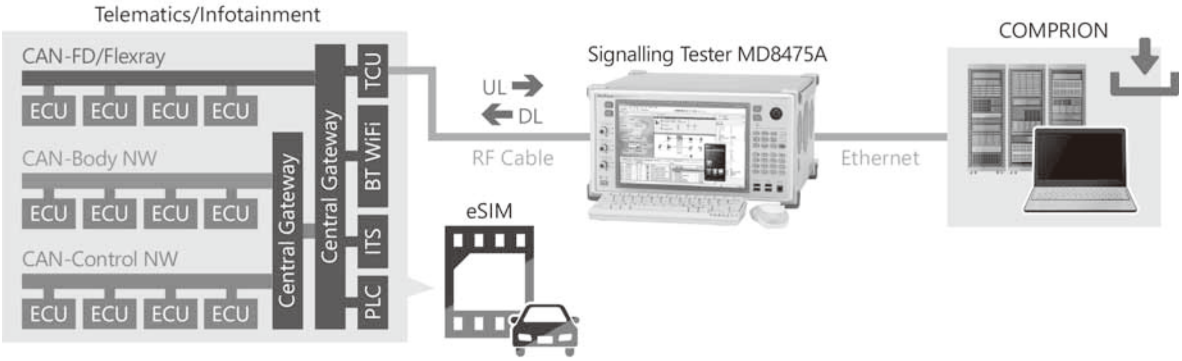
	LTE	W-CDMA	GSM
LTE*	—	✓	✓
W-CDMA	✓	✓	✓
GSM	✓	✓	✓

*: VoLTE not supported

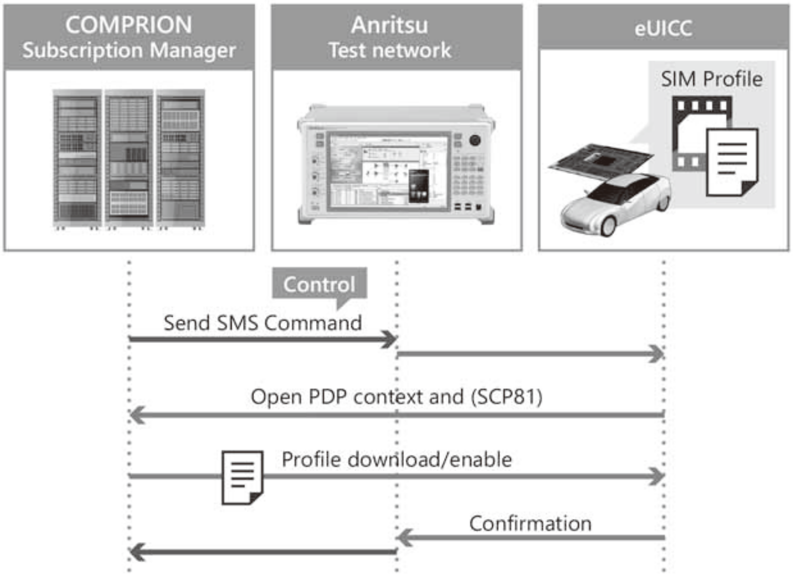
These tests help to greatly improve IVS quality and reliability.

eSIM OTA Verification Solution eUICC Profile Manager Z2002A

MD8475A with COMPRION's software eUICC Profile Manager can performing eSIM (Embedded SIM) test.
eSIM allows the communication protocol information on a SIM to be changed via an OTA (Over the Air) environment.



Sequence Flow



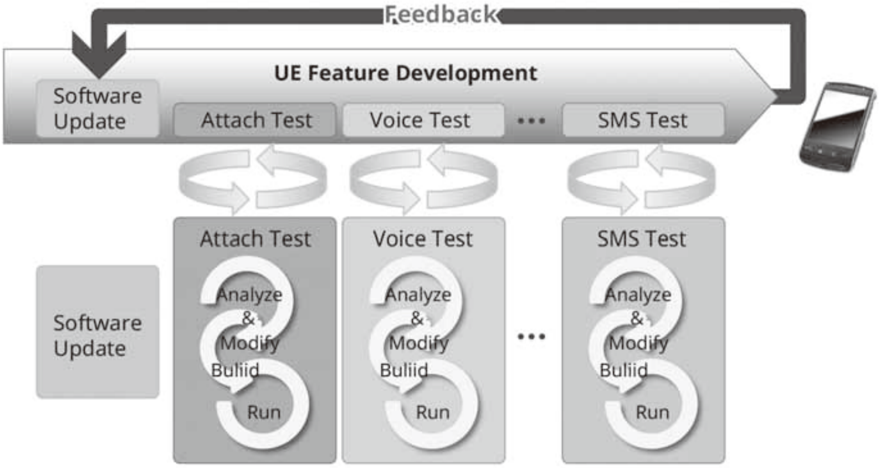
Z2002A include following Software and USB dongle 1pc made by COMPRION.

Model No.	Model name	Quantity
31000111	eUICC Profile Manager	1
31000204 31000134 31000057 31000205	Network Simulation Control Connection Package Anritsu MD8475A Network Simulation Control Connection SMSC Simulation Anritsu MD8475A Signaling Control	1
31000113	Profile Explorer	1
31000114	Profile Loader M2M	1
#3100 0171	Dongle	1

Signalling Tester MD8475A/MD8475B Automation Functions

Regression Tests Necessity

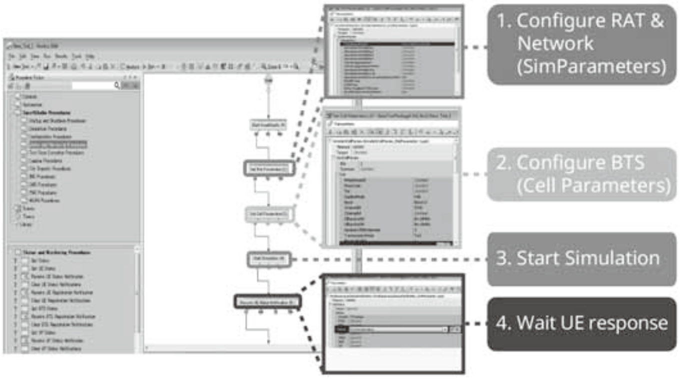
Verification of existing functions and regression testing are key elements of software update testing during UE development. Automated and repeated testing of known items to confirm the absence of new software bugs plays a major role in improving development efficiency and cutting costs.



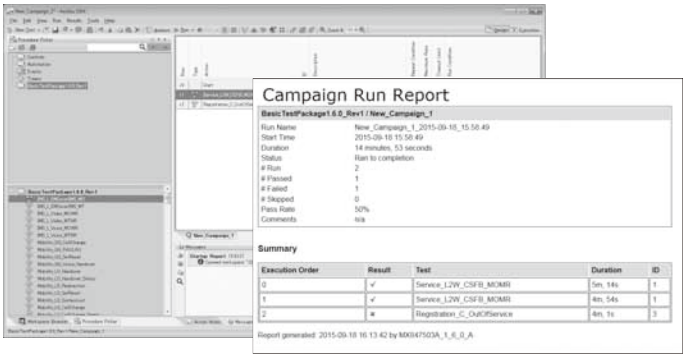
Automated Testing with SmartStudio: SmartStudio Manager MX847503A

The SmartStudio Manager MX847503A software is for editing test sequences and running created test sequences automatically and continuously. This software automates manual testing using the SmartStudio MX847570A software. Automated, unmanned operation test improves efficiency. Additionally, Pass/Fail results can be reported along with the continuous test.

Test Sequence Editing Screen



Test Sequence Continuous Execution Screen



Campaign Run Report

BasicTestPackage1.6.0_Rev1 / New_Campaign_1

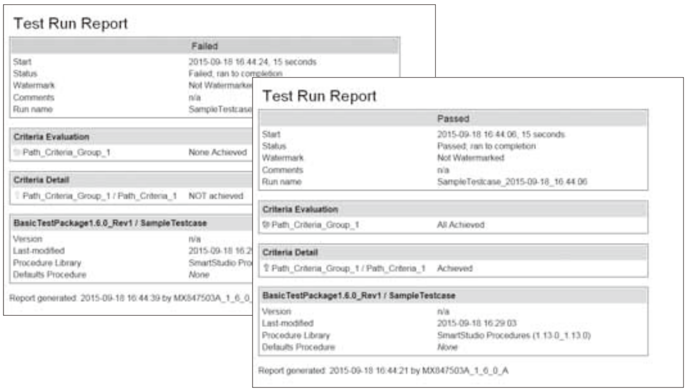
Run Name	New_Campaign_1_2015-09-18_15.58.49
Start Time	2015-09-18 15:58:49
Duration	14 minutes, 53 seconds
Status	Ran to completion
# Run	2
# Passed	1
# Failed	1
# Skipped	0
Pass Rate	50%
Comments	n/a

Summary

Execution Order	Result	Test	Duration	ID
0	✓	Service_L2W_CSFB_MOMR	5m, 14s	1
1	✓	Service_L2W_CSFB_MOMR	4m, 54s	1
2	✖	Registration_C_OutOfService	4m, 1s	3

Report generated: 2015-09-18 16:13:42 by MX847503A_1_6_0_A

Test Sequence Continuous Execution Results Display



Test Run Report

	Failed
Start	2015-09-18 16:44:24, 15 seconds
Status	Failed; ran to completion
Watermark	Not Watermarke
Comments	n/a
Run name	SampleTestcase

Criteria Evaluation	
Path_Criteria_Group_1	None Achieved

Criteria Detail	
Path_Criteria_Group_1 / Path_Criteria_1	NOT achieved

BasicTestPackage1.6.0_Rev1 / SampleTestcase	
Version	n/a
Last-modified	2015-09-18 16:2
Procedure Library	SmartStudio Pro
Defaults Procedure	None

Report generated: 2015-09-18 16:44:39 by MX847503A_1_6_0_

Test Run Report

	Passed
Start	2015-09-18 16:44:06, 15 seconds
Status	Passed; ran to completion
Watermark	Not Watermarked
Comments	n/a
Run name	SampleTestcase_2015-09-18_16.44.06

Criteria Evaluation	
Path_Criteria_Group_1	All Achieved

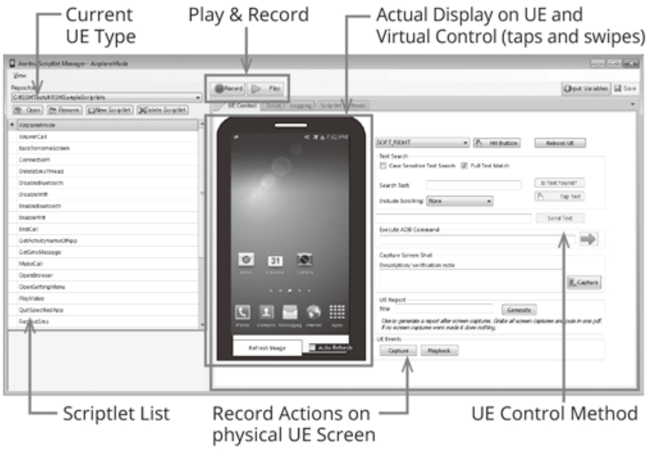
Criteria Detail	
Path_Criteria_Group_1 / Path_Criteria_1	Achieved

BasicTestPackage1.6.0_Rev1 / SampleTestcase	
Version	n/a
Last-modified	2015-09-18 16:29:03
Procedure Library	SmartStudio Procedures (1.13.0_1.13.0)
Defaults Procedure	None

Report generated: 2015-09-18 16:44:21 by MX847503A_1_6_0_A

UE Operation Auto-Recording/Auto-Executing: Smartphone Control Platform MX847504A

The MX847504A software option can records Android OS smartphone operations and offers an environment for creating, editing and running UE automated control scripts. Regression and stable operation confirmation testing of UE are easy using the intuitive editing environment with pre-installed scripts and GUI.



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Regression Tests and Test Sequences

SmartStudio Manager has various test sequences over 180. These test sequences can be used to confirm basic UE operations, such as making and answering voice calls and SMS messages, as well as measuring throughput. Users can use the AT command interface and Smartphone Control Platform MX847504A to control the UE remotely and perform continuous testing without hands-on UE operation.

Test Sequences (extract)

Category	Procedure	Comment
Registration	Attach	Testing UE and base station registration, etc.
	Out of Service	
Voice/Packet/SMS	Voice	Basic UE tests such as voice, data, CFSB, etc.
	Packet	
	SMS over SGs	
	MOMR/MTNR CSFB	
PWS	ETWS Primary + Secondary Notification	Emergency message tests
	CMAS Concurrent Notification	
	CMAS	
Cell Barred	Cell Barred	Network restriction tests
	Access Class Barred	
	PSIST	
CS Emergency	CS emergency	Emergency call tests
	CS emergency CSFB	
Stress Test	Voice	Basic function tests and throughput tests
	Handover	
	Throughput testing	
Mobility	Cell Selection/Reselection	Handover tests
	Handover	
	MOMR/MTNR SRVCC	
WLAN Offload	Untrusted non-3GPP access	WLAN Offload tests
	Trusted non-3GPP access	
IMS/RCS	MO/MT SMS over IMS	IMS/RCS tests
	MOMR: Voice/Video Call Establishment/Release	
	RCS Registration	
TS 09	Stand-by test	TS 09 power consumption tests
	MOMR: Talk time Test	
	MTNR: Talk time Test	
	Packet Switch Transfer Test	
	Browsing Test	
	Streaming Content Test (Video/Audio)	
	Video Telephony Test	
	FTP Download Test	

Signalling Tester MD8475A SmartStudio Test Functions

✓: Supported

Function	Description	MD8475A				
		LTE	W-CDMA	GSM	CDMA2000	TD-SCDMA
General						
Position Registration*1	Connects UE and creates test environment	✓	✓	✓	✓	✓
L1/L2 Counter	Counts values for each L1/L2 channel every second	✓	✓	—	—	✓
Throughput Counter	Simultaneously displays PHY layer and IP Throughput (SDU)	✓	✓	✓	—	✓
Trace	Displays events for each layer as arrows	✓	✓	✓	✓	✓
Reject	Returns arbitrary reject message when UE connected	✓	✓	✓	—	✓
Neighbor Cell Setting	Reports information to UE about BTS adjacent to BTS under test	✓	✓	✓	✓	✓
RF Related						
TRx Power Setting	Changes TRx power of BTS during Idle Communication	✓	✓	✓	✓	✓
No Network Setting	Sets BTS Power output to OFF and switches UE to no network status	✓	✓	✓	✓	✓
RF Monitor	Displays frequency, frequency error, and power for each channel such as PDSCH, PUSCH, etc.	✓	✓	✓	—	✓
TPC Setting	Changes TPC (Transmit Power Control) arbitrarily	✓	✓	✓	—	✓
AWGN	Sends AWGN in conjunction with normal signal	✓	✓	—	—	—
RF Measurement Options	Measures UE RF power at each second	✓	✓	✓	—	—
External Control						
Ethernet	Controls SmartStudio operation (parameter selection, start, etc.) from external PC	✓	✓	✓	✓	✓
GPIB	Controls SmartStudio setting parameters from external PC	✓	✓	✓	✓	✓
Voice/Video Communications						
LTE FDD/TDD						
VoLTE/Video Telephony Calling/Answering (Loopback)	Executes call test for UE supporting Voice over LTE/Video over LTE	✓	▨	▨	▨	▨
Emergency Call/Originating System	Sets emergency call, and VoLTE/Video call control at LTE	✓	▨	▨	▨	▨
Codec Change	Changes audio and video codecs arbitrarily and executes UE switchover test	✓	▨	▨	▨	▨
LTE FDD/TDD, W-CDMA, GSM, CDMA2000, TD-SCDMA						
CSFB/eCSFB*2	Auto-switches communication method when other system voice call received during LTE call	✓	✓	✓	✓	✓
SRVCC*2	Performs seamless switch to CS voice call during VoLTE call	✓	✓	✓	—	—
W-CDMA, GSM, CDMA2000, TD-SCDMA						
Voice Call/Answer/On-hook (Loopback/Echoback)	Performs loopback call test*3	▨	✓	✓	✓	✓
Voice Call/Answer/On-hook (Handset)	Performs call test using headset	▨	✓	✓	—	✓
Emergency Call/Originating	Performs emergency call test with and without Test SIM*4	▨	✓	✓	✓	✓
Caller ID Setting	Sets Caller ID notification/non-notification/notification disabled/public phone/ international call answer	▨	✓	✓	✓	✓
Call Blocking (Release99) <Barred>	Sets call conditions for Release99 for W-CDMA, GSM, TD-SCDMA and bars all calls	▨	✓	✓	▨	✓
Call Blocking (Release99) <Emergency>	Sets call conditions for Release99 for W-CDMA, GSM, TD-SCDMA and bars all calls except emergency calls	▨	✓	✓	▨	✓
Call Blocking (PSIST/ACCT)	Bars calls for CDMA2000	▨	▨	▨	✓	▨
W-CDMA, TD-SCDMA						
Videophone Call/Answer/On-hook (Loopback)	Performs loopback call test*3	▨	✓	▨	▨	✓
Packet Data Communications						
IPv4 Packet Test	Performs data TRx using IPv4	✓	✓	✓	✓	✓
IPv6 Packet Test	Performs data TRx using IPv6	✓	✓	✓	✓	✓
Packet Preservation/Dormant Test	Releases RRC Connection while preserving PDP Context	✓	✓	—	✓	✓
Multiple PDP Context/PDN Connect	Connects multiple PDN and performs multisession packet data test	✓	✓	—	✓	—
State Change	Changes state from BTS during packet data communications	✓	✓	—	✓	✓
LTE FDD/TDD						
SISO/MIMO Packet Calling/Answering	Connects server and performs application test using packet data communications	✓	▨	▨	▨	▨
SISO/MIMO Packet UE Side Disconnect		✓	▨	▨	▨	▨
SISO/MIMO Packet Network Side Disconnect		✓	▨	▨	▨	▨
DL2CC Carrier Aggregation	Performs DL2CC carrier application tests	✓*5	▨	▨	▨	▨
DL3CC Carrier Aggregation	Performs DL3CC carrier application tests	▨	▨	▨	▨	▨
UL2CC Carrier Aggregation	Performs UL2CC carrier application tests	✓*7	▨	▨	▨	▨
FDD/TDD Joint Operation	Performs FDD and TDD Joint Operation test	✓*6	▨	▨	▨	▨
W-CDMA						
W-CDMA/HSPA/HSPA Evolution Packet Calling/Answering	Connects server and performs application test using packet data communications	▨	✓	▨	▨	▨
W-CDMA/HSPA/HSPA Evolution Packet UE Side Disconnect		▨	✓	▨	▨	▨
W-CDMA/HSPA/HSPA Evolution Packet Network Side Disconnect		▨	✓	▨	▨	▨
PPP Packet Calling	Performs DL2CC carrier application tests	▨	✓	▨	▨	▨
PPP Packet UE Side Disconnect	Performs DL3CC carrier application tests	▨	✓	▨	▨	▨
PPP Packet Network Side Disconnect	Performs UL2CC carrier application tests	▨	✓	▨	▨	▨
GSM						
GPRS/EGPRS Packet Calling/Answering	Connects server and performs application test using packet data communications	▨	▨	✓	▨	▨
GPRS/EGPRS Packet UE Side Disconnect		▨	▨	✓	▨	▨
GPRS/EGPRS Packet Network Side Disconnect		▨	▨	✓	▨	▨
CDMA2000						
CDMA2000/EV-DO Packet Calling	Connects server and performs application test using packet data communications	▨	▨	▨	✓	▨
SV-DO Test	Performs simultaneous voice and packet communications	▨	▨	▨	✓	▨
TD-SCDMA						
TD-SCDMA/HSPA*8 Packet Calling/Answering	Connects server and performs application test using packet data communications	▨	▨	▨	▨	✓
TD-SCDMA/HSPA*8 Packet UE Side Disconnect		▨	▨	▨	▨	✓
TD-SCDMA/HSPA*8 Packet Network Side Disconnect		▨	▨	▨	▨	✓
Messaging						
ETWS Message Sending	Performs ETWS message send test during Idle or Communication state	✓	✓	—	—	—
CMAS Message Sending	Performs CMAS message send test during Idle or Communication state	✓	✓	—	✓	—
CBS Message Sending	Performs CBS message send test during Idle or Communication state	—	✓	✓	—	—
SMS Message Sending/Receiving	Performs SMS (7 bit-ASCII, Unicode, Binary) test using PS and CS networks*3	✓	✓	✓	✓	✓
SMS over IMS Test	Performs SMS send/receive test via IMS server	✓	—	—	—	—
SMS Message Continuous Sending	Sends selected multiple SMS to UE continuously	✓	✓	✓	✓	✓
MMS Sending/Receiving*9	Performs MMS send/receive test	✓	✓	✓	✓	✓

*1: Ciphering function not supported
*2: Only dual system configuration is supported
*3: Two-way tests using two UEs not supported
*4: Test SIM not required by CDMA2000
*5: Requires two MD8475A sets for 2CC MIMO tests
*6: LTE-FDD/TDD Joint CA test is not supported.
*7: Throughput limited up to 50 Mbps
*8: DCH Measurement Occasion/Idle Interval Measurement Function are not supported
*9: Requires separate MMS server

Signalling Tester MD8475A System Configurations/Option/Software

Main Frame Options

2nd RF MD8475A-001
This option is required for tests using two RF signals, such as 2-cell and MIMO tests.

Multi-cell Software MX847502A
This option is required when simultaneously activating two cells such as at handover tests within the same system, Inter-RAT tests between different systems, LTE Carrier Aggregation tests, etc.
However, it is not required when performing CDMA2000 and EV-DO hybrid tests using one MD8475A.

RF Measurement MX847506A
Installing combinations of the MX847510A, MX847520A, and MX847550A software options supports extended RF Tx power accuracy, RF Rx power, and BLER measurements for each system.

Multimedia Interface Software MX847508A
This software is required for end-to-end voice tests between microphones and speakers (headsets) connected to the MD8475A and the mobile equipment. The W-CDMA and GSM AMR-NB (AMR Narrowband), GSM EFR (Enhanced Full Rate Speech), FR (Full Rate Speech), and HR (Half Rate Speech) codec can be used.

AMR-WB MX847508A-001
This option supports the W-CDMA AMR-WB (AMR Wideband) codecs. The MX847508A is required.

Supported voice codec list

Supported Codecs	Multimedia Interface Software MX847508A	AMR-WB MX847508A-001
AMR-NB (W-CDMA/GSM)	✓	—
GSM-EFR (GSM)	✓	—
GSM-FR (GSM)	✓	—
GSM-HR (GSM)	✓	—
AMR-WB (W-CDMA)	—	✓

SmartStudio MX847570A
This software supports the user interface for scenario-less testing In addition to offering functions such as sending and receiving SMS messages, sending and receiving ETWS/CMAS messages, making and receiving voice calls, and sending and receiving data packets, it also supports CSCF server functions required for IMS service tests.

Automation Tool

SmartStudio Manager MX847503A
This option increases the efficiency of evaluations by automating manual tests performed by the MX847570A SmartStudio software.
In addition, the package includes test sequences required for evaluating basic functions.

eCall Tester Control Library MX847503A-923
This library option is for remote control of tests using the MX703330E eCall tester. Test automation without manual operation increases test efficiency.

Smartphone Control Platform MX847504A
Recorded via ADB and UE automated control scripts can be created, edited and run. As well as supporting automated control from the MX847503A, two-way automatic control of the measuring instrument and UE supports an operator-free test environment for higher test efficiency.

W-CDMA

- Basic Configuration (Voice/Video/Packet)
  Multi-signalling Unit MD8475A-070
  W-CDMA Simulation Software MX847510A
  W-CDMA Option MX847570A-010
  These are for basic W-CDMA configuration. These tests support voice, videophone, packet, and SMS tests.

- Options
  HSPA Option MX847510A-001
  This option supports HSPA UE categories defined by the 3GPP Release 5/Release 6 standards.

  HSPA Evolution/DC-HSDPA Option MX847510A-011
  HSPA Evolution/DC-HSDPA Option MX847570A-011
  These options support HSPA Evolution and DC-HSPA packet communications tests for high-speed packet services used by W-CDMA systems.

3GPP TS 25.306 Category List for MX847570A
HSDPA

HS-DSCH Category	HS-DSCH Codes	Minimum Inter-TTI	TB-Sizes	Total Number of Soft Channel Bits	Modulation	Maximum Throughput [bps]
5*	5	1	7298	57600	QPSK/16QAM	3649000
6	5	1	7298	67200	QPSK/16QAM	3649000
7*	10	1	14411	115200	QPSK/16QAM	7205500
8	10	1	14411	134400	QPSK/16QAM	7205500
9	15	1	20251	172800	QPSK/16QAM	10125500
10	15	1	27952	172800	QPSK/16QAM	13976000
12	5	1	3630	28800	QPSK	1815000
13	15	1	35280	259200	Not Applicable (dual cell operation not supported)	17640000
14	15	1	42192	259200		21096000
21	15	1	23370	345600	QPSK/16QAM	23370000
22	15	1	27952	345600	QPSK/16QAM	27952000
23	15	1	35280	518400	QPSK (16QAM) 64QAM	35280000
24	15	1	42192	518400		42192000

HSUPA

E-DCH Category	E-DCH Codes	Minimum Spreading Factor	Support for TTI EDCH	TB-Sizes E-DCH TTI	Maximum Throughput [bps]
3	2	SF4	10 ms TTI	14484	1459500
5	2	SF2	10 ms TTI	20000	2918500
6	4	SF2	10 ms TTI	14484	5760000

*: Not supported when UE specifies a category.

- Support Service
  MX847510A 1Year Support Service MX847510A-SS110
  This service contract offers customers 1 year of support for technical enquiries as well as updates to the latest software versions adding extra functionality and bug fixes via downloads from the web page.

LTE

- Basic Configuration
  Multi-signalling Unit MD8475A-070
  LTE Simulation Software MX847550A
  LTE FDD Option MX847550A-010
  LTE TDD Option MX847550A-015
  LTE FDD Option MX847570A-050
  LTE TDD Option MX847570A-055
  These are for basic LTE FDD/TDD configuration. It supports both FDD and TDD technologies. These tests support confirmation of connections with LTE UEs during SISO, packet communications, and SMS sending/receiving. In addition, 2-cell tests are supported by installing the 2-cell Software MX847502A.

3GPP TS 36.306 V12.5.0 (2015-06) Category List
Downlink physical layer parameter values set by the field *ue-Category*

UE DL Category	Maximum number of DL-SCH transport block bits received within a TTI	Maximum number of bits of a DL-SCH transport block received within a TTI	Total number of soft channel bits	Maximum number of supported layers for spatial multiplexing in DL
Category 0	1000	1000	25344	1
Category 1	10296	10296	250368	1
Category 2	51024	51024	1237248	2
Category 3	102048	75376	1237248	2
Category 4	150752	75376	1827072	2
Category 5	299552	149776	3667200	4
Category 6	301504	149776 (4 layers, 64QAM) 75376 (2 layers, 64QAM)	3654144	2 or 4
Category 7	301504	149776 (4 layers, 64QAM) 75376 (2 layers, 64QAM)	3654144	2 or 4
Category 8	2998560	299856	35982720	8
Category 9	452256	149776 (4 layers, 64QAM) 75376 (2 layers, 64QAM)	5481216	2 or 4
Category 10	452256	149776 (4 layers, 64QAM) 75376 (2 layers, 64QAM)	5481216	2 or 4
Category 11	603008	149776 (4 layers, 64QAM) 195816 (4 layers, 256QAM) 75376 (2 layers, 64QAM) 97896 (2 layers, 256QAM)	7308288	2 or 4
Category 12	603008	149776 (4 layers, 64QAM) 195816 (4 layers, 256QAM) 75376 (2 layers, 64QAM) 97896 (2 layers, 256QAM)	7308288	2 or 4

Uplink physical layer parameter values set by the field *ue-Category*

UE UL Category	Maximum number of UL-SCH transport block bits transmitted within a TTI	Maximum number of bits of an UL-SCH transport block transmitted within a TTI	Support for 64QAM in UL
Category 0	1000	1000	No
Category 1	5160	5160	No
Category 2	25456	25456	No
Category 3	51024	51024	No
Category 4	51024	51024	No
Category 5	75376	75376	Yes
Category 6	51024	51024	No
Category 7	102048	51024	No
Category 8	1497760	149776	Yes
Category 9	51024	51024	No
Category 10	102048	51024	No
Category 11	51024	51024	No
Category 12	102048	51024	No

- Options
  LTE 2×2 MIMO Option MX847550A-020
  This option adds 2×2 MIMO to the MX847550A. Supported LTE 2×2 MIMO Functions.*
  LTE Carrier Aggregation Option MX847550A-040
  This software options supports LTE 2CC Carrier Aggregation. It supports the 2CC SISO test environment. Additionally, installing the MX847550A-020 software supports the 2CC MIMO test environment.
  Fading IO Option MD8475A-003
  This hardware option is required for connecting two MD8475A sets or the combination of one MD8475A and one MD8430A. In addition, combining one MD8475A and one Fading Simulator MF6900A supports configuration of LTE FDD Fading test environment.
  LTE RoHC Option MX847550A-060
  This option adds better compression algorithms to improve LTE IP packet transfer efficiency.

Supported Profiles

IP	Profile
0x0000	No compression (LTE)/Uncompressed (UMTS)
0x0001	RTP/UDP/IP
0x0002	UDP/IP

- Support Service
  MX847550A 1Year Support Service MX847550A-SS110
  This service contract offers customers 1 year of support for technical enquiries as well as updates to the latest software versions adding extra functionality and bug fixes via downloads from the web page.

*: Handover tests not supported when testing 2×2 MIMO.

GSM

- Basic Configuration
  - GSM Signalling Unit MD8475A-020
  - GSM/GPRS Simulation Software MX847520A
  - GSM Option MX847570A-020

    This is the basic configuration for performing GSM/GPRS tests. It supports voice and packet communications tests, SMS sending and receiving, etc.

- Options
  - EGPRS Option MX847520A-001

    This option supports EGPRS evaluation — a GPRS high-speed, data communication method. Application tests using EGPRS communications are supported.

Supported EGPRS Specifications

Layer 1	Frequency Bandwidth	850, 900, 1800, 1900 MHz
	Modulation & Coding Scheme	MCS 1, 2, 3, 4 (GMSK) MCS 5, 6, 7, 8, 9 (8PSK)
	Number of Slots	Up to Multi Slot Class 12 (DL: 4/UL: 4/SUM: 5)
	Channel Combination	Combination 11 & 13
Layer 2, 3	Broadcasting Control Channel	BCCH/CCCH, PBCCH/PCCH
	ARQ Type	Type 1
	Window Size	64 to 192
Standard		3GPP Release 99

- Support Service
  - MX847520A 1Year Support Service MX847520A-SS110

    This service contract offers customers 1 year of support for technical enquiries as well as updates to the latest software versions adding extra functionality and bug fixes via downloads from the web page.

CDMA2000

- Basic Configuration
  - CDMA2000 1X Signalling Unit MD8475A-030
  - CDMA2000 1xEV-DO Signalling Unit MD8475A-032
  - CDMA2000 Simulation Software MX847530A
  - CDMA2000 Option MX847570A-030

    This is the basic configuration for performing CDMA2000 1X/1xEV-DO tests. It supports voice (echo-back) and packet communications tests, SMS sending and receiving, etc. Additionally, it can be used to configure a CDMA2000 and 1xEV-DO hybrid environment.

- Options
  - Multi-sector/Multi-carrier Option MX847530A-001*

    This software option supports simulation of various handover tests including Soft, Softer, Hard, Idle, and Access, by dynamically changing the CDMA2000 1X/1xEV-DO multi-carrier (Max. 2) and multi-sector (1X: Max. 6, 1xEV-DO: Max. 3). One MD8475A unit supports testing in multi-carrier/multi-sector environments where verification using a live network is difficult. It improves the efficiency of operation verification, the Inter Operability Test (IOT) at UE R&D, and the field-testing pre-verification.

*: Does not work with MX847570A.

- Support Service
  - MX847530A 1Year Support Service MX847530A-SS110

    This service contract offers customers 1 year of support for technical enquiries as well as updates to the latest software versions adding extra functionality and bug fixes via downloads from the web page.

TD-SCDMA

- Basic Configuration
  - TD-SCDMA Signalling Unit MD8475A-040
  - TD-SCDMA Simulation Software MX847540A
  - TD-SCDMA Option MX847570A-040

    These are for basic TD-SCDMA configuration which support voice, videophone, packet, and SMS tests.

- Options
  - TD-HSPA Option MX847540A-001

    This is for evaluating all 3GPP TS 25.306 HSPA UE categories*1.

3GPP TS 25.306
TD-HSDPA

HS-DSCH category	Maximum number of HSDSCH codes per timeslot	Maximum number of HSDSCH timeslots per TTI	Maximum number of HSDSCH transport channel bits can be received within an HSDSCH TTI	Total number of soft channel bits	Maximum Throughput [bps]
Category 1 to 3	16	2	2788	11264	557600
Category 4 to 6	16	2	5600	22528	1120000
Category 7 to 9	16	3	8416	33792	1688200
Category 10 to 12	16	4	11226	45056	2245200
Category 13 to 15	16	5	14043	56320	2808600

TD-HSUPA

E-DCH category	Maximum number of E-DCH timeslots per TTI	Maximum number of E-DCH transport channel bits that can be received within an E-DCH TTI	Maximum Throughput [bps]
Category 1	2*2	2754	550800
Category 2	3*2	4162	832400
Category 3	2*2	5532	1106400
Category 4	3*2	8348	1669600
Category 5	4*2	11160	2232000
Category 6	5*2	11160	2232000

*1: MX847570A supports Category 6 only.
*2: One timeslot supports two physical channels when 16QAM not used.

- Support Service
  - MX847540A 1Year Support Service MX847540A-SS110

    This service contract offers customers 1 year of support for technical enquiries as well as updates to the latest software versions adding extra functionality and bug fixes via downloads from the web page.

IMS Options

IMS Script Basic Option MX847570A-060

This software supports scripting of the communication procedure between the test UE and CSCF server using a ladder sequence to provide a very flexible and expandable test environment.

XCAP Script Option MX847570A-061

This option provides a test environment with high flexibility and expandability for creating scripts using a ladder sequence to edit XCAP messages between the UE and server without the need to prepare an actual server.

Extended CSCF Option MX847570A-080

This software option adds functions for calling from the network to the UE as well as extended functions for CSCF-server-side network congestion and no response status.

IMS Supplementary Service Option MX847570A-081

This software option adds other service tests, including VoLTE caller ID display, call forwarding, call holding, etc.

RCS Basic Option MX847570A-083

This software option simulates RCS services. It is used to perform tests including RCS Configuration, Registration, Instant Messaging, etc.

GBA Authentication Option MX847570A-084
This option has the 3GPP GBA Authentication algorithm, authentication procedure and parameter settings for simulating GBA operations.

IMS Early Media Option MX847570A-085
This software supports IMS Early Media sequence tests. It can be used to confirm customized call tone services at the network side, such as NRBT (Network Ring Back Tone) and CAT (Customized Alerting Tone).

RTP Frame Control Option MX847570A-086
This option is for controlling media data (RTP packets) during VoLTE communications. It can be used to configure a voice environment in the MUTE status and with fixed data; a measurement environment can be configured for abnormal audio quality verification and battery power consumption tests in a fixed state.

- Support Service

MX847570A-060 1-Year Technical Support Service MX847570A-TS160
This contract offers customers support for technical enquiries for 1 year.

MX847570A-061 1-Year Technical Support Service MX847570A-TS161
This contract offers customers support for technical enquiries for 1 year.

WLAN Offload Options

WLAN Offload Basic Option MX847570A-070
This software option provides an EAP authentication server for performing EAP over RADIUS communications (EAP-SIM/EAP-AKA) between a WLAN access point and the EAP authentication server. Additionally, data access by the physical bearers is displayed to verify the 3GPP/WLAN switchover.

ePDG Option MX847570A-071
This software option provides an ePDG server for testing the UE functions at Untrusted non-3GPP Access by running IKEv2 key exchanges and IPsec communications between the UE and ePDG.
It requires the MX847570A-070 option as well.

ANDSF Option MX847570A-072
This software option provides the ANDSF function for testing the UE functions after ANDSF policy distribution to the UE.
It requires the MX847570A-070 options as well.

Extended ePDG Option MX847570A-073
This software option supports configuration of an ePDG status fault test environment for inserting errors into the ePDG sequence, setting timeouts, etc. Additionally, this option can be used to support Fast Re-Authentication (EAP-SIM/EAP-AKA) tests without the need to generate UE-side authentication keys. It requires the MX847570A-070/MX847570A-071.

eCall Options

eCall Tester (Perpetual License) MX703330E-PL010
This option simulates the PSAP used by eCall services to support the eCall sequence (MSD call → Voice call) between the IVS and PSAP at a road accident.

The following test standards are supported:

- TS 26 .267 V8.6.0 (2011-03)
- EN15722: 2015
- EN16454: 2015
- TS 26 .268 V8.6.0 (2011-03)
- EN16062: 2015
- ISO3779: 2009

This option can be used as a test environment for model authentication in accordance with the EN16454 recommendations. This option provides audio replay and record functions.

MSD ERA GLONASS Option MX703330E-031
This option supports the MSD data communications function over SMS used by the ERA-GLONASS system

The following test standards are supported:

- GOST R 54619-2011
- GOST R 54721-2011
- GOST R 54620-2011
- GOST R 55530-2013

EGTS Server ERA GLONASS Option MX703330E-032
This option provides a test environment to send/receive and encode/decode EGTS messages defined in the GOST R 54619/54620.
MX703330E-031 is separately required.

Multi-Cell Option MX703330E-061
This option provides the handover test environment required when setting two or more cells as well as the CS Fallback test environment at the eCall environment. Practical eCall module tests are supported using this option.

The cell combinations are as follows:

	LTE	W-CDMA	GSM
LTE*	—	✓	✓
W-CDMA	✓	✓	✓
GSM	✓	✓	✓

*: VoLTE is not supported

- Support Service

MX703330E 1-Year Support Service MX703330E-SS110
This service contract offers customers 1 year of support for technical enquiries as well as updates to the latest software versions adding extra functionality and bug fixes via downloads from the web page.

SSM Test PKG European eCall MX847503A-601
This test package provides automated test environment. Opening the test case on the SSM, it shows test procedures of test items defined in the (EC) 2017/79 and EN16454, and automatically configures the setting of MD8475A/MD8475B and eCall tester. This test package also has report functions for each standards.

Scenario Tools

SIDE Software MX847580A
SIP Option MX847580A-018
These software are for executing scenarios created using the MX843080A Scenario Integrated Development Environment in combination with the MX847510A, MX847520A, and MX847550A software.

CDMA2000 Scenario Composer MX702600B
MX702600B 1 Year Support Service MX702600B-SS110
This software creates CDMA2000 test scenarios using a ladder sequence design. The created test scenarios can be executed using the PVT (Protocol Visualization Tool) provided with the MX847530A software.

Ciphering Option

W-CDMA Ciphering Option MX847510A-050
This option adds the W-CDMA ciphering function*1, *2 and supports for KASUMI (3GPP-recommended algorithm).

GSM/GPRS Ciphering Option MX847520A-050
This option adds the GSM/GPRS ciphering function*1, *2 and supports both the GSM A5/1, A5/2, and A5/3 ciphering algorithms as well as the GPRS GEA/1, GEA/2, and GEA/3 ciphering algorithms.

TD-SCDMA Ciphering Option MX847540A-050
This option adds the TD-SCDMA ciphering function*1, *2 and supports SNOW 3G (3GPP-recommended algorithm).

LTE Ciphering Option MX847550A-050
This option adds the LTE ciphering function*1, *2 and supports SNOW 3G (3GPP-recommended algorithm) and AES.

*1: Does not work with MX847570A.
*2: The Integrity Algorithm does not require this option.

Signalling Tester MD8475A SmartStudio System Configuration

System		LTE		W-CDMA	TD-SCDMA	GSM	CDMA2000
		FDD	TDD				
Unit		Signalling Tester MD8475A					
Unit Option		2nd RF MD8475A-001					
		Fading IO Option MD8475A-003					
Platform Software		Multi-cell Software MX847502A					
		—		Multimedia Interface Software MX847508B			—
		—		AMR-WB MX847508B-001	—	—	—
Basic Configuration	Hardware	Multi Signalling Unit MD8475A-070			TD-SCDMA/HSPA Signalling Unit MD8475A-040	GSM Signalling Unit MD8475A-020	CDMA2000 1X Signalling Unit MD8475A-030 CDMA2000 1xEV-DO Signalling Unit MD8475A-032
	Software	LTE Simulation Software MX847550A		W-CDMA Simulation Software MX847510A	TD-SCDMA Simulation Software MX847540A	GSM/GPRS Simulation Software MX847520A	CDMA2000 Simulation Software MX847530A
		LTE FDD Option MX847550A-010	LTE TDD Option MX847550A-015				
Options		LTE 2×2 MIMO Option MX847550A-020		HSPA Option MX847510A-001	TD-HSPA Option MX847540A-001	EGPRS Option MX847520A-001	Multi-Sector/ Multi-Carrier Option MX847530A-001
		LTE Carrier Aggregation Option MX847550A-040		HSPA Evolution/ DC-HSDPA Option MX847510A-011			
		LTE RoHC Option MX847550A-060					
		LTE Ciphering Option MX847550A-050		W-CDMA Ciphering Option MX847510A-050	TD-SCDMA Ciphering Option MX847540A-050	GSM/GPRS Ciphering Option MX847520A-050	—
Support Service		MX847550A 1Year Support Service MX847550A-SS110		MX847510A 1Year Support Service MX847510A-SS110	MX847540A 1Year Support Service MX847540A-SS110	MX847520A 1Year Support Service MX847520A-SS110	MX847530A 1Year Support Service MX847530A-SS110
User Interface		SmartStudio MX847570A					
SmartStudio License	System Option	LTE FDD Option MX847570A-050	LTE TDD Option MX847570A-055	W-CDMA Option MX847570A-010	TD-SCDMA Option MX847570A-040	GSM Option MX847570A-020	CDMA2000 Option MX847570A-030
				HSPA Evolution/ DC-HSDPA Option MX847570A-011			
	IMS	Extended CSCF Option MX847570A-080					
		IMS Supplementary Service Option MX847570A-081					
		RCS Basic Option MX847570A-083					
		GBA Authentication Option MX847570A-084					
		IMS Early Media Option MX847570A-085					
		RTP Frame Control Option MX847570A-086					
	WLAN	WLAN Offload Basic Option MX847570A-070					
		ePDG Option MX847570A-071					
		ANDSF Option MX847570A-072					
		Extended ePDG Option MX847570A-073					
	Scripting Option	IMS Script Basic Option MX847570A-060					
		XCAP Script Option MX847570A-061					
	Technical Support Service	MX847570A-060 1 Year Technical Support Service MX847570A-TS160					
		MX847570A-061 1 Year Technical Support Service MX847570A-TS161					
RF Measurement		RF Measurement MX847506A			—	RF Measurement MX847506A	—
Remote Interface		SmartStudio Manager MX847503A					
		eCall Tester Control Library MX847503A-923					
		Smartphone Control Platform MX847504A					
eCall Option		—		eCall Tester (Perpetual License) MX703330E-PL010	—	eCall Tester (Perpetual License) MX703330E-PL010	—
		—		MSD ERA GLONASS Option MX703330E-031	—	MSD ERA GLONASS Option MX703330E-031	—
		—		EGTS Server ERA GLONASS Option MX703330E-032	—	EGTS Server ERA GLONASS Option MX703330E-032	—
		—		Multi-Cell Option MX703330E-061	—	Multi-Cell Option MX703330E-061	—
		—		MX703330E 1-Year Support Service MX703330E-SS110	—	MX703330E 1-Year Support Service MX703330E-SS110	—

Signalling Tester MD8475A Specifications

RF Connector		RF Input/Output connector (Main, Aux 1, Aux 2) Connector: N type, Impedance: 50Ω, VSWR: ≤1.5 (500 MHz to 3 GHz) Reference oscillator Frequency: 10 MHz Level: TTL level Connector: BNC type Startup characteristics: ±5 × 10^{-8} (10 minutes after power-on, referenced to frequency 24 hours after power-on) Aging rate: 2 × 10^{-8}/day, ≤1 × 10^{-7}/year (referenced to frequency 24 hours after power-on) Temperature characteristics: ≤±2 × 10^{-8} External reference input Frequency: 10 MHz, Acceptable frequency range: ±0.5 ppm, Level: ≥0 dBm, Impedance: 50Ω, Connector: BNC type
Transmission Characteristics		Frequency Frequency range: 350 MHz to 3.6 GHz Setting resolution: 100 kHz (Depending on MX847501A used) Accuracy: Based on reference oscillator accuracy Output level Level range: –130 to –10 dBm (Main, Aux1, Aux2) Resolution: 0.1 dB Transmission level ±1.0 dB (–120 dBm ≤ Output level, 350 MHz ≤ Frequency ≤ 3 GHz, +20° to +30°C, after CAL) ±1.2 dB (–120 dBm ≤ Output level, 3 GHz < Frequency ≤ 3.6 GHz, +20° to +30°C, after CAL) Signal purity Non-harmonic spurious: ≤–40 dBc (at ≥500 kHz frequency offset) Harmonics: ≤–25 dBc
Reception Characteristics		Frequency Frequency range: 350 MHz to 3.6 GHz Setting resolution: 100 kHz (Depending on MX847501A used) Level Maximum input level: +35 dBm (Average) Input level range: –60 to +35 dBm (with MD8475A-010, MD8475A-011, MD8475A-030, MD8475A-032, MD8475A-050, MD8475A-070) –30 to +40 dBm (in-burst average power) (with MD8475A-020) Reference level: –60 to +35 dBm Reception level (with MX847506A) MX847510A ±1.1 dB (–60 to +35 dBm, 350 MHz ≤ Frequency ≤ 3 GHz, +20° to +30°C, after CAL) ±1.3 dB (–60 to +35 dBm, 3 GHz < Frequency ≤ 3.6 GHz, +20° to +30°C, after CAL) MX847520A ±1.1 dB (–30 to +40 dBm, 350 MHz ≤ Frequency ≤ 3 GHz, +20° to +30°C, after CAL) ±1.3 dB (–30 to +40 dBm, 3 GHz < Frequency ≤ 3.6 GHz, +20° to +30°C, after CAL) MX847550A ±1.1 dB (–50 to +35 dBm, 350 MHz ≤ Frequency ≤ 3 GHz, +20° to +30°C, after CAL) ±1.3 dB (–50 to +35 dBm, 3 GHz < Frequency ≤ 3.6 GHz, +20° to +30°C, after CAL) ±2.0 dB (–60 to +35 dBm, 350 MHz ≤ Frequency ≤ 3.6 GHz, after CAL) Variable range Rx level setting resolution: 1 dB
General		Display: Color TFT LCD screen, 12.1 inches (wide type), 1280 × 800 dots External interface Trigger I/O: BNC Call Proc Timing I/O: 15-pin mini D-Sub connector Call Proc Serial I/O: D-sub connector, RS-232C level Call Proc Ethernet A/B: RJ-45 connector, 10Base-T/100Base-TX/1000Base-T Handset: RJ-11 connector Headphone: 3.5-mm dia. headphone jack Microphone: 3.5-mm dia. microphone jack USB: Type A, 4 ports RS-232C: D-sub connector, conforms to RS-232C GPIB: IEEE488 connector VGA: Mini D-Sub connector Ethernet 0/1: RJ-45 connector 10Base-T/100Base-TX/1000Base-T
Power Supply		100 Vac to 120 Vac (±10%)/200 Vac to 240 Vac (–15%/+10%, Max.: 250 Vac), 50 Hz to 60 Hz (Rating), ≤600 VA (Max.)
Dimensions and Mass		426 (W) × 221.5 (H) × 398 (D) mm (excl. protrusions), <25 kg (with all options)
Temperature Range & Humidity		Operation: +5° to +40°C, Storage: –20° to +60°C, ≤90% (no condensation)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

Signalling Tester MD8475A Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main frame
MD8475A	Signalling Tester
	Standard accessories
MX847500A	Platform Software (Factory-installed)
MX847501A	Control Software (Factory-installed)
J0017F	Power Cord, 2.6 m
	MD8475A CD-ROM (Operation manual)
P0035B	W-CDMA/GSM Test USIM (Standard UICC size)
P0035B7	W-CDMA/GSM Test USIM (Micro UICC Size)
J1440A	LAN Cable (3 m)
Z0541A	USB Mouse
Z0975A	Keyboard (USB)
A0058A	Handset
	Hardware options
MD8475A-001	2nd RF
MD8475A-003	Fading IO Option
	Software options
MX847502A	Multi-cell Software
MX847506A	RF Measurement
MX847508A	Multimedia Interface Software
MX847508A-001	AMR-WB
	User interface
MX847570A	SmartStudio
MX847570A-010	W-CDMA Option
MX847570A-011	HSPA Evolution/DC-HSDPA Option
MX847570A-020	GSM Option
MX847570A-030	CDMA2000 Option
MX847570A-040	TD-SCDMA Option
MX847570A-050	LTE FDD Option
MX847570A-055	LTE TDD Option
MX847570A-060	IMS Script Basic Option
MX847570A-061	XCAP Script Option
MX847570A-070	WLAN Offload Basic Option
MX847570A-071	ePDG Option
MX847570A-072	ANDSF Option
MX847570A-073	Extended ePDG Option
MX847570A-080	Extended CSCF Option
MX847570A-081	IMS Supplementary Service Option
MX847570A-083	RCS Basic Option
MX847570A-084	GBA Authentication Option
MX847570A-085	IMS Early Media Option
MX847570A-086	RTP Frame Control Option
	LTE system
MD8475A-070	Multi-signalling Unit
MX847550A	LTE Simulation Software
MX847550A-010	LTE FDD Option
MX847550A-015	LTE TDD Option
MX847550A-020	LTE 2×2 MIMO Option
MX847550A-040	LTE Carrier Aggregation Option
MX847550A-060	LTE RoHC Option
	W-CDMA system
MD8475A-070	Multi-signalling Unit
MX847510A	W-CDMA Simulation Software
MX847510A-001	HSPA Option
MX847510A-011	HSPA Evolution/DC-HSDPA Option
	GSM system
MD8475A-020	GSM Signalling Unit
MX847520A	GSM/GPRS Simulation Software
MX847520A-001	EGPRS Option
	CDMA2000 system
MD8475A-030*1	CDMA2000 1X Signalling Unit
MD8475A-032*2	CDMA2000 1xEV-DO Signalling Unit
MX847530A	CDMA2000 Simulation Software
MX847530A-001	Multi-sector/Multi-carrier Option
	TD-SCDMA system
MD8475A-040	TD-SCDMA Signalling Unit
MX847540A	TD-SCDMA Simulation Software
MX847540A-001	TD-HSPA Option
	Automation tools
MX847503A	SmartStudio Manager
MX847503A-601	SSM Test PKG European eCall
MX847503A-923	eCall Tester Control Library
MX847504A	Smartphone Control Platform
Z1813A	USB Dongle (Automation)

Model/Order No.	Name
	Scenario tools
MX847580A	SIDE Execution Software
MX847580A-018	SIP Execution Option
MX702600B	CDMA2000 Scenario Composer
	Automotive applications
MX703330E-PL010	eCall Tester (Perpetual License)
MX703330E-031	MSD ERA GLONASS Option
MX703330E-032	EGTS Server ERA GLONASS Option
MX703330E-061	Multi-Cell Option
	Ciphering options
MX847510A-050	W-CDMA Ciphering Option
MX847520A-050	GSM/GPRS Ciphering Option
MX847540A-050	TD-SCDMA Ciphering Option
MX847550A-050	LTE Ciphering Option
	Software support services
MX847510A-SS110	MX847510A 1Year Support Service
MX847520A-SS110	MX847520A 1Year Support Service
MX847530A-SS110	MX847530A 1Year Support Service
MX847540A-SS110	MX847540A 1Year Support Service
MX847550A-SS110	MX847550A 1Year Support Service
MX702600B-SS110	MX702600B 1Year Support Service
MX703330E-SS110	MX703330E 1Year Support Service
	Technical support services
MX847570A-TS160	MX847570A-060 1 Year Technical Support Service
MX847570A-TS161	MX847570A-061 1Year Technical Support Service
MX703330E-TS110	MX703330E 1 Year Technical Support Service
	Warranty
MD8475A-ES210	2 Years Extended Warranty Service
MD8475A-ES310	3 Years Extended Warranty Service
MD8475A-ES510	5 Years Extended Warranty Service
	Application parts
41KC-3	Fixed Attenuator 3 dB
B0655A	Rack Mount Kit
J0004	Coaxial Adaptor (N (male)-SMA (female))
J0127A	Coaxial Cord, 1.0 m (BNC-P · RG58A/U · BNC-P)
J0127B	Coaxial Cord, 2.0 m (BNC-P · RG58A/U · BNC-P)
J0576B	Coaxial Cord, 1.0 m (N-P · 5D-2W · N-P)
J0576D	Coaxial Cord, 2.0 m (N-P · 5D-2W · N-P)
J0658	Adapter (SMA male-female L-type)
J1262A	RS-232C Cable (Straight 2 m, male-female)
J1262B	RS-232C Cable (Crossover 2 m, male-female)
J1263	W-CDMA Interface Cable (UE connection cable)
J1287	HDD-SUB15P Cable (milli-inch, for connecting MN8110B)
J1333A	HDD-SUB15P Crossover Cable (inch)
J1334A	CDMA2000 Cable
J1416A	LVDS Cable
J1440A	LAN Cable
J1524A	Dsub15-BNC Conversion Cable
J1549A	LTE-C2K Sync Cable
J1605A	MD8475A 3GPP Sync Cable
J1609A	Signal Divider
J1610A	MD8475A 2CC MIMO Connect Cable Kit
J1651A	MD8475A Sync In Cable (for 3CC Test)
P0035B	W-CDMA/GSM Test USIM (Standard UICC Size)
P0035B7	W-CDMA/GSM Test USIM (Micro UICC Size)
P0135A6	Anritsu Test UICC GA (nano UICC Size)
P0135A7	Anritsu Test UICC GA (Micro UICC Size)
P0135B6	Anritsu Test UICC GA (nano UICC Size)
P0135B7	Anritsu Test UICC GA (Micro UICC Size)
P0250A6	Anritsu Test UICC GT (nano UICC Size)
P0250A7	Anritsu Test UICC GT (Micro UICC Size)
P0250B6	Anritsu Test UICC GT (nano UICC Size)
P0250B7	Anritsu Test UICC GT (Micro UICC Size)
P0260A6	Anritsu Test UICC GM (nano UICC Size)
P0260A7	Anritsu Test UICC GM (Micro UICC Size)
P0260B6	Anritsu Test UICC GM (nano UICC Size)
P0260B7	Anritsu Test UICC GM (Micro UICC Size)
Z0749	MN8110B + Inch Screw Cable (for call processing I/O)
Z1908B	Standard Laptop for SSM
Z1919A	Standard Desktop for WLAN
Z2002A	eUICC Profile Manager

*1: RoHS not supported at MD8475A-030 installation
*2: RoHS not supported at MD8475A-032 installation

Signalling Tester MD8475B SmartStudio Test Functions

✓: Supported

Function	Description	MD8475B				
		LTE	W-CDMA*2	GSM*2	CDMA2000*2	TD-SCDMA*2
General						
Position Registration*1	Connects UE and creates test environment	✓	✓	✓	✓	✓
L1/L2 Counter	Counts values for each L1/L2 channel every second	✓	✓	–	–	✓
Throughput Counter	Simultaneously displays PHY layer and IP Throughput (SDU)	✓	✓	✓	–	✓
Trace	Displays events for each layer as arrows	✓	✓	✓	✓	✓
Reject	Returns arbitrary reject message when UE connected	✓	✓	✓	–	✓
Neighbor Cell Setting	Reports information to UE about BTS adjacent to BTS under test	✓	✓	✓	✓	✓
RF Related						
TRx Power Setting	Changes TRx power of BTS during Idle Communication	✓	✓	✓	✓	✓
No Network Setting	Sets BTS Power output to OFF and switches UE to no network status	✓	✓	✓	✓	✓
RF Monitor	Displays frequency, frequency error, and power for each channel such as PDSCH, PUSCH, etc.	✓	✓	✓	–	✓
TPC Setting	Changes TPC (Transmit Power Control) arbitrarily	✓	✓	✓	–	✓
AWGN	Sends AWGN in conjunction with normal signal	✓	✓	–	–	–
RF Measurement Options	Measures UE RF power at each second	✓	✓	✓	–	–
External Control						
Ethernet	Controls SmartStudio operation (parameter selection, start, etc.) from external PC	✓	✓	✓	✓	✓
GPIB	Controls SmartStudio setting parameters from external PC	✓	✓	✓	✓	✓
Voice/Video Communications						
LTE FDD/TDD						
VoLTE/Video Telephony Calling/Answering (Loopback)	Executes call test for UE supporting Voice over LTE/Video over LTE	✓				
Emergency Call/Originating System	Sets emergency call, and VoLTE/Video call control at LTE	✓				
Codec Change	Changes audio and video codecs arbitrarily and executes UE switchover test	✓				
LTE FDD/TDD, W-CDMA, GSM, CDMA2000, TD-SCDMA						
CSFB/eCSFB*3	Auto-switches communication method when other system voice call received during LTE call	✓	✓	✓	✓	✓
SRVCC*3	Performs seamless switch to CS voice call during VoLTE call	✓	✓	✓	–	–
W-CDMA, GSM, CDMA2000, TD-SCDMA						
Voice Call/Answer/On-hook (Loopback/Echoback)	Performs loopback call test*4		✓	✓	✓	✓
Voice Call/Answer/On-hook (Handset)	Performs call test using headset		✓	✓	–	✓
Emergency Call/Originating	Performs emergency call test with and without Test SIM*5		✓	✓	✓	✓
Caller ID Setting	Sets Caller ID notification/non-notification/notification disabled/public phone/ international call answer		✓	✓	✓	✓
Call Blocking (Release99) <Barred>	Sets call conditions for Release99 for W-CDMA, GSM, TD-SCDMA and bars all calls		✓	✓		✓
Call Blocking (Release99) <Emergency>	Sets call conditions for Release99 for W-CDMA, GSM, TD-SCDMA and bars all calls except emergency calls		✓	✓		✓
Call Blocking (PSIST/ACCT)	Bars calls for CDMA2000				✓	
W-CDMA, TD-SCDMA						
Videophone Call/Answer/On-hook (Loopback)	Performs loopback call test*4		✓			✓
Packet Data Communications						
IPv4 Packet Test	Performs data TRx using IPv4	✓	✓	✓	✓	✓
IPv6 Packet Test	Performs data TRx using IPv6	✓	✓	✓	✓	✓
Packet Preservation/Dormant Test	Releases RRC Connection while preserving PDP Context	✓	✓	–	✓	✓
Multiple PDP Context/PDN Connect	Connects multiple PDN and performs multisession packet data test	✓	✓	–	✓	–
State Change	Changes state from BTS during packet data communications	✓	✓	–	✓	✓
IP Data Traffic Functions	Uses built-in packet generator to implement simple measurement system with automated high-reproducibility data throughput test	✓	✓	✓	✓	✓
LTE FDD/TDD						
SISO/MIMO Packet Calling/Answering	Connects server and performs application test using packet data communications	✓				
SISO/MIMO Packet UE Side Disconnect		✓				
SISO/MIMO Packet Network Side Disconnect		✓				
DL2CC Carrier Aggregation	Performs DL2CC carrier application tests	✓				
DL3CC Carrier Aggregation	Performs DL3CC carrier application tests	✓				
DL4CC Carrier Aggregation	Performs DL4CC carrier application tests	✓				
DL5CC Carrier Aggregation	Performs DL5CC carrier application tests	✓				
UL2CC Carrier Aggregation	Performs UL2CC carrier application tests	✓*6				
FDD/TDD Joint Operation	Performs FDD and TDD Joint Operation test	✓*7				
W-CDMA						
W-CDMA/HSPA/HSPA Evolution Packet Calling/Answering	Connects server and performs application test using packet data communications		✓			
W-CDMA/HSPA/HSPA Evolution Packet UE Side Disconnect			✓			
W-CDMA/HSPA/HSPA Evolution Packet Network Side Disconnect			✓			
PPP Packet Calling	Performs DL2CC carrier application tests		✓			
PPP Packet UE Side Disconnect	Performs DL3CC carrier application tests		✓			
PPP Packet Network Side Disconnect	Performs UL2CC carrier application tests		✓			
GSM						
GPRS/EGPRS Packet Calling/Answering	Connects server and performs application test using packet data communications			✓		
GPRS/EGPRS Packet UE Side Disconnect				✓		
GPRS/EGPRS Packet Network Side Disconnect				✓		
CDMA2000						
CDMA2000/EV-DO Packet Calling	Connects server and performs application test using packet data communications				✓	
SV-DO Test	Performs simultaneous voice and packet communications				✓	
TD-SCDMA						
TD-SCDMA/HSPA*8 Packet Calling/Answering	Connects server and performs application test using packet data communications					✓
TD-SCDMA/HSPA*8 Packet UE Side Disconnect						✓
TD-SCDMA/HSPA*8 Packet Network Side Disconnect						✓
Messaging						
ETWS Message Sending	Performs ETWS message send test during Idle or Communication state	✓	✓	–	–	–
CMAS Message Sending	Performs CMAS message send test during Idle or Communication state	✓	✓	–	✓	–
CBS Message Sending	Performs CBS message send test during Idle or Communication state	–	✓	✓	–	–
SMS Message Sending/Receiving	Performs SMS (7 bit-ASCII, Unicode, Binary) test using PS and CS networks*4	✓	✓	✓	✓	✓
SMS over IMS Test	Performs SMS send/receive test via IMS server	✓	–	–	–	–
SMS Message Continuous Sending	Sends selected multiple SMS to UE continuously	✓	✓	✓	✓	✓
MMS Sending/Receiving*9	Performs MMS send/receive test	✓	✓	✓	✓	✓

*1: Ciphering function not supported

*2: Support for installing the Enhanced Multi-signalling Unit (MD8475B-071) is expected in future.

*3: Only dual system configuration supported

*4: Two-way tests using two UEs not supported

*5: Test SIM not required by CDMA2000

*6: Limited to 50 Mbps throughput when MD8475B-070 installed

*7: Requires MD8475B-071

*8: DCH Measurement Occasion/Idle Interval Measurement function not supported

*9: Requires separate MMS server

Signalling Tester MD8475B System Configurations/Option/Software

Main Frame Options

Extended RF MD8475B-002

This option is required to simulate the operation of three or more base-station cells. It supports 8Tx/4RX using the MD8475B.

Fading IO Option MD8475B-004

Combining the Signalling Tester MD8430A with the fading option and the MD8475B supports configuration of a fading test environment.

Multi-cell Software MX847502B

This option is required when simultaneously activating two or more cells such as at handover tests within the same system, Inter-RAT tests between different systems, LTE Carrier Aggregation tests, etc. However, it is not required when performing CDMA2000 and EV-DO hybrid tests using one MD8475B.

Multimedia Interface Software MX847508B

This option is required when performing end-to-end voice tests with microphones and speakers (headset) connected to the MD8475B. It can be used for W-CDMA and GSM AMR-NB (AMR Narrowband), GSM EFR (Enhanced Full Rate Speech), FR (Full Rate Speech), and HR (Half Rate Speech) codecs.

AMR-WB MX847508B-001

This option supports the W-CDMA AMR-WB (AMR Wideband) codec. It requires the MX847508B.

Supported voice codec list

Supported Codecs	Multimedia Interface Software MX847508B	AMR-WB MX847508B-001
AMR-NB (W-CDMA/GSM)	✓	—
GSM-EFR (GSM)	✓	—
GSM-FR (GSM)	✓	—
GSM-HR (GSM)	✓	—
AMR-WB (W-CDMA)	—	✓

SmartStudio MX847570B

This software supports the user interface for scenario-less testing. In addition to offering functions such as sending and receiving SMS messages, sending and receiving ETWS/CMAS messages, making and receiving voice calls, and sending and receiving data packets, it also supports CSCF server functions required for IMS service tests.

- Support Service

  MX847570B 1Year Support Service MX847570B-SS110

  This service contract offers customers 1 year of support for technical enquiries as well as updates to the latest software versions adding extra functionality and bug fixes via downloads from the web page.

W-CDMA

- Basic Configuration (Voice/Video/Packet)

  Multi-signalling Unit MD8475B-070
  W-CDMA Simulation Software MX847510B
  W-CDMA Option MX847570B-010

  These are for basic W-CDMA configuration. These tests support voice, videophone, packet, and SMS tests.

- Options

  HSPA Evolution/DC-HSDPA Option MX847510B-011
  HSPA Evolution/DC-HSDPA Option MX847570B-011

  These options support HSPA Evolution and DC-HSPA packet communications tests for high-speed packet services used by W-CDMA systems.

3GPP TS 25.306 Category List for MX847570A
HSDPA

HS-DSCH Category	HS-DSCH Codes	Minimum Inter-TTI	TB-Sizes	Total Number of Soft Channel Bits	Modulation	Maximum Throughput [bps]
5*	5	1	7298	57600	QPSK/16QAM	3649000
6	5	1	7298	67200	QPSK/16QAM	3649000
7*	10	1	14411	115200	QPSK/16QAM	7205500
8	10	1	14411	134400	QPSK/16QAM	7205500
9	15	1	20251	172800	QPSK/16QAM	10125500
10	15	1	27952	172800	QPSK/16QAM	13976000
12	5	1	3630	28800	QPSK	1815000
13	15	1	35280	259200	Not Applicable (dual cell operation not supported)	17640000
14	15	1	42192	259200		21096000
21	15	1	23370	345600	QPSK/16QAM	23370000
22	15	1	27952	345600	QPSK/16QAM	27952000
23	15	1	35280	518400	QPSK/16QAM 64QAM	35280000
24	15	1	42192	518400		42192000

HSUPA

E-DCH Category	E-DCH Codes	Minimum Spreading Factor	Support for TTI EDCH	TB-Sizes E-DCH TTI	Maximum Throughput [bps]
3	2	SF4	10 ms TTI	14484	1459500
5	2	SF2	10 ms TTI	20000	2918500
6	4	SF2	10 ms TTI	14484	5760000

*: Not supported when UE specifies a category

LTE

- Basic Configuration

  Multi-signalling Unit MD8475B-070
  Enhanced Multi-signalling Unit MD8475B-071
  LTE Simulation Software MX847550B
  LTE Option MX847570B-050

  These are for basic LTE FDD/TDD configuration. It supports both FDD and TDD technologies. These tests support confirmation of connections with LTE UEs during SISO, packet communications, and SMS sending/receiving. In addition, multi-cell tests are supported by installing the Multi-cell Software MX847502B.

3GPP TS 36.306 V13.5.0 (2017-03) Category List
Downlink physical layer parameter values set by the field UE-Category

UE DL Category	Maximum number of DL-SCH transport block bits received within a TTI	Maximum number of bits of a DL-SCH transport block received within a TTI	Total number of soft channel bits	Maximum number of supported layers for spatial multiplexing in DL
Category 0	1000	1000	25344	1
Category 1	10296	10296	250368	1
Category 2	51024	51024	1237248	2
Category 3	102048	75376	1237248	2
Category 4	150752	75376	1827072	2
Category 5*	299552	149776	3667200	4
Category 6	301504	149776 (4 layers, 64QAM) 75376 (2 layers, 64QAM)	3654144	2 or 4
Category 7*	301504	149776 (4 layers, 64QAM) 75376 (2 layers, 64QAM)	3654144	2 or 4
Category 8	2998560	299856	35982720	8
Category 9	452256	149776 (4 layers, 64QAM) 75376 (2 layers, 64QAM)	5481216	2 or 4
Category 10*	452256	149776 (4 layers, 64QAM) 75376 (2 layers, 64QAM)	5481216	2 or 4
Category 11	603008	149776 (4 layers, 64QAM) 195816 (4 layers, 256QAM) 75376 (2 layers, 64QAM) 97896 (2 layers, 256QAM)	7308288	2 or 4
Category 12*	603008	149776 (4 layers, 64QAM) 195816 (4 layers, 256QAM) 75376 (2 layers, 64QAM) 97896 (2 layers, 256QAM)	7308288	2 or 4
DL Category 13*	391632	195816 (4 layers, 256QAM) 97896 (2 layers, 256QAM)	3654144	2 or 4
DL Category 14	3916560	391656 (8 layers, 256QAM)	7431680	8
DL Category 15*	749856-798800	149776 (4 layers, 64QAM) 195816 (4 layers, 256QAM) 75376 (2 layers, 64QAM) 97896 (2 layers, 256QAM)	9744384	2 or 4
DL Category 16*	978960-1051360	149776 (4 layers, 64QAM) 195816 (4 layers, 256QAM) 75376 (2 layers, 64QAM) 97896 (2 layers, 256QAM)	12789504	2 or 4
Category 17	25065984	391656 (8 layers, 256QAM)	303562752	8
Category 18	1174752-1206016	[299856 (8 layers, 64QAM) 391656 (8 layers, 256QAM)] 149776 (4 layers, 64QAM) 195816 (4 layers, 256QAM) 75376 (2 layers, 64QAM) 97896 (2 layers, 256QAM)	14616576	2 or 4 [or 8]
Category 19	1566336-1658272	[299856 (8 layers, 64QAM) 391656 (8 layers, 256QAM)] 149776 (4 layers, 64QAM) 195816 (4 layers, 256QAM) 75376 (2 layers, 64QAM) 97896 (2 layers, 256QAM)	19488768	2 or 4 [or 8]

Uplink physical layer parameter values set by the field UE-Category

UE UL Category	Maximum number of UL-SCH transport block bits transmitted within a TTI	Maximum number of bits of an UL-SCH transport block transmitted within a TTI	Support for 64QAM in UL
Category 0	1000	1000	No
Category 1	5160	5160	No
Category 2	25456	25456	No
Category 3	51024	51024	No
Category 4	51024	51024	No
Category 5*	75376	75376	Yes
Category 6	51024	51024	No
Category 7*	102048	51024	No
Category 8	1497760	149776	Yes
Category 9	51024	51024	No
Category 10*	102048	51024	No
Category 11	51024	51024	No
Category 12*	102048	51024	No
UL Category 13*	150752	75376	Yes
UL Category 14	9585664	149776	Yes
UL Category 15	226128	75376	Yes

*: Requires MD8475B-071

- Options
  LTE 2×2 MIMO Option MX847550B-020
    This option adds 2×2 MIMO to the MX847550B.

  LTE 4×4 MIMO Option MX847550B-021
    This option adds 4×4 MIMO to the MX847550B.

  LTE Licensed Assisted Access (LAA) Option MX847550B-030
    This software option provides LTE Licensed Assisted Access (LAA) capability that can be used with the MIMO options and the Carrier Aggregation Options.

  LTE Carrier Aggregation Option MX847550B-040
    This software option supports LTE 2CC Carrier Aggregation. It supports the 2CC SISO test environment. Additionally, installing the MX847550B-020 software supports the 2CC MIMO test environment.

  LTE Carrier Aggregation DL3CCs Option MX847550B-041
    This software option supports LTE 3CC Carrier Aggregation. It supports the 3CC SISO test environment. Additionally, installing the MX847550B-020 software supports the 3CC MIMO test environment.

  LTE Carrier Aggregation DL4CCs Option MX847550B-042
    This software option supports LTE 4CC Carrier Aggregation. It supports the 4CC SISO test environment. Additionally, installing the MX847550B-020 software supports the 4CC MIMO test environment.

  LTE Carrier Aggregation DL5CCs Option MX847550B-043
    This software option supports LTE 5CC Carrier Aggregation. It supports the 5CC SISO test environment. Additionally, installing the MX847550B-020 software supports the 5CC MIMO test environment.

  LTE RoHC Option MX847550B-060
    This option adds better compression algorithms to improve LTE IP packet transfer efficiency.

Supported Profiles

IP	Profile
0x0000	No compression (LTE)/Uncompressed (UMTS)
0x0001	RTP/UDP/IP
0x0002	UDP/IP

GSM

- Basic Configuration
  GSM Signalling Unit MD8475B-020
  GSM/GPRS Simulation Software MX847520B
  GSM Option MX847570B-020
    This is the basic configuration for performing GSM/GPRS tests. It supports voice and packet communications tests, SMS sending and receiving, etc. Additionally, it can be used for evaluating application functions using EGPRS communications for EGPRS high-speed data communications.

Supported EGPRS Specifications

Layer 1	Frequency Bandwidth	850, 900, 1800, 1900 MHz
	Modulation & Coding Scheme	MCS 1, 2, 3, 4 (GMSK) MCS 5, 6, 7, 8, 9 (8PSK)
	Number of Slots	Up to Multi Slot Class 12 (DL: 4/UL: 4/SUM: 5)
	Channel Combination	Combination 11 & 13
Layer 2, 3	Broadcasting Control Channel	BCCH/CCCH, PBCCH/PCCH
	ARQ Type	Type 1
	Window Size	64 to 192
Standard		3GPP Release 99

CDMA2000

- Basic Configuration
  CDMA2000 1X Signalling Unit MD8475B-030
  CDMA2000 1xEV-DO Signalling Unit MD8475B-032
  CDMA2000 Simulation Software MX847530B
  CDMA2000 Option MX847570B-030
    This is the basic configuration for performing CDMA2000 1X/1xEV-DO tests. It supports voice (echo-back) and packet communications tests, SMS sending and receiving, etc.
    Additionally, it can be used to configure a CDMA2000 1X and 1xEV-DO hybrid environment.

- Extension Options
  Multi-Sector/Multi-Carrier Option MX847530B-001
    This software option support simulation* of various handover tests by dynamically changing CDMA2000 1X/1xEV-DO Multi-carriers (2 max.), and multi-sectors (1X: 6 max.; 1xEV-DO: 3 max.). It supports various handover tests such as Soft, Softer, Hard, Idle, and Access. Handover tests in a multi-sector/multi-carrier environment, which are hard to execute on a live network, can be implemented easily using one MD8475B 1 unit. The work efficiency for operation verification tests, Interoperability Tests (IOT), field-test pre-verification tests, undertaken by mobile development sections is greatly enhanced.

*: Does not work with MX847570B.

TD-SCDMA

- Basic Configuration
  - TD-SCDMA Signalling Unit MD8475B-040
  - TD-SCDMA Simulation Software MX847540B
  - TD-SCDMA Option MX847570B-040

    These are for basic TD-SCDMA configuration which support voice, videophone, packet, and SMS tests.

- Options
  - TD-HSPA Option MX847540B-001

    This is for evaluating all 3GPP TS 25.306 HSPA UE categories[*1].

3GPP TS 25.306
TD-HSDPA

HS-DSCH category	Maximum number of HSDSCH codes per timeslot	Maximum number of HSDSCH timeslots per TTI	Maximum number of HSDSCH transport channel bits can be received within an HSDSCH TTI	Total number of soft channel bits	Maximum Throughput [bps]
Category 1 to 3	16	2	2788	11264	557600
Category 4 to 6	16	2	5600	22528	1120000
Category 7 to 9	16	3	8416	33792	1688200
Category 10 to 12	16	4	11226	45056	2245200
Category 13 to 15	16	5	14043	56320	2808600

TD-HSUPA

E-DCH category	Maximum number of E-DCH timeslots per TTI	Maximum number of E-DCH transport channel bits that can be received within an E-DCH TTI	Maximum Throughput [bps]
Category 1	2[*2]	2754	550800
Category 2	3[*2]	4162	832400
Category 3	2[*2]	5532	1106400
Category 4	3[*2]	8348	1669600
Category 5	4[*2]	11160	2232000
Category 6	5[*2]	11160	2232000

*1: MX847570B supports Category 6 only.
*2: One timeslot supports two physical channels when 16QAM not used.

IMS Options

IMS Script Basic Option MX847570B-060
This software supports scripting of the communication procedure between the test UE and CSCF server using a ladder sequence to provide a very flexible and expandable test environment.

XCAP Script Option MX847570B-061
This option provides a test environment with high flexibility and expandability for creating scripts using a ladder sequence to edit XCAP messages between the UE and server without the need to prepare an actual server.

Extended CSCF Option MX847570B-080
This software option adds functions for calling from the network to UE as well as extended functions for CSCF-server-side network congestion and no response status.

IMS Supplementary Service Option MX847570B-081
This software option adds other service tests, including VoLTE caller ID display, call forwarding, call holding, etc.

RCS Basic Option MX847570B-083
This software option simulates RCS services. It is used to perform tests including RCS Configuration, Registration, Instant Messaging, etc.

GBA Authentication Option MX847570B-084
This option has the 3GPP GBA Authentication algorithm, authentication procedure and parameter settings for simulating GBA operations.

IMS Early Media Option MX847570B-085
This software supports IMS Early Media sequence tests. It can be used to confirm customized call tone services at the network side, such as NRBT (Network Ring Back Tone) and CAT (Customized Alerting Tone).

RTP Frame Control Option MX847570B-086
This option is for controlling media data (RTP packets) during VoLTE communications. It can be used to configure a voice environment in the MUTE status and with fixed data; a measurement environment can be configured for abnormal audio quality verification and battery power consumption tests in a fixed state.

- Support Service (IMS options)
  - MX847570B-060 1-Year Technical Support Service MX847570B-TS160

    This contract offers customers support for technical enquiries for 1 year.
  - MX847570B-061 1 Year Technical Support Service MX847570B-TS161

    This contract offers customers support for technical enquiries for 1 year.

WLAN Offload Options

WLAN Offload Basic Option MX847570B-070
This software option provides an EAP authentication server for performing EAP over RADIUS communications (EAP-SIM/EAP- AKA) between a WLAN access point and the EAP authentication server. Additionally, data access by the physical bearers is displayed to verify the 3GPP/WLAN switchover.

ePDG Option MX847570B-071
This software option provides an ePDG server for testing the UE functions at Untrusted non-3GPP Access by running IKEv2 key exchanges and IPsec communications between the UE and ePDG.
It requires the MX847570B-070 option as well.

ANDSF Option MX847570B-072
This software option provides the ANDSF function for testing the UE functions after ANDSF policy distribution to the UE.
It requires the MX847570B-070 options as well.

Extended ePDG Option MX847570B-073
This software option supports configuration of an ePDG status fault test environment for inserting errors into the ePDG sequence, setting timeouts, etc. Additionally, this option can be used to support Fast Re-Authentication (EAP-SIM/EAP-AKA) tests without the need to generate UE-side authentication keys. It requires the MX847570B-070/MX847570B-071.

eCall Options

eCall Tester (Perpetual License) MX703330E-PL010

This option simulates the PSAP used by eCall services to support the eCall sequence (MSD call → Voice call) between the IVS and PSAP at a road accident.

The following test standards are supported:

- TS 26 .267 V8.6.0 (2011-03)
- EN15722: 2015
- EN16454: 2015
- TS 26 .268 V8.6.0 (2011-03)
- EN16062: 2015
- ISO3779: 2009

This option can be used as a test environment for model authentication in accordance with the EN16454 recommendations. This option provides audio replay and record functions.

MSD ERA GLONASS Option MX703330E-031

This option supports the MSD data communications function over SMS used by the ERA-GLONASS system

The following test standards are supported:

- GOST R 54619-2011
- GOST R 54721-2011
- GOST R 54620-2011
- GOST R 55530-2013

EGTS Server ERA GLONASS Option MX703330E-032

This option provides a test environment to send/receive and encode/decode EGTS messages defined in the GOST R 54619/54620. MX703330E-031 is separately required.

Multi-Cell Option MX703330E-061

This option provides the handover test environment required when setting two or more cells as well as the CS Fallback test environment at the eCall environment. Practical eCall module tests are supported using this option.

The cell combinations are as follows:

	LTE	W-CDMA	GSM
LTE*	—	✓	✓
W-CDMA	✓	✓	✓
GSM	✓	✓	✓

*: VoLTE is not supported

- Support Service

MX703330E 1-Year Support Service MX703330E-SS110

This service contract offers customers 1 year of support for technical enquiries as well as updates to the latest software versions adding extra functionality and bug fixes via downloads from the web page.

SSM Test PKG European eCall MX847503A-601

This test package provides automated test environment. Opening the test case on the SSM, it shows test procedures of test items defined in the (EC) 2017/79 and EN16454, and automatically configures the setting of MD8475A/MD8475B and eCall tester. This test package also has report functions for each standards.

Scenario Tools

SIDE Software MX847580B
SIP Option MX847580B-018

These software are for executing scenarios created using the MX843080A Scenario Integrated Development Environment in combination with the MX847510B, MX847520B, and MX847550B software.

CDMA2000 Scenario Composer MX702600B
MX702600B 1 Year Support Service MX702600B-SS110

This software creates CDMA2000 test scenarios using a ladder sequence design. The created test scenarios can be executed using the PVT (Protocol Visualization Tool) provided with the MX847530B software.

Ciphering Option

W-CDMA Ciphering Option MX847510B-050

This option adds the W-CDMA ciphering function*1, *2 and supports for KASUMI (3GPP-recommended algorithm).

GSM/GPRS Ciphering Option MX847520B-050

This option adds the GSM/GPRS ciphering function*1, *2 and supports both the GSM A5/1, A5/2, and A5/3 ciphering algorithms as well as the GPRS GEA/1, GEA/2, and GEA/3 ciphering algorithms.

TD-SCDMA Ciphering Option MX847540B-050

This option adds the TD-SCDMA ciphering function*1, *2 and supports SNOW 3G (3GPP-recommended algorithm).

LTE Ciphering Option MX847550B-050

This option adds the LTE ciphering function*1, *2 and supports SNOW 3G (3GPP-recommended algorithm) and AES.

*1: Does not work with MX847570B.

*2: The Integrity Algorithm does not require this option.

Upgrade Kits*

MD8475A to MD8475B Upgrade MD8475B-UG101
MD8475A to MD8475B Upgrade (with Ciphering) MD8475B-UG102
MD8475A to MD8475B Upgrade (with SIDE) MD8475B-UG103
MD8475A to MD8475B Upgrade (with Ciphering/SIDE) MD8475B-UG104
MD8475A to MD8475B Upgrade MD8475B-UG201
MD8475A to MD8475B Upgrade (with Ciphering) MD8475B-UG202
MD8475A to MD8475B Upgrade (with SIDE) MD8475B-UG203
MD8475A to MD8475B Upgrade (with Ciphering/SIDE) MD8475B-UG204

These retrofit kits upgrade the MD8475A in use to the MD8475B.

MSU Upgrade MD8475B-UG170
MSU Upgrade MD8475B-UG270

When upgrading the MD8475A in use to the MD8475B specifications, if a legacy unit such as the MD8475A-010 or MD8475A-040 is installed that cannot be transferred to the MD8475B-070 Multi-signalling Unit, the legacy unit must be changed to the MD8475B-070 with these retrofit kits.

*: Upgrade kit models vary according to the configuration of the MD8475A options in use; contact our sales section for more details.

eMSU Upgrade MD8475B-UG171
eMSU Upgrade MD8475B-UG271

The MD8475A-011, MD8475A-050 and MD8475A-070 can be changed to the MD8475B-071 when upgrading the MD8475A to the MD8475B.

eMSU Upgrade MD8475B-UG179
eMSU Upgrade MD8475B-UG279

The MD8475B-070 can be changed to the MD8475B-071.

Automation Tool

SmartStudio Manager MX847503A

This option increases the efficiency of evaluations by automating manual tests performed by the SmartStudio software MX847570B. In addition, the package includes test sequences required for evaluating basic functions.

Smartphone Control Platform MX847504A

Using this option, Android OS smartphone operations can be recorded via ADB and UE automated control scripts can be created, edited and run. As well as supporting automated control from the MX847503A, two-way automatic control of the measuring instrument and UE supports an operator-free test environment for higher test efficiency.

Signalling Tester MD8475B SmartStudio System Configuration

System		LTE		W-CDMA	TD-SCDMA	GSM	CDMA2000
		LTE-A	LTE				
Unit		Signalling Tester MD8475B					
Unit Option		Extended RF MD8475B-002					
		Fading IO Option MD8475B-004					
Platform Software		Multi-cell Software MX847502B					
		—		Multimedia Interface Software MX847508B			—
		—		AMR-WB MX847508B-001	—	—	—
Basic Configuration	Hardware	Multi Signalling Unit MD8475B-070				GSM Signalling Unit MD8475B-020	CDMA2000 1X Signalling Unit MD8475B-030
		Enhanced Multi-signalling Unit MD8475B-071		—	—	—	CDMA2000 1xEV-DO Signalling Unit MD8475B-032
	Software	LTE Simulation Software MX847550B		W-CDMA Simulation Software MX847510B	TD-HSPA Option MX847540B-001	GSM/GPRS Simulation Software MX847520B	CDMA2000 Simulation Software MX847530B
Options		LTE 2×2 MIMO Option MX847550B-020		HSPA Evolution/ DC-HSDPA Option MX847510B-011	—	—	—
		LTE 4×4 MIMO Option MX847550B-021					
		LAA Option MX847550B-030	—				
		LTE Carrier Aggregation Option MX847550B-040					
		LTE Carrier Aggregation DL3CCs Option MX847550B-041					
		LTE Carrier Aggregation DL4CCs Option MX847550B-042					
		LTE Carrier Aggregation DL5CCs Option MX847550B-043					
		LTE RoHC Option MX847550B-060					
Support Service		MX847570B 1 Year Support Service MX847570B-SS110					
User Interface		SmartStudio MX847570B					
SmartStudio Licence	System Option	LTE Option MX847570B-050		W-CDMA Option MX847570B-010	TD-SCDMA Option MX847570B-040	GSM Option MX847570B-020	CDMA2000 Option MX847570B-030
		LTE Carrier Aggregation Option MX847570B-051	—	HSPA Evolution/ DC-HSDPA Option MX847570B-011			
		LTE Licensed Assisted Access (LAA) Option MX847570B-052					
	IMS	Extended CSCF Option MX847570B-080					
		IMS Supplementary Service Option MX847570B-081					
		RCS Basic Option MX847570B-083					
		GBA Authentication Option MX847570B-084					
		IMS Early Media Option MX847570B-085					
		RTP Frame Control Option MX847570B-086					
	WLAN	WLAN Offload Basic Option MX847570B-070					
		ePDG Option MX847570B-071					
		ANDSF Option MX847570B-072					
		Extended ePDG Option MX847570B-073					
	Scripting Option	IMS Script Basic Option MX847570B-060					
		XCAP Script Option MX847570B-061					
	Technical Support Service	MX847570B-060 1 Year Technical Support Service MX847570B-TS160					
		MX847570B-061 1 Year Technical Support Service MX847570B-TS161					
Remote Interface		Quick TRX Diagnosis MX847506B					
		SmartStudio Manager MX847503A					
		Smartphone Control Platform MX847504A					
eCall Option		—		eCall Tester (Perpetual License) MX703330E-PL010	—	eCall Tester (Perpetual License) MX703330E-PL010	—
		—		MSD ERA GLONASS Option MX703330E-031	—	MSD ERA GLONASS Option MX703330E-031	—
		—		EGTS Server ERA GLONASS Option MX703330E-032	—	EGTS Server ERA GLONASS Option MX703330E-032	—
		—		Multi-Cell Option MX703330E-061	—	Multi-Cell Option MX703330E-061	—
		—		MX703330E 1-Year Support Service MX703330E-SS110	—	MX703330E 1-Year Support Service MX703330E-SS110	—

Signalling Tester MD8475B Specifications

RF Connector		RF Input/Output connector (Main, Aux 1, Aux 2) Connector: N (j) type, Impedance: 50Ω VSWR (Main): ≤1.9 (350 MHz to 3.8 GHz), ≤2.0 (3.8 GHz to 6.0 GHz) VSWR (Aux1, 2): ≤1.5 (350 MHz to 3.8 GHz), ≤1.6 (3.8 GHz to 6.0 GHz) Output connector (DL Output 1 to 8) Connector: SMA (j) type, Impedance: 50Ω VSWR: ≤1.5 (350 MHz to 3.8 GHz), ≤1.6 (3.8 GHz to 6.0 GHz) Reference oscillator Frequency: 10 MHz Level: TTL level Connector: BNC (j) type Startup characteristics: ≤5 × 10^{-8} (10 minutes after power-on, referenced to frequency 24 hours after power-on) Aging rate: 2 × 10^{-8}/day, ≤1 × 10^{-7}/year (referenced to frequency 24 hours after power-on) Temperature characteristics: ≤5 × 10^{-8} Frequency Accuracy at Shipment: ±2.2 × 10^{-8} (At +20° to +30°C, 1 hour after power-up) External reference input Frequency: 10 MHz, Acceptable frequency range: ±1.0 ppm, Level: ≥0 dBm, Impedance: 50Ω, Connector: BNC (j) type
Transmission Characteristics		Frequency Frequency range: 350 MHz to 6.0 GHz Setting resolution: 100 kHz (Depending on MX847501B used) Accuracy: Based on reference oscillator accuracy Output level Level range: (Main, Aux1, Aux2): LTE: –130 to –27 dBm (350 MHz to 3.8 GHz), –130 to –32 dBm (3.8 GHz to 6.0 GHz) W-CDMA: –130 to –27 dBm (350 MHz to 3.6 GHz) Others: –130 to –25 dBm (350 MHz to 3.6 GHz) Level Range (DL Output 1 to 8): LTE: –115 to –5 dBm (350 MHz to 3.8 GHz), –115 to –10 dBm (3.8 GHz to 6.0 GHz) W-CDMA: –115 to –5 dBm (350 MHz to 3.6 GHz) Others: –115 to –3 dBm (350 MHz to 3.6 GHz) Resolution: 0.1 dB Level Accuracy (Main): –120 dBm ≤ Output Level, after CAL, excluding other effects of internal signal generator ±1.7 dB (350 MHz to 3.8 GHz, +20° to +30°C) ±2.0 dB (3.8 GHz to 6.0 GHz, +20° to +30°C) Level Accuracy (Aux 1, Aux 2): –120 dBm ≤ Output Level, after CAL, excluding other effects of internal signal generator ±1.0 dB ±1.0 dB (350 MHz to 3.8 GHz, +20° to +30°C) ±1.3 dB (3.8 GHz to 6.0 GHz, +20° to +30°C) Level Accuracy (DL Output 1 to 8): –110 dBm ≤ Output Level, after CAL ±1.0 dB (350 MHz to 3.8 GHz, +20° to +30°C) ±1.3 dB (3.8 GHz to 6.0 GHz, +20° to +30°C) Signal purity Non-harmonic spurious: ≤–30 dBc (at ≥100 kHz frequency offset) Harmonics: ≤–25 dBc Modulation Accuracy : At +20° to +30°C W-CDMA: ≤3.5%rms (350 MHz to 2.7 GHz) GSM: ≤1.5°rms (350 MHz to 2.7 GHz) CDMA2000 1x: p >0.995 (400 MHz to 2.7 GHz, Pilot Channel) CDMA2000 1xEV-DO: p >0.995 (400 MHz to 2.7 GHz, Pilot Channel) LTE: ≤3.5%rms (400 MHz to 6.0 GHz)
Reception Characteristics		Frequency Frequency range: 350 MHz to 6.0 GHz Setting resolution: 100 kHz (Depending on MX847501B used) Level Maximum input level: +35 dBm (Average)
General		Display: Color TFT LCD screen, 12.1 inches (WXGA), 1280 × 800 dots External interface Trigger I/O: BNC (j) Call Processing Timing I/O: 15-pin mini D-Sub (f) connector Call Processing Ethernet A/B: RJ-45 connector, 10Base-T/100Base-TX/1000Base-T Measure Ethernet: RJ-45 connector, 10Base-T/100Base-TX/1000Base-T Headphone: 3.5-mm dia. headphone jack Microphone: 3.5-mm dia. microphone jack USB (Type-A) × 2 (Back Panel) USB (Type-A) × 4 (Front Panel) GPIB: IEEE488 connector VGA: Mini D-Sub connector Ethernet 0/1: RJ-45 connector, 10Base-T/100Base-TX/1000Base-T ARB : Mini D-sub connector Sync Input: BNC (j) x 1, Output : BNC (j) ×2
Power Supply		100 Vac to 120 Vac (±10%)/200 Vac to 240 Vac (–10%/+10%, Max.: 250 Vac), 50 Hz to 60 Hz (Rating), ≤1350 VA (Max.)
Dimensions and Mass		426 (W) × 221.5 (H) × 578 (D) mm (excl. protrusions), <40 kg (with all options)
Temperature Range & Humidity		Operation: +5° to +40°C, Storage: –20° to +60°C, ≤90% (no condensation)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

Signalling Tester MD8475B Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main frame
MD8475B	Signalling Tester
	Standard accessories
MX847500B	Platform Software
MX847501B	Control Software
J1211	POWER CORD.3M
P0031A	USB Memory
P0035B	W-CDMA/GSM Test USIM (Standard UICC size)
P0035B7	W-CDMA/GSM Test USIM (Micro UICC Size)
J1440A	LAN Cable (3 m)
Z0541A	USB Mouse
Z0975A	Keyboard (USB)
A0131A	Handset
	Hardware options
MD8475B-002	Extended RF
MD8475B-004	Fading IO Option
	Software options
MX847502B	Multi-cell Software
MX847506B	Quick TRX Diagnosis
MX847508B	Multimedia Interface Software
MX847508B-001	AMR-WB
	User interface
MX847570B	SmartStudio
MX847570B-010	W-CDMA Option
MX847570B-011	HSPA Evolution/DC-HSDPA Option
MX847570B-020	GSM Option
MX847570B-030	CDMA2000 Option
MX847570B-050	LTE Option
MX847570B-051	LTE Carrier Aggregation Option
MX847570B-052	LTE Licensed Assisted Access (LAA) Option
MX847570B-060	IMS Script Basic Option
MX847570B-061	XCAP Script Option
MX847570B-070	WLAN Offload Basic Option
MX847570B-071	ePDG Option
MX847570B-072	ANDSF Option
MX847570B-073	Extended ePDG Option
MX847570B-080	Extended CSCF Option
MX847570B-081	IMS Supplementary Service Option
MX847570B-083	RCS Basic Option
MX847570B-084	GBA Authentication Option
MX847570B-085	IMS Early Media Option
MX847570B-086	RTP Frame Control Option
	LTE system
MD8475B-070	Multi-signalling Unit
MD8475B-071	Enhanced Multi-signalling Unit
MX847550B	LTE Simulation Software
MX847550B-020	LTE 2×2 MIMO Option
MX847550B-021	LTE 4×4 MIMO Option
MX847550B-030	LTE Licensed Assisted Access (LAA) Option
MX847550B-040	LTE Carrier Aggregation Option
MX847550B-041	LTE Carrier Aggregation DL3CCs Option
MX847550B-042	LTE Carrier Aggregation DL4CCs Option
MX847550B-043	LTE Carrier Aggregation DL5CCs Option
MX847550B-060	LTE RoHC Option
	W-CDMA system
MD8475B-070	Multi-signalling Unit
MX847510B	W-CDMA Simulation Software
MX847510B-011	HSPA Evolution/DC-HSDPA Option
	GSM system
MD8475B-020	GSM Signalling Unit
MX847520B	GSM/GPRS Simulation Software
	CDMA2000 system
MD8475B-030[*1]	CDMA2000 1X Signalling Unit
MD8475B-032[*2]	CDMA2000 1xEV-DO Signalling Unit
MX847530B	CDMA2000 Simulation Software
	TD-SCDMA system
MD8475B-070	Multi-signalling Unit
MX847540B	TD-SCDMA Simulation Software
MX847540B-001	TD-HSPA Option
	Automation tools
MX847503A	SmartStudio Manager
MX847503A-601	SSM Test PKG European eCall
MX847503A-923	eCall Tester Control Library
MX847504A	Smartphone Control Platform
Z1813A	USB Dongle (Automation)

Model/Order No.	Name
	Scenario tools
MX847580B	SIDE Execution Software
MX847580B-018	SIP Execution Option
MX702600B	CDMA2000 Scenario Composer
	Automotive applications
MX703330E-PL010	eCall Tester (Perpetual License)
MX703330E-031	MSD ERA GLONASS Option
MX703330E-032	EGTS Server ERA GLONASS Option
MX703330E-061	Multi-Cell Option
	Ciphering options
MX847510B-050	W-CDMA Ciphering Option
MX847520B-050	GSM/GPRS Ciphering Option
MX847540B-050	TD-SCDMA Ciphering Option
MX847550B-050	LTE Ciphering Option
	Software support services
MX847570B-SS110	MX847570B 1Year Support Service
MX703330E-SS110	MX703330E 1 Year Support Service
	Technical support services
MX847570B-TS160	MX847570B-060 1 Year Technical Support Service
MX847570B-TS161	MX847570B-061 1 Year Technical Support Service
MX703330E-TS110	MX703330E 1 Year Technical Support Service
	Upgrade kits[*3]
MD8475B-UG□01	MD8475A to MD8475B Upgrade
MD8475B-UG□02	MD8475A to MD8475B Upgrade (with Ciphering)
MD8475B-UG□03	MD8475A to MD8475B Upgrade (with SIDE)
MD8475B-UG□04	MD8475A to MD8475B Upgrade (with Ciphering/SIDE)
MD8475B-UG□70	MSU Upgrade
MD8475B-UG□71	eMSU Upgrade
MD8475B-UG□79	eMSU Upgrade
	Warranty
MD8475B-ES210	2 Years Extended Warranty Service
MD8475B-ES310	3 Years Extended Warranty Service
MD8475B-ES510	5 Years Extended Warranty Service
	Application parts
B0703A	Rack Mount Kit
B0726A	Carrying Case
J0004	Coaxial Adaptor (N (male)-SMA (female))
J0127A	Coaxial Cord, 1.0 m (BNC-P · RG58A/U · BNC-P)
J0127B	Coaxial Cord, 2.0 m (BNC-P · RG58A/U · BNC-P)
J0322B	Coaxial Cord, 1.0 m
J0322D	Coaxial Cord, 2.0 m
J0658	Adapter (SMA male-female L-type)
J0576B	Coaxial Cord, 1.0 m (N-P · 5D-2W · N-P)
J0576D	Coaxial Cord, 2.0 m (N-P · 5D-2W · N-P)
J1263	W-CDMA Interface Cable (UE connection cable)
J1287	HDD-SUB15P Cable (milli-inch, for connecting MN8110B)
J1333A	HDD-SUB15P Crossover Cable (inch)
J1398A	N-SMA ADAPTOR
J1416A	LVDS Cable
J1440A	LAN Cable
J1489A	PP2S OUTPUT CABLE
J1524A	Dsub15-BNC Conversion Cable
J1609A	Signal Divider
J1651A	MD8475A Sync In Cable (for 3CC Test)
P0035B	W-CDMA/GSM Test USIM (Standard UICC Size)
P0035B7	W-CDMA/GSM Test USIM (Micro UICC Size)
P0135A6	Anritsu Test UICC GA (nano UICC Size)
P0135A7	Anritsu Test UICC GA (Micro UICC Size)
P0250A6	Anritsu Test UICC GT (nano UICC Size)
P0250A7	Anritsu Test UICC GT (Micro UICC Size)
P0260A6	Anritsu Test UICC GM (nano UICC Size)
P0260A7	Anritsu Test UICC GM (Micro UICC Size)
Z0749	MN8110B + Inch Screw Cable (for call processing I/O)
Z1858A	Divider (2 way)
Z1859A	Divider (3 way)
Z1908B	Standard Laptop for SSM
Z1919A	Standard Desktop for WLAN

*1: RoHS not supported at MD8475B-030 installation
*2: RoHS not supported at MD8475B-032 installation
*3: MD8475B-UG □ ##
□: Select from the following according to the option type.
1: Retrofit option (Must be returned to factory in Japan)
2: Retrofit option (Must be returned to service center outside of Japan)

Radio Communication Analyzer

MT8821C

30 MHz to 3.8 GHz, 3.8 GHz to 6.0 GHz (Option)

Remote Control
GPIB | **Ethernet**

Tomorrow's Wireless Test Capability Today

Excellent Eco Product

The Radio Communication Analyzer MT8821C is designed for R&D into mobile devices (User Equipment: UE), such as smartphones, tablets and M2M modules. It builds on the technologies of its popular predecessor, the MT8820C used worldwide by UE and chipset vendors. It operates as a base station simulator using standard call processing sequences compliant with test standards to support a versatile test lineup, starting with RF tests.

Support Systems

- LTE/LTE-Advanced/Cat-M/NB-IoT
- W-CDMA/HSPA
- GSM/EGPRS
- TD-SCDMA/HSPA
- CDMA2000/EV-DO

More Efficient RF Testing Supporting LTE-Advanced UE Measurement

With the introduction of LTE-Advanced, wireless communications are starting to use Carrier Aggregation (CA) technology offering continuing extendibility to wider bandwidths and more frequency bands. Additionally, adoption of the latest in faster communications technologies, such as higher-order 4×4 Multiple Input Multiple Output (MIMO) to improve frequency usage efficiency, means that measurement technologies are also becoming increasingly complex.

Enhanced GUI for Efficient Operability

Better operability and visibility have been achieved using an enhanced next-generation GUI and easy-to-use large touch panel.
As well as operating screens by touching and swiping, easy operation is supported by one-touch switching between grouped/individual graph lists and results outline/detail displays.
Further, the efficiency of complex setting work is improved by a parameter search function, bookmarking function for commonly used parameters, and a function for setting test parameters using one-touch button operation.

2.0 Gbps PHY TPUT	Supports physical layer downlink maximum throughput 2.0 Gbps measurement*
8 CA 2×2	Supports LTE-Advanced 8CC 2×2 MIMO tests
4 CA 2×2MIMO	Supports LTE-Advanced 4CC 2×2 MIMO tests in one unit
4×4 MIMO	Supports LTE-Advanced 4CC 4×4 MIMO/4×2 MIMO tests
LAA	Supports tests of 5 GHz Unlicensed Band used by LAA and LTE-U
160 MHz BW	160 MHz wide frequency bandwidth (Generator/Analyzer) supports evolving UE technologies
HPUE	Supports tests of HPUE (High Power User Equipment) which is the specification to improve communication environment by increasing out put power of UE
5G NSA Anchor	Supports 5G NSA (Non-Standalone) tests by interlocking with Radio Communication Test Station MT8000A

* Under the condition of 5CC 4×4 MIMO (20 layer)

RF TRX Measurement

3GPP UE RF Measurement

The UE TRX characteristics must be evaluated for compliance with 3GPP/3GPP2 standards at chipset and UE development, evaluation, and acceptance testing by network operators, etc. UE circuits are becoming increasingly complex as more communications technologies and frequency bands are supported; with built-in support for the UE RF TRX tests compliant with the various communications standards, the MT8821C is the ideal test solution whatever the measurement scenario.

Supported 3GPP/3GPP2 Standards

Support Systems	RF TRX Measurements
LTE FDD/TDD (DL CA 2CC/3CC/4CC/5CC/6CC/ 7CC/8CC, UL CA 2CC)	3GPP TS 36.521-1 Chapter 6, 7
Cat-M1	
NB-IoT	
W-CDMA (HSPA, HSPA Evolution, (DB-)DC-HSDPA, 3C/4C-HSDPA, DC-HSUPA)	3GPP TS 34.121-1 Chapter 5, 6
GSM (GPRS, EGPRS)	3GPP TS 51.010-1 Chapter 12, 13, 14
TD-SCDMA (HSPA, HSPA Evolution)	3GPP TS 34.122 Chapter 5, 6
CDMA2000/EV-DO	3GPP2 C.S0011-C Chapter 3, 4 3GPP2 C.S0033-B Chapter 3, 4

One-touch Settings and PASS/FAIL Judgment

With preset measurement parameters based on the 3GPP RF test standard cases, the MT8821C simplifies measurement. In addition, PASS/FAIL judgment of measurement results according to the test standard conditions is automated and results are confirmed at a glance. Until now, LTE CA measurements have required complex Component Carrier (CC) settings, making operation difficult, but the MT8821C integrates multiple related parameters settings into one operation, greatly simplifying each operation stage to reduce setting operations and time.

For example, only the following three steps are required using the LTE measurement software to measure the 3GPP TS 36.521-1 6.5.2.1 Error Vector Magnitude (EVM):

① Select test parameters

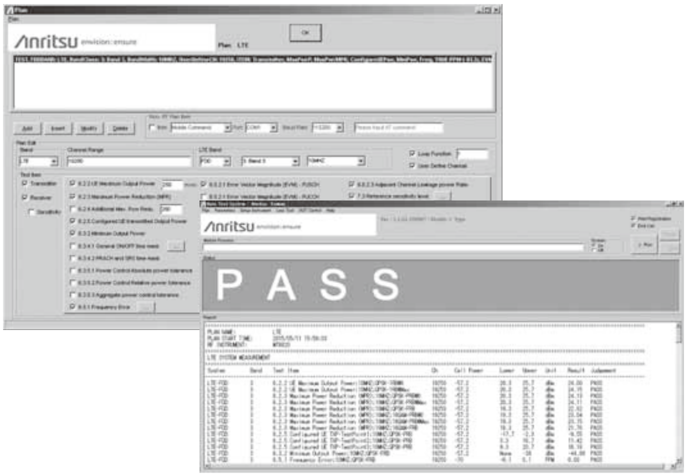
② Start measurement

③ Confirm PASS/FAIL judgment

3GPP RF Test Example

Remote Control Sample Tool

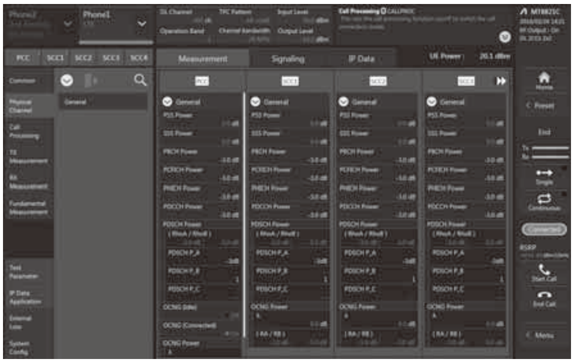
The MT8821C can be configured in an automated test system using either GPIB or Ethernet for remote control. Anritsu also provides the 3GPP RF test standard compliant automatic remote control sample tool. Operation is as simple as selecting the required test case from RF test items in the remote control sample tool, so even new users can easily configure automated test environment.



Remote Control Sample Tool

Flexible Parameter Setting

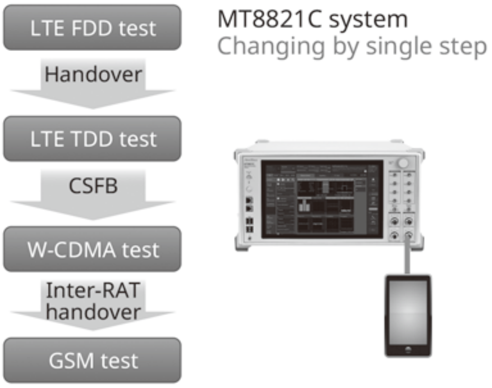
The MT8821C runs TRX measurements using parameters specified by the 3GPP/3GPP2 RF test standards. In addition, flexible parameter settings support both RF parametric and a range of protocol testing.



LTE Parameters Example

High Efficiency with Shorter Test Time

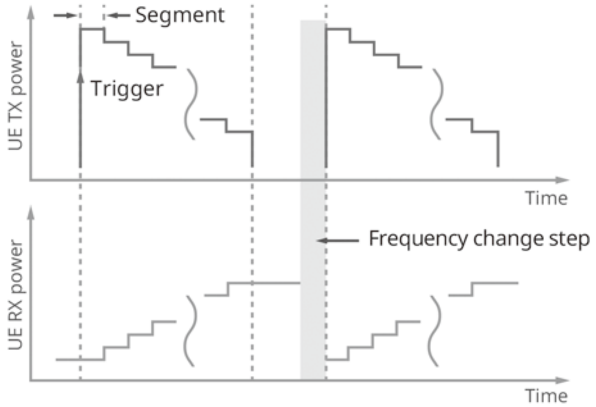
Test time is shortened for better efficiency by integrating multi-systems (several communications technologies) into one test by leveraging functions such as Circuit Switched fallback (CSFB), Inter-RAT handover, etc. These functions support testing without needing to switch between tester RF connectors or power-down and up again repeatedly.



Test Example

RF Calibration

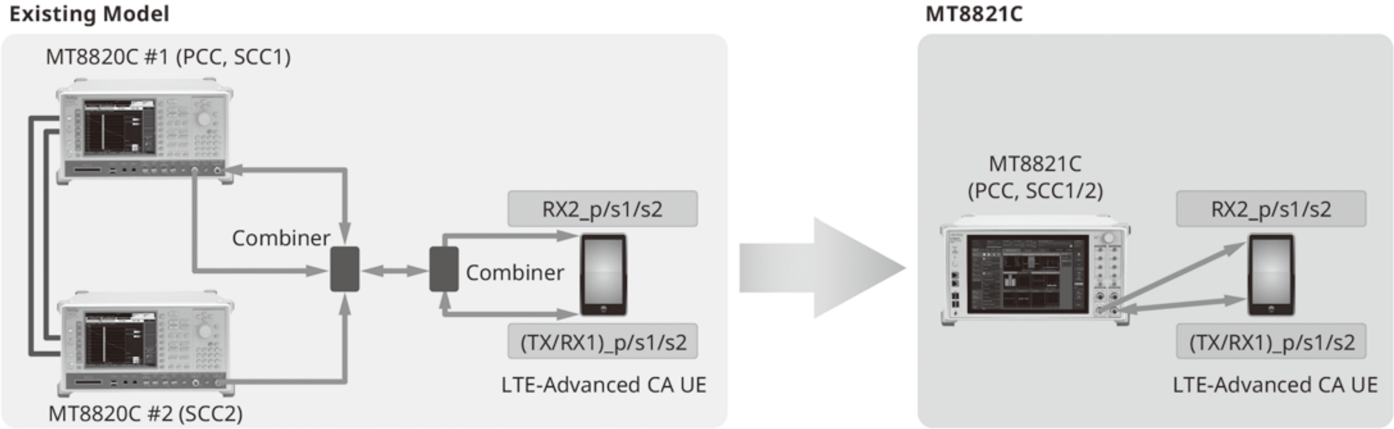
Recent UE designs support multiple frequency bands, requiring a lot of time for RF calibration. With high-speed measurement supported by chipsets vendors, the MT8821C increases measurement efficiency by reducing time required for RF calibration.



UE TRX Calibration Example

Built-in Combiner

With its built-in combiner, the MT8821C eliminates the need to configure a complex test system using external parts, as well as troublesome calibration.

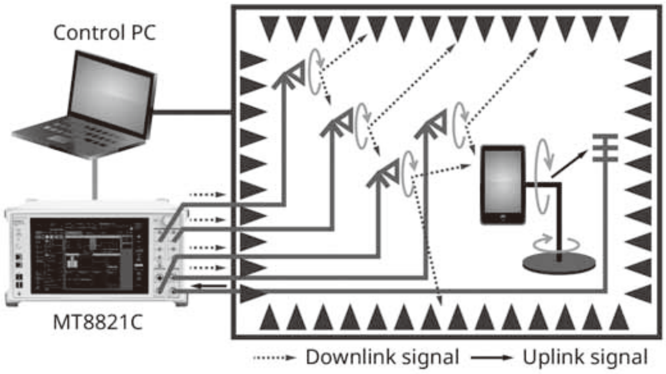


LTE-Advanced DL CA 3CC (SISO) Connection Example

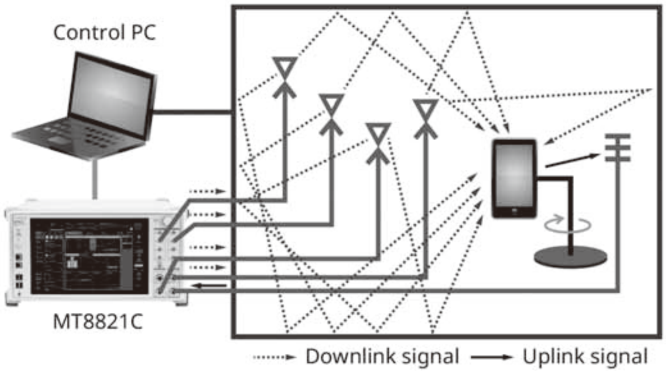
Functional Testing

Over The Air (OTA) Testing

The UE TRX performance is affected by factors such as the antenna form and characteristics. The OTA test measures the total UE TRX performance using actual radio waves reaching the antennas.
The MT8821C supports the various OTA vendor test system configurations in compliance with the 3GPP TS 34.114 and CTIA Total Radiated Power (TRP), and Total Radiated Sensitivity (TRS) test standards.



Anechoic Chamber

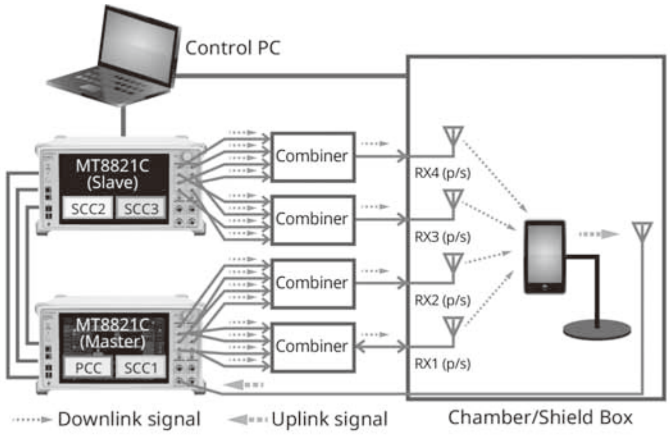


Reverberation Chamber

Moreover, it also supports the increasing number of test conditions demanded by higher antenna counts in UE units supporting LTE-Advanced CA and MIMO standards. Last, the shorter test time resulting from stable call processing performance is a key advantage of the MT8821C in various OTA test systems.

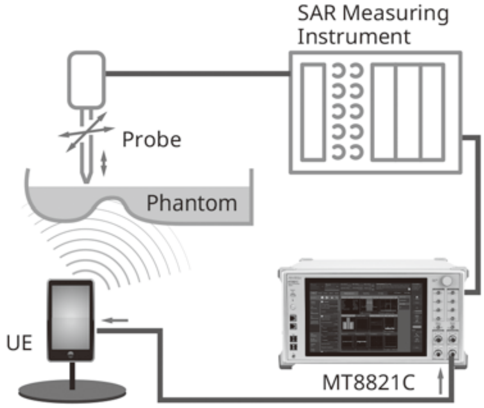
Support Systems	TRP	TRS	Comment
LTE FDD	✓	✓	SISO, 2×2 MIMO, 4×4 MIMO, DL CA 2CC/3CC/4CC/5CC/6CC/7CC/8CC, UL CA 2CC
LTE TDD	✓	✓	SISO, 2×2 MIMO, 4×4 MIMO, DL CA 2CC/3CC/4CC/5CC/6CC/7CC/8CC, UL CA 2CC
Cat-M1	✓	✓	
NB-IoT	✓	✓	
W-CDMA	✓	✓	HSPA, HSPA Evolution, DC-HSDPA
GSM	✓	✓	
GPRS/EGPRS	✓	✓	
TD-SCDMA	✓	✓	HSPA
CDMA2000 1X	✓	✓	1xEV-DO

Although one MT8821C unit can output up to 8 independent signals, DL 4CA 4×4 MIMO measurements require output of 16 signals. Using two linked MT8821C units supports unrestricted frequency allocation and bandwidth settings for all four CCs, enabling DL 4CA 4×4 MIMO measurements.



SAR (Specific Absorption Rate) Test

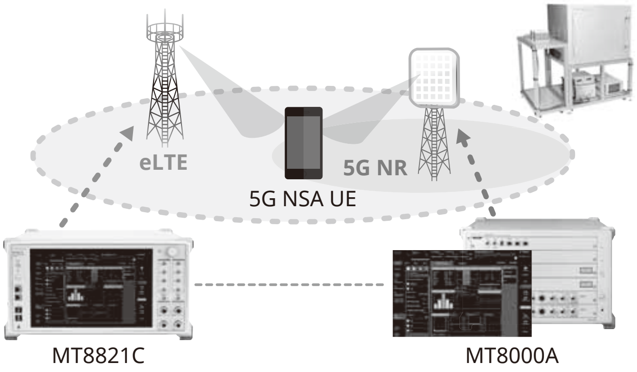
The SAR test evaluates the amount of energy in the electromagnetic waves radiated from a UE that is absorbed by a jig called a 'phantom' mimicking the human body. This test is designed to protect the health of UE users from the effects of electromagnetic waves.
The basic amount of absorbed energy is determined by the standard for each country and region.
The MT8821C supports the SAR test for each type of communication system.



SAR Test Setup Example

5G NSA (Non-Standalone) Testing

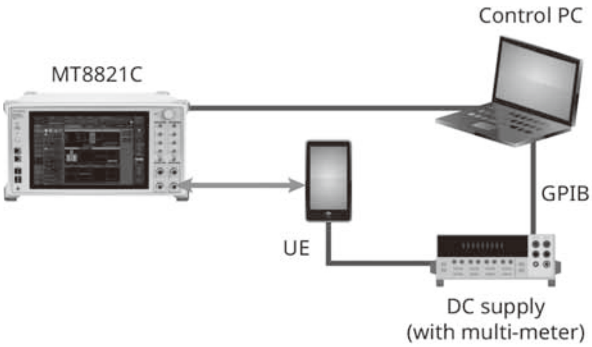
At the initial stage of 5G, NSA is considered as the main service form by many network operators who consider to realize 5G first network by adding 5G cell function to the existing LTE network. MT8821C can be the Anchor at 5G NSA call processing test by combining with Radio Communication Test Station MT8000A.



NSA-NR Network Configuration Example

Power Consumption Testing

Battery power consumption is a key point in differentiating chipsets and smartphones. As well as supporting the GSMA-defined power consumption tests, the MT8821C also supports power consumption tests at the maximum IP data throughput.

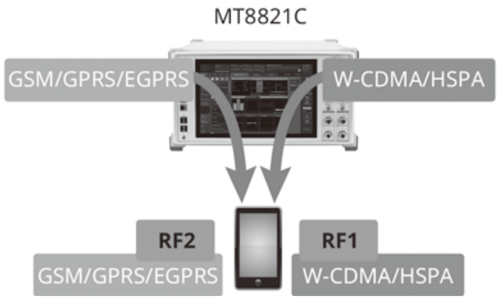


Power Consumption Test Example

Category	Procedure	Support Systems	Packet Rate (bps)
Power Consumption	Stan dBy Time Test	GSM	
		W-CDMA	
		LTE	
	MOMR: Talk Time Test	GSM	
		W-CDMA	
	MTNR: Talk Time Test	GSM	
		W-CDMA	
	Video Telephony Test	W-CDMA	
	Packet Switch Transfer Test (Download)	LTE	DL 5.16M, UL 5.54M @ 10 MHz
	Packet Switch Transfer Test (Upload)	LTE	DL 5.16M, UL 5.54M @ 10 MHz
	Packet Switch Transfer Test (Download/Upload)	LTE	DL 21.4M, UL 22.9M @ 10 MHz

Inter-RAT Measurement, DSDA RF Testing

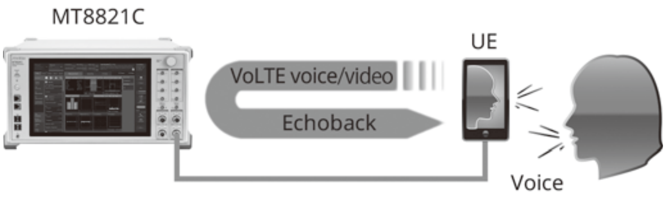
The all-in-one MT8821C can test two communications technologies simultaneously. As well as testing two UE units at the same time, it can also perform RF tests of a Dual SIM Dual Active (DSDA) dual-mode UE with two separate communications technologies for stan dBy and communications. It also supports Inter-RAT tests reporting the TX powers of base stations using different communications technologies to the UE.



VoLTE Voice/Video Echoback Testing

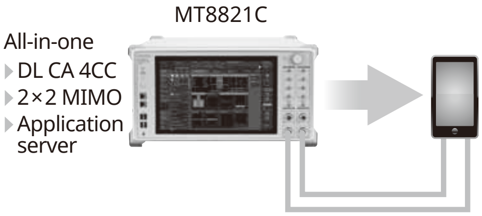
As VoLTE offering high-quality and low-latency voice calls becomes the de facto communications technology for recent UE, there is increasing demand for power consumption measurements during VoLTE calls as well as for confirmation of VoLTE call operations. However, setting the VoLTE IMS server is difficult.

With its built-in IMS server, the MT8821C reduces test preparation time and supports efficient VoLTE voice/video echoback tests, because the LTE measurement software GUI operations are also reflected at the IMS server.



End-to-End Communication Testing

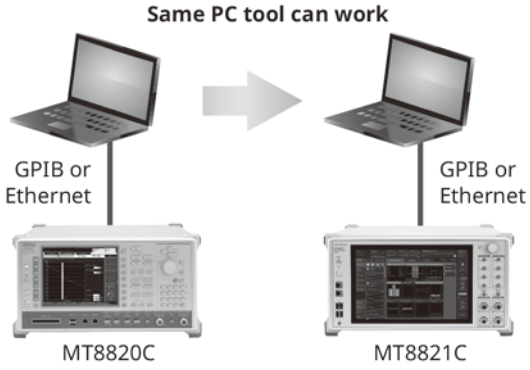
As well as evaluating UE RF performance, the MT8821C also supports functional tests, such as IP data throughput, audio/video tests, etc. Video calls between two UE units can be tested using one MT8821C with installed Parallel Phone measurement option. Furthermore, with its built-in application server function, smartphone and tablet IP data throughput tests require only the MT8821C and UE.



Backwards Compatibility

Remote Command

Since the MT8821C remote commands maintain good backwards compatibility with legacy MT8820 series, previously used remote tools are supported, helping reduce costs when configuring automated test environments.



MT8820C to MT8821C Upgrade

Anritsu offers an upgrade path from the MT8820C to the MT8821C making full use of the existing MT8820C hardware and software to maximize previous investment in the MT8820C and keep MT8821C costs down.

System Configurations/Options/Software

Support Systems		LTE		IoT		W-CDMA	GSM	TD-SCDMA	CDMA2000	HSPA	SEQ
		FDD	TDD	Cat-M	NB-IoT						
Main Frame		MT8821C Radio Communication Analyzer									
Unit Options		MT8821C-012 Parallel Phone Measurement Hardware									
		MT8821C-025 2nd RF for Phone1		—							
		MT8821C-026 3rd RF for Phone1									
		MT8821C-027 4th RF for Phone1									
		MT8821C-028 2nd RF for Phone2									
		MT8821C-029 3rd RF for Phone2									
		MT8821C-030 4th RF for Phone2									
		—				MT8821C-011 Audio Board				—	
		—							MT8821C-043 CDMA2000 Time Offset CAL for GPS SG	—	
Basic Configurations	Software	MX882112C LTE FDD Measurement Software	MX882113C LTE TDD Measurement Software	MX882116C LTE Category M1 Measurement Software	MX882117C NB-IoT Measurement Software	MX882100C W-CDMA Measurement Software	MX882101C GSM Measurement Software	MX882107C TD-SCDMA Measurement Software	MX882102C CDMA2000 Measurement Software	MX882115C W-CDMA HSPA Evolution IP Data Transfer	MX882120C Sequence Measurement Software
	Hardware	MT8821C-008 LTE Measurement Hardware				MT8821C-001 W-CDMA Measurement Hardware	MT8821C-002 TDMA Measurement Hardware	MT8821C-001 W-CDMA Measurement Hardware MT8821C-007 TD-SCDMA Measurement Hardware	MT8821C-003 CDMA2000 Measurement Hardware	MT8821C-008 LTE Measurement Hardware	—
Options		MX882164C LTE VoLTE Echoback		—		MX882100C-001 W-CDMA Voice Codec	MX882101C-001 GSM Voice Codec	MX882107C-001 TD-SCDMA Voice Codec	MX882102C-001 CDMA2000 Voice Codec	—	
		MX882112C-010 LTE FDD Anchor For 5G NSA	MX882113C-010 LTE TDD Anchor For 5G NSA	MX882116C-006 LTE Category M1 IP Data Transfer	MX882117C-006 NB-IoT IP Data Transfer	MX882100C-019 W-CDMA HSPA Measurement Software	MX882101C-011 EGPRS Measurement Software	MX882107C-011 TD-SCDMA HSDPA Measurement Software	MX882106C 1xEV-DO Measurement Software MT8821C-005 1xEV-DO Measurement Hardware	MX882115C-001 DC-HSDPA IP Data Transfer	MX882120C-001 W-CDMA Measurement Software
		MX882112C-021 LTE-Advanced FDD DL CA Measurement Software	MX882113C-021 LTE-Advanced TDD DL CA Measurement Software	—	—	MX882100C-032 DC-HSDPA Measurement Software	—	MX882107C-012 TD-SCDMA HSDPA Evolution Measurement Software		—	MX882120C-002 GSM Measurement Software
		MX882112C-022 LTE-Advanced FDD UL CA Measurement Software	MX882113C-022 LTE-Advanced TDD UL CA Measurement Software			MX882100C-033 DC-HSUPA Measurement Software		MX882107C-021 TD-SCDMA HSUPA Measurement Software	—		MX882120C-003 CDMA20000 Measurement Software
		MX882112C-031 LTE-Advanced FDD DL CA 3CCs Measurement Software	MX882113C-031 LTE-Advanced TDD DL CA 3CCs Measurement Software			MX882100C-034 4C-HSDPA Measurement Software		—			MX882120C-004 LTE Measurement Software
		MX882112C-041 LTE-Advanced FDD DL CA 4CCs Measurement Software	MX882113C-041 LTE-Advanced TDD DL CA 4CCs Measurement Software			—					MX882120C-005 TD-SCDMA Measurement Software
		MX882112C-051 LTE-Advanced FDD DL CA 5CCs Measurement Software	MX882113C-051 LTE-Advanced TDD DL CA 5CCs Measurement Software								—
		MX882112C-061 LTE-Advanced FDD DL CA 6CCs Measurement Software	MX882113C-061 LTE-Advanced TDD DL CA 6CCs Measurement Software								
		MX882112C-071 LTE-Advanced FDD DL CA 7CCs Measurement Software	MX882113C-071 LTE-Advanced TDD DL CA 7CCs Measurement Software								
		MX882112C-081 LTE-Advanced FDD DL CA 8CCs Measurement Software	MX882113C-081 LTE-Advanced TDD DL CA 8CCs Measurement Software								
		MX882112C-011 LTE FDD 2×2 MIMO DL	MX882113C-011 LTE TDD 2×2 MIMO DL								
		MX882112C-012 LTE FDD 4×4 MIMO DL	MX882113C-012 LTE TDD 4×4 MIMO DL								
		MX882112C-006 LTE FDD IP Data Transfer	MX882113C-006 LTE TDD IP Data Transfer								
		MX882112C-026 LTE-Advanced FDD DL CA IP Data Transfer	MX882113C-026 LTE-Advanced TDD DL CA IP Data Transfer								
		MX882112C-036 LTE-Advanced FDD DL CA 3CCs IP Data Transfer	MX882113C-036 LTE-Advanced TDD DL CA 3CCs IP Data Transfer								
		MX882112C-046 LTE-Advanced FDD DL CA 4CCs IP Data Transfer	MX882113C-046 LTE-Advanced TDD DL CA 4CCs IP Data Transfer								

Specifications

Radio Communication Analyzer MT8821C

Receiver	Frequency range: 30 MHz to 3.8 GHz 30 MHz to 6.0 GHz (with MT8821C-019) Maximum input level: +35 dBm (Main 1, 2) +10 dBm (SG Input)
Transmitter	Frequency Output frequency range: 30 MHz to 3.8 GHz 30 MHz to 6.0 GHz (with MT8821C-019) Setting resolution: 1 Hz Accuracy: Depends on reference oscillator accuracy Output level Level range Main 1, 2: –140 to –10 dBm (Internal signal generator TX 1 output) –140 to –16 dBm (Internal signal generator TX 2, 3, or 4 output) (with MT8821C-025, 026, 027 or with MT8821C-012, 028, 029, 030) Aux 1, 2, 3, 4: –125 to +5 dBm (Aux 2, 3, 4: With MT8821C-025, 026, 027 or with MT8821C-012, 028, 029, 030) Resolution: 0.1 dB Level accuracy 10° to 40°C, After Cal Main 1, 2 Level: ≥–120 dBm, SG Input: Off When outputting from either of Main 1 or 2. Except effect of noise floor from the other internal signal generators. ±1.5 dB (Frequency < 350 MHz, Internal signal generator TX 1 output) ±1.0 dB, ±0.7 dB (typ.) (350 MHz ≤ Frequency ≤ 3.8 GHz) ±1.3 dB, ±1.0 dB (typ.) (3.8 GHz < Frequency ≤ 6.0 GHz) Aux 1, 2, 3, 4 Level: ≥–110 dBm ±1.5 dB (Frequency < 350 MHz) ±1.0 dB, ±0.7 dB (typ.) (350 MHz ≤ Frequency ≤ 3.8 GHz) ±1.3 dB, ±1.0 dB (typ.) (3.8 GHz < Frequency ≤ 6.0 GHz) Signal purity Non-harmonic spurious: ≤–30 dBc (offset frequency: ≥100 kHz) Harmonics: ≤–25 dBc
Reference Oscillator	Reference oscillator Frequency: 10 MHz Start-up characteristics: ≤5 × 10^{-8} (10 min. after power-on referenced to frequency 24-hour after power-on) Aging rate: ≤2 × 10^{-8}/day, ≤1 × 10^{-7}/year (referenced to frequency 24-hour after power-on) Temperature characteristics: ≤5 × 10^{-8} Frequency accuracy before shipment: ±2.2 × 10^{-8} (20° to 30°C, 1 hour after power-on) Output connector: BNC-J, Level: TTL External reference input Frequency: 10 MHz or 13 MHz Operating range: ±1 ppm
Display	12.1-inch WXGA, 1280 × 800 pixels, color TFT LCD Touch panel: Projected capacitive type, multi-touch gestures
Front-panel Connectors	RF input/output Main 1, 2 Connector: N-J, 50Ω (nom.) VSWR: ≤1.35 (30 MHz ≤ Frequency < 350 MHz) ≤1.30 (350 MHz ≤ Frequency < 450 MHz) ≤1.20 (450 MHz ≤ Frequency ≤ 1.6 GHz) ≤1.30 (1.6 GHz < Frequency ≤ 3.8 GHz) (Main 1) ≤1.30 (1.6 GHz < Frequency ≤ 2.7 GHz) (Main 2) ≤1.35 (2.7 GHz < Frequency < 2.9 GHz) (Main 2) ≤1.30 (2.9 GHz ≤ Frequency ≤ 3.8 GHz) (Main 2) ≤1.40 (3.8 GHz < Frequency ≤ 6.0 GHz) Aux 1, 2, 3, 4 Connector: SMA-J, 50Ω (nom.) VSWR: SG output level: ≤–10 dBm ≤1.40 (30 MHz ≤ Frequency < 300 MHz) ≤1.30 (300 MHz ≤ Frequency ≤ 3.8 GHz) ≤1.60 (3.8 GHz < Frequency ≤ 6.0 GHz) SG Input Connector: SMA-J, 50Ω (nom.) VSWR: ≤1.40 (300 MHz ≤ Frequency ≤ 3.8 GHz) ≤1.60 (3.8 GHz < Frequency ≤ 6.0 GHz) Monitor Connector: SMA-J, 50Ω (nom.) VSWR: ≤1.30 (300 MHz ≤ Frequency ≤ 3.8 GHz) ≤1.60 (3.8 GHz < Frequency ≤ 6.0 GHz) Other Handset 1, 2: For dedicated handset Connector: RJ-12 USB Connector: USB 2.0, 4 ports

Continued on next page

Rear-panel Connectors		Reference signal 10 MHz Buf Out: For internal reference oscillator output Connector: BNC-J Frequency: 10 MHz Level: TTL 10 MHz/13 MHz Ref In: For external reference signal input Connector: BNC-J, 50Ω (nom.) Level: ≥0 dBm Control GPIB 1, 2: For remote control Interface function: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2 Connector: GPIB (IEEE 488) Remote 1, 2 (Ethernet): For remote control Connector: RJ-45 (10/100/1000BASE-T) Data input/output Application Server 1, 2: For data transfer tests Connector: RJ-45 (1000BASE-T) RS-232C 1, 2: For data transfer tests Connector: D-sub 9-pin (RS-232) Call Proc I/O 1, 2: For call processing timing signal input/output Connector: Mini D-sub 15-pin Signal level: TTL, LVCMOS 10BASE-T 1, 2: For data transfer tests Connector: RJ-45 (10BASE-T) 1000BASE-T 1, 2: For data transfer tests Connector: RJ-45 (1000BASE-T) Aux: For ARB input/output Connector: Mini D-sub 15-pin Signal level: LVCMOS Trigger Frame Trig Output 1, 2: For frame trigger output Event Trig Input 1, 2: For event trigger input Event Trig Output 1, 2: For event trigger output Connector: BNC-J Signal level: TTL Audio AF Output 1, 2: For AF output Connector: BNC-J AF Input 1, 2: For AF input Connector: BNC-J Maximum input level: 30 V (RMS) Other USB: For general-purpose I/F Connector: USB 3.0, 2 ports VGA: For external display Connector: Mini D-sub 15-pin Signal level: Analog RGB MEAS 1, 2: Not used Connector: RJ-45
Storage Device		2.5-inch SSD
Power Supply		100 V (ac) to 120 V (ac)/200 V (ac) to 240 V (ac) (250 V max.), 50 Hz/60 Hz ≤1200 VA (with all options)
Dimensions and Mass		426 (W) × 221.5 (H) × 578 (D) mm (excluding projections) ≤40 kg (with all options)
Environmental Conditions		Temperature and Humidity Operating: +5° to +40°C, ≤90% RH (no condensation) Storage: –20° to +60°C, ≤85% RH (no condensation)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

LTE Measurement Hardware MT8821C-008, LTE FDD Measurement Software MX882112C, LTE TDD Measurement Software MX882113C

Frequency/Modulation Measurement	Frequency range: 400 MHz to 3.8 GHz, 3.8 GHz to 5.0 GHz (with MT8821C-019) ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz to 457.5 MHz (LTE operating band 31) Input level: –40 to +35 dBm (Main1, 2) Carrier frequency accuracy: ± (Set frequency × Reference oscillator accuracy + 15 Hz) Modulation accuracy (residual vector error): ≤2.5% (400 MHz ≤ frequency ≤ 3.8 GHz, Measurement count: 20) ≤3.5% (3.8 GHz < frequency ≤ 5.0 GHz, Measurement count: 20) In-band emissions: ≤–40 dB (≥–10 dBm, Allocated RB: ≤18) Measurement object: PUSCH, PRACH, PUCCH

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Amplitude Measurement	Frequency range: 400 MHz to 3.8 GHz, 3.8 GHz to 5.0 GHz (with MT8821C-019) ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz to 457.5 MHz (LTE operating band 31) Input level: –60 to +35 dBm (Main1, 2) Measurement accuracy 10° to 40°C, After Cal, 400 MHz ≤ frequency ≤ 3.8 GHz ±0.3 dB (typ.), ±0.5 dB (–20 to +35 dBm), ±0.7 dB (–50 to –20 dBm), ±0.9 dB (–60 to –50 dBm) 20° to 30°C, After Cal, 3.8 GHz < frequency ≤ 5.0 GHz ±0.7 dB (–20 to +35 dBm), ±0.9 dB (–50 to –20 dBm), ±1.1 dB (–60 to –50 dBm) Linearity 400 MHz to 5.0 GHz, –40 to 0 dB ±0.2 dB (≥–50 dBm), ±0.4 dB (≥–60 dBm) Measurement object: PUSCH, PUCCH, PRACH
Occupied Bandwidth	Frequency range: 400 MHz to 3.8 GHz, 3.8 GHz to 5.0 GHz (with MT8821C-019) ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz to 457.5 MHz (LTE operating band 31) Input level: –10 to +35 dBm (Main1, 2) Channel bandwidth: 1.4, 3, 5 MHz (452.5 MHz ≤ UL frequency ≤ 457.5 MHz) 1.4, 3, 5, 10, 15, 20 MHz (500 MHz ≤ UL frequency)
Adjacent Channel Leakage Power	Frequency range: 400 MHz to 3.8 GHz, 3.8 GHz to 5.0 GHz (with MT8821C-019) ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz to 457.5 MHz (LTE operating band 31) Input level: –10 to +35 dBm (Main1, 2) Measurement point: E-UTRA ACLR 1, UTRA ACLR 1, UTRA ACLR 2 Measurement range: ≥45 dB (E-UTRA ACLR1), ≥50 dB (UTRA ACLR1), ≥55 dB (UTRA ACLR2) Channel bandwidth: 1.4, 3, 5 MHz (452.5 MHz ≤ UL frequency ≤ 457.5 MHz) 1.4, 3, 5, 10, 15, 20 MHz (500 MHz ≤ UL frequency)
Spectrum Emission Mask	Frequency range: 400 MHz to 3.8 GHz, 3.8 GHz to 5.0 GHz (with MT8821C-019) ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz to 457.5 MHz (LTE operating band 31) Input level: –10 to +35 dBm (Main1, 2) Channel bandwidth: 1.4, 3, 5 MHz (452.5 MHz ≤ UL frequency ≤ 457.5 MHz) 1.4, 3, 5, 10, 15, 20 MHz (500 MHz ≤ UL frequency)
RF Signal Generator	Output frequency range: 400 MHz to 3.8 GHz, 3.8 GHz to 6.0 GHz (with MT8821C-019) 1 Hz steps Output level Main: –140 to –10 dBm (Modulation: Off), –142 to –12 dBm (Modulation: On) Aux: –125 to +5 dBm (Modulation: Off), –127 to +3 dBm (Modulation: On) AWGN level: Off, –20 to +5 dB (0.1 dB steps, relative level to Ior) AWGN level accuracy: ±0.2 dB (relative level accuracy to Ior)
Throughput Measurement	Measures throughput using RMC Measurement object: ACK and NACK reported from UE
Call Processing	Call control: Location registration, Call processing using RMC (executes each 3GPP-defined processing and performs Pass/Fail evaluation) UE control: Output level (executes each 3GPP-defined UE control)

LTE FDD/TDD Anchor For 5G NSA MX882112C-010/13C-010

Function	Supports call processing test of 5G Non-Standalone environment as the Anchor between 5G supported UE.

LTE Category M1 Measurement Software MX882116C

Function	RF TRX measurement for LTE Category M1
Frequency/ Modulation Measurement	Frequency range: 400 MHz to 3.8 GHz 3.8 GHz to 5.0 GHz (With MT8821C-019) ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz≤frequency≤457.5 MHz (LTE Operating Band 31) Input level: -40 to +35 dBm (Main1, 2) Carrier frequency accuracy: ± (Set frequency × Reference oscillator accuracy + 15 Hz) Modulation accuracy (residual vector error): ≤2.5% (400 MHz≤frequency≤3.8 GHz, Measurement count: 20) ≤3.5% (3.8 GHz<frequency≤5.0 GHz, Measurement count: 20) ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz≤frequency≤457.5 MHz (LTE Operating Band 31) In-band Emmisions: ≤–40 dB (≥–10 dBm, Allocated RB≤18) Measurement object: PUSCH
Amplitude Measurement	Frequency range: 400 MHz to 3.8 GHz 3.8 GHz to 5.0 GHz (With MT8821C-019) ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz≤frequency≤457.5 MHz (LTE Operating Band 31) Input level: –60 to +35 dBm (Main1, 2) Measurement accuracy: ±0.5 dB, ±0.3 dB (typ.) (–20 to +35 dBm), ±0.7 dB (–50 to –20 dBm), ±0.9 dB (–60 to –50 dBm), 400 MHz≤frequency≤3.8 GHz, After Cal, 10° to 40°C ±0.7 dB (–20 to +35 dBm), ±0.9 dB (–50 to –20 dBm), ±1.1 dB (–60 to –50 dBm), 3.8 GHz<frequency≤5.0 GHz, After Cal, 20° to 30°C ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz≤frequency≤457.5 MHz (LTE Operating Band 31) Linearity: ±0.2 dB (–40 to 0 dB, ≥–50 dBm), ±0.4 dB (–40 to 0 dB, ≥–60 dBm), 400 MHz≤frequency≤5000 MHz ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz≤frequency≤457.5 MHz (LTE Operating Band 31) Measurement object: PUSCH

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Occupied Bandwidth	Frequency range: 400 MHz to 3.8 GHz 3.8 GHz to 5.0 GHz (With MT8821C-019) ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz to 457.5 MHz (LTE Operating Band 31) Input level: –10 to +35 dBm (Main1, 2) Channel bandwidth: 1.4 MHz, 3 MHz, 5 MHz (452.5 MHz≤UL frequency≤457.5 MHz) 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz (500 MHz≤UL frequency)
Adjacent Channel Leakage Power	Frequency range: 400 MHz to 3 .8 GHz 3.8 GHz to 5.0 GHz (With MT8821C-019) ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz to 457.5 MHz (LTE Operating Band 31) Input level: –10 to +35 dBm (Main1, 2) Measurement point: E-UTRA ACLR1, UTRA ACLR1, UTRA ACLR2 Measurement range: ≥45 dB (E-UTRA ACLR1), ≥50 dB (UTRA ACLR1), ≥55 dB (UTRA ACLR2) Channel bandwidth: 1.4 MHz, 3 MHz, 5 MHz (452 .5 MHz≤UL frequency≤457 .5 MHz) 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz (500 MHz≤UL frequency)
Spectrum Emission Mask	Frequency range: 400 MHz to 3 .8 GHz 3.8 GHz to 5.0 GHz (With MT8821C-019) ≤500 MHz: Only the following frequency range meets the specifications. 452 .5 MHz to 457 .5 MHz (LTE Operating Band 31) Input level: –10 to +35 dBm (Main1, 2) Channel bandwidth: 1.4 MHz, 3 MHz, 5 MHz (452 .5 MHz≤UL frequency≤457 .5 MHz) 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz (500 MHz≤UL frequency)
RF Signal Generator	Output frequency range: 400 MHz to 3.8 GHz (1Hz steps) 3.8 GHz to 6.0 GHz (1Hz steps) (With MT8821C-019)
Throughput Measurement	Measures throughput using RMC Measurement object: ACK and NACK reported from UE
Call Processing	Call control: Location registration, Call processing using RMC (executes each 3GPP-defined processing and performs Pass/Fail evaluation) UE control: Output level (executes each 3GPP-defined UE control)

NB-IoT Measurement Software MX882117C

Function	RF TRX measurement for NB-IoT
Frequency/ Modulation Measurement	Frequency range: 400 MHz to 3.8 GHz 3.8 GHz to 5.0 GHz (With MT8821C-019) ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz≤frequency≤457.5 MHz (LTE Operating Band 31) Input level: –40 to +35 dBm (Main1, 2) Carrier frequency accuracy: ± (Set frequency × Reference oscillator accuracy + 15 Hz) Modulation accuracy (residual vector error): ≤2.5% (400 MHz≤frequency≤3.8 GHz, Measurement count: 20) ≤3.5% (3.8 GHz<frequency≤5.0 GHz, Measurement count: 20) ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz≤frequency≤457.5 MHz (LTE Operating Band 31) In-band Emmisions: ≤–40 dB (≥–10 dBm, Allocated RB≤18) Measurement object: NPUSCH
Amplitude Measurement	Frequency range: 400 MHz to 3.8 GHz 3.8 GHz to 5.0 GHz (With MT8821C-019) ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz≤frequency≤457.5 MHz (LTE Operating Band 31) Input level: –60 to +35 dBm (Main1, 2) Measurement accuracy: ±0.5 dB, ±0.3 dB (typ.) (–20 to +35 dBm), ±0.7 dB (–50 to –20 dBm), ±0.9 dB (–60 to –50 dBm), 400 MHz≤frequency≤3.8 GHz, After Cal, 10° to 40°C ±0.7 dB (–20 to +35 dBm), ±0.9 dB (–50 to –20 dBm), ±1.1 dB (–60 to –50 dBm), 3.8 GHz<frequency≤5.0 GHz, After Cal, 20° to 30°C ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz≤frequency≤ 457.5 MHz (LTE Operating Band 31) Linearity: ±0.2 dB (–40 to 0 dB, ≥–50 dBm), ±0.4 dB (–40 to 0 dB, ≥–60 dBm), 400 MHz≤frequency≤5000 MHz ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz≤frequency≤457.5 MHz (LTE Operating Band 31) Measurement object: NPUSCH
Occupied Bandwidth	Frequency range: 400 MHz to 3.8 GHz 3.8 GHz to 5.0 GHz (With MT8821C-019) ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz to 457.5 MHz (LTE Operating Band 31) Input level: –10 to +35 dBm (Main1, 2)
Adjacent Channel Leakage Power	Frequency range: 400 MHz to 3.8 GHz 3.8 GHz to 5.0 GHz (With MT8821C-019) ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz to 457.5 MHz (LTE Operating Band 31) Input level: –10 to +35 dBm (Main1, 2) Measurement point: GSMACLR, UTRA ACLR Measurement range: ≥33 dB (GSMACLR), ≥50 dB (UTRA ACLR)
Spectrum Emission Mask	Frequency range: 400 MHz to 3 .8 GHz 3.8 GHz to 5.0 GHz (With MT8821C-019) ≤500 MHz: Only the following frequency range meets the specifications. 452 .5 MHz to 457 .5 MHz (LTE Operating Band 31) Input level: –10 to +35 dBm (Main1, 2)
RF Signal Generator	Output frequency range: 400 MHz to 3.8 GHz (1Hz steps) 3.8 GHz to 6.0 GHz (1Hz steps) (With MT8821C-019)
Throughput Measurement	Measures throughput using RMC Measurement object: ACK and NACK reported from UE
Call Processing	Call control: Location registration, Call processing using RMC (executes each 3GPP-defined processing) UE control: Output level (executes each 3GPP-defined UE control)

LTE-Advanced FDD/TDD DL CA Measurement Software MX882112C/13C-021

Function	This option for the MX882112C/13C measures DL CA RX performance.
RF Signal Generator	Output frequency range: 400 MHz to 3.8 GHz, 3.8 GHz to 6.0 GHz (with MT8821C-019) 1 Hz steps Output level Main output (CC output levels at Carrier Aggregation) –140 to –16 dBm (Modulation Off) –142 to –18 dBm (Modulation On) Aux output –125 to +5 dBm (Modulation Off) –127 to +3 dBm (Modulation On)
Throughput Measurement	Function Throughput measurement using RMC Measurement target ACK and NACK reported from UE

LTE-Advanced FDD/TDD UL CA Measurement Software MX882112C/13C-022

Function	This option for the MX882112C/13C measures the UL CA 2CC TRX performance.
Frequency/Modulation Measurement	Depends on MX882112C/13C performance except frequency range and modulation accuracy at CC measurement. Frequency range: 500 MHz to 3.8 GHz, 3.8 GHz to 4.2 GHz (with MT8821C-019) Modulation accuracy (residual vector error): ≤2.5% (500 MHz ≤ frequency ≤ 3.8 GHz, Measurement count: 20) ≤3.5% (3.8 GHz < frequency ≤ 4.2 GHz, Measurement count: 20) Measurement object: PUSCH
Amplitude Measurement	Depends on MX882112C/13C performance except frequency range, measurement accuracy and linearity at CC measurement. Frequency range: 500 MHz to 3.8 GHz, 3.8 GHz to 4.2 GHz (with MT8821C-019) Measurement accuracy Except intraband contiguous CA SCC and PCC+SCC measurement 10° to 40°C, After Cal, 500 MHz ≤ frequency ≤ 3.8 GHz ±0.3 dB (typ.), ±0.5 dB (–20 to +35 dBm), ±0.7 dB (–50 to –20 dBm), ±0.9 dB (–60 to –50 dBm) 20° to 30°C, After Cal, 3.8 GHz < frequency ≤ 4.2 GHz ±0.7 dB (–20 to +35 dBm), ±0.9 dB (–50 to –20 dBm), ±1.1 dB (–60 to –50 dBm) Intraband contiguous CA SCC and PCC+SCC measurement 10° to 40°C, After Cal, 500 MHz ≤ frequency ≤ 3.0 GHz ±0.7 dB (–50 to +35 dBm), ±0.9 dB (–60 to –50 dBm) 10° to 40°C, After Cal, 3.0 GHz ≤ frequency ≤ 3.8 GHz ±1.0 dB (–50 to +35 dBm), ±1.3 dB (–60 to –50 dBm) 20° to 30°C, After Cal, 3.8 GHz < frequency ≤ 4.2 GHz ±1.0 dB (–50 to +35 dBm), ±1.3 dB (–60 to –50 dBm) Linearity 20° to 30°C, –40 to 0 dB ±0.2 dB (≥–50 dBm), ±0.4 dB (≥–60 dBm)
Occupied Bandwidth	Depends on MX882112C/13C performance except frequency range at CC or contiguous CC measurement. Frequency range: 500 MHz to 3.8 GHz, 3.8 GHz to 4.2 GHz (with MT8821C-019) Measurement object: PUSCH
Adjacent Channel Leakage Power	Depends on MX882112C/13C performance except frequency range and measurement range at CC or contiguous CC measurement. Frequency range: 500 MHz to 3.8 GHz, 3.8 GHz to 4.2 GHz (with MT8821C-019) Measurement range: ≥45 dB (E-UTRA ACLR1), ≥50 dB (UTRA ACLR1), ≥55 dB (UTRA ACLR2) Measurement object: PUSCH
Spectrum Emission Mask	Depends on MX882112C/13C performance except frequency range at CC or contiguous CC measurement. Frequency range: 500 MHz to 3.8 GHz, 3.8 GHz to 4.2 GHz (with MT8821C-019) Measurement object: PUSCH
RF Signal Generator	Output frequency range: 400 MHz to 3.8 GHz, 3.8 GHz to 6.0 GHz (with MT8821C-019) 1 Hz steps Output level range (output level range for each CC when CC signals combined and output) Main: –140 to –16 dBm (Modulation: Off), –142 to –18 dBm (Modulation: On) Aux: –125 to +5 dBm (Modulation: Off), –127 to +3 dBm (Modulation: On)
Throughput Measurement	Measures throughput using RMC Measurement object: ACK and NACK reported from UE

LTE-Advanced FDD/TDD DL CA 3CCs Measurement Software MX882112C/13C-031

Function	This option for the MX882112C/13C measures DL CA 3CC/UL CA 1CC RX performance.
RF Signal Generator	Output frequency range: 400 MHz to 3.8 GHz, 3.8 GHz to 6.0 GHz (with MT8821C-019) 1 Hz steps Output level Main output (CC output levels at Carrier Aggregation) –140 to –16 dBm (Modulation Off) –142 to –18 dBm (Modulation On) Aux output –125 to +5 dBm (Modulation Off) –127 to +3 dBm (Modulation On)
Throughput Measurement	Function Throughput measurement using RMC Measurement target ACK and NACK reported from UE

LTE-Advanced FDD/TDD DL CA 4CCs Measurement Software MX882112C/13C-041

Function	This option for the MX882112C/13C measures DL CA 4CC/UL CA 1CC RX performance.
RF Signal Generator	Output frequency range: 400 MHz to 3.8 GHz, 3.8 GHz to 6.0 GHz (with MT8821C-019) 1 Hz steps Output level Main output (CC output levels at Carrier Aggregation) –140 to –16 dBm (Modulation Off) –142 to –18 dBm (Modulation On) Aux output –125 to +5 dBm (Modulation Off) –127 to +3 dBm (Modulation On)
Throughput Measurement	Function Throughput measurement using RMC Measurement target ACK and NACK reported from UE

LTE-Advanced FDD/TDD DL CA 5CCs Measurement Software MX882112C/13C-051

Function	This option for the MX882112C/13C measures DL CA 5CC/UL CA 1CC RX performance
RF Signal Generator	Output frequency range: 400 MHz to 3.8 GHz, 3.8 GHz to 6.0 GHz (with MT8821C-019) 1 Hz per step Output level Main output (CC output levels at Carrier Aggregation) –140 to –16 dBm (Modulation Off), –142 to –18 dBm (Modulation On) Aux output –125 to +5 dBm (Modulation Off), –127 to +3 dBm (Modulation On)
Throughput Measurement	Function Throughput measurement using RMC Measurement target ACK and NACK reported from UE

LTE-Advanced FDD/TDD DL CA 6CCs Measurement Software MX882112C/13C-061

Function	This option for the MX882112C measures DL CA 6CC/UL CA 1CC RX performance
RF Signal Generator	Output frequency range: 400 MHz to 3.8 GHz, 3.8 GHz to 6.0 GHz (with MT8821C-019) 1 Hz per step Output level Main output (CC output levels at Carrier Aggregation) –140 to –16 dBm (Modulation Off), –142 to –18 dBm (Modulation On) Aux output –125 to +5 dBm (Modulation Off), –127 to +3 dBm (Modulation On)
Throughput Measurement	Function Throughput measurement using RMC Measurement target ACK and NACK reported from UE

LTE-Advanced FDD/TDD DL CA 7CCs Measurement Software MX882112C/13C-071

Function	This option for the MX882112C measures DL CA 7CC/UL CA 1CC RX performance
RF Signal Generator	Output frequency range: 400 MHz to 3.8 GHz, 3.8 GHz to 6.0 GHz (with MT8821C-019) 1 Hz per step Output level Main output (CC output levels at Carrier Aggregation) –140 to –16 dBm (Modulation Off), –142 to –18 dBm (Modulation On) Aux output –125 to +5 dBm (Modulation Off), –127 to +3 dBm (Modulation On)
Throughput Measurement	Function Throughput measurement using RMC Measurement target ACK and NACK reported from UE

LTE-Advanced FDD/TDD DL CA 8CCs Measurement Software MX882112C/13C-081

Function	This option for the MX882112C measures DL CA 8CC/UL CA 1CC RX performance
RF Signal Generator	Output frequency range: 400 MHz to 3.8 GHz, 3.8 GHz to 6.0 GHz (with MT8821C-019) 1 Hz per step Output level Main output (CC output levels at Carrier Aggregation) –140 to –16 dBm (Modulation Off), –142 to –18 dBm (Modulation On) Aux output –125 to +5 dBm (Modulation Off), –127 to +3 dBm (Modulation On)
Throughput Measurement	Function Throughput measurement using RMC Measurement target ACK and NACK reported from UE

W-CDMA Measurement Hardware MT8821C-001, W-CDMA Measurement Software MX882100C

Frequency/ Modulation Measurement	Frequency range: 350 MHz to 2.7 GHz ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz to 457.5 MHz (LTE operating band 31) Input level: –30 to +35 dBm (Main1, 2) Carrier frequency accuracy: ± (Set frequency × Reference oscillator accuracy + 10 Hz) Modulation accuracy (residual vector error): ≤2.5% (input signal: one DPCCH and one DPDCH)
Amplitude Measurement	Frequency range: 350 MHz to 2.7 GHz ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz to 457.5 MHz (LTE operating band 31) Input level: –65 to +35 dBm (Main1, 2) Measurement accuracy 10° to 40°C, After Cal ±0.3 dB (typ.), ±0.5 dB (–30 to +35 dBm), ±0.7 dB (–55 to –30 dBm), ±0.9 dB (–65 to –55 dBm) Linearity: ±0.2 dB (–40 to 0 dB, ≥–55 dBm), ±0.4 dB (–40 to 0 dB, ≥–65 dBm) Relative Measurement Error: ±0.10 dB (–40 to 0 dB, ≥–50 dBm) (range: <2 dB) Measurement object: DPCH, PRACH
Occupied Bandwidth	Frequency range: 350 MHz to 2.7 GHz ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz to 457.5 MHz (LTE operating band 31) Input level: –10 to +35 dBm (Main1, 2)
Adjacent Channel Leakage Power	Frequency range: 350 MHz to 2.7 GHz ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz to 457.5 MHz (LTE operating band 31) Input level: –10 to +35 dBm (Main1, 2) Measurement range: ≥50 dB (±5 MHz), ≥55 dB (±10 MHz)
RF Signal Generator	Output frequency range: 300 MHz to 2.7 GHz, 1 Hz steps Channel level CPICH, P-CCPCH, SCH, PICH, DPCH, S-CCPCH, AICH: Off, –30 to 0 dB (0.1 dB steps, relative level to Ior) OCNS: Off, Automatic setting Channel level accuracy: ±0.2 dB (relative level accuracy to Ior) AWGN level: Off, –20 to +5 dB (0.1 dB steps, relative level to Ior) AWGN level accuracy: ±0.2 dB (relative level accuracy to Ior)
Error Rate Measurement	Measures BER, BLER Measurement object: Loopback data on uplink DTCH Serial data input from call processing I/O port (rear panel) (BER)
Call Processing	Call control: Location registration, Call origination, Call termination, Network-side release, UE-side release (executes each 3GPP-defined processing and performs Pass/Fail evaluation) UE control: Output level, Loopback (executes each 3GPP-defined UE control)

W-CDMA HSPA Measurement Software MX882100C-019

Function	This option for the MX882100C measures W-CDMA HSPA/HSPA Evolution TRX performance, and performs HSDPA-related peak-rate throughput tests for H-Set 6 and 8, and Category 6, 8, 9, 10, 13 and 14 UE.
Amplitude Measurement	Depends on MX882100C performance Measurement object: DPCH, HS-DPCCH, E-DPCCH, E-DPDCH
Throughput Measurement	Measures throughput using H-Set or throughput using peak-rate equivalent HS-SCCH and HS-PDSCH at H-Set 6 and 8 Category 6, 8, 9, 10, 13 and 14 UE. Measurement object: HS-DPCCH ACK and NACK
Call Processing	Call control: Location registration, Fixed Reference Channel, E-DCH RF Test (executes each 3GPP-defined processing and performs Pass/Fail evaluation) UE control: Output level (executes each 3GPP-defined UE control) Monitoring: Monitors E-TFCI included in uplink E-DPCCH and measures E-DCH throughput

DC-HSDPA Measurement Software MX882100C-032

Function	This option for the MX882100C measures DC-HSDPA RX performance.
Throughput Measurement	Measures throughput using H-Set or throughput using peak-rate equivalent HS-SCCH and HS-PDSCH at H-Set 6 and 8 Category 22 and 24 UE. Measurement object: HS-DPCCH ACK and NACK
CQI Measurement	Measurement object: HS-DPCCH CQI reported periodically from UE
Call Processing	Call control: Location registration, Fixed Reference Channel (executes each 3GPP-defined processing and performs Pass/Fail evaluation) UE control: Output level (executes each 3GPP-defined UE control)

DC-HSUPA Measurement Software MX882100C-033

Function	This option for the MX882100C measures DC-HSUPA TX performance.
Amplitude Measurement	Depends on MX882100C performance Measurement object: DPCH, HS-DPCCH, E-DPCCH, E-DPDCH
Call Processing	Call control: Location registration, E-DCH RF Test (executes each 3GPP-defined processing and performs Pass/Fail evaluation) UE control: Output level (executes each 3GPP-defined UE control)

4C-HSDPA Measurement Software MX882100C-034

Function	This option for the MX882100C measures 4C-HSDPA RX performance.
Throughput Measurement	Measures throughput using H-Set or throughput using peak-rate equivalent HS-SCCH and HS-PDSCH at H-Set 6 and 8 Category 29 and 31 UE. Measurement object: HS-DPCCH ACK and NACK
CQI Measurement	Measurement object: HS-DPCCH CQI reported periodically from UE
Call Processing	Call control: Location registration, Fixed Reference Channel (executes each 3GPP-defined processing and performs Pass/Fail evaluation) UE control: Output level (executes each 3GPP-defined UE control)

Audio Board MT8821C-001, W-CDMA Voice Codec MX882100C-001

Function	End-to-end communications test between a handset connected to the MT8821C and UE. Encode the voice from Audio Input, Output the decoded voice to AF Output. Encode the tone signal and Output the tone signal to AF Output. Measure the voice signal from AF Input and decoded voice signal.
Voice Codec	AMR 12.2 kbps
Level Control	Encoder input gain: –3.00 to +3.00 dB, 0.01 dB steps Handset microphone volume: 0, 1, 2, 3, 4, 5 Handset speaker volume: 0, 1, 2, 3, 4, 5
AF Output	Output frequency Frequency range: 30 Hz to 10 kHz Resolution: 1 Hz Accuracy: ± (Set frequency × Reference oscillator accuracy + 0.1 Hz) Output level Setting range: 0 to 5 V peak (AF output) Setting resolution: 1 mV (≤5 V peak), 100 μV (≤500 mV peak), 10 μV (≤50 mV peak) Accuracy: ±0.2 dB (≥10 mV peak, ≥50 Hz), ±0.3 dB (≥10 mV peak, <50 Hz) Waveform distortion Band: ≤30 kHz ≤–60 dB (≥500 mV peak, ≤5 kHz), ≤–54 dB (≥70 mV peak) Output impedance: ≤1Ω Maximum output current: 100 mA
AF Input	Input frequency Frequency range: 50 Hz to 10 kHz Accuracy: ± (Reference oscillator accuracy + 0.5 Hz) Input level Voltage range: 1 mV peak to 5 V peak (AF input) Maximum input voltage: 30 V RMS Level measurement Accuracy: ±0.2 dB (≥10 mV peak, ≥50 Hz), ±0.4 dB (≥1 mV peak, ≥1 kHz) SINAD measurement Frequency: 1 kHz ≥60 dB (≥1000 mV peak), ≥54 dB (>50 mV peak), ≥46 dB (≥10 mV peak) Distortion rate measurement Frequency: 1 kHz ≥60 dB (≥1000 mV peak), ≥54 dB (>50 mV peak), ≥46 dB (≥10 mV peak) Input impedance: 100 kΩ
Input/Output Connector	Handset, AF input/output

TDMA Measurement Hardware MT8821C-002, GSM Measurement Software MX882101C

Frequency/Modulation Measurement	Frequency range: 350 MHz to 2.7 GHz ≤500 MHz: Only the following frequency range meets the specifications. 380.2 MHz to 389.8 MHz (T-GSM380 band) 410.2 MHz to 419.8 MHz (T-GSM410 band) 450.4 MHz to 457.6 MHz (GSM450 band) 478.8 MHz to 486.0 MHz (GSM480 band) Input level: –30 to +40 dBm (Main1, 2) (average power in bursts) Carrier frequency accuracy: ± (Set frequency × Reference oscillator accuracy + 10 Hz) (Normal burst) ± (Set frequency × Reference oscillator accuracy + 20 Hz) (RACH) Modulation accuracy (Residual phase error): ≤0.5° RMS, 2° peak Measurement object: Normal burst, RACH
Amplitude Measurement	Frequency range: 350 MHz to 2.7 GHz ≤500 MHz: Only the following frequency range meets the specifications. 380.2 MHz to 389.8 MHz (T-GSM380 band) 410.2 MHz to 419.8 MHz (T-GSM410 band) 450.4 MHz to 457.6 MHz (GSM450 band) 478.8 MHz to 486.0 MHz (GSM480 band) Input level: –30 to +40 dBm (Main1, 2) (average power in bursts) Measurement accuracy 10° to 40°C, After Cal ±0.3 dB (typ.), ±0.5 dB (–30 to +40 dBm) Linearity: ±0.2 dB (–40 to 0 dB, ≥–30 dBm) Power measurement range (carrier off): ≥65 dB (≥–10 dBm), ≥45 dB (≥–30 to –10 dBm) Burst wave display: Rise, Fall, Slot, On-interval Measurement object: Normal burst, RACH

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Output Spectrum Measurement (Output RF Spectrum)	Frequency range: 350 MHz to 2.7 GHz ≤500 MHz: Only the following frequency range meets the specifications. 380.2 MHz to 389.8 MHz (T-GSM380 band) 410.2 MHz to 419.8 MHz (T-GSM410 band) 450.4 MHz to 457.6 MHz (GSM450 band) 478.8 MHz to 486.0 MHz (GSM480 band) Input level: –10 to +40 dBm (Main1, 2) (average power in bursts) Measurement range (modulation) Averaged with 10 measurements ≤–55 dB (≤250 kHz offset), ≤–66 dB (≥400 kHz offset) Measurement range (transient): ≤–57 dB (≥400 kHz offset) Measurement point: ±100 kHz, ±200 kHz, ±250 kHz, ±400 kHz, ±600 kHz, ±800 kHz, ±1000 kHz, ±1200 kHz, ±1400 kHz, ±1600 kHz, ±1800 kHz, ±2000 kHz Measurement object: Normal burst
RF Signal Generator	Output frequency range: 350 MHz to 2.7 GHz, 1 Hz steps Output pattern: CCH, TCH, CCH + TCH Channel coding: FS, EFS, HS0, HS1, AFS, AHS0, AHS1, CS-1, CS-2, CS-3, CS-4 TCH data: PN9, PN15, All0, All1, Fixed pattern (PAT0 to PAT9) USF: 0 to 7 (GPRS)
Error Rate Measurement	Measures error rate of frame, bit, and CRC Measurement object: Loopback data on uplink TCH Serial data input from call processing I/O port (rear panel) UE RX block count on GPRS uplink TCH GPRS UE USF RX block count
Call Processing	Call control: Location registration, Call origination, Call termination, Network-side termination, UE-side termination, Connection, termination and data transfer via GPRS UE control: Output level, Time slot, Timing advance, Loopback On/Off, GPRS test mode Channel coding: FS, EFS, HS0, HS1, AFS, AHS, CS-1, CS-2, CS-3, CS-4 Frequency band: GSM450, GSM480, GSM850, P-GSM, E-GSM, R-GSM, GSM710, T-GSM810, GSM750, DCS1800, PCS1900

EGPRS Measurement Software MX882101C-011

Function	This option for the MX882101C measures EGPRS TRX performance.
Frequency/Modulation Measurement	Frequency range: 350 MHz to 2.7 GHz ≤500 MHz: Only the following frequency range meets the specifications. 380.2 MHz to 389.8 MHz (T-GSM380 band) 410.2 MHz to 419.8 MHz (T-GSM410 band) 450.4 MHz to 457.6 MHz (GSM450 band) 478.8 MHz to 486.0 MHz (GSM480 band) Input level: –30 to +40 dBm (Main1, 2) (average power in bursts) Carrier frequency accuracy: ± (Set frequency × Reference oscillator accuracy + 10 Hz) (Normal burst) ± (Set frequency × Reference oscillator accuracy + 20 Hz) (RACH) Modulation accuracy (Residual phase error): ≤0.5° RMS, 2° peak Residual EVM: ≤1.5% RMS (8PSK) Measurement object: Normal burst (GMSK, 8PSK), RACH
Amplitude Measurement	Frequency range: 350 MHz to 2.7 GHz ≤500 MHz: Only the following frequency range meets the specifications. 380.2 MHz to 389.8 MHz (T-GSM380 band) 410.2 MHz to 419.8 MHz (T-GSM410 band) 450.4 MHz to 457.6 MHz (GSM450 band) 478.8 MHz to 486.0 MHz (GSM480 band) Input level: –30 to +40 dBm (Main1, 2) (average power in bursts) Measurement accuracy 10° to 40°C, After Cal ±0.3 dB (typ.), ±0.5 dB (–30 to +40 dBm) Linearity: ±0.2 dB (–40 to 0 dB, ≥–30 dBm) Power measurement range (carrier off): ≥65 dB (≥–10 dBm), ≥45 dB (≥–30 to –10 dBm) Burst wave display: Rise, Fall, Slot, On-interval Measurement object: Normal burst (GMSK, 8PSK), RACH
Output Spectrum Measurement (Output RF Spectrum)	Frequency range: 350 MHz to 2.7 GHz ≤500 MHz: Only the following frequency range meets the specifications. 380.2 MHz to 389.8 MHz (T-GSM380 band) 410.2 MHz to 419.8 MHz (T-GSM410 band) 450.4 MHz to 457.6 MHz (GSM450 band) 478.8 MHz to 486.0 MHz (GSM480 band) Input level: –10 to +40 dBm (Main1, 2) (average power in bursts) Measurement range (modulation) Averaged with 10 measurements ≤–55 dB (≤250 kHz offset), ≤–66 dB (≥400 kHz offset) Measurement range (transient): ≤–57 dB (≥400 kHz offset) Measurement point: ±100 kHz, ±200 kHz, ±250 kHz, ±400 kHz, ±600 kHz, ±800 kHz, ±1000 kHz, ±1200 kHz, ±1400 kHz, ±1600 kHz, ±1800 kHz, ±2000 kHz Measurement object: Normal burst (GMSK, 8PSK)
RF Signal Generator	Output frequency range: Depends on MX882101C performance Phase error: Depends on MX882101C performance Modulation accuracy: ≤3% (RMS) Output pattern: CCH, TCH, CCH + TCH Coding scheme: MCS-1, MCS-2, MCS-3, MCS-4, MCS-5, MCS-6, MCS-7, MCS-8, MCS-9 Puncturing scheme: P1, P2, P3 TCH data: PN9, PN15, All0, All1, Fixed pattern (PAT0 to PAT9)

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Error Rate Measurement	Measures bit error rate Measurement object: Loopback data on uplink TCH (GMSK, 8PSK) UE RX block count on EGPRS uplink TCH EGPRS UE USF RX block count
Call Processing	Call control: Location registration, Connection, termination and data transfer via EGPRS UE control: Output level, Time slot, Timing advance, EGPRS test mode Coding scheme: MCS-1, MCS-2, MCS-3, MCS-4, MCS-5, MCS-6, MCS-7, MCS-8, MCS-9 Puncturing scheme: P1, P2, P3 Frequency band: GSM450, GSM480, GSM710, GSM750, T-GSM810, GSM850, P-GSM, E-GSM, R-GSM, DCS1800, PCS1900

Audio Board MX882101C-001, GSM Voice Codec MT8821C-011

Function	End-to-end communications test between a handset connected to the MT8821C and UE. Encode the voice from Audio Input, Output the decoded voice to AF Output. Encode the tone signal and Output the tone signal to AF Output. Measure the voice signal from AF Input and decoded voice signal.
Voice Codec	GSM_EFR, GSM_AMR
Level Control	Encoder input gain: –3.00 to +3.00 dB, 0.01 dB step Handset microphone volume: 0, 1, 2, 3, 4, 5 Handset speaker volume: 0, 1, 2, 3, 4, 5
AF Output	Output frequency Frequency range: 30 Hz to 10 kHz Resolution: 1 Hz Accuracy: ± (Set frequency × Reference oscillator accuracy + 0.1 Hz) Output level Setting range: 0 to 5 V peak (AF output) Setting resolution: 1 mV (≤5 V peak), 100 µV (≤500 mV peak), 10 µV (≤50 mV peak) Accuracy: ±0.2 dB (≥10 mV peak, ≥50 Hz), ±0.3 dB (≥10 mV peak, <50 Hz) Waveform distortion Band: ≤30 kHz ≤–60 dB (≥500 mV peak, ≤5 kHz), ≤–54 dB (≥70 mV peak) Output impedance: ≤1Ω Maximum output current: 100 mA
AF Input	Input frequency Frequency range: 50 Hz to 10 kHz Accuracy: ± (Reference oscillator accuracy + 0.5 Hz) Input level Voltage range: 1 mV peak to 5 V peak (AF input) Maximum input voltage: 30 V RMS Level measurement Accuracy: ±0.2 dB (≥10 mV peak), ±0.4 dB (≥1 mV peak, ≥1 kHz) SINAD measurement Frequency: 1 kHz ≥60 dB (≥1000 mV peak), ≥54 dB (>50 mV peak), ≥46 dB (≥10 mV peak) Distortion rate measurement Frequency: 1 kHz ≥60 dB (≥1000 mV peak), ≥54 dB (>50 mV peak), ≥46 dB (≥10 mV peak) Input impedance: 100 kΩ
Input/Output Connector	Handset, AF input/output

CDMA2000 Measurement Hardware MT8821C-003, CDMA2000 Measurement Software MX882102C

Electrical Characteristics	Typical values (typ.) are only for reference and are not guaranteed.
Frequency/Modulation Measurement	Frequency range: 350 MHz to 2.7 GHz For the frequencies below 500 MHz, only the following range meets the specifications: 410.000 MHz to 419.975 MHz (CDMA2000 band Class 5, 11) 450.000 MHz to 459.990 MHz (CDMA2000 band Class 5, 11) 479.000 MHz to 483.480 MHz (CDMA2000 band Class 5, 11) Input level: –30 to +35 dBm Carrier frequency accuracy: ± (Set frequency × Reference oscillator accuracy + 10 Hz) Modulation accuracy Residual waveform quality >0.999
Amplitude Measurement	Frequency range: 350 MHz to 2.7 GHz For the frequencies below 500 MHz, only the following range meets the specifications: 410.000 MHz to 419.975 MHz (CDMA2000 band Class 5, 11) 450.000 MHz to 459.990 MHz (CDMA2000 band Class 5, 11) 479.000 MHz to 483.480 MHz (CDMA2000 band Class 5, 11) Input level: –65 to +35 dBm (Main) Measurement accuracy Filtered Power measurement, after Full Cal, Input level setting, 10° to 40°C ±0.5 dB (–30 to +35 dBm), typ. ±0.3 dB (–30 to +35 dBm), ±0.7 dB (–55 to –30 dBm), ±0.9 dB (–65 to –55 dBm) Linearity Filtered Power measurement, Input level setting for reference ±0.2 dB (–40 to 0 dB, ≥–55 dBm), ±0.4 dB (–40 to 0 dB, ≥–65 dBm)
Occupied Bandwidth	Frequency range: 350 MHz to 2.7 GHz For the frequencies below 500 MHz, only the following range meets the specifications: 410.000 MHz to 419.975 MHz (CDMA2000 band Class 5, 11) 450.000 MHz to 459.990 MHz (CDMA2000 band Class 5, 11) 479.000 MHz to 483.480 MHz (CDMA2000 band Class 5, 11) Input level: –10 to +35 dBm (Main1/2)

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Code Domain Power	Can be measured when Reverse-RC is set to RC 3 or RC 4. Measurement level range: –30 to +35 dBm Measurement accuracy: ±0.2 dB (Code power ≥–15 dBc), ±0.4 dB (Code power ≥–23 dBc)
Error Rate FER	FER measurement is enabled at Service Option 2, 9, 55 and 32 (TDSO) Indicated items: Confidence Level, FER, Error Frame count, Sample Frame count
RF Signal Generator	Output frequency range: 300 MHz to 2.7 GHz, 1 Hz steps Channel level Pilot channel: –30 to 0 dB, 0.25 dB step or Off SYNCH, PCH: –30 to 0 dB, 0.25 dB step or Off QPCH (Relative level to Pilot channel): –5 to +2 dB, 1 dB step or Off FCH, DCCH, SCH: –30 to 0 dB, 0.1 dB step or Off OCNS: Auto (0.01 dB step) or Off Channel level accuracy: <±0.2 dB (typ.) (≥–20 dB) PN offset: 0 to 511 can be set. AWGN AWGN level: –40 to +12 dB (Relative level to CDMA signal) or Off Maximum output level of CDMA signal at AWGN On –28 dBm (Main output), –18 dBm (Aux output)
AF Input	It is measurable when MT8821C-011 Audio Board is installed. Input frequency Frequency range: 50 Hz to 10 kHz Input level Input voltage range: 1 mV peak to 5 V peak (AF Input connector) Maximum allowable input voltage: 30 V rms Frequency measurement accuracy ± (Reference oscillator accuracy + 0.5 Hz) Level measurement accuracy ±0.2 dB (≥10 mV peak), ±0.4 dB (≥1 mV peak, ≥1 kHz) SINAD measurement range Frequency at 1 kHz ≥60 dB (≥1000 mV peak), ≥54 dB (>50 mV peak), ≥46 dB (≥10 mV peak) Distortion measurement range Frequency at 1 kHz ≤–60 dB (≥1000 mV peak), ≤–54 dB (>50 mV peak), ≤–46 dB (≥10 mV peak) Input impedance: 100 kΩ
AF Output	It is measurable when MT8821C-011 Audio Board is installed. Output Frequency Range: 30 Hz to 10 kHz Resolution: 1 Hz Accuracy: ± (Set frequency × Reference oscillator accuracy + 0.1 Hz) Output level Range: 0 to 5 V peak (AF Output connector) Resolution: 1 mV (≤5 V peak), 100 µV (≤500 mV peak), 10 µV (≤50 mV peak) Accuracy: ±0.2 dB (≥10 mV peak, ≥50 Hz), ±0.3 dB (≥10 mV peak, <50 Hz) Waveform distortion: at Band ≤30 kHz ≤–60 dB (≥500 mV peak, ≤5 kHz), ≤–54 dB (≥70 mV peak) Output impedance: ≤1Ω Max. output current: 100 mA
Call Processing	Band class: BC 0 to 12, 14, 15, 18, 19, 20, 21 Call control: Registration, MS call origination, MS call disconnection, NW call origination, NW call disconnection Handoff: Universal handoff, Band class/channel handoff, Protocol revision handoff, RC/SO handoff Rev. closed loop power control modes: Closed loop, Alternate, All 0 (All up), All 1 (All down) Usable protocol: IS-95B, J-STD-008C, ARIB T-53, Korean PCS, IS-2000 (SR1) Radio configuration: F-RC1 + R-RC1, F-RC2 + R-RC2, F-RC3 + R-RC3, F-RC4 + R-RC3, F-RC5 + R-RC4 Service option: SO 1, 2, 3, 9, 32, 33, 55, 32768 PCH data rate: Full QPCH data rate: Full Fwd. FCH data rate: Full, Half, Quarter or Eighth can be set for RC1 to RC5 Fwd. FCH walsh code: 10, 14, 26, 30, 42, 46, 58, 62 Fwd. DCCH data rate: Full for RC 3 to RC 5 Fwd. DCCH walsh code: 10, 14, 26, 30, 42, 46, 58, 62 Fwd. SCH: 1 channel (max.) Fwd. SCH data rate RC3: 9.6, 19.2, 38.4, 76.8, 153.6 kbps RC4: 9.6, 19.2, 38.4, 76.8, 153.6 kbps RC5: 14.4, 28.8, 57.6, 115.2, 230.4 kbps Access probe: Access channel usable

Audio Board MT8821C-011, CDMA2000 Voice Codec MX882102C-001

Functions	Voice call test by using handset, Encoding audio signal from AF Input connector, Decoding audio signal toward AF Output connector
Voice Codec	SO3 (EVRC)
Level Control	Encoder input gain: –3.00 to +3.00 dB, 0.01 dB steps Handset microphone volume: 0, 1, 2, 3, 4, 5 Handset speaker volume: 0, 1, 2, 3, 4, 5

1xEV-DO Measurement Hardware MT8821C-005, 1xEV-DO Measurement Software MX882106C

Frequency/Modulation Measurement	Frequency range: 350 MHz to 2.7 GHz ≤500 MHz: Only the following frequency range meets the specifications. 410.000 MHz to 419.975 MHz (CDMA2000 band Class 5, 11) 450.000 MHz to 459.990 MHz (CDMA2000 band Class 5, 11) 479.000 MHz to 483.480 MHz (CDMA2000 band Class 5, 11) Input level: –30 to +35 dBm (Main1, 2) Carrier frequency accuracy: ± (Set frequency × Reference oscillator accuracy + 10 Hz) Modulation accuracy (residual waveform quality): >0.999
Amplitude Measurement	Depends on MX882102C performance
Occupied Bandwidth	Depends on MX882102C performance
Code Domain Power	Input level: –30 to +35 dBm (Main1, 2) Measurement accuracy: ±0.2 dB (Code power: ≥–15 dBc), ±0.4 dB (Code power: ≥–23 dBc)
PER	Measures PER (FTAP, FETAP) Displayed item: PER, Confidence level, Sample packet count, Error packet count
RF Signal Generator	Output frequency range: 300 MHz to 2.7 GHz, 1 Hz steps Channel level (relative level to Ior): 0 dB (Pilot channel, MAC channel, Control channel, Traffic channel) PN offset: 0 to 511 AWGN level: –40 to +12 dB (relative level to CDMA signal) or Off Maximum output level CDMA signal, AWGN: On –28 dBm (Main1, 2), –18 dBm (Aux)
Call Processing	Band class: BC 0 to 12, 14, 15, 18, 19, 20, 21 Call control: Open session, Close session, AT origination, NW origination, AT release, NW release, Hard handoff, Softer handoff Rev. closed loop power control mode: Closed loop, Alternate, All 0 (all up), All 1 (all down) Test application protocol: FTAP (Forward Test Application Protocol), RTAP (Reverse Test Application Protocol), FTAP + RTAP

W-CDMA Measurement Hardware MT8821C-001, TD-SCDMA Measurement Hardware MT8821C-007, TD-SCDMA Measurement Software MX882107C

Frequency/Modulation Measurement	Frequency range: 350 MHz to 2.7 GHz ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz to 457.5 MHz (LTE operating band 31) Input level: –30 to +35 dBm (Main1, 2) Carrier frequency accuracy: ± (Set frequency × Reference oscillator accuracy + 10 Hz) Modulation accuracy (residual vector error): ≤2.5% (single code)
Amplitude Measurement	Frequency range: 350 MHz to 2.7 GHz ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz to 457.5 MHz (LTE operating band 31) Input level: –70 to +35 dBm (Main1, 2) Measurement accuracy 10° to 40°C, After Cal ±0.3 dB (typ.), ±0.5 dB (–30 to +35 dBm), ±0.7 dB (–55 to –30 dBm), ±0.9 dB (–70 to –55 dBm) Linearity: ±0.2 dB (–40 to 0 dB, ≥–55 dBm), ±0.4 dB (–40 to 0 dB, ≥–65 dBm) Measurement object: DPCH, UpPCH
Occupied Bandwidth	Frequency range: 350 MHz to 2.7 GHz ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz to 457.5 MHz (LTE operating band 31) Input level: –10 to +35 dBm (Main1, 2)
Adjacent Channel Leakage Power	Frequency range: 350 MHz to 2.7 GHz ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz to 457.5 MHz (LTE operating band 31) Input level: –10 to +35 dBm (Main1, 2) Measurement point: ±1.6 MHz, ±3.2 MHz Measurement range: ≥50 dB (±1.6 MHz), ≥55 dB (±3.2 MHz)
RF Signal Generator	Output frequency range: 300 MHz to 2.7 GHz, 1 Hz steps Channel level: –30.0 to 0.0 dBm (DPCH), 0.1 dB steps Channel level accuracy: ±0.2 dB AWGN level: Off, –20 to +5 dB, 0.1 dB steps AWGN level accuracy: ±0.2 dB EVM: ≤3% RMS
Error Rate Measurement	Function: Applying PN9 or PN15 pattern to DTCH Measures BER, BLER Measurement object: Loopback data on uplink DTCH
Call Processing	Call control: Location registration, Call origination, Call termination, Network-side release, UE-side release (executes each 3GPP-defined processing and performs Pass/Fail evaluation) UE control: Output level, Loopback (executes each 3GPP-defined UE control)

TD-SCDMA HSDPA Measurement Software MX882107C-011

Function	This option for the MX882107C measures HSDPA RX performance.
Reference Channel	RMC 0.5Mbps UE class (QPSK), RMC 1.1Mbps UE class (QPSK), RMC 1.1Mbps UE class (16QAM), RMC 1.6Mbps UE class (QPSK), RMC 1.6Mbps UE class (16QAM), RMC 2.2Mbps UE class (QPSK), RMC 2.2Mbps UE class (16QAM), RMC 2.8Mbps UE class (QPSK), RMC 2.8Mbps UE class (16QAM)
Throughput Measurement	Measures throughput using RMC Measurement object: HS-SICH ACK and NACK
CQI Measurement	Measurement object: HS-SICH CQI (RTBS, RMF) reported periodically from UE
Call Processing	Call control: Location registration, Call processing using RMC (executes each 3GPP-defined processing and performs Pass/Fail evaluation) UE control: Output level (executes each 3GPP-defined UE control)

TD-SCDMA HSDPA Evolution Measurement Software MX882107C-012

Function	This option for the MX882107C measures HSDPA Evolution RX performance.
Reference Channel	RMC Category 16 to 18 UE (64QAM), RMC Category 19 to 21 UE (64QAM), RMC Category 22 to 24 UE (64QAM), RMC Category 18 max., RMC Category 21 max., RMC Category 24 max.
Throughput Measurement	Throughput measurement using RMC Measurement object: HS-SICH ACK and NACK
CQI Measurement	Measurement object: HS-SICH CQI (RTBS) reported periodically from UE
Call Processing	Call control: Location registration, Call processing using RMC (executes each 3GPP-defined processing and performs Pass/Fail evaluation) UE control: Output level (executes each 3GPP-defined UE control)

TD-SCDMA HSUPA Measurement Software MX882107C-021

Function	This option for the MX882107C measures HSUPA, HSUPA Evolution TX performance.
Modulation Measurement	Depends on MX882107C performance
Call Processing	Call control: Location registration, Call processing using FRC1 and FRC2 (executes each 3GPP-defined processing and performs Pass/Fail evaluation) UE control: Output level (executes each 3GPP-defined UE control)

Audio Board MT8821C-011, TD-SCDMA Voice Codec MX882107C-001

Function	End-to-end communications test between a handset connected to the MT8821C and UE. Encode the voice from Audio Input, Output the decoded voice to AF Output. Encode the tone signal and Output the tone signal to AF Output. Measure the voice signal from AF Input and decoded voice signal.
Codec Level Adjustment	Encoder input gain: –3.00 to 3.00 dB, in increments of 0.01 dB Handset microphone volume: 0, 1, 2, 3, 4, 5 Handset speaker volume: 0, 1, 2, 3, 4, 5
AF Input	Frequency range: 50 Hz to 10 kHz Input voltage range: 1 mV peak to 5 V peak (AF input connector) Max. allowable input voltage: 30 V rms Input impedance: 100 kΩ Frequency measurement accuracy: ± (Reference oscillator accuracy + 0.5 Hz) Level measurement accuracy: ±0.2 dB (≥10 mV peak, ≥50 Hz), ±0.4 dB (≥1 mV peak, ≥1 kHz) SINAD measurement At frequency 1 kHz ≥60 dB (≥1000 mV peak), ≥54 dB (>50 mV peak), ≥46 dB (≥10 mV peak) Distortion rate measurement At frequency 1 kHz ≤–60 dB (≥1000 mV peak), ≤–54 dB (>50 mV peak), ≤–46 dB (≥10 mV peak)
AF Output	Frequency range: 30 Hz to 10 kHz, 1 Hz resolution Frequency accuracy: ± (Setting frequency × Reference oscillator accuracy + 0.1 Hz) Setting range: 0 to 5 V peak (AF output connector) Setting resolution: 1 mV (≤5 V peak), 100 µV (≤500 mV peak), 10 µV (≤50 mV peak) Level accuracy: ±0.2 dB (≥10 mV peak, ≥50 Hz), ±0.3 dB (≥10 mV peak, <50 Hz) Waveform distortion: ≤30 kHz band ≤–60 dB (≥500 mV peak, ≤5 kHz), ≤–54 dB (≥70 mV peak) Output impedance: ≤1 Ω Max. output current: 100 mA

CDMA2000 Measurement Software Lite MX882132C

Electrical Characteristics	Typical values (typ.) are only for reference and are not guaranteed.
Frequency/Modulation Measurement	Frequency range: 300 MHz to 2.7 GHz Input level: –30 to +35 dBm Carrier frequency accuracy: ± (Set frequency × Reference oscillator + 10 Hz) Modulation accuracy Residual waveform quality: >0.999
Amplitude Measurement	Frequency range: 300 MHz to 2.7 GHz Input level: –65 to +35 dBm (Main1/2) Measurement accuracy Filtered power measurement, after Full Cal, Input level setting, 10° to 40°C ±0.5 dB (–30 to +35 dBm), typ. ±0.3 dB (–30 to +35 dBm), ±0.7 dB (–55 to –30 dBm), ±0.9 dB (–65 to –55 dBm) Linearity Filtered power measurement, Input level setting for reference ±0.2 dB (–40 to 0 dB, ≥–55 dBm), ±0.4 dB (–40 to 0 dB, ≥–65 dBm)
Occupied Bandwidth	Frequency range: 300 MHz to 2.7 GHz Input level: –10 to +35 dBm (Main1/2)
Code Domain Power	Can be measured when Reverse-RC is set to RC 3 or RC 4. Measurement level range: –30 to +35 dBm Measurement accuracy: ±0.2 dB (Code power ≥–15 dBc), ±0.4 dB (Code power ≥–23 dBc)
RF Signal Generator	Output frequency range: 300 MHz to 2.7 GHz, 1 Hz steps CDMA2000 1X Waveform quality: >0.99

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AF Input	Input frequency Frequency range: 50 Hz to 10 kHz Input level Input voltage range: 1 mV peak to 5 V peak (AF input connector) Maximum allowable input voltage: 30 V rms Frequency measurement accuracy: ± (Reference oscillator accuracy + 0.5 Hz) Level measurement accuracy: ±0.2 dB (≥10 mV peak), ±0.4 dB (≥1 mV peak, ≥1 kHz) SINAD measurement range At frequency 1 kHz ≥60 dB (≥1000 mV peak), ≥54 dB (>50 mV peak), ≥46 dB (≥10 mV peak) Distortion measurement range At frequency 1 kHz ≤–60 dB (≥1000 mV peak), ≤–54 dB (>50 mV peak), ≤–46 dB (≥10 mV peak) Input impedance: 100 kΩ
AF Output	Output frequency Frequency range: 30 Hz to 10 kHz Resolution: 1 Hz Accuracy: ± (Set frequency × Reference oscillator accuracy + 0.1 Hz) Output level Range: 0 to 5 V peak (AF output connector) Resolution: 1 mV (≤5 V peak), 100 µV (≤500 mV peak), 10 µV (≤50 mV peak) Accuracy: ±0.2 dB (≥10 mV peak, ≥50 Hz), ±0.3 dB (≥10 mV peak, <50 Hz) Waveform distortion: ≤30 kHz band ≤–60 dB (≥500 mV peak, ≤5 kHz), ≤–54 dB (≥70 mV peak) Output impedance: ≤1 Ω Max. output current: 100 mA

1xEV-DO Measurement Software Lite MX882136C

Frequency/Modulation Measurement	Frequency range: 300 MHz to 2.7 GHz Input level: –30 to +35 dBm (Main1/2) Carrier frequency accuracy: ± (Set frequency × Reference oscillator accuracy + 10 Hz) Modulation accuracy Rresidual waveform quality: >0.999
Amplitude Measurement	Depends on MX882132C performance
Occupied Bandwidth	Depends on MX882132C performance
Code Domain Power	Input level: –30 to +35 dBm (Main1, 2) Measurement accuracy: ±0.2 dB (Code power: ≥–15 dBc), ±0.4 dB (Code power: ≥–23 dBc)
RF Signal Generator	Output frequency range: 300 MHz to 2.7 GHz, 1 Hz steps Channel level (relative level to Ior): 0 dB (Pilot channel, MAC channel, Control channel, Traffic channel) Waveform quality: >0.999

LTE FDD Measurement Software Lite MX882142C, LTE TDD Measurement Software Lite MX882143C

Frequency/Modulation Measurement	Frequency range: 400 MHz to 3.8 GHz, 3.8 GHz to 5.0 GHz (with MT8821C-019) ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz to 457.5 MHz (LTE operating band 31) Input level: –40 to +35 dBm (Main1, 2) Carrier frequency accuracy: ± (Set frequency × Reference oscillator accuracy + 15 Hz) Modulation accuracy (residual vector error): ≤2.5% (400 MHz ≤ frequency ≤ 3.8 GHz, Measurement count: 20) ≤3.5% (3.8 GHz < frequency ≤ 5.0 GHz, Measurement count: 20) In-band Emissions: ≤–40 dB (≥–10 dBm, Allocated RB: ≤18) Measurement object: PUSCH
Amplitude Measurement	Frequency range: 400 MHz to 3.8 GHz, 3.8 GHz to 5.0 GHz (with MT8821C-019) ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz to 457.5 MHz (LTE operating band 31) Input level: –60 to +35 dBm (Main1, 2) Measurement accuracy 10° to 40°C, After Cal, 400 MHz ≤ frequency ≤ 3.8 GHz ±0.3 dB (typ.), ±0.5 dB (–20 to +35 dBm), ±0.7 dB (–50 to –20 dBm), ±0.9 dB (–60 to –50 dBm) 20° to 30°C, After Cal, 3.8 GHz < frequency ≤ 5.0 GHz ±0.7 dB (–20 to +35 dBm), ±0.9 dB (–50 to –20 dBm), ±1.1 dB (–60 to –50 dBm) Linearity 400 MHz to 5.0 GHz, –40 to 0 dB ±0.2 dB (≥–50 dBm), ±0.4 dB (≥–60 dBm) Measurement object: PUSCH
Occupied Bandwidth	Frequency range: 400 MHz to 3.8 GHz, 3.8 GHz to 5.0 GHz (with MT8821C-019) ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz to 457.5 MHz (LTE operating band 31) Input level: –10 to +35 dBm (Main1, 2) Channel bandwidth: 1.4, 3, 5 MHz (452.5 MHz ≤ UL frequency ≤ 457.5 MHz) 1.4, 3, 5, 10, 15, 20 MHz (500 MHz ≤ UL frequency)
Adjacent Channel Leakage Power	Frequency range: 400 MHz to 3.8 GHz, 3.8 GHz to 5.0 GHz (with MT8821C-019) ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz to 457.5 MHz (LTE operating band 31) Input level: –10 to +35 dBm (Main1, 2) Measurement range: ≥45 dB (E-UTRA ACLR1), ≥50 dB (UTRA ACLR1), ≥55 dB (UTRA ACLR2) Channel bandwidth: 1.4, 3, 5 MHz (452.5 MHz ≤ UL frequency ≤ 457.5 MHz) 1.4, 3, 5, 10, 15, 20 MHz (500 MHz ≤ UL frequency)

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Spectrum Emission Mask	Frequency range: 400 MHz to 3.8 GHz, 3.8 GHz to 5.0 GHz (with MT8821C-019) ≤500 MHz: Only the following frequency range meets the specifications. 452.5 MHz to 457.5 MHz (LTE operating band 31) Input level: –10 to +35 dBm (Main1, 2) Channel bandwidth: 1.4, 3, 5 MHz (452.5 MHz ≤ UL frequency ≤ 457.5 MHz) 1.4, 3, 5, 10, 15, 20 MHz (500 MHz ≤ UL frequency)
RF Signal Generator	Output frequency range: 400 MHz to 3.8 GHz, 3.8 GHz to 6.0 GHz (with MT8821C-019) 1 Hz steps Output level Main: –140 to –10 dBm (Modulation: Off), –142 to –12 dBm (Modulation: On) Aux: –125 to +5 dBm (Modulation: Off), –127 to +3 dBm (Modulation: On)

Sequence Measurement Software MX882120C

Amplitude Measurement	Frequency: 400 MHz to 3.8 GHz 3.8 GHz to 5.0 GHz (when MT8821C-019 is installed) For the frequencies below 500 MHz, only the following range meets the specifications: 452.5 MHz to 457.5 MHz (LTE Operating Band 31) 410.0 MHz to 419.975 MHz (CDMA2000 Band Class 5, 11) 450.0 MHz to 459.990 MHz (CDMA2000 Band Class 5, 11) 479.0 MHz to 483.480 MHz (CDMA2000 Band Class 5, 11) 410.2 MHz to 419.8 MHz (Band T-GSM410) 450.4 MHz to 457.6 MHz (Band GSM450) 478.8 MHz to 486.0 MHz (Band GSM480) Input level: –70 to +35 dBm (Main1, 2) Measurement accuracy ±0.5 dB (–20 to +35 dBm) (typ.) ±0.3 dB (–20 to +35 dBm), ±0.7 dB (–50 to –20 dBm), ±0.9 dB (–60 to –50 dBm) For measurement bandwidth of ≤ 5 MHz ±0.5 dB (–30 to +35 dBm) (typ.) ±0.3 dB (–30 to +35 dBm), ±0.7 dB (–55 to –30 dBm), ±0.9 dB (–65 to –55 dBm) For measurement bandwidth of ≤2 MHz ±0.5 dB (–30 to +35 dBm) (typ.) ±0.3 dB (–30 to +35 dBm), ±0.7 dB (–55 to –30 dBm), ±0.9 dB (–70 to –55 dBm), 400 MHz ≤ freq. ≤ 3.8 GHz, after calibration, 10 to 40°C ±0.7 dB (–20 to +35 dBm), ±0.9 dB (–50 to –20 dBm), ±1.1 dB (–60 to –50 dBm), 3.8 GHz < freq. ≤ 5.0 GHz, after calibration, 20° to 30°C Linearity ±0.2 dB (–40 to 0 dB, ≥–50 dBm), ±0.4 dB (–40 to 0 dB, ≥–60 dBm) For measurement bandwidth of ≤5 MHz ±0.2 dB (–40 to 0 dB, ≥–55 dBm), ±0.4 dB (–40 to 0 dB, ≥–65 dBm), 400 MHz ≤ freq. ≤ 3.8 GHz, 10° to 40°C ±0.2 dB (–40 to 0 dB, ≥–50 dBm), ±0.4 dB (–40 to 0 dB, ≥–60 dBm), 3.8 GHz < freq. ≤ 5.0 GHz, 10° to 40°C Relative measurement error: Range <2 dB (typ.) ±0.10 dB (–40 to 0 dB, ≥–50 dBm)
RF Signal Generator	Output frequency: 400 MHz to 3.8 GHz, 3.8 GHz to 6 GHz (when MT8821C-019 is installed) 1 Hz steps Output level Main output –140.0 to –10.0 dBm (Modulation Off), –142.0 to –12.0 dBm (Modulation On) AUX output –125.0 to +5.0 dBm (Modulation Off), –127.0 to +3.0 dBm (Modulation On)

W-CDMA Measurement Software MX882120C-001

Frequency/Modulation Measurement	Frequency: 400 MHz to 2.7 GHz For the frequencies below 500 MHz, only the following range meets the specifications: 452.5 MHz to 457.5 MHz (LTE Operating Band 31) Input level: –30 to +35 dBm (Main1, 2) Carrier frequency accuracy: ± (Set frequency × Reference oscillator accuracy + 10 Hz) Modulation accuracy: ≤2.5% (when one DPCCH and one DPDCH are input)
Amplitude Measurement	Frequency: 400 MHz to 2.7 GHz For the frequencies below 500 MHz, only the following range meets the specifications: 452.5 MHz to 457.5 MHz (LTE Operating Band 31) Input level: –65 to +35 dBm (Main1, 2) Measurement accuracy: ±0.5 dB (–30 to +35 dBm) (typ.) ±0.3 dB (–30 to +35 dBm), ±0.7 dB (–55 to –30 dBm), ±0.9 dB (–65 to –55 dBm), after calibration, 10° to 40°C Linearity: ±0.2 dB (–40 to 0 dB, ≥–55 dBm), ±0.4 dB (–40 to 0 dB, ≥–65 dBm), 10° to 40°C Measurement object: DPCH
Occupied Bandwidth	Frequency: 400 MHz to 2.7 GHz For the frequencies below 500 MHz, only the following range meets the specifications: 452.5 MHz to 457.5 MHz (LTE Operating Band 31) Input level: –10 to +35 dBm (Main1, 2)
Adjacent Channel Leakage Power	Frequency: 400 MHz to 2.7 GHz For the frequencies below 500 MHz, only the following range meets the specifications: 452.5 MHz to 457.5 MHz (LTE Operating Band 31) Input level: –10 to +35 dBm (Main1, 2) Measurement range: ≥50 dB (±5 MHz), ≥55 dB (±10 MHz)

GSM Measurement Software MX882120C-002

Frequency/Modulation Measurement	Frequency: 400 MHz to 2.7 GHz For the frequencies below 500 MHz, only the following range meets the specifications: 410.2 MHz to 419.8 MHz (Band T-GSM410) 450.4 MHz to 457.6 MHz (Band GSM450) 478.8 MHz to 486 MHz (Band GSM480) Input level: –30 to +35 dBm (average power in bursts, Main1, 2) Carrier frequency accuracy: ± (Set frequency × Reference oscillator accuracy + 10 Hz) Modulation accuracy: Residual phase error ≤0.5 deg. (rms), ≤2 deg. (peak) (GMSK) Residual EVM ≤1.5% (rms) (8PSK) Measurement object: Normal burst (GMSK, 8PSK)
Amplitude Measurement	Frequency: 400 MHz to 2.7 GHz For the frequencies below 500 MHz, only the following range meets the specifications: 410.2 MHz to 419.8 MHz (Band T-GSM410) 450.4 MHz to 457.6 MHz (Band GSM450) 478.8 MHz to 486 MHz (Band GSM480) Input level: –30 to +35 dBm (average power in bursts, Main1, 2) Measurement accuracy: ±0.5 dB (–30 to +35 dBm) (typ.) ±0.3 dB (–30 to +35 dBm), after calibration, 10° to 40°C Linearity: ±0.2 dB (–40 to 0 dB, ≥–30 dBm), 10° to 40°C Power measurement range when carrier Off: ≥65 dB (≥–10 dBm), ≥45 dB (–30 to –10 dBm) Measurement object: Normal burst (GMSK, 8PSK)
Output Spectrum Measurement (Output RF Spectrum)	Frequency: 400 MHz to 2.7 GHz For the frequencies below 500 MHz, only the following range meets the specifications: 410.2 MHz to 419.8 MHz (Band T-GSM410) 450.4 MHz to 457.6 MHz (Band GSM450) 478.8 MHz to 486 MHz (Band GSM480) Input level: –10 to +35 dBm (average power in bursts, Main1, 2) Measurement point: ±100 kHz, ±200 kHz, ±250 kHz, ±400 kHz, ±600 kHz, ±800 kHz, ±1000 kHz, ±1200 kHz, ±1400 kHz, ±1600 kHz, ±1800 kHz, ±2000 kHz Modulation part measurement range: Averaged over 10 measurements, ≤–55 dB (≤250 kHz offset), ≤–66 dB (≥400 kHz offset) Transient part measurement range: ≤–57 dB (≥400 kHz offset) Measurement object: Normal burst (GMSK, 8PSK)

CDMA2000 Measurement Software MX882120C-003

Frequency/Modulation Measurement	Frequency: 400 MHz to 2.7 GHz For the frequencies below 500 MHz, only the following range meets the specifications: 410.0 MHz to 419.975 MHz (CDMA2000 Band Class 5, 11) 450.0 MHz to 459.990 MHz (CDMA2000 Band Class 5, 11) 479.0 MHz to 483.480 MHz (CDMA2000 Band Class 5, 11) Input level: –30 to +35 dBm (Main1, 2) Carrier frequency accuracy: ± (Set frequency × Reference oscillator accuracy + 10 Hz) Modulation accuracy: Residual Waveform Quality >0.999
Amplitude Measurement	Frequency: 400 MHz to 2.7 GHz For the frequencies below 500 MHz, only the following range meets the specifications: 410.0 MHz to 419.975 MHz (CDMA2000 Band Class 5, 11) 450.0 MHz to 459.990 MHz (CDMA2000 Band Class 5, 11) 479.0 MHz to 483.480 MHz (CDMA2000 Band Class 5, 11) Input level: –65 to +35 dBm (Main1, 2) Measurement accuracy: ±0.5 dB (–30 to +35 dBm) (typ.) ±0.3 dB (–30 to +35 dBm), ±0.7 dB (–55 to –30 dBm), ±0.9 dB (–65 to –55 dBm), after calibration, 10 °to 40°C (Filtered Power measurement) Linearity: ±0.2 dB (–40 to 0 dB, ≥–55 dBm), ±0.4 dB (–40 to 0 dB, ≥–65 dBm), 10° to 40°C (Filtered Power measurement)
Code Domain Power	Measurement available when Reverse RC3, RC4, or EV-DO mode Frequency: 400 MHz to 2.7 GHz For the frequencies below 500 MHz, only the following range meets the specifications: 410.0 MHz to 419.975 MHz (CDMA2000 Band Class 5, 11) 450.0 MHz to 459.990 MHz (CDMA2000 Band Class 5, 11) 479.0 MHz to 483.480 MHz (CDMA2000 Band Class 5, 11) Input level: –30 to +35 dBm (Main1, 2) Modulation accuracy: ±0.2 dB (code Power ≥–15 dBc) ±0.4 dB (code Power ≥–23 dBc)
Occupied Bandwidth	Frequency: 400 MHz to 2.7 GHz For the frequencies below 500 MHz, only the following range meets the specifications: 410.000 MHz to 419.975 MHz (CDMA2000 Band Class 5, 11) 450.000 MHz to 459.990 MHz (CDMA2000 Band Class 5, 11) 479.000 MHz to 483.480 MHz (CDMA2000 Band Class 5, 11) Input level: –10 to +35 dBm (Main1, 2)

LTE Measurement Software MX882120C-004

Frequency/Modulation Measurement	Frequency: 400 MHz to 3.8 GHz 3.8 GHz to 5.0 GHz (when MT8821C-019 is installed) For the frequencies below 500 MHz, only the following range meets the specifications: 452.5 MHz to 457.5 MHz (LTE Operating Band 31) Input level: –40 to +35 dBm (Main1, 2) Carrier frequency accuracy: ± (Set frequency × Reference oscillator accuracy + 15 Hz) Modulation accuracy: Residual vector error ≤ 2.5% (400 MHz ≤ freq. ≤ 3.8 GHz) (when measurement count is 20), ≤3.5% (3.8 GHz < freq. ≤ 5.0 GHz) (when measurement count is 20) For the frequencies below 500 MHz, only the following range meets the specifications: 452.5 MHz to 457.5 MHz (LTE Operating Band 31) In-Band Emissions: ≤ –40 dB (≥–10 dBm, Allocated RB ≤18) Measurement object: PUSCH
Amplitude Measurement	Frequency: 400 MHz to 3.8 GHz 3.8 GHz to 5.0 GHz (when MT8821C-019 is installed) For the frequencies below 500 MHz, only the following range meets the specifications: 452.5 MHz to 457.5 MHz (LTE Operating Band 31) Input level: –60 to +35 dBm (Main1, 2) Measurement accuracy: ±0.5 dB (–20 to +35 dBm) (typ.) ±0.3 dB (–20 to +35 dBm), ±0.7 dB (–50 to –20 dBm), ±0.9 dB (–60 to –50 dBm), 400 MHz ≤ freq. ≤ 3.8 GHz, after calibration, 10° to 40°C ±0.7 dB (–20 to +35 dBm), ±0.9 dB (–50 to –20 dBm), ±1.1 dB (–60 to –50 dBm), 3.8 GHz < freq. ≤ 5.0 GHz, after calibration, 20° to 30°C Linearity: ±0.2 dB (–40 to 0 dB, ≥–50 dBm), ±0.4 dB (–40 to 0 dB, ≥–60 dBm), 400 MHz ≤ freq. ≤ 3.8 GHz, 10° to 40°C ±0.2 dB (–40 to 0 dB, ≥–50 dBm), ±0.4 dB (–40 to 0 dB, ≥–60 dBm), 3.8 GHz < freq. ≤ 5.0 GHz, 10° to 40°C Measurement object: PUSCH
Occupied Bandwidth	Frequency: 400 MHz to 3.8 GHz 3.8 GHz to 5.0 GHz (when MT8821C-019 is installed) For the frequencies below 500 MHz, only the following range meets the specifications: 452.5 MHz to 457.5 MHz (LTE Operating Band 31) Input level: –10 to +35 dBm (Main1, 2) Channel bandwidth: 1.4, 3, 5 MHz (452.5 MHz ≤ UL frequency ≤ 457.5 MHz) 1.4, 3, 5, 10, 15213, 20 MHz (500 MHz ≤ UL frequency)
Adjacent Channel Leakage Power	Frequency: 400 MHz to 3.8 GHz 3.8 GHz to 5.0 GHz (when MT8821C-019 is installed) For the frequencies below 500 MHz, only the following range meets the specifications: 452.5 MHz to 457.5 MHz (LTE Operating Band 31) Input level: –10 to +35 dBm (Main1, 2) Measurement range: ≥45 dB (E-UTRA ACLR1), ≥50 dB (UTRA ACLR1), ≥55 dB (UTRA ACLR2) 400 MHz to 5.0 GHz For the frequencies below 500 MHz, only the following range meets the specifications: 452.5 MHz to 457.5 MHz (LTE Operating Band 31) Channel bandwidth: 1.4, 3, 5 MHz (452.5 MHz ≤ UL frequency ≤ 457.5 MHz) 1.4, 3, 5, 10, 15, 20 MHz (500 MHz ≤ UL frequency)
Spectrum Emission Mask	Frequency: 400 MHz to 3.8 GHz 3.8 GHz to 5.0 GHz (when MT8821C-019 is installed) For the frequencies below 500 MHz, only the following range meets the specifications: 452.5 MHz to 457.5 MHz (LTE Operating Band 31) Input level: –10 to +35 dBm (Main1, 2) Channel bandwidth: 1.4, 3, 5 MHz (452.5 MHz ≤ UL frequency ≤ 457.5 MHz) 1.4, 3, 5, 10, 15, 20 MHz (500 MHz ≤ UL frequency)

TD-SCDMA Measurement Software MX882120C-005

Frequency/Modulation Measurement	Frequency: 400 MHz to 2.7 GHz For the frequencies below 500 MHz, only the following range meets the specifications: 452.5 MHz to 457.5 MHz (LTE Operating Band 31) Input level: –30 to +35 dBm (Main1, 2) Carrier frequency accuracy: ± (Set frequency × Reference oscillator accuracy + 10 Hz) Modulation accuracy: Residual vector error ≤2.5% (Single code)
Amplitude Measurement	Frequency: 400 MHz to 2.7 GHz For the frequencies below 500 MHz, only the following range meets the specifications: 452.5 MHz to 457.5 MHz (LTE Operating Band 31) Input level: –70 to +35 dBm (Main1, 2) Measurement accuracy: ±0.5 dB (–30 to +35 dBm) (typ.) ±0.3 dB (–30 to +35 dBm), ±0.7 dB (–55 to –30 dBm), ±0.9 dB (–70 to –55 dBm), after calibration, 10° to 40°C Linearity: ±0.2 dB (–40 to 0 dB, ≥–55 dBm), ±0.4 dB (–40 to 0 dB, ≥–65 dBm), 10° to 40°C Measurement object: DPCH
Occupied Bandwidth	Frequency: 400 MHz to 2.7 GHz For the frequencies below 500 MHz, only the following range meets the specifications: 452.5 MHz to 457.5 MHz (LTE Operating Band 31) Input level: –10 to +35 dBm (Main1, 2)
Adjacent Channel Leakage Power	Frequency: 400 MHz to 2.7 GHz For the frequencies below 500 MHz, only the following range meets the specifications: 452.5 MHz to 457.5 MHz (LTE Operating Band 31) Input level: –10 to +35 dBm (Main1, 2) Measurement point: ±1.6 MHz, ±3.2 MHz Measurement range: ≥50 dB (±1.6 MHz), ≥ 55 dB (±3.2 MHz)

Typical (typ.): Performance not warranted. Most products meet typical performance.
Nominal (nom.): Values not warranted. Included to facilitate application of product.

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name	Remarks
	Main frame	
MT8821C	Radio Communication Analyzer	
	Standard accessories	
	Power Cord: 1 pc	
P0031A	USB Memory: 1 pc	
W3753AE	MT8821C Operation Manual: 1 pc	USB memory
	Options	
MT8821C-001	W-CDMA Measurement Hardware	
MT8821C-002	TDMA Measurement Hardware	
MT8821C-003	CDMA2000 Measurement Hardware*1	
MT8821C-005	1xEV-DO Measurement Hardware*1, *2	Requires MT8821C-003
MT8821C-007	TD-SCDMA Measurement Hardware	Requires MT8821C-001
MT8821C-008	LTE Measurement Hardware	
MT8821C-011	Audio Board	
MT8821C-012	Parallel Phone Measurement Hardware*3	
MT8821C-019	Extended RF 3.8 GHz to 6 GHz	
MT8821C-025	2nd RF for Phone1	
MT8821C-026	3rd RF for Phone1	Requires MT8821C-025
MT8821C-027	4th RF for Phone1	Requires MT8821C-026
MT8821C-028	2nd RF for Phone2	Requires MT8821C-012
MT8821C-029	3rd RF for Phone2	Requires MT8821C-028
MT8821C-030	4th RF for Phone2	Requires MT8821C-029
MT8821C-043	CDMA2000 Time Offset CAL for GPS SG	Requires MT8821C-003 and MX882102C
	Retrofit options*4	
MT8821C-□01	W-CDMA Measurement Hardware Retrofit	
MT8821C-□02	TDMA Measurement Hardware Retrofit	
MT8821C-□03	CDMA2000 Measurement Hardware Retrofit*1	
MT8821C-□05	1xEV-DO Measurement Hardware Retrofit*1, *2	Requires MT8821C-003
MT8821C-□07	TD-SCDMA Measurement Hardware Retrofit	Requires MT8821C-001
MT8821C-□08	LTE Measurement Hardware Retrofit	
MT8821C-□11	Audio Board Retrofit	
MT8821C-□12	Parallel Phone Measurement Hardware Retrofit*3	
MT8821C-□43	CDMA2000 Time Offset CAL for GPS SG Retrofit	Requires MT8821C-003 and MX882102C
	Software options	
MX882100C	W-CDMA Measurement Software	Requires MT8821C-001
MX882100C-001	W-CDMA Voice Codec	Requires MT8821C-011 and MX882100C
MX882100C-002	W-CDMA External Packet Data	Requires MX882100C
MX882100C-003	W-CDMA Video Phone Test*5	Requires MX882100C
MX882100C-005	W-CDMA A-GPS	Requires MX882100C
MX882100C-019	W-CDMA HSPA Measurement Software*5	Requires MX882100C
MX882100C-032	DC-HSDPA Measurement Software	Requires MT8821C-001 (2 sets), MT8821C-012, MX882100C and MX882100C-019
MX882100C-033	DC-HSUPA Measurement Software	Requires MX882100C-032
MX882100C-034	4C-HSDPA Measurement Software	Requires MX882100C-032
MX882170C	W-CDMA Ciphering Software*5	Requires MX882100C
MX882101C	GSM Measurement Software	Requires MT8821C-002
MX882101C-001	GSM Voice Codec	Requires MT8821C-011 and MX882101C
MX882101C-002	GSM External Packet Data	Requires MX882101C
MX882101C-005	GSM A-GPS	Requires MX882101C
MX882101C-011	EGPRS Measurement Software	Requires MX882101C
MX882102C	CDMA2000 Measurement Software	Requires MT8821C-003
MX882102C-001	CDMA2000 Voice Codec	Requires MT8821C-011 and MX882102C
MX882102C-002	CDMA2000 External Packet Data	Requires MX882102C
MX882106C	1xEV-DO Measurement Software	Requires MT8821C-005 and MX882102C
MX882106C-002	1xEV-DO External Packet Data	Requires MX882106C
MX882107C	TD-SCDMA Measurement Software	Requires MT8821C-007
MX882107C-001	TD-SCDMA Voice Codec	Requires MT8821C-011 and MX882107C
MX882107C-002	TD-SCDMA External Packet Data	Requires MX882107C
MX882107C-003	TD-SCDMA Video Phone Test	Requires MX882107C
MX882107C-011	TD-SCDMA HSDPA Measurement Software	Requires MX882107C
MX882107C-012	TD-SCDMA HSDPA Evolution Measurement Software	Requires MX882107C-011
MX882107C-021	TD-SCDMA HSUPA Measurement Software	Requires MX882107C-011

Continued on next page

Model/Order No.	Name	Remarks
MX882112C	LTE FDD Measurement Software	Requires MT8821C-008
MX882112C-006	LTE FDD IP Data Transfer	Requires MX882112C
MX882112C-010	LTE FDD Anchor For 5G NSA	Requires MT8000A and MX882112C
MX882112C-011	LTE FDD 2×2 MIMO DL	Requires MT8821C-012 and MX882112C
MX882112C-012	LTE FDD 4×4 MIMO DL	Requires MT8821C-026, MT8821C-029 and MX882112C-011
MX882112C-016	LTE FDD CS Fallback to W-CDMA/GSM	Requires MX882112C and MX882100C or MX882101C
MX882112C-017	LTE FDD CS Fallback to CDMA2000	Requires MX882112C and MX882102C
MX882112C-021	LTE-Advanced FDD DL CA Measurement Software	Requires MT8821C-025 and MX882112C Requires MT8821C-028 when MX882112C-011 installed
MX882112C-022	LTE-Advanced FDD UL CA Measurement Software	Requires MX882112C-021
MX882112C-026	LTE-Advanced FDD DL CA IP Data Transfer	Requires MX882112C-006 and MX882112C-021
MX882112C-031	LTE-Advanced FDD DL CA 3CCs Measurement Software	Requires MT8821C-008 (2 sets), MT8821C-026 and MX882112C-021 Requires MT8821C-029 when MX882112C-011 installed
MX882112C-036	LTE-Advanced FDD DL CA 3CCs IP Data Transfer	Requires MX882112C-026 and MX882112C-031
MX882112C-041	LTE-Advanced FDD DL CA 4CCs Measurement Software	Requires MT8821C-027 and MX882112C-031 Requires MT8821C-030 when MX882112C-011 installed
MX882112C-046	LTE-Advanced FDD DL CA 4CCs IP Data Transfer	Requires MX882112C-036 and MX882112C-041
MX882112C-051	LTE-Advanced FDD DL CA 5CCs Measurement Software	Requires MT8821C-012 and MX882112C-041
MX882112C-061	LTE-Advanced FDD DL CA 6CCs Measurement Software	Requires MX882112C-051
MX882112C-071	LTE-Advanced FDD DL CA 7CCs Measurement Software	Requires MX882112C-061
MX882112C-081	LTE-Advanced FDD DL CA 8CCs Measurement Software	Requires MX882112C-071
MX882113C	LTE TDD Measurement Software	Requires MT8821C-008
MX882113C-006	LTE TDD IP Data Transfer	Requires MX882113C
MX882113C-010	LTE TDD Anchor For 5G NSA	Requires MT8000A and MX882113C
MX882113C-011	LTE TDD 2×2 MIMO DL	Requires MT8821C-012 and MX882113C
MX882113C-012	LTE TDD 4×4 MIMO DL	Requires MT8821C-026, MT8821C-029 and MX882113C-011
MX882113C-016	LTE TDD CS Fallback to W-CDMA/GSM	Requires MX882113C and MX882100C or MX882101C
MX882113C-017	LTE TDD CS Fallback to CDMA2000	Requires MX882113C and MX882102C
MX882113C-018	LTE TDD CS Fallback to TD-SCDMA/GSM	Requires MX882113C and MX882101C or MX882107C
MX882113C-021	LTE-Advanced TDD DL CA Measurement Software	Requires MT8821C-025 and MX882113C Requires MT8821C-028 when MX882113C-011 installed
MX882113C-022	LTE-Advanced TDD UL CA Measurement Software	Requires MX882113C-021
MX882113C-026	LTE-Advanced TDD DL CA IP Data Transfer	Requires MX882113C-006 and MX882113C-021
MX882113C-031	LTE-Advanced TDD DL CA 3CCs Measurement Software	Requires MT8821C-008 (2 sets), MT8821C-026 and MX882113C-021 Requires MT8821C-029 when MX882113C-011 installed
MX882113C-036	LTE-Advanced TDD DL CA 3CCs IP Data Transfer	Requires MX882113C-026 and MX882113C-031
MX882113C-041	LTE-Advanced TDD DL CA 4CCs Measurement Software	Requires MT8821C-027 and MX882113C-031 Requires MT8821C-030 when MX882113C-011 installed
MX882113C-046	LTE-Advanced TDD DL CA 4CCs IP Data Transfer	Requires MX882113C-036 and MX882113C-041
MX882113C-051	LTE-Advanced TDD DL CA 5CCs Measurement Software	Requires MT8821C-012 and MX882113C-041
MX882113C-061	LTE-Advanced TDD DL CA 6CCs Measurement Software	Requires MX882113C-051
MX882113C-071	LTE-Advanced TDD DL CA 7CCs Measurement Software	Requires MX882113C-061
MX882113C-081	LTE-Advanced TDD DL CA 8CCs Measurement Software	Requires MX882113C-071
MX882115C	W-CDMA HSPA Evolution IP Data Transfer	Requires MT8821C-008
MX882115C-001	DC-HSDPA IP Data Transfer	Requires MX882115C
MX882116C	LTE Category M1 Measurement Software	Requires MT8821C-008
MX882116C-006	LTE Category M1 IP Data Transfer	Requires MX882116C
MX882117C	NB-IoT Measurement Software	Requires MT8821C-008
MX882117C-006	NB-IoT IP Data Transfer	Requires MX882117C
MX882120C	Sequence Measurement Software	
MX882120C-001	W-CDMA Measurement Software	Requires MX882120C
MX882120C-002	GSM Measurement Software	Requires MX882120C
MX882120C-003	CDMA20000 Measurement Software	Requires MX882120C
MX882120C-004	LTE Measurement Software	Requires MX882120C
MX882120C-005	TD-SCDMA Measurement Software	Requires MX882120C
MX882132C	CDMA2000 Measurement Software Lite	
MX882136C	1xEV-DO Measurement Software Lite	
MX882142C	LTE FDD Measurement Software Lite	
MX882143C	LTE TDD Measurement Software Lite	
MX882164C	LTE VoLTE Echoback	Requires MX882112C for LTE FDD, requires MX882113C for LTE TDD
	Upgrade kits[*4]	
MT8821C-UG□01	SPM Upgrade Kit from MT8820C	
MT8821C-UG□02	PPM Upgrade Kit from MT8820C	
MT8821C-UG□03	SPM Upgrade Kit from MT8820C with MX88207xC	
MT8821C-UG□04	PPM Upgrade Kit from MT8820C with MX88207xC	
MT8821C-UG011	Software Upgrade Kit	Required for additional purchase of software options, etc.
	Warranty service	
MT8821C-ES210	2 years Extended Warranty Service	
MT8821C-ES310	3 years Extended Warranty Service	
MT8821C-ES510	5 years Extended Warranty Service	

Continued on next page

Model/Order No.	Name	Remarks
	Application parts	
P0035B	W-CDMA/GSM Test USIM	
P0035B7	W-CDMA/GSM Test USIM[*6]	Micro UICC size
P0135A6	Anritsu Test UICC GA[*6, *7]	Nano UICC size
P0135A7	Anritsu Test UICC GA[*6, *7]	Micro UICC size
P0135B6	Anritsu Test UICC GA[*6, *7]	Nano UICC size
P0135B7	Anritsu Test UICC GA[*6, *7]	Micro UICC size
P0250A6	Anritsu Test UICC GT[*6, *7]	Nano UICC size
P0250A7	Anritsu Test UICC GT[*6, *7]	Micro UICC size
P0250B6	Anritsu Test UICC GT[*6, *7]	Nano UICC size
P0250B7	Anritsu Test UICC GT[*6, *7]	Micro UICC size
P0260A6	Anritsu Test UICC GM[*6, *7]	Nano UICC size
P0260A7	Anritsu Test UICC GM[*6, *7]	Micro UICC size
P0260B6	Anritsu Test UICC GM[*6, *7]	Nano UICC size
P0260B7	Anritsu Test UICC GM[*6, *7]	Micro UICC size
A0058A	Handset	
P0031A	USB Memory	
Z0541A	USB Mouse	
Z0975A	Keyboard	USB connection
Z1898A	Connector Cap	
J1643A	U Link	N-P · UT-141 · SMA-P (for connecting Phone 2 Main1 - SG input)
J1644A	U Link	N-P · UT-141 · SMA-P (for connecting Phone 2 Main1 - Monitor)
J0004	Coaxial Adaptor	
J1195A	PP2S Output Cable	
J1249	CDMA2000 Cable	D-sub (15-pin, P-type) · D-sub (15-pin, P-type), used in combination with J1267 (sold separately)
J1267	CDMA2000 Cross Cable	D-sub (9-pin, P-type) · D-sub (9-pin, P-type), reverse cable used in combination with J1249 (sold separately)
J1606A	Cable	D-sub (15-pin, P-type) · D-sub (15-pin, P-type) · D-sub (15-pin, P-type)
J0576B	Coaxial Cord, 1 m	N-P · 5D-2W · N-P
J0576D	Coaxial Cord, 2 m	N-P · 5D-2W · N-P
J0127A	Coaxial Cord, 1 m	BNC-P · RG58A/U · BNC-P
J0127C	Coaxial Cord, 0.5 m	BNC-P · RG58A/U · BNC-P
J0007	GPIB Cable, 1 m	
J0008	GPIB Cable, 2 m	
J1261A	Ethernet Cable (Shield Type)	1 m, straight
J1261B	Ethernet Cable (Shield Type)	3 m, straight
MN8110B	I/O Adapter	For call processing I/O
B0332	Joint Plate	4 pcs/set
B0703A	Rack Mount Kit (MT8821C)	
B0701A	Carrying Case	Hard type (with protective cover and casters)
B0702A	Carrying Case	Hard type (with protective cover, without casters)
Z1858A	Divider	2-way divider
Z1859A	Divider	3-way divider
J0322A	Coaxial Cord, 0.5 m	SMA-P · SMA-P, DC to 18 GHz, 50Ω
J0322B	Coaxial Cord, 1.0 m	SMA-P · SMA-P, DC to 18 GHz, 50Ω
J0322C	Coaxial Cord, 1.5 m	SMA-P · SMA-P, DC to 18 GHz, 50Ω
J0322D	Coaxial Cord, 2.0 m	SMA-P · SMA-P, DC to 18 GHz, 50Ω
J1398A	N-SMA ADAPTOR	

*1: RoHS not supported at MT8821C-□03, MT8821C-□05 installation.

*2: The MT8821C-005 hardware supports both IS-856-0 (1xEV-DO Rev. 0) and IS-856-A (1xEV-DO Rev. A) RF measurements.

*3: The following measurement hardware support the Parallelphone measurement option: MT8821C-001, MT8821C-002, MT8821C-003, MT8821C-005, MT8821C-007 and MT8821C-008.
All the measurement hardware can be installed simultaneously.

*4: MT8821C- □ ##
□: Select from the following according to the option type.
1: Retrofit option (Must be returned to factory in Japan)
2: Retrofit option (Must be returned to service center outside of Japan)

*5: For UE connectivity, contact your Anritsu sales representative.

*6: A commercial SIM adapter CANNOT be used. If used, it may jam and break in the UE.

*7: Refer to the P0135Ax/P0250Ax/P0260Ax/P0135Bx/P0250Bx/P0260Bx leaflet for details.

Parallelphone™ is a trademark of Anritsu Corporation.

Radio Communication Analyzer

MT8820C

30 MHz to 2.7 GHz (3.4 GHz to 3.8 GHz)

Remote Control
GPIB | **Ethernet**

All-in-one Platform Supporting RF Tx and Rx Tests Up to LTE-Advanced DL CA System

Excellent Eco Product

Supports Multi-Communication Systems

The MT8820C platform covers a frequency range of 30 MHz to 2.7 GHz (3.4 GHz to 3.8 GHz with MT8820C-018). When the dedicated optional measurement software and hardware is installed, the major Tx and Rx characteristics of LTE/LTE-Advanced*1, W-CDMA/HSPA/HSPA Evolution/ DC-HSPA/4C-HSDPA, GSM/GPRS/EGPRS, CDMA2000 1X/1xEV-DO Rev. A*2/ PHS/Advanced PHS and TD-SCDMA/HSPA/HSDPA Evolution terminals can be measured using a single MT8820C unit.

Advanced Digital Signal Processing and Batch Measurement

Manufacturing and inspection test times have been dramatically cut by incorporating advanced DSP and parallel measurement technologies. Furthermore, several measurement items can be selected freely for batch measurement, and the number of measurements for each measurement item can be configured separately.
The one-touch operation supports easy and quick measurement of Tx and Rx characteristics, including transmit frequency, modulation accuracy, transmit power, spectrum emission mask, adjacent channel leakage power ratio, occupied bandwidth, and BER.

Parallelphone Measurement

When the Parallelphone Measurement option is installed in the MT8820C main frame, two different mobile terminals can be connected and tested simultaneously with a single MT8820C using its second RF, AF, GPIB, and Ethernet port. This functionality significantly improves manufacturing efficiency by reducing production costs (return on investment and energy saving) and space.*3

*1: Supports FDD and TDD.
*2: 1x EV-DO Rev. A call processing not supported.
*3: Since both terminal are occupied for DC-HSDPA, DC-HSUPA, 4C-HSDPA, PPM measurement are not supported.

CDMA2000® is a registered trademark of the Telecommunications Industry Association (TIA-USA).

Measurement Software

Measurement Software	System	Description
MX882000C	W-CDMA	Tx and Rx measurements of mobile terminals including call processing (requires MT8820C-001 and MX882050C)
MX882000C-011	HSDPA	Tx and Rx measurements of mobile terminals including call processing (requires MT8820C-001, MX882000C and MX882050C)
MX882000C-021	HSUPA	Tx measurements of mobile terminals including call processing (test loop mode) (requires MT8820C-001, MX882000C, MX882000C-011 and MX882050C)
MX882000C-031	HSPA Evolution	Tx and Rx measurements of mobile terminals including call processing (requires MT8820C-001, MX882000C, MX882000C-011, MX882000C-021 and MX882050C)
MX882000C-032	DC-HSDPA	Rx measurement of mobile terminals including call processing (requires MT8820C-001 2 sets, MT8820C-012, MX882000C, MX882000C-011, MX882000C-021, MX882000C-031, MX882010C, MX882050C)
MX882000C-033	DC-HSUPA	Tx measurement of mobile terminals including call processing (requires MT8820C-001 2 sets, MT8820C-012, MX882000C, MX882000C-011, MX882000C-021, MX882000C-031, MX882000C-032, MX882010C, MX882050C)
MX882000C-034	4C-HSDPA	Rx measurement of mobile terminals including call processing (requires MT8820C-001 2 sets, MT8820C-012, MX882000C, MX882000C-011, MX882000C-021, MX882000C-031, MX882000C-032, MX882010C, MX882050C)
MX882001C	GSM/GPRS	Tx and Rx measurements of mobile terminals including call processing (requires MT8820C-002)
MX882001C-011	EGPRS	Tx and Rx measurements of mobile terminals including call processing (requires MT8820C-002 and MX882001C)
MX882002C	CDMA2000 1X	Tx and Rx measurements of mobile terminals including call processing (requires MT8820C-003)
MX882005C	PHS	Tx and Rx measurements of mobile terminals including call processing, Tx and Rx measurements of base stations without call processing (requires MT8820C-002)

Continued on next page

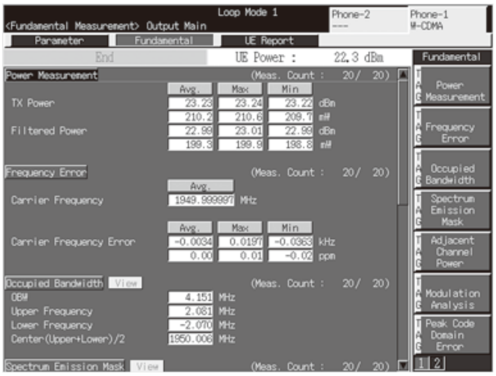
Measurement Software	System	Description
MX882005C-011	Advanced PHS	Tx and Rx measurements of mobile terminals including call processing, PHS Tx and Rx measurements of base stations without call processing (requires MT8820C-002 and MX882005C)
MX882007C	TD-SCDMA	Tx and Rx measurements of TD-SCDMA terminals including call processing (requires MT8820C-001 and MT8820C-007)
MX882007C-011	TD-SCDMA HSDPA	Tx and Rx measurements of TD-SCDMA/HSDPA terminals including call processing (requires MT8820C-001, MT8820C-007, and MX882007C)
MX882007C-012	TD-SCDMA HSDPA Evolution	Rx measurement of TD-SCDMA/HSDPA Evolution terminals including call processing (requires MT8820C-001, MT8820C-007, MX882007C and MX882007C-011)
MX882007C-021	TD-SCDMA HSUPA	Tx measurements of TD-SCDMA/HSUPA terminals including call processing (requires MT8820C-001, MT8820C-007, MX882007C, and MX882007C-011)
MX882012C	LTE FDD	Tx and Rx measurement of LTE FDD terminals including call processing (requires MT8820C-008)
MX882012C-021	LTE-Advanced FDD DL CA 2CCs	Rx measurement of LTE-Advanced FDD DL CA terminals including call processing (requires MT8820C-008 2 sets, MT8820C-012, MX882010C, and MX882012C)
MX882012C-031	LTE-Advanced FDD DL CA 3CCs	Rx measurement (SISO) of LTE-Advanced FDD DL CA 3CCs terminals including call processing (requires MT8820C 2 sets. One is required MT8820C-008 (2 sets), MT8820C-012, MX882010C, MX882012C and MX882012C-021. The other is required MT8820C-008, MX882012C)
MX882013C	LTE TDD	Tx and Rx measurement of LTE TDD terminals including call processing (requires MT8820C-008)
MX882013C-021	LTE-Advanced TDD DL CA 2CCs	Rx measurement of LTE-Advanced TDD DL CA terminals including call processing (requires MT8820C-008 2 sets, MT8820C-012, MX882010C, and MX882013C)
MX882013C-031	LTE-Advanced TDD DL CA 3CCs	RX measurement (SISO) of LTE-Advanced TDD DL CA 3CCs terminals including call processing (requires MT8820C 2 sets. One is required MT8820C-008 (2 sets), MT8820C-012, MX882010C, MX882013C and MX882013C-021. The other is required MT8820C-008, MX882013C.)
MX882032C	CDMA2000 1x	Tx measurement of CDMA2000 1x terminals excluding call processing
MX882036C	CDMA2000 1xEV-DO Rev. 0	Tx measurement of CDMA2000, 1EV-DO Rev.0 terminals excluding call processing
MX882036C-011	CDMA2000 1xEV-DO Rev. A	Tx measurement of CDMA2000, 1EV-DO Rev.A terminals excluding call processing
MX882042C	LTE FDD	Tx measurement of LTE FDD terminals excluding call processing
MX882043C	LTE TDD	Tx measurement of LTE TDD terminals excluding call processing

*: For LTE/LTE-Advanced, W-CDMA/HSPA/HSPA Evolution/DC-HSPA/4C-HSDPA, and TD-SCDMA/HSPA terminal connectivity, contact Anritsu sales representative.

Transmitter Measurement

Output Power

The MT8820C enables measuring output power of mobile stations. When the number of measurements is set to two or more, the max., mean, and min. values of the result are displayed, providing evaluation of the terminal randomness. This repeat measurement function is also available for other measurements.



```
                          Loop Mode 1          Phone-2     Phone-1
<Fundamental Measurement> Output Main          ---         W-CDMA
End                       UE Power :    22.3 dBm
Power Measurement                   (Meas. Count :  20/  20)
                        Avg.     Max      Min
 TX Power              23.23    23.24    23.22  dBm
                       210.2    210.6    209.7  mW
 Filtered Power        22.99    23.01    22.99  dBm
                       199.3    199.9    198.8  mW

Frequency Error                     (Meas. Count :  20/  20)
                        Avg.
 Carrier Frequency     1949.999997 MHz

                        Avg.     Max      Min
 Carrier Frequency Error -0.0034  0.0197  -0.0363  kHz
                        0.00     0.01    -0.02  ppm

Occupied Bandwidth  View            (Meas. Count :  20/  20)
 OBW                    4.151 MHz
 Upper Frequency        2.081 MHz
 Lower Frequency       -2.070 MHz
 Center(Upper+Lower)/2 1950.006 MHz
Spectrum Emission Mask  View        (Meas. Count :  20/  20)
```

Example of Transmission Power Measurement (HSDPA)

Modulation Analysis

The MT8820C enables modulation analysis of mobile equipment. For example in GSM, simultaneous measurement and display of frequency, frequency error (in kHz and ppm), phase error and peak phase error is performable. Amplitude error at the burst-on section can be also measured.

Occupied Frequency Bandwidth

This test measures the occupied frequency bandwidth of the W-CDMA terminal. The ratio of the frequency bandwidth to the total power can be changed in the range of 80.0 to 99.9%.

Adjacent Channel Power

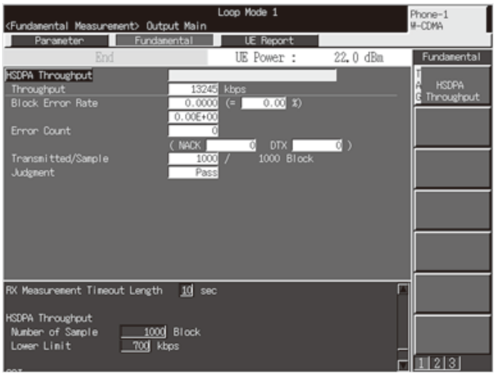
Adjacent channel power is measured according to each communication system.
In W-CDMA, the power can be measured in ±5 MHz, ±10 MHz from center frequency. In GSM, the power of 25 points can be measured in ±2 MHz from center frequency.

Spectrum Waveform Display

MT8820C has the spectrum waveform display function by W-CDMA. This function monitors the existence of the frequency ingredient with the spectrum exceeding the standard line defined by 3GPP standards.

Receiver Measurement

Measurement of the error rate conforming to the standard of each communication system is performable. For example, in HSPA Evolution, the bit error rate can be measured by the loopback test mode specified in the 3GPP standards.



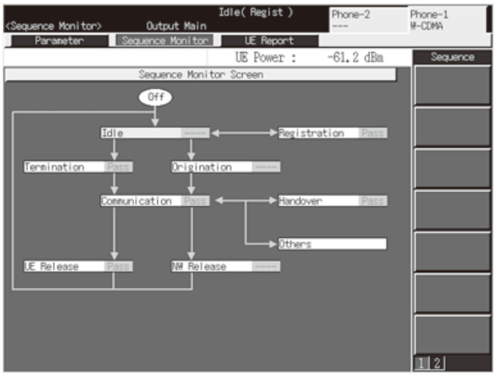
```
                          Loop Mode 1          Phone-1
<Fundamental Measurement> Output Main          W-CDMA
End                       UE Power :    22.0 dBm
HSDPA Throughput
 Throughput              13245 kbps
 Block Error Rate        0.0000 (=     0.00 %)
                       0.00E+00
 Error Count                  0
                       ( NACK        0   DTX        0 )
 Transmitted/Sample        1000 /    1000 Block
 Judgment                  Pass

RX Measurement Timeout Length  10  sec

HSDPA Throughput
 Number of Sample      1000 Block
 Lower Limit            700 kbps
```

Example of Error Rate Measurement (HSPA Evolution)

Call Processing

Connection Tests

Various connection tests*1, such as registration, origination, termination, handover, terminal disconnect, and network disconnect, can be tested using the call processing functionality. Moreover, voice from the mobile terminal can be echoed back while calling to test simple voice communications.



<Sequence Monitor> Output Main Idle(Regist)

Phone-2 ---

Phone-1 W-CDMA

UE Power : -61.2 dBm

Example of Sequence Monitor (W-CDMA)*2

*1: CDMA2000 1xEV-DO is not supported.
*2: Sequence Monitor function is supported W-CDMA and PHS.

Mobile Terminal Report Monitor

The mobile terminal status can be displayed as a periodic report sent by the mobile terminal to the MT8820C. The downlink RF signal level at the mobile receiver can be checked with the Rx level reported from the mobile terminal.

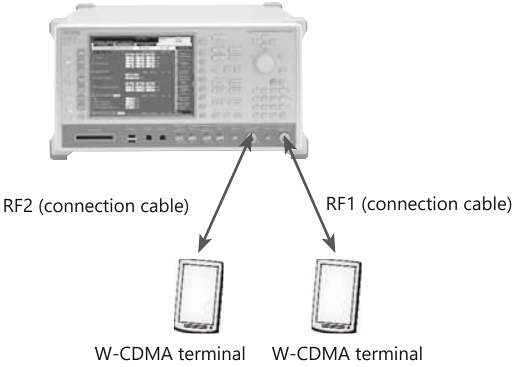
*: Excluding PHS and CDMA2000.

Parallelphone Measurement

Simultaneous Measurement of Two Mobile Terminals

Installing the Parallelphone Measurement option supports simultaneous measurement of two terminals using the second RF, AF, GPIB, or Ethernet port of a single MT8820C unit.*

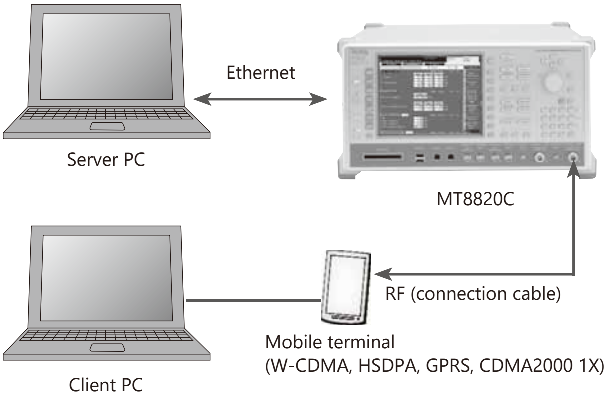
*: Since both terminal are occupied for DC-HSDPA, DC-HSUPA, 4C-HSDPA, LTE-Advanced, PPM measurement are not supported.



Packet Communication Data Transfer Test

End-to-End Data Transfer Tests

The External Packet Data option supports data transfer to/from external equipment via the Ethernet port. End-to-end Ping interconnect test between an application server connected to the MT8820C and the mobile terminal (W-CDMA, HSDPA, GPRS, CDMA2000 1X) or client PC connected to the mobile terminal can be tested using the External Packet Data option (MX882050C-002, MX882050C-011, MX882001C-002, MX882002C-002).

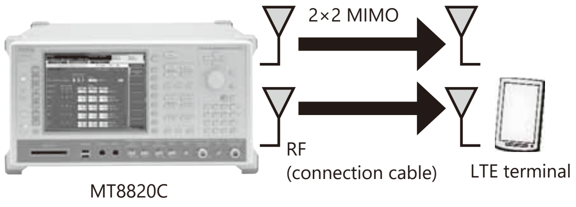


Sample MT8820C connection

*: Requires MX882050C-002, MX882050C-011, MX882001C-002, MX882002C-002

LTE 2×2 MIMO (Rx Throughput Test)

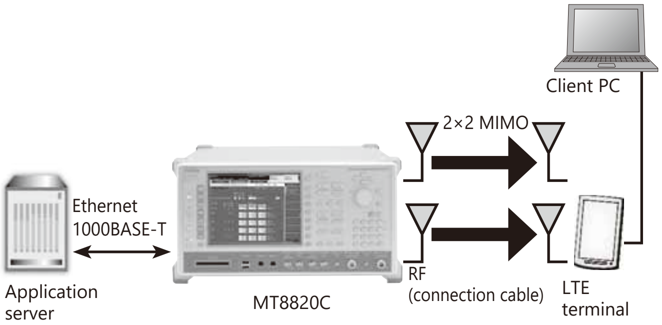
The LTE FDD 2×2 MIMO DL (LTE TDD 2×2 MIMO DL) option supports throughput measurements for 2×2 MIMO downlink signals connected with the MT8820C.



MT8820C Connection Example

IP Data Transfer Test (2×2 MIMO)

Simultaneous installation of the LTE FDD (TDD) IP Data Transfer option and the LTE FDD (TDD) 2×2 MIMO DL option supports connection with an external server and enables IP data communication at the maximum 2×2 MIMO Category 3 data rate.



MT8820C Connection Example

MX882012C-006
LTE FDD IP Data Transfer

MX882012C-011
LTE FDD 2×2 MIMO DL

MX882012C LTE FDD Measurement Software

MT8820C-008 LTE Measurement Hardware

MT8820C-012 Parallel Phone Measurement Hardware

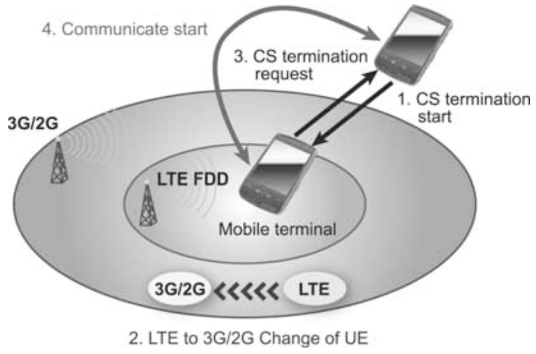
MT8820C Main frame

Example of IP Data Transfer (2×2 MIMO) Options Stack (LTE FDD)

LTE CS Fall Back Tests

LTE FDD (TDD) CS Fallback option supports simple CS Fallback tests* (Redirection base) for LTE FDD (TDD)/3G/2G terminals connected to the MT8820C.

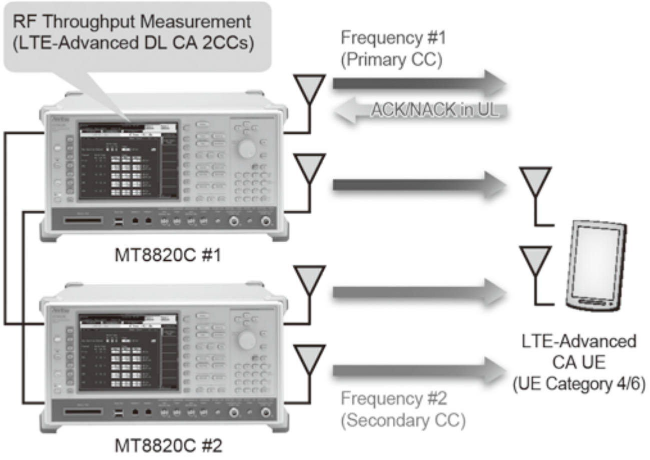
*: LTE/3G/2G mobile terminals must support CS Fallback function.
*: Support 1 port CS Fallback function.



CS Fallback Functional Image (LTE FDD)

LTE-Advanced DL CA plus MIMO (Receiver Measurement)

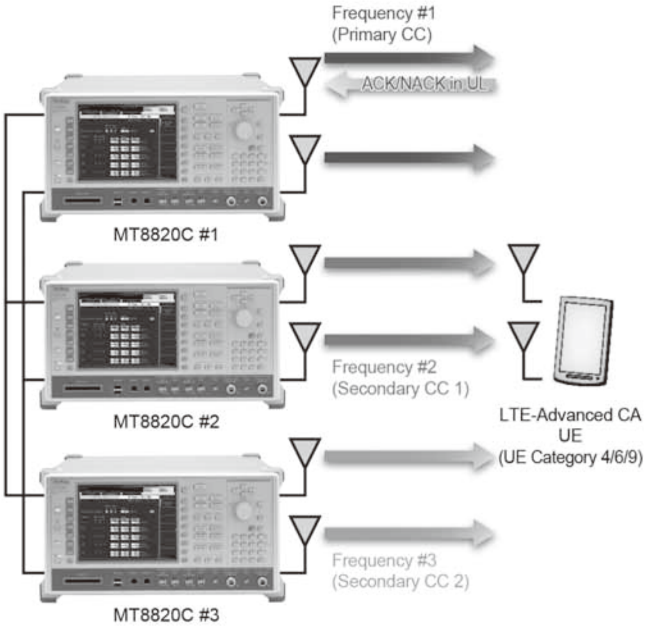
With two MT8820Cs capable of maximum throughput testing of DL CA 2CCs plus 2×2 MIMO PHY layer.



Sample MT8820C connection

*: MIMO Test requires MT8820C 2 set.
MT8820C #1 requires MT8820C-008, MT8820C-012, MX882012C (13C), MX882012C (13C)-011, and MX882012C (13C)-021.
MT8820C #2 requires MT8820C-008, MT8820C-012, MX882012C (13C), and MX882012C (13C)-011.

With three MT8820Cs capable of maximum throughput testing of LTE-Advanced FDD (TDD) DL CA 3CCs plus 2×2 MIMO PHY layer.



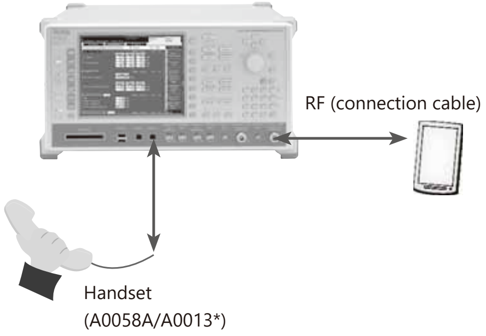
Sample MT8820C connection

*: MIMO Test requires MT8820C 3 set.
MT8820C #1 requires MT8820C-008, MT8820C-012, MX882012C (13C), MX882012C (13C)-011, MX882012C (13C)-021, and MX882012C (13C)-031.
MT8820C #2 and #3 require MT8820C-008, MT8820C-012, MX882012C (13C), and MX882012C (13C)-011.

Real-time Voice Encoding and Decoding

End-to-End Communications Test

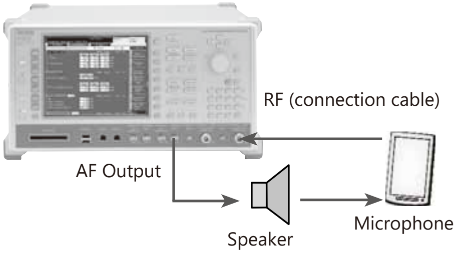
This supports the end-to-end communications test between a handset (A0058A/A0013*) connected to the RJ11 connector on the MT8820C and a mobile terminal.

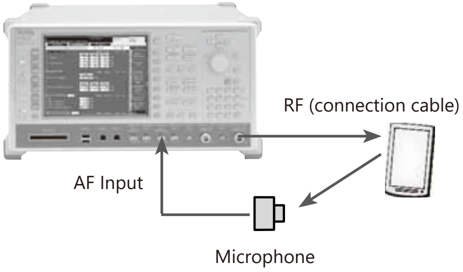


*: A0013 has been discontinued. Replacement model is A0058A.

Audio Transmitter Measurement

The tone signal from the MT8820C AF Output connector is supplied to the microphone of the mobile terminal and the audio transmitter characteristics of the mobile terminal can be measured using the MT8820C to demodulate the uplink RF signal and measure the level, frequency, and distortion of the demodulated tone signal.



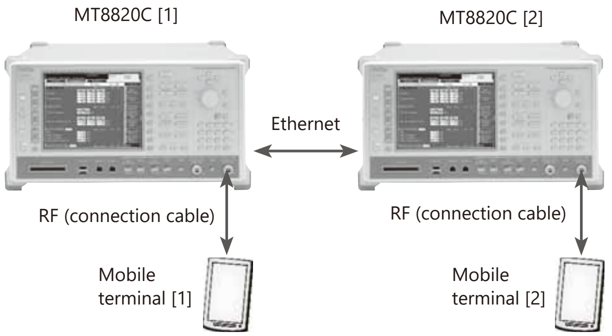


*: Requires MT8820C-011, MX882000C-001, MX882001C-001, or MX882007C-001

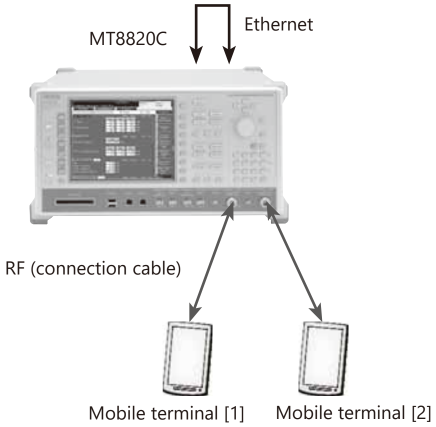
*: Audio Transmitter and Receiver Measurement supports W-CDMA, GSM, and TD-SCDMA.
CDMA Voice Codec MX882002C-001 only supports Audio Transmitter and Receiver Measurement under the condition of transmitter and receiver coexistence.

Video Phone Test

End-to-end video communication between two W-CDMA/TD-SCDMA terminals supporting a video phone can be tested via the Ethernet port in the rear panel of the MT8820C. End-to-end video communication can be tested with two MT8820C units or a single MT8820C configured with Parallelphone Measurement.



Sample MT8820C connection: when MT8820C is two sets



Sample MT8820C connection: when MT8820C is one set
(Parallelphone measurement correspondence)

*: Requires MX882050C-003 or MX882007C-003

GPIB Control

Batch Readout Command for Measured Results

All results obtained by batch measurement can be read out with the single command: “ALLMEAS?”. If required, only desired measurement results can be read out using a command such as “ALLMEAS? MOD” (modulation analysis).

The reduced number of GPIB commands cuts the overhead of both the MT8820C and control PC, increasing measurement throughput. Moreover, since the control program step size is also reduced, easy-to-read control programs with high maintainability are easily created.

Specifications

* Typical values are only for reference and are not guaranteed specifications.

Radio Communication Analyzer MT8820C

General		Frequency range: 30 MHz to 2.7 GHz 3.4 GHz to 3.8 GHz (with MT8820C-018) Max. input level: +35 dBm (Main) Main I/O Impedance: 50Ω VSWR: ≤1.2 (<1.6 GHz), ≤1.25 (1.6 GHz to 2.2 GHz), ≤1.3 (>2.2 GHz) Connector: N type AUX output Impedance: 50Ω VSWR: ≤1.3 (at SG Output level: ≤–10 dBm) Connector: SMA type Reference oscillator Frequency: 10 MHz Level: TTL Startup characteristics: ≤±5 × 10^{-8} (at 10 min. after startup referenced to frequency 24 h after startup) Aging rate: ≤±2 × 10^{-8}/day, ≤±1 × 10^{-7}/year (referenced to frequency 24 h after startup) Temperature characteristics: ≤±5 × 10^{-8} Connector: BNC type External reference input Frequency: 10 MHz or 13 MHz (±1 ppm) Level: ≥0 dBm Impedance: 50Ω Connector: BNC type
RF Signal Generator		Frequency Frequency range: 30 MHz to 2.7 GHz (Setting range: 400 kHz to 2.7 GHz) 3.4 GHz to 3.8 GHz (with MT8820C-018) Setting resolution: 1 Hz Accuracy: Due to reference oscillator accuracy Output level Level range: –140 to –10 dBm (Main), –130 to 0 dBm (AUX) Resolution: 0.1 dB Accuracy Main: ±1.0 dB, ±0.7 dB (typ.) (Output frequency: ≥50 MHz), ±1.5 dB (Output frequency: <50 MHz) (–120 to –10 dBm, after calibration, at 10° to 40°C) AUX: ±1.0 dB, ±0.7 dB (typ.) (Output frequency: ≥50 MHz), ±1.5 dB (Output frequency: <50 MHz) (–110 to 0 dBm, after calibration, at 10° to 40°C) Signal purity Non-harmonic spurious: ≤–40 dBc (Offset frequency: ≥100 kHz) Harmonics: ≤–25 dBc Uninterrupted level variation Variable range: –30 to 0 dB Setting resolution: 1 dB
Others		Display Color 8.4-inch TFT LCD, 640 × 480 dots External control GPIB: Control from external host with main unit as device (excluding some functions such as power-on), No external device control Interface functions: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2 Ethernet (100Base-TX/10Base-T): Controlled by an external controller, assuming the MT8820C as a device (except some functions such as power switch etc.). No controller function
Power Supply		100 V(ac) to 120 V(ac)/200 V(ac) to 240 V(ac)*, 50 Hz/60 Hz, ≤300 VA (Option 001 installed), ≤750 VA (with all Options)
Dimensions and Mass		426 (W) × 221.5 (H) × 498 (D) mm (excluding projections), ≤30 kg (with all Options)
Temperature and Humidity Range		Operating: 0° to +50°C, ≤95% (no condensation) Storage: –20° to +60°C, ≤85% (no condensation)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

*: Operating voltage: within the range of +10% to –15% from the rated voltage.

W-CDMA Measurement Hardware MT8820C-001, W-CDMA Measurement Software MX882000C, W-CDMA Call Processing Software MX88205xC

Modulation Analysis	Frequency range: 300 MHz to 2.7 GHz Input level: –30 to +35 dBm (Main) Carrier frequency accuracy: ± (Setting frequency × Reference oscillator accuracy + 10 Hz) Modulation accuracy (residual vector error): ≤2.5% (at input of single DPCCH and single DPDCH)
RF Power	Frequency range: 300 MHz to 2.7 GHz Input level: –65 to +35 dBm (Main) Measurement accuracy: ±0.3 dB (typ.), ±0.5 dB (–25 to +35 dBm), ±0.7 dB (–55 to –25 dBm), ±0.9 dB (–65 to –55 dBm) *After calibration, at 10° to 40°C Linearity: ±0.2 dB (–40 to 0 dB, ≥–55 dBm), ±0.4 dB (–40 to 0 dB, ≥–65 dBm) Measurement object: DPCH, PRACH
Occupied Bandwidth	Frequency range: 300 MHz to 2.7 GHz Input level: –10 to +35 dBm (Main)
Adjacent Channel Leakage Power	Frequency range: 300 MHz to 2.7 GHz Input level: –10 to +35 dBm (Main) Measurement point: ±5 MHz, ±10 MHz Measurement range: ≥50 dB (at ±5 MHz), ≥55 dB (at ±10 MHz)
RF Signal Generator	Output frequency range: 300 MHz to 2.7 GHz, 1 Hz step Channel level CPICH, P-CCPCH, SCH, PICH, DPCH, S-CCPCH, AICH: Off, –30 to 0 dB [0.1 dB step, relative level for Ior (total level)] OCNS: Off, Auto-setting Channel level accuracy: ±0.2 dB [relative level accuracy for Ior (total level)] AWGN level: Off, –20 to +5 dB [0.1 dB step, relative level for Ior (total level)] AWGN level accuracy: ±0.2 dB [relative level accuracy for Ior (total level)]
Error Rate Measurement	Function: Applying PN9 or PN15 pattern DTCH Measurement items: BER, BLER Measurement object: Loopback data imposed on DTCH (BER, BLER), serial data input from rear panel call processing I/O port (BER)
Call Processing	Call control: Location registration, Call origination, Call termination, Handover, Network-side release, Terminal-side release (executes each processing conforming to 3GPP standards and performs pass/fail evaluation) Mobile terminal control: Output level, Loopback (executes each terminal control conforming to 3GPP standards)

HSDPA Measurement Software MX882000C-011

RF Power	Frequency range: 300 MHz to 2.7 GHz Input level: –65 to +35 dBm (Main) Measurement accuracy: ±0.3 dB (typ.), ±0.5 dB (–25 to +35 dBm), ±0.7 dB (–55 to –25 dBm), ±0.9 dB (–65 to –55 dBm) *After calibration, at 10° to 40°C Linearity: ±0.2 dB (–40 to 0 dB, ≥–55 dBm), ±0.4 dB (–40 to 0 dB, ≥–65 dBm) Measurement object: DPCH, HS-DPCCH
Throughput Measurement	Functions: Transmit HS-SCCH, HS-PDSCH based on Fixed Reference Channel Measurement items: BLER, Throughput Measurement object: ACK and NACK data imposed on HS-DPCCH
CQI Measurement	Functions: Periodically reported CQI value applied to HS-DPCCH
Call Processing	Call control: Location registration, Connection based on Fixed Reference Channel (executes each processing conforming to 3GPP standards and performs pass/fail evaluation) Mobile terminal control: Output level (executes each terminal control conforming to 3GPP standards)

HSDPA High Data Rate MX882000C-013

Throughput Measurement	Functions: Transmit HS-SCCH, HS-PDSCH based on Fixed Reference Channel (H-Set 6) Transmit HS-SCCH, HS-PDSCH based on HSDPA full rate for Category 6, 8, 9, and 10 Measurement items: BLER, Throughput Measurement object: ACK and NACK data imposed on HS-DPCCH
Call Processing	Call control: Fixed Reference Channel (H-Set 6), Connection based on HSDPA full rate for Category 6, 8, 9, and 10 (executes each processing conforming to 3GPP standards and performs pass/fail evaluation)

HSUPA Measurement Software MX882000C-021

RF Power	Frequency range: 300 MHz to 2.7 GHz Input level: –65 to +35 dBm (Main) Measurement accuracy: ±0.3 dB (typ.), ±0.5 dB (–25 to +35 dBm), ±0.7 dB (–55 to –25 dBm), ±0.9 dB (–65 to –55 dBm) *After calibration, at 10° to 40°C Linearity: ±0.2 dB (–40 to 0 dB, ≥–55 dBm), ±0.4 dB (–40 to 0 dB, ≥–65 dBm) Measurement object: DPCH, HS-DPCCH, E-DPCCH, E-DPDCH
Call Processing	Call control: Location registration, Connection for E-DCH RF Test (executes each processing conforming to 3GPP standards and performs pass/fail evaluation) Mobile terminal control: Output level (executes each terminal control conforming to 3GPP standards)

HSPA Evolution Measurement Software MX882000C-031

Throughput Measurement	Functions: Transmit HS-SCCH, HS-PDSCH based on Fixed Reference Channel (H-Set 8) Transmit HS-SCCH, HS-PDSCH based on HSDPA full rate for Category 13 and 14 Measurement items: BLER, Throughput Measurement object: ACK and NACK data imposed on HS-DPCCH
Call Processing	Call control: Fixed Reference Channel (H-Set 8) HSDPA Full Rate (Category 13 and Category 14) and E-DCH RF Test (16QAM) (executes operation conforming to 3GPP standards and performs Pass/Fail evaluation)

DC-HSDPA Measurement Software MX882000C-032

Throughput Measurement	Functions: Transmit HS-SCCH and HS-PDSCH based on Fixed Reference Channel Measurement items: BLER, Throughput Measurement object: ACK and NACK applied to HS-DPCCH
CQI Measurement	Measurement object: Periodic CQI reports from UE over HS-DPCCH
Call Processing	Call control: Fixed Reference Channel (H-Set 1A, H-Set 8A, H-Set 12) and at Full Rate from Category 22 and Category 24 HSDPA mobile terminals (executes operation conforming to 3GPP standards and performs Pass/Fail evaluation)

DC-HSUPA Measurement Software MX882000C-033

RF Power	Frequency range: 300 MHz to 2.7 GHz Input level: –65 to +35 dBm (Main) Measurement accuracy: ±0.3 dB (typ.), ±0.5 dB (–25 to +35 dBm), ±0.7 dB (–55 to –25 dBm), ±0.9 dB (–65 to –55 dBm) *After calibration, at 10° to 40°C Linearity: ±0.2 dB (–40 to 0 dB, ≥–55 dBm), ±0.4 dB (–40 to 0 dB, ≥–65 dBm) Measurement object: DPCH, HS-DPCCH, E-DPCCH, E-DPDCH
Call Processing	Call control: Location registration, E-DCH RF Test (executes operation conforming to 3GPP standards and performs Pass/Fail evaluation) UE control: Output level (UE control conforming to the 3GPP standards can be performed)

4C-HSDPA Measurement Software MX882000C-034

Throughput Measurement	Functions: Transmit HS-SCCH and HS-PDSCH based on Fixed Reference Channel Transmit HS-SCCH and HS-PDSCH according to HSDPA Full Rate of Category 22, 24, 29, and 31 Measurement items: BLER, Throughput Measurement object: ACK and NACK applied to HS-DPCCH
CQI Measurement	Measurement object: Periodic CQI reports from UE over HS-DPCCH
Call Processing	Call control: Fixed Reference Channel (H-Set 1A, H-Set 8A, H-Set 12, H-Set 1B, H-Set 8B, H-Set 1C, H-Set 8C) and HSDPA Full Rate (Category 22, 24, 29, and 31) (executes operation conforming to 3GPP standards and performs Pass/Fail evaluation)

Audio Board MT8820C-011, W-CDMA Voice Codec MX882000C-001

Voice Codec	AMR 12.2 kbps
Codec Level Adjustment	Encoder input gain: –3 to +3 dB, 0.01 dB step Handset microphone volume: 0, 1, 2, 3, 4, 5 Handset speaker volume: 0, 1, 2, 3, 4, 5
AF Output	Frequency range: 30 Hz to 10 kHz, 1 Hz step Level setting range: 0 to 5 Vpeak (AF output) Level setting resolution: 1 mV (≤5 Vpeak), 100 µV (≤500 mVpeak), 10 µV (≤50 mVpeak) Level accuracy: ±0.2 dB (≥10 mVpeak, ≥50 Hz), ±0.3 dB (≥10 mVpeak, <50 Hz) Waveform distortion ≤30 kHz bandwidth: ≤–60 dB (≥500 mVpeak, ≤5 kHz), ≤–54 dB (≥70 mVpeak) Output impedance: ≤1Ω Max. Output current: 100 mA
AF Input	Frequency range: 50 Hz to 10 kHz Level range: 1 mVpeak to 5 Vpeak (AF input) Max. allowable Input level: 30 Vrms Input impedance: 100 kΩ
Frequency Measurement	Accuracy: ± (Reference oscillator accuracy + 0.5 Hz)
Level Measurement	Accuracy: ±0.2 dB (≥10 mVpeak, ≥50 Hz), ±0.4 dB (≥1 mVpeak, ≥1 kHz)
SINAD Measurement	Frequency: at 1 kHz ≥60 dB (≥1000 mVpeak), ≥54 dB (>50 mVpeak), ≥46 dB (≥10 mVpeak)
Distortion Rate Measurement	Frequency: at 1 kHz ≤–60 dB (≥1000 mVpeak), ≤–54 dB (>50 mVpeak), ≤–46 dB (≥10 mVpeak)

TDMA Measurement Hardware MT8820C-002, GSM Measurement Software MX882001C

Modulation Analysis	Frequency range: 300 MHz to 2.7 GHz Input level: –30 to +40 dBm (average power of burst signal, Main) Measurement object: Normal burst, RACH Carrier frequency accuracy: ± (Setting frequency × Reference oscillator accuracy + 10 Hz), Normal burst measurement ± (Setting frequency × Reference oscillator accuracy + 20 Hz), RACH measurement Residual phase error: ≤0.5° rms, ≤2° peak
RF Power	Frequency range: 300 MHz to 2.7 GHz Input level: –30 to +40 dBm (average power of burst signal, Main) Measurement object: Normal burst, RACH Measurement accuracy: ±0.3 dB (typ.), ±0.5 dB (–20 to +40 dBm), ±0.7 dB (–30 to –20 dBm) *After calibration, at 10° to 40°C Linearity: ±0.2 dB (–40 to 0 dB, ≥–30 dBm) Carrier-off power: ≥65 dB (≥–10 dBm), ≥45 dB (–30 to –10 dBm)
Output RF Spectrum	Frequency range: 300 MHz to 2.7 GHz Input level: –10 to +40 dBm (average power of burst signal, Main) Measurement object: Normal burst Measurement range in modulation area: (averaged over 10 measurements) ≤–55 dB (≤250 kHz offset), ≤–66 dB (≥400 kHz offset) Measurement range in transient area: ≤–57 dB (≥400 kHz offset) Measurement points: ±100, ±200, ±250, ±400, ±600, ±800, ±1000, ±1200, ±1400, ±1600, ±1800, ±2000 kHz
RF Signal Generator	Output frequency range: 300 MHz to 2.7 GHz, 1 Hz step Phase error: ≤1° rms, ≤4° peak TCH data: PN9, PN15, All 0, All 1, fixed pattern (PAT 0 - PAT 9)

Continued on next page

Error Rate Measurement	Functions: frame, bit, and CRC error measurement Measurement object: Loopback date imposed on uplink TCH Serial data input from rear panel call processing I/O port Number of blocks received from terminal imposed on uplink TCH for GPRS Number of USF blocks received from terminal for GPRS
Call Processing	Call control GSM: Location registration, Call origination, Call termination, Network-side termination, Terminal-side termination GPRS: Connection, Termination, Data transfer Mobile terminal control GSM: Output level, Time slot, Timing advance, Loopback On/Off GPRS: Test Mode Channel coding: FS, EFS, HS0, HS1, AFS, AHS0, AHS1 Coding scheme: CS-1, CS-2, CS-3, CS-4 Frequency bands: GSM450, GSM480, GSM710, GSM750, T-GSM810, GSM850, P-GSM, E-GSM, R-GSM, DCS1800, PCS1900

EGPRS Measurement Software MX882001C-011

Modulation Analysis	Frequency range: 300 MHz to 2.7 GHz Input level: –30 to +40 dBm (average power of burst signal, Main) Measurement object: Normal burst (GMSK, 8PSK), RACH Carrier frequency accuracy: ± (Setting frequency x Reference oscillator accuracy + 10 Hz), Normal burst measurement ± (Setting frequency x Reference oscillator accuracy + 20 Hz), RACH measurement Residual phase error (GMSK) : ≤0.5° rms, ≤2° peak Residual EVM (8PSK): ≤1.5% rms
RF Power	Frequency range: 300 MHz to 2.7 GHz Input level: –30 to +40 dBm (average power of burst signal, Main) Measurement object: Normal burst (GMSK, 8PSK), RACH Measurement accuracy: ±0.3 dB (typ.), ±0.5 dB (–20 to +40 dBm), ±0.7 dB (–30 to –20 dBm) *After calibration, at 10° to 40°C Linearity: ±0.2 dB (–40 to 0 dB, ≥–30 dBm) Carrier-off power: ≥65 dB (≥–10 dBm), ≥45 dB (–30 to –10 dBm)
Output RF Spectrum	Frequency range: 300 MHz to 2.7 GHz Input level: –10 to +40 dBm (average power of burst signal, Main) Measurement object: Normal burst (GMSK, 8PSK) Measurement range in modulation area (averaged over 10 measurements): ≤–55 dB (≤250 kHz offset), ≤–66 dB (≥400 kHz offset) Measurement range in transient area: ≤–57 dB (≥400 kHz offset) Measurement points: ±100, ±200, ±250, ±400, ±600, ±800, ±1000, ±1200, ±1400, ±1600, ±1800, ±2000 kHz
RF Signal Generator	Output frequency range: 300 MHz to 2.7 GHz, 1 Hz step Phase error (GMSK): ≤1° rms, ≤4° peak Modulation accuracy (8PSK): ≤3% rms TCH data: PN9, PN15, All 0, All 1, Fixed pattern (PAT 0 - PAT 9)
Error Rate Measurement	Functions: bit error measurement Measurement object: Loopback date imposed on uplink TCH (GMSK, 8PSK) Number of blocks received from terminal imposed on uplink TCH for EGPRS Number of USF blocks received from terminal for EGPRS
Call Processing	Call control: Location registration, Connection, Termination, Data transfer Mobile terminal control: Output level, Time slot, Timing advance, Test Mode Coding scheme: MCS-1 to MCS-9 Puncturing scheme: P1, P2, P3

Audio Board MT8820C-011, GSM Voice Codec MX882001C-001

Voice Codec	GSM_EFR, GSM_AMR
Codec Level Adjustment	Encoder input gain: –3 to +3 dB, 0.01 dB step Handset microphone volume: 0, 1, 2, 3, 4, 5 Handset speaker volume: 0, 1, 2, 3, 4, 5
AF Output	Frequency range: 30 Hz to 10 kHz, 1 Hz step Level setting range: 0 to 5 Vpeak (AF output) Level setting resolution: 1 mV (≤5 Vpeak), 100 µV (≤500 mVpeak), 10 µV (≤50 mVpeak) Level accuracy: ±0.2 dB (≥10 mVpeak, ≥50 Hz), ±0.3 dB (≥10 mVpeak, <50 Hz) Waveform distortion: ≤–60 dB (≥500 mVpeak, ≤5 kHz), ≤–54 dB (≥70 mVpeak) Output impedance: ≤1Ω Max. output current: 100 mA
AF Input	Frequency range: 50 Hz to 10 kHz Level range: 1 mVpeak to 5 Vpeak (AF input) Max. allowable Input level: 30 Vrms Input impedance: 100 kΩ
AF Frequency Measurement	Accuracy: ± (Reference oscillator accuracy + 0.5 Hz)
AF Level Measurement	Accuracy: ±0.2 dB (≥10 mVpeak), ±0.4 dB (≥1 mVpeak, ≥1 kHz)
AF SINAD Measurement	Frequency: at 1 kHz, BW ≤30 kHz ≥60 dB (≥1000 mVpeak), ≥54 dB (>50 mVpeak), ≥46 dB (≥10 mVpeak)
AF Distortion Rate Measurement	Frequency: at 1 kHz, BW ≤30 kHz ≤–60 dB (≥1000 mVpeak), ≤–54 dB (>50 mVpeak), ≤–46 dB (≥10 mVpeak)

CDMA2000 Measurement Hardware MT8820C-003, CDMA2000 Measurement Software MX882002C

The function for outputting and measuring the AF signal can be used when installing the MT8820C-011 Audio Board.

Modulation Analysis	Frequency range: 300 MHz to 2.7 GHz Input level: –30 to +35 dBm (Main) Carrier frequency accuracy: ± (Setting frequency × Reference oscillator accuracy + 10 Hz) Modulation accuracy Residual waveform quality: >0.999
RF Power	Input level: –65 to +35 dBm (Main) Measurement accuracy: ±0.3 dB (typ.), ±0.5 dB (–25 to +35 dBm), ±0.7 dB (–55 to –25 dBm), ±0.9 dB (–65 to –55 dBm) ∗Filtered Power measurement, after calibration, at 10° to 40°C Linearity: ±0.2 dB (–40 to 0 dB, ≥–55 dBm), ±0.4 dB (–40 to 0 dB, ≥–65 dBm) (Filtered Power measurement, Input Level setting for reference)
Occupied Bandwidth	Input level: –10 to +35 dBm (Main)
Code Domain Power Measurement	At Reverse RC3, RC4 Input level: –30 to +35 dBm (Main) Measurement accuracy: ±0.2 dB (Code power ≥–15 dBc), ±0.4 dB (Code power ≥–23 dBc)
RF Signal Generator	Output frequency range: 300 MHz to 2.7 GHz, 1 Hz step Channel level Pilot Channel: –30 to 0 dB, 0.25 dB step or Off SYNCH, PCH: –30 to 0 dB, 0.25 dB step or Off QPCH (Relative level to Pilot Channel): –5 to +2 dB, 1 dB step or Off FCH, DCCH, SCH: –30 to 0 dB, 0.1 dB step or Off OCNS: Auto (0.1 dB step) or Off Channel level accuracy: <±0.2 dB typ. (≥–20 dB) PN offset: 0 to 511 can be set. Waveform quality: >0.99 (Pilot only, AWGN Off) AWGN level: Off, –40 to +12 dB (relative level for CDMA signal) Max. Output level at AWGN ON: –28 dBm (Main Output), –18 dBm (AUX Output)
Error Rate Measurement	Functions: FER measurement with Service Option 2, 9, 55, and 32 (TDSO) Display items: FER, Confidence level, Sample frame count, Error frame count
Call Processing	Band Class: BC 0 to 12, 14, 15, 18, 19, 20, 21 Call control: Registration, MS Call origination, NW Call origination, NW Call disconnection, MS Call disconnection Radio Configuration: F-RC1+R-RC1, F-RC2+R-RC2, F-RC3+R-RC3, F-RC4+R-RC3, F-RC5+R-RC4 Service Option: SO1, 2, 3, 9, 32, 33, 55, 32768 PCH Data Rate: Full QPCH Data Rate: Full Fwd. FCH Data Rate: Full, Half, Quarter, Eighth (RC1 to 5) Fwd. FCH Walsh Code: 10, 14, 26, 30, 42, 46, 58, 62 Fwd. DCCH Data Rate: Full (RC3 to 5) Fwd. DCCH Walsh Code: 10, 14, 26, 30, 42, 46, 58, 62 Fwd. SCH: Max. 1 channel Fwd. SCH Data Rate RC3: 9.6, 19.2, 38.4, 76.8, 153.6 kbps RC4: 9.6, 19.2, 38.4, 76.8, 153.6 kbps RC5: 14.4, 28.8, 57.6, 115.2, 230.4 kbps Access Probe: Access Channel Rev. Closed Loop Power Control modes: Closed Loop, Alternate, All 0 (All up), All 1 (All down) Protocols: IS-95B, J-STD-008C, ARIB T-53, Korean PCS, IS-2000 (SR1) Handoff: Universal Handoff, Band Class/Channel Handoff, Protocol Revision Handoff, RC/SO Handoff
AF Output	Frequency range: 30 Hz to 10 kHz Set Resolution: 1 Hz Frequency accuracy: ± (Setting frequency × Reference oscillator accuracy + 0.1 Hz) Level setting range: 0 to 5 Vpeak (AF output) Level setting resolution: 1 mV (≤5 Vpeak), 100 µV (≤500 mVpeak), 10 µV (≤50 mVpeak) Level accuracy: ±0.2 dB (≥10 mVpeak, ≥50 Hz), ±0.3 dB (≥10 mVpeak, <50 Hz) Waveform distortion: ≤30 kHz bandwidth ≤–60 dB (≥500 mVpeak, ≤5 kHz), ≤–54 dB (≥70 mVpeak) Output impedance: ≤1Ω Max. Output current: 100 mA
AF Input	Frequency range: 50 Hz to 10 kHz Level range: 1 mVpeak to 5 Vpeak (AF input) Max. allowable Input level: 30 Vrms Frequency accuracy: ± (Reference oscillator accuracy + 0.5 Hz) Level accuracy: ±0.2 dB (≥10 mVpeak), ±0.4 dB (≥1 mVpeak, ≥1 kHz) SINAD measurement at 1 kHz: ≥60 dB (≥1000 mVpeak), ≥54 dB (>50 mVpeak), ≥46 dB (≥10 mVpeak) Distortion rate measurement at 1 kHz: ≤–60 dB (≥1000 mVpeak), ≤–54 dB (>50 mVpeak), ≤–46 dB (≥10 mVpeak) Input impedance: 100 kΩ

Audio Board MT8820C-011, CDMA2000 Voice Codec MX882002C-001

Voice Codec	EVRC (SO3)
Codec Level Adjustment	Encoder input gain: –3 to +3 dB, 0.01 dB step Handset microphone volume: 0, 1, 2, 3, 4, 5 Handset speaker volume: 0, 1, 2, 3, 4, 5

∗: MX882002C-001 only supports Audio Transmitter and Receiver Measurement under the condition of transmitter and receiver coexistence.

TDMA Measurement Hardware MT8820C-002, PHS Measurement Software MX882005C

Modulation Analysis	Frequency range: 300 MHz to 2.7 GHz Input level (average power in burst): –30 to +40 dBm (Main) (Measurement object: PS-TCH, PS-SYNC, CS-TCH, CS-SYNC) –30 to +35 dBm (Main) (Measurement object: Continuous wave) Carrier frequency accuracy: ± (Setting frequency × Reference oscillator accuracy + 10 Hz) Modulation accuracy: ± (indicated value of 2% + 0.7%) Origin offset: ±0.5 dB to single level of –30 dBc Bit rate: ±1 ppm (Measurement range: 384 kbps ±100 ppm)
RF Power	Frequency range: 300 MHz to 2.7 GHz Input level (average power in burst): –30 to +40 dBm (Main) (Measurement object: PS-TCH, PS-SYNC, CS-TCH, CS-SYNC) –30 to +35 dBm (Main) (Measurement object: Continuous wave) Measurement accuracy: ±0.5 dB (–20 to +40 dBm), ±0.7 dB (–30 to –20 dBm) ∗After calibration, at 10° to 40°C Linearity: ±0.2 dB (–40 to 0 dB, ≥–30 dBm) Carrier-off power measurement: ≥55 dB ≥ (RF power [dBm] + 70) dB (Wide dynamic range power measurement)
Occupied Bandwidth	Frequency range: 300 MHz to 2.7 GHz Input level: (average power in burst) –10 to +40 dBm (Burst average power, Main) (Measurement object: PS-TCH, PS-SYNC, CS-TCH, CS-SYNC) –10 to +35 dBm (Burst average power, Main) (Measurement object: Continuous wave)
Adjacent Channel Leakage Power	Frequency range: 300 MHz to 2.7 GHz Input level: –10 to +40 dBm (Burst average power, Main) (Measurement object: PS-TCH, PS-SYNC, CS-TCH, CS-SYNC) –10 to +35 dBm (Burst average power, Main) (Measurement object: Continuous wave) Measurement range: ≤–60 dB (±600 kHz offset), ≤–65 dB (±900 kHz offset)
RF Signal Generator	Output frequency range: 300 MHz to 2.7 GHz, 1 Hz step Modulation accuracy: ≤3% rms Modulation data Output continuous wave: PN9, PN15
Error Rate Measurement	Function: BER measurement Measurement object: serial data input from rear panel call processing I/O port
Call Processing	Call control: Location registration, Call origination, Call termination, Communication, Network-side release, Terminal-side release, Handover

Advanced PHS Measurement Software MX882005C-011

Measuring Object	Same performance as MX882005C PHS Measurement Software Measurement objects are as follows: Measurement object: PS-TCH (π/4 DQPSK, π/2 DBPSK, 8PSK, 16QAM) PS-SYNC (π/4 DQPSK, π/2 DBPSK) PS-SCCH (π/2 DBPSK) CS-TCH (π/4 DQPSK, π/2 DBPSK, 8PSK, 16QAM) CS-SYNC (π/4 DQPSK, π/2 DBPSK) (For modulation measurement, guaranteed only when no bias in symbol point, when measurement object modulation type is 16QAM)
Call Processing	Call control: Location registration, Call origination, Call termination, Communication, Network-side release, Terminal-side release, Handover (in π/4 DQPSK, π/2 DBPSK)

W-CDMA Measurement Hardware MT8820C-001, TD-SCDMA Measurement Hardware MT8820C-007, TD-SCDMA Measurement Software MX882007C

Modulation Analysis	Frequency range: 300 MHz to 2.7 GHz Input level: –30 to +35 dBm (Main) Carrier frequency accuracy: ± (Setting frequency × Reference oscillator accuracy + 10 Hz) Modulation accuracy (residual vector error): ≤2.5% (at single code input)
RF Power	Frequency range: 300 MHz to 2.7 GHz Input level: –70 to +35 dBm (Main) Measurement accuracy: ±0.3 dB (typ.), ±0.5 dB (–25 to +35 dBm), ±0.7 dB (–55 to –25 dBm), ±0.9 dB (–70 to –55 dBm) ∗After calibration, at 10° to 40°C Linearity: ±0.2 dB (–40 to 0 dB, ≥–55 dBm), ±0.4 dB (–40 to 0 dB, ≥–65 dBm) Measurement object: DPCH, UpPCH
Occupied Bandwidth	Frequency range: 300 MHz to 2.7 GHz Input level: –10 to +35 dBm (Main)
Adjacent Channel Leakage Power	Frequency range: 300 MHz to 2.7 GHz Input level: –10 to +35 dBm (Main) Measurement point: ±1.6 MHz, ±3.2 MHz Measurement range: ≥50 dB at ±1.6 MHz, ≥55 dB at ±3.2 MHz
RF Signal Generator	Output frequency range: 300 MHz to 2.7 GHz, 1 Hz step Channel level DPCH: –30 to 0 dB [0.1 dB step, Relative level for Ior (total level)] Channel level accuracy: ±0.2 dB (Relative level accuracy for Ior) AWGN level: Off, –20 to +5 dB [0.1 dB step, Relative level for Ior (total level)] AWGN level accuracy: ±0.2 dB (Relative level accuracy for Ior)
Error Rate Measurement	Measurement items: BER, BLER Measurement object: Loopback data imposed on DTCH (PN9, PN15)
Call Processing	Call control: Location registration, Call origination, Call termination, Network-side release, Terminal-side release (executes each processing conforming to 3GPP standards and performs pass/fail evaluation) Mobile terminal control: Output level, Loopback (executes each terminal control conforming to 3GPP standards)

TD-SCDMA HSDPA Measurement Software MX882007C-011

Reference Channel	Transferring RMC 0.5 Mbps UE Class (QPSK), RMC 1.1 Mbps UE Class (QPSK), RMC 1.1 Mbps UE Class (16QAM), RMC 1.6 Mbps UE Class (QPSK), RMC 1.6 Mbps UE Class (16QAM), RMC 2.2 Mbps UE Class (QPSK), RMC 2.2 Mbps UE Class (16QAM), RMC 2.8 Mbps UE Class (QPSK), RMC 2.8 Mbps UE Class (16QAM)
Throughput Measurement	Functions: Transferring HS-SCCH and HS-PDSCH according to fixed reference channel Measurement item: Throughput Measurement object: ACK and NACK applied to HS-SICH
CQI Measurement	Functions: Statistical analysis of CQI values reported from a mobile terminal on HS-SICH
Call Processing	Call control: Location registration, Fixed reference channel (executes each processing conforming to 3GPP standards and performs pass/fail evaluation) Mobile terminal control: Output level (executes each terminal control conforming to 3GPP standards)

W-CDMA Measurement Hardware MT8820C-001, TD-SCDMA Measurement Hardware MT8820C-007
TD-SCDMA HSDPA Evolution Measurement Software MX882007C-012

Reference Channel	Transferring RMC Category 16-18UE (64QAM), RMC Category 19-21UE (64QAM), RMC Category 22-24UE (64QAM), RMC Category 18 Max, RMC Category 21 Max, and RMC Category 24 Max
Throughput Measurement	Functions: Transferring HS-SCCH and HS-PDSCH according to fixed reference channel Measurement item: Throughput Measurement object: ACK and NACK applied to HS-SICH
CQI Measurement	Measurement object: Periodically reported CQI value applied to HS-SICH
Call Processing	Call control: Location registration, Fixed reference channel (Execution of the operation conforming to the 3GPP standard and pass/fail judgment can be performed.) Mobile terminal control: Output level (UE control conforming to the 3GPP standard can be performed.)

TD-SCDMA HSUPA Measurement Software MX882007C-021

Call Processing	Origination control: Location registration, FRC1, FRC2 (executes each processing conforming to 3GPP standards and performs pass/fail evaluation) Mobile terminal control: Output level (executes each terminal control conforming to 3GPP standards)

Audio Board MT8820C-011, TD-SCDMA Voice Codec MX882007C-001

Voice Codec	AMR 12.2 kbps
Codec Level Adjustment	Encoder input gain: –3 to +3 dB, 0.01 dB step Handset microphone volume: 0, 1, 2, 3, 4, 5 Handset speaker volume: 0, 1, 2, 3, 4, 5
AF Output	Frequency range: 30 Hz to 10 kHz, 1 Hz resolution Frequency accuracy: ± (Setting frequency × Reference oscillator accuracy + 0.1 Hz) Level setting range: 0 to 5 Vpeak (AF output) Level setting resolution: 1 mV (≤5 Vpeak), 100 μV (≤500 mVpeak), 10 μV (≤50 mVpeak) Level accuracy: ±0.2 dB (≥10 mVpeak, ≥50 Hz), ±0.3 dB (≥10 mVpeak, <50 Hz) Waveform distortion ≤30 kHz bandwidth: ≤–60 dB (≥500 mVpeak, ≤5 kHz), ≤–54 dB (≥70 mVpeak) Output impedance: ≤1Ω Max. Output current: 100 mA
AF Input	Frequency range: 50 Hz to 10 kHz Level range: 1 mVpeak to 5 Vpeak (AF input) Max. allowable input voltage: 30 Vrms Input impedance: 100 kΩ
AF Frequency Measurement	Accuracy: ± (Reference oscillator accuracy + 0.5 Hz)
AF Level Measurement	Accuracy: ±0.2 dB (≥10 mVpeak), ±0.4 dB (≥1 mVpeak, ≥1 kHz)
AF SINAD Measurement	Frequency: at 1 kHz ≥60 dB (≥1000 mVpeak), ≥54 dB (>50 mVpeak), ≥46 dB (≥10 mVpeak)
AF Distortion Rate Measurement	Frequency: at 1 kHz ≤–60 dB (≥1000 mVpeak), ≤–54 dB (>50 mVpeak), ≤–46 dB (≥10 mVpeak)

LTE Measurement Hardware MT8820C-008, LTE FDD Measurement Software MX882012C/LTE TDD Measurement Software MX882013C

Modulation Analysis	Frequency: 400 MHz to 2.7 GHz 3.4 GHz to 3.8 GHz (with MT8820C-018) Input level: –40 to +35 dBm (Main1) Carrier frequency accuracy: ± (Set frequency × Reference oscillator accuracy + 15 Hz) Modulation accuracy (residual vector error): ≤2.5% (400 MHz to 2.7 GHz) (3.4 GHz to 3.8 GHz, 18° to 28°C) (Measurement count: 20) ≤3.0% (3.4 GHz to 3.8 GHz, Measurement count: 20) In-Band Emissions: ≤–40 dB (≥–10 dBm, Allocated RB≤18) Measurement object: PUSCH, PRACH, PUCCH
RF Power	Frequency: 400 MHz to 2.7 GHz 3.4 GHz to 3.8 GHz (with MT8820C-018) Input level: –60 to +35 dBm (Main1) Measurement accuracy: 400 MHz to 2.7 GHz, After calibration, 10° to 40°C ±0.5 dB, ±0.3 dB (typ.) (–20 to +35 dBm), ±0.7 dB (–50 to –20 dBm), ±0.9 dB (–60 to –50 dBm) 3.4 GHz to 3.8 GHz, After calibration, 10° to 40°C ±0.5 dB, ±0.3 dB (typ.) (–20 to +35 dBm, 18° to 28°C), ±0.7 dB (–50 to +35 dBm), ±0.9 dB (–60 to –50 dBm) Linearity: 400 MHz to 2.7 GHz, After calibration, 10° to 40°C ±0.2 dB (–40 to 0 dB, ≥–50 dBm), ±0.4 dB (–40 to 0 dB, ≥–60 dBm) 3.4 GHz to 3.8 GHz, After calibration, 10° to 40°C ±0.2 dB (–40 to 0 dB, ≥–50 dBm, 18° to 28°C), ±0.3 dB (–40 to 0 dB, ≥–50 dBm), ±0.4 dB (–40 to 0 dB, ≥–60 dBm) Relative measurement error: <2 dB ±0.10 dB (typ., –40 to 0 dB, ≥–50 dBm) Measurement object: PUSCH, PRACH, PUCCH
Occupied Bandwidth	Frequency: 400 MHz to 2.7 GHz 3.4 GHz to 3.8 GHz (with MT8820C-018) Input level: –10 to +35 dBm (Main1)
Adjustment Channel Leakage Power Ratio	Frequency: 400 MHz to 2.7 GHz 3.4 GHz to 3.8 GHz (with MT8820C-018) Input level: –10 to +35 dBm (Main1) Measurement point: E-UTRA ACLR1, UTRA ACLR1, UTRA ACLR2 Measurement range: ≥45 dB (E-UTRA ACLR1), ≥50 dB (UTRA ACLR1), ≥55 dB (UTRA ACLR2)
Spectrum Emission Mask	Frequency: 400 MHz to 2.7 GHz 3.4 GHz to 3.8 GHz (with MT8820C-018) Input level: –10 to +35 dBm (Main1)
RF Signal Generator	Output frequency: 400 MHz to 2.7 GHz (1 Hz steps) 3.4 GHz to 3.8 GHz (with MT8820C-018) AWGN level: Off, –20 to +5 dB [0.1 dB steps, Relative level between Ior (Total power) and AWGN] AWGN level accuracy: ±0.2 dB (Relative level between Ior AWGN)
Throughput Measurement	Function: Throughput measurement according to Reference Measurement Channel (RMC) Measurement object: ACK and NACK data imposed on uplink from terminal
Call Processing	Call control: Position registration, Call processing for Reference Measurement Channel (executes each processing conforming to 3GPP standards and performs pass/fail evaluation) Mobile terminal control: Output level (executes each mobile terminal control conforming to 3GPP standards)

LTE-Advanced FDD DL CA Measurement Software MX882012C-021/LTE-Advanced TDD DL CA Measurement Software MX882013C-021

Function	The reception measurements of DL 2CCs and UL 1CC described in Chapter 7 of 3GPP TS 36.521-1 and the maximum throughput tests are available. By using with the MX882012C (13C)-011 LTE FDD (TDD) 2×2 MIMO DL option, the maximum throughput test of DL CA 2×2 MIMO is available.
RF Signal Generator	Output frequency: 400 MHz to 2.7 GHz, 1 Hz steps 3.4 GHz to 3.8 GHz (with MT8820C-018)
Throughput Measurement	Function: Throughput measurement according to Reference Measurement Channel (RMC) Measurement target: ACK and NACK reported from UE

LTE-Advanced FDD UL CA Measurement Software MX882012C-022/LTE-Advanced TDD UL CA Measurement Software MX882013C-022

Function	Installing the LTE Advanced FDD (TDD) DL CA Measurement Software (MX882012C (13C) -021) and this option enables the UL CA measurement of UE functions and the RF transmission (Supports only Inter-band UL CA) and reception measurement.
Frequency/Modulation measurement	Same as MX882012C (13C) in CC measurements. The measurement target is only PUSCH.
Amplitude measurement	Same as MX882012C (13C) in CC measurements. The measurement target is only PUSCH.
Occupied bandwidth	Same as MX882012C (13C) in CC measurements. The measurement target is only PUSCH.
Adjacent channel leakage power	Same as MX882012C (13C) in CC measurements. The measurement target is only PUSCH.
Spectrum emission mask	Same as MX882012C (13C) in CC measurements. The measurement target is only PUSCH.
RF signal generator	Output frequency: 400 to 2700 MHz (1 Hz steps) 3400 to 3800 MHz (1 Hz steps) (Can be used when installing MT8820C-018 option)
Throughput measurement	Function: Measures throughput using RMC Measurement object: ACK and NACK reported from UE

LTE-Advanced FDD DL CA 3CCs Measurement Software MX882012C-031/LTE-Advanced TDD DL CA 3CCs Measurement Software MX882013C-031

Function	The reception measurements of DL 3CCs and UL 1CC and the maximum throughput tests are available. By using with the MX882012C (13C)-011 LTE FDD (TDD) 2×2 MIMO DL option, the maximum throughput test of DL CA 2×2 MIMO is available.
RF Signal Generator	Output frequency: 400 MHz to 2.7 GHz, 1 Hz steps 3.4 GHz to 3.8 GHz (with MT8820C-018)
Throughput Measurement	Function: Throughput measurement using RMC Measurement target: ACK and NACK reported from UE

LTE FDD Measurement Software Lite MX882042C/LTE TDD Measurement Software Lite MX882043C

Modulation Analysis	Frequency: 400 MHz to 2.7 GHz 3.4 GHz to 3.8 GHz (with MT8820C-018) Input level: –40 to +35 dBm (Main1) Carrier frequency accuracy: ± (Set frequency × Reference oscillator accuracy + 15 Hz) Modulation accuracy (residual vector error): ≤2.5% (400 MHz to 2.7 GHz) (3.4 GHz to 3.8 GHz, 18° to 28°C) (Measurement count: 20) ≤3.0% (3.4 GHz to 3.8 GHz, Measurement count: 20) In-Band Emissions: ≤–40 dB (≥–10 dBm, Allocated RB≤18) Measurement object: PUSCH
RF Power	Frequency: 400 MHz to 2.7 GHz 3.4 GHz to 3.8 GHz (with MT8820C-018) Input level: –60 to +35 dBm (Main1) Measurement accuracy: 400 MHz to 2.7 GHz, After calibration, 10° to 40°C ±0.5 dB, ±0.3 dB (typ.) (–20 to +35 dBm), ±0.7 dB (–50 to –20 dBm), ±0.9 dB (–60 to –50 dBm) 3.4 GHz to 3.8 GHz, After calibration, 10° to 40°C ±0.5 dB, ±0.3 dB (typ.) (–20 to +35 dBm, 18° to 28°C), ±0.7 dB (–50 to +35 dBm), ±0.9 dB (–60 to –50 dBm) Linearity: 400 MHz to 2.7 GHz, After calibration, 10° to 40°C ±0.2 dB (–40 to 0 dB, ≥–50 dBm), ±0.4 dB (–40 to 0 dB, ≥–60 dBm) 3.4 GHz to 3.8 GHz, After calibration, 10° to 40°C ±0.2 dB (–40 to 0 dB, ≥–50 dBm, 18° to 28°C), ±0.3 dB (–40 to 0 dB, ≥–50 dBm), ±0.4 dB (–40 to 0 dB, ≥–60 dBm) Relative measurement error: Less than 2 dB ±0.10 dB (typ., –40 to 0 dB, ≥–50 dBm) Measurement object: PUSCH
Occupied Bandwidth	Frequency: 400 MHz to 2.7 GHz 3.4 GHz to 3.8 GHz (with MT8820C-018) Input level: –10 to +35 dBm (Main1)
Adjustment Channel Leakage Power Ratio	Frequency: 400 MHz to 2.7 GHz 3.4 GHz to 3.8 GHz (with MT8820C-018) Input level: –10 to +35 dBm (Main1) Measurement point: E-UTRA ACLR1, UTRA ACLR1, UTRA ACLR2 Measurement range: ≥45 dB (E-UTRA ACLR1), ≥50 dB (UTRA ACLR1), ≥55 dB (UTRA ACLR2)
Spectrum Emission Mask	Frequency: 400 MHz to 2.7 GHz 3.4 GHz to 3.8 GHz (with MT8820C-018) Input level: –10 to +35 dBm (Main1)

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main frame
MT8820C	Radio Communication Analyzer
	Standard accessories
	Power Cord: 1 pc
	CF Card: 1 pc
	PC Card Adapter (For CF card): 1 pc
W3320AE	MT8820C Operation Manual (CD-ROM): 1 pc
	Options
MT8820C-017	Extended RF Hardware*1
MT8820C-001	W-CDMA Measurement Hardware
MT8820C-002	TDMA Measurement Hardware
MT8820C-003	CDMA2000 Measurement Hardware*2
MT8820C-007	TD-SCDMA Measurement Hardware
MT8820C-008	LTE Measurement Hardware
MT8820C-011	Audio Board
MT8820C-012	Parallel Phone Measurement Hardware
MT8820C-018	Extended RF 3.4 GHz to 3.8 GHz (requires MT8820C-017, MT8820C-119, or MT8820C-120)
MT8820C-043	CDMA2000 Time Offset CAL for GPS SG (requires MT8820C-003 and MX882002C)
MT8820C-101	W-CDMA Measurement Hardware Retrofit
MT8820C-102	TDMA Measurement Hardware Retrofit
MT8820C-103	CDMA2000 Measurement Hardware Retrofit*3
MT8820C-107	TD-SCDMA Measurement Hardware Retrofit
MT8820C-108	LTE Measurement Hardware Retrofit
MT8820C-111	Audio Board Retrofit
MT8820C-112	Parallel Phone Measurement Hardware Retrofit
MT8820C-119	Extended RF Hardware for SPM Retrofit
MT8820C-120	Extended RF Hardware for PPM Retrofit
MT8820C-143	CDMA2000 Time Offset CAL for GPS SG Retrofit (requires MT8820C-003 and MX882002C)
MT8820C-177	TD-SCDMA Measurement Retrofit (requires MT8820C-001)
	Software options
MX882000C	W-CDMA Measurement Software (requires MT8820C-001 and MX88205xC)
MX882000C-001	W-CDMA Voice Codec (requires MT8820C-011 and MX882000C)
MX882000C-011	HSDPA Measurement Software (requires MT8820C-001, MX882000C, and MX882050C)
MX882000C-013	HSDPA High Data Rate (requires MT8820C-001, MX882000C, MX882000C-011, and MX882050C)
MX882000C-021	HSUPA Measurement Software (requires MT8820C-001, MX882000C, MX882000C-011, and MX882050C)
MX882000C-031	HSPA Evolution Measurement Software*4 (requires MT8820C-001, MX882000C, MX882000C-011, MX882000C-021, and MX882050C)
MX882000C-032	DC-HSDPA Measurement Software*4, *5 (requires MT8820C-001 (2 sets), MT8820C-012, MX882000C, MX882000C-011, MX882000C-021, MX882000C-031, MX882010C, and MX882050C)
MX882000C-033	DC-HSUPA Measurement Software*4, *6 (requires MT8820C-001 (2 sets), MT8820C-012, MX882000C, MX882000C-011, MX882000C-021, MX882000C-031, MX882000C-032, MX882010C, MX882050C)
MX882000C-034	4C-HSDPA Measurement Software*4, *6 (requires MT8820C-001 (2 sets), MT8820C-012, MX882000C, MX882000C-011, MX882000C-021, MX882000C-031, MX882000C-032, MX882010C, MX882050C)
MX882001C	GSM Measurement Software (requires MT8820C-002)
MX882001C-001	GSM Voice Codec (requires MT8820C-011 and MX882001C)
MX882001C-002	GSM External Packet Data (requires MX882001C)
MX882001C-011	EGPRS Measurement Software (requires MX882001C)
MX882001C-041	GSM High-speed Adjustment (requires MX882001C)
MX882002C	CDMA2000 Measurement Software (requires MT8820C-003)
MX882002C-001	CDMA2000 Voice Codec (requires MT8820C-011 and MX882002C)
MX882002C-002	CDMA2000 External Packet Data (requires MX882002C)
MX882005C	PHS Measurement Software (requires MT8820C-002)
MX882005C-011	Advanced PHS Measurement Software (requires MX882005C)
MX882007C	TD-SCDMA Measurement Software (requires MT8820C-001 and MT8820C-007)
MX882007C-001	TD-SCDMA Voice Codec (requires MT8820C-011 and MX882007C)
MX882007C-003	TD-SCDMA Video Phone Test (requires MX882007C)
MX882007C-011	TD-SCDMA HSDPA Measurement Software*4 (requires MT8820C-001, MT8820C-007, and MX882007C)
MX882007C-012	TD-SCDMA HSDPA Evolution Measurement Software*4 (requires MT8820C-001, MT8820C-007, MX882007C, MX882007C-011)
MX882007C-021	TD-SCDMA HSUPA Measurement Software*4 (requires MT8820C-001, MT8820C-007, MX882007C, MX882007C-011)
MX882010C	Parallel Phone Measurement Software*7 [requires MT8820C-012, the two same measurement hardware (2 board/set) and one measurement software]
MX882012C	LTE FDD Measurement Software*4 (requires MT8820C-008)
MX882012C-006	LTE FDD IP Data Transfer*4 (requires MX882012C)
MX882012C-011	LTE FDD 2×2 MIMO DL*4, *8 (requires MT8820C-012 and MX882012C)
MX882012C-016	LTE FDD CS Fallback to W-CDMA/GSM*9 (requires MX882012C)
MX882012C-017	LTE FDD CS Fallback to CDMA2000*9 (requires MX882012C)
MX882012C-021	LTE-Advanced FDD DL CA Measurement Software*4, *10 (requires MT8820C-008 (2 sets), MT8820C-012, MX882010C, and MX882012C)
MX882012C-022	LTE-Advanced FDD UL CA Measurement Software (requires MT8820C-008 (2 sets), MT8820C-012, MX882010C, MX882012C and MX882012C-021)
MX882012C-026	LTE-Advanced FDD DL CA IP Data Transfer*11 (requires MT8820C-008 (2 sets), MT8820C-012, MX882010C, MX882012C, MX882012C-006, MX882012C-021)
MX882012C-031	LTE-Advanced FDD DL CA 3CCs Measurement Software*4, *12 (requires MT8820C 2 sets. One is required MT8820C-008 (2 sets), MT8820C-012, MX882010C, MX882012C and MX882012C-021. The other is required MT8820C-008, MX882012C.)
MX882013C	LTE TDD Measurement Software*4 (requires MT8820C-008)
MX882013C-006	LTE TDD IP Data Transfer*4 (requires MX882013C)
MX882013C-011	LTE TDD 2×2 MIMO DL*4, *8 (requires MT8820C-012 and MX882013C)
MX882013C-016	LTE TDD CS Fallback to W-CDMA/GSM*13 (requires MX882013C)
MX882013C-017	LTE FDD CS Fallback to CDMA2000*9 (requires MX882013C)
MX882013C-018	LTE TDD CS Fallback to TD-SCDMA/GSM*13 (requires MX882013C)
MX882013C-021	LTE-Advanced TDD DL CA Measurement Software*4, *10 (requires MT8820C-008 (2 sets), MT8820C-012, MX882010C and MX882013C)
MX882013C-022	LTE-Advanced TDD UL CA Measurement Software (requires MT8820C-008 (2 sets), MT8820C-012, MX882010C, MX882013C and MX882013C-021)
MX882013C-026	LTE-Advanced TDD DL CA IP Data Transfer*11 (requires MT8820C-008 (2 sets), MT8820C-012, MX882010C, MX882013C, MX882013C-006, MX882013C-021)
MX882013C-031	LTE-Advanced TDD DL CA 3CCs Measurement Software*4, *12 (requires MT8820C 2 sets. One is required MT8820C-008 (2 sets), MT8820C-012, MX882010C, MX882013C, MX882013C-021. The other is required MT8820C-008, MX882013C.)
MX882032C	CDMA2000 Measurement Software Lite*4
MX882036C	1xEV-DO Measurement Software Lite*4
MX882036C-011	1xEV-DO Rev. A Measurement Software*4
MX882042C	LTE FDD Measurement Software Lite*4
MX882043C	LTE TDD Measurement Software Lite*4
MX882050C	W-CDMA Call Processing Software*2, *14 (requires MX882000C)
MX882050C-002	W-CDMA External Packet Data*4 (requires MX882050C)
MX882050C-003	W-CDMA Video Phone Test*4 (requires MX882050C)
MX882050C-007	W-CDMA Band XII, XIII, XIV, XIX, XX, XXI*4, *15 (requires MX882050C)
MX882050C-008	W-CDMA Band XI*4 (requires MX882050C)
MX882050C-009	W-CDMA Band IX*4 (requires MX882050C)
MX882050C-011	HSDPA External Packet Data*4 (requires MX882000C-011)
MX882051C	W-CDMA Call Processing Software*4 (requires MX882000C)
MX882051C-002	W-CDMA External Packet Data*4 (requires MX882051C)
MX882051C-003	W-CDMA Video Phone Test*4 (requires MX882051C)
MX882070C	W-CDMA Ciphering Software*4 (requires MX882050C)
MX882071C	W-CDMA Ciphering Software*4 (requires MX882051C)
	Warranty
MT8820C-ES210	2 years Extended Warranty Service
MT8820C-ES310	3 years Extended Warranty Service
MT8820C-ES510	5 years Extended Warranty Service

Continued on next page

Model/Order No.	Name
	Application parts
P0035B	W-CDMA/GSM Test USIM
P0035B7	W-CDMA/GSM Test USIM*16
P0135A6	Anritsu Test UICC GA (Nano UICC size)*17
P0135A7	Anritsu Test UICC GA (Micro UICC size)*17
P0250A6	Anritsu Test UICC GT (Nano UICC size)*17
P0250A7	Anritsu Test UICC GT (Micro UICC size)*17
P0260A6	Anritsu Test UICC GM (Nano UICC size)*17
P0260A7	Anritsu Test UICC GM (Micro UICC size)*17
P0135B6	Anritsu Test UICC GA (Nano UICC size)*17
P0135B7	Anritsu Test UICC GA (Micro UICC size)*17
P0250B6	Anritsu Test UICC GT (Nano UICC size)*17
P0250B7	Anritsu Test UICC GT (Micro UICC size)*17
P0260B6	Anritsu Test UICC GM (Nano UICC size)*17
P0260B7	Anritsu Test UICC GM (Micro UICC size)*17
A0058A	Handset
J1195A	PP2S Output Cable
J1249	CDMA2000 Cable [D-Sub (15 pin, P-type) · D-Sub (15 pin, P-type), used in combination with J1267 (sold separately)]*18
J1267	CDMA2000 Cross Cable [D-Sub (9 pin, P-type) · D-Sub (9 pin, P-type), reverse cable used in combination with J1249 (sold separately)]
J1606A	Cable*18
J0576B	Coaxial Cord, 1 m (N-P · 5D-2W · N-P)
J0576D	Coaxial Cord, 2 m (N-P · 5D-2W · N-P)
J0127A	Coaxial Cord, 1 m (BNC-P · RG58A/U · BNC-P)
J0127C	Coaxial Cord, 0.5 m (BNC-P · RG58A/U · BNC-P)
J0007	GPIB Cable, 1 m
J0008	GPIB Cable, 2 m
MN8110B	I/O Adapter (for call processing I/O)
B0332	Joint Plate (4 pcs/set)
B0643A	Rack Mount Kit (MT8820C)
B0499	Carrying Case (Hard type) (with protective cover and casters)

*1: MT8820C-017 has been a standard option that MT8820C are shipped with until July 2012 (Simultaneous order is required MT8820C and MT8820C-017).

*2: MT8820C-003 is not RoHS compliant.

*3: MT8820C-103 is not RoHS compliant.

*4: For terminal connectivity, contact your Anritsu sales representative.

*5: MX882000C-032 is required a Parallelphone measurement configuration of W-CDMA HSPA Evolution.
For use MT8820C 2 units, contact your Anritsu sales representative.

*6: MX882000C-033 (034) is required W-CDMA DC-HSDPA configuration.

*7: The following measurement hardware supports the Parallelphone measurement option: MT8820C-001, MT8820C-002, MT8820C-003, MT8820C-005, MT8820C-007, MT8820C-008.
All the measurement hardware can be installed simultaneously.

*8: MX882012C-011 is required MT8820C-012.

*9: The MX882012C-016 (017) LTE FDD CS Fallback to W-CDMA/GSM (CDMA2000) requires a separate MT8820C with the W-CDMA/GSM (CDMA2000) configuration. Contact your Anritsu sales representative for the CS Fallback function test configuration.

*10: MX882012C (12C)-021/-022 is required a Parallelphone measurement configuration of LTE FDD (TDD).
For Use MT8820C 2 units, contact your Anritsu sales representative.

*11: MX882012C (13C)-026 function test is required external server PCs (2 sets).
LTE Advanced FDD (TDD) DL CA IP Data Transfer (2CCs, 2Layer) is required MT8820C LTE 2×2 MIMO DL configuration (2 sets) and external server PCs (2 sets).

*12: One is required LTE FDD ParallelPhone Configuration.
The other is required LTE FDD Single Phone Configuration.
For use MT8820C 3 units, contact your Anritsu sales representative.
A synchronized cable is required too.

*13: The MX882013C-016 (018) LTE TDD CS Fallback to W-CDMA/GSM (TD-SCDMA/GSM) requires a separate MT8820C with the W-CDMA/GSM (TD-SCDMA/GSM) configuration. Contact your Anritsu sales representative for the CS Fallback function test configuration.

*14: These options preinstall the integrity protection function.

*15: MX882050C-007 supports W-CDMA Band 12, 13, 14, 19, 20, 21.

*16: The P0035B7 MicroSIM is a cut-down P0035B W-CDMA/GSM Test USIM. The P0035B7 Test USIM is a microSIM. It CANNOT be used in a normal size USIM card slot. A commercial SIM adapter CANNOT be used with the P0035B7. If used, it may jam and break in the terminal.

*17: Refer to the P0135Ax/P0250Ax/P0260Ax/P0135Bx/P0250Bx/P0260Bx leaflet for details.

*18: J1267 (J1606A) cable can use for LTE-Advanced DL CA synchronized cable. Contact your Anritsu sales representative for details.

Parallelphone™ is a registered trademark of Anritsu Corporation.
CF® card is a registered trademark of SanDisk Corporation in the United States and is licensed to CFA (Compact Flash Association).

ACE RNX Channel Emulator

ACE-RNX

Remote Control
Ethernet

Purpose-Built RF Environment Emulator for LTE-A, HetNet and Beyond

Consumers increasingly demand ubiquitous high-speed access to feed their bandwidth and data-hungry applications. The industry is addressing this through LTE Advanced (LTE-A), which takes the following new approaches to meet this demand:

- HetNet to improve capacity
- Small cells to expand coverage
- Carrier aggregation to boost data rates

Channel emulation is fine for testing single-link, planned environments with controlled interference, but it's inadequate for testing HetNet — a dynamic, multilink, interference-dominated, and increasingly dense network. For that, you need HetNet environment emulation. Only Azimuth's ACE RNX, with its unique built-in Virtual Network Environment™ (VNE™), fully addresses the technical and logistical challenges of LTE-A testing:

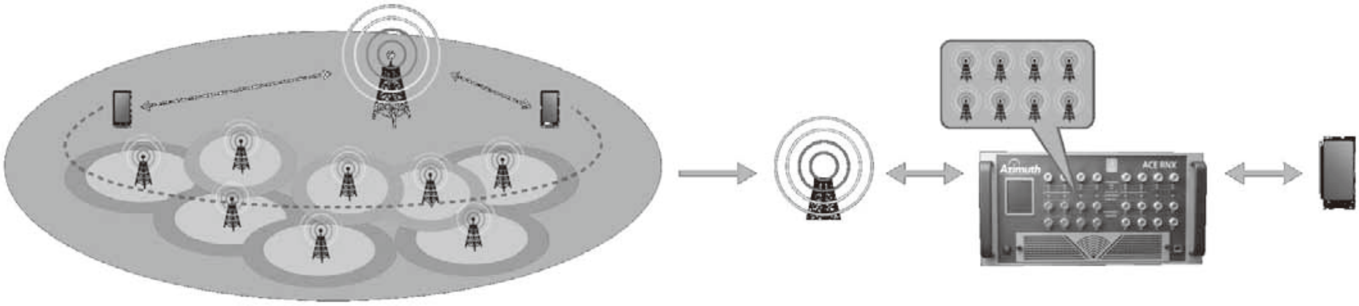
- Testing ICIC, eICIC, FeICIC, NAICS, and advanced interference cancellation receivers
- Prelaunch testing of small cells
- Recreating field environments for debugging
- Regression testing
- Testing builds/configurations before going to the field.

Virtual Network Environment (VNE™)

Virtual Network Environment™ (VNE™), available within the RNX platform, is the first and only solution capable of creating and controlling a complete HetNet radio environment in the lab. VNE™ provides a configurable, synchronized* LTE downlink (i.e., eNB) interferer within the RNX. Designed to include a fading channel, each interferer can be configured to be independent of the others.

*: Synchronization is critical since testing time-based mitigation schemes such as ABS (almost blank subframes) requires subframe-level synchronization.

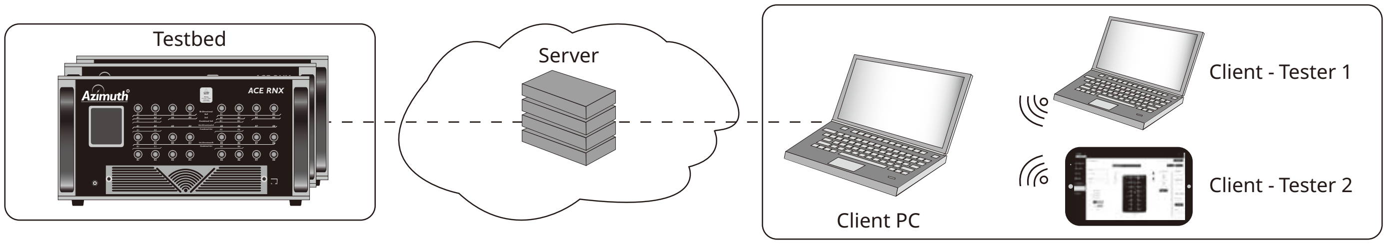
- Industry's first advanced environment emulation
- Fully configurable downlink interferers
- Synchronized with serving cell
- Includes a controllable fading environment and AWGN
- Logistically and technically feasible



Director 3 Test Executive (D3)

D3 provides a cloud-ready, server-client architecture that facilitates a single server, and multi-client setup. D3 doesn't require desktop software on dedicated PCs, and it's possible to access from any web browser. It means it's possible to access the test bed from anywhere and anytime globally, and it should be better to build test bed and lab space utilization.
The server consists of the following:

- **Server Component** — hosts a responsive and easy to use HTML5 single page application that enables you to create, run and analyze test cases with the ACE-RNX. It also serves as the endpoint for all of the Azimuth SOAP API.
- **Node (Slave) Component** — hosts a dedicated set of engines that stream real-time information to multiple ACE-RNXs.
- **Database Component** — all test cases created are stored in a database that pushes updates to clients and nodes in real time.



Server Requirements

- Desktop PC or server hardware
- Processor: Intel Core i5 64-bit processor or better
- Memory: 8 GB RAM minimum (16 GB recommended)
- Hard Drive: 10 GB free space minimum
- Operating System: Windows 7 Professional or Enterprise SPI (64-bit, English)
- Network: Ethernet 10/100/1000 Adapter
- .NET framework 4.5.2
- Microsoft AppFabric 1.1
- Microsoft SQL Server Express 2014

Client Requirements

- Internet Explorer 11
- Video Resolution: 1600 × 1200 or better (1920 × 1080 recommended)

Field-to-Lab™ (FTL)

Field testing is the final test for mobile devices prior to deployment to subscribers. It enables validation of the device in real world conditions in the environments where subscribers actually use them. However, field testing of devices in diverse conditions of terrain, population density, physical location and motion is extremely time-consuming and costly.

The Azimuth Field-to-Lab (FTL) solution is a unique and effective solution that allows service providers and equipment manufacturers to take real world channel conditions collected from drive testing and re-create the same channel conditions in the lab using the ACE RNX Channel Emulator. The need for a tightly knit end-to-end progression with significant synergy between one stage and the next has never been more relevant. A key enabler of this new testing paradigm is the ability to reliably and repeatedly recreate dynamic field environments in the lab.

Field-to-Lab Integration with Azimuth's Solution Portfolio

The core functionality for Field-to-Lab, integrated with Azimuth's scalable solutions, delivers unrivaled device testing.

- Real-World Applications — With real infrastructure (eNB or BSE), re-creates external conditions in the lab; enables interoperability, regression, network optimization, and performance testing across the full spectrum of dynamic radio environments
- Reciprocal Path Loss (RPL) — With dynamic RPL, FTL allows users to assess the impact of dynamic uplink channel conditions on overall device performance using current drive test scanner logs
- Device Automation and Control — FTL integrates Azimuth DAC for fully automated device application testing and performance benchmarking — including video streaming such as YouTube — while other apps run concurrently
- Can automate different test-bed components, including logging tools, emulators, and results analysis to re-create a complex field environment in the lab

Supported Technologies

LTE (FDD, TD), TD-SCDMA, UMTS (W-CDMA, HSPA+),
CDMA (CDMA2000, EVDO), GSM

Supported Scanners/DM

Hardware Scanner:
JDSU E6474A-W1314A
Software Scanners/Diagnostic Monitors:
QXDM
Accuver XCAL
Anite Nemo

Specifications

ACE RNX Channel Emulator

Channel Emulation Specifications

Digital Channels	32
Taps per Channel	24
Max Doppler Rate	2.0 kHz @ 3.8 GHz
Playback Rate	1 ms
Doppler Profiles	Classical
AWGN	+35 to –30 dB SNR, 0.1 dB
Channel Models: Model Packs	Industry standards models: • 3GPP/3GPP2 LTE/3G/2G channel models • WiMAX Forum channel models based on ITU M.1225 • 3GPP and SCM channel models (spatial channel model for MIMO simulations) • SCME channel models for linklevel extended SCM modes • IMT-A and SCME-A spatial channel models • High-speed train model scenarios • Moving propagation scenarios
Custom Model Mode	User-defined custom models
Bypass Mode (Identity Matrix)	No correlation, no fading, no multipath
Butler Mode (Butler Matrix)	No correlation, no fading, no multipath

Configurations

Test Configurations	• 1×1, 2×2, 4×4, 8×4 (U), subsets of these • 8×4 (B), 8×8 subsets of these on 2 ACE-RNXs with license • Unidirectional and bidirectional • Carrier aggregation

RF Specifications

RF Channels per RNX	8
RF Bandwidths	100 MHz
RF Input Range	+23 to –50 dBm, with 13 dB Crest factor
RF Input Peak Power	+36 dBm
RF Output Range	–25 to –120 dBm
RF Output Peak Power	0 dBm
RF Tuning Range	380 MHz to 3850 MHz
Insertion Delay	1.1 µs
EVM	< –40 dB typical
Noise Floor, Output	< –166 dBm/Hz @ –40 dBm output power

Director 3 Test Executive

Scenario Builder	Drag-and-drop wizard to design and execute multilink tests
Link Builder	Link-level GUI to create and run tests
Cloud Architecture	• Global access to the test-bed • No desktop software • Centralized test cases and results

Physical Specifications

Dimensions	17.45 (W) × 8.75 (H) × 28.5 (D) [44.32 (W) × 22.23 (H) × 72.39 (D) cm]
Mass	98 lb. (44.5 kg)
Power	100 V(ac) to 240 V(ac), 50 Hz to 60 Hz, 8.0 amps/4.0 amps

Virtual Network Environment (VNE™)

Capabilities

Interferer	LTE downlink (no uplink)
Unique Interferers Per RNX	12
Interferers Per Link	3
Types of Interferers	Any LTE cell (macrocell, small cell)
Sync Receiver	
Mode	Synchronized (to eNB) or unsynchronized
Input Signal	Nonfaded Power range: –50 to +23 dBm
Capability	Can decode up to 4 eNBs

VNE™ unlocks repeatable, scalable HetNet testing by

(1) defining interfering cells (through the signal generation tool in Director 3)

(2) creating a HetNet environment that uses those cells

(3) developing test scenarios specifically for that environment

VNE™ is integrated into the Director 3 test executive. Users can start with a pre-existing interferer or create an interferer signal with ease, using the signal generation tool. Once the interferer has been created, it can be added to any specific scenario and configured relative to the serving signal (e.g., SIR, delay, frequency offset, etc.).

Interferer Signals-Link-Level Parameters

Interferer Proportion (SIR)	–15 to +40 dB (0.1 dB resolution)
Delay	–1 s to 1 s (100 ns resolution)
Frequency	Anywhere within the channel bandwidth
Frequency Offset	–100 kHz to +100 kHz (10 Hz resolution)

Interferer Parameters

Bandwidth	1.4, 3, 5, 10, 20 MHz (or 6, 15, 25, 50, 75, 100 RBs)
Cyclic Prefix	Normal, extended
PHICH Duration	Normal
Number of eNB Antennas	1, 2, 4
Type of eNB Array	Uniform linear
PCI (Cell ID)	0 to 503
PDSCH	
Transmission Mode	1, 3, 4
Traffic Loading	0 to 100%
Rank Proportion	0 to 100%
ABS Pattern	Standard: Patterns 1–7, as per 3GPP 36.101 Custom: User-defined patterns
CFI Value	1, 2, 3
Propagation Conditions	
Channel Model	Butler, LTE EVA, EPA, ETU
Correlation	Low, Medium, High
Doppler/Velocity	5, 70, 300 Hz

EU Standards (CE Marking)

EMC	2014/30/EU, EN61326-1, EN61000-3-2
LVD	2014/35/EU, EN61010-1
RoHS	2011/65/EU

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main Frame
ACE-RNX	ACE RNX Channel Emulator
	Standard Accessories
ACC-293	ACE MX/MX2 2×2 Connection Pack (×2)
ACC-234	Power Cable - US, Canada, Mexico
ACC-235	Power Cable - Japan, Taiwan
ACC-236	Power Cable - United Kingdom
ACC-237	Power Cable - Hong Kong, Singapore, Malaysia
ACC-238	Power Cable - Continental Europe
ACC-239	Power Cable - Korea
ACC-240	Power Cable - China
ACC-241	Power Cable - Australia, New Zealand
ACC-242	Power Cable - Switzerland
ACC-243	Power Cable - Italy
ACC-244	Power Cable - Israel
	Hardware Option
RNX-1200	Advanced Capabilities Expansion Card
	Software Module
D3-1001	Director 3 Test Executive
D3-1002	Remote Client License
	Software Options
D3-1003	Director 3 Scenario Builder
D3-1004	3D Geometric Modeling Tool
D3-1005	3GPP TR38.900 5G RAN1 Geometric Stochastic Channel Model Pack
D3-1201	Director 3 Signal Generation & Management Tool
RNX-2201	LTE DL Signal Generation/Playback License
RNX-2202	8×8 MIMO License
RNX-3201	8×4 Bi-Directional License
	Application Parts
DIR-601	AzMapper
RPE-401L/AC	RadioProof Enclosures
RPE-402	RadioProof Enclosures
ACC-261	RadioProof - MIMO AP Cable Kit
ACC-262	RadioProof - MIMO Laptop Cable Kit
ACC-284	2:1 Combiner
ACC-295	ACE MX/MX2 Cable Starter Kit
ACC-308	MIMO Amplifier
ACC-312	MIMO Connectivity Unit
ACC-313	Trigger Synch Cable
ACC-315	Field To Lab Multi-Unit Connection Kit
	Support Services
SVC-101	Engineering and/or Training Service per hour
SVC-701	Annual Software Maintenance and System Technical Support
SVC-703	HW Advanced Replacement Service
SVC-710	Return To Factory Repair Evaluation
SVC-613	ACE-RNX Calibration Fee

Please contact our sales representative for more details.

Spider

SPI-100 Series

Remote Control
Ethernet

One Platform, Multiple Solutions

Automated, Scalable RF Platform for LTE Unlicensed, IoT and Wi-Fi

Technologies like LTE unlicensed and Internet of Things (IoT) are ushering wireless communications away from traditional point-to point topologies toward many-to-many topologies with the coexistence of multiple radio technologies and active communication links among multiple devices.

Wireless test systems currently available on the market focus on the testing, optimization, and validation of a single device in a point-to-point setup; there are no solutions designed specifically for accurate, repeatable, efficient testing of these newer technologies. This left developers with two options: one, manually field test over the air, which is time-consuming, unrepeatable, and (due to limited control of variables) not always accurate; or two, kludge together a solution using off-the-shelf components and test tools designed for point-to-point applications, knowing that the quantities required for a mesh network test would quickly make this cost-prohibitive. These challenges are addressed by Spider.

Spider™

The Spider™ platform comprises integrated hardware and software that provide complete RF isolation and automated control of the MIMO radio links between multiple devices. Different, turnkey solutions are built on the Spider™ platform to support LTE unlicensed, IoT, 802.11ac, and use cases such as mobility, handover, device to device, and radio coexistence testing. In addition, users can create their own solutions using the Spider platform and the modules available in the Director-II test executive. Because Spider is built specifically for testing mesh network topologies, it is much more accurate and reliable than off-the-shelf components but much more affordable that traditional wireless test systems.

Spider™ Platform

- An automated RF Platform that is modular, scalable, and cost effective
- Integrated H/W and S/W modules that provide:
  - Controllable bidirectional MIMO links in a variety of topologies with complete RF isolation
  - End-to-end automation of entire test- bed that includes devices, APs, and traffic sources
  - Turnkey, fully automated test cases and reporting
- Turnkey solutions for different technologies, applications

Technologies

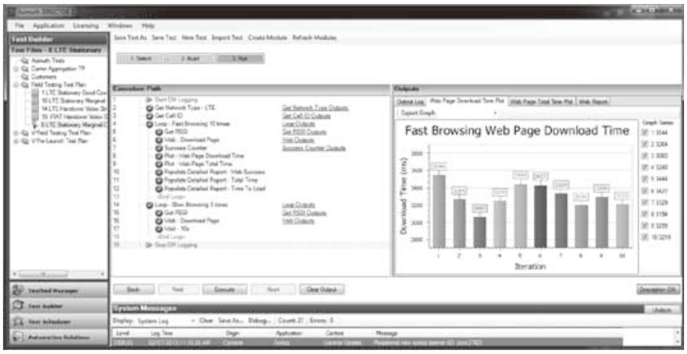
Cellular (LTE-A, LTE unlicensed, LTE, 3G/2G), Wi-Fi (802.11a/b/g/n/ac), Bluetooth, ZigBee

Testing Areas

Performance, conformance, interoperability, coexistence

Use Cases

LTE unlicensed, 802.11ac, IoT, handover testing, coexistence testing

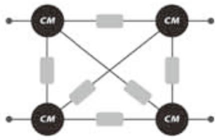


Standard Configurations

Spider™ is a modular, scalable, and cost-effective automated RF platform, comprising integrated hardware and software modules that provide:

- Controllable bidirectional MIMO links
- Wide channel bandwidth and wide frequency coverage (700 MHz to 6 GHz)
- A variety of topologies with complete RF isolation (90 dB)
- Connectivity with real devices in their native form
- Automation of the entire test-bed — devices, APs, traffic sources, etc.

Different turnkey solutions built on the Spider™ platform can support LTE unlicensed, IoT, 802.11ac, and use cases such as mobility, handover, device to device, and radio coexistence testing. Spider™ is a modular, scalable system.
Build on these standard configurations — or design your own!

	Configuration	Topology	Components	Typical Use Cases
SPI-102	Standalone RFCM		1 RFCM-B	• Wi-Fi, cellular linklevel testing • IoT, drones
SPI-103	Star 2		1 SCM-5 2 RFCM-B	• Wi-Fi performance • Wi-Fi roaming • Cellular handover • MIMO performance • Connected home • Medical devices
SPI-104	Star 3		1 SCM-5 2 RFCM-B 1 RFCM-C	
SPI-105	Mesh		4 MCM-4 6 RFCM-B	• LTE unlicensed • Radio coexistence • M2M • Drones • Connected home • Medical devices

CM Combiner Module ▨ RFCM-B □ RFCM-C

Note: All configurations include the Director II Test Executive, the Traffic Source Automation and Control Library (iPerf), RF cables, and Near Field Adapters.

Hardware

RF Channel Module with Butler Matrix (RFCM-B)
RF Channel Module without Butler Matrix (RFCM-C)

The RF Channel Module (RFCM) is a key module of the Spider™ platform that provides a MIMO path with controllable attenuation. The RFCM can be used standalone between two nodes or as a part of a star or a mesh topology in conjunction with other modules of the Spider™ platform, such as the combiner module or shielded enclosure.

- Programmable attenuation for up to 4×4 MIMO links
- Integrated Butler matrix ensures accurate phase amplitude relationship needed for MIMO, beamforming, etc.
- Compact form factor with all integrated components
- No more cluttered, messy setups
- Support for a wide frequency range with unlimited bandwidth

Star Combiner Module (SCM-5)
Mesh Combiner Module (MCM-4)

The Combiner Module, a key component of the Spider™ platform, merges the multiple MIMO paths from various modules in a star or mesh topology test configuration. Each Combiner Module can combine multiple groups of four paths each, enabling a multitude of test configurations for SISO and MIMO devices.

- Combine multiple nodes in different topologies — star, mesh, custom
- Compact form factor with all integrated components; no more cluttered, messy setups
- Supports a wide frequency range and unlimited bandwidth
- Supports up to 4×4 MIMO links

Optional Components

Near Field Adapter (MLA-01)

The Near Field Adapter (NFA) enables direct, conducted connectivity to devices without requiring disassembly. This removes the uncertainty and the potential for inaccuracy and nonrepeatability.

- Test any device — even those without exposed connectors!
- No more drilling, soldering, or waiting for custom devices!
- Connect to all devices — tablets, smartphones, etc. — easily and noninvasively
- Get the reliability and repeatability of a conducted connection with the ease-of-use of a radiated connection
- MIMO connection for different bands and technologies

STACSIM-(Static Channel Simulator) (ACC-290)
STACSIM-WB-(Static Channel Simulator) (ACC-339)

Azimuth's Static Channel Simulator (STACSIM) provides cross-path and fixed-phase shifts on a 4×4 matrix based on the commonly used Butler array, in which a signal incident at each input port provides equal amplitude signals at the N output ports.

- A wideband flat channel over a wide frequency range
- A 4×4 connection with Butler phase-amplitude characteristics
- A high-rank matrix with a low condition number
- Exceptional isolation

RadioProof Enclosures (RPE-401L/AC):
RadioProof Enclosures (RPE-402):

Azimuth's RadioProof™ enclosures provide superior isolation from 700 MHz to 6 GHz, support 4×4 multiple-input/multiple-output (MIMO) products and are ideal for accurate and reliable testing of all wireless technologies. Azimuth's patented design enables ultrahigh isolation (90 dB) with a range of filtered connection options, and thus outperforms other solutions in terms of performance and scalability.

- Exceptional isolation: up to 90 dB
- Wide frequency range support
- 4×4 multiple input/multiple output (MIMO) connections
- Filtered RJ45 Ethernet, serial, power (DC and AC)
- Support for USB
- Active and passive cooling

RPE-401L/AC

RPE-402

Software

Derector II Test Executive (DIR-II)

Director II, a universal test executive to control and automate a test-bed end-to-end, comprises the following components:

Test-Bed Manager: Manage the Test-Bed

- Control the ACE, Spider™, and other Azimuth products
- Manage other equipment in the test-bed (access points, devices, etc.)

Test Builder: Automate the Test-Bed

- Modules to control common elements of the test-bed
- Create test cases through a drag-and-drop GUI—without writing code

Test Scheduler: Run Tests

- Schedule and run synchronized tests
- View test results

Test Builder includes baseline modules for controlling Spider™ and ACE RNX, in addition to core modules for basic logic/execution and graphic and optional software automation modules for the following:

Access Point Automation & Control Library (DIR-805)

Control access points through the Cisco 2504, 3702 controller.
Configure radio, channel, bandwidth, etc.

Traffic Source Automation & Control Library - iPerf (DIR-806)

Configure iPerf3 between two endpoints (on device, PC)
Start iPerf session
Collect KPIs

Traffic Source Automation & Control Library – Chariot (DIR-807)

Configure Chariot between two endpoints (on device, PC)
Start Chariot session
Collect KPIs

Test Builder

Test Scheduler

Specifications

RF Channel Module with Butler Matrix (RFCM-B)
RF Channel Module without Butler Matrix (RFCM-C)

Usable Frequency Range	700 MHz to 6000 MHz
Number of Paths	4
Controlled Attenuation Range	RFCM–B 700 MHz to 3000 MHz: 54 dB 3001 MHz to 6000 MHz: 52 dB RFCM–C 700 MHz to 6000 MHz: 55 dB
Attenuation Resolution	0.5 dB
Attenuation Accuracy	±0.5 dB
Insertion Loss	RFCM–B 700 MHz to 3000 MHz: 15 dB 3001 MHz to 6000 MHz: 19.5 dB RFCM–C 700 MHz to 6000 MHz: 6 dB 3001 MHz to 6000 MHz: 9 dB
Return Loss	>10 dB
Isolation	15 dB typical for An to Am, where n≠m, and for Bn to Bm, where n≠m, with attenuators set to nominal 0 dB
Input Power	+20 dBm max.
Channel Configuration	RFCM–B: Butler RFCM–C: Bypass
Control Interface	Ethernet 10/100/1000
Control Software Included	Configure Unit Set Attenuator value: each path, all paths
Power	120 V(ac)/240 V(ac), 1.5/0.75 A 50 Hz to 60 Hz

Star Combiner Module (SCM-5)
Mesh Combiner Module (MCM-4)

Usable Frequency Range	700 MHz to 6000 MHz
Insertion Loss (typ.)	SCM-5 3 GHz: 5 dB 6 GHz: 14 dB MCM-4 Master Port (M) to any Split Port (S1, S2, S3) 3 GHz: 5 dB 6 GHz: 5 dB
Return Loss	MCM-4 Split Port (S1, S2, S3) to any other Split Port (S1, S2, S3) >20 dB
Input Power	SCM-5 +30 dBm average MCM-4 M Port: +43 dBm max. S Ports: +29 dBm max.
Number of Groups	SCM-5: 5 MCM-4: 4
Number of Paths Per Group	4
Channel Configuration	Identity Matrix

Near Field Adapter (MLA-01)

Usable Frequency Range	700 MHz to 6000 MHz
Coupling Loss	Typically up to 25 dB at 5 GHz
RF Connection	SMA (f)
Physical Connection	Velcro™ fastener

STACSIM-(Static Channel Simulator) (ACC-290)
STACSIM-WB-(Static Channel Simulator) (ACC-339)

<table>
<tr><td>Frequency</td><td colspan="6">ACC-290
2.4 GHz to 2.5 GHz and 4.9 GHz to 5.9 GHz
ACC-339
700 MHz to 6 GHz</td></tr>
<tr><td>Topology</td><td colspan="6">Up to 4×4 (full rank)</td></tr>
<tr><td>Isolation</td><td colspan="6">At least 20 dB</td></tr>
<tr><td rowspan="12">Butler Matrix Phase Characteristics</td><td colspan="2" rowspan="2">ACC-290</td><td colspan="4">Output Port</td></tr>
<tr><td>B1</td><td>B2</td><td>B3</td><td>B4</td></tr>
<tr><td rowspan="4">Input port</td><td>A1</td><td>–45</td><td>–90</td><td>–135</td><td>–180</td></tr>
<tr><td>A2</td><td>–135</td><td>0</td><td>135</td><td>270</td></tr>
<tr><td>A3</td><td>270</td><td>135</td><td>0</td><td>–135</td></tr>
<tr><td>A4</td><td>–180</td><td>–135</td><td>–90</td><td>–45</td></tr>
<tr><td colspan="2" rowspan="2">ACC-339</td><td colspan="4">Output port</td></tr>
<tr><td>B1</td><td>B2</td><td>B3</td><td>B4</td></tr>
<tr><td rowspan="4">Input port</td><td>A1</td><td>45</td><td>90</td><td>135</td><td>180</td></tr>
<tr><td>A2</td><td>135</td><td>–45</td><td>–135</td><td>90</td></tr>
<tr><td>A3</td><td>90</td><td>–135</td><td>0</td><td>135</td></tr>
<tr><td>A4</td><td>180</td><td>135</td><td>90</td><td>45</td></tr>
</table>

RadioProof Enclosures (RPE-401L/AC)
RadioProof Enclosures (RPE-402)

Model	RPE-401L/AC	RPE-402
Number of Chambers	1	2
RF Ports	12	6 per chamber
RF Port Type	8 SMA (front) 4 N-type (rear)	4 SMA (front), 2 N-type (rear) per chamber
Filtered Connections	• 2 × RJ45 Ethernet 10/100/100 • RJ45 for serial • DC power • 110 V to 240 V AC power • Cooling fan	• 2 × RJ45 Ethernet 10/100/100 • RJ45 for serial • DC power
Isolation	90 dB, 1.0 GHz to 6.0 GHz	90 dB, 1.0 GHz to 6.0 GHz
Configuration	Desktop or rack mount	Desktop or rack mount
Ventilation	Fan	Passive
Exterior Dimensions	422 (W) × 323 (H) × 686 (D) mm	422 (W) × 191 (H) × 407 (D) mm
Interior Dimensions	381 (W) × 254 (H) × 524 (D) mm	211 (W) × 121 (H) × 350 (D) mm
Mass	22.3 kg	15.5 kg

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main Frame
SPI-102	Spider - Standalone (Include RFCM-B, MLA-01 (×2))
SPI-103	Spider - Star - 2 node (Include RFCM-B (×2), SCM-5, MLA-01 (×4))
SPI-104	Spider - Star - 3 node (Include RFCM-B (×2), RFCM-C, SCM-5, MLA-01 (×4))
SPI-105	Spider - Mesh (Include RFCM-B (×6), MCM-4 (×4), MLA-01 (×6))
	Standard Software
DIR-II	Director-II Test Executive
DIR-805	Access Point Automation & Control Library
DIR-806	Traffic Source Automation & Control Library - iPerf
DIR-807	Traffic Source Automation & Control Library - Chariot
	Standard Accessory
	Power Cord: 1 pc
	Configuration Items
	-Hardware-
RFCM-B	RF Channel Module with Butler Matrix
RFCM-C	RF Channel Module without Butler Matrix
SCM-5	Star Combiner Module
MCM-4	Mesh Combiner Module
MLA-01	Near Field Adapter
	Hardware Options
TERM-4	4 port 50Ω Terminator
ACC-290	STACSIM – (Static Channel Simulator)
ACC-339	STACSIM-WB – (Static Channel Simulator)
RPE-401L/AC	RadioProof Enclosures
RPE-402	RadioProof Enclosures
	Support Services
SVC-101	Engineering and/or Training Service per hour
SVC-701	Annual Software Maintenance and System Technical Support
SVC-703	Advanced Replacement Service
SVC-710	Return To Factory Repair Evaluation

Please contact our sales representative for more details.

Universal Wireless Test Set

MT8870A

10 MHz to 3.8 GHz, 10 MHz to 6 GHz (Option)

Remote Control
GPIB | Ethernet

For Production Lines for Smartphones and Wireless Modules

Excellent Eco Product

Flexible Product Design for Parallel Testing of Multiple Wireless Standards

The remarkable success of smartphones and IoT is driving demand for faster inspection speeds on smartphone and communication module production lines and this market trend is expected to continue. Coupled with this, wireless communication standards are continuing to evolve and develop, leading to a growing range of specifications.
In these circumstances, terminal and module makers are looking to increase line efficiency while assuring smooth and flexible support for the various new standards.
With support for up to four test modules, the Universal Wireless Test Set MT8870A is the ideal cost-effective solution for high-efficiency inspection lines.

Four High-performance Test Modules in One Chassis

To enhance efficiency and reduce initial costs, up to four TRX test modules can installed in each MT8870A. This modular system brings with it the flexibility to adapt to changes in volume and to shifts and developments in wireless standards.

Up to 4 Modules

Up to four test modules can be installed in one chassis

Simultaneous Measurement of Multiple Wireless Standards

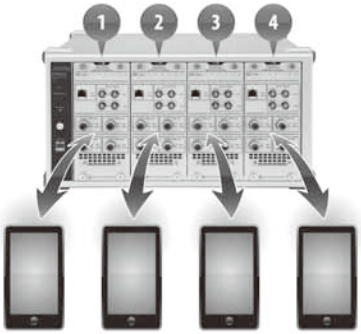
Smartphones and tablets with various wireless chipsets and antennas can all be tested with one MT8870A.
Because each installed test module can be controlled independently, multiple wireless tests can be run simultaneously.

Up to 4 Measurement Types

Four standards can be measured at once using four test modules in one chassis

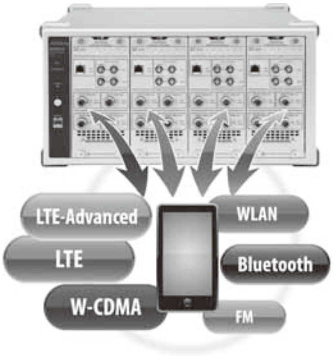
Simultaneous Control of Four Test Modules

Installing four independent test modules in the MT8870A supports simultaneous measurement of four separate wireless devices.
A unique IP address can be allocated to each slot and each test module supports remote control by Ethernet or optional GPIB connections.



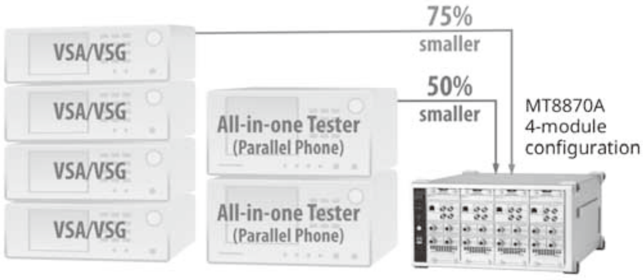
Four Simultaneous Measurements

Today's smartphones and tablets often support multiple wireless chipsets that all need to be tested and approved in the shortest possible time. Configuring an MT8870A with four test modules enables simultaneous testing of all wireless standards and greatly increases throughput efficiency.



50% to 75% Smaller Instrument Footprint

Instead of four separate test stations each requiring setup, the all-in-one, high-performance MT8870A main frame with up to four test modules saves both production line space and setup time.



Compared to conventional Anritsu products	All-in-one Tester (Parallel Phone)	VSA/VSG
MT8870A 4-module Configuration	50% smaller	75% smaller

40%* Reduction in Infrastructure Costs with Four Installed Test Modules

With four TRX test modules in one MT8870A main frame, the shared components cut capital costs by about 40%.

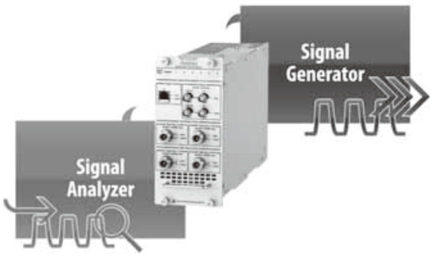
*: Typical 4-module configuration compared to single module design

Future-proof Inspection Lines

Mobile terminal manufacturers require not only production line efficiency but also the flexibility to adapt to changes in wireless standards. The MT8870A is the ideal instrument to meet these needs.

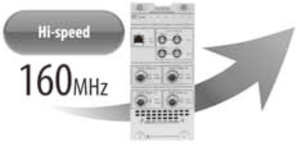
Built-in Signal Generator and Signal Analyzer in Each Test Module

The TRX Test Module MU887000A/01A (MU88700xA) has been developed for communication terminal device inspection lines.
Each installed test module has an independent high-performance signal generator and signal analyzer.



160 MHz Wide Bandwidth

To support the WLAN 802.11ac (Wave 2) and LTE-Advanced wireless standards requiring bandwidths of 100 MHz or more, the MU88700xA incorporates a signal generator and signal analyzer with a bandwidth of 160 MHz.



Wide Frequency Range from 10 MHz to 6 GHz (option)

The MU88700xA signal generator and signal analyzer cover a frequency range from 10 MHz to 3.8 GHz (extended to 6 GHz as option), assuring flexible support for new wireless standards.

Each Test Module Supports Multiple Wireless Standards

One MU88700xA supports multiple wireless communication standards.

Wireless Standards	Specifications
5G NR sub-6GHz	3GPP TS 38.101-1V15.0.0 (2017-12)
W-CDMA/HSDPA	3GPP TS 34.121-1 3GPP TS 25.141
GSM/EDGE	3GPP TS 51.010-1
LTE/LTE-Advanced/ NB-IoT/Cat-M	3GPP TS 36.521-1 3GPP TS 36.141
CDMA2000	3GPP2 TSG-C.S0011-C
1xEV-DO	3GPP2 TSG-C.S0033-B
TD-SCDMA	3GPP TS 34.122
WLAN	IEEE 802.11a/b/g/n/p/ac (Wave 2)/ax
Bluetooth®	Basic Rate/EDR/Bluetooth low energy (Bluetooth v5.0)
ZigBee	IEEE 802.15.4
Z-Wave	ITU-T G.9959
FM	RDS (IEC 62106 Edition 2.0)
GPS	GPS standard Positioning Service Signal
Galileo	European GNSS (Galileo) Open Service Signal In Space Interface Control Document
GLONASS	GLONASS ICD Navigational radiosignal In bands L1, L2
BeiDou	BeiDou Navigation Satellite System Signal In Space Interface Control Document Open Service Signal (Version 2.0)
DVB-H	ETSI EN300 744
ISDB-T/Tmm	ARIB STD-B31/B46

- Each standard is supported easily using a cost-effective licensing scheme
  Licenses are obtained by adding TX measurement software packages and waveform files.

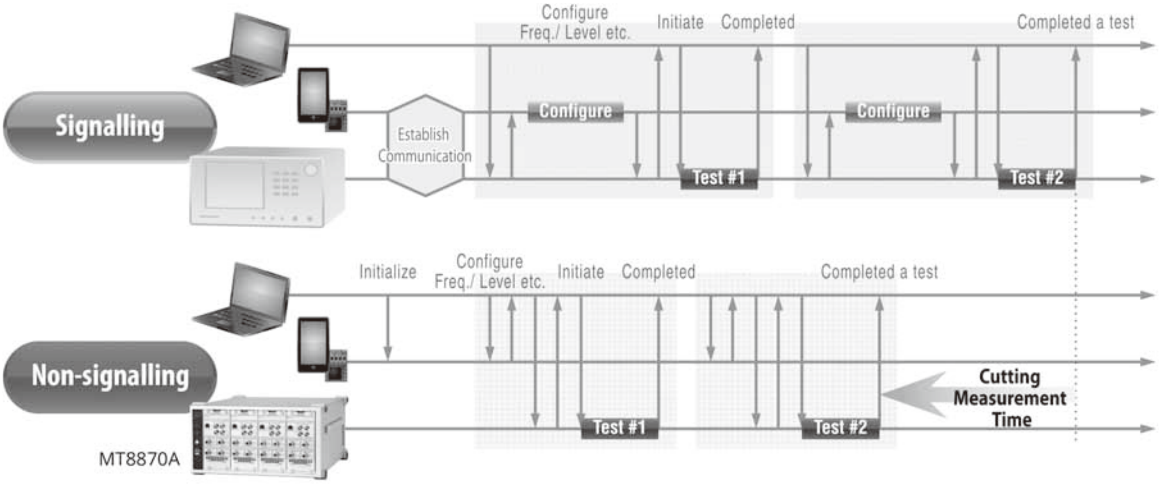
MU887000A/MU887001A
TRX Test Module

Integration with Leading-edge High-speed Measurement Methods

Times for manufacturing and testing mobile terminals have been slashed using leading-edge hardware architecture and parallel measurement technology. Additionally, multiple items for batch measurement processing can be freely selected for any number of repeat measurements. Batch measurement of selected items greatly simplifies and speeds up key tests.

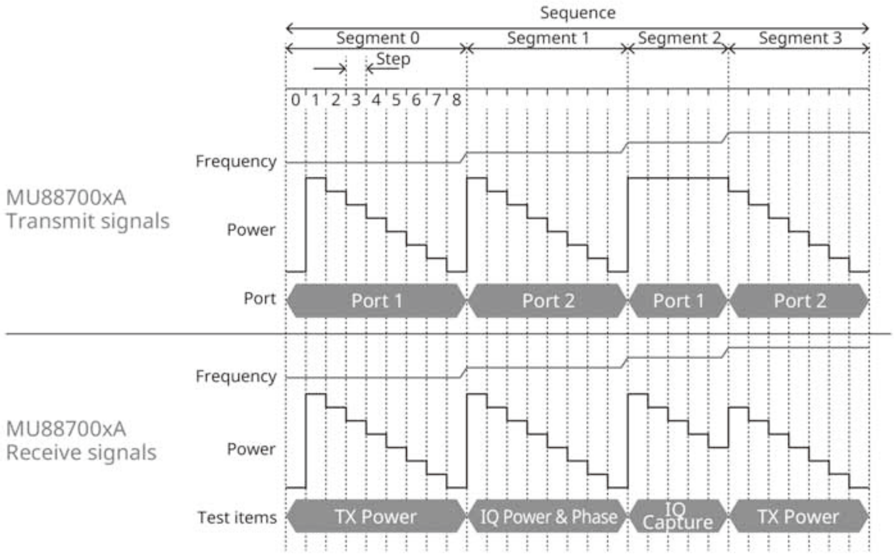
Non-signalling Measurement Support

The MT8870A performs measurements in a non-signalling environment. As shown in the figure below, alleviating the need to establish direct communication with the DUT brings considerable savings in both time and manufacturing costs.



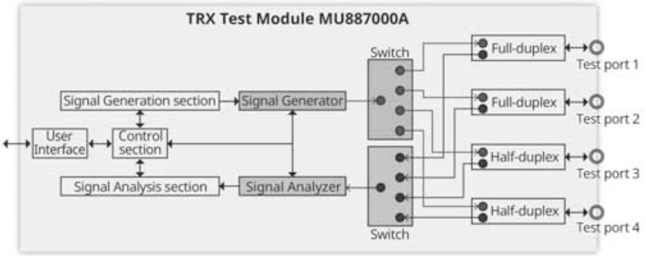
Sequence Measurement (Mobile Communication Terminals)

- For mobile terminals supporting sequence measurements (list mode), TRX tests are performed in accordance with a sequence table (list) where measurement conditions are recorded while changing the test conditions.
- Since each measurement is executed at high speed in accordance with a predetermined sequence without using remote control commands, line tact times are greatly reduced, increasing line throughput and efficiency.

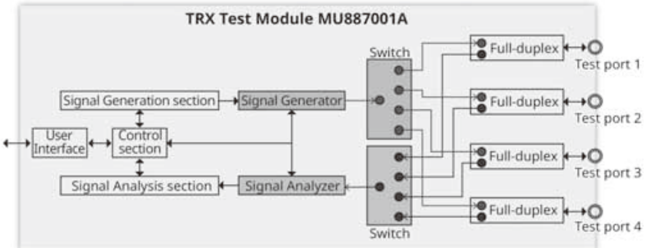


Four Test Ports per Module

Each MU887000A has two duplex and two half-duplex RF connectors. The duplex ports (Test port 1 and 2) incorporate dividers at the front end to support simultaneous tests in both TX and RX directions when testing typical wireless standards.
The half-duplex ports (Test port 3 and 4) incorporate switches at the front end to switch between each test port when used either for TX or RX tests. These half-duplex ports have higher sensitivity than the full-duplex ports and are ideal for low-level wireless signals.



The MU887001A has four duplex RF connectors.
Each MU887001A has four duplex RF connectors so that the test module can connect four mobile terminals at once to test them by high speed switching with the internal RF switches. Also the isolation performance between each test port is better than MU887000A.



The four test ports can be used for level calibration because they have high level accuracy over a wide frequency range from 10 MHz to 6 GHz (option). Internal switches can switch the TRX ports between input and output. Normally, simultaneous coupling measurements of multiple antennas require troublesome calibration corrections when using the required external dividers and external switches. With four test ports each incorporating the internal switch level deviation, the MU88700xA supports high level accuracy measurements over a wide frequency range.

Test Port and Wireless Technology

MU887000A

	Test port 1 and 2	Test port 3 and 4
Name	High power port	Low power port
Connector	N (female)	N (female)
Type (Configuration)	Duplex (divider)	Half-duplex (switch)
Outline	Support simultaneous use of VSG and VSA required for measuring mobile terminal standards	Do not support simultaneous use of VSA and VSG each of which must be used separately High accuracy supports measurement of low-level signals
Wireless Standards and Recommended Port	5G NR TDD sub-6GHz, LTE/LTE-Advanced FDD/TDD, W-CDMA, GSM/EDGE, CDMA2000/1xEV-DO, TD-SCDMA, NB-IoT, Category M, WLAN 802.11a/b/g/n/p/ac/ax*, Bluetooth*, IEEE 802.15.4*, Z-Wave, FM/RDS, GPS, Galileo, GLONASS, BeiDou, DVB-T, ISDB-T/Tmm	Cellular Diversity, WLAN 802.11a/b/g/n/p/ac, Bluetooth, IEEE 802.15.4, Z-Wave, FM/RDS, GPS, Galileo, GLONASS, BeiDou, DVB-T, ISDB-T/Tmm

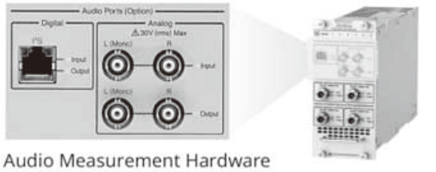
MU887001A

	Test port 1 to 4
Name	High power port
Connector	N (female)
Type (Configuration)	Duplex (divider)
Outline	Support simultaneous use of VSG and VSA required for measuring mobile terminal standards
Wireless Standards and Recommended Port	5G NR TDD sub-6GHz, LTE/LTE-Advanced FDD/TDD, W-CDMA, GSM/EDGE, CDMA2000/1xEV-DO, TD-SCDMA, NB-IoT, Category M, WLAN 802.11a/b/g/n/p/ac/ax, Bluetooth, IEEE 802.15.4, Z-Wave, FM/RDS, GPS, Galileo, GLONASS, BeiDou, DVB-T, ISDB-T/Tmm

*: Since test ports 1 and 2 have higher input levels than ports 3 and 4, use ports 3 and 4 when the MU88700xA input level is low.

Built-in Audio Analyzer/Audio Generator

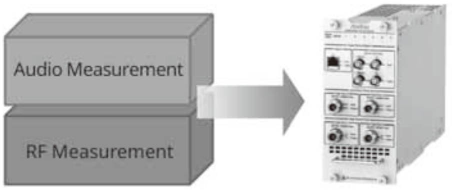
Installing the Audio Measurement Hardware MU88700xA-002 in the MU88700xA supports a built-in audio analyzer and audio generator. The MU88700xA-002 supports both analog and digital audio.
The stereo and monaural analog audio inputs and outputs of a communications device can be measured using the four BNC connectors (input and output for both left and right channels). Additionally, digital audio communications modules without analog audio inputs and outputs are supported without needing an AD/DC converter using the RJ-45 connector on the MU88700xA to measure digital audio signals using the standard inter-IC Sound (I2S) format.



Audio Measurement Hardware MU88700xA-002

TRX Test Module MU88700xA

The MU88700xA-002 solution saves spaces and cuts costs by combining RF and audio measurements into one unit, eliminating the need for separate production lines for RF measurements and audio measurements.



TRX Test Module	MU88700xA
Audio Measurement Hardware	MU88700xA-002

*: The audio analyzer and audio generator functions cannot be used simultaneously.

Ease of Configuration

Line capacity can change from week to week or month to month, depending on customers' needs and the specifications of the device under test. The number of test modules installed*[1] in the MT8870A can be tailored to meet changes in line test stations and items, keeping the line efficiency high without needing major configuration changes to the line and stations.

*1: Test modules cannot be hot-swapped with the power on.

One License for All Modules

Versatile Software Licenses

TX and RX measurement capabilities are enabled through licenses that can be purchased as required. Each license enables the associated capabilities on all installed test modules and represents excellent value for money in comparison to traditional, nonmodular test systems.

Software for TRX Test Module MU88700xA

Measurement Software MX8870xxA Series

Model	Description
MX887010A	Cellular Standards Sequence Measurement
MX887011A	W-CDMA/HSPA Uplink TX Measurement
MX887012A	GSM/EDGE Uplink TX Measurement
MX887013A	LTE FDD Uplink TX Measurement
MX887013A-001	LTE-Advanced FDD Uplink CA TX Measurement
MX887014A	LTE TDD Uplink TX Measurement
MX887014A-001	LTE-Advanced TDD Uplink CA TX Measurement
MX887015A	CDMA2000 Reverse Link TX Measurement
MX887016A	1xEV-DO Reverse Link TX Measurement
MX887017A	TD-SCDMA Uplink TX Measurement
MX887019A	NR TDD sub-6GHz Uplink Measurement
MX887021A	W-CDMA/HSPA Downlink TX Measurement
MX887023A	LTE FDD Downlink TX Measurement
MX887030A	WLAN 802.11b/g/a/n TX Measurement
MX887031A	WLAN 802.11ac TX Measurement
MX887032A	WLAN 802.11p TX Measurement (Automotive Connectivity V2X)
MX887033A	WLAN 802.11ax TX Measurement
MX887040A	Bluetooth TX Measurement
MX887040A-001	DLE TX Measurement
MX887040A-002	2LE TX Measurement
MX887040A-003	BLR TX Measurement
MX887050A	Short Range Wireless Average Power and Frequency Measurement
MX887060A	IEEE 802.15.4 TX Measurement
MX887061A	Z-Wave TX Measurement
MX887065A	Category M FDD Uplink TX Measurement
MX887067A	NB-IoT Uplink TX Measurement
MX887070A	FM/Audio TRX Measurement
MX887090A	Multi-DUT Measurement Scheduler

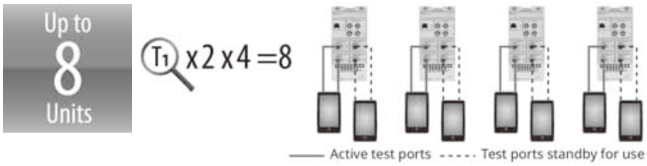
Waveforms MV887xxxA Series

Model	Description
MV887011A	W-CDMA/HSPA Downlink Waveforms
MV887012A	GSM/EDGE Downlink Waveforms
MV887013A	LTE FDD Downlink Waveforms
MV887014A	LTE TDD Downlink Waveforms
MV887015A	CDMA2000 Forward Link Waveforms
MV887016A	1xEV-DO Forward Link Waveforms
MV887017A	TD-SCDMA Downlink Waveforms
MV887019A	NR TDD sub-6GHz Downlink Waveforms
MV887021A	W-CDMA/HSPA Uplink Waveforms
MV887023A	LTE FDD Uplink Waveforms
MV887030A	WLAN 802.11b/g/a/n Waveforms
MV887031A	WLAN 802.11ac Waveforms
MV887032A	WLAN 802.11p Waveforms (Automotive Connectivity V2X)
MV887033A	WLAN 802.11ax Waveforms
MV887040A	Bluetooth Waveforms
MV887040A-001	DLE Waveforms
MV887040A-002	2LE Waveforms
MV887040A-003	BLR Waveforms
MV887060A	IEEE 802.15.4 Waveforms
MV887061A	Z-Wave Waveforms
MV887065A	Category M FDD Downlink Waveforms
MV887067A	NB-IoT Downlink Waveforms
MV887070A	FM RDS Waveforms
MV887100A	GPS Waveforms
MV887101A	Galileo Waveforms
MV887102A	GLONASS Waveforms
MV887103A	BeiDou Waveforms
MV887110A	DVB-H Waveforms
MV887111A	ISDB-T Waveforms
MV887112A	ISDB-Tmm Waveforms

Flexible Test System Configuration

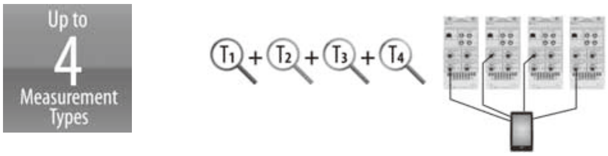
Simultaneous 8 Units Connection:

Since LTE/LTE-Advanced mobiles have RX diversity antenna, both TRX and RX diversity antennas must be adjusted and tested. The MU88700xA supports four ports in one module for connecting two LTE/LTE-Advanced terminals. Up to four modules can be installed in one MT8870A, supporting connection of up to eight LTE/LTE-Advanced terminals and simultaneous testing up to four terminals.



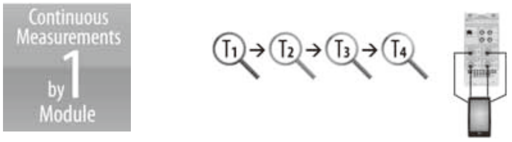
Four Simultaneous Measurements:

Recent smartphones support various wireless interfaces, such as Bluetooth and WLAN, in addition to cellular. Test times are cut by testing multiple wireless standards simultaneously.



Continuous Measurements of Multiple Communications Standards:

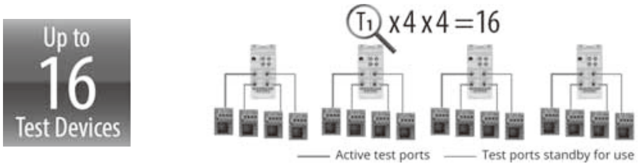
Licensing the TX measurement software packages and waveforms support continuous multiple measurements with one MU88700xA.



16 Simultaneous Connections:

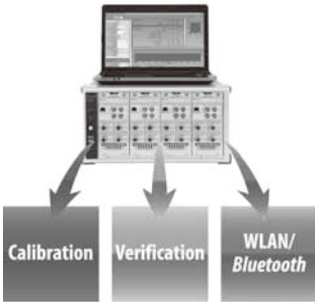
Each MU88700xA has four test ports. Up to four test modules can be installed in one MT8870A, supporting simultaneous connection of 16 test devices.

This versatility eliminates the need for external combiners and also reduces test fixture calibration.



Supports Flexible Line Changes

Generally, wireless device production lines are divided into different processing stages such as calibration, inspection, and function testing. Using different equipment at each stage causes problems, such as different test times, as well as the need to provide spare capacity to cover any faults at each process. Since the MT8870A has high versatility due to its modular configuration, it minimizes the need for spare capacity when reconfiguring the production line, etc.



Cellular Measurement Solution

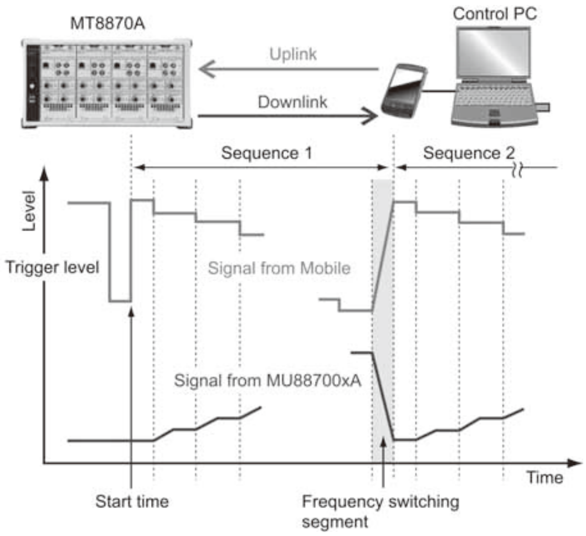
Cellular Standards Sequence Measurement **MX887010A**

Installing the Cellular Standards Sequence Measurement software MX887010A package in the MT8870A can be operated with preconfigured frequency and level in a sequence list to the signal generator and signal analyzer.

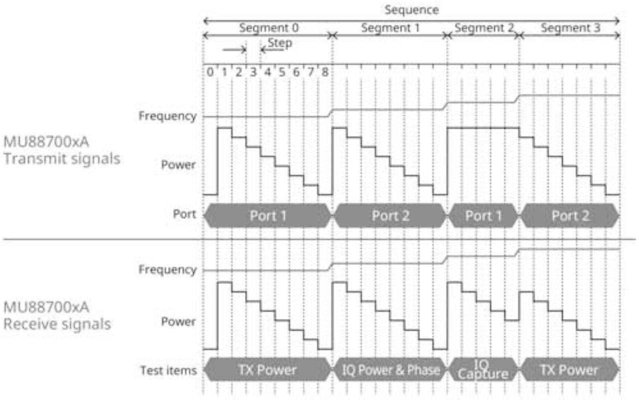
This software is able to greatly reduce calibration and verification time in conjunction with a chipset that supports capability for high-speed calibration and sequence measurement.

*1: Sequence measurement requires TX Measurement software MX88701xA

*2: Requires Waveforms MV88701xA for downlink signal modulation waveforms



TRX vs. Frequency Measurement



Sequence Measurement

W-CDMA/HSPA Uplink TX Measurement **MX887011A**
W-CDMA/HSPA Downlink Waveforms **MV887011A**

Installing the W-CDMA/HSPA Uplink TX Measurement software MX887011A in the MT8870A provides support for the following 3GPP W-CDMA and HSPA related TX characteristics measurements.

TX Power
Frequency Error
Occupied Bandwidth
Spectrum Mask
Adjacent Channel Leakage Power
Modulation Analysis

Additionally, the package of W-CDMA/HSPA Downlink Waveforms MV887011A contains downlink signals required for non-signaling measurements; sending the downlink signal for production is as easy as selecting the waveform file.

GSM/EDGE Uplink TX Measurement MX887012A
GSM/EDGE Downlink Waveforms MV887012A

Installing the GSM/EDGE Uplink TX Measurement software MX887012A in the MT8870A provides support for the following 3GPP GSM and EDGE related TX characteristics measurements.

TX Power
Power vs. Time
TX Frequency
Phase Error
EVM
Origin Offset
Output RF Spectrum

Additionally, the package of GSM/EDGE Downlink Waveforms MV887012A contains downlink signals required for non-signaling measurements; sending the downlink signal for production is as easy as selecting the waveform file.

LTE FDD Uplink TX Measurement MX887013A
LTE-Advanced FDD Uplink CA TX Measurement MX887013A-001
LTE FDD Downlink Waveforms MV887013A

Installing the LTE FDD Uplink TX Measurement software MX887013A in the MT8870A provides support for the following 3GPP LTE FDD related TX characteristics measurements.

TX Power
Frequency Error
Occupied Bandwidth
Spectrum Mask
Adjacent Channel Leakage Power
Modulation Analysis

Installing the LTE-Advanced FDD Uplink CA TX Measurement software MX887013A-001, extend LTE-Advanced Uplink CA (Carrier Aggregation) measurement on existing LTE FDD TX measurement software. Additionally, the package of LTE FDD Downlink Waveforms MV887013A contains downlink signals required for non-signaling measurements; sending the downlink signal for production is as easy as selecting the waveform file.

LTE TDD Uplink TX Measurement MX887014A
LTE-Advanced TDD Uplink CA TX Measurement MX887014A-001
LTE TDD Downlink Waveforms MV887014A

Installing the LTE TDD Uplink TX Measurement software MX887014A in the MT8870A provides support for the following 3GPP LTE TDD related TX characteristics measurements.

TX Power
Frequency Deviation
Occupied Bandwidth
Spectrum Mask
Adjacent Channel Leakage Power
Modulation Analysis

Installing the LTE-Advanced TDD Uplink CA TX Measurement software MX887014A-001, extend LTE Uplink CA (Carrier Aggregation) measurement on existing LTE TDD TX measurement software. Additionally, the package of LTE TDD Downlink Waveforms MV887014A contains downlink signals required for non-signaling measurements, sending the downlink signal for production is as easy as selecting the waveform file.

CDMA2000 Reverse Link TX Measurement MX887015A
CDMA2000 Forward Link Waveforms MV887015A

Installing the CDMA2000 Reverse Link TX Measurement software MX887015A in the MT8870A provides support for the following 3GPP2 CDMA2000 related TX characteristics measurements.

TX Power
Modulation Analysis
Occupied Bandwidth
Code Domain Power
Spurious Emissions

Additionally, the package of CDMA2000 Forward Link Waveforms MV887015A contains downlink signals required for non-signaling measurements; sending the downlink signal for production is as easy as selecting the waveform file.

1xEV-DO Reverse Link TX Measurement MX887016A
1xEV-DO Forward Link Waveforms MV887016A

Installing the 1xEV-DO Reverse Link TX Measurement software MX887016A in the MT8870A provides support for the following 3GPP2 CDMA2000 1xEV-DO related TX characteristics measurements.

TX Power
Modulation Analysis
Occupied Bandwidth
Code Domain Power
Spurious Emissions

Additionally, the package of 1xEV-DO Forward Link Waveforms MV887016A contains downlink signals required for non-signaling measurements; sending the downlink signal for production is as easy as selecting the waveform file.

TD-SCDMA Uplink TX Measurement MX887017A
TD-SCDMA Downlink Waveforms MV887017A

Installing the TD-SCDMA Uplink TX Measurement software MX887017A in the MT8870A provides support for the following 3GPP TD-SCDMA (1.28 Mcps TDD) related TX characteristics measurements.

TX Power
Frequency Deviation
Occupied Bandwidth
Spectrum Mask
Adjacent Channel Leakage Power
Modulation Analysis

Additionally, the package of TD-SCDMA Downlink Waveforms MV887017A contains downlink signals required for non-signaling measurements, sending the downlink signal for production is as easy as selecting the waveform file.

NR TDD sub-6GHz Uplink TX Measurement MX887019A
NR TDD sub-6GHz Downlink Waveforms MV887019A

Installing the NR TDD sub-6GHz Uplink Measurement MX887019A in the MT8870A provides support for the following 3GPP 5G NR TDD sub-6GHz related TX characteristics measurements.

TX Power
Frequency Deviation
Occupied Bandwidth
Spectrum Mask
Adjacent Channel Leakage Power
Modulation Analysis

Additionally, the package of NR TDD sub-6GHz Downlink Waveforms MV887019A contains downlink signals required for non-signaling measurements, sending the downlink signal for production is as easy as selecting the waveform file.

W-CDMA/HSPA Downlink TX Measurement MX887021A
W-CDMA/HSPA Uplink Waveforms MV887021A

Installing the W-CDMA/HSPA Downlink TX Measurement software MX887021A in the MT8870A provides support for the following 3GPP W-CDMA and HSPA related TX characteristics measurements.

TX Power
Frequency Deviation
Occupied Bandwidth
Spectrum Mask
Adjacent Channel Leakage Power
Modulation Analysis

Additionally, the package of W-CDMA/HSPA Uplink Waveforms MV887021A contains uplink signals required for non-signaling measurements, sending the uplink signal for production is as easy as selecting the waveform file.

LTE FDD Downlink TX Measurement MX887023A
LTE FDD Uplink Waveforms MV887023A

Installing the LTE FDD Downlink TX Measurement software MX887023A in the MT8870A provides support for the following 3GPP LTE FDD related TX characteristics measurements.

TX Power
Frequency Deviation
Occupied Bandwidth
Spectrum Mask
Adjacent Channel Leakage Power
Modulation Analysis

Additionally, the package of LTE FDD Uplink Waveforms MV887023A contains uplink signals required for non-signaling measurements, sending the uplink signal for production is as easy as selecting the waveform file.

Cellular-IoT Measurement Solution (Cellular-LPWA Solution)

Category M FDD Uplink TX Measurement MX887065A
Category M FDD Downlink Waveforms MV887065A

Installing the Category M FDD Uplink TX Measurement software MX887065A in the MT8870A provides support for the following 3GPP LTE Category M related TX characteristics measurements.

TX Power
Frequency Error
Occupied Bandwidth
Spectrum Mask
Adjacent Channel Leakage Power
Modulation Analysis

Additionally, the package of Category M FDD Downlink Waveforms MV887065A contains downlink signals required for non-signaling measurements; sending the downlink signal for production is as easy as selecting the waveform file.

NB-IoT Uplink TX Measurement MX887067A
NB-IoT Downlink Waveforms MV887067A

Installing the NB-IoT Uplink TX Measurement software MX887067A in the MT8870A provides support for the following 3GPP LTE NB-IoT related TX characteristics measurements.

TX Power
Frequency Error
Occupied Bandwidth
Spectrum Mask
Adjacent Channel Leakage Power
Modulation Analysis

Additionally, the package of NB-IoT Downlink Waveforms MV887067A contains downlink signals required for non-signaling measurements; sending the downlink signal for production is as easy as selecting the waveform file.

WLAN Measurement Solution

WLAN 802.11b/g/a/n TX Measurement MX887030A
WLAN 802.11b/g/a/n Waveforms MV887030A

The MT8870A/MU88700xA supports non-signalling transmitter and receiver tests for all WLAN 802.11a/b/g/n-compliant devices.
The 6 GHz Frequency Extension option MU88700xA-001 is required to measure 802.11a/n in 5 GHz band.

Transmitter Test

Installing the MX887030A in the MT8870A provides support for measurement of key IEEE 802.11a/b/g/n TX characteristics using all installed TRX test modules.

802.11b TX Measurement

IEEE 802.11b TX Test

802.11b	Test Items
17.4.7.2	Transmit Power Levels
17.4.7.3	Transmit Power Level Control
17.4.7.4	Transmit Spectrum Mask
17.4.7.5	Transmit Center Frequency Tolerance
17.4.7.6	Chip Clock Frequency Tolerance
17.4.7.7	Transmit power-on and power-down ramp
17.4.7.8	RF Carrier Suppression
17.4.7.9	Transmit Modulation Accuracy

Additional 802.11b Measurements

Test Items
Power crest factor
CCDF
IQ offset
Phase & magnitude error
Occupied bandwidth
Power spectral density

Graphical Displays (DSSS)

Power profile
Spectral mask
Constellation diagram
CCDF

802.11a/g/n TX Measurement

IEEE 802.11a/g/n TX Test

802.11a	802.11g	802.11n	Test Items
18.3.9.2	19.4.8.2	20.3.20.3	Transmit Power Levels
18.3.9.3	19.5.5	20.3.20.1	Transmit Spectrum Mask
18.3.9.5	19.4.8.3	20.3.20.4	Transmit center frequency tolerance
18.3.9.6	19.4.8.4	20.3.20.6	Symbol Clock frequency tolerance
18.3.9.7.2	19.4.8 (18.3.9.7.2)	20.3.20.7.2	Transmitter center frequency leakage
18.3.9.7.3	19.4.8 (18.3.9.7.3)	20.3.20.2	Transmitter spectral flatness
18.3.9.7.4	19.4.8 (18.3.9.7.4)	20.3.20.7.3	Transmitter constellation error
18.3.9.8	19.4.8 (18.3.9.8)	20.3.20.7.4	Transmitter modulation accuracy test

Additional 802.11a/g/n Measurements

Test Items
Power crest factor
CCDF
Occupied bandwidth
Power spectral density

Graphical Displays (OFDM)

Power profile
Spectral mask
Constellation diagram
CCDF
Spectral Flatness
EVM against Symbol
EVM against Subcarrier

Receiver Test

The MV887030A application provides support for transmission of WLAN 802.11a/b/g/n signals from the vector signal generator to the device under test (DUT). The number of received packets can then be read using the chipset vendor's control software.

Waveform Parameter

802.11 Standard	Data Rate/Modulation	Bandwidth	Packet Length	Remarks
802.11b	11, 5.5, 2, 1 Mbps	–	1024 or 100 bytes	Long Preamble
802.11a/g	54, 48, 36, 24, 18, 12, 9 and 6 Mbps	–	1000 or 100 bytes	
802.11n	MCS 0 to 7 and 32	20 MHz and 40 MHz	4096 or 500 bytes	Nss: 1, Guard Interval: Long

802.11b RX Measurement

IEEE 802.11b RX Test

802.11b	Test Items
17.4.8.2	Receiver minimum input level sensitivity
17.4.8.3	Receiver maximum input level

802.11a/g/n RX Measurement

IEEE 802.11a/g/n RX Test

802.11a	802.11g	802.11n	Test Items
18.3.10.2	19.5.2	20.3.21.1	Receiver minimum input level sensitivity
18.3.10.5	19.5.4	20.3.21.4	Receiver maximum input level

WLAN 802.11ac TX Measurement MX887031A
WLAN 802.11ac Waveforms MV887031A

The MT8870A/MU88700xA supports non-signalling transmitter and receiver tests for all WLAN 802.11ac-compliant devices.
The 6 GHz Frequency Extension option MU88700xA-001 is required.

Transmitter Test

Installing the WLAN 802.11ac TX Measurement software MX887031A in the MT8870A supports in-band wireless measurements defined by the IEEE 802.11ac on all installed TRX test modules.

802.11ac TX Measurement

IEEE 802.11ac TX Test

802.11ac	Test Items
22.3.18.1	Transmit spectrum mask
22.3.18.2	Spectral flatness
22.3.18.3	Transmit center frequency tolerance
22.3.18.3	Symbol Clock frequency tolerance
22.3.18.4	Modulation accuracy
22.3.18.4.2	Transmitter center frequency leakage
22.3.18.4.3	Transmitter constellation error
22.3.18.4.4	Transmitter modulation accuracy (EVM) test
	Transmit power level

Additional 802.11ac Measurements

Test Items
Power crest factor
CCDF
Occupied bandwidth
Power spectral density

Graphical Displays (OFDM)

Power profile
Spectral mask
Constellation diagram
CCDF
Spectral Flatness
EVM against Symbol
EVM against Subcarrier

Receiver Test

The MV887031A application provides support for transmission of WLAN 802.11ac signals from the vector signal generator to the device under test. The number of received packets can then be read using the chipset vendor's control software.

Waveform Parameter

802.11 Standard	Data Rate/Modulation	Bandwidth	Packet Length	Remarks
802.11ac	MCS 0 to 9	20, 40, 80, 160 MHz	4096 or 500 bytes	Nss: 1, Guard Interval: Long

802.11ac RX Measurement

IEEE 802.11ac RX Test

802.11ac	Test Items
22.3.19.1	Receiver minimum input level sensitivity
22.3.19.4	Receiver maximum input level

V2X Measurement Solution

WLAN 802.11p TX Measurement **MX887032A**
WLAN 802.11p Waveforms **MV887032A**

The MT8870A/MU88700xA supports non-signalling TRX tests for all WLAN 802.11p-compliant communications devices.
The 6 GHz Frequency Extension option MU88700xA-001 is required to measure 802.11p in 5.9 GHz band.

Transmitter Test

Installing the WLAN 802.11p TX Measurement software MX887032A in the MT8870A supports in-band wireless measurements for the 700 MHz and 5.9 GHz bands defined by IEEE 802.11p.

802.11p TX Measurement

IEEE 802.11p TX Test

802.11p	Test Items
18.3.9.2	Transmit power levels
18.3.9.3	Transmit spectrum mask
18.3.9.5	Transmit center frequency tolerance
18.3.9.6	Symbol clock frequency tolerance
18.3.9.7.2	Transmitter center frequency leakage
18.3.9.7.3	Transmitter spectral flatness
18.3.9.7.4	Transmitter constellation error

Additional 802.11p Measurements

Test Items
Power crest factor
CCDF
Occupied bandwidth
Power spectral density

Graph Displays (OFDM)

Power profile
Spectral mask
CCDF
IQ constellation
Spectral flatness
EVM vs. Symbol
EVM vs. Subcarrier
Frequency error vs. Time
Phase error vs. Symbol

Receiver Test

The MV887032A supports non-signalling RX tests of WLAN 802.11p devices under test (DUT) by sending WLAN 802.11p test signals from the MU88700xA installed in the vector signal generator. Reading the number of packets received by the DUT requires the chipset vendor's control software.

Waveform Parameter

Bandwidth	Data Rate	Packet Length
5 MHz	1.5, 2.25, 3, 4.5, 6, 9, 12, 13.5 Mbps	1000 bytes
10 MHz	3, 4.5, 6, 9, 12, 18, 24, 27 Mbps	1000 bytes
20 MHz	6, 9, 12, 18, 24, 36, 48, 54 Mbps	1000 bytes

802.11p RX Measurement

IEEE 802.11p RX Test

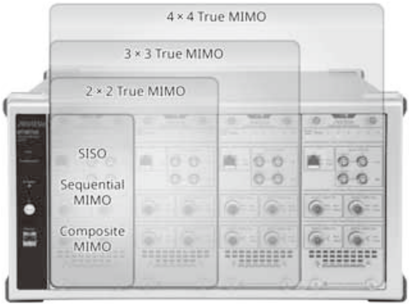
802.11p	Test Items
18.3.10.2	Receiver minimum input sensitivity
18.3.10.5	Receiver maximum input level

WLAN MIMO Measurement Solution

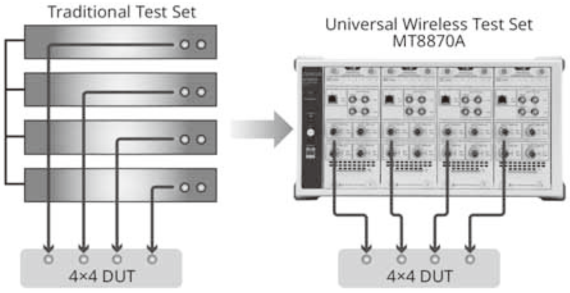
WLAN 802.11n/11ac MIMO Measurement Function

Installing the MU88700xA*[1] in the MT8870A with the installed WLAN TRX Measurement Software supports easy set-up and measurement of up to 4×4 WLAN MIMO devices.

*1: Requires 6 GHz Frequency Extension option MU88700xA-001 when measuring WLAN 802.11n (5 GHz) or 802.11ac



Normally, measuring each antenna of a MIMO device (streaming) requires a system set-up composed of up to four measuring instruments of the same type as well as synchronized timing of the signal generators required for MIMO measurement and the 10-MHz reference signal generators, plus complex cable connections to control each measuring instrument.
This type of system set-up is not only troublesome for technicians performing MIMO measurements, but also wastes man hours and money. Integrating the MU88700xA into the MT8870A main frame solves the problems of synchronizing signals over external cables experienced with conventional MIMO measurement systems to simplify system set-up and slash time and costs.

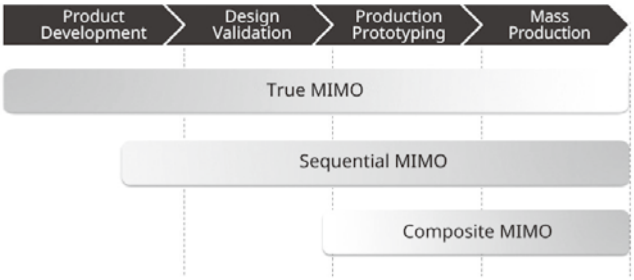


The MX887030A and MV887030A are required for WLAN 802.11n MIMO measurements.
The MX887031A and MV887031A are required for WLAN 802.11ac MIMO measurements*[2].

*2: Supports up to 4×4 MIMO WLAN 802.11ac measurements

MIMO Measurement Solutions

The MT8870A is the ideal MIMO measurement solution for WLAN MIMO devices at every stage from R&D to production.



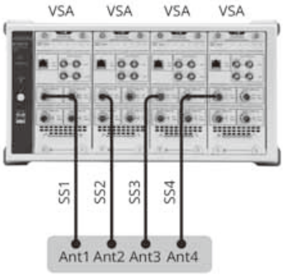
True MIMO

Features

The MT8870A supports parallel measurement of WLAN device streaming characteristics using multiple MU88700xA units installed in the main frame.
It is ideal for performing streaming measurements from each antenna under conditions closely mimicking a real usage environment at the R&D and design stages. There is no need for troublesome external cable connections, because the timing of each MU88700xA unit and the 10-MHz reference frequency are synchronized by the internal connections, offering easy True MIMO measurement.

Transmitter Test

- DUT transmits four MIMO signals simultaneously.
- MU88700xA in each slot tests each antenna (stream)
- Fully independent measurements with parallel processing by each MU88700xA
- Test Results
  Each TX power (Cross power), EVM, Spectral mask, etc.



Test sequence:

Antenna 1
Antenna 2
Antenna 3
Antenna 4

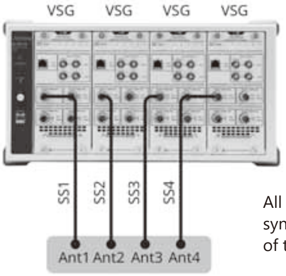
Test results:

Antenna 1: EVM_1, Power_1, Spectral mask_1 ...
Antenna 2: EVM_2, Power_2, Spectral mask_2 ...
Antenna 3: EVM_3, Power_3, Spectral mask_3 ...
Antenna 4: EVM_4, Power_4, Spectral mask_4 ...

Receiver Test

- Sends test packets for each antenna to TRX Test Module in each slot
- Test Results
  RX sensitivity of each antenna
- Synchronization
  10-MHz reference frequency
  Digital timing

Note: RF local frequency sync. not supported



All spatial streams must be synchoronized to the start of the packet.

Sequential MIMO

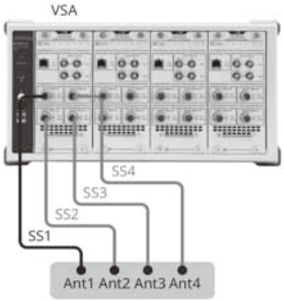
Features

WLAN device MIMO measurements at R&D design require stream measurements from each antenna. Although True MIMO measurement supports an environment in which each antenna is measured simultaneously in parallel, the cost is high because multiple MU88700xA units are required. Since one MU88700xA can support up to four test ports, the Sequential MIMO measurement functions helps cut costs by switching between antennas to perform accurate sequential measurement of each antenna of the MIMO device.

Transmitter Test

- DUT transmits four MIMO signals simultaneously
- MT8870A switches connected test port and performs TRX test at each antenna (stream)
- Test results
  Each TX power (Cross power*3), EVM, Spectral mask, etc.

*3: There are limitation on the combination of test ports used for cross power measurements.



Test sequence:

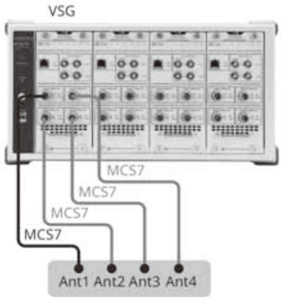
Antenna 1
Antenna 2
Antenna 3
Antenna 4

Test results:

Antenna 1: EVM_1, Power_1, Spectral mask_1 ...
Antenna 2: EVM_2, Power_2, Spectral mask_2 ...
Antenna 3: EVM_3, Power_3, Spectral mask_3 ...
Antenna 4: EVM_4, Power_4, Spectral mask_4 ...

Receiver Test

- MT8870A switches test port and sends test signal to each antenna to perform RX sensitivity test
- Waveform uses SISO signal
- Test results
  RX test for each antenna



Composite MIMO

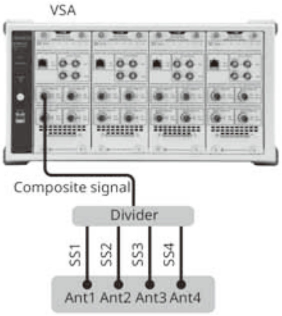
Features

Production-line operators urgently need ways to cut production costs by shortening tact times through reduced measurement times. MIMO device measurement methods currently focus on measuring each antenna one-by-one but viewed from the perspective of reduced tact time and lower costs, production lines could achieve better efficiency and profits with one single measurement of all MIMO device antennas instead of separate measurements of all antennas (total streaming). Installing the MT8870A with one MU88700xA supports use of the Composite MIMO measurement function to measure WLAN RF characteristics at one time by combining and dividing multiple MIMO signals using an external divider (combiner)*.

*: Recommended Product
Mini-Circuits, ZN4PD1-63 + (Frequency range: 2000 MHz to 6000 MHz)

Transmitter Test

- DUT transmits three MIMO signals simultaneously
- MT8870A receives composite test signal via combiner, which combines each streaming MIMO signal output from each antenna, and evaluates RF characteristics
- Test results
  Composite power (individual powers)
  Composite EVM and spectral mask values



Test sequence:

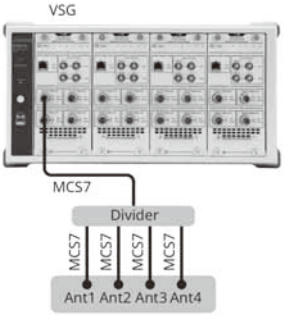
Composite

Test results:

EVM_Avg, Power_Avg, Spectral mask_Avg ...

Receiver Test

- Diversity test (SISO signal)
- Transmits test signal from MT8870A and splits into identical signals at divider (combiner) for input to each antenna
- Since same signal received by multiple antennas, performs better evaluation than RX sensitivity results obtained from one antenna
- Test results
  RX sensitivity (result is one value only; test specifications of sensitivity changed by number of antennas)



WLAN Measurement Solution

WLAN 802.11ax TX Measurement **MX887033A**
WLAN 802.11ax Waveforms **MV887033A**

The MT8870A/MU88700xA supports non-signalling transmitter and receiver tests for all WLAN 802.11ax-compliant devices.
The 6 GHz Frequency Extension option MU88700xA-001 is required.

Transmitter Test

Installing the WLAN 802.11ax TX Measurement software MX887033A in the MT8870A supports in-band wireless measurements defined by the latest IEEE 802.11ax/D1.3 standard on all installed TRX test modules.
The 802.11ax 20/40/80 MHz bandwidths and 1024QAM (MCS10/11) modulation method are supported.
Using the CombiView PC application bundle displays graphs of 802.11ax TX measurements.

802.11 ax TX Measurement

IEEE P802.11ax/D1.3 802.11ax

Chapter	Measurement Item
28.3.18.1	Transmit spectral mask
28.3.18.2	Spectral flatness
28.3.18.3	Transmit center frequency and symbol clock frequency tolerance
28.3.18.4.2	Transmit center frequency leakage
28.3.18.4.3	Transmitter constellation error
28.3.18.4.4	Transmitter modulation accuracy (EVM) test

Receiver Test

The MV887031A application provides support for transmission of WLAN 802.11ax signals from the vector signal generator to the device under test. The number of received packets can then be read using the chipset vendor's control software.
Waveform Parameter

802.11 Standard	Data Rate/Modulation	Bandwidth	Packet Length	Remarks
802.11ax	MCS 0 to 11	20, 40, 80 MHz	4096 bytes	Nss: 1, Guard interval: 800 ns

802.11 ax RX Measurement

IEEE P802.11ax/D1.3 802.11ax

Chapter	Measurement Item
28.3.17.2	Receiver minimum input sensitivity
28.3.17.5	Receiver maximum input level

Bluetooth Measurement Solution

Bluetooth TX Measurement	**MX887040A**
DLE TX Measurement	**MX887040A-001**
2LE TX Measurement	**MX887040A-002**
BLE TX Measurement	**MX887040A-003**
Bluetooth Waveforms	**MV887040A**
DLE Waveforms	**MV887040A-001**
2LE Waveforms	**MV887040A-002**
BLR Waveforms	**MV887040A-003**

The MT8870A/MU88700xA supports non-signalling transmitter and receiver tests for Basic Rate (BR), Enhanced Data Rate (EDR) and Bluetooth low-energy (BLE) devices.

Transmitter Test

The Bluetooth TX Measurement software MX887040A has two Bluetooth TX test modes. The SIG Standard mode measures TX test packets sent from the device under test according to the Bluetooth RF Test Specifications. In SIG standard mode, the system returns only measurements that are compatible with the payload type of the captured packets. In Speed Test mode, the system returns results for all enabled measurements regardless of the packet payload.
Because the Speed Test mode supports all BR/EDR measurements for individual packet types, it is ideal for rapid testing on production lines.

Bluetooth TX Measurement

Basic Rate and Enhanced Data Rate (EDR)
Basic Rate measurements and Enhanced Data Rate measurements made in compliance with Bluetooth RF Test Specification RF-PHY.TS.5.0.0

Specification	Test Items
TP/TRM/CA/BV-01-C	Output Power
TP/TRM/CA/BV-03-C	Power Control
TP/TRM/CA/BV-05-C	TX Output Spectrum 20 dB Bandwidth
TP/TRM/CA/BV-06-C	TX Output Spectrum Adjacent Channel Power
TP/TRM/CA/BV-07-C	Modulation Characteristics
TP/TRM/CA/BV-08-C	Initial Carrier Frequency Tolerance
TP/TRM/CA/BV-09-C	Carrier Frequency Drift
TP/TRM/CA/BV-10-C	EDR Relative Transmit Power
TP/TRM/CA/BV-11-C	EDR Carrier Frequency Stability and Modulation Accuracy
TP/TRM/CA/BV-12-C	EDR Differential Phase Encoding
TP/TRM/CA/BV-13-C	EDR In-band Spurious Emissions
TP/TRM/CA/BV-14-C	Enhanced Power Control

Bluetooth Low Energy
Bluetooth low energy measurements made in compliance with Bluetooth RF Test Specification RF-PHY.TS.5.0.0

Specification	Test Items
TP/TRM-LE/CA/BV-01-C	Output power
TP/TRM-LE/CA/BV-05-C	Modulation Characteristics, uncoded data at 1 Msym/s
TP/TRM-LE/CA/BV-06-C	Carrier frequency offset and drift, uncoded data at 1 Msym/s
TP/TRM-LE/CA/BV-09-C	Stable Modulation Characteristics, uncoded data at 1 Msym/s
TP/TRM-LE/CA/BV-10-C	Modulation Characteristics at 2 Msym/s
TP/TRM-LE/CA/BV-11-C	Stable Modulation Characteristics at 2 Msym/s
TP/TRM-LE/CA/BV-12-C	Carrier frequency offset and drift at 2 Msym/s
TP/TRM-LE/CA/BV-13-C	Modulation Characteristics, LE Coded (S = 8)
TP/TRM-LE/CA/BV-14-C	Carrier frequency offset and drift, LE Coded (S = 8)

Graphical Displays (BR/BLE)

Graphs
Power Burst profile
Frequency deviation
Eye diagram
Spectral profile

Graphical Displays (EDR)

Power burst profile
Frequency deviation
IQ constellation diagram
DEVM against symbol
Vector diagram
Spectral profile

Receiver Test

The MV887040A application provides support for transmission of Bluetooth signals from the vector signal generator to the device under test. The number of received packets can then be read using the chipset vendor's control software.

Standard Waveforms

Bluetooth	Waveform Type
Basic Rate (BR)	DH1/DH3/DH5
Enhanced Data Rate (EDR)	2-DH1/2-DH3/2-DH5/3-DH1/3-DH3/3-DH5
Bluetooth Low Energy (BLE)	BLE/PER Report Integrity Test
Others	GFSK/PSK CW (Interference Waveform)

Bluetooth RX Measurement

Basic Rate and Enhanced Data Rate (EDR)
Basic Rate measurements and Enhanced Data Rate measurements made in compliance with Bluetooth RF Test Specification RF-PHY.TS.5.0.0

Specification	Test Items
TP/RCV/CA/BV-01-C	Sensitivity – single slot packets
TP/RCV/CA/BV-02-C	Sensitivity – multi-slot packets
TP/RCV/CA/BV-06-C	Maximum Input Level
TP/RCV/CA/BV-07-C	EDR Sensitivity
TP/RCV/CA/BV-08-C	EDR BER Floor Performance
TP/RCV/CA/BV-10-C	EDR Maximum Input Level

Bluetooth Low Energy
Bluetooth low energy measurements made in compliance with Bluetooth RF Test Specification RF-PHY.TS.5.0.0

Specification	Test Items
TP/RCV-LE/CA/BV-01-C	Receiver sensitivity, uncoded data at 1 Msym/s
TP/RCV-LE/CA/BV-06-C	Maximum input signal level, uncoded data at 1 Msym/s
TP/RCV-LE/CA/BV-07-C	PER Report Integrity, uncoded data at 1 Msym/s
TP/RCV-LE/CA/BV-08-C	Receiver sensitivity at 2 Msym/s
TP/RCV-LE/CA/BV-12-C	Maximum input signal level at 2 Msym/s
TP/RCV-LE/CA/BV-14-C	Receiver sensitivity at 1 Msym/s, Stable Modulation Index
TP/RCV-LE/CA/BV-18-C	Maximum input signal level, uncoded data at 1 Msym/s, Stable Modulation Index
TP/RCV-LE/CA/BV-19-C	PER Report Integrity, uncoded data at 1 Msym/s, Stable Modulation Index
TP/RCV-LE/CA/BV-20-C	Receiver sensitivity at 2 Msym/s, Stable Modulation Index
TP/RCV-LE/CA/BV-24-C	Maximum input signal level at 2 Msym/s, Stable Modulation Index
TP/RCV-LE/CA/BV-26-C	Receiver sensitivity, LE Coded (S = 2)
TP/RCV-LE/CA/BV-27-C	Receiver sensitivity, LE Coded (S = 8)
TP/RCV-LE/CA/BV-32-C	Receiver sensitivity, LE Coded (S = 2), Stable Modulation Index
TP/RCV-LE/CA/BV-33-C	Receiver sensitivity, LE Coded (S = 8), Stable Modulation Index

Short Range Wireless Average Power and Frequency Measurement MX887050A

Installing the Short Range Wireless Average Power and Frequency Measurement software MX887050A in the MT8870A provides support for simple tests for WLAN and Bluetooth connectivity wireless. The MX887050A supports CW power and frequency measurements on unmodulated signals and on signals modulated using the methods shown in the table below.
MX887050A is also utilized for the RF calibration test of connectivity devices using unmodulated signals.

Supported Modulation Methods	
WLAN	DSSS, OFDM
Bluetooth	GFSK, PSK

IEEE 802.15.4 Measurement Solution

IEEE 802.15.4 TX Measurement MX887060A
IEEE 802.15.4 Waveforms MV887060A

The MT8870A/MU88700xA support IEEE 802.15.4-recommended O-QPSK modulation signal TRX tests of communications devices.

Transmitter Test

Installing the IEEE 802.15.4 TX Measurement software MX887060A in the MT8870A supports measurement of the key TX characteristics recommended by the IEEE 802.15.4 standard released in 2011.

802.15.4 TX Measurement

IEEE 802.15.4 - 2011: 802.15.4 TX Measurements

802.15.4	Measurements
10.3.2	Transmit power spectral density (PSD) mask
10.3.3	Symbol rate
10.3.7	RX-to-TX turnaround time
10.3.8	Error vector magnitude (EVM)
10.3.9	Transmit center frequency tolerance
10.3.10	Transmit power

Graphical Displays

Spectral mask
Constellation diagram
Power vs. Time

Receiver Test

With a vector signal generator built into the MU88700xA, transmitting the test signal from the selected package of IEEE 802.15.4 Waveforms MV887060A supports RX tests of IEEE 802.15.4 devices. The specified number of packets is sent from the MU88700xA to the device under test (DUT). The chipset developer’s control software is required to capture packets received by the DUT.

Waveform Parameter

Waveform Name	Modulation	Band	Data Rate	Chip Rate	Filter	Signal Length
MV887060A_ZB2450_0001	O-QPSK	2450 MHz	250 kbps	2000 kchip/s	Half-sine	1664 chip
MV887060A_ZB2450_0002	O-QPSK	2450 MHz	250 kbps	2000 kchip/s	Half-sine	1024 chip
MV887060A_ZB915_0001	O-QPSK	915 MHz	250 kbps	1000 kchip/s	Half-sine	832 chip
MV887060A_ZB915_0002	O-QPSK	915 MHz	250 kbps	1000 kchip/s	Half-sine	1024 chip
MV887060A_ZB868_0001	O-QPSK	868 MHz	100 kbps	400 kchip/s	Half-sine	832 chip
MV887060A_ZB868_0002	O-QPSK	868 MHz	100 kbps	400 kchip/s	Half-sine	1024 chip
MV887060A_ZB780_0001	O-QPSK	780 MHz	250 kbps	1000 kchip/s	Raised cosine (roll-off 0.8)	832 chip
MV887060A_ZB780_0002	O-QPSK	780 MHz	250 kbps	1000 kchip/s	Raised cosine (roll-off 0.8)	1024 chip

802.15.4 RX Measurement

IEEE 802.15.4 - 2011: 802.15.4 RX Measurements

802.15.4	Measurements
10.3.4	Receiver sensitivity
10.3.11	Receiver maximum input level of required signal

Z-Wave Measurement Solution

Z-Wave TX Measurements **MX887061A**
Z-Wave Waveforms **MV887061A**

The MT8870A/MU88700xA supports non-signalling TRX tests of ITU-T G.9959-compliant communications devices.

Transmitter Test

Installing the Z-Wave TX Measurement software MX887061A in the MT8870A supports the key TX measurements defined by ITU-T G.9959 - 2012. Using the CombiView PC application bundle displays graphs of various Z-Wave TX measurement results.

ITU-T G.9959 TX Measurement

ITU-T G.9959 2012 TX Measurements

ITU-T G.9959	Test Items
7.1.2.2	Data rates
7.1.2.5.1	Transmit frequency error
7.1.2.5.2	Transmit power adjustments (conducted)

Graphical Displays

Data table
Power vs. Time
Frequency vs. Time

Receiver Test

The MV887061A supports RX tests of Z-Wave devices under test (DUT) by sending Z-Wave test signals from the MU88700xA installed in the vector signal generator. Reading the number of packets received by the DUT requires the chipset vendor's control software.

Waveform Parameter

Waveform Name	Modulation	Data Rate	Bit Rate	Symbol Rate	Filter	PPDU	Preamble Sequence	SFD	PSDU
MV887061A_ZW_R1_0001	2FSK	R1	9.6 kbps	19.2 kbaud	Gaussian (BT=1.0)	26 bytes (208 bits)	10 bytes	1 byte	14 bytes (incl. MPSU 4 bytes)
MV887061A_ZW_R2_0001	2FSK	R2	40 kbps	40 kbaud	Gaussian (BT=1.0)	35 bytes (280 bits)	20 bytes	1 byte	14b ytes (incl. MPSU 4 bytes)
MV887061A_ZW_R3_0001	2FSK	R3	100 kbps	100 kbaud	Gaussian (BT=0.6)	40 bytes (320 bits)	24 bytes	1 byte	15 bytes (incl. MPSU 4 bytes)
MV887061A_ZW_R1_0002	2FSK	R1	9.6 kbps	19.2 kbaud	Gaussian (BT=1.0)	76 bytes (608 bits)	10 bytes	1 byte	64 bytes (incl. MPSU 54 bytes)
MV887061A_ZW_R2_0002	2FSK	R2	40 kbps	40 kbaud	Gaussian (BT=1.0)	85 bytes (680 bits)	20 bytes	1 byte	64 bytes (incl. MPSU 54 bytes)
MV887061A_ZW_R3_0002	2FSK	R3	100 kbps	100 kbaud	Gaussian (BT=0.6)	211 bytes (1688 bits)	40 bytes	1 byte	170 bytes (incl. MPSU 159 bytes)

ITU-T G.9959 RX Measurement

ITU-T G.9959 2012 RX Measurement

802.15.4	Test Items
ITU-T G.9959	Test Items
7.1.2.5.3	Receiver sensitivity

Receiver Measurement Solution

MV8871xx Series Waveforms

The MT8870A/MU88700xA supports RX tests of receivers using the various common communications technologies in widespread use today.

RX Test Using Waveforms

The Waveforms MV8871xxA series is a file of waveforms for generating any output waveform standardized by each communications technology. Saving and selecting these files in the internal waveform memory of the MU88700xA makes it easy to output a signal for any waveform pattern from the built-in vector signal generator.
Waveform file generated from the MU88700xA vector signal generator can be used to run sensitivity tests and simple BER RX tests* on GPS and digital broadcast equipment supporting mobile terminals and communications appliances.

*: An external attenuator is required when running RX tests at lower levels than the lower output limit of the signal generator.

Main Specifications of MV8871xxA Series Waveforms

GPS Waveforms MV887100A

Waveform File Name	MV887100A_GPS_0002	MV887100A_GPS_0003
Application	Sensitivity test/BER measurement	Parity detection/Sensitivity test
Transmitted Data Modulation Method	BPSK	
Satellite ID Number	1	
Reference Standard	GLOBAL POSITIONING SYSTEM STANDARD POSITIONING SERVICE SIGNAL SPECIFICATION	

Galileo Waveforms MV887101A

Waveform File Name	MV887101A_GALILEO_0001
Application	Parity detection/Sensitivity test
Transmitted Data Modulation Method	QPSK or CBOC (depending on selecting waveforms)
Satellite ID Number	1
Reference Standard	European GNSS (Galileo) Open Service Signal In Space Interface Control Document

GLONASS Waveforms MV887102A

Waveform File Name	MV887102A_GLONASS_0001	MV887102A_GLONASS_010x MV887102A_GLONASS_011x
Application	Sensitivity test/BER measurement	Simultaneous GPS and GLONASS measurements[*1], C/No measurements
Transmitted Data Modulation Method	BPSK	BPSK
Satellite ID Number	3	–
Reference Standard	INTERFACE CONTROL DOCUMENT Navigational radio signal In bands L1, L2 Edition 5.1	

*1: MV887100A GPS waveforms license is required to perform simultaneous GPS and GLONASS measurements.

BeiDou Waveform MV887103A

Waveform File Name	MV887103A_BEIDOU_0002
Application	Parity detection/Sensitivity test
Transmitted Data Modulation Method	QPSK (Only I phase)
Satellite ID Number	1, 6 (depending on selected waveforms)
Reference Standard	BeiDou Navigation Satellite System Signal In Space Interface Control Document Open Service Signal (Version 2.0)

DVB-H Waveforms MV887110A

Waveform File Name	MV887110A_DVBH_0001
Application	Simple BER measurement
Transmitted Data	PN9fix[*2]
Transmitted Data Modulation Method	QPSK
Encoding Rate	2/3
System Bandwidth	8 MHz
Cell ID	0x0000
Reference Standard	ETSI EN 300 744 V1.5.1 (2004-11)

*2: fix indicates the PN sequence is not continued if the waveform is regenerated from the first position.

ISDB-T Waveforms MV887111A

Waveform File Name	MV887111A_ISDBT_0001	MV887111A_ISDBT_0002	MV887111A_ISDBT_0003	MV887111A_ISDBT_0004
Application	Device evaluation	Video and audio evaluation[*3]		Simple BER measurement
Waveform Cycle/Group	2 [Frame]	40 [Frame]	40 [Frame]	4 [Frame]
Transmitted Data	PN23fix[*4]			
Transmitted Data Modulation Method	Layer A: 64QAM and Layer A: QPSK Layer B: 64QAM	Layer A: QPSK Layer B: 64QAM		Layer A: QPSK or 16QAM Layer B: 64QAM
Guard Interval	1/8			
Encoding Rate	No Encoding	Layer A: 2/3 Layer B: 7/8	Layer A: 2/3 Layer B: 3/4	Layer A: 2/3 or 1/2 Layer B: 3/4 or 7/8
Mode	3			
Reference Standard	ARIB STD-B31			

*3: RX not guaranteed for all receivers
*4: fix indicates the PN sequence is not continued if the waveform is regenerated from the first position.

ISDB-Tmm Waveforms MV887112A

Waveform File Name	MV887112A_ISDBTmm_SSpatA_000x_0M (x = 1 to 6) MV887112A_ISDBTmm_SSpatA_000x_8M (x = 1 to 6) MV887112A_ISDBTmm_SSpatC_000x_0M (x = 7 to 12) MV887112A_ISDBTmm_SSpatC_000x_8M (x = 7 to 12) The XXXX_8M waveform pattern is a waveform with the file name XXXX_0M to which an 8-MHz offset has been added.
Application	Simple BER measurement
Waveform Cycle/Group	4 [Frame]
Transmitted Data	PN23fix*5
Transmitted Data Modulation Method	QPSK or 16QAM
Waveform Format	A type or C type
Guard Interval	1/4
Encoding Rate	1/2 or 2/3
Mode	3
Reference Standard	ARIB STD-B46

*5: fix indicates the PN sequence is not continued if the waveform is regenerated from the first position.

Consult Anritsu for details about each waveform file.

FM/RDS Measurement Solution

FM/Audio TRX Measurement MX887070A
FM RDS Waveforms MV887070A
(RDS: Radio Data System)

The MT8870A/MU88700xA supports TRX tests of FM transceivers and adding an option also supports audio tests.

FM Transmitter Test

Installing the Audio Measurement Hardware MU88700xA-002 in the MU88700xA outputs either analog or digital format audio signals for up to 8 multi-tones (stereo left and right channels) from the output connector. The audio signal is available for input to the FM transmitter audio input connector.
The FM/Audio TRX Measurement software MX887070A is used with the built-in signal analyzer of the MU88700xA to execute various audio tests, such as measurement of RF frequency, level and frequency deviation of audio FM signals output from FM transmitters, as well as AF signal frequency, level (up to 12 multi-tones), distortion, stereo crosstalk, etc., when using AF signal waveforms, and analysis of internal data and output of RDS data by decoding data when receiving RDS waveforms.

FM Receiver Test

To test FM receivers using the FM/Audio TRX Measurement software MX887070A, the specified test audio signal is frequency modulated and a signal is output from the vector signal generator.
Installing the Audio Measurement Hardware MU88700xA-002 in the MU88700xA inputs either analog or digital format audio signals output from the FM receiver to the built-in audio analyzer of the MU88700xA to perform audio tests including AF signal frequency and level (up to 12 multi-tones), distortion rate, stereo crosstalk, etc.

FM Receiver Test RDS (Radio Data System)

Loading the FM RDS Waveforms MV887070A supports output of waveforms including transmitted data such as radio text data from the built-in vector signal generator based on the FM RDS (Radio Data System) standard.

Main Specifications of FM RDS Waveforms

Waveform File Name		MV887070A_FMRDS_0001	MV887070A_FMRDS_0002	MV887070A_FMRDS_0003	MV887070A_FMRDS_0004
Application		DUT RDS RX function test			DUT RX test
AF Left Channel	Tone Count	1			
	Tone Frequency	1 kHz			
	Tone Deviation	75 kHz × 0.9			
AF Right Channel	Tone Count	1			
	Tone Frequency	2 kHz			
	Tone Deviation	75 kHz × 0.9			
Pilot Deviation		75 kHz × 0.1			
RDS Deviation		75 kHz × 0.05			
Reference Standard		IEC 62106 Edition 2.0			

Consult Anritsu for details about the FM RDS waveform file.

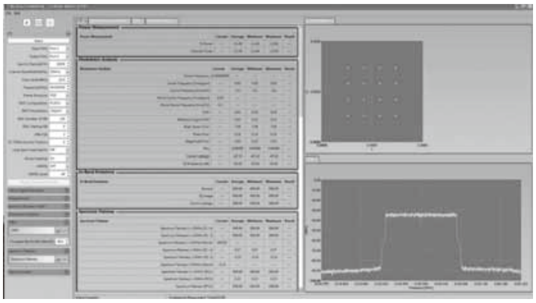
PC Applications

CombiView

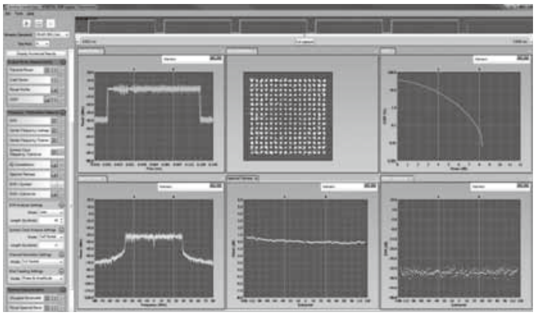
CombiView is a PC application used to control the MT8870A and display graphical and numerical test results.
It has the following functions:

Key Features

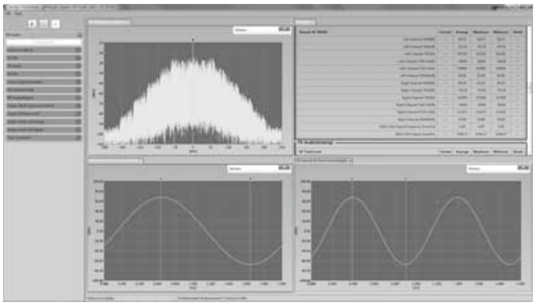
- Graphical display of TX measurement results using Windows interface
- Remote control of MT8870A (MU88700xA) via Ethernet and GPIB (option)
- Setting of MT8870A (MU88700xA)
- Signal generator interface for RX tests



LTE FDD Uplink TX Measurement with Cellular Application Applet



WLAN 802.11ac TX Measurement with SRW Application Applet



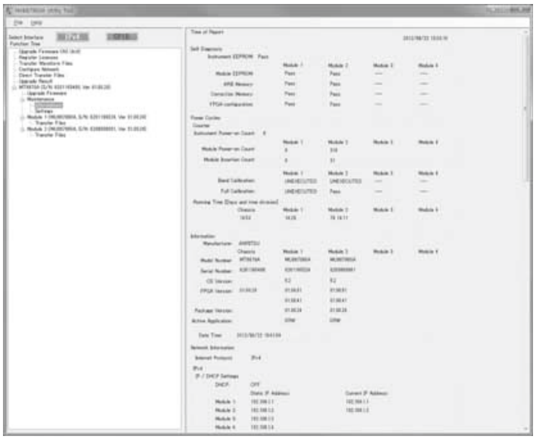
Audio Measurement with FM/Audio Application Applet

Utility Tool

The utility tool is a PC application used to detect the network and perform firmware updates.

Key Features

- Displays details of MT8870A and MU88700xA TRX Test Module(s) detected on network
- TRX Test Module MU88700xA firmware upgrade
- Waveform file transfer
- License registration



Specifications

Universal Wireless Test Set MT8870A

Electrical Characteristics

Number of Slots	4
Internal Reference Oscillator	Starting characteristics 25°C, Referenced to frequency at 24-hour after power-on $\pm 5 \times 10^{-7}$ (2 minutes after power-on) $\pm 5 \times 10^{-8}$ (5 minutes after power-on) Aging rate: $\pm 1 \times 10^{-7}$/year Temperature characteristics: $\pm 2 \times 10^{-8}$ (+5° to +45°C) Initial calibration accuracy +20° to +30°C, 1 hour after power-on $\pm 2.2 \times 10^{-8}$
Connector	External reference input Connector: BNC-J (rear panel), 50Ω (nom.) Frequency: 10 MHz Operating range: ±1 ppm Input level: –15 to +20 dBm, 50Ω (AC coupling) Reference signal output Connector: BNC-J (rear panel), 50Ω (nom.) Frequency: 10 MHz Output level: ≥0 dBm (AC coupling) Trigger Input/Output switching: Trigger input/output selectable Connector: BNC-J (rear panel, 4 ports) Input/Output level: TTL level Ethernet controller Control from external controller (excluding power-on/off) Ethernet (1000BASE-T) Connector: RJ-45 (front panel, rear panel) GPIB (with MT8870A-001) Connector: IEEE488 bus connector (rear panel, 4 ports) AUX Connector: 50-pin (correspond to DX10BM-50S, rear panel)

General

Dimensions and Mass		426 (W) × 221.5 (H) × 498 (D) mm (excluding projections) ≤11.5 kg (excluding all options and test modules) ≤30.0 kg (including options and test modules)
Power Supply		Power voltage: 100 V(ac) to 120 V(ac)/200 V(ac) to 240 V(ac) Frequency: 50 Hz/60 Hz Power consumption: ≤900 VA (including all options and test modules)
Temperature Range		+5° to +45°C (operating), –20° to +60°C (storage)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

TRX Test Module MU887000A

Input/Output Connector

RF Test Ports	Number of ports 4 Connector N (female) Impedance 50Ω (nom.) VSWR Test port 1 and 2 <1.5 (10 MHz ≤ f < 400 MHz) <1.2 (400 MHz ≤ f ≤ 2.7 GHz) <1.3 (2.7 GHz < f ≤ 3.8 GHz) <1.5 (3.8 GHz < f ≤ 6.0 GHz) Test port 3 and 4 <1.8 (10 MHz ≤ f < 30 MHz) <1.5 (30 MHz ≤ f ≤ 3.8 GHz) <1.6 (3.8 GHz < f ≤ 6.0 GHz) Maximum input level +35 dBm (Test port 1 and 2) +25 dBm (Test port 3 and 4)
AF Test Ports	Ports Analog port, Digital port Connector Analog port: BNC (female) Digital port: RJ-45

Signal Generator

Frequency	Setting range 10 MHz to 3.8 GHz 10 MHz to 6.0 GHz (with MU887000A-001) Setting resolution 1 Hz Accuracy Depends on MT8870A reference oscillator accuracy
Amplitude	Setting range Test port 1 and 2 –130 to –10 dBm (≤3.8 GHz) –130 to –18 dBm (>3.8 GHz) Test port 3 and 4 –120 to 0 dBm (≤3.8 GHz) –120 to –8 dBm (>3.8 GHz) Setting resolution 0.1 dB Accuracy CW, After CAL, 10° to 40°C Test port 1 and 2 Output level: ≥–120 dBm (≤3.8 GHz), ≥–100 dBm (>3.8 GHz) ±1.3 dB (10 MHz ≤ f < 400 MHz) (Signal Analyzer input level: +15 dBm) ±1.0 dB, ±0.7 dB (typ.) (400 MHz ≤ f ≤ 3.8 GHz) ±1.3 dB, ±1.0 dB (typ.) (3.8 GHz < f ≤ 6.0 GHz) Test port 3 and 4 Output level: ≥ –110 dBm ±1.3 dB (10 MHz ≤ f < 400 MHz) ±1.0 dB, ±0.7 dB (typ.) (400 MHz ≤ f ≤ 3.8 GHz) ±1.3 dB, ±0.7 dB (typ.) (3.8 GHz < f ≤ 6.0 GHz)
Spurious Response	Harmonic distortion <–25 dBc
Vector Modulation	Bandwidth 160 MHz (max.)

Signal Analyzer

Frequency	Setting range 10 MHz to 3.8 GHz 10 MHz to 6.0 GHz (with MU887000A-001) Resolution 0.1 Hz
Amplitude	Setting range CW Test port 1 and 2 –65 to +15 dBm (10 MHz ≤ f < 350 MHz) –65 to +35 dBm (350 MHz ≤ f ≤ 6.0 GHz) Test port 3 and 4 –65 to +15 dBm (10 MHz ≤ f < 350 MHz) –65 to +25 dBm (350 MHz ≤ f ≤ 6.0 GHz) Resolution 0.01 dB Accuracy CW, After CAL, Measurement bandwidth: 300 kHz, RBW: 100 kHz Test port 1 and 2 10 MHz ≤ f < 400 MHz, Signal Generator: Off, +10° to +40°C ±0.7 dB (–30 dBm ≤ p ≤ +15 dBm) ±0.9 dB (–55 dBm ≤ p < –30 dBm) ±1.1 dB (–65 dBm ≤ p < –55 dBm) 400 MHz ≤ f ≤ 3.8 GHz, +10° to +40°C ±0.5 dB, ±0.3 dB (typ.) (–30 dBm ≤ p ≤ +35 dBm) ±0.7 dB (–55 dBm ≤ p < –30 dBm) ±0.9 dB (–65 dBm ≤ p < –55 dBm) 3.8 GHz < f ≤ 6.0 GHz, +20° to +30°C ±0.7 dB (–30 dBm ≤ p ≤ +35 dBm) ±0.9 dB (–55 dBm ≤ p < –30 dBm) ±1.1 dB (–65 dBm ≤ p < –55 dBm) Test port 3 and 4 10 MHz ≤ f < 400 MHz, +10° to +40°C ±0.7 dB (–30 dBm ≤ p ≤ +15 dBm) ±0.9 dB (–55 dBm ≤ p < –30 dBm) ±1.1 dB (–65 dBm ≤ p < –55 dBm) 400 MHz ≤ f ≤ 3.8 GHz, +10° to +40°C ±0.7 dB (–30 dBm ≤ p ≤ +25 dBm) ±0.9 dB (–55 dBm ≤ p < –30 dBm) ±1.1 dB (–65 dBm ≤ p < –55 dBm) 3.8 GHz < f ≤ 6.0 GHz, +20° to +30°C ±0.7 dB (–30 dBm ≤ p ≤ +25 dBm) ±0.9 dB (–55 dBm ≤ p < –30 dBm) ±1.1 dB (–65 dBm ≤ p < –55 dBm) Linearity CW, Measurement bandwidth: 300 kHz, RBW: 100 kHz ±0.2 dB (0 to –40 dB, ≥ –55 dBm) ±0.4 dB (0 to –40 dB, ≥ –65 dBm)
Modulation Analysis	Maximum bandwidth 25 MHz (10 MHz ≤ f < 500 MHz) 80 MHz (500 MHz ≤ f < 1.9 GHz) 160 MHz (1.9 GHz ≤ f ≤ 6.0 GHz)

General

Interface		Trigger Trigger signals input/output at trigger connectors (rear panel) Remote control Ethernet: via MT8870A interface GPIB: with MT8870A GPIB option (MT8870A-001) Interface function: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0, E2
Dimensions and Mass		90 (W) × 193.6 (H) × 325 (D) mm (excluding projections) ≤5 kg (including options)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

TRX Test Module MU887001A

Input/Output Connector

RF Test Ports	Number of ports 4 Connector N (female) Impedance 50Ω (nom.) VSWR <1.5 (10 MHz ≤ f < 400 MHz) <1.2 (400 MHz ≤ f ≤ 2.7 GHz) <1.3 (2.7 GHz < f ≤ 3.8 GHz) <1.5 (3.8 GHz < f ≤ 6.0 GHz) Maximum input level +35 dBm
AF Test Ports	Ports Analog port, Digital port Connector Analog port: BNC (female) Digital port: RJ-45

Signal Generator

Frequency	Setting range 10 MHz to 3.8 GHz 10 MHz to 6.0 GHz (with MU887001A-001) Setting resolution 1 Hz Accuracy Depends on MT8870A reference oscillator accuracy
Amplitude	Setting range –130 to –10 dBm (≤3.8 GHz) –130 to –18 dBm (>3.8 GHz) Setting resolution 0.1 dB Accuracy CW, After CAL, 10° to 40°C Output level: ≥–120 dBm (≤3.8 GHz), ≥–100 dBm (>3.8 GHz) ±1.3 dB (10 MHz ≤ f < 400 MHz) (Signal Analyzer input level: +15 dBm) ±1.0 dB, ±0.7 dB (typ.) (400 MHz ≤ f ≤ 3.8 GHz) ±1.3 dB, ±1.0 dB (typ.) (3.8 GHz < f ≤ 6.0 GHz)
Spurious Response	Harmonic distortion <–25 dBc
Vector Modulation	Bandwidth 160 MHz (max.)

Signal Analyzer

Frequency	Setting range 10 MHz to 3.8 GHz 10 MHz to 6.0 GHz (with MU887001A-001) Resolution 0.1 Hz
Amplitude	Setting range CW –65 to +15 dBm (10 MHz ≤ f < 350 MHz) –65 to +35 dBm (350 MHz ≤ f ≤ 6.0 GHz) Resolution 0.01 dB Accuracy CW, After CAL, Measurement bandwidth: 300 kHz, RBW: 100 kHz 10 MHz ≤ f < 400 MHz, Signal Generator: Off, +10° to +40°C ±0.7 dB (–30 dBm ≤ p ≤ +15 dBm) ±0.9 dB (–55 dBm ≤ p < –30 dBm) ±1.1 dB (–65 dBm ≤ p < –55 dBm) 400 MHz ≤ f ≤ 3.8 GHz, +10° to +40°C ±0.5 dB, ±0.3 dB (typ.) (–30 dBm ≤ p ≤ +35 dBm) ±0.7 dB (–55 dBm ≤ p < –30 dBm) ±0.9 dB (–65 dBm ≤ p < –55 dBm) 3.8 GHz < f ≤ 6.0 GHz, +20° to +30°C ±0.7 dB (–30 dBm ≤ p ≤ +35 dBm) ±0.9 dB (–55 dBm ≤ p < –30 dBm) ±1.1 dB (–65 dBm ≤ p < –55 dBm) Linearity CW, Measurement bandwidth: 300 kHz, RBW: 100 kHz ±0.2 dB (0 to –40 dB, ≥ –55 dBm) ±0.4 dB (0 to –40 dB, ≥ –65 dBm)
Modulation Analysis	Maximum bandwidth 25 MHz (10 MHz ≤ f < 500 MHz) 80 MHz (500 MHz ≤ f < 1.9 GHz) 160 MHz (1.9 GHz ≤ f ≤ 6.0 GHz)

General

Interface		Trigger Trigger signals input/output at trigger connectors (rear panel) Remote control Ethernet: via MT8870A interface GPIB: with MT8870A GPIB option (MT8870A-001) Interface function: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0, E2
Dimensions and Mass		90 (W) × 193.6 (H) × 325 (D) mm (excluding projections) ≤5 kg (including options)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

Audio Measurement Hardware MU88700xA-002

Analog Audio	Audio generator Frequency range: 20 Hz to 20 kHz Output level range: 0 (off), 1 mV to 5 Vpeak (100 kΩ termination) Impedance: 1Ω (AC coupling) (nom.) Audio analyzer Frequency range: 20 Hz to 20 kHz Input level range: 1 mVpeak to 5 Vpeak (30 V rms, max.) Impedance: 100 kΩ (AC coupling)
Digital Audio	Audio generator Frequency range: 20 Hz to 20 kHz (Sampling rate: 44.1 kHz, 48 kHz) 20 Hz to 14 kHz (Sampling rate: 32 kHz) 20 Hz to 7 kHz (Sampling rate: 16 kHz) Bit resolution: 16 bits/24 bits Audio analyzer Sampling rate: 16, 32, 44.1, 48 kHz Bit resolution: 16 bits/24 bits

Cellular Standards Sequence Measurement MX887010A

<table>
<tr><td>Common Item</td><td>Measuring object
W-CDMA/GSM/LTE/LTE-Advanced uplink, CDMA2000/1xEV-DO reverse link
Frequency range
400 MHz to 6.0 GHz</td></tr>
<tr><td>Spectrum Monitor</td><td>Analysis time
1 ms, 10 ms
Span
1, 2.5, 5, 10, 25, 50, 100, 160 MHz
RBW
<table>
<tr><th>Span</th><th>RBW</th></tr>
<tr><td>1 MHz</td><td>100 Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz</td></tr>
<tr><td>2.5 MHz</td><td>1 kHz, 3 kHz, 10 kHz, 30 kHz</td></tr>
<tr><td>5 MHz</td><td>3 kHz, 10 kHz, 30 kHz, 100 kHz</td></tr>
<tr><td>10 MHz</td><td>3 kHz, 10 kHz, 30 kHz, 100 kHz</td></tr>
<tr><td>25 MHz</td><td>10 kHz, 30 kHz, 100 kHz, 300 kHz</td></tr>
<tr><td>50 MHz</td><td>30 kHz, 100 kHz, 300 kHz, 1 MHz</td></tr>
<tr><td>100 MHz</td><td>30 kHz, 100 kHz, 300 kHz, 1 MHz</td></tr>
<tr><td>160 MHz</td><td>30 kHz, 100 kHz, 300 kHz, 1 MHz</td></tr>
</table>
Detection mode
Average, Peak
Power measurement bandwidth
Range: 0.001 MHz to (setting span) MHz, Resolution: 0.001 MHz</td></tr>
<tr><td>Multiple Power Measurement</td><td>Number of steps
10 to 100 steps
Power step time
0.5, 1, 2, 4, 5, 10, 20, 30, 40, 50, 60, 70, 80 ms
Filter type
Low-pass filter: 1.23, 1.4, 3, 5, 10, 15, 20 MHz
RRC filter: 3.84 MHz
Measurement window
Range: 1 to 90%, Resolution 1%
Trigger level
–40 to 0 dB (based on the input level)</td></tr>
<tr><td>TX/RX vs. Frequency</td><td>Segment duration
Range: 1 to 80 ms, Resolution: 1 ms
Measurement filter
Low-pass filter: 1.23, 1.4, 3, 5, 10, 15, 20 MHz
RRC filter: 3.84 MHz
Measurement window
Range: 1 to 90%, Resolution: 1%
Number of segment
1 to 1600
Number of sequence
1 to 400</td></tr>
<tr><td>Narrowband Power vs. Time</td><td>Segment duration
Range: 200 μs to 20000 μs, Resolution: 1 μs
Measurement bandwidth
15 kHz
Measurement window
Range: 1 to 90%, Resolution: 1%
Number of segment
1 to 1000</td></tr>
<tr><td>IQ Capturing</td><td>Time span
Range: 1000 μs to 10000 μs, Resolution : 1 μs
Measurement bandwidth
Low-pass filter: 100, 300, 500 kHz, 1, 3, 5, 20 MHz
Gaussian filter: 1 MHz</td></tr>
</table>

W-CDMA/HSPA Uplink TX Measurement MX887011A

Common Item	Measuring object W-CDMA uplink Frequency range 400 MHz to 2.7 GHz
RF Power	Input level range –65 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –65 to +25 dBm (MU887000A test port 3 and 4) Measurement accuracy After CAL, 10° to 40°C MU887000A test port 1 and 2, MU887001A all test port ±0.3 dB (typ.), ±0.5 dB (–25 to +35 dBm) ±0.7 dB (–55 to –25 dBm) ±0.9 dB (–65 to –55 dBm) MU887000A test port 3 and 4 ±0.7 dB (–25 to +25 dBm) ±0.9 dB (–55 to –25 dBm) ±1.1 dB (–65 to –55 dBm) Linearity 0 to 40 dB ±0.2 dB (≥–55 dBm) ±0.4 dB (≥–65 dBm) Relative level accuracy At the power level difference within 2 dB, ≥–55 dBm, 0 to 40 dB ±0.1 dB (typ.)
Frequency/Modulation Analysis	Input level range –30 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –30 to +25 dBm (MU887000A test port 3 and 4) Carrier frequency accuracy ± (Setting frequency × Reference oscillator accuracy + 10 Hz) Modulation accuracy Residual EVM: at input of single DPCCH and single DPDCH ≤2.5%
Occupied Bandwidth	Input level range –10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –10 to +25 dBm (MU887000A test port 3 and 4) OBW ratio 80.0 to 99.9%
Adjacent Channel Leakage Power Ratio	Input level range –10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –10 to +25 dBm (MU887000A test port 3 and 4) Measurement points ±5 MHz, ±10 MHz Measurement range ≥50 dB (±5 MHz), ≥55 dB (±10 MHz)

GSM/EDGE Uplink TX Measurement MX887012A

Common Item	Measuring object Normal burst (GMSK, 8PSK) Frequency range 400 MHz to 2.0 GHz
RF Power	Input level range Average power of burst signal –30 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –30 to +25 dBm (MU887000A test port 3 and 4) Measurement accuracy After CAL, 10° to 40°C MU887000A test port 1 and 2, MU887001A all test port ±0.3 dB (typ.), ±0.5 dB (–30 to +35 dBm) MU887000A test port 3 and 4 ±0.7 dB (–30 to +25 dBm) Linearity ±0.2 dB (≥–30 dBm, 0 to 40 dB) Carrier off power ≥65 dB (≥–10 dBm), ≥45 dB (–30 to –10 dBm)
Frequency/Modulation Measurement	Input level range Average power of burst signal –30 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –30 to +25 dBm (MU887000A test port 3 and 4) Carrier frequency accuracy ± (Setting frequency × Reference oscillator accuracy + 10 Hz) Modulation accuracy Residual phase error (GMSK) ≤0.5°rms (f ≥500 MHz), ≤0.7°rms (f <500 MHz) ≤2° peak Residual EVM (8PSK) ≤1.5% rms

Continued on next page

Output RF Spectrum Measurement	Input level range Average power of burst signal –10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –10 to +25 dBm (MU887000A test port 3 and 4) Measurement point ±100 kHz, ±200 kHz, ±250 kHz, ±400 kHz, ±600 kHz, ±800 kHz, ±1000 kHz, ±1200 kHz, ±1600 kHz, ±1800 kHz, ±2000 kHz Measurement range of due to modulation Average of 10 measurements ≤–55 dB (200 kHz, 250 kHz offset), ≤–66 dB (≥400 kHz offset) Measurement range of switching transient ≤–57 dB (≥400 kHz offset)

LTE FDD Uplink TX Measurement MX887013A
LTE TDD Uplink TX Measurement MX887014A

Common Item	Measuring object PUSCH, PUCCH Frequency range 600 MHz to 2.7 GHz, 3.4 GHz to 3.8 GHz 600 MHz to 2.7 GHz, 3.4 GHz to 4.2 GHz (with MU88700xA-001/101 option)
RF Power	Input level range –65 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –65 to +25 dBm (MU887000A test port 3 and 4) Measurement accuracy 600 MHz to 2.7 GHz, 3.4 GHz to 3.8 GHz, After CAL, 10° to 40°C MU887000A test port 1 and 2, MU887001A all test ports ±0.3 dB (typ.), ±0.5 dB (–20 to +35 dBm) ±0.7 dB (–50 to –20 dBm) ±0.9 dB (–60 to –50 dBm) MU887000A test port 3 and 4 ±0.7 dB (–20 to +25 dBm) ±0.9 dB (–50 to –20 dBm) ±1.1 dB (–60 to –50 dBm) 3.8 GHz to 4.2 GHz, After CAL, 20° to 30°C MU887000A all test ports and MU887001A all test ports ±0.7 dB (–20 to +25 dBm) ±0.9 dB (–50 to –20 dBm) ±1.1 dB (–60 to –50 dBm) Linearity 0 to 40 dB ±0.2 dB (≥–50 dBm) ±0.4 dB (≥–60 dBm) Relative level accuracy At the power level difference within 2 dB ±0.1 dB (typ.)
Frequency/Modulation Measurement	Input level range –40 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –40 to +25 dBm (MU887000A test port 3 and 4) Carrier frequency accuracy ± (Setting frequency × Reference oscillator accuracy + 15 Hz) Modulation accuracy Residual EVM (average of 20 measurements) ≤2.5% In-band emission Input level: ≥–10 dBm, Allocated RB: ≤18 ≤–40 dBc
Occupied Bandwidth	Input level range –10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –10 to +25 dBm (MU887000A test port 3 and 4) OBW ratio 80.0 to 99.9%
Adjacent Channel Leakage Power Ratio	Input level range –10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –10 to +25 dBm (MU887000A test port 3 and 4) Measurement range ≥45 dB (E-UTRA ACLR1), ≥50 dB (UTRA ACLR1), ≥55 dB (UTRA ACLR2)
Spectrum Emission Mask	Input level range –10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –10 to +25 dBm (MU887000A test port 3 and 4)

LTE-Advanced FDD Uplink CA TX Measurement MX887013A-001
LTE-Advanced TDD Uplink CA TX Measurement MX887014A-001

Common Item	Measuring object PUSCH Frequency range 698 MHz to 2.7 GHz, 3.4 GHz to 3.8 GHz 698 MHz to 2.7 GHz, 3.4 GHz to 4.2 GHz (with MU88700xA-001/101 option)
RF Power	Input level range –65 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test ports) –65 to +25 dBm (MU887000A test port 3 and 4) Measurement accuracy MU887000A test port 1 and 2, MU887001A all test ports Excluding when measuring Intraband Contiguous CA SCC and PCC + SCC 698 MHz to 2.7 GHz, 3.4 GHz to 3.8 GHz, After CAL, 10° to 40°C ±0.3 dB (typ.) (–20 to +35 dBm, 20° to 30°C) ±0.5 dB (–20 to +35 dBm) ±0.7 dB (–50 to –20 dBm) ±0.9 dB (–60 to –50 dBm) 3.8 GHz to 4.2 GHz, After CAL, 10° to 40°C ±0.7 dB (–20 to +35 dBm) ±0.9 dB (–50 to –20 dBm) ±1.1 dB (–60 to –50 dBm) MU887000A test port 1 and 2, MU887001A all test ports When measuring Intraband Contiguous CA SCC and PCC + SCC 698 MHz to 2.7 GHz, After CAL, 10° to 40°C ±0.5 dB (typ.) (–20 to +35 dBm, 20° to 30°C) ±0.7 dB (–50 to +35 dBm) ±0.9 dB (–60 to –50 dBm) 3.4 GHz to 3.8 GHz, After CAL, 10° to 40°C 3.8 GHz to 4.2 GHz, After CAL, 20° to 30°C ±1.0 dB (–50 to +35 dBm) ±1.3 dB (–60 to –50 dBm) MU887000A test port 3 and 4 Excluding when measuring Intraband Contiguous CA SCC and PCC + SCC 698 MHz to 2.7 GHz, 3.4 GHz to 3.8 GHz, After CAL, 10° to 40°C 3.8 GHz to 4.2 GHz , After CAL, 20° to 30°C ±0.7 dB (–20 to +25 dBm) ±0.9 dB (–50 to –20 dBm) ±1.1 dB (–60 to –50 dBm) MU887000A test port 3 and 4 When measuring Intraband Contiguous CA SCC and PCC + SCC 698 MHz to 2.7 GHz, After CAL, 10° to 40°C ±0.7 dB (–20 to +25 dBm) ±0.9 dB (–50 to –20 dBm) ±1.1 dB (–60 to –50 dBm) 3.4 GHz to 3.8 GHz, After CAL, 10° to 40°C 3.8 GHz to 4.2 GHz, After CAL, 20° to 30°C ±1.0 dB (–50 to +25 dBm) ±1.3 dB (–60 to –50 dBm) Linearity 0 to 30 dB, 20° to 30°C ±0.2 dB (≥–50 dBm) ±0.4 dB (≥–60 dBm)
Frequency/Modulation Measurement	Input level range –40 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test ports) –40 to +25 dBm (MU887000A test port 3 and 4) Carrier frequency accuracy ± (Setting frequency × Reference oscillator accuracy + 15 Hz) Modulation accuracy Residual EVM (average of 20 measurements) ≤2.5% In-band emission Input level: ≥–10 dBm, Allocated RB: ≤18 ≤–40 dBc
Occupied Bandwidth	Input level range –10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test ports) –10 to +25 dBm (MU887000A test port 3 and 4) OBW ratio 80.0 to 99.9%
Adjacent Channel Leakage Power Ratio	Input level range –10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test ports) –10 to +25 dBm (MU887000A test port 3 and 4) Measurement range ≥45 dB (E-UTRA ACLR1), ≥50 dB (UTRA ACLR1), ≥55 dB (UTRA ACLR2)
Spectrum Emission Mask	Input level range –10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test ports) –10 to +25 dBm (MU887000A test port 3 and 4)

CDMA2000 Reverse Link TX Measurement MX887015A

Common Item	Measuring object Reverse RC-1/2/3/4 Frequency range 400 MHz to 2.7 GHz
RF Power	Input level range –65 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –65 to +25 dBm (MU887000A test port 3 and 4) Measurement accuracy After CAL, 10° to 40°C MU887000A test port 1 and 2, MU887001A all test port ±0.3 dB (typ.), ±0.5 dB (–25 to +35 dBm) ±0.7 dB (–55 to –25 dBm) ±0.9 dB (–65 to –55 dBm) MU887000A test port 3 and 4 ±0.7 dB (–25 to +25 dBm) ±0.9 dB (–55 to –25 dBm) ±1.1 dB (–65 to –55 dBm) Linearity 0 to 40 dB ±0.2 dB (≥–55 dBm) ±0.4 dB (≥–65 dBm)
Frequency/Modulation Measurement	Input level range –30 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –30 to +25 dBm (MU887000A test port 3 and 4) Carrier frequency accuracy ± (Setting frequency × Reference oscillator accuracy + 10 Hz) Waveform quality >0.999
Code Domain Power Measurement	Reverse RC3 or RC4 Input level range –30 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –30 to +25 dBm (MU887000A test port 3 and 4) Measurement accuracy ±0.2 dB (Code power: ≥–15 dBc), ±0.4 dB (Code power: ≥–23 dBc)
Occupied Bandwidth	Input level range –10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –10 to +25 dBm (MU887000A test port 3 and 4) OBW ratio 80.0 to 99.9%

1xEV-DO Reverse Link TX Measurement MX887016A

Common Item	Measuring object Reverse link Rev. 0/Rev. A Frequency range 400 MHz to 2.7 GHz
RF Power	Input level range –65 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –65 to +25 dBm (MU887000A test port 3 and 4) Measurement accuracy After CAL, 10° to 40°C MU887000A test port 1 and 2, MU887001A all test port ±0.3 dB (typ.), ±0.5 dB (–25 to +35 dBm) ±0.7 dB (–55 to –25 dBm) ±0.9 dB (–65 to –55 dBm) MU887000A test port 3 and 4 ±0.7 dB (–25 to +25 dBm) ±0.9 dB (–55 to –25 dBm) ±1.1 dB (–65 to –55 dBm) Linearity 0 to 40 dB ±0.2 dB (≥–55 dBm) ±0.4 dB (≥–65 dBm)
Frequency/Modulation Measurement	Input level range –30 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –30 to +25 dBm (MU887000A test port 3 and 4) Carrier frequency accuracy ± (Setting frequency × Reference oscillator accuracy + 10 Hz) Waveform quality >0.999
Code Domain Power Measurement	Input level range –30 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –30 to +25 dBm (MU887000A test port 3 and 4) Measurement accuracy ±0.2 dB (Code power: ≥–15 dBc), ±0.4 dB (Code power: ≥–23 dBc)
Occupied Bandwidth	Input level range –10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –10 to +25 dBm (MU887000A test port 3 and 4) OBW ratio 80.0 to 99.9%

TD-SCDMA Uplink TX Measurement MX887017A

Common Item	Measuring object TD-SCDMA uplink Frequency range 400 MHz to 2.7 GHz
RF Power	Input level range –65 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –65 to +25 dBm (MU887000A test port 3 and 4) Measurement accuracy After CAL, 10° to 40°C MU887000A test port 1 and 2, MU887001A all test port ±0.3 dB (typ.), ±0.5 dB (–25 to +35 dBm) ±0.7 dB (–55 to –25 dBm) ±0.9 dB (–65 to –55 dBm) MU887000A test port 3 and 4 ±0.7 dB (–25 to +25 dBm) ±0.9 dB (–55 to –25 dBm) ±1.1 dB (–65 to –55 dBm) Linearity 0 to 40 dB ±0.2 dB (≥–55 dBm) ±0.4 dB (≥–65 dBm)
Frequency/Modulation Measurement	Input level range –30 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –30 to +25 dBm (MU887000A test port 3 and 4) Carrier frequency accuracy ± (Setting frequency × Reference oscillator accuracy + 10 Hz) Modulation accuracy Residual EVM (at input of single code) ≤2.5%
Occupied Bandwidth	Input level range –10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –10 to +25 dBm (MU887000A test port 3 and 4) OBW ratio 99.0%
Adjacent Channel Leakage Power Ratio	Input level range –10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –10 to +25 dBm (MU887000A test port 3 and 4) Measurement points ±1.6 MHz, ±3.2 MHz Measurement range ≥50 dB (±1.6 MHz), ≥55 dB (±3.2 MHz)

NR TDD sub-6 GHz Uplink TX Measurement MX887019A

Common Item	Measuring object PUSCH Channel Bandwidth (MHz) 20, 25, 40, 50, 60, 80, 100 Modulation QPSK, 16QAM, 64QAM
RF Power	Input level range –65 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –65 to +25 dBm (MU887000A test port 3 and 4) Measurement accuracy MU887000A test port 1 and 2, MU887001A all test port 600 MHz to 2.7 GHz, After CAL, 10° to 40°C ±0.5 dB (typ.) (–20 to +35 dBm, 20° to 30°C) ±0.7 dB (–20 to +35 dBm) ±0.7 dB (–50 to –20 dBm) ±0.9 dB (–60 to –50 dBm) 3.3 GHz to 3.8 GHz, After CAL, 10° to 40°C ±1.0 dB (–50 to +35 dBm) ±1.3 dB (–60 to –50 dBm) 3.8 GHz to 5.0 GHz, After CAL, 20° to 30°C ±1.0 dB (–50 to +35 dBm) ±1.3 dB (–60 to –50 dBm) MU887000A test port 3 and 4 600 MHz to 2.7 GHz, After CAL, 10° to 40°C ±0.7 dB (–20 to +25 dBm) ±0.9 dB (–50 to –20 dBm) ±1.1 dB (–60 to –50 dBm) 3.3 GHz to 3.8 GHz, After CAL, 10° to 40°C ±1.0 dB (–50 to +25 dBm) ±1.3 dB (–60 to –50 dBm) 3.8 GHz to 5.0 GHz, After CAL, 20° to 30°C ±1.0 dB (–50 to +25 dBm) ±1.3 dB (–60 to –50 dBm)

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<table>
<tr><td>Frequency/Modulation Measurement</td><td>Input level range
Minimum output power* to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port)
Minimum output power* to +25 dBm (MU887000A test port 3 and 4)
*: Minimum output power
<table>
<tr><th>Channel Bandwidth (MHz)</th><th>Minimum output power (dBm)</th></tr>
<tr><td>20</td><td>–40</td></tr>
<tr><td>25</td><td>–39</td></tr>
<tr><td>40</td><td>–37</td></tr>
<tr><td>50</td><td>–36</td></tr>
<tr><td>60</td><td>–35.2</td></tr>
<tr><td>80</td><td>–34</td></tr>
<tr><td>100</td><td>–33</td></tr>
</table>
Carrier frequency accuracy
600 MHz to 2.7 GHz
± (Setting frequency × Reference oscillator accuracy) + 15 Hz
3.3 GHz to 5.0 GHz
± (Setting frequency × Reference oscillator accuracy) + 36 Hz
Modulation accuracy
Residual EVM (average of 20 measurements)
–25 dBm < Input Level Range
≤2.5%
Minimum output power ≤ Input Level Range ≤ –25 dBm
≤3.0% (600 MHz ≤ Frequency ≤ 2.7 GHz, 3.3 GHz ≤ Frequency ≤ 4.2 GHz)
≤3.0% (4.2 GHz < Frequency ≤ 5.0 GHz, 20° to 30°C)</td></tr>
<tr><td>Occupied Bandwidth</td><td>Frequency range
Channel Bandwidth ≤ 60 MHz
600 MHz to 2.7 GHz, 3.3 GHz to 3.8 GHz
3.8 GHz to 5.0 GHz (MU887000A-001 option)
60 MHz < Channel Bandwidth
2.0 GHz to 2.7 GHz, 3.3 GHz to 3.8 GHz
3.8 GHz to 5.0 GHz (MU887000A-001 option)
Input level range
–10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port)
–10 to +25 dBm (MU887000A test port 3 and 4)</td></tr>
<tr><td>Adjacent Channel Leakage Power Ratio</td><td>Frequency range
Channel Bandwidth ≤ 60 MHz
600 MHz to 2.7 GHz, 3.3 GHz to 3.8 GHz
3.8 GHz to 5.0 GHz (MU887000A-001 option)
60 MHz < Channel Bandwidth
2.0 GHz to 2.7 GHz, 3.3 GHz to 3.8 GHz
3.8 GHz to 5.0 GHz (MU887000A-001 option)
Input level range
–10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port)
–10 to +25 dBm (MU887000A test port 3 and 4)
Measurement range
≥42 dB (NR ACLR), ≥45 dB (UTRA ACLR1), ≥48 dB (UTRA ACLR2)</td></tr>
<tr><td>Spectrum Emission Mask</td><td>Frequency range
Channel Bandwidth ≤ 60 MHz
600 MHz to 2.7 GHz, 3.3 GHz to 3.8 GHz
3.8 GHz to 5.0 GHz (MU887000A-001 option)
60 MHz < Channel Bandwidth
2.0 GHz to 2.7 GHz, 3.3 GHz to 3.8 GHz
3.8 GHz to 5.0 GHz (MU887000A-001 option)
Input level range
–10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port)
–10 to +25 dBm (MU887000A test port 3 and 4)</td></tr>
</table>

W-CDMA/HSPA Downlink TX Measurement MX887021A

Common Item	Measuring object W-CDMA/HSPA downlink Frequency range 600 MHz to 2.7 GHz
RF Power	Input level range –65 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –65 to +25 dBm (MU887000A test port 3 and 4) Measurement accuracy After CAL, 10° to 40°C MU887000A test port 1 and 2, MU887001A all test port ±0.3 dB (typ.), ±0.5 dB (–15 to +35 dBm) MU887000A test port 3 and 4 ±0.7 dB (–15 to +25 dBm)
Frequency/Modulation Measurement	Input level range –30 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –30 to +25 dBm (MU887000A test port 3 and 4) Carrier frequency accuracy Average of 10 measurements, test model 4 signals ± (Setting frequency × Reference oscillator accuracy + 10 Hz) Modulation accuracy Average of 10 measurements, test model 4 signals ≤1%

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Adjacent Channel Leakage Power Ratio	Input level range –10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –10 to +25 dBm (MU887000A test port 3 and 4) Measurement points ±5 MHz, ±10 MHz Measurement range ≥55 dB (UTRA Adj./Alt.)

LTE FDD Downlink TX Measurement MX887023A

Common Item	Measuring object LTE FDD downlink signal Frequency range 600 MHz to 2.7 GHz, 3.4 GHz to 3.8 GHz
RF Power	Input level range –65 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –65 to +25 dBm (MU887000A test port 3 and 4) Measurement accuracy After CAL, 10° to 40°C MU887000A test port 1 and 2, MU887001A all test port ±0.3 dB (typ.), ±0.5 dB (–15 to +35 dBm) MU887000A test port 3 and 4 ±0.7 dB (–15 to +25 dBm)
Frequency/Modulation Measurement	Input level range –15 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –15 to +25 dBm (MU887000A test port 3 and 4) Carrier frequency accuracy Measurement interval: 10, test model 3.1 signals ± (Setting frequency × Reference oscillator accuracy + 10 Hz) Modulation accuracy Residual EVM Measurement interval: 10, Test model 3.1 signals, Channel bandwidth: 3, 5, 10, 15, 20 MHz ≤1%
Adjacent Channel Leakage Power Ratio	Input level range –10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –10 to +25 dBm (MU887000A test port 3 and 4) Measurement range Channel bandwidth: 1.4, 3, 5 MHz ≥54 dB (E-UTRA Adj.), ≥57 dB (E-UTRA Alt.) Channel bandwidth: 10, 15, 20 MHz ≥50 dB (E-UTRA Adj./Alt.) Full channel bandwidth ≥54 dB (UTRA Adj./Alt.)

W-CDMA/HSPA Downlink Waveforms MV887011A

EVM	≤3% rms (400 MHz ≤ f ≤ 2.7 GHz)

GSM/EDGE Downlink Waveforms MV887012A

Phase Error	≤1° rms (400 MHz ≤ f ≤ 2.7 GHz, GMSK)
EVM	≤1.8% rms (400 MHz ≤ f ≤ 2.7 GHz, 8PSK)

LTE FDD Downlink Waveforms MV887013A

Max. Output Level	MU887000A test port 1 and 2, MU887001A all test port –12 dBm (f ≤ 3.8 GHz), –20 dBm (f > 3.8 GHz) MU887000A test port 3 and 4 –2 dBm (f ≤ 3.8 GHz), –10 dBm (f > 3.8 GHz)
EVM	≤2% rms (400 MHz ≤ f ≤ 2.7 GHz), ≤3% rms (3.4 GHz ≤ f ≤ 3.8 GHz), ≤4% rms (3.8 GHz < f ≤ 6.0 GHz)

LTE TDD Downlink Waveforms MV887014A

Max. Output Level	MU887000A test port 1 and 2, MU887001A all test port –12 dBm (f ≤ 3.8 GHz), –20 dBm (f > 3.8 GHz) MU887000A test port 3 and 4 –2 dBm (f ≤ 3.8 GHz), –10 dBm (f > 3.8 GHz)
EVM	≤2% rms (400 MHz ≤ f ≤ 2.7 GHz), ≤3% rms (3.4 GHz ≤ f ≤ 3.8 GHz), ≤4% rms (3.8 GHz < f ≤ 6.0 GHz)

CDMA2000 Forward Link Waveforms MV887015A

Waveform Quality	>0.99 (400 MHz ≤ f ≤ 2.7 GHz)

1xEV-DO Forward Link Waveforms MV887016A

Waveform Quality	>0.99 (400 MHz ≤ f ≤ 2.7 GHz, Pilot channel)

TD-SCDMA Downlink Waveforms MV887017A

EVM	≤3% rms (400 MHz ≤ f ≤ 2.7 GHz)

NR TDD sub-6GHz Downlink Waveforms MV887019A

Max. Output Level	MU887000A test port 1 and 2, MU887001A all test port –10 dBm (f ≤ 3.8 GHz), –18 dBm (f > 3.8 GHz) MU887000A test port 3 and 4 0 dBm (f ≤ 3.8 GHz), –8 dBm (f > 3.8 GHz)
EVM	≤2% rms (600 MHz ≤ f ≤ 2.7 GHz), ≤3% rms (3.3 GHz ≤ f ≤ 3.8 GHz), ≤4% rms (3.8 GHz < f ≤ 5.0 GHz)

WLAN 802.11b/g/a/n TX Measurement MX887030A

Common Item	Measuring object WLAN signal packet Frequency range 2.4 GHz band: 2412 MHz to 2484 MHz 5 GHz band: 4920 MHz to 5825 MHz (required MU88700xA-001)
RF Power	Input level range –65 to +25 dBm (MU887000A test port 3 and 4) –55 to +35 dBm (MU887001A all test port) Accuracy After CAL, 20° to 30°C ±0.7 dB (–30 dBm ≤ p ≤ +25 dBm), ±1.0 dB (–50 dBm ≤ p < –30 dBm) (MU887000A) ±0.7 dB (–20 dBm ≤ p ≤ +35 dBm), ±1.0 dB (–40 dBm ≤ p < –20 dBm) (MU887001A) Bandwidth 40 MHz, 20 MHz (802.11n) 20 MHz (802.11a/b/g) Capture time 1.34 s Pre-trigger 1.33 s Resolution (time domain profile) 5 ns/sample CCDF CCDF defined as a percentage of samples against dB, where percentage of samples is normalized to the average power in the 'gate', and dB is defined as the relative value of samples greater than the average. Power distribution value A single numeric value called the power distribution value defines the number of dB above the average power below which a user defined percentage of the total number of samples falls.
Spectral Profile Measurement	Span ±65 MHz (802.11n) ±35 MHz (802.11a/b/g) Capture time 50 µs Measurement range (RBW: 100 kHz) –27 to +25 dBm (MU887000A) –17 to +35 dBm (MU887001A) Linearity CW, RBW: 100 kHz, Same as level linearity (MU887000A test port 3 and 4, MU887001A all test port) ±0.2 dB (≥ –55 dBm, –40 to 0 dB) Resolution 0.1 dB Bandwidth 100 kHz
EVM (Modulation accuracy)	Measurement range –20 to +25 dBm (MU887000A) –10 to +35 dBm (MU887001A) Residual EVM Signal level: >–20 dBm (MU887000A), >–10 dBm (MU887001A), Averaged over 20 packets <–28 dB (DSSS) <–40 dB (OFDM, Channel estimation: FULLPACKET) EVM data format dB, % Resolution 0.1% or 0.1 dB, All limit checking in dB to 0.1 dB resolution Speed >20 readings/second
DSSS EVM Measurement Setting	RX filter type None, Gaussian, Root raised cosine Gaussian filter setting BT BT 0.3 to 1.0, Resolution: 0.1 Root raised cosine filter setting α 0.30 to 1.00, Resolution: 0.01 Measurement start It shall be possible to measure EVM from the first data chip of the packet Measurement method Header or payload. Header measures the EVM of the first 1000 chips of the PLCP preamble and header. User specified measurement range 220 to 11000 chips Measurement functional range Measurement only possible if channel frequency error <±150 kHz (±60 ppm) Carrier lock Phase tracking automatically applied as per carrier lock 802.11-2007 18.4.7.8
OFDM EVM Measurement Setting	Channel estimation User selection of Long training sequence or Full packet. User specified measurement range 16 symbols (min.), 1000 symbols (max.) OFDM pilot tracking "Phase tracking only" or "Phase and Amplitude tracking". Peak and Average EVM on all sub-carriers, dB or percentage Peak and Average on each sub-carrier – frequency domain % vs. sub-carrier EVM vs. Symbol – time domain % vs. Symbol number, 1 to max

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DSSS Additional Measurement	Transmit center frequency tolerance Definition: Average frequency of the DSSS carrier signal Accuracy: ± (Setting frequency × Reference oscillator accuracy + 1 kHz) Resolution: Hz to no decimal places, ppm to one decimal place Chip clock frequency tolerance Definition: Frequency error relative to the 11 MHz chip clock. Measurement averaged over a fully coded DSSS packet with minimum payload length 3300 chips, 300 μs Display format: Hz, ppm Range: ±50 ppm Resolution: Hz to no decimal places, ppm to one decimal place Data analysis width: 20 μs (220 chips) (min.) User specified measurement range: 3300 to 30250 chips Transmit power-on and power-down ramp Definition: Time for burst to transit from 10 to 90% or 90 to 10% of linear power. Data outputs: 10%, 90%, Delta values Resolution: 5 ns RF carrier suppression Method: IEEE Std 802.11-2007 (18.4.7.7), IQ offset method IEEE method: Relative level of the carrier to the highest sideband for a 10101010 test pattern with scrambler disabled, data rate 2 Mbps. IQ offset method: Calculated from the relative values of the peak frequency response and the channel center frequency with the data rate processing gain.
OFDM Additional Measurement	Transmit center frequency tolerance Definition: Average frequency of the OFDM carrier signal Data output format: Hz, ppm Accuracy: ± (Setting frequency × Reference oscillator accuracy + 1 kHz) (>1 ms packet) Resolution: Hz to no decimal places, ppm to one decimal place Symbol clock frequency tolerance Definition: Frequency error relative to the 250 kHz symbol clock as per 19.4.7.3/17.3.9.5 Measurement averaged over a fully coded OFDM packet with a minimum payload length of 16 symbols (64 μs) Data output format: Hz, ppm Range: ±40 ppm Resolution: ppm to one decimal place User specified measurement range: 16- (define numbers) Transmitter center frequency leakage Definition: Measurement of the leakage of the center carrier Data output format: dB Resolution: dB to two decimal places Transmitter spectral flatness Definition: Measurement of RF sub-carrier power level Unit of measurement: dB
Additional Measurement (DSSS and OFDM)	Power spectral density The maximum power measured in a 1 MHz bandwidth within the occupied bandwidth of the signal Occupied bandwidth Measures the frequency range within which the specified percentage power is contained Occupied bandwidth percentage range 1 to 99%

WLAN 802.11ac TX Measurement MX887031A

Common Item	Measuring object WLAN signal packet Frequency range 5 GHz band: 4920 MHz to 5825 MHz (required MU88700xA-001)
RF Power	Input level range –65 to +25 dBm (MU887000A test port 3 and 4) –55 to +35 dBm (MU887001A all test port) Accuracy After CAL, 20° to 30°C ±0.7 dB (–30 dBm ≤ p ≤ +25 dBm), ±1.0 dB (–50 dBm ≤ p < –30 dBm) (MU887000A) ±0.7 dB (–20 dBm ≤ p ≤ +35 dBm), ±1.0 dB (–40 dBm ≤ p < –20 dBm) (MU887001A) Bandwidth 160, 80, 40, 20 MHz Capture time 1.34 s Pre-trigger 1.33 s Resolution (time domain profile) 5 ns/sample CCDF CCDF defined as a percentage of samples against dB, where percentage of samples is normalized to the average power in the ‘gate’, and dB is defined as the relative value of samples greater than the average. Power distribution value A single numeric value called the power distribution value defines the number of dB above the average power below which a user defined percentage of the total number of samples falls.

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Spectral Profile Measurement	Spectral profile measurement span ±80 MHz Capture time 50 µs Measurement range (RBW: 100 kHz) –27 to +25 dBm (MU887000A) –17 to +35 dBm (MU887001A) Linearity CW, RBW: 100 kHz, Same as level linearity (MU887000A test port 3 and 4, MU887001A all test port) ±0.2 dB (≥ –55 dBm, –40 to 0 dB) Resolution 0.1 dB Bandwidth 100 kHz
EVM (Modulation Accuracy)	EVM measurement range –20 to +25 dBm (MU887000A) –10 to +35 dBm (MU887001A) Residual EVM (Bandwidth: ≤80 MHz) Signal level: >–10 dBm (MU887000A), 0 dBm (MU887001A), Averaged over 20 packets, Channel estimation: FULLPACKET <–38 dB EVM data format dB, % Resolution 0.1% or 0.1 dB, All limit checking in dB to 0.1 dB resolution Speed >20 readings/second
OFDM EVM Measurement Setting	Channel estimation User selection of long training sequence or full packet. User specified measurement range 16 symbols (min.), 1000 symbols (max.) OFDM pilot tracking "Phase tracking only" or "Phase and Amplitude tracking". Peak and Average EVM on all sub-carriers, dB or percentage Peak and Average on each sub-carrier – frequency domain % vs. sub-carrier EVM vs. Symbol – time domain % vs. Symbol number, 1 to max.
OFDM Additional Measurement	Transmit center frequency tolerance Definition: Average frequency of the OFDM carrier signal Data output format: Hz, ppm Accuracy: ± (Setting frequency × Reference oscillator accuracy + 1 kHz) (>1 ms packet) Resolution: Hz to no decimal places, ppm to one decimal places Symbol clock frequency tolerance Definition: Frequency error relative to the 250 kHz symbol clock as per 19.4.7.3/17.3.9.5 Measurement averaged over a fully coded OFDM packet with a minimum payload length of 16 symbols (64 µs) Data output format: Hz, ppm Range: ±40 ppm Resolution: ppm to one decimal places User specified measurement range: 16- (Define numbers) Transmitter center frequency leakage Definition: Measurement of the leakage of the center carrier Data output format: dB Resolution: dB to two decimal places Transmitter spectral flatness Definition: Measurement of RF sub-carrier power level Unit of measurement: dB

WLAN 802.11p TX Measurement MX887032A (Automotive Connectivity V2X)

Common Item	Measuring object WLAN single packet Frequency range 715 MHz to 765 MHz 902 MHz to 928 MHz 5725 MHz to 5925 MHz (required MU88700xA-001 option)
RF Power	Input level range –65 to +25 dBm (MU887000A test port 3 and 4) –55 to +35 dBm (MU887001A all test port) Measurement accuracy After CAL, 20 to 30°C ±0.7 dB (–30 dBm ≤ p ≤ +25 dBm), ±1.0 dB (–50 dBm ≤ p < –30 dBm) (MU887000A) ±0.7 dB (–20 dBm ≤ p ≤ +35 dBm), ±1.0 dB (–40 dBm ≤ p < –20 dBm) (MU887001A) Bandwidth 5, 10, 20 MHz
EVM (Modulation Accuracy)	Measurement range –20 to +25 dBm (MU887000A) –10 to +35 dBm (MU887001A) Residual EVM (OFDM) Signal level: >–20 dBm (MU887000A), >–10 dBm (MU887001A), Averaged over 20 packets, Channel estimation: FULLPACKET <–40 dB EVM data format dB or % Measurement resolution 0.1% or 0.1 dB, All limit checking in dB to 0.1 dB resolution

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OFDM EVM Measurement Setting	Channel estimation User selection of Long training sequence or Full packet User specified measurement range 16 symbols (min.), 1000 symbols (max.) OFDM pilot tracking "Phase tracking only" or "Phase and amplitude tracking", default: Phase tracking only Peak and average EVM on all sub-carriers, dB or percentage Peak and average on each sub-carrier – frequency domain % vs. sub-carrier EVM vs. Symbol – time domain % vs. Symbol number, 1 to max
OFDM Additional Measurement	Transmit center frequency tolerance Definition: Average frequency of the OFDM carrier signal Data output format: Hz and ppm Measurement accuracy: ± (Setting frequency × Reference oscillator accuracy + 1 kHz) (packet: >1 ms) Resolution: Hz to no decimal places, ppm to 1 decimal place Transmit center frequency leakage Definition: Measurement of the leakage of the center carrier Data output format: dB Resolution: dB to two decimal places Transmitter spectral flatness Definition: Measurement of RF sub-carrier power level Data output format: dB

WLAN 802.11ax TX Measurement MX887033A

Common Item	Measuring object WLAN signal packet Frequency range 5 GHz Band: (required MU88700xA-001) 80 MHz BW: 4920 MHz to 5775 MHz 40 MHz BW: 4920 MHz to 5795 MHz 20 MHz BW: 4920 MHz to 5825 MHz 2.4 GHz Band: 40 MHz BW: 2412 MHz to 2472 MHz 20 MHz BW: 2412 MHz to 2484 MHz
RF Power	Input level range –65 to +25 dBm (MU887000A test port 3 and 4) –55 to +35 dBm (MU887001A all test port) Accuracy After CAL, 20° to 30°C ±0.7 dB (–30 dBm ≤ p ≤ +25 dBm), ±1.0 dB (–50 dBm ≤ p < –30 dBm) (MU887000A) ±0.7 dB (–20 dBm ≤ p ≤ +35 dBm), ±1.0 dB (–40 dBm ≤ p < –20 dBm) (MU887001A) Bandwidth 80, 40, 20 MHz Capture time 1.34 s Pre-trigger 1.33 s Resolution (time domain profile) 5 ns/sample CCDF CCDF defined as a percentage of samples against dB, where percentage of samples is normalized to the average power in the 'gate', and dB is defined as the relative value of samples greater than the average. Power distribution value A single numeric value called the power distribution value defines the number of dB above the average power below which a user defined percentage of the total number of samples falls.
Spectral Profile Measurement	Spectral profile measurement span ±80 MHz Capture time 50 µs Measurement range (RBW: 100 kHz) –27 to +25 dBm (MU887000A) –17 to +35 dBm (MU887001A) Linearity CW, RBW: 100 kHz, Same as level linearity (MU887000A test port 3 and 4, MU887001A all test port) ±0.2 dB (≥ –55 dBm, –40 to 0 dB) Resolution 0.1 dB Bandwidth 100 kHz
EVM (Modulation Accuracy)	EVM measurement range –20 to +25 dBm (MU887000A) –10 to +35 dBm (MU887001A) Residual EVM (Bandwidth: ≤80 MHz) 20° to 30°C Signal level: >–10 dBm (MU887000A), 0 dBm (MU887001A), averaged over 20 packets, where each packet is no less than 16 data OFDM symbols long. And for each subcarrier except Pilots, all data OFDM symbol should have same data field pattern. Channel estimation: FULLPACKET, Measured at 5210 MHz <–45 dB EVM data format dB, % Resolution 0.1% or 0.1 dB, All limit checking in dB to 0.1 dB resolution

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OFDM EVM Measurement Setting	Channel estimation User selection of long training sequence or full packet. User specified measurement range 16 symbols (min.), 1000 symbols (max.) OFDM pilot tracking "Phase tracking only" or "Phase and Amplitude tracking". Peak and Average EVM on all sub-carriers, dB or percentage Peak and Average on each sub-carrier – frequency domain % vs. sub-carrier EVM vs. Symbol – time domain % vs. Symbol number, 1 to max.
OFDM Additional Measurement	Transmit center frequency tolerance Definition: Average frequency of the OFDM carrier signal Data output format: Hz, ppm Accuracy: ± (Setting frequency × Reference oscillator accuracy + 1 kHz) (>1 ms packet) Resolution: Hz to no decimal places, ppm to one decimal places Symbol clock frequency tolerance Definition: Frequency error relative to the symbol clock depends on Signal's Guard interval. If GI is 0.8 us, Symbol Clock is (1 / (12.8 us + 0.8 us)) = 73.529 kHz approx. If GI is 1.6 us, Symbol Clock is (1 / (12.8 us + 1.6 us)) = 69.444 kHz approx. If GI is 3.2 us, Symbol Clock is (1 / (12.8 us + 3.2 us)) = 62.500 kHz approx. Measurement averaged over a fully coded OFDM packet with a minimum payload length of 16 symbols. Data output format: Hz, ppm Range: ±40 ppm Resolution: ppm to one decimal places User specified measurement range: 16- (Define numbers) Transmitter center frequency leakage Definition: Measurement of the leakage of the center carrier Data output format: dB Resolution: dB to two decimal places Transmitter spectral flatness Definition: Measurement of RF sub-carrier power level Unit of measurement: dB

Bluetooth TX Measurement MX887040A

Common Item	Measuring object Bluetooth signal packet (DH-1, 3, 5 2-DH-1, 3, 5 3-DH-1, 3, 5 LE) Frequency range 2402 MHz to 2480 MHz Measurement mode 'SIG Standard' Supports RF measurements on selected packet types as per the Bluetooth SIG RF test specification.
RF Power	Input level range –65 to +25 dBm (MU887000A test port 3 and 4) –55 to +35 dBm (MU887001A all test port) Measurement accuracy After CAL, 20° to 30°C ±0.7 dB (–30 dBm ≤ p ≤ +25 dBm), ±1.0 dB (–50 dBm ≤ p < –30 dBm) (MU887000A) ±0.7 dB (–20 dBm ≤ p ≤ +35 dBm), ±1.0 dB (–40 dBm ≤ p ≤ –20 dBm) (MU887001A)
EDR Relative Transmit Power	Input level range –35 to +25 dBm (MU887000A) –25 to +35 dBm (MU887001A) Measurement Value Maximum, Minimum, Average differential power Relative power measurement range Relative power measurement range between the GFSK and π/4-DQPSK, 8-DPSK sections of the packet. Bandwidth 1.3 MHz (IF filter response 'flat' fc ±550 kHz) Resolution (time domain) 0.01 dB
Bluetooth Modulation	GFSK, π/4-DQPSK, 8-DPSK Input level range –20 to +25 dBm (MU887000A) –10 to +35 dBm (MU887001A) Residual DEVM Signal level: >–20 dBm (MU887000A), >–10 dBm (MU887001A), Averaged over 10 packets <5% Resolution 0.1% GFSK modulation Deviation measurement range: 0 to 350 kHz Accuracy: Modulation index: 0.32, Signal level: >–20 dBm (MU887000A), >–10 dBm (MU887001A), Averaged over 10 packets 1% (±0.01 × expected deviation [Hz]) (nom.) Initial carrier frequency tolerance Input level range: –35 to +25 dBm (MU887000A) –25 to +35 dBm (MU887001A) Initial frequency range: 0 to ±150 kHz Resolution: 1 kHz Carrier-frequency drift Input signal range: –35 to +25 dBm (MU887000A) –25 to +35 dBm (MU887001A) Frequency drift range: 0 to ±200 kHz Time settings: 50 µs, >2000 µs

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EDR Carrier Frequency Stability	Measurement range ±100 kHz Resolution 1 kHz Accuracy Signal level: >–20 dBm (MU887000A), >–10 dBm (MU887001A), Averaged over 10 packets ± (Setting frequency × Reference oscillator accuracy + 500 Hz) Displayed results Initial frequency error ωi, Frequency error ωo, Frequency error ωi + ωo
EDR Modulation Accuracy	RMS DEVM range 0 to 30% (π/4-DQPSK), 0 to 20% (8-DPSK) Peak DEVM range 0 to 50% (π/4-DQPSK), 0 to 30% (8-DPSK)
BLE Modulation Characteristics	GFSK Input level range –35 to +25 dBm (MU887000A) –25 to +35 dBm (MU887001A) Frequency deviation range 0 to ±500 kHz peak Resolution 1 kHz Accuracy Modulation index: 0.5, Signal level: >–20 dBm (MU887000A), >–10 dBm (MU887001A), Averaged over 10 packets 1% (±0.01 × expected deviation [Hz]) (nom.)
BLE Carrier Frequency Offset and Drift	Input level range –35 to +25 dBm (MU887000A) –25 to +35 dBm (MU887001A) Frequency range 0 to ±500 kHz Accuracy Signal level: >–20 dBm (MU887000A), >–10 dBm (MU887001A), Averaged over 10 packets ± (Setting frequency × Reference oscillator accuracy + 500 Hz) Displayed results Carrier frequency error, Frequency drift, Drift rate

Short Range Wireless Average Power and Frequency Measurement MX887050A

RF Power (CW and Continuously Modulated)	Frequency range 2.4 GHz band: 2402 MHz to 2484 MHz 5 GHz band: 4920 MHz to 5825 MHz (require MU88700xA-001) Input level range –65 to +25 dBm (MU887000A test port 3 and 4) –55 to +35 dBm (MU887001A all test port) Accuracy After CAL 400 MHz ≤ f < 3.8 GHz, 10° to 40°C ±0.7 dB (–30 ≤ p ≤ +25 dBm) ±0.9 dB (–55 ≤ p < –30 dBm) ±1.1 dB (–65 ≤ p < –55 dBm) 3.8 GHz ≤ f ≤ 6 GHz, 20° to 30°C ±0.7 dB (–30 ≤ p ≤ +25 dBm) ±0.9 dB (–55 ≤ p < –30 dBm) ±1.1 dB (–65 ≤ p < –55 dBm) Linearity CW, RBW: 100 kHz ±0.2 dB (≥–55 dBm, –40 to 0 dB)
Frequency (CW)	Input level range –35 to +25 dBm (MU887000A) –25 to +35 dBm (MU887001A) Frequency range 0 to ±500 kHz Accuracy ± (Setting frequency × Reference oscillator accuracy + 500 Hz)

IEEE 802.15.4 TX Measurement MX887060A

Common Item	Frequency range 440 MHz to 2500 MHz
RF Power	Input level range –65 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –65 to +25 dBm (MU887000A test port 3 and 4) Accuracy After CAL, 10° to 40°C MU887000A test port 1 and 2, MU887001A all test port ±0.3 dB (typ.), ±0.5 dB (–25 to +35 dBm) ±0.7 dB (–55 to –25 dBm) ±0.9 dB (–65 to –55 dBm) MU887000A test port 3 and 4 ±0.7 dB (–25 to +25 dBm) ±0.9 dB (–55 to –25 dBm) ±1.1 dB (–65 to –55 dBm)

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Modulation Analysis	Input level range Analysis length: 1000 chips or more –30 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –30 to +25 dBm (MU887000A test port 3 and 4) Modulation accuracy Residual EVM ≤1.5% Carrier frequency accuracy ± (Setting frequency × Reference oscillator accuracy + 20 Hz)

Z-Wave TX Measurement MX887061A

Common Item	Frequency range 440 MHz to 1000 MHz
RF Power	Input level range –65 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –65 to +25 dBm (MU887000A test port 3 and 4) Accuracy After CAL, 10° to 40°C MU887000A test port 1 and 2, MU887001A all test port ±0.3 dB (typ.), ±0.5 dB (–25 to +35 dBm) ±0.7 dB (–55 to –25 dBm) ±0.9 dB (–65 to –55 dBm) MU887000A test port 3 and 4 ±0.7 dB (–25 to +25 dBm) ±0.9 dB (–55 to –25 dBm) ±1.1 dB (–65 to –55 dBm)
Modulation Analysis	Input level range Analysis length: 200 bits –30 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –30 to +25 dBm (MU887000A test port 3 and 4) Carrier frequency accuracy ± (Setting frequency × Reference oscillator accuracy + 20 Hz)

Category M FDD Uplink TX Measurement MX887065A

Common Item	Measuring Object PUSCH, PUCCH Frequency Range 600 MHz to 2.7 GHz, 3.4 GHz to 3.8 GHz 600 MHz to 2.7 GHz, 3.4 GHz to 4.2 GHz (with MU88700xA-001/101 option)
RF Power	Input Level Range –65 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –65 to +25 dBm (MU887000A test port 3 and 4) Measurement Accuracy 600 MHz to 2.7 GHz, 3.4 GHz to 3.8 GHz, After CAL, 10° to 40°C MU887000A test port 1 and 2, MU887001A all test port ±0.3 dB (typ.) (–20 to +35 dBm, 20° to 30°C) ±0.5 dB (–20 to +35 dBm) ±0.7 dB (–50 to –20 dBm) ±0.9 dB (–60 to –50 dBm) MU887000A test port 3 and 4 ±0.7 dB (–20 to +25 dBm) ±0.9 dB (–50 to –20 dBm) ±1.1 dB (–60 to –50 dBm) 3.8 GHz to 4.2 GHz, After CAL, 20° to 30°C MU887000A test port 1 and 2, MU887001A all test port ±0.7 dB (–20 to +35 dBm) ±0.9 dB (–50 to –20 dBm) ±1.1 dB (–60 to –50 dBm) MU887000A test port 3 and 4 ±0.7 dB (–20 to +25 dBm) ±0.9 dB (–50 to –20 dBm) ±1.1 dB (–60 to –50 dBm)
Frequency/Modulation Measurement	Input Level Range –40 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –40 to +25 dBm (MU887000A test port 3 and 4) Carrier Frequency Accuracy ± (Setting frequency × Reference oscillator accuracy + 15 Hz) Modulation Analysis Residual EVM: Average of 20 measurements ≤2.5% In-Band Emission In signal condition with Input Level ≥–10 dBm ≤–40 dBc
Occupied bandwidth	Input Level Range –10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –10 to +25 dBm (MU887000A test port 3 and 4)

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Adjacent channel leakage power ratio	Input Level Range –10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –10 to +25 dBm (MU887000A test port 3 and 4) Measurement Range ≥45 dB (E-UTRA ACLR1) ≥50 dB (UTRA ACLR1) ≥55 dB (UTRA ACLR2)
Spectrum Emission Mask	Input Level Range –10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –10 to +25 dBm (MU887000A test port 3 and 4)

NB-IoT Uplink TX Measurement MX887067A

Common Item	Measuring object NPUSCH Frequency range 600 MHz to 2.7 GHz, 3.4 GHz to 3.8 GHz 600 MHz to 2.7 GHz, 3.4 GHz to 4.2 GHz (with MU88700xA-001/101 option)
RF Power	Input level range -65 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) -65 to +25 dBm (MU887000A test port 3 and 4) Measurement accuracy 600 MHz to 2.7 GHz, 3.4 GHz to 3.8 GHz, After CAL, 10° to 40°C MU887000A test port 1 and 2, MU887001A all test port ±0.3 dB (typ.) (–20 to +35 dBm, 20° to 30°C) ±0.5 dB (–20 to +35 dBm) ±0.7 dB (-50 to -20 dBm) ±0.9 dB (-60 to -50 dBm) MU887000A test port 3 and 4 ±0.7 dB (-20 to +25 dBm) ±0.9 dB (-50 to -20 dBm) ±1.1 dB (-60 to -50 dBm) 3.8 GHz to 4.2 GHz, After CAL, 20° to 30°C MU887000A test port 1 and 2, MU887001A all test port ±0.7 dB (-20 to +35 dBm) ±0.9 dB (-50 to -20 dBm) ±1.1 dB (-60 to -50 dBm) MU887000A test port 3 and 4 ±0.7 dB (-20 to +25 dBm) ±0.9 dB (-50 to -20 dBm) ±1.1 dB (-60 to -50 dBm)
Frequency/Modulation Measurement	Input level range –40 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –40 to +25 dBm (MU887000A test port 3 and 4) Carrier frequency accuracy ±(Setting frequency × Reference oscillator accuracy + 15 Hz) Modulation analysis Residual EVM: Average of 20 measurements ≤1% In-band emission In signal condition with Input Level ≥-10 dBm ≤–40 dBc
Occupied bandwidth	Input level range –10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –10 to +25 dBm (MU887000A test port 3 and 4)
Adjacent channel leakage power ratio	Input level range –10 to +35 dBm (MU887000A test port 1 and 2, MU887001A all test port) –10 to +25 dBm (MU887000A test port 3 and 4) Measurement range ≥47 dB (GSM ACLR) ≥50 dB (UTRA ACLR)
Spectrum Emission Mask	Input level range –10 to +35dBm (MU887000A test port 1 and 2, MU887001A all test port) –10 to +25dBm (MU887000A test port 3 and 4)

WLAN 802.11b/g/a/n Waveforms MV887030A

EVM	802.11b Packet length: 1024 byte, Gaussian filter: BT 0.5 ≤–38 dB rms (2402 MHz to 2484 MHz) 802.11g Packet length: 1000 byte, 20° to 30°C ≤–40 dB rms (2402 MHz to 2484 MHz) 802.11a Packet length: 1000 byte, 20° to 30°C ≤–38 dB rms (4920 MHz to 5825 MHz) 802.11n Packet length: 4096 byte, Long guard interval, Channel bandwidth: 40 MHz, 20° to 30°C ≤–40 dB rms (2402 MHz to 2484 MHz) ≤–38 dB rms (4920 MHz to 5825 MHz)

Bluetooth Waveforms MV887040A

Deviation	Frequency: 2402 MHz to 2480 MHz, GFSK modulation 1% (±0.01 × deviation Hz) (nom.)
DEVM	Frequency: 2402 MHz to 2480 MHz, π/4-DQPSK, 8-DPSK modulation <5% rms

IEEE 802.15.4 Waveforms MV887060A

EVM	440 MHz ≤ f ≤ 2500 MHz ≤3.0%

Z-Wave Waveforms MV887061A

EVM	440 MHz ≤ f ≤ 2500 MHz ≤3.0%

Category M FDD Downlink Waveforms MV887065A

Max. Output Level	MU887000A test port 1 and 2, MU887001A all test port –12 dBm (f ≤ 3.8 GHz), –20 dBm (f > 3.8 GHz) MU887000A test port 3 and 4 –2 dBm (f ≤ 3.8 GHz), –10 dBm (f > 3.8 GHz)

NB-IoT Downlink Waveforms MV887067A

Max. Output Level	MU887000A test port 1 and 2, MU887001A all test port –12 dBm (f ≤ 3.8 GHz), –20 dBm (f > 3.8 GHz) MU887000A test port 3 and 4 –2 dBm (f ≤ 3.8 GHz), –10 dBm (f > 3.8 GHz)

ISDB-Tmm Waveforms MV887112A

MER	Frequency: 214.714285 MHz ≥37 dB (total)

FM/Audio TRX Measurement MX887070A

FM Signal Measurements

Common Item	Target signals FM/FM stereo/RDS (Radio Data System) signals Frequency range 65 MHz to 110 MHz
TX Measurements	Measurement functions Amplitude Carrier frequency Frequency deviation Occupied bandwidth Pilot frequency deviation Audio frequency deviation Audio frequency Pilot frequency THD THD+N/SINAD SNR Audio filter Low-pass: Off, 3 kHz, 15 kHz, 20 kHz, 30 kHz High-pass: Off, 20 Hz, 100 Hz, 400 Hz De-emphasis: Off, 50 µs, 75 µs Bandpass (Weighting filter): Off, A-Weighting (IEC 61672: 2003), C-Message, CCITT (ITU-T O.41) Input level range –30 to +15 dBm Level accuracy 10° to 40°C, Measurement bandwidth: 1.2 MHz, –30 dBm ≤ p ≤ +15 dBm ±0.7 dB Carrier frequency accuracy FM monaural modulation, Tone: 1 kHz, Deviation: 75 kHz ± (Setting frequency × Reference oscillator accuracy + 1 Hz) FM deviation range 1 kHz to 100 kHz Residual FM Monaural modulation, Tone: 1 kHz, Deviation: 75 kHz, Demodulation bandwidth: 20 Hz to 15 kHz, using De-emphasis filter (50 µs) >55 dB Demodulation signal analysis No. of FFT points: 65536 Sampling rate: 152 kHz FFT window function: Hanning window
RX Measurements	Measurement functions FM waveform output Modulation method FM Monaural, FM stereo Frequency deviation Setting range: 20 kHz to 100 kHz Distortion 65 MHz to 110 MHz (SINAD, 20 Hz to 15 kHz, Emphasis on, Monaural), Tone: 1 kHz, Deviation: 75 kHz >50 dB (SINAD) Resolution: 0.1 Hz Internal modulation signal AF tone L channel (Mono): 1 to 8 tones R channel: 1 to 8 tones Frequency range 20 Hz to 20 kHz, Resolution: 0.1 Hz

Audio Signal Measurements
With MU88700xA-002 Audio Measurement Hardware installed, TRX measurements of analog audio signal from AF input/output connector or digital audio signal from AF digital connector

TX Measurements	Measurement functions Amplitude Frequency Distortion ratio measurement Crosstalk THD THD+N/SINAD SNR Analog measurements All Single-tone measurement standard values Impedance: 100 kΩ (AC coupling) Frequency Frequency range: 20 Hz to 20 kHz Input level Level range: 1 mVpeak to 5 Vpeak (30 V rms, max.) Setting range: 50 mVpeak, 500 mVpeak, 5 Vpeak Level accuracy: ±0.4 dB (20° to 30°C) THD+N (total harmonic distortion + noise) <−60 dB (at 1 kHz, 2 Vpeak, 20 Hz to 20 kHz bandwidth, 5 Vpeak range, 20° to 30°C) Crosstalk L/R: >60 dB AF signal analysis Sampling rate: 192 kHz No. of FFT points: 65536 FFT window function: Hanning window Digital measurement All Single-tone measurement standard values Bit resolution: 16 bits/24 bits Sampling rate Frequency: 16, 32, 44.1, 48 kHz AF signal analysis No. of FFT points: 16384 (sampling rates of 48 kHz, 44.1 kHz) 8192 (sampling rate of 32 kHz) 4096 (sampling rate of 16 kHz) FFT window function: Hanning window
RX Measurement	Analog measurements All Single-tone measurement standard values Impedance: 1 Ω (AC coupling) (nom.) Output waveform: Single-tone, Multi-tone Frequency Frequency range: 20 Hz to 20 kHz Frequency resolution: 0.01 Hz Output level Level range: 0 (off), 1 mV to 5 Vpeak (100 kΩ termination) Resolution: 1 mV (≤5 Vpeak) 100 µV (≤500 mVpeak) 10 µV (≤50 mVpeak) Accuracy: ±0.3 dB (at 1 kHz, 100 kΩ termination, 20° to 30°C) Maximum output current 100 mA (nom.) (Do not do short circuit) THD+N (Total harmonic distortion + noise) <−60 dB (at 1 kHz, 1 Vpeak, 20 Hz to 20 kHz bandwidth, 100 kΩ termination, 20° to 30°C) Digital measurement All Single-tone measurement standard values Output waveform: Single-tone, Multi-tone Frequency Frequency range: 20 Hz to 20 kHz (44.1 kHz, 48 kHz sampling) 20 Hz to 14 kHz (32 kHz sampling) 20 Hz to 7 kHz (16 kHz sampling) Resolution: 0.01 Hz Output level Level range: Full scale to (Full scale – 40 dB) Resolution: 0.1 dB Bit resolution: 16 bits/24 bits Sampling rate Frequency: 16, 32, 44.1, 48 kHz

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main frame
MT8870A	Universal Wireless Test Set
	Standard accessories
	Power Cord: 1 pc
B0666A	Blank Panel: 0 to 4 pcs*1
	DVD-R: 1 pc
MX880050A	CombiView (DVD-R)
MX880051A	Cellular Application Applet (DVD-R)
MX880052A	SRW Application Applet (DVD-R)
MX880053A	FM/Audio Application Applet (DVD-R)
MX880054A	Signal Generator Application Applet (DVD-R)
MX880055A	Small Cell Application Applet (DVD-R)
MX880056A	IEEE 802.15.4 Application Applet (DVD-R)
MX887900A	MT8870A Utility Tool (DVD-R)
W3605AE	MT8870A Operation Manual (DVD-R)
W3606AE	MU887000A Operation Manual (DVD-R)
	Options
MT8870A-001	GPIB Control
MT8870A-101	GPIB Control Retrofit
	Warranty
MT8870A-ES210	2 Years Extended Warranty Service
MT8870A-ES310	3 Years Extended Warranty Service
MT8870A-ES510	5 Years Extended Warranty Service
	Application parts
B0666A	Blank Panel
B0664A	Rack Mount Kit (MT8870A)
B0665A	Carrying Case (MT8870A)
B0669A	Front Cover for 1MW5U (MT8870A)
J0006	GPIB Cable, 0.5 m
J0007	GPIB Cable, 1.0 m
J0008	GPIB Cable, 2.0 m
J0127A	Coaxial Cord, 1 m (BNC-P · RG-58A/U · BNC-P)
J0127B	Coaxial Cord, 2.0 m (BNC-P · RG-58A/U · BNC-P)
J0127C	Coaxial Cord, 0.5 m (BNC-P · RG-58A/U · BNC-P)
J0576B	Coaxial Cord, 1.0 m (N-P · 5D-2W · N-P)
J0576D	Coaxial Cord, 2.0 m (N-P · 5D-2W · N-P)
J0322A	Coaxial Cord, 0.5 m (SMA-P · SMA-P, DC to 18 GHz, 50Ω)
J0322B	Coaxial Cord, 1.0 m (SMA-P · SMA-P, DC to 18 GHz, 50Ω)
J0322C	Coaxial Cord, 1.5 m (SMA-P · SMA-P, DC to 18 GHz, 50Ω)
J0322D	Coaxial Cord, 2.0 m (SMA-P · SMA-P, DC to 18 GHz, 50Ω)
J0004	Coaxial Adapter (N-P · SMA-J)
J1261A	Ethernet Cable (Shield type, Straight, 1 m)
J1261B	Ethernet Cable (Shield type, Straight, 3 m)
J1261C	Ethernet Cable (Shield type, Crossover, 1 m)
J1261D	Ethernet Cable (Shield type, Crossover, 3 m)
J1941A	2way Low Amplitude Error Divider
J1942A	4way Low Amplitude Error Divider

*1: Installed in empty slots

Model/Order No.	Name
	Application instruments
MN8116A	Multi-Port Switch (16 ports)
MN8116A-001	16 Port Expansion Bank
MN8116A-101	16 Port Expansion Bank Retrofit
	Warranty
MN8116A-ES210	2 Years Extended Warranty Service
MN8116A-ES310	3 Years Extended Warranty Service
MN8116A-ES510	5 Years Extended Warranty Service

Model/Order No.	Name
	Test module
MU887000A	TRX Test Module
MU887001A	TRX Test Module
	Standard accessories
	DVD-R: 1 pc
W3606AE	MU887000A Operation Manual (DVD-R)
	Options
MU887000A-001	6 GHz Frequency Extension
MU887000A-101	6 GHz Frequency Extension Retrofit
MU887000A-002	Audio Measurement Hardware
MU887000A-102	Audio Measurement Hardware Retrofit
MU887001A-001	6 GHz Frequency Extension
MU887001A-101	6 GHz Frequency Extension Retrofit
MU887001A-002	Audio Measurement Hardware
MU887001A-102	Audio Measurement Hardware Retrofit
	Warranty
MU887000A-ES210	2 Years Extended Warranty Service
MU887000A-ES310	3 Years Extended Warranty Service
MU887000A-ES510	5 Years Extended Warranty Service
MU887001A-ES210	2 Years Extended Warranty Service
MU887001A-ES310	3 Years Extended Warranty Service
MU887001A-ES510	5 Years Extended Warranty Service

Model/Order No.	Name
	Measurement software
MX887010A	Cellular Standards Sequence Measurement
MX887011A	W-CDMA/HSPA Uplink TX Measurement
MX887012A	GSM/EDGE Uplink TX Measurement
MX887013A	LTE FDD Uplink TX Measurement
MX887013A-001	LTE-Advanced FDD Uplink CA TX Measurement
MX887014A	LTE TDD Uplink TX Measurement
MX887014A-001	LTE-Advanced TDD Uplink CA TX Measurement
MX887015A	CDMA2000 Reverse Link TX Measurement
MX887016A	1xEV-DO Reverse Link TX Measurement
MX887017A	TD-SCDMA Uplink TX Measurement
MX887019A	NR TDD sub-6GHz Uplink TX Measurement
MX887021A	W-CDMA/HSPA Downlink TX Measurement
MX887023A	LTE FDD Downlink TX Measurement
MX887030A	WLAN 802.11b/g/a/n TX Measurement*2
MX887031A	WLAN 802.11ac TX Measurement*2
MX887032A	WLAN 802.11p TX Measurement*2
MX887033A	WLAN 802.11ax TX Measurement*2
MX887040A	Bluetooth TX Measurement
MX887040A-001	DLE TX Measurement*3
MX887040A-002	2LE TX Measurement*3, *4
MX887040A-003	BLR TX Measurement*3, *4
MX887050A	Short Range Wireless Average Power and Frequency Measurement
MX887060A	IEEE 802.15.4 TX Measurement
MX887061A	Z-Wave TX Measurement
MX887065A	Category M FDD Uplink TX Measurement
MX887067A	NB-IoT Uplink TX Measurement
MX887070A	FM/Audio TRX Measurement*5
MX887090A	Multi-DUT Measurement Scheduler
	Waveforms
MV887011A	W-CDMA/HSPA Downlink Waveforms
MV887012A	GSM/EDGE Downlink Waveforms
MV887013A	LTE FDD Downlink Waveforms
MV887014A	LTE TDD Downlink Waveforms
MV887015A	CDMA2000 Forward Link Waveforms
MV887016A	1xEV-DO Forward Link Waveforms
MV887017A	TD-SCDMA Downlink Waveforms
MV887019A	NR TDD sub-6GHz Downlink Waveforms
MV887021A	W-CDMA/HSPA Uplink Waveforms
MV887023A	LTE FDD Uplink Waveforms
MV887030A	WLAN 802.11b/g/a/n Waveforms*2
MV887031A	WLAN 802.11ac Waveforms*2
MV887032A	WLAN 802.11p Waveforms
MV887033A	WLAN 802.11ax Waveforms*2
MV887040A	Bluetooth Waveforms
MV887040A-001	DLE Waveforms*6
MV887040A-002	2LE Waveforms*6, *7
MV887040A-003	BLR Waveforms*6, *7
MV887060A	IEEE 802.15.4 Waveforms
MV887061A	Z-Wave Waveforms
MV887065A	Category M FDD Downlink Waveforms
MV887067A	NB-IoT Downlink Waveforms
MV887070A	FM RDS Waveforms
MV887100A	GPS Waveforms
MV887101A	Galileo Waveforms
MV887102A	GLONASS Waveforms
MV887103A	BeiDou Waveforms
MV887110A	DVB-H Waveforms
MV887111A	ISDB-T Waveforms
MV887112A	ISDB-Tmm Waveforms

*2: Requires MU88700xA-001 for 5 GHz (802.11a/n/p/ac) frequency measurements
*3: Requires MX887040A
*4: Requires MX887040A-001
*5: Requires MU88700xA-002 for audio signal measurements
*6: Requires MV887040A
*7: Requires MV887040A-001

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Shield Box

MA8120E

800 MHz to 2500 MHz

Shield Box Suitable for Testing Mobile Phones

Features

- The internal wide-band antenna (800 MHz to 2500 MHz) enables testing of LTE, W-CDMA, CDMA2000, GSM, PDC, and PHS mobile terminals as well as Wireless LAN, Bluetooth, and other such mobile devices using an air connection.
- Both air and coaxial connections between mobile phones and the MA8120E are available.
- UE multi holder can hold various shape UEs, allowing air connection measurements in proper position.

Specifications

Frequency		800 MHz to 2500 MHz
Shield Performance		≥60 dB
Antenna Coupling Amount		≥–25 dB
Interface	External	RF connector: N type Control connector: DX50 type
	Internal	RF connector: SMA type Control connector: DX36 type
Dimensions and Mass (excluding protrusion)		330.8 (W) × 181 (H) × 393 (D) mm ≤7 kg
Temperature Range		Operating: 0° to +50°C Storage: –20° to +60°C
EMC		2014/30/EU, EN61326-1, EN61000-3-2

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Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main frame
MA8120E	Shield Box
	Standard accessories
B0560A	UE Multi Holder: 1 pc
W2651AE	MA8120E Operation Manual: 1 copy
	Application parts
J0576B	Coaxial Cord, 1.0 m (N-P · 5D-2W · N-P)
J0576D	Coaxial Cord, 2.0 m (N-P · 5D-2W · N-P)
J1151B	Control Cable for PC (USB cable externally connected to MA8120E[*1], used in combination with J1215A, sold separately)
J1155A	UE I/F Cable with RF (for W-CDMA mobile phone connection inside MA8120E, control signal and RF)[*1]
J1157B	Connecting Cable for RS232C (Serial cable externally connected to MA8120E, used in combination with J1311A/B, sold separately)
J1215A	Terminal I/F Cable [DX36 · USB A type Female], (for USB connection inside MA8120E[*1], used in combination with J1151B, sold separately)
J1311A	Connecting Cable for RS232C (DX36 · D-Sub 9 pin, J type, 100 mm, Serial cable internally connected to MA8120E)
J1311B	Connecting Cable for RS232C (DX36 · D-Sub 9 pin, J type, 300 mm, Serial cable internally connected to MA8120E)
	Optional parts
J1312	DX-50-CV1 Plug Cover Case[*2]
Z0820A	Rubber Band (for B0560A)

*1: MA8120E does not support USB2.0.
*2: In case of using MA8120A's connecting cable for MA8120E, cover for DX-50-CV need to change DX-50-CV1.

Vector Signal Generator

MG3710A

100 kHz to 2.7 GHz/4.0 GHz/6.0 GHz

Remote Control
GPIB | Ethernet | USB

Multi-Band/Multi-System/Multi-Channel – Cut Costs for New Wireless Tests –

Excellent Eco Product

The MG3710A is a vector signal generator with 6-GHz upper frequency limit and 160-MHz*/120-MHz wide RF modulation baseband generator. It outputs various radio systems signals for cellular communications, such as 5G, LTE FDD/TDD, W-CDMA, GSM as well as narrowband communications, such as WLAN, WiMAX, Bluetooth and GPS.

Cuts Equipment Costs

The dual waveform memory cuts equipment costs for tests, such as ACS, Blocking and IM, which require two modulation signal sources.
The dual RF cuts MIMO equipment costs and reduces workloads for phase synchronization between equipment.
It is important for tests using separate signals, such as Multi-Standard Radio (MSR) and multi-band.

Improves Yield

The excellent signal generator ACLR and SSB phase noise reduces the effect on wideband and narrowband measurements to improve test margins and yields.

–71 dBc @W-CDMA, TestModel1, 64DPCH, 2 GHz
<–140 dBc/Hz (nom.) @100 MHz, 20 kHz offset, CW

Cuts Tact Time

The List/Sweep mode switches the frequency and level faster than 600 µs. Moreover, the 4-GB waveform memory upgrade can load many waveform patterns while instantaneous switching eliminates time wasted reloading waveform patterns.

*: Supports firmware version 2.00.00 and later. Can generate 160-MHz bandwidth signals (WLAN 802.11ac) only when using WLAN IQproducer MX370111A and 802.11ac (160 MHz) option MX370111A-002.
The latest version can be downloaded from the Anritsu homepage.
<https://my.anritsu.com/home>

Key Features

Dual RF & Dual Waveform Memory

- One Unit Supports Two RF Outputs Max.
  Frequency Range
    1stRF: 100 kHz to 2.7/4.0/6.0 GHz [Option 032/034/036]
    2ndRF: 100 kHz to 2.7/4.0/6.0 GHz [Option 062/064/066]
    Independent Baseband and RF Outputs
- Output Two Signals from One RF Out [Option 048/078]
  Wanted Signal + Interfere Signal
  Wanted Signal + Delayed Signal, etc.

Basic Performance

- ACLR Performance
  –71 dBc @W-CDMA, TestModel1, 64 DPCH, 2 GHz
- High-power Output [Option 041/071]
  +23 dBm @CW, 400 MHz to 3 GHz
- High-speed Switching
  < 600 µs @List/Sweep mode
- High Level Accuracy
  Absolute Level Accuracy: ±0.5 dB
  Linearity: ±0.2 dB (typ.)
- Choice of Reference Oscillators
  Standard
    Aging rate ±1 × 10^{-6}/year, ±1 × 10^{-7}/day
  High Stability Reference Oscillator [Option 002]
    Aging rate ±1 × 10^{-7}/year, ±1 × 10^{-8}/day
  Rubidium Reference Oscillator [Option 001]
    Aging rate ±1 × 10^{-10}/month
- SSB Phase Noise Performance

<–140 dBc/Hz (nom.)	@100 MHz, 20-kHz offset, CW
<–131 dBc/Hz (typ.)	@1 GHz, 20-kHz offset, CW
<–125 dBc/Hz (typ.)	@2 GHz, 20-kHz offset, CW

High All-purpose Baseband Performance

- Wide Vector Modulation Bandwidth
  160 MHz*/120 MHz (using Internal baseband signal generator)
  160 MHz (using External IQ input)
  *:Supports firmware version 2.00.00 and later. Can generate 160-MHz bandwidth signals (WLAN 802.11ac) only when using WLAN IQproducer MX370111A and 802.11ac (160 MHz) option MX370111A-002.
- Large-capacity Waveform Memory
- Arbitrary Waveform Generation

Expandability

- BER Test Function [Option 021]
- Built-in analog modulation (AM/FM/ΦM) functions and pulse modulation (PM) functions [Standard]
- Adding additional analog modulation input options [Option 050/080]
- AWGN Generator [Option 049/079]
- USB Power Sensors [Sold separately]
- Local Signal I/O for MIMO Signal Source [Option 017]

Operability

- Simple Touch-panel Operation
- Signal Flowcharts with Signal Block Diagrams
- Frequency Channel Table

Connections with External Equipment

- Remote Control Interfaces
- USB Connections
- Analog IQ Input/Output [Option 018]
- Trigger Input
- Marker Output Editing
  Marker 1 output [Standard]
  Marker 2 and 3 output [Requires J1539A AUX Conversion Adapter]

Security

- MG3710A Windows XP OS can be upgraded to Window 7 (WES7) [Option 181]
- User Data Storage on 2ndary HDD [Option 011]

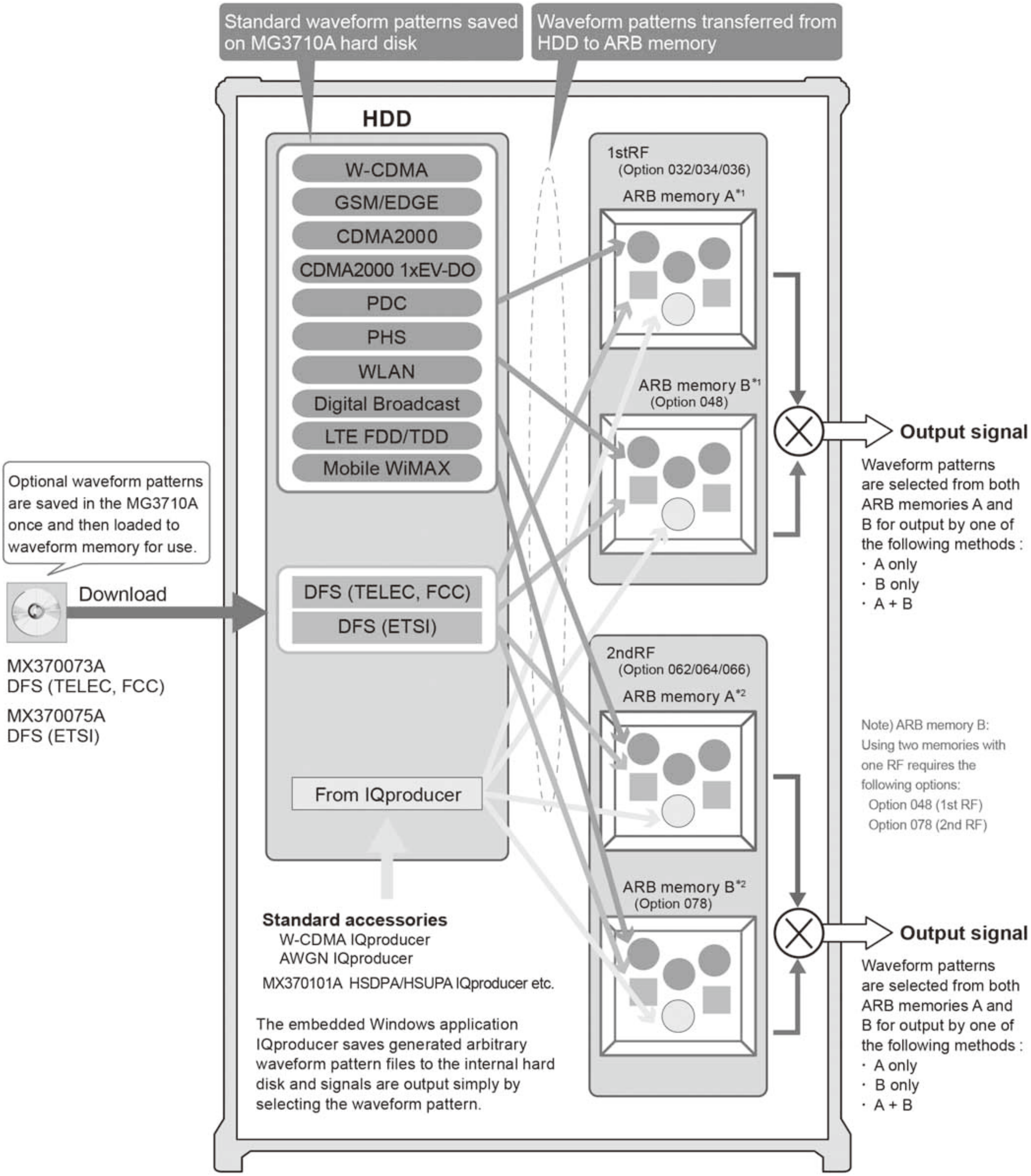
Pre-installed Key Waveform Patterns

- Waveform Patterns [Pre-installed]
  Waveform patterns for the world's main communications systems (below) are pre-installed in the MG3710A for license-free use.
    LTE FDD (E-TM1.1 to E-TM3.3)
    LTE TDD (E-TM1.1 to E-TM3.3)
    W-CDMA/HSDPA
    GSM/EDGE
    CDMA2000 1X/1xEV-DO
    Bluetooth®
    GPS
    PDC
    PHS
    Digital Broadcast (ISDB-T/BS/CS/CATV)
    WLAN (802.11a/b/g)

Waveform Pattern Options and Generation

- Optional Waveform Pattern [Optional License]
  DFS Radar Pattern (For TELEC & FCC)
  DFS (ETSI) Waveform Pattern
  ISDB-Tmm Waveform Pattern
- IQproducer Waveform Generation Software [Optional License]
  5G NR TDD sub-6GHz
  LTE FDD/LTE-Advanced FDD
  LTE TDD/LTE-Advanced TDD
  HSDPA/HSUPA/W-CDMA
  TD-SCDMA
  CDMA2000 1xEV-DO
  Mobile WiMAX
  WLAN (802.11a/b/g/n/j/p/ac)
  TDMA (PDC, PHS, Public Radio System)
  DVB-T/H
  Multi-carrier
  Fading

Vector Signal Generator MG3710A



Optional waveform patterns are saved in the MG3710A once and then loaded to waveform memory for use.

Standard accessories
W-CDMA IQproducer
AWGN IQproducer
MX370101A HSDPA/HSUPA IQproducer etc.

The embedded Windows application IQproducer saves generated arbitrary waveform pattern files to the internal hard disk and signals are output simply by selecting the waveform pattern.

Waveform patterns are selected from both ARB memories A and B for output by one of the following methods :
- A only
- B only
- A + B

Note) ARB memory B:
Using two memories with one RF requires the following options:
Option 048 (1st RF)
Option 078 (2nd RF)

Waveform patterns are selected from both ARB memories A and B for output by one of the following methods :
- A only
- B only
- A + B

[*1] 1stRF ARB memory size
256 MB × 1 pc = 64 Msamples (Std.)
1 GB × 1 pc = 256 Msamples × 1 pc (Option 045)
1 GB × 2 pcs = 256 Msamples × 2 pcs (Option 045 + Option 048)
4 GB × 1 pc = 1024 Msamples × 1 pc (Option 046)
4 GB × 2 pcs = 1024 Msamples × 2 pcs (Option 046 + Option 048)

[*2] 2ndRF ARB memory size
256 MB × 1 pc = 64 Msamples (Std.)
1 GB × 1 pc = 256 Msamples × 1 pc (Option 075)
1 GB × 2 pcs = 256 Msamples × 2 pcs (Option 075 + Option 078)
4 GB × 1 pc = 1024 Msamples × 1 pc (Option 076)
4 GB × 2 pcs = 1024 Msamples × 2 pcs (Option 076 + Option 078)

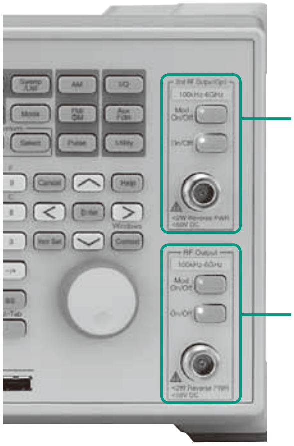
Dual RF & Dual Waveform Memory

Dual VSG: Two RF Outputs

The MG3710A supports two RF outputs (1stRF/2ndRF) max. in one unit. Moreover, different frequencies can be set independently at 1stRF and 2ndRF.

Not only different frequencies but also different levels and waveform patterns can be set independently at each SG while each is tracking the other. This is convenient in the R&D phase for evaluating interference between two different systems using different frequency bands.

Notes: Supported frequency bands cannot be changed after shipment.
IQ input is supported only by SG1 (1stRF) and requires Option 017.



2ndRF
Frequency Range:
2ndRF 100 kHz to 2.7 GHz [Option 062]
2ndRF 100 kHz to 4.0 GHz [Option 064]
2ndRF 100 kHz to 6.0 GHz [Option 066]
* Whether or not install and the frequency model can be selected at any time.

1stRF
Frequency Range:
1stRF 100 kHz to 2.7 GHz [Option 032]
1stRF 100 kHz to 4.0 GHz [Option 034]
1stRF 100 kHz to 6.0 GHz [Option 036]
* Must install any one of these.

Dual Waveform Memory: Four Waveform Outputs Max.

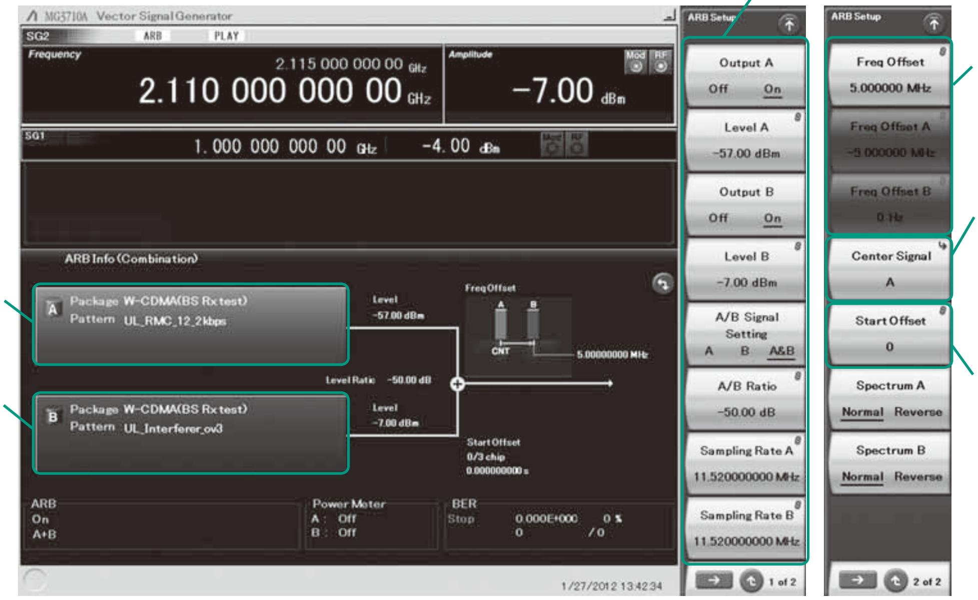
In the standard configuration, one VSG (1stRF or 2ndRF) has one waveform memory. However, adding the baseband signal combine option (Option 048/078) upgrades to two memories for one VSG.

In other words, models with two VSGs (1stRF and 2ndRF) installed can have a maximum of four waveform memories. Two waveform patterns can be set easily on-screen for one VSG, each with different frequency offset, level offset and delay time settings to output a combined baseband RF signal. With this setup, one MG3710A supports the following test environment — a setup that previously required two expensive signal generators:

Wanted Signal + Interference Signal
Wanted Signal + Delayed Signal

Synthesizing Signals with Different Sampling Rates
\- Rate Matching Function -
When signals with different sampling rates are set in memory A and memory B, a synthesized signal maintaining each of the different sampling rates can be output. This is useful when synthesizing signals for standards with different rates, such as multi-standard signals. However, depending on the combination of waveform sampling rates, sometimes it may not be possible to match rates due to internal operation clock limitations. The Mismatch warning dialog is displayed in this case.

Level Setting
Setting Range: –80 to +80 dB
Resolution: 0.01 dB



MG3710A Vector Signal Generator
SG2 ARB PLAY
Frequency 2.115 000 000 00 GHz
2.110 000 000 00 GHz
Amplitude –7.00 dBm
SG1 1. 000 000 000 00 GHz -4. 00 dBm
ARB Info (Combination)
A Package W-CDMA(BS Rx test) Pattern UL_RMC_12_2kbps
Level -57.00 dBm
B Package W-CDMA(BS Rx test) Pattern UL_Interferer_ov3
Level -7.00 dBm
Level Ratio -50.00 dB
Freq Offset 5.00000000 MHz
Start Offset 0/3 chip 0.000000000 s
ARB On A+B
Power Meter A : Off B : Off
BER Stop 0.000E+000 0 % 0 / 0
1/27/2012 13:42:34

ARB Setup (1 of 2)
Output A: Off On
Level A: -57.00 dBm
Output B: Off On
Level B: -7.00 dBm
A/B Signal Setting: A B A&B
A/B Ratio: -50.00 dB
Sampling Rate A: 11.520000000 MHz
Sampling Rate B: 11.520000000 MHz

ARB Setup (2 of 2)
Freq Offset: 5.000000 MHz
Freq Offset A: -5.000000 MHz
Freq Offset B: 0 Hz
Center Signal: A
Start Offset: 0
Spectrum A: Normal Reverse
Spectrum B: Normal Reverse

Waveform Pattern A
Example:
Wanted Signal

Waveform Pattern B
Example:
Interference Signal,
Delayed Signal

Frequency Offset Setting
Setting Range:
–100 to +100 MHz
Resolution: 1 Hz

Center Frequency Selection
A: Pattern A center
B: Pattern B center
Baseband DC:
Centered at baseband DC position

Time Offset Setting
Setting Range:
0 to pattern B sampling data count – 1

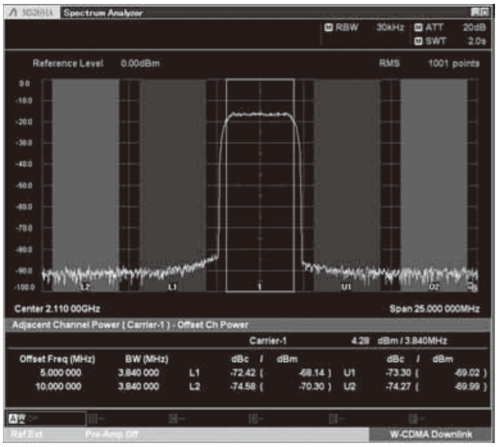
Baseband Signal Combine Example

Basic Performance

ACLR Performance

–71 dBc/3.84 MHz @W-CDMA, TestModel1, 64DPCH, 2 GHz

Evaluation of base station amplifiers, etc., requires excellent adjacent channel leakage power (ACLR) performance. Normally, the signal from the vector signal generator is inserted to an amplifier, and the amplifier output signal ACLR characteristics, etc., are measured with a spectrum analyzer. Instruments for these measurements require high ACLR performance.

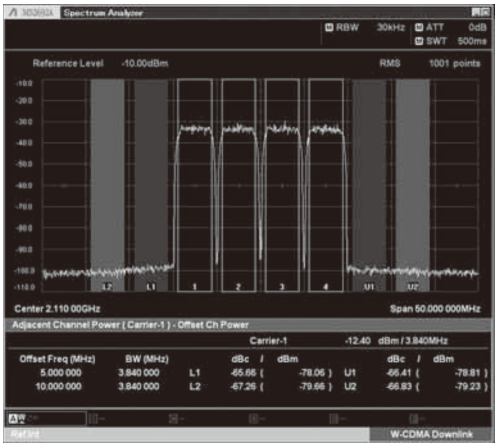


RBW 30kHz ATT 20dB
SWT 2.0s
Reference Level 0.00dBm
RMS 1001 points
Center 2.110 00GHz
Span 25.000 000MHz
Adjacent Channel Power (Carrier-1) - Offset Ch Power
Carrier-1 4.28 dBm / 3.840MHz

Offset Freq (MHz)	BW (MHz)		dBc / dBm			dBc / dBm	
5.000 000	3.840 000	L1	-72.42 (	-68.14)	U1	-73.30 (	-69.02)
10.000 000	3.840 000	L2	-74.58 (	-70.30)	U2	-74.27 (	-69.99)

Ref.Ext Pre-Amp Off W-CDMA Downlink

W-CDMA ACLR, 1 Carrier
(TestModel1, 64DPCH)

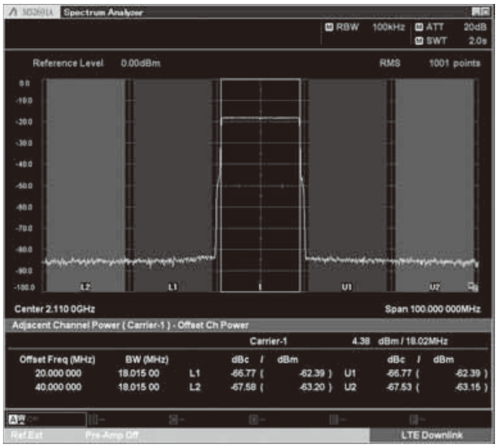


RBW 30kHz ATT 0dB
SWT 500ms
Reference Level -10.00dBm
RMS 1001 points
Center 2.110 00GHz
Span 50.000 000MHz
Adjacent Channel Power (Carrier-1) - Offset Ch Power
Carrier-1 -12.40 dBm / 3.840MHz

Offset Freq (MHz)	BW (MHz)		dBc / dBm			dBc / dBm	
5.000 000	3.840 000	L1	-65.66 (	-78.06)	U1	-66.41 (	-78.81)
10.000 000	3.840 000	L2	-67.26 (	-79.66)	U2	-66.83 (	-79.23)

Ref.Int W-CDMA Downlink

W-CDMA ACLR, 4 Carrier
(TestModel1, 64DPCH, 4 Carrier)



RBW 100kHz ATT 20dB
SWT 2.0s
Reference Level 0.00dBm
RMS 1001 points
Center 2.110 0GHz
Span 100.000 000MHz
Adjacent Channel Power (Carrier-1) - Offset Ch Power
Carrier-1 4.38 dBm / 18.02MHz

Offset Freq (MHz)	BW (MHz)		dBc / dBm			dBc / dBm	
20.000 000	18.015 00	L1	-66.77 (	-62.39)	U1	-66.77 (	-62.39)
40.000 000	18.015 00	L2	-67.58 (	-63.20)	U2	-67.53 (	-63.15)

Ref.Ext Pre-Amp Off LTE Downlink

LTE FDD ACLR, 1 Carrier
(E-TM1.1, Bandwidth 20 MHz)

High-power Output [Option 041*[1]/071*[2]]

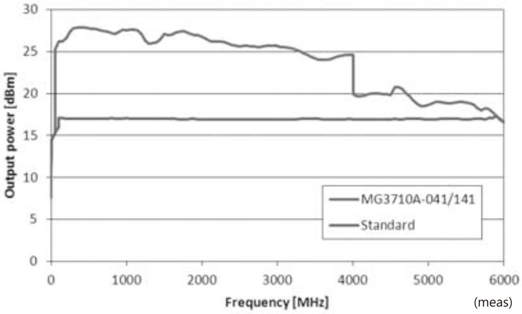
*1: High Power Extension for 1stRF [Option 041]
*2: High Power Extension for 2ndRF [Option 071]

Level Accuracy is assured at high levels (CW)

Frequency Range	Standard	Option 041/071
100 kHz ≤ f < 10 MHz	+5 dBm	+5 dBm
10 MHz ≤ f < 50 MHz	+10 dBm	+10 dBm
50 MHz ≤ f < 400 MHz	+13 dBm	**+20 dBm**
400 MHz ≤ f ≤ 3 GHz		**+23 dBm**
3 GHz < f ≤ 4 GHz		**+20 dBm**
4 GHz < f ≤ 5 GHz		+13 dBm
5 GHz < f ≤ 6 GHz	+11 dBm	+11 dBm

These options expand the MG3710A RF output upper limit.
They are used when compensating for level losses of parts in the measurement path.

Maximum output power



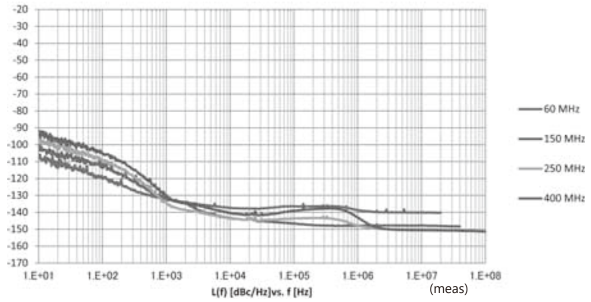
SSB Phase Noise

<–140 dBc/Hz (nom.)	@100 MHz, 20-kHz offset, CW
<–131 dBc/Hz (typ.)	@1 GHz, 20-kHz offset, CW
<–125 dBc/Hz (typ.)	@2 GHz, 20-kHz offset, CW

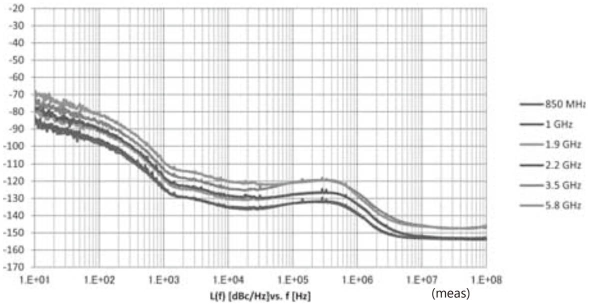
SSB phase noise is an important performance index for signal generators. For example, when using a signal generator for the following purposes, it is important to pre-confirm that the signal generator performance satisfies the measurement specifications.

- Communications with narrow bandwidth of several kHz
- OFDM Signals with narrow subcarrier gap
- CW interference waveforms

Single sideband phase noise



Single sideband phase noise



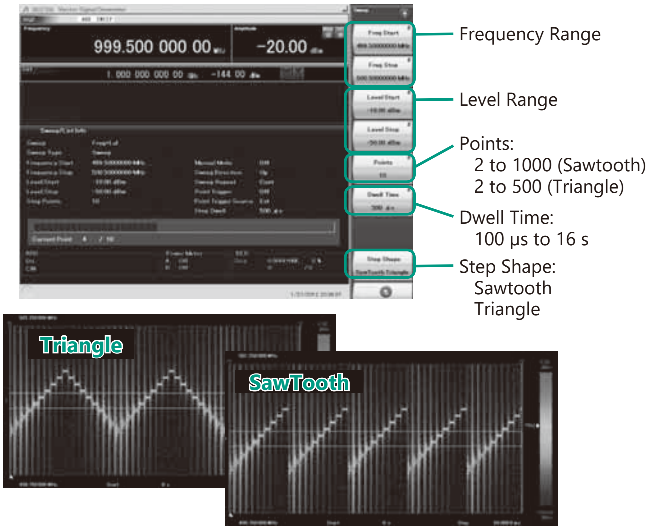
SSB Phase Noise
(Phase Noise Optimization <200 kHz, CW,
Optimize S/N Off, with Option 002)

High-speed Switching

<600 μs @List/Sweep mode

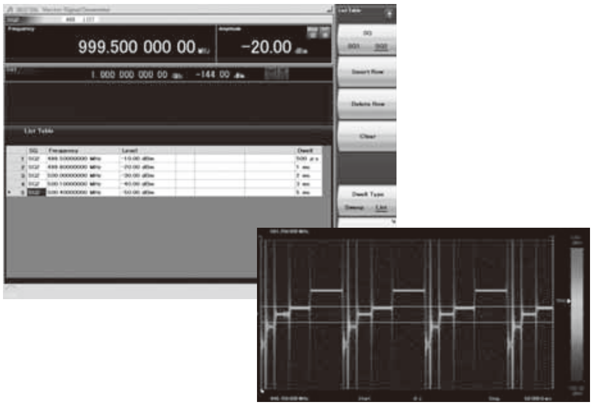
To shorten tact times on production lines the MG3710A supports two standard modes each with high-speed frequency and level switching.

- Sweep Mode
  In this mode, the dwell time per point or number of points is split between the frequency range and level range (Start/Stop).
  This mode is used when matching dwell time per point and frequency/level steps.



10 points, 500-μs Dwell Time

- List Mode
  In this mode, the frequency, level and dwell time can be set for each of up to 500 points. This mode is used when wanting to set any dwell time, and frequency/level step per point.



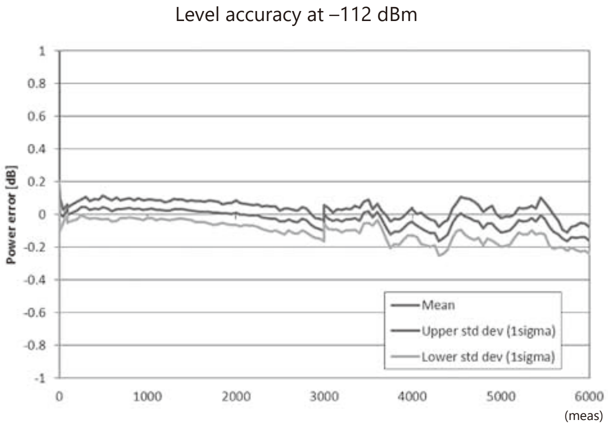
5 points, Any Dwell Time

High Level Accuracy

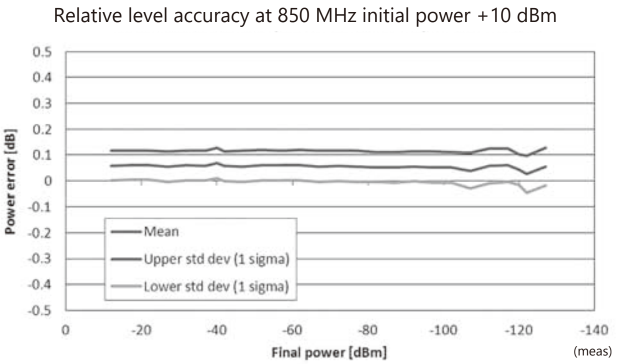
Absolute Level Accuracy: ±0.5 dB[*1]
Linearity: ±0.2 dB (typ.)[*2]

*1: 400 MHz to 3 GHz, –110 to +10 dBm
*2: 50 MHz to 3 GHz, –110 to –1 dBm

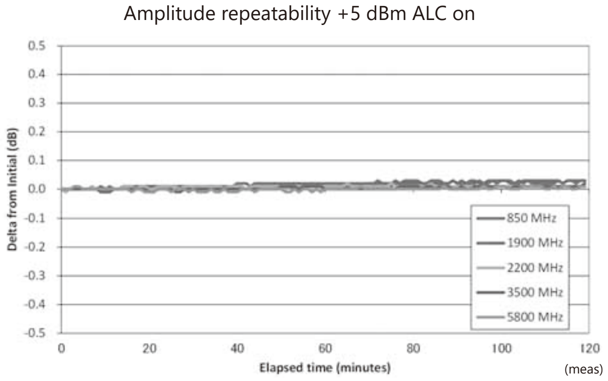
Excellent level accuracy and linearity are key factors with a large impact on measurement accuracy.



Frequency Characteristic



Linearity



Aging

Supports Rubidium Reference Oscillator (Option)

Three reference oscillator options are supported. Select the high-stability reference oscillator option [Option 002] when requiring high accuracy depending on the measurement conditions; for even higher accuracy, select the rubidium reference oscillator [Option 001]. However, if external high-accuracy reference signals are available, selecting the standard reference oscillator option helps reduce unnecessary costs.

- Reference Oscillator
  - Standard
    - Aging Rate: ±1 × 10^{-6}/year, ±1 × 10^{-7}/day
    - Temperature Stability: ±2.5 × 10^{-6} (5° to 45°C)
  - High Stability Reference Oscillator [Option 002]
    - Aging Rate: ±1 × 10^{-7}/year, ±1 × 10^{-8}/day
    - Temperature Stability: ±2 × 10^{-8} (5° to 45°C)
    - Start-up Characteristics*: ±5 × 10^{-7} (2 minutes after power-on)
      ±5 × 10^{-8} (5 minutes after power-on)
  - Rubidium Reference Oscillator [Option 001]
    - Aging Rate: ±1 × 10^{-10}/month
    - Temperature Stability: ±2 × 10^{-9} (5° to 45°C)
    - Start-up Characteristics*: ±1 × 10^{-9} (7.5 minutes after power-on)

*: Compared to frequency after 24-h warm-up at 23°C

High All-purpose Baseband Performance

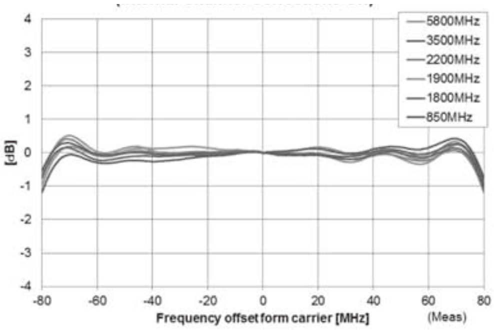
Wide Vector Modulation Bandwidth

160 MHz*/120 MHz (using Internal baseband signal generator)
160 MHz (using External IQ input)

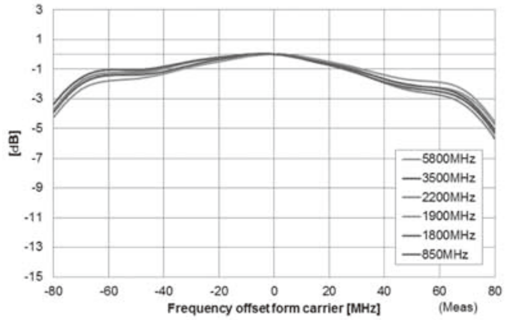
Using the standard internal baseband signal generator offers a wide vector modulation bandwidth of 160 MHz.

*: Supports firmware version 2.00.00 and later. Can generate 160-MHz bandwidth signals (Wireless LAN IEEE802.11ac) only when using WLAN IQproducer MX370111A and 802.11ac (160 MHz) option MX370111A-002.
The latest version can be downloaded from the Anritsu homepage.
<https://my.anritsu.com/home>

I/Q bandwidth plot using optional internal baseband generator (Internal Channel Corrections ON)



I/Q bandwidth plot using optional internal baseband generator



Point

One unit supports WLAN 802.11ac signal generation and output.

- Upper Frequency Limit: 6 GHz
- RF Modulation Bandwidth: 160 MHz
- Dual RF: Two RF Outputs
- Waveform Generation Software: WLAN IQproducer (MX370111A & MX370111A-002)

The MG3710A supports output from 160-MHz bandwidth signals to non-contiguous 80 MHz + 80 MHz signals in one unit, which generally requires two signal generators.

Example: Support WLAN 802.11ac signal generation and output

11ac Bandwidth	20/40/80/160 MHz	80 MHz + 80 MHz (non-contiguous)
MG3710A*1	✓	✓*2

*1: WLAN IQproducer MX370111A and 802.11ac (160 MHz) option MX370111A-002 installed. For detail, refer to the IQproducer catalog.
*2: 2ndRF option MG3710A-062 (2.7 GHz)/064 (4 GHz)/066 (6 GHz) installed.

Large-capacity Waveform Memory

64 Msamples (256 MB) [with 1stRF, 2ndRF]
256 Msamples (1 GB) [Option 045*1/075*2]
1024 Msamples (4 GB) [Option 046*1/076*2]

*1: ARB Memory Upgrade 256 Msample for 1stRF [Option 045]
ARB Memory Upgrade 1024 Msample for 1stRF [Option 046]
*2: ARB Memory Upgrade 256 Msample for 2ndRF [Option 075]
ARB Memory Upgrade 1024 Msample for 2ndRF [Option 076]

Memory size is the most important specification for arbitrary waveform memory. If the memory is small, large waveform patterns cannot be handled and the number of cases when multiple waveform patterns cannot be loaded increases. When this happens, the time to reload another waveform pattern wastes evaluation time and lowers efficiency. The MG3710A has a large 64 Msamples memory as standard and this can be upgraded to either 4 times (256 Msamples) or 16 times (1024 Msamples) by adding these options.

Point

Adding the baseband signal combine function (Option 048/078) supports waveform memories which can either be used separately or linked to multiply the memory size.

*: When attempting to load a waveform pattern exceeding the size of one memory, the memories are linked automatically to load the large pattern. However, in this case, other waveform patterns cannot be loaded into any remaining free space.
When dealing with many waveform patterns, we recommend upgrading the ARB memory size. If the waveform pattern can be handled by one memory, other waveform patterns can be loaded into the remaining free space and the other memory.
The maximum size per waveform pattern supported by the MG3710A varies with the IQproducer version.

Maximum Waveform Pattern Size and Required Options for Simultaneous Use

1stRF (Option 032/034/036)

Combination of Baseband Signal (Option 048)	ARB Memory Upgrade 256 Msample (Option 045) ARB Memory Upgrade 1024 Msample (Option 046)		
	W/O	With Option 045	With Option 046
W/O	64 Msamples × 1 pc	256 Msamples × 1 pc	1024 Msamples × 1 pc*1
With Option 048*2	64 Msamples × 2 pcs 128 Msamples × 1 pc	256 Msamples × 2 pcs 512 Msamples × 1 pc	1024 Msamples × 2 pcs*1

2ndRF (Option 062/064/066)

Combination of Baseband Signal (Option 078)	ARB Memory Upgrade 256 Msample (Option 075) ARB Memory Upgrade 1024 Msample (Option 076)		
	W/O	With Option 075	With Option 076
W/O	64 Msamples × 1 pc	256 Msamples × 1 pc	1024 Msamples × 1 pc*1
With Option 078*2	64 Msamples × 2 pcs 128 Msamples × 1 pc	256 Msamples × 2 pcs 512 Msamples × 1 pc	1024 Msamples × 2 pcs*1

*1: The maximum size per waveform pattern supported by the MG3710A varies with the IQproducer version.
*2: The Baseband Signal Combine option supports two ARB memories and can either set two different waveform patterns or combine them as one memory to support one large waveform pattern.

Free Waveform Generation

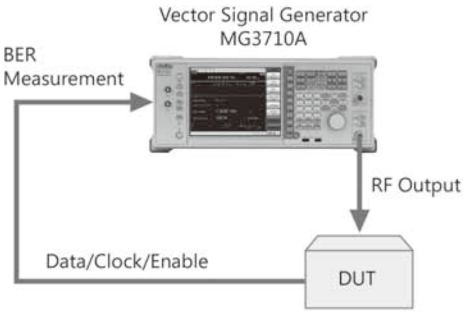
ASCII-format IQ sample data files created by other general-purpose EDA tools, such as MATLAB, can be converted into MG3710A waveform pattern files. Support for customer waveform pattern file creation makes the MG3710A ideal for R&D simulation applications too.

Expandability

BER Test Function [Option 021]

This option installs a BER measurement function for measuring error rates between 100 bps and 40 Mbps using the DUT demodulated Data/Clock/Enable signals. The results are displayed on the MG3710A screen.

- Input Bit Rate: 100 bps to 40 Mbps
- Input Signal: Data, Clock, Enable
  (Polarity reversal supported)
- Input Level: TTL
- Measured Patterns: PN9/11/15/20/23, ALL1, ALL0,
  Alternate (0101...), User Data,
  PN9fix/11fix/15fix/20fix/23fix
- Count Mode
  Data: Measures until specified Data count
  Error: Measures until specified Error count
- Measurable Bit Count: ≤2^{32} – 1 (4,294,967,295 bits)
- Measurement Mode
  Single: Measures specified measurement bit count once
  Continuous: Repeats Single measurement
  Endless: Continues measurement to upper limit of measurement bits

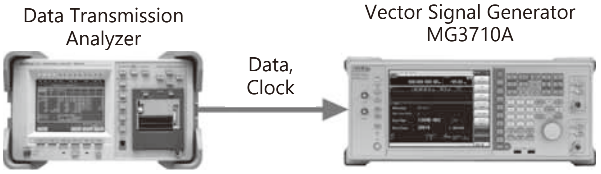


The BER can be measured using the DUT-demodulated Data/Clock/Enable.

BER Measurement Upper Limit

The table below shows one example of a BER measurement that indicates SyncLoss. Actual results depend on the specific communication systems and data rate, and will not necessarily match the measurement values below.

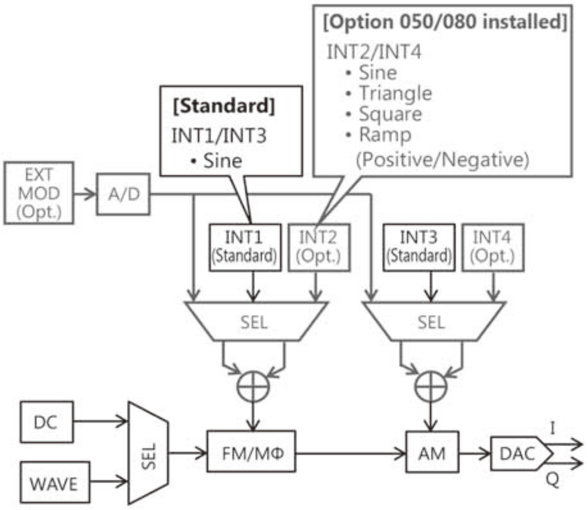
Error Rate	PN9	PN11	PN15	PN20	PN23
6.0%	–	–	–	–	–
5.0%	OK	–	–	–	–
4.0%	OK	OK	–	–	–
3.0%	OK	OK	OK	–	–
2.5%	OK	OK	OK	–	–
2.0%	OK	OK	OK	OK	OK
1.0%	OK	OK	OK	OK	OK



AM/FM/ΦM/PM Function

This option supports the following modulation functions as standard. Analog modulations (AM/FM/ΦM) are performed on CW signals or arbitral (ARB) waveform pattern signals.
Pulse modulation can be performed at any cycle or timing and also supports modulation using an external input signal.

- Amplitude Modulation (Internal Modulation Source)
  Depth: 0 to 100% (Linear)
  0 to 10 dB (Exponential)
  Modulation Frequency: 0.1 Hz to 50 MHz
- Frequency Modulation (Internal Modulation Source)
  Deviation: 0 to 40 MHz
  Modulation Frequency: 0.1 Hz to 40 MHz, or (50 MHz-FM Rate),
  whichever smaller
- Φ-Modulation (Internal Modulation Source)
  Deviation angle: 0 to 160 rad.
  or (40 MHz/ΦM Rate) rad., whichever smaller
  Modulation Frequency: 0.1 Hz to 40 MHz,
  or (40 MHz/ΦM Deviation),
  whichever smaller
- Pulse Modulation (Internal Modulation Source)
  Modulation Frequency: 0.1 Hz to 10 MHz
  Modulation Period: 10 ns to 20 s
- Additional Analog Modulation Input [Option 050/080]
  Adding additional analog modulation input options (Option 050/080) extends to two internal modulation sources (AM/FM/ΦM) and one external modulation source supporting simultaneous two-signal modulation.
  AM + FM
  AM + ΦM
  Internal 1 + Internal 2
  Internal + External
  *: FM + ΦM does not support.

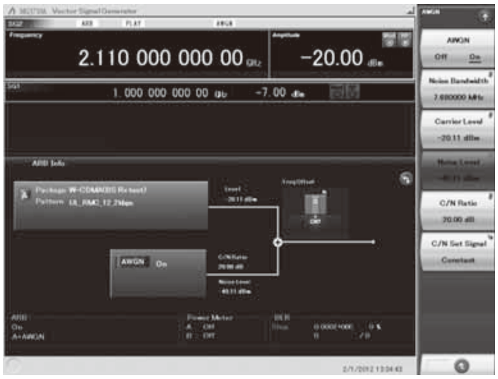


AWGN Generator [Option 049*[1]/079*[2]]

*1: AWGN for 1stRF [Option 049]
*2: AWGN for 2ndRF [Option 079]

This option adds internally generated AWGN to the wanted signal. The AWGN output is switched on and off just by pressing the On/Off button.

Absolute C/N Ratio: ≤40 dB



AWGN Signal Addition Screen

USB Power Sensors [Sold separately]

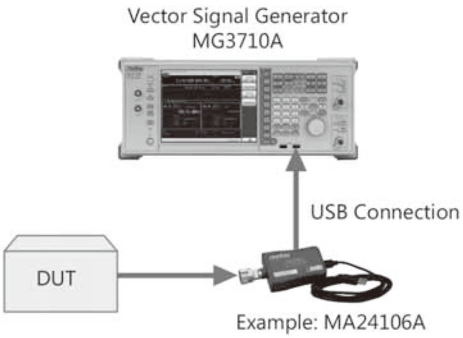
Up to two USB power sensors can be connected to the MG3710A to display the measurement results on the MG3710A screen.

Compatible USB power sensors

Model	Frequency Range	Dynamic Range
MA24104A*	600 MHz to 4 GHz, Resolution: 1 kHz	+3 to +51.76 dBm
MA24105A	350 MHz to 4 GHz, Resolution: 1 kHz	+3 to +51.76 dBm
MA24106A	50 MHz to 6 GHz, Resolution: 1 kHz	–40 to +23 dBm
MA24108A	10 MHz to 8 GHz, Resolution: 100 kHz	–40 to +20 dBm
MA24118A	10 MHz to 18 GHz, Resolution: 100 kHz	–40 to +20 dBm
MA24126A	10 MHz to 26 GHz, Resolution: 100 kHz	–40 to +20 dBm

*: MA24104A has been discontinued. Replacement model is MA24105A.

Level Offset: –100 to +100 dB
Average: 1 to 2048
Unit: dBm, W
COM Port: 2 to 8

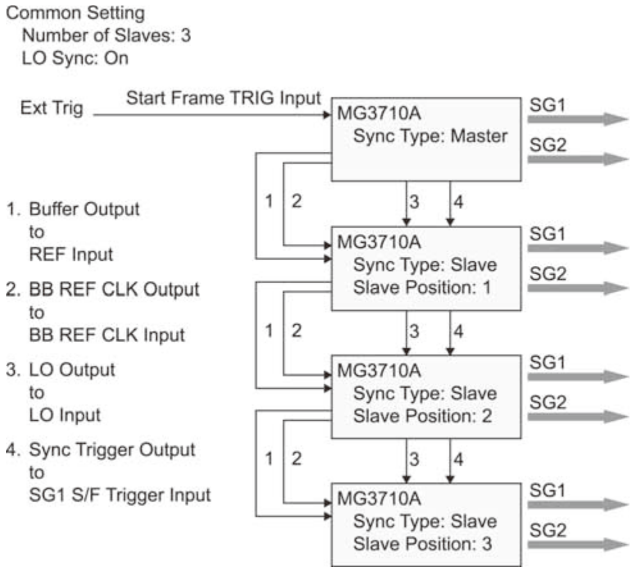


Power Meter Measurement Screen

Local Signal I/O for MIMO Signal Source [Option 017]

The Sync Multi SG function shares local, baseband and trigger signals between multiple MG3710A units to output phase coherency signals synchronized with the signal output timing.
An 8×8 MIMO test system is configured easily from four MG3710A units composed of one master and three slaves.

Synchronization mode: Master, Slave, SG1 & 2
Number of Slaves: 1 to 3
Slave Position: 1 to 3
Local Synchronization: On/Off
IQ Phase Adjustment: –360 deg. to +360 deg., Resolution 0.01 deg.
IQ Delay: –400 ns to +400 ns, Resolution 1 ps



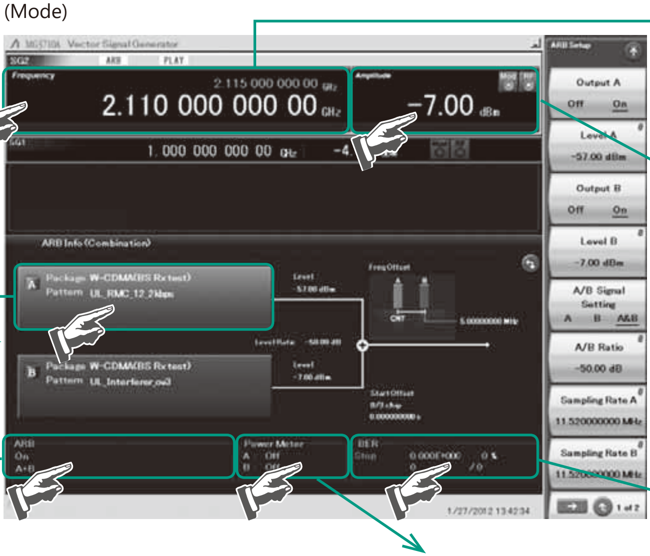
Note: Option-017 is not required when synchronizing the local signal and baseband clock of SG1 (1stRF) and SG2 (2ndRF) installed in one MG3710A unit.

Operability

Easy Touch-panel Operation

Simply touching parts of the screen display with a finger fetches related function keys and numeric inputs, offering a fast and easy way of navigating through multilayer menus.

Modulation Screen
(Mode)



Frequency 2.115 000 000 00 GHz 2.110 000 000 00 GHz

Amplitude −7.00 dBm

SG1 1.000 000 000 00 GHz

ARB Info (Combination)

Package W-CDMA(BS Rx test) Pattern UL_RMC_12_2kbps Level -57.00 dBm

Package W-CDMA(BS Rx test) Pattern UL_Interferer_cw3 Level -7.00 dBm

Level Rate -50.00 dB

Freq Offset 5.000000000 MHz

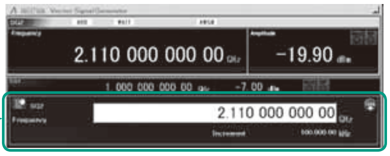
Start Offset 0/3 chip 0.000000000 s

ARB On A+B

Power Meter A Off B Off

BER Stop 0.000E+000 0 % 0 / 0

1/27/2012 13:42:34



Frequency 2.110 000 000 00 GHz

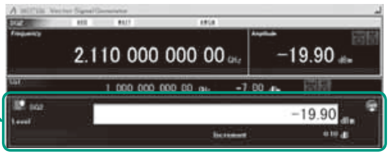
Amplitude −19.90 dBm

1 000 000 000 00 GHz −7.00 dBm

SG2 Frequency 2.110 000 000 00 GHz

Increment 100.000 00 kHz

Frequency Setting



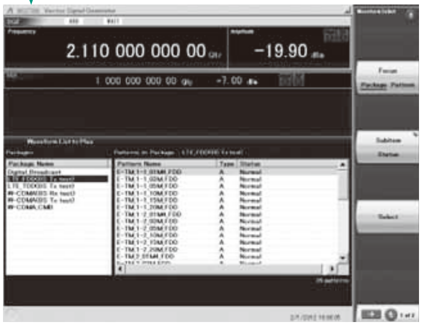
Frequency 2.110 000 000 00 GHz

Amplitude −19.90 dBm

1 000 000 000 00 GHz −7.00 dBm

SG2 Level −19.90 dBm

Level Setting



2.110 000 000 00 GHz −19.90 dBm

1 000 000 000 00 GHz −7.00 dBm

Waveform Pattern Selection

2.110 000 000 00 GHz −20.00 dBm

1 000 000 000 00 GHz −7.00 dBm

Power Meter Measurements

Ch. A Connected −20.13 dBm

Ch. B Off −−.−−

Power Meter Function

400.000 000 00 MHz −95.00 dBm

1 000 000 000 00 GHz −144.00 dBm

BER

Measuring Bit Error

Sync Loss Count 0

Error Rate 1.000E−002 1 %

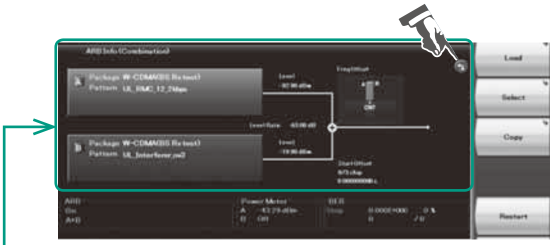
Error Count 38974 / 3897438

BER Function

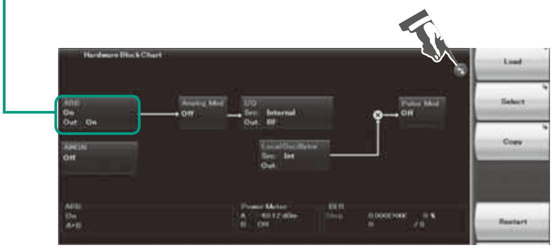
Two Signal Flowcharts

Pressing the on-screen ↻ button toggles instantly between the Hardware Block Chart and the ARB Info screens.

The Hardware Block Chart is a quick-and-easy way to grasp the status of each block (ARB, AWGN, I/Q, Analog Mod, Pulse Mod, Local) at a glance. The ARB Info screen displays more details about the ARB/AWGN block showing the baseband signal combine status of memory A + memory B, memory A + AWGN, etc.



ARB Info Screen



Hardware Block Chart Screen

Frequency Channel Table

Sometimes frequencies need setting by Channel No. The built-in frequency channel table where frequencies are set by channel number is ideal for this application. Once set and saved, these pre-settings can be read whenever needed.

- Channel Table Setting
  Group: 1 to 19
  Start Channel: 0 to 20000
  End Channel: (Start Channel) to 20000
  Start Frequency
  Channel Spacing

Channel Table

	Group Name	Start	End	Start Frequency	Channel Spacing
1	VHF1-3	1	3	93.14285714 MHz	6.00000000 MHz
2	VHF4-7	4	7	173.14285714 MHz	6.00000000 MHz
3	VHF8-12	8	12	195.14285714 MHz	6.00000000 MHz
4	UHF	13	62	473.14285714 MHz	6.00000000 MHz

Channel Table Setting Screen

Connection with External Equipment

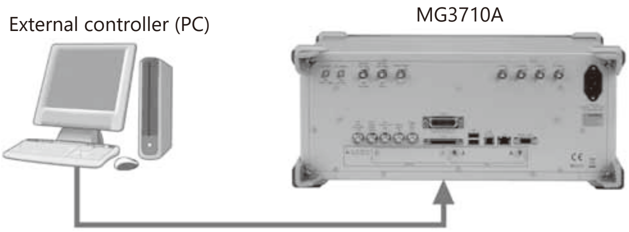
Remote Control Interfaces

The MG3710A has GPIB, Ethernet and USB interfaces as standard, supporting the following functions:

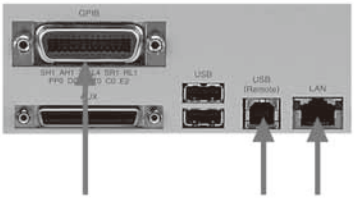
- Control all functions, except power switch
- Read all status conditions and settings
- Interrupts and serial polls

While in the Local status, the interface is determined automatically by the communication start command from the external controller (PC). To change the interface, put the MG3710A into the Local status again by pressing the Local key on the front panel and then send a command via the desired interface.

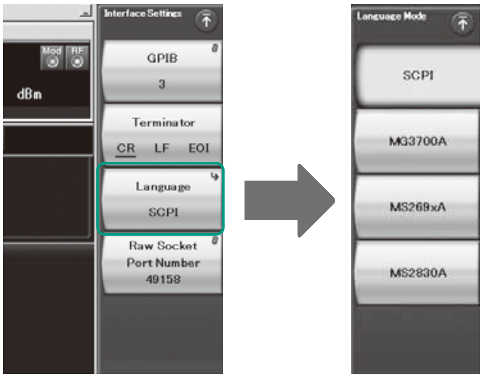
- GPIB: Conforms to IEEE 488.1/IEEE 488.2 standards
  SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0, E2
- Ethernet: Conforms to VXI-11 protocol using TCP/IP Control programs
  SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0
- USB: Conforms to USBTMC-USB488 protocols
  SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0n



Connect to GPIB, Ethernet or USB port



To remotely control the MG3710A, either select the SCPI mode command format defined by the SCPI Consortium, or select backwards compatible modes supporting earlier MG3700A, MS269xA, and MS2830A commands



Command Format Setting Example

USB Connections

The two type-A USB2.0 connectors on the front and rear panels support keyboard, mouse and USB memory connections. Supported USB power sensors can be connected too.

USB Power Sensor [Sold separately]

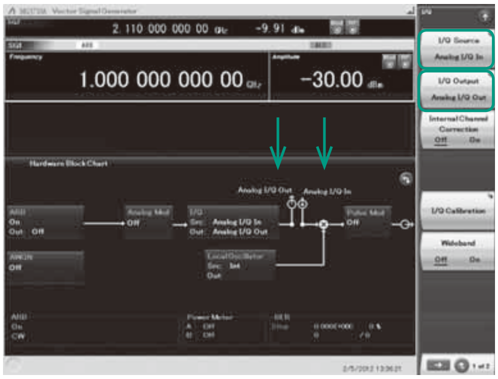
Frequency Range:	600 MHz to 4 GHz	[MA24104A]*
	350 MHz to 4 GHz	[MA24105A]
	50 MHz to 6 GHz	[MA24106A]
	10 MHz to 8 GHz	[MA24108A]
	10 MHz to 18 GHz	[MA24118A]
	10 MHz to 26 GHz	[MA24126A]

*: MA24104A has been discontinued. Replacement model is MA24105A.

Analog IQ Input/Output [Option 018]

This option adds analog IQ input and output connectors to the front and rear panels, respectively. It only supports SG1 (1stRF).

Input: I Input, Q Input
Output: I Output, $\overline{I}$Output, Q Output, $\overline{Q}$ Output,



Analog IQ I/O Setting Screen

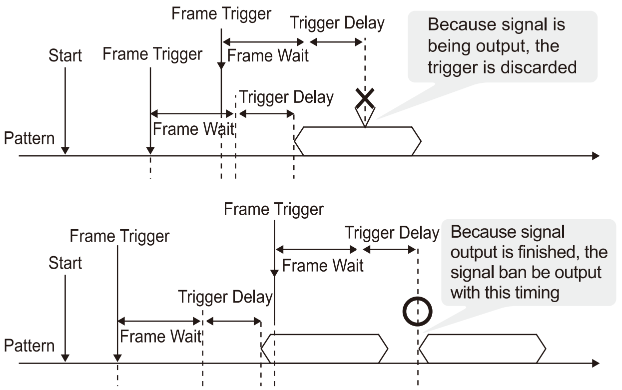
- Analog IQ Input Adjustment
  Setting Range: –100 mV to +100 mV
- Analog IQ Output Adjustment
  Output Voltage: 0.0 to 120.0%
  In-phase DC offset: –2.5 V to +5.0 V
  Differential DC offset: –50 mV to +50 mV

Trigger Input

Start and Frame triggers are installed as standard for outputting waveform patterns synchronized with externally input trigger signals.

- Start Trigger Operation
  At Start Trigger operation, after the waveform pattern is selected, output is started and continued by the rise timing of the first external trigger signal. Second and subsequent input external trigger signals are disabled. This is used when receiving a Start Trigger signal and reference frequency signal from the DUT at the MG3710A.
- Frame Trigger Operation
  At Frame Trigger operation, one frame of the waveform pattern is output at the rise timing of the external trigger signal. When frame output is finished, the trigger wait state is returned. This is used when receiving a Frame Trigger signal from the DUT at the MG3710A. Frame Trigger supports three operations as follows:

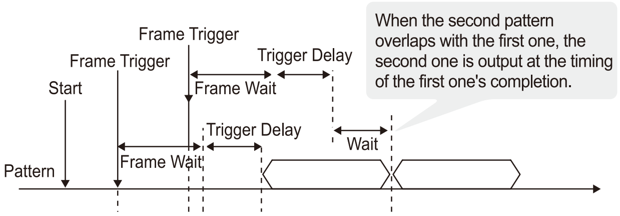
(1) No Retrigger
Ignores triggers received during pattern output (default setting)



Because signal is being output, the trigger is discarded

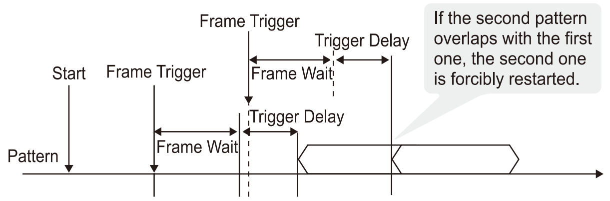
Because signal output is finished, the signal ban be output with this timing

(2) Buffered Trig
Holds triggers received during pattern output until current pattern output completed and then outputs next frame



When the second pattern overlaps with the first one, the second one is output at the timing of the first one's completion.

(3) Restart on Trig
Immediately restarts pattern when trigger received during pattern output

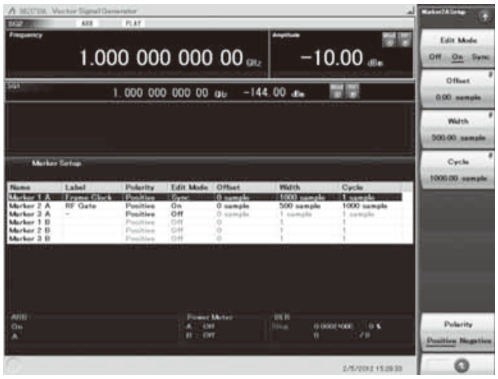


If the second pattern overlaps with the first one, the second one is forcibly restarted.

Marker Output Editing

- Marker 1 Output [Standard]
- Marker 2 & Marker 3 Output [Requires J1539A AUX Conversion Adapter]

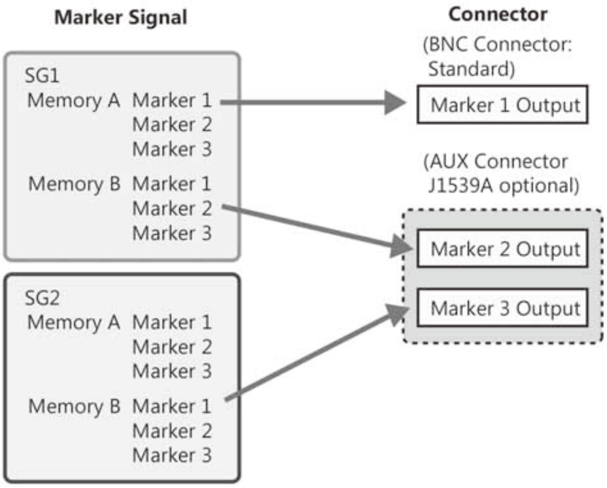
When the Marker Setup function Edit Mode is Off, a marker signal combining the preset waveform pattern with marker information is output. When the Edit Mode is On, any marker for output can be set at the MG3710A screen. Up to 12 markers can be set for SG1/SG2, memory A/B and Marker 1 to 3.



Name	Label	Polarity	Edit Mode	Offset	Width	Cycle
Marker 1 A	Frame Clock	Positive	Sync	0 sample	1000 sample	1 sample
Marker 2 A	RF Gate	Positive	On	0 sample	500 sample	1000 sample
Marker 3 A	-	Positive	Off	0 sample	1 sample	1 sample
Marker 1 B		Positive	Off	0	1	1
Marker 2 B		Positive	Off	0	1	1
Marker 3 B		Positive	Off	0	1	1

SG2 Marker Setup Screen
Memory A (1A/2A/3A), Memory B (1B/2B/3B)

There are three output connectors: Marker 1 Output on the rear panel and the AUX connector (Marker 2 Output and Marker 3 Output). The connector output signal layout can be selected freely.



The defaults are as follows:

Marker Signal	Connector
SG1/Memory A/Marker 1	Marker 1 Output
SG1/Memory A/Marker 2	Marker 2 (@AUX)
SG1/Memory A/Marker 3	Marker 3 (@AUX)

Waveform Patterns & License

* Read the "Waveform Pattern catalog" for details.

DFS Radar Pattern MX370073A
Sets pulse signals for testing 5-GHz band WLAN DFS functions. The MX370073A supports the waveform patterns for the TELEC and FCC test specifications. Pulse signals are output simply by selecting the pattern.

DFS (ETSI) Waveform Pattern MX370075A
Sets pulse signals for testing 5-GHz band WLAN DFS functions. The MX370075A supports the waveform patterns for the ETSI specifications. Pulse signals are output simply by selecting the pattern.

What is DFS?
5-GHz band wireless LAN devices like meteorological radar, marine radar, etc., have a Dynamic Frequency Selection (DFS) function for switching to an empty channel when detecting a radio wave. At testing, pulse, chirping and hopping signals like those used by radar are output from the SG to the WLAN equipment to check that it does not output signals in that channel.

ISDB-Tmm Waveform Pattern MX370084A
Archive of ARIB STD-B46 waveform patterns. Supports MER and spectrum evaluation of Tx characteristics tests and sensitivity/simple BER tests at Rx characteristics tests.

IQproducer License

IQproducer is PC application software for generating waveform patterns. The parameters are set using IQproducer and the waveform pattern is created to output the signal by selection at the MG3710A. This one software application includes all the following systems. Since it runs on any PC, the supported functions and parameter range can be verified before purchase.
When outputting a waveform pattern from the MG3710A, no signal is output unless a license for that system is installed in the main frame.
*: Read the "IQproducer catalog" for details.

HSDPA/HSUPA IQproducer MX370101A
Sets parameters according to HSDPA/HSUPA (Uplink and Downlink) specifications, and generates HSDPA/HSUPA waveform patterns including Fixed Reference Channel (3GPP TS 25.101 Annex A.7).

TDMA IQproducer MX370102A
Sets required parameters for TDMA waveform patterns and generates various waveform patterns. Setting parameters include Modulation, Frame, Slot, Data, Filter, etc. Supports wide application range including public wireless.

CDMA2000 1xEV-DO IQproducer MX370103A
Sets parameters according to CDMA2000 1xEV-DO Forward/Reverse specifications and generates 1xEV-DO waveform patterns.

Multi-carrier IQproducer MX370104A
Generates multi-carrier waveform patterns combination files using MG3710A Baseband Signal Combine function.
*: Requires Option 048/078.

Mobile WiMAX IQproducer MX370105A
Sets parameters according to IEEE 802.16e-2005, IEEE P802.16Rev2/D3 WirelessMAN-OFDMA MAC, PHY specifications and generates waveform patterns. Supports WirelessMAN-OFDMA specification used by 802.16e mobile standard.

DVB-T/H IQproducer MX370106A
Sets parameters according to ETSI EN 300 744 V1.5.1 (2004-11) physical layer standard and generates DVB-T/H waveform patterns. Generated waveform patterns can be used for device TRx characteristics evaluation tests (Error Correction, BER graphics).

Fading IQproducer MX370107A
Performs IQ channel fading processing, correlation matrix calculation, AWGN combination. Input data file created by selecting waveform pattern file created with other IQproducer software, and IQ data (ASCII) created with other general-purpose simulation tools.

LTE IQproducer MX370108A
Generates wanted waveform patterns with parameters modified according to 3GPP TS 36.211, TS 36.212, TS 36.213 LTE FDD specifications.

LTE-Advanced FDD Option MX370108A-001
Installing in the MX370108A supports simple generation of carrier aggregation signals added by 3GPP Rel. 10. Additionally, clustered SC-FDMA signals can be generated at Uplink.
*: Requires MX370108A

LTE TDD IQproducer MX370110A
Generates wanted waveform patterns with parameters modified according to 3GPP TS 36.211, TS 36.212, TS 36.213 LTE TDD specifications.

LTE-Advanced TDD Option MX370110A-001
Installing in the MX370110A supports simple generation of carrier aggregation signals added by 3GPP Rel. 10. Additionally, clustered SC-FDMA signals can be generated at Uplink.
*: Requires MX370110A

WLAN IQproducer MX370111A
Generates waveform patterns for IEEE Std 802.11-2007 and IEEE Std 802.11n-2009 IEEE 802.11a/b/g/j/n/p specifications.

802.11ac (160 MHz) Option MX370111A-002
Installing in the MX370111A supports waveform patterns generation compliant with WLAN 802.11ac specifications.
*: Requires MX370111A. Only for MG3710A.

TD-SCDMA IQproducer MX370112A
Generates wanted waveform patterns with parameters modified according to TD-SCDMA specifications standardized by TRx characteristics evaluation tests (excluding performance tests) for 3GPP TS 25.221, TS 25.222, TS 25.223, TS 25.105, TS 25.142

5G NR TDD sub-6GHz IQproducer MX370113A
Generates 3GPP TS 38.211, TS 38.212, and TS 38.213 defined waveform patterns in compliance with the 5G NR FR1 (sub-6 GHz) specifications.

Supported LTE-Advanced Carrier Aggregation Modes (Vector Signal Generator series)

Vector Signal Generator Series / Carrier Aggregation Mode	Vector Signal Generator		Vector Signal Generator Option for Signal Analyzer	
	MG3710A*1	MG3700A*1	MS2690A series Option 020*2	MS2830A Option 020/021*2
Intra-band contiguous Carrier Aggregation, Intra-band non-contiguous Carrier Aggregation	✓ (1 unit)	✓ (1 unit)	✓ (1 unit)	✓ (1 unit)
Inter-band non-contiguous Carrier Aggregation	✓ (2 RF 1 unit*3, or 1 RF 2 units)	✓ (2 units)	✓ (2 units)	✓ (2 units)

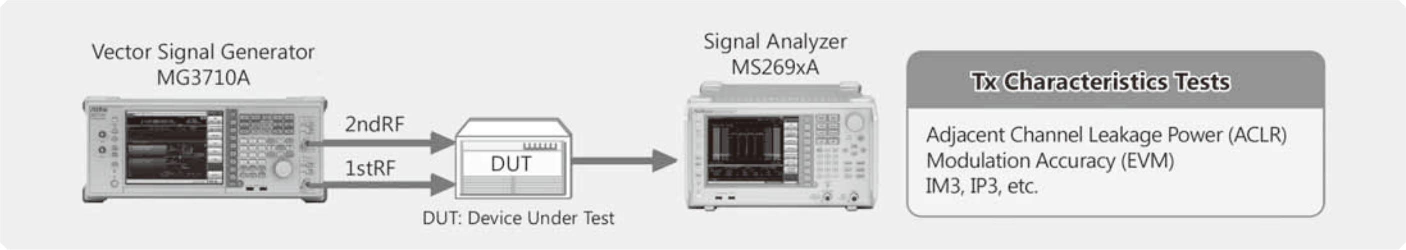
*1: LTE IQproducer MX370108A and LTE-Advanced FDD Option MX370108A-001 installed.
LTE TDD IQproducer MX370110A and LTE-Advanced TDD Option MX370110A-001 installed.
*2: LTE IQproducer MX269908A and LTE-Advanced FDD Option MX269908A-001 installed.
LTE TDD IQproducer MX269910A and LTE-Advanced TDD Option MX269910A-001 installed.
*3: 2ndRF Option MG3710A-062 (2.7 GHz)/064 (4 GHz)/066 (6 GHz) installed.

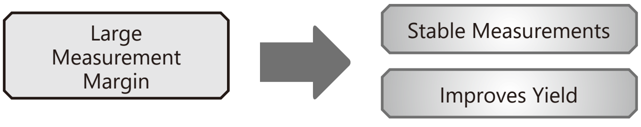
Supported WLAN 802.11ac Signal Bandwidth (Vector Signal Generator series)

Vector Signal Generator Series / IEEE802.11ac Signal Bandwidth	Vector Signal Generator		Vector Signal Generator Option for Signal Analyzer	
	MG3710A*1	MG3700A*2	MS2690A series Option 020*3	MS2830A Option 020/021*3
20 MHz/40 MHz/80 MHz	✓ (1 unit)	✓ (1 unit)	✓ (1 unit)	✓ (1 unit)
160 MHz	✓ (1 unit)	—	—	—
80 MHz + 80 MHz (non-contiguous)	✓ (2 RF 1 unit*4, or 1 RF 2 units)	✓ (2 units)	✓ (2 units)	✓ (2 units)

*1: WLAN IQproducer MX370111A and 802.11ac (160 MHz) Option MX370111A-002 installed.
*2: WLAN IQproducer MX370111A and 802.11ac (80 MHz) Option MX370111A-001 installed.
*3: WLAN IQproducer MX269911A and 802.11ac (80 MHz) Option MX269911A-001 installed.
*4: 2ndRF Option MG3710A-062 (2.7 GHz)/064 (4 GHz)/066 (6 GHz) installed.

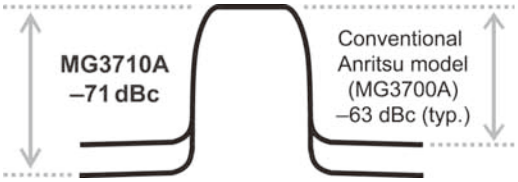
Reference Signal Source for Tx Characteristics Tests of Amplifiers, etc.

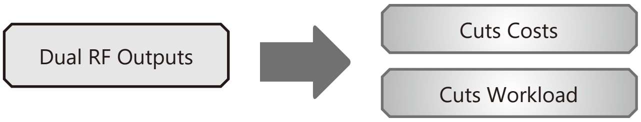




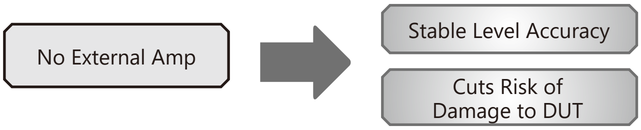
Supports –71 dBc* ACLR Performance
High ACLR performance increases specification margin and improves stable measurement and yield.

*: W-CDMA, TestModel1, 64DPCH, 2 GHz

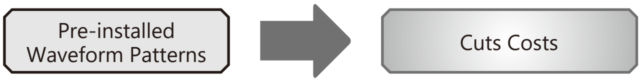




Supports Maximum Two RF Outputs
In general, two signal generators are required to output CW × 2 waveforms with IM3 or modulation signals with different communication methods. Not only is the cost for two signal generators high, but two separate software licenses are required to output modulation signals. In addition, setting two separate signal generators doubles the work load.
The MG3710A supports two signal generators (RF output) in one unit cutting equipment costs. And only one license is required to use modulation signals at two RF outputs.
Moreover, the frequency and level synchronization function cuts work loads.



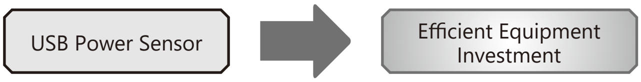
High-power Output Option Supports CW Levels of +23 dBm (Option 041/071)
In general, an external amp is required when the output of a signal generator is insufficient, such as covering the measurement system transmission path loss and inputting high-level modulation signals for amp distortion characteristics tests. Since the output of an external amp cannot be assured, it must be checked with a power meter each time the frequency and level are changed. Moreover, when using an external amp, sometimes the DUT may be damaged by mishandling errors.
The MG3710A high-power output supports signals required for measuring path loss. In addition, stable measurement is assured when used within the guaranteed setting range. And the risk of mistakenly damaging the DUT is reduced, even at the output limit.



License-free Pre-installed Waveform Patterns
LTE FDD/TDD (E-TM1.1 to E-TM3.3), W-CDMA/HSPA, GSM, CDMA2000/1xEV-DO, WLAN 11a/b/g, Mobile WiMAX, etc.

Optional waveform generation tools are also available (license sold separately):

LTE FDD	(MX370108A)
LTE-Advanced FDD	(MX370108A-001)
LTE TDD	(MX370110A)
LTE-Advanced TDD	(MX370110A-001)
Mobile WiMAX	(MX370105A)
WLAN 11a/b/g/n/j/p	(MX370111A)
WLAN 11ac	(MX370111A-002)
TD-SCDMA	(MX370112A) (etc.)



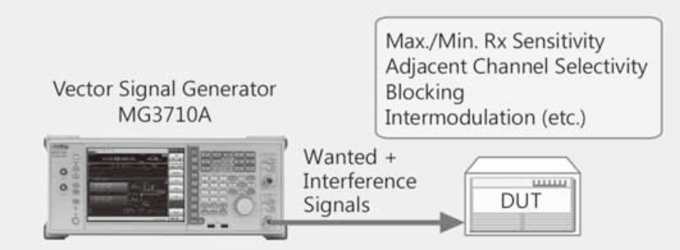
Up to two USB power sensors (separately sold) can be connected to the MG3710A.
USB connectors to display the measurement results on the MG3710A screen.

USB Power Sensor [Sold separately]

Frequency Range:	600 MHz to 4 GHz	[MA24104A]*
	350 MHz to 4 GHz	[MA24105A]
	50 MHz to 6 GHz	[MA24106A]
	10 MHz to 8 GHz	[MA24108A]
	10 MHz to 18 GHz	[MA24118A]
	10 MHz to 26 GHz	[MA24126A]

*: MA24104A has been discontinued. Replacement model is MA24105A.

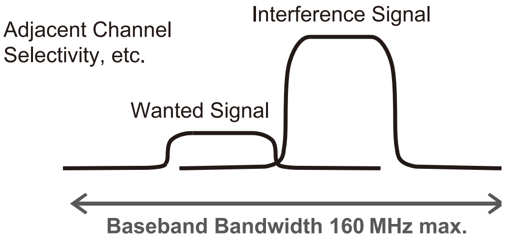
Wanted and Interference Waveforms for Rx Characteristics Evaluations of Cellular Base Station, etc.



One RF Output Outputs Two Signals: Wanted + Interference → Cuts Costs / Cuts Workload

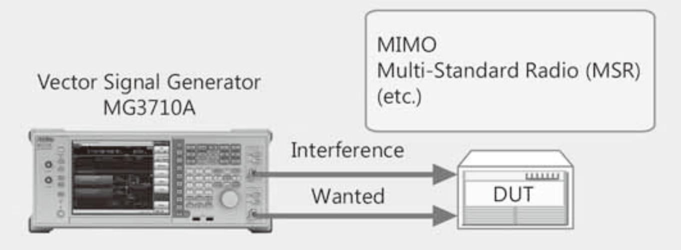
Two modulation signals can be output from one RF output using the baseband signal combine function (Option 048/078). The level ratio (CN = 80 dB) and the frequency offset (±80 MHz max.) can be set as well. Tests using two modulation signals, such as Adjacent Channel Selectivity (ACS), Blocking, and Intermodulation (IM), etc., require two separate signal generators and a license for each, greatly increasing equipment costs and setting work loads.

The MG3710A has two waveform memories for each RF output for setting and outputting different waveform data. One RF outputs the combined wanted + interference signals for a baseband bandwidth. Not only are equipment costs greatly reduced, but fewer external equipment, such as couplers, level adjusters, etc., as well as less setup time are required. In comparison to previous Anritsu instruments, frequency offsets can be set for both memory A and B, and the sampling rate for memory A and B can be adjusted automatically.



BER Measurement Function / AWGN Generation Function → Efficient Equipment Investment

Installing the BER measurement (Option 021) and AWGN Generation (Option 049/079) options supports the extra functions required for Rx tests of each type of communications system.

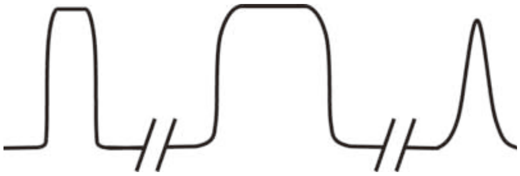


Dual RF outputs → Cuts Costs

Two RF outputs can be installed as an option.

A different frequency, level and waveform pattern/CW can be set for each RF output, which is ideal for Rx tests using two signals for frequency offset that cannot be set using the baseband combine function. For example, sometimes at MSR, multiple signals must be output simultaneously in the 200-MHz band, requiring two RF outputs.

Multi-Standard Radio Rx Characteristics Tests

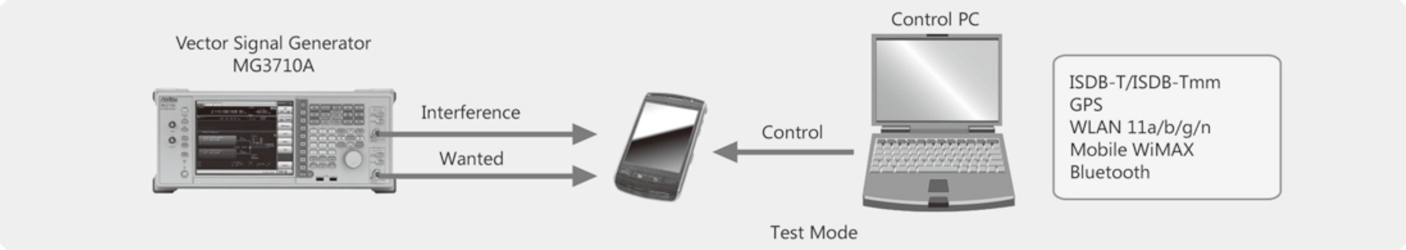


Lower-cost, Easy-to-operate SG for MIMO Evaluations → Cuts Costs / Cuts Workload

Installing two RF units in one MG3710A unit makes it easy to synchronize between channels. And adding the Universal Input/Output option (Option 017) supports Local Signal I/O for synchronizing with other MG3710A units.

The IQproducer waveform generation software can be used with one license when two RF units are installed. For example, for LTE 2×2 MIMO tests, LTE IQproducer can generate two patterns for the Tx antenna signals and Fading IQproducer can generate two patterns with spatial multiplexing for the Rx antennas. Previously, using two signal generators required two separate licenses for LTE and fading, but now only one license is required to use IQproducer with the MG3710A with two RF units installed, helping cut software costs too.

Rx Sensitivity Tests for Multi-system Mobile Terminals, etc.



Large 4-GB Memory Max. → Reduces Reload Times
Cuts Test Times

The MG3710A can save up to 1024 Msamples (4 GB) per RF. Memory size is one of the most important specifications for an arbitrary waveform signal generator. Small memory cannot save multiple waveform data and requires time-wasting reloading and measurement to output different signals each time.

With large waveform memory
- Switch loaded waveform data instantaneously
- Load multiple test waveforms
  → Reduce number of reloads → Cuts times

Pre-installed Waveform Patterns → Cuts Costs

License-free Pre-installed Waveform Patterns

WLAN 11a/b/g, Bluetooth, GPS, etc.

The following waveform patterns are available as options.

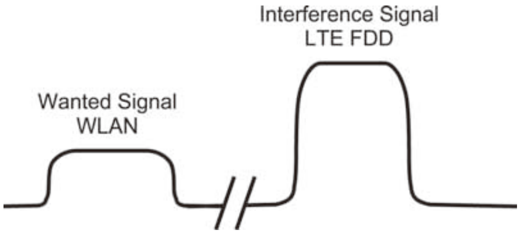
ISDB-Tmm	(MX370084A)

Optional waveform generation tools are also available (license separately sold):

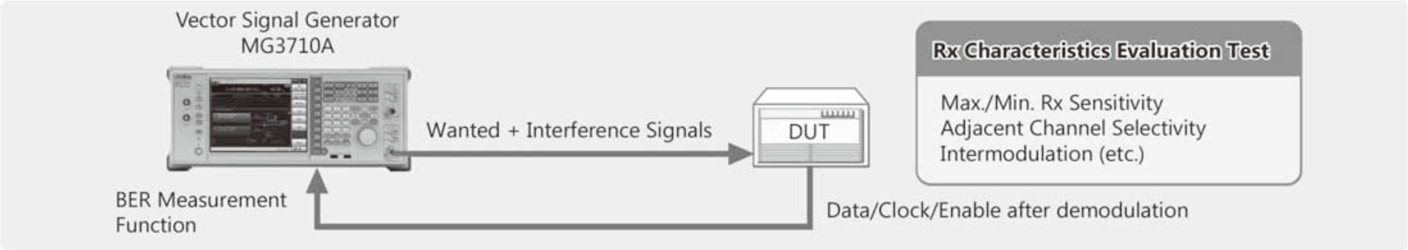
DVB-T/H	(MX370106A)
Mobile WiMAX	(MX370105A)
WLAN 11a/b/g/n/j/p	(MX370111A)
WLAN 11ac	(MX370111A-002)

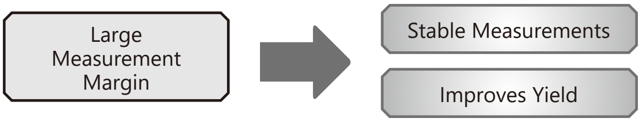
Dual RF outputs → Cuts Costs

Two RF outputs can be installed as an option.
Additionally, two RF output models with different frequencies can be installed. For example, if WLAN 11b/g are the wanted waveforms, mobile signals for LTE FDD, LTE TDD, W-CDMA, GSM, etc., are considered interference signals. Generally, these tests have high hardware and software costs because two separate signal generators are required. Using the MG3710A, the total investment costs for interference tests under simulated service conditions, such as WLAN + LTE FDD, or ISDB-T + W-CDMA, are reduced by selecting models with different frequencies for the 1stRF and 2ndRF outputs.



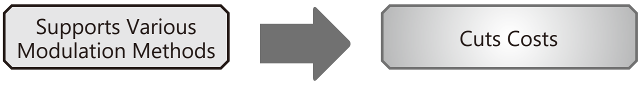
Rx Characteristics Evaluation Tests for Digital Narrowband Communications, Public Safety, etc.





Supports SSB Phase Noise Performance –140 dBc/Hz nom. (@100 MHz)
Phase noise performance affects measurement results at narrow bandwidths of several kHz. In particular, high phase-noise performance is required for interference waveforms.
Improved SSB phase noise supports wider specification margins and stable measurements to improve yields.

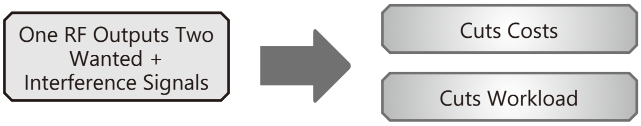
<–140 dBc/Hz (nom.)	@100 MHz, 20-kHz offset, CW
<–131 dBc/Hz (typ.)	@1 GHz, 20-kHz offset, CW
<–125 dBc/Hz (typ.)	@2 GHz, 20-kHz offset, CW



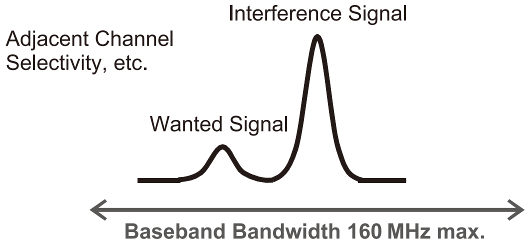
TDMA IQproducer [MX370102A] Supports Following Modulation Methods

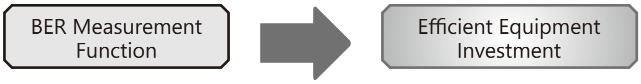
BPSK, DBPSK, PI/2DBPSK, QPSK, DQPSK, PI/4DQPSK,
8PSK, D8PSK, 16QAM, 32QAM, 256QAM, ASK, 2FSK, 4FSK,

The TDMA IQproducer PC software generates waveform patterns with any frame format or filter settings. One software package supports various narrowband digital communications.



Two modulation signals can be output from one RF output using the baseband signal combine function (Option 048/078). The level ratio (C/N = 80 dB) and the frequency offset (±80 MHz max.) can be set as well. Usually, tests using two modulation signals, such as adjacent channel selectivity (ACS) and intermodulation characteristics (IM) require two signal generators as well as a software license for each signal generator.
The MG3710A has two waveform memories for each RF output for setting and outputting different waveform data. One RF outputs the combined wanted + interference signals for a baseband bandwidth. Not only are equipment costs greatly reduced, but fewer external equipment, such as couplers, level adjusters, etc., as well as less setup time are required.





Supports BER Measurement Function [Option 021]
The BER can be measured using the DUT-demodulated Data/Clock/Enable. The measurement results are displayed on the MG3710A screen.

Input Bit Rate: 100 bps to 40 Mbps

Specifications

Refer to the Data Sheet for specification details such as guaranteed setting ranges, etc.

Frequency Setting Range

1stRF

MG3710A-032	9 kHz to 2.7 GHz
MG3710A-034	9 kHz to 4 GHz
MG3710A-036	9 kHz to 6 GHz

2ndRF

MG3710A-062	9 kHz to 2.7 GHz
MG3710A-064	9 kHz to 4 GHz
MG3710A-066	9 kHz to 6 GHz

Switching Speed (List Mode)

Frequency	≤600 µs
Level	≤600 µs

Amplitude Setting Range

Options	Setting Range [dBm]	
	without Reverse Power Protection	with Reverse Power Protection
Standard	–110 to +17	–110 to +17
with High-power Extension	–110 to +30	–110 to +25
with Low-power Extension	–144 to +17	–144 to +17
with High-power Extension and Low-power Extension	–144 to +30	–144 to +25

Level Accuracy is assured at high levels (CW)

Frequency Range	Standard	Option 041/071
100 kHz ≤ f < 10 MHz	+5 dBm	+5 dBm
10 MHz ≤ f < 50 MHz	+10 dBm	+10 dBm
50 MHz ≤ f < 400 MHz	+13 dBm	**+20 dBm**
400 MHz ≤ f ≤ 3 GHz		**+23 dBm**
3 GHz < f ≤ 4 GHz		**+20 dBm**
4 GHz < f ≤ 5 GHz		+13 dBm
5 GHz < f ≤ 6 GHz	+11 dBm	+11 dBm

Absolute Level Accuracy

CW, 18° to 28°C, –110 to +5 dBm

±0.5 dB (typ.)	(100 kHz ≤ f < 50 MHz)
±0.5 dB	(50 MHz ≤ f ≤ 3 GHz)
±0.7 dB	(3 GHz < f ≤ 4 GHz)
±0.8 dB	(4 GHz < f ≤ 6 GHz)

Harmonics

<–30 dBc

Non-Harmonics

Output level ≤+5 dBm, CW, Frequency offset ≥10 kHz

<–62 dBc (100 kHz ≤ f ≤ 187.5 MHz)
<–68 dBc (187.5 MHz < f ≤ 750 MHz)
<–62 dBc (750 MHz < f ≤ 1.5 GHz)
<–56 dBc (1.5 GHz < f ≤ 3 GHz)
<–50 dBc (3 GHz < f ≤ 6 GHz)

Single Sideband Phase Noise

CW, 20 kHz offset

<–140 dBc/Hz (nom.)	(100 MHz)
<–131 dBc/Hz (typ.)	(1 GHz)
<–125 dBc/Hz (typ.)	(2 GHz)

Analog Modulation

- Amplitude Modulation (Internal Modulation Source)
  Depth: 0 to 100% (Linear)
  0 to 10 dB (Log)
  Modulation Frequency: 0.1 Hz to 50 MHz
- Frequency Modulation (Internal Modulation Source)
  Deviation: 0 Hz to 40 MHz
  Modulation Frequency: 0.1 Hz to 40 MHz, or (50-MHz FM Rate), whichever smaller
- Φ-Modulation (Internal Modulation Source)
  Deviation angle: 0 to 160 rad., or (40 MHz/ΦM Rate) rad., whichever smaller
  Modulation Frequency: 0.1 Hz to 40 MHz, or (40 MHz/ΦM Deviation), whichever smaller
- Pulse Modulation (Internal Modulation Source)
  Modulation Frequency: 0.1 Hz to 10 MHz
  Modulation Period: 10 ns to 20 s

Baseband Performance

- RF Modulation Bandwidth
  160 MHz*/120 MHz (using Internal baseband signal generator)
- ARB Memory Size

64 Msamples (256 MB)	[with 1stRF, 2ndRF]
256 Msamples (1 GB)	[Option 045/075]
1024 Msamples (4 GB)	[Option 046/076]

- Sampling Rate
  20 kHz to 200 MHz*/160 MHz
- DAC Resolution
  14/15/16 bits

*: Supports firmware version 2.00.00 and later. Only when using WLAN IQproducer MX370111A and 802.11ac (160 MHz) option MX370111A-002.

EVM Performance

18° to 28°C, After CAL

- W-CDMA (Test Model 4):
  Output Frequency: 800 MHz to 900 MHz, 1.8 GHz to 2.2 GHz
  ≤0.62% (rms)
  ≤0.6% (rms) (typ.)
- GSM:
  Output Frequency: 800 MHz to 900 MHz, 1.8 GHz to 1.9 GHz
  ≤0.84° (rms)
  ≤0.8° (rms) (typ.)
- EDGE:
  Output Frequency: 800 MHz to 900 MHz, 1.8 GHz to 1.9 GHz
  ≤0.84% (rms)
  ≤0.8% (rms) (typ.)
- LTE (20 MHz Test Model 3.1):
  Output Frequency: 600 MHz to 2.7 GHz
  ≤0.82% (rms)
  ≤0.8% (rms) (typ.)

Dimensions, Mass

426 (W) × 177 (H) × 390 (D) mm
≤13.7 kg (with 1stRF, excluding other option)

Power Supply

100 V(ac) to 120 V(ac), 200 V(ac) to 240 V(ac)
50 Hz to 60 Hz

EU Standards (CE Marking)

EMC: 2014/30/EU, EN61326-1, EN61000-3-2
LVD: 2014/35/EU, EN61010-1
RoHS: 2011/65/EU

Typical (typ.): Performance not warranted. Must products meet typical performance.
Nominal (nom.): Values not warranted. Included to facilitate application of product.
Measured (meas): Performance not warranted. Data actually measured by randomly selected measuring instruments.

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name	Remarks
	Main frame	
MG3710A	Vector Signal Generator	
	Standard accessories	
	Power Cord: 1 pc	
P0031A	USB Memory	USB2.0 Flash Driver, ≥256 MB
	Install CD-ROM	Operation manual (PDF) and application software (IQproducer)
	Options	
	(Common Parts)	
MG3710A-001	Rubidium Reference Oscillator	Select when ordering main frame, aging rate: $\pm 1 \times 10^{-10}$/month
MG3710A-002	High Stability Reference Oscillator	Select when ordering main frame, aging rate: $\pm 1 \times 10^{-7}$/year
MG3710A-011	2ndary HDD	Select when ordering main frame, spare HDD for saving user data without Windows OS
MG3710A-017	Universal Input/Output	Select when ordering main frame, Adds BNC connectors for following signals to rear panel of main frame, includes J1539A AUX Conversion Adapter (Baseband Reference Clock Input/Output, Sweep Output, Local Signal Input/Output)
MG3710A-021	BER Test Function	Select when ordering main frame, Built-in BER measurement, Bit Rate: 100 bps to 40 Mbps J1539A AUX Conversion Adapter required for Data/Clock/Enable signal input
MG3710A-101	Rubidium Reference Oscillator Retrofit	Retrofitted to shipped MG3710A
MG3710A-102	High Stability Reference Oscillator Retrofit	Retrofitted to shipped MG3710A
MG3710A-111	2ndary HDD Retrofit	Retrofitted to shipped MG3710A
MG3710A-117	Universal Input/Output Retrofit	Retrofitted to shipped MG3710A
MG3710A-121	BER Test Function Retrofit	Retrofitted to shipped MG3710A
MG3710A-181	CPU/Windows7 Upgrade Retrofit	Retrofitted to shipped MG3710A This option is for MG3710A units ordered until May 2018. It upgrades the currently installed CPU to a faster CPU and the OS to Windows 7 (WES7). Due to OS license restrictions, this option is not applicable to MG3710A units in which Option 313 Removable HDD (sales discontinued) is installed.
	(For 1stRF)	
MG3710A-032	1stRF 100 kHz to 2.7 GHz	Select when ordering main frame, select 1stRF frequency range, frequency cannot be changed after installation
MG3710A-034	1stRF 100 kHz to 4 GHz	Select when ordering main frame, select 1stRF frequency range, frequency cannot be changed after installation
MG3710A-036	1stRF 100 kHz to 6 GHz	Select when ordering main frame, select 1stRF frequency range, frequency cannot be changed after installation
MG3710A-041	High Power Extension for 1stRF	Select when ordering main frame, increases upper limit of output signal power setting range
MG3710A-042	Low Power Extension for 1stRF	Select when ordering main frame, increases lower limit of output signal power setting range
MG3710A-043	Reverse Power Protection for 1stRF	Select when ordering main frame, prevents damage caused by reverse input to output connector
MG3710A-045	ARB Memory Upgrade 256 Msample for 1stRF	Select when ordering main frame, expands ARB memory capacity
MG3710A-046	ARB Memory Upgrade 1024 Msample for 1stRF	Select when ordering main frame, expands ARB memory capacity
MG3710A-048	Combination of Baseband Signal for 1stRF	Select when ordering main frame, adds baseband combine function
MG3710A-049	AWGN for 1stRF	Select when ordering main frame, adds AWGN combine function
MG3710A-050	Additional Analog Modulation Input for 1stRF	Select when ordering main frame, Adds BNC connector for inputting external signals to rear panel of mainframe
MG3710A-018	Analog IQ Input/Output	Select when ordering main frame, installs IQ input/output BNC connector in main frame
MG3710A-141	High Power Extension for 1stRF Retrofit	Retrofitted to shipped MG3710A
MG3710A-142	Low Power Extension for 1stRF Retrofit	Retrofitted to shipped MG3710A
MG3710A-143	Reverse Power Protection for 1stRF Retrofit	Retrofitted to shipped MG3710A
MG3710A-145	ARB Memory Upgrade 256 Msample for 1stRF Retrofit	Retrofitted to shipped MG3710A
MG3710A-146	ARB Memory Upgrade 1024 Msample for 1stRF Retrofit	Retrofitted to shipped MG3710A
MG3710A-148	Combination of Baseband Signal for 1stRF Retrofit	Retrofitted to shipped MG3710A
MG3710A-149	AWGN for 1stRF Retrofit	Retrofitted to shipped MG3710A
MG3710A-150	Additional Analog Modulation Input for 1stRF Retrofit	Retrofitted to shipped MG3710A
MG3710A-118	Analog IQ Input/Output Retrofit	Retrofitted to shipped MG3710A
	(For 2ndRF)	
MG3710A-062	2ndRF 100 kHz to 2.7 GHz	Select when ordering main frame, select 2ndRF frequency range, frequency cannot be changed after installation
MG3710A-064	2ndRF 100 kHz to 4 GHz	Select when ordering main frame, select 2ndRF frequency range, frequency cannot be changed after installation
MG3710A-066	2ndRF 100 kHz to 6 GHz	Select when ordering main frame, select 2ndRF frequency range, frequency cannot be changed after installation
MG3710A-071	High Power Extension for 2ndRF	Select when ordering main frame, increases upper limit of output signal power setting range
MG3710A-072	Low Power Extension for 2ndRF	Select when ordering main frame, increases lower limit of output signal power setting range
MG3710A-073	Reverse Power Protection for 2ndRF	Select when ordering main frame, prevents damage caused by reverse input to output connector
MG3710A-075	ARB Memory Upgrade 256 Msample for 2ndRF	Select when ordering main frame, expands ARB memory capacity
MG3710A-076	ARB Memory Upgrade 1024 Msample for 2ndRF	Select when ordering main frame, expands ARB memory capacity
MG3710A-078	Combination of Baseband Signal for 2ndRF	Select when ordering main frame, adds baseband combine function
MG3710A-079	AWGN for 2ndRF	Select when ordering main frame, adds AWGN combine function
MG3710A-080	Additional Analog Modulation Input for 2ndRF	Select when ordering main frame, Adds BNC connector for inputting external signals to rear panel of mainframe
MG3710A-162	2ndRF 100 kHz to 2.7 GHz Retrofit	Retrofitted to shipped MG3710A when 2ndRF not installed
MG3710A-164	2ndRF 100 kHz to 4 GHz Retrofit	Retrofitted to shipped MG3710A when 2ndRF not installed
MG3710A-166	2ndRF 100 kHz to 6 GHz Retrofit	Retrofitted to shipped MG3710A when 2ndRF not installed
MG3710A-171	High Power Extension for 2ndRF Retrofit	Retrofitted to shipped MG3710A
MG3710A-172	Low Power Extension for 2ndRF Retrofit	Retrofitted to shipped MG3710A
MG3710A-173	Reverse Power Protection for 2ndRF Retrofit	Retrofitted to shipped MG3710A
MG3710A-175	ARB Memory Upgrade 256 Msample for 2ndRF Retrofit	Retrofitted to shipped MG3710A
MG3710A-176	ARB Memory Upgrade 1024 Msample for 2ndRF Retrofit	Retrofitted to shipped MG3710A
MG3710A-178	Combination of Baseband Signal for 2ndRF Retrofit	Retrofitted to shipped MG3710A
MG3710A-179	AWGN for 2ndRF Retrofit	Retrofitted to shipped MG3710A
MG3710A-180	Additional Analog Modulation Input for 2ndRF Retrofit	Retrofitted to shipped MG3710A

Continued on next page

Model/Order No.	Name	Remarks
	Maintenance service	
MG3710A-ES210	2 Years Extended Warranty Service	
MG3710A-ES310	3 Years Extended Warranty Service	
MG3710A-ES510	5 Years Extended Warranty Service	
	Softwares	
	(Waveform pattern)	(License for waveform patterns)
MX370073A	DFS Radar Pattern	WLAN 5.3/5.6 GHz band DFS tests (for TELEC and FCC) waveform pattern, license for main frame, manual (PDF)
MX370075A	DFS (ETSI) Waveform Pattern	WLAN 5.3/5.6 GHz DFS test (ETSI) waveform pattern, license for main frame, manual (PDF)
MX370084A	ISDB-Tmm Waveform Pattern	ISDB-Tmm and ISDB-TSB Waveform Patterns, license for main frame, manual (PDF)
	(IQproducer)	(License for IQproducer)
MX370101A	HSDPA/HSUPA IQproducer	IQproducer software, license for main frame, manual (PDF)
MX370102A	TDMA IQproducer	IQproducer software, license for main frame, manual (PDF)
MX370103A	CDMA2000 1xEV-DO IQproducer	IQproducer software, license for main frame, manual (PDF)
MX370104A	Multi-carrier IQproducer	IQproducer software, license for main frame, manual (PDF)
MX370105A	Mobile WiMAX IQproducer	IQproducer software, license for main frame, manual (PDF)
MX370106A	DVB-T/H IQproducer	IQproducer software, license for main frame, manual (PDF)
MX370107A	Fading IQproducer	IQproducer software, license for main frame, manual (PDF)
MX370108A	LTE IQproducer	IQproducer software, license for main frame, manual (PDF)
MX370108A-001	LTE-Advanced FDD Option	IQproducer software, license for main frame, manual (PDF). Requires MX370108A
MX370110A	LTE TDD IQproducer	IQproducer software, license for main frame, manual (PDF)
MX370110A-001	LTE-Advanced TDD Option	IQproducer software, license for main frame, manual (PDF). Requires MX370110A
MX370111A	WLAN IQproducer	IQproducer software, license for main frame, manual (PDF)
MX370111A-002	802.11ac (160 MHz) Option	IQproducer software, license for main frame, manual (PDF) Only for MG3710A. Requires MX370111A
MX370112A	TD-SCDMA IQproducer	IQproducer software, license for main frame, manual (PDF)
MX370113A	5G NR TDD sub-6GHz IQproducer	IQproducer software, license for main frame, manual (PDF)
	Optional accessories	
W3580AE	MG3710A/MG3740A Operation Manual (Main Unit)	Booklet, for MG3710A/MG3740A Main Frame (Operation, Remote Control)
W2496AE	MG3710A/MG3740A Operation Manual (IQproducer)	Booklet, for IQproducer (Operation for Common Parts)
W3581AE	MG3710A Operation Manual (Pre-installed Waveform Patterns)	Booklet, for Pre-installed Waveform Patterns (Usage, Detailed Parameters)
W3596AE	MX370073A Operation Manual	Booklet, for DFS (TELEC and FCC) Waveform Patterns
W3597AE	MX370075A Operation Manual	Booklet, for DFS (ETSI) Waveform Patterns
W3508AE	MX370084A Operation Manual	Booklet, for ISDB-Tmm Waveform Patterns
W2915AE	MX370101A Operation Manual	Booklet, for HSDPA/HSUPA IQproducer
W2916AE	MX370102A Operation Manual	Booklet, for TDMA IQproducer
W2505AE	MX370103A Operation Manual	Booklet, for CDMA2000 1xEV-DO IQproducer
W2917AE	MX370104A Operation Manual	Booklet, for Multi-carrier IQproducer
W2918AE	MX370105A Operation Manual	Booklet, for Mobile WiMAX IQproducer
W2798AE	MX370106A Operation Manual	Booklet, for DVB-T/H IQproducer
W2995AE	MX370107A Operation Manual	Booklet, for Fading IQproducer
W3023AE	MX370108A Operation Manual	Booklet, for LTE IQproducer/LTE-Advanced FDD Option
W3221AE	MX370110A Operation Manual	Booklet, for LTE TDD IQproducer/LTE-Advanced TDD Option
W3488AE	MX370111A Operation Manual	Booklet, for WLAN IQproducer/802.11ac Option
W3582AE	MX370112A Operation Manual	Booklet, for TD-SCDMA IQproducer
W3984AE	MX370113A Operation Manual	Booklet, for 5G NR TDD sub-6GHz IQproducer
J1539A	AUX Conversion Adapter	Converts MG3710A rear-panel AUX connector to BNC connector
Z1572A	Installation Kit	Required when retrofitting hardware options or installing IQproducer (MX3701xxA)
Z1594A	Standard Waveform Pattern for Backup	Latest MG3710A Pre-installed waveform pattern set for backup
MA24105A	Inline Peak Power Sensor	350 MHz to 4 GHz, Inline type, with USB A to micro-B Cable
MA24106A	USB Power Sensor	50 MHz to 6 GHz, with USB A to mini-B Cable
MA24108A	Microwave USB Power Sensor	10 MHz to 8 GHz, with USB A to micro-B Cable
MA24118A	Microwave USB Power Sensor	10 MHz to 18 GHz, with USB A to micro-B Cable
MA24126A	Microwave USB Power Sensor	10 MHz to 26 GHz, with USB A to micro-B Cable
K240B	Power Divider (K connector)	DC to 26.5 GHz, K-J, 50Ω, 1 Wmax
MA1612A	Four-Port Junction Pad	5 MHz to 3 GHz, N-J
J0576B	Coaxial Cord, 1.0 m	N-P · 5D-2W · N-P
J0576D	Coaxial Cord, 2.0 m	N-P · 5D-2W · N-P
J0127A	Coaxial Cord, 1.0 m	BNC-P · RG-58A/U · BNC-P
J0127B	Coaxial Cord, 2.0 m	BNC-P · RG-58A/U · BNC-P
J0127C	Coaxial Cord, 0.5 m	BNC-P · RG-58A/U · BNC-P
J0322A	Coaxial Cord, 0.5 m	SMA-P · SMA-P, DC to 18 GHz, 50Ω
J0322B	Coaxial Cord, 1.0 m	SMA-P · SMA-P, DC to 18 GHz, 50Ω
J0322C	Coaxial Cord, 1.5 m	SMA-P · SMA-P, DC to 18 GHz, 50Ω
J0322D	Coaxial Cord, 2.0 m	SMA-P · SMA-P, DC to 18 GHz, 50Ω
J0004	Coaxial Adapter	N-P · SMA-J Conversion Adapter, DC to 12.4 GHz
J1261B	Ethernet Cable (Shield Type)	Straight-through, 3 m
J1261D	Ethernet Cable (Shield Type)	Crossover, 3 m
J0008	GPIB Cable, 2.0 m	
B0635A	Rack Mount Kit	EIA
B0657A	Rack Mount Kit (JIS)	JIS
B0636C	Carrying Case	Hard Type. With Casters and B0671A Front Cover
B0671A	Front Cover for 1MW4U	
Z0975A	Keyboard (USB)	
Z0541A	USB Mouse	

The following option is installed as standard when ordering the MG3710A. It does not require a separate order.
MG3710A Standard Waveform Pattern MX371099A

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Handheld Direction Finding System

MA2700A Handheld InterferenceHunter™

Includes GPS and Electronic Compass

Simplify your interference hunting tasks with the Handheld InterferenceHunter™ from Anritsu Company. This broadband, easy-to-use handheld direction finding antenna system includes everything you need to find the sources of signals. With a broadband preamplifier, the system is sensitive. With a GPS receiver, it knows where it is. With the electronic compass it knows where it is aimed. With an antenna attached, the InterferenceHunter captures a direction and signal level when the user presses the trigger on the ergonomic handle.
The included adjustable shoulder strap conveniently holds the MA2700A when out in the field. The ergonomic handle can be used with antennas having a female Type-N connector located at the back of the antenna. The included coupling nut allows for easy antenna connection.
Compatible antennas in many cellular bands are available from Anritsu. For details on these antennas including frequency range, gain, and pattern information, refer to the Directional Antennas Technical Data Sheet (11410-00376) available for download from the Anritsu web site.
Combined with Interference Analysis (Option 25) on Anritsu handheld instruments with spectrum analyzers, the captured location and bearing data is displayed on the instrument.

How to Use the MA2700A

Connections

- Connect an antenna to the male N-connector (inside the coupling nut).
- Connect USB cable between the MA2700A and the instrument. Connect coaxial cable between the MA2700A and the instrument's RF Input connector.

Instrument Setup

- Confirm that the instrument has SPA module V6.00 or higher.
- Select the Interference Analysis (Option 25) mode on the instrument, then select Interference Mapping measurement.
- The instrument will detect the connected MA2700A and display the message MA2700 detected – Device is ready to use. After GPS lock, the instrument will use GPS data from the MA2700A.
  - To manually select the MA2700A: In the Measurements menu, press Interference Mapping twice. Choose the Direction Finding submenu then Direction Finding Antenna Selection, and select MA2700 Handheld.

Mapping

- Anritsu easyMap Tools™ is used to create maps that are displayed on

Specifications

All specifications and characteristics apply to Revision 1 instruments. All published specifications are typical.

Power Consumption	Preamplifier On: 0.6 Watts Preamplifier Off: 0.5 Watts
Bandwidth	9 kHz to 6 GHz
Preamplifier	Bandwidth: 10 MHz to 6 GHz Gain ≥8 dB: 10 MHz to 2.4 GHz ≥5 dB: >2.4 GHz to 4 GHz ≥3 dB: >4 GHz to 6 GHz
Electronic Compass	Power: Powered from USB Accuracy: ≤5° (nom.) Interface: USB
GPS Receiver	Satellites Tracked: 12 (max.) GPS Locking Time Cold start: 30 s (typ.), with a clear view of the sky Warm start: 2 s (typ.), with a clear view of the sky Position Uncertainty: ±2 m (typ.)
Cables	USB cable terminated with a USB Type A Female Plug, 1.5 m Coaxial cable with Type-N male connector, 1.5 m
Tripod Mount	1/4 - 20 UNC × 7 mm
CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN61010-1 RoHS: 2011/65/EU Australia and New Zealand RCM AS/NZS 4417:2012 South Korea KCC-REM-A21-0004
Environmental	Temperature range: –10° to +55°C (Operating), –40° to +71°C (Storage) Maximum Humidity: 95% non-condensing Altitude: 4600 m Shock: MIL-PRF-28800F Class 2
Dimensions and Mass	303 (W) × 220 (H) × 70 (D) mm (11.9 × 8.7 × 2.76 in), <1 kg (2.2 lb)

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main frame
MA2700A	Interference Hunter™
	Standard Accessories (included with instrument)
2000-1729-R	Shoulder Strap
	Optional Accessories
	Directional Antennas
2000-1777-R	9 kHz to 20 MHz, N (f), Loop
2000-1778-R	20 MHz to 200 MHz, N (f), Loop
2000-1779-R	200 MHz to 500 MHz, N (f), Loop
2000-1812-R	450 MHz to 512 MHz, N (f), 7.1 dBd, Yagi
2000-1659-R	698 MHz to 787 MHz, N (f), 10.1 dBd, Yagi
2000-1411-R	824 MHz to 896 MHz, N (f), 12.3 dBd, Yagi
2000-1412-R	885 MHz to 975 MHz, N (f), 12.6 dBd, Yagi
2000-1660-R	1425 MHz to 1535 MHz, N (f), 14.3 dBd, Yagi
2000-1413-R	1710 MHz to 1880 MHz, N (f), 12.3 dBd, Yagi
2000-1414-R	1850 MHz to 1990 MHz, N (f), 11.4 dBd, Yagi
2000-1416-R	1920 MHz to 2170 MHz, N (f), 14.3 dBd, Yagi
2000-1415-R	2400 MHz to 2500 MHz, N (f), 14.1 dBd, Yagi
2000-1726-R	2500 MHz to 2700 MHz, N (f), 14.1 dBd, Yagi
2000-1747-R	300 MHz to 7000 MHz, N (f), 5.1 dBi (typ.) Log Periodic
2000-1748-R	1 GHz to 18 GHz, N (f), 6 dBi (typ.) Log Periodic
2000-1715-R	698 MHz to 2.5 GHz, N (f), gain of 2 dBi to 10 dBi (typ.) Bi-blade Directional Antenna
	Bandpass Filters
2000-1798-R	Port Extender, DC to 6 GHz, N (m) to N (f)
2000-1734-R	699 MHz to 715 MHz, N (m) to N (f), 50Ω
2000-1735-R	776 MHz to 788 MHz, N (m) to N (f), 50Ω
2000-1736-R	815 MHz to 850 MHz, N (m) to N (f), 50Ω
2000-1737-R	1711 MHz to 1756 MHz, N (m) to N (f), 50Ω
2000-1738-R	1850 MHz to 1910 MHz, N (m) to N (f), 50Ω
2000-1739-R	880 MHz to 915 MHz, N (m) to N (f), 50Ω
2000-1740-R	1710 MHz to 1785 MHz, N (m) to N (f), 50Ω
2000-1741-R	1920 MHz to 1980 MHz, N (m) to N (f), 50Ω
2000-1742-R	832 MHz to 862 MHz, N (m) to N (f), 50Ω
2000-1743-R	2500 MHz to 2570 MHz, N (m) to N (f), 50Ω
2000-1799-R	2305 MHz to 2320 MHz, N (m) to N (f), 50Ω
2000-1911-R	703 MHz to 748 MHz, N (m) to N (f), 50Ω
2000-1912-R	788 MHz to 798 MHz, N (m) to N (f), 50Ω
2000-1925-R	633 MHz to 698 MHz, N (m) to N (f), 50Ω
2000-1926-R	776 MHz to 806 MHz, N (m) to N (f), 50Ω

Model/Order No.	Name
	MA2700A Transit Cases
760-261-R	Transit Case, space for MA2700A, antennas, filters, instrument inside softcase, and other interference hunting accessories/tools
760-262-R	Transit Case for MA2700A, several Yagi antennas and filters
2000-1727	Monopod, extends to 180 cm (72 in)
	Additional Documents and Software
	• Spectrum Analyzer Measurement Guide applicable for your Anritsu Instrument. The Interference Analysis chapter will include a section on "Interference Mapping" with information on setup and selecting the MA2700A as the Direction Finding Antenna. • Anritsu easyMap Tools software creates Geo-enabled maps which are viewed on the Anritsu instruments during interference hunting. • Directional Antennas Technical Data Sheet (11410-00376) lists compatible antennas in many frequency bands. • The User Guide for your Anritsu instrument. These documents and programs along with additional applications notes, white papers, and videos covering interference analysis are available from the Anritsu web site (www.anritsu.com).

MX280007A InterferenceHunter™

Anritsu Mobile InterferenceHunter™ - How it Works

Interference from both illegal and unintentional signals is a significant problem for mobile service providers, security services and government regulators. Interference can often degrade network performance, causing critical communications to be interrupted. Locating these sources of interference has traditionally been labor intensive and time consuming. Traditional methods include manually making numerous measurements from multiple locations using a directional antenna. Triangulation is then used to approximate the signal location.
This process is then iterated a number of times until the interferer is precisely located.
The Anritsu mobile interference hunting system automates the interference hunting process. Multiple measurements are automatically taken and processed using the MX280007A software. Using mapping software resident on a Windows laptop/tablet, an Anritsu handheld spectrum analyzer and an omnidirectional antenna, directions and voice prompts are provided in this system to guide the driver to the source of interference.

A key component of the Anritsu mobile interference hunting system is an off-the shelf magnet mount omnidirectional antenna. Depending on the antenna used, this interference hunting system covers the entire frequency range provided by the spectrum analyzer. In most cases, this range covers from 9 kHz to a high frequency of 43 GHz for the MS2720T platform series of spectrum analyzers. Most Anritsu handheld spectrum analyzers can be employed with this system.
The patent-pending algorithm in the Anritsu Mobile InterferenceHunter software uses power-of-arrival technology to quickly measure and locate sources of interference. To guide the user to the interferer position, directional arrows are positioned on the map.
The accuracy of these directions is enhanced with GPS technology to precisely identify the driver's position and the path to follow.
Additionally, voice prompts are given allowing the user to minimize the need for viewing the map while driving. This helps to facilitate one-person operation. Voice prompts can be played on the tablet itself or fed into the car speaker system with an audio cable. Bluetooth® wireless technology can also be used where both the vehicle radio and the tablet are equipped with this feature. Care must be taken to insure that Bluetooth transmissions are not in the same frequency band being searched for interference.
The interference hunting algorithms employ channel power measurements. This feature facilitates hunting a wide variety of signal types, from wideband modulated signals to narrowband or CW sources. The channel power bandwidth can be easily configured by the user for settings appropriate for the signal of interest.
Once sufficient measurements are accumulated and filtered for multipath, the Anritsu Mobile InterferenceHunter software draws a circle on the map indicating the position estimate of the source of interference. The diameter of the circle becomes smaller as more measurements are taken, providing a higher degree of confidence for the location of the signal of interest. While driving, a series of color-coded dots is shown on the map, with color proportional to signal strength.

On set-up of the mobile interference hunting system, a USB cable is attached between the spectrum analyzer and the Windows tablet.
On boot-up, the spectrum analyzer is automatically placed into channel power mode. The operator sets the frequency, channel bandwidth and a few other settings. The appropriate OpenStreetMap™ is loaded into the program by the user. Alternatively, Google Maps™ can be utilized by the user (requires internet access for the duration of the interference hunt).
Once the user gets close enough to the interferer location, the Anritsu handheld spectrum analyzer with a Yagi or other directional antenna can then be used to pin-point the interferer. It is highly recommended that the Handheld InterferenceHunter MA2700A device be used as part of this pin-pointing operation.
In developing the Anritsu Mobile InterferenceHunter software, great care was taken to insure user-friendliness and simplicity of use. With an interface optimized for Windows touchscreen tablets, the Mobile InterferenceHunter software is simple to use.

Types of Interferers Found

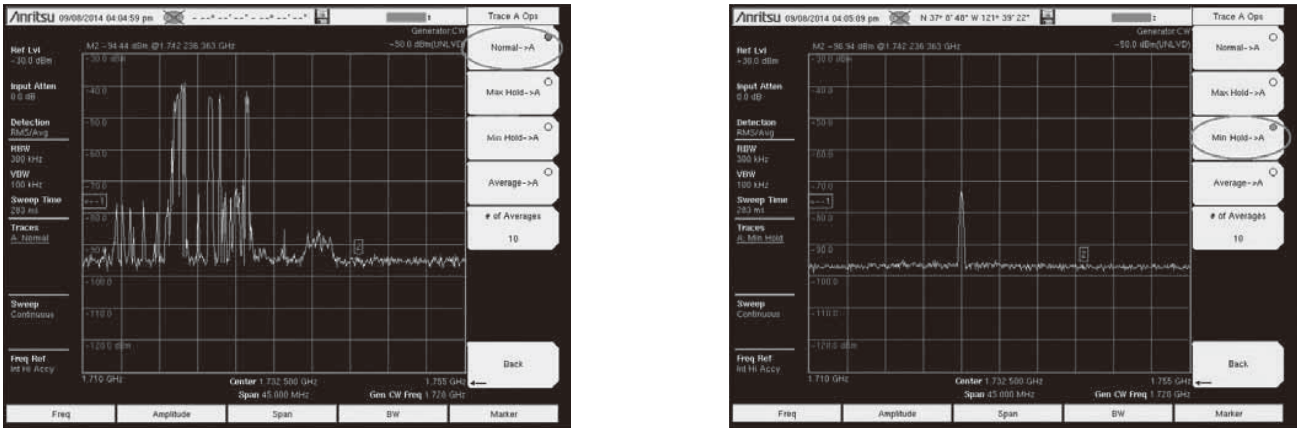
- Low power
- Narrowband, wideband
- Modulated
- Pulsed signals (similar to radar)
- Signals hidden in LTE uplink channels
- "Black" TV/radio stations and BTS cellular equipment operating illegally.

Anritsu Mobile InterferenceHunter Software Special Capabilities

For signals hidden in LTE uplink bands, the Mobile InterferenceHunter software uses a "min hold" algorithm which captures the interfering signal while eliminating the LTE traffic signal from measurement consideration. Once the signal of interest is captured, min hold is reset for another power measurement of the interferer. Min hold can be enabled under the 'Settings' tab in the software application user interface. Timing for the resetting of min hold is user settable.

For finding pulsed signals, the Mobile InterferenceHunter software uses a "max hold" algorithm, capturing the pulsed signal only when it is transmitting. This eliminates the possibility of erroneously measuring a pulsed signal when not active. Timing for the max hold reset time is user settable.

For finding extremely fast signal pulses, an innovative feature developed by Anritsu called "Burst Detect" can be used. Using FFT technology, Burst Detect enables the spectrum analyzer to capture and process intermittent signals at receiver-like speeds. Burst Detect is available on the Spectrum Master™ MS2720T, the BTS Master™MT8220T , and the VNA Masters™ MS203xC.



Anritsu 09/08/2014 04:04:59 pm

Ref Lvl -30.0 dBm

Input Atten 0.0 dB

Detection RMS/Avg

RBW 300 kHz

VBW 100 kHz

Sweep Time 283 ms

Traces A: Normal

Sweep Continuous

Freq Ref Int Hi Accy

M2 −94.44 dBm @1.742 236 363 GHz

Generator:CW −50.0 dBm(UNLVD)

Center 1.732 500 GHz

Span 45.000 MHz

Gen CW Freq 1.720 GHz

Anritsu 09/08/2014 04:05:09 pm N 37° 0' 48" W 121° 39' 22"

Ref Lvl -30.0 dBm

Input Atten 0.0 dB

Detection RMS/Avg

RBW 300 kHz

VBW 100 kHz

Sweep Time 283 ms

Traces A: Min Hold

Sweep Continuous

Freq Ref Int Hi Accy

M2 −96.94 dBm @1.742 236 363 GHz

Generator:CW −50.0 dBm(UNLVD)

Center 1.732 500 GHz

Span 45.000 MHz

Gen CW Freq 1.720 GHz

Comparison of LTE Uplink Band screenshots taken before and after MIN HOLD applied.
Interferer obscured by LTE traffic on left can clearly be seen on screen on right.

Other features provided by the Anritsu Mobile InterferenceHunter software include:

- Multi-emitter mode of operation, ideal for finding multiple leakage sources such as cable TV
- Squelch Control to optimize hunting for low-level signals or when signals are obscured by buildings and other obstructions
- Choice of Internet-provided Google Maps or maps to store on the laptop/tablet (provided by OpenStreetMap)
- Zoom In/Out controls provided on the map for desired street level view
- Full-Screen Spectrum View on the laptop or tablet allows easier examination and analysis of the spectrum trace data
- Visual indicators showing power levels measured at each point along the drive path
- Ability to capture and store interference hunt log files for later playback and analysis
- Voice prompts providing the driver with turn-by-turn directions to locate the source of interference (facilitates one-person operation)
- Extensive Help Menu for on-site assistance pertaining to Mobile InterferenceHunter operation

Configuration Overview

- Anritsu Mobile InterferenceHunter software with license key.
- Anritsu handheld spectrum analyzer with GPS receiver
- Tablet/laptop running Windows 7 or 8 (tablet running Windows 8 highly recommended for touchscreen capability)
- Off-the-shelf magnet mount omnidirectional antenna (Anritsu P/N 3-2000-1647-R or equivalent) This part also contains an integrated GPS antenna.
- Mounting hardware for tablet (Anritsu P/N 2000-1801-R or equivalent)
- Magnet mount GPS antenna (Anritsu P/N 2000-1528-R or equivalent) Required only if omnidirectional antenna used does not incorporate a GPS antenna.
- USB A - 5-PIN Mini-B Cable (Anritsu P/N 3-2000-1498 or equivalent) This cable is provided as an accessory for compatible Anritsu handheld spectrum analyzers.
- Optional audio cable or Bluetooth transmitter to connect the tablet speaker to the car audio system
- Mobile Internet connection for tablet/laptop to use Google Maps or download OpenStreetMap-based maps from: https://www.anritsu.com/en-US/Products-Solutions/Products/Maps.aspx

Anritsu Handheld Spectrum Analyzer
with GPS Option

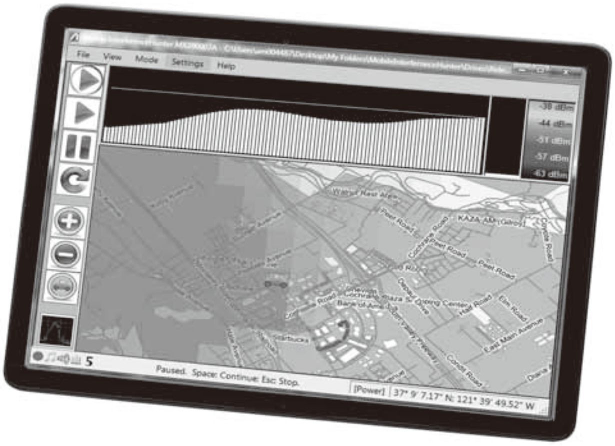
Dash-mounted Windows PC Tablet
with MX280007A Software and
2000-1801-R mounting hardware

2000-1647-R Broadband Magnet Mount
Omnidirectional Antenna 700 MHz to 6 GHz with
GPS Antenna in one housing
(recommended antenna for users operating in this
frewquency range)

Maps

Two types of mapping solutions are available using the Anritsu mobile interference hunting system:

- Google Maps - a free service offering the user the flexibility to automatically download maps for many parts of the world. However, an Internet connection must be set up and maintained during the entirety of the interference hunt. In many cases, a cellular USB modem is used for this connection. Care must be taken to ensure frequencies used by the modem do not interfere with interference signals being measured.
- OpenStreetMap - an open source database of maps that must be downloaded to the hard drive of the tablet before the interference hunt begins. Anritsu has created hundreds of maps of cities throughout the world that can be downloaded and used with this interference hunting system. Alternatively, users can create their own maps using an easy 4-step process. Maps and instructions can be found at the following Anritsu web page:
  https://www.anritsu.com/en-US/Products-Solutions/Products/Maps.aspx



Paused. Space: Continue; Esc: Stop.

[Power] 37° 9' 7.17" N; 121° 39' 49.52" W

OpenStreetMap™ Displayed on Windows PC Tablet

Summary

Users will appreciate the flexibility of the Anritsu mobile interference hunting system. When not employed on interference hunts, the spectrum analyzer can be re-purposed for a variety of other applications including signal quality analysis and coverage mapping. Portable off-the-shelf magnet mount omnidirectional antennas provide the ability to easily target a variety of signals at a wide range of frequencies. Channel bandwidth control allows easy measurements for both narrowband and wideband signals. Low noise floor and high dynamic range on the spectrum analyzer allows signal tracking of low-level signals from a greater distance from the interference source. With a less than 5 minute setup time and ease of use for one person operation, the Anritsu mobile interference hunting system adds up to be the optimal solution for finding interference.

Post Interference Hunt Analysis

Records of your interference hunt can be saved as log files either for submission to management or for use in analyzing the hunt itself. The log files can be re-played on the MX280007A software to examine the drive route taken and to review areas where the hunting process might be optimized.

Additional Equipment for the Interference Hunt

The Anritsu mobile interference hunting system allows the user to find the approximate location of interference fast. It has easy setup, user-friendly operation, and powerful patent-pending algorithms used by the software for finding interference sources. The Anritsu mobile interference hunting system allows the user to find the approximate location of the interferer quickly and efficiently. As a final step, the Handheld InterferenceHunter MA2700A mated with a directional antenna is the perfect solution for pinpointing the interference signal source.

MA2700A Handheld InterferenceHunter
with directional antenna and channel filter

Paused. Space: Continue; Esc: Stop.

[Power] 37° 9' 7.17" N; 121° 39' 49.52" W

Interference hunt screen capture. Dots shown along drive path are colored according to signal strength.

Compatible Analyzers

The following current Anritsu handheld spectrum analyzer models may be utilized in the Anritsu mobile interference hunting system.

Spectrum Master™	MS2712E/13E	Option 31, GPS Receiver
	MS2720T	Option 31, GPS Receiver
BTS Master™	MT8220T	GPS Receiver is standard
Cell Master™	MT8212E/13E	Option 31, GPS Receiver
Site Master™	S332E/62E	Option 31, GPS Receiver
LMR Master™	S412E	Option 31, GPS Receiver
VNA Master™	MS2034B/35B	Option 31, GPS Receiver
	MS2036C/37C/38C	Option 31, GPS Receiver
BTS Master™ Spectrum Master™	MT8221B/22B	Option 31, GPS Receiver
	MS2722C/23C/24C/25C/26C	Option 31, GPS Receiver

Ordering Information

Mobile InterferenceHunter™ Software	Model Number	Description
	MX280007A	Mobile InterferenceHunter Software (Spectrum Analyzer must have GPS Receiver)
Important: When placing order, an email address is always needed. For Spectrum Analyzers previously owned, the model and serial number of the analyzer must also be provided.		
	Part Number	Description
	MX280007A-PL001	Perpetual license ordered with a new Spectrum Analyzer
	MX280007A-PL002	Perpetual license ordered with an existing Spectrum Analyzer

Note: Customers order one of the two part numbers listed above to obtain a license. An email is then sent with a link to download the MX280007A Mobile InterferenceHunter software along with the license key. Multiple licenses may also be ordered that work with a corresponding number of Anritsu handheld spectrum analyzers.

Accessories

- Tablet/laptop running Windows 7 or 8 (tablet running Windows 8 highly recommended for touchscreen capability)
- Off-the-shelf magnet mount omnidirectional antenna (Anritsu P/N 3-2000-1647-R or equivalent) This part also contains an integrated GPS antenna.
- Mounting hardware for tablet (Anritsu P/N 2000-1801-R or equivalent)
- Magnet mount GPS antenna (Anritsu P/N 2000-1528-R or equivalent) Required only if omnidirectional antenna used does not incorporate a GPS antenna.
- USB A - 5-PIN Mini-B Cable (Anritsu P/N 3-2000-1498 or equiv alent) This cable is provided as an accessory for compatible Anritsu handheld spectrum analyzers.
- Optional audio cable or Bluetooth transmitter to connect the tablet speaker to the car audio system

Model/Order No.	Name
	Additional Accessories
	Bandpass Filters
1030-106-R	1710 MHz to 1790 MHz, N (m) to SMA (f), 50Ω
1030-107-R	1910 MHz to 1990 MHz, N (m) to SMA (f), 50Ω
1030-109-R	824 MHz to 849 MHz, N (m) to SMA (f), 50Ω
1030-110-R	880 MHz to 915 MHz, N (m) to SMA (f), 50Ω
1030-111-R	1850 MHz to 1910 MHz, N (m) to SMA (f), 50Ω
1030-112-R	2400 MHz to 2484 MHz, N (m) to SMA (f), 50Ω
1030-114-R	806 MHz to 869 MHz, N (m) to SMA (f), 50Ω
1030-155-R	2500 MHz to 2700 MHz, N (m) to N (f), 50Ω
1030-178-R	1920 MHz to 1980 MHz, N (m) to N (f), 50Ω
1030-179-R	777 MHz to 798 MHz, N (m) to N (f), 50Ω
1030-180-R	2500 MHz to 2570 MHz, N (m) to N (f), 50Ω
2000-1684-R	791 MHz to 821 MHz, N (m) to N (f), 50Ω
	Bandpass Filters (used with MA2700A InterferenceHunter™)
2000-1734-R	699 MHz to 715 MHz, N (m) to N (f), 50Ω
2000-1735-R	776 MHz to 788 MHz, N (m) to N (f), 50Ω
2000-1736-R	815 MHz to 850 MHz, N (m) to N (f), 50Ω
2000-1737-R	1711 MHz to 1756 MHz, N (m) to N (f), 50Ω
2000-1738-R	1850 MHz to 1910 MHz, N (m) to N (f), 50Ω
2000-1739-R	880 MHz to 915 MHz, N (m) to N (f), 50Ω
2000-1740-R	1710 MHz to 1785 MHz, N (m) to N (f), 50Ω
2000-1741-R	1920 MHz to 1980 MHz, N (m) to N (f), 50Ω
2000-1742-R	832 MHz to 862 MHz, N (m) to N (f), 50Ω
2000-1743-R	2500 MHz to 2570 MHz, N (m) to N (f), 50Ω
2000-1799-R	2305 MHz to 2320 MHz, N (m) to N (f), 50Ω
	Highpass/Lowpass Filters
1030-149-R	Hi-Pass, 150 MHz, N (m) to N (f), 50Ω
1030-150-R	Hi-Pass, 400 MHz, N (m) to N (f), 50Ω
1030-151-R	Hi-Pass, 700 MHz, N (m) to N (f), 50Ω
1030-152-R	Lo-Pass, 200 MHz, N (m) to N (f), 50Ω
1030-153-R	Lo-Pass, 550 MHz, N (m) to N (f), 50Ω

Model/Order No.	Name
	Directional Antennas
2000-1677-R	300 MHz to 3 GHz, SMA (m), Log Periodic
2000-1659-R	698 MHz to 787 MHz, N (f), 10.1 dBd, Yagi
2000-1411-R	824 MHz to 896 MHz, N (f), 12.3 dBd, Yagi
2000-1412-R	885 MHz to 975 MHz, N (f), 12.6 dBd, Yagi
2000-1413-R	1710 MHz to 1880 MHz, N (f), 12.3 dBd, Yagi
2000-1414-R	1850 MHz to 1990 MHz, N (f), 11.4 dBd, Yagi
2000-1416-R	1920 MHz to 2170 MHz, N (f), 14.3 dBd, Yagi
2000-1415-R	2400 MHz to 2500 MHz, N (f), 14.1 dBd, Yagi
2000-1660-R	1425 MHz to 1535 MHz, N (f), 14.3 dBd, Yagi
2000-1715-R	698 MHz to 2500 MHz, N (f), gain of 2 dBi to 10 dBi (typ.)
2000-1748-R	Antenna, Log Periodic, 1 GHz to 18 GHz, N (f), 6 dBi (typ.)
2000-1777-R	Portable Directional Antenna, 9 kHz to 20 MHz, N (f)
2000-1778-R	Portable Directional Antenna, 20 MHz to 200 MHz, N (f)
2000-1779-R	Portable Directional Antenna, 200 MHz to 500 MHz, N (f)
	Other Accessories
2000-1647-R	Mag mount broadband antenna Cable 1: 698 MHz to 1200 MHz 2 dBi peak gain, 1700 MHz to 2700 MHz, 5 dBi peak gain, N (m) 50Ω, 3 m (10 ft) Cable 2: 3000 MHz to 6000 MHz, 5 dBi peak gain, N (m), 50Ω, 3 m (10 ft) Cable 3: GPS 26 dB gain, SMA (m), 50Ω, 3 m (10 ft)
2000-1723-R	USB-based GPS
2000-1910-R	USB 3.0 Hub
15NN50-1.5C	1.5 m, DC to 6 GHz, N (m) to N (f) 50Ω cable for external antennas
2000-1801-R	Hardware for mounting Windows tablet onto car dash
2000-1648-R	Mag mount omnidirectional antenna, 1700 MHz to 6000 MHz, 3 dBi peak gain, N (m) 50Ω, 3 m (10 ft)
2000-1752-R	Wireless Router (TP Link Model TL-WR802N)
2000-1689	EMI Near Field Probe Kit
2000-1653	Anti-glare Screen Cover (package of 2)
633-75	Rechargeable Li-Ion Battery, 7500 mAh
806-141-R	Automotive Power Adapter, 12 VDC, 60 W
MA2700A	Handheld InterferenceHunter (Refer to TDS 11410-00692 for full specifications)
2000-1528-R	GPS Antenna, SMA (m) with 5 m (15 ft) cable, 3 dBi gain, requires 5 VDC
3-2000-1498	USB A/5-pin mini-B Cable, 10 ft/305 cm

MT8212E/MT8213E

Cable & Antenna Analyzer: 2 MHz to 4 GHz/6 GHz, Spectrum Analyzer: 9 kHz to 4 GHz/6 GHz, Power Meter: 10 MHz to 4 GHz/6 GHz

Remote Control
GPIB | Ethernet

Compact Handheld Base Station Analyzer

Anritsu introduces its compact handheld Base Station Analyzer for installation and maintenance of wireless networks. Designed as a lightweight base station tester meeting virtually all testing needs by an RF technician. The Cell Master features wireless measurement options for 2G, 3G and 4G cellular networks including LTE, WiMAX and digital broadcast.

Cable and Antenna Analyzer Highlights

- Measurements: RL, VSWR, Cable Loss, DTF, Phase
- 2-port Transmission Measurement: High/Low Power
- Sweep Speed: 1 ms/data point (typ.)
- Display: Single or Dual Measurement Touchscreen
- Calibration: OSL, InstaCal™, and Flex Cal™
- Bias-Tee: 32 V internal

Spectrum and Interference Analyzer Highlights

- Measurements: Occupied Bandwidth, Channel Power, ACPR, C/I
- Interference Analyzer: Spectrogram, Signal Strength, RSSI, Interference Mapping
- Dynamic Range: >102 dB in 1 Hz RBW
- DANL: –162 dBm in 1 Hz RBW
- Phase Noise: –100 dBc/Hz max @ 10 kHz offset at 1 GHz
- Frequency Accuracy: ±50 ppb with GPS On

Capabilities and Functional Highlights

- CPRI LTE RF Measurements
- OBSAI LTE RF Measurements
- LTE/LTE-A FDD/TDD; MIMO (2×2, 4×4)
- GSM/EDGE
- W-CDMA/HSPA+
- TD-SCDMA/HSPA+
- CDMA, EV-DO
- Fixed, Mobile WiMAX
- EMF Test
- USB Power Sensors up to 50 GHz
- Coverage Mapping
- 3 hour battery operation time
- USB or optional Ethernet data transfer
- PIM Alert Application
- ISDB-T, ISDB-T SFN
- DVB-T/H, DVB-T/H SFN
- Interference Analyzer
- GPS information on stored traces
- Built-in Bias Tee
- Internal Power Meter
- High Accuracy Power Meter
- Master Software Tools™
- Line Sweep Tools™
- easyTest Tools™
- Web Remote Control with Ethernet option
- NB-IoT Measurement

Cable and Antenna Analyzer Specifications

Measurements	Measurements	VSWR Return Loss Cable Loss Distance-to-Fault (DTF) Return Loss Distance-to-Fault (DTF) VSWR 1-port Phase Smith Chart (50Ω/75Ω Selectable)
Setup Parameters	Measurement Display	Single/Dual Measurement Display with independent markers
	Frequency	Start/Stop, Signal Standard, Start Cal
	DTF	Start/Stop, DTF Aid, Units (m/ft), Cable Loss, Propagation Velocity, Cable, Windowing
	Windowing	Rectangular, Normal Side Lobe, Low Side Lobe, Minimum Side Lobe
	Amplitude	Top, Bottom Auto Scale, Full Scale
	Sweep	Run/Hold, Single/Continuous, RF Immunity (High/Low), Data Points, Averaging/Smoothing, Output Power (High/Low), RF Pwr When Hold (On/Off)
	Data Points	137, 275, 551, 1102, 2204
	Markers	Markers 1-6 (On/Off), Delta Makers 1-6 (On/Off), Marker to Peak/Valley, Peak/Valley Auto, Marker Table (On/Off), All Markers Off
	Traces	Recall, Copy to Display Memory, No Trace Math, Trace ± Memory, Trace Overlay (On/Off)
	Limit Line	On/Off, Single Limit, Multi-segment Edit, Limit Alarm (On/Off), Pass Fail Message (On/Off), Pass/Fail (Unbounded/Bounded), Warning Limit Offset, Clear Limit
	Calibration	Start Cal, Cal Type (Standard/FlexCal™), Disp Valid Cal Temp Range
	Save/Recall	Setups, Measurements, Screen Shots (JPEG save only)
Frequency	Frequency Range	2 MHz to 4 GHz (MT8212E), 2 MHz to 6 GHz (MT8213E)
	Frequency Accuracy	≤±2.5 ppm @ 25°C
	Frequency Resolution	1 kHz (RF immunity low) 100 kHz (RF immunity high)
Output Power	High	0 dBm (typ.)
	Low	–30 dBm (typ.)
Interference Immunity	On-Channel	+17 dBm @ >1.0 MHz from carrier frequency
	On-Frequency	0 dBm within ±10 kHz of the carrier frequency
Measurement Speed	Return Loss	≤1.00 ms/data point, RF immunity low (typ.)
	Distance-to-Fault	≤1.25 ms/data point, RF immunity low (typ.)
Return Loss	Measurement Range	0 to 60 dB
	Resolution	0.01 dB
VSWR	Measurement Range	1:1 to 65:1
	Resolution	0.01
Cable Loss	Measurement Range	0 to 30 dB
	Resolution	0.01 dB
Distance-to-Fault	Vertical Range Return Loss	0 to 60 dB
	Vertical Range VSWR	1:1 to 65:1
	Fault Resolution (meters)	(1.5 × 10^8 × vp)/ΔF (vp = velocity propagation constant, ΔF is F2 – F1 in Hz)
	Horizontal Range (meters)	0 to (Data Points – 1) × Fault Resolution, to a maximum of 1500 meters (4921 ft)
1-Port Phase	Measurement Range	–180° to +180°
	Resolution	0.01°
Smith Chart	Resolution	0.01, 50Ω/75Ω Selectable
Measurement Accuracy	Corrected Directivity	>42 dB, OSL Calibration >38 dB, InstaCal™ Calibration

Spectrum Analyzer Specifications

Measurements	Smart Measurement	Field Strength (uses antenna calibration tables to measure dBm/m^2, dBmV/m, dBV/m, dBµV/m, Volt/m, Watt/m^2, dBW/m^2, A/m, dBA/m and Watt/cm^2) Occupied Bandwidth (measures 99% to 1% power channel of a signal) Channel Power (measures the total power in a specified bandwidth) ACPR (adjacent channel power ratio) AM/FM/SSB Demodulation (wide/narrow FM, USB and LSB), (audio out only) C/I (carrier-to-interference ratio) Emission Mask Coverage Mapping (requires Option 431) PIM Alert Application (available for download)
Setup Parameters	Frequency	Center/Start/Stop, Span, Frequency Step, Signal Standard, Channel #, Channel Increment
	Amplitude	Reference Level (RL), Scale, Attenuation Auto/Level, RL Offset, Pre-Amp On/Off, Detection
	Span	Span, Span Up/Down (1-2-5), Full Span, Zero Span, Last Span
	Bandwidth	RBW, Auto RBW, VBW, Auto VBW, RBW/WBW, Span/RBW
	File	Save, Recall, Delete, Directory Management
	Save/Recall	Setups, Measurements, Limit Lines, Screen Shots Jpeg (save only), Save-on-Event
	Save-on-Event	Crossing Limit Line, Sweep Complete, Save-then-Stop, Clear All
	Delete	Selected File, All Measurements, All Mode Files, All Content
	Directory Management	Sort Method (Name/Type/Date), Ascend/Descend, Internal/USB, Copy, Format USB
	Application Options	Bias-Tee (On/Off), Impedance (50Ω, 75Ω, Other)

Continued on next page

Sweep Functions	Sweep	Single/Continuous, Sweep Mode (Fast, Performance, No FFT), Reset, Detection, Minimum Sweep Time, Trigger Type, Gated Sweep (see Option 90)			
	Detection	Peak, RMS, Negative, Sample, Quasi-peak			
	Triggers	Free Run, External, Video, Change Position, Manual			
Trace Functions	Traces	Up to three Traces (A, B, C), View/Blank, Write/Hold, Trace A/B/C Operations			
	Trace A Operations	Normal, Max Hold, Min Hold, Average, # of Averages, (always the live trace)			
	Trace B Operations	A → B, B ↔ C, Max Hold, Min Hold			
	Trace C Operations	A → C, B ↔ C, Max Hold, Min Hold, A – B → C, B – A → C, Relative Reference (dB), Scale			
Marker Functions	Markers	Markers 1-6 each with a Delta Marker, or Marker 1 Reference with Six Delta Markers, Marker Table (On/Off), All Markers Off			
	Marker Types	Style (Fixed/Tracking), Noise Marker, Frequency Counter Marker			
	Marker Auto-Position	Peak Search, Next Peak (Right/Left), Peak Threshold %, Set Marker to Channel, Marker Frequency to Center, Delta Marker to Span, Marker to Reference Level			
	Marker Table	1-6 markers frequency and amplitude plus delta markers frequency amplitude and offset			
Limit Line Functions	Limit Lines	Upper/Lower, On/Off, Edit, Move, Envelope, Advanced, Limit Alarm, Default Limit			
	Limit Line Edit	Frequency, Amplitude, Add Point, Add Vertical, Delete Point, Next Point Left/Right			
	Limit Line Move	To Current Center Frequency, By dB or Hz, To Marker 1, Offset from Marker 1			
	Limit Line Envelope	Create Envelope, Update Amplitude, Points (41 max), Offset, Shape Square/Slope			
	Limit Line Advanced	Type (Absolute/Relative), Mirror, Save/Recall			
Frequency	Frequency Range	9 kHz to 4 GHz (MT8212E), 9 kHz to 6 GHz (MT8213E)			
	Tuning Resolution	1 Hz			
	Frequency Reference	Aging: ±1.0 ppm/year Accuracy: ±1.5 ppm (25° ±25°C) + aging, <±50 ppb with GPS On			
	Frequency Span	10 Hz to 4 GHz including zero span (MT8212E) 10 Hz to 6 GHz including zero span (MT8213E)			
	Sweep Time	Minimum 100 ms, 10 µs to 600 seconds in zero span			
	Sweep Time Accuracy	±2% in zero span			
Bandwidth	Resolution Bandwidth (RBW)	1 Hz to 3 MHz in 1–3 sequence ±10% (1 MHz max in zero-span) (–3 dB bandwidth)			
	Video Bandwidth (VBW)	1 Hz to 3 MHz in 1–3 sequence (–3 dB bandwidth)			
	RBW with Quasi-Peak Detection	200 Hz, 9 kHz, 120 kHz (–6 dB bandwidth)			
	VBW with Quasi-Peak Detection	Auto VBW is On, RBW/VBW = 1			
Spectral Purity	SSB Phase Noise @ 1 GHz	–100 dBc/Hz, –110 dBc/Hz (typ., 10 kHz offset) –105 dBc/Hz, –112 dBc/Hz (typ., 100 kHz offset) –115 dBc/Hz, –121 dBc/Hz (typ., 1 MHz offset)			
Amplitude Ranges	Dynamic Range	>102 dB (2.4 GHz), 2/3 (TOI-DANL) in 1 Hz RBW			
	Measurement Range	DANL to +26 dBm (≥50 MHz) DANL to 0 dBm (<50 MHz)			
	Display Range	1 to 15 dB/div in 1 dB steps, ten divisions displayed			
	Reference Level Range	–120 to +30 dBm			
	Maximum Continuous Input	+30 dBm			
	Attenuator Resolution	0 to 55 dB in 5 dB steps			
	Amplitude Units	Log Scale Modes: dBm, dBV, dBmV, dBµV, dBW, dBmW, dBµW, dBA, dBmA, dBµA Linear Scale Modes: nV, mV, V, kV, nW, µW, mW, W, kW, nA, µA, mA, A			
Amplitude Accuracy	9 kHz to 100 kHz	±2.00 dB (typ.) (Preamp Off)			
	100 kHz to 4 GHz	±1.25 dB, ±0.5 dB (typ.)			
	>4 GHz to 6 GHz	±1.50 dB, ±0.5 dB (typ.)			
Displayed Average Noise Level (DANL)		Preamp Off (Reference level –20 dBm)		Preamp On (Reference level –50 dBm)	
		Maximum	Typical	Maximum	Typical
	10 MHz to 2.4 GHz	–141 dBm	–146 dBm	–157 dBm	–162 dBm
	>2.4 GHz to 4 GHz	–137 dBm	–141 dBm	–154 dBm	–159 dBm
	>4 GHz to 5 GHz	–134 dBm	–138 dBm	–150 dBm	–155 dBm
	>5 GHz to 6 GHz	–126 dBm	–131 dBm	–143 dBm	–150 dBm
Spurs	Residual Spurious	<–90 dBm (RF input terminated, 0 dB input attenuation, >10 MHz)			
	Input-Related Spurious	<–75 dBc (0 dB attenuation, –30 dBm input, span <1.7 GHz, carrier offset >4.5 MHz)			
	Exceptions, typical	<–70 dBc @ <2.5 GHz, with 2072.5 MHz Input <–68 dBc @ F1 – 280 MHz with F1 Input <–70 dBc @ F1 + 190 MHz with F1 Input <–52 dBc @ 7349 – (2F2) MHz, with F2 Input, where F2 < 2437.5 MHz <–55 dBc @ 190.5 ± (F1/2) MHz, where F1 < 1 GHz			
Third-Order Intercept (TOI)	Preamp Off (–20 dBm tones 100 kHz apart, 10 dB attenuation)				
	800 MHz	+16 dBm			
	2400 MHz	+20 dBm			
	200 MHz to 2200 MHz	+25 dBm (typ.)			
	>2.2 GHz to 5.0 GHz	+28 dBm (typ.)			
	>5.0 GHz to 6.0 GHz	+33 dBm (typ.)			
Second Harmonic Distortion	Preamp Off, 0 dB input attenuation, –30 dBm input				
	50 MHz	–56 dBc			
	>50 MHz to 200 MHz	–60 dBc (typ.)			
	>200 MHz to 3000 MHz	–70 dBc (typ.)			
VSWR		2:1 (typ.)			

General Specifications

All specifications and characteristics apply under the following conditions, unless otherwise stated: 1) After 5 minutes of warm-up time, where the instrument is left in the ON state; 2) All specifications apply when using internal reference; 3) All specifications subject to change without notice; 4) Typical performance is the measured performance of an average unit and is not warranted; 5) Recommended calibration cycle is 12 months; 6) Performance Sweep Mode.

Setup Parameters	System	Status (Temperature, Battery Info, Serial Number, Firmware Version, Options Installed) Self Test, Application Self Test, GPS (see Option 31)
	System Options	Name, Date and Time, Brightness, Volume Language (English, French, German, Spanish, Chinese, Japanese, Korean, Italian, User defined) Reset (Factory Defaults, Master Reset, Update Firmware)
	File	Save, Recall, Delete, Directory Management
	Save/Recall	Setups, Measurements, Screen Shots (.jpg) (save only)
	Delete	Selected File, All Measurements, All Mode Files, All Content
	Directory Management	Sort Method (Name/Type/Date), Ascend/Descend, Internal/USB, Copy, Format USB
	Internal Trace/Setup Memory	2,000 traces, 2,000 setups
	External Trace/Setup Memory	Limited by size of USB Flash drive
	Mode Switching	Auto-Stores/Recalls most recently used Setup Parameters in the Mode
Connectors	RF Out	Type N, female, 50Ω (Reflection In)
	RF Out Damage Level	23 dBm, ±50 VDC
	RF In	Type N, female, 50Ω
	RF Input Damage Level	+33 dBm peak, ±50 VDC, Maximum Continuous Input (≥10 dB attenuation)
	ASI Output Connector	BNC-J 75Ω (with Option 57 or Option 79)
	GPS	SMA (f)
	External Power	5.5 mm barrel connector, 12.5 VDC to 15 VDC, <4.0 Amps
	USB Interface (2)	Type A (Connect USB Flash Drive and Power Sensor)
	USB Interface	5-pin mini-B (Connect to PC for data transfer and/or remote control)
	Ethernet Interface	RJ45 connector for Ethernet 10-Base T (available with Ethernet Option 413)
	Headset Jack	3.5 mm mini-phone plug
	External Reference In	BNC, female, Maximum Input +10 dBm, 1 MHz, 5 MHz, 10 MHz, 13 MHz
	External Trigger/Clock Recovery	BNC, female, Maximum Input ±5 VDC
	RF over Fiber	SFP/SFP+ compatible socket (available with Option 759)
Display	Type	Resistive Touchscreen
	Size	8.4-inch daylight viewable color LCD
	Resolution	800 × 600
	Pixel Defects	No more than one defective pixel (99.9989% good pixels)
Battery	Type	Li-Ion
	Battery Operation	3 hours (typ.)
	Battery Charging Limits	0° to +45°C, Relative Humidity ≤80%
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU
	Australia and New Zealand	RCM AS/NZS 4417:2012
	South Korea	KCC-REM-A21-0004
Environmental		MIL-PRF-28800F Class 2
	Operating Temperature Range	–10° to +55°C
	Storage Temperature Range	–51° to +71°C
	Maximum Relative Humidity	95% RH at +30°C, none condensing
	Vibration, Sinusoidal	5 Hz to 55 Hz
	Vibration, Random	10 Hz to 500 Hz
	Half Sine Shock	30 g_n
	Altitude	4600 meters, operating and non-operating
	Explosive Atmosphere	MIL-PRF-28800F Section 4.5.6.3 MIL-STD-810G, Method 511.5, Procedure 1
ESD	RF Port Center Pin	Withstands up to ±15 kV
Dimensions and Mass		273 (W) × 199 (H) × 91 (D) mm, (10.7 × 7.8 × 3.6 in), 3.71 kg, (8.2 lbs)

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main frame
MT8212E	Cable and Antenna Analyzer (2 MHz to 4 GHz)
	Spectrum Analyzer (9 kHz to 4 GHz)
	Power Meter (10 MHz to 4 GHz)
	Options
MT8212E-0021	2-port Transmission Measurement
MT8212E-0010	Bias-Tee
MT8212E-0031	GPS Receiver (Requires Antenna)
MT8212E-0019	High-accuracy Power Meter*3
MT8212E-0025	Interference Analyzer*4
MT8212E-0027	Channel Scanner
MT8212E-0431	Coverage Mapping*1
MT8212E-0444	EMF Measurement*6
MT8212E-0090	Gated Sweep
MT8212E-0028	C/W Signal Generator (Requires CW Signal Generator Kit, P/N 69793)
MT8212E-0752	CPRI LTE RF Measurements (Requires Option 759)
MT8212E-0753	OBSAI LTE RF Measurements (Requires Option 759)
MT8212E-0759	RF over Fiber Hardware (Requires Option 752 or 753, cannot be ordered with Option 57, or 79)
MT8212E-0880	GSM/GPRS/EDGE Measurement
MT8212E-0881	W-CDMA/HSPA+ Measurements*5
MT8212E-0882	TD-SCDMA/HSPA+ Measurements*5
MT8212E-0883	LTE/LTE-A FDD/TDD Measurements*5
MT8212E-0884	CDMA/EV-DO Measurements*5
MT8212E-0885	WiMAX Fixed/Mobile Measurements*5
MT8212E-0886	LTE 256-QAM Demodulation (Requires Option 883)
MT8212E-0030	ISDB-T Digital Video Measurements
MT8212E-0032	ISDB-T SFN Measurements
MT8212E-0079	ISDB-T BER Measurements*2
MT8212E-0064	DVB-T/H Digital Video Measurements
MT8212E-0078	DVB-T/H SFN Measurements
MT8212E-0057	DVB-T/H BER Measurements*2
MT8212E-0413	Ethernet Connectivity
MT8212E-0098	Standard Calibration (ANSI Z540-1-1994)
MT8212E-0099	Premium Calibration (ANSI Z540-1-1994 plus test data)
	Main frame
MT8213E	Cable and Antenna Analyzer (2 MHz to 6 GHz)
	Spectrum Analyzer (9 kHz to 6 GHz)
	Power Meter (10 MHz to 6 GHz)
	Options
MT8213E-0021	2-port Transmission Measurement
MT8213E-0010	Bias-Tee
MT8213E-0031	GPS Receiver (requires Antenna)
MT8213E-0019	High-accuracy Power Meter*3
MT8213E-0025	Interference Analyzer*4
MT8213E-0027	Channel Scanner
MT8213E-0431	Coverage Mapping*1
MT8213E-0444	EMF Measurement*6
MT8213E-0090	Gated Sweep
MT8213E-0028	C/W Signal Generator (Requires CW Signal Generator Kit, P/N 69793)
MT8213E-0752	CPRI LTE RF Measurements (Requires Option 759)
MT8213E-0753	OBSAI LTE RF Measurements (Requires Option 759)
MT8213E-0759	RF over Fiber Hardware (Requires Option 752 or 753, cannot be ordered with Option 57, or 79)
MT8213E-0880	GSM/GPRS/EDGE Measurement
MT8213E-0881	W-CDMA/HSPA+ Measurements*5
MT8213E-0882	TD-SCDMA/HSPA+ Measurements*5
MT8213E-0883	LTE/LTE-A FDD/TDD Measurements*5
MT8213E-0884	CDMA/EV-DO Measurements*5
MT8213E-0885	WiMAX Fixed/Mobile Measurements*5
MT8213E-0886	LTE 256-QAM Demodulation (Requires Option 883)
MT8213E-0030	ISDB-T Digital Video Measurements
MT8213E-0032	ISDB-T SFN Measurements
MT8213E-0079	ISDB-T BER Measurements*2
MT8213E-0064	DVB-T/H Digital Video Measurements
MT8213E-0078	DVB-T/H SFN Measurements
MT8213E-0057	DVB-T/H BER Measurements*2
MT8213E-0413	Ethernet Connectivity
MT8213E-0098	Standard Calibration (ANSI Z540-1-1994)
MT8213E-0099	Premium Calibration (ANSI Z540-1-1994 plus test data) Provides everything included with Option 98 plus test report and uncertainty data.

*1: Requires Option 31
*2: Requires Option 64; cannot be ordered with Option 751
*3: Requires External Power Sensor
*4: Option 31 recommended
*5: Requires Option 31 for full functionality
*6: Requires Anritsu Isotropic Antenna

Model/Order No.	Name
	Power Sensors (for complete ordering information see the respective datasheets of each sensor)
MA24105A	Inline Peak Power Sensor, 350 MHz to 4 GHz, +3 to +51.76 dBm
MA24106A	RF USB Power Sensor, 50 MHz to 6 GHz, +23 dBm
MA24108A	Microwave USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24118A	Microwave USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24126A	Microwave USB Power Sensor, 10 MHz to 26 GHz, +20 dBm
MA24208A	Microwave Universal USB Power Sensor, 10 MHz to 8 GHz, +20 to –60 dBm
MA24218A	Microwave Universal USB Power Sensor, 10 MHz to 18 GHz, +20 to –60 dBm
MA24330A	Microwave CW USB Power Sensor, 10 MHz to 33 GHz, +20 to –60 dBm
MA24340A	Microwave CW USB Power Sensor, 10 MHz to 40 GHz, +20 to –60 dBm
MA24350A	Microwave CW USB Power Sensor, 10 MHz to 50 GHz, +20 to –60 dBm
MA25100A	RF Power Indicator
	Manuals (available at www.anritsu.com)
10100-00065	Product Information Compliance and Safety
10580-00250	Cell Master User Guide - Bias-Tee, GPS Receiver
10580-00241	Cable and Antenna Analyzer Measurement Guide
10580-00242	2-Port Transmission Measurement - Bias-Tee
10580-00349	Spectrum Analyzer Measurement Guide
10580-00240	Power Meter Measurement Guide
10580-00234	3GPP Signal Analyzer Measurement Guide
10580-00235	3GPP2 Signal Analyzer Measurement Guide
10580-00236	WiMAX Signal Analyzer Measurement Guide
10580-00237	Digital TV Measurement Guide
10580-00238	Backhaul Analyzer Measurement Guide
10580-00415	CPRI LTE RF Analyzer Measurement Guide
10580-00434	OBSAI LTE RF Analyzer Measurement Guide
10580-00256	Programming Manual
	Troubleshooting Guides
	OBSAI LTE RF Analyzer Measurement Guide
11410-00472	Interference
11410-00473	Cable, Antenna and Components
11410-00551	Spectrum Analyzers
11410-00566	LTE eNodeB Base Stations
11410-00615	TD-LTE eNodeB Testing
11410-00466	GSM/GPRS/EDGE Base Stations
11410-00552	T1/DS1 Backhaul Testing
11410-00553	E1 Backhaul Testing
11410-00463	W-CDMA/HSDPA Base Stations
11410-00465	TD-SCDMA/HSDPA Base Stations
11410-00467	cdmaOne/CDMA2000 1X Base Stations
11410-00468	CDMA2000 1xEV-DO Base Stations
11410-00470	Fixed WiMAX Base Stations
11410-00469	Mobile WiMAX Base Stations
	Standard Accessories (included with instrument)
2000-1654-R	Soft Carrying Case
2000-1691-R	Stylus with Coiled Tether
2000-1797-R	Touchscreen Protective Film, 8.4 in
633-75	Rechargeable Li-Ion Battery, 7500 mAh
40-187-R	AC-DC Adapter
806-141-R	Automotive Power Adapter, 12 VDC, 60 W
3-2000-1498	USB A/5-pin mini-B Cable, 10 ft/305 cm
	Optional Accessories
	Calibration Components, 50Ω
ICN50B	InstaCal™ Calibration Module, 38 dB, 2 MHz to 6.0 GHz, N (m), 50Ω
2000-1618-R	Precision Open/Short/Load, 7/16 DIN (m), DC to 6.0 GHz, 50Ω
2000-1619-R	Precision Open/Short/Load, 7/16 DIN (f), DC to 6.0 GHz, 50Ω
22N50	Open/Short, N (m), DC to 18 GHz, 50Ω
22NF50	Open/Short, N (f), DC to 18 GHz, 50Ω
SM/PL-1	Precision Load, N (m), 42 dB, 6.0 GHz, 50Ω
SM/PLNF-1	Precision Load, N (f), 42 dB, 6.0 GHz, 50Ω
	Calibration Components, 75Ω
22N75	Open/Short, N (m), DC to 3 GHz, 75Ω
22NF75	Open/Short, N (f), DC to 3 GHz, 75Ω
26N75A	Precision Termination, N (m), DC to 3 GHz, 75Ω
26NF75A	Precision Termination, N (f), DC to 3 GHz, 75Ω
12N50-75B	Matching Pad, DC to 3 GHz, 50Ω to 75Ω

Continued on next page

Model/Order No.	Name
	Phase-Stable Test Port Cables, Armored w/Reinforced Grip (recommended for cable & antenna line sweep applications)
15RNFN50-1.5-R	1.5 m, DC to 6 GHz, N (m) - N (f), 50Ω
15RDFN50-1.5-R	1.5 m, DC to 6 GHz, N (m) - 7/16 DIN (f), 50Ω
15RDN50-1.5-R	1.5 m, DC to 6 GHz, N (m) - 7/16 DIN (m), 50Ω
15RNFN50-3.0-R	3.0 m, DC to 6 GHz, N (m) - N (f), 50Ω
15RDFN50-3.0-R	3.0 m, DC to 6 GHz, N (m) - 7/16 DIN (f), 50Ω
15RDN50-3.0-R	3.0 m, DC to 6 GHz, N (m) - 7/16 DIN (m), 50Ω
	Interchangeable Adaptor Phase Stable Test Port Cables, Armored w/Reinforced Grip (recommended for cable and antenna line sweep applications. It uses the same ruggedized grip as the Reinforced grip series cables. Now you can also change the adaptor interface on the grip to four different connector types)
15RCN50-1.5-R	1.5 m, DC to 6 GHz, N (m), N (f), 7/16 DIN (m), 7/16 DIN (f), 50Ω
15RCN50-3.0-R	3.0 m, DC to 6 GHz, N (m), N (f), 7/16 DIN (m), 7/16 DIN (f), 50Ω
	Phase-Stable Test Port Cables, Armored (recommended for use with tightly spaced connectors and other general use applications)
15NNF50-1.5C	1.5 m, DC to 6 GHz, N (m) - N (f), 50Ω
15NN50-1.5C	1.5 m, DC to 6 GHz, N (m) - N (m), 50Ω
15NDF50-1.5C	1.5 m, DC to 6 GHz, N (m) - 7/16 DIN (f), 50Ω
15ND50-1.5C	1.5 m, DC to 6 GHz, N (m) - 7/16 DIN (m), 50Ω
15NNF50-3.0C	3.0 m, DC to 6 GHz, N (m) - N (f), 50Ω
15NN50-3.0C	3.0 m, DC to 6 GHz, N (m) - N (m), 50Ω
15NNF50-5.0C	5.0 m, DC to 6 GHz, N (m) - N (f), 50Ω
15NN50-5.0C	5.0 m, DC to 6 GHz, N (m) - N (m), 50Ω
15N43M50-1.5C	Test Port Extension Cable, Armored, 1.5 m, DC to 6 GHz, N (m) to 4.3-10 (m)
15N43F50-1.5C	Test Port Extension Cable, Armored, 1.5 m, DC to 6 GHz, N (m) to 4.3-10 (f)
15N43M50-3.0C	Test Port Extension Cable, Armored, 3 m, DC to 6 GHz, N (m) to 4.3-10 (m)
15N43F50-3.0C	Test Port Extension Cable, Armored, 3 m, DC to 6 GHz, N (m) to 4.3-10 (f)
15NF43M50-1.5C	Test Port Extension Cable, Armored, 1.5 m, DC to 6 GHz, N (f) to 4.3-10 (m)
15NF43F50-1.5C	Test Port Extension Cable, Armored, 1.5 m, DC to 6 GHz, N (f) to 4.3-10 (f)
15NF43M50-3.0C	Test Port Extension Cable, Armored, 3 m, DC to 6 GHz, N (f) to 4.3-10 (m)
15NF43F50-3.0C	Test Port Extension Cable, Armored, 3 m, DC to 6 GHz, N (f) to 4.3-10 (f)
	Adapters
1091-417-R	N (m) - QMA (f), DC to 6 GHz, 50Ω
1091-418-R	N (m) - QMA (m), DC to 18 GHz, 50Ω
1091-465-R	4.3-10 (f) - N (f), DC to 6 GHz, 50Ω
1091-467-R	4.3-10 (m) - N (f), DC to 6 GHz, 50Ω
	Precision Adapters
1091-26-R	SMA (m) - N (m), DC to 18 GHz, 50Ω
1091-27-R	SMA (f) - N (m), DC to 18 GHz, 50Ω
1091-80-R	SMA (m) - N (f), DC to 18 GHz, 50Ω
1091-81-R	SMA (f) - N (f), DC to 18 GHz, 50Ω
1091-172-R	BNC (f) - N (m), DC to 1.3 GHz, 50Ω
510-90-R	7/16 DIN (f) - N (m), DC to 7.5 GHz, 50Ω
510-91-R	7/16 DIN (f) - N (f), DC to 7.5 GHz, 50Ω
510-92-R	7/16 DIN (m) - N (m), DC to 7.5 GHz, 50Ω
510-93-R	7/16 DIN (m) - N (f), DC to 7.5 GHz, 50Ω
510-96-R	7/16 DIN (m) - 7/16 DIN (m), DC to 7.5 GHz, 50Ω
510-97-R	7/16 DIN (f) - 7/16 DIN (f), DC to 7.5 GHz, 50Ω
510-102-R	N (m) - N (m), DC to 11 GHz, 50Ω, 90 degrees right angle
34NN50A	N (m) - N (m), DC to 18 GHz, 50Ω
34NFNF50	N (f) - N (f), DC to 18 GHz, 50Ω
	Miscellaneous Accessories
69793	CW Signal Generator Kit
2000-1374	External Dual Charger for Li-Ion Batteries
2000-1689	EMI Near Field Probe Kit
MA2700A	Handheld Interference Hunter (for full specifications, refer to the MA2700A Technical Data Sheet, 11410-00692)
633-75	Rechargeable Li-Ion Battery, 7500 mAh
2000-1797-R	Touchscreen Protective Film, 8.4 in.
2000-1691-R	Stylus with Coiled Tether
2000-1798-R	Port Extender, DC to 6 GHz, N (m) to N (f)
66864	Rack Mount Kit, Master Platform
	Backpack and Transit Case
67135	Anritsu Backpack (For Handheld Instrument and PC)
760-243-R	Large Transit Case with Wheels and Handle, 56 × 45.5 × 26.5 cm (22.07" × 17.92" × 10.42")
460-271-R	Transit Case for Portable Directional Antennas and Port Extender, 52.4 × 42.8 × 20.6 cm (20.62" × 16.87" × 8.12") (for 2000-1777-R, 2000-1778-R, 2000-1779-R, 2000-1798-R)

Model/Order No.	Name
	Directional antennas
2000-1411-R	824 MHz to 896 MHz, N (f), 12.3 dBd, Yagi
2000-1412-R	885 MHz to 975 MHz, N (f), 12.6 dBd, Yagi
2000-1413-R	1710 MHz to 1880 MHz, N (f), 12.3 dBd. Yagi
2000-1414-R	1850 MHz to 1990 MHz, N (f), 11.4 dBd, Yagi
2000-1415-R	2400 MHz to 2500 MHz, N (f), 14.1 dBd, Yagi
2000-1416-R	1920 MHz to 2170 MHz, N (f), 14.3 dBd, Yagi
2000-1659-R	698 MHz to 787 MHz, N (f), 10.1 dBd, Yagi
2000-1660-R	1425 MHz to 1535 MHz, N (f), 14.3 dBd, Yagi
2000-1715-R	698 MHz to 2500 MHz, N (f), gain of 2 dBi to 10 dBi (typ.)
2000-1726-R	Antenna, 2500 MHz to 2700 MHz, N (f), 14.1 dBi, Yagi
2000-1747-R	Antenna, Log Periodic, 300 MHz to 7000 MHz, N (f), 5.1 dBi (typ.)
2000-1748-R	Antenna, Log Periodic, 1 GHz to 18 GHz, N (f), 6 dBi (typ.)
2000-1777-R	Portable Directional Antenna, 9 kHz to 20 MHz, N (f)
2000-1778-R	Portable Directional Antenna, 20 MHz to 200 MHz, N (f)
2000-1779-R	Portable Directional Antenna, 200 MHz to 500 MHz N (f)
2000-1812-R	Portable Yagi Antenna, 450 MHz to 512 MHz N (f) 7.1 dBd
2000-1825-R	Portable Yagi Antenna, 380 MHz to 430 MHz N (f) 7.1 dBd
	Portable antennas
2000-1200-R	806 MHz to 866 MHz, SMA (m), 50Ω
2000-1473-R	870 MHz to 960 MHz, SMA (m), 50Ω
2000-1035-R	896 MHz to 941 MHz, SMA (m), 50Ω (1/2 wave)
2000-1030-R	1710 MHz to 1880 MHz, SMA (m), 50Ω (1/2 wave)
2000-1474-R	1710 MHz to 1880 MHz with knuckle elbow (1/2 wave)
2000-1031-R	1850 MHz to 1990 MHz, SMA (m), 50Ω (1/2 wave)
2000-1475-R	1920 MHz to 1980 MHz and 2110 MHz to 2170 MHz, SMA (m), 50Ω
2000-1032-R	2400 MHz to 2500 MHz, SMA (m), 50Ω (1/2 wave)
2000-1361-R	2400 MHz to 2500 MHz, 5000 MHz to 6000 MHz, SMA (m), 50Ω
2000-1636-R	Antenna Kit (Consists of: 2000-1030-R, 2000-1031-R, 2000-1032-R, 2000-1200-R, 2000-1035-R, 2000-1361-R, and carrying pouch)
2000-1751-R	LTE Dipole, 698 to 960/1710 to 2170/2500 MHz to 2700 MHz, SMA (m), 2 dBi (typ.), 50 W
	Mag mount broadband antennas
2000-1616-R	20 MHz to 21000 MHz, N (f), 50 Ω
2000-1647-R	Cable 1: 698 MHz to 1200 MHz, 2 dBi peak gain, 1700 MHz to 2700 MHz, 5 dBi peak gain, N (m), 50Ω, 3 m (10 ft) Cable 2: 3000 MHz to 6000 MHz, 5 dBi peak gain, N (m), 50Ω, 3 m (10 ft) Cable 3: GPS 26 dB gain, SMA (m), 50Ω, 3 m (10 ft)
2000-1645-R	694 MHz to 894 MHz, 3 dBi peak gain, 1700 MHz to 2700 MHz, 3 dBi peak gain, N (m), 50Ω, 3 m (10 ft)
2000-1646-R	750 MHz to 1250 MHz, 3 dBi peak gain, 1650 MHz to 2700 MHz, 5 dBi peak gain
2000-1648-R	1700 MHz to 6000 MHz, 3 dBi peak gain, N (m), 50Ω, 3 m (10 ft)
	Filters
1030-114-R	806 MHz to 869 MHz, N (m) - SMA (f), 50Ω
1030-109-R	824 MHz to 849 MHz, N (m) - SMA (f), 50Ω
1030-110-R	880 MHz to 915 MHz, N (m) - SMA (f), 50Ω
1030-105-R	890 MHz to 915 MHz, N (m) - SMA (f), 50Ω
1030-111-R	1850 MHz to 1910 MHz, N (m) - SMA (f), 50Ω
1030-112-R	2400 MHz to 2484 MHz, N (m) - SMA (f), 50Ω
1030-106-R	1710 MHz to 1790 MHz, N (m) - SMA (f), 50Ω
1030-107-R	1910 MHz to 1990 MHz, N (m) - SMA (f), 50Ω
1030-112-R	2400 MHz to 2484 MHz, N (m) - SMA (f), 50Ω
1030-149-R	High Pass, 150 MHz, N (m) to N (f), 50Ω
1030-150-R	High Pass, 400 MHz, N (m) to N (f), 50Ω
1030-151-R	High Pass, 700 MHz, N (m) to N (f), 50Ω
1030-152-R	Low Pass, 200 MHz, N (m) to N (f), 50Ω
1030-153-R	Low Pass, 550 MHz, N (m) to N (f), 50Ω
1030-155-R	2500 MHz to 2700 MHz, N (m) - N (f), 50Ω
1030-178-R	1920 MHz to 1980 MHz, N (m) to N (f), 50Ω
1030-179-R	777 MHz to 798 MHz, N (m) to N (f), 50Ω
1030-180-R	2500 MHz to 2570 MHz, N (m) to N (f), 50Ω
2000-1684-R	791 MHz to 821 MHz, N (m) to N (f), 50Ω
2000-1734-R	Bandpass Filter, 699 MHz to 715 MHz, N (m) to N (f), 50Ω
2000-1735-R	Bandpass Filter, 776 MHz to 788 MHz, N (m) to N (f), 50Ω
2000-1736-R	Bandpass Filter, 815 MHz to 850 MHz, N (m) to N (f), 50Ω
2000-1737-R	Bandpass Filter, 1711 MHz to 1756 MHz, N (m) to N (f), 50Ω
2000-1738-R	Bandpass Filter, 1850 MHz to 1910 MHz, N (m) to N (f), 50Ω
2000-1739-R	Bandpass Filter, 880 MHz to 915 MHz, N (m) to N (f), 50Ω
2000-1740-R	Bandpass Filter, 1710 MHz to 1785 MHz, N (m) to N (f), 50Ω
2000-1741-R	Bandpass Filter, 1920 MHz to 1980 MHz, N (m) to N (f), 50Ω
2000-1742-R	Bandpass Filter, 832 MHz to 862 MHz, N (m) to N (f), 50Ω
2000-1743-R	Bandpass Filter, 2500 MHz to 2570 MHz, N (m) to N (f), 50Ω
2000-1799-R	Bandpass Filter, 2305 MHz to 2320 MHz, N (m) to N (f), 50Ω
	Attenuators
3-1010-122	20 dB, 5 W, DC to 12.4 GHz, N (m) - N (f)
42N50-20	20 dB, 5 W, DC to 18 GHz, N (m) - N (f)
42N50A-30	30 dB, 50 W, DC to 18 GHz, N (m) - N (f)
3-1010-123	30 dB, 50 W, DC to 8.5 GHz, N (m) - N (f)
1010-127-R	30 dB, 150 W, DC to 3 GHz, N (m) - N (f)
3-1010-124	40 dB, 100 W, DC to 8.5 GHz, N (m) - N (f), Uni-directional
1010-121	40 dB, 100 W, DC to 18 GHz, N (m) - N (f), Uni-directional
1010-128-R	40 dB, 150 W, DC to 3 GHz, N (m) - N (f)

BTS Master™ High Performance Handheld Base Station Analyzer

MT8220T

400 MHz to 6.0 GHz Cable and Antenna Analyzer/150 kHz to 7.1 GHz Spectrum Analyzer/10 MHz to 7.1 GHz Power Meter

Remote Control
Ethernet | **USB**

High Performance Base Station Analyzer

The MT8220T BTS Master is Anritsu's high performance handheld Base Station Analyzer for installation and maintenance of wireless networks. Delivered with a standard three-year warranty, the MT8220T is the only all-in-one, touch screen handheld tool that combines cable and antenna testing, signal analysis for all cellular standards, ultra-sensitive spectrum analysis, sophisticated interference tracking, and a vector signal generator for receiver testing in a compact, easy-to-use instrument.

Cable and Antenna Analyzer Highlights

- Measurements: RL, VSWR, Cable Loss, DTF, Phase, Gain
- 2-port Gain Measurement Uncertainty: < 0.45 dB
- 2-port Dynamic Range: > 100 dB
- RF Immunity: +17 dBm on-channel, +10 dBm on-frequency
- Calibration: OSL and FlexCal™
- Bias Tee: 32 V internal

Spectrum and Interference Analyzer Highlights

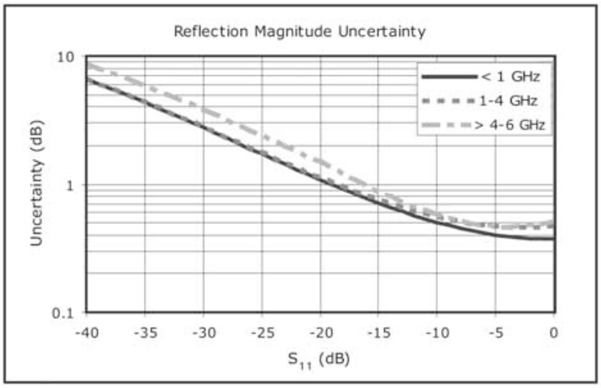
- Measurements: Occupied Bandwidth, Channel Power, ACPR, C/I, Field Strength, Spectral Emissions
- Interference Analyzer: Spectrogram, Signal Strength, RSSI, Signal ID
- Dynamic Range: >95 dB in 1 Hz RBW
- DANL: –163 dBm in 1 Hz RBW
- Phase Noise: –100 dBc/Hz @ 10 kHz offset
- Frequency Accuracy: ±2.5 × 10^{-8} with GPS On
- Burst Detect™ Sweep Mode: sweep 1000x in 15 MHz span
- Coverage Mapping: plot RSSI on on-screen map
- Interference Mapping: on-screen mapping with triangulation

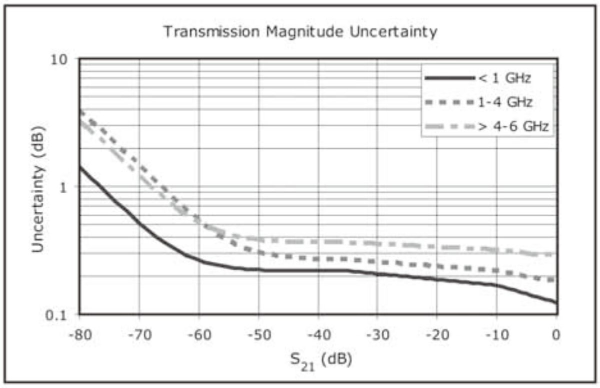
Capabilities and Functional Highlights

- CPRI LTE RF Measurements
- BBU Emulation Nokia/ALu LTE
- Remote Electrical Tilt (RET) antenna monitoring and control
- PIM over CPRI measurements
- OBSAI LTE RF Measurements
- LTE/LTE-A FDD/TDD; MIMO (2×2, 4×4)
- NB-IoT measurements
- GSM/GPRS/EDGE
- W-CDMA/HSPA+
- TD-SCDMA/HSPA+
- CDMA/EV-DO
- WiMAX Fixed/Mobile
- Vector Signal Generator
- Zero-span IF Output
- Gated Sweep
- Standard GPS receiver, GPS information on stored traces
- PIM Alert Application
- Standard Internal Preamp
- Internal Power Meter
- High Accuracy Power Meter
- USB Power Sensors up to 26 GHz
- Channel Scanner
- 2.5 hour battery operation time
- < 5 minute warm-up time
- Ethernet/USB data transfer
- Remote Access Tool
- Line Sweep Tools
- Standard 3-year warranty

Cable and Antenna Analyzer

Measurements	Measurements	VSWR, Return Loss, Cable Loss, Distance-to-Fault (DTF) VSWR, Distance-to-Fault (DTF) Return Loss, 1-port Phase, 2-port Phase , 2-port Gain, Smith Chart
Setup Parameters	Frequency	Start/Stop, Signal Standard, Start Cal
	DTF	Start/Stop, DTF Aid, Units (m/ft), Cable Loss, Propagation Velocity, Cable, Windowing
	Windowing	Rectangular, Normal Side Lobe, Low Side Lobe, Minimum Side Lobe
	Amplitude	Top, Bottom, Auto Scale, Full Scale
	Sweep	Run/Hold, Single/Continuous, RF Immunity (High/Low), Data Points, Averaging/Smoothing, Output Power (High/Low)
	Data Points	137, 275, 551
	Markers	Markers 1 to 6 each with a Delta Marker, Marker to Peak/Valley, Time Marker (DTF), Marker Table (On/Off), All Markers Off
	Traces	Recall, Copy to Display Memory, No Trace Math, Trace ±Memory, Trace Overlay (On/Off)
	Limit Line	On/Off, Single Limit, Multi-segment Edit, Limit Alarm (On/Off), Pass Fail Message (On/Off), Warning Limit Offset, Clear Limit
	Limit Line Edit	Frequency, Amplitude, Add Point, Delete Point, Next Point Left, Next Point Right, Move Limit
	Calibration	Start Cal, 1/2-port, Low/High Power, Standard/FlexCal™, DUT Connector, Configure DUT
	Save/Recall	Setups, Measurements, Screen Shots (JPEG - save only)
	Application Options	Bias-Tee (On/Off)
Frequency	Frequency Range	400 MHz to 6 GHz
	Frequency Accuracy	$\pm 3.0 \times 10^{-6}$
	Frequency Resolution	1 kHz (RF immunity low) 100 kHz (RF immunity high)
Output Power	High	–7 dBm (typ.), 1 or 2-port
	Low	–40 dBm, (typ.), 2-port
Dynamic Range (output power high, 25-trace average)	400 MHz to 2800 MHz	> 100 dB 110 dB (typ.)
	>2800 MHz to 4000 MHz	> 90 dB
	>4000 MHz to 6000 MHz	> 85 dB
Interference Immunity	On-Channel	+17 dBm @ >1.0 MHz from carrier frequency
	On-Frequency	+10 dBm within ±10 kHz from the carrier frequency
Measurement Speed	Return Loss	≤4.5 ms/data point, RF immunity low (typ.)
	Distance-to-Fault	≤4.5 ms/data point, RF immunity low (typ.)
Return Loss	Measurement Range	0 to 60 dB
	Resolution	0.01 dB
VSWR	Measurement Range	1:1 to 65:1
	Resolution	0.01
Cable Loss	Measurement Range	0 to 30 dB
	Resolution	0.01 dB
2-Port Gain	Measurement Range	–120 to +100 dB
	Resolution	0.01 dB
Distance-to-Fault	Vertical Range Return Loss	0 to 60 dB
	Vertical Range VSWR	1 to 65
	Fault Resolution (m)	$(1.5 \times 10^8 \times Vp) / \Delta F$ (Vp = velocity propagation constant, ΔF is F2 – F1 in Hz)
	Horizontal Range (m)	0 to (Data Points – 1) × Fault Resolution, to a maximum of 1500 m (4921 ft)
Phase (1- and 2-Port)	Measurement Range	–180° to +180°
	Resolution	0.01°
Smith Chart	Resolution	0.01
Measurement Accuracy	Corrected Directivity	> 42 dB
Measurement Uncertainty		





Bias-Tee (Option 10)

General	Setup	On/Off, Voltage, Current (Low/High)
	Voltage Range	+12 V to +32 V
	Current (Low/High)	250 mA/450 mA, 1 A surge for 100 ms
	Resolution	0.1 V

Spectrum Analyzer Specifications

Measurements	Smart Measurements	Field Strength (uses antenna calibration tables to measure dBm/m^2, dBµV/m, dBV/m, dBmV/m, V/m, W/m^2, dBW/m^2, A/m, dBA/m and W/cm^2) Occupied Bandwidth (measures 99% to 1% power channel of a signal) Channel Power (measures the total power in a specified bandwidth) ACPR (adjacent channel power ratio) AM/FM/SSB Demodulation (AM, wide/narrow FM, upper/lower SSB), (audio out only) C/I (carrier-to-interference ratio) Emission Mask (recall limit lines as emission mask) Coverage Mapping (requires Option 431) IQ Waveform Capture (requires Option 24) PIM Alert Application (available for download)
Setup Parameters	Frequency	Center/Start/Stop, Span, Frequency Step, Frequency Offset, Signal Standard, Channel #
	Amplitude	Reference Level (RL), Scale, Attenuation Auto/Level, RL Offset, Pre-Amp On/Off, Detection
	Span	Span, Span Up/Down (1-2-5), Full Span, Zero Span, Last Span
	Bandwidth	RBW, Auto RBW, VBW, Auto VBW, RBW/VBW Ratio, Span/RBW Ratio
	Application Options	Bias-Tee (On/Off), Impedance (50Ω, 75Ω, Other)
Sweep Functions	Sweep	Single/Continuous, Manual Trigger, Reset, Detection, Minimum Sweep Time, Trigger Type, Gated Sweep (requires Option 90)
	Sweep Mode	Fast (100x Performance), Performance, No FFT, Burst Detect (1000x Fast in 15 MHz span)
	Detection	Peak, RMS/Avg, Negative, Sample, Quasi-peak
	Triggers	Free Run, External, Video, Change Position, Manual
Trace Functions	Traces	Up to three Traces (A, B, C), View/Blank, Write/Hold, Trace A/B/C Operations
	Trace A Operations	Normal, Max Hold, Min Hold, Average, # of Averages, (always the live trace)
	Trace B Operations	A → B, B ↔ C, Max Hold, Min Hold
	Trace C Operations	A → C, B ↔ C, Max Hold, Min Hold, A – B → C, B – A → C, Relative Reference (dB), Scale
Marker Functions	Markers	Markers 1-6 each with a Delta Marker, or Marker 1 Reference with Six Delta Markers, Marker Table (On/Off/Large), All Markers Off
	Marker Types	Style (Fixed/Tracking), Noise Marker, Frequency Counter Marker
	Marker Auto-Position	Peak Search, Next Peak (Right/Left), Peak Threshold%, Set Marker to Channel, Marker Frequency to Center, Delta Marker to Span, Marker to Reference Level
	Marker Table	1-6 markers frequency and amplitude, plus delta markers frequency offset and amplitude
Limit Line Functions	Limit Lines	Upper/Lower, On/Off, Edit, Move, Envelope, Advanced, Limit Alarm, Default Limit
	Limit Line Edit	Frequency, Amplitude, Add Point, Add Vertical, Delete Point, Next Point Left/Right
	Limit Line Move	To Current Center Frequency, By dB or Hz, To Marker 1, Offset from Marker 1
	Limit Line Envelope	Create Envelope, Update Amplitude, Number of Points (41), Offset, Shape Square/Slope
	Limit Line Advanced	Type (Absolute/Relative), Mirror, Save/Recall
Frequency	Frequency Range	150 kHz to 7.1 GHz (usable to 0 Hz)
	Maximum Continuous Input	+30 dBm
	Tuning Resolution	1 Hz
	Frequency Reference	Aging: ±1.0 × 10^{-6}/10 years
	Frequency Span Accuracy	±3 × 10^{-7} (25° ±25°C) + aging, 10 Hz to 7.1 GHz including zero span
	Sweep Time	Minimum 100 ms, 10 µs to 600 s in zero span
	Sweep Time Accuracy	±2% in zero span
Bandwidth	Resolution Bandwidth (RBW)	1 Hz to 3 MHz in 1–3 sequence ±10% (–3 dB bandwidth)
	Video Bandwidth (VBW)	1 Hz to 3 MHz in 1–3 sequence (–3 dB bandwidth)
	RBW with Quasi-Peak Detection	200 Hz, 9 kHz, 120 kHz (–6 dB bandwidth)
	VBW with Quasi-Peak Detection	Auto VBW is On, RBW/VBW = 1
	VBW/Average Type	Linear/Log
Spectral Purity	SSB Phase Noise	–100 dBc/Hz @ 10 kHz, 20 kHz, and 30 kHz offset from carrier –102 dBc/Hz @ 100 kHz offset from carrier
Amplitude Ranges	Dynamic Range	>95 dB (600 MHz, 3.5 GHz), 2/3 (TOI-DANL) in 1 Hz RBW
	Measurement Range	DANL to +30 dBm
	Display Range	1 to 15 dB/div in 1 dB steps, ten divisions displayed
	Reference Level Range	–120 to +30 dBm
	Attenuator Resolution	0 to 65 dB, 5.0 dB steps
	Amplitude Units	Log Scale Modes: dBm, dBV, dBmV, dBµV, dBW, dBA Linear Scale Modes: nV, µV, mV, V, kV, nW, µW, mW, W, kW, fA, pA, nA, µA, mA, A

Continued on next page

<table>
<tr><td rowspan="7">Amplitude Accuracy
(Power level
>–50 dBm)</td><td colspan="2">Input attenuation</td><td>Preamp Off
(≤35 dB)</td><td>Preamp Off
(40 to 55 dB)</td><td>Preamp Off
(60 to 65 dB)</td><td>Preamp On
(0 or 10 dB)</td></tr>
<tr><td colspan="2">150 kHz to ≤10 MHz</td><td>±1.50 dB</td><td>±1.50 dB</td><td>±1.50 dB</td><td>—</td></tr>
<tr><td colspan="2">150 kHz to 4.0 GHz</td><td>—</td><td>—</td><td>—</td><td>±1.50 dB</td></tr>
<tr><td colspan="2">>10 MHz to 4.0 GHz</td><td>±1.25 dB</td><td>±1.75 dB</td><td>±1.75 dB</td><td>—</td></tr>
<tr><td colspan="2">>4.0 GHz to 6.5 GHz</td><td>—</td><td>±1.75 dB</td><td>±1.75 dB</td><td>—</td></tr>
<tr><td colspan="2">>4.0 GHz to 7.1 GHz</td><td>±1.75 dB</td><td>—</td><td>—</td><td>±1.75 dB</td></tr>
<tr><td colspan="2">>6.5 GHz to 7.1 GHz</td><td>—</td><td>±2.00 dB</td><td>±3.00 dB</td><td>—</td></tr>
<tr><td rowspan="6">Displayed Average
Noise Level (DANL)</td><td colspan="2" rowspan="2">DANL in 1 Hz RBW,
0 dB attenuation</td><td colspan="2">Preamp Off (Reference level –20 dBm)</td><td colspan="2">Preamp On (Reference level –50 dBm)</td></tr>
<tr><td>Maximum</td><td>Typical</td><td>Maximum</td><td>Typical</td></tr>
<tr><td colspan="2">3 MHz to 1.0 GHz</td><td>–137 dBm</td><td>–150 dBm</td><td>–161 dBm</td><td>–163 dBm</td></tr>
<tr><td colspan="2">>1.0 GHz to 2.2 GHz</td><td>–133 dBm</td><td>–147 dBm</td><td>–159 dBm</td><td>–160 dBm</td></tr>
<tr><td colspan="2">>2.2 GHz to 4.0 GHz</td><td>–133 dBm</td><td>–143 dBm</td><td>–156 dBm</td><td>–159 dBm</td></tr>
<tr><td colspan="2">>4.0 GHz to 7.1 GHz</td><td>–130 dBm</td><td>–138 dBm</td><td>–154 dBm</td><td>–156 dBm</td></tr>
<tr><td rowspan="5">Spurs</td><td colspan="2">Residual Spurs</td><td colspan="4">Preamp Off (RF input terminated, 0 dB input attenuation)
–90 dBm, 150 kHz to 3.2 GHz
–84 dBm, >3.2 GHz to 7.1 GHz</td></tr>
<tr><td colspan="2">Exceptions</td><td colspan="4">–70 dBm @ 3200 MHz
Preamp On (RF input terminated, 0 dB input attenuation)
–100 dBm, 10 MHz to 7.1 GHz</td></tr>
<tr><td colspan="2">Exceptions</td><td colspan="4">–95 dBm @ 50 MHz, 100 MHz, 150 MHz</td></tr>
<tr><td colspan="2">Input-Related Spurious</td><td colspan="4">(0 dB attenuation, –30 dBm input, span <1.7 GHz, carrier offset >4.5 MHz)
–60 dBc, –70 dBc (typ.)</td></tr>
<tr><td colspan="2">Exceptions</td><td colspan="4">–40 dBc, –60 dBc (typ.) @ 1672 MHz</td></tr>
<tr><td rowspan="2">Third-Order
Intercept (TOI)</td><td rowspan="2">Preamp Off</td><td>600 MHz</td><td colspan="4">+8 dBm (typ.)</td></tr>
<tr><td>3.5 GHz</td><td colspan="4">+9 dBm (typ.)</td></tr>
<tr><td rowspan="2">Second Harmonic
Distortion</td><td colspan="2" rowspan="2">Preamp Off</td><td colspan="4">–50 dBc maximum</td></tr>
<tr><td colspan="4">–70 dBc (typ.)</td></tr>
<tr><td rowspan="2">VSWR</td><td colspan="2"><4.0 GHz</td><td colspan="4">1.5:1 (typ.)</td></tr>
<tr><td colspan="2">4.0 GHz to 7.1 GHz</td><td colspan="4">1.8:1 (typ.)</td></tr>
</table>

Power Meter

General	Frequency	Center/Start/Stop, Span, Frequency Step, Signal Standard, Channel #, Full Band
	Amplitude	Maximum, Minimum, Offset, Relative On/Off, Units, Auto Scale
	Average	Acquisition Fast/Med/Slow, # of Running Averages
	Limits	Limit On/Off, Limit Upper/Lower
	Frequency Range	10 MHz to 7.1 GHz
	Span	1 kHz to 100 MHz
	Display Range	–140 to +30 dBm, ≤40 dB span
	Measurement Range	–120 to +30 dBm
	Offset Range	0 to +100 dB
	VSWR	1.5:1 (typ.)
	Maximum Power	+30 dBm without attenuator
	Accuracy	Same as Spectrum Analyzer
	Application Options	Impedance (50Ω, 75Ω, Other)

GPS Receiver

General	Setup	On/Off, Antenna Voltage 3.3 V/5.0 V, GPS Info
	GPS Time/ Location Indicator	Time, Latitude, Longitude and Altitude on display Time, Latitude, Longitude and Altitude with trace storage
	High Frequency Accuracy	Spectrum Analyzer, Interference Analyzer, Wireless Measurements when GPS Antenna is connected: ±2.5 × 10^{-8} with GPS On, 3 minutes after satellite lock in selected mode
	GPS Lock Accuracy	after antenna is disconnected: ±5.0 × 10^{-8} for 3 days, 0° to 50°C ambient temperature
	Connector	SMA (f)
	Supplied Antenna	2000-1760-R GPS Antenna, SMA (m), 25 dB gain, 2.5 VDC to 3.7 VDC

High Accuracy Power Meter (Option 19) (Requires external USB Power Sensor, sold separately)

Amplitude	Maximum, Minimum, Offset, Relative On/Off, Units, Auto Scale				
Average	# of Running Averages, Max Hold				
Zero/Cal	Zero On/Off, Cal Factor (Center Frequency, Signal Standard)				
Limits	Limit On/Off, Limit Upper/Lower				
Power Sensor Model	MA24105A	MA24106A	MA24108A/18A/26A	MA24208A/18A	MA24330A/40A/50A
Description	Inline High Power Sensor	High Accuracy RF Power Sensor	Microwave USB Power Sensor	Microwave Universal USB Power Sensor	Microwave CW USB Power Sensor
Frequency Range	350 MHz to 4 GHz	50 MHz to 6 GHz	10 MHz to 8/18/26 GHz	10 MHz to 8 GHz/18 GHz	10 MHz to 33/40/50 GHz
Connector	Type N (f), 50Ω	Type N (m), 50Ω	Type N (m), 50Ω (8 GHz/18 GHz) Type K (m), 50Ω (26 GHz)	Type N (m), 50Ω	Type K (m), 50Ω (33 GHz/40 GHz) Type V (m), 50Ω (50 GHz)
Dynamic Range	+3 to +51.76 dBm (2 mW to 150 W)	–40 to +23 dBm (0.1 µW to 200 mW)	–40 to +20 dBm (0.1 µW to 100 mW)	–60 to +20 dBm (1 nW to 100 mW)	–70 to +20 dBm (0.1 nW to 100 mW)
Measurand	True-RMS	True-RMS	True-RMS, Slot Power, Burst Average Power	True-RMS, Slot Power, Burst Average Power	Average Power
Measurement Uncertainty	± 0.17 dB*1	± 0.16 dB*2	± 0.18 dB*3	± 0.17 dB*4	± 0.17 dB*5
Data sheet (for complete specifications)	11410-00621	11410-00424	11410-00504	11410-00841	11410-00906

*1: Expanded uncertainty with K=2 for power measurements of a CW signal greater than +20 dBm with a matched load.
Measurement results referenced to the input side of the sensor.

*2: Total RSS measurement uncertainty (0° to 50°C) for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.

*3: Expanded uncertainty with K = 2 for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.

*4: Power uncertainty expressed with two sigma confidence level for CW measurement after zero operation. Includes calibration factor and linearity over temperature uncertainties, but not the effects of mismatch, zero set and drift, or noise.

*5: Includes linearity over temperature uncertainties, but not the effects of calibration factor, mismatch, zero set and drift, and noise.

Coverage Mapping (Option 431)

Measurements	Indoor Mapping	RSSI, ACPR
	Outdoor Mapping	RSSI, ACPR
Setup Parameters	Mode	Spectrum Analyzer
	Frequency	Center/Start/Stop, Span, Freq Step, Signal Standard, Channel #, Channel Increment
	Amplitude	Reference Level (RL), Scale, Attenuation Auto/Level, RL Offset, Pre-Amp On/Off, Detection
	Span	Span, Span Up/Down (1-2-5), Full Span, Zero Span, Last Span
	BW	RBW, Auto RBW, VBW, Auto VBW, RBW/VBW Ratio, Span/VBW Ratio
	Measurement Setup	ACPR, RSSI
	Point Distance/Time Setup	Repeat Type: Time Distance
	Save Points Map	Save KML, JPEG, Tab Delimited
	Recall Points Map	Recall Map, Recall KML Points only, Recall KML Points with Map, Recall Default Grid

Interference Analyzer (Option 25)

Measurements	Spectrum	Field Strength Occupied Bandwidth Channel Power Adjacent Channel Power Ratio (ACPR) AM/FM/SSB Demodulation (Wide/Narrow FM, Upper/Lower SSB), (audio out only) Carrier-to-Interference ratio (C/I)
	Spectrogram	Collect data up to one week
	Signal Strength	Gives visual and aural indication of signal strength
	Received Signal Strength Indicator (RSSI)	Collect data up to one week
	Signal ID	ID up to 12 FM, GSM, W-CDMA, CDMA or Wi-Fi signals based on RF bandwidth
	Interference Mapping	Draw multiple bearings of signal strength from GPS location on on-screen map Pan and Zoom on-screen maps Support for Handheld Interference Hunter MA2700A (see Optional Accessories)
	Application Options	Bias-Tee (On/Off), Impedance (50Ω, 75Ω, Other)

Channel Scanner (Option 27)

General	Number of Channels	1 to 20 Channels (Power Levels)
	Measurements	Graph/Table, Max Hold (On/5 sec/Off), Frequency/Channel, Current/Maximum, Dual Color
	Scanner	Scan Channels, Scan Frequencies, Scan Customer List, Scan Script Master™
	Amplitude	Reference Level, Scale
	Custom Scan	Signal Standard, Channel, # of Channels, Channel Step Size, Custom Scan
	Frequency Range	150 kHz to 7.1 GHz
	Frequency Accuracy	±10 Hz + time base error
	Measurement Range	–110 to +30 dBm
	Application Options	Bias-Tee (On/Off), Impedance (50Ω, 75Ω, Other)

Gated Sweep (Option 90)

General	Mode	Spectrum Analyzer, Sweep
	Trigger	External TTL
	Setup	Gated Sweep (On/Off) Gate Polarity (Rising, Falling) Gate Delay (0 to 65 ms typ.) Gate Length (1 µs to 65 ms typ.) Zero Span Time

Zero Span IF Output (Option 89)

General	Mode	Spectrum Analyzer/Span/Zero Span
	Center Frequency	140 MHz ±130 kHz
	Output Level	–25 dBm (typ.)
	Reference Level	–57 to +30 dBm (Preamp Off) –87 to –40 dBm (Preamp On)
	IF Bandwidth	Up to 30 MHz (3 dB bandwidth)
	RF Attenuation	Auto
	Connector	BNC (f)

I/Q Waveform Capture (Option 24)

General	Mode	Spectrum Analyzer
	Capture Mode	Single or Continuous
	Trigger	Free Run, External (Rising/Falling), Delay
	Maximum Capture Length	800 ms
	Maximum Sample Rate	40 MHz
	Maximum Signal Bandwidth	32 MHz

Vector Signal Generator (Option 23)

Setup Parameters	Frequency	Frequency, Signal Standard, Channel Number, Interferer Offset
	Amplitude	Signal/Interferer/Noise Level in dBm, Level Offset, Signal (CW/Modulated/Off), Interferer (CW/Modulated/Off), Noise (On/Off)
	Trigger (for modulated signals)	Type (None/Positive/Negative), Delay, Manual, Pattern Manager
	Pattern Manager	Add, Erase
	Modulation	Signal Pattern Select, Interferer Pattern Select, Edit
	Modulation Edit	Analog, Digital, Custom, Spectrum Inversion (Normal/Reverse)
	RF	On/Off
	Active Pattern Memory	256 MB
	Frequency Range	400 MHz to 6 GHz
	Frequency Resolution	1 Hz
	Frequency Accuracy	±3 × 10^{-7} (25° ±25°C) + aging
	Output Power	–124 to 0 dBm, CW –124 to –8 dBm, Modulated/Noise/Multi-carrier
	Step Size	0.1 dB nominal
	Bandwidth	1 signal to 10 MHz or 2 signals to 5 MHz each + AWGN
	Waveform Addition	Desired Signal + Interfering Signal + AWGN

Level Accuracy, Single Channel (At least 30 minutes warm-up after 1 hour non-operating at 15° to 35°C ambient, excludes load match errors, excludes radiated immunity)		(400 MHz to 2.0 GHz)		(> 2.0 GHz to 4.0 GHz)		(> 4.0 GHz to 6.0 GHz)	
	VSG Output Power	CW Mode	W-CDMA	CW Mode	W-CDMA	CW Mode	W-CDMA
	–46 to 0 dBm	±1.0 dB	—	±1.2 dB	—	±1.2 dB	—
	–46 to –8 dBm	—	±1.4 dB	—	±1.4 dB	—	±1.8 dB
	–84 to <–46 dBm	±1.1 dB	±1.4 dB	±1.3 dB	±1.4 dB	±1.3 dB	±2.0 dB
	–104 to <–84 dBm	±1.4 dB	±1.5 dB	±1.4 dB	±1.5 dB	±1.4 dB	±2.0 dB
	–124 to <–104 dBm	±1.7 dB	±1.7 dB	±1.7 dB	±1.7 dB	±1.7 dB	±2.4 dB

Standard Signal Patterns	AM (Frequency/Depth)	400 Hz/5%, 1 kHz/10%, 3 kHz/20%, 5 kHz/30%, 10 kHz/50%, 15 kHz/70%, 20 kHz/90%
	FM (Rate/Deviation)	1 kHz/100 Hz, 5 kHz/500 Hz, 10 kHz/1 kHz, 50 kHz/5 kHz, 100/10 kHz, 500 kHz/50 kHz, 500 kHz/100 kHz, 500 kHz/500 kHz
	Pulsed CW (Duty Cycle/Period)	50%/0.1 ms (10 kHz), 50%/1 ms (1 kHz), 50%/2.5 ms (400 Hz)
	EDGE – Continuous	3n/8-8PSK, 270.833 KSPS, Linearized Gaussian filtered, Data = PN9
	W-CDMA Pilot	QPSK, 3.84 MSPS, RRC filtered, alpha=0.22, Data = PN9
	DECT 16QAM – Continuous	1.152 MSPS, RRC filtered, alpha = 0.5, Data = PN9
	DECT 64QAM – Continuous	16QAM, 6.84 MSPS, RRC filtered, alpha = 0.15, Data = PN9
	DVB-C	1.152 MSPS, RRC filtered, alpha = 0.5, Data = PN9
	J.83C Digital Cable	16QAM, 5 MSPS, RRCC filtered, alpha = 0.13
	64QAM – US Digital Cable	5.056941 MSPS, RRC filtered, alpha = 0.18

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Customized Signal Patterns (contact Anritsu)	Input Waveform for MST Pattern Converter	ASCII Text or MATLAB® file format		
	Number of Waveforms	≤1000		
	Sampling Rate	12.500 MHz	6.250 MHz	1.625 MHz
	Bandwidth	10.0 MHz	5.0 MHz	1.2 MHz
	Time	≤4 s	≤8 s	≤32 s
	Length	N × 8 Samples	N × 4 Samples	N × 4 Samples

CPRI LTE RF Measurements (Option 752) (requires Option 759)

Measurements (CPRI measurements support LTE technology.)	Spectrum	Uplink or Downlink Spectrum
	Spectrogram	Collects data up to one week
	CPRI Alarms	Signal Level (Tx Power, Rx Power), Signal Loss, LOS, LOF, LSS, Remote LOS, Remote LOF, RAI, SDI, Reset
	SFP Data	Reads device information
	CPRI IQ Data Capture	Quick Save IQ Data, Playback IQ Data
Setup Parameters	Frequency	Center, Span (Span, Full Span, Last Span), Signal Standard, Channel #, CF Reference (On/Off)*
	Amplitude	Reference Level (RL), Scale, RL Offset
	Bandwidth	RBW, Auto RBW, VBW, Auto VBW
	Measurements	CPRI Configure, CPRI Spectrum, Spectrogram, CPRI Alarms, SFP Data (SFP Info/Compliance Info)
	CPRI Configure	SFP Port 1 and 2 Configure, Display Configure, AxC Trace Configure
	SFP Port Configure	Line Rate, Radio Presets, Auto Detect
	Display Configure	Display 1 and 2 CPRI BW, Display Mode (Single, Dual), Active Display
	AxC Trace Configure	AxC 1, 2, 3, and 4 (Display, SFP Port, AxC Group, Sampling Rate (Default, Compress))
	Radio Presets	Ericsson (Uplink/Downlink), Nokia/ALu (Uplink/Downlink), Huawei (Uplink/Downlink), Samsung (Uplink/Downlink), No Preset, Custom
	Custom	IQ Bit Width, No. of Reserve Bits, Aggregation (On/Off)
	Auto Detect	Radio Preset, IQ Bit Width, Reserve Bit, Aggregation, Start Auto Detect
Sweep Functions	Sweep	Single/Continuous, Sweep Once, Sweep 10 Averages
Trace Functions (AxC Trace 1 only)	Traces	Up to three Traces (A, B, C), View/Blank, Write/Hold, Trace A/B/C Operations
	Trace A Operations	Normal, Max Hold, Min Hold, Average, # of Averages, (always the live trace)
	Trace B Operations	A → B, B↔C, Max Hold, Min Hold
	Trace C Operations	A → C, B↔C, Max Hold, Min Hold, A – B → C, B – A → C, Relative Reference (dB), Scale
Marker Functions (AxC Traces 1 through 4)	Markers	Markers 1-6 each with a Delta Marker, or Marker 1 Reference with Six Delta Markers, Marker Table (On/Off/Large), All Markers Off
	Marker Table	Markers 1-6 markers frequency and amplitude, plus delta markers frequency offset and amplitude
Limit Line Functions	Limit Lines	Upper/Lower, On/Off, Edit, Move, Envelope, Advanced, Limit Alarm, Default Limit
	Limit Line Move	Move Up/Down, to Amplitude
Display Functions	Active Display	Display 1 or 2 (Single Display or Dual Display)
	Display Spectrum	Single or Dual
	Single Spectrum Display	One, two, three, or four AxC traces displayed (color coded), same CPRI BW for AxC traces
	Dual Spectrum Display	Any combination of the four available AxC traces, same CPRI BW per display and AxC trace, same or different SFP input per AxC trace
	Display Spectrogram	Single or Dual
	Single Spectrogram Display	One active AxC trace per waterfall display
	Dual Spectrogram Display	Any combination of the four available AxC traces may be configured per display One active AxC trace per waterfall display
	AxC Trace (1, 2, 3, 4)	Display 1, 2, or off SFP Port 1 or 2 AxC Group Sampling Rate (Default, Compress)
Bandwidth	Resolution Bandwidth (RBW)	300 Hz to 1 MHz in 1-3-10 sequence ±10% (–3 dB bandwidth point) (typ.)
	Video Bandwidth (VBW)	30 Hz to 1 MHz in 1-3-10 sequence ±10% (–3 dB bandwidth) (typ.)
	Line Bit Rate	Line bit rate 1: 614.4 Mbit/s Line bit rate 2: 1228.8 Mbit/s Line bit rate 3: 2457.6 Mbit/s Line bit rate 4: 3072.0 Mbit/s Line bit rate 5: 4915.2 Mbit/s Line bit rate 6: 6144.0 Mbit/s Line bit rate 7: 9830.4 Mbit/s Line bit rate 8: 10137.6 Mbit/s
CPRI Parameters	IQ Sample Width	10, 12, 15, 16 bits
	Bandwidth	5, 10, 15, 20 MHz
	Aggregation	On/Off

*: CF Reference is available only when Display 1 is active.

CPRI Base Band Unit Emulation ALu-Nokia LTE (Option 760) (Requires Option 752)

Measurements and RF Measurements	BBU Test	Initialization; RRH information Manufacturer, Model Number, Serial Number, Frequency Range, Output Power, Firmware, SFP Location
	SFP Data	Reads SFP information installed in RRH
	CPRI Alarms	LOS, LOF, RAI, SDI status lights
	RRH Antenna VSWR/ Return Loss	While RRH is transmitting; Pass/Fail Limit
	Uplink Spectrum	While RRH is transmitting; Uplink Markers, Limit Lines, Max., Min. Traces, RBW/VBW, Pan & Zoom
	Uplink Spectrogram	While RRH is transmitting; Uplink Markers, Limit Lines, Max., Min. Traces, RBW/VBW, Pan & Zoom
RF Transmission	Test Models	LTE test model waveforms Test models: E-Tm1.1, E-Tm1.2, E-Tm2, E-Tm3.1, E-Tm3.2, E-Tm3.3 Bandwidths: 5 MHz, 10 MHz, 15 MHz, 20 MHz
	Single Carrier Over CPRI	Adjust transmit power and center frequency of RRH
	Waveform Manager	Manages waveforms for transmission

OBSAI LTE RF Measurements (Option 753) (requires Option 759)

Measurements (OBSAI RF measurements support LTE technology)	Spectrum	Uplink or Downlink Spectrum
	Spectrogram	Collects data up to one week
	OBSAI Alarms	Signal Level (Tx Power, Rx Power), Signal Loss, LOS, LOF
	SFP Data	Reads device information
Setup Parameters	Frequency	Center, Span (Span, Full Span), Signal Standard, Channel #, CF Reference (On/Off)*1
	Amplitude	Reference Level (RL), Scale, RL Offset
	Bandwidth	RBW, Auto RBW, VBW, Auto VBW, LTE Bandwidth
	Measurements	Start OBSAI, OBSAI Configure, OBSAI Spectrum, Spectrogram, OBSAI Alarms, SFP Data (SFP Info/Compliance Info)
	Start OBSAI	Scans OBSAI links for active RP3 addresses; detects and sets link rate; configures first RP3 address and displays a Spectrum view.
	OBSAI Configure	Link Rate, Display Configure, Carrier Trace Configure
	Display Configure	Display 1 and 2 LTE BW, Display Mode (Single, Dual), Active Display
	Carrier Trace Configure	Carrier Trace 1 (Display 1, 2, or off; RP3 Address) Carrier Trace 2 (Display 1, 2, or off; RP3 Address) Carrier Trace 3 (Display 1, 2, or off; RP3 Address) Carrier Trace 4 (Display 1, 2, or off; RP3 Address)
	RP3 Address	RP3 list populated with Start OBSAI or plug-in of an active link Addresses removed from list upon fiber plug-out or Loss of Signal Address list is empty following power cycle or if no OBSAI carriers are found
Sweep Functions	Sweep	Single/Continuous, Sweep Once, Sweep 10 Averages
Trace Functions (AxC Trace 1 only)	Traces	Up to three Traces (A, B, C), View/Blank, Write/Hold, Trace A/B/C Operations
	Trace A Operations	Normal, Max Hold, Min Hold, Average, # of Averages, (always the live trace)
	Trace B Operations	A → B, B ↔ C, Max Hold, Min Hold
	Trace C Operations	A → C, B ↔ C, Max Hold, Min Hold, A – B → C, B – A → C, Relative Reference (dB), Scale
Marker Functions (AxC Traces 1 through 4)	Markers	Markers 1-6 On/Off, Delta On/Off, Marker Freq to Center, Marker Table (On, Large, Off), All Markers Off
	Marker Table	Markers 1-6 for frequency and amplitude, plus delta markers frequency offset and amplitude
Limit Line Functions	Limit Lines	Upper/Lower, On/Off, Move, Save/Recall Limit, Limit Alarm On/Off, Default Limit
	Limit Line Move	Move Up/Down, to Amplitude
Display Functions	Active Display	Display 1 or 2 (Single Display or Dual Display)
	Display Spectrum	Single or Dual
	Single Spectrum Display	Display One, two, three, or four carrier traces displayed (color coded) Trace LTE BW must match display LTE BW to be visible
	Dual Spectrum Display	Display Any combination of the four available carrier traces, same LTE BW per display and carrier trace, same or different SFP input per carrier trace
	Display Spectrogram	Single or Dual
	Single Spectrogram Display	One active carrier trace per waterfall display
	Dual Spectrogram Display	Any combination of the four available carrier traces may be configured per display One active carrier trace per waterfall display
	Carrier Trace (1, 2, 3, 4)	Display 1, 2, or off
Bandwidth	Resolution Bandwidth (RBW)	300 Hz to 1 MHz in 1-3-10 sequence ±10% (–3 dB bandwidth point) (typ.)
	Video Bandwidth (VBW)	30 Hz to 1 MHz in 1-3-10 sequence ±10% (–3 dB bandwidth) (typ.)
	Link Rate	1x: 768.0 Mbit/s 2x: 1536.0 Mbit/s 4x: 3072.0 Mbit/s 8x: 6144.0 Mbit/s
	LTE Bandwidth	5 MHz, 10 MHz, 15 MHz*2, 20 MHz

*1: CF Reference is available only when Display 1 is active.
*2: Only supports Dual Bit Map algorithm for 15 MHz bandwidth signals.

GSM/GPRS/EDGE Measurements (Option 880)

Measurements			
RF	Demodulation	Over-the-Air (OTA)	Pass/Fail
Channel Spectrum Channel Power Occupied Bandwidth Burst Power Average Burst Power Frequency Error Modulation Type BSIC (NCC, BCC) Multi-channel Spectrum Power vs. Time (Frame/Slot) Channel Power Occupied Bandwidth Burst Power Average Burst Power Frequency Error Modulation Type BSIC (NCC, BCC)	Phase Error EVM Origin Offset C/I Modulation Type Magnitude Error BSIC (NCC, BCC)	There are no additional OTA Measurements RF and Demodulation Measurements can be made OTA	View Pass/Fail Limits GSM, EDGE Available Measurements Channel Power Occupied Bandwidth Burst Power Average Burst power Frequency Error Phase Error EVM Origin Offset C/I Magnitude Error Script Master™

Setup Parameters	GSM/EDGE Select	Auto, GSM, EDGE
	Frequency	Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
	Amplitude	Power Offset, Auto Range, Adjust Range
	Sweep	Single/Continuous, Trigger Sweep
	Save/Recall	Setup, Measurement, Screen Shots (JPEG - save only), to Internal/External Memory
	Measurement Summary Screen	Overall Measurements
RF Measurements	Frequency Error	±10 Hz + time base error, 99% confidence level
	Occupied Bandwidth	Bandwidth within which lies 99% of the power transmitted on a single channel
	Burst Power Error	±1.5 dB; ±1 dB (typ.) (–50 to +20 dBm)
Demodulation Measurements	GMSK Modulation Quality (RMS Phase)	Measurement Accuracy: ±1° Residual Error (GMSK): 1°
	8PSK Modulation Quality (EVM)	Measurement Accuracy: ±1.5% Residual Error (8PSK): 2.5%

W-CDMA/HSPA+ Measurements (Option 881)

Measurements			
RF	Demodulation	Over-the-Air (OTA)	Pass/Fail
Band Spectrum Channel Spectrum Channel Power Occupied Bandwidth Peak-to-Average Power Spectral Emission Mask Single carrier ACLR Multi-carrier ACLR RF Summary	Code Domain Power Graph P-CPICH Power Channel Power Noise Floor EVM Carrier Feed Through Peak Code Domain Error Carrier Frequency Frequency Error Control Channel Power Abs/Rel/Delta Power CPICH, P-CCPCH S-CCPCH, PICH P-SCH, S-SCH HSPA+ Power vs. Time Constellation Code Domain Power Table Code, Status EVM, Modulation Type Power, Code Utilization Power Amplifier Capacity Codogram Modulation Summary Domain Error	Scrambling Code Scanner (Six) Scrambling Codes CPICH E_c/I_o E_c Pilot Dominance OTA Total Power Multipath Scanner (Six) Six Multipaths Tau Distance RSCP Relative Power Multipath Power	View Pass/Fail Limits All, RF, Demod Available Measurements Max Output Power Frequency Error EVM CPICH Occupied Bandwidth Spectral Mask ACLR PCDE P-CCPCH S-CCPCH Code Spread 3 PICH Code 128 Script Master™ Test Models 1 (16), (32), (64) 2 3 (16), (32) 4 (+CPICH), (-CPICH) 5 (2 HS), (4 HS), (8 HS)

Setup Parameters	Scrambling Code, Threshold	Auto, Manual
	User Selectable	Scrambling Code, S-CCPCH Spread, S-CCPCH Code, PICH Code, Threshold, Max Amp Power, CPICH Power, Frequency Error Average
	Maximum Spreading Factor	256, 512
	Frequency	Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
	Amplitude	Scale/Division, Power Offset, Auto Range, Adjust Range, Units (dBm/W)
	Marker	Six Markers, Table On/Off
	Sweep	Single/Continuous, Trigger Sweep
	Save/Recall	Setup, Measurement, Screen Shots (JPEG - save only), to Internal/External Memory
	Measurement Summary Screens	Overall Measurements, RF Measurements, Modulation Measurements
RF Measurements	RF Channel Power Accuracy	±1.25 dB; ±0.7 dB (typ.) (temperature range 15° to 35°C)
	Occupied Bandwidth Accuracy	±100 kHz
	Adjacent Channel Leakage Ratio (ACLR)	–54 dB/–59 dB ±0.8 dB @ 5 MHz/10 MHz offset (typ.), 824 MHz to 894 MHz, 1710 MHz to 2170 MHz –54 dB/–57 dB ±1.0 dB @ 5 MHz/10 MHz offset (typ.), 2300 MHz to 2700 MHz
Demodulation Measurements	W-CDMA Modulations	QPSK, QPSK-DTX (Codecs: AMR 4.75, 5.9, 7.4, 12.2 kbps; DTX 7.4, 12.2 kbps)
	HSPA+ Modulations	QPSK, 16QAM, 64QAM
	Frequency Error	±10 Hz + time base error, 99% confidence level
	EVM Accuracy	±2.5%, 6% ≤EVM ≤25%
	Residual EVM	2.5% (typ.)
	Code Domain Power	±0.5 dB for code channel power > –25 dB, 16, 32, 64 DCPH (test model 1), 16, 32 DCPH (test model 2, 3)
	CPICH (dBm) Accuracy	±0.8 dB (typ.)
Over-the-Air (OTA) Measurements	Scrambling Code Scanner	Six strongest Scrambling Codes
	Multipath Scanner	Multipath power of six signals relative to strongest pilot

TD-SCDMA/HSPA+ Measurements (Option 882)

Measurements			
RF	Demodulation	Over-the-Air (OTA)	Pass/Fail
Channel Spectrum Channel Power Occupied Bandwidth Left Channel Power Left Channel Occ B/W Right Channel Power Right Channel Occ B/W Power vs. Time Six Slot Powers Channel Power (RRC) DL-UL Delta Power UpPTS Power DwPTS Power On/Off Ratio Slot Peak-to-Average Power Spectral Emission RF Summary	Code Domain Power/Error (QPSK/8PSK/16QAM/64QAM) Slot Power DwPTS Power Noise Floor Frequency Error Tau Scrambling Code EVM Peak EVM Peak Code Domain Error CDP Marker Modulation Summary	Code Scan (32) Scrambling Code Group Tau E_c/I_o DwPTS Power Pilot Dominance Tau Scan (Six) Sync-DL# Tau E_c/I_o DwPTS Power Pilot Dominance Record Run/Hold	View Pass/Fail Limits All, RF, Demod Available Measurements Occupied Bandwidth Channel Power Channel Power RCC On/Off Ratio Peak-to-Average Ratio Frequency Error EVM Peak EVM Peak Code Domain Error Tau Noise Floor

Setup Parameters	Slot Selection	Auto, 0-6
	Trigger	Trigger Type (No Trigger/GPS/External), External Trigger (Rising/Falling), Tau Offset
	SYNC-DL Code	Auto, 0-31
	Scrambling/Midamble Code	Auto, 0-127
	Maximum Users	Auto, 2, 4, 6, 8, 10, 12, 14, 16
	Measurement Speed	Fast, Normal, Slow
	User Selectable	Uplink Switch Point, Number of Carriers (1, 3), Tau Offset
	Demodulation Type	Auto, QPSK, 8PSK, 16QAM, 64QAM
	Frequency	Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
	Amplitude	Scale/Division, Power Offset, Auto Range, Adjust Range, Units (dBm/W)
	Sweep	Hold/Run, Trigger Sweep
	Save/Recall	Setup, Measurement, Screen Shots (JPEG - save only), to Internal/External Memory
	Measurement Summary Screens	Overall Measurements, RF Measurements, Modulation Measurements
RF Measurements	RF Channel Power Accuracy (RRC)	±1.5 dB; ±1.0 dB (typ.), (slot power –40 to +10 dBm)
	Frequency Error	±10 Hz + time base error, in the presence of a downlink slot
Demodulation Measurements	Supported Modulation	QPSK, 8PSK, 16QAM, 64QAM
	Residual EVM (rms)	3% (typ.), P-CCPH Slot Power > –50 dBm
	PN Offset	Within 1 × 64 chips
	Pilot Power Accuracy	±1.0 dB (typ.)
	Timing Error (Tau) for Dominant SYNC-DL	±0.2 μs (external trigger)
	Spreading Factor	1, 16
Over-the-Air (OTA) Measurements	Code Scanner	32 Sync Codes and associated Scrambling Code Groups
	Tau Scanner	Six strongest Sync Codes
	Auto Save	Yes
	GPS Tagging and Logging	Yes

LTE/LTE-A FDD/TDD Measurements (Option 883 and 866)

LTE/LTE-A FDD Measurement			
RF	Modulation	Over-the-Air (OTA)	Pass/Fail
Channel Spectrum Channel Power Occupied Bandwidth ACPR Spectral Emission Mask Category A or B (Opt 1) RF Summary	Power vs. Resource Block (RB) RB Power (PDSCH) Active RBs, Utilization% Channel Power, Cell ID OSTP, Frame EVM by modulation Constellation QPSK, 16QAM, 64QAM Modulation Results Ref Signal Power (RS) Sync Signal Power (SS) EVM – rms, peak, max hold Frequency Error – Hz, ppm Carrier Frequency Cell ID Control Channel Power Bar Graph or Table View RS, P-SS, S-SS PBCH, PCFICH, PHICH, PDCCH Total Power (Table View) EVM per Control Channel Tx Time Alignment Modulation Summary Includes EVM by modulation Antenna Icons Detects active antennas (1 or 2)	Scanner Cell ID (Group, Sector) S-SS, RSRP, RSRQ, SINR Dominance Modulation Results – On/Off Auto Save - On/Off Tx Test Scanner RS Power of MIMO antennas (2×2, 4×4) Cell ID, Average Power Delta Power (Max-Min) Graph of Antenna Power Modulation Results – On/Off Mapping On-screen S-SS, RSRP, RSRQ, or SINR Scanner Modulation Results – Off Carrier Aggregation Up to 5 component carriers (CC1 to CC5) CP, MIMO status, RS & SS Power, EVM, Frequency Error, Time Alignment Error, Cell ID eMBMS Cell ID, RSRP	View Pass/Fail Limits All, RF, Modulation Available Measurements Channel Power Occupied Bandwidth ACLR Frequency Error Carrier Frequency Dominance EVM peak, rms Frame EVM by mod type RS, SS Power RS EVM P-SS, S-SS, Power, EVM PBCH, PCFICH, PHICH, PDCCH Power, EVM Cell, Group, Sector ID OSTP Tx Time Alignment

Setup Parameters	Frequency	E-UTRA Bands 1 - 14, 17 - 21, 23 - 28 (tunable 10 MHz to 4.0 GHz) Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
	Bandwidth (MHz)	1.4, 3, 5, 10, 15, 20
	Span (MHz)	Auto, 1.4, 3, 5, 10, 15, 20, 30
	Amplitude	Scale/Division, Power Offset, Auto Range, Adjust Range
	Sweep	Single/Continuous
	Cyclic Prefix (CP)	Auto, Normal, Extended
	EVM Mode	Auto, PBCH only, Max Hold
	Cyclic Prefix (CP)	Auto, Normal, Extended
	Sync Type	Normal (SS), RS/Cell ID
	Save/Recall	Setup, Measurement, Screen Shots (JPEG - save only), to Internal/External Memory
	Measurement Summary Screens	Overall Measurements, RF Measurements, Modulation Measurements
LTE FDD RF Measurements	RF Channel Power Accuracy	±1.5 dB; ±1.0 dB (typ.) (RF input –50 to +10 dBm)
LTE FDD Modulation Measurements	RS Power Accuracy	±1.0 dB (typ.), (RF input –50 to +10 dBm)
	Frequency Error	±10 Hz + time base error, 99% confidence level
	Residual EVM (rms)	2.0% (typ.) (E-UTRA Test Model 3.1, RF Input –50 to +10 dBm)
LTE FDD Over-the-Air (OTA) Measurements	Scanner	Six strongest signals if present Auto Save – Sync Signal power and Modulation Results with GPS information
	Tx Test	Scanner – Three strongest signals if present RS Power – Strongest Signal
	Mapping	Map On-screen S-SS, RSRP, RSRQ, or SINR of Cell ID with strongest signal Scanner – three strongest signals if present Save and Export Mapping data: KML, MTD (tab delimited)
	Carrier Aggregation	Up to 5 component carriers specified (CC1 to CC5) Automatic detection of CP and MIMO status for each active CC RS Power & RS Delta Power, SS Power, EVM (peak and rms), Freq Error (Hz & ppm), TAE, Cell ID
	Evolved Multimedia Broadcast Multicast Services (eMBMS)	Reports the Cell ID and measures the Received Signal Received Power (RSRP)

LTE-LTE-A FDD/TDD Measurements (Option 883 and 886) (continued)

LTE/LTE-A TDD Measurements			
RF	Modulation	Over-the-Air (OTA)	Pass/Fail
Channel Spectrum Channel Power Occupied Bandwidth Power vs. Time Frame View Sub-Frame View Total Frame Power DwPTS Power Transmit Off Power Cell ID Timing Error ACLR Spectral Emission Mask Category A or B (Opt 1) RF Summary	Power vs. Resource Block (RB) RB Power (PDSCH) Active RBs, Utilization % Channel Power, Cell ID OSTP, Frame EVM by modulation Constellation QPSK, 16QAM, 64QAM 256QAM Demod (Option 886) Modulation Results Ref Signal Power (RS) Sync Signal Power (SS) EVM – rms, peak, max hold Frequency Error – Hz, ppm Carrier Frequency Cell ID Control Channel Power Bar Graph or Table View RS, P-SS, S-SS PBCH, PCFICH, PHICH, PDCCH Total Power (Table View) EVM per Control Channel Tx Time Alignment Modulation Summary Includes EVM by modulation Antenna Icons Detects active antennas (1 or 2)	Scanner Cell ID (Group, Sector) S-SS, RSRP, RSRQ, SINR Dominance Modulation Results – On/Off Auto Save - On/Off Tx Test Scanner RS Power of MIMO antennas (2×2, 4×4) Cell ID, Average Power Delta Power (Max-Min) Graph of Antenna Power Modulation Results – On/Off Mapping On-screen S-SS, RSRP, RSRQ, or SINR Scanner Modulation Results – Off Carrier Aggregation Up to 5 component carriers (CC1 to CC5) CP, MIMO status, RS & SS Power, EVM, Frequency Error, Time Alignment Error, Cell ID	View Pass/Fail Limits All, RF, Modulation Available Measurements Channel Power Occupied Bandwidth ACLR Frequency Error Carrier Frequency Dominance EVM peak, rms Frame EVM, rms Frame EVM by mod type RS, SS Power RS EVM P-SS, S-SS, Power, EVM PBCH, PCFICH, PHICH, PDCCH Power, EVM Cell, Group, Sector ID OSTP Tx Time Alignment Frame Power DwPTS Power Transmit Off Power Timing Error

Setup Parameters	Frequency	E-UTRA bands 33 - 44 (tunable 10 MHz to 4.0 GHz) Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
	Bandwidth (MHz)	1.4, 3, 5, 10, 15, 20
	Span (MHz)	Auto, 1.4, 3, 5, 10, 15, 20, 30
	Amplitude	Scale/Division, Power Offset, Auto Range, Adjust Range
	Sweep	Single/Continuous, Trigger Sweep
	Cyclic Prefix (CP)	Auto, Normal, Extended
	EVM Mode	Auto, PBCH only, Max Hold
	Trigger	No Trigger/Ext Trigger, Rising/Falling
	Uplink/Downlink Configuration	0 to 6
	Save/Recall	Setup, Measurement, Screen Shots (JPEG - save only), to Internal/External Memory
	Measurement Summary Screens	Overall Measurements, RF Measurements, Modulation Measurements
LTE TDD RF Measurements	RF Channel Power Accuracy	±1.5 dB; ±1.0 dB (typ.) (RF input –30 to +10 dBm)
LTE TDD Modulation Measurements	RS Power Accuracy	±1.0 dB (typ.), (RF input –50 to +10 dBm)
	Frequency Error	±10 Hz + time base error, 99% confidence level
	Residual EVM (rms)	2.0% (typ.) (E-UTRA Test Model 3.1, RF Input –30 to +10 dBm)
Over-the-Air (OTA) Measurements	Scanner	Six strongest signals if present Auto Save – Sync Signal power and Modulation Results with GPS information
	Tx Test	Scanner – Three strongest signals if present RS Power – Strongest Signal
	Mapping	Map On-screen S-SS, RSRP, RSRQ, or SINR of Cell ID with strongest signal Scanner – three strongest signals if present Save and Export Mapping data: KML, MTD (tab delimited)
	Carrier Aggregation	Up to 5 component carriers specified (CC1 to CC5) Automatic detection of CP and MIMO status for each active CC RS Power & RS Delta Power, SS Power, EVM (peak and rms), Freq Error (Hz & ppm), TAE, Cell ID

CDMA/EV-DO Measurements (Option 884)

CDMA Measurements			
RF	Demodulation	Over-the-Air (OTA)	Pass/Fail
Channel Spectrum Channel Power Occupied Bandwidth Peak-to-Average Power Spectral Emission Mask Single Carrier ACPR Multi-carrier ACPR RF Summary	Code Domain Power Graph Pilot Power Channel Power Noise Floor Rho Carrier Feed Through Tau RMS Phase Error Frequency Error Abs/Rel/ Power Pilot Page Sync Q Page Code Domain Power Table Code Status Power Multiple Codes Code Utilization Modulation Summary	Pilot Scanner (Nine) PN E_c/I_o Tau Pilot Power Channel Power Pilot Dominance Multipath Scanner (Six) E_c/I_o Tau Channel Power Multipath Power Limit Test – 10 Tests Averaged Rho Adjusted Rho Multipath Pilot Dominance Pilot Power Pass/Fail Status	View Pass/Fail Limits All, RF, Modulation Available Measurements Channel Power Occupied Bandwidth Peak-to-Average Power Spectral Mask Test Frequency Error Channel Frequency Pilot Power Noise Floor Rho Carrier Feed Through Tau RMS Phase Error Code Utilization Measured PN Pilot Dominance Multipath Power

CDMA Setup Parameters	PN Setup	PN Trigger (No Trigger, GPS, External), PN Search Type (Auto, Manual), PN Offset
	Walsh Codes	64, 128
	Measurement Speed	Fast, Normal, Slow
	External Trigger Polarity	Rising, Falling
	Number of Carriers	1 to 5
	Carrier Bandwidth (MHz)	1.23, 1.24, 1.25
	Frequency	Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
	Amplitude	Scale/Division, Power Offset, Auto Range, Adjust Range, Units (dBm/W)
	Sweep	Single/Continuous, Trigger Sweep
	Save/Recall	Setup, Measurement, Screen Shots (JPEG - save only), to Internal/External Memory
	Measurement Summary Screens	Overall Measurements, RF Measurements, Modulation Measurements
CDMA RF Measurements	RF Channel Power Accuracy	±1.5 dB; ±1.0 dB (typ.) (RF input –50 to +20 dBm)
CDMA Demodulation Measurements	Frequency Error	±10 Hz + time base error, 99% confidence level (in slow mode)
	Rho Accuracy	±0.005, for Rho >0.9
	Residual Rho	>0.995 (typ.), >0.99 maximum, (RF input –50 to +20 dBm)
	PN Offset	1 × 64 chips
	Pilot Power Accuracy	±1.0 dB (typ.), relative to channel power
	Tau	±0.5 µs (typ.), ±1.0 µs maximum
CDMA Over-the-Air (OTA) Measurements	Pilot Scanner	Nine strongest pilots
	Multipath Scanner	Multipath power of six signals relative to strongest pilot
	Limit Test	Average of ten tests compared to limit

CDMA/EV-DO Measurements (Option 884) (continued)

EV-DO Measurements			
RF	Demodulation	Over-the-Air (OTA)	Pass/Fail
Channel Spectrum Channel Power Occupied Bandwidth Peak-to-Average Power Power vs. Time Pilot & MAC Power Channel Power Frequency Error Idle Activity On/Off Ratio Spectral Emission Mask Single Carrier ACPR Multi-carrier ACPR RF Summary	MAC Code Domain Power Graph Pilot & MAC Power Channel Power Frequency Error Rho Pilot Rho Overall Data Modulation Noise Floor MAC Code Domain Power Table Code Status Power Code Utilization Data Code Domain Power Active Data Power Data Modulation Rho Pilot Rho Overall Maximum Data CDP Minimum Data CDP Modulation Summary	Pilot Scanner (Nine) PN E_c/I_o Tau Pilot Power Channel Power Pilot Dominance Mulitpath Scanner (Six) E_c/I_o Tau Channel Power Multipath Power	View Pass/Fail Limits All, RF, Modulation Available Measurements Channel Power Occupied Bandwidth Peak-to-Average Power Carrier Frequency Frequency Error Spectral Mask Noise Floor Pilot Power RMS Phase Error Tau Code Utilization Measured PN Pilot Dominance Mulitpath Power

Setup Parameters	PN Setup	PN Trigger (No Trigger, GPS, External), PN Search Type (Auto, Manual), PN Offset
	Walsh Codes	64, 128
	Measurement	Speed Fast, Normal, Slow
	External Trigger Polarity	Rising, Falling
	Slot Type	Auto, Active, Idle
	Number of Carriers	1 to 5
	Carrier Bandwidth (MHz)	1.23, 1.24, 1.25
	Frequency	Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
	Amplitude	Scale/Division, Power Offset, Auto Range, Adjust Range, Units (dBm/W)
	Sweep	Single/Continuous, Trigger Sweep
	Save/Recall	Setup, Measurement, Screen Shots (JPEG - save only), to Internal/External Memory
	Measurement Summary Screens	Overall Measurements, RF Measurements, Modulation Measurements
EV-DO RF Measurements	RF Channel Power Accuracy	±1.5 dB; ±1.0 dB (typ.) (RF input –50 to +20 dBm)
EV-DO Demodulation Measurements	EV-DO Compatibility	Rev 0 and Rev A
	Frequency Error	±10 Hz + time base error, 99% confidence level
	Rho Accuracy	±0.01, for Rho >0.9
	Residual Rho	>0.995 (typ.), >0.99, maximum (RF input –50 to +20 dBm)
	PN Offset	Within 1 × 64 chips
	Pilot Power Accuracy	±1.0 dB (typ.), relative to channel power
	Tau	±0.5 µs (typ.), ±1.0 µs maximum
EV-DO Over-the-Air (OTA) Measurements	Pilot Scanner	Nine strongest pilots
	Multipath Scanner	Multipath power of six signals relative to strongest pilot

WiMAX Fixed/Mobile Measurements (Option 885)

WiMAX Fixed Measurements			
RF	Demodulation	Over-the-Air (OTA)	Pass/Fail
Channel Spectrum Channel Power Occupied Bandwidth Power vs. Time Channel Power Preamble Power Data Burst Power Crest Factor ACPR RF Summary	Constellation RCE (RMS/Peak) EVM (RMS/Peak) Frequency Error Carrier Frequency Base Station ID Spectral Flatness Adjacent Subcarrier Flatness EVM vs. Subcarrier/Symbol RCE (RMS/Peak) EVM (RMS/Peak) Frequency Error Carrier Frequency Base Station ID Sector ID (Mobile) Modulation Summary	There are no additional OTA Measurements RF and Demodulation Measurements can be made OTA	View Pass/Fail Limits All, RF, Modulation Available Measurements Channel Power Occupied Bandwidth Burst Power Preamble Power Crest Factor Frequency Error Carrier Frequency EVM RCE Base Station ID

Setup Parameters	Bandwidth (MHz)	1.25, 1.50, 2.50, 3.50, 5.00, 5.50, 6.00, 7.00, 10.00
	Cyclic Prefix Ratio (CP)	1/4, 1/8, 1/16, 1/32
	Span (MHz)	5, 10, 15, 20
	Frame Length (ms)	2.5, 5.0, 10.0
	Frequency	Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
	Amplitude	Scale/Division, Power Offset, Auto Range, Adjust Range
	Sweep	Single/Continuous, Trigger Sweep
	Save/Recall	Setup, Measurement, Screen Shot (JPEG - save only), to Internal/External Memory
	Measurement Summary Screens	Overall Measurements, RF Measurements, Modulation Measurements
WiMAX Fixed RF Measurements (temperature range 15° to 35°C)	RF Channel Power Accuracy	±1.5 dB; ±1.0 dB (typ.), (RF input –50 to +20 dBm)
WiMAX Fixed Demodulation Measurements (temperature range 15° to 35°C)	Frequency Error	7×10^{-8} + time base error, 99% confidence level
	Residual EVM (rms)	3% (typ.), 3.5% maximum (RF Input –50 to +20 dBm)

WiMAX Fixed/Mobile Measurements (Option 885) (continued)

WiMAX Mobile* Measurements			
RF	Demodulation	Over-the-Air (OTA)	Pass/Fail
Channel Spectrum Channel Power Occupied Bandwidth Power vs. Time Channel Power Preamble Power Downlink Burst Power Uplink Burst Power ACPR Spectral Emission Mask RF Summary	Constellation RCE (RMS/Peak) EVM (RMS/Peak) Frequency Error CINR Base Station ID Sector ID Spectral Flatness Adjacent Subcarrier Flatness EVM vs. Subcarrier/Symbol RCE (RMS/Peak) EVM (RMS/Peak) Frequency Error CINR Base Station ID Sector ID DL-MAP (Tree View) Modulation Summary	Channel Power Monitor Preamble Scanner (Six) Preamble Relative Power Cell ID Sector ID PCINR Dominant Preamble Base Station ID Auto Save - On/Off	View Pass/Fail Limits All, RF, Modulation Available Measurements Channel Power Occupied Bandwidth Downlink Burst Power Uplink Burst Power Preamble Power Crest Factor Frequency Error Carrier Frequency EVM RCE Sector ID

Setup Parameters	Zone Type	PUSC
	DL-MAP Auto Decoding	Convolutional Coding (CC), Convolutional Turbo Coding (CTC)
	Bandwidths (MHz)	3.50, 5.00, 7.00, 8.75, 10.00
	Cyclic Prefix Ratio (CP)	1/8
	Span (MHz)	5, 10, 20, 30
	Frame Lengths (ms)	5, 10
	Demodulation	Auto, Manual, FCH
	Frequency	Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
	Amplitude	Scale/Division, Power Offset, Auto Range, Adjust Range
	Sweep	Single/Continuous, Trigger Sweep
	Save/Recall	Setup, Measurement, Screen Shot (save only), to Internal/External Memory
	Measurement Summary Screens	Overall Measurements, RF Measurements, Modulation Measurements
WiMAX Mobile RF Measurements (temperature range 15° to 35°C)	RF Channel Power Accuracy	±1.5 dB; ±1.0 dB (typ.), (RF input –50 to +20 dBm)
WiMAX Mobile Demodulation Measurements (temperature range 15° to 35°C)	Frequency Error	2×10^{-8} + time base error, 99% confidence level
	Residual EVM (rms)	2.5% (typ.), 3.0% maximum (RF Input –50 to +20 dBm)
WiMAX Mobile Over-the-Air (OTA) Measurements	Channel Power Monitor	Over time (one week), measurement time interval 1 s to 60 s
	Preamble Scanner	Six strongest Preambles
	Auto Save	Yes
	GPS Tagging and Logging	Yes

*: Mobile WiMAX conforms to IEEE Std. 802.16e-2005, WiMAX Forum® Air Interface - Mobile System Profile - Release 1.0 Certified, System Profiles according to WMF-T24-001-R010v07

General Specifications

All specifications and characteristics apply under the following conditions, unless otherwise stated: 1) After 5 minutes of warm-up time, where the instrument is left in the ON state; 2) Apply when using internal reference and performance sweep mode; 3) Subject to change without notice; 4) Typical performance is the measured performance of an average unit and is not warranted; 5) Recommended calibration cycle is 12 months.

Setup Parameters	System	Status (Temperature, Battery Info, Serial Number, Firmware Version, Options Installed) Self Test, Application Self Test, GPS
	System Options	Name, Date and Time, Ethernet Configuration, Volume, Display (Brightness, Blank, Default, Black & White, Night Vision, High Contrast, Invert Black & White) Share Center Frequency and Power Offset (All Modes or Not Shared) Language (English, French, German, Spanish, Chinese, Japanese, Korean, Italian, Russian, User defined) Reset (Factory Defaults, Master Reset, Update Firmware)
	File	Save As, Save Meas, Save, Save On Event, Recall Meas, Recall, Copy, Delete
	Save/Recall	Setups, Measurements, Screen Shots (JPEG - save only)
	Delete	By File Type, All, Selected
	Internal Trace/Setup Memory	>30,000 traces
	External Trace/Setup Memory	Limited by size of USB Flash drive
	Mode Switching	Auto-Stores/Recalls most recently used Setup Parameters in the Mode
Connectors	RF Out	Type N (f), 50Ω, Maximum Input +23 dBm, ±50 VDC, (Reflection In)
	RF In	Type N (f), 50Ω, Maximum Input +30 dBm, ±50 VDC
	GPS	SMA (f)
	External Power	5.5 mm barrel connector, 12 VDC to 14.5 VDC, <5.0 A
	LAN Connection	RJ48C, 10/100 Mbps, Connect to PC or LAN for Remote Access
	USB Interface	Two Type A, Connect Flash Drive and Power Sensor One 5-pin mini-B, Connect to PC for data transfer
	Headset Jack	3.5 mm 3-wire headset jack
	External Reference In	BNC (f), 50Ω, Maximum Input +10 dB
	Reference Out	BNC (f), 50Ω, 10 MHz
	External Trigger In	BNC (f), 50Ω style, 100 kΩ input impedance (nominal), TTL levels, Maximum Input ±5 VDC
	RF over Fiber	SFP/SFP+ compatible sockets (available with Option 759)
Display and Keyboard	Display	8.4" Touch Screen, 800 × 600 Resolution
	Pixel Defects	No more than one defective pixel (99.9989% good pixels)
	Keyboard	Backlit (Red for Night Vision, White for all other display modes)
Battery	Type	Li-Ion
	Battery Operation	2.5 hours (typ.)
	Battery Charging Limits	0° to +45°C, Relative Humidity ≤80%
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU
RCM	Australia and New Zealand	RCM AS/NZS 4417:2012
KCC	South Korea	KCC-REM-A21-0004
Environmental	Operating Temperature Range	–10° to +55°C
	Storage Temperature Range	–51° to +71°C
	Maximum Relative Humidity	95% RH at +30°C, non-condensing
	Vibration, Sinusoidal	5 Hz to 55 Hz
	Vibration, Random	10 Hz to 500 Hz
	Half Sine Shock	30 gn (note: please make n sub script)
	Altitude	4600 m, operating and non-operating
	Explosive Atmosphere	MIL-PRF-28800F Section 4.5.6.3 MIL-STD-810G, Method 511.5, Procedure 1
Dimensions and Mass		315 (W) × 211 (H) × 102 (D) mm, (12.4 × 8.3 × 4.0 in), 4.7 kg (10.3 lb)
Warranty	Duration	Standard three-year warranty One-year warranty on battery

Line Sweep Tools™ (for your PC)

Trace Capture	Browse to Instrument	View and copy traces from the test equipment to your PC using Windows Explorer
	Open Legacy Files	Open DAT files captured with Handheld Software Tools v6.61
	Open Current Files	Open VNA or DAT files
	Capture Plots To	The Line Sweep Tools screen, DAT files, Database, or JPEG
Traces	Trace Types	Return Loss, VSWR, DTF-RL, DTF-VSWR, Cable Loss, Smith Chart, and PIM
	Trace Formats	DAT, VNA, CSV, PNG, BMP, JPG, HTML, Data Base, and PDF
Report Generation	Report Generator	Includes GPS location along with measurements
	Report Format	Create reports in HTML or PDF format
	Report Setup	Report Title, Company, Prepared for, Location, Date and Time, Filename, Company logo
	Trace Setup	1 Trace Portrait Mode, 2 Trace Portrait Mode, 1 Trace Landscape Mode
Trace Validation	Presets	7 presets allow "one click" setting of up to 6 markers and one limit line
	Marker Controls	6 regular Markers, Marker Peak, Marker Valley, Marker between, and frequency entry
	Delta Markers	6 Delta markers
	Limit Line	Enable and drag or value entry. Also works with presets
	Next Trace Button	Next Trace and Previous Trace arrow keys allow quick switching between traces
Tools	Cable Editor	Allows creation of custom cable parameters
	Distance to Fault	Converts a Return Loss trace to a Distance to Fault trace
	Measurement Calculator	Converts Real, Imaginary, Magnitude, Phase, RL, VSWR, Rho, and Transmit power
	Signal Standard Editor	Creates new band and channel tables
	Renaming Grid	36 user definable phrases for creation of file names, trace titles, and trace subtitles
Connectivity	Connections	Ethernet, USB cable, and USB memory stick

Master Software Tools™ (for your PC)

Mapping (GPS Required)	Spectrum Analyzer Mode	MapInfo, MapPoint
	Mobile WiMAX OTA, LTE OTA Options	Google Earth, Google Maps, MapInfo
Folder Spectrogram (Spectrum Monitoring for Interference Analysis and Spectrum Clearing)	Folder Spectrogram – 2D View	Creates a composite file of multiple traces Peak Power, Total Power, Peak Frequency, Histogram, Average Power (Max/Min) File Filter (Violations over limit lines or deviations from averages) Playback
	Video Folder Spectrogram – 2D View	Create AVI file to export for management review/reports
	Folder Spectrogram – 3D View	Views (Set Threshold, Markers) - 3D (Rotate X, Y, Z Axis, Level Scale, Signal ID) - 2D View (Frequency or Time Domain, Signal ID) - Top Down Playback (Frequency and/or Time Domain)
List/Parameter Editors	Traces	Add, delete, and modify limit lines and markers
	Product Updates	Auto-checks Anritsu website for latest revision firmware
	Pass/Fail	Create, download, or edit Signal Analysis Pass/Fail Limits
	Languages	Add custom language or modify non-English language menus
Script Master™	Channel Scanner Mode	Automate scan up to 1200 channels, repeat for sets of 20 channels, repeat all channels
	GSM/GPRS/EDGE or W-CDMA/HSPA+ Mode	Automate Signal Analysis testing requirements with annotated how-to pictures
Connectivity	Connections	Connect to PC using USB or Ethernet

easyMap Tools™ (for your PC)

Outdoor Maps	On-Line Sources	Google Maps, Cloud Made Open-Source Maps
	Pan & Zoom Mode	AZM map file format allows pan and zoom on-instrument
	Legacy Mode	MAP format is compatible with older firmware
	Geo-Referenced	Works with instrument based GPS
	Map Conversion	Convert scanned maps to geo-referenced
Indoor Maps	Sources	Scanned images in JPG, JPEG, JPE, JFIF, GIF, TIF, TIFF, PNG
General	Color Filter	Grayscale, High Contrast
	Coverage	Worldwide
	Zoom Levels	16 total zoom levels, 7 available in any one map
	Map Size	Less than 1 MB to over 1 GB

Web Remote Control

Control	Full instrument control through a browser – all instrument functions except power switch and rotary knob
Connections	RJ45 Ethernet jack Third party Wi-Fi router
Protocol	HTTP/TCP/IP
Physical Layer	Cat 5 Cable, Wi-Fi router compatible
Software Required	HTML 5 Compliant Browser – Newer versions of Chrome, Firefox, Internet Explorer and others
Operating System	iOS, Windows, Linux, Android operating systems that can host the HTML 5 Compliant browser
Remote Hardware	PCs, Tablets, and Smart Phones with Ethernet or Wi-Fi connections and a HTML 5 Compliant browser
Download	Individual instrument files downloaded via browser Multiple instrument files and directories zipped and downloaded via browser Screen capture capability
Display Modes	Normal: All modes & displays supported Fast: Spectrum traces update faster (up to 5 updates per second)
Password	The instrument can be password protected Passwords may be used to manage who is controlling the instrument
Users/Instruments	One user/device can view and control many instruments

Programmable Remote Control

Functionality	Many instrument functions are programmable. See the Programming Manual for details.
Programming Language	Standard Commands for Programmable Instruments (SCPI)
Interfaces	USB, LAN
Available Drivers	LabView (visit NI.com for driver)

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main Frame
MT8220T	400 MHz to 6 GHz Cable and Antenna Analyzer 150 kHz to 7.1 GHz Spectrum Analyzer 10 MHz to 7.1 GHz Power Meter
	Options
MT8220T-0010	Bias-Tee
MT8220T-0019	High-Accuracy Power Meter (requires external power sensor)
MT8220T-0025	Interference Analyzer
MT8220T-0027	Channel Scanner
MT8220T-0089	Zero-Span IF Output
MT8220T-0431	Coverage Mapping
MT8220T-0090	Gated Sweep
MT8220T-0024	I/Q Waveform Capture
MT8220T-0023	Vector Signal Generator
MT8220T-0752	CPRI LTE RF Measurements (requires Option 759)
MT8220T-0754	PIM over CPRI Measurements (requires Option 752)
MT8220T-0753	OBSAI LTE RF Measurements (requires Option 759)
MT8220T-0759	RF over Fiber hardware (requires Option 752 or 753)
MT8220T-0760	CPRI BBU Emulation Nokia ALu LTE (requires Option 751)
MT8220T-0761	RET Device Test Nokia/ALu (requires Options 760)
MT8220T-0880	GSM/GPRS/EDGE Measurements
MT8220T-0881	W-CDMA/HSPA+ Measurements
MT8220T-0882	TD-SCDMA/HSPA+ Measurements
MT8220T-0883	LTE/LTE-A FDD/TDD Measurements
MT8220T-0884	CDMA/EV-DO Measurements
MT8220T-0885	WiMAX Fixed/Mobile Measurements
MT8220T-0886	LTE 256QAM Demodulation (requires Option 883)
MT8220T-0887	NB-IoT Measurements
MT8220T-0098	Standard Calibration to 17025 and ANSI/MCSL Z540-1
MT8220T-0099	Premium Calibration to 17025 and ANSI/NCSL Z540-1 Provides everything included with Option 98 plus test report and uncertainty data.
	Power Sensors (for complete ordering information see the respective datasheets of each sensor)
MA24105A	Inline Peak Power Sensor, 350 MHz to 4 GHz, +3 to +51.76 dBm
MA24106A	RF USB Power Sensor, 50 MHz to 6 GHz, +23 dBm
MA24108A	Microwave USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24118A	Microwave USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24126A	Microwave USB Power Sensor, 10 MHz to 26 GHz, +20 dBm
MA24208A	Microwave Universal USB Power Sensor, 10 MHz to 8 GHz, +20 to –60 dBm
MA24218A	Microwave Universal USB Power Sensor, 10 MHz to 18 GHz, +20 to –60 dBm
MA24330A	Microwave CW USB Power Sensor, 10 MHz to 33 GHz, +20 to –60 dBm
MA24340A	Microwave CW USB Power Sensor, 10 MHz to 40 GHz, +20 to –60 dBm
MA24350A	Microwave CW USB Power Sensor, 10 MHz to 50 GHz, +20 to –60 dBm
MA25100A	RF Power Indicator

Model/Order No.	Name
	Manuals (available at www.anritsu.com)
10580-00366	BTS Master User Guide
10580-00230	Cable and Antenna Analyzer Measurement Guide
10580-00349	Spectrum Analyzer Measurement Guide
10580-00240	Power Meter Measurement Guide
10580-00232	Vector Signal Generator Measurement Guide
10580-00234	3GPP Signal Analyzer Measurement Guide
10580-00235	3GPP2 Signal Analyzer Measurement Guide
10580-00236	WiMAX Signal Analyzer Measurement Guide
10580-00415	CPRI LTE RF Analyzer Measurement Guide
10580-00434	OBSAI LTE RF Analyzer Measurement Guide
10580-00367	Programming Manual
10580-00368	Maintenance Manual
	Troubleshooting Guides
	OBSAI LTE RF Analyzer Measurement Guide
11410-00473	Cable, Antenna and Components
11410-00551	Spectrum Analyzers
11410-00472	Interference
11410-00566	LTE eNodeB Base Stations
11410-00615	TD-LTE eNodeB Testing
11410-00466	GSM/GPRS/EDGE Base Stations
11410-00463	W-CDMA/HSDPA Base Stations
11410-00465	TD-SCDMA/HSDPA Base Stations
11410-00467	cdmaOne/CDMA2000 1X Base Stations
11410-00468	CDMA2000 1xEV-DO Base Stations
11410-00470	Fixed WiMAX Base Stations
11410-00469	Mobile WiMAX Base Stations
	Standard Accessories (included with instrument)
2000-1686-R	Soft Carrying Case
2000-1760-R	GPS Antenna, SMA (m), 25 dB gain, 2.5 VDC to 3.7 VDC
2000-1691-R	Stylus with Coiled Tether
633-75	Rechargeable Li-Ion Battery, 7500 mAh
40-187-R	AC-DC Adapter
806-141-R	Automotive Power Adapter, 12 VDC, 60 W
2000-1371-R	Ethernet Cable, 213 cm (7 ft)
3-2000-1498	USB A15-pin mini-B Cable, 10 ft/305 cm

Continued on next page

Model/Order No.	Name
	RF over Fiber Accessories
67-12-R	Optical Tap; Single Mode/Multi Mode 80/20 Tap
67-13-R	Optical Tap; Single Mode 80/20 Tap
67-14-R	Optical Tap; Single Mode/Multi Mode 50/50 Tap
67-15-R	Optical Tap; Single Mode 50/50 Tap
68-5-R	SFP (Optical Module), 4.25 Gbps, 850 nm, 500 m
68-6-R	SFP+ (Optical Module), 8 Gbps FC/10G SR 850 nm
68-7-R	SFP (Optical Module), 2.7 Gbps, 1310 nm, 15 km
68-8-R	SFP+ (Optical Module), 10 Gbps LR 1310 nm
68-9-R	SFP (Optical Mode), 3.07 Gpbs, 1310 nm
68-10-R	SFP (Optical Mode), 3.7 Gpbs, 850 nm
68-11-R	SFP+ (Optical Mode), 10.5 Gpbs, 1310 nm
68-12-R	SFP+ (Optical Mode), 10.5 Gpbs, 850 nm
68-16-R	SFP+ (Oprical Module), SM (single Mode) 9.83 Gbps, 1310 nm
808-16-R	Fiber Optical Cable, 3 m, Duplex MM (Multi Mode) 1.6 mm LC/PC LC/PC 50 µm
808-17-R	Fiber Optical Cable, 3 m, Simple MM (Multi Mode) 1.6 mm LC/UPC LC/UPC 50 µm
808-18-R	Fiber Optical Cable, 3 m, Ruggedized Simplex SM (Single Mode) LC/UPC LC/UPC
808-19-R	Fiber Optical Cable, 3 m, Ruggedized Duplex SM (Single Mode) LC/UPC LC/UPC
2100-29-R	Fiber Optical Cable, 3 m, Simplex SM (Single Mode) LC/UPC
2100-30-R	Fiber Optical Cable, 10 m, Simplex LC-SC
2100-31-R	Fiber Optical Cable, 3 m, Duplex SM (Single Mode) LC/UPC
971-14-R	Ferrule cleaner, 2.5 mm SC
971-15-R	Ferrule cleaner, 1.25 mm LC
971-16	Fiber ferrule cleaner
2000-1849-R	SFP 4-slot ESD Box
	Optional Accessories
	Calibration Components, 50Ω
OSLN50A-8	High Performance, Type N (m), DC to 8 GHz, 50Ω
OSLNF50A-8	High Performance, Type N (f), DC to 8 GHz, 50Ω
2000-1914-R	Precision Open/Short/Load, 4.3-10 (f), DC to 6 GHz, 50Ω
2000-1615-R	Precision Open/Short/Load, 4.3-10 (m), DC to 6 GHz, 50Ω
2000-1618-R	Precision Open/Short/Load, 7/16 DIN (m), DC to 6.0 GHz 50Ω
2000-1619-R	Precision Open/Short/Load, 7/16 DIN (f), DC to 6.0 GHz 50Ω
22N50	Open/Short, N (m), DC to 18 GHz, 50Ω
22NF50	Open/Short, N (f), DC to 18 GHz, 50Ω
SM/PL-1	Precision Load, N (m), 42 dB, 6.0 GHz, 50Ω
SM/PLNF-1	Precision Load, N (f), 42 dB, 6.0 GHz, 50Ω
	Calibration Components, 75Ω
22N75	Open/Short, N (m), DC to 3 GHz, 75Ω
22NF75	Open/Short, N (f), DC to 3 GHz, 75Ω
26N75A	Precision Termination, N (m), DC to 3 GHz, 75Ω
26NF75A	Precision Termination, N (f), DC to 3 GHz, 75Ω
12N50-75B	Matching Pad, DC to 3 GHz, 50Ω to 75Ω
	Adapters
1091-417-R	N (m) to QMA (f), DC to 6 GHz, 50Ω
1091-418-R	N (m) to QMA (m), DC to 18 GHz, 50Ω
	Precision Adapters
1091-26-R	SMA (m) to N (m), DC to 18 GHz, 50Ω
1091-27-R	SMA (f) to N (m), DC to 18 GHz, 50Ω
1091-80-R	SMA (m) to N (f), DC to 18 GHz, 50Ω
1091-81-R	SMA (f) to N (f), DC to 18 GHz, 50Ω
1091-172-R	BNC (f) to N (m), DC to 1.3 GHz, 50Ω
510-90-R	7/16 DIN (f) to N (m), DC to 7.5 GHz, 50Ω
510-91-R	7/16 DIN (f) to N (f), DC to 7.5 GHz, 50Ω
510-92-R	7/16 DIN (m) to N (m), DC to 7.5 GHz, 50Ω
510-93-R	7/16 DIN (m) to N (f), DC to 7.5 GHz, 50Ω
510-96-R	7/16 DIN (m) to 7/16 DIN (m), DC to 7.5 GHz, 50Ω
510-97-R	7/16 DIN (f) to 7/16 DIN (f), DC to 7.5 GHz, 50Ω
510-102-R	N (m) to N (m), DC to 11 GHz, 50Ω, 90 degrees right angle
34NN50A	N (m) to N (m), DC to 18 GHz, 50Ω
34NFNF50	N (f) to N (f), DC to 18 GHz, 50Ω
	Phase-Stable Test Port Cables, Armored w/Reinforced Grip (recommended for cable & antenna line sweep applications)
15RNFN50-1.5-R	1.5 m, DC to 6 GHz, N (m) to N (f), 50Ω
15RDFN50-1.5-R	1.5 m, DC to 6 GHz, N (m) to 7/16 DIN (f), 50Ω
15RDN50-1.5-R	1.5 m, DC to 6 GHz, N (m) to 7/16 DIN (m), 50Ω
15RNFN50-3.0-R	3.0 m, DC to 6 GHz, N (m) to N (f), 50Ω
15RDFN50-3.0-R	3.0 m, DC to 6 GHz, N (m) to 7/16 DIN (f), 50Ω
15RDN50-3.0-R	3.0 m, DC to 6 GHz, N (m) to 7/16 DIN (m), 50Ω

Model/Order No.	Name
	InterChangeable Adaptor Phase Stable Test Port Cables, Armored w/Reinforced Grip (recommended for cable and antenna line sweep applications. It uses the same ruggedized grip as the Reinforced grip series cables. Now you can also change the adapter interface on the grip to four different connector types.)
15RCN50-1.5-R	1.5 m, DC to 6 GHz, N (m), N (f), 7/16 DIN (m), 7/16 DIN (f), 50Ω
15RCN50-3.0-R	3.0 m, DC to 6 GHz, N (m), N (f), 7/16 DIN (m), 7/16 DIN (f), 50Ω
	Phase-Stable Test Port Cables, Armored (recommended for use with tightly spaced connectors and other general use applications)
15NNF50-1.5C	1.5 m, DC to 6 GHz, N (m) to N (f), 50Ω
15NN50-1.5C	1.5 m, DC to 6 GHz, N (m) to N (m), 50Ω
15NDF50-1.5C	1.5 m, DC to 6 GHz, N (m) to 7/16 DIN (f), 50Ω
15ND50-1.5C	1.5 m, DC to 6 GHz, N (m) to 7/16 DIN (m), 50Ω
15NNF50-3.0C	3.0 m, DC to 6 GHz, N (m) to N (f), 50Ω
15NN50-3.0C	3.0 m, DC to 6 GHz, N (m) to N (m), 50Ω
15NNF50-5.0C	5.0 m, DC to 6 GHz, N (m) to N (f), 50Ω
15NN50-5.0C	5.0 m, DC to 6 GHz, N (m) to N (m), 50Ω
15N43M50-1.5C	Test Port Extension Cable, Armored, 1.5 m, DC to 6 GHz, N (m) to 4.3-10 (m)
15N43F50-1.5C	Test Port Extension Cable, Armored, 1.5 m, DC to 6 GHz, N (m) to 4.3-10 (f)
15N43M50-3.0C	Test Port Extension Cable, Armored, 3 m, DC to 6 GHz, N (m) to 4.3-10 (m)
15N43F50-3.0C	Test Port Extension Cable, Armored, 3 m, DC to 6 GHz, N (m) to 4.3-10 (f)
15NF43M50-1.5C	Test Port Extension Cable, Armored, 1.5 m, DC to 6 GHz, N (f) to 4.3-10 (m)
15NF43F50-1.5C	Test Port Extension Cable, Armored, 1.5 m, DC to 6 GHz, N (f) to 4.3-10 (f)
15NF43M50-3.0C	Test Port Extension Cable, Armored, 3 m, DC to 6 GHz, N (f) to 4.3-10 (m)
15NF43F50-3.0C	Test Port Extension Cable, Armored, 3 m, DC to 6 GHz, N (f) to 4.3-10 (f)
	Miscellaneous Accessories
2000-1374	External Dual Charger for Li-Ion Batteries
633-75	Rechargeable Li-Ion Battery, 7500 mAh
2000-1689	EMI Near Field Probe Kit
2000-1797-R	Touchscreen Protective Film, 8.4 in.
MA2700A	Handheld Interference Hunter (for full specifications, refer to the MA2700A Technical Data Sheet, 11410-00692)
2000-1884-R	PIM Hunter™ Test Probe (For full specifications, refer to the 2000-1884-R Technical Data Sheet 11410-00999)
2000-1691-R	Stylus with Coiled Tether
2000-1798-R	Port Extender, DC to 6 GHz, N (m) to N (f)
	Backpack and Transit Case
67135	Anritsu Backpack (For Handheld Instrument and PC)
760-243-R	Large Transit Case with Wheels and Handle, 56 × 45.5 × 26.5 cm (22.07" × 17.92" × 10.42")
760-271-R	Transit Case for Portable Directional Antennas and Port Extender, 52.4 × 42.8 × 20.6 cm (20.62" × 16.87" × 8.12") (for 2000-1777-R, 2000-1778-R, 2000-1779-R, 2000-1798-R)
	GPS Antennas
2000-1528-R	GPS Antenna, SMA (m) with 5 m (15 ft) cable, 3 dBi gain, requires 5 VDC
2000-1652-R	GPS Antenna, SMA (m) with 0.3 m (1 ft) cable, 5 dBi gain, requires 3.3 VDC or 5 VDC
2000-1760-R	GPS Antenna, SMA (m), 25 dB gain, 2.5 VDC to 3.7 VDC
	Directional Antennas
2000-1411-R	824 MHz to 896 MHz, N (f), 12.3 dBi, Yagi
2000-1412-R	885 MHz to 975 MHz, N (f), 12.6 dBi, Yagi
2000-1413-R	1710 MHz to 1880 MHz, N (f), 12.3 dBi, Yagi
2000-1414-R	1850 MHz to 1990 MHz, N (f), 11.4 dBi, Yagi
2000-1415-R	2400 MHz to 2500 MHz, N (f), 14.1 dBi, Yagi
2000-1416-R	1920 MHz to 2170 MHz, N (f), 14.3 dBi, Yagi
2000-1659-R	698 MHz to 787 MHz, N (f), 10.1 dBi, Yagi
2000-1660-R	1425 MHz to 1535 MHz, N (f), 14.3 dBi, Yagi
2000-1715-R	698 MHz to 2500 MHz, N (f), gain of 2 dBi to 10 dBi (typ.)
2000-1726-R	Antenna, 2500 MHz to 2700 MHz N (f), 14.1 dBi, Yagi
2000-1747-R	Antenna, Log Periodic, 300 MHz to 7000 MHz, N (f), 5.1 dBi (typ.)
2000-1748-R	Antenna, Log Periodic, 1 GHz to 18 GHz, N (f), 6 dBi (typ.)
2000-1777-R	Portable Directional Antenna, 9 kHz to 20 MHz, N (f)
2000-1778-R	Portable Directional Antenna, 20 MHz to 200 MHz, N (f)
2000-1779-R	Portable Directional Antenna, 200 MHz to 500 MHz, N (f)
2000-1812-R	Portable Yagi Antenna, 450 MHz to 512 MHz, N (f), 7.1 dBi
2000-1825-R	Portable Yagi Antenna, 380 MHz to 430 MHz, N (f), 7.1 dBi

Continued on next page

Model/Order No.	Name
	Portable Antennas
2000-1200-R	806 MHz to 866 MHz, SMA (m), 50Ω
2000-1473-R	870 MHz to 960 MHz, SMA (m), 50Ω
2000-1035-R	896 MHz to 941 MHz, SMA (m), 50Ω (1/2 wave)
2000-1030-R	1710 MHz to 1880 MHz, SMA (m), 50Ω (1/2 wave)
2000-1474-R	1710 MHz to 1880 MHz with knuckle elbow (1/2 wave)
2000-1031-R	1850 MHz to 1990 MHz, SMA (m), 50Ω (1/2 wave)
2000-1475-R	1920 MHz to 1980 MHz and 2110 MHz to 2170 MHz, SMA (m), 50Ω
2000-1032-R	2400 MHz to 2500 MHz, SMA (m), 50Ω (1/2 wave)
2000-1361-R	2400 MHz to 2500 MHz, 5000 MHz to 6000 MHz, SMA (m), 50Ω
2000-1636-R	Antenna Kit (Consists of: 2000-1030-R, 2000-1031-R, 2000-1032-R, 2000-1200-R, 2000-1035-R, 2000-1361-R, and carrying pouch)
2000-1751-R	LTE Dipole, 698 to 960/1710 to 2170/2500 MHz to 2700 MHz, SMA (m), 2 dBi (typ.), 50Ω
	Mag Mount Broadband Antenna
2000-1647-R	Cable 1: 698 MHz to 1200 MHz, 2 dBi peak gain, 1700 MHz to 2700 MHz, 5 dBi peak gain, N (m), 50Ω, 3 m (10 ft) Cable 2: 3000 MHz to 6000 MHz, 5 dBi peak gain, N (m), 50Ω, 3 m (10 ft) Cable 3: GPS 26 dB gain, SMA (m), 50Ω, 3 m (10 ft)
2000-1645-R	694 MHz to 894 MHz, 3 dBi peak gain, 1700 MHz to 2700 MHz, 3 dBi peak gain, N (m), 50Ω, 3 m (10 ft)
2000-1646-R	750 MHz to 1250 MHz, 3 dBi peak gain, 1650 MHz to 2700 MHz, 5 dBi peak gain
2000-1648-R	1700 MHz to 6000 MHz, 3 dBi peak gain, N (m), 50Ω, 3 m (10 ft)
	Filters
1030-114-R	806 MHz to 869 MHz, N (m) to SMA (f), 50Ω
1030-109-R	824 MHz to 849 MHz, N (m) to SMA (f), 50Ω
1030-110-R	880 MHz to 915 MHz, N (m) to SMA (f), 50Ω
1030-111-R	1850 MHz to 1910 MHz, N (m) to SMA (f), 50Ω
1030-112-R	2400 MHz to 2484 MHz, N (m) to SMA (f), 50Ω
1030-105-R	890 MHz to 915 MHz, N (m) to SMA (f), 50Ω
1030-106-R	1710 MHz to 1790 MHz, N (m) to SMA (f), 50Ω
1030-107-R	1910 MHz to 1990 MHz, N (m) to SMA (f), 50Ω
1030-149-R	High Pass, 150 MHz, N (m) to N (f), 50Ω
1030-150-R	High Pass, 400 MHz, N (m) to N (f), 50Ω
1030-151-R	High Pass, 700 MHz, N (m) to N (f), 50Ω
1030-152-R	Low Pass, 200 MHz, N (m) to N (f), 50Ω
1030-153-R	Low Pass, 550 MHz, N (m) to N (f), 50Ω
1030-155-R	2500 MHz to 2700 MHz, N (m) to N (f), 50Ω
1030-178-R	1920 MHz to 1980 MHz, N (m) to N (f), 50Ω
1030-179-R	777 MHz to 798 MHz, N (m) to N (f), 50Ω
1030-180-R	2500 MHz to 2570 MHz, N (m) to N (f), 50Ω
2000-1684-R	791 MHz to 821 MHz, N (m) to N (f), 50Ω
2000-1734-R	Bandpass Filter, 699 MHz to 715 MHz, N (m) to N (f), 50Ω
2000-1735-R	Bandpass Filter, 776 MHz to 788 MHz, N (m) to N (f), 50Ω
2000-1736-R	Bandpass Filter, 815 MHz to 850 MHz, N (m) to N (f), 50Ω
2000-1737-R	Bandpass Filter, 1711 MHz to 1756 MHz, N (m) to N (f), 50Ω
2000-1738-R	Bandpass Filter, 1850 MHz to 1910 MHz, N (m) to N (f), 50Ω
2000-1739-R	Bandpass Filter, 880 MHz to 915 MHz, N (m) to N (f), 50Ω
2000-1740-R	Bandpass Filter, 1710 MHz to 1785 MHz, N (m) to N (f), 50Ω
2000-1741-R	Bandpass Filter, 1920 MHz to 1980 MHz, N (m) to N (f), 50Ω
2000-1742-R	Bandpass Filter, 832 MHz to 862 MHz, N (m) to N (f), 50Ω
2000-1743-R	Bandpass Filter, 2500 MHz to 2570 MHz, N (m) to N (f), 50Ω
2000-1799-R	Bandpass Filter, 2305 MHz to 2320 MHz, N (m) to N (f), 50Ω
	Attenuators
3-1010-122	20 dB, 5 W, DC to 12.4 GHz, N (m) to N (f)
42N50-20	20 dB, 5 W, DC to 18 GHz, N (m) to N (f)
42N50A-30	30 dB, 50 W, DC to 18 GHz, N (m) to N (f)
3-1010-123	30 dB, 50 W, DC to 8.5 GHz, N (m) to N (f)
1010-127-R	30 dB, 150 W, DC to 3 GHz, N (m) to N (f)
3-1010-124	40 dB, 100 W, DC to 8.5 GHz, N (m) to N (f), Uni-directional
1010-121	40 dB, 100 W, DC to 18 GHz, N (m) to N (f), Uni-directional
1010-128-R	40 dB, 150 W, DC to 3 GHz, N (m) to N (f)

Model/Order No.	Name
	TRX NEON Signal Mapper Bundles ∗IMPORTANT: The primary end- user's name, phone number and email address must be provided when the order is placed.
MA8100A-001	TRX NEON® Signal Mapper with Anritsu Integration (Includes 1 Year TRX NEON Command Software and Cloud Service (P/N 2300-574) and Tracking Unit (P/N 2000-1852-R))
MA8100A-003	TRX NEON® Signal Mapper with Anritsu Integration (Includes 3 Year TRX NEON Command Software and Cloud Service (P/N 2300-575) and Tracking Unit (P/N 2000-1852-R))
MA8100A-005	TRX NEON® Signal Mapper with Anritsu Integration (Includes 5 Year TRX NEON Command Software and Cloud Service (P/N 2300-576) and Tracking Unit (P/N 2000-1852-R))
MA8100A-100	TRX NEON® Signal Mapper with Anritsu Integration and Tracking Unit. Includes Perpetual TRX NEON Software License with 3 years of maintenance and support and 3 years of Cloud Service.
2300-574	1 year TRX NEON Software License with 1 year of maintenance and support and 1 year of Cloud Service. Cannot be ordered separately from P/N MA8100A-001. See P/N 2300-612 for renewals.
2300-575	3 year TRX NEON Software License with 3 years of maintenance and support and 3 years of Cloud Service. Cannot be ordered separately from P/N MA8100A-003. See P/N 2300-613 for renewals.
2300-576	5 year TRX NEON Software License with 5 years of maintenance and support and 5 years of Cloud Service. Cannot be ordered separately from P/N MA8100A-005. See P/N 2300-614 for renewals.
2300-606	Perpetual TRX NEON Software License with 3 years of maintenance and support and 3 years of Cloud Service. Part number can also be used to order a perpetual license after a limited term license has expired.
2300-612	Renewal of 1 year TRX NEON Software License with 1 year of maintenance and support and 1 year of Cloud Service.
2300-613	Renewal of 3 year TRX NEON Software License with 3 years of maintenance and support and 3 years of Cloud Service.
2300-614	Renewal of 5 year TRX NEON Software License with 5 years of maintenance and support and 5 years of Cloud Service.

Bluetooth Test Set

MT8852B

2.4 GHz Reference Bluetooth Transceiver

Remote Control
GPIB

Test Bluetooth Modules and Products with a Bluetooth Interface

The Bluetooth Test Set MT8852B is the market leading RF measuring instrument for design proving and production test of a wide range of products that integrate *Bluetooth*® technology, including phones, headsets, computers, audio-visual and gaming products as well as modules. In production, a single key press initiates a measurement script that tests a device in less than 15 seconds.
9 Bluetooth Basic Rate and 8 EDR and 17 Bluetooth low energy test cases are supported in the MT8852B. EDR test cases supported include EDR Guard Time and EDR Synchronization Sequence and Trailer.
The introduction of the new Bluetooth 5.0 technology opens up a whole new range of applications including the IoT, sports and fitness monitoring and health and wellbeing sensors. The new MT8852B options add 11 Bluetooth low energy test cases to the standard product. These new test cases can be run as part of a test script so that test program creation is simplified and test times are minimized.
For audio measurement, the MT8852B supports all three codec air interfaces (µ-Law, A-Law and CVSD) on up to three SCO audio channels. It offers comprehensive testing facilities integrated within a Bluetooth wireless technology test set. Rear-panel jack-plug connectors provide analog inputs and outputs for all three audio channels.
The Adaptive Frequency Hopping (AFH) option facilitates analysis of interference from, and co-existence with, interfering signals such as WLAN. This option provides graphical displays of FER and masked channels when interfering signals are introduced, allowing optimization of hardware designs.

The *Bluetooth*® mark and logos are owned by Bluetooth SIG, Inc. and are used by Anritsu under license.

Features

- Qualified by Bluetooth SIG for measurements
- Compliant with Bluetooth Test Specification RF.TS.5.0.1 and RF-PHY.TS.5.0.2
- Basic Rate and EDR measurement performed in Bluetooth test mode – Loopback or Tx mode supported
- Signal generator and transmitter analyzer modes for protocol free applications
- "Quick Test" script validates Basic Rate, EDR and Bluetooth low energy test performance in under 15 seconds
- "Full Test" script performs full Bluetooth SIG compliant testing from single key press
- For design proving and production test
- Full implementation of Basic Rate, EDR and Bluetooth low energy dirty transmitter for Bluetooth SIG RF test specification compliant measurements
- Audio test capability, 3 SCO channels with CVSD, µ-Law and A-Law air interface
- Adaptive Frequency Hopping (AFH) measurements (MT8852B-015)
- Easy operation – one-touch testing with "Run" key
- BlueSuite Pro3 PC software displays; FSK modulation, power burst profile, PSK constellation diagrams and sensitivity searches graphically
- CombiTest software automates tests with test script generator and results data base
- GPIB and RS232 remote programming interfaces
- Initialization and control of test devices through USB, RS232 and USB-Adapter HCI control port
- Built-in support for Bluetooth low energy 2-Wire control interface
- Small size (half rack) and low weight (≤3.8 kg)

MT8852B is the Master, establishing the link by Paging the EUT. The EUT BT address can be entered manually or through the GPIB port. If the EUT BT address is not known, you can use Inquiry or read the address directly through the EUT HCI interface (RS232 or USB). Test Mode is then activated in the EUT and RF measurements performed. When the EUT is in Test Mode, the MT8852B has complete control over its operation. The EUT can be put into loopback or Tx test mode, frequency hopping can be disabled or the EUT sent to defined Tx and Rx frequencies as required by the test specification. The MT8852B runs a selected test script. A test script comprises of all (or a user selected subset) of the available RF measurements. The user can modify the measurements by editing test frequencies, number of bits/packets tested, hopping On or Off, and Pass/Fail limits. Pre programmed "Full" and "Quick Test" scripts plus user-defined scripts are selectable. Script results can be viewed on the screen and accessed over the GPIB. In addition any individual measurement can be run continuously.

Options

Adaptive Frequency Hopping (AFH) Option MT8852B-015

- Connect to an EUT using the Bluetooth v1.2 faster connection and display the connection time in milliseconds.
- Display the EUT Bluetooth v1.2 supported features map, including AFH capabilities.
- Read the EUT Local Assessment Scheme in the presence of an external interfering signal (e.g. WLAN).
- Manually define additional channels to mask in the MT8852B Pseudo Local Assessment Map.
- Display a graph of channel utilization against time to measure the speed with which an EUT masks channels when an interfering source is activated.
- Display a graph of Frame Error Rate (FER) against time to validate that an EUT identifies all "Bad" channels and maintains a zero or low FER.
- Establish an audio SCO link so that the audio quality can be monitored in the presence of interfering signals, and ensure that the AFH functionality maintains a high quality audio path.

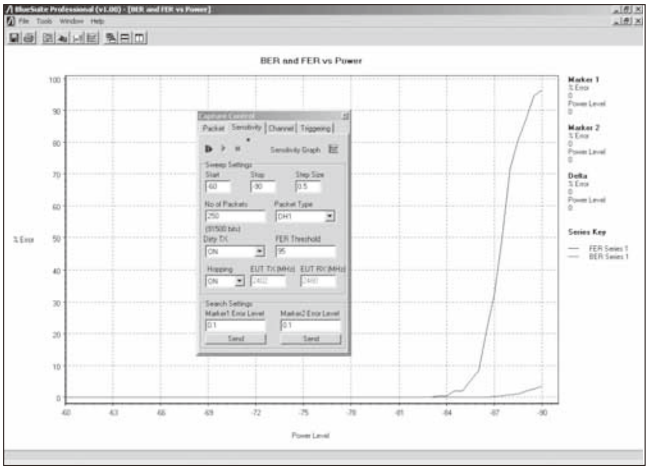
This screen presents a graph with 1 second resolution of the FER of the Bluetooth link with AFH enabled. When an interfering source such as a 802.11 WLAN access point is activated, the FER can be seen to increase immediately. As the EUT’s local assessment scheme identifies the "bad" channels and reports its assessment to the MT8852B, the FER will decrease as the channels are removed from the hopping plan.

Frame Error Rate against time with AFH active

BlueSuite Pro3

BlueSuite Pro3 is a comprehensive software tool that enables a greater understanding of all aspects of a device's RF characteristics. Running on a standard PC, BlueSuite Pro3 interfaces to the MT8852B through a GPIB interface. Use BlueSuite Pro3 to;

- Monitor the real-time state of the EUT through the display of frequency deviation, power burst, IQ constellation and vector graphs.
- Configure and run sensitivity sweeps and display the results graphically.
- Configure and run measurement sweeps for seven different tests and display the results graphically for each of the 79 Bluetooth channels.
- Configure and run audio tests and display the results graphically.
- Configure and run a power control test and display the results graphically.
- Read and write script and limit settings to and from the MT8852B.
- Edit and run a complete test script and generate a detailed report of the results.
- Step through individual connection and test mode controls to determine the cause of problems otherwise difficult to isolate.

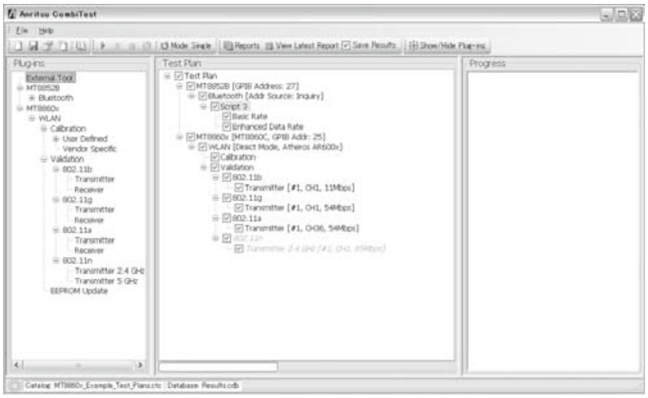


Sweep Settings
Start: -60
Stop: -90
Step Size: 0.5
No of Packets: 250
Packet Type: DH1
(81500 bits)
Dirty TX: ON
FER Threshold: 95
Hopping: ON
EUT TX (MHz): 2402
EUT RX (MHz): 2480
Search Settings
Marker1 Error Level: 0.1
Marker2 Error Level: 0.1

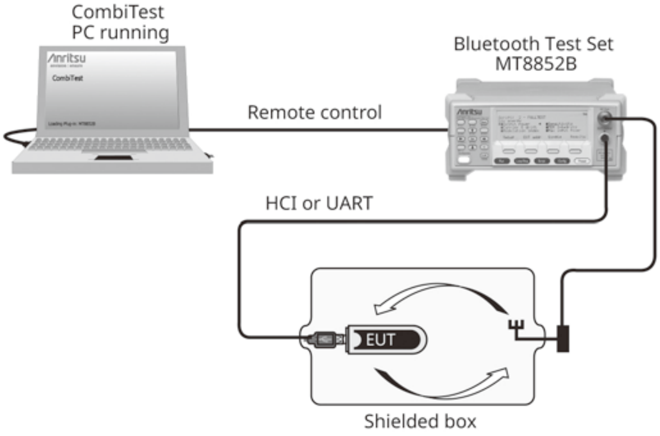
Automatic sensitivity search measurements display the FER/BER performance of an EUT with decreasing power into the receiver. Tests can be performed on all supported standard rate and EDR packet types.

CombiTest

CombiTest is a software application used to remotely control Anritsu Bluetooth test sets using a user-configured test plan of measurements. It is ideal for creating design-verification or production test plans for Bluetooth radios.



Setup



CombiTest features:

- Plug-in for Bluetooth Test Set MT8852B
- Bluetooth test mode measurements
- Rapid creation and execution of test plans
- Run an entire test plan or just the selected components
- Detailed report of test results with database of previous tests

Anritsu
Discover What's Possible™

CombiTest

Date: 24 February 2010
Test plan name: New
Test plan result: Passed
Test plan status: Complete

CombiTest version: 0.9
User: uk000307
Test station name: Station-XP-DM
Start time: 14:12:42
Elapsed time: 00:00:23

Bluetooth Test Results

MT8852B serial: 6K00005640
MT8852B firmware: 4.15.021
Plug-in version: 0.9
Bluetooth result: Passed
Elapsed time: 00:00:18
Connection time: 57 ms

EUT Bluetooth address: 00025B0298CC
Script Number: 1

Basic Rate Test Results

TRM/CA/01/C (Output Power)
Packet Length Tested: DH1

Hopping On	Avg	Limits
Average Power	-0.6 dBm	
Max Power	0.9 dBm	< 20.0 dBm
Min Power	-4.2 dBm	> -6.0 dBm
Peak Power	1.0 dBm	< 23.0 dBm
Total Packets Failed	0	

CombiTest reports clearly present full set up and results details of each device tested. Results are automatically archived into a database.

Specifications

Basic Rate Measurements

Basic Rate measurements made in compliance with Bluetooth RF Test Specification RF.TS.5.0.1.

Characteristic/Parameter	Specification
Output Power (TRM/CA/BV-01-C)	
Measurement Configuration	Hopping: Off or On – measure at defined, all, or any frequencies Loopback, Tx mode Payload: PRBS9 Packet type: DH1, DH3, DH5
Displayed Results	Average power Peak power
Number of Measurement Frequencies	Three, default to RF Test Specification or user defined
Measurement Range	–50 to +22 dBm (average power), +23 dBm (peak power)
Resolution	0.1 dB
Accuracy	±1.0 dB (–35 to +20 dBm) ±1.5 dB (+20 to +22 dBm)
Power Control (TRM/CA/BV-03-C)	
Measurement Configuration	Hopping: Off Loopback, Tx mode Payload: PRBS9 Packet type: DH1, DH3, DH5
Displayed Result	Maximum power, Minimum power, Maximum step size, Minimum step size, Power at each power step
Number of Measurement Frequencies	Three, default to RF Test Specification or user defined
Measurement Range	–35 to +22 dBm (average power), +23 dBm (peak power)
Resolution	0.1 dB
Accuracy	±1.0 dB (–35 to +20 dBm) ±1.5 dB (+20 to +22 dBm)
Modulation Characteristics (TRM/CA/BV-07-C)	
Measurement Configuration	Hopping: Off Loopback, Tx mode Payload: 11110000 and 10101010 Packet type: DH1, DH3, DH5
Displayed Results	Frequency deviation: Δf1max, Δf2max, Δf1avg, Δf2avg, Δf2avg/Δf1avg plus % of Δf2max <115 kHz
Number of Measurement Frequencies	Three, default to RF Test Specification or user defined
RF Input Measurement Range	–35 to +20 dBm
Deviation Measurement Range	0 to 350 kHz (peak power)
Deviation Resolution	1 kHz
Accuracy	1% for modulation index 0.32
Initial Carrier Frequency Tolerance (TRM/CA/BV-08-C)	
Measurement Configuration	Hopping: Off or On – measure at defined, all, or any frequencies Loopback, Tx mode Payload: PRBS9 Packet type: DH1
Displayed Results	Average initial frequency error Maximum positive frequency error Maximum negative frequency error
Number of Measurement Frequencies	Three, default to RF Test Specification or user defined
RF Input Measurement Range	–35 to +20 dBm
Initial Frequency Error Measurement Range	0 to ±150 kHz
Frequency Resolution	1 kHz
Accuracy	500 Hz ±frequency standard
Carrier Frequency Drift (TRM/CA/BV-09-C)	
Measurement Configuration	Hopping: Off or On – measure at defined, all, or any frequencies Loopback, Tx mode Payload: 10101010 Packet type: DH1, DH3, DH5
Displayed Results	Carrier frequency drift Drift rate
Number of Measurement Frequencies	Three, default to RF Test Specification or user defined
RF Input Measurement Range	–35 to +20 dBm
Frequency Drift Measurement Range	0 to 200 kHz, and >2000 µs/50 µs
Frequency Resolution	1 kHz

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Characteristic/Parameter	Specification
Enhanced Power Control (TRM/CA/BV-14-C)	
Measurement Configuration	Hopping: Off Loopback, Tx mode Payload: PRBS9 Packet type: DH1, 3, 5, 2-DH1, 3, 5 and 3-DH1, 3, 5
Displayed Result	Maximum power for each packet type Minimum power for each packet type Maximum power step for each packet type Minimum power step for each packet type Maximum power difference at any step between DHn and 2DHn or 3DHn packets
Number of Measurement Frequencies	Three, default to RF Test Specification or user defined
Measurement Range	–35 to +22 dBm (average power), +23 dBm (peak power)
Resolution	0.1 dB
Accuracy	±1.0 dB (–35 to +20 dBm) ±1.5 dB (+20 to +22 dBm)
Sensitivity – single slot packets (RCV/CA/BV-01-C)	
Measurement Configuration	Hopping: Off or On, user selectable Loopback only Payload: PRBS9 Packet type: DH1 Dirty transmitter (as defined in the RF test spec): On or Off, user defined
Displayed Results	BER (percentage) Total number of bit errors and FER
Number of Measurement Frequencies	Three, default to RF Test Specification or user defined
Number of Measured Bits	1 to 10000 packets (216 bits to 2160000 bits)
Output Power Range	–90 to 0 dBm, resolution: 0.1 dB
Output Power Accuracy	±1 dB (–80 to 0 dBm)
BER/FER Measurement Range	0 to 100%
BER/FER Resolution	0.001%
Sensitivity – multi-slot packets (RCV/CA/BV-02-C)	
Measurement Configuration	Hopping: Off or On, user selectable Loopback only Payload: PRBS9 Packet type: DH3, DH5 Dirty transmitter (as defined in RF test spec): On or Off, user defined
Displayed Results	BER (percentage) Total number of bit errors and FER
Number of Measurement Frequencies	Three, default to RF Test Specification or user defined
Number of Measured Bits	1 to 10000 packets (for DH3, 1464 bits to 14640000 bits), (for DH5, 2712 bits to 27120000 bits)
Output Power Range	–90 to 0 dBm, resolution: 0.1 dB
Output Power Accuracy	±1 dB (–80 to 0 dBm)
BER/FER Measurement Range	0 to 100%
BER/FER Resolution	0.001%
Maximum Input Level (RCV/CA/BV-06-C)	
Measurement Configuration	Hopping: Off Loopback only Payload: PRBS9 Packet type: DH1
Displayed Results	BER (percentage) Total number of bit errors and FER
Number of Measurement Frequencies	Three, default to RF Test Specification or user defined
Number of Measured Bits	1 to 10000 packets (216 bits to 2160000 bits)
Output Power Range	–90 to 0 dBm, resolution: 0.1 dB
Output Power Accuracy	±1 dB (–80 to 0 dBm)

Enhanced Data Rate (EDR) Measurements

Enhanced Data Rate measurements made in compliance with Bluetooth RF Test Specification RF.TS.5.0.1.

Characteristic/Parameter	Specification
EDR Relative Transmit Power (TRM/CA/BV-10-C)	
Measurement Configuration	Hopping: Off and On – measure at defined, all, or any frequencies Modulations: π/4DQPSK and 8DPSK Packet type: 2-DH1, 3, 5 and 3-DH1, 3, 5 Loopback, Tx mode EUT power level: Max. and Min.
Displayed Results	Max. differential power (from all packets) Min. differential power (from all packets) Average differential power (over all packets)
Number of Measurement Frequencies	Three, default to RF Test Specification or user defined
Measurement Range	–35 to +20 dBm (average power), +23 dBm (peak power)
Relative Power Resolution	0.01 dB, GFSK to π/4DQPSK and 8DPSK
Relative Power Accuracy	Relative power measurement accuracy between GFSK and π/4DQPSK or 8DPSK, 0.2 dB typical for a power difference of <6 dB
Relative Power Measurement Range	Relative power measurement range between GFSK and π/4DQPSK or 8DPSK, $(P_{GFSK} – 8\ dB) < P_{DPSK} < (P_{GFSK} + 4\ dB)$

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Characteristic/Parameter	Specification
EDR Carrier Frequency Stability and Modulation Accuracy (TRM/CA/BV-11-C)	
Measurement Configuration	Hopping: Off and On – measure at defined, all, or any frequencies Modulations: π/4DQPSK and 8DPSK Packet type: 2-DH1, 3, 5 and 3-DH1, 3, 5 Loopback, Tx mode EUT power level: Max. and Min.
Displayed Results	Initial frequency error ω_i Frequency error ω_o Frequency error $\omega_i + \omega_o$ RMS DEVM (block with greatest DEVM value displayed) Peak DEVM 99% DEVM Average RMS DEVM (average DEVM for all blocks measured)
Number of Measurement Frequencies	Three, default to RF Test Specification or user defined
Carrier Frequency Stability Measurement Range	0 to ±100 kHz
Carrier Frequency Stability Accuracy	500 Hz ±frequency standard
Carrier Frequency Stability Resolution	1 kHz
RMS DEVM Range	30% π/4DQPSK, 20% 8DPSK
RMS DEVM Resolution	0.1% π/4DQPSK and 8DPSK
Peak DEVM Range	0 to 50% π/4DQPSK, 0 to 30% 8DPSK
Peak DEVM Resolution	0.1% π/4DQPSK and 8DPSK
EDR Differential Phase Encoding (TRM/CA/BV-12-C)	
Measurement Configuration	Hopping: Off and On, user selectable Modulations: π/4DQPSK and 8DPSK Packet type: 2-DH1, 3, 5 and 3-DH1, 3, 5. Number of test packets: default 100 Tx mode only
Displayed Results	Number of packets received Number of packets with payload data errors Percentage of errored packets
Number of Measurement Frequencies	Three, default to RF Test Specification or user defined
EDR Guard Time (TP/TRM/CA/BV-15-C)	
Measurement Configuration	Hopping: Off Modulations: π/4DQPSK and 8DPSK Packet type: 2-DH1, 3, 5 and 3-DH1, 3, 5. Number of test packets: default 100 Loopback or Tx mode
Displayed Results	Maximum guard time Minimum guard time Packet in error Percentage of passed packets
Number of Measurement Frequencies	Three, default to RF Test Specification or user defined
EDR Synchronization Sequence and Trailer (TP/TRM/CA/BV-16-C)	
Measurement Configuration	Hopping: Off Modulations: π/4DQPSK and 8DPSK Packet type: 2-DH1, 3, 5 and 3-DH1, 3, 5. Number of test packets: default 50 Loopback or Tx mode
Displayed Results	Number of synchronization sequence bits received Number of synchronization sequence error bits Number of trailer bits received Number of trailer error bits
Number of Measurement Frequencies	Three, default to RF Test Specification or user defined
EDR Sensitivity (RCV/CA/BV-07-C)	
Measurement Configuration	Hopping: Off and On, user selectable Modulations: π/4DQPSK and 8DPSK Packet type: 2-DH1, 3, 5 and 3-DH1, 3, 5. Bit threshold control: Threshold 1, 1.6 million bits, Threshold 2, 16 million bits (user editable) Loopback only Dirty transmitter (as defined in RF test spec): On or Off, user selectable
Displayed Results	Overall BER (displayed in exponential format) Number of bits in error Number of packets sent by test set Number of packets received in error by EUT
Number of Measurement Frequencies	Three, default to RF Test Specification or user defined
Output Power Range	–90 to 0 dBm, resolution: 0.1 dB
Output Power Accuracy	±1 dB (–80 to 0 dBm)

Continued on next page

Characteristic/Parameter	Specification
EDR BER Floor Performance (RCV/CA/BV-08-C)	
Measurement Configuration	Hopping: Off and On, user selectable Modulations: π/4DQPSK and 8DPSK Packet type: 2-DH1, 3, 5 and 3-DH1, 3, 5 Bit threshold control: Threshold 1, 8 million bits, Threshold 2, 160 million bits (user editable) Loopback only
Displayed Results	Overall BER (displayed in exponential format) Number of bits in error Number of packets sent by test set Number of packets received in error by EUT
Number of Measurement Frequencies	Three, default to RF Test Specification or user defined
Output Power Range	–90 to 0 dBm, resolution: 0.1 dB
Output Power Accuracy	±1 dB (–80 to 0 dBm)
EDR Maximum Input Level (RCV/CA/BV-10-C)	
Measurement Configuration	Hopping: Off and On, user selectable Modulations: π/4DQPSK and 8DPSK Packet type: 2-DH1, 3, 5 and 3-DH1, 3, 5 Number of bits: default 1.6 million (user editable) Loopback only
Displayed Results	Overall BER (displayed in exponential format) Number of bits in error Number of packets sent by test set Number of packets received in error by EUT
Number of Measurement Frequencies	Three, default to RF Test Specification or user defined
Output Power Range	–90 to 0 dBm, resolution: 0.1 dB
Output Power Accuracy	±1 dB (–80 to 0 dBm)

Bluetooth Low Energy Measurements

BLE measurements made in compliance with Bluetooth RF test specification RF-PHY.TS/5.0.2.

Characteristic/Parameter	Specification
BLE Output power (TRM-LE/CA/BV-01-C)	
Measurement Configuration	DUT configured to transmit test reference packets Packet payload: PRBS9
Displayed Results	Average power Peak to average power
Number of Measurement Frequencies	Three, default to RF Test Specification or user defined
Measurement Range	–50 to +22 dBm (average power), +23 dBm (peak power)
Resolution	0.1 dB
Accuracy	±1.0 dB (–35 to +20 dBm) ±1.5 dB (+20 to +22 dBm)
BLE Modulation Characteristics (TRM-LE/CA/BV-05-C, TRM-LE/CA/BV-10-C, TRM-LE/CA/BV-13-C)	
Measurement Configuration	DUT configured to transmit test reference packets Packet payload: 10101010 and 11110000 (BLE and 2LE) Packet payload: 11111111 (BLR S=8)
Displayed Results	Frequency deviation: Δf1max, Δf2max (BLE and 2LE), Δf1avg, Δf2avg (BLE and 2LE), Δf2avg/Δf1avg ratio (BLE and 2LE), %Δf2max > 185 kHz (BLE), %Δf2max > 370 kHz (2LE)
Number of Measurement Frequencies	Three, default to RF Test Specification or user defined
Measurement Range	RF input: –35 to +20 dBm Deviation: 0 to 500 kHz peak (except 2LE)
Resolution	Deviation: 1 kHz
Accuracy	1% for modulation index 0.5
BLE Carrier frequency offset and drift (TRM-LE/CA/BV-06-C, TRM-LE/CA/BV-12-C, TRM-LE/CA/BV-14-C)	
Measurement Configuration	DUT configured to transmit test reference packets Packet payload: 10101010 (BLE and 2LE) Packet payload: 11111111 (BLR S=8)
Displayed Results	Carrier frequency error Frequency drift Drift rate Initial drift rate
Number of Measurement Frequencies	Three, default to RF Test Specification or user defined
Measurement Range	RF input: –35 to +20 dBm Frequency: 500 kHz
Frequency Resolution	1 kHz
Accuracy	500 Hz ±frequency standard
BLE Receiver sensitivity (RCV-LE/CA/BV-01-C, RCV-LE/CA/BV-08-C, RCV-LE/CA/BV-26-C, RCV-LE/CA/BV-27-C)	
Measurement Configuration	EUT configured to receive test reference packets Packet payload: PRBS9 Full support of dirty transmitter as defined in test specification
Displayed Results	Receiver PER. Requires EUT to support HCI or 2-Wire interface for automated PER results
Number of Measurement Frequencies	Three, default to RF Test Specification or user defined
Output Power Range	–90 to 0 dBm, resolution: 0.1 dB
Output Power Accuracy	±1 dB (–80 to 0 dBm)

Continued on next page

Characteristic/Parameter	Specification
BLE Maximum input signal level (RCV-LE/CA/BV-06-C, RCV-LE/CA/BV-12-C)	
Measurement Configuration	DUT configured to receive test reference packets Packet payload: PRBS9
Displayed Results	Receiver PER. Requires DUT to support HCI or 2-Wire interface for automated PER results
Number of Measurement Frequencies	Three, default to RF Test Specification or user defined
Output Power Range	–90 to 0 dBm, resolution: 0.1 dB
Output Power Accuracy	±1 dB (–80 to 0 dBm)
BLE PER Report Integrity (RCV-LE/CA/BV-07-C, RCV-LE/CA/BV-13-C, RCV-LE/CA/BV-30-C, RCV-LE/CA/BV-31-C)	
Measurement Configuration	DUT configured to receive test reference packets Packet payload: PRBS9 CRC corruption: Alternate packets Number of test packets: Random [100 ≤ RND ≤ 1500]
Displayed Results	Receiver PER. Requires DUT to support HCI or 2-Wire interface for automated PER results
Number of Measurement Frequencies	One, default to RF Test Specification or user defined
Output Power Range	–90 to 0 dBm, resolution: 0.1 dB
Output Power Accuracy	±1 dBm (–80 to 0 dBm)

Signal Generator

Characteristic/Parameter	Specification
Frequency	
Frequency Range	2.4 GHz to 2.5 GHz
Frequency Resolution	1 kHz
Frequency Accuracy	As frequency standard ±500 Hz
Level	
Amplitude Range	–90 to 0 dBm
Amplitude Accuracy	±1 dB (–80 to 0 dBm)
Amplitude Resolution	±0.1 dB
Output Impedance	50Ω (nom.)
Output VSWR	1.5:1 1.3:1 (typ.) Adjacent channels 3 or higher –40 dBc
GFSK Modulation	
Modulation Index	Variable, 0.25 to 0.50 (125 kHz to 250 kHz)
Modulation Index Resolution	0.01
Modulation Index Accuracy	1% (nom.) for modulation index = 0.32
Baseband Filter	BT = 0.5
π/4DQPSK Modulation	
Modulation Index Accuracy	<5% RMS DEVM
Baseband Filter	BT = 0.4
8DPSK Modulation	
Modulation Index Accuracy	<5% RMS DEVM
Baseband Filter	BT = 0.4

Measuring Receiver

Characteristic/Parameter	Specification
Frequency	
Frequency Range	2.4 GHz to 2.5 GHz
Frequency Resolution	1 kHz
Frequency Accuracy	As frequency standard ±500 Hz
Level	
Range	–55 to +22 dBm (average power)
Power Measurement Accuracy	±1 dB (–35 to +20 dBm)
Input VSWR	1.5:1
Damage Level	+25 dBm
Resolution	0.1 dB
GFSK Modulation	
Deviation Measurement Range	0 to 350 kHz (peak power)
Accuracy	1% for modulation index 0.32

EUT Control Interface

Characteristic/Parameter	Specification
RS232 HCI Commands	The EUT control interface provides RS232 HCI commands to the EUT through a standard RS232 interface. The interface meets the requirements of the Bluetooth specification for HCI UART transport layer. An RS232 cable is supplied.
USB HCI Commands	The EUT control interface provides USB HCI commands to the EUT through a standard USB interface. The interface meets the requirements of the Bluetooth specification section H:2. A USB cable is supplied.
2-Wire Control	For test control of Bluetooth Smart or Smart Ready devices the EUT control interface supports the 2-Wire specification
USB to RS232 HCI Command	For use with EUTs fitted with USB to RS232 FTDI chips

Audio Specifications

Characteristic/Parameter	Specification
Number of SCO Channels Supported	3
Codec Air Interfaces Supported	CVSD, A-Law, µ-Law
Frequency Response	(–3 dB) measured CODEC in to CODEC out: 160 Hz to 3.5 kHz. Measured with 50Ω source impedance and 10MΩ load impedance
Maximum Input/Output Signal Level	3.4 V_{pk-pk} = 1.2 V RMS
Distortion/Noise	A law: –37 dB (typical) (1 kHz, 1 V RMS) µ law: –37 dB (typical) (1 kHz, 1 V RMS) CVSD: –30 dB (typical) (300 Hz, 1 V RMS)
Input/Output Connectors	3.5 mm audio jack plugs (one for each SCO channel)
Input Impedance	20kΩ
Minimum Output Load	600Ω
Internal Audio Source	1 kHz fixed frequency

Adaptive Frequency Hopping (MT8852B-015)

Supported in ACL and SCO connections

Characteristic/Parameter	Specification
Displays	Active channel vs. time, FER vs. time
Other Features	ACL connection timer, resolution: 1 ms

Electrical Characteristics

Characteristic/Parameter	Specification
Frequency Standard	
Frequency	10 MHz
Temperature Stability	±0.5 ppm (–10° to +85°C)
Aging (1st year)	±1.0 ppm
Aging (over 10 years)	±2.5 ppm (including year 1)
Rear Panel Connectors	
External Frequency Standard Input	Rear panel, BNC connector, 50Ω, 1 V
Output 1	TTL output for TX ON, TX DATA, RX DATA, and correlator
Output 2	TTL output for RX ON, TX DATA, RX DATA, and correlator
Input 1	For service use only
GPIB	
IEEE 488.2	Offers full instrument control as standard
RS232	
RS232	Offers full instrument control as standard

General

Characteristic/Parameter		Specification
Power Supply		
Rated Voltage		100 V(ac) to 120 V(ac)/200 V(ac) to 240 V(ac)
Rated Frequency		50 Hz/60 Hz
Power Consumption		150 VA Max.
Environmental		
Operating Temperature		+5° to +40°C
Operating Humidity		20 to 75%
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581
Dimensions and Mass		
Dimensions		216.5 (W) × 88 (H) × 380 (D) mm
Mass		<3.8 kg

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Model/Order No.	Description
	Main frame
MT8852B	Bluetooth Test Set with EDR and Audio
MT8852B-040	Bluetooth Test Set with no EDR and no Audio
MT8852B-041	Bluetooth Test Set with no EDR and with Audio
MT8852B-042	Bluetooth Test Set with EDR and no Audio
MT8852B-043	Bluetooth Test Set with Low Energy Measurements only
	Standard accessories
	MT8852B Bluetooth Test Set Operation Manual
	MT8852B Bluetooth Test Set Operation Manual Remote Control
J1783A	USB HCI control interface lead
J1784A	RS232 HCI Control Interface Lead
J1785A	RS232 Cable for Firmware Updates
	Power Cord
	BlueSuite Software (Standard version)
	Bluetooth Low Energy Measurement Software application
	MT8852B Bootloader
J1786A	3.5 mm Jack Plugs (Qty. 3, Audio Version Only)
	Options and accessories
MT8852B-015	Adaptive Frequency Hopping option
MT8852B-017	IQ data output
MT8852B-027	Bluetooth low energy measurements
MT8852B-034*1	BLE Data Length Extension Option
MT8852B-035*1, *2	BLE 2LE Option (2 Mbps Low Energy)
MT8852B-036*1, *2, *3	BLE BLR Option (Bluetooth Long Range)
MT8852B-070	Platform Enhancement Option
MT8852B-315*4	Retrofit Adaptive Frequency Hopping option
MT8852B-317*4	Retrofit IQ data output
MT8852B-319*4	Retrofit Audio to MT8852B
MT8852B-325*4	Retrofit EDR to MT8852B
MT8852B-327	Retrofit Bluetooth low energy measurements
MT8852B-330	Retrofit Basic Rate Measurement to MT8852B
MT8852B-334*1	Retrofit BLE Data Length Extension Option
MT8852B-335*1, *2	Retrofit BLE 2LE Option
MT8852B-336*1, *2, *3	BLE BLR Option Retrofit
MT8852B-170	Platform Enhancement Option Retrofit (For units where the first three characters of the serial number are not "6A6 or 626")
MT8852B-270	Platform Enhancement Option Retrofit (For units where the first three characters of the serial number are not "6A6 or 626" (FO))
MT8852B-370	Platform Enhancement Option Retrofit (For units where the first three characters of the serial number are "6A6 or 626")
MX885201B	BlueSuite Pro3 software application
MX885201B-301	BlueSuite Pro2 to Pro3 Upgrade
Z1992A	2.4 GHz Antenna and Adapter
B0748A	Soft Carry Bag
B0749A	Rack Mount Kit
J0006	GP-IB CABLE, 0.5M
J0007	GPIB CABLE, 1.0M
J0008	GPIB CABLE, 2.0M
J0127A	COAXIAL CORD, 1.0M
J0127B	COAXIAL CORD, 2.0M
J0127C	COAXIAL CORD, 0.5M

*1: MT8852B-034 (334) requires MT8852B-027 (327) or MT8852B-043.

*2: MT8852B-035 (335) and MT8852B-036 (336) requires MT8852B-034 (334).

*3: MT8852B-036 (336) requires MT8852B-070 (270, 370).

*4: When installing MT8852B-315/317/319/325 to MT8852B-043, MT8852B-330 is necessary.

Wireless Connectivity Test Set

MT8862A

2.4 GHz/5 GHz bands

Remote Control
Ethernet

Ideal for RF TRx Tests of WLAN Devices

Excellent Eco Product

RF TRx Measurements of WLAN Equipment

The Wireless Connectivity Test Set MT8862A is designed for measuring the RF TRx characteristics of WLAN equipment. It has standard WLAN protocol messaging (WLAN signalling) to connect with the device under test (DUT) for measuring the TRx performance items as Network Mode.

Supported Communications Standards • Security encryption

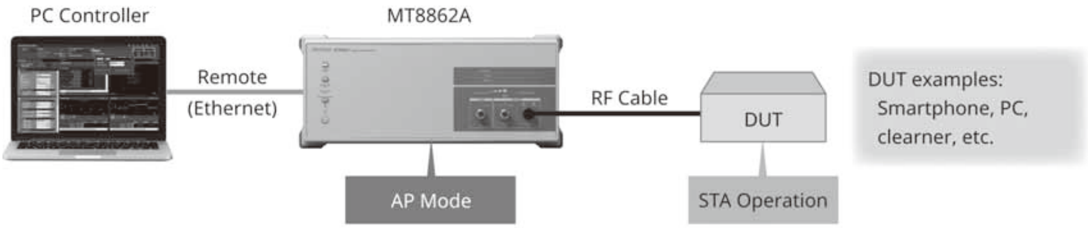
WLAN IEEE802.11a/b/g/n/ac (2.4 GHz and 5 GHz bands) [AP/STA]
WEP, WPA-Personal, and WPA2-Personal

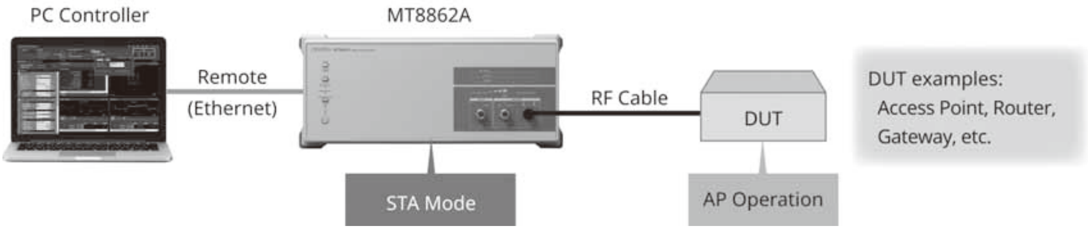
RF Performance Measurement under Actual Operation Conditions (Network Mode)

By using the MT8862A Network Mode, RF TRx characteristics, such as Tx power, modulation accuracy (EVM), etc., can be measured with the WLAN device in actual operation conditions. It is not necessary to put the DUT into dedicated test mode and directly control the DUT.
The DUT RF performance can be quantified under the firmware conditions at actual shipment.

Easy Measurement Environment Configuration

The MT8862A can simulate access points (AP) and station (STA) to establish the DUT network connection using IEEE802.11a/b/g/n/ac WLAN protocol messaging. Each WEP, WPA-Personal and WPA2-Personal secure connection method is supported, and TKIP and AES encryption schemes can be selected by combination with each standard. When the connection is established, RF measurements can be made using general WLAN communications procedures without requiring special tools and control procedures, eliminating the need for configuring a special measurement environment.

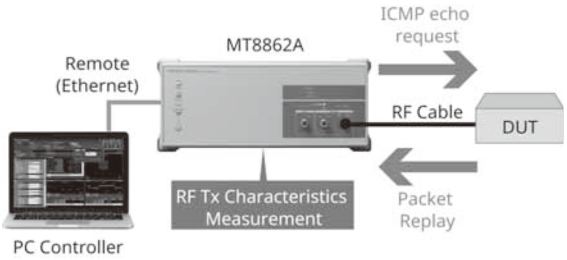




WLAN Measurement Software MX886200A Features

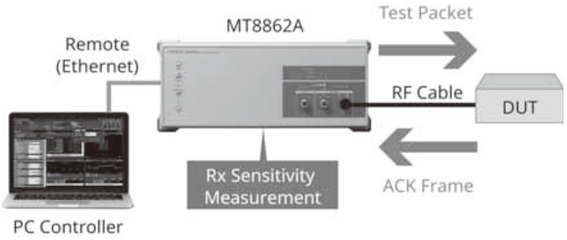
ICMP Echo Request for Tx Measurement

With the ICMP echo request, the MT8862A can measure RF Tx characteristics of reply packets from the DUT. The measurement targets are both data frames and ACK frames.



Rx Sensitivity Measurements using ACK Frame Count for Bathtub Curve Generation

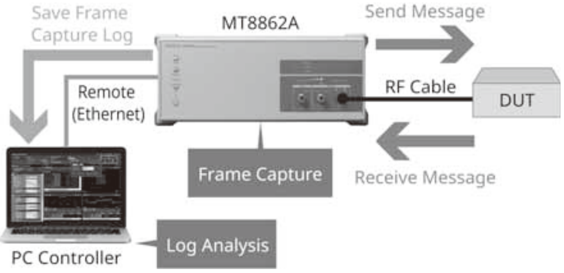
The MT8862A supports Rx sensitivity measurements using the ACK frame count; counting the ACK frames sent by the DUT versus the test packets sent from the MT8862A supports calculation of the packet error rate (PER). Packets can be sent while lowering the power level by setting the power level range (0 to −120 dBm) and step size, and the Rx sensitivity Bathtub curve can be generated automatically. Packets including MAC address and payload length can be configured in real-time for measurement at various data rates.



Function Test

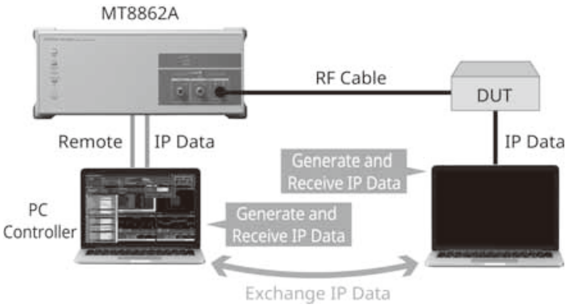
Frame Capture Logging for Troubleshooting Connection Problems

With built-in frame capture logging function, the MT8862A can capture and save frame logs for troubleshooting DUT connection problems. Captured logs are in the *.pcap format for viewing by supported applications, making it easier to analyze DUT connection problems.



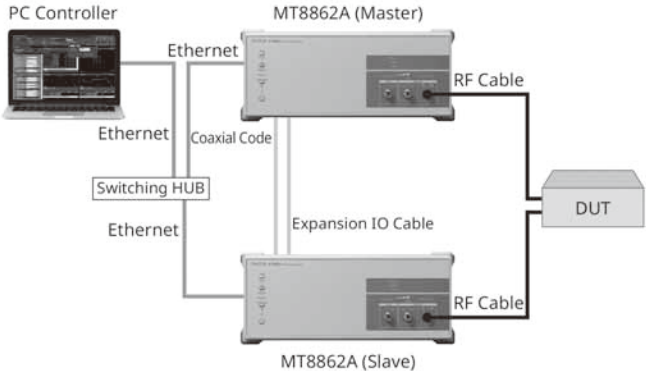
IP Data Transfer using Connection Verification Test

The Ethernet port on the back panel of the MT8862A can be used for exchanging IP data with an external server; IP connections between the client PC connected to the DUT and the external server connected to the MT8862A can be checked using the ping function, etc.



Receiver Sensitivity and Transmit Power Measurement Function for 2×2 MIMO

Receiver sensitivity and transmit power measurement under 2×2 MIMO communication can be tested by using 2 sets of MT8862A. This is suitable for RF performance evaluation for completed products.

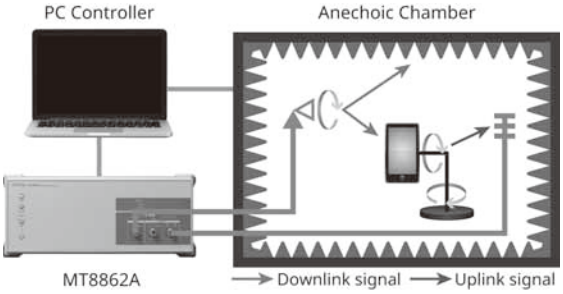


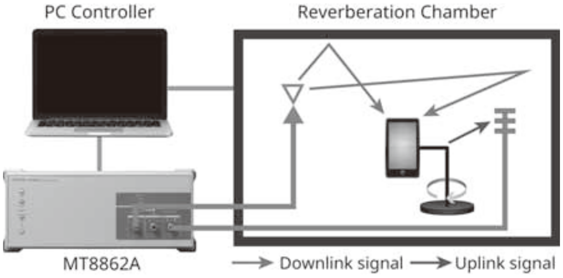
Application Test

Network Mode for Over The Air (OTA) Test

The TRx performance of wireless terminals is affected by factors such as the terminal form and antenna characteristics. The OTA test measures the general TRx performance of the wireless terminal using actual radio waves. The WLAN OTA test measures RF performance specifications in accordance with the recommendations of CTIA* and the Converged Wireless Group (CWG) of the Wi-Fi Alliance, including Total Radiated Power (TRP), Total Isotropic Sensitivity (TIS), System integrators have test solution using MT8862A.

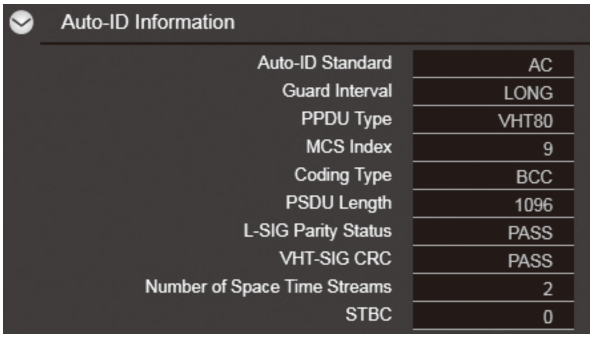
*: Cellular Telecommunications & Internet Association; international non-profit organization composed of wireless-communications-related businesses, manufacturers, service providers, etc.





Auto-ID information display

MT8862A displays header information of packets used for transmit measurement as Auto-ID Information.



Auto-ID Information

Auto-ID Standard	AC
Guard Interval	LONG
PPDU Type	VHT80
MCS Index	9
Coding Type	BCC
PSDU Length	1096
L-SIG Parity Status	PASS
VHT-SIG CRC	PASS
Number of Space Time Streams	2
STBC	0

WLAN Measurement Software MX886200A Key Functions

RF Tx Test

Tx Power Measurement and Power Profile Display

The MT8862A measures the Tx power and displays the average and peak power. The crest factor indicating the difference between the average power and peak power and the power-on ramp time and power-off ramp time indicating the time of ringing and falling are also displayed. The power profile is displayed as a graph of the power vs time for the signal.

Output Power Measurements

Transmit Power

	Average	Maximum	Minimum
Gate1 Average Power [dBm]	0.38	0.38	0.38
Gate1 Peak Power [dBm]	9.21	9.21	9.21

Crest Factor

	Average	Maximum	Minimum
Gate1 [dB]	8.83	8.83	8.83

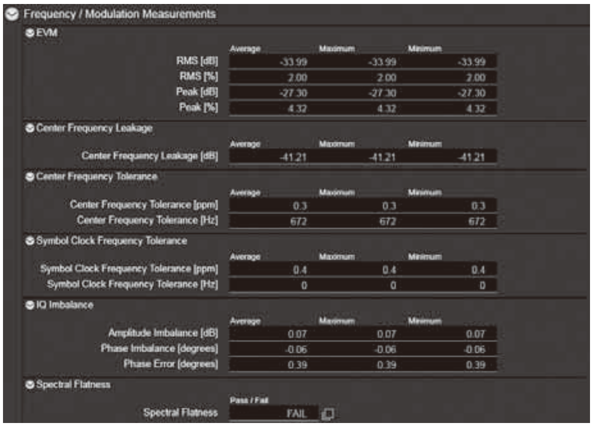
Power Ramp

	Average	Maximum	Minimum
Power-on Ramp Time [us]	0.09	0.09	0.09
Power-down Ramp Time [us]	0.11	0.11	0.11

Frequency and Modulation Analysis/IQ Constellation Display/Spectrum Display

The MT8862A performs frequency and modulation analyses to measure the Error Vector Magnitude (EVM), which is a good of overall indicator of transmitter quality. When the numerical EVM is bad, the Packet Error Rate (PER) is usually high at WLAN connection. The RMS EVM and Peak EVM for DSSS- and OFDM-modulated carrier waves are expressed as % and dB values, respectively.

In case of OFDM modulation, in addition to EVM, Center Frequency Leakage, Center Frequency Tolerance, Symbol Clock Frequency Tolerance, IQ Imbalance, and Spectral Flatness are also displayed. In case of DSSS modulation, in addition to EVM, Center Frequency Tolerance, IQ Offset, Phase & Magnitude Error, IQ Imbalance, Chip Clock Frequency Tolerance, and Carrier Suppression from IQ Offset are also displayed. Furthermore, the IQ constellation, spectrum flatness, and spectrum analysis results are displayed as graphs.



Frequency / Modulation Measurements

EVM

	Average	Maximum	Minimum
RMS [dB]	-33.99	-33.99	-33.99
RMS [%]	2.00	2.00	2.00
Peak [dB]	-27.30	-27.30	-27.30
Peak [%]	4.32	4.32	4.32

Center Frequency Leakage

	Average	Maximum	Minimum
Center Frequency Leakage [dB]	-41.21	-41.21	-41.21

Center Frequency Tolerance

	Average	Maximum	Minimum
Center Frequency Tolerance [ppm]	0.3	0.3	0.3
Center Frequency Tolerance [Hz]	672	672	672

Symbol Clock Frequency Tolerance

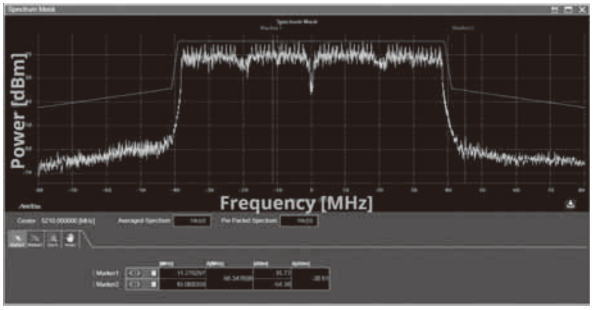
	Average	Maximum	Minimum
Symbol Clock Frequency Tolerance [ppm]	0.4	0.4	0.4
Symbol Clock Frequency Tolerance [Hz]	0	0	0

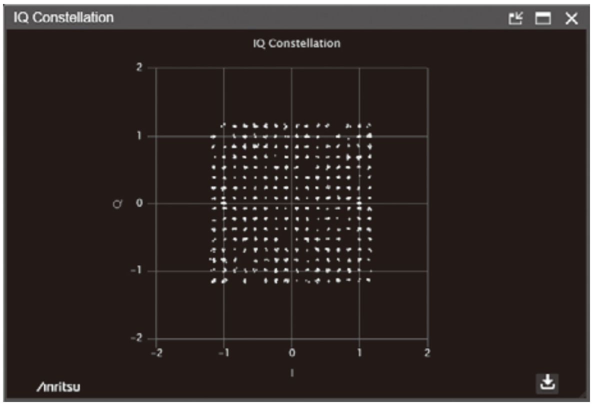
IQ Imbalance

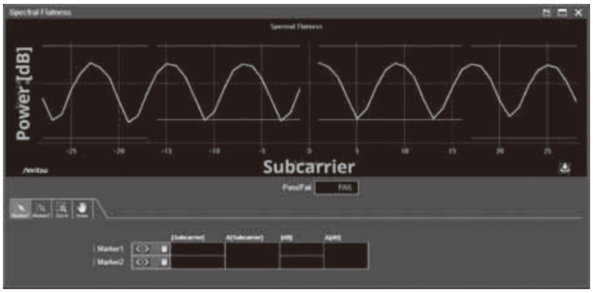
	Average	Maximum	Minimum
Amplitude Imbalance [dB]	0.07	0.07	0.07
Phase Imbalance [degrees]	-0.06	-0.06	-0.06
Phase Error [degrees]	0.39	0.39	0.39

Spectral Flatness

	Pass / Fail
Spectral Flatness	FAIL







RF Rx Test

Packet Error Rate (PER)

The MT8862A Network Mode is a unique function that can use general communication method and instead automatically implements the 802.11a/b/g/n/ac device sensitivity search measurement to output the Bathtub curve. By using this function, the device performance can be analyzed at high speed for each data rate, offering a convenient measurement solution for verifying compliance with the 802.11b minimum receiver sensitivity test specifications. This is a flexible test solution because the number of packets sent at each power level can be specified both as the start and stop search level and as step size.

Frame Rx rate (FRR)

The Frame Rx Rate can be displayed instead of displaying the Packet Rx Error Rate (PER).

WLAN Measurement Software MX886200A Measurement Items

Tx Measurements

IEEE802.11-2012: 802.11b Tx Measurements

802.11b	Measurement Item
17.4.7.2	Transmit power levels
17.4.7.4	Transmit spectral mask
17.4.7.5	Transmit center frequency tolerance
17.4.7.6	Chip clock frequency tolerance
17.4.7.7	Transmit power-on and power-down ramp
17.4.7.9	Transmit modulation accuracy

Other 802.11b Measurements

Measurement Item
Transmit power
Crest Factor
EVM (Transmit modulation accuracy)
Center frequency tolerance
IQ Offset
Phase Error
Magnitude Error
Amplitude Imbalance
Phase Imbalance
Chip clock frequency tolerance
Carrier Suppression from IQ Offset

Graph Display (DSSS)

Measurement Item
IQ Constellation
Power Profile
Spectrum

IEEE802.11-2012: 802.11a/g/n Tx Measurements, IEEE802.11ac-2013: 802.11ac Tx Measurements

802.11a	802.11g	802.11n	802.11ac*1	Measurement Item
18.3.9.2	19.4.8.2	20.3.20.3	N/A	Transmit power levels
18.3.9.3	19.5.5	20.3.20.1	22.3.18.1	Transmit spectrum mask*2
18.3.9.5	19.4.8.3	20.3.20.4	22.3.18.3	Transmit center frequency tolerance
18.3.9.6	19.4.8.4	20.3.20.6	22.3.18.3	Symbol clock frequency tolerance
18.3.9.7.2	18.3.9.7.2	20.3.20.7.2	22.3.18.4.2	Transmitter center frequency leakage
18.3.9.7.3	18.3.9.7.3	20.3.20.2	20.3.18.2	Transmitter spectral flatness
18.3.9.7.4	18.3.9.7.4	20.3.20.7.3	22.3.18.4.3	Transmitter constellation error
18.3.9.8	18.3.9.8	20.3.20.7.4	22.3.18.4.4	Transmitter modulation accuracy test

*1: 802.11ac Tx measurement requires MX886200A-001
*2: Frequency SPAN of 802.11ac supports up to ±80 MHz

Other 802.11a/g/n/ac Measurements

Measurement Item
Transmit power
Crest Factor
EVM (Transmit modulation accuracy)
Center frequency tolerance
Symbol clock frequency tolerance
Amplitude Imbalance
Phase Imbalance
Phase Error

Graph Display (OFDM)

Measurement Item
IQ Constellation
Power Profile
Spectrum

Rx Measurements

IEEE802.11-2012: 802.11b Rx Measurements

802.11b	Measurement Item
17.4.8.2	Receiver minimum input level sensitivity
17.4.8.3	Receiver maximum input level
17.4.8.4	Receiver adjacent channel rejection*

*: Sold separately; requires signal generator

IEEE802.11-2012: 802.11a/g/n Rx Measurements; IEEE802.11ac-2013: 802.11ac Rx Measurements

802.11a	802.11g	802.11n	802.11ac*1	Measurement Item
18.3.10.2	19.5.2	20.3.21.1	22.3.19.1	Receiver minimum input level sensitivity
18.3.10.3	19.5.3	20.3.21.2	22.3.19.2	Adjacent channel rejection*2
18.3.10.4	18.3.10.4	20.3.21.3	22.3.19.3	Nonadjacent channel rejection*2
18.3.10.5	19.5.4	20.3.21.4	22.3.19.4	Receiver maximum input level

*1: 802.11ac Rx measurement requires MX886200A-001
*2: Sold separately; requires signal generator

Graph Display

Measurement Item
Packet Error Rate (PER)
Frame Reception Rate (FRR)

WLAN Measurement Software MX886200A Connectivity

Connectivity

	802.11a
Frequency Range	5180 MHz to 5825 MHz
Operation Mode	—
Modulation	OFDM (BPSK, QPSK, 16QAM, 64QAM)
Data Rate	6, 9, 12, 18, 24, 36, 48, 54 Mbps
Security[*2]	WEP, WPA-Personal, WPA2-Personal

	802.11b	802.11g
Frequency Range	2412 MHz to 2484 MHz	
Operation Mode	—	ERP-OFDM
Modulation	DSSS, CCK	OFDM (BPSK, QPSK, 16QAM, 64QAM)
Data Rate	1, 2, 5.5, 11 Mbps	6, 9, 12, 18, 24, 36, 48, 54 Mbps
Security[*2]	WEP, WPA-Personal, WPA2-Personal	

	802.11n	802.11ac[*1]
Frequency Range	2412 MHz to 2484 MHz and 5180 MHz to 5825 MHz	5180 MHz to 5825 MHz
Bandwidth	20 MHz, 40 MHz	20, 40, 80 MHz
MCS	MCS0 to MCS7, MCS0 to MCS15[*3]	MCS0 to MCS9[*5]
FEC	BCC	BCC
PPDU Format	HT-mixed, HT-greenfield[*4]	VHT
Guard Interval Type	Long, Short	Long, Short
RF Chain	Single (SISO), 2×2 MIMO[*3]	Single (SISO), 2×2 MIMO[*3]
Security[*2]	WPA-Personal, WPA2-Personal	

*1: 802.11ac connection requires MX886200A-001
*2: Secure connections require the MX886200A-020
*3: Available when measure 2×2 MIMO receiver sensitivity using MX886200A-010.
*4: Only receiver sensitivity testing is supported in 2×2 MIMO.
*5: MCS9 is only available on 40 MHz or 80 MHz bandwidth.

Wireless Connectivity Test Set MT8862A Configuration

System Configurations/Options/Software/PC Controller Operation Environment

System	Wireless LAN
Main Frame	Wireless Connectivity Test Set MT8862A
Basic Configuration (Hardware)	RF Frequency 2.4 GHz, 5 GHz MT8862A-001
Basic Configuration (Software)	WLAN Measurement Software MX886200A
Options	WLAN 802.11ac Option MX886200A-001 2×2 MIMO Measurement Software MX886200A-010 WLAN Security Function MX886200A-020

Verified PC Operation Environment

PC	Software OS: Windows 7 or 10 Browser: Chrome CPU: Intel Core i5 processor Clock: 2.5 GHz Memory: 1 GB minimum Hard Disk: 500 MB minimum free space LAN: 100 Base-T LAN (1000-base T preferred)
Peripherals	Display: WXGA 1024 × 768 minimum

Wireless Connectivity Test Set MT8862A Specifications

Typical value: Reference data and not assured value

Receiver	Frequency Range: 2.4 GHz to 2.5 GHz, 5.0 GHz to 6.0 GHz (with MT8862A-001 installed) Resolution: 1 Hz Accuracy: Depends on reference oscillator accuracy Level Setting Range: –65 to +25 dBm Setting Resolution: 0.1 dB Accuracy Measurement Conditions: CW, Measurement Bandwidth: 300 kHz, 20° to 30°C 2.4 GHz ≤ Frequency ≤ 2.5 GHz ±0.7 dB (–30 dBm ≤ Setting Level ≤ +25 dBm) ±0.9 dB (–55 dBm ≤ Setting Level < –30 dBm) ±1.1 dB (–65 dBm ≤ Setting Level < –55 dBm) 5.0 GHz ≤ Frequency ≤ 6.0 GHz ±0.7 dB (–30 dBm ≤ Setting Level ≤ +25 dBm) ±0.9 dB (–55 dBm ≤ Setting Level < –30 dBm) ±1.1 dB (–65 dBm ≤ Setting Level < –55 dBm) Measurement Conditions: CW, Measurement Bandwidth: 160 MHz, 20° to 30°C 2.4 GHz ≤ Frequency ≤ 2.5 GHz ±0.7 dB (–30 dBm ≤ Setting Level ≤ +25 dBm) ±1.0 dB (–50 dBm ≤ Setting Level < –30 dBm) 5.0 GHz ≤ Frequency ≤ 6.0 GHz ±0.7 dB (–30 dBm ≤ Setting Level ≤ +25 dBm) ±1.0 dB (–50 dBm ≤ Setting Level < –30 dBm) Linearity Measurement Conditions: CW, Measurement Bandwidth: 300 kHz, 0 dB ≤ Setting Level ≤ –40 dB ±0.2 dB (–55 dBm ≤ Input Level) ±0.4 dB (–65 dBm ≤ Input Level < –55 dBm) Measurement Conditions: CW, Measurement Bandwidth: 160 MHz, 0 dB ≤ Setting Level ≤ –30 dB ±0.4 dB (–40 dBm ≤ Input Level)

Continued on next page

Transmitter	Frequency Output Frequency Range: 2.4 GHz to 2.5 GHz, 5.0 GHz to 6.0 GHz (with MT8862A-001 installed) Setting Resolution: 1 Hz Accuracy: Depends on reference oscillator accuracy Level Setting Range: –120 to 0 dBm Setting Resolution: 0.1 dB Accuracy Output Setting: CW 20° to 30°C, Output Level: ≥–110 dBm, after Calibration ±1.0 dB, ±0.7 dB (typ.) (2.4 GHz ≤ Frequency ≤ 2.5 GHz) ±1.3 dB, ±1.0 dB (typ.) (5.0 GHz ≤ Frequency ≤ 6.0 GHz) Signal Purity Harmonic: ≤–25 dBc
Reference Oscillator	At Start: ±5 × 10^{-7} (2 minutes after power-on, at 25°C referenced to frequency at 24 hour after power-on) ±5 × 10^{-8} (5 minutes after power-on, at 25°C referenced to frequency at 24 hour after power-on) Aging Rate: ±1 × 10^{-7}/year Temperature Characteristics: ±2 × 10^{-8} (5° to 45°C) Shipped Frequency Accuracy: ±2.2 × 10^{-8} (1 hour after power-on at 20° to 30°C)
Front Panel Connectors	RF Input/Output Main1, 2 Connector: N-J, 50Ω (nominal) VSWR: ≤1.5 (2.4 GHz ≤ Frequency ≤ 2.5 GHz) ≤1.7 (5.0 GHz ≤ Frequency ≤ 6.0 GHz) Aux Out Connector: N-J, 50Ω (nominal) VSWR: ≤1.5 (2.4 GHz ≤ Frequency ≤ 2.5 GHz) ≤1.6 (5.0 GHz ≤ Frequency ≤ 6.0 GHz)
Back Panel Connectors	Reference Signal External Reference Input Connector: BNC-J Frequency: 10 MHz, Impedance: 50Ω Operation range: ±1 ppm, Input Level: –15 dBm ≤ Level ≤+20 dBm, 50Ω (AC coupled) Reference Signal Output Connector: BNC-J Frequency: 10 MHz, Impedance: 50Ω Output Level: ≥0 dBm (AC coupled)) External Trigger Trigger Input 1/2 Connector: BNC 1/2, Input Level: TTL Trigger Output 1/2 Connector: BNC 1/2, Output Level: TTL External Interfaces Ethernet (Remote): Required for remote control from external controller Connector: RJ-45, Speed: 1000BASE-T USB: General Purpose, USB 2.0 Connector: USB-A, 2 Ports Expansion I/O: Connector for function expansion Connector: 50 pin (DX10A-50S) Ethernet (IP Data): IP Data Transfer Connector: RJ-45, Speed: 1000BASE-T
Dimensions and Mass	426 (W) × 177 (H) × 390 (D) mm (excluding projections), ≤14 kg
Power Supply	Rated voltage: 100 V(ac) to 120 V(ac) or 200 V(ac) to 240 V(ac) Rated frequency: 50 Hz/60 Hz Power consumption: ≤350 VA
Operating Conditions	Temperature Operating: +5° to +45°C, Storage: –20° to +60°C
CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN61010-1 RoHS: 2011/65/EU, EN50581

WLAN Measurement Software MX886200A Specifications

Frequency Range	2.4 GHz Band: 2412 MHz to 2484 MHz 5 GHz Band: 5180 MHz to 5825 MHz
Amplitude Measurement	Input Level Range: –50 to +25 dBm Input Level Accuracy: ±0.7 dB (–30 dBm ≤ Input Level ≤+25 dBm), ±1.0 dB (–50 dBm ≤ Input Level <–30 dBm), After Calibration at 20° to 30°C Linearity: ±0.4 dB (–40 dBm ≤ Input Level, 0 to –30 dB range compared to setting level) Bandwidth: 40 MHz/20 MHz (802.11n), 20 MHz (802.11a/b/g), 80/40/20 MHz (802.11ac, with MX886200A-001 installed)
Spectrum Measurement	Input Level Range: –10 to +25 dBm
EVM (Modulation Accuracy)	EVM Measurement Range: –20 to +25 dBm Residual EVM DSSS: <–28 dB (–20 dBm ≤ Input Level, Average of 20 Packets) OFDM (802.11a/g/n): <–40 dB (–20 dBm ≤ Input Level, Average of 20 Packets, Channel Estimate: Full Packets) OFDM (802.11ac, with MX886200A-001 installed): <–38 dB (–10 dBm ≤ Input Level, Average of 20 Packets, Channel Estimate: Full Packets) EVM Data Format: % or dB Measurement Resolution: 0.01% or 0.01 dB
Carrier Frequency Measurement	Measurement Level Range: –20 to +25 dBm Carrier Frequency Accuracy: ± (Setting Frequency × Reference Oscillator Accuracy +1 kHz) (Average of 20 Packets, DSSS) ± (Setting Frequency × Reference Oscillator Accuracy +1 kHz) (Average of 20 Packets, Channel Estimate: Full Packets, OFDM)
RF Signal Generator	EVM: Packet Length 1472 byte 802.11b: ≤–38 dB rms (2412 MHz to 2484 MHz, Long Preamble, Gaussian Filter BT0.5, 5° to 45°C) 802.11g (OFDM): ≤–40 dB rms(2412 MHz to 2484 MHz, 20° to 30°C) 802.11a: ≤–38 dB rms (5180 MHz to 5825 MHz) 802.11n: ≤–40 dB rms (2412 MHz to 2484 MHz, Long GI, HT-mixed format, Channel Bandwidth 40 MHz, 20° to 30°C) ≤–38 dB rms (5180 MHz to 5825 MHz, Long GI, HT-mixed format, Channel Bandwidth 40 MHz, 20° to 30°C) 802.11ac (with MX886200A-001 installed): ≤–37 dB rms (5180 MHz to 5825 MHz, Long GI, Channel Bandwidth 80 MHz, 20° to 30°C)
Functions	Network Functions Connection: Network Connection using Messages defined by IEEE802.11 Role: Access Point (AP/STA) Frame Capture: 1, 2, 4, 8, 16, 32, 64, 128, 256 MB Tx Test Measurement Type: Data, ACK Rx Test Measurement Type: Packet Error Rate (PER), Frame Reception Rate (FRR) Payload Type: All 0's, 0101, 1010, PN7, PN9, Random, Counting MIMO signal transmission (with MX886200A-010) – MIMO signals available for receiver testing. Spatial stream N_{SS}: 1 to 2 Space-time-stream N_{STS}: 1 to 2 RF chain N_{TX}: 2 STBC: Supported only with N_{SS} = 1 and N_{STS} = 2 Spatial mapping: Direct mapping Beamforming: Not supported Security encryption (with MX886200A-020 installed) WEP, WPA-Personal, WPA2-Personal

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main Frame
MT8862A	Wireless Connectivity Test Set
	Standard Accessories
J0017F	Power Code: 1
	DVD (Operation Manual): 1
W3901AE	MT8862A Operation Manual (Operation) [DVD]
W3902AE	MT8862A Operation Manual (Remote Control) [DVD]
W3903AE	MX886200A WLAN Measurement Software Manual (Operation) [DVD]
W3904AE	MX886200A WLAN Measurement Software Manual (Remote Control) [DVD]
	Options
MT8862A-001	RF Frequency 2.4 GHz, 5 GHz
	Software Options
MX886200A	WLAN Measurement Software (Requires MT8862A-001)
MX886200A-001	WLAN 802.11ac Option
MX886200A-010	2×2 MIMO Measurement Software
MX886200A-020	WLAN Security Function
	Options
MT8862A-ES210	2 Years Extended Warranty Service
MT8862A-ES310	3 Years Extended Warranty Service
MT8862A-ES510	5 Years Extended Warranty Service

Model/Order No.	Name
	Application Parts
J0127A	Coaxial Cord, 1 m (BNC-P, RG-58A/U, BNC-P)
J0127B	Coaxial Cord, 2 m (BNC-P, RG-58A/U, BNC-P)
J0127C	Coaxial Cord, 0.5 m (BNC-P, RG-58A/U, BNC-P)
J0576B	Coaxial Cord, 1 m (N-P, 5D-2W, N-P)
J0576D	Coaxial Cord, 2 m (N-P, 5D-2W, N-P)
J0322A	Coaxial Cord, 0.5 m (SMA-P, SMA-P)
J0322B	Coaxial Cord, 1.0 m (SMA-P, SMA-P)
J0322C	Coaxial Cord, 1.5 m (SMA-P, SMA-P)
J0322D	Coaxial Cord, 2.0 m (SMA-P, SMA-P)
J0004	Coaxial Adapter (N-P, SMA-J)
J1261A	Ethernet Cable (Straight, 1 m)
J1261B	Ethernet Cable (Straight, 3 m)
J1261C	Ethernet Cable (Cross, 1 m)
J1261D	Ethernet Cable (Cross, 3 m)
J1777A	Expansion IO Cable
B0635A	Rack Mount Kit (EIA)
B0657A	Rack Mount Kit (JIS)
B0636C*	Carrying Case (Hard type, with a front cover and casters)
B0671A	Front Cover (1MW4U)

*: The Carrying Case B0636C includes a Front Panel Protective Cover (B0671A).

PIM Master™ Available with Cable & Antenna Analyzer Option

MW82119B PIM Master™

Remote Control
Ethernet | **USB**

Passive Intermodulation Analyzer with Site Master™ Option

Anritsu introduces the first fully integrated Passive Intermodulation (PIM) Analyzer plus Cable and Antenna Analyzer (Option 331) suitable for commissioning and maintaining global wireless networks. This high performance, battery operated unit allows operators to fully characterize infrastructure quality by measuring Return Loss, VSWR, Cable Loss, Passive Intermodulation, Distance-to-Fault, and Distance-to-PIM with a single test instrument.

Passive Intermodulation (PIM) Analyzer Highlights

- PIM vs. Time, Swept PIM, Noise Floor, Distance-to-PIM
- 3rd, 5th, and 7th order intermodulation products
- 2nd order intermodulation products with Option 902
- Test power: 20 to 46 dBm
- Residual PIM: –125 dBm (typ.)

Cable and Antenna Analyzer (Option 331)

- Measurements: RL, VSWR, Cable Loss, DTF, Phase
- Frequency range: 2 MHz to 3 GHz
- Sweep Speed: 1 ms/data point (typ.)
- Calibration: OSL and FlexCal™

Capabilities and Functional

- Integrated solution
- Battery operated: >3.0 hour run time
- Display: 8.4 in (213 mm) daylight viewable
- IP54 rated for dust and water spray
- MIL-STD-810G drop test rated
- Stainless steel lifting rings
- Padded soft case for extra protection
- Easy-to-use, menu driven user interface
- Quick Name Matrix simplifies naming in the field
- GPS tag measurements (Option 31)
- High Accuracy Power Meter (Option 19)

Definitions

All specifications and characteristics apply to Revision 2 instruments under the following conditions, unless otherwise stated:

Warm-Up Time	After 10 minutes of warm-up time, where the instrument is left in the ON state.
Typical Performance	Typical specifications in parenthesis () describe performance that will be met by a minimum of 80% of all products. They do not include guard bands and are not warranted. Typical specifications that are not in parenthesis are not tested and not warranted. They are generally representative of the nominal characteristic performance.
Uncertainty	A coverage factor of k = 2 is applied to measurement uncertainties.
Calibration Cycle	Recommended calibration cycle is 12 months. All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site: www.anritsu.com

General Specifications

PIM Master Connectors	PIM Test Port: 7/16 DIN (f) 50Ω Dual USB Type A: 2x Type A (connect USB Flash Drive and USB Power Sensor) USB Mini-B: 1x Mini-B (connect to PC for data transfer) GPS: SMA (f) (with GPS option only) External Power: 2.1 × 5.5 mm barrel connector, 12 VDC to 15 VDC, <5.0 A PIM Test Port Damage Level: +10 dBm (10 mW) continuous, (PIM Rx band) +35 dBm (3 W) continuous, (PIM Tx band)* IM2 In Test Port: Type N (f) 50Ω (Option 902 only) IM2 In Test Port Damage Level: +10 dBm (10 mW) continuous, (IM2 Rx band) VNA Test Port: Type N (f) 50Ω (Option 331) VNA Test Port Damage Level: 40 dBm continuous * Able to survive full reflection of 2 × 46 dBm PIM test tones generated by the MW82119B.
Display	Size: 213 mm (8.4 in) touch screen, Resolution: 800 × 600 Pixel Defects: No more than five defective pixels (99.9989% good pixels)
Battery	Type: Li-Ion Battery Operation: 3.0 hours (typ.) Charging Limits: While charging, battery must be 0° to +45°C, Relative Humidity ≤80%
Power	AC/DC Adapter Input: 100 VAC to 240 VAC, 50 Hz/60 Hz, Output: 12 VDC
CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN61010-1 RoHS: 2011/65/EU Australia and New Zealand: RCM AS/NZS 4417:2012 South Korea: KCC-REM-A21-0004
Environmental	MIL-PRF-28800F Class 2 Operating Temperature Range: –10° to 55°C Storage Temperature Range: –51° to 71°C Maximum Relative Humidity: 95% RH at 30°C, non-condensing Vibration, Sinusoidal: 5 Hz to 55 Hz Vibration, Random: 10 Hz to 500 Hz Half Sine Shock: 30 gn Altitude: 4600 meters, operating and non-operating Explosive Atmosphere: MIL-PRF-28800F, Section 4.5.6.3 MIL-STD-810G, Method 511.5, Procedure 1 Ingress Protection (IP): IP54, IP67 when enclosed in optional transit case
ESD	PIM Test Port Connector Center Pin: Withstands up to ±15 kV VNA RF Out Connector Center Pin: Withstands up to ±15 kV
Dimensions and Mass	350 (W) × 314 (H) × 152 (D) mm (13.8 × 12.4 × 6.0 in) 9.2 kg to 12.4 kg (20 lb to 27 lb), varies by frequency option.

PIM Analyzer Specifications

Measurements	PIM vs. Time Noise Floor Distance-to-PIM Swept PIM
Setup Parameters	Frequency: Carrier F1, Carrier F2, Intermodulation Order Amplitude: Ref Value, Scale, Auto Range (On/Off), Amplitude Tone (On/Off) Setup: Output Power, Test Duration (1 s to 1,200 s) Limit Lines: Limit (Upper/Lower), On/Off, Limit Move, Limit Alarm (On/Off, PASS/FAIL indicator) Markers: Markers 1–6 (On/Off), Delta Markers 1 – 6 (On/Off), Marker to Peak/Valley, All Markers Off GPS: On/Off, 3.3 V/5.0 V DTP: Cable Velocity, Distance Save/Recall: Setups (.stp), Measurements (.pim), Limit Lines (.lim), Screen Shots (.jpg) (save only)
PIM Measurement Ranges	Test Method: Reverse (reflected) Passive Intermodulation (PIM) per IEC-62037-1 Intermodulation Order: 3rd, 5th, and 7th order, when in receive band (user selectable) RF Test Power: Two CW tones 20 to 46 dBm, 0.1 dBm steps, Accuracy ±5 dB (excluding uncertainty) RF Test Frequency: Accuracy: ±1.0 ppm at 23°C Stability: ±1.0 ppm from –10° to +55°C (typ.) Aging: ±1.0 ppm/yr aging (typ.) Residual PIM Performance: <–117 dBm, <–125 dBm (typ.) (2 × 43 dBm test tones) <–134 dBm, <–140 dBm (typ.) (2 × 20 dBm test tones) PIM Measurement Range: –70 to –140 dBm (Revision 1 instruments) –50 to –140 dBm (Revision 2 instruments)

Continued on next page

Option	Band	Frequency Range
Option 600	LTE 600	Tx_1: 617 MHz to 618 MHz, Tx_2: 633 MHz to 652 MHz Rx_1: 663 MHz to 698 MHz, Rx_2: Upper: 1867 MHz to 1888 MHz Please subscript 1 and 2 for Tx and Rx
Option 700	LTE 700	Tx_1: 734 MHz to 734.5 MHz, Tx_2: 746 MHz to 768 MHz Rx_{Lower}: 698 MHz to 717 MHz, Rx_{Upper}: 777 MHz to 806 MHz
Option 701	APT 700	Tx_1: 758 MHz to 776 MHz, Tx_2: 788 MHz to 803 MHz Rx_{Lower}: 710 MHz to 748 MHz, Rx_{Upper}: 825 MHz to 845 MHz
Option 800	LTE 800	Tx_1: 791 MHz to 795 MHz, Tx_2: 811.5 MHz to 821 MHz Rx: 832 MHz to 862 MHz
Option 850	Cellular 850	Tx_1: 869 MHz to 871 MHz, Tx_2: 881.5 MHz to 894 MHz Rx: 824 MHz to 849 MHz
Option 900	E-GSM 900	Tx_1: 925 MHz to 937.5 MHz, Tx_2: 951.5 MHz to 960 MHz Rx: 880 MHz to 915 MHz
Option 902	E-GSM 900 w/IM2	Tx_1: 925 MHz to 937.5 MHz, Tx_2: 951.5 MHz to 960 MHz Rx_1: 885 MHz to 915 MHz, Rx_2: 1877 MHz to 1920 MHz
Option 180	DCS 1800	Tx_1: 1805 MHz to 1837 MHz, Tx_2: 1857.5 MHz to 1880 MHz Rx: 1710 MHz to 1785 MHz
Option 194	PCS/AWS	Tx_1: 1930 MHz to 1945 MHz, Tx_2: 1965 MHz to 1995 MHz, Tx_3: 2110 MHz to 2155 MHz Rx_1: 1850 MHz to 1910 MHz (using Tx_1 and Tx_2), Rx_2: 1710 MHz to 1755 MHz (using Tx_1 and Tx_3)
Option 210	UMTS 2100	Tx_1: 2110 MHz to 2112.5 MHz, Tx_2: 2130 MHz to 2170 MHz Rx_{Lower}: 1920 MHz to 1980 MHz, Rx_{Upper}: 2050 MHz to 2090 MHz
Option 260	LTE 2600	Tx_1: 2620 MHz to 2630 MHz, Tx_2: 2650 MHz to 2690 MHz Rx: 2500 MHz to 2570 MHz
PIM vs. Time	Description: IM product magnitude vs. time Test Frequencies: F1, F2, and IM product frequencies fixed, user selectable Measurements: Peak PIM over measurement duration, Instantaneous PIM	
Noise Floor (Time View)	Noise level vs. time at IM product frequency Test Frequencies: IM product frequency fixed, user selectable Measurements: Peak signal level over measurement duration, Instantaneous signal level	
Noise Floor (Spectrum View)	Noise level vs. frequency Test Frequencies: Swept measurement over Rx band of instrument Measurements: Peak signal level, Instantaneous signal level	
Distance-to-PIM	IM product magnitude vs. distance Test Frequencies: F1 or F2 frequency swept to produce range of IM product frequencies for analysis Fault Resolution: Varies by frequency option, <3 m (<10 ft) (typ.) with Enhanced Resolution activated Maximum Range: Varies by frequency option and number of Data Points selected Markers: Standard marker functions plus Marker Table (On/Off) Trace Overlay: DTP/DTP, DTP/DTF	
Swept PIM	IM product magnitude vs. frequency Test Frequencies: F1 and F2 frequencies swept to produce range of IM product frequencies Measurements: Peak PIM over measurement duration, Instantaneous PIM	

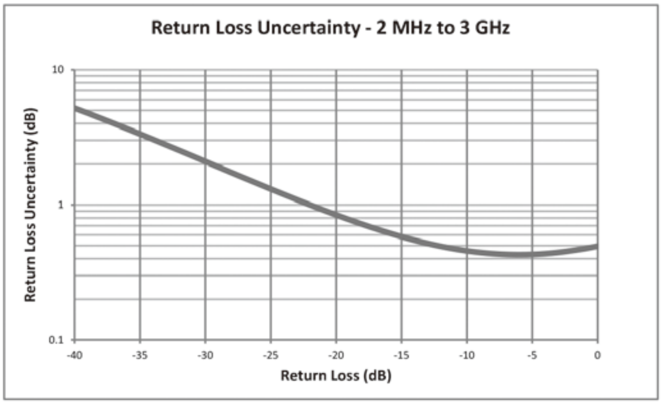
Cable and Antenna Analyzer (Option 331)

Measurements	VSWR Return Loss Cable Loss Distance-to-Fault (DTF) Return Loss Distance-to-Fault (DTF) VSWR 1-Port Phase Smith Chart (50/75Ω selectable)
Setup Parameters	Measurement Display: Single/Dual Measurement Display with independent markers Frequency: Start/Stop, Signal Standard, Start Cal DTF: Start/Stop, DTF Aid, Units (m/ft), Cable Loss, Propagation Velocity, Cable, Windowing Windowing: Rectangular, Normal Side Lobe, Low Side Lobe, Minimum Side Lobe Amplitude: Top, Bottom Auto Scale, Full Scale Sweep: Run/Hold, Single/Continuous, RF Immunity (High/Low), Data Points, Averaging/Smoothing, Output Power (High), RF Pwr When Hold (On/Off) Data Points: 137, 275, 551, 1102, 2204 Markers: Markers 1-6 (On/Off), Delta Makers 1-6 (On/Off), Marker to Peak/Valley, Peak/Valley Auto, Marker Table (On/Off), All Markers Off Traces: Recall, Copy to Display Memory, No Trace Math, Trace ± Memory, Trace Overlay (On/Off) Limit Line: On/Off, Single Limit, Multi-segment Edit, Limit Alarm (On/Off), Pass Fail Message (On/Off), Pass/Fail (Unbounded/Bounded), Warning Limit Offset, Clear Limit Calibration: Start Cal, Cal Type (Standard/FlexCal™), Disp Valid Cal Temp Range Save/Recall: Setups (.stp), Measurements (.vna, .dat), Screen Shots (.jpg) (save only) Application Options: Impedance (50Ω, 75Ω, Other)
Frequency	Frequency Accuracy: ±1.0 ppm at 23°C Stability: ±1.0 ppm from –10° to +55°C (typ.) Aging: ±1.0 ppm/yr (typ.)
Output Power	Power Level: –4 dBm (typ.)
Interference Immunity	On-Channel: +17 dBm @ >1.0 MHz from carrier frequency On-Frequency: 0 dBm within ±10 kHz of the carrier frequency
Measurement Speed	Return Loss: ≤1.00 ms/data point, RF immunity low (typ.) Distance-to-Fault: ≤1.25 ms/data point, RF immunity low (typ.)
Return Loss	Measurement Range: 0 to 60 dB Resolution: 0.01 dB
VSWR	Measurement Range: 1:1 to 65:1 Resolution: 0.01
Cable Loss	Measurement Range: 0 to 30 dB Resolution: 0.01 dB

Continued on next page

Distance-to-Fault	Vertical Range Return Loss: 0 to 60 dB Vertical Range VSWR: 1:1 to 65:1 Fault Resolution (meters): (1.5 × 10^8 × vp)/ΔF (vp = velocity propagation constant, ΔF is F2 – F1 in Hz) Horizontal Range (meters): 0 to (Data Points – 1) × Fault Resolution, to a maximum of 1500 meters (4921 ft)
1-Port Phase	Measurement Range: –180° to +180° Resolution: 0.01°
Smith Chart	Resolution: 0.01 50Ω/75Ω Selectable
Measurement Accuracy	Corrected Directivity: >42 dB, OSL Calibration

Measurement Uncertainty


Return Loss Uncertainty - 2 MHz to 3 GHz


Phase Uncertainty - 2 MHz to 3 GHz

GPS Receiver Option (Option 31) (Antenna sold separately)

Setup	On/Off, Antenna Voltage 3.3 V/5.0 V, GPS Info
GPS Time/ Location Indicator	Time, Latitude, Longitude and Altitude on display
	Time, Latitude, Longitude and Altitude with trace storage
Connector	SMA (f)

High Accuracy Power Meter (Option 19) (Requires external USB Power Sensor)

Amplitude	Maximum, Minimum, Offset, Relative On/Off, Units, Auto Scale
Average	# of Running Averages, Max Hold
Zero/Cal	Zero On/Off, Cal Factor (Center Frequency, Signal Standard)
Limits	Limit On/Off, Limit Upper/Lower

Power Sensor Model	MA24105A	MA24106A	MA24108A/18A/26A	MA24208A/18A	MA24330A/40A/50A
Description	Inline High Power Sensor	High Accuracy RF Power Sensor	Microwave USB Power Sensor	Microwave Universal USB Power Sensor	Microwave CW USB Power Sensor
Frequency Range	350 MHz to 4 GHz	50 MHz to 6 GHz	10 MHz to 8/18/26 GHz	10 MHz to 8 GHz/18 GHz	10 MHz to 33/40/50 GHz
Connector	Type N (f), 50Ω	Type N (m), 50Ω	Type N (m), 50Ω (8 GHz/18 GHz) Type K (m), 50Ω (26 GHz)	Type N (m), 50Ω	Type K (m), 50Ω (33 GHz/40 GHz) Type V (m), 50Ω (50 GHz)
Dynamic Range	+3 to +51.76 dBm (2 mW to 150 W)	–40 to +23 dBm (0.1 µW to 200 mW)	–40 to +20 dBm (0.1 µW to 100 mW)	–60 to +20 dBm (1 nW to 100 mW)	–70 to +20 dBm (0.1 nW to 100 mW)
Measurand	True-RMS	True-RMS	True-RMS, Slot Power, Burst Average Power	True-RMS, Slot Power, Burst Average Power	Average Power
Measurement Uncertainty	± 0.17 dB[*1]	± 0.16 dB[*2]	± 0.18 dB[*3]	± 0.17 dB[*4]	± 0.17 dB[*5]
Data sheet (for complete specifications)	11410-00621	11410-00424	11410-00504	11410-00841	11410-00906

*1: Expanded uncertainty with K=2 for power measurements of a CW signal greater than +20 dBm with a matched load. Measurement results referenced to the input side of the sensor.

*2: Total RSS measurement uncertainty (0° to 50°C) for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.

*3: Expanded uncertainty with K = 2 for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.

*4: Power uncertainty expressed with two sigma confidence level for CW measurement after zero operation. Includes calibration factor and linearity over temperature uncertainties, but not the effects of mismatch, zero set and drift, or noise.

*5: Includes linearity over temperature uncertainties, but not the effects of calibration factor, mismatch, zero set and drift, and noise.

Line Sweep Tools (for your PC)

Trace Capture	Browse to Instrument: View and copy traces from the test equipment to your PC using Windows Explorer Open Current Files: Open PIM or DAT files Capture Plots To: The Line Sweep Tools screen, DAT files, Database, or JPEG
Traces	Trace Types: Return Loss, VSWR, DTF-RL, DTF-VSWR, Cable Loss, Smith Chart, PIM vs. Time, Swept PIM, Noise Floor, and DTP Trace Formats: DAT, PIM, CSV, PNG, BMP, JPG, HTML, Data Base, and PDF
Report Generation	Report Generator: Includes GPS location along with measurements Report Format: Create reports in HTML or PDF format Report Setup: Report Title, Company, Prepared for, Location, Date and Time, Filename, Company logo Trace Setup: 1 Trace Portrait Mode, 2 Trace Portrait Mode, 1 Trace Landscape Mode PIM Report: Tabular summary report with pass/fail analysis
Trace Validation	Presets: 7 presets allow "one click" setting of up to 6 markers and one limit line Marker Controls: 6 regular Markers, Marker Peak, Marker Valley, Marker between, and frequency entry Delta Markers: 6 Delta markers Limit Line: Enable and drag or value entry. Also works with presets Next Trace Button: Next Trace and Previous trace arrow keys allow quick switching between traces
Tools	Cable Editor: Allows creation of custom cable parameters Distance to Fault: Converts a Return Loss trace to a Distance to Fault trace Measurement Calculator: Converts Real, Imaginary, Magnitude, Phase, RL, VSWR, Rho, and Transmit power Signal Standard Editor: Creates new band and channel tables Renaming Grid: 36 user definable phrases for creation of file names, trace titles, and trace subtitles
Connectivity	Connections: USB cable, USB Memory Stick

easyTest Tools (for your PC)

Instrument Mode	PIM Analyzer Mode, Cable & Antenna Analyzer Mode (Option 331)
Commands	Display Image: Allows putting a custom image on the instrument screen Recall Setup: Places the instrument into a known state Prompt: Displays instructional messages on the instrument screen Save: Allows automatic or manual saving of traces
Connectivity	Connections: Ethernet, USB cable or USB memory stick

Web Remote Control

Control	Full instrument control through a browser – all instrument functions except power switch
Connections	RJ45 Ethernet jack Third party Wi-Fi router
Protocol	HTTP/TCP/IP
Physical Layer	Cat 5 Cable, Wi-Fi router compatible
Browser	Designed for use with HTML 5 Compliant Browsers (Google Chrome or Mozilla Firefox preferred)
Operating System	iOS, Windows, Linux, Android operating systems that can host the HTML 5 Compliant browser
Remote Hardware	PCs, Tablets, and Smart Phones with Ethernet or Wi-Fi connections
Download	Individual instrument files downloaded via browser Multiple instrument files and directories zipped and downloaded via browser Screen capture capability File downloads are not supported by iOS
Display Modes	Normal: All modes & displays supported Fast: Not currently supported
Password	The instrument can be password protected Passwords may be used to manage who is controlling the instrument
Users/Instruments	One user/device can view and control many instruments

Programmable Remote Control

Functionality	Instrument functionality is available via remote programming. See the MW82119B Programming Manual for details.
Programming Language	Standard Commands for Programmable Instruments (SCPI)
Interfaces	USB, LAN

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main Frame
MW82119B	PIM Master™ Passive Intermodulation Analyzer (must be ordered with ONE frequency option)
	Frequency Options
	(must order one, and only one)
MW82119B-0700	LTE 700
MW82119B-0701	APT 700
MW82119B-0800	LTE 800
MW82119B-0850	Cellular 850
MW82119B-0900	E-GSM 900
MW82119B-0902	E-GSM w/IM2
MW82119B-0180	DCS 1800
MW82119B-0194	PCS/AWS 1900/2100
MW82119B-0210	UMTS 2100
MW82119B-0260	LTE 2600
	Other Options
MW82119B-0019	High Accuracy Power Meter (Requires USB power sensor)
MW82119B-0031	GPS Receiver (Requires GPS antenna)
MW82119B-0331	Site Master™ Cable and Antenna Analyzer
MW82119B-0098	Standard Calibration to ISO 17025 and/or Z540.1
MW82119B-0099	Premium Calibration to ISO 17025 and/or Z540.1 plus test data
	Standard Accessories
2000-1786-R	Soft Carrying Case, Screen Access
2000-1714-R	Shoulder Strap
2000-1691-R	Stylus with Coiled Tether
2000-1797-R	Touchscreen Protector Film, 8.4 in.
1091-422-R	Adapter, 7/16 DIN (f) to 7/16 DIN (m), 50Ω (Connector Saver)
633-75	Rechargeable Li-Ion Battery 7500 mAh
40-187-R	AC/DC adapter
806-141-R	Automotive Power Adapter, 12 VDC, 60 W
2000-1371-R	Ethernet Cable, 213 cm (7 ft)
3-2000-1498	USB A15-pin mini-B Cable, 10 ft/305 cm
	Miscellaneous Accessories
2000-1374	External Dual Charger for Li-Ion Batteries
2000-1528-R	GPS Antenna, SMA (m) with 5 m (15 ft) cable, 3 dBi gain, requires 5 VDC
2000-1652-R	GPS Antenna, SMA (m) with 0.3 m (1 ft) cable, 5 dBi gain, requires 3.3 VDC or 5 VDC
2000-1760-R	GPS Antenna, SMA (m), 25 dB gain, 2.5 VDC to 3.7 VDC
67135	Anritsu Backpack (For Handheld Instrument and PC)
760-259-R	Transit Case (holds MW82119A/B PIM Analyzer only)
760-265-R	Transit Case (holds MW82119A/B PIM Analyzer plus accessories)

Model/Order No.	Name
	Power Sensors
	Requires Option 19. (For complete ordering information, see the respective datasheet of each sensor)
MA24105A	Inline Peak Power Sensor, 350 MHz to 4 GHz, +3 to +51.76 dBm
MA24106A	RF USB Power Sensor, 50 MHz to 6 GHz, +23 dBm
MA24108A	Microwave USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24118A	Microwave USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24126A	Microwave USB Power Sensor, 10 MHz to 26 GHz, +20 dBm
MA24208A	Microwave Universal USB Power Sensor, 10 MHz to 8 GHz, +20 to –60 dBm
MA24218A	Microwave Universal USB Power Sensor, 10 MHz to 18 GHz, +20 to –60 dBm
MA24330A	Microwave CW USB Power Sensor, 10 MHz to 33 GHz, +20 to –60 dBm
MA24340A	Microwave CW USB Power Sensor, 10 MHz to 40 GHz, +20 to –60 dBm
MA24350A	Microwave CW USB Power Sensor, 10 MHz to 50 GHz, +20 to –60 dBm
MA25100A	RF Power Indicator
	Attenuators
	(Recommended for power measurements only. Not Low PIM.)
3-1010-122	20 dB, 5 W, DC to 12.4 GHz, N (m) to N (f)
3-1010-123	30 dB, 50 W, DC to 8.5 GHz, N (m) to N (f)
3-1010-124	40 dB, 100 W, DC to 8.5 GHz, N (m) to N (f), Uni-directional
	PIM Analyzer Accessory Kits
2000-1745-R	PIM Master Backpack Accessory Kit (Includes common items below plus 67135 backpack)
2000-1746-R	PIM Master Hard Case Accessory Kit (Includes common items below plus 760-260-R transit case)
	Items Common to Both Accessory Kits
2000-1626-R	PIM Test Cable, 3.0 m, 7/16 DIN (m) to 7/16 DIN (m), 50Ω
2000-1749-R	Low PIM Termination, 700 MHz to 2600 MHz, 10 W, 7/16 DIN (m),7/16 DIN (f), 50Ω
1091-446-R	PIM Standard, –80 dBm ±3 dB at 1730 MHz, with 2 x 20 W, 7/16 DIN (m) to 7/16 DIN (f), 50Ω
1091-425-R	Low PIM Adapter, 7/16 DIN (f) to N (f), DC to 3.0 GHz, 50Ω (Qty: 2)
1091-426-R	Low PIM Adapter, 7/16 DIN (f) to N (m), DC to 3.0 GHz, 50Ω (Qty: 2)
1091-427-R	Low PIM Adapter, 7/16 DIN (f) to 7/16 DIN (f), DC to 3.0 GHz, 50Ω
01-510	Adjustable Wrench
01-513-R	1-1/4 in Torque Wrench
971-9-R	Cleaning Wipes
971-10-R	Cleaning Swabs
11410-00726	Equipment Verification Guide

Continued on next page

Model/Order No.	Name
	Optional PIM Analyzer Accessories
16DD50-2.75-R	Armored PIM Test Cable, 2.75 m, 7/16 DIN (m) to 7/16 DIN (m), 50Ω
16DD50-4.0-R	Armored PIM Test Cable, 4.0 m, 7/16 DIN (m) to 7/16 DIN (m), 50Ω
2000-1626-R	PIM Test Cable, 3.0 m, 7/16 DIN (m) to 7/16 DIN (m), 50Ω
2000-1783-R	PIM Test Cable, 3.0 m, 7/16 DIN (m) to 7/16 DIN (f), 50Ω
2000-1845-R	PIM Test Cable, 3.0 m, 7/16 DIN (m) to 4.3-10 (m), 50Ω
2000-1846-R	PIM Test Cable, 3.0 m, 7/16 DIN (m) to 4.3-10 (f), 50Ω
2000-1724-R	Low PIM Termination, 700 MHz to 2600 MHz, 40 W, 7/16 DIN (m), 7/16 DIN (f), 50Ω
2000-1749-R	Low PIM Termination, 700 MHz to 2600 MHz, 10 W, 7/16 DIN (m), 7/16 DIN (f), 50Ω
2000-1913-R	Low PIM Termination, 700 MHz to 2600 MHz, 10 W, 4.3-10 (m) to 4.3-10 (f), 50Ω
1091-446-R	PIM Standard, –80 dBm ±3 dB at 1730 MHz, with 2 × 20 W, 7/16 DIN (m) to 7/16 DIN (f), 50Ω
1091-464-R	PIM Standard, –80 dBm at 1730 MHz, with 2 × 20 W, 4.3-10 (m) to 4.3-10 (f), 50Ω
1091-421-R	Low PIM Adapter, 7/16 DIN (m) to 7/16 DIN (m), DC to 6.0 GHz, 50Ω
1091-422-R	Low PIM Adapter, 7/16 DIN (m) to 7/16 DIN (f), DC to 6.0 GHz, 50Ω
1091-423-R	Low PIM Adapter, 7/16 DIN (m) to N (m), DC to 6.0 GHz, 50Ω
1091-424-R	Low PIM Adapter, 7/16 DIN (m) to N (f), DC to 6.0 GHz, 50Ω
1091-425-R	Low PIM Adapter, 7/16 DIN (f) to N (f), DC to 6.0 GHz, 50Ω
1091-426-R	Low PIM Adapter, 7/16 DIN (f) to N (m), DC to 6.0 GHz, 50Ω
1091-427-R	Low PIM Adapter, 7/16 DIN (f) to 7/16 DIN (f), DC to 6.0 GHz, 50Ω
1091-431-R	Low PIM Adapter, 45°, 7/16 DIN (m) to 7/16 DIN (f), DC to 3.0 GHz, 50Ω
1091-432-R	Low PIM Adapter, 45°, 7/16 DIN (f) to 7/16 DIN (f), DC to 3.0 GHz, 50Ω
1091-433-R	Low PIM Adapter, 4.1-9.5 (f) to 7/16 DIN (f), DC to 3.0 GHz, 50Ω
1091-434-R	Low PIM Adapter, 4.1-9.5 (m) to 7/16 DIN (f), DC to 3.0 GHz, 50Ω
1091-435-R	Low PIM Adapter, 4.1-9.5 (f) to N (m), DC to 3.0 GHz, 50Ω
1091-436-R	Low PIM Adapter, 4.1-9.5 (m) to N (m), DC to 3.0 GHz, 50Ω
1091-440-R	Low PIM Adapter, 4.3-10 (f) to 7/16 DIN (f), DC to 3.0 GHz, 50Ω
1091-441-R	Low PIM Adapter, 4.3-10 (m) to 7/16 DIN (f), DC to 3.0 GHz, 50Ω
1091-442-R	Low PIM Adapter, 4.3-10 (f) to N (m), DC to 3.0 GHz, 50Ω
1091-443-R	Low PIM Adapter, 4.3-10 (m) to N (m), DC to 3.0 GHz, 50Ω
1091-466-R	Low PIM Adapter, 4.3-10 (m) to 7/16 DIN (m), DC to 6.0 GHz, 50Ω
1091-468-R	Low PIM Adapter, 4.3-10 (f) to 7/16 DIN (m), DC to 6.0 GHz, 50Ω
01-510	Adjustable Wrench
01-513-R	1-1/4 in Torque Wrench
01-528-R	Torque Wrench for coupling torque of 4.3-10 connectors, 22 mm opening
971-9-R	Cleaning Wipes
971-10-R	Cleaning Swabs
	Optional Cable & Antenna Analyzer Accessories **Calibration Components, 50Ω** (These components are not designed to withstand PIM test power levels. Suitable for cable and antenna analyzer measurements only.)
OSLN50A-8	High Performance, Type N (m), DC to 8 GHz, 50Ω
OSLNF50A-8	High Performance, Type N (f), DC to 8 GHz, 50Ω
2000-1914-R	Precision Open/Short/Load, 4.3-10 (f), DC to 6 GHz, 50Ω
2000-1615-R	Precision Open/Short/Load, 4.3-10 (m), DC to 6 GHz, 50Ω
2000-1618-R	Precision Open/Short/Load, 7/16 DIN (m), DC to 6.0 GHz 50Ω
2000-1619-R	Precision Open/Short/Load, 7/16 DIN (f), DC to 6.0 GHz 50Ω
22N50	Open/Short, N (m), DC to 18 GHz, 50Ω
22NF50	Open/Short, N (f), DC to 18 GHz, 50Ω
SM/PL-1	Precision Load, N (m), 42 dB, 6.0 GHz, 50Ω
SM/PLNF-1	Precision Load, N (f), 42 dB, 6.0 GHz, 50Ω
	Phase-Stable Test Port Cables, Armored w/Reinforced Grip (recommended for cable & antenna line sweep applications)
15RNFN50-1.5-R	1.5 m, DC to 6 GHz, N (m) to N (f), 50Ω
15RDFN50-1.5-R	1.5 m, DC to 6 GHz, N (m) to 7/16 DIN (f), 50Ω
15RDN50-1.5-R	1.5 m, DC to 6 GHz, N (m) to 7/16 DIN (m), 50Ω
15RNFN50-3.0-R	3.0 m, DC to 6 GHz, N (m) to N (f), 50Ω
15RDFN50-3.0-R	3.0 m, DC to 6 GHz, N (m) to 7/16 DIN (f), 50Ω
15RDN50-3.0-R	3.0 m, DC to 6 GHz, N (m) to 7/16 DIN (m), 50Ω

Model/Order No.	Name
	Inter Changeable Adaptor Phase Stable Test Port Cables, Armored w/Reinforced Grip (recommended for cable and antenna line sweep applications. It uses the same ruggedized grip as the Reinforced grip series cables. Now you can also change the adaptor interface on the grip to four different connector types.)
15RCN50-1.5-R	1.5 m, DC to 6 GHz, N (m), N (f), 7/16 DIN (m), 7/16 DIN (f), 50Ω
15RCN50-3.0-R	3.0 m, DC to 6 GHz, N (m), N (f), 7/16 DIN (m), 7/16 DIN (f), 50Ω
	Phase-Stable Test Port Cables, Armored (recommended for use with tightly spaced connectors and other general use applications)
15NNF50-1.5C	1.5 m, DC to 6 GHz, N (m) to N (f), 50Ω
15NN50-1.5C	1.5 m, DC to 6 GHz, N (m) to N (m), 50Ω
15NDF50-1.5C	1.5 m, DC to 6 GHz, N (m) to 7/16 DIN (f), 50Ω
15ND50-1.5C	1.5 m, DC to 6 GHz, N (m) to 7/16 DIN (m), 50Ω
15NNF50-3.0C	3.0 m, DC to 6 GHz, N (m) to N (f), 50Ω
15NN50-3.0C	3.0 m, DC to 6 GHz, N (m) to N (m), 50Ω
15NNF50-5.0C	5.0 m, DC to 6 GHz, N (m) to N (f), 50Ω
15NN50-5.0C	5.0 m, DC to 6 GHz, N (m) to N (m), 50Ω
15N43M50-1.5C	Test Port Extension Cable, Armored, 1.5 m, DC to 6 GHz, N (m) to 4.3-10 (m)
15N43F50-1.5C	Test Port Extension Cable, Armored, 1.5 m, DC to 6 GHz, N (m) to 4.3-10 (f)
15N43M50-3.0C	Test Port Extension Cable, Armored, 3 m, DC to 6 GHz, N (m) to 4.3-10 (m)
15N43F50-3.0C	Test Port Extension Cable, Armored, 3 m, DC to 6 GHz, N (m) to 4.3-10 (f)
15NF43M50-1.5C	Test Port Extension Cable, Armored, 1.5 m, DC to 6 GHz, N (f) to 4.3-10 (m)
15NF43F50-1.5C	Test Port Extension Cable, Armored, 1.5 m, DC to 6 GHz, N (f) to 4.3-10 (f)
15NF43M50-3.0C	Test Port Extension Cable, Armored, 3 m, DC to 6 GHz, N (f) to 4.3-10 (m)
15NF43F50-3.0C	Test Port Extension Cable, Armored, 3 m, DC to 6 GHz, N (f) to 4.3-10 (f)
	Precision Adapters (Recommended for cable and antenna line sweep applications only. Not Low PIM.)
34NN50A	N (m) to N (m), DC to 18 GHz, 50Ω
34NFNF50	N (f) to N (f), DC to 18 GHz, 50Ω
1091-26-R	SMA (m) to N (m), DC to 18 GHz, 50Ω
1091-27-R	SMA (f) to N (m), DC to 18 GHz, 50Ω
1091-80-R	SMA (m) to N (f), DC to 18 GHz, 50Ω
1091-81-R	SMA (f) to N (f), DC to 18 GHz, 50Ω
1091-172-R	BNC (f) to N (m), DC to 1.3 GHz, 50Ω
1091-465-R	4.3-10 (f) to N (f), DC to 6 GHz, 50Ω
1091-467-R	4.3-10 (m) to N (f), DC to 6 GHz, 50Ω
510-90-R	7/16 DIN (f) to N (m), DC to 7.5 GHz, 50Ω
510-91-R	7/16 DIN (f) to N (f), DC to 7.5 GHz, 50Ω
510-92-R	7/16 DIN (m) to N (m), DC to 7.5 GHz, 50Ω
510-93-R	7/16 DIN (m) to N (f), DC to 7.5 GHz, 50Ω
510-96-R	7/16 DIN (m) to 7/16 DIN (m), DC to 7.5 GHz, 50Ω
510-97-R	7/16 DIN (f) to 7/16 DIN (f), DC to 7.5 GHz, 50Ω
510-102-R	N (m) to N (m), DC to 11 GHz, 50Ω, 90 degrees right angle
	Manuals (Soft copy at www.anritsu.com)
10580-00400	PIM Master User Guide
10580-00402	PIM Master Measurement Guide
10580-00403	PIM Master Programming Manual
10580-00241	Cable and Antenna Analyzer Measurement Guide
10580-00240	Power Meter Measurement Guide
11410-00473	Troubleshooting Guide – Cable, Antenna, and Components
	Anritsu Training (www.anritsu.com/training)
10580-00045	Site Master™ Certified Line Sweep
10580-00370	PIM Master™ Certified PIM Measurement

TRX NEON® Signal Mapper

MA8100A-00x Series

TRX NEON Signal Mapper for 3D In-Building Coverage Mapping

Anritsu is proud to introduce the new TRX NEON Signal Mapper (MA8100A-00x) 3D in-building coverage mapping solution for use with many Anritsu handheld instruments with spectrum analyzer mode. Instruments supported include Spectrum Master, LMR Master, Site Master, BTS/Cell Master, and VNA Master.
The TRX NEON Signal Mapper application provides an intuitive Android user interface enabling lightly trained users to map signal and sensor information within buildings. Users can initialize their location, start/stop mapping and load mapping data to the cloud.
RF data is captured by an Anritsu Handheld spectrum analyzer product and the data is sent to the Android device via a USB connection.
The TRX NEON Command PC Software, enables creation and visualization of 3D building maps and provides centralized access to the TRX NEON Cloud Service to access stored maps and measurement data.
Android device and PC are NOT included with the MA8100A-00x. Customers must purchase their own Android device and PC.
The MA8100A-00x consists of both hardware and software from TRX Systems, a 3rd party partner. The MA8100A-00x consists of a TRX Systems NEON Tracking Unit, NEON Signal Mapper Software for Android devices and the NEON Command Software for a PC.
The TRX NEON Tracking Unit supports collection and processing of sensor data that delivers 3D location information. The Tracking Unit connects to the TRX NEON Signal Mapper application, which is run on an Android device via a Bluetooth connection.

Key Features

Integrating NEON's capability to automatically collect geo-referenced test data with Anritsu handheld spectrum analyzer products saves valuable time and money by:

- Eliminating the need to manually perform "check-ins" at each test point by automatically calculating indoor location
- Providing vastly more data than is possible with manual processes by recording data with every step
- Removing typical data recording errors caused by "guesstimating" locations in large buildings through automatic indoor location and path estimation
- Delivering actionable data in areas not easily analyzed such as stairways and elevators by recording and referencing measurements in 3D
- Enabling quick analysis of signal coverage and faster problem resolution by delivering the industry's only geo-referenced 3D visualization
- Provides color-graded measurement results in 2D and 3D views. Measurement values can be seen by clicking on each point. A .csv file of all measurements is also provided.

EU Standards (CE Marking)

2011/65/EU

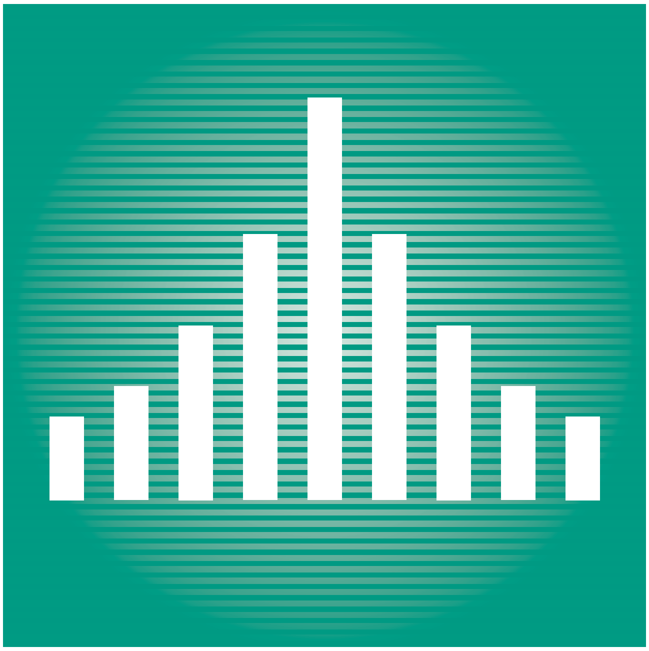
Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	TRX NEON® Signal Mapper Bundles*
MA8100A-000	NEON Signal Mapper with Anritsu Integration and Tracking Unit (P/N 2000-1852-R). (Includes 3-Month TRX NEON Trial Software License with 3 months of maintenance and support and 3 months of Cloud Service (P/N 2300-607))
MA8100A-001	NEON Signal Mapper with Anritsu Integration and Tracking Unit (P/N 2000-1852-R) (Includes 1 year TRX NEON Software License with 1 year of maintenance and support and 1 year of Cloud Service (P/N 2300-574))
MA8100A-003	NEON Signal Mapper with Anritsu Integration and Tracking Unit (P/N 2000-1852-R) (Includes 3 years TRX NEON Software License with 3 years of maintenance and support and 3 years of Cloud Service (P/N 2300-575))
MA8100A-005	NEON Signal Mapper with Anritsu Integration and Tracking Unit (P/N 2000-1852-R) (Includes 5 years TRX NEON Software License with 5 years of maintenance and support and 5 years of Cloud Service (P/N 2300-576))
MA8100A-100	NEON Signal Mapper with Anritsu Integration and Tracking Unit (P/N 2000-1852-R). (Includes Perpetual TRX NEON Software License with 3 years of maintenance and support and 3 years of Cloud Service (P/N 2300-606))
	License Renewal
2300-574	1 year TRX NEON Software License with 1 year of maintenance and support and 1 year of Cloud Service
2300-575	3 years TRX NEON Software License with 3 years of maintenance and support and 3 years of Cloud Service
2300-576	5 years TRX NEON Software License with 5 years of maintenance and support and 5 years of Cloud Service
2300-606	Perpetual TRX NEON Software License with 3 years of maintenance and support and 3 years of Cloud Service

* IMPORTANT: The primary end- user's name, phone number and email address must be provided when the order is placed.

Note: TRX NEON Command Software, which is cloud based, requires a renewable license. 1, 3 or 5 year licenses are available and are ordered as per the available part numbers outlined above. These licenses can be extended when they expire.



SIGNAL ANALYZERS/ SPECTRUM ANALYZERS

Selection Guide

Model	Measurement Frequency Range	Measurement Level Range (dBm @1 GHz)	Resolution Bandwidth	C/N (dBc/Hz)	RF-band Harmonic Distortion (dBc)*4	Third Order Intercept Point (TOI) (dBm)	Counter	Measure	Zone Marker	AM/FM Demodulation Mode	QP Detection	High-speed Time Domain	Gate	Tracking Generator	Remote Control	Features
MS2690A	50 Hz to 6 GHz	−155 to +30	30 Hz to 3 MHz, 50 kHz 5, 10, 20, 31.25 MHz (SPA mode) 1 Hz to 10 MHz*1 (VSA mode)	−116*2	−75	+22	✓	✓	✓	—	—	✓	✓	—	GPIB Ethernet USB	Portable
MS2691A	50 Hz to 13.5 GHz															
MS2692A	50 Hz to 26.5 GHz															
MS2850A	9 kHz to 32 GHz 9 kHz to 44.5 GHz	−151 to +30	1 Hz to 3 MHz (1–3 sequence), 500 Hz, 50 kHz, 2, 5, 10 MHz	−123*2,*3	−65	+16	✓	✓	✓	—	—	✓	✓	—	GPIB Ethernet USB	
MS2840A-040/041	9 kHz to 3.6 GHz 9 kHz to 6 GHz	−151 to +30	1 Hz to 3 MHz (1–3 sequence), 500 Hz, 50 kHz, 2, 5, 10, 20, 31.25 MHz	−123*2,*3 −133*1,*2,*3	−65	+16	✓	✓	✓	✓*1	✓*1	✓	✓	—	GPIB Ethernet USB	
MS2840A-044/046	9 kHz to 26.5 GHz 9 kHz to 44.5 GHz 26.5 GHz to 325 GHz (with external mixer)	−151 to +30	1 Hz to 3 MHz (1–3 sequence), 500 Hz, 50 kHz, 2, 5, 10 MHz, 20, 31.25 MHz (MS2840A-044)	−123*2,*3	−65	+16	✓	✓	✓	✓*1	✓*1	✓	✓	—	GPIB Ethernet USB	
MS2830A-040/041/043	9 kHz to 3.6 GHz 9 kHz to 6 GHz 9 kHz to 13.5 GHz	−151 to +30	1 Hz to 3 MHz (1–3 sequence), 500 Hz, 50 kHz, 2, 5, 10, 20*1, 31.25*1 MHz	−115*2 −133*1, *2	−65	+15	✓	✓	✓	✓*1	✓*1	✓	✓	✓*1,*5	GPIB Ethernet USB	
MS2830A-044/045	9 kHz to 26.5 GHz 9 kHz to 43 GHz 26.5 GHz to 325 GHz (with external mixer)	−150 to +30	1 Hz to 3 MHz (1–3 sequence), 500 Hz, 50 kHz, 2, 5, 10 MHz, 20*1, 31.25*1 MHz (MS2830A-044)	−115*2	−65	+15	✓	✓	✓	—	✓*1	✓	✓	—	GPIB Ethernet USB	
MS2711E	9 kHz to 3 GHz	−137 to +26	100 Hz to 3 MHz	−90*3	−70	+28	✓	✓	—	—	—	—	—	✓	USB	Handheld (<3.5 kg)
MS2712E	9 kHz to 4 GHz	−157 to +26	300 Hz to 1 MHz	−100*3	−70	+28	✓	✓	—	—	—	—	✓*1	✓	USB Ethernet (Opt.)	
MS2713E	9 kHz to 6 GHz	−157 to +26	300 Hz to 1 MHz	−100*3	−70	+33	✓	✓	—	—	—	—	✓*1	✓	USB Ethernet (Opt.)	
MS2720T	9 kHz to 9 GHz	−160 to +30	1 Hz to 10 MHz	−108	−75	+20	✓	✓	—	—	—	—	✓*1	✓	Ethernet USB	Handheld (3.7 kg to 4.4 kg)
	9 kHz to 13 GHz	−161 to +30		−102										✓		
	9 kHz to 20 GHz													✓		
	9 kHz to 32 GHz													—		
	9 kHz to 43 GHz													—		
MS27100A	9 kHz to 6 GHz	−145 to +30	10 Hz to 3 MHz	−98*3	−60	+17	—	✓	—	✓*1	—	—	—	—	Ethernet	Spectrum monitoring (1 kg)
MS27101A	9 kHz to 6 GHz	−145 to +30	10 Hz to 3 MHz	−98*3	−60	+17	—	✓	—	✓*1	—	—	—	—	Ethernet	Spectrum monitoring (2.78 kg)
MS27102A	9 kHz to 6 GHz	−145 to +30	10 Hz to 3 MHz	−98*3	−60	+17	—	✓	—	✓*1	—	—	—	—	Ethernet	Spectrum monitoring (6.87 kg)
MS27103A	9 kHz to 6 GHz	−140 to +22	10 Hz to 3 MHz	−98*3	−60	+17	—	✓	—	✓*1	—	—	—	—	Ethernet	Spectrum monitoring (3.9 kg to 4.5 kg)
MS2760A-0032	9 kHz to 32 GHz	DANL to +10	1 Hz to 3 MHz	−75*3,*6	−60	+25*7	—	✓	—	—	—	✓	—	—	USB3.0	Spectrum monitoring (255 g)
MS2760A-0044	9 kHz to 44 GHz															
MS2760A-0050	9 kHz to 50 GHz															
MS2760A-0070	9 kHz to 70 GHz															
MS2760A-0090	9 kHz to 90 GHz															
MS2760A-0110	9 kHz to 110 GHz															

*1: Option
*2: 100 kHz offset
*3: 10 kHz offset
*4: −30 dBm
*5: Similar function by built-in SG
*6: 60 GHz
*7: 72 GHz

Signal Analyzer

MS2690A	MS2691A	MS2692A
50 Hz to 6.0 GHz	50 Hz to 13.5 GHz	50 Hz to 26.5 GHz

Remote Control
GPIB | Ethernet | USB

Signal Analyzer Solving Wireless Communications Issues

Excellent Eco Product

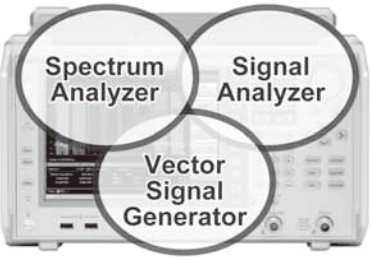
The Signal Analyzer MS2690A/MS2691A/MS2692A (MS269xA) has the excellent general level accuracy, dynamic range and performance of a high-end spectrum analyzer.

Its easy operability and built-in functions are perfect for tests of Tx characteristics. Not only can it capture wideband signals but FFT technology supports multifunction signal analyses in both the time and frequency domains. Behavior in the time domain that cannot be handled by a sweep type spectrum analyzer can be checked in the frequency domain. A wide frequency can be analyzed using sweep type spectrum analysis functions while detailed signal analysis of a specific frequency band is supported too. Moreover, the built-in signal generator function outputs both continuous wave (CW) and modulated signals for use as a reference signal source when testing Tx characteristics of parts and as a signal source for evaluating Rx characteristics.

Wireless communications are tending toward use of higher frequencies above 3 GHz and wider bandwidths. However, general-purpose spectrum analyzers suffer from a degraded noise floor above 3 GHz due to the 3-GHz baseband, so they cannot be used to verify the true product performance. Because the MS269xA baseband can be extended up to 6 GHz it offers excellent level accuracy and modulation precision at frequencies from 50 Hz to 6 GHz. Adding the full line of versatile analysis software options eliminates the need for an external PC at wireless modulation analysis. Moreover, installing a preselector bypass option (MS2692A-067) enables use of the signal analyzer and modulation analysis functions up to 26.5 GHz (MS2692A).

Waveform creation software generates modulation signal patterns for all common wireless technologies to output signals for the vector signal generator function.

The high-performance, multi-function MS269xA Signal Analyzer supports better analysis than more expensive standalone spectrum analyzers.



Key Features

Basic Performance/Functions

- Frequency Range
  MS2690A: 50 Hz to 6.0 GHz
  MS2691A: 50 Hz to 13.5 GHz
  MS2692A: 50 Hz to 26.5 GHz
- Total Level Accuracy: ±0.3 dB (typ.)
- Dynamic Range*1: 177 dB
  TOI*2: ≥+22 dBm
  DANL*3: –155 dBm/Hz
- Improved Level Linearity
- Internal Reference Oscillator
  Pre-installed Reference Oscillator
    Aging Rate: ±1 × 10^{-8}/day
    Start-up Characteristics: ±5 × 10^{-8} (5 minutes after power-on)
  Rubidium Reference Oscillator (MS269xA-001)
    Aging Rate: ±1 × 10^{-10}/month
    Start-up Characteristics: ±1 × 10^{-9} (7 minutes after power-on)
- Versatile Built-in Functions
  Standard
    Channel Power
    Adjacent Channel Leakage Power
    Spurious Emission*4
    Frequency Counter*4
    FM Deviation*5
    Highest 10 Markers
    Occupied Bandwidth
    Spectrum Emission Mask*4
    Burst Average Power
    AM Depth*5
    Multi-marker & Marker List
    Limit Line*4
    2-tone 3rd-order Intermodulation Distortion*4
    Phase Noise
    Power Meter*6
  Option
    Noise Figure*7

*1: Difference between TOI and DANL as simple guide
*2: TOI (Third Order Intercept)
*3: DANL (Displayed Average Noise Level)
*4: Spectrum Analyzer functions
*5: Signal Analyzer functions
*6: Use USB Power Sensors
*7: Noise Figure Measurement Function (Requires MS269xA-017)
[Use Noise Sources (Noisecom, NC346 series)]

Signal Analyzer Functions

- Analysis Bandwidth
  - Standard: 31.25 MHz max.
    (50 MHz max. sampling rate = 20 ns resolution, ADC resolution 16 bits)
  - MS269xA-077: 62.5 MHz max.
    (100 MHz max. sampling rate = 10 ns resolution, ADC resolution 14 bits)
  - MS269xA-078[*8, *9]: 125 MHz max.
    (200 MHz max. sampling rate = 5 ns resolution, ADC resolution 14 bits)
- Capture Function
  Saves analysis Span × Time signal to internal memory and writes to hard disk.
  Up to 100 Msamples per measurement can be saved to internal memory.
- Replay Function
  Reads saved data and replays using signal analyzer function.
- Measurement with Sub-trace Display
  Splits screen and confirms both main and sub-traces at same time to check errors.
  Main: Spectrum, Frequency vs. Time, Power vs. Time,
  Phase vs. Time, CCDF/APD, Spectrogram
  Sub: Power vs. Time, Spectrogram

Supports 125 MHz Wideband Measurements up to 26.5 GHz

Microwave Preselector Bypass	MS2692A-067[*10]
Analysis Bandwidth Extension to 125 MHz	MS269xA-078[*8]

Bypassing preselector improves RF frequency characteristics and in-band frequency characteristics. Supports modulation analysis and signal analyzer measurements for signals up to 26.5 GHz.

*8: Requires MS269xA-077
*9: Combining with WLAN 802.11ac (160 MHz) measurement software MX269028A-002 (only for MS269xA) supports modulation analysis up to 160-MHz bandwidth signals of the 802.11ac.
See measurement software catalog for more details.
*10: MS2692A-067 can be installed in MS2692A

Vector Signal Generator (MS269xA-020)

- Frequency Range: 125 MHz to 6 GHz
- Pre-installed Baseband Generator
  Vector Modulation Bandwidth: 120 MHz
  Sampling Clock: 20 kHz to 160 MHz
- Level Accuracy: ±0.5 dB
- Large-capacity Memory: 1 GB = 256 Msamples
- Internal AWGN Generator
- Internal BER Measurement Function
  Bit Rate: 100 bps to 10 Mbps
  Input Level: TTL level

Basic Performance

Excellent Total Level Accuracy: ±0.3 dB (typ.)

(Common to both Spectrum Analyzer and Signal Analyzer Functions)
With a 6-GHz basic band and level calibration over a wide frequency range, the MS269xA has excellent total level accuracy.
The Absolute Amplitude Accuracy specification described in catalogs of other spectrum analyzers ignores the important frequency characteristics, linearity, and attenuator switching errors. In contrast, the MS269xA Level Calibration technology assures excellent level accuracy over a wide frequency range from 50 Hz to 6 GHz even under measurement conditions including the above three errors. The level accuracy is assured even when the frequency and attenuator are switched.

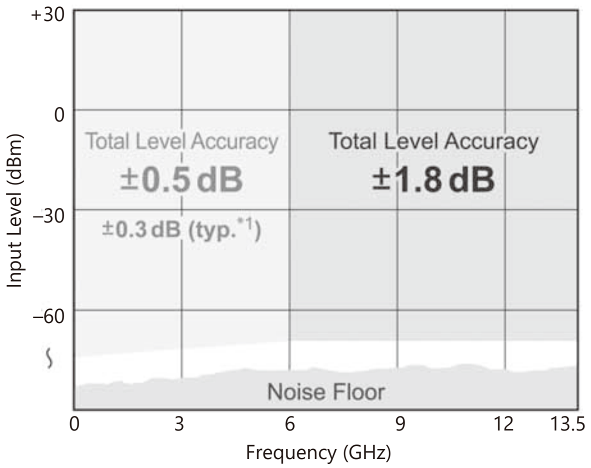
Advantage of 6 GHz Basic Band

Conventional spectrum analyzers have a degraded noise floor above 3 GHz because they use a preselector at the 3-GHz basic band, which causes lowered measurement accuracy. The MS269xA basic band of 6 GHz eliminates the degraded noise floor and improves measurement accuracy.

Advantage of MS269xA Level Accuracy Technology

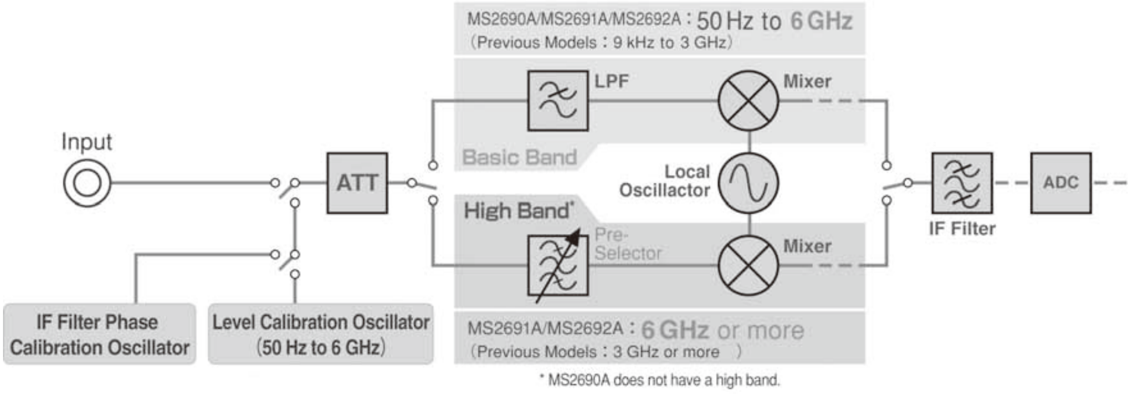
Conventional spectrum analyzers perform level calibration at just one frequency point, which causes errors when the frequency changes. The MS269xA has two built-in signal generators for level calibration over a wide frequency range from 50 kHz to 6 GHz, minimizing measurement errors in this frequency range.

The MS269xA total level accuracy includes:
- Frequency characteristics
- Linearity
- Attenuator switching error



Note: Eliminates effect of noise floor
Used only when Uncal does not occur
*1: Excluding Guard band

MS269xA Block Diagram



* MS2690A does not have a high band.

Preselector

The MS269xA has a basic band that goes to 6 GHz without a preselector. Most spectrum analyzers may use a preselector in the high band to clean-up images but it is extremely difficult to stabilize the amplitude and frequency characteristics of the preselector. This instability is the main cause of degraded level accuracy and modulation precision in measuring instruments.
Additionally, the preselector passband frequency can cause limitations at analysis bandwidths. No preselector means greater measurement accuracy.

Top Class Dynamic Range

Dynamic Range*1: 177 dB
TOI*2: ≥+22 dBm (700 MHz to 4 GHz)
DANL*3: –155 dBm/Hz (30 MHz to 2.4 GHz)

*1: Difference between TOI and DANL as simple guide.
*2: TOI (Third Order Intercept)
*3: DANL (Displayed Average Noise Level)

Dynamic range is a key specification for spectrum analyzers.
Low displayed average noise level (DANL) as well as high TOI are important too.
Low TOI may cause distortion with high-level carrier signals. Inserting an attenuator can lower the carrier level but this has the effect of lowering the level of weak spurious, making it hard to measure.

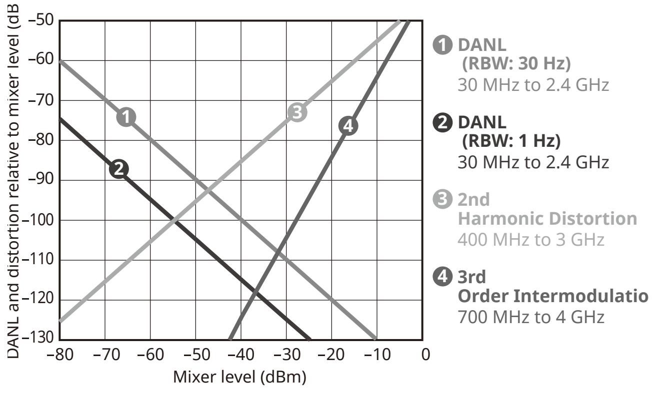
The MS269xA has an excellent dynamic range supporting true performance measurements of devices, such as base stations, requiring wideband measuring instruments.
For example, the 3GPP category-B spurious measurement specification requires a measuring instrument with severe dynamic range specifications. If the measurement is within the MS269xA dynamic range, measurement jigs such as filters and amplifiers are unnecessary and troublesome calibration is omitted, helping simplify setup and cut costs.

Microwave Preselector Bypass MS2692A-067*

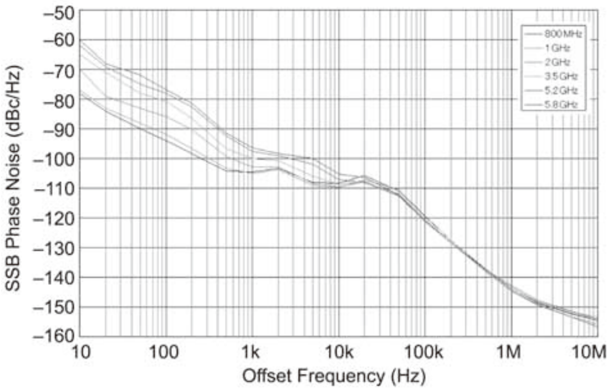
Bypasses the preselector to improve the RF frequency characteristics and the in-band frequency characteristics.
When the preselector option is set to On, the image response elimination filter is bypassed.
Therefore, this function is not appropriate for spurious measurement to receive the image response.

*: MS2692A-067 can be installed in MS2692A.

Distortion Characteristics (Spectrum Analyzer)



Example: SSB Phase Noise
(Spectrum Analyzer/Signal Analyzer Common)

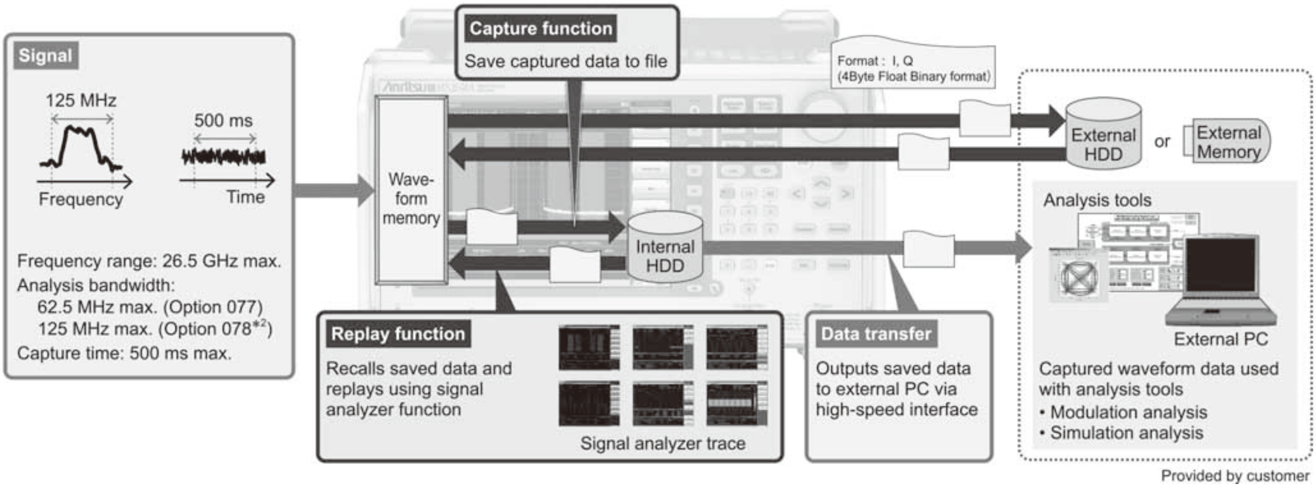


Supports 125 MHz Wideband Measurements up to 26.5 GHz

Microwave Preselector Bypass MS2692A-067*1 + Analysis Bandwidth Extension to 125 MHz MS2692A-078*2

*1: Can be installed in MS2692A.
*2: Require MS2692A-077.

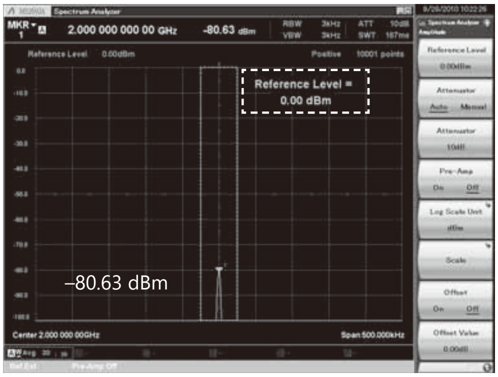
Supports wideband analysis with high frequencies for satellite communications
Microwave preselector bypass frequency range: 6 GHz to 26.5 GHz (MS2692A)
Installing the microwave preselector bypass supports signal analyzer measurement functions in the above frequency range.



Improved Level Linearity

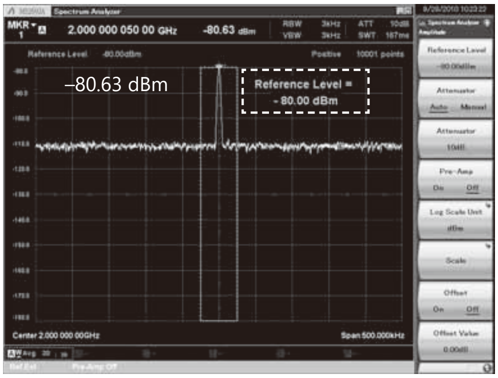
Conventional spectrum analyzers use an analog IF and log amp to achieve good level accuracy at points near the log scale reference level, but the accuracy degrades at points that are further away.
The MS269xA uses a digital IF instead of a log amp, which supports measurements with excellent accuracy at any point.

Example: Level Stability by Switching Reference Level


MKR 1 2.000 000 000 00 GHz -80.63 dBm
RBW 3kHz VBW 3kHz ATT 10dB SWT 167ms
Reference Level 0.00dBm
Positive 10001 points
Center 2.000 000 00GHz
Span 500.000kHz

Reference Level = 0.00 dBm

–80.63 dBm


MKR 1 2.000 000 050 00 GHz -80.63 dBm
RBW 3kHz VBW 3kHz ATT 10dB SWT 167ms
Reference Level -80.00dBm
Positive 10001 points
Center 2.000 000 00GHz
Span 500.000kHz

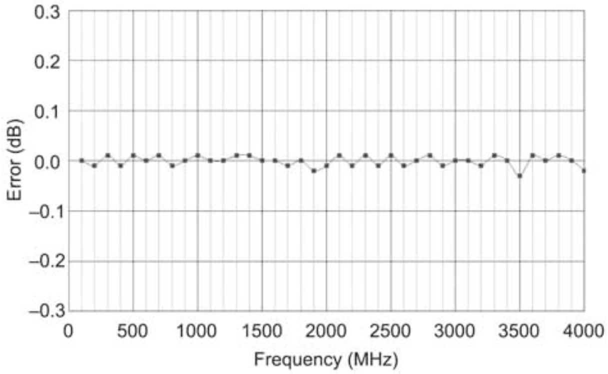
–80.63 dBm

Reference Level = – 80.00 dBm

Dual Sweep Speed: Normal/Fast

When sweep time is set to [Auto], Normal (normal sweep) or Fast mode (high-speed sweep) can be set. The Fast mode sweeps six times faster than the Normal mode.

Example of Sweep Mode Switch Error: (CW –10 dBm input)
Level Error when Switching from Normal to Fast



Resolution Bandwidth (RBW)

Setting Range

- Spectrum Analyzer:
  30 Hz to 3 MHz (1-3 sequence),
  50 kHz, 5 MHz, 10 MHz, 20 MHz, 31.25 MHz*1
- Spectrum trace in signal analyzer mode:
  1 Hz to 1 MHz (1-3 sequence), 3 MHz*2, *3, 10 MHz*3

When monitoring two adjacent signals, the frequency resolution can be increased by reducing the resolution bandwidth (RBW).
This also has the effect of reducing the noise level.
Conversely, to confirm level variations of 20-MHz band signals such as LTE, set the RBW to 31.25 MHz.

*1: Instead of Gaussian filter, 31.25 MHz RBW uses filter with flat top characteristics above 31.25 MHz.
*2: With MS269xA-077 installed and bandwidth setting ≥50 MHz
*3: With MS269xA-077+078 installed and bandwidth setting ≥50 MHz

Trigger Function

Trigger sweep executes sweeping using the specified trigger condition as the start point. In particular, "SG Marker" starts analyzer measurement in synchrony with the signal output by installing MS269xA-020.
Using this function supports simple synchronized measurement even when evaluating signals with large level variation over time, such as modulation signals.

- Video trigger:
  Trigger sweeping starts in synchronization with the rise or fall of the waveform. A trigger level indicator showing the trigger level is displayed on the screen.
- Wide IF video trigger:
  An IF signal with a wide passing band of about 50 MHz is detected, and sweeping starts in synchronization with either the rise or fall of the detected signal.
- External trigger:
  Sweeping starts in synchronization with the rise or fall of the signal input via the Trigger Input connector.
- SG Marker trigger (Requires MS269xA-020):
  Sweeping starts in synchronization with the rise or fall of the marker signal output of MS269xA-020. This function supports measurement in synchronization with the output signal of MS269xA-020.

Gate Sweep

Gate sweep executes sweeping only for the length of time specified by the gate length, starting from when the trigger condition is met.
A delay time until sweeping starts after the trigger condition is met can be set using trigger delay.

- The gate source can be selected from the following
  Wide IF video trigger
  External trigger
  SG marker trigger (Requires MS269xA-020)
- Setting range and resolution for gate delay
  Setting range: 0 to 1 s
  Resolution: 20 ns
- Setting range and resolution for gate length
  Setting range: 50 us to 1 s
  Resolution: 20 ns

Three Built-in External Interfaces

The built-in Gigabit Ethernet, USB2.0, and GPIB interfaces support remote operation.

GPIB: IEEE 488.2, Rear panel, IEEE 488 bus connector
Interface functions:
SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0, E2
Ethernet: 10/100/1000BASE-T, Rear panel, RJ-45
USB (B): USB2.0, Rear panel, USB-B connector

Saving Measurement Results

Measurement results can be saved to internal hard disk or external USB memory. Screen dumps and trace data can be saved too.

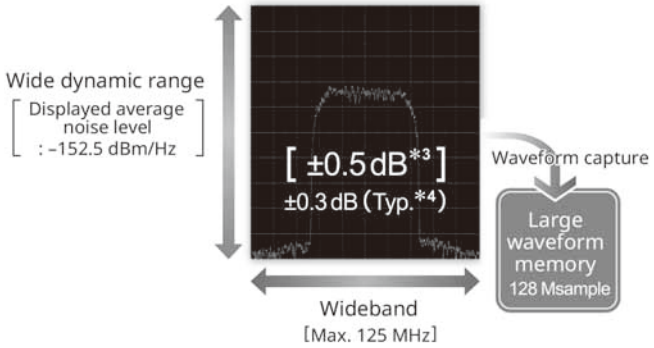
- Screen dump file type
  BMP
  PNG
- The color of the screen hard copy can be set as follows:
  Normal (same as screen display)
  Reverse
  Monochrome
  Reversed Monochrome

Signal Analyzer: Basic Performance/Functions

Wide bandwidth × High Accuracy FFT Analysis

Standard: 31.25 MHz max.
(50 MHz max. sampling rate = 20 ns resolution, ADC resolution 16 bits)
MS269xA-077: 62.5 MHz max.
(100 MHz max. sampling rate = 10 ns resolution, ADC resolution 14 bits)
MS269xA-078*1, *2: 125 MHz max.
(200 MHz max. sampling rate = 5 ns resolution, ADC resolution 14 bits)

Based on the excellent level accuracy and wide dynamic range of the MS269xA, a signal with an FFT analysis bandwidth of up to 125 MHz can be captured with a level accuracy of ±0.3 dB.



*1: Requires MS269xA-077
*2: Combining with WLAN 802.11ac (160 MHz) measurement software MX269028A-002 (only for MS269xA) supports modulation analysis up to 160-MHz bandwidth signals of the 802.11ac.
See measurement software catalog for more details.
*3: 50 Hz ≤ Frequency ≤ 6.0 GHz, Frequency band mode: Normal
*4: Excluding Guard band

Excellent Frequency Characteristics in Analysis Bandwidth

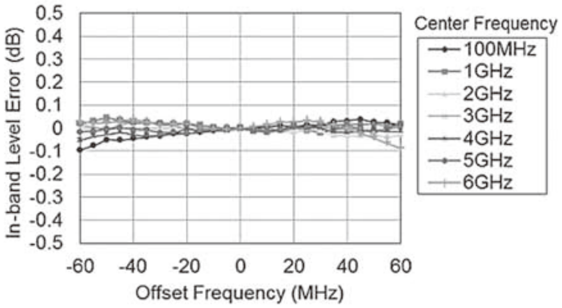
The Signal Analyzer Extra Band Cal function using the built-in oscillator for calibration supports analysis bandwidth calibration at the set frequency.
The excellent in-band frequency characteristics support wideband modulation analysis with less error.

Extra Band Cal Frequency Range

Span ≤ 31.25 MHz (Standard): 30 MHz to 6 GHz
Span > 31.25 MHz (MS269xA-077/078): 100 MHz to 6 GHz

*: Setting center frequency after Extra Band Cal, requires re-execution of Extra Band Cal.

Example of frequency characteristics in analysis bandwidth after Extra band Cal (With MS269xA-078, Reference level: –10 dBm, Input attenuator: 10 dB, Preamp: Off, Span: 125 MHz)



Save Signals in Internal Memory

Max. Capture Time: 0.5 s to 2000 s
Max. Number of Samples: 100 Msamples

The "Analysis bandwidth × Analysis time" signal is held in internal memory and saved to hard disk.
Up to 100 Msamples of data can be saved to memory for one measurement. The frequency span determines the sampling rate. The following chart shows the maximum capture time per frequency span.

Span	Sampling Rate	Capture Time	Max. Sampling Data
1 kHz	2 kHz	2000 s	4M
2.5 kHz	5 kHz	2000 s	10M
5 kHz	10 kHz	2000 s	20M
10 kHz	20 kHz	2000 s	40M
25 kHz	50 kHz	2000 s	100M
50 kHz	100 kHz	1000 s	100M
100 kHz	200 kHz	500 s	100M
250 kHz	500 kHz	200 s	100M
500 kHz	1 MHz	100 s	100M
1 MHz	2 MHz	50 s	100M
2.5 MHz	5 MHz	20 s	100M
5 MHz	10 MHz	10 s	100M
10 MHz	20 MHz	5 s	100M
25 MHz	50 MHz	2 s	100M
31.25 MHz	50 MHz	2 s	100M
50 MHz*	100 MHz	500 ms	50M
62.5 MHz*	100 MHz	500 ms	50M
100 MHz*	200 MHz	500 ms	100M
125 MHz*	200 MHz	500 ms	100M

*: With MS269xA-077: 50/62.5 MHz
With MS269xA-077/078: 50/62.5/100/125 MHz

Replay Function for Comparison Evaluation

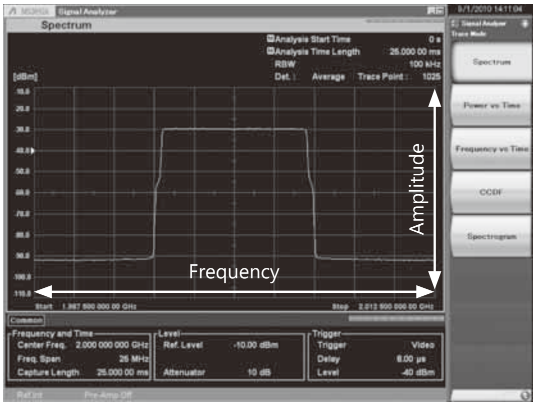
This function reads saved data and replays it using the signal analyzer measurement function.

Examples:
1. Data sharing between separate R&D and manufacturing
2. Later laboratory bench-top analysis of on-site signals
3. Save data at shipment and re-verify if problem occurs

Signal Analyzer: Trace

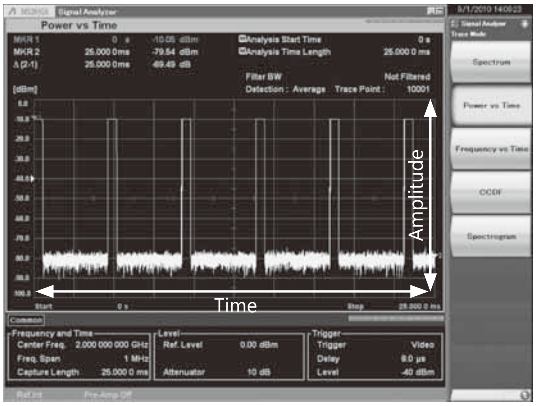
Spectrum

The Spectrum trace displays a graph with amplitude on the y-axis and frequency on the x-axis. The captured IQ data is FFT processed (fast Fourier transformed) and converted from the time domain to the frequency domain for display as a spectrum.


Spectrum
Analysis Start Time 0 s
Analysis Time Length 25.000 00 ms
RBW 100 kHz
Det. : Average Trace Point : 1025
Start 1.987 500 000 00 GHz
Stop 2.012 500 000 00 GHz
Center Freq. 2.000 000 000 GHz
Freq. Span 25 MHz
Capture Length 25.000 00 ms
Ref. Level -10.00 dBm
Attenuator 10 dB
Trigger Video
Delay 8.00 μs
Level -40 dBm

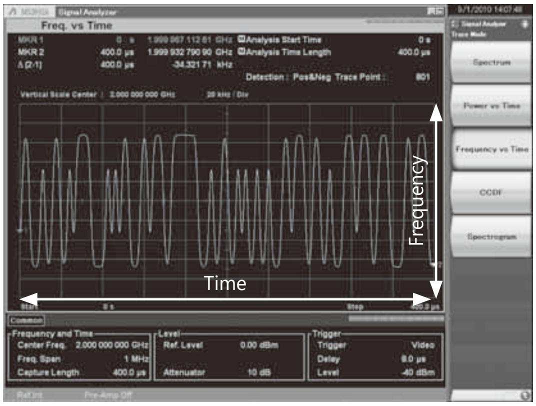
Power vs. Time

The Power vs. Time trace displays a graph with amplitude on the y-axis and time on the x-axis to confirm changes in power with time of measured signals.


Power vs Time
MKR 1 0 s -10.05 dBm
MKR 2 25.000 0ms -79.54 dBm
Δ (2-1) 25.000 0ms -69.49 dB
Analysis Start Time 0 s
Analysis Time Length 25.000 0 ms
Filter BW Not Filtered
Detection : Average Trace Point : 10001
Start 0 s
Stop 25.000 0 ms
Center Freq. 2.000 000 000 GHz
Freq. Span 1 MHz
Capture Length 25.000 0 ms
Ref. Level 0.00 dBm
Attenuator 10 dB
Trigger Video
Delay 8.0 μs
Level -40 dBm

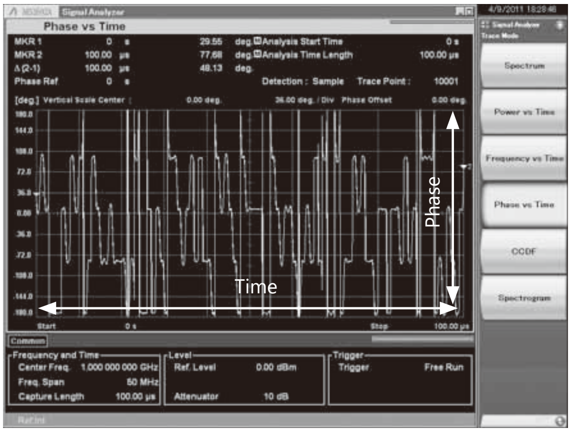
Frequency vs. Time

The Frequency vs. Time trace displays a graph with frequency on the y-axis and time on the x-axis to confirm time variation of the measured signal frequency.


Freq. vs Time
MKR 1 0 s
MKR 2 400.0 μs 1.999 932 790 90 GHz
Δ (2-1) 400.0 μs -34.321 71 kHz
Analysis Start Time 0 s
Analysis Time Length 400.0 μs
Detection : Pos&Neg Trace Point : 801
Vertical Scale Center : 2.000 000 000 GHz 20 kHz / Div
Start 0 s
Center Freq. 2.000 000 000 GHz
Freq. Span 1 MHz
Capture Length 400.0 μs
Ref. Level 0.00 dBm
Attenuator 10 dB
Trigger Video
Delay 8.0 μs
Level -40 dBm

Phase vs. Time

The Phase vs. Time trace displays a graph with phase on the y-axis and time on the x-axis to confirm time variation of the measured signal phase.



CCDF[*1]/APD[*2]

The CCDF trace displays the power variation probability on the y-axis and power variation on the y-axis to confirm the CCDF and APD of measured signals.

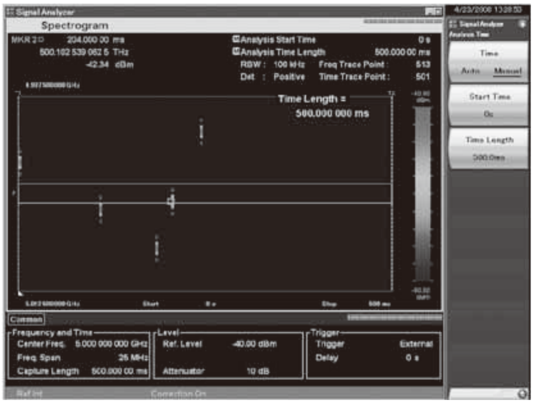
*1: CCDF (Complementary Cumulative Distribution Function)
*2: APD (Amplitude Probability Density)

Measurement Results

- CCDF: The CCDF display indicates the cumulative distribution of transient power variations compared to average power.
- APD: The APD display indicates the probability distribution of transient power fluctuations compared to average power.

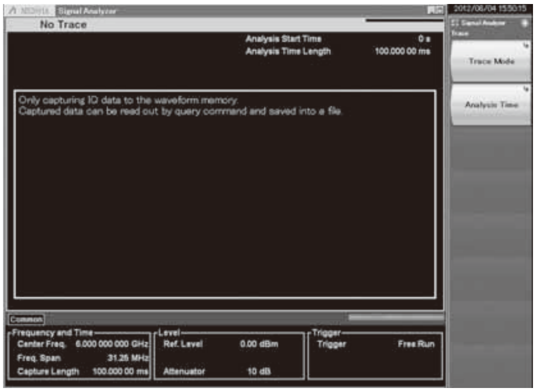
Spectrogram

The Spectrogram trace displays the level as color with frequency on the y-axis and time on the x-axis. The captured IQ data is FFT processed to confirm time variations in the continuous spectrum.
It is useful for monitoring frequency hopping and transient signals.



No Trace

No Trace mode does not execute signal analysis. Therefore, “IQ data output” and “IQ data readout using remote commands” can be executed quickly without the need to wait for completion of analysis.



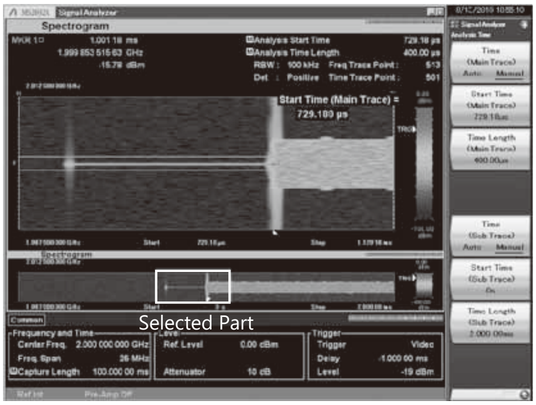
Only capturing IQ data to the waveform memory.
Captured data can be read out by query command and saved into a file.

Measurement with Sub-trace Display

This function splits the screen into top and bottom halves; simultaneous display of the sub-trace supports easy monitoring of fault locations and transient phenomena.

Main: Spectrum, Frequency vs. Time, Power vs. Time,
Phase vs. Time, CCDF/APD, Spectrogram
Sub: Power vs. Time, Spectrogram

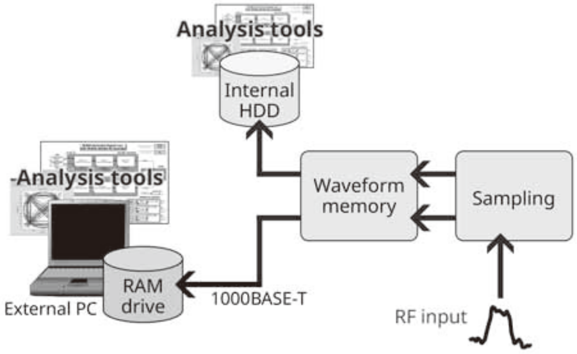
The part of a previously captured long-term signal to be monitored can be selected on the sub-trace to display the problem part only on the main trace.



Signal Analyzer: Applications

Analyze Captured Waveforms using Third-Party Tools

The MS269xA utilizes proprietary calibration technologies, enabling digitized baseband data to be used directly in third-party analysis tools without the need for correction.



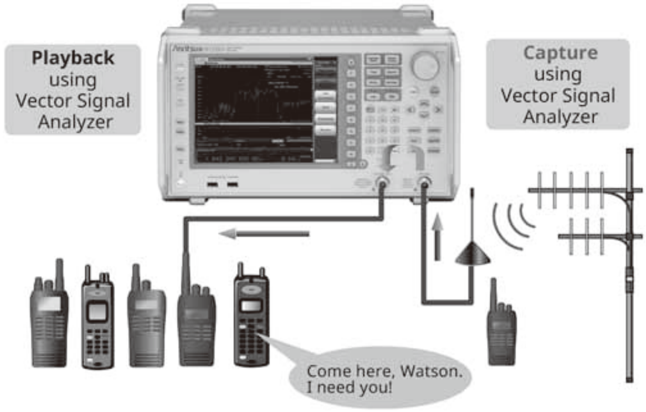
Capture & Playback Real-World Signals

The MS269xA provides Capture & Playback functionality that enables laboratory-grade testing of transceiver systems using real world signals. Using the optional integrated Vector Signal Analyzer and Vector Signal Generator of the MS269xA, Capture & Playback allows users to conveniently capture up to 100 MHz of spectrum and play it back at any designated frequency and amplitude, making it easy to determine device performance margins.

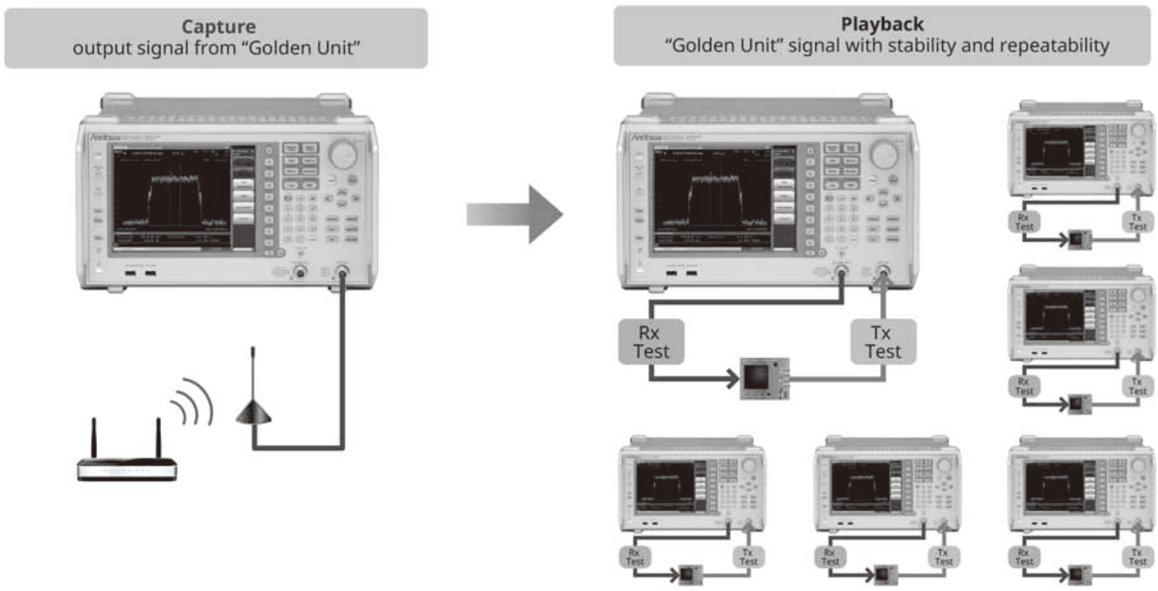
Applications for *Capture & Playback*

- Validation/Production Test
  Captured signals can be used to initiate a communications link and perform receiver sensitivity testing with a device under test (DUT) using signals captured from a Golden Unit.
- Device Characterization
  Actual baseband signals captured from an RFIC can be used as simulation for characterizing amplifiers and other downstream devices or modules.
- Electromagnetic Compatibility Test
  Problematic RF environments or discrete signals – such as cellular or Wi-Fi – can be captured and used to evaluate a device's susceptibility to RF interference, debug any problems found and validate the solution.

Wi-Fi® is a registered trademark of Wi-Fi Alliance.



Repeatably Test Device Performance using "Real-World" RF Environments



Use "Golden Unit" Signal for Manufacturing Test and Calibration

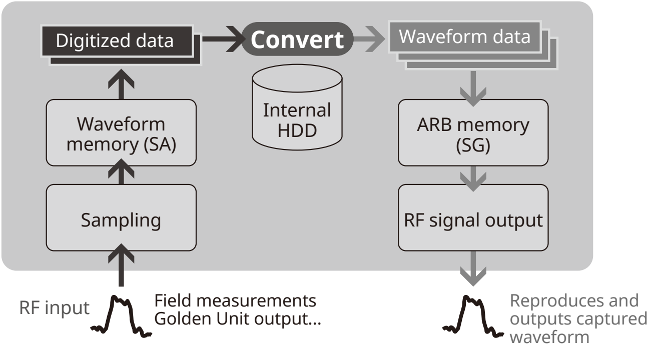
***Capture & Playback* Highlights**

- Bandwidth and Time Limits
  Minimum 10 kHz Bandwidth (2000 s maximum duration)*
  Maximum 100 MHz Bandwidth (500 ms maximum duration)*

*: Maximum bandwidth depends upon vector signal analyzer options installed (Standard analysis bandwidth or MS269xA-077/078).

- Captured signal may be freely tuned to any output frequency and amplitude supported by the vector signal generator.
- Any section of the captured waveform record may be selected and played back.

  Enables user to isolate and reproduce specific signal bursts
  Enables user to change duty cycle of pulsed waveforms



Playback Block Diagram

Playback any Desired Section of Captured Waveform

Versatile Built-in Functions

Useful for Tx Characteristics Evaluation

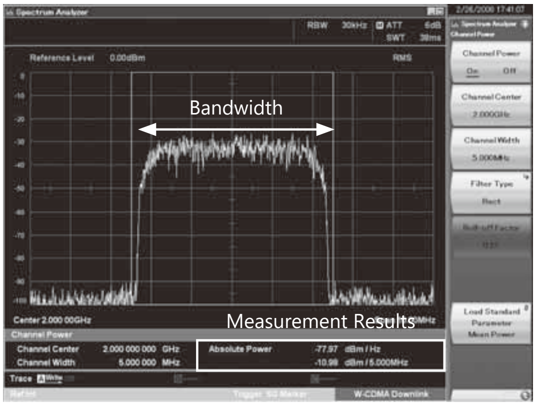
The MS269xA is fully loaded with all the functions required for evaluating Tx characteristics. Tests can be performed simply and in accordance with standards using functions tailored to measurement contents.

Measure Function	SPA*1	VSA*2
Channel Power	✓	✓
Occupied Bandwidth	✓	✓
Adjacent Channel Leakage Power	✓	✓
Spectrum Emission Mask	✓	
Burst Average Power	✓	✓
Spurious Emission	✓	
AM Depth		✓
FM Deviation		✓
Multi-marker & Marker List	✓	✓
Highest 10 Markers	✓	✓
Limit Line	✓	
Frequency Counter	✓	
2-tone 3rd-order Intermodulation Distortion	✓	
Annotation Display (On/Off)	✓	
Phase Noise	Independent function	
Power Meter	Independent function*3	
Noise Figure	MS269xA-017*4	

*1: SPA (Spectrum Analyzer)
*2: VSA (Vector Signal Analyzer)
*3: Use USB Power Sensors
*4: Use Noise Sources (Noisecom, NC346 series)

Channel Power SPA VSA

This function measures channel bandwidth power. Three types of filters (Rect, Nyquist, Root Nyquist) can be selected.
Pre-installed templates for each standard support easy parameter setting.

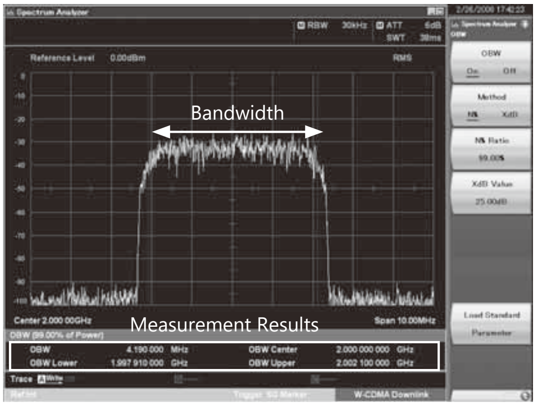


```
Center 2.000 00GHz
Channel Power
Channel Center    2.000 000 000  GHz     Absolute Power    -77.97  dBm / Hz
Channel Width         5.000 000  MHz                       -10.98  dBm / 5.000MHz
```

Measurement Results
- Absolute power per Hz in channel band
- Total power in channel band

Occupied Bandwidth SPA VSA

Occupied bandwidth is measured by selecting either the N% or X-dB mode. Pre-installed templates for each standard support easy parameter setting.

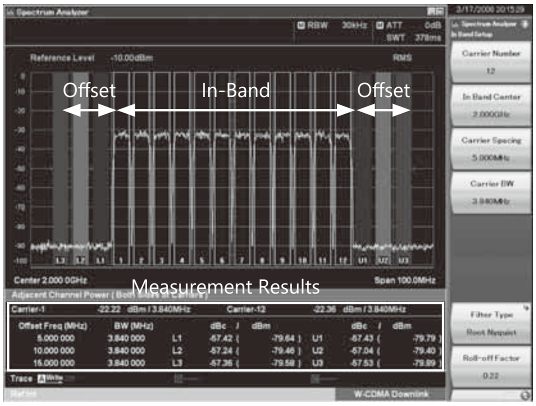


```
Center 2.000 00GHz                                   Span 10.00MHz
OBW (99.00% of Power)
OBW          4.190 000  MHz       OBW Center   2.000 000 000  GHz
OBW Lower  1.997 910 000  GHz     OBW Upper    2.002 100 000  GHz
```

Measurement Results
- Bandwidth for specified conditions

Adjacent Channel Leakage Power SPA VSA

This function measures carrier adjacent channel (offset) power (In-Band). 1 to 12 carriers can be set and switched instantaneously on-screen. True ACLR performance is measured using the noise cancellation function to subtract main-frame noise from the measurement result. Pre-installed templates for each standard support easy parameter setting.

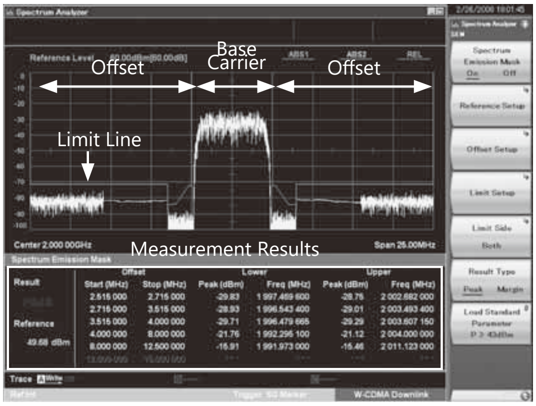


```
Center 2.000 0GHz                                               Span 100.0MHz
Adjacent Channel Power ( Both Sides of Carriers )
Carrier-1        -22.22  dBm / 3.840MHz      Carrier-12      -22.36  dBm / 3.840MHz
Offset Freq (MHz)   BW (MHz)        dBc  /   dBm                dBc  /   dBm
     5.000 000     3.840 000   L1   -67.42 (   -79.64 )   U1   -67.43 (   -79.79 )
    10.000 000     3.840 000   L2   -67.24 (   -79.46 )   U2   -67.04 (   -79.40 )
    15.000 000     3.840 000   L3   -67.36 (   -79.58 )   U3   -67.53 (   -79.89 )
```

Measurement Results
- Absolute power of Offset channel
- Relative values in relation to reference power selected in ACP reference

Spectrum Emission Mask SPA

This function splits the offset part into up to 12 segments; the measurement parameters and limit lines can be specified to measure the peak power and margin for each segment. The results are tabulated below the trace and marked PASS/FAIL. Pre-installed templates for each standard support easy parameter setting.



Center 2.000 00GHz Span 25.00MHz

Spectrum Emission Mask

Result

Reference -49.68 dBm

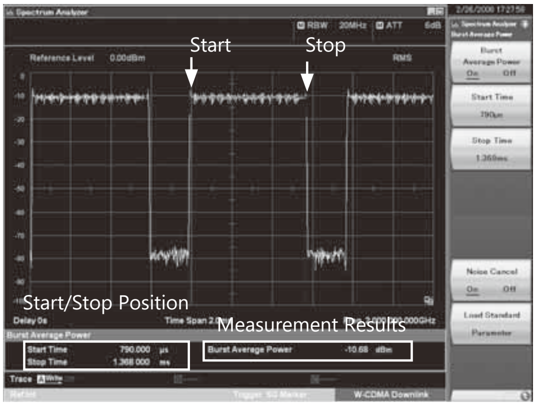
Offset		Lower		Upper	
Start (MHz)	Stop (MHz)	Peak (dBm)	Freq (MHz)	Peak (dBm)	Freq (MHz)
2.515 000	2.715 000	-29.83	1 997.469 600	-28.75	2 002.682 000
2.715 000	3.515 000	-28.93	1 996.543 400	-29.01	2 003.493 400
3.515 000	4.000 000	-29.71	1 996.479 665	-29.29	2 003.607 150
4.000 000	8.000 000	-21.76	1 992.295 100	-21.12	2 004.000 000
8.000 000	12.500 000	-15.91	1 991.973 000	-15.46	2 011.123 000

W-CDMA Downlink

Measurement Results
- Peak power (or margin) at offset
- Each peak frequency

Burst Average Power SPA VSA

The average power for the range specified by two markers is displayed in the time domain. Measurement only requires setting the measurement start and stop positions on the screen. True performance is measured using the noise cancellation function to subtract main-frame noise from the measurement result.
Pre-installed templates for each standard support easy parameter setting.



Burst Average Power

Start Time 790.000 μs
Stop Time 1.368 000 ms

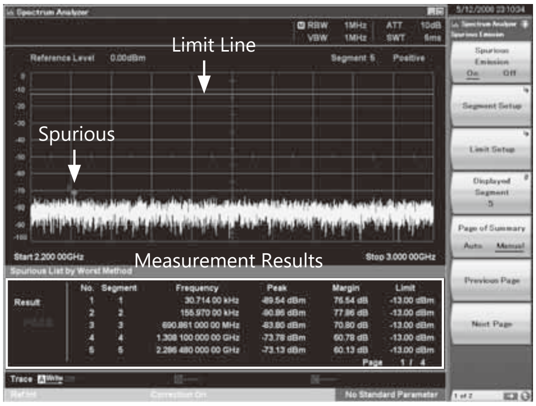
Burst Average Power -10.68 dBm

W-CDMA Downlink

Measurement Results
- Average power of specified range

Spurious Emission SPA

This function splits the frequency range into up to 20 segments for sweeping; the measurement parameters and limit lines can be specified to measure the peak power and margin for each segment. The results are tabulated below the trace and marked PASS/FAIL. In particular, all tests can be completed up to the final stage without an external PC because the zero-span capture function described in the technology compliance test is built-in.



Start 2.200 00GHz Stop 3.000 00GHz

Spurious List by Worst Method

No.	Segment	Frequency	Peak	Margin	Limit
1	1	30.714 00 kHz	-89.54 dBm	76.54 dB	-13.00 dBm
2	2	155.970 00 kHz	-90.86 dBm	77.86 dB	-13.00 dBm
3	3	690.861 000 00 MHz	-83.80 dBm	70.80 dB	-13.00 dBm
4	4	1.308 100 000 00 GHz	-73.78 dBm	60.78 dB	-13.00 dBm
5	5	2.286 480 000 00 GHz	-73.13 dBm	60.13 dB	-13.00 dBm

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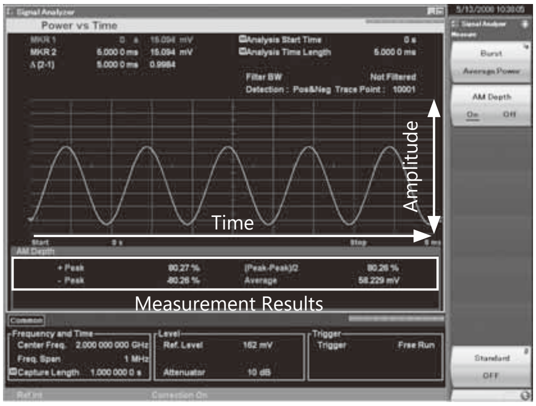
No Standard Parameter

Measurement Results
- Each segment peak power and margin
- Each peak frequency

AM Depth VSA

The Power vs. Time trace measurement function is used to confirm AM depth.
It measures the measured signal AM based on trace data at the displayed marker. When marker is Off, the whole range is measured.



Power vs Time

MKR 2 5.000 0 ms 15.094 mV
Δ (2-1) 5.000 0 ms 0.9984

Analysis Start Time 0 s
Analysis Time Length 5.000 0 ms
Filter BW Not Filtered
Detection : Pos&Neg Trace Point : 10001

AM Depth

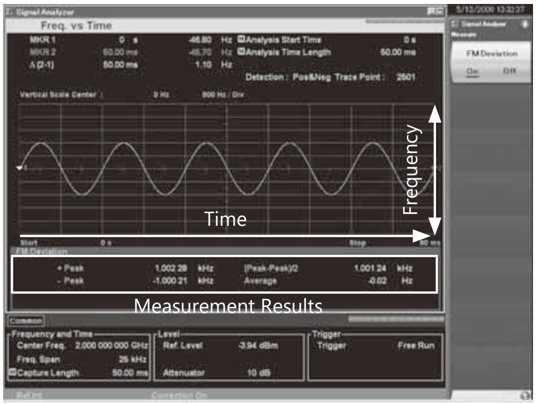
+ Peak	80.27 %	(Peak-Peak)/2	80.26 %
- Peak	-80.26 %	Average	58.229 mV

Center Freq. 2.000 000 000 GHz
Freq. Span 1 MHz
Capture Length 1.000 000 0 s
Ref. Level 162 mV
Attenuator 10 dB
Trigger Free Run

Measurement Results
- +Peak, –Peak, (Peak-Peak)/2, Average

FM Deviation VSA

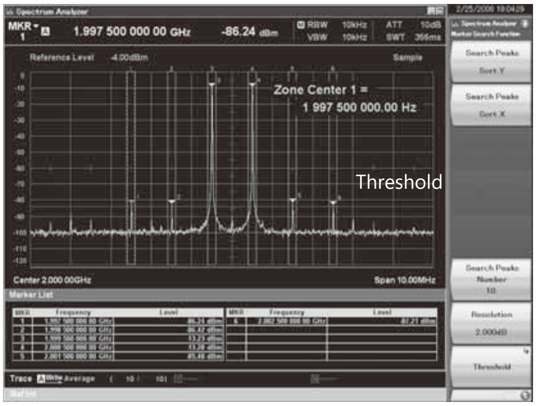
The Frequency vs. Time trace measurement is used to confirm the FM deviation. It measures the maximum and minimum frequencies from trace data in the marker range. When marker is Off, the whole range is measured.



Measurement Results
- +Peak, –Peak, (Peak-Peak)/2, Average

Multi-marker & Marker List SPA VSA

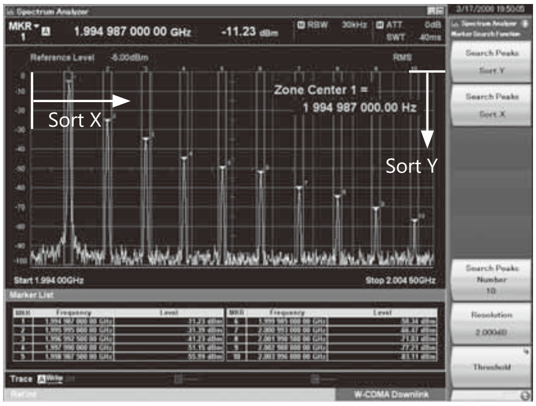
Up to 10 markers can be set for this function. Markers may be either a spot or a zone. Using a zone marker, the peak of a signal with an unstable variable frequency can be tracked and measured. Not only can the 10 markers be listed below the trace but the differences between markers can be calculated and displayed using the delta setting.



Measurement Results
- Marker point frequency
- Marker point power
- Absolute power per Hz in marker bandwidth
- Total power in marker bandwidth
- Difference between any markers

Highest 10 Markers SPA VSA

This function sets the threshold level and auto-detects peaks in the X (frequency) and Y (level/time) directions.

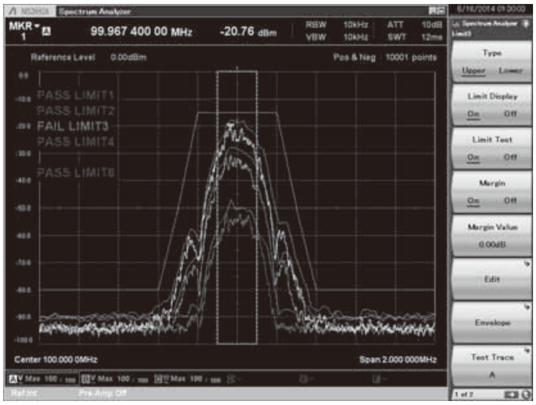


Measurement Results
- Peak Search Y:
  Sets up to 10 markers in order of peak level
- Peak Search X:
  Sets up to 10 markers in order of frequency (time) level

Limit Line SPA

- Setting Limit Lines
  Up to six types of Limit line can be set on the spectrum display (frequency domain).
  In addition to setting the frequency and level of crossover points manually in sequence from the low frequency, after creating the right half of a line, the left half can be created by reversing and copying the right half, to set a symmetric limit line. Additionally, a Limit line that traces the measured waveform can be created using the Limit Envelope function. A margin can be set on the Limit line in the amplitude direction.
- Evaluating using Limit Line Setting (Limit Test Function)
  When the waveform is above or below the Limit line, it is evaluated automatically as PASS or FAIL. Evaluation is also possible with an added margin. The target evaluation line can be chosen from any of six types.
- Auto-saving Waveform Data using Limit Line Setting (Save on Event Function)
  When the waveform matches the evaluation conditions (Event), it can be saved automaticaly as a csv format file. Any one of the following five Event types can be selected.

(1) Limit Fail: Saves waveform file when evaluation result is Fail
(2) Limit Pass: Saves waveform file when evaluation result is Pass
(3) Margin Fail: Saves waveform file when evaluation result including margin is Fail
(4) Margin Pass: Saves waveform file when evaluation result including margin is Pass
(5) Sweep Complete: Saves waveform file at every measurement regardless of evaluation result

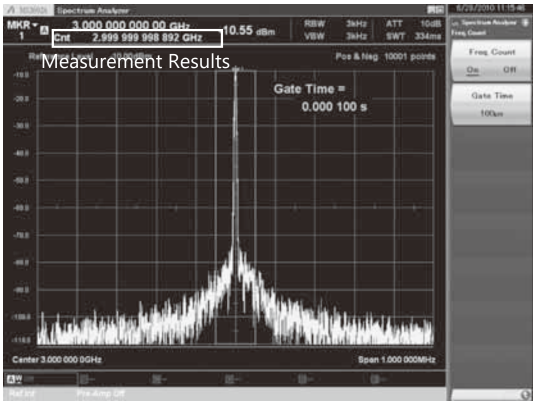


Example:
PASS/FAIL evaluation is performed by changing the input signal level.
The evaluation results for the five line types can be displayed simultaneously on one screen.

Line: Limit 1, Limit 2, Limit 3, Limit 4, Limit 5, Limit 6
Evaluation Type: Upper Limit, Lower Limit
Crossover (Point): 1 to 100
Margin: Set Margin line for each Limit 1, 2, 3, 4, 5, 6
Evaluation Result: PASS, FAIL
Result Save: Auto-save as csv format file

Frequency Counter SPA

This function of the marker functions is used to measure CW frequencies.
Gate Time sets the measurement target time.



Measurement Results
- Marker point frequency

2-tone 3rd-order Intermodulation Distortion SPA

By inputting two different frequency CW signals (desired waves), two-tone third-order intermodulation distortion is generated close to the desired waves according to non-linear characteristics of Device Under Test (DUT). Then, Third Order Intercept (TOI) is calculated from the two-tone third-order intermodulation distortion.

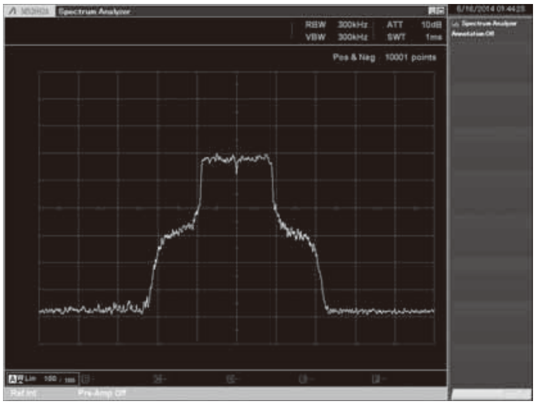
TOI (dBm) 1.69
Amplitude (dBc) -29.94

	Frequency (GHz)	Amplitude (dBm)	Amplitude (dBc)	TOI (dBm)
Lower 3rd	0.999 850 000	-43.21	-29.94	1.69
Lower Tone	0.999 949 960	-13.28		
Upper Tone	1.000 050 000	-13.27		
Upper 3rd	1.000 149 999	-43.30	-30.02	1.74

Measurement Results
- TOI: [dBm]
- Amplitude: [dBc]

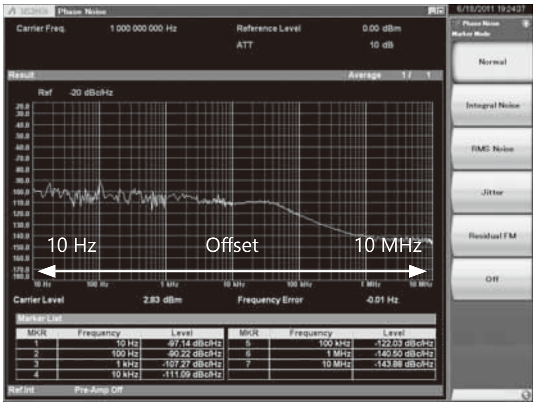
Annotation Display SPA

Screen annotations can be set to On or Off. Annotations about frequency, level, etc., are not displayed at the Off setting.



Phase Noise

This function measures phase noise in the 10 Hz to 10 MHz frequency offset range.



Carrier Freq. 1 000 000 000 Hz Reference Level 0.00 dBm

ATT 10 dB

Result Average 1 / 1

Carrier Level 2.83 dBm Frequency Error -0.01 Hz

Marker List

MKR	Frequency	Level	MKR	Frequency	Level
1	10 Hz	-97.14 dBc/Hz	5	100 kHz	-122.03 dBc/Hz
2	100 Hz	-90.22 dBc/Hz	6	1 MHz	-140.50 dBc/Hz
3	1 kHz	-107.27 dBc/Hz	7	10 MHz	-143.88 dBc/Hz
4	10 kHz	-111.09 dBc/Hz			

Ref.Int Pre-Amp Off

Measurement Results
- Carrier level
- Error between set frequency and carrier frequency
- Marker point phase noise level

Power Meter

Power meter function can connect a USB power sensor to the MS2830A and read the measurement values.

COM5 MA24108A Freq : 1.000 000 000 GHz Range : Auto

POWER : -10.00 dBm

0.00 dB

100. μW

Measuring Not Zeroed Offset : Off, 0.00 dB Average : 80 / 1000

Measurement Results
- Power: [dBm], [W]
- Relative power: [dB]

Compatible USB power sensors

Model	Frequency Range	Dynamic Range
MA24104A*	600 MHz to 4 GHz	+3 to +51.76 dBm
MA24105A	350 MHz to 4 GHz	+3 to +51.76 dBm
MA24106A	50 MHz to 6 GHz	–40 to +23 dBm
MA24108A	10 MHz to 8 GHz	–40 to +20 dBm
MA24118A	10 MHz to 18 GHz	–40 to +20 dBm
MA24126A	10 MHz to 26 GHz	–40 to +20 dBm

*: MA24104A has been discontinued.

Noise Figure Measurement (MS269xA-017)

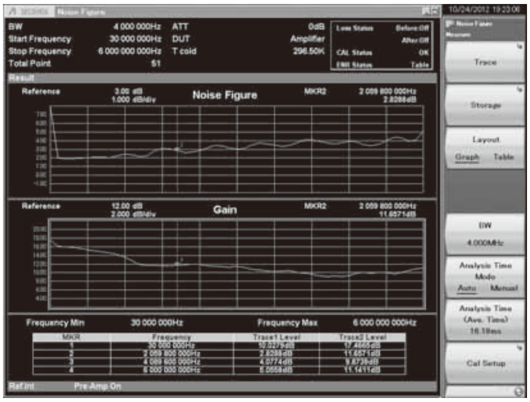
Noise Figure is measured with the measurement method of Y-factor method which uses a Noise Source*.

Frequency Mode: Fixed, List, Sweep
DUT Mode: Amplifier, Down Converter, Up Converter
Screen Layout: Graph, Table

Measurement Results Display

Graph/List/Spot

Displays measurement results for each trace (Trace1/Trace2).
- Noise Figure (NF) [dB]
- Noise Factor (F) [Linear]
- Gain
- Y-Factor: Power ratio when Noise Source is turned On/Off
- T effective: Effective noise temperature
- P Hot: Power measured when Noise Source is On.
- P Cold: Power measured when Noise Source is Off.



BW 4 000 000Hz ATT 0dB

Start Frequency 30 000 000Hz DUT Amplifier

Stop Frequency 6 000 000 000Hz T cold 296.50K

Total Point 51

Loss Status Before:Off After:Off

CAL Status OK

ENR Status Table

Result

Reference 3.00 dB 1.000 dB/div MKR2 2 059 800 000Hz 2.8288dB

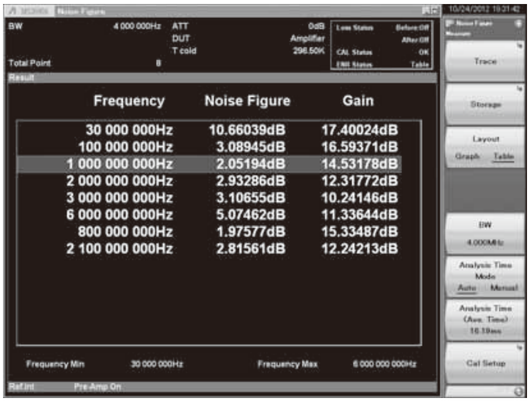
Reference 12.00 dB 2.000 dB/div MKR2 2 059 800 000Hz 11.6571dB

Frequency Min 30 000 000Hz Frequency Max 6 000 000 000Hz

MKR	Frequency	Trace1 Level	Trace2 Level
1	30 000 000Hz	10.0275dB	17.4665dB
2	2 059 800 000Hz	2.8288dB	11.6571dB
3	4 089 600 000Hz	4.0774dB	9.8739dB
4	6 000 000 000Hz	5.0558dB	11.1411dB

Ref.Int Pre-Amp On

Measurement Result: Example of Graph display
(Frequency Mode: Sweep, Screen Layout: Graph)



BW 4 000 000Hz ATT 0dB

DUT Amplifier

T cold 296.50K

Total Point 8

Loss Status Before:Off After:Off

CAL Status OK

ENR Status Table

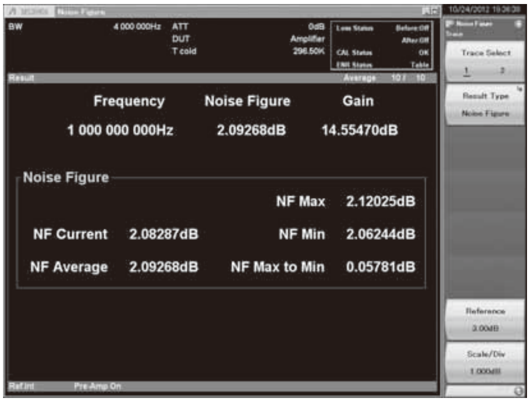
Result

Frequency	Noise Figure	Gain
30 000 000Hz	10.66039dB	17.40024dB
100 000 000Hz	3.08945dB	16.59371dB
1 000 000 000Hz	2.05194dB	14.53178dB
2 000 000 000Hz	2.93286dB	12.31772dB
3 000 000 000Hz	3.10655dB	10.24146dB
6 000 000 000Hz	5.07462dB	11.33644dB
800 000 000Hz	1.97577dB	15.33487dB
2 100 000 000Hz	2.81561dB	12.24213dB

Frequency Min 30 000 000Hz Frequency Max 6 000 000 000Hz

Ref.Int Pre-Amp On

Measurement Result: Example of List display
(Frequency Mode: List, Screen Layout: List)



BW 4 000 000Hz ATT 0dB

DUT Amplifier

T cold 296.50K

Loss Status Before:Off After:Off

CAL Status OK

ENR Status Table

Result Average 10 / 10

Frequency	Noise Figure	Gain
1 000 000 000Hz	2.09268dB	14.55470dB

Noise Figure

		NF Max	2.12025dB
NF Current	2.08287dB	NF Min	2.06244dB
NF Average	2.09268dB	NF Max to Min	0.05781dB

Ref.Int Pre-Amp On

Measurement Result: Example of Spot display
(Frequency Mode: Fixed)

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*: Supports noise sources from Noisecom NC346 series.
See the MS2690A/MS2691A/MS2692A catalog for more details.

Vector Signal Generator (MS269xA-020): Basic Performance

The Vector Signal Generator MS269xA-020 covers the frequency range from 125 MHz to 6 GHz; it has a wide vector modulation bandwidth of 120 MHz as well as a large built-in memory for storing 256 Msamples. Its level accuracy is at least as good as a dedicated signal generator and the ACLR performance is ideal for Tx tests of devices such as amplifiers and Rx tests of base stations.
The all-in-one analyzer and signal generator supports simple configuration of space-saving measurement systems as well as easy signal analysis matching the output timing from the signal generator option.

Frequency Range

Frequency Range: 125 MHz to 6 GHz
Resolution: 0.01 Hz step

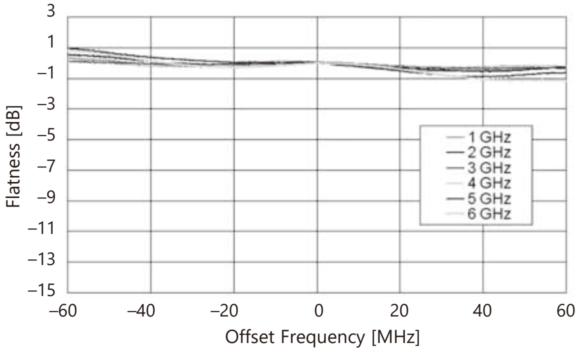
The Vector Signal Generator (MS269xA-020) frequency range is 125 MHz to 6 GHz, covering the key wireless communication range.

Internal Baseband Generator

Vector Modulation Bandwidth: 120 MHz
Sampling Clock: 20 kHz to 160 MHz

The wideband 120-MHz vector modulation bandwidth is achieved using the MS269xA-020 baseband signal generator.
The sampling clock supports up to 160 MHz.

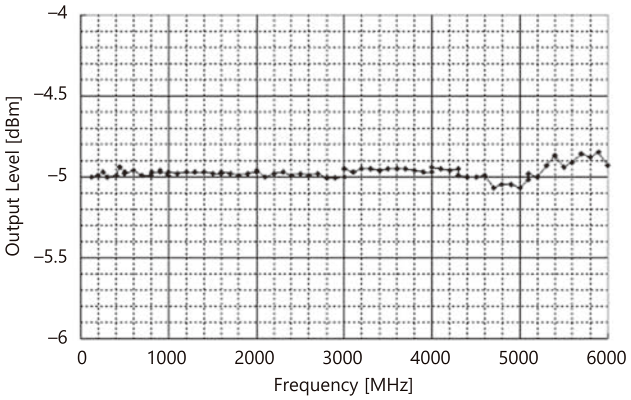
Example: Vector Modulation Bandwidth



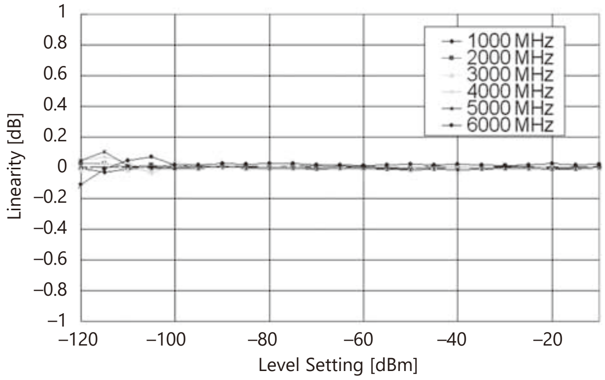
Level Accuracy ±0.5 dB

Output Level Accuracy (CW):
±0.5 dB (–120 dBm ≤ Level ≤ +5 dBm, Frequency ≤ 3 GHz)
±0.8 dB (–110 dBm ≤ Level ≤ +5 dBm, Frequency > 3 GHz)

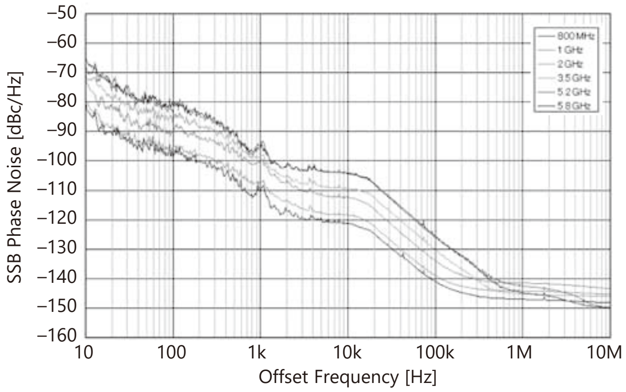
Example: Frequency Characteristics (Referenced to –5 dBm)



Example: Linearity (Referenced to –5 dBm)



Example: SSB Phase Noise



Large-capacity Memory

1 GB = 256 Msamples/channel

The MS269xA-020 arbitrary waveform memory can save 256 Msamples/channel as well as multiple waveform patterns at the same time. Waveform patterns in memory can be output instantaneously by switching without need to recall from hard disk.

Internal AWGN Generator

Absolute CN Ratio: ≤40 dB

This functions adds AWGN (Additive White Gaussian Noise) to the wanted waveform in memory. It is ideal for Tx dynamic range tests.

AWGN band set automatically to sampling clock of wanted signal.

Example: When wanted signal conditions are:
- W-CDMA
- Bandwidth = 3.84 MHz
- Over sampling = × 4

Internal BER Measurement Function

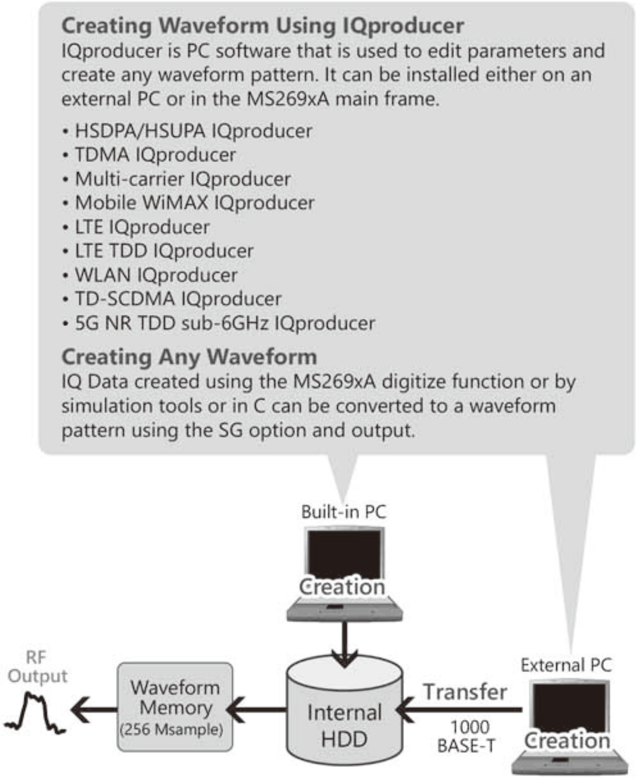
Input Bit Rate: 100 bps to 10 Mbps
Input Level: TTL Level
Input Signal: Data, Clock, Enable
Connector: Rear panel, Aux connector*

Adding the MS269xA-020 includes a built-in BER tester for measurements up to 10 Mbps. It supports Rx sensitivity tests by inputting the receiver-demodulated Data/Clock/Enable to the back of the MS269xA.

*: Requires AUX Conversion Adapter J1373A (sold separately)

Versatile Multiple Waveform Generation

Any type of waveform can be generated using the MS269xA-020. In addition to using C and simulation tools, Anritsu's IQproducer can be run on a PC to edit waveform parameters and output waveforms.



Creating Waveform Using IQproducer

IQproducer is PC software that is used to edit parameters and create any waveform pattern. It can be installed either on an external PC or in the MS269xA main frame.

- HSDPA/HSUPA IQproducer
- TDMA IQproducer
- Multi-carrier IQproducer
- Mobile WiMAX IQproducer
- LTE IQproducer
- LTE TDD IQproducer
- WLAN IQproducer
- TD-SCDMA IQproducer
- 5G NR TDD sub-6GHz IQproducer

Creating Any Waveform

IQ Data created using the MS269xA digitize function or by simulation tools or in C can be converted to a waveform pattern using the SG option and output.

Useful IQproducer Waveform Generation Software

IQproducer is application software for a PC for editing, creating and transferring waveform patterns using the MS269xA-020 arbitrary waveform generation option.
It has the following three main functions.

Parameter Editing:
Function for easily editing parameters matching each communication method

Simulation:
Function for checking generated waveform pattern before transfer to CCDF and FFT graphs

Conversion:
Function for converting ASCII format waveform patterns created by simulation software, files captured using digitizing function, and MG3700A waveform patterns, into files that can be used by MS269xA-020

Excellent Expandability Platform (Hardware)

The versatility of the MS269xA series is tailored easily to the application by installing modules in expansion slots.

Basic Function and Performance Upgrades

- Rubidium Reference Oscillator MS2690A/MS2691A/MS2692A-001
  This option is a 10 MHz reference crystal oscillator with excellent frequency stability startup characteristics of $\pm 1 \times 10^{-9}$ at 7 minutes after power-on.
  Aging Rate: $\pm 1 \times 10^{-10}$/month
  Start-up Characteristics: $\pm 1 \times 10^{-9}$ (7 minutes after power-on)
- Preselector Extended Lower Limit (3 GHz) MS2691A/MS2692A-003
  This option extends the lower limit of the preselector from 5.9 GHz to 3 GHz. It can only be installed in the MS2691A/MS2692A.
- 6 GHz Preamplifier MS2690A/MS2691A/MS2692A-008
  This option increases the sensitivity of the spectrum/signal analyzer functions and is used for examining low-level signals such as interference waveforms.
  Frequency range: 100 kHz to 6 GHz
  Gain: 14 dB (≤3 GHz)
  13 dB (3 GHz < Frequency ≤ 4 GHz)
  11 dB (4 GHz < Frequency ≤ 5 GHz)
  10 dB (5 GHz < Frequency ≤ 6 GHz)
- Microwave Preselector Bypass MS2692A-067
  Bypassing the preselector used for the microwave band improves RF frequency characteristics and in-band frequency characteristics.
  *: Cannot be installed simultaneously with MS2692A-003/008

Signal Analyzer Function and Performance Upgrade

- Analysis Bandwidth Extension to 62.5 MHz MS2690A/MS2691A/MS2692A-077
  This option expands the analysis bandwidth to 62.5 MHz.
- Analysis Bandwidth Extension to 125 MHz MS2690A/MS2691A/MS2692A-078*1, *2
  This option expands the analysis bandwidth to 125 MHz.
  *1: Requires MS269xA-077
  *2: Combining with MX269028A-002 WLAN 802.11ac (160 MHz) measurement software (only for MS269xA) supports modulation analysis up to 160-MHz bandwidth signals of the 802.11ac.
  See measurement software catalog for more details

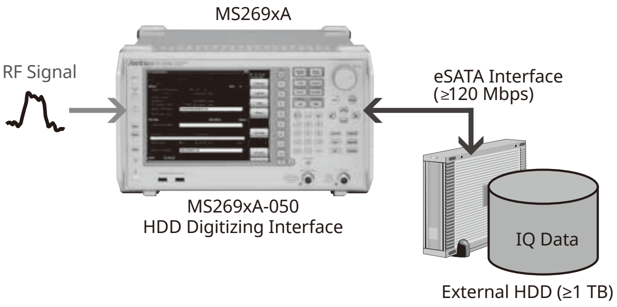
Usage Example: Record Noise and Replay

When the Vector Signal Generator (MS269xA-020) generates a signal based on the data captured by the signal analyzer, a signal that mimics the captured signal can be output*1.
The Capture & Playback function can also be used for capture and replay using a simple procedure.
For example, a variety of noise sources can be captured and edited using one MS269xA to evaluate the noise tolerance of a product. In some cases, it is not possible to capture minute level fluctuations with a resolution of 20 ns*2, depending on the noise components. In these circumstances, a signal very close to the actual noise can be captured and replayed by setting the resolution to 5 ns*3.
(At signal generation, the setting range of the pattern sampling rate must be within the 160 MHz upper limit of the vector signal generator sampling rate.)

*1: Capture time depends on memory capacity.
*2: Sampling rate of 50 MHz at 31.25 MHz FFT band
*3: Sampling rate of 200 MHz at 125 MHz FFT band

Expansion Functions

- Noise Figure Measurement Function MS2690A/MS2691A/MS2692A-017
  Adds noise figure measurement function.
  Noise Figure is measured with the measurement method of Y-factor method which uses a Noise Source.
- Vector Signal Generator MS2690A/MS2691A/MS2692A-020
  This option is a high-performance waveform generator covering a frequency range of 125 MHz to 6 GHz with a 120 MHz wideband vector modulation band and built-in 256 Msample waveform memory.
- HDD Digitizing Interface MS2690A/MS2691A/MS2692A-050
  Installing the HDD Digitizing Interface MS269xA-050 option captures up to 4 hours of 20 MHz wideband RF signals.
  It is convenient for troubleshooting uncommon faults.



- Removable HDD MS2690A/MS2691A/MS2692A-313
  The Removable HDD MS269xA-313 is useful when a user takes the instrument to an outside company for calibration but wants to protect the security of data in the instrument, such as measurement results, data and main frame settings. In this case, the user removes the regular MS269xA hard disk and replaces it with this product.

Future-proof Platform (Software)

Adding measurement software options to the signal analyzer assures that the modulation analysis and other functions will support all common current and future communications systems.

Measurement Software

Communications Systems	Model	Name
W-CDMA/HSPA/ HSPA Evolution	MX269011A	W-CDMA/HSPA Downlink Measurement Software
	MX269012A	W-CDMA/HSPA Uplink Measurement Software
W-CDMA/HSPA	MX269030A	W-CDMA BS Measurement Software
GSM/EDGE	MX269013A	GSM/EDGE Measurement Software
EDGE Evolution	MX269013A-001	EDGE Evolution Measurement Software
ETC/DSRC	MX269014A	ETC/DSRC Measurement Software
TD-SCDMA	MX269015A	TD-SCDMA Measurement Software
World Digital Wireless Standards	MX269017A	Vector Modulation Analysis Software
LTE/ LTE-Advanced (FDD)	MX269020A	LTE Downlink Measurement Software
	MX269020A-001	LTE-Advanced FDD Downlink Measurement Software
	MX269021A	LTE Uplink Measurement Software
	MX269021A-001	LTE-Advanced FDD Uplink Measurement Software
LTE/ LTE-Advanced (TDD)	MX269022A	LTE TDD Downlink Measurement Software
	MX269022A-001	LTE-Advanced TDD Downlink Measurement Software
	MX269023A	LTE TDD Uplink Measurement Software
	MX269023A-001	LTE-Advanced TDD Uplink Measurement Software
CDMA2000	MX269024A	CDMA2000 Forward Link Measurement Software
	MX269024A-001	All Measure Function
1xEV-DO	MX269026A	EV-DO Forward Link Measurement Software
	MX269026A-001	All Measure Function
WLAN	MX269028A	WLAN (802.11) Measurement Software (Supports IEEE 802.11n/11a/11b/ 11g/11j/11p)
	MX269028A-002*	802.11ac (160 MHz) Measurement Software (for MS269xA)
5G	MX269051A	5G Standard Measurement Software (Base License)
	MX269051A-011	NR TDD sub-6GHz Downlink
	MX269051A-061	NR TDD sub-6GHz Uplink

*: Only for MS269xA.
Combining with the Analysis Bandwidth Extension to 125 MHz MS269xA-078 supports modulation analysis up to 160-MHz bandwidth signals of the 802.11ac.
*: See each measurement software catalog for more details.

Measurement Software for Smart Meter

This software is for PC. This software supports automatic measurement of the PHY layer and protocol analysis of the PHY/MAC layer of smart utility network wireless communications (Wi-SUN).

• Wi-SUN PHY Measurement Software	MX705010A*1
• Wi-SUN Protocol Monitor	MX705110A*2

The MX705010A*1 supports automatic measurement of Wi-SUN Alliance PHY Conformance test cases. The MS269xA is controlled by remote commands from this software.

*1: Cannot be installed in MS269xA.
Requires the latest firmware of MS269xA.
Requires MX269017A, MS269xA-020 and MX269902A.

MX705110A*2 is possible to check the details of a Wi-SUN protocol. The wireless signals*3 between communicating wireless equipments are captured as I/Q data using the MS269xA digitize function and data analysis is performed by this software. Data analysis displays the PHY/MAC frame format, Tx timing, etc.

*2: Cannot be installed in MS269xA.
Requires the latest firmware of MS269xA.

*3: IEEE 802.15.4g/e (GFSK)

Adding a license for the IQproducer waveform generation software to the vector signal generator option supports easy generation of test patterns for all common communications systems worldwide.

IQproducer License for MS269xA-020 VSG

Waveforms generated by IQproducer can be downloaded to the MS269xA main frame in which the MS269xA-020 Vector Signal Generator is installed, but the following licenses (option) are required to output the signal.

• HSDPA/HSUPA IQproducer	MX269901A
• TDMA IQproducer	MX269902A
• Multi-Carrier IQproducer	MX269904A
• Mobile WiMAX IQproducer	MX269905A
• LTE IQproducer	MX269908A
• LTE-Advanced FDD Option	MX269908A-001*1
• LTE TDD IQproducer	MX269910A
• LTE-Advanced TDD Option	MX269910A-001*2
• WLAN IQproducer	MX269911A
• 802.11ac (80 MHz) Option	MX269911A-001*3
• TD-SCDMA IQproducer	MX269912A
• 5G NR TDD sub-6GHz IQproducer	MX269913A

*1: Requires MX269908A.

*2: Requires MX269910A.

*3: Requires MX269911A.

Waveform Patterns for MS269xA-020 VSG

Various waveforms with preset parameters matching each communication method are provided. The MS269xA-020 Vector Signal Generator option outputs RF signals.
Pre-installed reference waveforms are saved on the MS269xA hard disk for free use.

- Pre-installed Patterns
  - W-CDMA
  - HSDPA (Test Model5)
  - CDMA2000 1xEV-DO
  - CDMA2000
  - GSM/EDGE
  - Digital Broadcasting (ISDB-T/CS/BS/CATV)
  - WLAN 802.11a/b/g
  - Bluetooth
- Option Patterns
  - 1xEV-DO Reverse Receiver Test Waveform Pattern MX269970A

Specifications

The specification is the value after a 30-minute warm-up at a constant ambient temperature.
Typical values are only for reference and are not guaranteed specifications.

Vector Signal Analysis Function/Spectrum Analyzer Function Common

Frequency

<table>
<tr><td>Frequency Range</td><td>50 Hz to 6.0 GHz (MS2690A)
50 Hz to 13.5 GHz (MS2691A)
50 Hz to 26.5 GHz (MS2692A)</td></tr>
<tr><td>Frequency Bands</td><td>
<table>
<tr><th>Frequency Range</th><th>Band</th><th>Mixer Harmonic Order (N)</th><th></th></tr>
<tr><td>50 Hz ≤ Frequency ≤ 6.0 GHz</td><td>0</td><td>1</td><td></td></tr>
<tr><td>3.0 GHz ≤ Frequency ≤ 6.0 GHz</td><td>1 – L</td><td>1</td><td>(with MS2691A-003/MS2692A-003, MS2691A/MS2692A)</td></tr>
<tr><td>5.9 GHz ≤ Frequency ≤ 8.0 GHz</td><td>1–</td><td>1</td><td>(MS2691A/MS2692A)</td></tr>
<tr><td>7.9 GHz ≤ Frequency ≤ 13.5 GHz</td><td>1+</td><td>1</td><td>(MS2691A/MS2692A)</td></tr>
<tr><td>13.4 GHz ≤ Frequency ≤ 20.0 GHz</td><td>2–</td><td>2</td><td>(MS2692A)</td></tr>
<tr><td>19.9 GHz ≤ Frequency ≤ 26.5 GHz</td><td>2+</td><td>2</td><td>(MS2692A)</td></tr>
</table>
</td></tr>
<tr><td>Preselector Range</td><td>5.9 GHz to 13.5 GHz (Frequency band mode: Normal) (MS2691A)
5.9 GHz to 26.5 GHz (Frequency band mode: Normal) (MS2692A)
3.0 GHz to 13.5 GHz (Frequency band mode: Spurious) (MS2691A)
3.0 GHz to 26.5 GHz (Frequency band mode: Spurious) (MS2692A)</td></tr>
<tr><td>Frequency Setting Range</td><td>0 Hz to 6.0 GHz (MS2690A)
0 Hz to 13.5 GHz (MS2691A)
0 Hz to 26.5 GHz (MS2692A)
Setting resolution: 1 Hz</td></tr>
<tr><td>Internal Reference Oscillator</td><td>Start-up characteristics (23˚C, referenced to frequency at 24 h after power-on):
±5 × 10^{-7} (2 minutes after power-on), ±5 × 10^{-8} (5 minutes after power-on)
Aging rate: ±1 × 10^{-7}/year, ±1 × 10^{-8}/day
Temperature characteristics: ±2 × 10^{-8} (5˚ to 45˚C)
With MS269xA-001 Rubidium Reference Oscillator
Start-up characteristics (23˚C, referenced to frequency at 24 h after power-on): ±1 × 10^{-9} (7 minutes after power-on)
Aging rate: ±1 × 10^{-10}/month
Temperature characteristics: ±1 × 10^{-9} (5˚ to 45˚C)</td></tr>
<tr><td>SSB Phase Noise</td><td>18˚ to 28˚C, 2 GHz
<table>
<tr><th>Frequency Offset</th><th>Max.</th></tr>
<tr><td>100 kHz</td><td>–116 dBc/Hz</td></tr>
<tr><td>1 MHz</td><td>–137 dBc/Hz</td></tr>
</table>
</td></tr>
</table>

Amplitude

Measurement Range	Without MS269xA-008, or Preamp: Off DANL to +30 dBm With MS269xA-008, Preamp: On DANL to +10 dBm
Max. Input Level	Without MS269xA-008, or Preamp: Off CW Average power: +30 dBm (Input attenuator: ≥10 dB) DC Voltage: 0 Vdc With MS269xA-008, Preamp: On CW Average power: +10 dBm (Input attenuator: 0 dB) DC Voltage: 0 Vdc
Input Attenuator	0 to 60 dB, 2 dB steps
Input Attenuator Switching Error	Referenced to 10 dB input attenuator Without MS269xA-008, or Preamp: Off Frequency band mode: Normal ±0.2 dB (≤6.0 GHz, 10 to 60 dB) ±0.75 dB (>6.0 GHz, 10 to 60 dB) Frequency band mode: Spurious ±0.2 dB (<3.0 GHz, 10 to 60 dB) ±0.75 dB (≥3.0 GHz, 10 to 60 dB) With MS269xA-008, Preamp: On Frequency band mode: Normal ±0.65 dB (≤6.0 GHz, 10 to 60 dB)

Reference Level

Setting Range	Log scale: –120 to +50 dBm, or Equivalent level Linear scale: 22.4 µV to 70.7 V, or Equivalent level Setting resolution: 0.01 dB, or Equivalent level
Units	Log scale: dBm, dBµV, dBmV, dBµV (emf), dBµV/m, V, W Linear scale: V
Linearity Error	Excluding the noise floor effect Without MS269xA-008, or Preamp: Off ±0.07 dB (Mixer input level: ≤–20 dBm) ±0.10 dB (Mixer input level: ≤–10 dBm) Frequency band mode: Normal, Mixer input level: ≤0 dBm ±0.15 dB (≤6.0 GHz) ±0.50 dB (>6.0 GHz) (MS2691A) ±0.60 dB (>6.0 GHz) (MS2692A) Frequency band mode: Spurious, Mixer input level: ≤0 dBm ±0.15 dB (<3.0 GHz) ±0.50 dB (≥3.0 GHz) (MS2691A) ±0.60 dB (≥3.0 GHz) (MS2692A) With MS269xA-008, Preamp: On ±0.07 dB (Preamp input level: ≤–40 dBm) ±0.10 dB (Preamp input level: ≤–30 dBm) Frequency band mode: Normal ±0.50 dB (Preamp input level: ≤–20 dBm, ≤6.0 GHz)
RF Frequency Characteristics	18˚ to 28˚C, After CAL, Input attenuator: 10 dB Without MS269xA-008, or Preamp: Off ±0.35 dB (9 kHz ≤ Frequency ≤ 6.0 GHz, Frequency band mode: Normal) (9 kHz ≤ Frequency < 3.0 GHz, Frequency band mode: Spurious) Without MS2692A-067, or Microwave Preselector Bypass: Off, After Preselector tuning ±1.50 dB (6.0 GHz < Frequency ≤ 13.5 GHz, Frequency band mode: Normal) (3.0 GHz ≤ Frequency ≤ 13.5 GHz, Frequency band mode: Spurious) ±2.50 dB (13.5 GHz < Frequency ≤ 26.5 GHz) With MS269xA-008, Preamp: On ±0.65 dB (100 kHz ≤ Frequency ≤ 6.0 GHz, Frequency band mode: Normal) (100 kHz ≤ Frequency < 3.0 GHz, Frequency band mode: Spurious)
1 dB Gain Compression	Without MS269xA-008, or Preamp: Off, Mixer input level ≥+3 dBm (100 MHz ≤ Frequency < 400 MHz) ≥+7 dBm (400 MHz ≤ Frequency ≤ 6.0 GHz, Frequency band mode: Normal) (400 MHz ≤ Frequency < 3.0 GHz, Frequency band mode: Spurious) ≥+3 dBm (3.0 GHz ≤ Frequency ≤ 6.0 GHz, Frequency band mode: Spurious) (MS2691A) (6.0 GHz < Frequency ≤ 13.5 GHz) (MS2691A) ≥0 dBm (3.0 GHz ≤ Frequency ≤ 6.0 GHz, Frequency band mode: Spurious) (MS2692A) (6.0 GHz < Frequency ≤ 26.5 GHz) (MS2692A) With MS269xA-008, Preamp: On, Preamp input level ≥–20 dBm (100 MHz ≤ Frequency < 400 MHz) ≥–15 dBm (400 MHz ≤ Frequency ≤ 6.0 GHz, Frequency band mode: Normal) (400 MHz ≤ Frequency < 3.0 GHz, Frequency band mode: Spurious)

Spurious Response

<table>
<tr><td>2nd Harmonic Distortion</td><td>
Without MS269xA-008, or Preamp: Off, Mixer input level: –30 dBm
<table>
<tr><th>Harmonic (dBc)</th><th>SHI (dBm)</th><th></th></tr>
<tr><td>≤–60</td><td>≥+30</td><td>(10 Hz ≤ Frequency ≤ 400 MHz)</td></tr>
<tr><td>≤–75</td><td>≥+45</td><td>(400 MHz < Frequency ≤ 3.0 GHz)</td></tr>
</table>
Without MS2692A-067, Mixer input level: –10 dBm
<table>
<tr><th>Harmonic (dBc)</th><th>SHI (dBm)</th><th></th></tr>
<tr><td>≤–90</td><td>≥+80</td><td>(>3.0 GHz, Frequency band mode: Normal)</td></tr>
<tr><td>≤–90</td><td>≥+80</td><td>(≥1.5 GHz, Frequency band mode: Spurious)</td></tr>
</table>
With MS2692A-067, Microwave Preselector Bypass: Off, Mixer input level: –10 dBm
<table>
<tr><th>Harmonic (dBc)</th><th>SHI (dBm)</th><th></th></tr>
<tr><td>≤–70</td><td>≥+60</td><td>(3 GHz < Frequency ≤ 13.25 GHz)</td></tr>
</table>
With MS269xA-008, Preamp: On, Preamp input level: –45 dBm
<table>
<tr><th>Harmonic (dBc)</th><th>SHI (dBm)</th><th></th></tr>
<tr><td>≤–50</td><td>≥+5</td><td>(10 Hz ≤ Frequency ≤ 400 MHz)</td></tr>
<tr><td>≤–55</td><td>≥+10</td><td>(400 MHz < Frequency ≤ 3.0 GHz)</td></tr>
</table>
</td></tr>
<tr><td>Residual Response</td><td>Frequency: ≥1 MHz, Input attenuator: 0 dB, 50Ω terminated
Signal Analyzer: with MS269xA-077/078, Except bandwidth setting: >31.25 MHz
≤–100 dBm</td></tr>
</table>

Connector

RF Input	Front panel, N-J, 50Ω (nom.) 18˚ to 28˚C, Input attenuator: ≥10 dB VSWR: ≤1.2 (nom., 40 MHz ≤ Frequency ≤ 3.0 GHz) ≤1.5 (nom., 3.0 GHz < Frequency ≤ 6.0 GHz) ≤2.0 (nom., 6.0 GHz < Frequency ≤ 26.5 GHz)
IF Output	Rear panel, BNC-J, 50Ω (nom.) Frequency: 875 MHz (Signal Analyzer, without MS269xA-077/078, or Bandwidth: ≤31.25 MHz) 900 MHz (Signal Analyzer, with MS269xA-077/078, Bandwidth: >31.25 MHz) 874.988 MHz (Spectrum Analyzer) Gain: 0 dB (nom.) (Referenced to RF input level, RF frequency: 1 GHz, Input attenuator: 0 dB) IF bandwidth: 120 MHz (nom.)
External Reference Input	Rear panel, BNC-J, 50Ω (nom.) Frequency: 10 MHz,13 MHz Operation range: ±1 ppm Input level: –15 dBm ≤ Level ≤ +20 dBm, 50Ω (AC coupling)
Reference Signal Output	Rear panel, BNC-J, 50Ω (nom.) Frequency: 10 MHz Output level: ≥0 dBm (AC coupling)
Sweep Status Output	Rear panel, BNC-J Output level: TTL level (High level at sweeping or waveform capture)
Trigger Input	Rear panel, BNC-J Input level: TTL level
Noise Source Drive	This is available when the MS269xA-017/117 is installed. Supply(+28 V) of the Noise Source Drive. Rear panel, BNC-J Output voltage: 28 ±0.5 V, Pulsed
External Reference	Control from external controller (excluding power-on) Ethernet 10/100/1000BASE-T, Rear panel, RJ-45 GPIB: IEEE 488.2, Rear panel, IEEE 488 bus connector Interface functions: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0, E2 USB (B): USB2.0, Rear panel, USB-B connector
USB	USB2.0 supporting waveform hard copy to external device, and saving main frame settings USB-A connector (Front panel: 2 ports, Rear panel: 2 ports)
Monitor Output	Rear panel, VGA compatible, mini D-Sub 15 pin
Aux	When using MS269xA-020 trigger input/output Rear panel, 68 pins (DX10BM-68S equivalent)
Display	XGA-color LCD (1024 × 768 resolution), 8.4-inch (213 mm)

General Specifications

Dimensions and Mass		340 (W) × 200 (H) × 350 (D) mm (excluding projections), ≤13.5 kg (excluding options)
Power Supply		100 V(ac) to 120 V(ac), 200 V(ac) to 240 V(ac) (–15/+10%, 250 V max.), 50 Hz/60 Hz (±5%) ≤260 VA (excluding options), ≤440 VA (including all options, max.)
Temperature Range		Operating: +5˚ to +45˚C, Storage: –20˚ to +60˚C
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

Spectrum Analyzer Function

Frequency

Span	Range: 0 Hz, 300 Hz to 6.0 GHz (MS2690A) 0 Hz, 300 Hz to 13.5 GHz (MS2691A) 0 Hz, 300 Hz to 26.5 GHz (MS2692A) Resolution: 2 Hz Accuracy: ±0.2% (Number of trace points: 10001)
Display Frequency Accuracy	± [Display frequency × Reference oscillator accuracy + Span frequency × Span accuracy + RBW × 0.05 + 2 × N + Span frequency/(Number of trace points – 1)] Hz N: Mixer harmonic order
Resolution Bandwidth (RBW)	Setting range: 30 Hz to 3 MHz (1-3 sequence), 50 kHz, 5, 10, 20, 31.25 MHz *31.25 MHz: Can be set when Span: 0 Hz only Selectivity (–60 dB/–3 dB): 4.5: 1 (Nom., 30 Hz to 10 MHz)
Video Bandwidth (VBW)	Setting range: 1 Hz to 10 MHz (1-3 sequence), 5 kHz, Off VBW mode: Video average, Power average

Amplitude

Displayed Average Noise Level (DANL)

18˚ to 28˚C, Detector: Sample, VBW: 1 Hz (Video average), Input attenuator: 0 dB

Without MS269xA-008, 6.0 GHz ≤ Frequency ≤ 26.5 GHz: without MS2692A-067

Frequency Range	Max.	Frequency Band Mode
100 kHz	–135.0 [dBm/Hz]	
1 MHz	–145.0 [dBm/Hz]	
30 MHz ≤ Frequency < 2.4 GHz	–155.0 [dBm/Hz]	
2.4 GHz ≤ Frequency < 3.0 GHz	–153.0 [dBm/Hz]	
3.0 GHz ≤ Frequency < 4.0 GHz	–153.0 [dBm/Hz]	Normal
4.0 GHz ≤ Frequency < 6.0 GHz	–152.0 [dBm/Hz]	Normal
6.0 GHz ≤ Frequency < 10.0 GHz	–151.0 [dBm/Hz]	Normal
10.0 GHz ≤ Frequency ≤ 13.5 GHz	–150.0 [dBm/Hz]	Normal
13.5 GHz < Frequency ≤ 20.0 GHz	–147.0 [dBm/Hz]	Normal
20.0 GHz < Frequency ≤ 26.5 GHz	–143.0 [dBm/Hz]	Normal

With MS269xA-008, Preamp: On

Frequency Range	Max.	Frequency Band Mode
100 kHz	–150.0 [dBm/Hz]	
1 MHz	–159.0 [dBm/Hz]	
30 MHz ≤ Frequency < 2.4 GHz	–166.0 [dBm/Hz]	
2.4 GHz ≤ Frequency < 3.0 GHz	–165.0 [dBm/Hz]	
3.0 GHz ≤ Frequency < 4.0 GHz	–164.0 [dBm/Hz]	Normal
4.0 GHz ≤ Frequency < 5.0 GHz	–161.0 [dBm/Hz]	Normal
5.0 GHz ≤ Frequency ≤ 6.0 GHz	–159.0 [dBm/Hz]	Normal

With MS269xA-008, Preamp: Off

Frequency Range	Max.	Frequency Band Mode
100 kHz	–135.0 [dBm/Hz]	
1 MHz	–145.0 [dBm/Hz]	
30 MHz ≤ Frequency < 2.4 GHz	–153.0 [dBm/Hz]	
2.4 GHz ≤ Frequency < 3.0 GHz	–152.0 [dBm/Hz]	
3.0 GHz ≤ Frequency < 4.0 GHz	–151.0 [dBm/Hz]	Normal
4.0 GHz ≤ Frequency < 5.0 GHz	–150.0 [dBm/Hz]	Normal
5.0 GHz ≤ Frequency < 6.0 GHz	–149.0 [dBm/Hz]	Normal

Total Level Accuracy*

*: The Total level accuracy is found from root sum of squares (RSS) of RF characteristics, linearity error, and input attenuator switching error.

18˚ to 28˚C, After CAL, Input attenuator: ≥10 dB, Auto sweep time select: Normal, RBW: ≤1 MHz, Detection: Positive, CW, Excluding the noise floor effect

Without MS269xA-008, Preamp: Off
Mixer input level: ≤0 dBm,
±0.5 dB (50 Hz ≤ Frequency ≤ 6.0 GHz, Frequency band mode: Normal)
(50 Hz ≤ Frequency < 3.0 GHz, Frequency band mode: Spurious)
After preselector tuning
±1.8 dB (6.0 GHz < Frequency ≤ 13.5 GHz, Frequency band mode: Normal)
(3.0 GHz ≤ Frequency ≤ 13.5 GHz, Frequency band mode: Spurious)
±3.0 dB (13.5 GHz < Frequency ≤ 26.5 GHz)

With MS269xA-008, Preamp: On
Preamp input level: ≤–20 dBm
±1.0 dB (100 kHz ≤ Frequency ≤ 6.0 GHz, Frequency band mode: Normal)
(100 kHz ≤ Frequency < 3.0 GHz, Frequency band mode: Spurious)

Spurious Response

2-tone 3rd-order Intermodulation Distortion

18˚ to 28˚C, ≥300 kHz separation

Without MS269xA-008, or Preamp: Off
With MS2692A-067, Microwave Preselector Bypass: Off
Mixer input level: –15 dBm (per waveform)
≤–60 dBc (TOI: +15 dBm) (30 MHz ≤ Frequency < 400 MHz)
≤–66 dBc (TOI: +18 dBm) (400 MHz ≤ Frequency < 700 MHz)
≤–74 dBc (TOI: +22 dBm) (700 MHz ≤ Frequency < 4.0 GHz, Frequency band mode: Normal)
(700 MHz ≤ Frequency < 3.0 GHz, Frequency band mode: Spurious)
≤–66 dBc (TOI: +18 dBm) (4.0 GHz ≤ Frequency ≤ 6.0 GHz, Frequency band mode: Normal)
≤–45 dBc (TOI: +7.5 dBm) (6.0 GHz < Frequency ≤ 26.5 GHz, Frequency band mode: Normal)
(3.0 GHz ≤ Frequency ≤ 26.5 GHz, Frequency band mode: Spurious)

With MS269xA-008, Preamp: On
Preamp input level: –45 dBm (per waveform)
≤–73 dBc (TOI: –8.5 dBm) (30 MHz ≤ Frequency < 400 MHz)
≤–78 dBc (TOI: –6 dBm) (400 MHz ≤ Frequency < 700 MHz)
≤–81 dBc (TOI: –4.5 dBm) (700 MHz ≤ Frequency < 4.0 GHz, Frequency band mode: Normal)
(700 MHz ≤ Frequency < 3.0 GHz, Frequency band mode: Spurious)
≤–78 dBc (TOI: –6 dBm) (4.0 GHz ≤ Frequency ≤ 6.0 GHz, Frequency band mode: Normal)

Image Response

Without MS2692A-067
≤–70 dBc (Frequency ≤ 13.5 GHz)
≤–65 dBc (13.5 GHz < Frequency ≤ 26.5 GHz)

Sweep

Sweep Mode	Single, Continuous
Sweep Time	Setting range: 2 ms to 1000 s (Span: ≥300 Hz), 1 µs to 1000 s (Span: 0 Hz)

Waveform Display

Detector	Pos&Neg, Positive peak, Sample, Negative peak, RMS
Number of Trace Points	1001, 2001, 5001, 10001, 30001 (Span: >500 MHz) 101, 201, 251, 401, 501, 1001, 2001, 5001, 10001, 30001 (100 MHz < Span ≤ 500 MHz) (300 Hz ≤ Span ≤ 100 MHz, Sweep time: >10 s) 11, 21, 41, 51, 101, 201, 251, 401, 501, 1001, 2001, 5001, 10001, 30001 (300 Hz ≤ Span ≤ 100 MHz, Sweep time: ≤10 s) (Span: 0 Hz, Sweep time: ≤10 s) 101, 201, 251, 401, 501, 1001, 2001, 5001, 10001, 30001 (Span: 0 Hz, Sweep time: >10 s)
Scale	Log display: 10 div/12 div, 0.1 to 20 dB/div (1-2-5 sequence) Lin display: 10 div, 1 to 10%/div (1-2-5 sequence)
Trigger Function	Trigger mode: Free run (Trig Off), Video, Wide IF, External (TTL) SG Marker (with MS269xA-020), BBIF (with MS269xA-040)
Gate Function	Gate mode: Off, Wide IF, External SG Marker (with MS269xA-020), BBIF (with MS269xA-040)

Measurement Functions

Adjacent Channel Leakage Power (ACP)		Reference: Span total, Carrier total, Both side of carrier, Carrier select Adjacent channel specification: 3 channels × 2 (Normal mode), 8 channels × 2 (Advanced mode)
Burst Average Power		In time domain, displays average power in specified time
Channel Power		Absolute value measurement: dBm, dBm/Hz
Occupied Bandwidth (OBW)		N% of power, X-dB down
Spectrum Emission Mask		Pass/Fail evaluation at Peak/Margin measurement
Spurious Emission		Pass/Fail evaluation at Worst/Peaks measurement
Frequency Counter	Accuracy	Span: ≤1 MHz, RBW: 1 kHz, S/N: ≥50 dB, Gate time: ≥100 ms, ± (Marker frequency × Frequency reference accuracy + (0.01 × N/Gate Time[s]) Hz) N: Mixer harmonic order
	Gate Time Range	100 µs to 1 s
2-tone 3rd-order Intermodulation Distortion		Measures IM3 and TOI from two-tone signal.

Vector Signal Analysis Function

Common

Trace Mode	Spectrum, Power vs. Time, Frequency vs. Time, Phase vs. Time, CCDF, Spectrogram, No trace
Bandwidth	Without MS269xA-077/078 Specified analysis bandwidth from center frequency 1 kHz to 25 MHz (1-2.5-5 sequence), 31.25 MHz With MS269xA-077 Adds the 50 MHz, 62.5 MHz bandwidths to the standard analysis bandwidths. With MS269xA-077/078 Adds the 50, 62.5, 100, and 125 MHz bandwidths to the standard analysis bandwidths.
Sampling Rate	Auto-setting depending on RBW Without MS269xA-077/078, or Bandwidth: ≤31.25 MHz 2 kHz to 50 MHz (1-2-5 sequence) With MS269xA-077, Bandwidth: >31.25 MHz 100 MHz With MS269xA-077/078, Bandwidth: >31.25 MHz 100 MHz, 200 MHz
Capture Time	Set length of capture time Without MS269xA-077/078, or Bandwidth: ≤31.25 MHz Min. capture time length: 2 µs to 50 ms (determined depending on analysis bandwidth) Max. capture time length: 2 to 2000 s (determined depending on analysis bandwidth) Setting mode: Auto, Manual With MS269xA-077, Bandwidth: >31.25 MHz Min. capture time length: 1 µs (determined depending on analysis bandwidth) Max. capture time length: 500 ms With MS269xA-077/078, Bandwidth: >31.25 MHz Min. capture time length: 500 ns to 1 µs (determined depending on analysis bandwidth) Max. capture time length: 500 ms
Trigger	Trigger mode: Free run (Trig off), Video, Wide IF video, External (TTL) SG Marker (with MS269xA-020), BBIF (with MS269xA-040)
ADC Resolution	16 bits

Spectrum Display Function

Function Outline	Displays any time length in captured waveform data and spectrum in frequency range
Analysis Time Range	Analysis start time: Set analysis start time point from waveform data header Analysis time length: Set analysis time length Setting mode: Auto, Manual
Frequency	Set center frequency and span in frequency range of waveform data
Frequency Setting Range	Without MS269xA-077/078, or Bandwidth: ≤31.25 MHz 0 Hz to 6.0 GHz (MS2690A), 0 Hz to 13.5 GHz (MS2691A), 0 Hz to 26.5 GHz (MS2692A) With MS269xA-077, or with MS269xA-077/078, without MS2692A-067, Bandwidth: >31.25 MHz 100 MHz to 6.0 GHz With MS269xA-077, or with MS269xA-077/078, with MS2692A-067, Bandwidth: >31.25 MHz 100 MHz to 26.5 GHz
Resolution Bandwidth (RBW)	Without MS269xA-077/078, or Bandwidth: ≤31.25 MHz Setting range: 1 Hz to 1 MHz (1-3 sequence) Selectivity (–60 dB/–3 dB): 4.5: 1 (nom.) With MS269xA-077, Bandwidth: >31.25 MHz Setting range: 3 kHz to 3 MHz (1-3 sequence) Selectivity (–60 dB/–3 dB): 4.5: 1 (nom.) With MS269xA-077/078, Bandwidth: >31.25 MHz Setting range: 3 kHz to 10 MHz (1-3 sequence) Selectivity (–60 dB/–3 dB): 4.5: 1 (nom.)
Total Level Accuracy* *: The Total level accuracy is found from root sum of squares (RSS) of RF characteristics, linearity error, and input attenuator switching error.	18˚ to 28˚C, After CAL, Input attenuator: ≥10 dB, Center frequency, CW, RBW: Auto, Time detection: Average, Marker result: Integration or Peak (Accuracy), Excluding the noise floor effect Mixer input level: ≤0 dBm Without MS269xA-077/078, or Bandwidth: ≤31.25 MHz Without MS269xA-008, or Preamp: Off ±0.5 dB (50 Hz ≤ Frequency ≤ 6.0 GHz, Frequency band mode: Normal) (50 Hz ≤ Frequency < 3.0 GHz, Frequency band mode: Spurious) After Preselector tuning ±1.8 dB (6.0 GHz < Frequency ≤ 13.5 GHz, Frequency band mode: Normal) (3.0 GHz ≤ Frequency ≤ 13.5 GHz, Frequency band mode: Spurious) ±3.0 dB (13.5 GHz ≤ Frequency ≤ 26.5 GHz) With MS269xA-077, or with MS269xA-077/078, Bandwidth: >31.25 MHz Without MS269xA-008, or Preamp: Off ±0.5 dB (100 MHz ≤ Frequency ≤ 6.0 GHz, Frequency band mode: Normal) With MS269xA-077, or with MS269xA-077/078 With MS2692A-067, Microwave Preselector Bypass: On, Bandwidth: >31.25 MHz ±1.8 dB (6.0 GHz ≤ Frequency ≤ 13.5 GHz, Frequency band mode: Normal) ±3.0 dB (13.5 GHz ≤ Frequency ≤ 26.5 GHz) Preamp input level: ≤–20 dBm Without MS269xA-077/078, or Bandwidth: ≤31.25 MHz With MS269xA-008, Preamp: On ±1.0 dB (100 kHz ≤ Frequency ≤ 6.0 GHz, Frequency band mode: Normal) (100 kHz ≤ Frequency < 3.0 GHz, Frequency band mode: Spurious) With MS269xA-077, or with MS269xA-077/078, Bandwidth: >31.25 MHz With MS269xA-008, Preamp: On ±1.0 dB (100 MHz ≤ Frequency ≤ 6.0 GHz, Frequency band mode: Normal)

Continued on next page

<table>
<tr><td>Displayed Average Noise Level (DANL)</td><td>18° to 28°C, Input attenuator: 0 dB
Without MS269xA-008, 6.0 GHz ≤ Frequency ≤ 26.5 GHz: without MS2692A-067
<table>
<tr><th>Frequency Range</th><th>Max.</th><th>Frequency Band Mode</th></tr>
<tr><td>100 kHz</td><td>–132.5 [dBm/Hz]</td><td></td></tr>
<tr><td>1 MHz</td><td>–142.5 [dBm/Hz]</td><td></td></tr>
<tr><td>30 MHz ≤ Frequency < 2.4 GHz</td><td>–152.5 [dBm/Hz]</td><td></td></tr>
<tr><td>2.4 GHz ≤ Frequency < 3.0 GHz</td><td>–150.5 [dBm/Hz]</td><td></td></tr>
<tr><td>3.0 GHz ≤ Frequency < 4.0 GHz</td><td>–150.5 [dBm/Hz]</td><td>Normal</td></tr>
<tr><td>4.0 GHz ≤ Frequency < 6.0 GHz</td><td>–149.5 [dBm/Hz]</td><td>Normal</td></tr>
<tr><td>6.0 GHz ≤ Frequency < 10.0 GHz</td><td>–148.5 [dBm/Hz]</td><td>Normal</td></tr>
<tr><td>10.0 GHz ≤ Frequency ≤ 13.5 GHz</td><td>–147.5 [dBm/Hz]</td><td>Normal</td></tr>
<tr><td>13.5 GHz < Frequency ≤ 20.0 GHz</td><td>–144.5 [dBm/Hz]</td><td>Normal</td></tr>
<tr><td>20.0 GHz < Frequency ≤ 26.5 GHz</td><td>–140.5 [dBm/Hz]</td><td>Normal</td></tr>
</table>
With MS269xA-008, Preamp: On
<table>
<tr><th>Frequency Range</th><th>Max.</th><th>Frequency Band Mode</th></tr>
<tr><td>100 kHz</td><td>–147.5 [dBm/Hz]</td><td></td></tr>
<tr><td>1 MHz</td><td>–156.5 [dBm/Hz]</td><td></td></tr>
<tr><td>30 MHz ≤ Frequency < 2.4 GHz</td><td>–163.5 [dBm/Hz]</td><td></td></tr>
<tr><td>2.4 GHz ≤ Frequency < 3.0 GHz</td><td>–162.5 [dBm/Hz]</td><td></td></tr>
<tr><td>3.0 GHz ≤ Frequency < 4.0 GHz</td><td>–161.5 [dBm/Hz]</td><td>Normal</td></tr>
<tr><td>4.0 GHz ≤ Frequency < 5.0 GHz</td><td>–158.5 [dBm/Hz]</td><td>Normal</td></tr>
<tr><td>5.0 GHz ≤ Frequency ≤ 6.0 GHz</td><td>–156.5 [dBm/Hz]</td><td>Normal</td></tr>
</table>
With MS269xA-008, Preamp: Off
<table>
<tr><th>Frequency Range</th><th>Max.</th><th>Frequency Band Mode</th></tr>
<tr><td>100 kHz</td><td>–132.5 [dBm/Hz]</td><td></td></tr>
<tr><td>1 MHz</td><td>–142.5 [dBm/Hz]</td><td></td></tr>
<tr><td>30 MHz ≤ Frequency < 2.4 GHz</td><td>–150.5 [dBm/Hz]</td><td></td></tr>
<tr><td>2.4 GHz ≤ Frequency < 3.0 GHz</td><td>–149.5 [dBm/Hz]</td><td></td></tr>
<tr><td>3.0 GHz ≤ Frequency < 4.0 GHz</td><td>–148.5 [dBm/Hz]</td><td>Normal</td></tr>
<tr><td>4.0 GHz ≤ Frequency < 5.0 GHz</td><td>–147.5 [dBm/Hz]</td><td>Normal</td></tr>
<tr><td>5.0 GHz ≤ Frequency < 6.0 GHz</td><td>–146.5 [dBm/Hz]</td><td>Normal</td></tr>
</table>
</td></tr>
<tr><td>Adjacent Channel Leakage Power Measurement (ACP)</td><td>Reference: Span total, Carrier total, Both sides of carriers, Carrier select
Adjacent channel specification: 3 channels × 2</td></tr>
<tr><td>Channel Power</td><td>Absolute value measurement: dBm, dBm/Hz</td></tr>
<tr><td>Occupied Bandwidth (OBW)</td><td>N% of power, × dB down</td></tr>
</table>

Power vs. Time Display Function

Function Outline	Displays variation in power of captured waveform with time
Analysis Time Range	Analysis start time: Sets analysis start time point from waveform data header Analysis time length: Sets analysis time length Setting mode: Auto, Manual
Resolution Bandwidth	Filter type: Rect, Gaussian, Nyquist, Root nyquist, Off, (Default: Off) Roll-off ratio: 0.01 to 1 (Set for Nyquist, Root nyquist) Filter frequency offset: Set center frequency of filter in wavelength data frequency band
AM Depth (Peak to Peak Measurement)	Measures with AM depth or marker function +Peak, –Peak, (P-P)/2, Average
Burst Average Power	Measures average power of burst signal

Frequency vs. Time Display Function

Function Outline	Displays variation in frequency of input signal with time from captured waveform data
Analysis Time Range	Analysis start time: Sets analysis start time point from waveform data header Analysis time length: Sets analysis time length Setting mode: Auto, Manual
Operation Level Range	–17 to +30 dBm (Input attenuator: ≥10 dB)
Frequency (Vertical axis)	Sets center frequency and Span in waveform data frequency range Display frequency range: 1/25, 1/10, 1/5, 1/2 of RBW Input frequency range: 10 MHz to 6 GHz
Display Frequency Accuracy	Input level: –17 to +30 dBm (Span: ≤31.25 MHz, Scale: Span/25) CW input: ± (Reference oscillator accuracy × Center frequency + Display frequency range × 0.01) Hz
FM Deviation (Peak to Peak Measurement)	Measures with FM deviation or marker function +Peak, –Peak, (P-P)/2, Average

Phase vs. Time Display Function

Function Outline	Displays phase time fluctuation of input signal from captured waveform data
Analysis Time Range	Analysis start time: Sets analysis start time point from waveform data header Analysis time length: Sets analysis time length Setting mode: Auto, Manual
Phase (Vertical axis)	Display mode: Wrap, Unwrap Display phase range: 0.01 deg./div to 200 Gdeg./div Offset: –100 deg. to +100 Mdeg.

CCDF/APD Display Function

Function Outline	Displays CCDF and APD of waveform data captures for fixed time
Analysis Time Range	Analysis start time: Sets analysis start time point from waveform data header Analysis time length: Sets analysis time length Setting mode: Auto, Manual
Display	Displays CCDF or APD as graph Histogram resolution: 0.01 dB Numeric display: Average power, Max power, Crest factor
Resolution Bandwidth (RBW)	Filter type: Rectangle, Off, (Default: Off) Filter frequency offset: Sets filter center frequency in waveform data frequency band

Spectrogram Display Function

Function Outline	Displays spectrogram for time period in captured waveform data
Analysis Time Range	Analysis start time: Sets position of analysis start after waveform data header Analysis time length: Sets analysis time length Setting mode: Auto, Manual
Frequency	Settable as center frequency and span frequency of waveform data
Resolution Bandwidth (RBW)	Setting range: 1 Hz to 1 MHz (1-3 sequence) Selection (–60/–3 dB): 4.5: 1 (nom.)

Digitize Function

Function Outline	Outputs captured waveform data to internal hard disk or external device
Waveform Data	Format: I, Q (32 bit Float binary format) Level: Sets 0 dBm input to $\sqrt{(I^2 + Q^2)} = 1$ Level accuracy: Same as Total level accuracy of Signal Analyzer
External Output	Output to external PC via Ethernet

Replay Function

<table>
<tr><td>Function Outline</td><td>Captured waveforms can be replayed again by using the VSA function to read saved digitize data</td></tr>
<tr><td>Measurable Waveform Data Condition</td><td>Format: I, Q (Binary format)
Combination of Span, Sampling rate, and Minimum capture sample:
<table>
<tr><th>Span</th><th>Sampling Rate</th><th>Minimum Capture Sample</th></tr>
<tr><td>1 kHz</td><td>2 kHz</td><td>74000 (37 s)</td></tr>
<tr><td>2.5 kHz</td><td>5 kHz</td><td>160000 (32 s)</td></tr>
<tr><td>5 kHz</td><td>10 kHz</td><td>310000 (31 s)</td></tr>
<tr><td>10 kHz</td><td>20 kHz</td><td>610000 (30.5 s)</td></tr>
<tr><td>25 kHz</td><td>50 kHz</td><td>730000 (14.6 s)</td></tr>
<tr><td>50 kHz</td><td>100 kHz</td><td>730000 (7.3 s)</td></tr>
<tr><td>100 kHz</td><td>200 kHz</td><td>730000 (3.65 s)</td></tr>
<tr><td>250 kHz</td><td>500 kHz</td><td>730000 (1.46 s)</td></tr>
<tr><td>500 kHz</td><td>1 MHz</td><td>730000 (730 ms)</td></tr>
<tr><td>1 MHz</td><td>2 MHz</td><td>730000 (365 ms)</td></tr>
<tr><td>2.5 MHz</td><td>5 MHz</td><td>730000 (146 ms)</td></tr>
<tr><td>5 MHz</td><td>10 MHz</td><td>730000 (73 ms)</td></tr>
<tr><td>10 MHz</td><td>20 MHz</td><td>730000 (36.5 ms)</td></tr>
<tr><td>18.6 MHz</td><td>20 MHz</td><td>730000 (36.5 ms)</td></tr>
<tr><td>20 MHz</td><td>25 MHz</td><td>730000 (29.2 ms)</td></tr>
<tr><td>25 MHz</td><td>50 MHz</td><td>730000 (14.6 ms)</td></tr>
<tr><td>31.25 MHz</td><td>50 MHz</td><td>730000 (14.6 ms)</td></tr>
<tr><td>50 MHz</td><td>100 MHz</td><td>730000 (7.3 ms)</td></tr>
<tr><td>62.5 MHz</td><td>100 MHz</td><td>730000 (7.3 ms)</td></tr>
<tr><td>100 MHz</td><td>200 MHz</td><td>730000 (3.65 ms)</td></tr>
<tr><td>125 MHz</td><td>200 MHz</td><td>730000 (3.65 ms)</td></tr>
</table></td></tr>
</table>

Rubidium Reference Oscillator MS2690A/MS2691A/MS2692A-001

Function Outline	Generates 10 MHz reference signal with higher frequency stability

Extension of Preselector Lower Limit to 3 GHz MS2691A/MS2692A-003

Cannot be installed simultaneously MS2692A-003 and MS2692A-067.

Function Outline	Extends lower limit of preselector to 3 GHz

6 GHz Preamplifier MS2690A/MS2691A/MS2692A-008

Cannot be installed simultaneously MS2692A-008 and MS2692A-067.

Frequency

Range	100 kHz to 6 GHz

Amplitude

<table>
<tr><td>Measurement Range</td><td>Displayed average noise level to +10 dBm</td></tr>
<tr><td>Max. Input Level</td><td>CW average power: +10 dBm (Input attenuator: 0 dB)
DC voltage: 0 Vdc</td></tr>
<tr><td>Gain</td><td>14 dB (Frequency ≤ 3.0 GHz), 13 dB (3.0 GHz < Frequency ≤ 4.0 GHz), 11 dB (4.0 GHz < Frequency ≤ 5.0 GHz), 10 dB (5.0 GHz < Frequency ≤ 6.0 GHz)</td></tr>
<tr><td>Noise Factor</td><td>7.0 dB (Frequency ≤ 3.0 GHz), 8.5 dB (3.0 GHz < Frequency ≤ 4.0 GHz), 9.5 dB (4.0 GHz < Frequency ≤ 6.0 GHz)</td></tr>
<tr><td>Displayed Average Noise Level (DANL)</td><td>Spectrum analyzer function: 18˚ to 28˚C, Input attenuator: 0 dB, Detector: sample, VBW: 1 Hz (Video average)
Vector signal analysis function: 18˚ to 28˚C, Input attenuator: 0 dB
Preamp: On
<table>
<tr><th>Frequency Range</th><th>Max. (Spectrum Analyzer function)</th><th>Max. (Vector Signal Analysis Function)</th><th>Frequency Band Mode</th></tr>
<tr><td>100 kHz</td><td>–150.0 [dBm/Hz]</td><td>–147.5 [dBm/Hz]</td><td></td></tr>
<tr><td>1 MHz</td><td>–159.0 [dBm/Hz]</td><td>–156.5 [dBm/Hz]</td><td></td></tr>
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<tr><td>2.4 GHz ≤ Frequency < 3.0 GHz</td><td>–165.0 [dBm/Hz]</td><td>–162.5 [dBm/Hz]</td><td></td></tr>
<tr><td>3.0 GHz ≤ Frequency < 4.0 GHz</td><td>–164.0 [dBm/Hz]</td><td>–161.5 [dBm/Hz]</td><td>Normal</td></tr>
<tr><td>4.0 GHz ≤ Frequency < 5.0 GHz</td><td>–161.0 [dBm/Hz]</td><td>–158.5 [dBm/Hz]</td><td>Normal</td></tr>
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</table>
Preamp: Off
<table>
<tr><th>Frequency Range</th><th>Max. (Spectrum Analyzer function)</th><th>Max. (Vector Signal Analysis Function)</th><th>Frequency Band Mode</th></tr>
<tr><td>100 kHz</td><td>–135.0 [dBm/Hz]</td><td>–132.5 [dBm/Hz]</td><td></td></tr>
<tr><td>1 MHz</td><td>–145.0 [dBm/Hz]</td><td>–142.5 [dBm/Hz]</td><td></td></tr>
<tr><td>30 MHz ≤ Frequency < 2.4 GHz</td><td>–153.0 [dBm/Hz]</td><td>–150.5 [dBm/Hz]</td><td></td></tr>
<tr><td>2.4 GHz ≤ Frequency < 3.0 GHz</td><td>–152.0 [dBm/Hz]</td><td>–149.5 [dBm/Hz]</td><td></td></tr>
<tr><td>3.0 GHz ≤ Frequency < 4.0 GHz</td><td>–151.0 [dBm/Hz]</td><td>–148.5 [dBm/Hz]</td><td>Normal</td></tr>
<tr><td>4.0 GHz ≤ Frequency < 5.0 GHz</td><td>–150.0 [dBm/Hz]</td><td>–147.5 [dBm/Hz]</td><td>Normal</td></tr>
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</table>
</td></tr>
<tr><td>Input Attenuator Switching Error</td><td>Frequency band mode: Normal
±0.65 dB (≤6.0 GHz, 10 to 60 dB)</td></tr>
</table>

Reference Level

RF Frequency Characteristics	18˚ to 28˚C, After CAL, Input attenuator: 10 dB ±0.65 dB (100 kHz ≤ Frequency ≤ 6.0 GHz, Frequency band mode: Normal) (100 kHz ≤ Frequency < 3.0 GHz, Frequency band mode: Spurious)
Linearity Error	Excluding the noise floor effect ±0.07 dB (Preamp input level*: ≤–40 dBm) ±0.10 dB (Preamp input level*: ≤–30 dBm) Frequency band mode: Normal ±0.5 dB (Preamp input level*: ≤–20 dBm, frequency: ≤6.0 GHz)
1 dB Gain Compression	Preamp input level* ≥–20 dBm (100 MHz ≤ Frequency < 400 MHz) ≥–15 dBm (400 MHz ≤ Frequency ≤ 6.0 GHz, Frequency band mode: Normal) (400 MHz ≤ Frequency < 3.0 GHz, Frequency band mode: Spurious)

Spurious Response

2nd Harmonic Distortion	Preamp input level*: –45 dBm Harmonic SHI ≤–50 dBc ≥+5 dBm (10 Hz ≤ Frequency ≤ 400 MHz) ≤–55 dBc ≥+10 dBm (400 MHz < Frequency ≤ 3.0 GHz)
2-tone 3rd-order Intermodulation Distortion	18˚ to 28˚C, Preamp input level*: –45 dBm (per waveform), ≥300 kHz separation ≤–73 dBc (TOI: –8.5 dBm) (30 MHz ≤ Frequency < 400 MHz) ≤–78 dBc (TOI: –6 dBm) (400 MHz ≤ Frequency < 700 MHz) ≤–81 dBc (TOI: –4.5 dBm) (700 MHz ≤ Frequency < 4.0 GHz, Frequency band mode: Normal) (700 MHz ≤ Frequency < 3.0 GHz, Frequency band mode: Spurious) ≤–78 dBc (TOI: –6 dBm) (4.0 GHz ≤ Frequency ≤ 6.0 GHz, Frequency band mode: Normal)

*: Preamp input level = RF input level – Input attenuator setting value

Noise Figure Measurement Function* MS2690A/MS2691A/MS2692A-017

Frequency

Frequency Range	MS2690A: 30 MHz to 6 GHz MS2691A: 30 MHz to 6 GHz MS2692A: 30 MHz to 6 GHz
Frequency Setting Range	MS2690A: 10 MHz to 6 GHz MS2691A: 10 MHz to 13.5 GHz MS2692A: 10 MHz to 26.5 GHz

NF Measurement

Measurement Range	Within the frequency range, Attenuator = 0 dB, Preamp = On – 20 to +40 dB
Instrument Uncertainty	Within the measurement range ENR: 4 to 7 dB ±0.02 dB ENR: 12 to 17 dB ±0.025 dB ENR: 20 to 22 dB ±0.03 dB

GAIN Measurement

Measurement Range	Within the frequency range –20 to +40 dB
Instrument Uncertainty	Within the measurement range ≤0.07

Resolution Bandwidth

Setting Range	100 kHz to 8 MHz

Connector

Noise Source	Connector: Rear panel, BNC-J Output voltage: 28 ±0.5 V, Pulsed

*: Recommending the NC346 series noise sources by Noisecom company

Vector Signal Generator MS2690A/MS2691A/MS2692A-020

Frequency

Range	125 MHz to 6 GHz
Resolution	0.01 Hz steps

Output Level

Setting Range	–140 to +10 dBm (CW), –140 to 0 dBm (Modulation)
Units	dBm, dBμV (Terminated, Open)
Resolution	0.01 dB
Level Accuracy	18˚ to 28˚C, CW Output level: p –120 ≤ p ≤ +5 dBm ±0.5 dB (≤3.0 GHz) –110 ≤ p ≤ +5 dBm ±0.8 dB (>3.0 GHz) –127 ≤ p < –120 dBm ±0.7 dB (≤3.0 GHz) –127 ≤ p ≤ –110 dBm ±2.5 dB (typ.) (>3.0 GHz) –136 ≤ p < –127 dBm ±1.5 dB (typ.) (≤3.0 GHz)
Linearity	18˚ to 28˚C, CW, Referenced to –5 dBm output Output level: p –120 ≤ p ≤ –5 dBm ±0.2 dB (typ.) (≤3.0 GHz) –110 ≤ p ≤ –5 dBm ±0.3 dB (typ.) (>3.0 GHz)
Connector	N-J connector, 50Ω [Front panel, SG Output (Option)]
VSWR	CW: ≤–5 dBm, Modulation: ≤–15 dBm 1.3 (≤3.0 GHz) 1.9 (>3.0 GHz)
Max. Reverse Input	1 W peak (≥300 MHz), 0.25 W peak (<300 MHz)

Signal Purity

Harmonic Spurious	Output level: ≤+5 dBm, CW, Output frequency: ≥300 MHz ≤–30 dBc
Non-harmonic Spurious	Output level: ≤+5 dBm, CW, Offset: ≥15 kHz (from output frequency) <–68 dBc (125 MHz ≤ Frequency ≤ 500 MHz) <–62 dBc (500 MHz < Frequency ≤ 1.0 GHz) <–56 dBc (1.0 GHz < Frequency ≤ 2.0 GHz) <–50 dBc (2.0 GHz < Frequency ≤ 6.0 GHz)

Vector Modulation

18˚ to 28˚C, SG Level Auto CAL: On

Vector Accuracy	W-CDMA (DL 1code) Output level: ≤–5 dBm, Output frequency: 800 MHz to 2700 MHz ≤2% (rms)
Carrier Leak	Output frequency: ≥300 MHz ≤–40 dBc
Image Rejection	Output frequency: ≥300 MHz, Using 10 MHz max. sine wave ≤–40 dBc
ACLR	Output level: ≤–5 dBm, Using W-CDMA (Test Model 1 64DPCH) signal, 300 MHz ≤ Output frequency ≤ 2.4 GHz ≤–64 dBc/3.84 MHz (5 MHz offset), ≤–67 dBc/3.84 MHz (10 MHz offset)
CW and Level Error at Vector Modulation	AWGN signal with bandwidth of 5 MHz, Output frequency: ≥300 MHz ±0.2 dB (Output level: ≤–15 dBm) ±0.4 dB (typ., –15 dBm < Output level: ≤–5 dBm)
Spectrum Inversion	Supported

Pulse Modulation

On/Off Ratio	≥60 dB
Rising/Falling Edge Time	≤90 ns (10 to 90%)
Pulse Repetition Frequency	DC to 1 MHz (Duty 50%)
External Panel Modulation Signal Input	AUX connector (Rear panel), 600Ω, 0 to 5 V, Threshold value: approx. 1 V

Arbitrary Waveform Generator

Waveform Resolution	14 bits
Marker Output	Three signals (three signals in waveform pattern, or real-time three signals generation), TTL, Polarity inversion function
Internal Baseband Reference Clock	Range: 20 kHz to 160 MHz Resolution: 0.001 Hz
External Baseband Reference Clock	Range: 20 kHz to 40 MHz Division, Multiplier function: 1, 2, 4, 8, 16, 1/2, 1/4, 1/8, 1/16 of input signal Input connector: AUX connector (Rear panel), 0.7 Vp-p min. (AC/50Ω), or TTL
Waveform Memory	Memory: 256 Msamples
AWGN Addition Function	CN ratio absolute value: ≤40 dB

BER Measurement

Connector	AUX connector (Rear panel)
Input Level	TTL level
Input Signal	Data, Clock, Enable
Input Bit Rate	100 bps to 10 Mbps
Measured Patterns	PN9, PN11, PN15, PN20, PN23, ALL0, ALL1, 01 repeat PN9Fix, PN11Fix, PN15Fix, PN20Fix, PN23Fix, User define
Synchronization Establishing Condition	PN signal: PN stage × 2 bit error free At PNFix signal: 0 PN stage × 2 bit error free, PN signal and sync establishment, establish sync with PNFix signal at PN stage error free from PNFix signal header bit ALL0, ALL1, 01 Repeat: 10 bit error free User define: 8 to 1024 bits (variable) error free, Select header bit used at sync detection
Re-synchronization Judgment Condition	x/y y = Measured bit count: Select from 500, 5000, 50000 x = y bit error bit count: Setting range 1 to y/2
Measured Bit Count	$\leq 2^{32} - 1$ bits
Measured Error Bit Count	$\leq 2^{31} - 1$ bits
Measurement End Conditions	Measured bit count, Measured error bit count
Auto Re-synchronization Function	On/Off
Operation at Resync.	Select from Count clear, and Count keep
Measurement Mode	Single, Endless, Continuous
Display	Status, Error, Error rate, Error count, Sync loss count, Measured bit count
Polarity Inversion Function	Data, Clock, Enable polarity inversion
Clear Measurement Function	Clear measured value saved at sync during BER measurement, and select measurement from 0

HDD Digitizing Interface MS2690A/MS2691A/MS2692A-050

<table>
<tr><td>Bandwidth, Sampling Rate, Recorded Data Format</td><td>
<table>
<tr><th>Bandwidth</th><th>Sampling Rate</th><th>Recorded Data Format</th></tr>
<tr><td>100, 250, 500 kHz, 1, 2.5, 5 MHz</td><td>200, 500 kHz, 1, 2, 5, 10 MHz</td><td>Floating decimal format</td></tr>
<tr><td>10 MHz, 18.6 MHz</td><td>20 MHz</td><td rowspan="2">Fixed decimal format
(16 bits)</td></tr>
<tr><td>20 MHz</td><td>25 MHz</td></tr>
</table>
</td></tr>
<tr><td>Recording Time</td><td>5 seconds to 4 hours</td></tr>
<tr><td>Number of Recorded File</td><td>1000 files max.</td></tr>
<tr><td>Resample Function</td><td>Convert by resampling at data retrieval, Setting range: Sampling rate/2 to Sampling rate</td></tr>
<tr><td>Trigger Function</td><td>Video, Wide IF video, External, SG Marker</td></tr>
<tr><td>Count Mode</td><td>Capturing times: 1 to 20 times</td></tr>
<tr><td>Interface</td><td>Connector: External Serial ATA connector
Data rate: 1.5 Gbps
Hot plug: Not supported (The main frame and external HDD must be off when connecting/disconnecting connectors.)</td></tr>
</table>

Microwave Preselector Bypass MS2692A-067

Bypasses the preselector to improve the RF frequency characteristics and the in-band frequency characteristics.
When the preselector option is set to On, the image response elimination filter is bypassed.
Therefore, this function is not appropriate for spurious measurement to receive the image response.
Microwave Preselector Bypass: On (with MS2692A-067), Microwave Preselector Bypass: Off (with special directions)

Cannot install simultaneously with MS2692A-003, MS2692A-008.

Frequency

Frequency Range	6.0 GHz to 26.5 GHz

Amplitude

RF Frequency Characteristics	18° to 28°C, After CAL, Input attenuator: 10 dB, Microwave Preselector Bypass: On ±1.0 dB (6.0 GHz ≤ Frequency ≤ 13.5 GHz) ±1.5 dB (13.5 GHz < Frequency ≤ 26.5 GHz) * With MS2692A-067, Microwave Preselector Bypass: Off, see Signal Analyzer/Spectrum Analyzer (RF Frequency Characteristics)
Displayed Average Noise Level (DANL)	18° to 28°C, Detector: Sample, VBW: 1 Hz (Video average), Input attenuator: 0 dB Microwave Preselector Bypass: On or Off –146 dBm/Hz (6.0 GHz ≤ Frequency < 10.0 GHz) –145 dBm/Hz (10.0 GHz ≤ Frequency ≤ 13.5 GHz) –142 dBm/Hz (13.5 GHz < Frequency ≤ 20.0 GHz) –138 dBm/Hz (20.0 GHz < Frequency ≤ 26.5 GHz)
Image Responses	Microwave Preselector Bypass: Off ≤–60 dBc (6.0 GHz ≤ Frequency ≤ 26.5 GHz)

Analysis Bandwidth Extension to 62.5 MHz MS2690A/MS2691A/MS2692A-077
Analysis Bandwidth Extension to 125 MHz MS2690A/MS2691A/MS2692A-078 (Requires MS269xA-077)

Common

Bandwidth	With MS269xA-077 Adds the 50 MHz, 62.5 MHz bandwidths to the standard analysis bandwidths. With MS269xA-077/078 Adds the 50, 62.5, 100, and 125 MHz bandwidths to the standard analysis bandwidths.
Sampling Rate	Auto-setting depending on RBW With MS269xA-077, Bandwidth: >31.25 MHz 100 MHz With MS269xA-077/078, Bandwidth: >31.25 MHz 100 MHz, 200 MHz
Capture Time	Set length of capture time With MS269xA-077, Bandwidth: >31.25 MHz Min. capture time length: 1 μs (determined depending on analysis bandwidth) Max. capture time length: 500 ms With MS269xA-077/078, Bandwidth: >31.25 MHz Min. capture time length: 500 ns to 1 μs (determined depending on analysis bandwidth) Max. capture time length: 500 ms
Resolution Bandwidth (RBW)	With MS269xA-077, Bandwidth: >31.25 MHz Setting range: 3 kHz to 3 MHz (1-3 sequence) Selectivity (–60 dB/–3 dB): 4.5: 1 (nom.) With MS269xA-077/078, Bandwidth: >31.25 MHz Setting range: 3 kHz to 10 MHz (1-3 sequence) Selectivity (–60 dB/–3 dB): 4.5: 1 (nom.)
ADC Resolution	With MS269xA-077/078, Bandwidth: >31.25 MHz 14 bits
Frequency	Without MS2692A-067, Bandwidth: >31.25 MHz 100 MHz to 6.0 GHz With MS2692A-067, Bandwidth: >31.25 MHz 100 MHz to 26.5 GHz

Amplitude

<table>
<tr><td>Displayed Average Noise Level (DANL)</td><td>18˚ to 28˚C, Input attenuator: 0 dB
Without MS269xA-008, or Preamp: Off, Frequency band mode: Normal
<table>
<tr><th>Frequency Range</th><th>Max.</th></tr>
<tr><td>100 MHz ≤ Frequency < 2.2 GHz</td><td>–147.0 [dBm/Hz]</td></tr>
<tr><td>2.2 GHz ≤ Frequency < 4.0 GHz</td><td>–145.0 [dBm/Hz]</td></tr>
<tr><td>4.0 GHz ≤ Frequency ≤ 6.0 GHz</td><td>–143.0 [dBm/Hz]</td></tr>
</table>
With MS269xA-008, Preamp: On, Frequency band mode: Normal
<table>
<tr><th>Frequency Range</th><th>Max.</th></tr>
<tr><td>100 MHz ≤ Frequency < 2.2 GHz</td><td>–160.0 [dBm/Hz]</td></tr>
<tr><td>2.2 GHz ≤ Frequency < 4.0 GHz</td><td>–158.0 [dBm/Hz]</td></tr>
<tr><td>4.0 GHz ≤ Frequency ≤ 6.0 GHz</td><td>–154.0 [dBm/Hz]</td></tr>
</table>
With MS2692A-067, Microwave Preselector Bypass: On
<table>
<tr><th>Frequency Range</th><th>Max.</th></tr>
<tr><td>6.0 GHz < Frequency < 10.0 GHz</td><td>–140.0 [dBm/Hz]</td></tr>
<tr><td>10.0 GHz ≤ Frequency ≤ 13.5 GHz</td><td>–136.0 [dBm/Hz]</td></tr>
<tr><td>13.5 GHz < Frequency ≤ 20.0 GHz</td><td>–133.0 [dBm/Hz]</td></tr>
<tr><td>20.0 GHz < Frequency ≤ 26.5 GHz</td><td>–129.0 [dBm/Hz]</td></tr>
</table></td></tr>
<tr><td>Total Level Accuracy*
*: The Total level accuracy is found from root sum of squares (RSS) of RF characteristics, linearity error, and input attenuator switching error.</td><td>18˚ to 28˚C, After CAL, Input attenuator: ≥10 dB, Center frequency, CW, RBW: Auto, Time detection: Average, Marker result: Integration or Peak (Accuracy), Excluding the noise floor effect
Without MS269xA-008, or Preamp: Off, Mixer input level: ≤0 dBm, Bandwidth: >31.25 MHz
±0.5 dB (100 MHz ≤ Frequency ≤ 6.0 GHz, Frequency band mode: Normal)
With MS269xA-008, Preamp: On, Preamp input level: ≤–20 dBm, Bandwidth: >31.25 MHz
±1.0 dB (100 MHz ≤ Frequency ≤ 6.0 GHz, Frequency band mode: Normal)
With MS269xA-077, or MS269xA-077/078, Bandwidth: >31.25 MHz
With MS2692A-067, Microwave Preselector Bypass: On
±1.8 dB (6.0 GHz ≤ Frequency ≤ 13.5 GHz, Frequency band mode: Normal)
±3.0 dB (13.5 GHz ≤ Frequency ≤ 26.5 GHz)</td></tr>
<tr><td>Linearity Error</td><td>Excluding the noise floor effect
Without MS269xA-008, or Preamp: Off, Frequency band mode: Normal
±0.07 dB (Mixer input level: ≤–20 dBm)
±0.10 dB (Mixer input level: ≤–10 dBm)
±0.30 dB (Mixer input level: ≤0 dBm, Frequency: ≤6.0 GHz)
With MS269xA-008, Preamp: On, Frequency band mode: Normal
±0.07 dB (Mixer input level: ≤–40 dBm)
±0.10 dB (Mixer input level: ≤–30 dBm)
±0.50 dB (Mixer input level: ≤–20 dBm)
With MS2692A-067, Microwave Preselector Bypass: On
±0.60 dB (Mixer input level: ≤0 dBm, Frequency: > 6.0 GHz)</td></tr>
<tr><td>RF Frequency Characteristics</td><td>18˚ to 28˚C, After CAL, Input attenuator: 10 dB
Without MS269xA-008, or Preamp: Off
±0.35 dB (100 MHz ≤ Frequency ≤ 6.0 GHz, Frequency band mode: Normal)
With MS269xA-008, Preamp: On
±0.65 dB (100 MHz ≤ Frequency ≤ 6.0 GHz, Frequency band mode: Normal)
With MS2692A-067, Microwave Preselector Bypass: On
±1.0 dB (6.0 GHz < Frequency ≤ 13.5 GHz)
±1.5 dB (13.5 GHz < Frequency ≤ 26.5 GHz)</td></tr>
</table>

Note: Amplitude errors may occur in digitized IQ data at a probability of 0.0001 ppm or less. (AD converter maker nom. specifications) when the Analysis Bandwidth Extension 62.5 MHz/125 MHz option operates at the 50 MHz/62.5 MHz/100 MHz/125 MHz bandwidth setting.

Typical (typ.): Performance not warranted. Must products meet typical performance.
Nominal (nom.): Values not warranted. Included to facilitate application of product.
Example: Performance not warranted. Data actually measured by randomly selected measuring instruments.

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Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main frame
MS2690A	Signal Analyzer (50 Hz to 6.0 GHz)
MS2691A	Signal Analyzer (50 Hz to 13.5 GHz)
MS2692A	Signal Analyzer (50 Hz to 26.5 GHz)
	Standard accessories
	Power Cord: 1 pc
P0031A	USB Memory (>1 GB USB2.0 Flash Driver): 1 pc
Z0541A	USB Mouse: 1 pc
	Install CD-ROM (Application software, instruction manual CD-ROM): 1 pc
	Options
MS2690A-001	Rubidium Reference Oscillator (Aging rate ±1 × 10^{-10}/month)
MS2690A-008	6 GHz Preamplifier (100 kHz to 6 GHz)
MS2690A-017	Noise Figure Measurement Function
MS2690A-020	Vector Signal Generator (125 MHz to 6 GHz)
MS2690A-050	HDD Digitizing Interface
MS2690A-077	Analysis Bandwidth Extension to 62.5 MHz
MS2690A-078*2	Analysis Bandwidth Extension to 125 MHz (Requires MS2690A-077)
MS2691A-001	Rubidium Reference Oscillator (Aging rate ±1 × 10^{-10}/month)
MS2691A-003	Extension of Preselector Lower Limit to 3 GHz (Extends lower limit of preselector to 3 GHz)
MS2691A-008	6 GHz Preamplifier (100 kHz to 6 GHz)
MS2691A-017	Noise Figure Measurement Function
MS2691A-020	Vector Signal Generator (125 MHz to 6 GHz)
MS2691A-050	HDD Digitizing Interface
MS2691A-077	Analysis Bandwidth Extension to 62.5 MHz
MS2691A-078*2	Analysis Bandwidth Extension to 125 MHz (Requires MS2691A-077)
MS2692A-001	Rubidium Reference Oscillator (Aging rate ±1 × 10^{-10}/month)
MS2692A-003	Extension of Preselector Lower Limit to 3 GHz (Extends lower limit of preselector to 3 GHz)
MS2692A-008	6 GHz Preamplifier (100 kHz to 6 GHz)
MS2692A-017	Noise Figure Measurement Function
MS2692A-020	Vector Signal Generator (125 MHz to 6 GHz)
MS2692A-050	HDD Digitizing Interface
MS2692A-067*3	Microwave Preselector Bypass
MS2692A-077	Analysis Bandwidth Extension to 62.5 MHz
MS2692A-078*2	Analysis Bandwidth Extension to 125 MHz (Requires MS2692A-077)
	Retrofit options
MS2690A-101	Rubidium Reference Oscillator Retrofit (Aging rate ±1 × 10^{-10}/month)
MS2690A-108	6 GHz Preamplifier Retrofit (100 kHz to 6 GHz)
MS2690A-117	Noise Figure Measurement Function Retrofit
MS2690A-120	Vector Signal Generator Retrofit (125 MHz to 6 GHz)
MS2690A-150	HDD Digitizing Interface Retrofit
MS2690A-177*1	Analysis Bandwidth Extension to 62.5 MHz Retrofit
MS2690A-178*1, *2	Analysis Bandwidth Extension to 125 MHz Retrofit (Requires MS2690A-077/177)
MS2690A-180*4	CPU/Windows7 Upgrade Retrofit
MS2691A-101	Rubidium Reference Oscillator Retrofit (Aging rate ±1 × 10^{-10}/month)
MS2691A-103	Extension of Preselector Lower Limit to 3 GHz Retrofit (Extends lower limit of pre-selector to 3 GHz)
MS2691A-108	6 GHz Preamplifier Retrofit (100 kHz to 6 GHz)
MS2691A-117	Noise Figure Measurement Function Retrofit
MS2691A-120	Vector Signal Generator Retrofit (125 MHz to 6 GHz)
MS2691A-150	HDD Digitizing Interface Retrofit
MS2691A-177*1	Analysis Bandwidth Extension to 62.5 MHz Retrofit
MS2691A-178*1, *2	Analysis Bandwidth Extension to 125 MHz Retrofit (Requires MS2691A-077/177)
MS2691A-180*4	CPU/Windows7 Upgrade Retrofit
MS2692A-101	Rubidium Reference Oscillator Retrofit (Aging rate ±1 × 10^{-10}/month)
MS2692A-103	Extension of Preselector Lower Limit to 3 GHz Retrofit (Extends lower limit of pre-selector to 3 GHz)
MS2692A-108	6 GHz Preamplifier Retrofit (100 kHz to 6 GHz)
MS2692A-117	Noise Figure Measurement Function Retrofit
MS2692A-120	Vector Signal Generator Retrofit (125 MHz to 6 GHz)
MS2692A-150	HDD Digitizing Interface Retrofit
MS2692A-167*3	Microwave Preselector Bypass Retrofit
MS2692A-177*1	Analysis Bandwidth Extension to 62.5 MHz Retrofit
MS2692A-178*1, *2	Analysis Bandwidth Extension to 125 MHz Retrofit (Requires MS2692A-077/177)
MS2692A-180*4	CPU/Windows7 Upgrade Retrofit
	Software Options
	CD-ROM with License and Operation manuals
MX269011A	W-CDMA/HSPA Downlink Measurement Software
MX269012A	W-CDMA/HSPA Uplink Measurement Software
MX269013A	GSM/EDGE Measurement Software
MX269013A-001	EDGE Evolution Measurement Software (Requires MX269013A)
MX269014A	ETC/DSRC Measurement Software
MX269015A	TD-SCDMA Measurement Software
MX269017A	Vector Modulation Analysis Software
MX269020A	LTE Downlink Measurement Software
MX269020A-001	LTE-Advanced FDD Downlink Measurement Software (Requires MX269020A)
MX269021A	LTE Uplink Measurement Software
MX269021A-001	LTE-Advanced FDD Uplink Measurement Software (Requires MX269021A)
MX269022A	LTE TDD Downlink Measurement Software
MX269022A-001	LTE-Advanced TDD Downlink Measurement Software (Requires MX269022A)
MX269023A	LTE TDD Uplink Measurement Software
MX269023A-001	LTE-Advanced TDD Uplink Measurement Software (Requires MX269023A)
MX269024A	CDMA2000 Forward Link Measurement Software
MX269024A-001	All Measure Function (Requires MX269024A)
MX269026A	EV-DO Forward Link Measurement Software
MX269026A-001	All Measure Function (Requires MX269026A)
MX269028A	WLAN (802.11) Measurement Software
MX269028A-002*2	802.11ac (160 MHz) Measurement Software (For MS269xA. Requires MX269028A)
MX269030A	W-CDMA BS Measurement Software
MX269051A	5G Standard Measurement Software (Base License) (Requires MX269051A-011 or MX269051A-061)
MX269051A-011	NR TDD sub-6GHz Downlink (Requires MX269051A)
MX269051A-061	NR TDD sub-6GHz Uplink (Requires MX269051A)
MX269901A	HSDPA/HSUPA IQproducer
MX269902A	TDMA IQproducer
MX269904A	Multi-Carrier IQproducer
MX269905A	Mobile WiMAX IQproducer
MX269908A	LTE IQproducer
MX269908A-001	LTE-Advanced FDD Option (Requires MX269908A)
MX269910A	LTE TDD IQproducer
MX269910A-001	LTE-Advanced TDD Option (Requires MX269910A)
MX269911A	WLAN IQproducer
MX269911A-001	802.11ac (80 MHz) Option (Requires MX269911A)
MX269912A	TD-SCDMA IQproducer
MX269913A	5G NR TDD sub-6GHz IQproducer
MX269970A	1xEV-DO Reverse Receiver Test Waveform Pattern
	Other software options
	These software are for PC.
MX705010A	Wi-SUN PHY Measurement Software
MX705110A	Wi-SUN Protocol Monitor
	Warranty service
MS2690A-ES210	2 Years Extended Warranty Service
MS2690A-ES310	3 Years Extended Warranty Service
MS2690A-ES510	5 Years Extended Warranty Service
MS2691A-ES210	2 Years Extended Warranty Service
MS2691A-ES310	3 Years Extended Warranty Service
MS2691A-ES510	5 Years Extended Warranty Service
MS2692A-ES210	2 Years Extended Warranty Service
MS2692A-ES310	3 Years Extended Warranty Service
MS2692A-ES510	5 Years Extended Warranty Service

*1: The MS269xA-177/178 cannot be retrofitted to the MS269xA already fitted with the MS269xA-004/104 option (discontinued).

*2: Combining the MS269xA-078 Analysis Bandwidth Extension to 125 MHz and MX269028A-002 WLAN 802.11ac (160 MHz) measurement software (only for MS269xA) supports modulation analysis up to 160-MHz bandwidth signals of the 802.11ac.
See measurement software catalog for more details.

*3: Cannot be installed simultaneously with MS2692A-003/103/008/108 and MS2692A-004/104 option (discontinued).

*4: Contact our sales representative for more details.

Continued on next page

Model/Order No.	Name
	Application parts Following operation manuals provided as hard copy
W2850AE	MS2690A/MS2691A/MS2692A Operation Manual (Main frame Operation)
W2851AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Main frame Remote Control)
W2852AE	MS2690A/MS2691A/MS2692A Operation Manual (Signal Analyzer Function Operation)
W2853AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Signal Analyzer Function Remote Control)
W2854AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Spectrum Analyzer Function Operation)
W2855AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Spectrum Analyzer Function Remote Control)
W2856AE	MS2690A/MS2691A/MS2692A-020 Operation Manual (Vector Signal Generator Option Operation)
W2857AE	MS2690A/MS2691A/MS2692A-020 Operation Manual (Vector Signal Generator Option Remote Control)
W2914AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A Operation Manual (IQproducer for Vector Signal Generator Option)
W2929AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A Operation Manual (Standard Waveform Pattern for Vector Signal Generator Option)
W3117AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Phase Noise Measurement Function Operation)
W3118AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Phase Noise Measurement Function Remote control)
W3655AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A-017 Operation Manual (Noise Figure Measurement Function Operation)
W3656AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A-017 Operation Manual (Noise Figure Measurement Function Remote Control)
W3098AE	MX269011A Operation Manual (Operation)
W3099AE	MX269011A Operation Manual (Remote control)
W3060AE	MX269012A Operation Manual (Operation)
W3061AE	MX269012A Operation Manual (Remote control)
W3100AE	MX269013A Operation Manual (Operation)
W3101AE	MX269013A Operation Manual (Remote control)
W3031AE	MX269014A Operation Manual (Operation)
W3032AE	MX269014A Operation Manual (Remote control)
W3044AE	MX269015A Operation Manual (Operation)
W3045AE	MX269015A Operation Manual (Remote control)
W3305AE	MX269017A Operation Manual (Operation)
W3306AE	MX269017A Operation Manual (Remote control)
W3014AE	MX269020A Operation Manual (Operation)
W3064AE	MX269020A Operation Manual (Remote control)
W3015AE	MX269021A Operation Manual (Operation)
W3065AE	MX269021A Operation Manual (Remote control)
W3209AE	MX269022A Operation Manual (Operation)
W3210AE	MX269022A Operation Manual (Remote control)
W3521AE	MX269023A Operation Manual (Operation)
W3522AE	MX269023A Operation Manual (Remote Control)
W3201AE	MX269024A Operation Manual (Operation)
W3202AE	MX269024A Operation Manual (Remote control)
W3203AE	MX269026A Operation Manual (Operation)
W3204AE	MX269026A Operation Manual (Remote control)
W3528AE	MX269028A Operation Manual (Operation)
W3529AE	MX269028A Operation Manual (Remote Control)
W2860AE	MX269030A Operation Manual (Operation)
W2861AE	MX269030A Operation Manual (Remote control)
W3108AE	MX269050A Operation Manual (Operation)
W3109AE	MX269050A Operation Manual (Remote control)

Model/Order No.	Name
W3922AE	MX285051A/MX269051A Operation Manual
W3963AE	MX285051A-011/MX269051A-011/MX285051A-021/ MX285051A-061/MX269051A-061/MX285051A-071 Operation Manual (Operation)
W3964AE	MX285051A-011/MX269051A-011/MX285051A-021/ MX285051A-061/MX269051A-061/MX285051A-071 Operation Manual (Remote Control)
W2915AE	MX269901A Operation Manual
W2916AE	MX269902A Operation Manual
W2917AE	MX269904A Operation Manual
W2918AE	MX269905A Operation Manual
W3023AE	MX269908A Operation Manual
W3221AE	MX269910A Operation Manual
W3488AE	MX269911A Operation Manual
W3582AE	MX269912A Operation Manual
W3984AE	MX269913A Operation Manual
W3675AE	MX269970A Operation Manual
K240B	Power Divider (K connector, DC to 26.5 GHz, 50Ω, K-J, 1 W max)
MA1612A	Four-Port Junction Pad (5 MHz to 3 GHz, N-J)
J0576B	Coaxial Cord (N-P · 5D-2W · N-P), 1 m
J0576D	Coaxial Cord (N-P · 5D-2W · N-P), 2 m
J0127A	Coaxial Cord (BNC-P · RG58A/U · BNC-P), 1 m
J0127B	Coaxial Cord (BNC-P · RG58A/U · BNC-P), 2 m
J0127C	Coaxial Cord (BNC-P · RG58A/U · BNC-P), 0.5 m
J0322A	Coaxial Cord (SMA-P · 50Ω SUCOFLEX104 · SMA-P), 0.5 m (DC to 18 GHz)
J0322B	Coaxial Cord (SMA-P · 50Ω SUCOFLEX104 · SMA-P), 1 m (DC to 18 GHz)
J0322C	Coaxial Cord (SMA-P · 50Ω SUCOFLEX104 · SMA-P), 1.5 m (DC to 18 GHz)
J0322D	Coaxial Cord (SMA-P · 50Ω SUCOFLEX104 · SMA-P), 2 m (DC to 18 GHz)
J0805	DC Block, N type (MODEL 7003) (10 kHz to 18 GHz, N-P · N-J)
J1554A	DC Block, SMA type (MODEL 7006) (9 kHz to 26.5 GHz, SMA-P · SMA-J)
J1555A	DC Block, SMA type (MODEL 7006-1) (9 kHz to 20 GHz, SMA-P · SMA-J)
K261	DC Block (10 kHz to 40 GHz, K-P · K-J)
J0004	Coaxial Adapter (DC to 12.4 GHz, 50Ω, N-P · SMA-J)
J1398A	N-SMA Adapter (DC to 26.5 GHz, 50Ω, N-P · SMA-J)
J0911	Coaxial Cord, 1.0 M (for 40 GHz) (DC to 40 GHz, approx. 1 m) (SF102A, 11K254/K254/1.0M)
J0912	Coaxial Cord, 0.5 M (for 40 GHz) (DC to 40 GHz, approx. 0.5 m) (SF102A, 11K254/K254/0.5M)
41KC-3	Fixed Attenuator, 3 dB (DC to 40 GHz, 3 dB)
J1261A	Ethernet Cable (Shield type, straight), 1 m
J1261B	Ethernet Cable (Shield type, straight), 3 m
J1261C	Ethernet Cable (Shield type, cross), 1 m
J1261D	Ethernet Cable (Shield type, cross), 3 m
J0008	GPIB Connection Cable, 2.0 m
J1373A*	AUX Conversion Adapter (AUX → BNC, for vector signal generator option)
B0597A	Rack Mount Kit (EIA)
B0589A	Carrying Case (Hard type, with casters)
MA24105A	Inline Peak Power Sensor (350 MHz to 4 GHz, with USB A to mini B cable)
MA24106A	USB Power Sensor (50 MHz to 6 GHz, with USB A to mini B cable)
MA24108A	Microwave USB Power Sensor (10 MHz to 8 GHz, with USB A to Micro-B cable)
MA24118A	Microwave USB Power Sensor (10 MHz to 18 GHz, with USB A to Micro-B cable)
MA24126A	Microwave USB Power Sensor (10 MHz to 26 GHz, with USB A to Micro-B cable)
Z1037A	Installation Kit (required when retrofitting options or installing software)

*: The AUX Conversion Adapter J1373A is not a standard accessory for the MS269xA-020/120 Vector Signal Generator Option.


AUX Conversion Adapter J1373A


USB Power Sensor MA24106A


Carrying Case B0589A (Hard type)

Signal Analyzer

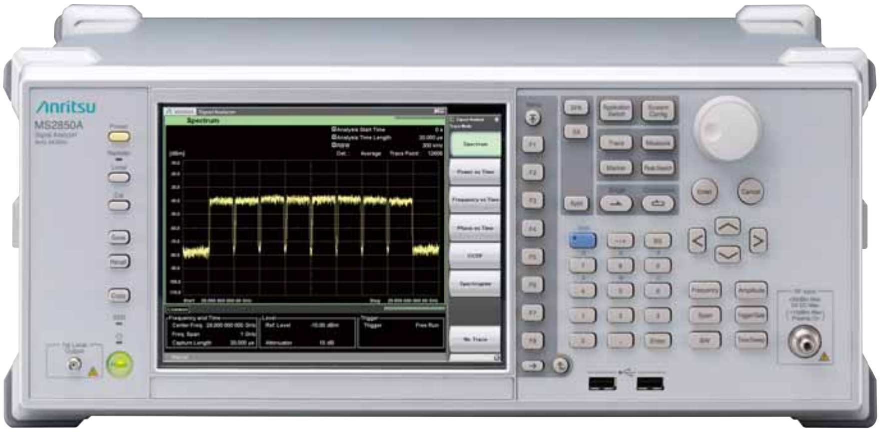
MS2850A

9 kHz to 32 GHz/ 44.5 GHz

Remote Control
GPIB | Ethernet | USB

Signal Analyzer with 1 GHz Analysis Bandwidth

Excellent Eco Product



Analysis Bandwidth up to 1 GHz Enabling 5G Mobile and Satellite Communications R&D/Manufacturing Development

The MS2850A is a spectrum analyzer/signal analyzer with a maximum analysis bandwidth of 1 GHz and a frequency range of 9 kHz to either 32 GHz or 44.5 GHz. It helps cut R&D and manufacturing costs for microwave and millimeter-wave wideband communications systems, such as 5G mobile and broadcast satellites.
Dedicated software for 5G measurements can be installed in the Signal Analyzer MS2850A, and detailed and accurate measurements are backed by the high-performance 1 GHz (max.) analysis bandwidth and high measurement dynamic range.

Features

- Analysis bandwidth:
  255 MHz (Standard), 510 MHz (Option), 1 GHz (Option)
- EVM performance:
  <1% (100 MHz bandwidth at Center Frequency: 28 GHz)
- Phase flatness performance: Center Frequency: 28 GHz, at Center Frequency ±500 MHz
  In-band Frequency Characteristics: ±1.2 dB (nom.)
  In-band Phase Linearity: 5 deg. p-p (nom.)
- Measurement applications (option):
  5G measurement, LTE/LTE-Advanced, Digital Modulation, etc.

Analysis Bandwidth 1 GHz

The 1 GHz analysis bandwidth supports wider-band microwave and millimeter- wave communications while high flatness performance facilitates multicarrier signal analysis.
With lower costs and higher measurement accuracy, the Signal Analyzer MS2850A is ideal for R&D and manufacturing of wideband next-generation communications systems, such as 5G mobile and broadcast satellites.

EVM Performance <1%

The measurement dynamic range is better than 140 dB*[1] at a 1 GHz analysis bandwidth. This performance is equivalent to <1% EVM performance which is considered Peak-to-Peak of modulation waveform at measurement of a single 5G carrier (100 MHz wide)*[2].
With its wide dynamic range, the MS2850A increases the reliability of next-generation, wideband communications systems.

*1: Difference between ADC Clipping level and DANL
*2: At 100 MHz bandwidth 64QAM xPDSCH

Main Frame Functions/Performance

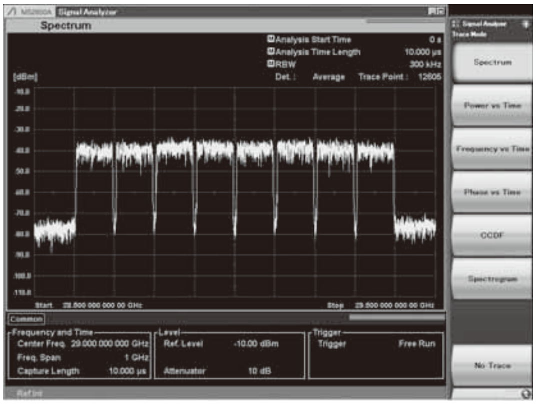
The MS2850A is a spectrum analyzer/signal analyzer with a maximum analysis bandwidth of 1 GHz and a frequency range of 9 kHz to either 32 GHz or 44.5 GHz. Its high cost-performance helps cut rising R&D and manufacturing CAPEX costs in future deployments of microwave and millimeter-wave wideband communications systems.

1 GHz Analysis Bandwidth

The 1 GHz analysis bandwidth supports wider bands for microwave and millimeter-wave communications systems, such as 5G mobile and broadcast satellites.

The signal analyzer function using FFT (Fast Fourier transform) analysis supports spectrum displays, spectrogram displays, and applications where frequency and phase change with elapsed time. In addition, frequency bands required for 5G measurements are covered and all-in-one evaluation of multicarrier signals is supported by the 5G measurement software.

Analysis Bandwidth: 255 MHz (standard)
510 MHz (option), 1 GHz (option)


Spectrum
Analysis Start Time 0 s
Analysis Time Length 10.000 μs
RBW 300 kHz
Det. : Average Trace Point : 12605
Start 28.500 000 000 00 GHz
Stop 29.500 000 000 00 GHz
Frequency and Time
Center Freq. 29.000 000 000 GHz
Freq. Span 1 GHz
Capture Length 10.000 μs
Level
Ref. Level -10.00 dBm
Attenuator 10 dB
Trigger
Trigger Free Run

Spectrum of eight 100 MHz bandwidth carriers
at 29 GHz center frequency

Excellent Flatness Performance

The amplitude and phase flatness performance*1 over a wide analysis bandwidth of 1 GHz exceed that of other signal analyzers*2. With this performance, the MS2850A supports high-accuracy amplitude and phase measurements for each carrier in wideband communications systems, such as 5G mobile, to play a key role in improving the quality of radio communications equipment.

Center Frequency: 28 GHz, at Center Frequency ±500 MHz
In-band Frequency Characteristics: ±1.2 dB (nom.)
In-band Phase Linearity: 5 deg. p-p (nom.)

*1: Stipulated as In-band Frequency Characteristics and In-band Phase Linearity in Anritsu specifications
*2: Anritsu test at May 2017

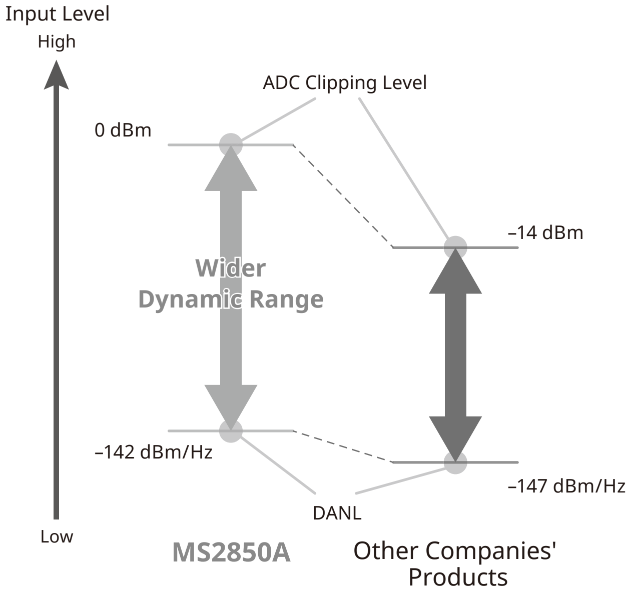
Wide Dynamic Range

High ADC*3 Clipping Level
Wide Measurement Dynamic Range at Difference from DANL*4

The MS2850A has a high ADC clipping level over an analysis bandwidth of 1 GHz. This performance can be used to obtain a wider difference from the DANL, which rises when inputting the actual signal input level and inputting a wideband signal when using an attenuator.
This wide dynamic range performance helps obtain more accurate EVM values at measurement of 5G signals. For example, in the 28 GHz band, the measured dynamic range at the difference between the ADC clipping level and DANL is better than 140 dB (ref.).

Center Frequency: 28 GHz
ADC Clipping Level: 0 dBm*5 (CW)
DANL: –142 dBm/Hz*5
Dynamic Range: 142 dB (ref.)

*3: Analog to Digital Converter
*4: Displayed Average Noise Level
*5: meas. means value measured as design stage but not guaranteed specification



The measurement dynamic range widens if the ADC clipping level is high even when the DANL is quite high.

High SFDR (Spurious Free Dynamic Range)
–70 dBc at 1 GHz Analysis Bandwidth

The MS2850A suppresses spurious generation due to ADC over the 1 GHz analysis bandwidth, assuring a wide measurement dynamic range at wideband signal analysis.

SFDR
800 MHz ≤ Frequency < 4.2 GHz: –60 dBc (nom.)
4.2 GHz ≤ Frequency ≤ 44.5 GHz: –70 dBc (nom.)

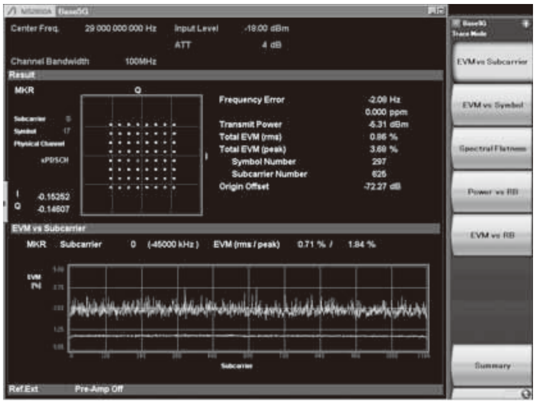
5G Measurement Software

Dedicated software for 5G measurements can be installed in the Signal Analyzer MS2850A, and detailed and accurate measurements are backed by the high-performance 1 GHz (max.) analysis bandwidth and high measurement dynamic range.

Standard		Model/Name	Channel Bandwidth (1CC)	Multi Carrier Measurement
V5G (Verizon 5GTF)		Pre-Standard CP-OFDM Downlink MX285051A-001 Pre-Standard CP-OFDM Uplink MX285051A-051	Up to 100 MHz	Support
5G NR (3GPP TS 38.211)	Range 1	NR TDD sub-6GHz Downlink MX285051A-011 NR TDD sub-6GHz Uplink MX285051A-061	Up to 100 MHz	—
	Range 2	NR TDD mmWave Downlink MX285051A-021 NR TDD mmWave Uplink MX285051A-071	Up to 400 MHz	Downlink only

Measurement Items

Numeric Results	**Graph Results**
• Frequency Error	• Constellation
• Tx Power	• EVM vs. Subcarrier
• EVM	• Spectral Flatness (Amplitude)
• Origin Offset	• Spectral Flatness (Phase)
• Timing Difference	• EVM vs. RB



Center Freq. 29 000 000 000 Hz Input Level -18.00 dBm
ATT 4 dB
Channel Bandwidth 100MHz

Result

MKR Q

Subcarrier 0
Symbol 17
Physical Channel xPDSCH
I -0.15252
Q -0.14607

Frequency Error -2.09 Hz
0.000 ppm
Transmit Power -6.31 dBm
Total EVM (rms) 0.86 %
Total EVM (peak) 3.69 %
Symbol Number 297
Subcarrier Number 626
Origin Offset -72.27 dB

EVM vs Subcarrier

MKR Subcarrier 0 (-45000 kHz) EVM (rms / peak) 0.71 % / 1.84 %

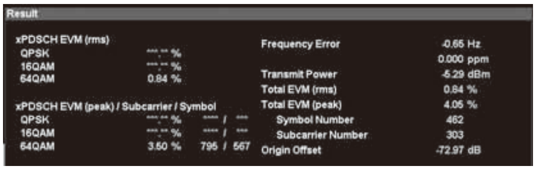
Basic Screen (EVM vs. Subcarrier)

High EVM Performance due to MS2850A Wide Dynamic Range (EVM: <1%)

Combining the 5G analysis software with the MS2850A offers an EVM performance of <1% at measurement of a 5G single carrier (100 MHz wide, 28 GHz)*1.

And even wider dynamic range performance is achieved over the difference between the MS2850A high ADC clipping level (0 dBm*2) and DANL.

Pressing [Auto Range] performs measurement at the optimum level setting.



Result

xPDSCH EVM (rms)
QPSK ***.** %
16QAM ***.** %
64QAM 0.84 %

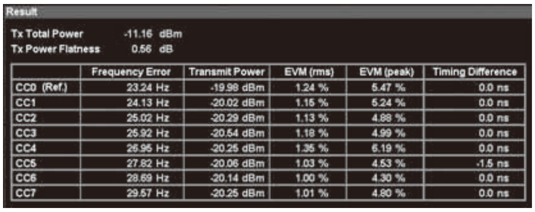
xPDSCH EVM (peak) / Subcarrier / Symbol
QPSK ***.** % **** / ***
16QAM ***.** % **** / ***
64QAM 3.50 % 795 / 567

Frequency Error -0.65 Hz
0.000 ppm
Transmit Power -5.29 dBm
Total EVM (rms) 0.84 %
Total EVM (peak) 4.05 %
Symbol Number 462
Subcarrier Number 303
Origin Offset -72.97 dB

Single Carrier EVM Measurement Example (Numeric Results)

Multicarrier Analysis and Batch Measurement at 1 GHz

The 5G measurement software uses the 1 GHz analysis bandwidth of the MS2850A to support batch (all-at-once) measurement of all 5G signal carriers (8 carriers × 100 MHz wide). The characteristics of each single carrier can be evaluated quickly at the same time without needing to measure each single carrier separately.



Result

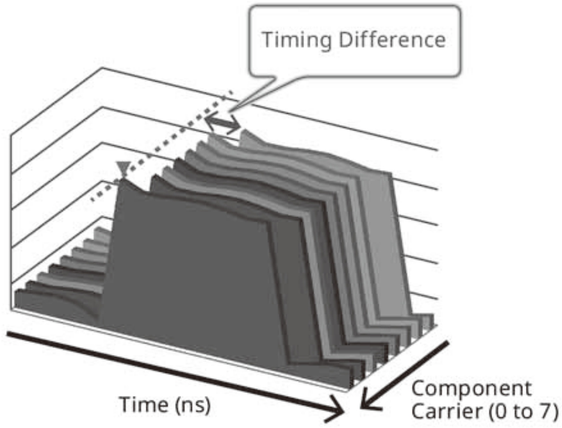
Tx Total Power -11.16 dBm
Tx Power Flatness 0.56 dB

	Frequency Error	Transmit Power	EVM (rms)	EVM (peak)	Timing Difference
CC0 (Ref.)	23.24 Hz	-19.98 dBm	1.24 %	5.47 %	0.0 ns
CC1	24.13 Hz	-20.02 dBm	1.15 %	5.24 %	0.0 ns
CC2	25.02 Hz	-20.29 dBm	1.13 %	4.88 %	0.0 ns
CC3	25.92 Hz	-20.54 dBm	1.18 %	4.99 %	0.0 ns
CC4	26.95 Hz	-20.25 dBm	1.35 %	6.19 %	0.0 ns
CC5	27.82 Hz	-20.06 dBm	1.03 %	4.53 %	-1.5 ns
CC6	28.69 Hz	-20.14 dBm	1.00 %	4.30 %	0.0 ns
CC7	29.57 Hz	-20.25 dBm	1.01 %	4.80 %	0.0 ns

Batch (All-at-Once) Carrier Measurements (Numeric Results)

Timing Difference Measurement

Batch (all-at-once) measurement of all carriers not only supports EVM and frequency error measurements for each carrier, but also supports timing difference measurements for each carrier.



High-Accuracy Measurement due to MS2850A Amplitude and Phase Flatness

The amplitude and phase flatness performance of the MS2850A over the wide analysis bandwidth of 1 GHz (max.) exceed that of other signal analyzers. For example, suppressing the measuring instrument error enables phase adjustment of each path in an antenna array.

MS2850A Specifications

Offset Frequency: At Center Frequency ±500 MHz
  In-band frequency characteristics (Amplitude flatness):
    ±1.2 dB (nom.)
  In-band phase linearity (Phase flatness):
    5° p-p (nom.)

*1: at 100 MHz bandwidth 64QAM xPDSCH

*2: meas. means value measured as design stage but not guaranteed specification

Signal Analyzer

MS2850A

The Signal Analyzer MS2850A has the analysis bandwidth and excellent flatness performance required for R&D and manufacturing of next-generation wideband communications systems. In addition to versatile basic functions for more convenient testing, it also has useful troubleshooting functions, such as Capture&Replay and sub-trace displays.

Standard Functions

Signal Analyzer (Analysis Bandwidth: 255 MHz)
Spectrum Analyzer

Option Functions

Signal Analyzer (Analysis Bandwidth: 510 MHz, 1 GHz)
Built-in Preamp
Low Second Harmonic Distortion
Phase Noise Measurement
Noise Figure (NF) Measurement
Modulation Analysis (5G, LTE, W-CDMA, etc.)

Application Parts

High Performance Waveguide Mixer (50 GHz to 90 GHz)
External Mixer (Harmonic, 26.5 GHz to 325 GHz)
USB Power Sensor

Typical Measurement Items and Functions

✓: Supported

Measurement Function/Item	Signal Analyzer	Spectrum Analyzer	Option/Application Part
Spectrum Display	✓	✓	
Power/Frequency/Phase vs. Time Display	✓		
Capture & Replay	✓		
CCDF/APD Display	✓		
Spectrogram Display	✓		
Sub-trace Display	✓		
Gate View (at Gate Sweep)		✓	
Channel Power	✓	✓	
Occupied Bandwidth	✓	✓	
Adjacent Channel Leakage Power	✓	✓	
Burst Average Power	✓	✓	
Multi-marker & List Display	✓	✓	
Highest 10 Markers	✓	✓	
Spectrum Emission Mask		✓	
Limit Line		✓	
Frequency Counter		✓	
Two-Signal Tertiary Distortion (TOI)		✓	
Power Meter*			✓
Modulation Analysis (5G, LTE, etc.)			✓
Phase Noise Measurement			✓
Noise Figure (NF) Measurement			✓
mmWave-band Spectrum Measurement using External Mixer Connection (sold separately)	✓	✓	✓

*: Connected to USB power sensor sold separately

Signal Analyzer Functions (Standard)

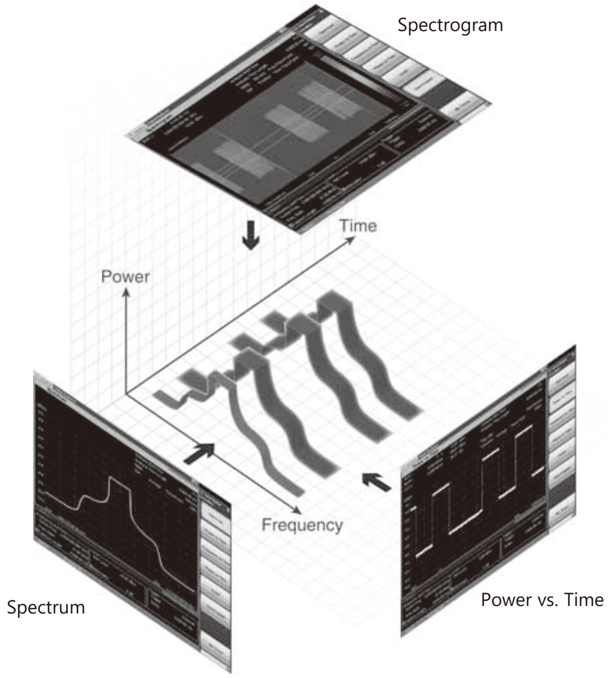
Analysis Bandwidth

Analysis Bandwidth	Frequency Measurement Range
255 MHz (standard)	100 MHz to 32 GHz/44.5 GHz
510 MHz (option)	100 MHz to 32 GHz/44.5 GHz
1 GHz (option)	4.2 GHz to 32 GHz/44.5 GHz

Multiple Display Modes at FFT Analysis

The MS2850A has a built-in 255 MHz analysis bandwidth FFT analysis function. The measured signal is captured for display in various domains. Troubleshooting efficiency is greatly improved because phenomena such as spectrum transients that cannot be monitored by sweep-type spectrum analyzers can be observed. The analysis bandwidth can be extended optionally to 510 MHz and 1 GHz.

Display Mode
- Spectrum
- Frequency vs. Time
- CCDF/APD
- Power vs. Time
- Phase vs. Time
- Spectrogram



Excellent Phase and Amplitude Flatness Performance

The phase-array antenna performs electronic scanning to control the phase of the parallel antenna elements because the mean width of the antenna directivity will become wider than expected if the phase of each antenna element is not the same. Consequently, the signal analyzer must be able to measure phase with high accuracy. Additionally, excellent amplitude characteristics are required at evaluation of communications using wideband signals, such as 5G mobile.

The MS2850A has excellent phase and amplitude flatness over a wide analysis bandwidth of 1 GHz.

Center Frequency 28 GHz, at Center Frequency ±500 MHz

In-band Frequency Characteristics (Amplitude Flatness)	±1.2 dB (nom.)
In-band Phase Linearity (Phase Flatness)	5˚p-p (nom.)

High Dynamic Range Performance

Analysis of wideband signals of 1 GHz does not simply require a signal analyzer with a wide analysis bandwidth. Accurate signal capture and analysis requires securing good dynamic range performance.

With a high ADC clipping level[*1] and low DANL, the MS2850A achieves a dynamic range of better than 140 dB[*2] at a center frequency of 28 GHz. Additionally, the SFDR (Spurious Free Dynamic Range) performance is an excellent –70 dBc at an analysis bandwidth of 1 GHz. As a result, the MS2850A is ideal for accurately capturing and analyzing the true performance next-generation wideband communications systems.

Dynamic Range: 142 dB (Center Frequency 28 GHz, CW, ref.)

ADC Clipping Level[*1]	0 dBm[*2]
DANL	–142 dBm/Hz[*2]

SFDR:

800 MHz to 4.2 GHz	–60 dBc (nom.)
4.2 GHz to 44.5 GHz	–70 dBc (nom.)

*1: Mixer level (CW) for using ADC at full scale

*2: meas. means value measured as design stage but not guaranteed specification

Capture & Replay Function

Waveform data can be saved (captured) in the internal memory for later display and replay. The causes of problems can be resolved quickly and easily because the display mode can be switched during replay.

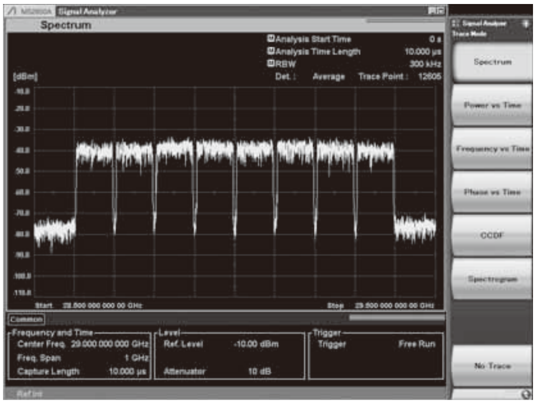
Maximum capture times for each frequency span

Span	Sampling Rate	Max. Capture Time
50 MHz	81.25 MHz	48 s
100 MHz	162.5 MHz	24 s
255 MHz	325 MHz	12 s
510 MHz	650 MHz	6 s
1000 MHz	1300 MHz	3 s

Refer to the MS2850A data sheet for details.

Spectrum Display

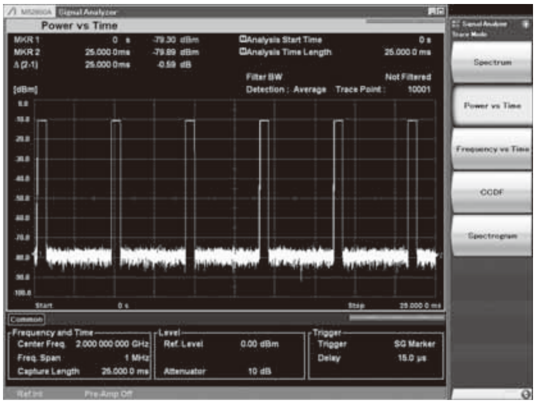
This function graphically displays the amplitude on the y-axis and the frequency on the x-axis. The captured IQ data are FFT- processed, and the time-domain data are converted to the frequency domain to display the spectrum. This is useful for confirming spectrum transients that cannot be monitored using spectrum analyzer functions.



Analysis Start Time 0 s
Analysis Time Length 10.000 µs
RBW 300 kHz
Det. : Average Trace Point : 12605
Start 28.500 000 000 00 GHz
Stop 29.500 000 000 00 GHz
Frequency and Time
Center Freq. 29.000 000 000 GHz
Freq. Span 1 GHz
Capture Length 10.000 µs
Level
Ref. Level -10.00 dBm
Attenuator 10 dB
Trigger
Trigger Free Run

Power vs. Time

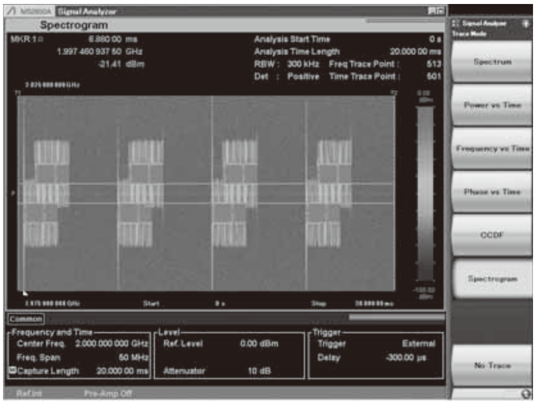
The Power vs. Time trace displays a graph with amplitude on the y-axis and time on the x-axis to confirm changes in power with time of measured signals.



MKR 1 0 s -79.30 dBm
MKR 2 25.000 0 ms -79.89 dBm
Δ (2-1) 25.000 0 ms -0.59 dB
Analysis Start Time 0 s
Analysis Time Length 25.000 0 ms
Filter BW Not Filtered
Detection : Average Trace Point : 10001
Start 0 s
Stop 25.000 0 ms
Frequency and Time
Center Freq. 2.000 000 000 GHz
Freq. Span 1 MHz
Capture Length 25.000 0 ms
Level
Ref. Level 0.00 dBm
Attenuator 10 dB
Trigger
Trigger SG Marker
Delay 15.0 µs
Ref.Int Pre-Amp Off

Spectrogram

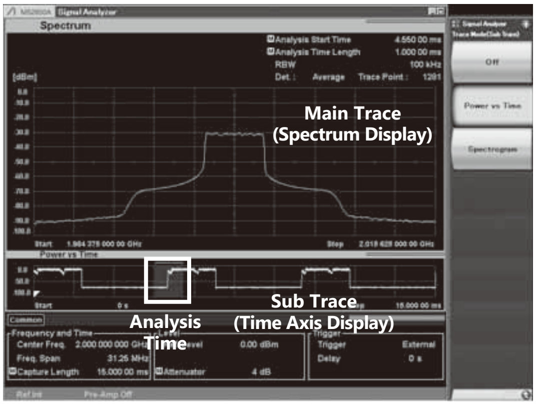
The Spectrogram trace displays the level as color with frequency on the y-axis and time on the x-axis. The captured IQ data is FFT processed to confirm time variations in the continuous spectrum.
It is useful for monitoring frequency hopping and transient signals.



MKR 1 6.880 00 ms
1.997 460 937 50 GHz
-21.41 dBm
Analysis Start Time 0 s
Analysis Time Length 20.000 00 ms
RBW : 300 kHz Freq Trace Point : 513
Det : Positive Time Trace Point : 501
Start 0 s
Frequency and Time
Center Freq. 2.000 000 000 GHz
Freq. Span 50 MHz
Capture Length 20.000 00 ms
Level
Ref. Level 0.00 dBm
Attenuator 10 dB
Trigger
Trigger External
Delay -300.00 µs
Ref.Int Pre-Amp Off

Sub-trace Display

This function is useful for checking the spectrum while changing the analysis time period arbitrarily (blue display) such as when confirming burst signal rise and fall times. Simultaneous display of the time axis (sub-trace) and frequency axis (main trace) is useful for visually confirming when spectrum waveform distortion components (adjacent channel components, etc.) occur in the time domain.



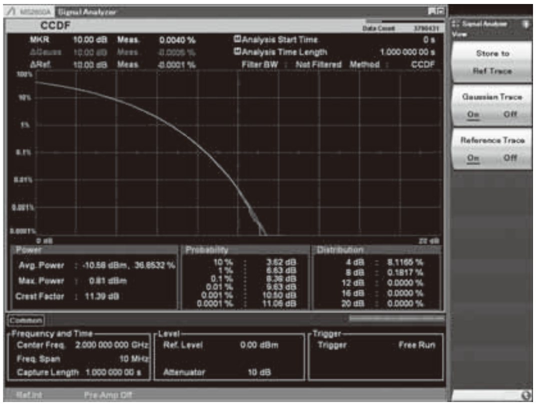
Analysis Start Time 4.550 00 ms
Analysis Time Length 1.000 00 ms
RBW 100 kHz
Det. : Average Trace Point : 1281
Start 1.984 375 000 00 GHz
Stop 2.015 625 000 00 GHz
Start 0 s
15.000 00 ms
Frequency and Time
Center Freq. 2.000 000 000 GHz
Freq. Span 31.25 MHz
Capture Length 15.000 00 ms
Level
0.00 dBm
Attenuator 4 dB
Trigger
Trigger External
Delay 0 s
Ref.Int Pre-Amp Off

CCDF/APD

The CCDF trace displays the power variation probability on the y-axis and power variation on the y-axis to confirm the CCDF and APD of measured signals.

CCDF (Complementary Cumulative Distribution Function):
The CCDF display indicates the cumulative distribution of transient power variations compared to average power.

APD (Amplitude Probability Density):
The APD display indicates the probability distribution of transient power



MKR 10.00 dB Meas. 0.0040 %
Analysis Start Time 0 s
Analysis Time Length 1.000 000 00 s
Filter BW : Not Filtered Method CCDF

Power
Avg. Power : -10.58 dBm, 36.8532 %
Max. Power : 0.81 dBm
Crest Factor : 11.39 dB

Probability	
10 %	3.62 dB
1 %	6.63 dB
0.1 %	8.36 dB
0.01 %	9.63 dB
0.001 %	10.50 dB
0.0001 %	11.06 dB

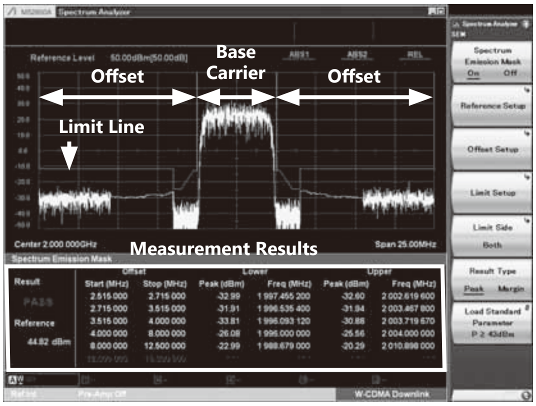
Distribution	
4 dB	8.1165 %
8 dB	0.1817 %
12 dB	0.0000 %
16 dB	0.0000 %
20 dB	0.0000 %

Frequency and Time
Center Freq. 2.000 000 000 GHz
Freq. Span 10 MHz
Capture Length 1.000 000 00 s
Level
Ref. Level 0.00 dBm
Attenuator 10 dB
Trigger
Trigger Free Run
Ref.Int Pre-Amp Off

Versatile Built-in Functions

Spectrum Emission Mask

This function splits the offset part into up to 12 segments; the measurement parameters and limit lines can be specified to measure the peak power and margin for each segment. The results are tabulated below the trace and marked PASS/FAIL. Pre-installed templates for each standard support easy parameter setting.

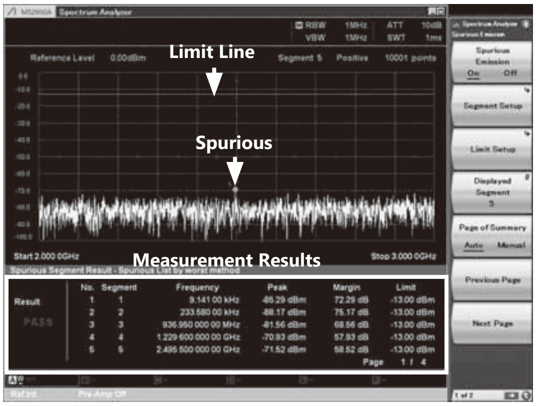


Result	Offset Start (MHz)	Offset Stop (MHz)	Lower Peak (dBm)	Lower Freq (MHz)	Upper Peak (dBm)	Upper Freq (MHz)
PASS	2.515 000	2.715 000	-32.99	1 997.455 200	-32.60	2 002.619 600
	2.715 000	3.515 000	-31.91	1 996.535 400	-31.94	2 003.467 800
Reference	3.515 000	4.000 000	-33.81	1 996.093 120	-30.88	2 003.719 670
44.82 dBm	4.000 000	8.000 000	-26.08	1 996.000 000	-25.56	2 004.000 000
	8.000 000	12.500 000	-22.99	1 988.679 000	-20.29	2 010.898 000

Measurement Results
- Peak power (or margin) at offset
- Each peak frequency

Spurious Emission

This function splits the frequency range into up to 20 segments for sweeping; the measurement parameters and limit lines can be specified to measure the peak power and margin for each segment.
The results are tabulated below the trace and marked PASS/FAIL



Result	No.	Segment	Frequency	Peak	Margin	Limit
PASS	1	1	9.141 00 kHz	-85.29 dBm	72.29 dB	-13.00 dBm
	2	2	233.580 00 kHz	-88.17 dBm	75.17 dB	-13.00 dBm
	3	3	936.950 000 00 MHz	-81.56 dBm	68.56 dB	-13.00 dBm
	4	4	1.229 600 000 00 GHz	-70.93 dBm	57.93 dB	-13.00 dBm
	5	5	2.495 500 000 00 GHz	-71.52 dBm	58.52 dB	-13.00 dBm

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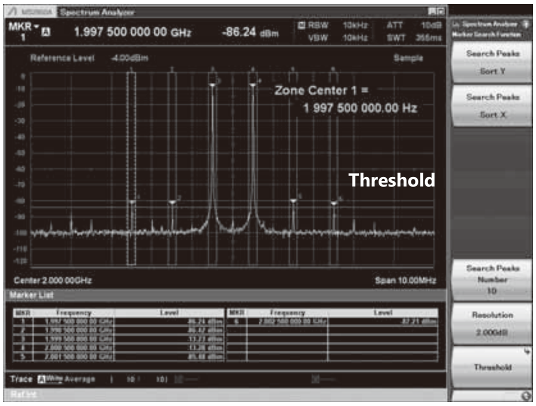
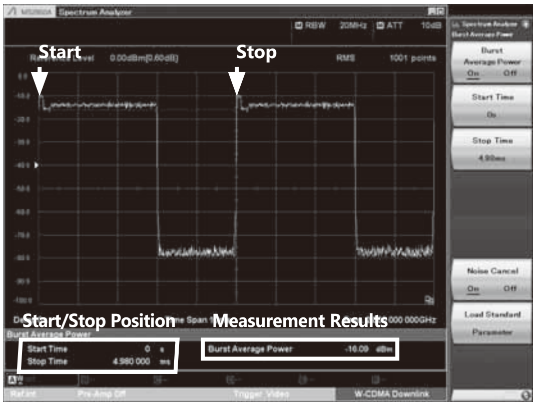
Multi-marker & Marker List

Up to 10 markers can be set for this function. Markers may be either a spot or a zone. Using a zone marker, the peak of a signal with an unstable variable frequency can be tracked and measured.
Not only can the 10 markers be listed below the trace but the differences between markers can be calculated and displayed using the delta setting.



Burst Average Power

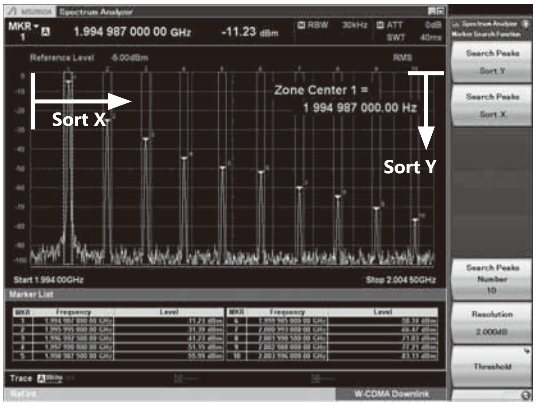
The average power for the range specified by two markers is displayed in the time domain. Measurement only requires setting the measurement start and stop positions on the screen. True performance is measured using the noise cancellation function to subtract mainframe noise from the measurement result.
Pre-installed templates for each standard support easy parameter setting.



Start Time 0 s
Stop Time 4.980 000 ms
Burst Average Power -16.09 dBm

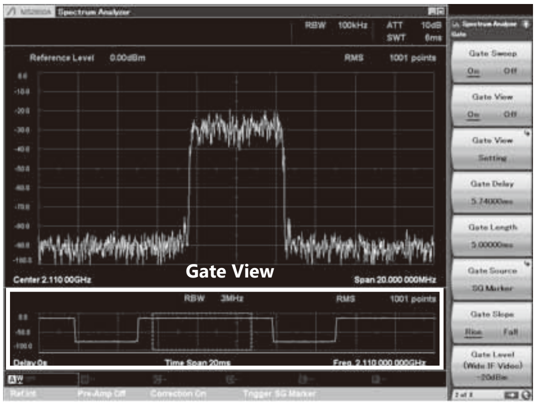
Highest 10 Markers

This function sets the threshold level and auto-detects peaks in the X (frequency) and Y (level/time) directions.



Gate View

For efficient gate sweeping when sweeping only the burst- signal on period, the spectrum analyzer functions include an auxiliary screen (Gate View) to display the gate sweep section.



Hardware Standard Functions/Options/Application Parts

Microwave Preselector Bypass (Standard Function)

Passing the input signal through a preselector removes generated spurious at microwave and mmWave band measurements. However, in this case, the signal passband width is restricted and the flatness of the in-band frequency characteristics is degraded, both of which can adversely affect FFT analysis and modulation analysis times. As a result, adding a preselector bypass improves the in-band frequency characteristics and supports analysis up to wide bandwidths of 44.5 GHz.

2 dB Step Attenuator (Standard Function)

The built-in attenuator can be set with a resolution of 2 dB and the level of the input signal to the mixer can be adjusted with high resolution to make best use of the MS2850A dynamic range.

Phase Noise Measurement Function (MS2850A-010)

Phase noise can be measured over a frequency offset of 10 Hz to 10 MHz. The local and remote phase noise vs the carrier signal can each be measured by automatically switching to the best filter.

Carrier Freq. 1 000 000 000 Hz
Reference Level 0.00 dBm
ATT 0 dB
Average 10 / 10
Carrier Power -0.54 dBm
Frequency Error 0.13 Hz

Marker List

MKR	Frequency	Level	MKR	Frequency	Level
1	10 Hz	-78.50 dBc/Hz	5	100 kHz	-129.53 dBc/Hz
2	100 Hz	-98.67 dBc/Hz	6	1 MHz	-137.73 dBc/Hz
3	1 kHz	-119.23 dBc/Hz	7	10 MHz	-143.25 dBc/Hz
4	10 kHz	-128.03 dBc/Hz			

Ref.Int Pre-Amp Off

Measurement Screen

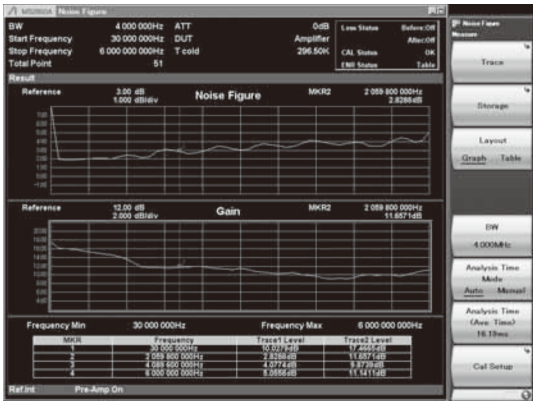
Secondary Storage Device (MS2850A-011)

This removable SSD extends the main unit internal storage capacity to save even more large digitized data files from wideband signals. Removability makes data transfer and exchange easy. The OS is not installed on this SSD and the MS2850A is shipped with the secondary SSD installed in the secondary SSD slot.

Noise Figure Measurement Function (MS2850A-017)

This option measures the noise figure according to the Y-Factor rule using a noise source. The Noisecom Inc. NC346 series of noise sources* is supported.

*: Refer to the MS2850A data sheet for details.



BW 4 000 000Hz
Start Frequency 30 000 000Hz
Stop Frequency 6 000 000 000Hz
Total Point 51
ATT 0dB
DUT Amplifier
T cold 296.50K
Loss Status Before:Off After:Off
CAL Status OK
ENR Status Table

Reference 3.00 dB 1.000 dB/div MKR2 2 059 800 000Hz 2.8288dB

Reference 12.00 dB 2.000 dB/div MKR2 2 059 800 000Hz 11.6571dB

Frequency Min 30 000 000Hz
Frequency Max 6 000 000 000Hz

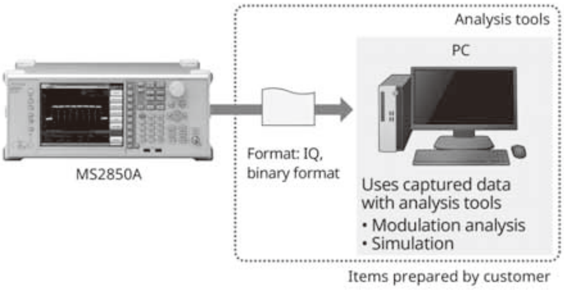
MKR	Frequency	Trace1 Level	Trace2 Level
1	30 000 000Hz	[illegible]	[illegible]
2	2 059 800 000Hz	2.8268dB	11.6571dB
3	4 089 600 000Hz	4.0774dB	[illegible]
4	6 000 000 000Hz	5.0556dB	11.1411dB

Ref.Int Pre-Amp On

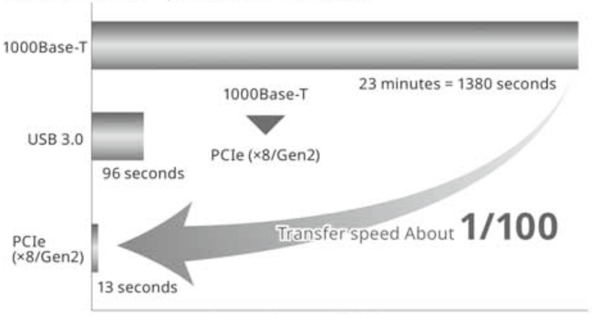
Measurement Result: Example of Graph display
(Frequency Mode: Sweep, Screen Layout: Graph)

External Interface for High Speed Data Transfer PCIe (MS2850A-053)
External Interface for High Speed Data Transfer USB3.0 (MS2850A-054)

The digitized data captured by the main unit is transferred at high speed to the PC, helping improve development efficiency and lower production costs.



IQ Data Transfer Speed (Reference Value)



Time required to transfer 32 GB* of IQ data
*: MS2850A maximum IQ data transfer size
Equivalent to about 3 seconds of digitized data at Span: 1 GHz

Noise Floor Reduction (MS2850A-051)

The Noise Floor Reduction (NFR) function increases the measurement accuracy for low-level signals. It subtracts the internal noise components (11 dB max. nominal) of the measuring instrument itself from the displayed measurement result.

Microwave Preamplifier (MS2850A-068)

With a 20 dB gain, this option improves DANL. It is useful for measuring low-level signals such as noise and interference as well as for measurements via antennas with large path losses.

Frequency Range: 100 kHz to 32 GHz (with MS2850A-047)
100 kHz to 44 .5 GHz (with MS2850A-046)

Low Second Harmonic Distortion (MS2850A-076)

Installation of this option is recommended when measuring secondary harmonics at an input frequency range of 2 GHz to 22.25 GHz. Installing this option upgrades the MS2850A secondary harmonic distortion performance.

Input Frequency	Harmonic Upper: when installed (Lower: when not installed)	SHI* Upper: when installed (Lower: when not installed)
2 GHz to 3 GHz	–80 dBc (–70 dBc)	+70 dBm (+60 dBm)
3 GHz to 22.25 GHz	–90 dBc (–70 dBc)	+80 dBm (+60 dBm)

* SHI: Second Harmonic Intercept

USB Power Sensor (Sold Separately)

Connecting this sensor to the MS2850A supports power and absolute power measurements.

Model	Frequency Range	Dynamic Range
MA24104A*	600 MHz to 4 GHz	+3 to +51.76 dBm
MA24105A	350 MHz to 4 GHz	+3 to +51.76 dBm
MA24106A	50 MHz to 6 GHz	–40 to +23 dBm
MA24108A	10 MHz to 8 GHz	–40 to +20 dBm
MA24118A	10 MHz to 18 GHz	–40 to +20 dBm
MA24126A	10 MHz to 26 GHz	–40 to +20 dBm

*: MA24104A has been discontinued.

High Performance Waveguide Mixer/External Mixers (Harmonic Mixers)

Two types of mixer can be connected to the MS2850A series (32 GHz/44.5 GHz models) for millimeter-wave-band measurements; spectrum measurements up to 325 GHz are supported using either a High-Performance Waveguide Mixer or an external harmonic mixer.
In particular, High Performance Waveguide Mixer are ideal for analyzing the true spectrum of millimeter-wave-band transmitters due to its excellent wide dynamic range.

High Performance Waveguide Mixer MA2806A/MA2808A

Model	Name	Frequency Band	Frequency Range	Waveguide	Flange
MA2806A	High Performance Waveguide Mixer (50 to 75 GHz)	V band	50 GHz to 75 GHz	WR15	UG-385/U
MA2808A	High Performance Waveguide Mixer (60 to 90 GHz)	E band	60 GHz to 90 GHz	WR12	UG-387/U

The widest analysis bandwidth of MS2850A is 510 MHz when connecting MS2850A to MA2806A/MA2808A.

MA2808A

Features

- Wide dynamic range based on excellent minimum sensitivity and P1dB performance
- Image-response-free measurement of wideband signals plus high IF frequency and PS function*

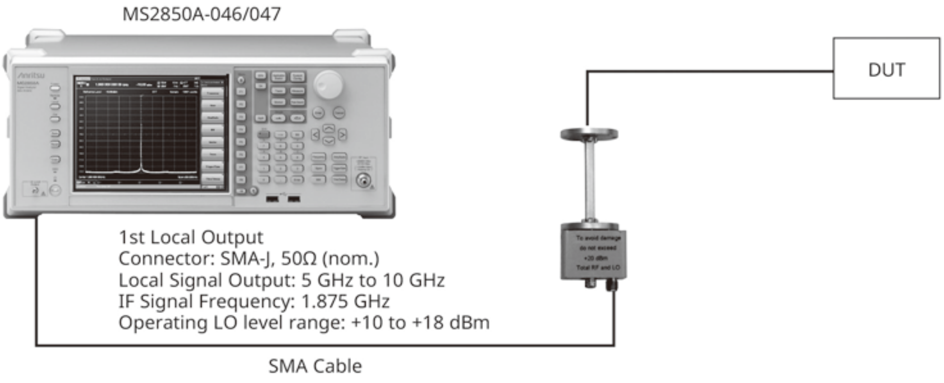
*: Patented

For further information see MA2806A/MA2808A page.

External Mixers (Harmonic Mixers)

Connecting the MS2850A to the MA2740C/MA2750C series of External Mixers (Harmonic Mixers) supports spectrum measurements up to 325 GHz with low costs.

Model	Name	Frequency Band	Frequency Range	Waveguide	Flange
MA2741C	External Mixer	A Band	26.5 GHz to 40 GHz	WR28	MIL-DTL-3922/54-003
MA2742C	External Mixer	Q Band	33 GHz to 50 GHz	WR22	MIL-DTL-3922/67D-006
MA2743C	External Mixer	U Band	40 GHz to 60 GHz	WR19	MIL-DTL-3922/67D-007
MA2744C	External Mixer	V Band	50 GHz to 75 GHz	WR15	MIL-DTL-3922/67D-008
MA2745C	External Mixer	E Band	60 GHz to 90 GHz	WR12	MIL-DTL-3922/67D-009
MA2746C	External Mixer	W Band	75 GHz to 110 GHz	WR10	MIL-DTL-3922/67D-010
MA2747C	External Mixer	F Band	90 GHz to 140 GHz	WR08	MIL-DTL-3922/67D-M08
MA2748C	External Mixer	D Band	110 GHz to 170 GHz	WR06	MIL-DTL-3922/67D-M06
MA2749C	External Mixer	G Band	140 GHz to 220 GHz	WR05	MIL-DTL-3922/67D-M05
MA2750C	External Mixer	Y Band	170 GHz to 260 GHz	WR04	MIL-DTL-3922/67D-M04
MA2751C	External Mixer	J Band	220 GHz to 325 GHz	WR03	MIL-DTL-3922/67D-M03



Connection Setup

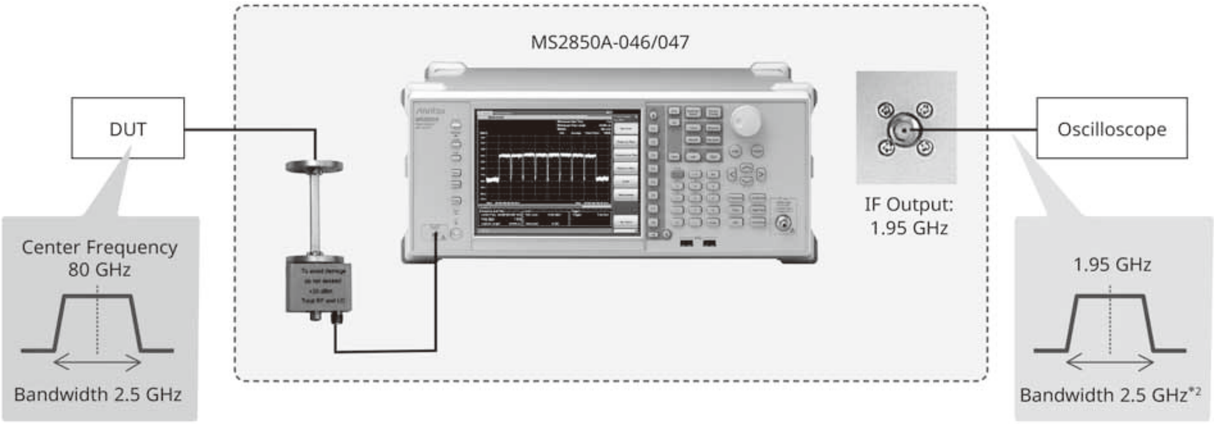
FFT Analysis in Millimeter Wave Band

The signal-analyzer functions can be used by connecting either the High-Performance Waveguide mixer or an external mixer. This helps improve troubleshooting efficiency when confirming transient phenomena, such as a degraded spectrum that cannot be captured using a sweep-type spectrum analyzer.
Additionally, MS2850A supports down converting signals up to a maximum bandwidth of 2.5 GHz through IF out port. This can be used as down convertor when performing modulation analysis by digitizing with an oscilloscope, etc.

	Maximum Bandwidth set by MS2850A	Maximum Bandwidth as Down Converter
High Performance Waveguide Mixer MA2806A/MA2808A	510 MHz*1	510 MHz*1
External Mixer MA2740C/MA2750C Series	1 GHz	2.5 GHz

*1: The widest analysis bandwidth of MS2850A is 510 MHz.

Measurement image: Down convert signals with 80 GHz center frequency and 2.5 GHz*2 bandwidth to 1.95 GHz



*2: When using external mixer bands (MA2740C/MA2750C Series), or using internal micro frequency bands (Band; 3 to 9) with Microwave Preselector Bypass MS2850A-067: On

Software Options

Measurement software options are provided with modulation analysis functions supporting various communications methods.
For details refer to the MX2690xxA Series, MX2830xxA Series, MX2850xxA Series Measurement Software brochure.

W-CDMA/HSPA Downlink Measurement Software	**MX269011A**

This software is for measuring the RF Tx characteristics of W-CDMA/HSDPA/HSPA Evolution base stations.

W-CDMA/HSPA Uplink Measurement Software	**MX269012A**

This software is for measuring the RF Tx characteristics of W-CDMA/HSUPA/HSPA Evolution terminals.

GSM/EDGE Measurement Software	**MX269013A**
EDGE Evolution Measurement Software	**MX269013A-001**

This software is for measuring the RF Tx characteristics of GSM/EDGE (EGPRS) and EDGE Evolution (EGPRS2) base stations and terminals.

TD-SCDMA Measurement Software	**MX269015A**

This software is for measuring the RF Tx characteristics of TD-SCDMA base stations and terminals. It supports multiple modulation methods, including ASK, FSK, QPSK, QAM, etc.

LTE Downlink Measurement Software	**MX269020A**
LTE-Advanced FDD Downlink Measurement Software	**MX269020A-001**
LTE TDD Downlink Measurement Software	**MX269022A**
LTE-Advanced TDD Downlink Measurement Software	**MX269022A-001**

This software is for measuring the RF Tx characteristics of LTE/LTE-Advanced base stations.

LTE Uplink Measurement Software	**MX269021A**
LTE-Advanced FDD Uplink Measurement Software	**MX269021A-001**
LTE TDD Uplink Measurement Software	**MX269023A**
LTE-Advanced TDD Uplink Measurement Software	**MX269023A-001**

This software is for measuring the RF Tx characteristics of LTE/LTE-Advanced terminals.

5G Standard Measurement Software (Base License)	**MX285051A**
Pre-Standard CP-OFDM Downlink	**MX285051A-001**
Pre-Standard CP-OFDM Uplink	**MX285051A-051**
NR TDD sub-6GHz Downlink	**MX285051A-011**
NR TDD sub-6GHz Uplink	**MX285051A-061**
NR TDD mmWave Downlink	**MX285051A-021**
NR TDD mmWave Uplink	**MX285051A-071**

This software is for measuring the RF Tx characteristics of 5G base stations and terminals.

Vector Signal Analysis Software	**MX269017A**
APSK Analysis	**MX269017A-001**
Higher-Order QAM Analysis	**MX269017A-011**

This software is for measuring the RF Tx characteristics of base stations and terminals using various digital wireless methods.

Supported Modulation Technologies
BPSK, QPSK, O-QPSK, π/4 DQPSK, 8PSK, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM, 2FSK, 4FSK, 2ASK, 4ASK, H-CPM, MSK

The software options as below are required.

Option	Modulation
MX269017A-001	16APSK, 32APSK
MX269017A-011	512QAM, 1024QAM, 2048QAM

5G Standard Measurement Software (Base License) MX285051A
Pre-Standard CP-OFDM Downlink MX285051A-001
Pre-Standard CP-OFDM Uplink MX285051A-051

The MX285051A-001 and MX285051A-051 software packages are for measuring the RF characteristics of CP-OFDM modulation downlink and uplink signals expected to be used for 5G demonstration tests and test operations.

Single Carrier Measurement

This function analyzes a 100 MHz band carrier to display the constellation, frequency error, Tx power, modulation accuracy (EVM), etc.

Multicarrier Measurement

Combination with the Analysis Bandwidth Extension to 1 GHz MS2850A-034 option supports batch (all-at-once) analysis of up to eight 100 MHz band carriers to display the frequency error for each carrier, Tx power, EVM, timing difference, etc.

Analysis Bandwidth	Batch Analysis Carrier Count
255 MHz (standard)	2
510 MHz (option)	5
1 GHz (option)	8

Numeric Results

Name	Unit	Single Carrier Measurement	Multicarrier Measurement	Remarks
Common				
Frequency Error	Hz, ppm	✓	✓	Displays frequency error
Transmit Power	dBm	✓	✓	Displays Tx power
Total EVM (rms/peak)	%, dB	✓	✓	Displays EVM rms/peak values
Origin Offset	dB	✓		Displays Origin Offset value
Time Offset	ns	✓		Displays time offset between Frame header and trigger in ns units Displays Trigger Switch = On only when using external trigger
Timing Difference	ns		✓	Displays timing difference between reference carrier and each carrier
Symbol Clock Error	ppm	✓		Displays Symbol Clock Error
IQ Skew	ns	✓		Displays IQ Skew
IQ Imbalance	dB	✓		Displays IQ Imbalance in dB units
IQ Quadrature Error	deg.	✓		Displays IQ Quadrature Error
Tx Total Power	dBm		✓	Displays total power of all carriers
Tx Power Flatness	dB		✓	Displays maximum power difference between carriers
Downlink				
xPDSCH EVM (rms/peak)	%, dB	✓		Displays EVM rms/peak values for QPSK/16QAM/64QAM
P-SS	%, dB, dBm	✓		Displays average EVM (rms) and maximum EVM (peak) as well as average power (dBm) for each PHY channel
S-SS		✓		
E-SS		✓		
BRS		✓		
xPBCH		✓		
xPDSCH		✓		
xPDCCH		✓		
UE-RS (xPDSCH)		✓		
UE-RS (xPDSCH)		✓		
Uplink				
xPUSCH EVM (rms/peak)	%, dB	✓		Displays EVM rms/peak value for QPSK/16QAM/64QAM
xPUSCH	%, dB, dBm	✓		Displays average EVM (rms) and maximum EVM (peak) as well as average power (dBm) for each PHY channel
DM-RS (xPUSCH)		✓		

Graph Displays

Name	Single Carrier Measurement	Multicarrier Measurement
Constellation	✓	
EVM vs. Subcarrier	✓	
EVM vs. Symbol	✓	
Spectral Flatness (Amplitude/Phase)	✓	
Power vs. RB	✓	✓
EVM vs. RB	✓	✓
Summary	✓	✓

5G Standard Measurement Software (Base License)	**MX285051A**
NR TDD sub-6GHz Downlink	**MX285051A-011**
NR TDD sub-6GHz Uplink	**MX285051A-061**
NR TDD mmWave Downlink	**MX285051A-021**
NR TDD mmWave Uplink	**MX285051A-071**

The 5G measurement and NR software options are installed in the MS2850A for developing and manufacturing 5G radio equipment. They support analyses of both uplink and downlink signals used by the sub-6GHz and mmWave bands in the 5G NR standards by specifying combinations of multiple component carriers (up to 400 MHz) and subcarrier spacing.

Single Carrier Measurement

This function analyzes a 400 MHz band carrier to display the constellation, frequency error, Tx power, modulation accuracy (EVM), etc.

Multicarrier Measurement

Combination with the Analysis Bandwidth Extension to 1 GHz MS2850A-034 option supports batch (all-at-once) analysis of up to eight carriers* to display the frequency error for each carrier, Tx power, EVM, timing difference, etc.

*: NR TDD mmWave Downlink MX285051A-021 available

Analysis Bandwidth	Batch Analysis Carrier Count (MX285051A-021)			
	50 MHz	100 MHz	200 MHz	400 MHz
255 MHz (standard)	5	2	1	—
512 MHz (option)	8	5	2	1
1 GHz (option)	8	8	4	2

Numeric Results

Name	Unit	Single Carrier Measurement	Multicarrier Measurement	Remarks
Common				
Frequency Error	Hz, ppm	✓	✓	Displays frequency error
Transmit Power	dBm	✓		Displays Tx power
Total EVM (rms/peak)	%, dB	✓	✓	Displays EVM rms/peak values
Origin Offset	dB	✓		Displays Origin Offset value
Time Offset (External Trigger)	ns	✓		Displays time offset between Frame header and trigger in ns units Displays Trigger Switch = On only when using external trigger
Timing Difference	ns		✓	Displays timing difference between reference carrier and each carrier
Symbol Clock Error	ppm	✓		Displays Symbol Clock Error
IQ Skew	ns	✓		Displays IQ Skew
IQ Imbalance	dB	✓		Displays IQ Imbalance in dB units
IQ Quad Error	deg.	✓		Displays IQ Quadrature Error
Tx Total Power	dBm		✓	Displays total power of all carriers
Tx Power Flatness	dB		✓	Displays maximum power difference between carriers
Downlink				
P-SS	%, dB, dBm	✓		Displays average EVM (rms) and maximum EVM (peak) as well as S-SS · average power (dBm) for each PHY channel
S-SS		✓		
PBCH		✓		
DM-RS (PBCH)		✓		
PDSCH		✓		
DM-RS (PDSCH)		✓		
PDCCH		✓		
DM-RS (PDCCH)		✓		
Cell ID	—	✓		
Uplink				
PUSCH	%, dB, dBm	✓		Displays average EVM (rms) and maximum EVM (peak) as well as S-SS · average power (dBm) for each PHY channel
DM-RS (PUSCH)		✓		

Graph Displays

Name	Single Carrier Measurement	Multicarrier Measurement
Constellation	✓	
EVM vs. Subcarrier	✓	
EVM vs. Symbol	✓	
Spectral Flatness (Amplitude/Phase)	✓	
Power vs. RB	✓	✓
EVM vs. RB	✓	✓
Summary	✓	✓

Standard		3GPP TS 38.211 (2018-06)			
Model/Name		NR TDD sub-6GHz (Range1)		NR TDD mmWave (Range2)	
		Downlink MX285051A-011	Uplink MX285051A-061	Downlink MX285051A-021	Uplink MX285051A-071
Frequency Range		800 MHz to 5 GHz		800 MHz to 32 GHz (MS2850A-047) 800 MHz to 44.5 GHz (MS2850A-046)	
Subcarrier Spacing (SCS)		15 kHz, 30 kHz		120 kHz	
Channel Bandwidth		5, 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 MHz		50, 100, 200, 400 MHz	
Modulation		CP-OFDM QPSK, 16QAM, 64QAM, 256QAM, Auto		CP-OFDM QPSK, 16QAM, 64QAM, 256QAM, Auto	
Measurement Channel		SS-Block, PDSCH, PDCCH, PT-RS for PDSCH	PUSCH, PT-RS for PUSCH	SS-Block, PDSCH, PDCCH	PUSCH
Component Carrier	Maximum Number of CCs	1	1	8	1
	Channel Bandwidth of each CC	to 100 MHz	to 100 MHz	50, 100 MHz	to 400 MHz

RB Number Table

The channel bandwidth is defined in accordance with SCS and RB.

		NR TDD sub-6GHz DL/UL Channel Bandwidth [MHz] (1CC)												
		5	10	15	30	20	25	40	50	60	70	80	90	100
SCS [kHz]	15	25	52	79	160	106	133	216	270	N.A	N.A	N.A	N.A	N.A
	30	—	24	38	78	51	65	106	133	162	189	217	245	273
	60	N.A	—	—	—	—	—	—	—	—	—	—	—	—

		NR TDD mmWave DL/UL Channel Bandwidth [MHz] (1CC)			
		50	100	200	400
SCS [kHz]	60	—	—	—	N.A
	120	32	66	132	264

Channel Bandwidth

The maximum channel bandwidth is determined by the Analysis Bandwidth option.

		Maximum Analysis Bandwidth
MS2850A	Standard	255 MHz
	MS2850A-033	510 MHz
	MS2850A-034	1 GHz

5G Standard Measurement Software (Base License) MX285051A
NR TDD sub-6GHz Downlink MX285051A-011
NR TDD sub-6GHz Uplink MX285051A-061

Specifications

<table>
<tr><td colspan="2">Signal Analyzer</td><td colspan="2">MS2850A</td></tr>
<tr><td colspan="2">Option</td><td>NR TDD sub-6GHz Downlink
MX285051A-011</td><td>NR TDD sub-6GHz Uplink
MX285051A-061</td></tr>
<tr><td rowspan="5">Electrical Characteristics</td><td>Target Signals</td><td>TS 38.211 Range1 (Sub-6GHz) compliant downlink signal</td><td>TS 38.211 Range1 (Sub 6-GHz) compliant uplink signal</td></tr>
<tr><td>Channel Bandwidth</td><td colspan="2"><table>
<tr><td>Subcarrier Spacing</td><td>Channel Bandwidth</td></tr>
<tr><td>15 kHz</td><td>5 MHz (RB: 25), 10 MHz (RB: 52), 15 MHz (RB: 79), 20 MHz (RB: 106),
25 MHz (RB: 133), 30 MHz (RB: 160), 40 MHz (RB: 216), 50 MHz (RB: 270)</td></tr>
<tr><td>30 kHz</td><td>10 MHz (RB: 24), 15 MHz (RB: 38), 20 MHz (RB: 51), 25 MHz (RB: 65),
30 MHz (RB: 78), 40 MHz (RB: 106), 50 MHz (RB: 133), 60 MHz (RB: 162),
70 MHz (RB: 189), 80 MHz (RB: 217), 90 MHz (RB: 245), 100 MHz (RB: 273)</td></tr>
</table></td></tr>
<tr><td>Capture Time</td><td colspan="2">1 Frame</td></tr>
<tr><td>Frequency Setting Range</td><td colspan="2">MS2850A-047: 100 MHz to 32 GHz
MS2850A-046: 100 MHz to 44.5 GHz</td></tr>
<tr><td>Measurement Frequency Range</td><td colspan="2">800 MHz to 5 GHz</td></tr>
<tr><td rowspan="3">Modulation/ Frequency Measurement</td><td>Measurement Level Range</td><td colspan="2">–10 to +30 dBm (Preamp Off, or Preamp not installed)
–30 to +10 dBm (Preamp On)</td></tr>
<tr><td>Carrier Frequency Measurement Accuracy</td><td>At 18° to 28°C, After calibration, EVM = 1% signal
1 Frame at downlink signal
Only 1 carrier of 100 MHz width at center frequency
± (Accuracy of reference frequency × carrier frequency + 10) Hz</td><td>At 18° to 28°C, After calibration, EVM = 1% signal
1 Frame at uplink signal
Only 1 carrier of 100 MHz width at center frequency
± (Accuracy of reference frequency × carrier frequency + 10) Hz</td></tr>
<tr><td>Residual Vector Error</td><td>At 18° to 28°C, After calibration
1 Frame at downlink signal
Only 1 carrier of 100 MHz width at center frequency
≤1.0%</td><td>At 18° to 28°C, After calibration
1 Frame at uplink signal
Only 1 carrier of 100 MHz width at center frequency
≤1.0%</td></tr>
<tr><td rowspan="2">Amplitude Measurement</td><td>Measurement Level Range</td><td colspan="2">–10 to +30 dBm (Preamp Off, or Preamp not installed)
–30 to +10 dBm (Preamp On)</td></tr>
<tr><td>Tx Power Measurement Accuracy (This is found from root sum of squares (RSS) of absolute amplitude accuracy and in-band frequency characteristics of main frame.)</td><td colspan="2">At 18° to 28°C, After calibration, Input attenuator ≥10 dB, Input signal within measurement level range and below value set at Input Level, Only 1 carrier at center frequency<table>
<tr><td>Frequency Range</td><td>Preamp Off, or without Preamp</td><td>Preamp On</td></tr>
<tr><td>800 MHz ≤ Frequency < 4 GHz</td><td>±0.68 dB (nom.)</td><td>±1.15 dB (nom.)</td></tr>
<tr><td>4 GHz ≤ Frequency < 4.2 GHz</td><td>±1.53 dB (nom.)</td><td>±2.01 dB (nom.)</td></tr>
<tr><td>4.2 GHz ≤ Frequency ≤ 5 GHz</td><td>±1.45 dB (nom.)</td><td>±1.94 dB (nom.)</td></tr>
</table></td></tr>
<tr><td colspan="2">Waveform Display</td><td colspan="2">Constellation, EVM vs. Subcarrier, EVM vs. Symbol, Spectral Flatness, Power vs. RB, EVM vs. RB</td></tr>
<tr><td rowspan="3">Digitize Function</td><td>Function Overview</td><td colspan="2">Supports output of captured waveform data to internal storage or external storage</td></tr>
<tr><td>Waveform Data</td><td colspan="2">Format: I, Q (32 bit floating point binary format)
Level: Assumes as $\sqrt{(I^2 + Q^2)} = 1$ for 0 dBm input
Level accuracy: Same as absolute amplitude accuracy and in-band frequency characteristics of the signal analyzer</td></tr>
<tr><td>Replay Function</td><td colspan="2">Analyzes traces of saved waveform data
Format: I, Q (32 bit floating point binary format)
Sampling Rate:<table>
<tr><td>Channel Bandwidth</td><td>Without MS2850A-033</td><td>With MS2850A-033</td></tr>
<tr><td>≤100 MHz</td><td>162.5 MHz</td><td>162.5 MHz</td></tr>
</table></td></tr>
</table>

5G Standard Measurement Software (Base License) MX285051A
NR TDD mmWave Downlink MX285051A-021
NR TDD mmWave Uplink MX285051A-071

Specifications

<table>
<tr><td colspan="2">Signal Analyzer</td><td colspan="2">MS2850A</td></tr>
<tr><td colspan="2">Option</td><td>NR TDD mmWave Downlink
MX285051A-021</td><td>NR TDD mmWave Uplink
MX285051A-071</td></tr>
<tr><td rowspan="4">Electrical Characteristics</td><td>Target Signals</td><td>TS 38.211 Range2 (mmWave) compliant downlink signal</td><td>TS 38.211 Range2 (mmWave) compliant uplink signal</td></tr>
<tr><td>Channel Bandwidth</td><td colspan="2"><table><tr><td>Subcarrier Spacing</td><td>Channel Bandwidth</td></tr><tr><td>120 kHz</td><td>50 MHz (RB: 32), 100 MHz (RB: 66), 200 MHz (RB: 132), 400 MHz (RB: 264)</td></tr></table></td></tr>
<tr><td>Capture Time</td><td colspan="2">1 Frame</td></tr>
<tr><td>Frequency Setting Range</td><td colspan="2">MS2850A-047: 100 MHz to 32 GHz
MS2850A-046: 100 MHz to 44.5 GHz</td></tr>
<tr><td rowspan="3">Modulation/ Frequency Measurement</td><td>Measurement Level Range</td><td colspan="2">–15 to +30 dBm (Preamp Off, or Preamp not installed)
–30 to +10 dBm (Preamp On)</td></tr>
<tr><td>Carrier Frequency Measurement Accuracy</td><td>At 18° to 28°C, After calibration, EVM = 2% signal
1 Frame at downlink signal
Only 1 carrier of 100 MHz width at center frequency setting of 28 GHz
± (Accuracy of reference frequency × carrier frequency + 10) Hz</td><td>At 18° to 28°C, After calibration, EVM = 2% signal
1 Frame at uplink signal
Only 1 carrier of 100 MHz width at center frequency setting of 28 GHz
± (Accuracy of reference frequency × carrier frequency + 10) Hz</td></tr>
<tr><td>Residual Vector Error</td><td>At 18° to 28°C, After calibration
1 Frame at downlink signal
Only 1 carrier of 100 MHz width at center frequency setting of 28 GHz
≤2.0%</td><td>At 18° to 28°C, After calibration
1 Frame at uplink signal
Only 1 carrier of 100 MHz width at center frequency setting of 28 GHz
≤2.0%</td></tr>
<tr><td rowspan="2">Amplitude Measurement</td><td>Measurement Level Range</td><td colspan="2">–15 to +30 dBm (Preamp Off, or Preamp not installed)
–30 to +10 dBm (Preamp On)</td></tr>
<tr><td>Tx Power Measurement Accuracy (This is found from root sum of squares (RSS) of absolute amplitude accuracy and in-band frequency characteristics of main frame.)</td><td colspan="2">At 18° to 28°C, After calibration, Input attenuator ≥10 dB
Input signal within measurement level range and below value set at Input Level
Only 1 carrier of 100 MHz width at center frequency<table><tr><td>Frequency Range</td><td>Preamp Off, or without Preamp</td><td>Preamp On</td></tr><tr><td>26.5 GHz < Frequency ≤ 40 GHz</td><td>±2.54 dB (nom.)</td><td>±3.74 dB (nom.)</td></tr></table></td></tr>
<tr><td colspan="2">Waveform Display</td><td colspan="2">Constellation, EVM vs. Subcarrier, EVM vs. Symbol, Spectral Flatness, Power vs. RB, EVM vs. RB</td></tr>
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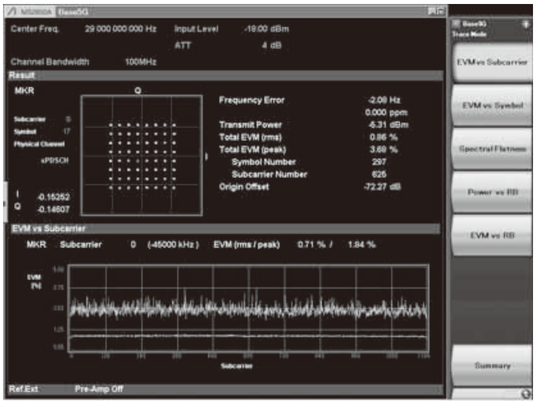
</table>

- **Single Carrier Measurement**

Constellation

The frequency error for all sub-carriers, Tx power, EVM, etc., are displayed together on a constellation graph. Since peak values can be displayed simultaneously with mean values, the randomness of characteristics can be evaluated by comparing both values. Characteristics can be confirmed easily using the many intuitive graph displays.



Center Freq. 29 000 000 000 Hz
Input Level -18.00 dBm
ATT 4 dB
Channel Bandwidth 100MHz

Result

Frequency Error -2.09 Hz
0.000 ppm
Transmit Power -6.31 dBm
Total EVM (rms) 0.86 %
Total EVM (peak) 3.69 %
Symbol Number 297
Subcarrier Number 625
Origin Offset -72.27 dB

Subcarrier 0
Symbol 17
Physical Channel xPDSCH
I -0.15252
Q -0.14607

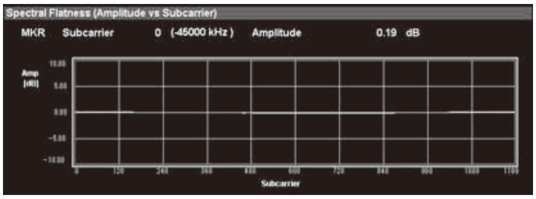
EVM vs Subcarrier

MKR Subcarrier 0 (-45000 kHz) EVM (rms / peak) 0.71 % / 1.84 %

Ref.Ext Pre-Amp Off

Spectral Flatness

Graphs of the amplitude and phase for each sub-carrier are displayed for all symbols in a specified measurement region.

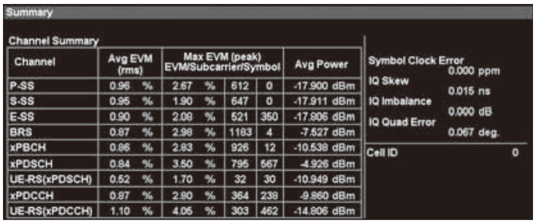


Spectral Flatness (Amplitude vs Subcarrier)

MKR Subcarrier 0 (-45000 kHz) Amplitude 0.19 dB

Summary

Various data, such as the EVM and power for each channel (SS, xPDSCH, xPUSCH, xPDCCH), are tabulated.



Summary

Channel Summary

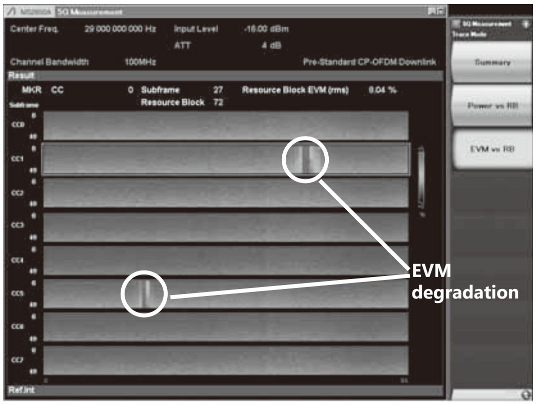
Channel	Avg EVM (rms)	Max EVM (peak) EVM/Subcarrier/Symbol			Avg Power
P-SS	0.96 %	2.67 %	612	0	-17.900 dBm
S-SS	0.95 %	1.90 %	647	0	-17.911 dBm
E-SS	0.90 %	2.08 %	521	350	-17.806 dBm
BRS	0.87 %	2.98 %	1183	4	-7.527 dBm
xPBCH	0.86 %	2.83 %	926	12	-10.538 dBm
xPDSCH	0.84 %	3.50 %	795	567	-4.926 dBm
UE-RS(xPDSCH)	0.52 %	1.70 %	32	30	-10.949 dBm
xPDCCH	0.87 %	2.80 %	364	238	-9.860 dBm
UE-RS(xPDCCH)	1.10 %	4.05 %	303	462	-14.806 dBm

Symbol Clock Error 0.000 ppm
IQ Skew 0.015 ns
IQ Imbalance 0.000 dB
IQ Quad Error 0.067 deg.
Cell ID 0

- **Multi Carrier Measurement**

EVM vs. RB
Power vs. RB

Up to eight carriers can be analyzed at once as a batch to display the EVM and power for each resource block in the sub-frame section as a gradation. Since the power boosting applied to each resource block and the location of the degraded EVM caused by in-band interference can be monitored and compared visually for each carrier, this function plays a key role at R&D troubleshooting.



Center Freq. 29 000 000 000 Hz
Input Level -16.00 dBm
ATT 4 dB
Channel Bandwidth 100MHz
Pre-Standard CP-OFDM Downlink

Result

MKR CC 0 Subframe 27 Resource Block EVM (rms) 8.04 %
Resource Block 72

Ref.Int

Summary

Various data, such as the frequency error, Tx power, EVM, etc., can be analyzed at once as a batch for each carrier, which is useful for measuring the timing difference with other carriers based on a specified carrier.

Result

Tx Total Power -11.16 dBm
Tx Power Flatness 0.56 dB

	Frequency Error	Transmit Power	EVM (rms)	EVM (peak)	Timing Difference
CC0 (Ref.)	23.24 Hz	-19.98 dBm	1.24 %	5.47 %	0.0 ns
CC1	24.13 Hz	-20.02 dBm	1.15 %	5.24 %	0.0 ns
CC2	25.02 Hz	-20.29 dBm	1.13 %	4.88 %	0.0 ns
CC3	25.92 Hz	-20.54 dBm	1.18 %	4.99 %	0.0 ns
CC4	26.95 Hz	-20.25 dBm	1.35 %	6.19 %	0.0 ns
CC5	27.82 Hz	-20.06 dBm	1.03 %	4.53 %	-1.5 ns
CC6	28.69 Hz	-20.14 dBm	1.00 %	4.30 %	0.0 ns
CC7	29.57 Hz	-20.25 dBm	1.01 %	4.80 %	0.0 ns

Signal Analyzer MS2850A Specifications

Refer to the MS2850A Data Sheet for detailed specifications.

- **Common Signal Analyzer and Spectrum Analyzer Specifications**

Frequency Range

9 kHz to 32 GHz (MS2850A-047)
9 kHz to 44.5 GHz (MS2850A-046)

Signal Analyzer Functions (at >31.25 MHz Analysis Bandwidth)
800 MHz to 32 GHz (MS2850A-047)
800 MHz to 44.5 GHz (MS2850A-046)

Frequency Setting Range

Spectrum Analyzer Function
–100 MHz to 32.5 GHz (MS2850A-047)
–100 MHz to 45 GHz (MS2850A-046)

Signal Analyzer Function
Analysis Bandwidth ≤31.25 MHz
0 MHz to 32 GHz (MS2850A-047)
0 MHz to 44.5 GHz (MS2850A-046)
31.25 < Analysis Bandwidth ≤ 510 MHz
100 MHz to 32 GHz (MS2850A-047)
100 MHz to 44.5 GHz (MS2850A-046)
Analysis Bandwidth = 1 GHz
4.2 GHz to 32 GHz (MS2850A-047)
4.2 GHz to 44.5 GHz (MS2850A-046)

RF Input Connector (Front Panel)

K-J, 50Ω (nom.)

Aging Rate

±1 × 10^{-7}/year

Max. Input Level

CW Average Power: +30 dBm
(Input Attenuator: ≥10 dB, Preamp: Off)

Attenuator

0 to 60 dB, 2 dB steps

Phase Noise

Spectrum Analyzer Function

Input Frequency	Frequency Offset	SSB Noise
1 GHz	10 Hz	–80 dBc/Hz (nom.)
	100 Hz	–92 dBc/Hz (nom.)
	1 kHz	–117 dBc/Hz (nom.)
	10 kHz	–123 dBc/Hz
	100 kHz	–123 dBc/Hz
	1 MHz	–135 dBc/Hz
	10 MHz	–148 dBc/Hz (nom.)

Total Level Accuracy

Preamp: None, Microwave Preselector Bypass: Off
±0.5 dB (300 kHz ≤ Frequency < 4 GHz)
±1.8 dB (4 GHz ≤ Frequency ≤ 13.8 GHz)
±3.0 dB (13.8 GHz < Frequency ≤ 40 GHz)
±3.5 dB (40 GHz < Frequency < 44.5 GHz, nom.)

Secondary Harmonic Distortion

Spectrum Analyzer Function
Signal Analyzer Function (Analysis Bandwidth: ≤31.25 MHz)
Preamp: None
Low Second Harmonic Distortion: Yes
Microwave Preselector Bypass: Off
Frequency Band Mode: Spurious

Input Frequency	Harmonic	SHI	Mixer Input Level
1 GHz	≤–65 dBc	≥+35 dBm	–30 dBm
4 GHz, 13 GHz	≤–90 dBc	≥+80 dBm	–10 dBm
20 GHz	≤–90 dBc (nom.)	≥+80 dBm (nom.)	–10 dBm

- **Spectrum Analyzer Function**

RBW (Resolution Bandwidth)

Setting Range:
1 Hz to 3 MHz (1-3 sequence), 500 Hz, 50 kHz, 2 MHz, 5 MHz, 10 MHz
(1 Hz to 10 Hz: Can not be set when Span 0 Hz)

VBW (Video Bandwidth)

Setting Range:
1 Hz to 3 kHz (1-3 sequence), 5 kHz,
10 kHz to 10 MHz (1-3 sequence), Off
VBW Mode: Video Average, Power Average

DANL (Display Average Noise Level)

Preamp: None
Low Second Harmonic Distortion: Yes
Microwave Preselector Bypass: On

Frequency	DANL
1 GHz	–150 dBm/Hz
4 GHz	–144 dBm/Hz
13 GHz	–146 dBm/Hz
20 GHz	–140 dBm/Hz
28 GHz	–140 dBm/Hz
39 GHz	–136 dBm/Hz
44 GHz	–130 dBm/Hz (nom.)

Two-Signal Tertiary Distortion

Preamp: None

Frequency	Two-Signal Tertiary Distortion
1 GHz	≤–62 dBc (TOI = +16 dBm)
4 GHz	≤–60 dBc (TOI = +15 dBm)
13 GHz, 20 GHz	≤–56 dBc (TOI = +13 dBm)
28 GHz, 39 GHz	≤–56 dBc (TOI = +13 dBm) (nom.)

• Signal Analyzer Function

Analysis Bandwidth

255 MHz (standard)
510 MHz (option)
1 GHz (option)

Display Functions (Trace Mode)

Spectrum, Power vs. Time, Frequency vs. Time, Phase vs. Time, CCDF, Spectrogram

ADC Resolution

Analysis Bandwidth ≤31.25 MHz: 16 bits
Analysis Bandwidth >31.25 MHz: 12 bits

SFDR (Spurious Free Dynamic Range)

Analysis Bandwidth >31.25 MHz

Frequency Range	SFDR
800 MHz ≤ Frequency < 4.2 GHz	–60 dBc (nom.)
4.2 GHz ≤ Frequency ≤ 44.5 GHz	–70 dBc (nom.)

RBW (Resolution Bandwidth)

Spectrum Display
Setting Range:
  Analysis Bandwidth ≤31.25 MHz: 1 Hz to 1 MHz (1-3 sequence)
  50 MHz ≤ Analysis Bandwidth ≤ 62.5 MHz:
    3 kHz to 3 MHz (1-3 sequence)
  Analysis Bandwidth ≥100 MHz: 10 kHz to 10 MHz (1-3 sequence)

DANL (Display Average Noise Level)

Analysis Bandwidth >31.25 MHz

Frequency	Preamp: None	Preamp: On
1 GHz	–141 dBm/Hz	–160 dBm/Hz
4 GHz	–138 dBm/Hz	–157 dBm/Hz
13 GHz	–140 dBm/Hz	–155 dBm/Hz
20 GHz	–135 dBm/Hz	–152 dBm/Hz
28 GHz	–135 dBm/Hz	–150 dBm/Hz
39 GHz	–132 dBm/Hz	–146 dBm/Hz
44 GHz	–125 dBm/Hz (nom.)	–138 dBm/Hz (nom.)

In-band Frequency Characteristics (Amplitude Flatness)

Analysis Bandwidth >31.25 MHz

Frequency	Frequency Offset	In-band Frequency Characteristic
13 GHz	CF ±500 MHz	±0.7 dB (nom.)
20 GHz		±1.0 dB (nom.)
28 GHz		±1.2 dB (nom.)
39 GHz, 44 GHz		±1.25 dB (nom.)

In-band Phase Linearity (Phase Flatness)

Analysis Bandwidth >31.25 MHz
Preamp: None
Offset Frequency ≤ Center Frequency ±500 MHz

Center Frequency	In-band Phase Linearity
13 GHz, 20 GHz, 28 GHz, 39 GHz	5°p-p (nom.)
44 GHz	6°p-p (nom.)

• General Specifications

Dimensions and Mass

426 (W) × 177 (H) × 390 (D) mm (excluding protrusions)
≤21 kg (with MS2850A-046 or 047 and other options installed)

Power

Power voltage: 100 V(ac) to 120 V(ac)/200 V(ac) to 240 V(ac)
Frequency: 50 Hz/60 Hz
Power Consumption:
  ≤500 VA (with all options installed)
  320 VA (nom.) (with MS2850A-047 or 046 and MS2850A-067/068/032/033/034 installed, but excluding other options)

EU Standards (CE Marking)

EMC: 2014/30/EU, EN61326-1, EN61000-3-2
LVD: 2014/35/EU, EN61010-1
RoHS: 2011/65/EU, EN50581

OS

Windows 7 (64 bit)

• 5G Measurement Software

Refer to the MX2690xxA Series, MX2830xxA Series, MX2850xxA Series Measurement Software brochure for the specification details.

Typical (typ.):
  Performance not warranted. Most products meet typical performance.
Nominal (nom.):
  Values not warranted. Included to facilitate application of product.
Measured (meas.):
  Performance not warranted. Data actually measured from randomly selected measuring instruments.

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main Frame
MS2850A	Signal Analyzer
	Standard accessories
	Power Cord: 1 pc
	USB Memory (≥1 GB): 1 pc
P0031A	USB Mouse: 1 pc
Z0541A	Install DVD-ROM (Application software, instruction manual DVD-ROM): 1 pc
	Options
MS2850A-047	32 GHz Signal Analyzer
MS2850A-046	44.5 GHz Signal Analyzer
MS2850A-033	Analysis Bandwidth Extension 510 MHz
MS2850A-034	Analysis Bandwidth Extension 1 GHz
MS2850A-010	Phase Noise Measurement Function
MS2850A-017	Noise Figure Measurement Function
MS2850A-068	Microwave Preamplifier
MS2850A-076	Low Second Harmonic Distortion
MS2850A-051	Noise Floor Reduction
MS2850A-011	Secondary Storage Device
MS2850A-053	External Interface for High Speed Data Transfer PCIe
MS2850A-054	External Interface for High Speed Data Transfer USB3.0
	Retrofit options
MS2850A-133	Analysis Bandwidth Extension 510 MHz Retrofit
MS2850A-134	Analysis Bandwidth Extension 1 GHz Retrofit
MS2850A-110	Phase Noise Measurement Function Retrofit
MS2850A-117	Noise Figure Measurement Function Retrofit
MS2850A-168	Microwave Preamplifier Retrofit
MS2850A-176	Low Second Harmonic Distortion Retrofit
MS2850A-151	Noise Floor Reduction Retrofit
MS2850A-111	Secondary Storage Device Retrofit
MS2850A-153	External Interface for High Speed Data Transfer PCIe Retrofit
MS2850A-154	External Interface for High Speed Data Transfer USB3.0 Retrofit
	Software options
	DVD-ROM with License and Operation manuals
MX285051A	5G Standard Measurement Software (Base License) (Requires MX285051A-001 and/or 051)
MX285051A-001	Pre-Standard CP-OFDM Downlink (Requires MX285051A)
MX285051A-051	Pre-Standard CP-OFDM Uplink (Requires MX285051A)
MX285051A-011	NR TDD sub-6GHz Downlink (Requires MX285051A)
MX285051A-061	NR TDD sub-6GHz Uplink (Requires MX285051A)
MX285051A-021	NR TDD mmWave Downlink (Requires MX285051A)
MX285051A-071	NR TDD mmWave Uplink (Requires MX285051A)
MX269011A	W-CDMA/HSPA Downlink Measurement Software
MX269012A	W-CDMA/HSPA Uplink Measurement Software
MX269013A	GSM/EDGE Measurement Software
MX269013A-001	EDGE Evolution Measurement Software (Requires MX269013A)
MX269015A	TD-SCDMA Measurement Software
MX269017A	Vector Modulation Analysis Software
MX269017A-001	APSK Analysis (Requires MX269017A)
MX269017A-011	Higher-Order QAM Analysis (Requires MX269017A)
MX269020A	LTE Downlink Measurement Software
MX269020A-001	LTE-Advanced FDD Downlink Measurement Software (Requires MX269020A)
MX269021A	LTE Uplink Measurement Software
MX269021A-001	LTE-Advanced FDD Uplink Measurement Software (Requires MX269021A)
MX269022A	LTE TDD Downlink Measurement Software
MX269022A-001	LTE-Advanced TDD Downlink Measurement Software (Requires MX269022A)
MX269023A	LTE TDD Uplink Measurement Software
MX269023A-001	LTE-Advanced TDD Uplink Measurement Software (Requires MX269023A)
	Warranty service
MS2850A-ES210	2 years Extended Warranty Service
MS2850A-ES310	3 years Extended Warranty Service
MS2850A-ES510	5 years Extended Warranty Service

Model/Order No.	Name
	Manuals Following operation manuals provided as hard copy and written in English.
W3920AE	MS2850A Operation Manual (Mainframe Operation)
W2851AE	MS2690A/MS2691A/MS2692A/MS2830A/MS2840A and MS2850A Operation Manual (Mainframe Remote Control)
W3335AE	MS2830A/MS2840A/MS2850A Operation Manual (Signal Analyzer Function Operation)
W2853AE	MS2690A/MS2691A/MS2692A/MS2830A/MS2840A and MS2850A Operation Manual (Signal Analyzer Function Remote Control)
W3336AE	MS2830A/MS2840A/MS2850A Operation Manual (Spectrum Analyzer Function Operation)
W2855AE	MS2690A/MS2691A/MS2692A/MS2830A/MS2840A and MS2850A Operation Manual (Spectrum Analyzer Function Remote Control)
W3117AE	MS2690A/MS2691A/MS2692A/MS2830A/MS2840A and MS2850A Operation Manual (Phase Noise Measurement Function Operation)
W3118AE	MS2690A/MS2691A/MS2692A/MS2830A/MS2840A and MS2850A Operation Manual (Phase Noise Measurement Function Remote Control)
W3655AE	MS2690A/MS2691A/MS2692A/MS2830A/MS2840A and MS2850A Operation Manual (Noise Figure Measurement Function Operation)
W3656AE	MS2690A/MS2691A/MS2692A/MS2830A/MS2840A and MS2850A Operation Manual (Noise Figure Measurement Function Remote control)
W3450AE	MS2850A-053/MS2850A-054 Operation Manual (External Interface for High Speed Data Transfer)
W3922AE	MX285051A Operation Manual (Operation)
W3924AE	MX285051A-011/MX269051A-011/MX285051A-021/ MX285051A-061/MX269051A-061/MX285051A-071 Operation Manual (Operation)
W3925AE	MX285051A-011/MX269051A-011/MX285051A-021/ MX285051A-061/MX269051A-061/MX285051A-071 Operation Manual (Remote Control)
W3098AE	MX269011A Operation Manual (Operation)
W3099AE	MX269011A Operation Manual (Remote Control)
W3060AE	MX269012A Operation Manual (Operation)
W3061AE	MX269012A Operation Manual (Remote Control)
W3100AE	MX269013A Operation Manual (Operation)
W3101AE	MX269013A Operation Manual (Remote Control)
W3044AE	MX269015A Operation Manual (Operation)
W3045AE	MX269015A Operation Manual (Remote Control)
W3305AE	MX269017A Operation Manual (Operation)
W3306AE	MX269017A Operation Manual (Remote Control)
W3014AE	MX269020A Operation Manual (Operation)
W3064AE	MX269020A Operation Manual (Remote Control)
W3015AE	MX269021A Operation Manual (Operation)
W3065AE	MX269021A Operation Manual (Remote Control)
W3209AE	MX269022A Operation Manual (Operation)
W3210AE	MX269022A Operation Manual (Remote Control)
W3521AE	MX269023A Operation Manual (Operation)
W3522AE	MX269023A Operation Manual (Remote Control)

The following options are installed as standard and do not require separate orders when ordering the MS2850A-046/047.

Standard Software	MX269000A
Analysis Bandwidth 255 MHz	MS2850A-032
Microwave Preselector Bypass	MS2850A-067

Requires Installation Kit Z1957A when retrofitting options or installing software.

The instruction manuals are published on our website except some.

Model/Order No.	Name
	High Performance Waveguide Mixer
MA2806A	High Performance Waveguide Mixer (50 to 75 GHz)
MA2808A	High Performance Waveguide Mixer (60 to 90 GHz)
	Standard accessories
Z1922A	MA2806A USB Memory (Saved conversion loss data, for MA2806A): 1 pc
Z1923A	MA2808A USB Memory (Saved conversion loss data, for MA2808A): 1 pc
Z1625A	AC Adapter: 1 pc Power Cord: 1 pc
J1692B	Coaxial Cord, 1 m (SMA-P · SUCOFLEX104PE · SMA-P, DC to 18 GHz, 50Ω): 1 pc
	External Mixer (Harmonic Mixer)
MA2741C	External Mixer (26.5 GHz to 40 GHz)
MA2742C	External Mixer (33 GHz to 50 GHz)
MA2743C	External Mixer (40 GHz to 60 GHz)
MA2744C	External Mixer (50 GHz to 75 GHz)
MA2745C	External Mixer (60 GHz to 90 GHz)
MA2746C	External Mixer (75 GHz to 110 GHz)
MA2747C	External Mixer (90 GHz to 140 GHz)
MA2748C	External Mixer (110 GHz to 170 GHz)
MA2749C	External Mixer (140 GHz to 220 GHz)
MA2750C	External Mixer (170 GHz to 260 GHz)
MA2751C	External Mixer (220 GHz to 325 GHz)

Model/Order No.	Name
	Application Parts
34AKNF50	Ruggedized K-to-Type N Adapter (DC to 20 GHz, 50Ω, Ruggedized K-M · N-F, SWR: 1.5 (max.), Insertion Loss: 0.4 dB (max.))
K240B	Power Divider (K connector, DC to 26.5 GHz, 50Ω, K-J, 1 W max.)
MA1612A	Four-port Junction Pad (5 MHz to 3 GHz, N-J)
J1359A	Coaxial Adaptor (K-P · K-J, SMA)
J0576B	Coaxial Cord, 1 m (N-P · 5D-2W · N-P)
J0576D	Coaxial Cord, 2 m (N-P · 5D-2W · N-P)
J0127A	Coaxial Cord, 1 m (BNC-P · RG58A/U · BNC-P)
J0127B	Coaxial Cord, 2 m (BNC-P · RG58A/U · BNC-P)
J0127C	Coaxial Cord, 0.5 m (BNC-P · RG58A/U · BNC-P)
J0322A	Coaxial Cord, 0.5 m (DC to 18 GHz), (SMA-P · 50Ω SUCOFLEX104 · SMA-P)
J0322B	Coaxial Cord, 1 m (DC to 18 GHz), (SMA-P · 50Ω SUCOFLEX104 · SMA-P)
J0322C	Coaxial Cord, 1.5 m (DC to 18 GHz), (SMA-P · 50Ω SUCOFLEX104 · SMA-P)
J0322D	Coaxial Cord, 2 m (DC to 18 GHz), (SMA-P · 50Ω SUCOFLEX104 · SMA-P)
J0805	DC Block, N type (MODEL 7003) (10 kHz to 18 GHz, N-P · N-J)
J1554A	DC Block, SMA type (MODEL 7006) (9 kHz to 26.5 GHz, SMA-P · SMA-J)
J1555A	DC Block, SMA type (MODEL 7006-1) (9 kHz to 20 GHz, SMA-P · SMA-J)
K261	DC Block (10 kHz to 40 GHz, K-P · K-J)
J0004	Coaxial Adapter (DC to 12.4 GHz, 50Ω, N-P · SMA-J)
J1398A	N-SMA Adaptor (DC to 26.5 GHz, 50Ω, N-P · SMA-J)
J0911	Coaxial Cable, 1.0 m for 40 GHz (DC to 40 GHz, approx. 1 m, SF102A, 11K254/K254/1.0M)
J0912	Coaxial Cable, 0.5 m for 40 GHz (DC to 40 GHz, approx. 0.5 m, SF102A, 11K254/K254/0.5M)
41KC-3	Fixed Attenuator (DC to 40 GHz, 3 dB)
J1261A	Ethernet Cable (Shield type, Straight, 1 m)
J1261B	Ethernet Cable (Shield type, Straight, 3 m)
J1261C	Ethernet Cable (Shield type, Cross, 1 m)
J1261D	Ethernet Cable (Shield type, Cross, 3 m)
J0008	GPIB Cable, 2.0 m
B0635A	Rack Mount Kit (EIA)
B0657A	Rack Mount Kit (JIS)
B0636C*	Carrying Case (Hard type, with casters)
B0671A*	Front Cover for 1MW4U
MA24105A	Inline Peak Power Sensor (350 MHz to 4 GHz, with USB A to mini B cable)
MA24106A	USB Power Sensor (50 MHz to 6 GHz, with USB A to mini B cable)
MA24108A	Microwave USB Power Sensor (10 MHz to 8 GHz, with USB A to Micro-B cable)
MA24118A	Microwave USB Power Sensor (10 MHz to 18 GHz, with USB A to Micro-B cable)
MA24126A	Microwave USB Power Sensor (10 MHz to 26 GHz, with USB A to Micro-B cable)
Z0975A	Keyboard (USB)
Z1957A	Installation Kit (required when retrofitting options or installing software)
	External Interface for High Speed Data Transfer
U0088A	PCIe Host Adapter
J1749A	PCIe x8 Cable (2 m)
J1749B	PCIe x8 Cable (5 m)

*: The Carrying Case B0636C includes the Front Panel Protective Cover (B0671A)

Signal Analyzer

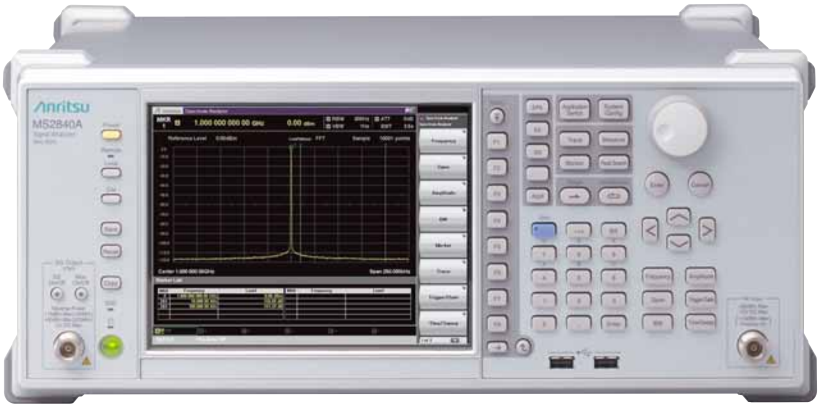
MS2840A

9 kHz to 3.6 GHz/6.0 GHz

Remote Control
GPIB | Ethernet | USB

Top-Class Close-in Phase Noise Performance at Middle-Price-Range Analyzer Cost

Excellent Eco Product



Better Than Expected Close-in Phase Noise Performance

Since 2000 most spectrum analyzers have been designed for mobile communications and the phase noise performance has been optimized for offset frequencies of several MHz. Consequently, customers requiring good close-in phase noise performance have been limited to a narrow choice of usable spectrum analyzers, causing problems. This new MS2840A series (3.6 GHz and 6 GHz models) has been designed with emphasis on offering a spectrum analyzer with excellent close-in phase noise performance at offset frequencies of just several kHz. This performance surpasses that of first-generation high-end spectrum analyzers and has sufficient margin for evaluating the close-in spurious of narrowband communications equipment in the short-wave, VHF, and UHF bands. Moreover, installing Low Phase Noise Performance MS2840A-066 option supports excellent phase noise performance surpassing that of current high-end instruments.

The high cost-performance of the MS2840A series (3.6 GHz and 6 GHz models) supporting not only development and production but also fundamental research for wireless and transmission equipment belies its mid-range price.

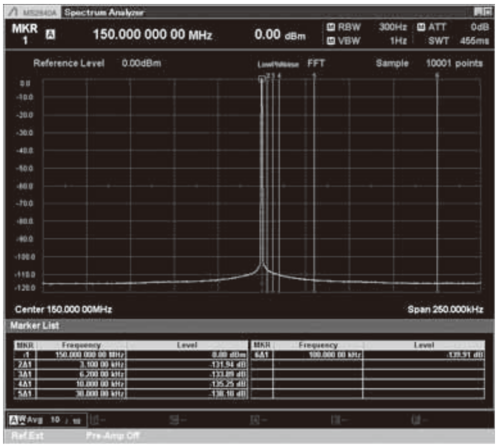
Close-in Phase Noise Performance (Spectrum Analyzer Function)

Carrier Offset	SSB Phase Noise		
	Standard	Low Phase Noise Performance MS2840A-066 Installed	
	Center Frequency: 1 GHz	Center Frequency: 1 GHz	Center Frequency: 500 MHz
10 Hz	–80 dBc/Hz (nom.)	—	—
100 Hz	–92 dBc/Hz (nom.)	–92 dBc/Hz (meas.*)	–98 dBc/Hz (nom.)
1 kHz	–117 dBc/Hz (nom.)	–125 dBc/Hz (meas.*)	–122 dBc/Hz
10 kHz	–123 dBc/Hz	–138 dBc/Hz (meas.*)	–133 dBc/Hz
100 kHz	–123 dBc/Hz	–142 dBc/Hz (meas.*)	–133 dBc/Hz
1 MHz	–135 dBc/Hz	–146 dBc/Hz (meas.*)	–148 dBc/Hz (nom.)
10 MHz	–148 dBc/Hz (nom.)	—	—

*: Value measured at design but not guaranteed specification, and value measured by Phase Noise Measurement function.

The Low Phase Noise Performance MS2840A-066 option greatly increases SSB phase noise performance for RF input signals of more than 130 MHz and less than 3.7 GHz at frequency offsets of 1 kHz to 1 MHz from the main carrier wave. Setting the span to a range of either 300 Hz to 1 MHz (spectrum analyzer function) or 1 kHz to 31.25 MHz (signal analyzer function) enables the function on Spectrum display.

Measurement Examples



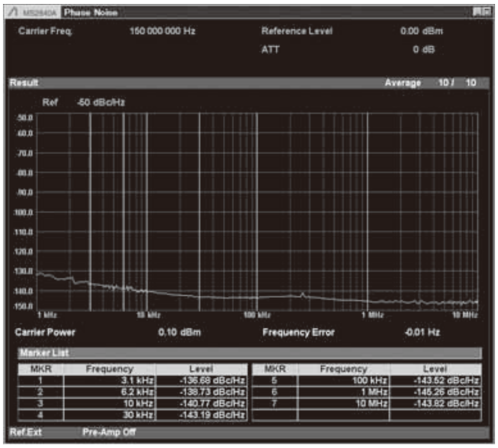
MKR 1 150.000 000 00 MHz 0.00 dBm
RBW 300Hz ATT 0dB
VBW 1Hz SWT 455ms
Reference Level 0.00dBm
FFT
Sample 10001 points
Center 150.000 00MHz
Span 250.000kHz

Marker List

MKR	Frequency	Level	MKR	Frequency	Level
1	150.000 000 00 MHz	0.00 dBm	6Δ1	100.000 00 kHz	-139.91 dB
2Δ1	3.100 00 kHz	-131.94 dB			
3Δ1	6.200 00 kHz	-133.89 dB			
4Δ1	10.000 00 kHz	-135.25 dB			
5Δ1	30.000 00 kHz	-138.10 dB			

Ref.Ext Pre-Amp Off

Spectrum Display
Low Phase Noise Performance MS2840A-066 On
150 MHz Measurement Frequency, Preamp Off



Carrier Freq. 150 000 000 Hz
Reference Level 0.00 dBm
ATT 0 dB
Result
Average 10 / 10
Ref -50 dBc/Hz
Carrier Power 0.10 dBm
Frequency Error -0.01 Hz

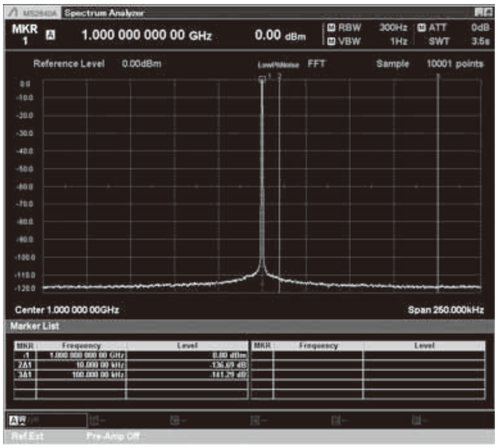
Marker List

MKR	Frequency	Level	MKR	Frequency	Level
1	3.1 kHz	-136.68 dBc/Hz	5	100 kHz	-143.52 dBc/Hz
2	6.2 kHz	-138.73 dBc/Hz	6	1 MHz	-146.26 dBc/Hz
3	10 kHz	-140.77 dBc/Hz	7	10 MHz	-143.82 dBc/Hz
4	30 kHz	-143.19 dBc/Hz			

Ref.Ext Pre-Amp Off

Phase Noise Measurement
Low Phase Noise Performance MS2840A-066 On
150 MHz Measurement Frequency, Preamp Off

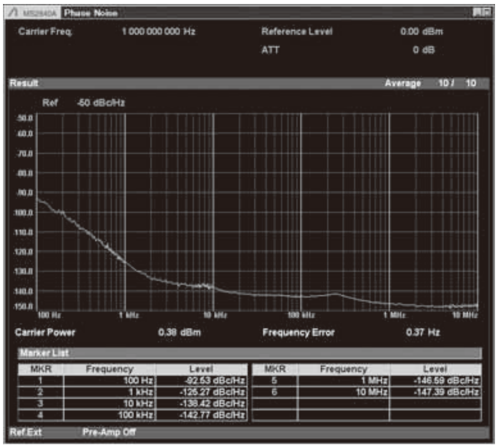
Measurement Examples



MKR 1 A 1.000 000 000 00 GHz 0.00 dBm
RBW 300Hz ATT 0dB
VBW 1Hz SWT 3.5s
Reference Level 0.00dBm
Low%Noise FFT
Sample 10001 points
Center 1.000 000 00GHz
Span 250.000kHz

MKR	Frequency	Level	MKR	Frequency	Level
1	1.000 000 000 00 GHz	0.00 dBm			
2Δ1	10.000 00 kHz	-136.69 dB			
3Δ1	100.000 00 kHz	-141.29 dB			

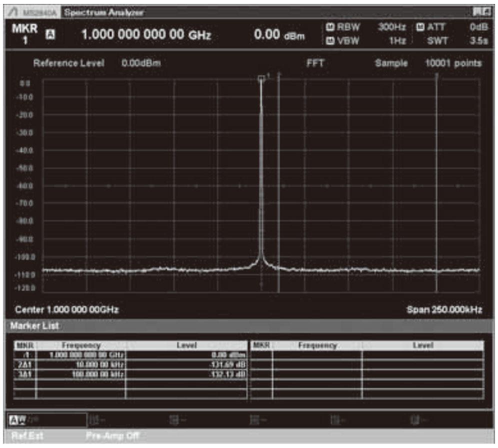
Spectrum Display
Low Phase Noise Performance MS2840A-066 On
1 GHz Measurement Frequency, Preamp Off



Carrier Freq. 1 000 000 000 Hz
Reference Level 0.00 dBm
ATT 0 dB
Result
Average 10 / 10
Ref -50 dBc/Hz
Carrier Power 0.38 dBm
Frequency Error 0.37 Hz

MKR	Frequency	Level	MKR	Frequency	Level
1	100 Hz	-92.63 dBc/Hz	5	1 MHz	-146.59 dBc/Hz
2	1 kHz	-126.27 dBc/Hz	6	10 MHz	-147.39 dBc/Hz
3	10 kHz	-138.42 dBc/Hz			
4	100 kHz	-142.77 dBc/Hz			

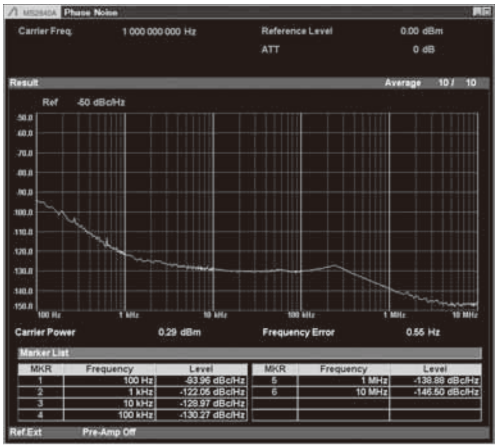
Phase Noise Measurement
Low Phase Noise Performance MS2840A-066 On
1 GHz Measurement Frequency, Preamp Off



MKR 1 A 1.000 000 000 00 GHz 0.00 dBm
RBW 300Hz ATT 0dB
VBW 1Hz SWT 3.5s
Reference Level 0.00dBm
FFT
Sample 10001 points
Center 1.000 000 00GHz
Span 250.000kHz

MKR	Frequency	Level	MKR	Frequency	Level
1	1.000 000 000 00 GHz	0.00 dBm			
2Δ1	10.000 00 kHz	-131.69 dB			
3Δ1	100.000 00 kHz	-132.13 dB			

Spectrum Display
Low Phase Noise Performance MS2840A-066 Off
1 GHz Measurement Frequency, Preamp Off



Carrier Freq. 1 000 000 000 Hz
Reference Level 0.00 dBm
ATT 0 dB
Result
Average 10 / 10
Ref -50 dBc/Hz
Carrier Power 0.29 dBm
Frequency Error 0.55 Hz

MKR	Frequency	Level	MKR	Frequency	Level
1	100 Hz	-83.96 dBc/Hz	5	1 MHz	-138.88 dBc/Hz
2	1 kHz	-122.05 dBc/Hz	6	10 MHz	-146.50 dBc/Hz
3	10 kHz	-128.97 dBc/Hz			
4	100 kHz	-130.27 dBc/Hz			

Phase Noise Measurement
Low Phase Noise Performance MS2840A-066 Off
1 GHz Measurement Frequency, Preamp Off

High-Sensitivity Measurements

The MS2840A has excellent display average noise level (DANL) specifications. In particular, when the built-in preamplifier is on, it has a high sensitivity measurement performance of better than –160 dBm/Hz in the frequency range from 30 MHz to 6 GHz.

Displayed Average Noise Level (DANL)

Spectrum Analyzer Function
Preamp: None, Low Phase Noise Performance: None

Frequency	DANL
30 MHz	–153 dBm/Hz
400 MHz	–153 dBm/Hz
1 GHz	–151 dBm/Hz
3 GHz	–149 dBm/Hz
6 GHz	–146 dBm/Hz

Preamp: On, Low Phase Noise Performance : None

Frequency	DANL
30 MHz	–166 dBm/Hz
400 MHz	–166 dBm/Hz
1 GHz	–165 dBm/Hz
3 GHz	–164 dBm/Hz
6 GHz	–161 dBm/Hz

Dynamic Range

Preamp: None

Frequency	Dynamic Range	DANL/TOI
30 MHz	165 dB	Displayed Average Noise Level (DANL): –153 dBm/Hz Third Order Intercept (TOI): +12 dBm
1 GHz	167 dB	Displayed Average Noise Level (DANL): –151 dBm/Hz Third Order Intercept (TOI): +16 dBm
6 GHz	161 dB	Displayed Average Noise Level (DANL): –146 dBm/Hz Third Order Intercept (TOI): +15 dBm (nom.)

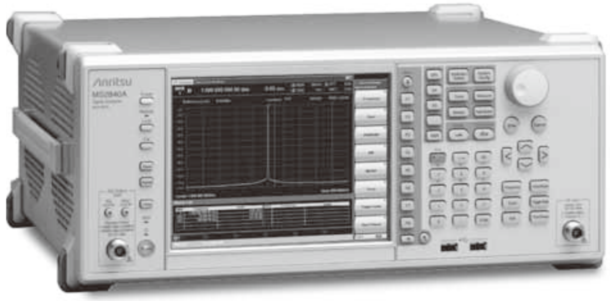
The dynamic range is assumed to be the simple difference between the TOI and DANL.

Noise Floor Reduction (MS2840A-051)

The Noise Floor Reduction (NFR) function increases the measurement accuracy for low-level signals. It subtracts the internal noise components (11 dB max. nominal) of the measuring instrument itself from the displayed measurement result.

Faster Measurement Speeds

With a built-in high-performance Intel Core i5-4400E, 2.7 GHz CPU and 8 GB of main memory supporting the 64-bit Windows 7 OS, the MS2840A is much faster than its predecessor MS2830A, offering greatly improved averaging processing times for screen displays and much faster processing when displaying the results of signal analyzer and software analysis functions.



Signal Analyzer MS2840A

The Signal Analyzer MS2840A is available as two series with two models in each series: 3.6 GHz and 6 GHz, and 26.5 GHz and 44.5 GHz; different options can be installed in each series. In addition to supporting installation of options offering various measurement functions needed both for evaluating the Tx characteristics of wireless and transmission equipment and for greatly improving phase noise performance, the 3.6 GHz/6 GHz models described in this brochure also provide all-in-one support for Rx measurements when the signal generator option is installed.

Standard Functions

- Spectrum Analyzer
- Signal Analyzer (31.25 MHz Analysis Bandwidth)
- Power Meter (Connected to USB Power Sensor)

Options

- Improved Phase Noise Performance
- Signal Analyzer (extended analysis bandwidth: 62.5 MHz, 125 MHz)
- Built-in Preamplifier
- Phase Noise Measurement
- Pre-compliance EMI Function
- Noise Figure (NF) Measurement
- BER Measurement
- Modulation Analysis
- Vector Signal Generator
- Analog Signal Generator

Optional Parts

- USB Power Sensor

Tx Measurement

Typical Measurement Items for Evaluating Tx Characteristics (3.6 GHz and 6 GHz models)

✓: Supported

Supported Standard Functions/Options Typical Measurement	Standard Functions			Options/Optional Parts
	Spectrum Analyzer	Signal Analyzer	Others	
Spectrum Trace	✓	✓		
Channel Power	✓	✓		
Occupied Bandwidth	✓	✓		
Adjacent Channel Leakage Power	✓	✓		
Spectrum Emission Mask	✓			
Burst Average Power	✓	✓		
Spurious Emission	✓			
AM Depth		✓		✓ Analog Measurement Software MX269018A
FM Deviation		✓		✓ Analog Measurement Software MX269018A
Multi-marker & Marker List	✓	✓		
Highest 10 Markers	✓	✓		
Limit Line	✓			
Frequency Counter	✓			
TOI	✓			
Hide Settings and Numeric Results	✓			
Power Meter Function (connected to USB Power Sensor)			✓	
Phase Noise Measurement				✓ Phase Noise Measurement Function MS2840A-010
EMI Measurement				✓ Precompliance EMI Function MS2840A-016
Vector Modulation Analysis (EVM, etc.)				✓ Vector Modulation Analysis Software MX269017A
Analog Modulation Analysis (AM/FM/ΦM) (FM Deviation, Demodulation Frequency, etc.)				✓ Analog Measurement Software MX269018A
Improved Phase Noise Performance				✓ Low Phase Noise Performance MS2840A-066

Rx Measurement

Typical Measurement Items for Evaluating Rx Characteristics (3.6 GHz and 6 GHz models)

✓: Supported

Supported Standard Functions/Options Typical Measurement	Standard Functions			Options/Optional Parts
	Spectrum Analyzer	Signal Analyzer	Others	
Vector Signal Generator				✓ Vector Signal Generator MS2840A-020/021, etc.
Analog Signal Generator				✓ Analog Signal Generator MS2840A-088, etc.
BER Measurement				✓ BER Measurement Function MS2840A-026

Others

Other Measurement Items (3.6 GHz and 6 GHz models)

✓: Supported

Supported Standard Functions/Options Typical Measurement	Standard Functions			Options/Optional Parts
	Spectrum Analyzer	Signal Analyzer	Others	
Noise Figure Measurement				✓ Noise Figure Measurement Function MS2840A-017

Tx Measurement

Versatile Standard Functions

The built-in spectrum and signal analyzer functions can be used to evaluate the Tx characteristics of wireless devices and transmitters by running easy tests, etc., in accordance with specifications.

Measure Function	Spectrum Analyzer (Standard)	Signal Analyzer (Standard)
Spectrum Trace	✓	✓
Channel Power	✓	✓
Occupied Bandwidth	✓	✓
Adjacent Channel Leakage Power	✓	✓
Spectrum Emission Mask	✓	
Burst Average Power	✓	✓
Spurious Emission	✓	
AM Depth		✓
FM Deviation		✓
Multi-marker & Marker List	✓	✓
Highest 10 Markers	✓	✓
Limit Line	✓	
Frequency Counter	✓	
TOI	✓	
Hide Settings and Numeric Results	✓	

Power Meter Function (USB Power Sensor Connection)

Connecting the optional USB Power Sensor to the MS2840A supports Power and Relative Power measurements.

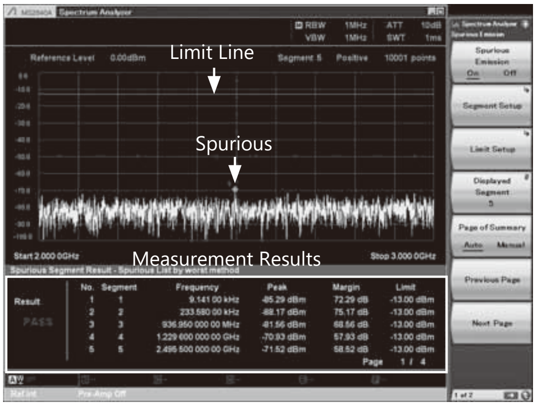
Compatible USB power sensors.

Model	Frequency Range	Dynamic Range
MA24104A*	600 MHz to 4 GHz	+3 to +51.76 dBm
MA24105A	350 MHz to 4 GHz	+3 to +51.76 dBm
MA24106A	50 MHz to 6 GHz	–40 to +23 dBm
MA24108A	10 MHz to 8 GHz	–40 to +20 dBm
MA24118A	10 MHz to 18 GHz	–40 to +20 dBm
MA24126A	10 MHz to 26 GHz	–40 to +20 dBm

*: MA24104A has been discontinued.

Spurious Emission

This function splits the frequency range into up to 20 segments for sweeping; the measurement parameters and limit lines can be specified to measure the peak power and margin for each segment.
The results are tabulated below the trace and marked PASS/FAIL.



Start 2.000 0GHz Stop 3.000 0GHz

Spurious Segment Result - Spurious List by worst method

Result PASS

No.	Segment	Frequency	Peak	Margin	Limit
1	1	9.141 00 kHz	-85.29 dBm	72.29 dB	-13.00 dBm
2	2	233.580 00 kHz	-88.17 dBm	75.17 dB	-13.00 dBm
3	3	936.950 000 00 MHz	-81.56 dBm	68.56 dB	-13.00 dBm
4	4	1.229 600 000 00 GHz	-70.93 dBm	57.93 dB	-13.00 dBm
5	5	2.495 500 000 00 GHz	-71.52 dBm	58.52 dB	-13.00 dBm

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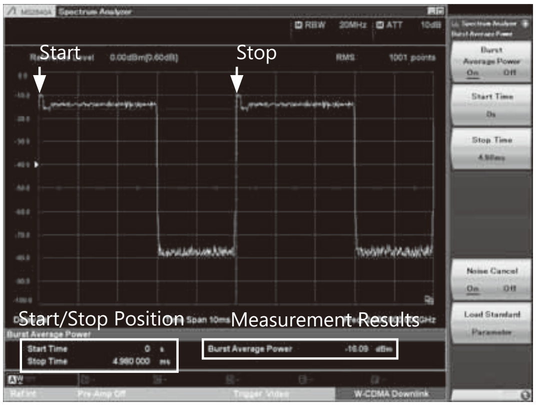
Burst Average Power

The average power for the range specified by two markers is displayed in the time domain. Measurement only requires setting the measurement start and stop positions on the screen. True performance is measured using the noise cancellation function to subtract main-frame noise from the measurement result.
Pre-installed templates for each standard support easy parameter setting.



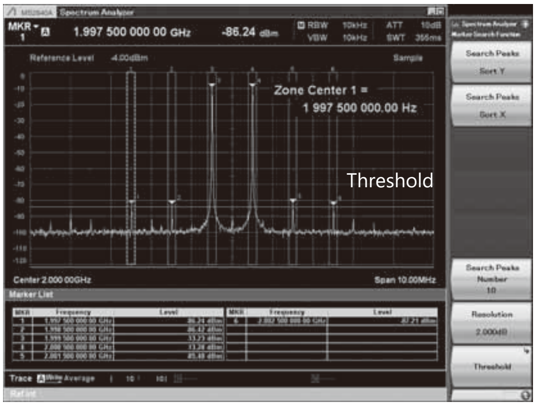
Burst Average Power

Start Time 0 s
Stop Time 4.980 000 ms

Burst Average Power -16.09 dBm

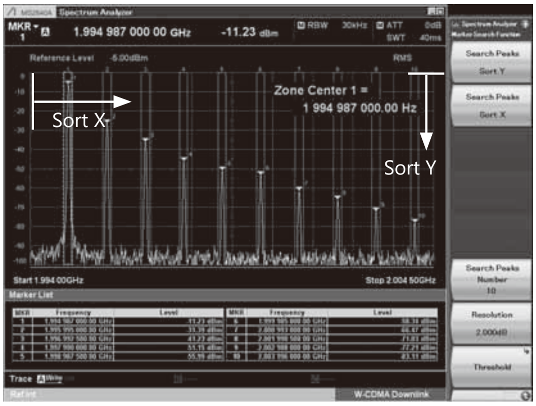
Multi-marker & Marker List

Up to 10 markers can be set for this function. Markers may be either a spot or a zone. Using a zone marker, the peak of a signal with an unstable variable frequency can be tracked and measured.
Not only can the 10 markers be listed below the trace but the differences between markers can be calculated and displayed using the delta setting.



Highest 10 Markers

This function sets the threshold level and auto-detects peaks in the X (frequency) and Y (level/time) directions.

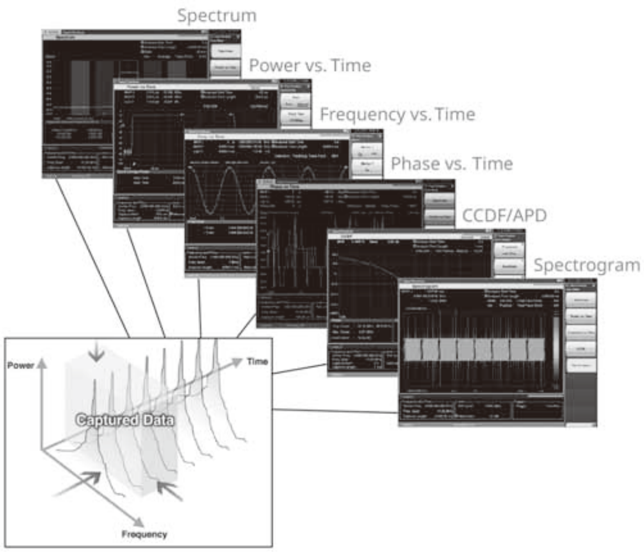


Signal Analyzer (Standard)

The MS2840A has a built-in 31.25 MHz bandwidth Fast Fourier Transformation (FFT) analysis function supporting multi-domain analysis of captured measured signals. Since it can capture phenomena such as spectrum transients that cannot be captured by conventional sweep-type spectrum analyzers, it improves the efficiency of troubleshooting. The analysis bandwidth can be expanded to either 62.5 MHz or 125 MHz as options.

Measurement Functions

- Spectrum trace
- Frequency vs. Time
- CCDF/APD
- Power vs. Time
- Phase vs. Time
- Spectrogram



Analysis Bandwidth:

31.25 MHz (Standard)
50 MHz max. sampling rate = 20 ns resolution, ADC resolution 16 bits)
62.5 MHz (MS2840A-077)
(100 MHz max. sampling rate = 10 ns resolution, ADC resolution 14 bits)
125 MHz (MS2840A-077/078)
(200 MHz max. sampling rate = 5 ns resolution, ADC resolution 14 bits)

Max. Capture Time: 0.5 s to 2000 s

Max. Number of Samples: 100 Msamples

Note: An image response is received when setting the bandwidth to more than 31.25 MHz. This can be used when not inputting a signal frequency outside the MS2840A analysis bandwidth (125 MHz max.). The Signal Analyzer series MS2690A/91A/92A is recommended for other measurement purposes.

Option

Analysis Bandwidth Extension to 62.5 MHz (MS2840A-077)

Extends analysis bandwidth to 62.5 MHz.

Analysis Bandwidth Extension to 125 MHz (MS2840A-078*)

Extends analysis bandwidth to 125 MHz.

*: Requires MS2840A-077.

Capture & Replay Function

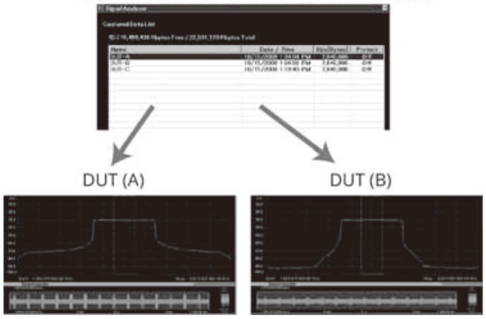
Waveform data can be saved (captured) to the internal memory.
In addition, previously saved waveform data can be loaded (replayed) to reproduce result displays whenever necessary using measurement functions.
The following chart shows the maximum capture time per frequency span.

Span	Sampling Rate	Capture Time	Max. Sampling Data
1 kHz	2 kHz	2000 s	4M
2.5 kHz	5 kHz	2000 s	10M
5 kHz	10 kHz	2000 s	20M
10 kHz	20 kHz	2000 s	40M
25 kHz	50 kHz	2000 s	100M
50 kHz	100 kHz	1000 s	100M
100 kHz	200 kHz	500 s	100M
250 kHz	500 kHz	200 s	100M
500 kHz	1 MHz	100 s	100M
1 MHz	2 MHz	50 s	100M
2.5 MHz	5 MHz	20 s	100M
5 MHz	10 MHz	10 s	100M
10 MHz	20 MHz	5 s	100M
25 MHz	50 MHz	2 s	100M
31.25 MHz	50 MHz	2 s	100M
50 MHz	100 MHz	500 ms	50M
62.5 MHz	100 MHz	500 ms	50M
100 MHz	200 MHz	500 ms	100M
125 MHz	200 MHz	500 ms	100M

Replay Usage Examples

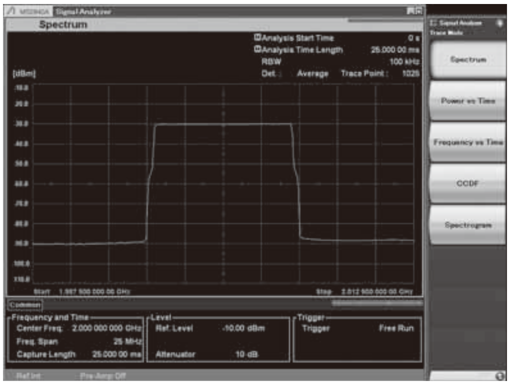
- Sharing data between development and manufacturing sections at separate locations
- Transferring signals captured onsite for later in-house analysis
- Saving product shipping data for later warranty-claim confirmation

Captured Waveform Data: Selection Screen



Spectrum trace

The CCDF trace displays the power variation probability on the y-axis and power variation on the y-axis to confirm the CCDF and APD of measured signals.



Analysis Start Time 0 s
Analysis Time Length 25.000 00 ms
RBW 100 kHz
Det. : Average Trace Point : 1025

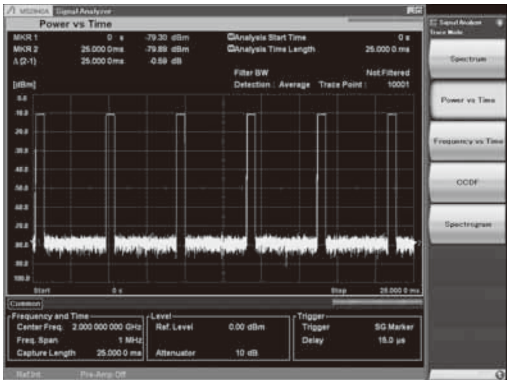
Frequency and Time
Center Freq. 2.000 000 000 GHz
Freq. Span 25 MHz
Capture Length 25.000 00 ms

Level
Ref. Level -10.00 dBm
Attenuator 10 dB

Trigger
Trigger Free Run

Power vs. Time

The Power vs. Time trace displays a graph with amplitude on the y-axis and time on the x-axis to confirm changes in power with time of measured signals.



MKR 1 0 s -79.30 dBm
MKR 2 25.000 0 ms -79.89 dBm
Δ (2-1) 25.000 0 ms -0.59 dB
Analysis Start Time 0 s
Analysis Time Length 25.000 0 ms
Filter BW Not Filtered
Detection : Average Trace Point : 10001

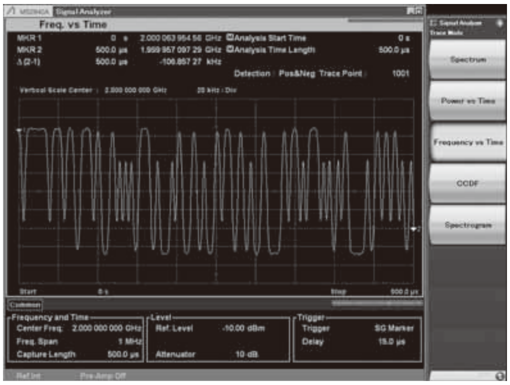
Frequency and Time
Center Freq. 2.000 000 000 GHz
Freq. Span 1 MHz
Capture Length 25.000 0 ms

Level
Ref. Level 0.00 dBm
Attenuator 10 dB

Trigger
Trigger SG Marker
Delay 15.0 μs

Frequency vs. Time

The Frequency vs. Time trace displays a graph with frequency on the y-axis and time on the x-axis to confirm time variation of the measured signal frequency.



MKR 1 0 s 2.000 063 954 56 GHz
MKR 2 500.0 μs 1.999 957 097 29 GHz
Δ (2-1) 500.0 μs -106.857 27 kHz
Analysis Start Time 0 s
Analysis Time Length 500.0 μs
Detection : Pos&Neg Trace Point : 1001
Vertical Scale Center : 2.000 000 000 GHz 25 kHz / Div

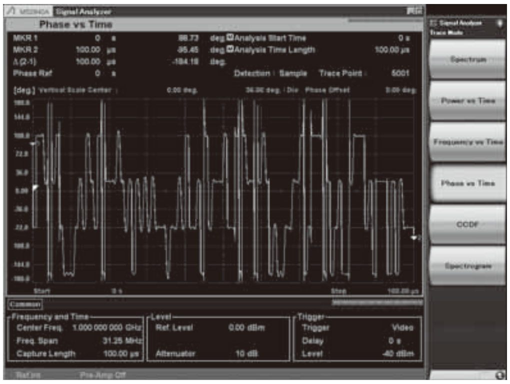
Frequency and Time
Center Freq. 2.000 000 000 GHz
Freq. Span 1 MHz
Capture Length 500.0 μs

Level
Ref. Level -10.00 dBm
Attenuator 10 dB

Trigger
Trigger SG Marker
Delay 15.0 μs

Phase vs. Time

The Phase vs. Time trace displays a graph with phase on the y-axis and time on the x-axis to confirm time variation of the measured signal phase.



MKR 1 0 s 88.73 deg
MKR 2 100.00 μs -95.45 deg
Δ (2-1) 100.00 μs -184.18 deg
Phase Ref 0 s
Analysis Start Time 0 s
Analysis Time Length 100.00 μs
Detection : Sample Trace Point : 5001
Vertical Scale Center : 0.00 deg. 36.00 deg. / Div Phase Offset 0.00 deg.

Frequency and Time
Center Freq. 1.000 000 000 GHz
Freq. Span 31.25 MHz
Capture Length 100.00 μs

Level
Ref. Level 0.00 dBm
Attenuator 10 dB

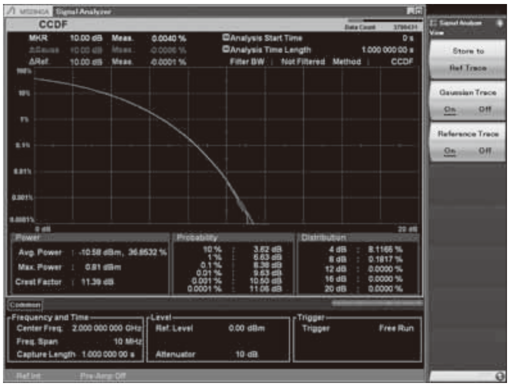
Trigger
Trigger Video
Delay 0 s
Level -40 dBm

CCDF/APD

The CCDF trace displays the power variation probability on the y-axis and power variation on the y-axis to confirm the CCDF and APD of measured signals.

CCDF (Complementary Cumulative Distribution Function):
The CCDF display indicates the cumulative distribution of transient power variations compared to average power.

APD (Amplitude Probability Density):
The APD display indicates the probability distribution of transient power.



MKR 10.00 dB Meas. 0.0040 %
ΔRef. 10.00 dB Meas. -0.0001 %
Analysis Start Time 0 s
Analysis Time Length 1.000 000 00 s
Filter BW : Not Filtered Method : CCDF

Power
Avg. Power : -10.58 dBm, 36.8532 %
Max. Power : 0.81 dBm
Crest Factor : 11.39 dB

Probability
10 % : 3.62 dB
1 % : 5.63 dB
0.1 % : 8.38 dB
0.01 % : 9.63 dB
0.001 % : 10.50 dB
0.0001 % : 11.06 dB

Distribution
4 dB : 8.1166 %
8 dB : 0.1817 %
12 dB : 0.0000 %
16 dB : 0.0000 %
20 dB : 0.0000 %

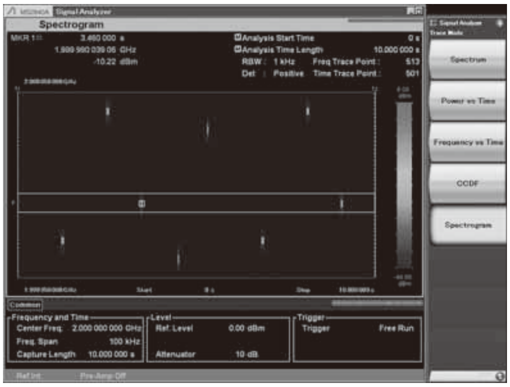
Frequency and Time
Center Freq. 2.000 000 000 GHz
Freq. Span 10 MHz
Capture Length 1.000 000 00 s

Level
Ref. Level 0.00 dBm
Attenuator 10 dB

Trigger
Trigger Free Run

Spectrogram

The Spectrogram trace displays the level as color with frequency on the y-axis and time on the x-axis. The captured IQ data is FFT processed to confirm time variations in the continuous spectrum.
It is useful for monitoring frequency hopping and transient signals.



MKR 1 3.460 000 s
1.999 960 039 06 GHz
-10.22 dBm
Analysis Start Time 0 s
Analysis Time Length 10.000 000 s
RBW : 1 kHz Freq Trace Point : 513
Det : Positive Time Trace Point : 501

Frequency and Time
Center Freq. 2.000 000 000 GHz
Freq. Span 100 kHz
Capture Length 10.000 000 s

Level
Ref. Level 0.00 dBm
Attenuator 10 dB

Trigger
Trigger Free Run

Signal Analyzer Function Applications ~ Capture & Playback Function ~

Outputs Waveforms Captured by Signal Analyzer from Built-in Vector Signal Generator

The MS2840A provides Capture & Playback functionality that enables laboratory-grade testing of transceiver systems using real world signals. Using the optional integrated Signal Analyzer and Vector Signal Generator of the MS2840A, Capture & Playback allows users to conveniently capture up to 100 MHz of spectrum and play it back at any designated frequency and amplitude, making it easy to determine device performance margins.

Applications for Capture & Playback

Validation/Production Test

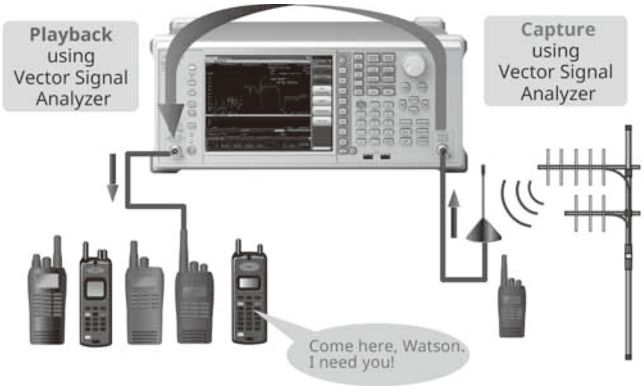
Captured signals can be used to initiate a communications link and perform receiver sensitivity testing with a device under test (DUT) using signals captured from a Golden Unit.

Device Characterization

Actual baseband signals captured from an RFIC can be used as simulation for characterizing amplifiers and other downstream devices or modules.

Electromagnetic Compatibility Test

Problematic RF environments or discrete signals can be captured and used to evaluate a device's susceptibility to RF interference, debug any problems found and validate the solution



Repeatably Test Device Performance using "Real-World" RF Environments

Other Measurement Functions

Phase Noise Measurement Function (MS2840A-010)

The excellent close-in phase noise performance of the MS2840A supports phase noise measurement of transmitters with a frequency offset range of 10 Hz to 10 MHz and also supports when connected to the High Performance Waveguide Mixer (MA2806A, MA2808A).

Measurement Results
- Carrier level
- Error between set frequency and carrier frequency
- Marker point phase noise level

There are four measurement modes using different loop filters, which are switched to match the DUT.

Auto:
This mode switches automatically to the best loop filter for measuring the carrier signal close-in and wide-offset phase noise characteristics

Best Close-in:
This mode uses the best loop filter for measuring the carrier signal close-in phase noise characteristics.

Best Wide-offset:
This mode uses the best loop filter for measuring the carrier signal close-in phase noise characteristics.

Balance
This mode uses the loop filter with a good balance for measuring both close-in and wide-offset phase noise characteristics of the carrier signal.

Carrier Freq. 1 000 000 000 Hz
Reference Level 0.00 dBm
ATT 0 dB

Carrier Power -0.54 dBm
Frequency Error 0.13 Hz

Marker List

MKR	Frequency	Level	MKR	Frequency	Level
1	10 Hz	-78.50 dBc/Hz	5	100 kHz	-129.53 dBc/Hz
2	100 Hz	-98.67 dBc/Hz	6	1 MHz	-137.73 dBc/Hz
3	1 kHz	-119.23 dBc/Hz	7	10 MHz	-143.26 dBc/Hz
4	10 kHz	-128.03 dBc/Hz			

Measurement Screen

Precompliance EMI Function (MS2840A-016)

This option adds an EMI measurement detection mode and RBW to the spectrum analyzer function. Both the detection mode used for CISPR standards (Quasi-Peak, CISPR-AVG, RMS-AVG) and RBW (200 Hz (6 dB), 9 kHz (6 dB), 120 kHz (6 dB), 1 MHz (Imp)) as well as conventional settings can be selected.

Measurement Software Options

Vector Modulation Analysis Software (MX269017A)

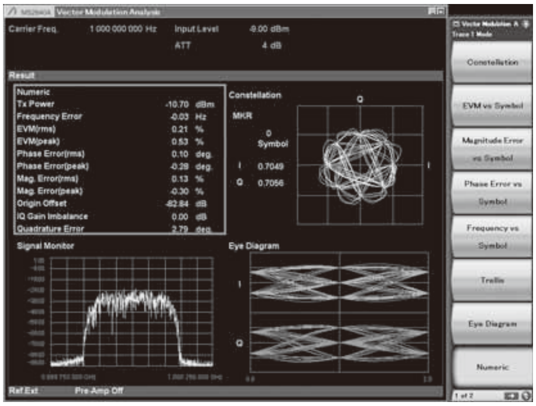
This software measures the modulation accuracy, carrier frequency, Tx power, etc., for each type of digital radio.

Supported Modulation Methods

Standard
BPSK, QPSK, O-QPSK, π/4DQPSK, 8PSK, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM, 2FSK, 4FSK, 2ASK, 4ASK, H-CPM*, MSK
*: Used for APCO-P25 Phase2 Inbound measurement
Option: APSK Analysis (MX269017A-001)
16APSK, 32APSK
Option: Higher-Order QAM Analysis (MX269017A-011)
512QAM, 1024QAM, 2048QAM

Frequency Setting Range

100 kHz to Upper frequency limit
(300 MHz to Upper frequency limit depending on measured symbol rate and installed option)



Carrier Freq. 1 000 000 000 Hz Input Level -9.00 dBm
ATT 4 dB

Result

Numeric
Tx Power -10.70 dBm
Frequency Error -0.03 Hz
EVM(rms) 0.21 %
EVM(peak) 0.53 %
Phase Error(rms) 0.10 deg.
Phase Error(peak) -0.28 deg.
Mag. Error(rms) 0.13 %
Mag. Error(peak) -0.30 %
Origin Offset -82.84 dB
IQ Gain Imbalance 0.00 dB
Quadrature Error 2.79 deg.

Measurement Screen

Analog Measurement Software (MX269018A)

When this software is installed in the MS2840A, the Tx performance (carrier frequency, Tx power, modulation rate/frequency deviation, demodulation frequency, demodulation signal distortion rate, etc.) of analog radios can be measured.
* The Audio Analyzer cannot be installed in the MS2840A.
* This software cannot be installed in the MS2830A 26.5 GHz/43 GHz models, but can be installed in the MS2840A 26.5 GHz/44.5 GHz models.

Supported Modulations

AM, FM, ΦM

Frequency Setting Range

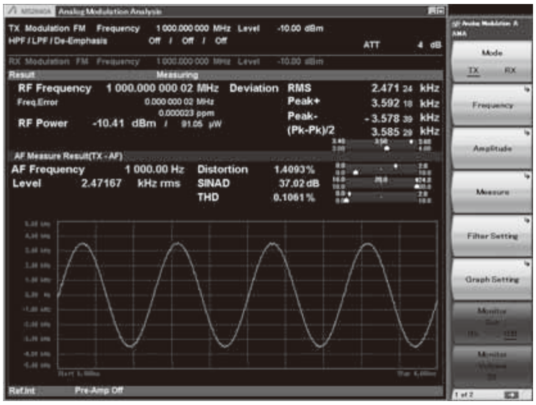
100 kHz to Upper frequency limit
(At Wide Band FM measurement: 10 MHz to Upper frequency limit)

Weighting Filter

CCITT, C-Message, CCIR 468, CCIR-ARM, A-Weighting

De-emphasis

25, 50, 75, 500, 750 µs



TX Modulation FM Frequency 1 000.000 000 MHz Level -10.00 dBm
HPF / LPF / De-Emphasis Off / Off / Off ATT 4 dB
RX Modulation FM Frequency 1 000.000 000 MHz Level -10.00 dBm

Result Measuring

RF Frequency 1 000.000 000 02 MHz Deviation RMS 2.471 24 kHz
Freq.Error 0.000 000 02 MHz Peak+ 3.592 18 kHz
0.000023 ppm Peak- -3.578 39 kHz
RF Power -10.41 dBm / 91.05 µW (Pk-Pk)/2 3.585 29 kHz

AF Measure Result(TX - AF)

AF Frequency 1 000.00 Hz Distortion 1.4093 %
Level 2.47167 kHz rms SINAD 37.02 dB
THD 0.1061 %

Measurement Screen

Refer to the MX2690xxA Series Measurement Software brochure for details.

Other Options

Preamplifier (MS2840A-008)

This option is for the 3.6 GHz/6 GHz models (MS2840A-040/041) and the 26.5 GHz/44.5 GHz models (MS2840A-044/046).
The gain of about 20 dB improves the Displayed Average Noise Level (DANL). This preamplifier is used to measure low-level signals such as noise and interference.

Frequency Range
With MS2840A-040: 100 kHz to 3.6 GHz
With MS2840A-041: 100 kHz to 6 GHz

Noise Floor Reduction (MS2840A-051)

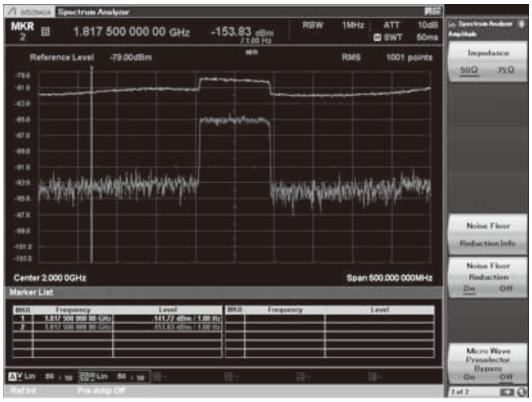
The Noise Floor Reduction (NFR) function increases the measurement accuracy for low-level signals. It subtracts the internal noise components (11 dB max. nominal) of the measuring instrument itself from the displayed measurement result.

When the NFR function is used with a connected external mixer (High Performance Waveguide Mixer MA2806A/MA2808A), it measures V- and E-band millimeter waveband applications with high dynamic range.

<Main Applications>
- Spurious Emission
- Spectrum Mask
- Adjacent Channel Leakage Power (ACLR)
- Power ON/OFF ratio

Measurement times using the NFR function remain unchanged.
The NFR function eliminates the procedure of measuring the instrument noise floor each time like using the earlier noise cancelling function. If the noise floor is measured once when an ambient temperature change affects the noise floor level or when an external mixer is connected, the NFR effect can be captured by the same operation as normal measurement, unless there is a change in these conditions.

[Notes]
The NFR function is enabled only by the Spectrum Analyzer function.
The design value is nominal and is not a guaranteed specification.



MKR 2 1.817 500 000 00 GHz -153.83 dBm / 1.00 Hz RBW 1MHz ATT 10dB SWT 50ms
Reference Level -79.00dBm RMS 1001 points
Center 2.000 0GHz Span 500.000 000MHz

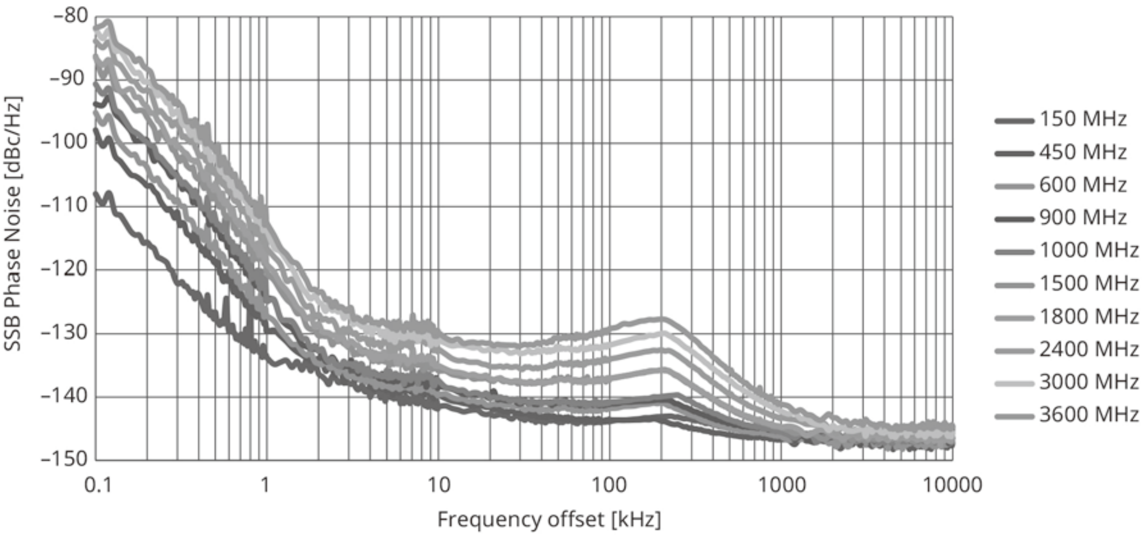
Measurement Screen

Low Phase Noise Performance (MS2840A-066)

The Low Phase Noise Performance MS2840A-066 option greatly increases SSB phase noise performance for RF input signals of more than 130 MHz and less than 3.7 GHz at frequency offsets of 1 kHz to 1 MHz from the main carrier wave. Setting the span to a range of either 300 Hz to 1 MHz (spectrum analyzer function) or 1 kHz to 31.25 MHz (signal analyzer function) enables the function on Spectrum display.

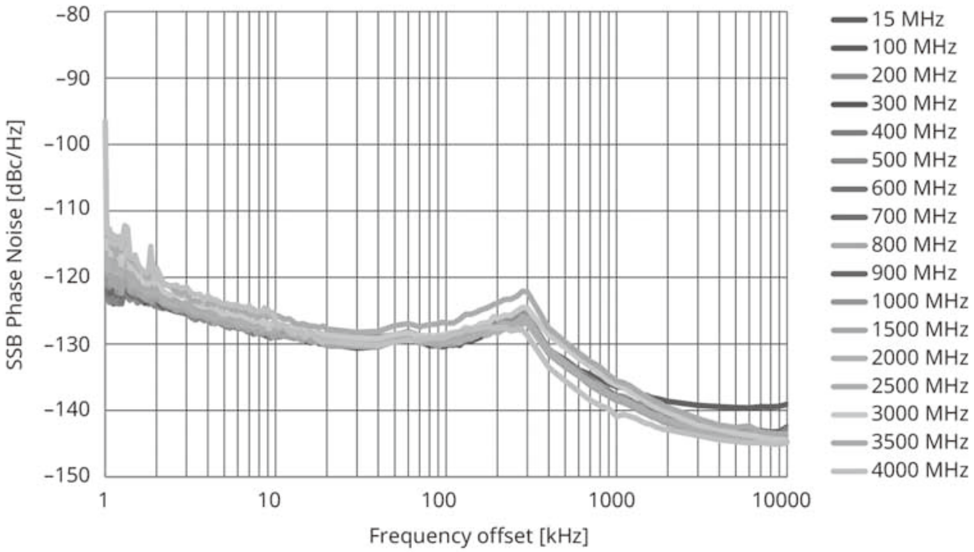
Phase Noise Performance (Spectrum Analyzer Function)

Carrier Offset	SSB Phase Noise			
	Standard	Low Phase Noise Performance MS2840A-066 Installed		
	Center Frequency: 1 GHz	Center Frequency: 1 GHz	Center Frequency: 500 MHz	Center Frequency: 150 MHz
10 Hz	–80 dBc/Hz (nom.)	—	—	—
100 Hz	–92 dBc/Hz (nom.)	–92 dBc/Hz (meas.*)	–98 dBc/Hz (nom.)	–107 dBc/Hz (meas.*)
1 kHz	–117 dBc/Hz (nom.)	–125 dBc/Hz (meas.*)	–122 dBc/Hz	–132 dBc/Hz (meas.*)
10 kHz	–123 dBc/Hz	–138 dBc/Hz (meas.*)	–133 dBc/Hz	–140 dBc/Hz (meas.*)
100 kHz	–123 dBc/Hz	–142 dBc/Hz (meas.*)	–133 dBc/Hz	–143 dBc/Hz (meas.*)
1 MHz	–135 dBc/Hz	–146 dBc/Hz (meas.*)	–148 dBc/Hz (nom.)	–145 dBc/Hz (meas.*)
10 MHz	–148 dBc/Hz (nom.)	—	—	—



Phase Noise Performance (meas.*), Low Phase Noise MS2840A-066 On

(Reference) Phase Noise Performance When MS2840A-066 Not Installed



Phase Noise Performance (meas.*), Low Phase Noise MS2840A-066 None

*: Value measured at design but not guaranteed specification, and value measured by Phase Noise Measurement function.

Rx Measurement

Built-in Signal Generator

A Vector Signal Generator and Analog Signal Generator can be installed in the MS2840A series (3.6 GHz/6 GHz models). Installing Tx and Rx (Signal Generator) measurement functions in one MS2840A makes it easy to configure a simple, small-footprint measurement system.

Vector Signal Generator

Vector Signal Generator (MS2840A-020/021)

The Vector Signal Generator MS2840A-020/021 covers a frequency range from 250 kHz to 3.6 GHz/6 GHz with a wide vector modulation bandwidth of 120 MHz and two waveform memory sizes of 64 Msamples (standard) and 256 Msamples (option).
A number of waveform patterns for various communications methods are built-in as standard. In addition, the IQproducer software for editing and generating waveform patterns is also supported. Waveform pattern files can be created using common Electronic Design Automation (EDA) tools, such as MATLAB.
The vector signal generator has various applications, such as Tx tests of equipment like amplifiers, and Rx tests of wireless equipment.

Frequency Range	250 kHz to 3.6 GHz (MS2840A-020) 250 kHz to 6 GHz (MS2840A-021)
Output Level	–40 to +20 dBm (>25 MHz) (Standard) –40 to +2 dBm (≤25 MHz) (Standard) –136 to +15 dBm (>25 MHz) (with MS2840A-022 installed) –136 to –3 dBm (≤25 MHz) (with MS2840A-022 installed)
Output Level Accuracy (at CW)	±0.5 dB (typ.) (–110 dBm ≤ Level ≤ +4 dBm, 100 MHz ≤ Frequency < 375 MHz) ±0.5 dB (–110 dBm ≤ Level ≤ +4 dBm, 375 MHz ≤ Frequency ≤ 3.6 GHz)
Waveform Memory	64 Msamples (Standard), 256 Msamples (with MS2840A-027 installed)
Vector Modulation Bandwidth	120 MHz
Internal Baseband Reference Clock	20 kHz to 160 MHz
Internal Waveform Pattern (Standard)*	WLAN (IEEE 802.11a/b/g), Bluetooth, GPS, GLONASS, QZSS, etc.
IQproducer Support*	TDMA IQproducer MX269902A Multi-Carrier IQproducer MX269904A

*: Refer to the MX269xxxA series Software (Waveform Pattern MX2690xxA, IQproducer MX2699xxA) brochure for details.

Options

Low Power Extension for Vector Signal Generator (MS2840A-022)

This option extends the lower limit of the output level from the standard value of –40 dBm to –136 dBm. Note that the upper limit drops by 5 dB.

ARB Memory Upgrade 256 MSa for Vector Signal Generator (MS2840A-027)

This option extends the ARB memory size from the standard value of 64 Msamples to 256 Msamples.

AWGN (MS2840A-028)

This option adds Additive White Gaussian Noise (AWGN) to the output wanted signal. It can be used for dynamic range tests of receivers, etc.

Analog Function Extension for Vector Signal Generator (MS2840A-029)

This option adds an analog signal generator function to the Vector Signal Generator MS2840A-020/021. The analog signal generator function frequency range and output level range are the same as the Analog Signal Generator MS2840A-088. Installing this option requires the Analog Measurement Software MX269018A, Vector Signal Generator Low Power Extension MS2840A-022 and USB Audio A0086C options. It is operated using the MX269018A.

Software for Vector Signal Generator

TDMA IQproducer MX269902A*

The IQproducer MX269902A is PC application software for generating waveform patterns using TDMA parameters. The generated waveform patterns are saved in the MS2840A to output TDMA modulation baseband signals and RF signals from the vector signal generator. Various signals, such as DMR, APCO-P25, NXDN, ARIB STD-T61/T79/T86/T98/T102, ETC, DSRC, etc., can be generated.

Multi-Carrier IQproducer MX269904A*

The Multi-Carrier IQproducer MX269904A is PC application software for generating multichannel waveform patterns for modulation signals and tone signals for various communications methods. The generated waveform patterns are saved in the MS2840A to output multi-carrier signals for various communication methods from the vector signal generator option.

*: Refer to the MX269xxxA series Software (Waveform Pattern MX2690xxA, IQproducer MX2699xxA) brochure for details.

Analog Signal Generator

Analog Signal Generator (MS2840A-088)

The Analog Signal Generator MS2840A-088 covers a frequency range of 100 kHz to 3 GHz and supports output of FM, ΦM, and AM signals. When used in combination with the Analog Measurement Software MX269018A, TRx tests of analog wireless equipment can be performed by one MS2840A set. The internal modulation output function outputs both AF tone and DCS (Digital Code Squelch) code signals for Rx tests of analog wireless equipment.

*: Refer to the MX2690xxA Series Measurement Software brochure for details.

Frequency Setting Range	100 kHz to 3 GHz (MS2840A-088)
Output Setting Level	–127 to +15 dBm (>25 MHz) –127 to –3 dBm (≤25 MHz)
Output Level Accuracy (at CW)	±0.5 dB (typ.) (–110 dBm ≤ Level ≤ +4 dBm, 100 MHz ≤ Frequency < 375 MHz) ±0.5 dB (–110 dBm ≤ Level ≤ +4 dBm, 375 MHz ≤ Frequency ≤ 3.6 GHz)
Output Modulation Signal	FM, ΦM, AM
Internal Modulation Signal Source	AF tone, DCS code

Options

Vector Function Extension for Analog Signal Generator Retrofit (MS2840A-189)

This option adds a vector signal generator function to the Analog Signal Generator MS2840A-088.
The specifications of this vector signal generator are the same as the Vector Signal Generator MS2840A-020 with a frequency range of 250 kHz to 3.6 GHz; the output level is the same as the Low Power Extension for Vector Signal Generator MS2840A-022.

Other Measurement Functions

The MS2840A with the BER Measurement Function MS2840A-026 supports measurement up to 10 Mbps.
It supports Rx sensitivity tests by inputting the receiver-demodulated Data/Clock/Enable to the back of the MS2840A.

- Input Signal: Data, Clock, Enable (Polarity reversal supported)
- Input Bit Rate: 100 bps to 10 Mbps
- Input Level: TTL 3.3 V
- Connector: Rear panel, AUX connector*
  *: Can convert to BNC by connecting AUX conversion adapter (J1556A).
- Measured Patterns:
  PN9, PN11, PN15, PN20, PN23, ALL0, ALL1, Alternate (0101...),
  PN9Fix, PN11Fix, PN15Fix, PN20Fix, PN23Fix,
  UserDefine (4096 bits max.)
- Measurable Bit Count: 1000 to 4294967295 bits (2^{32} – 1 bits)
- Measurable Error Bit Count: 1 to 2147483647 bits (2^{31} – 1 bits)
- Count Mode
  Data: Measures until specified Data count
  Error: Measures until specified Error count
- Measurement Mode
  Single: Measures specified measurement bit count once
  Continuous: Repeats Single measurement
  Endless: Continues measurement to upper limit of measurement bits

BER Test

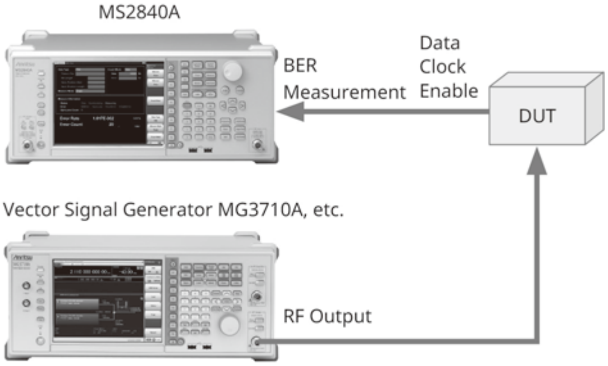
Data Type: PN9
Pattern File
Bit Length
Sync Position Start
Sync Position Length
Measure Mode: Single

Count Mode: Data
Data: 10000 Bit
Error: Bit

Measure Information
Status: Stop Synchronizing Measuring
Error: BitError SyncLoss ClockError EnableError
SyncLoss Count: 0

Error Rate 1.017E-002 1.017%
Error Count 20 / 1967

BER Measurement Function Main Screen



BER Measurement Setup Example
(using external vector signal generator)

Others Other Measurement Functions

This option is a 10-MHz reference crystal oscillator with excellent frequency stability startup characteristics of ±1 × 10^{-9} at 7 minutes after power-on.
Aging Rate: ±1 × 10^{-10}/month, ±1 × 10^{-9}/year
Start-up Characteristics: ±1 × 10^{-9} (7 minutes after power-on)

High Stability Reference Oscillator (MS2840A-002)

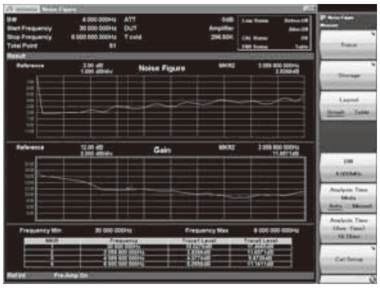
This 10-MHz reference crystal oscillator has excellent improved frequency stability with an aging rate of ±1 × 10^{-7}/year.
Aging Rate: ±1 × 10^{-7}/year
Start-up Characteristics: ±5 × 10^{-8} (5 minutes after power-on)

2ndary SSD (MS2840A-011)

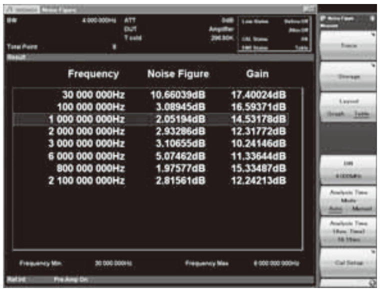
This removable SSD is for storing user data.
It has no installed OS. It is shipped mounted in the Secondary HDD/SSD slot of the MS2840A main unit.

Noise Figure Measurement Function (MS2840A-017)

Noise Figure is measured with the measurement method of Y-factor method which uses a Noise Source.
The Noisecom NC346 series* of noise sources is supported.
*: Refer to the MS2840A Data Sheet for more details.
Frequency Range (Noise sauce): 0.01 GHz to 40.0 GHz
Frequency Mode: Fixed, List, Sweep
DUT Mode: Amplifier, Down Converter, Up Converter
Screen Layout: Graph, Table
Measurement Results Display
Graph/List/Spot
Displays measurement results for each trace (Trace1/Trace2).
Noise Figure (NF) [dB]
Noise Factor (F) [Linear]
Gain
Y-Factor: Power ratio when Noise Source is turned On/Off
T effective: Effective noise temperature
P Hot: Power measured when Noise Source is On.
P Cold: Power measured when Noise Source is Off.

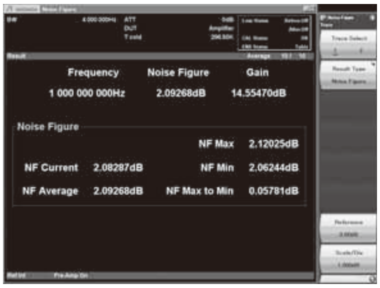


Measurement Result:
Example of Graph display
(Frequency Mode: Sweep,
Screen Layout: Graph)



Frequency	Noise Figure	Gain
30 000 000Hz	10.66039dB	17.40024dB
100 000 000Hz	3.08945dB	16.59371dB
1 000 000 000Hz	2.05194dB	14.53178dB
2 000 000 000Hz	2.93286dB	12.31772dB
3 000 000 000Hz	3.10655dB	10.24146dB
6 000 000 000Hz	5.07462dB	11.33644dB
800 000 000Hz	1.97577dB	15.33487dB
2 100 000 000Hz	2.81561dB	12.24213dB

Measurement Result:
Example of List display
(Frequency Mode: List,
Screen Layout: List)



Frequency	Noise Figure	Gain
1 000 000 000Hz	2.09268dB	14.55470dB

Noise Figure
NF Max 2.12025dB
NF Current 2.08287dB
NF Min 2.06244dB
NF Average 2.09268dB
NF Max to Min 0.05781dB

Measurement Result:
Example of Spot display
(Frequency Mode: Fixed)

Configurations

Configuration List

Model	Name	Remarks
MS2840A	Signal Analyzer	Analysis Bandwidth 31.25 MHz installed as standard
MS2840A-040	3.6 GHz Signal Analyzer	
MS2840A-041	6 GHz Signal Analyzer	
MS2840A-001	Rubidium Reference Oscillator	Option
MS2840A-002	High Stability Reference Oscillator	Option
MS2840A-077	Analysis Bandwidth Extension to 62.5 MHz	Option
MS2840A-078	Analysis Bandwidth Extension to 125 MHz	Option, Requires MS2840A-077
MS2840A-008	Preamplifier	Option, Frequency Range: 100 kHz to 6 GHz
MS2840A-010	Phase Noise Measurement Function	Option
MS2840A-011	2ndary SSD	Option
MS2840A-016	Precompliance EMI Function	Option
MS2840A-017	Noise Figure Measurement Function	Option, Preamplifier MS2840A-008 (or 108) recommended
MS2840A-026	BER Measurement Function	Option, AUX Conversion Adapter J1566A as standard accessory
MS2840A-051	Noise Floor Reduction	Option
MS2840A-066	Low Phase Noise Performance	Option
MS2840A-020	3.6 GHz Vector Signal Generator	Option
MS2840A-021	6 GHz Vector Signal Generator	Option
MS2840A-022	Low Power Extension for Vector Signal Generator	Option
MS2840A-027	ARB Memory Upgrade 256 Msa for Vector Signal Generator	Option
MS2840A-028	AWGN	Option
MS2840A-029	Analog Function Extension for Vector Signal Generator	Option, Requires Analog Measurement Software MX269018A, USB Audio A0086C and Low Power Extension for Vector Signal Generator MS2840A-022
MS2840A-088	3.6 GHz Analog Signal Generator	Option, Requires Analog Measurement Software MX269018A and USB Audio A0086C

The following options are installed as standard and do not require separate orders when ordering the MS2840A-040/041.

Standard Software	MX269000A
Analysis Bandwidth 10 MHz	MS2840A-006
Bandwidth Extension to 31.25 MHz	MS2840A-005

Order the following combination when installing the Vector Signal Generator and Analog Signal Generator in a new order:

MS2840A-020 or 021 + MS2840A-022 + MS2840A-029

List of Retrofit Options

The following hardware options can be retrofitted. Add to the retrofit options at ordering and also order the Retrofit Kit Z1932A.
In addition, the MS2840A main unit must be returned to the Anritsu plant for remodelling when retrofitting hardware options.

Model	Name	Remarks
MS2840A-101	Rubidium Reference Oscillator Retrofit	
MS2840A-102	High Stability Reference Oscillator Retrofit	
MS2840A-177	Analysis Bandwidth Extension to 62.5 MHz Retrofit	
MS2840A-178	Analysis Bandwidth Extension to 125 MHz Retrofit	Requires Analysis Bandwidth Extension to 62.5 MHz MS2840A-077 (or 177)
MS2840A-108	Preamplifier Retrofit	Frequency Range: 100 kHz to 6 GHz
MS2840A-110	Phase Noise Measurement Function Retrofit	
MS2840A-111	2ndary SSD Retrofit	
MS2840A-116	Precompliance EMI Function Retrofit	
MS2840A-117	Noise Figure Measurement Function Retrofit	Preamplifier MS2840A-008 (or 108) recommended
MS2840A-126	BER Measurement Function Retrofit	AUX Conversion Adapter J1566A as standard accessory
MS2840A-151	Noise Floor Reduction Retrofit	Option
MS2840A-166	Low Phase Noise Performance Retrofit	
MS2840A-120	3.6 GHz Vector Signal Generator Retrofit	
MS2840A-121	6 GHz Vector Signal Generator Retrofit	
MS2840A-122	Low Power Extension for Vector Signal Generator Retrofit	
MS2840A-127	ARB Memory Upgrade 256 Msa for Vector Signal Generator Retrofit	
MS2840A-128	AWGN Retrofit	
MS2840A-129	Analog Function Extension for Vector Signal Generator Retrofit	Requires Analog Measurement Software MX269018A, USB Audio A0086C and Low Power Extension for Vector Signal Generator MS2840A-022 (or 122)
MS2840A-188	3.6 GHz Analog Signal Generator Retrofit	Requires Analog Measurement Software MX269018A and USB Audio A0086C
MS2840A-189	Vector Function Extension for Analog Signal Generator Retrofit	

Software

The following software can be retrofitted. Add to the required software at ordering and also order the Retrofit Kit Z1932A.

Model	Name	Remarks
MX269017A	Vector Modulation Analysis Software	
MX269017A-001	APSK Analysis	Requires MX269017A
MX269017A-011	Higher-Order QAM Analysis	Requires MX269017A
MX269018A	Analog Measurement Software	Requires USB Audio A0086C
MX269902A	TDMA IQproducer	
MX269904A	Multi-Carrier IQproducer	

Signal Analyzer MS2840A Specifications

Refer to the MS2840A Data Sheet for more details.

Frequency Range

9 kHz to 3 .6 GHz (MS2840A-040)
9 kHz to 6 GHz (MS2840A-041)

Aging Rate

±1 × 10^{-6}/year (Standard)
±1 × 10^{-7}/year
(with High Stability Reference Oscillator MS2840A-002 installed)
±1 × 10^{-10}/month, ±1 × 10^{-9}/year
(with Rubidium Reference Oscillator MS2840A-001 installed)

Maximum Input Level

Average total power: +30 dBm
(Input attenuator: ≥10 dB, Preamp: Off)

Resolution Bandwidth (RBW)

Spectrum Analyzer Function
  Setting Range:
    1 Hz to 3 MHz (1–3 sequence), 500 Hz, 50 kHz, 2 MHz, 5 MHz, 10 MHz, 20 MHz
    [At Zero SPAN: 30 Hz to 3 MHz (1–3 sequence), 50 kHz, 5 MHz, 10 MHz, 20 MHz, 31.25 MHz]
Signal Analyzer Function
  Setting Range:
    1 Hz to 1 MHz (1–3 sequence)

Video Bandwidth (VBW)

Spectrum Analyzer Function
  Setting Range:
    1 Hz to 3 kHz (1-3 sequence), 5 kHz,
    10 kHz to 10 MHz (1-3 sequence), off
  VBW Mode: Video Average, Power Average

SSB Phase Noise

Spectrum Analyzer Function

Carrier Offset	SSB Phase Noise	
	Standard	Low Phase Noise Performance MS2840A-066 installed
	Center Frequency: 1 GHz	Center Frequency: 500 MHz
10 Hz	–80 dBc/Hz (nom.)	—
100 Hz	–92 dBc/Hz (nom.)	–98 dBc/Hz (nom.)
1 kHz	–117 dBc/Hz (nom.)	–122 dBc/Hz
10 kHz	–123 dBc/Hz	–133 dBc/Hz
100 kHz	–123 dBc/Hz	–133 dBc/Hz
1 MHz	–135 dBc/Hz	–148 dBc/Hz (nom.)
10 MHz	–148 dBc/Hz (nom.)	—

Display Average Noise Level (DANL)

Spectrum Analyzer Function
Preamp: None, Low Phase Noise: None

Frequency	DANL
30 MHz	–153 dBm/Hz
400 MHz	–153 dBm/Hz
1 GHz	–151 dBm/Hz
3 GHz	–149 dBm/Hz
6 GHz	–146 dBm/Hz

Preamp: On, Low Phase Noise: None

Frequency	DANL
30 MHz	–166 dBm/Hz
400 MHz	–166 dBm/Hz
1 GHz	–165 dBm/Hz
3 GHz	–164 dBm/Hz
6 GHz	–161 dBm/Hz

Noise Floor Reduction: On
It subtracts the internal noise components (11 dB max. nominal) of the measuring instrument itself from the displayed measurement result.

Total Absolute Amplitude Accuracy

Preamp: None
±0.5 dB (300 kHz ≤ f < 4 GHz)
±1.8 dB (4 GHz ≤ f < 6 GHz)

The MS2840A supports level calibration over a wide range of 300 kHz to 4 GHz using its built-in level calibration oscillator.
The level accuracy standards include frequency characteristics, linearity and attenuator switching error. Consequently, the level including the above three errors can still be measured accurately even when the measurement frequency and built-in attenuator settings are changed.

2-tone 3rd-order Intermodulation Distortion

Preamp: None

Frequency	2-tone 3rd-order Intermodulation Distortion
30 GHz	≤–54 dBc (TOI = +12 dBm)
400 GHz, 1 GHz, 3 GHz	≤–62 dBc (TOI = +16 dBm)
6 GHz	≤–60 dBc (TOI = +15 dBm)

Second Harmonic Distortion

Preamp: None

Input Frequency	Harmonic Distortion	SHI	Mixer Input Level
30 GHz	≤–60 dBc	≥+30 dBm	–30 dBm
400 MHz, 1 GHz	≤–65 dBc	≥+35 dBm	–30 dBm
3 GHz	≤–80 dBc	≥+60 dBm	–20 dBm

Analysis Bandwidth (Signal Analyzer Function)

31.25 MHz (standard)
62.5 GHz (Option)
125 MHz (Option)

Built-in Signal Generator

Vector Signal Generator (MS2840A-020/021)

Frequency Range
250 kHz to 3.6 GHz (MS2840A-020)
250 kHz to 6 GHz (MS2840A-021)
Output Level
–40 to +20 dBm (>25 MHz) (Standard)
–40 to +2 dBm (≤25 MHz) (Standard)
–136 to +15 dBm (>25 MHz) (with MS2840A-022 installed)
–136 to –3 dBm (≤25 MHz) (with MS2840A-022 installed)

Analog Signal Generator (MS2840A-088)

Frequency Setting Range
100 kHz to 3 GHz
Output Setting Level
–127 to +15 dBm (>25 MHz)
–127 to –3 dBm (≤25 MHz)

Shared

Output Level Accuracy (at CW)
±0.5 dB (typ.)
(–110 dBm ≤ level ≤ +4 dBm, 100 MHz ≤ Frequency < 375 MHz)
±0.5 dB
(–110 dBm ≤ level ≤ +4 dBm, 375 MHz ≤ Frequency ≤ 3.6 GHz)

Connector

RF Input (Front panel)
N–J, 50Ω (nom.): 3.6 GHz and 6 GHz models (MS2840A-040/041)
RF Output (Front panel)
N–J, 50Ω (nom.): Built-in Signal Generator (MS2840A-020/021/088)

Dimensions and Mass

426 (W) × 177 (H) × 390 (D) mm (excluding projections)
≤14.5 kg (with either MS2840A-040 or -041 installed, and either MS2840A-020 or -021 installed, excluding other options)

Power Supply

Power voltage: 100 V(ac) to 120 V(ac)/200 V(ac) to 240 V(ac)
Frequency: 50 Hz to 60 Hz
Power consumption:
≤350 VA (including all options)
140 VA (nom.)
(with MS2840A-040 or -041 installed, excluding other options)
220 VA (nom.)
(with either MS2840A-040 or -041 installed, and either MS2840A-020 or -021 installed excluding other options)

EU Standards (CE Marking)

EMC: 2014/30/EU, EN61326-1, EN61000-3-2
LVD: 2014/35/EU, EN61010-1
RoHS: 2011/65/EU, EN50581

OS

Windows 7 (64 bit)

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Typical (typ.): Performance not warranted. Most products meet typical performance.
Nominal (nom.): Values not warranted. Included to facilitate application of product.
Measured (meas.): Performance not warranted. Data actually measured from randomly selected measuring instruments.

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main Frame
MS2840A	Signal Analyzer
	Standard Accessories
	Power Cord: 1 pc
	USB Memory (≥ 1GB): 1 pc
P0031A	USB Mouse: 1 pc
Z0541A	Install DVD-ROM (Application software, instruction manual DVD-ROM): 1 pc
	Options
MS2840A-040	3.6 GHz Signal Analyzer
MS2840A-041	6 GHz Signal Analyzer
MS2840A-001	Rubidium Reference Oscillator
MS2840A-002	High Stability Reference Oscillator
MS2840A-077	Analysis Bandwidth Extension to 62.5 MHz
MS2840A-078	Analysis Bandwidth Extension to 125 MHz (Requires MS2840A-077)
MS2840A-008	Preamplifier
MS2840A-010	Phase Noise Measurement Function
MS2840A-011	2ndary SSD
MS2840A-016	Precompliance EMI Function
MS2840A-017	Noise Figure Measurement Function
MS2840A-026	BER Measurement Function (AUX Conversion Adapter J1556A as standard accessory)
MS2840A-051	Noise Floor Reduction
MS2840A-066	Low Phase Noise Performance
MS2840A-020	3.6 GHz Vector Signal Generator
MS2840A-021	6 GHz Vector Signal Generator
MS2840A-022	Low Power Extension for Vector Signal Generator
MS2840A-027	ARB Memory Upgrade 256 MSa for Vector Signal Generator
MS2840A-028	AWGN
MS2840A-029	Analog Function Extension for Vector Signal Generator
MS2840A-088	3.6 GHz Analog Signal Generator
	Retrofit Options
MS2840A-101	Rubidium Reference Oscillator Retrofit
MS2840A-102	High Stability Reference Oscillator Retrofit
MS2840A-177	Analysis Bandwidth Extension to 62.5 MHz Retrofit
MS2840A-178	Analysis Bandwidth Extension to 125 MHz Retrofit (Requires MS2840A-077 or 177)
MS2840A-108	Preamplifier Retrofit
MS2840A-110	Phase Noise Measurement Function Retrofit
MS2840A-111	2ndary SSD Retrofit
MS2840A-116	Precompliance EMI Function Retrofit
MS2840A-117	Noise Figure Measurement Function Retrofit
MS2840A-126	BER Measurement Function Retrofit (AUX Conversion Adapter J1556A as standard accessory)
MS2840A-151	Noise Floor Reduction Retrofit
MS2840A-166	Low Phase Noise Performance Retrofit
MS2840A-120	3.6 GHz Vector Signal Generator Retrofit
MS2840A-121	6 GHz Vector Signal Generator Retrofit
MS2840A-122	Low Power Extension for Vector Signal Generator Retrofit
MS2840A-127	ARB Memory Upgrade 256 MSa for Vector Signal Generator Retrofit
MS2840A-128	AWGN Retrofit
MS2840A-129	Analog Function Extension for Vector Signal Generator Retrofit
MS2840A-188	3.6 GHz Analog Signal Generator Retrofit
MS2840A-189	Vector Function Extension for Analog Signal Generator Retrofit
	Software Options
	DVD-ROM with License and Operation manuals
MX269017A	Vector Modulation Analysis Software
MX269017A-001	APSK Analysis (Requires MX269017A)
MX269017A-011	Higher-Order QAM Analysis (Requires MX269017A)
MX269018A	Analog Measurement Software (Requires USB Audio A0086C)
MX269902A	TDMA IQproducer
MX269904A	Multi-Carrier IQproducer
	Warranty Service
MS2840A-ES210	2 years Extended Warranty Service
MS2840A-ES310	3 years Extended Warranty Service
MS2840A-ES510	5 years Extended Warranty Service

Model/Order No.	Name
	Manuals Following operation manuals provided as hard copy
W3812AE	MS2840A Operation Manual (Mainframe Operation)
W2851AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Mainframe Remote Control)
W3335AE	MS2830A/MS2840A/MS2850A Operation Manual (Signal Analyzer Function Operation)
W2853AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Signal Analyzer Function Remote Control)
W3336AE	MS2830A/MS2840A/MS2850A Operation Manual (Spectrum Analyzer Function Operation)
W2855AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Spectrum Analyzer Function Remote Control)
W3117AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Phase Noise Measurement Function Operation)
W3118AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Phase Noise Measurement Function Remote Control)
W3655AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A-017 Operation Manual (Noise Figure Measurement Function Operation)
W3656AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A-017 Operation Manual (Noise Figure Measurement Function Remote control)
W3337AE	MS2830A/MS2840A-020/021 Operation Manual (Vector Signal Generator Option Operation)
W3338AE	MS2830A/MS2840A-020/021 Operation Manual (Vector Signal Generator Option Remote Control)
W2914AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A Operation Manual (IQproducer for Vector Signal Generator Option)
W2929AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A Operation Manual (Standard Waveform Pattern for Vector Signal Generator Option)
W3305AE	MX269017A Operation Manual (Operation)
W3306AE	MX269017A Operation Manual (Remote Control)
W3555AE	MX269018A Operation Manual (Operation)
W3556AE	MX269018A Operation Manual (Remote Control)
W2916AE	MX269902A Operation Manual
W2917AE	MX269904A Operation Manual

The following options are installed as standard and do not require separate orders when ordering the MS2840A-040/041.

Standard Software	MX269000A
Analysis Bandwidth 10 MHz	MS2840A-006
Bandwidth Extension to 31.25 MHz	MS2840A-005

Model/Order No.	Name
	Application Parts
34AKNF50	Ruggedized K-to-Type N Adapter (DC to 20 GHz, 50Ω, Ruggedized K-M · N-F, SWR: 1.5 (max.), Insertion Loss: 0.4 dB (max.))
K240B	Power Divider (K connector, DC to 26.5 GHz, 50Ω, K-J, 1 W max.)
MA1612A	Four-port Junction Pad (5 MHz to 3 GHz, N-J)
J1359A	Coaxial Adaptor (K-P · K-J, SMA)
J0576B	Coaxial Cord, 1 m (N-P · 5D-2W · N-P)
J0576D	Coaxial Cord, 2 m (N-P · 5D-2W · N-P)
J0127A	Coaxial Cord, 1 m (BNC-P · RG58A/U · BNC-P)
J0127B	Coaxial Cord, 2 m (BNC-P · RG58A/U · BNC-P)
J0127C	Coaxial Cord, 0.5 m (BNC-P · RG58A/U · BNC-P)
J0322A	Coaxial Cord, 0.5 m (DC to 18 GHz), (SMA-P · 50Ω SUCOFLEX104 · SMA-P)
J0322B	Coaxial Cord, 1 m (DC to 18 GHz), (SMA-P · 50Ω SUCOFLEX104 · SMA-P)
J0322C	Coaxial Cord, 1.5 m (DC to 18 GHz), (SMA-P · 50Ω SUCOFLEX104 · SMA-P)
J0322D	Coaxial Cord, 2 m (DC to 18 GHz), (SMA-P · 50Ω SUCOFLEX104 · SMA-P)
J0805	DC Block, N type (MODEL 7003) (10 kHz to 18 GHz, N-P · N-J)
J1554A	DC Block, SMA type (MODEL 7006) (9 kHz to 26.5 GHz, SMA-P · SMA-J)
J1555A	DC Block, SMA type (MODEL 7006-1) (9 kHz to 20 GHz, SMA-P · SMA-J)
K261	DC Block (10 kHz to 40 GHz, K-P · K-J)
J0004	Coaxial Adapter (DC to 12.4 GHz, 50Ω, N-P · SMA-J)
J1398A	N-SMA Adaptor (DC to 26.5 GHz, 50Ω, N-P · SMA-J)
J0911	Coaxial Cable, 1.0 m for 40 GHz (DC to 40 GHz, approx. 1 m, SF102A, 11K254/K254/1.0M)
J0912	Coaxial Cable, 0.5 m for 40 GHz (DC to 40 GHz, approx. 0.5 m, SF102A, 11K254/K254/0.5M)
41KC-3	Fixed Attenuator (DC to 40 GHz, 3 dB)
J1261A	Ethernet Cable (Shield type, Straight, 1 m)
J1261B	Ethernet Cable (Shield type, Straight, 3 m)
J1261C	Ethernet Cable (Shield type, Cross, 1 m)
J1261D	Ethernet Cable (Shield type, Cross, 3 m)
J0008	GPIB Cable, 2.0 m
J1556A	AUX Conversion Adapter (AUX → BNC, for vector signal generator option and BER measurement function option, standard accessory with BER Measurement Function MS2840A-026)
A0086C	USB Audio (for MX269018A)
B0635A	Rack Mount Kit (EIA)
B0657A	Rack Mount Kit (JIS)
B0636C*	Carrying Case (Hard type, with casters)
B0671A*	Front Cover for 1MW4U
MA24105A	Inline Peak Power Sensor (350 MHz to 4 GHz, with USB A to mini B cable)
MA24106A	USB Power Sensor (50 MHz to 6 GHz, with USB A to mini B cable)
MA24108A	Microwave USB Power Sensor (10 MHz to 8 GHz, with USB A to Micro-B cable)
MA24118A	Microwave USB Power Sensor (10 MHz to 18 GHz, with USB A to Micro-B cable)
MA24126A	Microwave USB Power Sensor (10 MHz to 26 GHz, with USB A to Micro-B cable)
Z0975A	Keyboard (USB)
Z1932A	Installation Kit (required when retrofitting options or installing software)

*: The Carrying Case B0636C includes the Front Panel Protective Cover (B0671A).

Sygnal Analyzer

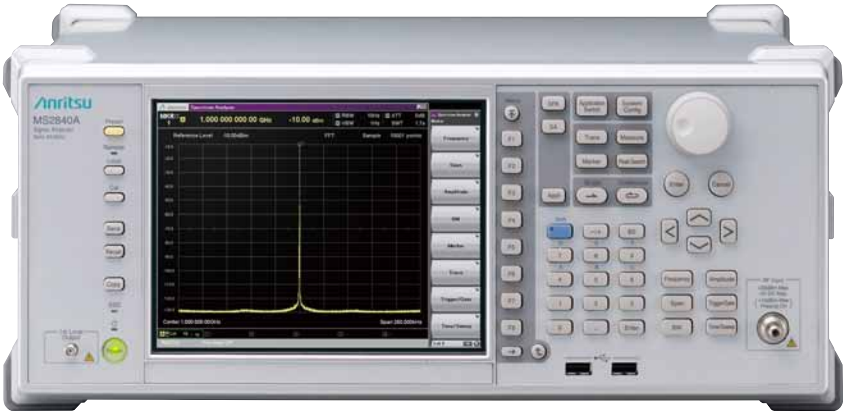
MS2840A

9 kHz to 26.5 GHz/44.5 GHz

Remote Control
GPIB | Ethernet | USB

New Choice of Microwave Models with Excellent Close-in Phase Noise Performance

Excellent Eco Product



Better Than Expected Close-in Phase Noise Performance

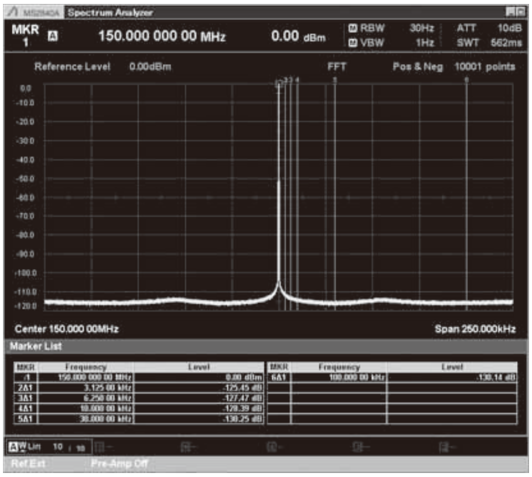
Since 2000 most spectrum analyzers have been designed for mobile communications and the phase noise performance has been optimized for offset frequencies of several MHz. Consequently, customers requiring good close-in phase noise performance have been limited to a narrow choice of usable spectrum analyzers, causing problems.
This new MS2840A series (26.5 GHz/44.5 GHz models) has been designed with emphasis on offering a spectrum analyzer with excellent close-in phase noise performance at offset frequencies of just several kHz.
This performance surpasses that of first-generation high-end spectrum analyzers and has sufficient margin for evaluating the close-in spurious of narrowband communications equipment in the short-wave, VHF, and UHF bands. Furthermore, this excellent phase noise performance proves its usefulness in the microwave and millimeter wave bands for evaluating microwave wireless equipment, aerospace equipment, weather radar, 79 GHz band automotive collision-prevention radar, and other devices requiring oscillator measurements. It supports measurements previously requiring large, expensive phase noise measuring instruments while offering excellent noise performance in a middle-price-range spectrum analyzer.

Close-in Phase Noise Performance

Specification at 1 GHz Measurement Frequency
(Spectrum Analyzer Function)

Carrier Offset	SSB Phase Noise
10 Hz	–80 dBc/Hz (nom.)
100 Hz	–92 dBc/Hz (nom.)
1 kHz	–117 dBc/Hz (nom.)
10 kHz	–123 dBc/Hz
100 kHz	–123 dBc/Hz
1 MHz	–135 dBc/Hz
10 MHz	–148 dBc/Hz (nom.)

Measurement Examples



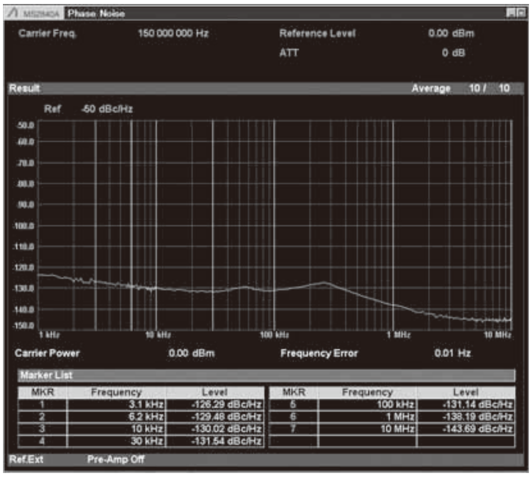
MKR 1 150.000 000 00 MHz 0.00 dBm
RBW 30Hz ATT 10dB
VBW 1Hz SWT 562ms
Reference Level 0.00dBm FFT Pos & Neg 10001 points
Center 150.000 00MHz Span 250.000kHz

Marker List

MKR	Frequency	Level	MKR	Frequency	Level
1	150.000 000 00 MHz	0.00 dBm	6Δ1	100.000 00 kHz	-130.14 dB
2Δ1	3.125 00 kHz	-125.45 dB			
3Δ1	6.250 00 kHz	-127.47 dB			
4Δ1	10.000 00 kHz	-128.39 dB			
5Δ1	30.000 00 kHz	-130.25 dB			

10 / 10
Ref.Ext Pre-Amp Off

Spectrum Display
150 MHz Measurement Frequency, Preamp Off



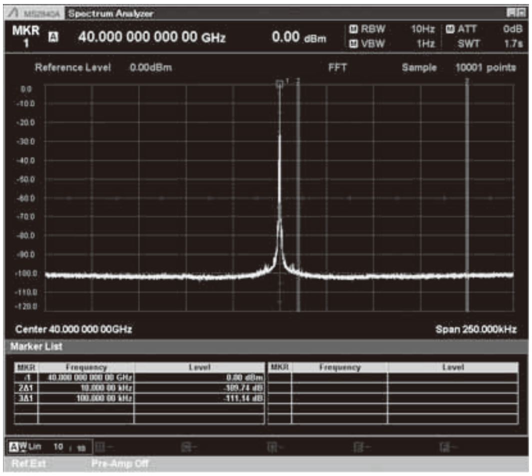
Carrier Freq. 150 000 000 Hz Reference Level 0.00 dBm
ATT 0 dB
Result Average 10 / 10
Ref -50 dBc/Hz
Carrier Power 0.00 dBm Frequency Error 0.01 Hz

Marker List

MKR	Frequency	Level	MKR	Frequency	Level
1	3.1 kHz	-126.29 dBc/Hz	5	100 kHz	-131.14 dBc/Hz
2	6.2 kHz	-129.46 dBc/Hz	6	1 MHz	-138.19 dBc/Hz
3	10 kHz	-130.02 dBc/Hz	7	10 MHz	-143.69 dBc/Hz
4	30 kHz	-131.54 dBc/Hz			

Ref.Ext Pre-Amp Off

Phase Noise Measurement
150 MHz Measurement Frequency, Preamp Off

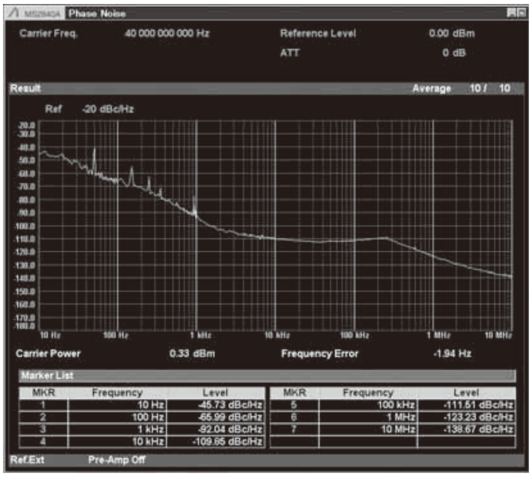


40.000 000 000 00 GHz 0.00 dBm
RBW 10Hz ATT 0dB
VBW 1Hz SWT 1.7s
Reference Level 0.00dBm FFT Sample 10001 points
Center 40.000 000 00GHz Span 250.000kHz

Marker List

MKR	Frequency	Level	MKR	Frequency	Level
1	40.000 000 000 00 GHz	0.00 dBm			
2Δ1	10.000 00 kHz	-109.74 dB			
3Δ1	100.000 00 kHz	-111.14 dB			

Spectrum Display
40 GHz Measurement Frequency, Preamp Off



Carrier Freq. 40 000 000 000 Hz Reference Level 0.00 dBm
ATT 0 dB
Result Average 10 / 10
Ref -20 dBc/Hz
Carrier Power 0.33 dBm Frequency Error -1.94 Hz

Marker List

MKR	Frequency	Level	MKR	Frequency	Level
1	10 Hz	-45.73 dBc/Hz	5	100 kHz	-111.51 dBc/Hz
2	100 Hz	-65.99 dBc/Hz	6	1 MHz	-123.23 dBc/Hz
3	1 kHz	-92.04 dBc/Hz	7	10 MHz	-138.67 dBc/Hz
4	10 kHz	-109.85 dBc/Hz			

Phase Noise Measurement
40 GHz Measurement Frequency, Preamp Off

Better Than Expected Close-in Phase Noise Performance (High-Performance Waveguide Mixer)

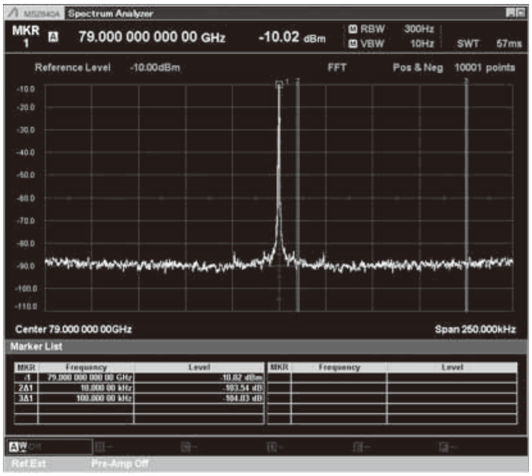
The MS2840A series (26.5 GHz/44.5 GHz models) is supported by two types of mixer: the high-performance waveguide mixers (50 GHz to 90 GHz) for measurements in the millimeter wave band, and external harmonic mixers (26.5 GHz to 325 GHz). In particular, the high-performance waveguide mixers make maximum use of the excellent phase noise performance of the MS2840A to monitor the actual spectrum floor of millimeter-wave-band transmitters and oscillators, playing a key role in evaluating their phase noise performance.

MA2808A

High-Performance Waveguide Mixers

Model	Name	Frequency Band	Frequency Range	Waveguide	Flange
MA2806A	High Performance Waveguide Mixer (50 to 75 GHz)	V band	50 GHz to 75 GHz	WR15	UG-385/U
MA2808A	High Performance Waveguide Mixer (60 to 90 GHz)	E band	60 GHz to 90 GHz	WR12	UG-387/U

Measurement Examples

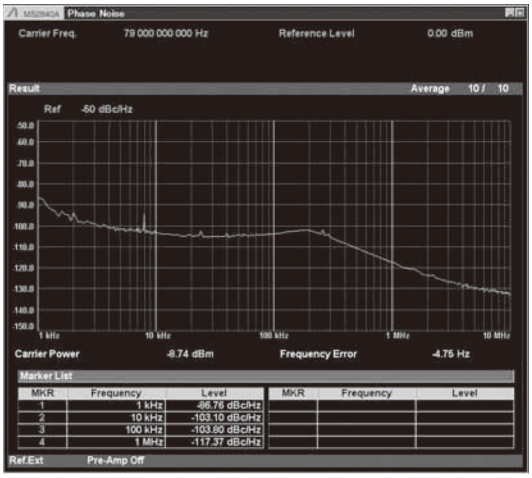


79.000 000 000 00 GHz -10.02 dBm
RBW 300Hz
VBW 10Hz SWT 57ms
Reference Level -10.00dBm FFT Pos & Neg 10001 points
Center 79.000 000 00GHz Span 250.000kHz

Marker List

MKR	Frequency	Level	MKR	Frequency	Level
1	79.000 000 000 00 GHz	-10.02 dBm			
2Δ1	10.000 00 kHz	-103.54 dB			
3Δ1	100.000 00 kHz	-104.03 dB			

Spectrum Display
79 GHz Measurement Frequency
(Using High-Performance Waveguide Mixer MA2808A)



Carrier Freq. 79 000 000 000 Hz Reference Level 0.00 dBm
Result Average 10 / 10
Ref -50 dBc/Hz
Carrier Power -8.74 dBm Frequency Error -4.75 Hz

Marker List

MKR	Frequency	Level	MKR	Frequency	Level
1	1 kHz	-86.76 dBc/Hz			
2	10 kHz	-103.10 dBc/Hz			
3	100 kHz	-103.80 dBc/Hz			
4	1 MHz	-117.37 dBc/Hz			

Phase Noise Measurement
79 GHz Measurement Frequency
(Using High-Performance Waveguide Mixer MA2808A)

High-Sensitivity Measurements in Microwave and Millimeter Wave Bands

The MS2840A has excellent display average noise level (DANL) as well as high dynamic range performance. When the built-in preamplifier is on, the DANL supports a high sensitivity measurement performance of better than –160 dBm/Hz in the frequency range from 0.03 GHz to 34 GHz.*1 Even when connected with either of the MA2806A and MS2808A high-performance waveguide mixers (50 GHz to 90 GHz), the MS2840A maintains a performance of –150 dBm/Hz (meas.*2) at 75 GHz, supporting high-sensitivity measurements over a wide frequency range. This performance proves its usefulness in capturing low-level signals and antenna side lobes in test systems with large coupling losses, such as free-space propagation measurements at antenna coupling.

Displayed Average Noise Level (DANL)

Spectrum Analyzer Function

Preamp: None, Microwave Preselector Bypass: None

Frequency	DANL		
	26 .5 GHz Model (MS2840A-044)	44 .5 GHz Model (MS2840A-046)	
		Without MS2840A-019	With MS2840A-019
30 MHz	–153 dBm/Hz	–153 dBm/Hz	–153 dBm/Hz
400 MHz	–153 dBm/Hz	–153 dBm/Hz	–153 dBm/Hz
1 GHz	–150 dBm/Hz	–150 dBm/Hz	–150 dBm/Hz
3 GHz	–147 dBm/Hz	–147 dBm/Hz	–147 dBm/Hz
13 GHz	–151 dBm/Hz	–151 dBm/Hz	–150 dBm/Hz
20 GHz	–146 dBm/Hz	–146 dBm/Hz	–146 dBm/Hz
30 GHz	—	–146 dBm/Hz	–146 dBm/Hz
40 GHz	—	–144 dBm/Hz	–142 dBm/Hz
44 GHz	—	–140 dBm/Hz	–137 dBm/Hz

Preamp: On, Microwave Preselector Bypass: None

Frequency	DANL		
	26 .5 GHz Model (MS2840A-044)	44 .5 GHz Model (MS2840A-046)	
		Without MS2840A-019	With MS2840A-019
30 MHz	–166 dBm/Hz	–166 dBm/Hz	–166 dBm/Hz
400 MHz	–166 dBm/Hz	–166 dBm/Hz	–166 dBm/Hz
1 GHz	–164 dBm/Hz	–164 dBm/Hz	–164 dBm/Hz
3 GHz	–163 dBm/Hz	–163 dBm/Hz	–163 dBm/Hz
13 GHz	–163 dBm/Hz	–163 dBm/Hz	–163 dBm/Hz
20 GHz	–157 dBm/Hz	–160 dBm/Hz	–160 dBm/Hz
30 GHz	—	–160 dBm/Hz	–159 dBm/Hz
40 GHz	—	–157 dBm/Hz	–156 dBm/Hz
44 GHz	—	–149 dBm/Hz	–149 dBm/Hz

Using High-Performance Waveguide Mixer MA2806A/MA2808A

Frequency	DANL
75 GHz	–150 dBm/Hz (meas.*2)

*1: 44.5 GHz (MS2840A-046)
*2: Value measured at design but not guaranteed specification.

Dynamic Range

Frequency	Dynamic Range	DANL/TOI
1 GHz	166 dB	Displayed Average Noise Level (DANL): –150 dBm/Hz Third Order Intercept (TOI): +16 dBm
20 GHz	159 dB	Displayed Average Noise Level (DANL): –146 dBm/Hz Third Order Intercept (TOI): +13 dBm
40 GHz	157 dB	Displayed Average Noise Level (DANL): –144 dBm/Hz Third Order Intercept (TOI): +13 dBm (nom.)

The dynamic range is assumed to be the simple difference between the TOI and DANL.

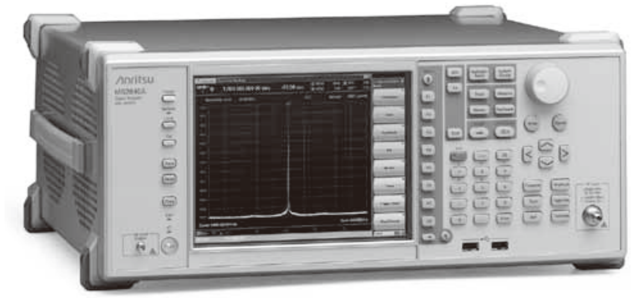
Noise Floor Reduction (MS2840A-051)

The Noise Floor Reduction (NFR) function increases the measurement accuracy for low-level signals. It subtracts the internal noise components (11 dB max. nominal) of the measuring instrument itself from the displayed measurement result.

Faster Measurement Speeds

With a built-in high-performance Intel Core i5-4400E, 2.7 GHz CPU and 8 GB of main memory supporting the 64-bit Windows 7 OS, the MS2840A is much faster than its predecessor MS2830A, offering greatly improved averaging processing times for screen displays and much faster processing when displaying the results of signal analyzer and software analysis functions.

The Signal Analyzer MS2840A is available as two series with two models in each series: 26.5 GHz and 44.5 GHz, and 3.6 GHz and 6 GHz; different options can be installed in each series. The 26.5 GHz and 44.5 GHz models described in this brochure support various measurement functions required for evaluating the Tx characteristics of wireless and transmission devices as well as millimeter- waveband spectrum measurements using a connected mixer.



Signal Analyzer
MS2840A

Standard Functions

Spectrum Analyzer
Signal Analyzer (31.25 MHz Analysis Bandwidth)
Power Meter (Connected to USB Power Sensor)

Options

Signal Analyzer (Analysis Bandwidth Expansion: 62.5 MHz, 125 MHz)
Built-in Preamplifier
Phase Noise Measurement
Precompliance EMI Measurement
Noise Figure Measurement
BER Measurement
Modulation Analysis

Optional Parts

High Performance Waveguide Mixer (50 GHz to 90 GHz)
External Mixer (Harmonic Mixer, 26.5 GHz to 325 GHz)
USB Power Sensor

Typical Measurement Items for Evaluating Tx Characteristics (26.5 GHz and 44.5 GHz models)

✓: Supported

Supported Standard Functions/Options Typical Measurement	Standard Functions			Options/Optional Parts
	Spectrum Analyzer	Signal Analyzer	Others	
Spectrum Trace	✓	✓		
Channel Power	✓	✓		
Occupied Bandwidth	✓	✓		
Adjacent Channel Leakage Power	✓	✓		
Spectrum Emission Mask	✓			
Burst Average Power	✓	✓		
Spurious Emission	✓			
AM Depth		✓		✓ Analog Measurement Software MX269018A
FM Deviation		✓		✓ Analog Measurement Software MX269018A
Multi-marker & Marker List	✓	✓		
Highest 10 Markers	✓	✓		
Limit Line	✓			
Frequency Counter	✓			
TOI	✓			
Hide Settings and Numeric Results	✓			
Power Meter Function (connected to USB Power Sensor)			✓	
Phase Noise Measurement				✓ Phase Noise Measurement Function MS2840A-010
EMI Measurement				✓ Precompliance EMI Function MS2840A-016
Vector Modulation Analysis (EVM, etc.)				✓ Vector Modulation Analysis Software MX269017A
Analog Modulation Analysis (AM/FM/ΦM) (FM Deviation, Demodulation Frequency, etc.)				✓ Analog Measurement Software MX269018A
Millimeter-wave Band Spectrum Measurement using Connected Mixer				✓ High Performance Waveguide Mixer MA2806A/MS2808A (50 GHz to 90 GHz) ✓ External Mixer (Harmonic Mixer) MA2740C/MA2750C series (26.5 GHz to 325 GHz)

Other Measurement Items (26.5 GHz and 44.5 GHz models)

✓: Supported

Supported Standard Functions/Options Typical Measurement	Standard Functions			Options/Optional Parts
	Spectrum Analyzer	Signal Analyzer	Others	
Noise Figure Measurement				✓ Noise Figure Measurement Function MS2840A-017
BER Measurement				✓ BER Measurement Function MS2840A-026

Versatile Standard Functions

The built-in spectrum and signal analyzer functions can be used to evaluate the Tx characteristics of wireless devices and transmitters by running easy tests, etc., in accordance with specifications.

Measure Function	Spectrum Analyzer (Standard)	Signal Analyzer (Standard)
Spectrum Trace	✓	✓
Channel Power	✓	✓
Occupied Bandwidth	✓	✓
Adjacent Channel Leakage Power	✓	✓
Spectrum Emission Mask	✓	
Burst Average Power	✓	✓
Spurious Emission	✓	
AM Depth		✓
FM Deviation		✓
Multi-marker & Marker List	✓	✓
Highest 10 Markers	✓	✓
Limit Line	✓	
Frequency Counter	✓	
TOI	✓	
Hide Settings and Numeric Results	✓	

Power Meter Function (USB Power Sensor Connection)

Connecting the optional USB Power Sensor to the MS2840A supports Power and Relative Power measurements.

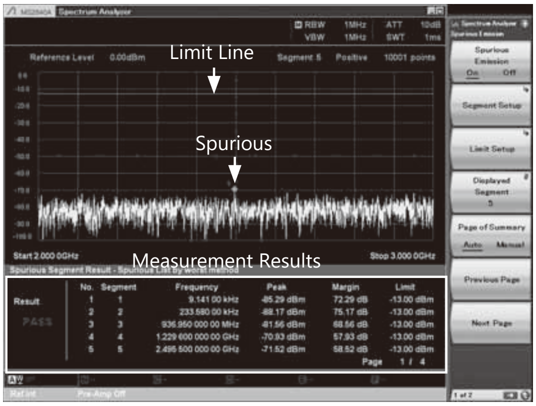
Compatible USB power sensors.

Model	Frequency Range	Dynamic Range
MA24104A*	600 MHz to 4 GHz	+3 to +51.76 dBm
MA24105A	350 MHz to 4 GHz	+3 to +51.76 dBm
MA24106A	50 MHz to 6 GHz	–40 to +23 dBm
MA24108A	10 MHz to 8 GHz	–40 to +20 dBm
MA24118A	10 MHz to 18 GHz	–40 to +20 dBm
MA24126A	10 MHz to 26 GHz	–40 to +20 dBm

*: MA24104A has been discontinued.

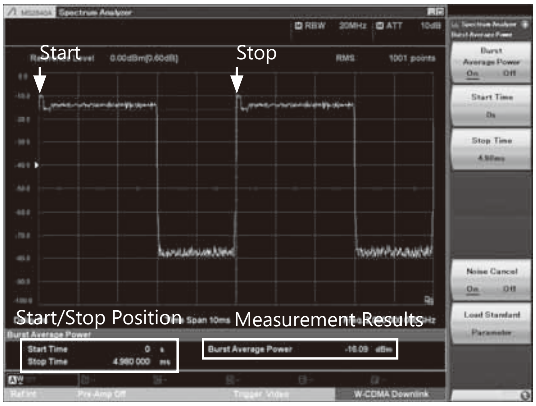
Spurious Emission

This function splits the frequency range into up to 20 segments for sweeping; the measurement parameters and limit lines can be specified to measure the peak power and margin for each segment.
The results are tabulated below the trace and marked PASS/FAIL.



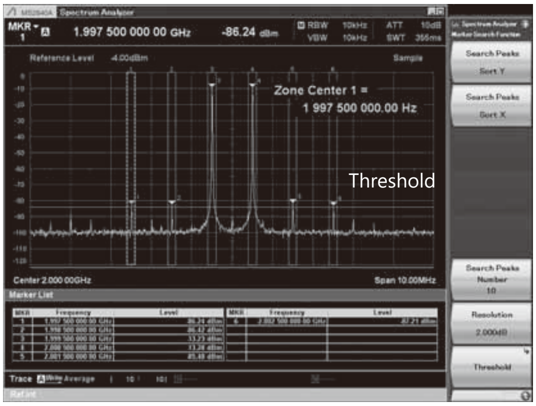
Burst Average Power

The average power for the range specified by two markers is displayed in the time domain. Measurement only requires setting the measurement start and stop positions on the screen. True performance is measured using the noise cancellation function to subtract main-frame noise from the measurement result.
Pre-installed templates for each standard support easy parameter setting.



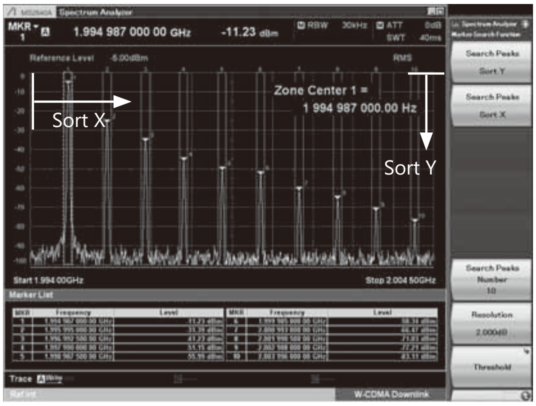
Multi-marker & Marker List

Up to 10 markers can be set for this function. Markers may be either a spot or a zone. Using a zone marker, the peak of a signal with an unstable variable frequency can be tracked and measured.
Not only can the 10 markers be listed below the trace but the differences between markers can be calculated and displayed using the delta setting.



Highest 10 Markers

This function sets the threshold level and auto-detects peaks in the X (frequency) and Y (level/time) directions.

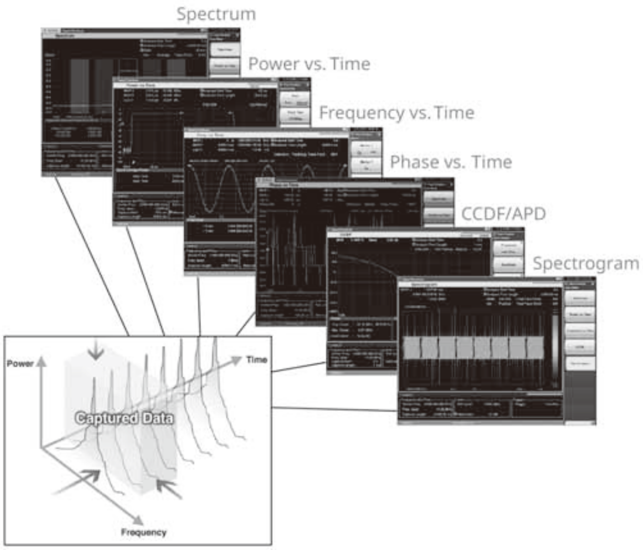


Signal Analyzer (Standard)

The MS2840A has a built-in 31.25 MHz bandwidth Fast Fourier Transformation (FFT) analysis function supporting multi-domain analysis of captured measured signals. Since it can capture phenomena such as spectrum transients that cannot be captured by conventional sweep-type spectrum analyzers, it improves the efficiency of troubleshooting. The analysis bandwidth can be expanded to either 62.5 MHz or 125 MHz as options.
In addition, add the Microwave Preselector Bypass (MS2840A-067) option when using the signal analyzer measurement function at a bandwidth of >31.25 MHz and a frequency of >6 GHz.

Measurement Functions

- Spectrum trace
- Frequency vs. Time
- CCDF/APD
- Power vs. Time
- Phase vs. Time
- Spectrogram



Analysis Bandwidth:
31.25 MHz (Standard)
50 MHz max. sampling rate = 20 ns resolution, ADC resolution 16 bits)
62.5 MHz (MS2840A-077)
(100 MHz max. sampling rate = 10 ns resolution, ADC resolution 14 bits)
125 MHz (MS2840A-077/078)
(200 MHz max. sampling rate = 5 ns resolution, ADC resolution 14 bits)

Max. Capture Time: 0.5 s to 2000 s

Max. Number of Samples: 100 Msamples

Note: An image response is received when setting the bandwidth to more than 31.25 MHz. This can be used when not inputting a signal frequency outside the MS2840A analysis bandwidth (125 MHz max.).

Option

Analysis Bandwidth Extension to 62.5 MHz (MS2840A-077)
Extends analysis bandwidth to 62.5 MHz.
Analysis Bandwidth Extension to 125 MHz (MS2840A-078*)
Extends analysis bandwidth to 125 MHz.

*: Requires MS2840A-077.

Capture & Replay Function

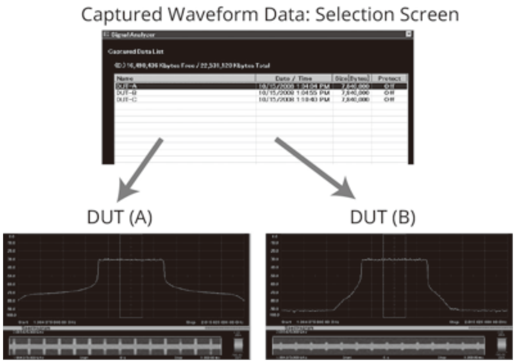
Waveform data can be saved (captured) to the internal memory.
In addition, previously saved waveform data can be loaded (replayed) to reproduce result displays whenever necessary using measurement functions.

The following chart shows the maximum capture time per frequency span.

Span	Sampling Rate	Capture Time	Max. Sampling Data
1 kHz	2 kHz	2000 s	4M
2.5 kHz	5 kHz	2000 s	10M
5 kHz	10 kHz	2000 s	20M
10 kHz	20 kHz	2000 s	40M
25 kHz	50 kHz	2000 s	100M
50 kHz	100 kHz	1000 s	100M
100 kHz	200 kHz	500 s	100M
250 kHz	500 kHz	200 s	100M
500 kHz	1 MHz	100 s	100M
1 MHz	2 MHz	50 s	100M
2.5 MHz	5 MHz	20 s	100M
5 MHz	10 MHz	10 s	100M
10 MHz	20 MHz	5 s	100M
25 MHz	50 MHz	2 s	100M
31.25 MHz	50 MHz	2 s	100M
50 MHz	100 MHz	500 ms	50M
62.5 MHz	100 MHz	500 ms	50M
100 MHz	200 MHz	500 ms	100M
125 MHz	200 MHz	500 ms	100M

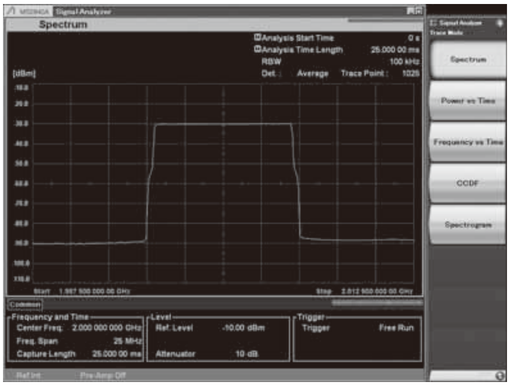
Replay Usage Examples

- Sharing data between development and manufacturing sections at separate locations
- Transferring signals captured onsite for later in-house analysis
- Saving product shipping data for later warranty-claim confirmation



Spectrum trace

The CCDF trace displays the power variation probability on the y-axis and power variation on the y-axis to confirm the CCDF and APD of measured signals.



Spectrum
Analysis Start Time 0 s
Analysis Time Length 25.000 00 ms
RBW 100 kHz
Det. : Average Trace Point : 1025
Start 1.987 500 000 00 GHz
Stop 2.012 500 000 00 GHz

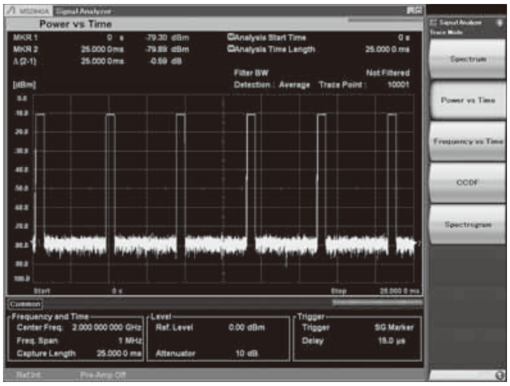
Frequency and Time
Center Freq. 2.000 000 000 GHz
Freq. Span 25 MHz
Capture Length 25.000 00 ms

Level
Ref. Level -10.00 dBm
Attenuator 10 dB

Trigger
Trigger Free Run

Power vs. Time

The Power vs. Time trace displays a graph with amplitude on the y-axis and time on the x-axis to confirm changes in power with time of measured signals.



Power vs Time
MKR 1 0 s -79.30 dBm
MKR 2 25.000 0 ms -79.89 dBm
Δ (2-1) 25.000 0 ms -0.59 dB
Analysis Start Time 0 s
Analysis Time Length 25.000 0 ms
Filter BW Not Filtered
Detection : Average Trace Point : 10001
Start 0 s
Stop 25.000 0 ms

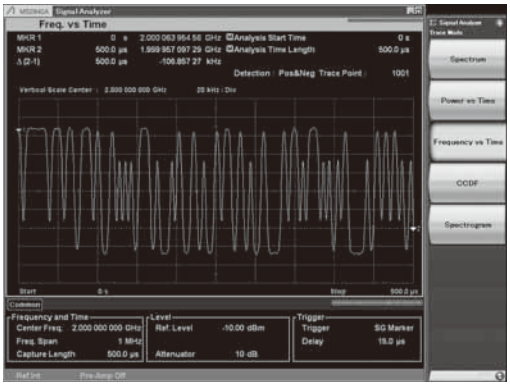
Frequency and Time
Center Freq. 2.000 000 000 GHz
Freq. Span 1 MHz
Capture Length 25.000 0 ms

Level
Ref. Level 0.00 dBm
Attenuator 10 dB

Trigger
Trigger SG Marker
Delay 15.0 μs

Frequency vs. Time

The Frequency vs. Time trace displays a graph with frequency on the y-axis and time on the x-axis to confirm time variation of the measured signal frequency.



Freq. vs Time
MKR 1 0 s 2.000 063 954 56 GHz
MKR 2 500.0 μs 1.999 957 097 29 GHz
Δ (2-1) 500.0 μs -106.857 27 kHz
Analysis Start Time 0 s
Analysis Time Length 500.0 μs
Detection : Pos&Neg Trace Point : 1001
Vertical Scale Center : 2.000 000 000 GHz 25 kHz / Div
Start 0 s
Stop 500.0 μs

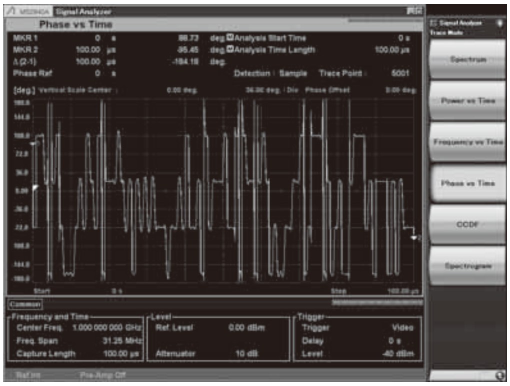
Frequency and Time
Center Freq. 2.000 000 000 GHz
Freq. Span 1 MHz
Capture Length 500.0 μs

Level
Ref. Level -10.00 dBm
Attenuator 10 dB

Trigger
Trigger SG Marker
Delay 15.0 μs

Phase vs. Time

The Phase vs. Time trace displays a graph with phase on the y-axis and time on the x-axis to confirm time variation of the measured signal phase.



Phase vs Time
MKR 1 0 s 88.73 deg
MKR 2 100.00 μs -95.45 deg
Δ (2-1) 100.00 μs -184.18 deg
Phase Ref 0 s
Analysis Start Time 0 s
Analysis Time Length 100.00 μs
Detection : Sample Trace Point : 5001
Start 0 s
Stop 100.00 μs

Frequency and Time
Center Freq. 1.000 000 000 GHz
Freq. Span 31.25 MHz
Capture Length 100.00 μs

Level
Ref. Level 0.00 dBm
Attenuator 10 dB

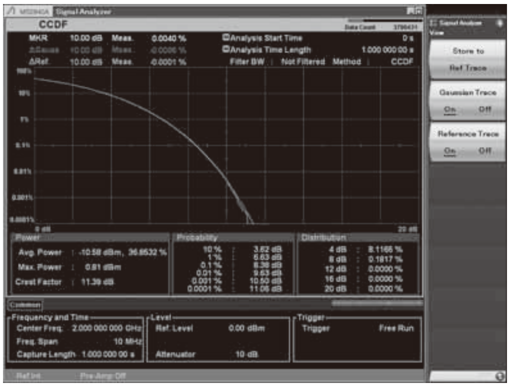
Trigger
Trigger Video
Delay 0 s
Level -40 dBm

CCDF/APD

The CCDF trace displays the power variation probability on the y-axis and power variation on the y-axis to confirm the CCDF and APD of measured signals.

CCDF (Complementary Cumulative Distribution Function):
The CCDF display indicates the cumulative distribution of transient power variations compared to average power.

APD (Amplitude Probability Density):
The APD display indicates the probability distribution of transient power.



CCDF
MKR 10.00 dB Meas. 0.0040 %
ΔRef. 10.00 dB Meas. -0.0001 %
Analysis Start Time 0 s
Analysis Time Length 1.000 000 00 s
Filter BW : Not Filtered Method : CCDF

Power
Avg. Power : -10.58 dBm, 36.8532 %
Max. Power : 0.81 dBm
Crest Factor : 11.39 dB

Probability	
10 %	3.82 dB
1 %	6.63 dB
0.1 %	8.38 dB
0.01 %	9.63 dB
0.001 %	10.50 dB
0.0001 %	11.06 dB

Distribution	
4 dB	8.1166 %
8 dB	0.1817 %
12 dB	0.0000 %
16 dB	0.0000 %
20 dB	0.0000 %

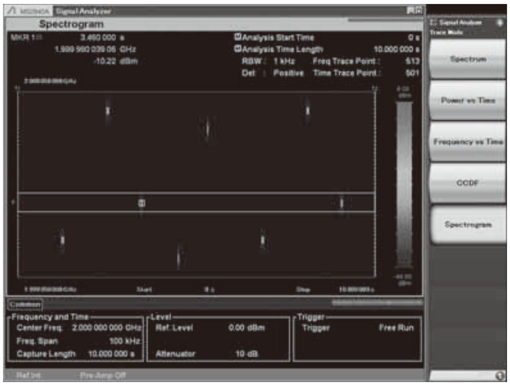
Frequency and Time
Center Freq. 2.000 000 000 GHz
Freq. Span 10 MHz
Capture Length 1.000 000 00 s

Level
Ref. Level 0.00 dBm
Attenuator 10 dB

Trigger
Trigger Free Run

Spectrogram

The Spectrogram trace displays the level as color with frequency on the y-axis and time on the x-axis. The captured IQ data is FFT processed to confirm time variations in the continuous spectrum.
It is useful for monitoring frequency hopping and transient signals.



Spectrogram
MKR 1 3.460 000 s
1.999 960 039 06 GHz
-10.22 dBm
Analysis Start Time 0 s
Analysis Time Length 10.000 000 s
RBW : 1 kHz Freq Trace Point : 513
Det : Positive Time Trace Point : 501
Start 0 s

Frequency and Time
Center Freq. 2.000 000 000 GHz
Freq. Span 100 kHz
Capture Length 10.000 000 s

Level
Ref. Level 0.00 dBm
Attenuator 10 dB

Trigger
Trigger Free Run

Other Measurement Functions

Phase Noise Measurement Function (MS2840A-010)

The excellent close-in phase noise performance of the MS2840A supports phase noise measurement of transmitters with a frequency offset range of 10 Hz to 10 MHz and also supports when connected to the High Performance Waveguide Mixer (MA2806A, MA2808A).

Measurement Results

- Carrier level
- Error between set frequency and carrier frequency
- Marker point phase noise level

There are four measurement modes using different loop filters, which are switched to match the DUT.

Auto:
This mode switches automatically to the best loop filter for measuring the carrier signal close-in and wide-offset phase noise characteristics.

Best Close-in:
This mode uses the best loop filter for measuring the carrier signal close-in phase noise characteristics.

Best Wide-offset:
This mode uses the best loop filter for measuring the carrier signal wide-offset phase noise characteristics.

Balance:
This mode uses the loop filter with a good balance for measuring both close-in and wide-offset phase noise characteristics of the carrier signal.

Carrier Freq. 1 000 000 000 Hz
Reference Level 0.00 dBm
ATT 0 dB
Average 10 / 10
Carrier Power -0.54 dBm
Frequency Error 0.13 Hz

MKR	Frequency	Level	MKR	Frequency	Level
1	10 Hz	-78.50 dBc/Hz	5	100 kHz	-129.53 dBc/Hz
2	100 Hz	-98.67 dBc/Hz	6	1 MHz	-137.73 dBc/Hz
3	1 kHz	-119.23 dBc/Hz	7	10 MHz	-143.25 dBc/Hz
4	10 kHz	-128.03 dBc/Hz			

Measurement Screen

Precompliance EMI Function (MS2840A-016)

This option adds an EMI measurement detection mode and RBW to the spectrum analyzer function. Both the detection mode used for CISPR standards (Quasi-Peak, CISPR-AVG, RMS-AVG) and RBW (200 Hz (6 dB), 9 kHz (6 dB), 120 kHz (6 dB), 1 MHz (Imp)) as well as conventional settings can be selected.

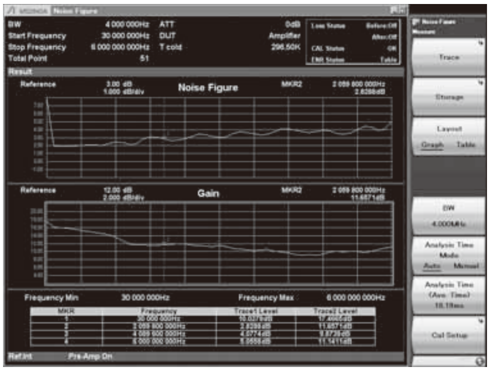
Noise Figure Measurement Function (MS2840A-017)

Noise Figure is measured with the measurement method of Y-factor method which uses a Noise Source.
The Noisecom NC346 series* of noise sources is supported.
*: Refer to the MS2840A Data Sheet for more details.

Frequency Range (Noise sauce): 0.01 GHz to 40.0 GHz
Frequency Mode: Fixed, List, Sweep
DUT Mode: Amplifier, Down Converter, Up Converter
Screen Layout: Graph, Table

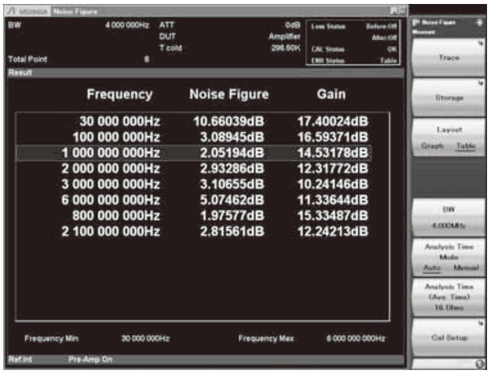
Measurement Results Display
Graph/List/Spot

Displays measurement results for each trace (Trace1/Trace2).
Noise Figure (NF) [dB]
Noise Factor (F) [Linear]
Gain
Y-Factor: Power ratio when Noise Source is turned On/Off
T effective: Effective noise temperature
P Hot: Power measured when Noise Source is On.
P Cold: Power measured when Noise Source is Off.



BW 4 000 000Hz
Start Frequency 30 000 000Hz
Stop Frequency 6 000 000 000Hz
Total Point 51
ATT 0dB
DUT Amplifier
T cold 296.50K
Frequency Min 30 000 000Hz
Frequency Max 6 000 000 000Hz

Measurement Result: Example of Graph display
(Frequency Mode: Sweep, Screen Layout: Graph)

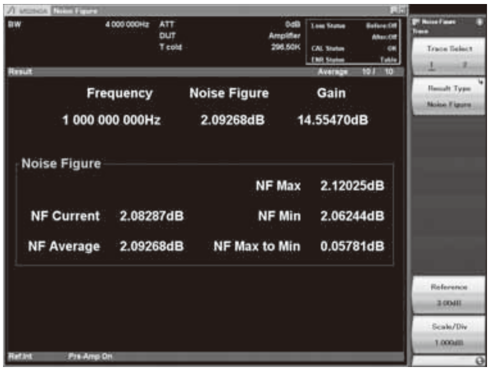


BW 4 000 000Hz
ATT 0dB
DUT Amplifier
T cold 296.50K
Total Point 8

Frequency	Noise Figure	Gain
30 000 000Hz	10.66039dB	17.40024dB
100 000 000Hz	3.08945dB	16.59371dB
1 000 000 000Hz	2.05194dB	14.53178dB
2 000 000 000Hz	2.93286dB	12.31772dB
3 000 000 000Hz	3.10655dB	10.24146dB
6 000 000 000Hz	5.07462dB	11.33644dB
800 000 000Hz	1.97577dB	15.33487dB
2 100 000 000Hz	2.81561dB	12.24213dB

Frequency Min 30 000 000Hz
Frequency Max 6 000 000 000Hz

Measurement Result: Example of List display
(Frequency Mode: List, Screen Layout: List)



BW 4 000 000Hz
ATT 0dB
DUT Amplifier
T cold 296.50K
Average 10 / 10

Frequency	Noise Figure	Gain
1 000 000 000Hz	2.09268dB	14.55470dB

Noise Figure

NF Max 2.12025dB
NF Current 2.08287dB
NF Min 2.06244dB
NF Average 2.09268dB
NF Max to Min 0.05781dB

Measurement Result: Example of Spot display
(Frequency Mode: Fixed)

BER Measurement Function (MS2840A-026)

The MS2840A with the BER Measurement Function MS2840A-026 supports measurement up to 10 Mbps.
It supports Rx sensitivity tests by inputting the receiver-demodulated Data/Clock/Enable to the back of the MS2840A.

- Input Signal: Data, Clock, Enable (Polarity reversal supported)
- Input Bit Rate: 100 bps to 10 Mbps
- Input Level: TTL 3.3 V
- Connector: Rear panel, AUX connector*

*: Can convert to BNC by connecting AUX conversion adapter (J1556A).

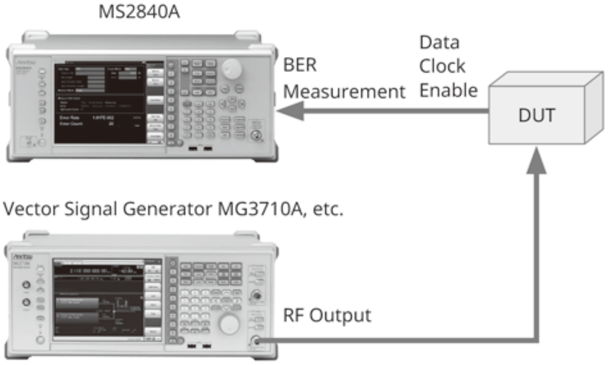
- Measured Patterns:
  PN9, PN11, PN15, PN20, PN23, ALL0, ALL1, Alternate (0101…), PN9Fix, PN11Fix, PN15Fix, PN20Fix, PN23Fix, UserDefine (4096 bits max.)
- Measurable Bit Count: 1000 to 4294967295 bits (2^{32} – 1 bits)
- Measurable Error Bit Count: 1 to 2147483647 bits (2^{31} – 1 bits)
- Count Mode
  Data: Measures until specified Data count
  Error: Measures until specified Error count
- Measurement Mode
  Single: Measures specified measurement bit count once
  Continuous: Repeats Single measurement
  Endless: Continues measurement to upper limit of measurement bits

Data Type: PN9
Pattern File
Bit Length
Sync Position Start
Sync Position Length
Measure Mode: Single
Count Mode: Data
Data: 10000 Bit
Error: Bit

Measure Information
Status: Stop Synchronizing Measuring
Error: BitError SyncLoss ClockError EnableError
SyncLoss Count: 0

Error Rate 1.017E-002 1.017%
Error Count 20 / 1967

BER Measurement Function Main Screen



BER Measurement Setup Example
(using external vector signal generator)

Measurement Software Options

Vector Modulation Analysis Software (MX269017A)

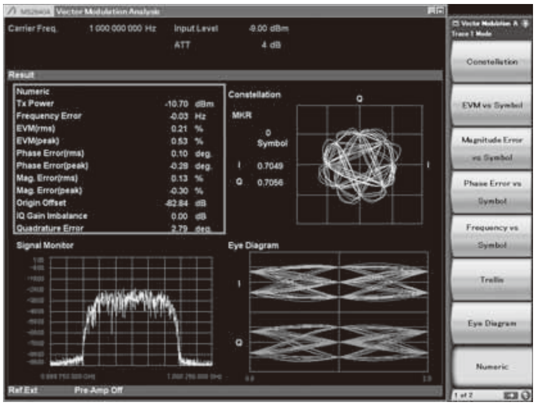
This software measures the modulation accuracy, carrier frequency, Tx power, etc., for each type of digital radio.

Supported Modulation Methods

Standard
BPSK, QPSK, O-QPSK, π/4DQPSK, 8PSK, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM, 2FSK, 4FSK, 2ASK, 4ASK, H-CPM*, MSK
*: Used for APCO-P25 Phase2 Inbound measurement
Option: APSK Analysis (MX269017A-001)
16APSK, 32APSK
Option: Higher-Order QAM Analysis (MX269017A-011)
512QAM, 1024QAM, 2048QAM

Frequency Setting Range

100 kHz to 44.5 GHz
(300 MHz to 6 GHz depending on measured symbol rate)



Carrier Freq. 1 000 000 000 Hz Input Level -9.00 dBm
ATT 4 dB

Result

Numeric		
Tx Power	-10.70	dBm
Frequency Error	-0.03	Hz
EVM(rms)	0.21	%
EVM(peak)	0.53	%
Phase Error(rms)	0.10	deg.
Phase Error(peak)	-0.29	deg.
Mag. Error(rms)	0.13	%
Mag. Error(peak)	-0.30	%
Origin Offset	-82.84	dB
IQ Gain Imbalance	0.00	dB
Quadrature Error	2.79	deg.

MKR 0 Symbol
I 0.7049
Q 0.7056

Ref.Ext Pre-Amp Off

Measurement Screen

Analog Measurement Software (MX269018A)

When this software is installed in the MS2840A, the Tx performance (carrier frequency, Tx power, modulation rate/frequency deviation, demodulation frequency, demodulation signal distortion rate, etc.) of analog radios can be measured.

* The Audio Analyzer and Analog Signal Generator cannot be installed in the MS2840A.
* This software cannot be installed in the MS2830A 26.5 GHz/43 GHz models, but can be installed in the MS2840A 26.5 GHz/44.5 GHz models.

Supported Modulations

AM, FM, ΦM

Frequency Range

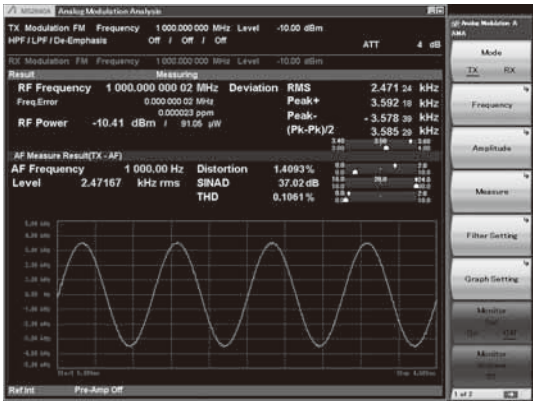
100 kHz to 2700 MHz
(At Wide Band FM measurement: 10 MHz to 2700 MHz)

Weighting Filter

CCITT, C-Message, CCIR 468, CCIR-ARM, A-Weighting

De-emphasis

25, 50, 75, 500, 750 µs



TX Modulation FM Frequency 1 000.000 000 MHz Level -10.00 dBm
HPF / LPF / De-Emphasis Off / Off / Off ATT 4 dB
RX Modulation FM Frequency 1 000.000 000 MHz Level -10.00 dBm

Result Measuring
RF Frequency 1 000.000 000 02 MHz
Freq.Error 0.000 000 02 MHz
0.000023 ppm
RF Power -10.41 dBm / 91.05 µW
Deviation RMS 2.471 24 kHz
Peak+ 3.592 18 kHz
Peak- -3.578 39 kHz
(Pk-Pk)/2 3.585 29 kHz

AF Measure Result(TX - AF)
AF Frequency 1 000.00 Hz
Level 2.47167 kHz rms
Distortion 1.4093 %
SINAD 37.02 dB
THD 0.1061 %

Ref.Int Pre-Amp Off

Measurement Screen

Refer to the MX2690xxA Series Measurement Software catalog for details.

Other Options

Rubidium Reference Oscillator (MS2840A-001)

This option is a 10-MHz reference crystal oscillator with excellent frequency stability startup characteristics of ±1 × 10^{-9} at 7 minutes after power-on.

Aging Rate: ±1 × 10^{-10}/month, ±1 × 10^{-9}/year
Start-up Characteristics: ±1 × 10^{-9} (7 minutes after power-on)

Preamplifier (MS2840A-008)

This option is for the 26.5 GHz/44.5 GHz models (MS2840A-044/046) and the 3.6 GHz/6 GHz models (MS2840A-040/041).
The gain of about 20 dB improves the Displayed Average Noise Level (DANL). This preamplifier is used to measure low-level signals such as noise and interference.

Frequency Range: 100 kHz to 6 GHz

26.5 GHz Microwave Preamplifier (MS2840A-069)

This option is for the 26.5 GHz model (MS2840A-044).
The gain of about 20 dB improves the Displayed Average Noise Level (DANL). This preamplifier is used to measure low-level signals, such as noise and interference.

Frequency Range: 100 kHz to 26.5 GHz

Microwave Preamplifier (MS2840A-068)

This option is for the 44.5 GHz model (MS2840A-046).
The gain of about 20 dB improves the Displayed Average Noise Level (DANL). This preamplifier is used to measure low-level signals, such as noise and interference.

Frequency Range: 100 kHz to 44.5 GHz

2ndary SSD (MS2840A-011)

This removable SSD is for storing user data.
It has no installed OS. It is shipped mounted in the Secondary HDD/SSD slot of the MS2840A main unit.

Microwave Preselector Bypass (MS2840A-067)

Bypassing the preselector used for the microwave band improves RF frequency characteristics and in-band frequency characteristics.
Add this option when the signal analyzer measurement function is set to a frequency band of >31.25 MHz and a frequency of >6 GHz.

2 dB Step Attenuator for Millimeter-wave (MS2840A-019)

This option is for the 44.5 GHz model (MS2840A-046).
The attenuator resolution is expanded to 2 dB (Standard resolution is 10 dB) and input level to internal mixer can be adjusted with high resolution. As a result, the radio test products using micro and millimeter wave which require wide dynamic range can be measured with a sufficient margin.

Noise Floor Reduction (MS2840A-051)

The Noise Floor Reduction (NFR) function increases the measurement accuracy for low-level signals. It subtracts the internal noise components (11 dB max. nominal) of the measuring instrument itself from the displayed measurement result.

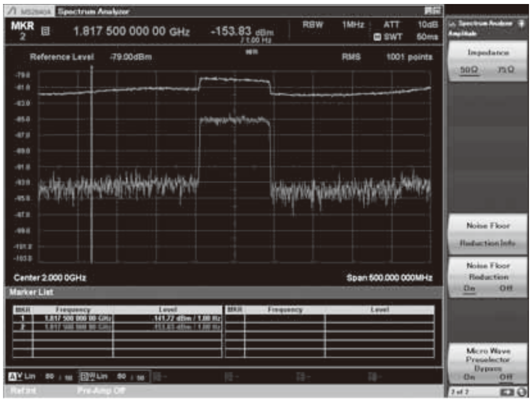
When the NFR function is used with a connected external mixer (High Performance Waveguide Mixer MA2806A/MA2808A), it measures V- and E-band millimeter waveband applications with high dynamic range.

<Main Applications>

- Spurious Emission
- Spectrum Mask
- Adjacent Channel Leakage Power (ACLR)
- Power ON/OFF ratio

Measurement times using the NFR function remain unchanged.
The NFR function eliminates the procedure of measuring the instrument noise floor each time like using the earlier noise cancelling function. If the noise floor is measured once when an ambient temperature change affects the noise floor level or when an external mixer is connected, the NFR effect can be captured by the same operation as normal measurement, unless there is a change in these conditions.

[Notes]
The NFR function is enabled only by the Spectrum Analyzer function.
The design value is nominal and is not a guaranteed specification.



MKR 2 1.817 500 000 00 GHz -153.83 dBm
RBW 1MHz ATT 10dB SWT 50ms
Reference Level -79.00dBm RMS 1001 points
Center 2.000 0GHz Span 500.000 000MHz

Measurement Screen

High Performance Waveguide Mixer/External Mixers (Harmonic Mixers)

Two types of mixer can be connected to the MS2840A series (26.5 GHz/44.5 GHz models) for millimeter-wave-band measurements; spectrum measurements up to 325 GHz are supported using either a High-Performance Waveguide Mixer or an external harmonic mixer. In particular, the two High Performance Waveguide Mixer models are ideal for measuring wideband signals and the excellent phase noise performance of the MS2840A series (26.5 GHz/44.5 GHz models)plays a key role in analyzing the true spectrum of millimeter-wave-band transmitters.

High Performance Waveguide Mixer MA2806A/MA2808A

Model	Name	Frequency Band	Frequency Range	Waveguide	Flange
MA2806A	High Performance Waveguide Mixer (50 to 75 GHz)	V band	50 GHz to 75 GHz	WR15	UG-385/U
MA2808A	High Performance Waveguide Mixer (60 to 90 GHz)	E band	60 GHz to 90 GHz	WR12	UG-387/U

MA2808A

Features

- •Wide dynamic range based on excellent minimum sensitivity and P1dB performance
- •High phase noise performance connected to MS2840A
- •Image-response-free measurement of wideband signals plus high IF frequency and PS function*

*: Patented

For Further information see MA2806A/MA2808A page.

External Mixers (Harmonic Mixers)

The MA2740C/MA2750C series of external mixers (harmonic mixers) supports spectrum measurements up to 325 GHz with excellent cost performance.

Model	Name	Frequency Band	Frequency Range	Waveguide	Flange
MA2741C	External Mixer	A Band	26.5 GHz to 40 GHz	WR28	MIL-DTL-3922/54-003
MA2742C	External Mixer	Q Band	33 GHz to 50 GHz	WR22	MIL-DTL-3922/67D-006
MA2743C	External Mixer	U Band	40 GHz to 60 GHz	WR19	MIL-DTL-3922/67D-007
MA2744C	External Mixer	V Band	50 GHz to 75 GHz	WR15	MIL-DTL-3922/67D-008
MA2745C	External Mixer	E Band	60 GHz to 90 GHz	WR12	MIL-DTL-3922/67D-009
MA2746C	External Mixer	W Band	75 GHz to 110 GHz	WR10	MIL-DTL-3922/67D-010
MA2747C	External Mixer	F Band	90 GHz to 140 GHz	WR08	MIL-DTL-3922/67D-M08
MA2748C	External Mixer	D Band	110 GHz to 170 GHz	WR06	MIL-DTL-3922/67D-M06
MA2749C	External Mixer	G Band	140 GHz to 220 GHz	WR05	MIL-DTL-3922/67D-M05
MA2750C	External Mixer	Y Band	170 GHz to 260 GHz	WR04	MIL-DTL-3922/67D-M04
MA2751C	External Mixer	J Band	220 GHz to 325 GHz	WR03	MIL-DTL-3922/67D-M03

Configurations

Configuration List

Model	Name	Remarks
MS2840A	Signal Analyzer	Analysis Bandwidth 31.25 MHz installed as standard
MS2840A-044	26.5 GHz Signal Analyzer	
MS2840A-046	44.5 GHz Signal Analyzer	
MS2840A-001	Rubidium Reference Oscillator	Option
MS2840A-077	Analysis Bandwidth Extension to 62.5 MHz	Option
MS2840A-078	Analysis Bandwidth Extension to 125 MHz	Option, requires MS2840A-077
MS2840A-008	Preamplifier	Option, Frequency Range: 100 kHz to 6 GHz
MS2840A-069	26.5 GHz Microwave Preamplifier	Option, For MS2840A-044, Frequency Range: 100 kHz to 26.5 GHz
MS2840A-068	Microwave Preamplifier	Option, For MS2840A-046, Frequency Range: 100 kHz to 44.5 GHz
MS2840A-010	Phase Noise Measurement Function	Option
MS2840A-011	2ndary SSD	Option
MS2840A-016	Precompliance EMI Function	Option
MS2840A-017	Noise Figure Measurement Function	Option
MS2840A-019	2 dB Step Attenuator for Millimeter-wave	Option, For MS2840A-046
MS2840A-026	BER Measurement Function	Option, AUX Conversion Adapter J1556A as standard accessory
MS2840A-051	Noise Floor Reduction	Option
MS2840A-067	Microwave Preselector Bypass	Option, Add this option when the signal analyzer measurement function is set to a frequency band of >31.25 MHz and a frequency of >6 GHz.

The following options are installed as standard and do not require separate orders when ordering the MS2840A-044.

Standard Software	MX269000A
Analysis Bandwidth 10 MHz	MS2840A-006
Bandwidth Extension to 31.25 MHz	MS2840A-005

The following options are installed as standard and do not require separate orders when ordering the MS2840A-046.

Standard Software	MX269000A
Analysis Bandwidth 10 MHz	MS2840A-006
Bandwidth Extension to 31.25 MHz for Millimeter Wave	MS2840A-009

List of Retrofit Options

The following hardware options can be retrofitted. Add to the retrofit options at ordering and also order the Retrofit Kit Z1932A.
In addition, the MS2840A main unit must be returned to the Anritsu plant for remodelling when retrofitting hardware options.

Model	Name	Remarks
MS2840A-101	Rubidium Reference Oscillator Retrofit	
MS2840A-177	Analysis Bandwidth Extension to 62.5 MHz Retrofit	
MS2840A-178	Analysis Bandwidth Extension to 125 MHz Retrofit	Requires MS2840A-077 or -177
MS2840A-108	Preamplifier Retrofit	Frequency Range: 100 kHz to 6 GHz
MS2840A-169	26.5 GHz Microwave Preamplifier Retrofit	For MS2840A-044, Frequency Range: 100 kHz to 26.5 GHz
MS2840A-168	Microwave Preamplifier Retrofit	For MS2840A-046, Frequency Range: 100 kHz to 44.5 GHz
MS2840A-110	Phase Noise Measurement Function Retrofit	
MS2840A-111	2ndary SSD Retrofit	
MS2840A-116	Precompliance EMI Function Retrofit	
MS2840A-117	Noise Figure Measurement Function Retrofit	
MS2840A-119	2 dB Step Attenuator for Millimeter-wave Retrofit	Option, For MS2840A-046
MS2840A-126	BER Measurement Function Retrofit	AUX Conversion Adapter J1556A as standard accessory
MS2840A-151	Noise Floor Reduction Retrofit	Option
MS2840A-167	Microwave Preselector Bypass Retrofit	Add this option when the signal analyzer measurement function is set to a frequency band of >31.25 MHz and a frequency of >6 GHz.

Software

The following software can be retrofitted. Add to the required software at ordering and also order the Retrofit Kit Z1932A.

Model	Name	Remarks
MX269017A	Vector Modulation Analysis Software	
MX269017A-001	APSK Analysis	Requires MX269017A
MX269017A-011	Higher-Order QAM Analysis	Requires MX269017A
MX269018A	Analog Measurement Software	Requires USB Audio A0086C

Mixer (External)

Model	Name	Remarks
MA2606A	High Performance Waveguide Mixer (50 to 75 GHz)	
MA2608A	High Performance Waveguide Mixer (60 to 90 GHz)	
MA2741C	External Mixer (26.5 to 40 GHz)	Harmonic Mixer
MA2742C	External Mixer (33 to 50 GHz)	Harmonic Mixer
MA2743C	External Mixer (40 to 60 GHz)	Harmonic Mixer
MA2744C	External Mixer (50 to 75 GHz)	Harmonic Mixer
MA2745C	External Mixer (60 to 90 GHz)	Harmonic Mixer
MA2746C	External Mixer (75 to 110 GHz)	Harmonic Mixer
MA2747C	External Mixer (90 to 140 GHz)	Harmonic Mixer
MA2748C	External Mixer (110 to 170 GHz)	Harmonic Mixer
MA2749C	External Mixer (140 to 220 GHz)	Harmonic Mixer
MA2750C	External Mixer (170 to 260 GHz)	Harmonic Mixer
MA2751C	External Mixer (220 to 325 GHz)	Harmonic Mixer

Signal Analyzer Specifications

Refer to the MS2840A Data Sheet for more details.

Frequency Range

9 kHz to 26 .5 GHz (MS2840A-044)
9 kHz to 44 .5 GHz (MS2840A-046)

Aging Rate

±1 × 10^{-7}/year (standard)
±1 × 10^{-10}/month, ±1 × 10^{-9}/year
(with Rubidium Reference Oscillator MS2840A-001 installed)

Maximum Input Level

Average total power: +30 dBm
(Input attenuator: ≥10 dB, Preamp: Off)

Resolution Bandwidth (RBW)

Spectrum Analyzer Function
Setting Range:
1 Hz to 3 MHz (1–3 sequence), 500 Hz, 50 kHz, 2 MHz, 5 MHz, 10 MHz, 20 MHz*
[At Zero SPAN: 30 Hz to 3 MHz (1–3 sequence), 50 kHz, 5 MHz, 10 MHz, 20 MHz*, 31.25 MHz*]
*: Cannot set 20 MHz or 31.25 MHz with 44.5 GHz model (MS2840A-046)

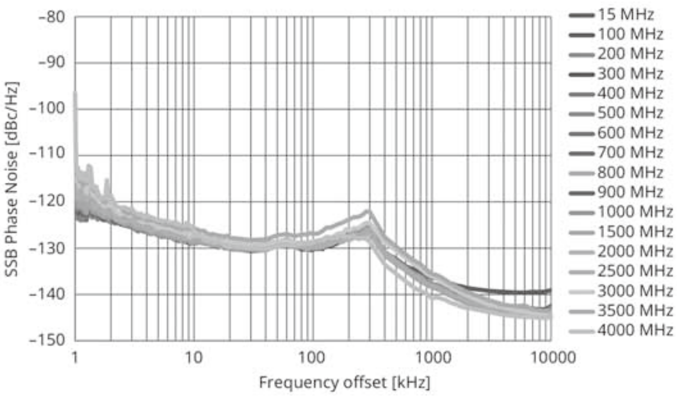
Video Bandwidth (VBW)

Spectrum Analyzer Function
Setting Range:
1 Hz to 3 kHz (1-3 sequence), 5 kHz,
10 kHz to 10 MHz (1-3 sequence), off
VBW Mode: Video Average, Power Average

SSB Phase Noise

Spectrum Analyzer Function

Input Frequency	Carrier Offset	SSB Phase Noise
1 GHz	10 Hz	–80 dBc/Hz (nom.)
	100 Hz	–92 dBc/Hz (nom.)
	1 kHz	–117 dBc/Hz (nom.)
	10 kHz	–123 dBc/Hz
	100 kHz	–123 dBc/Hz
	1 MHz	–135 dBc/Hz
	10 MHz	–148 dBc/Hz (nom.)



Phase Noise Performance (meas.)

Displayed Average Noise Level (DANL)

Spectrum Analyzer Function
Preamp: None, Microwave Preselector Bypass: None

Frequency	DANL		
	26 .5 GHz Model (MS2840A-044)	44 .5 GHz Model (MS2840A-046)	
		Without MS2840A-019	With MS2840A-019
30 MHz	–153 dBm/Hz	–153 dBm/Hz	–153 dBm/Hz
400 MHz	–153 dBm/Hz	–153 dBm/Hz	–153 dBm/Hz
1 GHz	–150 dBm/Hz	–150 dBm/Hz	–150 dBm/Hz
3 GHz	–147 dBm/Hz	–147 dBm/Hz	–147 dBm/Hz
13 GHz	–151 dBm/Hz	–151 dBm/Hz	–150 dBm/Hz
20 GHz	–146 dBm/Hz	–146 dBm/Hz	–146 dBm/Hz
30 GHz	—	–146 dBm/Hz	–146 dBm/Hz
40 GHz	—	–144 dBm/Hz	–142 dBm/Hz
44 GHz	—	–140 dBm/Hz	–137 dBm/Hz

Preamp: On, Microwave Preselector Bypass: None

Frequency	DANL		
	26 .5 GHz Model (MS2840A-044)	44 .5 GHz Model (MS2840A-046)	
		Without MS2840A-019	With MS2840A-019
30 MHz	–166 dBm/Hz	–166 dBm/Hz	–166 dBm/Hz
400 MHz	–166 dBm/Hz	–166 dBm/Hz	–166 dBm/Hz
1 GHz	–164 dBm/Hz	–164 dBm/Hz	–164 dBm/Hz
3 GHz	–163 dBm/Hz	–163 dBm/Hz	–163 dBm/Hz
13 GHz	–163 dBm/Hz	–163 dBm/Hz	–163 dBm/Hz
20 GHz	–157 dBm/Hz	–160 dBm/Hz	–160 dBm/Hz
30 GHz	—	–160 dBm/Hz	–159 dBm/Hz
40 GHz	—	–157 dBm/Hz	–156 dBm/Hz
44 GHz	—	–149 dBm/Hz	–149 dBm/Hz

Noise Floor Reduction: On
It subtracts the internal noise components (11 dB max. nominal) of the measuring instrument itself from the displayed measurement result.

Total Absolute Amplitude Accuracy

Preamp: None
±0.5 dB (300 kHz ≤ f < 4 GHz)
±1.8 dB (4 GHz ≤ f < 13.8 GHz)
±3.0 dB (13.8 GHz ≤ f < 40 GHz)
±3.5 dB (40 GHz ≤ f < 44.5 GHz, nom.)

The MS2840A supports level calibration over a wide range of 300 kHz to 4 GHz using its built-in level calibration oscillator.
The level accuracy standards include frequency characteristics, linearity and attenuator switching error. Consequently, the level including the above three errors can still be measured accurately even when the measurement frequency and built-in attenuator settings are changed.

2-tone 3rd-order Intermodulation Distortion

Preamp: None

Frequency	2-tone 3rd-order Intermodulation Distortion
1 GHz	≤–62 dBc (TOI = +16 dBm)
20 GHz	≤–56 dBc (TOI = +13 dBm)
40 GHz	≤–56 dBc (TOI = +13 dBm) (nom.)

Second Harmonic Distortion

Preamp: None, Microwave Preselector Bypass: None,
Frequency Band Mode: Spurious

Input Frequency	Harmonic Distortion	SHI	Mixer Input Level
400 MHz, 1 GHz	≤–65 dBc	≥+35 dBm	–30 dBm
3 GHz	≤–80 dBc	≥+70 dBm	–10 dBm
13 GHz	≤–90 dBc	≥+80 dBm	–10 dBm
20 GHz	≤–90 dBc (nom.)	≥+80 dBm (nom.)	–10 dBm

Analysis Bandwidth (Signal Analyzer Function)

31.25 MHz (Standard)
62.5 GHz (Option)
125 MHz (Option)

Connector

RF Input (Front panel)
  N–J, 50Ω (nom.): 26.5 GHz model (MS2840A-044)
  K–J, 50Ω (nom.): 44.5 GHz model (MS2840A-046)
IF Output (Rear panel)
  SMA-J, 50Ω (nom.)
  Frequency: 1.875 GHz
  Gain: –10 dB (nom., Input attenuator: 0 dB, Input frequency: 10 GHz)
1st Local Output (Front panel)
  For High Performance Waveguide Mixer and Harmonic Mixer
  SMA-J, 50Ω (nom.)
  Frequency: 5 GHz to 10 GHz (Local signal output)
    1.875 GHz (IF frequency)
  Local output level: ≥ +10 dBm (typ.)
  Bias current: Setting range 0.0 to 20.0 mA
    Resolution 0.1 mA

Dimensions and Mass

426 (W) × 177 (H) × 390 (D) mm (excluding projections)
≤15.3 kg (with MS2840A-044 or 046 installed, excluding other options)

Power Supply

Power voltage: 100 V(ac) to 120 V(ac)/200 V(ac) to 240 V(ac)
Frequency: 50 Hz to 60 Hz
Power consumption: ≤350 VA (including all options)
  220 VA (nom., with MS2840A-044 or 046 installed, excluding other options)

EU Standards (CE Marking)

EMC: 2014/30/EU, EN61326-1, EN61000-3-2
LVD: 2014/35/EU, EN61010-1
RoHS: 2011/65/EU, EN50581

OS

Windows 7 (64 bit)

High Performance Waveguide Mixer MA2806A/MA2808A Specifications

See MA2806A/MA2808A page for detail (Page 564).

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Typical (typ.):
  Performance not warranted. Most products meet typical performance.
Nominal (nom.):
  Values not warranted. Included to facilitate application of product.
Measured (meas.):
  Performance not warranted. Data actually measured from randomly selected measuring instruments.

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main frame
MS2840A	Signal Analyzer
	Standard accessories
	Power Cord: 1 pc
	USB Memory (≥ 1GB): 1 pc
P0031A	USB Mouse: 1 pc
Z0541A	Install DVD-ROM (Application software, instruction manual DVD-ROM): 1 pc
	Options
MS2840A-044	26.5 GHz Signal Analyzer
MS2840A-046	44.5 GHz Signal Analyzer
MS2840A-001	Rubidium Reference Oscillator
MS2840A-077	Analysis Bandwidth Extension to 62.5 MHz
MS2840A-078	Analysis Bandwidth Extension to 125 MHz (Requires MS2840A-077)
MS2840A-008	Preamplifier
MS2840A-069	26.5 GHz Microwave Preamplifier (for MS2840A-044)
MS2840A-068	Microwave Preamplifier (for MS2840A-046)
MS2840A-010	Phase Noise Measurement Function
MS2840A-011	2ndary SSD
MS2840A-016	Precompliance EMI Function
MS2840A-017	Noise Figure Measurement Function
MS2840A-019	2 dB Step Attenuator for Millimeter-wave (for MS2840A-046)
MS2840A-051	Noise Floor Reduction
MS2840A-026	BER Measurement Function (AUX Conversion Adapter J1556A as standard accessory)
MS2840A-067	Microwave Preselector Bypass
	Retrofit options
MS2840A-101	Rubidium Reference Oscillator Retrofit
MS2840A-177	Analysis Bandwidth Extension to 62.5 MHz Retrofit
MS2840A-178	Analysis Bandwidth Extension to 125 MHz Retrofit (Requires MS2840A-077 or 177)
MS2840A-108	Preamplifier Retrofit
MS2840A-169	26.5 GHz Microwave Preamplifier Retrofit (for MS2840A-044)
MS2840A-168	Microwave Preamplifier Retrofit (for MS2840A-046)
MS2840A-110	Phase Noise Measurement Function Retrofit
MS2840A-111	2ndary SSD Retrofit
MS2840A-116	Precompliance EMI Function Retrofit
MS2840A-117	Noise Figure Measurement Function Retrofit
MS2840A-119	2 dB Step Attenuator for Millimeter-wave Retrofit (for MS2840A-046)
MS2840A-151	Noise Floor Reduction Retrofit
MS2840A-126	BER Measurement Function Retrofit (AUX Conversion Adapter J1556A as standard accessory)
MS2840A-167	Microwave Preselector Bypass Retrofit
	Software options
MX269017A	DVD-ROM with License and Operation manuals Vector Modulation Analysis Software
MX269017A-001	APSK Analysis (Requires MX269017A)
MX269017A-011	Higher-Order QAM Analysis (Requires MX269017A)
MX269018A	Analog Measurement Software (Requires USB Audio A0086C)
	Warranty service
MS2840A-ES210	2 years Extended Warranty Service
MS2840A-ES310	3 years Extended Warranty Service
MS2840A-ES510	5 years Extended Warranty Service

The following options are installed as standard and do not require separate orders when ordering the MS2840A-044.

Standard Software	MX269000A
Analysis Bandwidth 10 MHz	MS2840A-006
Bandwidth Extension to 31.25 MHz	MS2840A-005

The following options are installed as standard and do not require separate orders when ordering the MS2840A-046.

Standard Software	MX269000A
Analysis Bandwidth 10 MHz	MS2840A-006
Bandwidth Extension to 31.25 MHz for Millimeter Wave	MS2840A-009

Model/Order No.	Name
	Manuals
	Following operation manuals provided as hard copy
W3812AE	MS2840A Operation Manual (Mainframe Operation)
W2851AE	MS2690A/MS2691A/MS2692A/MS2830A and MS2840A Operation Manual (Mainframe Remote Control)
W3335AE	MS2830A/MS2840A/MS2850A Operation Manual (Signal Analyzer Function Operation)
W2853AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Signal Analyzer Function Remote Control)
W3336AE	MS2830A/MS2840A/MS2850A Operation Manual (Spectrum Analyzer Function Operation)
W2855AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Spectrum Analyzer Function Remote Control)
W3117AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Phase Noise Measurement Function Operation)
W3118AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Phase Noise Measurement Function Remote Control)
W3655AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A-017 Operation Manual (Noise Figure Measurement Function Operation)
W3656AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A-017 Operation Manual (Noise Figure Measurement Function Remote control)
W3305AE	MX269017A Operation Manual (Operation)
W3306AE	MX269017A Operation Manual (Remote Control)
W3555AE	MX269018A Operation Manual (Operation)
W3556AE	MX269018A Operation Manual (Remote Control)
	High Performance Waveguide Mixer
MA2806A	High Performance Waveguide Mixer (50 to 75 GHz)
MA2808A	High Performance Waveguide Mixer (60 to 90 GHz)
	Standard accessories
Z1922A	MA2806A USB Memory (Saved conversion loss data, for MA2806A): 1 pc
Z1923A	MA2808A USB Memory (Saved conversion loss data, for MA2808A): 1 pc
	AC Adapter: 1 pc
Z1625A	Power Cord: 1 pc
J1692B	Coaxial Cord, 1 m (SMA-P · SUCOFLEX104PE · SMA-P, DC to 18 GHz, 50Ω): 1 pc
	External Mixer (Harmonic Mixer)
MA2741C	External Mixer (26.5 GHz to 40 GHz)
MA2742C	External Mixer (33 GHz to 50 GHz)
MA2743C	External Mixer (40 GHz to 60 GHz)
MA2744C	External Mixer (50 GHz to 75 GHz)
MA2745C	External Mixer (60 GHz to 90 GHz)
MA2746C	External Mixer (75 GHz to 110 GHz)
MA2747C	External Mixer (90 GHz to 140 GHz)
MA2748C	External Mixer (110 GHz to 170 GHz)
MA2749C	External Mixer (140 GHz to 220 GHz)
MA2750C	External Mixer (170 GHz to 260 GHz)
MA2751C	External Mixer (220 GHz to 325 GHz)

Model/Order No.	Name
	Application Parts
34AKNF50	Ruggedized K-to-Type N Adapter (DC to 20 GHz, 50Ω, Ruggedized K-M · N-F, SWR: 1.5 (max.), Insertion Loss: 0.4 dB (max.))
K240B	Power Divider (K connector, DC to 26.5 GHz, 50Ω, K-J, 1 W max.)
MA1612A	Four-port Junction Pad (5 MHz to 3 GHz, N-J)
J1359A	Coaxial Adaptor (K-P · K-J, SMA)
J0576B	Coaxial Cord, 1 m (N-P · 5D-2W · N-P)
J0576D	Coaxial Cord, 2 m (N-P · 5D-2W · N-P)
J0127A	Coaxial Cord, 1 m (BNC-P · RG58A/U · BNC-P)
J0127B	Coaxial Cord, 2 m (BNC-P · RG58A/U · BNC-P)
J0127C	Coaxial Cord, 0.5 m (BNC-P · RG58A/U · BNC-P)
J0322A	Coaxial Cord, 0.5 m (DC to 18 GHz), (SMA-P · 50Ω SUCOFLEX104 · SMA-P)
J0322B	Coaxial Cord, 1 m (DC to 18 GHz), (SMA-P · 50Ω SUCOFLEX104 · SMA-P)
J0322C	Coaxial Cord, 1.5 m (DC to 18 GHz), (SMA-P · 50Ω SUCOFLEX104 · SMA-P)
J0322D	Coaxial Cord, 2 m (DC to 18 GHz), (SMA-P · 50Ω SUCOFLEX104 · SMA-P)
J0805	DC Block, N type (MODEL 7003) (10 kHz to 18 GHz, N-P · N-J)
J1554A	DC Block, SMA type (MODEL 7006) (9 kHz to 26.5 GHz, SMA-P · SMA-J)
J1555A	DC Block, SMA type (MODEL 7006-1) (9 kHz to 20 GHz, SMA-P · SMA-J)
K261	DC Block (10 kHz to 40 GHz, K-P · K-J)
J0004	Coaxial Adapter (DC to 12.4 GHz, 50Ω, N-P · SMA-J)
J1398A	N-SMA Adaptor (DC to 26.5 GHz, 50Ω, N-P · SMA-J)
J0911	Coaxial Cable, 1.0 m for 40 GHz (DC to 40 GHz, approx. 1 m, SF102A, 11K254/K254/1.0M)
J0912	Coaxial Cable, 0.5 m for 40 GHz (DC to 40 GHz, approx. 0.5 m, SF102A, 11K254/K254/0.5M)
41KC-3	Fixed Attenuator (DC to 40 GHz, 3 dB)
J1261A	Ethernet Cable (Shield type, Straight, 1 m)
J1261B	Ethernet Cable (Shield type, Straight, 3 m)
J1261C	Ethernet Cable (Shield type, Cross, 1 m)
J1261D	Ethernet Cable (Shield type, Cross, 3 m)
J0008	GPIB Cable, 2.0 m
J1556A	AUX Conversion Adapter (AUX → BNC, for vector signal generator option and BER measurement function option, standard accessory with BER Measurement Function MS2840A-026)
A0086C	USB Audio (for MX269018A)
B0635A	Rack Mount Kit (EIA)
B0657A	Rack Mount Kit (JIS)
B0636C*	Carrying Case (Hard type, with casters)
B0671A*	Front Cover for 1MW4U
MA24105A	Inline Peak Power Sensor (350 MHz to 4 GHz, with USB A to mini B cable)
MA24106A	USB Power Sensor (50 MHz to 6 GHz, with USB A to mini B cable)
MA24108A	Microwave USB Power Sensor (10 MHz to 8 GHz, with USB A to Micro-B cable)
MA24118A	Microwave USB Power Sensor (10 MHz to 18 GHz, with USB A to Micro-B cable)
MA24126A	Microwave USB Power Sensor (10 MHz to 26 GHz, with USB A to Micro-B cable)
Z0975A	Keyboard (USB)
Z1932A	Installation Kit (required when retrofitting options or installing software)

*: The Carrying Case B0636C includes the Front Panel Protective Cover (B0671A).

Signal Analyzer

MS2830A

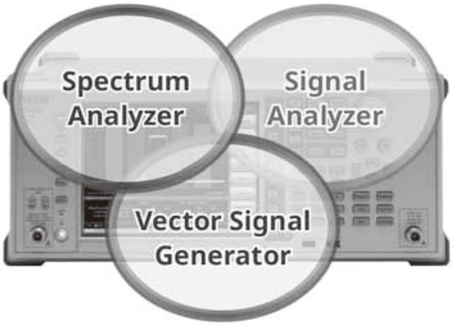
9 kHz to 3.6 GHz/6.0 GHz/13.5 GHz

Remote Control
GPIB | Ethernet | USB

[High Speed + High Performance] × [Low Cost] + Eco-friendly

Excellent Eco Product

The MS2830A is a high-speed, high-performance, cost-effective Spectrum Analyzer/Signal Analyzer.
Not only can it capture wideband signals but FFT technology supports multifunction signal analyses in both the time and frequency domains. Behavior in the time domain that cannot be handled by a sweep type spectrum analyzer can be checked in the frequency domain. A wide frequency can be analyzed using sweep type spectrum analysis functions while detailed signal analysis of a specific frequency band is supported too.
Moreover, the built-in signal generator function outputs both continuous wave (CW) and modulated signals for use as a reference signal source when testing Tx characteristics of parts and as a signal source for evaluating Rx characteristics.



Key Features

Basic Performance/Functions

- Frequency Range
  MS2830A-040: 9 kHz to 3.6 GHz
  MS2830A-041: 9 kHz to 6.0 GHz
  MS2830A-043: 9 kHz to 13.5 GHz
- Total Level Accuracy: ±0.3 dB (typ.)
- Dynamic Range*1: 168 dB
  TOI*2: ≥+15 dBm
  DANL*3: –153 dBm/Hz
- Improved Level Linearity
- Internal Reference Oscillator
  Pre-installed Reference Oscillator
    Aging Rate: ±1 × 10^{-6}/year, ±1 × 10^{-7}/day
    Start-up Characteristics: ±5 × 10^{-7} (5 minutes after power-on)
  Rubidium Reference Oscillator (MS2830A-001)
    Aging Rate: ±1 × 10^{-10}/month
    Start-up Characteristics: ±1 × 10^{-9} (7 minutes after power-on)
  High Stability Reference Oscillator (MS2830A-002)
    Aging Rate: ±1 × 10^{-7}/year, ±1 × 10^{-8}/day
    Start-up Characteristics: ±5 × 10^{-8} (5 minutes after power-on)
- Versatile Built-in Functions
  Channel Power
  Adjacent Channel Leakage Power
  Spurious Emission*4
  Frequency Counter*4
  FM Deviation*5
  Highest 10 Markers
  Occupied Bandwidth
  Spectrum Emission Mask*4
  Burst Average Power
  AM Depth*5
  Multi-marker & Marker List
  Limit Line*4
  2-tone 3rd-order Intermodulation Distortion*4
  Annotation Display (On/Off)
  Phase Noise*7
  Power Meter*6
  Noise Figure*8
- Low-power-consumption
  MS2830A-040: 110 VA (nom.)
  MS2830A-041: 110 VA (nom.)
  MS2830A-043: 130 VA (nom.)

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*1: Difference between TOI and DANL as simple guide
*2: TOI (Third Order Intercept)
*3: DANL (Displayed Average Noise Level)
*4: Spectrum Analyzer functions
*5: Signal Analyzer functions (Requires MS2830A-005/006/077/078)
*6: Power Meter Function (Use USB Power Sensors)
*7: Phase Noise Measurement Function (Requires MS2830A-010)
*8: Noise Figure Measurement Function (Requires MS2830A-017)
[Use Noise Sources (Noisecom, NC346 series)]

Signal Analyzer Functions (MS2830A-005/006/077/078)

- Analysis Bandwidth
  MS2830A-006: 10 MHz max.
  (20 MHz max. sampling rate = 50 ns resolution, ADC resolution 16 bits)
  MS2830A-005[*9]: 31.25 MHz max
  (50 MHz max. sampling rate = 20 ns resolution, ADC resolution 16 bits)
  MS2830A-077[*10]: 62.5 MHz max.
  (100 MHz max. sampling rate = 10 ns resolution, ADC resolution 14 bits)
  MS2830A-078[*11]: 125 MHz max
  (200 MHz max. sampling rate = 5 ns resolution, ADC resolution 14 bits)

Note: An image response is received when setting the bandwidth to more than 31.25 MHz. This can be used when not inputting a signal frequency outside the MS2830A analysis bandwidth (125 MHz max.). The Signal Analyzer series MS2690A/91A/92A is recommended for other measurement purposes.

*9: Requires MS2830A-006
*10: Requires MS2830A-005 and MS2830A-006
*11: Requires MS2830A-005, MS2830A-006 and MS2830A-077

- Capture Function
  Saves analysis Span × Time signal to internal memory and writes to hard disk.
  Up to 100 Msamples per measurement can be saved to internal memory.
- Replay Function
  Reads saved data and replays using signal analyzer function.
- Measurement with Sub-trace Display
  Splits screen and confirms both main and sub-traces at same time to check errors.
  Main: Spectrum, Frequency vs. Time, Power vs. Time,
  Phase vs. Time, CCDF/APD, Spectrogram
  Sub: Power vs. Time, Spectrogram

Vector Signal Generator (MS2830A-020/021)

- Frequency Range
  MS2830A-020: 250 kHz to 3.6 GHz
  MS2830A-021: 250 kHz to 6 GHz
- Pre-installed Baseband Generator
  Vector Modulation Bandwidth: 120 MHz
  Sampling Clock: 20 kHz to 160 MHz
- Level Accuracy: ±0.5 dB (typ.)
- Large-capacity Memory
  256 MB = 64 Msamples
  1 GB = 256 Msamples (MS2830A-027)
- Internal AWGN Generator (MS2830A-028)

BER Measurement Function (MS2830A-026)

This option measures BER using Data/Clock/Enable demodulated at the DUT.

Input Bit Rate: 100 bps to 10 Mbps
Input Level: TTL Level

Basic Performance

Excellent Total Level Accuracy: ±0.3 dB (typ.)

(Common to both Spectrum Analyzer and Signal Analyzer Performances)

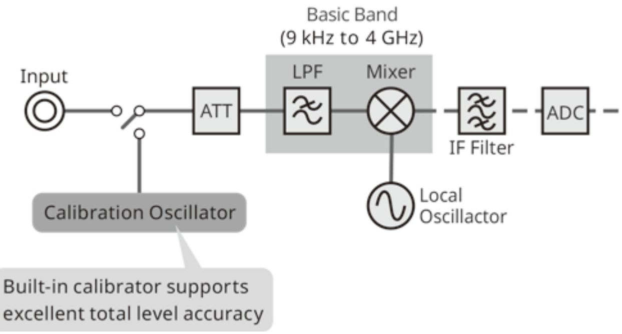
With a level calibration over a wide frequency range, the MS2830A has excellent total level accuracy.
The Absolute Amplitude Accuracy specification described in catalogs of other spectrum analyzers ignores the important frequency characteristics, linearity, and attenuator switching errors.
In contrast, the MS2830A Level Calibration technology assures excellent level accuracy over a wide frequency range from 300 kHz to 4 GHz even under measurement conditions including the above three errors. The level accuracy is assured even when the frequency and attenuator are switched.

The MS2830A total level accuracy includes:
- Frequency characteristics
- Linearity
- Attenuator switching error

Advantage of MS2830A Level Accuracy Technology

Conventional spectrum analyzers perform level calibration at just one frequency point, which causes errors when the frequency changes.
The MS2830A has a built-in calibration oscillator for level calibration over a wide frequency range from 300 kHz to 4 GHz, minimizing measurement errors in this frequency range.

MS2830A Block Diagram



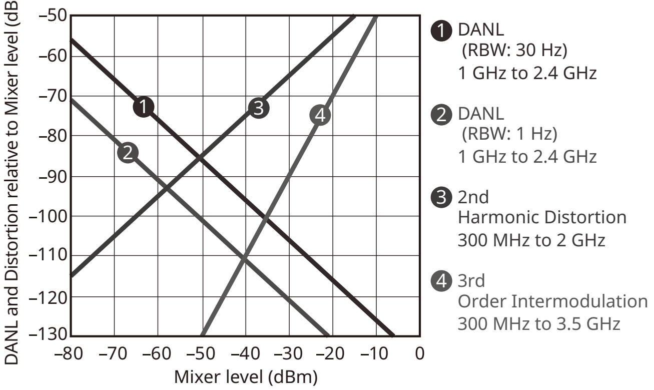
Wide Dynamic Range

Dynamic Range[*1]: 168 dB
TOI[*2]: ≥+15 dBm (300 MHz to 3.5 GHz)
DANL[*3]: –153 dBm/Hz (30 MHz to 1 GHz)

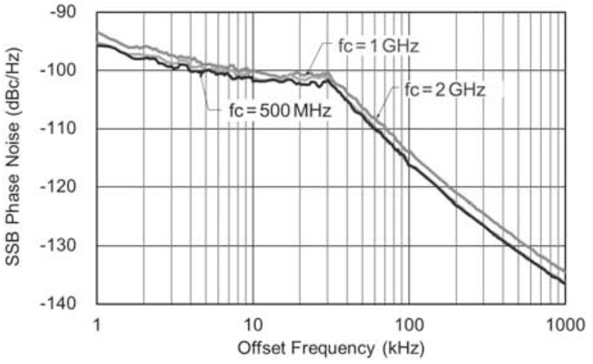
*1: Difference between TOI and DANL as simple guide.
*2: TOI (Third Order Intercept)
*3: DANL (Displayed Average Noise Level)

Dynamic range is a key specification for spectrum analyzers. Low displayed average noise level (DANL) as well as high TOI are important too.
Low TOI may cause distortion with high-level carrier signals. Inserting an attenuator can lower the carrier level but this has the effect of lowering the level of weak spurious, making it hard to measure.
The MS2830A has an excellent dynamic range supporting true performance measurements of devices, such as base stations, requiring wideband measuring instruments.

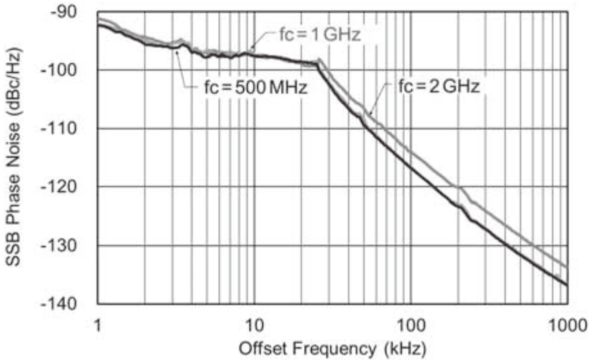
Distortion Characteristics (Spectrum Analyzer)
MS2830A-040/041/043



Example: SSB Phase Noise
(Spectrum Analyzer/Signal Analyzer Common)



(Applies for instruments with serial number ≥ 6201349078)

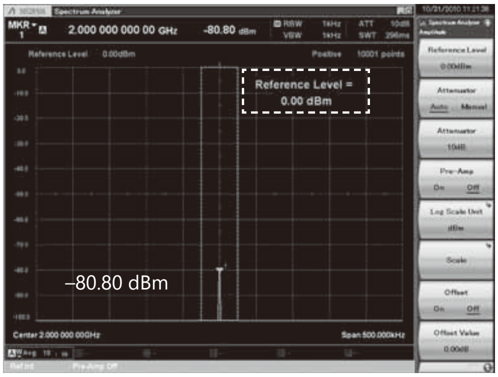


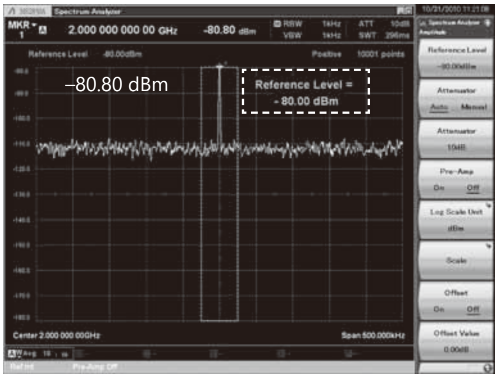
(Applies for instruments with serial number < 6201349078)

Improved Level Linearity

Conventional spectrum analyzers use an analog IF and log amp to achieve good level accuracy at points near the log scale reference level, but the accuracy degrades at points that are further away.
The MS2830A uses a digital IF instead of a log amp, which supports measurements with excellent accuracy at any point.

Example: Level Stability by Switching Reference Level

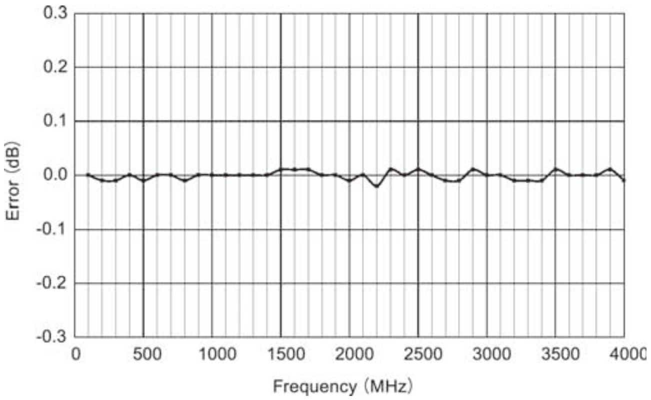




Dual Sweep Speed: Normal/Fast

When sweep time is set to [Auto], Normal (normal sweep) or Fast mode (high-speed sweep) can be set. The Fast mode sweeps six times faster than the Normal mode.

Example of Sweep Mode Switch Error: (CW –10 dBm input)
Level Error when Switching from Normal to Fast



Low Consumption Power, Excellent Eco Product

The MS2830A meets Anritsu "Excellent eco products" standard for environment-friendly products. It cuts consumed power by 50% compared to conventional models.

Power Consumption:
≤350 VA (including all options)
110 VA (nom., with MS2830A- 40, 3.6 GHz*1)
110 VA (nom., with MS2830A-041, 6 GHz*1)
130 VA (nom., with MS2830A-043, 13.5 GHz*1)

*1: One of the MS2830A-040, 041 or 043. Excludes other options.

Resolution Bandwidth (RBW)

Setting Range

- Spectrum Analyzer:
  1 Hz to 3 MHz (1-3 sequence),
  500 Hz, 50 kHz, 2 MHz, 5 MHz, 10 MHz, 20 MHz*2, 31.25 MHz*2, *3,
  200 Hz (6 dB)*4, 9 kHz (6 dB)*4, 120 kHz (6 dB)*4,
  1 MHz (Impulse)*4
- Spectrum trace in signal analyzer mode:
  1 Hz to 1 MHz (1-3 sequence)*5
  1 Hz to 3 MHz (1-3 sequence)*6
  1 Hz to 10 MHz (1-3 sequence)*7

When monitoring two adjacent signals, the frequency resolution can be increased by reducing the resolution bandwidth (RBW).
This also has the effect of reducing the noise level.
Conversely, to confirm level variations of 20-MHz band signals such as LTE, set the RBW to 31.25 MHz.

*2: Can be set when with MS2830A-005.
*3: Instead of Gaussian filter, 31.25 MHz RBW uses filter with flat top characteristics above 31.25 MHz.
*4: When MS2830A-016 installed.
*5: Without MS2830A-077/078, or Bandwidth: ≤31.25 MHz.
*6: With MS2830A-077, Bandwidth: >31.25 MHz.
*7: With MS2830A-078, Bandwidth: >31.25 MHz.

Gate Sweep

Gate sweep executes sweeping only for the length of time specified by the gate length, starting from when the trigger condition is met.
A delay time until sweeping starts after the trigger condition is met can be set using trigger delay.

- The gate source can be selected from the following
  Wide IF video trigger
  External trigger
  Frame trigger
  SG marker trigger (Requires MS2830A-020/021)
- Setting range and resolution for gate delay
  Setting range: 0 to 1 s
  Resolution: 20 ns
- Setting range and resolution for gate length
  Setting range: 50 µs to 1 s
  Resolution: 20 ns

Trigger Function

Trigger sweep executes sweeping using the specified trigger condition as the start point. In particular, "SG Marker" starts analyzer measurement in synchrony with the signal output by installing MS2830A-020/021. Using this function supports simple synchronized measurement even when evaluating signals with large level variation over time, such as modulation signals.

- Video trigger:
  Trigger sweeping starts in synchronization with the rise or fall of the waveform. A trigger level indicator showing the trigger level is displayed on the screen.
- Wide IF video trigger:
  An IF signal with a wide passing band of about 5 MHz is detected, and sweeping starts in synchronization with either the rise or fall of the detected signal.
- External trigger:
  Sweeping starts in synchronization with the rise or fall of the signal input via the Trigger Input connector.
- Frame trigger:
  An equipment-internal trigger signal is used to generate a trigger and start the sweep. The generation period (Period) and offset time (Offset) for the trigger signal can be set. It is also possible to re-synchronize the trigger signal with either the Wide IF Video signal or an external trigger.
- SG Marker trigger (Requires MS2830A-020/021):
  Sweeping starts in synchronization with the rise or fall of the marker signal output of MS2830A-020/021. This function supports measurement in synchronization with the output signal of MS2830A-020/021.

Three Built-in External Interfaces

The built-in Gigabit Ethernet, USB2.0, and GPIB interfaces support remote operation.

GPIB: IEEE 488.2, Rear panel, IEEE 488 bus connector
Interface functions:
SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0, E2
Ethernet: 10/100/1000BASE-T, Rear panel, RJ-45
USB (B): USB2.0, Rear panel, USB-B connector

Saving Measurement Results

Measurement results can be saved to internal hard disk or external USB memory. Screen dumps and trace data can be saved too.

- Screen dump file type
  BMP
  PNG
- The color of the screen hard copy can be set as follows:
  Normal (same as screen display)
  Reverse
  Monochrome
  Reversed Monochrome

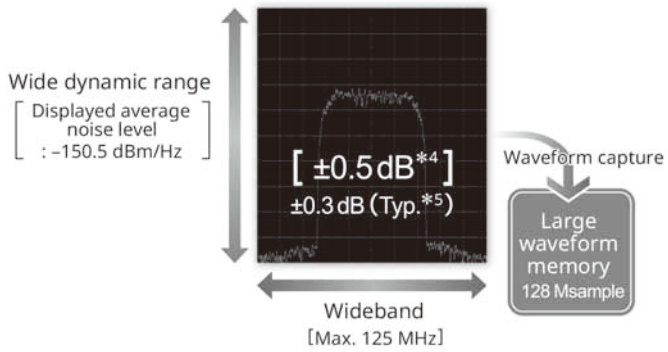
Signal Analyzer: Basic Performance/Functions

Wide bandwidth × High Accuracy FFT Analysis

MS2830A-006: 10 MHz max.
(20 MHz max. sampling rate = 50 ns resolution, ADC resolution 16 bits)
MS2830A-005*1: 31.25 MHz max.
(50 MHz max. sampling rate = 20 ns resolution, ADC resolution 16 bits)
MS2830A-077*2: 62.5 MHz max.
(100 MHz max. sampling rate = 10 ns resolution, ADC resolution 14 bits)
MS2830A-078*3: 125 MHz max.
(200 MHz max. sampling rate = 5 ns resolution, ADC resolution 14 bits)

Note: An image response is received when setting the bandwidth to more than 31.25 MHz. This can be used when not inputting a signal frequency outside the MS2830A analysis bandwidth (125 MHz max.).
The Signal Analyzer series MS2690A/91A/92A is recommended for other measurement purposes.

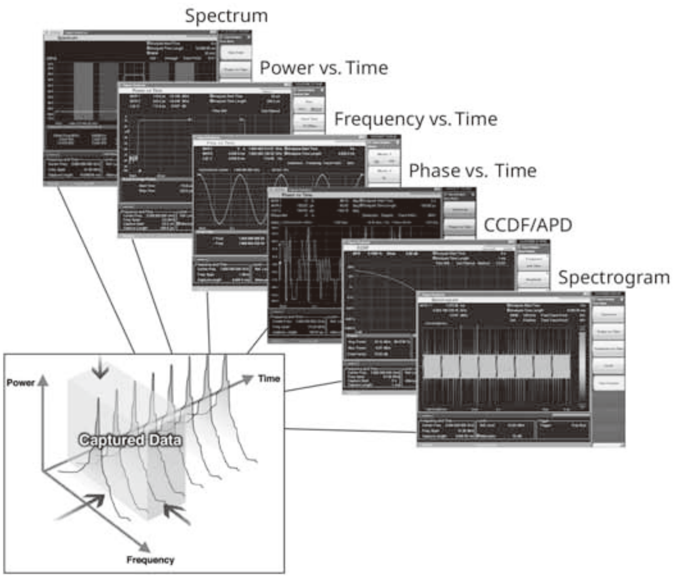
Based on the excellent level accuracy and wide dynamic range of the MS2830A, a signal with an FFT analysis bandwidth of up to 125 MHz can be captured with a level accuracy of ±0.3 dB.



*1: Requires MS2830A-006.
*2: Requires MS2830A-005 and MS2830A-006.
*3: Requires MS2830A-005, MS2830A-006 and MS2830A-077.
*4: 300 kHz ≤ f < 4 GHz, Frequency band mode Normal.
*5: Excluding Guard band.

Vector Signal Analysis (VSA) Function

Seamless signal capture and VSA analysis in multiple domains make it easy to evaluate burst-signal responses and capture degraded spectrum transients, etc., which cannot be checked by conventional sweep spectrum analyzers. This greatly improves design verification and troubleshooting efficiency.



Save Signals in Internal Memory

Max. Capture Time: 0.5 s to 2000 s
Max. Number of Samples: 100 Msamples

The "Analysis bandwidth × Analysis time" signal is held in internal memory and saved to hard disk.
Up to 100 Msamples of data can be saved to memory for one measurement. The frequency span determines the sampling rate. The following chart shows the maximum capture time per frequency span.

Span*	Sampling Rate	Capture Time	Max. Sampling Data
1 kHz	2 kHz	2000 s	4M
2.5 kHz	5 kHz	2000 s	10M
5 kHz	10 kHz	2000 s	20M
10 kHz	20 kHz	2000 s	40M
25 kHz	50 kHz	2000 s	100M
50 kHz	100 kHz	1000 s	100M
100 kHz	200 kHz	500 s	100M
250 kHz	500 kHz	200 s	100M
500 kHz	1 MHz	100 s	100M
1 MHz	2 MHz	50 s	100M
2.5 MHz	5 MHz	20 s	100M
5 MHz	10 MHz	10 s	100M
10 MHz	20 MHz	5 s	100M
25 MHz	50 MHz	2 s	100M
31.25 MHz	50 MHz	2 s	100M
50 MHz	100 MHz	500 ms	50M
62.5 MHz	100 MHz	500 ms	50M
100 MHz	200 MHz	500 ms	100M
125 MHz	200 MHz	500 ms	100M

*: With MS2830A-006: 1 kHz to 10 MHz
With MS2830A-005/006: 1 kHz to 31.25 MHz
With MS2830A-005/006/077: 1 kHz to 62.5 MHz
With MS2830A-005/006/077/078: 1 kHz to 125 MHz

Replay Function for Comparison Evaluation

This function reads saved data and replays it using the signal analyzer measurement function.

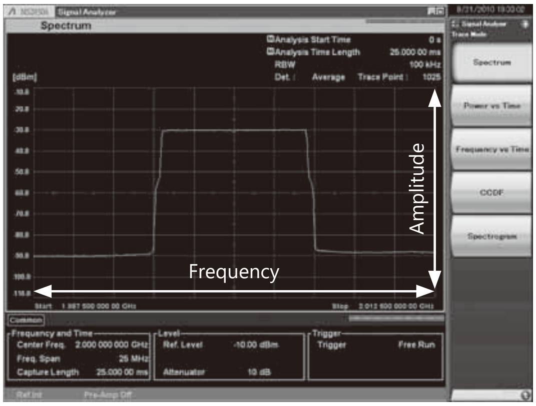
Examples:

1. Data sharing between separate R&D and manufacturing
2. Later laboratory bench-top analysis of on-site signals
3. Save data at shipment and re-verify if problem occurs

Signal Analyzer: Trace

Spectrum

The Spectrum trace displays a graph with amplitude on the y-axis and frequency on the x-axis. The captured IQ data is FFT processed (fast Fourier transformed) and converted from the time domain to the frequency domain for display as a spectrum.



Analysis Start Time 0 s
Analysis Time Length 25.000 00 ms
RBW 100 kHz
Det. : Average Trace Point : 1025
Start 1.987 500 000 00 GHz
Stop 2.012 500 000 00 GHz

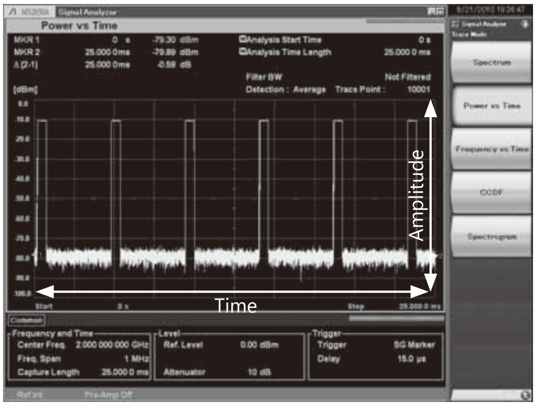
Frequency and Time
Center Freq. 2.000 000 000 GHz
Freq. Span 25 MHz
Capture Length 25.000 00 ms

Level
Ref. Level -10.00 dBm
Attenuator 10 dB

Trigger
Trigger Free Run

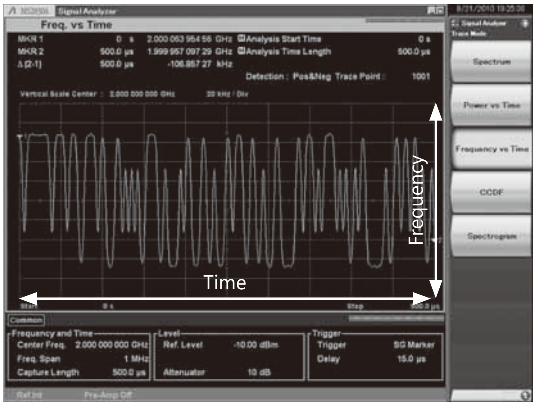
Power vs. Time

The Power vs. Time trace displays a graph with amplitude on the y-axis and time on the x-axis to confirm changes in power with time of measured signals.


Power vs Time
MKR 1 0 s -79.30 dBm
MKR 2 25.000 0 ms -79.89 dBm
Δ (2-1) 25.000 0 ms -0.59 dB
Analysis Start Time 0 s
Analysis Time Length 25.000 0 ms
Filter BW Not Filtered
Detection : Average Trace Point : 10001
Frequency and Time
Center Freq. 2.000 000 000 GHz
Freq. Span 1 MHz
Capture Length 25.000 0 ms
Level
Ref. Level 0.00 dBm
Attenuator 10 dB
Trigger
Trigger SG Marker
Delay 15.0 μs

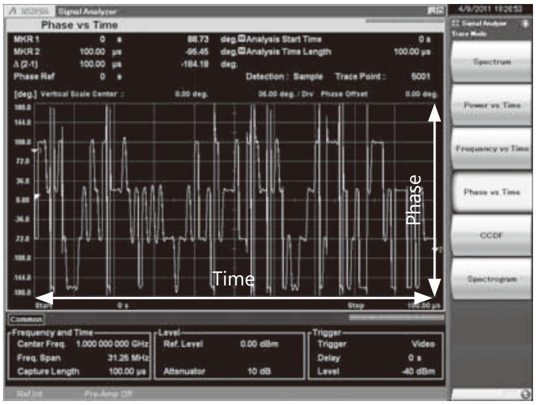
Frequency vs. Time

The Frequency vs. Time trace displays a graph with frequency on the y-axis and time on the x-axis to confirm time variation of the measured signal frequency.


Freq. vs Time
MKR 1 0 s 2.000 063 954 56 GHz
MKR 2 500.0 μs 1.999 957 097 29 GHz
Δ (2-1) 500.0 μs -106.857 27 kHz
Analysis Start Time 0 s
Analysis Time Length 500.0 μs
Detection : Pos&Neg Trace Point : 1001
Vertical Scale Center : 2.000 000 000 GHz 20 kHz / Div
Frequency and Time
Center Freq. 2.000 000 000 GHz
Freq. Span 1 MHz
Capture Length 500.0 μs
Level
Ref. Level -10.00 dBm
Attenuator 10 dB
Trigger
Trigger SG Marker
Delay 15.0 μs

Phase vs. Time

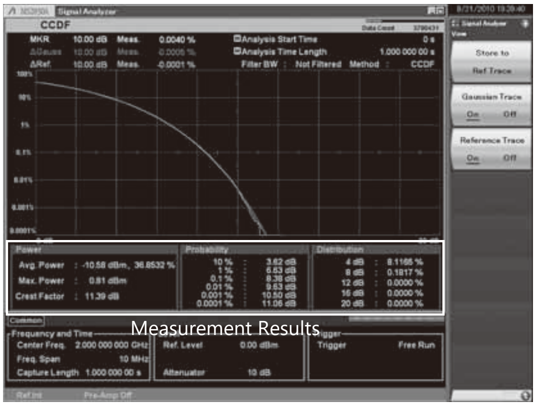
The Phase vs. Time trace displays a graph with phase on the y-axis and time on the x-axis to confirm time variation of the measured signal phase.


Phase vs Time
MKR 1 0 s 88.73 deg.
MKR 2 100.00 μs -95.45 deg.
Δ (2-1) 100.00 μs -184.18 deg.
Phase Ref 0 s
Analysis Start Time 0 s
Analysis Time Length 100.00 μs
Detection : Sample Trace Point : 5001
[deg.] Vertical Scale Center : 0.00 deg. 36.00 deg. / Div Phase Offset 0.00 deg.
Frequency and Time
Center Freq. 1.000 000 000 GHz
Freq. Span 31.25 MHz
Capture Length 100.00 μs
Level
Ref. Level 0.00 dBm
Attenuator 10 dB
Trigger
Trigger Video
Delay 0 s
Level -40 dBm

CCDF*1/APD*2

The CCDF trace displays the power variation probability on the y-axis and power variation on the y-axis to confirm the CCDF and APD of measured signals.

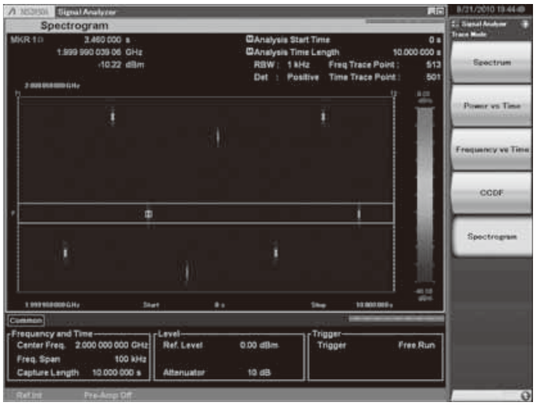
*1: CCDF (Complementary Cumulative Distribution Function)
*2: APD (Amplitude Probability Density)


CCDF
MKR 10.00 dB Meas. 0.0040 %
ΔRef. 10.00 dB Meas. -0.0001 %
Analysis Start Time 0 s
Analysis Time Length 1.000 000 00 s
Filter BW : Not Filtered Method : CCDF
Power
Avg. Power : -10.58 dBm, 36.8532 %
Max. Power : 0.81 dBm
Crest Factor : 11.39 dB
Probability
10 % : 3.62 dB
1 % : 6.63 dB
0.1 % : 8.38 dB
0.01 % : 9.53 dB
0.001 % : 10.50 dB
0.0001 % : 11.06 dB
Distribution
4 dB : 8.1165 %
8 dB : 0.1817 %
12 dB : 0.0000 %
16 dB : 0.0000 %
20 dB : 0.0000 %
Frequency and Time
Center Freq. 2.000 000 000 GHz
Freq. Span 10 MHz
Capture Length 1.000 000 00 s
Ref. Level 0.00 dBm
Attenuator 10 dB
Trigger
Trigger Free Run

Measurement Results
- CCDF: The CCDF display indicates the cumulative distribution of transient power variations compared to average power.
- APD: The APD display indicates the probability distribution of transient power fluctuations compared to average power.

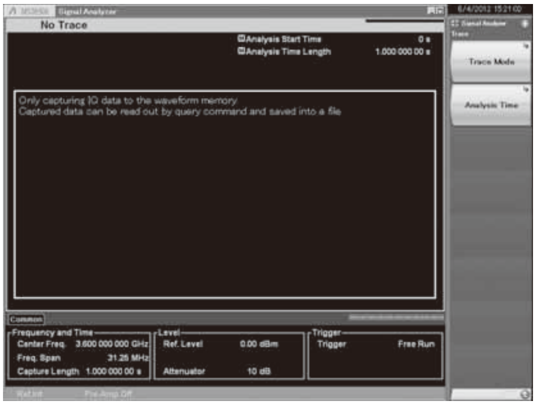
Spectrogram

The Spectrogram trace displays the level as color with frequency on the y-axis and time on the x-axis. The captured IQ data is FFT processed to confirm time variations in the continuous spectrum.
It is useful for monitoring frequency hopping and transient signals.


Spectrogram
MKR 1 3.460 000 s
1.999 990 039 06 GHz
-10.22 dBm
Analysis Start Time 0 s
Analysis Time Length 10.000 000 s
RBW : 1 kHz Freq Trace Point : 513
Det : Positive Time Trace Point : 501
Frequency and Time
Center Freq. 2.000 000 000 GHz
Freq. Span 100 kHz
Capture Length 10.000 000 s
Level
Ref. Level 0.00 dBm
Attenuator 10 dB
Trigger
Trigger Free Run

No Trace

No Trace mode does not execute signal analysis. Therefore, “IQ data output” and “IQ data readout using remote commands” can be executed quickly without the need to wait for completion of analysis.



No Trace

☐Analysis Start Time 0 s
☐Analysis Time Length 1.000 000 00 s

Only capturing IQ data to the waveform memory
Captured data can be read out by query command and saved into a file

Frequency and Time
Center Freq. 3.600 000 000 GHz
Freq. Span 31.25 MHz
Capture Length 1.000 000 00 s

Level
Ref. Level 0.00 dBm
Attenuator 10 dB

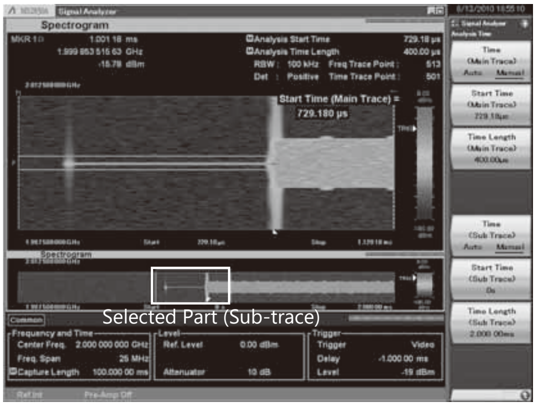
Trigger
Trigger Free Run

Measurement with Sub-trace Display

This function splits the screen into top and bottom halves; simultaneous display of the sub-trace supports easy monitoring of fault locations and transient phenomena.

Main: Spectrum, Frequency vs. Time, Power vs. Time,
Phase vs. Time, CCDF/APD, Spectrogram
Sub: Power vs. Time, Spectrogram

The part of a previously captured long-term signal to be monitored can be selected on the sub-trace to display the problem part only on the main trace.



Spectrogram

MKR 1 1.001 18 ms
1.999 853 515 63 GHz
-15.78 dBm

☐Analysis Start Time 729.18 µs
☐Analysis Time Length 400.00 µs
RBW : 100 kHz Freq Trace Point : 513
Det : Positive Time Trace Point : 501

Start Time (Main Trace) =
729.180 µs

Selected Part (Sub-trace)

Frequency and Time
Center Freq. 2.000 000 000 GHz
Freq. Span 25 MHz
☐Capture Length 100.000 00 ms

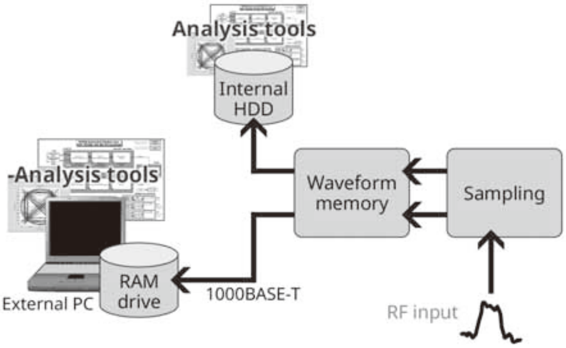
Level
Ref. Level 0.00 dBm
Attenuator 10 dB

Trigger
Trigger Video
Delay -1.000 00 ms
Level -19 dBm

Signal Analyzer: Applications

Analyze Captured Waveforms using Third-Party Tools

The MS2830A utilizes proprietary calibration technologies, enabling digitized baseband data to be used directly in third-party analysis tools without the need for correction.

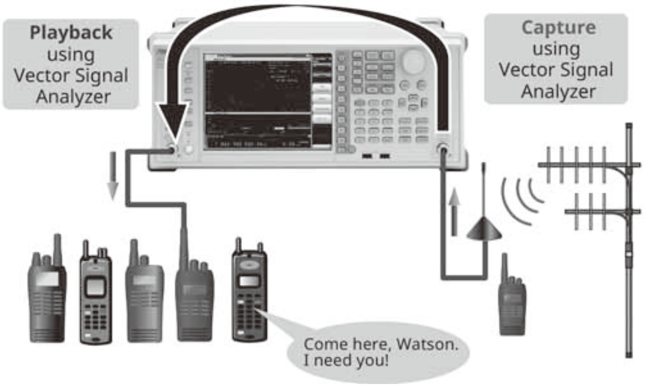


Capture & Playback Real-World Signals

The MS2830A provides *Capture & Playback* functionality that enables laboratory-grade testing of transceiver systems using real world signals. Using the optional integrated Vector Signal Analyzer and Vector Signal Generator of the MS2830A, *Capture & Playback* allows users to conveniently capture up to 100 MHz of spectrum and play it back at any designated frequency and amplitude, making it easy to determine device performance margins.

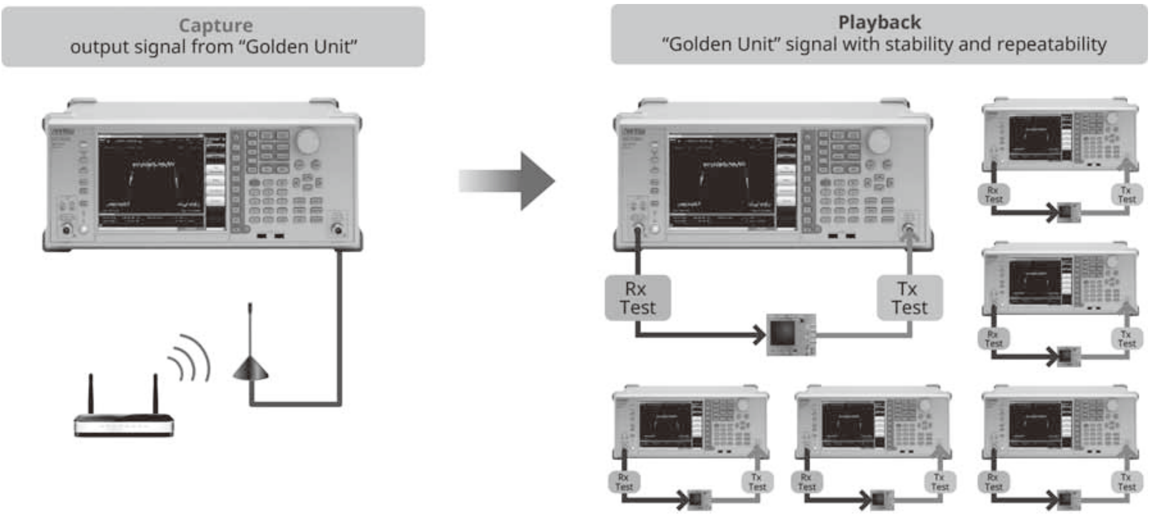
Applications for ***Capture & Playback***

- Validation/Production Test
  Captured signals can be used to initiate a communications link and perform receiver sensitivity testing with a device under test (DUT) using signals captured from a Golden Unit.
- Device Characterization
  Actual baseband signals captured from an RFIC can be used as simulation for characterizing amplifiers and other downstream devices or modules.
- Electromagnetic Compatibility Test
  Problematic RF environments or discrete signals – such as cellular or Wi-Fi – can be captured and used to evaluate a device’s susceptibility to RF interference, debug any problems found and validate the solution



Repeatably Test Device Performance
using “Real-World” RF Environments

Wi-Fi® is a registered trademark of Wi-Fi Alliance.



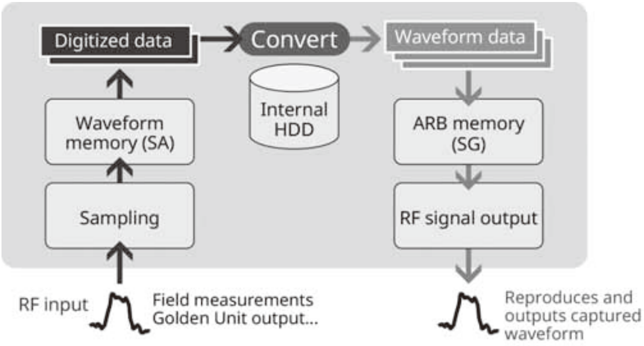
Use "Golden Unit" Signal for Manufacturing Test and Calibration

Capture & Playback **Highlights**

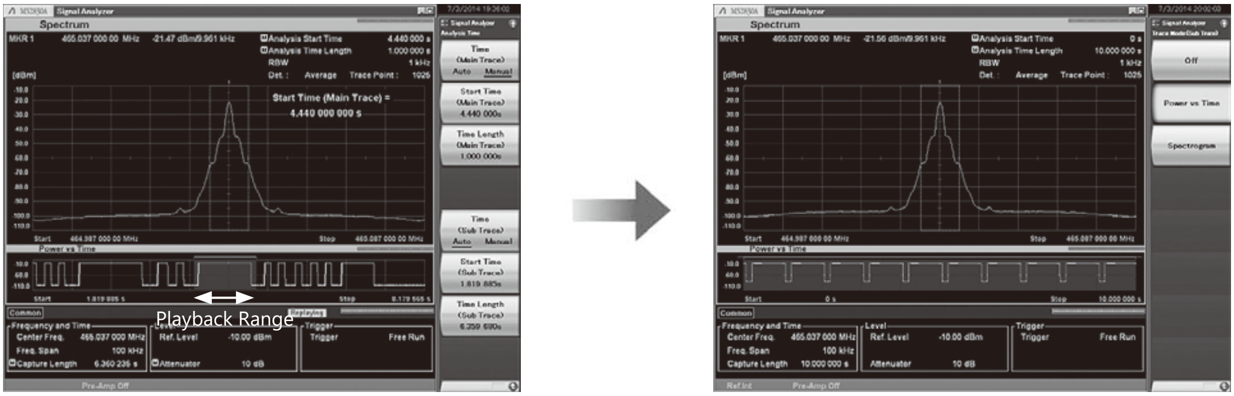
- Bandwidth and Time Limits
  Minimum 10 kHz Bandwidth (2000 s maximum duration)*
  Maximum 100 MHz Bandwidth (500 ms maximum duration)*

  *: Maximum bandwidth depends upon vector signal analyzer options installed (MS2830A-006/005/077/078). Maximum playback duration depends upon whether vector signal generator memory upgrade (MS2830A-027) is installed.
- Captured signal may be freely tuned to any output frequency and amplitude supported by the vector signal generator.
- Any section of the captured waveform record may be selected and played back.

  Enables user to isolate and reproduce specific signal bursts
  Enables user to change duty cycle of pulsed waveforms



Playback Block Diagram



Playback any Desired Section of Captured Waveform

Versatile Built-in Functions

Useful for Tx Characteristics Evaluation

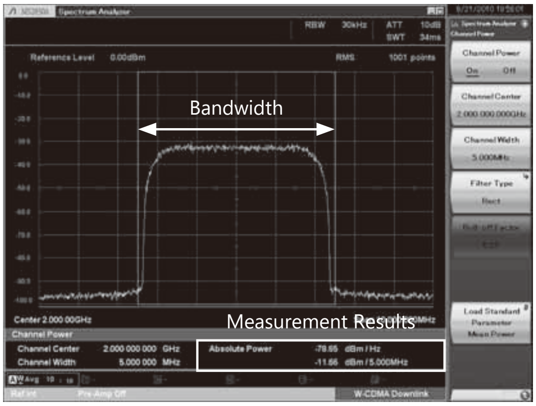
The MS2830A is fully loaded with all the functions required for evaluating Tx characteristics. Tests can be performed simply and in accordance with standards using functions tailored to measurement contents.

Measure Function	SPA*1	VSA*2
Channel Power	✓	✓
Occupied Bandwidth	✓	✓
Adjacent Channel Leakage Power	✓	✓
Spectrum Emission Mask	✓	
Burst Average Power	✓	✓
Spurious Emission	✓	
AM Depth		✓
FM Deviation		✓
Multi-marker & Marker List	✓	✓
Highest 10 Markers	✓	✓
Limit Line	✓	
Frequency Counter	✓	
2-tone 3rd-order Intermodulation Distortion	✓	
Annotation Display (On/Off)	✓	
Power Meter	Independent function*3	
Phase Noise	MS2830A-010	
Noise Figure	MS2830A-017*4	

*1: SPA (Spectrum Analyzer)
*2: VSA (Vector Signal Analyzer), Requires MS2830A-005/006/077/078
*3: Use USB Power Sensors
*4: Use Noise Sources (Noisecom, NC346 series)

Channel Power SPA VSA

This function measures channel bandwidth power. Three types of filters (Rect, Nyquist, Root Nyquist) can be selected.
Pre-installed templates for each standard support easy parameter setting.

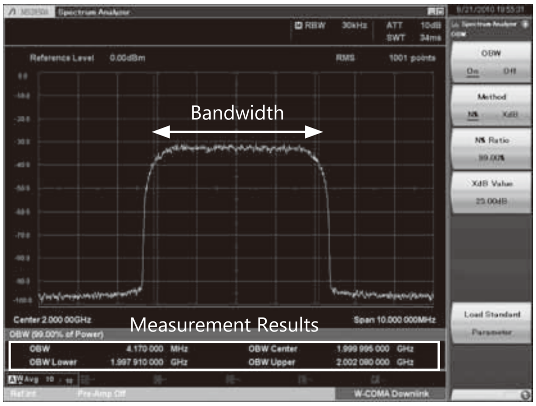


Center 2.000 00GHz
Channel Power
Channel Center 2.000 000 000 GHz
Channel Width 5.000 000 MHz
Absolute Power -78.65 dBm / Hz
-11.66 dBm / 5.000MHz
W-CDMA Downlink

Measurement Results
- Absolute power per Hz in channel band
- Total power in channel band

Occupied Bandwidth SPA VSA

Occupied bandwidth is measured by selecting either the N% or X-dB mode.
Pre-installed templates for each standard support easy parameter setting.

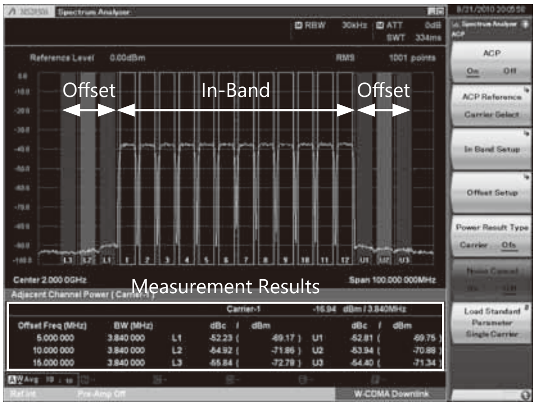


Center 2.000 00GHz
Span 10.000 000MHz
OBW (99.00% of Power)
OBW 4.170 000 MHz
OBW Center 1.999 995 000 GHz
OBW Lower 1.997 910 000 GHz
OBW Upper 2.002 080 000 GHz
W-CDMA Downlink

Measurement Results
- Bandwidth for specified conditions

Adjacent Channel Leakage Power SPA VSA

This function measures carrier adjacent channel (offset) power (In-Band). 1 to 12 carriers can be set and switched instantaneously on-screen.
True ACLR performance is measured using the noise cancellation function to subtract main-frame noise from the measurement result.
Pre-installed templates for each standard support easy parameter setting.



Center 2.000 0GHz
Span 100.000 000MHz
Adjacent Channel Power (Carrier-1)
Carrier-1 -16.94 dBm / 3.840MHz

Offset Freq (MHz)	BW (MHz)		dBc / dBm		dBc / dBm
5.000 000	3.840 000	L1	-52.23 (-69.17)	U1	-52.81 (-69.75)
10.000 000	3.840 000	L2	-54.92 (-71.86)	U2	-53.94 (-70.88)
15.000 000	3.840 000	L3	-55.84 (-72.78)	U3	-54.40 (-71.34)

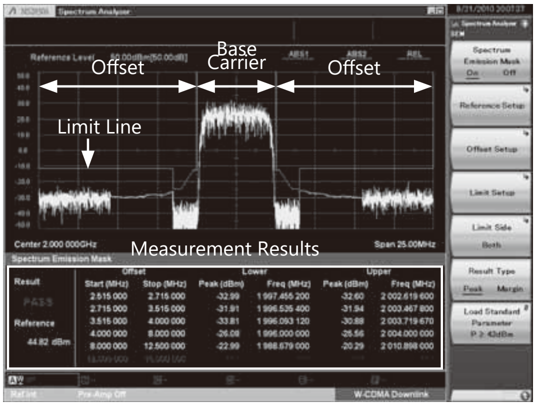
W-CDMA Downlink

Measurement Results
- Absolute power of Offset channel
- Relative values in relation to reference power selected in ACP reference

Spectrum Emission Mask

SPA

This function splits the offset part into up to 12 segments; the measurement parameters and limit lines can be specified to measure the peak power and margin for each segment. The results are tabulated below the trace and marked PASS/FAIL. Pre-installed templates for each standard support easy parameter setting.



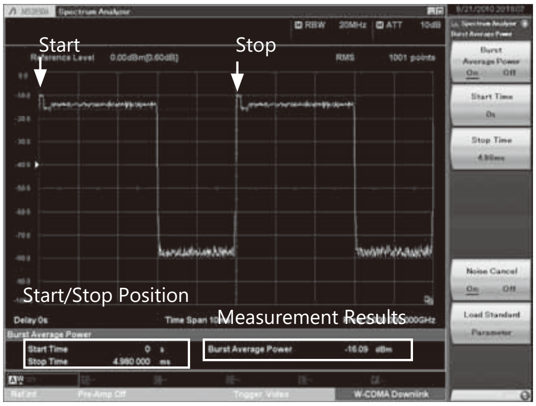
Result	Offset Start (MHz)	Offset Stop (MHz)	Lower Peak (dBm)	Lower Freq (MHz)	Upper Peak (dBm)	Upper Freq (MHz)
PASS	2.515 000	2.715 000	-32.99	1 997.455 200	-32.60	2 002.619 600
	2.715 000	3.515 000	-31.91	1 996.535 400	-31.94	2 003.467 800
Reference	3.515 000	4.000 000	-33.81	1 996.093 120	-30.88	2 003.719 670
44.82 dBm	4.000 000	8.000 000	-26.08	1 996.000 000	-25.56	2 004.000 000
	8.000 000	12.500 000	-22.99	1 988.679 000	-20.29	2 010.898 000

Measurement Results
- Peak power (or margin) at offset
- Each peak frequency

Burst Average Power

SPA VSA

The average power for the range specified by two markers is displayed in the time domain. Measurement only requires setting the measurement start and stop positions on the screen. True performance is measured using the noise cancellation function to subtract mainframe noise from the measurement result.
Pre-installed templates for each standard support easy parameter setting.



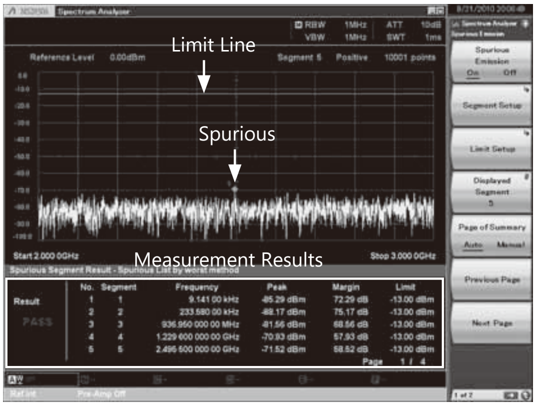
Start Time 0 s
Stop Time 4.980 000 ms
Burst Average Power -16.09 dBm

Measurement Results
- Average power of specified range

Spurious Emission

SPA

This function splits the frequency range into up to 20 segments for sweeping; the measurement parameters and limit lines can be specified to measure the peak power and margin for each segment. The results are tabulated below the trace and marked PASS/FAIL. In particular, all tests can be completed up to the final stage without an external PC because the zero-span capture function described in the technology compliance test is built-in.



Result	No.	Segment	Frequency	Peak	Margin	Limit
PASS	1	1	9.141 00 kHz	-85.29 dBm	72.29 dB	-13.00 dBm
	2	2	233.580 00 kHz	-88.17 dBm	75.17 dB	-13.00 dBm
	3	3	936.950 000 00 MHz	-81.56 dBm	68.56 dB	-13.00 dBm
	4	4	1.229 600 000 00 GHz	-70.93 dBm	57.93 dB	-13.00 dBm
	5	5	2.496 500 000 00 GHz	-71.52 dBm	58.52 dB	-13.00 dBm

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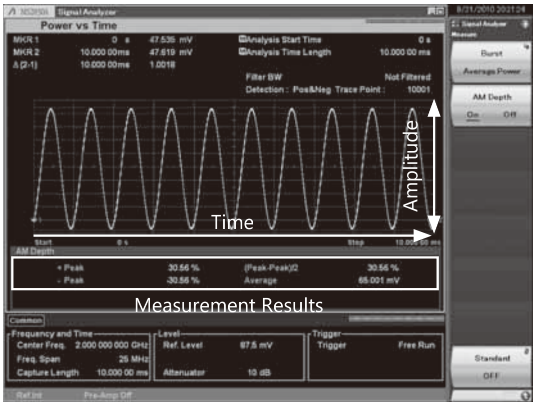
Measurement Results
- Each segment peak power and margin
- Each peak frequency

AM Depth

VSA

The Power vs. Time trace measurement function is used to confirm AM depth.
It measures the measured signal AM based on trace data at the displayed marker. When marker is Off, the whole range is measured.



MKR 1 0 s 47.535 mV
MKR 2 10.000 00ms 47.619 mV
Δ (2-1) 10.000 00ms 1.0018
Analysis Start Time 0 s
Analysis Time Length 10.000 00 ms
Filter BW Not Filtered
Detection : Pos&Neg Trace Point : 10001

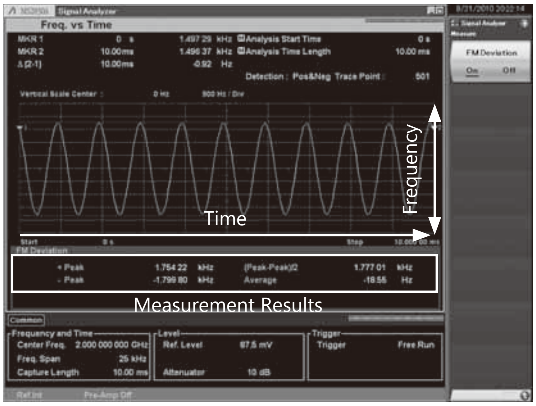
+ Peak	30.56 %	(Peak-Peak)/2	30.56 %
- Peak	-30.56 %	Average	65.001 mV

Center Freq. 2.000 000 000 GHz
Freq. Span 25 MHz
Capture Length 10.000 00 ms
Ref. Level 87.5 mV
Attenuator 10 dB
Trigger Free Run

Measurement Results
- +Peak, –Peak, (Peak-Peak)/2, Average

FM Deviation VSA

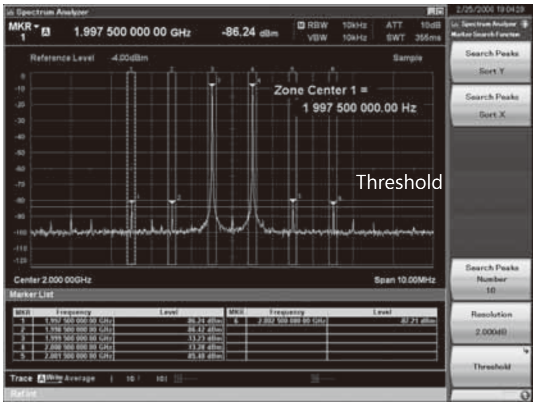
The Frequency vs. Time trace measurement is used to confirm the FM deviation. It measures the maximum and minimum frequencies from trace data in the marker range. When marker is Off, the whole range is measured.



Measurement Results
- +Peak, –Peak, (Peak-Peak)/2, Average

Multi-marker & Marker List SPA VSA

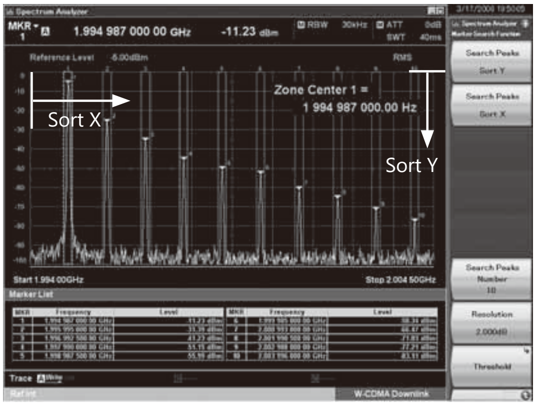
Up to 10 markers can be set for this function. Markers may be either a spot or a zone. Using a zone marker, the peak of a signal with an unstable variable frequency can be tracked and measured. Not only can the 10 markers be listed below the trace but the differences between markers can be calculated and displayed using the delta setting.



Measurement Results
- Marker point frequency
- Marker point power
- Absolute power per Hz in marker bandwidth
- Total power in marker bandwidth
- Difference between any markers

Highest 10 Markers SPA VSA

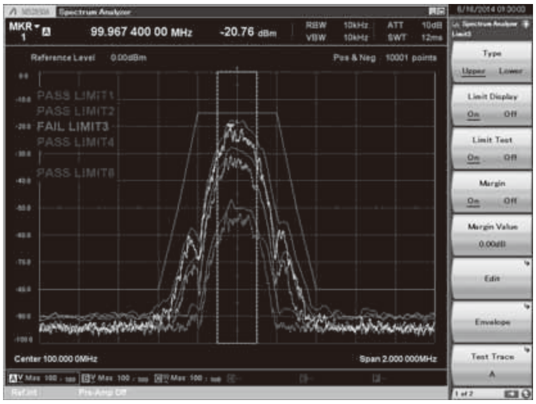
This function sets the threshold level and auto-detects peaks in the X (frequency) and Y (level/time) directions.



Measurement Results
- Peak Search Y:
  Sets up to 10 markers in order of peak level
- Peak Search X:
  Sets up to 10 markers in order of frequency (time) level

Limit Lines SPA

- Setting Limit Lines
  Up to six types of Limit line can be set on the spectrum display (frequency domain).
  In addition to setting the frequency and level of crossover points manually in sequence from the low frequency, after creating the right half of a line, the left half can be created by reversing and copying the right half, to set a symmetric limit line. Additionally, a Limit line that traces the measured waveform can be created using the Limit Envelope function. A margin can be set on the Limit line in the amplitude direction.
- Evaluating using Limit Line Setting (Limit Test Function)
  When the waveform is above or below the Limit line, it is evaluated automatically as PASS or FAIL. Evaluation is also possible with an added margin. The target evaluation line can be chosen from any of six types.
- Auto-saving Waveform Data using Limit Line Setting (Save on Event Function)
  When the waveform matches the evaluation conditions (Event), it can be saved automaticaly as a csv format file. Any one of the following five Event types can be selected.
  (1) Limit Fail: Saves waveform file when evaluation result is Fail
  (2) Limit Pass: Saves waveform file when evaluation result is Pass
  (3) Margin Fail: Saves waveform file when evaluation result including margin is Fail
  (4) Margin Pass: Saves waveform file when evaluation result including margin is Pass
  (5) Sweep Complete: Saves waveform file at every measurement regardless of evaluation result

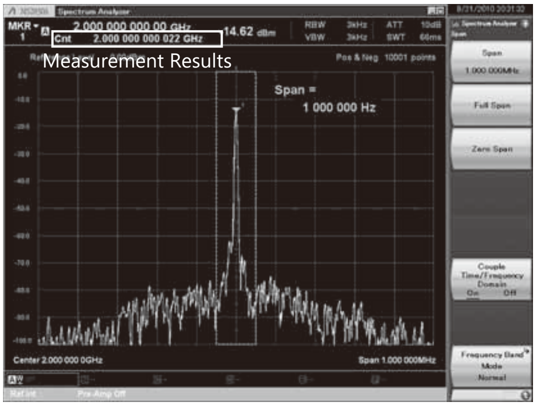


Example:
PASS/FAIL evaluation is performed by changing the input signal level. The evaluation results for the five line types can be displayed simultaneously on one screen.

Line: Limit 1, Limit 2, Limit 3, Limit 4, Limit 5, Limit 6
Evaluation Type: Upper Limit, Lower Limit
Crossover (Point): 1 to 100
Margin: Set Margin line for each Limit 1, 2, 3, 4, 5, 6
Evaluation Result: PASS, FAIL
Result Save: Auto-save as csv format file

Frequency Counter SPA

This function of the marker functions is used to measure CW frequencies. Gate Time sets the measurement target time.



Measurement Results
- Marker point frequency

2-tone 3rd-order Intermodulation Distortion SPA

By inputting two different frequency CW signals (desired waves), two-tone third-order intermodulation distortion is generated close to the desired waves according to non-linear characteristics of Device Under Test (DUT). Then, Third Order Intercept (TOI) is calculated from the two-tone third-order intermodulation distortion.

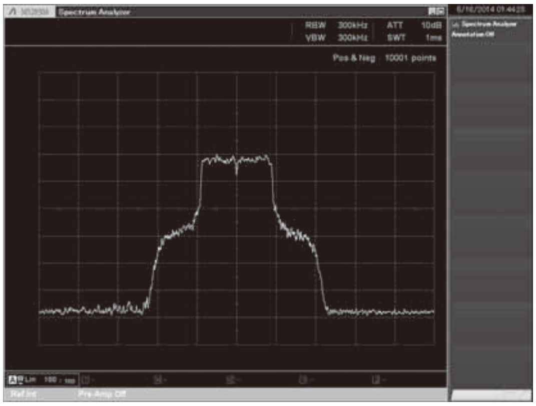
TOI

TOI (dBm)		Frequency (GHz)	Amplitude (dBm)	Amplitude (dBc)	TOI (dBm)
1.69	Lower 3rd	0.999 850 000	-43.21	-29.94	1.69
	Lower Tone	0.999 949 960	-13.28		
Amplitude (dBc)	Upper Tone	1.000 050 000	-13.27		
-29.94	Upper 3rd	1.000 149 999	-43.30	-30.02	1.74

Measurement Results
- TOI: [dBm]
- Amplitude: [dBc]

Annotation Display SPA

Screen annotations can be set to On or Off. Annotations about frequency, level, etc., are not displayed at the Off setting.



Power Meter

Power meter function can connect a USB power sensor to the MS2830A and read the measurement values.

COM5 | MA24108A | Freq : 1.000 000 000 GHz | Range : Auto

POWER : -10.00 dBm
0.00 dB
100. μW

Measuring | Not Zeroed | Offset : Off, 0.00 dB | Average : 80 / 1000

Measurement Results
- Power: [dBm], [W]
- Relative power: [dB]

Compatible USB power sensors

Model	Frequency Range	Dynamic Range
MA24104A*	600 MHz to 4 GHz	+3 to +51.76 dBm
MA24105A	350 MHz to 4 GHz	+3 to +51.76 dBm
MA24106A	50 MHz to 6 GHz	–40 to +23 dBm
MA24108A	10 MHz to 8 GHz	–40 to +20 dBm
MA24118A	10 MHz to 18 GHz	–40 to +20 dBm
MA24126A	10 MHz to 26 GHz	–40 to +20 dBm

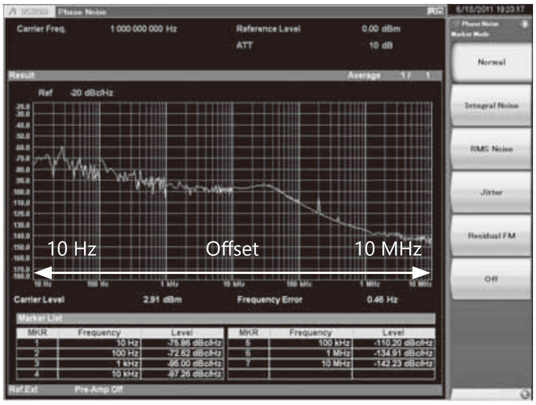
*: MA24104A has been discontinued.

Installing the PowerXpert™

Installing the PowerXpert™ PC application software for the Anritsu USB Power Sensor in the MS2830A supports various measurement functions offered by PowerXpert™, as well as use of other USB power sensors by the MS2830A.
PowerXpert™ for the MS2830A can be downloaded from the MS2830A and MS2830A Microwave product pages at the Anritsu website. When using the PowerXpert™ software with a PC, download the latest version from the USB Power Sensor product page at the Anritsu website.

Phase Noise (MS2830A-010)

This function measures phase noise in the 10 Hz to 10 MHz frequency offset range.



Carrier Freq. 1 000 000 000 Hz
Reference Level 0.00 dBm
ATT 10 dB
Carrier Level 2.91 dBm
Frequency Error 0.46 Hz

MKR	Frequency	Level	MKR	Frequency	Level
1	10 Hz	-75.86 dBc/Hz	5	100 kHz	-110.20 dBc/Hz
2	100 Hz	-72.62 dBc/Hz	6	1 MHz	-134.91 dBc/Hz
3	1 kHz	-95.00 dBc/Hz	7	10 MHz	-142.23 dBc/Hz
4	10 kHz	-97.26 dBc/Hz			

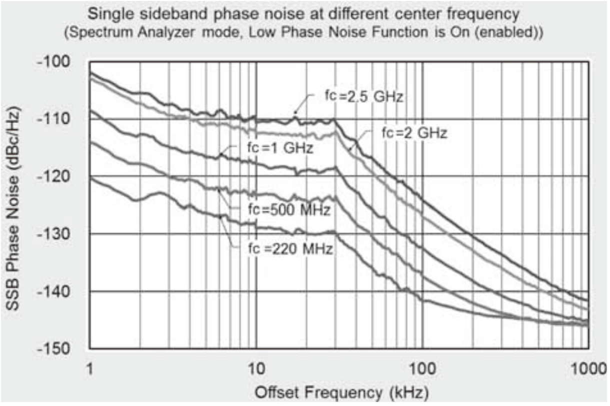
Measurement Results
- Carrier level
- Error between set frequency and carrier frequency
- Marker point phase noise level

Basic Performance Upgrade:
Low Phase Noise Performance (MS2830A-066)

The MS2830A with MS2830A-066 supports significantly improved phase noise performance, especially at carrier offsets of 1 kHz to 100 kHz.

Spectrum analyzer phase noise performance affects ACLR/MASK measurements at narrowband communications (Channel bandwidth: <100 kHz).

Add MS2830A-066 when required by the specifications.



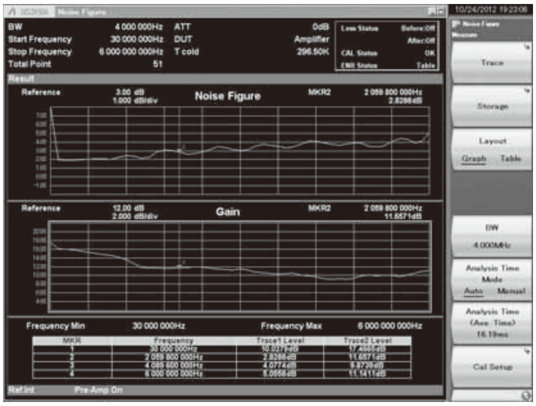
Noise Figure Measurement (MS2830A-017)

Noise Figure is measured with the measurement method of Y-factor method which uses a Noise Source*.

Frequency Mode: Fixed, List, Sweep
DUT Mode: Amplifier, Down Converter, Up Converter
Screen Layout: Graph, Table

Measurement Results Display
Graph, List, Spot

Displays measurement results for each trace (Trace1/Trace2).
Noise Figure (NF) [dB]
Noise Factor (F) [Linear]
Gain
Y-Factor: Power ratio when Noise Source is turned On/Off
T effective: Effective noise temperature
P Hot: Power measured when Noise Source is On.
P Cold: Power measured when Noise Source is Off.



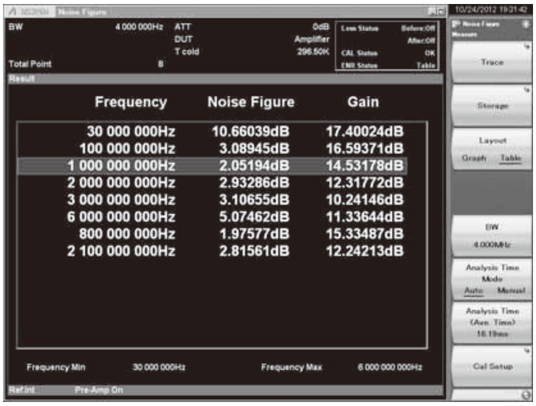
BW 4 000 000Hz
Start Frequency 30 000 000Hz
Stop Frequency 6 000 000 000Hz
Total Point 51
ATT 0dB
DUT Amplifier
T cold 296.50K
Loss Status Before:Off After:Off
CAL Status OK
ENR Status Table

Reference 3.00 dB 1.000 dB/div MKR2 2 059 800 000Hz 2.8288dB
Reference 12.00 dB 2.000 dB/div MKR2 2 059 800 000Hz 11.6571dB

Frequency Min 30 000 000Hz
Frequency Max 6 000 000 000Hz

MKR	Frequency	Trace1 Level	Trace2 Level
1	30 000 000Hz	10.0279dB	17.4665dB
2	2 059 800 000Hz	2.8288dB	11.6571dB
3	4 089 600 000Hz	4.0774dB	9.8720dB
4	6 000 000 000Hz	5.0558dB	11.1411dB

Measurement Result: Example of Graph display
(Frequency Mode: Sweep, Screen Layout: Graph)



Noise Figure

10/24/2012 19:31:42

BW 4 000 000Hz ATT 0dB

DUT Amplifier

T cold 296.50K

Total Point 8

Loss Status Before:Off After:Off

CAL Status OK

ENR Status Table

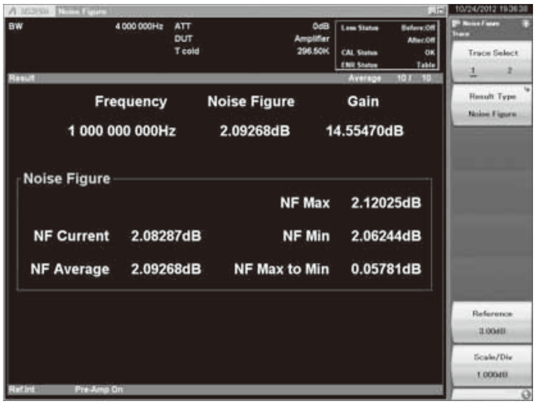
Result

Frequency	Noise Figure	Gain
30 000 000Hz	10.66039dB	17.40024dB
100 000 000Hz	3.08945dB	16.59371dB
1 000 000 000Hz	2.05194dB	14.53178dB
2 000 000 000Hz	2.93286dB	12.31772dB
3 000 000 000Hz	3.10655dB	10.24146dB
6 000 000 000Hz	5.07462dB	11.33644dB
800 000 000Hz	1.97577dB	15.33487dB
2 100 000 000Hz	2.81561dB	12.24213dB

Frequency Min 30 000 000Hz Frequency Max 6 000 000 000Hz

Ref.Int Pre-Amp On

Measurement Result: Example of List display
(Frequency Mode: List, Screen Layout: List)



Noise Figure

10/24/2012 19:36:38

BW 4 000 000Hz ATT 0dB

DUT Amplifier

T cold 296.50K

Loss Status Before:Off After:Off

CAL Status OK

ENR Status Table

Result Average 10 / 10

Frequency	Noise Figure	Gain
1 000 000 000Hz	2.09268dB	14.55470dB

Noise Figure

		NF Max	2.12025dB
NF Current	2.08287dB	NF Min	2.06244dB
NF Average	2.09268dB	NF Max to Min	0.05781dB

Ref.Int Pre-Amp On

Measurement Result: Example of Spot display
(Frequency Mode: Fixed)

*: Supports noise sources from Noisecom NC346 series.
See the MS2830A catalog for more details.

Vector Signal Generator (MS2830A-020/021): Basic Performance

The Vector Signal Generator MS2830A-020/021 covers the frequency range from 250 kHz to 3.6 GHz/6.0 GHz; it has a wide vector modulation bandwidth of 120 MHz as well as a large built-in memory for storing 64 Msamples/256 Msamples (with MS2830A-027).
Its level accuracy is at least as good as a dedicated signal generator and the ACLR performance is ideal for Tx tests of devices such as amplifiers and Rx tests of base stations. The all-in-one analyzer and signal generator supports simple configuration of space-saving measurement systems as well as easy signal analysis matching the output timing from the signal generator option.

Frequency Range

Frequency Range: 250 kHz to 3.6 GHz (MS2830A-020)
250 kHz to 6 GHz (MS2830A-021)
Resolution: 0.01 Hz step

The Vector Signal Generator option (MS2830A-020/021) frequency range is 250 kHz to 3.6 GHz/6.0 GHz, covering the key wireless communication range.

Output Level Range

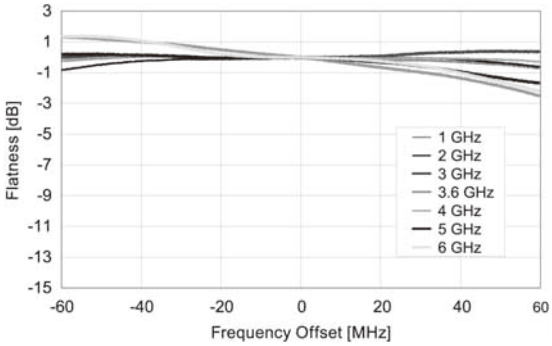
Output Level Range:
–40 to +20 dBm (without MS2830A-022, >25 MHz)
–136 to +15 dBm (with MS2830A-022, >25 MHz)
Resolution: 0.01 dB step

Internal Baseband Generator

Vector Modulation Bandwidth: 120 MHz
Sampling Clock: 20 kHz to 160 MHz

The wideband 120-MHz vector modulation bandwidth is achieved using the MS2830A-020/021 baseband signal generator.
The sampling clock supports up to 160 MHz.

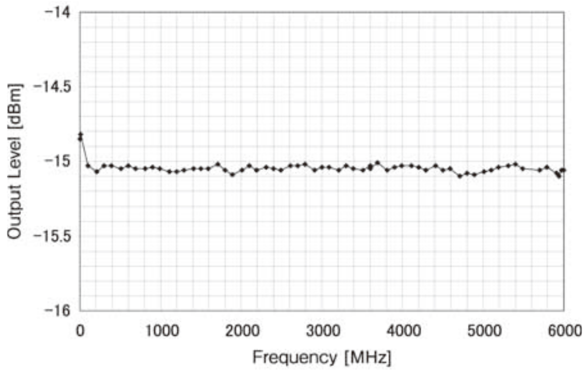
Example: Vector Modulation Bandwidth



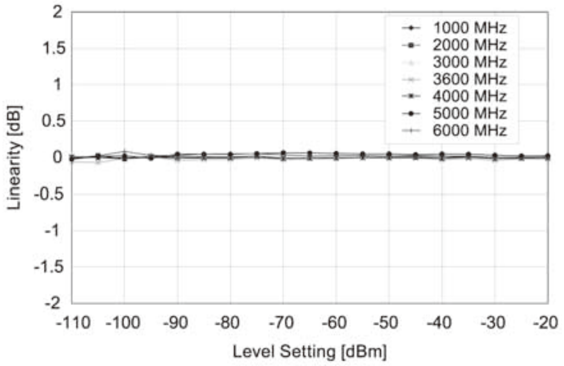
Level Accuracy ±0.5 dB

Output Level Accuracy (CW):
±0.5 dB (typ.)
(–110 dBm ≤ Level ≤ +4 dBm,100 MHz ≤ Frequency ≤ 3.6 GHz)

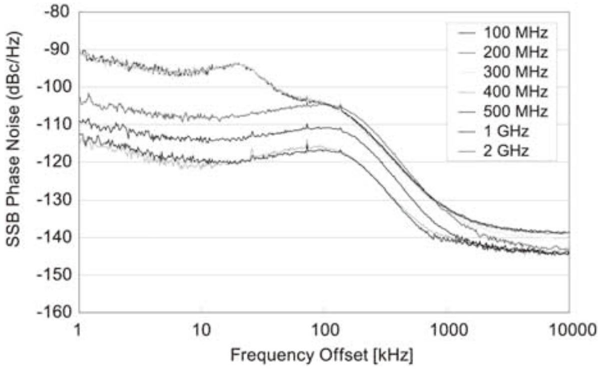
Example: Frequency Characteristics (Referenced to –15 dBm)



Example: Linearity (Referenced to –15 dBm)



Example: SSB Phase Noise



Large-capacity Memory (MS2830A-027)

256 MB = 64 Msamples/channel (without MS2830A-027)
1 GB = 256 Msamples/channel (with MS2830A-027)

The MS2830A-020/021 arbitrary waveform memory can save MAX. 256 Msamples/channel as well as multiple waveform patterns at the same time. Waveform patterns in memory can be output instantaneously by switching without need to recall from hard disk.

Internal AWGN Generator (MS2830A-028)

Absolute CN Ratio: ≤40 dB

This functions adds AWGN (Additive White Gaussian Noise) to the wanted waveform in memory. It is ideal for Tx dynamic range tests.

AWGN band set automatically to sampling clock of wanted signal.

Example: When wanted signal conditions are:

- W-CDMA
- Bandwidth = 3.84 MHz
- Over sampling = × 4

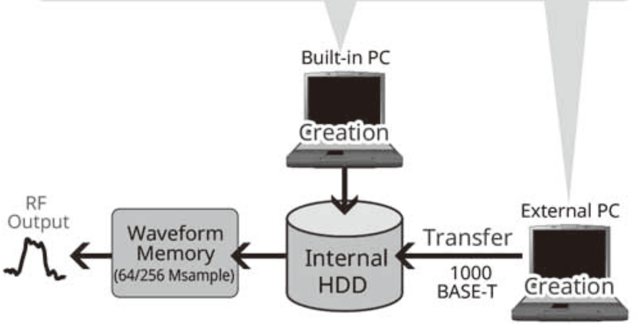
Versatile Multiple Waveform Generation

Any type of waveform can be generated using the MS2830A-020/021 Signal Generator option. In addition to using C and simulation tools, Anritsu's IQproducer can be run on a PC to edit waveform parameters and output waveforms.

Creating Waveform Using IQproducer
IQproducer is PC software that is used to edit parameters and create any waveform pattern. It can be installed either on an external PC or in the MS2830A main frame.

- HSDPA/HSUPA IQproducer
- TDMA IQproducer
- Multi-carrier IQproducer
- Mobile WiMAX IQproducer
- LTE IQproducer
- LTE TDD IQproducer
- WLAN IQproducer
- TD-SCDMA IQproducer

Creating Any Waveform
IQ Data created using the MS2830A digitize function or by simulation tools or in C can be converted to a waveform pattern using the SG option and output.



Useful IQproducer Waveform Generation Software

IQproducer is application software for a PC for editing, creating and transferring waveform patterns using the MS2830A-020/021 arbitrary waveform generation option.
It has the following three main functions.

Parameter Editing:
Function for easily editing parameters matching each communication method

Simulation:
Function for checking generated waveform pattern before transfer to CCDF and FFT graphs

Conversion:
Function for converting ASCII format waveform patterns created by simulation software, files captured using digitizing function, and MG3700A/MS269xA-020 waveform patterns, into files that can be used by MS2830A-020/021

BER Measurement Function (MS2830A-026): Basic Performance

Convenient Built-in BER Measurement Function for Rx Evaluations

The MS2830A with the BER Measurement Function MS2830A-026 supports measurement up to 10 Mbps.
It supports Rx sensitivity tests by inputting the receiver-demodulated Data/Clock/Enable to the back of the MS2830A.

- Input Signal: Data, Clock, Enable (Polarity reversal supported)
- Input Bit Rate: 100 bps to 10 Mbps
- Input Level: TTL 3.3 V
- Connector: Rear panel, AUX connector*

*: Can convert to BNC by connecting AUX conversion adapter (J1556A).

- Measured Patterns:
  PN9, PN11, PN15, PN20, PN23, ALL0, ALL1, Alternate (0101...), PN9Fix, PN11Fix, PN15Fix, PN20Fix, PN23Fix, UserDefine (4096 bits Max.)
- Measurable Bit Count: 1000 to 4294967295 bits (2^{32} – 1 bits)
- Measurable Error Bit Count: 1 to 2147483647 bits (2^{31} – 1 bits)
- Count Mode
  Data: Measures until specified Data count
  Error: Measures until specified Error count
- Measurement Mode
  Single: Measures specified measurement bit count once
  Continuous: Repeats Single measurement
  Endless: Continues measurement to upper limit of measurement bits

BER Test

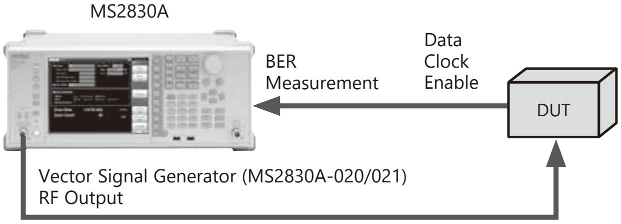
Data Type: PN9
Pattern File
Bit Length
Sync Position Start
Sync Position Length
Measure Mode: Single

Count Mode: Data
Data: 10000 Bit
Error: Bit

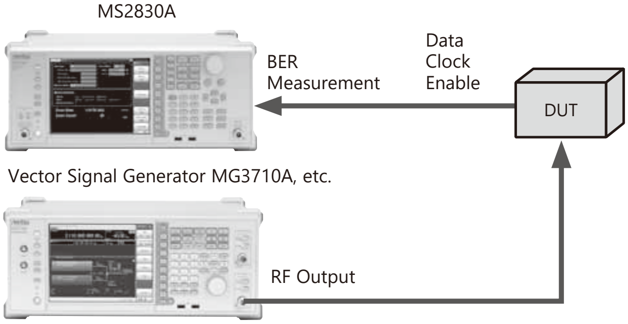
Measure Information
Status: Stop Synchronizing Measuring
Error: BitError SyncLoss ClockError EnableError
SyncLoss Count: 0

Error Rate 1.017E-002 1.017%
Error Count 20 / 1967

BER Measurement Function Main Screen



BER Measurement Setup Example (with MS2830A-020/021 installed)



BER Measurement Setup Example
(using external vector signal generator)

Excellent Expandability Platform (Hardware)

The versatility of the MS2830A series is tailored easily to the application by installing modules in expansion slots.

Basic Function and Performance Upgrades

- Rubidium Reference Oscillator/Retrofit MS2830A-001/101
  This option is a 10 MHz reference crystal oscillator with excellent frequency stability startup characteristics of ±1 × 10–9 at 7 minutes after power-on.
  Aging Rate: ±1 × 10–10/month
  Start-up Characteristics: ±1 × 10–9 (7 minutes after power-on)
- High Stability Reference Oscillator/Retrofit MS2830A-002/102
  The 10 MHz reference oscillator improving frequency stability up to aging rate: ±1 × 10–8/day
  Aging Rate: ±1 × 10–8/day
  Start-up Characteristics: ±5 × 10–8 (5 minutes after power-on)
- Preamplifier/Retrofit MS2830A-008/108
  This option increases the sensitivity of the spectrum/signal analyzer functions and is used for examining low-level signals such as interference waveforms.
- Precompliance EMI Function/Retrofit MS2830A-016/116
  This option adds an EMI measurement detection mode and RBW to the spectrum analyzer function. Both the detection mode used for CISPR standards (Quasi-Peak, CISPR-AVG, RMS-AVG) and RBW (200 Hz (6 dB), 9 kHz (6 dB), 120 kHz (6 dB), 1 MHz (Imp)) as well as conventional settings can be selected.
- Low Phase Noise Performance MS2830A-066
  Phase noise performance is increasingly important at carrier offsets of 1 kHz to 100 kHz.
  Spectrum analyzer phase noise performance affects ACLR/MASK measurements at narrowband communications.
  (Channel bandwidth: <100 kHz)
  Add MS2830A-066 when required by the specifications.
  Frequency Range: 9 kHz to 3.7 GHz
  (Frequency band mode: * Normal)
  9 kHz to 3.5 GHz
  (Frequency band mode: * Spurious)

  *: Requires MS2830A-041/043 for setting.

  Span: 300 Hz to 1 MHz (Spectrum Analyzer)
  1 kHz to 31.25 MHz (Signal Analyzer)

  MS2830A-066 cannot be retrofitted
  MS2830A-066 sometimes cannot be installed depending on options.

Model	Case 1	Case 2	Case 3
MS2830A-020/021	Yes	Yes	No
MS2830A-043	Yes	No	Yes
MS2830A-066	No	Yes	Yes

Signal Analyzer Function and Performance Upgrade

- Analysis Bandwidth Extension to 31.25 MHz/Retrofit MS2830A-005/105
  Extends analysis bandwidth to 31.25 MHz.
  *: Requires MS2830A-006.
- Analysis Bandwidth 10 MHz/Retrofit MS2830A-006/106
  This option supports the VSA and digitize functions.
- Analysis Bandwidth Extension to 62.5 MHz MS2830A-077
  Extends analysis bandwidth to 62.5 MHz.
  *: Retrofit not supported.
  *: Requires MS2830A-005 and MS2830A-006.
- Analysis Bandwidth Extension to 125 MHz MS2830A-078
  Extends analysis bandwidth to 125 MHz.
  *: Retrofit not supported.
  *: Requires MS2830A-005, MS2830A-006 and MS2830A-077.

  Note: An image response is received when setting the bandwidth to more than 31.25 MHz. This can be used when not inputting a signal frequency outside the MS2830A analysis bandwidth (125 MHz max.). The Signal Analyzer series MS2690A/91A/92A is recommended for other measurement purposes.

Expansion Functions

- Phase Noise Measurement Function/Retrofit MS2830A-010/110
  Phase Noise Measurements
  Frequency Range: 10 MHz to main-frame upper limit frequency
  Offset Frequency Range: 10 Hz to 10 MHz
- 2ndary HDD/Retrofit MS2830A-011/111
  This removable 2ndary HDD is installed in the HDD Option Slot of the MS2830A main frame to expand the user data storage space.
  It does not have the Windows OS installed. The MS2830A ships with it installed. Only one expansion HDD can be installed in the MS2830A.
  It is useful when taking the instrument for calibration but the security of saved user data, such as measurement results, must be protected.
- 2ndary HDD Retrofit MS2830A-311
  This removable 2ndary HDD is installed in the HDD Option Slot of the MS2830A main frame to expand the user data storage space.
  It does not have the Windows OS installed.
  It is useful when taking the instrument for calibration but the security of saved user data, such as measurement results, must be protected.
- Noise Figure Measurement Function/Retrofit MS2830A-017/117
  Adds noise figure measurement function.
  Noise Figure is measured with the measurement method of Y-factor method which uses a Noise Source.
- Audio Analyzer/Retrofit MS2830A-018/118
  Adds AF signal Input/Output function. Measurement operation performed using Analog Measurement Software MX269018A.
  *: Requires MX269018A
- BER Measurement Function/Retrofit MS2830A-026/126
  Adds BER measurement function.
  It supports Rx sensitivity tests by inputting the receiver-demodulated Data/Clock/Enable to the back of the MS2830A.
  Input Bit Rate: 100 bps to 10 Mbps
  Input Level: TTL
  Connector: Rear panel, AUX connector*
  *: Can convert to BNC by connecting AUX Conversion Adapter (J1556A).
- 3.6 GHz Vector Signal Generator/Retrofit MS2830A-020/120
  Cover frequency ranging from 250 kHz to 3.6 GHz with 120 MHz wideband vector modulation bandwidth
- 6 GHz Vector Signal Generator/Retrofit MS2830A-021/121
  Cover frequency ranging from 250 kHz to 6 GHz with 120 MHz wideband vector modulation bandwidth
- Low Power Extension for Vector Signal Generator/Retrofit MS2830A-022/122
  Extends lower limit of output level from –40 to –136 dBm
  (Note: 5-dB drop in upper output level)
- ARB Memory Upgrade 256 Msa for Vector Signal Generator/Retrofit MS2830A-027/127
  Extends ARB memory capacity from 64 Msample to 256 Msample
- AWGN/Retrofit MS2830A-028/128
  AWGN generator function
- Analog Function Extension for Vector Signal Generator MS2830A-029
  Adds analog signal generation function using Analog Measurement Software MX269018A to Vector Signal Generator option (MS2830A-020/021). Can calibrate lower limit frequency up to 100 kHz (MS2830A-020/021 lower limit frequency is 250 kHz)
  *: Requires MX269018A, MS2830A-020 or 021, and MS2830A-022
- 3.6 GHz Analog Signal Generator/Retrofit MS2830A-088/188
  Outputs analog signals and includes low power expansion (equivalent to MS2830A-022). Measurement operation performed using Analog Measurement Software MX269018A.
  Can calibrate lower limit frequency up to 100 kHz (MS2830A-020/021 lower limit frequency is 250 kHz)
  *: Requires MX269018A.
  *: Vector modulation signal output not supported (added by MS2830A-189)
- Vector Function Extension for Analog Signal Generator Retrofit MS2830A-189
  Installs license required for vector signal generation in existing Analog Signal Generator (MS2830A-088/188).
  Use following options when ordering new Analog Signal Generator + Vector Signal Generator:
  - MS2830A-020 or 021 + MS2830A-022 + MS2830A-029 + MX269018A + MS2830A-066 + A0086C
- Internal Signal Generator Control Function/User-Installable MS2830A-052/352
  The transmission characteristics of amplifiers, filters etc., can be measured using linked operation between the Spectrum Analyzer function and the Vector Signal Generator option (MS2830A-020/120 or 021/121) or the Analog Signal Generator option (MS2830A-088/188).
  *: Requires any of MS2830A-020/120, 021/121, or 088/188.

Future-proof Platform (Software)

Adding measurement software options to the signal analyzer assures that the modulation analysis and other functions will support all common current and future communications systems.

Measurement Software

Communications Systems	Model	Name	Addition to Main frame (✓: Can be installed, No: Cannot be installed)		Analysis Bandwidth Extension Option (✓: Required, ✓+: Function expansion, Space (no symbol): No specification)			
			Opt. 040/041/043	Opt. 044/045	Opt. 006	Opt. 005/009	Opt. 077	Opt. 078
LTE/LTE-Advanced (FDD)	MX269020A	LTE Downlink Measurement Software	✓	✓	✓	✓		
	MX269020A-001	LTE-Advanced FDD Downlink Measurement Software	✓	✓	✓	✓	✓+*1	✓+*1
	MX269021A	LTE Uplink Measurement Software	✓	✓	✓	✓		
	MX269021A-001	LTE-Advanced FDD Uplink Measurement Software	✓	✓	✓	✓	✓+	✓+
LTE/LTE-Advanced (TDD)	MX269022A	LTE TDD Downlink Measurement Software	✓	✓	✓	✓		
	MX269022A-001	LTE-Advanced TDD Downlink Measurement Software	✓	✓	✓	✓	✓+*1	✓+*1
	MX269023A	LTE TDD Uplink Measurement Software	✓	✓	✓	✓		
	MX269023A-001	LTE-Advanced TDD Uplink Measurement Software	✓	✓	✓	✓	✓+	✓+
W-CDMA/HSPA/ HSPA Evolution	MX269011A	W-CDMA/HSPA Downlink Measurement Software	✓	✓	✓			
	MX269012A	W-CDMA/HSPA Uplink Measurement Software	✓	✓	✓			
W-CDMA/HSPA (Downlink)	MX269030A	W-CDMA BS Measurement Software	✓	✓	✓			
TD-SCDMA	MX269015A	TD-SCDMA Measurement Software	✓	✓	✓			
CDMA2000	MX269024A	CDMA2000 Forward Link Measurement Software	✓	✓	✓			
	MX269024A-001	All Measure Function	✓	✓	✓			
1xEV-DO	MX269026A	EV-DO Forward Link Measurement Software	✓	✓	✓			
	MX269026A-001	All Measure Function	✓	✓	✓			
GSM/EDGE	MX269013A	GSM/EDGE Measurement Software	✓	✓	✓			
EDGE Evolution	MX269013A-001	EDGE Evolution Measurement Software	✓	✓	✓			
World Digital Wireless Standards	MX269017A	Vector Modulation Analysis Software	✓	✓*2	✓	✓+*3	✓+*3	✓+*3
Analog (FM/ΦM/AM)	MX269018A	Analog Measurement Software	✓*4	No				
WLAN IEEE 802.11a/b/g/n/j/p	MX269028A	WLAN (802.11) Measurement Software (Supports IEEE 802.11n/11a/11b/11g/11j/11p)	✓	✓	✓	✓		
WLAN IEEE 802.11ac (80 MHz)	MX269028A-001*5	802.11ac (80 MHz) Measurement Software	✓	✓	✓	✓	✓	✓
WLAN IEEE 802.11a/b/g/n	MX283027A	Wireless Network Device Test Software	✓	✓				
WLAN	MX283027A-001	WLAN Test Software	✓	✓	✓	✓		
Bluetooth	MX283027A-002	Bluetooth Test Software	✓	✓	✓	✓		

*1: The LTE-Advanced Carrier Aggregation measurement range varies as follows, depending on the Analysis Bandwidth Extension option configuration.

Main Frame	Analysis Bandwidth Extension Option Configuration	Maximum Analysis Bandwidth (In-band carrier aggregation range)	Maximum Number of Bands	Maximum Number of Component Carriers
MS2830A	MS2830A-078 installed	125 MHz	1	5
	MS2830A-077 installed	31.25 MHz	3	5
	MS2830A-005/009 installed	31.25 MHz	3	5
MS269xA	MS269xA-078 installed	125 MHz	3	5
	MS269xA-077 installed	31.25 MHz	3	5
	Standard	31.25 MHz	3	5

*2: By the measurement of the narrowband signal, add MS2830A-066. (Channel bandwidth: x kHz to 100 kHz)
MS2830A-044/045 cannot be installed MS2830A-066.

*3: The Symbol Rate setting range varies as follows, depending on the option configuration.

	O-QPSK	FSK	Except FSK	
			Frame Formatted	Non-Formatted
MS2830A-078, 077, 005, 006 installed	0.1 ksps to 12.5 Msps	0.1 ksps to 25 Msps	0.1 ksps to 50 Msps	0.1 ksps to 140 Msps
MS2830A-077, 005, 006 installed	0.1 ksps to 6.25 Msps	0.1 ksps to 12.5 Msps	0.1 ksps to 25 Msps	0.1 ksps to 70 Msps
MS2830A-005, 006 installed	0.1 ksps to 3.125 Msps	0.1 ksps to 6.25 Msps	0.1 ksps to 12.5 Msps	0.1 ksps to 35 Msps
MS2830A-006 installed	0.1 ksps to 1.25 Msps	0.1 ksps to 2.5 Msps	0.1 ksps to 5 Msps	0.1 ksps to 5 Msps

*4: MS2830A-043 can implement only either MS2830A-020/021 or MS2830A-066.
By the system that MS2830A-066 is necessary, MS2830A-020/021 is not added to MS2830A-043.

*5: Requires MX269028A. The IEEE 802.11ac measurement range varies as follows, depending on the Analysis Bandwidth Extension option configuration.

Model			Bandwidth of 802.11ac signal				
Main Frame	Measurement Software	Analysis Bandwidth Extension Option Configuration	20 MHz	40 MHz	80 MHz	160 MHz	80 MHz + 80 MHz
MS2830A	MX269028A-001 (Only for MS2830A)	MS2830A-078 installed	✓	✓	✓*5-2		
		MS2830A-077 installed	✓	✓			
		MS2830A-005/009 installed	✓	✓			
MS269xA	MX269028A-002 (Only for MS269xA)	MS269xA-078 installed	✓	✓	✓	✓	✓*5-1
		MS269xA-077 installed	✓	✓			
		Standard	✓	✓			

*5-1: Measurement required for each carrier signal (80-MHz bandwidth)
*5-2: Measurement is only possible when the carrier signal (80-MHz bandwidth) is input due to the effect of the image response.

See each software catalog for more details.

CDMA2000® is a registered trademark of the Telecommunications Industry Association (TIA-USA).
The Bluetooth® word mark and logos are registered trademarks owned by Bluetooth SIG, Inc. and are used of such marks by Anritsu is under license.
IQproducer™ is a trademark of Anritsu Corporation.

Measurement Software for Smart Meter

This software is for PC. This software supports automatic measurement of the PHY layer and protocol analysis of the PHY/ MAC layer of smart utility network wireless communications (Wi-SUN).

• Wi-SUN PHY Measurement Software*1	MX705010A
• Wi-SUN Protocol Monitor*2	MX705110A

The MX705010A*1 supports automatic measurement of Wi-SUN Alliance PHY Conformance test cases. The MS2830A is controlled by remote commands from this software.

*1: Cannot be installed in MS2830A.
Requires the latest firmware of MS2830A.
This service, which provides updated versions of firmware and software for downloading by product customers, is available on Anritsu's website.
<https: //my.anritsu.com/home>

Options Configuration Examples
MS2830A-041, MS2830A-002, MS2830A-006, MX269017A, MS2830A-020, MS2830A-022, MS2830A-027, MX269902A

MX705110A*2 is possible to check the details of a Wi-SUN protocol. The wireless signals*3 between communicating wireless equipments are captured as I/Q data using the MS2830A digitize function and data analysis is performed by this software. Data analysis displays the PHY/ MAC frame format, Tx timing, etc.

*2: Cannot be installed in MS2830A.
Requires the latest firmware of MS2830A.
*3: IEEE 802.15.4g/e (GFSK)

Wi-SUN® is a registered trademark of Wi-SUN Alliance.

Adding a license for the IQproducer waveform generation software to the vector signal generator option supports easy generation of test patterns for all common communications systems worldwide.

IQproducer License for MS2830A-020/021 VSG

Following licenses (option) are required to download waveform pattern created with IQproducer to the MS2830A with vector signal generator option and output signals.

• HSDPA/HSUPA IQproducer	MX269901A
• TDMA IQproducer	MX269902A
• Multi-carrier IQproducer	MX269904A
• Mobile WiMAX IQproducer	MX269905A
• LTE IQproducer	MX269908A
• LTE-Advanced FDD Option	MX269908A-001*4
• LTE TDD IQproducer	MX269910A
• LTE-Advanced TDD Option	MX269910A-001*5
• WLAN IQproducer	MX269911A
• 802.11ac (80 MHz) Option	MX269911A-001*6
• TD-SCDMA IQproducer	MX269912A

*4: Requires MX269908A
*5: Requires MX269910A
*6: Requires MX269911A

IQproducer™ is a trademark of Anritsu Corporation.

Waveform patterns for MS2830A-020/021 VSG

Various waveforms with preset parameters matching each communication method are provided. The MS2830A-020/021 Vector Signal Generator option outputs RF signals.
Pre-installed reference waveforms are saved on the MS2830A hard disk for free use.

- Pre-installed patterns
  W-CDMA
  HSDPA (Test Model5)
  CDMA2000 1xEV-DO
  CDMA2000
  GSM/EDGE
  Digital Broadcasting (ISDB-T/CS/BS/CATV)
  WLAN 802.11a/b/g
  Bluetooth
- Option Patterns
  1xEV-DO Reverse Receiver Test Waveform Pattern MX269970A

Excellent-Expandability Platform (Analog Radio Equipment Measurement)

Supports Key TRx Performance Tests (FM/ΦM/AM) Required by Analog Equipment

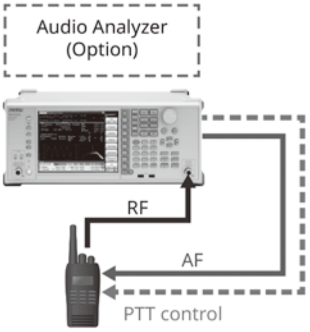
Combining the MS2830A-088 (or 029) 3.6 GHz Analog Signal Generator, Audio Analyzer MS2830A-018 and Analog Measurement Software MX269018A options in the all-in-one MS2830A main frame supports the simultaneous RF and AF signals required for implementing key TRx tests of analog radio equipment.

At Tx tests, the AF signal output from the Audio Analyzer is input to the radio equipment and the RF signal output from the radio is measured. As well as simultaneously outputting an AF signal with up to three tones, tone + DCS, white noise (ITU-T G.227), and DTMF signals can also be output. Furthermore, at RF signal measurement, the Tx frequency, power, modulation, demodulated AF signal frequency, level, and distortion can be displayed simultaneously on time vs. level and frequency vs. level graphs.

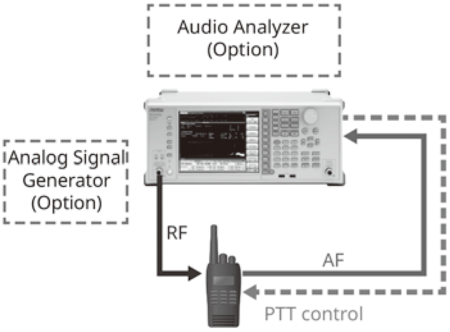
The DCS Code is also displayed at frequency modulation. By using the spectrum analyzer display it is also possible to measure the spurious and occupied bandwidth (OBW) while outputting an AF signal such as white noise (ITU-T G.227) from the Audio Analyzer.

The Audio Analyzer option has a Push To Talk (PTT) connector for On/Off control of the radio equipment PTT.

At Rx tests, the RF signal output from the Analog Signal Generator is input to the radio equipment and the AF signal from the radio is measured using the Audio Analyzer. As well as outputting up to three AF tones simultaneously from the internal modulation signal source of the Analog Signal Generator, both DCS (FM only) and Wave audio format files can be output as signals. At AF signal measurement using the Audio Analyzer, the frequency, level and distortion (SINAD measurement, etc.) can be displayed simultaneously on time vs. level and frequency vs. level graphs.

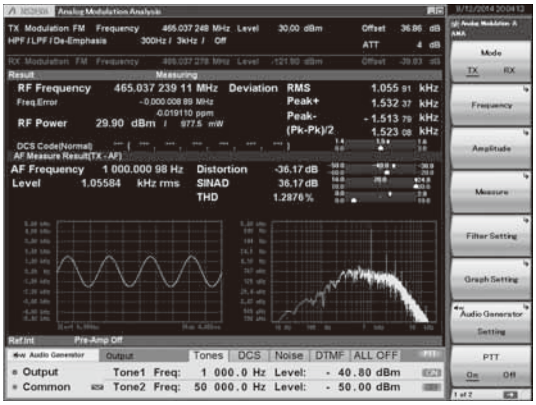


Tx Characteristics Test Setup



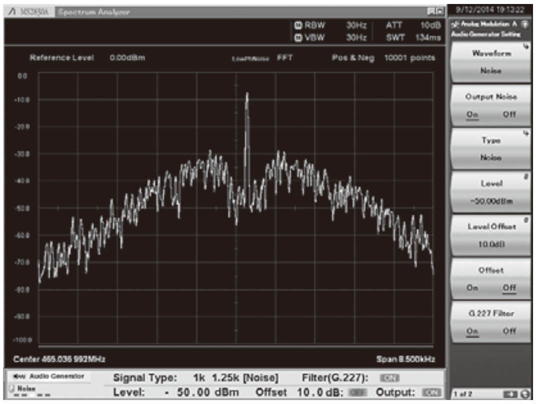
Rx Sensitivity Test Setup

- Tx Tests
  - Key Measurement Test Items (FM Radio Equipment)
    - Tx Power, Tx Frequency, FM Deviation, Microphone input sensitivity, Modulation frequency characteristics, Distortion, S/N, Tone frequency, Occupied bandwidth (OBW)/Spurious emission or Unwanted emission strength (White noise (ITU-T G.227) output supported)



TX Modulation FM Frequency 465.037 248 MHz Level 30.00 dBm Offset 36.86 dB
HPF / LPF / De-Emphasis 300Hz / 3kHz / Off ATT 4 dB
Result Measuring
RF Frequency 465.037 239 11 MHz Deviation RMS 1.055 91 kHz
Freq.Error -0.000 008 89 MHz Peak+ 1.532 37 kHz
-0.019110 ppm Peak- -1.513 79 kHz
RF Power 29.90 dBm / 977.5 mW (Pk-Pk)/2 1.523 08 kHz
AF Measure Result(TX - AF)
AF Frequency 1 000.000 98 Hz Distortion -36.17 dB
Level 1.05584 kHz rms SINAD 36.17 dB
THD 1.2876 %
Ref.Int Pre-Amp Off
Audio Generator Output
Output Tone1 Freq: 1 000.0 Hz Level: - 40.80 dBm
Common Tone2 Freq: 50 000.0 Hz Level: - 50.00 dBm

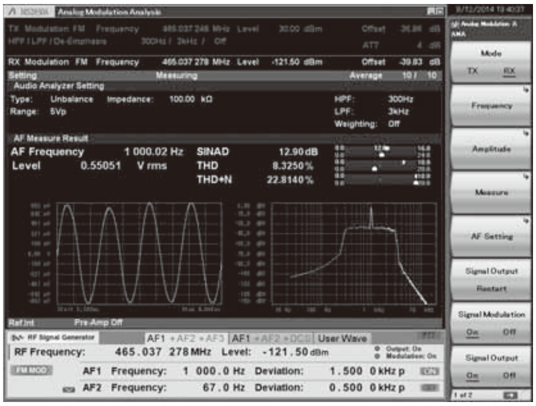
Example of AF Signal Output (bottom) and FM Signal (top) Measurement



RBW 30Hz ATT 10dB
VBW 30Hz SWT 134ms
Reference Level 0.00dBm FFT Pos & Neg 10001 points
Center 465.036 992MHz Span 8.500kHz
Audio Generator Noise
Signal Type: 1k 1.25k [Noise] Filter(G.227): ON
Level: - 50.00 dBm Offset 10.0 dB: OFF Output: ON

Example of White Noise (ITU-T G.227) Output (bottom) and Spectrum Analyzer (top)

- Rx Tests
  - Key Measurement Test Items (FM Radio Equipment)
    - Receiving sensitivity (SINAD and NQ method), Bandwidth, AF level, Demodulation frequency characteristics, Distortion, S/N, Squelch sensitivity



RX Modulation FM Frequency 465.037 278 MHz Level -121.50 dBm Offset -39.83 dB
Setting Measuring Average 10 / 10
Audio Analyzer Setting
Type: Unbalance Impedance: 100.00 kΩ HPF: 300Hz
Range: 5Vp LPF: 3kHz
Weighting: Off
AF Measure Result
AF Frequency 1 000.02 Hz SINAD 12.90 dB
Level 0.55051 V rms THD 8.3250 %
THD+N 22.8140 %
Ref.Int Pre-Amp Off
RF Signal Generator
RF Frequency: 465.037 278 MHz Level: -121.50 dBm Output: On Modulation: On
FM MOD AF1 Frequency: 1 000.0 Hz Deviation: 1.500 0 kHz p ON
AF2 Frequency: 67.0 Hz Deviation: 0.500 0 kHz p

Example of FM Signal Output (bottom) and AF Signal (top) Measurement

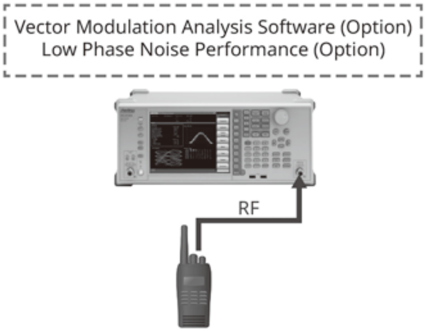
Excellent-Expandability Platform (Digital LMR/PMR Measurement)

Digital Radio (π/4DQPSK, 4FSK, etc.)

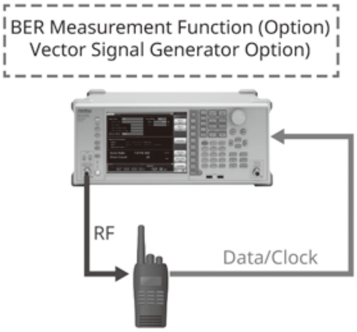
Combining the Vector Modulation Analysis Software MX269017A with the Low Phase Noise Performance MS2830A-066, 3.6 GHz Vector Signal Generator MS2830A-020, and BER Measurement Function MS2830A-026 supports all-in-one measurement of key TRx characteristics of narrow-band digital radio.
As Tx test items, it covers Tx frequency and power measurement of the RF signal output from the radio, as well as the π/4DQPSK, QPSK, and 16QAM modulation accuracy (EVM), the zero offset, 4FSK modulation accuracy (FSK Error), and frequency shift at each symbol rate. It has the parameters supporting easy settings for the standards and technologies.

- APCO P25,NXDN,TETRA,DMR,dPMR,etc.
- ARIB STD-T61,T79,T86,T98,T102,etc.

Adding the Low Phase Noise MS2830A-066 option uses a unique circuit technology to improve the MS2830A close-in phase noise by about 20 dB. As well as supporting the severe close-in spurious measurement standards, this platform also has sufficient margins for measuring adjacent channel leakage power.
Rx tests measure the bit error rate (BER) by inputting an RF signal output from a vector signal generator to the radio and then inputting the demodulated Data and Clock from the radio to the MS2830A.

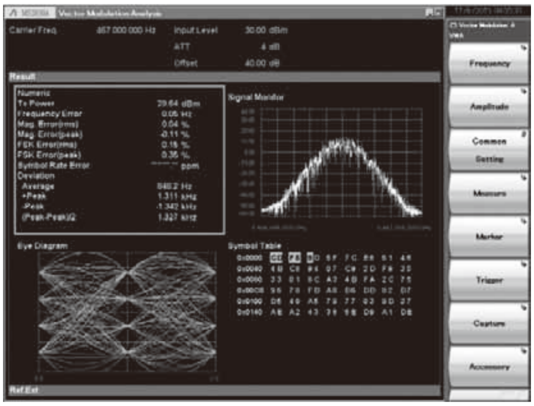


Tx Characteristics Test Setup



Rx Sensitivity Test Setup

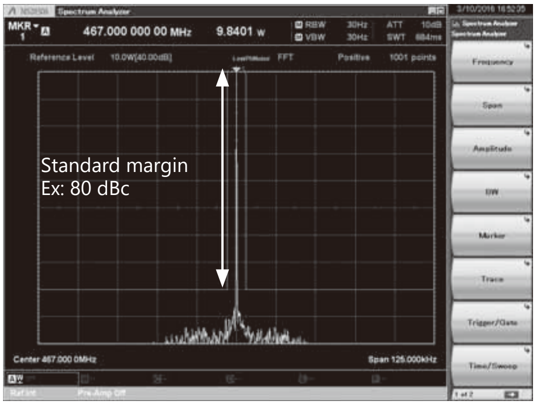
- Tx Tests
  Key Tx Test Items
    Tx Power, Tx Frequency, Modulation Accuracy, Zero Offset, Frequency Shift, Occupied Bandwidth, Adjacent Channel Leakage Power, Spurious Emissions, and Unwanted Emissions



Carrier Freq 467 000 000 Hz
Input Level 30.00 dBm
ATT 4 dB
Offset 40.00 dB

Numeric
Tx Power 29.64 dBm
Frequency Error 0.05 Hz
Mag. Error(rms) 0.04 %
Mag. Error(peak) -0.11 %
FSK Error(rms) 0.15 %
FSK Error(peak) 0.35 %
Symbol Rate Error ------ ppm
Deviation
Average 948.2 Hz
+Peak 1.311 kHz
-Peak -1.342 kHz
(Peak-Peak)/2 1.327 kHz

4FSK Modulation Analysis Measurement Example



MKR 1 467.000 000 00 MHz 9.8401 W
RBW 30Hz
VBW 30Hz
ATT 10dB
SWT 684ms
Reference Level 10.0W[40.00dB]
FFT
Positive
1001 points
Center 467.000 0MHz
Span 125.000kHz

Spurious Emissions (out-of-band) Measurement Example

- Rx Tests
  Key Test Items
    Rx Sensitivity (BER)

Data Type PN9
Pattern File
Bit Length
Sync Position Start
Sync Position Length
Measure Mode Single
Count Mode Data
Data 10000 Bit
Error Bit

Measure Information
Status Stop Synchronizing Measuring
Error BitError SyncLoss ClockError EnableError
SyncLoss Count 0

Error Rate 1.017E-002 1.017%
Error Count 20 / 1967

PN9
Frequency 467 000 000.00 Hz
Amplitude -121.50 dBm

BER Measurement Function (top) and Vector Signal Generator (bottom)
Measurement Examples

Specifications

The specification is the value after 30-minute warm-up at a constant ambient temperature.
The specifications are defined under the following conditions unless otherwise specified.
Auto sweep time select: Normal, Auto sweep type rules: Sweep only, Switching speed mode: Normal mode,
Attenuator mode: Mechanical Attenuator Only
The specifications of the Signal Analyzer function are values at the center frequency if not specified.
Nominal values indicate expected performance or describe product performance. That is not covered by the product warranty.

Signal Analyzer/Spectrum Analyzer

Frequency

<table>
<tr><td>Frequency Range</td><td>9 kHz to 3.6 GHz [MS2830A-040]
9 kHz to 6 GHz [MS2830A-041]
9 kHz to 13.5 GHz [MS2830A-043]</td></tr>
<tr><td>Frequency Bands</td><td><table>
<tr><th>Frequency Range</th><th>Band</th><th>Mixer Harmonics Order (N)</th></tr>
<tr><td>9 kHz to 4 GHz</td><td>0</td><td>1</td></tr>
<tr><td>3.5 GHz to 4.4 GHz</td><td>1</td><td>1/2</td></tr>
<tr><td>4.3 GHz to 6.1 GHz</td><td>1</td><td>1</td></tr>
<tr><td>5.9 GHz to 10.575 GHz</td><td>2</td><td>1</td></tr>
<tr><td>10.425 GHz to 13.6 GHz</td><td>2</td><td>2</td></tr>
</table></td></tr>
<tr><td>Frequency Setting Range</td><td>–100 MHz to 3.7 GHz [MS2830A-040]
–100 MHz to 6.1 GHz [MS2830A-041]
–100 MHz to 13.6 GHz [MS2830A-043]
Setting resolution: 1 Hz</td></tr>
<tr><td>Pre-Selector Range</td><td><table>
<tr><th>MS2830A-041</th><th>MS2830A-043</th><th></th></tr>
<tr><td>4 GHz to 6 GHz</td><td>4 GHz to 13.5 GHz</td><td>(Frequency band mode: Normal)</td></tr>
<tr><td>3.5 GHz to 6 GHz</td><td>3.5 GHz to 13.5 GHz</td><td>(Frequency band mode: Spurious)</td></tr>
</table></td></tr>
<tr><td>Internal Reference Oscillator</td><td>Without MS2830A-001/002
Aging rate: ±1 × 10–6/year, ±1 × 10–7/day
Temperature stability: ±2.5 × 10–6 (5° to 45°C)
With MS2830A-001
23°C, Referenced to frequency at 24-hour after power-on
Start-up characteristics: ±1 × 10–9 (7 minutes after power-on)
Aging rate: ±1 × 10–10/month
Temperature stability: ±1 × 10–9 (5° to 45°C)
With MS2830A-002
23°C, Referenced to frequency at 24-hour after power-on
Start-up characteristics: ±5 × 10–7 (2 minutes after power-on)
±5 × 10–8 (5 minutes after power-on)
Aging rate: ±1 × 10^{-7}/year, ±1 × 10–8/day
Temperature stability: ±2 × 10–8 (5° to 45°C)</td></tr>
<tr><td>SSB Phase Noise</td><td>18° to 28°C, 500 MHz, Spectrum Analyzer, Switching speed mode: Normal
–115 dBc/Hz (100 kHz offset)
–133 dBc/Hz (1 MHz offset)</td></tr>
</table>

Amplitude

Level Measurement Range	Without MS2830A-008, or Preamp: Off DANL to +30 dBm With MS2830A-008, Preamp: On DANL to +10 dBm
Maximum Input Level	Without MS2830A-008, or Preamp: Off Average total power: +30 dBm (Input attenuator: ≥10 dB) +20 dBm (Input attenuator: 0 dB) DC voltage: ±10 Vdc With MS2830A-008, Preamp: On Average total power: +10 dBm (Input attenuator: 0 dB) DC voltage: ±10 Vdc
Input Attenuator Range	0 to 60 dB, 2 dB steps
Input Attenuator Switching Uncertainty	18° to 28°C, Referenced to 10 dB Without MS2830A-008, or Preamp: Off Frequency band mode: Normal ±0.2 dB (<4 GHz, 10 to 60 dB) ±0.75 dB (≥4 GHz, 10 to 60 dB) Frequency band mode: Spurious ±0.2 dB (<3.5 GHz, 10 to 60 dB) ±0.75 dB (≥3.5 GHz, 10 to 60 dB)

Reference Level

Setting Range	Log scale: –120 to +50 dBm, or Equivalent level Linear scale: 22.4 µV to 70.7 V, or Equivalent level Setting resolution: 0.01 dB, or Equivalent level
Scale Units	Log scale: dBm, dBµV, dBmV, dBµV (emf), dBµV/m, V, W Linear scale: V
Linearity Error	Excluding the noise floor effect Without MS2830A-008, or Preamp: Off ±0.07 dB (Mixer input level: ≤–20 dBm) ±0.10 dB (Mixer input level: ≤–10 dBm) With MS2830A-008, Preamp: On ±0.07 dB (Preamp input level: ≤–40 dBm) ±0.10 dB (Preamp input level: ≤–30 dBm)
RF Frequency Characteristics	18° to 28°C, After CAL, Input attenuator: 10 dB Without MS2830A-008, or Preamp: Off ±1.0 dB (9 kHz ≤ f < 300 kHz) ±0.35 dB (300 kHz ≤ f < 4 GHz, Frequency band mode: Normal) (300 kHz ≤ f < 3.5 GHz, Frequency band mode: Spurious) ±1.5 dB (4 GHz ≤ f ≤ 6 GHz, Frequency band mode: Normal) (3.5 GHz ≤ f ≤ 6 GHz, Frequency band mode: Spurious) ±1.5 dB (6 GHz < f) With MS2830A-008, Preamp: On ±0.65 dB (300 kHz ≤ f < 4 GHz, Frequency band mode: Normal) (300 kHz ≤ f < 3.5 GHz, Frequency band mode: Spurious) ±1.8 dB (4 GHz ≤ f ≤ 6 GHz, Frequency band mode: Normal) (3.5 GHz ≤ f ≤ 6 GHz, Frequency band mode: Spurious)
1 dB Gain Compression	Without MS2830A-008, or Preamp: Off, At mixer input level ≥+3 dBm (300 MHz ≤ f ≤ 6 GHz) ≥–1 dBm (6 GHz < f ≤ 13.5 GHz) With MS2830A-008, Preamp: On, At preamp input level ≥–15 dBm (300 MHz ≤ f ≤ 6 GHz)

Spurious Responses

<table>
<tr><td>Second Harmonic Distortion</td><td>Without MS2830A-008, or Preamp: Off
Mixer input level: –30 dBm
<table>
<tr><td>Harmonic Distortion</td><td>SHI</td><td></td></tr>
<tr><td>≤–60 dBc</td><td>≥+30 dBm</td><td>(10 MHz ≤ f ≤ 300 MHz)</td></tr>
<tr><td>≤–65 dBc</td><td>≥+35 dBm</td><td>(300 MHz < f ≤ 2 GHz)</td></tr>
</table>
Mixer input level: –10 dBm
<table>
<tr><td>Harmonic Distortion</td><td>SHI</td><td></td></tr>
<tr><td>≤–70 dBc</td><td>≥+60 dBm</td><td>(2 GHz < f ≤ 3 GHz, Frequency band mode: Normal)</td></tr>
<tr><td>≤–70 dBc</td><td>≥+60 dBm</td><td>(1.75 GHz ≤ f ≤ 3 GHz, Frequency band mode: Spurious)</td></tr>
<tr><td>≤–70 dBc</td><td>≥+60 dBm</td><td>(3 GHz < f ≤ 6.75 GHz)</td></tr>
</table>
With MS2830A-008, Preamp: On
Preamp input level: –45 dBm
<table>
<tr><td>Harmonic Distortion</td><td>SHI</td><td></td></tr>
<tr><td>≤–50 dBc</td><td>≥+5 dBm</td><td>(10 MHz ≤ f ≤ 300 MHz)</td></tr>
<tr><td>≤–55 dBc</td><td>≥+10 dBm</td><td>(300 MHz < f ≤ 3 GHz)</td></tr>
</table>
SHI: Second Harmonic Intercept</td></tr>
<tr><td>Residual Responses</td><td>Frequency: ≥1 MHz, Input attenuator: 0 dB, 50Ω terminated
With MS2830A-077/078, except bandwidth setting: >31.25 MHz
≤–100 dBm (up to 1 GHz)
≤–90 dBm (typ., 1 GHz to 6 GHz)
≤–90 dBm (nom., 6 GHz to 13.5 GHz)</td></tr>
</table>

Connector

RF Input	Connector: N-J (Front panel), 50Ω (nom.) 18° to 28°C, Input attenuator: ≥10 dB VSWR (nom.): ≤1.2 (40 MHz ≤ f ≤ 3 GHz) ≤1.5 (3 GHz < f ≤ 6 GHz) ≤1.6 (6 GHz < f ≤ 13.5 GHz)
External Reference Input	Connector: BNC-J (Rear panel), 50Ω (nom.) Frequency: 5, 10, 13 MHz Operating range: ±1 ppm Input level: –15 to +20 dBm, 50Ω (AC coupling)
Reference Signal Output	Connector: BNC-J (Rear panel), 50Ω (nom.) Frequency: 10 MHz Output level: ≥0 dBm (AC coupling)
Sweep Status Output	Connector: BNC-J (Rear panel) Output level: TTL level (High level at sweeping or waveform capture)
SA Trigger Input	Connector: BNC-J (Rear panel) Output level: TTL level
Noise Source Drive	This is available when the MS2830A-017/117 is installed. Supply (+28 V) of the Noise Source Drive. Rear Panel, BNC-J Output Voltage: 28 ±0.5 V, Pulsed
External Controller	Control from external controller (excluding power-on/off)
Ethernet (10/100/1000BASE-T)	Connector: RJ-45 (Rear panel)
GPIB	IEEE488 bus connector (IEEE 488.2, Rear panel) Interface function: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0, E2
USB (B)	USB-B connector (USB2.0, Rear panel)
USB	USB-A connector (USB2.0, Front panel: 2 ports, Rear panel: 2 ports)
Monitor Output	Mini D-Sub 15 pin (Compatible with VGA, Rear panel)
Aux	50 pin (Correspond to DX10A-50S, Rear panel), Using extended input/output
Display	XGA-color LCD (Resolution: 1024 × 768), 8.4 inches (Diagonal: 213 mm)

General

Dimensions and Mass		426 (W) × 177 (H) × 390 (D) mm (excluding projections) ≤14.5 kg (with MS2830A-040/041, and MS2830A-020/021, excluding other options) ≤13.5 kg (with MS2830A-043, excluding other options)
Power Supply		Power voltage: 100 V(ac) to 120 V(ac) / 200 V(ac) to 240 V(ac) (–15/+10%, except 250 V max.) Frequency: 50 Hz/60 Hz Power consumption: ≤350 VA (including all options) 110 VA (nom., with MS2830A-040/041, excluding other options) 130 VA (nom., with MS2830A-043, excluding other options) 170 VA (nom., with MS2830A-040/041, MS2830A-020/021, and MS2830A-022, excluding other options) 190 VA (nom., with MS2830A-043, MS2830A-020/021, and MS2830A-022, excluding other options)
Temperature Range		Operating: +5° to +45°C Storage: –20° to +60°C
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581
Vibration		MIL-STD-810D
Shock		MIL-T-28800E

Spectrum Analyzer

Frequency

Span	Range: 0 Hz, 300 Hz to 3.6 GHz [MS2830A-040] 0 Hz, 300 Hz to 6 GHz [MS2830A-041] 0 Hz, 300 Hz to 13.5 GHz [MS2830A-043] Resolution: 2 Hz Accuracy: ±0.2% (Sweep points: 10001)
Frequency Readout Accuracy	±(Display frequency × Frequency reference accuracy + Span frequency × Span accuracy + RBW × 0.05 + 2 × N + Span frequency/(Sweep points–1))Hz N: Mixer harmonic order
Resolution Bandwidth (RBW)	Setting range: 1 Hz to 3 MHz (1-3 sequence), 500 Hz, 50 kHz, 2 MHz, 5 MHz, 10 MHz, 20 MHz, 31.25 MHz 1 Hz to 10 Hz: Can not be set when Span: 0 Hz 31.25 MHz: Can be set when Span: 0 Hz only 20 MHz, 31.25 MHz: Can be set when with MS2830A-005 200 Hz (6 dB), 9 kHz (6 dB), 120 kHz (6 dB), 1 MHz (Impulse) (with MS2830A-016) Selectivity (–60 dB/–3 dB): 4.5: 1 (nom., 1 Hz to 10 MHz)
Video Bandwidth (VBW)	1 Hz to 3 kHz (1-3 sequence), 5 kHz, 10 kHz to 10 MHz (1-3 sequence), Off VBW mode: Video average, Power average

Amplitude

Displayed Average Noise Level (DANL)	18° to 28°C, Detector: Sample, VBW: 1 Hz (Video average), Input attenuator: 0 dB Without MS2830A-062/066, without MS2830A-008, or Preamp: Off –120 dBm/Hz (9 kHz ≤ f < 100 kHz, nom.) –134 dBm/Hz (100 kHz) –134 dBm/Hz (100 kHz < f < 1 MHz, nom.) –144 dBm/Hz (1 MHz) –144 dBm/Hz (1 MHz < f < 10 MHz, nom.) –150 dBm/Hz (10 MHz ≤ f < 30 MHz, nom.) –153 dBm/Hz (30 MHz ≤ f < 1 GHz) –151 dBm/Hz (1 GHz ≤ f < 2.4 GHz) –149 dBm/Hz (2.4 GHz ≤ f ≤ 3.5 GHz) –146 dBm/Hz (3.5 GHz < f ≤ 6 GHz) [MS2830A-041/043] –142 dBm/Hz (6 GHz < f ≤ 13.5 GHz) [MS2830A-043] Without MS2830A-062/066, with MS2830A-008, Preamp: On –147 dBm/Hz (100 kHz, nom.) –156 dBm/Hz (1 MHz) –163 dBm/Hz (30 MHz ≤ f < 1 GHz) –162 dBm/Hz (1 GHz ≤ f < 2 GHz) –160 dBm/Hz (2 GHz ≤ f ≤ 3.5 GHz) –157 dBm/Hz (3.5 GHz < f ≤ 4 GHz, Frequency band mode: Normal) [MS2830A-041/043] –157 dBm/Hz (3.5 GHz < f ≤ 4 GHz, Frequency band mode: Spurious) [MS2830A-041/043] –157 dBm/Hz (4 GHz < f ≤ 6 GHz) [MS2830A-041/043] With MS2830A-062/066 and inactive, without MS2830A-008, or Preamp: Off –120 dBm/Hz (9 kHz ≤ f < 100 kHz, nom.) –133 dBm/Hz (100 kHz) –133 dBm/Hz (100 kHz < f < 1 MHz, nom.) –143 dBm/Hz (1 MHz) –143 dBm/Hz (1 MHz < f < 10 MHz, nom.) –149 dBm/Hz (10 MHz ≤ f < 30 MHz, nom.) –152 dBm/Hz (30 MHz ≤ f < 1 GHz) –150 dBm/Hz (1 GHz ≤ f < 2.4 GHz) –147 dBm/Hz (2.4 GHz ≤ f ≤ 3.5 GHz) –144 dBm/Hz (3.5 GHz < f ≤ 6 GHz) [MS2830A-041/043] –142 dBm/Hz (6 GHz < f ≤ 13.5 GHz) [MS2830A-043] With MS2830A-062/066 and active, without MS2830A-008, or Preamp: Off –133 dBm/Hz (100 kHz) –143 dBm/Hz (1 MHz) –152 dBm/Hz (30 MHz ≤ f < 1 GHz) –150 dBm/Hz (1 GHz ≤ f < 2.4 GHz) –147 dBm/Hz (2.4 GHz ≤ f ≤ 3.5 GHz) –144 dBm/Hz (3.5 GHz < f ≤ 6 GHz) [MS2830A-041/043] –142 dBm/Hz (6 GHz < f ≤ 13.5 GHz) [MS2830A-041/043] With MS2830A-062/066, with MS2830A-008, Preamp: On –146 dBm/Hz (100 kHz, nom.) –155 dBm/Hz (1 MHz) –162 dBm/Hz (30 MHz ≤ f < 1 GHz) –161 dBm/Hz (1 GHz ≤ f < 2 GHz) –158 dBm/Hz (2 GHz ≤ f ≤ 3.5 GHz) –154 dBm/Hz (3.5 GHz < f ≤ 4 GHz, Frequency band mode: Normal) [MS2830A-041/043] –154 dBm/Hz (3.5 GHz < f ≤ 4 GHz, Frequency band mode: Spurious) [MS2830A-041/043] –154 dBm/Hz (4 GHz < f ≤ 6 GHz) [MS2830A-041/043]
Total Absolute Amplitude Accuracy* *: Total absolute amplitude accuracy is found from root sum of squares (RSS) of RF frequency characteristics, Linearity error, and Input attenuator switching uncertainty.	18° to 28°C, After CAL, Auto sweep time select: Normal, 30 Hz ≤ RBW ≤ 1 MHz, Detector: Positive, CW Excluding the noise floor effect, and FFT runtime (Display: On) Without MS2830A-008, or Preamp: Off Input attenuator: ≥10 dB, Mixer input level: ≤–10 dBm ±0.5 dB (300 kHz ≤ f < 4 GHz, Frequency band mode: Normal) (300 kHz ≤ f < 3.5 GHz, Frequency band mode: Spurious) ±1.8 dB (4 GHz ≤ f ≤ 6 GHz, Frequency band mode: Normal) (3.5 GHz ≤ f ≤ 6 GHz, Frequency band mode: Spurious) ±1.8 dB (6 GHz < f ≤ 13.5 GHz) With MS2830A-008, Preamp: On Input attenuator: 10 dB, Preamp input level: –30 dBm ±1.0 dB (300 kHz ≤ f < 4 GHz, Frequency band mode: Normal) (300 kHz ≤ f < 3.5 GHz, Frequency band mode: Spurious) ±1.8 dB (4 GHz ≤ f ≤ 6 GHz, Frequency band mode: Normal) (3.5 GHz ≤ f ≤ 6 GHz, Frequency band mode: Spurious)

Spurious Responses

2-tone 3rd-order Intermodulation Distortion	18° to 28°C, ≥300 kHz separation Without MS2830A-008, or Preamp: Off Mixer input level: –15 dBm (1 wave) ≤–54 dBc, TOI = +12 dBm (30 MHz ≤ f < 300 MHz) ≤–60 dBc, TOI = +15 dBm (300 MHz ≤ f < 3.5 GHz) ≤–58 dBc, TOI = +14 dBm (3.5 GHz ≤ f ≤ 6 GHz) ≤–50 dBc, TOI = +10 dBm (6 GHz < f ≤ 13.5 GHz) With MS2830A-008, Preamp: On Preamp input level: –45 dBm (1 wave) ≤–73 dBc, TOI = –8.5 dBm (30 MHz ≤ f < 300 MHz) ≤–78 dBc, TOI = –6 dBm (300 MHz ≤ f ≤ 700 MHz) ≤–81 dBc, TOI = –4.5 dBm (700 MHz ≤ f < 4 GHz, Frequency band mode: Normal) (700 MHz ≤ f < 3.5 GHz, Frequency band mode: Spurious) ≤–78 dBc, TOI = –6 dBm (4 GHz ≤ f ≤ 6 GHz, Frequency band mode: Normal) (3.5 GHz ≤ f ≤ 6 GHz, Frequency band mode: Spurious) TOI: Third-order intermodulation distortion
Image Responses	Frequency band mode: Normal ≤–70 dBc (10 MHz ≤ f < 4 GHz) ≤–55 dBc (4 GHz ≤ f ≤ 6 GHz) ≤–60 dBc (6 GHz < f ≤ 13.5 GHz)

Sweep

Sweep Mode	Continuous, Single
Sweep Time	Setting range: 1 ms to 1000 s (Span: ≥300 Hz) 1 µs to 1000 s (Span: 0 Hz)

Waveform Display

<table>
<tr><td>Detector</td><td>Positive & Negative, Positive peak, Sample, Negative peak, RMS
Quasi-Peak, CISPR-AVG, RMS-AVG (with MS2830A-016)</td></tr>
<tr><td>Sweep (trace) Point</td><td><table>
<tr><td>SPAN</td><td></td></tr>
<tr><td>500 MHz < SPAN ≤ 13.5 GHz</td><td>1001, 2001, 5001, 10001, 30001</td></tr>
<tr><td>100 MHz < SPAN ≤ 500 MHz</td><td>101, 201, 251, 401, 501, 1001, 2001, 5001, 10001, 30001</td></tr>
<tr><td>300 Hz ≤ SPAN ≤ 100 MHz and Sweep Time > 10 s</td><td>101, 201, 251, 401, 501, 1001, 2001, 5001, 10001, 30001</td></tr>
<tr><td>300 Hz ≤ SPAN ≤ 100 MHz and Sweep Time ≤ 10 s</td><td>11, 21, 41, 51, 101, 201, 251, 401, 501, 1001, 2001, 5001, 10001, 30001</td></tr>
<tr><td>0 Hz</td><td>11, 21, 41, 51, 101, 201, 251, 401, 501, 1001, 2001, 5001, 10001, 30001</td></tr>
</table></td></tr>
<tr><td>Scale</td><td>Log scale: 10 div/12 div, 0.1 to 20 dB/div (1-2-5 sequence)
Linear scale: 10 div, 1 to 10%/div (1-2-5 sequence)</td></tr>
<tr><td>Trigger</td><td>Free run (Trigger off), Video, Wide IF video, External, Frame
SG Marker (with MS2830A-020/021)</td></tr>
<tr><td>Gate</td><td>Off, Wide IF video, External, Frame
SG Marker (with MS2830A-020/021)</td></tr>
</table>

Measure Function

<table>
<tr><td colspan="2">Adjust Channel Power (ACP)</td><td>Reference: Span total, Carrier total, Both sides of carriers, Carrier select
Adjust channel specifications: 3 channels × 2 (Normal mode), 8 channels × 2 (Advanced mode)</td></tr>
<tr><td colspan="2">Burst Average Power</td><td>Displayed average power of specified interval at time domain</td></tr>
<tr><td colspan="2">Channel Power</td><td>Measurement of absolute values: dBm, dBm/Hz</td></tr>
<tr><td colspan="2">Occupied Bandwidth (OBW)</td><td>N% of power, X-dB down</td></tr>
<tr><td colspan="2">Spectrum Emission Mask (SEM)</td><td>Decision to Pass/Fail at Peak/Margin measurement</td></tr>
<tr><td colspan="2">Spurious Emission</td><td>Decision to Pass/Fail at Worst/Peaks measurement</td></tr>
<tr><td rowspan="2">Frequency Counter</td><td>Accuracy</td><td>Span: ≤1 MHz, RBW: 1 kHz, S/N: ≥50 dB, Gate time: ≥100 ms
± (Marker frequency × Frequency reference accuracy + (0.1 × N / Gate time [s] Hz)
N: Mixer harmonic order</td></tr>
<tr><td>Gate Time Setting</td><td>100 µs to 1 s</td></tr>
<tr><td colspan="2">2-tone 3rd-order Intermodulation Distortion</td><td>Measures IM3 and TOI from two-tone signal.</td></tr>
</table>

Signal Analyzer

Display waveform data, such as Spectrum, Power vs. Time captured at specific time

General

Trace Mode	Spectrum, Power vs. Time, Frequency vs. Time, Phase vs. Time, CCDF, Spectrogram, No trace
Analysis Bandwidth	Sets capture analysis bandwidth from center frequency 1 kHz to 10 MHz (1-2.5-5 sequence) (with MS2830A-006) 1 kHz to 25 MHz (1-2.5-5 sequence), 31.25 MHz (with MS2830A-005) 1 kHz to 25 MHz (1-2.5-5 sequence), 31.25 MHz, 50 MHz, 62.5 MHz (with MS2830A-077) 1 kHz to 25 MHz (1-2.5-5 sequence), 31.25 MHz, 50 MHz, 62.5 MHz, 100 MHz, 125 MHz (with MS2830A-078)
Sampling Rate	Auto setting by conditions of analysis bandwidth 2 kHz to 20 MHz (1-2-5 sequence) (with MS2830A-006) 2 kHz to 50 MHz (1-2-5 sequence) (with MS2830A-005) 2 kHz to 100 MHz (1-2-5 sequence) (with MS2830A-077) 2 kHz to 200 MHz (1-2-5 sequence) (with MS2830A-078)
Capture Time	Without MS2830A-077/078, or ≤31.25 MHz bandwidth Setting capture time length Minimum capture time length: 2 µs to 50 ms (Determined according to analysis bandwidth) Maximum capture time length: 2 s to 2000 s (Determined according to analysis bandwidth) Setting mode: Auto, Manual With MS2830A-077, >31.25 MHz bandwidth Setting capture time length Minimum capture time length: 1 µs Maximum capture time length: 500 ms Setting mode: Auto, Manual With MS2830A-078, >31.25 MHz bandwidth Setting capture time length Minimum capture time length: 500 ns to 1 µs (Determined according to analysis bandwidth) Maximum capture time length: 500 ms Setting mode: Auto, Manual
Trigger	Free run (Trigger off), Video, Wide IF video, Frame, External (TTL) SG Marker (with MS2830A-020/021)
ADC Resolution	Without MS2830A-077/078, or ≤31.25 MHz bandwidth 16 bits

Spectrum Displayed Function

Function Outline	Displayed spectrum of any time length and frequency range within captured waveform data
Analysis Time Length	Analysis start time: Sets analysis start time point from waveform data header Analysis time length: Sets analysis time length Setting mode: Auto, Manual
Frequency	Can be set Center frequency and Span at frequency range in waveform data
Frequency Setting	Without MS2830A-077/078, or ≤31.25 MHz bandwidth 0 MHz to 3.6 GHz [MS2830A-040] 0 MHz to 6 GHz [MS2830A-041] 0 MHz to 13.5 GHz [MS2830A-043] With MS2830A-077/078, >31.25 MHz bandwidth 300 MHz to 3.6 GHz [MS2830A-040] 300 MHz to 6 GHz [MS2830A-041] 300 MHz to 13.5 GHz [MS2830A-043]
Resolution Bandwidth (RBW)	Without MS2830A-077/078, or ≤31.25 MHz bandwidth Setting range: 1 Hz to 1 MHz (1-3 sequence) Selectivity (–60 dB/–3 dB): 4.5: 1 (nom.) With MS2830A-077, >31.25 MHz bandwidth Setting range: 3 kHz to 3 MHz (1-3 sequence) Selectivity (–60 dB/–3 dB): 4.5: 1 (nom.) With MS2830A-078, >31.25 MHz bandwidth Setting range: 3 kHz to 10 MHz (1-3 sequence) Selectivity (–60 dB/–3 dB): 4.5: 1 (nom.)
Total Absolute Amplitude Accuracy* *: Total absolute amplitude accuracy is found from root sum of squares (RSS) of RF frequency characteristics, Linearity error, and Input attenuator switching uncertainty.	18° to 28°C, After CAL, Input attenuator: ≥10 dB, RBW: Auto, Time detection: Average, Marker result: Integration or Peak (Accuracy), Center frequency, CW Excluding the noise floor effect Without MS2830A-008, or Preamp: Off Input attenuator: ≥10 dB, Mixer input level: ≤–10 dBm ±0.5 dB (300 kHz ≤ f < 4 GHz, Frequency band mode: Normal) (300 kHz ≤ f < 3.5 GHz, Frequency band mode: Spurious) ±1.8 dB (4 GHz ≤ f ≤ 6 GHz, Frequency band mode: Normal) (3.5 GHz ≤ f ≤ 6 GHz, Frequency band mode: Spurious) ±1.8 dB (6 GHz < f ≤ 13.5 GHz) With MS2830A-008, Preamp: On Input attenuator: 10 dB, Preamp input level: ≤–30 dBm ±1.0 dB (300 kHz ≤ f < 4 GHz, Frequency band mode: Normal) (300 kHz ≤ f < 3.5 GHz, Frequency band mode: Spurious) ±1.8 dB (4 GHz ≤ f ≤ 6 GHz, Frequency band mode: Normal) (3.5 GHz ≤ f ≤ 6 GHz, Frequency band mode: Spurious)

Continued on next page

In-band Frequency Characteristics	18° to 28°C, Referenced to level at center frequency, Center frequency: ±10 MHz Without MS2830A-077/078, or ≤31.25 MHz bandwidth ±0.31 dB (30 MHz ≤ f ≤ 4 GHz, Frequency band mode: Normal) (30 MHz ≤ f < 3.5 GHz, Frequency band mode: Spurious)
Displayed Average Noise Level (DANL)	18° to 28°C, Time Detection: Average, Input attenuator: 0 dB Without MS2830A-062/066, without MS2830A-008, or Preamp: Off –131.5 dBm/Hz (100 kHz) –141.5 dBm/Hz (1 MHz) –150.5 dBm/Hz (30 MHz ≤ f < 1 GHz) –148.5 dBm/Hz (1 GHz ≤ f < 2.4 GHz) –146.5 dBm/Hz (2.4 GHz ≤ f ≤ 3.5 GHz) –143.5 dBm/Hz (3.5 GHz < f ≤ 6 GHz) [MS2830A-041/043] –139.5 dBm/Hz (6 GHz < f ≤ 13.5 GHz) [MS2830A-043] Without MS2830A-062/066, with MS2830A-008, Preamp: On –144.5 dBm/Hz (100 kHz, nom.) –153.5 dBm/Hz (1 MHz) –160.5 dBm/Hz (30 MHz ≤ f < 1 GHz) –159.5 dBm/Hz (1 GHz ≤ f < 2 GHz) –157.5 dBm/Hz (2 GHz ≤ f ≤ 3.5 GHz) –154.5 dBm/Hz (3.5 GHz < f ≤ 4 GHz, Frequency band mode: Normal) [MS2830A-041/043] –154.5 dBm/Hz (3.5 GHz < f ≤ 4 GHz, Frequency band mode: Spurious) [MS2830A-041/043] –154.5 dBm/Hz (4 GHz < f ≤ 6 GHz) [MS2830A-041/043] With MS2830A-062/066, without MS2830A-008, or Preamp: Off –130.5 dBm/Hz (100 kHz) –140.0 dBm/Hz (1 MHz) –149.5 dBm/Hz (30 MHz ≤ f < 1 GHz) –147.0 dBm/Hz (1 GHz ≤ f < 2.4 GHz) –144.5 dBm/Hz (2.4 GHz ≤ f ≤ 3.5 GHz) –141.5 dBm/Hz (3.5 GHz < f ≤ 6 GHz) [MS2830A-041/043] –139.5 dBm/Hz (6 GHz < f ≤ 13.5 GHz) [MS2830A-043] With MS2830A-062/066, with MS2830A-008, Preamp: On –143.5 dBm/Hz (100 kHz, nom.) –152.5 dBm/Hz (1 MHz) –159.5 dBm/Hz (30 MHz ≤ f < 1 GHz) –158.5 dBm/Hz (1 GHz ≤ f < 2 GHz) –155.5 dBm/Hz (2 GHz ≤ f ≤ 3.5 GHz) –151.5 dBm/Hz (3.5 GHz < f ≤ 4 GHz, Frequency band mode: Normal) [MS2830A-041/043] –151.5 dBm/Hz (3.5 GHz < f ≤ 4 GHz, Frequency band mode: Spurious) [MS2830A-041/043] –151.5 dBm/Hz (4 GHz < f ≤ 6 GHz) [MS2830A-041/043] With MS2830A-077, 078: See MS2830A-077, 078 specifications.
Adjacent Channel Power (ACP)	Reference: Span total, Carrier total, Both sides of carriers, Carrier select Adjacent channel specifications: 3 channels × 2
Channel Power	Measurement of absolute values: dBm, dBm/Hz
Occupied Bandwidth (OBW)	N% of Power, X-dB Down

Power vs. Time Displayed Function

Function Outline	Displayed time changes of power for captured waveform data
Analysis Time Range	Analysis start time: Sets analysis start time position from beginning of waveform data Analysis time length: Sets analysis time length Setting mode: Auto, Manual
Resolution Bandwidth	Filter type: Rect, Gaussian, Nyquist, Root nyquist, Off, (Default: Off) Roll-off ratio: 0.01 to 1 (Set for Nyquist, Root nyquist) Filter frequency offset: Set center frequency of filter in wavelength data frequency band
AM Depth (Peak to Peak Measurement)	Measures with AM depth or marker function +Peak, –Peak, (P-P)/2, Average
Burst Average Power	Measures average power of burst signal

Frequency vs. Time Displayed Function

Function Outline	Displayed frequency time fluctuations of input signal from captured waveform data
Analysis Time Range	Analysis start time: Sets analysis start time point from waveform data header Analysis time length: Sets analysis time length Setting mode: Auto, Manual
Operating Level Range	–17 to +30 dBm (Input attenuator: ≥10 dB)
Frequency (Vertical axis)	Can be set Center frequency and Span at frequency range in waveform data Displayed frequency range: Selectable 1/25, 1/10, 1/5, 1/2 of analysis bandwidth Input frequency range: 10 MHz to 6 GHz
Frequency Readout Accuracy	Input level: –17 to +30 dBm, Span: ≤31.25 MHz, Scale: Span/25, CW input ± (Reference oscillator accuracy × Center frequency + Displayed frequency range × 0.01) Hz
FM Deviation (Peak to Peak Measurement)	Measures FM deviation or marker function +Peak, –Peak, (P-P)/2, Average
FMCW Measurement	Display items: FM Error Peak, FM Error RMS, Chirp Deviation, Chirp Rate, Chirp Length The measurement range can be set by automatic detection or marker.

Phase vs. Time Displayed Function

Function Outline	Displayed phase time fluctuation of input signal from captured waveform data
Analysis Time Range	Analysis start time: Sets analysis start time point from waveform data header Analysis time length: Sets analysis time length Setting mode: Auto, Manual
Phase (Vertical Axis)	Display mode: Wrap, Unwrap Displayed phase range: 0.01 deg./div to 200 Gdeg./div Offset: –100 deg. to +100 Mdeg.

CCDF/APD Displayed Function

Function Outline	Displayed CCDF and APD of waveform date within a given length of time
Analysis Time Range	Analysis start time: Sets analysis start time point from waveform data header Analysis time length: Sets analysis time length Setting mode: Auto, Manual
Display	Displayed CCDF or APD as graphs Histogram resolution: 0.01 dB Value: Average power, Max. power, Crest factor
Resolution Bandwidth	Filter type: Rectangle, Off, (Default: Off) Filter frequency offset: Sets filter center frequency in frequency band of waveform data

Spectrogram Displayed Function

Function Outline	Displayed spectrogram for arbitrary time length in captured waveform data
Analysis Time Range	Analysis start time: Sets analysis start time point from waveform data header Analysis time length: Sets analysis time length Setting mode: Auto, Manual
Frequency	Can be set Center frequency and Span at frequency range in waveform data
Resolution Bandwidth (RBW)	Setting range: 1 Hz to 1 MHz (1-3 sequence) Selectivity (–60 dB/–3 dB): 4.5: 1 (nom.)

Digitize Function

Function Outline	Captured waveform data saved to internal HDD or output to external devices
Waveform Data	Format: I, Q (each 32 bit, Float binary type) Level: 0 dBm input is $\sqrt{(I^2 + Q^2)} = 1$ Level accuracy: Same as signal analyzer absolute amplitude accuracy
External Output	Can be output to external PC via Ethernet

Replay Function

<table>
<tr><td>Function Outline</td><td>Captured waveforms can be replayed again by using the VSA function to read saved digitize data</td></tr>
<tr><td>Conditions for Measurable Waveform Data</td><td>Format: I, Q (binary format)
Combination of span, sampling rate, and minimum capture sample
<table>
<tr><th>Span</th><th>Sampling Rate</th><th>Minimum Capture Sample</th></tr>
<tr><td>1 kHz</td><td>2 kHz</td><td>74000 (37 s)</td></tr>
<tr><td>2.5 kHz</td><td>5 kHz</td><td>160000 (32 s)</td></tr>
<tr><td>5 kHz</td><td>10 kHz</td><td>310000 (31 s)</td></tr>
<tr><td>10 kHz</td><td>20 kHz</td><td>610000 (30.5 s)</td></tr>
<tr><td>25 kHz</td><td>50 kHz</td><td>730000 (14.6 s)</td></tr>
<tr><td>50 kHz</td><td>100 kHz</td><td>730000 (7.3 s)</td></tr>
<tr><td>100 kHz</td><td>200 kHz</td><td>730000 (3.65 s)</td></tr>
<tr><td>250 kHz</td><td>500 kHz</td><td>730000 (1.46 s)</td></tr>
<tr><td>500 kHz</td><td>1 MHz</td><td>730000 (730 ms)</td></tr>
<tr><td>1 MHz</td><td>2 MHz</td><td>730000 (365 ms)</td></tr>
<tr><td>2.5 MHz</td><td>5 MHz</td><td>730000 (146 ms)</td></tr>
<tr><td>5 MHz</td><td>10 MHz</td><td>730000 (73 ms)</td></tr>
<tr><td>10 MHz</td><td>20 MHz</td><td>730000 (36.5 ms)</td></tr>
<tr><td>18.6 MHz</td><td>20 MHz</td><td>730000 (36.5 ms)</td></tr>
<tr><td>20 MHz</td><td>25 MHz</td><td>730000 (29.2 ms)</td></tr>
<tr><td>25 MHz</td><td>50 MHz</td><td>730000 (14.6 ms)</td></tr>
<tr><td>31.25 MHz</td><td>50 MHz</td><td>730000 (14.6 ms)</td></tr>
<tr><td>50 MHz</td><td>100 MHz</td><td>730000 (7.3 ms)</td></tr>
<tr><td>62.5 MHz</td><td>100 MHz</td><td>730000 (7.3 ms)</td></tr>
<tr><td>100 MHz</td><td>200 MHz</td><td>730000 (3.65 ms)</td></tr>
<tr><td>125 MHz</td><td>200 MHz</td><td>730000 (3.65 ms)</td></tr>
</table>
</td></tr>
</table>

Noise Figure Measurement Function MS2830A-017*[1]

Frequency

Frequency Range	MS2830A-040: 30 MHz to 3.6 GHz MS2830A-041: 30 MHz to 6 GHz MS2830A-043: 30 MHz to 13.5 GHz
Frequency Setting Range	MS2830A-040: 10 MHz to 3.6 GHz MS2830A-041: 10 MHz to 6 GHz MS2830A-043: 10 MHz to 13.5 GHz

NF Measurement
Within the measurement range,
Attenuator = 0 dB*[2]

Measurement Range	–20 to +40 dB
Instrument Uncertainty	ENR: 4 to 7 dB ±0.02 dB ENR: 12 to 17 dB ±0.025 dB ENR: 20 to 22 dB ±0.03 dB

Gain Measurement

Measurement Range	Within the frequency range –20 to +40 dB
Instrument Uncertainty	Within the measurement range ≤0.07

Resolution Bandwidth

Setting Range	100 kHz to 8 MHz

Connector

Noise Source	Connector: Rear panel, BNC-J Output voltage: 28 ±0.5 V, Pulsed

*1: Recommending the NC346 Series noise sources by Noisecom company
*2: Recommend to use Pre Amp

Audio Analyzer MS2830A-018

The Audio Analyzer is used in combination with the Analog Measurement Software MX269018A.

Audio Analyzer Function
The specifications for single tone measurement

Measurement Function	Amplitude, Frequency, THD, THD + N, SINAD
Connector	Balanced: 1/4-inch phone jack (3-pole, Φ6.3 mm) Unbalanced: BNC-J
Impedance	Balanced: 200kΩ (AC coupled, nom.) Unbalanced: 100kΩ (AC coupled, nom.)
Frequency Measurement Range	20 Hz to 50 kHz
Level Measurement Range	1 mV rms to 25 V rms (30 V rms max.)
Input Range Setting	50 mV peak, 500 mV peak, 5 V peak, 50 V peak
Level Accuracy	18° to 28°C ±0.4 dB (20 Hz ≤ f ≤ 25 kHz) ±3.0 dB (25 kHz < f ≤50 kHz)
THD + N (Total Harmonic Distortion + Noise)	At 1 kHz, 1.4 V rms, Band: 20 Hz to 20 kHz, Range: 5 Vp-p, 18° to 28°C <–60 dB <–80 dB (nom.)
Audio Filter	LPF: Off, 3, 15, 20, 30, 50 kHz HPF: Off, 20, 50, 100, 300, 400 Hz, 30 kHz BPF (Weighting filter): Off, CCITT, C-Message, CCIR468, CCIR-ARM, A-Weighting

Audio Generator Function
The specifications for all single-tone measurements except White Noise (through ITU-T G.227 filter)

<table>
<tr><td>Connector Type</td><td colspan="3">Balanced: 1/4-inch phone jack (3-pole, Φ6.3 mm)
Unbalanced: BNC-J</td></tr>
<tr><td>Impedance</td><td colspan="3">Balanced: 100Ω/600Ω (AC coupled, nom.)
Unbalanced: 50Ω/600Ω (AC coupled, nom.)</td></tr>
<tr><td>Output Waveform</td><td colspan="3">Single tone
Multi tone: Tone × 3, DCS, White noise (ITU-T G.227), DTMF</td></tr>
<tr><td>Guaranteed Frequency Range</td><td colspan="3">20 Hz to 25 kHz</td></tr>
<tr><td>Frequency Setting Range</td><td colspan="3">10 Hz to 50 kHz</td></tr>
<tr><td>Frequency Resolution</td><td colspan="3">0.01 Hz</td></tr>
<tr><td rowspan="11">Output Level Range</td><td colspan="3">Using sub supply/audio revision 2*1
Single tone</td></tr>
<tr><td rowspan="2">Open circuit voltage (≥100kΩ termination)</td><td>Balanced</td><td>Off, 1 mV rms to 12.4 V rms</td></tr>
<tr><td>Unbalanced</td><td>Off, 1 mV rms to 6.2 V rms</td></tr>
<tr><td rowspan="2">600Ω termination*</td><td>Balanced</td><td>Off, –63 dBm (equivalent to 0.5 mV rms) to +18 dBm (equivalent to 6.2 V rms)</td></tr>
<tr><td>Unbalanced</td><td>Off, –63 dBm (equivalent to 0.5 mV rms) to +12 dBm (equivalent to 3.1 V rms)</td></tr>
<tr><td colspan="3">White noise (through ITU-T G.227 filter)</td></tr>
<tr><td rowspan="2">Open circuit voltage (≥100kΩ termination)</td><td>Balanced</td><td>Off, 1.545 mV rms to 3.083 V rms (nom.)</td></tr>
<tr><td>Unbalanced</td><td>Off, 1.545 mV rms to 1.545 V rms (nom.)</td></tr>
<tr><td rowspan="2">600Ω termination*</td><td>Balanced</td><td>Off, –60 dBm (equivalent to 0.774 mV rms) to +6 dBm (equivalent to 1.545 V rms) (nom.)</td></tr>
<tr><td>Unbalanced</td><td>Off, –60 dBm (equivalent to 0.774 mV rms) to 0 dBm (equivalent to 0.774 V rms) (nom.)</td></tr>
<tr><td colspan="3">*: Output Impedance = 600Ω , and Output Impedance Reference = 600Ω</td></tr>
<tr><td>Output Level Resolution</td><td colspan="3">Single tone: 1 mV (350 mV rms < Output level ≤ 6.2 V rms)
100 μV (35 mV rms < Output level ≤ 350 mV rms)
10 μV (Output Level ≤ 35 mV rms)
White noise (through ITU-T G.227 filter): 0.01 dB (nom.)</td></tr>
<tr><td>Level Accuracy</td><td colspan="3">Single tone: ±0.3 dB (1 kHz, 100 kΩ termination, 18° to 28°C)
White noise (through ITU-T G.227 filter): ±3 dB</td></tr>
<tr><td>Maximum Output Currency</td><td colspan="3">100 mA (nom., no short circuit)</td></tr>
<tr><td>THD + N (Total Harmonic Distortion + Noise)</td><td colspan="3">At 1 kHz, 0.7 V rms, Band: 20 Hz to 25 kHz, 100kΩ termination, 18° to 28°C
< –60 dB
< –80 dB (nom.)</td></tr>
</table>

Other Functions

Demodulation Output (FM only)*2	Connector: BNC-J Level: –10 dBm ±2 dB (Frequency deviation = 3.5 kHz, 600Ω) Impedance: 600Ω Sound Monitor: Internal speaker or 3.5 mm phone jack (2-pole, monaural)
Others	Crosstalk: Crosstalk from Audio Generator to Audio Analyzer >80 dB Push To Talk (PTT) control Connector: Banana jack (Φ4.0 mm, 30 V max., 500 mA max.) General Input/Output (Audio function) Connector: D-Sub 15 pin (jack) Function: Open collector × 1 (5 V, 100 mA max.), TTL Output × 2, TTL Input × 2

*1: Sub Supply/Audio Revision is the MS2830A-018/118 printed-circuit board version.
<Sub Supply/Audio Revision Confirmation Method>
(1) MS2830A units with Sub Supply/Audio Revision 2 have a sticker marked 'A1' next to the main-frame serial number.
(2) The MS2830A Sub Supply/Audio Revision can be confirmed as follows:
Press [System Config] → [F5] System Information → [F4] Board Revision View to list the Board Revisions; check the displayed Sub Supply/Audio Revision number. (It may be either 1 or 2.)
*2: For Tx test of analog wireless equipment. Wide FM measurements not supported.

3.6 GHz Vector Signal Generator MS2830A-020
6 GHz Vector Signal Generator MS2830A-021

*: Use the MS2830A-021 for frequencies higher than 3.6 GHz.
Available to use for signal source of Internal Signal Generator Control Function MS2830A-052.

The specifications of the MS2830A-020/021 are defined under the following conditions unless otherwise specified.

CW	Pulse modulation: Off
Modulation	After CAL Waveform pattern RMS value: At RMSw (linear value) and each combination less than following ranges: RMSnom = 20 • log (RMSw/4628) [16-bit data] RMSnom = 20 • log (RMSw/2314) [15-bit data] RMSnom = 20 • log (RMSw/1157) [14-bit data] –3.00 dB ≤ RMSnom ≤ +3.00 dB Pulse modulation: Off

Frequency

Range	250 kHz to 3.6 GHz [MS2830A-020] 250 kHz to 6 GHz [MS2830A-021]
Resolution	0.01 Hz steps

Above specifications also apply under MS2830A-052 working.

Output Level

<table>
<tr><td>Setting Range</td><td>Without MS2830A-022
–40 to +20 dBm (>25 MHz), –40 to +2 dBm (≤25 MHz)
With MS2830A-022
–136 to +15 dBm (>25 MHz), –136 to –3 dBm (≤25 MHz)</td></tr>
<tr><td>Units</td><td>dBm, dBμV (terminated, open)</td></tr>
<tr><td>Resolution</td><td>0.01 dB</td></tr>
<tr><td>Output Level Accuracy</td><td>18° to 28°C, CW
Without MS2830A-022
<table>
<tr><th></th><th>Output Level [p] (dBm)</th></tr>
<tr><td>±0.5 dB (typ., ≤25 MHz)</td><td>–40 ≤ p ≤ +2</td></tr>
<tr><td>±0.5 dB (typ., 25 MHz < f ≤ 375 MHz)</td><td>–40 ≤ p ≤ +9</td></tr>
<tr><td>±0.5 dB (375 MHz ≤ f ≤ 3.6 GHz)</td><td>–40 ≤ p ≤ +9</td></tr>
<tr><td>±0.8 dB (>3.6 GHz)</td><td>–40 ≤ p ≤ +4</td></tr>
</table>
With MS2830A-022
<table>
<tr><th></th><th>Output Level [p] (dBm)</th></tr>
<tr><td>±1.0 dB (typ., ≤25 MHz)</td><td>–110 ≤ p ≤ –3</td></tr>
<tr><td>±1.0 dB (typ., 25 MHz < f < 100 MHz)</td><td>–110 ≤ p ≤ +4</td></tr>
<tr><td>±0.5 dB (typ., 100 MHz ≤ f < 375 GHz)</td><td>–110 ≤ p ≤ +4</td></tr>
<tr><td>±0.5 dB (375 MHz ≤ f ≤ 3.6 GHz)</td><td>–110 ≤ p ≤ +4</td></tr>
<tr><td>±0.8 dB (>3.6 GHz)</td><td>–110 ≤ p ≤ –1</td></tr>
<tr><td>±1.0 dB (100 MHz ≤ f ≤ 3.6 GHz)</td><td>–120 ≤ p < –110</td></tr>
<tr><td>±1.0 dB (typ., 100 MHz ≤ f ≤ 3.6 GHz)</td><td>–127 ≤ p < –120</td></tr>
<tr><td>±2.5 dB (typ., >3.6 GHz)</td><td>–127 ≤ p < –110</td></tr>
</table>
</td></tr>
<tr><td>Output Level Linearity</td><td>18° to 28°C, CW
Without MS2830A-022, Referenced to –10 dBm output
<table>
<tr><th></th><th>Output Level [p] (dBm)</th></tr>
<tr><td>±0.2 dB (typ., ≤3.6 GHz)</td><td>–40 ≤ p ≤ –10</td></tr>
<tr><td>±0.3 dB (typ., >3.6 GHz)</td><td>–40 ≤ p ≤ –10</td></tr>
</table>
With MS2830A-022, Referenced to –15 dBm output
<table>
<tr><th></th><th>Output Level [p] (dBm)</th></tr>
<tr><td>±0.2 dB (typ., ≤3.6 GHz)</td><td>–110 ≤ p ≤ –15</td></tr>
<tr><td>±0.3 dB (typ., >3.6 GHz)</td><td>–110 ≤ p ≤ –15</td></tr>
</table>
</td></tr>
</table>

Above specifications also apply under MS2830A-052 working.

Output Connector

Connector	N-J connector, 50Ω (Front panel, SG output)
VSWR	18° to 28°C Without MS2830A-022, Output level ≤–10 dBm 1.5 (≤3.6 GHz), 2.0 (>3.6 GHz) With MS2830A-022, Output level: ≤–15 dBm 1.3 (≤3.6 GHz), 1.9 (>3.6 GHz)
Max. Reverse Input	0 Vdc (max.) Without MS2830A-022 +12 dBm (<20 MHz), +24 dBm (≥20 MHz) With MS2830A-022 +18 dBm (<20 MHz), +30 dBm (≥20 MHz)

Above specifications also apply under MS2830A-052 working.

Signal Purity

Harmonic Spurious	Output level: ≤0 dBm (without MS2830A-022), ≤–5 dBm (with MS2830A-022), CW <–30 dBc (≥1 MHz)
Non-Harmonic Spurious	Offset from output frequency: ≥15 kHz Output level: ≤0 dBm (without MS2830A-022), ≤–5 dBm (with MS2830A-022), CW <–46 dBc (100 MHz ≤ f ≤ 3 GHz) <–40 dBc (3 GHz < f ≤ 6 GHz)

Above specifications also apply under MS2830A-052 working.

Vector Modulation

<table>
<tr><td>Vector Accuracy</td><td>18° to 28°C, Output level: ≤0 dBm (without MS2830A-022), ≤–5 dBm (with MS2830A-022)
W-CDMA (DL 1 code), Output frequency: 800 MHz to 2.7 GHz
LTE-DL (20 MHz), Output frequency: 600 MHz to 2.7 GHz
≤1.4% (rms)</td></tr>
<tr><td>Carrier Leak</td><td>18° to 28°C, RMS: 0 dB
≤–40 dBc (375 MHz ≤ f ≤ 2.4 GHz)</td></tr>
<tr><td>Image Rejection</td><td>18° to 28°C, use sine wave <10 MHz
≤–40 dBc</td></tr>
<tr><td>ACLR</td><td>18° to 28°C, W-CDMA (Test Model 1 64DPCH)
Output level: ≤0 dBm (without MS2830A-022), ≤–5 dBm (with MS2830A-022)
<table>
<tr><td></td><td>5 MHz Offset</td><td>10 MHz Offset</td></tr>
<tr><td>375 MHz ≤ f ≤ 2.4 GHz</td><td>≤–64 dBc/3.84 MHz</td><td>≤–67 dBc/3.84 MHz</td></tr>
<tr><td>2.4 GHz < f ≤ 3.6 GHz</td><td>≤–59 dBc/3.84 MHz</td><td>≤–63 dBc/3.84 MHz</td></tr>
<tr><td>3.6 GHz < f ≤ 6 GHz</td><td>≤–56 dBc/3.84 MHz</td><td>≤–60 dBc/3.84 MHz</td></tr>
</table></td></tr>
<tr><td>CW and Level Error at Vector Modulation</td><td>18° to 28°C, Bandwidth: 5 MHz (AWGN), Output frequency: ≥100 MHz
Output level: ≤0 dBm (without MS2830A-022), ≤–5 dBm (with MS2830A-022)
±0.2 dB</td></tr>
</table>

Pulse Modulation

On/Off Ratio	>60 dB (≤3 GHz) >40 dB (3 GHz < f ≤ 6 GHz)
Rising/Falling Edge Time	≤90 ns (10% to 90%)
Pulse Repetition Frequency	DC to 1 MHz (Duty: 50%)
External Panel Modulation Signal Input	Aux connector (Rear panel), TTL H: Signal On, L: Signal Off

Arbitrary Waveform Generator

Waveform Resolution	14/15/16 bits
Marker Output	14 bits: Three signals in waveform pattern, or real-time three-signal generation 15 bits: One signal in waveform pattern, or real-time three-signal generation 16 bits: Real-time three-signal generation Switching positive and negative logic pulse outputs
Internal Baseband Reference Clock	Range: 20 kHz to 160 MHz Resolution: 0.001 Hz
External Baseband Reference Clock	Range: 20 kHz to 40 MHz Division, multiplier function: Internally generate 1, 2, 4, 8, 16, 1/2, 1/4, 1/8 and 1/16 times input signals and use as DAC sampling clock Input connector: Aux connector (Rear panel) Input level ≥0.7 Vp-p, 50Ω (AC coupling)
Waveform Memory	Memory: 64 Msamples (without MS2830A-027) 256 Msamples (with MS2830A-027) File (package) open count: Max. package count: 100 Max. patterns per package: 1000 However, 4096 patterns in total and 128 samples minimum per pattern SG Trigger input: Synchronize with trigger signals and start waveform pattern output. Switch start trigger/frame trigger Start trigger: To start waveform output Frame trigger: To output signals at burst timing To output data for burst length at frame trigger timing and wait for next frame trigger.
Input Connector	Function switch: Common start/frame trigger connector. Switch to use. Connector: BNC-J connector (Rear panel) Input level: TTL Logic: Select rise/fall polarity

AWGN Addition Function

CN Ratio Absolute Value	≤40 dB (with MS2830A-028)

BER Measurement Function MS2830A-026

Connector	AUX connector (Rear panel)* *: Can convert to BNC by connecting AUX Conversion Adapter (J1556A).
Input Level	TTL level
Input Signal	Data, Clock, Enable
Input Bit Rate	100 bps to 10 Mbps
Measured Patterns	PN9, PN11, PN15, PN20, PN23, ALL0, ALL1, Alternate (0101 ...) PN9Fix, PN11Fix, PN15Fix, PN20Fix, PN23Fix, User define (4096 bits max.)
Synchronization Establishing Condition	PN signal: PN stage × 2 bit error free At PNFix signal: PN stage × 2 bit error free, PN signal and sync establishment, establish sync with PNFix signal at PN stage error free from PNFix signal header bit ALL0, ALL1, Alternate (0101 ...): 10 bit error free User define: 8 to 1024 bits (variable) error free Select header bit used at sync detection
Re-synchronization Judgment Condition	x/y (Resynchronization at detection of x-bit error in y bits) y ... Measured bit count: Select from 500 bits, 5000 bits, 50000 bits x ... Number of error bits in y bits: Setting range 1 to y/2
Measured Bit Count	$\leq 2^{32} - 1$ bits
Measured Error Bit Count	$\leq 2^{31} - 1$ bits
Measurement End Conditions	Measured bit count, Measured error bit count
Auto Re-synchronization Function	Can be toggled on and off
Operation at Resync.	Select from Count clear, and Count keep
Measurement Mode	Single, Endless, Continuous
Display	Status, Error, Error rate, Error count, SyncLoss count, Measured bit count
Polarity Inversion Function	Supports polarity reversal for Data, Clock, Enable
Clear Measurement Function	At BER measurement, hold sync status, clears measured value and measures from 0

Low Phase Noise Performance MS2830A-066

Signal Analyzer/Spectrum Analyzer

Frequency Range	9 kHz to 3.7 GHz 9 kHz to 3.5 GHz (Frequency band mode: Spurious)
Span	300 Hz to 1 MHz (Spectrum Analyzer) 1 kHz to 31.25 MHz (Signal Analyzer)
SSB Phase Noise	18° to 28°C 500 MHz, Spectrum Analyzer, Switching speed mode: Normal –115 dBc/Hz (100 kHz offset) –133 dBc/Hz (1 MHz offset) With MS2830A-066, MS2830A-066: On Center frequency: 500 MHz, Span: ≤1 MHz (Spectrum Analyzer) –109 dBc/Hz (1 kHz offset) –118 dBc/Hz (10 kHz offset) –133 dBc/Hz (100 kHz offset) –148 dBc/Hz (1 MHz offset, nom.) Center frequency: 220 MHz, Span: ≤500 kHz (Spectrum Analyzer) –122 dBc/Hz (25 kHz offset)

Spectrum Analyzer

Displayed Average Noise Level (DANL)	18° to 28°C, Detector: Sample, VBW: 1 Hz (Video average), Input attenuator: 0 dB With MS2830A-066 installed and inactive, without MS2830A-008, or Preamp: Off –120 dBm/Hz (9 kHz ≤ f < 100 kHz, nom.) –133 dBm/Hz (100 kHz) –133 dBm/Hz (100 kHz < f < 1 MHz, nom.) –143 dBm/Hz (1 MHz) –143 dBm/Hz (1 MHz < f < 10 MHz, nom.) –149 dBm/Hz (10 MHz ≤ f < 30 MHz, nom.) –152 dBm/Hz (30 MHz ≤ f < 1 GHz) –150 dBm/Hz (1 GHz ≤ f < 2.4 GHz) –147 dBm/Hz (2.4 GHz ≤ f ≤ 3.5 GHz) –144 dBm/Hz (3.5 GHz < f ≤ 6 GHz) [MS2830A-041/043] –142 dBm/Hz (6 GHz < f ≤ 13.5 GHz) [MS2830A-043] With MS2830A-066 installed and active, without MS2830A-008, or Preamp: Off –133 dBm/Hz (100 kHz) –143 dBm/Hz (1 MHz) –152 dBm/Hz (30 MHz ≤ f < 1 GHz) –150 dBm/Hz (1 GHz ≤ f < 2.4 GHz) –147 dBm/Hz (2.4 GHz ≤ f ≤ 3.5 GHz) –144 dBm/Hz (3.5 GHz < f ≤ 6 GHz) [MS2830A-041/043] –142 dBm/Hz (6 GHz < f ≤ 13.5 GHz) [MS2830A-043] With MS2830A-066, with MS2830A-008, Preamp: On –146 dBm/Hz (100 kHz, nom.) –155 dBm/Hz (1 MHz) –162 dBm/Hz (30 MHz ≤ f < 1 GHz) –161 dBm/Hz (1 GHz ≤ f < 2 GHz) –158 dBm/Hz (2 GHz ≤ f ≤ 3.5 GHz) –154 dBm/Hz (3.5 GHz < f ≤ 4 GHz, Frequency band mode: Normal) [MS2830A-041/043] –154 dBm/Hz (3.5 GHz < f ≤ 4 GHz, Frequency band mode: Spurious) [MS2830A-041/043] –154 dBm/Hz (4 GHz < f ≤ 6 GHz) [MS2830A-041/043]
Image Responses	With MS2830A-066 MS2830A-066: On, Center frequency: ≤3.6 GHz, Span: ≤1 MHz (Spectrum Analyzer) Image responses (Input signal + 150 MHz): ≤–10 dBc (110 MHz ≤ f < 3.6 GHz)
Multiple Responses	With MS2830A-066 MS2830A-066: On, Center frequency: ≤3.6 GHz, Span: ≤1 MHz (Spectrum Analyzer), Mixer input level: –15 dBm ≤10 dBc (nom.)

Signal Analyzer

Displayed Average Noise Level (DANL)	18° to 28°C, Input attenuator: 0 dB With MS2830A-066, without MS2830A-008, or Preamp: Off –130.5 dBm/Hz (100 kHz) –140.5 dBm/Hz (1 MHz) –149.5 dBm/Hz (30 MHz ≤ f < 1 GHz) –147.5 dBm/Hz (1 GHz ≤ f < 2.4 GHz) –144.5 dBm/Hz (2.4 GHz ≤ f ≤ 3.5 GHz) –141.5 dBm/Hz (3.5 GHz < f ≤ 6 GHz) [MS2830A-041/043] –139.5 dBm/Hz (6 GHz < f ≤ 13.5 GHz) [MS2830A-043] With MS2830A-066, MS2830A-008, Preamp: On –143.5 dBm/Hz (100 kHz, nom.) –152.5 dBm/Hz (1 MHz) –159.5 dBm/Hz (30 MHz ≤ f < 1 GHz) –158.5 dBm/Hz (1 GHz ≤ f < 2 GHz) –155.5 dBm/Hz (2 GHz ≤ f ≤ 3.5 GHz) –151.5 dBm/Hz (3.5 GHz < f ≤ 4 GHz, Frequency band mode: Normal) [MS2830A-041/043] –151.5 dBm/Hz (3.5 GHz < f ≤ 4 GHz, Frequency band mode: Spurious) [MS2830A-041/043] –151.5 dBm/Hz (4 GHz < f ≤ 6 GHz) [MS2830A-041/043]

Analysis Bandwidth Extension to 62.5 MHz MS2830A-077 (Requires MS2830A-005 and MS2830A-006)
Analysis Bandwidth Extension to 125 MHz MS2830A-078 (Requires MS2830A-005, MS2830A-006 and MS2830A-077)

An image response is received when setting the bandwidth to more than 31.25 MHz. This can be used when not inputting a signal frequency outside the MS2830A analysis bandwidth (125 MHz max.). The Signal Analyzer series MS2690A/91A/92A is recommended for other measurement purposes.

General

Analysis Bandwidth	Sets capture analysis bandwidth from center frequency 1 kHz to 25 MHz (1-2.5-5 sequence), 31.25 MHz, 50 MHz, 62.5 MHz (with MS2830A-077) 1 kHz to 25 MHz (1-2.5-5 sequence), 31.25 MHz, 50 MHz, 62.5 MHz, 100 MHz, 125 MHz (with MS2830A-078)
Sampling Rate	Auto setting by conditions of analysis bandwidth 2 kHz to 100 MHz (1-2-5 sequence) (with MS2830A-077) 2 kHz to 200 MHz (1-2-5 sequence) (with MS2830A-078)
Capture Time	With MS2830A-077, >31.25 MHz bandwidth Setting capture time length Minimum capture time length: 1 µs Maximum capture time length: 500 ms Setting mode: Auto, Manual With MS2830A-078, >31.25 MHz bandwidth Setting capture time length Minimum capture time length: 500 ns to 1 µs (Determined according to analysis bandwidth) Maximum capture time length: 500 ms Setting mode: Auto, Manual
ADC Resolution	With MS2830A-077/078, >31.25 MHz bandwidth 14 bits

Frequency

Frequency Setting	With MS2830A-077/078, >31.25 MHz bandwidth 300 MHz to 3.6 GHz [MS2830A-040] 300 MHz to 6 GHz [MS2830A-041] 300 MHz to 13.5 GHz [MS2830A-043]
Resolution Bandwidth (RBW)	With MS2830A-077, >31.25 MHz bandwidth Setting range: 1 Hz to 3 MHz (1-3 sequence) Selectivity (–60 dB/–3 dB): 4.5: 1 (nom.) With MS2830A-078, >31.25 MHz bandwidth Setting range: 1 Hz to 10 MHz (1-3 sequence) Selectivity (–60 dB/–3 dB): 4.5: 1 (nom.)

Amplitude

Displayed Average Noise Level (DANL)	18° to 28°C, Time Detection: Average, Input attenuator: 0 dB With MS2830A-077, or 078, > 31.25 MHz bandwidth Without MS2830A-066, MS2830A-008, or with MS2830A-008, Preamp: Off –146.5 dBm/Hz (300 MHz ≤ f < 1 GHz) –144.5 dBm/Hz (1 GHz ≤ f < 2.4 GHz) –142.5 dBm/Hz (2.4 GHz ≤ f ≤ 3.5 GHz) –139.5 dBm/Hz (3.5 GHz < f ≤ 6 GHz) [MS2830A-041/043] –135.5 dBm/Hz (6 GHz < f ≤ 13.5 GHz) [MS2830A-043] Without MS2830A-066, with MS2830A-008, Preamp: On –156.5 dBm/Hz (300 MHz ≤ f < 1 GHz) –155.5 dBm/Hz (1 GHz ≤ f < 2 GHz) –153.5 dBm/Hz (2 GHz ≤ f ≤ 3.5 GHz) –150.5 dBm/Hz (3.5 GHz < f ≤ 6 GHz) [MS2830A-041/043] With MS2830A-066, without MS2830A-008, or Preamp: Off –143.5 dBm/Hz (300 MHz ≤ f < 1 GHz) –141.5 dBm/Hz (1 GHz ≤ f < 2.4 GHz) –138.5 dBm/Hz (2.4 GHz ≤ f ≤ 3.5 GHz) –135.5 dBm/Hz (3.5 GHz < f ≤ 6 GHz) [MS2830A-041/043] –135.5 dBm/Hz (6 GHz < f ≤ 13.5 GHz) [MS2830A-043] With MS2830A-066, MS2830A-008, Preamp: On –153.5 dBm/Hz (300 MHz ≤ f < 1 GHz) –152.5 dBm/Hz (1 GHz ≤ f < 2 GHz) –149.5 dBm/Hz (2 GHz ≤ f ≤ 3.5 GHz) –145.5 dBm/Hz (3.5 GHz < f ≤ 6 GHz) [MS2830A-041/043]
Image Response	With MS2830A-077/078, >31.25 MHz bandwidth Image response (Occurs at frequency 200 MHz away): 0 dBc (nom., 300 MHz < f ≤ 13.5 GHz)
Linearity Error	Excluding the noise floor effect Without MS2830A-008, or Preamp: Off ±0.07 dB (Mixer input level: ≤–20 dBm) ±0.10 dB (Mixer input level: ≤–10 dBm) With MS2830A-008, Preamp: On ±0.07 dB (Preamp input level: ≤–40 dBm) ±0.10 dB (Preamp input level: ≤–30 dBm)
RF Frequency Characteristics	18° to 28°C, After CAL, Input attenuator: 10 dB, Frequency band mode: Normal Without MS2830A-008, or Preamp: Off ±0.35 dB(300 MHz ≤ f < 4 GHz) ±1.5 dB(4 GHz ≤ f ≤ 6 GHz) ±1.5 dB (6 GHz < f) With MS2830A-008, Preamp: On ±0.65 dB(300 MHz ≤ f < 4 GHz) ±1.8 dB(4 GHz ≤ f ≤ 6 GHz)

Internal Signal Generator Control Function MS2830A-052 (Requires any of MS2830A-020, 021, or 088)

This option measures the DUT transmission characteristics using linked operation between the Spectrum Analyzer functions and the installed signal generator. For the performance, refer to specifications for the Spectrum Analyzer function and the installed vector signal generator or analog signal generator.

3.6 GHz Analog Signal Generator MS2830A-088
Analog Function Extension for Vector Signal Generator MS2830A-029

The Analog Signal Generator and Analog Function Extension for Vector Signal Generator are used in combination with the Analog Measurement Software MX269018A.
And these are available to use for signal source of Internal Signal Generator Control Function MS2830A-052.
The following specifications are added to or changed from the specifications of the "Vector Signal Generator MS2830A-020/021" and "Low Power Extension for Vector Signal Generator MS2830A-022" installed.

Frequency

Frequency Setting Range	With FM, φM, AM modulation signal 100 kHz to 3000 MHz With Internal Signal Generator Control Function (MS2830A-052) 100 kHz to 3.6 GHz (With MS2830A-088 or MS2830A-020 + 029) 100 kHz to 6 GHz (With MS2830A-021 + 029)
Frequency Setting Resolution	1 Hz

Output Level

<table>
<tr><td>Output Setting Level</td><td>With FM, φM, AM modulation signal
−136 to +15 dBm (Rx frequency: > 25 MHz)
−136 to −3 dBm (Rx frequency: ≤ 25 MHz)
With Internal Signal Generator Control Function MS2830A-052
−136 to +15 dBm (> 25 MHz), −136 to −3 dBm (≤ 25 MHz)</td></tr>
<tr><td>Output Level Accuracy</td><td>18° to 28°C, CW
MS2830A-029/088
<table>
<tr><td></td><td>Output Level [p] (dBm)</td></tr>
<tr><td>±3.0 dB (typ., 100 kHz ≤ f < 250 kHz)</td><td>−110 ≤ p ≤ −3</td></tr>
</table>
Refer to the MS2830A-020/021 Vector Signal Generator section (with MS2830A-022) for the output level accuracy for other frequency ranges.</td></tr>
</table>

Arbitrary Signal Generator

Available when the MS2830A-020, 021 or 189 (Vector Signal Generator) is installed.

Typical (typ.): Performance not warranted. Must products meet typical performance.
Nominal (nom.): Values not warranted. Included to facilitate application of product.
Example: Performance not warranted. Data actually measured by randomly selected measuring instruments.

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main Frame
MS2830A	Signal Analyzer
	Standard Accessories
	Power Cord: 1 pc
P0031A	USB Memory (≥256 MB, USB2.0 Flash Driver): 1 pc
Z0541A	USB Mouse: 1 pc
	Install CD-ROM (Application software, instruction manual CD-ROM): 1 pc
	Options
MS2830A-040	3.6 GHz Signal Analyzer
MS2830A-041	6 GHz Signal Analyzer
MS2830A-043	13.5 GHz Signal Analyzer
MS2830A-001	Rubidium Reference Oscillator
MS2830A-002	High Stability Reference Oscillator
MS2830A-005*1	Analysis Bandwidth Extension to 31.25 MHz (Requires MS2830A-006)
MS2830A-006	Analysis Bandwidth 10 MHz
MS2830A-008	Preamplifier
MS2830A-010	Phase Noise Measurement Function
MS2830A-011	2ndary HDD
MS2830A-016	Precompliance EMI Function
MS2830A-017	Noise Figure Measurement Function
MS2830A-018	Audio Analyzer
MS2830A-026*2	BER Measurement Function (AUX Conversion Adapter J1556A as standard accessory)
MS2830A-066*3	Low Phase Noise Performance
MS2830A-077*4	Analysis Bandwidth Extension to 62.5 MHz
MS2830A-078*5	Analysis Bandwidth Extension to 125 MHz
MS2830A-311	2ndary HDD Retrofit
MS2830A-052*6	Internal Signal Generator Control Function
MS2830A-020	3.6 GHz Vector Signal Generator
MS2830A-021	6 GHz Vector Signal Generator
MS2830A-022	Low Power Extension for Vector Signal Generator
MS2830A-027	ARB Memory Upgrade 256 Msa for Vector Signal Generator
MS2830A-028	AWGN
MS2830A-029*7	Analog Function Extension for Vector Signal Generator
MS2830A-088	3.6 GHz Analog Signal Generator
	Retrofit Options
MS2830A-101	Rubidium Reference Oscillator Retrofit
MS2830A-102	High Stability Reference Oscillator Retrofit
MS2830A-105*1	Analysis Bandwidth Extension to 31.25 MHz Retrofit (Requires MS2830A-006)
MS2830A-106	Analysis Bandwidth 10 MHz Retrofit
MS2830A-108	Preamplifier Retrofit
MS2830A-110	Phase Noise Measurement Function Retrofit
MS2830A-111	2ndary HDD Retrofit
MS2830A-116	Precompliance EMI Function Retrofit
MS2830A-117	Noise Figure Measurement Function Retrofit
MS2830A-118	Audio Analyzer Retrofit
MS2830A-126*2	BER Measurement Function Retrofit (AUX Conversion Adapter J1556A as standard accessory)
MS2830A-352*6	Internal Signal Generator Control Function User-Installable
MS2830A-120	3.6 GHz Vector Signal Generator Retrofit
MS2830A-121	6 GHz Vector Signal Generator Retrofit
MS2830A-122	Low Power Extension for Vector Signal Generator Retrofit
MS2830A-127	ARB Memory Upgrade 256 Msa for Vector Signal Generator Retrofit
MS2830A-128	AWGN Retrofit
MS2830A-188	3.6 GHz Analog Signal Generator Retrofit
MS2830A-189	Vector Function Extension for Analog Signal Generator Retrofit
MS2830A-152	Internal Signal Generator Control Function Retrofit
MS2830A-180*8	CPU/Windows 7 64 bit Upgrade Retrofit

Model/Order No.	Name
	Software Options
	CD-ROM with License and Operation manuals
MX269011A	W-CDMA/HSPA Downlink Measurement Software
MX269012A	W-CDMA/HSPA Uplink Measurement Software
MX269013A	GSM/EDGE Measurement Software
MX269013A-001	EDGE Evolution Measurement Software (Requires MX269013A)
MX269015A	TD-SCDMA Measurement Software
MX269017A	Vector Modulation Analysis Software
MX269018A	Analog Measurement Software (For MS2830A. Requires MS2830A-066 and A0086C)
MX269020A	LTE Downlink Measurement Software
MX269020A-001	LTE-Advanced FDD Downlink Measurement Software (Requires MX269020A)
MX269021A	LTE Uplink Measurement Software
MX269021A-001	LTE-Advanced FDD Uplink Measurement Software (Requires MX269021A)
MX269022A	LTE TDD Downlink Measurement Software
MX269022A-001	LTE-Advanced TDD Downlink Measurement Software (Requires MX269022A)
MX269023A	LTE TDD Uplink Measurement Software
MX269023A-001	LTE-Advanced TDD Uplink Measurement Software (Requires MX269023A)
MX269024A	CDMA2000 Forward Link Measurement Software
MX269024A-001	All Measure Function (Requires MX269024A)
MX269026A	EV-DO Forward Link Measurement Software
MX269026A-001	All Measure Function (Requires MX269026A)
MX269028A	WLAN (802.11) Measurement Software
MX269028A-001	802.11ac (80 MHz) Measurement Software (For MS2830A. Requires MX269028A.)
MX269030A	W-CDMA BS Measurement Software
MX283027A	Wireless Network Device Test Software
MX283027A-001	WLAN Test Software (Requires MX283027A)
MX283027A-002	Bluetooth Test Software (Requires MX283027A)
MX283087A	TRX Sweep Calibration
MX269901A	HSDPA/HSUPA IQproducer
MX269902A	TDMA IQproducer
MX269904A	Multi-Carrier IQproducer
MX269905A	Mobile WiMAX IQproducer
MX269908A	LTE IQproducer
MX269908A-001	LTE-Advanced FDD Option (Requires MX269908A)
MX269910A	LTE TDD IQproducer
MX269910A-001	LTE-Advanced TDD Option (Requires MX269910A)
MX269911A	WLAN IQproducer
MX269911A-001	802.11ac (80 MHz) Option (Requires MX269911A)
MX269912A	TD-SCDMA IQproducer
MX269970A	1xEV-DO Reverse Receiver Test Waveform Pattern
	Other Software Options
	These software are for PC.
MX705010A	Wi-SUN PHY Measurement Software
MX705110A	Wi-SUN Protocol Monitor
	Warranty Service
MS2830A-ES210	2 years Extended Warranty Service
MS2830A-ES310	3 years Extended Warranty Service
MS2830A-ES510	5 years Extended Warranty Service

Continued on next page

*1: Requires MS2830A-006/106.

*2: The AUX Conversion Adapter J1556A is a standard accessory supplied with MS2830A-026/126.

*3: Retrofit not supported.
MS2830A-066 sometimes cannot be installed depending on options.

Model	Case 1	Case 2	Case 3
MS2830A-020/021	Yes	Yes	No
MS2830A-043	Yes	No	Yes
MS2830A-066	No	Yes	Yes

*4: Retrofit not supported. Requires MS2830A-005 and MS2830A-006.

*5: Retrofit not supported. Requires MS2830A-005, MS2830A-006 and MS2830A-077.

*6: Requires any of MS2830A-020/120, 021/121, or 088/188.

*7: Please contact our sales representative when requesting retrofitting.

*8: Replace the CPU board and upgrade the OS to Windows 7.

Model/Order No.	Name
	Application Parts Following operation manuals provided as hard copy
W3334AE	MS2830A Operation Manual (Mainframe Operation)
W2851AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Mainframe Remote Control)
W3335AE	MS2830A/MS2840A/MS2850A Operation Manual (Signal Analyzer Function Operation)
W2853AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Signal Analyzer Function Remote Control)
W3336AE	MS2830A/MS2840A/MS2850A Operation Manual (Spectrum Analyzer Function Operation)
W2855AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Spectrum Analyzer Function Remote Control)
W3117AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Phase Noise Measurement Function Operation)
W3118AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Phase Noise Measurement Function Remote Control)
W3655AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A-017 Operation Manual (Noise Figure Measurement Function Operation)
W3656AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A-017 Operation Manual (Noise Figure Measurement Function Remote control)
W3337AE	MS2830A/MS2840A-020/021 Operation Manual (Vector Signal Generator Option Operation)
W3338AE	MS2830A/MS2840A-020/021 Operation Manual (Vector Signal Generator Option Remote Control)
W2914AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A Operation Manual (IQproducer for Vector Signal Generator Option)
W2929AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A Operation Manual (Standard Waveform Pattern for Vector Signal Generator Option)
W3098AE	MX269011A Operation Manual (Operation)
W3099AE	MX269011A Operation Manual (Remote Control)
W3060AE	MX269012A Operation Manual (Operation)
W3061AE	MX269012A Operation Manual (Remote Control)
W3100AE	MX269013A Operation Manual (Operation)
W3101AE	MX269013A Operation Manual (Remote Control)
W3044AE	MX269015A Operation Manual (Operation)
W3045AE	MX269015A Operation Manual (Remote Control)
W3305AE	MX269017A Operation Manual (Operation)
W3306AE	MX269017A Operation Manual (Remote Control)
W3555AE	MX269018A Operation Manual (Operation)
W3556AE	MX269018A Operation Manual (Remote Control)
W3014AE	MX269020A Operation Manual (Operation)
W3064AE	MX269020A Operation Manual (Remote Control)
W3015AE	MX269021A Operation Manual (Operation)
W3065AE	MX269021A Operation Manual (Remote Control)
W3209AE	MX269022A Operation Manual (Operation)
W3210AE	MX269022A Operation Manual (Remote Control)
W3521AE	MX269023A Operation Manual (Operation)
W3522AE	MX269023A Operation Manual (Remote Control)
W3201AE	MX269024A Operation Manual (Operation)
W3202AE	MX269024A Operation Manual (Remote Control)
W3203AE	MX269026A Operation Manual (Operation)
W3204AE	MX269026A Operation Manual (Remote Control)
W3528AE	MX269028A Operation Manual (Operation)
W3529AE	MX269028A Operation Manual (Remote Control)
W2860AE	MX269030A Operation Manual (Operation)
W2861AE	MX269030A Operation Manual (Remote Control)
W3471AE	MX283027A Operation Manual (Operation)
W3473AE	MX283027A-001 Operation Manual (Operation)
W3474AE	MX283027A-001 Operation Manual (Remote Control)
W3516AE	MX283027A-002 Operation Manual (Operation)
W3517AE	MX283027A-002 Operation Manual (Remote Control)
W3448AE	MX283087A Operation Manual (Operation)
W3449AE	MX283087A Operation Manual (Remote Control)
W2915AE	MX269901A Operation Manual
W2916AE	MX269902A Operation Manual
W2917AE	MX269904A Operation Manual
W2918AE	MX269905A Operation Manual
W3023AE	MX269908A Operation Manual
W3221AE	MX269910A Operation Manual
W3488AE	MX269911A Operation Manual
W3582AE	MX269912A Operation Manual
W3675AE	MX269970A Operation Manual

Model/Order No.	Name
K240B	Power Divider (K connector, DC to 26.5 GHz, 50Ω, K-J, 1 W max.)
MA1612A	Four-port Junction Pad (5 MHz to 3 GHz, N-J)
J0576B	Coaxial Cord, 1 m (N-P · 5D-2W · N-P)
J0576D	Coaxial Cord, 2 m (N-P · 5D-2W · N-P)
J0127A	Coaxial Cord, 1 m (BNC-P · RG58A/U · BNC-P)
J0127B	Coaxial Cord, 2 m (BNC-P · RG58A/U · BNC-P)
J0127C	Coaxial Cord, 0.5 m (BNC-P · RG58A/U · BNC-P)
J0322A	Coaxial Cord, 0.5 m (DC to 18 GHz), (SMA-P · 50Ω SUCOFLEX104 · SMA-P)
J0322B	Coaxial Cord, 1 m (DC to 18 GHz), (SMA-P · 50Ω SUCOFLEX104 · SMA-P)
J0322C	Coaxial Cord, 1.5 m (DC to 18 GHz), (SMA-P · 50Ω SUCOFLEX104 · SMA-P)
J0322D	Coaxial Cord, 2 m (DC to 18 GHz), (SMA-P · 50Ω SUCOFLEX104 · SMA-P)
J0805	DC Block, N type (MODEL 7003) (10 kHz to 18 GHz, N-P · N-J)
J1554A	DC Block, SMA type (MODEL 7006) (9 kHz to 26.5 GHz, SMA-P · SMA-J)
J1555A	DC Block, SMA type (MODEL 7006-1) (9 kHz to 20 GHz, SMA-P · SMA-J)
K261	DC Block (10 kHz to 40 GHz, K-P · K-J)
J0004	Coaxial Adapter (DC to 12.4 GHz, 50Ω, N-P · SMA-J)
J1398A	N-SMA Adaptor (DC to 26.5 GHz, 50Ω, N-P · SMA-J)
34AKNF50	Ruggedized K-to-Type N Adapter (DC to 20 GHz, 50Ω, Ruggedized K-M · N-F, SWR: 1.5 (max.), Insertion Loss: 0.4 dB (max.))
J0911	Coaxial Cable, 1.0 m for 40 GHz (DC to 40 GHz, approx. 1 m, SF102A, 11K254/K254/1.0M)
J0912	Coaxial Cable, 0.5 m for 40 GHz (DC to 40 GHz, approx. 0.5 m, SF102A, 11K254/K254/0.5M)
41KC-3	Fixed Attenuator (DC to 40 GHz, 3 dB)
J1261A	Ethernet Cable (Shield type, Straight, 1 m)
J1261B	Ethernet Cable (Shield type, Straight, 3 m)
J1261C	Ethernet Cable (Shield type, Cross, 1 m)
J1261D	Ethernet Cable (Shield type, Cross, 3 m)
J0008	GPIB Cable, 2.0 m
J1556A*9	AUX Conversion Adapter (AUX → BNC, for vector signal generator option and BER measurement function option)
A0086C	USB Audio (for MX269018A)
B0635A	Rack Mount Kit (EIA)
B0657A	Rack Mount Kit (JIS)
B0636C*10	Carrying Case (Hard type, with casters)
B0671A*10	Front Cover for 1MW4U
MA24105A	Inline Peak Power Sensor (350 MHz to 4 GHz, with USB A to mini B cable)
MA24106A	USB Power Sensor (50 MHz to 6 GHz, with USB A to mini B cable)
MA24108A	Microwave USB Power Sensor (10 MHz to 8 GHz, with USB A to Micro-B cable)
MA24118A	Microwave USB Power Sensor (10 MHz to 18 GHz, with USB A to Micro-B cable)
MA24126A	Microwave USB Power Sensor (10 MHz to 26 GHz, with USB A to Micro-B cable)
Z0975A	Keyboard (USB)
Z1345A	Installation Kit (required when retrofitting options or installing software)

*9: The AUX Conversion Adapter J1556A is not a standard accessory for the Vector Signal Generator Option MS2830A-020/120/021/121.
The AUX Conversion Adapter J1556A is a standard accessory supplied with BER Measurement Function MS2830A-026/126.

*10: The Carrying Case B0636C includes a Front Panel Protective Cover (B0671A).

MS2830A Microwave

9 kHz to 26.5 GHz/43 GHz (26.5 GHz to 325 GHz)

Remote Control
GPIB | Ethernet | USB

[High Speed + High Performance] × [Low Cost] + Eco-friendly

Excellent Eco Product

The Signal Analyzer MS2830A-044/045 includes a spectrum analyzer function with upper frequency limits of 26.5 GHz and 43 GHz. Combining it with the High Performance Waveguide Mixer MA2806A/MA2808A or the External Mixer MA2740C/MA2750C series supports measurements up to 325 GHz. It supports measurements of Tx characteristics, including adjacent channel leakage power, spectrum mask, and frequency counter, as well as spurious measurements requiring a wide dynamic range.
Installing the bandwidth analysis option up to 125 MHz adds signal analyzer functions for checking phenomena that are hard to check using a spectrum analyzer, such as frequency vs. time, phase vs. time, spectrogram, and CCDF. In addition, optional measurement software supports modulation analysis. Moreover, installing a preselector bypass option enables use of the signal analyzer and modulation analysis functions up to 26.5 GHz/43 GHz (MS2830A-044/045). Finally, it can be customized to support a range of application-specific measurements.

- Installing a microwave-band preamp supports measurement of weaker signals.
- Using the 1st local signal output as an external mixer supports measurement of high-frequency signals up to 325 GHz.
- Using the 1st IF signal output as a down converter supports analysis in combination with external equipment.

Key Features

Basic Performance/Functions

- Frequency Range
  MS2830A-044: 9 kHz to 26.5 GHz
  MS2830A-045: 9 kHz to 43 GHz
- Measures up to 325 GHz using High Performance Waveguide Mixer and External Mixer
  Frequency Range:
    26.5 GHz to 325 GHz (External Mixer)
    50 GHz to 90 GHz (High Performance Waveguide Mixer)
  Built-in connector to connect High Performance Waveguide Mixer and External Mixer (MS2830A-044/045)
    Connector: SMA-J, 50Ω
    Local Signal Output: 5 GHz to 10 GHz
    IF Signal Frequency: 1.875 GHz
- Excellent Dynamic Range[*1]:
  159 dB (at 25 GHz)
    TOI[*2]: ≥+13 dBm, DANL[*3]: –146 dBm/Hz
  157 dB (at 40 GHz)
    TOI: ≥+13 dBm (nom.), DANL: –144 dBm/Hz
- Preamp up to 43 GHz
  → MS2830A-068/168: Microwave Preamplifier
  DANL[*3]: –156 dBm/Hz (at 25 GHz)[*4], –150 dBm/Hz (at 40 GHz)[*4]
- Total Level Accuracy:
  ±0.5 dB (300 kHz ≤ f < 4 GHz), ±3.0 dB (13.8 GHz < f ≤ 40 GHz)
- Used as Wideband Down Converter
  Built-in IF Output Function (MS2830A-044/045)
    Connector: SMA-J, 50Ω
    IF Output Frequency: 1.875 GHz
    IF Output Bandwidth: 1 GHz (3 dB Bandwidth, nom.)[*5]
    Gain: –10 dB (nom.)
- Improved Level Linearity
- Reference Oscillator
  Pre-installed Reference Oscillator
    Aging Rate: ±1 × 10^{-7}/year, ±1 × 10^{-8}/day
    Start-up Characteristics: ±5 × 10^{-8} (5 minutes after power-on)
  Rubidium Reference Oscillator (MS2830A-001)
    Aging Rate: ±1 × 10^{-10}/month
    Start-up Characteristics: ±1 × 10^{-9} (7 minutes after power-on)

*1: Difference between TOI and DANL as simple guide
*2: TOI (Third Order Intercept)
*3: DANL (Displayed Average Noise Level)
*4: Spectrum Analyzer functions
*5: When using external mixer bands, or using internal micro frequency bands (Band; 3 to 9) with Microwave Preselector Bypass option: On

- Versatile Built-in Functions

Channel Power	Occupied Bandwidth
Adjacent Channel Leakage Power	Spectrum Emission Mask*1
Spurious Emission*1	Burst Average Power
Frequency Counter*1	AM Depth*2
FM Deviation*2	Multi-marker & Marker List
Highest 10 Markers	Limit Line*1
2-tone 3rd-order Intermodulation Distortion*1	
Annotation Display (On/Off)	Power Meter*3
Phase Noise*4	Noise Figure*5

- Low-power Consumption
  MS2830A-044/045: 190 VA (nom.)

*1: Spectrum Analyzer Functions
*2: Signal Analyzer functions (requires MS2830A-005/006/009/077/078)
*3: Power Meter Function (use USB power sensors)
*4: Phase Noise Measurement Function (requires MS2830A-010)
*5: Noise Figure Measurement function (Requires MS2830A-017)
[Use Noise Sources (Noisecom, NC346 series)]

Signal Analyzer Functions

- Analysis Bandwidth
  MS2830A-006: 10 MHz max.
  (20 MHz max. sampling rate = 50 ns resolution, ADC resolution 16 bits)
  MS2830A-005*6, Option 009*7: 31.25 MHz max.
  (50 MHz max. sampling rate = 20 ns resolution, ADC resolution 16 bits)
  MS2830A-077*8: 62.5 MHz max.
  (100 MHz max. sampling rate = 10 ns resolution, ADC resolution 14 bits)
  MS2830A-078*9: 125 MHz max.
  (200 MHz max. sampling rate = 5 ns resolution, ADC resolution 14 bits)

Note: An image response is received when setting the bandwidth to more than 31.25 MHz. This can be used when not inputting a signal frequency outside the MS2830A analysis bandwidth (125 MHz max.).
The Signal Analyzer series MS2690A/91A/92A is recommended for other measurement purposes.

- Capture Function
  Saves analysis Span × Time signal to internal memory and writes to hard disk. Up to 100 Msamples per measurement saved to internal memory.
  Example: Span 1 MHz: Max. capture time 50 s
  Span 10 MHz: Max. capture time 5 s
  Span 100 MHz: Max. capture time 0.5 s
- Replay Function
  Reads saved data and replays using signal analyzer function.
  Example:
  1. Data sharing between R&D and manufacturing
  2. Later laboratory bench-top analysis of on-site signals
- Measurement with Sub-trace Display
  Split screen displaying both main and sub-traces at same time to check errors
  Main: Spectrum, Frequency vs. Time, Power vs. Time,
  Phase vs. Time, CCDF/APD, Spectrogram
  Sub: Power vs. Time, Spectrogram
- Supports 125 MHz Wideband Measurements up to 43 GHz
  → MS2830A-067: Microwave Preselector Bypass
  → MS2830A-078*9:Analysis Bandwidth Extension to 125 MHz
  Bypassing preselector improves RF frequency characteristics and in-band frequency characteristics. Supports modulation analysis and signal analyzer measurements for signals up to 43 GHz.
- BER Measurement Function (MS2830A-026)
  This option measures BER using Data/Clock/Enable demodulated at the DUT.
  Input Bit Rate: 100 bps to 10 Mbps
  Input Level: TTL Level

*6: MS2830A-005 can be installed in MS2830A-044. Requires MS2830A-006.
*7: MS2830A-009 can be installed in MS2830A-045. Requires MS2830A-006.
Cannot be set the RBW to more than 10 MHz in spectrum analyzer function.
*8: Requires MS2830A-006 and MS2830A-005 (for MS2830A-044).
Requires MS2830A-006 and MS2830A-009 (for MS2830A-045).
*9: Requires MS2830A-006, MS2830A-005 and MS2830A-077 (for MS2830A-044).
Requires MS2830A-006, MS2830A-009 and MS2830A-077 (for MS2830A-045).

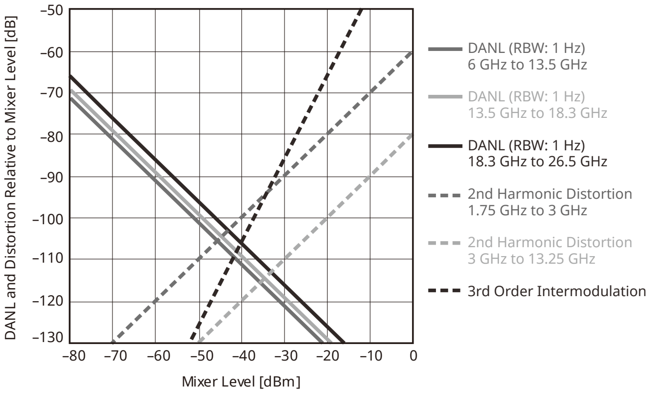
Basic Performance

Dynamic Range*10
159 dB (at 25 GHz)
TOI*11: ≥+13 dBm (6 GHz < f ≤ 26.5 GHz)
DANL*12: –146 dBm/Hz (18.3 GHz < f ≤ 34 GHz)
157 dB (nom., at 40 GHz)
TOI: ≥+13 dBm (nom., 26.5 GHz < f ≤ 40 GHz)
DANL: –144 dBm/Hz (34 GHz < f ≤ 40 GHz)

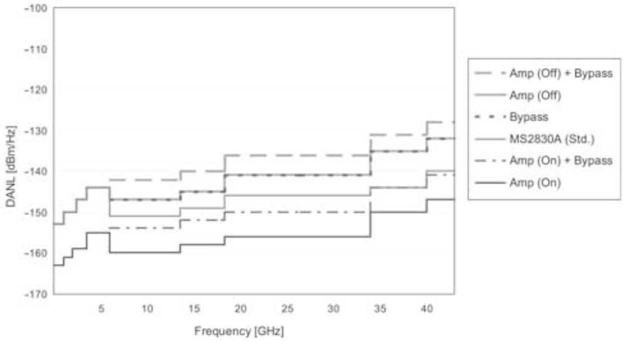
*10: Difference between TOI and DANL as simple guide
*11: TOI (Third Order Intercept)
*12: DANL (Displayed Average Noise Level)

Dynamic range is a key specification for spectrum analyzers. Low displayed average noise level (DANL) as well as high TOI are important too. Low TOI may cause distortion with high-level carrier signals. Inserting an attenuator can lower the carrier level but this has the effect of lowering the level of weak spurious, making it hard to measure. The MS2830A has an excellent dynamic range supporting true performance measurements of devices, such as base stations, requiring wideband measuring instruments.

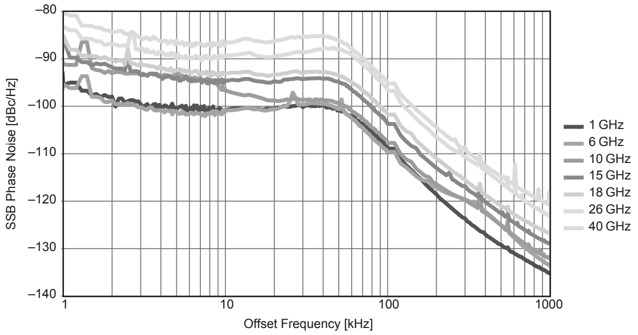
Distortion Characteristics (Spectrum Analyzer)



DANL (MS2830A-045)
Amp (Preamplifier: MS2830A-068), Bypass (Preselector Bypass: MS2830A-067/009)



Example: SSB Phase Noise (Spectrum Analyzer/Signal Analyzer Common)



Total Level Accuracy

±0.5 dB (300 kHz ≤ f <4 GHz)
±1.8 dB (4 GHz ≤ f ≤ 13.8 GHz)
±3.0 dB (13.8 GHz < f ≤ 40 GHz)

The absolute level accuracy in most spectrum analyzer catalogs does not include frequency characteristics, linearity, and attenuator switching error.
However, the MS2830A Total Level Accuracy in the catalog includes the above three errors.
Even when changing the frequency and attenuator, stable measurement is assured in the specified error range.

The MS2830A total level accuracy includes:
- Frequency characteristics
- Linearity
- Attenuator switching error

Preamp up to 43 GHz (Microwave Preamplifier MS2830A-068)

DANL: –156 dBm/Hz (at 25 GHz)
–150 dBm/Hz (at 40 GHz)

Installing the Microwave Preamplifier (MS2830A-068) amplifies signals before the mixer to improve the spectrum analyzer and signal analyzer sensitivity. This is recommended when measuring low-level signals, such as noise and interference signals.

Frequency range: 100 kHz to 26.5 GHz (MS2830A-044)
100 kHz to 43 GHz (MS2830A-045)

*: Simultaneous installation with MS2830A-008 not supported

Measures Up To 325 GHz using High Performance Waveguide Mixer and External Mixer

High Performance Waveguide Mixer MA2806A and MA2808A Targeting Spectrum Analysis for Wider-Band Millimeter-Wave Wireless Transmitters

The High Performance Waveguide Mixer MA2806A and MA2808A are new mixers for connection to the Signal Analyzer MS2830A with frequency option 044 or option 045. It has the good features of both a harmonic mixer and a down converter and is ideal for spectrum analysis of millimeter-wave (50 GHz to 90 GHz-band) wireless transmitters now being used for future wider-band applications, such as wireless backhaul, automotive radar, etc.

Model	Name	Frequency Band	Frequency Range	Waveguide Flange	Waveguide Size
MA2806A	High Performance Waveguide Mixer (50 to 75 GHz)	V band	50 GHz to 75 GHz	UG-385/U	WR15
MA2808A	High Performance Waveguide Mixer (60 to 90 GHz)	E band	60 GHz to 90 GHz	UG-387/U	WR12

Specifications in back of this catalog

MA2808A

Features
- Wide dynamic range based on excellent minimum sensitivity and P1dB performance
- Image-response-free measurement of wideband signals plus high IF frequency and PS function*

*: Patented

For Further information see MA2806A/MA2808A page.

Minimum Recommended Configuration

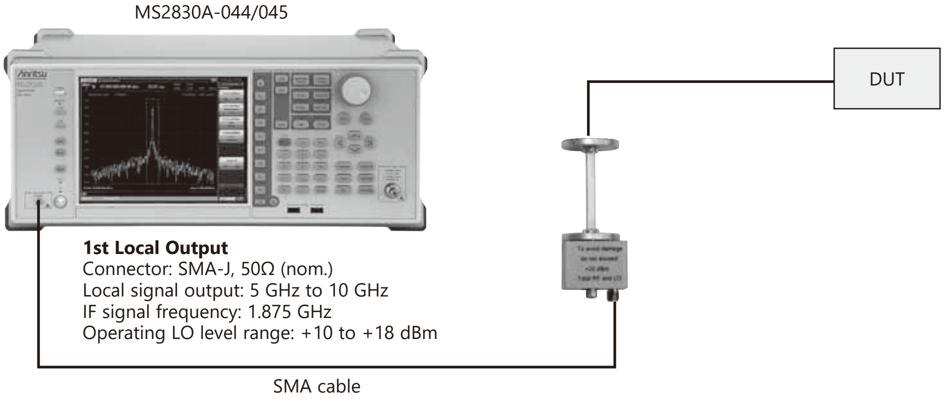
Model No.	Name	Notes
MS2830A	Signal Analyzer	Main unit
MS2830A-044	26.5 GHz Signal Analyzer	Select upper frequency Select one of MS2830A-044 or MS2830A-045 options
MS2830A-045	43 GHz Signal Analyzer	
MA2806A	High Performance Waveguide Mixer (50 to 75 GHz)	Select mixer model Select one of MA2806A or MA2808A
MA2808A	High Performance Waveguide Mixer (60 to 90 GHz)	

External Mixers (MA2740C/MA2750C Series)

The MA2740C/MA2750C series of External Mixers (Harmonic Mixers) supports spectrum measurements up to 325 GHz with high sensitivity and fewer LO harmonic order because these mixers output 1st local signals from 5 GHz to 10 GHz.

Model	Name	Frequency Band	Frequency Range	LO Harmonic Order	Mixing Mode	Conversion Loss* (dB)	Waveguide Flange	Wave Guide Size
MA2741C	External Mixer	A Band	26.5 GHz to 40 GHz	4	+	23	MIL-DTL-3922/54-003	WR28
MA2742C	External Mixer	Q Band	33 GHz to 50 GHz	5	+	26	MIL-DTL-3922/67D-006	WR22
MA2743C	External Mixer	U Band	40 GHz to 60 GHz	6	+	28	MIL-DTL-3922/67D-007	WR19
MA2744C	External Mixer	V Band	50 GHz to 75 GHz	8	+	32	MIL-DTL-3922/67D-008	WR15
MA2745C	External Mixer	E Band	60 GHz to 90 GHz	9	+	36	MIL-DTL-3922/67D-009	WR12
MA2746C	External Mixer	W Band	75 GHz to 110 GHz	11	+	39	MIL-DTL-3922/67D-010	WR10
MA2747C	External Mixer	F Band	90 GHz to 140 GHz	14	+	40	MIL-DTL-3922/67D-M08	WR08
MA2748C	External Mixer	D Band	110 GHz to 170 GHz	17	+	45	MIL-DTL-3922/67D-M06	WR06
MA2749C	External Mixer	G Band	140 GHz to 220 GHz	22	+	50	MIL-DTL-3922/67D-M05	WR05
MA2750C	External Mixer	Y Band	170 GHz to 260 GHz	26	+	65	MIL-DTL-3922/67D-M04	WR04
MA2751C	External Mixer	J Band	220 GHz to 325 GHz	33	+	70	MIL-DTL-3922/67D-M03	WR03

*: The Conversion loss is a typical value near the center frequency of each band but is not a guaranteed specification.



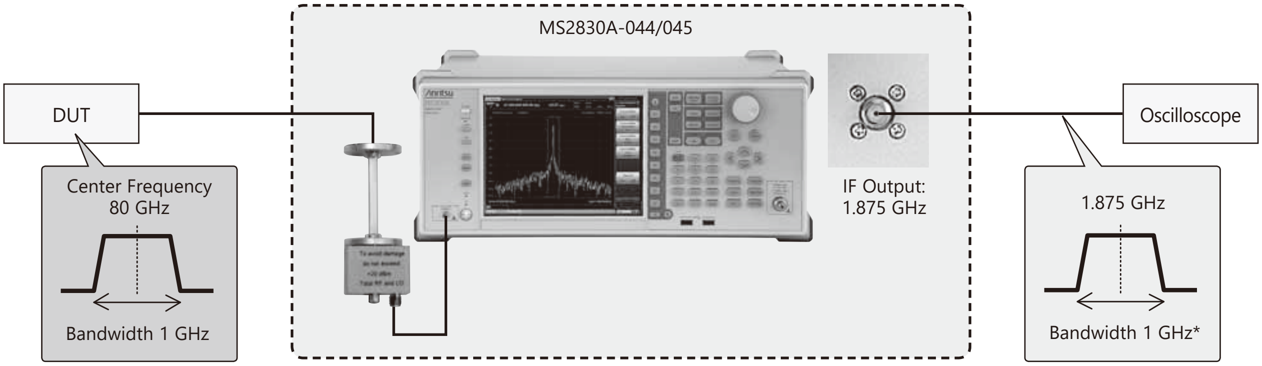
1st Local Output
Connector: SMA-J, 50Ω (nom.)
Local signal output: 5 GHz to 10 GHz
IF signal frequency: 1.875 GHz
Operating LO level range: +10 to +18 dBm

Connection Setup

Used as Wideband Down Converter: IF Output Frequency 1.875 GHz

Since IF Out supports a high frequency of 1.875 GHz, 1 GHz* wideband signals can be down converted. This can be used for down converting when performing modulation analysis by digitizing with an oscilloscope, etc.

Measurement image: Down convert signals with 80 GHz center frequency and 1 GHz* bandwidth to 1.875 GHz



*: When using external mixer bands (MA2740C/MA2750C Series), or using internal micro frequency bands (Band; 3 to 9) with Microwave Preselector Bypass option: On

Supports 125 MHz Wideband Measurements up to 43 GHz

Microwave Preselector Bypass MS2830A-067 + Analysis Bandwidth Extension to 125 MHz MS2830A-078*

*: Requires MS2830A-006, MS2830A-005 and MS2830A-077 (for MS2830A-044).
Requires MS2830A-006, MS2830A-009 and MS2830A-077 (for MS2830A-045).

Supports wideband analysis with high frequencies

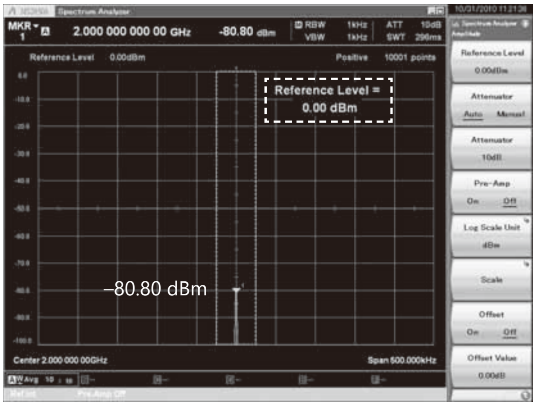
Frequency range: 4 GHz to 26.5 GHz (MS2830A-044, Frequency band mode: Normal)
4 GHz to 43 GHz (MS2830A-045, Frequency band mode: Normal)

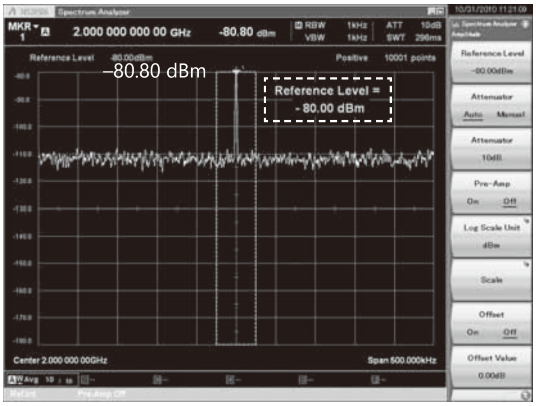
Installing the Microwave Preselector Bypass supports signal analyzer measurement functions in the above frequency range.
Adding the measurement software permits modulation analysis and is very useful for designing and inspecting high-frequency devices.

Improved Level Linearity

Conventional spectrum analyzers use an analog IF and log amp to achieve good level accuracy at points near the log scale reference level, but the accuracy degrades at points that are further away.
The MS2830A uses a digital IF instead of a log amp, which supports measurements with excellent accuracy at any point.

Example: Level Stability by Switching Reference Level

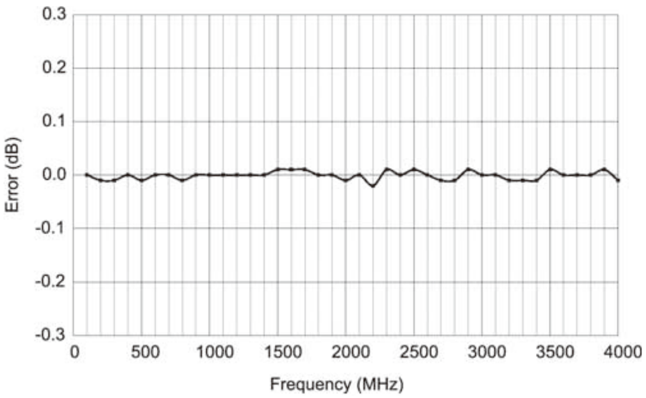




Dual Sweep Speed: Normal/Fast

When sweep time is set to [Auto], Normal (normal sweep) or Fast mode (high-speed sweep) can be set. The Fast mode sweeps six times faster than the Normal mode.

Example of Sweep Mode Switch Error: (CW –10 dBm input)
Level Error when Switching from Normal to Fast



Low Consumption Power, Excellent Eco Product

The MS2830A meets Anritsu "Excellent eco products" standard for environment-friendly products. It cuts consumed power by 50% compared to conventional models.

Power Consumption:
≤350 VA (including all options)
190 VA (nom., MS2830A-044 only, 26.5 GHz*1)
190 VA (nom., MS2830A-045 only, 43 GHz*1)
*1: Excluding other options

Resolution Bandwidth (RBW)

Setting Range

- Spectrum Analyzer:
  1 Hz to 3 MHz (1-3 sequence),
  500 Hz, 50 kHz, 2 MHz, 5 MHz, 10 MHz, 20 MHz*2, 31.25 MHz*2, *3,
  200 Hz (6 dB)*4, 9 kHz (6 dB)*4, 120 kHz (6 dB)*4,
  1 MHz (Impulse)*4
- Spectrum trace in signal analyzer mode:
  1 Hz to 1 MHz (1-3 sequence)*5
  1 Hz to 3 MHz (1-3 sequence)*6
  1 Hz to 10 MHz (1-3 sequence)*7

When monitoring two adjacent signals, the frequency resolution can be increased by reducing the resolution bandwidth (RBW).
This also has the effect of reducing the noise level.
Conversely, to confirm level variations of 20-MHz band signals such as LTE, set the RBW to 31.25 MHz.

*2: Can be set when with MS2830A-005. Can not be set when with MS2830A-009.
*3: Instead of Gaussian filter, 31.25 MHz RBW uses filter with flat top characteristics above 31.25 MHz.
*4: When MS2830A-016 installed.
*5: Without MS2830A-077/078, or Bandwidth: ≤31.25 MHz
*6: With MS2830A-077, Bandwidth: >31.25 MHz
*7: With MS2830A-078, Bandwidth: >31.25 MHz

Gate Sweep

Gate sweep executes sweeping only for the length of time specified by the gate length, starting from when the trigger condition is met.
A delay time until sweeping starts after the trigger condition is met can be set using trigger delay.

- The gate source can be selected from the following
  Wide IF video trigger
  External trigger
  Frame trigger
- Setting range and resolution for gate delay
  Setting range: 0 to 1 s
  Resolution: 20 ns
- Setting range and resolution for gate length
  Setting range: 50 μs to 1 s
  Resolution: 20 ns

Trigger Function

Trigger sweep executes sweeping using the specified trigger condition as the start point.

- Video trigger:
  Trigger sweeping starts in synchronization with the rise or fall of the waveform. A trigger level indicator showing the trigger level is displayed on the screen.
- Wide IF video trigger:
  An IF signal with a wide passing band of about 5 MHz is detected, and sweeping starts in synchronization with either the rise or fall of the detected signal.
- External trigger:
  Sweeping starts in synchronization with the rise or fall of the signal input via the Trigger Input connector.
- Frame trigger:
  An equipment-internal trigger signal is used to generate a trigger and start the sweep. The generation period (Period) and offset time (Offset) for the trigger signal can be set. It is also possible to resynchronize the trigger signal with either the Wide IF Video signal or an external trigger.

Three Built-in External Interfaces

The built-in Gigabit Ethernet, USB2.0, and GPIB interfaces support remote operation.

GPIB: IEEE 488.2, Rear panel, IEEE 488 bus connector
Interface functions:
SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0, E2
Ethernet: 10/100/1000BASE-T, Rear panel, RJ-45
USB (B): USB2.0, Rear panel, USB-B connector

Saving Measurement Results

Measurement results can be saved to internal hard disk or external USB memory. Screen dumps and trace data can be saved too.

- Screen dump file type
  - BMP
  - PNG
- The color of the screen hard copy can be set as follows:
  - Normal (same as screen display)
  - Reverse
  - Monochrome
  - Reversed Monochrome

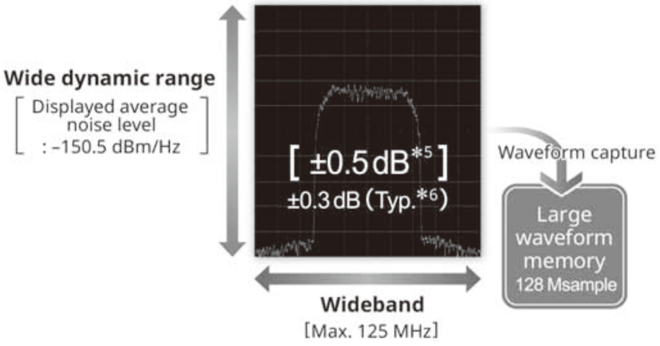
Signal Analyzer: Basic Performance/Functions

Wide Bandwidth × High Accuracy FFT Analysis

Analysis Bandwidth
MS2830A-006: 10 MHz max.
(20 MHz max. sampling rate = 50 ns resolution, ADC resolution 16 bits)
MS2830A-005[*1], MS2830A-009[*2]: 31.25 MHz max.
(50 MHz max. sampling rate = 20 ns resolution, ADC resolution 16 bits)
MS2830A-077[*3]: 62.5 MHz max.
(100 MHz max. sampling rate = 10 ns resolution, ADC resolution 14 bits)
MS2830A-078[*4]: 125 MHz max.
(200 MHz max. sampling rate = 5 ns resolution, ADC resolution 14 bits)

Note: An image response is received when setting the bandwidth to more than 31.25 MHz. This can be used when not inputting a signal frequency outside the MS2830A analysis bandwidth (125 MHz max.). The Signal Analyzer series MS2690A/91A/92A is recommended for other measurement purposes.

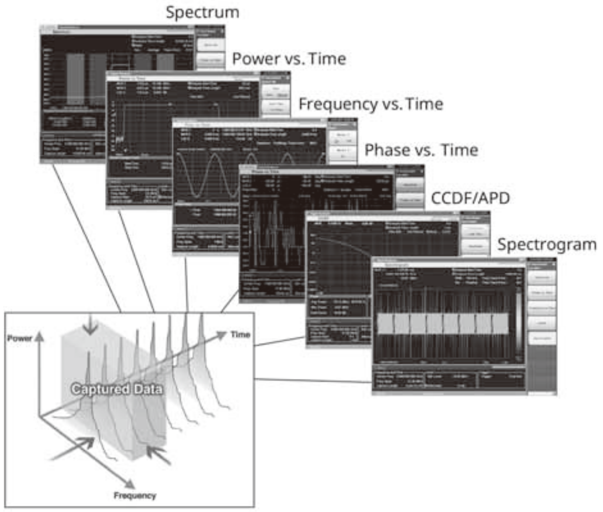
Based on the excellent level accuracy and wide dynamic range of the MS2830A, a signal with an FFT analysis bandwidth of up to 125 MHz can be captured with a level accuracy of ±0.3 dB.



[*1]: MS2830A-005 can be installed in MS2830A-044. Requires MS2830A-006.
[*2]: MS2830A-009 can be installed in MS2830A-045. Requires MS2830A-006.
[*3]: Requires MS2830A-006 and MS2830A-005 (for MS2830A-044). Requires MS2830A-006 and MS2830A-009 (for MS2830A-045).
[*4]: Requires MS2830A-006, MS2830A-005 and MS2830A-077 (for MS2830A-044). Requires MS2830A-006, MS2830A-009 and MS2830A-077 (for MS2830A-045).
[*5]: 300 kHz ≤ f < 4 GHz, Frequency band mode Normal.
[*6]: Excluding Guard band

Vector Signal Analysis (VSA) Function

Seamless signal capture and VSA analysis in multiple domains make it easy to evaluate burst-signal responses and capture degraded spectrum transients, etc., which cannot be checked by conventional sweep spectrum analyzers. This greatly improves design verification and troubleshooting efficiency.



Save Signals in Internal Memory

Max. Capture Time: 0.5 s to 2000 s
Max. Number of Samples: 100 Msamples

The "Analysis bandwidth × Analysis time" signal is held in internal memory and saved to hard disk.
Up to 100 Msamples of data can be saved to memory for one measurement. The frequency span determines the sampling rate.
The following chart shows the maximum capture time per frequency span.

Span*	Sampling Rate	Capture Time	Max. Sampling Data
1 kHz	2 kHz	2000 s	4M
2.5 kHz	5 kHz	2000 s	10M
5 kHz	10 kHz	2000 s	20M
10 kHz	20 kHz	2000 s	40M
25 kHz	50 kHz	2000 s	100M
50 kHz	100 kHz	1000 s	100M
100 kHz	200 kHz	500 s	100M
250 kHz	500 kHz	200 s	100M
500 kHz	1 MHz	100 s	100M
1 MHz	2 MHz	50 s	100M
2.5 MHz	5 MHz	20 s	100M
5 MHz	10 MHz	10 s	100M
10 MHz	20 MHz	5 s	100M
25 MHz	50 MHz	2 s	100M
31.25 MHz	50 MHz	2 s	100M
50 MHz	100 MHz	500 ms	50M
62.5 MHz	100 MHz	500 ms	50M
100 MHz	200 MHz	500 ms	100M
125 MHz	200 MHz	500 ms	100M

*: With MS2830A-006: 1 kHz to 10 MHz
With MS2830A-005/006 (for MS2830A-044) or MS2830A-006/009 (for MS2830A-045): 1 kHz to 31.25 MHz
With MS2830A-005/006/077 (for MS2830A-044) or MS2830A-006/009/077 (for MS2830A-045): 1 kHz to 62.5 MHz
With MS2830A-005/006/077/078 (for MS2830A-044) or MS2830A-006/009/077/078 (for MS2830A-045): 1 kHz to 125 MHz

Replay Function for Comparison Evaluation

This function reads saved data and replays it using the signal analyzer measurement function.

Examples:

1. Data sharing between separate R&D and manufacturing
2. Later laboratory bench-top analysis of on-site signals
3. Save data at shipment and re-verify if problem occurs

Signal Analyzer: Trace

Spectrum

The Spectrum trace displays a graph with amplitude on the y-axis and frequency on the x-axis. The captured IQ data is FFT processed (fast Fourier transformed) and converted from the time domain to the frequency domain for display as a spectrum.

Power vs. Time

The Power vs. Time trace displays a graph with amplitude on the y-axis and time on the x-axis to confirm changes in power with time of measured signals.

Frequency vs. Time

The Frequency vs. Time trace displays a graph with frequency on the y-axis and time on the x-axis to confirm time variation of the measured signal frequency.

Phase vs. Time

The Phase vs. Time trace displays a graph with phase on the y-axis and time on the x-axis to confirm time variation of the measured signal phase.

CCDF*1/APD*2

The CCDF trace displays the power variation probability on the y-axis and power variation on the y-axis to confirm the CCDF and APD of measured signals.

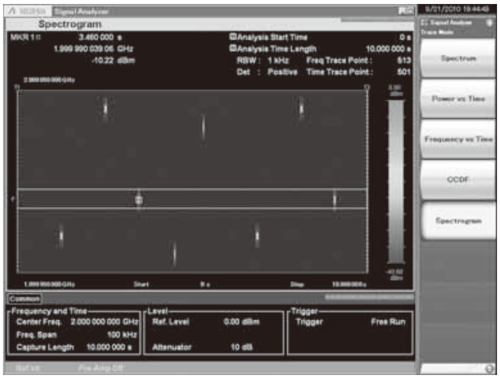
*1: CCDF (Complementary Cumulative Distribution Function)
*2: APD (Amplitude Probability Density)

Measurement Results

- CCDF: The CCDF display indicates the cumulative distribution of transient power variations compared to average power.
- APD: The APD display indicates the probability distribution of transient power fluctuations compared to average power.

Spectrogram

The Spectrogram trace displays the level as color with frequency on the y-axis and time on the x-axis. The captured IQ data is FFT processed to confirm time variations in the continuous spectrum.
It is useful for monitoring frequency hopping and transient signals.



Spectrogram

MKR 1 3.460 000 s
1.999 990 039 06 GHz
-10.22 dBm

Analysis Start Time 0 s
Analysis Time Length 10.000 000 s
RBW : 1 kHz Freq Trace Point : 513
Det : Positive Time Trace Point : 501

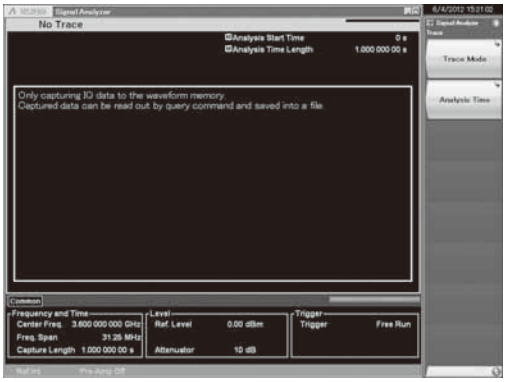
Frequency and Time
Center Freq. 2.000 000 000 GHz
Freq. Span 100 kHz
Capture Length 10.000 000 s

Level
Ref. Level 0.00 dBm
Attenuator 10 dB

Trigger
Trigger Free Run

No Trace

No Trace mode does not execute signal analysis. Therefore, “IQ data output” and “IQ data readout using remote commands” can be executed quickly without the need to wait for completion of analysis.



No Trace

Analysis Start Time 0 s
Analysis Time Length 1.000 000 00 s

Only capturing IQ data to the waveform memory.
Captured data can be read out by query command and saved into a file.

Frequency and Time
Center Freq. 3.600 000 000 GHz
Freq. Span 31.25 MHz
Capture Length 1.000 000 00 s

Level
Ref. Level 0.00 dBm
Attenuator 10 dB

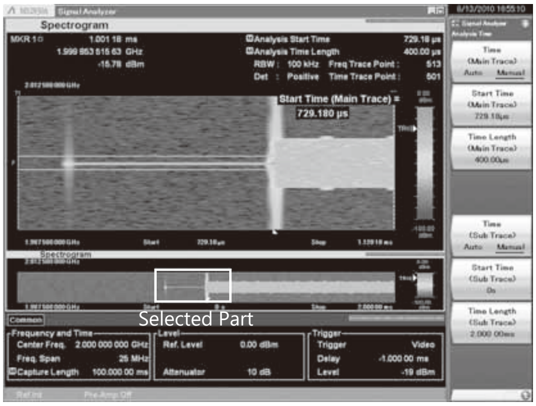
Trigger
Trigger Free Run

Measurement with Sub-trace Display

This function splits the screen into top and bottom halves; simultaneous display of the sub-trace supports easy monitoring of fault locations and transient phenomena.

Main: Spectrum, Frequency vs. Time, Power vs. Time,
Phase vs. Time, CCDF/APD, Spectrogram
Sub: Power vs. Time, Spectrogram

The part of a previously captured long-term signal to be monitored can be selected on the sub-trace to display the problem part only on the main trace.



Spectrogram

MKR 1 1.001 18 ms
1.999 953 515 63 GHz
-15.78 dBm

Analysis Start Time 729.18 μs
Analysis Time Length 400.00 μs
RBW : 100 kHz Freq Trace Point : 513
Det : Positive Time Trace Point : 501

Frequency and Time
Center Freq. 2.000 000 000 GHz
Freq. Span 25 MHz
Capture Length 100.000 00 ms

Level
Ref. Level 0.00 dBm
Attenuator 10 dB

Trigger
Trigger Video
Delay -1.000 00 ms
Level -19 dBm

Versatile Built-in Functions

Useful for Tx Characteristics Evaluation

The MS2830A is fully loaded with all the functions required for evaluating Tx characteristics. Tests can be performed simply and in accordance with standards using functions tailored to measurement contents.

Measure Function	SPA*1	VSA*2
Channel Power	✓	✓
Occupied Bandwidth	✓	✓
Adjacent Channel Leakage Power	✓	✓
Spectrum Emission Mask	✓	
Burst Average Power	✓	✓
Spurious Emission	✓	
AM Depth		✓
FM Deviation		✓
Multi-marker & Marker List	✓	✓
Highest 10 Markers	✓	✓
Limit Line	✓	
Frequency Counter	✓	
2-tone 3rd-order Intermodulation Distortion	✓	
Annotation Display (On/Off)	✓	
Power Meter	Independent function*3	
Phase Noise	MS2830A-010	
Noise Figure	MS2830A-017*4	

*1: SPA (Spectrum Analyzer)
*2: VSA (Vector Signal Analyzer), requires MS2830A-005/006/009/077/078
*3: Use USB Power Sensors
*4: Use Noise Sources (Noisecom, NC346 series)

Channel Power

SPA VSA

This function measures channel bandwidth power. Three types of filters (Rect, Nyquist, Root Nyquist) can be selected.
Pre-installed templates for each standard support easy parameter setting.

Measurement Results

- Absolute power per Hz in channel band
- Total power in channel band

Occupied Bandwidth

SPA VSA

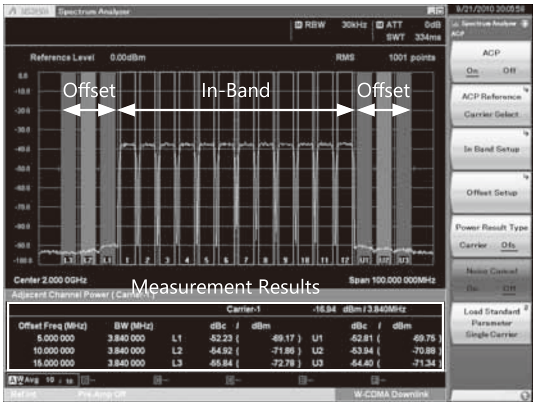
Occupied bandwidth is measured by selecting either the N% or X-dB mode.
Pre-installed templates for each standard support easy parameter setting.

Measurement Results
- Bandwidth for specified conditions

Adjacent Channel Leakage Power

SPA VSA

This function measures carrier adjacent channel (offset) power (In-Band). 1 to 12 carriers can be set and switched instantaneously on-screen.
True ACLR performance is measured using the noise cancellation function to subtract main-frame noise from the measurement result.
Pre-installed templates for each standard support easy parameter setting.



Carrier-1 -16.94 dBm / 3.840MHz

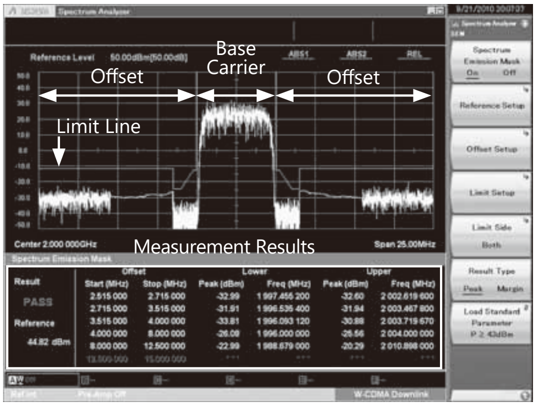
Offset Freq (MHz)	BW (MHz)		dBc /	dBm		dBc /	dBm
5.000 000	3.840 000	L1	-52.23 (	-69.17)	U1	-52.81 (	-69.75)
10.000 000	3.840 000	L2	-54.92 (	-71.86)	U2	-53.94 (	-70.88)
15.000 000	3.840 000	L3	-55.84 (	-72.78)	U3	-54.40 (	-71.34)

Measurement Results
- Absolute power of Offset channel
- Relative values in relation to reference power selected in ACP reference

Spectrum Emission Mask

SPA

This function splits the offset part into up to 12 segments; the measurement parameters and limit lines can be specified to measure the peak power and margin for each segment. The results are tabulated below the trace and marked PASS/FAIL. Pre-installed templates for each standard support easy parameter setting.



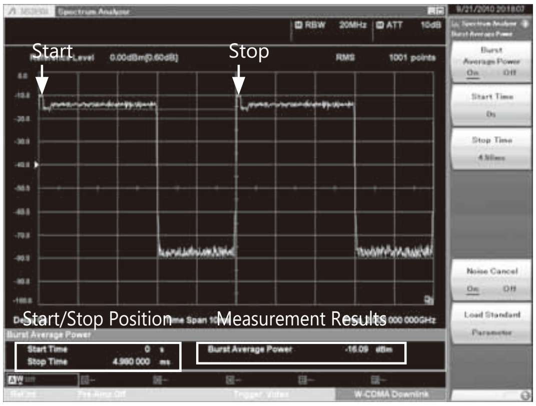
Result	Offset		Lower		Upper	
	Start (MHz)	Stop (MHz)	Peak (dBm)	Freq (MHz)	Peak (dBm)	Freq (MHz)
PASS	2.515 000	2.715 000	-32.99	1 997.455 200	-32.60	2 002.619 600
	2.715 000	3.515 000	-31.91	1 996.535 400	-31.94	2 003.467 800
Reference	3.515 000	4.000 000	-33.81	1 996.093 120	-30.88	2 003.719 670
44.82 dBm	4.000 000	8.000 000	-26.08	1 996.000 000	-25.56	2 004.000 000
	8.000 000	12.500 000	-22.99	1 988.679 000	-20.29	2 010.898 000
	13.500 000	15.000 000	***	***	***	***

Measurement Results
- Peak power (or margin) at offset
- Each peak frequency

Burst Average Power

SPA VSA

The average power for the range specified by two markers is displayed in the time domain. Measurement only requires setting the measurement start and stop positions on the screen. True performance is measured using the noise cancellation function to subtract main-frame noise from the measurement result.
Pre-installed templates for each standard support easy parameter setting.



Start Time 0 s
Stop Time 4.990 000 ms

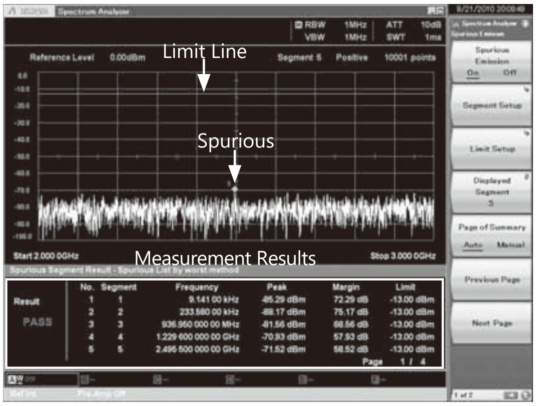
Burst Average Power -16.09 dBm

Measurement Results
- Average power of specified range

Spurious Emission

SPA

This function splits the frequency range into up to 20 segments for sweeping; the measurement parameters and limit lines can be specified to measure the peak power and margin for each segment. The results are tabulated below the trace and marked PASS/FAIL.
In particular, all tests can be completed up to the final stage without an external PC because the zero-span capture function described in the technology compliance test is built-in.



Result	No.	Segment	Frequency	Peak	Margin	Limit
PASS	1	1	9.141 00 kHz	-85.29 dBm	72.29 dB	-13.00 dBm
	2	2	233.580 00 kHz	-88.17 dBm	75.17 dB	-13.00 dBm
	3	3	936.950 000 00 MHz	-81.56 dBm	68.56 dB	-13.00 dBm
	4	4	1.229 600 000 00 GHz	-70.93 dBm	57.93 dB	-13.00 dBm
	5	5	2.496 500 000 00 GHz	-71.52 dBm	58.52 dB	-13.00 dBm

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Measurement Results
- Each segment peak power and margin
- Each peak frequency

AM Depth

VSA

The Power vs. Time trace measurement function is used to confirm AM depth.
It measures the measured signal AM based on trace data at the displayed marker. When marker is Off, the whole range is measured.

Measurement Results
- +Peak, –Peak, (Peak-Peak)/2, Average

FM Deviation VSA

The Freq. vs. Time trace measurement is used to confirm the FM deviation. It measures the maximum and minimum frequencies from trace data in the marker range. When marker is Off, the whole range is measured.

Measurement Results
- +Peak, –Peak, (Peak-Peak)/2, Average

Multi-marker & Marker List SPA VSA

Up to 10 markers can be set for this function. Markers may be either a spot or a zone. Using a zone marker, the peak of a signal with an unstable variable frequency can be tracked and measured. Not only can the 10 markers be listed below the trace but the differences between markers can be calculated and displayed using the delta setting.

Measurement Results
- Marker point frequency
- Marker point power
- Absolute power per Hz in marker bandwidth
- Total power in marker bandwidth
- Difference between any markers

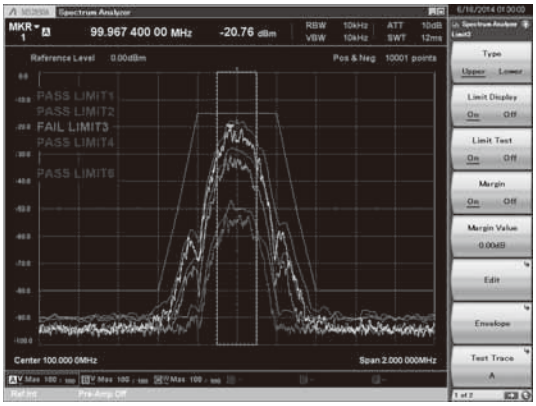
Highest 10 Markers SPA VSA

This function sets the threshold level and auto-detects peaks in the X (frequency) and Y (level/time) directions.

Measurement Results
- Peak Search Y: Sets up to 10 markers in order of peak level
- Peak Search X: Sets up to 10 markers in order of frequency (time) level

Limit Line SPA

- Setting Limit Lines
  Up to six types of Limit line can be set on the spectrum display (frequency domain).
  In addition to setting the frequency and level of crossover points manually in sequence from the low frequency, after creating the right half of a line, the left half can be created by reversing and copying the right half, to set a symmetric limit line. Additionally, a Limit line that traces the measured waveform can be created using the Limit Envelope function. A margin can be set on the Limit line in the amplitude direction.
- Evaluating using Limit Line Setting (Limit Test Function)
  When the waveform is above or below the Limit line, it is evaluated automatically as PASS or FAIL. Evaluation is also possible with an added margin. The target evaluation line can be chosen from any of six types.
- Auto-saving Waveform Data using Limit Line Setting (Save on Event Function)
  When the waveform matches the evaluation conditions (Event), it can be saved automaticaly as a csv format file. Any one of the following five Event types can be selected.
  (1) Limit Fail: Saves waveform file when evaluation result is Fail
  (2) Limit Pass: Saves waveform file when evaluation result is Pass
  (3) Margin Fail: Saves waveform file when evaluation result including margin is Fail
  (4) Margin Pass: Saves waveform file when evaluation result including margin is Pass
  (5) Sweep Complete: Saves waveform file at every measurement regardless of evaluation result



Example:
PASS/FAIL evaluation is performed by changing the input signal level. The evaluation results for the five line types can be displayed simultaneously on one screen.

Line: Limit 1, Limit 2, Limit 3, Limit 4, Limit 5, Limit 6
Evaluation Type: Upper Limit, Lower Limit
Crossover (Point): 1 to 100
Margin: Set Margin line for each Limit 1, 2, 3, 4, 5, 6
Evaluation Result: PASS, FAIL
Result Save: Auto-save as csv format file

Frequency Counter SPA

This function of the marker functions is used to measure CW frequencies.
Gate Time sets the measurement target time.

Measurement Results
- Marker point frequency

2-tone 3rd-order Intermodulation Distortion SPA

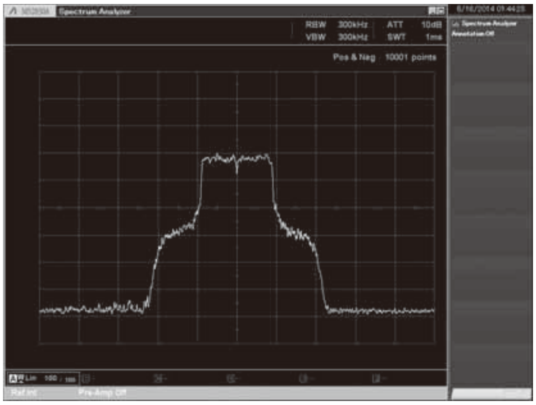
By inputting two different frequency CW signals (desired waves), two-tone third-order intermodulation distortion is generated close to the desired waves according to non-linear characteristics of Device Under Test (DUT). Then, Third Order Intercept (TOI) is calculated from the two-tone third-order intermodulation distortion.

TOI (dBm)		Frequency (GHz)	Amplitude (dBm)	Amplitude (dBc)	TOI (dBm)
1.69	Lower 3rd	0.999 850 000	-43.21	-29.94	1.69
Amplitude (dBc)	Lower Tone	0.999 949 960	-13.28		
	Upper Tone	1.000 050 000	-13.27		
-29.94	Upper 3rd	1.000 149 999	-43.30	-30.02	1.74

Measurement Results
- TOI: [dBm]
- Amplitude: [dBc]

Annotation Display SPA

Screen annotations can be set to On or Off. Annotations about frequency, level, etc., are not displayed at the Off setting.



Power Meter

Power meter function can connect a USB power sensor to the MS2830A and read the measurement values.

COM5 MA24108A Freq : 1.000 000 000 GHz Range : Auto

POWER : -10.00 dBm

0.00 dB

100. μW

Measuring Not Zeroed Offset : Off , 0.00 dB Average : 80 / 1000

Measurement Results
- Power: [dBm], [W]
- Relative power: [dB]

Compatible USB power sensors.

Model	Frequency Range	Dynamic Range
MA24104A*	600 MHz to 4 GHz	+3 to +51.76 dBm
MA24105A	350 MHz to 4 GHz	+3 to +51.76 dBm
MA24106A	50 MHz to 6 GHz	–40 to +23 dBm
MA24108A	10 MHz to 8 GHz	–40 to +20 dBm
MA24118A	10 MHz to 18 GHz	–40 to +20 dBm
MA24126A	10 MHz to 26 GHz	–40 to +20 dBm

*: MA24104A has been discontinued.

Installing the PowerXpert™

Installing the PowerXpert™ PC application software for the Anritsu USB Power Sensor in the MS2830A supports various measurement functions offered by PowerXpert™, as well as use of other USB power sensors by the MS2830A.

PowerXpert™ for the MS2830A can be downloaded from the MS2830A and MS2830A Microwave product pages at the Anritsu website. When using the PowerXpert™ software with a PC, download the latest version from the USB Power Sensor product page at the Anritsu website.

Phase Noise (MS2830A-010)

This function measures phase noise in the 10 Hz to 10 MHz frequency offset range.

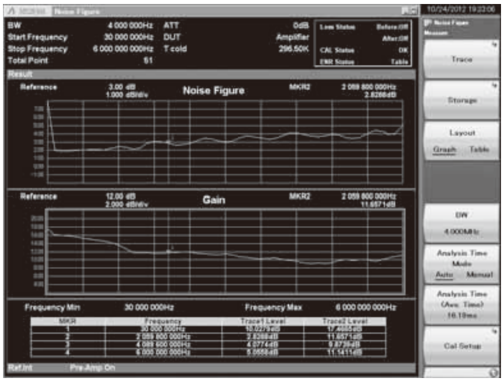
Measurement Results
- Carrier level
- Error between set frequency and carrier frequency
- Marker point phase noise level

Noise Figure Measurement (MS2830A-017)

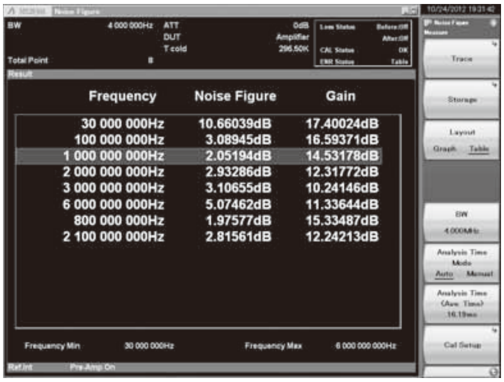
Noise Figure is measured with the measurement method of Y-factor method which uses a Noise Source*.

Frequency Mode: Fixed, List, Sweep
DUT Mode: Amplifier, Down Converter, Up Converter
Screen Layout: Graph, Table

Measurement Results Display
Graph, List, Spot
Displays measurement results for each trace (Trace1/Trace2).
Noise Figure (NF) [dB]
Noise Factor (F) [Linear]
Gain
Y-Factor: Power ratio when Noise Source is turned ON/OFF
T effective: Effective noise temperature
P Hot: Power measured when Noise Source is On.
P Cold: Power measured when Noise Source is Off.



Measurement Result: Example of Graph display
(Frequency Mode: Sweep, Screen Layout: Graph)

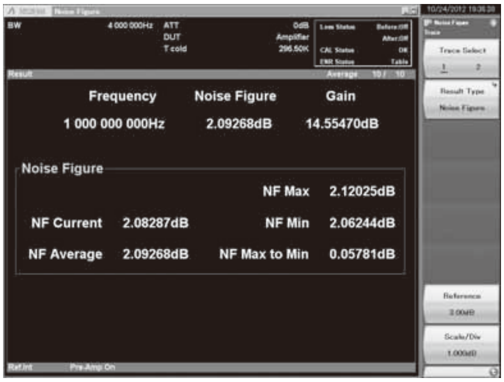


BW 4 000 000Hz ATT 0dB
DUT Amplifier
T cold 296.50K
Total Point 8

Frequency	Noise Figure	Gain
30 000 000Hz	10.66039dB	17.40024dB
100 000 000Hz	3.08945dB	16.59371dB
1 000 000 000Hz	2.05194dB	14.53178dB
2 000 000 000Hz	2.93286dB	12.31772dB
3 000 000 000Hz	3.10655dB	10.24146dB
6 000 000 000Hz	5.07462dB	11.33644dB
800 000 000Hz	1.97577dB	15.33487dB
2 100 000 000Hz	2.81561dB	12.24213dB

Frequency Min 30 000 000Hz Frequency Max 6 000 000 000Hz

Measurement Result: Example of List display
(Frequency Mode: List, Screen Layout: List)



BW 4 000 000Hz ATT 0dB
DUT Amplifier
T cold 296.50K

Average 10 / 10

Frequency	Noise Figure	Gain
1 000 000 000Hz	2.09268dB	14.55470dB

Noise Figure

NF Max 2.12025dB
NF Current 2.08287dB
NF Min 2.06244dB
NF Average 2.09268dB
NF Max to Min 0.05781dB

Measurement Result: Example of Spot display
(Frequency Mode: Fixed)

*: Supports noise sources from Noisecom NC346 series.
See the MS2830A catalog for more details.

BER Measurement Function (MS2830A-026): Basic Performance

Convenient Built-in BER Measurement Function for Rx Evaluations

The MS2830A with the BER Measurement Function MS2830A-026 supports measurement up to 10 Mbps.
It supports Rx sensitivity tests by inputting the receiver-demodulated Data/Clock/Enable to the back of the MS2830A.

- Input Signal: Data, Clock, Enable (Polarity reversal supported)
- Input Bit Rate: 100 bps to 10 Mbps
- Input Level: TTL 3.3 V
- Connector: Rear panel, AUX connector*

*: Can convert to BNC by connecting AUX conversion adapter (J1556A).

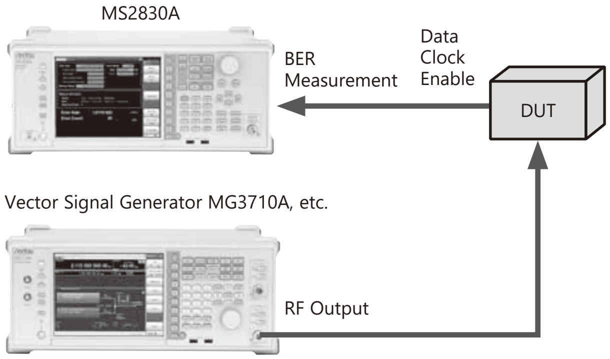
- Measured Patterns:
  PN9, PN11, PN15, PN20, PN23, ALL0, ALL1, Alternate (0101...), PN9Fix, PN11Fix, PN15Fix, PN20Fix, PN23Fix, UserDefine (4096 bits Max.)
- Measurable Bit Count: 1000 to 4294967295 bits (2^{32} – 1 bits)
- Measurable Error Bit Count: 1 to 2147483647 bits (2^{31} – 1 bits)
- Count Mode
  Data: Measures until specified Data count
  Error: Measures until specified Error count
- Measurement Mode
  Single: Measures specified measurement bit count once
  Continuous: Repeats Single measurement
  Endless: Continues measurement to upper limit of measurement bits


Data Type PN9
Pattern File
Bit Length
Sync Position Start
Sync Position Length
Measure Mode Single
Count Mode Data
Data 10000 Bit
Error Bit

Measure Information
Status Stop Synchronizing Measuring
Error BitError SyncLoss ClockError EnableError
SyncLoss Count 0

Error Rate 1.017E-002 1.017%
Error Count 20 / 1967

BER Measurement Function Main Screen



BER Measurement Setup Example
(using external vector signal generator)

Excellent Expandability Platform (Hardware)

The versatility of the MS2830A series is tailored easily to the application by installing modules in expansion slots.

Basic Performance and Function Improvement

- Rubidium Reference Oscillator/Retrofit MS2830A-001/101
  This option is a 10 MHz reference crystal oscillator with excellent frequency stability startup characteristics of ±1 × 10^{-9} at 7 minutes after power-on.
  Aging Rate: ±1 × 10^{-10}/month
  Start-up Characteristics: ±1 × 10^{-9} (7 minutes after power-on)
- Preamplifier/Retrofit MS2830A-008/108
  This option is used to measure low-level signals, such as noise and interference signals.
  Frequency Range: 100 kHz to 6 GHz
  *: Cannot be installed simultaneously with MS2830A-068/168
- Precompliance EMI Function/Retrofit MS2830A-016/116
  This option adds an EMI measurement detection mode and RBW to the spectrum analyzer function. Both the detection mode used for CISPR standards (Quasi-Peak, CISPR-AVG, RMS-AVG) and RBW (200 Hz (6 dB), 9 kHz (6 dB), 120 kHz (6 dB), 1 MHz (Imp)) as well as conventional settings can be selected.
- Microwave Preselector Bypass/Retrofit MS2830A-067/167
  Bypassing the preselector used for the microwave band improves RF frequency characteristics and in-band frequency characteristics.
  *: Add MS2830A-067 when using the signal analyzer measurement functions at bandwidth: >31.25 MHz and frequency: >6 GHz.
- Microwave Preamplifier/Retrofit MS2830A-068/168
  This option is used to measure low-level signals, such as noise and interference signals.
  Frequency Range: 100 kHz to 26.5 GHz (MS2830A-044)
  100 kHz to 43 GHz (MS2830A-045)
  *: Cannot be installed simultaneously with MS2830A-008/108

Signal Analyzer Function and Performance Improvement

- Analysis Bandwidth Extension to 31.25 MHz/Retrofit MS2830A-005/105
  This option extends the analysis bandwidth to 31.25 MHz.
  *: Requires MS2830A-006/106
  Not supported by MS2830A-045 (43 GHz Signal Analyzer) - use MS2830A-009
- Analysis Bandwidth 10 MHz/Retrofit MS2830A-006/106
  This option supports the VSA and digitize functions.
- Bandwidth Extension to 31.25 MHz for Millimeter-wave/Retrofit MS2830A-009/109
  This option extends the MS2830A-045 (43 GHz Signal Analyzer) analysis bandwidth to 31.25 MHz.
  *: Requires MS2830A-006/106
  Dedicated option for MS2830A-045 (43 GHz Signal Analyzer)
  Cannot be set the RBW to more than 10 MHz in spectrum analyzer function.
- Analysis Bandwidth Extension to 62.5 MHz MS2830A-077
  This option extends the analysis bandwidth to 62.5 MHz.
  *: Retrofit not supported.
  Requires MS2830A-006 and MS2830A-005 (for MS2830A-044).
  Requires MS2830A-006 and MS2830A-009 (for MS2830A-045).
- Analysis Bandwidth Extension to 125 MHz MS2830A-078
  This option extends the analysis bandwidth to 125 MHz.
  *: Retrofit not supported.
  Requires MS2830A-006, MS2830A-005 and MS2830A-077 (for MS2830A-044).
  Requires MS2830A-006, MS2830A-009 and MS2830A-077 (for MS2830A-045).
  Note: An image response is received when setting the bandwidth to more than 31.25 MHz. This can be used when not inputting a signal frequency outside the MS2830A analysis bandwidth (125 MHz max.). The Signal Analyzer series MS2690A/91A/92A is recommended for other measurement purposes.

Expansion Functions

- Phase Noise Measurement Function/Retrofit MS2830A-010/110
  Adds phase noise measurements.
  Frequency Range: 10 MHz to main-frame upper limit frequency
  Offset Frequency Range: 10 Hz to 10 MHz
- 2ndary HDD/Retrofit MS2830A-011/111
  This removable 2ndary HDD is installed in the HDD Option Slot of the MS2830A main frame to expand the user data storage space.
  It does not have the Windows OS installed. The MS2830A ships with it installed. Only one expansion HDD can be installed in the MS2830A.
  It is useful when taking the instrument for calibration but the security of saved user data, such as measurement results, must be protected.
- 2ndary HDD Retrofit MS2830A-311
  This removable 2ndary HDD is installed in the HDD Option Slot of the MS2830A main frame to expand the user data storage space.
  It does not have the Windows OS installed.
  It is useful when taking the instrument for calibration but the security of saved user data, such as measurement results, must be protected.

- Noise Figure Measurement Function/Retrofit MS2830A-017/117
  Adds noise figure measurement function.
  Noise Figure is measured with the measurement method of Y-factor method which uses a Noise Source.

- BER Measurement Function/Retrofit MS2830A-026/126
  Adds BER measurement function.
  It supports Rx sensitivity tests by inputting the receiver-demodulated Data/Clock/Enable to the back of the MS2830A.
  Input Bit Rate: 100 bps to 10 Mbps

Future-proof Platform (Software)

Adding measurement software options to the signal analyzer assures that the modulation analysis and other functions will support all common current and future communications systems.

Measurement Software

Communications Systems	Model	Name	Addition to Main frame (✓: Can be installed, No: Cannot be installed)		Analysis Bandwidth Extension Option (✓: Required, ✓+: Function expansion, Space (no symbol): No specification)			
			Opt. 040/041/043	Opt. 044/045	Opt. 006	Opt. 005/009	Opt. 077	Opt. 078
LTE/LTE-Advanced (FDD)	MX269020A	LTE Downlink Measurement Software	✓	✓	✓	✓		
	MX269020A-001	LTE-Advanced FDD Downlink Measurement Software	✓	✓	✓	✓	✓+*1	✓+*1
	MX269021A	LTE Uplink Measurement Software	✓	✓	✓	✓		
	MX269021A-001	LTE-Advanced FDD Uplink Measurement Software	✓	✓	✓	✓	✓+	✓+
LTE/LTE-Advanced (TDD)	MX269022A	LTE TDD Downlink Measurement Software	✓	✓	✓	✓		
	MX269022A-001	LTE-Advanced TDD Downlink Measurement Software	✓	✓	✓	✓	✓+*1	✓+*1
	MX269023A	LTE TDD Uplink Measurement Software	✓	✓	✓	✓		
	MX269023A-001	LTE-Advanced TDD Uplink Measurement Software	✓	✓	✓	✓	✓+	✓+
W-CDMA/HSPA/ HSPA Evolution	MX269011A	W-CDMA/HSPA Downlink Measurement Software	✓	✓	✓			
	MX269012A	W-CDMA/HSPA Uplink Measurement Software	✓	✓	✓			
W-CDMA/HSPA (Downlink)	MX269030A	W-CDMA BS Measurement Software	✓	✓	✓			
TD-SCDMA	MX269015A	TD-SCDMA Measurement Software	✓	✓	✓			
CDMA2000	MX269024A	CDMA2000 Forward Link Measurement Software	✓	✓	✓			
	MX269024A-001	All Measure Function	✓	✓	✓			
1xEV-DO	MX269026A	EV-DO Forward Link Measurement Software	✓	✓	✓			
	MX269026A-001	All Measure Function	✓	✓	✓			
GSM/EDGE	MX269013A	GSM/EDGE Measurement Software	✓	✓	✓			
EDGE Evolution	MX269013A-001	EDGE Evolution Measurement Software	✓	✓	✓			
World Digital Wireless Standards	MX269017A	Vector Modulation Analysis Software	✓	✓*2	✓	✓+*3	✓+*3	✓+*3
Analog Wireless	MX269018A	Analog Measurement Software	✓*4	No				
WLAN IEEE 802.11a/b/g/n/j/p	MX269028A	WLAN (802.11) Measurement Software (Supports IEEE 802.11n/11a/11b/11g/11j/11p)	✓	✓	✓	✓		
WLAN IEEE 802.11ac (80 MHz)	MX269028A-001*5	802.11ac (80 MHz) Measurement Software	✓	✓	✓	✓	✓	✓
WLAN IEEE 802.11a/b/g/n	MX283027A	Wireless Network Device Test Software	✓	✓				
WLAN	MX283027A-001	WLAN Test Software	✓	✓	✓	✓		
Bluetooth	MX283027A-002	Bluetooth Test Software	✓	✓	✓	✓		

*1: The LTE-Advanced Carrier Aggregation measurement range varies as follows, depending on the Analysis Bandwidth Extension option configuration.

Main Frame	Analysis Bandwidth Extension Option Configuration	Maximum Analysis Bandwidth (In-band carrier aggregation range)	Maximum Number of Bands	Maximum Number of Component Carriers
MS2830A	MS2830A-078 installed	125 MHz	1	5
	MS2830A-077 installed	31.25 MHz	3	5
	MS2830A-005/009 installed	31.25 MHz	3	5
MS269xA	MS269xA-078 installed	125 MHz	3	5
	MS269xA-077 installed	31.25 MHz	3	5
	Standard	31.25 MHz	3	5

*2: By the measurement of the narrowband signal, add MS2830A-066. (Channel bandwidth: x kHz to 100 kHz)
MS2830A-044/045 cannot be installed MS2830A-066.

*3: The Symbol Rate setting range varies as follows, depending on the option configuration.

	O-QPSK	FSK	Except FSK	
			Frame Formatted	Non-Formatted
MS2830A-078, 077, 005, 006 installed	0.1 ksps to 12.5 Msps	0.1 ksps to 25 Msps	0.1 ksps to 50 Msps	0.1 ksps to 140 Msps
MS2830A-077, 005, 006 installed	0.1 ksps to 6.25 Msps	0.1 ksps to 12.5 Msps	0.1 ksps to 25 Msps	0.1 ksps to 70 Msps
MS2830A-005, 006 installed	0.1 ksps to 3.125 Msps	0.1 ksps to 6.25 Msps	0.1 ksps to 12.5 Msps	0.1 ksps to 35 Msps
MS2830A-006 installed	0.1 ksps to 1.25 Msps	0.1 ksps to 2.5 Msps	0.1 ksps to 5 Msps	0.1 ksps to 5 Msps

*4: MS2830A-043 can implement only either MS2830A-020/021 or MS2830A-066.
By the system that MS2830A-066 is necessary, MS2830A-020/021 is not added to MS2830A-043.

*5: Requires MX269028A. The IEEE 802.11ac measurement range varies as follows, depending on the Analysis Bandwidth Extension option configuration.

Model			Bandwidth of IEEE 802.11ac signal				
Main Frame	Measurement Software	Analysis Bandwidth Extension Option Configuration	20 MHz	40 MHz	80 MHz	160 MHz	80 MHz + 80 MHz
MS2830A	MX269028A-001 (Only for MS2830A)	MS2830A-078 installed	✓	✓	✓*5-2		
		MS2830A-077 installed	✓	✓			
		MS2830A-005/009 installed	✓	✓			
MS269xA	MX269028A-002 (Only for MS269xA)	MS269xA-078 installed	✓	✓	✓	✓	✓*5-1
		MS269xA-077 installed	✓	✓			
		Standard	✓	✓			

*5-1: Measurement required for each carrier signal (80-MHz bandwidth)
*5-2: Measurement is only possible when the carrier signal (80-MHz bandwidth) is input due to the effect of the image response.

See each software catalog for more details.

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Specifications

The specification is the value after 30-minute warm-up at a constant ambient temperature.
The specifications are defined under the following conditions unless otherwise specified.
Auto sweep time select: Normal, Auto sweep type rules: Sweep only, Switching speed mode: Normal mode
The specifications of the Signal Analyzer function are values at the center frequency if not specified.Nominal values indicate expected performance or describe product performance. That is not covered by the product warranty.
Specifications above 26.5 GHz: MS2830A-045 only.

Signal Analyzer/Spectrum Analyzer

Frequency

<table>
<tr><td>Frequency Range</td><td>9 kHz to 26.5 GHz [MS2830A-044], 9 kHz to 43 GHz [MS2830A-045]</td></tr>
<tr><td>Frequency Bands</td><td>
<table>
<tr><th>Frequency Range</th><th>Band</th><th>Mixer Harmonics Order (N)</th></tr>
<tr><td>9 kHz to 4 GHz</td><td>0</td><td>1</td></tr>
<tr><td>3.5 GHz to 4.4 GHz</td><td>1</td><td>1/2</td></tr>
<tr><td>4.3 GHz to 6 GHz</td><td>1</td><td>1</td></tr>
<tr><td>3.9 GHz to 8 GHz</td><td>3</td><td>1</td></tr>
<tr><td>7.9 GHz to 10.575 GHz</td><td>4</td><td>1</td></tr>
<tr><td>10.475 GHz to 12.2 GHz</td><td>5</td><td>2</td></tr>
<tr><td>12.1 GHz to 18.4 GHz</td><td>6</td><td>2</td></tr>
<tr><td>18.3 GHz to 26.6 GHz</td><td>7</td><td>4</td></tr>
<tr><td>26.5 GHz to 41.9 GHz</td><td>8</td><td>4</td></tr>
<tr><td>41.8 GHz to 43 GHz</td><td>9</td><td>8</td></tr>
</table>
</td></tr>
<tr><td>Frequency Setting Range</td><td>–100 MHz to 26.6 GHz [MS2830A-044]
–100 MHz to 43.1 GHz [MS2830A-045]
Setting resolution: 1 Hz</td></tr>
<tr><td>Pre-selector Range</td><td>
<table>
<tr><th>MS2830A-044</th><th>MS2830A-045</th><th></th></tr>
<tr><td>4 GHz to 26.5 GHz</td><td>4 GHz to 43 GHz</td><td>(Frequency band mode: Normal)</td></tr>
<tr><td>3.5 GHz to 26.5 GHz</td><td>3.5 GHz to 43 GHz</td><td>(Frequency band mode: Spurious)</td></tr>
</table>
</td></tr>
<tr><td>Internal Reference Oscillator</td><td>With MS2830A-044/045
23°C, Referenced to frequency at 24-hour after power-on
Start-up characteristics: ±5 × 10^{-7} (2 minutes after power-on), ±5 × 10^{-8} (5 minutes after power-on)
Aging rate: ±1 × 10^{-7}/year
Temperature stability: ±2 × 10^{-8} (5° to 45°C)
With MS2830A-001
23°C, Referenced to frequency at 24-hour after power-on
Start-up characteristics: ±1 × 10^{-9} (7 minutes after power-on)
Aging rate: ±1 × 10^{-10}/month
Temperature stability: ±1 × 10^{-9} (5° to 45°C)</td></tr>
<tr><td>SSB Phase Noise</td><td>18° to 28°C, 500 MHz, Spectrum Analyzer mode, Switching speed mode: Normal
–115 dBc/Hz (100 kHz offset)
–133 dBc/Hz (1 MHz offset)</td></tr>
</table>

Amplitude

Level Measurement Range	Without MS2830A-008/068, or Preamp: Off DANL to +30 dBm With MS2830A-008/068, Preamp: On DANL to +10 dBm
Maximum Input Level	Without MS2830A-008/068, or Preamp: Off Average total power: +30 dBm (Input attenuator: ≥10 dB) DC voltage: ±0 Vdc With MS2830A-008/068, Preamp: On Average total power: +10 dBm (Input attenuator: 0 dB) DC voltage: ±0 Vdc
Input Attenuator Range	With MS2830A-044 0 to 60 dB, 2 dB steps With MS2830A-045 0 to 60 dB, 10 dB steps (ATT mode: Mechanical ATT only, or E-ATT combined mode, Stop frequency: ≥6 GHz) 0 to 10 dB, 10 dB steps/10 to 40 dB, 2 dB steps/40 to 60 dB, 10 dB steps (Attenuator mode: E-ATT combined mode, Stop frequency: <6 GHz)
Input Attenuator Switching Uncertainty	18° to 28°C, Referenced to 10 dB, ATT mode: Mechanical ATT only Without MS2830A-008/068, or Preamp: Off ±0.2 dB (10 to 60 dB) (300 kHz ≤ f < 4 GHz, Frequency band mode: Normal) (300 kHz ≤ f < 3.5 GHz, Frequency band mode: Spurious) ±0.75 dB (10 to 60 dB) (4 GHz ≤ f ≤ 13.8 GHz, Frequency band mode: Normal) (3.5 GHz ≤ f ≤ 13.8 GHz, Frequency band mode: Spurious) ±0.8 dB (10 to 60 dB) (13.8 GHz < f ≤ 26.5 GHz) ±1.0 dB (10 to 60 dB) (26.5 GHz < f ≤ 40 GHz) ±1.0 dB (10 to 60 dB) (typ., 40 GHz < f ≤ 43 GHz)

Reference Level

Setting Range	Log scale: –120 to +50 dBm, or Equivalent level (Signal Analyzer function) –130 to +50 dBm, or Equivalent level (Spectrum Analyzer function) Linear scale: 22.4 µV to 70.7 V, or Equivalent level (Signal Analyzer function) 70.7 nV to 70.7 V, or Equivalent level (Spectrum Analyzer function) Setting resolution: 0.01 dB, or Equivalent level
Scale Units	Log scale: dBm, dBµV, dBmV, dBµV (emf), dBµV/m, V, W Linear scale: V
Linearity Error	Excluding the noise floor effect, Input level: ≤–10 dB (f: <30 MHz) ±0.07 dB (Mixer input level: ≤–20 dBm) ±0.10 dB (Mixer input level: ≤–10 dBm)
RF Frequency Characteristics	18° to 28°C, After Cal, Input attenuator: 10 dB Without MS2830A-008/068, or Preamp: Off Without MS2830A-067, or Microwave Preselector Bypass: Off, After preselector auto tune ±1.0 dB (9 kHz ≤ f < 300 kHz) ±0.35 dB (300 kHz ≤ f < 4 GHz, Frequency band mode: Normal) (300 kHz ≤ f < 3.5 GHz, Frequency band mode: Spurious) ±1.5 dB (4 GHz ≤ f ≤ 6 GHz, Frequency band mode: Normal) (3.5 GHz ≤ f ≤ 6 GHz, Frequency band mode: Spurious) ±1.5 dB (6 GHz < f ≤ 13.8 GHz) ±2.5 dB (13.8 GHz < f ≤ 26.5 GHz) ±2.5 dB (26.5 GHz < f ≤ 40 GHz) ±2.5 dB (typ., 40 GHz < f ≤ 43 GHz) With MS2830A-008, Preamp: On ±0.65 dB (300 kHz ≤ f < 4 GHz, Frequency band mode: Normal) (300 kHz ≤ f < 3.5 GHz, Frequency band mode: Spurious) ±1.8 dB (4 GHz ≤ f ≤ 6 GHz, Frequency band mode: Normal) (3.5 GHz ≤ f ≤ 4 GHz, Frequency band mode: Spurious) With MS2830A-068, or Preamp: On Without MS2830A-067, or Microwave Preselector Bypass: Off, After preselector auto tune ±0.65 dB (300 kHz ≤ f < 4 GHz, Frequency band mode: Normal) (300 kHz ≤ f < 3.5 GHz, Frequency band mode: Spurious) ±1.8 dB (4 GHz ≤ f ≤ 13.8 GHz, Frequency band mode: Normal) (3.5 GHz ≤ f ≤ 13.8 GHz, Frequency band mode: Spurious) ±2.5 dB (13.8 GHz < f ≤ 26.5 GHz) ±3.5 dB (26.5 GHz < f ≤ 40 GHz) ±3.5 dB (nom., 40 GHz < f ≤ 43 GHz)
1 dB Gain Compression	Without MS2830A-008/068, or Preamp: Off, At mixer input level ≥+3 dBm (300 MHz ≤ f ≤ 4 GHz) ≥–1 dBm (4 GHz < f ≤ 13.5 GHz) ≥–1 dBm (13.5 GHz < f ≤ 26.5 GHz) ≥–1 dBm (nom., 26.5 GHz < f ≤ 40 GHz) With MS2830A-068, Preamp: On, At preamp input level ≥–15 dBm (300 MHz ≤ f ≤ 4 GHz) ≥–21 dBm (4 GHz < f ≤ 13.5 GHz) ≥–21 dBm (13.5 GHz < f ≤ 26.5 GHz) ≥–21 dBm (nom., 26.5 GHz < f ≤ 40 GHz)

Spurious Responses

<table>
<tr><td>Second Harmonic Distortion</td><td>
Without MS2830A-008/068, without MS2830A-067
Mixer input level: –30 dBm
<table>
<tr><th>Harmonic Distortion</th><th>SHI</th><th></th></tr>
<tr><td>≤–60 dBc</td><td>≥+30 dBm</td><td>(10 MHz ≤ f ≤ 300 MHz)</td></tr>
<tr><td>≤–65 dBc</td><td>≥+35 dBm</td><td>(300 MHz < f ≤ 1 GHz)</td></tr>
<tr><td>≤–65 dBc</td><td>≥+35 dBm</td><td>(1 GHz < f ≤ 2 GHz, Frequency band mode: Normal)</td></tr>
<tr><td>≤–65 dBc</td><td>≥+35 dBm</td><td>(1 GHz < f < 1.75 GHz, Frequency band mode: Spurious)</td></tr>
</table>
Mixer input level: –10 dBm
<table>
<tr><th>Harmonic Distortion</th><th>SHI</th><th></th></tr>
<tr><td>≤–70 dBc</td><td>≥+60 dBm</td><td>(2 GHz < f ≤ 3 GHz, Frequency band mode: Normal)</td></tr>
<tr><td>≤–70 dBc</td><td>≥+60 dBm</td><td>(1.75 GHz ≤ f ≤ 3 GHz, Frequency band mode: Spurious)</td></tr>
<tr><td>≤–90 dBc</td><td>≥+80 dBm</td><td>(3 GHz < f ≤ 13.25 GHz)</td></tr>
<tr><td>≤–90 dBc</td><td>≥+80 dBm</td><td>(13.25 GHz < f ≤ 21.5 GHz, nom.)</td></tr>
</table>
With MS2830A-068, Preamp: Off, or with MS2830A-067, Microwave Preselector Bypass: Off
Mixer input level: –30 dBm
<table>
<tr><th>Harmonic Distortion</th><th>SHI</th><th></th></tr>
<tr><td>≤–60 dBc</td><td>≥+30 dBm</td><td>(10 MHz ≤ f ≤ 300 MHz)</td></tr>
<tr><td>≤–65 dBc</td><td>≥+35 dBm</td><td>(300 MHz < f ≤ 1 GHz)</td></tr>
<tr><td>≤–65 dBc</td><td>≥+35 dBm</td><td>(1 GHz < f ≤ 2 GHz, Frequency band mode: Normal)</td></tr>
<tr><td>≤–65 dBc</td><td>≥+35 dBm</td><td>(1 GHz < f < 1.75 GHz, Frequency band mode: Spurious)</td></tr>
</table>
Mixer input level: –10 dBm
<table>
<tr><th>Harmonic Distortion</th><th>SHI</th><th></th></tr>
<tr><td>≤–70 dBc</td><td>≥+60 dBm</td><td>(2 GHz < f ≤ 3 GHz, Frequency band mode: Normal)</td></tr>
<tr><td>≤–70 dBc</td><td>≥+60 dBm</td><td>(1.75 GHz ≤ f ≤ 3 GHz, Frequency band mode: Spurious)</td></tr>
<tr><td>≤–70 dBc</td><td>≥+60 dBm</td><td>(2 GHz < f ≤ 3 GHz, Frequency band mode: Spurious)</td></tr>
<tr><td>≤–70 dBc</td><td>≥+60 dBm</td><td>(3 GHz < f ≤ 13.25 GHz)</td></tr>
<tr><td>≤–70 dBc</td><td>≥+60 dBm</td><td>(13.25 GHz < f ≤ 21.5 GHz, nom.)</td></tr>
</table>
With MS2830A-008/068, Preamp: On, with MS2830A-067, Microwave Preselector Bypass: Off
Preamp input level: –45 dBm
<table>
<tr><th>Harmonic Distortion</th><th>SHI</th><th></th></tr>
<tr><td>≤–50 dBc</td><td>≥+5 dBm</td><td>(10 MHz ≤ f ≤ 300 MHz)</td></tr>
<tr><td>≤–55 dBc</td><td>≥+10 dBm</td><td>(300 MHz < f ≤ 2 GHz)</td></tr>
<tr><td>≤–45 dBc</td><td>≥0 dBm</td><td>(2 GHz < f ≤ 13.25 GHz)</td></tr>
<tr><td>≤–40 dBc</td><td>≥–5 dBm</td><td>(13.25 GHz < f < 21.5 GHz, nom.)</td></tr>
</table>
SHI: Second harmonic intercept
</td></tr>
<tr><td>Residual Responses</td><td>Frequency: ≥1 MHz, Input attenuator: 0 dB, 50Ω terminated
With MS2830A-077/078, except bandwidth setting: >31.25 GHz
≤–100 dBm (up to 1 GHz)
≤–90 dBm (typ., 1 GHz to 6 GHz)
≤–90 dBm (nom., 6 GHz to 13.5 GHz)
≤–90 dBm (nom., 13.25 GHz to 26.5 GHz)
≤–80 dBm (nom., 26.5 GHz to 40 GHz)</td></tr>
</table>

Spectrum Analyzer

Frequency

Span	Range: 0 Hz, 300 Hz to 26.5 GHz [MS2830A-044] 0 Hz, 300 Hz to 43 GHz [MS2830A-045] Resolution: 2 Hz Accuracy: ±0.2% (Sweep points: 10001)
Frequency Readout Accuracy	± (Display frequency × Frequency reference accuracy + Span frequency × Span accuracy + RBW × 0.05 + 2 × N + Span frequency/(Sweep points–1)) Hz N: Mixer harmonic order
Resolution Bandwidth (RBW)	Setting range: 1 Hz to 3 MHz (1-3 sequence), 500 Hz, 50 kHz, 2 MHz, 5 MHz, 10 MHz, 20 MHz, 31.25 MHz 1 Hz to 10 Hz: Can not be set when span: 0 Hz 31.25 MHz: Can be set when span: 0 Hz only 20 MHz, 31.25 MHz: Can be set when with MS2830A-005, Can not be set when with MS2830A-009 Selectivity (–60 dB/–3 dB): 4.5:1 (nom., 1 Hz to 10 MHz)
Resolution Bandwidth (CISPR RBW)	With MS2830A-016 Setting range: 200 Hz (6 dB), 9 kHz (6 dB), 120 kHz (6 dB), 1 MHz (Impulse)
Video Bandwidth (VBW)	1 Hz to 3 kHz (1-3 sequence), 5 kHz, 10 kHz to 10 MHz (1-3 sequence), Off VBW mode: Video average, Power average

Amplitude

Displayed Average Noise Level (DANL)	18° to 28°C, Detector: Sample, VBW: 1 Hz (Video average), Input attenuator: 0 dB Without MS2830A-067/068, Frequency band mode: Normal –120 dBm/Hz (9 kHz ≤ f < 100 kHz, nom.) –134 dBm/Hz (100 kHz) –134 dBm/Hz (100 kHz < f < 1 MHz, nom.) –144 dBm/Hz (1 MHz) –144 dBm/Hz (1 MHz < f < 10 MHz, nom.) –150 dBm/Hz (10 MHz ≤ f < 30 MHz, nom.) –153 dBm/Hz (30 MHz ≤ f < 1 GHz) –150 dBm/Hz (1 GHz ≤ f < 2.4 GHz) –147 dBm/Hz (2.4 GHz ≤ f ≤ 3.5 GHz) –144 dBm/Hz (3.5 GHz < f ≤ 4 GHz) –144 dBm/Hz (4 GHz < f ≤ 6 GHz) –151 dBm/Hz (6 GHz < f ≤ 13.5 GHz) –149 dBm/Hz (13.5 GHz < f ≤ 18.3 GHz) –146 dBm/Hz (18.3 GHz < f ≤ 26.5 GHz) –146 dBm/Hz (26.5 GHz < f ≤ 34 GHz) [MS2830A-045] –144 dBm/Hz (34 GHz < f ≤ 40 GHz) [MS2830A-045] –140 dBm/Hz (40 GHz < f ≤ 43 GHz) [MS2830A-045] Without MS2830A-067, with MS2830A-068, Preamp: Off, Frequency band mode: Normal –120 dBm/Hz (9 kHz ≤ f < 100 kHz, nom.) –134 dBm/Hz (100 kHz) –134 dBm/Hz (100 kHz < f < 1 MHz, nom.) –144 dBm/Hz (1 MHz) –144 dBm/Hz (1 MHz < f < 10 MHz, nom.) –150 dBm/Hz (10 MHz ≤ f < 30 MHz, nom.) –153 dBm/Hz (30 MHz ≤ f < 1 GHz) –150 dBm/Hz (1 GHz ≤ f < 2.4 GHz) –147 dBm/Hz (2.4 GHz ≤ f ≤ 3.5 GHz) –144 dBm/Hz (3.5 GHz < f ≤ 4 GHz) –144 dBm/Hz (4 GHz < f ≤ 6 GHz) –147 dBm/Hz (6 GHz < f ≤ 13.5 GHz) –145 dBm/Hz (13.5 GHz < f ≤ 18.3 GHz) –141 dBm/Hz (18.3 GHz < f ≤ 26.5 GHz) –141 dBm/Hz (26.5 GHz < f ≤ 34 GHz) [MS2830A-045] –135 dBm/Hz (34 GHz < f ≤ 40 GHz) [MS2830A-045] –132 dBm/Hz (40 GHz < f ≤ 43 GHz) [MS2830A-045] Without MS2830A-067, or Microwave Preselector Bypass: Off With MS2830A-068, Preamp: On, Frequency band mode: Normal –147 dBm/Hz (100 kHz, nom.) –156 dBm/Hz (1 MHz) –163 dBm/Hz (30 MHz ≤ f < 1 GHz) –161 dBm/Hz (1 GHz ≤ f < 2 GHz) –159 dBm/Hz (2 GHz ≤ f ≤ 3.5 GHz) –155 dBm/Hz (3.5 GHz < f ≤ 4 GHz) –155 dBm/Hz (4 GHz < f ≤ 6 GHz) –160 dBm/Hz (6 GHz < f ≤ 13.5 GHz) –158 dBm/Hz (13.5 GHz < f ≤ 18.3 GHz) –156 dBm/Hz (18.3 GHz < f ≤ 26.5 GHz) –156 dBm/Hz (26.5 GHz < f ≤ 34 GHz) [MS2830A-045] –150 dBm/Hz (34 GHz < f ≤ 40 GHz) [MS2830A-045] –147 dBm/Hz (40 GHz < f ≤ 43 GHz) [MS2830A-045] With MS2830A-067: See Microwave Preselector Bypass (Displayed average noise level)
Total Absolute Amplitude Accuracy* *: Total absolute amplitude accuracy is found from root sum of squares (RSS) of RF frequency characteristics, Linearity error, and Input attenuator switching uncertainty.	18° to 28°C, After Cal, Auto sweep time select: Normal, 30 Hz ≤ RBW ≤ 1 MHz, Detector: Positive, CW, Excluding the noise floor effect, and FFT runtime (Display: On) Without MS2830A-068, or Preamp: Off Input attenuator: ≥10 dB, Input level: ≤–10 dBm (f: <30 MHz), Mixer input level: ≤–10 dBm (f: ≥30 MHz) ±0.5 dB (300 kHz ≤ f < 4 GHz, Frequency band mode: Normal) (300 kHz ≤ f < 3.5 GHz, Frequency band mode: Spurious) ±1.8 dB (4 GHz ≤ f ≤ 6 GHz, Frequency band mode: Normal) (3.5 GHz ≤ f ≤ 4 GHz, Frequency band mode: Spurious) ±1.8 dB (6 GHz < f ≤ 13.8 GHz, Frequency band mode: Normal) (4 GHz < f ≤ 13.8 GHz, Frequency band mode: Spurious) ±3.0 dB (13.8 GHz < f ≤ 26.5 GHz) ±3.0 dB (26.5 GHz < f ≤ 40 GHz) ±3.5 dB (nom., 40 GHz < f ≤ 43 GHz) With MS2830A-068, Preamp: On Input attenuator: 10 dB, Preamp input level: ≤–30 dBm ±1.0 dB (300 kHz ≤ f < 4 GHz, Frequency band mode: Normal) (300 kHz ≤ f < 3.5 GHz, Frequency band mode: Spurious) ±1.8 dB (4 GHz ≤ f ≤ 6 GHz, Frequency band mode: Normal) (3.5 GHz ≤ f ≤ 4 GHz, Frequency band mode: Spurious) ±2.0 dB (6 GHz < f ≤ 13.8 GHz, Frequency band mode: Normal) (4 GHz < f ≤ 13.8 GHz, Frequency band mode: Spurious) ±3.0 dB (13.8 GHz < f ≤ 26.5 GHz) ±4.0 dB (26.5 GHz < f ≤ 40 GHz) ±4.0 dB (nom., 40 GHz < f ≤ 43 GHz)

Spurious Responses

2-tone 3rd-order Intermodulation Distortion	18° to 28°C, ≥300 kHz separation Without MS2830A-068, or Preamp: Off, Mixer input level: –15 dBm (1 wave) ≤–54 dBc, TOI = +12 dBm (30 MHz ≤ f < 300 MHz) ≤–60 dBc, TOI = +15 dBm (300 MHz ≤ f < 3.5 GHz) ≤–58 dBc, TOI = +14 dBm (3.5 GHz ≤ f ≤ 6 GHz, Frequency band mode: Normal) ≤–56 dBc, TOI = +13 dBm (6 GHz < f ≤ 13.5 GHz) ≤–56 dBc, TOI = +13 dBm (13.5 GHz < f ≤ 26.5 GHz) ≤–56 dBc, TOI = +13 dBm (nom., 26.5 GHz < f ≤ 40 GHz) With MS2830A-068, Preamp: On Without MS2830A-067, Microwave Preselector Bypass: Off, Preamp input level: –45 dBm (1 wave) ≤–73 dBc, TOI = –8.5 dBm (30 MHz ≤ f < 300 MHz) ≤–78 dBc, TOI = –6 dBm (300 MHz ≤ f ≤ 700 MHz) ≤–81 dBc, TOI = –4.5 dBm (700 MHz < f < 4 GHz, Frequency band mode: Normal) (700 MHz < f < 3.5 GHz, Frequency band mode: Spurious) ≤–78 dBc, TOI = –6 dBm (4 GHz ≤ f ≤ 6 GHz, Frequency band mode: Normal) (3.5 GHz ≤ f ≤ 4 GHz, Frequency band mode: Spurious) ≤–70 dBc, TOI = –10 dBm (6 GHz < f ≤ 13.5 GHz, Frequency band mode: Normal) (4 GHz < f ≤ 13.5 GHz, Frequency band mode: Spurious) ≤–70 dBc, TOI = –10 dBm (13.5 GHz < f ≤ 26.5 GHz) ≤–70 dBc, TOI = –10 dBm (nom., 26.5 GHz < f ≤ 40 GHz) TOI: Third-order intermodulation distortion
Image Responses	ATT mode: Mechanical-ATT only, Frequency band mode: Normal Without MS2830A-067 ≤–70 dBc (10 MHz ≤ f < 4 GHz) ≤–55 dBc (4 GHz ≤ f ≤ 6 GHz) ≤–70 dBc (6 GHz < f ≤ 13.5 GHz) ≤–70 dBc (13.5 GHz < f ≤ 26.5 GHz) With MS2830A-067: See Microwave Preselector Bypass (Image responses)

Sweep

Sweep Mode	Continuous, Single
Sweep Time	Setting range: 1 ms to 1000 s (Span: ≥300 Hz) 1 µs to 1000 s (Span: 0 Hz)

Waveform Display

<table>
<tr><td>Detector</td><td>Positive & Negative, Positive peak, Sample, Negative peak, RMS</td></tr>
<tr><td>CISPR Detector</td><td>Quasi-Peak, CISPR-AVG, RMS-AVG (with MS2830A-016)</td></tr>
<tr><td>Sweep (Trace) Point</td><td><table>
<tr><td>SPAN</td><td></td></tr>
<tr><td>> 30 GHz</td><td>5001, 10001, 30001</td></tr>
<tr><td>500 MHz < SPAN ≤ 30 GHz</td><td>1001, 2001, 5001, 10001, 30001</td></tr>
<tr><td>100 MHz < SPAN ≤ 500 MHz</td><td>101, 201, 251, 401, 501, 1001, 2001, 5001, 10001, 30001</td></tr>
<tr><td>300 Hz ≤ SPAN ≤ 100 MHz and Sweep Time > 10 s</td><td>101, 201, 251, 401, 501, 1001, 2001, 5001, 10001, 30001</td></tr>
<tr><td>300 Hz ≤ SPAN ≤ 100 MHz and Sweep Time ≤ 10 s</td><td>11, 21, 41, 51, 101, 201, 251, 401, 501, 1001, 2001, 5001, 10001, 30001</td></tr>
<tr><td>0 Hz</td><td>11, 21, 41, 51, 101, 201, 251, 401, 501, 1001, 2001, 5001, 10001, 30001</td></tr>
</table></td></tr>
<tr><td>Scale</td><td>Log scale: 10 div/12 div, 0.1 to 20 dB/div (1-2-5 sequence)
Linear scale: 10 div, 1 to 10%/div (1-2-5 sequence)</td></tr>
<tr><td>Trigger</td><td>Free run (Trigger off), Video, Wide IF video, External, Frame</td></tr>
<tr><td>Gate</td><td>Off, Wide IF video, External, Frame</td></tr>
</table>

Measure Function

Adjust Channel Power (ACP)		Reference: Span total, Carrier total, Both sides of carriers, Carrier select Adjust channel specifications: 3 channels × 2 (Normal mode), 8 channels × 2 (Advanced mode)
Burst Average Power		Displayed average power of specified interval at time domain
Channel Power		Measurement of absolute values: dBm, dBm/Hz
Occupied Bandwidth (OBW)		N% of power, X-dB down
Spectrum Emission Mask (SEM)		Decision to Pass/Fail at Peak/Margin measurement
Spurious Emission		Decision to Pass/Fail at Worst/Peaks measurement
Frequency Counter	Accuracy	Span: ≤1 MHz, RBW: 1 kHz, S/N: ≥50 dB, Gate time: ≥100 ms ± (Marker frequency × Frequency reference accuracy + (0.1 × N / Gate time [s] Hz) N: Mixer harmonic order
	Gate Time Setting	100 µs to 1 s
2-tone 3rd-order Intermodulation Distortion		Measures IM3 and TOI from two-tone signal

Signal Analyzer

Display waveform data, such as Spectrum, Power vs. Time captured at specific time

General

Trace Mode	Spectrum, Power vs. Time, Frequency vs. Time, Phase vs. Time, CCDF, Spectrogram, No trace
Analysis Bandwidth	Sets capture analysis bandwidth from center frequency 1 kHz to 10 MHz (1-2.5-5 sequence) (with MS2830A-006) 1 kHz to 25 MHz (1-2.5-5 sequence), 31.25 MHz (with MS2830A-005, or with MS2830A-009) 1 kHz to 25 MHz (1-2.5-5 sequence), 31.25 MHz, 50 MHz, 62.5 MHz (with MS2830A-077) 1 kHz to 25 MHz (1-2.5-5 sequence), 31.25 MHz, 50 MHz, 62.5 MHz, 100 MHz, 125 MHz (with MS2830A-078) *MS2830A-005 is not available when MS2830A-045 is installed.
Sampling Rate	Auto setting by conditions of analysis bandwidth 2 kHz to 20 MHz (1-2-5 sequence) (with MS2830A-006) 2 kHz to 50 MHz (1-2-5 sequence) (with MS2830A-005, or with MS2830A-009) 2 kHz to 100 MHz (1-2-5 sequence) (with MS2830A-077) 2 kHz to 200 MHz (1-2-5 sequence) (with MS2830A-078)
Capture Time	Without MS2830A-077/078, or ≤31.25 MHz bandwidth Setting capture time length Minimum capture time length: 2 µs to 50 ms (Determined according to analysis bandwidth) Maximum capture time length: 2 s to 2000 s (Determined according to analysis bandwidth) Setting mode: Auto, Manual With MS2830A-077, >31.25 MHz bandwidth Setting capture time length Minimum capture time length: 1 µs Maximum capture time length: 500 ms Setting mode: Auto, Manual With MS2830A-078, >31.25 MHz bandwidth Setting capture time length Minimum capture time length: 500 ns to 1 µs (Determined according to analysis bandwidth) Maximum capture time length: 500 ms Setting mode: Auto, Manual
Trigger	Free run (Trigger off), Video, Wide IF video, Frame, External
ADC Resolution	Without MS2830A-077/078, or ≤31.25 MHz bandwidth 16 bits

Spectrum Displayed Function

Function Outline	Displayed spectrum of any time length and frequency range within captured waveform data
Analysis Time Length	Analysis start time: Sets analysis start time point from waveform data header Analysis time length: Sets analysis time length Setting mode: Auto, Manual
Frequency	Can be set center frequency and span at frequency range in waveform data
Frequency Setting	Without MS2830A-077/078, or ≤31.25 MHz bandwidth 0 MHz to 26.5 GHz [MS2830A-044] 0 MHz to 43 GHz [MS2830A-045] With MS2830A-077/078, without MS2830A-067, >31.25 MHz bandwidth 300 MHz to 6 GHz [MS2830A-044] 300 MHz to 6 GHz [MS2830A-045] With MS2830A-077/078, MS2830A-067, >31.25 MHz bandwidth 300 MHz to 26.5 GHz [MS2830A-044] 300 MHz to 43 GHz [MS2830A-045]
Resolution Bandwidth (RBW)	Without MS2830A-077/078, or ≤31.25 MHz bandwidth Setting range: 1 Hz to 1 MHz (1-3 sequence) Selectivity (–60 dB/–3 dB): 4.5:1 (nom.) With MS2830A-077, >31.25 MHz bandwidth Setting range: 3 kHz to 3 MHz (1-3 sequence) Selectivity (–60 dB/–3 dB): 4.5:1 (nom.) With MS2830A-078, >31.25 MHz bandwidth Setting range: 3 kHz to 10 MHz (1-3 sequence) Selectivity (–60 dB/–3 dB): 4.5:1 (nom.)

Continued on next page

Total Absolute Amplitude Accuracy* *: Total absolute amplitude accuracy is found from root sum of squares (RSS) of RF frequency characteristics, Linearity error, and Input attenuator switching uncertainty.	18° to 28°C, After Cal, Input attenuator: ≥10 dB, RBW: Auto, Time detection: Average, Marker result: Integration or Peak (Accuracy), Center frequency, CW, Excluding the noise floor effect Without MS2830A-068, or Preamp: Off Input attenuator: ≥10 dB, Input level: ≤–10 dBm (f: <30 MHz), Mixer input level: ≤–10 dBm (f: ≥30 MHz) ±0.5 dB (300 kHz ≤ f < 4 GHz, Frequency band mode: Normal) (300 kHz ≤ f < 3.5 GHz, Frequency band mode: Spurious) ±1.8 dB (4 GHz ≤ f ≤ 6 GHz, Frequency band mode: Normal) (3.5 GHz ≤ f ≤ 4 GHz, Frequency band mode: Spurious) ±1.8 dB (6 GHz < f ≤ 13.8 GHz, Frequency band mode: Normal) (4 GHz < f ≤ 13.8 GHz, Frequency band mode: Spurious) ±3.0 dB (13.8 GHz < f ≤ 26.5 GHz) ±3.0 dB (26.5 GHz < f ≤ 40 GHz) ±3.5 dB (nom., 40 GHz < f ≤ 43 GHz) With MS2830A-068, Preamp: On Input attenuator: 10 dB, Preamp Input level: ≤–30 dBm ±1.0 dB (300 kHz ≤ f < 4 GHz, Frequency band mode: Normal) (300 kHz ≤ f < 3.5 GHz, Frequency band mode: Spurious) ±1.8 dB (4 GHz ≤ f ≤ 6 GHz, Frequency band mode: Normal) (3.5 GHz ≤ f ≤ 4 GHz, Frequency band mode: Spurious) ±2.0 dB (6 GHz < f ≤ 13.8 GHz, Frequency band mode: Normal) (4 GHz < f ≤ 13.8 GHz, Frequency band mode: Spurious) ±3.0 dB (13.8 GHz < f ≤ 26.5 GHz) ±4.0 dB (26.5 GHz < f ≤ 40 GHz) ±4.0 dB (nom., 40 GHz < f ≤ 43 GHz)
In-band Frequency Characteristics	18° to 28°C, Referenced to level at center frequency, Center frequency: ±10 MHz Without MS2830A-077/078, or ≤31.25 MHz bandwidth ±0.31 dB (30 MHz ≤ f ≤ 4 GHz, Frequency band mode: Normal) (30 MHz ≤ f < 3.5 GHz, Frequency band mode: Spurious)
Displayed Average Noise Level (DANL)	18° to 28°C, Time Detection: Average, Input attenuator: 0 dB Without MS2830A-067/068, Frequency band mode: Normal –131.5 dBm/Hz (100 kHz) –141.5 dBm/Hz (1 MHz) –150.5 dBm/Hz (30 MHz ≤ f < 1 GHz) –147.5 dBm/Hz (1 GHz ≤ f < 2.4 GHz) –144.5 dBm/Hz (2.4 GHz ≤ f ≤ 3.5 GHz) –141.5 dBm/Hz (3.5 GHz < f ≤ 4 GHz) –141.5 dBm/Hz (4 GHz < f ≤ 6 GHz) –148.5 dBm/Hz (6 GHz ≤ f ≤ 13.5 GHz) –146.5 dBm/Hz (13.5 GHz < f ≤ 18.3 GHz) –143.5 dBm/Hz (18.3 GHz < f ≤ 26.5 GHz) –143.5 dBm/Hz (26.5 GHz < f ≤ 34 GHz) –141.5 dBm/Hz (34 GHz < f ≤ 40 GHz) –137.5 dBm/Hz (40 GHz < f ≤ 43 GHz) Without MS2830A-067, with MS2830A-068, Preamp: Off, Frequency band mode: Normal –131.5 dBm/Hz (100 kHz) –141.5 dBm/Hz (1 MHz) –150.5 dBm/Hz (30 MHz ≤ f < 1 GHz) –147.5 dBm/Hz (1 GHz ≤ f < 2.4 GHz) –144.5 dBm/Hz (2.4 GHz ≤ f ≤ 3.5 GHz) –141.5 dBm/Hz (3.5 GHz < f ≤ 4 GHz) –141.5 dBm/Hz (4 GHz < f ≤ 6 GHz) –144.5 dBm/Hz (6 GHz < f ≤ 13.5 GHz) –142.5 dBm/Hz (13.5 GHz < f ≤ 18.3 GHz) –138.5 dBm/Hz (18.3 GHz < f ≤ 26.5 GHz) –138.5 dBm/Hz (26.5 GHz < f ≤ 34 GHz) –132.5 dBm/Hz (34 GHz < f ≤ 40 GHz) –129.5 dBm/Hz (40 GHz < f ≤ 43 GHz) Without MS2830A-067, with MS2830A-068, Preamp: On, Frequency band mode: Normal –144.5 dBm/Hz (nom., 100 kHz) –153.5 dBm/Hz (1 MHz) –160.5 dBm/Hz (30 MHz ≤ f < 1 GHz) –158.5 dBm/Hz (1 GHz ≤ f < 2 GHz) –156.5 dBm/Hz (2 GHz ≤ f ≤ 3.5 GHz) –152.5 dBm/Hz (3.5 GHz < f ≤ 4 GHz) –152.5 dBm/Hz (4 GHz < f ≤ 6 GHz) –157.5 dBm/Hz (6 GHz < f ≤ 13.5 GHz) –155.5 dBm/Hz (13.5 GHz < f ≤ 18.3 GHz) –153.5 dBm/Hz (18.3 GHz < f ≤ 26.5 GHz) –153.5 dBm/Hz (26.5 GHz < f ≤ 34 GHz) –147.5 dBm/Hz (34 GHz < f ≤ 40 GHz) –144.5 dBm/Hz (40 GHz < f ≤ 43 GHz) With MS2830A-067: See Microwave Preselector Bypass (Displayed average noise level) With MS2830A-077/078: See Analysis Bandwidth Extension MS2830A-077/078 (Displayed average noise level)
Adjacent Channel Power (ACP)	Reference: Span total, Carrier total, Both sides of carriers, Carrier select Adjacent channel specifications: 3 channels × 2
Channel Power	Measurement of absolute values: dBm, dBm/Hz
Occupied Bandwidth (OBW)	N% of power, X-dB down

Power vs. Time Displayed Function

Function Outline	Displayed time changes of power for captured waveform data
Analysis Time Range	Analysis start time: Sets analysis start time position from beginning of waveform data Analysis time length: Sets analysis time length Setting mode: Auto, Manual
Resolution Bandwidth	Filter type: Rect, Gaussian, Nyquist, Root nyquist, Off, (Default: Off) Roll-off ratio: 0.01 to 1 (Set for Nyquist, Root nyquist) Filter frequency offset: Set center frequency of filter in wavelength data frequency band
AM Depth (Peak to Peak Measurement)	Measures with AM depth or marker function +Peak, –Peak, (P-P)/2, Average
Burst Average Power	Measures average power of burst signal

Frequency vs. Time Displayed Function

Function Outline	Displayed frequency time fluctuations of input signal from captured waveform data
Analysis Time Range	Analysis start time: Sets analysis start time point from waveform data header Analysis time length: Sets analysis time length Setting mode: Auto, Manual
Operating Level Range	–17 to +30 dBm (Input attenuator: ≥10 dB)
Frequency (Vertical Axis)	Can be set center frequency and span at frequency range in waveform data Displayed frequency range: Selectable 1/25, 1/10, 1/5, 1/2 of analysis bandwidth Input frequency range: 10 MHz to 6 GHz
Frequency Readout Accuracy	Input level: –17 to +30 dBm, Span: ≤31.25 MHz, Scale: Span/25, CW input ± (Reference oscillator accuracy × Center frequency + Displayed frequency range × 0.01) Hz
FM Deviation (Peak to Peak Measurement)	Measures FM deviation or marker function +Peak, –Peak, (P-P)/2, Average
FMCW Measurement	Display items: FM Error Peak, FM Error RMS, Chirp Deviation, Chirp Rate, Chirp Length The measurement range can be set by automatic detection or marker.

Phase vs. Time Displayed Function

Function Outline	Displayed phase time fluctuation of input signal from captured waveform data
Analysis Time Range	Analysis start time: Sets analysis start time point from waveform data header Analysis time length: Sets analysis time length Setting mode: Auto, Manual
Phase (Vertical Axis)	Display mode: Wrap, Unwrap Displayed phase range: 0.01 deg./div to 200 Gdeg./div Offset: –100 deg. to +100 Mdeg.

CCDF/APD Displayed Function

Function Outline	Displayed CCDF and APD of waveform date within a given length of time
Analysis Time Range	Analysis start time: Sets analysis start time point from waveform data header Analysis time length: Sets analysis time length Setting mode: Auto, Manual
Display	Displayed CCDF or APD as graphs Histogram resolution: 0.01 dB Value: Average power, Max. power, Crest factor
Resolution Bandwidth	Filter type: Rectangle, Off, (Default: Off) Filter frequency offset: Sets filter center frequency in frequency band of waveform data

Spectrogram Displayed Function

Function Outline	Displayed spectrogram for arbitrary time length in captured waveform data
Analysis Time Range	Analysis start time: Sets analysis start time point from waveform data header Analysis time length: Sets analysis time length Setting mode: Auto, Manual
Frequency	Can be set center frequency and span at frequency range in waveform data
Resolution Bandwidth (RBW)	Setting range: 1 Hz to 1 MHz (1-3 sequence) Selectivity (–60 dB/–3 dB): 4.5:1 (nom.)

Digitize Function

Function Outline	Captured waveform data saved to internal HDD or output to external devices
Waveform Data	Format: I, Q (each 32 bit, Float binary type) Level: 0 dBm input is $\sqrt{(I^2 + Q^2)} = 1$ Level accuracy: Same as signal analyzer absolute amplitude accuracy
External Output	Can be output to external PC via Ethernet

Replay Function

<table>
<tr><td>Function Outline</td><td>Captured waveforms can be replayed again by using the VSA function to read saved digitize data</td></tr>
<tr><td>Conditions for Measurable Waveform Data</td><td>Format: I, Q (binary format)
Combination of span, sampling rate, and Minimum capture sample
<table>
<tr><th>Span</th><th>Sampling Rate</th><th>Minimum Capture Sample</th></tr>
<tr><td>1 kHz</td><td>2 kHz</td><td>74000 (37 s)</td></tr>
<tr><td>2.5 kHz</td><td>5 kHz</td><td>160000 (32 s)</td></tr>
<tr><td>5 kHz</td><td>10 kHz</td><td>310000 (31 s)</td></tr>
<tr><td>10 kHz</td><td>20 kHz</td><td>610000 (30.5 s)</td></tr>
<tr><td>25 kHz</td><td>50 kHz</td><td>730000 (14.6 s)</td></tr>
<tr><td>50 kHz</td><td>100 kHz</td><td>730000 (7.3 s)</td></tr>
<tr><td>100 kHz</td><td>200 kHz</td><td>730000 (3.65 s)</td></tr>
<tr><td>250 kHz</td><td>500 kHz</td><td>730000 (1.46 s)</td></tr>
<tr><td>500 kHz</td><td>1 MHz</td><td>730000 (730 ms)</td></tr>
<tr><td>1 MHz</td><td>2 MHz</td><td>730000 (365 ms)</td></tr>
<tr><td>2.5 MHz</td><td>5 MHz</td><td>730000 (146 ms)</td></tr>
<tr><td>5 MHz</td><td>10 MHz</td><td>730000 (73 ms)</td></tr>
<tr><td>10 MHz</td><td>20 MHz</td><td>730000 (36.5 ms)</td></tr>
<tr><td>18.6 MHz</td><td>20 MHz</td><td>730000 (36.5 ms)</td></tr>
<tr><td>20 MHz</td><td>25 MHz</td><td>730000 (29.2 ms)</td></tr>
<tr><td>25 MHz</td><td>50 MHz</td><td>730000 (14.6 ms)</td></tr>
<tr><td>31.25 MHz</td><td>50 MHz</td><td>730000 (14.6 ms)</td></tr>
<tr><td>50 MHz</td><td>100 MHz</td><td>730000 (7.3 ms)</td></tr>
<tr><td>62.5 MHz</td><td>100 MHz</td><td>730000 (7.3 ms)</td></tr>
<tr><td>100 MHz</td><td>200 MHz</td><td>730000 (3.65 ms)</td></tr>
<tr><td>125 MHz</td><td>200 MHz</td><td>730000 (3.65 ms)</td></tr>
</table>
</td></tr>
</table>

Connector

RF Input	18° to 28°C, Input attenuator: ≥10 dB With MS2830A-044 Connector: N-J (Front panel), 50Ω (nom.) VSWR: ≤1.2 (nom., 40 MHz ≤ f ≤ 3 GHz) ≤1.5 (nom., 3 GHz < f ≤ 6 GHz) ≤1.6 (nom., 6 GHz < f ≤ 13.5 GHz) ≤1.9 (nom., 13.5 GHz < f ≤ 26.5 GHz) With MS2830A-045 Connector: K-J (Front panel), 50Ω (nom.) VSWR: ≤1.2 (nom., 40 MHz ≤ f ≤ 3 GHz) ≤1.3 (nom., 3 GHz < f ≤ 6 GHz) ≤1.3 (nom., 6 GHz < f ≤ 13.5 GHz) ≤1.4 (nom., 13.5 GHz < f ≤ 26.5 GHz) ≤1.6 (nom., 26.5 GHz < f ≤ 40 GHz) ≤1.6 (Reference data, 40 GHz < f ≤ 43 GHz, V-K converter mounted and included)
External Reference Input	Connector: BNC-J (Rear panel), 50Ω (nom.) Frequency: 5, 10, 13 MHz Operating range: ±1 ppm Input level: –15 to +20 dBm, 50Ω (AC coupling)
Reference Signal Output	Connector: BNC-J (Rear panel), 50Ω (nom.) Frequency: 10 MHz Output level: ≥0 dBm (AC coupling)
Sweep Status Output	Connector: BNC-J (Rear panel) Output level: TTL level (High level at sweeping or waveform capture)
SA Trigger Input	Connector: BNC-J (Rear panel) Output level: TTL level
Noise Source Drive	This is available when the MS2830A-017/117 is installed. Supply (+28 V) of the noise source drive. Rear panel, BNC-J Output voltage: 28 ±0.5 V, Pulsed
External Controller	Control from external controller (excluding power-on/off)
Ethernet (10/100/1000BASE-T)	Connector: RJ-45 (Rear panel)
GPIB	IEEE 488 bus connector (IEEE 488.2, Rear panel) Interface function: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0, E2
USB (B)	USB-B connector (USB2.0, Rear panel)
USB	USB-A connector (USB2.0, Front panel: 2 ports, Rear panel: 2 ports)
Monitor Output	Mini D-Sub 15 pin (Compatible with VGA, Rear panel)
AUX	50-pin (Correspond to DX10A-50S, Rear panel), Using extended input/output
IF Output*	Connector: SMA-J (Rear panel), 50Ω (nom.) Frequency: 1.875 GHz Gain: –10 dB (nom., Input attenuator: 0 dB, Input frequency: 10 GHz)
1st Local Output*	Connector: SMA-J (Front panel), 50Ω (nom.) Frequency: 5 GHz to 10 GHz (Local signal output), 1.875 GHz (IF frequency) Gain: –10 dB (nom., Input attenuator: 0 dB, Input frequency: 10 GHz)

*: With MS2830A-044/045 only

Display

Display	XGA-color LCD (Resolution: 1024 × 768), 8.4 inches (Diagonal: 213 mm)

General

Dimensions and Mass		426 (W) × 177 (H) × 390 (D) mm (excluding projections) ≤15 kg (excluding other options)
Power Supply		Power voltage: 100 V(ac) to 120 V(ac)/200 V(ac) to 240 V(ac) Frequency: 50 Hz/60 Hz Power consumption: 190 VA (nom., excluding other options)
Temperature Range		Operating: +5° to +45°C, Storage: –20° to +60°C
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, EN50581

External Mixer Function (26.5 GHz to 325 GHz)

<table>
<tr>
<td>External Mixer*</td>
<td>
Frequency
Frequency range: 26.5 GHz to 325 GHz
Frequency bands:
<table>
<tr><th>Model</th><th>Band</th><th>Frequency Range</th><th>Mixer Harmonics Order (N)</th></tr>
<tr><td>MA2741C</td><td>A</td><td>26.5 GHz to 40 GHz</td><td>4+</td></tr>
<tr><td>MA2742C</td><td>Q</td><td>33 GHz to 50 GHz</td><td>5+</td></tr>
<tr><td>MA2743C</td><td>U</td><td>40 GHz to 60 GHz</td><td>6+</td></tr>
<tr><td>MA2744C</td><td>V</td><td>50 GHz to 75 GHz</td><td>8+</td></tr>
<tr><td>MA2745C</td><td>E</td><td>60 GHz to 90 GHz</td><td>9+</td></tr>
<tr><td>MA2746C</td><td>W</td><td>75 GHz to 110 GHz</td><td>11+</td></tr>
<tr><td>MA2747C</td><td>F</td><td>90 GHz to 140 GHz</td><td>14+</td></tr>
<tr><td>MA2748C</td><td>D</td><td>110 GHz to 170 GHz</td><td>17+</td></tr>
<tr><td>MA2749C</td><td>G</td><td>140 GHz to 220 GHz</td><td>22+</td></tr>
<tr><td>MA2750C</td><td>Y</td><td>170 GHz to 260 GHz</td><td>26+</td></tr>
<tr><td>MA2751C</td><td>J</td><td>220 GHz to 325 GHz</td><td>33+</td></tr>
</table>
Amplitude
Mixer conversion loss
Setting range: 0 to 99.9 dB
Maximum input level, Average noise level, Frequency response: Depends on external mixer
Input/Output
Applicable mixer: 2-port mixer only
Local frequency: 5 GHz to 10 GHz
IF frequency: 1.875 GHz
</td>
</tr>
</table>

*: With MS2830A-044/045 only

Rubidium Reference Oscillator MS2830A-001

Generates 10 MHz reference signal with higher frequency stability.

Frequency

Internal Reference Oscillator	See Signal Analyzer/Spectrum Analyzer (Internal reference oscillator)

Analysis Bandwidth 10 MHz MS2830A-006

This option adds a function to analyze 10 MHz bandwidth.

Analysis Bandwidth Extension to 31.25 MHz MS2830A-005

This option adds a function to analyze 31.25 MHz bandwidth. (Requires MS2830A-006)
MS2830A-005 is not available when MS2830A-045 is installed.

Bandwidth Extension to 31.25 MHz for Millimeter-wave MS2830A-009

This option adds a function to analyze 31.25 MHz bandwidth (Requires MS2830A-006).
MS2830A-009 is available when MS2830A-045 is installed.
Cannot be set the RBW to more than 10 MHz in Spectrum Analyzer function.

Preamplifier MS2830A-008

This option amplifies signal prior to mixer to enhance sensitivity.
Cannot install simultaneously with MS2830A-068.

Frequency

Frequency Range	100 kHz to 6 GHz

Amplitude

Level Measurement Range	See Signal Analyzer/Spectrum Analyzer (Level measurement range)
Maximum Input Level	See Signal Analyzer/Spectrum Analyzer (Maximum input level)
Displayed Average Noise Level (DANL)	See Spectrum Analyzer, Signal Analyzer (Displayed average noise level (DANL))
RF Frequency Characteristics	See Signal Analyzer/Spectrum Analyzer (RF frequency characteristics)
Input Attenuator Switching Uncertainty	See Signal Analyzer/Spectrum Analyzer (Input attenuator switching uncertainty)
Linearity Error	See Signal Analyzer/Spectrum Analyzer (Linearity error)
Second Harmonic Distortion	See Signal Analyzer/Spectrum Analyzer (Second harmonic distortion)
1 dB Gain Compression	See Signal Analyzer/Spectrum Analyzer (1 dB gain compression)
2-tone 3rd-order Intermodulation Distortion	See Spectrum Analyzer (2-tone 3rd-order intermodulation distortion)

Phase Noise Measurement Function MS2830A-010

Displays the phase noise characteristics on a logarithmic scale

Frequency

Frequency Range	10 MHz to Upper frequency limit
Offset Frequency Range	10 Hz to 10 MHz
Marker Mode	Normal, Integral noise, RMS noise, Jitter, Residual FM

2ndary HDD MS2830A-011

This option adds a Removable HDD for storing user data.

Precompliance EMI Function MS2830A-016

Adds the detection mode and the resolution bandwidth for EMI measurement to the Spectrum Analyzer function.

Resolution Bandwidth (RBW)	Setting range: 200 Hz (6 dB), 9 kHz (6 dB), 120 kHz (6 dB), 1 MHz (Impulse)
Detector	Quasi-Peak, CISPR-AVG, RMS-AVG

Noise Figure Measurement Function MS2830A-017*[1]

Frequency

Frequency Range	MS2830A-044: 30 MHz to 26.5 GHz MS2830A-045: 30 MHz to 40 GHz
Frequency Setting Range	MS2830A-044: 10 MHz to 26.5 GHz MS2830A-045: 10 MHz to 43 GHz

NF Measurement
Within the measurement range,
Attenuator = 0 dB*[2]

Measurement Range	–20 to +40 dB
Instrument Uncertainty	ENR: 4 to 7 dB ±0.02 dB ENR: 12 to 17 dB ±0.025 dB ENR: 20 to 22 dB ±0.03 dB

Gain Measurement

Measurement Range	Within the frequency range –20 to +40 dB
Instrument Uncertainty	Within the measurement range ≤0.07

Resolution Bandwidth

Setting Range	100 kHz to 8 MHz

Connector

Noise Source	Connector: Rear panel, BNC-J Output voltage: 28 ±0.5 V, Pulsed

*1: Recommending the NC346 series noise sources by Noisecom company
*2: Recommend to use Pre Amp

BER Measurement Function MS2830A-026

Connector	AUX connector (Rear panel)* *: Can convert to BNC by connecting AUX Conversion Adapter (J1556A).
Input Level	TTL level
Input Signal	Data, Clock, Enable
Input Bit Rate	100 bps to 10 Mbps
Measured Patterns	PN9, PN11, PN15, PN20, PN23, ALL0, ALL1, Alternate (0101 ...) PN9Fix, PN11Fix, PN15Fix, PN20Fix, PN23Fix, User define (4096 bits max.)
Synchronization Establishing Condition	PN signal: PN stage × 2 bit error free At PNFix signal: PN stage × 2 bit error free, PN signal and sync establishment, establish sync with PNFix signal at PN stage error free from PNFix signal header bit ALL0, ALL1, Alternate (0101 ...): 10 bit error free User define: 8 to 1024 bits (variable) error free Select header bit used at sync detection
Re-synchronization Judgment Condition	x/y (Resynchronization at detection of x-bit error in y bits) y ... Measured bit count: Select from 500 bits, 5000 bits, 50000 bits x ... Number of error bits in y bits: Setting range 1 to y/2
Measured Bit Count	$\leq 2^{32} - 1$ bits
Measured Error Bit Count	$\leq 2^{31} - 1$ bits
Measurement End Conditions	Measured bit count, Measured error bit count
Auto Re-synchronization Function	Can be toggled on and off
Operation at Resync.	Select from Count clear, and Count keep
Measurement Mode	Single, Endless, Continuous
Display	Status, Error, Error rate, Error count, SyncLoss count, Measured bit count
Polarity Inversion Function	Supports polarity reversal for Data, Clock, Enable
Clear Measurement Function	At BER measurement, hold sync status, clears measured value and measures from 0

Microwave Preamplifier MS2830A-068

This option amplifies signal prior to mixer to enhance sensitivity.
Cannot install simultaneously with MS2830A-008.
When MS2830A-168 is added to MS2830A (with MS2830A-008), only MS2830A-168 becomes available.

Frequency

Frequency Range	100 kHz to 26.5 GHz [MS2830A-044] 100 kHz to 43 GHz [MS2830A-045]

Amplitude

Level Measurement Range	See Signal Analyzer/Spectrum Analyzer (Level measurement range)
Maximum Input Level	See Signal Analyzer/Spectrum Analyzer (Maximum input level)
Displayed Average Noise Level (DANL)	See Spectrum Analyzer, Signal Analyzer (Displayed average noise level (DANL))
RF Frequency Characteristics	See Signal Analyzer/Spectrum Analyzer (RF frequency characteristics)
Input Attenuator Switching Uncertainty	See Signal Analyzer/Spectrum Analyzer (Input attenuator switching uncertainty)
Linearity Error	See Signal Analyzer/Spectrum Analyzer (Linearity error)
Second Harmonic Distortion	See Signal Analyzer/Spectrum Analyzer (Second harmonic distortion)
1 dB Gain Compression	See Signal Analyzer/Spectrum Analyzer (1 dB gain compression)
2-tone 3rd-order Intermodulation Distortion	See Spectrum Analyzer (2-tone 3rd-order intermodulation distortion)

Microwave Preselector Bypass MS2830A-067

Bypasses the preselector to improve the RF frequency characteristics and the in-band frequency characteristics.
Add MS2830A-067 when using the signal analyzer measurement functions at bandwidth: >31.25 MHz and frequency: >6 GHz.
When the preselector option is set to On, the image response elimination filter is bypassed.
Therefore, this function is not appropriate for spurious measurement to receive the image response.
Microwave Preselector Bypass: On (with MS2830A-067), Microwave Preselector Bypass: Off (with special directions)

Frequency

Frequency Range	4 GHz to 26.5 GHz [MS2830A-044] 4 GHz to 43 GHz [MS2830A-045]

Amplitude

Frequency Characteristics	18° to 28°C, After Cal, Input attenuator: 10 dB, Microwave Preselector Bypass: On Without MS2830A-068, Preamp: Off ±1.0 dB (6 GHz ≤ f ≤ 13.8 GHz, Frequency band mode: Normal) (4 GHz ≤ f ≤ 13.8 GHz, Frequency band mode: Spurious) ±1.5 dB (13.8 GHz < f ≤ 26.5 GHz) ±2.0 dB (26.5 GHz < f ≤ 40 GHz) ±2.0 dB (typ., 40 GHz < f ≤ 43 GHz) With MS2830A-068, Preamp: On ±1.8 dB (6 GHz ≤ f ≤ 13.8 GHz, Frequency band mode: Normal) (4 GHz ≤ f ≤ 13.8 GHz, Frequency band mode: Spurious) ±2.5 dB (13.8 GHz < f ≤ 26.5 GHz) ±3.0 dB (26.5 GHz < f ≤ 40 GHz) ±3.0 dB (nom., 40 GHz < f ≤ 43 GHz) * With MS2830A-067, Microwave Preselector Bypass: Off, see Signal Analyzer/Spectrum Analyzer (RF frequency characteristics)
Displayed Average Noise Level (DANL)	18° to 28°C, Detector: Sample, VBW: 1 Hz (Video average), Input attenuator: 0 dB, Frequency band mode: Normal Without MS2830A-068, Microwave Preselector Bypass: On, Off –120 dBm/Hz (9 kHz ≤ f < 100 kHz, nom.) –134 dBm/Hz (100 kHz) –134 dBm/Hz (100 kHz < f < 1 MHz, nom.) –144 dBm/Hz (1 MHz) –144 dBm/Hz (1 MHz < f < 10 MHz, nom.) –150 dBm/Hz (10 MHz ≤ f < 30 MHz, nom.) –153 dBm/Hz (30 MHz ≤ f < 1 GHz) –150 dBm/Hz (1 GHz ≤ f < 2.4 GHz) –147 dBm/Hz (2.4 GHz ≤ f ≤ 3.5 GHz) –144 dBm/Hz (3.5 GHz < f ≤ 4 GHz) –144 dBm/Hz (4 GHz < f ≤ 6 GHz) –147 dBm/Hz (6 GHz < f ≤ 13.5 GHz) –145 dBm/Hz (13.5 GHz < f ≤ 18.3 GHz) –141 dBm/Hz (18.3 GHz < f ≤ 26.5 GHz) –141 dBm/Hz (26.5 GHz < f ≤ 34 GHz) –135 dBm/Hz (34 GHz < f ≤ 40 GHz) –132 dBm/Hz (40 GHz < f ≤ 43 GHz) With MS2830A-068, Preamp: Off, Microwave Preselector Bypass: On, Off –120 dBm/Hz (9 kHz ≤ f < 100 kHz, nom.) –134 dBm/Hz (100 kHz) –134 dBm/Hz (100 kHz < f < 1 MHz, nom.) –144 dBm/Hz (1 MHz) –144 dBm/Hz (1 MHz < f < 10 MHz, nom.) –150 dBm/Hz (10 MHz ≤ f < 30 MHz, nom.) –153 dBm/Hz (30 MHz ≤ f < 1 GHz) –150 dBm/Hz (1 GHz ≤ f < 2.4 GHz) –147 dBm/Hz (2.4 GHz ≤ f ≤ 3.5 GHz) –144 dBm/Hz (3.5 GHz < f ≤ 4 GHz) –144 dBm/Hz (4 GHz < f ≤ 6 GHz) –142 dBm/Hz (6 GHz < f ≤ 13.5 GHz) –140 dBm/Hz (13.5 GHz < f ≤ 18.3 GHz) –136 dBm/Hz (18.3 GHz < f ≤ 26.5 GHz) –136 dBm/Hz (26.5 GHz < f ≤ 34 GHz) –131 dBm/Hz (34 GHz < f ≤ 40 GHz) –128 dBm/Hz (40 GHz < f ≤ 43 GHz) With MS2830A-068, Preamp: On, Microwave Preselector Bypass: On –147 dBm/Hz (100 kHz, nom.) –156 dBm/Hz (1 MHz) –163 dBm/Hz (30 MHz ≤ f < 1 GHz) –161 dBm/Hz (1 GHz ≤ f < 2 GHz) –159 dBm/Hz (2 GHz ≤ f ≤ 3.5 GHz) –155 dBm/Hz (3.5 GHz < f ≤ 4 GHz) –155 dBm/Hz (4 GHz < f ≤ 6 GHz) –154 dBm/Hz (6 GHz < f ≤ 13.5 GHz) –152 dBm/Hz (13.5 GHz < f ≤ 18.3 GHz) –150 dBm/Hz (18.3 GHz < f ≤ 26.5 GHz) –150 dBm/Hz (26.5 GHz < f ≤ 34 GHz) –144 dBm/Hz (34 GHz < f ≤ 40 GHz) –141 dBm/Hz (40 GHz < f ≤ 43 GHz)
Image Responses	With MS2830A-067, Microwave Preselector Bypass: Off ≤–60 dBc (6 GHz < f ≤ 13.5 GHz) ≤–60 dBc (13.5 GHz < f ≤ 26.5 GHz) With MS2830A-067, Microwave Preselector Bypass: On Generated at the frequency at the distance of 1.875 GHz × 2 0 dBc (nom., 4 GHz ≤ f ≤ 26.5 GHz) 0 dBc (nom., 26.5 GHz < f ≤ 43 GHz)

Analysis Bandwidth Extension to 62.5 MHz MS2830A-077

This option adds a function to analyze 62.5 MHz bandwidth.

MS2830A-044: Requires MS2830A-006 and MS2830A-005
MS2830A-045: Requires MS2830A-006 and MS2830A-009

Analysis Bandwidth Extension to 125 MHz MS2830A-078

This option adds a function to analyze 125 MHz bandwidth.

MS2830A-044: Requires MS2830A-006, MS2830A-005 and MS2830A-077
MS2830A-045: Requires MS2830A-006 MS2830A-009 and MS2830A-077

An image response is received when setting the bandwidth to more than 31.25 MHz.
This can be used when not inputting a signal frequency outside the MS2830A analysis bandwidth (125 MHz max.).
The Signal Analyzer series MS2690A/91A/92A is recommended for other measurement purposes.

General

Analysis Bandwidth	See Signal Analyzer (Analysis bandwidth)
Sampling Rate	See Signal Analyzer (Sampling rate)
Capture Time	See Signal Analyzer (Capture time)
ADC Resolution	With MS2830A-077/078, >31.25 MHz bandwidth 14 bits

Frequency

Frequency Setting	See Signal Analyzer/Spectrum display function (Frequency setting)
Resolution Bandwidth (RBW)	See Signal Analyzer/Spectrum display function(Resolution bandwidth (RBW))

Amplitude

Displayed Average Noise Level (DANL)	18° to 28°C, Time Detection: Average, Input attenuator: 0 dB With MS2830A-077 or 078, >31.25 MHz bandwidth Without MS2830A-008/068, or with MS2830A-008/068, Preamp: Off –146.5 dBm/Hz (300 MHz ≤ f < 1 GHz), –143.5 dBm/Hz (1 GHz ≤ f < 2.4 GHz), –140.5 dBm/Hz (2.4 GHz ≤ f ≤ 3.5 GHz), –137.5 dBm/Hz (3.5 GHz < f ≤ 4 GHz), –137.5 dBm/Hz (4 GHz < f ≤ 6 GHz) With MS2830A-008/068, Preamp: ON –156.5 dBm/Hz (300 MHz ≤ f < 1 GHz), –154.5 dBm/Hz (1 GHz ≤ f < 2 GHz), –152.5 dBm/Hz (2 GHz ≤ f ≤ 3.5 GHz), –148.5 dBm/Hz (3.5 GHz < f ≤ 4 GHz), –148.5 dBm/Hz (4 GHz < f ≤ 6 GHz) 18° to 28°C, Input attenuator: 0 dB With MS2830A-077 or 078, with MS2830A-067, >31.25 MHz bandwidth Without MS2830A-068 –137.5 dBm/Hz (6 GHz < f ≤ 13.5 GHz), –135.5 dBm/Hz (13.5 GHz < f ≤ 18.3 GHz), –131.5 dBm/Hz (18.3 GHz < f ≤ 26.5 GHz) –131.5 dBm/Hz (26.5 GHz < f ≤ 34 GHz), –125.5 dBm/Hz (34 GHz < f ≤ 40 GHz), –122.5 dBm/Hz (40 GHz < f ≤ 43 GHz) [MS2830A-045] With MS2830A-068, Preamp: Off –132.5 dBm/Hz (6 GHz < f ≤ 13.5 GHz), –130.5 dBm/Hz (13.5 GHz < f ≤ 18.3 GHz), –126.5 dBm/Hz (18.3 GHz < f ≤ 26.5 GHz) –126.5 dBm/Hz (26.5 GHz < f ≤ 34 GHz), –121.5 dBm/Hz (34 GHz < f ≤ 40 GHz), –118.5 dBm/Hz (40 GHz < f ≤ 43 GHz) [MS2830A-045] With MS2830A-068, Preamp: On –147.5 dBm/Hz (6 GHz < f ≤ 13.5 GHz), –145.5 dBm/Hz (13.5 GHz < f ≤ 18.3 GHz), –143.5 dBm/Hz (18.3 GHz < f ≤ 26.5 GHz) –143.5 dBm/Hz (26.5 GHz < f ≤ 34 GHz), –137.5 dBm/Hz (34 GHz < f ≤ 40 GHz), –134.5 dBm/Hz (40 GHz < f ≤ 43 GHz) [MS2830A-045]
Image Response	With MS2830A-077/078, >31.25 MHz bandwidth Image response (occurs at frequency 200 MHz away): 0 dBc (nom., 300 MHz < f ≤ 43 GHz) With MS2830A-077/078, MS2830A-067, >31.25 MHz bandwidth Image response (occurs at frequency 1.875 GHz × 2 away): 0 dBc (nom., 6 GHz < f ≤ 43 GHz)
RF Frequency Characteristics	18° to 28°C, After Cal, Input attenuator: 10 dB, Frequency band mode: Normal, >31.25 MHz bandwidth Without MS2830A-008/068, or Preamp: Off ±0.35 dB (300 MHz ≤ f < 4 GHz), ±1.5 dB (4 GHz ≤ f ≤ 6 GHz) With MS2830A-008, Preamp: On ±0.65 dB (300 MHz ≤ f < 4 GHz), ±1.8 dB (4 GHz ≤ f ≤ 6 GHz) Without MS2830A-068, or Preamp: Off With MS2830A-067, Microwave Preselector Bypass: On ±1.0 dB (6 GHz ≤ f ≤ 13.8 GHz), ±1.5 dB (13.8 GHz < f ≤ 26.5 GHz), ±2.0 dB (26.5 GHz < f ≤ 40 GHz), ±2.0 dB (typ., 40 GHz < f ≤ 43 GHz) With MS2830A-068, or Preamp: On With MS2830A-067, Microwave Preselector Bypass: On ±1.8 dB (6 GHz ≤ f ≤ 13.8 GHz), ±2.5 dB (13.8 GHz < f ≤ 26.5 GHz), ±3.0 dB (26.5 GHz < f ≤ 40 GHz), ±3.0 dB (nom., 40 GHz < f ≤ 43 GHz)
Linearity Error	See Signal Analyzer/Spectrum Analyzer (Linearity error)

High Performance Waveguide Mixer (50 to 75 GHz) MA2806A
High Performance Waveguide Mixer (60 to 90 GHz) MA2808A

See MA2806A/MA2808A page for detail (Page 564).

Typical (typ.): Performance not warranted. Most products meet typical performance.
Nominal (nom.): Values not warranted. Included to facilitate application of product.
Example: Performance not warranted. Data actually measured by randomly selected measuring instruments.

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main frame
MS2830A	Signal Analyzer
	Standard accessories
	Power Cord: 1 pc
P0031A	USB Memory (≥256 MB, USB2.0 Flash Driver): 1 pc
Z0541A	USB Mouse: 1 pc
	Install CD-ROM (Application software, instruction manual CD-ROM): 1 pc
	Options
MS2830A-044	26.5 GHz Signal Analyzer
MS2830A-045	43 GHz Signal Analyzer
MS2830A-001	Rubidium Reference Oscillator
MS2830A-005[*1]	Analysis Bandwidth Extension to 31.25 MHz
MS2830A-006	Analysis Bandwidth 10 MHz
MS2830A-008	Preamplifier
MS2830A-009[*2]	Bandwidth Extension to 31.25 MHz for Millimeter-wave
MS2830A-010	Phase Noise Measurement Function
MS2830A-011	2ndary HDD
MS2830A-016	Precompliance EMI Function
MS2830A-017	Noise Figure Measurement
MS2830A-026[*3]	BER Measurement Function (AUX Conversion Adapter J1556A as standard accessory)
MS2830A-067	Microwave Preselector Bypass
MS2830A-068	Microwave Preamplifier
MS2830A-077[*4]	Analysis Bandwidth Extension to 62.5 MHz
MS2830A-078[*5]	Analysis Bandwidth Extension to 125 MHz
MS2830A-311	2ndary HDD Retrofit
	Retrofit options
MS2830A-101	Rubidium Reference Oscillator Retrofit
MS2830A-105[*1]	Analysis Bandwidth Extension to 31.25 MHz Retrofit
MS2830A-106	Analysis Bandwidth 10 MHz Retrofit
MS2830A-108	Preamplifier Retrofit
MS2830A-109[*2]	Bandwidth Extension to 31.25 MHz for Millimeter-wave Retrofit
MS2830A-110	Phase Noise Measurement Function Retrofit
MS2830A-111	2ndary HDD Retrofit
MS2830A-116	Precompliance EMI Function Retrofit
MS2830A-117	Nose Figure Measurement Retrofit
MS2830A-126[*3]	BER Measurement Function Retrofit (AUX Conversion Adapter J1556A as standard accessory)
MS2830A-167	Microwave Preselector Bypass Retrofit
MS2830A-168	Microwave Preamplifier Retrofit
MS2830A-180[*6]	CPU/Windows 7 64 bit Upgrade Retrofit
	Software options
	CD-ROM with License and Operation manuals
MX269011A	W-CDMA/HSPA Downlink Measurement Software
MX269012A	W-CDMA/HSPA Uplink Measurement Software
MX269013A	GSM/EDGE Measurement Software
MX269013A-001	EDGE Evolution Measurement Software (Requires MX269013A)
MX269015A	TD-SCDMA Measurement Software
MX269017A	Vector Modulation Analysis Software
MX269020A	LTE Downlink Measurement Software
MX269020A-001	LTE-Advanced FDD Downlink Measurement Software (Requires MX269020A)
MX269021A	LTE Uplink Measurement Software
MX269021A-001	LTE-Advanced FDD Uplink Measurement Software (Requires MX269021A)
MX269022A	LTE TDD Downlink Measurement Software
MX269022A-001	LTE-Advanced TDD Downlink Measurement Software (Requires MX269022A)
MX269023A	LTE TDD Uplink Measurement Software
MX269023A-001	LTE-Advanced TDD Uplink Measurement Software (Requires MX269023A)
MX269024A	CDMA2000 Forward Link Measurement Software
MX269024A-001	All Measure Function (Requires MX269024A)
MX269026A	EV-DO Forward Link Measurement Software
MX269026A-001	All Measure Function (Requires MX269026A)
MX269028A	WLAN (802.11) Measurement Software
MX269028A-001	802.11ac (80 MHz) Measurement Software (For MS2830A. Requires MX269028A.)
MX269030A	W-CDMA BS Measurement Software
MX283027A	Wireless Network Device Test Software
MX283027A-001	WLAN Test Software (Requires MX283027A)
MX283027A-002	Bluetooth Test Software (Requires MX283027A)

Model/Order No.	Name
	Warranty service
MS2830A-ES210	2 years Extended Warranty Service
MS2830A-ES310	3 years Extended Warranty Service
MS2830A-ES510	5 years Extended Warranty Service
	Application parts
	Following operation manuals provided as hard copy
W3334AE	MS2830A Operation Manual (Mainframe Operation)
W2851AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Mainframe Remote Control)
W3335AE	MS2830A/MS2840A/MS2850A Operation Manual (Signal Analyzer Function Operation)
W2853AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Signal Analyzer Function Remote Control)
W3336AE	MS2830A/MS2840A/MS2850A Operation Manual (Spectrum Analyzer Function Operation)
W2855AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Spectrum Analyzer Function Remote Control)
W3117AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Phase Noise Measurement Function Operation)
W3118AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A Operation Manual (Phase Noise Measurement Function Remote Control)
W3655AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A-017 Operation Manual (Noise Figure Measurement Function Operation)
W3656AE	MS2690A/MS2691A/MS2692A and MS2830A/MS2840A/MS2850A-017 Operation Manual (Noise Figure Measurement Function Remote Control)
W3098AE	MX269011A Operation Manual (Operation)
W3099AE	MX269011A Operation Manual (Remote Control)
W3060AE	MX269012A Operation Manual (Operation)
W3061AE	MX269012A Operation Manual (Remote Control)
W3100AE	MX269013A Operation Manual (Operation)
W3101AE	MX269013A Operation Manual (Remote Control)
W3044AE	MX269015A Operation Manual (Operation)
W3045AE	MX269015A Operation Manual (Remote Control)
W3305AE	MX269017A Operation Manual (Operation)
W3306AE	MX269017A Operation Manual (Remote Control)
W3014AE	MX269020A Operation Manual (Operation)
W3064AE	MX269020A Operation Manual (Remote Control)
W3015AE	MX269021A Operation Manual (Operation)
W3065AE	MX269021A Operation Manual (Remote Control)
W3209AE	MX269022A Operation Manual (Operation)
W3210AE	MX269022A Operation Manual (Remote Control)
W3521AE	MX269023A Operation Manual (Operation)
W3522AE	MX269023A Operation Manual (Remote Control)
W3201AE	MX269024A Operation Manual (Operation)
W3202AE	MX269024A Operation Manual (Remote Control)
W3203AE	MX269026A Operation Manual (Operation)
W3204AE	MX269026A Operation Manual (Remote Control)
W3528AE	MX269028A Operation Manual (Operation)
W3529AE	MX269028A Operation Manual (Remote Control)
W2860AE	MX269030A Operation Manual (Operation)
W2861AE	MX269030A Operation Manual (Remote Control)
W3471AE	MX283027A Operation Manual (Operation)
W3473AE	MX283027A-001 Operation Manual (Operation)
W3474AE	MX283027A-001 Operation Manual (Remote Control)
W3516AE	MX283027A-002 Operation Manual (Operation)
W3517AE	MX283027A-002 Operation Manual (Remote Control)

*1: MS2830A-005/105 is available when MS2830A-044 is installed.
Requires MS2830A-006/106.

*2: MS2830A-009/109 is available when MS2830A-045 is installed.
Requires MS2830A-006/106

*3: The Aux Conversion Adapter J1556A is a standard accessory supplied with MS2830A-026/126.

*4: Retrofit not supported.
Requires MS2830A-006 and MS2830A-005 (for MS2830A-044).
Requires MS2830A-006 and MS2830A-009 (for MS2830A-045).

*5: Retrofit not supported.
Requires MS2830A-006, MS2830A-005 and MS2830A-077 (for MS2830A-044).
Requires MS2830A-006, MS2830A-009 and MS2830A-077 (for MS2830A-045).

*6: Replace the CPU board and upgrade the OS to Windows 7.

Model/Order No	Name
	High Performance Waveguide Mixer
MA2806A	High Performance Waveguide Mixer (50 to 75 GHz)
MA2808A	High Performance Waveguide Mixer (60 to 90 GHz)
	Standard accessories
Z1922A	MA2806A USB Memory (Saved conversion loss data, for MA2806A): 1 pc
Z1923A	MA2808A USB Memory (Saved conversion loss data, for MA2808A): 1 pc
Z1625A	AC Adapter: 1 pc
	Power Cord: 1 pc
J1692B	Coaxial Cord, 1 m (SMA-P · SUCOFLEX104PE · SMA-P, DC to 18 GHz, 50Ω): 1 pc
	External Mixer
MA2741C	External Mixer (26.5 GHz to 40 GHz)
MA2742C	External Mixer (33 GHz to 50 GHz)
MA2743C	External Mixer (40 GHz to 60 GHz)
MA2744C	External Mixer (50 GHz to 75 GHz)
MA2745C	External Mixer (60 GHz to 90 GHz)
MA2746C	External Mixer (75 GHz to 110 GHz)
MA2747C	External Mixer (90 GHz to 140 GHz)
MA2748C	External Mixer (110 GHz to 170 GHz)
MA2749C	External Mixer (140 GHz to 220 GHz)
MA2750C	External Mixer (170 GHz to 260 GHz)
MA2751C	External Mixer (220 GHz to 325 GHz)
K240B	Power Divider (K connector, DC to 26.5 GHz, 50Ω, K-J, 1 W max.)
MA1612A	Four-port Junction Pad (5 MHz to 3 GHz, N-J)
J1359A	Coaxial Adaptor (K-P · K-J, SMA)
J0576B	Coaxial Cord, 1 m (N-P · 5D-2W · N-P)
J0576D	Coaxial Cord, 2 m (N-P · 5D-2W · N-P)
J0127A	Coaxial Cord, 1 m (BNC-P · RG58A/U · BNC-P)
J0127B	Coaxial Cord, 2 m (BNC-P · RG58A/U · BNC-P)
J0127C	Coaxial Cord, 0.5 m (BNC-P · RG58A/U · BNC-P)
J0322A	Coaxial Cord, 0.5 m (DC to 18 GHz), (SMA-P · 50Ω SUCOFLEX104 · SMA-P)
J0322B	Coaxial Cord, 1 m (DC to 18 GHz), (SMA-P · 50Ω SUCOFLEX104 · SMA-P)
J0322C	Coaxial Cord, 1.5 m (DC to 18 GHz), (SMA-P · 50Ω SUCOFLEX104 · SMA-P)
J0322D	Coaxial Cord, 2 m (DC to 18 GHz), (SMA-P · 50Ω SUCOFLEX104 · SMA-P)
J0805	DC Block, N type (MODEL 7003) (10 kHz to 18 GHz, N-P · N-J)
J1554A	DC Block, SMA type (MODEL 7006) (9 kHz to 26.5 GHz, SMA-P · SMA-J)
J1555A	DC Block, SMA type (MODEL 7006-1) (9 kHz to 20 GHz, SMA-P · SMA-J)
K261	DC Block (10 kHz to 40 GHz, K-P · K-J)
J0004	Coaxial Adapter (DC to 12.4 GHz, 50Ω, N-P · SMA-J)
J1398A	N-SMA Adaptor (DC to 26.5 GHz, 50Ω, N-P · SMA-J)
34AKNF50	Ruggedized K-to-Type N Adapter (DC to 20 GHz, 50Ω, Ruggedized K-M · N-F, SWR: 1.5 (max.), Insertion Loss: 0.4 dB (max.))
J0911	Coaxial Cable, 1.0 m for 40 GHz (DC to 40 GHz, approx. 1 m, SF102A, 11K254/K254/1.0M)
J0912	Coaxial Cable, 0.5 m for 40 GHz (DC to 40 GHz, approx. 0.5 m, SF102A, 11K254/K254/0.5M)
41KC-3	Fixed Attenuator (DC to 40 GHz, 3 dB)
J1261A	Ethernet Cable (Shield type, Straight, 1 m)
J1261B	Ethernet Cable (Shield type, Straight, 3 m)
J1261C	Ethernet Cable (Shield type, Cross, 1 m)
J1261D	Ethernet Cable (Shield type, Cross, 3 m)
J0008	GPIB Cable, 2.0 m
J1556A*7	AUX Conversion Adapter (AUX → BNC, for vector signal generator option and BER measurement function option)
B0635A	Rack Mount Kit (EIA)
B0657A	Rack Mount Kit (JIS)
B0636C*8	Carrying Case (Hard type, with casters)
B0671A*8	Front Cover for 1MW4U
MA24105A	Inline Peak Power Sensor (350 MHz to 4 GHz, with USB A to mini B cable)
MA24106A	USB Power Sensor (50 MHz to 6 GHz, with USB A to mini B Cable)
MA24108A	Microwave USB Power Sensor (10 MHz to 8 GHz, with USB A to Micro-B Cable)
MA24118A	Microwave USB Power Sensor (10 MHz to 18 GHz, with USB A to Micro-B Cable)
MA24126A	Microwave USB Power Sensor (10 MHz to 26 GHz, with USB A to Micro-B Cable)
Z0975A	Keyboard (USB)
Z1345A	Installation Kit (required when retrofitting options or installing software)

*7: The AUX Conversion Adapter J1556A is not a standard accessory for the Vector Signal Generator Option MS2830A-020/120/021/121.
The J1556A AUX Conversion Adapter is a standard accessory supplied with BER Measurement Function MS2830A-026/126.

*8: The B0636C Carrying Case includes a Front Panel Protective Cover (B0671A).

High Performance Waveguide Mixer

MA2806A/MA2808A

50 GHz to 75 GHz/60 GHz to 90 GHz

Wide Dynamic Range Based on Excellent Minimum Sensitivity and P1dB Performance


MA2806A

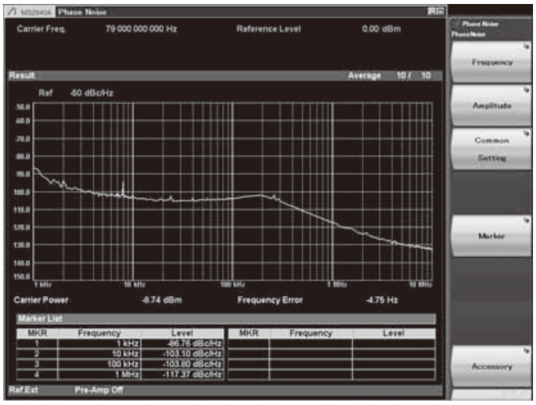

MA2808A

The High Performance Waveguide Mixer MA2806A and MA2808A have a dedicated multiplier, amplifier, bandpass filter, etc., supporting an excellent conversion loss of at least 10 dB better than conventional harmonic mixers, as well as P1dB performance exceeding 0 dBm. When used in combination with the Signal Analyzer MS2850A/MS2840A series (26.5 GHz/44.5 GHz models)/MS2830A Microwave the display average noise performance level is excellent at –150 dBm/Hz (meas.)*1 at 75 GHz.
Due to this wide dynamic range, the MA2806A and MA2808A support evaluation of the true spurious performance of wider-band, millimeter-wave wireless transmitters as well as various types of millimeter-wave equipment, such as automotive radar, wireless backhaul and gigabit wireless LAN (IEEE 802.11ad/WiGig) etc., that cannot be evaluated accurately using conventional harmonic-mixer and downconverter methods.

Moreover, by using the high IF frequency (1.875 GHz) of the MS2850A/MS2840A series (26.5 GHz/44.5 GHz models)/MS2830A Microwave, spectrum mask measurements can be made over a wide measurement span with no impact from image-response effects. Spectrum mask measurements require measurement over a wider measurement span than the bandwidth of the signal to be measured. For example, when using the MA2806A and MA2808A to measure a signal with a bandwidth of 1 GHz, no image response occurs in a wide measurement span covering 6.5 GHz. Moreover, no image response occurs in a measurement span of 5.5 GHz for a signal with a bandwidth of 2 GHz. Additionally, use of the newly developed PS function*2 supports image-response-free measurements over a measurement span of up to 7.5 GHz, irrespective of the measured signal bandwidth.

Additionally, connecting these mixers to the MS2850A/MS2840A series (26.5 GHz/44.5 GHz models)/MS2830A Microwave supports measurements using its excellent high phase noise performance of –100 dBc/Hz (10 kHz offset frequency, meas.)*1 in the 79 GHz band for evaluating the intrinsic phase noise performance of millimeter- waveband devices, such as automotive radar.
Connection to the MS2850A/MS2840A series (26.5 GHz/44.5 GHz models)/MS2830A Microwave is as easy as simply connecting a cable to the IF port. Conversion loss data saved in a USB memory stick is loaded into the Signal Analyzer for reflection in the measured values.

*1: Example when connected with MS2840A. Value measured at design but not guaranteed specification.
*2: Patented



Carrier Freq. 79 000 000 000 Hz
Reference Level 0.00 dBm

Result Average 10 / 10

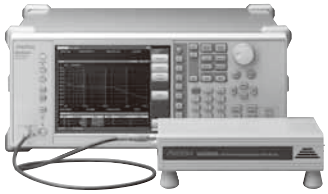
Carrier Power -8.74 dBm
Frequency Error -4.75 Hz

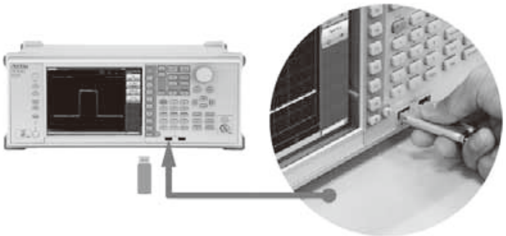
Marker List

MKR	Frequency	Level	MKR	Frequency	Level
1	1 kHz	-86.76 dBc/Hz			
2	10 kHz	-103.10 dBc/Hz			
3	100 kHz	-103.80 dBc/Hz			
4	1 MHz	-117.37 dBc/Hz			

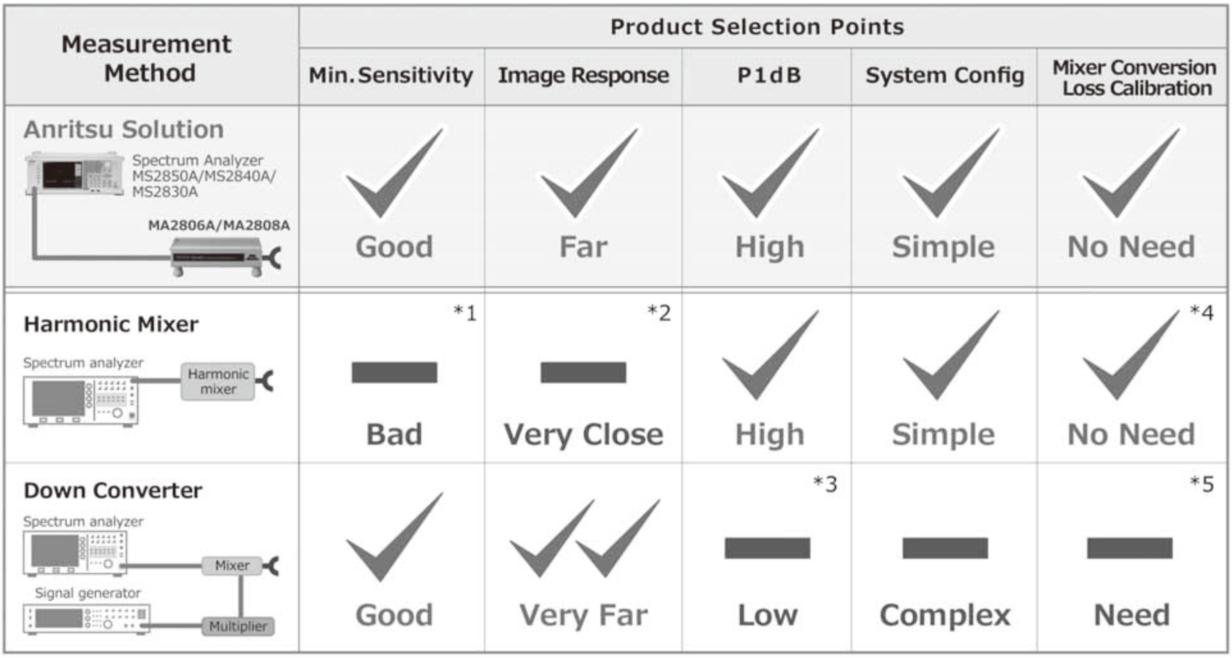
Ref.Ext Pre-Amp Off

Phase Noise measurement with MS2840A using High Performance Waveguide Mixer MA2808A (Measurement frequency: 79 GHz)


Simple Connection


Save mixer conversion loss data to USB memory

Measurement Method Performance Comparison



Measurement Method	Product Selection Points				
	Min. Sensitivity	Image Response	P1dB	System Config	Mixer Conversion Loss Calibration
Anritsu Solution Spectrum Analyzer MS2850A/MS2840A/MS2830A MA2806A/MA2808A	✓ Good	✓ Far	✓ High	✓ Simple	✓ No Need
Harmonic Mixer Spectrum analyzer Harmonic mixer	*1 ▬ Bad	*2 ▬ Very Close	✓ High	✓ Simple	*4 ✓ No Need
Down Converter Spectrum analyzer Mixer Signal generator Multiplier	✓ Good	✓✓ Very Far	*3 ▬ Low	▬ Complex	*5 ▬ Need

*1: High noise floor level and narrow dynamic range due to high mixer conversion order
*2: Low IF frequency depending on spectrum analyzer causes occurrence of image response generated in measurement range
*3: Narrow dynamic range due to mixer P1dB performance of only –10 to –5 dBm
*4: Different calibration procedure depending on spectrum analyzer used
*5: Requires mixer conversion loss data for measurement range because any IF frequency can be set

Specifications

Electrical Characteristics

Frequency Range		MA2806A: 50 GHz to 75 GHz MA2808A: 60 GHz to 90 GHz
LO Amplitude Range		> +10 dBm
Multiplication factor		MA2806A: 8 MA2808A: 12
Conversion Loss		<15 dB (typ.)*
1 dB Gain Compression (P1dB)		>0 dBm (typ.)*
LO Leakage		<–30 dBm (nom.)
RF Input VSWR		≤1.5 (nom.)
IF/LO Port VSWR	1.875 GHz (IF)	≤2.0 (nom.)
	5 GHz to 10 GHz (LO)	MA2806A: ≤2.4 (nom.) MA2808A: ≤2.0 (nom.)
Max. Input Level (CW)		+10 dBm

*: At assured performance temperature range

Interface

RF	MA2806A: Waveguide (WR15, UG-385/U) MA2808A: Waveguide (WR12, UG-387/U)
IF/LO	SMA-J

General

Power Supply	100 V(ac) to 120 V(ac)/200 V(ac) to 240 V(ac), 50 Hz/60 Hz, 40 VA
Dimensions and Mass	134 (W) × 51 (H) × 229 (D) mm (excluding projections), <2 kg
Temperature Range	Assured performance range: +18° to +28°C Operating: +5° to +45°C (no condensation) Storage: –20° to +60°C (no condensation)
CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN61010-1 RoHS: 2011/65/EU, EN50581

Typical (typ.):
Performance not warranted. Most products meet typical performance.
Nominal (nom.):
Values not warranted. Included to facilitate application of product.

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main frame
MA2806A	High Performance Waveguide Mixer (50 GHz to 75 GHz)
MA2808A	High Performance Waveguide Mixer (60 GHz to 90 GHz)
	Standard accessories
Z1922A	MA2806A USB Memory (Saved conversion loss data): 1 pc
Z1923A	MA2808A USB Memory (Saved conversion loss data): 1 pc
	AC Adapter: 1 pc
Z1625A	Power Cord: 1 pc
J1692B	Coaxial Cord, 1 m (SMA-P · SUCOFLEX104PE · SMA-P, DC to 18 GHz, 50Ω): 1 pc

V2X 802.11p Message Evaluation Software

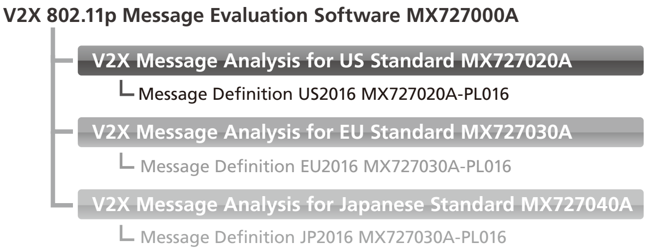
MX727000A

Decrease Burden for V2X Middleware Development

V2X 802.11p Message Evaluation Software MX727000A

Supports Required Message Evaluations and Measurements for V2V and V2I Communications

The V2X 802.11p Measurement and Analysis Software MX727000A is designed to be used in conjunction with the Signal Analyzer MS269xA/MS2830A to demodulate, analyze, and display V2X messages.
The MX727000A has the application options shown in Figure 1.



V2X 802.11p Message Evaluation Software MX727000A

- V2X Message Analysis for US Standard MX727020A
  - Message Definition US2016 MX727020A-PL016
- V2X Message Analysis for EU Standard MX727030A
  - Message Definition EU2016 MX727030A-PL016
- V2X Message Analysis for Japanese Standard MX727040A
  - Message Definition JP2016 MX727030A-PL016

Figure 1: V2X 802.11p Message Evaluation Software MX727000A Configuration

V2X Message Analysis MX727020A/30A/40A

The V2X Message Analysis is the MX727000A application to capture the signal with V2X Message using the Signal Analyzer MS269xA/MS2830A, and to decode, display V2X Message. It supports V2X message standards for the three main markets of United States, Europe, and Japan, and shows its power at middleware development.

Middleware Evaluation Tools

Conventionally, developers face big challenges in correctly evaluating key data (messages) sent by wireless equipment at V2X middleware development. Previously, developers ran two-way tests between test prototypes after collating bit strings and ASCII code, which caused heavy work burdens. However, debugging two-way communications at tests between prototypes is not simple and particularly so for different regional communications standards. However, this way is not difficult to find the bug because developers cannot find such bug with two-way test and developer may interpret something wrongly. With its integrated development environment for comparing V2X messages developed in-house and by other companies, the V2X Message Analysis MX727020A/30A/40A software makes it easy to objectively evaluate messages using impartial measurements. Figure 2 shows a typical setup.

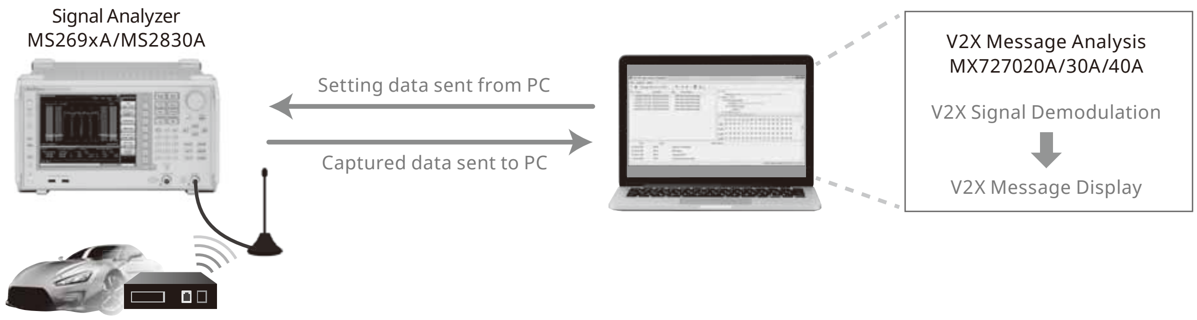
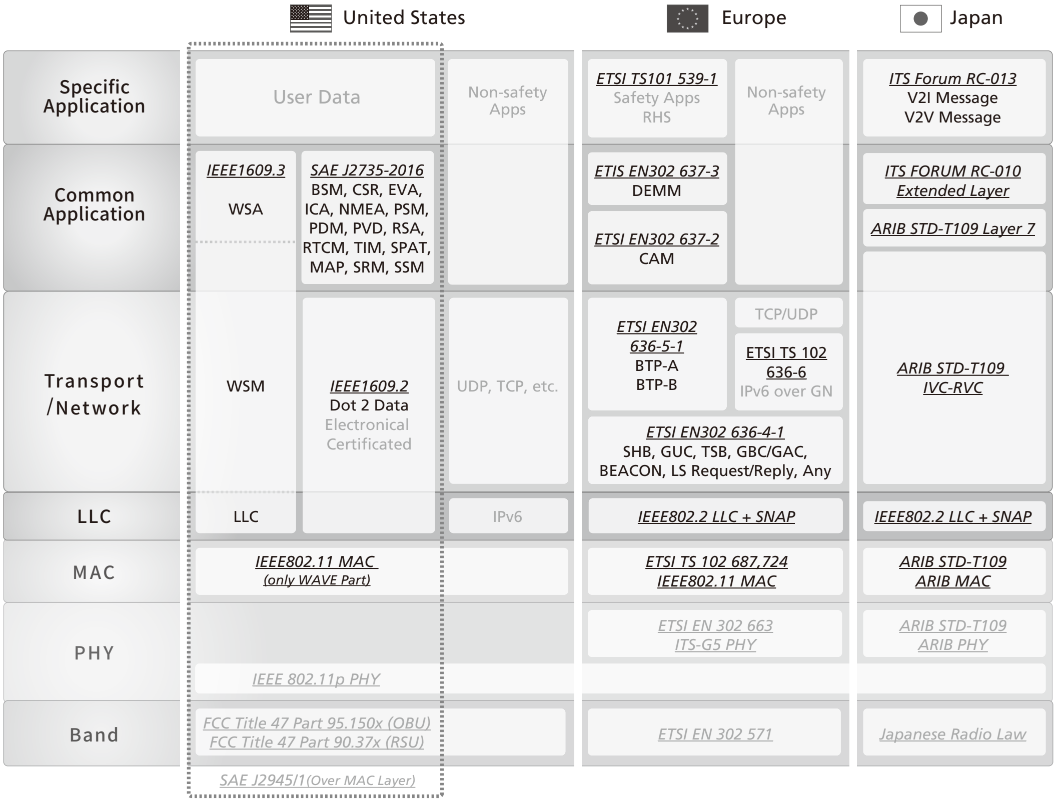


Figure 2: V2X Message Analysis using MX727020A/30A/40A

Evaluations from MAC to Applications Layers/Standard Tools for, United States, Europe and Japanese Message Definitions

Due to different standard in US, Europe and Japan, the developers need to develop V2X Message stack for all regions.
The V2X Message Analysis MX727020A/30A/40A supports the safety message definition of US, Europe and Japanese standard, and also supports the wide-ranging evaluation from MAC to Application layers which are extremely difficult to analyze using wireless two-way testing.
This means that not only can V2X messages be evaluated in-house with no need to visit Plugfest events and/or perform field tests, but also test engineers have a "magic wand" for improving V2X product quality and cutting development and test man hours. Message definitions that can be evaluated are listed in Figure 3.



*: Items in black are supported.

Figure 3: Message Definition Evaluations Supported by V2X Message Evaluation MX727020A/30A/40A

Easy-to-Understand Displays of Incorrect Messages from Wireless Equipment

When bugs occur in V2V and V2I complex middleware, it can be extremely difficult to troubleshoot the cause. If the V2X Message Analysis software discovers an error in a supported message definition or an argument in a message definition, the background of the relevant part changes as shown in the following figure, helping cut debugging time and improve development efficiency.

```
◢ MAC:
  ◢ Frame Control: 0x8800
       Protocol Version: 0
       Type: 0b10 [Data]
       Subtype: 0b1000 [QoS Data]
       To DS: 0b0
       From DS: 0b0
       More Fragments: 0b0
       Retry: 0b0
       Power Management: 0b0
       More Data: 0b0
       Protected Frame: 0b0
       Order: 0b0
    Duration/ID: 0x7800 [120 microseconds]
    Address 1: 0xFFFFFFFFFFFF [FF:FF:FF:FF:FF:FF]
    Address 2: 0x000091000001 [00:00:91:00:00:01]
    Address 3: 0x6F1FCFF0E566 [6F:1F:CF:F0:E5:66]
  ◢ Sequence Control: 0x375E
       Fragment Number: 7
       Sequence Number: 1507
  ◢ QoS Control: 0x1B09
       TID: 11 [TSID]
       EOSP: 0b1
       Ack Policy: 0b00 [Normal Ack or Implicit Block Ack Request]
       A-MSDU Present: 0b0
```

Figure 4: Undefined Message Display Examples

Specifications

V2X 802.11p Message Evaluation Software MX727000A

PC	Operating Environment OS: Microsoft Windows 7 SP1 (64-bit) Microsoft Windows 10 (64-bit) Memory: 8 GB min. HDD Free Space: 20 GB min. Screen Resolution: Full HD 1920 × 1080 min Ethernet I/F: 1000BASE-T (RJ-45) ∗ Other: National Instruments NI-VISA version 16.0, Microsoft NET Framework version 4.6.2

V2X Message Analysis MX727020A/30A/40A

Supported Measuring Instruments	Signal Analyze MS2692A/91A/90A, MS2830A The signal analyzer and vector signal generator embedded OS requires Windows 7.
Supported Standards	United States: IEEE802.11-2012, IEEE802.2-1998, IEEE1609.2-2016 (partly), IEEE1609.3-2016, IEEE1609.12-2016, SAR J2735 MAR 2016 Europe: IEEE802.11-2012, IEEE802.2-1998, IEEE802-2014, ETSI EN302 636-4-1 v1.2.1, ETSI EN 302 636-5-1 v1.2.1, ETSI EN 302 637-2 v1.2.1, ETSI EN 302 637-3 v1.2.1, ETSI TS 103 097 v1.2.1 Japan: IEEE Std 802.11-2012, ARIB STD-109 Ver.1.2, ITS Forum RC-010 Ver.1.0, ITS Forum RC-013 Ver.1.0

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Model/Order No.	Name
MX727000A	V2X 802.11p Message Evaluation Software
MX727020A	V2X Message Analysis for US Standard
MX727020A-PL016	Message Definition US2016
MX727030A	V2X Message Analysis for EU Standard
MX727030A-PL016	Message Definition EU2016
MX727040A	V2X Message Analysis for Japanese Standard
MX727040A-PL016	Message Definition JP2016

Spectrum Master™ High Performance Handheld Spectrum Analyzer

MS2720T

9 kHz to 9 GHz, 13 GHz, 20 GHz, 32 GHz, 43 GHz

Remote Control
Ethernet | **USB**

High Performance Handheld Spectrum Analyzer

From Anritsu, the inventor of the handheld spectrum analyzer first introduced in 1999, we are proud to introduce our 7th generation Spectrum Master MS2720T. The MS2720T represents the highest performance handheld spectrum analyzers available in the world as Anritsu pushes the envelope closer to benchtop quality. This generation introduces a touch screen, full-band tracking generators to 20 GHz, and best-in-class performance for dynamic range, DANL, phase noise, and sweep speed.

Spectrum and Interference Analyzer Highlights

- Measure: Occupied Bandwidth, Channel Power, ACPR, C/I, Field Strength, Spectral Emissions
- Measure Interference: Spectrogram, Signal Strength, RSSI
- Dynamic Range: >106 dB in 1 Hz RBW
- DANL: –164 dBm in 1 Hz RBW
- Phase Noise: –112 dBc/Hz @ 10 kHz offset at 1 GHz
- Resolution Bandwidth (RBW): 1 Hz to 10 MHz
- Full-band Tracking Generators: 9, 13, 20 GHz
- Full-band Preamplifiers standard
- Channel Scanner: scan up to 20 channels at once
- Burst Detect™ Sweep Mode: Sweep 1000x in 15 MHz span
- Coverage Mapping: plot RSSI on on-screen map
- Interference Mapping: on-screen mapping with triangulation
- Operation to +55°C: full performance on AC or battery

Capabilities and Functional Highlights

Wireless Measurements

- GSM/GPRS/EDGE
- W-CDMA/HSPA+
- TD-SCDMA/HSPA+
- PIM Alert Application
- LTE/LTE-A FDD/TDD
- NB-IoT
- CDMA/EV-DO
- WiMAX Fixed/Mobile
- EMF Test
- Zero-span IF Output
- I/Q Waveform Capture
- Gated Sweep
- AM/FM/PM Demodulator
- High Accuracy Power Meter up to 26 GHz USB Sensors
- Three Hour Battery

Spectrum Analyzer

All specifications and characteristics apply to Revision 3 instruments under the following conditions, unless otherwise stated. After 5 minutes of warm-up time, where the instrument is left in the ON state. Sweep Mode set to Performance. When using the internal reference signal.

Measurements	Smart Measurements	Field Strength (dBm/m^2, dBV/m, dBmV/m, dBµV/m, V/m, Watt/m^2, dBW/m^2, A/m, dBA/m, or Watt/cm^2) Occupied Bandwidth (measures 99% to 1% power channel of a signal, or N dB from center of signal) Channel Power (measures the total power in a specified bandwidth) ACPR (adjacent channel power ratio) Emission Mask (recall limit lines as emission mask) Spurious Emissions (measures up to 32 segments with independent setups and limits) C/I (carrier-to-interference ratio) AM/FM/SSB Demodulation (AM, wide/narrow FM, upper/lower SSB), (audio only) PIM Alert Application (available for download)
Setup Parameters	Frequency	Center/Start/Stop, Span, Frequency Step, Frequency Offset, Signal Standard, Channel #, Channel Increment
	Amplitude	Reference Level (RL), Scale, Attenuation Auto/Level, RL Offset, Units (dBm, dBV, dBmV, dBµV, Volt, Watt, dBW, A, dBA), Pre-Amp On/Off, Detection (Peak, RMS/Avg, Negative Peak, Sample, Quasi-Peak)
	Span	Span, Span Up/Down (1-2-5), Full Span, Zero Span, Last Span
	Bandwidth	RBW, Auto RBW, VBW, Auto VBW, VBW/Avg Type (Linear, Log), RBW/VBW Ratio, Span/RBW Ratio
	Impedance	50Ω, 75Ω; external pad required for 75Ω operation
Sweep Functions	Sweep	Single/Continuous, Sweep Time, Gated Sweep (see Option 0090)
	Sweep Mode	Fast (up to 100x faster than Performance), Performance, No FFT, Burst Detect (1000x Fast in 15 MHz span)
	Triggers	Free Run, External, Video, IF Power, Force Trigger Once
	Trigger Parameters	Delay, Level, Slope, Hysteresis, Holdoff (availability varies with trigger)
Trace Functions	Traces	Up to three Traces (A, B, C), View/Blank, Write/Hold, Trace A/B/C Operations
	Trace A Operations	Normal, Max Hold, Min Hold, Average, # of Averages, (always the live trace)
	Trace B Operations	A → B, B ↔ C, Max Hold, Min Hold
	Trace C Operations	A → C, B ↔ C, Max Hold, Min Hold, A – B → C, B – A → C, Relative Reference (dB), Scale
Marker Functions	Markers	Markers 1-6 each with a Delta Marker, or Marker 1 Reference with Six Delta Markers, Marker Table (On/Off/Large), All Markers Off
	Marker Types	Style (Fixed/Tracking), Noise Marker, Frequency Counter Marker
	Marker Auto-Position	Peak Search, Next Peak (Right/Left), Peak Threshold %, Set Marker to Channel, Marker Frequency to Center, Delta Marker to Span, Marker to Reference Level
	Marker Table	1-6 markers frequency and amplitude, plus delta markers frequency offset and amplitude
Limit Line Functions	Limit Lines	Upper/Lower, On/Off, Edit, Move, Envelope, Advanced, Limit Alarm, Default Limit
	Limit Line Edit	Frequency, Amplitude, Add Point, Add Vertical, Delete Point, Next Point Left/Right
	Limit Line Move	To Current Center Frequency, By dB or Hz, To Marker 1, Offset from Marker 1
	Limit Line Envelope	Create Envelope, Update Amplitude, Number of Points (2-41), Offset, Shape Square/Slope
	Limit Line Advanced	Type (Absolute/Relative), Mirror, Save/Recall
	Available Spans	>0 Hz
	Save on Event	When Limit Crossed
Frequency	Frequency Range	(usable to 0 Hz)
	MS2720T-0709	9 kHz to 9 GHz
	MS2720T-0713	9 kHz to 13 GHz
	MS2720T-0720	9 kHz to 20 GHz
	MS2720T-0732	9 kHz to 32 GHz
	MS2720T-0743	9 kHz to 40 GHz
	Tuning Resolution	1 Hz
	Frequency Reference	Aging: ±1.0 × 10^{-6} per 10 years Accuracy: ±0.3 × 10^{-6} (25° ±25°C) plus aging (see Options 1 and 31 for improved frequency reference aging and accuracy)
	Auto-sensing External Frequency Reference	1, 1.2288, 1.544, 2.048, 2.4576, 4.8, 4.9152, 5, 9.8304, 10, 13, 19.6608 MHz
	Sweep Time	7 µs to 3600 s in zero span
	Sweep Time Accuracy	±2% in zero span
Bandwidth	Resolution Bandwidth (RBW)	1 Hz to 10 MHz in 1–3 sequence ±10% (–3 dB bandwidth)
	Video Bandwidth (VBW)	1 Hz to 10 MHz in 1–3 sequence (–3 dB bandwidth)
	RBW with Quasi-Peak Detection	200 Hz, 9 kHz, 120 kHz (–6 dB bandwidth)
	VBW with Quasi-Peak Detection	Auto VBW is On, RBW/VBW = 1
	VBW/Average Type	Linear/Log

Continued on next page

Spectrum Analyzer (continued)

Spectral Purity – SSB Phase Noise	Offset from 1 GHz	9 GHz Instrument		13 GHz to 43 GHz Instruments	
		Maximum	Typical	Maximum	Typical
	10 kHz	–108 dBc/Hz	–112 dBc/Hz	–102 dBc/Hz	–106 dBc/Hz
	100 kHz	–110 dBc/Hz	–115 dBc/Hz	–106 dBc/Hz	–110 dBc/Hz
	1 MHz	–118 dBc/Hz	–123 dBc/Hz	–111 dBc/Hz	–116 dBc/Hz
	10 MHz	–129 dBc/Hz	–133 dBc/Hz	–123 dBc/Hz	–129 dBc/Hz
	Offset from 300 MHz	9 GHz Instrument			
		Maximum	Typical		
	1 kHz	–107 dBc/Hz	–111 dBc/Hz		
	10 kHz	–112 dBc/Hz	–114 dBc/Hz		
	62.5 kHz	–113 dBc/Hz	–115 dBc/Hz		
	100 kHz	–114 dBc/Hz	–117 dBc/Hz		
	1 MHz	–120 dBc/Hz	–122 dBc/Hz		
	10 MHz	–128 dBc/Hz	–131 dBc/Hz		
Amplitude Ranges (excluding effects of VSWR, noise, and spurs)	Dynamic Range	>106 dB minimum at 2.4 GHz, 2/3 (TOI-DANL) in 1 Hz RBW			
	Measurement Range	DANL to +30 dBm			
	Display Range	1 to 15 dB/div in 1 dB steps, ten divisions displayed			
	Reference Level Range	–150 to +30 dBm			
	Attenuator Resolution	0 to 65 dB, 5.0 dB steps			
	Reference Level Offset	99.9 dB External Loss to 99.9 dB External Gain			
	Amplitude Units	Log Scale Modes: dBm, dBW, dBV, dBmV, dBµV Linear Scale Modes: fV, nV, µV, mV, V, pW, nW, µW, mW, W, pA, nA, uA, mA, A			
	Maximum Continuous Input	+30 dBm Peak (typ.), ±50 VDC (≥10 dB Attenuation) +23 dBm Peak (typ.), ±50 VDC (<10 dB Attenuation) +13 dBm Peak (typ.), ±50 VDC (Preamp = ON Option 713, 720, 732, 743; no extra limit for Option 709)			
Amplitude Accuracy		+20° to +30°C (after 30 minute warm-up)		–10° to +55°C (after 60 minute warm-up)	
	9 GHz Instrument	Maximum	Typical	Maximum	Typical
	9 kHz to 100 kHz*1	±2.3 dB	±0.5 dB	±2.3 dB	±0.5 dB
	100 kHz to 7 GHz	±1.3 dB	±0.5 dB	±2.3 dB	±0.5 dB
	>7 GHz to 9 GHz	±1.8 dB	±0.5 dB	±2.8 dB	±0.5 dB
	13 GHz, 20 GHz Instruments				
	100 kHz to 13 GHz	–1.3 dB	±0.5 dB	±2.3 dB	±0.5 dB
	>13 GHz to 18 GHz	±2.3 dB	±0.5 dB	±3.3 dB	±0.5 dB
	>18 GHz to 20 GHz	—	±1.0 dB	—	±1.0 dB
	32 GHz, 43 GHz Instruments				
	>100 kHz to 13 GHz	±1.3 dB	±0.5 dB	±2.3 dB	±0.5 dB
	>13 GHz to 40 GHz	±2.3 dB	±0.5 dB	±3.3 dB	±0.5 dB
	>40 GHz to 43 GHz	—	±1.0 dB	—	±1.0 dB
Displayed Average Noise Level (DANL) (RMS detection, VBW/Avg type = Log, Ref Level = –20 dBm for Preamp Off and –50 dBm for Preamp On, Auto Attenuator On Performance Sweep Mode)		Preamp = Off		Preamp = On	
	9 GHz Instrument	Maximum	Typical	Maximum	Typical
	10 MHz to 3 GHz	–146 dBm	–149 dBm	–160 dBm	–163 dBm
	>3 GHz to 8 GHz	–140 dBm	–143 dBm	–152 dBm	–155 dBm
	>8 GHz to 9 GHz	—	–138 dBm	—	–155 dBm
	13 GHz to 43 GHz Instruments				
	10 MHz to 4 GHz	–145 dBm	–148 dBm	–161 dBm	–164 dBm
	>4 GHz to 9 GHz	–142 dBm	–145 dBm	–159 dBm	–162 dBm
	>9 GHz to 13 GHz	–136 dBm	–139 dBm	–156 dBm	–159 dBm
	20 GHz Instrument				
	>13 GHz to 20 GHz	–136 dBm	–142 dBm	–155 dBm	–161 dBm
	32 GHz to 43 GHz Instruments				
	>13 GHz to 20 GHz	–134 dBm	–141 dBm	–152 dBm	–158 dBm
	>20 GHz to 32 GHz	–135 dBm	–140 dBm	–154 dBm	–159 dBm
	>32 GHz to 40 GHz	–127 dBm	–130 dBm	–148 dBm	–151 dBm
	>40 GHz to 43 GHz	—	–130 dBm	—	–151 dBm
Spurs (0 dB input attenuation)		(RF input terminated, 0 dB input attenuation)			
	Residual Spurs (RF input terminated)	Preamp = Off		Preamp = On	
	<13 GHz	–90 dBm (max.)		–100 dBm (max.)	
	13 GHz to 20 GHz	–85 dBm (max.)		–100 dBm (max.)	
	>20 GHz to 32 GHz	–80 dBm (max.)		–100 dBm (max.)	
	>32 GHz to 43 GHz	–80 dBm (max.)		–95 dBm (max.)	
	Input-Related Spurious (–30 dBm input)	Maximum*1 –60 dBc		Typical –70 dBc	

*1: Values below 100 kHz are with the preamplifier turned off.
*2: Instrument centered on single signal, span <1.7 GHz

Continued on next page

Spectrum Analyzer (continued)

Third-Order Intercept (TOI) (–20 dBm tones 100 kHz apart, 0 dB Attenuation, Preamp OFF, Reference Level –20 dBm)	2.4 GHz	+14 dBm (min.)
	50 MHz to 20 GHz	+20 dBm (typ.)
	>20 GHz to 32 GHz	+15 dBm (typ.)
	>32 GHz to 43 GHz	+20 dBm (typ.)
P1dB	<4 GHz	+5 dBm (nom.)
	4 GHz to 20 GHz	+12 dBm (nom.)
	>20 GHz to 32 GHz	+7 dBm (nom.)
	>32 GHz to 43 GHz	+12 dBm (nom.)
Second Harmonic Distortion	(0 dB input attenuation, –30 dBm input)	
	50 MHz	–54 dBc (max.)
	<4 GHz	–60 dBc (typ.)
	>4 GHz	–75 dBc (typ.)
VSWR (≥10 dB input attenuation)	9 GHz Instruments	
	<4 GHz	1.5:1 (typ.)
	4 GHz to 8 GHz	1.8:1 (typ.)
	13 GHz to 43 GHz Instruments	
	<20 GHz	1.5:1 (typ.)
	20 GHz to 43 GHz	2.0:1 (typ.)

High Accuracy Power Meter (Option 19) (Requires external USB Power Sensor)

Amplitude	Maximum, Minimum, Offset, Relative On/Off, Units, Auto Scale				
Average	# of Running Averages, Max Hold				
Zero/Cal	Zero On/Off, Cal Factor (Center Frequency, Signal Standard)				
Limits	Limit On/Off, Limit Upper/Lower				
Power Sensor Model	MA24105A	MA24106A	MA24108A/18A/26A	MA24208A/18A	MA24330A/40A/50A
Description	Inline High Power Sensor	High Accuracy RF Power Sensor	Microwave USB Power Sensor	Microwave Universal USB Power Sensor	Microwave CW USB Power Sensor
Frequency Range	350 MHz to 4 GHz	50 MHz to 6 GHz	10 MHz to 8/18/26 GHz	10 MHz to 8/18 GHz	10 MHz to 33/40/50 GHz
Connector	Type N (f), 50Ω	Type N (m), 50Ω	Type N (m), 50Ω (8 GHz/18 GHz) Type K (m), 50Ω (26 GHz)	Type N (m), 50Ω	Type K (m), 50Ω (33 GHz/40 GHz) Type V (m), 50Ω (50 GHz)
Dynamic Range	+3 to + 51.76 dBm (2 mW to 150 W)	–40 to +23 dBm (0.1 µW to 200 mW)	–40 to +20 dBm (0.1 µW to 100 mW)	–60 to + 20 dBm (1 nW to 100 mW)	–70 to + 20 dBm (0.1 nW to 100 mW)
Measurand	True-RMS	True-RMS	True-RMS, Slot Power, Burst Average Power	True-RMS, Slot Power, Burst Average Power	Average Power
Measurement Uncertainty	± 0.17 dB[*1]	± 0.16 dB[*2]	± 0.18 dB[*3]	± 0.17 dB[*4]	± 0.17 dB[*5]
Data sheet (for complete specifications)	11410-00621	11410-00424	11410-00504	11410-00841	11410-00906

*1: Expanded uncertainty with K = 2 for power measurements of a CW signal greater than +20 dBm with a matched load.
Measurement results referenced to the input side of the sensor.

*2: Total RSS measurement uncertainty (0º to 50ºC) for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.

*3: Expanded uncertainty with K = 2 for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.

*4: Power uncertainty expressed with two sigma confidence level for CW measurement after zero operation. Includes calibration factor and linearity over temperature uncertainties, but not the effects of mismatch, zero set and drift, or noise.

*5: Includes linearity over temperature uncertainties, but not the effects of calibration factor, mismatch, zero set and drift, and noise.

Tracking Generator (Options 809, 813 and 820)

<table>
<tr><td rowspan="8">Setup Parameters</td><td>Frequency</td><td colspan="4">Center/Start/Stop, Span, Signal Standard, Channel #, Frequency Step/Offset, Channel, Channel Increment</td></tr>
<tr><td>Amplitude</td><td colspan="4">Reference Level (RL), Scale, Attenuation Auto/Level, RL Offset, Units, Pre-Amp, Detection</td></tr>
<tr><td>Span</td><td colspan="4">Span, Span Up/Down (1-2-5), Full Span, Zero Span, Last Span</td></tr>
<tr><td>Bandwidth</td><td colspan="4">RBW, Auto RBW, VBW, Auto VBW, VBW/Average Type (Linear/Log), RBW/VBW Ratio, Span/RBW Ratio</td></tr>
<tr><td>Generator</td><td colspan="4">On/Off, Output Power, Mode (CW/Tracking), Settings, Transmission Measurement</td></tr>
<tr><td>Tracking Generator Settings</td><td colspan="4">External Gain/Loss, Power Statistics (On/Off)</td></tr>
<tr><td>Transmission Measurement Settings</td><td colspan="4">Normalize (Off/On), Scale, Reference Position and Amplitude, Transmission Statistics and Offset</td></tr>
<tr><td>Maximum Continuous Input</td><td colspan="4">+23 dBm, ±50 VDC</td></tr>
<tr><td rowspan="4">Frequency</td><td>MS2720T-0809</td><td colspan="4">Frequency Range: 100 kHz to 9 GHz</td></tr>
<tr><td>MS2720T-0813</td><td colspan="4">Frequency Range: 100 kHz to 13 GHz</td></tr>
<tr><td>MS2720T-0820</td><td colspan="4">Frequency Range: 100 kHz to 20 GHz</td></tr>
<tr><td>Frequency Accuracy</td><td colspan="4">Aging: ±1.0 × 10^{-6} per 10 years
Accuracy: ±0.3 × 10^{-6} (25° ±25°C) plus aging</td></tr>
<tr><td rowspan="5">Output Power</td><td>100 kHz to 20 GHz</td><td colspan="4">–40 to 0 dBm</td></tr>
<tr><td>Step Size</td><td colspan="4">0.1 dB (nom.)</td></tr>
<tr><td>Dynamic Range</td><td colspan="4"></td></tr>
<tr><td>9 GHz Instrument</td><td colspan="4">>110 dB (typ.) 100 kHz to 7 GHz
>100 dB (typ.) >7 GHz to 9 GHz</td></tr>
<tr><td>13 GHz and 20 GHz Instruments</td><td colspan="4">>100 dB (typ.) 100 kHz to 12 GHz
>80 dB (typ.) >12 GHz to 20 GHz</td></tr>
<tr><td rowspan="5">Level Accuracy
(At least 30 minute warm-up after 1 hour non-operating at 15° to 35°C ambient, excludes load VSWR effects)</td><td>Frequency Range</td><td colspan="2">20° to 30°C
(after 30 minute warm-up)</td><td colspan="2">0° to 50°C
(after 60 minute warm-up)</td></tr>
<tr><td></td><td>Maximum</td><td>Typical</td><td>Maximum</td><td>Typical</td></tr>
<tr><td>100 kHz to 9 GHz</td><td>±1.5 dB</td><td>±0.5 dB</td><td>±2.0 dB</td><td>±1.0 dB</td></tr>
<tr><td>>9 GHz to 13 GHz</td><td>±1.6 dB</td><td>±1.0 dB</td><td>±2.1 dB</td><td>±1.5 dB</td></tr>
<tr><td>>13 GHz to 18 GHz</td><td>±2.0 dB</td><td>±1.0 dB</td><td>±2.5 dB</td><td>±1.5 dB</td></tr>
<tr><td rowspan="2">VSWR</td><td>100 kHz to 5 GHz</td><td colspan="4">2:1 (typ.)</td></tr>
<tr><td>>5 GHz to 20 GHz</td><td colspan="4">4:1 (typ.)</td></tr>
</table>

Interference Analyzer (Option 25)

Measurements	Spectrum	Field Strength Occupied Bandwidth Channel Power Adjacent Channel Power Ratio (ACPR) AM/FM/SSB Demodulation (Wide/Narrow FM, Upper/Lower SSB), (audio out only) Carrier-to-Interference ratio (C/I)
	Spectrogram	Collect data up to 3 days
	Signal Strength	Gives visual and aural indication of signal strength
	Received Signal Strength Indicator (RSSI)	Collect data up to 1 week
	Interference Mapping	Draw multiple bearings of signal strength from GPS location on on-screen map Pan and Zoom on-screen maps Support for Anritsu MA2700A Handheld Interference Hunter
	Impedance	50Ω, 75Ω; external pad required for 75Ω operation

Channel Scanner (Option 27)

General	Number of Channels	1 to 20 Channels (Power Levels)
	Measurements	Graph/Table, Max Hold (On/5 s/Off), Frequency/Channel, Current/Maximum, Dual Color
	Scanner	Scan Channels, Scan Frequencies, Scan Custom List, Scan Script Master™
	Amplitude	Reference Level, Scale
	Custom Scan	Number of Channels, Signal Standard & Channel, Frequency, Bandwidth
	Frequency Range	9 kHz to 9, 13, 20, 32, or 43 GHz
	Frequency Accuracy	±10 Hz + time base error
	Measurement Range	–110 to +30 dBm
	Impedance	50Ω, 75Ω; external pad required for 75Ω operation

Coverage Mapping (Option 431)

Measurements	Indoor Mapping: RSSI, ACPR	
	Outdoor Mapping: RSSI, ACPR	
Setup Parameters	Mode	Spectrum Analyzer
	Frequency	Center, Span (ACPR only), Freq Step, Signal Standard, Channel #, Channel Increment
	Amplitude	Reference Level (RL), Attenuation Auto/Level, RL Offset, Pre-Amp On/Off, Detection
	Span	RSSI Mode: Zero Span ACPR Mode: Span, Span Up/Down (1-2-5), Full Span, Last Span
	BW	RBW, Auto RBW, VBW, Auto VBW, RBW/VBW Ratio, Span/VBW Ratio
	Measurement Setup	RSSI: Mapping color thresholds ACPR: Main Ch BW, Adj Ch BW, Ch Spacing, Adjacent Ch dB Offset, Thresholds for Good and Poor main channel levels
	Mapping Colors	RSSI: Dark Green (Excellent), Light Green (Very Good), Yellow (Good), Orange (Fair), Dark Red (Poor) ACPR: Dark Green (Good), Yellow (between Good and Poor), Dark Red (Poor)
	Point Distance/Time Setup	Repeat Type: Time (100 ms to 16 s), Distance (1 m to 10,000 m) Distance Units: m, ft
	Save Points Map	Save KML, JPEG, Tab Delimited
	Recall Points Map	Recall Map, Recall KML Points only, Recall KML Points with Map, Recall Default Grid
	Map Types	Outdoor (GPS embedded), Indoor (non-GPS embedded). Import maps using the Anritsu easyMap Tools. Zoomable (.azm) maps are usable, but cannot be zoomed.

Electromagnetic Field Test (Option 444)

Measurements	Setup	Limit lines, axis dwell time, measurement time, auto-logging, measurement units, trace display
	Spectrum Analyzer	Field strength is measured
	LTE OTA, TD-LTE OTA	P-SS, S-SS, and RS are measured and displayed based on each Cell ID received
	W-CDMA OTA	P-CPICH signals are measured and displayed for each Scrambling Code measured
	Units	Spectrum Analyzer: dBm/m^2, dBV/m, dBmV/m, dBuV/m, V/m, W/m^2, dBW/m^2, A/m, dBA/m, W/cm^2 LTE OTA, TD-LTE OTA, W-CDMA OTA: dBm/m^2, V/m, W/m^2
	Results	Maximum, minimum, and average of all measurements conducted
	Display	Measurement status, number of measurements taken, pass/fail indicators
Frequency Range	Supported Antenna	2000-1800-R: 9 kHz to 300 MHz 2000-1792-R: 30 MHz to 3 GHz 2000-1791-R: 700 MHz to 6 GHz
Modes where EMF Measurements available	Spectrum Analyzer LTE (both FDD and TDD Modes, Option 883) W-CDMA (Option 881)	

GPS Receiver (Option 31)

Setup	On/Off, Antenna Voltage 3.3 V/5.0 V, GPS Info
Anritsu Antennas	2000-1528-R GPS antenna requires +5 VDC 2000-1652-R GPS antenna requires +3.3 VDC or +5 VDC 2000-1760-R GPS antenna requires +2.5 VDC to +3.7 VDC
GPS Time/Location Indicator	UTC Time, Latitude, Longitude, and Altitude on display (UTC Time and Altitude on GPS Info display) UTC Time, Latitude, Longitude, and Altitude with trace storage
High Frequency Accuracy	$< \pm 2.5 \times 10^{-8}$ with GPS On, 3 minutes after satellite lock in selected mode (GPS Antenna connected) $< \pm 5.0 \times 10^{-8}$ for 3 days after GPS lock, 0° to 50°C ambient temperature (GPS Antenna disconnected)
Connector	SMA (f)

Gated Sweep (Option 90)

Mode	Spectrum Analyzer, Sweep
Trigger	External TTL, IF Level
IF Trigger Level	–80 dBm to +25 dBm (typ.)
Setup	Gated Sweep (On/Off) Gate Polarity (Rising, Falling) Gate Delay (0 ms to 10 ms) (typ.) Gate Length (1 µs to 65 ms) (typ.) Gate View Settings: Zero Span Time , Zero Span RBW, Zero Span VBW

Zero Span IF Output (Option 89)

Mode	Spectrum Analyzer/Span/Zero Span
Center Frequency	140 MHz (nom.) (varies up to ±10 kHz nominal with center frequency and IF bandwidth)
Output Level	–25 dBm typical for signals at below reference levels, with Auto Attenuation. Maximum –10 dBm (typ.).
Reference Level	–57 to +30 dBm (Preamp Off) –87 to –40 dBm (Preamp On)
IF Bandwidths	Up to 30 MHz (3 dB bandwidth)
Connector	BNC (f)

I/Q Waveform Capture (Option 24)

Mode	Spectrum Analyzer
Capture Mode	Single or Continuous
Trigger	Free Run, External (Rising/Falling), Delay
Maximum Capture Length	800 ms
Maximum Sample Rate	40 MHz
Maximum Signal Bandwidth	32 MHz

Secure Data (Option 7)

Set at Factory	Save measurement files on external USB flash drive only Internal memory is permanently disabled

AM/FM/PM Signal Analyzer (Option 509)

Measurements							
Display Type	RF Spectrum (AM/FM/PM)	Audio Spectrum (AM)	Audio Spectrum (FM/PM)	Audio Waveform (AM)	Audio Waveform (FM/PM)	Summary (AM)	Summary (FM/PM)
Graphic Display	Power (dBm) vs. Frequency	Depth (%) vs. Modulation Frequency	Deviation (kHz/rad) vs. Modulation Frequency	Depth (%) vs. Time	Deviation (kHz/rad) vs. Time	None	None
Numerical Displays	Carrier Power Carrier Frequency Occupied Bandwidth	AM Rate RMS Depth (Pk-Pk)/2 Depth SINAD* THD* Distortion/Total Vrms*	FM/PM Rate RMS Deviation (Pk-Pk)/2 Deviation SINAD* THD* Distortion/Total Vrms*	AM Rate RMS Depth (Pk-Pk)/2 Depth SINAD* THD* Distortion/Total Vrms*	FM/PM Rate RMS Deviation (Pk-Pk)/2 Deviation SINAD* THD* Distortion/Total Vrms*	RMS Depth Peak + Depth Peak – Depth (Pk-Pk)/2 Depth Carrier Power Carrier Frequency Occupied Bandwidth AM Rate SINAD* THD* Distortion/Total Vrms*	RMS Deviation Peak + Deviation Peak – Deviation (Pk-Pk)/2 Depth Carrier Power Carrier Frequency Occupied Bandwidth FM/PM Rate SINAD* THD* Distortion/Total Vrms*

*: Requires sine wave modulation

Setup Parameters	Frequency	Center Freq, Span, Freq Step, Signal Standard, Channel, Channel Increment, Set (measured) Carrier Freq to Center
	Amplitude Setup	Scale, Power Offset, Adjust Range
	Measurements	RF Spectrum, Audio Spectrum (demodulated), Audio Waveform (demodulated), Summary, Coverage Mapping (Option 431 required), Audio Demod (AM/FM only)
	Measurement Setup	All Measurements: Demod Type (AM, FM, PM), IFBW, Auto IFBW, Squelch Units, Distortion Measurements (Sinewave or Broadcast) RF Spectrum: OBW Method, OBW %, OBW dBC Audio Spectrum: Span, Scale, Squelch Power Audio Waveform: Sweep Time, Scale, Squelch Power Summary: Average count, Squelch Power Coverage Mapping: Measurement (SINAD, Carrier Power, Multiple), Thresholds, Point Distance/Time Audio Demod: Demod Type (AM, USB, LSB, Wideband FM, Narrowband FM), Volume, Squelch
	Mapping Colors	Dark Green (Excellent), Light Green (Very Good), Orange (Good), Yellow (Fair), Dark Red (Poor)
	Marker	Six markers with Delta for each, Peak Search, Marker Freq to Center, Marker to Ref Lvl, Marker Table
RF and Modulation Measurements	AM	Modulation Rate: ±1 Hz (<100 Hz), ±2% (>100 Hz) Depth: ±5% for (Modulation rates 10 Hz to 100 kHz)
	FM	Modulation Rate: ±1 Hz (<100 Hz); ±2% (100 Hz to 100 kHz) Deviation Accuracy: ±5% (100 Hz to 100 kHz)*
	PM	Modulation Rate: ±1 Hz (<100 Hz); ±2% (100 Hz to 100 kHz) Deviation Accuracy: ±5% (deviation 0 to 93 Rad, rate 10 Hz to 5 kHz)*
	IF Bandwidth	1 kHz to 300 kHz in 1-3 sequence
	Frequency Span	RF Spectrum: 10 kHz to 10 MHz Audio Spectrum: 2 kHz, 5 kHz, 10 kHz, 20 kHz, 70 kHz, 140 kHz
	RBW/VBW	30
	Span/RBW	100
	Sweep Time	50 µs to 50 ms (Audio Waveform)

*: IFBW must be greater than 95% occupied BW

GSM/GPRS/EDGE Measurements (Option 880)

Measurements			
RF	Demodulation	Over-the-Air (OTA)	Pass/Fail
Channel Spectrum Channel Power Occupied Bandwidth Burst Power Average Burst Power Frequency Error Modulation Type BSIC (NCC, BCC) Multi-channel Spectrum Power vs. Time (Frame/Slot) Channel Power Occupied Bandwidth Burst Power Average Burst Power Frequency Error Modulation Type BSIC (NCC, BCC)	Phase Error EVM Origin Offset C/I Modulation Type Magnitude Error BSIC (NCC, BCC)	There are no additional OTA Measurements RF and Demodulation Measurements can be made OTA	View Pass/Fail Limits GSM, EDGE Available Measurements Channel Power Occupied Bandwidth Burst Power Average Burst power Frequency Error Phase Error EVM Origin Offset C/I Magnitude Error Script Master™

Setup Parameters	GSM/EDGE Select	Auto, GSM, EDGE
	Frequency	Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
	Amplitude	Power Offset, Auto Range, Adjust Range
	Sweep	Single/Continuous, Trigger Sweep
	Save/Recall	Setup, Measurement, Screen Shot (JPEG - save only), to Internal/External Memory
	Measurement Summary Screen	Overall Measurements
RF Measurements	Frequency Error	±10 Hz + time base error, 99% confidence level
	Occupied Bandwidth	Bandwidth within which lies 99% of the power transmitted on a single channel
	Burst Power Error	±1.5 dB, ±1 dB (typ.), (–50 to +20 dBm)
Demodulation Measurements	GMSK Modulation Quality (RMS Phase)	
	Measurement Accuracy	±1°
	Residual Error (GSMK)	1°
	8PSK Modulation Quality (EVM)	
	Measurement Accuracy	±1.5%
	Residual Error (8PSK)	2.5%

W-CDMA/HSPA+ Measurements (Option 881)

Measurements			
RF	Demodulation	Over-the-Air (OTA)	Pass/Fail
Band Spectrum Channel Spectrum Channel Power Occupied Bandwidth Peak-to-Average Power Spectral Emission Mask Single carrier ACLR Multi-carrier ACLR RF Summary	Code Domain Power Graph P-CPICH Power Channel Power Noise Floor EVM Carrier Feed Through Peak Code Domain Error Carrier Frequency Frequency Error Control Channel Power Abs/Rel/Delta Power CPICH, P-CCPCH S-CCPCH, PICH P-SCH, S-SCH HSPA+ Power vs. Time Constellation Code Domain Power Table Code, Status EVM, Modulation Type Power, Code Utilization Power Amplifier Capacity Codogram Modulation Summary	Scrambling Code Scanner (Six) Scrambling Codes CPICH E_C/I_O E_C Pilot Dominance OTA Total Power Multipath Scanner (Six) Six Multipaths Tau Distance RSCP Relative Power Multipath Power	View Pass/Fail Limits All, RF, Demod Available Measurements Max Output Power Frequency Error EVM CPICH Occupied Bandwidth Spectral Mask ACLR PCDE P-CCPCH S-CCPCH Code Spread 3 PICH Code 128 Test Models 1 (16), (32), (64) 2 3 (16), (32) 4 (+CPICH), (–CIPCH) 5 (2 HS), (4 HS), (8 HS)

Setup Parameters	Scrambling Code, Threshold	Auto, Manual
	User Selectable	Scrambling Code, S-CCPCH Spread, S-CCPCH Code, PICH Code, Threshold, Max Amp Power, CPICH Power, Frequency Error Average
	Maximum Spreading Factor	256, 512
	Frequency	Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
	Amplitude	Scale/Division, Power Offset, Auto Range, Adjust Range, Units (dBm/Watts)
	Marker	Six Markers, Table On/Off
	Sweep	Single/Continuous, Trigger Sweep
	Save/Recall	Setup, Measurement, Screen Shot (JPEG - save only), to Internal/External Memory
	Measurement Summary Screens	Overall Measurements, RF Measurements, Modulation Measurements
RF Measurements	RF Channel Power Accuracy	±1.25 dB, ±0.7 dB (typ.), (temperature range 15° to 35°C)
	Occupied Bandwidth Accuracy	±100 kHz
	Adjacent Channel Leakage Ratio (ACLR)	–54 dB/–59 dB ±0.8 dB @ 5 MHz/10 MHz offset (typ.), 824 MHz to 894 MHz, 1710 MHz to 2170 MHz –54 dB/–57 dB ±1.0 dB @ 5 MHz/10 MHz offset (typ.), 2300 MHz to 2700 MHz
Demodulation Measurements	W-CDMA Modulations	QPSK, QPSK-DTX (Codecs: AMR 4.75, 5.9, 7.4, 12.2 kbps, DTX 7.4, 12.2 kbps)
	HSPA+ Modulations	QPSK, 16 QAM, 64 QAM
	Frequency Error	±10 Hz + time base error, 99% confidence level
	EVM Accuracy	±2.5%, 6% ≤EVM ≤25%
	Residual EVM	2.5% (typ.)
	Code Domain Power	±0.5 dB for code channel power >–25 dB, 16, 32, 64 DCPH (test model 1), 16, 32 DCPH (test model 2, 3)
	CPICH (dBm) Accuracy	±0.8 dB (typ.)
Over-the-Air (OTA) Measurements	Scrambling Code Scanner	Six strongest Scrambling Codes
	Multipath Scanner	Multipath power of six signals relative to strongest pilot

TD-SCDMA/HSPA+ Measurements (Option 882)

Measurements			
RF	Demodulation	Over-the-Air (OTA)	Pass/Fail
Channel Spectrum Channel Power Occupied Bandwidth Left Channel Power Left Channel Occ B/W Right Channel Power Right Channel Occ B/W Power vs. Time Six Slot Powers Channel Power (RRC) DL-UL Delta Power UpPTS Power DwPTS Power On/Off Ratio Slot Peak-to-Average Power Spectral Emission RF Summary	Code Domain Power/Error (QPSK/8PSK/16 QAM/64 QAM) Slot Power DwPTS Power Noise Floor Frequency Error Tau Scrambling Code EVM Peak EVM Peak Code Domain Error CDP Marker Modulation Summary	Code Scan (32) Scrambling Code Group Tau E_c/I_o DwPTS Power Pilot Dominance Tau Scan (Six) Sync-DL# Tau E_c/I_o DwPTS Power Pilot Dominance Record Run/Hold	View Pass/Fail Limits All, RF, Demod Available Measurements Occupied Bandwidth Channel Power Channel Power RCC On/Off Ratio Peak-to-Average Ratio Frequency Error EVM Peak EVM Peak Code Domain Error Tau Noise Floor

Setup Parameters	Slot Selection	Auto, 0-6
	Trigger	Trigger Type (No Trigger/GPS/External), External Trigger (Rising/Falling), Tau Offset
	SYNC-DL Code	Auto, 0-31
	Scrambling/Midamble Code	Auto, 0-127
	Maximum Users	Auto, 2, 4, 6, 8, 10, 12, 14, 16
	Measurement Speed	Fast, Normal, Slow
	User Selectable	Uplink Switch Point, Number of Carriers (1, 3), Tau Offset
	Demodulation Type	Auto, QPSK, 8PSK, 16 QAM, 64 QAM
	Frequency	Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
	Amplitude	Scale/Division, Power Offset, Auto Range, Adjust Range, Units (dBm/Watts)
	Sweep	Hold/Run, Trigger Sweep
	Save/Recall	Setup, Measurement, Screen Shot (JPEG - save only), to Internal/External Memory
	Measurement Summary Screens	Overall Measurements, RF Measurements, Signal Quality Measurements
RF Measurements	RF Channel Power Accuracy (RRC)	±1.5 dB, ±1.0 dB (typ.), (slot power –40 to +10 dBm)
	Frequency Error	±10 Hz + time base error, in the presence of a downlink slot
Demodulation Measurements	Supported Modulation	QPSK, 8PSK, 16 QAM, 64 QAM
	Residual EVM (rms)	3% (typ.), P-CCPH Slot Power >–50 dBm
	PN Offset	Within 1 × 64 chips
	Pilot Power Accuracy	±1.0 dB (typ.)
	Timing Error (Tau) for Dominant SYNC-DL	±0.2 µs (external trigger)
	Spreading Factor	1, 16
Over-the-Air (OTA) Measurements	Code Scanner	32 Sync Codes and associated Scrambling Code Groups
	Tau Scanner	Six strongest Sync Codes
	Auto Save	Yes
	GPS Tagging and Logging	Yes

LTE/LTE-A FDD/TDD Measurements (Option 883 and 886)

LTE FDD Measurements			
RF	Modulation	Over-the-Air (OTA)	Pass/Fail
Channel Spectrum Channel Power Occupied Bandwidth ACLR Spectral Emission Mask Category A or B (Opt 1) RF Summary	Power vs. Resource Block (RB) RB Power (PDSCH) Active RBs, Utilization% Channel Power, Cell ID OSTP, Frame EVM by modulation Constellation QPSK, 16 QAM, 64 QAM 256 QAM Demod (Option 886) Modulation Results Ref Signal Power (RS) Sync Signal Power (SS) EVM – rms, peak, max hold Frequency Error – Hz, ppm Carrier Frequency Cell ID Control Channel Power Bar Graph or Table View RS, P-SS, S-SS PBCH, PCFICH, PHICH, PDCCH Total Power (Table View) EVM per Control Channel Tx Time Alignment Modulation Summary Includes EVM by modulation Antenna Icons Detects active antennas (1 or 2)	Scanner Cell ID (Group, Sector) S-SS, RSRP, RSRQ, SINR Dominance Modulation Results – On/Off Auto Save – On/Off Tx Test Scanner RS Power of MIMO antennas (2×2, 4×4) Cell ID, Average Power Delta Power (Max-Min) Graph of Antenna Power Modulation Results – On/Off Mapping On-screen S-SS, RSRP, RSRQ, or SINR Scanner Modulation Results – Off Carrier Aggregation Up to 5 component carriers (CC1 to CC5) CP, MIMO status, RS & SS Power, EVM, Frequency Error, Time Alignment Error, Cell ID	View Pass/Fail Limits All, RF, Modulation Available Measurements Channel Power Occupied Bandwidth ACLR Frequency Error Carrier Frequency Dominance EVM peak, rms Frame EVM, rms Frame EVM by mod type RS, SS Power RS EVM P-SS, S-SS, Power, EVM PBCH, PCFICH, PHICH, PDCCH Power, EVM Cell, Group, Sector ID OSTP Tx Time Alignment

Setup Parameters	Frequency	E-UTRA Bands 1 - 14, 17 - 21, 23 - 32, 66A (tunable 10 MHz to 4.0 GHz) Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
	Bandwidth (MHz)	1.4, 3, 5, 10, 15, 20
	Span (MHz)	Auto, 1.4, 3, 5, 10, 15, 20, 30
	Amplitude	Scale/Division, Power Offset, Auto Range, Adjust Range
	Sweep	Single/Continuous
	EVM Mode	Auto, PBCH only, Max Hold
	Cyclic Prefix (CP)	Auto, Normal, Extended
	Sync Type	Normal (SS), RS/Cell ID
	Save/Recall	Setup, Measurement, Screen Shot (JPEG - save only), to Internal/External Memory
	Measurement Summary Screens	Overall Measurements, RF Measurements, Modulation Measurements
LTE/LTE-A FDD RF Measurements	RF Channel Power Accuracy	±1.5 dB, ±1.0 dB (typ.), (RF input –50 to +10 dBm)
LTE/LTE-A FDD Modulation Measurements	RS Power Accuracy	±1.0 dB (typ.), (RF input –50 to +10 dBm)
	Frequency Error	±10 Hz + time base error, 99% confidence level
	Residual EVM (rms)	2.0% (typ.) (E-UTRA Test Model 3.1, RF Input –50 to +10 dBm)
LTE/LTE-A FDD Over-the-Air (OTA) Measurements	Scanner	Six strongest signals if present Auto Save – Sync Signal power and Modulation Results with GPS information
	Tx Test	Scanner – Three strongest signals if present RS Power – Strongest signal
	Mapping	Map On-screen S-SS, RSRP, RSRQ, or SINR of Cell ID with strongest signal Scanner – three strongest signals if present Save and Export Mapping data: KML, MTD (tab delimited)
	Carrier Aggregation	Up to 5 component carriers specified (CC1 to CC5) Automatic detection of CP and MIMO status for each active CC RS Power & RS Delta Power, SS Power, EVM (peak and rms), Freq Error (Hz & ppm), TAE, Cell ID

LTE/LTE-A FDD/TDD Measurements (Option 883 and 886) (continued)

LTE TDD Measurements			
RF	Modulation	Over-the-Air (OTA)	Pass/Fail
Channel Spectrum Channel Power Occupied Bandwidth Power vs. Time Frame View Sub-Frame View Total Frame Power DwPTS Power Transmit Off Power Cell ID Timing Error ACLR Spectral Emission Mask Category A or B (Opt 1) RF Summary	Power vs. Resource Block (RB) RB Power (PDSCH) Active RBs, Utilization% Channel Power, Cell ID OSTP, Frame EVM by modulation Constellation QPSK, 16 QAM, 64 QAM 256 QAM Demod (Option 886) Modulation Results Ref Signal Power (RS) Sync Signal Power (SS) EVM – rms, peak, max hold Frequency Error – Hz, ppm Carrier Frequency Cell ID Control Channel Power Bar Graph or Table View RS, P-SS, S-SS PBCH, PCFICH, PHICH, PDCCH Total Power (Table View) EVM per Control Channel Tx Time Alignment Modulation Summary Includes EVM by modulation Antenna Icons Detects active antennas (1/2)	Scanner Cell ID (Group, Sector) S-SS, RSRP, RSRQ, SINR Dominance Modulation Results – On/Off Tx Test Scanner RS Power of MIMO antennas Cell ID, Average Power Delta Power (Max-Min) Graph of Antenna Power Modulation Results – On/Off Mapping On-screen S-SS, RSRP, RSRQ, or SINR Scanner Modulation Results – Off Carrier Aggregation Up to 5 component carriers (CC1 to CC5) CP, MIMO status, RS & SS Power, EVM, Frequency Error, Time Alignment Error, Cell ID	View Pass/Fail Limits All, RF, Modulation Available Measurements Channel Power Occupied Bandwidth ACLR Frequency Error Carrier Frequency Dominance EVM peak, rms Frame EVM, rms Frame EVM by mod type RS, SS Power RS EVM P-SS, S-SS, Power, EVM PBCH, PCFICH, PHICH, PDCCH Power, EVM Cell, Group, Sector ID OSTP Tx Time Alignment Frame Power DWPTS Power Transmit Off Power Timing Error

Setup Parameters	Frequency	E-UTRA bands 33 - 43 (tunable 10 MHz to 4.0 GHz) Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
	Bandwidth (MHz)	1.4, 3, 5, 10, 15, 20
	Span (MHz)	Auto, 1.4, 3, 5, 10, 15, 20, 30
	Amplitude	Scale/Division, Power Offset, Auto Range, Adjust Range
	Sweep	Single/Continuous, Trigger Sweep
	EVM Mode	Auto, PBCH only, Max Hold
	Cyclic Prefix (CP)	Auto, Normal, Extended
	Trigger	No Trigger/Ext Trigger, Rising/Falling
	Uplink/Downlink Configuration	0 to 6
	Save/Recall	Setup, Measurement, Screen Shot (JPEG - save only), to Internal/External Memory
	Measurement Summary Screens	Overall Measurements, RF Measurements, Modulation Measurements
LTE/LTE-A TDD RF Measurements	RF Channel Power Accuracy	±1.5 dB, ±1.0 dB (typ.), (RF input –30 to +10 dBm)
LTE/LTE-A TDD Modulation Measurements	RS Power Accuracy	±1.0 dB (typ.), (RF input –50 to +10 dBm)
	Frequency Error	±10 Hz + time base error, 99% confidence level
	Residual EVM (rms)	2.0% (typ.) (E-UTRA Test Model 3.1, RF Input –30 to +10 dBm)
LTE/LTE-A TDD Over-the-Air (OTA) Measurements	Scanner	Six strongest signals if present Auto Save – Sync Signal power and Modulation Results with GPS information
	Tx Test	Scanner – Three strongest signals if present RS Power – Strongest signal
	Mapping	Map On-screen S-SS, RSRP, RSRQ, or SINR of Cell ID with strongest signal Scanner – three strongest signals if present Save and Export Mapping data: *.kml, *.mtd (tab delimited)
	Carrier Aggregation	Up to 5 component carriers specified (CC1 to CC5) Automatic detection of CP and MIMO status for each active CC RS Power & RS Delta Power, SS Power, EVM (peak and rms), Freq Error (Hz & ppm), TAE, Cell ID

CDMA/EV-DO Measurements (Option 884)

CDMA Measurements			
RF	Demodulation	Over-the-Air (OTA)	Pass/Fail
Channel Spectrum Channel Power Occupied Bandwidth Peak-to-Average Power Spectral Emission Mask Single Carrier ACPR Multi-carrier ACPR RF Summary	Code Domain Power Graph Pilot Power Channel Power Noise Floor Rho Carrier Feed Through Tau RMS Phase Error Frequency Error Abs/Rel/ Power Pilot Page Sync Q Page Code Domain Power Table Code Status Power Multiple Codes Code Utilization Modulation Summary	Pilot Scanner (Nine) PN E_c/I_o Tau Pilot Power Channel Power Pilot Dominance Multipath Scanner (Six) E_c/I_o Tau Channel Power Multipath Power Limit Test – 10 Tests Averaged Rho Adjusted Rho Multipath Pilot Dominance Pilot Power Pass/Fail Status	View Pass/Fail Limits All, RF, Modulation Available Measurements Channel Power Occupied Bandwidth Peak-to-Average Power Spectral Mask Test Frequency Error Channel Frequency Pilot Power Noise Floor Rho Carrier Feed Through Tau RMS Phase Error Code Utilization Measured PN Pilot Dominance Multipath Power

CDMA Setup Parameters	PN Setup	PN Trigger (No Trigger, GPS, External), PN Search Type (Auto, Manual), PN Offset
	Walsh Codes	64, 128
	Measurement Speed	Fast, Normal, Slow
	External Trigger Polarity	Rising, Falling
	Number of Carriers	1 to 5
	Carrier Bandwidth (MHz)	1.23, 1.24, 1.25
	Frequency	Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
	Amplitude	Scale/Division, Power Offset, Auto Range, Adjust Range, Units (dBm/Watts)
	Sweep	Single/Continuous, Trigger Sweep
	Save/Recall	Setup, Measurement, Screen Shot (JPEG - save only), to Internal/External Memory
	Measurement Summary Screens	Overall Measurements, RF Measurements, Signal Quality Measurements
CDMA RF Measurements	RF Channel Power Accuracy	±1.5 dB, ±1.0 dB (typ.), (RF input –50 to +20 dBm)
CDMA Demodulation Measurements	Frequency Error	±10 Hz + time base error, 99% confidence level (in slow mode)
	Rho Accuracy	±0.005, for Rho >0.9
	Residual Rho	>0.995 (typ.), >0.99 (max.), (RF input –50 to +20 dBm)
	PN Offset	1 × 64 chips
	Pilot Power Accuracy	±1.0 dB (typ.), relative to channel power
	Tau	±0.5 µs (typ.), ±1.0 µs (max.)
CDMA Over-the-Air (OTA) Measurements	Pilot Scanner	Nine strongest pilots
	Multipath Scanner	Multipath power of six signals relative to strongest pilot
	Limit Test	Average of ten tests compared to limit

CDMA/EV-DO Measurements (Option 884) (continued)

EV-DO Measurements			
RF	Demodulation	Over-the-Air (OTA)	Pass/Fail
Channel Spectrum Channel Power Occupied Bandwidth Peak-to-Average Power Power vs. Time Pilot & MAC Power Channel Power Frequency Error Idle Activity On/Off Ratio Spectral Emission Mask Single Carrier ACPR Multi-carrier ACPR RF Summary	MAC Code Domain Power Graph Pilot & MAC Power Channel Power Frequency Error Rho Pilot Rho Overall Data Modulation Noise Floor MAC Code Domain Power Table Code Status Power Code Utilization Data Code Domain Power Active Data Power Data Modulation Rho Pilot Rho Overall Maximum Data CDP Minimum Data CDP Modulation Summary	Pilot Scanner (Nine) PN E_c/I_o Tau Pilot Power Channel Power Pilot Dominance Mulitpath Scanner (Six) E_c/I_o Tau Channel Power Multipath Power	View Pass/Fail Limits All, RF, Modulation Available Measurements Channel Power Occupied Bandwidth Peak-to-Average Power Carrier Frequency Frequency Error Spectral Mask Noise Floor Pilot Power RMS Phase Error Tau Code Utilization Measured PN Pilot Dominance Mulitpath Power

Setup Parameters	PN Setup	PN Trigger (No Trigger, GPS, External), PN Search Type (Auto, Manual), PN Offset
	Walsh Codes	64, 128
	Measurement	Speed Fast, Normal, Slow
	External Trigger Polarity	Rising, Falling
	Slot Type	Auto, Active, Idle
	Number of Carriers	1 to 5
	Carrier Bandwidth (MHz)	1.23, 1.24, 1.25
	Frequency	Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
	Amplitude	Scale/Division, Power Offset, Auto Range, Adjust Range, Units (dBm/W)
	Sweep	Single/Continuous, Trigger Sweep
	Save/Recall	Setup, Measurement, Screen Shots (JPEG - save only), to Internal/External Memory
	Measurement Summary Screens	Overall Measurements, RF Measurements, Modulation Measurements
EV-DO RF Measurements	RF Channel Power Accuracy	±1.5 dB; ±1.0 dB (typ.) (RF input –50 to +20 dBm)
EV-DO Demodulation Measurements	EV-DO Compatibility	Rev 0 and Rev A
	Frequency Error	±10 Hz + time base error, 99% confidence level
	Rho Accuracy	±0.01, for Rho >0.9
	Residual Rho	>0.995 (typ.), >0.99 (max.) (RF input –50 to +20 dBm)
	PN Offset	Within 1 × 64 chips
	Pilot Power Accuracy	±1.0 dB (typ.), relative to channel power
	Tau	±0.5 µs (typ.), ±1.0 µs (max.)
EV-DO Over-the-Air (OTA) Measurements	Pilot Scanner	Nine strongest pilots
	Multipath Scanner	Multipath power of six signals relative to strongest pilot

WiMAX Fixed/Mobile Measurements (Option 885)

WiMAX Fixed Measurements			
RF	Demodulation	Over-the-Air (OTA)	Pass/Fail
Channel Spectrum Channel Power Occupied Bandwidth Power vs. Time Channel Power Preamble Power Data Burst Power Crest Factor ACPR RF Summary	Constellation RCE (RMS/Peak) EVM (RMS/Peak) Frequency Error Carrier Frequency Base Station ID Spectral Flatness Adjacent Subcarrier Flatness EVM vs. Subcarrier/Symbol RCE EVM Frequency Error Carrier Frequency Base Station ID Sector ID (Mobile) Modulation Summary	There are no additional OTA Measurements RF and Demodulation Measurements can be made OTA	View Pass/Fail Limits All, RF, Modulation Available Measurements Channel Power Occupied Bandwidth Burst Power Preamble Power Crest Factor Frequency Error Carrier Frequency EVM RCE Base Station ID

Setup Parameters	Bandwidth (MHz)	1.25, 1.50, 2.50, 3.50, 5.00, 5.50, 6.00, 7.00, 10.00
	Cyclic Prefix Ratio (CP)	1/4, 1/8, 1/16, 1/32
	Span (MHz)	5, 10, 15, 20
	Frame Length (ms)	2.5, 5.0, 10.0
	Frequency	Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
	Amplitude	Scale/Division, Power Offset, Auto Range, Adjust Range
	Sweep	Single/Continuous, Trigger Sweep
	Save/Recall	Setup, Measurement, Screen Shot (JPEG - save only), to Internal/External Memory
	Measurement Summary Screens	Overall Measurements, RF Measurements, Modulation Measurements
WiMAX Fixed RF Measurements (temperature range 15° to 35°C)	RF Channel Power Accuracy	±1.5 dB; ±1.0 dB (typ.), (RF input –50 to +20 dBm)
WiMAX Fixed Demodulation Measurements (temperature range 15° to 35°C)	Frequency Error	7 × 10^{-8} + time base error, 99% confidence level
	Residual EVM (rms)	3% (typ.), 3.5% (max.) (RF Input –50 to +20 dBm)

WiMAX* Fixed/Mobile Measurements (Option 885) (continued)

WiMAX Mobile^5 Measurements			
RF	Demodulation	Over-the-Air (OTA)	Pass/Fail
Channel Spectrum Channel Power Occupied Bandwidth Power vs. Time Channel Power Preamble Power Downlink Burst Power Uplink Burst Power ACPR Spectral Emission Mask RF Summary	Constellation RCE (RMS/Peak) EVM (RMS/Peak) Frequency Error CINR Base Station ID Sector ID Spectral Flatness Adjacent Subcarrier Flatness EVM vs. Subcarrier/Symbol RCE (RMS/Peak) EVM (RMS/Peak) Frequency Error CINR Base Station ID Sector ID DL-MAP (Tree View) Modulation Summary	Channel Power Monitor Preamble Scanner (Six) Preamble Relative Power Cell ID Sector ID PCINR Dominant Preamble Base Station ID Auto Save - On/Off	View Pass/Fail Limits All, RF, Modulation Available Measurements Channel Power Occupied Bandwidth Downlink Burst Power Uplink Burst Power Preamble Power Crest Factor Frequency Error Carrier Frequency EVM RCE Sector ID

Setup Parameters	Zone Type	PUSC
	DL-MAP Auto Decoding	Convolutional Coding (CC), Convolutional Turbo Coding (CTC)
	Bandwidths (MHz)	3.50, 5.00, 7.00, 8.75, 10.00
	Cyclic Prefix Ratio (CP)	1/8
	Span (MHz)	5, 10, 20, 30
	Frame Lengths (ms)	5, 10
	Demodulation	Auto, Manual, FCH
	Frequency	Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
	Amplitude	Scale/Division, Power Offset, Auto Range, Adjust Range
	Sweep	Single/Continuous, Trigger Sweep
	Save/Recall	Setup, Measurement, Screen Shot (JPEG - save only), to Internal/External Memory
	Measurement Summary Screens	Overall Measurements, RF Measurements, Modulation Measurements
WiMAX Mobile RF Measurements (temperature range 15° to 35°C)	RF Channel Power Accuracy	±1.5 dB; ±1.0 dB (typ.), (RF input –50 to +20 dBm)
WiMAX Mobile Demodulation Measurements (temperature range 15° to 35°C)	Frequency Error	2×10^{-8} plus time base error, 99% confidence level
	Residual EVM (rms)	2.5% (typ.), 3.0% (max.) (RF Input –50 to +20 dBm)
WiMAX Mobile Over-the-Air (OTA) Measurements	Channel Power Monitor	Over time (one week), measurement time interval 1 s to 60 s
	Preamble Scanner	Six strongest Preambles
	Auto Save	Yes
	GPS Tagging and Logging	Yes

*: Mobile WiMAX conforms to IEEE Std. 802.16e-2005, WiMAX Forum® Air Interface – Mobile System Profile – Release 1.0 Certified, System Profiles according to WMF-T24-001-R010v07

General Specifications

Setup Parameters	System	Status (Temperature, Battery Info, S/N, Firmware Version, Installed Options) Self Test, Application Self Test, GPS (see Option 31) Name, Date and Time, Ethernet Configuration, Volume
	System Options	Display (Brightness, Blank, Default, Black & White, Night Vision, High Contrast, Invert Black & White) Language (English, French, German, Spanish, Chinese, Japanese, Korean, Italian, Russian, Portuguese) Reset (Factory Defaults, Master Reset, Update Firmware) Share Center Frequency and Power (All Modes are Not Shared) Power-On (via Power Switch or when DC is Applied)
	File	Save As, Save Meas, Save, Save On Event, Recall Meas, Recall, Copy, Delete
	Save/Recall	Setups, Measurements, Screen Shots (JPEG - save only), Limit Lines, Spurious Emissions Mask, Mapping results (for options with mapping), including KML with or without altitude, tab-delimited
	Delete	By File Type, All, Selected
	Internal Trace/Setup Memory	>40,000 single-trace measurements; >500 Spectrograms, each with 156 traces (with Option 25)
	External Trace/Setup Memory	Limited by size of USB Flash Drive
Connectors	RF In	9 GHz to 20 GHz Instruments: Type N (f), 50Ω 32 GHz to 43 GHz Instruments: Ruggedized Type K, male
	RF Out	9 GHz to 20 GHz Instruments: Type N (f), 50Ω
	GPS	SMA (f)
	External Power	5.5 mm barrel connector, 12 to 14.5 VDC, <5.0 A
	LAN Connection	RJ48C, 10/100 Mbps, Connect to PC or LAN for Remote Access
	USB Interface	Two Type A, Connect FAT 32 formatted Flash Drive, and Power Sensor; 5-pin mini-B, Connect to PC for data transfer
	Headset Jack	3.5 mm 3-wire headset jack
	External Reference In	BNC (f), 50Ω, Maximum Input +10 dBm
	External Reference Out	BNC (f), 50Ω, 10 MHz
	External Trigger	BNC (f), 50Ω, TTL-compatible levels, Maximum Input +5 VDC
	IF Out	BNC (f), 50Ω, 140 MHz (nom.)
Display and Keyboard	Display	8.4 inch Touch Screen, 800 × 600 Resolution
	Pixel Defects	No more than five defective pixels (99.9989% good pixels)
	Keyboard	Backlit (Red for Night Vision, White for all other display modes)
Battery	Type, Operation	Li-Ion, 3 hour operation (typ.)
	Battery Charging Limits	0° to +45°C, Relative Humidity ≤80%
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU
	Australia and New Zealand	RCM AS/NZS 4417:2012
	South Korea	KCC-REM-A21-0004
Warranty	Duration	Standard three-year warranty One-year warranty on battery
Environmental	Operating Temperature Range	–10° to +55°C
	Storage Temperature Range	–40° to +71°C
	Maximum Relative Humidity	95% RH at 40°C, non-condensing
	Vibration, Sinusoidal	5 Hz to 55 Hz
	Vibration, Random	10 Hz to 500 Hz
	Half Sine Shock	30 g_n
	Altitude	4600 m, operating and non-operating
	Explosive Atmosphere	MIL-PRF-28800F Section 4.5.6.3 MIL-STD-810G, Method 511.5, Procedure 1
Dimensions and Mass	Dimensions	315 (W) × 211 (H) × 77 (D) mm, (12.4 × 8.3 × 3.0 in)
	Mass	3.7 kg to 4.4 kg (8.1 lb to 9.8 lb) depending on Frequency Option and Tracking Generator

easyTest Tools™ (for your PC)

Instrument Modes	Spectrum Analyzer	
	Interference Analyzer	
	Channel Scanner	
	AM/FM/PM Analyzer	
Commands	Display Image	Allows putting a custom image on the instrument screen
	Recall Setup	Places the instrument into a known state; auto-advance to next command available
	Prompt	Displays instructional messages on the instrument screen; timed advance to next command available; instrument users can be allowed or disallowed from making setup adjustments
	Save	Allows automatic or manual saving of traces; auto-advance to next command available

easyMap Tools™ (create instrument-compatible maps on your PC)

Outdoor Maps	On-Line Sources	Google Maps, Cloud Made Open-Source Maps
	Pan & Zoom Mode	AZM map file format allows pan and zoom on-instrument
	Legacy Mode	MAP format is compatible with older firmware
	Geo-Referenced	Works with instrument based GPS
	Map Conversion	Convert scanned maps to geo-referenced
Indoor Maps	Sources	Scanned images in JPG, JPEG, JPE, JFIF, GIF, TIF, TIFF, PNG
General	Color Filter	Grayscale, High Contrast
	Coverage	Worldwide
	Zoom Levels	16 total zoom levels, 7 available in any one map
	Map Size	Less than 1 MB to over 1 GB

Master Software Tools (for your PC)

Measurement Viewing	Display	Modify display settings, including scale
	Spectrum Traces	Add, delete, and modify limit lines and markers. Overlay traces.
	Spectrum Analyzer Measurements	Field Strength, Occupied Bandwidth, Channel Power, ACPR, Emission Mask, C/I*1
	Interference Analyzer Measurements	Spectrograms, Signal Strength Meter, RSSI*2
	Non-Spectrum Measurements	Hi Accuracy Power Meter, Channel Scanner, GSM, W-CDMA/HSPA, LTE, TD-LTE, TD-SCDMA, CDMA, EV-DO, Fixed WiMAX, Mobile WiMAX, Screen captures (JPEGs)
Database Management	Full Trace Retrieval	Retrieve all traces from instrument into one PC directory (limited to approximately 15,000 files)
	Trace Catalog	Index all traces in selected folder & subfolder on PC into one catalog
	Trace Rename Utility	Rename measurement traces
	Group Edit	Titles, subtitles, plot scaling, markers and limit lines, simultaneously on similar files
Data Analysis	Trace Math and Smoothing	Compare multiple traces
	Measurement Calculator	Translate into other units
Report Generation	Report Generator	Includes GPS, power level, and with measurements
	Edit Graph	Change scale, limit lines, and markers
	Report Format	Create reports in HTML
	Export Measurements	Export measurements or entire folders to *.jpg or *.csv format
	Notes	Annotate measurements
Mapping (GPS Required)	Spectrum Analyzer Mode	MapInfo
	LTE Mode	Google Earth, Google Maps
Spectrogram (Spectrum Monitoring for Interference Analysis and Spectrum Clearing)	Source	Recorded Spectrogram or multiple spectrum traces
	Folder Spectrogram	2D View creates a composite file of multiple traces
	Available Displays	Spectrogram, Peak Power vs. Time, Variation in Total Power vs. Time, Peak Frequency vs. Time, Number of Traces Saved vs. Time (useful with Save on Limit Exceeded), Maximum/Average/Minimum Power vs. Time File Filter (Violations over limit lines or deviations from averages) Playback
	Display Functions per Trace	Markers, GPS location altitude and time (when recorded), instrument time Filename per trace for Folder Spectrogram
	Export to Video	Create AVI file of 2D Spectrogram for management review/reports
	Export to 3D Spectrogram	Views (Set Threshold, Markers) - 3D (Rotate X, Y, Z Axis, Level Scale, Signal ID) - 2D (Frequency or Time Domain, Signal ID) - Top Down Playback (Frequency and/or Time Domain)
List/Parameter Editors	Antennas, Cables, Signal Standards	Modify instrument's Antenna, Cable, and Signal Standard List
	Pass/Fail	Create, download, or edit Signal Analysis Pass/Fail Limits
	Script Master	Create Script Master files for GSM/W-CDMA or Channel Scanner
	Languages	Modify non-English language menus
	Mobile WiMAX	DL-MAP Parameters
Connectivity	Connections	Connect to PC using USB, LAN, or Direct Ethernet connection
	Network Search	Find all Anritsu handheld instruments on local network
	Download	Download measurements and live traces to PC for storage and analysis
	Upload	Upload measurements from PC to instrument
	Remote Access Tool	Remote control and monitoring of instrument (via Ethernet port) over the Internet
	Export	Measurements can be saved in various formats, depending on the measurement type, including JPEG, CSV, and Anritsu DAT format
	Printing	Print individual or all measurement screens

*1: Spurious Emissions results viewable in a browser
*2: Coverage Mapping and Interference Mapping files viewable in spreadsheet, Google Earth, or Google Maps

Web Remote Control

Control	Full instrument control through a browser – all instrument functions except power switch and rotary knob
Connections	RJ45 Ethernet jack Third party Wi-Fi router
Protocol	HTTP/TCP/IP
Physical Layer	Cat 5 Cable, Wi-Fi router compatible
Software Required	HTML 5 Compliant Browser – Newer versions of Chrome, Firefox, Internet Explorer and others
Operating System	iOS, Windows, Linux, Android operating systems that can host the HTML 5 Compliant browser
Remote Hardware	PCs, Tablets, and Smart Phones with Ethernet or Wi-Fi connections and a HTML 5 Compliant browser
Download	Individual instrument files downloaded via browser Multiple instrument files and directories zipped and downloaded via browser Screen capture capability
Display Modes	Normal: All modes & displays supported Fast: Spectrum traces update faster (up to 5 updates per second)
Password	The instrument can be password protected Passwords may be used to manage who is controlling the instrument
Users/Instruments	One user/device can view and control many instruments

Programmable Remote Control

Functionality	Many instrument functions are programmable. See the Programming Manual for details.
Programming Language	Standard Commands for Programmable Instruments (SCPI)
Interfaces	USB, Ethernet
Available Drivers	LabView. Visit NI.com for driver.

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main Frame
MS2720T	Spectrum Master (Requires Option 709, 713, 720, 732, or 743)
	Frequency Options
MS2720T-0709	Frequency Range 9 kHz to 9 GHz
MS2720T-0713	Frequency Range 9 kHz to 13 GHz
MS2720T-0720	Frequency Range 9 kHz to 20 GHz
MS2720T-0732	Frequency Range 9 kHz to 32 GHz
MS2720T-0743	Frequency Range 9 kHz to 43 GHz
	Tracking Generator Options
MS2720T-0809	9 GHz Tracking Generator (Requires Option 709)
MS2720T-0813	13 GHz Tracking Generator (Requires Option 713)
MS2720T-0820	20 GHz Tracking Generator(Requires Option 720)
	Spectrum Analyzer Options
MS2720T-0025	Interference Analyzer (Option 31 is recommended)
MS2720T-0027	Channel Scanner
MS2720T-0431	Coverage Mapping (Requires Option 31 for full functionality)
MS2720T-0444	EMF Measurements (Requires Anritsu Isotropic Antenna)
MS2720T-0509	AM/FM/PM Measurements (Option 431 required for full functionality)
MS2720T-0024	I/Q Waveform Capture (Requires Option 9)
MS2720T-0089	Zero-Span IF Output
MS2720T-0090	Gated Sweep
	Power Meter Option
MS2720T-0019	High Accuracy Power Meter (Requires USB Power Sensor, sold separately)
	Wireless Measurement Options
MS2720T-0009	Demodulation Hardware
MS2720T-0880	GSM/GPRS/EDGE Measurements (Requires Option 9)
MS2720T-0881	W-CDMA/HSPA+ Measurements (Requires Option 9, Option 31 recommended)
MS2720T-0882	TD-SCDMA/HSPA+ Measurements (Requires Option 9, Option 31 required for full functionality)
MS2720T-0883	LTE/LTE-A FDD/TDD Measurements (Requires Option 9, Option 31 required for full functionality)
MS2720T-0884	CDMA/EV-DO Measurements (Requires Option 9, Option 31 required for full functionality)
MS2720T-0885	WiMAX Fixed/Mobile Measurements (Requires Option 9, Option 31 required for full functionality)
MS2720T-0886	LTE 256-QAM Demodulation (Requires Option 883)
MS2720T-0887	NB-IoT Measurement (requires Option 9)

Model/Order No.	Name
	General Options
MS2720T-0007	Secure Data Operation
MS2720T-0031	GPS Receiver (Requires GPS Antenna, sold separately) - 2000-1528-R GPS Antenna, SMA (m) with 5 m (15 ft) cable, requires 5 VDC - 2000-1652-R GPS Antenna, SMA (m) with 0.3 m (1 ft) cable, requires 3.3 VDC or 5 VDC - 2000-1760-R GPS Antenna, SMA (m) with no cable, 2.5 VDC to 3.7 VDC
MS2720T-0098	Standard Calibration to ISO17025 and ANSI/NCSL Z540-1
MS2720T-0099	Premium Calibration to ISO17025 and ANSI/NCSL Z540-1 Provides everything included with Option 98 plus test report and uncertainty data.
	Power Sensors (for complete ordering information see the respective datasheets of each sensor)
MA24105A	Inline Peak Power Sensor, 350 MHz to 4 GHz, +3 to +51.76 dBm
MA24106A	RF USB Power Sensor, 50 MHz to 6 GHz, +23 dBm
MA24108A	Microwave USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24118A	Microwave USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24126A	Microwave USB Power Sensor, 10 MHz to 26 GHz, +20 dBm
MA24208A	Microwave Universal USB Power Sensor, 10 MHz to 8 GHz, +20 to –60 dBm
MA24218A	Microwave Universal USB Power Sensor, 10 MHz to 18 GHz, +20 to –60 dBm
MA24330A	Microwave CW USB Power Sensor, 10 MHz to 33 GHz, +20 to –60 dBm
MA24340A	Microwave CW USB Power Sensor, 10 MHz to 40 GHz, +20 to –60 dBm
MA24350A	Microwave CW USB Power Sensor, 10 MHz to 50 GHz, +20 to –60 dBm
MA25100A	RF Power Indicator
	Manuals (soft copy at www.anritsu.com)
10580-00340	Spectrum Master User Guide
10580-00349	Spectrum Analyzer Measurement Guide
10580-00339	Tracking Generator Measurement Guide
10580-00240	Power Meter Measurement Guide
10580-00234	3GPP Signal Analyzer Measurement Guide
10580-00235	3GPP2 Signal Analyzer Measurement Guide
10580-00236	WiMAX Signal Analyzer Measurement Guide
10580-00341	Spectrum Master Programming Manual
10580-00342	Spectrum Master Maintenance Manual

Continued on next page

Model/Order No.	Name
	Troubleshooting Guides
	OBSAI LTE RF Analyzer Measurement Guide
11410-00551	Spectrum Analyzers
11410-00472	Interference
11410-00566	LTE eNodeB Base Stations
11410-00615	TD-LTE eNodeB Testing
11410-00466	GSM/GPRS/EDGE Base Stations
11410-00463	W-CDMA/HSDPA Base Stations
11410-00465	TD-SCDMA/HSDPA Base Stations
11410-00467	cdmaOne/CDMA2000 1X Base Stations
11410-00468	CDMA2000 1xEV-DO Base Stations
11410-00470	Fixed WiMAX Base Stations
11410-00469	Mobile WiMAX Base Stations
	Standard Accessories (included with instrument)
2000-1371-R	Ethernet Cable, 213 cm (7 ft)
2000-1685-R	Soft Carrying Case
2000-1691-R	Stylus with Coiled Tether
2000-1797-R	Touchscreen Protective Film, 8.4 in
633-75	Rechargeable Li-Ion Battery, 7500 mAh
40-187-R	AC-DC Adapter
806-141-R	Automotive Power Adapter, 12 VDC, 60 W
3-2000-1498	USB A15-pin mini-B Cable, 10 ft/305 cm
	Optional Accessories
	GPS Antennas
2000-1528-R	GPS Antenna, SMA (m) with 5 m (15 ft) cable, 3 dBi gain, requires 5 VDC
2000-1652-R	GPS Antenna, SMA (m) with 0.3 m (1 ft) cable, 5 dBi gain, requires 3.3 VDC or 5 VDC
2000-1760-R	GPS Antenna, SMA (m), 25 dB gain, 2.5 VDC to 3.7 VDC
	Directional Antennas
2000-1411-R	824 MHz to 896 MHz, N (f), 12.3 dBi, Yagi
2000-1412-R	885 MHz to 975 MHz, N (f), 12.6 dBi, Yagi
2000-1413-R	1710 MHz to 1880 MHz, N (f), 12.3 dBi, Yagi
2000-1414-R	1850 MHz to 1990 MHz, N (f), 11.4 dBi, Yagi
2000-1415-R	2400 MHz to 2500 MHz, N (f), 14.1 dBi, Yagi
2000-1416-R	1920 MHz to 2170 MHz, N (f), 14.3 dBi, Yagi
2000-1659-R	698 MHz to 787 MHz, N (f), 10.1 dBi, Yagi
2000-1660-R	1425 MHz to 1535 MHz, N (f), 14.3 dBi, Yagi
2000-1715-R	698 MHz to 2500 MHz, N (f), gain of 2 dBi to 10 dBi (typ.)
2000-1726-R	Antenna, 2500 MHz to 2700 MHz N (f), 14.1 dBi, Yagi
2000-1747-R	Antenna, Log Periodic, 300 MHz to 7000 MHz, N (f), 5.1 dBi (typ.)
2000-1748-R	Antenna, Log Periodic, 1 GHz to 18 GHz, N (f), 6 dBi (typ.)
2000-1777-R	Portable Directional Antenna, 9 kHz to 20 MHz, N (f)
2000-1778-R	Portable Directional Antenna, 20 MHz to 200 MHz, N (f)
2000-1779-R	Portable Directional Antenna, 200 MHz to 500 MHz, N (f)
2000-1812-R	Portable Yagi Antenna, 450 MHz to 512 MHz, N (f), 7.1 dBi
2000-1825-R	Portable Yagi Antenna, 380 MHz to 430 MHz, N (f), 7.1 dBi
	Portable Antennas
2000-1200-R	806 MHz to 866 MHz, SMA (m), 50Ω
2000-1473-R	870 MHz to 960 MHz, SMA (m), 50Ω
2000-1035-R	896 MHz to 941 MHz, SMA (m), 50Ω (1/2 wave)
2000-1030-R	1710 MHz to 1880 MHz, SMA (m), 50Ω (1/2 wave)
2000-1474-R	1710 MHz to 1880 MHz with knuckle elbow (1/2 wave)
2000-1031-R	1850 MHz to 1990 MHz, SMA (m), 50Ω (1/2 wave)
2000-1475-R	1920 MHz to 1980 MHz and 2110 MHz to 2170 MHz, SMA (m), 50Ω
2000-1032-R	2400 MHz to 2500 MHz, SMA (m), 50Ω (1/2 wave)
2000-1361-R	2400 MHz to 2500 MHz, 5000 MHz to 6000 MHz, SMA (m), 50Ω
2000-1751-R	698 MHz to 960 MHz, 1710 MHz to 2100 MHz, 2500 MHz to 2700 MHz, SMA (m), 2 dB (typ.), 50Ω
2000-1636-R	Antenna Kit (Consists of: 2000-1030-R, 2000-1031-R, 2000-1032-R, 2000-1200-R, 2000-1035-R, 2000-1361-R, and carrying pouch)
	Isotropic Antenna
2000-1791-R	700 MHz to 6000 MHz, N (m)
2000-1792-R	30 MHz to 3000 MHz, N (m)
2000-1800-R	9 kHz to 300 MHz, N (m)
	Mag Mount Broadband Antenna
2000-1616-R	20 MHz to 21000 MHz, N(f), 50Ω
2000-1645-R	694 MHz to 894 MHz, 3 dBi peak gain, 1700 MHz to 2700 MHz, 3 dBi peak gain, N (m), 50Ω, 3 m (10 ft)
2000-1646-R	750 MHz to 1250 MHz, 3 dBi peak gain, 1650 MHz to 2700 MHz, 5 dBi peak gain
2000-1647-R	Cable 1: 698 MHz to 1200 MHz, 2 dBi peak gain, 1700 MHz to 2700 MHz, 5 dBi peak gain, N (m), 50Ω, 3 m (10 ft) Cable 2: 3000 MHz to 6000 MHz, 5 dBi peak gain, N (m), 50Ω, 3 m (10 ft) Cable 3: GPS 26 dB gain, SMA (m), 50Ω, 3 m (10 ft)
2000-1648-R	1700 MHz to 6000 MHz, 3 dBi peak gain, N (m), 50Ω, 3 m (10 ft)

Model/Order No.	Name
	Bandpass Filters
1030-114-R	806 MHz to 869 MHz, N (m) to SMA (f), 50Ω
1030-109-R	824 MHz to 849 MHz, N (m) to SMA (f), 50Ω
1030-110-R	880 MHz to 915 MHz, N (m) to SMA (f), 50Ω
1030-111-R	1850 MHz to 1910 MHz, N (m) to SMA (f), 50Ω
1030-112-R	2400 MHz to 2484 MHz, N (m) to SMA (f), 50Ω
1030-105-R	890 MHz to 915 MHz, N (m) to SMA (f), 50Ω
1030-106-R	1710 MHz to 1790 MHz, N (m) to SMA (f), 50Ω
1030-107-R	1910 MHz to 1990 MHz, N (m) to SMA (f), 50Ω
1030-149-R	High Pass, 150 MHz, N (m) to N (f), 50Ω
1030-150-R	High Pass, 400 MHz, N (m) to N (f), 50Ω
1030-151-R	High Pass, 700 MHz, N (m) to N (f), 50Ω
1030-152-R	Low Pass, 200 MHz, N (m) to N (f), 50Ω
1030-153-R	Low Pass, 550 MHz, N (m) to N (f), 50Ω
1030-155-R	2500 MHz to 2700 MHz, N (m) to N (f), 50Ω
1030-178-R	1920 MHz to 1980 MHz, N (m) to N (f), 50Ω
1030-179-R	777 MHz to 798 MHz, N (m) to N (f), 50Ω
1030-180-R	2500 MHz to 2570 MHz, N (m) to N (f), 50Ω
2000-1684-R	791 MHz to 821 MHz, N (m) to N (f), 50Ω
2000-1734-R	Bandpass Filter, 699 MHz to 715 MHz, N (m) to N (f), 50Ω
2000-1735-R	Bandpass Filter, 776 MHz to 788 MHz, N (m) to N (f), 50Ω
2000-1736-R	Bandpass Filter, 815 MHz to 850 MHz, N (m) to N (f), 50Ω
2000-1737-R	Bandpass Filter, 1711 MHz to 1756 MHz, N (m) to N (f), 50Ω
2000-1738-R	Bandpass Filter, 1850 MHz to 1910 MHz, N (m) to N (f), 50Ω
2000-1739-R	Bandpass Filter, 880 MHz to 915 MHz, N (m) to N (f), 50Ω
2000-1740-R	Bandpass Filter, 1710 MHz to 1785 MHz, N (m) to N (f), 50Ω
2000-1741-R	Bandpass Filter, 1920 MHz to 1980 MHz, N (m) to N (f), 50Ω
2000-1742-R	Bandpass Filter, 832 MHz to 862 MHz, N (m) to N (f), 50Ω
2000-1743-R	Bandpass Filter, 2500 MHz to 2570 MHz, N (m) to N (f), 50Ω
2000-1799-R	Bandpass Filter, 2305 MHz to 2320 MHz, N (m) to N (f), 50Ω
	Adapters
1091-417-R	N (m) to QMA (f), DC to 6 GHz, 50Ω
1091-418-R	N (m) to QMA (m), DC to 18 GHz, 50Ω
	Precision Adapters
1091-26-R	SMA (m) to N (m), DC to 18 GHz, 50Ω
1091-27-R	SMA (f) to N (m), DC to 18 GHz, 50Ω
1091-80-R	SMA (m) to N (f), DC to 18 GHz, 50Ω
1091-81-R	SMA (f) to N (f), DC to 18 GHz, 50Ω
1091-172-R	BNC (f) to N (m), DC to 1.3 GHz, 50Ω
510-90-R	7/16 DIN (f) to N (m), DC to 7.5 GHz, 50Ω
510-91-R	7/16 DIN (f) to N (f), DC to 7.5 GHz, 50Ω
510-92-R	7/16 DIN (m) to N (m), DC to 7.5 GHz, 50Ω
510-93-R	7/16 DIN (m) to N (f), DC to 7.5 GHz, 50Ω
510-96-R	7/16 DIN (m) to 7/16 DIN (m), DC to 7.5 GHz, 50Ω
510-97-R	7/16 DIN (f) to 7/16 DIN (f), DC to 7.5 GHz, 50Ω
510-102-R	N (m) to N (m), DC to 11 GHz, 50Ω, 90 degrees right angle
71693-R	Ruggedized K (f) to Type N (f)
34NN50A	N (m) to N (m), DC to 18 GHz, 50Ω
34NFNF50	N (f) to N (f), DC to 18 GHz, 50Ω
	Attenuators
3-1010-122	20 dB, 5 W, DC to 12.4 GHz, N (m) to N (f)
42N50-20	20 dB, 5 W, DC to 18 GHz, N (m) to N (f)
42N50A-30	30 dB, 50 W, DC to 18 GHz, N (m) to N (f)
3-1010-123	30 dB, 50 W, DC to 8.5 GHz, N (m) to N (f)
1010-127-R	30 dB, 150 W, DC to 3 GHz, N (m) to N (f)
3-1010-124	40 dB, 100 W, DC to 8.5 GHz, N (m) to N (f), Uni-directional
1010-121	40 dB, 100 W, DC to 18 GHz, N (m) to N (f), Uni-directional
1010-128-R	40 dB, 150 W, DC to 3 GHz, N (m) to N (f)
	Miscellaneous Accessories
2000-1374	External Dual Charger for Li-Ion Batteries
633-75	Rechargeable Li-Ion Battery, 7500 mAh
66864	Rack Mount Kit, Master Platform
2000-1689	EMI Near Field Probe Kit
2000-1797-R	Touchscreen Protective Film, 8.4 in.
MA2700A	Handheld Interference Hunter (for full specifications, refer to the MA2700A Technical Data Sheet, 11410-00692)
2000-1884-R	PIM Hunter™ Test Probe (For full specifications, refer to the 2000-1884-R Technical Data Sheet 11410-00999)
2000-1691-R	Stylus with Coiled Tether
2000-1798-R	Port Extender, DC to 6 GHz, N (m) to N (f)
	Backpack and Transit Case
67135	Anritsu Backpack (For Handheld Instrument and PC)
760-243-R	Large Transit Case with Wheels and Handle, 56 × 45.5 × 26.5 cm (22.07" × 17.92" × 10.42")
760-261-R	Transit Case, space for MA2700A, antennas, filters, instrument inside softcase, and other interference hunting accessories/tools
760-271-R	Transit Case for Portable Directional Antennas and Port Extender, 52.4 × 42.8 × 20.6 cm (20.62" × 16.87" × 8.12") (for 2000-1777-R, 2000-1778-R, 2000-1779-R, 2000-1798-R)

Spectrum Master Ultraportable Spectrum Analyzer

MS2760A

9 kHz to 32 GHz/44 GHz/50 GHz/70 GHz/110 GHz

Pocket-sized, Big Performance

Excellent Eco Product

The MS2760A Spectrum Master – is our first Ultraportable Spectrum Analyzer. By utilizing our patented ShockLine non-linear transmission line (NLTL) technology, the MS2760A shatters the cost, size, and performance barriers associated with traditional large form factor instruments to more efficiently advance technology development.
It is truly pocket-sized, but big on performance with industry leading dynamic range, sweep speed, and amplitude accuracy.
Its ultraportable size enables direct connect to almost any DUT, eliminating the need for lossy, expensive cables or antennas.
The MS2760A is the world's first handheld millimeter-wave spectrum analyzer to provide continuous coverage from 9 kHz up to 110 GHz, positioning it perfectly for growing millimeter-wave applications like 5G, 802.11ad, satellite communications, automotive radar, and more. The MS2760A is USB-powered and controlled from a Windows-based PC, laptop, or tablet, making it uniquely flexible for use in the lab, on the manufacturing floor, or in the field.

Key Features

- Measure: Channel Power, Adjacent Channel Power, Occupied Bandwidth
- Spectrum and Spectrogram Displays
- External 10 MHz Frequency Reference
- External TTL Trigger Input
- Resolution Bandwidth (RBW): 1 Hz to 3 MHz
- Phase Noise: –116 dBc/Hz @ 1 GHz, typical
- Up to Six Spectrum Traces and Spectrogram Cursors, Three Trace Detectors, 12 Markersy
- Dynamic Range: >103 dB from 6.15 GHz up to 110 GHz
- DANL: as low as –136 dBm

Specifications

Smart Measurements	Channel Power	Measures the total power in a specified bandwidth
	Occupied Bandwidth	Measures 99 to 1% power channel of a signal
	Adjacent Channel Power	Measures channel power of the adjacent channel
Setup Parameters	Frequency	Center/Start/Stop, Frequency Step, Frequency Offset
	Span	Span, Span Up/Down, Full Span, Last Span
	Bandwidth	RBW, Auto RBW, VBW, Auto VBW, VBW/RBW, Span/RBW, VBW Log/Lin Averaging
	Amplitude	Reference Level, Scale/Division, Ref Level Offset, IF Gain
Sweep Functions	Sweep	Single/Continuous, Restart, Sweep Once, Sweep to N
	Zero Span Sweep Time	0.02 ms to 6000 ms
	Minimum Capture Time	0 s to 10 s
Trace Functions	Traces	Up to six traces
	Trace Type	Clear/Write, Trace Average, Max Hold, Min Hold, Rolling Average, Rolling Max Hold, Rolling Min Hold
	Trace Mode	Active, Hold/View, Blank
	Detector Type per Trace	Peak, RMS/Avg, Negative
Spectrogram	Spectrogram Position	Selectable from Top, Bottom, or Full Screen
	Trace Time Cursor	Up to six Time Cursors to recall historical trace data by trace number or time
	Color Setup	Set Color Top/Bottom Range, Set Color Reference Hue
Marker Functions	Markers	Up to 12 Markers
	Marker Mode	Normal, Delta, Fixed
	Delta Marker	Relative to any Normal or Fixed Marker
	Marker Trace	Assign Marker to any Trace
	Peak Search	Peak Search, Next Peak, Next Peak Left, Next Peak Right, Next Point Left, Next Point Right
	Peak Search Setup	Peak Threshold, Peak Excursion

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<table>
<tr><td rowspan="4">Limit Line Functions</td><td>Limit Setup</td><td>Upper/Lower, Limit On/Off, Limit Alarm On/Off, Set Default Limit Line, Absolute/Relative, Mirror On/Off</td></tr>
<tr><td>Limit Line Edit</td><td>Frequency, Amplitude, Add Point, Add Vertical, Delete Point, Next Point Left/Right</td></tr>
<tr><td>Limit Line Move</td><td>To Current Center Frequency, By dB or Hz, To Marker 1, Offset from Marker 1</td></tr>
<tr><td>Limit Line Envelope</td><td>Create Envelope, Update Envelope, Points (41 max.), Offset, Shape Square/Slope</td></tr>
<tr><td rowspan="11">Frequency</td><td>Frequency Range</td><td>(usable to 0 Hz)</td></tr>
<tr><td>MS2760A-0032</td><td>9 kHz to 32 GHz</td></tr>
<tr><td>MS2760A-0044</td><td>9 kHz to 44 GHz</td></tr>
<tr><td>MS2760A-0050</td><td>9 kHz to 50 GHz</td></tr>
<tr><td>MS2760A-0070</td><td>9 kHz to 70 GHz</td></tr>
<tr><td>MS2760A-0090</td><td>9 kHz to 90 GHz</td></tr>
<tr><td>MS2760A-0110</td><td>9 kHz to 110 GHz</td></tr>
<tr><td>Tuning Resolution</td><td>1 Hz</td></tr>
<tr><td>Internal 10 MHz Frequency Reference</td><td>Aging: ±1.0 ppm/year
Accuracy: ±0.2 ppm (25° ±25°C) + aging</td></tr>
<tr><td>Frequency Span</td><td>10 Hz to maximum frequency range of instrument</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td rowspan="4">Bandwidth</td><td>Resolution Bandwidth (RBW)</td><td>1 Hz to 3 MHz</td></tr>
<tr><td>Video Bandwidth (VBW)</td><td>1 Hz to 3 MHz</td></tr>
<tr><td>VBW/Average Type</td><td>Linear/Log</td></tr>
<tr><td>RBW Filters</td><td>Flat Top, Nuttall</td></tr>
<tr><td rowspan="6">Amplitude Ranges</td><td>Dynamic Range</td><td>>103 dB (typ.) at 70 GHz, 2/3 (TOI – DANL) in 1 Hz RBW</td></tr>
<tr><td>Display Range</td><td>1 to 15 dB/div in 1 dB steps, ten divisions displayed</td></tr>
<tr><td>Measurement Range</td><td>DANL to +10 dBm</td></tr>
<tr><td>Reference Level Range</td><td>–120 to +30 dBm</td></tr>
<tr><td>Amplitude Units</td><td>dBm</td></tr>
<tr><td>Maximum Safe Level Input</td><td>+30 dBm CW, ±10 VDC</td></tr>
<tr><td rowspan="6">Spectral Purity –
SSB Phase Noise
(dBc/Hz, 20° to 30°C)</td><td>Spurs</td><td>
<table>
<tr><th>Residual Spurs</th><th>Maximum (dBm)</th><th>Typical (dBm)</th></tr>
<tr><td>10 MHz to 70 GHz</td><td>–85</td><td>–95</td></tr>
<tr><td>>70 MHz to 90 GHz</td><td>–84</td><td>–95</td></tr>
<tr><td>>90 MHz to 110 GHz</td><td>–81</td><td>–95</td></tr>
</table>
Input-related Spurious (–10 dBm CW input)
28 MHz: –50 dBc @ 70 MHz
35 MHz: –50 dBc @ 133 MHz
770 MHz: –35 dBc @ 3430 MHz, 4970 MHz, 7630 MHz
910 MHz: –35 dBc @ 4970 MHz, 6790 MHz
All other input frequencies: <–60 dBc
Zero Span: No image rejection is applied to the sweep while in zero span, therefore spurious impact may be different.</td></tr>
<tr><td>Amplitude Accuracy</td><td>
<table>
<tr><th></th><th colspan="2">20° to 30°C
(after 30 minute warm-up)</th><th colspan="2">0° to 50°C
(after 60 minute warm-up)</th></tr>
<tr><th>Frequency Range</th><th>Maximum (dB)</th><th>Typical (dB)</th><th>Maximum (dB)</th><th>Typical (dB)</th></tr>
<tr><td>9 kHz to 644 MHz</td><td>±1.3</td><td>±0.5</td><td>±2.0</td><td>±0.5</td></tr>
<tr><td>>644 MHz to 40 GHz</td><td>±1.8</td><td>±0.5</td><td>±3.0</td><td>±1.0</td></tr>
<tr><td>>40 GHz to 70 GHz</td><td>±2.0</td><td>±0.5</td><td>±3.0</td><td>±1.0</td></tr>
<tr><td>>70 GHz to 90 GHz</td><td>±2.2</td><td>±0.5</td><td>±3.0</td><td>±1.0</td></tr>
<tr><td>>90 GHz to 110 GHz</td><td>±2.5</td><td>±0.5</td><td>±3.0</td><td>±1.0</td></tr>
</table></td></tr>
<tr><td>Displayed Average Noise Level (DANL)
(RMS detection,
VBW/Avg type = Log,
IF Gain On)</td><td>
<table>
<tr><th>Frequency Range</th><th>Maximum (dB)</th><th>Typical (dB)</th></tr>
<tr><td>10 MHz to 644 MHz</td><td>–131</td><td>–134</td></tr>
<tr><td>>644 MHz to 4 GHz</td><td>–136</td><td>–140</td></tr>
<tr><td>>4 GHz to 40 GHz</td><td>–131</td><td>–134</td></tr>
<tr><td>>40 GHz to 70 GHz</td><td>–128</td><td>–132</td></tr>
<tr><td>>70 GHz to 90 GHz</td><td>–127</td><td>–130</td></tr>
<tr><td>>90 GHz to 110 GHz</td><td>–124</td><td>–127</td></tr>
</table></td></tr>
<tr><td>Third-Order Intercept (TOI)
(typ., 0 dBm tones 1 MHz apart, 0 dBm reference level)</td><td>2 GHz (+35 dBm)
18 GHz (+35 dBm)
62 GHz (+25 dBm)</td></tr>
<tr><td>Second Harmonic Distortion
(at 1 GHz input)</td><td>0 dBm Input (–50 dBc max.)
–20 dBm Input (–60 dBc max.)</td></tr>
<tr><td>Input Match (typ.)</td><td>
<table>
<tr><th></th><th colspan="2">K Connector</th><th colspan="2">V Connector</th><th colspan="2">W Connector</th></tr>
<tr><th>Frequency Range</th><th>VSWR</th><th>Return Loss</th><th>VSWR</th><th>Return Loss</th><th>VSWR</th><th>Return Loss</th></tr>
<tr><td>9 kHz to 12.4 GHz</td><td>1.29:1</td><td>18 dB</td><td>1.29:1</td><td>18 dB</td><td>1.29:1</td><td>18 dB</td></tr>
<tr><td>>12.4 GHz to 26.5 GHz</td><td>1.67:1</td><td>12 dB</td><td>1.43:1</td><td>15 dB</td><td>1.67:1</td><td>12 dB</td></tr>
<tr><td>>26.5 GHz to 40 GHz</td><td>1.67:1</td><td>12 dB</td><td>1.58:1</td><td>13 dB</td><td>1.67:1</td><td>12 dB</td></tr>
<tr><td>>40 GHz to 50 GHz</td><td>1.67:1</td><td>12 dB</td><td>1.67:1</td><td>12 dB</td><td>1.67:1</td><td>12 dB</td></tr>
<tr><td>>50 GHz to 70 GHz</td><td>—</td><td>—</td><td>2.10:</td><td>9 dB</td><td>2.10:1</td><td>9 dB</td></tr>
<tr><td>>70 GHz to 110 GHz</td><td>—</td><td>—</td><td>—</td><td>—</td><td>2.10:1</td><td>9 dB</td></tr>
</table></td></tr>
</table>

General

Setup Parameters	System Status	Connected Port, Model, Serial Number, Software Version, Frequency, Options
	Preset	Preset Traces, Preset Markers, Preset Limit Lines, Preset Meas Setup, Preset All
	Save/Recall	Save As, Save (Measurement, Set-up PNG, Limit Line), Recall, Save on Event (Crossing Limit, Sweep Complete, Save at Interval)
Connectors	RF In	32 GHz and 44 GHz Instruments: K Connector (2.92 mm), male 50Ω 50 GHz and 70 GHz Instruments: V Connector (1.85 mm), male 50Ω 90 GHz and 110 GHz Instruments: W Connector (1.0 mm), male 50Ω
	USB Interface	USB 3.0, Type C Connector
	External Reference In	MCX (f), 50Ω, 10 MHz
	External Trigger In	MCX (f), 50Ω, TTL Levels
Computer Requirement	Display Resolution	16:9/16:10 Aspect Ratio (>1280 × 720/1280 × 800)
	Operating System	Windows® 7, 8.1, 10; 64-bit
	Recommended Minimum Configuration	Quad Core i7 fourth generation or higher CPU, 16 GB RAM, 128 GB Data Storage, USB 3.0
Regulatory Compliance (not including Windows Tablet/ Laptop/PC)	CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN 61010-1:2010 RoHS: 2011/65/EU
	Australia and New Zealand	RCM AS/NZS 4417:2012
	South Korea	KCC-REM-A21-0004
Environmental MIL-PRF-28800F Class 3 (not including Windows Tablet/ Laptop/PC)	Operating Temperature Range	0° to +50°C
	Storage Temperature Range	–40° to +71°C
	Maximum Relative Humidity	95% RH at +30°C, non-condensing
	Vibration, Sinusoidal	5 Hz to 55 Hz
	Vibration, Random	10 Hz to 500 Hz
	Half Sine Shock	30 g_n
	Altitude	4600 meters, operating and non-operating
	Explosive Atmosphere	MIL-PRF-28800F Section 4.5.6.3 MIL-STD-810G, Method 511.5, Procedure 1
Warranty	Duration	Standard three-year warranty
Dimensions and Mass (not including Windows Tablet/Laptop/PC)		84 (W) × 155 (H) × 27 (D) mm (6.1 × 3.3 × 1.1 in) 255 g (9.0 oz)

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Models and Options
MS2760A-0032	Ultraportable Spectrum Master, Frequency Range 9 kHz to 32 GHz
MS2760A-0044	Ultraportable Spectrum Master, Frequency Range 9 kHz to 44 GHz
MS2760A-0050	Ultraportable Spectrum Master, Frequency Range 9 kHz to 50 GHz
MS2760A-0070	Ultraportable Spectrum Master, Frequency Range 9 kHz to 70 GHz
MS2760A-0090	Ultraportable Spectrum Master, Frequency Range 9 kHz to 90 GHz
MS2760A-0110	Ultraportable Spectrum Master, Frequency Range 9 kHz to 110 GHz

Model/Order No.	Name
	Option Number
MS2760A-0032-0098 MS2760A-0044-0098 MS2760A-0050-0098 MS2760A-0070-0098 MS2760A-0090-0098 MS2760A-0110-0098	Standard Calibration (ISO/IEC 17025 and ANSI/NCSL Z540-1)
MS2760A-0032-0099 MS2760A-0044-0099 MS2760A-0050-0099 MS2760A-0070-0099 MS2760A-0090-0099 MS2760A-0110-0099	Premium Calibration (ISO/IEC 17025 and ANSI/NCSL Z540-1 plus test data)
	Standard Accessories
	(Included with instrument)
2300-1859-R	USB 3.0 Type C to Type A Cable, 1 m
2300-1605-R	BNC (m) to MCX (m) Cable (qty 2)
	Certificate of Calibration and Conformance
	Manuals
	(available at www.anritsu.com)
10580-00427	User Guide

Spectrum Master

MS2711E MS2712E MS2713E

9 kHz to 3 GHz 9 kHz to 4 GHz 9 kHz to 6 GHz

Remote Control
USB

Compact Handheld Spectrum Analyzer

The wireless communications market is rapidly growing as the telecommunications sectors continue to evolve. Whether you are installing, troubleshooting, or solving problems for public safety providers, or wireless service providers, Anritsu has a solution. Anritsu's new Spectrum Master has been designed for technicians, installers, field radio frequency (RF) engineers, and contractors who struggle with both keeping track of the growing number of interfering signals and assessing signal quality on a wide range of increasingly complex signals. Easy-to-use, integrated and high performing, the Spectrum Master helps users address those challenges and more. Its feature-rich and compact design helps users comply to regulatory requirements, manage and maximize efficiency, improve system up-time, and increase revenue – all in a rugged and field-proven device designed to withstand even the most punishing conditions. This next generation of Anritsu's best-in-class Spectrum Master series is ideal for spectrum monitoring, interference analysis, RF and microwave measurements, field strength measurements, transmitter spectrum analysis, electromagnetic field strength, signal strength mapping, and overall field analysis of cellular 2G/3G/4G, land mobile radio, Wi-Fi, and broadcast signals.

Designed for Field Use

The Spectrum Master was designed specifically for field environments. Weighing less than 3.45 kg, it is small and compact and easy to carry. Its field replaceable Li-Ion battery typically lasts for more than 3 hours, and a new bright 8.4-inch color display provides visibility even in broad daylight. With an operating temperature range from –10° to +55°C, a rugged case and splash proof design, the Spectrum Master works in the most extreme weather conditions with guaranteed performance anywhere and anytime.

Integrated Solution

The Spectrum Master is a multifunctional instrument that eliminates the need for you to carry and learn multiple instruments. It can be configured to across a broad range of parameters, including a 3 GHz, 4 GHz or 6 GHz spectrum analyzer, an interference analyzer, tracking generator, channel scanner, power meter, high accuracy power meter, and GPS receiver for time/location stamping and accuracy enhancements.

Easy-to-Use

The Spectrum Master users intuitive spectrum analyzer menus. A touchscreen keypad combination provides you with an intuitive menu-driven interface designed to give a familiar menu structure with quick access to popular measurements.

Key Features

- 9 kHz to 3 GHz (MS2711E)
- 9 kHz to 4 GHz (MS2712E)
- 9 kHz to 6 GHz (MS2713E)
- Interference Analyzer:
  Spectrogram, Signal Strength, RSSI, Signal ID, Interference Mapping (MS2711E)
  Spectrogram, Signal Strength, RSSI, Mapping (MS2712E/MS2713E)
- DANL: –142 dBm in 100 Hz RBW with Preamp Option (MS2711E)
  –162 dBm in 1 Hz RBW (MS2712E/MS2713E)
- Dynamic Range:
  >85 dB in 100 Hz RBW (MS2711E)
  >102 dB in 1 Hz RBW (MS2712E/MS2713E)
- Phase Noise:
  –90 dBc/Hz max @ 10 kHz offset at 1 GHz (MS2711E)
  –100 dBc/Hz max @ 10 kHz offset at 1 GHz (MS2712E/MS2713E)
- Frequency Accuracy:
  <±1.5 ppm, <±50 ppb with GPS Option 31 (MS2711E)
  <±50 ppb with GPS On (MS2712E/MS2713E)

Functions and Description

- Spectrum Analyzer, 9 kHz to 3 GHz, 4 GHz, or 6 GHz
  - Locates and identifies various signals over a wide frequency range. Detects signals as low as –152 dBm with phase noise better than –100 dBc/Hz (–110 dBc/Hz, typ.).
- CPRI LTE RF measurements (Option 752)
  - RF-based measurements over fiber optic CPRI link
- OBSAI LTE RF measurements (Option 753)
  - RF-based measurements over fiber optic OBSAI link
- Interference Analyzer (Option 25)
  - Includes everything you need to monitor, identify, and locate interference using the spectrogram display, Mapping, RSSI, Signal ID, and signal strength meter.
- GPS receiver (Option 31)
  - Provides location and UTC time information. Also improves the accuracy of the reference oscillator.
- Bias-Tee (Option 10)*
  - Possesses a built-in 32 V bias-tee that can be turned on as needed and applied to the RF In port.
- High Accuracy Power Meter (Option 19)
  - Connects high accuracy 4, 6, 8, and 18 GHz USB power sensors with better than ±0.16 dB accuracy.
- Power Meter (Option 29)
  - EMF Test makes channelized transmitter power measurements.
- Channel Scanner (Option 27)
  - Measures the power of multiple transmitted signals. Scans up to 1200 channels using Script Master.
- Tracking Generator
  - Provides tracking generator and CW generator source to test filters and amplifiers
- Gated Sweep (Option 90)*
  - Views pulsed or burst signals such as WiMAX, GSM, and TD-SCDMA only when they are on.

*: Indicates option not available in the MS2711E

Specifications

Spectrum Analyzer

<table>
<tr><td rowspan="6">Frequency</td><td>Frequency Range</td><td>9 kHz to 3 GHz (MS2711E), 9 kHz to 4 GHz (MS2712E), 9 kHz to 6 GHz (MS2713E)
(usable to 0 Hz)</td></tr>
<tr><td>Tuning Resolution</td><td>1 Hz</td></tr>
<tr><td>Frequency Reference</td><td>Aging: ±1.0 ppm/year
Accuracy: ±1.5 ppm (25° ±25°C) + aging, <±50 ppb with GPS On</td></tr>
<tr><td>Frequency Span</td><td>10 Hz to 3 GHz including zero span (MS2711E), 10 Hz to 4 GHz including zero span (MS2712E),
10 Hz to 6 GHz including zero span (MS2713E)</td></tr>
<tr><td>Sweep Time</td><td>Minimum 100 ms, 10 µs to 600 seconds in zero span</td></tr>
<tr><td>Sweep Time Accuracy</td><td>±2% in zero span</td></tr>
<tr><td rowspan="4">Bandwidth</td><td>Resolution Bandwidth (RBW)</td><td>1 Hz to 3 MHz in 1–3 sequence ±10% (1 MHz max in zero span) (–3 dB bandwidth)
(100 Hz to 3 MHz for MS2711E)</td></tr>
<tr><td>Video Bandwidth (VBW)</td><td>1 Hz to 3 MHz in 1–3 sequence (–3 dB bandwidth) (auto or manually selectable)
(10 Hz to 3 MHz for MS2711E)</td></tr>
<tr><td>RBW with Quasi-Peak Detection</td><td>200 Hz, 9 kHz, 120 kHz (–6 dB bandwidth)</td></tr>
<tr><td>VBW with Quasi-Peak Detection</td><td>Auto VBW is On, RBW/VBW = 1</td></tr>
<tr><td>Spectral Purity</td><td>SSB Phase Noise @ 1 GHz</td><td>–100 dBc/Hz, –110 dBc/Hz (typ., 10 kHz offset) (MS2711E)
–105 dBc/Hz, –112 dBc/Hz (typ., 100 kHz offset) (MS2711E)
–115 dBc/Hz, –121 dBc/Hz (typ., 1 MHz offset) (MS2711E)</td></tr>
<tr><td rowspan="7">Amplitude Ranges</td><td>Dynamic Range</td><td>>85 dB (2.4 GHz), 2/3 (TOI-DANL) in 100 Hz RBW (MS2711E)
>102 dB (2.4 GHz), 2/3 (TOI-DANL) in 1 Hz RBW (MS2712E/MS2713E)</td></tr>
<tr><td>Measurement Range</td><td>DANL to +26 dBm (≥50 MHz)
DANL to 0 dBm (<50 MHz)</td></tr>
<tr><td>Display Range</td><td>1 to 15 dB/div in 1 dB steps, ten divisions displayed</td></tr>
<tr><td>Reference Level Range</td><td>–120 to +30 dBm</td></tr>
<tr><td>Attenuator Range</td><td>0 to 55 dB, 5.0 dB steps</td></tr>
<tr><td>Maximum Continuous Input</td><td>+30 dBm</td></tr>
<tr><td>Amplitude Units</td><td>Log Scale Modes: dBm, dBV, dBmV, dBµV, dBW, dBmW, dBµW, dBA, dBmA, dBµA
Linear Scale Modes: nV, µV, mV, V, kV, nW, µW, mW, W, kW, nA, µA, mA, A</td></tr>
<tr><td rowspan="4">Amplitude Accuracy</td><td>9 kHz to 100 kHz</td><td>±2.0 dB (typ.) (Preamp Off)</td></tr>
<tr><td>100 kHz to 3.0 GHz</td><td>±1.25 dB, ±0.5 dB (typ.) (MS2711E)</td></tr>
<tr><td>100 kHz to 4.0 GHz</td><td>±1.25 dB, ±0.5 dB (typ.) (MS2712E/MS2713E)</td></tr>
<tr><td>>4.0 GHz to 6 GHz</td><td>±1.50 dB, ±0.5 dB (typ.) (MS2712E/MS2713E)</td></tr>
<tr><td>Displayed Average Noise Level (DANL)</td><td colspan="2">
RBW Normalized to 1 Hz, 0 dB attenuation (MS2711E)
<table>
<tr><td></td><td colspan="2">Preamp Off (Reference level –20 dBm)</td><td colspan="2">Preamp On (Reference level –50 dBm)</td></tr>
<tr><td></td><td>Maximum</td><td>Typical</td><td>Maximum</td><td>Typical</td></tr>
<tr><td>10 MHz to 2.4 GHz</td><td>–141 dBm</td><td>–146 dBm</td><td>–157 dBm</td><td>–162 dBm</td></tr>
<tr><td>>2.4 GHz to 3 GHz</td><td>–137 dBm</td><td>–141 dBm</td><td>–154 dBm</td><td>–159 dBm</td></tr>
</table>
RBW= 100 Hz, 0 dB attenuation (MS2711E)
<table>
<tr><td></td><td colspan="2">Preamp Off (Reference level –20 dBm)</td><td colspan="2">Preamp On (Reference level –50 dBm)</td></tr>
<tr><td></td><td>Maximum</td><td>Typical</td><td>Maximum</td><td>Typical</td></tr>
<tr><td>10 MHz to 2.4 GHz</td><td>–121 dBm</td><td>–126 dBm</td><td>–137 dBm</td><td>–142 dBm</td></tr>
<tr><td>>2.4 GHz to 3 GHz</td><td>–117 dBm</td><td>–121 dBm</td><td>–134 dBm</td><td>–139 dBm</td></tr>
</table>
RBW= 1 Hz, 0 dB attenuation (MS2712E/MS2713E)
<table>
<tr><td></td><td colspan="2">Preamp Off (Reference level –20 dBm)</td><td colspan="2">Preamp On (Reference level –50 dBm)</td></tr>
<tr><td></td><td>Maximum</td><td>Typical</td><td>Maximum</td><td>Typical</td></tr>
<tr><td>10 MHz to 2.4 GHz</td><td>–141 dBm</td><td>–146 dBm</td><td>–157 dBm</td><td>–162 dBm</td></tr>
<tr><td>>2.4 GHz to 4 GHz</td><td>–137 dBm</td><td>–141 dBm</td><td>–154 dBm</td><td>–159 dBm</td></tr>
<tr><td>>4 GHz to 5 GHz</td><td>–134 dBm</td><td>–138 dBm</td><td>–150 dBm</td><td>–155 dBm</td></tr>
<tr><td>>5 GHz to 6 GHz</td><td>–126 dBm</td><td>–131 dBm</td><td>–143 dBm</td><td>–150 dBm</td></tr>
</table>
</td></tr>
</table>

Continued on next page

Spurs	Residual Spurious	<–90 dBm (RF input terminated, 0 dB input attenuation, >10 MHz)
	Input-Related Spurious	<–75 dBc (0 dB attenuation, –30 dBm input, span <1.7 GHz, carrier offset >4.5 MHz)
	Exceptions (typ.)	<–70 dBc @ <2.5 GHz, with 2072.5 MHz Input <–68 dBc @ F1 – 280 MHz with F1 Input <–70 dBc @ F1 + 190.5 MHz with F1 Input <–52 dBc @ 7349 – (2F2) MHz, with F2 Input, where F2 <2437.5 MHz <–55 dBc @ 190.5 ± (F1/2) MHz, F1 <1 GHz
Third-Order Intercept (TOI)		Preamp Off (–20 dBm tones 100 kHz apart, 10 dB attenuation)
	800 MHz	+16 dBm
	2400 MHz	+20 dBm
	200 MHz to 2200 MHz	+25 dBm (typ.)
	>2.2 GHz to 3.0 GHz (MS2711E) >2.2 GHz to 5.0 GHz (MS2712E/MS2713E)	+28 dBm (typ.)
	>5.0 GHz to 6.0 GHz (MS2712E/MS2713E)	+33 dBm (typ.)
Second Harmonic Distortion		Preamp Off, 0 dB input attenuation, –30 dBm input
	50 MHz	–56 dBc
	>50 MHz to 200 MHz	–60 dBc (typ.)
	>200 MHz to 3000 MHz	–70 dBc (typ.)
VSWR		2:1 (typ.)

Tracking Generator (Option 20)

Frequency Range	500 kHz to 3 GHz (MS2711E), 500 kHz to 4 GHz (MS2712E), 500 kHz to 6 GHz (MS2713E)
Output Power Range	–50 to 0 dBm
Step Size	0.1 dB (nom.)
Output Flatness	±1 dB max, ±0.3 dB (typ.) (Using field calibration, relative to spectrum analyzer input with ≥3 dB attenuator)
Zero Span Behavior	CW output
Output Connector	Type N (f), 50Ω
Damage Level	+23 dBm ±50 V DC (limited dv/dt)

Bias-Tee (Option 10) (MS2712E/MS2713E)

Setup	On/Off, Voltage, Current (Low/High)
Voltage Range	+12 V to +32 V
Current (Low/High)	250 mA/450 mA, 1 A surge for 100 ms
Resolution	0.1 V

GPS Receiver (Option 31) (Antenna sold separately)

Setup	On/Off, Antenna Voltage 3.3 V/5.0 V, GPS Info
GPS Time/Location Indicator	Time, Latitude, Longitude and Altitude on display Time, Latitude, Longitude and Altitude with trace storage
High Frequency Accuracy	Spectrum Analyzer, Interference Analyzer, CW Signal Analyzer <±50 ppb with GPS On, GPS antenna connected, 3 minutes after satellite lock in selected mode
Connector	SMA (f)

Power Meter (Option 29)

Frequency Range	10 MHz to 3 GHz (MS2711E), 10 MHz to 4 GHz (MS2712E), 10 MHz to 6 GHz (MS2713E)
Span	1 kHz to 100 MHz
Display Range	–140 to +30 dBm, ≤40 dB span
Measurement Range	–120 to +26 dBm
Offset Range	0 to +100 dB (External Gain or Loss)
VSWR	2:1 (typ.)
Maximum Power	+30 dBm without attenuator
Accuracy	Same as Spectrum Analyzer
Application Options	Impedance (50Ω, 75Ω, Other)

High Accuracy Power Meter (Option 19) (Requires external USB Power Sensor)

Power Sensor Model	MA24105A	MA24106A*5	MA24108A/18A/26A	MA24208A/18A	MA24330A/40A/50A (MS2712E/MS2713E)
Description	Inline High Power Sensor	High Accuracy RF Power Sensor	Microwave USB Power Sensor	Microwave Universal USB Power Sensor	Microwave CW USB Power Sensor
Frequency Range	350 MHz to 4 GHz	50 MHz to 6 GHz	10 MHz to 8 GHz 10 MHz to 18 GHz 10 MHz to 26 GHz	10 MHz to 8 GHz 10 MHz to 18 GHz	10 MHz to 33 GHz 10 MHz to 40 GHz 10 MHz to 50 GHz
Connector	Type N (f), 50Ω	Type N (m), 50Ω	Type N (m), 50Ω (8 GHz/18 GHz) Type K (m), 50Ω (26 GHz)	Type N (m), 50Ω	Type K (m), 50Ω (33 GHz/40 GHz) Type V (m), 50Ω (50 GHz)
Dynamic Range	+3 to +51.76 dBm (2 mW to 150 W)	–40 to +23 dBm (0.1 µW to 200 mW)	–40 to +20 dBm (0.1 µW to 100 mW)	–60 to +20 dBm (1 nW to 100 mW)	–70 to +20 dBm (0.1 nW to 100 mW)
Measurand	True-RMS	True-RMS	True-RMS, Slot Power, Burst Average Power	True-RMS, Slot Power, Burst Average Power	Average Power
Measurement Uncertainty	±0.17 dB*1	±0.16 dB*2	±0.18 dB*3	±0.17 dB*4	± 0.17 dB*5
Datasheet (for complete specifications)	11410-00621	11410-00424	11410-00504	11410-00841	11410-00906

*1: Expanded uncertainty with K = 2 for power measurements of a CW signal greater than +20 dBm with a matched load. Measurement results referenced to the input side of the sensor.
*2: Total RSS measurement uncertainty (0° to 50°C) for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.
*3: Expanded uncertainty with K = 2 for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.
*4: Power uncertainty expressed with two sigma confidence level for CW measurement after zero operation. Includes calibration factor and linearity over temperature uncertainties, but not the effects of mismatch, zero set and drift, or noise.
*5: Includes linearity over temperature uncertainties, but not the effects of calibration factor, mismatch, zero set and drift, and noise.

Interference Analyzer (Option 25)

Spectrum	Field Strength Occupied Bandwidth Channel Power Adjacent Channel Power Ratio (ACPR) AM/FM/SSB Demodulation (Wide/Narrow FM, Upper/Lower SSB - audio out only) Carrier-to-Interference ratio (C/I)
Spectrogram	Collect data up to one week
Signal Strength	Gives visual and aural indication of signal strength
Received Signal Strength Indicator (RSSI)	Collect data up to one week
Signal ID	Up to 12 signals Center Frequency Bandwidth Signal Type (FM, GSM, W-CDMA, CDMA, Wi-Fi) Closest Channel Number Number of Carriers Signal-to-Noise Ratio (SNR) >10 dB
Interference Mapping	Triangulate location of interference with on-display maps (MS2711E) Draw multiple bearings of signal strength from GPS location on on-screen map (MS2712E/MS2713E) Pan and Zoom on-screen maps (MS2712E/MS2713E) Support for MA2700A Handheld Interference Hunter (see Optional Accessories) (MS2712E/MS2713E)
Application Options	Bias-Tee (On/Off), Impedance (50Ω, 75Ω, Other) (MS2712E/MS2713E)

Channel Scanner (Option 27)

Number of Channels	1 to 20 Channels
Measurements	Graph/Table, Max Hold (On/5 sec/Off), Freq/Channel, Current/Max, Single/Dual Color
Scanner	Scan Channels, Scan Frequencies, Scan Customer List, Scan Script Master™
Amplitude	Reference Level, Scale
Custom Scan	Signal Standard, Channel, # of Channels, Channel Step Size, Custom Scan
Frequency Range	100 kHz to 3 GHz (MS2711E), 9 kHz to 4 GHz (MS2712E), 9 kHz to 6 GHz (MS2713E)
Frequency Accuracy	±10 Hz + Time base error
Measurement Range	–110 to +26 dBm
Application Options	Impedance (50Ω, 75Ω, Other) Bias-Tee (On/Off) (MS2712E/MS2713E)

Gated Sweep (Option 90) (MS2712E/MS2713E)

Mode	Spectrum Analyzer, Sweep
Trigger	External TTL
Setup	Gated Sweep (On/Off) Gate Polarity (Rising, Falling) Gate Delay (0 to 65 ms) (typ.) Gate Length (1 µs to 65 ms) (typ.) Zero Span Time

Coverage Mapping (Option 431) (MS2712E/MS2713E) (Requires Option 31)

Measurements	Indoor Mapping RSSI ACPR	Outdoor Mapping RSSI ACPR
Setup Parameters	Frequency	Center/Start/Stop, Span, Freq. Step, Signal Standard, Channel #, Channel Increment
	Amplitude	Reference Level (RL), Scale, Attenuation Auto/Level, RL Offset, Pre-Amp On/Off, Detection
	Span	Span, Span Up/Down (1-2-5), Full Span, Zero Span, Last Span
	BW	RBW, Auto RBW, VBW, Auto VBW, RBW/VBW, Span/VBW
	Measurement Setup	ACPR, RSSI
	Point Distance/ Time Setup	Repeat Type Time Distance
	Save Points Map	Save KML, JPEG, Tab Delimited
	Recall Points Map	Recall Map, Recall KML Points only, Recall KML Points with Map, Recall Default Grid

Electromagnetic Field Measurements (Option 444) (Requires Anritsu Isotropic Antenna)

Measurements	Setup	Limit lines, axis dwell time, measurement time, auto-logging, measurement units, trace display
	Spectrum Analyzer	Field strength is measured
	LTE OTA, TD-LTE OTA (MS2712E/MS2713E)	P-SS, S-SS, and RS are measured and displayed based on each Cell ID received
	W-CDMA OTA (MS2712E/MS2713E)	P-CPICH signals are measured and displayed for each Scrambling Code measured
	Units	Spectrum Analyzer: dBm/m^2, dBV/m, dBmV/m, dBuV/m, V/m, W/m^2, dBW/m^2, A/m, dBA/m, W/cm^2 LTE OTA, TD-LTE OTA: dBm/m^2, V/m, W/m^2 W-CDMA OTA: dBm/m^2, V/m, W/m^2, % of Limit (V/m), % of Limit (W/m^2)
	Results	Maximum, minimum, and average of all measurements conducted
	Display	Measurement status, number of measurements taken, pass/fail indicators
Frequency Range	Supported Antenna	2000-1800-R: 9 kHz to 300 MHz 2000-1792-R: 30 MHz to 3 GHz 2000-1791-R: 700 MHz to 3 GHz (MS2711E) 2000-1791-R: 700 MHz to 6 GHz (MS2712E/MS2713E)
EMF Measurement Modes	Spectrum Analyzer LTE OTA (Option 883) TD-LTE OTA (Option 883) W-CDMA OTA (Option 881)	

RF over Fiber Hardware (Option 759)

Must be ordered with either	Option 752: CPRI LTE RF measurements, or Option 753: OBSAI LTE RF measurements
RF over Fiber Interface	Connector Port Small form factor pluggable (SFP) optical transceiver port

CPRI LTE RF Measurements (Option 752) (MS2712E/MS2713E) (Requires Option 759)

Measurements (CPRI RF measurements support LTE technology)	Spectrum	Uplink or Downlink Spectrum
	Spectrogram	Collects data up to one week
	CPRI Alarms	Signal Level (Tx Power, Rx Power), Signal Loss, LOS, LOF, LSS, Remote LOS, Remote LOF, RAI, SDI, Reset
	SFP Data	Reads device information
	CPRI IQ Data Capture	Quick Save IQ Data, Playback IQ Data
	Operating Temperature Range	–10° to +45°C
Setup Parameters	Frequency	Center, Span (Span, Full Span), Signal Standard, Channel #, CF Reference (On/Off)*
	Amplitude	Reference Level (RL), Scale, RL Offset
	Bandwidth	RBW, Auto RBW, VBW, Auto VBW
	Measurements	CPRI Configure, CPRI Spectrum, Spectrogram, CPRI Alarms, SFP Data (SFP Info/Compliance Info)
	CPRI Configure	SFP Port Configure, Display Configure, AxC Trace Configure
	SFP Port Configure	Line Rate, Radio Presets, Auto Detect
	Display Configure	Display 1 and 2 CPRI BW, Display Mode (Single, Dual), Active Display
	AxC Trace Configure	AxC 1, 2, 3, and 4 (Display, SFP Port, AxC Group, Sampling Rate (Default, Compress))
	Radio Presets	Ericsson (Uplink/Downlink), Nokia/ALu (Uplink/Downlink), Huawei (Uplink/Downlink), Samsung (Uplink/Downlink), No Preset, Custom
	Custom	IQ Bit Width, IQ Mapping (Method1, Method3), No. of Reserve Bits, Aggregation (On/Off)
	Auto Detect	Radio Preset, IQ Bit Width, Reserve Bit, Aggregation, Start Auto Detect
Sweep Functions	Sweep	Single/Continuous, Sweep Once, Sweep 10 Averages
Trace Functions (AxC Trace 1 only)	Traces	Up to three Traces (A, B, C), View/Blank, Write/Hold, Trace A/B/C Operations
	Trace A Operations	Normal, Max Hold, Min Hold, Average, # of Averages, (always the live trace)
	Trace B Operations	A → B, B ↔ C, Max Hold, Min Hold
	Trace C Operations	A → C, B ↔ C, Max Hold, Min Hold, A – B → C, B – A → C, Relative Reference (dB), Scale
Marker Functions (AxC Traces 1 through 4)	Markers	Markers 1-6 On/Off, Delta Marker On/Off, Marker Frequency to Center, Marker Table (On, Large, Off), All Markers Off
	Marker Table	Markers 1-6 for frequency and amplitude, plus delta markers frequency offset and amplitude

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Limit Line Functions	Limit Lines	Upper/Lower, On/Off, Move, Save/Recall Limit, Limit Alarm On/Off, Default Limit
	Limit Line Move	Move Up/Down, to Amplitude
Display Functions	Active Display	Display 1 or 2 (Single Display or Dual Display)
	Display Spectrum	Single or Dual
	Single Spectrum Display	One, two, three, or four AxC traces displayed (color coded), same CPRI BW for AxC traces
	Dual Spectrum Display	Any combination of the four available AxC traces, same CPRI BW per display and AxC trace
	Display Spectrogram	Single or Dual
	Single Spectrogram Display	One active AxC trace per waterfall display
	Dual Spectrogram Display	Any combination of the four available AxC traces may be configured per display One active AxC trace per waterfall display
	AxC Trace (1, 2, 3, 4)	Display 1, 2, or off AxC Group Sampling Rate (Default, Compress)
Bandwidth	Resolution Bandwidth (RBW)	300 Hz to 1 MHz in 1-3-10 sequence ±10 % (–3 dB bandwidth point) (typ.)
	Video Bandwidth (VBW)	30 Hz to 1 MHz in 1-3-10 sequence ±10 % (–3 dB bandwidth) (typ.)
	Line Bit Rate	Line bit rate 1: 614.4 Mbit/s Line bit rate 2: 1228.8 Mbit/s Line bit rate 3: 2457.6 Mbit/s Line bit rate 4: 3072.0 Mbit/s Line bit rate 5: 4915.2 Mbit/s Line bit rate 6: 6144.0 Mbit/s Line bit rate 7: 9830.4 Mbit/s Line bit rate 8: 10137.6 Mbit/s
CPRI Parameters	IQ Sample Width	10, 12, 15, 16 bits
	Bandwidth	5, 10, 15, 20 MHz
	Aggregation	On/Off

*: CF Reference is available only when Display 1 is active.

OBSAI LTE RF Measurements (Option 753) (MS2712E/MS2713E) (Requires Option 759)

Measurements (OBSAI RF measurements support LTE technology)	Spectrum	Uplink or Downlink Spectrum
	Spectrogram	Collects data up to one week
	OBSAI Alarms	Signal Level (Tx Power, Rx Power), Signal Loss, LOS, LOF
	SFP Data	Reads device information
Setup Parameters	Frequency	Center, Span (Span, Full Span), Signal Standard, Channel #, CF Reference (On/Off)[*1]
	Amplitude	Reference Level (RL), Scale, RL Offset
	Bandwidth	RBW, Auto RBW, VBW, Auto VBW, LTE Bandwidth
	Measurements	Start OBSAI, OBSAI Configure, OBSAI Spectrum, Spectrogram, OBSAI Alarms, SFP Data (SFP Info/Compliance Info)
	Start OBSAI	Scans OBSAI link for active RP3 addresses; detects and sets link rate; configures first RP3 address and displays a Spectrum view.
	OBSAI Configure	Link Rate, Display Configure, Carrier Trace Configure
	Display Configure	Display 1 and 2 LTE BW, Display Mode (Single, Dual), Active Display
	Carrier Trace Configure	Carrier Trace 1 (Display 1, 2, or off; RP3 Address) Carrier Trace 2 (Display 1, 2, or off; RP3 Address) Carrier Trace 3 (Display 1, 2, or off; RP3 Address) Carrier Trace 4 (Display 1, 2, or off; RP3 Address)
	RP3 Address	RP3 list populated with Start OBSAI or plug-in of an active link Addresses removed from list upon fiber plug-out or Loss of Signal Address list is empty following power cycle or if no OBSAI carriers are found
Sweep Functions	Sweep	Single/Continuous, Sweep Once, Sweep 10 Averages
Trace Functions (Carrier Trace 1 only)	Traces	Up to three Traces (A, B, C), View/Blank, Write/Hold, Trace A/B/C Operations
	Trace A Operations	Normal, Max Hold, Min Hold, Average, # of Averages, (always the live trace)
	Trace B Operations	A → B, B ↔ C, Max Hold, Min Hold
	Trace C Operations	A → C, B ↔ C, Max Hold, Min Hold, A – B → C, B – A → C, Relative Reference (dB), Scale
Marker Functions (Carrier Traces 1 through 4)	Markers	Markers 1-6 On/Off, Delta On/Off, Marker Freq to Center, Marker Table (On, Large, Off), All Markers Off
	Marker Table	Markers 1-6 for frequency and amplitude, plus delta markers frequency offset and amplitude
Limit Line Functions	Limit Lines	Upper/Lower, On/Off, Move, Save/Recall Limit, Limit Alarm On/Off, Default Limit
	Limit Line Move	Move Up/Down, to Amplitude

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Display Functions	Active Display	Display 1 or 2 (Single Display or Dual Display)
	Display Spectrum	Single or Dual
	Single Spectrum Display	One, two, three, or four carrier traces displayed (color coded) Trace LTE BW must match display LTE BW to be visible
	Dual Spectrum Display	Any combination of the four available carrier traces, same LTE BW per display and carrier trace
	Display Spectrogram	Single or Dual
	Single Spectrogram Display	One active carrier trace per waterfall display
	Dual Spectrogram Display	Any combination of the four available carrier traces may be configured per display One active carrier trace per waterfall display
	Carrier Trace (1, 2, 3, 4) Display	1, 2, or off
Bandwidth	Resolution Bandwidth (RBW)	300 Hz to 1 MHz in 1-3-10 sequence ±10 % (–3 dB bandwidth point) (typ.)
	Video Bandwidth (VBW)	30 Hz to 1 MHz in 1-3-10 sequence ±10 % (–3 dB bandwidth) (typ.)
	Link Rate	1x: 768.0 Mbit/s 2x: 1536.0 Mbit/s 4x: 3072.0 Mbit/s 8x: 6144.0 Mbit/s
	LTE Bandwidth	5 MHz, 10 MHz, 15 MHz*2, 20 MHz

*1: CF Reference is available only when Display 1 is active.
*2: Only supports Dual Bit Map algorithm for 15 MHz bandwidth signals.

General Specifications

All specifications and characteristics apply under the following conditions, unless otherwise stated: 1) After 5 minutes of warm-up time, where the instrument is left in the ON state; 2) All specifications apply when using internal reference; 3) All specifications subject to change without notice; 4) Typical performance is the measured performance of an average unit; 5) Recommended calibration cycle is 12 months.

Setup Parameters	System	Status (Temperature, Battery Info, Serial Number, Firmware Version, Options Installed) Self Test, Application Self Test GPS (see Option 31)
	System Options	Name, Date and Time, Brightness, Volume Language (English, French, German, Spanish, Chinese, Japanese, Korean, Italian, Russian, User defined) Reset (Factory Defaults, Master Reset, Update Firmware)
	File	Save, Recall, Delete, Directory Management
	Save/Recall	Setups, Measurements, Screen Shots (.jpg) (save only)
	Delete	Selected File, All Measurements, All Mode Files, All Content
	Directory Management	Sort Method (Name/Type/Date), Ascend/Descend, Internal/USB, Copy, Format USB
	Internal Trace/Setup Memory	2,000 traces, 2,000 Setups
	External Trace/Setup Memory	Limited by size of USB Flash drive
	Mode Switching	Auto-Stores/Recalls most recently used Setup Parameters in the Mode
Connectors	RF Out	Type N (f), 50Ω
	RF Out Damage Level	23 dBm, ±50 VDC
	RF In	Type N (f), 50Ω
	RF In Damage Level	+33 dBm peak, ±50 VDC, Maximum Continuous Input (≥10 dB attenuation)
	GPS	SMA (f)
	External Power	5.5 mm barrel connector, 11.0 to 14.5 VDC, <4.0 Amps
	USB Interface (2)	Type A, Connect USB Flash Drive and Power Sensor
	USB Interface	5-pin mini-B, Connect to PC for data transfer
	Ethernet Interface	RJ45 connector for Ethernet 10-Base T (available with Ethernet Option 413)
	Headset Jack	3.5 mm mini-phone plug
	External Reference In	BNC (f), 50Ω, Maximum Input +10 dBm, 1, 5, 10, 13 MHz
	External Trigger/ Clock Recovery	BNC (f), 50Ω, Maximum Input ±5 VDC
	RF over Fiber	SFP/SFP+ compatible socket (available with Option 759)
Display	Type	Resistive Touchscreen
	Size	8.4-inch daylight viewable color LCD
	Resolution	800 × 600
Battery	Type	Li-Ion
	Battery Operation	3.0 hours (typ.)
	Battery Charging Limits	0° to +45°C, Relative Humidity ≤80%
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU
	Australia and New Zealand	RCM: AS/NZS 4417:2012
	South Korea	KCC: REM-A21-0004
Environmental	Temperature Range	–10° to +55°C (Operating), –51° to +71°C (Storage)
	Maximum Humidity	95% RH at 30°C, non-condensing
	Shock	30 g_n
	Altitude	4600 meters, operating and non-operating
	Explosive Atmosphere	MIL-PRF-28800F Section 4.5.6.3 MIL-STD-810G, Method 511.5, Procedure 1
Dimensions and Mass		273 (W) × 199 (H) × 91 (D) mm, (10.7 × 7.8 × 3.6 in), 3.45 kg, (7.6 lbs)

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main Frame
MS2711E	Spectrum Analyzer (9 kHz to 3 GHz)
MS2712E	Spectrum Analyzer (9 kHz to 4 GHz)
MS2713E	Spectrum Analyzer (9 kHz to 6 GHz)
	MS2711E Options
MS2711E-0019	High-Accuracy Power Meter (Requires External Power Sensor)
MS2711E-0025	Interference Analyzer (Option 31 recommended)
MS2711E-0027	Channel Scanner
MS2711E-0029	Power Meter
MS2711E-0444	EMF Measurements (Requires Anritsu Isotropic Antenna)
MS2711E-0098	Standard Calibration (ANSI Z540-1-1994)
MS2711E-0099	Premium Calibration (ANSI Z540-1-1994) plus test data
MS2711E-0008	Preamplifier
MS2711E-0020	Tracking Generator
MS2711E-0031	GPS Receiver (Requires antenna)
MS2711E-0509	AM/FM/PM Analyzer
	MS2712E Options
MS2712E-0010	Bias-Tee
MS2712E-0009	20 MHz BW Demod
MS2712E-0031	GPS Receiver (Requires GPS antenna)
MS2712E-0019	High-Accuracy Power Meter (Requires External Power Sensor)
MS2712E-0029	Power Meter
MS2712E-0025	Interference Analyzer (Option 31 recommended)
MS2712E-0027	Channel Scanner
MS2712E-0431	Coverage Mapping (Requires Option 31)
MS2712E-0444	EMF Measurements (Requires Anritsu Isotropic Antenna)
MS2712E-0090	Gated Sweep
MS2712E-0020	Tracking Generator
MS2712E-0509	AM/FM/PM Analyzer
MS2712E-0752	CPRI LTE RF Measurements (Requires Option 759)
MS2712E-0753	OBSAI LTE RF Measurements (Requires Option 759)
MS2712E-0759	RF over Fiber Hardware (Requires Option 752 or 753; cannot be ordered with Option 57 or 79)
MS2712E-0880	GSM/GPRS/EDGE Measurements (Requires Option 9)
MS2712E-0881	W-CDMA/HSPA+ Measurements (Requires Option 9; Option 31 recommended)
MS2712E-0882	TD-SCDMA/HSPA+ Measurements (Requires Option 9; requires Option 31 for full functionality)
MS2712E-0883	LTE/LTE-A FDD/TDD Measurements (Requires Option 9; requires Option 31 for full functionality)
MS2712E-0884	CDMA/EV-DO Measurements (Requires Option 9; requires Option 31 for full functionality)
MS2712E-0885	WiMAX Fixed/Mobile Measurements (Requires Option 9; requires Option 31 for full functionality)
MS2712E-0886	LTE 256QAM Demodulation (Requires Option 883)
MS2712E-0887	NB-IoT Measurements (Requires Option 9)
MS2712E-0030	ISDB-T Digital Video Measurements (Requires Option 9)
MS2712E-0032	ISDB-T SFN Measurements (Requires Option 9)
MS2712E-0079	ISDB-T BER Measurements (Requires Options 9 and 30. Cannot be ordered with Option 759)
MS2712E-0064	DVB-T/H Digital Video Measurements (Requires Option 9)
MS2712E-0078	DVB-T/H SFN Measurements (Requires Option 9)
MS2712E-0057	DVB-T/H BER Measurements (Requires Option 64. Cannot be ordered with Option 759)
MS2712E-0413	Ethernet Connectivity
MS2712E-0098	Standard Calibration to ISO17025 and ANSI/NCSL Z540-1
MS2712E-0099	Premium Calibration to ISO17025 and ANSI/NCSL Z540-1 Provides everything included with Option 98 plus test report and uncertainty data.
	MS2713E Options
MS2713E-0010	Bias-Tee
MS2713E-0009	20 MHz BW Demod
MS2713E-0031	GPS Receiver (Requires GPS antenna)
MS2713E-0019	High-Accuracy Power Meter (Requires External Power Sensor)
MS2713E-0029	Power Meter
MS2713E-0025	Interference Analyzer (Option 31 recommended)
MS2713E-0027	Channel Scanner
MS2713E-0431	Coverage Mapping (Requires Option 31)
MS2713E-0444	EMF Measurements (Requires Anritsu Isotropic Antenna)
MS2713E-0090	Gated Sweep
MS2713E-0020	Tracking Generator
MS2713E-0509	AM/FM/PM Analyzer
MS2713E-0752	CPRI LTE RF Measurements (Requires Option 759)
MS2713E-0753	OBSAI LTE RF Measurements (Requires Option 759)
MS2713E-0759	RF over Fiber Hardware (Requires Option 752 or 753; cannot be ordered with Option 57 or 79)
MS2713E-0880	GSM/GPRS/EDGE Measurements (Requires Option 9)
MS2713E-0881	W-CDMA/HSPA+ Measurements (Requires Option 9; Option 31 recommended)
MS2713E-0882	TD-SCDMA/HSPA+ Measurements (Requires Option 9; requires Option 31 for full functionality)
MS2713E-0883	LTE/LTE-A FDD/TDD Measurements (Requires Option 9; requires Option 31 for full functionality)
MS2713E-0884	CDMA/EV-DO Measurements (Requires Option 9; requires Option 31 for full functionality)
MS2713E-0885	WiMAX Fixed/Mobile Measurements (Requires Option 9; requires Option 31 for full functionality)
MS2713E-0886	LTE 256QAM Demodulation (Requires Option 883)
MS2713E-0887	NB-IoT Measurements (Requires Option 9)
MS2713E-0030	ISDB-T Digital Video Measurements (Requires Option 9)
MS2713E-0032	ISDB-T SFN Measurements (Requires Option 9)
MS2713E-0079	ISDB-T BER Measurements (Requires Options 9 and 30. Cannot be ordered with Option 759)
MS2713E-0064	DVB-T/H Digital Video Measurements (Requires Option 9)
MS2713E-0078	DVB-T/H SFN Measurements (Requires Option 9)
MS2713E-0057	DVB-T/H BER Measurements (Requires Option 64. Cannot be ordered with Option 759)
MS2713E-0413	Ethernet Connectivity
MS2713E-0098	Standard Calibration to ISO17025 and ANSI/NCSL Z540-1
MS2713E-0099	Premium Calibration to ISO17025 and ANSI/NCSL Z540-1 Provides everything included with Option 98 plus test report and uncertainty data.
	Power Sensors (for complete ordering information, see the respective data sheets of each sensor)
PSN50	RF USB Power Sensor, 50 MHz to 6 GHz, +20 dBm (see data sheet 11410-00414 for details)
MA24105A	Inline Peak Power Sensor, 350 MHz to 4 GHz, +3 to +51.76 dBm
MA24106A	RF USB Power Sensor, 50 MHz to 6 GHz, +23 dBm
MA24108A	Microwave USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24118A	Microwave USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24126A	Microwave USB Power Sensor, 10 MHz to 26 GHz, +20 dBm
MA24208A	Microwave Universal USB Power Sensor, 10 MHz to 8 GHz, +20 to –60 dBm
MA24218A	Microwave Universal USB Power Sensor, 10 MHz to 18 GHz, +20 to –60 dBm
MA24330A	Microwave CW USB Power Sensor, 10 MHz to 33 GHz, +20 to –60 dBm
MA24340A	Microwave CW USB Power Sensor, 10 MHz to 40 GHz, +20 to –60 dBm
MA24350A	Microwave CW USB Power Sensor, 10 MHz to 50 GHz, +20 to –60 dBm
MA25100A	RF Power Indicator
	Manuals (soft copy at www.anritsu.com)
10100-00065	Product Information Compliance and Safety
10580-00251	Spectrum Master User Guide
10580-00349	Spectrum Analyzer Measurement Guide
10580-00234	3GPP Signal Analyzer Measurement Guide
10580-00235	3GPP2 Signal Analyzer Measurement Guide
10580-00236	WiMAX Signal Analyzer Measurement Guide
10580-00237	Digital TV Measurement Guide
10580-00240	Power Meter Measurement Guide
10580-00415	CPRI LTE RF Analyzer Measurement Guide
10580-00434	OBSAI LTF RF Analyzer Measurement Guide
10580-00256	Programming Manual
	Standard Accessories (included with instrument)
2000-1654-R	Soft Carrying Case
2000-1691-R	Stylus with Coiled Tether
2000-1797-R	Touchscreen Protective Film, 8.4 in
633-75	Rechargeable Li-Ion Battery, 7500 mAh
40-187-R	AC-DC Adapter
806-141-R	Automotive Power Adapter, 12 VDC, 60 W
3-2000-1498	USB A15-pin mini-B Cable, 10 ft/305 cm

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Model/Order No.	Name
	Optional Accessories
	Directional Antennas
2000-1411-R	824 MHz to 896 MHz, N (f), 12.3 dBi, Yagi
2000-1412-R	885 MHz to 975 MHz, N (f), 12.6 dBi, Yagi
2000-1413-R	1710 MHz to 1880 MHz, N (f), 12.3 dBi, Yagi
2000-1414-R	1850 MHz to 1990 MHz, N (f), 11.4 dBi, Yagi
2000-1415-R	2400 MHz to 2500 MHz, N (f), 14.1 dBi, Yagi
2000-1416-R	1920 MHz to 2170 MHz, N (f), 14.3 dBi, Yagi
2000-1659-R	698 MHz to 787 MHz, N (f), 10.1 dBi, Yagi
2000-1660-R	1425 MHz to 1535 MHz, N (f), 14.3 dBi, Yagi
2000-1715-R	698 MHz to 2500 MHz, N (f), gain of 2 dBi to 10 dBi (typ.)
2000-1726-R	Antenna, 2500 MHz to 2700 MHz N (f), 14.1 dBi, Yagi
2000-1747-R	Antenna, Log Periodic, 300 MHz to 7000 MHz, N (f), 5.1 dBi (typ.)
2000-1748-R	Antenna, Log Periodic, 1 GHz to 18 GHz, N (f), 6 dBi (typ.)
2000-1777-R	Portable Directional Antenna, 9 kHz to 20 MHz, N (f)
2000-1778-R	Portable Directional Antenna, 20 MHz to 200 MHz, N (f)
2000-1779-R	Portable Directional Antenna, 200 MHz to 500 MHz, N (f)
2000-1812-R	Portable Yagi Antenna, 450 MHz to 512 MHz, N (f), 7.1 dBi
2000-1825-R	Portable Yagi Antenna, 380 MHz to 430 MHz, N (f), 7.1 dBi
	Portable Antennas
2000-1200-R	806 MHz to 866 MHz, SMA (m), 50Ω
2000-1473-R	870 MHz to 960 MHz, SMA (m), 50Ω
2000-1035-R	896 MHz to 941 MHz, SMA (m), 50Ω (1/2 wave)
2000-1030-R	1710 MHz to 1880 MHz, SMA (m), 50Ω (1/2 wave)
2000-1474-R	1710 MHz to 1880 MHz with knuckle elbow (1/2 wave)
2000-1031-R	1850 MHz to 1990 MHz, SMA (m), 50Ω (1/2 wave)
2000-1475-R	1920 MHz to 1980 MHz and 2110 MHz to 2170 MHz, SMA (m), 50Ω
2000-1032-R	2400 MHz to 2500 MHz, SMA (m), 50Ω (1/2 wave)
2000-1361-R	2400 MHz to 2500 MHz, 5000 MHz to 6000 MHz, SMA (m), 50Ω
2000-1751-R	698 MHz to 960 MHz, 1710 MHz to 2100 MHz, 2500 MHz to 2700 MHz, SMA (m), 2 dB (typ.), 50Ω
2000-1636-R	Antenna Kit (Consists of: 2000-1030-R, 2000-1031-R, 2000-1032-R, 2000-1200-R, 2000-1035-R, 2000-1361-R, and carrying pouch)
	Isotropic Antennas
2000-1791-R	700 MHz to 6000 MHz, N (m)
2000-1792-R	30 MHz to 3000 MHz, N (m)
2000-1800-R	9 kHz to 300 MHz, N (m)
	Filters
1030-114-R	806 MHz to 869 MHz, N (m) to SMA (f), 50Ω
1030-109-R	824 MHz to 849 MHz, N (m) to SMA (f), 50Ω
1030-110-R	880 MHz to 915 MHz, N (m) to SMA (f), 50Ω
1030-111-R	1850 MHz to 1910 MHz, N (m) to SMA (f), 50Ω
1030-112-R	2400 MHz to 2484 MHz, N (m) to SMA (f), 50Ω
1030-105-R	890 MHz to 915 MHz, N (m) to SMA (f), 50Ω
1030-106-R	1710 MHz to 1790 MHz, N (m) to SMA (f), 50Ω
1030-107-R	1910 MHz to 1990 MHz, N (m) to SMA (f), 50Ω
1030-149-R	High Pass, 150 MHz, N (m) to N (f), 50Ω
1030-150-R	High Pass, 400 MHz, N (m) to N (f), 50Ω
1030-151-R	High Pass, 700 MHz, N (m) to N (f), 50Ω
1030-152-R	Low Pass, 200 MHz, N (m) to N (f), 50Ω
1030-153-R	Low Pass, 550 MHz, N (m) to N (f), 50Ω
1030-155-R	2500 MHz to 2700 MHz, N (m) to N (f), 50Ω
1030-178-R	1920 MHz to 1980 MHz, N (m) to N (f), 50Ω
1030-179-R	777 MHz to 798 MHz, N (m) to N (f), 50Ω
1030-180-R	2500 MHz to 2570 MHz, N (m) to N (f), 50Ω
2000-1684-R	791 MHz to 821 MHz, N (m) to N (f), 50Ω
2000-1734-R	Bandpass Filter, 699 MHz to 715 MHz, N (m) to N (f), 50Ω
2000-1735-R	Bandpass Filter, 776 MHz to 788 MHz, N (m) to N (f), 50Ω
2000-1736-R	Bandpass Filter, 815 MHz to 850 MHz, N (m) to N (f), 50Ω
2000-1737-R	Bandpass Filter, 1711 MHz to 1756 MHz, N (m) to N (f), 50Ω
2000-1738-R	Bandpass Filter, 1850 MHz to 1910 MHz, N (m) to N (f), 50Ω
2000-1739-R	Bandpass Filter, 880 MHz to 915 MHz, N (m) to N (f), 50Ω
2000-1740-R	Bandpass Filter, 1710 MHz to 1785 MHz, N (m) to N (f), 50Ω
2000-1741-R	Bandpass Filter, 1920 MHz to 1980 MHz, N (m) to N (f), 50Ω
2000-1742-R	Bandpass Filter, 832 MHz to 862 MHz, N (m) to N (f), 50Ω
2000-1743-R	Bandpass Filter, 2500 MHz to 2570 MHz, N (m) to N (f), 50Ω
2000-1799-R	Bandpass Filter, 2305 MHz to 2320 MHz, N (m) to N (f), 50Ω
	Attenuators
3-1010-122	20 dB, 5 W, DC to 12.4 GHz, N (m) - N (f)
42N50-20	20 dB, 5 W, DC to 18 GHz, N (m) - N (f)
42N50A-30	30 dB, 50 W, DC to 18 GHz, N (m) - N (f)
3-1010-123	30 dB, 50 W, DC to 8.5 GHz, N (m) - N (f)
1010-127-R	30 dB, 150 W, DC to 3 GHz, N (m) - N (f)
3-1010-124	40 dB, 100 W, DC to 8.5 GHz, N (m) - N (f), Uni-directional
1010-121	40 dB, 100 W, DC to 18 GHz, N (m) - N (f), Uni-directional
1010-128-R	40 dB, 150 W, DC to 3 GHz, N (m) - N (f)
	Adapters
1091-417-R	N (m) to QMA (f), DC to 6 GHz, 50Ω (MS2712E, MS2713E)
1091-418-R	N (m) to QMA (m), DC to 18 GHz, 50Ω (MS2712E, MS2713E)
	Precision Adapters
1091-26-R	SMA (m) to N (m), DC to 18 GHz, 50Ω
1091-27-R	SMA (f) to N (m), DC to 18 GHz, 50Ω
1091-80-R	SMA (m) to N (f), DC to 18 GHz, 50Ω
1091-81-R	SMA (f) to N (f), DC to 18 GHz, 50Ω
1091-172-R	BNC (f) to N (m), DC to 1.3 GHz, 50Ω
510-90-R	7/16 DIN (f) to N (m), DC to 7.5 GHz, 50Ω (MS2712E, MS2713E)
510-91-R	7/16 DIN (f) to N (f), DC to 7.5 GHz, 50Ω (MS2712E, MS2713E)
510-92-R	7/16 DIN (m) to N (m), DC to 7.5 GHz, 50Ω (MS2712E, MS2713E)
510-93-R	7/16 DIN (m) to N (f), DC to 7.5 GHz, 50Ω (MS2712E, MS2713E)
510-96-R	7/16 DIN (m) to 7/16 DIN (m), DC to 7.5 GHz, 50Ω (MS2712E, MS2713E)
510-97-R	7/16 DIN (f) to 7/16 DIN (f), DC to 7.5 GHz, 50Ω (MS2712E, MS2713E)
510-102-R	N (m) to N (m), DC to 11 GHz, 50Ω, 90 degrees right angle (MS2712E, MS2713E)
34NN50A	N (m) to N (m), DC to 18 GHz, 50Ω
34NFNF50	N (f) to N (f), DC to 18 GHz, 50Ω
	Backpack and Transit Case
67135	Anritsu Backpack (For Handheld Instrument and PC)
760-243-R	Large Transit Case with Wheels and Handle, 56 × 45.5 × 26.5 cm (22.07" × 17.92" × 10.42")
760-271-R	Transit Case for Portable Directional Antennas and Port Extender, 52.4 × 42.8 × 20.6 cm (20.62" × 16.87" × 8.12") (for 2000-1777-R, 2000-1778-R, 2000-1779-R, 2000-1798-R)
	Miscellaneous Accessories
2000-1374	External Dual Charger for Li-Ion Batteries
633-75	Rechargeable Li-Ion Battery, 7500 mAh
66864	Rack Mount Kit, Master Platform
2000-1689	EMI Near Field Probe Kit
2000-1797-R	Touchscreen Protective Film, 8.4 in.
MA2700A	Handheld Interference Hunter (for full specifications, refer to the MA2700A Technical Data Sheet, 11410-00692)
2000-1884-R	PIM Hunter™ Test Probe (For full specifications, refer to the 2000-1884-R Technical Data Sheet 11410-00999)
2000-1691-R	Stylus with Coiled Tether
2000-1798-R	Port Extender, DC to 6 GHz, N (m) to N (f)
	RF over Fiber Accessories
67-12-R	Optical Tap; Single Mode/Multi Mode 80/20 Tap
67-13-R	Optical Tap; Single Mode 80/20 Tap
67-14-R	Optical Tap; Single Mode/Multi Mode 50/50 Tap
67-15-R	Optical Tap; Single Mode 50/50 Tap
68-5-R	SFP (Optical Module), 4.25 Gbps, 850 nm, 500 m
68-6-R	SFP+ (Optical Module), 8 Gbps FC/10G SR 850 nm
68-7-R	SFP (Optical Module), 2.7 Gbps, 1310 nm, 15 km
68-8-R	SFP+ (Optical Module), 10 Gbps LR 1310 nm
68-9-R	SFP (Optical Mode), 3.07 Gpbs, 1310 nm
68-10-R	SFP (Optical Mode), 3.7 Gpbs, 850 nm
68-11-R	SFP+ (Optical Mode), 10.5 Gpbs, 1310 nm
68-12-R	SFP+ (Optical Mode), 10.5 Gpbs, 850 nm
68-16-R	SFP+ (Oprical Module), SM (Single Mode) 9.83 Gbps, 1310 nm
808-16-R	Fiber Optical Cable, 3 m, Duplex MM (Multi Mode) 1.6 mm LC/PC LC/PC 50 µm
808-17-R	Fiber Optical Cable, 3 m, Simple MM (Multi Mode) 1.6 mm LC/UPC LC/UPC 50 µm
808-18-R	Fiber Optical Cable, 3 m, Ruggedized Simplex SM (Single Mode) LC/UPC LC/UPC
808-19-R	Fiber Optical Cable, 3 m, Ruggedized Duplex SM (Single Mode) LC/UPC LC/UPC
2100-29-R	Fiber Optical Cable, 3 m, Simplex SM (Single Mode) LC/UPC
2100-30-R	Fiber Optical Cable, 10 m, Simplex LC-SC
2100-31-R	Fiber Optical Cable, 3 m, Duplex SM (Single Mode) LC/UPC
971-14-R	Ferrule cleaner, 2.5 mm SC
971-15-R	Ferrule cleaner, 1.25 mm LC
971-16	Fiber ferrule cleaner
2000-1849-R	SFP 4-slot ESD Box (requires software Option 406 above)

Remote RF Signal Monitoring

MS27100A

9 kHz to 6 GHz

High Performance Real-time Monitoring of the Radio Spectrum

The Anritsu platform of spectrum monitors provide high performance real-time monitoring of the radio spectrum. Designed to be stable over time under continuous operation, the MS27100A spectrum monitor module provides superior sweep speeds, high dynamic range, and low spurious levels for fast and accurate measurements. Applications include monitoring for interference, white space analysis, unlicensed transmission discovery, and signal coverage. The MS27100A spectrum monitor module is available as a single RF input port instrument with wired Ethernet for remote interface and USB ports for connecting accessories. The MS27100A can also be expanded to four RF input ports with an optional multiplexer accessory.

Key Features

- Sweep rates up to 24 GHz/s
- Integrated web server to view, control, and conduct measurements via a web browser (Chrome or Firefox)
- Remote firmware updates
- Watchdog timer to insure long-term stability for remotely deployed monitors
- Low spurious signals for accurate signal discovery
- 20 MHz IF bandwidth
- Low power consumption < 11 watts
- Integrated GPS receiver for monitoring location and time synchronization applications
- Gigabit Ethernet available for high speed communications
- Measurements: occupied bandwidth, channel power
- Interference analysis: spectrogram and signal strength
- Dynamic range: >106 dB normalized to 1 Hz BW
- DANL: <–150 dBm referenced to 1 Hz BW, preamp On
- Phase noise: –98 dBc/Hz @ 10 kHz offset at 1 GHz
- Frequency accuracy:
  <±1.5 ppm, <±50 ppb with GPS High Accuracy Mode
- IQ block mode and streaming with time stamping for TDOA applications
- Remote control via SCPI commands
- Vision™ software optional for automated spectrum measurements, setting alarms, and geo-locating signal sources
- SpectraVision software optional for TETRA and Satellite measurements and Channel scanning

Definitions

All specifications and characteristics apply under the following conditions, unless otherwise stated:

Warm-Up Time	After 10 minutes of warm-up time, where the instrument is left in the on state.
Temperature Range	Over the 23° ±5°C temperature range.
Typical Performance	Typical specifications in parenthesis () describe performance that will be met by a minimum of 80% of all products. They do not include guard bands and are not warranted. Typical specifications that are not in parenthesis are not tested and not warranted. They are generally representative of the nominal characteristic performance.
Uncertainty	A coverage factor of k = 2 is applied to the measurement uncertainties to facilitate comparison with other industry monitors.
Specifications Subject to Change	All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site: www.anritsu.com

Remote Spectrum Monitor

Frequency

Frequency Range	9 kHz to 6 GHz (tunable to 0 Hz)
Tuning Resolution	1 Hz
Frequency Reference Accuracy	±1.5 ppm (25° ±25°C) ±1.0 ppm/year aging <±50 ppb with GPS on
Frequency Span	10 Hz to 6 GHz

Sweep Speed Typical (full span FFT mode)

10 kHz RBW	5 GHz/s
30 kHz RBW	12 GHz/s
3 MHz RBW	24 GHz/s

Bandwidth

Resolution Bandwidth (RBW)	10 Hz to 3 MHz in 1–3 sequence (–3 dB bandwidth)
Video Bandwidth (VBW)	10 Hz to 3 MHz in 1–3 sequence (–3 dB bandwidth) (auto or manually selectable)

Spectral Purity

SSB Phase Noise @ 1 GHz	(–98 dBc/Hz) @ 10 kHz offset (–98 dBc/Hz) @ 100 kHz offset

Amplitude Range

<table>
<tr><td>Dynamic Range</td><td>>106 dB (2.4 GHz), 2/3 (TOI-DANL) in 1 Hz RBW</td></tr>
<tr><td>Measurement Range</td><td>DANL to Maximum Continuous Input</td></tr>
<tr><td>Reference Level Range</td><td>–150 to +30 dBm</td></tr>
<tr><td>Attenuator Range</td><td>0 to 50 dB in 5 dB steps</td></tr>
<tr><td>Maximum Continuous Input</td><td>
<table>
<tr><td></td><td>without Option 406
(RF Input to MS27100A)</td><td>with Option 406
(RF Input to multiplexer)</td></tr>
<tr><td>100 MHz to 6 GHz, ≥ 10 dB attenuation</td><td>+30 dBm[*1], ±50 VDC</td><td>+20 dBm[*2], ±50 VDC</td></tr>
<tr><td>300 kHz to 6 GHz, < 10 dB attenuation</td><td>+10 dBm[*1], ±50 VDC</td><td>+10 dBm[*2], ±50 VDC</td></tr>
<tr><td>9 kHz to 6 GHz, preamp on</td><td>–10 dBm, ±50 VDC</td><td>–10 dBm, ±50 VDC</td></tr>
</table>
*1: For lower frequencies, derate maximum continuous input by 6 dB per decade
*2: For lower frequencies, derate maximum continuous input by 4 dB per decade
</td></tr>
<tr><td>Amplitude Units</td><td>Log Scale Modes: dBm</td></tr>
</table>

Amplitude Accuracy

Attenuation ≤40 dB, preamp off for frequencies less than 100 kHz

9 kHz to 100 kHz	± 2.5 dB
>100 kHz to 6 GHz	± 1.5 dB

Displayed Average Noise Level (DANL)

RBW normalized to 1 Hz, 0 dB attenuation

	Preamp Off, Reference Level –20 dBm		Preamp On, Reference Level –50 dBm	
	Max (dBm)	Typical (dBm)	Max (dBm)	Typical (dBm)
10 MHz to 3.3 GHz	–145	–150	–162	–165
>3.3 GHz to 4.1 GHz	–140	–145	–159	–162
>4.1 GHz to 5 GHz	–138	–143	–156	–160
>5 GHz to 6 GHz	–128	–136	–146	–154

Spurious (typ.)

Residual Spurious	RF input terminated, 0 dB input attenuation, preamp off (<–80 dBm), >10 MHz RF input terminated, 0 dB input attenuation, preamp on (<–95 dBm), >10 MHz (<–88 dBm), 16 MHz to 18 MHz
Input-Related Spurious	<–60 dBc, 0 dB attenuation, –30 dBm input, carrier offset >5 MHz
Exceptions	<–60 dBc, input = 4140 MHz

Second Harmonic Distortion

Typical; 0 dB attenuation, –30 dBm input

50 MHz	(–50 dBc)
>50 MHz to 200 MHz	<–60 dBc
>200 MHz to 3000 MHz	<–60 dBc

Third-Order Intercept (TOI)

Typical; preamp off, –20 dBm tones 100 kHz apart, 0 dB attenuation, reference level –20 dBm

800 MHz	(+7 dBm)
2400 MHz	(+17 dBm)
200 MHz to 2200 MHz	+10 dBm
>2.2 GHz to 5.0 GHz	+8 dBm
>5.0 GHz to 6.0 GHz	+14 dBm
VSWR	<2.5:1 (typ.)

Signal Processing

Data Types	I/Q time series: 8, 10, 16 or 24 bit resolution Spectrum trace: 100 to 4000 points
Data Transfer Modes	I/Q time series or spectrum trace in streaming or block mode
I/Q Data Streaming Rate	Gapless on 100BASE-T network, Up to 2.6 MHz signal bandwidth
I/Q Data Time Stamp Resolution	8.7 ns

I/Q Recording Time Typical

Output Data Rate		I/Q Bit Resolution			
Signal Bandwidth	MSPS	24 bits	16 bits	10 bits	8 bits
20 MHz	76.25/3	1.3 s	2.5 s	3.8 s	5 s
13.3 MHz	76.25/4	1.7 s	3.4 s	5 s	6.7 s
6.67 MHz	76.25/8	3.4 s	6.7 s	10.1 s	13.4 s
2.67 MHz	76.25/20	8.4 s	16.8 s	25.2 s	33.6 s
1.33 MHz	76.25/40	16.8 s	33.6 s	50.4 s	1.12 min
667 kHz	76.25/80	33.6 s	1.12 min	1.68 min	2.24 min
267 kHz	76.25/200	1.4 min	2.8 min	4.2 min	5.6 min
133 kHz	76.25/400	2.8 min	5.6 min	8.39 min	11.19 min
66.7 kHz	76.25/800	5.6 min	11.19 min	16.79 min	22.38 min
26.7 kHz	76.25/2000	13.99 min	27.98 min	41.97 min	55.96 min
13.3 kHz	76.25/4000	27.98 min	55.96 min	1.4 h	1.87 h
6.67 kHz	76.25/8000	55.96 min	1.87 h	2.8 h	3.73 h
2.67 kHz	76.25/20000	2.33 h	4.66 h	6.99 h	9.33 h
1.33 kHz	76.25/40000	4.66 h	9.33 h	13.99 h	18.65 h

General Specifications

Setup Parameters

Setup System	Temperature, Serial Number, Firmware Version, Options Installed, Self-Test, Application Self Test, GPS
System Options	Name, Date and Time, Reset (Factory Defaults, Master Reset, Update Firmware)
Directory Management	Sort Method (Name/Type/Date), Ascend/Descend, Internal/USB, Copy
Internal Trace/Setup Memory	4 GB internal memory available for storing files
Mode Switching	Automatically stores/recalls most recently used setup parameters in the mode

Warranty

Instrument	Standard three-year warranty

Environmental

Operating Temperature Range	0° to +50°C
Storage Temperature Range	–40° to +71°C
Maximum Humidity	95% RH (non-condensing) at 30°C
Vibration, Sinusoidal	5 Hz to 55 Hz
Vibration, Random	10 Hz to 500 Hz
Half Sine Shock	30 g_n
Altitude	4600 meters, operating and non-operating
Explosive Atmosphere	MIL-PRF-28800F Section 4.5.6.3 MIL-STD-810G, Method 511.5, Procedure 1

ESD

RF Input Pin	Withstands up to ±4 kV

Dimension and Mass

Dimensions	244 (W) × 165.36 (H) × 27.75 (D) mm
Mass	0.93 kg (2.05 lb) without packaging

EU Standards (CE Marking)

EMC	2014/30/EU, EN61326-1, EN61000-3-2
LVD	2014/35/EU, EN61010-1
RoHS	2011/65/EU

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Model/Order No.	Name
MS27100A	**Standard Hardware** Spectrum Monitor Module with 1 RF IN Port (requires one frequency option)
 MS27100A-0406 MS27100A-0706	**Hardware Options** Enables USB Interface to 6-port RF multiplexer (requires 2000-1894-R) 9 kHz to 6 GHz Frequency Range, Option 706
 40-187-R	**Standard Accessories** (includes with instrument) AC-DC Adapter
 2000-1849-R 3-767367	**Optional Accessories** SFP 4-slot ESD Box (requires software Option 406 above) USB-A to HC5 5-pin header cable, 30 cm (included with 2000-1894-R)

Remote Spectrum Monitor

MS27101A/MS27102A/MS27103A

9 kHz to 6 GHz

For Remote RF Signal Monitoring

Excellent Eco Product

MS27101A
1/2 Rack model

MS27102A
Operates outodoor model

MS27103A
Multi-port model

Anritsu offers three models of remote spectrum monitoring products, designed to both mitigate interference problems and to identify illegal or unlicensed signal activity. The MS27101A is housed in a ½ rack enclosure with 1U height, designed exclusively for indoor applications. MS27102A is an IP67 rated device which operates outdoors, with the ability to be mounted on poles or walls (using the included mounting bracket). The MS27103A is a multi-port spectrum monitor (12 RF In ports or optionally 24 RF In ports) which is ideal for cellular, DAS and other applications requiring the use of multiple antennas.

MS27102A is a full featured platform for monitoring and recording signals in user specified frequencies. Capable of sweep rates up to 24 GHz/s, this probe allows for the capture of many types of signals. This includes periodic or transient transmissions as well as short “bursty” signals. The 20 MHz instantaneous FFT bandwidth available on the MS27102A monitor provides the ability for wideband real-time captures of signal activity for subsequent post-processing.

The MS27103A remote spectrum monitor is designed to identify and locate interfering signals. This serves to optimize the user experience, a key goal for network operators. This translates into customer loyalty, reduced customer churn and superior brand.

Remote Spectrum Monitor Highlights

- Sweep rates up to 24 GHz/s
- Integrated web server to view, control, and conduct measurements via a web browser (Chrome or Firefox)
- Remote firmware updates
- Watchdog timer to insure long-term stability for remotely deployed monitors
- Low spurious signals for accurate signal discovery
- 20 MHz IF bandwidth
- Low power consumption <11 watts
- Integrated GPS receiver for monitoring location and time synchronization applications
- Gigabit Ethernet available for high speed communications
- Measurements: occupied bandwidth, channel power
- Interference analysis: spectrogram and signal strength
- Dynamic range: >106 dB normalized to 1 Hz BW
- Phase noise: –98 dBc/Hz @ 10 kHz offset at 1 GHz
- Frequency accuracy:
  <±1.5 ppm, <±50 ppb with GPS High Accuracy Mode
- IQ block mode and streaming with time stamping for time difference of arrival (TDOA) applications
- Remote control via SCPI commands
- Vision™ software optional for automated spectrum measurements, setting alarms, and geo-locating signal sources

* SpectraVision software optional for TETRA and satellite measurements and channel scanning

Definitions

All specifications and characteristics apply under the following conditions, unless otherwise stated:

Warm-Up	After 10 minutes of warm-up time, where the instrument is left in the on state.
Temperature Range	Over the 23° ±5°C temperature range.
Typical Performance	Typical specifications in parenthesis () describe performance that will be met by a minimum of 80% of all products. They do not include guard bands and are not warranted. Typical specifications that are not in parenthesis are not tested and not warranted. They are generally representative of the nominal characteristic performance.
Uncertainty	A coverage factor of k = 2 is applied to the measurement uncertainties to facilitate comparison with other industry monitors.
Specifications Subject to Change	All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site: www.anritsu.com

Remote Spectrum Monitor

Frequency

Frequency Range	9 kHz to 6 GHz (tunable to 0 Hz)
Tuning Resolution	1 Hz
Frequency Reference Accuracy	±1.5 ppm (25° ±25°C) ±1.0 ppm/year aging <±50 ppb with GPS on
Frequency Span	10 Hz to 6 GHz

Sweep Speed Typical (full span FFT mode)

10 kHz RBW	5 GHz/s
30 kHz RBW	12 GHz/s
3 MHz RBW	24 GHz/s

Bandwidth

Resolution Bandwidth (RBW)	10 Hz to 3 MHz in 1–3 sequence (–3 dB bandwidth)
Video Bandwidth (VBW)	10 Hz to 3 MHz in 1–3 sequence (–3 dB bandwidth) (auto or manually selectable)

Spectral Purity

SSB Phase Noise @ 1 GHz	(–98 dBc/Hz) @ 10 kHz offset (–98 dBc/Hz) @ 100 kHz offset

Amplitude Range

Dynamic Range	>106 dB (2.4 GHz), 2/3 (TOI-DANL) in 1 Hz RBW
Measurement Range	DANL to Maximum Continuous Input
Reference Level Range	–150 to +30 dBm
Attenuator Range	0 to 50 dB in 5 dB steps
Maximum Continuous Input	100 MHz to 6 GHz, ≥ 10 dB attenuation +30 dBm*, ±50 VDC 300 kHz to 6 GHz, < 10 dB attenuation +10 dBm*, ±50 VDC 9 kHz to 6 GHz, preamp on –10 dBm, ±50 VDC *: For lower frequencies, derate maximum continuous input by 6 dB per decade
Amplitude Units	Log Scale Modes: dBm, dBµV

Amplitude Accuracy

Attenuation ≤40 dB, preamp off for frequencies less than 100 kHz

9 kHz to 6.0 GHz	±2.5 dB (MS27101A and MS27102A)
9 kHz to 5.0 GHz	±2.5 dB Port 1 (dB), ±3.0 dB Port 2 to 12 dB (typ.), ±3.0 dB Port 13 to 24 dB (typ.) (MS27102A with Option 402 installed, MS27103A)
>5 GHz to 6.0 GHz	±3.0 dB Port 1 (dB), ±3.5 dB Port 2 to 12 dB (typ.), ±3.5 dB Port 13 to 24 dB (typ.) (MS27102A with Option 402 installed, MS27103A)

Displayed Average Noise Level (DANL)

RBW normalized to 1 Hz, 0 dB attenuation (MS27101A, MS27102A)

	Preamp Off, Reference Level –20 dBm		Preamp On, Reference Level –50 dBm	
	Max (dBm)	Typical (dBm)	Max (dBm)	Typical (dBm)
10 MHz to 3.3 GHz	–145	–150	–162	–165
>3.3 GHz to 4.1 GHz	–140	–145	–159	–162
>4.1 GHz to 5 GHz	–138	–143	–156	–160
>5 GHz to 6 GHz	–128	–136	–146	–154

RBW normalized to 1 Hz, 0 dB attenuation (Port 1 is specified. All other ports are typical and within 1 dBm of the specified values) (MS27103A)

	Preamp Off, Reference Level –20 dBm		Preamp On, Reference Level –50 dBm	
	Max (dBm)	Typical (dBm)	Max (dBm)	Typical (dBm)
10 MHz to 3.3 GHz	–140	–145	–157	–160
>3.3 GHz to 4.1 GHz	–133	–138	–152	–155
>4.1 GHz to 5 GHz	–130	–135	–148	–152
>5 GHz to 6 GHz	–115	–123	–133	–141

Spurious (typ.)

Residual Spurious (MS27101A and MS27102A)	(< –80 dBm) RF input terminated, 0 dB input attenuation, preamp off, > 10 MHz (< –95 dBm) RF input terminated, 0 dB input attenuation, preamp on, > 10 MHz (< –88 dBm) RF input terminated, 0 dB input attenuation, preamp on, 16 MHz to 18 MHz
Residual Spurious (MS27103A)	RF input terminated, 0 dB input attenuation, preamp Off (<–80 dBm), 10 MHz to 4.5 GHz (<–70 dBm), >4.5 GHz to 6.0 GHz RF input terminated, 0 dB input attenuation, preamp On (<–95 dBm)*, 10 MHz to 5.0 GHz (<–85 dBm), >5.0 GHz to 6.0 GHz *: (<–88 dBm), >16 MHz to 18 MHz
Input-Related Spurious (All)	<–60 dBc, 0 dB attenuation, –30 dBm input, carrier offset >5 MHz

Second Harmonic Distortion

Typical; 0 dB attenuation, –30 dBm input

50 MHz	(–50 dBc)
>50 MHz to 200 MHz	<–60 dBc
>200 MHz to 3000 MHz	<–60 dBc

Third-Order Intercept (TOI)

Typical; preamp off, –20 dBm tones 100 kHz apart, 0 dB attenuation, reference level –20 dBm

800 MHz	(+7 dBm)
2400 MHz	(+17 dBm)
200 MHz to 2200 MHz	+10 dBm
>2.2 GHz to 5.0 GHz	+8 dBm
>5.0 GHz to 6.0 GHz	+14 dBm
VSWR	<2.5:1 (typ.)

Signal Processing

Data Types	I/Q time series: 8, 10, 16 or 24 bit resolution Spectrum trace: 100 to 4000 points
Data Transfer Modes	I/Q time series or spectrum trace in streaming or block mode
I/Q Data Streaming Rate	Gapless on 100BASE-T network, Up to 2.6 MHz signal bandwidth
I/Q Data Time Stamp Resolution	8.7 ns

I/Q Recording Time Typical

Output Data Rate		I/Q Bit Resolution			
Signal Bandwidth	MSPS	24 bits	16 bits	10 bits	8 bits
20 MHz	76.25/3	1.3 s	2.5 s	3.8 s	5 s
13.3 MHz	76.25/4	1.7 s	3.4 s	5 s	6.7 s
6.67 MHz	76.25/8	3.4 s	6.7 s	10.1 s	13.4 s
2.67 MHz	76.25/20	8.4 s	16.8 s	25.2 s	33.6 s
1.33 MHz	76.25/40	16.8 s	33.6 s	50.4 s	1.12 min
667 kHz	76.25/80	33.6 s	1.12 min	1.68 min	2.24 min
267 kHz	76.25/200	1.4 min	2.8 min	4.2 min	5.6 min
133 kHz	76.25/400	2.8 min	5.6 min	8.39 min	11.19 min
66.7 kHz	76.25/800	5.6 min	11.19 min	16.79 min	22.38 min
26.7 kHz	76.25/2000	13.99 min	27.98 min	41.97 min	55.96 min
13.3 kHz	76.25/4000	27.98 min	55.96 min	1.4 h	1.87 h
6.67 kHz	76.25/8000	55.96 min	1.87 h	2.8 h	3.73 h
2.67 kHz	76.25/20000	2.33 h	4.66 h	6.99 h	9.33 h
1.33 kHz	76.25/40000	4.66 h	9.33 h	13.99 h	18.65 h

Antenna Port Isolation (MS27102A) Typical

≤3 GHz	>40 dB
>3 GHz	>30 dB

General Specifications

Setup Parameters

Setup System	Temperature, Serial Number, Firmware Version, Options Installed, Self-Test, Application Self Test, GPS
System Options	Name, Date and Time, Reset (Factory Defaults, Master Reset, Update Firmware)
Directory Management	Sort Method (Name/Type/Date), Ascend/Descend, Internal/USB, Copy
Internal Trace/Setup Memory	4 GB internal memory available for storing files
Mode Switching	Automatically stores/recalls most recently used setup parameters in the mode

Connectors

RF In	One type N, female port, 50Ω (MS27101A, MS27102A) 12 SMA (f) ports, 50Ω (MS27103A) 24 SMA (f) ports, 50Ω (optional) (MS27103A)
External Power	11 W, 5.5 mm barrel connector, 11 VDC to 14 VDC (MS27101A) 11 W, 11 V to 24 V, 3-pin IP67 power connector (MS27102A) 11 W, ±20 VDC to ±70 VDC (110/220 VAC optional) (MS27103A)
External Reference In	10 MHz, +10 dBm max, +5 VDC max, BNC (f) (MS27101A, MS27103A)
Ethernet	1 RJ45 connector (MS27101A) 1 RJ45 connector for Gbit LAN (ruggedized and weatherproof) (MS27102A) One RJ45 connector for Gbit LAN, 2nd port optional for daisy chain (MS27103A)
USB	2 Type A interface connectors (MS27101A) 2 USB Type A connectors (MS27103A)
GPS	SMA (f)

EU Standards (CE Marking)

EMC	2014/30/EU, EN61326:2013 CISPR 11/EN55011 IEC/EN61000-4-2/3/4/5/6/8/11
LVD	2014/35/EU
Safety	EN61010-1:2010
RoHS	2011/65/EU applies to instruments with CE marking placed on the market after July 22, 2017
Australia and New Zealand	RCM AS/NZS 4417:2012
Korea	KCC-REM-A21-0004

Warranty

Instrument	Standard three-year warranty

Environmental

Operating Temperature Range	0° to +50°C (MS27101A, MS27103A) –40° to +55°C (MS27102A)
Storage Temperature Range	–40° to +71°C (MS27101A, MS27103A) –51° to +71°C (MS27102A)
Maximum Relative Humidity	95% RH at 30°C, non-condensing
Half Sine Shock	30 g_n
Altitude	4600 meters, operating and non-operating

ESD

RF Input Pin	Withstands up to ±4 kV

Dimension and Mass

Dimensions	216 (W) × 45 (H) × 368 (D) mm (8.5 × 1.75 × 14.5 in) (MS27101A) 310 (W) × 102 (H) × 310 (D) mm (12.2 × 4.0 × 12.2 in) (MS27102A) 480 (W) × 90 (H) × 300 (D) mm (18.9 × 3.5 × 11.8 in) (MS27103A)
Mass	2.78 kg (6.2 lb) (MS27101A) 6.87 kg (15.2 lb) (MS27102A) 12-port: 3.9 kg (8.9 lb) (MS27103A) 24-port: 4.5 kg (9.9 lb) (MS27103A)

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Standard Hardware
MS27101A	Spectrum Monitor with 1 RF IN Port (Requires one frequency option)
MS27102A	Spectrum Monitor with 1 RF IN Port (Requires one frequency option)
MS27103A	Spectrum Monitor with 12 SMA (f) Input Ports (Requires one frequency option)
	Hardware Options
MS27101A-0706	9 kHz to 6 GHz Frequency Range
MS27101A-0001	Rack Mount Kit
MS27102A-0402	2 RF IN Ports
MS27102A-0404	4 RF IN Ports
MS27102A-0406	6 RF IN Ports
MS27102A-0706	9 kHz to 6 GHz Frequency Range
MS27103A-0706	9 kHz to 6 GHz Frequency Range
MS27103A-0424	Expands Input Ports to 24 SMA (f)
MS27103A-0110	110-220 VAC Power Supply
MS27103A-0412	Two Ethernet Ports

Model/Order No.	Name
	Software Options
MS27101A-0400	Vision Monitor Enabled
MS27101A-0401	Vision Locate Enabled (Requires Option 400 above)
MS27101A-0407	Vision High-Speed Port Scanner Enabled
MS27101A-0479	Vision AM Demodulation/FM Deviation
MS27101A-0485	Vision Spectrum Occupancy (Requires Option 400)
Ms27101A-0486	Vision Coverage Mapping (Requires Option 407)
MS27102A-0400	Vision Monitor Enabled
MS27102A-0401	Vision Locate Enabled (Requires Option 400 above)
MS27102A-0407	Vision High-Speed Port Scanner Enabled
MS27102A-0479	Vision AM Demodulation/FM Deviation
MS27102A-0485	Vision Spectrum Occupancy (Requires Option 400)
Ms27102A-0486	Vision Coverage Mapping (Requires Option 407)
MS27103A-0400	Vision Monitor Enabled
MS27103A-0401	Vision Locate Enabled (Requires Option 400 above)
MS27103A-0407	Vision High-Speed Port Scanner Enabled
MS27103A-0479	Vision AM Demodulation/FM Deviation
MS27103A-0485	Vision Spectrum Occupancy (Requires Option 400)
Ms27103A-0486	Vision Coverage Mapping (Requires Option 407)
	Standard Accessories (includes with instrument)
40-187-R	AC-DC Adapter (MS27101A, MS27102A)
2100-32-R	Power Adapter (MS27102A)
2000-1371-R	Ethernet Cable, 2.13 m (7 ft) (MS27102A, MS27103A)
2000-1528-R	GPS Antenna, SMA (m) with 5 m (15 ft) cable, 3 dBi gain, requires 5 VDC (MS27102A, MS27103A)
	Optional Accessories
760-288-R	Transit Case (MS27101A)
760-285-R	Large Transit Case with Wheels and Handle (MS27102A)
760-287-R	Large Transit Case with Wheels and Handle (MS27103A)

MX280001A Vision™ Software

Remote Control
GPIB | **Ethernet**

Automate the Process of Collecting Measurement Data

Spectrum monitoring systems facilitate the identification and removal of interference signals that degrade network capacity.
By monitoring spectrum on a continual basis, problem signals can be identified as they occur in real time. Patterns of unwanted signal activity can also be examined, providing an efficient way to characterize and locate the source of the interference problem.
In addition to interference detection, spectrum monitoring is also used to characterize spectrum occupancy. Government regulators and operators are often interested in determining the usage rate for various frequency bands. Monitoring these frequencies provides the information needed to optimize spectrum for maximum utilization. Spectrum can be re-purposed for other applications or multiplexed with other signals using cognitive radio techniques.
Spectrum monitoring also serves to enforce compliance with government regulations. Police, fire fighters, air traffic control and emergency services must all have access to communications free of impediments and distortion. Compliance with spectrum regulations is often enforced by spectrum monitoring.

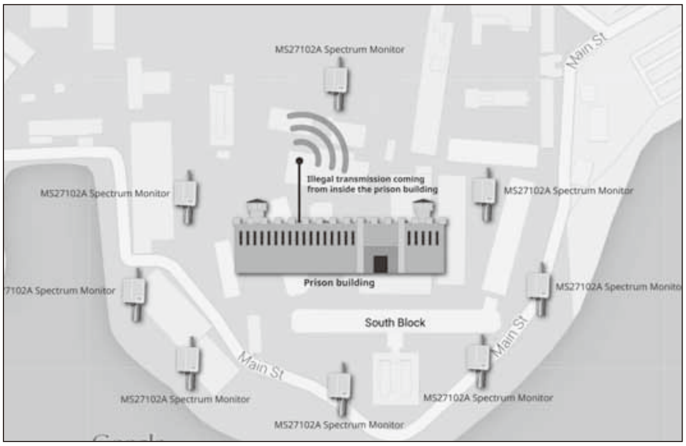


Figure 1: Monitoring for illegal transmissions from prison facility

Vision™ Software Overview (MX280001A)

The Vision™ software platform works with Anritsu's spectrum monitoring hardware to automate the process of collecting measurement data, providing useful information about network health and use of the spectrum. Using multiple hardware probes covering a wide geographical area, Vision presents a comprehensive picture of spectral activity to assist users in monitoring the spectrum for unusual activity. Figure 2 shows a typical signal monitoring system with Anritsu spectrum monitors positioned for maximum coverage.

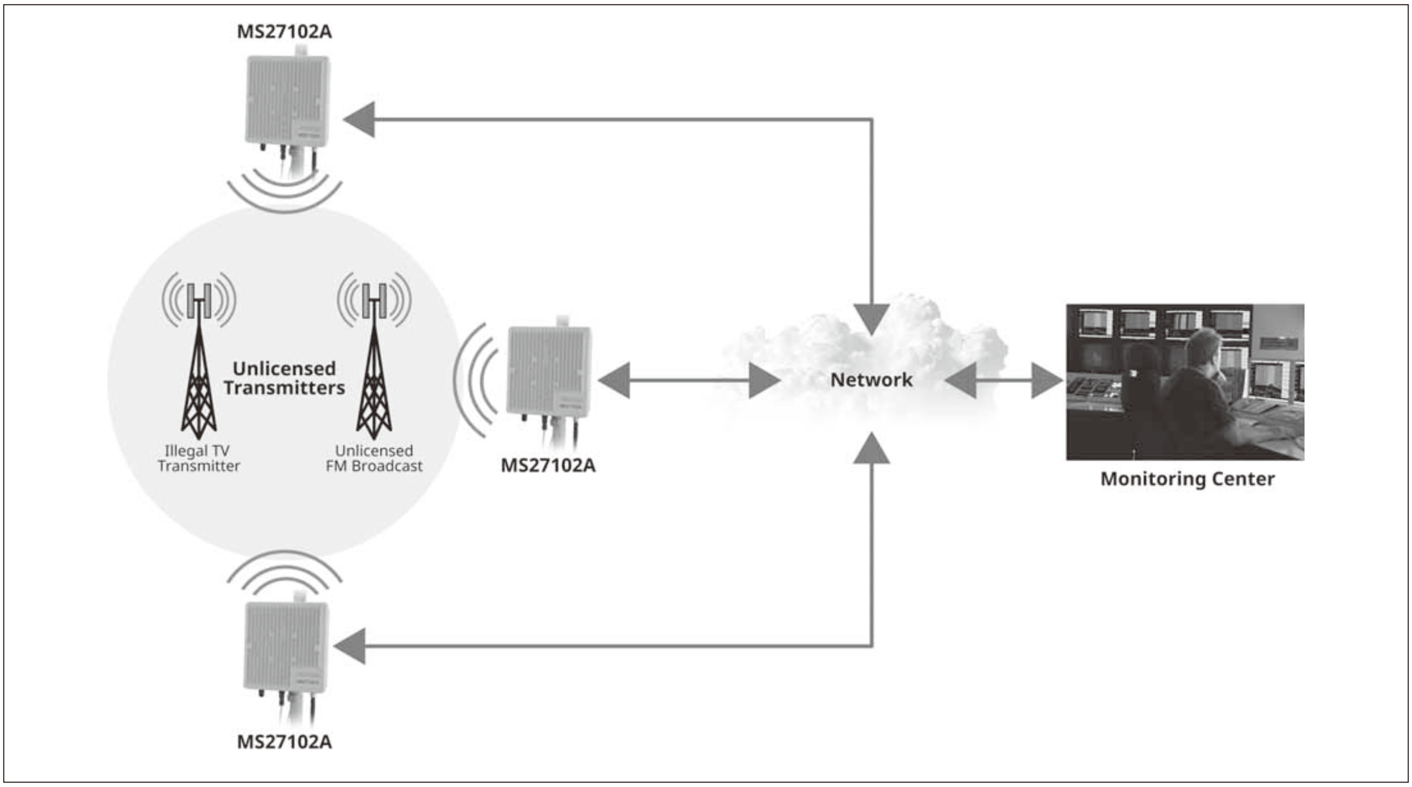


Figure 2: Spectrum monitoring system

Vision software facilitates a variety of applications used for spectrum monitoring systems. One important application includes determining the presence of interferers in a network which can degrade communications services. Cellular operators in particular are vulnerable to such interference that manifests itself in slower data rates and dropped calls. In most cases, network performance is compromised on the uplink frequency bands (communication from the mobile unit to the base station). However, network quality of service can also be impacted by interference on the downlink channels. This type of interference can be prevalent at the cell periphery where the power levels of the interference signals approximate those transmitted by the base station itself.

Another important application for Vision software is the detection of illegal or unlicensed broadcast signals. Illegal broadcasters may set up AM/FM, cellular or other types of transmissions which must be identified and ultimately located. By using spectrum monitors, unlicensed broadcasts can be tracked, processed and stored in a database for further examination and potential use in legal proceedings. See figures 3 and 4 for important spectrum monitoring applications.

Figure 3: Stadium monitoring

Figure 4: Airport frequency monitoring

Other Applications Include the Following:

- Inform spectrum policy – accumulate historical spectrum data to determine percent time of occupancy
- Monitor jails/prisons for unauthorized transmissions
- Monitor borders, airports, nuclear facilities and other sensitive areas
- Railroads – monitor spectrum for potential interference of positive train control (PTC) signals
- Satellite reception interference detection
- Interference monitoring at large venues such as stadiums, malls, etc
- White space monitoring
- Indoor monitoring (board rooms, embassies and other sensitive facilities). See Figure 5.

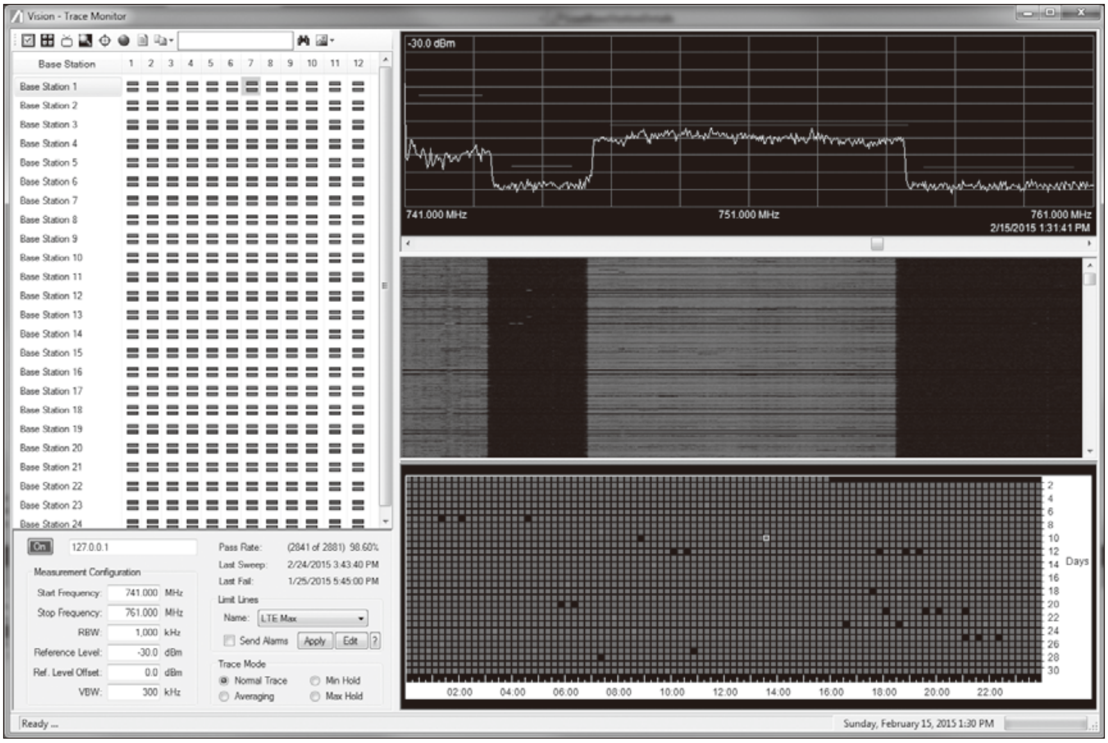
Figure 5: Indoor transmissions detection

Vision Software – How it Works

Vision is an optional software program which runs on a PC using the Windows operating system (Windows 7, 8 or 10). This software provides control and automation capabilities when used with Anritsu's spectrum monitor hardware. Vision is composed of two components responsible for monitoring and geo-locating interference signals, called Vision Monitor and Vision Locate respectively. Each performs a wide range of spectrum monitoring and control applications designed to mitigate interference problems and detect unusual signal activity. A summary of each vision software product is presented below.

Vision Monitor

The Vision Monitor program is the visible user interface for monitoring remote spectrum activity. It provides a listing of all hardware monitors in the system along with a graphic overview of system health. A screenshot of the main user interface for Vision Monitor is shown in figure 6.



127.0.0.1

Measurement Configuration

Start Frequency: 741.000 MHz

Stop Frequency: 761.000 MHz

RBW: 1,000 kHz

Reference Level: -30.0 dBm

Ref. Level Offset: 0.0 dBm

VBW: 300 kHz

Pass Rate: (2841 of 2881) 98.60%

Last Sweep: 2/24/2015 3:43:40 PM

Last Fail: 1/25/2015 5:45:00 PM

Limit Lines

Name: LTE Max

☐ Send Alarms

Trace Mode

● Normal Trace ○ Min Hold

○ Averaging ○ Max Hold

Ready ...

Sunday, February 15, 2015 1:30 PM

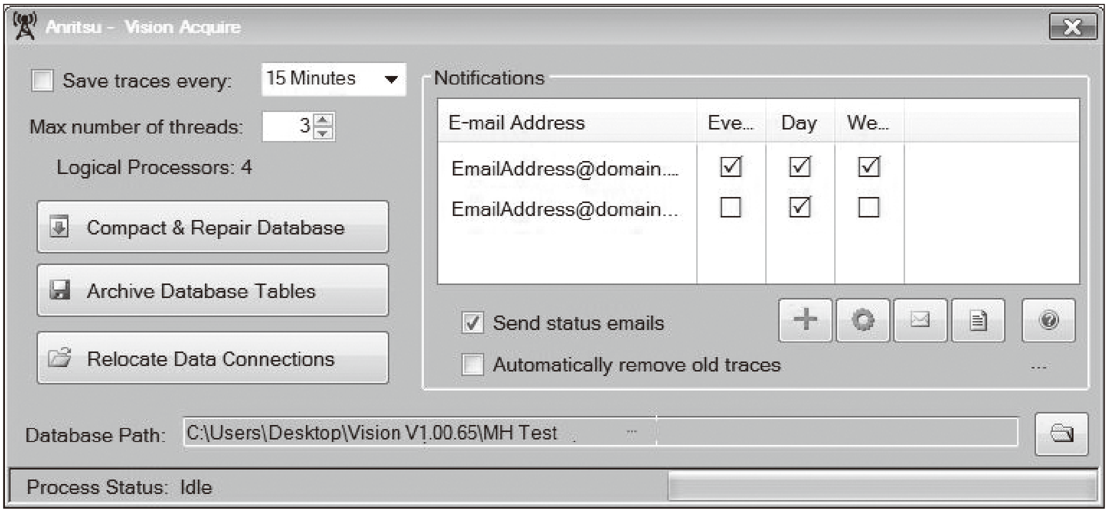
Figure 6: Vision monitor screen

Shown here is a listing of the deployed monitors, with the ability to view both "real-time" and historic measurement trace and spectrogram data.

Vision Monitor performs a wide range of spectrum monitoring duties. These functions include:

- Measurement acquisition
- Data storage
- Threshold setting/Alarm generation
- Reporting

Users can set up the Vision program to take automatic measurements for all spectrum monitors. The measurements are in turn uploaded into a database for further review. The database is updated with new data, while old information is periodically purged according to user settings. Functions are also available for archiving, copying and compressing the database. See Figure 7 for illustration.



☐ Save traces every: 15 Minutes

Max number of threads: 3

Logical Processors: 4

E-mail Address	Eve...	Day	We...
EmailAddress@domain....	☑	☑	☑
EmailAddress@domain...	☐	☑	☐

☑ Send status emails

☐ Automatically remove old traces

Database Path: C:\Users\Desktop\Vision V1.00.65\MH Test

Process Status: Idle

Figure 7: Vision Monitor measurement and database control

With Vision Monitor, the user can set up limit lines for triggering alarms, view spectrum history and change measurement parameters of individual or groups of spectrum monitor probes. The program makes heavy use of intuitive graphics to indicate the presence of interference or other signals of interest. Additionally, searches both in real-time and over history can be made to indicate patterns of interference. In some cases, interference may only occur at certain times of the day or certain days of the week. It is important to be able to capture the signal, identify the pattern and subsequently hunt for the signal location at the appropriate times. In addition to trace data, spectrograms can be viewed to indicate changes in frequency over time for suspicious signals. For each remote monitor, Vision Monitor is capable of collecting data from as many as 24 input RF ports. This can be ideal for cellular systems with multiple sectors and multiple frequencies per sector. Figure 8 shows a screen shot of the user interface with multiple monitors overlayed on a map. Both GoogleMaps and OpenStreetMap are available. Using this map, alarm threshold violations can be easily seen with color changes on the probe indicating a frequency threshold violation at that site. If needed, automated email alerts can be sent to any email address provided. These alerts can be emailed in real-time or sent as summary reports on a daily or weekly basis. These reports are a great tool for provide a snap shot of the network's health and provide time-stamped indications of when a suspicious signal might be present.

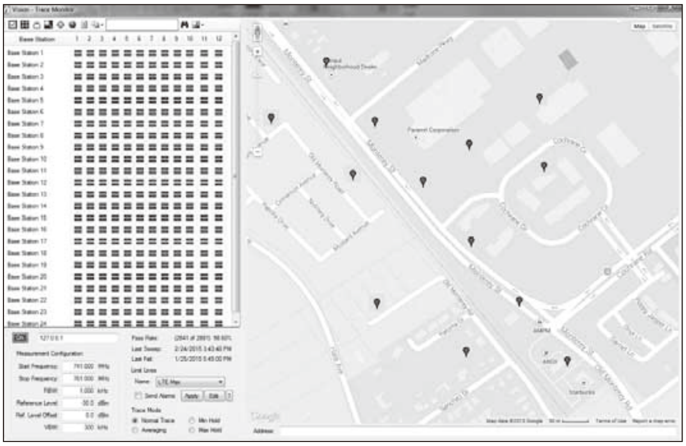


Figure 8: Monitor positions overlaid on map

Vision Locate

Vision Locate is an optional program used with Vision Monitor. Once an interferer or suspected illegal signal is identified, a geo-location algorithm is employed to fix the approximate position of the signal. This enables the user to narrow down the signal location, minimizing the time and expense for pin-pointing its position. A sample map is shown in Figure 9 showing the suspected interference position. In this window, the probe locations are indicated by the red squares. The interference position is identified by the concentric circles.

For interference that may have occurred in the past, users can also use historical data for positioning the signal of interest. A search can be done for alarm violations that occurred at any of the spectrum monitor probes in the network. Using three probes in the vicinity, the interference position can be geo-located. Power of Arrival (POA) algorithms are used to position the interference signal. Three or more probes must be in the vicinity to detect the signal of interest in order to correctly triangulate the position. See figure 9 for example for geo-location positioning on the map.

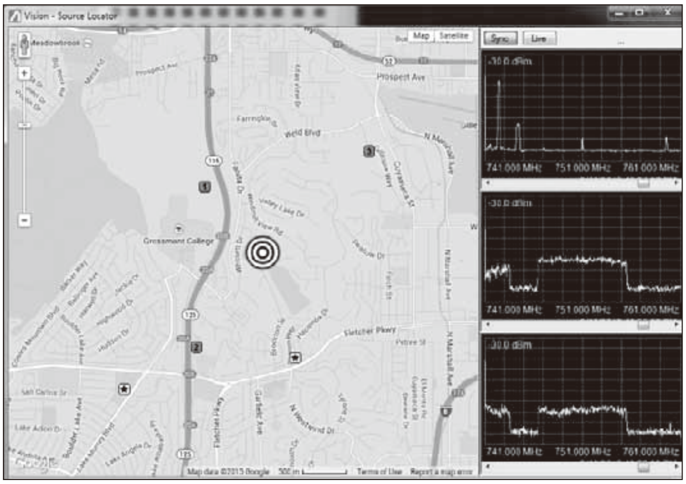


Figure 9: Geo-location of interference position

Remote Spectrum Monitoring Hardware

Anritsu offers several spectrum monitoring systems designed for both indoor and outdoor environments. The MS27101A remote spectrum monitor addresses the need for an accurate remote solution for white space monitoring, harm claim threshold detection, in-building interference monitoring, positive train control system protection and locating illegal/unlicensed signal sources or similar interference. Housed in a half-rack size enclosure, the MS27101A is ideal for spectrum monitoring where a small footprint is required. The MS27102A monitor is an outdoor IP67-rated probe that can be positioned on towers, rooftops or poles. It is ideally used to monitor for both interference and unusual signal activity. The MS27103A, which maintains 12 or optionally 24 RF inputs, is designed specifically for cellular system or in applications requiring multiple RF inputs. The MS27103A is also ideal for monitoring for interference in DAS environments. Both platforms are designed for stability, sweep speed and low spurious signals. Figures 11 and 12 show each probe.

MS27101A

MS27102A

MS27103A (24-Port RF Input option shown)

Key features for each hardware platform include the following:

- 9 kHz to 6 GHz
- Sweep speed up to 24 GHz/s
- Integrated web server to view, control and conduct measurements via a web browser (both Chrome and FireFox supported)
- Remote firmware update capable
- Watchdog timer to insure long-term stability for remotely deployed monitors
- IP67 rated for outdoor deployments
- Linux operating system
- Low spurious signals for accurate signal discovery
- 20 MHz instantaneous FFT bandwidth
- Low power consumption < 11 watts (input voltage 11 to 24 VDC)
- Integrated GPS receiver for monitoring location and time synchronization applications
- Gigabit Ethernet available for high speed transmissions
- Interference analysis: spectrogram and signal strength
- Dynamic range: > 106 dB normalized to 1 Hz BW
- Phase noise: –98 dBc/Hz @ 10 kHz offset at 1 GHz
- IQ block mode and streaming with time stamping for TDOA applications
- Vision™ software optional for automated spectrum measurements, setting alarms and geo-locating signal sources

Summary

In order to minimize expense while preserving network integrity, a highly automated process is required. Vision software provides an efficient user-friendly method for monitoring frequencies, alerting the user when unusual signal activity is present. By identifying patterns of interference, recording spectrum history and geo-locating the position of target signals, Vision software is the perfect solution for your interference mitigation needs.

Ordering Information

The Vision software application can be downloaded from the Anritsu website. In order to use Vision, an Anritsu spectrum monitor must be purchased and enabled with the option. Note that in order to use Vision Locate for geo-location, Vision Monitor must also be purch

Model/Order No.	Name
MS27101A-0400	Vision Monitor enabled on MS27101A
MS27101A-0401	Vision Locate enabled on MS27101A
MS27102A-0400	Vision Monitor enabled on MS27102A
MS27102A-0401	Vision Locate enabled on MS27102A
MS27103A-0400	Vision Monitor enabled on MS27103A
MS27103A-0401	Vision Located enabled on MS27103A

VECTOR NETWORK ANALYZERS

Selection Guide

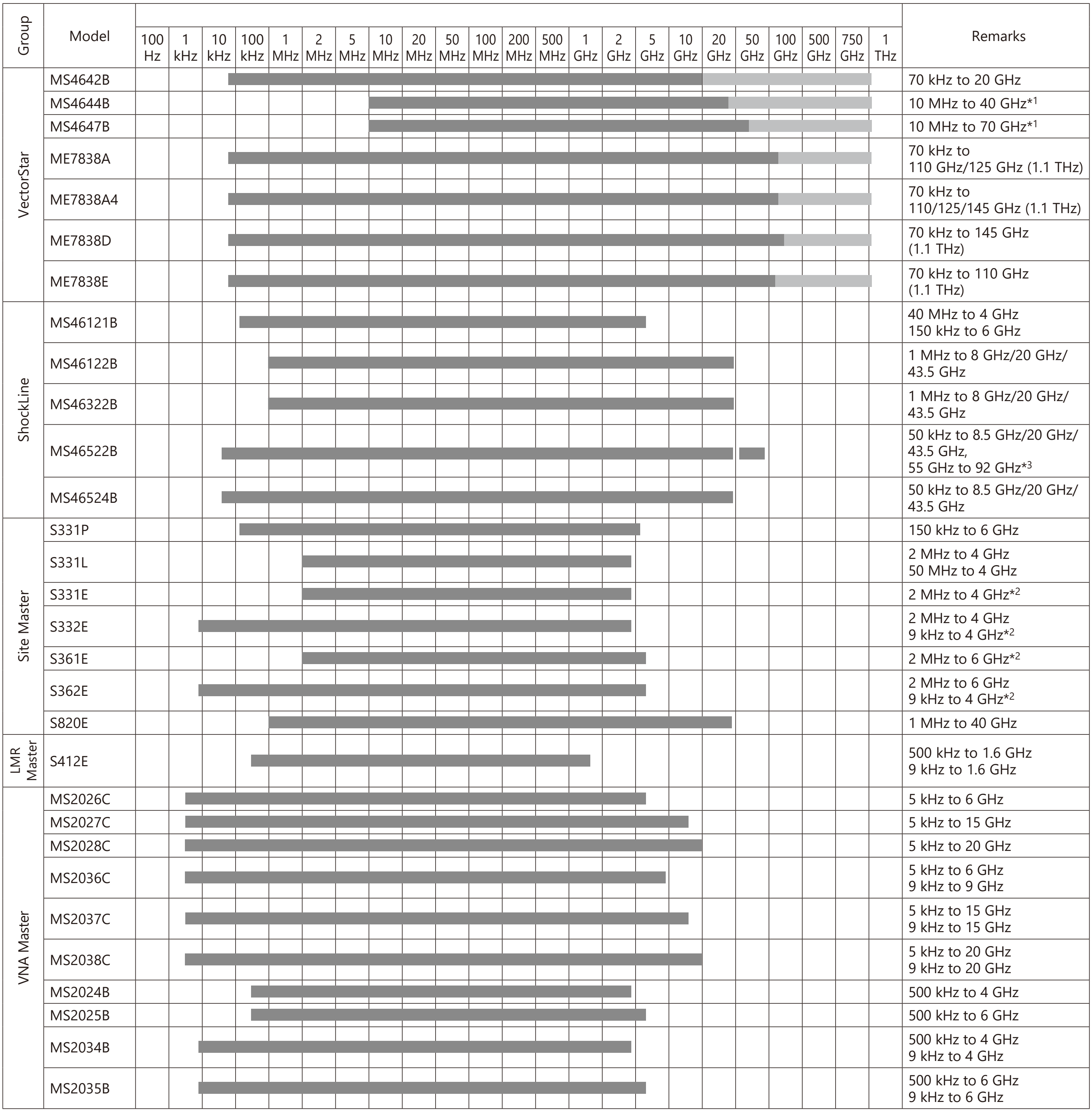
Group	Model	Frequency Band	Measurement Function									
			S-Parameter	Power Sweep Mode	Receiver Offset Mode (Option)	Multiple-source Control (Option)	Time Domain (Option)	Mixer Measurement (Option)	Pulse (Option)	Internal Second Source (Option)	Spectrum Analyzer	Distance-to-Fault (DTF)
VectorStar	MS4642B	70 kHz to 20 GHz	✓	✓	✓	✓	✓	✓	✓	✓		
	MS4644B	10 MHz to 40 GHz*1	✓	✓	✓	✓	✓	✓	✓	✓		
	MS4647B	10 MHz to 70 GHz*1	✓	✓	✓	✓	✓	✓	✓	✓		
	ME7838A	70 kHz to 110 GHz/125 GHz (1.1 THz)	✓	✓	✓	✓	✓		✓	✓		
	ME7838A4	70 kHz to 110/125/145 GHz (1.1 THz)	✓	✓	✓	✓	✓		✓	✓		
	ME7838D	70 kHz to 145 GHz (1.1 THz)	✓	✓	✓	✓	✓		✓	✓		
	ME7838E	70 kHz to 110 GHz (1.1 THz)	✓	✓	✓	✓	✓		✓	✓		
ShockLine	MS46121B	40 MHz to 4 GHz 150 kHz to 6 GHz	✓				✓					
	MS46122B	1 MHz to 8 GHz 1 MHz to 20 GHz 1 MHz to 43.5 GHz	✓				✓					
	MS46322B	1 MHz to 8 GHz 1 MHz to 20 GHz 1 MHz to 43.5 GHz	✓				✓					
	MS46522B	50 kHz to 8.5/20/43.5/92 GHz	✓	✓			✓					
	MS46524B	50 kHz to 8.5/20/43.5 GHz	✓	✓			✓					
Site Master	S331P	150 kHz to 6 GHz										✓
	S331L	2 MHz to 4 GHz Cable & Antenna Analyzer 50 MHz to 4 GHz Power Meter										✓
	S331E	2 MHz to 4 GHz										✓
	S332E	2 MHz to 4 GHz Cable & Antenna Analyzer 9 kHz to 4 GHz Spectrum Analyzer									✓	✓
	S361E	2 MHz to 6 GHz										✓
	S362E	2 MHz to 6 GHz Cable & Antenna Analyzer 9 kHz to 4 GHz Spectrum Analyzer									✓	✓
	S820E	1 MHz to 40 GHz	✓									✓
LMR Master	S412E	500 kHz to 1.6 GHz 9 kHz to 1.6 GHz	✓								✓	✓
VNA Master	MS2026C	5 kHz to 6 GHz	✓				✓					✓*2
	MS2027C	5 kHz to 15 GHz	✓				✓					✓*2
	MS2028C	5 kHz to 20 GHz	✓				✓					✓*2
	MS2036C	5 kHz to 6 GHz 9 kHz to 9 GHz	✓				✓				✓	✓
	MS2037C	5 kHz to 15 GHz 9 kHz to 15 GHz	✓				✓				✓	✓
	MS2038C	5 kHz to 20 GHz 9 kHz to 20 GHz	✓				✓				✓	✓
	MS2024B	500 kHz to 4 GHz	✓*3									✓
	MS2025B	500 kHz to 6 GHz	✓*3									✓
	MS2034B	500 kHz to 4 GHz 9 kHz to 4 GHz	✓*3								✓	✓
	MS2035B	500 kHz to 6 GHz 9 kHz to 6 GHz	✓*3								✓	✓

*1: Requires Option 070 (70 kHz Frequency Extension)

*2: Requires Time Domain Option (Option 0002)

*3: S_{11}/S_{21} measurement by 1 path 2 ports calibration can be performed.

Selection Guide (Frequency Range)



Group	Model	Remarks
VectorStar	MS4642B	70 kHz to 20 GHz
	MS4644B	10 MHz to 40 GHz*1
	MS4647B	10 MHz to 70 GHz*1
	ME7838A	70 kHz to 110 GHz/125 GHz (1.1 THz)
	ME7838A4	70 kHz to 110/125/145 GHz (1.1 THz)
	ME7838D	70 kHz to 145 GHz (1.1 THz)
	ME7838E	70 kHz to 110 GHz (1.1 THz)
ShockLine	MS46121B	40 MHz to 4 GHz 150 kHz to 6 GHz
	MS46122B	1 MHz to 8 GHz/20 GHz/ 43.5 GHz
	MS46322B	1 MHz to 8 GHz/20 GHz/ 43.5 GHz
	MS46522B	50 kHz to 8.5 GHz/20 GHz/ 43.5 GHz, 55 GHz to 92 GHz*3
	MS46524B	50 kHz to 8.5 GHz/20 GHz/ 43.5 GHz
Site Master	S331P	150 kHz to 6 GHz
	S331L	2 MHz to 4 GHz 50 MHz to 4 GHz
	S331E	2 MHz to 4 GHz*2
	S332E	2 MHz to 4 GHz 9 kHz to 4 GHz*2
	S361E	2 MHz to 6 GHz*2
	S362E	2 MHz to 6 GHz 9 kHz to 4 GHz*2
	S820E	1 MHz to 40 GHz
LMR Master	S412E	500 kHz to 1.6 GHz 9 kHz to 1.6 GHz
VNA Master	MS2026C	5 kHz to 6 GHz
	MS2027C	5 kHz to 15 GHz
	MS2028C	5 kHz to 20 GHz
	MS2036C	5 kHz to 6 GHz 9 kHz to 9 GHz
	MS2037C	5 kHz to 15 GHz 9 kHz to 15 GHz
	MS2038C	5 kHz to 20 GHz 9 kHz to 20 GHz
	MS2024B	500 kHz to 4 GHz
	MS2025B	500 kHz to 6 GHz
	MS2034B	500 kHz to 4 GHz 9 kHz to 4 GHz
	MS2035B	500 kHz to 6 GHz 9 kHz to 6 GHz

*1: Requires Option 070 (70 kHz Frequency Extension)
*2: Requires Option 2 (2 MHz Frequency Extension)
*3: Requires Option 082

VectorStar™ Broadband Vector Network Analyzers

ME7838A Series

Broadband Coaxial and Millimeter Waveguide VNA System, 70 kHz to 1.1 THz

Remote Control
GPIB | **Ethernet**

High Performance, Broadband Network Analysis Solutions

VectorStar

The ME7838A broadband VNA system provides single sweep coverage from 70 kHz to 110 GHz and is operational from 40 kHz to 125 GHz. It consists of the following items:

- MS4647B VectorStar VNA, 70 kHz to 70 GHz with Option 7, Option 70, and Option 80/81
- 3739C Broadband Millimeter-wave Test Set and Interface Cables
- 3743A Broadband Millimeter-Wave (mmWave) modules, 2 each

The ME7838A Millimeter-wave configuration provides waveguide output from 50 GHz to 1.1 THz in waveguide bands.
The system can extend the broadband system or be configured to operate only as a waveguide system. It consists of the following items:

- MS464xB VectorStar VNA, with Option 7 and Option 82/83
- 3739C Broadband/Millimeter-Wave Test Set and Interface Cables
- Millimeter-Wave modules, 2 each

Broadband/Millimeter-Wave System Options

- MS4640B-002 – Time Domain
- MS4640B-021 – Universal Fixture Extraction
- MS464xB-031 – Dual Source Architecture
- MS464xB-032 – Internal RF Combiner
- MS4640B-035 – IF Digitizer
- MS4640B-041 – Noise Figure
- MS4640B-042 – PulseView™
- MS4640B-043 – DifferentialView™
- MS4640B-044 – IMDView™
- MS4640B-046 – Fast CW
- MS4640B-047 – Eye Diagram
- MS4640B-048 – Differential Noise Figure
- MS464xB-051 – External VNA Direct Access Loops
- MS464xB-061 – Active Measurement Suite, with 2 Attenuators
- MS464xB-062 – Active Measurement Suite, with 4 Attenuators
- 3744E-Rx – 30 GHz to 110 GHz mm-Wave Receiver for Noise Figure and mm-Wave Antenna Measurements
- 3744E-EE – 56 GHz to 95 GHz WR-12 Waveguide Module
- 3744E-EW – 65 GHz to 110 GHz WR-10 Waveguide Module
- SC8215 and SC7287 – Kelvin Bias Tees

Definitions

All specifications and characteristics apply under the following conditions, unless otherwise stated:

Warm-Up Time	After 90 minutes of warm-up time, where the instrument is left in the ON state.
Temperature Range	Over the 25° ±5°C temperature range.
Error-Corrected Specifications	For error-corrected specifications, over 23° ±3°C, with <1°C variation from calibration temperature. For error-corrected specifications are warranted and include guard bands, unless otherwise stated.
Typical Performance	"Typical" specifications describe expected, but not warranted, performance based on sample testing. Typical performance indicates the measured performance of an average unit and do not guarantee the performance of any individual product. "Typical" specifications do not account for measurement uncertainty and are shown in parenthesis, such as (–102 dB), or noted as Typical.
User Cables	Specifications do not include effects of any user cables attached to the instrument.
Discrete Spurious Responses	Specifications may exclude discrete spurious responses.
Internal Reference Signal	All specifications apply with internal 10 MHz Crystal Oscillator Reference Signal.
Characteristic Performance	Characteristic performance indicates a performance designed-in and verified during the design phase. It does include guard-bands and is not covered by the product warranty.
Below 300 kHz	All uncertainties below 300 kHz are typical.
Recommended Calibration Cycle	12 months
Interpolation Mode	All specifications are with Interpolation Mode Off.
Specifications Subject to Change	All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site at www.anritsu.com.

Specifications for Broadband Configuration

ME7838A Broadband System 70 kHz to 110 GHz

Does not include source or receive attenuators for Port1 or Port2. Kelvin bias tees not included. Connection to Triax output Source Measure Units (SMUs) available.

System and Receiver Dynamic Range, Noise Floor

System dynamic range is measured as the difference between maximum port power and the RMS noise floor in a 10 Hz bandwidth and no averaging (ports terminated).
Noise floor is calculated as the difference between maximum rated port power and system dynamic range.
Receiver Dynamic Range is calculated as the difference between the receiver compression level and the noise floor at ports 1 or 2.
Normalizing measurement made with a through line connection, with its effects compensated for. The cables between the VNA and the 3743A modules are assumed to be the 806-206 1.85 mm cable (61 cm, 24 in long) or the 806-209 1.85 mm cable (91 cm, 36 in long).
All figures are typical.

Frequency Range	System Dynamic Range*1 (dB)		Receiver Dynamic Range*1 (dB)		Noise Floor*1 (dBm)	
	ME7838A*2	ME7838A Option 62*3	ME7838A*2	ME7838A Option 62*3	ME7838A*2	ME7838A Option 62*3
70 kHz to 300 kHz	93	90	89	86	–83	–80
>0.3 MHz to 2 MHz	103	100	103	102	–93	–90
>2 MHz to 10 MHz	115	112	115	114	–105	–102
>0.01 GHz to 2.5 GHz	120	116	121	122	–110	–109
>2.5 GHz to 24 GHz	110	105	121	121	–110	–108
>24 GHz to 54 GHz	108	105	124	123	–114	–113
>54 GHz to 60 GHz	112	112	122	122	–112	–112
>60 GHz to 65 GHz	108	108	117	117	–107	–107
>65 GHz to 80 GHz	108	108	120	120	–110	–110
>80 GHz to 85 GHz	110	110	123	123	–113	–113
>85 GHz to 90 GHz	105	108	121	121	–111	–111
>90 GHz to 95 GHz	112	112	121	121	–111	–111
>95 GHz to 100 GHz	105	108	117	117	–107	–107
>100 GHz to 110 GHz	109	109	122	122	–112	–112
>110 GHz to 120 GHz	107	107	115	115	–110	–110
>120 GHz to 125 GHz	104	104	112	112	–107	–107

*1: Excludes localized spurious responses and crosstalk
*2: Also ME7838A Option 61, S_{12} values
*3: Also ME7838A Option 61, S_{21} values

Test Port Power, Receiver Compression*1

Port power control is provided by the base VNA for frequencies below 54 GHz, and by the 3743A mmWave module for frequencies greater than 54 GHz. Receiver compression point is defined as the port power level beyond which the response may be compressed more than 0.2 dB relative to normalization level. 10 Hz IF bandwidth used to remove trace noise effects. All typical.

Frequency Range	Port Power		Receiver Compression	
	Max. Power ME7838A	Max. Power ME7838A Option 62*2	Compression ME7838A	Compression ME7838A Option 62
70 kHz to 300 kHz	10	10	6	6
>0.3 MHz to 2 MHz	10	10	10	12
>2 MHz to 10 MHz	10	10	10	12
>0.01 GHz to 2.5 GHz	10	7	11	13
>2.5 GHz to 24 GHz	0	–3	11	13
>24 GHz to 54 GHz	–6	–8	10	10
>54 GHz to 60 GHz	0	0	10	10
>60 GHz to 65 GHz	1	1	10	10
>65 GHz to 80 GHz	–2	–2	10	10
>80 GHz to 85 GHz	–3	–3	10	10
>85 GHz to 90 GHz	–3	–3	10	10
>90 GHz to 95 GHz	1	1	10	10
>95 GHz to 100 GHz	1	1	10	10
>100 GHz to 110 GHz	–3	–3	10	10
>110 GHz to 120 GHz	–3	–3	5	5
>120 GHz to 125 GHz	–3	–3	5	5

*1: Using the 806-206 1.85 mm (61 cm, 24 in long) test port cables between the VNA and the 3743A mm-Wave modules.
*2: Use this column also for Options 51 and 61 although the performance between 10 MHz and 54 GHz will characteristically be better by 1 dB or more for Option 51, and will characteristically be better by 1 dB or more for Option 61 (with port 1 driving and port 2 receiving).

Power Range, Accuracy, Linearity and Resolution

Accuracy is defined at –10 dBm or max. rated power, whichever is lower. Linearity is defined as the incremental error between the accuracy test power level and 5 dB below. Typical.

Frequency Range	Power Range (dB)		Accuracy (dB)	Linearity (dB)	Resolution (dB)
	ME7838A	ME7838A Option 62			
70 kHz to 300 kHz	+10 to –25	+10 to –85	±1.5	±1.5	0.01
>0.3 MHz to 2 MHz	+10 to –25	+10 to –85	±1.5	±1.5	0.01
>2 MHz to 10 MHz	+10 to –25	+10 to –85	±1.5	±1.5	0.01
>0.1 GHz to 2.5 GHz	+10 to –25	+8 to –85	±1.0	±1.0	0.01
>2.5 GHz to 24 GHz	0 to –25	–3 to –85	±1.0	±1.0	0.01
>24 GHz to 54 GHz	–6 to –30	–8 to –90	±1.5	±1.0	0.01
>54 GHz to 60 GHz	0 to –55	0 to –55	±2.0	±1.5	0.01
>60 GHz to 65 GHz	+1 to –55	+1 to –55	±2.0	±1.5	0.01
>65 GHz to 80 GHz	–2 to –55	–2 to –55	±2.0	±1.5	0.01
>80 GHz to 85 GHz	–3 to –55	–3 to –55	±2.0	±1.5	0.01
>85 GHz to 90 GHz	–3 to –55	–3 to –55	±2.0	±1.5	0.01
>90 GHz to 95 GHz	+1 to –55	+1 to –55	±2.0	±1.5	0.01
>95 GHz to 100 GHz	–+1 to –55	+1 to –55	±3.0	±2.0	0.01
>100 GHz to 110 GHz	–3 to –50	–3 to –50	±3.0	±2.0	0.01
>110 GHz to 120 GHz	–3 to –40	–3 to –40	±4.0	±3.0	0.01
>120 GHz to 125 GHz	–3 to –40	–3 to –40	±4.0	±3.0	0.01

High Level Noise

Noise measured at 1 kHz IF bandwidth, at maximum power or compression limit (whichever is less), with through transmission. RMS. Typical.

Frequency Range	Magnitude (dB)	Phase (degree/°C)
70 kHz to 500 kHz	<0.04	<0.4
>0.5 MHz to 2 MHz	<0.005	<0.05
>2 MHz to 10 MHz	<0.005	<0.05
>0.01 GHz to 2.5 GHz	<0.005	<0.05
>2.5 GHz to 24 GHz	<0.006	<0.06
>24 GHz to 54 GHz	<0.005	<0.06
>54 GHz to 80 GHz	<0.005	<0.06
>80 GHz to 110 GHz	<0.008	<0.09
>110 GHz to 120 GHz	<0.010	<0.20
>120 GHz to 125 GHz	<0.025	<0.30

Stability

Ratioed measurement at max. leveled power and with nominally a full reflect or a stable thru over the normal specified temperature range. Typical.

Frequency Range	Magnitude (dB/°C)	Phase (degree/°C)
70 kHz to 300 kHz	<0.015	<0.1
>0.3 MHz to 2 MHz	<0.015	<0.05
>2 MHz to 10 MHz	<0.01	<0.05
>0.01 GHz to 2.5 GHz	<0.01	<0.05
>2.5 GHz to 30 GHz	<0.01	<0.09
>30 GHz to 54 GHz	<0.01	<0.07
>54 GHz to 80 GHz	<0.015	<0.1
>80 GHz to 110 GHz	<0.015	<0.15
>110 GHz to 120 GHz	<0.02	<0.2
>120 GHz to 125 GHz	<0.04	<0.25

Frequency Resolution, Accuracy and Stability

Resolution	Accuracy	Stability
1 Hz	±5 × 10^{-7} Hz/Hz (at time of calibration)	<5 × 10^{-9}/°C over 0° to 50°C temperature <1 × 10^{-9}/day aging, instrument on

Uncorrected (Raw) Port Characteristics

Typical performance with either ME7838A or ME7838A with Option 62.

Frequency Range	Directivity (dB)	Port Match (dB)
≤10 MHz	10*	8
>0.01 GHz to 2.5 GHz	9*	10
>2.5 GHz to 30 GHz	5*	12
>30 GHz to 40 GHz	5*	5
>40 GHz to 54 GHz	10	5
>54 GHz to 80 GHz	10	10
>80 GHz to 110 GHz	5	7
>110 GHz to 120 GHz	5	7
>120 GHz to 125 GHz	5	7

*: Raw directivity is degraded below 300 kHz, 2.2 GHz to 2.5 GHz and in narrow bands within 10 GHz to 34 GHz

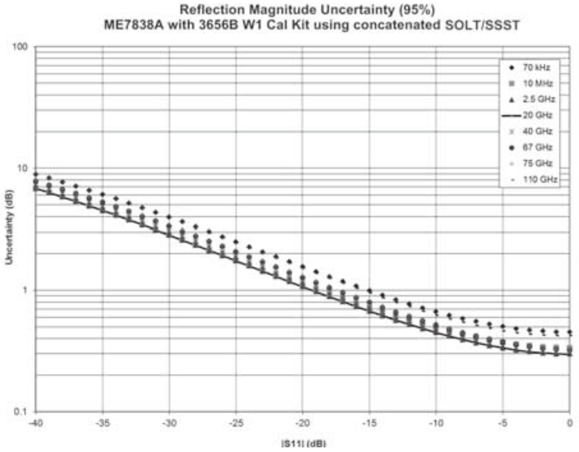
Corrected System Performance and Uncertainties

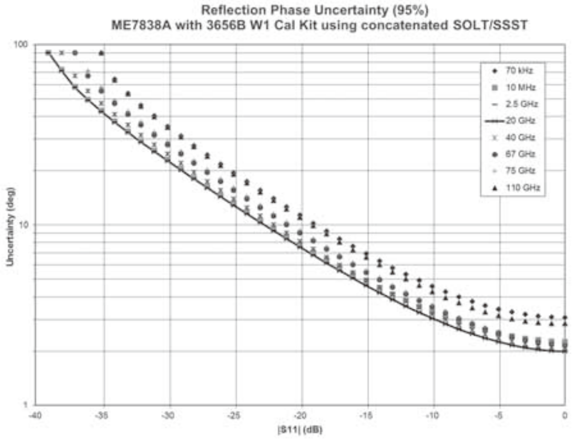
With 12-term concatenated SOLT and Triple Offset Short Calibration, using the 3656B W1 Calibration Kit. Typical.

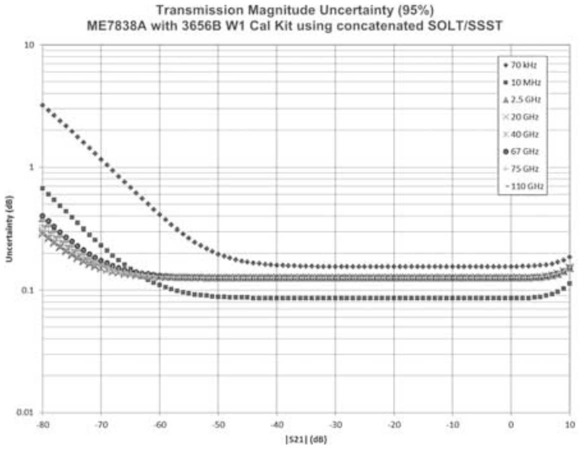
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
70 kHz to 10 MHz	36	36	36	±0.1	±0.1
>0.01 GHz to 2.5 GHz	40	41	40	±0.05	±0.03
>2.5 GHz to 20 GHz	40	41	40	±0.05	±0.05
>20 GHz to 67 GHz	38	41	38	±0.05	±0.07
>67 GHz to 95 GHz	37	42	37	±0.05	±0.07
>95 GHz to 110 GHz	35	35	35	±0.05	±0.07

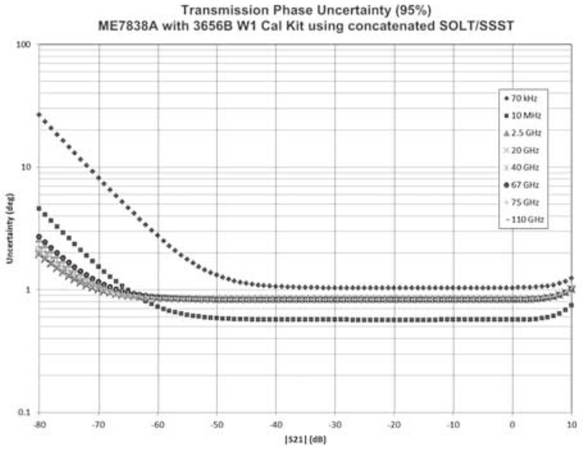
Measurement Uncertainties – SOLT/SSST

The graphs give measurement uncertainties after the above calibration. The errors are worst case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability while noise effects are added on an RSS basis. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. For other conditions, please use our free Exact Uncertainty calculator software, down-loadable from the Anritsu website at, www.anritsu.com.


Reflection Magnitude Uncertainty (95%)
ME7838A with 3656B W1 Cal Kit using concatenated SOLT/SSST

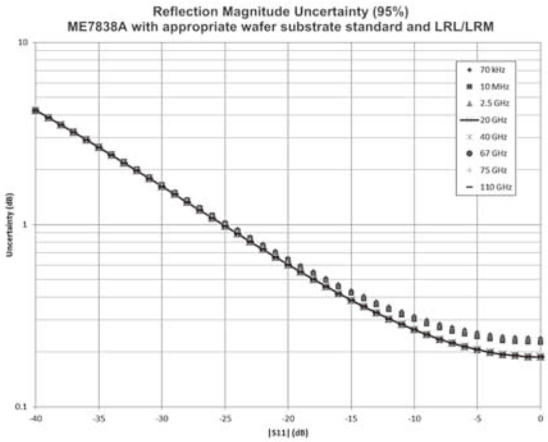

Reflection Phase Uncertainty (95%)
ME7838A with 3656B W1 Cal Kit using concatenated SOLT/SSST

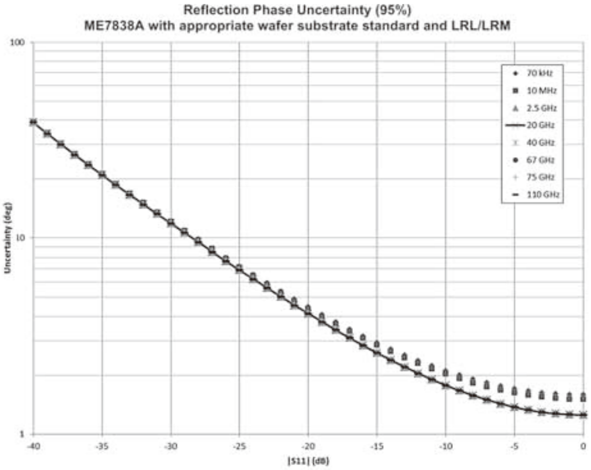

Transmission Magnitude Uncertainty (95%)
ME7838A with 3656B W1 Cal Kit using concatenated SOLT/SSST

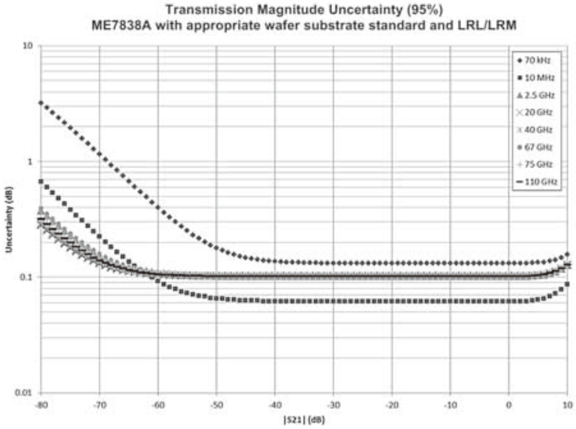

Transmission Phase Uncertainty (95%)
ME7838A with 3656B W1 Cal Kit using concatenated SOLT/SSST

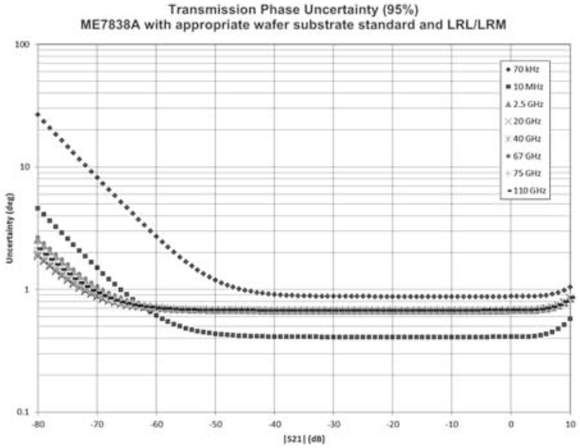
Corrected System Performance and Uncertainties – LRL/LRM

With 12 term LRL/LRM calibration using on-wafer substrate standards. Typical. Based on a typical vendor supplied impedance standard substrate.


Reflection Magnitude Uncertainty (95%)
ME7838A with appropriate wafer substrate standard and LRL/LRM


Reflection Phase Uncertainty (95%)
ME7838A with appropriate wafer substrate standard and LRL/LRM


Transmission Magnitude Uncertainty (95%)
ME7838A with appropriate wafer substrate standard and LRL/LRM


Transmission Phase Uncertainty (95%)
ME7838A with appropriate wafer substrate standard and LRL/LRM

Measurement Time (ms)*

Measurement times include sweep time, retrace time, and band-switching time. Typical.
Full Band, 70 kHz to 110 GHz, Display ON and ALC ON.

Calibration	IF BW	401 points	1,601 points	10,001 points	25,001 points
1-port calibration	1 MHz	80	100	350	700
	30 kHz	90	160	600	1,500
	10 kHz	110	240	1,100	2,600
	1 kHz	470	1,600	10,000	25,000
	10 Hz	47,000	160,000	1,000,000	2,500,000
2-port calibration	1 MHz	160	200	700	1,400
	30 kHz	180	320	1,200	3,000
	10 kHz	220	480	2,200	5,200
	1 kHz	940	3,200	20,000	50,000
	10 Hz	94,000	320,000	2,000,000	5,000,000

* Measurement times are for ME7838A Broadband and ME7838A Millimeter-Wave Systems

Measurement Time (ms) vs. System dynamic range (dB)

Full Band, Display ON and ALC ON.

Calibration	401 points Measurement Time	Achieved System Dynamic Range (Option 62 at 54 GHz)	IF BW and Averaging Used
Uncorrected or 1-port calibration	110 470	77 87	10 kHz/no avg 1 kHz/no avg
2-port calibration	220 940	77 87	10 kHz/no avg 1 kHz/no avg

SC8215 and SC7287 Kelvin Bias Tees

Provides Sense and Force SMC connections per combiner, close to the mmWave module, to minimize the IR drops associated with the impedances between the bias tee and the DUT. The SC8215 is a bias tee providing DC bias from 70 kHz to 125 GHz with Max. Voltage: 16 VDC, Max Current: 100 mA. The SC7287 is a bias tee providing DC bias from 100 MHz to 125 GHz with Max Voltage: 50 VDC, Max. Current: 500 mA.
For applications requiring Source Measure Units (SMUs) with tri-axial outputs, a tri-axial (m) to BNC (m) cable is available, with the inner-shield isolated from ground at the bias tee BNC end, to float at the SMU's guard potential. (Check the accessories list for ordering information.)

Waveguide Band Configuration

ME7838A Millimeter-Wave VNA, Waveguide Bands

Three configurations are available for waveguide band operation for E and W bands when using the ME7838A system.

3743A Module	First, the Anritsu 3743A Broadband Millimeter-Wave (mm-Wave) module can be adapted to waveguide measurements using waveguide adapters.
3744A-EE or 3744A-EW Module	Second, the Anritsu 3744A-EE or 3744A-EW millimeter-wave module can be used. These version modules operate in the extended E and W waveguide bands and are operational using the MS4644B or MS4647B VectorStar (with Options 8x and 7) and the 3739C broadband/millimeter-wave test set.
OML or VDI mm-Wave Modules	The third configuration option is to use external millimeter-wave modules with any model VectorStar (with Options 8x and 7) and the 3739C test set. For millimeter bands above 110 GHz either the OML or VDI modules may be used.

E and W Band Operation Using the 3743A, 3744A-EE, or 3744A-EW mm–Wave Module

3743A Millimeter-Wave Modules

3744A-EE/3744A-EW
Millimeter-Wave Module with Waveguide Adapter

The 3743A Broadband mm-Wave module can be adapted to a waveguide band output by adding an available waveguide band adapter and mounting flange.

VectorStar menus automatically configure the system frequencies incorporating the 3743A module for banded operation. Using the 3743A modules provides the opportunity to sweep frequencies for broadband applications and quickly convert to waveguide configurations for banded measurements. The advantages of small compact modules with excellent RF performance and power range control can therefore be realized in both broadband and waveguide configurations when using the 3743A mm-Wave module. For systems where only waveguide band operation is required, the 3744A-EE or 3744A-EW mm-Wave module can be used.

The 3744A-EE or 3744A-EW mm-Wave module operates from 54 GHz to 110 GHz. The band supported is determined by the waveguide adapter connected to the 1 mm test port output of the 3744A-EE/EW module:

3744A-EE	Configures the module for Extended E Band
3744A-EW	Configures for Extended W Band

The RF input port of the 3744A-EE or 3744A-EW module is restricted below 54 GHz, however, the RF input port retains a DC connection to the 1 mm test port.

Thus, the waveguide adapter can be removed for on-wafer applications from 54 GHz to 110 GHz operation and the on-wafer DUT can be biased through the RF input port.

Band	Frequency Range	Waveguide Flange	Transmission/Reflection Module
Ext-E	56 GHz to 94 GHz*	WR-12	3744A-EE
Ext-W	65 GHz to 110 GHz	WR-10	3744A-EW

*: Operational to 95 GHz.

Waveguide Band Specifications

Port Power, Noise Floor, Dynamic Range – 3744A-EE/3744A-EW mm-Wave Modules

System dynamic range is defined as the ratio of the source power to the noise floor. Maximum Receiver Power is defined as the 0.2 dB compression point of the receiver at the waveguide port. Receiver dynamic range is defined as the ratio of maximum receive power to the noise floor. Noise Floor measurements are RMS, are made with no average in a 10 Hz IF bandwidth, and include an isolation calibration.
All figures are typical.

3744A-EE Extended-E Band (WR-12) Waveguide

Frequency Range	Source Power (dBm)	Max. Receive Power (0.2 dB comp. pt.) (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)	Receiver Dynamic Range (dB)
56 GHz to 60 GHz	–2	11	–111	109	122
>60 GHz to 65 GHz	0	11	–106	106	117
>65 GHz to 80 GHz	–3	11	–109	106	120
>80 GHz to 85 GHz	–4	11	–112	108	123
>85 GHz to 90 GHz	–4	11	–110	106	121
>90 GHz to 94 GHz*	0	12	–109	109	117

*: Operational to 95 GHz.

3744A-EW Extended-W Band (WR-10) Waveguide

Frequency Range	Source Power (dBm)	Max. Receive Power (0.2 dB comp. pt.) (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)	Receiver Dynamic Range (dB)
65 GHz to 67 GHz	0	11	–106	106	117
>67 GHz to 80 GHz	–3	11	–109	106	120
>80 GHz to 85 GHz	–4	11	–112	108	123
>85 GHz to 90 GHz	–4	11	–110	106	121
>90 GHz to 100 GHz	0	12	–109	109	121
>100 GHz to 110 GHz	–5	12	–110	105	122

Power Range, Accuracy, Linearity and Resolution

Accuracy is defined at –10 dBm or max rated power, whichever is lower. Linearity is defined as the incremental error between the accuracy test power level and 5 dB below. Typical.

Frequency Range	Range (dBm)		Accuracy (dB)	Linearity (dB)	Resolution (dB)
	ME7838A	ME7838A Option 62			
54 GHz to 60 GHz	–55 to –2	–55 to –2	±2.0	±1.5	0.01
>60 GHz to 65 GHz	–55 to 0	–55 to 0	±2.0	±1.5	0.01
>65 GHz to 80 GHz	–55 to–3	–55 to –3	±2.0	±1.5	0.01
>80 GHz to 85 GHz	–55 to –4	–55 to –4	±2.0	±1.5	0.01
>85 GHz to 90 GHz	–55 to –4	–55 to –4	±2.0	±1.5	0.01
>90 GHz to 100 GHz	–55 to 0	–55 to 0	±3.0	±2.0	0.01
>100 GHz to 110 GHz	–50 to –5	–50 to –5	±3.0	±2.0	0.01
>110 GHz to 120 GHz*	–40 to –12	–40 to –12	±4.0	±3.0	0.01
>120 GHz to 125 GHz*	–40 to –15	–40 to –15	±4.0	±3.0	0.01

*: 110 GHz to 125 GHz frequency range is available as operational.

Corrected System Performance/Uncertainties – 3744A-EE/3744A-EW mm-Wave Modules

With 12-term Offset Short Sliding Load or LRL calibrations, using high precision waveguide sections and standards from the appropriate calibration kit.

3744A-EE Extended-E Band (WR-12) Waveguide – 56 GHz to 94 GHz

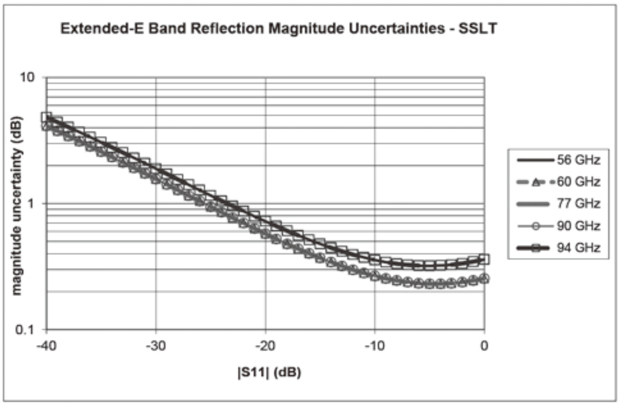
Calibration Type	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
Offset Short	>44	>33	>44	±0.080	±0.100
LRL	>44	>43	>44	±0.006	±0.006

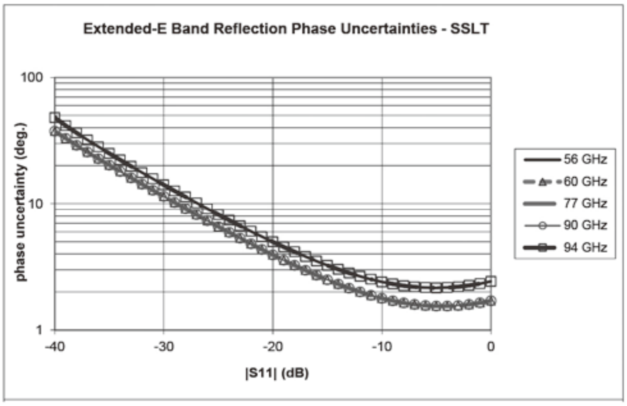
3744A-EW Extended-W Band (WR-10) Waveguide – 65 GHz to 110 GHz

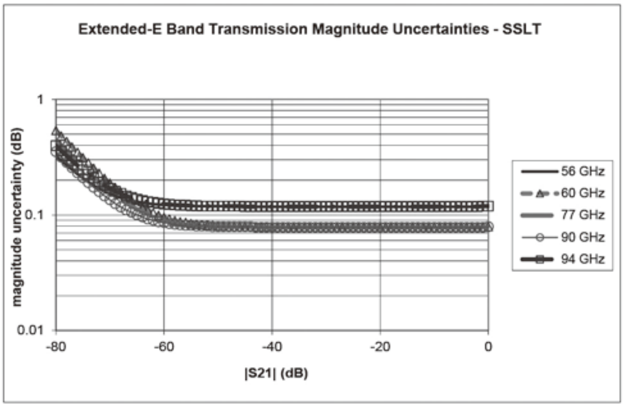
Calibration Type	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
Offset Short	>40	>30	>46	±0.080	±0.100
LRL	>40	>40	>46	±0.006	±0.006

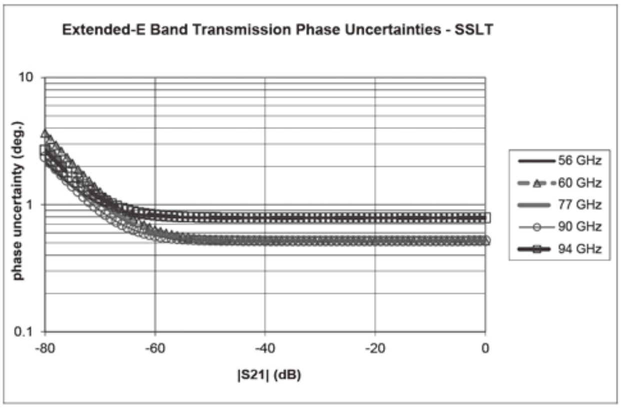
Measurement Uncertainties – Extended-E Band – SSLT

The graphs give measurement uncertainties after the above calibration. The errors are worse case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used.
For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$.
All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com. Typical.









Measurement Uncertainties – Extended-E Band – LRL

The graphs give measurement uncertainties after the above calibration. The errors are worse case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used.
For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$.
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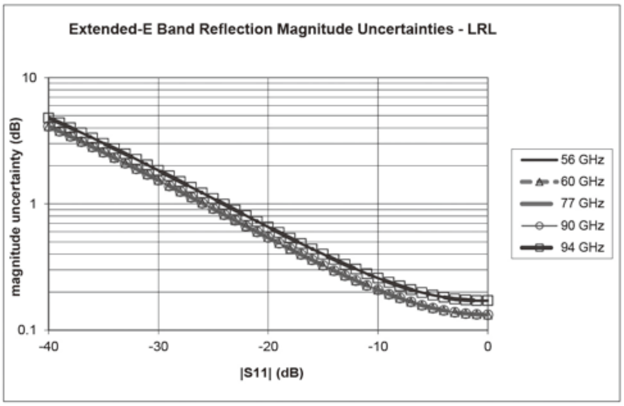
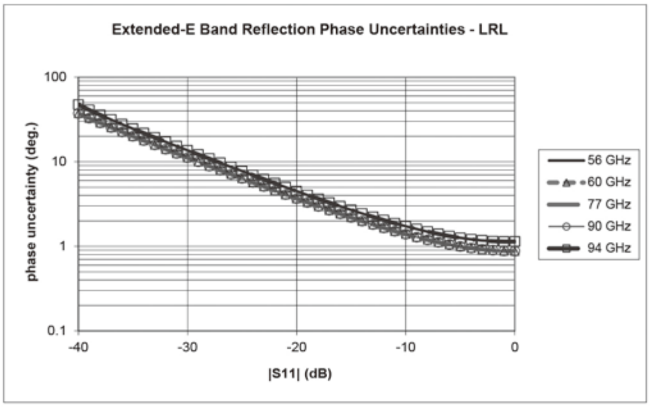
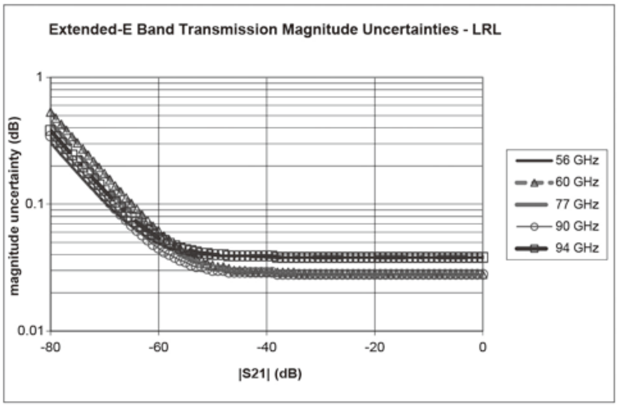
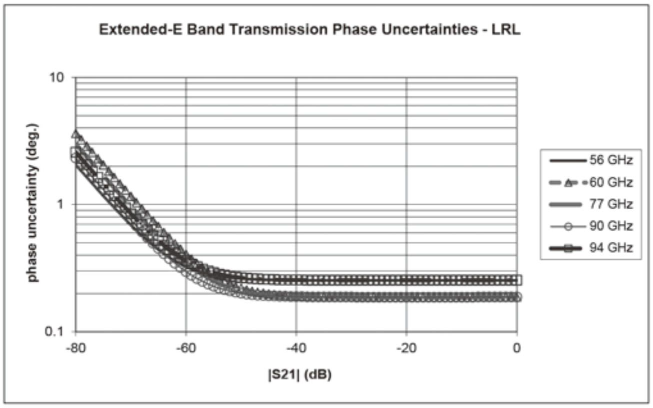


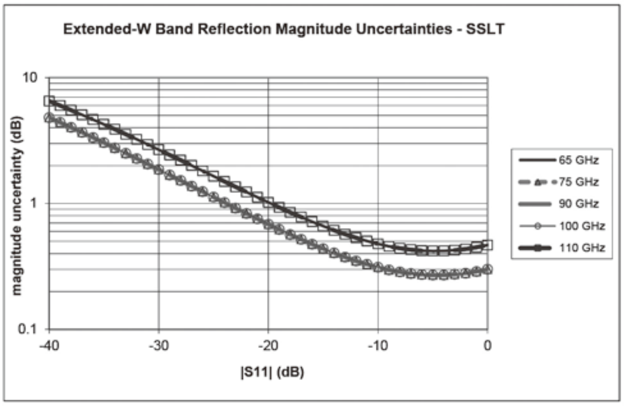


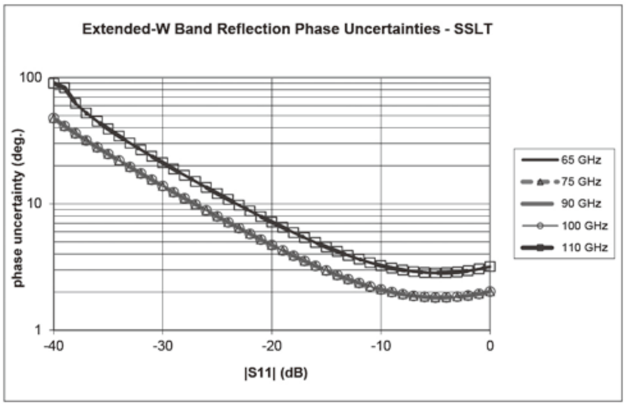


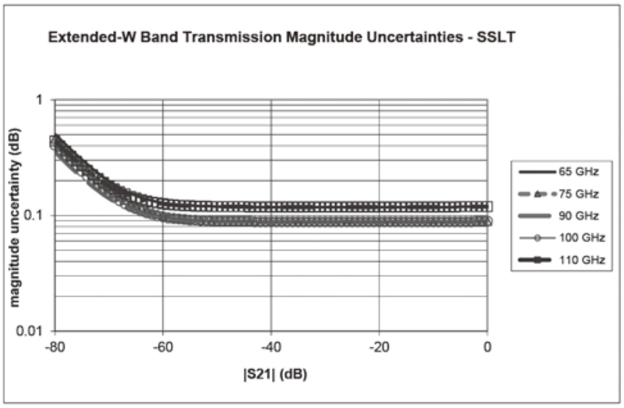


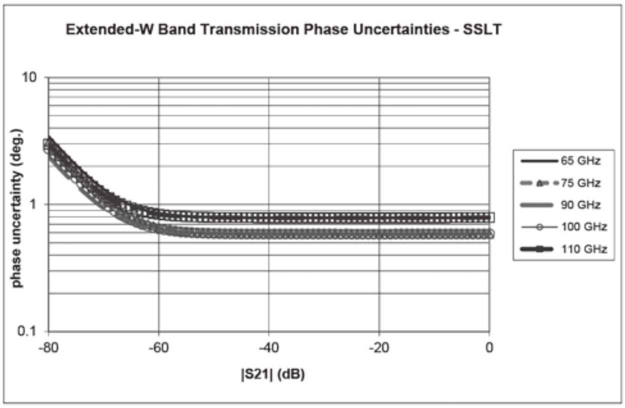
Measurement Uncertainties – Extended-W Band – SSLT

The graphs give measurement uncertainties after the above calibration. The errors are worse case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used.
For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$.
All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu website at www.anritsu.com. Typical.



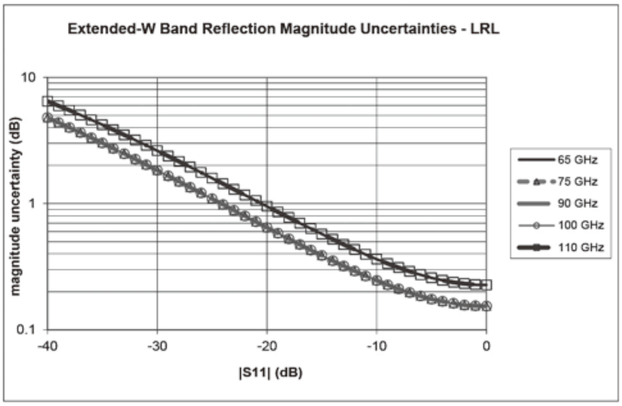


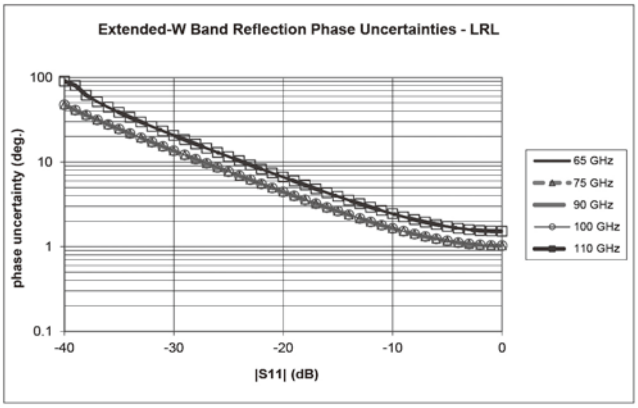


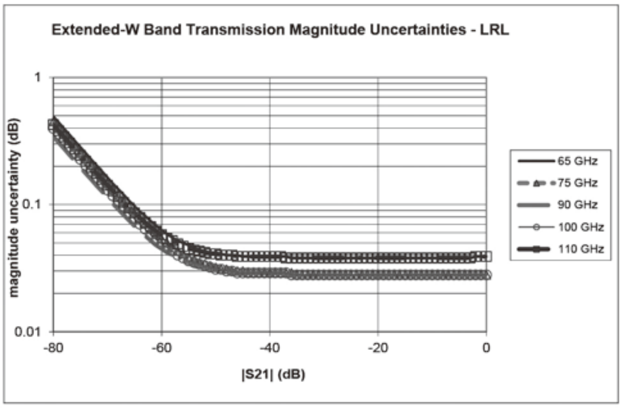


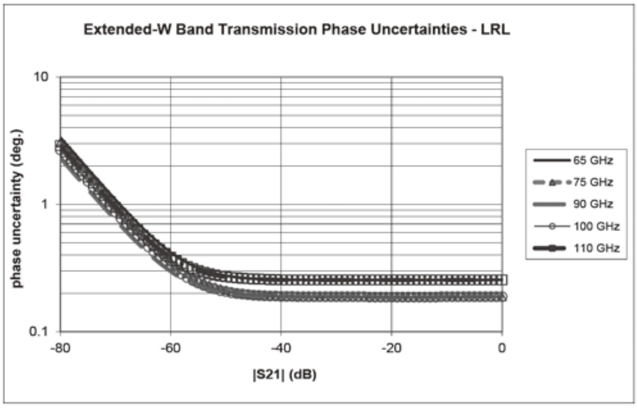
Measurement Uncertainties – Extended-W Band – LRL

The graphs give measurement uncertainties after the above calibration. The errors are worse case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used.
For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$.
All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu website at www.anritsu.com. Typical.









ME7838A BB/mm-Wave VNA

Millimeter-Wave Noise Figure Measurements with Option 41/48 and 3744A-Rx

3744A-Rx Receiver Compression, Noise Floor

Receiver Compression Point is defined as the port power level beyond which the response may be compressed more than 0.2 dB relative to the normalization level. 10 Hz IF bandwidth is used to remove trace noise effects. All typical.
Noise Floor is relative to the receiver power calibration performed at –10 dBm. Typical.

Frequency	Receiver Compression (dBm)*1	Noise Floor (dBm)*2
30 to 54 GHz	0	–124
>54 to 60 GHz	0	–122
>60 to 67 GHz	0	–117
>67 to 80 GHz	0	–120
>80 to 85 GHz	0	–123
>85 to 90 GHz	0	–121
>90 to 95 GHz	0	–121
>95 to 105 GHz	0	–117
>105 to 110 GHz	0	–122
>110 to 120 GHz	–5	–120
>120 to 125 GHz	–5	–117

*1: At the 3744A-Rx test port.
*2: Excludes localized spurious responses and crosstalk.

Waveguide Bands from 50 GHz to 1.1 THz

VectorStar ME7838A Millimeter-Wave System with VDI Modules

This section provides the specifications for the VectorStar MS4640B series microwave Vector Network Analyzers (VNAs) when configured with the Virginia Diodes, Inc. millimeter-wave (mm-Wave) frequency extension modules. The following frequency bands are supported:

Waveguide Band	WR15	WR10	WR8.0	WR6.5	WR5.1	WR4.3	WR3.4	WR2.8	WR2.2	WR1.5	WR1.0*
Frequency (GHz)	50 to 75	75 to 110	90 to 140	110 to 170	140 to 220	170 to 260	220 to 330	260 to 400	330 to 500	500 to 750	750 to 1100

*: Contact Anritsu

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

ME7838A Broadband System, 70 kHz to 125 GHz

Action	Part Number and Description	Additional Information
Order the base VectorStar model with the listed components and options:	MS4647B, 70 kHz to 70 GHz VNA MS4640B-007, receiver offset MS4640B-070, 70 kHz frequency coverage 3739C, Broadband Test Set with 36 inch interface cables 3743A, Millimeter-Wave Module, 2 each ME7838A-SS020, On-site system assembly and verification	
Include one of the following:	MS4647B-080, MS4647B with ME7838A system option	MS4647B-084 is ordered when Option 31 is included.
	MS4647B-081, MS4647B with ME7838A system option and Option 51 or 61 or 62	MS4647B-085 is ordered when Option 31 is included.
Include one of the following:	806-206, 1.85 mm phase stable VNA RF cables, 24”, M-F, 2 each	
	806-209, 1.85 mm phase stable VNA RF cables, 36”, M-F, 2 each	
Add options if desired:	Option 51, 61, or 62: MS4647B-051 – External VNA Loops MS4647B-061 – Active Measurement Suite, 2 Attenuators MS4647B-062 – Active Measurement Suite, 4 Attenuators	
	MS4640B-002 – Time domain MS464xB-031 – Dual Source Architecture MS4640B-035 – IF Digitizer MS4640B-041 – Noise Figure MS4640B-042 – PulseView™ MS4640B-043 – DifferentialView™ MS4640B-048 – Differential Noise Figure	MS464xB-031 requires Option 84 or 85. For other available options, see “ME7838A Broadband/Millimeter-Wave System Options”
Accessories	MS4640B-001, MS4640B rack mount 3739C-001, 3739C rack mount	

ME7838A Waveguide-Band System to 110 GHz – 3744A-EE or 3744A-EW mm-Wave Modules

Configurator for ME7838A Millimeter-Wave System using 3744A-EE or 3744A-EW mm-Wave Modules:

Action	Part Number and Description	Additional Information
Choose and order one of the two base VectorStar models with options listed:	MS4644B VNA, 10 MHz to 40 GHz MS4640B-007 MS4644B-082 or MS4644B-083	MS4644B-083 is ordered when Option 51, 61, or 62 is included. MS4644B-084 is ordered when Option 31 is included and Option 51, 61, or 62 is excluded. MS4644B-085 is ordered when Option 31 and Option 51, 61, or 62 is included.
	MS4647B VNA, 10 MHz to 70 GHz MS4647B-007 MS4647B-080 or MS4647B-081	MS4647B-081 is ordered when Option 51, 61, or 62 is included. MS4647B-084 is ordered when Option 31 is included and Option 51, 61, or 62 is excluded. MS4647B-085 is ordered when Option 31 and Option 51, 61, or 62 is included.
Order Test Set	3739C mm-Wave Test Set	
Choose and order Extended-E or Extended-W Band Modules:	3744A-EE, 56 GHz to 94 GHz Extended E Band module, 2 each	
	3744A-EW, 65 GHz to 110 GHz Extended W Band module, 2 each	
Add options if desired:	Option 51, 61, or 62: MS464xB-051 – External VNA Loops MS464xB-061 – Active Measurement Suite, 2 Attenuators MS464xB-062 – Active Measurement Suite, 4 Attenuators	
	MS4640B-070 – for 70 kHz operation in base VNA MS4640B-002 – for Time Domain MS464xB-031 – Dual Source Architecture MS4640B-035 – IF Digitizer MS4640B-041 – Noise Figure MS4640B-042 – PulseView™ MS4640B-043 – DifferentialView™ MS4640B-048 – Differential Noise Figure	MS464xB-031 requires Option 84 or 85. For other available options, see “ME7838A Broadband/Millimeter-Wave System Options”
	MS4640B-001, MS4640B Rack Mount 3739C-001, 3739C Rack Mount	
Accessories	35WR12WF-EE – Precision Waveguide to Coax Adapter Kit, 56 GHz to 94 GHz, WR-12 to W1 (f)	
	35WR10WF-EW – Precision Waveguide to Coax Adapter Kit, 65 GHz to 110 GHz, WR-10 to W1 (f)	

ME7838A Waveguide-Band System – OML/VDI mm-Wave Modules

ME7838A Waveguide-band System using OML or VDI Millimeter-Wave modules:

Action	Part Number and Description	Additional Information
Choose and order one of the three base VectorStar models with options listed:	MS4642B VNA, 70 kHz to 20 GHz MS4642B-008 or MS4642B-009 MS4642B-083	MS4642B-008 includes Active Device Measurements, with 2 Step Attenuators MS4642B-009 includes Active Device Measurements, with 4 Step Attenuators MS4642B-085 is ordered when Option 31 is included.
	MS4644B VNA, 10 MHz to 40 GHz MS4640B-007 Receiver Offset MS4644B-082 or MS4644B-083	MS4644B-083 is ordered when Option 51, 61, or 62 is included. MS4644B-084 is ordered when Option 31 is included and Option 51, 61, or 62 is excluded. MS4644B-085 is ordered when Option 31 and Option 51, 61, or 62 is included.
	MS4647B VNA, 10 MHz to 70 GHz MS4647B-007 Receiver Offset MS4647B-080 or MS4647B-081	MS4647B-081 is ordered when Option 51, 61, or 62 is included. MS4647B-084 is ordered when Option 31 is included and Option 51, 61, or 62 is excluded. MS4647B-085 is ordered when Option 31 and Option 51, 61, or 62 is included.
Order:	3739C mm-Wave Test Set	
	SM6537 Interface Cables (2) for OML/VDI mm-Wave Modules	Does not include DC cable. DC supply is provided by mm-Wave module power supply.
Choose and order one of the two appropriate millimeter-wave module combinations:	2 each TxRx transmission and reflection millimeter-Wave Modules	Choose appropriate OML or VDI modules. Contact Anritsu Company for ordering information.
	1 each TxRx transmission and reflection module, and 1 each Tx transmission only module	
Add options if desired:	Option 51, or 61, or 62: MS464xB-051 – External VNA Loops MS464xB-061 – Active Measurement Suite, 2 Attenuators MS464xB-062 – Active Measurement Suite, 4 Attenuators	
	MS4640B-070 – for 70 kHz operation in base VNA MS4640B-002 – for Time Domain MS464xB-031 – Dual Source Architecture MS4640B-035 – IF Digitizer MS4640B-041 – Noise Figure MS4640B-042 – PulseView™ MS4640B-043 – DifferentialView™ MS4640B-048 – Differential Noise Figure	MS464xB-031 requires Option 84 or Option 85 For other available options, see "ME7838A Broadband/Millimeter-Wave System Options"

Model/Order No.	Name
	Calibration/Verification Kits
3656B	W1 (1 mm) Calibration/Verification Kit
3655V	WR-15 Waveguide Calibration Kit, Without Sliding Loads
3655V-1	WR-15 Waveguide Calibration Kit, With Sliding Loads
3655E	WR-12 Waveguide Calibration Kit, Without Sliding Loads
3655E-1	WR-12 Waveguide Calibration Kit, With Sliding Loads
3655W	WR-10 Waveguide Calibration Kit, Without Sliding Loads
3655W-1	WR-10 Waveguide Calibration Kit, With Sliding Loads
3650A	SMA/3.5 mm Calibration Kit, Without Sliding Loads
3650A-1	SMA/3.5 mm Calibration Kit, With Sliding Loads
3652A	K Calibration Kit, Without Sliding Loads
3652A-2	K Calibration Kit, Without additional options
3652A-3	K Calibration Kit, With Pin Depth Gauge and .s1p Characterization Files
3652A-4	K Calibration Kit, With .s1p Characterization Files
3654D	V Calibration Kit, With Pin Depth Gauge
3654D-2	V Calibration Kit Without additional options
3654D-3	V Calibration Kit, With Pin Depth Gauge and .s1p Characterization Files
3654D-4	V Calibration Kit, With .s1p Characterization Files
3657	V Multi-Line Calibration Kit, Without Shorts
3657-1	V Multi-Line Calibration Kit, With Shorts
	External Power Meters/Sensors
ML243xA	CW Power Meter, Single Input or Dual Input Recommended Power Sensors: SC7770, MA247xD, MA244xD, MA248xD, MA2400xA
ML248xB	Wideband Power Meter, Single Input or Dual Input Recommended Power Sensors: MA249xA, MA2411B
ML249xA	Pulse Power Meter, Single Input or Dual Input Recommended Power Sensors: MA249xA, MA2411B
MA24106A	USB Power Sensor, 50 MHz to 6 GHz
MA24108A	USB Power Sensor, 10 MHz to 8 GHz
MA24118A	USB Power Sensor, 10 MHz to 18 GHz
MA24126A	USB Power Sensor, 10 MHz to 26 GHz
MA24330A	USB Power Sensor, 10 MHz to 33 GHz
MA24340A	USB Power Sensor, 10 MHz to 40 GHz
MA24350A	USB Power Sensor, 10 MHz to 50 GHz
MA24507A*	Power Master™ Frequency Selectable mm-Wave Power Analyzer, 9 kHz to 70 GHz
MA24510A	Power Master™ Frequency Selectable mm-Wave Power Analyzer, 9 kHz to110 GHz Note that usage of the MA24507A or MA24510A Power Master™ sensor requires connection to two USB ports to supply needed current draw.
	Test Port Cables, Flexible, High Performance
3671W1-50-1	W1 (m) to W1 (f), 1 each, 10.0 cm (3.9 in)
3671W1-50-2	W1 (m) to W1 (f), 1 each, 13.0 cm (5.1 in)
3671W1-50-3	W1 (m) to W1 (f), 1 each, 16.0 cm (6.3 in)
3671KFS50-60	K (f) to 3.5 mm (m) cable, 60 cm (one cable)
3671KFK50-60	K (f) to K (m) cable, 60 cm (one cable)
3671KFK50-100	K (f) to K (m) cable, 1 each, 100 cm (one cable)
3671KFKF50-60	K (f) to K (f) cable, 1 each, 60 cm (once cable)
3671VFV50-60	V (f) to V (m) cable, 1 each, 60 cm (one cable)
3671VFV50-100	V (f) to V (m) cable, 1 each, 100 cm (one cable)
3671KFSF50-60	K (f) to 3.5 mm (f) cable, 1 each, 60 cm (one cable)
3671VFVF50-60	V (f) to V (f) cable, 1 each, 60 cm (one cable)

Model/Order No.	Name
	Adapters and More
34WV50	W1 (m) to V (m) Adapter, W1 (1 mm) to V, Coaxial
34WVF50	W1 (m) to V (f) Adapter, W1 (1 mm) to V, Coaxial
34WFV50	W1 (f) to V (m) Adapter, W1 (1 mm) to V, Coaxial
34WFVF50	W1 (f) to V (f) Adapter, W1 (1 mm) to V, Coaxial
33WW50	W1 (m) to W1 (m) Adapter, W1 (1 mm) in-series, Coaxial
33WWF50	W1 (m) to W1 (f) Adapter, W1 (1 mm) in-series, Coaxial
33WFWF50	W1 (f) to W1 (f) Adapter, W1 (1 mm) in-series, Coaxial
35WR10W	WR10 to W1 (m) Adapter, W1 (1 mm) to WR10 Waveguide
35WR10WF	WR10 to W1 (f) Adapter, W1 (1 mm) to WR10 Waveguide
SC7260	WR12 to W1 (m) Adapter, W1 (1 mm) to WR12 Waveguide
SC7442	WR12 to W1 (f) Adapter, W1 (1 mm) to WR12 Waveguide
35WR15V	WR15 to V (m) Adapter, V (1.85 mm) to WR15 Waveguide
35WR15VF	WR15 to V (f) Adapter, V (1.85 mm) to WR15 Waveguide
For More Information	Refer to our Precision RF & Microwave Components Catalog for descriptions of adapters and other components.
	Accessories
SC8215	Kelvin Bias Tee 70 kHz to 125 GHz, Max Voltage: 16 VDC, Max Current: 100 mA
SC7287	Kelvin Bias Tee 100 MHz to 125 GHz, Max Voltage: 50 VDC, Max Current: 500 mA
SC8218	Triax (m) to SMC (m) Cable, (Inner-shield floating at SMC end), 1.5 m (60 in) long two (2) needed per Kelvin Bias Tee
SM6494	System floor console. Includes larger size writing table
2100-1	GPIB cable, 1 m (39 in) long
2100-2	GPIB cable, 2 m (79 in) long
2100-4	GPIB cable, 4 m (157 in) long
806-206	1.85 mm cable, 61 cm (24 in) long, for connecting the VNA and the 3743A Modules
806-209	1.85 mm cable, 91 cm (36 in) long, for connecting the VNA and the 3743A Modules
01-201	Torque Wrench (for tightening male devices), 8 mm (5/16 in), 0.9 N·m (8 lbf·in) for SMA, 3.5 mm, 2.4 mm, K, and V connectors
01-202	Universal Test Port Connector Wrench
01-203	Torque Wrench (for tightening the VNA test ports to female devices) 20.6 mm (13/16 in), 0.9 N·m (8 lbf·in)
01-204	Anritsu Stainless Steel Connector Wrench, circular, open-ended for SMA, 3.5 mm, 2.4 mm, K and V connectors

*: The MA24507A sensor requires connection to two USB ports to supply needed current draw.

VectorStar™ Vector Network Analyzers

ME7838E Series

Broadband VNA System: 70 kHz to 110 GHz/Millimeter Waveguide VNA System: 50 GHz to 1.1 THz (optional)

High Performance, Broadband Network Analysis Solutions

Broadband VNA System 70 kHz to 110 GHz

The ME7838E Broadband VNA System provides single sweep coverage from 70 kHz to 110 GHz. It consists of the following items:

- MS4647B VectorStar VNA, 70 kHz to 70 GHz with Option 7, Option 70, and Options 86/87 or Options 88/89
- 3739C Broadband Millimeter-Wave Test Set and Interface Cables
- 3743E Millimeter-Wave Modules, 2 each

Millimeter Waveguide VNA System 50 GHz to 1.1 THz (Optional)

The ME7838E Millimeter-Wave configuration provides waveguide output from 50 GHz to 1.1 THz in waveguide bands. The system can extend the broadband system or be configured to operate only as a waveguide system. It consists of the following items:

- MS464xB VectorStar VNA, with Option 7 and Options 86/87 or Options 88/89
- 3739C Broadband/Millimeter-Wave Test Set and Interface Cables
- Banded Millimeter-Wave modules, 2 each

Broadband/Millimeter-Wave System Options

- MS4640B-002 – Time Domain
- MS4640B-021 – Universal Fixture Extraction
- MS4640B-032 – Internal RF Combiner
- MS4640B-035 – IF Digitizer
- MS4640B-041 – Noise Figure
- MS4640B-042 – PulseView™
- MS4640B-043 – DifferentialView™
- MS4640B-044 – IMDView™
- MS4640B-046 – Fast CW
- MS4640B-047 – Eye Diagram
- MS4640B-048 – Differential Noise Figure
- MS4640B-051 – Direct Access Loops
- MS464xB-061 – Active Measurement Suite, with 2 Attenuators
- MS464xB-062 – Active Measurement Suite, with 4 Attenuators
- SC8215 and SC7287 Kelvin Bias Tees
- 3744E-Rx – 30 GHz to 110 GHz mm-Wave Receiverfor Noise Figure and mm-Wave Antenna Measurements
- 3744E-EE – 56 GHz to 95 GHz WR-12 Waveguide Module
- 3744E-EW – 65 GHz to 110 GHz WR-10 Waveguide Module

Broadband Configuration

ME7838E Broadband System Configuration

ME7838E Broadband Hardware Configuration

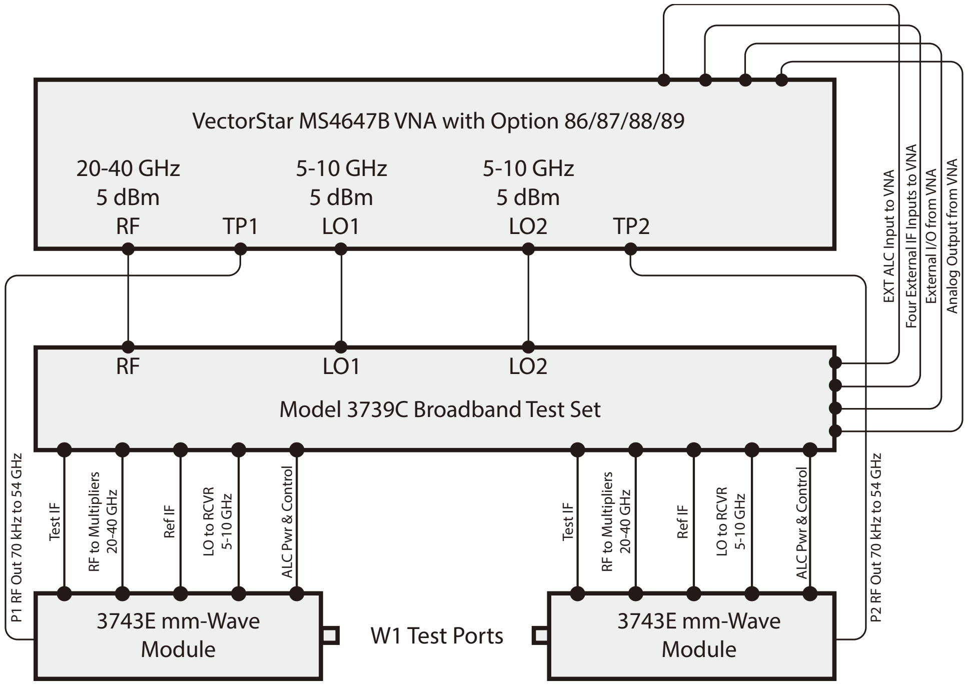
The ME7838E broadband VNA system provides single sweep coverage from 70 kHz to 110 GHz. It consists of the following items:	
VNA	MS4647B VectorStar VNA, 70 kHz to 70 GHz with Option 7, Option 70, and Options 86/87/88/89
Test Set	3739C Broadband Test Set and interface cables
mm-Wave Modules	3743E Millimeter-Wave Modules, 2 each

ME7838E Broadband/Millimeter-Wave System Options

The major ME7838E broadband VNA system options are:

Option 2	MS4640B-002 Time Domain
Option 21	MS4640B-021 Universal Fixture Extraction
Option 31	MS464xB-031 Dual Source Architecture
Option 32	MS4640B-032 Internal RF Combiner
Option 35	MS4640B-035 IF Digitizer
Option 41	MS4640B-041 Noise Figure
Option 42	MS4640B-042 PulseView™
Option 43	MS4640B-043 DifferentialView™
Option 44	MS4640B-044 IMDView™
Option 46	MS4640B-046 Fast CW
Option 47	MS4640B-047 Eye Diagram
Option 48	MS4640B-048 Differential Noise Figure
Option 51	MS4647B-051 External VNA Direct Access Loops
Option 61	MS4647B-061 Active Measurement Suite, with 2 Attenuators
Option 62	MS4647B-062 Active Measurement Suite, with 4 Attenuators
Bias Tees	SC8215 and SC7287 Kelvin Bias Tees

Block Diagram – ME7838E Broadband VNA System



Broadband Configuration Block Diagram

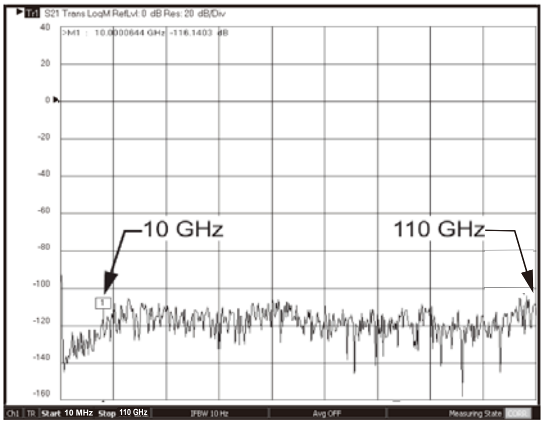
SC8215 and SC7287 Kelvin Bias Tees

Provides Sense and Force SMC connections close to the mm-Wave module to minimize the IR drops associated with the impedances between the bias tee and the DUT.

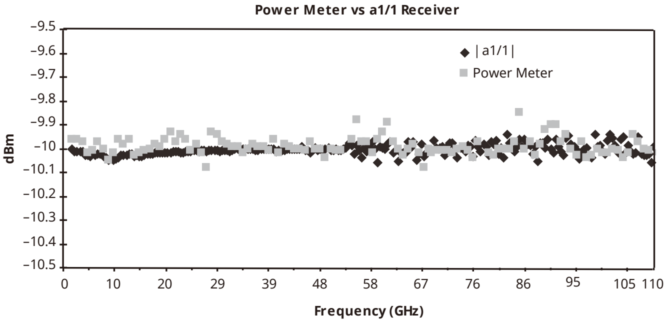
Part Number	Description	Voltage	Current
SC8215	The SC8215 is a bias tee operating for system frequencies of 70 kHz to 110 GHz	Max Voltage: 16 VDC	Max Current: 100 mA
SC7287	The SC7287 is a bias tee operating for system frequencies of 100 MHz to 110 GHz.	Max Voltage: 50 VDC	Max Current: 500 mA
Tri-Axial Output SMUs	For applications requiring Source Measure Units (SMU) with tri-axial outputs, a tri-axial (m) to SMC (m) cable is available, with the inner-shield isolated from ground at the bias tee SMC end, to float at the SMU guard potential. Check the accessories on the ordering information.		

Measurement Examples

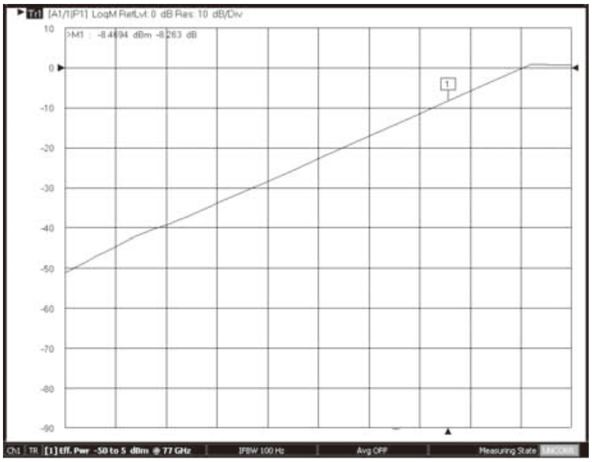
The following figures are measurement examples of the ME7838E Broadband system performance.



Dynamic range of ME7838E system
at the W1 1 mm coaxial test port from 70 kHz to 110 GHz.



An example of power measurement agreement:
power sensor vs. ME7838E a1 reference receiver.

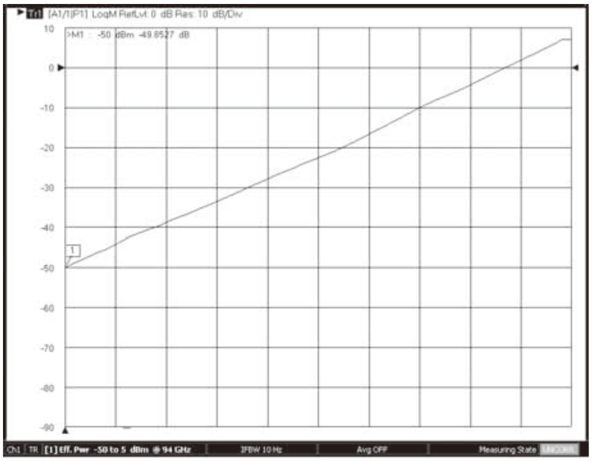


Tr1 [A1/1[P1] LogM RefLvl: 0 dB Res: 10 dB/Div

>M1 : -8.4694 dBm -8.263 dB

Ch1 TR [1] Eff. Pwr -50 to 5 dBm @ 77 GHz IFBW 100 Hz Avg OFF Measuring State

Power sweep range at 77 GHz. By using detection and power control inside the 3743E millimeter-wave module; improved accuracy, linearity and range can be achieved.



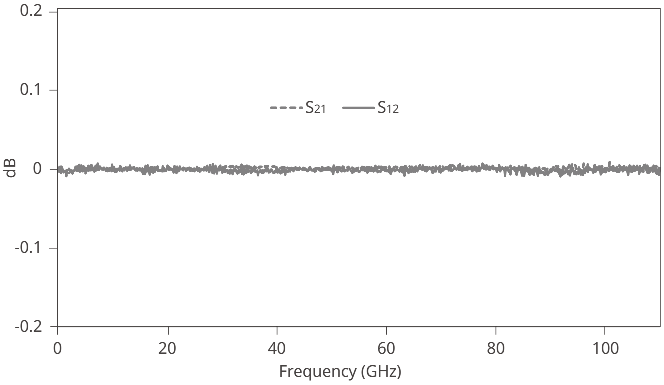
Tr1 [A1/1[P1] LogM RefLvl: 0 dB Res: 10 dB/Div

>M1 : -50 dBm -49.8527 dB

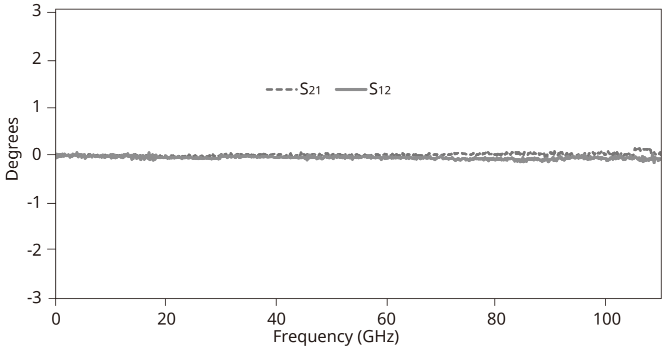
Ch1 TR [1] Eff. Pwr -50 to 5 dBm @ 94 GHz IFBW 10 Hz Avg OFF Measuring State

Power sweep range at 94 GHz demonstratinggreater than 50 dB of control.

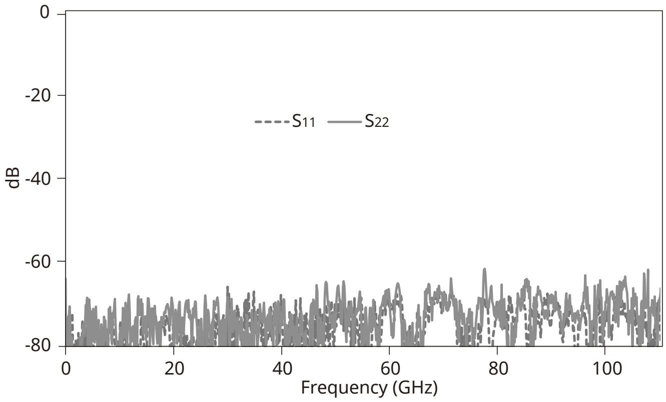
24-Hour, 25°C Transmission Magnitude Stability



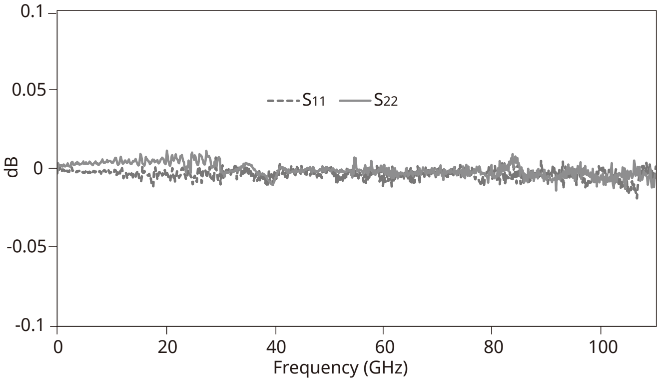
24-Hour, 25°C Transmission Phase Stability



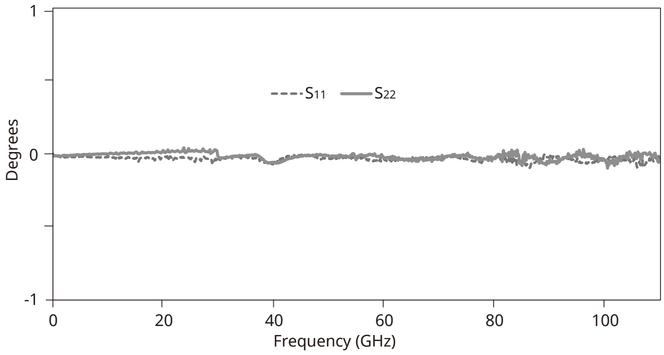
24-Hour, 25°C Reflection (of thru) Vector-delta Stability

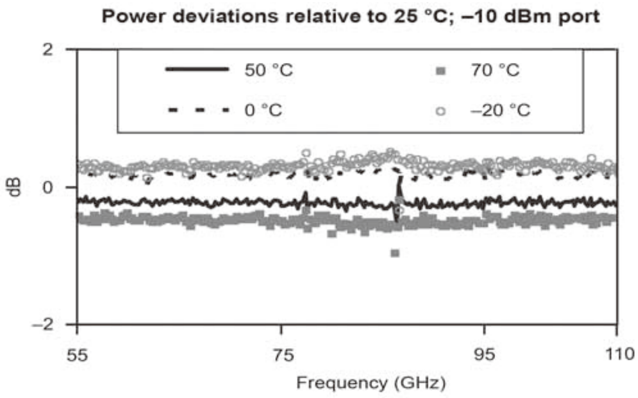


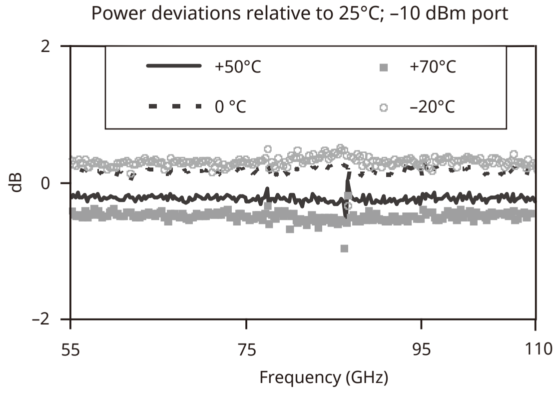
24-Hour, 25°C Reflection Magnitude Stability (Short Measurement)



24-Hour, 25°C Reflection Phase Stability (Short Measurement)







Specifications for Waveguide Band Configuration

ME7838E Millimeter-Wave VNA, Waveguide Bands

Three configurations are available for waveguide band operation for E and W bands when using the ME7838E system.
3743E Module First, the Anritsu 3743E Broadband Millimeter-Wave (mm-Wave) module can be adapted to waveguide measurements using waveguide adapters.
mm-Wave Modules Second, the Anritsu 3744E-EE or 3744E-EW millimeter-wave module can be used. These version modules operate in the extended E and W waveguide bands and are operational using the MS4644B, or MS4647B VectorStar (with Options 86/87/88/89 and Option 7) and the 3739C broadband/millimeter-wave test set.
E and W Band mm-Wave Modules The third configuration is to use external E and W band millimeter-wave modules with any model VectorStar (with Options 86/87/88/89 and Option 7) and the 3739C test set. The ME7838E system may also be configured for the above W band mm wave operation. With the addition of VDI modules, operation up to 1.1 THz can be achieved.

E and W Band Operation Using the 3743E, 3744E-EE, or 3744E-EW mmWave Module

3743E Millimeter-Wave Modules

3744E-EE/3744E-EW
Millimeter-Wave Module with Waveguide Adapter

The 3743E Broadband mm-Wave module can be adapted to a waveguide band output by adding an available waveguide band adapter and mounting flange. VectorStar menus automatically configure the system frequencies incorporating the 3743E module for banded operation. Using the 3743E modules provides the opportunity to sweep frequencies for broadband applications and quickly convert to waveguide configurations for banded measurements. The advantages of small compact modules with excellent RF performance and power range control can therefore be realized in both broadband and waveguide configurations when using the 3743E mm-Wave module. For systems where only waveguide band operation is required, the 3744E-EE or 3744E-EW mm-Wave module can be used.
The 3744E-EE or 3744E-EW mm-Wave module operates from 54 GHz to 110 GHz. The band supported is determined by the waveguide adapter connected to the 1 mm test port output of the 3744E-EE/EW module:

- 3744E-EE configures the module for Extended E Band
- 3744E-EW configures for Extended W Band

The RF input port of the 3744E-EE or 3744E-EW module is restricted below 54 GHz, however, the RF input port retains a DC connection to the 1 mm test port. Thus, the waveguide adapter can be removed for on-wafer applications from 54 GHz to 110 GHz operation and the on-wafer DUT can be biased through the RF input port.

Band	Frequency Range (GHz)	Waveguide Flange	Transmission/Reflection Module
Ext-E	56 to 94*	WR-12	3744E-EE
Ext-W	65 to 110	WR-10	3744E-EW

*: Operational to 95 GHz.

Waveguide Band Specifications

Port Power, Noise Floor, Dynamic Range – 3744E-EE/3744E-EW mmWave Modules

System dynamic range is defined as the ratio of the source power to the noise floor. Maximum Receiver Power is defined as the 0.2 dB compression point of the receiver at the waveguide port. Receiver dynamic range is defined as the ratio of maximum receive power to the noise floor. Noise Floor measurements are RMS, are made with no average in a 10 Hz IF bandwidth, and include an isolation calibration.
All figures are typical.

3744E-EE Extended-E Band (WR-12) Waveguide

Frequency Range	Source Power (dBm)	Max. Receive Power (0.2 dB comp. pt.) (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)	Receiver Dynamic Range (dB)
56 GHz to 60 GHz	–2	11	–111	109	122
>60 GHz to 65 GHz	0	11	–106	106	117
>65 GHz to 80 GHz	–3	11	–109	106	120
>80 GHz to 85 GHz	–4	11	–112	108	123
>85 GHz to 90 GHz	–4	11	–110	106	121
>90 GHz to 94 GHz*	0	12	–105	105	117

*: Operational to 95 GHz.

3744E-EW Extended-W Band (WR-10) Waveguide

Frequency Range	Source Power (dBm)	Max. Receive Power (0.2 dB comp. pt.) (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)	Receiver Dynamic Range (dB)
65 GHz to 67 GHz	0	11	–106	106	117
>67 GHz to 80 GHz	–3	11	–109	106	120
>80 GHz to 85 GHz	–4	11	–112	108	123
>85 GHz to 90 GHz	–4	11	–110	106	121
>90 GHz to 100 GHz	0	12	–105	105	117
>100 GHz to 110 GHz	–5	12	–110	105	122

Power Range, Accuracy, Linearity and Resolution

Accuracy is defined at –10 dBm or max rated power, whichever is lower. Linearity is defined as the incremental error between the accuracy test power level and 5 dB below. Typical.

Frequency Range	Range (dBm)		Accuracy (dB)	Linearity (dB)	Resolution (dB)
	ME7838E	ME7838E Option 62			
54 GHz to 60 GHz	–55 to –2	–55 to –2	±2.0	±1.5	0.01
>60 GHz to 65 GHz	–55 to 0	–55 to 0	±2.0	±1.5	0.01
>65 GHz to 80 GHz	–55 to –3	–55 to –3	±2.0	±1.5	0.01
>80 GHz to 85 GHz	–55 to –4	–55 to –4	±2.0	±1.5	0.01
>85 GHz to 90 GHz	–55 to –4	–55 to –4	±2.0	±1.5	0.01
>90 GHz to 100 GHz	–55 to 0	–55 to 0	±3.0	±2.0	0.01
>100 GHz to 110 GHz	–50 to –5	–50 to –5	±3.0	±2.0	0.01

Alternatively, the V, E and W bands can be supported using external millimeter-wave modules such as the 3740/41A series modules available from Anritsu.
For further description and specifications, please refer to the VectorStar ME7828A Technical Data Sheet 11410-00452 available at www.anritsu.com.

Corrected System Performance/Uncertainties – 3744E-EE/3744E-EW mm-Wave Modules

With 12-term Offset, Short, Sliding-Load, or LRL calibrations, using high precision waveguide sections and standards from the appropriate calibration kit.

3744E-EE Extended-E Band (WR-12) Waveguide – 56 GHz to 94 GHz

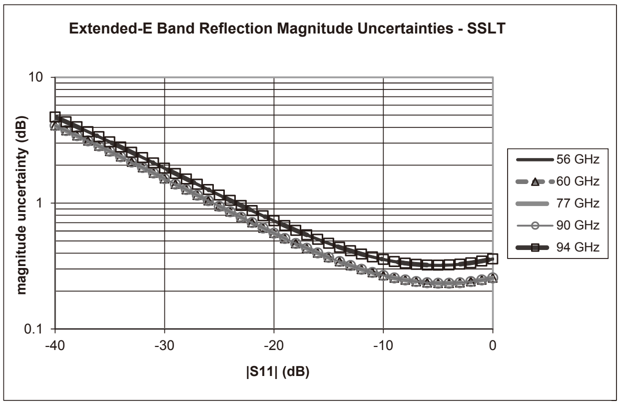
Calibration Type	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
Offset Short	>44	>33	>44	±0.080	±0.100
LRL	>44	>43	>44	±0.006	±0.006

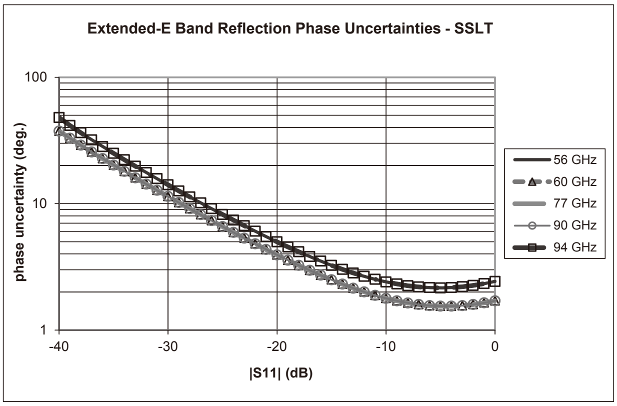
3744E-EW Extended-W Band (WR-10) Waveguide – 65 GHz to 110 GHz

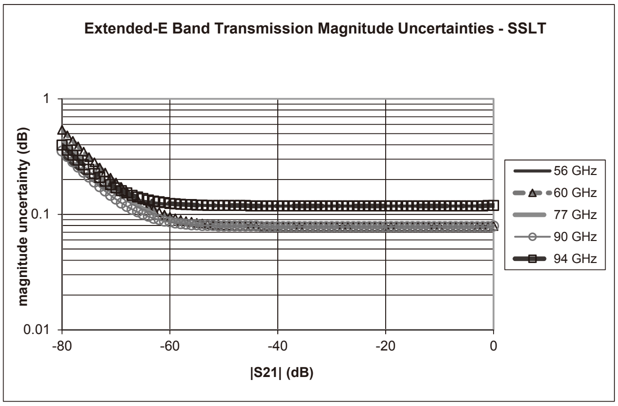
Calibration Type	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
Offset Short	>40	>30	>46	±0.080	±0.100
LRL	>40	>40	>46	±0.006	±0.006

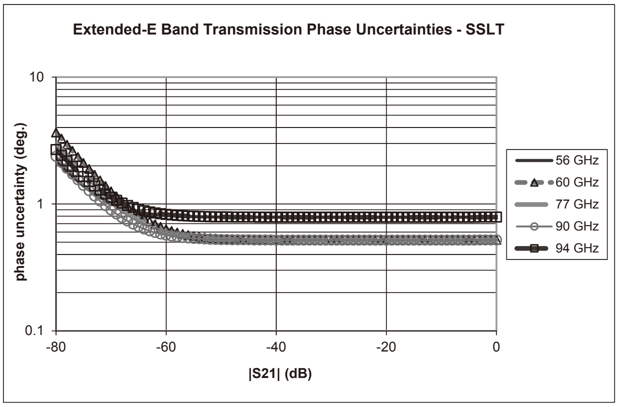
Measurement Uncertainties – Extended-E Band – SSLT

The graphs give measurement uncertainties after the above calibration. The errors are worse case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used.
For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$.
All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com. The results below are typical.



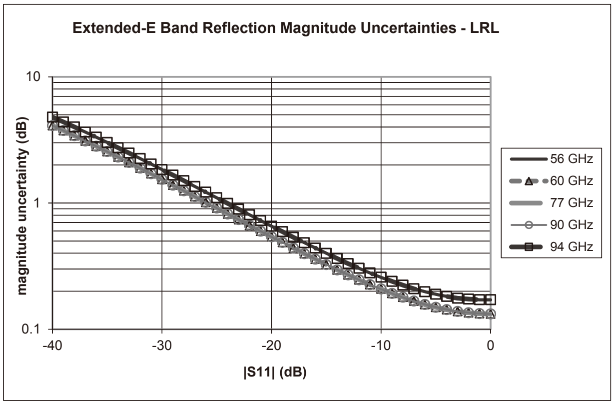


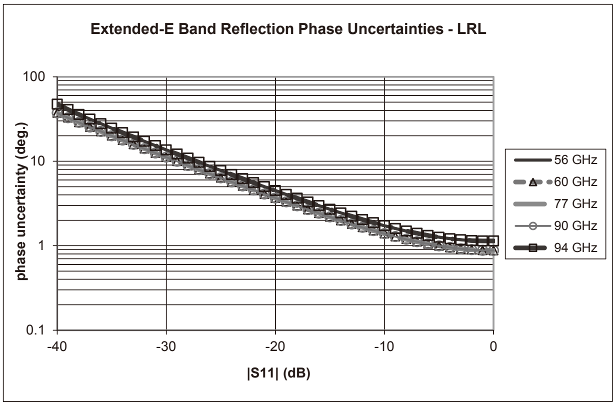


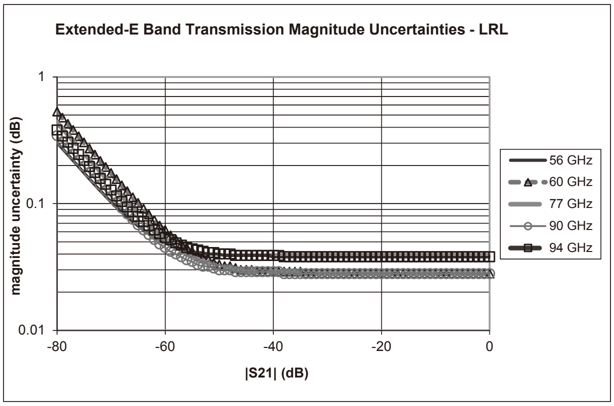


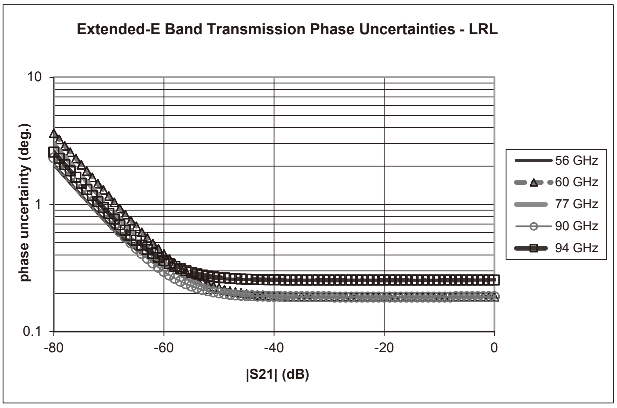
Measurement Uncertainties – Extended-E Band – LRL

The graphs give measurement uncertainties after the above calibration. The errors are worse case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used.
For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$.
All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com. The results below are typical.









Measurement Uncertainties – Extended-W Band – SSLT

The graphs give measurement uncertainties after the above calibration. The errors are worse case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used.
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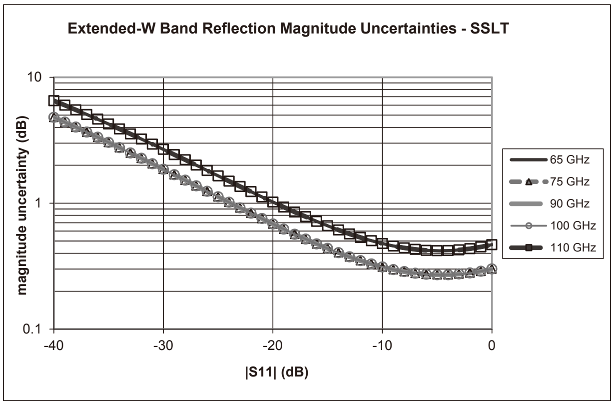
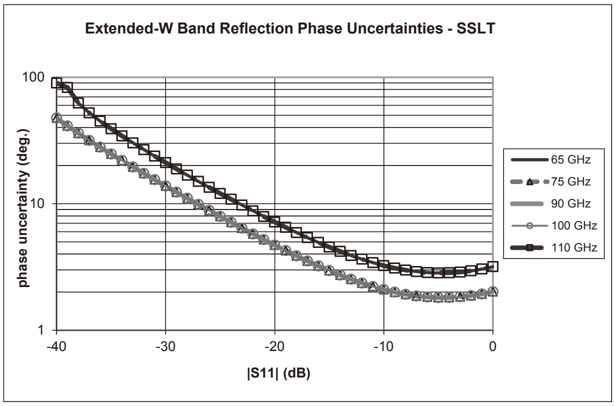
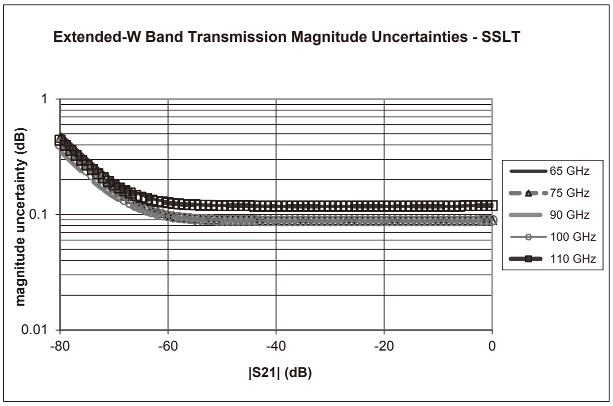
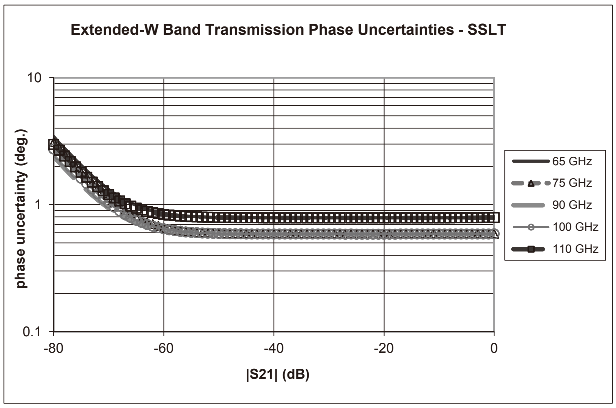
All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu website at www.anritsu.com. The results below are typical.



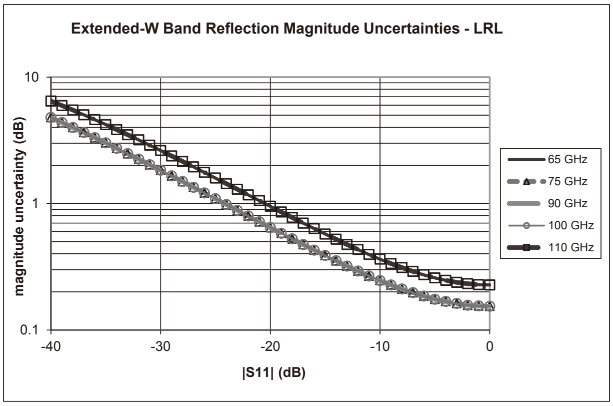


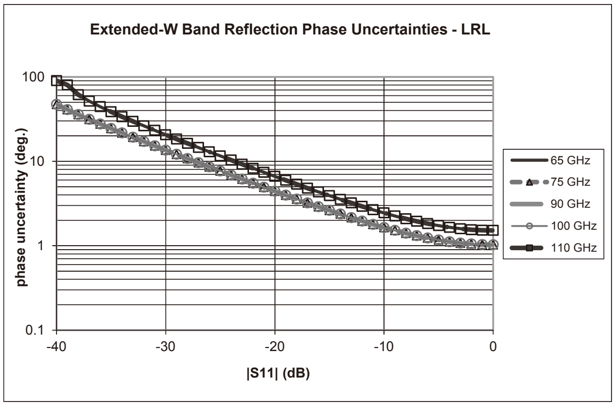


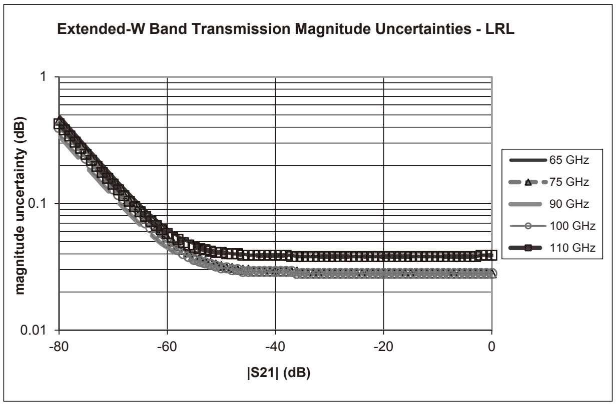


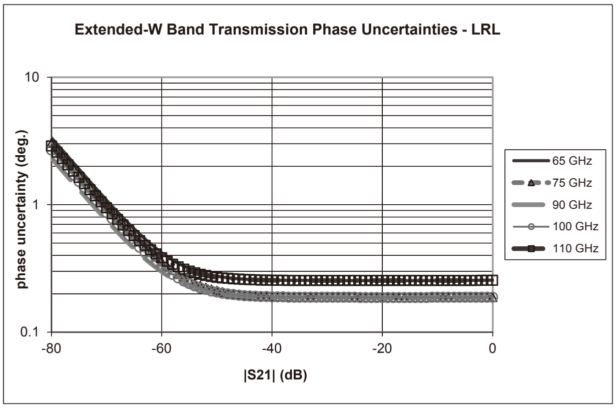
Measurement Uncertainties – Extended-W Band – LRL

The graphs give measurement uncertainties after the above calibration. The errors are worse case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used.
For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$.
All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu website at www.anritsu.com. The results below are typical.



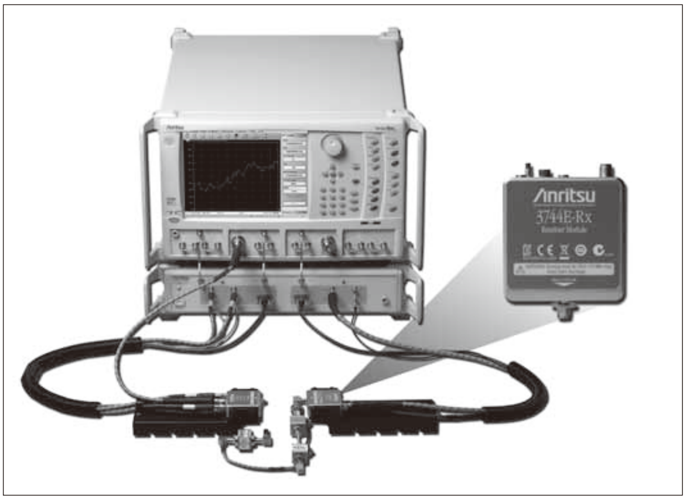






Millimeter-Wave Noise Figure Measurements with Option 41/48 and 3744E-Rx

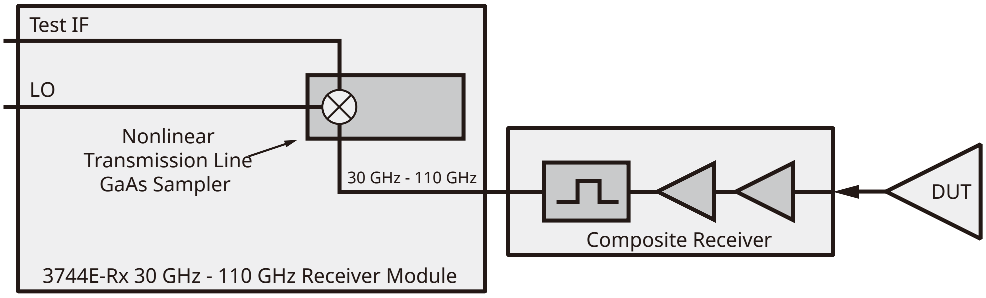
The 3744E-Rx receiver module can be used with Option 41, Noise Figure, and the ME7838E mm-Wave or broadband system to perform mm-Wave noise figure measurements from 30 GHz to 110 GHz.
The receiver bypasses the internal couplers (see block diagram on next page), maximizing the noise figure of the receiver for optimum noise figure measurement accuracy. The receiver is derived from the 3743E mm-Wave module and utilizes the same nonlinear transmission line technology for optimum mm-Wave performance. Using the advantages of the 3743E mm-Wave module system architecture provides a unique solution to mm-Wave noise figure measurements previously unavailable.
With Option 48, differential (and common-mode) noise figure measurements are possible in the same wide frequency ranges. In this case, two 3744A-Rx modules (along with needed pre-amplifiers/filters) are used to complete the differential receiver. While usually a 4-port system is used, a 2-port ME7838E can be used for the noise measurements as long as DUT gain information is available.



ME7838E with 3744E-Rx Receiver Module

Block Diagram – 3744E Receiver Module

As with all cold source method noise figure measurements, the output of the DUT is first sent to an external composite receiver for pre-amplification. This ensures that the system noise figure is minimized for optimum measurement accuracy. The Anritsu Noise Figure Uncertainty Calculator (available on the website at www.anritsu.com can be used to determine optimum preamplifier gain needed for the desired measurement uncertainty.



3744E-Rx Block Diagram

3744E-Rx Receiver Compression, Noise Floor

Receiver Compression Point is defined as the port power level beyond which the response may be compressed more than 0.2 dB relative to the normalization level. 10 Hz IF bandwidth is used to remove trace noise effects. All typical.

Noise Floor is relative to the receiver power calibration performed at –10 dBm (typ.).

Frequency Range (GHz)	Receiver Compression (dBm)*1	Noise Floor (dBm)*2
30 to 54	0	–124
54 to 60	0	–122
60 to 67	0	–117
67 to 80	0	–120
80 to 85	0	–123
85 to 90	0	–121
90 to 95	0	–121
95 to 105	0	–117
105 to 110	0	–122

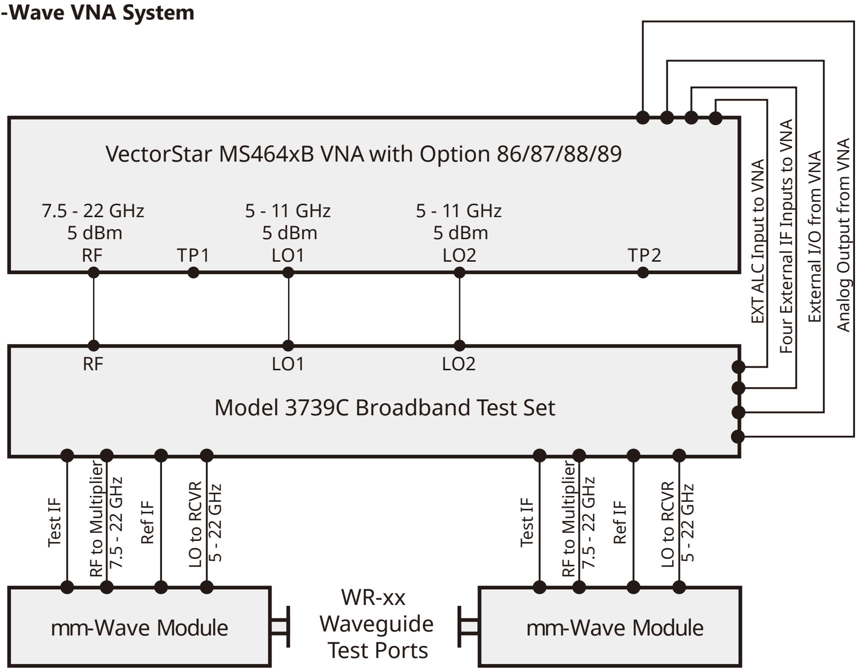
*1: At the 3744A-Rx test port.
*2: Excludes localized spurious responses and crosstalk.

Waveguide Bands from 50 GHz to 1.1 THz

The VectorStar Millimeter-Wave system supports OML or VDI modules starting at 50 GHz. System performance is based on the specific mm-Wave module installed and appropriate cal kit. Contact the vendor web site for additional information.

VDI and OML Millimeter-Wave Modules

Block Diagram – Millimeter-Wave VNA System



Millimeter-Wave Configuration Block Diagram

VectorStar ME7838E-Millimeter-Wave System with VDI Modules

This section provides the specifications for the VectorStar MS4640B series microwave Vector Network Analyzers (VNAs) when configured with the Virginia Diodes, Inc. millimeter-wave (mm-Wave) frequency extension modules. The following frequency bands are supported:

Waveguide Band	WR15	WR10	WR8.0	WR6.5	WR5.1	WR4.3	WR3.4	WR2.8	WR2.2	WR1.5	WR1.0
Frequency Range (GHz)	50 to 75	75 to 110	90 to 140	110 to 170	140 to 220	170 to 260	220 to 330	260 to 400	330 to 500	500 to 750	750 to 1100

System Configuration with VDI Modules

The VectorStar Millimeter-Wave system provides control of VDI modules for frequency extension coverage up to 1.1 THz. MS4640B series VectorStar VNA may be configured for mm-Wave operation by adding the appropriate control option and test set. System requirements include:

- MS4642B, MS4644B, or MS4647B
  (Note: For 1.1 THz operation the 40 GHz MS4644B or higher model is required.)
- MS4640B Option 7, Receiver Offset
- MS4640B Option 80, 81, 82, or 83
- SM6537 Interface Cable – Connection between VectorStar and the VDI mm-Wave module is provided with this interface cable.
  Each VDI module is equipped with a dedicated external power supply and DC cable.
- 3739C Test Set

VDI Module Head Configurations

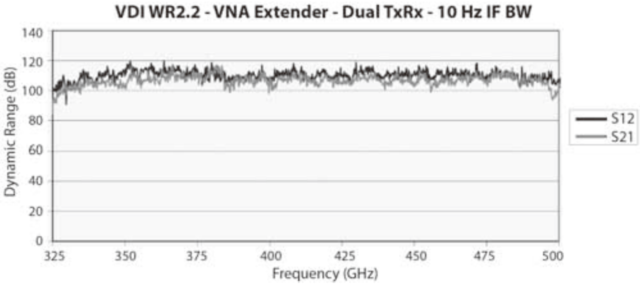
TxRx	Transmitter with two Receivers (Reference and Measurement), and two couplers. Two TxRx heads are required for full two-port measurements.
TxRef	Transmitter with Reference Receiver and one coupler.
Rx	Measurement Receiver.
Tx	Transmitter

VDI Module Options

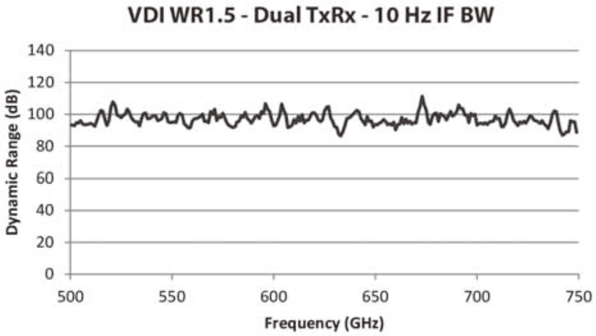
Options available for millimeter-wave extenders are listed below:

Micrometer-Drive Variable Attenuator	A 0 to 30 dB micrometer-drive variable attenuator option is available on TxRx and Tx modules up through WR1.5. If ordered, "–Attn" is added as an option suffix to the module model number. The attenuators reduce TPP and DR by as much as 5 dB in the WR3.4 and higher frequency bands and add approximately 2 in to the enclosure.
Increased Test Port Power	Options exist for increasing test port power in some full bands or in partial bands. Consult factory for more information.
Non-Standard Frequency Bands	Non-standard frequency bands are possible. Consult factory for more information.
Custom Configuration	Anritsu/VDI will work with customers to reconfigure any extender to meet specific needs.

ME7838E Measurement Examples Using VDI Millimeter-Wave Modules

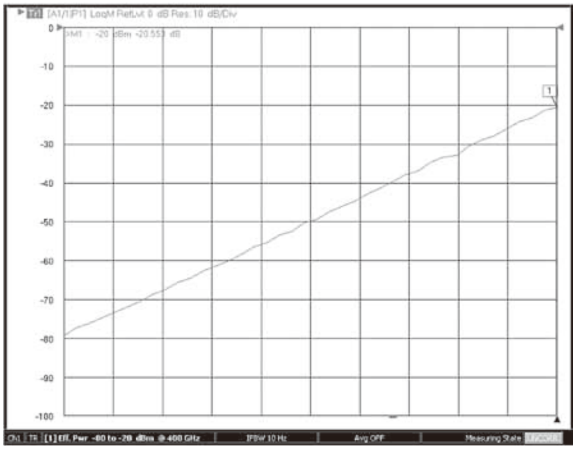


Dynamic Range Plot of VDI WR2.2 Module – 10 Hz IFBW



Dynamic Range Plot of VDI WR1.5 Dual TxRx – 10 Hz IFBW

ME7838E 400 GHz Power Sweep with VDI WR2.2 TxRx Module



Real time power sweep of VDI WR2.2 module using system power level control and no mechanical attenuators.

VectorStar ME7838E-Millimeter-Wave System with OML Modules

This section provides specifications for the VectorStar MS4640B series microwave Vector Network Analyzers (VNAs) when configured with the OML millimeter-wave frequency extension modules.

Description	Each OML module must be equipped with a dedicated external power supply and DC cable. Connection between the VectorStar and the OML mm-Wave module is provided with the supplied interface cable.
System Configuration	The VectorStar Millimeter-Wave system provides control of OML modules for frequency extension coverage up to 325 GHz. The MS4640B series VectorStar VNA may be configured for mm-Wave operation by adding the appropriate control option and test set.
System requirements	MS4642B, MS4644B, or MS4647B Model VectorStar VNA MS4640B Option 7, Receiver Offset MS464xB Option 80, 81, 82, or 83 SM6537 Interface Cable 3739C Test Set
Specifications	Dynamic range specifications are valid for any MS4640B VectorStar VNA with appropriate options. Directivity specifications are valid when using appropriate OML calibration kits.

Standard Capabilities for All Configurations

For standard capabilities of the VectorStar VNAs, please see the VectorStar MS4640B Series VNA Technical Data Sheet and Configuration Guide – 11410-00432, available at www.anritsu.com.

Mechanical and Environmental

MS4640B Vector Network Analyzer

Dimensions without rack mount option.

Width	426 mm body 457 mm between feet outer edges 487 mm between front panel handles outer edges
Height	267 mm body (6u) 286 mm between feet outer edges
Depth	502 mm body 591 mm between handle and foot outer edges
Mass	<28 kg (<60 lbs), Typical weight for a fully-loaded MS4647B VNA

3739C Broadband/Millimeter-Wave Test Set

Dimensions without rack mount option.

Width	426 mm body 457 mm between feet outer edges 487 mm between front panel handles outer edges
Height	89 mm body (2u) 108 mm between feet outer edges
Depth	502 mm body 591 mm between handle and foot outer edges
Mass	5.75 kg

3743E Millimeter-Wave Module

Width	54 mm
Height	21.5 mm
Depth	55.3 mm
Mass	0.27 kg

Environmental – Operating

Conforms to MIL-PRF-28800F (Class 3)

Temperature Range	0° to +50°C without error codes* * Except for 'unleveled' error messages that may occur at the extreme edges of the temperature range above.
Relative Humidity	5 to 95% at +40°C, Non-condensing
Altitude	4,600 m (15,000 ft)

Environmental – Non-Operating

Temperature Range	–40° to +71°C
Relative Humidity	0 to 90% at +30°C, Non-condensing
Altitude	4,600 m (15,000 feet)

Regulatory Compliance

CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN61010-1 RoHS: 2011/65/EU
RCM	Australia and New Zealand: RCM AS/NZS 4417:2012
KCC	South Korea: KCC-REM-A21-0004

Calibration and Correction Capabilities

Calibration Methods	Short-Open-Load-Through (SOLT) with Fixed or Sliding Load and supporting .s1p-defined cal kits Offset-Short-Offset-Short-Load-Through (SSLT) with Fixed or Sliding Load Triple-Offset-Short-Through (SSST) Short-Open-Load-Reciprocal (SOLR) or Unknown Through Method (SSLR, SSSR) Line-Reflect-Line (LRL) / Line-Reflect-Match (LRM) – (up to 5 bands supported for multi-line configurations) Advanced-LRM (A-LRM™) for improved on-wafer calibrations AutoCal Thru Update available Secondary match correction available for improved low insertion loss measurements
Correction Models	2-Port (Forward, Reverse, or both directions) 1-Port (S_{11}, S_{22}, or both) Transmission Frequency Response (Forward, Reverse, or both directions) Reflection Frequency Response (S_{11}, S_{22}, or both)
Merged Calibration	Merge multiple calibration methods over bands of frequency points. Note that merge does not need to be used for broadband coaxial (SOLT/R-SSST/R) 1 mm or 0.8 mm calibrations using Anritsu calibration kits. These can be done as one unified calibration.
Coefficients for Calibration Standards	Use the Anritsu calibration kit USB Memory Device to load kit coefficients and characterization files. Enter manual coefficients into user-defined locations. Use complex load models.
Reference Impedance	Modify the reference impedance from 50Ω to any impedance greater than 0Ω.
Interpolation	Allows interpolation between calibration frequency points. Accuracy will be reduced at non-calibration frequencies and that degradation is dependent on the frequency step size in the initial calibration and the electrical length of the user's setup.
Adapter Removal Calibration	Characterizes and "removes" an adapter that is used during calibration that will not be used for subsequent device measurements; for accurate measurement of non-insertable devices.
Dispersion Compensation	Selectable as Coaxial, other non-dispersive (e.g., for coplanar waveguide), Waveguide, or Microstrip.
Power	Power Meter Correction: Different power meter calibrations are available to enhance power accuracy at the desired reference plane. The source power will match the target calibration power, as read by the power meter, to within ~0.1 dB for short periods of time (determined by thermal drift of the system and the power meter). The absolute accuracy of the calibrated power will be dependent on the power meter and sensor used. Flat Power Calibrations: A flat power calibration (when in frequency sweep mode) is available at a user-selectable power level, if it is within the power adjustment range of the internal source. The flat power correction is applied to other power levels directly as an offset. Multiple power meters/sensors may be needed depending on the frequency range. An adapter may be required to the 1 mm module test port. Linear Power Calibrations: A linear power calibration is performed over a range of power levels for use in power sweep mode and is performed at a specified frequency or frequency range (for multifrequency gain compression). External Power Meter: Both calibrations are performed using an external power meter (Anritsu ML2438A, ML248xB, ML249xA, Agilent 437B (or equivalent), Rhode and Schwarz NRP2 meter with a broadband 110 GHz sensor, or Elva DPM power meter) over the Dedicated GPIB port, or a USB power sensor (Anritsu MA24106A, MA24108A, MA24118A, MA24126A, MA24330A, MA24340A, MA24350A, MA24507A) connected to a USB port. Note: Usage of the MA24507A sensor requires connection to two USB ports to supply needed current draw.
Embedding/De-embedding	The MS4640B is equipped with an Embedding/De-embedding system. De-embedding: De-embedding is generally used for removal of test fixture contributions, modeled networks and other networks described by S-parameters (s2p files) from measurements. Embedding: Similarly, the Embedding function can be used to simulate matching circuits for optimizing amplifier designs or simply adding effects of a known structure to a measurement. Multiple Networks: Multiple networks can be embedded/de-embedded and changing the port and network orientations is handled easily. Extraction Utility: An extraction utility is part of this package that allows the easier computation of de-embedding files based on some additional calibration steps and measurements.
Impedance Conversion	Allows entry of different impedances (complex values) for different ports.

Mechanical Calibration/Verification Kits

W1 (1 mm) Calibration/Verification Kit, 3659

Provides 12-term SOLT or Triple Offset Short calibrations, for W1 (1 mm) devices, and two verification standards.

3656B W1 1 mm Calibration/Verification Kit providing 12-Term SOLT or SSST calibrations and two verification standards.

3656B Cal Kit Contains:	Additional Information (typ.)	Quantity	Part Number
Offset Short W1 (m)	Offset: 2.020 mm	1	23W50-1
Offset Short W1 (m)	Offset: 2.650 mm	1	23W50-2
Offset Short W1 (m)	Offset: 3.180 mm	1	23W50-5
Offset Short W1 (f)	Offset: 2.020 mm	1	23WF50-1
Offset Short W1 (f)	Offset: 2.650 mm	1	23WF50-2
Offset Short W1 (f)	Offset: 3.180 mm	1	23WF50-5
Open W1 (m)	Offset: 1.510 mm	1	24W50
Open W1 (f)	Offset: 1.930 mm	1	24WF50
Fixed Termination W1 (m)		1	28W50
Fixed Termination W1 (f)		1	28WF50
Adapter, W1 (m) to Fixed SC* Connector		1	33WSC50
Adapter, W1 (f) to Fixed SC* Connector		1	33WSC50
Interchangeable Slider for SC* Connector (m)		1	—
Interchangeable Slider for SC* Connector (f)		1	—
Locking Keys for SC* Connectors		2	—
Pin Exchange Tool for SC* Connectors	Contains 1 male pin	1	01-402
Adapter, W1 (m) to W1 (f)		1	33WWF50
Adapter, W1 (m) to W1 (m)		1	33WW50
Adapter, W1 (f) to W1 (f)		1	33WFWF50
Stepped Impedance Thruline, W1 (m - f)	Verification Device	1	18WWF50-1B
50Ω matched Thruline, W1 (m - f)	Verification Device	1	18WWF50-1
Torque Wrench	6 mm, 5.4 N·cm (4 lbf·in)	1	01-504
Open-ended Wrench	6 mm/7 mm	1	01-505
Coefficients for standards	On USB Memory Device and 3.5 in Floppy Disk	1	—

*: SC Connectors are a solution for accurate calibrations for non-insertable 1 mm devices. Users can change the gender of the SC connector using the provided tool, pin, sliders, and locking keys to ensure the best pin-depth, thus calibrations are valid after changing the gender of the adapter.

Test Port Cables

Test Port Cables, Flexible, High Performance

Description	Frequency Range	Impedance	Length (cm)	Insertion Loss (dB)	Return Loss (dB)	Part Number
W1 (1 mm) (m) to W1 (1 mm) (f)	DC to 110 GHz	50Ω	10	1.74	≥14	3671W1-50-1
			13	2.23	≥14	3671W1-50-2
			16	2.74	≥14	3671W1-50-3

3671W1-50-X Flexible Test Cables

Precision Adapters, Attenuators, and Other Components

Anritsu offers a complete line of precision adapters and attenuators. For more information, please visit our web site at www.anritsu.com.

Warranty

The ME7838E Series VNAs and related accessories offer a 3 year warranty from the date of shipment. Please contact your local service center for additional warranty coverage. Note that the key component of the system, the MS4640B VNA, is covered by a 3-year standard warranty.

Ordering Information

The ME7838E Broadband/Millimeter-Wave VNA System provides single sweep coverage from 70 kHz to 110 GHz and consists of the following standard components and optional accessories, which are described in the sections below:

ME7838E Broadband System, 70 kHz to 110 GHz

Action	Part Number and Description	Additional Information
Order the base VectorStar model with the listed components and options:	MS4647B, 70 kHz to 70 GHz VNA MS4640B-007, Receiver Offset MS4640B-070, 70 kHz Frequency Coverage 3739C, Broadband Test Set with 36 inch interface cables 3743E, Millimeter-Wave Module, 2 each ME7838E-SS020, On-site system assembly and verification	
Include one of the following:	MS4647B-086, MS4647B with ME7838E system option	MS4647B-088 is ordered when Option 31 is included
	MS4647B-087, MS4647B with ME7838E system option and Option 51, or 61, or 62	MS4647B-089 is ordered when Option 31 is included
Include one of the following:	806-206, 1.85 mm phase stable VNA RF cables, 24”, M-F, 2 each	
	806-209, 1.85 mm phase stable VNA RF cables, 36”, M-F, 2 each	
Add options if desired:	Option 51, or 61, or 62: MS4647B-051 – External VNA Loops MS4647B-061 – Active Measurement Suite, 2 Attenuators MS4647B-062 – Active Measurement Suite, 4 Attenuators	
	MS4640B-070 – for 70 kHz operation in base VNA MS4640B-002 – for Time Domain MS464xB-031 – Dual Source Architecture MS4640B-035 – IF Digitizer MS4640B-041 – Noise Figure MS4640B-042 – PulseView™ MS4640B-043 – DifferentialView™ MS4640B-048 – Differential Noise Figure	MS464xB-031 requires Option 88 or 89 For other available options, see “ME7838E Broadband/Millimeter-Wave System Options”
Accessories	MS4640B-001, MS4640B Rack Mount 3739C-001, 3739C Rack Mount	

ME7838E Waveguide-Band System to 110 GHz – 3744E-EE or 3744E-EW mm-Wave Modules

Configuration for ME7838E Millimeter-Wave System using 3744E-EE or 3744E-EW mm-Wave Modules:

Action	Part Number and Description	Additional Information
Choose and order one of the two base VectorStar models with options listed:	MS4644B VNA, 10 MHz to 40 GHz MS4640B-007 MS4644B-086 or -087 or -088 or -089	MS4644B-087 is ordered when Options 51, 61, or 62 is included. MS4644B-088 is ordered when Option 31 is included and Option 51, 61, or 62 is excluded. MS4644B-089 is ordered when Option 31 and Option 51, 61, or 62 is included.
	MS4647B VNA, 10 MHz to 70 GHz MS4647B-007 MS4647B-086 or -087 or -088 or -089	MS4647B-087 is ordered when Options 51, 61, or 62 are included. MS4647B-088 is ordered when Option 31 is included and Option 51, 61, or 62 is excluded. MS4647B-089 is ordered when Option 31 and Option 51, 61, or 62 is included.
Order Test Set	3739C mm-Wave Test Set	
Choose and order Extended-E or Extended-W Band Modules:	3744A-EE, 56 GHz to 94 GHz Extended E Band module, 2 each	
	3744A-EW, 65 GHz to 110 GHz Extended W Band module, 2 each	
Add options if desired:	Option 51, or 61, or 62: MS4647B-051 – External VNA Loops MS4647B-061 – Active Measurement Suite, 2 Attenuators MS4647B-062 – Active Measurement Suite, 4 Attenuators	
	MS4640B-070 – for 70 kHz operation in base VNA MS4640B-002 – for Time Domain MS464xB-031 – Dual Source Architecture MS4640B-035 – IF Digitizer MS4640B-041 – Noise Figure MS4640B-042 – PulseView™ MS4640B-043 – DifferentialView™ MS4640B-048 – Differential Noise Figure	MS464xB-031 requires Option 88 or 89 For other available options, see "ME7838E Broadband/Millimeter-Wave System Options"
	MS4640B-001, MS4640B Rack Mount 3739C-001, 3739C Rack Mount	
Accessories	35WR12WF-EE – Precision Waveguide to Coax Adapter Kit, 56 GHz to 94 GHz, WR-12 to W1 (f)	
	35WR10WF-EW – Precision Waveguide to Coax Adapter Kit, 65 GHz to 110 GHz, WR-10 to W1 (f)	

ME7838E-Waveguide-Band System – OML/VDI mm-Wave Modules

ME7838E Waveguide-band System using OML or VDI Millimeter-Wave modules:

Action	Part Number and Description	Additional Information
Choose and order one of the three base VectorStar models with options listed:	MS4642B VNA, 70 kHz to 20 GHz MS4642B-008 or MS4642B-009 MS4642B-083 or MS4642B-089	MS4642B-008 includes Active Device Measurements, with 2 Step Attenuators MS4642B-009 includes Active Device Measurements, with 4 Step Attenuators MS4642B-089 is ordered when Option 31 is included.
	MS4644B VNA, 10 MHz to 40 GHz MS4640B-007 Receiver Offset MS4644B-086 or -087 or -088 or -089	MS4644B-087 is ordered when Options 51, 61, or 62 are included. MS4644B-088 is ordered when Option 31 is included and Option 51, 61, or 62 is excluded. MS4644B-089 is ordered when Option 31 and Option 51, 61, or 62 is included.
	MS4647B VNA, 10 MHz to 70 GHz MS4647B-007 Receiver Offset MS4647B-086 or -087 or -088 or -089	MS4647B-087 is ordered when Options 51, 61, or 62 are included. MS4647B-088 is ordered when Option 31 is included and Option 51, 61, or 62 is excluded. MS4647B-089 is ordered when Option 31 and Option 51, 61, or 62 is included.
Order:	3739C mm-Wave Test Set	
	SM6537 Interface Cables (2) for OML/VDI mm-Wave Modules	Does not include DC cable. DC supply is provided by mm-Wave module power supply.
Choose and order one of the two appropriate millimeter-wave module combinations:	2 each TxRx transmission and reflection millimeter-wave modules	Choose appropriate OML or VDI modules. Contact Anritsu Company for ordering information.
	1 each TxRx transmission and reflection module, and 1 each Tx transmission only module	
Add options if desired:	Option 51, or 61, or 62: MS4647B-051 – External VNA Loops MS4647B-061 – Active Measurement Suite, 2 Attenuators MS4647B-062 – Active Measurement Suite, 4 Attenuators	
	MS4640B-070 – for 70 kHz operation in base VNA MS4640B-002 – for Time Domain MS464xB-031 – Dual Source Architecture MS4640B-035 – IF Digitizer MS4640B-041 – Noise Figure MS4640B-042 – PulseView™ MS4640B-043 – DifferentialView™ MS4640B-048 – Differential Noise Figure	MS464xB-031 requires Option 88 or 89 For other available options, see "ME7838E Broadband/Millimeter-Wave System Options"

Model/Order No.	Name
	Calibration/Verification Kits
3656B	W1 (1 mm) Calibration/Verification Kit
3655V	WR-15 Waveguide Calibration Kit, Without Sliding Loads
3655V-1	WR-15 Waveguide Calibration Kit, With Sliding Loads
3655E	WR-12 Waveguide Calibration Kit, Without Sliding Loads
3655E-1	WR-12 Waveguide Calibration Kit, With Sliding Loads
3655W	WR-10 Waveguide Calibration Kit, Without Sliding Loads
3655W-1	WR-10 Waveguide Calibration Kit, With Sliding Loads
3650A	SMA/3.5 mm Calibration Kit, Without Sliding Loads
3650A-1	SMA/3.5 mm Calibration Kit, With Sliding Loads
3652A	K Calibration Kit, Without Sliding Loads
3652A-2	K Calibration Kit, Without additional options
3652A-3	K Calibration Kit, With Pin Depth Gauge and .s1p Characterization Files
3652A-4	K Calibration Kit, With .s1p Characterization Files
3654D	V Calibration Kit, With Pin Depth Gauge
3654D-2	V Calibration Kit Without additional options
3654D-3	V Calibration Kit, With Pin Depth Gauge and .s1p Characterization Files
3654D-4	V Calibration Kit, With .s1p Characterization Files
3657	V Multi-Line Calibration Kit, Without Shorts
3657-1	V Multi-Line Calibration Kit, With Shorts
	External Power Meters/Sensors
ML243xA	CW Power Meter, Single Input or Dual Input Recommended Power Sensors: SC7770, MA247xD, MA244xD, MA248xD, MA2400xA
ML248xB	Wideband Power Meter, Single Input or Dual Input Recommended Power Sensors: MA249xA, MA2411B
ML249xA	Pulse Power Meter, Single Input or Dual Input Recommended Power Sensors: MA249xA, MA2411B
MA24106A	USB Power Sensor, 50 MHz to 6 GHz
MA24108A	USB Power Sensor, 10 MHz to 8 GHz
MA24118A	USB Power Sensor, 10 MHz to 18 GHz
MA24126A	USB Power Sensor, 10 MHz to 26 GHz
MA24330A	USB Power Sensor, 10 MHz to 33 GHz
MA24340A	USB Power Sensor, 10 MHz to 40 GHz
MA24350A	USB Power Sensor, 10 MHz to 50 GHz
MA24507A*	Power Master™ Frequency Selectable mm-Wave Power Analyzer, 9 kHz to 70 GHz
MA24510A	Power Master™ Frequency Selectable mm-Wave Power Analyzer, 9 kHz to110 GHz Note that usage of the MA24507A or MA24510A Power Master™ sensor requires connection to two USB ports to supply needed current draw.
	Test Port Cables, Flexible, High Performance
3671W1-50-1	W1 (m) to W1 (f), 1 each, 10.0 cm (3.9 in)
3671W1-50-2	W1 (m) to W1 (f), 1 each, 13.0 cm (5.1 in)
3671W1-50-3	W1 (m) to W1 (f), 1 each, 16.0 cm (6.3 in)
3671KFS50-60	K (f) to 3.5 mm (m) cable, 60 cm (one cable)
3671KFK50-60	K (f) to K (m) cable, 60 cm (one cable)
3671KFK50-100	K (f) to K (m) cable, 1 each, 100 cm (one cable)
3671KFKF50-60	K (f) to K (f) cable, 1 each, 60 cm (once cable)
3671VFV50-60	V (f) to V (m) cable, 1 each, 60 cm (one cable)
3671VFV50-100	V (f) to V (m) cable, 1 each, 100 cm (one cable)
3671KFSF50-60	K (f) to 3.5 mm (f) cable, 1 each, 60 cm (one cable)
3671VFVF50-60	V (f) to V (f) cable, 1 each, 60 cm (one cable)

Model/Order No.	Name
	Adapters and More
34WV50	W1 (m) to V (m) Adapter, W1 (1 mm) to V, Coaxial
34WVF50	W1 (m) to V (f) Adapter, W1 (1 mm) to V, Coaxial
34WFV50	W1 (f) to V (m) Adapter, W1 (1 mm) to V, Coaxial
34WFVF50	W1 (f) to V (f) Adapter, W1 (1 mm) to V, Coaxial
33WW50	W1 (m) to W1 (m) Adapter, W1 (1 mm) in-series, Coaxial
33WWF50	W1 (m) to W1 (f) Adapter, W1 (1 mm) in-series, Coaxial
33WFWF50	W1 (f) to W1 (f) Adapter, W1 (1 mm) in-series, Coaxial
35WR10W	WR10 to W1 (m) Adapter, W1 (1 mm) to WR10 Waveguide
35WR10WF	WR10 to W1 (f) Adapter, W1 (1 mm) to WR10 Waveguide
SC7260	WR12 to W1 (m) Adapter, W1 (1 mm) to WR12 Waveguide
SC7442	WR12 to W1 (f) Adapter, W1 (1 mm) to WR12 Waveguide
35WR15V	WR15 to V (m) Adapter, V (1.85 mm) to WR15 Waveguide
35WR15VF	WR15 to V (f) Adapter, V (1.85 mm) to WR15 Waveguide
For More Information	Refer to our Precision RF & Microwave Components Catalog for descriptions of adapters and other components.
	Accessories
SC8215	Kelvin Bias Tee 70 kHz to 110 GHz, Max Voltage: 16 VDC, Max Current: 100 mA
SC7287	Kelvin Bias Tee 100 MHz to 110 GHz, Max Voltage: 50 VDC, Max Current: 500 mA
SC8218	Triax (m) to SMC (m) Cable, (Inner-shield floating at SMC end), 1.5 m (60 in) long two (2) needed per Kelvin Bias Tee
SM6494	System floor console. Includes larger size writing table
2100-1	GPIB cable, 1 m (39 in) long
2100-2	GPIB cable, 2 m (79 in) long
2100-4	GPIB cable, 4 m (157 in) long
806-206	1.85 mm cable, 61 cm (24 in) long, for connecting the VNA and the 3743E Modules
806-209	1.85 mm cable, 91 cm (36 in) long, for connecting the VNA and the 3743E Modules
01-201	Torque Wrench (for tightening male devices), 8 mm (5/16 in), 0.9 N·m (8 lbf·in) for SMA, 3.5 mm, 2.4 mm, K, and V connectors
01-202	Universal Test Port Connector Wrench
01-203	Torque Wrench (for tightening the VNA test ports to female devices) 20.6 mm (13/16 in), 0.9 N·m (8 lbf·in)
01-204	Anritsu Stainless Steel Connector Wrench, circular, open-ended for SMA, 3.5 mm, 2.4 mm, K and V connectors

*: The MA24507A sensor requires connection to two USB ports to supply needed current draw.

VectorStar™ Vector Network Analyzers

ME7838D Series

Broadband VNA System: 70 kHz to 145 GHz/Millimeter Waveguide VNA System: 50 GHz to 1.1 THz

High Performance, Broadband Network Analysis Solutions

Through the use of the Anritsu-developed 0.8 mm coaxial onnector, frequencies up to 145 GHz can be propagated within a coaxial transmission line without waveguide flange connections.
A broadband frequency sweep from 70 kHz to 145 GHz is now available without the need to concatenate multiple systems.
The result is more accurate device characterization from near-DC through the W band and F band frequencies. W band devices can now be characterized beyond the operating frequency of the application for more accurate modeling and higher success rate from the first design turn. The ME7838D fully supports the 3744A-Rx 30 GHz to 125 GHz receiver for noise figure measurements up to 125 GHz. Integrating Anritsu's unique strength in nonlinear transmission line technology (NLTL), the ME7838D system offers many advances in broadband performance over traditional systems including:

- Industry-best broadband frequency coverage, starts at 70 kHz instead of 10 MHz and is operational from 40 kHz to 145 GHz through a single coaxial connector
- Industry-best dynamic range, 120 dB at 10 MHz, 108 dB at 65 GHz, 108 dB at 110 GHz, and 94 dB at 145 GHz
- Industry-best measurement speed, 55 ms for 201 points at 10 kHz IFBW
- Compact, lightweight mm-Wave modules for easy, precise, and economical positioning on the wafer probe station, 0.7 lb and 1/50 the volume of traditional mm-wave modules
- The first millimeter-wave system with real time leveling of power without the need for calibration software correction tables
- Industry-best calibration and measurement stability, 0.1 dB over 24 hrs
- Fully supports tri-axial Kelvin bias tee connections for on-wafer device biasing up to 145 GHz
- Millimeter-wave waveguide coverage to 1.1 THz
- The ME7838A 110 GHz/125 GHz Broadband system can be easily upgraded to 145 GHz by incorporating the new Anritsu MA25300A mm-wave module

Broadband VNA System 70 kHz to 145 GHz

The ME7838D broadband VNA system provides single sweep coverage from 70 kHz to 145 GHz and is operational from 40 kHz to 145 GHz.
It consists of the following items:

- MS4647B VectorStar VNA, 70 kHz to 70 GHz with Option 7, Option 70, and Options 80/81
- 3739C Broadband Millimeter-Wave Test Set and Interface Cables
- MA25300A Millimeter-Wave Module, 2 each

Millimeter Waveguide VNA System 50 GHz to 1.1 THz

The ME7838D Millimeter-wave configuration provides waveguide output from 50 GHz to 1.1 THz in waveguide bands. The system can extend the broadband system or be configured to operate only as a waveguide system. It consists of the following items:

- MS4647B VectorStar VNA, 70 kHz to 70 GHz with Option 7, and Options 82/83
- 3739C Broadband Millimeter-Wave Test Set and Interface Cables
- Millimeter-Wave Module, 2 each

VectorStar ME7838D Broadband System Configuration

ME7838D Broadband Hardware Configuration

The ME7838D broadband VNA system provides single sweep coverage from 70 kHz to 145 GHz and is operational from 40 kHz to 145 GHz.
It consists of the following items

VNA	MS4647B* VectorStar VNA, 70 kHz to 70 GHz with Option 7, Option 70, and Options 80/81
Test Set	3739C Broadband Test Set and interface cables
mm-Wave Modules	MA25300A Millimeter-Wave Module, 2 each

*: Support for the MS464xA VectorStar is available.

ME7838D Broadband/Millimeter-Wave System Options

The major ME7838D broadband VNA system options are:

Option 2	MS4640B-002 Time Domain
Option 21	MS4640B-021 Universal Fixture Extraction
Option 31	MS464xB-031 Dual Source Architecture
Option 32	MS4640B-032 Internal RF Combiner
Option 35	MS4640B-035 IF Digitizer
Option 41	MS4640B-041 Noise Figure
Option 42	MS4640B-042 PulseView™
Option 43	MS4640B-043 DifferentialView™
Option 44	MS4640B-044 IMDView™
Option 46	MS4640B-046 Fast CW

Option 47	MS4640B-047 Eye Diagram
Option 48	MS4640B-048 Differential Noise Figure
Option 51	MS4647B-051 External VNA Direct Access Loops
Option 61	MS4647B-061 Active Measurement Suite, with 2 Attenuators
Option 62	MS4647B-062 Active Measurement Suite, with 4 Attenuators
3744E-Rx	30 to 110 GHz mm-Wave Receiver for Noise Figure and mm-Wave Antenna Measurements
3744E-EE	56 to 95 GHz WR-12 Waveguide Module
3744E-EW	65 to 110 GHz WR-10 Waveguide Module
Bias Tees	SC8215 and SC7287 Kelvin Bias Tees

System and Receiver Dynamic Range, Noise Floor (Excludes localized spurious responses and crosstalk)

System Dynamic Range	System dynamic range is measured as the difference between maximum port power and the RMS noise floor in a 10 Hz bandwidth and no averaging (ports terminated).
Noise Floor	Noise floor is calculated as the difference between maximum rated port power and system dynamic range.
Receiver Dynamic Range	Receiver Dynamic Range is calculated as the difference between the receiver compression level and the noise floor at Ports 1 or 2.
Normalizing Measurement	Normalizing measurement made with a through line connection, with its effects compensated for. The cables between the VNA and the MA25300A modules are assumed to be the 806-206 1.85 mm cable (61 cm, 24 in long) or the 806-209 1.85 mm cable (91 cm, 36 in long). All figures are typical.

Frequency Range	System Dynamic Range* (dB)		Receiver Dynamic Range* (dB)		Noise Floor*1 (dBm)	
	ME7838D	ME7838D Option 62	ME7838D	ME7838D Option 62	ME7838D	ME7838D Option 62
70 kHz to 300 kHz	93	90	89	86	–83	–80
>0.3 MHz to 2 MHz	103	100	103	102	–93	–90
>2 MHz to 10 MHz	115	112	115	114	–105	–102
>0.01 GHz to 2.5 GHz	120	116	121	122	–110	–109
>2.5 GHz to 24 GHz	110	105	121	121	–110	–108
>24 GHz to 54 GHz	110	107	125	125	–115	–115
>54 GHz to 60 GHz	110	110	124	124	–114	–114
>60 GHz to 67 GHz	110	110	123	123	–113	–113
>67 GHz to 80 GHz	108	108	121	121	–111	–111
>80 GHz to 85 GHz	106	106	123	123	–113	–113
>85 GHz to 90 GHz	106	106	122	122	–112	–112
>90 GHz to 95 GHz	106	106	121	121	–111	–111
>95 GHz to 105 GHz	106	106	121	121	–111	–111
>105 GHz to 110 GHz	109	109	125	125	–115	–115
>110 GHz to 120 GHz	108	108	118	118	–111	–111
>120 GHz to 125 GHz	104	104	116	116	–109	–109
>125 GHz to 140 GHz	92	92	109	109	–102	–102
>140 GHz to 145 GHz	94	94	107	107	–100	–100

*: Excludes localized spurious responses and crosstalk

Test Port Power, Receiver Compression

Port power control is provided by the base VNA for frequencies below 54 GHz, and by the MA25300A mm-Wave module for frequencies greater than 54 GHz. Receiver compression point is defined as the port power level beyond which the response may be compressed more than 0.2 dB relative to normalization level. 10 Hz IF bandwidth used to remove high level noise effects. All typical.

Frequency Range	Port Power		Receiver Compression*1	
	Max. Power ME7838D	Max. Power ME7838D Option 62*2	Compression ME7838D	Compression ME7838D Option 62
70 kHz to 300 kHz	10	10	6	6
>0.3 MHz to 2 MHz	10	10	10	12
>2 MHz to 10 MHz	10	10	10	12
>0.01 GHz to 2.5 GHz	10	7	11	13
>2.5 GHz to 24 GHz	0	–3	11	13
>24 GHz to 54 GHz	–5	–8	10	10
>54 GHz to 60 GHz	–4	–4	10	10
>60 GHz to 67 GHz	–3	–3	10	10
>67 GHz to 80 GHz	–3	–3	10	10
>80 GHz to 85 GHz	–7	–7	10	10
>85 GHz to 90 GHz	–6	–6	10	10
>90 GHz to 95 GHz	–5	–5	10	10
>95 GHz to 105 GHz	–5	–5	10	10
>105 GHz to 110 GHz	–6	–6	10	10
>110 GHz to 120 GHz	–3	–3	7	7
>120 GHz to 125 GHz	–5	–5	7	7
>125 GHz to 140 GHz	–10	–10	7	7
>140 GHz to 145 GHz	–6	–6	7	7

*1: Using the 806-206 1.85 mm (61 cm, 24 in long) test port cables between the VNA and the MA25300A mm-Wave modules.

*2: Use this column also for Options 51 and 61 although the performance between 10 MHz and 54 GHz will characteristically be better by 1 dB or more for Option 51, and will characteristically be better by 1 dB or more for Option 61 (with port 1 driving and port 2 receiving).

Power Range, Accuracy, Linearity and Resolution

Accuracy is defined at –10 dBm or max rated power, whichever is lower. Linearity is defined as the port power linearity error between the accuracy test power level and 5 dB below. Typical.

Frequency Range	Range (dBm)		Accuracy (dB)	Linearity (dB)	Resolution (dB)
	ME7838D	ME7838D Option 62			
70 kHz to 300 kHz	–25 to +10	–85 to +10	±1.5	±1.5	0.01
>0.3 MHz to 2 MHz	–25 to +10	–85 to +10	±1.5	±1.5	0.01
>2 MHz to 10 MHz	–25 to +10	–85 to +10	±1.5	±1.5	0.01
>0.01 GHz to 2.5 GHz	–25 to +10	–85 to +8	±1.0	±1.0	0.01
>2.5 GHz to 24 GHz	–25 to 0	–85 to –3	±1.0	±1.0	0.01
>24 GHz to 54 GHz	–30 to –5	–90 to –8	±1.5	±1.0	0.01
>54 GHz to 60 GHz	–55 to –4	–55 to –4	±2.0	±1.5	0.01
>60 GHz to 67 GHz	–55 to –3	–55 to –3	±2.0	±1.5	0.01
>67 GHz to 80 GHz	–55 to –3	–55 to –3	±2.0	±1.5	0.01
>80 GHz to 85 GHz	–55 to –7	–55 to –7	±2.0	±1.5	0.01
>85 GHz to 90 GHz	–55 to –6	–55 to –6	±2.0	±1.5	0.01
>90 GHz to 95 GHz	–55 to –5	–55 to –5	±2.0	±1.5	0.01
>95 GHz to 105 GHz	–55 to –5	–55 to –5	±3.0	±2.0	0.01
>105 GHz to 110 GHz	–55 to –6	–55 to –6	±3.0	±2.0	0.01
>110 GHz to 120 GHz	–55 to –3	–55 to –3	±4.0	±3.0	0.01
>120 GHz to 125 GHz	–55 to –5	–55 to –5	±4.0	±3.0	0.01
>125 GHz to 140 GHz	–50 to –10	–50 to –10	±5.0	±4.0	0.01
>140 GHz to 145 GHz	–50 to –6	–50 to –6	±5.0	±4.0	0.01

High Level Noise

Noise measured at 1 kHz IF bandwidth, at maximum power or compression limit (whichever is less), with through transmission. RMS. Typical.

Frequency Range	Magnitude (dB)	Phase (degree/°C)
70 kHz to 500 kHz	<0.04	<0.4
>0.5 MHz to 2 MHz	<0.005	<0.05
>2 MHz to 10 MHz	<0.005	<0.05
>0.01 GHz to 2.5 GHz	<0.005	<0.05
>2.5 GHz to 24 GHz	<0.006	<0.06
>24 GHz to 54 GHz	<0.005	<0.06
>54 GHz to 80 GHz	<0.005	<0.06
>80 GHz to 110 GHz	<0.008	<0.09
>110 GHz to 120 GHz	<0.008	<0.09
>120 GHz to 125 GHz	<0.011	<0.11
>125 GHz to 140 GHz	<0.016	<0.16
>140 GHz to 145 GHz	<0.016	<0.16

Stability

Measurement ratio at maximum leveled power and with nominally a full reflect or a stable thru over the normal specified temperature range. (23° ±3°C, typ.)

Frequency Range	Magnitude (dB/°C)	Phase (degree/°C)
70 kHz to 300 kHz	<0.015	<0.1
>0.3 MHz to 2 MHz	<0.015	<0.05
>2 MHz to 10 MHz	<0.01	<0.05
>0.01 GHz to 2.5 GHz	<0.01	<0.05
>2.5 GHz to 30 GHz	<0.01	<0.09
>30 GHz to 54 GHz	<0.01	<0.07
>54 GHz to 80 GHz	<0.015	<0.1
>80 GHz to 110 GHz	<0.015	<0.15
>110 GHz to 120 GHz	<0.02	<0.2
>120 GHz to 125 GHz	<0.025	<0.2
>125 GHz to 140 GHz	<0.03	<0.35
>140 GHz to 145 GHz	<0.04	<0.5

Frequency Resolution, Accuracy and Stability

Resolution	Accuracy	Stability
1 Hz	±5 × 10^{-7} Hz/Hz (at time of calibration)	<5 × 10^{-9}/°C over 0° to 50°C temperature <1 × 10^{-9}/day aging, instrument on

Uncorrected (Raw) Port Characteristics

Typical performance with either ME7838D or ME7838D with Option 62.

Frequency Range	Directivity (dB)	Port Match (dB)
70 kHz to 10 MHz	10*	8
>0.01 GHz to 2.5 GHz	9*	10
>2.5 GHz to 30 GHz	5*	11
>30 GHz to 40 GHz	9*	11
>40 GHz to 54 GHz	9*	11
>54 GHz to 80 GHz	9	10
>80 GHz to 110 GHz	5	7
>110 GHz to 120 GHz	5	7
>120 GHz to 125 GHz	5	7
>125 GHz to 140 GHz	5	7
>140 GHz to 145 GHz	5	6

*: Raw directivity is degraded below 300 kHz, 2.2 GHz to 2.5 GHz and in narrow bands within 10 GHz to 34 GHz

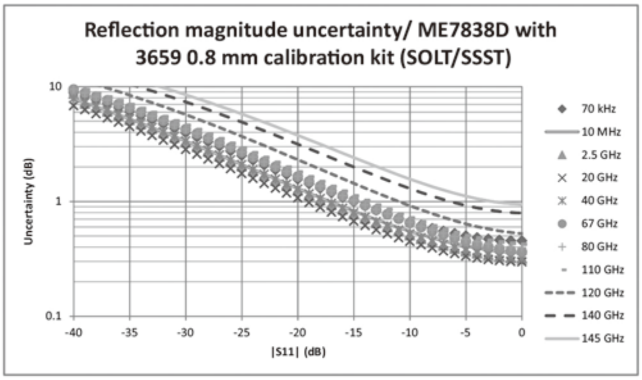
Corrected System Performance and Uncertainties – SOLT/SSST

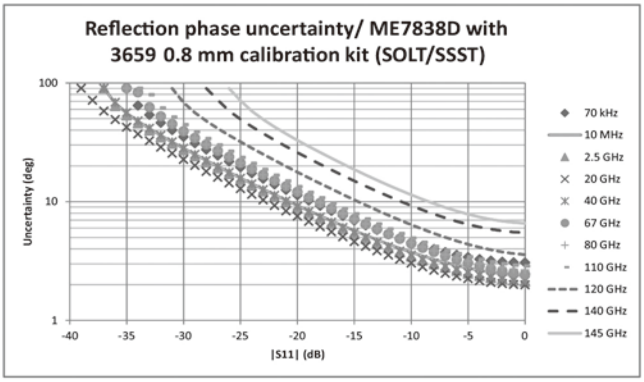
With 12-term concatenated SOLT and Triple Offset Short Calibration (SSST), using the 3659 0.8 mm Calibration Kit. Typical.

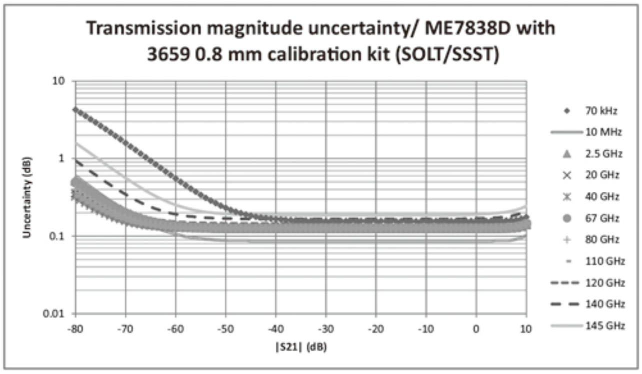
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
70 kHz to 10 MHz	36	36	36	±0.1	±0.1
>0.01 GHz to 2.5 GHz	38	41	38	±0.05	±0.03
>2.5 GHz to 20 GHz	40	41	40	±0.05	±0.05
>20 GHz to 67 GHz	35	41	35	±0.05	±0.07
>67 GHz to 80 GHz	35	38	35	±0.05	±0.07
>80 GHz to 95 GHz	35	40	35	±0.05	±0.07
>95 GHz to 110 GHz	34	37	34	±0.05	±0.07
>110 GHz to 125 GHz	30	34	30	±0.07	±0.09
>125 GHz to 140 GHz	28	28	28	±0.09	±0.11
>140 GHz to 145 GHz	26	28	26	±0.11	±0.13

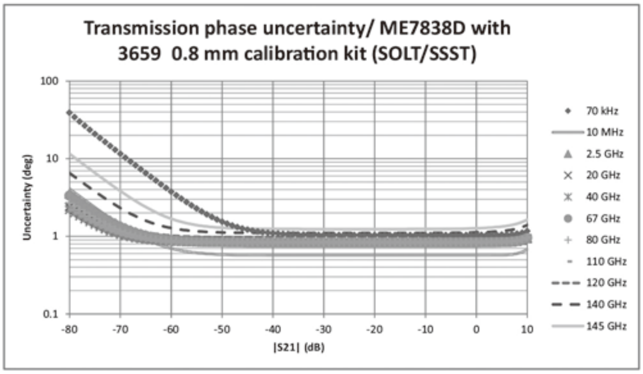
Measurement Uncertainties – SOLT/SSST

The graphs give measurement uncertainties after the above calibration. The component uncertainties are combined based on their characteristics: residual directivity, load and source match, tracking, network analyzer dynamic accuracy and connector repeatability are assumed to be fully correlated while noise effects (high level noise and noise floor effects) are assumed to be internally uncorrelated and uncorrelated with the first group of terms. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$.
For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. For other conditions, please use our free Exact Uncertainty calculator software, downloadable from the Anritsu web site at www.anritsu.com.



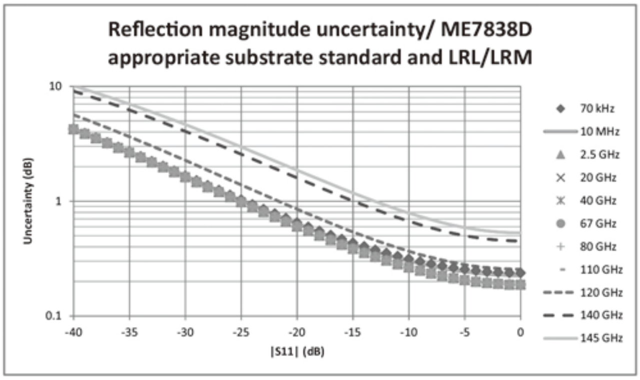


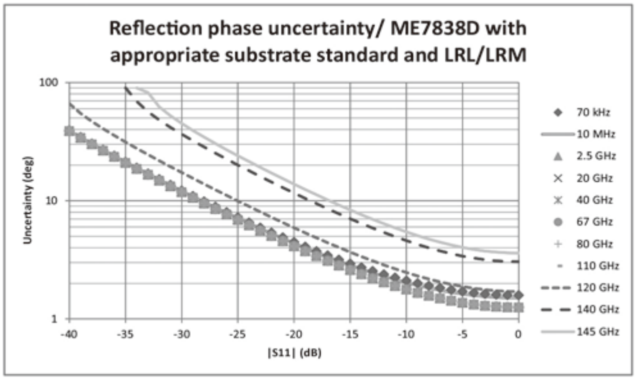


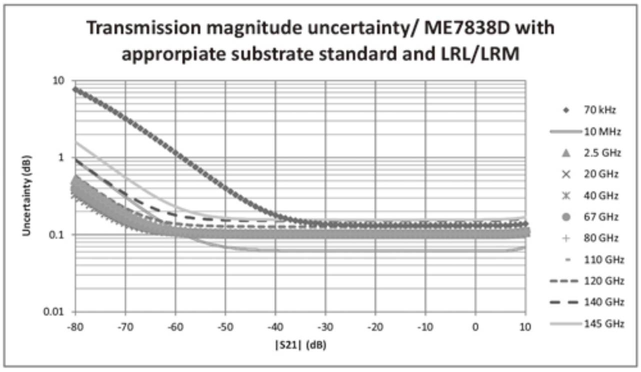


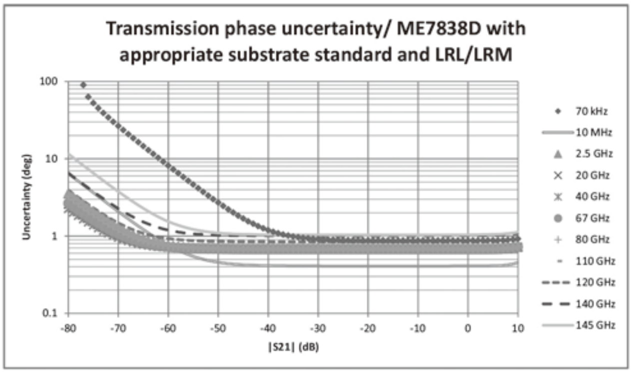
Corrected System Performance and Uncertainties – LRL/LRM

With 12 term LRL/LRM calibration using on-wafer substrate standards. Typical. Based on a typical vendor supplied impedance standard substrate









Measurement Time

Measurement times include sweep time, retrace time, and band-switching time. Typical.
Full Band, 70 kHz to 145 GHz, Display ON, and ALC ON.

Calibration	IFBW	Measurement Time (ms)*			
		401 Points	1,601 Points	10,001 Points	25,000 Points
1-port calibration	1 MHz	80	100	350	700
	30 kHz	90	160	600	1,500
	10 kHz	110	240	1,100	2,600
	1 kHz	470	1,600	10,000	25,000
	10 Hz	47,000	160,000	1,000,000	2,500,000
2-port calibration	1 MHz	160	200	700	1,400
	30 kHz	180	320	1,200	3,000
	10 kHz	220	480	2,200	5,200
	1 kHz	940	3,200	20,000	50,000
	10 Hz	94,000	320,000	2,000,000	5,000,000

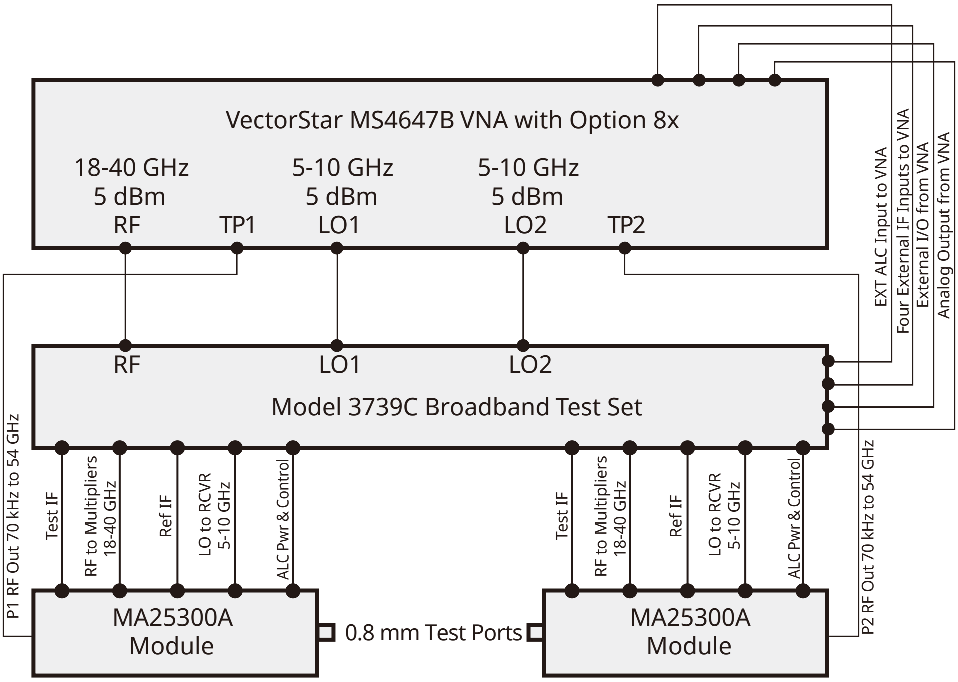
*: Measurement times are for ME7838D Broadband and ME7838D Millimeter-Wave Systems.

Measurement Time (ms) vs. System dynamic range (dB)

Full Band, Display ON, and ALC ON.

Calibration	401 Points Measurement Time	Achieved System Dynamic Range (Option 62 at 54 GHz)	IFBW and Averaging Used
Uncorrected or 1-port calibration	110 470	77 87	10 kHz/no avg 1 kHz/no avg
2-port calibration	220 940	77 87	10 kHz/no avg 1 kHz/no avg

Block Diagram – ME7838D Broadband VNA System



Broadband Configuration Block Diagram

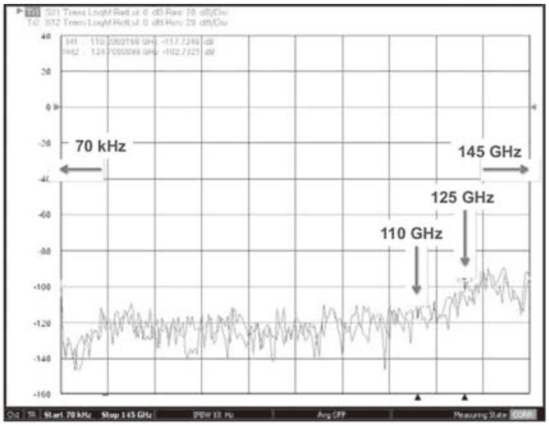
SC8215 and SC7287 Kelvin Bias Tees

When connected to the Source input of the MA25300A module, provides Sense and Force SMC connections 1.5 in from the test port to minimize the IR drops associated with the impedances between the bias tee and the DUT.

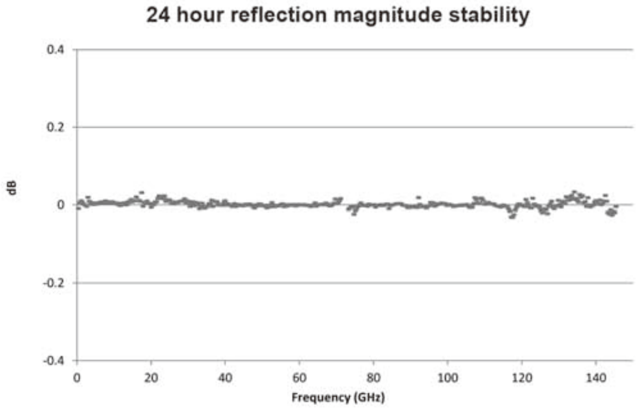
Part Number	Description	Voltage	Current
SC8215	The SC8215 is a bias tee operating for system frequencies of 70 kHz to 110/145 GHz.	Max. Voltage: 16 VDC	Max. Current: 100 mA
SC7287	The SC7287 is a bias tee operating for system frequencies of 100 MHz to 110/145 GHz.	Max. Voltage: 50 VDC	Max. Current: 500 mA
Tri-Axial Output SMUs	For applications requiring Source Measure Units (SMU) with tri-axial outputs, a tri-axial (m) to SMC (m) cable is available, with the inner-shield isolated from ground at the bias tee SMC end, to float at the SMU guard potential. Check the accessories on the ordering information.		

Measurement Examples

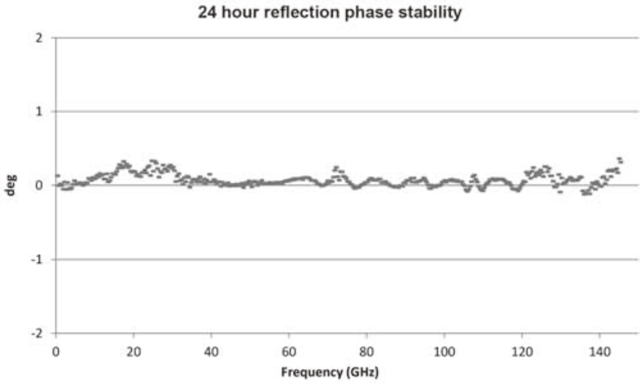
The following figures are measurement examples of the ME7838D Broadband system performance.



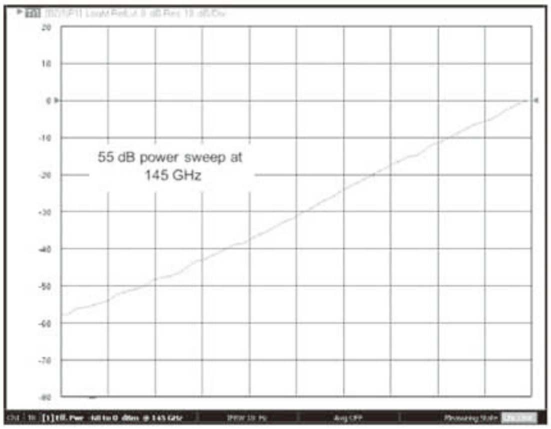
Dynamic range of ME7838D system at the 0.8 mm coaxial test port from 70 kHz to 145 GHz.



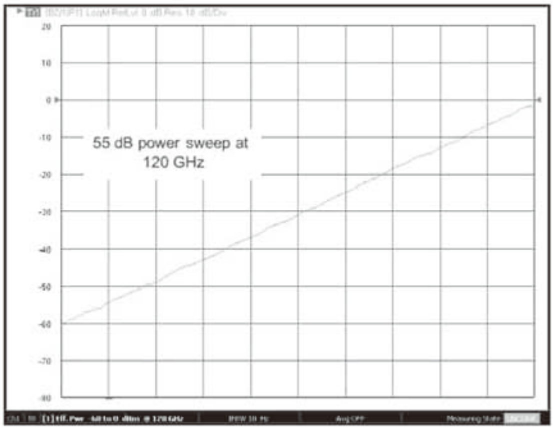
24 hour reflection magnitude stability from 70 kHz to 145 GHz in a typical lab environment when measured at 23° ±3°C.



24 hour reflection phase stability from 70 kHz to 145 GHz in a typical Lab environment when measured at 23° ±3°C



Power sweep range at 145 GHz. By using detection and power control inside the MA25300A millimeter-wave module; improved accuracy, linearity and range can be achieved.



Power sweep range at 120 GHz demonstrating greater than 55 dB of control

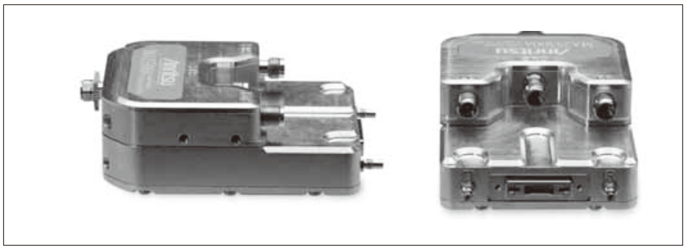
Specifications for Waveguide Band Configuration

ME7838D Millimeter-Wave VNA, Waveguide Bands

Three configurations are available for waveguide band operation above 145 GHz when using the ME7838D system.

- First, the Anritsu MA25300A Broadband Millimeter-Wave module can be adapted to waveguide measurements using waveguide adapters. Waveguide adapters from Flann are available with 0.8 mm connectors and cover the WR08 and WR06 bands.
- Second, the Anritsu 3744A-EE or 3744A-EW millimeter-wave module can be used. These version modules operate in the extended E and W waveguide bands and are operational using the MS4644B or MS4647B VectorStar (with options 8x and 7) and the 3739C broadband/millimeter-wave test set.
- The third configuration option is to use external millimeter-wave modules with any model VectorStar (with options 8x and 7) and the 3739C test set. For millimeter bands either the OML or VDI modules may be used.

E and W Band Operation Using the MA25300A, 3744A-EE, or 3744A-EW mm-Wave Module



MA25300A Millimeter-Wave Modules

3744A-EE/3744A-EW
Millimeter-Wave Module with Waveguide Adapter

The MA25300A Broadband mm-Wave module can be adapted to a waveguide band output by adding an available waveguide band adapter. Using the MA25300A modules provides the opportunity to sweep frequencies for broadband applications and quickly convert to waveguide configurations for banded measurements.

The advantages of small compact modules with excellent RF performance and power range control can therefore be realized in both broadband and waveguide configurations when using the MA25300A mm-Wave module. For systems where only waveguide band operation is required, for E band or W band modules can be used.

The 3744A-EE or 3744A-EW mm-Wave module operates from 54 GHz to 110 GHz. The band supported is determined by the waveguide adapter connected to the 1.0 mm test port output of the 3744A-EE/EW module:

- 3744A-EE configures the module for Extended E Band
- 3744A-EW configures for Extended W Band

The RF input port of the 3744A-EE or 3744A-EW module is restricted below 54 GHz, however, the RF input port retains a DC connection to the 1 mm test port. Thus, the waveguide adapter

Band	Frequency Range (GHz)	Waveguide Flange	Transmission/Reflection Module
Ext-E	56 to 94*	WR-12	3744A-EE
Ext-W	65 to 110	WR-10	3744A-EW

*: Operational to 95 GHz.

Waveguide Band Specifications

Port Power, Noise Floor, Dynamic Range – 3744E-EE/3744E-EW mm-Wave Modules

System dynamic range is defined as the ratio of the source power to the noise floor. Maximum Receiver Power is defined as the 0.2 dB compression point of the receiver at the waveguide port. Receiver dynamic range is defined as the ratio of maximum receive power to the noise floor. Noise Floor measurements are RMS, are made with no average in a 10 Hz IF bandwidth, and include an isolation calibration.

All figures are typical.

3744E-EE Extended-E Band (WR-12) Waveguide

Frequency Range	Source Power (dBm)	Max. Receive Power (0.2 dB comp. pt.) (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)	Receiver Dynamic Range (dB)
56 GHz to 60 GHz	–2	11	–111	109	122
>60 GHz to 65 GHz	0	11	–106	106	117
>65 GHz to 80 GHz	–3	11	–109	106	120
>80 GHz to 85 GHz	–4	11	–112	108	123
>85 GHz to 90 GHz	–4	11	–110	106	121
>90 GHz to 94 GHz*	0	12	–105	105	117

*: Operational to 95 GHz.

3744E-EW Extended-W Band (WR-10) Waveguide

Frequency Range	Source Power (dBm)	Max. Receive Power (0.2 dB comp. pt.) (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)	Receiver Dynamic Range (dB)
65 GHz to 67 GHz	0	11	–106	106	117
>67 GHz to 80 GHz	–3	11	–109	106	120
>80 GHz to 85 GHz	–4	11	–112	108	123
>85 GHz to 90 GHz	–4	11	–110	106	121
>90 GHz to 100 GHz	0	12	–105	105	117
>100 GHz to 110 GHz	–5	12	–110	105	122

Power Range, Accuracy, Linearity and Resolution

Accuracy is defined at –10 dBm or max rated power, whichever is lower. Linearity is defined as the incremental error between the accuracy test power level and 5 dB below. Typical.

Frequency Range	Range (dBm)		Accuracy (dB)	Linearity (dB)	Resolution (dB)
	ME7838D	ME7838D Option 62			
54 GHz to 60 GHz	–55 to –2	–55 to –2	±2.0	±1.5	0.01
>60 GHz to 65 GHz	–55 to 0	–55 to 0	±2.0	±1.5	0.01
>65 GHz to 80 GHz	–55 to –3	–55 to –3	±2.0	±1.5	0.01
>80 GHz to 85 GHz	–55 to –4	–55 to –4	±2.0	±1.5	0.01
>85 GHz to 90 GHz	–55 to –4	–55 to –4	±2.0	±1.5	0.01
>90 GHz to 100 GHz	–55 to 0	–55 to 0	±3.0	±2.0	0.01
>100 GHz to 110 GHz	–50 to –5	–50 to –5	±3.0	±2.0	0.01
>110 GHz to 120 GHz*	–40 to –12	–40 to –12	±4.0	±3.0	0.01
>120 GHz to 125 GHz*	–40 to –15	–40 to –15	±4.0	±3.0	0.01

*: 110 GHz to 125 GHz frequency range is available as operational.

Alternatively, the V, E and W bands can be supported using external millimeter-wave modules such as the 3740/41A series modules available from Anritsu.
For further description and specifications, please refer to the VectorStar ME7828A Technical Data Sheet 11410-00452 available at www.anritsu.com.

Corrected System Performance/Uncertainties – 3744E-EE/3744E-EW mm-Wave Modules

With 12-term Offset, Short, Sliding-Load, or LRL calibrations, using high precision waveguide sections and standards from the appropriate calibration kit.

3744E-EE Extended-E Band (WR-12) Waveguide – 56 GHz to 94 GHz

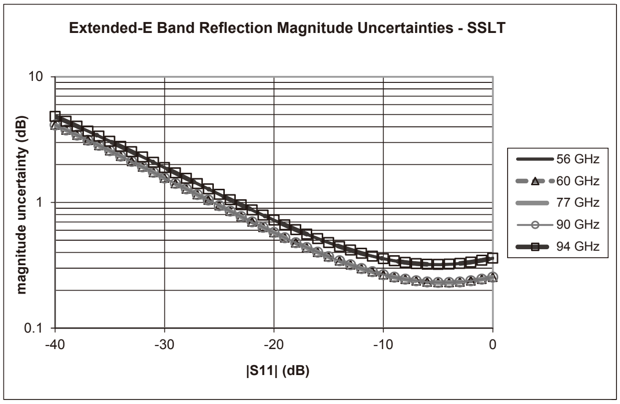
Calibration Type	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
Offset Short	>44	>33	>44	±0.080	±0.100
LRL	>44	>43	>44	±0.006	±0.006

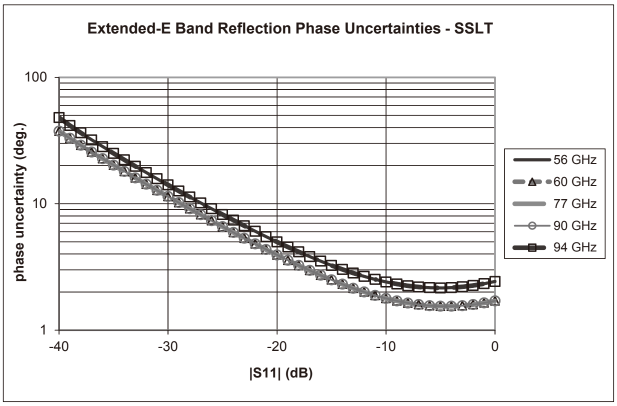
3744E-EW Extended-W Band (WR-10) Waveguide – 65 GHz to 110 GHz

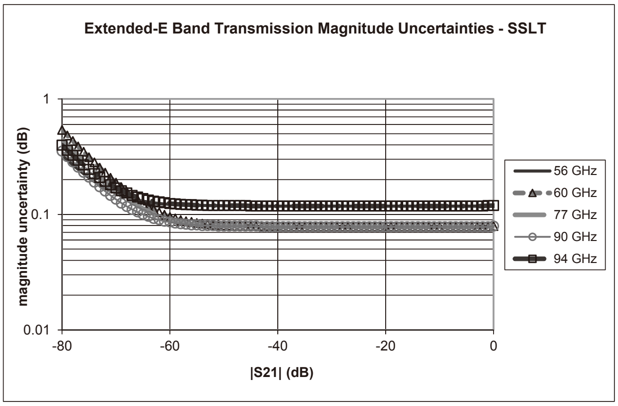
Calibration Type	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
Offset Short	>40	>30	>46	±0.080	±0.100
LRL	>40	>40	>46	±0.006	±0.006

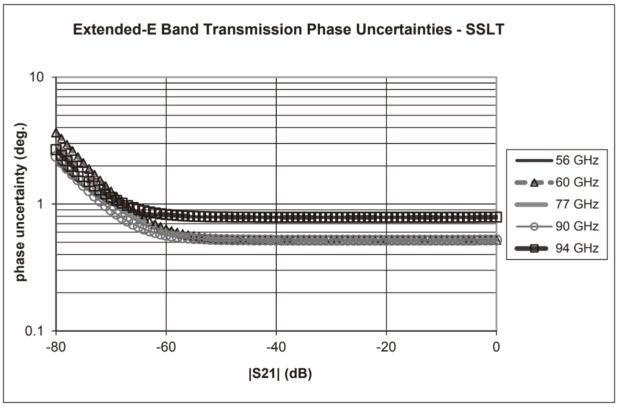
Measurement Uncertainties – Extended-E Band – SSLT

The graphs give measurement uncertainties after the above calibration. The errors are worse case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used.
For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$.
All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com. Typical.



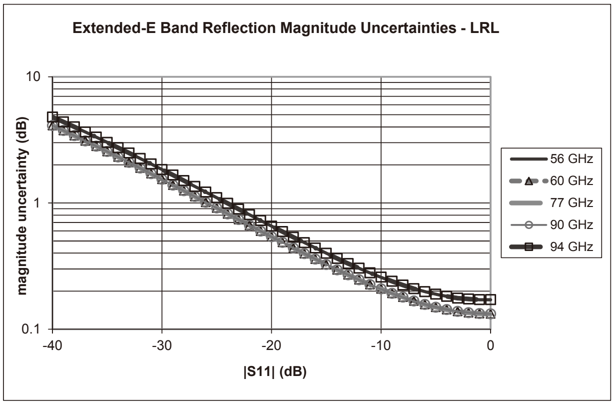


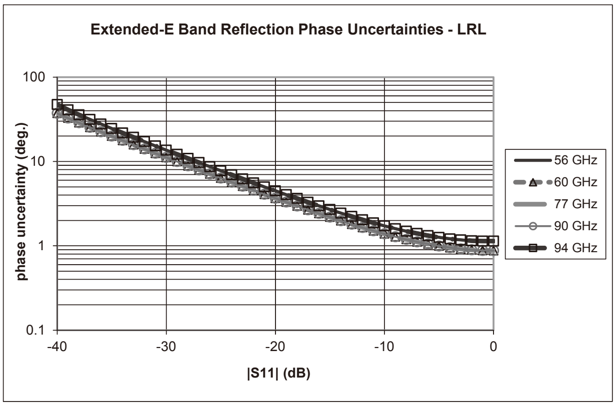


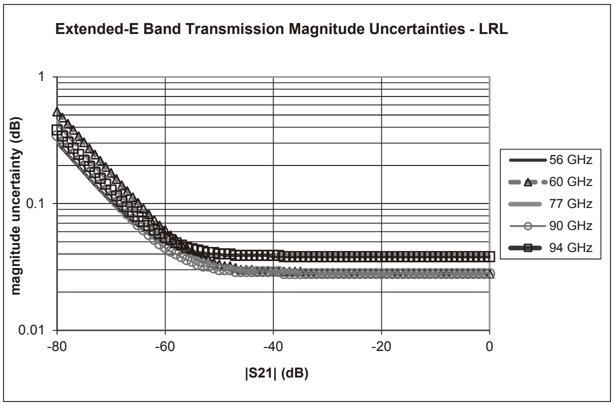


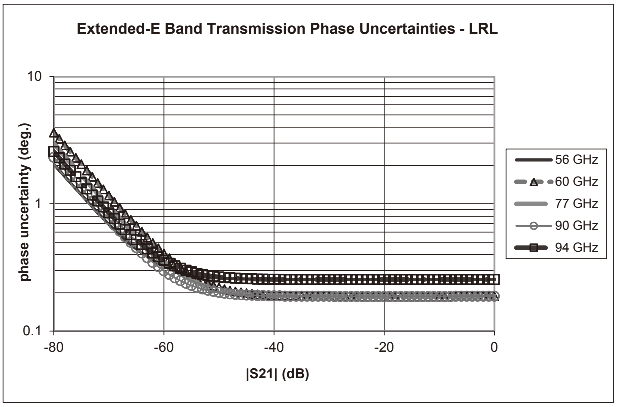
Measurement Uncertainties – Extended-E Band – LRL

The graphs give measurement uncertainties after the above calibration. The errors are worse case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used.
For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$.
All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com. Typical.


Extended-E Band Reflection Magnitude Uncertainties - LRL

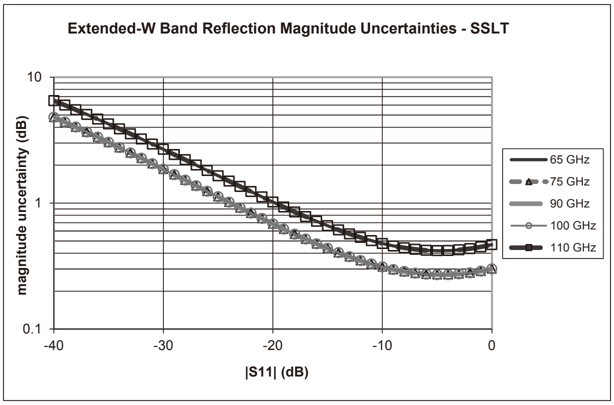

Extended-E Band Reflection Phase Uncertainties - LRL

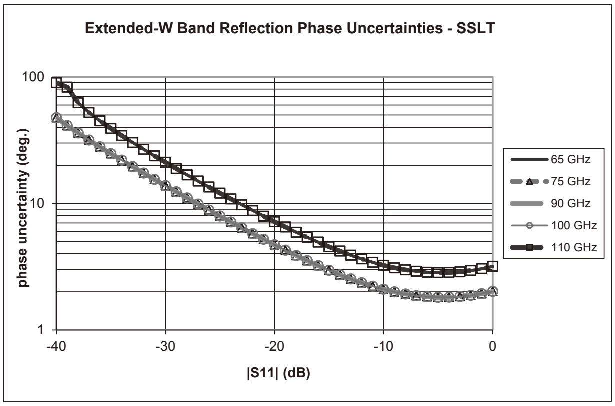

Extended-E Band Transmission Magnitude Uncertainties - LRL

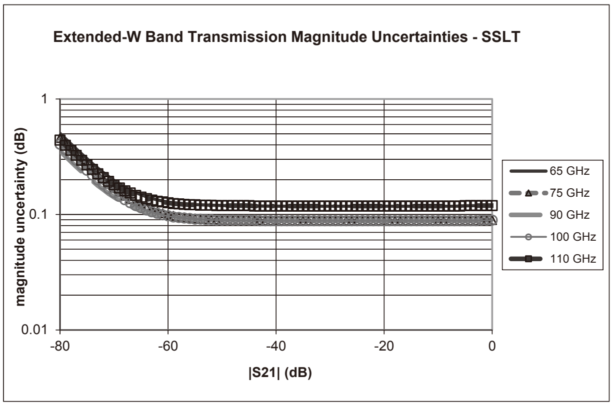

Extended-E Band Transmission Phase Uncertainties - LRL

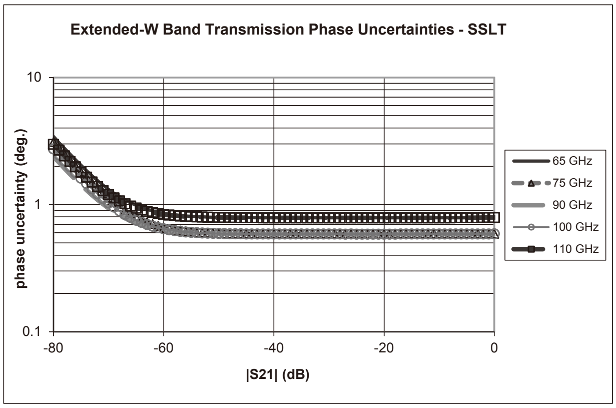
Measurement Uncertainties – Extended-W Band – SSLT

The graphs give measurement uncertainties after the above calibration. The errors are worse case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used.
For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$.
All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu website at www.anritsu.com. Typical.



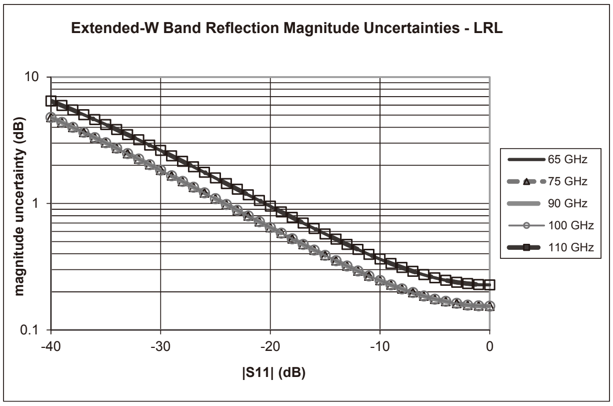


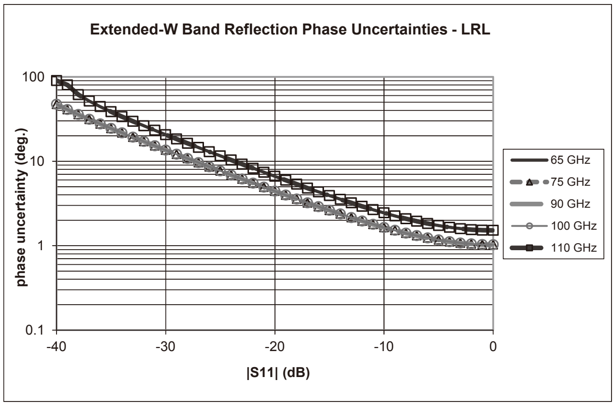


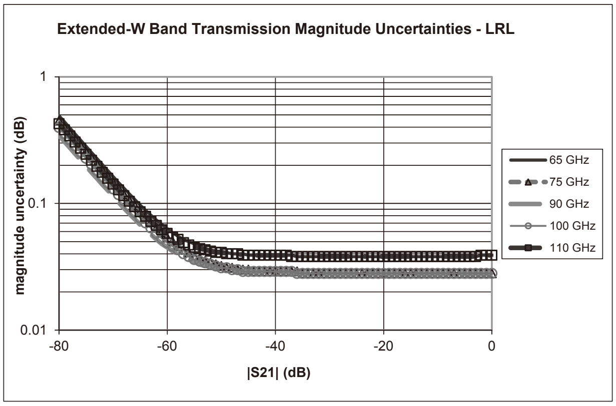


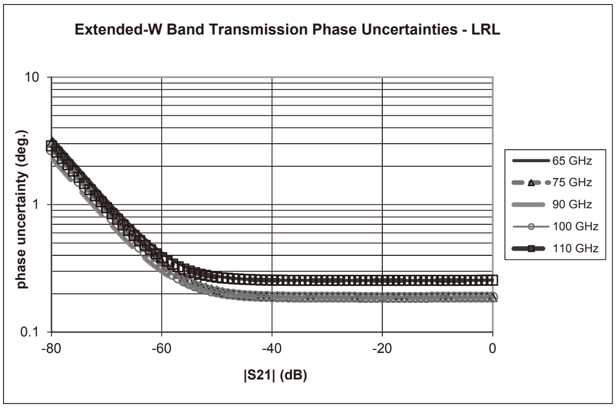
Measurement Uncertainties – Extended-W Band – LRL

The graphs give measurement uncertainties after the above calibration. The errors are worse case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used.
For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$.
All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu website at www.anritsu.com. Typical.



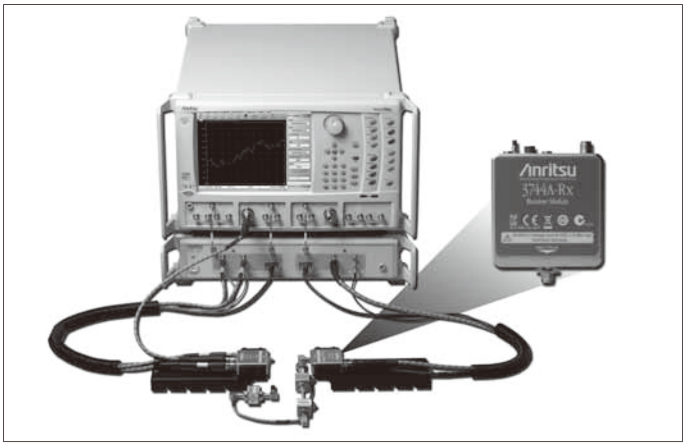






ME7838D with Option 41/48 and 3744A-Rx mm-Wave Noise Figure Measurements

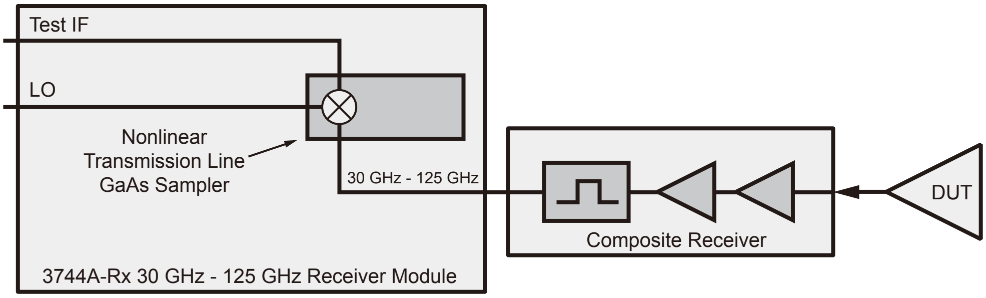
The 3744A-Rx receiver module can be used with Option 41, Noise Figure, and the ME7838D mm-Wave or broadband system to perform mm-Wave noise figure measurements from 30 GHz to 125 GHz.
The receiver bypasses the internal couplers (see block diagram), maximizing the noise figure of the receiver for optimum noise figure measurement accuracy. The receiver is derived from the 3743A mm-Wave module and utilizes the same nonlinear transmission line technology for optimum mm-Wave performance. Using the advantages of the 3743A mm-Wave module system architecture provides a unique solution to mm-Wave noise figure measurements previously unavailable.
With Option 48, differential (and common-mode) noise figure measurements are possible in the same wide frequency ranges. In this case, two 3744A-Rx modules (along with needed pre-amplifiers/filters) are used to complete the differential receiver. While usually a 4-port system is used, a 2-port ME7838D can be used for the noise measurements as long as DUT gain information is available.



ME7838D with 3744A-Rx Receiver Module

Block Diagram – 3744A Receiver Module

The 3744A-Rx receiver module is optimized as a receiver-only mm-Wave module for applications such as mm-Wave antenna measurements and mm-Wave noise figure measurements. Elimination of the input coupler produces a mm-Wave receiver with excellent noise floor sensitivity and dynamic range. When coupled with a composite receiver, the receiver module provides a solution for mm-Wave noise figure measurements.
As with all cold source method noise figure measurements, the output of the DUT is first sent to an external composite receiver for pre-amplification. This ensures that the system noise figure is minimized for optimum measurement accuracy. The Anritsu Noise Figure Uncertainty Calculator (available on the website at www.anritsu.com) can be used to determine optimum preamplifier gain needed for the desired measurement uncertainty.



3744A-Rx Block Diagram configured for mm-Wave noise figure measurements

3744A-Rx Receiver Compression, Noise Floor

Receiver Compression Point is defined as the port power level beyond which the response may be compressed more than 0.2 dB relative to the normalization level. 10 Hz IF bandwidth is used to remove trace noise effects. All typical.
Noise Floor is relative to the receiver power calibration performed at –10 dBm (typ.).

Frequency Range (GHz)	Receiver Compression (dBm)*1	Noise Floor (dBm)*2
30 to 54	0	–124
>54 to 60	0	–122
>60 to 67	0	–117
>67 to 80	0	–120
>80 to 85	0	–123
>85 to 90	0	–121
>90 to 95	0	–121
>95 to 105	0	–117
>105 to 110	0	–122
>110 to 120	–5	–120
>120 to 125	–5	–117

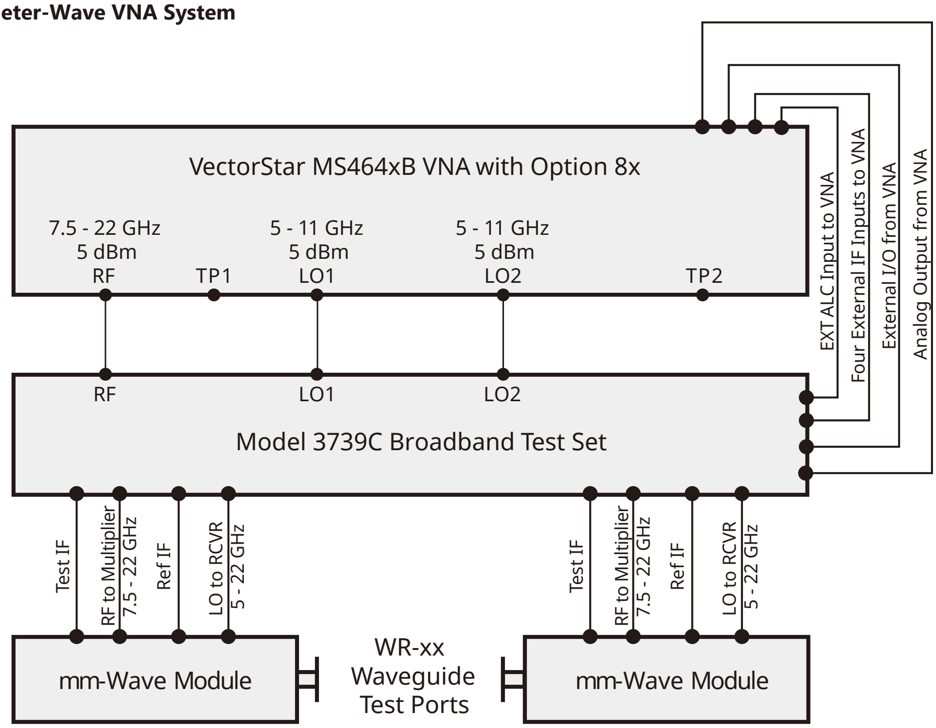
*1: At the 3744A-Rx test port.
*2: Excludes localized spurious responses and crosstalk.

VectorStar ME7838D Waveguide Bands from 50 GHz to 1.1 THz, Waveguide Bands from 50 GHz to 1.1 THz

The VectorStar Millimeter-Wave system supports OML or VDI modules starting at 50 GHz. System performance is based on the specific mm-Wave module installed and appropriate cal kit. Contact the vendor web site for additional information.

VDI and OML Millimeter-Wave Modules

Block Diagram – Millimeter-Wave VNA System



Millimeter-Wave Configuration Block Diagram

VectorStar ME7838D Millimeter-Wave System with VDI Modules

This section provides the specifications for the VectorStar MS4640B series microwave Vector Network Analyzers (VNAs) when configured with the Virginia Diodes, Inc. millimeter-wave (mm-Wave) frequency extension modules. The following frequency bands are supported:

Waveguide Band	WR15	WR10	WR8.0	WR6.5	WR5.1	WR4.3	WR3.4	WR2.8	WR2.2	WR1.5	WR1.0*
Frequency Range (GHz)	50 to 75	75 to 110	90 to 140	110 to 170	140 to 220	170 to 260	220 to 330	260 to 400	330 to 500	500 to 750	750 to 1100

*: Contact Anritsu

System Configuration with VDI Modules

The VectorStar Millimeter-Wave system provides control of VDI modules for frequency extension coverage up to 1.1 THz. MS4640B series VectorStar VNA may be configured for mm-Wave operation by adding the appropriate control option and test set. System requirements include:

- MS4642B, MS4644B or MS4647B Model VectorStar VNA (Note: For 1.1 THz operation, the 40 GHz MS4644B or higher model is required.)
- MS4640B Option 7, Receiver Offset
- MS4640B Option 80, 81, 82, or 83
- SM6537 Interface Cable – Connection between VectorStar and the VDI mm-Wave module is provided with the supplied interface cable.
- 3739C Test Set

Each VDI module is equipped with a dedicated external power supply and DC cable.

VDI Module Options

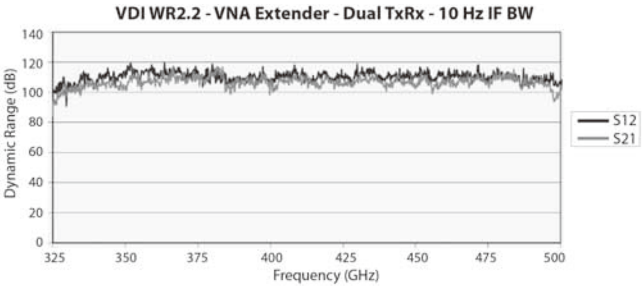
Options available for millimeter-wave extenders are listed below:

Micrometer-Drive Variable Attenuator	A 0 to 30 dB micrometer-drive variable attenuator option is available on TxRx and Tx modules up through WR1.5. If ordered, "–Attn" is added as an option suffix to the module model number. The attenuators reduce TPP and DR by as much as 5 dB in the WR3.4 and higher frequency bands and add approximately 2 inches to the enclosure.
Increased Test Port Power	Options exist for increasing test port power in some full bands or in partial bands. Consult factory for more information.
Non-Standard Frequency Bands	Non-standard frequency bands are possible. Consult factory for more information.
Custom Configuration	Anritsu/VDI will work with customers to reconfigure any extender to meet specific needs.

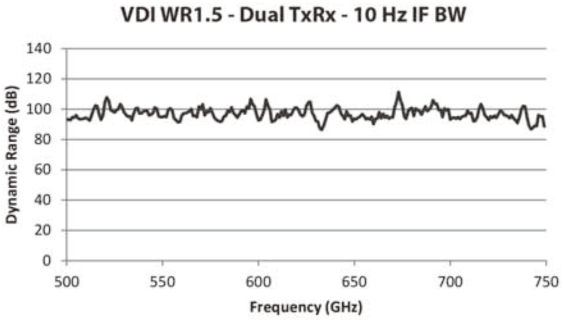
VDI Module Head Configurations

TxRx	Transmitter with two Receivers (Reference and Measurement), and two couplers. Two TxRx heads are required for full two-port measurements.
TxRef	Transmitter with Reference Receiver and one coupler.
Rx	Measurement Receiver.
Tx	Transmitter

ME7838D Measurement Examples Using VDI Millimeter-Wave Modules

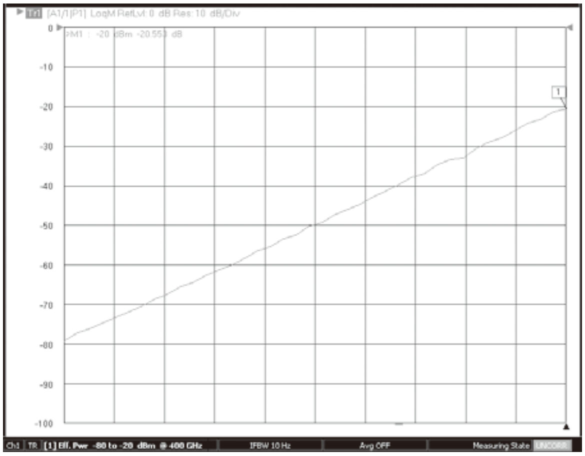


Dynamic Range Plot of VDI WR2.2 Module – 10 Hz IFBW



Dynamic Range Plot of VDI WR1.5 Dual TxRx – 10 Hz IFBW

ME7838D 400 GHz Power Sweep with VDI WR2.2 TxRx Module



Real time power sweep of VDI WR2.2 module using system power level control and no mechanical attenuators.

VectorStar ME7838D Millimeter-Wave System with OML Modules

This section provides specifications for the VectorStar MS4640B series microwave Vector Network Analyzers (VNAs) when configured with the OML millimeter-wave frequency extension modules.

Description	Each OML module must be equipped with a dedicated external power supply and DC cable. Connection between the VectorStar and the OML mm-Wave module is provided with the supplied interface cable.
System Configuration	The VectorStar Millimeter-Wave system provides control of OML modules for frequency extension coverage up to 325 GHz. The MS4640B series VectorStar VNA may be configured for mm-Wave operation by adding the appropriate control option and test set.
System requirements	MS4642B, MS4644B or MS4647B Model VectorStar VNA MS4640B Option 7, Receiver Offset MS4640B Option 80, 81, 82, or 83 SM6537 Interface Cable 3739C Test Set
Specifications	Dynamic range specifications are valid for any MS4640B VectorStar VNA with appropriate options. Directivity specifications are valid when using appropriate OML calibration kits.

Standard Capabilities for All Configurations

For standard capabilities of the VectorStar VNAs, please see the VectorStar MS4640B Series VNA Technical Data Sheet and Configuration Guide – 11410-00611, available at www.anritsu.com.

Mechanical and Environmental

MS4640B Vector Network Analyzer

Dimensions without rack mount option.

Width	426 mm body 457 mm between feet outer edges 487 mm between front panel handles outer edges
Height	267 mm body (6u) 286 mm between feet outer edges
Depth	502 mm body 591 mm between handle and foot outer edges
Mass	<28 kg (<62 lbs) (lbs), Typical weight for a fully-loaded MS4647B VNA

3739C Broadband/Millimeter-Wave Test Set

Dimensions without rack mount option.

Width	426 mm body 457 mm between feet outer edges 487 mm between front panel handles outer edges
Height	89 mm body (2u) 108 mm between feet outer edges
Depth	502 mm body 591 mm between handle and foot outer edges
Mass	5.75 kg (12.7 lbs)

MA25300A Millimeter-Wave Module

Width	54 mm
Height	21.5 mm
Depth	55.3 mm
Mass	0.27 kg (0.6 lbs)

Environmental – Operating

Conforms to MIL-PRF-28800F (Class 3)

Temperature Range	0° to +50°C without error codes* ∗ Except for 'unleveled' error messages that may occur at the extreme edges of the temperature range above.
Relative Humidity	5 to 95 % at +30°C, Non-condensing
Altitude	4,600 m (15,000 ft)

Environmental – Non-Operating

Temperature Range	–40° to +71°C
Relative Humidity	0 to 90 % at +30°C, Non-condensing
Altitude	4,600 m (15,000 ft)

Regulatory Compliance

CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN61010-1 RoHS: 2011/65/EU
RCM	Australia and New Zealand: RCM AS/NZS 4417:2012
KCC	South Korea: KCC-REM-A21-0004

Calibration and Correction Capabilities

Calibration Methods	Short-Open-Load-Through (SOLT) with Fixed or Sliding Load and supporting .s1p-defined cal kits Offset-Short-Offset-Short-Load-Through (SSLT) with Fixed or Sliding Load Triple-Offset-Short-Through (SSST) Short-Open-Load-Reciprocal (SOLR) or Unknown Through Method (SSLR, SSSR) Line-Reflect-Line (LRL) / Line-Reflect-Match (LRM) – (up to 5 bands supported for multi-line configurations) Advanced-LRM (A-LRM™) for improved on-wafer calibrations AutoCal Thru Update available Secondary match correction available for improved low insertion loss measurements
Correction Models	2-Port (Forward, Reverse, or both directions) 1-Port (S_{11}, S_{22}, or both) Transmission Frequency Response (Forward, Reverse, or both directions) Reflection Frequency Response (S_{11}, S_{22}, or both)
Merged Calibration	Merge multiple calibration methods over bands of frequency points. Note that merge does not need to be used for broadband coaxial (SOLT/R-SSST/R) 1 mm or 0.8 mm calibrations using Anritsu calibration kits. These can be done as one unified calibration.
Coefficients for Calibration Standards	Use the Anritsu calibration kit USB Memory Device to load kit coefficients and characterization files. Enter manual coefficients into user-defined locations. Use complex load models.
Reference Impedance	Modify the reference impedance from 50Ω to any impedance greater than 0Ω.
Interpolation	Allows interpolation between calibration frequency points. Accuracy will be reduced at non-calibration frequencies and that degradation is dependent on the frequency step size in the initial calibration and the electrical length of the user's setup.
Adapter Removal Calibration	Characterizes and "removes" an adapter that is used during calibration that will not be used for subsequent device measurements; for accurate measurement of non-insertable devices.
Dispersion Compensation	Selectable as Coaxial, other non-dispersive (e.g., for coplanar waveguide), Waveguide, or Microstrip.
Power	Power Meter Correction: Different power meter calibrations are available to enhance power accuracy at the desired reference plane. The source power will match the target calibration power, as read by the power meter, to within ~0.1 dB for short periods of time (determined by thermal drift of the system and the power meter). The absolute accuracy of the calibrated power will be dependent on the power meter and sensor used. Flat Power Calibrations: A flat power calibration (when in frequency sweep mode) is available at a user-selectable power level, if it is within the power adjustment range of the internal source. The flat power correction is applied to other power levels directly as an offset. Multiple power meters/sensors may be needed depending on the frequency range. An adapter may be required to the 1mm module test port. Linear Power Calibrations: A linear power calibration is performed over a range of power levels for use in power sweep mode and is performed at a specified frequency or frequency range (for multifrequency gain compression). External Power Meter: Both calibrations are performed using an external power meter (Anritsu ML2438A, ML248xB, ML249xA, Agilent 437B (or equivalent), Rhode and Schwarz NRP2 meter with a broadband 110 GHz sensor, or Elva DPM power meter) over the Dedicated GPIB port, or a USB power sensor (Anritsu MA24106A, MA24108A, MA24118A, MA24126A, MA24208A, MA24218A, MA24330A, MA24340A, MA24350A, MA24507A, or MA24510A) connected to a USB port. Note: Usage of the MA24507A sensor requires connection to two USB ports to supply needed current draw.
Embedding/De-embedding	The MS4640B is equipped with an Embedding/De-embedding system. De-embedding: De-embedding is generally used for removal of test fixture contributions, modeled networks and other networks described by S-parameters (s2p files) from measurements. Embedding: Similarly, the Embedding function can be used to simulate matching circuits for optimizing amplifier designs or simply adding effects of a known structure to a measurement. Multiple Networks: Multiple networks can be embedded/de-embedded and changing the port and network orientations is handled easily. Extraction Utility: An extraction utility is part of this package that allows the easier computation of de-embedding files based on some additional calibration steps and measurements.
Impedance Conversion	Allows entry of different impedances (complex values) for different ports.

Mechanical Calibration/Verification Kits

0.8 mm Calibration/Verification Kit, 3659

Provides 12-term SOLT or Triple Offset Short calibrations, for 0.8 mm devices, and two verification standards.

3659 0.8 mm Calibration/Verification Kit providing 12-Term SOLT or SSST calibrations and two verification standards.

3659 Cal Kit Contains:	Additional Information (typ.)	Quantity	Part Number
0.8 mm Calibration/Verification Kit			3659
Offset Short 0.8 mm (m)	Offset: 2.020 mm	1	23.850-1
Offset Short 0.8 mm (m)	Offset: 2.650 mm	1	23.850-2
Offset Short 0.8 mm (m)	Offset: 3.180 mm	1	23.850-3
Offset Short 0.8 mm (f)	Offset: 2.020 mm	1	23.8F50-1
Offset Short 0.8 mm (f)	Offset: 2.650 mm	1	23.8F50-2
Offset Short 0.8 mm (f)	Offset: 3.180 mm	1	23.8F50-3
Open 0.8 mm (m)	Offset: 1.510 mm	1	24.850
Open 0.8 mm (f)	Offset: 1.930 mm	1	24.8F50
Fixed Termination 0.8 mm (m)		1	28.850
Fixed Termination 0.8 mm (f)		1	28.8F50
Adapter, 1.0 mm (m) to 0.8 mm (m) Connector		1	33W.850
Adapter, 1.0 mm (m) to 0.8 mm (f) Connector		1	33W.8F50
Adapter, 1.0 mm (f) to 0.8 mm (m) Connector		1	33WF.850
Adapter, 1.0 mm (f) to 0.8 mm (f) Connector		1	33WF.8F50
Adapter, 0.8 mm (m) to 0.8 mm (f)		1	33.8.8F50
Adapter, 0.8 mm (m) to 0.8 mm (m)		1	33.8.850
Adapter, 0.8 mm (f) to 0.8 mm (f)		1	33.8F.8F50
Stepped Impedance Thruline, 0.8 mm (m - f)	Verification Device	1	18.8.8F50-1B
50Ω matched Thruline, 0.8 mm (m - f)	Verification Device	1	18.8.8F50-1
Torque Wrench	6 mm, 5.4 N·cm (4 lbf·in)	1	01-524
Open-ended Wrench	6 mm/7 mm 01-525	1	01-525
Coefficients for standards	On USB Memory Device	1	—

Test Port Cables

Test Port Cables, Flexible, High Performance

Description	Frequency Range	Impedance	Length (cm)	Insertion Loss (dB)	Return Loss (dB)	PartNumber
1.0 mm (m) 1.0 mm (f)	DC to 110 GHz (125 GHz)	50Ω	10	1.74	≥14	3671W1-50-1
			13	2.23	≥14	3671W1-50-2
			16	2.74	≥14	3671W1-50-3
0.8 mm (m) 0.8 mm (f)	DC to 145 GHz	50Ω	10	2	≥12	3670.850-1
0.8 mm (m) 0.8 mm (f)	DC to 145 GHz	50Ω	16	3.5	≥12	3670.850-2

3670.850-1, 3670.850-2, 0.8 mm Test Port Cables

Precision Adapters, Attenuators, and Other Components

Anritsu offers a complete line of precision adapters and attenuators.
For more information, please visit our web site at www.anritsu.com.

Warranty

The ME7838D Series VNAs and related accessories offer a 3 year warranty from the date of shipment. Please contact your local service center for additional warranty coverage. Note that the key component of the system, the MS4640B VNA, is covered by a 3-year standard warranty.

Ordering Information

The ME7838D Broadband/Millimeter-Wave VNA System provides single sweep coverage from 70 kHz to 145 GHz and consists of the following standard components and optional accessories, which are described in the sections below:

ME7838D Broadband System, 70 kHz to 145 GHz

Action	Part Number and Description	Additional Information
Order the base VectorStar model with the listed options:	MS4647B, 70 kHz to 70 GHz VNA MS4640B-007, receiver offset MS4640B-070, 70 kHz frequency coverage 3739C, Broadband Test Set with 36 inch interface cables M25300A, Millimeter-Wave Module, 2 each ME7838D-SS020, On-site system assembly and verification	
Include one of the following:	MS4647B-080, MS4647B with ME7838D system option	MS4647B-084 is ordered when Option 31 is included.
	MS4647B-081, MS4647B with ME7838D system option and Option 51 or 61 or 62	MS4647B-085 is ordered when Option 31 is included.
Include one of the following:	806-206, 1.85 mm phase stable VNA RF cables, 24”, M-F, 2 each	
	806-209, 1.85 mm phase stable VNA RF cables, 36”, M-F, 2 each	
Add options if desired:	Option 51, or 61, or 62: MS4647B-051 – External VNA Loops MS4647B-061 – Active Measurement Suite, 2 Attenuators MS4647B-062 – Active Measurement Suite, 4 Attenuators	
	MS4640B-002 – for Time Domain MS464xB-031 – Dual Source Architecture MS4640B-035 – IF Digitizer MS4640B-041 – Noise Figure MS4640B-042 – PulseView™ MS4640B-043 – DifferentialView™ MS4640B-048 – Differential Noise Figure	MS464xB-031 requires Option 84 or 85. For other available options, see “ME7838D Broadband/Millimeter-Wave System Options”
Accessories	MS4640B-001, MS4640B rack mount 3739C-001, 3739C rack mount	

ME7838D Waveguide-Band System to 110 GHz – 3744A-EE or 3744A-EW mm-Wave Modules

Configurator for ME7838D Millimeter-Wave System using 3744A-EE or 3744A-EW mm-Wave Modules:

Action	Part Number and Description	Additional Information
Choose and order one of the two base VectorStar models with options listed:	MS4644B VNA, 10 MHz to 40 GHz MS4640B-007 MS4644B-082 or -083 or -084 or -085	MS4644B-083 is ordered when Options 51, 61, or 62 are included. MS4644B-084 is ordered when Option 31 is included and Options 51, 61, or 62 are excluded. MS4644B-085 is ordered when Option 31 and Options 51, 61, or 62 are included.
	MS4647B VNA, 10 MHz to 70 GHz MS4647B-007 MS4647B-080 or -081 or -084 or -085	MS4647B-081 is ordered when Options 51, 61, or 62 are included MS4647B-084 is ordered when Option 31 is included and Options 51, 61, or 62 are excluded. MS4647B-085 is ordered when Option 31 and Options 51, 61, or 62 are included. MS4647B-085 is ordered when Option 31 is included.
Order Test Set	3739C mm-Wave Test Set	
Choose and order Extended-E or Extended-W Band Modules:	3744A-EE, 56 GHz to 94 GHz Extended E Band module, 2 each	
	3744A-EW, 65 GHz to 110 GHz Extended W Band module, 2 each	
Add options if desired:	Option 51, or 61, or 62: MS4647B-051 – External VNA Loops MS4647B-061 – Active Measurement Suite, 2 Attenuators MS4647B-062 – Active Measurement Suite, 4 Attenuators	
	MS4640B-070 – for 70 kHz operation in base VNA MS4640B-002 – for Time Domain MS464xB-031 – Dual Source Architecture MS4640B-035 – IF Digitizer MS4640B-041 – Noise Figure MS4640B-042 – PulseView™ MS4640B-043 – DifferentialView™ MS4640B-048 – Differential Noise Figure	MS464xB-031 requires Option 84 or 85. For other available options, see "ME7838D Broadband/Millimeter-Wave System Options"
	MS4640B-001, MS4640B Rack Mount 3739C-001, 3739C Rack Mount	
Accessories	35WR12WF-EE – Precision Waveguide to Coax Adapter Kit, 56 GHz to 94 GHz, WR-12 to W1 (f)	
	35WR10WF-EW – Precision Waveguide to Coax Adapter Kit, 65 GHz to 110 GHz, WR-10 to W1 (f)	

ME7838D Waveguide-Band System – OML/VDI mm-Wave Modules

ME7838D Waveguide-band System using OML or VDI Millimeter-Wave modules:

Action	Part Number and Description	Additional Information
Choose and order one of the three base VectorStar models with options listed:	MS4642B VNA, 70 kHz to 20 GHz MS4642B-008 or MS4642B-009 MS4642B-083	MS4642B-008 includes Active Device Measurements, with 2 Step Attenuators MS4642B-009 includes Active Device Measurements, with 4 Step Attenuators MS4642B-085 is ordered when Option 31 is included.
	MS4644B VNA, 10 MHz to 40 GHz MS4640B-007 Receiver Offset MS4644B-082 or -083 or -084 or -085	MS4644B-083 is ordered when Options 51, 61, or 62 are included. MS4644B-084 is ordered when Option 31 is included and Options 51, 61, or 62 are excluded. MS4644B-085 is ordered when Option 31 and Options 51, 61, or 62 are included.
	MS4647B VNA, 10 MHz to 70 GHz MS4647B-007 Receiver Offset MS4647B-080 or -081 or -084 or -085	MS4647B-081 is ordered when Options 51, 61, or 62 are included. MS4647B-084 is ordered when Option 31 is included and Options 51, 61, or 62 are excluded. MS4647B-085 is ordered when Option 31 and Options 51, 61, or 62 are included.
Order:	3739C mm-Wave Test Set	
	SM6537 Interface Cables (2) for OML/VDI mm-Wave Modules	Does not include DC cable. DC supply is provided by mm-Wave module power supply.
Choose and order one of the two appropriate millimeter-wave module combinations:	2 each TxRx transmission and reflection millimeter-wave modules	Choose appropriate OML or VDI modules. Contact Anritsu Company for ordering information.
	1 each TxRx transmission and reflection module, and 1 each Tx transmission only module	
Add options if desired:	Option 51, or 61, or 62: MS4647B-051 – External VNA Loops MS4647B-061 – Active Measurement Suite, 2 Attenuators MS4647B-062 – Active Measurement Suite, 4 Attenuators	
	MS4640B-070 – for 70 kHz operation in base VNA MS4640B-002 – for Time Domain MS464xB-031 – Dual Source Architecture MS4640B-035 – IF Digitizer MS4640B-041 – Noise Figure MS4640B-042 – PulseView™ MS4640B-043 – DifferentialView™ MS4640B-048 – Differential Noise Figure	MS464xB-031 requires Option 84 or Option 85 For other available options, see "ME7838D Broadband/Millimeter-Wave System Options"

Model/Order No.	Name
	Calibration/Verification Kits
3659	0.8 mm Calibration/Verification Kit
3656B	1.0 mm Calibration/Verification Kit
3655V	WR-15 Waveguide Calibration Kit, Without Sliding Loads
3655V-1	WR-15 Waveguide Calibration Kit, With Sliding Loads
3655E	WR-12 Waveguide Calibration Kit, Without Sliding Loads
3655E-1	WR-12 Waveguide Calibration Kit, With Sliding Loads
3655W	WR-10 Waveguide Calibration Kit, Without Sliding Loads
3655W-1	WR-10 Waveguide Calibration Kit, With Sliding Loads
3650A	SMA/3.5 mm Calibration Kit, Without Sliding Loads
3650A-1	SMA/3.5 mm Calibration Kit, With Sliding Loads
3652A	K Calibration Kit, Without Sliding Loads
3652A-2	K Calibration Kit, Without additional options
3652A-3	K Calibration Kit, With Pin Depth Gauge and .s1p Characterization Files
3652A-4	K Calibration Kit, With .s1p Characterization Files
3654D	V Calibration Kit, With Pin Depth Gauge
3654D-2	V Calibration Kit Without additional options
3654D-3	V Calibration Kit, With Pin Depth Gauge and .s1p Characterization Files
3654D-4	V Calibration Kit, With .s1p Characterization Files
3657	V Multi-Line Calibration Kit, Without Shorts
3657-1	V Multi-Line Calibration Kit, With Shorts
	External Power Meters/Sensors
ML243xA	CW Power Meter, Single Input or Dual Input Recommended Power Sensors: SC7770, MA247xD, MA244xD, MA248xD, MA2400xA
ML248xB	Wideband Power Meter, Single Input or Dual Input Recommended Power Sensors: MA249xA, MA2411B
ML249xA	Pulse Power Meter, Single Input or Dual Input Rcommended Power Sensors: MA249xA, MA2411B
MA24106A	USB Power Sensor, 50 MHz to 6 GHz
MA24108A	USB Power Sensor, 10 MHz to 8 GHz
MA24118A	USB Power Sensor, 10 MHz to 18 GHz
MA24126A	USB Power Sensor, 10 MHz to 26 GHz
MA24330A	USB Power Sensor, 10 MHz to 33 GHz
MA24340A	USB Power Sensor, 10 MHz to 40 GHz
MA24350A	USB Power Sensor, 10 MHz to 50 GHz
MA24507A*	Power Master™ Frequency Selectable mm-Wave Power Analyzer, 9 kHz to 70 GHz
MA24510A	Power Master™ Frequency Selectable mm-Wave Power Analyzer, 9 kHz to110 GHz Note that usage of the MA24507A or MA42510A Power Master™ sensor requires connection to two USB ports to supply needed current draw.
	Test Port Cables, Flexible, High Performance
3671W1-50-1	1.0 mm (m) to 1.0 mm (f), 1 each, 10.0 cm (3.9 in)
3671W1-50-2	1.0 mm (m) to 1.0 mm (f), 1 each, 13.0 cm (5.1 in)
3671W1-50-3	1.0 mm (m) to 1.0 mm (f), 1 each, 16.0 cm (6.3 in)
3671KFS50-60	K (f) to 3.5 mm (m) cable, 60 cm (one cable)
3671KFK50-60	K (f) to K (m) cable, 60 cm (one cable)
3671KFK50-100	K (f) to K (m) cable, 1 each, 100 cm (one cable)
3671KFKF50-60	K (f) to K (f) cable, 1 each, 60 cm (once cable)
3671VFV50-60	V (f) to V (m) cable, 1 each, 60 cm (one cable)
3671VFV50-100	V (f) to V (m) cable, 1 each, 100 cm (one cable)
3671KFSF50-60	K (f) to 3.5 mm (f) cable, 1 each, 60 cm (one cable)
3671VFVF50-60	V (f) to V (f) cable, 1 each, 60 cm (one cable)
3671VFV50-100	V (f) to V (m) cable, 1 each, 60 cm (one cable)
3670.850-1	0.8 mm (m) to 0.8 mm (f), 1 each, 10.0 cm (3.9 in)
3670.850-2	0.8 mm (m) to 0.8 mm (f), 1 each, 16.0 cm (6.3 in)

Model/Order No.	Name
	Adapters and More
0.8-105F	0.8 mm (f) Sparkplug Launcher Connector, DC to 145 GHz
0.8-105M	0.8 mm (m) Sparkplug Launcher Connector, DC to 145 GHz
34WV50	1.0 mm (m) to V (m) Adapter, 1.0 mm to V, Coaxial
34WVF50	1.0 mm (m) to V (f) Adapter, 1.0 mm to V, Coaxial
34WFV50	1.0 mm (f) to V (m) Adapter, 1.0 mm to V, Coaxial
34WFVF50	1.0 mm (f) to V (f) Adapter, 1.0 mm to V, Coaxial
33WW50	1.0 mm (m) to 1.0 mm (m) Adapter, 1.0 mm in-series, Coaxial
33WWF50	1.0 mm (m) to 1.0 mm (f) Adapter, 1.0 mm in-series, Coaxial
33WFWF50	1.0 mm (f) to 1.0 mm (f) Adapter, 1.0 mm in-series, Coaxial
35WR10W	WR10 to 1.0 mm (m) Adapter, 1.0 mm to WR10 Waveguide
35WR10WF	WR10 to 1.0 mm (f) Adapter, 1.0 mm to WR10 Waveguide
SC7260	WR12 to 1.0 mm (m) Adapter, 1.0 mm to WR12 Waveguide
SC7442	WR12 to 1.0 mm (f) Adapter, 1.0 mm to WR12 Waveguide
35WR15V	WR15 to V (m) Adapter, V (1.85 mm) to WR15 Waveguide
35WR15VF	WR15 to V (f) Adapter, V (1.85 mm) to WR15 Waveguide
For More Information	Refer to Precision RF & Microwave Components Catalog for descriptions of adapters and other components.
	Accessories
SC8215	Kelvin Bias Tee 70 kHz to 145 GHz, Max Voltage: 16 VDC, Max Current: 100 mA
SC7287	Kelvin Bias Tee 100 MHz to 145 GHz, Max Voltage: 50 VDC, Max Current: 500 mA
SC8218	Triax (m) to SMC (m) Cable, (Inner-shield floating at SMC end), 1.5 m (60 in) long two (2) needed per Kelvin Bias Tee
SM6494	System floor console (includes larger size writing table)
2100-1	GPIB cable, 1 m (39 in) long
2100-2	GPIB cable, 2 m (79 in) long
2100-4	GPIB cable, 4 m (157 in) long
806-206	1.85 mm cable, 61 cm (24 in) long, for connecting the VNA and the MA25300A Modules
806-209	1.85 mm cable, 91 cm (36 in) long, for connecting the VNA and the MA25300A Modules
01-201	Torque Wrench (for tightening male devices), 8 mm (5/16 in), 0.9 N·m (8 lbf·in) for SMA, 3.5 mm, 2.4 mm, K, and V connectors
01-202	Universal Test Port Connector Wrench
01-203	Torque Wrench (for tightening the VNA test ports to female devices) 20.6 mm (13/16 in), 0.9 N·m (8 lbf·in)
01-204	Anritsu Stainless Steel Connector Wrench, circular, open-ended for SMA, 3.5 mm, 2.4 mm, K and V connectors
01-504	Torque wrench (for tightening male devices) 6 mm, 0.45 N-m (4 lbf-in) for 1.0 mm and 0.8 mm connectors
01-524	Low profile Torque Wrench (for tightening male devices), 6 mm, 0.45 N-m (4 lbf-in), 126 mm long for 1.0 mm and 0.8 mm connectors
	Additional Accessories
	0.8 mm to Waveguide adapters available from Flann Microwave Ltd 0.8 mm Infinity probes available from Cascade Microtech

*: The MA24507A sensor requires connection to two USB ports to supply needed current draw.

VectorStar™ Broadband Vector Network Analyzers

ME7838A4 4-Port Broadband Vector Network Analyzers

4-Port Broadband VNA System, 70 kHz to 110 (125) GHz
4-Port Millimeter Waveguide VNA System, 50 GHz to 1.1 THz

Remote Control
GPIB | **Ethernet**

High Performance, Broadband Network Analysis Solutions

VectorStar

ME7838A Broadband VNA System 70 kHz to 110 (125) GHz

The VectorStar ME7838A4 system incorporates the Anritsu millimeter-wave module utilizing Non Linear Transmission Line (NLTL) technology with single sweep 4-port coverage from 70 kHz to 110 GHz and provides:
Industry-best broadband frequency coverage – starts at 70 kHz instead of 10 MHz and is operational from 40 kHz to 125 GHz.
Industry-best calibration and measurement stability – 0.1 dB vs. 0.6 dB over 24 hrs.
Industry-best compact, lightweight mmWave modules for easy, precise, and economical positioning on the wafer probe station – 0.6 dB vs. 7.6 lb and 1/50 the volume.
Thin film multipliers, receivers, and couplers at the test port, offering best raw directivity and providing excellent calibration and measurement stability.
The industry’s only available mmWave real time electronic power leveling – eliminates time-lagging software correction tables.
Compatibility with all major probe stations.
Kelvin bias tees for sense and force capabilities closely positioned to the DUT.
Can be upgraded to a 4-port 145 GHz with the addition of MA25300A modules.

4-Port Millimeter Waveguide VNA System 50 GHz to 1.1 THz

The ME7838A4 4-port millimeter-wave configuration provides waveguide output from 50 GHz to 1.1 THz in waveguide bands.
The system can extend the broadband system or be configured to operate only as a waveguide system.

Broadband/Millimeter-Wave System Options

- MS4640B-002 – Time Domain
- MS4640B-021 – Universal Fixture Extraction
- MS464xB-031 – Dual Source Architecture
- MS4640B-032 – Internal RF Combiner
- MS4640B-035 – IF Digitizer
- MS4640B-041 – Noise Figure
- MS4640B-042 – PulseView™
- MS4640B-043 – DifferentialView™
- MS4640B-044 – IMDView™
- MS4640B-046 – Fast CW
- MS4640B-047 – Eye Diagram
- MS4640B-048 – Differential Noise Figure
- MS464xB-051 – External VNA Direct Access Loops
- MS464xB-061 – Active Measurement Suite, with 2 Attenuators
- MS464xB-062 – Active Measurement Suite, with 4 Attenuators
- SC8215 and SC7287 – Kelvin Bias Tees
- 3744A-Rx – 30 GHz to 125 GHz mm-Wave Receiver for Noise Figure and mm-Wave Antenna Measurements
- 3744A-EE – 56 GHz to 95 GHz WR-12 Waveguide Module
- 3744A-EW – 65 GHz to 110 GHz WR-10 Waveguide Module

Definitions

All specifications and characteristics apply under the following conditions, unless otherwise stated:

Warm-Up Time	After 90 minutes of warm-up time, where the instrument is left in the ON state.
Temperature Range	Over the 25° ±5°C temperature range.
Error Corrected Specifications	For error-corrected specifications, over 23° ±3°C, with <1°C variation from calibration temperature. For error-corrected specifications are warranted and include guard bands, unless otherwise stated.
Typical Performance	"Typical" specifications describe expected, but not warranted, performance based on sample testing. Typical performance indicates the measured performance of an average unit and do not guarantee the performance of any individual product. "Typical" specifications do not account for measurement uncertainty and are shown in parenthesis, such as (–102 dB), or noted as Typical.
User Cables/Adapters	Specifications do not include effects of any user cables attached to the instrument.
Discrete Spurious Responses	Specifications may exclude discrete spurious responses.
Internal Reference Signal	All specifications apply with internal 10 MHz Crystal Oscillator Reference Signal.
Characteristic Performance	Characteristic performance indicates a performance designed-in and verified during the design phase. It does include guard-bands and is not covered by the product warranty.
Below 300 kHz	All uncertainties below 300 kHz are typical.
Recommended Calibration Cycle	12 months
Interpolation Mode	All specifications are with Interpolation Mode Off.
Specifications Subject to Change	All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site at www.anritsu.com.

Specifications for Broadband Configuration

System and Receiver Dynamic Range, Noise Floor

(Excludes localized spurious responses and crosstalk)

System Dynamic Range	System dynamic range is measured as the difference between maximum port power and the RMS noise floor in a 10 Hz bandwidth and no averaging (ports terminated).
Noise Floor	Noise floor is calculated as the difference between maximum rated port power and system dynamic range.
Receiver Dynamic Range	Receiver Dynamic Range is calculated as the difference between the receiver compression level and the noise floor at the appropriate port.
Normalizing Measurement	Normalizing measurement made with a through line connection, with its effects compensated for. The cables between the VNA and the 3743A modules are assumed to be the 806-206 1.85 mm cable (61 cm, 24 in long) or the 806-209 1.85 mm cable (91 cm, 36 in long). All figures are typical.

Frequency Range	System Dynamic Range (dB)*1, *3		Receiver Dynamic Range (dB)*1		Noise Floor (dBm)*1	
	ME7838A4 Option 51	ME7838A4 Option 31/51	ME7838A4 Option 51	ME7838A4 Option 62	ME7838A4 Option 51	ME7838A4 Option 62
70 kHz to 300 kHz	76	78	78	79	–72	–73
>0.3 MHz to 2 MHz	86	88	94	94	–82	–81
>2 MHz to 10 MHz	100	102	106	105	–94	–92
>0.01 GHz to 2.5 GHz	111	115	115	115	–103	–101
>2.5 GHz to 24 GHz	96	97	114	114	–102	–100
>24 GHz to 54 GHz	90	91	114	113	–104	–103
>54 GHz to 60 GHz	112	112	122	122	–112	–112
>60 GHz to 65 GHz	108	108	117	117	–107	–107
>65 GHz to 80 GHz	108	108	120	120	–110	–110
>80 GHz to 85 GHz	110	110	123	123	–113	–113
>85 GHz to 90 GHz	108	108	121	121	–111	–111
>90 GHz to 95 GHz	112	112	121	121	–111	–111
>95 GHz to 100 GHz	108	108	117	117	–107	–107
>100 GHz to 110 GHz	109	109	122	122	–112	–112
>110 GHz to 120 GHz*2	107	107	115	115	–110	–110
>120 GHz to 125 GHz*2	104	104	112	112	–107	–107

*1: Excludes localized spurious responses and crosstalk.

*2: 110 GHz to 125 GHz frequency range is available as operational.

*3: Table represents dynamic range with Ports 1 and/or 3 driving. With Port 2 driving, dynamic range may be up to 4 dB lower in the 24-54 GHz band. With Port 4 driving, dynamic range may be up to 3 dB higher in the 24-54 GHz band.

Test Port Power

Port power control is provided by the base VNA for frequencies below 54 GHz, and by the 3743A mm-Wave module for frequencies greater than 54 GHz. Port Power and Power Range tables represent powers available at Ports 1 and 3. Max Power may be up to 4 dB lower on Port 2 in the 24-54 GHz band (only for option 31 systems). Max Power may be up to 3 dB higher on Port 4 in the 24-54 GHz band. Receiver compression point is defined as the port power level beyond which the response may be compressed more than 0.2 dB relative to normalization level. 10 Hz IF bandwidth used to remove trace noise effects. All typical.

Frequency Range	Port Power*1		Port Power*1 W/MS4647B Option 31 Dual Source Architecture	
	Max Power ME7838A4 Option 51	Max Power ME7838A4 Option 62	Max Power ME7838A4 Option 31/51	Max Power ME7838A4 Option 31/62
70 kHz to 300 kHz	4	6	6	8
>0.3 MHz to 2 MHz	4	6	6	8
>2 MHz to 10 MHz	6	6	8	8
>0.01 GHz to 2.5 GHz	8	6	12	10
>2.5 GHz to 24 GHz	–6	–8	–5	–7
>24 GHz to 54 GHz	–14	–16	–13	–15
>54 GHz to 60 GHz	0	0	0	0
>60 GHz to 65 GHz	1	1	1	1
>65 GHz to 80 GHz	–2	–2	–2	–2
>80 GHz to 85 GHz	–3	–3	–3	–3
>85 GHz to 90 GHz	–3	–3	–3	–3
>90 GHz to 95 GHz	1	1	1	1
>95 GHz to 100 GHz	1	1	1	1
>100 GHz to 110 GHz	–3	–3	–3	–3
>110 GHz to 120 GHz*2	–3	–3	–3	–3
>120 GHz to 125 GHz*2	–3	–3	–3	–3

*1: Using the 806–206 1.85 mm (61 cm, 24 in long) test port cables between the VNA and the 3743A mm-Wave modules.

*2: 110 GHz to 125 GHz frequency range is available as operational.

Power Range, Accuracy, Linearity and Resolution

Accuracy is defined at –10 dBm or max rated power, whichever is lower. Linearity is defined as the incremental error between the accuracy test power level and 5 dB below. Typical.

Frequency Range	Range (dB)		Accuracy (dB)	Linearity (dB)	Resolution (dB)
	ME7838A4 Option 51	ME7838A4 Option 62			
70 kHz to 300 kHz	4 to –25	6 to –85	±1.5	±1.5	0.01
>0.3 MHz to 2 MHz	4 to –25	6 to –85	±1.5	±1.5	0.01
>2 MHz to 10 MHz	6 to –25	6 to –85	±1.5	±1.5	0.01
>0.01 GHz to 2.5 GHz	8 to –25	6 to –85	±1.0	±1.0	0.01
>2.5 GHz to 24 GHz	–6 to –25	–8 to –85	±1.0	±1.0	0.01
>24 GHz to 54 GHz	–14 to –30	–16 to –90	±1.5	±1.0	0.01
>54 GHz to 60 GHz	0 to –55	–4 to –55	±2.0	±1.5	0.01
>60 GHz to 65 GHz	1 to –55	1 to –55	±2.0	±1.5	0.01
>65 GHz to 80 GHz	–2 to –55	–2 to –55	±2.0	±1.5	0.01
>80 GHz to 85 GHz	–3 to –55	–3 to –55	±2.0	±1.5	0.01
>85 GHz to 90 GHz	–3 to –55	–3 to –55	±2.0	±1.5	0.01
>90 GHz to 95 GHz	1 to –55	–1 to –55	±2.0	±1.5	0.01
>95 GHz to 100 GHz	1 to –55	–1 to –55	±3.0	±2.0	0.01
>100 GHz to 110 GHz	–3 to –55	–3 to –55	±3.0	±2.0	0.01
>110 GHz to 120 GHz*	–3 to –40	–3 to –40	±4.0	±3.0	0.01
>120 GHz to 125 GHz*	–3 to –40	–3 to –40	±4.0	±3.0	0.01

*: 110 GHz to 125 GHz frequency range is available as operational.

Receiver Compression*1

Receiver compression point is defined as the port power level beyond which the response may be compressed more than 0.2 dB relative to normalization level. 10 Hz IF bandwidth used to remove trace noise effects. All typical.

Frequency Range	Compression ME7838A4 Option 51	Compression ME7838A4 Option 62
70 kHz to 300 kHz	6	6
>0.3 MHz to 10 MHz	12	13
>0.01 GHz to 24 GHz	12	14
>24 GHz to 110 GHz*2	10	10
>110 GHz to 125 GHz*2	5	5

*1: Using the 806–206 1.85 mm (61 cm, 24 in long) test port cables between the VNA and the 3743A mm-Wave modules.
*2: 110 GHz to 125 GHz frequency range is available as operational.

High Level Noise

Noise measured at 1 kHz IF bandwidth, at maximum power or compression limit (whichever is less), with through transmission. RMS. Typical.

Frequency Range	Magnitude (dB)	Phase (deg)
70 kHz to 500 kHz	<0.04	<0.4
>0.5 MHz to 2 MHz	<0.006	<0.06
>2 MHz to 10 MHz	<0.006	<0.06
>0.01 GHz to 24 GHz	<0.006	<0.06
>24 GHz to 54 GHz	<0.005	<0.06
>54 GHz to 80 GHz	<0.005	<0.06
>80 GHz to 110 GHz	<0.008	<0.09
>110 GHz to 120 GHz*	<0.010	<0.20
>120 GHz to 125 GHz*	<0.025	<0.30

*: 110 GHz to 125 GHz frequency range is available as operational.

Stability

Ratioed measurement at maximum leveled power with nominally a full reflect or a stable thru over the normal specified temperature range. Typical.

Frequency Range	Magnitude (dB/°C)	Phase (deg/°C)
70 kHz to 300 kHz	<0.015	<0.15
>0.3 MHz to 2 MHz	<0.015	<0.1
>2 MHz to 10 MHz	<0.02	<0.1
>0.01 GHz to 25 GHz	<0.02	<0.05
>25 GHz to 30 GHz	<0.02	<0.09
>30 GHz to 54 GHz	<0.01	<0.07
>54 GHz to 80 GHz	<0.15	<0.1
>80 GHz to 110 GHz	<0.15	<0.15
>110 GHz to 120 GHz*	<0.02	<0.2
>120 GHz to 125 GHz*	<0.04	<0.25

*: 110 to 125 GHz frequency range is available as operational.

Frequency Resolution, Accuracy and Stability

Resolution	Accuracy	Stability
1 Hz	±5 × 10^{-7} Hz/Hz (at time of calibration)	<5 × 10^{-9}/°C over 0° to 50°C temperature <1 × 10^{-9}/day aging, instrument on

Uncorrected (Raw) Port Characteristics

Typical performance

Frequency Range	Directivity (dB)	Port Match (dB)
70 kHz to 0.01 MHz	10*1	8
>0.01 GHz to 2.5 GHz	9*1	10
>2.5 GHz to 30 GHz	5*1	12
>30 GHz to 40 GHz	5*1	5
>40 GHz to 54 GHz	10	5
>54 GHz to 80 GHz	10	10
>80 GHz to 110 GHz	5	7
>110 GHz to 120 GHz*2	5	7
>120 GHz to 125 GHz*2	5	7

*1: Raw directivity is degraded below 300 kHz, 2.2 GHz to 2.5 GHz and in narrow bands within 10 GHz to 34 GHz.
*2: 110 GHz to 125 GHz frequency range is available as operational.

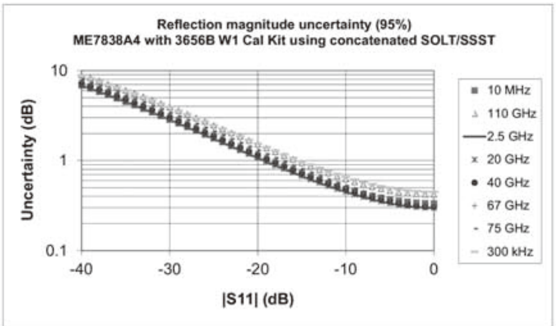
Corrected System Performance and Uncertainties – SOLT/SSST

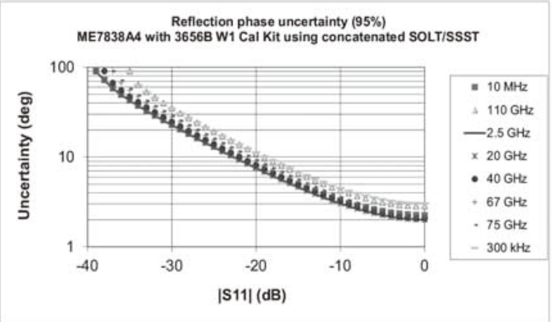
With 12-term concatenated SOLT and Triple Offset Short Calibration (SSST), using the 3656B W1 Calibration Kit. Typical.

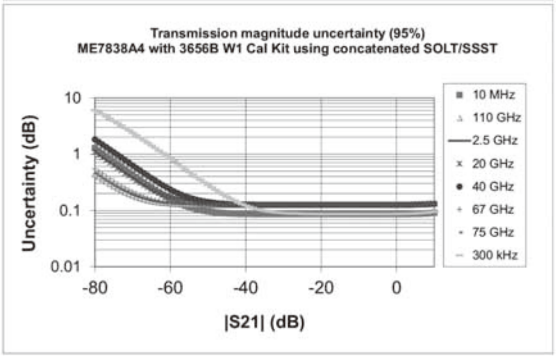
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
70 kHz to 10 MHz	36	36	36	±0.1	±0.1
>0.01 GHz to 2.5 GHz	40	41	40	±0.05	±0.03
>2.5 GHz to 20 GHz	40	41	40	±0.05	±0.05
>20 GHz to 67 GHz	38	41	38	±0.05	±0.07
>67 GHz to 95 GHz	37	42	37	±0.05	±0.07
>95 GHz to 110 GHz	35	35	35	±0.05	±0.07

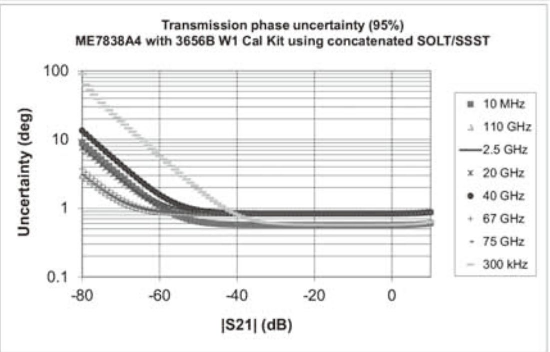
Measurement Uncertainties – SOLT/SSST

The graphs give measurement uncertainties after the above calibration. The errors are worst case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability while noise effects are added on an RSS basis. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that S_{11} = S_{22} = 0. For reflection uncertainties, it is assumed that S_{21} = S_{12}= 0. For other conditions, please use our free Exact Uncertainty calculator software, downloadable from the Anritsu web site at, www.anritsu.com.
*: Although the graph axes show specific S-parameters, they apply to all transmission or reflection parameters, as appropriate.



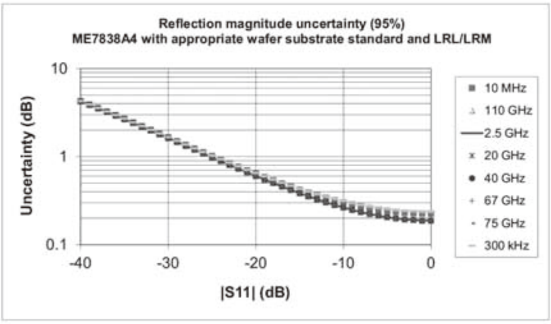


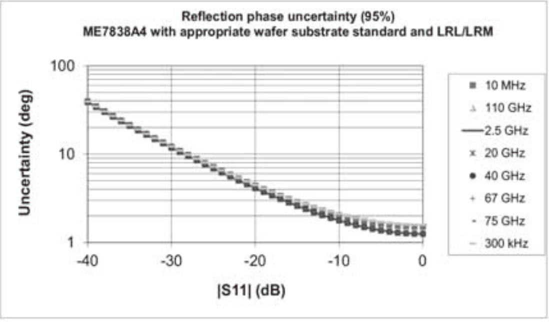


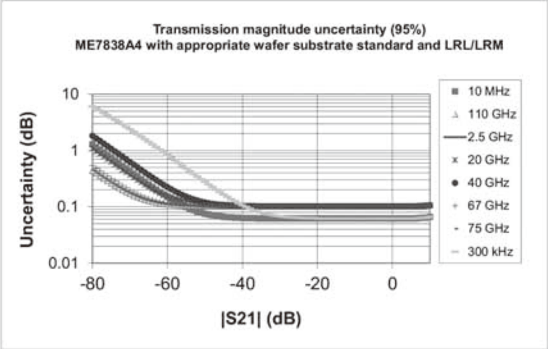


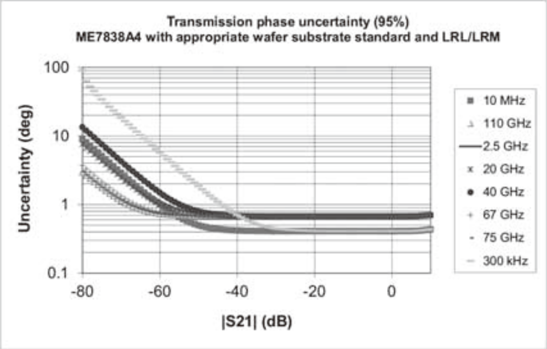
Corrected System Performance and Uncertainties – LRL/LRM

With 12 term LRL/LRM calibration using single-ended probes and on-wafer substrate standards. Typical. Based on a typical vendor supplied impedance standard substrate.









SC8215 and SC7287 Kelvin Bias Tees

Provides Sense and Force SMC connections close to the mm-Wave module to minimize the IR drops associated with the impedances between the bias tee and the DUT. The bias tees are V-type connectors and are to be connected to the inputs of the 374x modules.

Part Number	Description	Voltage	Current
SC8215	The SC8215 is a bias tee that can be used with system frequencies in the range 70 kHz to 125 GHz	Max. Voltage: 16 VDC	Max. Current: 100 mA
SC7287	The SC7287 is a bias tee that can be used with system frequencies in the range 100 MHz to 125 GHz	Max. Voltage: 50 VDC	Max. Current: 500 mA
Tri-Axial Output SMUs	For applications requiring Source Measure Units (SMU) with tri-axial outputs, a tri-axial (male) to SMC (male) cable is available. Check the accessories list for ordering information.		

Specifications for Waveguide Band Configuration

ME7838A4 4-Port Millimeter-Wave VNA, Waveguide Bands

Three configurations are available for 4-port waveguide band operation for E and W bands when using the ME7838A4 4-port system.

- First, the Anritsu 3743A Broadband Millimeter-Wave (mm-Wave) module can be configured for waveguide measurements using waveguide adapters.
- Second, the Anritsu 3744A-EE or 3744A-EW millimeter-Wave module can be used. These version modules operate in the extended E and W waveguide bands and are operational using the MS4644B or MS4647B VectorStar (with options 8x and 7), and the 3739C broadband/millimeter-wave test set and 3736B Broadband test set.
- The third configuration option is to use external millimeter-wave modules with any model VectorStar (with options 8x and 7), and the 3739C test set and 3736B broadband/millimeter-wave test set. For millimeter bands above 110 GHz, either the OML or VDI modules may be used.

E and W Band Operation Using the 3743A, 3744A-EE, or 3744A-EW mm-Wave Module

3743A Millimeter-Wave Modules

3744A-EE/3744A-EW Millimeter-Wave Module with Waveguide Adapter

The 3743A Broadband mm-Wave module can be adapted to a waveguide band output by adding an available waveguide band adapter and mounting flange. VectorStar menus automatically configure the system frequencies incorporating the 3743A module for banded operation. Using the 3743A modules provides the opportunity to sweep frequencies for broadband applications and quickly convert to waveguide configurations for banded measurements. The advantages of small compact modules with excellent RF performance and power range control can therefore be realized in both broadband and waveguide configurations when using the 3743A mm-Wave module. For systems where only waveguide band operation is required, the 3744A-EE or 3744A-EW mm-Wave module can be used.
The 3744A-EE or 3744A-EW mm-Wave module operates from 54 GHz to 110 GHz. The band supported is determined by the waveguide adapter connected to the 1 mm test port output of the 3744A-EE/EW module:

- 3744A-EE configures the module for Extended E Band
- 3744A-EW configures for Extended W Band

The RF input port of the 3744A-EE or 3744A-EW module is restricted below 54 GHz, however, the RF input port retains a DC connection to the 1 mm test port. Thus, the waveguide adapter can be removed for on-wafer applications from 54 GHz to 110 GHz operation and the on-wafer DUT can be biased through the RF input port.

Band	Frequency Range	Waveguide Flange	Transmission/Reflection Module
Ext-E	56 GHz to 94 GHz*	WR-12	3744A-EE
Ext-W	65 GHz to 110 GHz	WR-10	3744A-EW

*: Operational to 95 GHz.

Port Power, Noise Floor, Dynamic Range – 3744A-EE/3744A-EW mm-Wave Modules

System dynamic range is defined as the ratio of the source power to the noise floor.
Maximum Receiver Power is defined as the 0.2 dB compression point of the receiver at the waveguide port.
Receiver dynamic range is defined as the ratio of maximum receive power to the noise floor.
Noise Floor measurements are RMS, are made with no average in a 10 Hz IF bandwidth, and include an isolation calibration.
All figures are typical.

3744A-EE Extended-E Band (WR-12) Waveguide

Frequency Range	Source Power (dBm)	Max. Receive Power (0.2 dB comp. pt.) (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)	Receiver Dynamic Range (dB)
56 GHz to 60 GHz	–2	11	–111	109	122
>60 GHz to 65 GHz	0	11	–106	106	117
>65 GHz to 80 GHz	–3	11	–109	106	120
>80 GHz to 85 GHz	–4	11	–112	108	123
>85 GHz to 90 GHz	–4	11	–110	106	121
>90 GHz to 94 GHz*	0	12	–105	105	117

*: Operational to 95 GHz.

3744A-EW Extended-W Band (WR-10) Waveguide

Frequency Range	Source Power (dBm)	Max. Receive Power (0.2 dB comp. pt.) (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)	Receiver Dynamic Range (dB)
65 GHz to 67 GHz	0	11	–106	106	117
>67 GHz to 80 GHz	–3	11	–109	106	120
>80 GHz to 85 GHz	–4	11	–112	108	123
>85 GHz to 90 GHz	–4	11	–110	106	121
>90 GHz to 100 GHz	0	12	–105	105	117
>100 GHz to 110 GHz	–5	12	–110	105	122

Power Range, Accuracy, Linearity and Resolution

Accuracy is defined at –10 dBm or max rated power, whichever is lower. Linearity is defined as the incremental error between the accuracy test power level and 5 dB below. Typical.

Frequency Range (GHz)	Range (dBm)		Accuracy (dB)	Linearity (dB)	Resolution (dB)
	ME7838A4	ME7838A4 Option 62			
54 to 60	–55 to –2	–55 to –2	±2.0	±1.5	0.01
>60 to 65	–55 to 0	–55 to 0	±2.0	±1.5	0.01
>65 to 80	–55 to –3	–55 to –3	±2.0	±1.5	0.01
>80 to 85	–55 to –4	–55 to –4	±2.0	±1.5	0.01
>85 to 90	–55 to –4	–55 to –4	±2.0	±1.5	0.01
>90 to 100	–55 to 0	–55 to 0	±3.0	±2.0	0.01
>100 to 110	–55 to –5	–55 to –5	±3.0	±2.0	0.01
>110 to 120*	–40 to –3	–40 to –3	±4.0	±3.0	0.01
>120 to 125*	–40 to –3	–40 to –3	±4.0	±3.0	0.01

*: 110 GHz to 125 GHz frequency range is available as operational.

For further description and specifications please refer to the VectorStar ME7838A Technical Data Sheet – 11410-00593 available at www.anritsu.com.

Corrected System Performance/Uncertainties – 3744A-EE/3744A-EW mm-Wave Modules

With 12-term Offset Short Sliding Load or LRL calibrations, using high precision waveguide sections and standards from the appropriate calibration kit.

3744A-EE Extended-E Band (WR-12) Waveguide – 56 GHz to 94 GHz

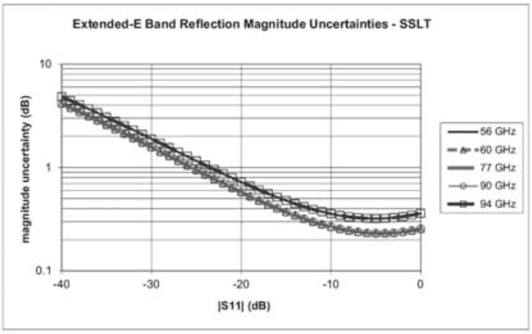
Calibration Type	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
Offset Short	>44	>33	>44	±0.080	±0.100
LRL	>44	>43	>44	±0.006	±0.006

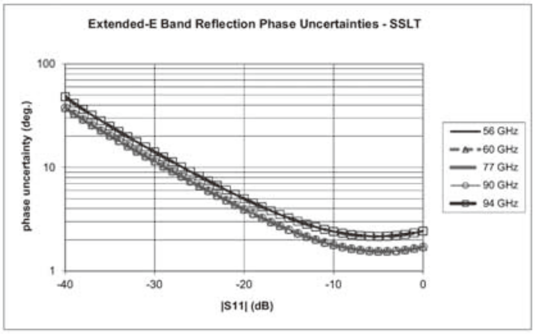
3744A-EE Extended-E Band (WR-12) Waveguide – 56 GHz to 94 GHz

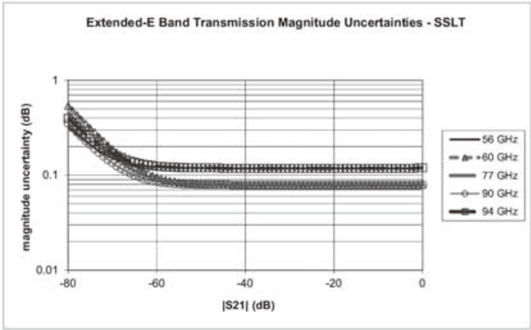
Calibration Type	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
Offset Short	>40	>30	>46	±0.080	±0.100
LRL	>40	>40	>46	±0.006	±0.006

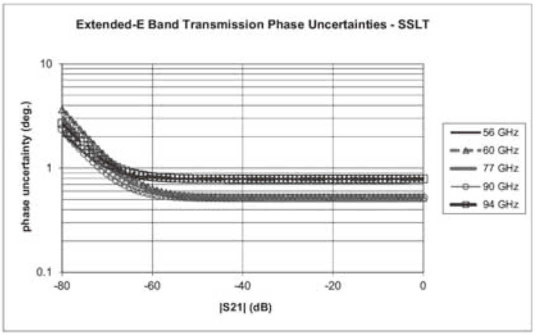
Measurement Uncertainties – Extended-E Band – SSLT

The graphs give measurement uncertainties after the above calibration. The errors are worse case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used.
For transmission uncertainties, it is assumed that $S_{11}= S_{22}= 0$. For reflection uncertainties, it is assumed that $S_{21}= S_{12}= 0$. All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com. Typical.


Extended-E Band Reflection Magnitude Uncertainties - SSLT

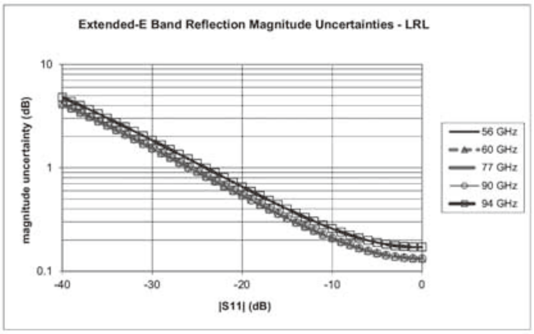

Extended-E Band Reflection Phase Uncertainties - SSLT

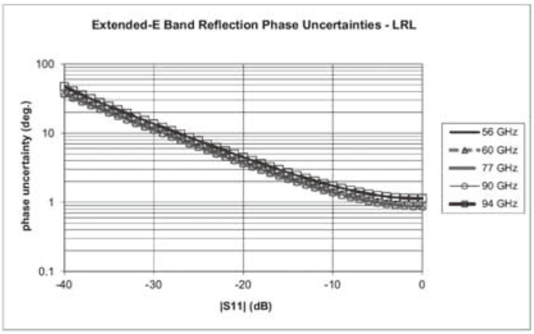

Extended-E Band Transmission Magnitude Uncertainties - SSLT

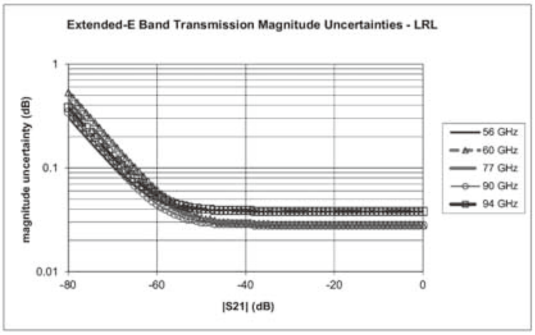

Extended-E Band Transmission Phase Uncertainties - SSLT

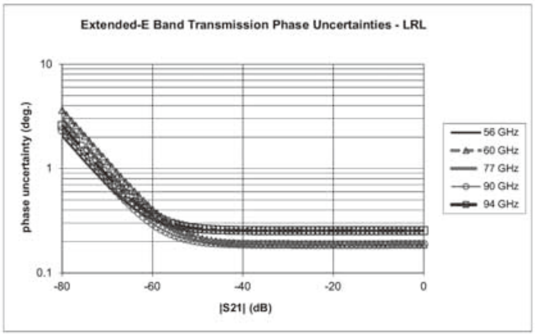
Measurement Uncertainties – Extended-E Band – LRL

The graphs give measurement uncertainties after the above calibration. The errors are worse case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used.
For transmission uncertainties, it is assumed that $S_{11}= S_{22}= 0$. For reflection uncertainties, it is assumed that $S_{21}= S_{12}= 0$. All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com. Typical.



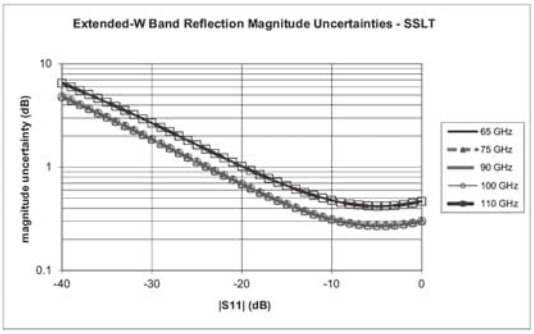


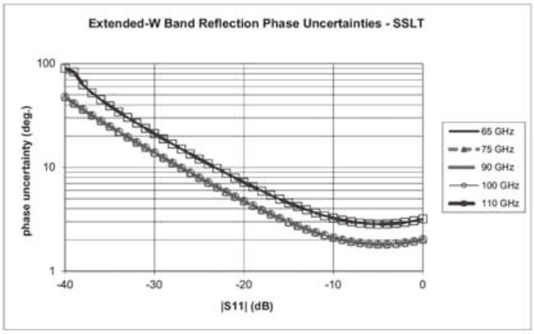


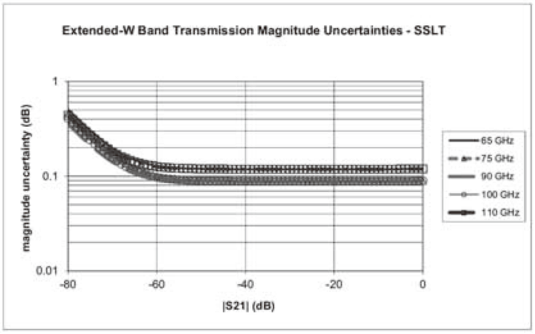


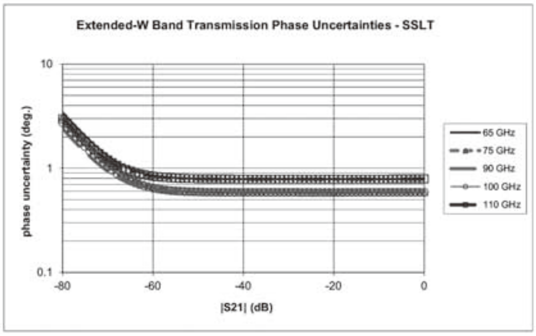
Measurement Uncertainties – Extended-W Band – SSLT

The graphs give measurement uncertainties after the above calibration. The errors are worse case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used.
For transmission uncertainties, it is assumed that $S_{11}= S_{22}= 0$. For reflection uncertainties, it is assumed that $S_{21}= S_{12}= 0$. All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com. Typical.



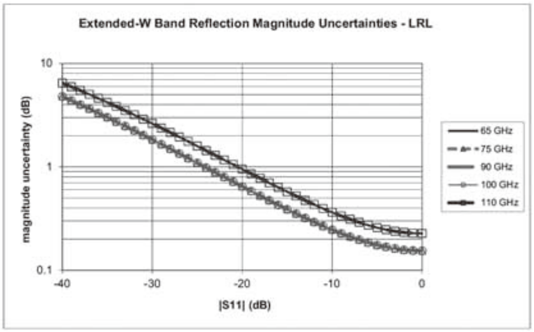


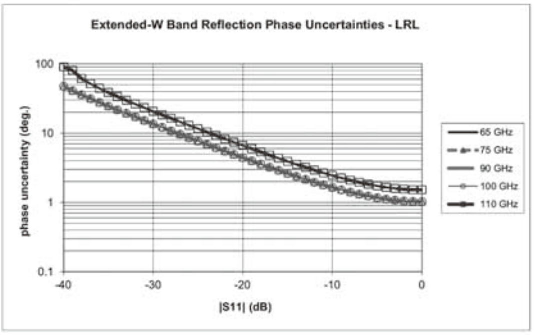


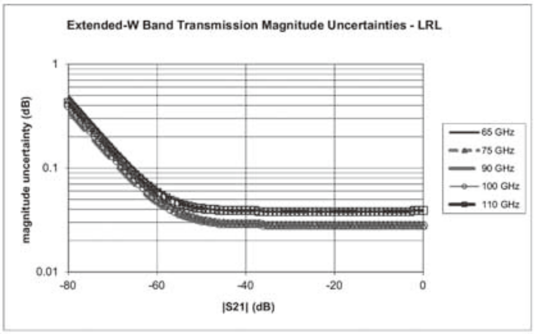


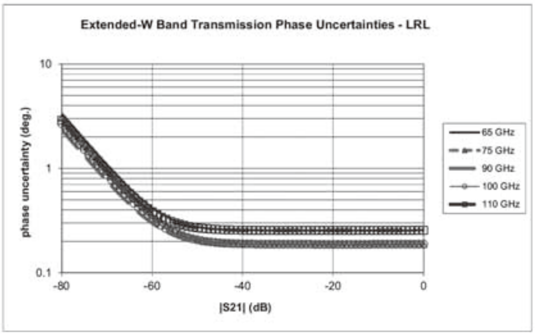
Measurement Uncertainties – Extended-W Band – LRL

The graphs give measurement uncertainties after the above calibration. The errors are worse case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used.
For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com. Typical.

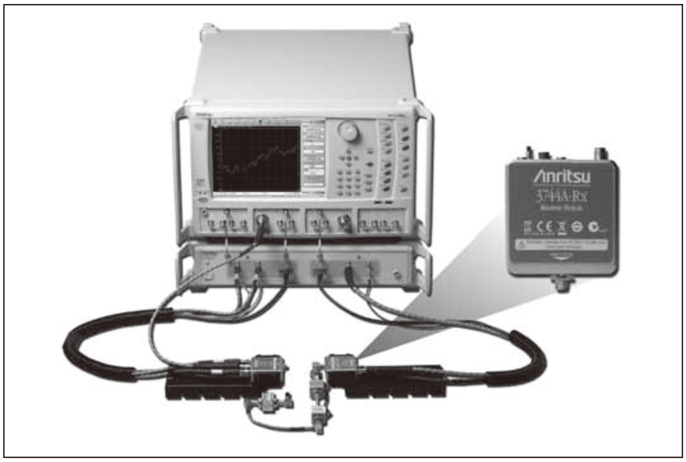








ME7838A4 with Option 41/48 and 3744A-Rx mm-Wave Noise Figure Measurements



3744A-Rx Receiver Module

The 3744A-Rx receiver module can be used with Option 41, Noise Figure, and the ME7838A4 mm-Wave or broadband system to perform mm-Wave noise figure measurements from 30 GHz to 125 GHz.
The receiver bypasses the internal couplers, maximizing the noise figure of the receiver for optimum noise figure measurement accuracy.
The receiver is derived from the 3743A mm-Wave module and utilizes the same nonlinear transmission line technology for optimum mm-Wave performance. Using the advantages of the 3743A mm-Wave module system architecture provides a unique solution to mm-Wave noise figure measurements previously unavailable.
With Option 48, differential (and common-mode) noise figure measurements are possible in the same wide frequency ranges. In this case, two 3744A-Rx modules (along with needed pre-amplifiers/filters) are used to complete the differential receiver. The Rx modules are typically connected as ports 2 and 4 to act as the differential/common-mode noise receiver when used with the ME7838A4.

Warranty

The ME7838A4 4-Port BB/mm-Wave VNA and related accessories offer a 3 year warranty from the date of shipment (excluding OML and VDI modules). Please contact your local service center for additional warranty coverage.

Ordering Information

The ME7838A4 4-Port Broadband/Millimeter-Wave VNA System provides single sweep coverage from 70 kHz to 110 GHz and consists of the following standard components and optional accessories, which are described in the sections below:

ME7838A4 4-Port Broadband System, 70 kHz to 110 GHz

Action	Part Number and Description	Additional Information
Order the base VectorStar model with the listed components and options:	MS4647B, 70 kHz to 70 GHz VNA MS4640B-007, receiver offset MS4640B-070, 70 kHz frequency coverage MN4697C, 4-Port Test Set 3739C, Broadband Test Set with 36 inch interface cables 3736B Broadband/Millimeter-Wave Test Set 3743A, Millimeter-Wave Module, 2 each 806-209, 1.85mm phase stable VNA RF cables, 36 in, (m-f) 2 each ME7838A4-SS020, On-site system assembly and verification	
Include the following:	MS4647B-081, MS4647B with ME7838A4 system option and Option 51, 61, or 62: MS4647B-051 – External VNA Loops MS4647B-061 – Active Measurement Suite, 2 Attenuators MS4647B-062 – Active Measurement Suite, 4 Attenuators	MS4647B-085 is ordered when Option 31 is included
Add options if desired	MS4640B-070 – for 70 kHz operation in base VNA MS4640B-002 – for Time Domain MS464xB-031 – Dual Source Architecture MS4640B-035 – IF Digitizer MS4640B-041 – Noise Figure MS4640B-042 – PulseView™ MS4640B-043 – DifferentialView™ MS4640B-048 – Differential Noise Figure	MS464xB-031 requires Option 85 For other available options, see “ME7838A4 Broadband/Millimeter-Wave System Options”

ME7838A4 4-Port Waveguide-Band System to 110 GHz – 3744A-EE or 3744A-EW mm-Wave Modules

Configurator for ME7838A4 Millimeter-Wave System using 3744A-EE or 3744A-EW mm-Wave Modules:

Action	Part Number and Description	Additional Information
Choose and order one of the two base VectorStar models with options listed:	MS4644B VNA, 10 MHz to 40 GHz MS4640B-007 MS4644B-083 or MS4644B-085	MS4644B-083 is ordered when Option 51, 61, or 62 is included MS4644B-085 is ordered when Option 31 and Option 51, 61, or 62 is included.
	MS4647B VNA, 10 MHz to 70 GHz MS4647B-007 MS4647B-081 or MS4647B-085	MS4647B-081 is ordered when Option 51, 61, or 62 is included MS4647B-085 is ordered when Option 31 and Option 51, 61, or 62 is included.
Order:	MN4697C, 4-Port Test Set 3736B Broadband/Millimeter-Wave Test Set 3739C Broadband/Millimeter-Wave Test Set	
Choose and order Extended-E or Extended-W Band Modules:	3744A-EE, 56 GHz to 94 GHz Extended E Band module, 4 each	
	3744A-EW, 65 GHz to 110 GHz Extended W Band module, 4 each	
Order one of the following:	Option 51, 61, or 62: MS4647B-051 – External VNA Loops MS4647B-061 – Active Measurement Suite, 2 Attenuators MS4647B-062 – Active Measurement Suite, 4 Attenuators	ME7838A4 requires Option 51, or 61, or 62
Add options if desired:	MS4640B-070 – for 70 kHz operation in base VNA MS4640B-002 – for Time Domain MS464xB-031 – Dual Source Architecture MS4640B-035 – IF Digitizer MS4640B-041 – Noise Figure MS4640B-042 – PulseView™ MS4640B-043 – DifferentialView™ MS4640B-048 – Differential Noise Figure	MS464xB-031 requires Option 85 For other available options, see “ME7838A4 Broadband/Millimeter-Wave System Options”
Accessories	35WR12WF-EE – Precision Waveguide to Coax Adapter Kit, 56 GHz to 94 GHz, WR-12 to W1 (f)	
	35WR10WF-EW – Precision Waveguide to Coax Adapter Kit, 65 GHz to 110 GHz, WR-10 to W1 (f)	

ME7838A4 4-Port Waveguide-Band System – OML/VDI mm-Wave Modules

ME7838A4 4-Port Waveguide-Band System using OML or VDI Millimeter-Wave modules:

Action	Part Number and Description	Additional Information
Choose and order one of the three base VectorStar models with options listed:	MS4642B VNA, 70 kHz to 20 GHz MS4642B-008 or MS4642B-009 MS4642B-083	MS4642B-008 includes Active Device Measurements, with 2 Step Attenuators MS4642B-009 includes Active Device Measurements, with 4 Step Attenuators MS4642B-085 is ordered when Option 31 is included.
	MS4644B VNA, 10 MHz to 40 GHz MS4640B-007 Receiver Offset MS4644B-083	MS4644B-085 is ordered when Option 31 is included.
	MS4647B VNA, 10 MHz to 70 GHz MS4640B-007 Receiver Offset MS4647B-081	MS4647B-085 is ordered when Option 31 is included.

Continued on next page

Action	Part Number and Description	Additional Information
Order:	MN469xC, 4-port Test Set 3739C Broadband/Millimeter-Wave Test Set 3736B Broadband/Millimeter-Wave Test Set	
	SM6537 Interface Cables (4) for OML/VDI mm-Wave Modules	Does not include DC cable. DC supply is provided by mm-Wave module power supply.
Choose and order one of the two appropriate millimeter-wave module combinations:	4 each TxRx transmission and reflection millimeter-wave modules	Choose appropriate OML or VDI modules. Contact Anritsu Company for ordering information.
For MS4644B or MS4647B, order:	Option 51, 61, or 62: MS4647B-051 – External VNA Loops MS4647B-061 – Active Measurement Suite, 2 Attenuators MS4647B-062 – Active Measurement Suite, 4 Attenuators	ME7838A4 requires Option 51, 61, or 62
Add options if desired:	MS4640B-070 – for 70 kHz operation in base VNA MS4640B-002 – for Time Domain MS464xB-031 – Dual Source Architecture MS4640B-035 – IF Digitizer MS4640B-041 – Noise Figure MS4640B-042 – PulseView™ MS4640B-043 – DifferentialView™ MS4640B-048 – Differential Noise Figure	MS464xB-031 requires Option 85 For other available options, see "ME7838A4 Broadband/Millimeter-Wave System Options"

Model/Order No.	Name
	Calibration/Verification Kits
3656B	W1 (1 mm) Calibration/Verification Kit
3655V	WR-15 Waveguide Calibration Kit, Without Sliding Loads
3655V-1	WR-15 Waveguide Calibration Kit, With Sliding Loads
3655E	WR-12 Waveguide Calibration Kit, Without Sliding Loads
3655E-1	WR-12 Waveguide Calibration Kit, With Sliding Loads
3655W	WR-10 Waveguide Calibration Kit, Without Sliding Loads
3655W-1	WR-10 Waveguide Calibration Kit, With Sliding Loads
3650A	SMA/3.5 mm Calibration Kit, Without Sliding Loads
3650A-1	SMA/3.5 mm Calibration Kit, With Sliding Loads
3652A	K Calibration Kit, Without Sliding Loads
3652A-2	K Calibration Kit, Without additional options
3652A-3	K Calibration Kit, With Pin Depth Gauge and .s1p Characterization Files
3652A-4	K Calibration Kit, With .s1p Characterization Files
3654D	V Calibration Kit, With Pin Depth Gauge
3654D-2	V Calibration Kit Without additional options
3654D-3	V Calibration Kit, With Pin Depth Gauge and .s1p Characterization Files
3654D-4	V Calibration Kit, With .s1p Characterization Files
3657	V Multi-Line Calibration Kit, Without Shorts
3657-1	V Multi-Line Calibration Kit, With Shorts
	External Power Meters/Sensors
ML243xA	CW Power Meter, Single Input or Dual Input Recommended Power Sensors: SC7770, MA247xD, MA244xD, MA248xD, MA2400xA
ML248xB	Wideband Power Meter, Single Input or Dual Input Recommended Power Sensors: MA249xA, MA2411B
ML249xA	Pulse Power Meter, Single Input or Dual Input Rcommended Power Sensors: MA249xA, MA2411B
MA24106A	USB Power Sensor, 50 MHz to 6 GHz
MA24108A	USB Power Sensor, 10 MHz to 8 GHz
MA24118A	USB Power Sensor, 10 MHz to 18 GHz
MA24126A	USB Power Sensor, 10 MHz to 26 GHz
MA24330A	USB Power Sensor, 10 MHz to 33 GHz
MA24340A	USB Power Sensor, 10 MHz to 40 GHz
MA24350A	USB Power Sensor, 10 MHz to 50 GHz
MA24507A*	Power Master™ Frequency Selectable mm-Wave Power Analyzer, 9 kHz to 70 GHz
MA24510A	Power Master™ Frequency Selectable mm-Wave Power Analyzer, 9 kHz to110 GHz Note that usage of the MA24507A or MA24510A Power Master™ sensor requires connection to two USB ports to supply needed current draw.
	Test Port Cables, Flexible, High Performance
3671W1-50-1	W1 (m) to W1 (f), 1 each, 10.0 cm (3.9 in)
3671W1-50-2	W1 (m) to W1 (f), 1 each, 13.0 cm (5.1 in)
3671W1-50-3	W1 (m) to W1 (f), 1 each, 16.0 cm (6.3 in)
3671KFS50-60	K (f) to 3.5 mm (m) cable, 60 cm (one cable)
3671KFK50-60	K (f) to K (m) cable, 60 cm (one cable)
3671KFK50-100	K (f) to K (m) cable, 1 each, 100 cm (one cable)
3671KFKF50-60	K (f) to K (f) cable, 1 each, 60 cm (once cable)
3671VFV50-60	V (f) to V (m) cable, 1 each, 60 cm (one cable)
3671VFV50-100	V (f) to V (m) cable, 1 each, 100 cm (one cable)
3671KFSF50-60	K (f) to 3.5 mm (f) cable, 1 each, 60 cm (one cable)
3671VFVF50-60	V (f) to V (f) cable, 1 each, 60 cm (one cable)

Model/Order No.	Name
	Adapters and More
34WV50	W1 (m) to V (m) Adapter, W1 (1 mm) to V, Coaxial
34WVF50	W1 (m) to V (f) Adapter, W1 (1 mm) to V, Coaxial
34WFV50	W1 (f) to V (m) Adapter, W1 (1 mm) to V, Coaxial
34WFVF50	W1 (f) to V (f) Adapter, W1 (1 mm) to V, Coaxial
33WW50	W1 (m) to W1 (m) Adapter, W1 (1 mm) in-series, Coaxial
33WWF50	W1 (m) to W1 (f) Adapter, W1 (1 mm) in-series, Coaxial
33WFWF50	W1 (f) to W1 (f) Adapter, W1 (1 mm) in-series, Coaxial
35WR10W	WR10 to W1 (m) Adapter, W1 (1 mm) to WR10 Waveguide
35WR10WF	WR10 to W1 (f) Adapter, W1 (1 mm) to WR10 Waveguide
SC7260	WR12 to W1 (m) Adapter, W1 (1 mm) to WR12 Waveguide
SC7442	WR12 to W1 (f) Adapter, W1 (1 mm) to WR12 Waveguide
35WR15V	WR15 to V (m) Adapter, V (1.85 mm) to WR15 Waveguide
35WR15VF	WR15 to V (f) Adapter, V (1.85 mm) to WR15 Waveguide
For More Information	Refer to our Precision RF & Microwave Components Catalog for descriptions of adapters and other components.
	Accessories
SC8215	Kelvin Bias Tee 70 kHz to 125 GHz, Max Voltage: 16 VDC, Max Current: 100 mA
SC7287	Kelvin Bias Tee 100 MHz to 125 GHz, Max Voltage: 50 VDC, Max Current: 500 mA
SC8218	Triax (m) to SMC (m) Cable, (Inner-shield floating at SMC end), 1.5 m (60 in) long two (2) needed per Kelvin Bias Tee
SM6494	System floor console. Includes larger size writing table
2100-1	GPIB cable, 1 m (39 in) long
2100-2	GPIB cable, 2 m (79 in) long
2100-4	GPIB cable, 4 m (157 in) long
806-206	1.85 mm cable, 61 cm (24 in) long, for connecting the VNA and the 3743A Modules
806-209	1.85 mm cable, 91 cm (36 in) long, for connecting the VNA and the 3743A Modules
01-201	Torque Wrench (for tightening male devices), 8 mm (5/16 in), 0.9 N·m (8 lbf·in) for SMA, 3.5 mm, 2.4 mm, K, and V connectors
01-202	Universal Test Port Connector Wrench
01-203	Torque Wrench (for tightening the VNA test ports to female devices) 20.6 mm (13/16 in), 0.9 N·m (8 lbf·in)
01-204	Anritsu Stainless Steel Connector Wrench, circular, open-ended for SMA, 3.5 mm, 2.4 mm, K and V connectors

*: The MA24507A sensor requires connection to two USB ports to supply needed current draw.

Contact Anritsu regarding rack mount options www.anritsu.com.

VectorStar™ Microwave Vector Network Analyzers

MS4640B Series

70 kHz to 20 GHz, 40 GHz, 70 GHz

Remote Control
Ethernet | USB

High Performance, Broadband Network Analysis Solutions

VectorStar

The VectorStar™ family is Anritsu's Premium VNA line, providing the highest overall performance on a modern platform. The MS4640B VectorStar VNA offers the broadest coverage in a single instrument, 70 kHz to 70 GHz.

The additional two decades at the low end are even more impressive than the guaranteed 70 GHz coverage on the high end.

PulseView™, when combined with the innovative IF digitizing option, offers industry-leading 2.5 ns pulse resolution and 100 dB dynamic range with no compromises or trade-offs due to varying duty cycles. PulseView provides real time display of pulse measurements while dynamically modifying pulse parameters for immediate design validation.

DifferentialView™, when combined with the dual internal source option, offers real time display analysis of differential devices, drivers, and components while actively modifying phase and magnitude relationships of the internal dual sources.

The noise figure option is based on a cold source technique for improved noise figure measurement accuracy. VectorStar is the only VNA platform capable of measuring noise figure from 70 kHz to 110 GHz and available with an optimized noise receiver for measurements from 30 GHz to 110 GHz.

IMDView, when combined with the dual source option and internal switch and combiner, VectorStar provides the only VNA platform with a choice of all 3 most common IMD configuraitons: IMD software only, IMD software with internal 2nd source, and IMD software with internal 2nd source and switch with combiner.

The internal switch and combiner provides the ability to perform single connection IMD measurements. Using the multiple channel capabilities of VectorStar allows automatic switching from S-Parameter measurements, power sweep gain compression measurements, spectrum view of intermodulation products, and frequency sweeping of intermodulation products for complete active device characterization. The IMD measurements are also supported in the broadband systems up to 145 GHz and mmwave bands up to 1.1 THz.

For broadband applications, the ME7838 Series offers superior performance and coverage spanning a range from 70 kHz to 110/125/145 GHz in a single coaxial test port. The Anritsu developed Non-linear Transmission Line mmWave module is compact while providing high performance up to 145 GHz.

The Anritsu MS4640B Vector Network Analyzer offers a new level of performance for device modeling engineers struggling to accurately and reliably characterize their devices, for R&D engineers pushing the last fraction of a dB out of their state-of-the-art designs, and for the manufacturing engineer trying to maximize throughput without sacrificing accuracy. Backed by a 3-year warranty and the most responsive sales support team, the MS4640B is the VNA of choice for the discerning engineer.

Key Features

- Broadest frequency span from a single coaxial test port covering 70 kHz to 70 GHz in a single instrument and 70 kHz to 110/125/145 GHz in the Broadband configuration
- Highest performance pulse measurements – PulseView™ offers 2.5 ns pulse resolution with 100 dB dynamic range
- 4-port single-ended or balanced measurements using DifferentialView™ analysis
- Superior Dynamic Range – up to 142 dB
- High available power – up to +14 dBm
- Best test port characteristic performance – up to 50 dB in Directivity, Source Match and Load Match
- Most convenient automatic calibration system with best accuracy
- Best time domain analysis

Instrument Models and Operating Frequencies

- MS4642B – 70 kHz to 20 GHz
- MS4644B – (Optional 70 kHz) 10 MHz to 40 GHz
- MS4647B – (Optional 70 kHz) 10 MHz to 70 GHz
- Extended Operating Frequency Details Inside

Principal Options

- MS4640B-002 – Time Domain
- MS4640B-007 – Receiver Offset
- MS4640B-021 – Universal Fixture Extraction
- MS4640B-031 – Dual Source Architecture
- MS4640B-032 – Internal RF Combiner
- MS4640B-035 – IF Digitizer
- MS4640B-036 – Extended IF Digitizer Memory
- MS4640B-041 – Noise Figure
- MS4640B-042 – PulseView™
- MS4640B-043 – DifferentialView™
- MS4640B-044 – IMDView™
- MS4640B-046 – Fast CW
- MS4640B-047 – Eye Diagram
- MS4640B-048 – Differential Noise Figure
- MS4640B-051 – Direct Access Loops
- MS4640B-053 – External ALC
- MS4640B-061/062 – Active Measurements Suite
- MS4640B-070 – 70 kHz Low-End Frequency Extension

A detailed color brochure available on the Anritsu web site provides descriptions and examples of the VectorStar family’s features and benefits. The web site also provides detailed information on 110/125/145 GHz Broadband Coaxial, Banded Waveguide, and Multiport solutions based on the MS4640B VNA.

Definitions

All specifications and characteristics apply under the following conditions, unless otherwise stated:	
Warm-Up Time	After 90 minutes of warm-up time, where the instrument is left in the ON state.
Temperature Range	Over the 25° ±5°C temperature range.
Error-Corrected Specifications	For error-corrected specifications, over 23° ±3°C, with <1°C variation from calibration temperature. For error-corrected specifications are warranted and include guard-bands, unless otherwise stated.
Frequency Bands in Tables	When a frequency is listed in two rows of the same table, the specification for the common frequency is taken from the lower frequency band, except when the band edge is less than 5 GHz.
User Cables	Specifications do not include effects of any user cables, adapters, or fixtures attached to the instrument.
Discrete Spurious Responses	Specifications may exclude discrete spurious responses.
Internal Reference Signal	All specifications apply with internal 10 MHz Crystal Oscillator Reference Signal.
Interpolation Mode	All specifications are with Interpolation Mode Off.
Standard	Refers to instruments without Option 51, 61, or 62.
Typical Performance	Typical performance indicates the measured performance of an average unit. It does not include guard-bands and is not covered by the product warranty. Typical specifications are shown in parentheses, such as (–102 dB), or noted as typical.
Characteristic Performance	Characteristic performance indicates a performance designed-in and verified during the design phase. It does include guard-bands and is not covered by the product warranty.
Nominal Performance	Nominal performance indicates a performance designed in and observed during the design phase. It does not include guard bands, is not production tested, and is not covered by the product warranty.
Below 300 kHz	All uncertainties below 300 kHz are typical.
Recommended Calibration Cycle	12 months (Residual specifications also require calibration kit calibration cycle adherence.)
Specifications Subject to Change	All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site: www.anritsu.com

System Dynamic Range

System dynamic range is calculated as the difference between the maximum rated source power and the specified noise floor at the specified reference plane. Option 31 System Dynamic Range is listed in alternating tables. Note that Option 32 System Dynamic Range differs by the delta in max power.

MS4642B 20 GHz Model, System Dynamic Range (dB)		
	at Ports 1 or 2	at b_1 or b_2
Frequency Range	Option 8* or 9	Option 8* or 9
0.07 MHz to 0.3 MHz	81	112
>0.3 MHz to 2 MHz	98	124
>2 MHz to 10 MHz	111	132
>0.01 GHz to 2.5 GHz	114	135
>2.5 GHz to 20 GHz	115	130
With Option 31		
0.07 MHz to 0.3 MHz	83	114
>0.3 MHz to 2 MHz	100	126
>2 MHz to 10 MHz	113	134
>0.01 GHz to 2.5 GHz	116	137
>2.5 GHz to 20 GHz	116	131

*: The option 8 dynamic range reported in this column corresponds to S_{21}. For S_{12}, add 2 dB.

MS4644B 40 GHz Model, System Dynamic Range (dB)					
	at Ports 1 or 2			at b_1 or b_2	
Frequency Range	Standard	Option 51	Option 61* or 62	Option 51	Option 61* or 62
0.07 MHz to 0.3 MHz	85	83	81	114	112
>0.3 MHz to 2 MHz	102	100	98	126	124
>2 MHz to 10 MHz	115	113	111	134	132
>0.01 GHz to 2.5 GHz	122	119	114	140	135
>2.5 GHz to 40 GHz	119	115	110	130	125
With Option 31					
0.07 MHz to 0.3 MHz	87	85	83	116	114
>0.3 MHz to 2 MHz	104	102	100	128	126
>2 MHz to 10 MHz	117	115	113	136	134
>0.01 GHz to 2.5 GHz	129	121	116	142	137
>2.5 GHz to 40 GHz	122	118	113	133	128

*: The Option 61 Dynamic Range reported in this column applies for S_{21} measurements. For S_{12} Dynamic Range, use the figures from the Option 51 column.

MS4647B 70 GHz Model, System Dynamic Range (dB)					
	at Ports 1 or 2			at b_1 or b_2	
Frequency Range	Standard	Option 51	Option 61* or 62	Option 51	Option 61* or 62
0.07 MHz to 0.3 MHz	85	83	81	114	112
>0.3 MHz to 2 MHz	102	100	98	126	124
>2 MHz to 10 MHz	115	113	111	134	132
>0.01 GHz to 2.5 GHz	122	119	114	140	135
>2.5 GHz to 5 GHz	116	112	106	127	121
>5 GHz to 20 GHz	115	111	105	126	120
>20 GHz to 38 GHz	116	111	105	126	120
>38 GHz to 50 GHz	115	109	104	124	119
>50 GHz to 65 GHz	110	104	99	119	115
>65 GHz to 67 GHz	108	103	95	117	111
>67 GHz to 70 GHz	107	100	90	110	106
With Option 31					
0.07 MHz to 0.3 MHz	87	85	83	116	114
>0.3 MHz to 2 MHz	104	102	100	128	126
>2 MHz to 10 MHz	117	115	113	136	134
>0.01 GHz to 2.5 GHz	124	121	116	142	137
>2.5 GHz to 5 GHz	118	114	108	129	123
>5 GHz to 20 GHz	118	114	108	129	123
>20 GHz to 38 GHz	118	113	107	128	122
>38 GHz to 50 GHz	117	111	106	126	121
>50 GHz to 65 GHz	117	111	106	126	122
>65 GHz to 67 GHz	116	111	103	125	119
>67 GHz to 70 GHz	114	107	97	120	113

*: The Option 61 Dynamic Range reported in this column applies for S_{21} measurements. For S_{12} Dynamic Range, use the figures from the Option 51 column.

Receiver Dynamic Range

Calculated as the difference between the maximum receiver input level for 0.1 dB compression and the specified noise floor at the specified reference plane. Characteristic Performance.

All Models, Receiver Dynamic Range (dB)					
	at Ports 1 or 2			at b_1 or b_2	
Frequency Range	Standard[*1]	Option 51[*1]	Option 61[*2, *3, *4] or 62	Option 51[*1]	Option 61[*3, *4] or 62
0.07 MHz to 0.3 MHz	80	79	78	90	89
>0.3 MHz to 2 MHz	102	102	102	107	107
>2 MHz to 10 MHz	115	115	115	115	115
>0.01 GHz to 2.5 GHz	120	119	116	119	116
>2.5 GHz to 5 GHz	120	118	115	117	114
>5 GHz to 20 GHz	120	118	115	118	115
>20 GHz to 40 GHz[*5]	120	118	115	118	116
>38 GHz to 50 GHz	120	118	117	117	117
>50 GHz to 65 GHz	117	115	115	113	114
>65 GHz to 67 GHz	115	113	111	110	109
>67 GHz to 70 GHz	113	110	109	107	108

*1: Not applicable to MS4642B.
*2: The Option 61 dynamic range reported in this column applies for S_{21} measurements. For S_{12} dynamic range, use the figures from the Option 51 column.
*3: Option 8 or 9 for MS4642B.
*4: The Option 8 dynamic range reported in this column corresponds to S_{21}. For S_{12}, add 2 dB.
*5: 20 GHz to 38 GHz for MS4647B.

Receiver Compression

Port power level beyond which the response may be compressed more than 0.1 dB relative to the normalization level. 10 Hz IF bandwidth used to remove any high level noise effects. Match not included. Performance is characteristic. In pulse modes (Option 42), compression is measured with 1 kHz IF bandwidth and the compression level is 0.3 dB below 1 GHz.

All Models, Compression Levels (dBm)						
	0.1 dB Compression Levels in dBm relative to the Normalization Level[*1]					
	at Ports 1 or 2			at a_x loops	at b_x loops	
Frequency Range	Standard[*2]	Option 51[*2]	Option 61[*3, *4, *5] or 62	Option 51, 061[*5], or 62	Option 51[*2]	Option 61[*3, *4, *5] or 62
0.07 MHz to 0.3 MHz	+5	+5	+5	–15	–15	–15
>0.3 MHz to 10 MHz	+10	+11	+12	–10	–10	–9
>0.01 GHz to 2.5 GHz	+10	+11	+12	–10	–10	–9
>2.5 GHz to 5 GHz	+10	+11	+12	–5	–5	–4
>5 GHz to 20 GHz	+10	+11	+12	–4	–4	–3
>20 GHz to 40 GHz[*6]	+10	+11	+12	–4	–4	–2
>38 GHz to 50 GHz	+10	+12	+14	–4	–4	–1
>50 GHz to 65 GHz	+10	+12	+14	–5	–5	–2
>65 GHz to 67 GHz	+10	+13	+15	–5	–5	–2
>67 GHz to 70 GHz	+10	+13	+15	–5	–5	–1

*1: 0.3 dB for <0.3 MHz.

*2: Not applicable to MS4642B.

*3: The Option 61 compression level reported in this column applies to Port 2 or b_2. For Port 1 or b_1 compression level, use the figures from the appropriate Port X or bx Option 51 column.

*4: Option 8 or 9 for MS4642B.

*5: For Option 8, the value in this column corresponds to that for port 2 or b_2. For port 1 or b_1, subtract 1 dB.

*6: 20 GHz to 38 GHz for MS4647B.

During intermodulation measurements it is useful to know the linearity of the receiver. In addition to considering the receiver compression point, it is helpful to understand the third order Intercept Point (IP3) of the receiver. IP3 can therefore be used as a figure of merit to describe the range and quality of IMD measurements. The nominal IP3 performance provided is valid with or without the Option 32 combiner and represents the receiver performance at the input of the test port. Minimal degradation of IP3 at different tone spacings. For the approximate IP3 of the receiver at the sampler input, deduct ~13 dB from the numbers below. The spec values below were derived by using –10 dBm/tone power incident at the receive port, a tone spacing of 3 MHz (reducing to frequency/10 for frequencies under 30 MHz) and an IF bandwidth of no more than 10 Hz.

All Models, Third Order Intercept Point (IP3, dBm)	
Frequency Range	At Ports 2 (nom.)
0.07 MHz to 0.3 MHz	+20
>0.3 MHz to 1 GHz	+25
>1 GHz to 20/40/70 GHz (max. frequency of the models)	+35

High Level Noise

Measured at 1 kHz IF bandwidth, at default power, with either full reflects or through transmission. RMS. Characteristic performance on MS4647B with either Option 51, 61, or 62. High level noise magnitude may be degraded to 20 dBm RMS (typ.) at particular frequencies due to receiver residuals.

Frequency Range	Magnitude (dB)	Phase (degree)
70 kHz to 500 kHz	<0.04	<0.4
>500 kHz to 2.5 GHz	<0.0045	<0.05
>2.5 GHz to 5 GHz	<0.0045	<0.05
>5 GHz to 20 GHz	<0.0045	<0.05
>20 GHz to 40 GHz	<0.006	<0.06
>40 GHz to 67 GHz	<0.006	<0.08
>67 GHz to 70 GHz	<0.008 (<0.006)	<0.08

Noise Floor

Measured at 10 Hz IF Bandwidth with no averaging, and at –10 dBm port power. RMS, no leakage correction applied. Measurement made with a through line connection, with its effects compensated for Performance at a_x and b_x loops is characteristic.

	At Ports 1 or 2			At a_x Loops	At b_x Loops	
Frequency Range	Standard[*1]	Option 51[*1]	Option 61[*2, *3, *4] or 62	Option 51, 61[*3], or 62	Option 51[*1]	Option 61[*2, *3, *4] or 62
0.07 MHz to 0.3 MHz	–75	–74	–73	–105	–105	–104
>0.3 MHz to 2 MHz	–92	–91	–90	–117	–117	–116
>2 MHz to 10 MHz	–105	–104	–103	–125	–125	–124
>0.01 GHz to 2.5 GHz	–110	–108	–104	–129	–129	–125
>2.5 GHz to 40 GHz[*5]	–110	–107	–103	–121	–122	–118
>38 GHz to 50 GHz	–110	–106	–103	–121	–121	–118
>50 GHz to 65 GHz	–110	–106	–103	–121	–121	–119
>65 GHz to 67 GHz	–110	–106	–100	–120	–120	–116
>67 GHz to 70 GHz	–110	–106	–100	–115	–119	–116

*1: Not applicable to MS4642B.

*2: The Option 61 noise floor reported in this column applies to Port 2 or b_2. For Port 1 or b_1 noise floor, use the figures from the appropriate Portx or bx Option 51 column.

*3: Option 8 or 9 for MS4642B.

*4: For Option 8, the value in this column applies to port 2 or b_2. For port 1 or b_1, the appropriate value is 1 dB more negative.

*5: 2.5 GHz to 38 GHz for MS4647B.

Power Range

Maximum Rated Power to minimum level. The difference reflects the ALC range for standard models or with Option 51, and the ALC + Attenuator Range for models with Options 61 or 62. Maximum Rated Power is typical from 2.4 GHz to 2.7 GHz.

MS4642B, 20 GHz Model, Power Range (dBm)	
Frequency Range	Option 8* or 9
70 kHz to 0.01 GHz	+8 to –95
>0.01 GHz to 2.5 GHz	+10 to –95
>2.5 GHz to 20 GHz	+11 to –90
With Option 31	
70 kHz to 0.01 GHz	+10 to –95
>0.01 GHz to 2.5 GHz	+12 to –95
>2.5 GHz to 20 GHz	+12 to –90

*: For Option 8, the power range reported in this column applies to Port 1. For Port 2, add 1 dB to the maximum (minimum unchanged).

MS4644B, 40 GHz Model, Power Range (dBm)			
Frequency Range	Standard	Option 51	Option 61*1 or 62
70 kHz to 0.01 GHz	+10 to –25	+9 to –25	+8 to –95
>0.01 GHz to 2.5 GHz	+12 to –25	+11 to –25	+10 to –95
>2.5 GHz to 20 GHz	+9 to –20	+8 to –20	+7 to –90
>20 GHz to 40 GHz	+9 to –25	+8 to –25	+7 to –95
With Option 31*2			
70 kHz to 0.01 GHz	+12 to –25	+11 to –25	+10 to –95
>0.01 GHz to 2.5 GHz	+14 to –25	+13 to –25	+12 to –95
>2.5 GHz to 20 GHz	+12 to –20	+11 to –20	+10 to –90
>20 GHz to 40 GHz	+12 to –25	+11 to –25	+10 to –95

*1: The Option 61 power range reported in this column applies to Port 1. For Port 2, use the figures from the Option 51 column.
*2: With Option 8x, Test Port 2 maximum power is equivalent to the non-option 31 range (typ.).

MS4647B, 70 GHz Model, Power Range (dBm)			
Frequency Range	Standard	Option 51	Option 61*1 or 62
70 kHz to 0.01 GHz	+10 to –25	+9 to –25	+8 to –85
>0.01 GHz to 2.5 GHz	+12 to –25	+11 to –25	+10 to –85
>2.5 GHz to 5 GHz	+6 to –20	+5 to –20	+3 to –80
>5 GHz to 20 GHz	+5 to –20	+4 to –20	+2 to –80
>20 GHz to 38 GHz	+6 to –25	+4 to –25	+2 to –85
>38 GHz to 50 GHz*2	+5 to –25	+3 to –25	+1 to –85
>50 GHz to 65 GHz	0 to –25	–2 to –25	–4 to –85
>65 GHz to 67 GHz	–2 to –25	–3 to –25	–5 to –85
>67 GHz to 70 GHz	–3 to –25	–6 to –25	–10 to –85
With Option 31*3			
70 kHz to 0.01 GHz	+12 to –25	+11 to –25	+10 to –85
>0.01 GHz to 2.5 GHz	+14 to –25	+13 to –25	+12 to –85
>2.5 GHz to 5 GHz	+8 to –20	+7 to –20	+5 to –80
>5 GHz to 20 GHz	+8 to –20	+7 to –20	+5 to –80
>20 GHz to 38 GHz	+8 to –25	+6 to –25	+4 to –85
>38 GHz to 50 GHz	+7 to –25	+5 to –25	+3 to –85
>50 GHz to 65 GHz	+7 to –25	+5 to –25	+3 to –85
>65 GHz to 67 GHz	+6 to –25	+4 to –25	+2 to –85
>67 GHz to 70 GHz	+4 to –25	+1 to –25	–3 to –85

*1: The Option 61 power range reported in this column applies to Port 1. For Port 2, use the figures from the Option 51 column.
*2: Rated power is typical 49 GHz to 50 GHz.
*3: With Option 8x, Test Port 2 maximum power is equivalent to the non-option 31 range (typ.). 38 GHz to 50 GHz range may degrade by up to 3 dB.

Output Default Power

Instrument default power. For maximum rated power, refer to "Power Range" above.

Model	Standard (No Options)	Option 51, 61 or 62*1
MS4642B, 20 GHz	NA	+5 dBm
MS4644B, 40 GHz	+5 dBm	+5 dBm
MS4647B, 70 GHz	–3 dBm*2	–10 dBm

*1: Measured at default power.
*2: Measured between default and 5 dB below default port power.

Power Accuracy, Linearity and Resolution

Frequency Range	Accuracy*1 (dB)	Linearity*2 (dB)	Resolution (dB)
70 kHz to 0.01 GHz	±1.5	±1.5	0.01
>0.01 GHz to 40 GHz	±1.5	±1.0	0.01
>40 GHz to 67 GHz	±3.0	±1.0	0.01
>67 GHz to 70 GHz	±4.0 (±3.0)	±2.0 (±1.0)	0.01

*1: Measured at default power.
*2: Measured between default and 5 dB below default port power.

Measurement Stability

Ratio measurement, with ports shorted. Characteristic.

Frequency Range	Magnitude (dB/°C)	Phase (degree/°C)
70 kHz to 0.01 GHz	<0.04	<0.4
>0.01 GHz to 20 GHz	<0.02	<0.2
>20 GHz to 40 GHz	<0.03	<0.5
>40 GHz to 67 GHz	<0.03	<0.7
>67 GHz to 70 GHz	<0.04	<0.8

Frequency Resolution, Accuracy, and Stability

Resolution	Accuracy	Stability
1 Hz	±5 × 10^{-7} Hz/Hz (at time of calibration)	<5 × 10^{-9}/°C over 0° to 50°C temperature <1 × 10^{-9}/day aging, instrument on

Phase Noise, Harmonics, and Non-Harmonics (Spurious)

Measured at default power. Phase Noise values are typical. Non-Harmonics are characteristic performance.

Frequency Range	SSB Phase Noise (dBc/Hz) at 1 kHz Offset	SSB Phase Noise (dBc/Hz) at 10 kHz Offset	SSB Phase Noise (dBc/Hz) at 100 kHz Offset	Harmonics (dBc) (second and third)	Non-Harmonic Spurious (dBc) at > 1 kHz Offsets
70 kHz to 0.01 GHz	–86	–83	–88[*1]	–20	–20
>0.01 GHz to 2.5 GHz	–90	–92	–96	–20	–30
>2.5 GHz to 5 GHz	–93	–94	–95	–20[*2]	–30
>5 GHz to 10 GHz	–86	–90	–90	–20	–30
>10 GHz to 20 GHz	–81	–84	–84	–20	–30
>20 GHz to 26.5 GHz	–78	–81	–81	–20	–30
>26.5 GHz to 40 GHz	–72	–76	–78	–20[*2]	–30
>40 GHz to 50 GHz	–70	–75	–75	–20	–30
>50 GHz to 70 GHz	–69	–71	–71	–20	–30

*1: Only applies for source frequencies >300 kHz.
*2: Typical from 2.5 GHz to 2.7 GHz on MS4642B systems and from 20.0 GHz to 21.0 GHz on MS4647B systems.

Uncorrected (Raw) Port Characteristics

Characteristic performance with Options 31, 51, 61, or 62 (and Option 8 or 9 for MS4642B).

Frequency Range	Directivity (dB)	Port Match[*1] (dB)
70 kHz to 0.01 GHz	>10[*2]	>8
>0.01 GHz to 2.5 GHz	>9[*2]	>10
>2.5 GHz to 5 GHz	>20	>10
>5 GHz to 20 GHz	>17	>9
>20 GHz to 40 GHz	>14	>7
>40 GHz to 65 GHz	>11	>7
>65 GHz to 67 GHz	>11	>7
>67 GHz to 70 GHz	>5 (>10)	>7

*1: Port Match is defined as the worst of source and load match.
*2: Raw Directivity degraded to 4 dB (typ.) below 300 kHz and in a 300 MHz window below 2.5 GHz.

Power Range with Option 32

Maximum Rated Power to minimum level. Option 32 System Dynamic range differs by the delta in max power.

Source1 to port1 power range (dBm)

Frequency Range	Standard	Option 51	Option 61 or 62
MS4642B, 20 GHz with Option 31 and Option 32			
70 kHz to 0.01 GHz	—	—	+8 to –95
>0.01 GHz to 2.5 GHz	—	—	+10 to –95
>2.5 GHz to 20 GHz	—	—	+10 to –90
MS4644B, 40 GHz with Option 31 and Option 32			
70 kHz to 0.01 GHz	+10 to –25	+9 to –25	+8 to –95
>0.01 GHz to 2.5 GHz	+12 to –25	+11 to –25	+10 to –95
>2.5 GHz to 20 GHz	+10 to –20	+9 to –20	+8 to –90
>20 GHz to 40 GHz	+10 to –25	+9 to –25	+8 to –95
MS4647B, 70 GHz with Option 31 and Option 32			
70 kHz to 0.01 GHz	+10 to –25	+9 to –25	+8 to –85
>0.01 GHz to 2.5 GHz	+12 to –25	+11 to –25	+10 to –85
>2.5 GHz to 5 GHz	+6 to –20	+5 to –20	+3 to –80
>5 GHz to 20 GHz	+6 to –20	+5 to –20	+3 to –80
>20 GHz to 38 GHz	+6 to –25	+4 to –25	+2 to –85
>38 GHz to 50 GHz	+5 to –25	+3 to –25	+1 to –85
>50 GHz to 65 GHz	+5 to –25	+3 to –25	+1 to –85
>65 GHz to 67 GHz	+3 to –25	+1 to –25	–1 to –85
>67 GHz to 70 GHz	+2 to –25	–1 to –25	–5 to –85

Source2 to port2 power range (dBm)

Frequency Range	Standard	Option 51	Option 61 or 62
MS4642B, 20 GHz with Option 31 and Option 32			
70 kHz to 0.01 GHz	—	—	+6 to –95
>0.01 GHz to 2.5 GHz	—	—	+8 to –95
>2.5 GHz to 20 GHz	—	—	+9 to –90
MS4644B, 40 GHz with Option 31 and Option 32			
70 kHz to 0.01 GHz	+8 to –25	+7 to –25	+6 to –95
>0.01 GHz to 2.5 GHz	+10 to –25	+9 to –25	+8 to –95
>2.5 GHz to 20 GHz	+7 to –20	+6 to –20	+5 to –90
>20 GHz to 40 GHz	+7 to –25	+6 to –25	+5 to –95
MS4647B, 70 GHz with Option 31 and Option 32			
70 kHz to 0.01 GHz	+8 to –25	+7 to –25	+6 to –85
>0.01 GHz to 2.5 GHz	+10 to –25	+9 to –25	+8 to –85
>2.5 GHz to 5 GHz	+4 to –20	+3 to –20	+1 to –80
>5 GHz to 20 GHz	+3 to –20	+2 to –20	0 to –80
>20 GHz to 38 GHz	+4 to –25	+2 to –25	0 to –85
>38 GHz to 50 GHz*	+3 to –25	+1 to –25	–1 to –85
>50 GHz to 65 GHz	–2 to –25	–4 to –25	–6 to –85
>65 GHz to 67 GHz	–4 to –25	–5 to –25	–7 to –85
>67 GHz to 70 GHz	–5 to –25	–8 to –25	–12 to –85

*: Rated power is typical 49 GHz to 50 GHz.

Source2 to port1 power range (dBm, typical performance)

Frequency Range	Standard	Option 51 or 61	Option 62
MS4642B, 20 GHz with Option 31 and Option 32			
70 kHz to 0.01 GHz	—	—	–22 to –95
>0.01 to 2.5 GHz	—	—	–15 to –95
>2.5 to 20 GHz	—	—	–11 to –95
MS4644B, 40 GHz with Option 31 and Option 32			
70 kHz to 0.01 GHz	–20 to –25	–21 to –25	–22 to –95
>0.01 GHz to 2.5 GHz	–13 to –25	–14 to –25	–15 to –95
>2.5 GHz to 20 GHz	–9 to –25	–10 to –25	–11 to –95
>20 GHz to 40 GHz	–8 to –25	–9 to –25	–10 to –95
MS4647B, 70 GHz with Option 31 and Option 32			
70 kHz to 0.01 GHz	–20 to –25	–21 to –25	–22 to –85
>0.01 GHz to 2.5 GHz	–13 to –25	–14 to –25	–15 to –85
>2.5 GHz to 5 GHz	–12 to –25	–13 to –25	–15 to –85
>5 GHz to 20 GHz	–11 to –25	–12 to –25	–14 to –85
>20 GHz to 38 GHz	–11 to –25	–13 to –25	–15 to –85
>38 GHz to 50 GHz	–12 to –25	–14 to –25	–16 to –85
>50 GHz to 65 GHz	–16 to –25	–18 to –25	–20 to –85
>65 GHz to 67 GHz	–17 to –25	–18 to –25	–20 to –85
>67 GHz to 70 GHz	–20 to –25	–23 to –25	–27 to –85

MS4642B 20 GHz VNA System Performance

MS4642B – 12-Term SOLT – Sliding Load – 3652A-1 K Calibration Kit

MS4642B 20 GHz Model, with 12-term SOLT with Sliding Load Calibration, using the 3652A-1 K Calibration Kit.

Frequency Range	Directivity	Source Match	Load Match[*1]	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz	>38 dB	>36 dB	>38 dB	±0.02 dB	±0.05 dB
>0.01 GHz to 2.5 GHz	>42 dB	>41 dB	>42 dB	±0.005 dB	±0.03 dB
>2.5 GHz to 20 GHz	>43 dB	>39 dB	>43 dB	±0.006 dB	±0.07 dB

MS4642B – 12-Term SOLT – 3652A or 3652A-1 K Calibration Kit

MS4642B 20 GHz Model, with 12-term SOLT Calibration, using 3652A K or 3652A-1 K Cal Kit.

Frequency Range	Directivity	Source Match	Load Match[*1]	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz	>38 dB	>36 dB	>38 dB	±0.02 dB	±0.05 dB
>0.01 GHz to 2.5 GHz	>37 dB	>41 dB	>37 dB	±0.005 dB	±0.03 dB
>2.5 GHz to 20 GHz	>34 dB	>39 dB	>35 dB	±0.006 dB	±0.07 dB

MS4642B with .s1p Calibration and 3652A-3 or 3652A-4 K Calibration Kit

MS4642B 20 GHz Model, with.s1p Calibration, using the 3652A-3 or 3652A-4 K Calibration Kit.

Frequency Range	Directivity	Source Match	Load Match[*1]	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz	>47 dB	>45 dB	>46 dB	±0.02 dB	±0.05 dB
>0.01 GHz to 2.5 GHz	>47 dB	>45 dB	>46 dB	±0.005 dB	±0.03 dB
>2.5 GHz to 20 GHz	>46 dB	>45 dB	>46 dB	±0.006 dB	±0.07 dB

MS4642B – 12-Term SOLT – Sliding Load – 3650A-1 3.5 mm Calibration Kit

MS4642B 20 GHz Model, with 12-term SOLT Calibration with Sliding Load Calibration, using the 3650A-1 3.5 mm Cal Kit.

Frequency Range	Directivity	Source Match	Load Match*1	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz	>40 dB	>37 dB	>40 dB	±0.02 dB	±0.05 dB
>0.01 GHz to 2.5 GHz	>42 dB	>41 dB	>42 dB	±0.005 dB	±0.03 dB
>2.5 GHz to 10 GHz	>43 dB	>39 dB	>43 dB	±0.005 dB	±0.03 dB
>10 GHz to 20 GHz	>43 dB	>39 dB	>43 dB	±0.006 dB	±0.07 dB

MS4642B – 12-Term SOLT – 3650A or 3650A-1 3.5 mm Calibration Kit

MS4642B 20 GHz Model, with 12-term SOLT Calibration, using the 3650A or 3650A-1 3.5 mm Cal Kit.

Frequency Range	Directivity	Source Match	Load Match*1	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz	>40 dB	>37 dB	>40 dB	±0.02 dB	±0.05 dB
>0.01 GHz to 2.5 GHz	>42 dB	>40 dB	>42 dB	±0.005 dB	±0.03 dB
>2.5 GHz to 10 GHz	>40 dB	>34 dB	>40 dB	±0.005 dB	±0.03 dB
>10 GHz to 20 GHz	>30 dB	>34 dB	>30 dB	±0.006 dB	±0.07 dB

MS4642B – 12-Term – 36585K K AutoCal™

MS4642B 20 GHz Model, with 12-term Calibration, using the 36585K K Automatic Calibrator (AutoCal)

Frequency Range	Directivity	Source Match	Load Match*1	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz*2	>40 dB	>40 dB	>43 dB	±0.10 dB	±0.10 dB
>0.01 GHz to 2.5 GHz	>43 dB	>47 dB	>43 dB	±0.05 dB	±0.03 dB
>2.5 GHz to 20 GHz	>50 dB	>47 dB	>50 dB	±0.09 dB	±0.03 dB

*1: Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

*2: Typical performance below 2 MHz.

MS4644B 40 GHz VNA System Performance

MS4644B – 12-Term SOLT – Sliding Load – 3652A-1 K Calibration Kit

MS4644B 40 GHz Model, with 12-term SOLT with Sliding Load Calibration, using the 3652A-1 K Calibration Kit.

Frequency Range	Directivity	Source Match	Load Match*1	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz	>38 dB	>36 dB	>38 dB	±0.02 dB	±0.05 dB
>0.01 GHz to 2.5 GHz	>42 dB	>41 dB	>42 dB	±0.005 dB	±0.03 dB
>2.5 GHz to 20 GHz	>43 dB	>39 dB	>43 dB	±0.006 dB	±0.07 dB
>20 GHz to 40 GHz	>40 dB	>34 dB	>40 dB	±0.006 dB	±0.08 dB

MS4644B – 12-Term SOLT – 3652A or 3652A-1 K Calibration Kit

MS4644B 40 GHz Model, with 12-term SOLT Calibration, using the 3652A or 3652A-1 K Calibration Kit.

Frequency Range	Directivity	Source Match	Load Match*1	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz	>38 dB	>36 dB	>38 dB	±0.02 dB	±0.05 dB
>0.01 GHz to 2.5 GHz	>37 dB	>41 dB	>37 dB	±0.005 dB	±0.03 dB
>2.5 GHz to 20 GHz	>34 dB	>39 dB	>35 dB	±0.006 dB	±0.07 dB
>20 GHz to 40 GHz	>32 dB	>34 dB	>32 dB	±0.006 dB	±0.08 dB

MS4644B with .s1p Calibration and 3652A-3 or 3652A-4 K Calibration Kit

MS4644B 40 GHz Model, with .s1p Calibration , using the 3652A-3 or 3652A-4 K Calibration Kit.

Frequency Range	Directivity	Source Match	Load Match*1	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz	>47 dB	>45 dB	>46 dB	±0.02 dB	±0.05 dB
>0.01 GHz to 2.5 GHz	>47 dB	>45 dB	>46 dB	±0.005 dB	±0.03 dB
>2.5 GHz to 20 GHz	>46 dB	>45 dB	>46 dB	±0.006 dB	±0.07 dB
>20 GHz to 40 GHz	>42 dB	>38 dB	>42 dB	±0.006 dB	±0.07 dB

MS4644B – 12-Term – 36585K K AutoCal

MS4644B 40 GHz Model, with 12-term Calibration, using the 36585K K AutoCal.

Frequency Range	Directivity	Source Match	Load Match*1	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz*2	>40 dB	>40 dB	>43 dB	±0.10 dB	±0.10 dB
>0.01 GHz to 2.5 GHz	>43 dB	>47 dB	>43 dB	±0.05 dB	±0.03 dB
>2.5 GHz to 20 GHz	>50 dB	>47 dB	>50 dB	±0.09 dB	±0.03 dB
>20 GHz to 40 GHz	>48 dB	>47 dB	>48 dB	±0.14 dB	±0.07 dB

*1: Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 Series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

*2: Typical performance below 2 MHz.

MS4647B 70 GHz VNA System Performance

MS4647B VNA – 12-Term SOLT Sliding Load – 3654D-1 V Calibration Kit

Frequency Range	Directivity	Source Match	Load Match*	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz	>38 dB	>36 dB	>38 dB	±0.02 dB	±0.05 dB
>0.01 GHz to 2.5 GHz	>41 dB	>39 dB	>41 dB	±0.02 dB	±0.05 dB
>2.5 GHz to 20 GHz	>41 dB	>37 dB	>41 dB	±0.02 dB	±0.07 dB
>20 GHz to 40 GHz	>37 dB	>32 dB	>37 dB	±0.02 dB	±0.08 dB
>40 GHz to 65 GHz	>35 dB	>28 dB	>35 dB	±0.08 dB	±0.12 dB
>65 GHz to 67 GHz	>35 dB	>28 dB	>35 dB	±0.15 dB	±0.15 dB
>67 GHz to 70 GHz	>30 dB	>26 dB	>30 dB	±0.30 dB	±0.15 dB

*: Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

MS4647B VNA – 12-Term SOLT – 3654D or 3654D-1 V Calibration Kit

Frequency Range	Directivity	Source Match	Load Match*	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz	>38 dB	>36 dB	>38 dB	±0.02 dB	±0.05 dB
>0.01 GHz to 2.5 GHz	>40 dB	>39 dB	>40 dB	±0.02 dB	±0.05 dB
>2.5 GHz to 20 GHz	>40 dB	>37 dB	>40 dB	±0.02 dB	±0.07 dB
>20 GHz to 40 GHz	>35 dB	>32 dB	>35 dB	±0.02 dB	±0.08 dB
>40 GHz to 65 GHz	>32 dB	>28 dB	>32 dB	±0.08 dB	±0.12 dB
>65 GHz to 67 GHz	>32 dB	>28 dB	>32 dB	±0.15 dB	±0.15 dB
>67 GHz to 70 GHz	>28 dB	>26 dB	>28 dB	±0.30 dB	±0.15 dB

*: Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

MS4647B VNA with .s1p Calibration and 3654D-3 or 3654D-4 Calibration Kit

Frequency Range*1	Directivity	Source Match	Load Match*2	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz	>47 dB	>47 dB	>46 dB	±0.02 dB	±0.05 dB
>0.01 GHz to 2.5 GHz	>47 dB	>47 dB	>46 dB	±0.01 dB	±0.05 dB
>2.5 GHz to 20 GHz	>46 dB	>42 dB	>46 dB	±0.01 dB	±0.07 dB
>20 GHz to 35 GHz	>44 dB	>42 dB	>44 dB	±0.01 dB	±0.07 dB
>35 GHz to 40 GHz	>44 dB	>41 dB	>44 dB	±0.03 dB	±0.08 dB
>40 GHz to 50 GHz	>42 dB	>37 dB	>42 dB	±0.05 dB	±0.1 dB
>50 GHz to 65 GHz	>42 dB	>34 dB	>42 dB	±0.06 dB	±0.1 dB
>65 GHz to 67 GHz	>40 dB	>34 dB	>40 dB	±0.1 dB	±0.12 dB
>67 GHz to 70 GHz	>37 dB	>34 dB	>37 dB	±0.15 dB	±0.12 dB

*1: The performance levels for the s1p calibration processes are contingent on the pin depth of the connector at the reference plane (and of any DUT connector) meeting Anritsu specifications.

*2: Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

MS4647B VNA – LRL – 3657-1 V Multi-Line Calibration Kit

MS4647B 70 GHz VNA, with an LRL Calibration, using the 3657-1 V Multi-Line Calibration Kit, with symmetric reflects.

Frequency Range	Directivity	Source Match	Load Match*1	Reflection Tracking	Transmission Tracking
0.24 GHz*2 to 2.5 GHz	>50 dB	>50 dB	>50 dB	±0.005 dB	±0.02 dB
>2.5 GHz to 20 GHz	>50 dB	>50 dB	>50 dB	±0.005 dB	±0.02 dB
>20 GHz to 40 GHz	>50 dB	>50 dB	>50 dB	±0.005 dB	±0.02 dB
>40 GHz to 65 GHz	>45 dB	>50 dB	>45 dB	±0.015 dB	±0.02 dB
>65 GHz to 67 GHz	>45 dB	>50 dB	>45 dB	±0.03 dB	±0.04 dB
>67 GHz to 70 GHz	>45 dB	>45 dB	>45 dB	±0.10 dB	±0.08 dB

*1: Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

*2: Limited to about 240 MHz, due to the longest line delta of 34.84 mm in the 3657 Series Multi-Line Calibration Kit.

MS4647B VNA – 12-Term – 36585V V AutoCal

MS4647B 70 GHz VNA, with 12-term Calibration, using the 36585V V AutoCal.

Frequency Range	Directivity	Source Match	Load Match*1	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz*2	>40 dB	>40 dB	>40 dB	±0.10 dB	±0.10 dB
>0.01 GHz to 2.5 GHz	>43 dB	>47 dB	>43 dB	±0.05 dB	±0.03 dB
>2.5 GHz to 20 GHz	>50 dB	>47 dB	>50 dB	±0.09 dB	±0.03 dB
>20 GHz to 40 GHz	>48 dB	>47 dB	>48 dB	±0.14 dB	±0.07 dB
>40 GHz to 65 GHz	>43 dB	>45 dB	>43 dB	±0.17 dB*3	±0.10 dB
>65 GHz to 67 GHz	>43 dB	>45 dB	>43 dB	±0.17 dB	±0.10 dB
>67 GHz to 70 GHz	>42 dB	>40 dB	>42 dB	±0.30 dB	±0.12 dB

*1: Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

*2: Limited to about 240 MHz, due to the longest line delta of 34.84 mm in the 3657 Series Multi-Line Calibration Kit.

*3: ±0.25 dB from 51 GHz to 55 GHz.

Measurement Times

Measurement times include sweep time, and band-switching time, in single channel mode. Typical.
~30 µs/point is achieved in true swept mode, with 100,000 points, with ALC turned on for level accuracy, with display turned-on for tuning purposes, with locking turned-on for frequency accuracy and repeatability, with correction turned on to meet published residual specifications, and over the full span of the product with all band-switch points to fully characterize a device.

Measurement Time (ms), SYNTHESIZED Sweep, Display ON and ALC ON

Calibration	Sweep Width	IFBW	Measurement Time (ms)			
			401 Points	1,601 Points	25,000 Points	100,000 Points
Uncorrected or 1-port calibration	Narrow (≤1 GHz span without band-switch points)	1 MHz	20	60	890	3,300
		30 kHz	30	110	1,600	6,100
		1 kHz	380	1,600	25,000	100,000
	Wide (70 GHz span)	1 MHz	50	90	1,000	3,400
		30 kHz	60	140	1,700	6,200
		1 kHz	420	1,670	25,000	100,000
2-port calibration (per sweep)	Narrow (≤1 GHz span without band-switch points)	1 MHz	20	60	890	3,300
		30 kHz	30	110	1,600	6,100
		1 kHz	400	1,610	25,000	100,000
	Wide (70 GHz span)	1 MHz	50	90	1,000	3,400
		30 kHz	60	140	1,700	6,200
		1 kHz	420	1,670	25,000	100,000

Measurement Time (ms) vs. Noise Floor (dBm), SYNTHESIZED Sweep, Display ON and ALC ON

Calibration	Full Band Sweep	Measurement Time 1,601 Points	Achieved Noise Floor at Maximum Frequency (dBm)	IFBW (kHz)
2-port calibration (per sweep)	MS4642B	110	–85	100
		210	–95	10
	MS4644B	115	–80	100
		210	–90	10
	MS4647B	120	–75	100
		210	–85	10

Standard Capabilities

Operating Frequency	MS4642B	40 kHz to 20.2 GHz
	MS4644B	10 MHz to 40.5 GHz
	MS4647B	10 MHz to 70 GHz
	MS4640B-070	Optional for all MS4640B Series VNAs. Provides 40 kHz to 10 MHz Coverage Extension. Provides a lower limit specified to 70 kHz, which is allowed to extend to 40 kHz.
Measurement Parameters	2-Port Measurements	S_{11}, S_{21}, S_{22}, S_{12}, and any user-defined combination of a_1, a_2, b_1, b_2, and 1.
	4-Port Measurements	Refer to the separate VectorStar MN469xC Series Multiport VNA Measurement System Technical Data Sheet – 11410-00777, available at https://www.anritsu.com/en-us/test-measurement/products/ms4640b-series
	Domains	Frequency Domain, Power Domain, CW Draw, and Time (Distance) Domain
Sweeps	Frequency Sweep Types	Linear, Log, CW, or Segmented
	Power Sweep Types	Linear, constant power sweeps, or constant power slope (dB/GHz) over frequency sweep
Display Graphs	Single Rectilinear Graph Types	Log Magnitude, Phase, Group Delay, Linear Magnitude, Real, Imaginary, SWR, Power Out, Impedance, and Power In
	Dual Rectilinear Graph Types	Log Magnitude and Phase, Linear Magnitude and Phase, and Real and Imaginary
	Circular Graph Types	Smith Chart (Impedance), Smith Chart (Admittance), Linear Polar, and Log Polar
Measurements Data Points	25,000 Data Points	2 to 25,000 points in up to 16 channels
	100,000 Data Points	2 to 100,000 points in single channel
Limit Lines	Limit Lines	Single or segmented. 2 limit lines per trace. 50 segments per limit line.
	Single Limit Readouts	Uses interpolation to determine the intersection frequency.
	Test Limits	Both single and segmented limits can be used for PASS/FAIL testing.
Averaging	Point-by-Point	Point-by-point (default), max Averaging = IF Bandwidth/1 Hz
	Sweep-by-Sweep	Sweep-by-sweep (no limit)
IF Bandwidth	1, 2, 3, 5, 7, 10, 20, 30, 50, 70, 100, 200, 300, 500, 700 Hz, 1, 2, 3, 5, 7, 10, 20, 30, 50, 70, 100, 200, 300, 500, 700 kHz, 1 MHz	
Reference Plane	Line Length or Time Delay	The reference planes of a calibration or other normalization can be changed by entering a line length or time delay.
	Dielectric Constants	Dielectric constants may be entered for different media so the length entry can be physically meaningful.
	Dispersion Modeling	Dispersion modeling is used in the cases of microstrip and waveguide to take into account frequency dependent phase velocities.
	Attenuations	Attenuations (with frequency slope) and constant phase offsets can be entered to better describe any reference plane distortions.
	Auto Modes	Automatic reference plane finding tools are available for phase alone or phase + magnitude. These routines do a fitting process on phase or phase and magnitude to estimate the reference plane location and enter correcting values
	De-embedding	For more complete reference plane manipulation, the full de-embedding system can also be used.
Measurement Frequency Range	Frequency Range Change	Frequency range of the measurement can be narrowed within the calibration range without recalibration.
	CW Mode	CW mode permits single frequency measurements also without recalibration.
	Interpolation Not Activated	If interpolation is not activated, the subset frequency range is forced to use calibration frequency points.
	Interpolation Activated	If interpolation is activated, any frequency range that is a subset of the calibration frequency range can be used, but there may be some added interpolation error.

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Group Delay	Group Delay Aperture	Defined as the frequency span over which the phase change is computed at a given frequency point.
	Aperture	The aperture can be changed without recalibration.
	Minimum Aperture	The minimum aperture is the frequency range divided by the number of points in calibration and can be increased to 20% of the frequency range.
	Group Delay Range	<180° of phase change within the aperture
Channels, Display, and Traces	Channels and Traces	16 channels, each with up to 16 traces
	Display	Color touch screen LCD, 26.4 cm (10.4") diagonal
	Display Colors	Unlimited colors for data traces, memory, text, markers, graticules and limit lines.
	Trace Memory and Math	A separate memory for each trace can be used to store measurement data for later display or subtraction, addition, multiplication or division with current measurement data. The trace data can be saved and recalled.
	Inter-trace Math	Any two traces within a channel can also be combined (via addition, subtraction, multiplication or division) and displayed on another trace. An equation editor mode is also available that allows the combination of trace data, trace memory and S-parameter data in more complex equations. Over 30 built-in functions are available. Simple editing tools and the ability to save/recall equations are also provided.
Scale Resolution Minimum per division, varies with graph type.	Log Magnitude	0.001 dB
	Linear Magnitude	1 pu
	Phase	0.01°
	Group Delay	0.001 ps
	Time	0.001 ps
	Distance	0.1 µm
	SWR	1 pu
	Power	0.01 dB
Markers	Markers	12 markers per trace (× 16 traces × 16 channels, for a total of 3,072)
	Marker Coupling	Coupled or decoupled within a channel
	Marker Data	Data displayed in graph area or in table form
	Reference Marker	Additional marker per trace for reference
	Marker Statistics	Mean, maximum, minimum, standard deviation Per trace or over a marker region.
	Marker Search and Tracking	Search and/or track for minimum, maximum, peak, or target value.
Other	Filter Parameters	Display bandwidth (user-selectable loss value), corner and center frequencies, loss, Q, and shape factors.
	Blank Frequency Information	Blanking function removes all references to frequencies on the display. Frequency references can only be restored through a system preset or GPIB command.

Calibration and Correction Capabilities

Calibration Methods	Short-Open-Load-Through (SOLT) with Fixed or Sliding Load and supporting .s1p-defined cal kits Offset-Short-Offset-Short-Load-Through (SSLT) with Fixed or Sliding Load Triple-Offset-Short-Through (SSST) Short-Open-Load-Reciprocal (SOLR) or Unknown Through Method (SSLR, SSSR) Line-Reflect-Line (LRL)/Line-Reflect-Match (LRM) – (up to 5 bands supported for multi-line configurations) Advanced-LRM (A-LRM™) for improved on-wafer calibrations AutoCal Thru Update available Secondary match correction available for improved low insertion loss measurements
Correction Models	2-Port (Forward, Reverse, or both directions) 1-Port (S_{11}, S_{22}, or both) Transmission Frequency Response (Forward, Reverse, or both directions) Reflection Frequency Response (S_{11}, S_{22}, or both)
Merged Calibration	Merge multiple calibrations over bands of frequency points and with different algorithms
Coefficients for Calibration Standards	Use the Anritsu calibration kit USB Memory Device to load kit coefficients and characterization files. Enter manual coefficients into user-defined locations. Complex load models are available. Full .s1p definitions of calibration standards can be loaded.
Reference Impedance	Modify the reference impedance from 50Ω to any impedance greater than 0Ω.
Interpolation	Allows interpolation between calibration frequency points. Accuracy will be reduced at non-calibration frequencies and that degradation is dependent on the frequency step size in the initial calibration and the electrical length of the user's setup.
Adapter Removal Calibration	Characterizes and "removes" an adapter that is used during calibration that will not be used for subsequent device measurements; for accurate measurement of non-insertable devices.
Dispersion Compensation	Selectable as Coaxial, other non-dispersive (e.g., for coplanar waveguide), Waveguide, or Microstrip.

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Power	Power Meter Correction	Different power meter calibrations are available to enhance power accuracy at the desired reference plane. The source power will match the target calibration power, as read by the power meter, to within ~0.1 dB for short periods of time (determined by thermal drift of the system and the power meter). The absolute accuracy of the calibrated power will be dependent on the power meter and sensor used.
	Flat Power Calibrations	A flat power calibration (when in frequency sweep mode) is available at a user-selectable power level, if it is within the power adjustment range of the internal source. The flat power correction is applied to other power levels.
	Linear Power Calibrations	A linear power calibration is performed over a range of power levels for use in power sweep mode and is performed at a specified frequency or frequency range.
	External Power Meter	Both calibrations are performed using an external power meter (Anritsu ML2438A, ML248xB, ML249xA, Agilent 437, or equivalent) over the Dedicated GPIB port, or a USB power sensor (Anritsu MA24106A, MA24108A, MA24118A, MA24126A, MA24330A, MA24340A, MA24350A, MA24507A) connected to a USB port. Note: Usage of the MA24507A sensor requires connection to two USB ports to supply needed current draw.
Embedding/ De-embedding	The MS4640B is equipped with an Embedding/De-embedding system.	
	De-embedding	De-embedding is generally used for removal of test fixture contributions, modeled networks and other networks described by S-parameters (s2p files) from measurements.
	Embedding	Similarly, the Embedding function can be used to simulate matching circuits for optimizing amplifier designs or simply adding effects of a known structure to a measurement.
	Multiple Networks	Multiple networks can be embedded/de-embedded and changing the port and network orientations is handled easily.
	Extraction Utility	An extraction utility is part of this package that allows the easier computation of deembedding files based on some additional calibration steps and measurements.
Impedance Conversion	Allows entry of different reference impedances (complex values) for different ports	
Mixer Setup	Mixer setup provides assistance to configure common mixer measurements including a simple, yet accurate, calibration methodology.	
	Mixer Setup – Single Channel	The prime objective of the guided Mixer Setup Single Channel is to help configure the frequency plan of the measurement using easy-to-understand diagrams. Mixers using harmonics of the LO are supported as are mm-wave configurations (see ME7838x documentation).
	Mixer Setup – Multiple Channel	The Mixer Setup Multiple Channels helps configure measurement channels to handle any of a suite of possible mixer measurements and to list the required calibration steps.
	Mixer Calibration	Both of these tools are coupled with the mixer calibration menu system that enables both scalar and vector-corrected measurements. The user can be directed to power calibrations that are automatically set up based on the mixer configuration.
	Dual Source Mixer	Allows easier external mixer setups and can take advantage of the flexibility of having two independent internal sources within the VNA.

Remote Operability

VectorStar supports several remote operability options.

Communication Type	Data Format	Performance	Description
Via GPIB	Using IEEE 488.2	1 MB/s Data Transfer Speed	Use SCPI or previous generation Lightning VNA commands. Also compatible with a fundamental set of HP/Agilent 8510x VNA commands.
Via LAN	Using VXI-11 Protocol	2.5 MB/s Data Transfer Speed	
Via USB	Using USBTMC Protocol	5.5 MB/s Data Transfer Speed	
Drivers for GPIB, LAN, or USB	National Instruments LabVIEW and LabWindows/CVI drivers are available for download from both the Anritsu and National Instruments web sites. .NET/COM driver for Windows™ Applications such as Visual Studio 6 thru VS 2005, VB6, C#, C++, C, Visual C, HP Vee, and more are available for download from the Anritsu web site. These drivers require VISA runtime, not provided by Anritsu. NI VISA version 3.2 or higher is recommended for .NET and USB support.		
Triggering	Internal, External, GPIB Single point, Single Sweep, and Single Channel. All Channels are hand-shaking for optimum tandem sweeps (check rear panel connections).		

Throughput Time

Throughput Time (ms), Synthesized Sweep, Display ON and ALC ON, single 20 GHz sweep, 30 kHz IFBW, including trigger and data transfer time.

Communication Type	Data Format	Measurement Time		
		401 points	1,601 points	100,000 points
GPIB (IEEE-488.2)	32- or 64-bit Floating	380	410	6,400
	ASCII	290	370	7,400
LAN (VXI-11)	32- or 64-bit Floating	280	320	6,300
	ASCII	290	350	7,400
USB (USBTMC class)	32- or 64-bit Floating	280	310	6,000
	ASCII	290	350	6,800

Optional Capabilities

Time Domain Measurements — Option 2	Displays all S-parameters and overlays with Frequency Domain, Low-pass Mode with added harmonics frequency list flexibility, Band-pass Mode, Phasor Impulse Mode, Windowing, Gating (pass-band or reject-band), and Frequency with Time Gate. Low-pass mode requires a harmonically related frequency list (step size = start frequency). A harmonic sweep tool is available to help with this setup. In low-pass mode, the impulse or step response can be displayed (the latter for a TDR-like presentation). When applying gating, the impedance levels at gate edges can be changed to simplify de-embedding operations.	
Receiver Offset — Option 7	Independent Source/Receive Functions	Allows for independent source and receive functions for Mixer, Harmonics, IMD and other measurements, where the source and receive frequencies are offset.
	Multiple Source Control Mode	To independently control the frequencies of up to four external sources, in addition to the internal source, and the receiver, in a synchronized manner.
	NxN Frequency-Translated Devices	Provides calibration and measurements capability for NxN Frequency-translated devices. For accurate and absolute magnitude and phase measurements of match, gain/loss, and group delay of devices such as mixers and converters.
Active Device Measurements — Option 8	(MS4642B Minimum configuration requirement – with two attenuators) Option 8 (ordered as MS4642B-008) configures the MS4642B for active device measurements which includes the following features:	
	Frequency Offset Control	For measurements of harmonics, spurious, etc. See Receiver Offset — Option 7 for details.
	70 kHz Frequency	See 70 kHz Low End Frequency Extension — Option 70 for details.
	Noise Figure Measurements	If MS4642B-008 ordered, see Noise Figure — Option 41 for details. If MS4642B-008D ordered, see Differential Noise Figure — Option 48 for details.
	Active Measurement Suite	Adds two 70 dB attenuators and bias tees (Formerly ordered as MS4642B-061. See Active Measurements Suite — Option 61/62 for details)
Active Device Measurements — Option 9	(MS4642B Minimum configuration requirement – with four attenuators) Option 9 (ordered as MS4642B-009) configures the MS4642B for active device measurements which includes the following features:	
	Frequency Offset Control	For measurements of harmonics, spurious, etc. See Receiver Offset — Option 7 for details.
	70 kHz Frequency Coverage	See 70 kHz Low End Frequency Extension — Option 70 for details.
	Noise Figure Measurements	If MS4642B-009 ordered, see Noise Figure — Option 41 for details. If MS4642B-009D ordered, see Differential Noise Figure — Option 48 for details.
	Active Measurement Suite	Adds four 70 dB attenuators and bias tees See Active Measurements Suite — Option 61/62 for details.
Universal Fixture Extraction — Option 21	Description	Provides a suite of additional network extraction techniques for different de-embedding problems, particularly those when only partial interface information is available at the DUT plane. These are often useful for on-wafer and fixtured environments with more complex DUT interfaces where traditional standards may not be available. In most cases, .s1p definition/model of reflect standards is allowed and generally automatic fixture length detection is available. In addition, a sequential extraction (peeling) of isolated fixture defects is possible and allows one to generate sNp files for portions of the fixture for design analysis.
Dual Source Architecture — Option 31	Description	Adds a second internal source to the VNA structure and removes the transfer switch. This architecture results in higher test port power and improved dynamic range. Combined with Option 7 Receiver Offset, allows two sources and the receiver to be active at the same time and at independent frequencies. When both sources are active and at the same frequency, a relative phase shift can be set between them. When combined with Option 43 DifferentialView™, adds the ability to perform true mode stimulus measurements of differential devices. The dual source mixer capability allows the flexibility of two independent sources within the VNA to allow external mixer measurements.
	Required Options	None, except with the dual source mixer applications which require Option 7.
	System Compatible Options	Option 2 Time Domain Option 7 Receiver Offset Option 21 Universal Fixture Extraction Option 32 Internal RF Combiner Option 35 IF Digitizer Option 36 Extended IF Digitizer Memory Option 41 Noise Figure Option 42 PulseView™ Option 43 DifferentialView™ Option 44 IMDView™ Option 46 Fast CW Option 47 Eye Diagram Option 48 Differential Noise Figure Option 51 Direct Access Loops Option 53 External ALC Option 53 External ALC Options 61/62 Active Measurements Suite Option 70 70 kHz Low Frequency Extension Options 84/85 Broadband/Banded/Millimeter-Wave Extension Options 88/89 Broadband/Banded/Millimeter-Wave Extension. Maximum frequency available is 110 GHz
	Incompatible	Options 80/81 Broadband/Millimeter-Wave Options 82/83 Banded Millimeter-Wave Extension Options 86/87 Broadband/Millimeter-Wave. Maximum frequency available is 110 GHz.

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Internal RF Combiner — Option 32	Description	Adds an internal combiner to combine Source 2 of the Dual Source Architecture option (Option 31) with Source 1 and routes to Port 1 of the VectorStar front panel. When combined with IMDView Option 44 the configuration provides optimized intermodulation distortion (IMD) measurements. The Frequency Offset (Option 7) and Dual Source (Option 31) must be ordered with the combiner option. If IMDView Option 44 is not included, switching of the combiner is activated using the Multiple Source Control menus supplied with the frequency offset option.
	Required Options	Option 7 Receiver Offset and Option 31 Dual Source Architecture
	System Compatible Options	Option 2 Time Domain Option 21 Universal Fixture Extraction Option 35 IF Digitizer Option 36 Extended IF Digitizer Memory Option 41 Noise Figure Option 42 PulseView™ Option 43 DifferentialView™ Option 44 IMDView™ Option 46 Fast CW Option 47 Eye Diagram Option 48 Differential Noise Figure Option 51 Direct Access Loops Option 53 External ALC Option 61/62 Active Measurements Suite Option 70 70 kHz Low Frequency Extension Options 84/85 Broadband/Banded/Millimeter-Wave Extension Options 88/89 Broadband/Banded/Millimeter-Wave Extension. Maximum frequency available is 110 GHz
	Incompatible Options	Options 80/81 Broadband/Millimeter-Wave Options 82/83 Banded/Millimeter-Wave Extension Options 86/87 Broadband/Millimeter-Wave. Maximum frequency available is 110 GHz
IF Digitizer — Option 35	Description	When combined with Option 42 PulseView™, adds the capability to generate and measure pulsed signals. Four internal signal generators are included enabling singlet, doublet, triplet, quadruplet, and/or burst signal generation. Pulse measurements include pulse profile, point-inpulse, and pulse-to-pulse capability.
	Required Options	None
	System Compatible Options	All
	Incompatible Options	None
	Multiport Systems	Compatible with the MN469xC Series Multiport System on any model VNA. Fast CW (non-pulsed) Captures up to 400 million data points per measurement channel with variable acquisition rates from 80 MHz to 400 MHz. This capability enables long time records (0.5 s to 2.5 s, depending on acquisition rate) stored in files retrievable via USB or a local area network.
	Additional Information	For detailed pulse measurement theory, description, and operational information, see the VectorStar MS464xB Series VNA Calibration and Measurement Guide, 10410-00318.
Extended IF Digitizer Memory — Option 36	Description	Provides additional memory for the IF digitizer option to allow for longer record lengths. This option increases the maximum record length from 0.5 seconds to 2.5 seconds at the maximum sampling rate (minimum time resolution) with proportionate increases in record length increases at other sampling rates.
	Required Options	Option 35 IF Digitizer
	System Compatible Options	All
	Incompatible Options	None
Noise Figure — Option 41	Description	Adds the capability to measure degradation of the signal-to-noise ratio caused by components in a signal chain. The Noise Figure measurement is based on a cold source technique for improved accuracy. Various levels of match and fixture correction are available for additional enhancement.
	Required Options	Option 51, Option 61, or Option 62
	System Compatible Options	Option 2 Time Domain Option 7 Receiver Offset Option 21 Universal Fixture Extraction Option 31 Dual Source Architecture Option 32 Internal RF Combiner Option 35 IF Digitizer Option 36 Extended IF Digitizer Memory Option 42 PulseView™ Option 43 DifferentialView™ Option 44 IMDView™ Option 46 Fast CW Option 47 Eye Diagram Option 53 External ALC Option 70 70 kHz Low Frequency Extension Options 81/87 Broadband/Millimeter-Wave Option 83 Millimeter-Wave Extension Options 85/89 Broadband/Banded/Millimeter-Wave Extension
	Incompatible Options	Option 48 Differential Noise Figure Options 80/86 Broadband/Millimeter-Wave Option 82 Banded Millimeter-Wave Extension Option 84 Broadband/Banded/Millimeter-Wave Extension Option 86 Broadband/Millimeter-Wave Option 88 Broadband/Banded/Millimeter-Wave Extension
	Multiport System	MN469xC Series Multiport System on any model VNA; Noise Figure is only available when configured as a 2-Port VNA.
	Additional Information	For detailed Noise Figure measurement theory, description, and operational information, see the VectorStar MS464xB Series VNA Calibration and Measurement Guide, 10410-00318.

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PulseView™ — Option 42	Description	When combined with Option 35 IF Digitizer, adds the capability to generate and measure pulsed signals. Four internal signal generators are included enabling singlet, doublet, triplet, quadruplet, and/or burst signal generation. Pulse measurements include pulse profile, point-in-pulse, and pulse-to-pulse capability.
	Required Options	Option 35 IF Digitizer
	System Compatible Options	All
	Incompatible Options	None
	Multiport Systems	Compatible with the MN469xC Series Multiport System on any model VNA
	Additional Information	For detailed pulse generation and measurement capability theory, description, and operation information, see the VectorStar MS464xB Series VNA Calibration and Measurement Guide - 10410-00318.
	Pulse Measurements	Pulse profile (PP), point-in-pulse (PIP), pulse-to-pulse (P2P), continuous pulse profiling (Cprof), and continuous point-in-pulse (CPIP)
	Minimum Profile Width	2.5 ns (5 ns minimum for continuous profiling)
	Minimum PIP Measurement Width	2.5 ns (5 ns minimum for continuous point-in-pulse)
	P2P Measurement Width	Minimum 5 ns
	Record Length	0.5 s
	Pulse Repetition Frequency (PRF)	4 Hz to 67 MHz in Pulse mode; PRFs slower than 4 Hz can be measured in standard Transmission/Reflection mode with triggering.
	Duty Cycle (DC) Dynamic Range Reduction (characteristic)	
	1% DC	0 dB
	0.1% DC	0 dB
	0.01% DC	0 dB
	Pulse Generation	Four (4) internal pulse generators: PG1-PG4.
	Pulse Formats	Singlet, doublet, triplet, quadruplet, and burst
	Pulse Repetition Frequency (PRF) Range	4 Hz to 67 MHz
	Maximum Pulse Width	0.25 s
	Minimum Pulse Width	5 ns
	RF Modulation	Requires a SM6628, SM6629, SM6630, or SM6631 Pulse Modulator Test Set (see next section)
RF Modulation (Pulse Modulator Test Sets for use with Option 42 PulseView™)	Description	Pulse Modulator Test Sets are available to pulse the RF stimulus and/or provide receiver gating (modulation). Receiver gating generally required only for higher power antenna and related applications where undesired pulses could saturate the VNA receiver. The Test Set frequency range is limited to that of the VNA with which it is used. Test Sets include necessary cabling and installation documentation.
	Required Options	Option 35 IF Digitizer Option 42 PulseView™ Option 51 Direct Access Loops or Options 61/62 Active Measurements Suite
	Requires one of the following compatible Pulse Modulator Test Sets	SM6628, 70 kHz to 40 GHz. Provides the MS4642B and MS4644B VNA with source modulation. SM6629, 70 kHz to 40 GHz. Provides the MS4642B and MS4644B VNA with source and receiver modulation. SM6630, 70 kHz to 70 GHz. Provides the MS4647B VNA with source modulation. SM6631, 70 kHz to 70 GHz. Provides the MS4647B VNA with source and receiver modulation.
	Polarity	Low (<1 V) = RF ON High (3.3 V ±10%) = RF OFF
	Pulse Rise/Fall Time (typ.)	5 ns (10 to 90%)
	Insertion Loss (typ.)	<10 dB, to 20 GHz <12 dB, 20 GHz to 40 GHz <15 dB, 40 GHz to 60 GHz <20 dB, 60 GHz to 70 GHz
	On/Off Ratio (typ.)	>100 dB, to 20 GHz >95 dB, 20 GHz to 60 GHz >90 dB, 60 GHz to 70 GHz
	Max Input Power	+20 dBm max, 0 VDC max
	Latency (typ.)	35 ns
DifferentialView™ — Option 43	Description	When combined with Option 31 Dual Source Architecture, provides dual source control and calibrations required for stimulating and measuring differential devices. Allows true differential and common mode device drives. Corrects mismatch introduced error of the DUT to VNA interface via real and time calibration. This mode supports balanced in/out or combined balanced and single source drive configurations. In addition, it provides the ability to control amplitude and phase offsets of the drive conditions as well as swept phase offset for custom characterization.
	Required Options	Option 31 Dual Source Architecture
	Compatible Options	All
	Incompatible Options	None
	Multiport Systems	Requires an MN469xC Series Multiport System for full differential characterization of a multiport device.

Continued on next page

IMDView™— Option 44	Description	When combined with Options 31, 32, and 7, IMDView provides user interface for setting up and performing IMD measurements. Interface configures and controls source routing, power and receiver calibrations, for baseband or mmWave VectorStar systems. Frequency Offset Option 7 required. If Options 31 and/or 32 are not included, the IMDView software will control external sources and perform power calibrations of external combiners.
	Required Options	Option 7 Receiver Offset
	System Compatible Options	Option 2 Time Domain Option 7 Receiver Offset Option 21 Universal Fixture Extraction Option 31 Dual Source Architecture Option 32 Internal RF Combiner Option 35 IF Digitizer Option 36 Extended IF Digitizer Memory Option 42 PulseView™ Option 43 DifferentialView™ Option 46 Fast CW Option 47 Eye Diagram Option 51 Direct Access Loops Option 53 External ALC Options 61/62 Active Measurements Suite Option 70 70 kHz Low Frequency Extension Options 84/85 Broadband/Banded/Millimeter-Wave Extension Options 88/89 Broadband/Banded/Millimeter-Wave Extension. Maximum frequency available is 110 GHz Options 80/81 Broadband/Millimeter-Wave Options 82/83 Banded/Millimeter-Wave Extension Options 86/87 Broadband/Millimeter-Wave. Maximum frequency available is 110 GHz Option 88 Broadband/Banded/Millimeter-Wave Extension
	Multiport System	Compatible with the MN469xC Series Multiport System on any model VNA; IMDView measurements can only be performed when the system is configured as a 2-Port VNA.
	Additional Information	For detailed IMD measurement theory, description and operational information, see the VectorStar MS464xB Series VNA Calibration and Measurement Guide - 10410-00318.
Fast CW — Option 46	Description: Standard Mode Fast CW	If Option 35 is not installed then Standard Mode Fast CW operations are available in T/R mode via remote commands. Standard Option CW supports both continuous data streaming and buffered data collection maximum data rates of ~200,000 measurements/second. The maximum buffer size is up to 60 million measurements with transfer blocks of up to 5 million measurements. Fast transfers are available for both streaming and buffered modes. Data extraction at corrected and final formatted layers is permitted.
	Description: Advanced Fast CW	With Options 35 and 46 installed, Advanced Fast CW becomes available that allows data rates of up to 100,000,000 measurements/second on all receivers at once and buffers of up to 800,000,000 measurements deep (with Option 36). Advanced Fast CW is available in the user interface as well as remotely and has on-board synchronization choices and data reduction functionality.
	Required Options	Option 35 IF Digitizer (required for Advanced Fast CW only)
	System Compatible Options	All
	Incompatible Options	None
Eye Diagram — Option 47	Description	Adds the capability to calculate an eye diagram representation of what the currently measured trace data would do to a digital data stream (that can be configured by the user). This is particularly valuable in seeing the data stream signal integrity issues that could occur with a given transmission path and can help with building up subsystem simulation results. Since the eye diagram computation is per-trace, one can configure a single channel having frequency domain, time domain impulse response, TDR-like and eye diagram traces simultaneously and all responding to the same live data.
	Required Options	Option 2 Time Domain
	System Compatible Options	All
	Incompatible Options	None
	Additional Information	For detailed Eye Diagram measurement theory, description and operational information, see the VectorStar MS4640B Series VNA Calibration and Measurement Guide - 10410-00318.

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Differential Noise Figure — Option 48	Description	Includes all the functionality of Option 41 and allows measurement of differential and common-mode noise properties with the cold source method. Three operating modes (uncorrelated, correlated, and combiner-based) are available for measurement efficiency and accuracy optimization. Full treatment of output port correlation is available for 3- and 4-port DUTs. Mixer noise figure measurements are supported. Various levels of vector correction are available, as is full fixture/probe embedding and de-embedding. Compatible with mm-wave measurements in the ME7838X family with the use of receiver-only modules (e.g., 3744A-Rx).
	Required Options	Option 51 or Option 61 or Option 62
	System Compatible Options	Option 2 Time Domain Option 7 Receiver Offset Option 21 Universal Fixture Extraction Option 31 Dual Source Architecture Option 32 Internal RF Combiner Option 35 IF Digitizer Option 36 Extended IF Digitizer Memory Option 42 PulseView™ Option 43 DifferentialView™ Option 44 IMDView™ Option 46 Fast CW Option 47 Eye Diagram Option 53 External ALC Option 70 70 kHz Low Frequency Extension Option 81 Broadband/Millimeter-Wave Option 83 Millimeter-Wave Extension Option 85 Broadband/Banded/Millimeter-Wave Extension Option 87 Broadband/Millimeter-Wave Option 89 Broadband/Banded/Millimeter-Wave Extension
	Incompatible Options	Option 41 Noise Figure Option 80 Broadband/Millimeter-Wave Option 82 Banded Millimeter-Wave Extension Option 84 Broadband/Banded/Millimeter-Wave Extension Option 86 Broadband/Millimeter-Wave Option 88 Broadband/Banded/Millimeter-Wave Extension
	Multiport System	MN469xC Series Multiport System on any model VNA; Differential Noise Figure measurements can be performed when the system is configured as a 2-Port VNA or a 4-Port VNA.
	Additional Information	For detailed Differential Noise Figure measurement theory, description, and operational information, see the VectorStar MS4640B Series VNA Calibration and Measurement Guide, 10410-00318.
Direct Access Loops — Option 51	Access Loops Per Port	Adds three (3) Access loops per port for Source, Test, and Receive Paths. Note: Direct access loops are not available for VNAs equipped with Option 61 or 62, which include access loops.
	Front Panel Loops	≥2.5 GHz Frequency Coverage loops, located at front panel.
	Rear Panel Loops	<2.5 GHz Frequency Coverage loops, located at rear panel.
External ALC — Option 53	External ALC access allows leveling of source power at an external point (e.g., after a preamplifier). The connector is also installed with Option 8x for use with the modular broadband and mm-wave functions (when in a 3739 mode, the broadband/mm-wave functionality takes precedence).	
	Required Options	Option 61 or 62
	System Compatible Options	All
	Incompatible Options	None
Active Measurements Suite — Options 61/62	Adds Step Attenuators, Bias Tees, Direct Access Loops, and Gain Compression and Efficiency Measurement Capabilities.	
	MS4644B Attenuators	70 dB, 10 dB/step
	MS4647B Attenuators	60 dB, 10 dB/step
	Option 61	Two (2) attenuators: One in Source 1 path, and one in Receive 2 path.
	Option 62	Four (4) attenuators: One in each Source path and in each Receive path.
	Bias Tees	0.5 A max., 40 VDC max. 3 kHz BW (nominal), looking into a High Impedance 10MΩ to Ground for DUT Static Discharge Protection located at rear panel.
	Access Loops	Includes Option 51 loops, listed above. (Option 51, 61, and 62 are mutually exclusive)
	Gain Compression	Swept Power Gain Compression at a CW frequency Px dB over Swept Frequency, up to 401 points.
70 kHz Low End Frequency Extension — Option 70	Extends the VNA standard 10 MHz low-end start frequency to 70 kHz, providing 70 kHz to 20, 40, or 70 GHz coverage models. The low-end is allowed to extend to 40 kHz.	
Broadband/Banded/ Millimeter-Wave Systems	For details on the MS464xB-08x series of options, see the: VectorStar ME7838A Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00593 (For 70 kHz to 125 GHz) VectorStar ME7838D Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00778 (For 70 kHz to 145 GHz) VectorStar ME7838E Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00767 (For 70 kHz to 110 GHz)	

CPU, OS, Memory, and Security Features

CPU	Intel Core™ i5	
O/S	The Microsoft® Windows® 7 operating system on the MS4640B Series VNA is configured for optimum performance when the instrument leaves the factory.	
Display	26.4 cm (10.4") Color XGA Touch-Screen Display	
Storage	Serial-ATA (SATA) Solid State Drive (SSD), for OS, Programs, and Data. (>30 GB)	
Security Features	Display Blanking	For security, VectorStar™ software can obscure frequency and power levels on the system display for security.
	Removable Internal Drive	Rear Panel accessible Solid State Drive (SSD) is quickly removable and easy to secure.
	Option 4 Spare SSD	A bootable SSD module is available as a spare for VectorStar units used in multiple or compartmentalized locations. The VectorStar's operating system and software are preinstalled on each Option 4 SSD.
	Virus Protection, Best Practices	If the VNA is attached to a network, best practices recommend installing anti-virus software.

Front Panel Connections

Test Ports 1 and 2	Type	Universal Test Port Connectors, easily exchangeable in case of damage.
	MS4642B and MS4644B	K (m)
	MS4647B	V (m)
	Damage Input Levels	+27 dBm maximum, 40 VDC maximum
Direct Access Loops (optional)	Type	For Source, Test and Receive paths, 3 per port, for ≥2.5 GHz frequency coverage.
	MS4642B and MS4644B	K (f)
	MS4647B	V (f)
	Damage Input Levels	+20 dBm maximum, 0 VDC maximum (+27 dBm maximum on source loop ports)
USB Ports	Four type A USB 2.0 Ports (two each on the front and rear panel) for peripherals such as keyboard, mouse, memory stick, hardware key, and similar devices.	
Chassis Grounding Port	Banana (f)	
Ports to Millimeter-Wave Test Set (optional)	Connector Type	K (f) (LO1, and LO2 for RF; One with single source; Two with Option 31 Dual Source)

Rear Panel Connections

AC Power Input	AC Input connector, with On/Off switch, and fuses 350 VA maximum, 90 V(ac) to 264 V(ac), 47 Hz to 63 Hz (power factor controlled)	
USB, PS/2, and LAN	USB Control Port	Type B USB 2.0 port for controlling the instrument externally, for remote operation
	USB Ports	Two Type A USB 2.0 Ports for peripherals such as keyboard, mouse, memory stick, hardware key, etc. (Two more USB ports at the front panel)
	Keyboard and Mouse Ports	Dedicated PS/2 ports.
	LAN Port	10/100BASE-T Ethernet
GPIB Ports	GPIB Port (Talker/Listener)	Type D-24, female, IEEE 488.2 compatible, for controlling the instrument externally, for remote operation.
	GPIB Port (Dedicated Controller)	Type D-24, female, for the control of external instruments such as power meters, external test sets, and similar devices.
External I/O Port	Type	25-pin D-Sub, female, User-defined I/O for custom external test set interface, to synchronize with different sweep states, such as Start, Stop, Driven Port, and similar parameters.
	Pin 1	Limit Pass/Fail
	Pins 2, 3, 15, 16	TTL In
	Pins 4, 13 14, 21	GND
	Pins 5-12, 17-20, 22	TTL Out
	Pins 23-25	Reserved
Serial Port	9-pin D-Sub, male, compatible with RS-232, provides control for AutoCal modules and similar devices.	
VGA Port	15-pin mini D-Sub, for simultaneously projecting the instrument's screen display onto an external VGA monitor, with 1024 × 768 minimum resolution.	
Bias Inputs	Optional	Requires Active Measurement Suite, Option 61 or 62
	Bias Inputs	BNC (f), one per port
	Bias Fuses	0.5 A, 250 V, one per port
Direct Access Loops	Required Options	Options 51, 61, or 62
	Connector Type	SMA (f)
	Description	For Source, Test, and Receive paths, 3 per port, for <2.5 GHz frequency coverage
	Damage Input Levels	+20 dBm maximum, 0 VDC maximum (+27 dBm maximum on source loop ports)
IF Inputs/Outputs	a_1, a_2, b_1, b_2, IF Inputs/Outputs	
	Connector Type	SMA (f)
	Inputs	Inputs used with external converters such as millimeter-wave modules, or for antenna testing.
	Outputs	Outputs used with external IF digitizers and processors
	Nominal Inputs	5 MHz to 200 MHz (mode dependent), 0 dBm for full scale
	Nominal Outputs	0.2 MHz to 200 MHz (mode dependent), +10 dBm maximum
10 MHz In	Signal presence is auto-sensing (better than 1000 ppm frequency accuracy is recommended).	
	Connector Type	BNC (f)
	Signal	–10 to +3 dBm, 50Ω (nom.)

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10 MHz Out	Derived from the internal reference, unless an external 10 MHz reference input is applied.	
	Connector Type	BNC (f)
	Signal	0 ±5 dBm sinusoidal, 50Ω (nom.)
Analog In 1 and 2	Two independent inputs for measurements simultaneous with the RF measurements, for current sensing, efficiency computation, power detection, and similar parameters.	
	Connector Type	BNC (f)
	Range	–10 V to +10 V with automatic offset and gain calibrations
	Accuracy	2 mV + 2% for |V| <5 V; 2% for |V| >5 V
	Nominal Input Impedance	60kΩ
Ext In ALC 1 and ALC 2	For external automatic level control of the internal signal source generators. The input assumes 0 V represents no RF power and a larger negative value represents increasing RF power. The maximum range is 0 to –1.3 V.	
	Optional	ALC 1 is available with Options 80/81, 82/83, 86/87. ALC 1 and ALC 2 are both available with Options 31 and 84/85, 88/89.
	Connector Type	BNC (f)
Ext Analog Out	For external attenuator control, external switch control, analog triggering assistance, measurement system integration, and other purposes.	
	Connector Type	BNC (f)
	Normal Operating Modes	Sawtooth synch sweep, TTL indication of driving port, open loop level controller
	Range	–10 V to +10 V; low impedance drive
	Accuracy	20 mV + 2% (Load: >5kΩ)
Ext Trigger	Connector Type	BNC (f)
	Voltage Input	0 to 3.3 V input (5 V tolerant) Low threshold = 0.8 V High threshold = 2 V
	Impedance	High impedance (>100kΩ)
	Pulse Width	100 ns minimum input pulse width
	Edge Trigger	Programmable edge trigger
Lock Status	Connector Type	BNC (f)
	Voltage Input	0 to 3.3 V input (5 V tolerant) Low threshold = 0.8 V High threshold = 2 V
	Impedance	High impedance (>100kΩ)
	Pulse Width	100 ns minimum input pulse width
	Edge Trigger	Positive-edge trigger
Ready for Trigger	Connector Type	BNC (f)
	Voltage Input	0 to 3.3 V latched output
	Impedance	Low impedance (approximately 50Ω)
	Voltage	$V_{(output\ high)}$ = 2 V min @ –12 mA $V_{(output\ low)}$ = 0.8 V max @ +12 mA
Trigger Out	Connector Type	BNC (f)
	Voltage Output	0 to 3.3 V pulse output 1 µs positive pulse
	Voltage	$V_{(output\ high)}$ = 2 V min @ –12 mA $V_{(output\ low)}$ = 0.8 V max @ +12 mA
	Impedance	Low impedance (approximately 50Ω)
Pulse Generator Outputs	All values listed are nominal.	
	Optional	Requires Options 35 and 42 PulseView™
	Connector Type	SMA (f)
	Pulse Generator Outputs	P GEN 1, P GEN 2, P GEN 3, and P GEN 4
	Voltage	High: 3.3 V ±10% Low: <1 V
	Drive Impedance	Low impedance (approximately 50Ω)
	Load Impedance	50Ω or higher impedance
Pulse Synch Input	All values listed are nominal.	
	Optional	Requires Options 35 and 42 PulseView™
	Connector Type	SMA (f)
	Voltage Input	High threshold: 2.2 V Low threshold: 1 V
	Signal	5.5 VDC damage level
	Latency	55 ns delay from received synch to T0 (typ.)
	Impedance	High impedance input
Pulse Synch Output	All values listed are nominal.	
	Optional	Requires Options 35 and 42 PulseView™
	Connector Type	SMA (f)
	Voltage Output	High: 3.3 V ±10% Low: <1 V
	Signal	5.5 VDC damage level
	Latency	<5 ns delay from T0 to providing an external synch (typ.)
	Drive Impedance	Low impedance (approximately 50Ω)
	Load Impedance	50Ω or higher impedance

Mechanical and Environmental

Dimensions	Dimensions listed are for the instrument without rack mount option (MS4640B-001) attached.	
	Width	426 mm body 457 mm between feet outer edges 487 mm between front panel handle outer edges
	Height	267 mm body (6U) 286 mm between feet outer edges
	Depth	502 mm body 591 mm between handle and foot outer edges
Mass	<30 kg (<66 lb), Typical weight for a fully-loaded MS4647B VNA	
Environmental – Operating	Specification	Conforms to MIL-PRF-28800F (class 3)
	Temperature Range	0° to +50°C without error codes Except for 'unleveled' error messages that may occur at the extreme edges of the temperature range.
	Relative Humidity	5 to 95% at +40°C, Non-condensing
	Altitude	4,600 m (15,000 ft)
Environmental – Non-Operating	Temperature Range	–40° to +71°C
	Relative Humidity	0 to 95% at +30°C, Non-condensing
	Altitude	4,600 m (15,000 ft)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU
RCM	Australia and New Zealand	RCM AS/NZS 4417:2012
KCC	South Korea	KCC-REM-A21-0004
Warranty	Instrument and Built-In Options	3 years from the date of shipment (standard warranty)
	Calibration Kits	Typically 1 year from the date of shipment
	Test Port Cables	Typically 1 year from the date of shipment
	Additional Warranty Options	Additional warranty available

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Instrument Models
MS4642B	Vector Network Analyzer 10 MHz to 20 GHz
MS4644B	Vector Network Analyzer 10 MHz to 40 GHz
MS4647B	Vector Network Analyzer 10 MHz to 70 GHz
	Included Accessories Each VNA comes with a set of included accessories: The user documentation USB includes PDF files for the VectorStar Operation Manual, User Interface Reference Manual, Programming Manual, Programming Manual Supplement, Calibration and Measurement Guide, Technical Data Sheet and Configuration Guide, and Maintenance Manual. Online Help – The instrument is equipped with context-sensitive help built from the first five documents above. Peripherals – Optical USB Mouse Power – Power Cord
	Main VNA Options
MS4640B-001	Rack Mount, adds handles and removes feet for shelf-mounting into a 19″ universal rack
MS4640B-002	Time Domain
MS4640B-004	Additional Serial-ATA (SATA) Solid State Drive (SSD) with OS and VectorStar Application Software
MS4640B-007	Receiver Offset
MS4642B-008	Active Device Measurements, with 2 Step Attenuators
MS4642B-009	Active Device Measurements, with 4 Step Attenuators
MS4640B-021	Universal Fixture Extraction
MS464xB-031	Dual Source Architecture
MS464xB-032	Internal RF Combiner, requires Option 31
MS4640B-035	IF Digitizer
MS464xB-036	Extended IF Digitizer Memory
MS4640B-041	Noise Figure, requires Option 51, 61, or 62
MS4640B-042	PulseView™, requires Option 35
MS4640B-043	DifferentialView™
MS4640B-044	IMDView™
MS4640B-046	Fast CW software, requires Option 35
MS4640B-047	Eye Diagram requires Option 2
MS4640B-048	Differential Noise Figure, requires Option 51 or Option 61 or Option 62
MS464xB-051	Direct Access Loops, see description below
MS464xB-053	External ALC
MS464xB-061/062	Active Measurement Suite options, see description below
MS4640B-070	70 kHz Low-End Frequency Extension

Model/Order No.	Name
	Direct Access Loop Options Note: Direct access loops are not available for VNAs equipped with Options 61 or 62, which include loops.
MS4644B-051	Direct Access Loops for MS4644B, not available with Options 61 or 62
MS4647B-051	Direct Access Loops for MS4647B, not available with Options 61 or 62
	Active Measurement Suite Options
MS4642B-008	Active Device Measurements, with 2 Step Attenuators
MS4642B-009	Active Device Measurements, with 4 Step Attenuators
MS4644B-061	Active Measurements Suite, For MS4644B, with 2 Step Attenuators
MS4644B-062	Active Measurements Suite, For MS4644B, with 4 Step Attenuators
MS4647B-061	Active Measurements Suite, For MS4647B, with 2 Step Attenuators
MS4647B-062	Active Measurements Suite, For MS4647B, with 4 Step Attenuators
	Pulse Modulator Test Set Note: Pulse Modulator Test Set options require the VNA to be equipped with Options 35, 42, and Option 51, 61, or 62)
SM6628	Pulse Modulator Test Set, 70 kHz to 40 GHz, for source modulation with an MS4642B or MS4644B
SM6629	Pulse Modulator Test Set, 70 kHz to 40 GHz, for source and receiver modulation with an MS4642B or MS4644B
SM6630	Pulse Modulator Test Set, 70 kHz to 70 GHz, for source modulation with an MS4647B
SM6631	Pulse Modulator Test Set, 70 kHz to 70 GHz, for source and receiver modulation with an MS4647B

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Model/Order No.	Name
	Multiport VNA Options The multiport VNA option provides four test ports for all VectorStar MS4640B Series VNAs with the MN4690C Series Multiport Test Sets. The option provides the Test Set, necessary cabling, and installation documentation. The Test Set frequency range is limited to that of the attached VNA.
MN4694C	70 kHz to 40 GHz, Use the MN4694C Test Set with MS4642B and MS4644B VNAs
MN4697C	70 kHz to 70 GHz, Use the MN4697C Test Set with MS4647B VNA
Documentation	For detailed MN469xC specifications, refer to the VectorStar MN469xC Series Multiport VNA Technical Data Sheet – 11410-00777
	Broadband/Banded/Millimeter-Wave Systems For details on the MS464xB-08x series of options, see the: VectorStar ME7838A Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00593 VectorStar ME7838D Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00778 VectorStar ME7838E Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00767 VectorStar ME7838A4 4-Port Modular Broadband/ Millimeter-Wave Technical Data Sheet – 11410-00704
	Calibration Options
MS4640B-098	Z540/Guide 25 Calibration, No Data
MS4640B-099	Premium Calibration, With Data
	Precision Automatic Calibrator Modules (Precision AutoCal)
36585K-2M	K Precision AutoCal Module, 70 kHz to 40 GHz, K (m) to K (m)
36585K-2F	K Precision AutoCal Module, 70 kHz to 40 GHz, K (f) to K (f)
36585K-2MF	K Precision AutoCal Module, 70 kHz to 40 GHz, K (m) to K (f)
36585V-2M	V Precision AutoCal Module, 70 kHz to 70 GHz, V (m) to V (m)
36585V-2F	V Precision AutoCal Module, 70 kHz to 70 GHz, V (f) to V (f)
36585V-2MF	V Precision AutoCal Module, 70 kHz to 70 GHz, V (m) to V (f)
	Mechanical Calibration Kits
3650A	SMA/3.5 mm Calibration Kit, Without Sliding Loads
3650A-1	SMA/3.5 mm Calibration Kit, With Sliding Loads
3652A	K Calibration Kit, Without Sliding Loads
3652A-2	K Calibration Kit, Without additional options
3652A-3	K Calibration Kit, With Pin Depth Gauge and .s1p Characterization Files
3652A-4	K Calibration Kit, With .s1p Characterization Files
3654D	V Calibration Kit, Without Sliding Loads
3654D-2	V Calibration Kit Without additional options
3654D-3	V Calibration Kit, With Pin Depth Gauge and .s1p Characterization Files
3654D-4	V Calibration Kit, With .s1p Characterization Files
3657	V Multi-Line Calibration Kit, Without Shorts
3657-1	V Multi-Line Calibration Kit, With Shorts
	Verification Kits
3666-1	SMA/3.5 mm Verification Kit
3668-1	K Verification Kit
3669B-1	V Verification Kit
	Test Port Cables, Ruggedized Semi-Rigid
3670K50-1	Test Port Cable, K (f) to K (m), 1 each, 30.5 cm (12 in)
3670K50-2	Test Port Cable, K (f) to K (m), 1 each, 61.0 cm (24 in)
3670V50A-1	Test Port Cable, V (f) to V (m), 1 each, 30.5 cm (12 in), rated to 70 GHz
3670V50A-2	Test Port Cable, V (f) to V (m), 1 each, 61.0 cm (24 in), rated to 70 GHz
	Test Port Cables, Flexible, Ruggedized-Style Female Connectors, Phase Stable Ruggedized style female connectors for VNA test ports.
3671KFS50-60	K (f) to 3.5 mm (m), 1 each 63.5 cm (25 in)*
3671KFK50-60	K (f) to K (m), 1 each, 63.5 cm (25 in)*
3671KFK50-100	K (f) to K (m), 1 each, 96.5 cm (38 in)
3671KFKF50-60	K (f) to K (m), 1 each, 63.5 cm (25 in)
3671KFK50-60	K (f) to K m), 1 each 63.5 cm (25 in)*
3671VFV50-60	V (f) to V (m), 1 each, 63.5 cm (25 in), rated to 70 GHz*
3671VFV50-100	V (f) to V (m), 1 each 96.5 cm (38 in), rated to 70 GHz

Model/Order No.	Name
	Test Port Converters To change or replace VNA test ports.
34YK50C	Universal Test Port Connector to K (m), Installation requires wrench 01-202 (not included)
34YV50C	Universal Test Port Connector to V (m), Installation requires wrench 01-202 (not included)
34YS50A	Universal Test Port Connector to 3.5 mm (m), Installation requires wrench 01-202 (not included)
34YQ50A	Universal Test Port Connector to 2.4 mm (m), Installation requires wrench 01-202 (not included)
	Universal Test Fixture (UTF)
3680-20	UTF, DC to 20 GHz
3680K	UTF, DC to 40 GHz
3680V	UTF, DC to 60 GHz
36801K	UTF Right Angle Launcher, DC to 30 GHz
36801V	UTF Right Angle Launcher, DC to 50 GHz
36803	Bias Probe
36804B-10M	Microstrip Calibration/Verification Kit, 10 mil, DC to 50 GHz
36804B-15M	Microstrip Calibration/Verification Kit, 15 mil, DC to 30 GHz
36804B-25M	Microstrip Calibration/Verification Kit, 25 mil, DC to 15 GHz
	Precision Fixed Attenuators, Adapters (In and Out of Series, Waveguide to Coaxial), and More Refer to our extensive Precision RF & Microwave Components Catalog – 11410-00235
	GPIB Cables
2100-5	GPIB Cable, 0.5 m long
2100-1	GPIB Cable, 1 m long
2100-2	GPIB Cable, 2 m long
2100-4	GPIB Cable, 4 m long
	Transit Case
760-246-R	Transit Case, for all MS4640B Series VNAs, Hard plastic with wheels, 85 × 70 × 45 cm
	Tools
01-201	Torque End Wrench, 5/16 in, 0.9 N·m (8 lbf·in), For tightening male devices, For SMA, 3.5 mm, 2.4 mm, K, and V connectors.
01-202	Torque End Wrench, 1/2 in, 60 lbf ·in, For servicing the universal test port, For the removal or installation of a test port.
01-203	Torque End Wrench, 20.6 mm (13/16 in), 0.9 N·m (8 lbf·in), For tightening the VNA test ports to female devices.
01-204	End Wrench, 5/16 in, Universal, Circular, Open-ended, For SMA, 3.5 mm, 2.4 mm, K and V connectors.
01-504	Torque End Wrench, 6 mm, 0.45 N·m (4 lbf·in), For tightening 1 mm connectors.
01-505	6 mm × 7 mm Open End Wrench, Backing wrench for 6 mm torque wrench above for W1 connectors.
01-511	Torque End Wrench, 4 mm (5/32 in), 0.22 N·m (2 lbf·in), For tightening the SSMC TEST and REF connectors on 3743A Modules.
	Documentation User Documentation at www.anritsu.com. Printed manuals in 3-ring binders are available for a nominal charge.
10410-00317	MS4640B Series VNA Operation Manual (OM)
10410-00318	MS4640B Series VNA Calibration and Measurement Guide (MG)
10410-00319	MS4640B Series VNA User Interface Reference Manual (UIRM)
10410-00320	MS4640B Series VNA Maintenance Manual (MM)
10410-00322	MS4640B Series VNA Programming Manual (PM), for IEEE 488.2, System, and SCPI Commands
10410-00323	MS4640B Series VNA Programming Manual Supplement (PMS), for Lightning 37xxxx and HP8510 Emulation

*: Due to length, two (2) cables are required for each system

ShockLine™ 1-Port Vector Network Analyzers

MS46121B Series

One Port USB Vector Network Analyzers

Ideal for Testing Multiple 1-Port Devices in Parallel for Improved Test Productivity and Throughput

SHOCKLINE™

The MS46121B is part of the ShockLine™ family of Vector Network Analyzers from Anritsu. It is available in two frequency ranges of 40 MHz to 4 GHz and 150 kHz to 6 GHz, and is capable of 1-port s-parameter and band pass time domain (distance to fault) measurements.

The MS46121B series is controlled through USB from an external PC. The MS46121B runs the same software as the rest of the ShockLine family, providing a powerful graphical user interface for testing of passive devices. Up to 16 MS46121B VNAs can be controlled from one computer, making it ideal for testing multiple 1-port devices in parallel for improved test productivity and throughput.

The MS46121B with Option 2 provides a Time Domain Reflectometry (TDR) like display that enables real impedance measurements over frequency. With Option 21, scalar transmission between two to four MS46121B instruments can be performed in various configurations.

This document provides detailed specifications for the MS46121B series Vector Network Analyzer (VNA) and related options.

Instrument Models and Operating Frequencies

Base Model

- MS46121B, 1-Port ShockLine VNA

Requires one Frequency Option

- MS46121B-004, 40 MHz to 4 GHz, 1-Port
- MS46121B-006, 150 kHz to 6 GHz, 1-Port

Principal Option

- MS46121B-002, Time Domain
- MS46121B-021, Scalar Transmission Measurement

Definitions

All specifications and characteristics apply under the following conditions, unless otherwise stated:

Warm-Up Time	After 30 minutes of warm-up time, where the instrument is left in the ON state.
Temperature Range	Specifications apply over the 25° ±5°C temperature range.
Error-Corrected Specifications	Specifications are valid over 23° ±3°C, with <1°C variation from calibration temperature.
Frequency Bands in Tables	When a frequency is listed in two rows of the same table, the specification for the common frequency is taken from the lower frequency band.
User Cables	Specifications do not include effects of any user cables attached to the instrument.
Discrete Spurious Responses	Specifications may exclude discrete spurious responses.
Internal Reference Signal	All specifications apply with internal 10 MHz Crystal Oscillator Reference Signal.
Interpolation Mode	All specifications are with Interpolation Mode Off.
Standard	Refers to instruments without Options.
Typical Performance	Typical performance indicates the measured performance of an average unit. It does not include guard-bands and is not covered by the product warranty.
Characteristic Performance	Characteristic performance indicates a performance designed-in and verified during the design phase. It does include guard-bands and is not covered by the product warranty.
Uncertainty	A coverage factor of x1 is applied to the measurement uncertainties to facilitate comparison to other industry analyzers.
Recommended Calibration Cycle	12 months (Residual specifications also require calibration kit calibration cycle adherence.)
Specifications Subject to Change	All specifications are typical unless otherwise noted and are subject to change without notice.

High Level Noise

Measured at 100 Hz IF bandwidth and at default power level, RMS.

Frequency Range	Magnitude (dB)	Phase Noise (deg RMS)
150 kHz to 6 GHz	0.02	0.2

Output Power

Frequency Range	Power Setting	Standard (dBm)
150 kHz to 46 MHz	Default	–5 dBm
>46 MHz to 4 GHz	Default	+3 dBm
>4 GHz to 6 GHz	Default	–5 dBm

Measurement Stability

Ratio measurement, with ports shorted. Typical.

Frequency Range	Magnitude (dB/°C)	Phase (deg/°C)
150 kHz to 1 MHz	0.1	0.1
>1 MHz to 4 GHz	0.01	0.1
>4 GHz to 6 GHz	0.05	0.2

Frequency Resolution, Accuracy and Stability

Resolution	Accuracy	Stability	Aging
1 Hz*	±0.5 ppm (at time of calibration)	±1.0 ppm from –10° to +55°C	±1.0 ppm/year

*: Frequency resolution is 10 kHz when using an external reference.

Uncorrected (Raw) Port Characteristics

User and System Correction Off.

Frequency Range	Directivity (dB)	Port Match (dB)
150 kHz to 6 GHz	10 dB*1	10 dB*2

*1: Raw directivity specification degrades by 2 dB above 4 GHz.
*2: Raw port match specification degrades by 5 dB above 4 GHz.

Scalar Transmission Measurement Accuracy

Measurement accuracy is specified @ 1 kHz IFBW with external reference, scalar normalization On, and from 0 dB to –50 dB attenuation levels. Scalar transmission is functional to 6 GHz.

Frequency Range	Accuracy (dB)
150 kHz to 6 GHz	±1.0

Dynamic Range for Scalar Transmission

Dynamic range is specified @ 30 Hz IFBW with external reference, scalar normalization On, and using a USB hub with two MS46121B instruments connected.

Frequency Range	Dynamic Range (dB, typ.)
150 kHz to 6 GHz	80

VNA System Performance

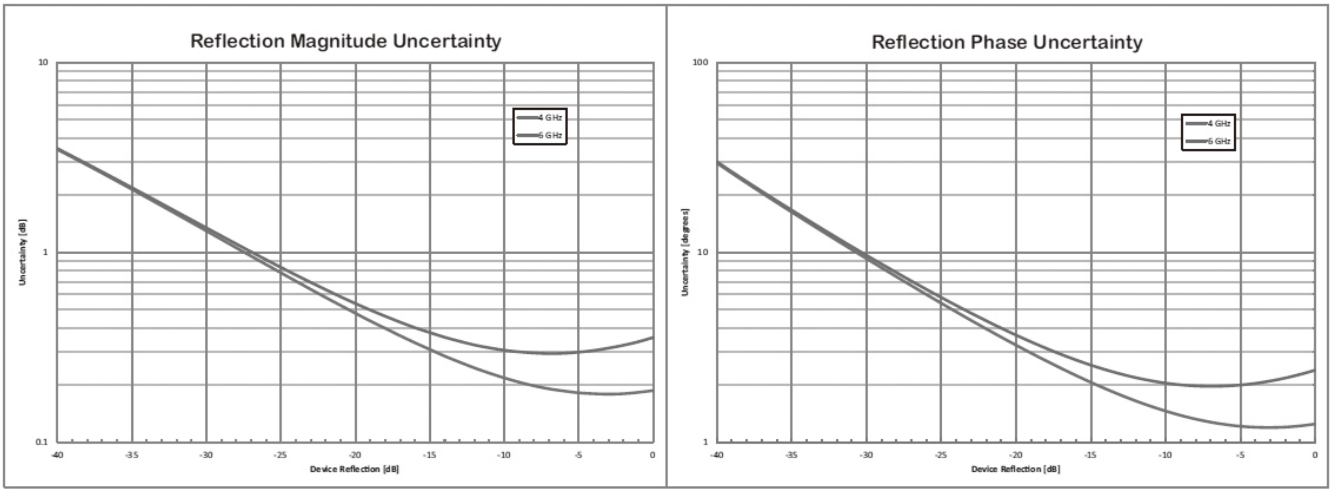
Error-Corrected Specifications

With calibration using TOSLN50A-8 or TOSLNF50A-8 N-type connector manual calibration kits or the MN25208A SmartCal™ automatic calibration kit with connector options MN25208A-001, -002, -003, and -004*.

Frequency Range	Directivity (dB)	Source Match (dB)	Reflection Tracking (dB)
150 kHz to 4 GHz	42	35	±0.1
>4 GHz to 6 GHz	42	35	±0.2

Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability.
10 Hz IF Bandwidth is used. All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.



*: Specifications are not warranted. All values are typical.

Measurement Throughput

Measurement Speed	120 µs/point, typical. Per point single sweep time, including placing measurement data into memory. Average of narrow, mid, and wide frequency span sweeps. 100 kHz IFBW, 1601 points, 1 port calibrated data measurement. Timing dependent on external computer configuration. Measurements taken with an Intel® Core™ i5-6300U processor running Windows 7 with 4 GB of RAM and 60 GB of free hard disk space.

Standard Capabilities

Operating Frequencies

MS46121B-004	40 MHz to 4 GHz
MS46121B-006	150 kHz to 6 GHz

Measurement Parameters

1-Port Measurements	S_{11} or any user-defined combination of a_1, b_1, 1
2-Port Measurements	$S_{|XY|}$ where Y is the source and X is the receiver
Domains	Frequency Domain and Band Pass Time Domain (Distance to Fault)

Sweeps

Frequency Sweep Types	Linear, Log, or Segmented

Display Graphs

Single Rectilinear Graph Types	Log Magnitude, Phase, Linear Magnitude, Real, Imaginary, SWR, and Impedance
Dual Rectilinear Graph Types	Log Mag and Phase, Linear Mag and Phase, Real and Imaginary
Circular Graph Types	Smith Chart, Polar

Measurements Data Points

Maximum Data Points	2 to 20,001 points

Limit Lines

Limit Lines	Single or segmented. 2 limit lines per trace. 50 segments per trace.
Single Limit Readouts	Uses interpolation to determine the intersection frequency.
Test Limits	Both single and segmented limits can be used for PASS/FAIL testing.

Ripple Limit Lines

Limit Lines	Single or segmented. 2 limit lines per trace. 50 segments per trace.
Ripple Value	Absolute Value or Margin
Test Limits	Both single and segmented limits can be used for PASS/FAIL testing.

Averaging

Point-by-Point	Point-by-point (default), maximum number of averages = 4096
Sweep-by-Sweep	Sweep-by-sweep, maximum number of averages = 4096

IF Bandwidth (All IFBW settings applicable with Option 21 enabled.)

	10, 20, 30, 50, 70, 100, 200, 300, 500, 700 Hz 1, 2, 3, 5, 7, 10, 20, 30, 50, 100 kHz

Reference Plane

Line Length or Time Delay	The reference planes of a calibration or other normalization can be changed by entering a line length or time delay.
Dielectric Constants	Dielectric constants may be entered for different media so the length entry can be physically meaningful.
Dispersion Modeling	Dispersion modeling is used in the cases of microstrip and waveguide to take into account frequency dependent phase velocities.
Attenuations	Attenuations and constant phase offsets can be entered to better describe any reference plane distortions.
De-embedding	For more complete reference plane manipulation, the full de-embedding system can also be used.

Measurement Frequency Range

Frequency Range Change	Frequency range of the measurement can be narrowed within the calibration range without recalibration.
CW Mode	CW mode permits single frequency measurements also without recalibration.
Interpolation Not Activated	If interpolation is not activated, the subset frequency range is forced to use calibration frequency points.
Interpolation Activated	If interpolation is activated, any frequency range that is a subset of the calibration frequency range can be used, but there may be some added interpolation error.

Channels, Display and Traces

Channels	Up to 16 MS46121B VNAs can operate in parallel while controlled from a single host computer. ShockLine software dedicates one channel per MS46121B VNA with 16 channels maximum
Traces	Each channel supports up to 16 data traces.
Display Colors	Unlimited colors for data traces, memory, text, markers, graticules, and limit lines
Trace Memory and Math	A separate memory for each trace can be used to store measurement data for later display or subtraction, addition, multiplication or division with current measurement data. The trace data can be saved and recalled.
Intra-trace Math	Any two traces within a channel can be combined (via addition, subtraction, multiplication, or division) and displayed on another trace.

Scale Resolution

	Minimum per division, varies with graph type.
Log Magnitude	0.001 dB
Linear Magnitude	10 µU
Phase	0.01°
Time	0.0001 ps
Distance	0.1 µm
SWR	10 µU
Power	0.01 dB

Markers

Markers	12 markers + 1 reference marker
Marker Coupling	Coupled or decoupled
Marker Overlay	Display markers on active trace only or on all traces when multiple trace responses are present on the same trace.
Marker Data	Data displayed in graph area or in table form
Reference Marker	Additional marker per trace for reference
Marker Statistics	Mean, maximum, minimum, standard deviation Per trace or over a marker region
Marker Search and Tracking	Search and/or track for minimum, maximum, peak, or target value

Other

Filter Parameters	Display bandwidth (user-selectable loss value), corner and center frequencies, loss, Q and shape factors.
S-Parameter Conversion	Z Reflection Impedance Z Transmission Impedance Y Reflection Admittance Y Transmission Admittance 1/S

Calibration and Correction Capabilities

Calibration Methods

Open Short Load (OSL)
Offset Short (SSL)
Triple Offset Short (SSS)
SmartCal™
AutoCal™

Correction Models

1-Port	Reflection Frequency Response (S_{11})
2-Port	Transmission Frequency Response (Scalar) ($S_{|XY|}$) where Y is the source and X is the receiver

Coefficients for Calibration Standards

Use the Anritsu calibration kit USB memory device to load kit coefficients and characterization files.
Enter coefficients into user-defined locations.
Use complex load models.

Interpolation

Allows interpolation between calibration frequency points.

Dispersion Compensation

Selectable as Coaxial, other non-dispersive (e.g., for coplanar waveguide), Waveguide, or Microstrip

Embedding/De-embedding

The MS46121B is equipped with an Embedding/De-embedding system.

De-embedding	De-embedding is generally used for removal of test fixture contributions, modeled networks, and other networks described by S-parameters (s2p files) from measurements.
Embedding	Similarly, the Embedding function can be used to simulate matching circuits for optimizing amplifier designs or simply adding effects of a known structure to a measurement.
Multiple Networks	Multiple networks can be embedded/de-embedded and changing the port and network orientations is handled easily.

Remote Operability

ShockLine supports several remote operability options.

Communication Type	Data Format	Performance	Description
Drivers	IVI-C drivers are available for download from the Anritsu website. The IVI-C package supports National Instruments LabVIEW and LabWindows, C#, .NET, MATLAB, and Python34 programming environments.		
Triggering	Start Trigger	Software	

Recommended External PC Configuration

CPU	Intel® Core™ i5-6300U Processor
RAM	4 GB
Disk	120 GB
DirectX	Version 9 with Windows Display Driver Model (WDDM) installed
USB	One USB 2.0 (or higher) type A port per MS46121B used To increase the number of USB ports available an externally powered USB hub may also be used.
ShockLine software OS Compatibility	Windows® 7, 8, 8.1 or 10; 32 or 64 bit operating systems

Device Connections

Front

Back

Port Connector
N (m)

Test Port 1

MS46121B	N (m)
Damage Input Levels	+23 dBm maximum, ±50 VDC maximum

External Reference In

Frequency Input	10 MHz (better than 10 ppm frequency accuracy is recommended)
Connector Type	MCX (f)
Signal	0.89 $V_{pp,}$ minimum; 80Ω, nominal

USB Ports

One Micro USB 2.0 port for connecting to an external PC controller. For multiple MS46121B instruments on one PC, an externally powered USB 2.0 hub is recommended

Mechanical

Dimensions	52 (W) × 148 (H) × 36 (D) mm
Mass	<0.4 kg (<0.9 lb), typical weight

Regulatory Compliance

CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN61010-1 RoHS Directive 2011/65/EU applies to instruments with CE marking placed on the market after July 22, 2017
Australia and New Zealand	RCM AS/NZS 4417:2012
South Korea	KCC-REM-A21-0004

Environmental

MIL-PRF-28800F Class 2

Operating Temperature Range	–10° to 55°C
Storage Temperature Range	–51° to 71°C
Maximum Relative Humidity	95% RH at 30°C, non-condensing
Vibration, Sinusoidal	5 Hz to 55 Hz
Vibration, Random	10 Hz to 500 Hz
Half Sine Shock	30 gn
Altitude	4600 meters, operating and non-operating

Warranty

Instrument and Built-In Options	Three (3) years from the date of shipment (standard warranty)
Calibration Kits	Typically 1 year from the date of shipment
Test Port Cables	Typically 1 year from the date of shipment
Warranty Options	Additional warranty available

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Instrument Models
Base Model	MS46121B, ShockLine™ 1-Port USB VNA
Required Option (Select one frequency option only)	MS46121B-004, 40 MHz to 4 GHz, type N (m) port MS46121B-006, 150 kHz to 6 GHz, type N (m) port
	Included Accessories
USB Cable	USB-A to Micro-B with latch cable, 2000-1816-R, 1.8 m (6 ft) Getting Started with Anritsu Flier, provides access to all ShockLine web content and services.
	Main VNA Options
MS46121B-002	Low Pass Time Domain
MS46121B-021	Scalar Transmission Measurement
	Precision Automatic Calibrator Module
MN25208A	2-port USB SmartCal Module, 300 kHz to 8.5 GHz (available with connector Options -001 N (f), -002 K (f), -003 3.5 mm (f))
MN25408A	4-port USB SmartCal Module, 300 kHz to 8.5 GHz (available with connector Options -001 N (f), -002 K (f), -003 3.5 mm (f))
MN25218A	2-port USB SmartCal Module, 300 kHz to 20 GHz (available with connector Option -002 K (f))
MN25418A	4-port USB SmartCal Module, 300 kHz to 20 GHz (available with connector Option -002 K (f))
36585K-2M	K Connector Precision AutoCal Module, 70 kHz to 40 GHz, K (m) to K (m)
36585K-2F	K Connector Precision AutoCal Module, 70 kHz to 40 GHz, K (f) to K (f)
36585K-2MF	K Connector Precision AutoCal Module, 70 kHz to 40 GHz, K (m) to K (f)
2000-1809-R	Serial to USB Adapter (required for use with 36585 AutoCal module if control PC does not have a serial port)
	Mechanical Calibration Kits
3653A	N Calibration Kit, Without Sliding Loads, DC to 18 GHz, 50Ω
OSLN50A-8	Precision N Male Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50Ω
OSLNF50A-8	Precision N Female Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50Ω
TOSLN50A-8	Precision N Male Through/Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50Ω
TOSLNF50A-8	Precision N Female Through/Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50Ω
	RF Cables and Adapters
1091-26-R	SMA (m) to N (m), DC to 18 GHz, 50Ω
1091-27-R	SMA (f) to N (m), DC to 18 GHz, 50Ω
1091-80-R	SMA (m) to N (f), DC to 18 GHz, 50Ω
1091-81-R	SMA (f) to N (f), DC to 18 GHz, 50Ω
71693-R	Ruggedized adapter, K (f) to N (f), DC to 18 GHz, 50Ω
34NK50	Precision Adapter, N (m) to K (m), DC to 18 GHz, 50Ω
34NKF50	Precision Adapter, N (m) to K (f), DC to 18 GHz, 50Ω
34NFK50	Precision Adapter, N (f) to K (m), DC to 18 GHz, 50Ω
34NFKF50	Precision Adapter, N (f) to K (f), DC to 18 GHz, 50Ω
K220B	Precision Adapter, K (m) to K (m), DC to 40 GHz, 50Ω
K222B	Precision Adapter, K (f) to K (f), DC to 40 GHz, 50Ω
K224B	Precision Adapter, K (m) to K (f), DC to 40 GHz, 50Ω

Model/Order No.	Name
	Test Port Cables, Flexible, Ruggedized, Phase Stable
15NNF50-1.0B	1.0 m (39"), DC to 18 GHz, Test Port Cable, Flexible, Phase Stable, N (f) to N (m), 50Ω
15NNF50-1.5B	1.5 m (59"), DC to 18 GHz, Test Port Cable, Flexible, Phase Stable, N (f) to N (m), 50Ω
15NN50-1.0B	1.0 m (39"), DC to 18 GHz, Test Port Cable, Flexible, Phase Stable, N (m) to N (m), 50Ω
15LL50-1.0A	1.0 m (39"), DC to 20 GHz, Test Port Cable, Armored, Phase Stable, 3.5 mm (m) to 3.5 mm (m), 50Ω
15LLF50-1.0A	1.0 m (39"), DC to 20 GHz, Test Port Cable, Armored, Phase Stable, 3.5 mm (m) to 3.5 mm (f), 50Ω
15KK50-1.0A	1.0 m (39"), DC to 20 GHz, Test Port Cable, Armored, Phase Stable, K (m) to K (m), 50Ω
15KKF50-1.0A	1.0 m (39"), DC to 20 GHz, Test Port Cable, Armored, Phase Stable, K (m) to K (f), 50Ω
	Tools
01-200	Calibrated Torque End Wrench, GPC-7 and Type N
01-201	Torque End Wrench, 5/16 in, 0.9 N·m (8 lbf·in) For tightening male devices, for SMA, 3.5 mm, 2.4 mm, K and V connectors
01-203	Torque End Wrench, 13/16 in, 0.9 N.m (8 lbf.in) For tightening ruggedized SMA, 2.4 mm, K and V connectors
01-204	End Wrench, 5/16 in, Universal, Circular, Open-ended, For SMA, 3.5 mm, 2.4 mm, K and V connectors
More Information	Refer to our Precision RF & Microwave Components Catalog for descriptions of adapters and other components.
	Documentation
User Documentation	Soft copies of the manuals as Adobe Acrobat PDF files are available for download from the instrument model web page at www.anritsu.com. For more information and product support, please contact ShockLineVNA.support@Anritsu.com.
10100-00067	Product information, compliance, and safety
10410-00344	MS46121A/B Series VNA User Guide
10410-00337	MS46121A/B, MS46122A/B, and MS46322A/B Series VNA User Interface Reference Manual

ShockLine™ Compact USB Vector Network Analyzers

MS46122B Series

MS46122B-010: 1 MHz to 8 GHz/MS46122B-020: 1 MHz to 20 GHz/MS46122B-040: 1 MHz to 43.5 GHz

Low-cost series of 1U high, 2-port Compact Vector Network Analyzers

SHOCKLINE™

The MS46122B is part of the ShockLine™ family of Vector Network Analyzers from Anritsu. It is a very low-cost series of 1U high, 2-port Compact Vector Network Analyzers (VNAs). It is available in three frequency ranges: 1 MHz to 8 GHz/20 GHz/43.5 GHz, and is capable of s-parameter and time domain measurements.
The MS46122B is based on patented ShockLine™ VNA-on-chip technology, which simplifies the internal VNA architecture at high frequencies, reduces instrument cost, and enhances accuracy and measurement repeatability. The combination of low cost and good performance make ShockLine™ VNAs ideal candidates for testing RF and Microwave passive devices to 43.5 GHz.
The MS46122B series is controlled through USB from an external PC. The MS46122B runs the same software as the rest of the ShockLine family, providing a powerful graphical user interface for debugging and manual testing of devices.

Instrument Models and Operating Frequencies

Base Model
- MS46122B, 2-Port ShockLine VNA

Requires one Frequency Option
- MS46122B-010, 1 MHz to 8 GHz, 2-Port
- MS46122B-020, 1 MHz to 20 GHz, 2-Port
- MS46122B-040, 1 MHz to 43.5 GHz, 2-Port

Principal Options

- MS46122B-002, Time Domain

Definitions

All specifications and characteristics apply under the following conditions, unless otherwise stated:

Warm-Up Time	After 30 minutes of warm-up time, where the instrument is left in the ON state.
Temperature Range	Over the 25° ±5°C temperature range.
Error-Corrected Specifications	Specifications are valid over 23° ±3°C, with <1°C variation from calibration temperature. Error-corrected specifications are warranted and include guard-bands, unless otherwise stated.
Frequency Bands in Tables	When a frequency is listed in two rows of the same table, the specification for the common frequency is taken from the lower frequency band.
User Cables	Specifications do not include effects of any user cables attached to the instrument.
Discrete Spurious Responses	Specifications may exclude discrete spurious responses.
Internal Reference Signal	All specifications apply with internal 10 MHz Crystal Oscillator Reference Signal.
Interpolation Mode	All specifications are with Interpolation Mode Off.
Standard	Refers to instruments without Options.
Typical Performance	Typical performance indicates the measured performance of an average unit. It does not include guard-bands and is not covered by the product warranty. Typical specifications are shown in parenthesis, such as (–102 dB), or noted as Typical. The MS46122B is operational to 43.5 GHz. All specifications above 40 GHz are typical.
Characteristic Performance	Characteristic performance indicates a performance designed-in and verified during the design phase. It does include guard-bands and is not covered by the product warranty.
Recommended Calibration Cycle	12 months (Residual specifications also require calibration kit calibration cycle adherence.)
Specifications Subject to Change	All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site: www.anritsu.com

Specifications

System Dynamic Range

System dynamic range is calculated as the difference between High source power and the noise floor (RMS) at the specified reference plane at 10 Hz IF Bandwidth.

Frequency Range	Standard (dB)	Typical (dB)
1 MHz to 10 MHz	85	105
>10 MHz to 8 GHz*1	100	115
>8 GHz*2 to 43.5 GHz*2	100	110

*1: Crosstalk may reduce dynamic range up to 20 dB (typical) at lower IF bandwidths (≤10 kHz) when measuring highly reflective DUT's from 4 GHz to 8 GHz. Reflection measurements are not affected.

*2: Decrease specification by 5 dB between 8 GHz and 14 GHz.

Receiver Compression Levels

Performance is typical.

Frequency Range	Standard (dBm)
1 MHz to 43.5 GHz	+5

High Level Noise

Measured at 100 Hz IF bandwidth and at High power level, RMS. Performance is characteristic.

Frequency Range	Magnitude (dB)	Phase (deg)
1 MHz to <20 MHz	0.03 (0.005, typ.)	<0.2 (<0.035 typ.)
20 MHz to 43.5 GHz	0.006 (0.001, typ.)	<0.1 (<0.05 typ.)*

*: Above 20 GHz, High Level Noise (phase only) is increased by a factor of 1.5.

Output Power Settings

Power Setting	Frequency Range	Standard (dBm)
High (default)	1 MHz to 8 GHz > 8 GHz to 43.5 GHz	5 –3
Low	1 MHz to 43.5 GHz	–20

Measurement Stability

Ratio measurement, with ports shorted. Typical.

Frequency Range	Magnitude (dB/°C)	Phase (deg/°C)
10 MHz to 43.5 GHz	0.02	0.3

Frequency Resolution, Accuracy, and Stability

Resolution	Accuracy	Stability	Aging
1 Hz	±1.0 ppm (at time of calibration)	±1.0 ppm from –10° to +55°C, typ.	±1.0 ppm/year, typ.

Uncorrected (Raw) Port Characteristics

User and System Correction Off. All specifications typical.

Frequency Range	Directivity (dB)	Port Match (dB)
1 MHz to 43.5 GHz	>8	>8

VNA System Performance for the MS46122B-010 (Manual Cal Kits)

Error-Corrected Specifications

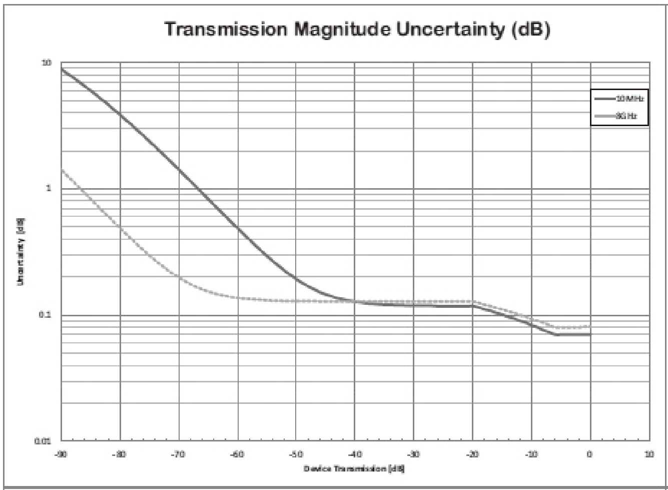
With 12-term SOLT Calibration using TOSLN50A-8 or TOSLNF50A-8 N type connector calibration kits.

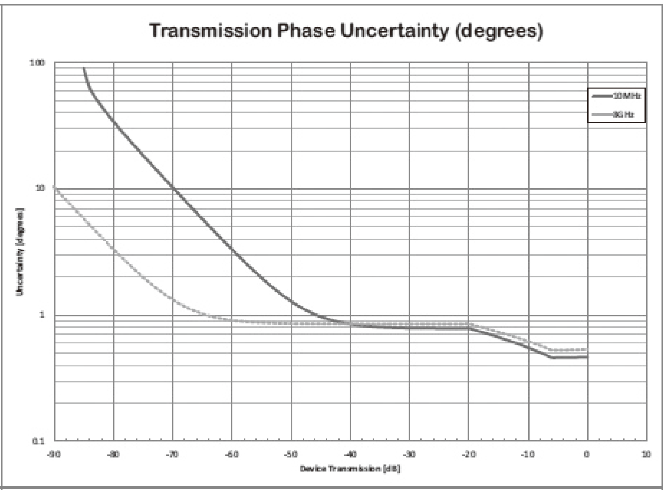
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
1 MHz to 6 GHz	≥42	≥33	≥42	±0.15	±0.06
>6 GHz to 8 GHz	≥37	≥33	≥37	±0.15	±0.06

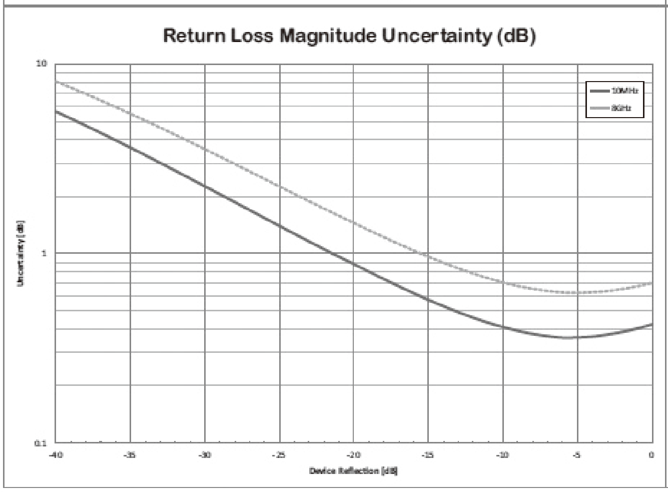
*: Characteristic performance.

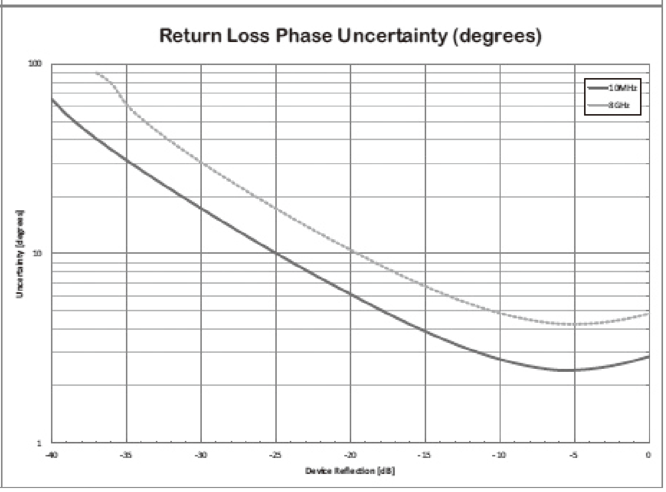
Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.


Transmission Magnitude Uncertainty (dB)


Transmission Phase Uncertainty (degrees)


Return Loss Magnitude Uncertainty (dB)


Return Loss Phase Uncertainty (degrees)

VNA System Performance for the MS46122B-020 (Manual Cal Kits)

Error-Corrected Specifications

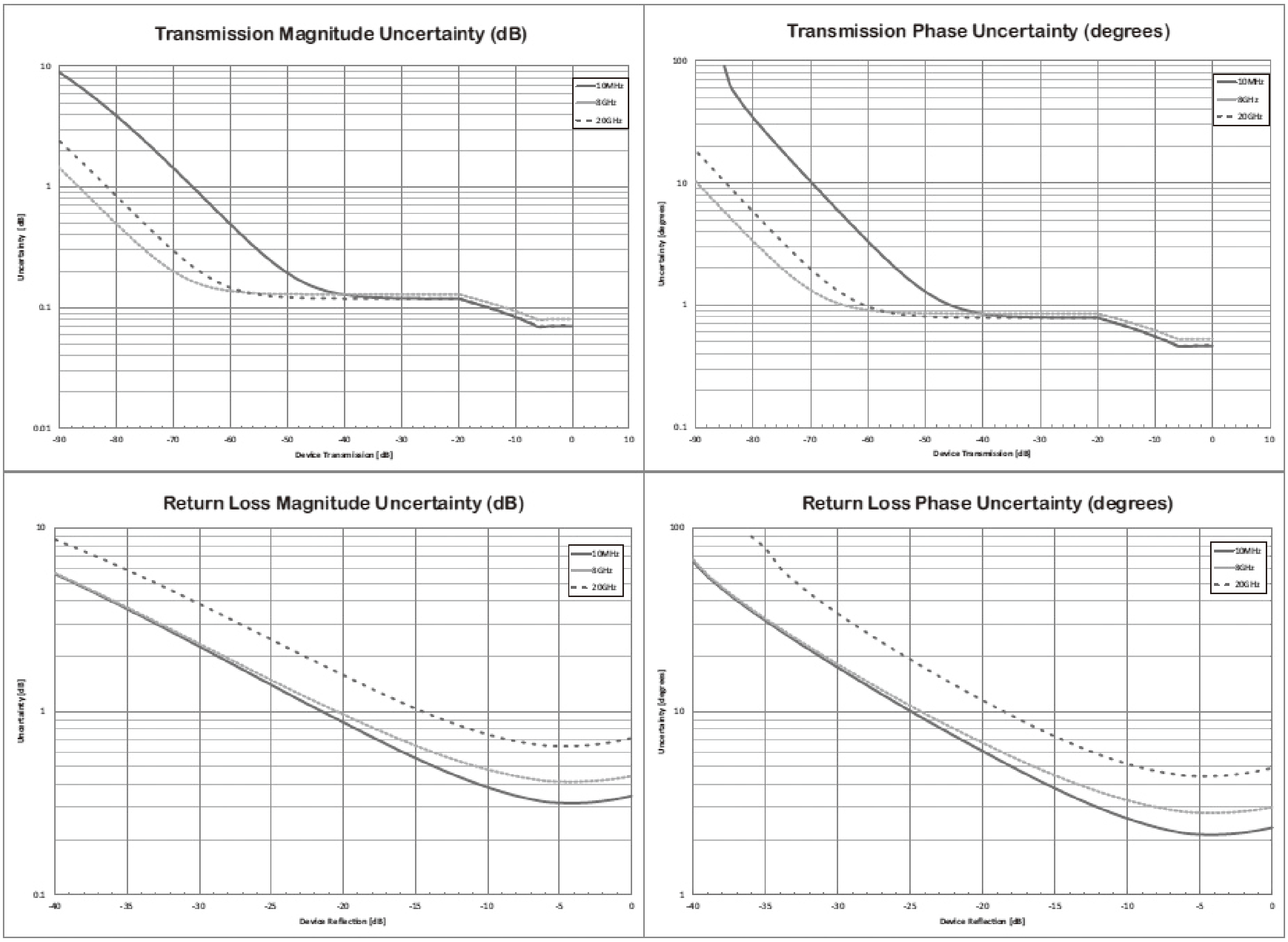
With 12-term SOLT calibration using the TOSLK50A-20 or TOSLKF50A-20 K type connector calibration kits.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
1 MHz to 10 GHz	≥42	≥33	≥42	±0.15	±0.06
>10 GHz to 20 GHz	≥36	≥26	≥36	±0.15	±0.05

*: Characteristic performance.

Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.


Transmission Magnitude Uncertainty (dB)

Transmission Phase Uncertainty (degrees)

Return Loss Magnitude Uncertainty (dB)

Return Loss Phase Uncertainty (degrees)

VNA System Performance for the MS46122B-040 (Manual Cal Kits)

Error-Corrected Specifications

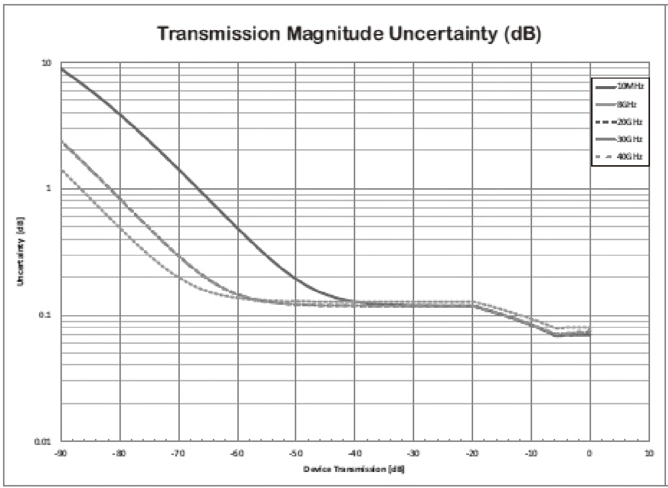
With 12-term SOLT Calibration using TOSLK50A-40 or TOSLKF50A-40 K type connector calibration kits.

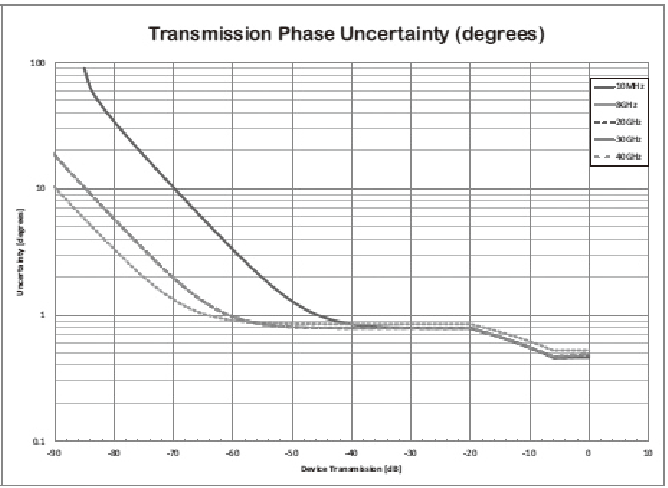
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
1 MHz to 10 GHz	≥42	≥33	≥42	±0.15	±0.06
>10 GHz to 20 GHz	≥36	≥26	≥36	±0.15	±0.05
>20 GHz to 30 GHz	≥32	≥22	≥32	±0.10	±0.05
>30 GHz to 43.5 GHz	≥30	≥20	≥30	±0.10	±0.05

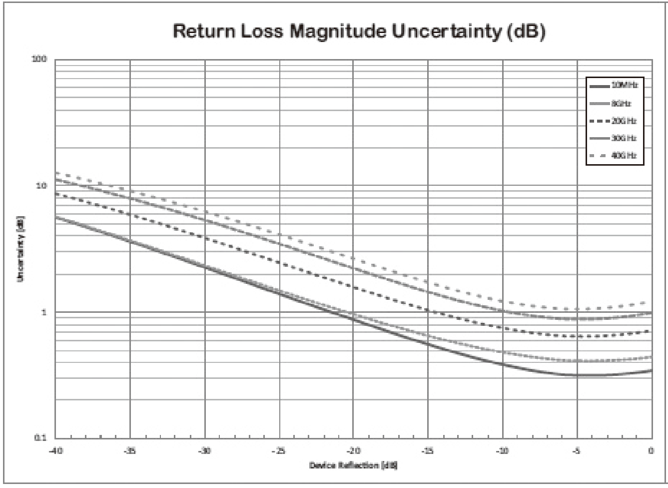
*: Characteristic performance.

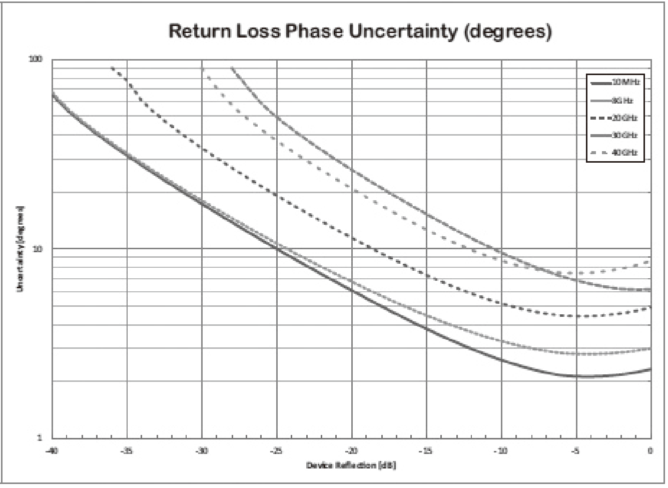
Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.


Transmission Magnitude Uncertainty (dB)


Transmission Phase Uncertainty (degrees)


Return Loss Magnitude Uncertainty (dB)


Return Loss Phase Uncertainty (degrees)

VNA System Performance for MS46122B-010 (SmartCal™)

Error-Corrected Specifications

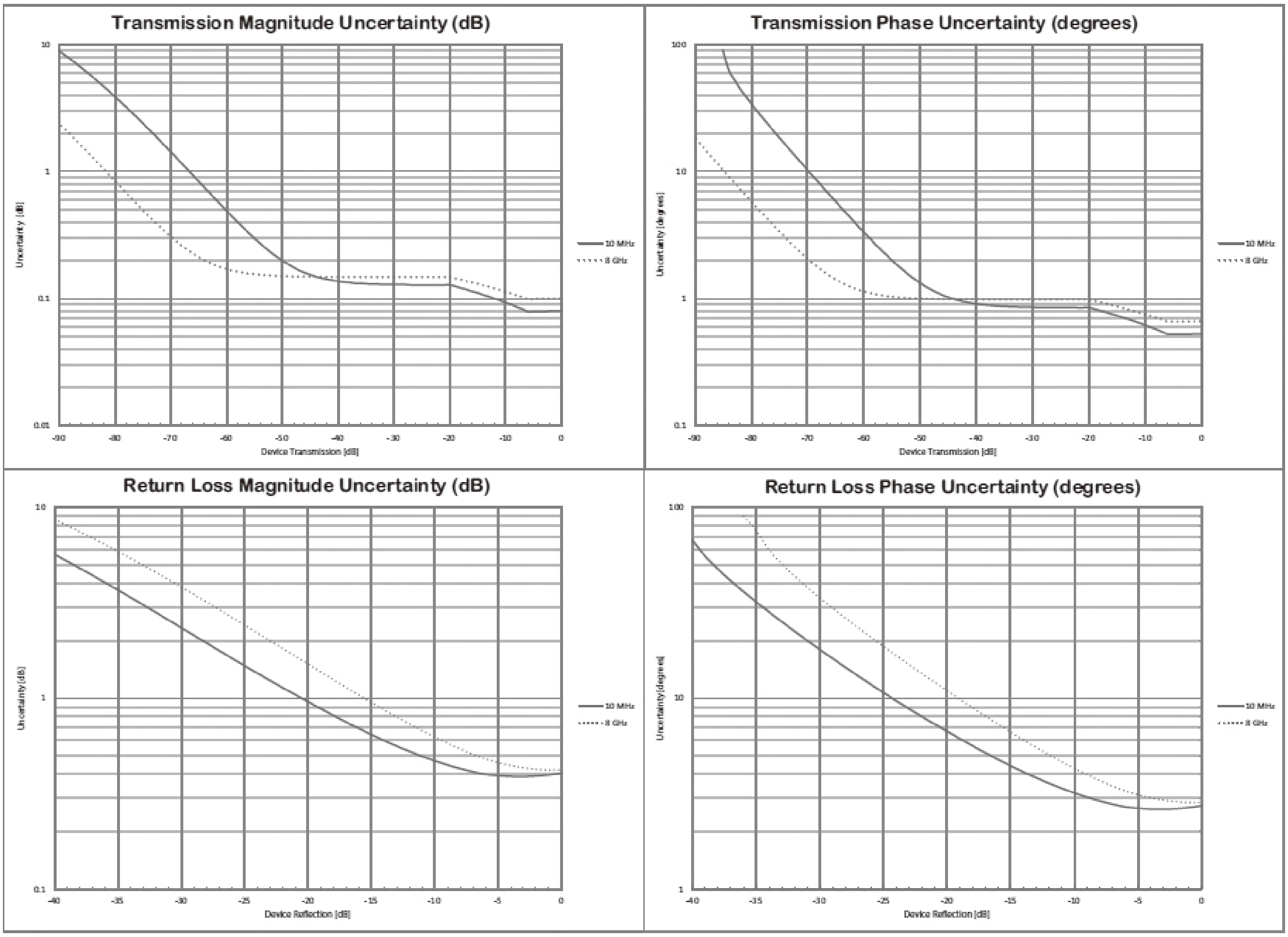
With 12-term calibration using the MN25208A SmartCal™ automatic calibration kit with connector options MN25208A-001, -002, -003.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
1 MHz to 1 GHz	≥42	≥35	≥42	±0.15	±0.06
>1 GHz to 5 GHz	≥42	≥35	≥42	±0.08	±0.08
>5 GHz to 8 GHz	≥36	≥35	≥37	±0.1	±0.08

*: Characteristic performance.

Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.



VNA System Performance for MS46122B-010 and MS46122B-020 (SmartCal™)

Error-Corrected Specifications

With 12-term calibration using the MN25218A SmartCal™ automatic calibration kit.

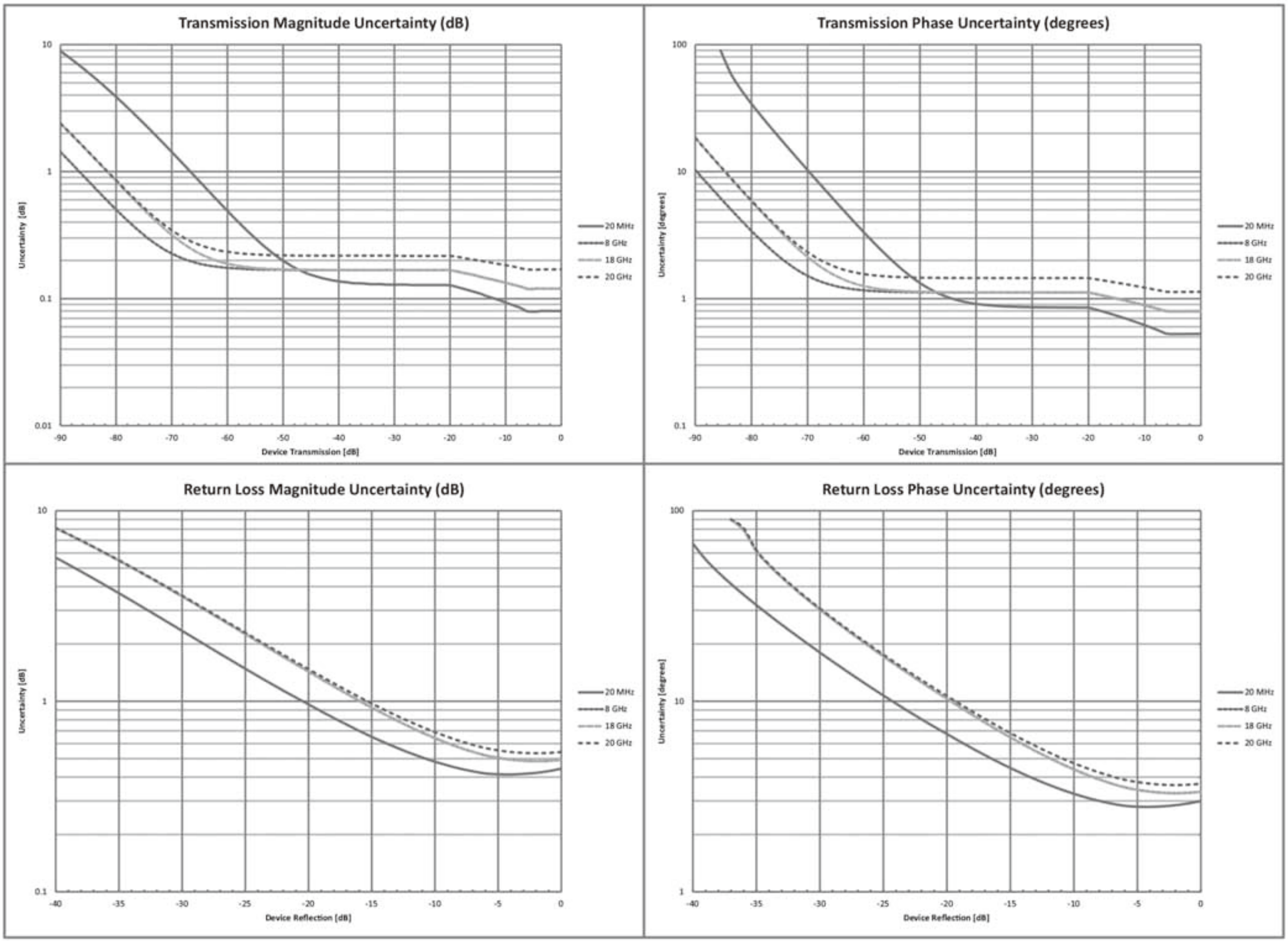
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
1 MHz to 1 GHz*2	≥42	≥33	≥42	±0.15	±0.06
>1 GHz to 10 GHz	≥37	≥33	≥42	±0.15	±0.1
>10 GHz to 18 GHz	≥37	≥33	≥36	±0.15	±0.1
>18 GHz to 20 GHz	≥37	≥33	≥36	±0.20	±0.15

*1: Characteristic performance.

*2: Applies to Rev 2 SmartCal Modules. MN25218A with serial numbers <1817999 operate from 1 MHz to 20 GHz.

Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.


Transmission Magnitude Uncertainty (dB)

Transmission Phase Uncertainty (degrees)

Return Loss Magnitude Uncertainty (dB)

Return Loss Phase Uncertainty (degrees)

VNA System Performance for the MS46122B-040 (AutoCal)

Error-Corrected Specifications with 36585K AutoCal

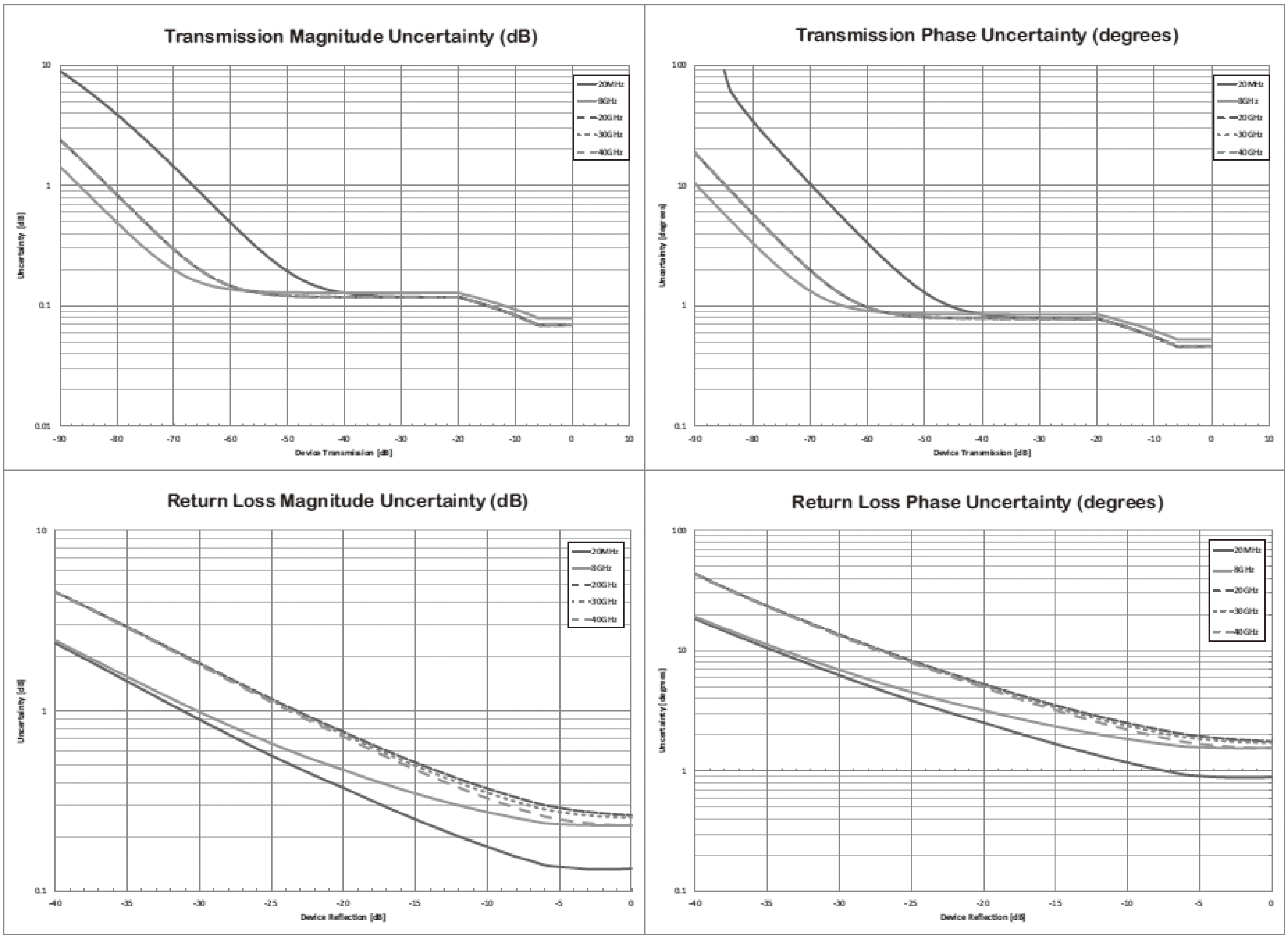
With 12-term calibration using the 36585K automatic calibrator (AutoCal). Performance is typical.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
1 MHz to <10 GHz	≥50	≥49	≥42	±0.15	±0.06
10 GHz to <20 GHz	≥45	≥49	≥36	±0.15	±0.05
20 GHz to <30 GHz	≥45	≥45	≥36	±0.10	±0.05
30 GHz to 40 GHz	≥45	≥45	≥30	±0.10	±0.05

*: Characteristic performance.

Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.



Measurement Throughput

Measurement Speed	130 µs/point, typical. Per point single sweep time, including placing measurement data into memory. Average of narrow, mid, and wide frequency span sweeps. 300 kHz IFBW, 201 points, 2 port calibrated data measurement. Timing dependent on external computer configuration. Measurements taken with a an Intel® Core™ i5-6300U processor running Windows 7 with 4 GB of RAM and 60 GB of free hard disk space.

Standard Capabilities

Operating Frequencies	MS46122B-010: 1 MHz to 8 GHz MS46122B-020: 1 MHz to 20 GHz MS46122B-040: 1 MHz to 43.5 GHz
Measurement Parameters	2-Port Measurements: S_{11}, S_{21}, S_{22}, S_{12}, and any user-defined combination of a_1, a_2, b_1, b_2, 1. Maximum Efficiency Analysis, Mixed-mode SDD, SDC, SCD, SCC Domains: Frequency Domain, and Time (Distance) Domain (Option 2)
Sweeps	Frequency Sweep Types: Linear, Log, or Segmented
Display Graphs	Single Rectilinear Graph Types: Log Magnitude, Phase, Group Delay, Linear Magnitude, Real, Imaginary, SWR, Impedance, KQ and η Max Dual Rectilinear Graph Types: Log Mag and Phase, Linear Mag and Phase, Real and Imaginary, KQ and η Max Circular Graph Types: Smith Chart (Impedance), Polar
Measurements Data Points	Maximum Data Points: 2 to 16,001 points
Limit Lines	Limit Lines: Single or segmented. 2 limit lines per trace. 50 segments per trace. Single Limit Readouts: Uses interpolation to determine the intersection frequency. Test Limits: Both single and segmented limits can be used for PASS/FAIL testing.
Ripple Limit Lines	Limit Lines: Single or segmented. 2 limit lines per trace. 50 segments per trace. Ripple Value: Absolute Value or Margin Test Limits: Both single and segmented limits can be used for PASS/FAIL testing.
Averaging	Point-by-Point: Point-by-point (default), maximum number of averages = 200 Sweep-by-Sweep: Sweep-by-sweep, maximum number of averages = 4096
IF Bandwidth	10, 20, 50, 70, 100, 200, 300, 500, 700 Hz 1, 2, 3, 5, 7, 10, 20, 30, 50, 70, 100, 200, 300 kHz
Reference Plane	Line Length or Time Delay: The reference planes of a calibration or other normalization can be changed by entering a line length or time delay. Dielectric Constants: Dielectric constants may be entered for different media so the length entry can be physically meaningful. Dispersion Modeling: Dispersion modeling is used in the cases of microstrip and waveguide to take into account frequency dependent phase velocities. Attenuations: Attenuation (with frequency slope) and constant phase offsets can be entered to better describe any reference plane distortions. The frequency dependence exponent is changeable. Auto Modes: Automatic reference plane finding tools are available for phase alone or phase + magnitude. These routines do a fitting process on phase or phase and magnitude to estimate the reference plane location and enter correcting values. De-embedding: For more complete reference plane manipulation, the full de-embedding system can also be used.
Measurement Frequency Range	Frequency Range Change: Frequency range of the measurement can be narrowed within the calibration range without recalibration. CW Mode: CW mode permits single frequency measurements also without recalibration. Interpolation Not Activated: If interpolation is not activated, the subset frequency range is forced to use calibration frequency points. Interpolation Activated: If interpolation is activated, any frequency range that is a subset of the calibration frequency range can be used, but there may be some added interpolation error.
Group Delay	Group Delay Aperture: Defined as the frequency span over which the phase change is computed at a given frequency point. Aperture: The aperture can be changed without recalibration. Minimum Aperture: The minimum aperture is the frequency range divided by the number of points in calibration and can be increased to 20 % of the frequency range. Group Delay Range: <180° of phase change within the aperture
Channels, Display, and Traces	Channels and Traces: 16 channels, each with up to 16 traces Display Colors: Unlimited colors for data traces, memory, text, markers, graticules, and limit lines Trace Memory and Math: A separate memory for each trace can be used to store measurement data for later display or subtraction, addition, multiplication or division with current measurement data. The trace data can be saved and recalled. Intra-trace Math: Any two traces within a channel can be combined (via addition, subtraction, multiplication, or division) and displayed on another trace.
Scale Resolution	Minimum per division, varies with graph type. Log Magnitude: 0.001 dB Linear Magnitude: 10 µU Phase: 0.01° Group Delay: 0.1 ps Time: 0.0001 ps Distance: 0.1 µm SWR: 10 µU Power: 0.01 dB
Markers	Markers: 12 markers + 1 reference marker Marker Coupling: Coupled or decoupled Marker Overlay: Display markers on active trace only or on all traces when multiple trace responses are present on the same trace. Marker Data: Data displayed in graph area or in table form Reference Marker: Additional marker per trace for reference Marker Statistics: Mean, maximum, minimum, standard deviation Per trace or over a marker region Marker Search and Tracking: Search and/or track for minimum, maximum, peak, or target value
Other	Filter Parameters: Display bandwidth (user-selectable loss value), corner and center frequencies, loss, Q, and shape factors. S-Parameter Conversion: Z Reflection Impedance Z Transmission Impedance Y Reflection Admittance Y Transmission Admittance 1/S

Calibration and Correction Capabilities

Calibration Methods	Short-Open-Load-Through (SOLT) Offset-Short-Offset-Short-Load-Through (SSLT) Triple-Offset-Short-Through (SSST) Short-Open-Load-Reciprocal (SOLR) Line-Reflect-Line (LRL) / Line-Reflect-Match (LRM) SmartCal™ AutoCal™ Thru Update available
Correction Models	2-Port (Forward, Reverse, or both directions) 1-Port (S_{11}, S_{22}, or both) Transmission Frequency Response (Forward, Reverse, or both directions) Reflection Frequency Response (S_{11}, S_{22}, or both)
Coefficients for Calibration Standards	Use the Anritsu calibration kit USB memory device to load kit coefficients and characterization files. Enter coefficients into user-defined locations. Use complex load models.
Interpolation	Allows interpolation between calibration frequency points.
Adapter Removal Calibration	Characterizes and "removes" an adapter that is used during calibration that will not be used for subsequent device measurements; for accurate measurement of non-insertable devices.
Dispersion Compensation	Selectable as Coaxial, other non-dispersive (e.g., for coplanar waveguide), Waveguide, or Microstrip
Embedding/ De-embedding	The MS46122B is equipped with an Embedding/De-embedding system.
	De-embedding: De-embedding is generally used for removal of test fixture contributions, modeled networks, and other networks described by S-parameters (s2p files) from measurements. Embedding: Similarly, the Embedding function can be used to simulate matching circuits for optimizing amplifier designs or simply adding effects of a known structure to a measurement. Multiple Networks: Multiple networks can be embedded/de-embedded and changing the port and network orientations is handled easily. Extraction Utility: An extraction utility is part of this package that allows easier computation of de-embedding files based on additional calibration steps and measurements.
Optical/Electrical Conversion	O/E & E/O: O/E and E/O setup wizard is provided
Impedance Conversion	Allows entry of different reference impedances (complex values) for different ports

Optional Capabilities

Time Domain Measurements Option 2	Displays all S-parameters and overlays with Frequency Domain, Low-pass Mode with added harmonics frequency list flexibility, Band-pass Mode, Phasor Impulse Mode, Windowing, Gating (pass-band or reject-band), and Frequency with Time Gate.

Remote Operability

ShockLine supports several remote operability options.

Communication Type	Data Format	Performance	Description
Drivers	IVI-C drivers are available for download from the Anritsu website. The IVI-C package supports National Instruments LabVIEW and LabWindows, C#, .NET, MATLAB, and Python34 programming environments.		
Triggering	Start Trigger: Software and Digital Edge Input Range: +3.3 V logic level (+5 V tolerant) Minimum Trigger Width: 50 ns Trigger Delay: 6 µs, typical		

Front Panel Connections

MS46122B Front Panel

Rear Panel Connections

MS46122B Series Rear Panel

Test Ports 1 and 2	MS46122B-010: N (f) MS46122B-020: Ruggedized K (m) MS46122B-040: Ruggedized K (m) Damage Input Levels: +23 dBm maximum, ±50 VDC maximum
USB Ports	One mini type B USB port for connecting to an external PC controller.
Power Input	Input connector for external power supply.
10 MHz In	Signal presence is auto-sensing (better than 10 ppm frequency accuracy is recommended). Connector Type: BNC (f) Signal: +0 dBm, typical; 50Ω, nominal
External Trigger Input	Connector Type: BNC (f) Voltage Input: 0 to 3.3 V input (5 V tolerant) Impedance: High impedance (>100kΩ) Pulse Width: 50 ns minimum input pulse width Trigger Delay: 6 µs typical

Recommended External PC Configuration

CPU	Intel® Core™ i5-6300U Processor
RAM	4 GB
Disk	120 GB
DirectX	Version 9 with Windows Display Driver Model (WDDM) installed ShockLine software is compatible with Windows® 7,8, 8.1, or 10; 32 or 64 bit operating systems

Mechanical

Dimensions	Dimensions listed are for the instrument body without rack mount option attached. 328.1 (W) × 61.1 (H) × 197.87 (D) mm
Mass	<2.2 kg (<5 lb), typical weight for a fully-loaded MS46122B VNA

Regulatory Compliance

CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN61010-1 RoHS: 2011/65/EU
Australia and New Zealand	RCM AS/NZS 4417:2012
South Korea	KCC-REM-A21-0004

Environmental

MIL-PRF-28800F Class 3

Operating Temperature Range	0° to +50°C
Storage Temperature Range	–40° to +71°C
Maximum Relative Humidity	95% RH at 30°C, non-condensing
Altitude	4600 meters, operating and non-operating

Warranty

Instrument and Built-In Options	3 years from the date of shipment (standard warranty)
Calibration Kits	Typically 1 year from the date of shipment
Test Port Cables	Typically 1 year from the date of shipment
Warranty Options	Additional warranty available

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main Frame
MS46122B	2-Port ShockLine™ Economy VNA
	Required Option
	(Select one frequency option only)
MS46122B-010	1 MHz to 8 GHz, type N (f) ports
MS46122B-020	1 MHz to 20 GHz, Ruggedized type K (m) ports (compatible with 3.5 mm and SMA connectors)
MS46122B-040	1 MHz to 43.5 GHz, Ruggedized type K (m) ports (compatible with 3.5 mm and SMA connectors)
	Included Accessories
	Each VNA comes with a set of included accessories.
User Documentation	Getting Started with Anritsu Flier, provides access to all ShockLine web content and services.
Power	40-187-R, 12V, 5A Power supply (and power cord)
USB Cable	3-2000RS-1815, USB 2.0 A to Mini B cable, 10 ft
Rack Mount	Bracket hardware for shelf-mounting into a 19 inch universal rack
	Main VNA Options
MS46122B-002	Time Domain with Time Gating
	Calibration Options
MS46122B-098	Standard Calibration, ISO 17025 compliant, without data
MS46122B-099	Premium Calibration, ISO 17025 compliant, with data
	Precision Automatic Calibrator Modules
MN25208A	2-port USB SmartCal Module, 300 kHz to 8.5 GHz (available with connector Options -001 N (f), -002 K (f), -003 3.5 mm (f))
MN25408A	4-port USB SmartCal Module, 300 kHz to 8.5 GHz (available with connector Options -001 N (f), -002 K (f), -003 3.5 mm (f))
MN25218A	2-port USB SmartCal Module, 300 kHz to 20 GHz (available with connector Option -002 K (f))
MN25418A	4-port USB SmartCal Module, 300 kHz to 20 GHz (available with connector Option -002 K (f))
36585K-2M	K Connector Precision AutoCal Module, 70 kHz to 40 GHz, K (m) to K (m)
36585K-2F	K Connector Precision AutoCal Module, 70 kHz to 40 GHz, K (f) to K (f)
36585K-2MF	K Connector Precision AutoCal Module, 70 kHz to 40 GHz, K (m) to K (f)
2000-1809-R	Serial to USB Adapter (required for use with 36585 AutoCal module if control PC does not have a serial port)
	Mechanical Calibration Kits
3650A	SMA/3.5 mm Calibration Kit, Without Sliding Loads, DC to 26.5 GHz, 50Ω
3650A-1	SMA/3.5 mm Calibration Kit, With Sliding Loads, DC to 26.5 GHz, 50Ω
3652A	K Connector Calibration Kit, Without Sliding Loads, DC to 40 GHz, 50Ω
3652A-1	K Connector Calibration Kit, With Sliding Loads, DC to 40 GHz, 50Ω
3653A	N Connector Calibration Kit, Without Sliding Loads, DC to 18 GHz, 50Ω
OSLN50A-8	Precision N Male Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50Ω
OSLNF50A-8	Precision N Female Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50Ω
TOSLN50A-8	Precision N Male Through/Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50Ω
TOSLNF50A-8	Precision N Female Through/Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50Ω
OSLN50A-18	Precision N Male Open/Short/Load Mechanical Calibration Tee, DC to 18 GHz, 50Ω
OSLNF50A-18	Precision N Female Open/Short/Load Mechanical Calibration Tee, DC to 18 GHz, 50Ω
TOSLN50A-18	Precision N Male Through/Open/Short/Load Mechanical Calibration Tee, DC to 18 GHz, 50Ω
TOSLNF50A-18	Precision N Female Through/Open/Short/Load Mechanical Calibration Tee, DC to 18 GHz, 50Ω
TOSLK50A-20	Precision K Male Through/Open/Short/Load Mechanical Calibration Tee, DC to 20 GHz, 50Ω
TOSLKF50A-20	Precision K Female Through/Open/Short/Load Mechanical Calibration Tee, DC to 20 GHz, 50Ω
TOSLK50A-40	Precision K Male Through/Open/Short/Load Mechanical Calibration Tee, DC to 40 GHz, 50Ω
TOSLKF50A-40	Precision K Female Through/Open/Short/Load Mechanical Calibration Tee, DC to 40 GHz, 50Ω

Model/Order No.	Name
	Verification Kits
3663-3	N Connector Verification Kit
3668-3	K Connector Verification Kit
	RF Cables and Adapters
1091-26-R	SMA (m) to N (m), DC to 18 GHz, 50Ω
1091-27-R	SMA (f) to N (m), DC to 18 GHz, 50Ω
1091-80-R	SMA (m) to N (f), DC to 18 GHz, 50Ω
1091-81-R	SMA (f) to N (f), DC to 18 GHz, 50Ω
71693-R	Ruggedized adapter, K (f) to N (f), DC to 18 GHz, 50Ω
34NK50	Precision Adapter, N (m) to K (m), DC to 18 GHz, 50Ω
34NKF50	Precision Adapter, N (m) to K (f), DC to 18 GHz, 50Ω
34NFK50	Precision Adapter, N (f) to K (m), DC to 18 GHz, 50Ω
34NFKF50	Precision Adapter, N (f) to K (f), DC to 18 GHz, 50Ω
K220B	Precision Adapter, K (m) to K (m), DC to 40 GHz, 50Ω
K222B	Precision Adapter, K (f) to K (f), DC to 40 GHz, 50Ω
K224B	Precision Adapter, K (m) to K (f), DC to 40 GHz, 50Ω
	Test Port Cables, Flexible, Ruggedized, Phase Stable
15NNF50-1.0B	Test Port Cable, Flexible, Phase Stable, N (f) to N (m), 1.0 m, 50Ω
15NNF50-1.5B	Test Port Cable, Flexible, Phase Stable, N (f) to N (m), 1.5 m, 50Ω
15NN50-1.0B	Test Port Cable, Flexible, Phase Stable, N (m) to N (m), 1.0 m, 50Ω
15LL50-1.0A	Test Port Cable, Armored, Phase Stable, DC to 20 GHz, 3.5 mm (m) to 3.5 mm (m), 1.0 m, 50Ω
15LLF50-1.0A	Test Port Cable, Armored, Phase Stable, DC to 20 GHz, 3.5 mm (m) to 3.5 mm (f), 1.0 m, 50Ω
15KK50-1.0A	Test Port Cable, Armored, Phase Stable, DC to 20 GHz, K (m) to K (m), 1.0 m, 50Ω
15KKF50-1.0A	Test Port Cable, Armored, Phase Stable, DC to 20 GHz, K (m) to K (f), 1.0 m, 50Ω
3671KFS50-60	Test Port Cable, Flexible, Phase Stable, DC to 26.5 GHz, K (f) to 3.5 mm (m), 63.5 cm, 50Ω
3671KFK50-60	Test Port Cable, Flexible, Phase Stable, DC to 40 GHz, K (f) to K (m), 63.5 cm (25 in), 50Ω
3671KFKF50-60	Test Port Cable, Flexible, Phase Stable, DC to 40 GHz, K (f) to K (f), 63.5 cm (25 in), 50Ω
3671KFK50-100	Test Port Cable, Flexible, Phase Stable, DC to 40 GHz, K (f) to K (m), 1 m (38 in), 50Ω
SC8267	1.0 m (36"), Cable, 40 GHz, K(m) to K(f), 50 Ω
	Phase-Stable 18 GHz and 40 GHz Semi-Rigid Cables (Armored)
3670K50-1	0.3 m (12”), DC to 40 GHz, K (f) to K (m), 50Ω
3670K50-2	0.6 m (24”), DC to 40 GHz, K (f) to K (m), 50Ω
3670N50-1	0.3 m (12”), DC to 18 GHz, N (f) to N (m), 50Ω
3670NN50-1	0.3 m (12”), DC to 18 GHz, N (m) to N (m), 50Ω
3670N50-2	0.6 m (24”), DC to 18 GHz, N (f) to N (m), 50Ω
3670NN50-2	0.6 m (24”), DC to 18 GHz, N (m) to N (m), 50Ω
	Tools
01-201	Torque End Wrench, 5/16 in, 0.9 N·m (8 lbf·in) For tightening male devices, for SMA, 3.5 mm, 2.4 mm, K, and V connectors
01-203	Torque End Wrench, 13/16 in, 0.9 N.m (8 lbf.in) For tightening ruggedized SMA, 2.4 mm, K and V connectors
01-204	End Wrench, 5/16 in, Universal, Circular, Open-ended, For SMA, 3.5 mm, 2.4 mm, K and V connectors
More Information	Refer to our Precision RF & Microwave Components Catalog for descriptions of adapters and other components.
	Documentation
User Documentation	Soft copies of the manuals as Adobe Acrobat PDF files are available for download from the instrument model web page at www.anritsu.com. For more information and product support, please contact ShockLineVNA.support@Anritsu.com.
10100-00067	Product information, compliance, and safety
10410-00340	MS46122A/B Series VNA Operation Manual
10410-00337	MS46121A/B, MS46122A/B, and MS46322A/B Series VNA User Interface Reference Manual
10410-00746	ShockLine Series VNA Programming Manual, for IEEE 488.2 and SCPI Commands

ShockLine™ Economy Vector Network Analyzers

MS46322B Series

1 MHz to 8 GHz/20 GHz/43.5 GHz

Low-Cost Series of 2U High, 2-Port Economy Vector Network Analyzers

The MS46322B is part of the ShockLine™ family of Vector Network Analyzers from Anritsu. It is a low-cost series of 2U high, 2-port Economy Vector Network Analyzers. It is available in three frequency ranges: 1 MHz to 8/20/43.5 GHz, and is capable of s-parameter and time domain measurements.

The MS46322B is based on patented ShockLine™ VNA-on-chip technology, which simplifies the internal VNA architecture at high frequencies, reduces instrument cost, and enhances accuracy and measurement repeatability. The combination of low cost and good performance make ShockLine™ VNAs ideal candidates for testing RF and Microwave passive devices to 43.5 GHz.

The MS46322B series supports SCPI command programming and has software driver support for the most common programming environments. The MS46322B use industry standard LAN communications for robust remote control in test applications.

ShockLine™ VNAs provide a powerful graphical user interface for manual testing of devices. The full-featured user interface is enabled by attaching a (user-supplied) touchscreen monitor, keyboard, and mouse.

This document provides detailed specifications for the MS46322B series Vector Network Analyzers (VNAs) and related options.

Instrument Models and Operating Frequencies

Base Model
- MS46322B, 2-Port ShockLine VNA

Requires one Frequency Option
- MS46322B-010, 1 MHz to 8 GHz, 2-port
- MS46322B-020, 1 MHz to 20 GHz, 2-Port
- MS46322B-040, 1 MHz to 43.5 GHz, 2-Port

Principal Options

- MS46322B-002, Time Domain

Definitions

All specifications and characteristics apply under the following conditions, unless otherwise stated:

Warm-Up Time	After 30 minutes of warm-up time, where the instrument is left in the ON state.
Temperature Range	Over the 25° ±5°C temperature range.
Error-Corrected Specifications	Specifications are valid over 23° ±3°C, with <1°C variation from calibration temperature. Error-corrected specifications are warranted and include guard-bands, unless otherwise stated.
Frequency Bands in Tables	When a frequency is listed in two rows of the same table, the specification for the common frequency is taken from the lower frequency band.
User Cables	Specifications do not include effects of any user cables attached to the instrument.
Discrete Spurious Responses	Specifications may exclude discrete spurious responses.
Internal Reference Signal	All specifications apply with internal 10 MHz Crystal Oscillator Reference Signal.
Interpolation Mode	All specifications are with Interpolation Mode Off.
Standard	Refers to instruments without Options.
Typical Performance	Typical performance indicates the measured performance of an average unit. It does not include guard-bands and is not covered by the product warranty. Typical specifications are shown in parenthesis, such as (–102 dB), or noted as Typical. The MS46322B is operational to 43.5 GHz. All specifications above 40 GHz are typical.
Characteristic Performance	Characteristic performance indicates a performance designed-in and verified during the design phase. It does include guard-bands and is not covered by the product warranty.
Recommended Calibration Cycle	12 months (Residual specifications also require calibration kit calibration cycle adherence.)
Specifications Subject to Change	All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site: www.anritsu.com

Specifications

System Dynamic Range

System dynamic range is calculated as the difference between High source power and the noise floor (RMS) at the specified reference plane at 10 Hz IF Bandwidth.

Frequency Range	Standard (dB)	Typical (dB)
1 MHz to 10 MHz	85	105
>20 MHz to 8 GHz*1	100	115
>8 GHz to 43.5 GHz*2	100	110

*1: Crosstalk may reduce dynamic range up to 20 dB (typical) at lower IF bandwidths (≤ 10 kHz) when measuring highly reflective DUT's from 4 GHz to 8 GHz. Reflection measurements are not affected.

*2: Decrease specification by 5 dB between 8 GHz and 14 GHz.

Receiver Compression Levels

Performance is typical.

Frequency Range	Standard (dBm)
1 MHz to 43.5 GHz	+5

High Level Noise

Measured at 100 Hz IF bandwidth and at High power level, RMS. Performance is characteristic.

Frequency Range	Magnitude (dB)	Phase (deg)
1 MHz to <20 MHz	0.03 (0.005, typ.)	<0.2 (<0.035 typ.)
20 MHz to 43.5 GHz	0.006 (0.001, typ.)	<0.1 (<0.05 typ.)*

*: Above 20 GHz, High Level Noise (phase only) is increased by a factor of 1.5.

Output Power Settings

Power Setting	Frequency Range	Standard (dBm)
High (default)	1 MHz to 8 GHz >8 GHz to 43.5 GHz	5 –3
Low	1 MHz to 43.5 GHz	–20

Measurement Stability

Ratio measurement, with ports shorted. Typical.

Frequency Range	Magnitude (dB/°C)	Phase (deg/°C)
10 MHz to 43.5 GHz	0.02	0.3

Frequency Resolution, Accuracy, and Stability

Resolution	Accuracy	Stability	Aging
1 Hz	±1.0 ppm (at time of calibration)	±1.0 ppm from –10° to +55°C, typ.	±1.0 ppm/year, typ.

Uncorrected (Raw) Port Characteristics

User and System Correction Off. All specifications typical.

Frequency Range	Directivity (dB)	Port Match (dB)
1 MHz to 43.5 GHz	>8	>8

VNA System Performance for MS46322B-010 (Manual Cal Kits)

Error-Corrected Specifications

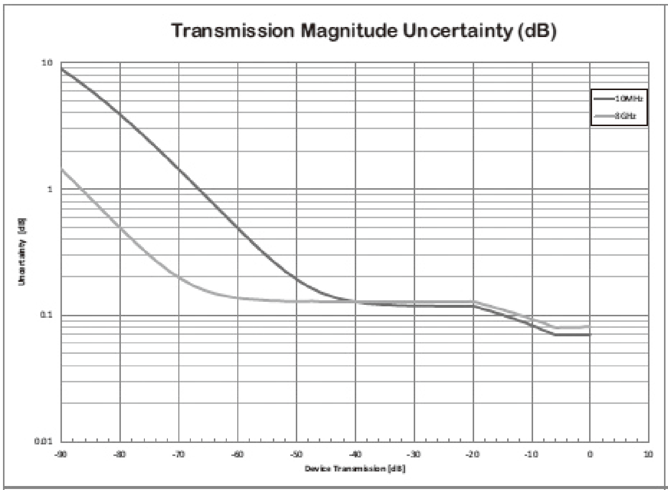
With 12-term SOLT Calibration using TOSLN50A-8 or TOSLNF50A-8 N type connector calibration kits.

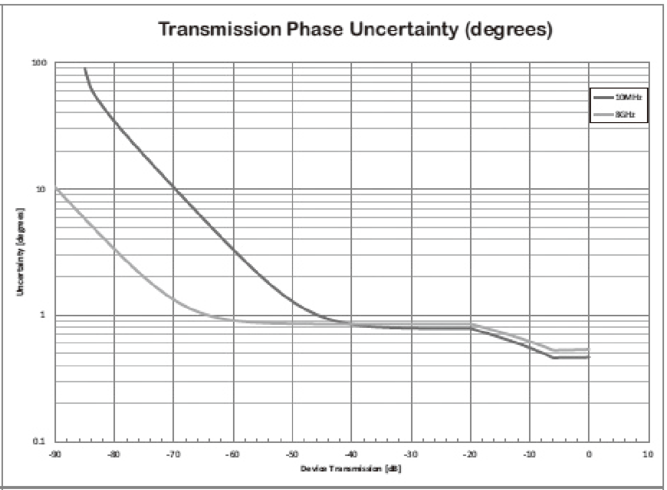
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
1 MHz to 6 GHz	≥42	≥33	≥42	±0.15	±0.06
>6 GHz to 8 GHz	≥37	≥33	≥37	±0.15	±0.06

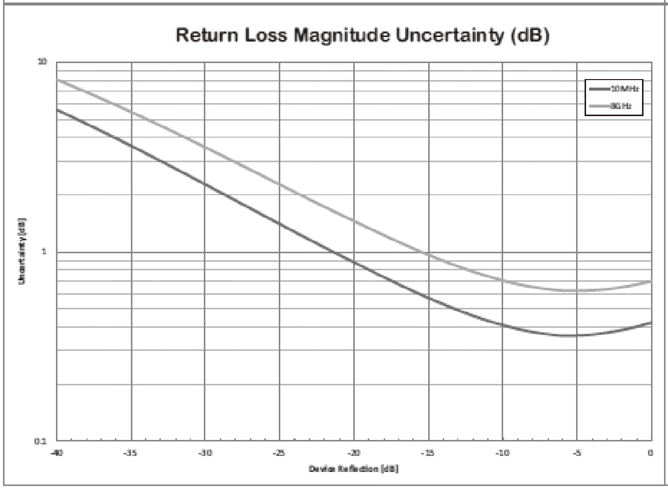
*: Characteristic performance.

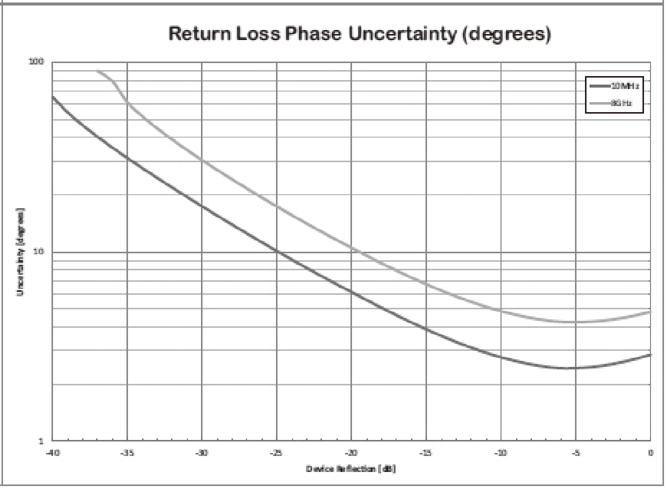
Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.


Transmission Magnitude Uncertainty (dB)


Transmission Phase Uncertainty (degrees)


Return Loss Magnitude Uncertainty (dB)


Return Loss Phase Uncertainty (degrees)

VNA System Performance for MS46322B-020 (Manual Cal Kits)

Error-Corrected Specifications

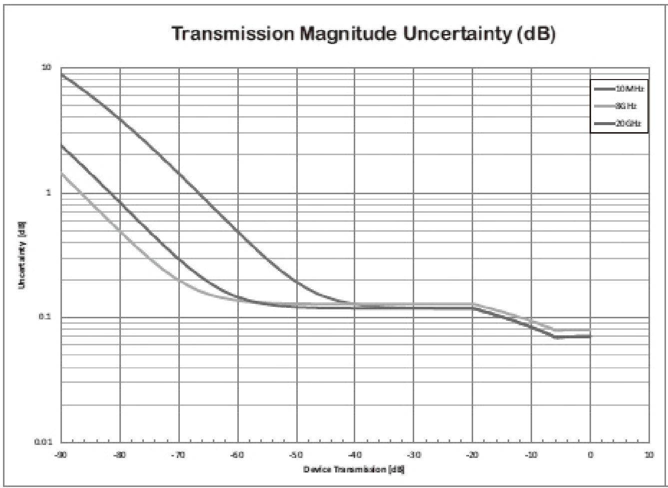
With 12-term SOLT calibration using the TOSLK50A-20 or TOSLKF50A-20 K type connector calibration kits.

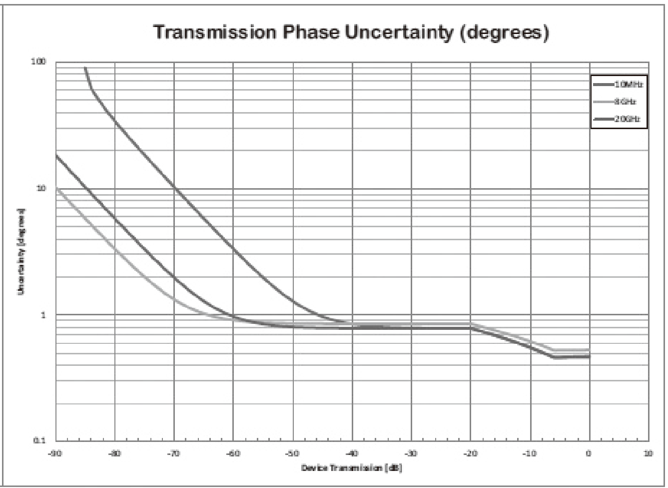
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
1 MHz to 10 GHz	≥42	≥33	≥42	±0.15	±0.06
> 10 GHz to 20 GHz	≥36	≥26	≥36	±0.15	±0.05

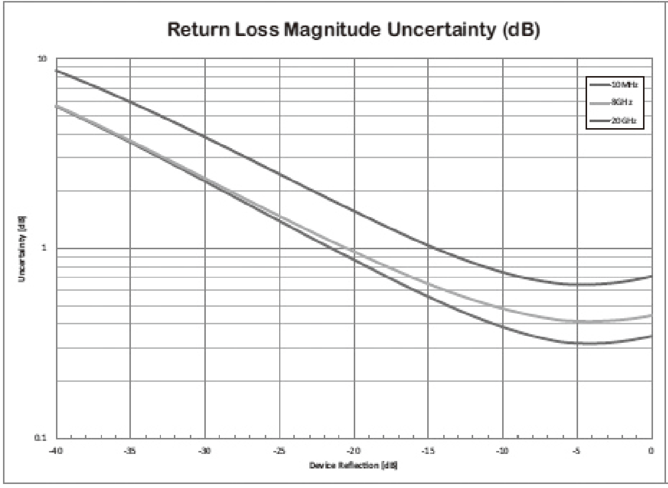
*: Characteristic performance.

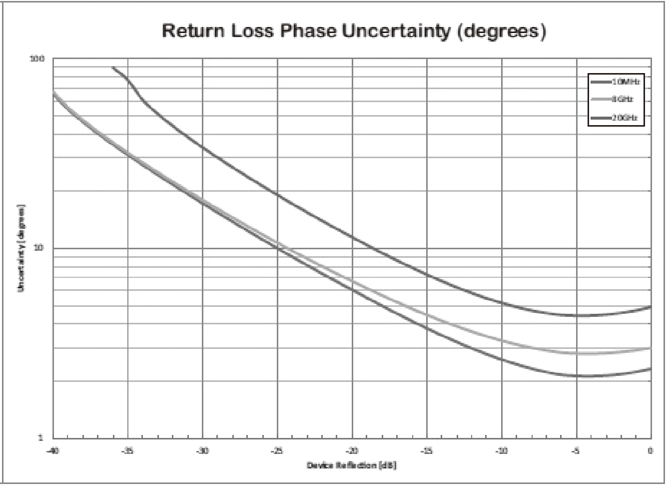
Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.









VNA System Performance for MS46322B-040 (Manual Cal Kits)

Error-Corrected Specifications

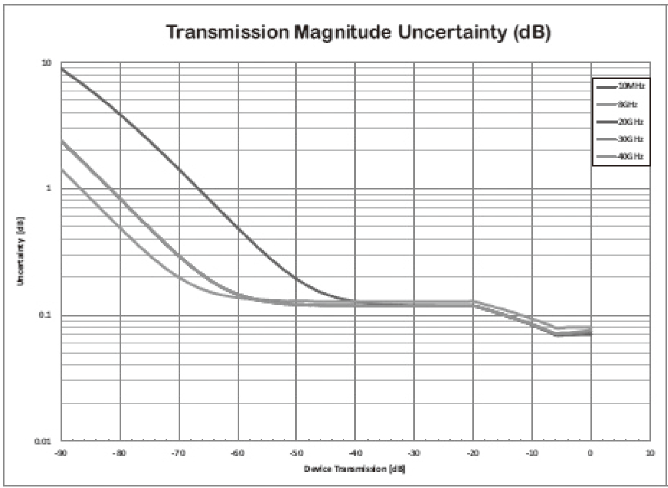
With 12-term SOLT Calibration using TOSLK50A-40 or TOSLKF50A-40 K type connector calibration kits.

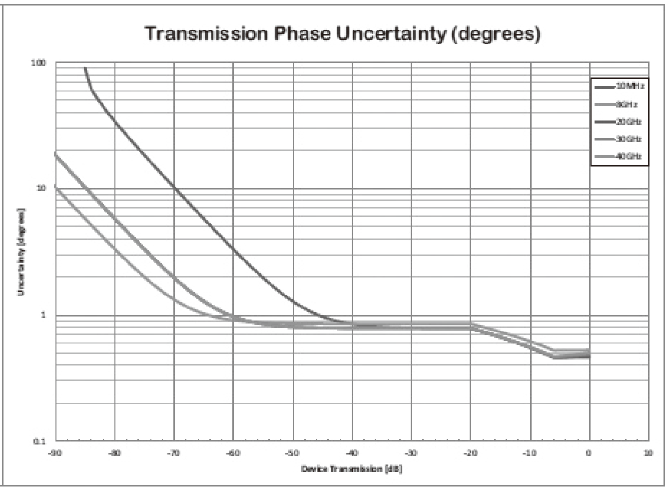
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
1 MHz to 10 GHz	≥42	≥33	≥42	±0.15	±0.06
>10 GHz to 20 GHz	≥36	≥26	≥36	±0.15	±0.05
>20 GHz to 30 GHz	≥32	≥22	≥32	±0.10	±0.05
>30 GHz to 43.5 GHz	≥30	≥20	≥30	±0.10	±0.05

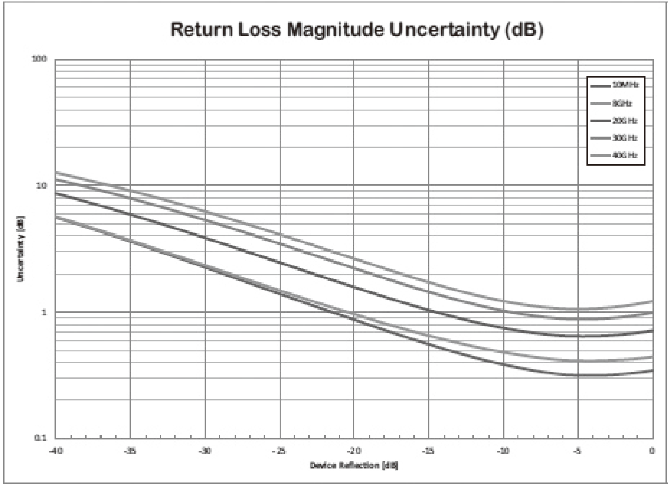
*: Characteristic performance.

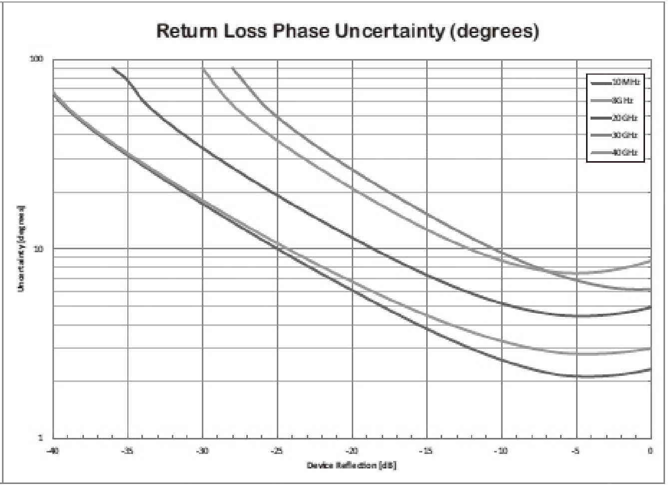
Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.


Transmission Magnitude Uncertainty (dB)


Transmission Phase Uncertainty (degrees)


Return Loss Magnitude Uncertainty (dB)


Return Loss Phase Uncertainty (degrees)

VNA System Performance for MS46322B-010 (SmartCal™)

Error-Corrected Specifications

With 12-term calibration using the MN25208A SmartCal™ automatic calibration kit with connector options MN25208A-001, -002, -003.

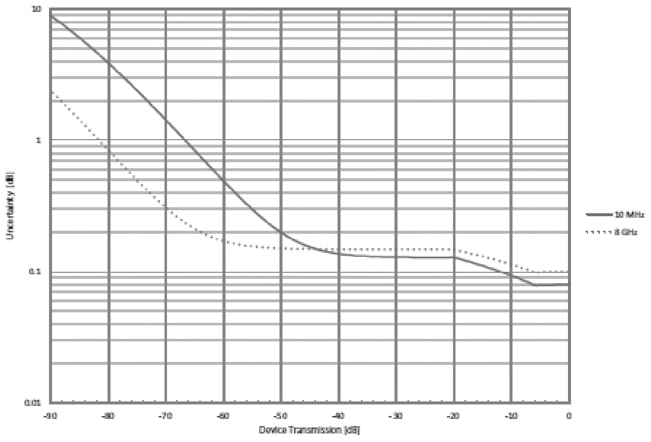
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
1 MHz to <1 GHz	≥42	≥35	≥42	±0.15	±0.06
1 GHz to 5 GHz	≥42	≥35	≥42	±0.08	±0.08
>5 GHz to 8 GHz	≥36	≥35	≥37	±0.1	±0.08

*: Characteristic performance.

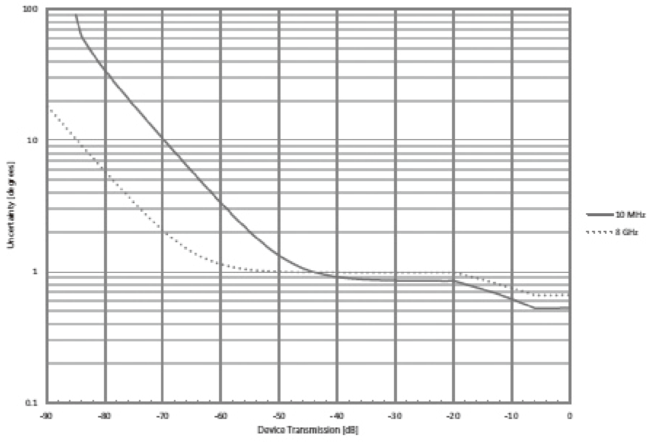
Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.

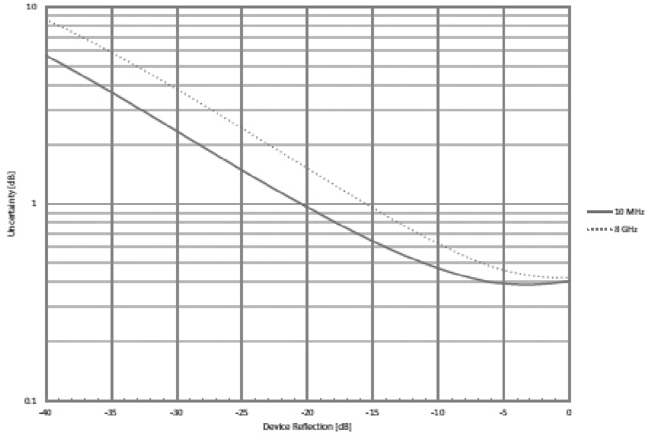
Transmission Magnitude Uncertainty (dB)



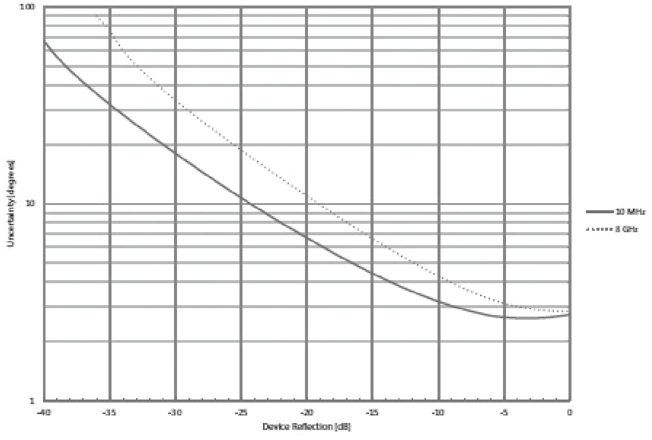
Transmission Phase Uncertainty (degrees)



Return Loss Magnitude Uncertainty (dB)



Return Loss Phase Uncertainty (degrees)



VNA System Performance for MS46322B-010 and MS46322B-020 (SmartCal™)

Error-Corrected Specifications

With 12-term calibration using the MN25218A SmartCal™ automatic calibration kit.

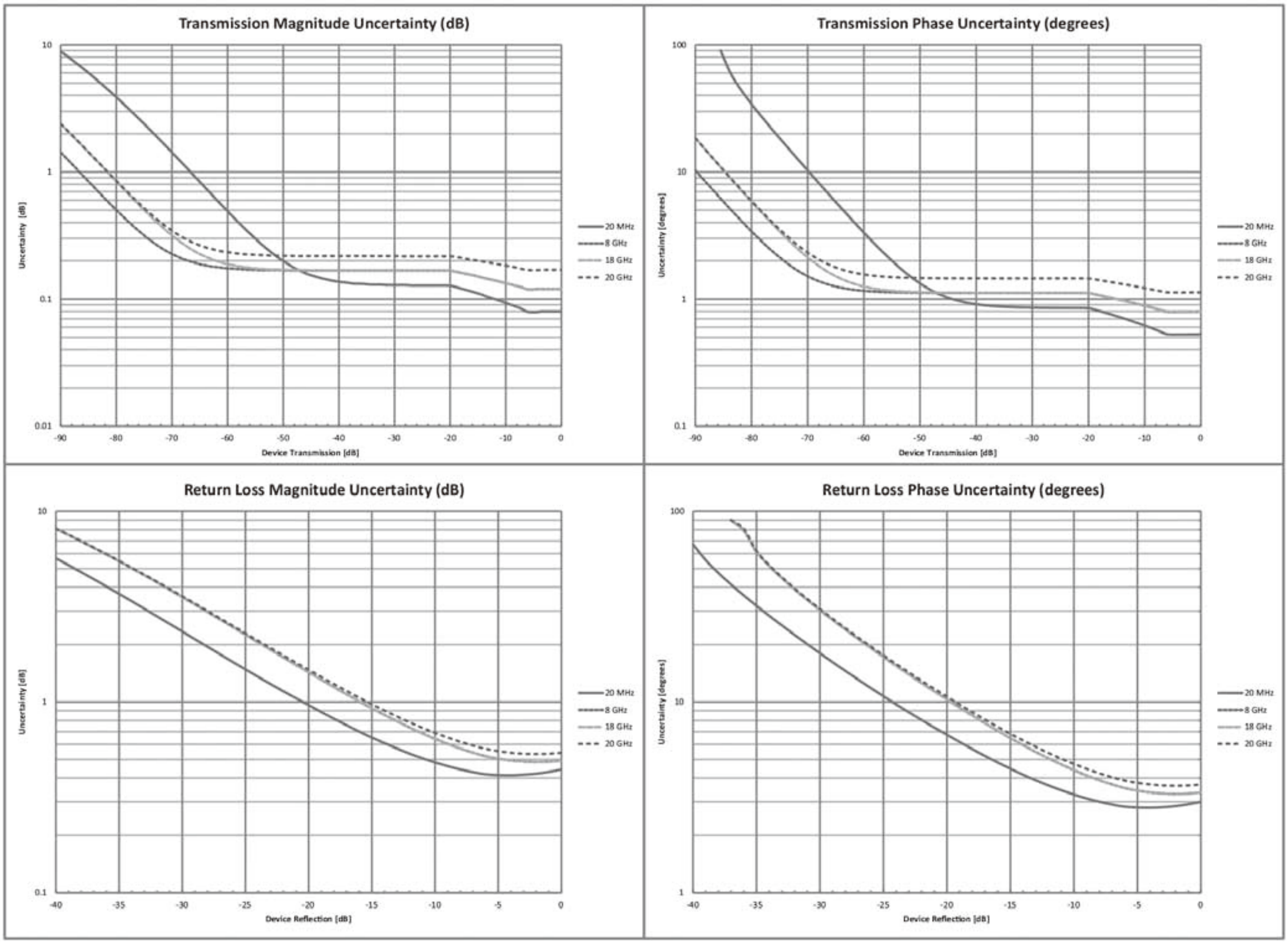
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match*1 (dB)	Reflection Tracking*1 (dB)	Transmission Tracking*1 (dB)
1 MHz to <1 GHz*2	≥42	≥33	≥42	±0.15	±0.6
1 GHz to 10 GHz	≥37	≥33	≥42	±0.15	±0.1
>10 GHz to 18 GHz	≥37	≥33	≥36	±0.15	±0.1
>18 GHz to 20 GHz	≥37	≥33	≥36	±0.20	±0.15

*1: Characteristic performance.

*2: Applies to Rev 2 SmartCal Modules. MN25218A with serial numbers <1817999 operate from 1 MHz to 20 GHz.

Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.


Transmission Magnitude Uncertainty (dB)

Transmission Phase Uncertainty (degrees)

Return Loss Magnitude Uncertainty (dB)

Return Loss Phase Uncertainty (degrees)

VNA System Performance for MS46322B-040 (AutoCal™)

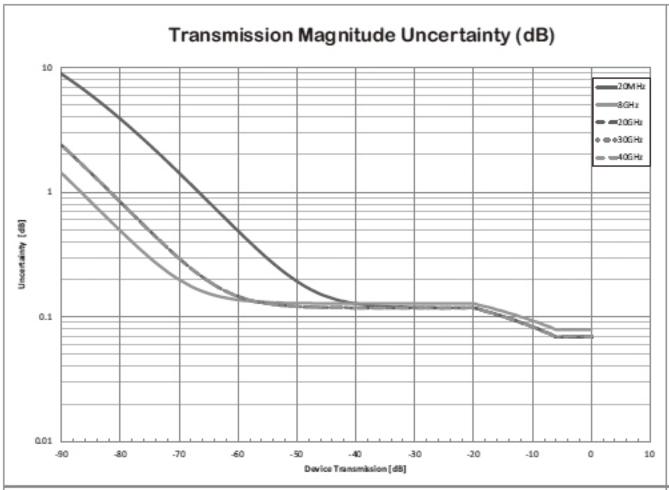
Error-Corrected Specifications

With 12-term calibration using the 36585K automatic calibrator (AutoCal™). Performance is typical.

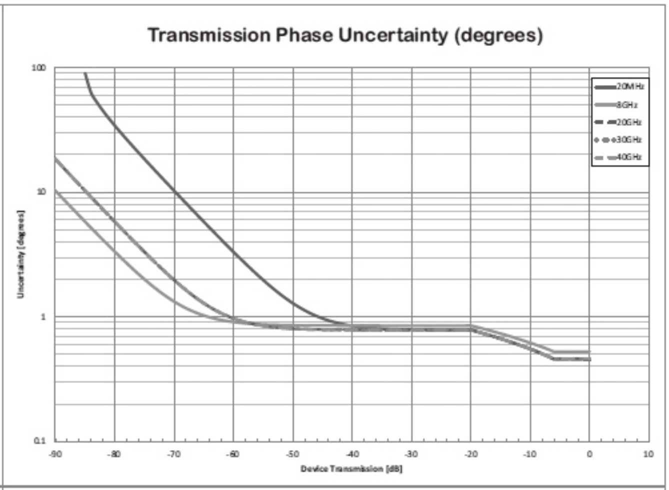
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
1 MHz to <10 GHz	≥50	≥49	≥42	±0.15	±0.06
10 GHz to <20 GHz	≥45	≥49	≥36	±0.15	±0.05
20 GHz to <30 GHz	≥45	≥45	≥36	±0.10	±0.05
30 GHz to 40 GHz	≥45	≥45	≥30	±0.10	±0.05

Measurement Uncertainties

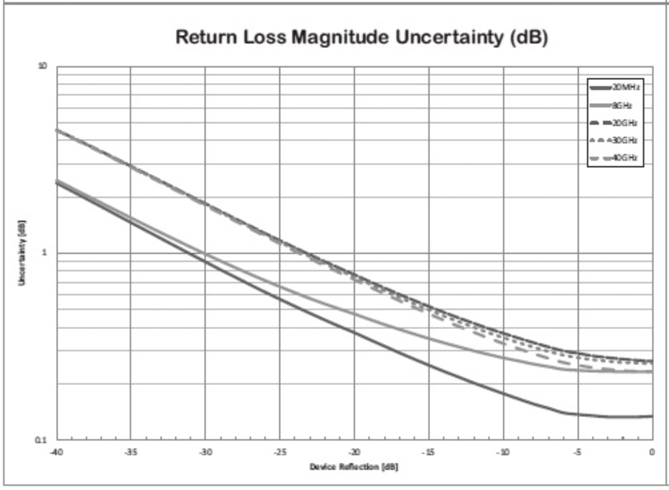
The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that S_{11} = S_{22} = 0. For reflection uncertainties, it is assumed that S_{21} = S_{12} = 0. All calibrations and measurements were performed at default port power. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.



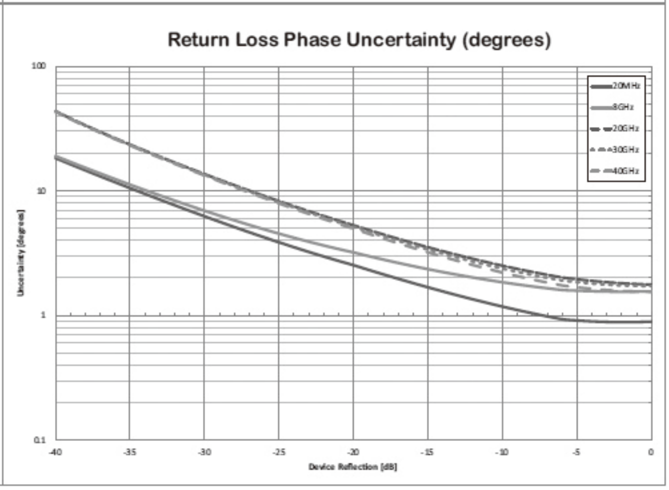
Transmission Magnitude Uncertainty (dB)



Transmission Phase Uncertainty (degrees)



Return Loss Magnitude Uncertainty (dB)



Return Loss Phase Uncertainty (degrees)

Measurement Throughput

Measurement Speed

130 µs/point, typical. Per point single sweep time, including placing measurement data into memory. Average of narrow, mid, and wide frequency span sweeps. 300 kHz IFBW, 1601 points, 2 port calibrated data measurement.

Data Transfer Time (ms)

Transferred complex S_{11} data, using "CALC:DATA:SDATA?" command. Typical performance data.*

Number of Points	51	201	401	1601
SCPI over LAN				
REAL 64	4	4	4	8
REAL 32	4	4	4	8
ASCII	14	34	60	209

*: Data transfer time varies depending on the PC and control software used with the VNA.

Standard Capabilities

Operating Frequencies	MS46322B-010: 1 MHz to 8 GHz MS46322B-020: 1 MHz to 20 GHz MS46322B-040: 1 MHz to 43.5 GHz
Measurement Parameters	2-Port Measurements: S_{11}, S_{21}, S_{22}, S_{12}, and any user-defined combination of a_1, a_2, b_1, b_2, 1. Maximum Efficiency Analysis, Mixed-mode SDD, SDC, SCD, SCC Domains: Frequency Domain, and Time (Distance) Domain (Option 2)
Sweeps	Frequency Sweep Types: Linear, Log, or Segmented
Display Graphs	Single Rectilinear Graph Types: Log Magnitude, Phase, Group Delay, Linear Magnitude, Real, Imaginary, SWR, Impedance, KQ and η Max Dual Rectilinear Graph Types: Log Mag and Phase, Linear Mag and Phase, Real, Imaginary, KQ and η Max Circular Graph Types: Smith Chart (Impedance), Polar
Measurements Data Points	Maximum Data Points: 2 to 16,001 points
Limit Lines	Limit Lines: Single or segmented. 2 limit lines per trace. 50 segments per trace. Single Limit Readouts: Uses interpolation to determine the intersection frequency. Test Limits: Both single and segmented limits can be used for PASS/FAIL testing.
Ripple Limit Lines	Limit Lines: Single or segmented. Two limit lines per trace. 50 segments per trace. Ripple Value: Absolute Value or Margin Test Limits: Both single and segmented limits can be used for PASS/FAIL testing.
Averaging	Point-by-Point: Point-by-point (default), maximum number of averages = 200 Sweep-by-Sweep: Sweep-by-sweep, maximum number of averages = 4096
IF Bandwidth	10, 20, 50, 70, 100, 200, 300, 500, 700 Hz 1, 2, 3, 5, 7, 10, 20, 30, 50, 70, 100, 200, 300 kHz
Reference Plane	Line Length or Time Delay: The reference planes of a calibration or other normalization can be changed by entering a line length or time delay. Dielectric Constants: Dielectric constants may be entered for different media so the length entry can be physically meaningful. Dispersion Modeling: Dispersion modeling is used in the cases of microstrip and waveguide to take into account frequency dependent phase velocities. Attenuations: Attenuation (with frequency slope) and constant phase offsets can be entered to better describe any reference plane distortions. The frequency dependence exponent is changeable. Auto Modes: Automatic reference plane finding tools are available for phase alone or phase + magnitude. These routines do a fitting process on phase or phase and magnitude to estimate the reference plane location and enter correcting values. De-embedding: For more complete reference plane manipulation, the full de-embedding system can also be used.
Measurement Frequency Range	Frequency Range Change: Frequency range of the measurement can be narrowed within the calibration range without recalibration. CW Mode: CW mode permits single frequency measurements also without recalibration. Interpolation Not Activated: If interpolation is not activated, the subset frequency range is forced to use calibration frequency points. Interpolation Activated: If interpolation is activated, any frequency range that is a subset of the calibration frequency range can be used, but there may be some added interpolation error.
Group Delay	Group Delay Aperture: Defined as the frequency span over which the phase change is computed at a given frequency point. Aperture: The aperture can be changed without recalibration. Minimum Aperture: The minimum aperture is the frequency range divided by the number of points in calibration and can be increased to 20% of the frequency range. Group Delay Range: <180° of phase change within the aperture
Channels, Display, and Traces	Channels and Traces: 16 channels, each with up to 16 traces Display Colors: Unlimited colors for data traces, memory, text, markers, graticules, and limit lines Trace Memory and Math: A separate memory for each trace can be used to store measurement data for later display or subtraction, addition, multiplication or division with current measurement data. The trace data can be saved and recalled. Intra-trace Math: Any two traces within a channel can be combined (via addition, subtraction, multiplication, or division) and displayed on another trace.
Scale Resolution	Minimum per division, varies with graph type. Log Magnitude: 0.001 dB Linear Magnitude: 10 µU Phase: 0.01° Group Delay: 0.1 ps Time: 0.0001 ps Distance: 0.1 µm SWR: 10 µU Power: 0.01 dB
Markers	Markers: 12 markers + 1 reference marker Marker Coupling: Coupled or decoupled Marker Overlay: Display markers on active trace only or on all traces when multiple trace responses are present on the same trace. Marker Data: Data displayed in graph area or in table form Reference Marker: Additional marker per trace for reference Marker Statistics: Mean, maximum, minimum, standard deviation Per trace or over a marker region Marker Search and Tracking: Search and/or track for minimum, maximum, peak, or target value
Other	Filter Parameters: Display bandwidth (user-selectable loss value), corner and center frequencies, loss, Q, and shape factors. S-Parameter Conversion: Z Reflection Impedance Z Transmission Impedance Y Reflection Admittance Y Transmission Admittance 1/S

Calibration and Correction Capabilities

Calibration Methods	Short-Open-Load-Through (SOLT) Offset-Short-Offset-Short-Load-Through (SSLT) Triple-Offset-Short-Through (SSST) Short-Open-Load-Reciprocal (SOLR) Line-Reflect-Line (LRL) / Line-Reflect-Match (LRM) SmartCal™ AutoCal™ Thru Update available
Correction Models	2-Port (Forward, Reverse, or both directions) 1-Port (S_{11}, S_{22}, or both) Transmission Frequency Response (Forward, Reverse, or both directions) Reflection Frequency Response (S_{11}, S_{22}, or both)
Coefficients for Calibration Standards	Use the Anritsu calibration kit USB memory device to load kit coefficients and characterization files. Enter coefficients into user-defined locations. Use complex load models.
Interpolation	Allows interpolation between calibration frequency points.
Adapter Removal Calibration	Characterizes and "removes" an adapter that is used during calibration that will not be used for subsequent device measurements; for accurate measurement of non-insertable devices.
Dispersion Compensation	Selectable as Coaxial, other non-dispersive (e.g., for coplanar waveguide), Waveguide, or Microstrip
Embedding/De-embedding	The MS46322B is equipped with an Embedding/De-embedding system. De-embedding: De-embedding is generally used for removal of test fixture contributions, modeled networks, and other networks described by S-parameters (s2p files) from measurements. Embedding: Similarly, the Embedding function can be used to simulate matching circuits for optimizing amplifier designs or simply adding effects of a known structure to a measurement. Multiple Networks: Multiple networks can be embedded/de-embedded and changing the port and network orientations is handled easily. Extraction Utility: An extraction utility is part of this package that allows easier computation of de-embedding files based on additional calibration steps and measurements.
Optical/Electrical Conversion	O/E & E/O: O/E and E/O setup wizard is provided
Impedance Conversion	Allows entry of different reference impedances (complex values) for different ports

Optional Capabilities

Time Domain Measurements Option 2	Displays all S-parameters and overlays with Frequency Domain, Low-pass Mode with added harmonics frequency list flexibility, Band-pass Mode, Phasor Impulse Mode, Windowing, Gating (pass-band or reject-band), and Frequency with Time Gate.

Remote Operability

ShockLine supports several remote operability options.

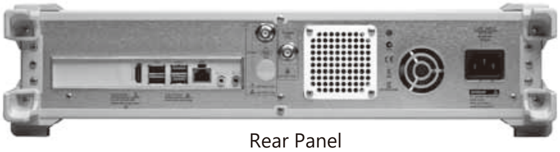
Communication Type	Data Format	Performance	Description
Via LAN	Using VXI-11 Protocol	Gigabit Data Transfer Speed	Use SCPI commands
Driver for LAN	IVI-C drivers are available for download from the Anritsu website. The IVI-C package supports National Instruments LabVIEW and LabWindows, C#, .NET, MATLAB, and Python34 programming environments.		
Triggering	Start Trigger: Software and Digital Edge Input Range: +3.3 V logic level (+5 V tolerant) Minimum Trigger Width: 50 ns Trigger Delay: 6 µs, typical		

Front Panel Connections

Front Panel

Test Ports 1 and 2	MS46322B-010: N (f) MS46322B-020: Ruggedized K (m) MS46322B-040: Ruggedized K (m) Damage Input Levels: +23 dBm maximum, ±50 VDC maximum
USB Ports	Two type A USB 2.0 Ports for peripherals such as keyboard, mouse, flash drive, hardware key, and similar devices.
Chassis Grounding Port	Banana (f)

Rear Panel Connections



Rear Panel

AC Power Input	AC Input connector, with On/Off switch, and fuses 350 VA maximum, 90 VAC to 264 VAC, 47 Hz to 63 Hz (power factor controlled)
USB and LAN	USB Ports: Four type A USB 3.0 for peripherals such as keyboard, mouse, memory stick, USB monitor, and hardware key. LAN Port: Gigabit Ethernet
Media	HDMI Port: Video output, touchscreen compatible Audio: External stereo speaker and microphone (3.5 mm) HDD: Standard removable hard disc drive
10 MHz In	Signal presence is auto-sensing (better than 10 ppm frequency accuracy is recommended). Connector Type: BNC (f) Signal: +0 dBm, typical; 50Ω, nominal
10 MHz Out	Signal presence is synchronized to and dependent upon the 10 MHz input signal. Connector Type BNC (f) Signal: +8 dBm, typical; 50Ω, nominal
External Trigger Input	Connector Type: BNC (f) Voltage Input: 0 to 3.3 V input (5 V tolerant) Impedance: High impedance (>100kΩ) Pulse Width: 50 ns minimum input pulse width Trigger Delay: 6 µs typical

CPU, Memory, and Security Features

CPU	Intel Core™ i5
Storage	Serial-ATA (SATA) Solid State Drive (> 30 GB SSD, removable) for OS, Programs, and Data
Security Features	Virus Protection, Best Practices: If the VNA is attached to a network, best practices recommend installing anti-virus software. Display Blanking: ShockLine™ software can obscure frequency on the system display for security. Removable Internal Drive: Rear Panel accessible Solid State Drive (SSD) is quickly removable and easy to secure. 2000-1857-R Spare SSD: A bootable SSD module is available as a spare for MS46322B units used in multiple or compartmentalized locations. The operating system and software are pre-installed on each 2000-1858-R SSD.

Mechanical

Dimensions	Dimensions listed are for the instrument body without rack mount option attached. 484 (W) × 108 (H) × 590 (D) mm
Mass	<11 kg (<25 lb), typical weight for a fully-loaded MS46322B VNA

Regulatory Compliance

CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN61010-1 RoHS: 2011/65/EU
Australia and New Zealand	RCM AS/NZS 4417:2012
South Korea	KCC-REM-A21-0004

Environmental

MIL-PRF-28800F Class 3

Operating Temperature Range	0° to +50°C
Storage Temperature Range	–40° to +71°C
Maximum Relative Humidity	95% RH at 30°C, non-condensing
Altitude	4600 meters, operating and non-operating

Warranty

Instrument and Built-In Options	3 years from the date of shipment (standard warranty)
Calibration Kits	Typically 1 year from the date of shipment
Test Port Cables	Typically 1 year from the date of shipment
Warranty Options	Additional warranty available

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main Frame
MS46322B	2-Port ShockLine™ Economy VNA
	Required Options (Select one frequency option only)
MS46322B-010	1 MHz to 8 GHz, type N (f) ports
MS46322B-020	1 MHz to 20 GHz, Ruggedized type K (m) ports (compatible with 3.5 mm and SMA connectors)
MS46322B-040	1 MHz to 43.5 GHz, Ruggedized type K (m) ports (compatible with 3.5 mm and SMA connectors)
	Included Accessories
User Documentation	Each VNA comes with a power cord and instructions on where to download software and related literature.
	Main VNA Options
MS46322B-001	Rack Mount, adds handles and removes feet for shelf-mounting into a 19 inch universal rack
MS46322B-002	Time Domain with Time Gating
	Removable SSD Kit
2000-1858-R	Spare SSD Disk Drive Kit
	Calibration Options
MS46322B-098	Standard Calibration, ISO 17025 compliant, without data
MS46322B-099	Premium Calibration, ISO 17025 compliant, with data

Model/Order No.	Name
	Precision Automatic Calibrator Modules
MN25208A	2-port USB SmartCal Module, 300 kHz to 8.5 GHz (available with connector Options -001 N (f), -002 K (f), -003 3.5 mm (f))
MN25408A	4-port USB SmartCal Module, 300 kHz to 8.5 GHz (available with connector Options -001 N (f), -002 K (f), -003 3.5 mm (f))
MN25218A	2-port USB SmartCal Module, 300 kHz to 20 GHz (available with connector Option -002 K (f))
MN25418A	4-port USB SmartCal Module, 300 kHz to 20 GHz (available with connector Option -002 K (f))
36585K-2M	K Connector Precision AutoCal Module, 70 kHz to 40 GHz, K (m) to K (m)
36585K-2F	K Connector Precision AutoCal Module, 70 kHz to 40 GHz, K (f) to K (f)
36585K-2MF	K Connector Precision AutoCal Module, 70 kHz to 40 GHz, K (m) to K (f)
2000-1809-R	Serial to USB Adapter (required for use with 36585 AutoCal module if control PC does not have a serial port)

Continued on next page

Model/Order No.	Name
	Mechanical Calibration Kits
3650A	SMA/3.5 mm Calibration Kit, Without Sliding Loads, DC to 26.5 GHz, 50Ω
3650A-1	SMA/3.5 mm Calibration Kit, With Sliding Loads, DC to 26.5 GHz, 50Ω
3652A	K Connector Calibration Kit, Without Sliding Loads, DC to 40 GHz, 50Ω
3652A-1	K Connector Calibration Kit, With Sliding Loads, DC to 40 GHz, 50Ω
3653A	N Connector Calibration Kit, Without Sliding Loads, DC to 18 GHz, 50Ω
OSLN50A-8	Precision N Male Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50Ω
OSLNF50A-8	Precision N Female Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50Ω
TOSLN50A-8	Precision N Male Through/Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50Ω
TOSLNF50A-8	Precision N Female Through/Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50Ω
OSLN50A-18	Precision N Male Open/Short/Load Mechanical Calibration Tee, DC to 18 GHz, 50Ω
OSLNF50A-18	Precision N Female Open/Short/Load Mechanical Calibration Tee, DC to 18 GHz, 50Ω
TOSLN50A-18	Precision N Male Through/Open/Short/Load Mechanical Calibration Tee, DC to 18 GHz, 50Ω
TOSLNF50A-18	Precision N Female Through/Open/Short/Load Mechanical Calibration Tee, DC to 18 GHz, 50Ω
TOSLK50A-20	Precision K Male Through/Open/Short/Load Mechanical Calibration Tee, DC to 20 GHz, 50Ω
TOSLKF50A-20	Precision K Female Through/Open/Short/Load Mechanical Calibration Tee, DC to 20 GHz, 50Ω
TOSLK50A-40	Precision K Male Through/Open/Short/Load Mechanical Calibration Tee, DC to 40 GHz, 50Ω
TOSLKF50A-40	Precision K Female Through/Open/Short/Load Mechanical Calibration Tee, DC to 40 GHz, 50Ω
	Verification Kits
3663-3	N Connector Verification Kit
3668-3	K Connector Verification Kit
	RF Cables and Adapters
N120-6	RF Cables, Semi-Rigid, N(m) to N(m), 1 each, 0.01 GHz to 18 GHz, 50Ω, 15 cm (5.9 in)
NS120MF-6	RF Cables, Semi-Rigid, N(f) to N(f), 1 each, 0.01 GHz to 18 GHz, 50Ω, 15 cm (5.9 in)
1091-26-R	SMA (m) to N (m), DC to 18 GHz, 50Ω
1091-27-R	SMA (f) to N (m), DC to 18 GHz, 50Ω
1091-80-R	SMA (m) to N (f), DC to 18 GHz, 50Ω
1091-81-R	SMA (f) to N (f), DC to 18 GHz, 50Ω
71693-R	Ruggedized adapter, K (f) to N (f), DC to 18 GHz, 50Ω
34NN50A	Precision Adapter, N (m) to N (m), DC to 18 GHz, 50Ω
34NFNF50	Precision Adapter, N (f) to N (f), DC to 18 GHz, 50Ω
34NK50	Precision Adapter, N (m) to K (m), DC to 18 GHz, 50Ω
34NKF50	Precision Adapter, N (m) to K (f), DC to 18 GHz, 50Ω
34NFK50	Precision Adapter, N (f) to K (m), DC to 18 GHz, 50Ω
34NFKF50	Precision Adapter, N (f) to K (f), DC to 18 GHz, 50Ω
K220B	Precision Adapter, K (m) to K (m), DC to 40 GHz, 50Ω
K222B	Precision Adapter, K (f) to K (f), DC to 40 GHz, 50Ω
K224B	Precision Adapter, K (m) to K (f), DC to 40 GHz, 50Ω

Model/Order No.	Name
	Test Port Cables, Flexible, Ruggedized, Phase Stable
15NNF50-1.0B	Test Port Cable, Flexible, Phase Stable, N (f) to N (m), 1.0 m, 50Ω
15NNF50-1.5B	Test Port Cable, Flexible, Phase Stable, N (f) to N (m), 1.5 m, 50Ω
15NN50-1.0B	Test Port Cable, Flexible, Phase Stable, N (m) to N (m), 1.0 m, 50Ω
15LL50-1.0A	Test Port Cable, Armored, Phase Stable, DC to 20 GHz, 3.5 mm (m) to 3.5 mm (m), 1.0 m, 50Ω
15LLF50-1.0A	Test Port Cable, Armored, Phase Stable, DC to 20 GHz, 3.5 mm (m) to 3.5 mm (f), 1.0 m, 50Ω
15KK50-1.0A	Test Port Cable, Armored, Phase Stable, DC to 20 GHz, K (m) to K (m), 1.0 m, 50Ω
15KKF50-1.0A	Test Port Cable, Armored, Phase Stable, DC to 20 GHz, K (m) to K (f), 1.0 m, 50Ω
3671KFS50-60	Test Port Cable, Flexible, Phase Stable, DC to 26.5 GHz, K (f) to 3.5 mm (m), 63.5 cm, 50Ω
3671KFK50-60	Test Port Cable, Flexible, Phase Stable, DC to 40 GHz, K (f) to K (m), 63.5 cm (25 in), 50Ω
3671KFKF50-60	Test Port Cable, Flexible, Phase Stable, DC to 40 GHz, K (f) to K (f), 63.5 cm (25 in), 50Ω
3671KFK50-100	Test Port Cable, Flexible, Phase Stable, DC to 40 GHz, K (f) to K (m), 1 m (38 in), 50Ω
SC8267	1.0 m (36"), Cable, 40 GHz, K (m) to K (f), 50Ω
	Phase-Stable 18 GHz and 40 GHz Semi-Rigid Cables (Armored)
3670K50-1	0.3 m (12"), DC to 40 GHz, K (f) to K (m), 50Ω
3670K50-2	0.6 m (24"), DC to 40 GHz, K (f) to K (m), 50Ω
3670N50-1	0.3 m (12"), DC to 18 GHz, N (f) to N (m), 50Ω
3670NN50-1	0.3 m (12"), DC to 18 GHz, N (m) to N (m), 50Ω
3670N50-2	0.6 m (24"), DC to 18 GHz, N (f) to N (m), 50Ω
3670NN50-2	0.6 m (24"), DC to 18 GHz, N (m) to N (m), 50Ω
	Transit Case
760-269	ShockLine™ VNA Transit Case, Hard plastic with wheels
	Tools
01-200	Calibrated Torque End Wrench, GPC-7 and Type N
01-201	Torque End Wrench, 5/16 in, 0.9 N·m (8 lbf·in) For tightening male devices, for SMA, 3.5 mm, 2.4 mm, K, and V connectors
01-203	Torque End Wrench, 13/16 in, 0.9 N.m (8 lbf.in) For tightening ruggedized SMA, 2.4 mm, K and V connectors
01-204	End Wrench, 5/16 in, Universal, Circular, Open-ended, For SMA, 3.5 mm, 2.4 mm, K and V connectors
More Information	Refer to our Precision RF & Microwave Components Catalog for descriptions of adapters and other components.
	Documentation
User Documentation	Soft copies of the manuals as Adobe Acrobat PDF files are included on the User Documentation USB memory device provided with the instrument. The Maintenance Manual is available from Anritsu Customer Service. For more information, please contact ShockLineVNA.support@Anritsu.com.
10100-00067	Product information, compliance and safety
10410-00335	MS46322A/B Series VNA Operation Manual
10410-00336	MS46322A/B Series VNA Calibration and Measurement Guide
10410-00337	MS46121A/B, MS46122A/B, and MS46322A/B Series VNA User Interface Reference Manual
10410-00746	ShockLine Series VNA Programming Manual, for IEEE 488.2 and SCPI Commands

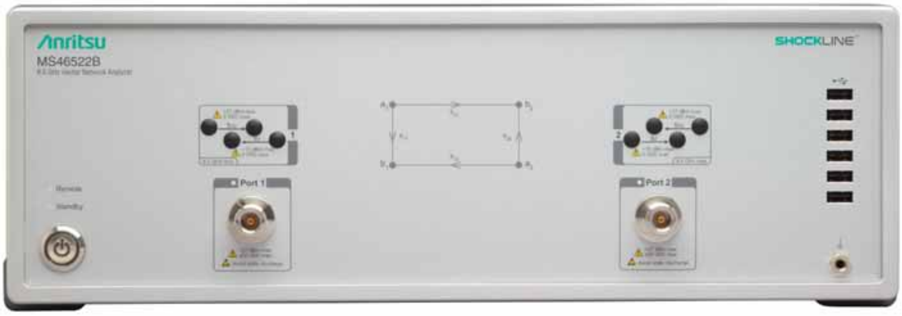
ShockLine™ Performance Vector Network Analyzers

MS46522B

2-Port Vector Network Analyzers

Remote Control
Ethernet

High Performance, 3U high, 2-port VNA Available in a 50 kHz to 43.5 GHz Frequency Range



The MS46522B is part of the ShockLine family of Vector Network Analyzers from Anritsu. It is a high performance, 3U high, 2-port VNA available in broadband frequency ranges from 50 kHz to 43.5 GHz and a banded E-band option covering the 55 GHz to 92 GHz frequency range. It is capable of measuring s-parameters and time domain characteristics of passive RF devices.
The VNA supports SCPI command programming and has software driver support for the most common programming environments. The MS46522B uses industry standard LAN communications for robust remote control in test applications. ShockLine VNAs provide a powerful graphical user interface for manual testing of devices.
A full-featured user interface is enabled by attaching a (user-supplied) touchscreen monitor, keyboard, and mouse.

Instrument Models and Operating Frequencies

- Base Model: MS46522B, 2-Port ShockLine VNA

Requires one Frequency Option:
- MS46522B-010, 50 kHz to 8.5 GHz
- MS46522B-020, 50 kHz to 20 GHz
- MS46522B-040, 50 kHz to 43.5 GHz
- MS46522B-082, 55 GHz to 92 GHz

Principal Options

- MS46522B-002, Time Domain
- MS46522B-022, Advanced Time Domain
- MS46522B-051, Access Loops (Only available with Option 10)
- MS46522B-061, Bias Tee (Only available with Option 10)

Definitions

All specifications and characteristics apply under the following conditions, unless otherwise stated:

Warm-Up Time	After 45 minutes of warm-up time, where the instrument is left in the ON state.
Temperature Range	Over the 25° ±5°C temperature range.
Frequency Range	The instrument operates in the following frequency ranges without any implied or warranted specifications: 50 kHz to 300 kHz, 40 GHz to 43.5 GHz, 55 GHz to 60 GHz, and from 90 GHz to 92 GHz.
Error-Corrected Specifications	For error-corrected specifications, over 23° ±3°C, with <1°C variation from calibration temperature. For error-corrected specifications are warranted and include guard-bands, unless otherwise stated.
Simultaneous Sweep Mode	Specifications are not warranted in simultaneous sweep mode (only applicable to the 8.5 GHz model).
Frequency Bands in Tables	When a frequency is listed in two rows of the same table, the specification for the common frequency is taken from the lower frequency band.
User Cables	Specifications do not include effects of any user cables attached to the instrument.
Discrete Spurious Responses	Specifications may exclude discrete spurious responses.
Internal Reference Signal	All specifications apply with internal 10 MHz Crystal Oscillator Reference Signal.
Interpolation Mode	All specifications are with Interpolation Mode Off.
Standard	Refers to instruments with mandatory frequency option only.
Typical Performance	Typical performance indicates the measured performance of an average unit. It does not include guard-bands and is not covered by the product warranty. Typical specifications are shown in parenthesis, such as (–102 dB), or noted as Typical.
Characteristic Performance	Characteristic performance indicates a performance designed-in and verified during the design phase. It does include guard-bands and is not covered by the product warranty.
Recommended Calibration Cycle	12 months (Residual specifications also require calibration kit calibration cycle adherence.)
Specifications Subject to Change	All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site: www.anritsu.com

Specifications

System Dynamic Range*1

System dynamic range is calculated as the difference between the test port maximum source power and the RMS noise floor at 10 Hz IF Bandwidth with averaging off and smoothing on after calibrating the instrument for transmission frequency response and isolation.

Frequency Range	Standard (dB)	Typical (dB)
300 kHz to 1 MHz	90	101
>1 MHz to 50 MHz	100	108
>50 MHz to 2 GHz	140	144
>2 GHz to 4 GHz	137	142
>4 GHz to 6 GHz	130	137
>6 GHz to 8 GHz*2	128	130
>8 GHz to 8.5 GHz	120	127*2
>8.5 GHz to 25 GHz	117	122
>25 GHz to 40 GHz	120	127
>40 GHz to 43.5 GHz	—	120

*1: System dynamic range is degraded by 20 dB from the standard specifications in simultaneous sweep mode and by 3 dB between ports 1 or 2 and ports 3 or 4 (typical). The dynamic range performance with Option 51 at the b1/b2 ports is +10 dB higher than the standard specification (typical).

*2: Dynamic range degrades by 4 dB for Options 20 and 40.

Receiver Compression Levels

Port power level beyond which the response may be compressed more than 0.1 dB relative to the normalization level. Measured at 300 Hz IF bandwidth. Match not included. Performance is typical.

Frequency Range	Level (dBm)
300 kHz to 43.5 GHz	+15

High Level Noise

Measured at 100 Hz IF bandwidth and at default power level, RMS.

Frequency Range	Magnitude (dB)	Phase (deg)
300 kHz to 1 GHz	0.004 (0.003 (typ.))	0.04 (0.02 (typ.))
>1 GHz to 25 GHz	0.003 (0.002 (typ.))	0.05 (0.02 (typ.))
>25 GHz to 40 GHz	0.004 (0.002 (typ.))	0.05 (0.04 (typ.))
>40 GHz to 43.5 GHz	(0.002 (typ.))	(0.05 (typ.))

*: High level noise specification in simultaneous sweep mode: Magnitude 0.005 dB (typ.), Phase 0.05 degree (typ.).

Output Power Range

Minimum to maximum rated leveled output power. Performance is characteristic.

Frequency Range	Standard (dBm)	Typical (dBm)
300 kHz to 6 GHz	–30 to +15	–30 to +17
>6 GHz to 8 GHz	–30 to +12*	–30 to +13
>8 GHz to 8.5 GHz	–30 to +10	–30 to +11
>8.5 GHz to 40 GHz	–30 to +7	–30 to +10
>40 GHz to 43.5 GHz	—	–30 to +4

*: Maximum power degrades by 2 dB for Options 20 and 40.

Output Default Power

Instrument default power is 0 dBm. For maximum rated power, refer to Output Power Range above. Not applicable to MS46522B-082.

Power Accuracy

Performance is characteristic. Not applicable to MS46522B-082.

Output Power	Standard (dB)	Typical (dB)
At +5 dBm	±1.0*1	±0.7
At 0 dBm	±1.5*2	±0.5
At –30 dBm	±3.0	±1.8

*1: Power accuracy degrades by 0.5 dB (>8.5 GHz to 25 GHz), and by 1 dB (>25 GHz to 40 GHz).

*2: Power accuracy degrades by 0.5 dB (>8.5 GHz).

Setting Resolution

Output Power	Setting Resolution (dB)
300 kHz to 43.5 GHz	0.01

Measurement Stability

Ratio measurement, with ports shorted. Typical.

Frequency Range	Magnitude (dB/°C)	Phase (deg/°C)
300 kHz to 8.5 GHz	0.02	0.5
>8.5 GHz to 40 GHz	0.01	1.0

Frequency Resolution, Accuracy, and Stability

All specifications typical. Not applicable to MS46522B-082.

Resolution	Accuracy	Stability/Temperature	Stability
1 Hz	±0.1 (at time of calibration)	±0.1 ppm/10° to 50°C	±0.02 ppm/24 hours ±0.2 ppm/1 month ±1.0 ppm/1 year ±2.0 ppm/3 years

Source Harmonics and Non-Harmonics (Spurious)

Measured at 0 dBm. All specifications typical.

Frequency Range	Harmonics (second and third) (dBc)	Non-Harmonic Spurious (dBc)	Phase Noise @ 10 kHz Offset (dBc/Hz)
300 kHz to 8.5 GHz	<–30	<–30	>60

Uncorrected (Raw) Port Characteristics

User correction off. System correction on. All specifications typical.

Frequency Range	Directivity (dB)	Port Match (dB)*
300 kHz to 1 GHz	>21	>17
>1 GHz to 4 GHz	>21	>17
>4 GHz to 8.5 GHz	>15	>15
>8.5 GHz to 43.5 GHz	>15	>15

*: Port Match is defined as the worst of source and load match.

MS46522B-010 VNA System Performance (Manual Cal Kits)

Error-Corrected Specifications

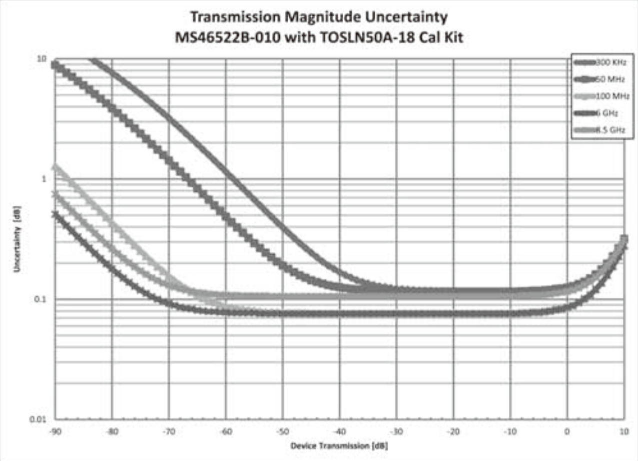
With 12-term SOLT Calibration using the TOSLN50A-18 N Type Connector Calibration Kit.

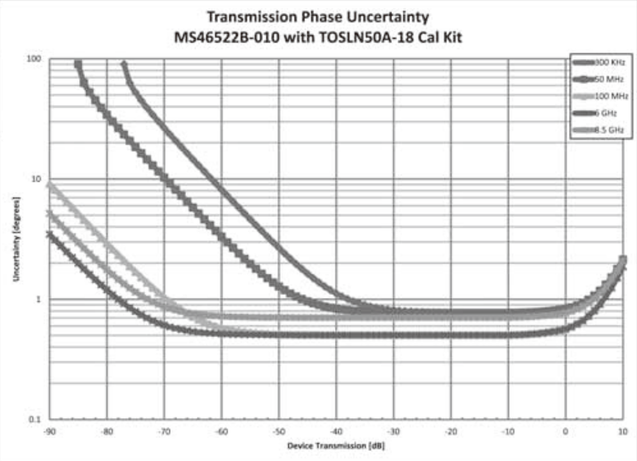
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
300 kHz to 50 MHz	>40	>35	>38	±0.15	±0.09
>50 MHz to 6 GHz	>40	>35	>38	±0.08	±0.05
>6 GHz to 8 GHz	>36	>35	>34	±0.08	±0.05
>8 GHz to 8.5 GHz	>36	>35	>34	±0.10	±0.08

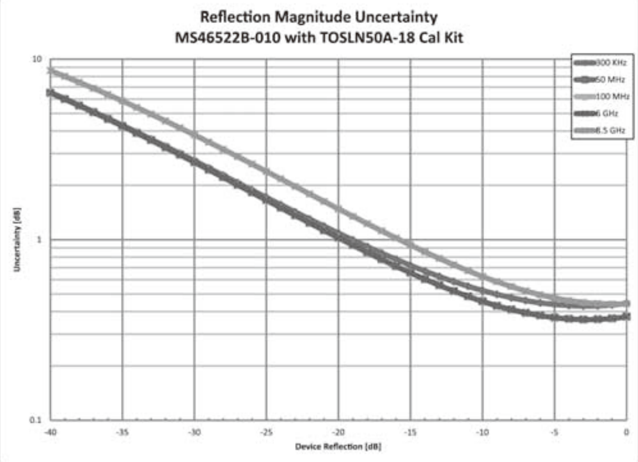
*: Characteristic performance.

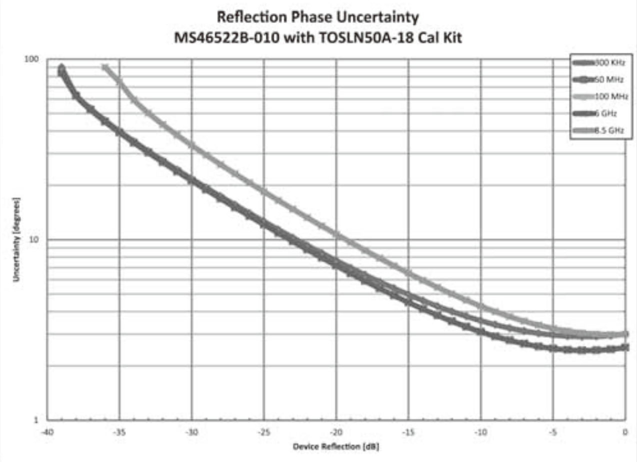
Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.


Transmission Magnitude Uncertainty
MS46522B-010 with TOSLN50A-18 Cal Kit


Transmission Phase Uncertainty
MS46522B-010 with TOSLN50A-18 Cal Kit


Reflection Magnitude Uncertainty
MS46522B-010 with TOSLN50A-18 Cal Kit


Reflection Phase Uncertainty
MS46522B-010 with TOSLN50A-18 Cal Kit

MS46522B-020 VNA System Performance (Manual Cal Kits)

Error-Corrected Specifications

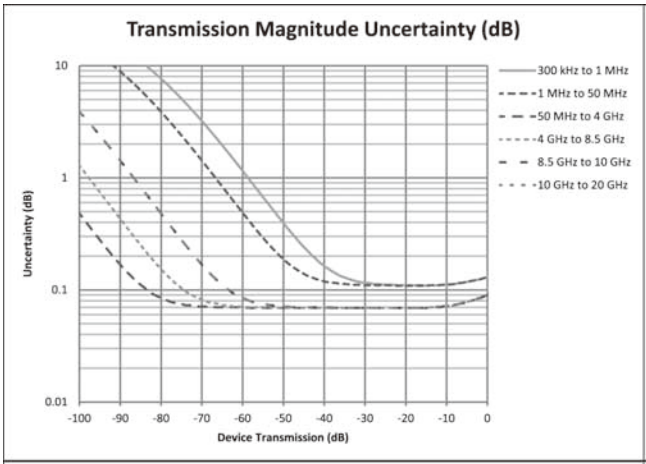
With 12-term SOLT Calibration using the TOSLKF50A-40 K Type Connector Calibration Kit.

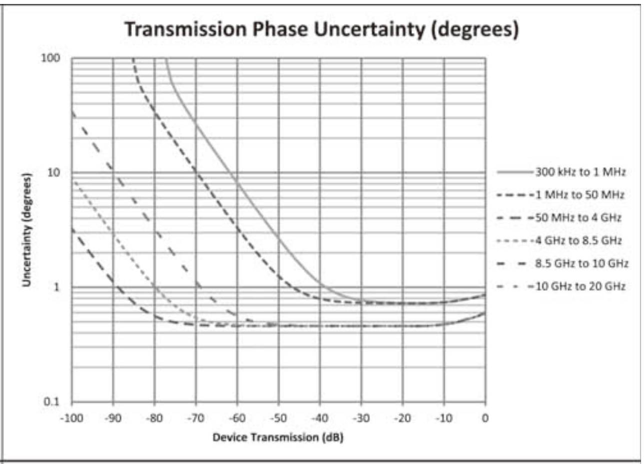
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
300 kHz to 50 MHz	>42	>35	>42	±0.10	±0.09
>50 MHz to 10 GHz	≥42	≥35	≥42	±0.10	±0.05
>10 GHz to 20 GHz	≥36	≥26.5	≥36	±0.10	±0.05

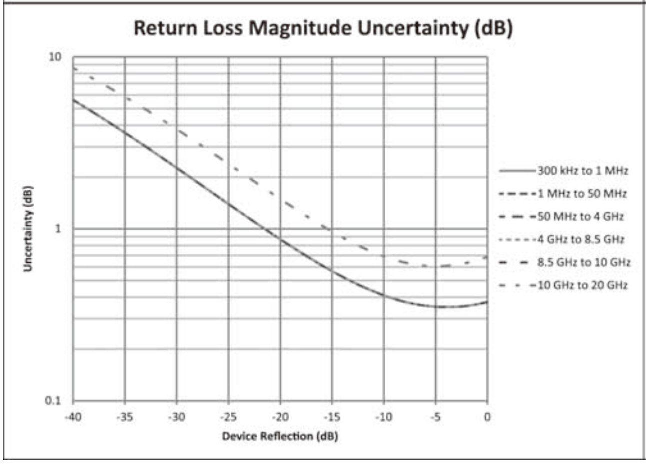
*: Characteristic performance.

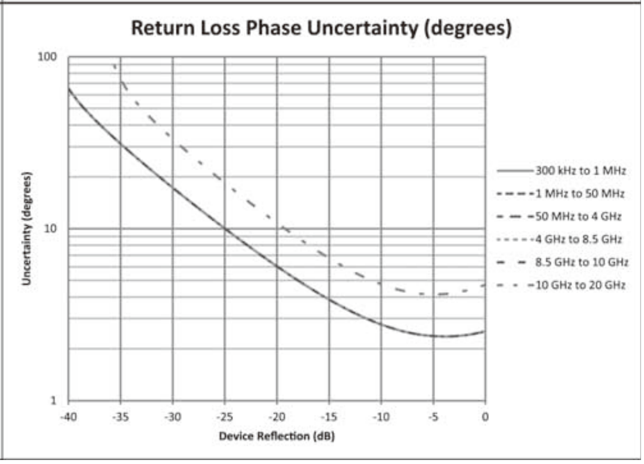
Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, oad and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.


Transmission Magnitude Uncertainty (dB)


Transmission Phase Uncertainty (degrees)


Return Loss Magnitude Uncertainty (dB)


Return Loss Phase Uncertainty (degrees)

MS46522B-040 VNA System Performance (Manual Cal Kits)

Error-Corrected Specifications

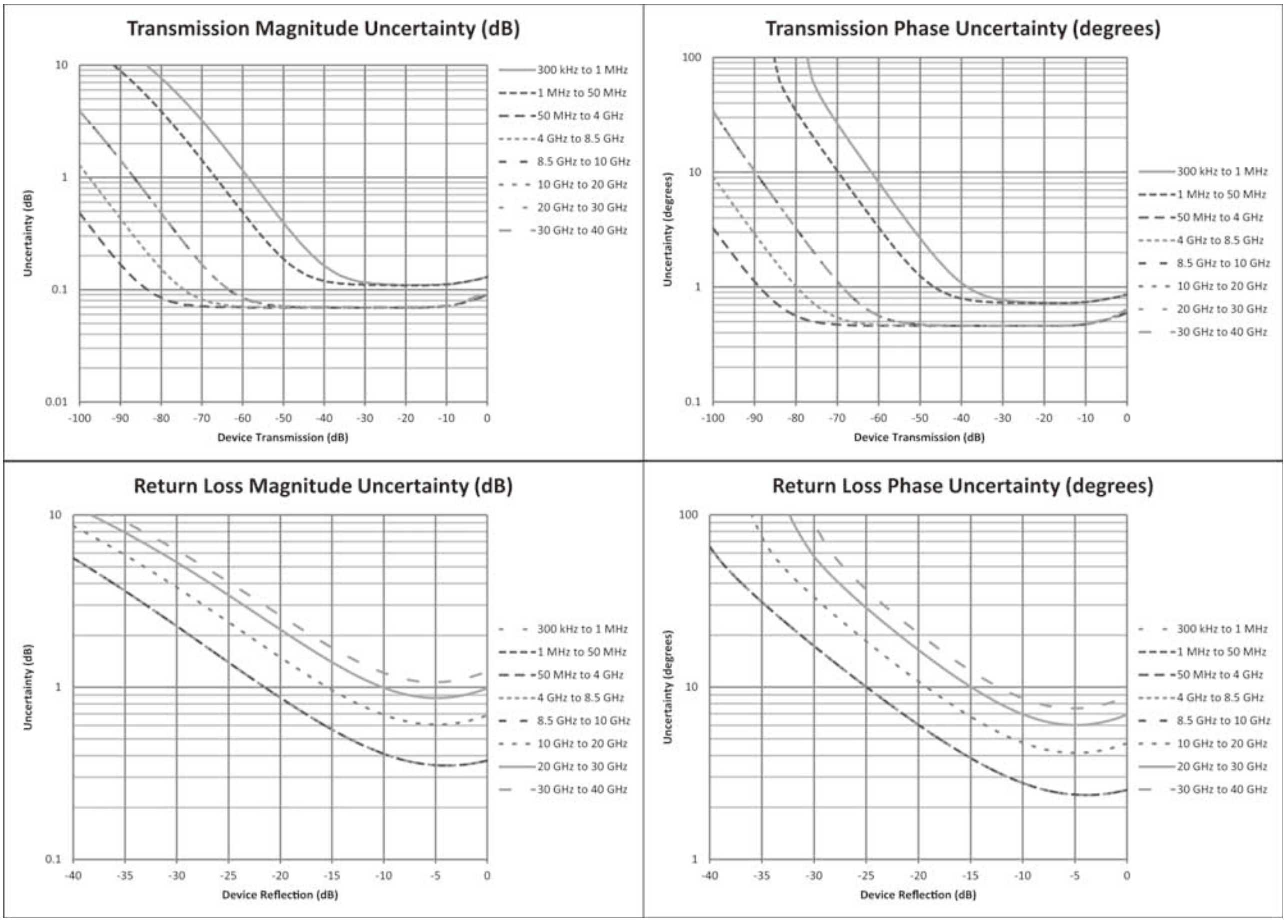
With 12-term SOLT Calibration using the TOSLKF50A-40 K Type Connector Calibration Kit.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
300 kHz to 50 MHz	>42	>35	>42	±0.10	±0.09
>50 MHz to 10 GHz	≥42	≥35	≥42	±0.10	±0.05
>10 GHz to 20 GHz	≥36	≥26.5	≥36	±0.10	±0.05
>20 GHz to 30 GHz	≥32	≥22.5	≥32	±0.10	±0.05
>30 GHz to 43.5 GHz	≥30	≥20	≥30	±0.10	±0.05

*: Characteristic performance.

Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.



MS46522B-010 VNA System Performance (SmartCal™)

Error-Corrected Specifications

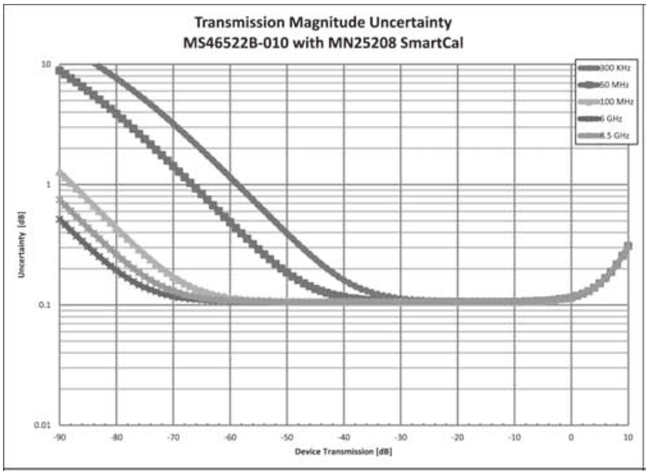
With 12-term calibration using the MN25208A SmartCal™ automatic calibration kit with connector options MN25208A-001, -002, -003.

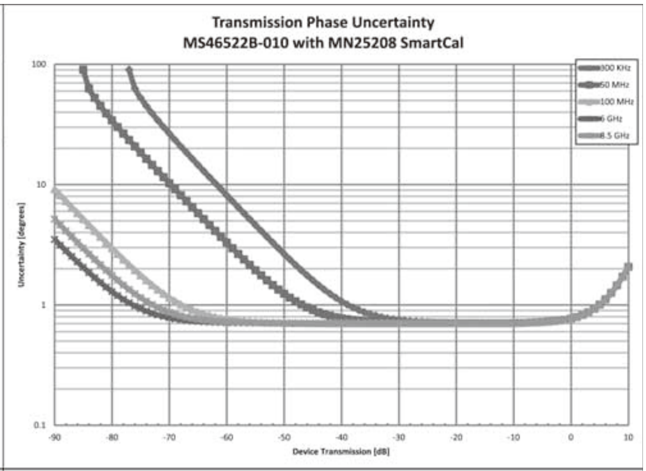
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
300 kHz to 1 GHz	>42	>35	>38	±0.15	±0.08
>1 GHz to 5 GHz	>42	>35	>38	±0.08	±0.08
>5 GHz to 8 GHz	>36	>35	>33	±0.10	±0.08

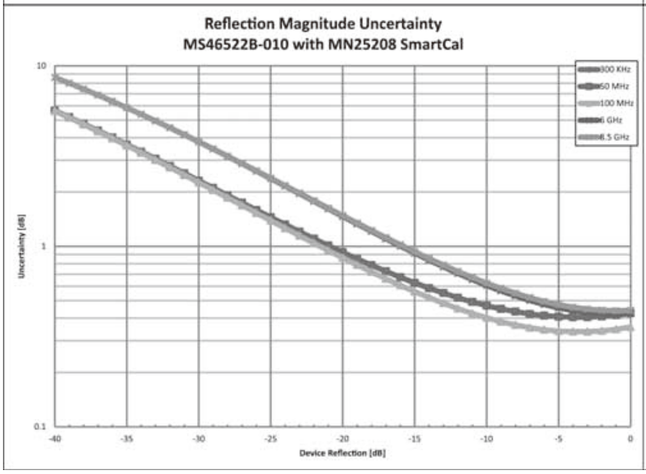
*: Characteristic performance.

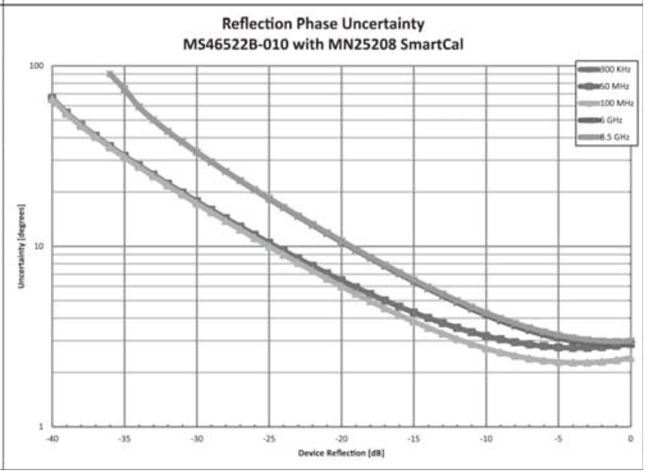
Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.


Transmission Magnitude Uncertainty
MS46522B-010 with MN25208 SmartCal


Transmission Phase Uncertainty
MS46522B-010 with MN25208 SmartCal


Reflection Magnitude Uncertainty
MS46522B-010 with MN25208 SmartCal


Reflection Phase Uncertainty
MS46522B-010 with MN25208 SmartCal

MS46522B-010 VNA System Performance with SmartCal™

Error-Corrected Specifications

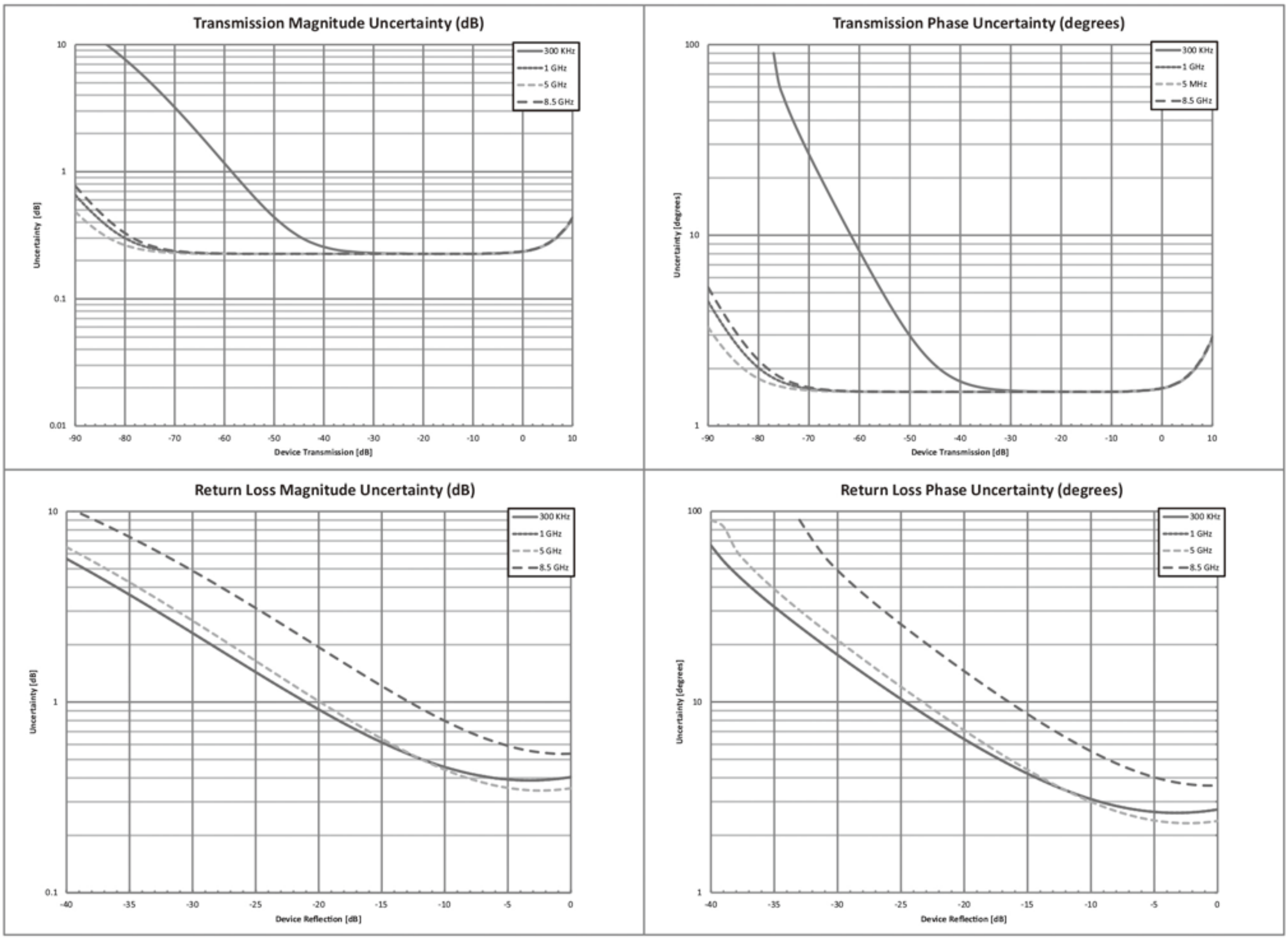
With 12-term calibration using the MN25408A SmartCal™ automatic calibration kit with option MN25408A-001, -002, -003.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
300 kHz to 1 GHz	>42	>35	>38	±0.15	±0.2
>1 GHz to 5 GHz	>40	>35	>38	±0.08	±0.2
>5 GHz to 8.5 GHz	>33	>32	>33	±0.10	±0.2

*: Characteristic performance.

Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.



MS46522B-010 and MS46522B-020 VNA System Performance (SmartCal™)

Error-Corrected Specifications

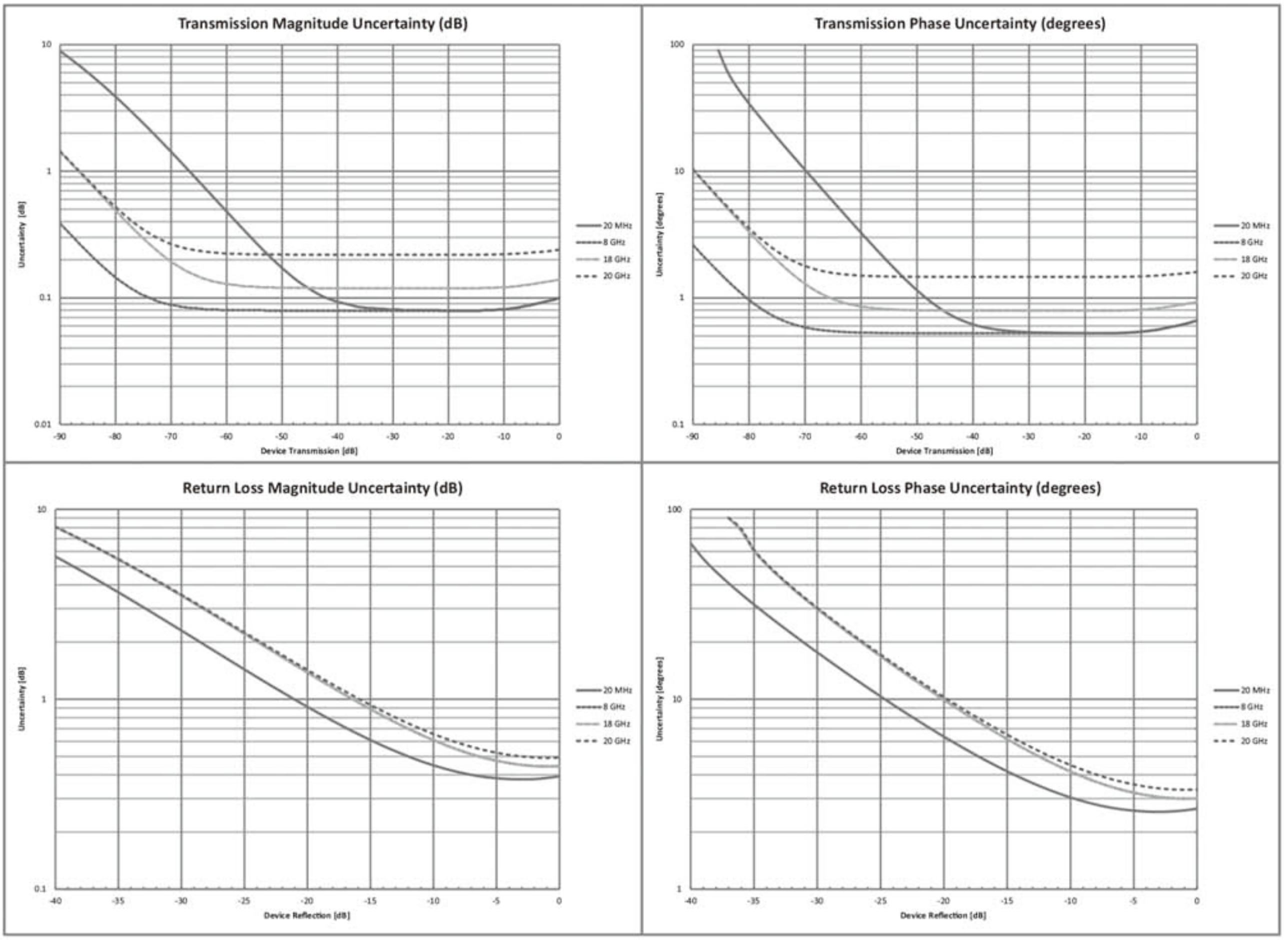
With 12-term calibration using the MN25218A SmartCal™ automatic calibration kit.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match*1 (dB)	Reflection Tracking*1 (dB)	Transmission Tracking*1 (dB)
300 kHz to 1 GHz*2	>42	>33	>42	±0.15	±0.06
>1 GHz to 10 GHz	>37	>33	>42	±0.15	±0.06
>10 GHz to 18 GHz	>37	>33	>37	±0.15	±0.10
>18 GHz to 20 GHz	>37	>33	>37	±0.20	±0.20

*1: Characteristic performance.
*2: Applies to Rev 2 SmartCal Modules. MN25218A with serial numbers <1817999 operate from 1 MHz to 20 GHz.

Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.



MS46522B-010 and MS46522B-020 VNA System Performance with SmartCal™

Error-Corrected Specifications

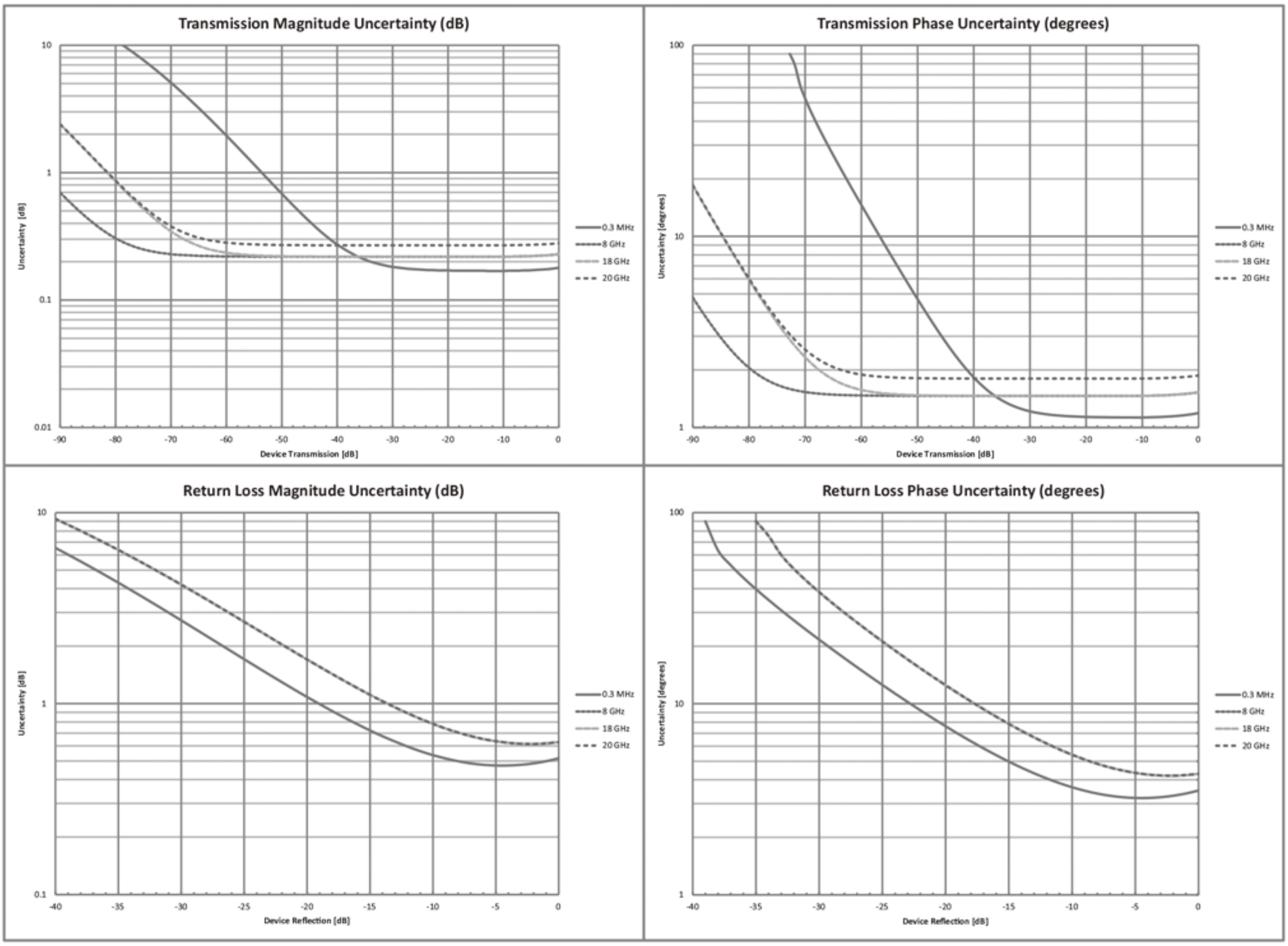
With 12-term calibration using the MN25418A SmartCal™ automatic calibration kit.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
300 kHz to <6 GHz	≥40	≥31	≥42	±0.15	±0.15
>6 GHz to 18 GHz	≥35	≥31	≥37	±0.20	±0.20
>18 GHz to 20 GHz	≥35	≥31	≥34	±0.20	±0.25

*: Characteristic performance.

Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that S_{11} = S_{22} = 0. For reflection uncertainties, it is assumed that S_{21} = S_{12} = 0. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.



Transmission Magnitude Uncertainty (dB)

Transmission Phase Uncertainty (degrees)

Return Loss Magnitude Uncertainty (dB)

Return Loss Phase Uncertainty (degrees)

MS46522B-040 VNA System Performance (Precision AutoCal™)

Error-Corrected Specifications

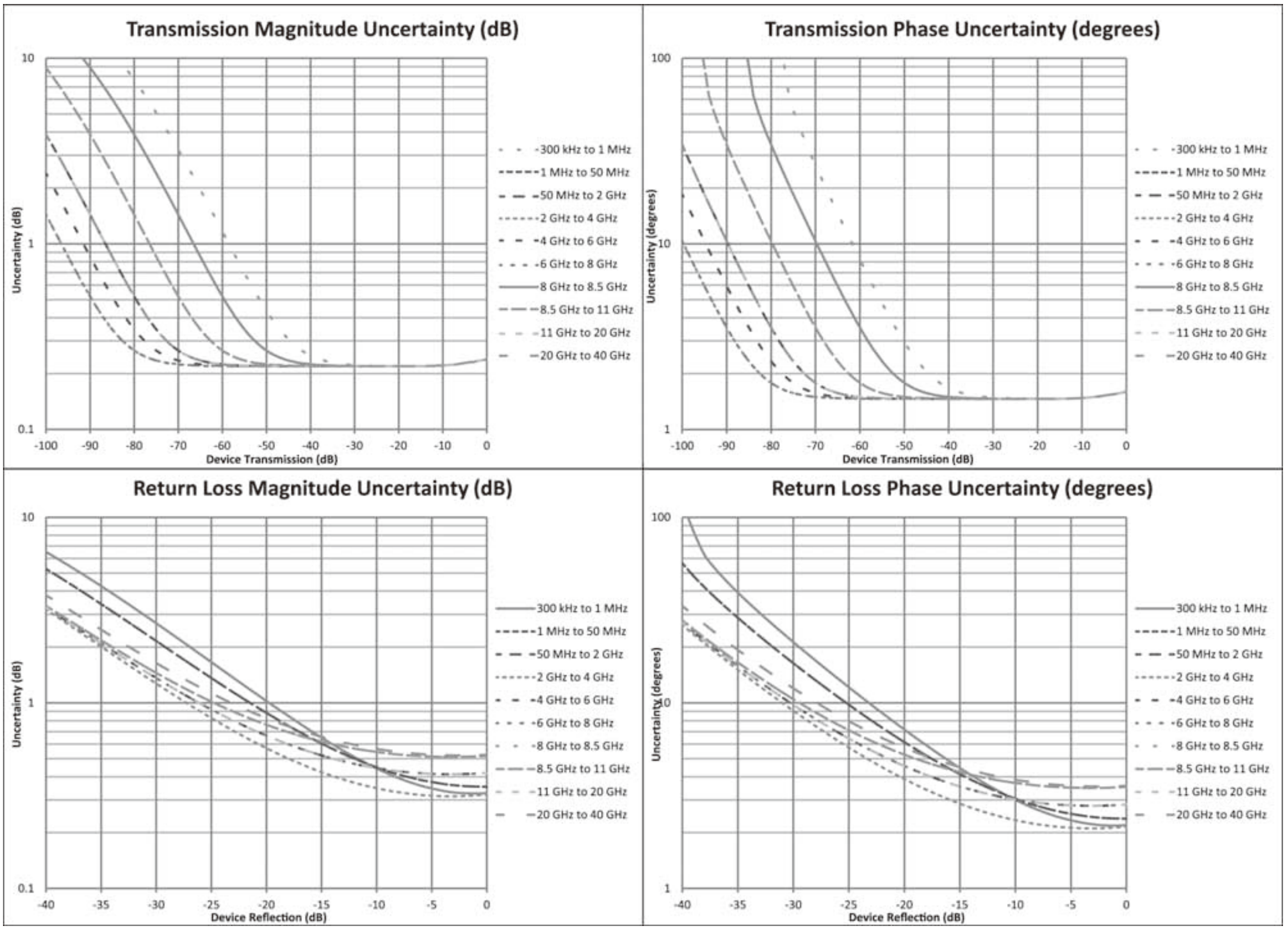
With 12-term calibration using the 36585K series automatic calibration kit with type K connectors.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
300 kHz to <10 MHz	≥40	≥40	≥40	±0.10	±0.20
10 MHz to <2.5 GHz	≥43	≥47	≥43	±0.20	±0.20
2.5 GHz to <4 GHz	≥50	≥47	≥50	±0.20	±0.20
4 GHz to <8 GHz	≥50	≥47	≥50	±0.30	±0.20
8 GHz to <11 GHz	≥50	≥47	≥50	±0.40	±0.20
11 GHz to <20 GHz	≥50	≥47	≥50	±0.30	±0.20
20 GHz to <40 GHz	≥48	≥47	≥48	±0.40	±0.20

*: Characteristic performance.

Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.



Transmission Magnitude Uncertainty (dB)

Transmission Phase Uncertainty (degrees)

Return Loss Magnitude Uncertainty (dB)

Return Loss Phase Uncertainty (degrees)

MS46522B-082 E-Band Option VNA System Performance

Introduction

The E-band option (Option 82) consists of the MS46500B Series VNA base chassis and small source/receiver modules. The modules are attached to the chassis through one meter flexible tethers that are permanently attached to the unit.

Band	Frequency Range	Waveguide Flange
Extended E-Band	55 GHz to 92 GHz	WR-12

MS46522B E-Band VNA

System Dynamic Range

System dynamic range is calculated as the difference between the test port maximum source power and the RMS noise floor at 10 Hz IF Bandwidth with averaging off and smoothing on after calibrating the instrument for transmission frequency response and isolation.

Frequency Range	Standard (dB)	Typical (dB)
60 GHz to 67 GHz	106	112
>67 GHz to 87 GHz	110	118
>87 GHz to 90 GHz	98	111

High Level Noise

Measured at 100 Hz IF bandwidth and at default power level, RMS. Performance is typical.

Frequency Range	Magnitude (mdB)	Phase (deg)
60 GHz to 90 GHz	4	0.06

Output Power Range

Minimum to maximum rated leveled output power. Performance is typical.

Frequency Range	Standard (dBm)
60 GHz to 69 GHz	–55 to –5
>69 GHz to 88 GHz	–50 to 0
>88 GHz to 90 GHz	–60 to –10

Power Accuracy

Accuracy is defined at –10 dBm or max rated power, whichever is lower. Performance is typical.

Frequency Range	Accuracy (dB)	Resolution (dB)
60 GHz to 90 GHz	±2.0	0.01

MS46522B-082 E-Band VNA System Performance (Waveguide Cal Kit)

Error-Corrected Specifications

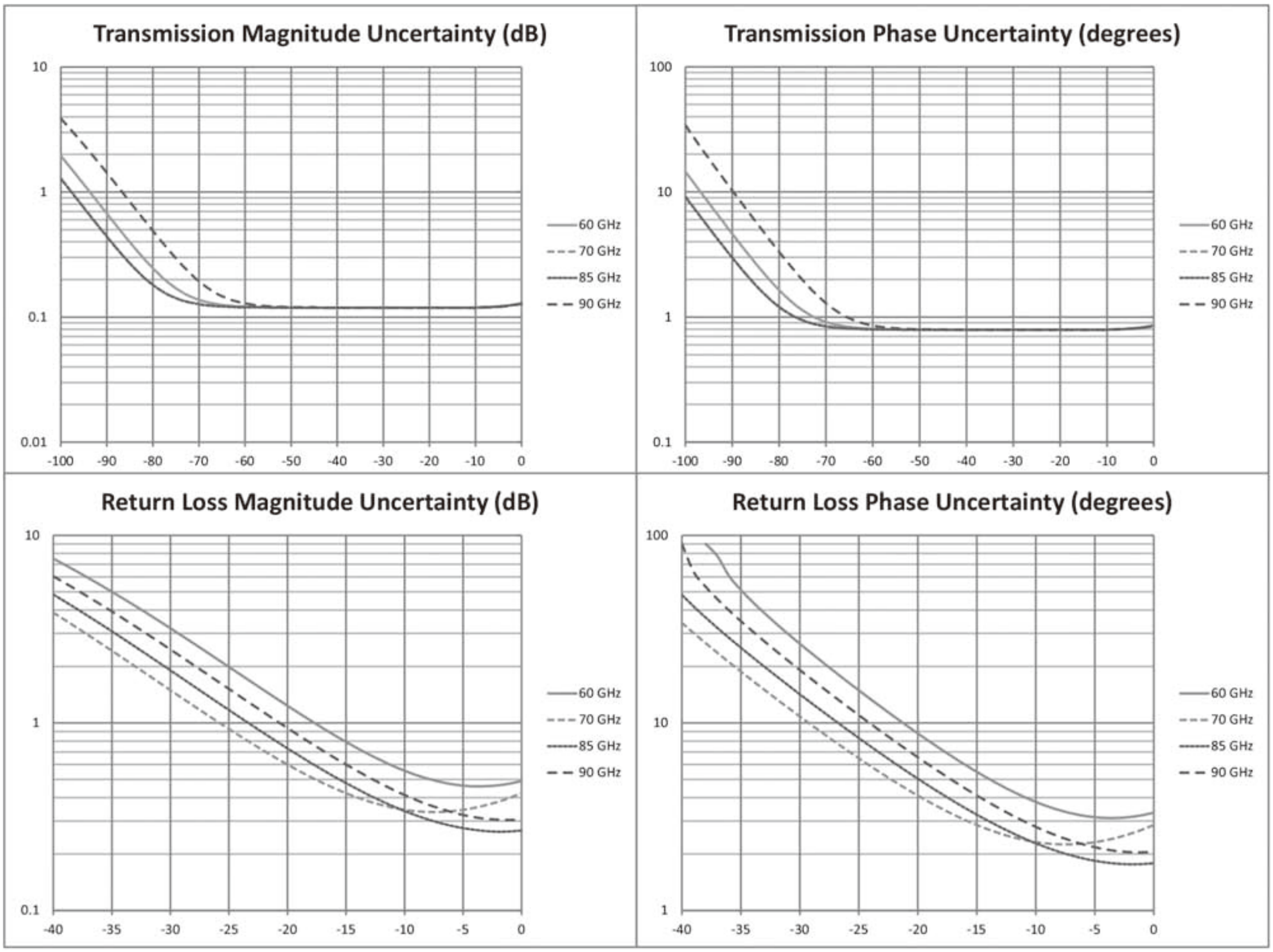
With 12-term SSLT calibration using the 3655E WR12 Waveguide Calibration Kit. Typical.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
60 GHz to 63 MHz	>36	>31	>36	±0.10	±0.10
>63 MHz to 67 GHz	≥45	≥29	≥45	±0.10	±0.10
>67 GHz to 71 GHz	≥47	≥31	≥47	±0.10	±0.10
>71 GHz to 75 GHz	≥42	≥33	≥42	±0.10	±0.10
>75 GHz to 79 GHz	≥40	≥36	≥40	±0.10	±0.10
>79 GHz to 83 GHz	≥44	≥36	≥44	±0.10	±0.10
>83 GHz to 87 GHz	≥44	≥42	≥44	±0.10	±0.10
>87 GHz to 90 GHz	≥41	≥40	≥41	±0.10	±0.10

*: Characteristic performance.

Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.



Transmission Magnitude Uncertainty (dB)

Transmission Phase Uncertainty (degrees)

Return Loss Magnitude Uncertainty (dB)

Return Loss Phase Uncertainty (degrees)

Measurement Throughput Summary

Cycle Time for Measurement Completion (ms)

Number of traces = 1; system error correction on. Typical performance data.

	500 kHz IF Bandwidth				100 kHz IF Bandwidth				1 kHz IF Bandwidth			
Number of Points	51	201	401	1601	51	201	401	1601	51	201	401	1601
Start 1 GHz, stop 1.2 GHz												
Uncorrected	2	6	11	41	2	6	11	41	54	211	421	1677
2-Port Cal, S_{21}	8	19	35	129	8	21	39	151	113	433	860	3422
Start 300 kHz, stop 4.5 GHz												
Uncorrected	3	7	12	43	3	7	12	43	55	213	422	1680
2-Port Cal, S_{21}	9	20	37	135	10	23	41	154	115	434	865	3421
Start 300 kHz, stop 8.5 GHz												
Uncorrected	4	7	12	43	4	8	13	43	56	213	423	1680
2-Port Cal, S_{21}	9	21	36	129	10	23	42	153	119	435	861	3424

Data Transfer Time (ms)

Transferred complex S_{11} data, using "CALC:DATA:SDATA?" command. Typical performance data.*

Number of Points	51	201	401	1601
SCPI over LAN				
REAL 64	4	4	4	8
REAL 32	4	4	4	8
ASCII	14	34	60	209

*: Data transfer time varies depending on the PC and control software used with the VNA.

Standard Capabilities

Operating Frequencies

MS46522B-010	50 kHz to 8.5 GHz
MS46522B-020	50 kHz to 20 GHz
MS46522B-040	50 kHz to 43.5 GHz
MS46522B-082	55 GHz to 92 GHz

Measurement Parameters

2-Port Measurements	S_{11}, S_{21}, S_{22}, S_{12}, and any user-defined combination of a_1, a_2, b_1, b_2, 1 Maximum Efficiency Analysis, Mixed-mode SDD, SDC, SCD, SCC
Domains	Frequency Domain, and Time (Distance) Domain (Option 2), Power Domain

Sweeps

Sweep Configurations	Standard or Simultaneous (MS46522B-010 option only)
Frequency Sweep Types	Linear, Log, or Segmented
Power Sweep Types	Linear

Display Graphs

Single Rectilinear Graph Types	Log Magnitude, Phase, Group Delay, Linear Magnitude, Real, Imaginary, SWR, Impedance, KQ and η Max
Dual Rectilinear Graph Types	Log Mag and Phase, Linear Mag and Phase, Real, Imaginary, KQ and η Max
Circular Graph Types	Smith Chart (Impedance), Polar

Measurements Data Points

Maximum Data Points	2 to 20,001 points

Limit Lines

Limit Lines	Single or segmented. 2 limit lines per trace. 50 segments per trace.
Single Limit Readouts	Uses interpolation to determine the intersection frequency.
Test Limits	Both single and segmented limits can be used for PASS/FAIL testing.

Ripple Limit Lines

Limit Lines	Single or segmented. Two limit lines per trace. 50 segments per trace.
Ripple Value	Absolute Value or Margin
Test Limits	Both single and segmented limits can be used for PASS/FAIL testing.

Averaging

Point-by-Point	Point-by-point (default), maximum number of averages = 4096
Sweep-by-Sweep	Sweep-by-sweep, maximum number of averages = 4096

IF Bandwidth

	10, 20, 30, 50, 70, 100, 200, 300, 500, 700 Hz 1, 2, 3, 5, 7, 10, 20, 30, 70, 100, 200, 300, 500 kHz

Reference Plane

Line Length or Time Delay	The reference planes of a calibration or other normalization can be changed by entering a line length or time delay.
Dielectric Constants	Dielectric constants may be entered for different media so the length entry can be physically meaningful.
Dispersion Modeling	Dispersion modeling is used in the cases of microstrip and waveguide to take into account frequency dependent phase velocities.
Attenuations	Attenuations and constant phase offsets can be entered to better describe any reference plane distortions.
Auto Modes	Automatic reference plane finding tools are available for phase alone or phase + magnitude. These routines do a fitting process on phase or phase and magnitude to estimate the reference plane location and enter correcting values.
De-embedding	For more complete reference plane manipulation, the full de-embedding system can also be used.

Measurement Frequency Range

Frequency Range Change	Frequency range of the measurement can be narrowed within the calibration range without recalibration.
CW Mode	CW mode permits single frequency measurements also without recalibration.
Interpolation Not Activated	If interpolation is not activated, the subset frequency range is forced to use calibration frequency points.
Interpolation Activated	If interpolation is activated, any frequency range that is a subset of the calibration frequency range can be used, but there may be some added interpolation error.

Group Delay

Group Delay Aperture	Defined as the frequency span over which the phase change is computed at a given frequency point.
Aperture	The aperture can be changed without recalibration.
Minimum Aperture	The minimum aperture is the frequency range divided by the number of points in calibration and can be increased to 20% of the frequency range.
Group Delay Range	<180° of phase change within the aperture

Channels, Display and Traces

Channels and Traces	16 channels, each with up to 16 traces
Display Colors	Unlimited colors for data traces, memory, text, markers, graticules, and limit lines
Trace Memory and Math	A separate memory for each trace can be used to store measurement data for later display or subtraction, addition, multiplication or division with current measurement data. The trace data can be saved and recalled.
Intra-trace Math	Any two traces within a channel can be combined (via addition, subtraction, multiplication, or division) and displayed on another trace.

Scale Resolution

	Minimum per division, varies with graph type.
Log Magnitude	0.001 dB
Linear Magnitude	10 µU
Phase	0.01°
Group Delay	0.1 ps
Time	0.0001 ps
Distance	0.1 µm
SWR	10 µU
Power	0.001 dB

Markers

Markers	12 markers + 1 reference marker per trace
Marker Coupling	Coupled or decoupled
Marker Overlay	Display markers on active trace only or on all traces when multiple trace responses are present on the same trace
Marker Data	Data displayed in graph area or in table form
Reference Marker	Additional marker per trace for reference
Marker Statistics	Mean, maximum, minimum, standard deviation Per trace or over a marker region
Marker Search and Tracking	Search and/or track for minimum, maximum, peak, or target value

Other

Filter Parameters	Display bandwidth (user-selectable loss value), corner and center frequencies, loss, Q, and shape factors.
S-Parameter Conversion	Z Reflection Impedance Z Transmission Impedance Y Reflection Admittance Y Transmission Admittance 1/S

Calibration and Correction Capabilities

Calibration Methods	Short-Open-Load-Through (SOLT) Short-Open-Load-Reciprocal (SOLR) Offset-Short-Offset-Short-Load-Through (SSLT) Triple-Offset-Short-Through (SSST) Line-Reflect-Line (LRL) / Line-Reflect-Match (LRM) Source Calibration Receiver Calibration SmartCal™, AutoCal™ Thru Update available
Correction Models	2-Port (Forward, Reverse, or both directions) 1-Port (S_{11}, S_{22}, or both) Transmission Frequency Response (Forward, Reverse, or both directions) Reflection Frequency Response (S_{11}, S_{22}, or both)

Continued on next page

Coefficients for Calibration Standards	Use the Anritsu calibration kit USB memory device to load kit coefficients and characterization files. Use predefined coefficients for Anritsu calibration kits in ShockLine software. Enter coefficients into user-defined locations. Use complex load models.
Interpolation	Allows interpolation between calibration frequency points.
Adapter Removal Calibration	Characterizes and "removes" an adapter that is used during calibration that will not be used for subsequent device measurements; for accurate measurement of non-insertable devices.
Dispersion Compensation	Selectable as Coaxial, other non-dispersive (e.g., for coplanar waveguide), Waveguide, or Microstrip
Power	Power Meter Correction: Different power meter calibrations are available to enhance power accuracy at the desired reference plane. The source power will match the target calibration power, as read by the power meter, to within ~0.1 dB for short periods of time (determined by thermal drift of the system and the power meter). The absolute accuracy of the calibrated power will be dependent on the power meter and sensor used. Flat Power Calibrations: A flat power calibration (when in frequency sweep mode) is available at a user-selectable power level, if it is within the power adjustment range of the internal source. The flat power correction is applied to other power levels. Linear Power Calibrations: A linear power calibration is performed over a range of power levels for use in power sweep mode and is performed at a specified frequency or frequency range. External Power Meter: Both calibrations are performed using an external USB power sensor (Anritsu MA24106A, MA24108A, MA24118A, MA24126A, MA24330A, MA24340A, MA24350A) over a USB 2.0 port.
Embedding/De-embedding	The MS46522B is equipped with an Embedding/De-embedding system. De-embedding: De-embedding is generally used for removal of test fixture contributions, modeled networks, and other networks described by S-parameters (s2p files) from measurements. Embedding: Similarly, the Embedding function can be used to simulate matching circuits for optimizing amplifier designs or simply adding effects of a known structure to a measurement. Multiple Networks: Multiple networks can be embedded/de-embedded and changing the port and network orientations is handled easily. Extraction Utility: An extraction utility is part of this package that allows easier computation of de-embedding files based on additional calibration steps and measurements.
Optical/Electrical Conversion	O/E & E/O: O/E and E/O setup wizard is provided
Impedance Conversion	Allows entry of different reference impedances (complex values) for different ports

Optional Capabilities

Time Domain Measurements Option 2	Displays all S-parameters and overlays with Frequency Domain, Low-pass Mode with added harmonics frequency list flexibility, Band-pass Mode, Phasor Impulse Mode, Windowing, Gating (pass-band or reject-band), and Frequency with Time Gate.
Advanced Time Domain Measurements, Option 22	The ATD option has two basic elements. The first element is an Eye Diagram automatically created from a stored .SnP data file after launching the ADK software. The second element accesses the following functions: Check Passivity and Causality, Combine .SnP Files, Plot Eye Diagram, Plot Crosstalk, Plot TDT/TDR/Skew, and Perform Compliance Test. Option 2 recommended with Option 22, but is not required.

Remote Operability

ShockLine supports several remote operability options.

Communication Type	Data Format	Performance	Description
Via LAN	Using VXI-11 Protocol	Gigabit Data Transfer Speed	Use SCPI commands
Drivers for LAN	IVI-C drivers are available for download from the Anritsu website. The IVI-C package supports National Instruments LabVIEW and LabWindows, C#, .NET, MATLAB, and Python programming environments.		
Triggering	Start Trigger: Software and digital edge Input Range: +3.3 V logic level (+5 V tolerant) Minimum Trigger Width: 50 ns Trigger Delay: 6 µs (typ.)		

Front Panel Connections

MS46522B Front Panel (8.5 GHz model shown)

Test Ports 1 and 2	MS46522B-010: N (f) MS46522B-020: K (m) MS46522B-040: K (m) MS46522B-082: WR12 Waveguide Flange Damage Input Levels: +27 dBm max., 50 VDC max.
Ports 1 to 2 Access Loops (Only available with Option 10)	Source Path: K (f) Damage Input Levels: +27 dBm max., 0 VDC max. Required: Only available with frequency Option 10 Receiver path: K (f) Damage Input Levels: +15 dBm max., 0 VDC max. Required: Only available with frequency Option 10
USB Ports	Six type A USB 2.0 Ports for peripherals such as keyboard, mouse, memory stick, hardware key, and similar devices.
Chassis Grounding Port	Banana (f)

Rear Panel Connections

MS46522B Rear Panel

AC Power Input	AC Input connector, with On/Off switch, and fuses 350 VA maximum, 90 V(ac) to 264 V(ac), 47 Hz to 63 Hz (power factor controlled)
USB Ports	Four type A USB 3.0 for peripherals such as keyboard, mouse, memory stick, USB monitor, and hardware key.
LAN Port	Gigabit Ethernet
Media	HDMI and Display Port: Video output, touchscreen compatible Audio: External stereo speaker and microphone (3.5 mm)
10 MHz In	Signal presence is auto-sensing (better than 10 ppm frequency accuracy is recommended). Connector Type: BNC (f) Signal: +0 dBm (typ.); 50Ω (nom.)
10 MHz Out	Signal presence is synchronized to and dependent upon the 10 MHz input signal Connector Type: BNC (f) Signal: +8 dBm (typ.); 50Ω (nom.)
External Trigger Input	Connector Type: BNC (f) Voltage Input: 0 to 3.3 V input (5 V tolerant) Impedance: High impedance (>100kΩ) Pulse Width: 50 ns minimum input pulse width Trigger Delay: 6 µs (typ.)
External Trigger Output	Connector type: BNC (f) Voltage Output: 0 to 3.3 V (HCMOS logic) Drive Current: 24 mA max. Pulse Width: 1 µs (typ.)
Bias Inputs (Only available with Option 10)	Connector: BNC (f) (one input per port); 50 VDC max., 0.5 A max. Required: Only available with frequency Option 10

CPU, Memory and Security Features

CPU	Intel Core™ i5
Storage	Serial-ATA (SATA) Solid State Drive (SSD, removable), for OS, Programs, and Data. (>30 GB)
Security Features	If the VNA is attached to a network, best practices recommend installing anti-virus software.

Dimensions and Mass

Dimensions	Dimensions listed are for the instrument body only, without rack mount option attached. 445 (W) × 152 (H) × 442 (D) mm
Mass	<11 kg (<25 lb), typical weight for a fully-loaded MS46522B-010 VNA <13 kg (<28 lb), typical weight for a fully-loaded MS46522B-20 or MS46522B-040 VNA

Regulatory Compliance

CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN61010-1 RoHS: 2011/65/EU
Australia and New Zealand	RCM AS/NZS 4417:2012
South Korea	KCC-REM-A21-0004

Environmental

MIL-PRF-28800F Class 3 (vibration and shock do not apply to Option 82 instruments)

Operating Temperature Range	0° to +50°C
Storage Temperature Range	–40° to +71°C
Maximum Relative Humidity	95% RH at +30°C, non-condensing
Vibration, Sinusoidal	5 Hz to 55 Hz
Vibration, Random	10 Hz to 500 Hz
Half Sine Shock	30 gn
Altitude	4600 meters, operating and non-operating

Warranty

Instrument and Built-In Options	3 years from the date of shipment (standard warranty)
Calibration Kits	Typically 1 year from the date of shipment
Test Port Cables	Typically 1 year from the date of shipment
Warranty Options	Additional warranty available

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main Frame
MS46522B	ShockLine 2-Port Vector Network Analyzer
	Required Options
MS46522B-010	50 kHz to 8.5 GHz, type N (f) ports
MS46522B-020	50 kHz to 20 GHz, type K (m) Ruggedized ports (compatible with 3.5 mm and SMA connectors)
MS46522B-040	50 kHz to 43.5 GHz, type K (m) Ruggedized ports (compatible with 3.5 mm and SMA connectors)
MS46522B-082	55 GHz to 92 GHz, WR12 waveguide flange
	Included Accessories
User Document	Each VNA comes with a power cord and instructions on where to download software and related literature.
	Main VNA Options
MS46522B-001	Rack Mount, adds handles and removes feet for shelf-mounting into a 19 inch universal rack
MS46522B-002	Time Domain with Time Gating
MS46522B-022	Advanced Time Domain
MS46522B-051	Access Loops (Only available with Option 10)
MS46522B-061	Bias Tee (Only available with Option 10)
	Calibration Options (not available for the MS46522B-082)
MS46522B-098	Standard Calibration, ISO 17025 compliant, without data
MS46522B-099	Premium Calibration, ISO 17025 compliant, with data
	Precision Automatic Calibrator Modules
MN25208A	2-port USB SmartCal Module, 300 kHz to 8.5 GHz (available with connector Options -001 N (f), -002 K (f), -003 3.5 mm (f))
MN25408A	4-port USB SmartCal Module, 300 kHz to 8.5 GHz (available with connector Options -001 N (f), -002 K (f), -003 3.5 mm (f))
MN25218A	2-port USB SmartCal Module, 300 kHz to 20 GHz (available with connector Option -002 K (f))
MN25418A	4-port USB SmartCal Module, 300 kHz to 20 GHz (available with connector Option -002 K (f))
36585K-2M	K Connector Precision AutoCal Module, 70 kHz to 40 GHz, K (m) to K (m)
36585K-2F	K Connector Precision AutoCal Module, 70 kHz to 40 GHz, K (f) to K (f)
36585K-2MF	K Connector Precision AutoCal Module, 70 kHz to 40 GHz, K (m) to K (f)
2000-1809-R	Serial to USB Adapter (required for use with 36585 AutoCal module if control PC does not have a serial port)
	Mechanical Calibration Kits
3650A	SMA/3.5 mm Calibration Kit, Without Sliding Loads, DC to 26.5 GHz, 50Ω
3650A-1	SMA/3.5 mm Calibration Kit, With Sliding Loads, DC to 26.5 GHz, 50Ω
3652A	K Connector Calibration Kit, Without Sliding Loads, DC to 40 GHz, 50Ω
3652A-1	K Connector Calibration Kit, With Sliding Loads, DC to 40 GHz, 50Ω
3653A	N Connector Calibration Kit, Without Sliding Loads, DC to 18 GHz, 50Ω
OSLN50A-8	Precision N Male Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50Ω
OSLNF50A-8	Precision N Female Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50Ω
TOSLN50A-8	Precision N Male Through/Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50Ω
TOSLNF50A-8	Precision N Female Through/Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50Ω
OSLN50A-18	Precision N Male Open/Short/Load Mechanical Calibration Tee, DC to 18 GHz, 50Ω
OSLNF50A-18	Precision N Female Open/Short/Load Mechanical Calibration Tee, DC to 18 GHz, 50Ω
TOSLN50A-18	Precision N Male Through/Open/Short/Load Mechanical Calibration Tee, DC to 18 GHz, 50Ω
TOSLNF50A-18	Precision N Female Through/Open/Short/Load Mechanical Calibration Tee, DC to 18 GHz, 50Ω
TOSLK50A-20	Precision K Male Through/Open/Short/Load Mechanical Calibration Tee, DC to 20 GHz, 50Ω
TOSLKF50A-20	Precision K Female Through/Open/Short/Load Mechanical Calibration Tee, DC to 20 GHz, 50Ω
TOSLK50A-40	Precision K Male Through/Open/Short/Load Mechanical Calibration Tee, DC to 40 GHz, 50Ω
TOSLKF50A-40	Precision K Female Through/Open/Short/Load Mechanical Calibration Tee, DC to 40 GHz, 50Ω

Model/Order No.	Name
	USB Power Sensors
MA24106A	True-RMS USB Power Sensor, 50 MHz to 6 GHz
MA24108A	True-RMS USB Power Sensor, 10 MHz to 8 GHz
MA24118A	True-RMS USB Power Sensor, 10 MHz to 18 GHz
MA24126A	True-RMS USB Power Sensor, 10 MHz to 26 GHz
MA24330A	Microwave CW USB Power Sensor, 10 MHz to 33 GHz
MA24340A	Microwave CW USB Power Sensor, 10 MHz to 40 GHz
MA24350A	Microwave CW USB Power Sensor, 10 MHz to 50 GHz
	RF Cables and Adapters
N120-6	RF Cables, Semi-Rigid, N (m) to N (m), 1 each, 0.01 GHz, to 18 GHz, 50Ω, 15 cm (5.9 in)
NS120MF-6	RF Cables, Semi-Rigid, N (f) to N (f), 1 each, 0.01 GHz, to 18 GHz, 50Ω, 15 cm (5.9 in)
1091-26-R	SMA (m) to N (m), DC to 18 GHz, 50Ω
1091-27-R	SMA (f) to N (m), DC to 18 GHz, 50Ω
1091-80-R	SMA (m) to N (f), DC to 18 GHz, 50Ω
1091-81-R	SMA (f) to N (f), DC to 18 GHz, 50Ω
34NN50A	Precision Adapter, N (m) to N (m), DC to 18 GHz, 50Ω
34NFNF50	Precision Adapter, N (f) to N (f), DC to 18 GHz, 50Ω
34NK50	Precision Adapter, N (m) to K (m), DC to 18 GHz, 50Ω
34NKF50	Precision Adapter, N (m) to K (f), DC to 18 GHz, 50Ω
34NFK50	Precision Adapter, N (f) to K (m), DC to 18 GHz, 50Ω
34NFKF50	Precision Adapter, N (f) to K (f), DC to 18 GHz, 50Ω
K220B	Precision Adapter, K (m) to K (m), DC to 40 GHz, 50Ω
K222B	Precision Adapter, K (f) to K (f), DC to 40 GHz, 50Ω
K224B	Precision Adapter, K (m) to K (f), DC to 40 GHz, 50Ω
SC7260	WR12 to W1 (m) Adapter, W1 (1 mm) to WR12 Waveguide
SC7442	WR12 to W1 (f) Adapter, W1 (1 mm) to WR12 Waveguide
35WR12WF-EE	Precision Waveguide to Coax Adapter Kit, 56 GHz to 94 GHz, WR-12 to 1.0 mm (f)
	Test Port Cables, Flexible, Ruggedized, Phase Stable
15NNF50-1.0B	Test Port Cable, Flexible, Phase Stable, N (f) to N (m), 1.0 m, 50Ω
15NNF50-1.5B	Test Port Cable, Flexible, Phase Stable, N (f) to N (m), 1.5 m, 50Ω
15NN50-1.0B	Test Port Cable, Flexible, Phase Stable, N (m) to N (m), 1.0 m, 50Ω
15LL50-1.0A	Test Port Cable, Armored, Phase Stable, DC to 20 GHz, 3.5 mm (m) to 3.5 mm (m), 1.0 m, 50Ω
15LLF50-1.0A	Test Port Cable, Armored, Phase Stable, DC to 20 GHz, 3.5 mm (m) to 3.5 mm (f), 1.0 m, 50Ω
15KK50-1.0A	Test Port Cable, Armored, Phase Stable, DC to 20 GHz, K (m) to K (m), 1.0 m, 50Ω
15KKF50-1.0A	Test Port Cable, Armored, Phase Stable, DC to 20 GHz, K (m) to K (f), 1.0 m, 50Ω
3671KFS50-60	Test Port Cable, Flexible, Phase Stable, DC to 26.5 GHz, K (f) to 3.5 mm (m), 63.5 cm, 50Ω
3671KFK50-60	Test Port Cable, Flexible, Phase Stable, DC to 40 GHz, K (f) to K (m), 63.5 cm (25 in), 50Ω
3671KFKF50-60	Test Port Cable, Flexible, Phase Stable, DC to 40 GHz, K (f) to K (f), 63.5 cm (25 in), 50Ω
3671KFK50-100	Test Port Cable, Flexible, Phase Stable, DC to 40 GHz, K (f) to K (m), 1 m (38 in), 50Ω
	Phase-Stable 18 GHz and 40 GHz Semi-Rigid Cables (Armored)
3670K50-1	0.3 m (12”), DC to 40 GHz, K (f) to K (m), 50Ω
3670K50-2	0.6 m (24”), DC to 40 GHz, K (f) to K (m), 50Ω
3670N50-1	0.3 m (12”), DC to 18 GHz, N (f) to N (m), 50Ω
3670NN50-1	0.3 m (12”), DC to 18 GHz, N (m) to N (m), 50Ω
3670N50-2	0.6 m (24”), DC to 18 GHz, N (f) to N (m), 50Ω
3670NN50-2	0.6 m (24”), DC to 18 GHz, N (m) to N (m), 50Ω
	Tools
01-200	Calibrated Torque End Wrench, GPC-7 and Type N
01-201	Torque End Wrench, 5/16 in, 0.9 N·m (8 lbf·in) For tightening male devices, for SMA, 3.5 mm, 2.4 mm, K, and V connectors
01-204	End Wrench, 5/16 in, Universal, Circular, Open-ended, For SMA, 3.5 mm, 2.4 mm, K and V connectors
More Information	Refer to our Precision RF & Microwave Components Catalog for descriptions of adapters and other components.
	Documentation
User Documentation	Soft copies of the manuals as Adobe Acrobat PDF files are available for download from the instrument model web page at www.anritsu.com. For more information and product support, please contact ShockLineVNA.support@Anritsu.com.
10100-00067	Product information, compliance, and safety
10410-00743	MS46522B/524B VNA Operation Manual
10410-00744	MS46522B/524B VNA User Interface Reference Manual
10410-00746	ShockLine Series VNA Programming Manual, for IEEE 488.2 and SCPI Commands
10410-00753	MS46522B/524B VNA Calibration and Measurement Guide

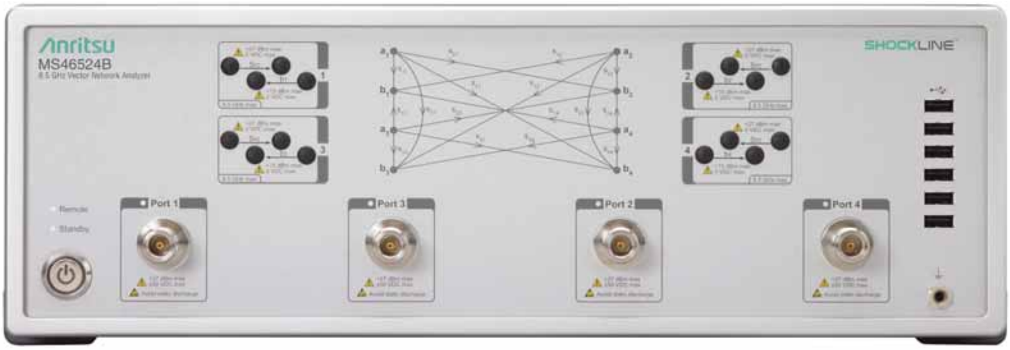
ShockLine™ Performance Vector Network Analyzers

MS46524B

4-Port Vector Network Analyzers

Remote Control
Ethernet

High Performance, 3U high, 4-port VNA Available in a 50 kHz to 43.5 GHz Frequency Range



The MS46524B is part of the ShockLine family of Vector Network Analyzers from Anritsu. It is a high performance, 3U high, 4-port VNA available in broadband frequency ranges from 50 kHz to 43.5 GHz.
It is capable of measuring 16 single-ended and mixed-mode s-parameters of passive multiport and differential devices.
The MS46524B series supports SCPI command programming and has software driver support for the most common programming environments. The MS46524B use industry standard LAN communications for robust remote control in test applications. ShockLine VNAs provide a powerful graphical user interface for manual testing of devices.
The full-featured user interface is enabled by attaching a (user-supplied) touchscreen monitor, keyboard, and mouse.

Instrument Models and Operating Frequencies

- MS46524B, 4-Port ShockLine VNA

Requires one Frequency Option:

- MS46524B-010, 50 kHz to 8.5 GHz
- MS46524B-020, 50 kHz to 20 GHz
- MS46524B-040, 50 kHz to 43.5 GHz

Principal Options

- MS46524B-002, Time Domain
- MS46524B-022, Advanced Time Domain
- MS46524B-051, Access Loops (Only available with Option 10)
- MS46524B-061, Bias Tee (Only available with Option 10)

Definitions

All specifications and characteristics apply under the following conditions, unless otherwise stated:

Warm-Up Time After	45 minutes of warm-up time, where the instrument is left in the ON state.
Temperature Range	Over the 25° ±5°C temperature range.
Frequency Range	The instrument operates in the following frequency ranges without any implied or warranted specifications: 50 kHz to 300 kHz, 40 GHz to 43.5 GHz.
Error-Corrected Specifications	For error-corrected specifications, over 23° ±3°C, with <1°C variation from calibration temperature. For error-corrected specifications are warranted and include guard-bands, unless otherwise stated.
Simultaneous Sweep Mode	Specifications are not warranted in simultaneous sweep mode.
User Cables	Specifications do not include effects of any user cables attached to the instrument.
Discrete Spurious Responses	Specifications may exclude discrete spurious responses.
Internal Reference Signal	All specifications apply with internal 10 MHz Crystal Oscillator Reference Signal.
Interpolation Mode	All specifications are with Interpolation Mode Off.
Standard	Refers to instruments without Options.
Typical Performance	Typical performance indicates the measured performance of an average unit. It does not include guard-bands and is not covered by the product warranty. Typical specifications are shown in parenthesis, such as (–102 dB), or noted as Typical.
Characteristic Performance	Characteristic performance indicates a performance designed-in and verified during the design phase. It does include guard-bands and is not covered by the product warranty.
Recommended Calibration Cycle	12 months (Residual specifications also require calibration kit calibration cycle adherence.)
Specifications Subject to Change	All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site: www.anritsu.com

Specifications

System Dynamic Range*1

System dynamic range is calculated as the difference between the test port maximum source power and the RMS noise floor at 10 Hz IF bandwidth with averaging off and smoothing on after calibrating the instrument for transmission frequency response and isolation.

Frequency Range	Standard (dB)	Typical (dB)
300 kHz to 1 MHz	90	101
>1 MHz to 50 MHz	100	108
>50 MHz to 2 GHz	140	144
>2 GHz to 4 GHz	137	142
>4 GHz to 6 GHz	130	137
>6 GHz to 8 GHz*2	128	130
>8 GHz to 8.5 GHz	120	127*2
>8.5 GHz to 25 GHz	117	122
>25 GHz to 40 GHz	120	127
>40 GHz to 43.5 GHz	—	120

*1: System dynamic range is degraded by 20 dB from the standard specifications in simultaneous sweep mode and by 3 dB between ports 1 or 2 and ports 3 or 4 (typical). The dynamic range performance with Option 51 at the b1/b2 ports is +10 dB higher than the standard specification (typical).

*2: Dynamic range degrades by 4 dB for Options 20 and 40.

Receiver Compression Levels

Port power level beyond which the response may be compressed more than 0.2 dB relative to the normalization level. Measured at 300 Hz IF bandwidth. Match not included. Performance is typical.

Frequency Range	Standard (dBm)
300 kHz to 43.5 GHz	+15

High Level Noise*

Measured at 100 Hz IF bandwidth and at default power level, RMS.

Frequency Range	Magnitude (dB)	Phase (deg)
300 kHz to 1 GHz	0.004 (0.003 (typ.))	0.04 (0.02 (typ.))
>1 GHz to 25 GHz	0.003 (0.002 (typ.))	0.05 (0.02 (typ.))
>25 GHz to 40 GHz	0.004 (0.002 (typ.))	0.05 (0.04 (typ.))
>40 GHz to 43.5 GHz	(0.002 (typ.))	(0.05 (typ.))

*: High level noise specification in simultaneous sweep mode: Magnitude 0.005 dB (typical), Phase 0.05 degree (typ.).

Output Power Range

Minimum to maximum rated power level. Performance is characteristic.

Frequency Range	Standard (dBm)	Typical (dBm)
300 kHz to 6 GHz	–30 to +15	–30 to +17
>6 GHz to 8 GHz	–30 to +12*	–30 to +13
>8 GHz to 8.5 GHz	–30 to +10	–30 to +11
>8.5 GHz to 40 GHz	–30 to +7	–30 to +10
>40 GHz to 43.5 GHz	—	–30 to +4

*: Maximum power degrades by 2 dB for Options 20 and 40.

Output Default Power

Instrument default power is 0 dBm. For maximum rated power, refer to Output Power Range above.

Power Accuracy

Performance is typical.

Output Power	Standard (dB)	Typical (dB)
At +5 dBm	±1.0*1	±0.7
At 0 dBm	±1.5*2	±0.5
At –30 dBm	±3.0	±1.8

*1: Power accuracy degrades by 0.5 dB (>8.5 GHz to 25 GHz), and by 1 dB (>25 GHz to 40 GHz).

*2: Power accuracy degrades by 0.5 dB (>8.5 GHz).

Setting Resolution

Frequency Range	Setting Resolution (dB)
300 kHz to 43.5 GHz	0.01

Measurement Stability

Ratio measurement, with ports shorted. Typical.

Frequency Range	Magnitude (dB/°C)	Phase (deg/°C)
300 kHz to 8.5 GHz	0.02	0.5
>8.5 GHz to 40 GHz	0.01	1.0

Frequency Resolution, Accuracy, and Stability

All specifications typical.

Resolution	Accuracy	Stability/Temperature	Stability
1 Hz	±0.1 (at time of calibration)	±0.1 ppm/10° to 50°C	±0.02 ppm/24 hours ±0.2 ppm/1 month ±1.0 ppm/1 year ±2.0 ppm/3 years

Source Harmonics and Non-Harmonics (Spurious)

Measured at 0 dBm. All specifications typical.

Frequency Range	Harmonics (second and third) (dBc)	Non-Harmonic Spurious (dBc)	Phase Noise @ 10 kHz Offset (dBc/Hz)
300 kHz to 8.5 GHz	<–30	<–30	>60

Uncorrected (Raw) Port Characteristics

All specifications typical. User correction off, system correction on.

Frequency Range	Directivity (dB)	Port Match (dB)*
300 kHz to 1 GHz	>21	>17
>1 GHz to 4 GHz	>21	>17
>4 GHz to 8.5 GHz	>15	>15
>8.5 GHz to 43.5 GHz	>15	>15

*: Port Match is defined as the worst of source and load match.

VNA System Performance for MS46524B-010 Frequency Options

Error-Corrected Specifications

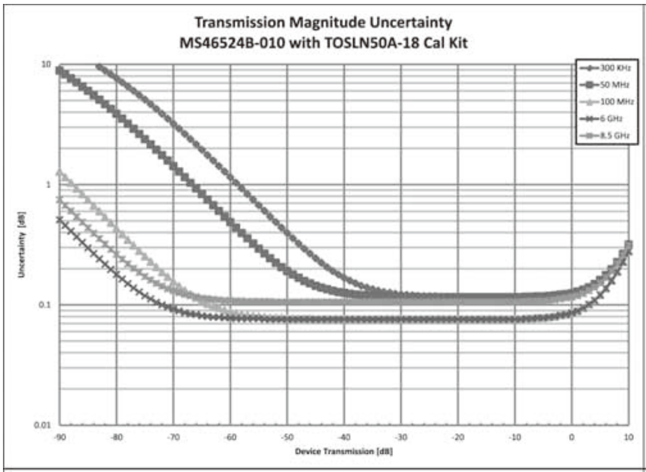
With 12-term SOLT calibration using the TOSLN50A-18 N Type connector calibration kit and two Anritsu 3670N50-1, N (f) to N (m) cables.

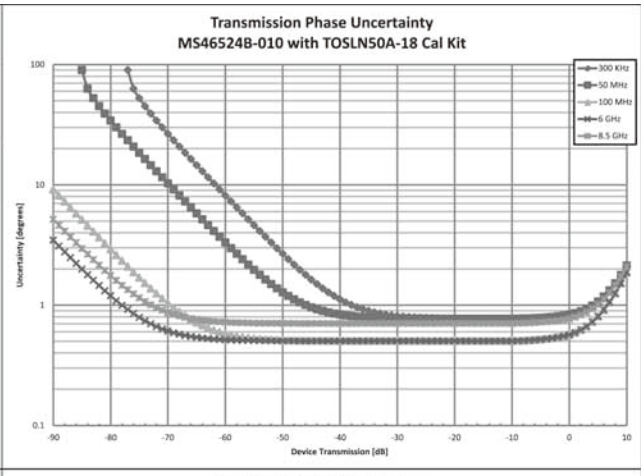
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
300 kHz to 50 MHz	>40	>35	>38	±0.15	±0.09
>50 MHz to 6 GHz	>40	>35	>38	±0.08	±0.05
>6 GHz to 8 GHz	>36	>35	>34	±0.08	±0.05
>8 GHz to 8.5 GHz	>36	>35	>34	±0.10	±0.08

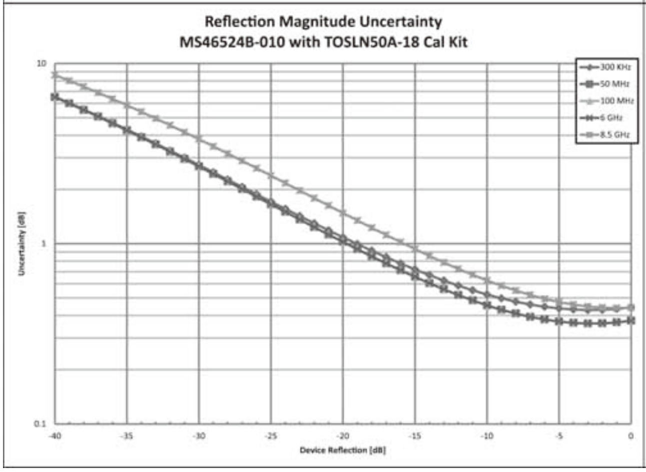
*: Characteristic performance.

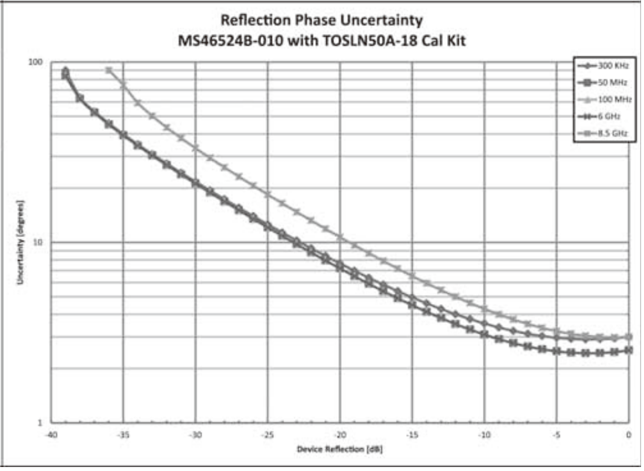
Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.


Transmission Magnitude Uncertainty
MS46524B-010 with TOSLN50A-18 Cal Kit


Transmission Phase Uncertainty
MS46524B-010 with TOSLN50A-18 Cal Kit


Reflection Magnitude Uncertainty
MS46524B-010 with TOSLN50A-18 Cal Kit


Reflection Phase Uncertainty
MS46524B-010 with TOSLN50A-18 Cal Kit

VNA System Performance for MS46524B-020 Frequency Options

Error-Corrected Specifications

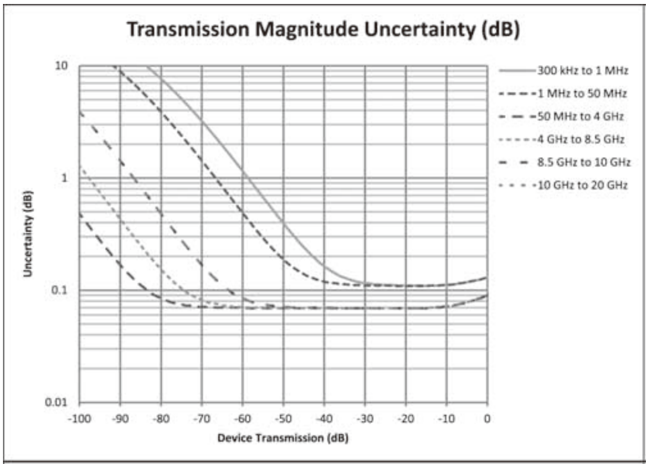
With 12-term SOLT Calibration using the TOSLKF50A-40 K Type Connector Calibration Kit.

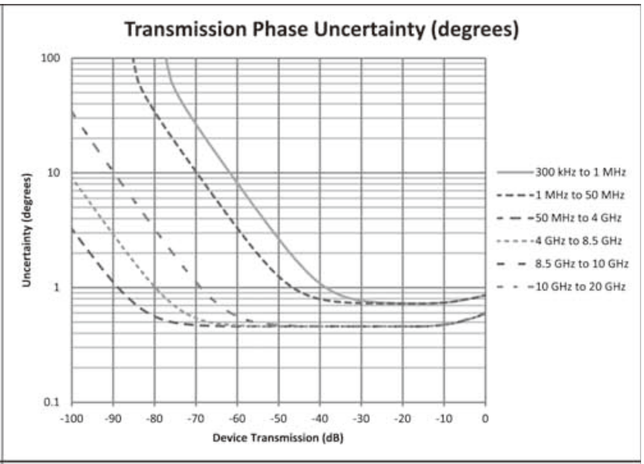
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
300 kHz to 50 MHz	>42	>35	>42	±0.10	±0.09
>50 MHz to 10 GHz	≥42	≥35	≥42	±0.10	±0.05
>10 GHz to 20 GHz	≥36	≥26.5	≥36	±0.10	±0.05

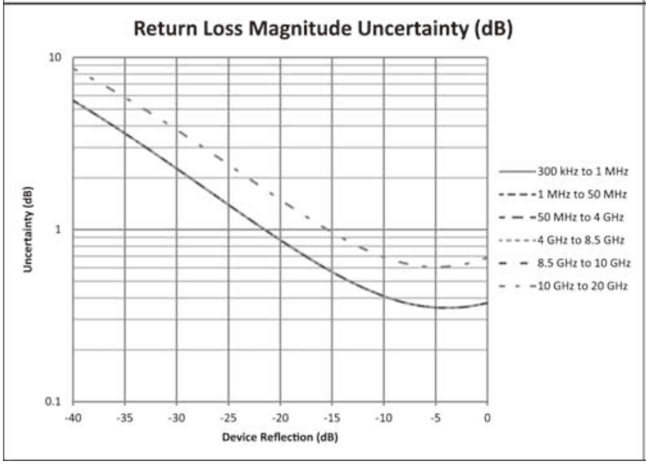
*: Characteristic performance.

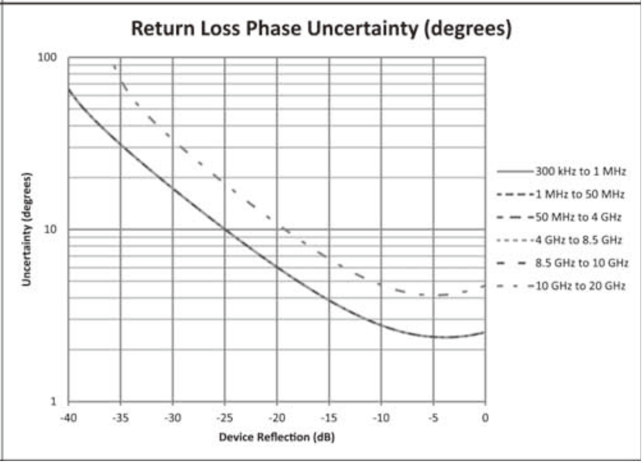
Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.


Transmission Magnitude Uncertainty (dB)


Transmission Phase Uncertainty (degrees)


Return Loss Magnitude Uncertainty (dB)


Return Loss Phase Uncertainty (degrees)

VNA System Performance for MS46524B-040 Frequency Options

Error-Corrected Specifications

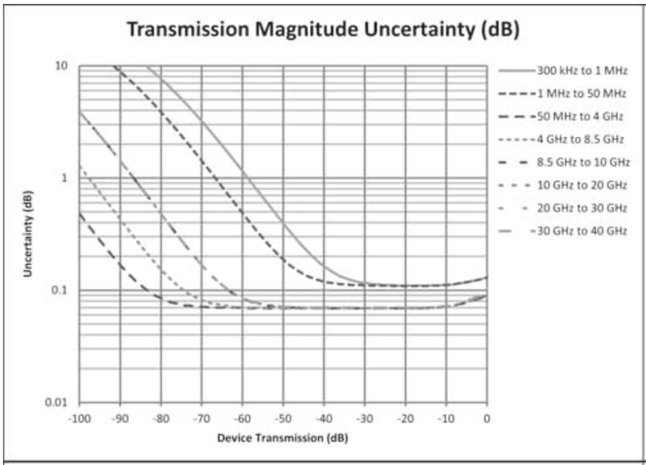
With 12-term SOLT Calibration using the TOSLKF50A-40 K Type Connector Calibration Kit.

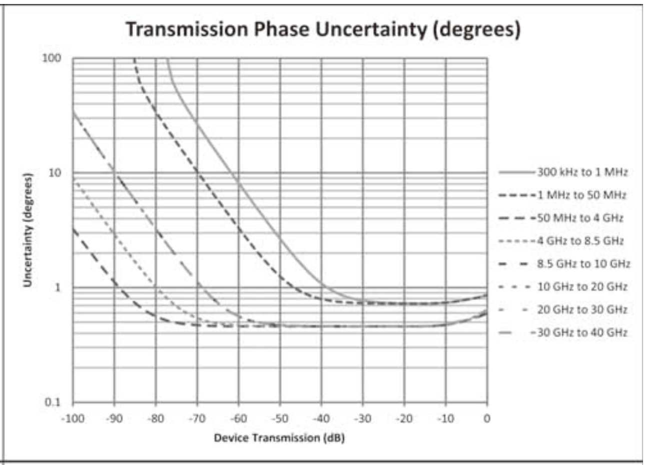
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
300 kHz to 50 MHz	>42	>35	>42	±0.10	±0.09
>50 MHz to 10 GHz	≥42	≥35	≥42	±0.10	±0.05
>10 GHz to 20 GHz	≥36	≥26.5	≥36	±0.10	±0.05
>20 GHz to 30 GHz	≥32	≥22.5	≥32	±0.10	±0.05
>30 GHz to 43.5 GHz	≥30	≥20	≥30	±0.10	±0.05

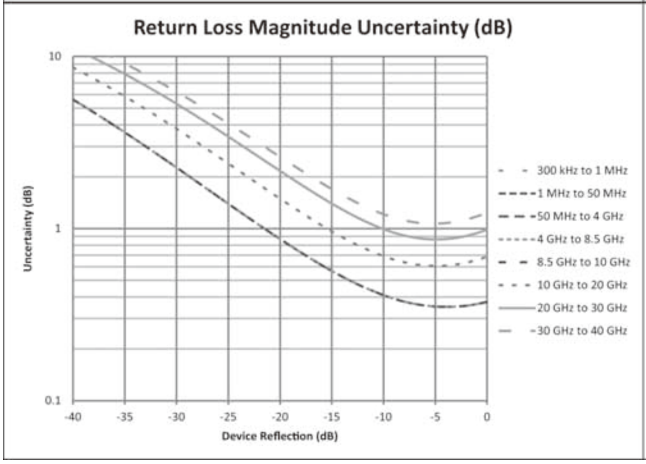
*: Characteristic performance.

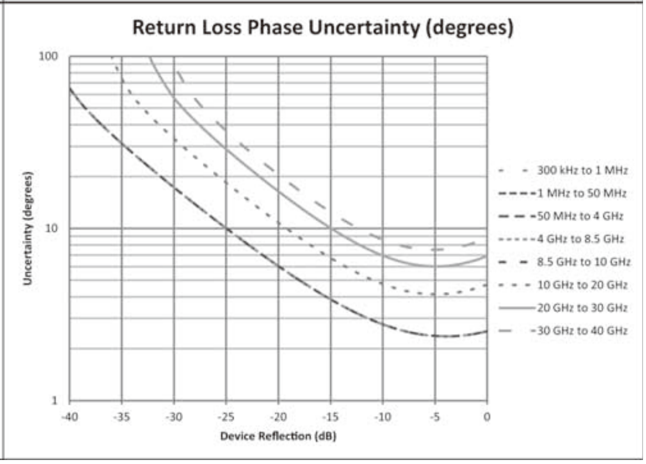
Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.


Transmission Magnitude Uncertainty (dB)


Transmission Phase Uncertainty (degrees)


Return Loss Magnitude Uncertainty (dB)


Return Loss Phase Uncertainty (degrees)

MS46524B-010 VNA System Performance with SmartCal™

Error-Corrected Specifications

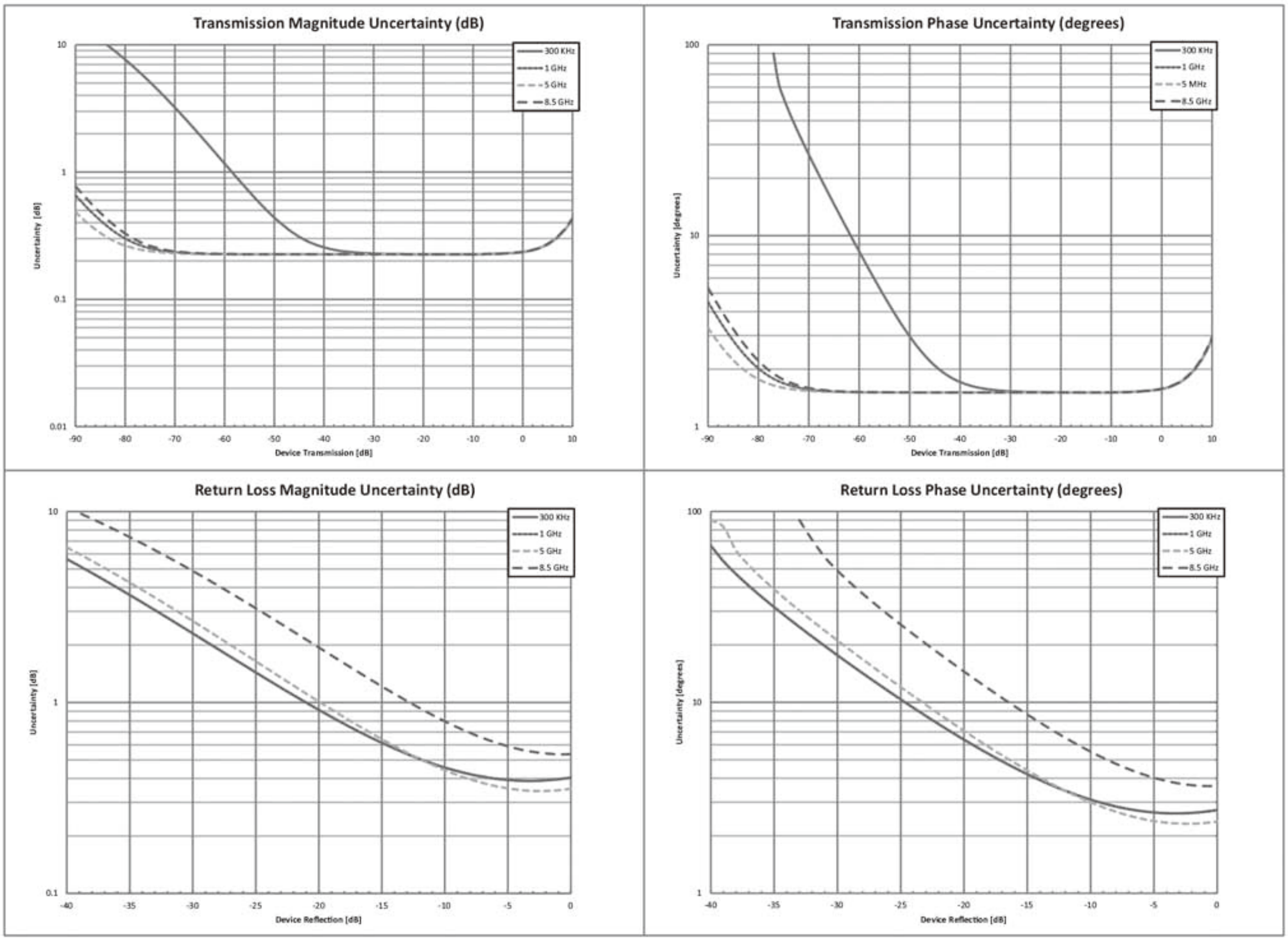
With 12-term calibration using the MN25408A SmartCal™ automatic calibration kit with option MN25408A-001, -002, -003.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
300 kHz to 1 GHz	>42	>35	>38	±0.15	±0.2
>1 GHz to 5 GHz	>40	>35	>38	±0.08	±0.2
>5 GHz to 8.5 GHz	>33	>32	>33	±0.10	±0.2

*: Characteristic performance.

Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.



MS46524B-010 and MS46524B-020 VNA System Performance with SmartCal™

Error-Corrected Specifications

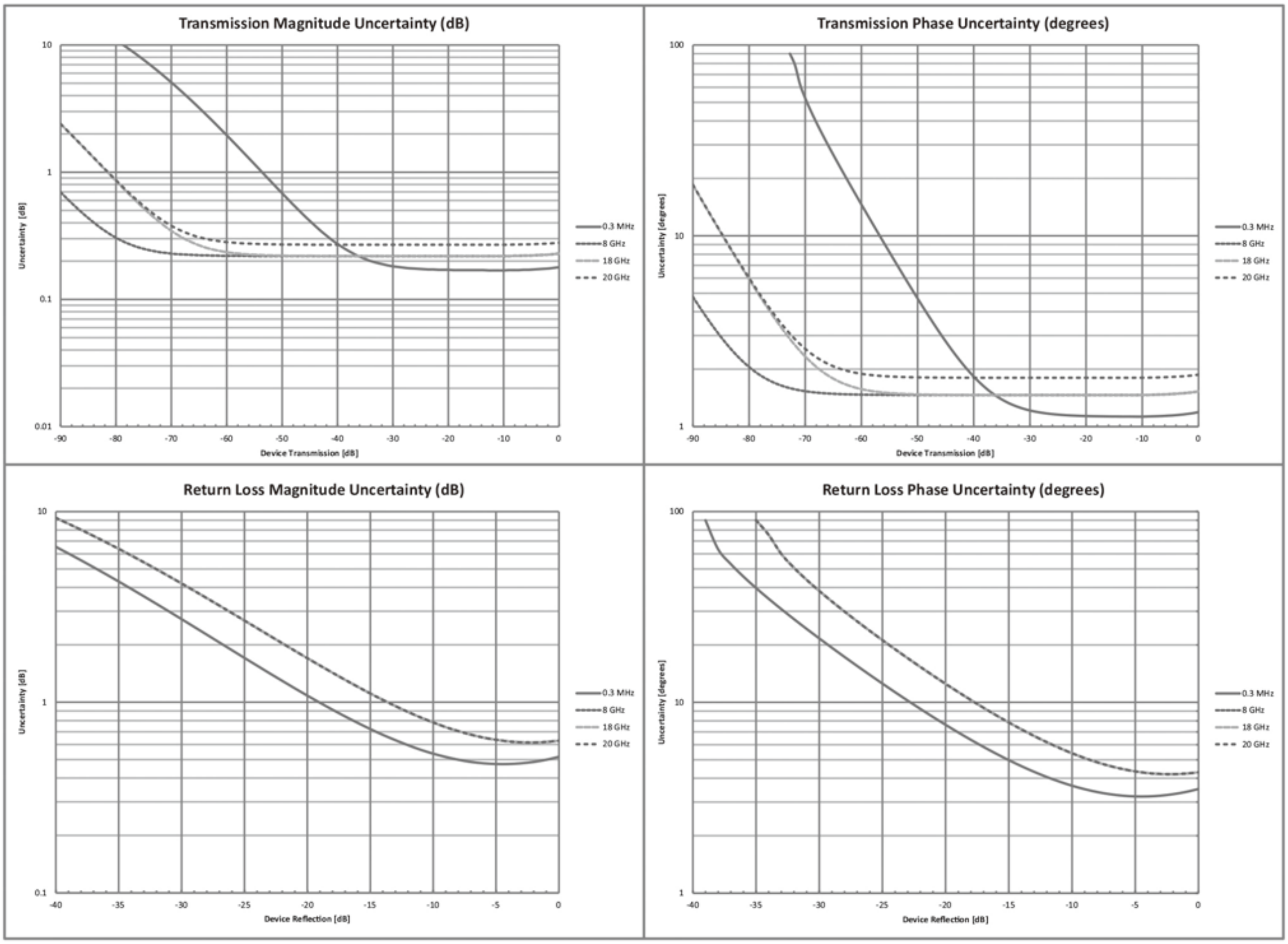
With 12-term calibration using the MN25418A SmartCal™ automatic calibration kit.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
300 kHz to 6 GHz	≥40	≥31	≥42	±0.15	±0.15
>6 GHz to 18 GHz	≥35	≥31	≥37	±0.20	±0.20
>18 GHz to 20 GHz	≥35	≥31	≥34	±0.20	±0.25

*: Characteristic performance.

Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.



MS46524B-040 VNA System Performance with 40 GHz 36585K Precision AutoCal™

Error-Corrected Specifications

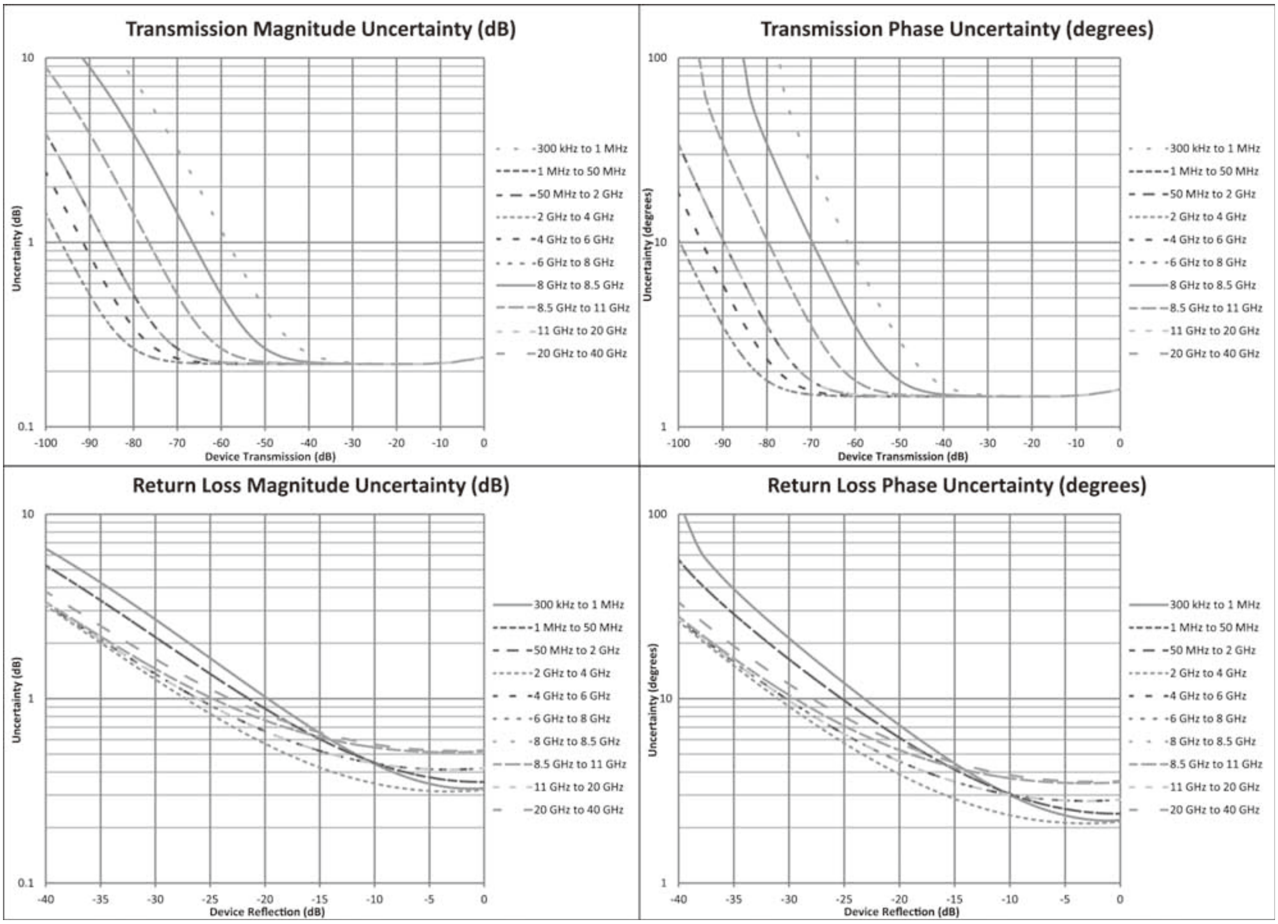
With 12-term calibration using the 36585K series automatic calibration kit with type K connectors. Performance is typical.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match* (dB)	Reflection Tracking* (dB)	Transmission Tracking* (dB)
300 kHz to <10 MHz	≥40	≥40	>40	±0.10	±0.20
10 MHz to <2.5 GHz	≥43	≥47	>43	±0.20	±0.20
2.5 GHz to <4 GHz	≥50	≥47	>50	±0.20	±0.20
4 GHz to <8 GHz	≥50	≥47	>50	±0.30	±0.20
8 GHz to <11 GHz	≥50	≥47	≥50	±0.40	±0.20
11 GHz to <20 GHz	≥50	≥47	≥50	±0.30	±0.20
20 GHz to <40 GHz	≥48	≥47	≥48	±0.40	±0.20

*: Characteristic performance.

Measurement Uncertainties

The graphs give measurement uncertainties after the above error-corrected calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.



Measurement Throughput Summary

Cycle Time for Measurement Completion (ms)

Number of traces = 1; system error correction on. Typical performance data.

	500 kHz IF Bandwidth				100 kHz IF Bandwidth				1 kHz IF Bandwidth			
Number of Points	51	201	401	1601	51	201	401	1601	51	201	401	1601
Start 1 GHz, stop 1.2 GHz												
Uncorrected	2	6	12	46	2	7	12	46	56	213	422	1679
2-Port Cal, S_{21}	4	12	24	91	4	12	24	91	114	428	1692	3360
4-Port Cal	12	40	78	307	13	41	78	303	227	854	1692	6719
Start 300 kHz, stop 4.5 GHz												
Uncorrected	3	7	13	48	4	8	13	52	57	214	423	1683
2-Port Cal, S_{21}	6	14	26	95	6	15	26	95	116	430	849	3368
4-Port Cal	13	41	79	309	13	41	78	312	231	860	1698	6734
Start 300 kHz, stop 8.5 GHz												
Uncorrected	4	7	13	48	4	8	14	48	57	215	424	1681
2-Port Cal, S_{21}	6	14	26	94	7	16	27	95	116	431	851	3368
4-Port Cal	13	41	78	306	14	40	78	306	249	862	1701	6734

Data Transfer Time (ms)

Transferred complex S_{11} data, using "CALC:DATA:SDATA?" command. Typical performance data.*

Number of Points	51	201	401	1601
SCPI over LAN				
REAL 64	4	4	4	8
REAL 32	4	4	4	8
ASCII	14	34	60	209

*: Data transfer time varies depending on the PC and control software used with the VNA.

Standard Capabilities

Operating Frequencies

MS46524B-010	50 kHz to 8.5 GHz
MS46524B-020	50 kHz to 20 GHz
MS46524B-040	50 kHz to 43.5 GHz

Measurement Parameters

4-Port Measurements	16 single-ended S-parameters, and any user-defined combination of $a_{1\text{-}4}$, $b_{1\text{-}4}$, and 1. 16 mixed-mode S-parameters (DD, CC, DC, CD); uses the superposition technique Maximum Efficiency Analysis
Domains	Frequency Domain, and Time (Distance) Domain

Sweeps

Sweep Configurations	Standard or Simultaneous (MS46522B-010 option only)
Frequency Sweep Types	Linear, Log, or Segmented
Power Sweep Types	Linear

Display Graphs

Single Rectilinear Graph Types	Log Magnitude, Phase, Group Delay, Linear Magnitude, Real, Imaginary, SWR, Impedance, KQ and η Max
Dual Rectilinear Graph Types	Log Mag and Phase, Linear Mag and Phase, Real, Imaginary, KQ and η Max
Circular Graph Types	Smith Chart (Impedance), Polar

Measurements Data Points

Maximum Data Points	2 to 20,001 points

Limit Lines

Limit Lines	Single or segmented. 2 limit lines per trace. 50 segments per trace.
Single Limit Readouts	Uses interpolation to determine the intersection frequency.
Test Limits	Both single and segmented limits can be used for PASS/FAIL testing.

Ripple Limit Lines

Limit Lines	Single or segmented. 2 limit lines per trace. 50 segments per trace.
Ripple Value	Absolute Value or Margin
Test Limits	Both single and segmented limits can be used for PASS/FAIL testing.

Averaging

Point-by-Point	Point-by-point (default), maximum number of averages = 4096
Sweep-by-Sweep	Sweep-by-sweep, maximum number of averages = 4096

IF Bandwidth

	10, 20, 30, 50, 70, 100, 200, 300, 500, 700 Hz 1, 2, 3, 5, 7, 10, 20, 30, 50, 70, 100, 200, 300, 500 kHz

Reference Plane

Line Length or Time Delay	The reference planes of a calibration or other normalization can be changed by entering a line length or time delay.
Dielectric Constants	Dielectric constants may be entered for different media so the length entry can be physically meaningful.
Dispersion Modeling	Dispersion modeling is used in the cases of microstrip and waveguide to take into account frequency dependent phase velocities.
Attenuations	Attenuations and constant phase offsets can be entered to better describe any reference plane distortions.
Auto Modes	Automatic reference plane finding tools are available for phase alone or phase + magnitude. These routines do a fitting process on phase or phase and magnitude to estimate the reference plane location and enter correcting values.
De-embedding	For more complete reference plane manipulation, the full de-embedding system can also be used.

Measurement Frequency Range

Frequency Range Change	Frequency range of the measurement can be narrowed within the calibration range without recalibration.
CW Mode	CW mode permits single frequency measurements also without recalibration.
Interpolation Not Activated	If interpolation is not activated, the subset frequency range is forced to use calibration frequency points.
Interpolation Activated	If interpolation is activated, any frequency range that is a subset of the calibration frequency range can be used, but there may be some added interpolation error.

Group Delay

Group Delay Aperture	Defined as the frequency span over which the phase change is computed at a given frequency point.
Aperture	The aperture can be changed without recalibration.
Minimum Aperture	The minimum aperture is the frequency range divided by the number of points in calibration and can be increased to 20% of the frequency range.
Group Delay Range	<180° of phase change within the aperture

Channels, Display and Traces

Channels and Traces	16 channels, each with up to 16 traces
Display Colors	Unlimited colors for data traces, memory, text, markers, graticules, and limit lines
Trace Memory and Math	A separate memory for each trace can be used to store measurement data for later display or subtraction, addition, multiplication or division with current measurement data. The trace data can be saved and recalled.
Intra-trace Math	Any two traces within a channel can be combined (via addition, subtraction, multiplication, or division) and displayed on another trace.

Scale Resolution

	Minimum per division, varies with graph type.
Log Magnitude	0.001 dB
Linear Magnitude	10 µU
Phase	0.01°
Group Delay	0.1 ps
Time	0.0001 ps
Distance	0.1 µm
SWR	10 µU
Power	0.001 dB

Markers

Markers	12 markers + 1 reference marker per trace
Marker Coupling	Coupled or decoupled
Marker Overlay	Display markers on active trace only or on all traces when multiple trace responses are present on the same trace.
Marker Data	Data displayed in graph area or in table form
Reference Marker	Additional marker per trace for reference
Marker Statistics	Mean, maximum, minimum, standard deviation Per trace or over a marker region
Marker Search and Tracking	Search and/or track for minimum, maximum, peak, or target value

Other

Filter Parameters	Display bandwidth (user-selectable loss value), corner and center frequencies, loss, Q, and shape factors.
S-Parameter Conversion	Z Reflection Impedance Z Transmission Impedance Y Reflection Admittance Y Transmission Admittance 1/S

Calibration and Correction Capabilities

Calibration Methods	Short-Open-Load-Through (SOLT) Short-Open-Load-Reciprocal (SOLR) Offset-Short-Offset-Short-Load-Through (SSLT) Triple-Offset-Short-Through (SSST) Line-Reflect-Line (LRL) / Line-Reflect-Match (LRM) Source Calibration Receiver Calibration SmartCal™, AutoCal™ Thru Update available
Correction Models	4-port Cals (uses two Full 2-port Cals and up to 4 additional Thru/Reciprocals, minimum of 1) 3-port Cals (uses one Full 2-port Cal, one Full 1-port Cal, and up to 2 additional Thru/Reciprocals, minimum of 1) 2-Port (Forward, Reverse, or both directions) 1-Port (S_{11}, S_{22}, or both) Transmission Frequency Response (Forward, Reverse, or both directions) Reflection Frequency Response (S_{11}, S_{22}, or both)
Coefficients for Calibration Standards	Use the Anritsu calibration kit USB memory device to load kit coefficients and characterization files. Use predefined coefficients for Anritsu calibration kits in ShockLine software. Enter coefficients into user-defined locations. Use complex load models.
Interpolation	Allows interpolation between calibration frequency points.
Adapter Removal Calibration	Characterizes and "removes" an adapter that is used during calibration that will not be used for subsequent device measurements; for accurate measurement of non-insertable devices.
Dispersion Compensation	Selectable as Coaxial, other non-dispersive (e.g., for coplanar waveguide), Waveguide, or Microstrip
Optical/Electrical Conversion	O/E & E/O O/E and E/O setup wizard is provided.
Embedding/De-embedding	The MS46524B is equipped with an Embedding/De-embedding system. De-embedding: De-embedding is generally used for removal of test fixture contributions, modeled networks, and other networks described by S-parameters (s2p files) from measurements. Embedding: Similarly, the Embedding function can be used to simulate matching circuits for optimizing amplifier designs or simply adding effects of a known structure to a measurement. Multiple Networks: Multiple networks can be embedded/de-embedded and changing the port and network orientations is handled easily. Extraction Utility: An extraction utility is part of this package that allows easier computation of de-embedding files based on additional calibration steps and measurements.
Impedance Conversion	Allows entry of different reference impedances (complex values) for different ports.

Power

Power Meter Correction	Different power meter calibrations are available to enhance power accuracy at the desired reference plane. The source power will match the target calibration power, as read by the power meter, to within ~0.1 dB for short periods of time (determined by thermal drift of the system and the power meter). The absolute accuracy of the calibrated power will be dependent on the power meter and sensor used.
Flat Power Calibrations	A flat power calibration (when in frequency sweep mode) is available at a user-selectable power level, if it is within the power adjustment range of the internal source. The flat power correction is applied to other power levels.
Linear Power Calibrations	A linear power calibration is performed over a range of power levels for use in power sweep mode and is performed at a specified frequency or frequency range.
External Power Meter	Both calibrations are performed using an external USB power sensor (Anritsu MA24106A, MA24108A, MA24118A, MA24126A, MA24330A, MA24340A, MA24350A) over a USB 2.0 port.

Optional Capabilities

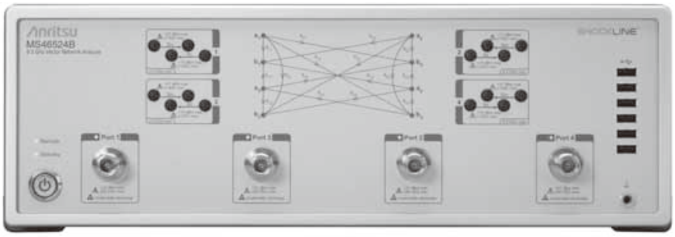
Time Domain Measurements, Option 2	Displays all S-parameters and overlays with Frequency Domain, Low-pass Mode with added harmonics frequency list flexibility, Band-pass Mode, Phasor Impulse Mode, Windowing, Gating (pass-band or reject-band), and Frequency with Time Gate.
Advanced Time Domain Measurements, Option 22	The ATD option has two basic elements. The first element is an Eye Diagram automatically created from a stored .SnP data file after launching the ADK software. The second element accesses the following functions: Check Passivity and Causality, Combine .SnP Files, Plot Eye Diagram, Plot Crosstalk, Plot TDT/TDR/Skew, and Perform Compliance Test. Option 2 recommended with Option 22, but is not required.

Remote Operability

ShockLine supports several remote operability options.

Communication Type	Data Format	Performance	Description
Via LAN	Using VXI-11 Protocol	Gigabit Data Transfer Speed	Use SCPI commands
Drivers for LAN	IVI-C drivers are available for download from the Anritsu website. The IVI-C package supports National Instruments LabVIEW and LabWindows, C#, .NET, MATLAB, and Python34 programming environments.		
Triggering	Start Trigger: Software and Digital Edge Input Range: +3.3 V logic level (+5 V tolerant) Minimum Trigger Width: 50 ns Trigger Delay: 6 µs (typ.)		

Front Panel Connections



MS46524B Front Panel (8.5 GHz model shown)

Test Ports 1 through 4	MS46524B-010: N (f) MS46524B-020: K (m) MS46524B-040: K (m) Damage Input Levels: +27 dBm max., 50 VDC max.
Ports 1 to 4 Access Loops (Only available with Option 10)	Source Path: K (f) Damage Input Levels: +27 dBm max., 0 VDC max. Required: Only available with frequency Option 10 Receiver path: K (f) Damage Input Levels: +15 dBm max., 0 VDC max. Required: Only available with frequency Option 10
USB Ports	Six type A USB 2.0 Ports for peripherals such as keyboard, mouse, memory stick, hardware key, and similar devices.
Chassis Grounding Port	Banana (f)

Rear Panel Connections

MS46524B Rear Panel

AC Power Input	AC Input connector, with On/Off switch, and fuses 350 VA maximum, 90 V(ac) to 264 V(ac) 47 Hz to 63 Hz (power factor controlled)
USB and LAN	USB Ports: Two type A USB 3.0 ports for peripherals such as keyboard, mouse, flashdrive, USB monitor, and hardware key. LAN Port: Gigabit Ethernet
HDMI Port	Video output, touchscreen compatible
Audio	External stereo speaker and microphone (3.5 mm)
10 MHz In	Signal presence is synchronized to and dependent upon the 10 MHz input signal. Connector Type: BNC (f) Signal: +0 dBm, typical; 50Ω, nominal
10 MHz Out	Signal presence is synchronized to and dependent upon the 10 MHz input signal Connector Type: BNC (f) Signal: +8 dBm, typical; 50Ω, nominal
External Trigger Input	Connector Type: BNC (f) Voltage Input: 0 to 3.3 V input (5 V tolerant) Impedance: High impedance (>100kΩ) Pulse Width: 50 ns minimum input pulse width Trigger Delay: 6 µs (typ.)
External Trigger Output	Connector type: BNC (f) Voltage Output: 0 to 3.3 V (HCMOS logic) Drive Current: 24 mA maximum Pulse Width: 1 µs (typ.)
Bias Inputs (Only available with Option 10)	Connector: BNC (f) (one input per port); 50 VDC max., 0.5 A max. Required: Only available with frequency Option 10

CPU, Memory and Security Features

CPU	Intel Core™ i5
Storage	Serial-ATA (SATA) Solid State Drive (SSD, removable), for OS, Programs, and Data. (>30 GB)
Security Features	If the VNA is attached to a network, best practices recommend installing anti-virus software.

Dimensions and Mass

Dimensions	Dimensions listed are for the instrument body only, without rack mount option attached. 445 (W) × 152 (H) × 442 (D) mm
Mass	<13.6 kg (<30 lb), typical weight for a fully-loaded MS46524B-010 VNA <15.9 kg (<35 lb), typical weight for a fully-loaded MS46524B-20 or MS46524B-040 VNA

Regulatory Compliance

CE	EEMC: 2014/30/EU, EN 61326:2013, CISPR 11/EN 55011, IEC/EN 61000-4-2/3/4/5/6/8/11 LVD: 2014/35/EU RoHS: 2011/65/EU applies to instruments with CE marking placed on the market after July 22, 2017
Australia and New Zealand	RCM AS/NZS 4417:2012
South Korea	KCC-REM-A21-0004

Environmental

MIL-PRF-28800F Class 3

Operating Temperature Range	0° to +50°C
Storage Temperature Range	–40° to +71°C
Maximum Relative Humidity	95% RH at +30°C, non-condensing
Vibration, Sinusoidal	5 Hz to 55 Hz
Vibration, Random	10 Hz to 500 Hz
Half Sine Shock	30 gn
Altitude	4600 meters, operating and non-operating

Warranty

Instrument and Built-In Options	3 years from the date of shipment (standard warranty)
Calibration Kits	Typically 1 year from the date of shipment
Test Port Cables	Typically 1 year from the date of shipment
Warranty Options	Additional warranty available

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main Frame
MS46524B	ShockLine 4-Port Vector Network Analyzer
	Required Options
MS46524B-010	50 kHz to 8.5 GHz, type N (f) ports
MS46524B-020	50 kHz to 20 GHz, type K (m) Ruggedized ports (compatible with 3.5 mm and SMA connectors)
MS46524B-040	50 kHz to 43.5 GHz, type K (m) Ruggedized ports (compatible with 3.5 mm and SMA connectors)
	Included Accessories
User Document	Each VNA comes with a power cord and instructions on where to download software and related literature.
	Main VNA Options
MS46524B-001	Rack Mount, adds handles and removes feet for shelf-mounting into a 19 inch universal rack
MS46524B-002	Time Domain with Time Gating
MS46524B-022	Advanced Time Domain
MS46524B-051	Access Loops (Only available with Option 10)
MS46524B-061	Bias Tee (Only available with Option 10)
	Calibration Options
MS46524B-098	Standard Calibration, ISO 17025 compliant, without data
MS46524B-099	Premium Calibration, ISO 17025 compliant, with data
	Precision Automatic Calibrator Modules
MN25408A	4-port USB SmartCal Module, 300 kHz to 8.5 GHz (available with connector Options -001 N (f), -002 K (f), -003 3.5 mm (f))
MN25218A	2-port USB SmartCal Module, 300 kHz to 20 GHz (available with connector Option -002 K (f))
MN25418A	4-port USB SmartCal Module, 300 kHz to 20 GHz (available with connector Option -002 K (f))
36585K-2M	K Connector Precision AutoCal Module, 70 kHz to 40 GHz, K (m) to K (m)
36585K-2F	K Connector Precision AutoCal Module, 70 kHz to 40 GHz, K (f) to K (f)
36585K-2MF	K Connector Precision AutoCal Module, 70 kHz to 40 GHz, K (m) to K (f)
2000-1809-R	Serial to USB Adapter (required for use with 36585 AutoCal module if control PC does not have a serial port)

Model/Order No.	Name
	Mechanical Calibration Kits
3650A	SMA/3.5 mm Calibration Kit, Without Sliding Loads, DC to 26.5 GHz, 50Ω
3650A-1	SMA/3.5 mm Calibration Kit, With Sliding Loads, DC to 26.5 GHz, 50Ω
3652A	K Connector Calibration Kit, Without Sliding Loads, DC to 40 GHz, 50Ω
3652A-1	K Connector Calibration Kit, With Sliding Loads, DC to 40 GHz, 50Ω
3653A	N Connector Calibration Kit, Without Sliding Loads, DC to 18 GHz, 50Ω
OSLN50A-8	Precision N Male Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50Ω
OSLNF50A-8	Precision N Female Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50Ω
TOSLN50A-8	Precision N Male Through/Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50Ω
TOSLNF50A-8	Precision N Female Through/Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50Ω
OSLN50A-18	Precision N Male Open/Short/Load Mechanical Calibration Tee, DC to 18 GHz, 50Ω
OSLNF50A-18	Precision N Female Open/Short/Load Mechanical Calibration Tee, DC to 18 GHz, 50Ω
TOSLN50A-18	Precision N Male Through/Open/Short/Load Mechanical Calibration Tee, DC to 18 GHz, 50Ω
TOSLNF50A-18	Precision N Female Through/Open/Short/Load Mechanical Calibration Tee, DC to 18 GHz, 50Ω
TOSLK50A-20	Precision K Male Through/Open/Short/Load Mechanical Calibration Tee, DC to 20 GHz, 50Ω
TOSLKF50A-20	Precision K Female Through/Open/Short/Load Mechanical Calibration Tee, DC to 20 GHz, 50Ω
TOSLK50A-40	Precision K Male Through/Open/Short/Load Mechanical Calibration Tee, DC to 40 GHz, 50Ω
TOSLKF50A-40	Precision K Female Through/Open/Short/Load Mechanical Calibration Tee, DC to 40 GHz, 50Ω

Continued on next page

Model/Order No.	Name
	USB Power Sensors
MA24106A	True-RMS USB Power Sensor, 50 MHz to 6 GHz
MA24108A	True-RMS USB Power Sensor, 10 MHz to 8 GHz
MA24118A	True-RMS USB Power Sensor, 10 MHz to 18 GHz
MA24126A	True-RMS USB Power Sensor, 10 MHz to 26 GHz
MA24330A	Microwave CW USB Power Sensor, 10 MHz to 33 GHz
MA24340A	Microwave CW USB Power Sensor, 10 MHz to 40 GHz
MA24350A	Microwave CW USB Power Sensor, 10 MHz to 50 GHz
	Verification Kits
3663-3	N Connector Verification Kit
3668-3	K Connector Verification Kit
	RF Cables and Adapters
N120-6	RF Cables, Semi-Rigid, N (m) to N (m), 1 each, 0.01 GHz to 18 GHz, 50Ω, 15 cm (5.9 in)
NS120MF-6	RF Cables, Semi-Rigid, N (f) to N (f), 1 each, 0.01 GHz to 18 GHz, 50Ω, 15 cm (5.9 in)
1091-26-R	SMA (m) to N (m), DC to 18 GHz, 50Ω
1091-27-R	SMA (f) to N (m), DC to 18 GHz, 50Ω
1091-80-R	SMA (m) to N (f), DC to 18 GHz, 50Ω
1091-81-R	SMA (f) to N (f), DC to 18 GHz, 50Ω
34NN50A	Precision Adapter, N (m) to N (m), DC to 18 GHz, 50Ω
34NFNF50	Precision Adapter, N (f) to N (f), DC to 18 GHz, 50Ω
34NK50	Precision Adapter, N (m) to K (m), DC to 18 GHz, 50Ω
34NKF50	Precision Adapter, N (m) to K (f), DC to 18 GHz, 50Ω
34NFK50	Precision Adapter, N (f) to K (m), DC to 18 GHz, 50Ω
34NFKF50	Precision Adapter, N (f) to K (f), DC to 18 GHz, 50Ω
K220B	Precision Adapter, K (m) to K (m), DC to 40 GHz, 50Ω
K222B	Precision Adapter, K (f) to K (f), DC to 40 GHz, 50Ω
K224B	Precision Adapter, K (m) to K (f), DC to 40 GHz, 50Ω
SC7260	WR12 to W1 (m) Adapter, W1 (1 mm) to WR12 Waveguide
SC7442	WR12 to W1 (f) Adapter, W1 (1 mm) to WR12 Waveguide
35WR12WF-EE	Precision Waveguide to Coax Adapter Kit, 56 GHz to 94 GHz, WR-12 to 1.0 mm (f)
	Test Port Cables, Flexible, Ruggedized, Phase Stable
15NNF50-1.0B	Test Port Cable, Flexible, Phase Stable, N (f) to N (m), 1.0 m, 50Ω
15NNF50-1.5B	Test Port Cable, Flexible, Phase Stable, N (f) to N (m), 1.5 m, 50Ω
15NN50-1.0B	Test Port Cable, Flexible, Phase Stable, N (m) to N (m), 1.0 m, 50Ω
15LL50-1.0A	Test Port Cable, Armored, Phase Stable, DC to 20 GHz, 3.5 mm (m) to 3.5 mm (m), 1.0 m, 50Ω
15LLF50-1.0A	Test Port Cable, Armored, Phase Stable, DC to 20 GHz, 3.5 mm (m) to 3.5 mm (f), 1.0 m, 50Ω
15KK50-1.0A	Test Port Cable, Armored, Phase Stable, DC to 20 GHz, K (m) to K (m), 1.0 m, 50Ω
15KKF50-1.0A	Test Port Cable, Armored, Phase Stable, DC to 20 GHz, K (m) to K (f), 1.0 m, 50Ω
3671KFS50-60	Test Port Cable, Flexible, Phase Stable, DC to 26.5 GHz, K (f) to 3.5 mm (m), 63.5 cm, 50Ω
3671KFK50-60	Test Port Cable, Flexible, Phase Stable, DC to 40 GHz, K (f) to K (m), 63.5 cm (25 in), 50Ω
3671KFKF50-60	Test Port Cable, Flexible, Phase Stable, DC to 40 GHz, K (f) to K (f), 63.5 cm (25 in), 50Ω
3671KFK50-100	Test Port Cable, Flexible, Phase Stable, DC to 40 GHz, K (f) to K (m), 1 m (38 in), 50Ω

Model/Order No.	Name
	Phase-Stable 18 GHz and 40 GHz Semi-Rigid Cables (Armored)
3670K50-1	0.3 m (12”), DC to 40 GHz, K (f) to K (m), 50Ω
3670K50-2	0.6 m (24”), DC to 40 GHz, K (f) to K (m), 50Ω
3670N50-1	0.3 m (12”), DC to 18 GHz, N (f) to N (m), 50Ω
3670NN50-1	0.3 m (12”), DC to 18 GHz, N (m) to N (m), 50Ω
3670N50-2	0.6 m (24”), DC to 18 GHz, N (f) to N (m), 50Ω
3670NN50-2	0.6 m (24”), DC to 18 GHz, N (m) to N (m), 50Ω
	Tools
01-200	Calibrated Torque End Wrench, GPC-7 and Type N
01-201	Torque End Wrench, 5/16 in, 0.9 N·m (8 lbf·in) For tightening male devices, for SMA, 3.5 mm, 2.4 mm, K, and V connectors
01-204	End Wrench, 5/16 in, Universal, Circular, Open-ended, For SMA, 3.5 mm, 2.4 mm, K and V connectors
More Information	Refer to our Precision RF & Microwave Components Catalog for descriptions of adapters and other components.
	Documentation
User Documentation	Soft copies of the manuals as Adobe Acrobat PDF files are available for download from the instrument model web page at www.anritsu.com. For more information and product support, please contact ShockLineVNA.support@Anritsu.com.
10100-00067	Product information, compliance, and safety
10410-00743	MS46522B/524B VNA Operation Manual
10410-00744	MS46522B/524B VNA User Interface Reference Manual
10410-00746	ShockLine Series VNA Programming Manual, for IEEE 488.2 and SCPI Commands
10410-00753	MS46522B/524B VNA Calibration and Measurement Guide

VNA Master

MS2026C/MS2036C/MS2027C/MS2037C/MS2028C/MS2038C

5 kHz to 6 GHz	5 kHz to 6 GHz	5 kHz to 15 GHz	5 kHz to 15 GHz	5 kHz to 20 GHz	5 kHz to 20 GHz
	9 kHz to 9 GHz		9 kHz to 15 GHz		9 kHz to 20 GHz

Remote Control
GPIB | **Ethernet**

The Ultimate Handheld Vector Network + Spectrum Analyzer for Cable, Antenna and Signal Analysis Anytime, Anywhere

High Performance Handheld S-Parameters

Anritsu introduces the MS202xC/3xC VNA Master + Spectrum Analyzer, the industry's broadest frequency handheld solution to address cable, antenna, component and signal analysis needs in the field: with frequency coverage from 5 kHz up to 20 GHz. Equally impressive, this broadband measurement tool offers the industry's first 12-term error correction algorithm in a truly handheld, battery-operated, rugged multi-function instrument. Optional Time Domain with Low Pass Step response and Real Impedance graph delivers standard TDR-type display results. Time Domain also includes a standard gating function.

The MS203xC models include a powerful spectrum analyzer that enhances user convenience by combining spectrum analysis with the VNA into a single measurement powerhouse for the harsh RF and physical environments of field test. Whether it is for spectrum monitoring, broadcast proofing, interference analysis, RF and microwave measurements, regulatory compliance, or 3G/4G and wireless data network measurements, this VNA/Spectrum Analyzer combination is the ideal instrument for making fast and reliable measurements in the field.

Performance and Functional Highlights

VNA Master

- Broadband coverage of 5 kHz up to 20 GHz
- True 2-port, 2-path Vector Network Analyzer
- Ultimate accuracy with 12-term error correction
- High performance handheld S-parameters
- User-defined Quad Display for viewing all 4 S-Parameters
- Arbitrary data points up to 4001
- IF Bandwidth selections of 10 Hz to 100 kHz
- Directivity:
  >42 dB up to 6 GHz (all models)
  >36 dB > 6 GHz up to 20 GHz (all models)
- Supports Reciprocal Through Calibration types (SOLR, SSLR, SSSR)
- All models support waveguide measurements
- 350 µs/data point sweep speed
- USB/Ethernet for PC data transfer and control
- Automate repetitive tasks via Ethernet & USB
- Field upgradable firmware
- Operation to +55°C: full performance on AC or battery
- Store more than 4000 traces and setups in memory
- Portable: 4.5 kg/4.8 kg (9.9 lb/10.5 lb)
- Time Domain (with gating) option
- Internal Bias Tee option
- Vector Voltmeter option
- High Accuracy Power Meter option
- Differential option (S_{d1d1}, S_{c1c1}, S_{d1c1} and S_{c1d1})
- Secure Data Operation option for safe use in high security environments
- GPS Receiver option
- Low Pass Stepped Response and Real Impedance graph type provide TDR functionality (standard capability with Time Domain option)
- Multiple display formats including Polar and Real Impedance
- Supports Anritsu USB Power Sensors
- 8.4 in, 800 × 600 high resolution, daylight-viewable TFT color display
- Complies with MIL-PRF-28800F Class 2, Certified for use in Explosive Atmosphere per MIL-PRF-28800F and MIL-STD-810G

Spectrum Analyzer Performance and Functional Highlights (MS203xC Models Only)

- Measure: Occupied Bandwidth, Channel Power, ACPR, C/I
- Dynamic Range: >106 dB in 1 Hz RBW
- DANL: –164 dBm in 1 Hz RBW
- Phase Noise: –106 dBc/Hz @ 10 kHz offset at 1 GHz
- GPS-Enhanced Frequency Accuracy: <±25 ppb with GPS On and locked. GPS-Enhanced Frequency Accuracy is retained after GPS unlock at <50 ppb for 72 hours, 0° to 50°C
- 1 Hz to 10 MHz Resolution Bandwidth (RBW)
- Traces: Normal, Max Hold, Min Hold, Average, # of Averages
- Detectors: Peak, Negative, Sample, Quasi-peak, and true RMS
- Markers: 6, each with a Delta Marker, or 1 Reference with 6 Deltas
- Limit Lines: up to 40 segments with one-button envelope creation
- Trace Save-on-Event: crossing limit line or sweep complete
- Option to automatically optimize sweep-RBW-VBW trade-off for best possible display
- Interference Analyzer Option: Spectrogram, Signal Strength, RSSI
- Standard Burst Detect: 1000X faster sweep with spans up to 15 MHz. Captures intermittent signals as narrow as 200 µs every time
- GPS tagging of stored traces
- Internal Preamplifier standard
- High Accuracy Power Meter Option
- AM/FM/SSB Demodulation (audio only)
- Optional AM/FM/PM Analyzer
- Optional Coverage Mapping
- Optional Channel Scanner

VNA Master Functional Specifications

Definitions

- All specifications and characteristics apply to Revision 2 instruments under the following conditions, unless otherwise stated:
- Warm-up time — After 15 minutes of warm-up time in VNA mode, where the instrument is left in the ON state.
- Temperature range is 23° ±5°C.
- Reference Signal — When using internal reference signal.
- Spectrum Analyzer — After 5 minutes of warm-up time, where the instrument is left in the ON state and Sweep Mode set to Performance.
- Typical Performance — Typical specifications that are not in parenthesis are not tested and not warranted. They are generally representative of characteristic performance. Typical specifications in parenthesis ( ) represent the mean value of measured units and do not include any guard-bands or uncertainties. They are not warranted.
- Uncertainty — A coverage factor of x1 is applied to the "VNA" or "corrected system" measurement uncertainties to facilitate comparison with other industry handheld analyzers.
- Calibration Cycle — Calibration is within the recommended 12 month period (residual specifications also require calibration kit calibration cycle adherence.)

All specifications subject to change without notice.
For the most current data sheet, please visit the Anritsu website:
www.anritsu.com

Frequency

VNA Master Frequency Range	MS2026C/36C	MS2027C/37C	MS2028C/38C
	5 kHz to 6 GHz	5 kHz to 15 GHz	5 kHz to 20 GHz
Frequency Accuracy	±1.5 ppm		
Frequency Resolution	1 Hz to 375 MHz, 10 Hz to 6 GHz, and 100 Hz to 20 GHz		

Test Port Power

VNA Master supports selection of either High (default) or Low test port power. Changing power after calibration can degrade the calibrated performance. Typical power by bands is shown in the following table.

Frequency Range	High Port Power	Low Port Power
5 kHz to 3 GHz	+3 dBm	–25 dBm
>3 GHz to 6 GHz	–3 dBm	–25 dBm
>6 GHz to 20 GHz	–3 dBm	–15 dBm

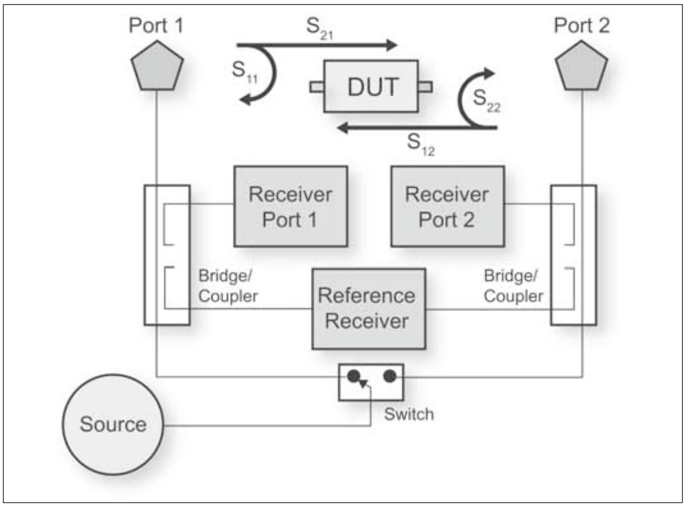
Transmission Dynamic Range

The transmission dynamic range (the difference between test port power and noise floor) using 10 Hz IF Bandwidth and High Port Power is shown in the following table.

Frequency Range	Dynamic Range
5 kHz to 2 MHz	85 dB
>2 MHz to 3 GHz	100 dB
>3 GHz to 6 GHz	90 dB
>6 GHz to 20 GHz	85 dB

Block Diagram

As shown in the following block diagram, the VNA Master has a 2-port, 2-path architecture that automatically measures four S-parameters with a single connection.



The above illustration is a simplified block diagram of VNA Master's 2-port, 2-path architecture.

Sweep Speed

The typical sweep speed in µs/point for IF Bandwidth of 100 kHz, 1001 data points, and single display is shown for the following frequencies. The three receiver architecture will simultaneously collect S_{21} and S_{11} (or S_{12} and S_{22}) in a single sweep.

Frequency Range	Typical Sweep Speed
5 kHz to 6 GHz	350 µs/point
>6 GHz to 20 GHz	650 µs/point

High-Level Noise

S_{11} or S_{22}, Short, Power = High, IFBW = 200 Hz (typ.)

Frequency Range	Magnitude	Phase
5 kHz to 6 GHz	0.004 dB (rms)	0.040 deg
>6 GHz to 20 GHz	0.010 dB (rms)	0.050 deg

Noise Floor

10 Hz IFBW

Frequency Range	Noise Floor
5 kHz to 2 MHz	–85 dBm (typ.)
>2 MHz to 3 GHz	–100 dBm (typ.)
>3 GHz to 6 GHz	–96 dBm (typ.)
>6 GHz to 20 GHz	–91 dBm (typ.)

Temperature Stability

S_{11} or S_{22}, Short, 23° ± 5°C (typ.)

Frequency Range	Magnitude	Phase
5 kHz to 10 GHz	0.018 dB/°C	0.160 deg/°C
>10 GHz to 20 GHz	0.070 dB/°C	0.800 deg/°C

Corrected System Performance and Uncertainties — High Port Power

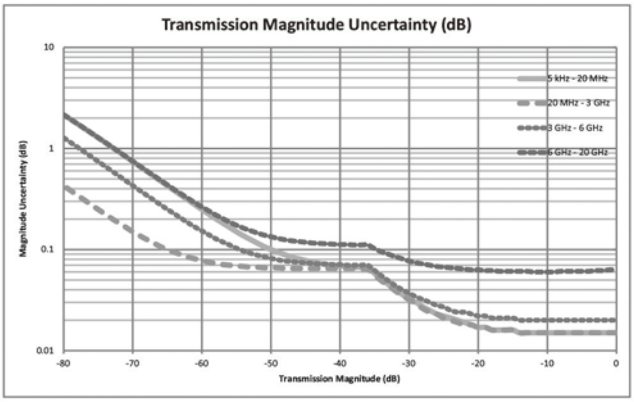
Measurement Accuracy (OSLN50A-18 or TOSLN50A-18)

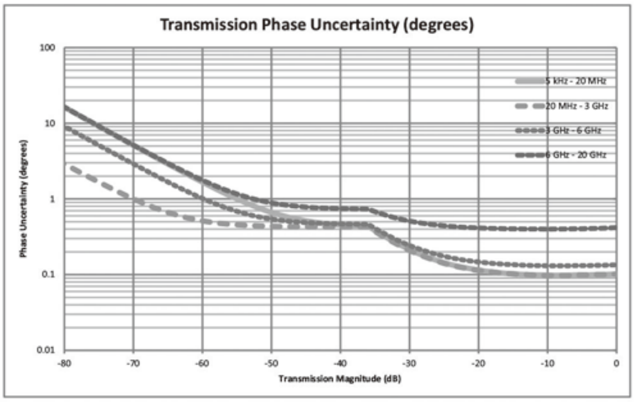
Full 2-Port calibration, Default Power, 10 Hz IFBW, No averaging, 10 minute warm-up. OSLN50A-18 or TOSLN50A-18 calibration kit.
Load match specification applicable directly at corrected port only. De-rate by approximately 8 dB if using a 3670 series test port cable.
Reflection and Transmission Tracking are typical.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
5 kHz to 20 MHz	≥42	≥30	≥42	±0.02	±0.01
>20 MHz to 3 GHz	≥42	≥30	≥42	±0.07	±0.01
>3 GHz to 6 GHz	≥42	≥30	≥42	±0.05	±0.02
>6 GHz to 20 GHz*	≥33	≥24	≥33	±0.2	±0.1

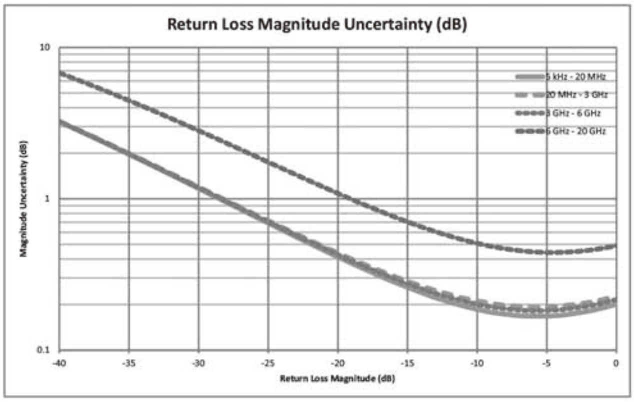
*: Specified only to 18 GHz, typical above 18 GHz.

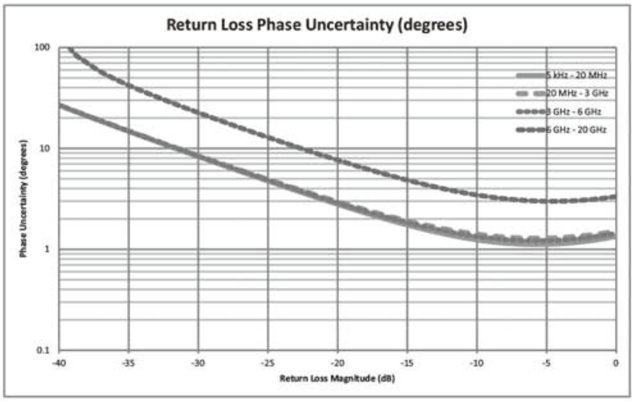
Transmission Uncertainty (S_{21}, S_{12})*


Transmission Magnitude Uncertainty (dB)


Transmission Phase Uncertainty (degrees)

Reflection Uncertainty (S_{11}, S_{22})*


Return Loss Magnitude Uncertainty (dB)


Return Loss Phase Uncertainty (degrees)

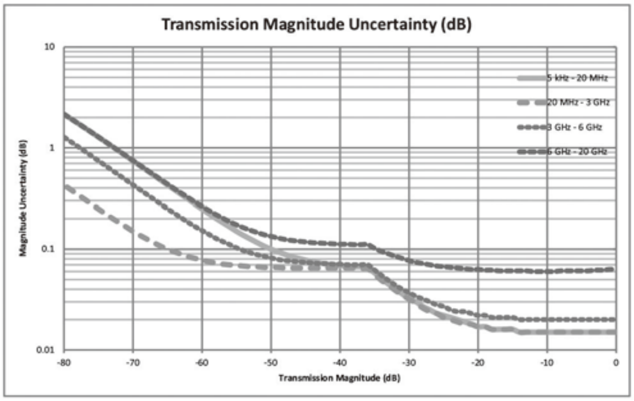
Measurement Accuracy (OSLNF50A-18 or TOSLNF50A-18)

Full 2-Port calibration, Default Power, 10 Hz IFBW, No averaging, 10 minute warm-up. OSLNF50A-18 or TOSLNF50A-18 calibration kit.
Load match specification applicable directly at corrected port only. De-rate by approximately 8 dB if using a 3670 series test port cable.
Reflection and Transmission Tracking are typical.

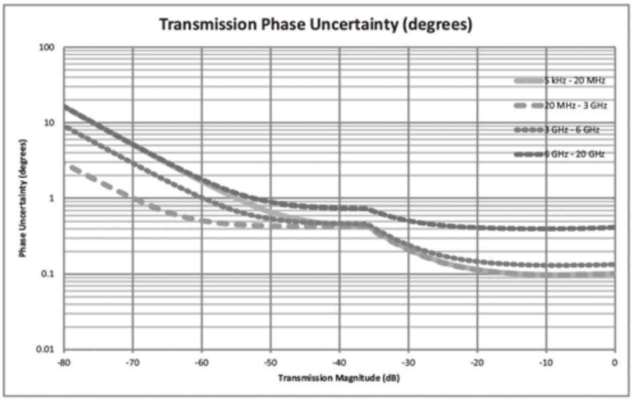
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
5 kHz to 20 MHz	≥42	≥30	≥42	±0.02	±0.01
>20 MHz to 3 GHz	≥42	≥30	≥42	±0.07	±0.01
>3 GHz to 6 GHz	≥42	≥30	≥42	±0.05	±0.02
>6 GHz to 20 GHz*	≥33	≥24	≥33	±0.2	±0.1

*: Specified only to 18 GHz, typical above 18 GHz.

Transmission Uncertainty (S_{21}, S_{12})*

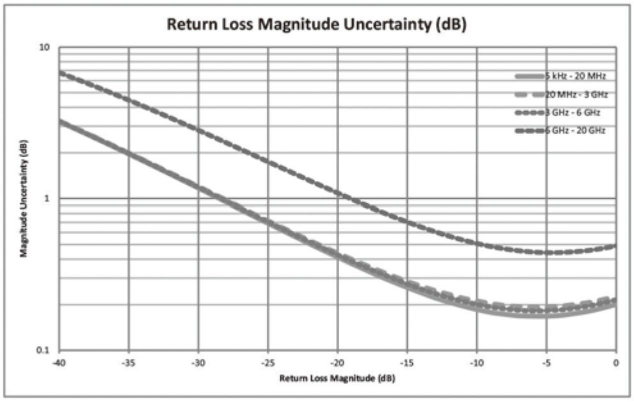


Transmission Magnitude Uncertainty (dB)

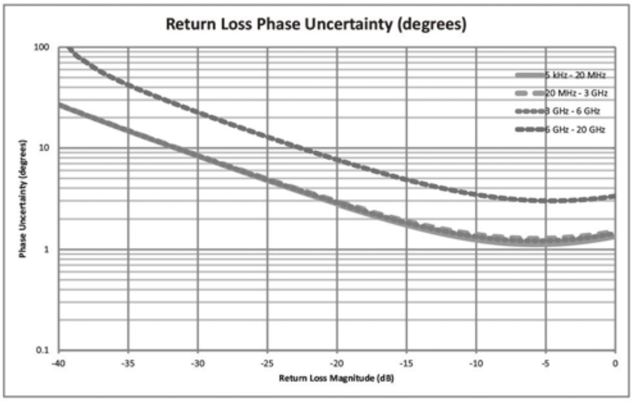


Transmission Phase Uncertainty (degrees)

Reflection Uncertainty (S_{11}, S_{22})*



Return Loss Magnitude Uncertainty (dB)



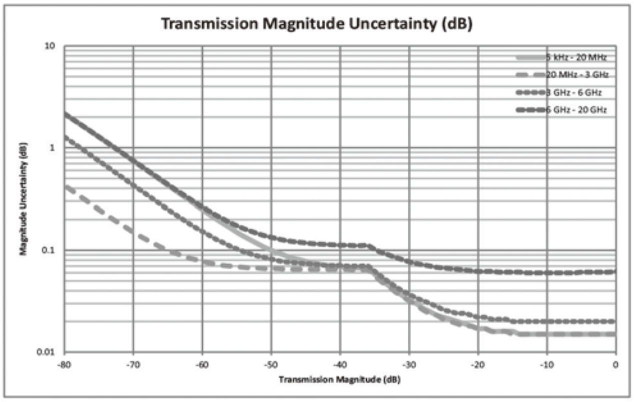
Return Loss Phase Uncertainty (degrees)

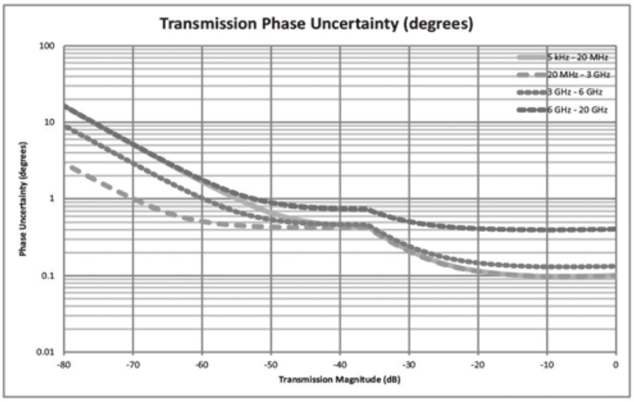
Measurement Accuracy (TOSLK50A-20 or TOSLK50A-40)

Full 2-Port calibration, Default Power, 10 Hz IFBW, No averaging, 10 minute warm-up. TOSLK50A-20 or TOSLK50A-40 calibration kit.
Load match specification applicable directly at corrected port only. De-rate by approximately 8 dB if using a 3670 series test port cable.
Reflection and Transmission Tracking are typical.

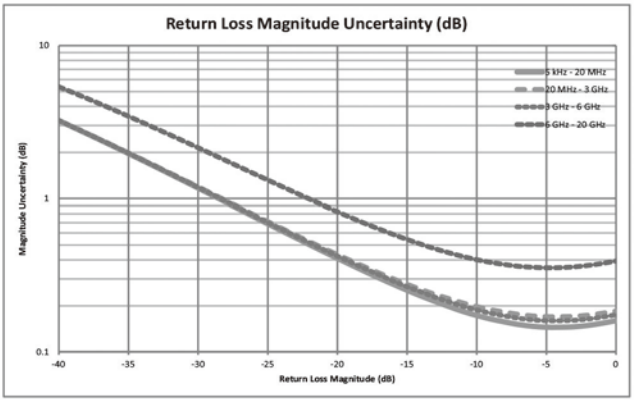
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
5 kHz to 20 MHz	≥42	≥33	≥42	±0.02	±0.01
>20 MHz to 3 GHz	≥42	≥33	≥42	±0.07	±0.01
>3 GHz to 6 GHz	≥42	≥33	≥42	±0.05	±0.02
>6 GHz to 20 GHz	≥36	≥26.5	≥36	±0.2	±0.1

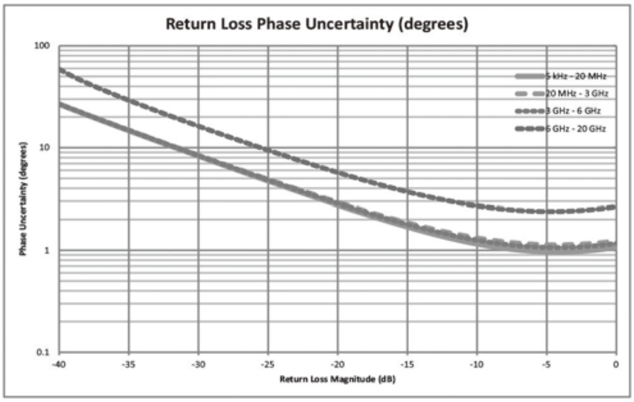
Transmission Uncertainty (S_{21}, S_{12})


Transmission Magnitude Uncertainty (dB)


Transmission Phase Uncertainty (degrees)

Reflection Uncertainty (S_{11}, S_{22})


Return Loss Magnitude Uncertainty (dB)

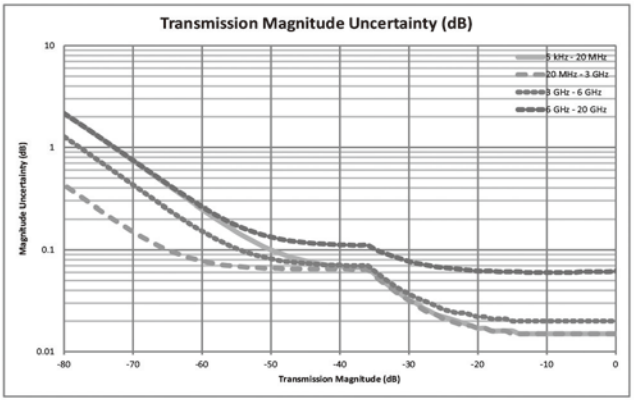

Return Loss Phase Uncertainty (degrees)

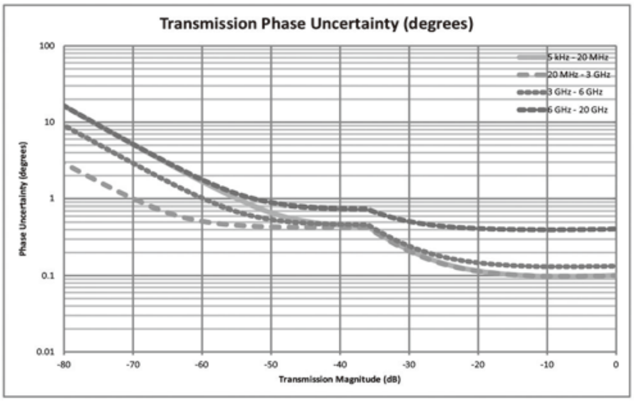
Measurement Accuracy (TOSLKF50A-20 or TOSLKF50A-40)

Full 2-Port calibration, Default Power, 10 Hz IFBW, No averaging, 10 minute warm-up. TOSLKF50A-20 or TOSLKF50A-40 calibration kit.
Load match specification applicable directly at corrected port only. De-rate by approximately 8 dB if using a 3670 series test port cable.
Reflection and Transmission Tracking are typical.

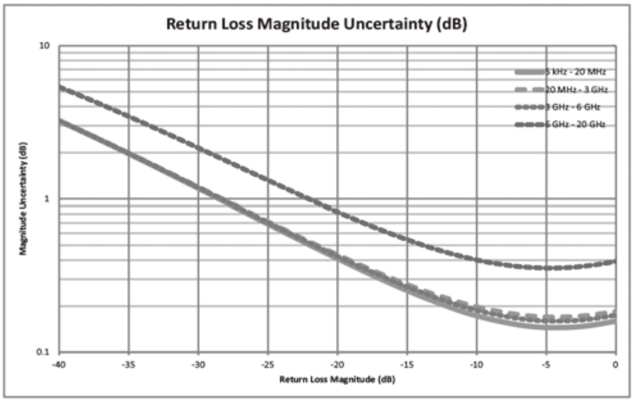
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
5 kHz to 20 MHz	≥42	≥33	≥42	±0.02	±0.01
>20 MHz to 3 GHz	≥42	≥33	≥42	±0.07	±0.01
>3 GHz to 6 GHz	≥42	≥33	≥42	±0.05	±0.02
>6 GHz to 20 GHz	≥36	≥26.5	≥36	±0.2	±0.1

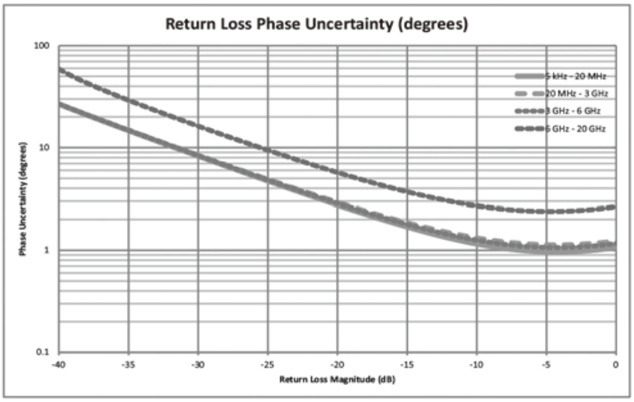
Transmission Uncertainty (S_{21}, S_{12})


Transmission Magnitude Uncertainty (dB)


Transmission Phase Uncertainty (degrees)

Reflection Uncertainty (S_{11}, S_{22})


Return Loss Magnitude Uncertainty (dB)


Return Loss Phase Uncertainty (degrees)

VNA Functional Specifications

Measurement Parameters	S_{11}, S_{21}, S_{22}, S_{12}, (optionally: S_{d1d1}, S_{c1c1}, S_{d1c1}, S_{c1d1})
Number of Traces	Four: TR1, TR2, TR3, TR4
Trace Format	Single, Dual, Tri, Quad, with Trace overlay capabilities
Graph Types	Log Magnitude, SWR, Phase, Real, Imaginary, Group Delay, Smith Chart, Inverted Smith Chart (Admittance), Log Mag/2 (1-Port Cable Loss), Linear Polar, Log Polar, Real Impedance, Imaginary Impedance
Domains	Frequency Domain, Distance Domain, Time Domain with gating (Time Domain optional)
Frequency	Start Frequency, Stop Frequency, Center Frequency, Span
Distance	Start Distance, Stop Distance
Time	Start Time, Stop Time
Frequency Sweep Type: Linear	Single Sweep, Continuous
Data Points	2 to 4001 (arbitrary setting); data points can be reduced without recalibration.
Limit Lines	Upper, Lower, 10-segmented Upper, 10-segmented Lower
Test Limits	Pass/Fail for Upper, Pass/Fail for Lower, Limit Audible Alarm
Data Averaging	Sweep-by-sweep
Smoothing	0 to 20%
IF Bandwidth	10, 20, 50, 100, 200, 500 Hz, 1, 2, 5, 10, 20, 50, 100 kHz
Reference Plane	The reference planes of a calibration (or other normalization) can be changed by entering a line length. Assumes no loss, flat magnitude, linear phase,and constant impedance.

Continued on next page

Auto Reference Plane Extension	Instead of manually entering a line length, this feature automatically adjusts phase shift from the current calibration (or other normalization) to compensate for external cables (or test fixtures). Assumes no loss, flat magnitude, linear phase, and constant impedance.
Group Delay Aperture	Defined as the frequency span over which the phase change is computed at a given frequency point. The aperture can be changed without recalibration. The minimum aperture is the frequency range divided by the number of points in calibration and can be increased to 20% of the frequency range.
Trace Memory	A separate memory for each trace can be used to store measurement data for later display. The trace data can be saved and recalled.
Trace Math	Complex trace math operations of subtraction, addition, multiplication, or division are provided.
Number of Markers	Twelve, arbitrary assignments to any trace
Marker Types	Reference, Delta
Marker Readout Styles	Log Mag, Cable Loss (Log Mag/2), Log Mag and Phase, Phase, Real and Imaginary, SWR, Impedance, Admittance, Normalized Impedance, Normalized Admittance, Polar Impedance, Group Delay, Linear Mag, Linear Mag and Phase
Marker Search	Peak Search, Valley Search, Find Marker Value
Correction Models	Full 2-Port, Full S_{11}, Full S_{22}, Full S_{11} & S_{22}, Response S_{21}, Response S_{12}, Response S_{21} & S_{12}, Response S_{11}, Response S_{22}, Response S_{11} & S_{22}, One-Path Two-Port (S_{11}, S_{21}), One-Path Two-Port (S_{22}, S_{12})
Calibration Types	Flex, Standard
Calibration Methods	Short-Open-Load-Through (SOLT), Offset-Short (SSLT), and Triple-Offset-Short (SSST), Short-Open-Load-Reciprocal (SOLR), Double-Offset-Short-Load-Reciprocal (SSLR), Triple-Offset-Short-Reciprocal (SSSR)
Calibration Standard Coefficients	Coax: N-Connector, K-Connector, 7/16, TNC, SMA, and four User Defined coax types Waveguide: WG11A, WG12, WG13, WG14, WG15, WG16, WG17, WG18, WG20, and four User Defined rectangular waveguide types
Cal Correction Toggle	On/Off
Interpolation	On/Off
Dispersion Compensation	Waveguide correction that improves accuracy of distance-to-fault data by compensating for different wavelengths propagating at different speeds.
Impedance Conversion	Support for 50Ω and 75Ω are provided.
Units	Meters, Feet
Bias Tee Settings	Internal, External, Off
Timebase Reference	Internal, External
File Storage Types	Measurement (.mna), Setup (.stp, with or without CAL), S2P (Real/Imag), S2P (Lin Mag/Phase), S2P (Log Mag/Phase), Text (VNA Only), CSV (VNA Only), JPEG
Ethernet Configuration	DHCP or Manual (Static) IP configuration, 10/100 Base-T, RJ45 jack
Languages	English, French, German, Spanish, Chinese, Japanese, Korean, Italian, Russian, Portuguese

Measurement Options Specifications

Distance Domain (formerly Option 501, now standard with firmware revision v1.16 or higher)

Distance Domain Analysis is a powerful field test tool to analyze cables for faults, including minor discontinuities that may occur due to a loose connection, corrosion, or other aging effects. By using Frequency Domain Reflectometry (FDR), the VNA Master exploits a user-specified band of full power operational frequencies (instead of DC pulses from TDR approaches) to more precisely identify cable discontinuities. The VNA Master converts S-parameters from frequency domain into distance domain on the horizontal display axis, using a mathematical computation called Inverse Fourier Transform. Connect a reflection at the opposite end of the cable, and the discontinuities appear versus distance to reveal any potential maintenance issues. When access to both ends of the cable is convenient, a similar distance domain analysis is available on transmission measurements.

Distance Domain will improve your productivity with displays of the cable in terms of discontinuities versus distance. This readout can then be compared against previous measurements (from stored data) to determine whether any degradations have occurred since installation (or the last maintenance activity). More importantly, you will know precisely where to go to fix the problem and so minimize or prevent downtime of the system.

Round-Trip (reflection) Fault Resolution (meters)	(0.5 × c × Vp)/ΔF; (c is speed of light = 299,792,458 m/s, ΔF is F2 – F1 in Hz)
One-Way (transmission) Fault Resolution (meters)	(c × Vp)/ΔF; (c is speed of light = 299,792,458 m/s, ΔF is F2 – F1 in Hz)
Horizontal Range (meters)	0 to (data points – 1) × Fault Resolution to a maximum of 3000 m (9843 ft.)
Windowing	Rectangular, Nominal Side Lobe (NSL), Low Side Lobe (LSL), and Minimum Side Lobe (MSL)

Time Domain (Option 2) (includes Distance Domain)

The VNA Master can display the S-parameter measurements in the time or distance domain using lowpass or bandpass processing analysis modes. The broadband frequency coverage coupled with 4001 data points means you can measure discontinuities both near and far with unprecedented clarity for a handheld tool. With this option, you can simultaneously view S-parameters in frequency, time, and distance domain to quickly identify faults in the field. Advanced features available with this option include step response, phasor impulse, gating, and frequency gated in time. The option includes computational routines that further enhance the Distance Domain results by compensating for cable loss, relative velocity of propagation, and dispersion compensation in waveguide. See the Distance Domain Specifications above.

Option Comparison Table (Distance Domain and Time Domain)

Measurement	Distance Domain (formerly Option 501)	Option 2 Time Domain
Distance-to-Fault	×	×
Distance Domain Display	×	×
Windowing	×	×
Distance of Waveguide		×
Time Domain Display		×
One Way vs. Round Trip Reflection		×
Phasor Impulse		×
Impulse Response		×
Step Response		×
Low Pass vs. Bandpass		×
Frequency Gated by Time		×
Frequency Gated by Distance		×

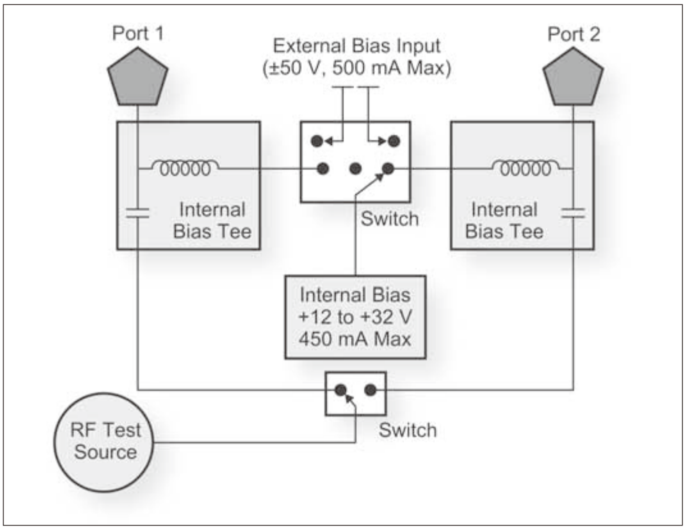
Secure Data Operation (Option 7)

For highly secure data handling requirements, this software option prevents the storing of measurement setup or data information onto any internal file storage location. Instead, setup and measurement information is stored ONLY to the external USB memory location.
A simple factory preset prepares the VNA Master for transportation while the USB memory remains behind in the secure environment.
The VNA Master cannot be switched between secure and non-secure operation by the user once configured for secure data operation.
With this option enabled, the user can also choose to blank the frequency values displayed on the screen.

Bias Tee (Option 10)

For tower mounted amplifier tests, the MS202xC/3xC series with optional internal bias tees can supply both DC and RF signals on the center conductor of the cable during measurements. For frequency sweeps in excess of 2 MHz, the VNA Master can supply internal voltage control from +12 V to +32 V in 0.1 V steps up to 450 mA.
To extend battery life, an external power supply can substitute for the internal supply by using the included external bias ports.
Both test ports can be configured to supply voltage via this integrated bias tees option. Bias can be directed to VNA Port 1 or Port 2.
The VNA Master offers optional integrated bias tee for supplying DC plus RF to the DUT as shown in the simplified block diagram.
Connectivity is also provided for external supply (instead of internal) to preserve battery consumption.

Frequency Range	2 MHz to 6 GHz (MS20x6C) 2 MHz to 15 GHz (MS20x7C) 2 MHz to 20 GHz (MS20x8C)
Internal Voltage/Current	+12 V to +32 V at 450 mA steady rate
Internal Resolution	0.1 V
External Voltage/Current	±50 V at 500 mA steady rate
Bias Tee Selections	Internal, External, Off



Vector Voltmeter (Option 15)

A phased array system relies on phase matched cables for nominal performance. For this class of application, the VNA Master offers this special software mode to simplify phase matching cables at a single frequency. The similarity between the popular vector voltmeter and this software mode ensures minimal training is required to phase match cables. Operation is as simple as configuring the display for absolute or relative measurements.
The easy-to-read large fonts show either reflection or transmission measurements using impedance, magnitude, or VSWR readouts. For instrument landing system (ILS) or VHF Omni-directional Range (VOR) applications, a table view improves operator efficiency when phase matching up to twelve cables. The MS202xC/3xC solution is superior because the signal source is included internally, precluding the need for an external signal generator.

CW Frequency Range	5 kHz to 6 GHz (MS20x6C) 5 kHz to 15 GHz (MS20x7C) 5 kHz to 20 GHz (MS20x8C)
Measurement Display	CW, Table (Twelve Entries, Plus Reference)
Measurement Types	Return Loss, Insertion
Measurement Format	dB/VSWR/Impedance

Spectrum Analyzer Performance Specifications (MS203xC only)

Measurements	Field Strength	dBm/m^2, dBV/m, dBmV/m, dBµV/m, V/m, Watt/m^2, dBW/m^2, A/m, dBA/m, or Watt/cm^2
	Occupied Bandwidth	Measures 99 % to 1 % power channel of a signal, or N dB from center of signal
	Channel Power	Measures the total power in a specified bandwidth
	ACPR	Adjacent channel power ratio
	Emission Mask	Recall limit lines as emission mask
	Spurious Emissions	Measures up to 32 segments with independent setups and limits
	C/I	Carrier-to-interference ratio
	AM/FM/SSB Demodulation	AM, wide/narrow FM, upper/lower SSB (audio only)
Setup Parameters	Frequency	Center/Start/Stop, Span, Frequency Step, Signal Standard, Channel #, Channel Increment
	Amplitude	Reference Level (RL), Scale, Attenuation Auto/Level, RL Offset, Units (dBm, dBV, dBmV, dBµV, Volt, Watt, dBW, A, dBA), Pre-Amp On/Off, Detection (Peak, RMS/Avg, Negative Peak, Sample, Quasi-Peak)
	Span	Span, Span Up/Down (1-2-5), Full Span, Zero Span, Last Span
	Bandwidth	RBW, Auto RBW, VBW, Auto VBW, VBW/Avg Type (Linear, Log), RBW/VBW Ratio, Span/RBW Ratio
	Impedance	50Ω, 75Ω; external pad required for 75Ω operation
Sweep Functions	Sweep	Single/Continuous, Sweep Time
	Sweep Mode	Fast (up to 100x faster than Performance), Performance, No FFT, Burst Detect (1000x Fast in 15 MHz span)
	Triggers	Free Run, External, Video, IF Power, Force Trigger Once
	Trigger Parameters	Delay, Level, Slope, Hysteresis, Holdoff (availability varies with trigger)
Trace Functions	Traces	Up to three Traces (A, B, C), View/Blank, Write/Hold, Trace A/B/C Operations
	Trace A Operations	Normal, Max Hold, Min Hold, Average, # of Averages, (always the live trace)
	Trace B Operations	A → B, B ↔ C, Max Hold, Min Hold
	Trace C Operations	A → C, B ↔ C, Max Hold, Min Hold, A – B → C, B – A → C, Relative Reference (dB), Scale
Marker Functions	Markers	Markers 1-6 each with a Delta Marker, or Marker 1 Reference with Six Delta Markers, Marker Table (On/Off/Large), All Markers Off
	Marker Types	Style (Fixed/Tracking), Noise Marker, Frequency Counter Marker
	Marker Auto-Position	Peak Search, Next Peak (Right/Left), Peak Threshold %, Set Marker to Channel, Marker Frequency to Center, Delta Marker to Span, Marker to Reference Level
	Marker Table	1-6 markers frequency and amplitude plus delta markers frequency offset and amplitude
Limit Line Functions	Available Spans	>0 Hz
	Limit Lines	Upper/Lower, On/Off, Edit, Move, Envelope, Advanced, Limit Alarm, Default Limit
	Limit Line Edit	Frequency, Amplitude, Add Point, Add Vertical, Delete Point, Next Point Left/Right
	Limit Line Move	To Current Center Frequency, By dB or Hz, To Marker 1, Offset from Marker 1
	Limit Line Envelope	Create Envelope, Update Amplitude, Number of Points (2 to 41), Offset, Shape Square/Slope
	Limit Line Advanced	Type (Absolute/Relative), Mirror, Save/Recall
	Save on Event	When Limit Crossed
Frequency	Frequency Range	(usable to 0 Hz) MS2036C: 9 kHz to 9 GHz MS2037C: 9 kHz to 15 GHz MS2038C: 9 kHz to 20 GHz
	Tuning Resolution	1 Hz
	Frequency Reference	Aging: ± 1.0 × 10^{-6} per year for 10 years Accuracy: ± 0.3 × 10^{-6} (25° ±25°C) plus aging (see Option 31 for improved frequency reference aging and accuracy)
	External Frequency Reference	1, 1.2288, 1.544, 2.048, 2.4576, 4.8, 4.9152, 5, 9.8304, 10, 13, 19.6608 MHz (auto-sensing)
	Sweep Time	7 µs to 3600 seconds in zero span
	Sweep Time Accuracy	±2% in zero span
Bandwidth	Resolution Bandwidth (RBW)	1 Hz to 10 MHz in 1–3 sequence ±10% (–3 dB bandwidth)
	Video Bandwidth (VBW)	1 Hz to 10 MHz in 1–3 sequence (–3 dB bandwidth)
	RBW with Quasi-Peak Detection	200 Hz, 9 kHz, 120 kHz (–6 dB bandwidth)
	VBW with Quasi-Peak Detection	Auto VBW is On, RBW/VBW = 1
	VBW/Average	Type Linear/Log
Spectral Purity – SSB Phase Noise		Offset from 1 GHz

	Maximum	Typical
10 kHz	–102 dBc/Hz	–106 dBc/Hz
100 kHz	–106 dBc/Hz	–110 dBc/Hz
1 MHz	–111 dBc/Hz	–116 dBc/Hz
10 MHz	–123 dBc/Hz	–129 dBc/Hz

Continued on next page

<table>
<tr><td rowspan="8">Amplitude Ranges</td><td>Dynamic Range</td><td>>106 dB @ 2.4 GHz, 2/3 (TOI-DANL) in 1 Hz RBW</td></tr>
<tr><td>Measurement Range</td><td>DANL to +30 dBm</td></tr>
<tr><td>Display Range</td><td>1 to 15 dB/div in 1 dB steps, ten divisions displayed</td></tr>
<tr><td>Reference Level Range</td><td>–150 to +30 dBm</td></tr>
<tr><td>Reference Level Offset</td><td>99.9 dB External Loss to 99.9 dB External Gain</td></tr>
<tr><td>Attenuator Resolution</td><td>0 to 65 dB, 5.0 dB steps</td></tr>
<tr><td>Amplitude Units</td><td>Log Scale Modes: dBm, dBW, dBV, dBmV, dBµV, dBA
Linear Scale Modes: fV, nV, µV, mV, V, fW, pW, nW, µW, mW, W, pA, nA, µA, mA, A</td></tr>
<tr><td>Maximum Continuous Input (typ.)</td><td>+30 dBm Peak, ±50 VDC (≥10 dB Attn)
+23 dBm Peak, ±50 VDC (<10 dB Attn)
+13 dBm Peak, ±50 VDC (Preamp On)</td></tr>
<tr><td colspan="2">Amplitude Accuracy
(excluding effects of VSWR, noise and spurs)</td><td>
<table>
<tr><td rowspan="2">Frequency Range</td><td colspan="2">+20° to +30°C
(after 30 minute warm-up)</td><td colspan="2">–10° to +55°C
(after 60 minute warm-up)</td></tr>
<tr><td>Maximum</td><td>Typical</td><td>Maximum</td><td>Typical</td></tr>
<tr><td>9 kHz to 100 kHz*</td><td>±2.3 dB</td><td>±0.5 dB</td><td>±2.3 dB</td><td>±0.5 dB</td></tr>
<tr><td>>100 kHz to 13 GHz</td><td>±1.3 dB</td><td>±0.5 dB</td><td>±2.3 dB</td><td>±0.5 dB</td></tr>
<tr><td>>13 GHz to 18 GHz</td><td>±2.3 dB</td><td>±0.5 dB</td><td>±3.3 dB</td><td>±0.5 dB</td></tr>
<tr><td>>18 GHz to 20 GHz</td><td>—</td><td>±1.0 dB</td><td>—</td><td>±1.0 dB</td></tr>
</table>
*: Values below 100 kHz are with the preamplifier turned off.</td></tr>
<tr><td colspan="2">Displayed Average Noise Level (DANL)
(RMS detection, VBW/Avg type = Log., Ref Level = –20 dBm for preamp Off and –50 dBm for preamp On, Auto Attenuation, Performance Sweep Mode)</td><td>
<table>
<tr><td rowspan="2">Frequency Range</td><td colspan="2">Preamp = Off</td><td colspan="2">Preamp = On</td></tr>
<tr><td>Maximum</td><td>Typical</td><td>Maximum</td><td>Typical</td></tr>
<tr><td>10 MHz to 4 GHz</td><td>–145 dBm</td><td>–148 dBm</td><td>–161 dBm</td><td>–164 dBm</td></tr>
<tr><td>>4 GHz to 9 GHz</td><td>–142 dBm</td><td>–145 dBm</td><td>–159 dBm</td><td>–162 dBm</td></tr>
<tr><td>>9 GHz to 13 GHz</td><td>–136 dBm</td><td>–139 dBm</td><td>–156 dBm</td><td>–159 dBm</td></tr>
<tr><td>>13 GHz to 20 GHz</td><td>–136 dBm</td><td>–142 dBm</td><td>–155 dBm</td><td>–161 dBm</td></tr>
</table></td></tr>
<tr><td rowspan="2">Spurs
(0 dB input attenuation)</td><td>Residual Spurs
(RF input terminated)</td><td>Preamp Off: –90 dBm (<13 GHz), –85 dBm (13 GHz to 20 GHz)
Preamp On: –100 dBm (<13 GHz, 13 GHz to 20 GHz)</td></tr>
<tr><td>Input-Related Spurious
(–30 dBm input)</td><td>Preamp Off: –60 dBc (Instrument centered on single signal, span <1.7 GHz)
Preamp On: –70 dBc (typ.)</td></tr>
<tr><td colspan="2">Third-Order Intercept (TOI)</td><td>(–20 dBm tones 100 kHz apart, –20 dBm Ref level, 0 dB input attenuation, preamp Off)
2.4 GHz: +14 dBm minimum
50 MHz to 20 GHz: 20 dBm (typ.)</td></tr>
<tr><td colspan="2">P1dB</td><td><4 GHz: +5 dBm (nom.)
4 GHz to 20 GHz: +12 dBm (nom.)</td></tr>
<tr><td colspan="2">Second Harmonic Distortion
(0 dB input attenuation, –30 dBm input)</td><td>50 MHz: –54 dBc (max.)
<4 GHz: –60 dBc (typ.)
≥4 GHz: –75 dBc (typ.)</td></tr>
<tr><td colspan="2">VSWR (≥10 dB input attenuation)</td><td>≤20 GHz: 1:5:1 (typ.)</td></tr>
</table>

High Accuracy Power Meter (Option 19)

Requires external USB power sensor.

Amplitude	Maximum, Minimum, Offset, Relative On/Off, Units, Auto Scale
Average	# of Running Averages, Max Hold
Zero/Cal	Zero On/Off, Cal Factor (Center Frequency, Signal Standard)
Limits	Limit On/Off, Limit Upper/Lower

USB Power Sensors (Ordered separately):

Power Sensor Model	MA24105A	MA24106A	MA24108A/18A/26A	MA24208A/18A	MA24330A/40A/50A
Description	Inline High Power Sensor	High Accuracy RF Power Sensor	Microwave USB Power Sensor	Microwave Universal USB Power Sensor	Microwave CW USB Power Sensor
Frequency Range	350 MHz to 4 GHz	50 MHz to 6 GHz	10 MHz to 8/18/26 GHz	10 MHz to 8 GHz/18 GHz	10 MHz to 33/40/50 GHz
Connector	Type N (f), 50Ω	Type N (m), 50Ω	Type N (m), 50Ω (8 GHz/18 GHz) Type K (m), 50Ω (26 GHz)	Type N (m), 50Ω	Type K (m), 50Ω (33 GHz/40 GHz) Type V (m), 50Ω (50 GHz)
Dynamic Range	+3 to +51.76 dBm (2 mW to 150 W)	–40 to +23 dBm (0.1 µW to 200 mW)	–40 to +20 dBm (0.1 µW to 100 mW)	–60 to +20 dBm (1 nW to 100 mW)	–70 to +20 dBm (0.1 nW to 100 mW)
Measurand	True-RMS	True-RMS	True-RMS, Slot Power, Burst Average Power	True-RMS, Slot Power, Burst Average Power	Average Power
Measurement Uncertainty	± 0.17 dB*1	± 0.16 dB*2	± 0.18 dB*3	± 0.17 dB*4	± 0.17 dB*5
Data sheet (for complete specifications)	11410-00621	11410-00424	11410-00504	11410-00841	11410-00906

*1: Expanded uncertainty with K = 2 for power measurements of a CW signal greater than +20 dBm with a matched load. Measurement results referenced to the input side of the sensor.

*2: Total RSS measurement uncertainty (0° to 50°C) for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.

*3: Expanded uncertainty with K = 2 for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.

*4: Power uncertainty expressed with two sigma confidence level for CW measurement after zero operation. Includes calibration factor and linearity over temperature uncertainties, but not the effects of mismatch, zero set and drift, or noise.

*5: Includes linearity over temperature uncertainties, but not the effects of calibration factor, mismatch, zero set and drift, and noise.

Interference Analyzer (Option 25)

Spectrum	Field Strength Occupied Bandwidth Channel Power Adjacent Channel Power (ACPR) AM/FM/SSB Demodulation (Wide/Narrow FM, Upper/Lower SSB), (audio out only) Carrier-to-Interference ratio (C/I)
Spectrogram	Collect data up to 3 days
Signal Strength	Gives visual and aural indication of signal strength
Received Signal Strength Indicator (RSSI)	Collect data up to one week
Interference Mapping	Draw multiple bearings of signal strength from GPS location on on-screen map Pan and Zoom on-screen maps Support for Anritsu MA2700A Handheld Interference Hunter
Impedance	50Ω, 75Ω; external pad required for 75Ω operation

Channel Scanner (Option 27)

Number of Channels	1 to 20 Channels (Power Levels)
Measurements	Graph/Table, Max Hold (On/5 sec/Off), Frequency/Channel, Current/Maximum, Dual Color
Scanner	Scan Channels, Scan Frequencies, Scan Custom List, Scan Script Master™
Amplitude	Reference Level, Scale
Custom Scan	Number of Channels, Signal Standard & Channel, Frequency, Bandwidth
Frequency Range	9 kHz to 9, 15, or 20 GHz
Frequency Accuracy	±10 Hz + frequency reference error
Measurement Range	–110 to +30 dBm
Impedance	50Ω, 75Ω; external pad required for 75Ω operation

GPS Receiver (Option 31)

Setup	On/Off, Antenna Voltage 3.3 V/5.0 V, GPS Info Note: 2000-1528-R GPS antenna requires +5 VDC 2000-1652-R GPS antenna requires +3.3 VDC or +5 VDC 2000-1760-R GPS antenna requires +2.5 VDC to +3.7 VDC
GPS Time/ Location Indicator	UTC Time, Latitude, Longitude, and Altitude on display (UTC Time and Altitude on GPS Info display) UTC Time, Latitude, Longitude, and Altitude with trace storage
High Frequency Accuracy	$< \pm 2.5 \times 10^{-8}$ Hz/Hz with GPS On, 3 minutes after satellite lock in selected mode (GPS Antenna connected) $< \pm 5.0 \times 10^{-8}$ Hz/Hz for 3 days after GPS lock, 0° to 50°C (GPS Antenna disconnected)
Connector	SMA (f)

Coverage Mapping (Option 431)

Measurements	Indoor Mapping	RSSI, ACPR
	Outdoor Mapping	RSSI, ACPR
Setup Parameters	Mode	Spectrum Analyzer
	Frequency	Center, Span (ACPR only), Freq Step, Signal Standard, Channel #, Channel Increment
	Amplitude	Reference Level (RL), Attenuation Auto/Level, RL Offset, Pre-Amp On/Off, Detection
	Span	RSSI Mode: Zero Span ACPR Mode: Span, Span Up/Down (1-2-5), Full Span, Last Span
	BW	RBW, Auto RBW, VBW, Auto VBW, RBW/VBW Ratio, Span/RBW Ratio
	Measurement Setup	RSSI: Mapping color thresholds
	Mapping Colors	ACPR: Main Ch BW, Adj Ch BW, Ch Spacing, Adjacent Ch dB Offset, Thresholds for Good and Poor main channel levels RSSI: Dark Green (Excellent), Light Green (Very Good), Yellow (Good), Orange (Fair), Dark Red (Poor) ACPR: Dark Green (Good), Yellow (between Good and Poor), Dark Red (Poor)
	Point Distance or Time Setup	Repeat Type: Time (100 ms to 16 s), Distance (1 m to 10,000 m) Distance Units: m, ft
	Save Points Map	Save KML, JPEG, Tab Delimited
	Recall Points Map	Recall Map, Recall KML Points only, Recall KML Points with Map, Recall Default Grid
	Map Types	Outdoor (GPS embedded), Indoor (non-GPS embedded). Import maps using the Anritsu easyMap Tools. Zoomable (.azm) maps are usable, but cannot be zoomed.

Balanced/Differential S-Parameters, 1-port (Option 77)

As an alternative to a sampling oscilloscope, verifying the performance and identifying discontinuities in high-data-rate differential cables is now possible with the VNA Master. After a full two-port calibration, connect your differential cable directly to the two test ports and reveal the S_{d1d1} performance, which is essentially differential return loss, or any of the other differential S-Parameters, S_{c1c1}, S_{d1c1}, or S_{c1d1}. With optional time domain, you can convert frequency sweeps to distance. This capability is especially valuable for applications in high data rate cables where balanced data formats are used to isolate noise and interference.

AM/FM/PM Signal Analyzer (Option 509, MS203xC only)

Measurements							
Display Type	RF Spectrum AM/FM/PM	Audio Spectrum (AM)	Audio Spectrum (FM/PM)	Audio Waveform (AM)	Audio Waveform (FM/PM)	Summary (AM)	Summary (FM/PM)
Graphic Display	Power (dBm) vs. Frequency	Depth (%) vs. Modulation Frequency	Deviation (kHz/rad) vs. Modulation Frequency	Depth (%) vs. Time	Deviation (kHz/rad) vs. Time	None	None
Numerical Displays	Carrier Power Carrier Frequency Occupied Bandwidth	AM Rate RMS Depth (Pk-Pk)/2 Depth SINAD* THD* Distortion/Total Vrms*	FM/PM Rate RMS Deviation (Pk-Pk)/2 Deviation SINAD* THD* Distortion/Total Vrms*	AM Rate RMS Depth (Pk-Pk)/2 Depth SINAD* THD* Distortion/Total Vrms*	FM/PM Rate RMS Depth (Pk-Pk)/2 Depth SINAD* THD* Distortion/Total Vrms*	RMS Depth Peak + Depth Peak – Depth (Pk-Pk)/2 Depth Carrier Power Carrier Frequency Occupied Bandwidth AM Rate SINAD* THD* Distortion/Total Vrms*	RMS Deviation Peak + Deviation Peak – Deviation (Pk-Pk)/2 Deviation Carrier Power Carrier Frequency Occupied Bandwidth FM/PM Rate SINAD* THD* Distortion/Total Vrms*

*: Requires sine wave modulation

Setup Parameters	Frequency	Center Freq, Span, Freq Step, Signal Standard, Channel, Channel Increment, Set (measured) Carrier Freq to Center
	Amplitude Setu	Scale, Power Offset, Adjust Range
	Measurements	RF Spectrum, Audio Spectrum (demodulated), Audio Waveform (demodulated), Summary, Coverage Mapping (Option 431 required), Audio Demod (AM/FM only)
	Measurement Setup	All Measurements: Demod Type (AM, FM, PM), IFBW, Auto IFBW, Squelch Units, Distortion Measurements (Sinewave or Broadcast) RF Spectrum: OBW Method, OBW %, OBW dBC Audio Spectrum: Span, Scale, Squelch Power Audio Waveform: Sweep Time, Scale, Squelch Power Summary: Average count, Squelch Power Coverage Mapping: Measurement (SINAD, Carrier Power, Multiple), Thresholds, Point Distance/Time Audio Demod: Demod Type (AM, USB, LSB, Widband FM, Narrowband FM), Volume, Squelch
	Mapping Colors	Dark Green (Excellent), Light Green (Very Good), Orange (Good), Yellow (Fair), Dark Red (Poor)
	Marker	Six markers with Delta for each, Peak Search, Marker Freq to Center, Marker to Ref Lvl, Marker Table
RF and Modulation Measurements	AM	Modulation Rate: ±1 Hz (<100 Hz), ±2% (>100 Hz) Depth: ±5% for (Modulation rates 10 Hz to 100 kHz)
	FM	Modulation Rate: ±1 Hz (<100 Hz); ±2% (100 Hz to 100 kHz) Deviation Accuracy: ±5% (100 Hz to 100 kHz)*
	PM	Modulation Rate: ±1 Hz (<100 Hz); ±2% (100 Hz to 100 kHz) Deviation Accuracy: ±5% (deviation 0 to 93 Rad, rate 10 Hz to 5 kHz)*
	IF Bandwidth	1 kHz to 300 kHz in 1-3 sequence
	Frequency Span	RF Spectrum: 10 kHz to 10 MHz Audio Spectrum: 2, 5, 10, 20, 70, 140 kHz
	RBW/VBW	30
	Span/RBW	100
	Sweep Time	50 µs to 50 ms (Audio Waveform) IFBW must be greater than 95% occupied BW

*: IFBW must be greater than 95% occupied BW

General Specifications

Setup Parameters	System	Status (Temperature, Battery Info, S/N, Firmware Ver, IP Address, Options Installed) Self Test, Application Self Test, GPS (see Option 31)
	System Options	Name, Date and Time, Ethernet Configuration, Brightness, Volume Language (English, French, German, Spanish, Chinese, Japanese, Korean, Italian, Russian, Portuguese) Reset (Factory Defaults, Master Reset, Update Firmware)
	File	Save, Recall, Delete, Directory Management
	Save/Recall	Setups, Measurements, Screen Shots Jpeg (save only)
	Delete	Selected File, All Measurements, All Mode Files, All Content
	Directory Management	Sort Method (Name/Type/Date), Ascend/Descend, Internal/USB, Copy
	Internal Trace/Setup Memory	Store more than 4000 traces and setups in memory
	External Trace/Setup Memory	Limited by size of USB Flash drive
	Mode Switching	Auto-Stores/Recalls most recently used setup parameters for the mode
Connectors	Maximum Input (Damage Level)	Vector Network Analyzer Input: +23 dBm, ±50 VDC (all models) Spectrum Analyzer Input: +30 dBm, ±50 VDC (MS203xC models only)
	VNA Connectors	Type N (f) (or ruggedized K (f) with Option 11, MS20x7C or MS20x8C only) (× 2)
	Spectrum Analyzer Connectors	Type N (f) (or ruggedized K (f) with Option 11, MS2037C or MS2038C only)
	Bias Tee	Type BNC (f) (enabled with Option 10) (× 2)
	Ext Ref	Type BNC (f), 10 MHz, ±10 dBm
	GPS	SMA (f) (available with Option 31 GPS)
	External Power	5.5 mm barrel connector, 12 to 14.5 VDC, <5.0 A
	LAN Connection	RJ48C, 10/100 Mbps, Connect to PC or LAN for Remote Access
	USB Interface (2)	Type A, Connect Flash Drive and Power Sensor
	USB Interface	5-pin mini-B, Connect to PC for data transfer
	Headset Jack	3.5 mm 3-wire headset jack
	External Trigger	BNC (f), TTL 3.3 V or 5 V triggers on positive edge, Maximum Input +5 VDC
	10 MHz Out	SMA (f), 50Ω
Display	Size	8.4 in, daylight viewable color LCD
	Resolution	800 × 600
	Pixel Defects	No more than five defective pixels (99.9989% good pixels)
Power	Field Replaceable Li-Ion Battery	40 W when powered by factory 7500 mAh Li-Ion battery (part number: 633-75)
	AC/DC Power Adapter	55 W when powered by supplied universal 110 V/220 V AC/DC adaptor while charging battery
	Life Time Charging Cycles	>300 (80% of initial capacity)
	Battery Operation	3.0 hours, (typ.)
	Battery Charging Limits	0° to +45°C, Relative Humidity ≤80%, non-condensing
Regulatory Compliance	CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD 2014/35/EU, EN61010-1 RoHS: 2011/65/EU
	Australia and New Zealand	RCM AS/NZS 4417:2012
	South Korea	KCC-REM-A21-0004
Environmental	MIL-PRF-28800F, Class 2	
	Operating Temperature Range	–10° to +55°C
	Storage Temperature Range	–51° to +71°C
	Maximum Relative Humidity	95% RH at +30°C, non-condensing
	Vibration, Sinusoidal	5 Hz to 55 Hz
	Vibration, Random	10 Hz to 500 Hz
	Half Sine Shock	30 gn
	Altitude	4600 meters, operating and non-operating
	Explosive Atmosphere	MIL-PRF-28800F Section 4.5.6.3 MIL-STD-810G, Method 511.5, Procedure 1
Dimensions and Mass	Dimensions	Width: 315 mm (12.4 in) Height: 211 mm (8.3 in) Depth: 78 mm (3.1 in) (MS202xC), 97 mm (3.8 in) (MS203xC)
	Mass, Including Battery	4.5 kg (9.9 lb) (MS202xC), 4.8 kg (10.5 lb) (MS203xC)
Warranty		Standard three-year warranty (one year warranty on battery)

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	VNA Master™ 2-Port, 1-Path VNA
MS2026C	VNA: 5 kHz to 6 GHz
MS2027C	VNA: 5 kHz to 15 GHz
MS2028C	VNA: 5 kHz to 20 GHz
	VNA Master™ 2-Port, 1-Path VNA + Spectrum Analyzer
MS2036C	VNA: 5 kHz to 6 GHz, S/A: 9 kHz to 9 GHz
MS2037C	VNA: 5 kHz to 15 GHz, S/A: 9 kHz to 15 GHz
MS2038C	VNA: 5 kHz to 20 GHz, S/A: 9 kHz to 20 GHz
	MS2026C VNA Master Options
MS2026C-0002	Time Domain (includes Distance Domain capabilities)
MS2026C-0007	Secure Data Operation
MS2026C-0010	Built-in Bias-Tee
MS2026C-0015	Vector Voltmeter
MS2026C-0019	High Accuracy Power Meter (requires external USB sensor)
MS2026C-0031	GPS Receiver (requires GPS antenna, 2000-1528-R, 2000-1652-R, or 2000-1760-R)
MS2026C-0077	Balanced/Differential S-Parameters, 1-port
MS2026C-0098	Standard Calibration (ISO 17025 and Z540.1)
MS2026C-0099	Premium Calibration (ISO 17025 and Z540.1 plus test data)
	MS2027C VNA Master Options
MS2027C-0002	Time Domain (includes Distance Domain capabilities)
MS2027C-0007	Secure Data Operation
MS2027C-0010	Built-in Bias-Tee
MS2027C-0011	K (f) Test Port Connectors (MS20x7C & MS20x8C only)
MS2027C-0015	Vector Voltmeter
MS2027C-0019	High Accuracy Power Meter (requires external USB sensor)
MS2027C-0031	GPS Receiver (requires GPS antenna, 2000-1528-R, 2000-1652-R, or 2000-1760-R)
MS2027C-0077	Balanced/Differential S-Parameters, 1-port
MS2027C-0098	Standard Calibration (ISO 17025 and Z540.1)
MS2027C-0099	Premium Calibration (ISO 17025 and Z540.1 plus test data)
	MS2028C VNA Master Options
MS2028C-0002	Time Domain (includes Distance Domain capabilities)
MS2028C-0007	Secure Data Operation
MS2028C-0010	Built-in Bias-Tee
MS2028C-0011	K (f) Test Port Connectors (MS20x7C & MS20x8C only)
MS2028C-0015	Vector Voltmeter
MS2028C-0019	High Accuracy Power Meter (requires external USB sensor)
MS2028C-0031	GPS Receiver (requires GPS antenna, 2000-1528-R, 2000-1652-R, or 2000-1760-R)
MS2028C-0077	Balanced/Differential S-Parameters, 1-port
MS2028C-0098	Standard Calibration (ISO 17025 and Z540.1)
MS2028C-0099	Premium Calibration (ISO 17025 and Z540.1 plus test data)
	MS2036C VNA Master, + Spectrum Analyzer Options
MS2036C-0002	Time Domain (includes Distance Domain capabilities)
MS2036C-0007	Secure Data Operation
MS2036C-0010	Built-in Bias-Tee
MS2036C-0015	Vector Voltmeter
MS2036C-0019	High Accuracy Power Meter (requires external USB sensor)
MS2036C-0025	Interference Analysis, 9 kHz to 9/15/20 GHz*1
MS2036C-0027	Channel Scanner, 9 kHz to 9/15/20 GHz*1
MS2036C-0031	GPS Receiver (requires GPS antenna, 2000-1528-R, 2000-1652-R, or 2000-1760-R)
MS2036C-0077	Balanced/Differential S-Parameters, 1-port
MS2036C-0431	Coverage Mapping*2
MS2036C-0098	Standard Calibration (ISO 17025 and Z540.1)
MS2036C-0099	Premium Calibration (ISO 17025 and Z540.1 plus test data)
MS2036C-0509	AM/FM/PM Analyzer*3
	MS2037C VNA Master, + Spectrum Analyzer Options
MS2037C-0002	Time Domain (includes Distance Domain capabilities)
MS2037C-0007	Secure Data Operation
MS2037C-0010	Built-in Bias-Tee
MS2037C-0011	K (f) Test Port Connectors (MS20x7C & MS20x8C only)
MS2037C-0015	Vector Voltmeter
MS2037C-0019	High Accuracy Power Meter (requires external USB sensor)
MS2037C-0025	Interference Analysis, 9 kHz to 9/15/20 GHz*1
MS2037C-0027	Channel Scanner, 9 kHz to 9/15/20 GHz*1
MS2037C-0031	GPS Receiver (requires GPS antenna, 2000-1528-R, 2000-1652-R, or 2000-1760-R)
MS2037C-0077	Balanced/Differential S-Parameters, 1-port
MS2037C-0431	Coverage Mapping*2
MS2037C-0098	Standard Calibration (ISO 17025 and Z540.1)
MS2037C-0099	Premium Calibration (ISO 17025 and Z540.1 plus test data)
MS2037C-0509	AM/FM/PM Analyzer*3

Model/Order No.	Name
	MS2038C VNA Master, + Spectrum Analyzer Options
MS2038C-0002	Time Domain (includes Distance Domain capabilities)
MS2038C-0007	Secure Data Operation
MS2038C-0010	Built-in Bias-Tee
MS2038C-0011	K (f) Test Port Connectors (MS20x7C & MS20x8C only)
MS2038C-0015	Vector Voltmeter
MS2038C-0019	High Accuracy Power Meter (requires external USB sensor)
MS2038C-0025	Interference Analysis, 9 kHz to 9/15/20 GHz*1
MS2038C-0027	Channel Scanner, 9 kHz to 9/15/20 GHz*1
MS2038C-0031	GPS Receiver (requires GPS antenna, 2000-1528-R, 2000-1652-R, or 2000-1760-R)
MS2038C-0077	Balanced/Differential S-Parameters, 1-port
MS2038C-0431	Coverage Mapping*2
MS2038C-0098	Standard Calibration (ISO 17025 and Z540.1)
MS2038C-0099	Premium Calibration (ISO 17025 and Z540.1 plus test data)
MS2038C-0509	AM/FM/PM Analyzer*3
	MS202xC/3xC Standard Accessories
2000-1685-R	Soft Carrying Case (supplied with MS202xC only)
2000-1686-R	Soft Carrying Case (supplied with MS203xC only)
40-187-R	AC-DC Adapter
806-141-R	Automotive Power Adapter, 12 VDC, 60 W
3-2000-1498	USB A/5-pin Mini-B Cable, 3.05 m (10 ft)
2000-1371-R	Ethernet Cable, 2.13 m (7 ft)
	Certificate of Calibration and Conformance
	Optional Accessories
	GPS Antennas (active)
2000-1528-R	Magnet Mount, SMA (m), 3 VDC to 5 VDC with 4.6 m (15 ft) extension cable
2000-1652-R	Magnet Mount, SMA (m), 3 VDC to 5 VDC with 1 ft cable
2000-1760-R	Mini GPS Antenna, SMA (m), 25 dB gain, 2.5 VDC to 3.7 VDC
	High Accuracy Power Sensor
MA24105A	Inline Peak Power Sensor, 350 MHz to 4 GHz, +3 to +51.76 dBm
MA24106A	RF USB Power Sensor, 50 MHz to 6 GHz, +23 dBm
MA24108A	Microwave USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24118A	Microwave USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24126A	Microwave USB Power Sensor, 10 MHz to 26 GHz, +20 dBm
MA24208A	Microwave Universal USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24218A	Microwave Universal USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24330A	Microwave CW USB Power Sensor, 10 MHz to 33 GHz, +20 dBm
MA24340A	Microwave CW USB Power Sensor, 10 MHz to 40 GHz, +20 dBm
MA24350A	Microwave CW USB Power Sensor, 10 MHz to 50 GHz, +20 dBm
MA25100A	RF Power Indicator
	Directional Antennas
2000-1411-R	824 MHz to 896 MHz, N (f), 12.3 dBd, Yagi
2000-1412-R	885 MHz to 975 MHz, N (f), 12.6 dBd, Yagi
2000-1413-R	1710 MHz to 1880 MHz, N (f), 12.3 dBd. Yagi
2000-1414-R	1850 MHz to 1990 MHz, N (f), 11.4 dBd, Yagi
2000-1415-R	2400 MHz to 2500 MHz, N (f), 14.1 dBd, Yagi
2000-1416-R	1920 MHz to 2170 MHz, N (f), 14.3 dBd, Yagi
2000-1659-R	698 MHz to 787 MHz, N (f), 10.1 dBi, Yagi
2000-1660-R	1425 MHz to 1535 MHz, N (f), 14.3 dBi, Yagi
2000-1715-R	698 MHz to 2500 MHz, N (f), gain of 2 dBi to 10 dBi, typical
2000-1726-R	Antenna, 2500 MHz to 2700 MHz, N (f), 14.1 dBi, Yagi
2000-1747-R	Antenna, Log Periodic, 300 MHz to 7000 MHz, N (f), 5.1 dBi, typical
2000-1748-R	Antenna, Log Periodic, 1 GHz to 18 GHz, N (f), 6 dBi, typical
2000-1777-R	Portable Directional Antenna, 9 kHz to 20 MHz, N (f)
2000-1778-R	Portable Directional Antenna, 20 MHz to 200 MHz, N (f)
2000-1779-R	Portable Directional Antenna, 200 MHz to 500 MHz, N (f)
2000-1812-R	Portable Yagi Antenna, 450 MHz to 512 MHz, N (f), 7.1 dBi
2000-1825-R	Portable Yagi Antenna, 380 MHz to 430 MHz, N (f), 7.1 dBi

Continued on next page

*1: Option 31 (GPS) is recommended.
*2: Requires Option 31 (GPS) for full functionality.
*3: Requires Option 431 (Coverage Mapping) for full functionality.

Model/Order No.	Name
	Portable Antennas
2000-1200-R	806 MHz to 866 MHz, SMA (m), 50Ω
2000-1473-R	870 MHz to 960 MHz, SMA (m), 50Ω
2000-1035-R	896 MHz to 941 MHz, SMA (m), 50Ω (1/2 wave)
2000-1030-R	1710 MHz to 1880 MHz, SMA (m), 50Ω (1/2 wave)
2000-1474-R	1710 MHz to 1880 MHz with knuckle elbow (1/2 wave)
2000-1031-R	1850 MHz to 1990 MHz, SMA (m), 50Ω (1/2 wave)
2000-1475-R	1920 MHz to 1980 MHz and 2110 MHz to 2170 MHz, SMA (m), 50Ω
2000-1032-R	2400 MHz to 2500 MHz, SMA (m), 50Ω (1/2 wave)
2000-1361-R	2400 MHz to 2500 MHz, 5000 MHz to 6000 MHz, SMA (m), 50Ω
2000-1751-R	698 MHz to 960 MHz, 1710 MHz to 2100 MHz, 2500 MHz to 2700 MHz, SMA (m), 2 dB typical, 50Ω
2000-1636-R	Antenna Kit (Consists of: 2000-1030-R, 2000-1031-R, 2000-1032-R, 2000-1200-R, 2000-1035-R, 2000-1361-R, and carrying pouch)
2000-1487-R	VHF/UHF, Telescopic Whip antenna, straight or 90°, BNC (m), 50Ω
	Bandpass Filters
1030-114-R	806 MHz to 869 MHz, N (m) to SMA (f), 50Ω
1030-109-R	824 MHz to 849 MHz, N (m) to SMA (f), 50Ω
1030-110-R	880 MHz to 915 MHz, N (m) to SMA (f), 50Ω
1030-111-R	1850 MHz to 1910 MHz, N (m) to SMA (f), 50Ω
1030-112-R	2400 MHz to 2484 MHz, N (m) to SMA (f), 50Ω
1030-105-R	890 MHz to 915 MHz, N (m) to N (f), 50Ω
1030-106-R	1710 MHz to 1790 MHz, N (m) to N (f), 50Ω
1030-107-R	1910 MHz to 1990 MHz, N (m) to N (f), 50Ω
1030-149-R	High Pass, 150 MHz, N (m) to N (f), 50Ω
1030-150-R	High Pass, 400 MHz, N (m) to N (f), 50Ω
1030-151-R	High Pass, 700 MHz, N (m) to N (f), 50Ω
1030-152-R	Low Pass, 200 MHz, N (m) to N (f), 50Ω
1030-153-R	Low Pass, 550 MHz, N (m) to N (f), 50Ω
1030-155-R	2500 MHz to 2700 MHz, N (m) to N (f), 50Ω
1030-178-R	1920 MHz to 1980 MHz, N (m) to N (f), 50Ω
1030-179-R	777 MHz to 798 MHz, N (m) to N (f), 50Ω
1030-180-R	2500 MHz to 2570 MHz, N (m) to N (f), 50Ω
2000-1684-R	791 MHz to 821 MHz, N (m) to N (f), 50Ω
2000-1734-R	699 MHz to 715 MHz, N (m) and N (f), 50Ω
2000-1735-R	776 MHz to 788 MHz, N (m) and N (f), 50Ω
2000-1736-R	815 MHz to 850 MHz, N (m) and N (f), 50Ω
2000-1737-R	1711 MHz to 1756 MHz, N (m) and N (f), 50Ω
2000-1738-R	1850 MHz to 1910 MHz, N (m) and N (f), 50Ω
2000-1739-R	880 MHz to 915 MHz, N (m) and N (f), 50Ω
2000-1740-R	1710 MHz to 1785 MHz, N (m) and N (f), 50Ω
2000-1741-R	1920 MHz to 1980 MHz, N (m) and N (f), 50Ω
2000-1742-R	832 MHz to 862 MHz, N (m) and N (f), 50Ω
2000-1743-R	2500 MHz to 2570 MHz, N (m) and N (f), 50Ω
2000-1799-R	2305 MHz to 2320 MHz, N (m) and N (f), 50Ω
2000-1911-R	703 MHz to 748 MHz, N (m) and N (f), 50Ω
2000-1912-R	788 MHz to 798 MHz, N (m) and N (f), 50Ω
2000-1925-R	663 MHz to 698 MHz, N (m) and N (f), 50Ω
2000-1926-R	776 MHz to 806 MHz, N (m) and N (f), 50Ω
	Attenuators N Type (up to 18 GHz)
3-1010-122	20 dB, 5 W, DC to 12.4 GHz, N (m) to N (f)
42N50-20	20 dB, 5 W, DC to 18 GHz, N (m) to N (f)
42N50A-30	30 dB, 5 W, DC to 18 GHz, N (m) to N (f)
3-1010-123	30 dB, 50 W, DC to 8.5 GHz, N (m) to N (f)
1010-127-R	30 dB, 150 W, DC to 3 GHz, N (m) to N (f)
3-1010-124	40 dB, 100 W, DC to 8.5 GHz, N (m) to N (f), Uni-directional
1010-121-R	40 dB, 100 W, DC to 18 GHz, N (m) to N (f), Uni-directional
1010-128-R	40 dB, 150 W, DC to 3 GHz, N (m) to N (f)
	Related Literature, Application Notes
10100-00065	Product Information, Compliance, and Safety
10580-00349	Spectrum Analyzer Measurement Guide
10580-00240	Power Meter Measurement Guide
10580-00289	VNA Measurement Guide
10580-00305	VNA Master User Guide
10580-00306	VNA Master Programming Manual
10580-00307	VNA Master Maintenance Manual
11410-00387	Primer on Vector Network Analysis
11410-00424	USB Power Sensor MA24106A
11410-00472	Measuring Interference
11410-00504	Microwave USB Power Sensor MA241x8A
11410-00531	Practical Tips on Making "Vector Voltmeter (VVM)" Phase Measurements using VNA Master (Option 15)
11410-00545	VNA Master + Spectrum Analyzer Brochure
11410-00549	VNA Master + Spectrum Analyzer Technical Data Sheet
11410-00565	Troubleshoot Wire Cable Assemblies with Frequency-Domain Reflectometry
11410-00700	Evaluation of RF Network Testing

Model/Order No.	Name
	Adapters
1091-26-R	SMA (m) to N (m), DC to 18 GHz, 50Ω
1091-27-R	SMA (f) to N (m), DC to 18 GHz, 50Ω
1091-80-R	SMA (m) to N (f), DC to 18 GHz, 50Ω
1091-81-R	SMA (f) to N (f), DC to 18 GHz, 50Ω
1091-172	BNC (f) to N (m), DC to 1.3 GHz, 50Ω
510-90-R	7/16 DIN (f) to N (m), DC to 7.5 GHz, 50Ω
510-91-R	7/16 DIN (f) to N (f), DC to 7.5 GHz, 50Ω
510-92-R	7/16 DIN (m) to N (m), DC to 7.5 GHz, 50Ω
510-93-R	7/16 DIN (m) to N (f), DC to 7.5 GHz, 50Ω
510-96-R	7/16 DIN (m) to 7/16 DIN (m), DC to 7.5 GHz, 50Ω
510-97-R	7/16 DIN (f) to 7/16 DIN (f), DC to 7.5 GHz, 50Ω
513-62-R	TNC (f) to N (f), DC to 18 GHz, 50Ω
1091-315-R	TNC (m) to N (f), DC to 18 GHz, 50Ω
1091-324-R	TNC (f) to N (m), DC to 18 GHz, 50Ω
1091-325-R	TNC (m) to N (m), DC to 18 GHz, 50Ω
1091-317-R	TNC (m) to SMA (f), DC to 18 GHz, 50Ω
1091-318-R	TNC (m) to SMA (m), DC to 18 GHz, 50Ω
1091-323-R	TNC (m) to TNC (f), DC to 18 GHz, 50Ω
1091-326-R	TNC (m) to TNC (m), DC to 18 GHz, 50Ω
34RKNF50	Ruggedized K (m) to N (f), DC to 18 GHz, 50Ω
510-102-R	N (m) to N (m), DC to 11 GHz, 50Ω, 90 degrees right angle
	Precision Adapters
34NN50A	N (m) to N (m), DC to 18 GHz, 50Ω
34NFNF50	N (f) to N (f), DC to 18 GHz, 50Ω
34NK50	DC to 18 GHz, N (m) to K (m), 50Ω
34NFKF50	DC to 18 GHz, N (m) to K (f), 50Ω
K220B	DC to 40 GHz, K (m) to K (m), 50Ω
K222B	DC to 40 GHz, K (f) to K (f), 50Ω
K224B	DC to 40 GHz, K (m) to K (f), 50Ω
	MA8100A TRX NEON Signal Mapper (supported on MS2036C, MS2037C, MS2038C models only)
MA8100A-001	TRX NEON® Signal Mapper with Anritsu Integration and Tracking Unit. Includes 1 year TRX NEON Software License with 1 year of maintenance and support and 1 year of Cloud Service.
MA8100A-003	TRX NEON® Signal Mapper with Anritsu Integration and Tracking Unit. Includes 3 year TRX NEON Software License with 3 years of maintenance and support and 3 years of Cloud Service.
MA8100A-005	TRX NEON® Signal Mapper with Anritsu Integration and Tracking Unit. Includes 5 year TRX NEON Software License with 5 years of maintenance and support and 5 years of Cloud Service.
MA8100A-100	TRX NEON® Signal Mapper with Anritsu Integration and Tracking Unit. Includes Perpetual TRX NEON Software License with 3 years of maintenance and support and 3 years of Cloud Service.
2300-574	1 year TRX NEON Software License with 1 year of maintenance and support and 1 year of Cloud Service. Cannot be ordered separately from P/N MA8100A-001. See P/N 2300-612 for renewals.
2300-575	3 year TRX NEON Software License with 3 years of maintenance and support and 3 years of Cloud Service. Cannot be ordered separately from P/N MA8100A-003. See P/N 2300-613 for renewals.
2300-576	5 year TRX NEON Software License with 5 years of maintenance and support and 5 years of Cloud Service. Cannot be ordered separately from P/N MA8100A-005. See P/N 2300-614 for renewals.
2300-606	Perpetual TRX NEON Software License with 3 years of maintenance and support and 3 years of Cloud Service. Part number can also be used to order a perpetual license after a limited term license has expired.
2300-612	Renewal of 1 year TRX NEON Software License with 1 year of maintenance and support and 1 year of Cloud Service.
2300-613	Renewal of 3 year TRX NEON Software License with 3 years of maintenance and support and 3 years of Cloud Service.
2300-614	Renewal of 5 year TRX NEON Software License with 5 years of maintenance and support and 5 years of Cloud Service.

Waveguide Calibration Components and WG/Coaxial Adapters, Rectangular Type 50Ω

Recommended waveguide calibration procedure requires two offset shorts and a precise load. The waveguide/coax adapter, shown attached to test port #1, adapts the VNA Master test ports to the waveguide under test.

Frequency Range (GHz)	1/8 Offset	3/8 Offset	Termination	Coax to Waveguide Adapter	Compatible Flanges
3.95 to 5.85	23UA187-R	24UA187-R	26UA187-R	35UA187N-R	CPR187F-R, CPR187G-R, UG-1352/U-R, UG-1353/U-R, UG-1728/U-R, UG-1729/U-R, UG-148/U-R, UG-149A/U-R
5.85 to 8.20	23UA137-R	24UA137-R	26UA137-R	35UA137N-R	CPR137F-R, CPR137G-R, UG-1356/U-R, UG-1357/U-R, UG-1732/U-R, UG-1733/U-R, UG-343B/U-R, UG-344/U-R, UG-440B/U-R, UG-441/U-R
7.05 to 10.00	23UA112-R	24UA112-R	26UA112-R	35UA112N-R	CPR112F-R, CPR112G-R, UG-1358/U-R, UG-1359/U-R, UG-1734/U-R, UG-1735/U-R, UG-52B/U-R, UG-51/U-R, UG-137B/U-R, UG-138/U-R
8.20 to 12.40	23UA90-R	24UA90-R	26UA90-R	35UA90N-R	CPR90F-R, CPR90G-R, UG-1360/U-R, UG-1361/U-R, UG-1736/U-R, UG-1737/U-R, UG-40B/U-R, UG-39/U-R, UG-135/U-R, UG-136B/U-R
12.40 to 18.00	23UA62-R	24UA62-R	26UA62-R	35UA62N-R	UG-541A/U-R, UG-419/U-R, UG-1665/U-R, UG1666/U-R
17.00 to 26.50	23UA42-R	24UA42-R	26UA42-R	35UA42K-R	UG-596A/U-R, UG-595/U-R, UG-597/U-R, UG-598A/U-R
26.50 to 40.00	23UA28-R	24UA28-R	26UA28-R	35UA28K-R	UG-599/U-R
3.30 to 4.90	23UM40-R	24UM40-R	26UM40-R	35UM40N-R	PDR40-R
3.95 to 5.85	23UM48-R	24UM48-R	26UM48-R	35UM48N-R	CAR48-R, PAR48-R, UAR48-R, PDR48-R
5.85 to 8.20	23UM70-R	24UM70-R	26UM70-R	35UM70N-R	CAR70-R, PAR70-R, UAR 70-R, PDR70-R
7.05 to 10.00	23UM84-R	24UM84-R	26UM84-R	35UM84N-R	CBR84-R, UBR84-R, PBR84-R, PDR84-R
8.20 to 12.40	23UM100-R	24UM100-R	26UM100-R	35UM100N-R	CBR100-R, UBR100-R, PBR100-R, PDR100-R
10.00 to 15.00	23UM120-R	24UM120-R	26UM120-R	35UM120N-R	CBR120-R, UBR120-R, PBR120-R, PDR120-R
12.40 to 18.00	23UM140-R	24UM140-R	26UM140-R	35UM140N-R	CBR140-R, UBR140-R, PBR140-R, PDR140-R
17.00 to 26.50	23UM220-R	24UM220-R	26UM220-R	35UM220K-R	CBR220-R, UBR220-R, PBR220-R, PDR220-R

∗: For Coaxial/Waveguide Adapter part numbers, N designates Type N and K designates K-Connector

VNA Master™ Handheld Vector Network Analyzer + Spectrum Analyzer

MS202xB VNAs/MS203xB VNAs + Spectrum Analyzers

VNA: 500 kHz to 6 GHz/Spectrum Analyzer: 9 kHz to 6 GHz

Affordable Handheld Vector Network + Spectrum Analyzer for Cable, Antenna, and Signal Analysis Anytime, Anywhere

Anritsu proudly offers the VNA Master + Spectrum Analyzer MS202xB/MS203xB, the industry's most affordable and compact handheld solution to address cable, antenna, component, and signal analysis needs in the field. All MS202xB/3xB VNA Master models offer benchtop accuracy and high performance S-parameter measurements in portable form. With frequency coverage from 500 kHz up to 4 GHz or 6 GHz in a truly handheld, battery-operated, rugged, multi-function instrument, the VNA Master also provides a field-friendly touchscreen user interface. MS2034B/35B models include a powerful spectrum analyzer which multiplies user convenience by combining both a VNA and a separate spectrum analyzer into a single measurement powerhouse for the harsh RF and physical environments of field test. Whether it is for spectrum monitoring, broadcast proofing, interference analysis, RF and microwave measurements, regulatory compliance, 3G/4G, Land Mobile Radio, or wireless data network measurements, this VNA/Spectrum Analyzer combination is the ideal instrument for making fast and reliable measurements in the field.

Vector Network Analyzer Performance and Functional

- Broadband coverage of 500 kHz to 4 GHz/6 GHz
- 1-path, 2-port Vector Network Analyzer
- Intuitive Graphical User Interface (GUI) with convenient Touch Screen
- VNA-quality error correction for directivity and source match
- 2-port Transmission Measurements: High/Default/Low Power
- Outstanding calibration stability, minimal drift error
- Calibration Interpolation feature adds flexibility
- User-defined overlays for viewing multiple S-Parameters
- Arbitrary data points up to 4001
- IF Bandwidth selections of 10 Hz to 100 kHz
- 100 dB Transmission Dynamic Range
- 850 µs/data point sweep speed
- Greater than 3 hour battery life
- USB and (Optional) Ethernet for data transfer and instrument control
- User-selectable menu options: Choose either VNA or Field Mode for simplified Cable & Antenna analysis
- Field upgradable firmware
- Internal Flash Memory: 2 GB — Store more than 4000 traces and setups in memory
- Portable: 3.5 kg (7.6 lb)
- Full Speed USB Memory support
- Automate repetitive tasks via optional Ethernet and USB
- High resolution daylight-viewable TFT color display
- "Glove Friendly" Resistive Touchscreen Display
- Distance Domain (Standard with firmware V1.20 and above)
- Internal Bias Tee Option
- Vector Voltmeter Option, ideal for cable phase matching
- High Accuracy Power Meter Option
- GPS Receiver Option
- Polar Format Impedance Display
- Complies with MIL-PRF-28800F Class 2.
- Certified for use in Explosive Atmosphere per MIL-PRF-28800F and MIL-STD-810G

Spectrum Analyzer Performance and Functional (MS203xB Models Only)

- Measure: Occupied Bandwidth, Channel Power, ACPR, C/I
- Interference Analyzer: Spectrogram, Signal Strength, RSSI, Signal ID
- Dynamic Range: >95 dB in 10 Hz RBW
- DANL: –162 dBm in 1 Hz RBW (normalized)
- Phase Noise: –100 dBc/Hz max @ 10 kHz offset at 1 GHz
- Frequency Accuracy: <±50 ppb 3 minutes after GPS lock
- Traces: Normal, Max Hold, Min Hold, Average, # of Averages
- Detectors: Peak, Negative, Sample, Quasi-peak, and RMS
- Markers: 6, each with a Delta Marker, or
  1 Reference Marker with 6 Delta Markers
- Trace Save-on-Event: crossing limit line or sweep complete
- Limit Lines: up to 41 segments with one-button envelope creation
- AM/FM/SSB Audio-only Demodulation
- Optional AM/FM/PM Demodulation Analyzer
- Store thousands of traces internally
- Channel Scanner Option
- GPS tagging of stored traces
- Internal Preamplifier standard
- High Accuracy Power Meter Option
- Coverage Mapping Option

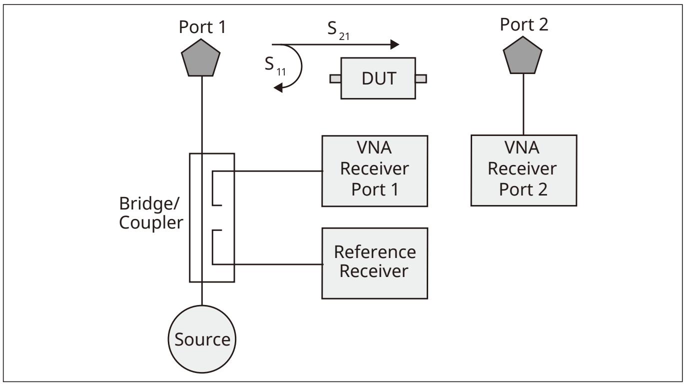
Definitions

All specifications and characteristics apply under the following conditions, unless otherwise noted:

Specifications	All specifications and characteristics apply under the following conditions, unless otherwise stated:
Temperature Range	Over the 23° ±5°C temperature range.
Warm-Up Time	After 10 minutes of warm-up time in VNA mode, where the instrument is left in the ON state.
Reference Signal	When using internal reference signal.
Typical Performance	Typical specifications that are not in parenthesis are not tested and not warranted. They are generally representative of characteristic performance. Typical specifications in parenthesis () represent the mean value of measured units and do not include any guard-bands or uncertainties. They are not warranted.
Uncertainty	A coverage factor of x1 is applied to the measurement uncertainties to facilitate comparison with other industry handheld analyzers.
Time Base Error	Input Frequency × Frequency Reference Error
Calibration Cycle	Calibration is within the recommended 12 month period (residual specifications also require calibration kit calibration cycle adherence.) All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site: www.anritsu.com

Block Diagram

As shown in the following block diagram, the VNA Master has a 2-port, 1-path architecture that automatically measures 2 S-parameters with error-correction precision inherent to VNA operation. The above illustration is a simplified block diagram of the VNA Master 2-port, 1-path architecture. The magnitude AND phase information gained from Vector Network data enables the VNA Master to provide improved field measurements with greater accuracy.



<table>
<tr><td>Frequency Range</td><td>MS2024/34B: 500 kHz to 4 GHz
MS2025/35B: 500 kHz to 6 GHz
Frequency Accuracy: 2.5 ppm
Frequency Resolution: 1 Hz</td></tr>
<tr><td>Test Port Power (typ.)</td><td>VNA Master supports selection of High, Default, or Low test port power. Changing power after calibration can degrade the calibrated performance. Typical power by bands:
<table>
<tr><th>Frequency Range</th><th>High Port Power (dBm)</th><th>Default Port Power (dBm)</th><th>Low Port Power (dBm)</th></tr>
<tr><td>500 kHz to <3 GHz</td><td>+3</td><td>–5</td><td>–25</td></tr>
<tr><td>3 GHz to 6 GHz</td><td>0</td><td>–5</td><td>–25</td></tr>
</table></td></tr>
<tr><td>Transmission Dynamic Range</td><td>The transmission dynamic range (the difference between test port power and noise floor) using 10 Hz IF Bandwidth and High Port Power:
2 MHz to ≤4 GHz: 100 dB
4 GHz to ≤6 GHz: 90 dB</td></tr>
<tr><td>Sweep Speed (typ.)</td><td>Sweep speed in µs/point for IF Bandwidth of 100 kHz, 1001 data points, and single display.
The two-receiver architecture will simultaneously collect S_{21} and S_{11} in a single sweep.
500 kHz to 6 GHz : 850 µs/point</td></tr>
<tr><td>Noise Floor</td><td>
<table>
<tr><th>Frequency Range</th><th>Noise Floor (typ.)</th></tr>
<tr><td>500 kHz to 3 GHz</td><td>–100 dBm</td></tr>
<tr><td>3 GHz to 4 GHz</td><td>–103 dBm</td></tr>
<tr><td>4 GHz to 6 GHz</td><td>–93 dBm</td></tr>
</table></td></tr>
<tr><td>Temperature Stability</td><td>(S_{11} or S_{21}, Short, 23° ±5°C)
<table>
<tr><th>Frequency Range</th><th>Magnitude (typ.)</th><th>Phase (typ.)</th></tr>
<tr><td>500 kHz to 6 GHz</td><td>0.020 dB/°C</td><td>0.200 deg/°C</td></tr>
</table></td></tr>
<tr><td>Interference Immunity</td><td>On-Channel: +17 dBm at >1.0 MHz from carrier frequency
On-Frequency: 0 dBm within ±10 kHz of the carrier frequency</td></tr>
</table>

VNA Functional Specifications

Measurements	Measurement Parameters	S_{11}, S_{21}
	Number of Traces	Four: TR1, TR2, TR3, TR4
	Trace Format	Single, Dual, Tri, Quad. When used with Number of Traces, overlays are possible including a Single Format with Four trace overlays.
	Graph Types	Log Magnitude, SWR, Phase, Real, Imaginary, Group Delay, Smith Chart, Log Mag/2 (1-Port Cable Loss), Linear Polar, Log Polar, Real Impedance, Imaginary Impedance
	Domains	Frequency Domain, Distance Domain
	Frequency	Start Frequency, Stop Frequency, Center Frequency, Span
	Distance	Start Distance, Stop Distance
	Frequency Sweep Type: Linear	Single Sweep, Continuous
	Data Points	2 to 4001 (arbitrary setting); data points can be reduced without recalibration.
	Limit Lines	Upper, Lower, 10 segmented Upper, 10 segmented Lower
	Test Limits	Pass/Fail for Upper, Pass/Fail for Lower, Limit Audible Alarm
	Data Averaging	Sweep-by-sweep
	Smoothing	0 to 20%
	IF Bandwidth	10, 20, 50, 100, 200, 500, 1 k, 2 k, 5 k, 10 k, 20 k, 50 k, 100 k (Hz)
	Reference Plane	The reference planes of a calibration (or other normalization) can be changed by entering a line length. Assumes no loss, flat magnitude, linear phase, and constant impedance.
	Auto Reference Plane Extension	Instead of manually entering a line length, this feature automatically adjusts phase shift from the current calibration (or other normalization) to compensate for external cables (or test fixtures). Assumes no loss, flat magnitude, linear phase, and constant impedance.
	Frequency Range	Frequency range of the measurement can be narrowed (reduces number of data points) within the calibration range without recalibration. When Interpolation is On, narrowed frequency range will retain original number of data points.
	Group Delay Aperture	Defined as the frequency span over which the phase change is computed at a given frequency point. The aperture can be changed without recalibration. The minimum aperture is the frequency range divided by the number of points in calibration and can be increased to 20% of the frequency range.
	Group Delay Range	<180° of phase change within the aperture
	Trace Memory	A separate memory for each trace can be used to store measurement data for later display. The trace data can be saved and recalled.
	Trace Math	Complex trace math operations of subtraction, addition, multiplication, or division are provided.
	Number of Markers	12, arbitrary assignments to any trace
	Marker Types	Reference, Delta
	Marker Readout Styles	Log Mag, Cable Loss (Log Mag/2), Log Mag and Phase, Phase, Real and Imaginary, SWR, Impedance, Admittance, Normalized Impedance, Normalized Admittance, Polar Impedance, and Group Delay
	Marker Search	Peak Search, Valley Search, Find Marker Value
	Calibration Type	Full S_{11}, 1-Path, 2-Port (S_{11} and S_{21}), Response S_{11}, Response S_{21}
	Calibration Methods	Short-Open-Load-Through (SOLT)
	Calibration Standards' Coefficients	Coax: N-Connector, K-Connector, 7/16, TNC, SMA, and four User Defined
	Cal Correction Toggle	On/Off
	Interpolation	On/Off (Interpolation may be activated before or after calibration)
	Impedance Conversion (Smith Chart)	Support for 50Ω and 75Ω are provided.
	Units	Meters, Feet
	Bias Tee Settings	Internal, Off
	Timebase Reference	Internal
	File Storage Types	Measurement, Setup (with CAL), Setup (without CAL), S2P (Real/Imag), S2P (Lin Mag/Phase), S2P (Log Mag/Phase), JPEG
	Ethernet Configuration	DHCP or Manual (Static); IP, Gateway, Subnet entries
	Languages	English, French, German, Spanish, Chinese, Japanese, Korean, Italian, Russian plus one User Defined

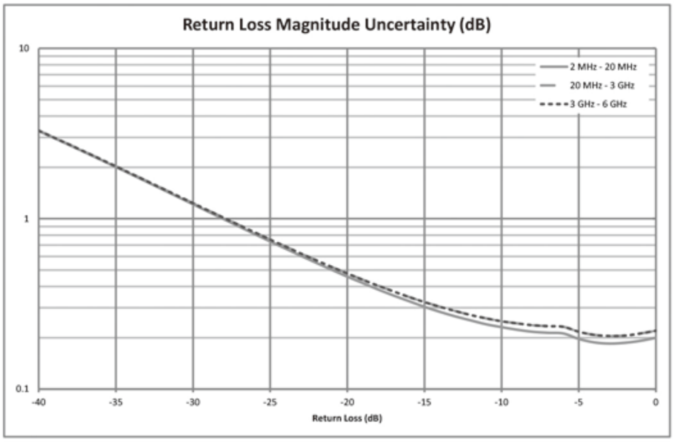
Corrected System Performance and Uncertainties — High Port Power, N-Type

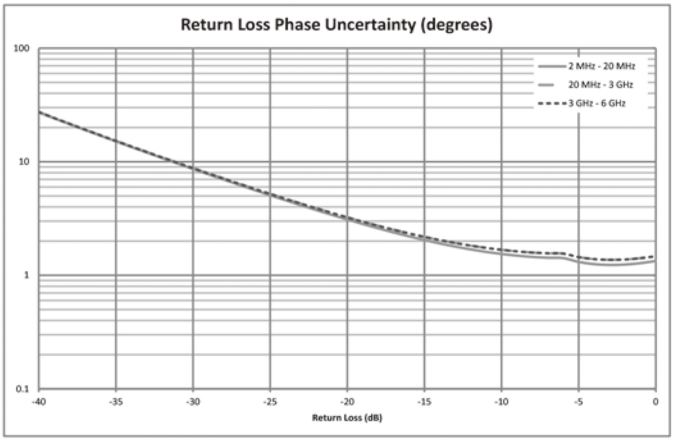
Measurement Accuracy OSLN50A-8 or OSLNF50A-8, TOSLN50A-8 or TOSLNF50A-8.

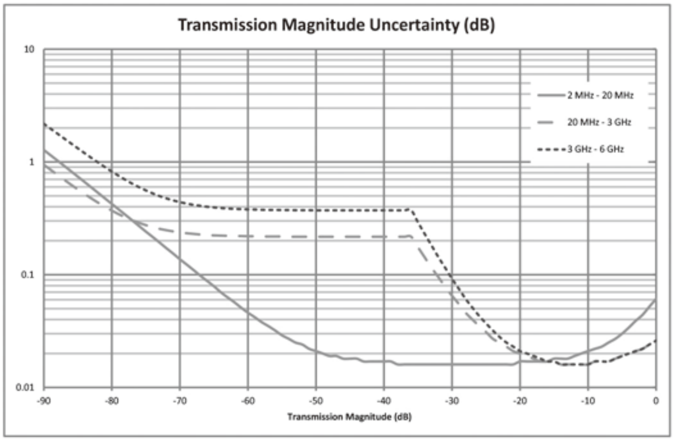
Full 1-path, 2-port forward path calibration with isolation, high power, 10 Hz IFBW, no averaging, 10 minute warm-up.
OSLN50A-8, OSLNF50A-8, TOSLN50A-8, or TOSLNF50A-8 calibration kit. Reflection and Transmission Tracking are typical.

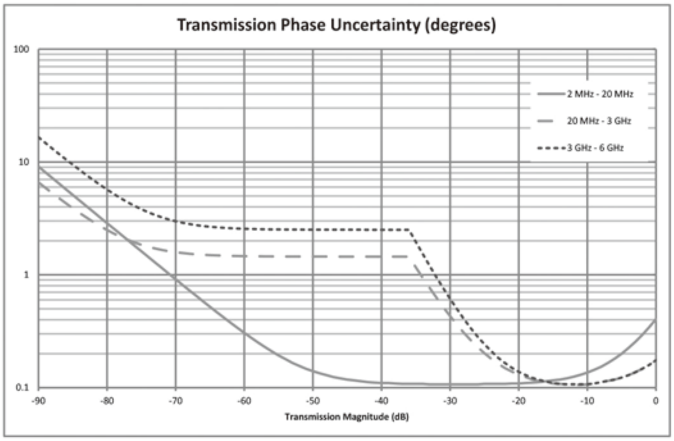
Frequency Range	Directivity (dB)	Source Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
<20 MHz	≥42	≥30	±0.01	±0.01
20 MHz to <3 GHz	≥42	≥30	±0.05	±0.01
3 GHz to 6 GHz	≥42	≥30	±0.05	±0.01

Corrected Measurement Uncertainty (Transmission from Port 1 to Port 2)









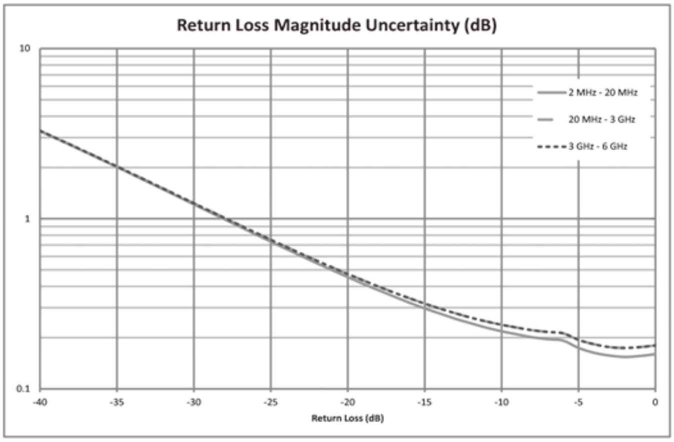
Corrected System Performance and Uncertainties — High Port Power, K-Type

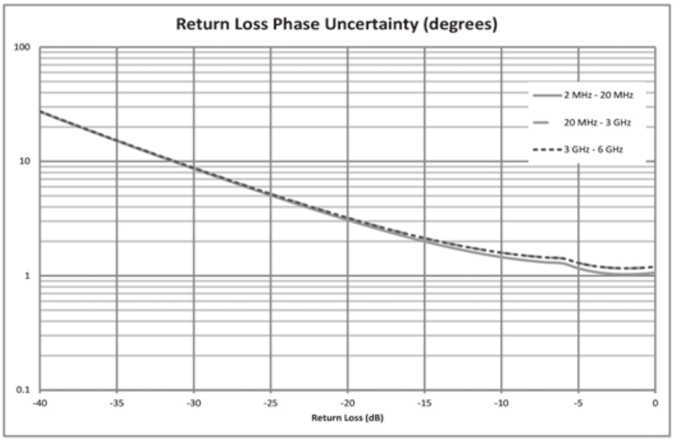
Measurement Accuracy TOSLK50A-20 or TOSLKF50A-20. Compatible with 3.5 mm and SMA connectors.

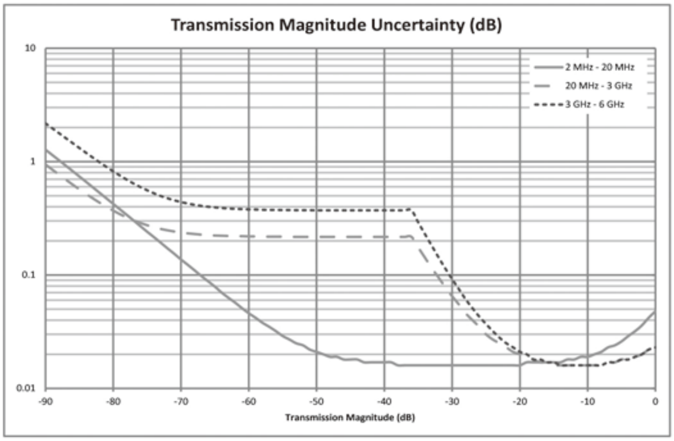
Full 1-path, 2-port forward path calibration with isolation, high power, 10 Hz IFBW, no averaging, 10 minute warm-up.
TOSLK50A-20, TOSLKF50A-20 calibration kit. Reflection and Transmission Tracking are typical.

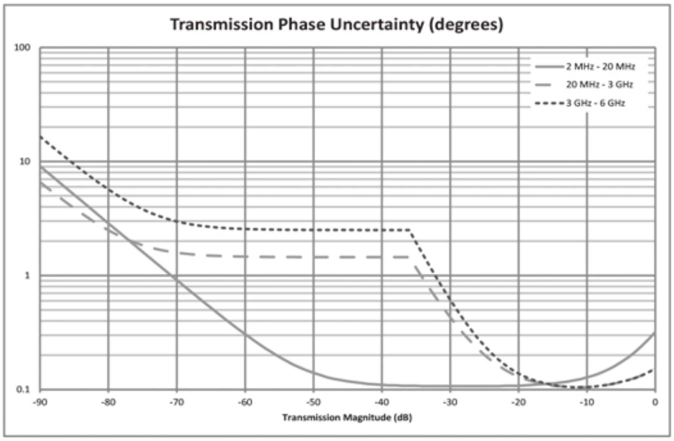
Frequency Range	Directivity (dB)	Source Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
<20 MHz	≥42	≥33	±0.01	±0.01
20 MHz to <3 GHz	≥42	≥33	±0.05	±0.01
3 GHz to 6 GHz	≥42	≥33	±0.05	±0.01

Corrected Measurement Uncertainty (Transmission from Port 1 to Port 2)


Return Loss Magnitude Uncertainty (dB)


Return Loss Phase Uncertainty (degrees)


Transmission Magnitude Uncertainty (dB)


Transmission Phase Uncertainty (degrees)

Spectrum Analyzer Performance Specifications (Models MS203xB only)

Frequency	Frequency Range	MS2034B: 9 kHz to 4 GHz, (tunable to 0 Hz) MS2035B: 9 kHz to 6 GHz, (tunable to 0 Hz)
	Frequency Span	MS2034B: 10 Hz to 4 GHz including zero span MS2035B: 10 Hz to 6 GHz including zero span
	Tuning Resolution	1 Hz
	Frequency Reference Aging	±1.0 ppm/year
	Frequency Reference Accuracy	±1.5 ppm (25° ±25°C) + aging, <±50 ppb with GPS On
	Sweep Time	Minimum 100 ms, 10 µs to 600 seconds in zero span
	Sweep Time Accuracy	±2% in zero span
Bandwidth	Resolution Bandwidth (RBW)	10 Hz to 3 MHz in 1–3 sequence ±10% (1 MHz max in zero-span) (–3 dB bandwidth)
	Video Bandwidth (VBW)	1 Hz to 3 MHz in 1–3 sequence (–3 dB bandwidth) (auto or manually selectable)
	RBW with Quasi-Peak Detection	200 Hz, 9 kHz, 120 kHz (–6 dB bandwidth)
	VBW with Quasi-Peak Detection	Auto VBW is On, RBW/VBW = 1
Spectral Purity	SSB Phase Noise @ 1 GHz	–100 dBc/Hz, –110 dBc/Hz (typ.) @ 10 kHz offset –105 dBc/Hz, –112 dBc/Hz (typ.) @ 100 kHz offset –115 dBc/Hz, –121 dBc/Hz (typ.) @ 1 MHz offset
Amplitude	Dynamic Range	>102 dB (2.4 GHz), 2/3 (TOI-DANL) in 10 Hz RBW
	Measurement Range	DANL to +26 dBm (≥ 50 MHz) DANL to 0 dBm (<50 MHz)
	Maximum Continuous Input	+30 dBm Peak
	Display Range	1 to 15 dB/div in 1 dB steps, ten divisions displayed
	Reference Level Range	–120 to +30 dBm
	Attenuator Resolution	0 to 55 dB, 5.0 dB steps
	Amplitude Units Log Scale Modes	dBm, dBV, dBmV, dBmV, dBW, dBA
	Linear Scale Modes	nV, mV, mV, V, kV, nW, mW, mW, W, kW, nA, mA, mA, A
Displayed Average Noise Level (DANL)		(RBW Normalized to 1 Hz, 0 dB attenuation)

	Preamp Off (Reference level –20 dBm)		Preamp On (Reference level –50 dBm)	
	Maximum	Typical	Maximum	Typical
10 MHz to 2.4 GHz	–141 dBm	–146 dBm	–157 dBm	–162 dBm
>2.4 GHz to 4 GHz	–137 dBm	–141 dBm	–154 dBm	–159 dBm
>4 GHz to 5 GHz	–134 dBm	–138 dBm	–150 dBm	–155 dBm
>5 GHz to 6 GHz	–126 dBm	–131 dBm	–143 dBm	–150 dBm

Spurs	Residual Spurious	<–90 dBm (RF input terminated, 0 dB input attenuation, >10 MHz)
	Input-Related Spurious	<–75 dBc (0 dB attenuation, –30 dBm input, span <1.7 GHz, carrier offset >4.5 MHz)
	Exceptions (typ.)	<–70 dBc @ <2.5 GHz with 2072.5 MHz Input <–68 dBc @ F1 – 280 MHz with F1 Input <–70 dBc @ F1 + 190.5 MHz with F1 Input <–52 dBc @ 7349 – 2F2 MHz, with F2 Input, where F2 <2424.5 MHz <–55 dBc @ 190.5 ± (F1/2) MHz, F1 <1 GHz
Second Harmonic Distortion	Preamp Off, 0 dB input attenuation, –30 dBm input	
	50 MHz	–56 dBc
	>50 MHz to 200 MHz	–60 dBc (typ.)
	>200 MHz to 3000 MHz	–70 dBc (typ.)
	VSWR	2:1 (typ.)
Third-Order Intercept (TOI)	Preamp Off, –20 dBm tones 100 kHz apart, 10 dB attenuation	
	800 MHz	+16 dBm
	2400 MHz	+20 dBm
	200 MHz to 2200 MHz	+25 dBm (typ.)
	>2.2 GHz to 5.0 GHz	+28 dBm (typ.)
	>5.0 GHz to 6.0 GHz	+33 dBm (typ.)

Spectrum Analyzer Functional Specifications (Models MS203xB only)

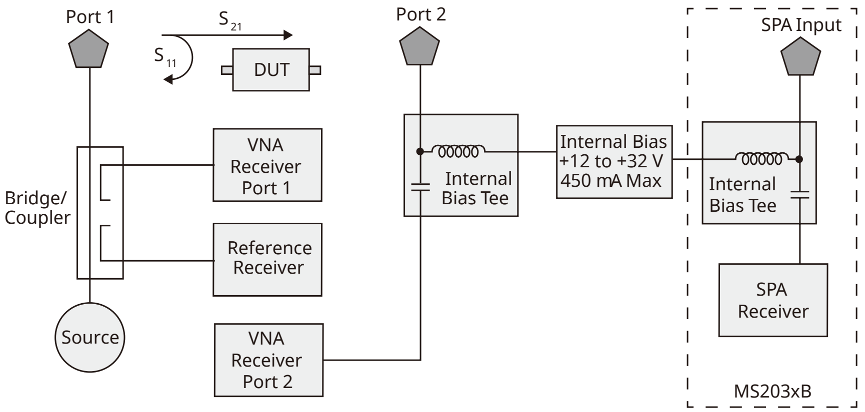
Measurements	Measurements	Field Strength (uses antenna calibration tables to measure dBm/m^2, dBmV/m, dBV/m, dBμV/m, Volt/m, Watt/m^2, dBW/m^2, A/m, dBA/m and Watt/cm^2) Occupied Bandwidth (measures 99 to 1% power channel of a signal) Channel Power (measures the total power in a specified bandwidth) ACPR (Adjacent Channel Power Ratio) AM/FM/SSB Demodulation (Wide/Narrow FM, AM, Upper/Lower SSB), (audio out only) C/I (carrier-to-interference ratio) Emission Mask Coverage Mapping (requires Option 431 and Option 31) PIM Alert Application (available for download)
Setup Parameters	Frequency	Center/Start/Stop, Span, Frequency Step, Signal Standard, Channel #, Channel Increment
	Amplitude	Reference Level (RL), Scale, Attenuation Auto/Level, RL Offset, Pre-Amp On/Off, Detection
	Span	Span, Span Up/Down (1-2-5), Full Span, Zero Span, Last Span
	Bandwidth	RBW, Auto RBW, VBW, Auto VBW, RBW/VBW, Span/RBW
	File	Save, Recall, Delete, Directory Management
	Save/Recall	Setups, Measurements, Limit Lines, Screen Shots JPEG (save only), Save-on-Event
	Save-on-Event	Crossing Limit Line, Sweep Complete, Save-then-Stop, Clear All
	Delete	Selected File, All Measurements, All Mode Files, All Content
	Directory Management	Sort Method (Name/Type/Date), Ascend/Descend, Internal/USB, Copy, Format USB
	Application Options	Bias-Tee (On/Off), Impedance (50Ω, 75Ω, Other)
Sweep Functions	Sweep	Single/Continuous, Sweep Mode (Fast, Performance, No FFT), Reset, Detection, Minimum Sweep Time, Trigger Type, Gated Sweep (see Option 90)
	Detection	Peak, RMS, Negative, Sample, Quasi-peak
	Triggers	Free Run, External, Video, Change Position, Manual
Trace Functions	Traces	Up to three Traces (A, B, C), View/Blank, Write/Hold, Trace A/B/C Operations
	Trace A	Operations Normal, Max Hold, Min Hold, Average, # of Averages, (always the live trace)
	Trace B	Operations A → B, B ↔ C, Max Hold, Min Hold
	Trace C	Operations A → C, B ↔ C, Max Hold, Min Hold, A – B → C, B – A → C, Relative Reference (dB), Scale
Marker Functions	Markers	Markers 1–6 each with a Delta Marker, or Marker 1 Reference with Six Delta Markers, Marker Table (On/Off), All Markers Off
	Marker Types Marker Auto-Position Marker Table	Style (Fixed/Tracking), Noise Marker, Frequency Counter Marker Peak Search, Next Peak (Right/Left), Peak Threshold%, Set Marker to Channel, Marker Frequency to Center, Delta Marker to Span, Marker to Reference Level 1–6 markers frequency and amplitude plus delta markers frequency amplitude and offset
	Marker Table	1–6 markers frequency and amplitude plus delta markers frequency offset and amplitude
Limit Line Functions	Limit Lines	Upper/Lower, On/Off, Edit, Move, Envelope, Advanced, Limit Alarm, Default Limit
	Limit Line Edit	Frequency, Amplitude, Add Point, Add Vertical, Delete Point, Next Point Left/Right
	Limit Line Move	To Current Center Frequency, By dB or Hz, To Marker 1, Offset from Marker 1
	Limit Line Envelope	Create Envelope, Update Amplitude, Number of Points (41 max), Offset, Shape Square/Slope
	Limit Line Advanced	Type (Absolute/Relative), Mirror, Save/Recall

Bias Tee (Option 10)

Bias Tee Measurements
For tower mounted amplifier tests, the MS202xB/MS203xB series with optional internal bias tees can supply both DC and RF signals on the center conductor of the cable during measurements. For frequency sweeps in excess of 2 MHz, the VNA Master can supply internal voltage control from +12 V to +32 V in 0.1 V steps up to 450 mA. Bias can be directed to VNA Port 2 or to the Spectrum Analyzer Input Port (MS203xB).

Frequency Range	MS20x4B: 2 MHz to 4 GHz MS20x5B: 2 MHz to 6 GHz
Internal Voltage/Current	+12 V to +32 V at 450 mA (1 A surge for 100 ms)
Internal Resolution	0.1 V
Bias Tee Selections	Internal, Off

The Compact VNA Master offers optional integrated bias tee for supplying DC plus RF to the DUT as shown in this simplified block diagram.



Vector Voltmeter (Option 15)

A phased array system relies on phase matched cables for nominal performance. For this class of application, the VNA Master offers this special software mode to simplify phase matching cables at a single frequency. The similarity between the popular vector voltmeter and this software mode ensures minimal training is required to phase match cables. Operation is as simple as configuring the display for absolute or relative measurements. The easy-to-read large fonts show either reflection or transmission measurements using impedance, magnitude, or VSWR readouts. For instrument landing system (ILS) or VHF Omnidirectional Range (VOR) applications, a table view improves operator efficiency when phase matching up to twelve cables. The MS202xB/MS203xB solution is superior because the signal source is included internally, precluding the need for an external signal generator.

VVM Specifications	CW Frequency Range	500 kHz to 4 GHz/6 GHz
	Source Power	High, Default, Low
	IFBW	10 Hz to 100 kHz in 1-2-5 sequence
	Measurement Display	CW, Table (twelve entries, plus reference)
	Measurement Types	Return Loss, Insertion
	Measurement Format	dB/VSWR/Impedance

High Accuracy Power Meter (Option 19) (Requires external USB power sensor)

Conduct precise measurements of CW and digitally modulated transmitters in the field using this VNA Master software mode with a separately purchased Anritsu USB power sensor. After specifying the center frequency and zeroing the sensor to ensure accuracy at low power levels, the software offers intuitive operation for absolute and relative readouts in dBm or Watts.

Amplitude	Maximum, Minimum, Offset, Relative On/Off, Units, Auto Scale
Average	# of Running Averages, Max Hold
Zero/Cal	Zero On/Off, Cal Factor (Center Frequency, Signal Standard)
Limits	Limit On/Off, Limit Upper/Lower

Power Sensor Model	MA24105A	MA24106A	MA24108A/18A/26A	MA24208A/18A	MA24330A/40A/50A
Description	Inline High Power Sensor	High Accuracy RF Power Sensor	Microwave USB Power Sensor	Microwave Universal USB Power Sensor	Microwave CW USB Power Sensor
Frequency Range	350 MHz to 4 GHz	50 MHz to 6 GHz	10 MHz to 8/18/26 GHz	10 MHz to 8 GHz/18 GHz	10 MHz to 33/40/50 GHz
Connector	Type N (f), 50Ω	Type N (m), 50Ω	Type N (m), 50Ω (8 GHz/18 GHz) Type K (m), 50Ω (26 GHz)	Type N (m), 50Ω	Type K (m), 50Ω (33 GHz/40 GHz) Type V (m), 50Ω (50 GHz)
Dynamic Range	+3 to +51.76 dBm (2 mW to 150 W)	–40 to +23 dBm (0.1 µW to 200 mW)	–40 to +20 dBm (0.1 µW to 100 mW)	–60 to +20 dBm (1 nW to 100 mW)	–70 to +20 dBm (0.1 nW to 100 mW)
Measurand	True-RMS	True-RMS	True-RMS, Slot Power, Burst Average Power	True-RMS, Slot Power, Burst Average Power	Average Power
Measurement Uncertainty	± 0.17 dB*1	± 0.16 dB*2	± 0.18 dB*3	± 0.17 dB*4	± 0.17 dB*5
Data sheet (for complete specifications)	11410-00621	11410-00424	11410-00504	11410-00841	11410-00906

*1: Expanded uncertainty with K = 2 for power measurements of a CW signal greater than +20 dBm with a matched load. Measurement results referenced to the input side of the sensor.

*2: Total RSS measurement uncertainty (0° to 50°C) for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.

*3: Expanded uncertainty with K = 2 for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.

*4: Power uncertainty expressed with two sigma confidence level for CW measurement after zero operation. Includes calibration factor and linearity over temperature uncertainties, but not the effects of mismatch, zero set and drift, or noise.

*5: Includes linearity over temperature uncertainties, but not the effects of calibration factor, mismatch, zero set and drift, and noise.

Interference Analyzer (Option 25) (Models MS203xB only, GPS Option 31 recommended)

Measurements	Spectrum	Field Strength Occupied Bandwidth Channel Power Adjacent Channel Power (ACPR) AM/FM/SSB Demodulation (Wide/Narrow FM, Upper/Lower SSB – audio out only) Carrier-to-Interference ratio (C/I)
	Spectrogram	Collect data up to one week
	Signal Strength	Gives visual and aural indication of signal strength
	Received Signal Strength Indicator (RSSI)	Collect data up to one week
	Signal ID	Up to 12 signals Center Frequency Bandwidth Signal Type: FM, GSM, W-CDMA, CDMA, Wi-Fi Closest Channel Number Number of Carriers
	Signal-to-Nose Ratio (SNR)	>10 dB
	Interference Mapping	Triangulate location of interference with on-display maps
	Application Options	Bias-Tee (On/Off), Impedance (50Ω, 75Ω, Other)

Channel Scanner (Option 27) (Models MS203xB only, GPS Option 31 recommended)

General	Number of Channels	1 to 20 Channels
	Measurements	Graph/Table, Max Hold (On/5 s/Off), Freq/Channel, Current/Max, Single/Dual Color
	Scanner	Scan Channels, Scan Frequencies, Scan Customer List, Scan Script Master™
	Amplitude	Reference Level, Scale
	Custom Scan	Scan Signal Standard, Channel, # of Channels, Channel Step Size, Custom Scan
	Frequency Range	9 kHz to 4 GHz (MS2034B), 9 kHz to 6 GHz (MS2035B)
	Frequency Accuracy	±10 Hz + Time base error
	Measurement Range	–110 to +26 dBm
	Application Options	Bias-Tee (On/Off), Impedance (50Ω, 75Ω, Other)

GPS (Option 31) (requires external GPS antenna, sold separately)

Built-in GPS provides location information (latitude, longitude, altitude) and Universal Time (UT) information for storage along with trace data so that you can later verify that measurements were taken at the right location. The GPS option requires a separately ordered Anritsu GPS antenna. Frequency accuracy is enhanced for the Spectrum Analyzer (on MS203xB models) when GPS is active and has achieved satellite lock.

Setup	On/Off, Antenna Voltage 3.3 V/5.0 V, GPS Info
GPS Time/Location Indicator	Time, Latitude, Longitude and Altitude on display Time, Latitude, Longitude and Altitude with trace storage
High Frequency Accuracy	Spectrum Analyzer, Interference Analyzer, CW Signal Analyzers <±50 ppb with GPS On, GPS antenna connected, 3 minutes after satellite lock in selected mode
Connector	SMA, Female

Ethernet Connectivity (Option 411)

Connector	RJ45
LAN Speed	10 Mbps
Mode	Static, DHCP
Static IP settings	IP address Subnet Mask IP Gateway
Remote Control	Fully remote programmable via SCPI commands and/or remote access utility provided with Master Software Tools
Data Upload	With Line Sweep Tools or Master Software Tools through a LAN connection

Distance Domain (Formerly Option 501, now standard with firmware v1.20 or greater)

Distance-to-Fault Analysis (standard with firmware v1.20 and above) is a powerful field test tool to analyze cables for faults, including minor discontinuities that may occur due to a loose connection, corrosion, or other aging effects. By using Frequency Domain Reflectometry (FDR), the Compact VNA Master exploits a user-specified band of full power operational frequencies (instead of DC pulses from TDR approaches) to more precisely identify discontinuities. The Compact VNA Master converts S-parameters from frequency domain into distance domain on the horizontal display axis, using a mathematical computation called Inverse Fourier Transform. Connect a reflection at the opposite end of the cable, and the discontinuities appear versus distance to reveal any potential maintenance issues. When access to both ends of the cable is convenient, a similar distance domain analysis is available on transmission measurements.

Distance Domain, will improve your productivity with displays of the cable in terms of discontinuities versus distance. This readout can then be compared against previous measurements (from stored data) to determine whether any degradations have occurred since installation (or the last maintenance activity). More importantly, you will know precisely where to go to fix the problem and so minimize or prevent downtime of the system.

Coverage Mapping (Option 431) (Models MS203xB only. Requires GPS)

Measurements	Indoor Mapping	RSSI and ACPR
	Outdoor Mapping	RSSI and ACPR
Setup Parameters	Frequency	Center/Start/Stop, Span, Freq Step, Signal Standard, Channel #, Channel Increment
	Amplitude	Reference Level (RL), Scale, Attenuation Auto/Level, RL Offset, Pre-Amp On/Off, Detection
	Span	Span, Span Up/Down (1-2-5), Full Span, Zero Span, Last Span
	BW	RBW, Auto RBW, VBW, Auto VBW, RBW/VBW, Span/VBW
	Measurement Setup	ACPR, RSSI
	Point Distance/Time Setup	Repeat Type Time Distance
	Save Points Map	Save KML, JPEG, Tab Delimited
	Recall Points Map	Recall Map, Recall KML Points only, Recall KML Points with Map, Recall Default Grid

AM/FM/PM Demodulation Analyzer (Option 509) (Models MS203xB only)

Measurements							
Display Type	RF Spectrum AM/FM/PM	Audio Spectrum (AM)	Audio Spectrum (FM/PM)	Audio Waveform (AM)	Audio Waveform (FM/PM)	Summary (AM)	Summary (FM/PM)
Graphic Display	Power (dBm) vs. Frequency	Depth (%) vs. Modulation Frequency	Deviation (kHz/rad) vs. Modulation Frequency	Depth (%) vs. Time	Deviation (kHz/rad) vs. Time	None	None
Numerical Displays	Carrier Power Carrier Frequency Occupied Bandwidth	AM Rate RMS Depth (Pk-Pk)/2 Depth SINAD* THD* Distortion/Total Vrms*	FM/PM Rate RMS Deviation (Pk-Pk)/2 Deviation SINAD* THD* istortion/Total Vrms*	AM Rate RMS Depth (Pk-Pk)/2 Depth SINAD* THD* Distortion/Total Vrms*	FM/PM Rate RMS Depth (Pk-Pk)/2 Depth SINAD* THD* Distortion/Total Vrms*	RMS Depth (AM) Peak + Depth Peak – Depth (Pk-Pk)/2 Depth Carrier Power Carrier Frequency Occupied Bandwidth AM Rate SINAD* THD* Distortion/Total Vrms*	RMS Deviation (FM/PM) Peak + Depth Peak – Depth (Pk-Pk)/2 Depth Carrier Power Carrier Frequency Occupied Bandwidth AM Rate SINAD* THD* Distortion/Total Vrms*

*: Requires Sinewave modulation

Setup Parameters	Frequency	Center Freq, Span, Freq Step, Signal Standard, Channel, Channel Increment, Set Carrier Freq
	Amplitude	Scale, Power Offset, Adjust Range
	Setup	Demod Type (AM, FM, PM), IFBW, Auto IFBW
	Measurements	RF Spectrum AM/FM/PM, Audio Spectrum (AM/FM/PM), Audio Waveform (AM/FM/PM), Summary (AM/FM/PM), Average
	Marker	On/Off, Delta, Peak Search, Marker Freq to Center, Marker to Ref Lvl, Marker Table, All Markers Off
Specifications	AM	Modulation Rate: ±1 Hz (<100 Hz), ±2% (>100 Hz) Depth: ±5% for (Modulation rates 10 Hz to 100 kHz)
	FM	Modulation Rate: ±1 Hz (<100 Hz); ±2% (100 Hz to 100 kHz) Deviation Accuracy: ±5% (100 Hz to 100 kHz)*
	PM	Modulation Rate: ±1 Hz (<100 Hz); ±2% (100 Hz to 100 kHz) Deviation Accuracy: ±5% (deviation 0 to 93 rad, rate 10 Hz to 5 kHz)*
	IF bandwidth	1 kHz to 300 kHz in 1-3 sequence
	Frequency Span	RF Spectrum: 10 kHz to 10 MHz Audio Spectrum: 2 kHz, 5 kHz, 10 kHz, 20 kHz, 70 kHz, 140 kHz
	RBW/VBW	30
	Span/RBW	100
	Sweep time	50 µs to 50 ms (Audio Waveform)

*: IFBW must be greater than 95% occupied BW

Line Sweep Tools (for your PC)

Trace Capture	Browse to Instrument	View and copy traces from the test equipment to your PC using Windows Explorer
	Open Legacy Files	Open DAT files captured with Hand Held Software Tools v6.61
	Open Current Files	Open VNA or DAT files
	Capture plots To	The Line Sweep Tools screen, DAT files, Database, or JPEG
Traces	Trace Types	Return Loss, VSWR, DTF-RL, DTF-VSWR, Cable Loss, Smith and Smith Chart
	Trace Formats	DAT, VNA, CSV, PNG, BMP, JPG, HTML, Data Base, and PDF
Report Generation	Report Generator	Includes GPS location along with measurements
	Report Format	Create reports in HTML or PDF format
	Report Setup	Report Title, Company, Prepared for, Location, Date and Time, Filename, Company logo
	Trace Setup	1 trace Portrait Mode, 2 Trace Portrait Mode, 1 Trace Landscape Mode
Trace Validation	Presets	7 presets allow “one click” setting of up to 6 markers and one limit line
	Marker Controls	6 regular Markers, Marker Peak, Marker valley, Marker between, and frequency entry
	Delta Markers	6 Delta markers
	Limit Line	Enable and drag or value entry. Also works with presets
	Next Trace Button	Next Trace and Previous trace arrow keys allow quick switching between traces
Tools	Cable Editor	Allows creation of custom cable parameters
	Distance to Fault	Converts a Return Loss trace to a Distance to Fault trace
	Measurement Calculator	Converts Real, Imaginary, Magnitude, Phase, RL, VSWR, Rho, and Transmit power
	Signal Standard Editor	Creates new band and channel tables
	Renaming Grid	36 user definable phrases for creation of file names, trace titles, and trace subtitles
Connectivity	Connections	Ethernet, USB cable, USB Memory Stick (Ethernet requires Option 411)

Master Software Tools (for your PC)

Mapping (GPS Required)	Spectrum Analyzer Mode	MapInfo, MapPoint
	Mobile WiMAX OTA, LTE OTA Options	Google Earth, Google Maps, MapInfo
Spectrogram	(Spectrum Monitoring for Interference Analysis and Spectrum Clearing)	
	Source	Recorded Spectrogram or multiple spectrum traces
	Folder Spectrogram	2D View creates a composite file of multiple traces
	Available Displays	Spectrogram, Peak Power vs. Time, Variation in Total Power vs. Time, Peak Frequency vs. Time, Number of Traces Saved vs. Time (useful with Save on Limit Exceeded), Maximum/Average/Minimum Power vs. Time File Filter (Violations over limit lines or deviations from averages) Playback
	Display Functions per Trace	Markers, GPS location altitude and time (when recorded), instrument time Filename per trace for Folder Spectrogram
	Export to Video	Create AVI file of 2D Spectrogram for management review/reports
	Export to 3D Spectrogram	Views (Set Threshold, Markers) - 3D (Rotate X, Y, Z Axis, Level Scale, Signal ID) - 2D (Frequency or Time Domain, Signal ID) - Top Down Playback (Frequency and/or Time Domain)
List/Parameter Editors	Antennas, Cables, Signal Standards	Modify instrument's Antenna, Cable, and Signal Standard List
	Pass/Fail	Create, download, or edit Signal Analysis Pass/Fail Limits
	Script Master	Create Script Master files for GSM/WCDMA or Channel Scanner
	Languages	Modify non-English language menus
	Mobile WiMAX	DL-MAP Parameters
Connectivity	Connections	Connect to PC using USB, LAN, or Direct Ethernet connection (LAN and Ethernet require Option 411)
	Network Search	Find all Anritsu handheld instruments on local network
	Download	Download measurements and live traces to PC for storage and analysis
	Upload	Upload measurements and other files from PC to instrument
	Export	Measurements can be saved in various formats, depending on the measurement type, including JPEG, CSV, and Anritsu DAT format
	Printing	Print individual or all measurement screens

General Specifications

Maximum Input		(Damage Level)
	VNA Port 1 or 2	+23 dBm, ±50 VDC
	Spectrum Analyzer Port	+30 dBm peak, ±50 VDC, Maximum Continuous Input, ≥10 dB attenuation (Models MS203xB, spectrum analyzer input port only)
Setup Parameters	System	Status (Temperature, Battery Info, Serial Number, Firmware Version, Options Installed) Self Test, Application Self Test GPS (see Option 31)
	System Options	Name, Date and Time, Ethernet Configuration, Brightness, Volume, Language (English, French, German, Spanish, Chinese, Japanese, Korean, Italian, Russian, User defined), Reset (Factory Defaults, Master Reset, Update Firmware)
	File	Save, Recall, Copy, Delete, Directory Management
	Save/Recall	Setups, Measurements, Screen Shots JPEG (save only), Limit Lines
	Copy	Setups, Measurements, Screen Shots JPEG
	Delete	Selected File, All Measurements, All Mode Files, All Content
	Directory Management	Sort Method (Name/Type/Date), Ascend/Descend, Internal/USB, Copy, Format USB
	Internal Trace/Setup Memory	2000 traces, 2000 setups
	External Trace/Setup Memory	Limited by size of USB Flash drive
	Mode Switching	Auto-Stores/Recalls most recently used Setup Parameters in the Mode
Connectors	VNA Port 1 or 2	Type N (f), 50Ω
	Spectrum Analyzer Port	Type N (f), 50Ω (MS203xB only)
	GPS	SMA (f)
	External Power	5.5 mm barrel connector, 12.5 VDC to 15 VDC, <4.0 Amps
	USB Interface (2)	Type A, Connect Flash Drive and Power Sensor
	USB Interface	5-pin mini-B, Connect to PC for data transfer
	Headset Jack	3.5 mm barrel connector
	External Reference In	BNC (f), Maximum Input ±5 VDC 1, 5, 10, 13 MHz
	External Trigger/Clock Recovery	BNC (f), Maximum Input ±5 VDC
	Ethernet	RJ45 connector for Ethernet 10/100-BaseT (Available with Option 411 Ethernet)
Display	Type	Resistive Touch Screen
	Size	8.4 in, daylight viewable color LCD
	Resolution	800 × 600
	Pixel Defects	No more than five defective pixels (99.9989% good pixels)

Continued on next page

Power	Field replaceable Battery	Li-Ion, 633-75, 7500 mAh
	DC Power	40 W on battery power only Universal 110 V/220 V AC/DC Adapter 55 W running off AC/DC adaptor while charging battery
	Life time charging cycles	>300 (80% of initial capacity)
	Battery Operation	3.6 hours (typ.)
	Battery Charging Limits	0° to +45°C, Relative Humidity ≤80%
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU
RCM	Australia and New Zealand	RCM AS/NZS 4417:2012
KCC	South Korea	KCC-REM-A21-0004
Environmental (MS202xB/3xB) MIL-PRF-28800F, Class 2	Operating Temperature Range	–10° to +55°C
	Storage Temperature Range	–51° to +71°C
	Maximum Relative Humidity	95% RH at +30°C, non-condensing
	Vibration, Sinusoidal	5 Hz to 55 Hz
	Vibration, Random	10 Hz to 500 Hz
	Half Sine Shock	30 g_n
	Altitude	4600 meters, operating and non-operating
	Explosive Atmosphere	MIL-PRF-28800F Section 4.5.6.3 MIL-STD-810G, Method 511.5, Procedure 1
Dimensions and Mass	Dimensions	273 (W) × 199 (H) × 91 (D) mm [10.7 (W) × 7.8 (H) × 3.6 (D) in]
	Mass, Including Battery	3.5 kg (7.6 lb)
Warranty	Duration	Standard three-year warranty (battery one-year warranty)

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Instrument Options

VNA Master Handheld Vector Network Analyzer + Spectrum Analyzer

Includes standard three-year warranty and Certificate of Calibration and Conformance.

MS2024B	MS2025B	MS2034B	MS2035B	Description
500 kHz to 4 GHz	500 kHz to 6 GHz	500 kHz to 4 GHz	500 kHz to 6 GHz	Vector Network Analyzer
—	—	9 kHz to 4 GHz	9 kHz to 6 GHz	Spectrum Analyzer
MS2024B-0010	MS2025B-0010	MS2034B-0010	MS2035B-0010	Built-in Bias-Tee, +12 V to +32 V variable
MS2024B-0015	MS2025B-0015	MS2034B-0015	MS2035B-0015	Vector Voltmeter
MS2024B-0019	MS2025B-0019	MS2034B-0019	MS2035B-0019	High Accuracy Power Meter (requires external USB sensor, sold separately)
—	—	MS2034B-0025	MS2035B-0025	Interference Analyzer*1
—	—	MS2034B-0027	MS2035B-0027	Channel Scanner*1
MS2024B-0031	MS2025B-0031	MS2034B-0031	MS2035B-0031	GPS Receiver*2
MS2024B-0098	MS2025B-0098	MS2034B-0098	MS2035B-0098	Standard Calibration to ISO17025 and ANSI/NCSL Z540-1. Includes calibration certificate.
MS2024B-0099	MS2025B-0099	MS2034B-0099	MS2035B-0099	Premium Calibration to ISO17025 and ANSI/NCSL Z540-1. Includes calibration certificate, test report, and uncertainty data.
MS2024B-0411	MS2025B-0411	MS2034B-0411	MS2035B-0411	Ethernet Connectivity
—	—	MS2034B-0431	MS2035B-0431	Coverage Mapping*3
—	—	MS2034B-0509	MS2035B-0509	AM/FM/PM Demodulation Analyzer

*1: GPS Option 31 recommended.
*2: Requires external GPS antenna (sold separately).
*3: Requires GPS Option 31.

Model/Order No.	Name
	Standard Accessories (Included with instrument)
2000-1654-R	Soft Carrying Case
2000-1691-R	Stylus with Coiled Tether
2000-1797-R	Screen Protector Film (x2, one factory installed, one spare)
633-75	Rechargeable Li-Ion Battery, 7500 mAh
40-187-R	AC-DC Adapter
806-141-R	Automotive Power Adapter, 12 VDC, 60 W
3-2000-1498	USB A/5-pin mini-B Cable, 10 ft/305 cm
	- Certificate of Calibration and Conformance
	Optional Accessories
	Miscellaneous Accessories
MA2700A	Handheld Interference Hunter (For full specifications, refer to the Technical Data Sheet 11410-00692)
2000-1371-R	Ethernet Cable, 2.13 m (7 ft)
3-806-152	Cat 5e Crossover Patch Cable, 2.13 m (7 ft)
633-75	Rechargeable Li-Ion Battery, 7500 mAh
2000-1374	External Dual Charger for Li-Ion Batteries
2000-1689	EMI Near Field Probe Kit
66864	Rack Mount Kit

Model/Order No.	Name
	Backpack and Transit Case
67135	Anritsu Backpack (For Handheld Instrument and PC)
760-243-R	Transit Case with Wheels and Handle 56 × 45.5 × 26.5 cm (22.07 × 17.92 × 10.42")
760-261-R	Large Transit Case with Wheels and Handle 63.1 × 50 × 30 cm (24.83 × 19.69 × 11.88"), space for MA2700A, antennas, filters, instrument inside soft case, and other interference hunting accessories/tools
760-271-R	Transit Case for Portable Directional Antennas and Port Extender 52.4 × 42.8 × 20.6 cm (20.62 × 16.87 × 8.12") (for 2000-1777-R, 2000-1778-R, 2000-1779-R, 2000-1798-R)
	GPS Antennas (Active)
2000-1652-R	Magnet Mount, SMA (m), 3 VDC to 5 VDC with 1 ft cable
2000-1528-R	Magnet Mount, SMA (m), 3 VDC to 5 VDC with 4.6 m (15 ft) extension cable
2000-1760-R	Mini GPS Antenna, SMA (m), 25 dB gain, 2.5 VDC to 3.7 VDC

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Model/Order No.	Name
	Power Sensors (For complete ordering information see the respective datasheets of each sensor)
MA24105A	Inline Peak Power Sensor, 350 MHz to 4 GHz, +3 to +51.76 dBm
MA24106A	RF USB Power Sensor, 50 MHz to 6 GHz, +23 dBm
MA24108A	Microwave USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24118A	Microwave USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24126A	Microwave USB Power Sensor, 10 MHz to 26 GHz, +20 dBm
MA24208A	Microwave Universal USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24218A	Microwave Universal USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24330A	Microwave CW USB Power Sensor, 10 MHz to 33 GHz, +20 dBm
MA24340A	Microwave CW USB Power Sensor, 10 MHz to 40 GHz, +20 dBm
MA24350A	Microwave CW USB Power Sensor, 10 MHz to 50 GHz, +20 dBm
MA25100A	RF Power Indicator
	Full Temperature N-Type Coaxial Calibration Kits –10° to +55°C (see individual data sheets on www.anritsu.com)
OSLN50A-8	High Performance Type N (m), DC to 8 GHz, 50Ω
OSLNF50A-8	High Performance Type N (f), DC to 8 GHz, 50Ω
TOSLN50A-8	High Performance with Through, Type N (m), DC to 8 GHz, 50Ω
TOSLNF50A-8	High Performance with Through, Type N (f), DC to 8 GHz, 50Ω
OSLN50A-18	High Performance Type N (m), DC to 18 GHz, 50Ω
OSLNF50A-18	High Performance Type N (f), DC to 18 GHz, 50Ω
TOSLN50A-18	High Performance with Through Type N (m), DC to 18 GHz, 50Ω
TOSLNF50A-18	High Performance with Through Type N (f), DC to 18 GHz, 50Ω
TOSLK50A-20	High Performance with Through Type K (m), DC to 20 GHz, 50Ω
TOSLKF50A-20	High Performance with Through Type K (f), DC to 20 GHz, 50Ω
TOSLK50A-40	High Performance with Through Type K (m), DC to 40 GHz, 50Ω
TOSLKF50A-40	High Performance with Through Type K (f), DC to 40 GHz, 50Ω
	Coaxial Calibration Components, other 50Ω, 75Ω
SM/PL-1	Precision N (m) Load, 42 dB, 6 GHz
SM/PLNF-1	Precision N (f) Load, 42 dB, 6 GHz
2000-1618-R	Open/Short/Load, 7/16 DIN (m), DC to 6.0 GHz 50Ω
2000-1914-R	Precision Open/Short/Load, 4.3-10 (f), DC to 6 GHz, 50Ω
2000-1915-R	Precision Open/Short/Load, 4.3-10 (m), DC to 6 GHz, 50Ω
2000-1619-R	Open/Short/Load, 7/16 DIN (f), DC to 6.0 GHz 50Ω
12N50-75B	Matching Pad, DC to 3 GHz, 50Ω to 75Ω
22N75	Open/Short, N (m), DC to 3 GHz, 75Ω
22NF75	Open/Short, N (f), DC to 3 GHz, 75Ω
26N75A	Precision Termination, N (m), DC to 3 GHz, 75Ω
26NF75A	Precision Termination, N (f), DC to 3 GHz, 75Ω
1091-55-R	Open, TNC (f), DC to 18 GHz
1091-53-R	Open, TNC (m), DC to 18 GHz
1091-56-R	Short, TNC (f), DC to 18 GHz
1091-54-R	Short, TNC (m), DC to 18 GHz
1015-54-R	Termination, TNC (f), DC to 18 GHz
1015-55-R	Termination, TNC (m), DC to 18 GHz
	Phase-Stable Test Port Cables, Armored
15NNF50-1.5C	1.5 m, DC to 6 GHz, N (m) to N (f), 50Ω
15NN50-1.5C	1.5 m, DC to 6 GHz, N (m) to N (m), 50Ω
15NDF50-1.5C	1.5 m, DC to 6 GHz, N (m) to 7/16 DIN (f), 50Ω
15ND50-1.5C	1.5 m, DC to 6 GHz, N (m) to 7/16 DIN (m), 50Ω
15NNF50-3.0C	3.0 m, DC to 6 GHz, N (m) to N (f), 50Ω
15NN50-3.0C	3.0 m, DC to 6 GHz, N (m) to N (m), 50Ω
15NNF50-5.0C	5.0 m, DC to 6 GHz, N (m) to N (f), 50Ω
15NN50-5.0C	5.0 m, DC to 6 GHz, N (m) to N (m), 50Ω
15N43M50-1.5C	Test Port Extension Cable, 1.5 m, DC to 6 GHz, N (m) to 4.3-10 (m)
15N43F50-1.5C	Test Port Extension Cable, 1.5 m, DC to 6 GHz, N (m) to 4.3-10 (f)
15N43M50-3.0C	Test Port Extension Cable, 3 m, DC to 6 GHz, N (m) to 4.3-10 (m)
15N43F50-3.0C	Test Port Extension Cable, 3 m, DC to 6 GHz, N (m) to 4.3-10 (f)
15NF43M50-1.5C	Test Port Extension Cable, 1.5 m, DC to 6 GHz, N (f) to 4.3-10 (m)
15NF43F50-1.5C	Test Port Extension Cable, 1.5 m, DC to 6 GHz, N (f) to 4.3-10 (f)
15NF43M50-3.0C	Test Port Extension Cable, 3 m, DC to 6 GHz, N (f) to 4.3-10 (m)
15NF43F50-3.0C	Test Port Extension Cable, 3 m, DC to 6 GHz, N (f) to 4.3-10 (f)

Model/Order No.	Name
	Directional Antennas
2000-1411-R	824 MHz to 896 MHz, N (f), 12.3 dBi, Yagi
2000-1412-R	885 MHz to 975 MHz, N (f), 12.6 dBi, Yagi
2000-1413-R	1710 MHz to 1880 MHz, N (f), 12.3 dBi, Yagi
2000-1414-R	1850 MHz to 1990 MHz, N (f), 11.4 dBi, Yagi
2000-1415-R	2400 MHz to 2500 MHz, N (f), 14.1 dBi, Yagi
2000-1416-R	1920 MHz to 2170 MHz, N (f), 14.3 dBi, Yagi
2000-1659-R	698 MHz to 787 MHz, N (f), 10.1 dBi, Yagi
2000-1660-R	1425 MHz to 1535 MHz, N (f), 14.3 dBi, Yagi
2000-1715-R	698 MHz to 2500 MHz, N (f), gain of 2 dBi to 10 dBi, typical
2000-1726-R	Antenna, 2500 MHz to 2700 MHz, N (f), 14.1 dBi, Yagi
2000-1747-R	Antenna, Log Periodic, 300 MHz to 7000 MHz, N (f), 5.1 dBi, typical
2000-1748-R	Antenna, Log Periodic, 1 GHz to 18 GHz, N (f), 6 dBi, typical
2000-1777-R	Portable Directional Antenna, 9 kHz to 20 MHz, N (f)
2000-1778-R	Portable Directional Antenna, 20 MHz to 200 MHz, N (f)
2000-1779-R	Portable Directional Antenna, 200 MHz to 500 MHz, N (f)
2000-1812-R	Portable Yagi Antenna, 450 MHz to 512 MHz, N (f), 7.1 dBi
2000-1825-R	Portable Yagi Antenna, 380 MHz to 430 MHz, N (f), 7.1 dBi
	Portable Antennas
2000-1200-R	806 MHz to 866 MHz, SMA (m), 50Ω
2000-1473-R	870 MHz to 960 MHz, SMA (m), 50Ω
2000-1035-R	896 MHz to 941 MHz, SMA (m), 50Ω (1/2 wave)
2000-1030-R	1710 MHz to 1880 MHz, SMA (m), 50Ω (1/2 wave)
2000-1474-R	1710 MHz to 1880 MHz with knuckle elbow (1/2 wave)
2000-1031-R	1850 MHz to 1990 MHz, SMA (m), 50Ω (1/2 wave)
2000-1475-R	1920 MHz to 1980 MHz and 2110 MHz to 2170 MHz, SMA (m), 50Ω
2000-1032-R	2400 MHz to 2500 MHz, SMA (m), 50Ω (1/2 wave)
2000-1361-R	2400 MHz to 2500 MHz, 5000 MHz to 6000 MHz, SMA (m), 50Ω
2000-1751-R	698 MHz to 960 MHz, 1710 MHz to 2100 MHz, 2500 MHz to 2700 MHz, SMA (m), 2 dB (typ.), 50Ω
2000-1636-R	Antenna Kit (Consists of: 2000-1030-R, 2000-1031-R, 2000-1032-R, 2000-1200-R, 2000-1035-R, 2000-1361-R, and carrying pouch)
2000-1487-R	VHF/UHF, Telescopic Whip antenna, straight or 90°, BNC (m), 50Ω
	Bandpass Filters
1030-114-R	806 MHz to 869 MHz, N (m) to SMA (f), 50Ω
1030-109-R	824 MHz to 849 MHz, N (m) to SMA (f), 50Ω
1030-110-R	880 MHz to 915 MHz, N (m) to SMA (f), 50Ω
1030-111-R	1850 MHz to 1910 MHz, N (m) to SMA (f), 50Ω
1030-112-R	2400 MHz to 2484 MHz, N (m) to SMA (f), 50Ω
1030-105-R	890 MHz to 915 MHz, N (m) to N (f), 50Ω
1030-106-R	1710 MHz to 1790 MHz, N (m) to N (f), 50Ω
1030-107-R	1910 MHz to 1990 MHz, N (m) to N (f), 50Ω
1030-149-R	High Pass, 150 MHz, N (m) to N (f), 50Ω
1030-150-R	High Pass, 400 MHz, N (m) to N (f), 50Ω
1030-151-R	High Pass, 700 MHz, N (m) to N (f), 50Ω
1030-152-R	Low Pass, 200 MHz, N (m) to N (f), 50Ω
1030-153-R	Low Pass, 550 MHz, N (m) to N (f), 50Ω
1030-155-R	2500 MHz to 2700 MHz, N (m) to N (f), 50Ω
1030-178-R	1920 MHz to 1980 MHz, N (m) to N (f), 50Ω
1030-179-R	777 MHz to 798 MHz, N (m) to N (f), 50Ω
1030-180-R	2500 MHz to 2570 MHz, N (m) to N (f), 50Ω
2000-1684-R	791 MHz to 821 MHz, N (m) to N (f), 50Ω
2000-1734-R	699 MHz to 715 MHz, N (m) and N (f), 50Ω
2000-1735-R	776 MHz to 788 MHz, N (m) and N (f), 50Ω
2000-1736-R	815 MHz to 850 MHz, N (m) and N (f), 50Ω
2000-1737-R	1711 MHz to 1756 MHz, N (m) and N (f), 50Ω
2000-1738-R	1850 MHz to 1910 MHz, N (m) and N (f), 50Ω
2000-1739-R	880 MHz to 915 MHz, N (m) and N (f), 50Ω
2000-1740-R	1710 MHz to 1785 MHz, N (m) and N (f), 50Ω
2000-1741-R	1920 MHz to 1980 MHz, N (m) and N (f), 50Ω
2000-1742-R	832 MHz to 862 MHz, N (m) and N (f), 50Ω
2000-1743-R	2500 MHz to 2570 MHz, N (m) and N (f), 50Ω
2000-1799-R	2305 MHz to 2320 MHz, N (m) and N (f), 50Ω
2000-1911-R	703 MHz to 748 MHz, N (m) and N (f), 50Ω
2000-1912-R	788 MHz to 798 MHz, N (m) and N (f), 50Ω
2000-1925-R	663 MHz to 698 MHz, N (m) and N (f), 50Ω
2000-1926-R	776 MHz to 806 MHz, N (m) and N (f), 50Ω

Continued on next page

Model/Order No.	Name
	Adapters
1091-26-R	SMA (m) to N (m), DC to 18 GHz, 50Ω
1091-27-R	SMA (f) to N (m), DC to 18 GHz, 50Ω
1091-80-R	SMA (m) to N (f), DC to 18 GHz, 50Ω
1091-81-R	SMA (f) to N (f), DC to 18 GHz, 50Ω
1091-172-R	BNC (f) to N (m), DC to 1.3 GHz, 50Ω
510-90-R	7/16 DIN (f) to N (m), DC to 7.5 GHz, 50Ω
510-91-R	7/16 DIN (f) to N (f), DC to 7.5 GHz, 50Ω
510-92-R	7/16 DIN (m) to N (m), DC to 7.5 GHz, 50Ω
510-93-R	7/16 DIN (m) to N (f), DC to 7.5 GHz, 50Ω
510-96-R	7/16 DIN (m) to 7/16 DIN (m), DC to 7.5 GHz, 50Ω
510-97-R	7/16 DIN (f) to 7/16 DIN (f), DC to 7.5 GHz, 50Ω
513-62-R	TNC (f) to N (f), DC to 18 GHz, 50Ω
1091-315-R	TNC (m) to N (f), DC to 18 GHz, 50Ω
1091-324-R	TNC (f) to N (m), DC to 18 GHz, 50Ω
1091-325-R	TNC (m) to N (m), DC to 18 GHz, 50Ω
1091-317-R	TNC (m) to SMA (f), DC to 18 GHz, 50Ω
1091-318-R	TNC (m) to SMA (m), DC to 18 GHz, 50Ω
1091-323-R	TNC (m) to TNC (f), DC to 18 GHz, 50Ω
1091-326-R	TNC (m) to TNC (m), DC to 18 GHz, 50Ω
510-102-R	N (m) to N (m), DC to 11 GHz, 50Ω, 90 degrees right angle
34RKNF50	Ruggedized K (m) to N (f), DC to 18 GHz, 50Ω
	Precision Adapters
34NN50A	N (m) to N (m), DC to 18 GHz, 50Ω
34NFNF50	N (f) to N (f), DC to 18 GHz, 50Ω
34NK50	DC to 18 GHz, N (m) to K (m), 50Ω
34NFKF50	DC to 18 GHz, N (m) to K (f), 50Ω
K220B	DC to 40 GHz, K (m) to K (m), 50
K222B	DC to 40 GHz, K (f) to K (f), 50Ω
K224B	DC to 40 GHz, K (m) to K (f), 50Ω
	Attenuators N Type (up to 18 GHz)
3-1010-122	20 dB, 5 W, DC to 12.4 GHz, N (m) to N (f)
42N50-20	20 dB, 5 W, DC to 18 GHz, N (m) to N (f)
42N50A-30	30 dB, 50 W, DC to 18 GHz, N (m) to N (f)
3-1010-123	30 dB, 50 W, DC to 8.5 GHz, N (m) to N (f)
1010-127-R	30 dB, 150 W, DC to 3 GHz, N (m) to N (f)
3-1010-124	40 dB, 100 W, DC to 8.5 GHz, N (f) to N (m), Uni-directional
1010-121-R	40 dB, 100 W, DC to 18 GHz, N (f) to N (m), Uni-directional
1010-128-R	40 dB, 150 W, DC to 3 GHz, N (m) to N (f)
	Attenuators K Type (up to 40 GHz)
41KB-3	Precision Fixed Attenuator, K (m) to K (f), 3 dB, DC to 26.5 GHz, 50Ω
41KB-6	Precision Fixed Attenuator, K (m) to K (f), 6 dB, DC to 26.5 GHz, 50Ω
41KB-10	Precision Fixed Attenuator, K (m) to K (f), 10 dB, DC to 26.5 GHz, 50Ω
41KB-20	Precision Fixed Attenuator, K (m) to K (f), 20 dB, DC to 26.5 GHz, 50Ω
41KC-3	Precision Fixed Attenuator, K (m) to K (f), 3 dB, DC to 40 GHz, 50Ω
41KC-6	Precision Fixed Attenuator, K (m) to K (f), 6 dB, DC to 40 GHz, 50Ω
41KC-10	Precision Fixed Attenuator, K (m) to K (f), 10 dB, DC to 40 GHz, 50Ω
41KC-20	Precision Fixed Attenuator, K (m) to K (f), 20 dB, DC to 40 GHz, 50Ω

LMR Master™ Vector Network ANALYZER

S412E

VNA: 500 kHz to 1.6 GHz/Spectrum Analyzer: 9 kHz to 1.6 GHz

Land Mobile Radio Modulation Analyzer and Signal Analyzer, Vector Network Analyzer, Spectrum Analyzer

The LMR Master S412E is Anritsu's second generation solution for installing and maintaining public safety systems. Built on Anritsu's ninth generation handheld platform, the S412E combines a high performance receiver/spectrum analyzer with the world's most advanced handheld vector network analyzer plus a powerful vector signal generator with internally adjustable power from 0 to –130 dBm.

Spectrum Analyzer Highlights

- Measurements: Occupied Bandwidth, Channel Power, ACPR, C/I, Coverage Mapping
- Interference Analyzer: Spectrogram, Signal Strength, RSSI, Mapping
- 9 kHz to 1.6 GHz frequency coverage (Optional extension to 6 GHz)
- Dynamic Range: >95 dB in 10 Hz RBW
- DANL: –152 dBm in 10 Hz RBW
- Phase Noise: –100 dBc/Hz max @ 10 kHz offset at 1 GHz
- Frequency Accuracy: 120 ppb standard (25° ±25°C);
  <50 ppb after 3 minutes with GPS lock

VNA Analyzer Highlights

- 1-path, 2-port Vector Network Analyzer (VNA) w/ quad trace display
- 500 kHz to 1.6 GHz frequency coverage (Optional extension to 6 GHz)
- Intuitive Graphical User Interface (GUI) with convenient Touch Screen
- VNA-quality error correction for directivity and source match
- Outstanding calibration stability, up to 16 hours
- Arbitrary data points up to 4001
- IF Bandwidth selections of 10 Hz to 100 kHz
- 100 dB transmission dynamic range
- 850 µs/data point sweep speed

Land Mobile Radio Signal Analyzer Highlights

- Analyzes Narrowband FM analog systems
- Analyzes P25 (TIA-102.CAAA-C), P25 Phase 2 (TIA-102.CCAA), DMR (MOTOTRBO™), NXDN™, dPRM, ITC-R PTC, and TETRA digital systems
- 100 kHz to 1.6 GHz frequency coverage (Optional extension to 6 GHz)
- Internal signal generator: 0.1 dB resolution, 0 to –130 dBm (spec to –120 dBm)
- 2.0 dB signal generator accuracy (typ.)
- P25/P25p2, NXDN, and ETSI DMR BER test patterns including 1011 Hz, 1031 Hz, and V.52/O.153
- Duplex test: Simultaneous analysis and generation of analog or digital LMR signals
- Independent control of both receive/transmit frequencies and test patterns
- TETRA Base Station Receiver Sensitivity Measurements

Capabilities and Functional Highlights

- Analog FM and digital LMR analyzer
- High accuracy internal power meter
- On-screen LMR Coverage Mapping (Outdoor and Indoor)
- GPS tagging of saved traces
- USB data transfer
- Complies with MIL-PRF-28800F Class 2 and MIL-STD-810G
- Certified for use in Explosive Atmosphere per MIL-PRF-28800F 8.4 inch daylight-viewable TFT LCD color resistive touchscreen – allows use while wearing gloves
- Touchscreen keyboard
- USB and Ethernet data transfer
- Web Remote Control
- Master Software Tools™
- 3 hour battery operation time

Definitions

All specifications and characteristics apply under the following conditions, unless otherwise noted:

Warm-Up Time	After 15 minutes of warm-up time in VNA mode, where the instrument is left in the ON state.
Temperature Range	Over the 23° ±5°C temperature range, unless otherwise noted.
Reference Signal	When using internal reference signal.
Typical Performance	Typical specifications that are not in parenthesis are not tested and not warranted. They are generally representative of characteristic performance. Typical specifications in parenthesis () represent the mean value of measured units and do not include any guard-bands or uncertainties. They are not warranted.
Uncertainty	A coverage factor of x1 is applied to the measurement uncertainties to facilitate comparison with other industry handheld analyzers.
Calibration Cycle	Calibration is within the recommended 12 month period (residual specifications also require calibration kit calibration cycle adherence.) All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site: www.anritsu.com

Spectrum Analyzer Specifications

Measurements	Smart Measurements	Field Strength (uses antenna calibration tables to measure dBm/m^2 or dBmV/m) Occupied Bandwidth (measures 99 to 1% power channel of a signal) Channel Power (measures the total power in a specified bandwidth) ACPR (Adjacent Channel Power Ratio) AM/FM/SSB Audio Demodulation (Wide/Narrow FM, AM, Upper/Lower SSB) C/I (carrier-to-interference ratio) Emission Mask Coverage Mapping (requires option 431)
Setup Parameters	Frequency	Center/Start/Stop, Span, Frequency Step, Signal Standard, Channel #, Channel Increment
	Amplitude	Reference Level (RL), Scale, Attenuation Auto/Level, RL Offset, Pre-Amp On/Off, Detection
	Span	Span, Span Up/Down (1-2-5), Full Span, Zero Span, Last Span
	Bandwidth	RBW, Auto RBW, VBW, Auto VBW, RBW/VBW, Span/RBW
	File	Save, Recall, Delete, Directory Management
	Save/Recall	Setups, Measurements, Limit Lines, Screen Shots Jpeg (save only), Save-on-Event
	Save-on-Event	Crossing Limit Line, Sweep Complete, Save-then-Stop, Clear All
	Delete	Selected File, All Measurements, All Mode Files, All Content
	Directory Management	Sort Method (Name/Type/Date), Ascend/Descend, Internal/USB, Copy, Format USB
	Application Options	Bias-Tee (On/Off), Impedance (50Ω, 75Ω, Other)
Sweep Functions	Sweep	Single/Continuous, Manual Trigger, Reset, Detection, Minimum Sweep Time, Trigger Type
	Detection	Peak, RMS, Negative, Sample, Quasi-peak
	Triggers	Free Run, External, Video, Change Position, Manual
Trace Functions	Traces	Up to three Traces (A, B, C), View/Blank, Write/Hold, Trace A/B/C Operations
	Trace A Operations	Normal, Max Hold, Min Hold, Average, # of Averages, (always the live trace)
	Trace B Operations	A → B, B ↔ C, Max Hold, Min Hold
	Trace C Operations	A → C, B ↔ C, Max Hold, Min Hold, A – B → C, B – A → C, Relative Reference (dB), Scale
Marker Functions	Markers	Markers 1-6 each with a Delta Marker, or Marker 1 Reference with Six Delta Markers, Marker Table (On/Off), All Markers Off
	Marker Types	Style (Fixed/Tracking), Noise Marker, Frequency Counter Marker, Marker Auto-Position Peak Search, Next Peak (Right/Left), Peak Threshold %, Set Marker to Channel, Marker Frequency to Center, Delta Marker to Span, Marker to Reference Level
	Marker Table	1-6 markers frequency and amplitude plus delta markers frequency offset and amplitude
Limit Line Functions	Limit Lines	Upper/Lower, On/Off, Edit, Move, Envelope, Advanced, Limit Alarm, Default Limit
	Limit Line Edit	Frequency, Amplitude, Add Point, Add Vertical, Delete Point, Next Point Left/Right
	Limit Line Move	To Current Center Frequency, By dB or Hz, To Marker 1, Offset from Marker 1
	Limit Line Envelope	Create Envelope, Update Amplitude, Points (41 max), Offset, Shape Square/Slope
	Limit Line Advanced	Type (Absolute/Relative), Mirror, Save/Recall
Frequency	Frequency Range	9 kHz to 1.6 GHz, (6 GHz with Option 6)
	Tuning Resolution	1 Hz
	Frequency Reference Aging	±1.0 ppm/year
	Frequency Reference Accuracy	±120 ppb (25° ±25°C) + aging, <50 ppb + aging with GPS lock
	Frequency Span	10 Hz to 1.6 GHz including zero span (10 Hz to 6 GHz with Option 6)
	Sweep Time	100 ms, 7 µs to 3600 seconds in zero span
	Sweep Time Accuracy	±2% in zero span
Bandwidth	Resolution Bandwidth (RBW)	10 Hz to 3 MHz in 1–3 sequence ±10% (1 MHz max in zero-span) (–3 dB bandwidth)
	Video Bandwidth (VBW)	1 Hz to 3 MHz in 1–3 sequence (–3 dB bandwidth) (auto or manually selectable)
	RBW with Quasi-Peak Detection	200 Hz, 9 kHz, 120 kHz (–6 dB bandwidth)
	VBW with Quasi-Peak Detection	Auto VBW is On, RBW/VBW = 1
Spectral Purity	SSB Phase Noise @ 1 GHz	–100 dBc/Hz, –110 dBc/Hz (typ.) @ 10 kHz offset –105 dBc/Hz, –112 dBc/Hz (typ.) @ 100 kHz offset –115 dBc/Hz, –121 dBc/Hz (typ.) @ 1 MHz offset

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Amplitude Ranges	Dynamic Range	>95 dB (2.4 GHz), 2/3 (TOI-DANL) in 10 Hz RBW			
	Measurement Range	DANL to +26 dBm (≥50 MHz) DANL to 0 dBm (<50 MHz)			
	RF In Port Damage Level	+33 dBm peak, ± 50 VDC, Maximum Continuous Input (≥10 dB attenuation)			
	Display Range	1 to 15 dB/div in 1 dB steps, ten divisions displayed			
	Reference Level Range	–120 to +30 dBm			
	Attenuator Resolution	0 to 55 dB, 5.0 dB steps			
	Amplitude Units	Log Scale Modes: dBm, dBV, dBmv, dBµV Linear Scale Modes: nV, µV, mV, V, kV, nW, µW, mW, W, kW			
Amplitude Accuracy	(Single sine wave, input power <Ref level and >DANL, Attenuation: Auto, Ambient: –10° to +50°C after 30 minute warm-up)				
	9 kHz to 100 kHz	±2.0 dB (typ.) (Preamp Off)			
	>100 kHz to 4.0 GHz	±1.25 dB, ±0.5 dB (typ.)			
	>4.0 GHz to 6 GHz	±1.50 dB, ±0.5 dB (typ.)			
Displayed Average Noise Level (DANL)		Preamp Off (Reference Level –20 dBm)		Preamp On (Reference Level –50 dBm)	
	(RBW = 1 Hz, 0 dB attenuation)	Maximum	Typical	Maximum	Typical
	10 MHz to 2.4 GHz	–141 dBm	–146 dBm	–157 dBm	–162 dBm
	>2.4 GHz to 4 GHz	–137 dBm	–141 dBm	–154 dBm	–159 dBm
	>4 GHz to 5 GHz	–134 dBm	–138 dBm	–150 dBm	–155 dBm
	>5 GHz to 6 GHz	–126 dBm	–131 dBm	–143 dBm	–150 dBm
	(RBW = 10 Hz, 0 dB attenuation)				
	10 MHz to 2.4 GHz	–131 dBm	–136 dBm	–147 dBm	–152 dBm
	>2.4 GHz to 4 GHz	–127 dBm	–131 dBm	–144 dBm	–149 dBm
	>4 GHz to 5 GHz	–124 dBm	–128 dBm	–140 dBm	–145 dBm
	>5 GHz to 6 GHz	–116 dBm	–121 dBm	–133 dBm	–140 dBm
Spurs	Residual Spurious	<–90 dBm (RF input terminated, 0 dB input attenuation, >10 MHz)			
	Input-Related Spurious	<–75 dBc (0 dB attenuation, –30 dBm input, span <1.7 GHz, carrier offset >4.5 MHz)			
	Exceptions, typical	<–70 dBc @ <2.5 GHz with 2072.5 MHz Input <–68 dBc @ F1 – 280 MHz with F1 Input <–70 dBc @ F1 + 190.5 MHz with F1 Input <–52 dBc @ 7349 – 2F2 MHz with F2 Input, where F2 <2424.5 MHz <–55 dBc @ 190.5 ±F1/2 MHz, F1 <1 GHz			
Third-Order Intercept (TOI)	(Preamp Off (–20 dBm tones, 100 kHz apart, 10 dB attenuation)				
	800 MHz	+16 dBm			
	2400 MHz	+20 dBm			
	200 MHz to 2200 MHz	+25 dBm (typ.)			
	>2.2 GHz to 5.0 GHz	+28 dBm (typ.)			
	>5.0 GHz to 6.0 GHz	+33 dBm (typ.)			
Second Harmonic Distortion	(Preamp Off, 0 dB input attenuation, –30 dBm input)				
	50 MHz	–56 dBc			
	>50 MHz to 200 MHz	–60 dBc (typ.)			
	>200 MHz to 3000 MHz	–70 dBc (typ.)			
VSWR	2:1 (typ.)				

Vector Network Analyzer

Definitions

All specifications and characteristics apply under the following conditions, unless otherwise stated:

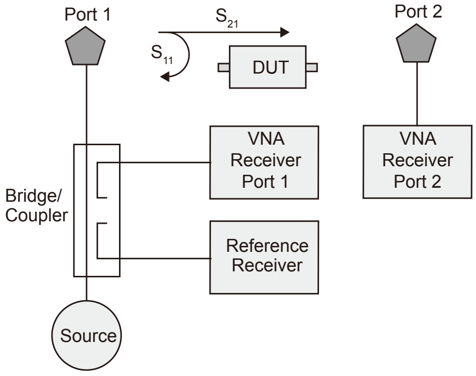
- After 15 minutes of warm-up time, where the instrument is left in the ON state.
- Temperature range is 23° ±5°C.
- All specifications apply when using internal reference.
- All specifications subject to change without notice. Please visit www.anritsu.com for most current data sheet.
- Typical performance is the measured performance of an average unit.
- Recommended calibration cycle is 12 months.

Frequency

Frequency Range: 500 kHz to 1.6 GHz
(500 kHz to 6.0 GHz with Option 16)
Frequency Accuracy: 2.5 ppm
Frequency Resolution: 1 Hz

Block Diagram

As shown in the following block diagram, the LMR Master has a 2-port, 1-path architecture that automatically measures 2 S-parameters with error-correction precision inherent to VNA operation.



The above illustration is a simplified block diagram of LMR Master's 2-port, 1-path architecture. The magnitude and phase information gained from vector network data enables the LMR Master to make significant error corrections and provide improved field measurements.

Test Port Power (typ.)

LMR Master supports selection of either High, Default, or Low test port power. Changing power after calibration can degrade the calibrated performance. Typical test port power by bands is shown in the following table.

Frequency Range	High Port Power	Default Port Power	Low Port Power
500 kHz to ≤3 GHz	+3 dBm	–5 dBm	–25 dBm
3 GHz to ≤6 GHz	0 dBm	–5 dBm	–25 dBm

Transmission Dynamic Range

The transmission dynamic range (the difference between test port power and noise floor) using 10 Hz IF Bandwidth and High Port Power is shown in the following table.

Frequency Range	Dynamic Range
2 MHz to ≤4 GHz	100 dB
4 GHz to ≤6 GHz	90 dB

Sweep Speed (Typ.)

The typical sweep speed for IF Bandwidth of 100 Hz, 1001 data points, and single display is shown in the following table. The two-receiver architecture will simultaneously collect S_{21} and S_{11} in a single sweep.

Frequency Range	Typical Sweep Speed
500 kHz to 6 GHz	850 µs/point

Noise Floor (Typ.)

Frequency Range	Typical Noise Floor
500 kHz to 3 GHz	–100 dBm
3 GHz to 4 GHz	–103 dBm
4 GHz to 6 GHz	–93 dBm

Temperature Stability (S_{11} or S_{21}, Short, 23° ±5°C)

Frequency Range	Magnitude (typ.)	Phase (typ.)
500 kHz to 6 GHz	0.020 dB/°C	0.200 deg/°C

Interference Immunity

On-Channel	+17 dBm at >1.0 MHz from carrier frequency
On-Frequency	0 dBm within ±10 kHz of the carrier frequency

Measurements

Measurement Parameters	S_{11}, S_{21}
Number of Traces	Four: TR1, TR2, TR3, TR4
Trace Format	Single, Dual, Tri, Quad. When used with Number of Traces, overlays are possible including a Single Format with Four trace overlays.
Graph Types	Log Magnitude, SWR, Phase, Real, Imaginary, Group Delay, Smith Chart, Log Mag/2 (1-Port Cable Loss), Linear Polar, Log Polar, Real Impedance, Imaginary Impedance
Domains	Frequency Domain, Distance Domain
Frequency	Start Frequency, Stop Frequency, Center Frequency, Span
Distance	Start Distance, Stop Distance
Frequency Sweep Type: Linear	Single Sweep, Continuous
Data Points	2 to 4001 (arbitrary setting); data points can be reduced without recalibration.
Limit Lines	Upper, Lower, 10 segmented Upper, 10 segmented Lower
Test Limits	Pass/Fail for Upper, Pass/Fail for Lower, Limit Audible Alarm
Data Averaging	Sweep-by-sweep
Smoothing	0 to 20%
IF Bandwidth	10, 20, 50, 100, 200, 500, 1 k, 2 k, 5 k, 10 k, 20 k, 50 k, 100 k (Hz)
Reference Plane	The reference planes of a calibration (or other normalization) can be changed by entering a line length. Assumes no loss, flat magnitude, linear phase, and constant impedance.
Auto Reference Plane Extension	Instead of manually entering a line length, this feature automatically adjusts phase shift from the current calibration (or other normalization) to compensate for external cables (or test fixtures). Assumes no loss, flat magnitude, linear phase, and constant impedance.
Frequency Range	Frequency range of the measurement can be narrowed (reduces number of data points) within the calibration range without recalibration. When Interpolation is On, narrowed frequency range will retain original number of data points.
Group Delay Aperture	Defined as the frequency span over which the phase change is computed at a given frequency point. The aperture can be changed without recalibration. The minimum aperture is the frequency range divided by the number of points in calibration and can be increased to 20% of the frequency range.
Group Delay Range	<180° of phase change within the aperture
Trace Memory	A separate memory for each trace can be used to store measurement data for later display. The trace data can be saved and recalled.

Continued on next page

Trace Math	Complex trace math operations of subtraction, addition, multiplication, or division are provided.
Number of Markers	12, arbitrary assignments to any trace
Marker Types	Reference, Delta
Marker Readout Styles	Log Mag, Cable Loss (Log Mag/2), Log Mag and Phase, Phase, Real and Imaginary, SWR, Impedance, Admittance, Normalized Impedance, Normalized Admittance, Polar Impedance, and Group Delay
Marker Search	Peak Search, Valley Search, Find Marker Value
Calibration Type	Full S_{11}, 1-Path, 2-Port (S_{11} and S_{21}), Response S_{11}, Response S_{21}
Calibration Methods	Short-Open-Load-Through (SOLT)
Calibration Standards' Coefficients	Coax: N-Connector, K-Connector, 7/16, TNC, SMA, and four User Defined
Cal Correction Toggle	On/Off
Interpolation	On/Off (Interpolation may be activated before or after calibration)
Impedance Conversion (Smith Chart)	Support for 50Ω and 75Ω are provided.
Units	Meters, Feet
Bias Tee Settings	Internal, Off
Timebase Reference	Internal
File Storage Types	Measurement, Setup (with CAL), Setup (without CAL), S2P (Real/Imag), S2P (Lin Mag/Phase), S2P (Log Mag/Phase), JPEG
Languages	English, French, German, Spanish, Chinese, Japanese, Korean, Italian, Russian plus and Portuguese

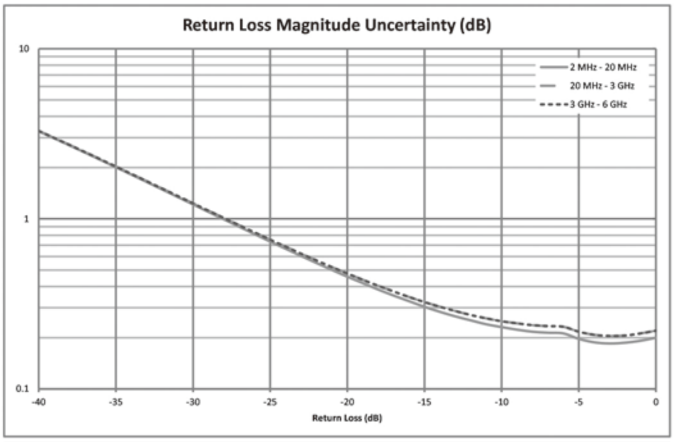
Corrected System Performance and Uncertainties — High Port Power, N-Type

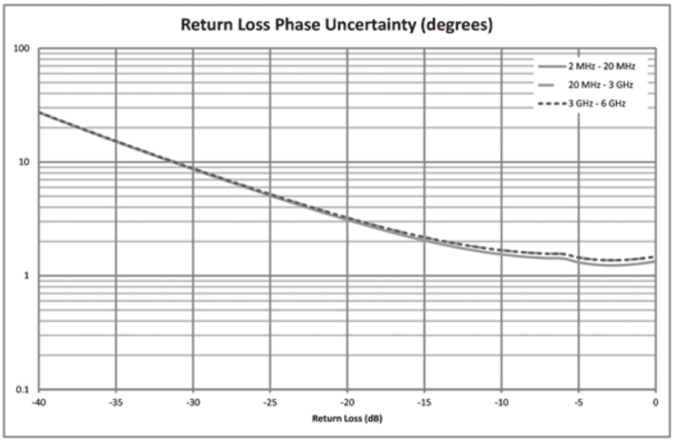
Measurement Accuracy* (OSLN50A-8 or OSLNF50A-8, TOSLN50A-8 or TOSLNF50A-8)

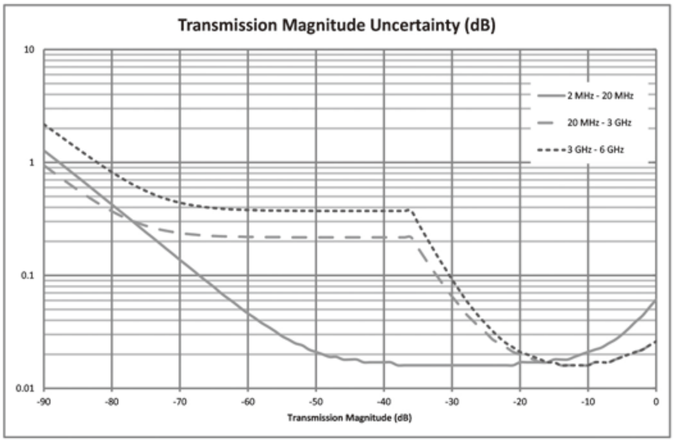
Frequency Range	Directivity (dB)	Source Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
<20 MHz	≥42	≥30	±0.01	±0.01
20 MHz to <3 GHz	≥42	≥30	±0.05	±0.01
3 GHz to 6 GHz	≥42	≥30	±0.05	±0.01

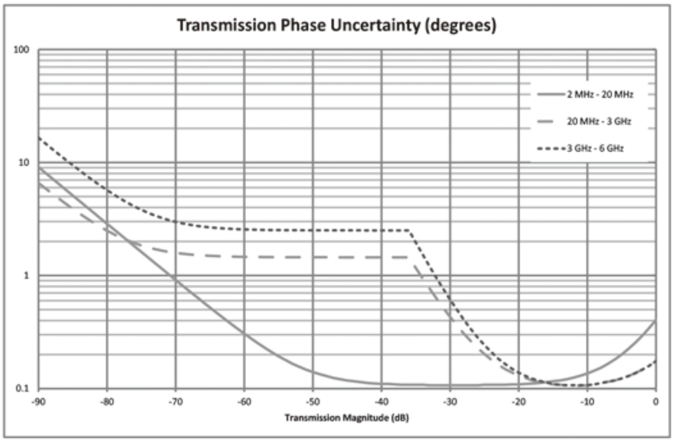
*: Full 1-path, 2-port forward path calibration with isolation, high power, 10 Hz IFBW, no averaging, 10 minute warm-up.
OSLN50A-8, OSLNF50A-8, TOSLN50A-8, or TOSLNF50A-8 calibration kit. Reflection and Transmission Tracking are typical.

Corrected Measurement Uncertainty (Transmission from Port 1 to Port 2)


Return Loss Magnitude Uncertainty (dB)


Return Loss Phase Uncertainty (degrees)


Transmission Magnitude Uncertainty (dB)


Transmission Phase Uncertainty (degrees)

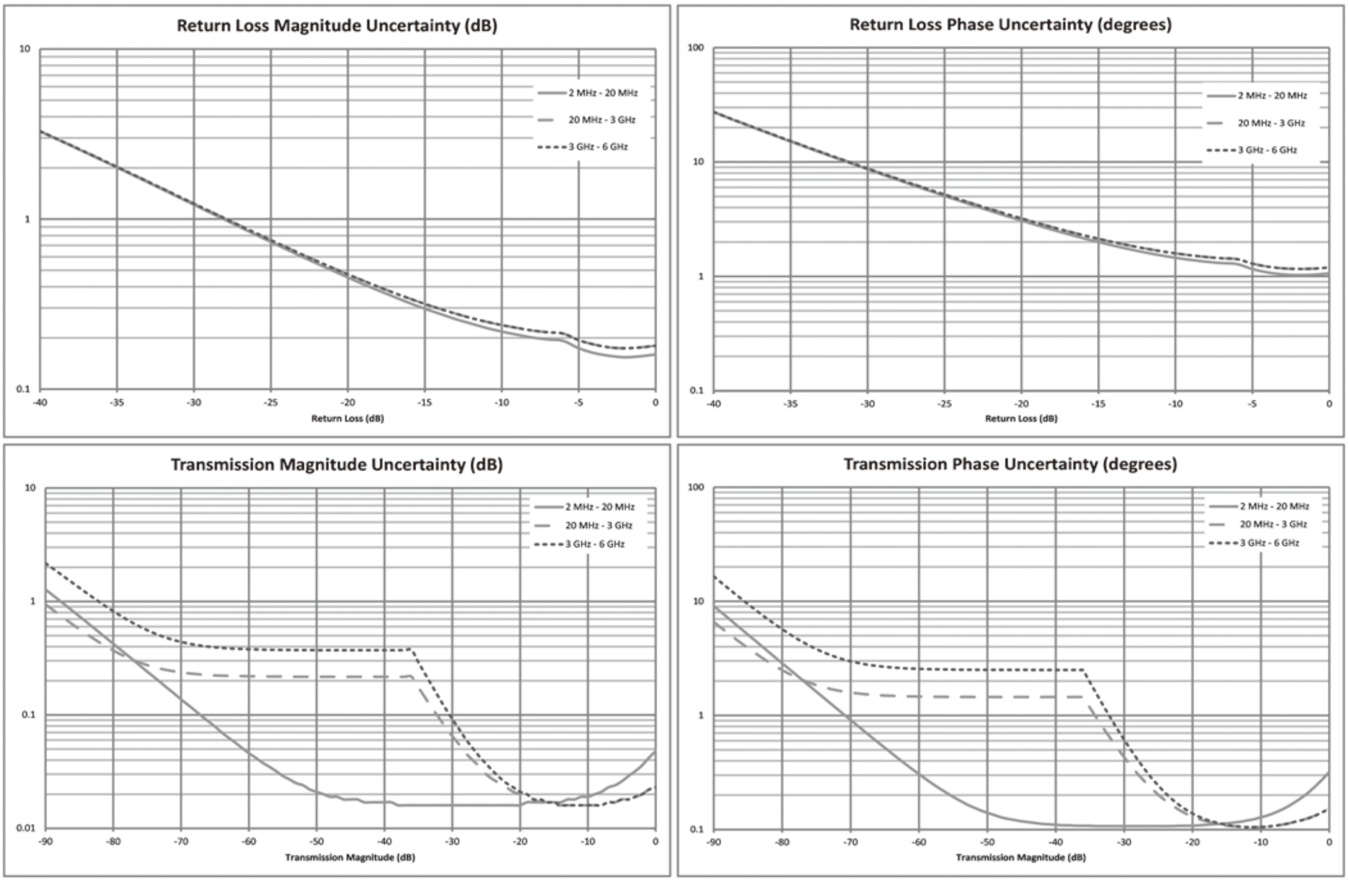
Corrected System Performance and Uncertainties — High Port Power, K-Type

Measurement Accuracy* (OSLK50A-20 or TOSLKF50A-20. Compatible with 3.5 mm and SMA connectors)

Frequency Range	Directivity (dB)	Source Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
<20 MHz	≥42	≥33	±0.01	±0.01
20 MHz to <3 GHz	≥42	≥33	±0.05	±0.01
3 GHz to 6 GHz	≥42	≥33	±0.05	±0.01

*: Full 1-path, 2-port forward path calibration with isolation, high power, 10 Hz IFBW, no averaging, 10 minute warm-up.
TOSLK50A-20, TOSLKF50A-20 calibration kit. Reflection and Transmission Tracking are typical.

Corrected Measurement Uncertainty (Transmission from Port 1 to Port 2)



Return Loss Magnitude Uncertainty (dB)

Return Loss Phase Uncertainty (degrees)

Transmission Magnitude Uncertainty (dB)

Transmission Phase Uncertainty (degrees)

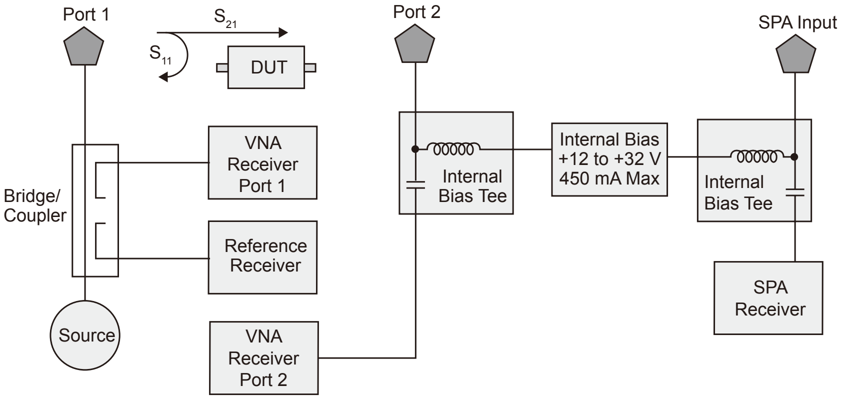
Bias Tee (Option 10)

For tower mounted amplifier tests, the S412E with optional internal bias tees can supply both DC and RF signals on the center conductor of the cable during measurements. For frequency sweeps in excess of 2 MHz, the LMR Master can supply internal voltage control from +12 V to +32 V in 0.1 V steps up to 450 mA. Bias is available on VNA Port 2 and the SPA Input (RF In) for use with antenna pre-amplifiers.

Bias Tee Specifications

Frequency Range	2 MHz to 4 GHz/6 GHz at VNA Port 2
Internal Voltage/Current	+12 V to +32 V at 450 mA (Steady state)
Internal Resolution	0.1 V
Bias Tee Selections	Internal, Off

The Compact LMR Master offers optional integrated bias tee for supplying DC plus RF to the DUT as shown in this simplified block diagram.



Vector Voltmeter (Option 15)

A phased array system relies on phase matched cables for nominal performance. For this class of application, the LMR Master offers this special software mode to simplify phase matching cables at a single frequency. The similarity between the popular vector voltmeter and this software mode ensures minimal training is required to phase match cables. Operation is as simple as configuring the display for absolute or relative measurements. The easy-to-read large fonts show either reflection or transmission measurements using impedance, magnitude, or VSWR readouts. For instrument landing system (ILS) or VHF Omni-directional Range (VOR) applications, a table view improves operator efficiency when phase matching up to twelve cables.

The S412E solution is superior because the signal source is included internally, precluding the need for an external signal generator.

CW Frequency Range	500 kHz to 1.6 GHz (6 GHz with Option 16)
Measurement Display	CW, Table (Twelve Entries, Plus Reference)
Measurement Types	Return Loss, Insertion
Measurement Format	dB/VSWR/Impedance

Distance Domain

Distance-to-Fault Analysis is a powerful field test tool to analyze cables for faults, including minor discontinuities that may occur due to a loose connection, corrosion, or other aging effects. By using Frequency Domain Reflectometry (FDR), the VNA's DTF mode exploits a user-specified band of full power operational frequencies (instead of DC pulses from TDR approaches) to more precisely identify discontinuities. The VNA converts S-parameters from frequency domain into distance domain on the horizontal display axis, using a mathematical computation called Inverse Fourier Transform. Connect a reflection at the opposite end of the cable and the discontinuities appear versus distance to reveal any potential maintenance issues. When access to both ends of the cable is convenient, a similar distance domain analysis is available on transmission measurements. Distance Domain will improve your productivity with displays of the cable in terms of discontinuities versus distance. This readout can then be compared against previous measurements (from stored data) to determine whether any degradations have occurred since installation (or the last maintenance activity). More importantly, you will know precisely where to go to fix the problem and minimize or prevent downtime of the system.

Maximum Distance (4001 data points, 1.6 GHz span)	374.9 m (1,229.9 ft)
Maximum Distance (4001 data points, 6.0 GHz span)	99.9 m (327.75 ft)
Minimum Distance Resolution (1.6 GHz span)	18.7 cm (7.36 in)
Minimum Distance Resolution (6.0 GHz span)	4.99 cm (1.97 in)
Measurement Display	Return Loss, VSWR
Measurement Format	dB, VSWR

Interference Analyzer (Option 25) (GPS Option 31 recommended)

Measurements	Spectrum	Field Strength Occupied Bandwidth Channel Power Adjacent Channel Power Ratio (ACPR) AM/FM/SSB Demodulation (Wide/Narrow FM, Upper/Lower SSB - audio out only) Carrier-to-Interference ratio (C/I)
	Spectrogram	Collect data up to one week
	Signal Strength	Gives visual and aural indication of signal strength
	Received Signal Strength Indicator (RSSI)	Collect data up to one week
	Signal ID	Up to 12 signals Center Frequency Bandwidth Signal Type: FM, GSM, W-CDMA, CDMA, Wi-Fi Closest Channel Number Number of Carriers
	Signal-to-Nose Ratio (SNR)	>10 dB
	Interference Mapping	Triangulate location of interference with on-display maps
	Application Options	Bias-Tee (On/Off) Impedance (50Ω, 75Ω, Other) Compatible with the MA2700A InterferenceHunter™ Handheld Direction Finding System

GPS Receiver (Option 31) (Antenna sold separately)

Setup	On/Off, Antenna Voltage 3.3 V/5.0 V, GPS Info
GPS Time/Location Indicator	Time, Latitude, Longitude and Altitude on display Time, Latitude, Longitude and Altitude with trace storage
GPS-Enhanced Frequency Accuracy	<50 ppb with GPS On, 3 minutes after satellite is locked in selected mode (Applies to Spectrum Analyzer, Interference Analyzer, LMR Signal Analyzers)
Connector	SMA (f)

Ethernet Connectivity

Connector	RJ45
LAN Speed	10 Mbps
Mode	Static, DHCP
Static IP settings	IP address Subnet Mask IP Gateway
Remote Control	Remote capability provided with Web Remote Control and SCPI programming
Data Upload	With Line Sweep Tools through Ethernet connection

Coverage Mapping (Options 431)

Measurements	Indoor Mapping	RSSI, ACPR
	Outdoor Mapping	RSSI, ACPR

Setup Parameters	Frequency	Center/Start/Stop, Span, Freq Step, Signal Standard, Channel #, Channel Increment
	Amplitude	Reference Level (RL), Scale, Attenuation Auto/Level, RL Offset, Pre-Amp On/Off, Detection
	Span	Span, Span Up/Down (1-2-5), Full Span, Zero Span, Last Span
	BW	RBW, VBW, Auto VBW, RBW/VBW, Span/VBW
	Measurement Setup	ACPR, RSSI
	Point Distance/Time Setup	Repeat Type Time Distance
	Save Points Map	Save KML, JPEG, Tab Delimited
	Recall Points Map	Recall Map, Recall KML Points only, Recall KML Points with Map, Recall Default Grid

Channel Scanner (Option 27)

Number of Channels	1 to 20 Channels
Measurements	Graph/Table, Max Hold (On/5 sec/Off), Freq/Channel, Current/Max, Single/Dual Color
Scanner	Scan Channels, Scan Frequencies, Scan Customer List, Scan Script Master™
Amplitude	Reference Level, Scale
Custom Scan	Signal Standard, Channel, # of Channels, Channel Step Size, Custom Scan
Frequency Accuracy	±10 Hz + Frequency Reference
Measurement Range	–110 to +26 dBm
Application Options	Bias-Tee (On/Off), Impedance (50Ω, 75Ω, Other)

Electromagnetic Field Test (Option 444)

Measurements	Setup	Limit lines, axis dwell time, measurement time, auto-logging, measurement units, trace display
	Spectrum Analyzer	Field strength is measured
	LTE OTA	P-SS, S-SS, and RS are measured and displayed based on each Cell ID received
	Units	Spectrum Analyzer: dBm/m^2, dBV/m, dBmV/m, dBuV/m, V/m, W/m^2, dBW/m^2, A/m, dBA/m, W/cm^2 LTE OTA: dBm/m^2, V/m, W/m^2
	Results	Maximum, minimum, and average of all measurements conducted
	Display	Measurement status, number of measurements taken, pass/fail indicators

Frequency Range	Supported Antenna	
	2000-1800-R	9 kHz to 300 MHz
	2000-1792-R	30 MHz to 1.6 GHz
	2000-1791-R	700 MHz to 1.6 GHz

Modes where EMF Measurements Available	Spectrum Analyzer
	LTE OTA (Option 546)

CW Signal Generator

Setup Parameters	Generator	On/Off
	Tx Output Level	0.1 dB resolution, 0 to –130 dBm (spec to –120 dBm)
	Tx Pattern	CW, AM w/ 1 kHz, FM w/ 1 kHz
RF Characteristics	Power Level Accuracy	2.0 dB (CW Pattern, temperature range 15° to 35°C, –120 to 0 dBm) (typ.)
	Frequency Range	500 kHz to 1.6 GHz
	Frequency Accuracy	Same as Spectrum Analyzer

Internal Power Meter

Frequency	Center/Start/Stop, Span, Frequency Step, Signal Standard, Channel #, Full Band
Amplitude	Maximum, Minimum, Offset, Relative On/Off, Units, Auto Scale
Average	Acquisition Fast/Med/Slow, # of Running Averages
Limits	Limit On/Off, Limit Upper/Lower
Frequency Range	10 MHz to 1.6 GHz (Standard), 10 MHz to 6 GHz (Option 6)
Span	1 kHz to 100 MHz
Display Range	–140 to +30 dBm, ≤ 40 dB span
Measurement Range	–120 to +26 dBm
Offset Range	0 to +100 dB
VSWR	2:1 (typ.)
Maximum Power	Same as RF In Damage Level
Accuracy	Same as Spectrum Analyzer
Application Options	Impedance (50Ω, 75Ω, Other)

High Accuracy Power Meter (Option 19) (Requires external USB Power Sensor)

Amplitude	Maximum, Minimum, Offset, Relative On/Off, Units, Auto Scale
Average	# of Running Averages, Max Hold
Zero/Cal	Zero On/Off, Cal Factor (Center Frequency, Signal Standard)
Limits	Limit On/Off, Limit Upper/Lower

Power Sensor Model	MA24105A	MA24106A	MA24108A/18A/26A	MA24208A/18A	MA24330A/40A/50A
Description	Inline High Power Sensor	High Accuracy RF Power Sensor	Microwave USB Power Sensor	Microwave Universal USB Power Sensor	Microwave CW USB Power Sensor
Frequency Range	350 MHz to 4 GHz	50 MHz to 6 GHz	10 MHz to 8 GHz (MA24108A) 10 MHz to 18 GHz (MA24118A) 10 MHz to 26 GHz (MA24126A)	10 MHz to 8/18 GHz	10 MHz to 33/40/50 GHz
Connector Type	Type N (f), 50Ω	Type N (m), 50Ω	Type N (m), 50Ω (MA24108A/18A) Type K (m), 50Ω (MA24126A)	Type N (m), 50Ω	Type K(m), 50Ω (33/40 GHz) Type V(m), 50Ω (50 GHz)
Dynamic Range	+3 to +51.76 dBm (2 mW to 150 W)	–40 to +23 dBm (0.1 µW to 200 mW)	–40 to +20 dBm (0.1 µW to 100 mW)	–60 to +20 dBm (1 nW to 100 mW)	–70 to +20 dBm (0.1 nW to 100 mW)
Measurand	True-RMS	True-RMS	True-RMS, Slot Power, Burst Average Power	True-RMS, Slot Power, Burst Average Power	Average Power
Measurement Uncertainty	±0.17 dB*1	±0.16 dB*2	±0.18 dB*3	± 0.17 dB*4	± 0.17 dB*5
Data sheet (for complete specifications)	11410-00621	11410-00424	11410-00504	11410-00841	11410-00906

*1: Expanded uncertainty with K = 2 for power measurements of a CW signal greater than +20 dBm with a matched load.
Measurement results referenced to the input side of the sensor.

*2: Total RSS measurement uncertainty (0° to 50°C) for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.

*3: Expanded uncertainty with K = 2 for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.

*4: Power uncertainty expressed with two sigma confidence level for CW measurement after zero operation.
Includes calibration factor and linearity over temperature uncertainties, but not the effects of mismatch, zero set and drift, or noise.

*5: Includes linearity over temperature uncertainties, but not the effects of calibration factor, mismatch, zero set and drift, and noise.

NBFM Analyzer and Coverage Mapping

Measurements	
NBFM Analyzer	NBFM Talk-Out Coverage (requires Option 31 GPS and a suitable GPS antenna)
Carrier Power Carrier Frequency Frequency Error FM Deviation (Peak, Average, RMS) Modulation Rate SINAD Quieting THD Occupied Bandwidth (% Int Pwr or >dBc method) Decoded CTCSS/DCS/DTMF Encoded CTCSS/DCS/DTMF	RSSI THD SINAD External SINAD
Graphs	
NBFM Analyzer	NBFM Talk-Out Coverage
Spectrum Audio Spectrum Audio Waveform/Scope Summary Display	Outdoor measured values are overlayed on a geo-tagged map, or displayed on a value vs. time graph. Captured data is exportable to both KML and CSV text (Requires Option 31 GPS and a suitable GPS antenna). Indoor measured values are referenced by creating touchscreen points on a floorplan.

Setup Parameters	Frequency	Receive Frequency, Transmit Frequency, Span, Offset
	Amplitude	Reference level, Scale, Ext Attenuation, Auto Range, Adjust Range
	Setup	Tone Type (CTCSS, DCS, DTMF)
	Filters	High Pass (300 Hz, 3 kHz, None) and Low Pass (300 Hz, 3 kHz, 15 kHz, None) De-emphasis On/Off
	Measurement	NBFM Analyzer, NBFM Coverage, Quieting, SINAD
	Auto Scan	Detection and frequency lock when RF In > +10 dBm, FM or CW signal
	Tx Patterns	CW, FM w/ CTCSS/DCS/DTMF, FM w/ CTCSS/DCS/DTMF + Tone Modulation, FM + Tone Modulation
	NBFM Analyzer	Active Graph, Maximize Active Trace, Graph Type, Audio Span, Audio Sweep Time, Occupied Bandwidth, Frequency Display (Carrier or Error)
	Graph Type	Spectrum, Audio Spectrum, Audio Waveform/Scope, Summary Display
	NBFM Coverage (Requires Option 31 GPS)	Display Type (Map or Time Graph) USB Memory File Format: .nbfm, .kml, both Log data On/Off
RF Measurements (temperature range 15° to 35°C)	Received Power dBm	±1.25 dB, ±0.5 dB (typ.)
	Frequency Error Hz	±10 Hz + Frequency Reference
	SINAD/Quieting	Audio In port conforms to TIA-603-D for input voltage and impedance
	Additional Summary Measurements	Deviation Modulation Rate THD Occupied Bandwidth
	Tone Decode	CTCSS/DCS (standard tones per TIA-603-D), DTMF
Coverage Measurements	RSSI, SINAD, THD	

NBFM Signal Generator

Setup Parameters	Generator	On/Off
	TX Output Level	0.1 dB resolution, 0 to –130 dBm (spec to –120 dBm)
	Frequency Accuracy	Same as Spectrum Analyzer

P25/P25p2 Analyzer and P25/P25p2 Talk-Out Coverage (Options 521 and 522)

Measurements	
P25/P25p2 Analyzer (Option 521)	P25/P25p2 Talk-Out Coverage (Option 522, requires Option 31 GPS)
Received Power Frequency Error Modulation Fidelity NAC (hex) Symbol Rate Error BER (1011 for P25, 1031 for P25p2), O.153, Voice, and Control Channel) Symbol Deviation Hexadecimal Display of Control Channel Traffic	BER RSSI Modulation Fidelity
Graphs	
P25/P25p2 Analyzer (Option 521)	P25/P25p2 Talk-Out Coverage (Option 522, requires Option 31 GPS)
Constellation (P25 only) Linear Constellation Spectrum [Spans (kHz) = 25, 50, 100, 500, 1000, 5000] Histogram Eye Diagram Demodulation Summary Display Base Station Control Channel Summary Displays (Active Control Channel, Band Plan, Backup Control Channel, Adjacent Site Summary) TDMA Power Profile (P25p2 only)	Outdoor measured values are overlayed on a geo-tagged map, or displayed on a value vs time graph, and are exportable to both KML and CSV text (requires Option 31 GPS and a suitable GPS antenna). Indoor measured values are referenced by creating touchscreen points on a floorplan.

Standards Compliance	P25: Relevant sections of TIA-102.CAAA-C P25 Phase 2: Relevant sections of TIA-102.CCAA	
Setup Parameter	Frequency	Receive Frequency, Transmit Frequency, Span, Offset
	Amplitude	Reference level, Scale, Ext Attenuation, Auto Range, Adjust Range
	Setup	P25 Modulation Types: C4FM, CQPSK P25 BER patterns: 1011 Hz, O.153 (V.52), Voice, Control Channel P25 Phase 2 Modulation Types: Base Station (H-DQPSK) & Mobile Station (H-CPM) P25 Phase 2 BER patterns: 1031 Hz, Silence, Voice, Control Channel Averaging, WACN ID, System ID, Color Code, Descrambling (On/Off)
	Measurement	P25 Analyzer, P25 Coverage
	P25/P25p2 Analyzer	Active Graph, Maximize Active Trace, Graph Type, Symbol Span
	Graph Type	Constellation (P25 only), Linear Constellation, Spectrogram, Histogram, Eye Diagram, Demodulation Summary Display, Base Station Control Channel Summary Displays (Active Control Channel, Band Plan, Backup Control Channel, Adjacent Site Summary)
	Eye Diagram Symbol Span	2, 3, 4, 5
	P25/P25p2 Coverage	USB Memory File Format .p25, .kml, both (Option 522, requires Option 31 GPS)
	Log Data	On/Off

RF Measurements (Option 521) (temperature range 15° to 35°C)

Received Power dBm	±1.25 dB, ±0.5 dB (typ.)
Frequency Error Hz	±10 Hz + Frequency Reference
Additional Summary Measurements	Modulation Fidelity (%) BER/MER (%) Symbol Deviation (Hz) Network Access Code (Hex) Symbol Rate Error (Hz)

Measurements (Option 522)

RSSI, BER, Modulation Fidelity

P25/P25p2 Signal Generator

Setup Parameters	Generator	On/Off
	Tx Output Level	0.1 dB resolution, 0 to –130 dBm (spec to –120 dBm)
	P25 Tx Patterns	P25: 1011, 1011 Cal, Interference, Silence, Busy, Idle, High Dev, Low Dev, O.153 (v. 52) p25_lsm_1011, 511 (O.153/v.52), 1011_cal, Interference, Silence, Busy, Idle, Fidelity CW, AM and FM
	P25p2 Tx Patterns	Base Station (H-DQPSK): 1031, 1031 Cal, Silence Mobile Station (H-CPM, Selectable timeslot): 1031, 1031 Cal, Silence CW, AM, FM
RF Characteristics	Power Level Accuracy	2.0 dB (CW Pattern, temperature range 15° to 35°C, –120 to 0 dBm) (typ.)
	Frequency Accuracy	Same as Spectrum Analyzer
	Frequency Range	500 kHz to 1.6 GHz
	P25 Modulation Fidelity	<1.25% max, <0.75% (typ.)
	P25p2 Modulation Fidelity	<2.0% max, <1.75% (typ.)

DMR (MOTOTRBO) Analyzer and DMR Talk-Out Coverage (Options 591 and 592)

Measurements	
DMR (MOTOTRBO) Analyzer (Option 591)	DMR Talk-Out Coverage (Option 592, requires Option 31 GPS)
Received Power Frequency Error Modulation Fidelity Color Code (decimal) RX Timeslot (Base Station only) Symbol Rate Error Symbol Deviation Base Station: 1031, 1031-1 % BER, O.153, O.153-1 % BER, Silence, tscc Mobile Station: 1031, 1031-1 % BER, O.153, O.153-1 % BER, Silence CW, AM, FM Repeater Receiver Sensitivity Test	BER RSSI Modulation Fidelity
Graphs	
DMR (MOTOTRBO) Analyzer (Option 591)	DMR Talk-Out Coverage (Option 592, requires Option 31 GPS)
Constellation Linear Constellation Spectrum [Spans (kHz) = 25, 50, 100, 500, 1000, 5000] Histogram Eye Diagram Summary Display DMR Summary Power Profile	Outdoor measured values are overlayed on a geo-tagged map, or displayed on a value vs. time graph, and are exportable to both KML and CSV text (requires Option 31 GPS and a suitable GPS antenna). Indoor measured values are referenced by creating touchscreen points on a floorplan.

Setup Parameters	Frequency	Receive Frequency, Transmit Frequency, Span, Rx/Tx Coupling, Coupling Offset
	Amplitude	Reference level, Scale, Ext Attenuation, Auto Range, Adjust Range
	Setup	Modulation Type (Base Station, Mobile Station), BER pattern (1031, O.153, Voice, Silence)
	Measurement	DMR Analyzer, DMR Coverage, DMR Bit Capture
	DMR Analyzer	Active Graph, Maximize Active Trace, Graph Type, Symbol Span
	Graph Type	Constellation, Linear Constellation, Spectrogram, Histogram, Eye Diagram, Summary, DMR Summary, Power Profile
	Eye Diagram Symbol Span	2, 3, 4, 5
	DMR Coverage (Option 592, requires Option 31 GPS)	USB Memory File Format .dmr2, .kml, both Log data On/Off

RF Measurements (Option 591) (temperature range 15° to 35°C)

Received Power dBm	±1.25 dB, ±0.5 dB (typ.)
Frequency Error Hz	±10 Hz + Frequency Reference
Summary Measurements	Received Power, Frequency Error, Modulation Fidelity, BER, Symbol Deviation, Color Code, Symbol Rate Error
DMR Summary Measurements	MS ID, Target ID, Talk Group ID, FID, Call Type, Base Station ID

Measurements (Option 592)

RSSI, BER, Modulation Fidelity

DMR Signal Generator

Setup Parameters	Generator	On/Off
	Tx Output Level	0.1 dB resolution, 0 to –130 dBm (spec to –120 dBm)
	Tx Pattern	Base Station: 1031, 1031-1 % BER, O.153, O.153-1 % BER, Silence, tscc Mobile Station: 1031, 1031-1 % BER, O.153, O.153-1 % BER, Silence CW, AM, FM
RF Characteristics	Power Level Accuracy	2.0 dB (CW Pattern, temperature range 15° to 35°C, –120 to 0 dBm) (typ.)
	Frequency Range	500 kHz to 1.6 GHz
	Modulation Fidelity	1.25% max, 0.75% (typ.)
	Frequency Accuracy	Same as Spectrum Analyzer

dPMR Analyzer (Option 573 and 572)

Measurements	
dPMR RF Analyzer (Option 573)	dPMR Talk-Out Coverage (Option 572, requires Option 31 GPS)
Received Power Frequency Error Modulation Fidelity Symbol Rate Error Symbol Deviation	RSSI Modulation Fidelity
Graphs	
dPMR RF Analyzer (Option 573)	dPMR Talk-Out Coverage (Option 572, requires Option 31 GPS)
Constellation Linear Constellation Spectrum [Spans (kHz) = 25, 50, 100, 500, 1000, 5000] Histogram Eye Diagram Summary Display	Outdoor measured values are overlayed on a geo-tagged map and exportable to both KML and CSV text (requires Option 31 GPS and a suitable GPS antenna). Indoor measured values are referenced by creating touchscreen points on a floorplan.

Setup Parameters	Frequency	Receive Frequency, Transmit Frequency, Span, Rx/Tx Coupling, Coupling Offset
	Amplitude	Reference level, Scale, Ext Attenuation, Auto Range, Adjust Range
	Setup	Modulation Bandwidth (6.25 kHz)
	Measurement	dPMR Analyzer, dPMR Coverage
	dPMR Analyzer	Active Graph, Maximize Active Trace, Graph Type, Symbol Span
	Graph Type	Constellation, Linear Constellation, Spectrogram, Histogram, Eye Diagram, Summary
	Eye Diagram Symbol Span	2, 3, 4, 5
	dPMR Coverage (Option 592, requires Option 31 GPS)	USB Memory File Format .dpmr, .kml, both Log data on/off

RF Measurements (Option 573) (temperature range 15° to 35°C)

Received Power dBm	±1.25 dB, ±0.5 dB (typ.)
Frequency Error Hz	±10 Hz + Frequency Reference
Additional Summary Measurements	Modulation Fidelity (%) Symbol Deviation (Hz) Symbol Rate Error (Hz)

Measurements (Option 572)

RSSI, Modulation Fidelity

Signal Generator

Setup Parameters	Generator	On/Off
	Tx Output Level	0.1 dB resolution, 0 to –130 dBm (spec to –120 dBm)
	Tx Pattern	CW, AM, FM, O.153
RF Characteristics	Power Level Accuracy	2.0 dB (CW Pattern, temperature range 15° to 35°C, -120 to 0 dBm) (typ.)
	Frequency Range	500 kHz to 1.6 GHz
	Frequency Accuracy	Same as Spectrum Analyzer

NXDN Analyzer and NXDN Talk-Out Coverage (Options 531 and 532)

Measurements	
NXDN Analyzer (Option 531)	NXDN Talk-Out Coverage (Option 532, requires Option 31 GPS)
Received Power Frequency Error Modulation Fidelity RAN (decimal) Symbol Rate Error BER (1031, O.153, Voice, and Control Channel) Symbol Deviation	BER RSSI Modulation Fidelity
Graphs	
NXDN Analyzer (Option 531)	NXDN Talk-Out Coverage (Option 532, requires Option 31 GPS)
Constellation Linear Constellation Spectrum [Spans (kHz) = 25, 50, 100, 500, 1000, 5000] Histogram Eye Diagram Summary Display	Outdoor measured values are overlayed on a geo-tagged map and exportable to both KML and CSV text (Requires Option 31 GPS and a suitable GPS antenna). Indoor measured values are referenced by creating touchscreen points on a floorplan.

Setup Parameters	Frequency	Receive Frequency, Transmit Frequency, Span, Offset
	Amplitude	Reference level, Scale, Ext Attenuation, Auto Range, Adjust Range
	Setup	Modulation Bandwidth (6.25 kHz and 12.5 kHz), BER pattern (1031, O.153, Voice, Control Channel)
	Measurement	NXDN Analyzer, NXDN Coverage
	NXDN Analyzer	Active Graph, Maximize Active Trace, Graph Type, Symbol Span
	Graph Type	Constellation, Linear Constellation, Spectrogram, Histogram, Eye Diagram, Summary
	Eye Diagram Symbol Span	2, 3, 4, 5
	NXDN Coverage (Option 532, requires Option 31 GPS)	USB Memory File Format .nxdn, .kml, both Log data On/Off

RF Measurements (Option 531) (temperature range 15° to 35°C)

Received Power dBm	±1.25 dB, ±0.5 dB (typ.)
Frequency Error Hz	±10 Hz + Frequency Reference
Additional Summary Measurements	Modulation Fidelity (%) BER/MER (%) Symbol Deviation (Hz) Radio Access Number (RAN) Decimal Symbol Rate Error (Hz)

Measurements (Option 532)

RSSI, BER, Modulation Fidelity

NXDN Signal Generator

Setup Parameters	Modulation Bandwidth	6.25 kHz, 12.5 kHz
	Generator	On/Off
	Tx Output Level	0.1 dB resolution, 0 to –130 dBm (spec to –120 dBm)
	Tx Patterns (9600 and 4800)	1031, O.153 (v. 52), High Dev, Low Dev, UDCH Pattern 10, CAC, 1031 Hz DTS, FACCH3 DTS, Framed PN9, 1031 Cal. CW, AM, FM
RF Characteristics	Power Level Accuracy	2.0 dB (CW Pattern, temperature range 15° to 35°C, –120 to 0 dBm) (typ.)
	Frequency Range	500 kHz to 1.6 GHz
	Modulation Fidelity	1.25% max
	Frequency Accuracy	Same as Spectrum Analyzer

TETRA Analyzer and TETRA Coverage Mapping (Options 581 and 582)

<table>
<tr><th colspan="2">Measurements</th></tr>
<tr><th>TETRA Analyzer
(Option 581)</th><th>TETRA Coverage
(Option 582, requires Option 31 GPS)</th></tr>
<tr><td>Received Power
Frequency Error
Error Vector, RMS, and Peak Carrier Magnitude
IQ Imbalance
Magnitude & Phase Error
Base Station Extended Color Code
Base Station Receiver Sensitivity Test
Symbol Rate Error</td><td>RSSI
EVM</td></tr>
<tr><th colspan="2">Graphs</th></tr>
<tr><th>TETRA Analyzer
(Option 581)</th><th>TETRA Coverage
(Option 582, requires Option 31 GPS)</th></tr>
<tr><td>Constellation
Spectrum [Spans (kHz) = 25, 50, 100, 500, 1000, 5000]
Eye Diagram
Summary Display
TETRA Summary</td><td>Outdoor measured values are overlayed on a geo-tagged map and exportable to both KML and CSV text (requires Option 31 GPS and a suitable GPS antenna).
Indoor measured values are referenced by creating touchscreen points on a floorplan.</td></tr>
</table>

Setup Parameters	Frequency	Receive Frequency, Tx Frequency, Rx Coupling, Coupling Offset, Span
	Amplitude	Reference level, Scale, Ext Attenuation, Auto Range, Adjust Range, Tx Output Lvl, Tx Power Offset, Units
	Setup	Mod Type, Rx Pattern, Tx Pattern, Squelch Lvl, Numeric Averaging
	Measurements	TETRA Analyzer, TETRA Coverage, TETRA BS Sensitivity
	TETRA Analyzer	Active Graph, Maximize Active Graph, Graph Type, Symbol Span
	Graph Type	Constellation, Spectrogram, Eye Diagram, Summary, TETRA Summary
	Eye Diagram Symbol Span	2, 3, 4, 5
	TETRA Coverage (Option 582, requires Option 31 GPS)	USB Memory File Format .tetra, .kml, or both Log data On/Off

RF Measurements (Option 581) (temperature range 15° to 35°C)

Received Power dBm	±1.25 dB, ±0.5 dB (typ.)
Frequency Error Hz	±10 Hz + Frequency Reference
Additional Summary Measurements	Vector Error, RMS and Peak (%) Residual Carrier Magnitude (%) IQ Imbalance (dB) Phase Error Degrees Magnitude Error (%) Symbol Rate Error (Hz)
TETRA Summary Measurements	Mobile Color Code (Decimal) Mobile Network Code (Decimal) Base Station Color Code (Decimal) Base Station Extended Color Code (Hex) Location Area Code (Decimal) Mobile Station Maximum Transmit Power (dBm)

Measurements (Option 582)

RSSI, BER, Error Vector Magnitude

TETRA Signal Generator

Setup Parameters	Modulation Type	π/4 (Pi/4) DQPSK
	Generator	On/Off
	Tx Output Level	0.1 dB resolution, 0 to –130 dBm (spec to –120 dBm)
	Base Station Test Patterns	tetra_bs_idle_unallocPCH tetra_bs_busy_allocPCH T1_TCH_7p2 (Airbus TB3, Hytera, Sepura, Motorola, ETELM NeTIS)
RF Characteristics	Power Level Accuracy	2.0 dB (CW Pattern, temperature range 15° to 35°C, –120 to 0 dBm) (typ.)
	Frequency Range	500 kHz to 1.6 GHz
	EVM	3.5% max
	Frequency Accuracy	Same as Spectrum Analyzer

PTC Analyzer and PTC Talk-Out Coverage (Options 721 and 722)

Measurements	
PTC Analyzer (Option 721)	PTC Talk-Out Coverage (Option 722, requires Option 31 GPS)
Received Power Frequency Error π/4 DQPSK: Error Vector Magnitude, BER, IQ Imbalance, Phase Error, Magnitude Error, Symbol Rate Error	BER RSSI Modulation Fidelity
Graphs	
PTC Analyzer (Option 721)	PTC Talk-Out Coverage (Option 722, requires Option 31 GPS)
Constellation Linear Constellation Spectrum [Spans (kHz) = 25, 50, 100, 500, 1000, 5000] Histogram Eye Diagram Summary Display	Outdoor measured values are overlayed on a geo-tagged map, or displayed on a value vs time graph, and are exportable to both KML and CSV text (requires Option 31 GPS and a suitable GPS antenna). Indoor measured values are referenced by creating touchscreen points on a floorplan.

Setup Parameters	Frequency	Receive Frequency, Transmit Frequency, Span, Offset
	Amplitude	Reference level, Scale, Ext Attenuation, Auto Range, Adjust Range
	Setup	RX Pattern (O.153/V.52, PN9 Normal), Symbol Rate (Half Rate 8 ksps, Full Rate 16 ksps), TX Pattern (O.153 Continuous, PN9 Normal Types 1 - 4, PN9 Normal Continuous), CW, AM 1 kHz tone, FM 1 kHz tone
	Measurement	PTC Analyzer, PTC Coverage
	PTC Analyzer	Active Graph, Maximize Active Trace, Graph Type, Symbol Span
	Graph Type	Constellation, Linear Constellation, Spectrogram, Histogram, Eye Diagram, Summary
	Eye Diagram Symbol Span	2, 3, 4, 5
	PTC Coverage (Option 722)	USB Memory File Format .ptc, .kml, both (requires Option 31 GPS)
	Log data	On/Off

RF Measurements (Option 721) (temperature range 15° to 35°C)

Received Power dBm	±1.25 dB, ±0.5 dB (typ.)
Burst Power dBm	±1.25 dB, ±0.5 dB (typ.)
Peak Envelope Power dBm	±1.25 dB, ±0.5 dB (typ.)
Frequency Error Hz	±10 Hz + Frequency Reference
Additional Summary Measurements	Error Vector Magnitude (%) BER (%) IQ Imbalance (dB) Phase Error (degrees) Magnitude Error (%) Symbol Rate Error (Hz)

Measurements (Option 722)

RSSI, BER, Modulation Fidelity

PTC Signal Generator

Setup Parameters	Modulation Type	π/4 DQPSK
	Symbol Rate (ksps)	8 (Half Rate), 16 (Full Rate)
	Generator	On/Off
	Tx Output Level	0.1 dB resolution, 0 to –130 dBm (spec to –120 dBm)
	Tx Pattern	PN9 Continuous, PN9 Burst, CW, AM, FM
RF Characteristics	Power Level Accuracy	2.0 dB (CW Pattern, temperature range 15° to 35°C, –120 to 0 dBm) (typ.)
	Frequency Range	500 kHz to 1.6 GHz
	EVM	3.5% max
	Frequency Accuracy	Same as Spectrum Analyzer

AM/FM/PM Signal Analyzers (Option 509)

Display Type	Measurements							
	RF Spectrum (AM/FM/PM)	Audio Spectrum (AM)	Audio Spectrum (FM/PM)	Audio Waveform (AM)	Audio Waveform (FM/PM)	Summary (AM)	Summary (FM/PM)
Graphic Display	Power (dBm) vs. Frequency	Depth (%) vs. Modulation Frequency	Deviation (kHz/rad) vs. Modulation Frequency	Depth (%) vs. Time	Deviation (kHz/rad) vs. Time	None	None
Numerical Displays	Carrier Power Carrier Frequency Occupied Bandwidth	AM Rate RMS Depth (Pk-Pk)/2 Depth SINAD* THD* Distortion/Total Vrms*	FM/PM Rate RMS Deviation (Pk-Pk)/2 Deviation SINAD* THD* Distortion/Total Vrms*	AM Rate RMS Depth (Pk-Pk)/2 Depth SINAD* THD* Distortion/Total Vrms*	FM/PM Rate RMS Depth (Pk-Pk)/2 Depth SINAD* THD* Distortion/Total Vrms*	RMS Depth (AM) Peak + Depth Peak – Depth (Pk-Pk)/2 Depth Carrier Power Carrier Frequency Occupied Bandwidth AM Rate SINAD* THD* Distortion/Total Vrms*	RMS Deviation (FM/PM) Peak + Depth Peak – Depth (Pk-Pk)/2 Depth Carrier Power Carrier Frequency Occupied Bandwidth AM Rate SINAD* THD* Distortion/Total Vrms*

*: Requires Sinewave modulation

Setup Parameters	Frequency	Center Freq, Span, Freq Step, Signal Standard, Channel, Channel Increment, Set Carrier Freq
	Amplitude	Scale, Power Offset, Adjust Range
	Setup	Demod Type (AM, FM, PM), IFBW, Auto IFBW
	Measurements	RF Spectrum AM/FM/PM, Audio Spectrum (AM/FM/PM), Audio Waveform (AM/FM/PM), Summary (AM/FM/PM), Average
	Marker	On/Off, Delta, Peak Search, Marker Freq to Center, Marker to Ref Lvl, Marker Table, All Markers Off
Specifications	AM	Modulation Rate: ±1 Hz (<100 Hz), ±2% (>100 Hz) Depth: ±5% for modulation rates 10 Hz to 100 kHz
	FM	Modulation Rate: ±1 Hz (<100 Hz); ±2% (100 Hz to 100 kHz) Deviation Accuracy: ±5% (100 Hz to 100 kHz, IFBW must be greater than 95% occupied BW)
	PM	Modulation Rate: ±1 Hz (<100 Hz); ±2% (100 Hz to 100 kHz) Deviation Accuracy: ±5% (deviation 0 to 93 Rad, rate 10 Hz to 5 kHz, IFBW must be greater than 95% occupied BW)
	IF Bandwidth	1 kHz to 300 kHz in 1-3 sequence
	Frequency Span	RF Spectrum: 10 kHz to 10 MHz Audio Spectrum: 2 kHz, 5 kHz, 10 kHz, 20 kHz
	RBW/VBW	30
	Span/RBW	100
	Sweep time	50 µs to 50 ms (Audio Waveform)

LTE Signal Analyzers (Options 541, 542 and 546)

Measurements			
RF (Option 541)	Demodulation (Option 542)	Over-the-Air (OTA) (Option 546)	Pass/Fail (User Editable)
Channel Spectrum Channel Power Occupied Bandwidth ACPR Spectral Emission Mask Category A or B (Opt 0001) RF Summary	Power vs. Resource Block (RB) RB Power (PDSCH) Active RBs, Utilization%, Channel Power, Cell ID OSTP, Frame EVM by modulation Constellation QPSK, 16 QAM, 64 QAM Modulation Results Ref Signal Power (RS) Sync Signal Power (SS) EVM – rms, peak, max hold Frequency Error – Hz, ppm Carrier Frequency Cell ID Control Channel Power Bar Graph or Table View RS, P-SS, S-SS PBCH, PCFICH, PHICH, PDCCH Total Power (Table View) EVM Modulation Results Tx Time Alignment Modulation Summary Includes EVM by modulation Antenna Icons Detects active antennas (1/2)	Scanner Cell ID (Group, Sector) S-SS Power, RSRP, RSRQ, SINR Dominance Modulation Results – On/Off Tx Test Scanner RS Power of MIMO antennas (2 × 2, 4 × 4) Cell ID, Average Power Delta Power (Max-Min) Graph of Antenna Power Modulation Results – On/Off Mapping On-screen S-SS Power, RSRP, RSRQ, or SINR Scanner Modulation Results – Off	View Pass/Fail Limits All, RF, Modulation Available Measurements Channel Power Occupied Bandwidth ACLR Frequency Error Carrier Frequency Dominance EVM peak, rms RS Power RS EVM SS, P-SS, S-SS Power SS, P-SS, S-SS EVM PBCH Power PBCH EVM PCFICH Power PCFICH EVM PHICH Power, EVM PDCCH Power, EVM Cell, Group, Sector ID OSTP Tx Time Alignment

Setup Parameters	Frequency	E-UTRA bands 1 – 5, 7 – 14, 17 – 21, 23 – 32, 66A (tunable 10 MHz to 6.0 GHz) Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
	Bandwidth	1.4, 3, 5, 10 MHz
	Span	Auto, 1.4, 3, 5, 10, 15, 20, 30 MHz
	Amplitude	Scale/Division, Power Offset, Auto Range, Adjust Range
	Sweep	Single/Continuous, Trigger Sweep
	EVM Mode	Auto, PBCH only
	Save/Recall	Setup, Measurement, Screen Shot (save only), to Internal/External Memory
	Measurement Summary Screens	Overall Measurements, RF Measurements, Modulation Measurements

RF Measurements (Options 541)

RF Channel Power Accuracy	±1.5 dB, ±1.0 dB (typ.), (RF input –50 to +10 dBm) (Option 541)

Demodulation Measurements (Options 542)

Frequency Error	±10 Hz + Frequency Reference, 99% confidence level
Residual EVM (rms)	2.0% (typ.) (E-UTRA Test Model 3.1, RF Input –50 to +10 dBm) for BW ≤10 MHz

Over-the-Air (OTA) Measurements (Options 546)

Scanner	Six strongest signals if present Auto Save — Sync Signal Power and Modulation Results with GPS tagging
Auto Save	Scanner — three strongest signals if present RS Power — strongest signal
Mapping	Map On-screen S-SS Power, RSRP, RSRQ, or SINR of Cell ID with strongest signal Scanner — three strongest signals if present Save and Export Scanner data: *.kml, *.mtd (tab delimited)

IEEE 802.16 Fixed WiMAX Signal Analyzers (Options 46 and 47)

Measurements			
RF (Option 46)	Demodulation (Option 47)	Over-the-Air (OTA)	Pass/Fail (User Editable)
Channel Spectrum Channel Power Occupied Bandwidth Power vs. Time Channel Power Preamble Power Data Burst Power Crest Factor ACPR	Constellation RCE (RMS/Peak) EVM (RMS/Peak) Frequency Error Carrier Frequency Base Station ID Spectral Flatness Adjacent Subcarrier Flatness EVM vs. Subcarrier/Symbol RCE EVM Frequency Error Carrier Frequency Base Station ID	There are no additional OTA Measurements. RF Measurements and Demodulation can be made OTA.	Channel Power Occupied Bandwidth Burst Power Preamble Power Crest Factor Frequency Error Carrier Frequency EVM RCE Base Station ID

Setup Parameters	Bandwidth	1.25, 1.50, 2.50, 3.50, 5.00, 5.50, 6.00, 7.00, 10.00 MHz
	Cyclic Prefix Ratio (CP)	1/4, 1/8, 1/16, 1/32
	Span	5, 10, 15, 20 MHz
	Frame Length	2.5, 5.0, 10.0 ms
	Frequency	Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
	Amplitude	Scale/Division, Power Offset, Auto Range, Adjust Range
	Sweep	Single/Continuous, Trigger Sweep
	Save/Recall	Setup, Measurement, Screen Shot (save only), to Internal/External Memory
	Measurement Summary Screens	Overall Measurements, RF Measurements, Signal Quality Measurements

RF Measurements (Option 46) (temperature range 15° to 35°C)

RF Channel Power Accuracy	±1.5 dB, ±1.0 dB (typ.), (RF input –50 to +20 dBm) (Option 541)

Demodulation (Option 47) (temperature range 15° to 35°C)

Frequency Error	0.07 ppm + Frequency Reference, 99% confidence level
Residual EVM (rms)	3% (typ.), 3.5% max (RF Input –50 to +20 dBm)

IEEE 802.16 Mobile WiMAX Signal Analyzers (Options 66, 67 and 37)

Measurements			
RF (Option 66)	Demodulation (Option 67)	Over-the-Air (OTA) (Option 37)	Pass/Fail (User Editable)
Channel Spectrum Channel Power Occupied Bandwidth Power vs. Time Channel Power Preamble Power Downlink Burst Power Uplink Burst Power ACPR	Constellation RCE (RMS/Peak) EVM (RMS/Peak) Frequency Error CINR Base Station ID Sector ID Spectral Flatness Adjacent Subcarrier Flatness EVM vs. Subcarrier/Symbol RCE (RMS/Peak) EVM (RMS/Peak) Frequency Error CINR Base Station ID Sector ID DL-MAP (Tree View)	Channel Power Monitor Preamble Scanner (Six) Preamble Relative Power Cell ID Sector ID PCINR Dominant Preamble Base Station ID	Channel Power Occupied Bandwidth Downlink Burst Power Uplink Burst Power Preamble Power Crest Factor Frequency Error Carrier Frequency EVM RCE Sector ID

Setup Parameters	Zone Type	PUSC
	DL-MAP Auto Decoding	Convolutional Coding (CC), Convolutional Turbo Coding (CTC)
	Bandwidths	3.50, 5.00, 7.00, 8.75, 10.00 MHz
	Cyclic Prefix Ratio (CP)	1/8
	Span	5, 10, 20, 30 MHz
	Frame Lengths	5, 10 ms
	Demodulation	Auto, Manual, FCH
	Frequency	Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
	Amplitude	Scale/Division, Power Offset, Auto Range, Adjust Range
	Sweep	Single/Continuous, Trigger Sweep
	Save/Recall	Setup, Measurement, Screen Shot (save only), to Internal/External Memory
	Measurement Summary Screens	Overall Measurements, RF Measurements, Signal Quality Measurements

RF Measurements (Option 66) (temperature range 15° to 35°C)

RF Channel Power Accuracy	±1.5 dB, ±1.0 dB (typ.), (RF input –50 to +20 dBm)

Demodulation (Option 67) (temperature range 15° to 35°C)

Frequency Error	0.02 ppm + Frequency Reference, 99% confidence level
Residual EVM (rms)	2.5% (typ.), 3.0% max, (RF Input –50 to +20 dBm)

Over-the-Air (OTA) Measurements (Option 37)

Channel Power Monitor	Over time (one week), measurement time interval 1 to 60 sec
Preamble Scanner	Six Strongest Preambles
Auto Save	Yes
GPS Logging	Yes

General Specifications

Setup Parameters	System	Status (Temperature, Battery Info, Serial Number, Firmware Version, Options Installed) Self Test, Application Self Test, GPS (see Option 31)
	System Options	Name, Date and Time, Brightness, Volume Language (English, French, German, Spanish, Chinese, Japanese, Korean, Italian, Russian, Portuguese) Reset (Factory Defaults, Master Reset, Update Firmware)
	File	Save, Recall, Delete, Directory Management
	Save/Recall	Setups, Measurements, Screen Shots jpeg (save only)
	Delete	Selected File, All Measurements, All Mode Files, All Content
	Directory Management	Sort Method (Name/Type/Date), Ascend/Descend, Internal/USB, Copy, Format USB
	Internal Trace/Setup Memory	2,000 traces, 2,000 setups
	External Trace/Setup Memory	Limited by size of USB Flash drive
	Mode Switching	Auto-Stores/Recalls most recently used Setup Parameters in the Mode
Connectors	VNA Port 1, VNA Port 2	N (f), 50Ω
	VNA Port Damage Level	23 dBm, ±50 VDC
	RF In Port	N (f), 50Ω
	RF In Port Damage Level	+33 dBm peak, ±50 VDC, Maximum Continuous Input (≥10 dB attenuation)
	Signal Generator Port	N (f), 50Ω
	Signal Generator Port Damage Level	+27 dBm, ±16 VDC
	GPS	SMA (f)
	External Power	5.5 mm barrel connector, 12.5 VDC to 15 VDC, <4.0 A
	USB Interface (2)	Type A (Connect USB Flash Drive and Power Sensor)
	USB Interface	5-pin mini-B, Connect to PC for data transfer
	Ethernet Interface	RJ45 connector for Ethernet 10-Base T
	Headset Jack	3.5 mm mini-phone plug
	External Reference In	BNC, female, 1 MHz, 1.2288 MHz, 1.544 MHz, 2.048 MHz, 2.4576 MHz, 4.8 MHz, 4.9152 MHz, 5 MHz, 9.8304 MHz, 10 MHz, 13 MHz, and 19.6608 MHz at –10 to +10 dBm
	Audio In (SINAD/Quieting)	BNC, female, Impedance 50kΩ, Maximum Voltage >1.77 Vrms (TIA-603-D compliant)
	External Trigger/ Clock Recovery	BNC, female, Maximum Input ±5 VDC
Display	Type	Resistive TFT Touchscreen
	Size	8.4 inch daylight viewable color LCD
	Resolution	800 × 600
	Pixel Defects	No more than five defective pixel (99.9989% good pixels)
Power	Field Replaceable Battery	Li-Ion, 7500 mAh rated capacity 40 W on battery power only
	DC Power	Universal 110 V/220 V AC/DC Adapter 55 W running off AC/DC adapter while charging battery
	Life Time Charging Cycles	>300 (80% of initial capacity)
	Battery Operation	3.6 hours (typ.)
	Battery Charging Limits	0 to +45°C, Relative Humidity ≤80%
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU
RCM	Australia and New Zealand	RCM AS/NZS 4417:2012
KCC	South Korea	KCC-REM-A21-0004
Environmental	Operating Temperature Range	–10° to +55°C
	Storage Temperature Range	–51° to +71°C
	Maximum Humidity	95% RH at +30°C, non-condensing
	Vibration, Sinusoidal	5 Hz to 55 Hz
	Vibration, Random	10 Hz to 500 Hz
	Half Sine Shock	30 g_n
	Explosive Atmosphere	MIL-PRF-28800F, Section 4.5.6.3 MIL-STD-810G, Method 511.5, Procedure 1
	Altitude	4600 m, operating and non-operating
ESD	RF Port Center Pin	Withstands up to ±15 kV
Dimensions and Mass		273 (W) × 199 (H) × 91 (D) mm (10.7 × 7.8 × 3.6 in), 3.6 kg (7.9 lb)
Warranty	Duration	Standard three-year warranty (battery one-year warranty)

Master Software Tools (for your PC)

Database Management	Full Trace Retrieval	Retrieve spectrum analyzer traces from instrument into one PC directory
	Trace Catalog	Index all traces into one catalog
	Trace Rename Utility	Rename measurement traces
	Group Edit	Titles, subtitles, plot scaling, markers and limit lines, simultaneously on similar files
	DAT File Converter	Converts HHST files to MST file format and vice-versa
Data Analysis	Trace Math and Smoothing	Compare multiple traces
	Data Converter	Convert from/to Return Loss, VSWR, Cable Loss, DTF and also into Smith Charts
	Measurement Calculator	Translates into other units
Report Generation	Report Generator	Includes GPS, power level, and calibration status along with measurements
	Edit Graph	Change scale, limit lines, and markers
	Report Format	Create reports in HTML for PDF format
	Export Measurements	Export measurements to *.s2p, *.jpg or *.csv format
	Notes	Annotate measurements
Mapping (GPS Required)	Spectrum Analyzer Mode	MapInfo, MapPoint
Folder Spectrogram (Spectrum Monitoring for Interference Analysis and Spectrum Clearing)	Folder Spectrogram – 2D View	Creates a composite file of multiple traces Peak Power, Total Power, Peak Frequency, Histogram, Average Power (Max/Min) File Filter (Violations over limit lines or deviations from averages) Playback
	Video Folder Spectrogram – 2D View	Create AVI file to export for management review/reports
	Folder Spectrogram – 3D View	Views (Set Threshold, Markers) - 3D (Rotate X, Y, Z Axis, Level Scale, Signal ID) - 2D View (Frequency or Time Domain, Signal ID) - Top Down Playback (Frequency and/or Time Domain)
List/Parameter Editors	Traces	Add, delete, and modify limit lines and markers
	Antennas, Cables, Signal Standards	Modify instrument's Antenna, Cable, and Signal Standard List
	Product Updates	Auto-checks Anritsu website for latest revision firmware
	Languages	Customize non-English language menus
	Display	Modify display settings
Script Master™	Channel Scanner Mode	Automate scan up to 1200 channels, repeat for sets of 20 channels, repeat all channels
Connectivity	Connections	Connect to PC using USB, LAN, or Direct Ethernet connection
	Network Search	Find all Anritsu handheld instruments on local network
	Download	Download measurements and live traces to PC for storage and analysis
	Upload	Upload measurements from PC to instrument
	Export	Measurements can be saved in various formats, depending on the measurement type, including JPEG, CSV, and Anritsu DAT format
	Printing	Print individual or all measurement screens

easyTest Tools™ (for your PC)

Instrument Modes	Cable & Antenna Analyzer Spectrum Analyzer
Commands	Display Image: Allows putting a custom image on the instrument screen Recall Setup: Places the instrument into a known state; auto-advance to next command available Prompt: Displays instructional messages on the instrument screen; timed advance to next command available; instrument users can be allowed or disallowed from making setup adjustments Save: Allows automatic or manual saving of traces; auto-advance to next command available

Line Sweep Tools (for your PC)

Line Sweep Tools (LST) is a free PC based program that increases productivity for people who deal with numerous Cable and Antenna traces every day. LST is the next generation of Anritsu's familiar Handheld Software Tools (HHST) and shares its uncomplicated user interface, giving a new face to the term "ease of use."

Trace Capture	Browse to Instrument: View and copy traces from the test equipment to your PC using Windows Explorer Open Legacy Files: Open DAT files captured with Handheld Software Tools v6.61 Open Current Files: Open VNA or DAT files Capture Plots To: The Line Sweep Tools screen, DAT files, Database, or JPEG
Traces	Trace Types: Return Loss, VSWR, DTF-RL, DTF-VSWR, Cable Loss, Smith Chart, and PIM Trace Formats: DAT, VNA, CSV, PNG, BMP, JPG, HTML, Data Base, and PDF
Report Generation	Report Generator: Includes GPS location along with measurements Report Format: Create reports in HTML or PDF format Report Setup: Report Title, Company, Prepared for, Location, Date and Time, Filename, Company logo*1 Trace Setup: One Trace Portrait Mode, Two Trace Portrait Modes, One Trace Landscape Mode
Trace Validation	Presets: 7 presets allow "one click" setting of up to 6 markers and one limit line Marker Controls: 6 regular Markers, Marker Peak, Marker Valley, Marker between, and frequency entry Delta Markers: 6 Delta markers Limit Line: Enable and drag or value entry. Also works with presets Next Trace Button: Next Trace and Previous Trace arrow keys allow quick switching between traces
Tools	Cable Editor*2: Allows creation of custom cable parameters Distance to Fault*3: Converts a Return Loss trace to a Distance to Fault trace Measurement Calculator: Converts Real, Imaginary, Magnitude, Phase, RL, VSWR, Rho, and Transmit power Signal Standard Editor*2: Creates new band and channel tables Renaming Grid: 36 user definable phrases for creation of file names, trace titles, and trace subtitles
Connectivity	Connections: Ethernet, USB cable, and USB memory stick

*1: Optionally set by user
*2: Instrument type/model must match original
*3: Only *.dat and *.vna file types supported

Web Remote Control

Control	Full instrument control through a browser – all instrument functions except power switch and rotary knob
Connections	RJ45 Ethernet jack Third party Wi-Fi router
Protocol	HTTP/TCP/IP
Physical Layer	Cat 5 Cable, Wi-Fi router compatible
Software Required	HTML 5-compliant browser – Google Chrome, Mozilla Firefox
Operating System	iOS, Windows, Linux, Android operating systems that can host the HTML 5-compliant browser
Remote Hardware	PCs, tablets, and smart phones with Ethernet or Wi-Fi connection and an HTML 5-compliant browser
Download	Individual instrument files downloaded via browser Multiple instrument files and directories zipped and downloaded via browser File downloads are not supported by iOS Screen capture capability
Display Modes	Normal: All modes and displays supported Fast: Spectrum traces update faster (up to 5 updates per second)
Password	The instrument can be password protected Passwords may be used to manage who is controlling the instrument
Users/Instruments	One user/device can view and control many instruments

Programmable Remote Control

Functionality	Many instrument functions are programmable. See the Programming Manual for details.
Programming Language	Standard Commands for Programmable Instruments (SCPI)
Interfaces	Ethernet, USB
Available Drivers	LabView. Visit NI.com for driver

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main Frame
S412E	500 kHz to 1.6 GHz Vector Network Analyzer 9 kHz to 1.6 GHz Spectrum Analyzer 10 MHz to 1.6 GHz Power Meter 500 kHz to 1.6 GHz CW Signal Generator 10 MHz to 1.6 GHz NBFM Analyzer
	Options
S412E-0010	High Voltage Variable Bias Tee
S412E-0031	GPS Receiver (requires suitable GPS antenna)
S412E-0019	High-Accuracy Power Meter (Requires External Power Sensor)
S412E-0025	Interference Analyzer (Option 31 recommended)
S412E-0027	Channel Scanner
S412E-0006	6 GHz Coverage on Spectrum Analyzer
S412E-0016	6 GHz Coverage on Vector Network Analyzer
S412E-0015	Vector Voltmeter
S412E-0431	Coverage Mapping (Requires Option 31)
S412E-0444	EMF Measurements (Requires Anritsu Isotropic Antenna)
S412E-0509	AM/FM/PM Analyzer
S412E-0521	P25/P25p2 Analyzer Measurements
S412E-0522	P25/P25p2 Coverage Measurements (Requires Options 31 and 521)
S412E-0531	NXDN Analyzer Measurements
S412E-0532	NXDN Coverage Measurements (Requires Options 31 and 531)
S412E-0573	dPMR RF Analyzer Measurements
S412E-0572	dPMR Coverage Measurements (Requires Options 31 and 573)
S412E-0581	TETRA Analyzer Measurements
S412E-0582	TETRA Coverage Measurements (Requires Options 31 and 581)

Model/Order No.	Name
S412E-0591	DMR (MOTOTRBO) Analyzer Measurements
S412E-0592	DMR (MOTOTRBO) Coverage Measurements (Requires Options 31 and 591)
S412E-0721	PTC Analyzer
S412E-0722	PTC Coverage Measurements (Requires Options 31 and 721)
S412E-0541	LTE RF Measurements (Requires Option 31)
S412E-0542	LTE Modulation Quality (Requires Option 31)
S412E-0886	LTE 256QAM Demodulation (Requires Option 542)
S412E-0546	LTE Over-the-Air Measurements (Requires Option 31)
S412E-0046	IEEE 802.16 Fixed WiMAX RF Measurements (Requires Option 6)
S412E-0880	GSM/GPRS/EDGE Measurements
S412E-0047	IEEE 802.16 Fixed WiMAX Demodulation (Requires Option 6)
S412E-0066	IEEE 802.16 Mobile WiMAX RF Measurements (Requires Option 6)
S412E-0067	IEEE 802.16 Mobile WiMAX Demodulation (Requires Option 6)
S412E-0037	IEEE 802.16 Mobile WiMAX Over-the-Air Measurements (Requires Option 6, Option 31 required for full functionality)
S412E-0098	Standard Calibration (ANSI Z540-1-1994)
S412E-0099	Premium Calibration (ANSI Z540-1-1994) plus printed test data
	Standard Accessories
	(Included with instrument)
2000-1691-R	Stylus with Coiled Tether
2000-1797-R	Screen Protector Film, 8.4 inch (2, one installed)
2000-1654-R	Soft Carrying Case
633-75	Rechargeable Li-Ion Battery, 7500 mAh
40-187-R	AC-DC Adapter
806-141-R	Automotive Power Adapter, 12 VDC, 60 W
3-2000-1498	USB A/5-pin mini-B Cable, 10 ft/305 cm
	Standard Three Year Warranty (one year on battery) Certificate of Conformance

Continued on next page

Model/Order No.	Name
	Manuals, Related Literature (Soft copy at www.anritsu.com)
10580-00318	LMR Master User Guide
10580-00289	Vector Network Analyzer Measurement Guide
10580-00243	Land Mobile Radio Measurement Guide
10580-00241	Cable and Antenna Analyzer Measurement Guide
10580-00244	Spectrum Analyzer Measurement Guide - Interference Analyzer, Channel Scanner, Gated Sweep, CW Signal Generator, AM/FM/PM Analyzer, Interference Mapping, Coverage Mapping
10580-00240	Power Meter Measurement Guide - High Accuracy Power Meter
10580-00234	3GPP Signal Analyzer Measurement Guide - GSM/EDGE, W-CDMA/HSDPA, TD-SCDMA/HSDPA, LTE
10580-00236	WiMAX Signal Analyzer Measurement Guide - Fixed WiMAX, Mobile WiMAX
10580-00319	Programming Manual
	Troubleshooting Guides (Soft copy at www.anritsu.com)
11410-00551	Spectrum Analyzers
11410-00472	Interference
11410-00566	LTE eNode Testing
11410-00466	GSM/GPRS/EDGE Base Stations
11410-00473	Cable, Antenna, and Component Troubleshooting Guide
11410-00427	Understanding Cable & Antenna Analysis White Paper
	Optional Accessories
	USB Power Sensors (For complete ordering information see the respective datasheets of each sensor)
MA24105A	Inline Peak Power Sensor, 350 MHz to 4 GHz, +3 to +51.76 dBm
MA24106A	RF USB Power Sensor, 50 MHz to 6 GHz, +23 dBm
MA24108A	Microwave USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24118A	Microwave USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24126A	Microwave USB Power Sensor, 10 MHz to 26 GHz, +20 dBm
MA24208A	Microwave Universal USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24218A	Microwave Universal USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24330A	Microwave CW USB Power Sensor, 10 MHz to 33 GHz, +20 dBm
MA24340A	Microwave CW USB Power Sensor, 10 MHz to 40 GHz, +20 dBm
MA24350A	Microwave CW USB Power Sensor, 10 MHz to 50 GHz, +20 dBm
MA25100A	RF Power Indicator
	MA8100A NEON® Signal Mapper Accessories
MA8100A-001	TRX NEON Signal Mapper with Anritsu Integration and Tracking Unit (Includes 1 year TRX NEON Software License with 1 year of maintenance and support and 1 year of Cloud Service)
MA8100A-003	TRX NEON Signal Mapper with Anritsu Integration and Tracking Unit (Includes 3 years TRX NEON Software License with 3 years of maintenance and support and 3 years of Cloud Service)
MA8100A-005	TRX NEON Signal Mapper with Anritsu Integration and Tracking Unit (Includes 5 years TRX NEON Software License with 5 years of maintenance and support and 5 years of Cloud Service)
MA8100A-100	TRX NEON Signal Mapper with Anritsu Integration and Tracking Unit (Includes Perpetual TRX NEON Software License with 3 years of maintenance and support and 3 years of Cloud Service)
2300-574	1 year TRX NEON Software License with 1 year of maintenance and support and 1 year of Cloud Service
2300-575	3 years TRX NEON Software License with 3 years of maintenance and support and 3 years of Cloud Service
2300-576	5 years TRX NEON Software License with 5 years of maintenance and support and 5 years of Cloud Service
2300-606	Perpetual TRX NEON Software License with 3 years of maintenance and support and 3 years of Cloud Service
2300-612	Renewal of 1 year TRX NEON Software License with 1 year of maintenance and support and 1 year of Cloud Service
2300-613	Renewal of 3 years TRX NEON Software License with 3 years of maintenance and support and 3 years of Cloud Service
2300-614	Renewal of 5 years TRX NEON Software License with 5 years of maintenance and support and 5 years of Cloud Service
	Full Temperature N-Type Coaxial Calibration Kits –10° to +55°C (see individual data sheets on www.anritsu.com)
OSLN50A-8	High Performance Type N (m), DC to 8 GHz, 50Ω
OSLNF50A-8	High Performance Type N (f), DC to 8 GHz, 50Ω
TOSLN50A-8	High Performance with Through, Type N (m), DC to 8 GHz, 50Ω
TOSLNF50A-8	High Performance with Through, Type N (f), DC to 8 GHz, 50Ω

Model/Order No.	Name
	Full Temperature K-Type Coaxial Calibration Kits K-type connectors are compatible with 3.5 mm and SMA connectors. –10° to +55°C
TOSLK50A-20	High Performance with Through, Type K (m), DC to 20 GHz, 50Ω
TOSLKF50A-20	High Performance with Through, Type K (f), DC to 20 GHz, 50Ω
	Coaxial Calibration Components, Other 50Ω, 75Ω
22N50	Precision N (m) Short/Open, 18 GHz
22NF50	Precision N (f) Short/Open, 18 GHz
28N50-2	Precision Termination, DC to 18 GHz, 50Ω, N (m)
28NF50-2	Precision Termination, DC to 18 GHz, 50Ω, N (f)
SM/PL-1	Precision N (m) Load, 42 dB, 6 GHz
SM/PLNF-1	Precision N (f) Load, 42 dB, 6 GHz
2000-1914-R	Precision Open/Short/Load, 4.3-10 (f), DC to 6 GHz, 50Ω
2000-1915-R	Precision Open/Short/Load, 4.3-10 (m), DC to 6 GHz, 50Ω
2000-1618-R	Open/Short/Load, 7/16 DIN (m), DC to 6 GHz 50Ω
2000-1619-R	Open/Short/Load, 7/16 DIN (f), DC to 6 GHz 50Ω
12N50-75B	Matching Pad, DC to 3 GHz, 50Ω to 75Ω
22N75	Open/Short, N (m), DC to 3 GHz, 75Ω
22NF75	Open/Short, N (f), DC to 3 GHz, 75Ω
26N75A	Precision Termination, N (m), DC to 3 GHz, 75Ω
26NF75A	Precision Termination, N (f), DC to 3 GHz, 75Ω
1091-55-R	Open, TNC (f), DC to 18 GHz
1091-53-R	Open, TNC (m), DC to 18 GHz
1091-56-R	Short, TNC (f), DC to 18 GHz
1091-54-R	Short, TNC (m), DC to 18 GHz
1015-54-R	Termination, TNC (f), DC to 18 GHz
1015-55-R	Termination, TNC (m), DC to 18 GHz
	Directional Antennas
2000-1411-R	824 MHz to 896 MHz, N (f), 12.3 dBi, Yagi
2000-1412-R	885 MHz to 975 MHz, N (f), 12.6 dBi, Yagi
2000-1413-R	1710 MHz to 1880 MHz, N (f), 12.3 dBi, Yagi
2000-1414-R	1850 MHz to 1990 MHz, N (f), 11.4 dBi, Yagi
2000-1415-R	2400 MHz to 2500 MHz, N (f), 14.1 dBi, Yagi
2000-1416-R	1920 MHz to 2170 MHz, N (f), 14.3 dBi, Yagi
2000-1659-R	698 MHz to 787 MHz, N (f), 10.1 dBi, Yagi
2000-1660-R	1425 MHz to 1535 MHz, N (f), 14.3 dBi, Yagi
2000-1715-R	698 MHz to 2500 MHz, N (f), gain of 2 dBi to 10 dBi, typical
2000-1726-R	Antenna, 2500 MHz to 2700 MHz, N (f), 14.1 dBi, Yagi
2000-1747-R	Antenna, Log Periodic, 300 MHz to 7000 MHz, N (f), 5.1 dBi, typical
2000-1748-R	Antenna, Log Periodic, 1 GHz to 18 GHz, N (f), 6 dBi, typical
2000-1777-R	Portable Directional Antenna, 9 kHz to 20 MHz, N (f)
2000-1778-R	Portable Directional Antenna, 20 MHz to 200 MHz, N (f)
2000-1779-R	Portable Directional Antenna, 200 MHz to 500 MHz, N (f)
2000-1812-R	Portable Yagi Antenna, 450 MHz to 512 MHz, N (f), 7.1 dBi
2000-1825-R	Portable Yagi Antenna, 380 MHz to 430 MHz, N (f), 7.1 dBi
	Portable Antennas
2000-1200-R	806 MHz to 866 MHz, SMA (m), 50Ω[*1]
2000-1473-R	870 MHz to 960 MHz, SMA (m), 50Ω[*1]
2000-1035-R	896 MHz to 941 MHz, SMA (m), 50Ω (1/2 wave)[*1]
2000-1030-R	1710 MHz to 1880 MHz, SMA (m), 50Ω (1/2 wave)[*1]
2000-1474-R	1710 MHz to 1880 MHz with knuckle elbow (1/2 wave)[*1]
2000-1031-R	1850 MHz to 1990 MHz, SMA (m), 50Ω (1/2 wave)[*1]
2000-1475-R	1920 MHz to 1980 MHz and 2110 MHz to 2170 MHz, SMA (m), 50Ω[*1]
2000-1032-R	2400 MHz to 2500 MHz, SMA (m), 50Ω (1/2 wave)[*1]
2000-1361-R	2400 MHz to 2500 MHz, 5000 MHz to 6000 MHz, SMA (m), 50Ω[*1]
2000-1636-R	Antenna Kit (Consists of: 2000-1030-R, 2000-1031-R, 2000-1032-R, 2000-1200-R, 2000-1035-R, 2000-1361-R,and carrying pouch)
2000-1616	20 MHz to 21000 MHz, N (f), 50Ω
2000-1487	Telescoping Whip Antenna, BNC[*2]
	GPS Antennas (Active)
2000-1652-R	Magnet Mount, SMA (m), 3 VDC to 5 VDC with 1 ft cable
2000-1528-R	Magnet Mount, SMA (m), 3 VDC to 5 VDC with 4.6 m (15 ft) extension cable
2000-1760-R	Mini GPS Antenna, SMA (m), 25 dB gain, 2.5 VDC to 3.7 VDC

Continued on next page

Model/Order No.	Name
	Filters
1030-114-R	806 MHz to 869 MHz, N (m) to SMA (f), 50Ω
1030-109-R	824 MHz to 849 MHz, N (m) to SMA (f), 50Ω
1030-110-R	880 MHz to 915 MHz, N (m) to SMA (f), 50Ω
1030-105-R	890 MHz to 915 MHz, N (m) to N (f), 50Ω
1030-111-R	1850 MHz to 1910 MHz, N (m) to SMA (f), 50Ω
1030-106-R	1710 MHz to 1790 MHz, N (m) to N (f), 50Ω
1030-107-R	1910 MHz to 1990 MHz, N (m) to N (f), 50Ω
1030-112-R	2400 MHz to 2484 MHz, N (m) to SMA (f), 50Ω
1030-149-R	High Pass, 150 MHz, N (m) to N (f), 50Ω
1030-150-R	High Pass, 400 MHz, N (m) to N (f), 50Ω
1030-151-R	High Pass, 700 MHz, N (m) to N (f), 50Ω
1030-152-R	Low Pass, 200 MHz, N (m) to N (f), 50Ω
1030-153-R	Low Pass, 550 MHz, N (m) to N (f), 50Ω
1030-155-R	2500 MHz to 2700 MHz, N (m) to N (f), 50Ω
	Attenuators
3-1010-122	20 dB, 5 W, DC to 12.4 GHz, N (m) to N (f)
42N50-20	20 dB, 5 W, DC to 18 GHz, N (m) to N (f)
42N50A-30	30 dB, 50 W, DC to 18 GHz, N (m) to N (f)
3-1010-123	30 dB, 50 W, DC to 8.5 GHz, N (m) to N (f)
1010-127-R	30 dB, 150 W, DC to 3 GHz, N (m) to N (f)
3-1010-124	40 dB, 100 W, DC to 8.5 GHz, N (m) to N (f), Uni-directional
1010-121	40 dB, 100 W, DC to 18 GHz, N (m) to N (f), Uni-directional
1010-128-R	40 dB, 150 W, DC to 3 GHz, N (m) to N (f)
	Phase-Stable Test Port Cables, Armored
15NNF50-1.5C	1.5 m, DC to 6 GHz, N (m) to N (f), 50Ω
15NN50-1.5C	1.5 m, DC to 6 GHz, N (m) to N (m), 50Ω
15NDF50-1.5C	1.5 m, DC to 6 GHz, N (m) to 7/16 DIN (f), 50Ω
15ND50-1.5C	1.5 m, DC to 6 GHz, N (m) to 7/16 DIN (m), 50Ω
15NNF50-3.0C	3.0 m, DC to 6 GHz, N (m) to N (f), 50Ω
15NN50-3.0C	3.0 m, DC to 6 GHz, N (m) to N (m), 50Ω
15NNF50-5.0C	5.0 m, DC to 6 GHz, N (m) to N (f), 50Ω
15NN50-5.0C	5.0 m, DC to 6 GHz, N (m) to N (m), 50Ω
15N43M50-1.5C	Test Port Extension Cable, 1.5 m, DC to 6 GHz, N (m) to 4.3-10 (m)
15N43F50-1.5C	Test Port Extension Cable, 1.5 m, DC to 6 GHz, N (m) to 4.3-10 (f)
15N43M50-3.0C	Test Port Extension Cable, 3 m, DC to 6 GHz, N (m) to 4.3-10 (m)
15N43F50-3.0C	Test Port Extension Cable, 3 m, DC to 6 GHz, N (m) to 4.3-10 (f)
15NF43M50-1.5C	Test Port Extension Cable, 1.5 m, DC to 6 GHz, N (f) to 4.3-10 (m)
15NF43F50-1.5C	Test Port Extension Cable, 1.5 m, DC to 6 GHz, N (f) to 4.3-10 (f)
15NF43M50-3.0C	Test Port Extension Cable, 3 m, DC to 6 GHz, N (f) to 4.3-10 (m)
15NF43F50-3.0C	Test Port Extension Cable, 3 m, DC to 6 GHz, N (f) to 4.3-10 (f)
	Adapters
1091-26-R	SMA (m) to N (m), DC to 18 GHz, 50Ω
1091-27-R	SMA (f) to N (m), DC to 18 GHz, 50Ω
1091-80-R	SMA (m) to N (f), DC to 18 GHz, 50Ω
1091-81-R	SMA (f) to N (f), DC to 18 GHz, 50Ω
1091-465-R	4.3-10 (f) to N (f), DC to 6 GHz, 50Ω
1091-467-R	4.3-10 (m) to N (f), DC to 6 GHz, 50Ω
1091-172	BNC (f) to N (m), DC to 1.3 GHz, 50Ω
510-90-R	7/16 DIN (f) to N (m), DC to 7.5 GHz, 50Ω
510-91-R	7/16 DIN (f) to N (f), DC to 7.5 GHz, 50Ω
510-92-R	7/16 DIN (m) to N (m), DC to 7.5 GHz, 50Ω
510-93-R	7/16 DIN (m) to N (f), DC to 7.5 GHz, 50Ω
510-96-R	7/16 DIN (m) to 7/16 DIN (m), DC to 7.5 GHz, 50Ω
510-97-R	7/16 DIN (f) to 7/16 DIN (f), DC to 7.5 GHz, 50Ω
513-62	Adapter, DC to 18 GHz, TNC (f) to N (f), 50Ω
1091-315	Adapter, DC to 18 GHz, TNC (m) to N (f), 50Ω
1091-324	Adapter, DC to 18 GHz, TNC (f) to N (m), 50Ω
1091-325	Adapter, DC to 18 GHz, TNC (m) to N (m), 50Ω
1091-317	Adapter, DC to 18 GHz, TNC (m) to SMA (f), 50Ω
1091-318	Adapter, DC to 18 GHz, TNC (m) to SMA (m), 50Ω
1091-323	Adapter, DC to 18 GHz, TNC (m) to TNC (f), 50Ω
1091-326	Adapter, DC to 18 GHz, TNC (m) to TNC (m), 50Ω
510-102-R	N (m) to N (m), DC to 11 GHz, 50Ω, 90 degrees right angle
	Precision Adapters
34NN50A	Precision Adapter, N (m) to N (m), DC to 18 GHz, 50Ω
34NFNF50	Precision Adapter, N (f) to N (f), DC to 18 GHz, 50Ω
	Backpack and Transit Case
67135	Anritsu Backpack (For Handheld Instrument and PC)
760-243-R	Large Transit Case with Wheels and Handle 56 × 45.5 × 26.5 cm (22.07" × 17.92" × 10.42")
760-271-R	Transit Case for Portable Directional Antennas and Port Extender 52.4 × 42.8 × 20.6 cm (20.62" × 16.87" × 8.12") (for 2000-1777-R, 2000-1778-R, 2000-1779-R, 2000-1798-R)

Model/Order No.	Name
	Miscellaneous Accessories
MA2700A	Handheld Interference Hunter (For full specifications, refer to the MA2700A Technical Data Sheet 11410-00692)
MA25200A	High Power Tx/Rx Input Protection Module
2000-1374	External Dual Charger for Li-Ion Batteries
2000-1797-R	Screen Protector Film, 8.4 inch
66864	Rack Mount Kit, Master Platform
2000-1689	EMI Near Field Probe Kit
	Interchangeable Adaptor Phase Stable Test Port Cables, Armored W/Reinforced Grip (recommended for cable and antenna line sweep applications. It uses the same ruggedized grip as the Reinforced grip series cables. Now you can also change the adaptor interface on the grip to four different connector types)
15RCN50-1.5-R	1.5 m, DC to 6 GHz, N (m), N (f), 7/16 DIN (m), 7/16 DIN (f), 50Ω
15RCN50-3.0-R	3.0 m, DC to 6 GHz, N (m), N (f), 7/16 DIN (m), 7/16 DIN (f), 50Ω

*1: Requires 1091-27-R SMA (f) to N (m) adapter

*2: Requires 1091-172-R BNC (f) to N (m) adapter

Site Master

S331E	**S332E**	**S361E**	**S362E**	
2 MHz to 4 GHz	2 MHz to 4 GHz	2 MHz to 6 GHz	2 MHz to 6 GHz	Cable & Antenna Analyzer
	9 kHz to 4 GHz		9 kHz to 6 GHz	Spectrum Analyzer

Remote Control
Ethernet OPTION | USB

Compact Handheld Cable & Antenna Analyzer with Spectrum Analyzer

The wireless communications market continues to evolve at a rapid pace. Operators and service providers have to maintain existing 2G and 3G networks while deploying new 4G LTE networks. They face the additional challenge of needing to ensure their networks are competitive from a reliability, quality, and cost perspective. As a result, more is expected from the contractors and technicians who maintain their networks. To stay competitive, these contractors and technicians must maintain more base stations than before and complete a wide variety of tasks in the shortest time possible.

Indeed, since 1995, Anritsu's Site Master has been the de facto standard for contractors, installers, and wireless service providers who need a portable and rugged cable and antenna analyzer.

The Site Master reduces per site maintenance expense, maximizes system up-time, and breaks away from the traditional fix-after-failure maintenance mode by finding small problems before major failures occur. Radio frequency (RF) engineers and field technicians for installing and maintaining communication systems use Site Master's frequency domain reflectometry (FDR)-based approach to improve the quality of their communication systems.

Integrated

The Site Master is a 4 GHz or 6 GHz cable and antenna analyzer that can be configured to include either a 4 GHz or 6 GHz spectrum analyzer, 2-port transmission measurement with built-in 32 V bias tee, an interference analyzer with spectrogram displays, a channel scanner, power meter, high accuracy power meter, and GPS receiver for time and location stamping. Because of its multi-functional capabilities, it eliminates the need for you to carry and learn multiple instruments.

Trusted

Anritsu builds upon its expertise in portable compact cable and antenna analyzers and spectrum analyzers. The Site Master is approved by all major operators and service providers worldwide.

Designed for Field Use

The Site Master was designed specifically for field environments.
It weighs less than 2.71 kg (6.0 lb, S331E, S361E), 3.71 kg (8.2 lb, S332E, S362E) and its field replaceable Li-Ion battery typically lasts for more than 4.5 hours (typ., S331E, S361E), 3.5 hours (typ., S332E, S362E). A new bright 8.4-inch color display provides visibility even in broad daylight. With an operating temperature range from –10° to +55°C, the Site Master will work in the most extreme weather conditions. The analyzer is almost impervious to the bumps and bangs typically encountered by portable field equipment, and its ruggedized case and splash proof design allow you to depend on high performance anywhere, anytime.

Functions and Description

- Cable and Antenna Analyzer, 2 MHz to 4 GHz/6 GHz
- Measurements: RL, VSWR, Cable Loss, DTF, Phase
- 2-port Transmission Measurement: High/Low Power
- Sweep Speed: 1 ms/data point, typical
- Display: Single or Dual Measurement Touchscreen
- Calibration: OSL, InstaCal™, and FlexCal™
- Bias Tee: 32 V internal
- Spectrum Analyzer, 9 kHz to 4 GHz/6 GHz
- Measurements: Occupied Bandwidth, Channel Power, ACPR, C/I
- Interference Analyzer: Spectrogram, Signal Strength, RSSI, Signal ID, Interference Mapping
- Dynamic Range: >95 dB in 10 Hz RBW
- DANL: –152 dBm in 10 Hz RBW
- Phase Noise: –100 dBc/Hz max @ 10 kHz offset at 1 GHz
- Frequency Accuracy: <±50 ppb with GPS On

Capabilities and Functional Highlights

- AM/FM/PM Analyzer
- CPRI LTE RF Measurements
- OBSAI LTE RF Measurements
- LTE/LTE-A FDD/TDD; MIMO (2×2, 4×4)
- EMF Test (S332E & S362E)
- High Accuracy Power Meter
- Up to 50 GHz USB Sensors
- PIM Alert Application (S332E & S362E)
- Master Software Tools™
- Line Sweep Tools™
- easyTest Tools™
- USB & Optional Ethernet (Option 413) for data transfer and instrument control
- Handheld Interference Hunter support (S332E & S362E)
- On-Screen Interference Mapping
- On-Screen Coverage Mapping
- GPS tagging of saved traces
- Increase throughput by automating repetitive or operator intensive tasks via Ethernet or USB. Remote programming provided via Ethernet (Option 413)
- 4.5 hour battery operation time
- Store 2000 Traces internally
- Touchscreen keyboard
- Quick Name Matrix
- <5 minute warm-up time
- E-Learning Training
- Certified Line Sweep Training

Specifications

Cable and Antenna Analyzer

Frequency	Frequency Range	2 MHz to 4 GHz (S331E, S332E), 2 MHz to 6 GHz (S361E, S362E)
	Frequency Accuracy	≤±2.5 ppm @ 25°C
	Frequency Resolution	1 kHz (RF immunity low), 100 kHz (RF immunity high)
Output Power	High	0 dBm (typ.)
	Low	2 MHz to 1.5 GHz: –40 dBm, typical >1.5 GHz to 4/6 GHz: –30 dBm, typical
Interference Immunity	On-Channel	+17 dBm @ >1.0 MHz from carrier frequency
	On-Frequency	0 dBm within ±10 kHz of the carrier frequency
Measurement Speed	Return Loss	≤1.00 msec/data point, RF immunity low (typ.)
	Distance-to-Fault	≤1.25 msec/data point, RF immunity low (typ.)
Return Loss	Measurement Range	0 to 60 dB
	Resolution	0.01 dB
VSWR	Measurement Range	1:1 to 65:1
	Resolution	0.01
Cable Loss	Measurement Range	0 to 30 dB
	Resolution	0.01 dB
Distance-to-Fault	Vertical Range Return Loss	0 to 60 dB
	Vertical Range VSWR	1:1 to 65:1
	Fault Resolution (meters)	(1.5 × 10^8 × vp)/ΔF (vp = velocity propagation constant, ΔF is F2 – F1 in Hz)
	Horizontal Range (meters)	0 to (Data Points – 1) × Fault Resolution, to a maximum of 1500 meters (4921 ft)
1-Port Phase	Measurement Range	–180° to +180°
	Resolution	0.01°
Smith Chart	Resolution	0.01 50/75Ω Selectable
Measurement Accuracy	Corrected Directivity	>42 dB, OSL calibration>38 dB, InstaCal™ calibration >38 dB, InstaCal™ Calibration to a second line

Spectrum Analyzer (S332E, S362E)

Frequency	Frequency Range	9 kHz to 4 GHz (S332E), 9 kHz to 6 GHz (S362E) (usable to 0 Hz)
	Tuning Resolution	1 Hz
	Frequency Reference	Aging: ±1.0 ppm/year Accuracy: ±1.5 ppm (25° ±25°C) + aging, <±50 ppb with GPS On
	Frequency Span	10 Hz to 4 GHz including zero span (S332E), 10 Hz to 6 GHz including zero span (S362E)
	Sweep Time	Minimum 100 ms, 10 µs to 600 seconds in zero span
	Sweep Time Accuracy	±2% in zero span
Bandwidth	Resolution Bandwidth (RBW)	10 Hz to 3 MHz in 1–3 sequence ±10% (1 MHz max in zero-span) (–3 dB bandwidth)
	Video Bandwidth (VBW)	1 Hz to 3 MHz in 1–3 sequence (–3 dB bandwidth) (auto or manually selectable)
	RBW with Quasi-Peak Detection	200 Hz, 9 kHz, 120 kHz (–6 dB bandwidth)
	VBW with Quasi-Peak Detection	Auto VBW is On, RBW/VBW = 1
Spectral Purity	SSB Phase Noise @ 1 GHz	–100 dBc/Hz, –110 dBc/Hz (typ.) @ 10 kHz offset –105 dBc/Hz, –112 dBc/Hz (typ.) @ 100 kHz offset –115 dBc/Hz, –121 dBc/Hz (typ.) @ 1 MHz offset
Amplitude Ranges	Dynamic Range	>95 dB (2.4 GHz), 2/3 (TOI-DANL) in 10 Hz RBW
	Measurement Range	DANL to +26 dBm (≥50 MHz), DANL to 0 dBm (<50 MHz)
	Display Range	1 to 15 dB/div in 1 dB steps, ten divisions displayed
	Reference Level Range	–120 to +30 dBm
	Attenuator Range	0 to 55 dB, 5.0 dB steps
	Maximum Continuous Input	+30 dBm
	Amplitude Units	Log Scale Modes: dBm, dBV, dBmV, dBmV, dBW, dBmW, dBmW, dBA Linear Scale Modes: nV, mV, mV, V, kV, nW, mW, mW, W, kW, nA, mA, mA, A
Amplitude Accuracy	9 kHz to 100 kHz	±2.0 dB (typ.)(Preamp Off)
	100 kHz to 4.0 GHz	±1.25 dB, ±0.5 dB (typ.)
	>4.0 GHz to 6 GHz	±1.50 dB, ±0.5 dB (typ.)

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		Preamp Off (Reference level –20 dBm)		Preamp On (Reference level –50 dBm)	
		Maximum	Typical	Maximum	Typical
Displayed Average Noise Level (DANL)	(RBW Normalized to 1 Hz, 0 dB attenuation)				
	10 MHz to 2.4 GHz	–141 dBm	–146 dBm	–157 dBm	–162 dBm
	>2.4 GHz to 4 GHz	–137 dBm	–141 dBm	–154 dBm	–159 dBm
	>4 GHz to 5 GHz	–134 dBm	–138 dBm	–150 dBm	–155 dBm
	>5 GHz to 6 GHz	–126 dBm	–131 dBm	–143 dBm	–150 dBm
	(RBW = 10 Hz, 0 dB attenuation)				
	10 MHz to 2.4 GHz	–131 dBm	–136 dBm	–147 dBm	–152 dBm
	>2.4 GHz to 4 GHz	–127 dBm	–131 dBm	–144 dBm	–149 dBm
	>4 GHz to 5 GHz	–124 dBm	–128 dBm	–140 dBm	–145 dBm
	>5 GHz to 6 GHz	–116 dBm	–121 dBm	–133 dBm	–140 dBm
Spurs	Residual Spurious	<–90 dBm (RF input terminated, 0 dB input attenuation, >10 MHz)			
	Input-Related Spurious	<–75 dBc (0 dB attenuation, –30 dBm input, span <1.7 GHz, carrier offset >4.5 MHz)			
	Exceptions (typ.)	<–70 dBc @ <2.5 GHz, with 2072.5 MHz Input <–68 dBc @ F1 – 280 MHz with F1 Input <–70 dBc @ F1 + 190.5 MHz with F1 Input <–52 dBc @ 7349 – 2F2 MHz, with F2 Input, where F2 <2437.5 MHz <–55 dBc @ 190.5 ± F1/F2 MHz, F1 <1 GHz			
Third-Order Intercept (TOI)	Preamp Off (–20 dBm tones 100 kHz apart, 10 dB attenuation)				
	800 MHz	+16 dBm			
	2400 MHz	+20 dBm			
	200 MHz to 2200 MHz	+25 dBm (typ.)			
	>2.2 GHz to 5.0 GHz	+28 dBm (typ.)			
	>5.0 GHz to 6.0 GHz	+33 dBm (typ.)			
Second Harmonic Distortion	Preamp Off, 0 dB input attenuation, –30 dBm input				
	50 MHz	–56 dBc			
	>50 MHz to 200 MHz	–60 dBc (typ.)			
	>200 MHz to 3000 MHz	–70 dBc (typ.)			
VSWR		2:1 (typ.)			

Ethernet Connectivity (Option 413)

Connector	RJ45
LAN Speed	10 Mbps
Mode	Static, DHCP
Static IP Settings	IP address Subnet Mask IP Gateway
Remote Control	Remote Access utility provided with Web Remote Control and SCPI programming
Data Upload	With Line Sweep Tools through Ethernet connection

2-Port Transmission Measurement (Option 21)

Frequency	Frequency Range	2 MHz to 4 GHz (S331E, S332E), 2 MHz to 6 GHz (S361E, S362E)
	Frequency Resolution	10 Hz
Output Power	High	0 dBm (typ.)
	Low	2 MHz to 1.5 GHz: –40 dBm, typical >1.5 GHz to 4/6 GHz: –30 dBm, typical
Dynamic Range	2 MHz to 4 GHz	80 dB, 95 dB (typ.)
	>4 GHz to 6 GHz	70 dB, 85 dB (typ.)
Application Options		Bias-Tee (On/Off), Impedance (50Ω, 75Ω, Other)

Bias-Tee (Option 10) (Requires Option 21 for S331E and S361E)

Setup	On/Off, Voltage, Current (Low/High)
Voltage Range	+12 V to +32 V
Current (Low/High)	250 mA/450 mA, 1 A surge for 100 ms
Resolution	0.1 V

GPS Receiver (Option 31) (Antenna sold separately, P/N 2000-1528-R)

Setup	On/Off, Antenna Voltage 3.3 V/5.0 V, GPS Info
GPS Time/Location Indicator	Time, Latitude, Longitude and Altitude on display Time, Latitude, Longitude and Altitude with trace storage
High Frequency Accuracy	Spectrum Analyzer, Interference Analyzer, CW Signal Analyzers
When GPS Antenna is connected	<±50 ppb with GPS On, GPS antenna connected, 3 minutes after satellite lock in selected mode
Connector	SMA (f)

Power Meter (Option 29) (S332E, S362E)

Frequency	Center/Start/Stop, Span, Frequency Step, Signal Standard, Channel #, Full Band
Amplitude	Maximum, Minimum, Offset, Relative On/Off, Units, Auto Scale
Average	Acquisition Fast/Med/Slow, # of Running Averages
Limits	Limit On/Off, Limit Upper/Lower
Frequency Range	10 MHz to 4 GHz (S332E), 10 MHz to 6 GHz (S362E)
Span	1 kHz to 100 MHz
Display Range	–140 to +30 dBm, ≤40 dB span
Measurement Range	–120 to +26 dBm
Offset Range	0 to +100 dB (External Gain or Loss)
VSWR	2:1 (typ.)
Maximum Power	+30 dBm without attenuator
Accuracy	Same as Spectrum Analyzer
Application Options	Impedance (50Ω, 75Ω, Other)

High Accuracy Power Meter (Option 19) (Requires external USB Power Sensor(s)

Amplitude	Maximum, Minimum, Offset, Relative On/Off, Units, Auto Scale				
Average	# of Running Averages, Max Hold				
Zero/Cal	Zero On/Off, Cal Factor (Center Frequency, Signal Standard)				
Limits	Limit On/Off, Limit Upper/Lower				
Power Sensor Model	MA24105A	MA24106A	MA24108A/18A/26A	MA24208A/18A	MA24330A/40A/50A
Description	Inline High Power Sensor	High Accuracy RF Power Sensor	Microwave USB Power Sensor	Microwave Universal USB Power Sensor	Microwave CW USB Power Sensor
Frequency Range	350 MHz to 4 GHz	50 MHz to 6 GHz	10 MHz to 8/18/26 GHz	10 MHz to 8 GHz/18 GHz	10 MHz to 33/40/50 GHz
Connector	Type N (f), 50Ω	Type N (m), 50Ω	Type N (m), 50Ω (8 GHz/18 GHz) Type K (m), 50Ω (26 GHz)	Type N (m), 50Ω	Type K (m), 50Ω (33 GHz/40 GHz) Type V (m), 50Ω (50 GHz)
Dynamic Range	+3 to +51.76 dBm (2 mW to 150 W)	–40 to +23 dBm (0.1 µW to 200 mW)	–40 to +20 dBm (0.1 µW to 100 mW)	–60 to +20 dBm (1 nW to 100 mW)	–70 to +20 dBm (0.1 nW to 100 mW)
Measurand	True-RMS	True-RMS	True-RMS, Slot Power, Burst Average Power	True-RMS, Slot Power, Burst Average Power	Average Power
Measurement Uncertainty	± 0.17 dB[*1]	± 0.16 dB[*2]	± 0.18 dB[*3]	± 0.17 dB[*4]	± 0.17 dB[*5]
Data sheet (for complete specifications)	11410-00621	11410-00424	11410-00504	11410-00841	11410-00906

*1: Expanded uncertainty with K = 2 for power measurements of a CW signal greater than +20 dBm with a matched load. Measurement results referenced to the input side of the sensor.

*2: Total RSS measurement uncertainty (0° to 50°C) for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.

*3: Expanded uncertainty with K = 2 for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.

*4: Power uncertainty expressed with two sigma confidence level for CW measurement after zero operation. Includes calibration factor and linearity over temperature uncertainties, but not the effects of mismatch, zero set and drift, or noise.

*5: Includes linearity over temperature uncertainties, but not the effects of calibration factor, mismatch, zero set and drift, and noise.

Interference Analyzer (Option 25) (S332E, S362E)

Measurements	Spectrum	Field Strength Occupied Bandwidth Channel Power Adjacent Channel Power (ACPR) AM/FM/SSB Demodulation (Wide/Narrow FM, Upper/Lower SSB), (audio out only) Carrier-to-Interference ratio (C/I)
	Spectrogram	Collect data up to 72 hours
	Signal Strength	Gives visual and aural indication of signal strength
	Received Signal Strength Indicator (RSSI)	Collect data up to one week Gives visual and aural indication of signal strength
	Signal ID (up to 12 signals)	Center Frequency Bandwidth Signal Type (FM, GSM, W-CDMA, CDMA, Wi-Fi) Closest Channel Number Number of Carriers
	Signal-to-Nose Ratio (SNR)	>10 dB
	Interference Mapping	Triangulate location of interference with on display maps
	Application Options	Bias-Tee (On/Off), Impedance (50Ω, 75Ω, Other) Support for MA2700A Handheld Interference Hunter

AM/FM/PM Signal Analyzers (Option 509) (S332E, S362E only)

Measurements	RF Spectrum (AM/FM/PM)	Audio Spectrum (AM)	Audio Spectrum (FM/PM)	Audio Waveform (AM)	Audio Waveform (FM/PM)	Summary (AM)	Summary (FM/PM)
Graphic Display	Power (dBm) vs. Frequency	Depth (%) vs. Modulation Frequency	Deviation (kHz/rad) vs. Modulation Frequency	Depth (%) vs. Time	Deviation (kHz/rad) vs. Time	—	—
Numerical Displays	Carrier Power Carrier Frequency Occupied Bandwidth	AM Rate RMS Depth (Pk-PK)/2 Depth SINAD* THD* Distortion/Total Vrms*	FM/PM Rate RMS Deviation (Pk-PK)/2 Deviation SINAD* THD* Distortion/Total Vrms*	AM Rate RMS Depth (Pk-PK)/2 Depth SINAD* THD* Distortion/Total Vrms*	FM/PM Rate RMS Depth (Pk-PK)/2 Depth SINAD* THD* Distortion/Total Vrms*	RMS Depth (AM) Peak + Depth Peak – Depth (Pk-PK)/2 Depth Carrier Power Carrier Frequency Occupied Bandwidth AM Rate SINAD* THD* Distortion/Total Vrms*	RMS Deviation (FM/PM) Peak + Depth Peak – Depth (Pk-PK)/2 Depth Carrier Power Carrier Frequency Occupied Bandwidth AM Rate SINAD* THD* Distortion/Total Vrms*
Setup Parameters	Frequency	Center Freq, Span, Freq Step, Signal Standard, Channel, Channel Increment, Set Carrier Freq					
	Amplitude	Scale, Power Offset, Adjust Range					
	Setup	Demod Type (AM, FM, PM), IFBW, Auto IFBW					
	Measurements	RF Spectrum AM/FM/PM, Audio Spectrum (AM/FM/PM), Audio Waveform (AM/FM/PM), Summary (AM/FM/PM), Average					
	Marker	On/Off, Delta, Peak Search, Marker Freq to Center, Marker to Ref Lvl, Marker Table, All Markers Off					
Specifications	AM	Modulation Rate: ±1 Hz (<100 Hz), ±2% (>100 Hz) Depth: ±5% for (Modulation rates 10 Hz to 100 kHz)					
	FM	Modulation Rate: ±1 Hz (<100 Hz); ±2% (100 Hz to 100 kHz) Deviation Accuracy: ±5%					
	PM	Modulation Rate: ±1 Hz (<100 Hz); ±2% (100 Hz to 100 kHz) Deviation Accuracy: ±5% (deviation 0 to 93 Rad, rate 10 Hz to 5 kHz, IFBW must be greater than 95% occupied BW)					
	IF Bandwidth	1 kHz to 300 kHz in 1-3 sequence					
	Frequency Span	RF Spectrum: 10 kHz to 10 MHz Audio Spectrum: 2, 5, 10, 20, 70, 140 kHz					
	RBW/VBW	30					
	Span/RBW	100					
	Sweep Time	50 µs to 50 ms (Audio Waveform)					

*: Requires Sinewave modulation

Channel Scanner (Option 27) (S332E, S362E only)

Number of Channels	1 to 20 Channels
Measurements	Graph/Table, Max Hold (On/5 sec/Off), Freq/Channel, Current/Max, Single/Dual Color
Scanner	Scan Channels, Scan Frequencies, Scan Customer List, Scan Script Master™
Amplitude	Reference Level, Scale
Custom Scan	Signal Standard, Channel, # of Channels, Channel Step Size, Custom Scan
Frequency Range	9 kHz to 4 GHz (S332E), 9 kHz to 6 GHz (S362E)
Frequency Accuracy	±10 Hz + Time base error
Measurement Range	–110 to +26 dBm
Application Options	Bias-Tee (On/Off), Impedance (50Ω, 75Ω, Other)

CW Signal Generator (Option 28) (S332E, S362E only; requires CW Signal Generator Kit, P/N 69793)

Setup Parameters	Frequency	Frequency, Signal Standard, Channel Number, Display Setup Help
	Amplitude	Power Level (Low/High), Offset (dB)
	Frequency Range	2 MHz to 2 GHz
	Frequency Reference Accuracy	±1.5 ppm (25° ±25°C) + aging, <±50 ppb with GPS On
	Output Power	High 0 dBm (typ.), Low –30 dBm (typ.) Attenuator (included in kit 69793): 0 to 90 dB in 1 dB steps

Gated Sweep (Option 90) (S332E, S362E only)

Mode	Spectrum Analyzer, Sweep
Trigger	External TTL
Setup	Gated Sweep (On/Off) Gate Polarity (Rising, Falling) Gate Delay (0 to 65 ms) (typ.) Gate Length (1 µs to 65 ms) (typ.) Zero Span Time

Electromagnetic Field Test (Option 444) (S332E, S362E only)

Measurements	Setup	Limit lines, axis dwell time, measurement time, auto-logging, measurement units, trace display
	Spectrum Analyzer	Field strength is measured
	Units	dBm/m^2, dBV/m, dBmV/m, dBuV/m, V/m, W/m^2, dBW/m^2, A/m, dBA/m, W/cm^2
	Results	Maximum, minimum, and average of all measurements conducted
	Display	Measurement status, number of measurements taken, pass/fail indicators
Frequency Range	Supported Antenna	2000-1800-R: 9 kHz to 300 MHz 2000-1792-R: 30 MHz to 3 GHz 2000-1791-R: 700 MHz to 6 GHz
Modes where EMF Measurements Available		Spectrum Analyzer

Coverage Mapping (Option 431) (S332E, S362E only) (Requires Option 31 GPS)

Measurements	Indoor Mapping	RSSI, ACPR
	Outdoor Mapping	RSSI, ACPR
Setup Parameters	Frequency	Center/Start/Stop, Span, Freq Step, Signal Standard, Channel #, Channel Increment
	Amplitude	Reference Level (RL), Scale, Attenuation Auto/Level, RL Offset, Pre-Amp On/Off, Detection
	Span	Span, Span Up/Down (1-2-5), Full Span, Zero Span, Last Span
	BW	RBW, Auto RBW, VBW, Auto VBW, RBW/VBW, Span/VBW
	Measurement Setup	ACPR, RSSI
	Point Distance/Time Setup	Repeat Type Time Distance
	Save Points Map	Save KML, JPEG, Tab Delimited
	Recall Points Map	Recall Map, Recall KML Points only, Recall KML Points with Map, Recall Default Grid

RF over Fiber Hardware (Option 759)

Must be ordered with either
Option 752: CPRI LTE RF measurements, or Option 753: OBSAI LTE RF measurements

RF over Fiber Interface	Connector Port	Small form factor pluggable (SFP) optical transceiver port
Operating Temperature	Range	–10° to +45°C

CPRI LTE RF Measurements (Option 752) (Requires Option 759)

Measurements (CPRI RF measurements support LTE technology)	Spectrum	Uplink or Downlink Spectrum
	Spectrogram	Collects data up to one week
	CPRI Alarms	Signal Level (Tx Power, Rx Power), Signal Loss, LOS, LOF, LSS, Remote LOS, Remote LOF, RAI, SDI, Reset
	SFP Data	Reads device information
	CPRI IQ Data Capture	Quick Save IQ Data, Playback IQ Data
Setup Parameters	Frequency	Center, Span (Span, Full Span), Signal Standard, Channel #, CF Reference (On/Off)*
	Amplitude	Reference Level (RL), Scale, RL Offset
	Bandwidth	RBW, Auto RBW, VBW, Auto VBW
	Measurements	CPRI Configure, CPRI Spectrum, Spectrogram, CPRI Alarms, SFP Data (SFP Info/Compliance Info)
	CPRI Configure	SFP Port Configure, Display Configure, AxC Trace Configure
	SFP Port Configure	Line Rate, Radio Presets, Auto Detect
	Display Configure	Display 1 and 2 CPRI BW, Display Mode (Single, Dual), Active Display
	AxC Trace Configure	AxC 1, 2, 3, and 4 (Display, SFP Port, AxC Group, Sampling Rate (Default, Compress))
	Radio Presets	Ericsson (Uplink/Downlink), Nokia/ALu (Uplink/Downlink), Huawei (Uplink/Downlink), Samsung (Uplink/Downlink), No Preset, Custom
	Custom	IQ Bit Width, IQ Mapping (Method1, Method3), No. of Reserve Bits, Aggregation (On/Off)
	Auto Detect	Radio Preset, IQ Bit Width, Reserve Bit, Aggregation, Start Auto Detect
Sweep Functions	Sweep	Single/Continuous, Sweep Once, Sweep 10 Averages
Trace Functions (AxC Trace 1 only)	Traces	Up to three Traces (A, B, C), View/Blank, Write/Hold, Trace A/B/C Operations
	Trace A Operations	Normal, Max Hold, Min Hold, Average, # of Averages, (always the live trace)
	Trace B Operations	A → B, B ↔ C, Max Hold, Min Hold
	Trace C Operations	A → C, B ↔ C, Max Hold, Min Hold, A – B → C, B – A → C, Relative Reference (dB), Scale
Marker Functions (AxC Traces 1 through 4)	Markers	Markers 1-6 On/Off, Delta Marker On/Off, Marker Frequency to Center, Marker Table (On, Large, Off), All Markers Off
	Marker Table	Markers 1-6 for frequency and amplitude, plus delta markers frequency offset and amplitude
Limit Line Functions	Limit Lines	Upper/Lower, On/Off, Move, Save/Recall Limit, Limit Alarm On/Off, Default Limit
	Limit Line Move	Move Up/Down, to Amplitude
Display Functions	Active Display	Display 1 or 2 (Single Display or Dual Display)
	Display Spectrum	Single or Dual
	Single Spectrum Display	One, two, three, or four AxC traces displayed (color coded), same CPRI BW for AxC traces
	Dual Spectrum Display	Any combination of the four available AxC traces, same CPRI BW per display and AxC trace
	Display Spectrogram	Single or Dual
	Single Spectrogram Display	One active AxC trace per waterfall display
	Dual Spectrogram Display	Any combination of the four available AxC traces may be configured per display One active AxC trace per waterfall display
	AxC Trace (1, 2, 3, 4)	Display 1, 2, or off AxC Group Sampling Rate (Default, Compress)

*: CF Reference is available only when Display 1 is active.

OBSAI LTE RF Measurements (Option 753) (Requires Option 759)

Measurements (OBSAI RF measurements support LTE technology)	Spectrum	Uplink or Downlink Spectrum
	Spectrogram	Collects data up to one week
	OBSAI Alarms	Signal Level (Tx Power, Rx Power), Signal Loss, LOS, LOF
	SFP Data	Reads device information
Setup Parameters	Frequency	Center, Span (Span, Full Span), Signal Standard, Channel #, CF Reference (On/Off)*1
	Amplitude	Reference Level (RL), Scale, RL Offset
	Bandwidth	RBW, Auto RBW, VBW, Auto VBW, LTE Bandwidth
	Measurements	Start OBSAI, OBSAI Configure, OBSAI Spectrum, Spectrogram, OBSAI Alarms, SFP Data (SFP Info/Compliance Info)
	Start OBSAI	Scans OBSAI link for active RP3 addresses; detects and sets link rate; configures first RP3 address and displays a Spectrum view.
	OBSAI Configure	Link Rate, Display Configure, Carrier Trace Configure
	Display Configure	Display 1 and 2 LTE BW, Display Mode (Single, Dual), Active Display
	Carrier Trace Configure	Carrier Trace 1 (Display 1, 2, or off; RP3 Address) Carrier Trace 2 (Display 1, 2, or off; RP3 Address) Carrier Trace 3 (Display 1, 2, or off; RP3 Address) Carrier Trace 4 (Display 1, 2, or off; RP3 Address)
	RP3 Address	RP3 list populated with Start OBSAI or plug-in of an active link Addresses removed from list upon fiber plug-out or Loss of Signal Address list is empty following power cycle or if no OBSAI carriers are found
Sweep Functions	Sweep	Single/Continuous, Sweep Once, Sweep 10 Averages
Trace Functions (Carrier Trace 1 only)	Traces	Up to three Traces (A, B, C), View/Blank, Write/Hold, Trace A/B/C Operations
	Trace A Operations	Normal, Max Hold, Min Hold, Average, # of Averages, (always the live trace)
	Trace B Operations	A → B, B ↔ C, Max Hold, Min Hold
	Trace C Operations	A → C, B ↔ C, Max Hold, Min Hold, A – B → C, B – A → C, Relative Reference (dB), Scale
Marker Functions (Carrier Traces 1 through 4)	Markers	Markers 1-6 On/Off, Delta On/Off, Marker Freq to Center, Marker Table (On, Large, Off), All Markers Off
	Marker Table	Markers 1-6 for frequency and amplitude, plus delta markers frequency offset and amplitude
Limit Line Functions	Limit Lines	Upper/Lower, On/Off, Move, Save/Recall Limit, Limit Alarm On/Off, Default Limit
	Limit Line Move	Move Up/Down, to Amplitude
Display Functions	Active Display	Display 1 or 2 (Single Display or Dual Display)
	Display Spectrum	Single or Dual
	Single Spectrum Display	One, two, three, or four carrier traces displayed (color coded) Trace LTE BW must match display LTE BW to be visible
	Dual Spectrum Display	Any combination of the four available carrier traces, same LTE BW per display and carrier trace
	Display Spectrogram	Single or Dual
	Single Spectrogram Display	One active carrier trace per waterfall display
	Dual Spectrogram Display	Any combination of the four available carrier traces may be configured per display One active carrier trace per waterfall display
	Carrier Trace (1, 2, 3, 4)	Display 1, 2, or off
Bandwidth	Resolution Bandwidth (RBW)	300 Hz to 1 MHz in 1-3-10 sequence ±10 % (–3 dB bandwidth point, typ.)
	Video Bandwidth (VBW)	30 Hz to 1 MHz in 1-3-10 sequence ±10 % (–3 dB bandwidth, typ.)
	Link Rate	1x: 768.0 Mbit/s 2x: 1536.0 Mbit/s 4x: 3072.0 Mbit/s 8x: 6144.0 Mbit/s
	LTE Bandwidth	5, 10, 15*2, 20 MHz

*1: CF Reference is available only when Display 1 is active.
*2: Only supports Dual Bit Map algorithm for 15 MHz bandwidth signals.

General Specifications

All specifications and characteristics apply under the following conditions, unless otherwise stated: 1) After 5 minutes of warm-up time, where the instrument is left in the ON state; 2) All specifications apply when using internal reference; 3) All specifications subject to change without notice; 4) Typical performance is the measured performance of an average unit, and is not warranted; 5) Recommended calibration cycle is 12 months. Performance Sweep Mode.

Setup Parameters	System	Status (Temperature, Battery Info, Serial Number, Firmware Version, Options Installed) Self Test, Application Self Test GPS (see Option 31)
	System Options	Name, Date and Time, Brightness, Volume Language (English, French, German, Spanish, Chinese, Japanese, Korean, Italian, Russian, User defined) Reset (Factory Defaults, Master Reset, Update Firmware)
	File	Save, Recall, Delete, Directory Management
	Save/Recall	Setups, Measurements, Screen Shots (.jpg) (save only)
	Delete	Selected File, All Measurements, All Mode Files, All Content
	Directory Management	Sort Method (Name/Type/Date), Ascend/Descend, Internal/USB, Copy, Format USB
	Internal Trace/Setup Memory	2,000 traces, 2,000 Setups
	External Trace/Setup Memory	Limited by size of USB Flash drive
	Mode Switching	Auto-Stores/Recalls most recently used Setup Parameters in the Mode
Connectors	RF Out	Type N (f), 50Ω (Reflection In)
	RF Out Damage Level	23 dBm (+42 dBm typical), ±50 VDC
	RF In	Type N (f), 50Ω
	RF In Damage Level	+30 dBm peak, ±50 VDC, Maximum Continuous Input (≥10 dB attenuation)
	GPS	SMA (f)
	External Power	5.5 mm barrel connector, 12.5 to 15 VDC, <4.0 Amps
	USB Interface (2)	Type A, Connect USB Flash Drive and Power Sensor
	USB Interface	5-pin mini-B, Connect to PC for data transfer
	Ethernet Interface	RJ45 connector for Ethernet 10BASE-T (Available with Option 413 Ethernet)
	Headset Jack	3.5 mm mini-phone plug
	External Reference In	BNC (f), 50Ω, Maximum Input +10 dBm 1, 5, 10, 13 MHz
	External Trigger/Clock Recovery	BNC (f), 50Ω, Maximum Input ±50 VDC
	RF over Fiber	SFP/SFP+ compatible socket (Available with Option 759)
Display	Type	Resistive Touchscreen
	Size	8.4” daylight viewable color LCD
	Resolution	800 × 600
	Pixel Defects	No more than five defective pixels (99.9989% good pixels)
Battery	Type	Li-Ion
	Battery Operation	4.5 hours (typ.) (S331E, S361E) 3.5 hours (typ.) (S332E, S362E)
Regulatory Compliance	CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN61010-1 RoHS: 2011/65/EU
	Australia and New Zealand	RCM AS/NZS 4417:2012
	South Korea	KCC-REM-A21-0004
Environmental (MIL-PRF-28800F Class 2)	Operating Temperature Range	–10° to +55°C
	Storage Temperature Range	–51° to +71°C
	Maximum Relative Humidity	95% RH at +30°C, non-condensing
	Vibration, Sinusoidal	5 Hz to 55 Hz
	Vibration, Random	10 Hz to 500 Hz
	Half Sine Shock	30 gn
	Altitude	4600 meters, operating and non-operating
	Explosive Atmosphere	MIL-PRF-28800F, Section 4.5.6.3 MIL-STD-810G, Method 511.5, Procedure 1
ESD	RF Port Center Pin	Withstands up to ±15 kV
Dimensions and Mass	Dimensions	273 (W) × 199 (H) × 91 (D) mm (10.7 × 7.8 × 3.6 in)
	Mass	2.71 kg (6.0 lbs, S331E, S361E), 3.71 kg (8.2 lbs, S332E, S362E)

Line Sweep Tools (for your PC)

Trace Capture	Browse to Instrument	View and copy traces from the test equipment to your PC using Windows Explorer
	Open Legacy File	Open DAT files captured with Hand Held Software Tools v6.61
	Open Current File	Open VNA or DAT file
	Capture Plots to:	The Line Sweep Tools screen, DAT files, Database, or JPEG
Traces	Trace Types	Return Loss, VSWR, DTF-RL, DTF-VSWR, Cable Loss, Smith Chart, and PIM
	Trace Formats	DAT, VNA, CSV, PNG, BMP, JPG, HTML, Data Base, and PDF
Report Generation	Report Generator	Includes GPS location along with measurements
	Report Format	Create reports in HTML or PDF format
	Report Setup	Report Title, Company, Prepared for, Location, Date and Time, Filename, Company logo
	Trace Setup	1 trace Portrait Mode, 2 Trace Portrait Mode, 1 Trace Landscape Mode

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Trace Validation	Presets	7 presets allow "one click" setting of up to 6 markers and one limit line
	Marker Controls	6 regular Markers, Marker Peak, Marker valley, Marker between, and frequency entry
	Delta Markers	6 Delta markers
	Limit Line	Enable and drag or value entry. Also works with presets
	Next Trace Button	Next Trace and Previous trace arrow keys allow quick switching between traces
Tools	Cable Editor	Allows creation of custom cable parameters
	Distance to Fault	Converts a Return Loss trace to a Distance to Fault trace
	Measurement Calculator	Converts Real, Imaginary, Magnitude, Phase, RL, VSWR, Rho, and Transmit power
	Signal Standard Editor	Creates new band and channel tables
	Renaming Grid	36 user definable phrases for creation of file names, trace titles, and trace subtitles
Connectivity	Connections	USB cable, USB Memory Stick

Master Software Tools (for your PC)

Mapping (GPS Required)	Spectrum Analyzer Mode	MapInfo, MapPoint
	Mobile WiMAX OTA, LTE OTA Options	Google Earth, Google Maps, MapInfo
Folder Spectrogram (Spectrum Monitoring for Interference Analysis and Spectrum Clearing)	Folder Spectrogram – 2D View	Creates a composite file of multiple traces Peak Power, Total Power, Peak Frequency, Histogram, Average Power (Max/Min) File Filter (Violations over limit lines or deviations from averages) Playback
	Video Folder Spectrogram – 2D View	Create AVI file to export for management review/reports
	Folder Spectrogram – 3D View	Views (Set Threshold, Markers) - 3D (Rotate X, Y, Z Axis, Level Scale, Signal ID) Playback (Frequency and/or Time Domain)
List/Parameter Editors	Traces	Add, delete, and modify limit lines and markers
	Product Updates	Auto-checks Anritsu website for latest revision firmware
	Pass/Fail	Create, download, or edit Signal Analysis Pass/Fail Limits
	Languages	Add up to two languages and modify non-English language menus
Connectivity	Connections	Connect to PC using USB or Ethernet (Ethernet requires Option 413)
	Remote Operation	Operate unit remotely with MST Remote Access Tool

easyTest Tools (for your PC)

Instrument Mode		Cable & Antenna Analyzer Mode
Commands	Display Image	Allows putting a custom image on the instrument screen
	Recall Setup	Places the instrument into a known state
	Prompt	Displays instructional messages on the instrument screen
	Save	Allows automatic or manual saving of traces
Connectivity	Connections	Ethernet, USB cable or USB memory stick (Ethernet requires Option 413)

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Site Masters
S331E	2 MHz to 4 GHz Cable and Antenna Analyzer
S332E	2 MHz to 4 GHz Cable and Antenna Analyzer 9 kHz to 4 GHz Spectrum Analyzer
S361E	2 MHz to 6 GHz Cable and Antenna Analyzer
S362E	2 MHz to 6 GHz Cable and Antenna Analyzer 9 kHz to 6 GHz Spectrum Analyzer
	S331E Site Master Options
S331E-0010	Bias-Tee (requires Option 21 for S331E/S361E)
S331E-0019	High-Accuracy Power Meter (Requires External Power Sensor)
S331E-0021	2-Port Transmission Measurement
S331E-0031	GPS Receiver (Requires Antenna)
S331E-0098	Standard Calibration to ISO17025 and ANSI/NCSL Z540-1
S331E-0099	Premium Calibration to ISO17025 and ANSI/NCSL Z540-1 Provides everything included with Option 98 plus test report and uncertainty data.
S331E-0413	Ethernet Connectivity
S331E-0752	CPRI LTE RF Measurements (requires Option 759)
S331E-0753	OBSAI LTE RF Measurements (requires Option 759)
S331E-0759	RF over Fiber hardware (requires Option 752 or 753)

Model/Order No.	Name
	S332E Site Master Options
S332E-0010	Bias-Tee (requires Option 21 for S331E/S361E)
S332E-0019	High-Accuracy Power Meter (Requires External Power Sensor)
S332E-0021	2-Port Transmission Measurement
S332E-0025	Interference Analyzer (recommend Option 31)
S332E-0027	Channel Scanner
S332E-0028	C/W Signal Generator (Requires CW Signal Generator Kit, P/N 69793)
S332E-0029	Power Meter
S332E-0031	GPS Receiver (Requires Antenna)
S332E-0090	Gated Sweep
S332E-0098	Standard Calibration to ISO17025 and ANSI/NCSL Z540-1
S332E-0099	Premium Calibration to ISO17025 and ANSI/NCSL Z540-1 Provides everything included with Option 98 plus test report and uncertainty data.
S332E-0413	Ethernet Connectivity
S332E-0431	Coverage Mapping (Requires Option 31)
S332E-0444	EMF Measurements (requires Anritsu Isotropic Antenna)
S332E-0509	AM/FM/PM Analyzer
S332E-0752	CPRI LTE RF Measurements (requires Option 759)
S332E-0753	OBSAI LTE RF Measurements (requires Option 759)
S332E-0759	RF over Fiber hardware (requires Option 752 or 753)

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Model/Order No.	Name
	S361E Site Master Options
S361E-0010	S362E-0010 Bias-Tee (requires Option 21 for S331E/S361E)
S361E-0019	High-Accuracy Power Meter (Requires External Power Sensor)
S361E-0021	2-Port Transmission Measurement
S361E-0031	GPS Receiver (Requires Antenna)
S361E-0098	Standard Calibration to ISO17025 and ANSI/NCSL Z540-1
S361E-0099	Premium Calibration to ISO17025 and ANSI/NCSL Z540-1 Provides everything included with Option 98 plus test report and uncertainty data.
S361E-0413	Ethernet Connectivity
S361E-0752	CPRI LTE RF Measurements (requires Option 759)
S361E-0753	OBSAI LTE RF Measurements (requires Option 759)
S361E-0759	RF over Fiber hardware (requires Option 752 or 753)
	S362E Site Master Options
S362E-0010	S362E-0010 Bias-Tee (requires Option 21 for S331E/S361E)
S362E-0019	High-Accuracy Power Meter (Requires External Power Sensor)
S362E-0021	2-Port Transmission Measurement
S362E-0025	Interference Analyzer (recommend Option 31)
S362E-0027	Channel Scanner
S362E-0028	C/W Signal Generator (Requires CW Signal Generator Kit, P/N 69793)
S362E-0031	GPS Receiver (Requires Antenna)
S362E-0090	Gated Sweep
S362E-0098	Standard Calibration to ISO17025 and ANSI/NCSL Z540-1
S362E-0099	Premium Calibration to ISO17025 and ANSI/NCSL Z540-1 Provides everything included with Option 98 plus test report and uncertainty data.
S362E-0413	Ethernet Connectivity
S362E-0431	Coverage Mapping (Requires Option 31)
S362E-0444	EMF Measurements (requires Anritsu Isotropic Antenna)
S362E-0509	AM/FM/PM Analyzer
S362E-0752	CPRI LTE RF Measurements (requires Option 759)
S362E-0753	OBSAI LTE RF Measurements (requires Option 759)
S362E-0759	RF over Fiber hardware (requires Option 752 or 753)
	USB Power Sensors (For complete ordering information see the respective datasheets of each sensor)
MA24105A	Inline Peak Power Sensor, 350 MHz to 4 GHz, +3 to +51.76 dBm
MA24106A	RF USB Power Sensor, 50 MHz to 6 GHz, +23 dBm
MA24108A	Microwave USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24118A	Microwave USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24126A	Microwave USB Power Sensor, 10 MHz to 26 GHz, +20 dBm
MA24208A	Microwave Universal USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24218A	Microwave Universal USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24330A	Microwave CW USB Power Sensor, 10 MHz to 33 GHz, +20 dBm
MA24340A	Microwave CW USB Power Sensor, 10 MHz to 40 GHz, +20 dBm
MA24350A	Microwave CW USB Power Sensor, 10 MHz to 50 GHz, +20 dBm
MA25100A	RF Power Indicator
	Manuals (soft copy at www.us.anritsu.com, website should be www.anritsu.com)
10100-00065	Product Information, Compliance, and Safety
10580-00252	Site Master User Guide
10580-00241	Cable and Antenna Analyzer Measurement Guide
10580-00242	2-Port Transmission Measurement
10580-00349	Spectrum Analyzer Measurement Guide
10580-00240	Power Meter Measurement Guide - High Accuracy Power Meter
10580-00415	CPRI LTE RF Analyzer Measurement Guide
10580-00434	OBSAI LTE RF Analyzer Measurement Guide
10580-00256	Programming Manual
	Standard Accessories (included with instrument)
2000-1654-R	Soft Carrying Case
633-75	Rechargeable Li-Ion Battery, 7500 mAh
2000-1691-R	Stylus with Coiled Tether
2000-1797-R	Screen Protector Film, 8.4 inch (2, one installed)
40-187-R	AC-DC Adapter
806-141-R	Automotive Power Adapter 12 VDC, 60 W
3-2000-1498	USB A/5-pin mini-B Cable, 10 ft/305 cm

Model/Order No.	Name
	Optional Accessories
	Calibration Components, 50Ω
ICN50B	InstaCal™ Calibration Module, 38 dB, 2 MHz to 6.0 GHz, N (m), 50Ω
OSLN50A-8	High Performance Type N (m), DC to 8 GHz, 50Ω
OSLNF50A-8	High Performance Type N (f), DC to 8 GHz, 50Ω
2000-1618-R	Open/Short/Load, 7/16 DIN (m), DC to 6 GHz 50Ω
2000-1619-R	Open/Short/Load, 7/16 DIN (f), DC to 6 GHz 50Ω
2000-1914-R	Precision Open/Short/Load, 4.3-10 (f), DC to 6 GHz, 50Ω
2000-1915-R	Precision Open/Short/Load, 4.3-10 (m), DC to 6 GHz, 50Ω
22N50	Precision Open/Short, N (m), DC to 18 GHz, 50Ω
22NF50	Precision Open/Short, N (f), DC to 18 GHz, 50Ω
SM/PL-1	Precision N (m) Load, 42 dB, 6 GHz
SM/PLNF-1	Precision N (f) Load, 42 dB, 6 GHz
	Calibration Components, 75Ω
22N75	Open/Short, N (m), DC to 3 GHz, 75Ω
22NF75	Open/Short, N (f), DC to 3 GHz, 75Ω
26N75A	Precision Termination, N (m), DC to 3 GHz, 75Ω
26NF75A	Precision Termination, N (f), DC to 3 GHz, 75Ω
12N50-75B	Matching Pad, DC to 3 GHz, 50Ω to 75Ω
	Phase-Stable Test Port Cables, Armored w/Reinforced Grip (recommended for cable & antenna line sweep applications)
15RNFN50-1.5-R	1.5 m, DC to 6 GHz, N (m) - N (f), 50Ω
15RDFN50-1.5-R	1.5 m, DC to 6 GHz, N (m) - 7/16 DIN (f), 50Ω
15RDN50-1.5-R	1.5 m, DC to 6 GHz, N (m) - 7/16 DIN (m), 50Ω
15RNFN50-3.0-R	3.0 m, DC to 6 GHz, N (m) - N (f), 50Ω
15RDFN50-3.0-R	3.0 m, DC to 6 GHz, N (m) - 7/16 DIN (f), 50Ω
15RDN50-3.0-R	3.0 m, DC to 6 GHz, N (m) - 7/16 DIN (m), 50Ω
	Interchangeable Adaptor Phase Stable Test Port Cables, Armored W/Reinforced Grip (recommended for cable and antenna line sweep applications. It uses the same ruggedized grip as the Reinforced grip series cables. Now you can also change the adaptor interface on the grip to four different connector types)
15RCN50-1.5-R	1.5 m, DC to 6 GHz, N (m), N (f), 7/16 DIN (m), 7/16 DIN (f), 50Ω
15RCN50-3.0-R	3.0 m, DC to 6 GHz, N (m), N (f), 7/16 DIN (m), 7/16 DIN (f), 50Ω
	Phase-Stable Test Port Cables, Armored
15NNF50-1.5C	1.5 m, DC to 6 GHz, N (m) - N (f), 50Ω
15NN50-1.5C	1.5 m, DC to 6 GHz, N (m) - N (m), 50Ω
15NDF50-1.5C	1.5 m, DC to 6 GHz, N (m) - 7/16 DIN (f), 50Ω
15ND50-1.5C	1.5 m, DC to 6 GHz, N (m) - 7/16 DIN (m), 50Ω
15NNF50-3.0C	3.0 m, DC to 6 GHz, N (m) - N (f), 50Ω
15NN50-3.0C	3.0 m, DC to 6 GHz, N (m) - N (m), 50Ω
15NNF50-5.0C	5.0 m, DC to 6 GHz, N (m) - N (f), 50Ω
15NN50-5.0C	5.0 m, DC to 6 GHz, N (m) - N (m), 50Ω
15N43M50-1.5C	Test Port Extension Cable, 1.5 m, DC to 6 GHz, N (m) - 4.3-10 (m)
15N43F50-1.5C	Test Port Extension Cable, 1.5 m, DC to 6 GHz, N (m) - 4.3-10 (f)
15N43M50-3.0C	Test Port Extension Cable, 3 m, DC to 6 GHz, N (m) - 4.3-10 (m)
15N43F50-3.0C	Test Port Extension Cable, 3 m, DC to 6 GHz, N (m) - 4.3-10 (f)
15NF43M50-1.5C	Test Port Extension Cable, 1.5 m, DC to 6 GHz, N (f) - 4.3-10 (m)
15NF43F50-1.5C	Test Port Extension Cable, 1.5 m, DC to 6 GHz, N (f) - 4.3-10 (f)
15NF43M50-3.0C	Test Port Extension Cable, 3 m, DC to 6 GHz, N (f) - 4.3-10 (m)
15NF43F50-3.0C	Test Port Extension Cable, 3 m, DC to 6 GHz, N (f) - 4.3-10 (f)
	Adapters
1091-26-R	SMA (m) - N (m), DC to 18 GHz, 50Ω
1091-27-R	SMA (f) - N (m), DC to 18 GHz, 50Ω
1091-80-R	SMA (m) - N (f), DC to 18 GHz, 50Ω
1091-81-R	SMA (f) - N (f), DC to 18 GHz, 50Ω
1091-172	BNC (f) - N (m), DC to 1.3 GHz, 50Ω
1091-465-R	4.3-10 (f) - N (f), DC to 6 GHz, 50Ω
1091-467-R	4.3-10 (m) - N (f), DC to 6 GHz, 50Ω
510-90-R	7/16 DIN (f) - N (m), DC to 7.5 GHz, 50Ω
510-91-R	7/16 DIN (f) - N (f), DC to 7.5 GHz, 50Ω
510-92-R	7/16 DIN (m) - N (m), DC to 7.5 GHz, 50Ω
510-93-R	7/16 DIN (m) - N (f), DC to 7.5 GHz, 50Ω
510-96-R	7/16 DIN (m) - 7/16 DIN (m), DC to 7.5 GHz, 50Ω
510-97-R	7/16 DIN (f) - 7/16 DIN (f), DC to 7.5 GHz, 50Ω
1091-433-R	Low PIM Adapter, 4.1-9.5 (f) - 7/16 DIN (f), DC to 3.0 GHz, 50Ω
1091-434-R	Low PIM Adapter, 4.1-9.5 (m) - 7/16 DIN (f), DC to 3.0 GHz, 50Ω
510-102-R	N (m) - N (m), DC to 11 GHz, 50Ω, 90 degrees right angle

Continued on next page

Model/Order No.	Name
	Precision Adapters
34NN50A	Precision Adapter, N (m) - N (m), DC to 18 GHz, 50Ω
34NFNF50	Precision Adapter, N (f) - N (f), DC to 18 GHz, 50Ω
	Filters
1030-114-R	806 MHz to 869 MHz, N (m) to SMA (f), 50Ω
1030-109-R	824 MHz to 849 MHz, N (m) to SMA (f), 50Ω
1030-110-R	880 MHz to 915 MHz, N (m) to SMA (f), 50Ω
1030-111-R	1850 MHz to 1910 MHz, N (m) to SMA (f), 50Ω
1030-112-R	2400 MHz to 2484 MHz, N (m) to SMA (f), 50Ω
1030-105-R	890 MHz to 915 MHz, N (m) to N (f),50Ω
1030-106-R	1710 MHz to 1790 MHz, N (m) to N (f), 50Ω
1030-107-R	1910 MHz to 1990 MHz, N (m) to N (f), 50Ω
1030-149-R	High Pass, 150 MHz, N (m) to N (f), 50Ω
1030-150-R	High Pass, 400 MHz, N (m) to N (f), 50Ω
1030-151-R	High Pass, 700 MHz, N (m) to N (f), 50Ω
1030-152-R	Low Pass, 200 MHz, N (m) to N (f), 50Ω
1030-153-R	Low Pass, 550 MHz, N (m) to N (f), 50Ω
1030-155-R	2500 MHz to 2700 MHz, N (m) to N (f), 50Ω
1030-178-R	1920 MHz to 1980 MHz, N (m) to N (f), 50Ω
1030-179-R	777 MHz to 798 MHz, N (m) to N (f), 50Ω
1030-180-R	2500 MHz to 2570 MHz, N (m) to N (f), 50Ω
2000-1684-R	791 MHz to 821 MHz, N (m) to N (f), 50Ω
2000-1734-R	699 MHz to 715 MHz, N (m) and N (f), 50Ω
2000-1735-R	776 MHz to 788 MHz, N (m) and N (f), 50Ω
2000-1736-R	815 MHz to 850 MHz, N (m) and N (f), 50Ω
2000-1737-R	1711 MHz to 1756 MHz, N (m) and N (f), 50Ω
2000-1738-R	1850 MHz to 1910 MHz, N (m) and N (f), 50Ω
2000-1739-R	880 MHz to 915 MHz, N (m) and N (f), 50Ω
2000-1740-R	1710 MHz to 1785 MHz, N (m) and N (f), 50Ω
2000-1741-R	1920 MHz to 1980 MHz, N (m) and N (f), 50Ω
2000-1742-R	832 MHz to 862 MHz, N (m) and N (f), 50Ω
2000-1743-R	2500 MHz to 2570 MHz, N (m) and N (f), 50Ω
2000-1799-R	2305 MHz to 2320 MHz, N (m) and N (f), 50Ω
2000-1911-R	703 MHz to 748 MHz, N (m) and N (f), 50Ω
2000-1912-R	788 MHz to 798 MHz, N (m) and N (f), 50Ω
2000-1925-R	663 MHz to 698 MHz, N (m) and N (f), 50Ω
2000-1926-R	776 MHz to 806 MHz, N (m) and N (f), 50Ω
	Attenuators
3-1010-122	20 dB, 5 W, DC to 12.4 GHz, N (m) to N (f)
42N50-20	20 dB, 5 W, DC to 18 GHz, N (m) to N (f)
42N50A-30	30 dB, 50 W, DC to 18 GHz, N (m) to N (f)
3-1010-123	30 dB, 50 W, DC to 8.5 GHz, N (m) to N (f)
1010-127-R	30 dB, 150 W, DC to 3 GHz, N (m) to N (f)
3-1010-124	40 dB, 100 W, DC to 8.5 GHz, N (m) to N (f), Uni-directional
1010-121	40 dB, 100 W, DC to 18 GHz, N (m) to N (f), Uni-directional
1010-128-R	40 dB, 150 W, DC to 3 GHz, N (m) to N (f)
	RF over Fiber Accessories
67-12-R	Optical Tap; Single Mode/Multi Mode 80/20 Tap
67-13-R	Optical Tap; Single Mode 80/20 Tap
67-14-R	Optical Tap; Single Mode/Multi Mode 50/50 Tap
67-15-R	Optical Tap; Single Mode 50/50 Tap
68-5-R	SFP (Optical Module), MM (Multi Mode) 4.25 Gbps, 850 nm, 500 m
68-6-R	SFP+ (Optical Module), MM (Multi Mode) 8 Gbps FC/ 10G SR 850 nm
68-7-R	SFP (Optical Module), SM (Single Mode) 2.7 Gbps, 1310 nm, 15 km
68-8-R	SFP+ (Optical Module), SM (Single Mode) 10 Gbps LR, 1310 nm
68-9-R	SFP (Optical Module), SM (Single Mode) 3.07 Gbps, 1310 nm
68-10-R	SFP (Optical Module), MM (Multi Mode) 3.7 Gbps, 850 nm
68-11-R	SFP+ (Optical Module), SM (Single Mode) 10.5 Gbps, 1310 nm
68-12-R	SFP+ (Optical Module), MM (Multi Mode) 10.5 Gbps, 850 nm
808-16-R	Fiber Optic Cable, 3 m, Duplex MM (Multi Mode) 1.6 mm LC/PC LC/PC 50 µm
808-17-R	Fiber Optic Cable, 3 m, Simplex MM (Multi Mode) 1.6 mm LC/UPC LC/UPC 50 µm
808-18-R	Fiber Optic Cable, 3 m, Ruggedized Simplex SM (Single Mode) LC/UPC LC/UPC
808-19-R	Fiber Optic Cable, 3 m, Ruggedized Duplex SM (Single Mode) LC/UPC LC/UPC
2100-29-R	Fiber Optic Cable, 3 m, Simplex SM (Single Mode) LC/UPC
2100-30-R	Fiber Optic Cable, 10 m, Simplex MM (Multi Mode) LC-SC
2100-31-R	Fiber Optic Cable, 3 m, Duplex SM (Single Mode) LC/UPC
971-14-R	Ferrule Cleaner, 2.5 mm SC
971-15-R	Ferrule Cleaner, 1.25 mm LC
971-16	Fiber Ferrule Cleaner
2000-1849-R	SFP 4-slot ESD Box

Model/Order No.	Name
	Miscellaneous Accessories
2000-1528-R	GPS Antenna, Magnet Mount, SMA (m), 3 VDC to 5 VDC with 4.6 m
69793	CW Signal Generator Kit
2000-1374	External Charger for Li-Ion Batteries
633-75	7500 mAh High-capacity Battery Pack
2000-1652-R	GPS Antenna, Magnet Mount, SMA (m), 3 VDC to 5 VDC with 1 ft cable
2000-1689-R	EMI Near Field Probe Kit
2000-1371-R	Ethernet Cable, 7 feet/213 cm
3-806-152	Cat 5e Crossover Patch Cable, 7 feet/213 cm)
MA2700A	Handheld Interference Hunter (For full specifications, refer to the MA2700A Technical Data Sheet 11410-00692)
2000-1884-R	PIM Hunter™ Test Probe (For full specifications, refer to the 2000-1884-R Technical Data Sheet 11410-00999)
2000-1797-R	Screen Protector Film, 8.4 inch
66864	Rack Mount Kit, Master Platform
	Backpack and Transit Case
67135	Anritsu Backpack (For Handheld Instrument and PC)
760-243-R	Large Transit Case with Wheels and Handle 56 × 45.5 × 26.5 cm (22.07" × 17.92" × 10.42")
760-271-R	Transit Case for Portable Directional Antennas and Port Extender 52.4 × 42.8 × 20.6 cm (20.62" × 16.87" × 8.12") (for 2000-1777-R, 2000-1778-R, 2000-1779-R, 2000-1798-R)
	Directional Antennas
2000-1411-R	824 MHz to 896 MHz, N (f), 12.3 dBi, Yagi
2000-1412-R	885 MHz to 975 MHz, N (f), 12.6 dBi, Yagi
2000-1413-R	1710 MHz to 1880 MHz, N (f), 12.3 dBi, Yagi
2000-1414-R	1850 MHz to 1990 MHz, N (f), 11.4 dBi, Yagi
2000-1415-R	2400 MHz to 2500 MHz, N (f), 14.1 dBi, Yagi
2000-1416-R	1920 MHz to 2170 MHz, N (f), 14.3 dBi, Yagi
2000-1659-R	698 MHz to 787 MHz, N (f), 10.1 dBi, Yagi
2000-1660-R	1425 MHz to 1535 MHz, N (f), 14.3 dBi, Yagi
2000-1715-R	698 MHz to 2500 MHz, N (f), gain of 2 dBi to 10 dBi, typical
2000-1726-R	Antenna, 2500 MHz to 2700 MHz, N (f), 14.1 dBi, Yagi
2000-1747-R	Antenna, Log Periodic, 300 MHz to 7000 MHz, N (f), 5.1 dBi, typical
2000-1748-R	Antenna, Log Periodic, 1 GHz to 18 GHz, N (f), 6 dBi, typical
2000-1777-R	Portable Directional Antenna, 9 kHz to 20 MHz, N (f)
2000-1778-R	Portable Directional Antenna, 20 MHz to 200 MHz, N (f)
2000-1779-R	Portable Directional Antenna, 200 MHz to 500 MHz, N (f)
2000-1812-R	Portable Yagi Antenna, 450 MHz to 512 MHz, N (f), 7.1 dBi
2000-1825-R	Portable Yagi Antenna, 380 MHz to 430 MHz, N (f), 7.1 dBi
	Isotropic Antennas
2000-1791-R	Isotropic Antenna, 700 MHz to 6000 MHz, N (m)
2000-1792-R	Isotropic Antenna, 30 MHz to 3000 MHz, N (m)
2000-1800-R	Isotropic Antenna, 9 kHz to 300 MHz, N (m)
	Portable Antennas
2000-1200-R	806 MHz to 866 MHz, SMA (m), 50Ω
2000-1473-R	870 MHz to 960 MHz, SMA (m), 50Ω
2000-1035-R	896 MHz to 941 MHz, SMA (m), 50Ω (1/2 wave)
2000-1030-R	1710 MHz to 1880 MHz, SMA (m), 50Ω (1/2 wave)
2000-1474-R	1710 MHz to 1880 MHz with knuckle elbow (1/2 wave)
2000-1031-R	1850 MHz to 1990 MHz, SMA (m), 50Ω (1/2 wave)
2000-1475-R	1920 MHz to 1980 MHz and 2110 MHz to 2170 MHz, SMA (m), 50Ω
2000-1032-R	2400 MHz to 2500 MHz, SMA (m), 50Ω (1/2 wave)
2000-1361-R	2400 MHz to 2500 MHz, 5000 MHz to 6000 MHz, SMA (m), 50Ω
2000-1636-R	Antenna Kit (Consists of: 2000-1030-R, 2000-1031-R, 2000-1032-R, 2000-1200-R, 2000-1035-R, 2000-1361-R, and carrying pouch)
	Mag Mount Broadband Antenna
2000-1647-R	Cable 1: 698 MHz to 1200 MHz 2 dBi peak gain, 1700 MHz to 2700 MHz 5 dBi peak gain, N (m), 50Ω, 10 ft Cable 2: 3000 MHz to 6000 MHz 5 dBi peak gain, N (m), 50Ω, 10 ft Cable 3: GPS 26 dB gain, SMA(m), 50Ω, 10 ft
2000-1645-R	694 MHz to 894 MHz 3 dBi peak gain, 1700 MHz to 2700 MHz 3 dBi peak gain, N (m), 50Ω, 10 ft
2000-1646-R	750 MHz to 1250 MHz 3 dBi peak gain, 1650 MHz to 2000 MHz 5 dBi peak gain, 2100 MHz to 2700 MHz 3 dBi peak gain, N (m), 50Ω, 10 ft
2000-1648-R	1700 MHz to 6000 MHz 3 dBi peak gain, N (m), 50Ω, 10 ft

S331L

Cable & Antenna Analyzer: 2.0 MHz to 4.0 GHz, Power Meter: 50 MHz to 4.0 GHz

Remote Control
USB

Handheld Cable & Antenna Analyzer Featuring Classic and Advanced Modes

The Site Master S331L is Anritsu's 9th generation compact handheld Cable & Antenna Analyzer. The S331L was designed based on years of field experience, customer feedback, field trials and the latest technology advances. The resulting instrument is the best value in a low cost, field optimized, reliable, rugged, easy to use, one port Cable & Antenna analyzer.

Optimized for Field Use

- > 8 Hours Battery Life
- Instant On from Standby Mode
- Highest RF Immunity
- Built-in InstaCal™ Module
  - Fast, One-connection Calibration
- FlexCal™ Calibration
  - One Calibration for All Frequencies
- Built-in Power Meter
- High Accuracy USB Power Meter (requires USB Sensor, sold separately)
- Rugged and Reliable
- Impact, Dust, and Splash Resistant
- Smallest, Lightest Site Master™
- Optical connector inspection with IEC 61300-3-35 based pass/fail standard (requires USB Video Inspection Probe, sold separately)

Easy to Use

- Integrated Help Function
- S331D-like Classic Mode
- S331E-like Advanced Mode
  - Additional Markers
  - Customizable Shortcuts
  - Full-screen View
- Multiple USB Ports
- 800 × 480 7" TFT Touch Screen
  - Alphanumeric Keyboard
  - EZ Name Quick Matrix
- Backlit Keypad
- easyTest™

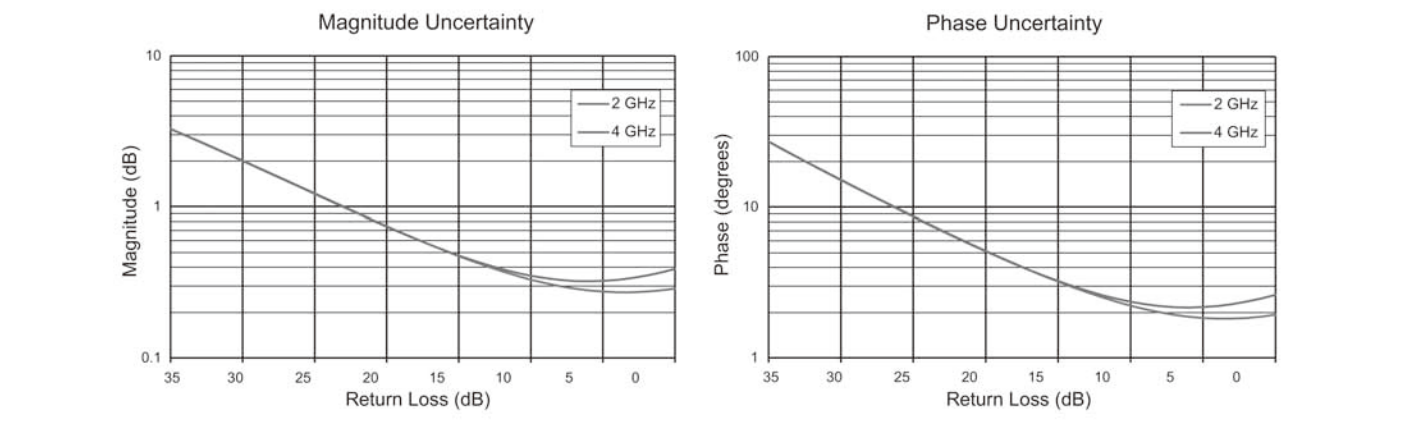
Efficient Sweep Management

- Internally Store >1000 Files
  - Sweeps, Setups, Screen Shots
- Fast Preview of Stored Sweeps
- Line Sweep Tools (LST) Software
  - Edit Sweeps, Rename, Archive
  - Generate PDF or HTML Reports
- Standard*.dat Sweep File Format
- Compatible with HHST
  - Widely Accepted by Operators
- Location Data with Compatible USB GPS Module

Cable and Antenna Analyzer Specifications

Measurements	VSWR	
	Return Loss	
	Cable Loss (One Port)	
	Distance-to-Fault (DTF) Return Loss	
	Distance-to-Fault (DTF) VSWR	
	Smith Chart 50Ω/75Ω (Advanced Mode Only)	
	1-Port Phase (Advanced Mode Only)	
	Transmission with External Sensor (Advanced Mode Only)	
Setup Parameters – Classic Mode	Measurement Display	Single Display with independent markers
	Frequency	F1/F2
	DTF	D1/D2 Units m/ft, DTF Aid, Cable Loss, Propagation Velocity, Cable type
	Windowing	Rectangular, Normal Side Lobe, Low Side Lobe, Minimum Side Lobe
	Amplitude	Top, Bottom Auto Scale, Full Scale
	Sweep	Data Points, Run/Hold, Single/Continuous, RF Immunity (High/Low), RF Power in Hold (On/Off), Trace
	Data Points	130, 259, 517, 1033, 2065
	Markers	Markers 1 to 6 (On/Off), Delta Markers 2 to 4 (Ref M1), Marker to Peak/Valley, Marker Table, Marker 5 (Peak/Valley between M1 & M2), Marker 6 (Peak/Valley between M3 & M4)
	Traces	Copy Trace To Memory, Trace Display, Trace Math [Trace – Memory, Trace + Memory, (Trace + Memory)/2]
	Limit Line	On/Off, Edit Value, Limit Alarm, Pass/Fail On/Off, Limit Preset
	Calibration	Start Calibration, Cal Info, Cal Correction (On/Off), Cal Method (OSL, InstaCal™), Cal Type (Standard, FlexCal™)
	Save/Recall	Setups, Measurements, Screen Shots
Setup Parameters – Advanced Mode	Measurement Display	Single/Dual Display with independent markers
	Frequency	Start Frequency (F1), Stop Frequency (F2)
	DTF	Start Distance (D1), Stop Distance (D2), Units m/ft, DTF Aid, Cable List, Cable Loss, Propagation Velocity
	Windowing	Rectangular, Normal Side Lobe, Low Side Lobe, Minimum Side Lobe
	Amplitude	Top, Bottom, Auto Scale, Full Scale
	Sweep	Data Points, Run/Hold, Single/Continuous, RF Immunity (High/Low), RF Power in Hold (On/Off)
	Data Points	130, 259, 517, 1033, 2065
	Markers	Markers 1 to 8 (On/Off), Delta Markers 2 to 8 (Ref M1), Marker Tracking (On/Off), Marker to Peak/Valley, Marker Table, Marker 5 & 7 (Peak/Valley between M1 & M2), Marker 6 & 8 (Peak/Valley between M3 & M4), Independent Markers for Frequency and Distance Measurements
	Traces	Copy Trace to Memory, Trace Display, Trace Math [Trace – Memory, Trace + Memory, (Trace + Memory)/2]
	Limit Line	Active Limit (Upper/Lower), Limit State (On/Off), Move Active Limit, Edit Segments (42 upper and 42 lower segments maximum), Limit Alarm, Pass/Fail On/Off, Limit Preset
	Calibration	Start Calibration, Cal Info, Cal Correction (On/Off), Cal Method (OSL, InstaCal™), Transmission, OSL + Transmission Cal Type (Standard, FlexCal™)
	Save/Recall	Setups, Measurements, Screen Shots
Frequency	Frequency Range	2 MHz to 4 GHz
	Frequency Accuracy	±5 ppm @ 23° ±3°C
	Frequency Resolution	1 kHz
Power	Output Power	–3 dBm (typ.)
Interference Immunity	On-Channel	+17 dBm outside calibrated sweep range
	On-Frequency	+13 dBm within calibrated sweep range
Measurement Speed	Return Loss	≤1.50 ms/data point, RF immunity low (typ.)
	Distance-to-Fault	≤1.75 ms/data point, RF immunity low (typ.)
Return Loss	Measurement Range Resolution	0 to 60 dB 0.01 dB
VSWR	Measurement Range	1 to 65
	Resolution	0.01
Cable Loss	Measurement Range	0 to 30 dB
	Resolution	0.01 dB
Distance-to-Fault	Vertical Range Return Loss	0 to 60 dB
	Vertical Range VSWR	1 to 65
	Fault Resolution (meters)	(1.5 × 10^8 × vp)/ΔF (vp = propagation velocity, ΔF is F2 – F1 in Hz)
	Horizontal Range (meters)	0 to (Data Points – 1) × Fault Resolution, to maximum of 1500 meters (4921 feet)
1-Port Phase (Advanced Mode Only)	Measurement Display Range	–450° to +450°
	Resolution	0.01°
Smith Chart (Advanced Mode Only)	Impedance	50Ω, 75Ω
	Resolution	0.01
Transmission Ext Sensor (Advanced Mode Only)	Measurement Display Range	–100 to +100 dB
	Resolution	0.01 dB
Measurement Accuracy (at 23° ±3°C)	Corrected Directivity	≥38 dB, InstaCal™ calibration ≥42 dB, OSL calibration (OSLN50A-8, OSLNF50A-8, OSLN50-1, OSLNF50-1)

Return Loss Measurement Uncertainty (Standard OSL calibration. OSLN50-1 Precision Open/Short/Load calibration component.)



Internal Power Meter Specifications

Frequency	Measurement Frequency (for Cal Factor)
Amplitude	Max Value, Min Value, Offset Value, Relative On/Off, Units dBm/Watts, Auto Scale, Fullscale
Calibration	Zero On/Off
Average	Running Average, Max Hold (On/Off), Run/Hold, Average Mode (Continuous/Single)
Limits	Limit On/Off, Upper Value, Lower Value
Frequency Range	50 MHz to 4 GHz
Display Range	–100 to +100 dBm
Measurement Range	–33 to +20 dBm
Offset Range	Max ±100 dB, user settable value
VSWR	1.5:1 (typ.)
Maximum Power	+27 dBm, ±45 VDC (damage level)
Connector	Type N (m), 50Ω
Accuracy	±0.7 dB (0 dBm, 1 GHz CW, @ 23° ±3°C)
Frequency Response and Linearity	Additional ±0.8 dB (±0.5 dB) (typ.)
Temperature Effect	Additional ±0.02 dB per 1°C change (typ.)

High Accuracy Power Meter (Requires external USB Power Sensor)

Amplitude	Maximum, Minimum, Offset, Relative On/Off, Units, Auto Scale				
Average	# of Running Averages, Max Hold				
Zero/Cal	Zero On/Off, Cal Factor (Center Frequency, Signal Standard)				
Limits	Limit On/Off, Limit Upper/Lower				
Power Sensor Model	MA24105A	MA24106A	MA24108A/18A/26A	MA24208A/18A	MA24330A/40A/50A
Description	Inline High Power Sensor	High Accuracy RF Power Sensor	Microwave USB Power Sensor	Microwave Universal USB Power Sensor	Microwave CW USB Power Sensor
Frequency Range	350 MHz to 4 GHz	50 MHz to 6 GHz	10 MHz to 8/18/26 GHz	10 MHz to 8/18 GHz	10 MHz to 33/40/50 GHz
Connector	Type N (f), 50Ω	Type N (m), 50Ω	Type N (m), 50Ω (8 GHz/18 GHz) Type K (m), 50Ω (26 GHz)	Type N (m), 50Ω	Type K (m), 50Ω (33 GHz/40 GHz) Type V (m), 50Ω (50 GHz)
Dynamic Range	+3 to + 51.76 dBm (2 mW to 150 W)	–40 to +23 dBm (0.1 µW to 200 mW)	–40 to +20 dBm (0.1 µW to 100 mW)	–60 to + 20 dBm (1 nW to 100 mW)	–70 to + 20 dBm (0.1 nW to 100 mW)
Measurand	True-RMS	True-RMS	True-RMS, Slot Power, Burst Average Power	True-RMS, Slot Power, Burst Average Power	Average Power
Measurement Uncertainty	± 0.17 dB*[1]	± 0.16 dB*[2]	± 0.18 dB*[3]	± 0.17 dB*[4]	± 0.17 dB*[5]
Data sheet (for complete specifications)	11410-00621	11410-00424	11410-00504	11410-00841	11410-00906

*1: Expanded uncertainty with K = 2 for power measurements of a CW signal greater than +20 dBm with a matched load. Measurement results referenced to the input side of the sensor.

*2: Total RSS measurement uncertainty (0° to 50°C) for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.

*3: Expanded uncertainty with K = 2 for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.

*4: Power uncertainty expressed with two sigma confidence level for CW measurement after zero operation. Includes calibration factor and linearity over temperature uncertainties, but not the effects of mismatch, zero set and drift, or noise.

*5: Includes linearity over temperature uncertainties, but not the effects of calibration factor, mismatch, zero set and drift, and noise.

Video Inspection Probe (requires external USB Video Inspection Probe, sold separately)

All specifications and characteristics apply to Revision 2 instruments under the following conditions, unless otherwise stated: 1) After 5 minutes of warm-up time, where the instrument has completely stabilized to the ambient temperature; 2) Internal frequency reference is used; 3) Instrument is within the recommended calibration cycle of 12 months. Cable and Antenna Analyzer measurements applicable after standard OSL calibration is performed using Anritsu calibration components; 4) Typical specifications in parentheses () describe performance that will be met by a minimum of 80% of all products. They do not include guard bands and are not warranted; 5) Typical specifications that are not in parentheses are not tested and not warranted. They are generally representative of the nominal characteristic performance; A coverage factor of k = 2 is applied to the measurement uncertainties to facilitate comparison with other industry monitors; 6) All specifications subject to change without notice.

Setup Parameters	Probe Model	G0306A or G0306B 400X USB Visual Inspection Probe
	Tip Type (included with G0306B)	SC_APC_F:, SC_PC_F:, LC_PC_F:, FC_PC_F:, 2.5APC_M:, 2.5PC_M:, 1.25PC_M:
	Test Profile (IEC 61300-3-35)	SM PC >45:, SM APC:, SM PC >25:, MM PC 62.5:, MM PC 50.0:
	Auto Analyze	On/Off
	Auto Filename	On/Off
	Auto Filename Settings	Location, File Prefix, Start Number, Include Date
Measurement Parameters	Live	View Live Image
	Captured	Capture Image for Analysis
	Analyze	Analyze Image
	Results Table	Auto/Off
	Overlay	On/Off
	Zoom Control Help	Displays instruction for image Zoom feature
Save/Recall Parameters	Save: Measurement (*.vipi), VIP Image (*.png), Screen Shot (.png) Recall: Measurement (*.vipi), VIP Image (*.png), Screen Shot (.png) File Management: Rename: Create Folder, Copy, Paste, Delete	
Report Parameters	Header Settings: Customer, Project, Operator, Notes, Include Logo Generate Report: Generates pdf report with options to include multiple *.vipi files	

General Specifications

Setup Parameters	System Info	Status, Battery
	System Setups	Date/Time, Language, Display/Audio
	Date/Time	Time and Date Settings, Time Zone Settings
	Language	English, French, German, Italian, Spanish, Russian, Portuguese, Japanese, Korean, Chinese
	Display/Audio	Brightness, Color Schemes, Screen Shot Settings, Volume
	Connectivity	GPS, Ethernet Configuration (DHCP/Static)
	Diagnostics	Self Test
	Preset	Preset, Reset, Update Firmware
	Reset	Factory Reset, Delete All User Files, Delete Custom Files, Master Reset
	File	Save, Recall, File Management
	Save	Measurement (*.dat), Setup (*.stp), Screen Shot (*.png)
	Recall	Recall, Create Folder, Copy, Paste, Delete
	File Management	Rename, Create Folder, Copy, Paste, Delete, Navigation
	Navigation	Top, Bottom, Page Up, Page Down
	Help Menu	System Info, FAQ, User Guide
	Internal Trace/Setup Memory	>1000 files (files may be traces, setups, screen shots, or any combination)
	External Trace/Setup Memory	Limited only by size of USB Flash drive
Connectors	RF Out/Reflect In	Type N, female, 50Ω, Maximum Input +42 dBm, ±50 VDC
	InstaCal™/Power Meter	Type N, male, 50Ω, Maximum Input +27 dBm, ±45 VDC (Damage Level)
	External Power	5.5 mm barrel connector, 11 to 14 VDC, <3.0 A
	USB Ports	USB 2.0 Type A (two ports)
	USB Interface	Type mini-B, Connect to PC for data transfer
Display	Type	TFT Resistive Touch Screen
	Size	7.0" daylight viewable color LCD
	Resolution	800 × 480
	Pixel Defects	No more than five defective pixels (99.9986% good pixels)
GPS Connectivity (external GPS USB module sold separately)	GPS Time/Location Indicator	Time, Latitude, Longitude and Altitude in GPS dialog (current or last known location) Time, Latitude, Longitude and Altitude with trace storage (current or last known location) Setup: Clear Data, Synchronize system time to GPS
Battery	Type	Li-Ion
	Battery Operation	>8.0 Hours (typ.) (70% brightness setting, continuous usage)
	Standby	7 days (typ.) (With fully charged battery. Actual time will vary depending on battery charge level)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU
RCM	Australia and New Zealand	RCM AS/NZS 4417:2012
KCC	South Korea	KCC-REM-A21-0004

Continued on next page

Environmental (MIL-PRF-28800F Class 2)	Operating Temperature Range	–10° to +55°C
	Storage Temperature Range	–51° to +71°C
	Maximum Relative Humidity	95% RH at +30°C, non-condensing
	Vibration, Sinusoidal	5 Hz to 55 Hz
	Vibration, Random	10 Hz to 500 Hz
	Half Sine Shock	30 g_n
	Altitude	4600 meters, operating and non-operating
	Explosive Atmosphere	MIL-PRF-28800F, Section 4.5.6.3 MIL-STD-810G, Method 511.5, Procedure 1
Dimensions and Mass		250 (W) × 177 (H) × 61 (D) mm (10.0 × 7.1 × 2.4 in) <2.0 kg (4.4 lb), including battery

Anritsu Tool Box and Line Sweep Tools (for your PC)

Line Sweep Tools (LST) is a free PC based program that increases productivity for people who deal with numerous Cable and Antenna traces every day. LST is the next generation of Anritsu's familiar Handheld Software Tools (HHST) and shares its uncomplicated user interface, giving a new face to the term "ease of use."

Cable Editor*[1]	Instrument Cable Lists may be retrieved from the instrument, modified as required, and uploaded back into instrument.
Distance to Fault*[2] (DTF)	Easily convert Return Loss or VSWR traces to Distance to Fault traces with one button press.
Measurement Calculator	Provides quick conversion between commonly used measurement units such as VSWR, RL, and others.
Signal Standard Editor*[1]	Signal Standard Lists may be retrieved from the instrument, modified as required, and uploaded back into instrument.
Naming Grid	A naming grid function makes changing file names, trace titles, and trace subtitles from field values to those required by contract simple and quick. Once the naming grid is populated with user defined file name segments, a few simple button presses will then fill out the file, title, and sub-title names. Quickly applied to multiple traces, the naming grid can save time, increase efficiency and accuracy.
Presets	Presets make applying markers and a limit line to similar traces quick and easy. They only need to be set once, and recorded. After this, applying them to a similar trace requires only one button push. This speeds up trace processing and makes providing consistent marker and limit line settings easy.
Report Generator	The report generator creates a professional PDF or HTML based report. Reports may include GPS*[3] location, power level*[3], company logo*[4], instrument and calibration status along with a display of all open traces. It also may contain additional information such as addresses and phone numbers.
Capture	Plots to Screen, Database, *.dat, *.jpg
Connect	To PC using USB, Ethernet, Serial
Download/Upload*[1]	Lists/measurements and live traces to PC for storage and analysis.
Supported File Types	Input: *.dat, *.vna, *.mna, *.pim, *.tm Output: *.dat, *.vna, *.pim, *.tm, *.csv, *.bmp, *.jpg, *.png

*1: Instrument type/model must match original
*2: Only *.dat and *.vna file types supported
*3: Model dependent
*4: Optionally set by user

easyTest Tools (for your PC)

Instrument Mode		Cable & Antenna Analyzer Mode
Commands	Display Image	Allows putting a custom image on the instrument screen
	Recall Setup	Places the instrument into a known state
	Prompt	Displays instructional messages on the instrument screen
	Save	Allows automatic or manual saving of traces
Connectivity	Connections	USB cable or USB memory stick

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main Frame
S331L	Cable and Antenna Analyzer (2 MHz to 4 GHz) Internal InstaCal™ (2 MHz to 4 GHz) Internal Power Meter (50 MHz to 4 GHz) High Accuracy Power Meter (Requires External USB Power Sensor, sold separately) GPS Location/System Time Sync (Requires External GPS Module 2000-1723-R, sold separately) Optical connector inspection with IEC 61300-3-35 based Pass/Fail standard (Requires USB Video Inspection Probe, sold separately)
	Calibration and Extended Warranty Options
S331L-ES510	Warranty Extension to 5 Years, Return to Anritsu
	Warranty with Z540 Calibration
S331L-ES513	Warranty Extension to 5 Years, Return to Anritsu
	Calibration Only Options
S331L-0098	Standard Calibration to ISO/IEC 17025:2005
S331L-0099	Premium Calibration to ISO/IEC 17025:2005 plus test data

Model/Order No.	Name
	Standard Accessories (included with instrument)
2000-1676-R	Soft Carrying Case
2000-1691-R	Stylus with Coiled Tether
2000-1687-R	Torque Multiplier N (m)
40-187-R	AC-DC Adapter
806-141-R	Automotive Power Adapter, 12 VDC, 60 W
3-2000-1498	USB A/5-pin mini-B Cable, 10ft/305 cm
	Standard Three-Year Warranty (battery one-year warranty)
	Certificate of Calibration and Conformance
	Documentation (available at www.anritsu.com)
11410-00616	Site Master™ S331L Technical Data Sheet
10580-00321	Site Master™ S331L User Guide
11410-00640	Site Master S331L Product Brochure (Includes information about additional Site Master models)
11410-00662	Site Master S331L Quick Fact Sheet
11410-00674	Cable and Antenna Analysis Troubleshooting Guide
10580-00253	Site Master™ S331L Maintenance Manual

Continued on next page

Model/Order No.	Name
	USB Power Sensors and Transmission Sensors (for complete ordering information, see the respective datasheets of each sensor)
MA24105A	Inline Peak Power Sensor, 350 MHz to 4 GHz, +3 to +51.76 dBm
MA24106A	RF USB Power Sensor, 50 MHz to 6 GHz, +23 dBm
MA24108A	Microwave USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24118A	Microwave USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24126A	Microwave USB Power Sensor, 10 MHz to 26 GHz, +20 dBm
MA24208A	Microwave Universal USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24218A	Microwave Universal USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24330A	Microwave CW USB Power Sensor, 10 MHz to 33 GHz, +20 dBm
MA24340A	Microwave CW USB Power Sensor, 10 MHz to 40 GHz, +20 dBm
MA24350A	Microwave CW USB Power Sensor, 10 MHz to 50 GHz, +20 dBm
SC8268	USB Transmission Sensor, K (m), 1 MHz to 40 GHz, +10 to –50 dBm
MA25100A	RF Power Indicator
	USB Extender Kit (for two port cable loss/transmission (external sensor) measurements)
2000-1717-R	USB 1.1 Passive 40 m Extender
2000-1900-R	USB 2.0 Active 100 m Extender (with Type A power cord for USA, Japan, North America, Central America and Caribbean)
2000-1901-R	USB 2.0 Active 100 m Extender (with Type C power cord for use in Europe, India, South Korea, and many countries in Middle East and Africa)
2000-1902-R	USB 2.0 Active 100 m Extender (with Type I power cord for use in Australia, New Zealand, Argentina, and the South Pacific)
2000-1903-R	USB 2.0 Active 100 m Extender (with Type G power cord for use in the UK, and several other countries in Asia, the Middle East, and Africa)
2100-28-R	Cat 5e extension cable for use with USB Extender (22.5 m)
	GPS Module
2000-1723-R	High Performance USB Mag-Mount GPS Module
	Ethernet Adapter
2000-1810-R	Portable USB to Ethernet LAN Adapter
	Video Inspection Probe
G0306B	Video Inspection Probe (400x), including the following standard connector tips: Universal Tips: H0361A 1.25PC-M, H0360A 2.5PC-M, H0362A 2.5APC-M Bulkhead Tips: H0363A LC-PC-F, H0364A FC-PC-F, H0375A ST-PC-F, H0366A SC-APC-F Additional Tips Available: H0372A E2000-PC-F, H0373A FC-APC-F, H0374A MU-PC-F, H0365A SC-PC-F, H0376A 1.25APC-M
	Accessories
971-14-R	Ferrule Cleaner, 2.5 mm SC
971-15-R	Ferrule Cleaner, 1.25 mm LC
971-16	Fiber Ferrule Cleaner
	Optional Accessories
	Calibration Components, 50Ω
OSLN50A-8	High Performance Type, N (m), DC to 8 GHz, 50Ω
OSLNF50A-8	High Performance Type, N (f), DC to 8 GHz, 50Ω
2000-1618-R	Open/Short/Load, 7/16 DIN (m), DC to 6 GHz 50Ω
2000-1619-R	Open/Short/Load, 7/16 DIN (f), DC to 6 GHz 50Ω
2000-1914-R	Precision Open/Short/Load, 4.3-10 (f), DC to 6 GHz, 50Ω
2000-1915-R	Precision Open/Short/Load, 4.3-10 (m), DC to 6 GHz, 50Ω
22N50	Precision Open/Short, N (m), DC to 18 GHz, 50Ω
22NF50	Precision Open/Short, N (f), DC to 18 GHz, 50Ω
SM/PL-1	Precision, N (m) Load, 42 dB, 6 GHz
SM/PLNF-1	Precision, N (f) Load, 42 dB, 6 GHz
	Calibration Components, 75Ω
12N50-75B	Matching Pad, DC to 3 GHz, 50Ω to 75Ω
22N75	Open/Short, N (m), DC to 3 GHz, 75Ω
22NF75	Open/Short, N (f), DC to 3 GHz, 75Ω
26N75A	Precision Termination, N (m), DC to 3 GHz, 75Ω
26NF75A	Precision Termination, N (f), DC to 3 GHz, 75Ω

Model/Order No.	Name
	Adapters
510-90-R	7/16 DIN (f) to N (m), DC to 7.5 GHz, 50Ω
510-91-R	7/16 DIN (f) to N (f), DC to 7.5 GHz, 50Ω
510-92-R	7/16 DIN (m) to N (m), DC to 7.5 GHz, 50Ω
510-93-R	7/16 DIN (m) to N (f), DC to 7.5 GHz, 50Ω
510-96-R	7/16 DIN (m) to 7/16 DIN (m), DC to 7.5 GHz, 50Ω
510-97-R	7/16 DIN (f) to 7/16 DIN (f), DC to 7.5 GHz, 50Ω
510-102-R	N (m) to N (m), DC to 11 GHz, 50Ω, 90 degrees right angle
1091-26-R	SMA (m) to N (m), DC to 18 GHz, 50Ω
1091-27-R	SMA (f) to N (m), DC to 18 GHz, 50Ω
1091-80-R	SMA (m) to N (f), DC to 18 GHz, 50Ω
1091-81-R	SMA (f) to N (f), DC to 18 GHz, 50Ω
1091-172	BNC (f) to N (m), DC to 1.3 GHz, 50Ω
1091-433-R	Low PIM Adapter, 4.1-9.5 (f) to 7/16 DIN (f), DC to 3.0 GHz, 50Ω
1091-434-R	Low PIM Adapter, 4.1-9.5 (m) to 7/16 DIN (f), DC to 3.0 GHz, 50Ω
1091-435-R	Low PIM Adapter, 4.1-9.5 (f) to N (m), DC to 3.0 GHz, 50Ω
1091-436-R	Low PIM Adapter, 4.1-9.5 (m) to N (m), DC to 3.0 GHz, 50Ω
1091-440-R	Low PIM Adapter, 4.3-10 (f) to 7/16 DIN (f), DC to 3.0 GHz, 50Ω
1091-441-R	Low PIM Adapter, 4.3-10 (m) to 7/16 DIN (f), DC to 3.0 GHz, 50Ω
1091-442-R	Low PIM Adapter, 4.3-10 (f) to N (m), DC to 3.0 GHz, 50Ω
1091-443-R	Low PIM Adapter, 4.3-10 (m) to N (m), DC to 3.0 GHz, 50Ω
1091-465-R	4.3-10 (f) to N (f), DC to 6 GHz, 50Ω
1091-467-R	4.3-10 (m) to N (f), DC to 6 GHz, 50Ω
	Precision Adapters
34NN50A	Precision Adapter, N (m) to N (m), DC to 18 GHz, 50Ω
34NFNF50	Precision Adapter, N (f) to N (f), DC to 18 GHz, 50Ω
	Attenuators
3-1010-122	20 dB, 5 W, DC to 12.4 GHz, N (m) to N (f)
42N50-20	20 dB, 5 W, DC to 18 GHz, N (m) to N (f)
42N50A-30	30 dB, 50 W, DC to 18 GHz, N (m) to N (f)
3-1010-123	30 dB, 50 W, DC to 8.5 GHz, N (m) to N (f)
1010-127-R	30 dB, 150 W, DC to 3 GHz, N (m) to N (f)
3-1010-124	40 dB, 100 W, DC to 8.5 GHz, N (m) to N (f), Unidirectional
1010-121	40 dB, 100 W, DC to 18 GHz, N (m) to N (f), Unidirectional
1010-128-R	40 dB, 150 W, DC to 3 GHz, N (m) to N (f)
	Phase-Stable Test Port Cables, Armored w/Reinforced Grip (recommended for cable & antenna line sweep applications)
15RNFN50-1.5-R	1.5 m, DC to 6 GHz, N (m) to N (f), 50Ω
15RDFN50-1.5-R	1.5 m, DC to 6 GHz, N (m) to 7/16 DIN (f), 50Ω
15RDN50-1.5-R	1.5 m, DC to 6 GHz, N (m) to 7/16 DIN (m), 50Ω
15RNFN50-3.0-R	3.0 m, DC to 6 GHz, N (m) to N (f), 50Ω
15RDFN50-3.0-R	3.0 m, DC to 6 GHz, N (m) to 7/16 DIN (f), 50Ω
15RDN50-3.0-R	3.0 m, DC to 6 GHz, N (m) to 7/16 DIN (m), 50Ω
	Interchangeable Adapter Phase Stable Test Port Cables, Armored w/Reinforced Grip (recommended for cable and antenna line sweep applications. It uses the same ruggedized grip as the reinforced grip series cables. Now you can also change the adapter interface on the grip to four different connector types)
15RCN50-1.5-R	1.5 m, DC to 6 GHz, N (m), N (f), 7/16 DIN (m), 7/16 DIN (f), 50Ω
15RCN50-3.0-R	3.0 m, DC to 6 GHz, N (m), N (f), 7/16 DIN (m), 7/16 DIN (f), 50Ω
	Phase-Stable Test Port Cables, Armored
15NNF50-1.5C	1.5 m, DC to 6 GHz, N (m) to N (f), 50Ω
15NN50-1.5C	1.5 m, DC to 6 GHz, N (m) to N (m), 50Ω
15NDF50-1.5C	1.5 m, DC to 6 GHz, N (m) to 7/16 DIN (f), 50Ω
15ND50-1.5C	1.5 m, DC to 6 GHz, N (m) to 7/16 DIN (m), 50Ω
15NNF50-3.0C	3.0 m, DC to 6 GHz, N (m) to N (f), 50Ω
15NN50-3.0C	3.0 m, DC to 6 GHz, N (m) to N (m), 50Ω
15NNF50-5.0C	5.0 m, DC to 6 GHz, N (m) to N (f), 50Ω
15NN50-5.0C	5.0 m, DC to 6 GHz, N (m) to N (m), 50Ω
15N43M50-1.5C	Test Port Extension Cable, 1.5 m, DC to 6 GHz, N (m) to 4.3-10 (m)
15N43F50-1.5C	Test Port Extension Cable, 1.5 m, DC to 6 GHz, N (m) to 4.3-10 (f)
15N43M50-3.0C	Test Port Extension Cable, 3 m, DC to 6 GHz, N (m) to 4.3-10 (m)
15N43F50-3.0C	Test Port Extension Cable, 3 m, DC to 6 GHz, N (m) to 4.3-10 (f)
15NF43M50-1.5C	Test Port Extension Cable, 1.5 m, DC to 6 GHz, N (f) to 4.3-10 (m)
15NF43F50-1.5C	Test Port Extension Cable, 1.5 m, DC to 6 GHz, N (f) to 4.3-10 (f)
15NF43M50-3.0C	Test Port Extension Cable, 3 m, DC to 6 GHz, N (f) to 4.3-10 (m)
15NF43F50-3.0C	Test Port Extension Cable, 3 m, DC to 6 GHz, N (f) to 4.3-10 (f)
	Backpack and Transit Case
67135	Anritsu Backpack (For Handheld Instrument and PC)
760-256-R	Large Transit Case with Wheels and Handle

Microwave Site Master™

S820E

1 MHz to 8 GHz, 14 GHz, 20 GHz, 30 GHz, 40 GHz

Remote Control
Ethernet | USB

Cable & Antenna Analyzer Featuring Classic and Advanced Modes

Anritsu is proud to introduce the world's most advanced Site Master. With microwave frequency coverage up to 40 GHz, the new S820E completely redefines the standards for portable handheld analyzers, setting another new industry benchmark for performance and accuracy. The new S820E is the culmination of over 50 years of microwave development, utilizing the very latest technologies to deliver accuracy and performance previously reserved only for benchtop instruments. Based on a true 4 channel receiver design, the S820E offers true VNA performance in a portable package.

Optional VNA Mode provides fully reversing S-parameter measurements anywhere, anytime. Optional Vector Voltmeter Mode (VVM) with standard A/B and B/A ratio may be used as drop-in replacement for legacy VVM products.

Cable and Antenna Analyzer Highlights

- 1-Port Measurements: RL, VSWR, Cable Loss, DTF, Phase, Smith Chart
- 2-Port Measurements: Transmission, Cable Loss
- Display: Single or Dual Measurement Touchscreen
- Calibration: Coaxial (OSL, TOSL), Waveguide (SSL, SSLT)
- Dynamic Range: 110 dB (20 MHz to 40 GHz)
- Frequency Resolution: 1 Hz (1 MHz to 40 GHz)
- Sweep Speed: 550 µs/data point
- Calibration Temperature Window: ±10°C
- Full Temperature Calibration Kits: –10° to +55°C

Vector Network Analyzer Highlights

- Fully Reversing Error Corrected Measurements
- Measure All Four S-Parameters Simultaneously
- Flexible Trace Display Layout: 1, 2, 3, or 4, and Overlay on top
- Calibration Interpolation and Through Update
- Independent Markers and Limits Per Trace
- Fast Sweeps (<600 µs/pt) Even in 5 kHz IFBW
- Arbitrary Data Point Setting
- Port Reference Plane Extension (Distance and/or Loss)

Vector Voltmeter Highlights

- A/B & B/A Ratio Measurement Standard
- Reflection/Transmission Measurement Standard
- Reference Auto-tune reduces or eliminates need for common 10 MHz reference (for A/B & B/A Ratio measurement only)
- Vector Error Correction for Absolute Measurement (Reflection/Transmission only)
- 4 Flexible Data Display Formats
- Table Display allows 12 Measurements and 1 Reference, Simultaneously

Capabilities and Functional Highlights

- Benchtop VNA Performance
- Intuitive GUI + Classic Mode
- 2-Port Measurements Standard
- 2-Port Cable Loss
- Std High Accuracy Power Meter (Requires external USB sensor)
- USB Transmission Sensors up to 40 GHz
- Ethernet/USB Connectivity
- USB Peripheral Support
- Touchscreen Popup Keyboard
- easyTest™ Automated Scripts
- Embeddded Help (FAQand UserGuide)
- Optical connector inspection with IEC 61300-3-35 based Pass/Fail standard (Requires USB Video Inspection Probe, sold separately)

Definitions

All specifications and characteristics apply to Revision 2 instruments under the following conditions, unless otherwise stated:

Warm-Up Time	After 10 minutes of warm-up time, where the instrument is left in the ON state.
Reference Signal	When using internal reference signal.
Typical Performance	Typical specifications that are not in parenthesis are not tested and not warranted. They are generally representative of characteristic performance. Typical specifications in parenthesis ( ) represent the mean value of measured units and do not include any guard-bands or uncertainties. They are not warranted.
Uncertainty	A coverage factor of x1 is applied to the measurement uncertainties to facilitate comparison with other industry handheld analyzers.
Calibration Cycle	Calibration is within the recommended 12 month period (residual specifications also require calibration kit calibration cycle adherence.) All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site: www.anritsu.com

Cable and Antenna Analyzer Specifications

Measurements	1-Port Measurements	Return Loss Distance-to-Fault (DTF) Return Loss Cable Loss VSWR Distance-to-Fault (DTF) VSWR Smith Chart 50Ω/75Ω (Advanced Mode Only) Phase (Advanced Mode Only)
	2-Port Measurements	Transmission (Advanced Mode Only) Transmission with External Sensor (Advanced Mode Only) Cable Loss (2-Port) with External Sensor (Classic Mode Only)
Setup Parameters Classic Mode	Measurement Display	Single Display with independent markers
	Frequency	F1/F2
	DTF	D1/D2, Units m/ft, DTF Aid, Cable List, Cable Loss, Propagation Velocity
	Windowing	Rectangular, Nominal Side Lobe, Low Side Lobe, Minimum Side Lobe
	Amplitude	Top, Bottom Auto Scale, Full Scale, Scale Preset
	Sweep	Data Points (130, 259, 517, 1033, 2065), Run/Hold, Sweep Type (Single/Continuous), RF Immunity (High/Low), RF Power in Hold (On/Off), Smoothing, Sweep Averaging (1 to 1000), Trace
	Marker	Markers 1 to 6 (On/Off), Delta Makers 2 to 4 (Ref Mk1), Marker to Peak/Valley, Marker Table, Marker 5 (Peak/Valley between M1 and M2), Marker 6 (Peak/Valley between M3 and M4)
	Trace	Copy Trace To Memory, Trace Display, Trace Math
	Limit	On/Off, Edit Value, Limit Alarm (On/ Off), Pass/Fail (On/Off), Limit Preset
	Calibration	Start Calibration, Calibration Info, Calibration Correction (On/ Off)
	Calibration Setup	Coax., Waveguide
	Save/Recall/File Management*[1]	Measurement (.dat), Setups (.stp), Screen Shots (.png), Text (.txt), CSV (.csv)
Setup Parameters Advanced Mode	Measurement Display	Single/Dual Display with independent markers
	Frequency	Start Frequency (F1), Stop Frequency (F2)
	Distance	Start Distance (D1), Stop Distance (D2), Units (meters/feet), DTF Aid
	DTF Setup	DTF Line Type (Coax/Waveguide), Cable List, Cable Loss, Propagation Velocity, Windowing (Rectangular, Nominal Side Lobe, Low Side Lobe, Minimum Side Lobe)
	Amplitude	Top, Bottom, Auto Scale, Full Scale, Scale Preset
	Sweep	Data Points (130, 259, 517, 1033, 2065), Run/Hold, Sweep Type (Single/Continuous), RF Immunity (High/Low), RF Power in Hold (On/Off), Source Power (High/Low), IFBW (10 Hz, 100 Hz, 1 kHz, 100 kHz), Smoothing, Sweep Averaging (1 to 1000)
	Markers	Markers 1 to 8 (On/Off), Delta Makers 2 to 8 (Ref Mk1), Marker to Peak/Valley, Marker Tracking (On/Off), Marker Table, Marker 5 and 7 (Peak/Valley between M1 and M2), Marker 6 and 8 (Peak/Valley between M3 and M4)
	Trace	Copy Trace to Memory, Trace Display, Trace Math
	Limit	Active Limit (Upper/Lower), Limit State (On/Off), Move Active Limit, Edit Segments (42 upper and 42 lower segments maximum), Pass./Fail (on/Off), Limit Preset, Limit Alarm (On/Off)
	Calibration	Start Calibration, Calibration Info, Calibration Correction (On/Off)
	Save/Recall/File Management*[1]	Measurement (.dat), Setups (.stp), Screen Shots (.png), Text (.txt), CSV (.csv)
Frequency	Frequency Range	1 MHz to 8 GHz, 14 GHz, 20 GHz, 30 GHz, 40 GHz (frequency option dependent)
	Frequency Accuracy	±1.0 ppm at 23°C
	Stability	±1.0 ppm from –10° to +55°C (typ.)
	Aging	±1.0 ppm/yr (typ.)
	Frequency Resolution	1 Hz
IFBW	Advanced Mode Only	10 Hz, 100 Hz, 1 kHz, 100 kHz
Output Power	1 MHz to 8 GHz	+5 dBm (typ.) (High); –20 dBm (typ.) (Low)
	>8 GHz to 40 GHz	–3 dBm (typ.) (High); –20 dBm (typ.) (Low)
RF Immunity*[2]		+17 dBm (typ.)
Measurement Speed*[3]	Reflection/Transmission Measurements	≤550 µs/data point, RF immunity low (typ.)
	Transmission Ext. Sensor (2-port Cable Loss)	Determined by USB sensor and may vary with model used, not specified.

Continued on next page

Dynamic Range*4, *5	(High Power, 10 Hz IFBW, 10 averages Port 1 to Port 2)	
	1 MHz to 10 MHz	≥85 dB (105 dB) (typ.)
	>10 MHz to 8 GHz	≥100 dB (115 dB) (typ.)
	>8 GHz to 40 GHz	≥100 dB (110 dB) (typ.)
Receiver Compression Port 1 or Port 2	1 MHz to 40 GHz	+5 dBm (0.1 dB compression) (typ.)
High Level Noise*6	(High Power, 100 Hz IFBW, 20 MHz to 40 GHz)	
	Magnitude	±0.006 dB (±0.001 dB) (typ.) rms
	Phase	±0.090° (±0.060°) (typ.)
Temperature Stability	(10 MHz to 40 GHz, ratio measurement, ports shorted)	
	Magnitude	±0.02 dB/°C (typ.)
	Phase	±0.3 degrees/°C (typ.)
Smoothing	Range	0 to 20%
System Impedance	Port 1 or Port 2	50Ω standard, 75Ω with 50Ω to 75Ω adapter
Return Loss	Measurement Display Range	0 to 1000 dB
	Resolution	0.01 dB
VSWR	Measurement Display Range	1 to 1000
	Resolution	0.01
Cable Loss	Measurement Display Range	0 to 500 dB
	Resolution	0.01 dB
Distance-to-Fault	Vertical Range Return Loss	0 to 1000 dB
	Vertical Range VSWR	1 to 1000
	Fault Resolution (meters)	(1.5 × 10^8 × vp)/ΔF (vp = propagation velocity constant, ΔF is F2 – F1 in Hz)
	Horizontal Range (meters)	0 to (Data Points – 1) × Fault Resolution, to a maximum of 1500 m (4921 ft)
1-Port Phase	Measurement Display Range	–450° to +450°
	Resolution	0.01°
Smith Chart	Impedance	50Ω, 75Ω
	Resolution	0.01
Cable Loss 2-Port	(Classic Mode Only)	
	Measurement Display Range	–1000 to +1000 dB
	Resolution	0.01 dB
Transmission	(Advanced Mode Only)	
	Measurement Display Range	–1000 to +1000 dB
	Resolution	0.01 dB
Transmission Ext Sensor	(Advanced Mode Only)	
	Measurement Display Range	–1000 dB

*1: Text (.txt) and CSV (.csv) files cannot be recalled to the instrument.

*2: +13 dBm for interfering signals landing in-band.

*3: 100 kHz IFBW (typ.).

*4: Dynamic range is defined as the difference between output power and receiver noise floor.

*5: Decrease specification by 5 dB between 8 GHz and 14 GHz. Crosstalk may reduce dynamic range up to 20 dB (typ.) at lower IF bandwidths (≤10 kHz) when measuring highly reflective DUT's from 4 GHz to 8 GHz. Reflection measurements are not affected.

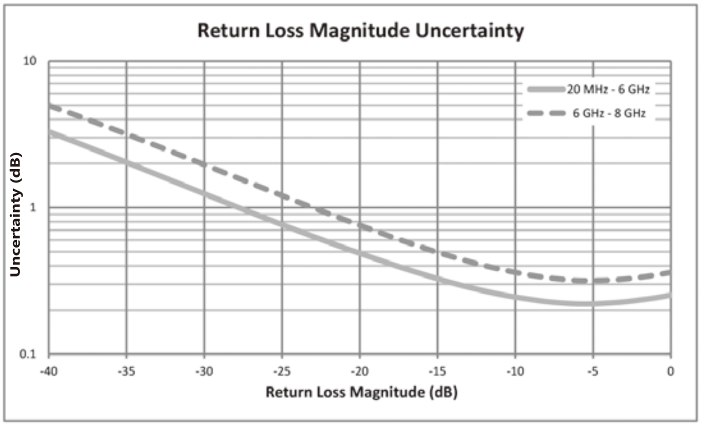
*6: High Level Noise below 20 MHz is increased by a factor of 5.0.
High Level Noise (Phase only) above 20 GHz is increased by a factor of 1.5.

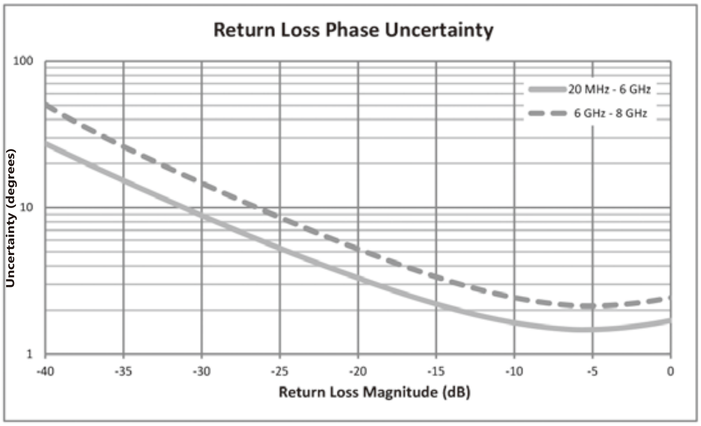
Measurement Accuracy* (OSLN50A-8 or OSLNF50A-8, TOSLN50A-8 or TOSLNF50A-8)

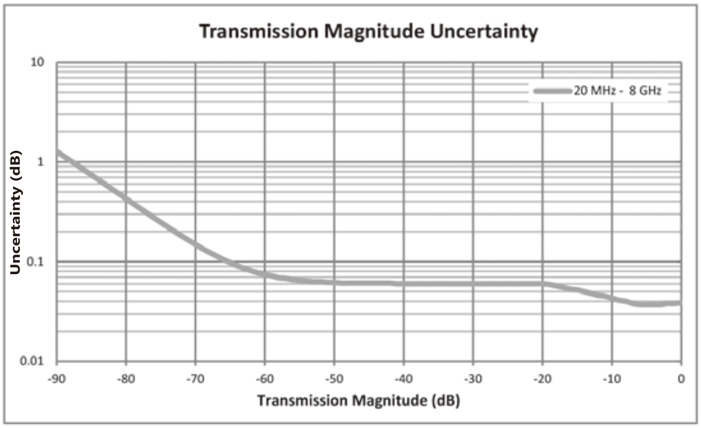
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
1 MHz to 6 GHz	≥42	≥33	≥42	±0.08	±0.06
>6 GHz to 8 GHz	≥37	≥33	≥37	±0.08	±0.06

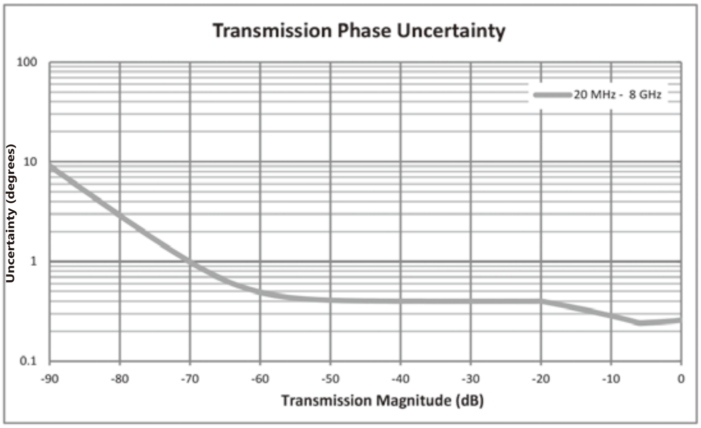
*: Full 2-Port calibration with isolation, Default Power, 10 Hz IFBW, No averaging, 10 minute warm-up. OSLN50A-8, OSLNF50A-8, TOSLN50A-8, or TOSLNF50A-8 calibration kit.
Load match specification applicable directly at corrected port only. De-rate by approximately 8 dB if using a 3670 series test port cable.
Reflection and Transmission Tracking are typical.

Corrected Measurement Uncertainty (Transmission from Port 1 to Port 2)


Return Loss Magnitude Uncertainty


Return Loss Phase Uncertainty


Transmission Magnitude Uncertainty

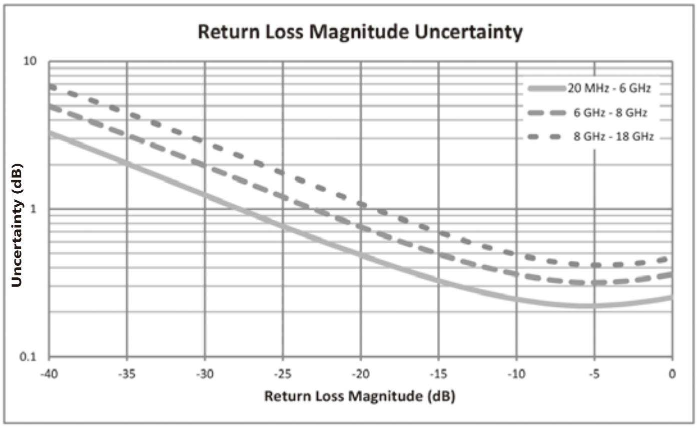

Transmission Phase Uncertainty

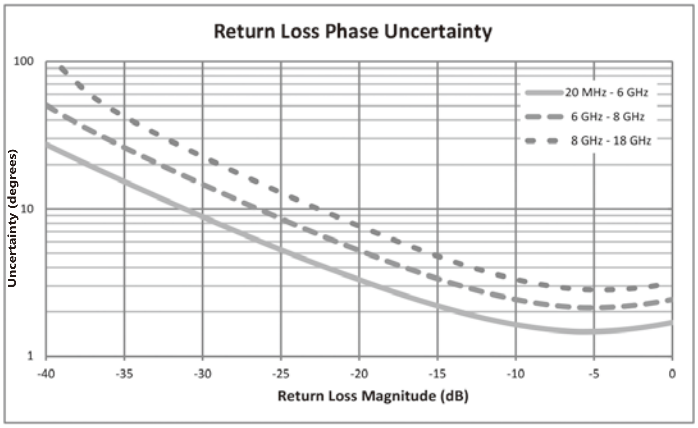
Measurement Accuracy* (OSLN50A-18 or OSLNF50A-18, TOSLN50A-18 or TOSLNF50A-18)

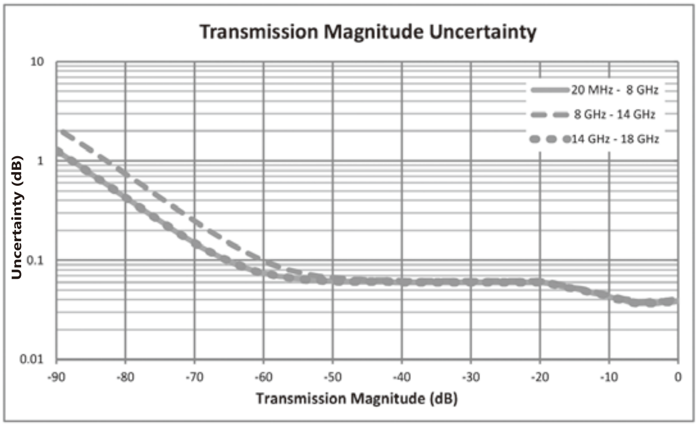
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
1 MHz to 6 GHz	≥42	≥33	≥42	±0.08	±0.06
>6 GHz to 9 GHz	≥37	≥33	≥37	±0.08	±0.06
>9 GHz to 18 GHz	≥33	≥26	≥33	±0.04	±0.03

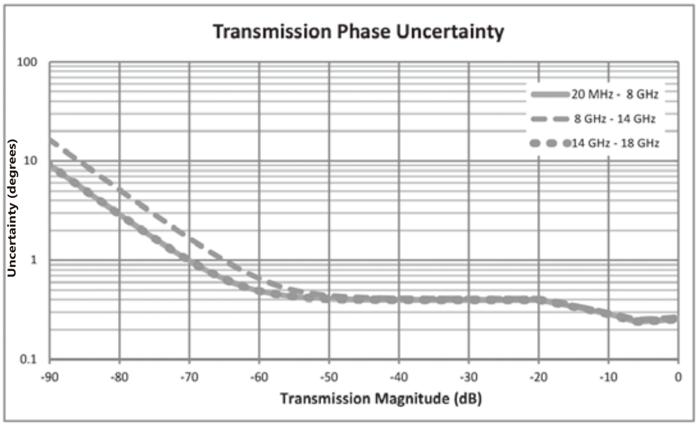
*: Full 2-Port calibration with isolation, Default Power, 10 Hz IFBW, No averaging, 10 minute warm-up. OSLN50A-18, OSLNF50A-18, TOSLN50A-18, or TOSLNF50A-18 calibration kit. Load match specification applicable directly at corrected port only. De-rate by approximately 8 dB if using a 3670 series test port cable. Reflection and Transmission Tracking are typical.

Corrected Measurement Uncertainty (Transmission from Port 1 to Port 2)







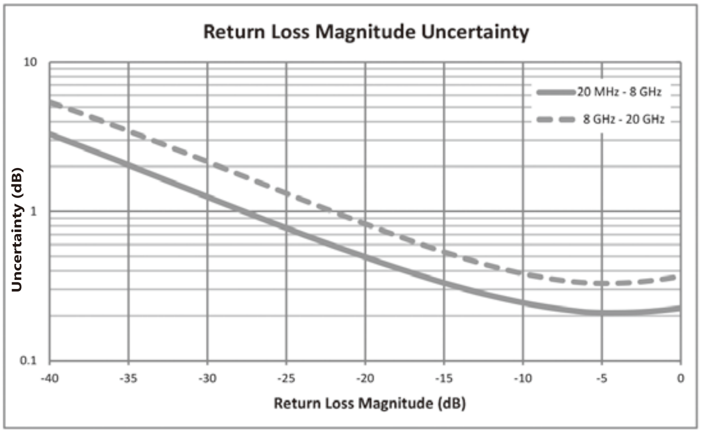


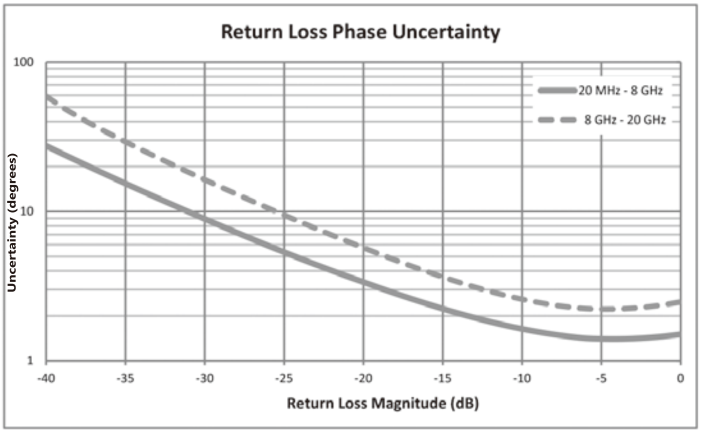
Measurement Accuracy* (TOSLK50A-20 or TOSLKF50A-20)

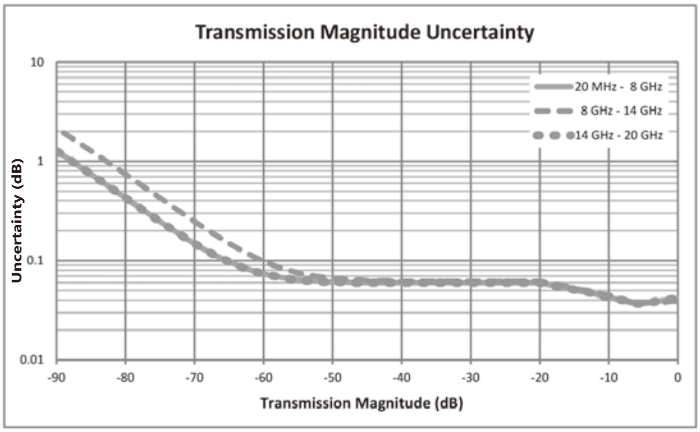
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
1 MHz to 10 GHz	≥42	≥33	≥42	±0.08	±0.06
>10 GHz to 20 GHz	≥36	≥26	≥36	±0.04	±0.03

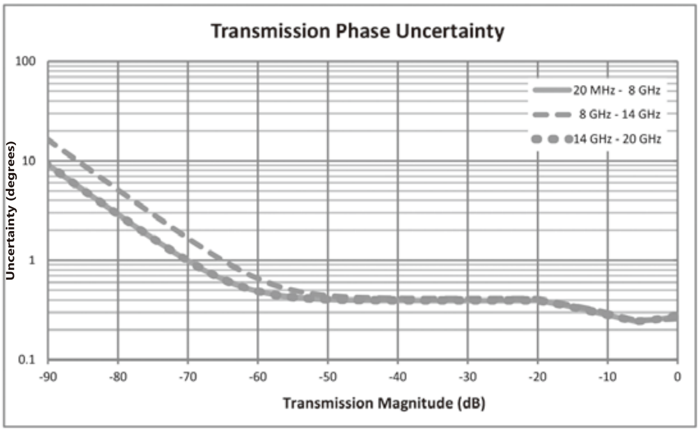
*: Full 2-Port calibration with isolation, Default Power, 10 Hz IFBW, No averaging, 10 minute warm-up. TOSLK50A-20 or TOSLKF50A-20 calibration kit.
Load match specification applicable directly at corrected port only. De-rate by approximately 8 dB if using a 3670 series test port cable.
Reflection and Transmission Tracking are typical.

Corrected Measurement Uncertainty (Transmission from Port 1 to Port 2)







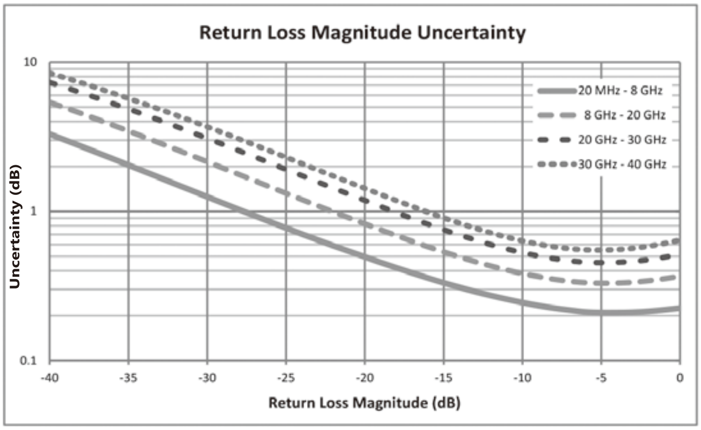


Measurement Accuracy* (TOSLK50A-40 or TOSLKF50A-40)

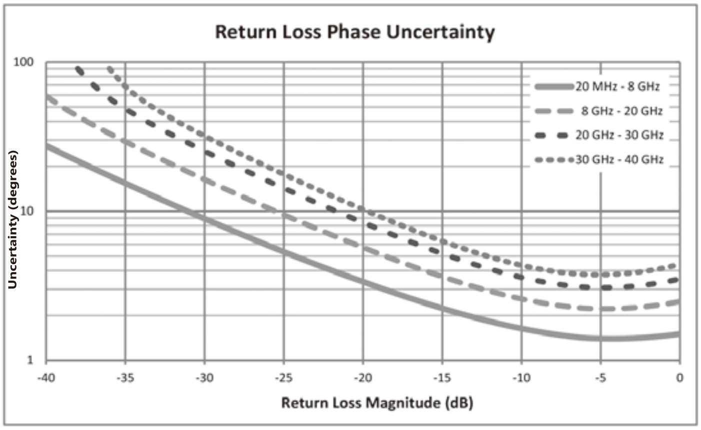
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
1 MHz to 10 GHz	≥42	≥33	≥42	±0.08	±0.06
>10 GHz to 20 GHz	≥36	≥26	≥36	±0.04	±0.03
>20 GHz to 30 GHz	≥32	≥22	≥32	±0.04	±0.03
>30 GHz to 40 GHz	≥30	≥20	≥30	±0.04	±0.03

*: Full 2-Port calibration with isolation, Default Power, 10 Hz IFBW, No averaging, 10 minute warm-up. TOSLK50A-40 or TOSLKF50A-40 calibration kit.
Load match specification applicable directly at corrected port only. De-rate by approximately 8 dB if using a 3670 series test port cable.
Reflection and Transmission Tracking are typical.

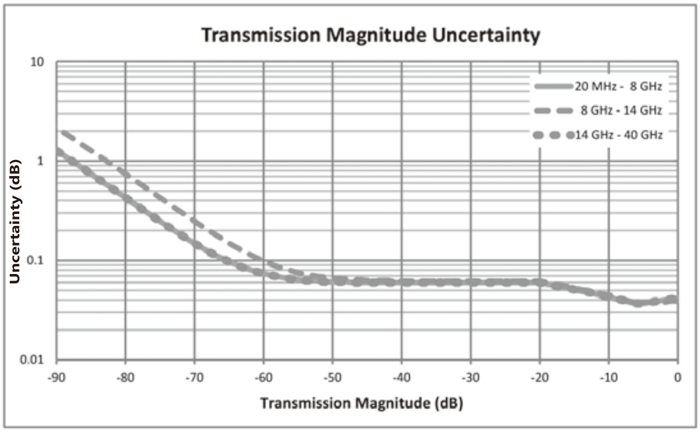
Corrected Measurement Uncertainty (Transmission from Port 1 to Port 2)



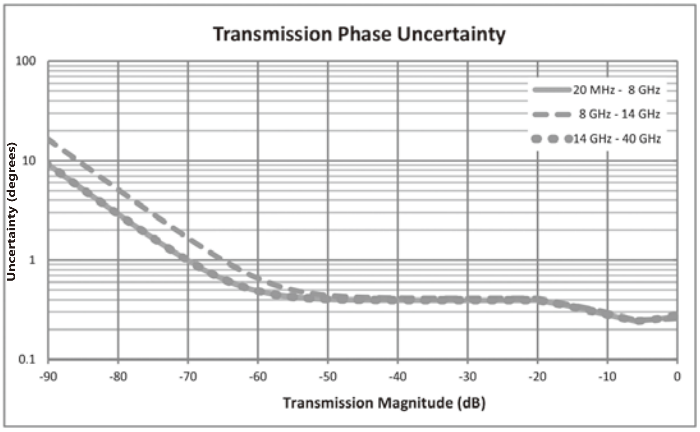
Return Loss Magnitude Uncertainty



Return Loss Phase Uncertainty



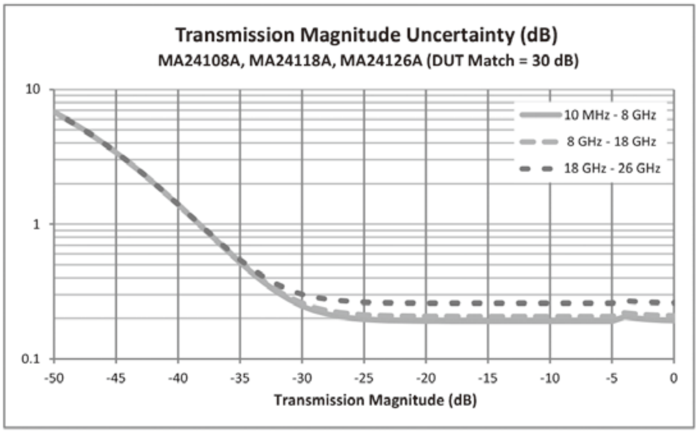
Transmission Magnitude Uncertainty

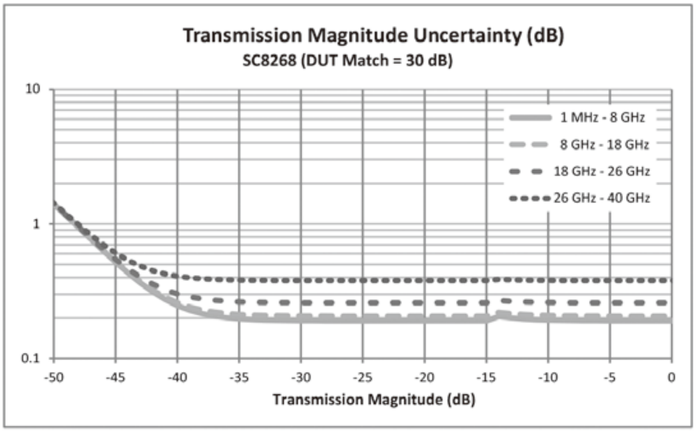


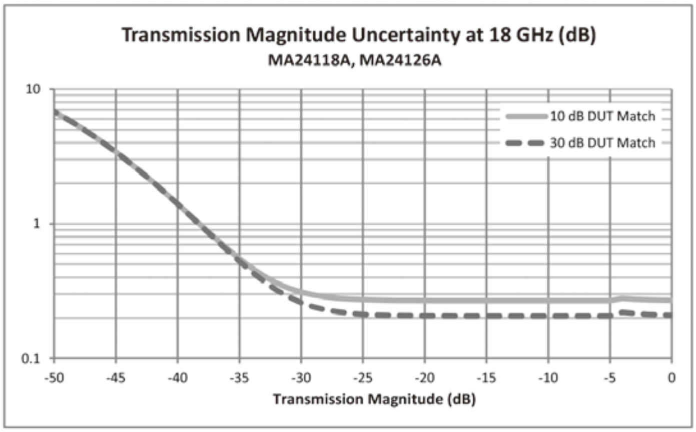
Transmission Phase Uncertainty

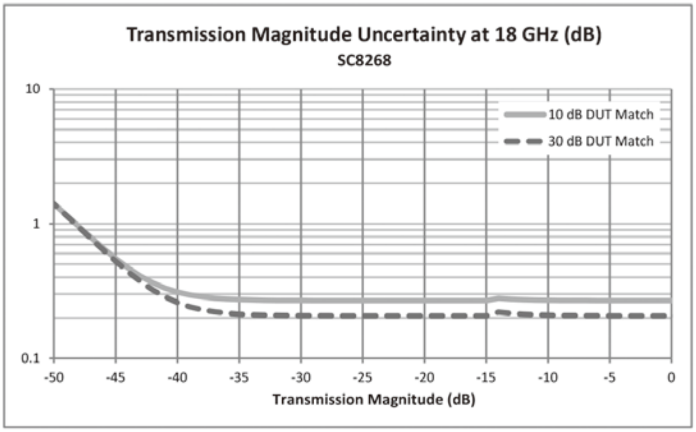
External Sensor Transmission Measurement Accuracy* (Corrected Transmission Uncertainty, Magnitude Only)

*: Sensor Transmission Calibration from Port 1 to Sensor, default power, 10 Hz bandwidth. SC8268 specifications below 10 MHz are typical.









High Accuracy Power Meter – Standard (Requires external USB Power Sensor, sold separately)

Amplitude	Maximum, Minimum, Offset, Relative On/Off, Units, Auto Scale				
Average	# of Running Averages, Max Hold				
Zero/Cal	Zero On/Off, Cal Factor (Center Frequency, Signal Standard)				
Limits	Limit On/Off, Limit Upper/Lower				
Power Sensor Model	MA24105A	MA24106A	MA24108A/18A/26A	MA24208A/18A	MA24330A/40A/50A
Description	Inline High Power Sensor	High Accuracy RF Power Sensor	Microwave USB Power Sensor	Microwave Universal USB Power Sensor	Microwave CW USB Power Sensor
Frequency Range	350 MHz to 4 GHz	50 MHz to 6 GHz	10 MHz to 8/18/26 GHz	10 MHz to 8 GHz/18 GHz	10 MHz to 33/40/50 GHz
Connector	Type N (f), 50Ω	Type N (m), 50Ω	Type N (m), 50Ω (8 GHz/18 GHz) Type K (m), 50Ω (26 GHz)	Type N (m), 50Ω	Type K (m), 50Ω (33 GHz/40 GHz) Type V (m), 50Ω (50 GHz)
Dynamic Range	+3 to +51.76 dBm (2 mW to 150 W)	–40 to +23 dBm (0.1 µW to 200 mW)	–40 to +20 dBm (0.1 µW to 100 mW)	–60 to +20 dBm (1 nW to 100 mW)	–70 to +20 dBm (0.1 nW to 100 mW)
Measurand	True-RMS	True-RMS	True-RMS, Slot Power, Burst Average Power	True-RMS, Slot Power, Burst Average Power	Average Power
Measurement Uncertainty	± 0.17 dB[*1]	± 0.16 dB[*2]	± 0.18 dB[*3]	± 0.17 dB[*4]	± 0.17 dB[*5]
Data sheet (for complete specifications)	11410-00621	11410-00424	11410-00504	11410-00841	11410-00906

*1: Expanded uncertainty with K=2 for power measurements of a CW signal greater than +20 dBm with a matched load. Measurement results referenced to the input side of the sensor.

*2: Total RSS measurement uncertainty (0° to 50°C) for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.

*3: Expanded uncertainty with K = 2 for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.

*4: Power uncertainty expressed with two sigma confidence level for CW measurement after zero operation. Includes calibration factor and linearity over temperature uncertainties, but not the effects of mismatch, zero set and drift, or noise.

*5: Includes linearity over temperature uncertainties, but not the effects of calibration factor, mismatch, zero set and drift, and noise.

Video Inspection Probe (Requires External USB Video Inspection Probe, sold separately)

Setup Parameters	Probe Model	G0306A or G0306B 400X USB Visual Inspection Probe
	Tip Type (included with G0306A)	SC_APC_F:, SC_PC_F:, LC_PC_F:, FC_PC_F:, 2.5APC_M:, 2.5PC_M:, 1.25PC_M:
	Test Profile (IEC 61300-3-35)	SM PC >45:, SM APC:, SM PC >25:, MM PC 62.5:, MM PC 50.0:
	Auto Analyze	On/Off
	Auto Filename	On/Off
	Auto Filename Settings	Location, File Prefix, Start Number, Include Date
Measurement Parameters	Live	View Live Image
	Captured	Capture Image for Analysis
	Analyze	Analyze Image
	Results Table	Auto/Off
	Overlay	On/Off
	Zoom Control Help	Displays instruction for image Zoom feature
Save/Recall Parameters	Save	Measurement (*.vipi), VIP Image (*.png), Screen Shot (.png)
	Recall	Measurement (*.vipi), VIP Image (*.png), Screen Shot (.png)
	File Management	Rename, Create Folder, Copy, Paste, Delete
Report Parameters	Header Settings	Customer, Project, Operator, Notes, Include Logo
	Generate Report	Generates pdf report with options to include multiple *.vipi files

Vector Network Analyzer (Option 440)

Setup Parameters	Active Trace	Tr1, Tr2, Tr3, Tr4
	Measurement (S Parameter)	S_{11}, S_{21}, S_{12}, S_{22}
	Graph Types	Log Magnitude, SWR, Phase, Unwrapped Phase, Real, Imaginary, Group Delay, Smith Chart (Impedance), Inverted Smith Chart (Admittance), Log Mag/2 (1-Port Cable Loss), Real Impedance, Imaginary Impedance
	Domain	Frequency Domain, Distance Domain
	Number of Traces	1, 2, 3, 4
	Trace Format	Single, Dual, Tri, Quad. When used with Number of Traces, overlays are possible including a Single Format with Four trace overlays.
	Smoothing	Smoothing 0 to 20 % Independent Trace based.
	Group Delay Aperture	Aperture 0.25 to 20 % Aperture Defined as the frequency span over which the phase change is computed at a given frequency point. The aperture can be changed without recalibration.
	Group Delay Range	<180º of phase change within the aperture
	Frequency	Start Frequency (F1), Stop Frequency (F2)
	Distance	Start Distance (D1), Stop Distance (D2)
	Distance Units	Meters (m), Feet (ft)
	DTF Aid	Provides detailed DTF resolution information based on current instrument settings. Also provides helpful tips to optimize results.
	DTF Setup	DUT Line Type (Coax/WG), Cable List, Cable Loss, Propagation Velocity, Windowing
	Windowing	Rectangular, Nominal Side Lobe, Low Side Lobe, Minimum Side Lobe
	Amplitude	Resolution Per Division, Reference Value, Reference Line, Autoscale, Scale Preset
	Calibration	Start Calibration, Thru Update, Cal Info, Interpolation (On/Off), Cal Correction (On/Off)
	Cal Type	Full 2-Port, Full S_{11}, Full S_{22}, Full S_{11} & S_{22}, One-Path Two-Port (S_{11}, S_{21}), One-Path Two-Port (S_{22}, S_{12}), Response S_{11}, Response S_{22}, Response S_{11} & S_{22}, Response S_{21}, Response S_{12}, Response S_{21} & S_{12}
	Cal Line	Coax, Waveguide
	Cal Method	Short-Open-Load-Through (SOLT), Offset-Short (SSLT)
	Calibration Standards' Coefficients	Coax: K-Connector, N-Connector, 7/16, SMA, TNC, and four User defined Waveguide: WG11A, WG12, WG13, WG14, WG15, WG16, WG17, WG18, WG20, WG22, and four User Defined
	Marker	Markers 1 to 8 (On/Off), Delta Makers 2 to 8 (Ref Mk1), Marker to Peak/Valley, Marker Tracking (On/Off), 4 Marker Table, Marker 5 and 7 (Peak/Valley between M1 and M2), Marker 6 and 8 (Peak/Valley between M3 and M4)
	Limit	Active Limit (Upper/Lower), Limit State (On/Off, Single, Segmented), Move Active Limit, Edit Segments (42 upper and 42 lower segments maximum), Limit Alarm (On/Off), Pass/Fail (On/Off), Limit Preset
	Test Limits	Pass/Fail for Upper, Pass/Fail for Lower, Limit Audible Alarm
	Save[*1]	Measurement (.svna), Setup (.stp), Screen Shot (.png), S2P-Real/Imaginary (.s2p), S2P-Linear Mag/Phase (.s2p), S2P-Log Mag/Phase (.s2p), Text (.txt), CSV (.csv)
	Recall[*2]	Measurement (.svna), Setup (.stp), Screen Shot (.png)
	File Management	Rename, Create Folder, Copy, Paste, Delete
	Navigation (File Management)	Top, Bottom, Page Up, Page Down
	Frequency Sweep Type	Linear Continuous, Linear Single Sweep
	Data Points	Data Points 2 to 4001 (arbitrary setting)
	Data Averaging	Sweep-by-Sweep, 1 to 1000
	IF Bandwidth (Hz)	10, 20, 50, 100, 200, 500, 1k, 2k, 5k, 10k, 20k, 50k, 100k
	Reference Plane	Reference Plane The reference planes of a calibration (or other normalization) can be changed by entering a line length or time, and loss. Assumes flat magnitude, linear phase, and constant impedance.

Continued on next page

Setup Parameters	Auto Reference Plane Extension	Instead of manually entering a line length, this feature automatically adjusts phase shift from the current calibration (or other normalization) to compensate for external cables (or test fixtures). Assumes no loss (user can manually enter loss if known), flat magnitude, linear phase, and constant impedance.
	Trace Memory	A separate memory for each trace can be used to store measurement data for later display. The trace data can be saved and recalled.
	Trace Math	Complex trace math operations of subtraction, addition, multiplication, or division are provided.
	Dispersion Compensation	Waveguide correction that improves accuracy of distance-to-fault data by automatically compensating for different wavelengths propagating at different speeds.
	Impedance Conversion	Support for 50Ω and 75Ω Smith Charts are provided.
	Timebase Reference	Internal (default), External 10 MHz (Auto-sense, BNC female, Max +10 dBm)
	Ethernet Configuration	DHCP or Manual (Static) IP configuration, 10/100 Base-T, RJ45 jack
	Languages	English, French, German, Italian, Spanish, Russian, Portuguese, Japanese, Korean, Chinese
Frequency	Frequency Range	1 MHz to 8/14/20/30/40 GHz (Frequency option dependent)
	Frequency Accuracy	±1.0 ppm at 23°C
	Stability	±1.0 ppm from –10° to +55°C (typ.)
	Aging	±1.0 ppm/yr (typ.)
	Frequency Resolution	1 Hz
Output Power	1 MHz to 8 GHz	+5 dBm (typ.) (High); –20 dBm (typ.) (Low)
	>8 GHz to 40 GHz	–3 dBm (typ.) (High); –20 dBm (typ.) (Low)
RF Immunity*3	RF Immunity High	+17 dBm (nom.)
Measurement Speed*4		≤ 550 µs/pt (S_{11} and S_{21}, 1001 points, 100 kHz IFBW, RF immunity low (typ.))
Dynamic Range*5, *6	(High Power, 10 Hz IFBW, 10 averages Port 1 to Port 2)	
	1 MHz to 10 MHz	≥85 dB (105 dB) (typ.)
	>10 MHz to 8 GHz	≥100 dB (115 dB) (typ.)
	>8 GHz to 40 GHz	≥100 dB (110 dB) (typ.)
Receiver Compression Port 1 or Port 2 (0.1 dB compression)	1 MHz to 40 GHz	+5 dBm (typ.)
High Level Noise*7	(High Power, 100 Hz IFBW, 20 MHz to 40 GHz)	
	Magnitude	±0.006 dB (±0.001 dB) (typ.) rms
	Phase	±0.090° (±0.060°) (typ.)
Temperature Stability	(Typical, 10 MHz to 40 GHz, ratio measurement, ports shorted)	
	Magnitude	±0.02 dB/°C
	Phase	±0.3 degrees/°C
Log Mag	Resolution Per Division	0.01 to 100 dB
	Reference Value	±1000 dB
	Reference Line	0 to 10
Log Mag/2	Resolution Per Division	0.01 to 100 dB
	Reference Value	±1000 dB
	Reference Line	0 to 10
SWR	Resolution Per Division	0.01 to 100
	Reference Value	1 to 1000
	Reference Line	0 to 10
Phase	Resolution Per Division	0.01° to 90°
	Reference Value	±1000°
	Reference Line	0 to 10
Unwrapped Phase	Resolution Per Division	0.01 degrees to 10^{13} degrees
	Reference Value	±10^{13} degrees
	Reference Line	0 to 10
Real/Imaginary	Resolution Per Division	0.01 to 260
	Reference Value	±10000
	Reference Line	0 to 10
Real/Imaginary Impedance	Resolution Per Division	0.01Ω to 100,000Ω
	Reference Value	±100,000Ω
	Reference Line	0 to 10
Group Delay	Resolution Per Division	1 fs to 100 s
	Reference Value	±100 s
	Reference Line	0 to 10
Smith Chart/ Inv Smith Chart	Reference Impedance	50Ω, 75Ω

*1: SVNA (.svna) and S2P (.s2p) file formats are available in VNA Mode only.

*2: SVNA (.svna) file format recall is available in VNA Mode only.

*3: +13 dBm for interfering signals landing in-band.

*4: Single trace display, frequency domain. Excludes Group Delay, Smith, or Admittance graph types. Excludes Active Smoothing, Markers, and/or Limits.

*5: Dynamic range is defined as the difference between output power and receiver noise floor.

*6: Decrease specification by 5 dB between 8 GHz and 14 GHz. Crosstalk may reduce dynamic range up to 20 dB (typical) at lower IF bandwidths (≤ 10 kHz) when measuring highly reflective DUT's from 4 GHz to 8 GHz. Reflection measurements are not affected.

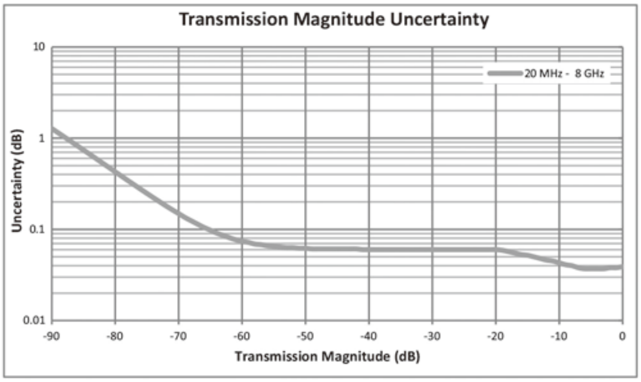
*7: High Level Noise below 20 MHz is increased by a factor of 5.0. High Level Noise (Phase only) above 20 GHz is increased by a factor of 1.5.

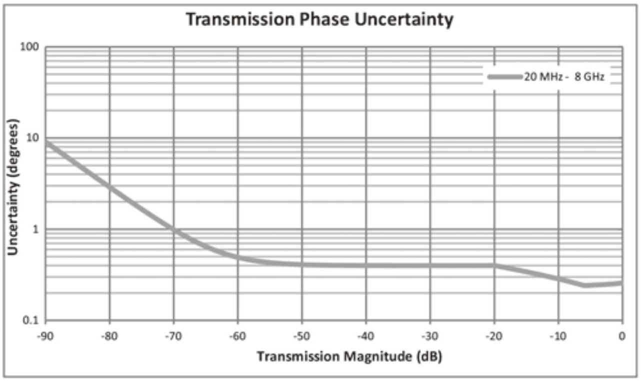
Measurement Accuracy* (OSLN50A-8 or OSLNF50A-8, TOSLN50A-8 or TOSLNF50A-8)

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
1 MHz to 6 GHz	≥42	≥33	≥42	±0.08	±0.06
>6 GHz to 8 GHz	≥37	≥33	≥37	±0.08	±0.06

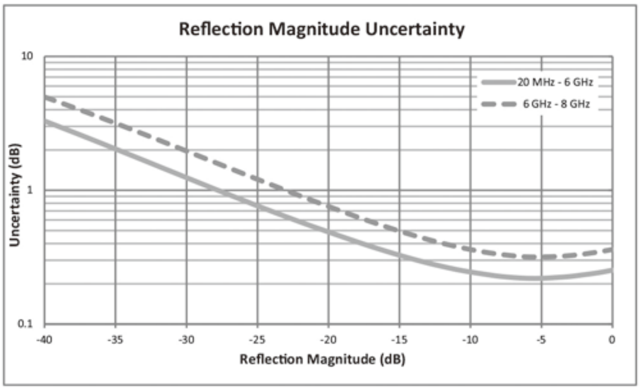
*: Full 2-Port calibration with isolation, Default Power, 10 Hz IFBW, No averaging, 10 minute warm-up. OSLN50A-8, OSLNF50A-8, TOSLN50A-8, or TOSLNF50A-8 calibration kit.
Load match specification applicable directly at corrected port only. De-rate by approximately 8 dB if using a 3670 series test port cable.
Reflection and Transmission Tracking are typical.

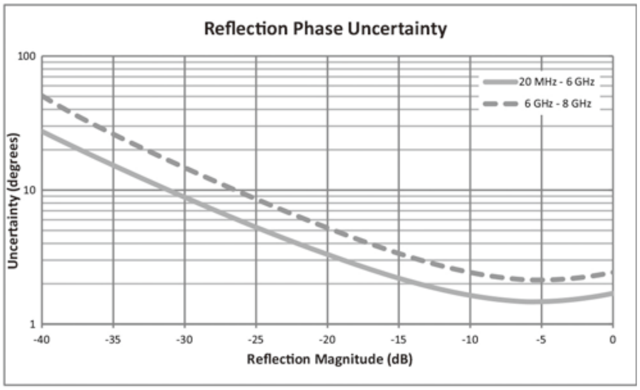
Transmission Uncertainty (S_{21}, S_{12}) ($S_{11} = S_{22} = 0$)


Transmission Magnitude Uncertainty


Transmission Phase Uncertainty

Reflection Uncertainty (S_{11}, S_{22}) ($S_{21} = S_{12} = 0$)


Reflection Magnitude Uncertainty

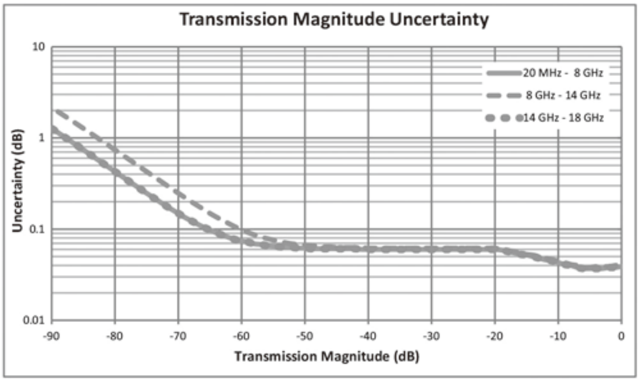

Reflection Phase Uncertainty

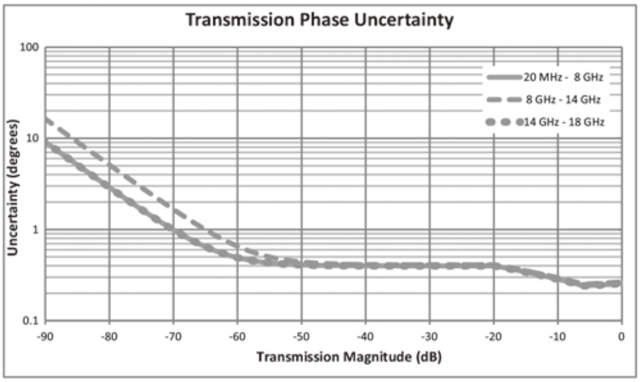
Measurement Accuracy* (OSLN50A-18 or OSLNF50A-18, TOSLN50A-18 or TOSLNF50A-18)

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
1 MHz to 6 GHz	≥42	≥33	≥42	±0.08	±0.06
>6 GHz to 9 GHz	≥37	≥33	≥37	±0.08	±0.06
>9 GHz to 18 GHz	≥33	≥26	≥33	±0.04	±0.03

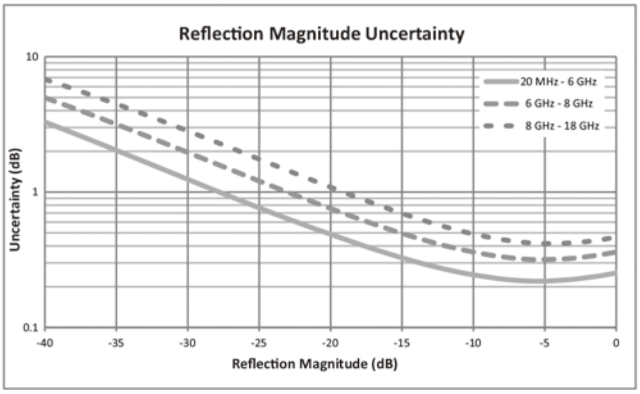
*: Full 2-Port calibration with isolation, Default Power, 10 Hz IFBW, No averaging, 10 minute warm-up. OSLN50A-18, OSLNF50A-18, TOSLN50A-18, or TOSLNF50A-18 calibration kit. Load match specification applicable directly at corrected port only. De-rate by approximately 8 dB if using a 3670 series test port cable. Reflection and Transmission Tracking are typical.

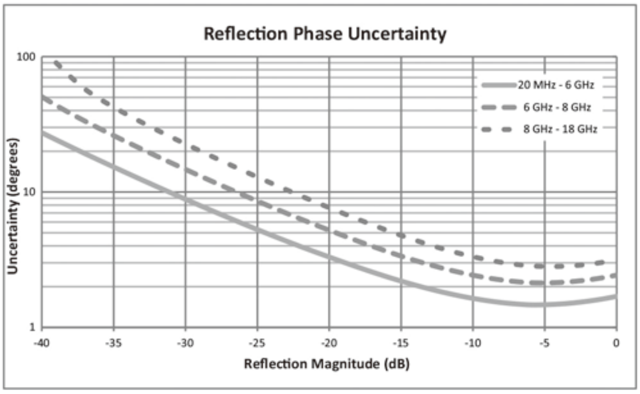
Transmission Uncertainty (S_{21}, S_{12}) ($S_{11} = S_{22} = 0$)


Transmission Magnitude Uncertainty


Transmission Phase Uncertainty

Reflection Uncertainty (S_{11}, S_{22}) ($S_{21} = S_{12} = 0$)


Reflection Magnitude Uncertainty

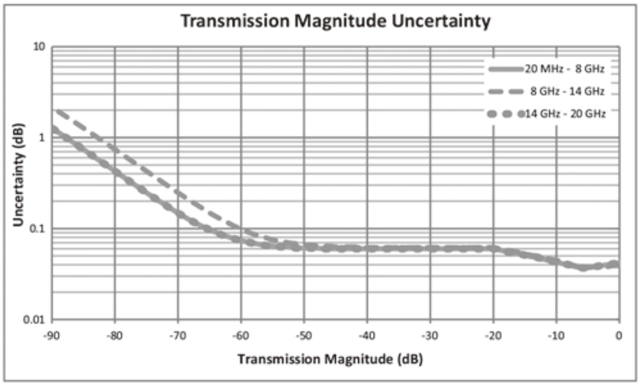

Reflection Phase Uncertainty

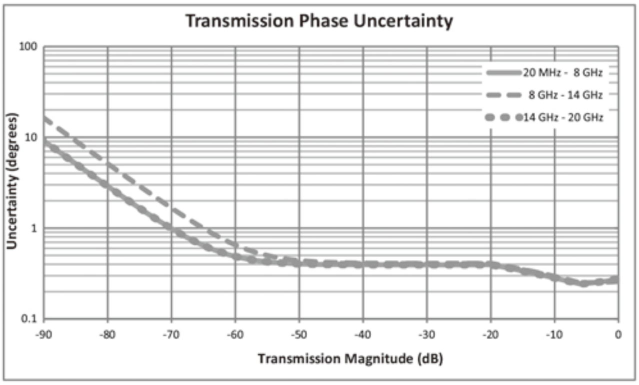
Measurement Accuracy* (TOSLK50A-20 or TOSLKF50A-20)

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
1 MHz to 10 GHz	≥42	≥33	≥42	±0.08	±0.06
>10 GHz to 20 GHz	≥36	≥26	≥36	±0.04	±0.03

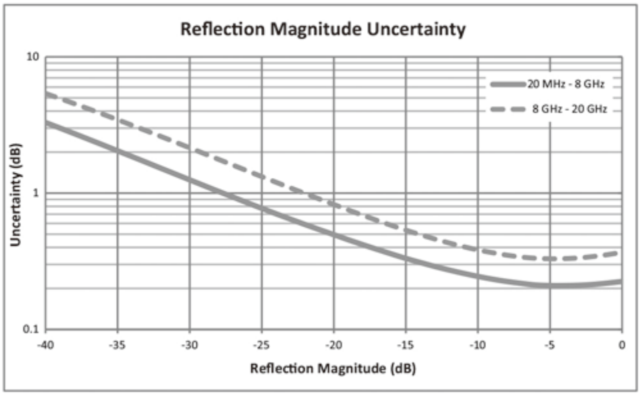
*: Full 2-Port calibration with isolation, Default Power, 10 Hz IFBW, No averaging, 10 minute warm-up. TOSLK50A-20 or TOSLKF50A-20 calibration kit.
Load match specification applicable directly at corrected port only. De-rate by approximately 8 dB if using a 3670 series test port cable.
Reflection and Transmission Tracking are typical.

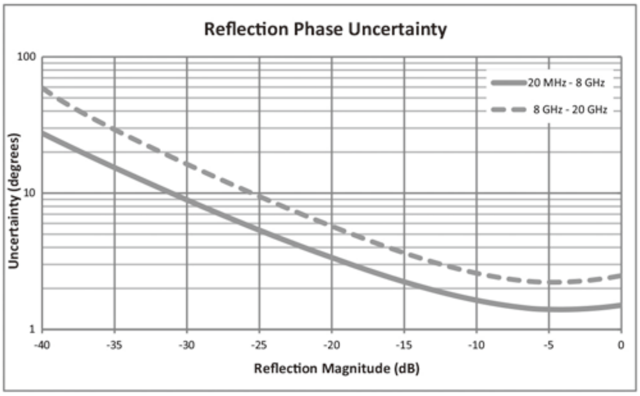
Transmission Uncertainty (S_{21}, S_{12}) (S_{11} = S_{22} = 0)





Reflection Uncertainty (S_{11}, S_{22}) (S_{21} = S_{12} = 0)



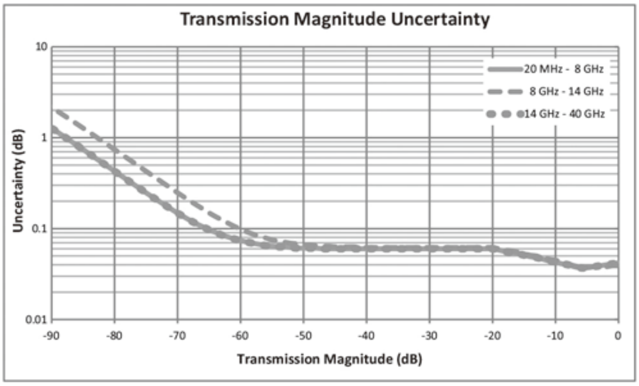


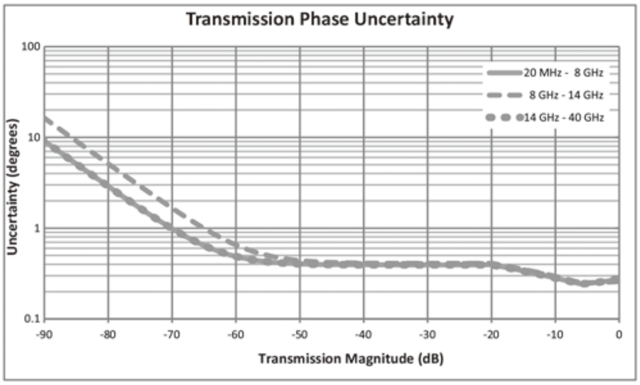
Measurement Accuracy* (TOSLK50A-40 or TOSLKF50A-40)

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
1 MHz to 10 GHz	≥42	≥33	≥42	±0.08	±0.06
>10 GHz to 20 GHz	≥36	≥26	≥36	±0.04	±0.03
>20 GHz to 30 GHz	≥32	≥22	≥32	±0.04	±0.03
>30 GHz to 40 GHz	≥30	≥20	≥30	±0.04	±0.03

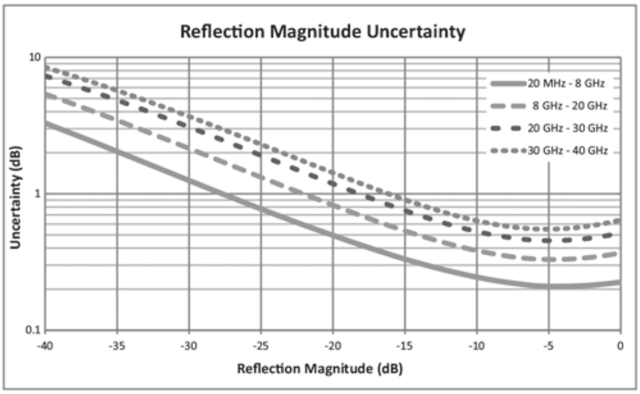
*: Full 2-Port calibration with isolation, Default Power, 10 Hz IFBW, No averaging, 10 minute warm-up. TOSLK50A-40 or TOSLKF50A-40 calibration kit.
Load match specification applicable directly at corrected port only. De-rate by approximately 8 dB if using a 3670 series test port cable.
Reflection and Transmission Tracking are typical.

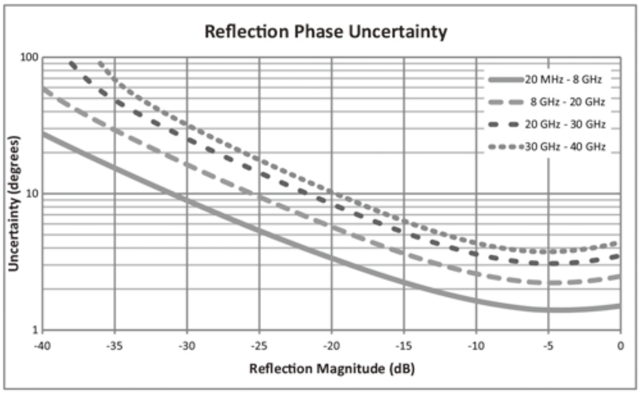
Transmission Uncertainty (S_{21}, S_{12}) (S_{11} = S_{22} = 0)





Reflection Uncertainty (S_{11}, S_{22}) (S_{21} = S_{12} = 0)





Vector Voltmeter (Option 441)

Setup Parameters (Measurement)	Reflection	1-port Reflection (best for cable trimming, stub tuning, magnitude and phase matching of low loss DUTs)
	Transmission	2-port Transmission (best magnitude and phase matching of splitters, high loss DUTs, glide slope, etc.)
	Ratio A/B	Magnitude & Phase Ratio of A & B receivers. Port 1 = A, Port 2 = B. Requires external CW source
	Ratio B/A	Magnitude & Phase Ratio of A & B receivers. Port 1 = A, Port 2 = B. Requires external CW source
	Measurement Format	LogMag/Phase, LinMag/Phase, SWR, Impedance
	Display Format	Single, Table (table holds up to 12 measurements plus reference)
	Save Reference	Normalize response (Measurements become relative to saved reference)
	Clear Reference	Clears normalized response (Measurements are no longer relative to saved reference)
	Clear Table	Clears all values in table
Setup Parameters (Frequency)*1	Measurement Frequency	Set CW Frequency, 1 MHz (minimum)
Setup Parameters (Amplitude)	Resolution	1 or 2 Decimal Display Resolution
	Reference Impedance	50Ω or 75Ω (Impedance Measurement Format only)
Setup Parameters (Calibration)	Start Calibration	Measure, Cal Setup
	Thru Update	Updates Thru parameters of active calibration and maintains OSL calibration parameters
	Cal Info	Display current calibration status, including temperature
	Cal Correction	On/Off
Setup Parameters (Sweep)	Run/Hold	Hold stops measurement and freezes display data
	RF Pwr In Hold	On/Off
	Source Power	High/Low
	IFBW	10 Hz, 100 Hz (default), 1 kHz, 100 kHz
	Sweep Averaging	Range 1 to 1000 rolling average
Setup Parameters (File)	Save	Measurement (.vvm), Setup (.stp), Screen Shot (.png), Text (.txt), CSV (.csv)
	Recall	Measurement (.vvm), Setup (.stp), Screen Shot (.png)
	File Management	Rename, Create Folder, Copy, Paste, Delete
	Navigation (File management)	Top, Bottom, Page Up, Page Down
Setup Parameters (System)	Timebase Reference	Internal (default), External 10 MHz (Auto-sense, BNC female, Max +10 dBm)
	Ethernet Configuration	DHCP or Manual (Static) IP configuration, 10/100 Base-T, RJ45 connector
	Languages	English, French, German, Italian, Spanish, Russian, Portuguese, Japanese, Korean, Chinese
Frequency	Frequency Range	1 MHz to 8/14/20/30/40 GHz (frequency option dependent)
	Frequency Accuracy	±1.0 ppm at 23°C
	Stability	±1.0 ppm from –10° to +55°C (typ.)
	Aging	±1.0 ppm/yr (typ.)
	Frequency Resolution	1 Hz
Output Power*2	1 MHz to 8 GHz	+5 dBm (typ.) (High); –20 dBm (typ.) (Low)
	>8 GHz to 40 GHz	–3 dBm (typ.) (High); –20 dBm (typ.) (Low)
Reflection/ Transmission Uncertainty	1 MHz to 40 GHz	See the uncertainty curves in the Cable and Antenna Analyzer section. Applicable only when a vector error correction (calibration) is performed and active. Uncalibrated reflection/transmission uncertainty is not specified.
Receiver Compression*3 Port 1 or Port 2 (0.1 dB compression)	1 MHz to 40 GHz	+5 dBm (typ.)
Reference Level Input Range*3 (A/B and B/A)	1 MHz to 40 GHz	+5 to –60 dBm (auto ranging) (typ.)
Ratio Accuracy*4 (A/B and B/A)	1 MHz to 1 GHz	≤ ±0.2 dB typical (Relative to stored reference, DUT loss <10 dB)
	>1 GHz to 20 GHz	≤ ±0.5 dB typical (Relative to stored reference, DUT loss <10 dB)
	>20 GHz to 40 GHz	≤ ±1.0 dB typical (Relative to stored reference, DUT loss <10 dB)
Measurement Format	LogMag/Phase	Resolution: 1 or 2 decimal places Magnitude Display: dB Phase Display Range: ±180°
	LinMag/Phase	Resolution: 1 or 2 decimal places Magnitude Display: Linear Phase Display Range: ±180°
	SWR	Resolution: 1 or 2 decimal places Display: Linear SWR
	Impedance	Resolution: 1 or 2 decimal places Display: Real and Imaginary (complex impedance) Ω

*1: Reference receiver (A or B) will Auto-tune approximately ±100 kHz to lock onto external CW signal during A/B & B/A Ratio measurement.
*2: Not applicable in A/B or B/A Ratio Measurement.
*3: Recommend ≤+3 dBm for A/B or B/A Ratio Measurement.
*4: Reference signal level 0 to –20 dBm at input port.

General Specifications

Setup Parameters	System Info	Status, Battery
	System Setups	Date/Time, Language, Display/Audio, Option Configuration
	Option Configuration	Enable Options Using Key and Enable Options Using File
	Date/Time	Day, Month, Year, Time
	Language	English, French, German, Italian, Spanish, Russian, Portuguese, Japanese, Korean, Chinese
	Display/Audio	Brightness, Color Schemes, Screen Shot Settings, Volume
	Connectivity	GPS (Clear Data, Sync System Time), Ethernet Configuration (DHCP/Static)
	Diagnostics	Self Test
	Preset	Preset, Reset
	Reset	Factory Reset, Delete All User or Custom Files, Master Reset, Update Firmware
	File	Save, Recall, File Management
	File Management	Rename, Create Folder, Copy, Paste, Delete, Navigation
	Save	Measurement (*.dat, *.vipi), Setup (*.stp), Screen Shot and VIP Image (*.png), Text (*.txt), CSV (*.csv)
	Recall	Measurement (*.dat, *.vipi), Setup (*.stp), Screen Shot and VIP Image (*.png)
	Navigation	Top, Bottom, Page Up, Page Down
	Internal Trace/Setup Memory	>2000 files, files may be traces, setups, screenshots, or any combination
	External Trace/Setup Memory	Limited only by size of USB Flash drive
Connectors	Port 1 (models up to 14 GHz)	Type N (f), 50Ω, Maximum Input +23 dBm, ±50 VDC
	Port 2 (models up to 14 GHz)	Type N (f), 50Ω, Maximum Input +23 dBm, ±50 VDC
	Port 1 (models >14 GHz)	Type Ruggedized K (m), 50Ω, Maximum Input +23 dBm, ±50 VDC
	Port 2 (models >14 GHz)	Type Ruggedized K (m), 50Ω, Maximum Input +23 dBm, ±50 VDC
	External Reference In	Type BNC (f), 50Ω, 10 MHz, Maximum +10 dBm
	External Trigger In	Type BNC female, 50Ω, 3.3 V or 5 V TTL triggers on positive edge. Maximum +5 VDC
	Headset Jack	3.5 mm mini-jack
	External Power	5.5 mm barrel connector, +11 VDC to +14 VDC, ≤4.0 A
	USB Interface (2)	Type A, Connect USB Flash Drive, GPS Module, Power Sensor, other
	USB Interface	5-pin Mini-B, Connect to PC for data transfer and/or control
	Ethernet	RJ-45, Category 5, 10/100 MB/s. Connect to PC for data transfer and/or control
Display	Type	High Resolution Resistive Touchscreen
	Size	8.4 in daylight viewable color LCD
	Resolution	800 × 600 Pixel Defects No more than five defective pixels (99.9989% good pixels)
	Pixel Defects	No more than five defective pixels (99.9989% good pixels)
Battery	Type	Li-Ion
	Battery Operation	5.0 hr (typ.)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU
RCM	Australia and New Zealand	RCM AS/NZS 4417:2012
KCC	South Korea	KCC-REM-A21-0004
Environmental MIL-PRF-28800F Class 2	Operating Temperature Range	–10° to +55°C
	Storage Temperature Range	–51° to +71°C
	Maximum Relative Humidity	95% RH at +30°C, non-condensing
	Vibration, Sinusoida	5 Hz to 55 Hz
	Vibration, Random	10 Hz to 500 Hz
	Half Sine Shock	30 g_n
	Altitude	4600 meters, operating and non-operating
	Explosive Atmosphere	MIL-PRF-28800F Section 4.5.6.3 MIL-STD-810G, Method 511.5, Procedure 1
Dimensions and Mass		273 (W) × 199 (H) × 91 (D) mm (10.7 × 7.8 × 3.6 in) 3.0 kg (6.6 lb), including battery

Line Sweep Tools™ (for your PC)

Trace Capture	Browse to Instrument	View and copy traces from the test equipment to your PC using Windows Explorer
	Open Legacy Files	Open DAT files captured with Handheld Software Tools v6.61
	Open Current Files	Open VNA or DAT files
	Capture Plots To	The Line Sweep Tools screen, DAT files, Database, or JPEG
Traces	Trace Types	Return Loss, VSWR, DTF-RL, DTF-VSWR, Cable Loss, Smith Chart, and PIM
	Trace Formats	DAT, VNA, CSV, PNG, BMP, JPG, HTML, Data Base, and PDF
Report Generation	Report Generator	Includes GPS location along with measurements
	Report Format	Create reports in HTML or PDF format
	Report Setup	Report Title, Company, Prepared for, Location, Date and Time, Filename, Company logo
	Trace Setup	1 Trace Portrait Mode, 2 Trace Portrait Mode, 1 Trace Landscape Mode
Trace Validation	Presets	7 presets allow “one click” setting of up to 6 markers and one limit line
	Marker Controls	6 regular Markers, Marker Peak, Marker Valley, Marker between, and frequency entry
	Delta Markers	6 Delta markers
	Limit Line	Enable and drag or value entry. Also works with presets
	Next Trace Button	Next Trace and Previous Trace arrow keys allow quick switching between traces
Tools	Cable Editor	Allows creation of custom cable parameters
	Distance to Fault	Converts a Return Loss trace to a Distance to Fault trace
	Measurement Calculator	Converts Real, Imaginary, Magnitude, Phase, RL, VSWR, Rho, and Transmit power
	Signal Standard Editor	Creates new band and channel tables
	Renaming Grid	36 user-definable phrases for creation of file names, trace titles, and trace subtitles
Connectivity	Connections	Ethernet, USB cable, and USB memory stick

easyTest Tools™ (for your PC)

Instrument Mode	Cable & Antenna Analyzer Mode	
Commands	Display Image	Allows putting a custom image on the instrument screen
	Recall Setup	Places the instrument into a known state
	Prompt	Displays instructional messages on the instrument screen
	Save	Allows automatic or manual saving of traces

Programmable Remote Control

Functionality: Instrument functionality is available via remote programming.
See the S820E Programming Manual for details.
Programming Language: Standard Commands for Programmable Instruments (SCPI)
Interfaces: USB, Ethernet

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Standard Configuration
S820E	Microwave Site Master
	(Requires one Frequency Option 708, 714, 720, 730, or 740)
	Three Year Warranty (One year on battery)
	Instrument Options
S820E-0440	Vector Network Analyzer (VNA)
S820E-0441	Vector Voltmeter (VVM)
S820E-0098	Standard Calibration to ISO17025 and ANSI/NCSL Z540-1. Includes calibration certificate.
S820E-0099	Premium Calibration to ISO17025 and ANSI/NCSL Z540-1. Includes calibration certificate, test report, and uncertainty data.
	Frequency Options
	(Select one frequency option only)
S820E-0708	1 MHz to 8 GHz, type N (f) ports
S820E-0714	1 MHz to 14 GHz, type N (f) ports
S820E-0720	1 MHz to 20 GHz, type Ruggedized K (m) ports (compatible with 3.5 mm and SMA connectors)
S820E-0730	1 MHz to 30 GHz, type Ruggedized K (m) ports (compatible with 3.5 mm and SMA connectors)
S820E-0740	1 MHz to 40 GHz, type Ruggedized K (m) ports (compatible with 3.5 mm and SMA connectors)
	USB Power Sensors
	(For complete ordering information see the respective data sheets of each sensor)
MA24105A	Inline Peak Power Sensor, 350 MHz to 4 GHz, +3 to +51.76 dBm
MA24106A	RF USB Power Sensor, 50 MHz to 6 GHz, +23 dBm
MA24108A	Microwave USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24118A	Microwave USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24126A	Microwave USB Power Sensor, 10 MHz to 26 GHz, +20 dBm
MA24208A	Microwave Universal USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24218A	Microwave Universal USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24330A	Microwave CW USB Power Sensor, 10 MHz to 33 GHz, +20 dBm
MA24340A	Microwave CW USB Power Sensor, 10 MHz to 40 GHz, +20 dBm
MA24350A	Microwave CW USB Power Sensor, 10 MHz to 50 GHz, +20 dBm
SC8268	USB Transmission Sensor, K (m), 1 MHz to 40 GHz, +10 to –50 dBm
MA25100A	RF Power Indicator
	USB Extender Kit
	(for use with external 2-port cable loss/transmission sensors; requires Cat 5e extension cable, sold separately)
2000-1717-R*	USB 1.1 Passive 40 m Extender
2000-1900-R	USB 2.0 100 meter Cat 5e Extender (with Type A power cord for USA, Japan, North America, Central America and Caribbean)
2000-1901-R	USB 2.0 100 meter Cat 5e Extender (with Type C power cord for use in Europe, India, South Korea, and many countries in Middle East and Africa)
2000-1902-R	USB 2.0 100 meter Cat 5e Extender (with Type I power cord for use in Australia, New Zealand, Argentina, and the South Pacific)
2000-1903-R	USB 2.0 100 meter Cat 5e Extender (with Type G power cord for use in the UK, and several other countries in Asia, the Middle East, and Africa)
2100-28-R	Cat 5e extension cable for use with USB Extender (22.5 m)
	Documentation (soft copy at www.anritsu.com)
10100-00065	Product Information, Compliance, and Safety
11410-00749	Technical Data Sheet
10580-00343	User Guide
10580-00344	Programming Manual
10580-00345	Maintenance Manual
	Standard Accessories (included with instrument)
2000-1654-R	Soft Carrying Case
71693-R	Ruggedized K (f) to N (f), 2 pcs (included only with S820E-0720)
633-75	Rechargeable Li-Ion Battery
40-187-R	AC-DC Adapter
806-141-R	Automotive Power Adapter, 12 VDC, 60 W
2000-1691-R	Stylus with Coiled Tether
2000-1797-R	Screen Protector Film (one factory installed, one spare)
3-2000-1498	USB A/5-pin Mini-B Cable, 3.05 m (10 ft)
2000-1371-R	Ethernet Cable, 2.13 m (7 ft)
	Certificate of Calibration and Conformance

Model/Order No.	Name
	Optional Accessories
	Miscellaneous Accessories
2000-1723-R	High Performance USB Mag-Mount GPS Antenna/Receiver
2000-1374	External Charger for Li-Ion Batteries
67135	Anritsu Backpack (For Handheld Instrument and PC)
760-243-R	Large Transit Case with Wheels and Handle
	Full Temperature Coaxial Calibration Kits
	(–10° to +55°C, K Type is compatible with 3.5 mm and SMA connectors see individual data sheets on www.anritsu.com)
OSLN50A-8	High Performance Type N (m), DC to 8 GHz, 50Ω
OSLNF50A-8	High Performance Type N (f), DC to 8 GHz, 50Ω
TOSLN50A-8	High Performance with Through Type N (m), DC to 8 GHz, 50Ω
TOSLNF50A-8	High Performance with Through Type N (f), DC to 8 GHz, 50Ω
OSLN50A-18	High Performance Type N (m), DC to 18 GHz, 50Ω
OSLNF50A-18	High Performance Type N (f), DC to 18 GHz, 50Ω
TOSLN50A-18	High Performance with Through Type N (m), DC to 18 GHz, 50Ω
TOSLNF50A-18	High Performance with Through Type N (f), DC to 18 GHz, 50Ω
TOSLK50A-20	High Performance with Through Type K (m), DC to 20 GHz, 50Ω
TOSLKF50A-20	High Performance with Through Type K (f), DC to 20 GHz, 50Ω
TOSLK50A-40	High Performance with Through Type K (m), DC to 40 GHz, 50Ω
TOSLKF50A-40	High Performance with Through Type K (f), DC to 40 GHz, 50Ω
	Coaxial Calibration Components, N Type 50Ω, K Type 50Ω
	(K Type is compatible with 3.5 mm and SMA connectors)
22N50	Precision Open/Short, N (m), DC to 18 GHz, 50Ω
22NF50	Precision Open/Short, N (f), DC to 18 GHz, 50Ω
28N50-2	Precision Load, N (m), DC to 18 GHz, 50Ω
28NF50-2	Precision Load, N (f), DC to 18 GHz, 50Ω
22K50	Precision Open/Short, K (m), DC to 40 GHz, 50Ω
22KF50	Precision Open/Short, K (f), DC to 40 GHz, 50Ω
28K50	Precision Load, K (m), DC to 40 GHz, 50Ω
28KF50	Precision Load, K (f), DC to 40 GHz, 50Ω
	Coaxial Calibration Components, Other 50Ω, 75Ω
2000-1618-R	Open/Short/Load, 7/16 DIN (m), DC to 6.0 GHz 50Ω
2000-1619-R	Open/Short/Load, 7/16 DIN (f), DC to 6.0 GHz 50Ω
2000-1914-R	Precision Open/Short/Load, 4.3-10 (f), DC to 6 GHz, 50Ω
2000-1915-R	Precision Open/Short/Load, 4.3-10 (m), DC to 6 GHz, 50Ω
12N50-75B	Matching Pad, DC to 3 GHz, 50Ω to 75Ω
22N75	Open/Short, N (m), DC to 3 GHz, 75Ω
22NF75	Open/Short, N (f), DC to 3 GHz, 75Ω
26N75A	Precision Termination, N (m), DC to 3 GHz, 75Ω
26NF75A	Precision Termination, N (f), DC to 3 GHz, 75Ω
1091-55-R	Open, TNC (f), DC to 18 GHz
1091-53-R	Open, TNC (m), DC to 18 GHz
1091-56-R	Short, TNC (f), DC to 18 GHz
1091-54-R	Short, TNC (m), DC to 18 GHz
1015-54-R	Termination, TNC (f), DC to 18 GHz
1015-55-R	Termination, TNC (m), DC to 18 GHz
	Video Inspection Probe
G0306B	Video Inspection Probe (400x), including the following standard connector tips:
Universal Tips	H0361A 1.25PC-M, H0360A 2.5PC-M, H0362A 2.5APC-M
Bulkhead Tips	H0363A LC-PC-F, H0364A FC-PC-F, H0375A ST-PC-F, H0366A SC-APC-F
Additional Tips	H0372A E2000-PC-F, H0373A FC-APC-F, H0374A MU-PC-F, H0365A SC-PC-F, H0376A 1.25APC-M
971-14-R	Ferrule Cleaner, 2.5 mm SC
971-15-R	Ferrule Cleaner, 1.25 mm LC
971-16	Fiber Ferrule Cleaner

Continued on next page

*: Not compatible with sensors MA24208A, MA24218A, MA24330A, MA24340A, MA24350A; must use active extenders with these sensors.

Waveguide Calibration Components, Rectangular Type 50Ω

Frequency Range (GHz)	1/8 Offset	3/8 Offset	Termination	Coax to Waveguide Adapter	Compatible Flanges
3.95 to 5.85	23UA187-R	24UA187-R	26UA187-R	35UA187N-R	CPR187F-R, CPR187G-R, UG-1352/U-R, UG-1353/U-R, UG-1728/U-R, UG-1729/U-R, UG-148/U-R, UG-149A/U-R
5.85 to 8.20	23UA137-R	24UA137-R	26UA137-R	35UA137N-R	CPR137F-R, CPR137G-R, UG-1356/U-R, UG-1357/U-R, UG-1732/U-R, UG-1733/U-R, UG-343B/U-R, UG-344/U-R, UG-440B/U-R, UG-441/U-R
7.05 to 10.00	23UA112-R	24UA112-R	26UA112-R	35UA112N-R	CPR112F-R, CPR112G-R, UG-1358/U-R, UG-1359/U-R, UG-1734/U-R, UG-1735/U-R, UG-52B/U-R, UG-51/U-R, UG-137B/U-R, UG-138/U-R
8.20 to 12.40	23UA90-R	24UA90-R	26UA90-R	35UA90N-R	CPR90F-R, CPR90G-R, UG-1360/U-R, UG-1361/U-R, UG-1736/U-R, UG-1737/U-R, UG-40B/U-R, UG-39/U-R, UG-135/U-R, UG-136B/U-R
12.40 to 18.00	23UA62-R	24UA62-R	26UA62-R	35UA62N-R	UG-541A/U-R, UG-419/U-R, UG-1665/U-R, UG1666/U-R
17.00 to 26.50	23UA42-R	24UA42-R	26UA42-R	35UA42K-R	UG-596A/U-R, UG-595/U-R, UG-597/U-R, UG-598A/U-R
26.50 to 40.00	23UA28-R	24UA28-R	26UA28-R	35UA28K-R	UG-599/U-R
3.30 to 4.90	23UM40-R	24UM40-R	26UM40-R	35UM40N-R	PDR40-R
3.95 to 5.85	23UM48-R	24UM48-R	26UM48-R	35UM48N-R	CAR48-R, PAR48-R, UAR48-R, PDR48-R
5.85 to 8.20	23UM70-R	24UM70-R	26UM70-R	35UM70N-R	CAR70-R, PAR70-R, UAR70-R, PDR70-R
7.05 to 10.00	23UM84-R	24UM84-R	26UM84-R	35UM84N-R	CBR84-R, UBR84-R, PBR84-R, PDR84-R
8.20 to 12.40	23UM100-R	24UM100-R	26UM100-R	35UM100N-R	CBR100-R, UBR100-R, PBR100-R, PDR100-R
10.00 to 15.00	23UM120-R	24UM120-R	26UM120-R	35UM120N-R	CBR120-R, UBR120-R, PBR120-R, PDR120-R
12.40 to 18.00	23UM140-R	24UM140-R	26UM140-R	35UM140N-R	CBR140-R, UBR140-R, PBR140-R, PDR140-R
17.00 to 26.50	23UM220-R	24UM220-R	26UM220-R	35UM220K-R	CBR220-R, UBR220-R, PBR220-R, PDR220-R
26.50 to 40.00	23UM320-R	24UM320-R	26UM320-R	35UM320K-R	UBR320-R

Model/Order No.	Name
	Phase-Stable Test Port Extension Cables (Armored and Flexible)
14RKFKF50-0.6	0.6 m (24 in), DC to 40 GHz, Ruggedized K (f) to K (f), 50Ω
14RKFKF50-1.0	1.0 m (39 in), DC to 40 GHz, Ruggedized K (f) to K (f), 50Ω
14RKFK50-0.6	0.6 m (24 in), DC to 40 GHz, Ruggedized K (f) to K (m), 50Ω
14RKFK50-1.0	1.0 m (39 in), DC to 40 GHz, Ruggedized K (f) to K (m), 50Ω
14KFKF50-0.6	0.6 m (24 in), DC to 40 GHz, K (f) to K (f), 50Ω
14KFKF50-1.0	1.0 m (39 in), DC to 40 GHz, K (f) to K (f), 50Ω
14KFK50-0.6	0.6 m (24 in), DC to 40 GHz, K (f) to K (m), 50Ω
14KFK50-1.0	1.0 m (39 in), DC to 40 GHz, K (f) to K (m), 50Ω
15NN50-1.0B	1.0 m (39 in), DC to 18 GHz, N (m) to N (m), 50Ω
15NNF50-1.0B	1.0 m (39 in), DC to 18 GHz, N (m) to N (f), 50Ω
15LL50-1.0A	1.0 m (39 in), DC to 20 GHz, 3.5 mm (m) to 3.5 mm (m), 50Ω
15LLF50-1.0A	1.0 m (39 in), DC to 20 GHz, 3.5 mm (m) to 3.5 mm (f), 50Ω
15KK50-1.0A	1.0 m (39 in), DC to 26.5 GHz, K (m) to K (m), 50Ω
15KKF50-1.0A	1.0 m (39 in), DC to 26.5 GHz, K (m) to K (f), 50Ω
15N43M50-1.5C	Test Port Extension Cable, 1.5 m, DC to 6 GHz, N (m) to 4.3-10 (m)
15N43F50-1.5C	Test Port Extension Cable, 1.5 m, DC to 6 GHz, N (m) to 4.3-10 (f)
15N43M50-3.0C	Test Port Extension Cable, 3 m, DC to 6 GHz, N (m) to 4.3-10 (m)
15N43F50-3.0C	Test Port Extension Cable, 3 m, DC to 6 GHz, N (m) to 4.3-10 (f)
15NF43M50-1.5C	Test Port Extension Cable, 1.5 m, DC to 6 GHz, N (f) to 4.3-10 (m)
15NF43F50-1.5C	Test Port Extension Cable, 1.5 m, DC to 6 GHz, N (f) to 4.3-10 (f)
15NF43M50-3.0C	Test Port Extension Cable, 3 m, DC to 6 GHz, N (f) to 4.3-10 (m)
15NF43F50-3.0C	Test Port Extension Cable, 3 m, DC to 6 GHz, N (f) to 4.3-10 (f)
	Phase-Stable 18 GHz and 40 GHz Semi-Rigid Cables (Armored)
3670K50-1	0.3 m (12 in), DC to 40 GHz, K (f) to K (m), 50Ω
3670K50-2	0.6 m (24 in), DC to 40 GHz, K (f) to K (m), 50Ω
3670N50-1	0.3 m (12 in), DC to 18 GHz, N (f) to N (m), 50Ω
3670NN50-1	0.3 m (12 in), DC to 18 GHz, N (m) to N (m), 50Ω
3670N50-2	0.6 m (24 in), DC to 18 GHz, N (f) to N (m), 50Ω
3670NN50-2	0.6 m (24 in), DC to 18 GHz, N (m) to N (m), 50Ω

Model/Order No.	Name
	Adapters
71693-R	Ruggedized K (f) to N (f), DC to 18 GHz, 50Ω
1091-26-R	SMA (m) to N (m), DC to 18 GHz, 50Ω
1091-27-R	SMA (f) to N (m), DC to 18 GHz, 50Ω
1091-80-R	SMA (m) to N (f), DC to 18 GHz, 50Ω
1091-81-R	SMA (f) to N (f), DC to 18 GHz, 50Ω
1091-172	BNC (f) to N (m), DC to 1.3 GHz, 50Ω
510-90-R	7/16 DIN (f) to N (m), DC to 7.5 GHz, 50Ω
510-91-R	7/16 DIN (f) to N (f), DC to 7.5 GHz, 50Ω
510-92-R	7/16 DIN (m) to N (m), DC to 7.5 GHz, 50Ω
510-93-R	7/16 DIN (m) to N (f), DC to 7.5 GHz, 50Ω
510-96-R	7/16 DIN (m) to 7/16 DIN (m), DC to 7.5 GHz, 50Ω
510-97-R	7/16 DIN (f) to 7/16 DIN (f), DC to 7.5 GHz, 50Ω
513-62	DC to 18 GHz, TNC (f) to N (f), 50Ω
1091-315	DC to 18 GHz, TNC (m) to N (f), 50Ω
1091-324	DC to 18 GHz, TNC (f) to N (m), 50Ω
1091-325	DC to 18 GHz, TNC (m) to N (m), 50Ω
1091-317	DC to 18 GHz, TNC (m) to SMA (f), 50Ω
1091-318	DC to 18 GHz, TNC (m) to SMA (m), 50Ω
1091-323	DC to 18 GHz, TNC (m) to TNC (f), 50Ω
1091-326	DC to 18 GHz, TNC (m) to TNC (m), 50Ω
1091-465-R	DC to 6 GHz, 4.3-10 (f) to N (f), 50Ω
1091-467-R	DC to 6 GHz, 4.3-10 (m) to N (f), 50Ω
510-102-R	N (m) to N (m), DC to 11 GHz, 50Ω, 90 degrees right angle
	Precision Adapters
34NN50A	N (m) to N (m), DC to 18 GHz, 50Ω
34NFNF50	N (f) to N (f), DC to 18 GHz, 50Ω
K220B	DC to 40 GHz, K (m) to K (m), 50Ω
K222B	DC to 40 GHz, K (f) to K (f), 50Ω
K224B	DC to 40 GHz, K (m) to K (f), 50Ω
	Attenuators N Type (Up to 18 GHz)
3-1010-122	20 dB, 5 W, DC to 12.4 GHz, N (m) to N (f)
42N50-20	20 dB, 5 W, DC to 18 GHz, N (m) to N (f)
42N50A-30	30 dB, 5 W, DC to 18 GHz, N (m) to N (f)
3-1010-123	30 dB, 50 W, DC to 8.5 GHz, N (m) to N (f)
1010-127-R	30 dB, 150 W, DC to 3 GHz, N (m) to N (f)
3-1010-124	40 dB, 100 W, DC to 8.5 GHz, N (f) to N (m), Uni-directional
1010-121-R	40 dB, 100 W, DC to 18 GHz, N (f) to N (m), Uni-directional
1010-128-R	40 dB, 150 W, DC to 3 GHz, N (m) to N (f)
	Attenuators K Type (Up to 40 GHz)
41KB-3	Precision Fixed Attenuator, K (m) to K (f), 3 dB, DC to 26.5 GHz, 50Ω
41KB-6	Precision Fixed Attenuator, K (m) to K (f), 6 dB, DC to 26.5 GHz, 50Ω
41KB-10	Precision Fixed Attenuator, K (m) to K (f), 10 dB, DC to 26.5 GHz, 50Ω
41KB-20	Precision Fixed Attenuator, K (m) to K (f), 20 dB, DC to 26.5 GHz, 50Ω
41KC-3	Precision Fixed Attenuator, K (m) to K (f), 3 dB, DC to 40 GHz, 50Ω
41KC-6	Precision Fixed Attenuator, K (m) to K (f), 6 dB, DC to 40 GHz, 50Ω
41KC-10	Precision Fixed Attenuator, K (m) to K (f), 10 dB, DC to 40 GHz, 50Ω
41KC-20	Precision Fixed Attenuator, K (m) to K (f), 20 dB, DC to 40 GHz, 50Ω

S331P

Compact handheld Cable & Antenna Analyzer: 150 kHz to 4.0 GHz or 6.0 GHz

Remote Control
USB

Ultraportable Cable & Antenna Analyzer
Featuring Classic and Advanced Modes

Anritsu introduces its ninth generation, compact handheld Cable & Antenna Analyzer for installation and maintenance of antenna systems. It is available in two frequency ranges starting from 150 kHz and up to 4 GHz or 6 GHz.

Key Features

- FlexCal™ Calibration
  - One Calibration for All Frequencies
- Impact, Dust, and Splash Resistant
- Smallest, Lightest, and Fastest Site Master™

Easy to Use

- Factory default calibration (1-Port ReadyCal) automatically applied to OSL measurements
- S331D-like Classic Mode
- S331E-like Advanced Mode
  - Additional Markers
  - Customizable Shortcuts
  - Full-screen View
- S331L-like Graphical User Interface and Functionality
- Integrated Help Function
- EZ Name Quick Matrix
- easyTest™
- Controlled and Powered by a Windows tablet or PC using standard USB 2.0 (not included)

Efficient Sweep Management

- Internal File Storage (limited only by space on PC or Tablet)
  - Sweeps, Setups, Screen Shots
- Line Sweep Tools (LST) Software
  - Edit Sweeps, Rename, Archive
  - Generate PDF or HTML Reports
- Fast Preview of Stored Sweeps
- Standard *.dat Sweep File Format
- Compatible with HHST
  - Widely Accepted by Operators

Definitions

All specifications and characteristics apply to Revision 2 instruments under the following conditions, unless otherwise stated:

Warm-Up Time	After 10 minutes of warm-up time, where the instrument has completely stabilized to the ambient temperature.
Temperature Range	Over the 23° ±5°C temperature range.
Frequency Reference	Internal frequency reference is used.
Calibration	Instrument is within the recommended calibration cycle of 12 months. Cable and Antenna Analyzer measurements applicable after standard OSL calibration is performed using Anritsu calibration components.
Typical Performance	Typical specifications in parenthesis () describe performance that will be met by a minimum of 80% of all products. They do not include guard bands and are not warranted. Typical specifications that are not in parenthesis are not tested and not warranted. They are generally representative of the nominal characteristic performance.
Uncertainty	A coverage factor of k = 2 is applied to the measurement uncertainties to facilitate comparison with other industry monitors. All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site: www.anritsu.com

Cable and Antenna Analyzer Specifications

Measurements

Measurements	VSWR Return Loss Cable Loss (One Port) Distance-to-Fault (DTF) Return Loss Distance-to-Fault (DTF) VSWR Smith Chart 50Ω/75Ω (Advanced Mode Only) 1-Port Phase (Advanced Mode Only) Transmission with External Sensor (Advanced Mode Only)

Setup Parameters–Classic Mode

Measurement Display	Single Display with independent markers
Frequency	Start Frequency (F1), Stop Frequency (F2)
DTF	Start Distance (D1), Stop Distance (D2), DTF Aid, Cable Loss, Propagation Velocity, Cable type
Windowing	Rectangular, Normal Side Lobe, Low Side Lobe, Minimum Side Lobe
Amplitude	Top, Bottom Auto Scale, Full Scale
Sweep	Data Points, Run/Hold, Single/Continuous, Trace
Data Points	130, 259, 517, 1033, 2065
Markers	Markers 1 to 6 (On/Off), Delta Markers 2 to 4 (Ref M1), Marker to Peak/Valley, Marker Table, Marker 5 (Peak/Valley between M1 & M2), Marker 6 (Peak/Valley between M3 & M4), Independent Markers for Frequency and Distance Measurements
Traces	Copy Trace To Memory, Trace Display, Trace Math [Trace – Memory, Trace + Memory, (Trace + Memory)/2]
Limit Line	On/Off, Edit Value, Limit Alarm, Pass/Fail On/Off, Limit Preset
Calibration	Factory default 1-Port ReadyCal (automatically applied to all measurements) User calibration (User Cal) overrides ReadyCal Start Calibration, Cal Info, User Cal (On/Off), Cal Method: OSL Cal Types: Standard, FlexCal™
Save/Recall	Setups, Measurements, Screen Shots

Setup Parameters–Advanced Mode

Measurement Display	Single/Dual Display with independent markers
Frequency	Start Frequency (F1), Stop Frequency (F2)
DTF	Start Distance (D1), Stop Distance (D2), Units m/ft, DTF Aid, Cable List, Cable Loss, Propagation Velocity
Windowing	Rectangular, Normal Side Lobe, Low Side Lobe, Minimum Side Lobe
Amplitude	Top, Bottom, Auto Scale, Full Scale
Sweep	Data Points, Run/Hold, Single/Continuous
Data Points	130, 259, 517, 1033, 2065
Markers	Markers 1 to 8 (On/Off), Delta Markers 2 to 8 (Ref M1), Marker Tracking (On/Off), Marker to Peak/Valley, Marker Table, Marker 5 & 7 (Peak/Valley between M1 & M2), Marker 6 & 8 (Peak/Valley between M3 & M4), Independent Markers for Frequency and Distance Measurements
Traces	Copy Trace to Memory, Trace Display, Trace Math [Trace – Memory, Trace + Memory, (Trace + Memory)/2]
Limit Line	Active Limit (Upper/Lower), Limit State (On/Off), Move Active Limit, Edit Segments (42 upper and 42 lower segments maximum), Limit Alarm, Pass/Fail On/Off, Limit Preset
Calibration	Factory default 1-Port ReadyCal (automatically applied to all measurements except Transmission) User calibration (User Cal) overrides ReadyCal Start Calibration, Cal Info, User Cal (On/Off), Cal Methods: OSL, Transmission, OSL + Transmission Cal Types: Standard, FlexCal™
Save/Recall	Setups, Measurements, Screen Shots

Frequency

Frequency Ranges	500 kHz to 4 GHz (S331P-0704) 500 kHz to 6 GHz (S331P-0706) Either option can be set as low as 150 kHz
Frequency Accuracy	±2.5 ppm @ 23° ±3°C
Frequency Resolution	1 kHz

Power

Output Power	–5 dBm (typ.)

Interference Immunity

	On Channel and On Frequency +17 dBm (typ.)

Measurement Speed

	500 µs/data point (typ.)*

*: Timing dependent on external computer configuration

Return Loss

Measurement Range	0 to 60 dB
Resolution	0.01 dB

VSWR

Measurement Range	1 to 65
Resolution	0.01

Cable Loss

Measurement Range	0 to 30 dB
Resolution	0.01 dB

Distance-to-Fault

Vertical Range Return Loss	0 to 60 dB
Vertical Range VSWR	1 to 65
Fault Resolution (meters)	$(1.5 \times 10^8 \times vp)/\Delta F$ (vp = propagation velocity, ΔF is F2 – F1 in Hz)
Horizontal Range (meters)	0 to (Data Points – 1) × Fault Resolution, to maximum of 1500 meters (4921 ft)

1-Port Phase (Advanced Mode Only)

Measurement Display Range	–450° to +450°
Resolution	0.01°

Smith Chart (Advanced Mode Only)

Impedance	50Ω, 75Ω
Resolution	0.01

Transmission Ext Sensor (Advanced Mode Only)

Measurement Display Range	–100 to +100 dB
Resolution	0.01 dB

Measurement Accuracy (at 23° ±3°C)

Corrected Directivity	≥42 dB, OSL calibration (OSLN50A-8, OSLNF50A-8)

General Specifications

Setup Parameters

System Info	Status
System Setups	Language, Display/Audio
Language	English, French, German, Italian, Spanish, Russian, Portuguese, Japanese, Korean, Chinese
Display/Audio	Brightness, Color Schemes, Screen Shot Settings, Volume
Connectivity	USB
Diagnostics	Self Test
Preset	Preset, Reset
Reset	Factory Reset, Delete All User Files, Delete Custom Files, Master Reset
File	Save, Recall, File Management
Save	Measurement (*.dat), Setup (*.stp), Screen Shot (*.png), System and Self Test Info (*.txt)
Recall	Recall, Create Folder, Copy, Paste, Delete
File Management	Rename, Create Folder, Copy, Paste, Delete
Navigation	Top, Bottom, Page Up, Page Down
Help Menu	System Info, FAQ, User Guide
Internal Trace/Setup Memory	>1000 files for traces, setups, screen shots, or any combination (limited by PC/Tablet storage)
External Trace/Setup Memory	Limited only by size of USB Flash drive

Connectors

RF Port	Type N (m), 50Ω, Maximum input +23 dBm maximum, ±50 VDC maximum
USB Port	USB 2.0 port for connecting to an external PC controller

Regulatory Compliance

CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN61010-1 RoHS: 2011/65/EU
Australia and New Zealand	RCM AS/NZS 4417:2012
South Korea	KCC-REM-A21-0004

Environmental

Operating Temperature Range	–10° to +55°C
Storage Temperature Range	–51° to +71°C
Maximum Relative Humidity	95% RH at +30°C, non-condensing
Vibration, Sinusoidal	5 Hz to 55 Hz
Vibration, Random	10 Hz to 500 Hz
Altitude	4600 m (15092 ft), operating and non-operating

Dimensions and Mass

Dimensions	52 (W) × 148 (H) × 36 (D) mm (2 × 5.8 × 1.4 in)
Mass	<0.4 kg (<0.9 lb) (typ.)

Recommended External PC Configuration

	One USB 2.0 (or higher) port S331P software is compatible with Windows® 7, 8, 8.1, or 10; 32 or 64 bit operating systems. Tested with tablets running Windows 10 and Intel Atom X5-Z8300 processor.

Anritsu Tool Box and Line Sweep Tools (for your PC)

Line Sweep Tools (LST) is a free PC based program that increases productivity for people who deal with numerous Cable and Antenna traces every day. LST is the next generation of Anritsu’s familiar Handheld Software Tools (HHST) and shares its uncomplicated user interface, giving a new face to the term “ease of use.”

Cable Editor*1	Instrument Cable Lists may be retrieved from the instrument, modified as required, and uploaded back into instrument.
Distance to Fault*2 (DTF)	Easily convert Return Loss or VSWR traces to Distance to Fault traces with one button press.
Measurement Calculator	Provides quick conversion between commonly used measurement units such as VSWR, RL, and others.
Signal Standard Editor*1	Signal Standard Lists may be retrieved from the instrument, modified as required, and uploaded back into instrument.
Naming Grid	A naming grid function makes changing file names, trace titles, and trace subtitles from field values to those required by contract simple and quick. Once the naming grid is populated with user defined file name segments, a few simple button presses will then fill out the file, title, and sub-title names. Quickly applied to multiple traces, the naming grid can save time, increase efficiency and accuracy.
Presets	Presets make applying markers and a limit line to similar traces quick and easy. They only need to be set once, and recorded. After this, applying them to a similar trace requires only one button push. This speeds up trace processing and makes providing consistent marker and limit line settings easy.
Report Generator	The report generator creates a professional PDF or HTML based report. Reports may include GPS*3 location, power level*3, company logo*4, instrument and calibration status along with a display of all open traces. It also may contain additional information such as addresses and phone numbers.
Connection	File transfer.
Supported File Types	Input: *.dat, *.vna, *.mna, *.pim, *.tm Output: *.dat, *.vna, *.pim, *.tm, *.csv, *.bmp, *.jpg, *.png

*1: Instrument type/model must match original
*2: Only *.dat and *.vna file types supported
*3: Model dependent
*4: Optionally set by user

easyTest Tools (for your PC)

Instrument Mode

	Cable & Antenna Analyzer Mode

Commands

Display Image	Allows a custom on-screen image
Recall Setup	Places the instrument into a known state
Prompt	Displays instructional messages for the user
Save	Allows automatic or manual saving of traces

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main Frame
S331P	Cable and Antenna Analyzer (required one frequency option)
	Frequency Options
S331P-0704	150 kHz to 4 GHz
S331P-0706	150 kHz to 6 GHz
	Calibration and Extended Warranty Options
S331P-ES510	Warranty Extension to 5 Years
S331P-ES513	Warranty Extension to 5 Years with Z540 Calibration
S331P-0098	Standard Calibration to ISO17025 and ANSI/NCSL Z540-1. Includes calibration certificate.
S331P-0099	Premium Calibration to ISO17025 and ANSI/NCSL Z540-1. Includes calibration certificate, test report, and uncertainty data.
	Standard Accessories (included with instrument)
2000-1864-R	Soft Carrying Case
2000-1606-R	USB-A to Micro-B with latch cable, 1.8 m (6 ft)
2000-1687-R	Torque Multiplier N (m)
	Standard Three-Year Warranty
	Certificate of Calibration and Conformance
	Reference Documents
	(Soft copies available at www.anritsu.com)
11410-00964	Site Master™ S331P Technical Data Sheet
10580-00426	Site Master™ S331P User Guide
11410-00674	Cable and Antenna Analysis Troubleshooting Guide
	Optional Accessories
	Calibration Components, 50Ω
OSLN50A-8	Precision Open/Short/Load, N (m), 42 dB, DC to 8.0 GHz, 50Ω
OSLNF50A-8	Precision Open/Short/Load, N (f), 42 dB, DC to 8.0 GHz, 50Ω
2000-1618-R	Precision Open/Short/Load, 7/16 DIN (m), DC to 6.0 GHz, 50Ω
2000-1619-R	Precision Open/Short/Load, 7/16 DIN (f), DC to 6.0 GHz, 50Ω
2000-1914-R	Precision Open/Short/Load, 4.3-10 (f), DC to 6 GHz, 50Ω
2000-1915-R	Precision Open/Short/Load, 4.3-10 (m), DC to 6 GHz, 50Ω
22N50	Open/Short, N (m), DC to 18 GHz, 50Ω
22NF50	Open/Short, N (f), DC to 18 GHz, 50Ω
SM/PL-1	Precision Load, N (m), 42 dB, DC to 6.0 GHz
SM/PLNF-1	Precision Load, N (f), 42 dB, DC to 6.0 GHz
	Calibration Components, 75Ω
12N50-75B	Matching Pad, DC to 3 GHz, 50Ω to 75Ω
22N75	Open/Short, N (m), DC to 3 GHz, 75Ω
22NF75	Open/Short, N (f), DC to 3 GHz, 75Ω
26N75A	Precision Termination, N (m), DC to 3 GHz, 75Ω
26NF75A	Precision Termination, N (f), DC to 3 GHz, 75Ω
	Adapters
510-91-R	7/16 DIN (f) to N (f), DC to 7.5 GHz, 50Ω
510-96-R	7/16 DIN (m) to 7/16 DIN (m), DC to 7.5 GHz, 50Ω
510-97-R	7/16 DIN (f) to 7/16 DIN (f), DC to 7.5 GHz, 50Ω
1091-80-R	SMA (m) to N (f), DC to 18 GHz, 50Ω
1091-81-R	SMA (f) to N (f), DC to 18 GHz, 50Ω
1091-433-R	Low PIM Adapter, 4.1/9.5 (f) to 7/16 DIN (f), DC to 3.0 GHz, 50Ω
1091-434-R	Low PIM Adapter, 4.1/9.5 (m) to 7/16 DIN (f), DC to 3.0 GHz, 50Ω
1091-435-R	Low PIM Adapter, 4.1/9.5 (f) to N (m), DC to 3.0 GHz, 50Ω
1091-436-R	Low PIM Adapter, 4.1/9.5 (m) to N (m), DC to 3.0 GHz, 50Ω
1091-440-R	Low PIM Adapter, 4.3/10 (f) to 7/16 DIN (f), DC to 3.0 GHz, 50Ω
1091-441-R	Low PIM Adapter, 4.3/10 (m) to 7/16 DIN (f), DC to 3.0 GHz, 50Ω
1091-442-R	Low PIM Adapter, 4.3/10 (f) to N (m), DC to 3.0 GHz, 50Ω
1091-443-R	Low PIM Adapter, 4.3/10 (m) to N (m), DC to 3.0 GHz, 50Ω
1091-465-R	DC to 6 GHz, 4.3-10 (f) to N (f), 50Ω
1091-467-R	DC to 6 GHz, 4.3-10 (m) to N (f), 50Ω

Model/Order No.	Name
	Precision Adapters
34NN50A	Precision Adapter, N (m) to N (m), DC to 18 GHz, 50Ω
34NFNF50	Precision Adapter, N (f) to N (f), DC to 18 GHz, 50Ω
	Attenuators
3-1010-122	20 dB, 5 W, DC to 12.4 GHz, N (m) to N (f)
42N50-20	20 dB, 5 W, DC to 18 GHz, N (m) to N (f)
42N50A-30	30 dB, 50 W, DC to 18 GHz, N (m) to N (f)
3-1010-123	30 dB, 50 W, DC to 8.5 GHz, N (m) to N (f)
1010-127-R	30 dB, 150 W, DC to 3 GHz, N (m) to N (f)
3-1010-124	40 dB, 100 W, DC to 8.5 GHz, N (f) to N (m), Unidirectional
1010-121	40 dB, 100 W, DC to 18 GHz, N (f) to N (m), Unidirectional
1010-128-R	40 dB, 150 W, DC to 3 GHz, N (m) to N (f)
	USB Extender Kit (for 2-port cable loss/transmission (external sensor) measurements)
2000-1717-R*	USB Extender, Requires Cat 5e extension cable (sold separately)
2000-1900-R	USB 2.0 Active 100 meter Extender (with Type A power cord for USA, Japan, North America, Central America and Caribbean)
2000-1901-R	USB 2.0 Active 100 meter Extender (with Type C power cord for use in Europe, India, South Korea, and many countries in Middle East and Africa)
2000-1902-R	USB 2.0 Active 100 meter Extender (with Type I power cord for use in Australia, New Zealand, Argentina, and the South Pacific)
2000-1903-R	USB 2.0 Active 100 meter Extender (with Type G power cord for use in the UK, and several other countries in Asia, the Middle East, and Africa)
2100-28-R	Cat 5e extension cable for use with USB Extender (22.5 m)
	USB Power Sensors and Transmission Sensors
	(For complete ordering information see the respective data sheets of each sensor)
MA24105A	Inline Peak Power Sensor, 350 MHz to 4 GHz, +3 to +51.76 dBm
MA24106A	RF USB Power Sensor, 50 MHz to 6 GHz, +23 dBm
MA24108A	Microwave USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24118A	Microwave USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24126A	Microwave USB Power Sensor, 10 MHz to 26 GHz, +20 dBm
MA24208A	Microwave Universal USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24218A	Microwave Universal USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24330A	Microwave CW USB Power Sensor, 10 MHz to 33 GHz, +20 dBm
MA24340A	Microwave CW USB Power Sensor, 10 MHz to 40 GHz, +20 dBm
MA24350A	Microwave CW USB Power Sensor, 10 MHz to 50 GHz, +20 dBm
SC8268	USB Transmission Sensor, K (m), 1 MHz to 40 GHz, +10 to –50 dBm
MA25100A	RF Power Indicator
	Backpack and Transit Case
67135	Anritsu Backpack (for instrument and PC)
760-283	Transit Case, USB 1 Port VNA

*: Not compatible with MA24208A, MA24218A, MA24330A, MA24340A and MA24350A sensors; must use active extenders with these sensors.

Calibration Kits

For Performing Precise Calibrations of Vector Network Analyzers

3652A

The Anritsu Calibration Kits contain all the precision components and tools required to calibrate your VNA for 12-term error-corrected measurements in the connector style of your choice. Components are included for calibrating male and female test ports as required. The kits support calibration with opens, shorts, an broadband loads. Option 1 adds sliding terminations and a pin depth gauge where required.

3650A SMA/3.5 mm Calibration Kit consisting of:

- 33SFSF50 Female-Female Adapter (2)*
- 33SS50 Male-Male Adapter*
- 28S50-2 Broadband Male Termination (2)
- 28SF50-2 Broadband Female Termination (2)
- 33SSF50 Male-Female Adapter (2)*
- 24S50 Male Open
- 24SF50 Female Open
- 23S50 Male Short
- 23SF50 Female Short
- Connector Thumb Wheel (4)
- 01-201 Torque Wrench
- 01-210 Reference Flat
- 01-222 Pin Depth Gauge
- 01-223 Pin Depth Gauge Female Adapter
- Calibration coefficients media
- Calibration coefficients memory stick

Option 1 adds the following:

- 17SF50 Female Sliding Termination
- 17S50 Male Sliding Termination

3651 GPC-7 Calibration Kit consisting of:

- 28A50-2 Broadband Termination (2)
- 24A50 Open
- 23A50 Short
- 01-200 Torque Wrench
- 01-221 Collet Extractor Tool and 4 Collets
- Calibration coefficients diskette
- Calibration coefficients memory stick

Option 1 adds the following:

- 17A50 Sliding Termination
- 01-210 Reference Flat
- 01-220 Pin Depth Gauge

3652A K Connector® Calibration Kit consisting of:

- 33KFKF50B Female-Female Adapter (2)*
- 33KK50B Male-Male Adapter*
- 28K50 Broadband Male Termination (2)
- 28KF50A Broadband Female termination (2)
- 33KKF50B Male-Female Adapter (2)*
- 24K50 Male Open
- 24KF50 Female Open
- 23K50 Male Short
- 23KF50 Female Short
- 01-201 Torque Wrench
- 01-210 Reference Flat
- 01-222 Pin Depth Gauge
- 01-223 Pin Depth Gauge
- Calibration coefficients media
- Connector thumb wheel (4)
- Calibration coefficients memory stick

Option 1 adds the following:

- 17KF50 Female Sliding Termination
- 17K50 Male Sliding Termination

Option 2 removes the following:

- 01-222 Pin Depth Gage
- 01-223 Pin Depth Gage

Option 3 adds the following:

- .slp Database calibration

Option 4 adds the following:

- .slp Database calibration

Option 4 removes the following:

- 01-222 Pin Depth Gage
- 01-223 Pin Depth Gage

3653 Type N Calibration Kit consisting of:
- 23NF50 Female Short
- 23N50 Male Short
- 24NF50 Female Open
- 24N50 Male Open
- 28N50-2 Broadband Male Termination (2)
- 28NF50-2 Broadband Female Termination (2)
- 34AN50-2 Male Adapter (2)
- 34ANF50-2 Female Adapter (2)
- 01-213 Reference Gauge
- 01-224 Pin Depth Gauge
- Calibration coefficients diskette
- Calibration coefficients memory stick

3654D V Connector® Calibration Kit consisting of:
- 23V50C-5.1 Male Short 5.1 mm
- 23VF50C-5.1 Female Short 5.1 mm
- 24V50C Male Open
- 24VF50C Female Open
- 28V50D Male Broadband Termination (2)
- 28VF50D Female Broadband Termination (2)
- 33VV50C Male-Male Adapter*
- 33VFVF50C Female-Female Adapter (2)*
- 33VVF50C Male-Female Adapter (2)*
- Calibration coefficients diskette
- Connector thumb wheel (4)
- 01-201 Torque Wrench
- 01-210 Reference Flat
- 01-322 Pin Depth Gauge
- 01-323 Female Adapter for pin gauge
- 01-204 Adapter Wrench
- 01-312 Male Flush Short
- 01-311 Female Flush Short
- Calibration coefficients memory stick

Option 2 removes the following:
- 01-322 Pin Depth Gage
- 01-323 Pin Depth Gage

Option 3 Adds the following:
- .slp Database calibration

Option 4 adds the following:
- .slp Database calibration

Option 4 removes the following:
- 01-322 Pin Depth Gage
- 01-323 Pin Depth Gage

3655 Series Waveguide Calibration Kit

The 3655 Series Calibration Kit contains all of the precision components and tools required to calibrate your VNA for 12-term error-corrected measurements of test devices with the appropriate waveguide designation. Components are included for calibrating both module ports. The kit supports calibration with offset shorts and broadband loads. Option 1 adds a sliding termination.

Consisting of:
- 3-1091-302 Short, Flush (2)
- 3-1091-223 SHORT, OFFSET, 3/8WAVE
- 3-1091-222 SHORT, OFFSET, 1/8WAVE
- 3-B27394-3 Terminations, Fixed (2)
- Test Port Sections (2)

Option 1 adds the following:
- Sliding Termination

3656B W1 Calibration/Verification Kit consisting of:
- 23W50-1 Male Offset Short (2.02 mm)
- 23W50-2 Male Offset Short (2.65 mm)
- 23W50-3 Male Offset Short (3.180 mm)
- 24W50 Male Open (1.510 mm)
- 28W50 Male Broadband Termination
- 23WF50-1 Female Offset Short 1 (2.02 mm)
- 23WF50-2 Female Offset Short 2 (2.65 mm)
- 23WF50-3 Female Offset Short 3 (3.180 mm)
- 28WF50 Female Broadband Termination
- 24WF50 Female Open (1.930 mm)
- 33WSC50 Fixed Male SC Connector
- 33WFSC50 Fixed Female SC Connector
- Interchangeable Sliders, SC Connectors
- Locking Keys, SC Connectors
- 01-402 Interchange Adapter Fixed Male
- 33WWF50 Male-Female Adapter
- 33WW50 Male-Male Adapter
- 33WFWF50 Female-Female Adapter
- 01-504 6 mm Torque Wrench
- 01-505 6-7 mm End Wrench
- 18WWF50-1B Stepped Impedance Thruline (Verification Device)
- 18WWF50-1 50Ω Matched Thruline (Verification Device)
- Calibration coefficients diskette
- Calibration coefficients memory stick

Verification Kits

For Confirming Accuracy of Vector Network Analyzers

3669B

The Anritsu Verification Kits contain precision components with characteristics that are traceable to NIST. Used primarily by the metrology laboratory, these components provide the most dependable means of determining the system accuracy of your VNA. A USB memory device containing factory measured test data for all components is supplied for comparison with customer-measured data.

3663-1 Type N Verification Kit consisting of:

- 42N-50, 50 dB Attenuator
- 18N50-10, 10 cm Airline
- 42N-20, 20 dB Attenuator
- 18N50-10B, 10 cm Stepped Impedance Airline (Beatty standard)
- Verification Kit USB Memory Device containing PVS (Product Verification Software) Application

3666-1 SMA/3.5 mm Verification Kit consisting of:

- 19S50-7, 7.5 cm Airline
- 19S50-7B, 7.5 cm Stepped Impedance Airline (Beatty standard)
- 42S-50, 50 dB Attenuator
- 42S-20, 20 dB Attenuator
- Verification Kit USB Memory Device containing PVS (Product Verification Software) Application

3668-1 K Connector® Verification Kit consisting of:

- 19K50-7, 7.5 cm Airline
- 42K-50, 50 dB Attenuator
- 42K-20, 20 dB Attenuator
- 19K50-7B, 7.5 cm Stepped Impedance Airline (Beatty standard)
- Verification Kit USB Memory Device containing PVS (Product Verification Software) Application

3669B-1 V Connector® Verification Kit consisting of:

- 42V-50, 50 dB Offset attenuator
- 42V-20, 20 dB Offset attenuator
- 19V50-5, 5 cm Airline
- 19V50-5B, 5 cm Stepped Impedance Airline (Beatty standard)
- Verification Kit USB Memory Device containing PVS (Product Verification Software) Application

W1 (1.0 mm) Verification Components are included in W1 Calibration kit and Verification Kit (3656B).

See previous section for details.

EU Standards (CE Marking)

2011/65/EU

O/E Calibration Module

MN4765B

70 kHz to 110 GHz range, with 1310 nm and 1550 nm wavelength coverage

Fast and Accurate Optoelectronic Measurements

The MN4765B is a characterized, unamplified photodiode module. It is used as an optical receiver with the VectorStar™ VNAs MS4640B Series VNA, and ShockLine MS46122A/B, MS46322A/B and MS4652xB Series VNA to perform highly accurate and stable optoelectronic measurements of both modulators (E/O) and photoreceivers (O/E). Model MN4765B is the base calibration module part number only. Customers are required to also order an option to configure the bandwidth and wavelength coverage. These options consist of an InGaAs photodiode that converts modulated optical signals to electrical signals, and includes additional circuitry for temperature and bias stability. Available configuration options are:

- MN4765B-0070 (Option 70) Configured for 70 kHz to 70 GHz range, with 1550 nm wavelength coverage.
- MN4765B-0071 (Option 71) Configured for 70 kHz to 70 GHz range, with 1310 nm wavelength coverage.
- MN4765B-0072 (Option 72) Configured for 70 kHz to 70 GHz range, with 1310 and 1550 nm wavelength coverage.
- MN4765B-0110 (Option 110) Configured for 70 kHz to 110 GHz range, with 1550 nm wavelength coverage.

Calibration Options

MN4765B-0098 (Option 98) Standard Calibration

Standard Calibrations provide a Certificate of Calibration which certifies that the product has been calibrated in compliance with a quality system registered to ISO 9001:2000, and in compliance with ISO/IEC 17025-2005 and ANSI/NCSL Z540-1-1994 (R2002). It lists the measurement standards used in the calibration of the new equipment, the test procedure and its revision, as well as the environmental conditions.

MN4765B-0099 (Option 99) Premium Calibration

Premium calibration includes everything provided with a Standard Calibration plus Test Data showing actual measured values.
The test data provided varies by product complexity.

Key Features

Fast and Accurate Optoelectronic Measurements

The VectorStar and Shockline VNA Series, when calibrated using the MN4765B module, enable error-corrected Transfer Function, Group Delay, and Return Loss measurements of E/O, O/E and O/O components and subsystems.

National Institute of Standards and Technology Derived Characterization

Magnitude and phase characterization is obtained using a primary standard characterized by NIST or other National Metrology Institutes and held in the Anritsu Calibration Lab. The magnitude and phase data is provided on a USB drive with the module.

Temperature Stable

The MN4765B is thermally stabilized to eliminate drift in photodiode performance over temperature.

Internal Biasing

Accurate bias voltage to the photodiode is maintained internally.
An external, multi-country, AC adapter is included for easy operation.

High Linearity

Linear operating range to +6 dBm (+3 dBm for MN4765B-004x) for transfer function measurement uncertainties of:
<0.5 dB at 40 GHz
(Typical specifications for MN4765B-0043 at 1550 or 1310 nm)
<1 dB at 40 GHz
(Typical specifications for MN4765B-004x at 850 nm)
<2 dB at 40 GHz
(Typical specifications for MN4765B-0042 and MN4765B-0043 at 1060 nm)
<0.45 dB at 50 GHz and <0.7 dB at 70 GHz
(Typical specifications for MN4765B-0070 and MN4765B-0072 at 1550 nm)
<0.35 dB at 40 GHz and <1 dB at 70 GHz
(Typical specifications for MN4765B-0071 and MN4765B-0072 at 1310 nm)
<0.5 dB at 70 GHz and <0.75 dB at 110 GHz
(Typical specifications for MN4765B-0110)

High Responsivity

>0.2 A/W for MN4765B-0040 at 850 nm (Typical specification)
>0.2 A/W for MN4765B-0042 at 850 nm and >0.6 A/W at 1060 nm (Typical specification)
>0.2 A/W for MN4765B-0043 at 850 nm, >0.6 A/W at 1060 nm, >0.7 A/W at 1310 nm and >0.8 A/W at 1550 nm (Typical spec.)
>0.7 A/W for MN4765B-0070 (Typical specification)
>0.45 A/W for MN4765B-0071 (Typical specification)
>0.45 A/W for MN4765B-0072 at 1310 nm (Typical specification)
>0.65 A/W for MN4765B-0072 at 1550 nm (Typical specification)
>0.5 A/W for MN4765B-0110 (Typical specification)

Typical Specifications*1

MN4765B-0040	Frequency Range	70 kHz to 40 GHz
	Operating Wavelength Range	800 nm to 900 nm
	Characterized Wavelength	850 nm ±20 nm
	Linear Optical Input Power	<3 dBm
	Maximum Optical Input PTD-SCDMA Simulation Softwareower	7 dBm
	Electrical Return Loss	<–10 dB at <18GHz <–3 dB from 18 GHz to 40 GHz
	Optical Return Loss	<–20 dB
	DC Responsivity	>0.2 A/W (850 nm ±20 nm)
	RF OUT Connector	K male (2.92 mm)
MN4765B-0042	Frequency Range	70 kHz to 40 GHz
	Operating Wavelength Range	800 nm to 1100 nm
	Characterized Wavelength	850 nm ±20 nm, 1060 nm ±20 nm
	Linear Optical Input Power	<3 dBm
	Maximum Optical Input Power	7 dBm
	Electrical Return Loss	<–10 dB at <18 GHz < –3 dB from 18 GHz to 40 GHz
	Optical Return Loss	<–20 dB
	DC Responsivity	>0.2 A/W (850 nm ±20 nm), > 0.6 A/W (1060 nm ±20 nm)
	RF OUT Connector	K male (2.92 mm)
MN4765B-0043	Frequency Range	70 kHz to 40 GHz
	Operating Wavelength Range	800 nm to 1700 nm
	Characterized Wavelength	850 nm ±20 nm, 1060 nm ±20 nm, 1319 nm ±20 nm, and 1550 nm ±20 nm
	Linear Optical Input Power	<3 dBm
	Maximum Optical Input Power	7 dBm
	Electrical Return Loss	<–10 dB at <18 GHz <–3 dB from 18 GHz to 40 GHz
	Optical Return Loss	<–20 dB
	DC Responsivity	>0.2 A/W (850 nm ±20 nm), >0.6 A/W (1060 nm ±20 nm), >0.7 A/W (1310 nm ±20 nm), and >0.8 A/W (1550 nm ±20 nm)
	RF OUT Connector	K male (2.92 mm)
MN4765B-0070	Frequency Range	70 kHz to 70 GHz
	Operating Wavelength Range	1480 nm to 1620 nm
	Characterized Wavelength	1550 nm ±20 nm
	Linear Optical Input Power	<6 dBm
	Maximum Optical Input Power	10 dBm
	Electrical Return Loss	<–8 dB at <50 GHz <–5 dB from 50 GHz to 70 GHz
	Optical Return Loss	<–24 dB
	DC Responsivity	>0.7 A/W (1550 nm ±20 nm)
	RF OUT Connector	V male (1.85 mm)
MN4765B-0071	Frequency Range	70 kHz to 70 GHz
	Operating Wavelength Range	1300 nm to 1330 nm
	Characterized Wavelength	1319 nm ±10 nm
	Linear Optical Input Power	<6 dBm
	Maximum Optical Input Power	10 dBm
	Electrical Return Loss	<–8 dB at <50 GHz <–5 dB from 50 GHz to 70 GHz
	Optical Return Loss	<–24 dB
	DC Responsivity	>0.45 A/W (1319 nm ±10 nm)
	RF OUT Connector	V male (1.85 mm)
MN4765B-0072	Frequency Range	70 kHz to 70 GHz
	Operating Wavelength Range	1300 nm to 1330 nm and 1530 nm to 1620 nm
	Characterized Wavelength	1319 nm ±10 nm and 1550 nm ±20 nm
	Linear Optical Input Power	<6 dBm
	Maximum Optical Input Power	10 dBm
	Electrical Return Loss	<–8 dB at <50 GHz <–5 dB from 50 GHz to 70 GHz
	Optical Return Loss	<–24 dB
	DC Responsivity	>0.45 A/W (1319 nm ±10 nm) and >0.65 A/W (1550 nm ±20 nm)
	RF OUT Connector	V male (1.85 mm)

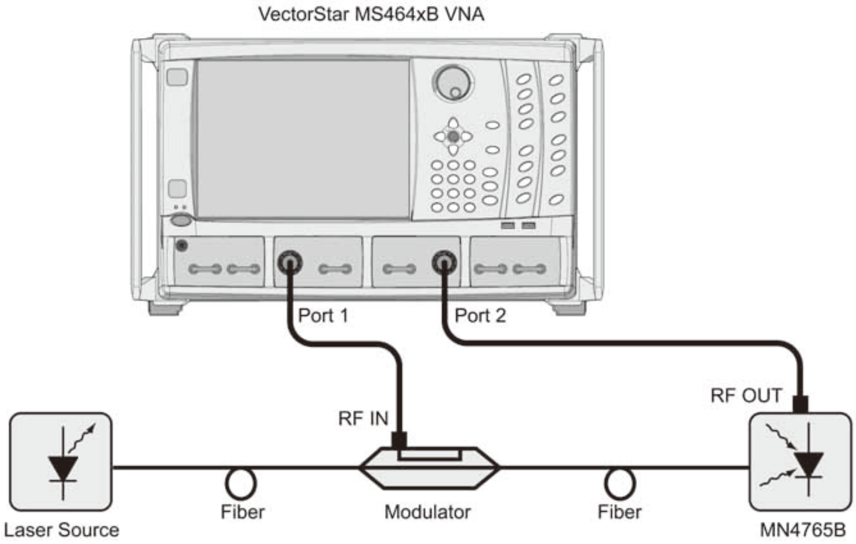
Continued on next page

MN4765B-0110	Frequency Range	70 kHz to 110 GHz
	Operating Wavelength Range	1480 nm to 1620 nm
	Characterized Wavelength	1550 nm ±20 nm
	Linear Optical Input Power	<6 dBm
	Maximum Optical Input Power	10 dBm
	Electrical Return Loss	<–6 dB at <50 GHz <–4 dB from 50 GHz to 110 GHz
	Optical Return Loss	<–24 dB
	DC Responsivity	>0.5 A/W (1550 nm ±20 nm)
	RF OUT Connector	W male (1.0 mm)
General Specifications	Optical IN	FC/APC
	AC Adapter	100 V to 240 V (50 Hz to 60 Hz) input, +12 VDC output
	Power LED	On when the AC adapter is plugged in and the internal photodiode is properly biased
	Operate LED	On when the module's internal temperature has stabilized at an optimum temperature for accurate calibrations and measurements
	Dimensions	51 (W) × 33 (H) × 127 (D) mm (2.0 (W) × 1.3 (H) × 5.0 (D) in)
Environmental Specifications	Calibrated temperature	23° ± 3°C
	Operating Temperature	+18° to +28°C
	Storage Temperature	–20° to +70°C (–15° to +60°C for -004x)
	Relative Humidity	5 to 95%
	CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN61010-1 RoHS: 2011/65/EU

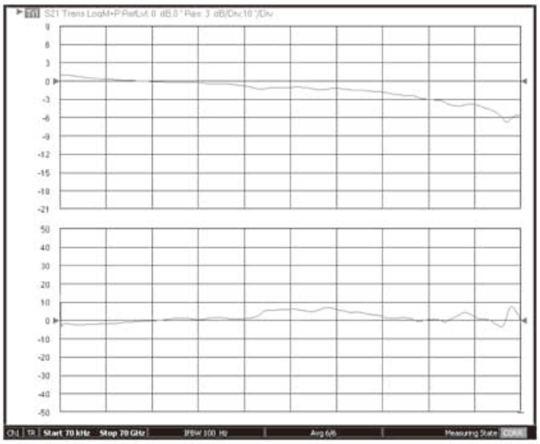
*1: Typical specifications represent the measured performance of an average unit. They do not include guard-bands and are not covered by the product warranty.

MN4765B Measurement Setup and Module Frequency Response

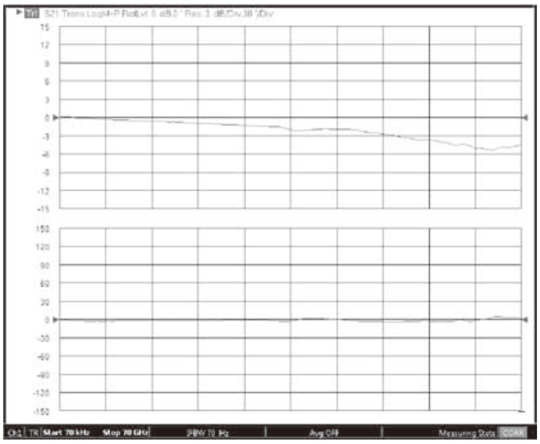
Full frequency use of the Option 70/71/72 module requires a MS4647B 70 GHz VNA although lower frequency VNAs can be used for their portion of the MN4765B-0070/-0071/-0072 frequency range and for all of the MN4765B-0040/0042/0043 frequency range. Full use of the frequency range of the Option 110 module requires a ME7838x broadband system. Below is an example of the general E/O or O/E measurement setup. Frequency response traces for the different options are shown below.



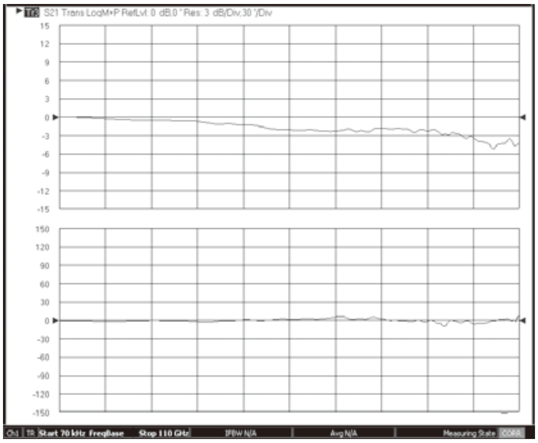
MN4765B Frequency Response Measurement Setup (Refer to Application Note 11410-00798)



Example of Frequency Response –
Option 70, 1550 nm (MN4765B-0070)



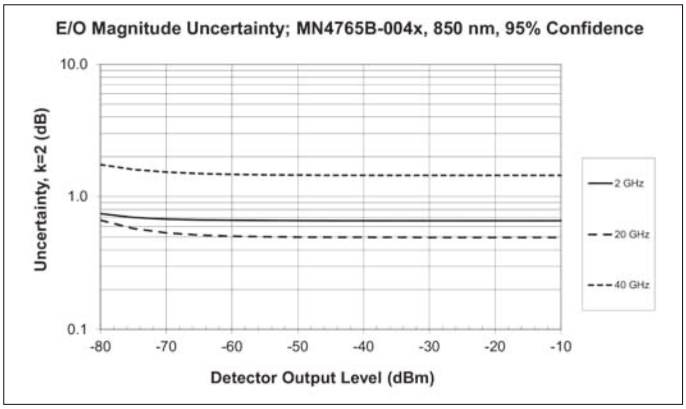
Example of Frequency Response –
Option 71 or Option 72 at 1310 nm (MN4765B-0071/0072)

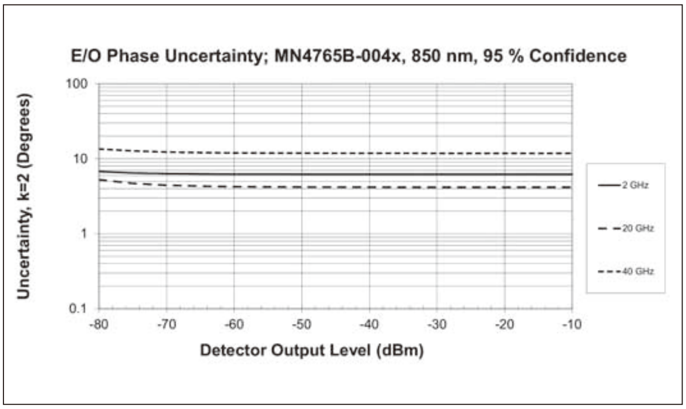


Example of Frequency Response –
Option 110, 1550 nm (MN4765B-0110)

Measurement Uncertainties for Option 40, Option 42, or Option 43 (850 nm)

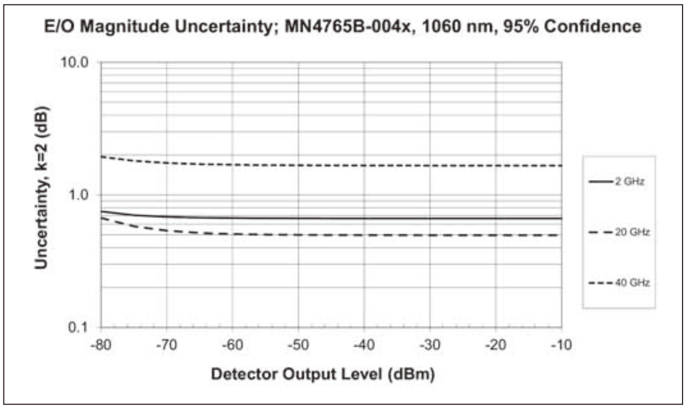
Uncertainty curves apply for temperatures of 23° ±3°C (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95% confidence interval. Analysis based on a 9 µm fiber connecting devices.
See the section: "Notes on Multimode Operation" for information on use with large core diameters.

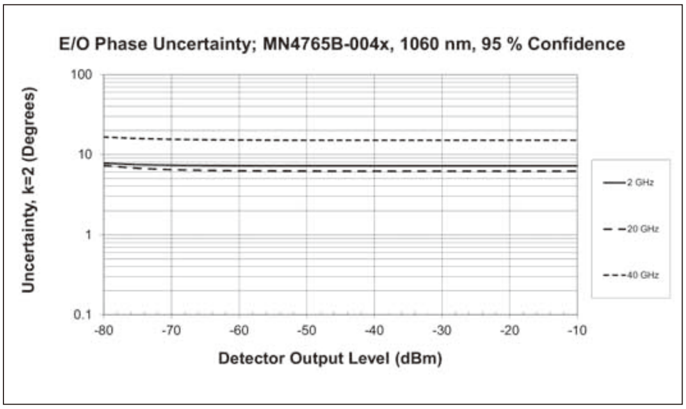




Measurement Uncertainties for Option 42, or Option 43 (1060 nm)

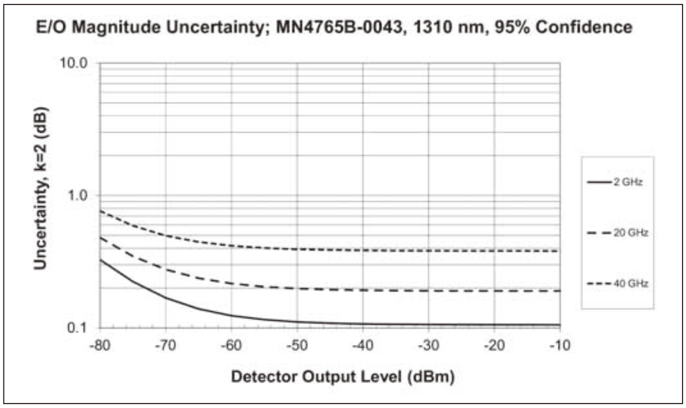
Uncertainty curves apply for temperatures of 23° ±3°C (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95% confidence interval. Derived from interpolation and wavelength dependence information. Analysis based on a 9 µm fiber connecting devices. See the section: "Notes on Multimode Operation" for information on use with large core diameters.

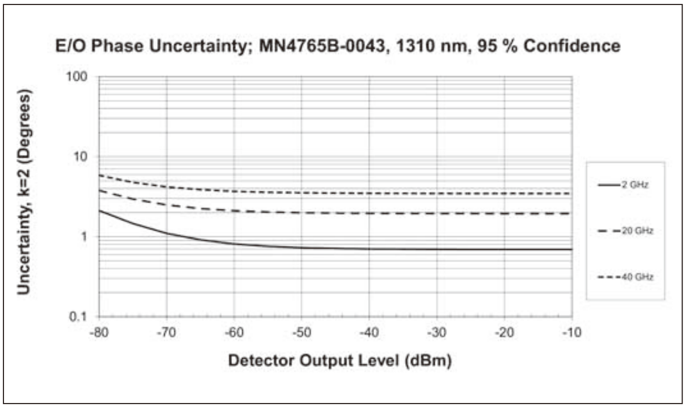




Measurement Uncertainties for Option 43 (1310 nm)

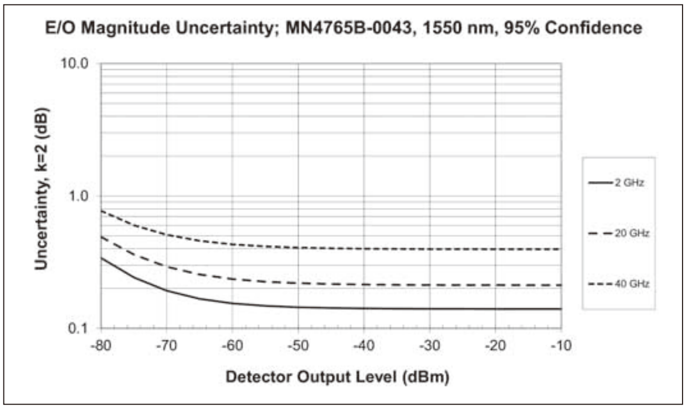
Uncertainty curves apply for temperatures of 23° ±3°C (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95% confidence interval.

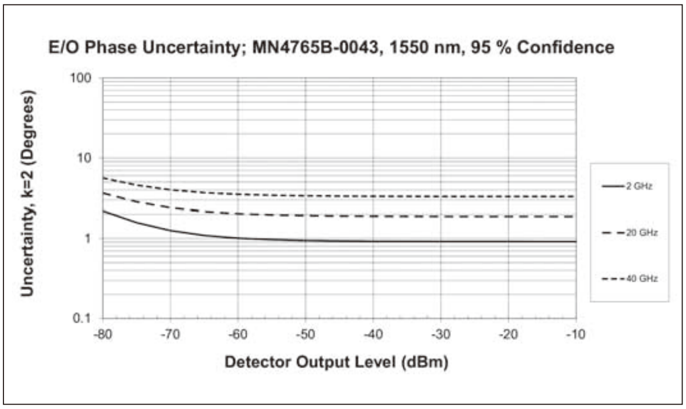




Measurement Uncertainties for Option 43 (1550 nm)

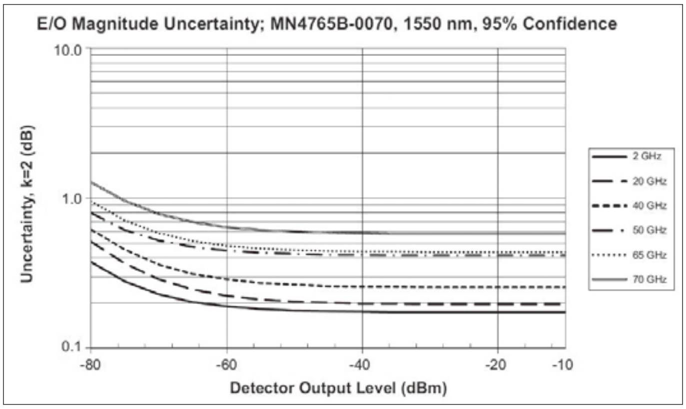
Uncertainty curves apply for temperatures of 23° ±3°C (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95% confidence interval.

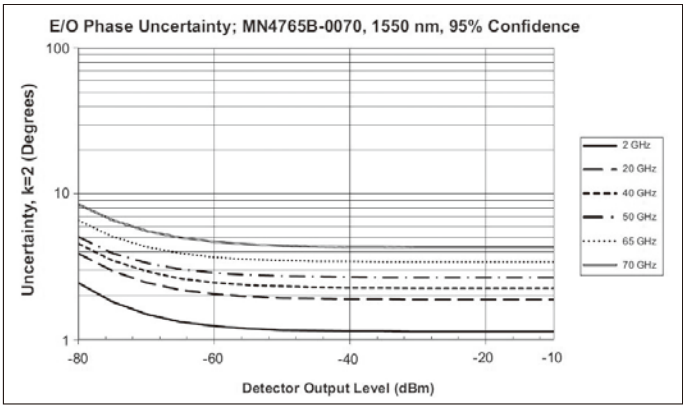




Measurement Uncertainties for Option 70 or Option 72 (at 1550 nm)

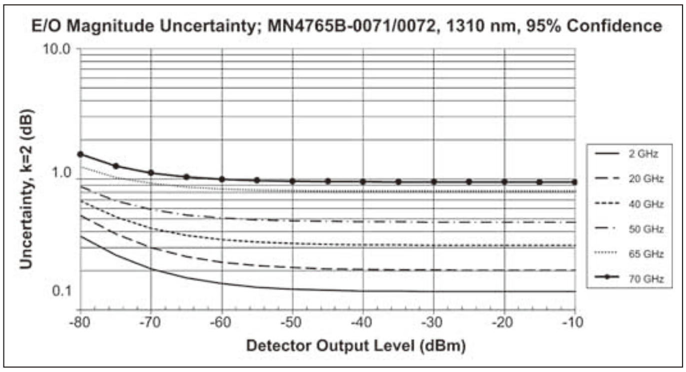
Uncertainty curves apply for temperatures of 23° ±3°C (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95% confidence interval.

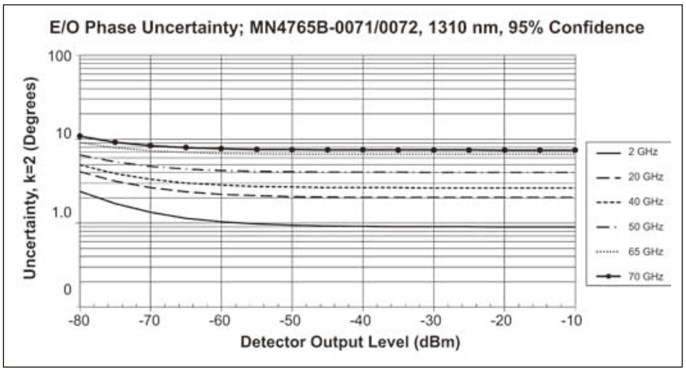




Measurement Uncertainties for Option 71 or Option 72 (at 1310 nm)

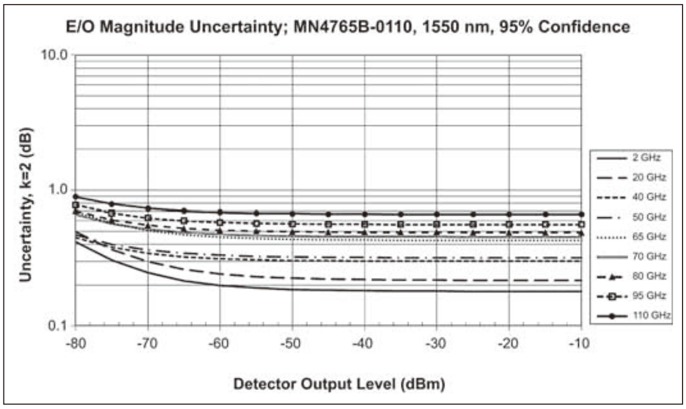
Uncertainty curves apply for temperatures of 23° ±3°C (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95% confidence interval. Magnitude uncertainty values above 40 GHz and phase uncertainty values are based on a 1550-1310 nm transfer model.

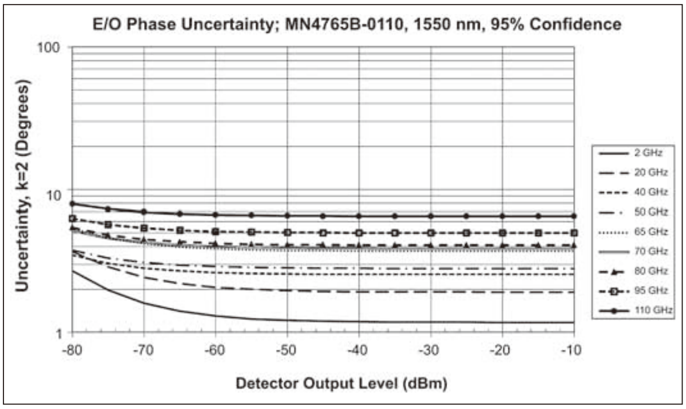




Measurement Uncertainties for Option 110 (at 1550 nm)

Uncertainty curves apply for temperatures of 23° ±3°C (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95% confidence interval.





Find Drivers, Utilities, Software Updates, and other Helpful Tools at the VectorStar Users Site visit:
https://www.anritsu.com/en-us/test-measurement/products/users-site

Training at Anritsu

Anritsu has designed courses to help you stay up to date with technologies important to your job.
For available training courses, visit: www.anritsu.com/training

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Options
MN4765B-0040	Configured for 70 kHz to 40 GHz range, with 850 nm wavelength coverage.
MN4765B-0042	Configured for 70 kHz to 40 GHz range, with 800 nm wavelength coverage.
MN4765B-0043	Configured for 70 kHz to 40 GHz range, with 800 nm wavelength coverage.
MN4765B-0070	Configured for 70 kHz to 70 GHz range, with 1550 nm wavelength coverage.
MN4765B-0071	Configured for 70 kHz to 70 GHz range, with 1310 nm wavelength coverage.
MN4765B-0072	Configured for 70 kHz to 70 GHz range, with 1310 nm and 1550 nm wavelength coverage.
MN4765B-0110	Configured for 70 kHz to 110 GHz range, with 1550 nm wavelength coverage.

ShockLine™ 2-Port and 4-Port SmartCal Calibration Units

MN252x8A SmartCal™ and MN254x8A SmartCal™

MN25208A: 300 kHz to 8.5 GHz, 2-Port Auto Calibration Module, MN25218A: 1 MHz to 20 GHz, 2-Port Auto Calibration Module
MN25408A: 300 kHz to 8.5 GHz, 4-Port Auto Calibration Module, MN25418A: 300 kHz to 20 GHz, 4-Port Auto Calibration Module

Remote Control
USB

Low Cost USB Automatic Calibration Units

SHOCKLINE™

The MN252x8A and MN254x8A SmartCal's are a series of 2-port and 4-port automatic calibration units covering a frequency range from 300 kHz to 20 GHz.

The MN252x8A and MN254x8A deliver automatic, fast and errorfree calibrations for any ShockLine VNA. The SmartCals automatically powers on via an USB connection and loads calibration kit coefficients from on-board memory into the ShockLine software. The SmartCals are ready to use immediately after detection by the VNA because it doesn't require warm-up. The SmartCal's improve productivity by providing easier and faster single connection calibrations. Port auto sense and port mapping feature reduce errors and make multi-port calibrations easier.

The MN252x8A and MN254x8A, along with easyTest, can also be used in guided graphical test procedures to further simplify complex calibrations.

MN252x8A and MN254x8A SmartCal™ Highlights

- Auto load of calibration kit coefficients speeds up setups and reduces calibration error.
- Auto sense determines the number of VNA ports connected preventing poor connections and calibration.
- VNA to SmartCal Port mapping increases flexibility and simplifies multiport calibrations.
- ShockLine software auto detects SmartCal providing simple and easy to use calibration software.
- No internal heater eliminates warm up time and provides a stable calibration.
- USB powered and controlled provides the convenience of a one plug interface without an external power supply.
- Single connection calibrations reduce wear and tear on connectors and cables over manual calibrations.
- Supports all ShockLine VNAs with 1-, 2-, 4-port calibration available.
- SCPI command set allows for easy integration into automated test environments.
- Automatic and fast calibrations at a low price.
- Small size provides easier use when moving between VNAs.
- Supports ShockLine Vector Network Analyzer A and B models.

VNA MS46121B Performance with SmartCal

Error-Corrected Specifications

With calibration using TOSLN50A-8 or TOSLNF50A-8 N-type connector manual calibration kits or the MN25208A SmartCal™ automatic calibration kit with connector options MN25208A-001, -002 and -003.

Frequency Range	Directivity (dB)	Source Match (dB)	Reflection Tracking (dB)
150 kHz to 4 GHz	42	35	±0.1
>4 GHz to 6 GHz	42	35	±0.2

MS46122B-010 VNA System Performance with SmartCal™

Error-Corrected Specifications

With 12-term calibration using the MN25208A SmartCal™ automatic calibration kit with connector options MN25208A-001, -002 and -003.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
1 MHz to 3 GHz	≥42	≥33	≥42	±0.15	±0.06
3 GHz to 6 GHz	≥42	≥33	≥42	±0.15	±0.08
>6 GHz to 8 GHz	≥37	≥33	≥37	±0.15	±0.08

MS46122B-010 and MS46122B-020 VNA System Performance with SmartCal™

Error-Corrected Specifications

With 12-term calibration using the MN25218A SmartCal™ automatic calibration kit.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
1 MHz to 1 GHz	≥42	≥33	≥42	±0.15	±0.06
>1 GHz to 10 GHz	≥37	≥33	≥42	±0.15	±0.1
>10 GHz to 18 GHz	≥37	≥33	≥36	±0.15	±0.1
>18 GHz to 20 GHz	≥37	≥33	≥36	±0.20	±0.15

With 12-term calibration using the MN25418A SmartCal™ automatic calibration kit.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
1 MHz to 10 MHz	≥40	≥31	≥42	±0.15	±0.20
10 MHz to 6 GHz	≥40	≥31	≥42	±0.15	±0.15
>6 GHz to 18 GHz	≥35	≥31	≥37	±0.20	±0.20
>18 GHz to 20 GHz	≥35	≥31	≥34	±0.20	±0.25

MS46322B-010 VNA System Performance with SmartCal™

Error-Corrected Specifications

With 12-term calibration using the MN25208A SmartCal™ automatic calibration kit with connector options MN25208A-001, -002 and -003.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
1 MHz to 1 GHz	≥42	≥35	≥42	±0.15	±0.06
>1 GHz to 5 GHz	≥42	≥35	≥42	±0.08	±0.08
>5 GHz to 8 GHz	≥36	≥35	≥37	±0.1	±0.08

MS46322B-010 and MS46322B-020 VNA System Performance with SmartCal™

Error-Corrected Specifications

With 12-term calibration using the TOSLK50A-20 or TOSLKF50A-20 K type connector calibration kits.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
1 MHz to 10 MHz	≥42	≥33	≥42	±0.15	±0.06
>10 MHz to 20 GHz	≥36	≥26	≥36	±0.15	±0.05

MS46322B-010 and MS46322B-020 VNA System Performance with SmartCal™

Error-Corrected Specifications

With 12-term calibration using the MN25418A SmartCal™ automatic calibration kit.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
1 MHz to 10 MHz	≥40	≥31	≥42	±0.20	±0.20
>10 MHz to 6 GHz	≥40	≥31	≥42	±0.15	±0.15
>6 GHz to 18 GHz	≥35	≥31	≥37	±0.20	±0.20
>18 GHz to 20 GHz	≥35	≥31	≥34	±0.20	±0.25

MS46522B-010 VNA System Performance with SmartCal™

Error-Corrected Specifications

With 12-term calibration using the MN25208A SmartCal™ automatic calibration kit with connector options MN25208A-001, -002 and -003.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
300 kHz to 1 GHz	>42	>35	>38	±0.15	±0.08
>1 GHz to 5 GHz	>42	>35	>38	±0.08	±0.08
>5 GHz to 8.5 GHz	>36	>35	>33	±0.10	±0.08

MS46522B-010 and MS46522B-020 VNA System Performance with SmartCal™

Error-Corrected Specifications

With 12-term calibration using the MN25218A SmartCal™ automatic calibration kit.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
300 kHz to 1 GHz	>42	>33	>42	±0.15	±0.06
>1 GHz to 10 GHz	>37	>33	>42	±0.15	±0.06
>10 GHz to 18 GHz	>37	>33	>37	±0.15	±0.10
>18 GHz to 20 GHz	>37	>33	>37	±0.20	±0.20

MS46522B-010 and MS46522B-020 VNA System Performance with SmartCal™

Error-Corrected Specifications

With 12-term calibration using the MN25418A SmartCal™ automatic calibration kit.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
300 kHz to 6 GHz	≥40	≥31	≥42	±0.15	±0.15
>6 GHz to 18 GHz	≥35	≥31	≥37	±0.20	±0.20
>18 GHz to 20 GHz	≥35	≥31	≥34	±0.20	±0.25

MS46524B-010 VNA System Performance with SmartCal™

Error-Corrected Specifications

With 12-term calibration using the MN25208A SmartCal™ automatic calibration kit with connector options MN25208A-001, -002 and -003.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
300 kHz to 1 GHz	>42	>35	>38	±0.15	±0.08
>1 GHz to 5 GHz	>42	>35	>38	±0.08	±0.08
>5 GHz to 8.5 GHz	>36	>35	>33	±0.10	±0.08

With 12-term calibration using the MN25408A SmartCal™ automatic calibration kit with option MN25408A-001, -002 and -003.

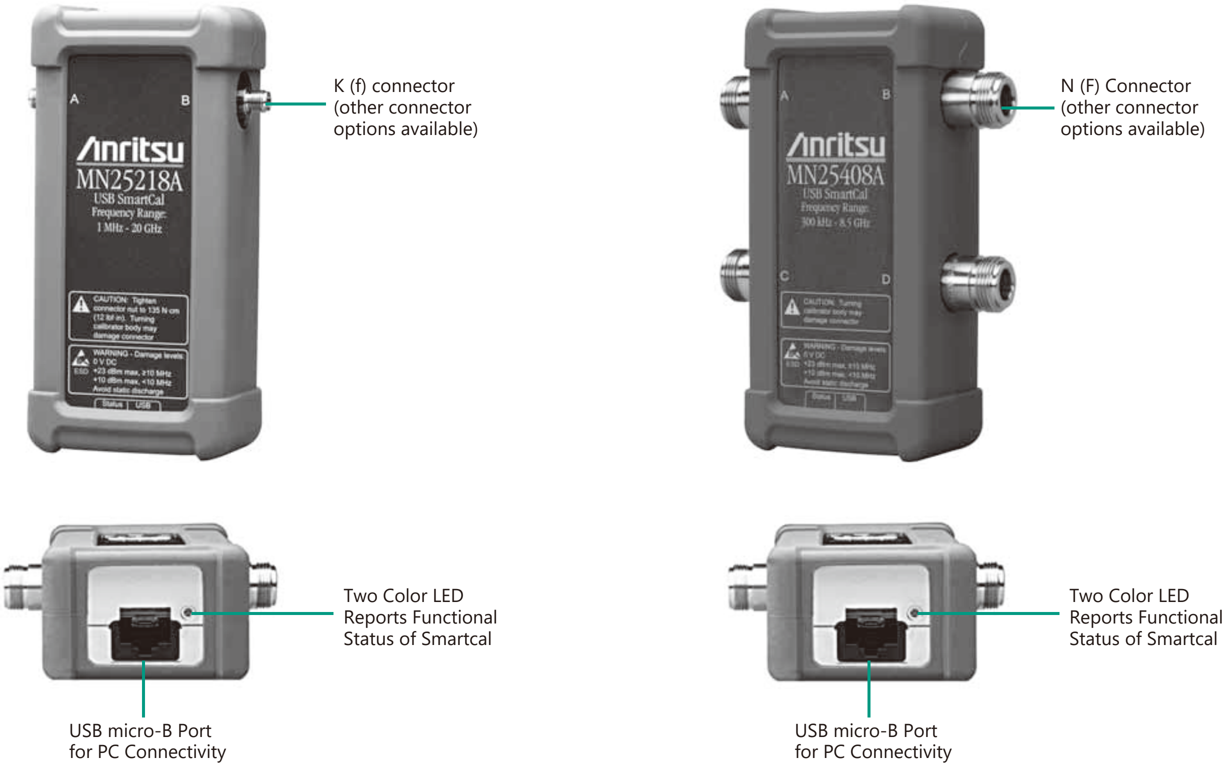
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
300 kHz to 1 GHz	>42	>35	>38	±0.15	±0.2
>1 GHz to 5 GHz	>40	>35	>38	±0.08	±0.2
>5 GHz to 8.5 GHz	>33	>32	>33	±0.10	±0.2

MS46524B-010 and MS46524B-020 VNA System Performance with SmartCal™

Error-Corrected Specifications

With 12-term calibration using the MN25418A SmartCal™ automatic calibration kit.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
300 kHz to 6 GHz	≥40	≥31	≥42	±0.15	±0.15
>6 GHz to 18 GHz	≥35	≥31	≥37	±0.20	±0.20
>18 GHz to 20 GHz	≥35	≥31	≥34	±0.20	±0.25



EU Standards (CE Marking)

EMC: 2014/30/EU, EN 61326:2013, CISPR 11/EN 55011, IEC/EN 61000-4-2/3/4/5/6/8/11
LVD: 2014/35/EU
RoHS: 2011/65/EU

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	SmartCal
MN25208A	2-port USB SmartCal Module, 300 kHz to 8.5 GHz (available with connector Options -001 N (f), -002 K (f), -003 3.5 mm (f))
MN25218A	2-port USB SmartCal Module, 300 kHz to 20 GHz (available with connector Option -002 K (f))
MN25408A	4-port USB SmartCal Module, 300 kHz to 8.5 GHz (available with connector Options -001 N (f), -002 K (f), -003 3.5 mm (f))
MN25418A	4-port USB SmartCal Module, 300 kHz to 20 GHz (available with connector Option -002 K (f))
	Recommended Accessories
01-200	Calibrated Torque End Wrench, GPC-7 and Type N
01-201	Torque End Wrench, 5/16 in, 0.9 N·m (8 lbf·in) (for tightening male devices, for SMA, 3.5 mm, 2.4 mm, K, and V connectors)
34NN50A	Precision Adapter, DC to 18 GHz, N (m) - N (m), 50Ω
K220B	Precision Adapter, DC to 40 GHz, K (m), 50Ω (MN25218A)

SIGNAL GENERATORS

Synthesizer Selection Guide (Measurement Function)

Group	Model	Functions																														Remarks
		Frequency Extensions				Level Extensions							Modulation						Others													
		8 MHz to 2 GHz	8 MHz to 2.2 GHz	0.1 Hz to 10 MHz	mmWave (50 GHz to 500 GHz) signal source	110 dB step attenuator (<20 GHz)	110 dB step attenuator (<40 GHz)	90 dB step attenuator (>40 GHz)	23-26 dBm high power (<20 GHz, with Option 15)	19 dBm high power (<40 GHz, with Option 15)	13 dBm high power (<50 GHz, with Option 15)	9 dBm high power (<60 GHz, with Option 15)	AM modulation (external)	FM/ΦM modulation (external)	Pulse modulation (external, <40 GHz)	Pulse modulation (external, >40 GHz)	For AM/FM/ΦM modulation (Internal signal source)	For pulse modulation (Internal signal source)	Low phase noise	Analog sweep	High stability time base	User-Defined Modulation Waveform Software	IF Up-conversion	Power monitor	Rear panel RF output (<40 GHz)	Rear panel RF output (>40 GHz)	Delete front panel	Scan modulation	Rack mount kit (without slides)	Rack mount kit (with slides)	Ultra-Stable Phase Tracking	
Main frame	MG3692C	✓	✓	✓	✓	✓			✓				✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	2 GHz to 20 GHz
	MG3694C	✓	✓	✓	*		✓			✓			✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	2 GHz to 40 GHz
	MG3695C	✓	✓	✓	*			✓			✓		✓	✓		✓	✓	✓	✓	✓	✓	✓		✓		✓	✓		✓	✓	✓	2 GHz to 50 GHz
	MG3697C	✓	✓	✓	*			✓				✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓		✓	✓		✓	✓	✓	2 GHz to 67 GHz (setting range: 2 GHz to 70 GHz)
Options	1A																												✓			Either selection
	1B																													✓		
	2A					✓																										Choose corresponding to main frame frequency range
	2B						✓																									
	2C							✓																								
	3																		✓													Ultra and premium versions available. Consult the TDS for more information
	4		✓																													For MG37022A, starts at 10 MHz
	5	✓																														
	6																			✓												When used with Option 4, analog sweep capability is limited to ≥500 MHz
	7																						✓									<40 GHz model: cannot be combined with Option 18, 20, or 36
	8																							✓								Not available with Option 9
	9A																								✓							Not available with Option 8
	9B																									✓						
	10																					✓										Requires Option 27
	12													✓																		For internal modulation capability, requires addition of a LF Generator, Option 27
	14												✓																			
	15A								✓																							Choose corresponding to main frame frequency range
	15B									✓																						
	15C										✓																					
	15D											✓																				
	16																				✓											
	17																										✓					Only available with Options 1A or 1B
	18																															(for MG369xC) DC Output supplying +15 VDC, 1A (nominal). Not available with Option 7 or 15x
	20																											✓				Not available on models >20 GHz or with Options 2E, 7, 15x, or 22
	22			✓																												No modulation available in this frequency band
	26A														✓																	Choose corresponding to main frame frequency range. For MG3690C and internal modulation capability, requires addition of Option 27
	26B															✓																
	27																✓	✓														For MG3690C, provides modulation waveforms for internal AM (with Option 14), FM (with Option 12), ΦM (with Option 12) and Pulse (with Option 26). Not available without Option 12, 14, or 26
	28A												✓	✓	✓		✓	✓														Choose corresponding to main frame frequency range
	28B												✓	✓		✓	✓	✓														
	36																														✓	Requires Option 3 or 3X. Not available with Option 7 or with both Option 18 and 20 together

*: The maximum of frequency required for frequency extension to mm Wave is 20 GHz.

Model	Frequency Range	Output Level Range	Harmonics	Non-harmonics	SSB Phase Noise (CW 1 GHz, 20 kHz offset)	Amplitude Modulation	Frequency Modulation	Pulse Modulation	Sine-wave	Triangular-wave	Square-wave	Sawtooth-wave	Mass
MG3740A (Option 032/062)	100 kHz to 2.7 GHz	−110 to +17 dBm [Standard] −144 to +25 dBm [Option]	<−30 dBc	<−68 dBc (187.5 MHz < f ≤ 750 MHz)	−131 dBc/Hz (typ.)	✓	✓	✓	✓	Option	Option	Option	≤13.7kg
MG3740A (Option 034/064)	100 kHz to 4 GHz												
MG3740A (Option 036/066)	100 kHz to 6 GHz												

Synthesizer Selection Guide (Frequency Range)

Group	Model	Frequency Range																										Remarks
		0.1 Hz	1 Hz	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	2 MHz	5 MHz	10 MHz	20 MHz	50 MHz	100 MHz	200 MHz	500 MHz	1 GHz	2 GHz	5 GHz	10 GHz	20 GHz	50 GHz	100 GHz	200 GHz	300 GHz	500 GHz	
Main frame	MG3692C																		▬	▬	▬							2 GHz to 20 GHz
	MG3694C																		▬	▬	▬	▬						2 GHz to 40 GHz
	MG3695C																		▬	▬	▬	▬						2 GHz to 50 GHz
	MG3697C																		▬	▬	▬	▬	▬					2 GHz to 67 GHz
Options	4											▬	▬	▬	▬	▬	▬	▬										8 MHz to 2.2 GHz
	5											▬	▬	▬	▬	▬	▬	▬										8 MHz to 2 GHz
	22	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬																	0.1 Hz to 10 MHz
	2000-1694-15-R																						▬					50 GHz to 75 GHz
	2000-1694-12-R																						▬					60 GHz to 90 GHz
	2000-1694-10-R																						▬	▬				75 GHz to 110 GHz
	2000-1694-08-R																							▬				90 GHz to 140 GHz
	2000-1694-06-R																							▬				110 GHz to 170 GHz
	2000-1694-05-R																							▬	▬			140 GHz to 220 GHz
	2000-1694-03-R																								▬	▬		220 GHz to 325 GHz
	2000-1694-02-R																									▬		325 GHz to 500 GHz

Model	Frequency Range																		Remarks
	0.1 Hz	1 Hz	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	10 MHz	20 MHz	30 MHz	50 MHz	100 MHz	1 GHz	2 GHz	3 GHz	5 GHz	10 GHz	
MG3740A (Option 032/062)							▬	▬	▬	▬	▬	▬	▬	▬	▬				100 kHz to 2.7 GHz
MG3740A (Option 034/064)							▬	▬	▬	▬	▬	▬	▬	▬	▬	▬			100 kHz to 4 GHz
MG3740A (Option 036/066)							▬	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬		100 kHz to 6 GHz

RF/Microwave Signal Generator

MG3690C Series

0.1 Hz to 70 GHz/500 GHz

Remote Control
GPIB | **LAN**

The Ideal Microwave Signal Generator

Value Without Compromise

Your microwave signal generation requirements have never been tougher, and yet your capital equipment budget has never been tighter. You need the most value you can get in a synthesizer, but you can't compromise performance. You need a synthesizer that meets today's needs yet can be upgraded at a reasonable cost to satisfy future requirements without shattering your test equipment budget. Anritsu's MG3690C series of synthesizers deliver the highest performance and the highest value available today.

Key Features

Basic CW Generators configurable to full-featured Signal Generators.

- Broad Frequency Coverage, in a Single Output: 0.1 Hz to 70 GHz
  - Four Models, 2 to 20, 40, 50 and 67 GHz (operational to 70 GHz)
  - 8 MHz Coverage Optional (Analog or Digital Down-Conversion)
  - 0.1 Hz Coverage Optional
- mmW Coverage up to 500 GHz, in Waveguide
- Ultra-Low SSB Phase Noise Option
- –109 dBc/Hz (typ.) at 1 kHz Offset, 10 GHz Carrier
- Excellent Harmonics and Spurious Response
- High Output Power Option
  - +26 dBm to 10 GHz
  - +23 dBm to 20 GHz
  - +19 dBm to 40 GHz
  - +9 dBm to 67 GHz
- CW and Step Sweep Modes; Analog Sweep Optional
- <5 ms Switching Time (typ.) for <100 MHz steps
- 0.01 Hz standard Frequency Resolution
- Phase Offset Capability
- AM, FM/ΦM Modulations Optional
  - Internal LF Generator Optional
- Pulse Modulation Optional
  - 100 ns Leveled Width, ≥1 GHz
  - Internal Pulse Generator Optional
- IF Up-Conversion Option, for IQ Modulation Solutions
- Intuitive, Menu-driven Front Panel
- Proven Reliability with 3 Year Standard Warranty
- Completely Configurable and Upgradable

High Performance Signal Generators

The ultimate in full-function signal generation, including comprehensive, high-performance modulation for signal simulation applications. Additional features in these units include:

- Internal pulse generator with swept delay capability for moving target simulation
- Flexible pulse triggering including free-run, delayed, gated, and composite
- 0 to 90% AM, log or linear over DC to 100 kHz rates
- Four FM modes for up to 10 MHz deviation at 8 MHz rates or 100 MHz deviation at 100 Hz rates
- Phase modulation (ΦM) up to 400 radians deviation at 1 MHz rates
- Internal AM, FM, and ΦM generators, each with 7 modulating waveforms
- Optional user-defined complex modulation

Automatic Test Equipment

The MG3690C is an ideal signal generator for an ATE system. It packs the highest performance in a 13.3 cm (3u) package with a 450 mm depth that minimizes rack space. High output power assures adequate signal strength to the device under test, even after ATE switching and cabling losses. Accurately leveled output power to –115 dBm in 0.01 dB steps facilitates receiver sensitivity measurements. Fast 5 ms switching time maximizes system throughput. Internal list mode frees the A.T.E. controller to perform measurement analysis tasks. Free application drivers, including the IVI-COM driver and National Instruments LabView® drivers, save you time and money in code generation and maintenance. For additional cost savings, Option 17 eliminates the complete front panel, including circuitry.

Interchangeable Virtual Instruments Standard

The IVI Foundation defines a standard instrument driver model that enables instrument interchangeability and interoperability without software changes. Anritsu's IVI-driver supported synthesizer minimizes instrument development and maintenance cost through the use of IVI-standard interfaces as well as instrument-specific interfaces for unique instrument features. The IVI standard provides a single driver that supports the common application development environments such as Visual Basic, Visual C++, and Labview.

Anritsu Corporation leads the way with IVI technology, having released the first COM-based IVI driver supporting the Signal Generator instrument class, and includes the driver with every MG3690C series synthesizer. As an active member of the IVI Foundation, Anritsu supports the Foundation's drive toward instrument driver standardization as a powerful means of delivering interchangeable ATE instrumentation solutions.

Specifications

For detailed and most up-to-date specifications, please refer to the MG3690C data sheet, p/n 11410-00515. The latest version of this data sheet is available for down-loading in pdf format from the MG3690C product page on the Anritsu website www.anritsu.com.

CW Mode	Accuracy	Same as internal or external 10 MHz time base
	Internal Time Base Stability	With Aging: $<2 \times 10^{-9}$/day ($<5 \times 10^{-10}$/day with Option 16) With Temperature: $<2 \times 10^{-8}$/°C over 0 to 55°C ($<2 \times 10^{-10}$/°C with Option 16)
	Resolution	0.01 Hz
	Internal Time Base Calibration	The internal time base can be calibrated via the System Cal menu to match an external reference (10 MHz ±50 Hz).
	External 10 MHz Reference Input	Accepts external 10 MHz ±50 Hz (typ.), 0 to +20 dBm time base signal. Automatically disconnects the internal high-stability time-base option (if installed) Rear panel BNC (50Ω impedance) Selectable bandwidth for best phase noise immunity or best phase tracking performance
	10 MHz Reference Output	1 Vp-p into 50Ω, AC coupled. Rear panel BNC (50Ω impedance)
	Phase Offset	Adjustable in 0.1° steps
	Electronic Frequency Control (EFC) Input	–4 V to +4 V input range 0.2 ppm/V (typ.) sensitivity (0.08 ppm/V (typ.) for Option 3x) ≤250 Hz modulation bandwidth Rear panel BNC (high impedance)
Phase-locked Step Sweep Mode	Sweep Width	Independently selected, 0.01 Hz to full range. Every frequency step in sweep range is phase-locked
	Accuracy	Same as internal or external 10 MHz time base
	Resolution (Minimum Step Size)	0.01 Hz
	Linear/Log Sweep	User-selectable linear or log sweep. In log sweep, step size logarithmically increases with frequency
	Steps	User-selectable number of steps or the step size
	Number of Steps	Variable from 1 to 10,000
	Step Size	0.01 Hz to the full frequency range of the instrument. If the step size does not divide into the selected frequency range, the last step is truncated.
	Dwell Time per Step	Variable from 1 ms to 99 s
	Fixed Rate Sweep	Variable from 20 ms to 99 s Allows the user to set the total time of the sweep, including lock time.
Alternate Sweep Mode		Sweeps alternately in step sweep between any two sweep ranges. Each sweep range may be associated with a power level.
Analog Sweep Mode (Option 6)	Sweep Width	Independently selected from 1 MHz to full frequency range For units with Option 4 (Digital Down Converter), the start frequency during analog sweep is limited to ≥2.2 GHz for stop frequencies >20 GHz. For stop frequencies ≤ 20 GHz, the start frequency is limited to ≥500 MHz. A range error will be displayed if any of these analog sweep start/stop limits are exceeded. Analog sweep is not available < 10 MHz with Option 22.
	Accuracy	The lesser of ±30 MHz or ±2 MHz + 0.25% of sweep width for sweep speeds of ≤50 MHz/ms (typ.).
	Sweep Time Range	30 ms to 99 s
Manual Sweep Mode		Provides stepped, phase-locked adjustment of frequency between sweep limits. User-selectable number of steps or step size.
List Sweep Mode		Under GPIB or Ethernet control, or via the front panel, up to 4 tables with 2000 non-sequential frequency/power sets can be stored and then addressed as a phase-locked step sweep. One table of 2000 points is stored in non-volatile memory. All other tables are stored in volatile memory.
Programmable Frequency Agility		Under GPIB or Ethernet control, up to 3202 non-sequential frequency/power sets can be stored and then addressed as a phase-locked step sweep. Data is stored in volatile memory.
Markers	Up to 20 independent, settable markers (F0 to F9 and M0 to M9)	
	Video Markers	+5 V or –5 V marker output, selectable from system menus. AUX I/O connector, rear panel
	Marker Accuracy	Same as sweep frequency accuracy
	Intensity Markers	Produces an intensity dot on analog display traces, obtained by a momentary dwell in RF sweep, in analog sweeps of <1 second.
	Marker Resolution	Analog Sweep: 1 MHz or Sweep Width/4096, which ever is greater Step Sweep: 0.01 Hz
Sweep Triggering	Sweep triggering is provided for step frequency sweep, list frequency sweep, and CW power sweep.	
	Auto	Triggers sweep automatically
	External	Triggers a sweep on the low-to-high transition of an external TTL signal. AUX I/O connector, rear panel
	Single	Triggers, aborts, and resets a single sweep. Reset sweep may be selected to be at the top or bottom of the sweep

Continued on next page

General	Stored Setups	Stores front panel settings and nine additional front-panel setups in a non-volatile RAM. A system menu allows for saving and recalling instrument setups. Whenever the instrument is turned on, control settings and values are the same as when last turned off.
	Memory Sequencing Input	Accepts a TTL low-level signal to sequence through ten stored setups. AUX I/O connector, rear panel
	Self-test	Instrument self-test is performed when Selftest soft-key is selected. If an error is detected, an error message is displayed in a window on the LCD identifying the probable cause and remedy.
	Secure Mode	Disables all frequency and power level state displays. Stored setups saved in secure mode remain secured when recalled. Mode selectable from a system menu and via GPIB.
	Parameter Entry	Instrument-controlled parameters can be entered in three ways — keypad, rotary data knob, or the "∧" and "∨" touch pads of the cursor-control key (use up/down-arrow symbol). The keypad is used to enter new parameter values; the rotary data knob and the cursor-control key are used to edit existing parameter values. The "<" and ">" touch pads of the cursor-control key move the cursor left and right one digit under the open parameter. The rotary data knob or the "∧" and "∨" touch pads will increment or decrement the digit position over the cursor. Controlled parameters are frequency, power level, sweep time, dwell time, and number of steps. Keypad entries are terminated by pressing the appropriate soft key. Edits are terminated by exiting the edit menu
	Reset	Returns all instrument parameters to predefined default states or values. Any pending GPIB I/O is aborted. Selectable from the system menu
	Master/Slave Operation	Allows two output signals to be swept with a user-selected frequency offset. One instrument controls the other via AUX I/O and SERIAL I/O connections. Requires a Master/Slave Interface Cable Set (Part No. ND36329)
	User Level Flatness Correction	Allows user to calibrate out path loss due to external switching and cables via entered power table from a GPIB power meter or calculated data. When user level correction is activated, entered power levels are delivered at the point where calibration was performed. Supported power meters are Anritsu ML2437A, ML2438A, ML2480A/B, ML2490A, and ML4803A and HP 437B, 438A, and 70100A. Five user tables are available with up to 801 points/table.
	Warm Up Time	From Standby: 30 minutes From Cold Start (0°C): 120 hours to achieve specified frequency stability with aging. Instruments disconnected from ac line power for more than 72 hours require 30 days to return to specified frequency stability with aging
	Power	85 V(ac) to 264 V(ac), 48 Hz to 440 Hz, 250 VA (max.)
	Standby	With AC line power connected, unit is placed in standby when front panel power switch is released from the OPERATE position
	Dimensions	429 (W) × 133 (H) × 450 (D) mm
	Mass	18 kg (max.)
Remote Operation	All instrument functions, settings, and operating modes (except for power on/standby) are controllable using commands sent from an external computer via Ethernet (VXI-11 over TCP/IP) or GPIB (IEEE-488 interface bus). Note: For users who wish to use a USB control interface, the following adapter available from National Instruments is recommended: USB: NI GPIB-USB-MS	
	Ethernet Port	10/100 Base-T
	Ethernet Address	DHCP with Auto-IP 169.254.90.55 (default) or static 192.168.0.254
	GPIB Address	Selectable from a system menu
	GPIB Commands	Native, SCPI
	IEEE-488 Interface Function Subset	Source Handshake: SH1 Acceptor Handshake: AH1 Talker: T6 Listener: L4 Service Request: SR1 Remote/Local: RL1 Parallel Poll: PP1 Device Clear: DC1 Device Trigger: DT1 Controller Capability: C0, C1, C2, C3, C28 Tri-state Driver: E2
	GPIB Status Annunciators	When the instrument is operating in remote, the GPIB status annunciators (listed below) will appear in a window on the front panel LCD
	Remote	Operating on the GPIB or via Ethernet, all instrument front panel keys (except for the SYSTEM key and the RETURN TO LOCAL soft key) are ignored.
	LLO (Local Lockout)	Disables the RETURN TO LOCAL soft-key. Instrument can be placed in local mode only via GPIB or by cycling line power
	Emulations	The instrument responds to the published GPIB commands and responses of the Anritsu Models 6600, 6700, and 6XX00-series signal sources. When emulating another signal source, the instrument will be limited to the capabilities, mnemonics, and parameter resolutions of the emulated instrument.
Environmental	Temperature Range	0° to +50°C (Operating), –40° to +75°C (Storage)
	Relative Humidity	5 to 95% at +40°C (non-condensing)
	Altitude	4,600 m, 43.9 cm Hg
	Vibration	Random, 5 Hz to 500 Hz, 0.015 to 0.0039 g^2/Hz PSD; Sinusoidal, 5 Hz to 55 Hz, 0.33 mm displacement
	CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN61010-1

Spectral Purity

All specifications apply at the lesser of +10 dBm output or maximum specified leveled output power, unless otherwise noted.

Spurious Signals

Harmonic and Harmonic Helated

Frequency Range	Standard
0.1 Hz to 10 MHz (Option 22)	<–30 dBc
10 MHz to ≤100 MHz (Option 4)	<–40 dBc
>100 MHz to ≤2.2 GHz (Option 4)	<–50 dBc
10 MHz to ≤50 MHz (Option 5)	<–30 dBc
>50 MHz to <2 GHz (Option 5)	<–40 dBc
2 GHz (>2.2 GHz w/Option 4) to ≤20 GHz	<–60 dBc*1
>20 GHz to ≤40 GHz	<–40 dBc*1, *2
>40 GHz to ≤50 GHz (MG3695C)	<–40 dBc*1
>40 GHz to ≤67 GHz (MG3697C)	<–25 dBc

*1: –30 dBc (typ.) with high power Option 15

*2: 20 GHz to 21 GHz and 39 GHz to 40 GHz – 20 dBc (typ., Option 15 only)

Non-harmonics

Frequency Range	Standard
0.1 Hz to 10 MHz (Option 22)	<–30 dBc
10 MHz to ≤2.2 GHz (Option 4)	<–60 dBc
10 MHz to ≤2 GHz (Option 5)	<–40 dBc
>2 GHz (2.2 GHz w/Option 4) to ≤67 GHz	<–60 dBc

Power Line and Fan Rotation Spurious Emissions (dBc)

Frequency Range	Offset from Carrier		
	<300 Hz	300 Hz to 1 kHz	>1 kHz
≥10 MHz to ≤500 MHz (Option 4)	<–68	<–72	<–72
>500 MHz to = 1050 MHz (Option 4)	<–62	<–72	<–72
>1050 MHz to ≤2200 MHz (Option 4)	<–56	<–66	<–66
≥0.01 GHz to ≤8.4 GHz	<–50	<–60	<–60
>8.4 GHz to ≤20 GHz	<–46	<–56	<–60
>20 GHz to ≤40 GHz	<–40	<–50	<–54
>40 GHz to ≤67 GHz	<–34	<–44	<–48

Residual FM (CW and Step Sweep modes, 50 Hz to 15 kHz BW)

Frequency Range	Residual FM (Hz RMS) Option 3, 3x	Standard
≤8.4 GHz	<40	<120
>8.4 GHz to ≤20 GHz	<40	<220
>20 GHz to ≤40 GHz	<80	<440
>40 GHz to ≤67 GHz	<160	<880

Residual FM
(Analog Sweep and Unlocked FM modes, 50 Hz to 15 kHz BW)

Frequency Range	Residual FM (kHz RMS)	
	Unlocked Narrow FM mode	Unlocked Wide FM mode or Analog Sweep
0.01 GHz to <20 GHz	<10	<25
>20 GHz to <40 GHz	<20	<50
>40 GHz to <67 GHz	<40	<100

AM Noise Floor

Typically <–145 dBm/Hz at 0 dBm output and offsets >5 MHz from carrier.

Single-Sideband Phase Noise

When fitted with Option 36 and when multiple units are connected for purposes of Ultra-Stable Phase Tracking, phase noise may be degraded by up to 4 dB at 1 kHz and 10 kHz offsets.

Single-Sideband Phase Noise (dBc/Hz): (Typ.)

Frequency Range	Offset from Carrier					
	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz
0.1 Hz to <10 MHz (Option 22)	–80 (–100)	–90 (–110)	–120 (–125)	–130 (–139)	–130 (–141)	–130 (–141)
10 MHz to 15.625 MHz (Option 4)	–102 (–113)	–128 (–133)	–142 (–149)	–145 (–152)	–145 (–153)	–145 (–153)
>15.625 MHz to 31.25 MHz (Option 4)	–97 (–109)	–125 (–130)	–142 (–147)	–144 (–149)	–144 (–153)	–145 (–155)
>31.25 MHz to 62.5 MHz (Option 4)	–92 (–104)	–122 (–128)	–140 (–146)	–142 (–146)	–143 (–150)	–145 (–155)
>62.5 MHz to 125 MHz (Option 4)	–87 (–98)	–114 (–118)	–133 (–139)	–130 (–140)	–130 (–143)	–145 (–155)
>125 MHz to 250 MHz (Option 4)	–82 (–93)	–108 (–113)	–126 (–134)	–124 (–134)	–124 (–138)	–145 (–153)
>250 MHz to 500 MHz (Option 4)	–75 (–87)	–102 (–109)	–120 (–128)	–118 (–127)	–118 (–130)	–143 (–149)
>500 MHz to 1050 MHz (Option 4)	–70 (–80)	–94 (–100)	–115 (–123)	–115 (–122)	–116 (–126)	–138 (–144)
>1050 MHz to 2200 MHz (Option 4)	–65 (–74)	–86 (–96)	–113 (–117)	–111 (–116)	–114 (–120)	–133 (–139)
10 MHz to <2000 MHz (Option 5)	–62 (–72)	–85 (–95)	–100 (–104)	–102 (–106)	–102 (–106)	–111 (–114)
2 GHz to 6 GHz	–54 (–64)	–81 (–88)	–102 (–109)	–103 (–110)	–106 (–114)	–128 (–133)
>6 GHz to 10 GHz	–52 (–62)	–75 (–85)	–98 (–106)	–104 (–109)	–106 (–113)	–126 (–132)
>10 GHz to 20 GHz	–45 (–55)	–69 (–78)	–92 (–101)	–98 (–103)	–98 (–106)	–124 (–131)
>20 GHz to 40 GHz	–38 (–48)	–62 (–72)	–86 (–94)	–92 (–100)	–92 (–100)	–118 (–124)
>40 GHz to 67 GHz	–32 (–42)	–56 (–66)	–80 (–88)	–87 (–94)	–82 (–91)	–112 (–118)

Single-Sideband Phase Noise (dBc/Hz) - Option 3: (Typ.)

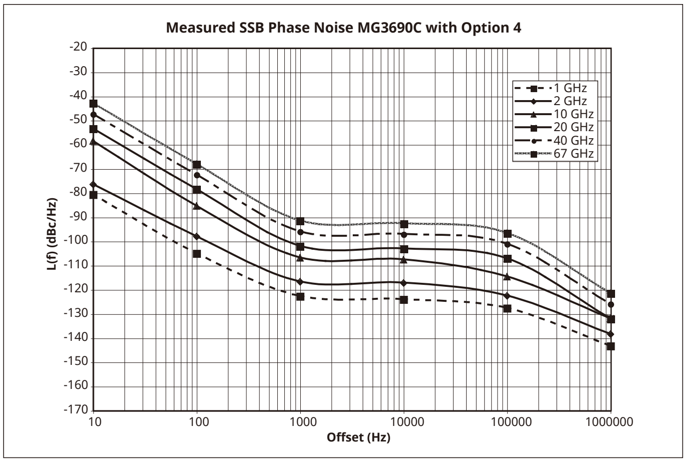
Frequency Range	Offset from Carrier					
	10 Hz	100 Hz	1 kHz*	10 kHz*	100 kHz	1 MHz
0.1 Hz to <10 MHz (Option 22)	–80 (–100)	–90 (–110)	–120 (–125)	–130 (–139)	–130 (–141)	–130 (–141)
10 MHz to 15.625 MHz (Option 4)	–102 (–120)	–128 (–140)	–142 (–150)	–145 (–152)	–148 (–153)	–148 (–152)
>15.625 MHz to 31.25 MHz (Option 4)	–97 (–108)	–125 (–128)	–142 (–149)	–145 (–153)	–148 (–153)	–148 (–155)
>31.25 MHz to 62.5 MHz (Option 4)	–92 (–109)	–122 (–131)	–140 (–146)	–145 (–153)	–148 (–153)	–148 (–156)
>62.5 MHz to 125 MHz (Option 4)	–87 (–98)	–114 (–118)	–134 (–139)	–142 (–147)	–143 (–148)	–148 (–155)
>125 MHz to 250 MHz (Option 4)	–82 (–93)	–108 (–113)	–129 (–134)	–138 (–143)	–137 (–142)	–148 (–153)
>250 MHz to 500 MHz (Option 4)	–77 (–91)	–102 (–114)	–124 (–130)	–132 (–137)	–128 (–137)	–144 (–153)
>500 MHz to 1050 MHz (Option 4)	–72 (–83)	–98 (–103)	–119 (–123)	–126 (–132)	–122 (–132)	–139 (–150)
>1050 MHz to 2200 MHz (Option 4)	–66 (–77)	–92 (–101)	–113 (–119)	–121 (–126)	–117 (–125)	–135 (–146)
10 MHz to <2000 MHz (Option 5)	–64 (–72)	–85 (–95)	–100 (–104)	–102 (–106)	–102 (–106)	–111 (–114)
2 GHz to 6 GHz	–54 (–77)	–82 (–93)	–106 (–111)	–115 (–119)	–112 (–119)	–136 (–140)
>6 GHz to 10 GHz	–52 (–73)	–75 (–88)	–102 (–109)	–113 (–119)	–115 (–120)	–134 (–140)
>10 GHz to 20 GHz	–52 (–66)	–69 (–82)	–100 (–105)	–109 (–115)	–109 (–115)	–130 (–137)
>20 GHz to 40 GHz	–45 (–59)	–63 (–75)	–94 (–98)	–104 (–108)	–103 (–109)	–122 (–131)
>40 GHz to 67 GHz	–40 (–51)	–58 (–68)	–89 (–91)	–97 (–103)	–97 (–103)	–118 (–125)

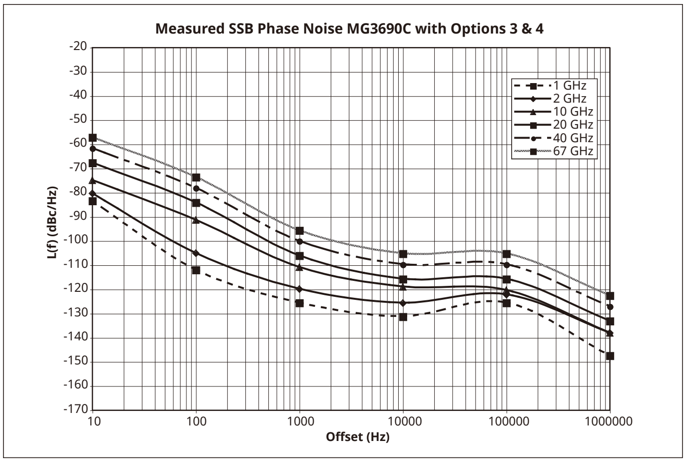
Single-Sideband Phase Noise (dBc/Hz) - Option 3X: (Typ.)

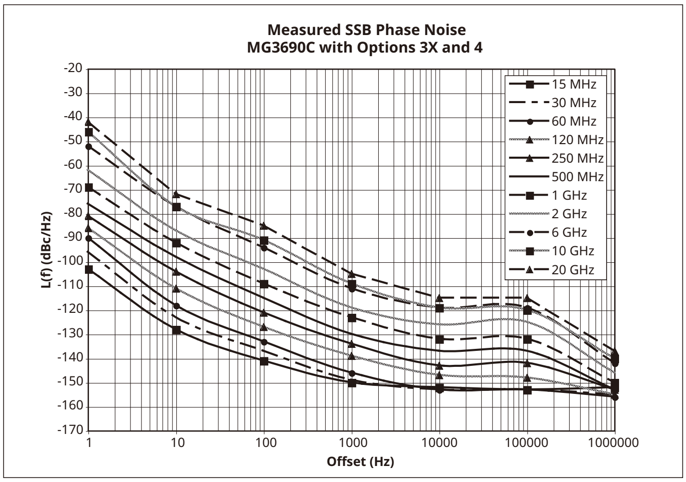
Frequency Range	Offset from Carrier						
	1 Hz	10 Hz	100 Hz	1 kHz*	10 kHz*	100 kHz	1 MHz
0.1 Hz to <10 MHz (Option 22)	–60 (–70)	–80 (–100)	–90 (–110)	–120 (–125)	–130 (–139)	–130 (–141)	–130 (–141)
10 MHz to 15.625 MHz (Option 4)	–94 (–103)	–118 (–128)	–136 (–141)	–142 (–150)	–145 (–152)	–148 (–153)	–148 (–152)
>15.625 MHz to 31.25 MHz (Option 4)	–88 (–96)	–113 (–123)	–130 (–137)	–142 (–149)	–145 (–153)	–148 (–153)	–148 (–155)
>31.25 MHz to 62.5 MHz (Option 4)	–83 (–90)	–109 (–118)	–125 (–133)	–140 (–146)	–145 (–153)	–148 (–153)	–148 (–156)
>62.5 MHz to 125 MHz (Option 4)	–77 (–86)	–103 (–111)	–119 (–127)	–134 (–139)	–142 (–147)	–143 (–148)	–148 (–155)
>125 MHz to 250 MHz (Option 4)	–71 (–81)	–97 (–104)	–113 (–121)	–129 (–134)	–138 (–143)	–137 (–142)	–148 (–153)
>250 MHz to 500 MHz (Option 4)	–67 (–76)	–91 (–98)	–107 (–115)	–124 (–130)	–132 (–137)	–128 (–137)	–144 (–153)
>500 MHz to 1050 MHz (Option 4)	–60 (–69)	–84 (–92)	–101 (–109)	–119 (–123)	–126 (–132)	–122 (–132)	–139 (–150)
>1050 MHz to 2200 MHz (Option 4)	–53 (–62)	–77 (–87)	–95 (–103)	–113 (–119)	–121 (–126)	–117 (–125)	–135 (–146)
10 MHz to <2000 MHz (Option 5)	–38 (–45)	–68 (–78)	–85 (–95)	–100 (–104)	–102 (–106)	–102 (–106)	–111 (–114)
2 GHz to 6 GHz	–46 (–52)	–70 (–77)	–86 (–94)	–106 (–111)	–115 (–119)	–112 (–119)	–136 (–140)
>6 GHz to 10 GHz	–38 (–46)	–68 (–77)	–83 (–91)	–102 (–109)	–113 (–119)	–115 (–120)	–134 (–140)
>10 GHz to 20 GHz	–35 (–42)	–64 (–72)	–80 (–85)	–100 (–105)	–109 (–115)	–109 (–115)	–130 (–137)
>20 GHz to 40 GHz	–29 (–36)	–58 (–65)	–74 (–79)	–94 (–98)	–104 (–108)	–103 (–109)	–122 (–131)
>40 GHz to 67 GHz	–23 (–30)	–53 (–59)	–69 (–73)	–89 (–91)	–97 (–103)	–97 (–103)	–118 (–125)

*: When fitted with Option 36 and when multiple units are connected for purposes of Ultra-Stable Phase Tracking, phase noise may be degraded by up to 4 dB at 1 kHz and 10 kHz offsets.

Typical MG3690C single sideband phase noise at 10 GHz carrier.







RF Output

Power level specifications apply at 25°C ±10°C.

Maximum Leveled Output Power*1

Model Number	Configuration	Frequency Range (GHz)	Output Power (dBm)	Output Power with Step Attenuator (dBm)
MG3692C	w/opt 4 or 5 STD STD	<2 GHz*2 ≥2 GHz*3 to ≤10 GHz >10 GHz to ≤20 GHz	+19.0 +19.0 +17.0	+18.0 +18.0 +15.0
MG3694C	w/opt 4 or 5 STD STD STD	<2 GHz*2 ≥2 GHz*3 to ≤10 GHz >10 GHz to ≤20 GHz >20 GHz to ≤40 GHz	+15.0 +15.0 +12.0 +9.0	+14.0 +14.0 +10.0 +6.0
MG3695C	w/opt 4 or 5 STD STD STD	<2 GHz*2 ≥2 GHz*3 to ≤20 GHz >20 GHz to ≤40 GHz >40 GHz to ≤50 GHz	+12.0 +10.0 +6.0 +3.0	+10.0 +8.0 +3.0 +0.0
MG3697C	w/opt 4 or 5 STD STD STD	<2 GHz*2 ≥2 GHz*3 to ≤20 GHz >20 GHz to ≤40 GHz >40 GHz to ≤67 GHz	+12.0 +10.0 +6.0 +3.0	+10.0 +8.0 +3.0 +0.0*4

*1: For output power with Option 22, 0.1 Hz to 10 MHz coverage, derate all specifications by 2 dB
*2: ≤2.2 GHz with Option 4
*3: >2.2 GHz with Option 4
*4: Typical 60 GHz to 67 GHz

Maximum Leveled Output Power with Option 15 (high power) installed*1

Model Number	Configuration	Frequency Range (GHz)	Output Power (dBm)	Output Power with Step Attenuator (dBm)
MG3692C	w/opt 4 or 5	<2 GHz*2	+19.0	+18.0
	w/opt 4 or 5	2 GHz*3 to 10 GHz	+25.0	+24.0
	w/opt 4 or 5	>10 GHz to 16 GHz	+22.0	+20.0
	w/opt 4 or 5	>16 GHz to 20 GHz	+21.0	+19.0
	w/o opt 4 or 5	≥2 GHz to ≤20 GHz	+23.0	+21.0
MG3694C	w/opt 4 or 5	<2 GHz*2	17.0	+16.0
	w/opt 4 or 5	≥2 GHz*3 to ≤20 GHz	+21.0	+19.0
	w/opt 4 or 5	>20 GHz to ≤40 GHz	+17.0	+15.0
	w/o opt 4 or 5	≥2 GHz to ≤20 GHz	+23.0	+21.0
	w/o opt 4 or 5	>20 GHz to ≤40 GHz	+19.0	+17.0
MG3695C	w/opt 4 or 5	<2 GHz*2	+16	+14
	w/opt 4 or 5	≥2 GHz*3 to ≤20 GHz	+21	+19
	w/opt 4 or 5	>20 GHz to ≤40 GHz	+17	+15
	w/opt 4 or 5	>40 GHz to ≤50 GHz	+11	+8
	w/o opt 4 or 5	≥2 GHz to ≤20 GHz	+23	+21
	w/o opt 4 or 5	>20 GHz to ≤40 GHz	+19	+17
	w/o opt 4 or 5	>40 GHz to ≤50 GHz	+13	+10
MG3697C	w/opt 4 or 5	<2 GHz*2	+16	+15
	w/opt 4 or 5	≥2 GHz*3 to ≤20 GHz	+19	+18
	w/opt 4 or 5	>20 GHz to ≤40 GHz	+16	+14
	w/opt 4 or 5	>40 GHz to ≤67 GHz	+9	+6*4
	w/opt 4 or 5	>67 GHz to ≤70 GHz	+3*5	0*5
	w/o opt 4 or 5	≥2 GHz to ≤20 GHz	+21	+19
	w/o opt 4 or 5	>20 GHz to ≤40 GHz	+19	+16
	w/o opt 4 or 5	>40 GHz to ≤67 GHz	+9	+6*4
	w/o opt 4 or 5	>67 GHz to ≤70 GHz	+3*5	0*5

*1: For output power with Option 22, 0.1 Hz to 10 MHz coverage, derate all specifications by 2 dB
*2: ≤2.2 GHz with Option 4
*3: >2.2 GHz with Option 4
*4: Typical 60 GHz to 67 GHz
*5: Typical

Minimum Settable Power	Without an Attenuator	–20 dBm
	With an Attenuator	–120 dBm
Minimum Leveled Output Power	Without an Attenuator	–15 dBm (–20 dBm, typ.)
	With an Attenuator	–115 dBm (MG3692C and MG3694C) –105 dBm (MG3695C and MG3697C)
Unleveled Output Power Range (Typ.)	Without an Attenuator	>40 dB below max. power
	With an Attenuator	>130 dB below max. power
Power Level Switching Time (to within specified accuracy)	Without Change in Step Attenuator	<3 ms (typ.)
	With Change in Step Attenuator	<20 ms (typ.)
Step Attenuator (Option 2)	Adds a 10 dB/step attenuator, with 110 dB range on models ≤40 GHz, and 90 dB range on models >40 GHz.	

<table>
<tr><td rowspan="3">Accuracy and Flatness</td><td colspan="2">Accuracy specifies the total worst case accuracy. Flatness is included within the accuracy</td></tr>
<tr><td>Step Sweep and CW Modes</td><td>Attenuation below Max. power
<table>
<tr><th rowspan="2">Accuracy</th><th colspan="4">Frequency Range</th></tr>
<tr><th>≤40 GHz*2</th><th>40 GHz to 50 GHz</th><th>50 GHz to 60 GHz</th><th>60 GHz to 67 GHz</th></tr>
<tr><td>0 to 25 dB</td><td>±1.0 dB</td><td>±1.5 dB</td><td>±1.5 dB</td><td>±1.5 dB</td></tr>
<tr><td>25 to 60 dB</td><td>±1.0 dB</td><td>±1.5 dB</td><td>±3.5 dB*1</td><td>N/A</td></tr>
<tr><td>60 to 100 dB</td><td>±1.0 dB</td><td>±2.5 dB*1</td><td>±3.5 dB*1</td><td>N/A</td></tr>
</table>
<table>
<tr><th rowspan="2">Flatness</th><th colspan="4">Frequency Range</th></tr>
<tr><th>≤40 GHz*2</th><th>40 GHz to 50 GHz</th><th>50 GHz to 60 GHz</th><th>60 GHz to 67 GHz</th></tr>
<tr><td>0 to 25 dB</td><td>±0.8 dB</td><td>±1.1 dB</td><td>±1.1 dB</td><td>±1.1 dB</td></tr>
<tr><td>25 to 60 dB</td><td>±0.8 dB</td><td>±1.1 dB</td><td>±3.1 dB*1</td><td>N/A</td></tr>
<tr><td>60 to 100 dB</td><td>±0.8 dB</td><td>±2.1 dB*1</td><td>±3.1 dB*1</td><td>N/A</td></tr>
</table></td></tr>
<tr><td>Analog Sweep Mode (typ.)</td><td>Attenuation below Max. power
<table>
<tr><th rowspan="2">Accuracy</th><th colspan="4">Frequency Range</th></tr>
<tr><th>0.01 GHz to 0.05 GHz</th><th>0.05 GHz to 20 GHz</th><th>20 GHz to 40 GHz</th><th>40 GHz to 67 GHz</th></tr>
<tr><td>0 to 12 dB</td><td>±2.0 dB</td><td>±2.0 dB</td><td>±2.0 dB</td><td>±3.0 dB</td></tr>
<tr><td>12 to 30 dB</td><td>±3.5 dB</td><td>±3.5 dB</td><td>±4.6 dB</td><td>±5.6 dB</td></tr>
<tr><td>30 to 60 dB</td><td>±4.0 dB</td><td>±4.0 dB</td><td>±5.2 dB</td><td>±6.2 dB</td></tr>
<tr><td>60 to 122 dB</td><td>±5.0 dB</td><td>±5.0 dB</td><td>±6.2 dB</td><td>±7.2 dB</td></tr>
</table>
<table>
<tr><th rowspan="2">Flatness</th><th colspan="4">Frequency Range</th></tr>
<tr><th>0.01 GHz to 0.05 GHz</th><th>0.05 GHz to 20 GHz</th><th>20 GHz to 40 GHz</th><th>40 GHz to 67 GHz</th></tr>
<tr><td>0 to 12 dB</td><td>±2.0 dB</td><td>±2.0 dB</td><td>±2.0 dB</td><td>±2.5 dB</td></tr>
<tr><td>12 to 30 dB</td><td>±3.5 dB</td><td>±3.5 dB</td><td>±4.1 dB</td><td>±5.1 dB</td></tr>
<tr><td>30 to 60 dB</td><td>±4.0 dB</td><td>±4.0 dB</td><td>±4.6 dB</td><td>±5.6 dB</td></tr>
<tr><td>60 to 122 dB</td><td>±5.0 dB</td><td>±5.0 dB</td><td>±5.2 dB</td><td>±6.2 dB</td></tr>
</table></td></tr>
<tr><td rowspan="11">Other Output Power Specifications</td><td>Output Units</td><td>Output units selectable as either dBm or mV. Selection of mV assumes 50Ω load. All data entry and display are in the selected units</td></tr>
<tr><td>Output Power Resolution</td><td>0.01 dB or 0.001 mV</td></tr>
<tr><td>Source Impedance</td><td>50Ω (nom.)</td></tr>
<tr><td>Source SWR (internal leveling)</td><td><2.0 (typ.)</td></tr>
<tr><td>Power Level Stability with Temperature</td><td>±0.04 dB/°C (typ.)</td></tr>
<tr><td>Level Offset</td><td>Offsets the displayed power level to establish a new reference level</td></tr>
<tr><td>Output On/Off</td><td>Toggles the RF output between an off and on state. During the off state, the RF oscillator is turned off. The on or off state is indicated by two LEDs located below the OUTPUT ON/OFF key on the front panel</td></tr>
<tr><td>RF On/Off Between Frequency Steps</td><td>System menu selection of RF on or RF off during frequency switching in CW, step sweep, and list sweep modes</td></tr>
<tr><td>RF On/Off During Retrace</td><td>System menu selection of RF on or RF off during retrace</td></tr>
<tr><td>Internal Leveling</td><td>Power is leveled at the output connector in all modes</td></tr>
<tr><td>External Leveling</td><td>External Detector:
Levels output power at a remote detector location. Accepts a positive or negative 0.5 mV to 500 mV input signal from the remote detector. L1 adjusts the input signal range to an optimum value. BNC connector, rear panel
External Power Meter:
Levels output power at a remote power meter location. Accepts a ±1 V full scale input signal from the remote power meter. L1 adjusts the input signal range to an optimum value. BNC connector, rear panel
External Leveling Bandwidth: 30 kHz (typ.) in detector mode. 0.7 Hz (typ.) in power meter mode
User Level Flatness Correction
Number of points: 2 to 801 points per table
Number of tables: 5 available
Entry modes: GPIB power meter or computed data</td></tr>
<tr><td rowspan="6">CW Power Sweep</td><td>Range</td><td>Sweeps between any two power levels at a single CW frequency</td></tr>
<tr><td>Resolution</td><td>0.01 dB/step (Log) or 0.001 mV (Linear)</td></tr>
<tr><td>Accuracy</td><td>Same as CW power accuracy</td></tr>
<tr><td>Log/Linear Sweep</td><td>Power sweep selectable as either log or linear. Log sweep is in dB; linear sweep is in mV</td></tr>
<tr><td>Step Size</td><td>User-controlled, 0.01 dB (Log) or 0.001 mV (Linear) to the full power range of the instrument</td></tr>
<tr><td>Step Dwell Time</td><td>Variable from 1 ms to 99 seconds. If the sweep crosses a step attenuator setting, there will be a sweep dwell of approximately 20 ms to allow setting of the step attenuator</td></tr>
<tr><td colspan="2">Sweep Frequency/Step Power</td><td>A power level step occurs after each frequency sweep. Power level remains constant for the length of time required to complete each sweep</td></tr>
</table>

*1: Typical
*2: Accuracy and Flatness with high power option 15, is ±1.5 dB. It is also ±1.5 dB below 20 MHz with or without Option 15.

Internal Power Monitor (Option 8)

Sensors: Compatible with Anritsu 560-7, 5400-71 or 6400-71 series detectors

	Range	Accuracy	Resolution
Rear panel input	+16 to −35 dBm	±1 dB (+16 to −10 dBm) ±2 dB (−10 to −35 dBm)	0.1 dB minimum

Frequency/Phase Modulation (Option 12)

Option 12 adds frequency and phase modulation, driven externally via a rear panel BNC connector, 50Ω. For internal modulation, add Internal LF and Pulse Generators Option 27. Frequency/Phase Modulation is not available <10 MHz with Option 22.

For the most accurate FM and ΦM measurements, Bessel Null methods are used. When verifying FM and ΦM, the use of the "carrier null" technique is recommended. Measured residual FM effects must be subtracted from modulation meter measurements.

Frequency Generator Multiplication/Division Ratios	Frequency Range	Divide Ratio, n
	<10 MHz (Option 22)	Modulation not available
	≥10 MHz to ≤15.625 MHz (Option 4)	256
	>15.625 MHz to ≤31.25 MHz (Option 4)	128
	>31.25 MHz to ≤62.5 MHz (Option 4)	64
	>62.5 MHz to ≤125 MHz (Option 4)	32
	>125 MHz to ≤250 MHz (Option 4)	16
	>250 MHz to ≤500 MHz (Option 4)	8
	>500 MHz to ≤1050 MHz (Option 4)	4
	>1050 MHz to ≤2200 MHz (Option 4)	2
	>10 MHz to ≤2000 MHz (Option 5)	1
	>2 GHz to ≤20 GHz	1
	>20 GHz to ≤40 GHz	1/2
	>40 GHz to ≤67 GHz	1/4

Frequency Modulation:

Parameter	Modes	Conditions	Specifications	Conditions	Specifications
		For all Frequencies other than <2.2 GHz with Option 4		For Frequencies <2.2 GHz with Option 4	
Deviation	Locked	Rate = 1 kHz to 8 MHz	± [Lesser of 10 MHz or 300 * (mod rate)]/n	Rate = 1 kHz to (Lesser of 8 MHz or 0.03 * Fcarrier)	± [Lesser of 10 MHz or 300 * (mod rate)]/n
	Locked Low-noise	Rate = 50 kHz to 8 MHz	± [Lesser of 10 MHz or 3 * (mod rate)]/n	Rate = 50 kHz to (Lesser of 8 MHz or 0.03 * Fcarrier)	± [Lesser of 10 MHz or 3 * (mod rate)]/n
	Unlocked Narrow	Rate = DC to 8 MHz	±10 MHz/n	Rate = DC to (Lesser of 8 MHz or 0.03 * Fcarrier)	± (10 MHz)/n
	Unlocked Wide	Rate = DC to 100 Hz	±100 MHz/n	Rate = DC to 100 Hz	± (100 MHz)/n
Bandwidth (3 dB)	Locked		1 kHz to 10 MHz		1 kHz to (Lesser of 10 MHz or 0.03 * Fcarrier)
	Locked Low-noise		30 kHz to 10 MHz		30 kHz to (Lesser of 8 MHz or 0.03 * Fcarrier)
	Unlocked Narrow		DC to 10 MHz		DC to (Lesser of 10 MHz or 0.03 * Fcarrier)
	Unlocked Wide		DC to 100 Hz		DC to 100 Hz
Flatness	Locked	Rate = 10 kHz to 1 MHz	±1 dB relative to 100 kHz	Rate = 10 kHz to (Lesser of 1 MHz or 0.01 * Fcarrier)	±1 dB relative to 100 kHz
Accuracy	Locked and Low-noise Unlocked Narrow	Rate = 100 kHz sinewave Int. or 1 Vpk Ext.	10% (5% typ.)	Rate = 100 kHz sinewave Int. or 1 Vpk Ext.	10% (5% typ.)
Incidental AM	Locked and Low-noise Unlocked Narrow	1 MHz Rate, ±1 MHz Dev.	<2% (typ.)	Rate and Dev. = Lesser of 1 MHz or 0.01 * Fcarrier	<2% (typ.)
Harmonic Distortion	Locked	10 kHz Rate, ±1 MHz Dev.	<1%	Rate = 10 kHz, Dev.= ± (1 MHz)/n	<1%
External Sensitivity	Locked Locked Low-noise Unlocked Narrow Unlocked Wide	(±1 V maximum input)	± (10 kHz/V to 20 MHz/V)/n ± (10 kHz/V to 20 MHz/V)/n ± (10 kHz/V to 20 MHz/V)/n ± (100 kHz/V to 100 MHz/V)/n	(±1 Vpk maximum input)	± (10 kHz/V to 20 MHz/V)/n ± (10 kHz/V to 20 MHz/V)/n ± (10 kHz/V to 20 MHz/V)/n ± (100 kHz/V to 100 MHz/V)/n

Phase Modulation:

Parameter	Modes	Conditions	Specifications	Conditions	Specifications
		For all Frequencies other than <2.2 GHz with Option 4		For Frequencies <2.2 GHz with Option 4	
Deviation	Narrow	Rate = DC to 8 MHz	± [Lesser of 3 rad or (5 MHz/mod rate)]/n	Rate = DC to (Lesser of 8 MHz or 0.03 * Fcarrier)	± [Lesser of 3 rad or (5 MHz/mod rate)]/n
	Wide	Rate = DC to 1 MHz	± [Lesser of 400 rad or (10 MHz/mod rate)]/n	Rate = DC to (Lesser of 1 MHz or 0.03 * Fcarrier)	± [Lesser of 400 rad or (10 MHz/mod rate)]/n
Bandwidth (3 dB)	Narrow		DC to 10 MHz		DC to (Lesser of 10 MHz or 0.03 * Fcarrier)
	Wide		DC to 1 MHz		DC to (Lesser of 1 MHz or 0.03 * Fcarrier)
Flatness	Narrow	Rate = DC to 1 MHz	±1 dB relative to 100 kHz	Rate = DC to (Lesser of 1 MHz or 0.01 * Fcarrier)	±1 dB relative to 100 kHz rate
	Wide	Rate = DC to 500 kHz	±1 dB relative to 100 kHz	Rate = DC to (Lesser of 500 kHz or 0.01 * Fcarrier)	±1 dB relative to 100 kHz rate
Accuracy	Narrow and Wide	100 kHz Internal or 1 Vpk External, sine	10%	100 kHz Internal or 1 Vpk External, sine	10%
External Sensitivity	Narrow Wide	(±1 V maximum input)	± (0.0025 rad/V to 5 rad/V)/n ± (0.25 rad/V to 500 rad/V)/n	(±1 Vpk maximum input)	± (0.0025 rad/V to 5 rad/V)/n ± (0.25 rad/V to 500 rad/V)/n

Amplitude Modulation (Option 14)

Option 14 adds amplitude modulation, driven externally via a rear panel BNC connector 50Ω. For internal modulation, add Internal LF and Pulse Generators Option 27.
All amplitude modulation specifications apply at 50% depth, 1 kHz rate, with RF level set 6 dB below maximum specified leveled output power, unless otherwise noted. Amplitude Modulation is not available <10 MHz with Option 22.

AM Depth (typ.)	0 to 90% linear; 20 dB log
AM Bandwidth (3 dB)*	DC to 50 kHz minimum, DC to 100 kHz (typ.)
Flatness (DC to 10 kHz rates)	±0.3 dB
Accuracy	±5%
Distortion	<5% (typ.)
Incidental Phase Modulation (30% depth, 10 kHz rate)	<0.2 radians (typ.)
External AM Input	Log AM or Linear AM input, rear panel BNC, 50Ω input impedance. For internal modulation, add LF Generator Option 27. Sensitivity Log AM: Continuously variable from 0 dB per volt to 25 dB per volt. Linear AM: Continuously variable from 0% per volt to 100% per volt. Maximum Input: ±1 Vpk

*: Typical below 2.2 GHz, when ordered with Options 4 and 15.

Pulse Modulation (Option 26)

Option 26 adds pulse modulation, driven externally via a rear panel BNC connector, TTL. For internal modulation, add Internal LF and Pulse Generators Option 27.
Pulse modulation specifications apply at maximum rated power, unless otherwise noted. Pulse modulation is not available <10 MHz with Option 22.

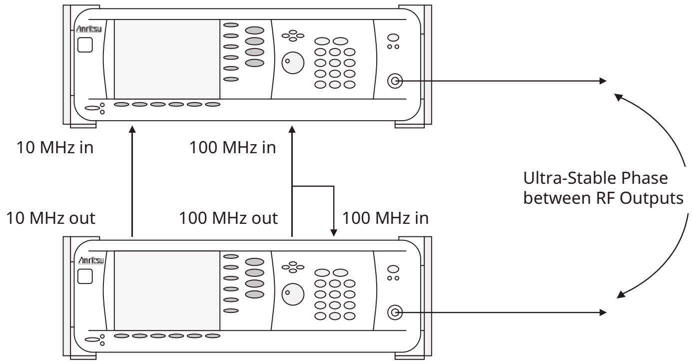
On/Off Ratio	>80 dB (>70 dB with high power Option 15)			
Minimum Leveled Pulse Width	100 ns, ≥1 GHz 1 μs, <1 GHz			
Minimum Unleveled Pulse Width	<10 ns			
Level Accuracy Relative to CW (100 Hz to 1 MHz PRF)	±0.5 dB, ≥1 μs pulse width ±1.0 dB, <1 μs pulse width			
Pulse Delay (typ.)	External Mode: 50 ns			
PRF Range	DC to 10 MHz, unleveled 100 Hz to 5 MHz, leveled			
Frequency Range	Rise & Fall Time (10 to 90%)	Overshoot	Pulse Width Compression*1	Video Feedthrough*1
≥10 to <31.25 MHz (Option 4)	400 ns*1	33%*1	40 ns	±70 mV
≥31.25 to <125 MHz (Option 4)	90 ns*1	22%*1	12 ns	±130 mV
≥125 to <500 MHz (Option 4)	33 ns*1	11%*1	12 ns	±70 mV
≥500 to <2200 MHz (Option 4)	15 ns	10%*1	12 ns	±50 mV
≥10 to <1000 MHz (Option 5)	15 ns/10 ns*1	10%*1	8 ns	±30 mV
≥1 to <2 GHz (Option 5)	10 ns/5 ns*1	10%*1	8 ns	±30 mV
≥2 to ≤67 GHz*2	10 ns/5 ns*1	10%*3	8 ns	±30 mV
External Input	Rear panel BNC. For internal modulation, add Pulse Generator Option 27. Drive Level: TTL compatible input Input Logic: Positive-true or negative-true, selectable from modulation menu.			

*1: Typical
*2: Rise time and pulse width compression >20 GHz, degrades by 2 ns with High Power Option 15.
*3: For 50 and 67 GHz units, overshoot >40 GHz is 20% typical at rated power.

Ultra-Stable Phase Tracking (Option 36)

Option 36 enables up to three MG3690C units fitted with option 3, 3X to phase track with a very high degree of stability. Option 36 provides additional rear panel connectors to link internal reference signals together.

100 MHz Reference Output	Provides the reference signal to drive up to two other MG3690C. All must have Option 36 and either option 3 or 3x. This signal is only intended for use with other Option 36 instruments.
100 MHz Reference Input	Accepts the 100 MHz reference signal from another MG3690C fitted with Option 36. This input is only intended for use with other Option 36 instruments.
Phase Drift	<±1° over 5 seconds (typ.), <±1.5° over 100 seconds (typ.), after 24 hours warm-up time.



Internal LF and Pulse Generators (Option 27)

An internal pulse generator and two internal waveform generators are added, one providing a frequency or phase modulating signal and the other an amplitude modulating signal. This Internal LF and Pulse Generators option can only be ordered in combination with either FM/ΦM, AM, or Pulse options, 12, 14, and 26 respectively.

Waveforms	Sinusoid, square-wave, triangle, positive ramp, negative ramp, Gaussian noise, uniform noise. (Check Option 10 for User-Defined)	
Rate	0.1 Hz to 10 MHz sinusoidal 0.1 Hz to 100 kHz square-wave, triangle, ramps	
Resolution	0.1 Hz	
Accuracy	Same as instrument timebase ±0.014 Hz	
Output	Two BNC connectors on the rear panel, FM/ΦM OUT and AM OUT	
Pulse Triggers	Free run, triggered, gated, delayed, triggered with delay, swept-delay	
Pulse Modes	Singlet, doublet, triplet, quadruplet.	
Parameter	Selectable Clock Rate	
	Narrow (100 MHz)	Wide (10 MHz)
Pulse Width	10 ns to 160 ms	100 ns to 1.6 s
Pulse Period*	100 ns to 160 ms	600 ns to 1.6 s
Variable Delay Singlet Doublet Triplet Quadruplet	 0 to 160 ms 100 ns to 160 ms 100 ns to 160 ms 100 ns to 160 ms	 0 to 1.6 s 300 ns to 1.6 s 300 ns to 1.6 s 300 ns to 1.6 s
Resolution	10 ns	100 ns
Accuracy	10 ns (5 ns, typ.)	
Inputs/Outputs	Inputs/Outputs: Video pulse and sync out, rear panel BNC connectors	

*: Period must be longer than the sum of delay and width by 5 clock cycles minimum.

Millimeter-Wave Multiplier 2000-1694 Series

External waveguide output multipliers 2000-1694 series are available for banded frequency coverage up to 500 GHz. These external multipliers require at a minimum, an MG3692C with 20 GHz coverage. The output power required to drive the modules is +10 dBm.

They can be powered from an external power supply (+12 VDC, 1.5 A typ.) using the supplied double banana power cord, or from the 40-187-R DC Power Supply and 2000-1710-R Millimeter-wave Power Supply Adapter (both included with the modules).

2000-1694 series multipliers have a saturated, unleveled, output power, yet their inherent flatness is exceptional. Modulating the input drive will indeed modulate the output, except for the case of Amplitude Modulation. Since the output is saturated, Amplitude Modulation is not recommended with these millimeter-wave modules. Frequency and Phase Modulation is possible, but the achieved deviation will be multiplied based on the multiplication factor of the module. Pulse modulation is also possible, with even sharper rise and fall times than the input. All modulation performances are not specified.

For ease of operation, the MG3690C allows the user to enter a frequency scaling factor, the module's multiplication factor, which will be used only for purposes of displaying the proper frequency at the output of the millimeter-wave module, on the MG3690C front panel display.

Millimeter-Wave Multiplier 2000-1694 Series are not for use with MG3690C Option 18.

Multiplier p/n[*1, *2, *3]	2000-1694-15-R	2000-1694-12-R	2000-1694-10-R	2000-1694-08-R	2000-1694-06-R	2000-1694-05-R	2000-1694-03-R	2000-1694-02-R
Frequency	50 GHz to 75 GHz	60 GHz to 90 GHz	75 GHz to 110 GHz	90 GHz to 140 GHz	110 GHz to 170 GHz	140 GHz to 220 GHz	220 GHz to 325 GHz	325 GHz to 500 GHz
Waveguide Output	WR-15	WR-12	WR-10	WR-08	WR-06	WR-05	WR-03	WR-02.2
Flange[*4]	(008)	(009)	(010)	(M08)	(M06)	(M05)	(M03)	(M02.2)
Output Power (typ.)	+8 dBm	+6 dBm	+7 dBm	–5 dBm	–9 dBm	–15 dBm	–25 dBm[*5]	–27 dBm[*5]
Output Flatness (typ.) (Unleveled)	±2 dB	±2 dB	±3 dB	—	—	—	—	—
Output Match	>11.7 dB	>11.7 dB	>11.7 dB	>11.7 dB	>11.7 dB	>11.7 dB	6 dB (typ.)	6 dB (typ.)
Multiplication Factor (m)	× 4	× 6	× 6	× 8	× 12	× 12	× 18	× 30
Input Frequency	12.5 GHz to 18.8 GHz	10 GHz to 15 GHz	12.5 GHz to 18.4 GHz	11.2 GHz to 17.5 GHz	9.1 GHz to 14.2 GHz	11.6 GHz to 18.4 GHz	12.2 GHz to 18.1 GHz	10.8 GHz to 16.7 GHz
Frequency Accuracy	(Synthesizer Accuracy × m)							
Frequency Resolution	(Synthesizer Resolution × m)							
Manual Adjustable Attenuator[*6]	25 dB min							—
Harmonics & Spurious[*7, *8]	–20 dBc (typ.)							—
Input Power Required	+10 dBm							
RF Input Connector	SMA (female)							
DC Power	12 VDC, 1.5 A (double-banana power cord included)[*2]							
Dimensions	145 × 110 × 72 mm (not including feet, interfaces, or optional manual attenuation adjuster)							
Mass	<1 kg							
Temperature	+20° to +30°C							

*1: These millimeter-wave modules are produced by OML Inc. (Oleson Microwave Labs), located in Morgan Hill, CA., with mutual collaborative experiences over many years. For detailed and up-to-date specifications, please call OML, Inc. or visit their website at http://www.omlinc.com.

*2: Multipliers require power from an external power supply (+12 VDC, 1.5 A typ.) using the supplied double banana power cord, or from the DC Power Supply 40-187-R and Millimeter-wave Power Supply Adapter 2000-1710-R (both included with the modules).

*3: Warranty period for the 2000-1694 Series is one year.

*4: Waveguide output flanges are per MIL-DTL-3922/67D (UG387/U-M).

*5: Output power is estimated.

*6: Available as an option. To order, add "A" to multiplier module part number (for example, 2000-1694-15A-R). Not available with 2000-1694-02-R.

*7: In-band mixing products typ.ly ≤ –15 dBc in the lower 10% of the waveguide band.

*8: As relates to multiplied output frequencies.

Inputs and Outputs*1

EXT ALC IN	Provides for leveling the RF output signal externally with either a detector or power meter. Signal requirements are shown in the RF Output specifications.
RF OUTPUT (Option 9)*2	Provides for RF output from 50Ω source impedance. K Connector, female. Option 9 moves the RF Output connector to the rear panel.
10 MHz REF IN	Accepts an external 10 MHz ±100 Hz, 0 to +20 dBm time-base signal. Automatically disconnects the internal high-stability time-base option, if installed. 50Ω impedance.
10 MHz REF OUT	Provides a 1 Vp-p, AC coupled, 10 MHz signal derived from the internal frequency standard. 50Ω impedance.
100 MHz REF IN (Option 36)	Accepts the 100 MHz signal from an MG3690C with Option 36 for ultra-stable phase tracking.
100 MHz REF OUT (Option 36)	Provides the 100 MHz signal for an MG3690C with Option 36 ultra-stable phase tracking.
HORIZ OUT (Horizontal Sweep Output)	Provides 0 V at beginning and +10 V at end of sweep, regardless of sweep width. In CW mode, the voltage is proportional to frequency between 0 V at low end and +10 V at the high end of range. In CW mode, if CW RAMP is enabled, a repetitive, 0 to +10 V ramp is provided.
EFC IN	Provides the capability to frequency modulate the internal crystal oscillator, allowing phase locking the synthesizer inside an external lock loop.
AUX I/O (Auxiliary Input/Output)	Provides for most of the rear panel BNC connections through a single, 25-pin, D type connector. Supports master-slave operation with another synthesizer or allows for a single-cable interface with the Model Scalar Network Analyzer 56100A and other Anritsu instruments.
SERIAL I/O (Serial Input/Output)	Provides access to RS-232 terminal ports to support service and calibration functions and master slave operations.
IEEE-488 GPIB	Provides input/output connections for the General Purpose Interface Bus (GPIB).
DC OUT (Option 18)*2	Supplies +15 VDC, 1 A (nom.).
RF, LO, IF (Option 7)*2	Provides access to an internal IF up-conversion mixer, Option 7.
PULSE TRIG IN (Option 26)	Accepts an external TTL compatible signal to pulse modulate the RF output signal or to trigger or to gate the optional internal pulse generator. Available with Option 26, Pulse Modulation.
PULSE SYNC OUT (Option 27)	Provides a TTL compatible signal, synchronized to the internal pulse modulation output, Option 27.
PULSE VIDEO OUT (Option 27)	Provides a video modulating signal from the internal pulse generator, Option 27.
AM IN (Option 14)	Accepts an external signal to amplitude modulate the RF output signal, Option 14. 50Ω impedance
FM/ΦM IN (Option 12)	Accepts an external signal to frequency or phase modulate the RF output signal, Option 12. 50Ω impedance
AM OUT (Option 27)	Provides the amplitude modulation waveform from the internal LF generator, Option 27.
FM/ΦM OUT (Option 27)	Provides the frequency or phase modulation waveform from the internal LF generator, Option 27.
SCAN MOD IN (Option 20)*2	Accepts an external signal to scan modulate the RF output signal, Option 20, High Impedance.
POWER MONITOR IN (Option 8)	Accepts an external detector for power monitoring, Option 8.

*1: Connectors may be available but not active if option not ordered.
*2: Options (7 & 18), (7 & 20), (8 & 9) are mutually exclusive, as they share the same rear panel space.

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main Frame
MG3692C	2 GHz to 20 GHz CW Generator
MG3694C	2 GHz to 40 GHz CW Generator
MG3695C	2 GHz to 50 GHz CW Generator
MG3697C	2 GHz to 67 GHz CW Generator (operational to 70 GHz)
	Options and Accessories
MG3690C/1A	Rack Mount with slides – Rack mount kit containing a set of track slides (90 degree tilt capability), mounting ears, and front panel handles to let the instrument be mounted in a standard 19-inch equipment rack.
MG3690C/1B	Rack Mount without slides – Modifies rack mounting hardware to install unit in a console that has mounting shelves. Includes mounting ears and front panel handles.
MG3690C/2X	Mechanical Step Attenuator – Adds a 10 dB/step attenuator. Rated RF output power is reduced. (This option comes in different versions, based on instrument configuration.)
MG3690C/3*1	Ultra Low Phase Noise, main band – Adds new modules to significantly reduce SSB phase noise. (Not available with Option 3X.)
MG3690C/3X*1	Premium Phase Noise, improves Option 3 (<1 kHz offset). (Not available with Option 3)
MG3690C/4	8 MHz to 2.2 GHz RF coverage, Ultra-Low Phase Noise version – Uses a digital down converter to significantly reduce SSB phase noise.*2
MG3690C/5	8 MHz to 2 GHz RF coverage – Uses an analog down converter.*2
MG3690C/6	Analog Sweep Capability (limited to ≥500 MHz when used with Option 4)
MG3690C/7	IF Up-Conversion – Adds an internal 40 GHz mixer for up-converting an IF signal. (Not available with MG3695C, MG3697C, or with Option 18, 20 or 36)
MG3690C/8	Power Monitor – Adds internal power measurement capability (not available with Option 9).
MG3690C/9X	Rear Panel Output – Moves the RF output connector to the rear panel. (This option comes in different versions, based on instrument configuration.)
MG3690C/10	User-Defined Modulation Waveform Software – External software package provides the ability to download user-defined waveforms into the memory of the internal waveform generator, serially or via GPIB. External PC and an instrument with LF Generator, Option 27, are required. This external software package can only be used with Option 10 enabled instruments.
MG3690C/12	Frequency and Phase Modulation – External, via a rear panel BNC connector. For internal modulation capability, requires additionally LF Generator, Option 27.
MG3690C/14	Amplitude Modulation – External, via a rear panel BNC connector. For internal modulation capability, requires additionally LF Generator, Option 27.
MG3690C/15X	High Power – Adds high-power RF components to the instrument to increase its output power level. (This option comes in different versions, based on instrument configuration.)
MG3690C/16	High Stability Time Base – Adds an ovenized, 10 MHz crystal oscillator as a high-stability time base.
MG3690C/17	Delete Front Panel – Deletes the front panel for use in remote control applications where a front panel display and keyboard control are not needed.
MG3690C/18	DC Output – Adds a rear panel BNC Twinax connector supplying +15 VDC, 1A (nom.). (Not available with Option 7 or 15x)
MG3690C/20	Scan Modulation – Adds an internal Scan modulator for simulating high-depth amplitude modulated signals. Requires an external modulating signal input capability. (Not available on models MG3694C, MG3695C, MG3697C, or with Options 7, 15X, or 22)
MG3690C/22	0.1 Hz to 10 MHz Audio coverage – Uses a DDS for coverage down to approximately DC. When adding Option 22, the output power is derated by 2 dB. The frequency resolution below 10 MHz is 0.02 Hz. No modulation is available in the 0.1 Hz to 10 MHz band (Not available without Option 4 or 5 or with Option 20).
MG3690C/26X*3	Pulse Modulation – External, via a rear panel BNC connector. For internal modulation capability, requires additionally Pulse Generator, Option 27. (This option comes in different versions, based on instrument configuration.)
MG3690C/27	Internal LF and Pulse Generators – Provides modulation waveforms for internal AM, FM, FM, and Pulse. (Not available without Option 12, 14, or 26.)
MG3690C/28X*3	Analog Modulation Suite – For ease of ordering and package pricing, this option bundles Options 12, 14, 26 and 27, offering internaland external AM, FM, ΦM, and Pulse Modulation. (This option comes in different versions, based on instrument configuration.)
MG3690C/36	Ultra-Stable Phase Tracking - Provides the capability for ultra-stable phase tracking between instruments using the internal 100 MHz reference. (Requires Option 3 or 3X) (Not available with Option 7 or with both Option 18 and 20 together)
	Accessories
34RKNF50	DC to 20 GHz, Ruggedized Type N female adapter for units with a K Connector Output
ND36329	Master/Slave Interface Cable Set
63270	Transit Case
2300-469	IVI Driver, includes LabView® driver
806-97	Aux I/O Cable, 25 pin to BNC: Provides BNC access to V/GHz and Sequential Sync connections and other AUX I/O data lines
	Millimeter Wave Accessories*4
2000-1694-15-R	50 GHz to 75 GHz V band Multiplier Source Module, WR-15
2000-1694-12-R	60 GHz to 90 GHz E band Multiplier Source Module, WR-12
2000-1694-10-R	75 GHz to 110 GHz W band Multiplier Source Module, WR-10
2000-1694-08-R	90 GHz to 140 GHz F band Multiplier Source Module, WR-08
2000-1694-06-R	110 GHz to 170 GHz D band Multiplier Source Module, WR-06
2000-1694-05-R	140 GHz to 220 GHz G band Multiplier Source Module, WR-05
2000-1694-03-R	220 GHz to 325 GHz H band Multiplier Source Module, WR-03
2000-1694-02-R	325 GHz to 500 GHz Multiplier Source Module, WR-02.2
40-187-R	DC Power Supply (Included with Multiplier Source Module)
2000-1710-R	Millimeter wave Power Supply Adapter (Included with Multiplier Source Module)
	Upgrades Economical upgrades are available to upgrade any model to any higher performing model. Consult Anritsu for details.

*1: Phase Noise performance is controlled by United States Export Control regulations. For solutions that do not require export licences, please consult your Anritsu Sales Representative.

*2: All specifications for Options 4 and 5 apply ≥10 MHz.

*3: Pulse Modulation performance is controlled by United States Export Control regulations, >31.8 GHz. For Pulse Modulation solutions that do not require export licenses, please consult with your Anritsu sales representative.

*4: To order a multiplier with an optional manually adjustable attenuator, add an "A" to the multiplier module part number (for example, 2000-1694-15A-R). Not available with 200-1694-02-R

Analog Signal Generator

MG3740A

100 kHz to 2.7 GHz/4.0 GHz/6.0 GHz

Remote Control
GPIB | Ethernet | USB

Excellent RF Performance, Versatile Modulation Functions, Built-in Dual RF Outputs

The Analog Signal Generator MG3740A has excellent RF specifications, including SSB Phase Noise, output level, etc., and versatile modulation functions (AM/FM/ΦM/Pulse).

High-Purity Signal Source for Testing Analog Radio

The excellent SSB phase noise performance supports narrowband radio Rx sensitivity suppression tests.
<–140 dBc/Hz (nominal) [100 MHz, 20 kHz offset, CW]
Excellent level accuracy over a wide level range, the MG3740A is the solution for accurate tests of radio Rx sensitivity and amplifier distortion characteristics.
Setting Range: –144 to +25 dBm
(CW, Option 041/071, 042/072, 043/073 installed)

Cuts Tact Time

To shorten tact times on production lines the MG3740A supports two standard modes.
The List/Sweep mode switches the frequency and level faster than 600 µs.

Cut Equipment Costs

The dual RF outputs supporting wanted + interference waves for tests of Rx characteristics, evaluation of wireless and amplifier intermodulation characteristics, and output of RF/LO signals for mixer tests, cut test costs by eliminating the need for two signal generators.

Extendible Narrowband Digital Modulation Function

Adding the digital modulation option adds a digital modulation signal generator function providing a cost-effective solution for testing public safety digital radio systems.
Digital Modulation Performance
- RF Modulation Bandwidth: 2 MHz
- Sampling Rate: 20 kHz to 8 MHz

Main Applications

- Testing Rx characteristics of analog radio
- Testing amplifier distortion and intermodulation characteristics
- RF/LO Signal source for evaluating mixer characteristics
- Testing Rx characteristics of narrowband digital radio

Key Features

Basic Performance

- SSB Phase Noise Performance
  <–140 dBc/Hz (nom.) @100 MHz, 20-kHz offset, CW
  <–131 dBc/Hz (typ.) @1 GHz, 20-kHz offset, CW
  <–125 dBc/Hz (typ.) @2 GHz, 20-kHz offset, CW
- High-power Output [Option 041/071]
  +23 dBm @CW, 400 MHz to 3 GHz
- High-speed Switching
  < 600 µs @List/Sweep mode
- High Level Accuracy
  Absolute Level Accuracy: ±0.5 dB
  Linearity: ±0.2 dB (typ.)
- Choice of Reference Oscillators
  Standard
    Aging rate ±1 × 10^{-6}/year, ±1 × 10^{-7}/day
  High Stability Reference Oscillator [Option 002]
    Aging rate ±1 × 10^{-7}/year, ±1 × 10^{-8}/day
  Rubidium Reference Oscillator [Option 001]
    Aging rate ±1 × 10^{-10}/month

Dual RF

- One Unit Supports Two RF Outputs Max.
  Frequency Range
    1stRF: 100 kHz to 2.7/4.0/6.0 GHz [Option 032/034/036]
    2ndRF: 100 kHz to 2.7/4.0/6.0 GHz [Option 062/064/066]
  Independent Baseband and RF Outputs

Expandability

- Analog modulation (AM/FM/ΦM) functions and pulse modulation (PM) functions [Standard]
- Additional analog modulation input options [Option 050/080]
- USB Power Sensors [Sold separately]

Operability

- Simple Touch-panel Operation
- Signal Flowcharts with Signal Block Diagrams
- Frequency Channel Table

Connections with External Equipment
- Remote Control Interfaces
- USB Connections

Expansion to Digital Modulation Signal Generator
- Digital Modulation [Option 020]
  Adding the digital modulation option [Option 020] supports generation of digital modulation signals by outputting narrowband digital modulation signals.
  Digital Modulation Performance
    RF Modulation Bandwidth: 2 MHz
    Sampling Rate: 20 kHz to 8 MHz
  Waveform generation software: IQproducer (License sold separately)
    TDMA IQproducer
    Fading IQproducer
- BER Test Function [Option 021]
- Output Two Signals from One RF Out [Option 048/078]
  Wanted Signal + Interfere Signal
  Wanted Signal + Delayed Signal, etc.

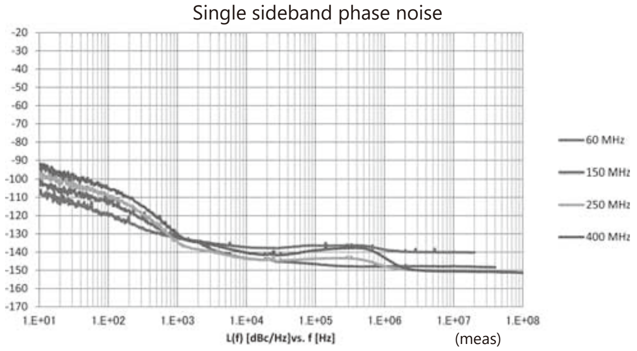
Basic Performance

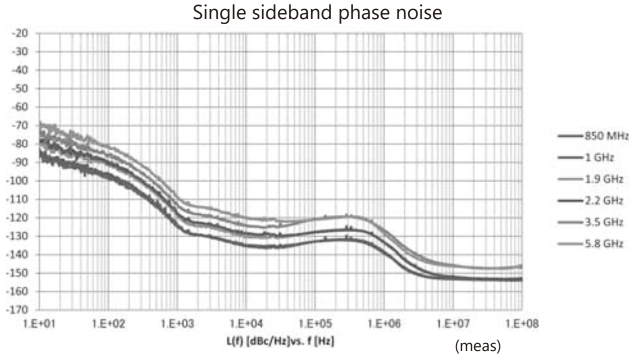
SSB Phase Noise

<–140 dBc/Hz (nom.)	@100 MHz, 20-kHz offset, CW
<–131 dBc/Hz (typ.)	@1 GHz, 20-kHz offset, CW
<–125 dBc/Hz (typ.)	@2 GHz, 20-kHz offset, CW

SSB phase noise is an important performance index for signal generators. For example, when using a signal generator for the following purposes, it is important to pre-confirm that the signal generator performance satisfies the measurement specifications.

- Communications with narrow bandwidth of several kHz
- CW interference waveforms
- Full range of reference and local signals





Example: SSB Phase Noise
(Phase Noise Optimization <200 kHz, CW,
Optimize S/N Off, with Option 002)

Low-power Output [Option 042*[1]/072*[2]]

*1: Low Power Extension for 1stRF [Option 042]
*2: Low Power Extension for 2ndRF [Option 072]

Amplitude Setting Range

Options	Setting Range [dBm]	
	without Reverse Power Protection*3	with Reverse Power Protection*3
Standard	–110 to +17	–110 to +17
with High-power Extension	–110 to +30	–110 to +25
with Low-power Extension	–144 to +17	–144 to +17
with High-power Extension and Low-power Extension	–144 to +30	–144 to +25

*3: Reverse Power Protection for 1stRF/2ndRF [Option 043/073]

The MG3740A supports a convenient option for extending the lower RF output limit when performing high-sensitivity Rx tests.

High-power Output [Option 041*1/071*2]

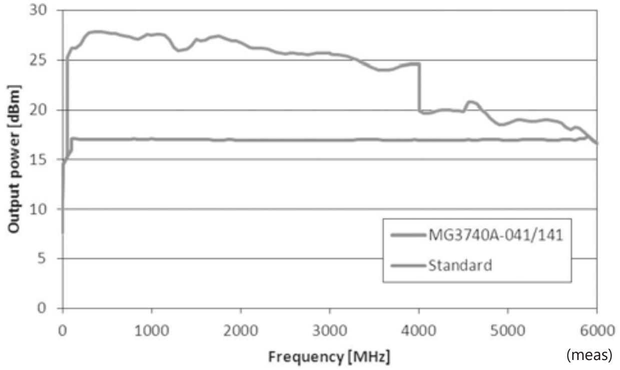
*1: High Power Extension for 1stRF [Option 041]
*2: High Power Extension for 2ndRF [Option 071]

Level Accuracy is assured at high levels (CW)

Frequency Range	Standard	Option 041/071
100 kHz ≤ f < 10 MHz	+5 dBm	+5 dBm
10 MHz ≤ f < 50 MHz	+10 dBm	+10 dBm
50 MHz ≤ f < 400 MHz	+13 dBm	**+20 dBm**
400 MHz ≤ f ≤ 3 GHz		**+23 dBm**
3 GHz < f ≤ 4 GHz		**+20 dBm**
4 GHz < f ≤ 5 GHz		+13 dBm
5 GHz < f ≤ 6 GHz	+11 dBm	+11 dBm

These options expand the MG3740A RF output upper limit.
They are used when compensating for level losses of parts in the measurement path.

Maximum output power



Supports Rubidium Reference Oscillator (Option)

Three reference oscillator options are supported. Select the high-stability reference oscillator option [Option 002] when requiring high accuracy depending on the measurement conditions; for even higher accuracy, select the rubidium reference oscillator [Option 001]. However, if external high-accuracy reference signals are available, selecting the standard reference oscillator option helps reduce unnecessary costs.

- Reference Oscillator
  Standard
    Aging Rate: ±1 × 10^{-6}/year, ±1 × 10^{-7}/day
    Temperature Stability: ±2.5 × 10^{-6} (5° to 45°C)
  High Stability Reference Oscillator [Option 002]
    Aging Rate: ±1 × 10^{-7}/year, ±1 × 10^{-8}/day
    Temperature Stability: ±2 × 10^{-8} (5° to 45°C)
    Start-up Characteristics*: ±5 × 10^{-7} (2 minutes after power-on)
    ±5 × 10^{-8} (5 minutes after power-on)
  Rubidium Reference Oscillator [Option 001]
    Aging Rate: ±1 × 10^{-10}/month
    Temperature Stability: ±2 × 10^{-9} (5° to 45°C)
    Start-up Characteristics*: ±1 × 10^{-9} (7.5 minutes after power-on)

*: Compared to frequency after 24-h warm-up at 23°C

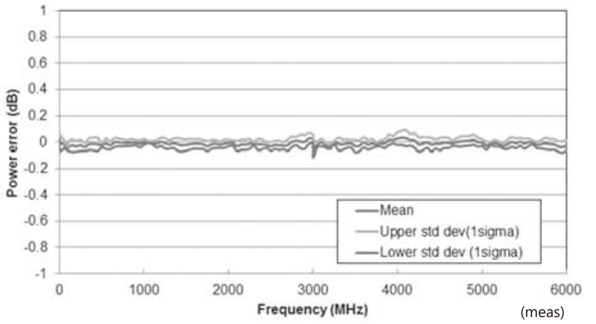
High Level Accuracy

Absolute Level Accuracy: ±0.5 dB*1
Linearity: ±0.2 dB (typ.)*2

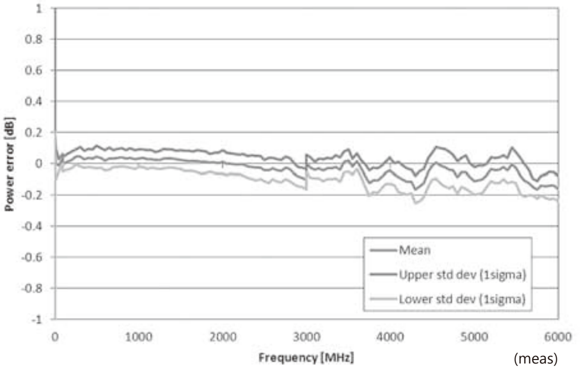
*1: 400 MHz to 3 GHz, –110 to +10 dBm
*2: 50 MHz to 3 GHz, –110 to –1 dBm

Excellent level accuracy and linearity are key factors with a large impact on measurement accuracy.

Level accuracy at 0 dBm

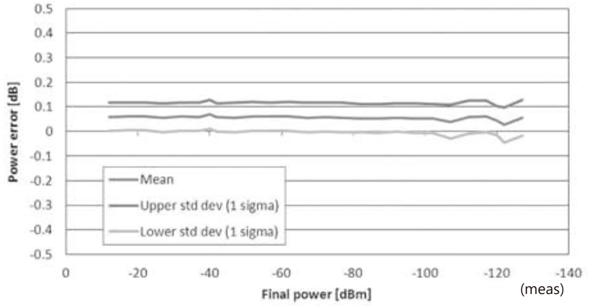


Level accuracy at –112 dBm



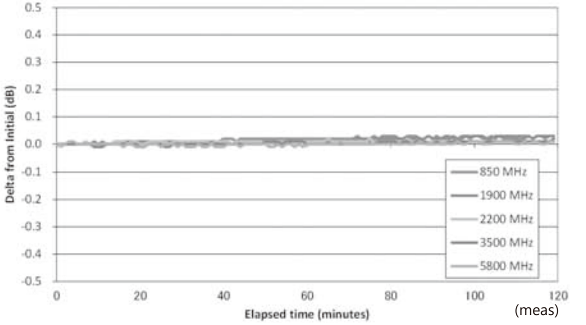
Frequency Characteristic

Relative level accuracy at 850 MHz initial power +10 dBm



Linearity

Amplitude repeatability +5 dBm ALC on



Aging

High-speed Switching

<600 µs @List/Sweep mode

To shorten tact times on production lines the MG3740A supports two standard modes each with high-speed frequency and level switching.

- Sweep Mode
  In this mode, the dwell time per point or number of points is split between the frequency range and level range (Start/Stop).
  This mode is used when matching dwell time per point and frequency/level steps.

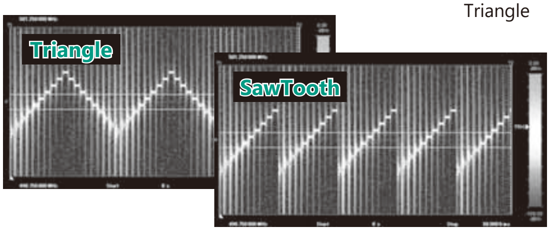
Frequency Range

Level Range

Points:
2 to 1000 (Sawtooth)
2 to 500 (Triangle)

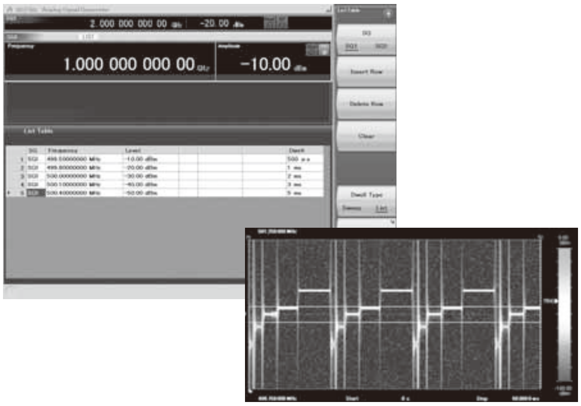
Dwell Time:
100 µs to 16 s

Step Shape:
Sawtooth
Triangle



10 points, 500-µs Dwell Time

- List Mode
  In this mode, the frequency, level and dwell time can be set for each of up to 500 points. This mode is used when wanting to set any dwell time, and frequency/level step per point.



5 points, Any Dwell Time

Dual VSG: Two RF Outputs

The MG3740A supports two RF outputs (1stRF/2ndRF) max. in one unit. Moreover, different frequencies can be set independently at 1stRF and 2ndRF.
Not only different frequencies but also different levels and modulations can be set independently at each SG while each is tracking the other.
The all-in-one MG3740A eliminates the need for two conventional signal generators when requiring wanted + interference waveforms for evaluating Rx signal characteristics, testing intermodulation characteristics of radio equipment and amplifiers, and generating RF/LO signals for evaluating mixers.

Notes: Supported frequency bands cannot be changed after shipment.
IQ input is supported only by SG1 (1stRF) and requires Option 017.

2ndRF
Frequency Range:
100 kHz to 2.7 GHz [Option 062]
100 kHz to 4.0 GHz [Option 064]
100 kHz to 6.0 GHz [Option 066]
* Whether or not install and the frequency model can be selected at any time.

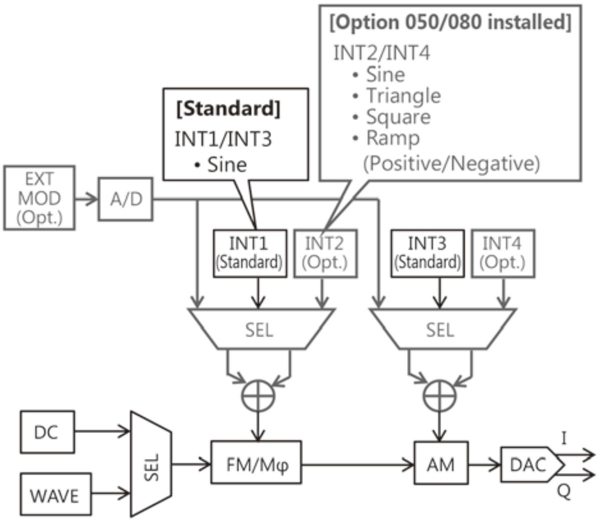
1stRF
Frequency Range:
100 kHz to 2.7 GHz [Option 032]
100 kHz to 4.0 GHz [Option 034]
100 kHz to 6.0 GHz [Option 036]
* Must install any one of these.

Expandability

AM/FM/ΦM/Pulse Function

This option supports the following modulation functions as standard. Analog modulation (AM/FM/ΦM) is supported using both CW and internal modulation signals.
Pulse modulation can be performed at any cycle or timing and also supports modulation using an external input signal.

- Amplitude Modulation (Internal Modulation Source)
  Depth: 0 to 100% (Linear)
  0 to 10 dB (Exponential)
  Modulation Frequency: 0.1 Hz to 50 MHz
- Frequency Modulation (Internal Modulation Source)
  Deviation: 0 to 40 MHz
  Modulation Frequency: 0.1 Hz to 40 MHz, or (50 MHz-FM Rate), whichever smaller
- Φ-Modulation (Internal Modulation Source)
  Deviation angle: 0 to 160 rad.
  or (40 MHz/ΦM Rate) rad., whichever smaller
  Modulation Frequency: 0.1 Hz to 40 MHz,
  or (40 MHz/ΦM Deviation), whichever smaller
- Pulse Modulation (Internal Modulation Source)
  Modulation Frequency: 0.1 Hz to 10 MHz
  Modulation Period: 10 ns to 20 s
- Additional Analog Modulation Input [Option 050/080]
  Adding additional analog modulation input options (Option 050/080) extends to two internal modulation sources (AM/FM/ΦM) and one external modulation source supporting simultaneous two-signal modulation. This is used when superimposing tone squelch signals.
  AM + FM
  AM + ΦM
  Internal 1 + Internal 2
  Internal + External
  *: FM + ΦM does not support.



USB Power Sensors [Sold separately]

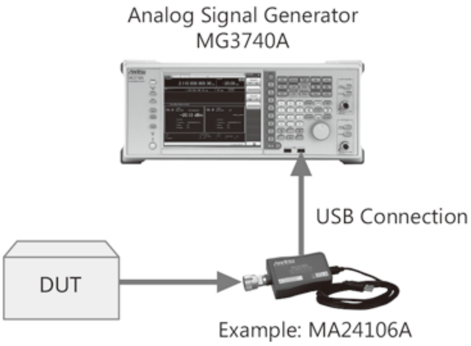
Up to two USB power sensors can be connected to the MG3740A to display the measurement results on the MG3740A screen.

Compatible USB power sensors

Model	Frequency Range	Dynamic Range
MA24104A*	600 MHz to 4 GHz, Resolution: 1 kHz	+3 to +51.76 dBm
MA24105A	350 MHz to 4 GHz, Resolution: 1 kHz	+3 to +51.76 dBm
MA24106A	50 MHz to 6 GHz, Resolution: 1 kHz	–40 to +23 dBm
MA24108A	10 MHz to 8 GHz, Resolution: 100 kHz	–40 to +20 dBm
MA24118A	10 MHz to 18 GHz, Resolution: 100 kHz	–40 to +20 dBm
MA24126A	10 MHz to 26 GHz, Resolution: 100 kHz	–40 to +20 dBm

*: MA24104A has been discontinued. Replacement model is MA24105A.

Level Offset: –100 to +100 dB
Average: 1 to 2048
Unit: dBm, W
COM Port: 2 to 8



Ch. A COM 5 MA24106A Connected
−20.13 dBm
Settings
Frequency 1.00000000000 GHz
Offset Off
Average Off

Ch. B COM 2 MA24106A Off
--.--
Settings
Frequency 1.00000000000 GHz
Offset Off
Average Off

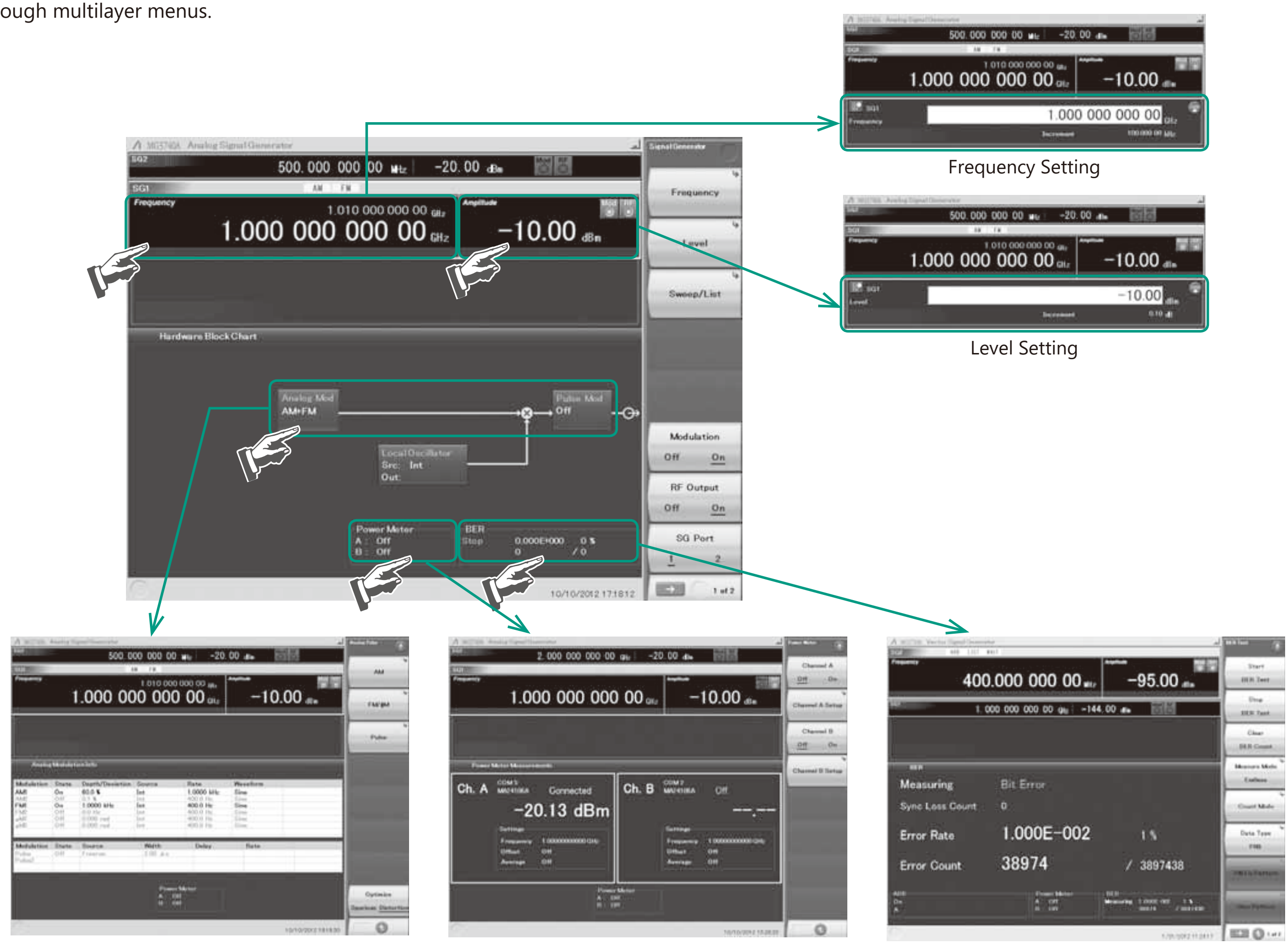
Power Meter
A : Off
B : Off

Power Meter Measurement Screen

Operability

Easy Touch-panel Operation

Simply touching parts of the screen display with a finger fetches related function keys and numeric inputs, offering a fast and easy way of navigating through multilayer menus.



Frequency Setting

Level Setting

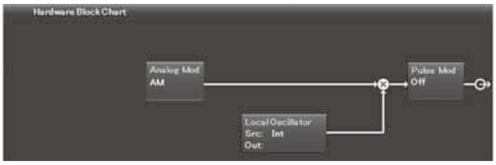
AM/FM/ΦM/Pulse Function

Power Meter Function

BER Function [Option 021]

Signal Flowcharts

The Hardware Block Chart provides an intuitive at-a-glance understanding of the settings and signals for each block (Analog Mod, Pulse Mod, Local, etc.)



Hardware Block Chart Screen

Frequency Channel Table

Sometimes frequencies need setting by Channel No. The built-in frequency channel table where frequencies are set by channel number is ideal for this application. Once set and saved, these pre-settings can be read whenever needed.

- Channel Table Setting
  Group: 1 to 19
  Start Channel: 0 to 20000
  End Channel: (Start Channel) to 20000
  Start Frequency
  Channel Spacing

Connection with External Equipment

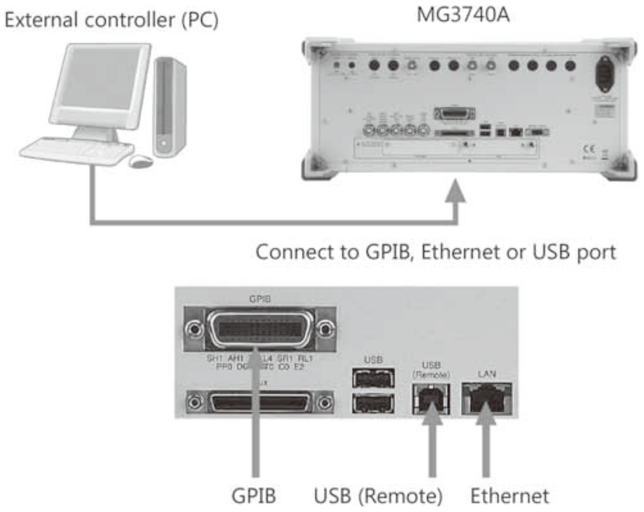
Remote Control Interfaces

The MG3740A has GPIB, Ethernet and USB interfaces as standard, supporting the following functions:

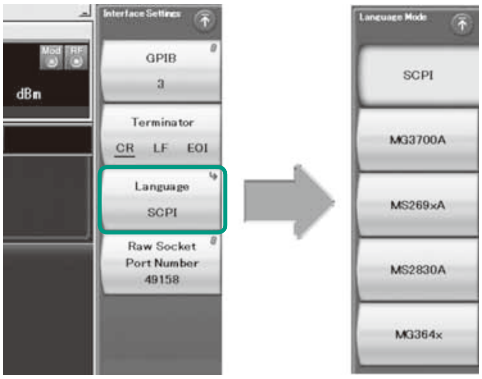
- Control all functions, except power switch
- Read all status conditions and settings
- Interrupts and serial polls

While in the Local status, the interface is determined automatically by the communication start command from the external controller (PC). To change the interface, put the MG3740A into the Local status again by pressing the Local key on the front panel and then send a command via the desired interface.

- GPIB: Conforms to IEEE 488.1/IEEE 488.2 standards
  SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0, E2
- Ethernet: Conforms to VXI-11 protocol using TCP/IP Control programs
  SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0
- USB: Conforms to USBTMC-USB488 protocols
  SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0n



To remotely control the MG3740A, either select the SCPI mode command format defined by the SCPI Consortium, or select backwards compatible modes supporting earlier MG3700A, MS269xA, MS2830A, and MG364xA commands



GPIB 3

Terminator CR LF EOI

Language SCPI

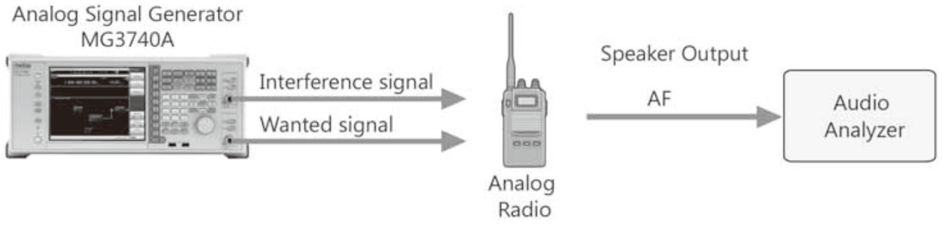
Raw Socket Port Number 49158

Command Format Setting Example

USB Connections

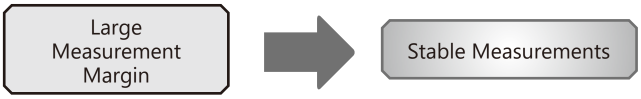
The two type-A USB2.0 connectors on the front and rear panels support keyboard, mouse and USB memory connections. Supported USB power sensors can be connected too.

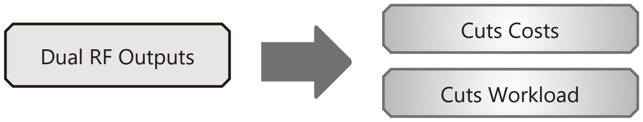
Analog Radio Rx Characteristics Tests



Setup for analog radio Rx characteristics tests

The MG3740A outputs RF signals for radio operation verification tests and evaluation of Rx characteristics, when the radio AF output can be measured with an external audio analyzer.





High-Purity Signal Source for Testing Analog Radio

Supports SSB Phase Noise Performance –140 dBc/Hz nom. (@100 MHz)

Phase noise performance affects measurement results at narrow bandwidths of several kHz. In particular, high phase-noise performance is required for interference waveforms.

The excellent SSB phase noise performance supports narrowband radio Rx sensitivity suppression tests.

<–140 dBc/Hz (nom.)	@100 MHz, 20-kHz offset, CW
<–131 dBc/Hz (typ.)	@1 GHz, 20-kHz offset, CW
<–125 dBc/Hz (typ.)	@2 GHz, 20-kHz offset, CW

The excellent level accuracy over a wide output level range supports accurate Rx sensitivity tests.

Amplitude setting range: –110 to +17 dBm (Standard)
–144 to +17 dBm (with Option 042/072)
Absolute level accuracy: ±0.5 dB*1
Linearity 1: ±0.2 dB (typ)*2

*1: 400 MHz to 3 GHz, –110 to +10 dBm
*2: 50 MHz to 3 GHz, –110 to –1 dBm

Supports Maximum Two RF Outputs

The dual RF outputs of the all-in-one MG3740A help cut infrastructure costs by eliminating the need for two signal sources when outputting wanted + interference waves for RX characteristics tests, and evaluating intermodulation characteristics, etc. Additionally, there is no need for troublesome settings at each of two separate signal generators helping cut operation time and costs using the frequency/level synchronization function.

AM/FM/ΦM/Pulse Function (Standard)

Supports built-in analog modulation (AM/FM/ΦM) functions and pulse modulation (PM) functions.

Adding additional analog modulation input options (Option 050/080) supports modulation by external signal input. This is used when superimposing tone squelch signals.

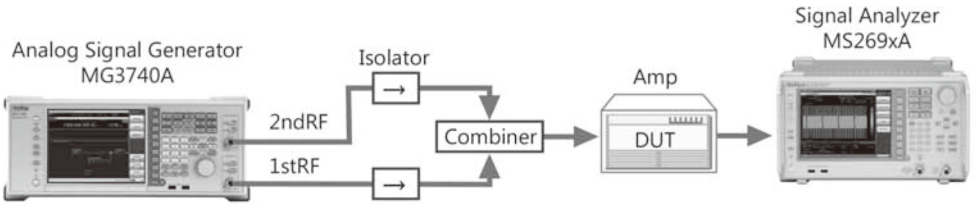
AM + FM
AM + ΦM
Internal 1 + Internal 2
Internal + External

* FM + ΦM does not support.

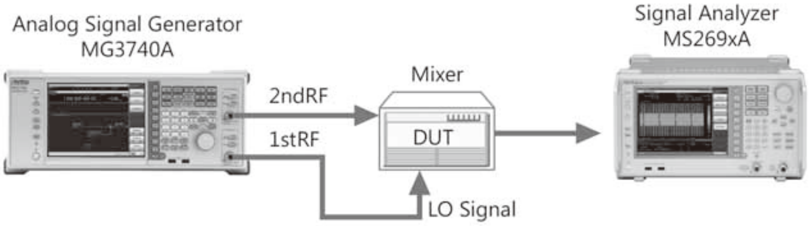
Analog Radio Main Rx Characteristics Evaluation Items

Test Items	MG3740A Key Features	
Sensitivity	✓	Wide level range, High level accuracy, Internal modulation function (standard)
Passing Bandwidth, Attenuation	✓	High level accuracy, Frequency offset setting function
AF Level	✓	Internal modulation function (standard)
Demodulation Frequency Characteristics	✓	Internal modulation function (standard)
Demodulation Distortion	✓	Internal modulation function (standard)
Demodulation S/N	✓	Internal modulation function (standard), External modulation function (Option)
Spurious Response	✓	High level accuracy, Internal modulation function (standard)
Sensitivity Suppression Effect	✓	Dual RF, Low SSB Phase Noise *All-in-one evaluation without requiring two separate signal sources.
Intermodulation Characteristics	✓	Dual RF, Low SSB Phase Noise *Two units of MG3740A support evaluation without requiring three separate signal sources.

Reference Signal Generator for Evaluating Characteristics of Amplifiers, Mixers, etc.



Setup for evaluating intermodulation characteristics of amplifier



Setup for evaluating distortion characteristics of Mixer

The dual RF outputs of the MG3740A are ideal for evaluating intermodulation (IM3) characteristics of amplifiers, etc., as well as for use as RF/LO signal sources for testing mixers, eliminating the need for two separates signal generators. The high-performance MS269xA Signal Analyzer series is recommended for intermodulation and harmonic wave distortion measurements.

Dual RF Outputs → Cuts Costs
Cuts Workload

Supports Maximum Two RF Outputs

Usually, two general signal generators are required to output two continuous waveforms when evaluating the intermodulation characteristics of amplifiers, etc., or for use as RF/LO signal sources at mixer tests. A maximum of two RF outputs (1stRF/2ndRF) can be installed in the MG3740A and the product lineup includes models with different 1stRF and 2ndRF frequencies.

Different frequencies and levels can be set at the two signal outputs and the frequency/level synchronization function cuts the setting workload too.

USB Power Sensor → Efficient Equipment Investment

USB Power Sensor

Up to two USB power sensors (separately sold) can be connected to the MG3740A.

USB connectors to display the measurement results on the MG3740A screen.

Compatible USB power sensors

Model	Frequency Range	Dynamic Range
MA24104A*	600 MHz to 4 GHz, Resolution: 1 kHz	+3 to +51.76 dBm
MA24105A	350 MHz to 4 GHz, Resolution: 1 kHz	+3 to +51.76 dBm
MA24106A	50 MHz to 6 GHz, Resolution: 1 kHz	–40 to +23 dBm
MA24108A	10 MHz to 8 GHz, Resolution: 100 kHz	–40 to +20 dBm
MA24118A	10 MHz to 18 GHz, Resolution: 100 kHz	–40 to +20 dBm
MA24126A	10 MHz to 26 GHz, Resolution: 100 kHz	–40 to +20 dBm

*: MA24104A has been discontinued. Replacement model is MA24105A.

No External Amp → Stable Level Accuracy
Cuts Risk of Damage to DUT

High-power Output Option Supports CW Levels of +23 dBm (Option 041/071)

In general, an external amp is required when the output of a signal generator is insufficient, such as covering the measurement system transmission path loss and inputting high-level modulation signals for amp distortion characteristics tests. Since the output of an external amp cannot be assured, it must be checked with a power meter each time the frequency and level are changed. Moreover, when using an external amp, sometimes the DUT may be damaged by mishandling errors. The MG3740A high-power output supports signals required for measuring path loss. In addition, stable measurement is assured when used within the guaranteed setting range. And the risk of mistakenly damaging the DUT is reduced, even at the output limit.

Expansion to Digital Modulation Signal Generator

The MG3740A can be expanded to add digital modulation generation functions, supporting evaluation of digital public safety radio systems. All-in-one support for both analog and digital tests maximizes equipment investment efficiency.

Digital Modulation [Option 020]

Adding the digital modulation option [Option 020] supports generation of digital modulation signals by outputting narrowband digital modulation signals.

Digital Modulation Performance
  RF Modulation Bandwidth: 2 MHz
  Sampling Rate: 20 kHz to 8 MHz

Dual Waveform Memory: Four Waveform Outputs Max.

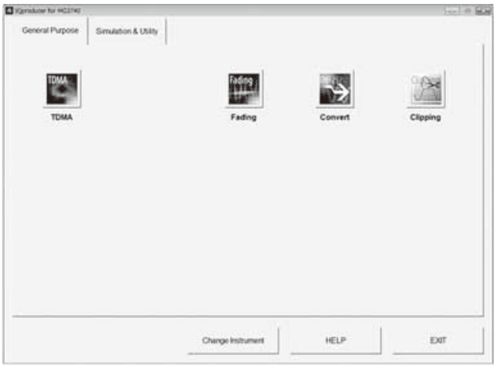
In the standard configuration, one RF (1stRF or 2ndRF) has one waveform memory. However, adding the baseband signal combine option (Option 048/078) upgrades to two memories for one RF.
In other words, models with two RFs (1stRF and 2ndRF) installed can have a maximum of four waveform memories. Two waveform patterns can be set easily on-screen for one RF, each with different frequency offset, level offset and delay time settings to output a combined baseband RF signal. With this setup, one MG3740A supports the following test environment — a setup that previously required two signal generators:

Wanted Signal + Interference Signal
Wanted Signal + Delayed Signal

Waveform Generation Software (Separate License)

The IQproducer system provides an easy-to-use GUI for setting parameters according to each communications method.
The parameter setting results file can be saved as a file for easy recall later.

* For detail, refer to the IQproducer catalog.



IQproducer Main Screen

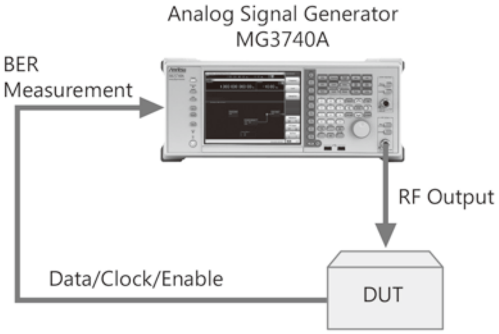
MG3740A Option IQproducer

- TDMA IQproducer MX370102A
  Sets required parameters for TDMA waveform patterns and generates various waveform patterns.
- Fading IQproducer MX370107A
  Performs IQ channel fading processing, correlation matrix calculation, AWGN combination.

BER Test Function [Option 021]

This option installs a BER measurement function for measuring error rates between 100 bps and 40 Mbps using the DUT demodulated Data/Clock/Enable signals. The results are displayed on the MG3740A screen.

- Input Bit Rate: 100 bps to 40 Mbps
- Input Signal: Data, Clock, Enable
  (Polarity reversal supported)
- Input Level: TTL
- Measured Patterns: PN9/11/15/20/23, ALL1, ALL0,
  Alternate (0101...), User Data,
  PN9fix/11fix/15fix/20fix/23fix
- Count Mode
  Data: Measures until specified Data count
  Error: Measures until specified Error count
- Measurable Bit Count: ≤2^{32} – 1 (4,294,967,295 bits)
- Measurement Mode
  Single: Measures specified measurement bit count once
  Continuous: Repeats Single measurement
  Endless: Continues measurement to upper limit of measurement bits

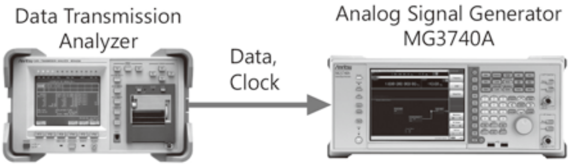


The BER can be measured using the DUT-demodulated Data/Clock/Enable.

BER Measurement Upper Limit

The table below shows one example of a BER measurement that indicates SyncLoss. Actual results depend on the specific communication systems and data rate, and will not necessarily match the measurement values below.

Error Rate	PN9	PN11	PN15	PN20	PN23
6.0%	–	–	–	–	–
5.0%	OK	–	–	–	–
4.0%	OK	OK	–	–	–
3.0%	OK	OK	OK	–	–
2.5%	OK	OK	OK	–	–
2.0%	OK	OK	OK	OK	OK
1.0%	OK	OK	OK	OK	OK



Key Differences from MG3710A Vector Signal Generator

Installing the Digital Modulation Option (Option 020) in the MG3740A Analog Signal Generator adds the functions of a digital modulation signal generator. The key differences in the main functions compared to the conventional MG3710A Vector Signal Generator are listed below.

Key Functional Differences between Analog Signal Generator MG3740A and Vector Signal Generator MG3710A

	MG3740A Analog Signal Generator	MG3710A[*1] Vector Signal Generator	Remarks
Frequency Range	100 kHz to 2.7 GHz (Option 032/062) 100 kHz to 4.0 GHz (Option 034/064) 100 kHz to 6.0 GHz (Option 036/066)	100 kHz to 2.7 GHz (Option 032/062) 100 kHz to 4.0 GHz (Option 034/064) 100 kHz to 6.0 GHz (Option 036/066)	Supports two signal generators (1stRF/2ndRF output) in one unit
Analog Modulation Internal Source	[Standard]	[Standard]	AM, FM/ΦM Each one internal source
Additional Analog Modulation Input	[Option 050/080]	[Option 050/080]	Extends to one external input, two internal source (AM, FM/ΦM)
Digital Modulation	[Option 020] Digital modulation performance - RF modulation bandwidth: 2 MHz - Sampling rate: 20 kHz to 8 MHz	[Standard] Digital modulation performance - RF modulation bandwidth: 160 MHz[*2]/120 MHz - Sampling rate: 20 kHz to 200 MHz[*2]/160 MHz	
Pre-installed Waveform Patterns	No	Yes	LTE FDD/TDD (E-TM1.1 to E-TM3.3) W-CDMA/HSDPA, GSM/EDGE, CDMA2000 1X/1xEV-DO, WLAN (802.11a/11b/11g), etc.
Waveform pattern/IQproducer	TDMA IQproducer Fading IQproducer	Listed bellow	Listed bellow
ARB Memory Upgrade (per RF)	[Option 045/075] Max. 256 Msamples	[Option 046/076] Max. 1024 Msamples	Standard: 64 Msamples
Combination of Baseband Signal	[Option 048/078]	[Option 048/078]	
AWGN Generator	No	[Option 049/079]	
Analog IQ Input/Output	No	[Option 018]	
Universal Input/Output	[Option 017] - Sweep Output (1stRF) - AUX-BNC conversion adapter	[Option 017] - Baseband Reference Clock Input/Output - Sweep Output (1stRF) - Local Signal Input/Output - AUX-BNC conversion adapter	
BER Measurement Function	[Option 021]	[Option 021]	

*1: The MG3710A Vector Signal Generator is recommended for many purposes.
For detail, refer to the MG3710A product brochure.
*2: Only when using WLAN IQproducer MX370111A and 802.11ac (160 MHz) option MX370111A-002.

Waveform Pattern Support Systems

Main frame support Waveform Pattern

Waveform pattern Support Systems	MG3740A (with Option 020)	MG3710A
MX370073A DFS Radar Pattern	—	✓
MX370075A DFS (ETSI) Waveform Pattern	—	✓

For detail, refer to the MX3700xxA Waveform pattern product brochure.

IQproducer Support Systems

Main frame support IQproducer

IQproducer Support Systems		MG3740A (with Option 020)	MG3710A
Standard Accessories	W-CDMA IQproducer	—	✓
	AWGN IQproducer	—	✓
Options	MX370101A HSDPA/HSUPA IQproducer	—	✓
	MX370102A TDMA IQproducer	✓	✓
	MX370103A CDMA2000 1xEV-DO IQproducer	—	✓
	MX370104A Multi-carrier IQproducer	—	✓
	MX370105A Mobile WiMAX IQproducer	—	✓
	MX370106A DVB-T/H IQproducer	—	✓
	MX370107A Fading IQproducer	✓	✓
	MX370108A LTE IQproducer	—	✓
	MX370108A-001 LTE-Advanced FDD Option	—	✓
	MX370110A LTE TDD IQproducer	—	✓
	MX370110A-001 LTE-Advanced TDD Option	—	✓
	MX370111A WLAN IQproducer	—	✓
	MX370111A-002 802.11ac (160 MHz) Option	—	✓
	MX370112A TD-SCDMA IQproducer	—	✓

For detail, refer to the MX3701xxA IQproducer product brochure.

Specifications

Refer to the Data Sheet for specification details such as guaranteed setting ranges, etc.

Frequency Setting Range

1stRF	
MG3740A-032	9 kHz to 2.7 GHz
MG3740A-034	9 kHz to 4 GHz
MG3740A-036	9 kHz to 6 GHz
2ndRF	
MG3740A-062	9 kHz to 2.7 GHz
MG3740A-064	9 kHz to 4 GHz
MG3740A-066	9 kHz to 6 GHz

Switching Speed (List Mode)

Frequency	≤600 μs
Level	≤600 μs

Amplitude Setting Range

Options	Setting Range [dBm]	
	without Reverse Power Protection	with Reverse Power Protection
Standard	–110 to +17	–110 to +17
with High-power Extension	–110 to +30	–110 to +25
with Low-power Extension	–144 to +17	–144 to +17
with High-power Extension and Low-power Extension	–144 to +30	–144 to +25

Level Accuracy is assured at high levels (CW)

Frequency Range	Standard	Option 041/071
100 kHz ≤ f < 10 MHz	+5 dBm	+5 dBm
10 MHz ≤ f < 50 MHz	+10 dBm	+10 dBm
50 MHz ≤ f < 400 MHz	+13 dBm	**+20 dBm**
400 MHz ≤ f ≤ 3 GHz		**+23 dBm**
3 GHz < f ≤ 4 GHz		**+20 dBm**
4 GHz < f ≤ 5 GHz		+13 dBm
5 GHz < f ≤ 6 GHz	+11 dBm	+11 dBm

Absolute Level Accuracy

CW, 18° to 28°C, –110 to +5 dBm
±0.5 dB (typ.) (100 kHz ≤ f < 50 MHz)
±0.5 dB (50 MHz ≤ f ≤ 3 GHz)
±0.7 dB (3 GHz < f ≤ 4 GHz)
±0.8 dB (4 GHz < f ≤ 6 GHz)

Harmonics

<–30 dBc

Non-Harmonics

Output level ≤+5 dBm, CW, Frequency offset ≥10 kHz
<–62 dBc (100 kHz ≤ f ≤ 187.5 MHz)
<–68 dBc (187.5 MHz < f ≤ 750 MHz)
<–62 dBc (750 MHz < f ≤ 1.5 GHz)
<–56 dBc (1.5 GHz < f ≤ 3 GHz)
<–50 dBc (3 GHz < f ≤ 6 GHz)

Single Sideband Phase Noise

CW, 20 kHz offset
<–140 dBc/Hz (nom.) (100 MHz)
<–131 dBc/Hz (typ.) (1 GHz)
<–125 dBc/Hz (typ.) (2 GHz)

Analog Modulation

- Amplitude Modulation (Internal Modulation Source)
  Depth: 0 to 100% (Linear)
  0 to 10 dB (Log)
  Modulation Frequency: 0.1 Hz to 50 MHz
- Frequency Modulation (Internal Modulation Source)
  Deviation: 0 Hz to 40 MHz
  Modulation Frequency: 0.1 Hz to 40 MHz, or (50-MHz FM Rate), whichever smaller
- Φ-Modulation (Internal Modulation Source)
  Deviation angle: 0 to 160 rad., or (40 MHz/ΦM Rate) rad., whichever smaller
  Modulation Frequency: 0.1 Hz to 40 MHz, or (40 MHz/ΦM Deviation), whichever smaller
- Pulse Modulation (Internal Modulation Source)
  Modulation Frequency: 0.1 Hz to 10 MHz
  Modulation Period: 10 ns to 20 s

Digital Modulation Performance [Option 020 installed]

- RF Modulation Bandwidth
  2 MHz
- ARB Memory Size
  64 Msamples (256 MB) [with 1stRF, 2ndRF]
  256 Msamples (1 GB) [Option 045/075]
- Sampling Rate
  20 kHz to 8 MHz
- DAC Resolution
  14/15/16 bits

EU Standards (CE Marking)

EMC: 2014/30/EU, EN61326-1, EN61000-3-2
LVD: 2014/35/EU, EN61010-1
RoHS: 2011/65/EU

Dimensions, Mass

426 (W) × 177 (H) × 390 (D) mm
≤13.7 kg (with 1stRF, excluding other option)

Power Supply

100 V(ac) to 120 V(ac), 200 V(ac) to 240 V(ac)
50 Hz to 60 Hz

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name	Remarks
	Main frame	
MG3740A	Analog Signal Generator	
	Standard accessories	
	Power Cord: 1 pc	
P0031A	USB Memory	USB2.0 Flash Driver, ≥256 MB
	Install CD-ROM	Operation manual (PDF) and application software (IQproducer)
	Options	
	(Common Parts)	
MG3740A-001	Rubidium Reference Oscillator	Select when ordering main frame, aging rate: ±1 × 10^{-10}/month
MG3740A-002	High Stability Reference Oscillator	Select when ordering main frame, aging rate: ±1 × 10^{-7}/year
MG3740A-011	2ndary HDD	Select when ordering main frame, spare HDD for saving user data without Windows OS
MG3740A-017	Universal Input/Output	Select when ordering main frame, Adds BNC connector for outputting Sweep Output signal (only supports SG1) to rear panel of main frame, includes J1539A AUX Conversion Adapter
MG3740A-020	Digital Modulation	Select when ordering main frame, Built-in Digital Modulation function. Digital modulation Performance: - RF modulation bandwidth: 2 MHz - Sampling rate: 20 kHz to 8 MHz
MG3740A-021	BER Test Function	Select when ordering main frame, Built-in BER measurement, Bit Rate: 100 bps to 40 Mbps J1539A AUX Conversion Adapter required for Data/Clock/Enable signal input
MG3740A-101	Rubidium Reference Oscillator Retrofit	Retrofitted to shipped MG3740A
MG3740A-102	High Stability Reference Oscillator Retrofit	Retrofitted to shipped MG3740A
MG3740A-111	2ndary HDD Retrofit	Retrofitted to shipped MG3740A
MG3740A-117	Universal Input/Output Retrofit	Retrofitted to shipped MG3740A
MG3740A-120	Digital Modulation Retrofit	Retrofitted to shipped MG3740A
MG3740A-121	BER Test Function Retrofit	Retrofitted to shipped MG3740A
MG3740A-181	CPU/Windows7 Upgrade Retrofit	Retrofitted to shipped MG3740A This option is for MG3740A units ordered until May 2018. It upgrades the currently installed CPU to a faster CPU and the OS to Windows 7 (WES7). Due to OS license restrictions, this option is not applicable to MG3740A units in which Option 313 Removable HDD (sales discontinued) is installed.
	(For 1stRF)	
MG3740A-032	1stRF 100 kHz to 2.7 GHz	Select when ordering main frame, select 1stRF frequency range, frequency cannot be changed after installation
MG3740A-034	1stRF 100 kHz to 4 GHz	Select when ordering main frame, select 1stRF frequency range, frequency cannot be changed after installation
MG3740A-036	1stRF 100 kHz to 6 GHz	Select when ordering main frame, select 1stRF frequency range, frequency cannot be changed after installation
MG3740A-041	High Power Extension for 1stRF	Select when ordering main frame, increases upper limit of output signal power setting range
MG3740A-042	Low Power Extension for 1stRF	Select when ordering main frame, increases lower limit of output signal power setting range
MG3740A-043	Reverse Power Protection for 1stRF	Select when ordering main frame, prevents damage caused by reverse input to output connector
MG3740A-045	ARB Memory Upgrade 256 Msample for 1stRF	Select when ordering main frame, expands ARB memory capacity. Requires MG3740A-020.
MG3740A-048	Combination of Baseband Signal for 1stRF	Select when ordering main frame, adds baseband combine function. Requires MG3740A-020.
MG3740A-050	Additional Analog Modulation Input for 1stRF	Select when ordering main frame, Adds BNC connector for inputting external signals to rear panel of mainframe.
MG3740A-141	High Power Extension for 1stRF Retrofit	Retrofitted to shipped MG3740A
MG3740A-142	Low Power Extension for 1stRF Retrofit	Retrofitted to shipped MG3740A
MG3740A-143	Reverse Power Protection for 1stRF Retrofit	Retrofitted to shipped MG3740A
MG3740A-145	ARB Memory Upgrade 256 Msample for 1stRF Retrofit	Retrofitted to shipped MG3740A. Requires MG3740A-020/120.
MG3740A-148	Combination of Baseband Signal for 1stRF Retrofit	Retrofitted to shipped MG3740A. Requires MG3740A-020/120.
MG3740A-150	Additional Analog Modulation Input for 1stRF Retrofit	Retrofitted to shipped MG3740A
	(For 2ndRF)	
MG3740A-062	2ndRF 100 kHz to 2.7 GHz	Select when ordering main frame, select 2ndRF frequency range, frequency cannot be changed after installation
MG3740A-064	2ndRF 100 kHz to 4 GHz	Select when ordering main frame, select 2ndRF frequency range, frequency cannot be changed after installation
MG3740A-066	2ndRF 100 kHz to 6 GHz	Select when ordering main frame, select 2ndRF frequency range, frequency cannot be changed after installation
MG3740A-071	High Power Extension for 2ndRF	Select when ordering main frame, increases upper limit of output signal power setting range
MG3740A-072	Low Power Extension for 2ndRF	Select when ordering main frame, increases lower limit of output signal power setting range
MG3740A-073	Reverse Power Protection for 2ndRF	Select when ordering main frame, prevents damage caused by reverse input to output connector
MG3740A-075	ARB Memory Upgrade 256 Msample for 2ndRF	Select when ordering main frame, expands ARB memory capacity. Requires MG3740A-020.
MG3740A-078	Combination of Baseband Signal for 2ndRF	Select when ordering main frame, adds baseband combine function. Requires MG3740A-020.
MG3740A-080	Additional Analog Modulation Input for 2ndRF	Select when ordering main frame, Adds BNC connector for inputting external signals to rear panel of mainframe.
MG3740A-162	2ndRF 100 kHz to 2.7 GHz Retrofit	Retrofitted to shipped MG3740A when 2ndRF not installed
MG3740A-164	2ndRF 100 kHz to 4 GHz Retrofit	Retrofitted to shipped MG3740A when 2ndRF not installed
MG3740A-166	2ndRF 100 kHz to 6 GHz Retrofit	Retrofitted to shipped MG3740A when 2ndRF not installed
MG3740A-171	High Power Extension for 2ndRF Retrofit	Retrofitted to shipped MG3740A
MG3740A-172	Low Power Extension for 2ndRF Retrofit	Retrofitted to shipped MG3740A
MG3740A-173	Reverse Power Protection for 2ndRF Retrofit	Retrofitted to shipped MG3740A
MG3740A-175	ARB Memory Upgrade 256 Msample for 2ndRF Retrofit	Retrofitted to shipped MG3740A. Requires MG3740A-020/120.
MG3740A-178	Combination of Baseband Signal for 2ndRF Retrofit	Retrofitted to shipped MG3740A. Requires MG3740A-020/120.
MG3740A-180	Additional Analog Modulation Input for 2ndRF Retrofit	Retrofitted to shipped MG3740A

Continued on next page

Model/Order No.	Name	Remarks
	Maintenance service	
MG3740A-ES210	2 Years Extended Warranty Service	
MG3740A-ES310	3 Years Extended Warranty Service	
MG3740A-ES510	5 Years Extended Warranty Service	
	Softwares (IQproducer)	(License for IQproducer)
MX370102A	TDMA IQproducer	IQproducer software, license for main frame, manual (PDF)
MX370107A	Fading IQproducer	IQproducer software, license for main frame, manual (PDF)
	Optional accessories	
W3580AE	MG3710A/MG3740A Operation Manual (Main Unit)	Booklet, for MG3710A/MG3740A Main Frame (Operation, Remote Control)
W2496AE	MG3710A/MG3740A Operation Manual (IQproducer)	Booklet, for IQproducer (Operation for Common Parts)
W2916AE	MX370102A Operation Manual	Booklet, for TDMA IQproducer
W2995AE	MX370107A Operation Manual	Booklet, for Fading IQproducer
J1539A	AUX Conversion Adapter	Converts MG3740A rear-panel AUX connector to BNC connector
Z1572A	Installation Kit	Required when retrofitting hardware options or installing IQproducer (MX3701xxA)
MA24105A	Inline Peak Power Sensor	350 MHz to 4 GHz, Inline type, with USB A to micro-B Cable
MA24106A	USB Power Sensor	50 MHz to 6 GHz, with USB A to mini-B Cable
MA24108A	Microwave USB Power Sensor	10 MHz to 8 GHz, with USB A to micro-B Cable
MA24118A	Microwave USB Power Sensor	10 MHz to 18 GHz, with USB A to micro-B Cable
MA24126A	Microwave USB Power Sensor	10 MHz to 26 GHz, with USB A to micro-B Cable
K240B	Power Divider (K connector)	DC to 26.5 GHz, K-J, 50Ω, 1 Wmax
MA1612A	Four-Port Junction Pad	5 MHz to 3 GHz, N-J
J0576B	Coaxial Cord, 1.0 m	N-P · 5D-2W · N-P
J0576D	Coaxial Cord, 2.0 m	N-P · 5D-2W · N-P
J0127A	Coaxial Cord, 1.0 m	BNC-P · RG-58A/U · BNC-P
J0127B	Coaxial Cord, 2.0 m	BNC-P · RG-58A/U · BNC-P
J0127C	Coaxial Cord, 0.5 m	BNC-P · RG-58A/U · BNC-P
J0322A	Coaxial Cord, 0.5 m	SMA-P · SMA-P, DC to 18 GHz, 50Ω
J0322B	Coaxial Cord, 1.0 m	SMA-P · SMA-P, DC to 18 GHz, 50Ω
J0322C	Coaxial Cord, 1.5 m	SMA-P · SMA-P, DC to 18 GHz, 50Ω
J0322D	Coaxial Cord, 2.0 m	SMA-P · SMA-P, DC to 18 GHz, 50Ω
J0004	Coaxial Adapter	N-P · SMA-J Conversion Adapter, DC to 12.4 GHz
J1261B	Ethernet Cable (Shield Type)	Straight-through, 3 m
J1261D	Ethernet Cable (Shield Type)	Crossover, 3 m
J0008	GPIB Cable, 2.0 m	
B0635A	Rack Mount Kit	EIA
B0657A	Rack Mount Kit (JIS)	JIS
B0636C	Carrying Case	Hard Type. With Casters and B0671A Front Cover
B0671A	Front Cover for 1MW4U	
Z0975A	Keyboard (USB)	
Z0541A	USB Mouse	

Typical (typ.): Performance not warranted. Must products meet typical performance.
Nominal (nom.): Values not warranted. Included to facilitate application of product.
Measured (meas): Performance not warranted. Data actually measured by randomly selected measuring instruments.

Trademarks:

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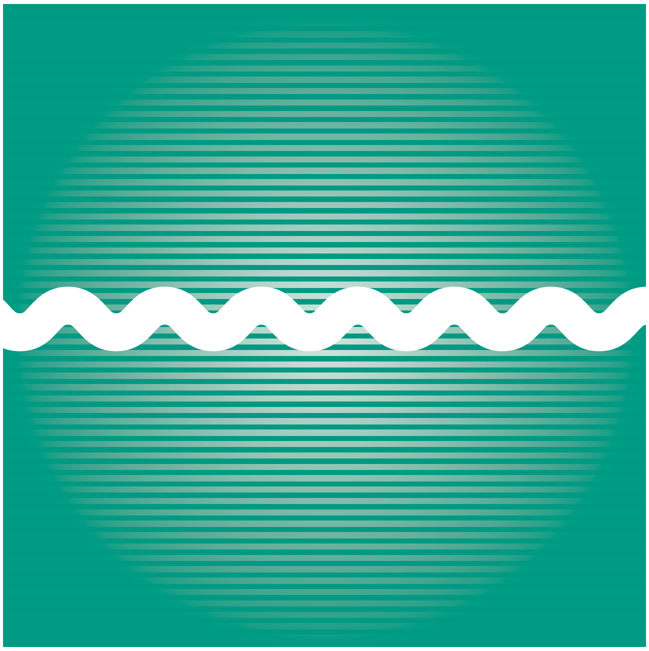


RF MICROWAVE MEASURING INSTRUMENTS

ML2430A Series

Remote Control
GPIB

For Measuring Wide Dynamic Range Power

The Power Meters ML2430A series combine the advantages of thermal meter accuracy, diode meter speed, and peak power meter display graphics. The result is a single instrument that achieves 90 dB dynamic range with a single sensor. The ML2430A series includes graphics display capability as a standard feature.
The ruggedized housing and optional high-capacity NiMH battery bring convenience and accuracy to field service applications.

Performance

Speed and Dynamic Range

The 90 dB range Power Sensors MA2470D series' high sensitivity reaches stable power readings to –70 dBm. 35 kHz sample rates profile cellular, PCS, and other pulsed signals to 0.1 µsec resolution. Superior connector technology achieves industry-leading return loss for improved accuracy through 50 GHz. The 87 dB range MA2440D series High Accuracy Sensors further improve return loss performance by adding a matching circuit to the MA2470D series' front end.

New power sensor technology achieves industry leading measurement linearity and high sensitivity.

Universal Power Sensors

The Universal Power Sensor MA2480D series will measure any modulated or multi-tone signal thanks to a patented sensor architecture with three diode pairs. Universal power sensors deliver over 80 dB of dynamic range with speed and accuracy.
Average power measurements on W-CDMA signals can now be made without the need for special power meters. Universal sensors are also ideal for power measurements on other digitally modulated carriers such as HDTV, DAB or QAM modulated radio links.
The sensor architecture ensures that one of the diode pairs is always operating in its square law region. The meter selects the diode pair operating in its square law region and is designed so that even the peaks of CDMA signals are measured accurately. Anritsu's three stage diode pair approach leads to a very much faster measurement time than the two stage approach used in previous generations of average power sensors. No slowing of measurement speed is observed at switching points, making them transparent to the user.
Universal power sensors are also ideal for applications where multiple signals are present, such as intermodulation measurements and satellite multi carrier power loading measurements.
A unique additional capability of the Anritsu Universal power sensor is the ability to use it as a standard diode sensor for fast CW measurements and pulse or TDMA measurements. In this mode the fast response of diode sensors is maintained across the full dynamic range of the sensor, meaning that for the majority of users it is the only sensor that they will ever need - a truly Universal Power Sensor.

GPIB Speed

A speed of >600 continuous readings per second is achieved under a variety of operating conditions including averaging settings, sensor control settings, triggering conditions, operating mode, sensor type, and GPIB interface manufacturer. The ML2430A series offers the ability to measure and transfer a high-speed burst of 200 data points using profile operating mode with sampling rates of 35k per second.

GPIB Emulation

With 99.9% emulation of older meters, the ML2430A series improves ATE system productivity. Typical test system speed improvement is 2 to 10 times faster system speed depending upon the number of measurements taken during the test, the minimal use of wait statements within the code, and the meter model emulated.

Triggering Controls

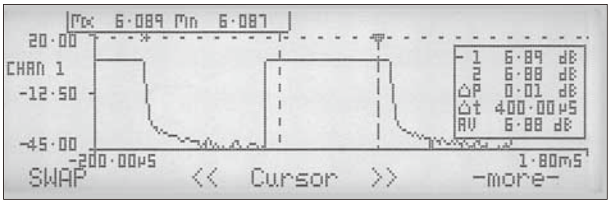
What use is high speed without triggering and sample controls? Data acquisition event arming and triggering functions traditionally found on expensive peak power meters are standard in the ML2430A series. Triggering delay and the sample integration time per reading can be directly controlled by the operator. Trigger sources include, continuous, internal, external TTL, and manual. Thus, data acquisition can be optimally controlled for synchronization with other test equipment.

Burst profile graphics display

The ML2430A features random repetitive sampling for high resolution of fast signals. A time domain graphic display profiles pulsed signals over a power range of –40 to +20 dBm. 35 kHz sampling speed produces clear power profiles of cellular and PCS signals including TDMA, PHS, GSM, and DCS-1800. Pulse top power is easily and repeatably measured using between cursor averaging. Measure pulse-top power over >80 dB dynamic range in readout mode at GPIB speeds >200 readings per second.

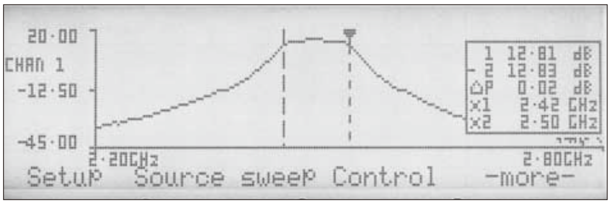
Power vs. Time Graphics Display

The power versus time mode is a strip chart style display for monitoring gain and output power variations over time/temperature, supply voltage, or a component tolerance. In service applications, measurement of power versus time aids trouble shooting of unusual conditions, such as intermittent switches or abnormal power control in a mobile telephone base stations. The power versus time mode provides a clear strip chart display of RF power variation.



Source Sweep Graphic Display

Power Sweep or frequency sweep data are acquired at more than 10 sweeps per second over GPIB. Synchronization with synthesizers requires connection (BNC) of a 10.0 V sweep ramp input and an RF blanking/dwell input.



Parallel Printer Connector

Many deskjet series printers can be connected directly to the ML2430A for fast documentation of performance on the bench or in the field. Meter calibration, triggering, and averaging settings are listed with the display printout. Thus, evidence of DUT (device under test) anomalies can be duplicated quickly.

90 dB Dynamic Range

Typical communications industry ATE systems operate over a 60 to 80 dB dynamic range. The MA2470D series' 90 dB dynamic range replaces two 50 dB sensors. Furthermore, an RF switch is no longer needed for the two sensors. This reduces software control complexity and further speeds test execution.

Sensor EEPROM

All MA2400D series sensors are equipped with internal EEPROMs for storage of calibration factor data vs. frequency. This allows the power meter to interpolate and correct readings automatically, improving accuracy and convenience.

High Reliability

A rugged polycarbonate chassis handles drop shocks and rough field treatment. The absence of vent holes makes the meter splash resistant. A front cover panel and softcase are optional for further environmental protection. Power sensors are also ruggedized for rough handling.

Improved Accuracy

Mismatch uncertainty is typically the largest source of error.
The Power Sensors MA2400D series offer a typical 5 to 6 dB improvement in sensor return loss, typically cutting mismatch uncertainty in half.
The High Accuracy Sensors MA2440D series incorporate a matching pad which further improves return loss by 5 to 6 dB — again halving mismatch uncertainty.

Offset Table for Path Loss Correction

Compensating for the true frequency response of attenuators, couplers, cables, switches, and other test setup devices improves measurement accuracy. For this reason, the ML2430A series can apply an offset table of attenuation-versus-frequency in addition to the traditional fixed dB offset capability. When a power sensor connection is preceded with a wideband power limiter, the offset table compensates for frequency response. Thus, the combination achieves an accurate, "burnout-proof" sensor.

Softkey Menu Control

Softkey menus simplify instrument control by making the user interface easier to understand. The numerical keypad simplifies the operator interface.

Battery

The optional NiMH "Smart" battery supports high charge density for a typical 8 hour day of operation. Accurate fuel gauging, <2 hour fast charge cycling, and the elimination of NiCd style memory effect further enhance the convenience of this battery technology.

Voltmeter

The ML2430A series also supports high-speed voltage measurement. A rear panel BNC measures voltage or operates as V/GHz input supporting automated sensor calibration factor correction.

High power applications

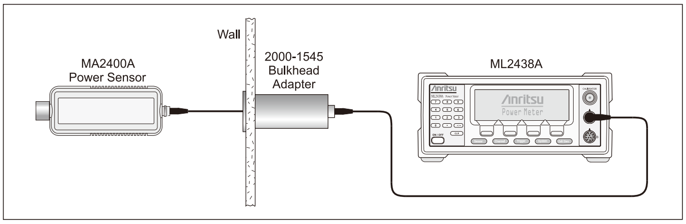
Traditional high power sensors are expensive and have degraded accuracy specifications. Further, their annual calibration requires more time and expense. Anritsu's User Calibration Factor Tables avoid these problems. Any attenuator or coupler can be compensated by entering frequency and attenuation values into the Power Sensors MA2400D Series internal EEPROM. The attenuation device can be semi-permantly attached; the power meter automatically applies compensation during the 0.0 dBm, 50 MHz calibration reference process. The User Calibration Factor Tables are easily deactivated – allowing the power sensor to be used stand-alone also.

Remote monitoring by telephone

Monitor transmitter performance remotely with standard telephone lines using the ML2430A's full duplex RS232 and dial-out capabilities. When the ML2430A detects a high or low limit line violation, it will automatically dial a phone number. The meter's data acquisition settings can adjust to monitor average power or the burst power of specific timeslots. The RS232 port uses the same commands as the GPIB. Contact your Anritsu representative for PC compatible software.

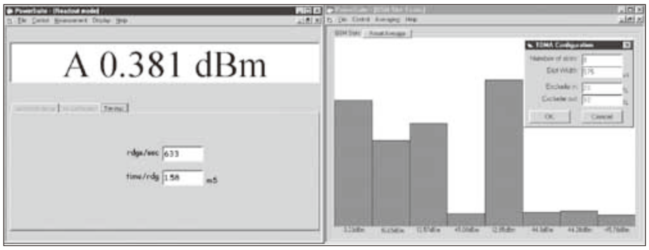
Locate power sensors remotely

When a power sensor's cable must pass through walls or shielded enclosures, the Model 2000-1545 Bulkhead Adapter provides a convenient connection between two sensor cables.



PowerSuite

PowerSuite software runs on a standard PC running Windows® 95 (or higher), via GPIB or RS232. PowerSuite is a very flexible package that provides full user control over measurement settings.
The PC screen can be set for continuous update so that changes to the device or system under test can be viewed instantly. Alternatively, plots can be archived for later analysis.


A 0.381 dBm

rdgs/sec 633

time/rdg 158 mS

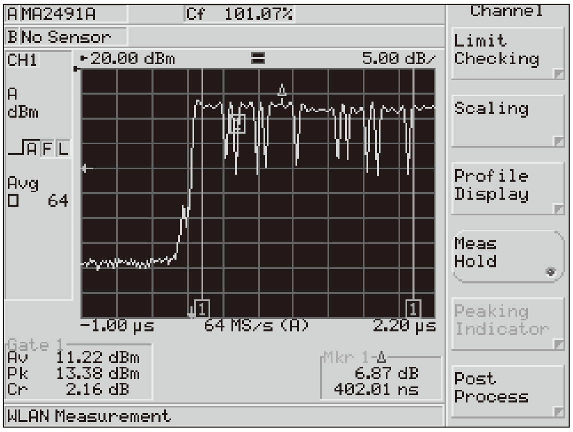
ML2480B Series

10 MHz to 50 GHz*

Remote Control
GPIB | Ethernet

For High Speed Modulated Power Measurements

The Wideband Peak Power Meters ML2480B Series are especially designed for accurate power measurements on high speed modulated signals, as well as pulsed power measurements.
The power meter combines advances in diode sensor technology with DSP to produce a compact and economical high speed peak power meter. A color display is used to display the results in graphical or numerical format. The power meter incorporates features normally found in digital oscilloscopes to produce an easy to use high speed peak power meter. A high speed GPIB interface can be used for rapid automation of the power measurement.
The ML2480B series has been designed to use the Wideband Sensor MA2491A. The ML2480B is fully compatible with the wide range of Anritsu diode, fast thermal and universal sensors.
Two versions of the product are available; the ML2487B Single Input unit and the ML2488B Dual Input unit.

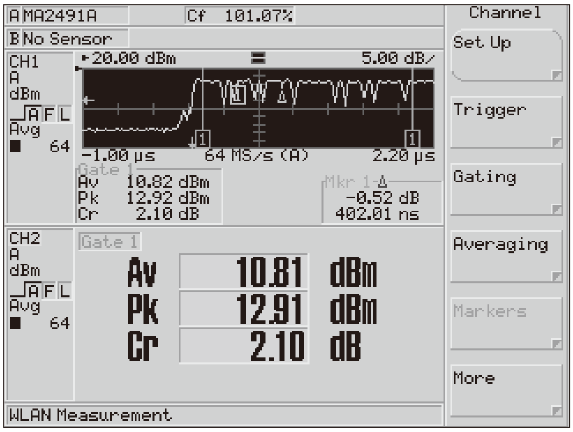


A MA2491A Cf 101.07%
B No Sensor
CH1 ▸20.00 dBm 5.00 dB/
A dBm
Avg 64
Gate 1
Av 11.22 dBm
Pk 13.38 dBm
Cr 2.16 dB
Mkr 1-Δ 6.87 dB 402.01 ns
WLAN Measurement

Performance

The ML2480B series has a 20 MHz instrument bandwidth and a sampling rate of 64 MS/s. This makes the power meter especially suitable for making measurements on a wide variety of signal formats such as 3G/4G, WLAN, and WiMAX as well as providing fast rise times for examining pulsed signals such as radar.

The wideband sensors MA2490A/91A have been designed for a variety of applications. With a selectable 5/20 MHz bandwidth, measurements can be made on the rising edges of pulsed systems as well as CDMA waveforms. The sensors have a dynamic range of –60 to +20 dBm in CW mode and a range of –25 to +20 dBm in pulse modulated mode.
The power meter combines the very best of high-speed measurement technology and CW stability.



A MA2491A Cf 101.07%
B No Sensor
CH1 ▸20.00 dBm 5.00 dB/
A dBm
Avg 64
Gate 1
Av 10.82 dBm
Pk 12.92 dBm
Cr 2.10 dB
Mkr 1-Δ -0.52 dB 402.01 ns
CH2 Gate 1
A dBm
Avg 64
Av 10.81 dBm
Pk 12.91 dBm
Cr 2.10 dB
WLAN Measurement

Profile or Readout Displays can be chosen

Key Features

Dual Display Channel

The ML2480B series supports dual display channels. Each display channel is a measurement set up and can use any selection or combination of the sensor inputs. The instrument can be configured to view one display channel or two. The instrument can be switched between display channels quickly and simply via the CH1/CH2 "hot" key on the front panel. The user can choose to view the measurement results as a graph profile or numerical readout.

*: Frequency range is sensor dependent.

Measurement Gates

At the heart of the new power meter's signal processing lies the measurement gate facility. The new power meter supports up to four independently set gates or eight gates repeated in a pattern.
The gate allows the user to capture the relevant information from the signal under test. The wide bandwidth and high speed A/D allow the positioning of the gate very accurately within the signal profile. The user can choose between several measurements performed within the gate. Average, peak, crest, max. and min. are available as selections for the output.
The max. and min. data are time stamped so that the position of these signals is recorded within the gate and can be used to record the overshoot and undershoot of a pulsed signal.
Exclusion zones within the measurement gate are also available. Termed fences, these can be used to exclude sections of the signal from the measurement gate. Particularly useful for excluding mid-burst training sequences. Each gate has a switchable fence associated with it.

Markers

Four independent markers are available for denoting points of interest on the signal profile. The active marker can be scrolled directly from the front panel. A delta marker can be set independently from the active marker to read the difference or the average power result. The delta marker can be linked to provide continuous scrolling through the signal. A set of specialized automatic marker functions has been provided to ease the measurement of pulsed systems. These functions are automatic pulse rise time, pulse fall time, off time and pulse repetition interval.

Trigger facilities

High speed measurements require precise triggering. The ML2480B series offer the following trigger modes:
Continuous, internal trigger on the rising or falling edge of either input A or input B and external TTL trigger. The external trigger allows the power meter to be synchronized to external equipment. Data collection can be delayed for a pre-determined time after the trigger point. The trigger facility incorporates a settable hold off facility which prevents the trigger from being re-armed and re-triggering on a noisy signal.
A pre-trigger facility allows the capture and display of pre-trigger information on the signal.
The single shot trigger facility can be used to capture specific one off events.

Test Limits

The ML2480B series has two different types of automatic test limits. For many applications a simple power limit can be set up to test the upper and /or lower boundaries of the signal. For pulsed systems such as radar, TDMA phone systems or WLAN, a time varying limit line can be set up to test all aspects of the pulse profile.
The power meter can be set up to indicate pass or fail and to hold the measurement display on failure which is important when trying to track down intermittent faults. An internal limit editor enables the user to create and select their own limit profiles.

Presets

The ML2480B series offers a number of radio system presets.
Each preset configures the power meter settings to measure a radio system. GSM, GPRS, W-CDMA, WLAN and Bluetooth are some of the examples of radio systems supported by this facility.

Settings stores

The Wideband Peak Power Meters ML2480B Series has 20 settings stores.
These provide a convenient way of having application specific measurement set ups for easy recall by the user.

Remote Interfaces

The ML2480B series supports Ethernet, GPIB and RS232 as standard.

Secure mode

The ML2480B series has a secure mode for operations in security sensitive areas. Once activated the secure mode deletes all information stored in the non-volatile RAM on power up.

Applications

WLAN

The ML2480B series is the ideal power meter for many variants of the 802.11 WLAN specification. The 20 MHz bandwidth allows users to get an accurate peak (and average) power reading without having to resort to manual correction of the peak reading due to bandwidth limitations. The wide bandwidth of the signal channel allows for the accurate placement of the gate to measure precise selections of the signal such as the OFDM training sequence at the start of the 802.11g signal.

GSM/EDGE/GPRS

The graphical display and the measurement gates make the measurement of GSM and PCS systems straightforward.
The Wideband Peak Power Meters ML2480B Series is set up to trigger on the GSM pulse. The active gate is set up to measure the power within the 10% to 90% section of the burst profile. An automatic limit can be used to give pass or fail indication. The display shows the results from the active gate, indicating the average power within the burst.
GPRS and GSM test modes can be tested easily with the use of the multiple gates. A GSM gate pattern can be repeated up to eight times to allow the power meter to capture and read back the power from each of the slots, giving up to eight simultaneous measurements.
EDGE measurements are quick and simple to make. The high sample rate leads to improved settling time and the use of the trigger hold off facility prevents re-triggering on the symbol transitions. PHS and IS-136 systems can also be measured effectively and quickly in this way.

3G-CDMA

The ML2480B series has been designed to measure the peak power of major CDMA systems in the world including those that use Time Division Duplexing such as TD-SCDMA. The display can be configured to measure Average, Peak and Crest Factor. The measurement period can be set for accurate results. TDD systems can be displayed as a graph profile and the measurement gates can be set to measure and display the peak and crest factor during the transmission.
CCDF, CDF and PDF statistical functions are supported on the CDMA measurements and enable the designers of power amplifiers to correctly estimate the margins on the peak power handling capabilities of the amplifiers.

Amplifier and PAE Measurements

Use the dual input ML2488B to measure the gain or the return loss of an amplifier under its correct operating conditions. Power amplifiers designed for peak applications, whether pulsed or CDMA, cannot operate at full peak power with CW test inputs. The gain and output power can only be measured accurately using a peak power meter under representative conditions.

PowerMax

PowerMax is a free graphical user-interface software, for the ML249xA power meter series (with firmware v2.20 or greater).
PowerMax provides the user an enhanced visualization of instrument display and full remote control of the instrument, allowing continuous view of measurement traces in real-time, archiving or printing of data and plots for future analysis.
PowerMax runs on a standard PC running Windows® 95 (or higher), and communicates with the power meter via Ethernet interface.

ML2490A Series

10 MHz to 50 GHz*

Remote Control
GPIB | Ethernet

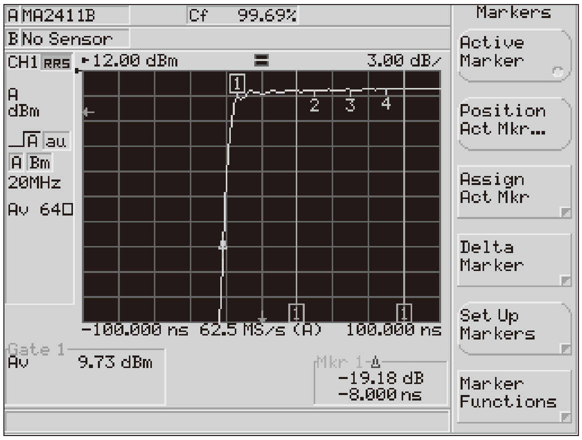
For Narrow Pulse Radar and 4G Power Measurements

The ML2490A is the latest addition to the Anritsu Peak Power meter line and extends the performance of the successful ML2480B series for the most demanding high bandwidth peak power measurement applications. This instrument incorporates extra wide bandwidth and a high resolution sampling system to provide detailed information on the power profile of Radar signals and the latest generation of wide bandwidth OFDM 4G systems.

The ML2490A series supports all the functionality of the ML2480B series and offers in addition a mainframe bandwidth of 65 MHz and an 8 ns rise time with the Pulse sensor MA2411B.

The ML2490A series has been designed to use the Pulse sensor MA2411B and the wideband sensors MA2490/91A, and is fully compatible with the wide range of Anritsu diode and universal sensors. See the section on the Power Meters ML2430A Series for more details on these sensors.

The power meter also offers a high performance CW mode creating a truly universal power meter for all applications.



Fast Rise Time Measurements

*: Frequency range is sensor dependent

Graphical or Numerical Results can be selected and displayed.

A comprehensive GPIB command set gives a wide range of commands to extract data from the signal under test.

A variety of built-in processing functions such as gates and markers enable precise sections of the signal to be measured and analysed using different processing functions.

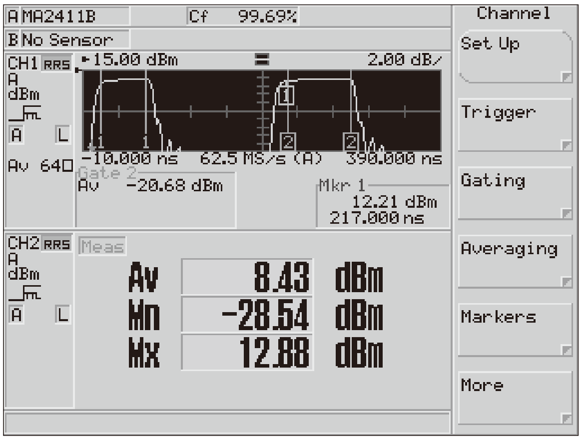
Two versions of the product are available: The ML2495A Single sensor Input version and the ML2496A, the dual sensor input version.

The ML2496A can be used for measuring gain under pulsed conditions.

The ML2490A is the ideal companion for other Anritsu test equipment, such as the MG3690C series and the MG3700A series.

Performance

- 65 MHz mainframe bandwidth
- 8 ns rise time with MA2411B sensor
- 50 ns to 7 s signal capture time
- Multi-pulse triggering capability
- External video connection



Title Flexible Display offers Single or Dual display output.

Key Features

1 ns Settable Display Resolution

The ML2490A has 1 ns settable resolution on time based measurements from 50 ns to 3.2 µs.

50 ns Minimum Time Display

The ML2490A can be set to measure narrow pulse width signals.

8 ns Typical Rise Time with MA2411B Sensor

The ML2490A rise time is typically 8 ns with the pulse sensor MA2411B providing a fast measurement on the most demanding of radar signals.

65 MHz Bandwidth

The power meter mainframe has 65 MHz bandwidth. Wide enough for accurate rise time measurements on radar signals or for measuring the peak signal of the latest 4G OFDM signals.

Two Sample Modes

For time durations up to 3.2 µs, the ML2490A series has a continuous sample rate. This can be set either automatically or the sample rate can be adjusted directly by the user.

For time durations of 50 ns to 3.2 µs the power meter uses repetitive sampling to build up the trace to 1 ns settable display resolution. Changeover between the two modes is automatic.

External Video Connector

The ML2490A has a video connector on the rear panel as standard. The power meter can be connected to a standard VGA monitor.

The power meter can be located remotely in a test rack and the video screen located close to where the adjustments are taking place.

50 MHz and 1 GHz Calibration Signals

The ML2490A has 50 MHz and 1 GHz calibrators as standard. Frequency is automatically selected with the appropriate sensor.

Dual Display Channel

The ML2490A supports dual display channels. Each display channel is a measurement set up and can use any selection or combination of the sensor inputs. The instrument can be configured to view one display channel or two. The instrument can be switched between display channels quickly and simply via the CH1/CH2 Hard 'hot' key on the front panel. The user can choose to view the measurement results as a graph profile or numerical readout.

Measurement Gates

At the heart of the power meter's signal processing lies the measurement gate facility. The power meter supports up to 4 independently set gates or 8 gates repeated in a pattern. The gate allows the user to capture the relevant information from the signal under test. The wide bandwidth and high speed A/D allow the positioning of the gate very accurately within the signal profile. The user can choose between several measurements performed within the gate. Average, peak, crest, max and min are available as selections for the output. The max and min data are time stamped so that the position of these signals is recorded within the gate and can be used to record the overshoot and undershoot of a pulsed signal.

Markers

Four independent markers are available for denoting points of interest on the signal profile. The active marker can be scrolled directly from the front panel. A delta marker can be set independently from the active marker to read the difference or the average power result. The delta marker can be linked to provide continuous scrolling through the signal.

Special Marker Features

A set of specialised automatic marker functions has been provided for to ease the measurement of pulsed systems. These functions are automatic pulse rise time, pulse fall time, off time and pulse repetition interval.

Trigger Facilities

High speed measurements require precise triggering. The trigger level can be set manually or automatically.

The ML2490A series offer the following trigger modes: Continuous, internal trigger on the rising or falling edge of either input A or input B and external TTL trigger.

The external trigger allows the power meter to be synchronized to external equipment. Data collection can be delayed for a pre-determined time after the trigger point. The trigger facility incorporates a settable frame arming facility which enables the power meter to synchronize to multi-pulse signals. A pre-trigger facility allows the capture and display of pre-trigger information on the signal.

The single shot trigger facility has settable bandwidths up to 20 MHz and can be used to capture specific one off events.

Long duration pulses can also be measured in CW mode.

Test Limits

The ML2490 series has two different types of automatic test limits. For many applications a simple power limit can be set up to test the upper and /or lower boundaries of the signal. For pulsed systems such as radar, a time varying limit line can be set up to test all aspects of the pulse profile. The power meter can be set up to indicate pass or fail and to hold the measurement display on failure which is important when trying to track down intermittent faults. An internal limit editor enables the user to create and select his or her own limit profiles.

Presets

The ML2490A offers a number of radio system presets. Each preset configures the power meter settings to measure a radio system.

Radar and OFDM presets are available.

Settings Stores

The power meter has 20 settings stores. These provide a convenient way of having application specific measurement set ups for easy recall by the user.

Remote Interfaces

The ML2490A series supports Ethernet (10/100BASE-T LAN), GPIB, and RS 232 as standard.

Secure Mode

The ML2490A series has a secure mode for operations in security sensitive areas. Once activated the secure mode wipes all information stored in the non-volatile RAM on power up.

CW Meter Mode

Functions as a dual purpose high accuracy, high dynamic range CW power meter.

Applications

Radar

The high bandwidth and sample rate of the ML2490A provide accurate peak measurements on a variety of radar, radio-navigation and radio-location systems.

The ML2490A series has a number of features tailored for peak power measurement on pulsed systems. With a typical 8 ns rise time, and a 1 ns resolution on the measurement, the ML2490A and MA2411B (pulse sensor) have the performance to look at the rising edge of radar signals. The power meter can be easily set up to trigger on a pulse or sequence of pulses. Up to 4 independent gates can be set to measure the average, max and min powers on a sequence of pulses. The data for the max and min includes the timestamp and gives the user automatic display of the position and value of the maximum overshoot and minimum undershoot in each pulse.

A set of automatic marker functions gives pulse rise time, fall time, off time and Pulse Repetition Interval. The Delta marker can be set up to measure the droop of the pulse top.

The Trigger event display is available as either arrows on the border of the screen or as an adjustable trigger event waveform on the display. All timings for the gates and markers are taken from the trigger event. The offset table function corrects the power meter reading to read the true output power when the power meter is being used with a coupler or high power attenuator in the radar test system.

OFDM Systems

Multi-carrier OFDM systems place high demands on the amplifiers and other components in the systems. The latest generation of communication systems (such as WiFi, WiMAX, and LTE) are adopting OFDM technologies. Conventional power meters do not have the bandwidth to see the signal power envelope change as the symbols in the multi-carrier system change. The ML2490A series can measure both continuous OFDM and framed OFDM. The increased bandwidth reduces errors made by lower bandwidth meters.

GSM/EDGE/GPRS

The graphical display and the measurement gates make the measurement of GSM and PCS systems straightforward. The power meter ML2490B series is set up to trigger on the GSM pulse. The active gate is set up to measure the power within the 10% to 90% section of the burst profile. An automatic limit can be used to give pass or fail indication. The display shows the results from the active gate, indicating the average power within the burst. GPRS and GSM test modes can be tested easily with the use of the multiple gates. A GSM gate pattern can be repeated up to eight times to allow the power meter to capture and read back the power from each of the slots, giving up to eight simultaneous measurements. EDGE measurements are quick and simple to make. The high sample rate leads to improved settling time and the use of the trigger hold off facility prevents re-triggering on the symbol transitions. PHS and IS-136 systems can also be measured effectively and quickly in this way.

3G-CDMA

The ML2490A series has been designed to measure the peak power of all the major CDMA systems in the world including those that use Time Division Duplexing such as TD-SCDMA. The display can be configured to measure Average, Peak and Crest Factor. The measurement period can be set for accurate results. TDD systems can be displayed as a graph profile and the measurement gates can be set to measure and display the peak and crest factor during the transmission. CCDF, CDF and PDF statistical functions are supported on the CDMA measurements and enable the designers of power amplifiers to correctly estimate the margins on the peak power handling capabilities of the amplifiers.

Amplifier and Return Loss Measurements

Use the dual input ML2496A to measure the gain or the return loss of an amplifier under its correct operating conditions. Power amplifiers designed for peak applications, whether pulsed or CDMA, cannot operate at full peak power with CW test inputs. The gain and output power can only be measured accurately using a peak power meter under representative conditions. The Power Added Efficiency of chipsets can be measured using the PAE feature and a current probe connected to the power meter.

PowerMax

PowerMax is a free graphical user-interface software, for the power meter ML249xA series (with firmware v2.20 or greater).

PowerMax provides the user an enhanced visualization of instrument display and full remote control of the instrument, allowing continuous view of measurement traces in real-time, archiving or printing of data and plots for future analysis.

PowerMax runs on a standard PC running Windows® 95 (or higher), and communicates with the power meter via Ethernet interface.

Power Meter Specifications

	ML2430A Series		ML2480B Series		ML2490A Series		Comments
	ML2437A	ML2438A	ML2487B	ML2488B	ML2495A	ML2496A	
Signal Inputs	1	2	1	2	1	2	
Frequency Range	100 kHz to 65 GHz (sensor dependent)						
Dynamic Range Continuous or Peak	–70 to +20 dBm (dependent on sensor, external coupler or attenuator)						Continuous or Peak
Performance	100 kHz (Profile mode)		Pulse/Modulated mode 20 MHz with MA2491A sensor CW mode 17 kHz ranges 1–4 35 Hz range 5		Pulse/Modulated mode >65 MHz range 7 >38 MHz range 8 >16 MHz range 9 (Repetitive Sampling) 20 MHz (One shot) Combined B/W (with MA2411B sensor) >39 MHz range 7 >29 MHz range 8 >12 MHz range 9 MA2411B (nom.) Bandwidth = 50 MHz CW mode 17 kHz range 1-4 36 Hz range 5		Nominal Video BW
	31.25 kS/s		Auto/Manual CW Mode 75 kS/s Pulse/Modulated Mode 31.25 kS/s to 62.5 MS/s (dependent on trigger capture time) Conflicts between selected settings and other instrument settings are indicated through user warnings (displayed and GPIB)		Auto/Manual CW Mode 75 kS/s Pulse/Modulated Mode 31.25 kS/s to 62.5 MS/s Continuous Sampling (Trigger capture time 3.2 μs to 7 s, 200 data points) 1 GS/s Random Repetitive Sampling (Trigger capture time 50 ns - 3.2 μs, 200 data points) Conflicts between selected settings and other instrument settings are indicated through user warnings (displayed and GPIB)		Sampling rate
	N/A		<18 ns (with MA2411B sensor) (typ.)		Typical 8 ns, Maximum 12 ns (with MA2411B sensor) Fall-time typically 11 ns		System rise-time (10 to 90% at +10 dBm)
			10% to 90% Rise-time measurement of –20 to +20 dBm Peak power (with MA2491A)				Rise-time measurement dynamic range
			≤3% in linear power at +10 dBm				Overshoot (Pulse/ Modulated mode)
Accuracy (Defined by uncertainty calculations with relevant sensor and source match conditions)	<0.5%		CW Mode <0.5% (±0.02 dB absolute Accuracy, ±0.04 dB relative Accuracy) Pulse/Modulated Mode <0.8% (nom.) range 7, 8				Instrumentation Accuracy
	Equivalent Noise Power (512 Moving Average) MA2472D MA2491A MA24002A Range 1 0.5 μW 2 μW N/A Range 2 50 nW 100 nW 0.5 nW Range 3 0.8 nW 2 nW 8 μW Range 4 0.2 nW 1 nW 2 μW Range 5 50 pW 0.5 nW 0.5 nW (CW mode) Range 7 5 μW 15 μW N/A Range 8 1 μW 5 μW N/A Range 9 0.5 μW 2 μW N/A (Pulse/Modulated mode)						Equivalent Noise Power is RSS of Zero Set, Zero Drift and noise. Zero Set and Drift is measured over on hour warm-up at constant ambient temperature. Noise is measured over five minutes over 512 averaging after one hour warm up at constant ambient temperature.

Continued on next page

	ML2430A Series	ML2480B Series	ML2490A Series	Comments
Operation	2	2 (CW or Pulse/Modulated measurement modes)		Measurement Display-Readout (Numerical)
	Power vs. Time graphic of readout data or Profile of Peak power for analysis of repetitive pulse or transient waveforms	2 (Pulse/Modulated measurement mode)		Measurement Display-Profile (Graph)
	Single channel power sweep or frequency sweep			Source sweep
	±5 dB range CW (Readout mode) only			Peaking meter
	Dynamic range covered by five overlapping amplifier ranges, R1, R2, R3, R4 and R5 Universal Sensor MA2481/82D ranges 1 to 6	Pulse modulated mode: Dynamic range covered by three overlapping amplifier ranges, R7, R8 and R9 CW mode: Dynamic range covered by five overlapping amplifier ranges, R1, R2, R3, R4 and R5 Universal Sensor MA2481/82D ranges 1 to 6		Amplifier Range
	Auto or Manual (current range or selectable 1 through 5)	Automatic or manual. When in manual clear indication given to user (display and GPIB) of fault conditions (under or over-range)		Range Hold
Features (summary)	Monochrome LCD, with backlight and adjust- able contrast	Color LCD		Display
	0.1 to 0.001 dB Linear power units, 3 to 6 digit, 1 to 3 digits selectable to right of decimal nW to W; Voltage, 1 to 2 digits selectable to right of decimal	0.1 to 0.001 dB		Display resolution in Readout mode
	0.01 dB			Display resolution in Profile mode
	Profile and P vs. T modes: 200 pixels display resolution For a 1 ms Profile window, cursor resolution on the display is 5 µs	16 ns Pulse/Modulated mode 15 µs CW Mode	1 ns (RRS mode) 16 ns (non RRS mode) Pulse/Modulated mode 15 µs CW Mode	Time measurement resolution
	Hold, Max, Min			Measurement hold
	Average, Min, Max	Average, Min, Max, Peak, Crest, PAE (Power Added Efficiency)		Measurements
	—	PDF, CDF, CCDF		Power statistics
	0.00 to 20.00 V (nom.)			Voltage measurement range
	Watt, %, VoltsdBm, dB, dBµV, dBmV, dBr	dBm, dBW, dB, dBµV, dBmV		Display units (Lin) Display units (Log)
	–199.99 to +199.99 dB			Display range
	1	Four Independently set Gates or eight repeated Gates One Fence per Measurement gate Gate measurement supports Average, Peak, Crest, Max and Min		Measurement Gates
	2	Four Markers and One Delta Marker, Marker to Max/Min, Pulse Rise/Fall-time, Pulse Width, Off Period, Pulse Repetition Interval Rise Fall/Search Parameter Variable % Reference: Max Marker or Gate Power Level		Markers
	Fixed value high and low limits with audible, rear panel TTL output, and/or visible Pass/Fail alarm indication Failure indication can latch for transient failure detection	Simple pass/fail for CW Complex limits for pulsed and TDMA systems 30 Limits Stores available on the instrument		Limit lines
	–199.99 to +199.99 dB (Fixed value or frequency dependent table)			Offset range
Averaging	Auto (Moving), Manual (Moving, Repeat)			Type
	1 to 512			Range
	Low, Medium and High settings apply post average low pass filter to improve visibility at high display resolution	N/A		Low-level Averaging

Continued on next page

	ML2430A Series	ML2480B Series	ML2490A Series	Comments
Triggering	Internal, External (TTL or RF Blanking), GPIB, Manual, Continuous	Continuous (not in Random Repetitive Sampling mode) Internal, External TTL (Rising or falling Edge), GPIB or external Bus		Source
	Manual Single power value set to cover entire measurement dynamic range of sensor Auto Automatically sets trigger level for signal over measurement dynamic range			Trigger modes
	N/A	Variable-auto set and manual 20 MHz, 2 MHz, 200 kHz, 20 kHz		Nominal Internal Trigger Bandwidth
	Sets the trigger arming, unless the trigger source is set to EXT TTL When ARMING is set to Blanking ON, only samples taken when the rear panel Digital Input BNC is active will be averaged in the measurement	Repetitive Sampling Modes: Automatic Frame for QAM and multi-pulse Continuous Sampling Modes: Single Automatic Frame for QAM and multi-pulse		Arming Sources
	N/A	0 to 64 × trigger capture time range or 120 s whichever is the greater		Frame Arming Time range
	–15 to 20 dBm (all diode sensors, selectable to –25 dBm)	–28 to +10 dBm with MA2472D CW mode –18 to +14 dBm with MA2491A –30 to +10 dBm with MA2472D Pulse/Modulated mode		Internal Trigger dynamic range
	1 dB			Internal Trigger level Accuracy (typ.)
	0.1 dB			Internal Trigger settable resolution
	N/A	±2 ns or display resolution, whichever is the larger (Trigger Capture time 50 ns to 3.2 µs) ±16 ns or display resolution whichever is the larger (Trigger Capture time 3.2 µs to 7 s)		Trigger time resolution Uncertainty
	0.0 to 999 ms	Pulse modulated mode Pretrigger (-ve): 95% of the Trigger Capture range Post Trigger: Set by 256K buffer and sample rate CW mode Post Trigger Only: 0-999 ms depending on Trigger Capture period setting		Trigger delay range
	TTL rising or falling edge (BNC input)			External Trigger range
	N/A	90% of trigger capture range		Pre-trigger range
	0.5% of display period or 100 ns	200 display points 1 ns or 0.5% of trigger capture time, whichever is the larger 400 display points 1 ns or 0.25% of trigger capture time (400 points), whichever is the larger		Trigger delay settable resolution
	N/A	±2 ns for pre and post trigger (Trigger capture time of 3.2 µs or 50 ns)		Trigger delay uncertainty
	N/A	±15 ns (20 MHz trigger BW)		Trigger latency
	Profile mode: 10 ms to 7 s P v T mode: 1 m to 24 hrs	3.2 µs to 7 s	50 ns to 7 s	
	N/A	200 display points 16 ns or 0.5% of trigger capture time, whichever is the larger 400 display Points 16 ns or 0.25% of trigger capture time, whichever is the larger	200 display points 1 ns or 0.5% of trigger capture time, whichever is the larger 400 display Points 1 ns or 0.25% of trigger capture time, whichever is the larger	Trigger capture time settable resolution
	On-screen indicator/message	Trigger point depicted by trigger edge waveform (edge represents trigger point of signal). Display position of trigger edge waveform adjustable.		Trigger point display (on-screen)
System Configuration	10 storage registers plus RESET default settings	20 settings stores Preset accessible on Front Panel Offset tables		Save/Recall
	Wipes non-volatile memory on power up when active.			Secure mode

Continued on next page

	ML2430A Series	ML2480B Series	ML2490A Series	Comments
Interfaces	Yes	No		Remote monitoring
	Yes	No		Modem Compatibility
	>600 readings/sec (per input channel) Emulation of Anritsu ML4803, Agilent 436, 437 and 438	>400 Readings/second CW Mode [TR3 mode] >350 Readings/second Pulse/Modulated Mode (Continuous Sampling) [1 µs pulse, readout mode, Display turned off, TR3 Mode] >10 profile transfers/sec Pulse/Modulated Mode (Profile data) [200 points per sweep, Binary Float Output, 5 µs Trigger Capture Time] >20 Readings/sec Pulse/Modulated Mode (Repetitive Sampling) [50 ns pulse, readout mode, Display turned off, TR3 Mode] Back Compatible with ML2480B with Additional functionality added		GPIB (IEEE–488.2, IEC–625)
	N/A	1/4 VGA		External Video Output
	Compatible with Deskjet 540 and 340 Models (other 500 Series and 300 Series and later are typically compatible). Canon BJC 80.	N/A		Parallel Printer Port
	N/A	Allows remote control, direct from a PC or Local/Wide-area network, using Dynamic (Auto) or Static IP assignment		Ethernet (10/100BASE-T LAN)
	Supports software download, Instrument control 1200, 2400, 4800, 9600, 19200, 38400, 57600 Baud rates are supported	Supports software download and Instrument control 1200, 2400, 4800, 9600, 19200, 38400, 57600 Baud rates supported		RS232
	Operating Modes: Display voltage reading on selected channel Voltage proportional to frequency for sensor calibration factor compensation Blanking Input -TTL levels only Selectable positive or negative polarity Input Range: 0 to 20 V Resolution: 0.5 mV Control: Adjustable voltage to frequency relationship	Can be configured for: Cal factor correction from synthesiser, Ext Voltage Voltmeter, Connection:- current probe for PAE applications		Cal Factor Voltage Input (BNC)
	TTL, maximum frequency of 800 kHz	TTL, maximum frequency of 10 MHz		External trigger (BNC)
	Two outputs configurable to Log or Lin Operating Modes: Selectable channel adjusted for calibration factors and other power reading correction settings Pass/Fail – Selectable TTL High or Low Channel output -Near real time analog Uncalibrated AC Modulation Output -Output 1 only Dwell Output -Output 2 only Output Range: –5.0 to +5.0 V Resolution: 0.1 mV	Output 1 can be configured for: Analog Output, Pass/Fail TTL o/p Limits, Levelling: -Sensor Input A Output 2 can be configured for: Analog Output, Pass/Fail TTL o/p Limits, Levelling: -Sensor Input B, Trigger Output		Analogue Output (BNC)
Reference Calibrator	1 mW			Power
	±1.2% per year			Power accuracy (Traceable to National Standards)
	50 MHz (nom.)	50 MHz (standard), 1 GHz (optional)	50 MHz, 1 GHz (both standard)	Frequency
	<1%	<1% (50 MHz) <2% (1 GHz)		Frequency Accuracy
	<1.04	<1.12 (50 MHz) <1.2 (1 GHz)		VSWR
	N (f)			Connector type

Continued on next page

	ML2430A Series	ML2480B Series	ML2490A Series	Comments
General	MIL-T28800F, class 3			
Non Volatile RAM Battery	Lithium (10 year life)	Lithium (5 year life)		
Battery Option	>6 hr usable with 3000 mAhr (NiMH) battery	N/A		
DC Power Requirements	12 to 24 VDC, Reverse protected to –40 V Maximum input 30 V	N/A		
AC Power Requirements	85 V(ac) to 264 V(ac), 47 Hz to 440 Hz, 40 VA (max.)	85 V(ac) to 264 V(ac), 47 Hz to 440 Hz		
CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN61010-1 RoHS: 2011/65/EU			
RCM	Australia and New Zealand: RCM AS/NZS 4417:2012			
KCC	South Korea: KCC-REM-A21-0004			
Operating Temperature	0° to +50°C			
Storage Temperature	–40° to +70°C			
Moisture	Splash and rain resistant, 95% humidity non-condensing			
Dimensions	223 (W) × 88 (H) × 390 (D) mm			
Mass	3 kg (excluding battery option)	3 kg		
Warranty	Power meters have a standard 3 year warranty. Power sensors have a standard 1 year warranty.			

Power Sensors

Power Sensors for every application

Anritsu's power sensors have been designed with just one thing in mind: everything. The range of sensors provide frequency coverage to 50 GHz, with dynamic range up to 90 dB, and includes both diode and thermal based technologies.

The Anritsu diode-based sensors offer speed, sensitivity, and dynamic range with designs using half- or full-wave diode rectifiers constructed from zero-bias Schottky diodes. The rectifier output is low-pass filtered, forming an envelope detector. This post-detection bandwidth is sometimes referred to as the video bandwidth and is a measure of how quickly the power sensor can respond to a changing input signal, such as a radar pulse or a multi-carrier OFDM signal.

Pulse and Wideband Sensors: MA2490/91A and MA2411B

The MA2490A and MA2491A have been designed as dual-purpose, wideband and CW sensors. An FET switch is used to chop the signal from the sensor, to improve stability at low power levels, in CW mode. These sensors have 20 MHz video bandwidth (and 18 ns rise-time in the pulse modulated mode), and can be used to make average and peak power factor measurements on signals with rapid amplitude change, such as those in 3G/4G, WLAN, WiMAX and radar systems.

The pulse sensor MA2411B has been specifically designed for a wide video bandwidth of 50 MHz, providing a fast rise-time of better than 8 ns. This power sensor does not contain a FET switch for low-level CW applications. Use this sensor for the most demanding rising-edge measurements, such as radar and OFDM, multi-carrier signals.

Standard Diode Sensors: MA2470D

Designed for high dynamic range, high accuracy CW and TDMA measurements, these power sensors have 90 dB dynamic range and linearity better than 1.8%. This makes them the choice for precision measurements. The rise-time of these sensors is fast enough for power measurements on GSM and similar TDMA systems that use GMSK modulation.

High Accuracy Diode Sensors: MA2440D

With its built in 3 dB attenuator, the MA2440D sensors minimize input VSWR. They are typically used when high measurement accuracy is required over a large dynamic range, for example when measuring amplifiers. High accuracy diode sensors have a dynamic range of 87 dB compared to the 90 dB of standard diode sensors. In all other respects, the performance of the sensors is identical to the standard diode sensor.

Universal Power Sensors: MA2480D

The MA2480A series are true RMS sensors with a dynamic range of 80 dB. These power sensors are modulation independent and can be used for average power measurements on a wide variety of signals, including multi-tone or W-CDMA signals. The sensor architecture consists of three pairs of diodes, each one configured to work in its square law region over the dynamic range of the sensor. Option 1 provides TDMA measurement capability, calibrating one of the diode pairs for linearity over a wide dynamic range.

Thermal Power Sensors: MA24000A

The Anritsu thermal sensors MA24000A series provide excellent power measurement accuracy over 50 dB of dynamic range. Thermal sensors use Seebeck elements, where the combined effect of a thermal gradient and charge migration between dissimilar metals gives a true reading of the average power of any incident waveform. Anritsu thermal sensors have class leading SWR and a built-in EEPROM with calibration factor and linearity correction data. This results in assured accuracy when measuring any signal.

Power Sensor Specifications

Sensor	Frequency Range	CW Dynamic Range (dBm)	SWR	Rise Time*1 (ms)	Sensor Linearity*7	RF Connector*2
Standard Diode Sensors						
MA2472D	10 MHz to 18 GHz	–70 to +20 CW mode –43 to +20 (ML243xA, Profile mode) –37 to +20 (ML2480A/B or ML2490A, Pulse/Mod mode)	<1.17; 10 MHz to 50 MHz*8 <1.90; 10 MHz to 50 MHz <1.17; 50 MHz to 150 MHz <1.12; 150 MHz to 2 GHz <1.22; 2 GHz to 12.4 GHz <1.25; 12.4 GHz to 18 GHz <1.35; 18 GHz to 32 GHz <1.50; 32 GHz to 40 GHz <1.63; 40 GHz to 50 GHz	<0.004	<1.8%, ≤18 GHz <2.5%, ≤40 GHz <3.5%, ≤50 GHz for MA2475D*4	N (m)
MA2473D	10 MHz to 32 GHz					K (m)
MA2474D	10 MHz to 40 GHz					K (m)
MA2475D	10 MHz to 50 GHz					V (m)
Temperature accuracy: <1% <40 GHz, <1.5% <50 GHz, 5° to 50°C						
High Accuracy Diode Sensors						
MA2442D	10 MHz to 18 GHz	–67 to +20 CW mode –40 to +20 (ML243xA, Profile mode) –34 to +20 (ML2480A/B or ML2490A, Pulse/Mod mode)	<1.17; 10 MHz to 150 MHz <1.08; 150 MHz to 2 GHz <1.16; 2 GHz to 12.4 GHz <1.21; 12.4 GHz to 18 GHz <1.29; 18 GHz to 32 GHz <1.44; 32 GHz to 40 GHz <1.50; 40 GHz to 50 GHz	<0.004	<1.8%, ≤18 GHz <2.5%, ≤40 GHz <3.5%, ≤50 GHz for MA2445D*5	N (m)
MA2444D	10 MHz to 40 GHz					K (m)
MA2445D	10 MHz to 50 GHz					V (m)
Temperature accuracy: <1% <40 GHz, <1.5% <50 GHz, 5° to 50°C						
Universal Power Sensors						
MA2481D	10 MHz to 6 GHz	–60 to +20	<1.17; 10 MHz to 150 MHz <1.12; 150 MHz to 2 GHz <1.22; 2 GHz to 6 GHz <1.22; 6 GHz to 12.4 GHz <1.25; 12.4 GHz to 18 GHz	<0.004 with Option 1 only	<3%, ≤6 GHz <3%, ≤18 GHz (1.8% CW with Option 1)	N (m)
MA2482D	10 MHz to 18 GHz					
Option 1	Adds fast CW mode to Universal Power Sensors for high speed measurements of CW signal plus TDMA and pulse measurements.					
Temperature accuracy: <1%, 15° to 35°C						
Wideband Sensors						
MA2490A*3	50 MHz to 8 GHz	CW Mode: –60 to +20 Pulse/Modulated Mode: –30 to +20 (with ML2480B/90A)	<1.17; 50 MHz to 150 MHz <1.12; 150 MHz to 2.5 GHz <1.22; 2.5 GHz to 8 GHz <1.22; 8 GHz to 12.4 GHz <1.25; 12.4 GHz to 18 GHz	<18 ns	<7%, 50 MHz to 300 MHz <3.5%, 300 MHz to 8 GHz	N (m)
MA2491A*3	50 MHz to 18 GHz					
Temperature accuracy: <1%, 10° to 45°C						
Pulse Sensor						
MA2411B	300 MHz to 40 GHz	–20 to +20	<1.15; 300 MHz to 2.5 GHz <1.35; 2.5 GHz to 26 GHz <1.50; 26 GHz to 40 GHz	<8 ns (typ.) 12 ns maximum <18 ns when used with ML2487B/M L2488B	<4.5%, 300 MHz to 18 GHz <7%, 18 GHz to 40 GHz	K (m)
Requires 1 GHz Calibrator (Option 15) to be fitted on the meter, if used with ML248xB. Temperature accuracy: <2%, 10° to 45°C						
Thermal Sensor						
MA24002A	10 MHz to 18 GHz	–30 to +20	<1.90; 10 MHz to 50 MHz <1.17; 50 MHz to 150 MHz <1.10; 150 MHz to 2 GHz <1.15; 2 GHz to 12.4 GHz <1.20; 12.4 GHz to 18 GHz <1.25; 18 GHz to 32 GHz <1.30; 32 GHz to 40 GHz <1.40; 40 GHz to 50 GHz	<15	1.8%, <18 GHz*6 2.0%, <40 GHz*6 2.5%, <50 GHz*6	N (m)
MA24004A	10 MHz to 40 GHz					K (m)
MA24005A	10 MHz to 50 GHz					V (m)
Temperature accuracy: <1% <30 GHz <+10 dBm, <1.5% ≥30 GHz ≥+10 dBm						

*1: 0.0 dBm, room temperature with standard 1.5 m sensor cable.
*2: Each MA2400A/D Series sensor incorporates precision RF connectors with hexagon coupling nut for attachment by industry standard torque wrench.
*3: MA2490/1A and MA2411B sensors must be used with power meters ML2480B or ML2490A series.
*4: MA2475D Linearity applicable from –70 to +15 dBm.
Add 1% for power levels >+15 dBm
2000-1537-R supplied as standard with the power meter.
*5: MA2445D Linearity applicable from –67 to +15 dBm.
Add 1% for power levels >+15 dBm
*6: MA245005D Linearity applicable from –30 to +15 dBm.
Add 1% for power levels >+15 dBm
*7: Sensor linearity specifications are ± value. Pulse/modulated performance only specified with 1.5 m sensor cable length option.
*8: MA2472D only.

Power Meters & Sensors Selection Guide

Choose the right power meter and power sensor for your measurement application.

Power Sensors	Standard Diode	(High Accuracy) Diode	Universal	Wideband	Pulse	Thermal
Model Number	MA2470D Series	MA2440D Series	MA2480D Series	MA249XA Series	MA2411B	MA2400xA
Power Measurement	Average (RMS)	Average (RMS)	Average (RMS)	Average (RMS), Peak	Average (RMS), Peak	Average (RMS)
Measurement Application (Examples)	CW, GMSK, GFSK, 8PSK	CW, GMSK	CW, GMSK, GFSK, 8PSK, QPSK, QAM	CW, GMSK, 8PSK, QPSK, QAM	Pulse, QAM	Any Modulation
	TDMA, FDMA, IS136	TDMA, FDMA	TDMA, FDMA, CDMA, OFDM, Radar	TDMA, FDMA, CDMA, OFDM, Radar	Radar, OFDM	Any Access Scheme
Compatible Power Meters	ML24xxA/B	ML24xxA/B	ML24xxA/B	ML2480A/B, ML2490A	ML2480A/B, ML2490A	ML24xxA/B

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Power Meter Models
ML2495A	Pulse Power Meter, Single Input
ML2496A	Pulse Power Meter, Dual Input
ML2487B	Wideband Power Meter, Single Input
ML2488B	Wideband Power Meter, Dual Input
ML2437A	CW Power Meter, Single Input
ML2438A	CW Power Meter, Dual Input
	ML2490A Series Options
ML2400A-05	Front Bail Handle
ML2490A-06	Rear Mount Input A on ML2495A
ML2490A-07	Rear Input A and Reference on ML2495A
ML2490A-08	Rear Mount Inputs A, B and Reference on ML2496A
ML2490A-09	Rear Mount Inputs A, B on ML2496A
ML2490A-98	Calibration to ISO 17025 and/or ANSI/NCSL Z540
ML2490A-99	Premium Calibration
13000-00238	Operation Manual (hard copy)
13000-00239	Programming Manual (hard copy)
13000-00164	Maintenance Manual (hard copy)
	Option 5, 2400-82, and 2400-83 are mutually exclusive for any given ML2480B/90A.
	Options 6, 7, 8 and 9 are mutually exclusive for any given ML2480B/90A.
	ML2480B Series Options
ML2480B-005	Front Bail Handle
ML2480B-006	Rear Mount Input A on ML2487B
ML2480B-007	Rear Input A and Reference on ML2487B
ML2480B-008	Rear Mount Inputs A, B and Reference on ML2488B
ML2480B-009	Rear Mount Inputs A, B on ML2488B
ML2480B-015	Factory Fitted 50 MHz and 1 GHz Calibrator (required by MA2411B Sensor)
ML2480B-098	Calibration to ISO 17025 and/or ANSI/NCSL Z540
ML2480B-099	Premium Calibration
13000-00238	Extra Operation Manual (hard copy)
13000-00239	Extra Programming Manual (hard copy)
13000-00164	Maintenance Manual (hard copy)
	Option 5, 2400-82, and 2400-83 are mutually exclusive for any given ML2480B/90A.
	Options 6, 7, 8 and 9 are mutually exclusive for any given ML2480B/90A.
	ML2430A Series Options
ML2400A-05	Front Bail Handle
ML2400A-06	Rear Mount Input A on ML2437A
ML2400A-07	Rear Input A and Reference on ML2437A
ML2400A-08	Rear Mount Inputs A, B and Reference on ML2438A
ML2400A-09	Rear Mount Inputs A and B on ML2438A
2000-1603	NiMH Battery
2000-996-R	Desktop Battery Charger with Power Supply
2000-1534-R	Desktop Battery Charger with Power Supply (for use in Japan only)
2000-1538-R	3 m Sensor Cable
2000-1539-R	5 m Sensor Cable
2000-1540-R	10 m Sensor Cable
2000-1541-R	30 m Sensor Cable
2000-1542-R	50 m Sensor Cable
2000-1543-R	100 m Sensor Cable
2000-1545	Bulkhead Adapter
10585-00001	Operation and Programming Manual (hard copy)
10585–00003	Maintenance Manual (hard copy)
ML2400A-98	Calibration to ISO 17025 and/or ANSI/NCSL Z540
ML2400A-99	Premium Calibration
	Option 5, 2400-82, and 2400-83 are mutually exclusive for any given ML2430A unit.
	Options 6, 7, 8 and 9 are mutually exclusive for any given ML2430A unit.
	Pulse/modulated performance only specified with 1.5 m sensor cable length.

Model/Order No.	Name
	Standard Accessories
2300-283	Power Meter and Sensors Product Disc - which includes Documentation and Literature - PowerMax (ML249xA and ML248xB only) - PowerSuite (ML243xA only) Power Cord (for destination country) 1.5 m Sensor Cord (one per meter input) Certificate of Calibration (also included with sensors)
	General Options and Accessories
760-209	Hardside Transit Case
D41310	Soft Carry Case with Shoulder Strap
2000-1535	Front Panel Cover
2000-1536-R	0.3 m Sensor Cable
2000-1537-R	Spare 1.5 m Sensor Cable
2000-1544	RS232 Bootload Cable
2400-82	Rack Mount, Single Unit
2400-83	Rack Mount, Side-by-Side
	(Options 5, 2400-82, and 2400-83 are mutually exclusive)
	Power Sensor Models
MA2472D	Standard Diode Sensor (10 MHz to 18 GHz, –70 to 20 dBm)
MA2473D	Standard Diode Sensor (10 MHz to 32 GHz, –70 to 20 dBm)
MA2474D	Standard Diode Sensor (10 MHz to 40 GHz, –70 to 20 dBm)
MA2475D	Standard Diode Sensor (10 MHz to 50 GHz, –70 to 20 dBm)
MA2442D	High Accuracy Diode Sensor (10 MHz to 18 GHz, –67 to 20 dBm)
MA2444D	High Accuracy Diode Sensor (10 MHz to 40 GHz, –67 to 20 dBm)
MA2445D	High Accuracy Diode Sensor (10 MHz to 50 GHz,–67 to 20 dBm)
MA2481D	Universal Sensor (10 MHz to 6 GHz, –60 to 20 dBm)
MA2482D	Universal Sensor (10 MHz to 18 GHz, –60 to 20 dBm)
MA2490A	Wideband Sensor (50 MHz to 8 GHz, –60 to 20 dBm)
MA2491A	Wideband Sensor (50 MHz to 18 GHz, –60 to 20 dBm)
MA2411B	Pulse Sensor (300 MHz to 40 GHz, –20 to 20 dBm)
MA24002A	Thermal Sensor (10 MHz to 18 GHz, –30 to 20 dBm)
MA24004A	Thermal Sensor (10 MHz to 40 GHz, –30 to 20 dBm)
MA24005A	Thermal Sensor (10 MHz to 50 GHz, –30 to 20 dBm)

See your Anritsu Representative or Components catalogue for available Attenuators, Limiters, Coaxial adapters, Waveguide-to-Coaxial adapters, Splitters & Dividers, Loads, Bridges, Open/Shorts, and Calibrated Torque wrenches.

For the complete and most up-to-date power meter and sensor specifications; Technical Datasheet p/n: 11410-00423.

Software upgrades, Labview drivers and additional literature can be downloaded from the Anritsu web site at www.anritsu.com

Inline Peak Power Sensor

MA24105A

350 MHz to 4 GHz

A Standalone, Compact, and Highly Accurate Bi-directional Inline Peak Power Sensor for your RF Power Measurement Needs

The Inline Peak Power Sensor MA24105A is designed to take accurate average power measurements from 2 mW to 150 W and peak power measurements from 2 W to 300 W, over the frequency range of 350 MHz to 4 GHz. The sensor employs a "dual path" architecture that enables True-RMS measurements over the entire frequency and dynamic range allowing users to measure CW, multi-tone and digitally modulated signals such as LTE, LTE-TDD, GSM/EDGE, CDMA, W-CDMA, WiMAX, TD-SCDMA, WLAN, and LTE. The forward direction path also include a 4 MHz bandwidth channel that has peak and comparator/integrator circuits that add measurement functions such as PEP power, crest factor, CCDF, and burst average power. Another detection circuit on the reverse direction adds reverse power measurement capabilities including reverse power, reflection coefficient (magnitude), return-loss, and SWR. The presence of a micro-controller along with signal conditioning circuitry, ADC, and power supply in the sensor makes it a complete miniature power meter. This MA24105A comes standard with application software (PowerXpert™) for use with PC that mimics the user interface of a power meter.

Features and Benefits

- Broad Frequency Range (350 MHz to 4 GHz)
  - Covers all major cellular and communication bands, such as LTE, LTE-TDD, GSM/EDGE, CDMA/EV-DO, W-CDMA/HSPA+, WiMAX, and TD-SCDMA
- Widest Dynamic Range Inline Power Sensor in its Class
  - Eliminates need for additional low level power sensors
- Forward and Reverse Measurements
  - Measures both transmitted power and reflection from antenna or other reflections using the single inline tool
- True-RMS Measurements to 150 W
  - Enables accurate average power measurements of modulation signals
- Standalone, Low Cost, Plug and Play Device
  - No extra elements or element holder required

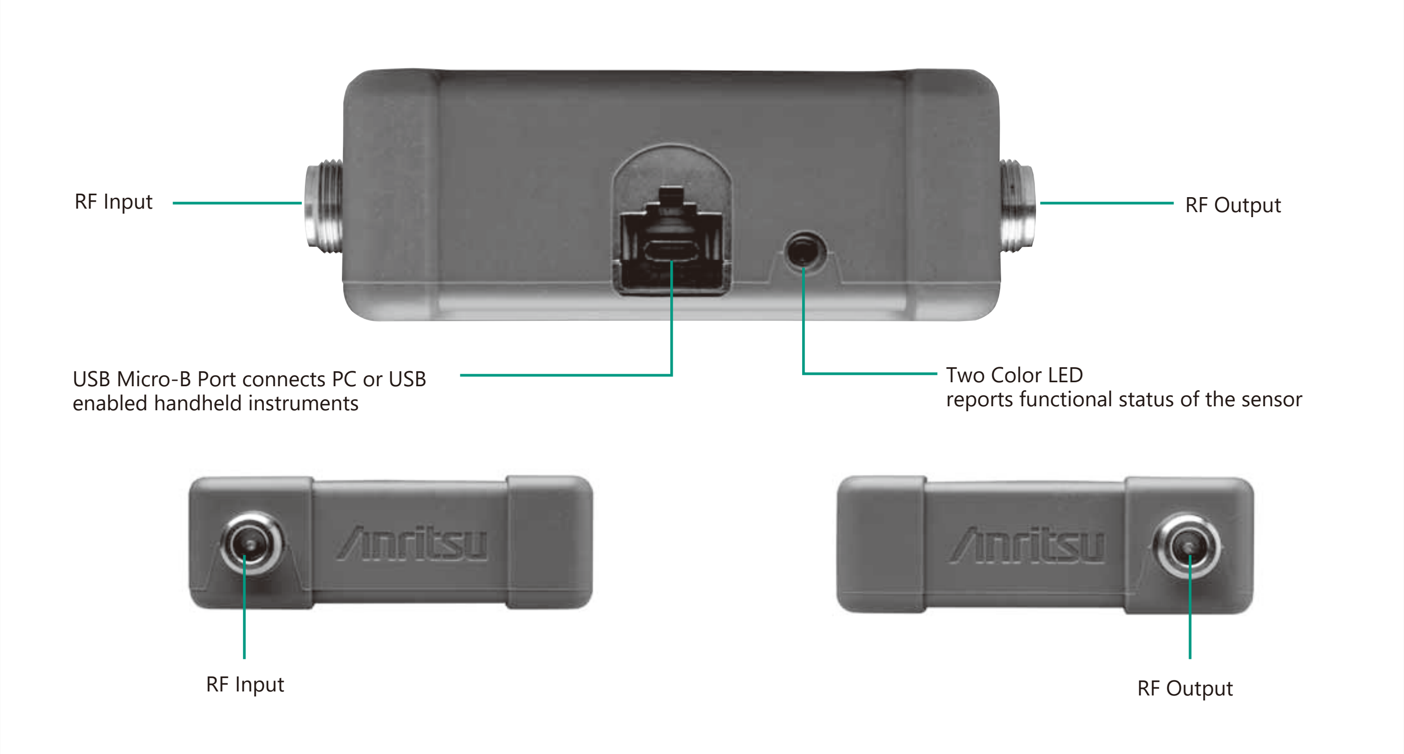
Complements Your Existing Instrument

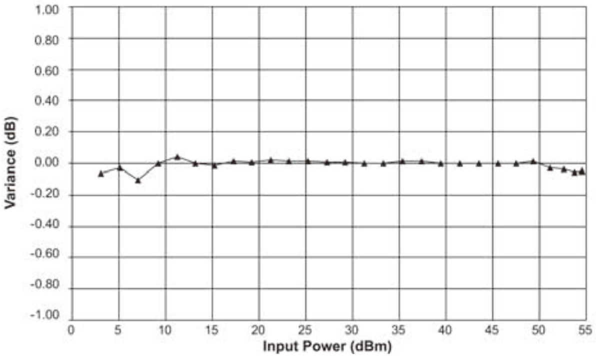
Operation with Personal Computer (PC)

The power sensor can be used with a personal computer running Microsoft® Windows via USB. It comes with a complimentary copy of the PowerXpert™ application (version 2.11 or greater) for data display, analysis, and sensor control. The software provides a front panel display making the personal computer appear like a traditional power meter. The application has abundant features like data logging, power versus time graph, and offset table that enable quick and accurate measurements.

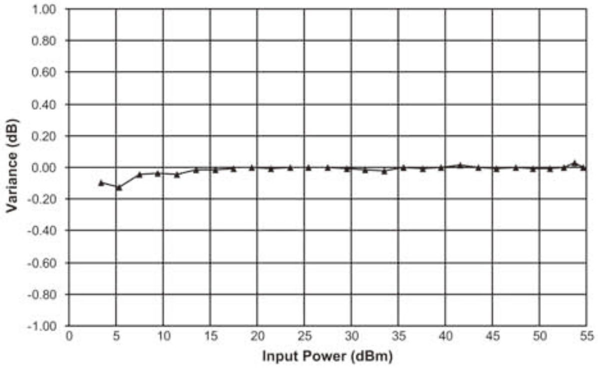
Operation with Anritsu Handheld Instruments

The MA24105A is compatible with most Anritsu RF and microwave handheld analyzers. In some cases the high accuracy power meter software option (Option 19) is required.

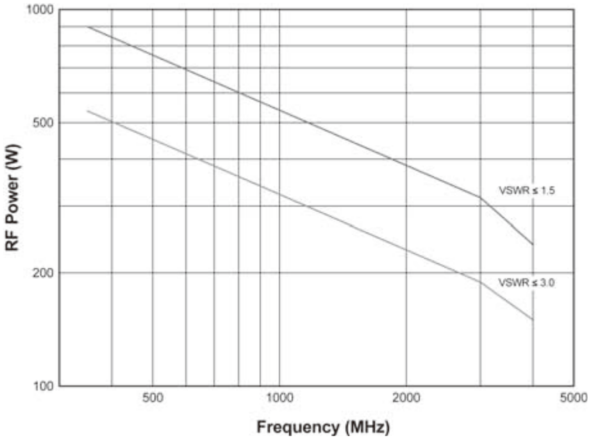




Measurement linearity error referenced to an ideal thermal power sensor measurement of a 900 MHz CW signal in the forward direction.



Measurement linearity error referenced to an ideal thermal power sensor measurement of a 900 MHz CW signal in the reverse direction.



Maximum power handling capacity of the sensor terminated with a load having VSWR of ≤ 1.5 and ≤ 3.0.

High Accuracy Measurements

Accurate power measurements in the field are important for verifying that transmitter outputs are operating at specified levels. For example, service technicians need to verify base station output power because lower output power can quickly translate into large coverage differences. Highly accurate average power measurements to 150 W are assured as the calibration data is stored directly in the sensor and all necessary corrections (frequency and temperature) are done inside the microprocessor of the sensor. Also, the return loss and directivity of the instrument are optimized to maintain high accuracy. The standards used to calibrate this sensor are directly traceable to NIST.

Continuous Monitoring of Radio Systems

This sensor is designed to have good match and low insertion loss making it ideal for continuous power monitoring of transmitter systems and antennas. The data logging function in the PowerXpert software application for PC equips the user the ability to record measured power over time to a hard disk or other storage media. This is useful for long term drift measurements, environmental testing, and trend analysis. A user settable data logging interval allows measurement speed adjustment to match the user test application requirements. Data are stored as comma-separate files that can be directly opened in Microsoft Excel allowing powerful custom analysis of measured data.

Ideal for Field Use

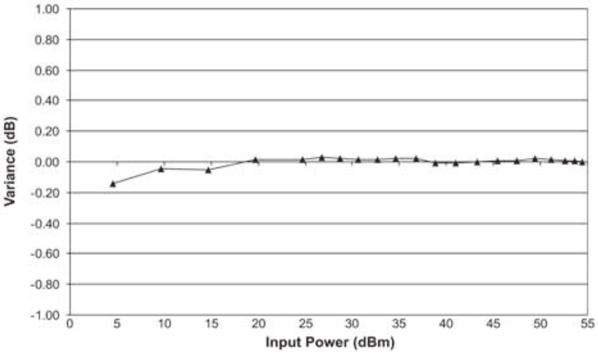
The power sensor MA24105A provides lab performance accuracy in a rugged and portable field solution. The sensor is accurate over a wide temperature range (0° to 55°C), making it perfect for cellular base station installation and maintenance applications. Field and service technicians will appreciate the small size and lightweight of this stand-alone unit as they will not have to carry extra elements, heavy high power attenuators, or power meters. A very easy to use PC application with a large display makes the job even easier for technicians who need accurate measurement results quickly.

Average Measurements of CW, Pulsed, or Modulated Signals

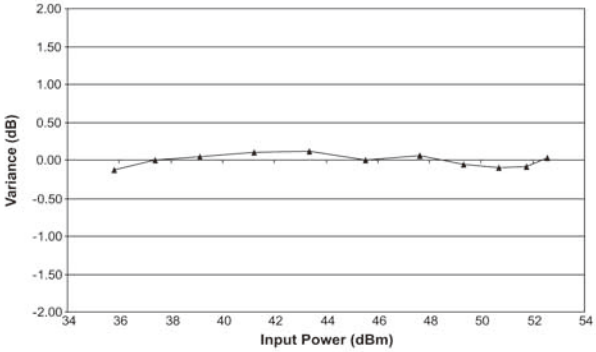
The MA24105A is rated to meet all specifications up to an average input power level of 150 W. Although the average power of all signals should be kept at or below 150 W, time varying and burst signals having peak powers less than the limits shown in the Maximum Power graph can be measured. To ensure accurate readings, the peak to average ratio (crest factor) of signals must be less than 12 dB.

Peak Power, Crest Factor, Burst Average and Complementary Cumulative Distribution Function (CCDF)

The MA24105A and associated PowerXpert™ application provide information critical to development, manufacture and operation of modern communications systems. The Peak Power function enables the user to determine the maximum power of the modulated signal envelope. The ratio between the Peak Power and Average Power result provides the Crest Factor. Of particular use in TDMA systems, the Burst Average Function uses duty cycle information obtained either automatically or as user-entry to calculate the average power during a burst based on the measurement of Average Power. Critical to those working with spread spectrum systems, which exhibit a non-deterministic envelope, the CCDF feature shows the percentage of the time that the peak power exceeds a user-set threshold.



Forward average power linearity error referenced to an ideal thermal power sensor measurement of a W-CDMA signal at 2 GHz.



Forward Peak power linearity error referenced to Anritsu MA2491A peak power sensor measurement of a W-CDMA signal.

Reverse Power, Reflection Coefficient (magnitude), Return Loss and Standing Wave Ratio (SWR)

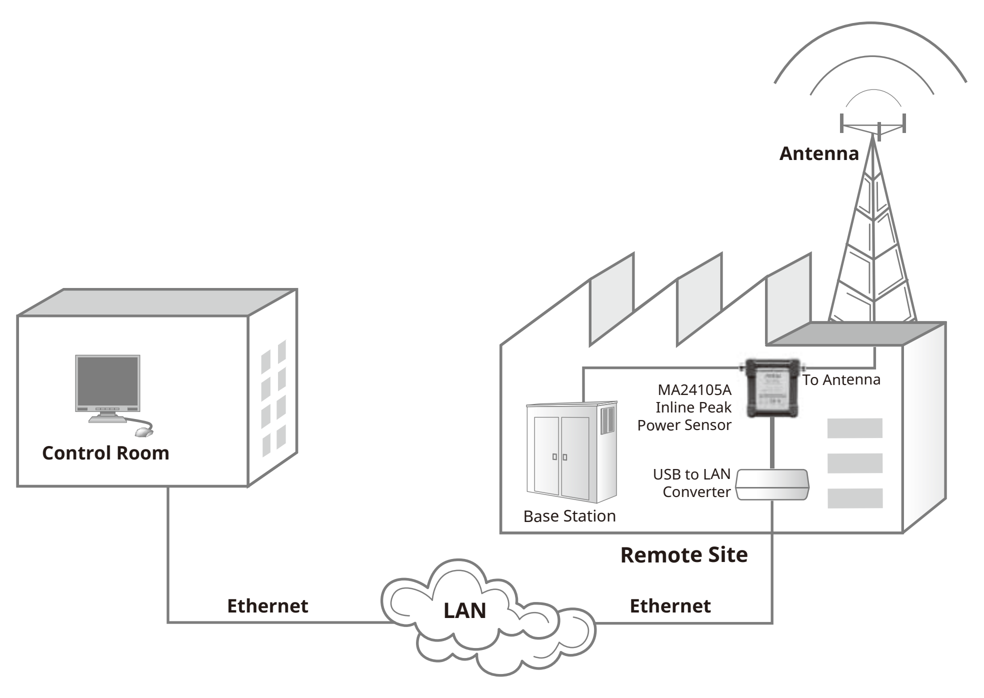
The MA24105A sensor's capability to measure both forward and reverse average power also permits the user to gain information about the load mismatch. This result is conveniently available in Reflection Coefficient (magnitude), Return Loss and SWR forms.

Optimized for Production

The MA24105A facilitates lab quality measurements on the production floor for a fraction of cost of existing solutions. Since the sensor is connected directly to the PC, there is no need for a base unit saving valuable rack space. The Inline Sensor can measure signals with levels as low as 2 mW, thus eliminating the need of terminated power sensors in the production line resulting in reduced capital expenditure and set up costs. The sensor's speed is optimized for best accuracy and noise performance thus making it suitable for wide variety of ATE applications. Multiple sensors can be connected and remote controlled via a single PC allowing flexibility to match specific measurement needs. A software toolkit is supplied with every sensor containing a sample program with source code for controlling the sensor. The 1 mW reference calibrator typically needed by power meters has also been eliminated as the connecting USB cable only transfers digital data (corrected power), minimizing test station complexity, sensor handling and test times.

Remote Monitoring via LAN or Data-Logging

Since the USB cable connected to the sensor only transfers corrected power back to the host, a 1 mW reference calibrator is not required. USB data transfer capabilities limit the cable length to 5 meters prohibiting remote monitoring. However, this limitation can be overcome by installing a low cost USB-to-LAN hub converter (e.g. BELKIN® F5L009) at the measurement site along with the MA24105A. In this way, power monitoring can be performed across continents if desired. Or, data can be logged in a .csv file for offline analysis.



Specifications

Sensor	Frequency Range	350 MHz to 4 GHz				
	Dynamic Range	2 mW to 150 W (+3 to +51.76 dBm)				
	Input Return Loss	≥29.5 dB from 350 MHz to 3 GHz ≥26.5 dB from >3 GHz to 4 GHz				
	Insertion Loss (typ.)	≤0.15 dB from 350 MHz to 1.25 GHz ≤0.20 dB from >1.25 GHz to 4 GHz				
	Directivity	≥28 dB from 350 MHz to <1 GHz ≥30 dB from ≥1 GHz to ≤3 GHz ≥28 dB from >3 GHz to 4 GHz				
	Measurement Channel	2 (Forward and Reverse)				
	Signal Channel Bandwidth	Average: 100 Hz Peak (Selectable): 4 MHz (full) 200 kHz 4 kHz				
Base Average Power Measurement	Measurement Range	Range 1: 2 mW to 6.31 W (+3 to +38 dBm) Range 2: 6.31 W to 150 W (+38 to +51.76 dBm)				
	Maximum Power*1	150 W average, 300 W pulse				
	Measurement Uncertainty*2	±3.8% (Range 1 and Range 2)				
	Effect of Noise*3	±170 µW (Range 1) ±1.9 mW (Range 2)				
	Effect of Zero Set*4	±250 µW (Range 1) ±3.0 mW (Range 2)				
	Effect of Zero Drift*4	±230 µW (Range 1) ±2.7 mW (Range 2)				
	Effect of Temperature (0° to 50°C)	±0.06 dB				
	Effect of Digital Modulation*5	±0.02 dB				
Forward Average Power Measurement	Forward Average Power Uncertainty is same as Base Average Power Uncertainty					
Forward Peak Power Measurement*6	Measurement Range	2 W to 300 W (+33 to +54.77 dBm)				
	Burst Signal Measurement Base Uncertainty	Repetition Rate: ≥10/s Duty Cycle: ≥10%	Full Bandwidth: ± (Base Average Power Uncertainty +7% + 400 mW)			
			4 kHz and 200 kHz Bandwidth: ± (Base Average Power Uncertainty + 3% + 200 mW)			
	Effect of Low Repetition Rate (≤ 10/s)	±1.6% ±150 mW				
	Effect of Low Duty Cycle (0.1 to 10%)	±100 mW				
	Effect of Short Burst Width (500 ps to 1 µs) (200 ps to <500 ps)	±5% ±10%				
	Effect of Temperature on Peak Circuit (0° to 50°C)	±6%				
	Spread-spectrum Measurement Uncertainty	± (Base Average Power Uncertainty + 15% + 400 mW)				
Reverse Power Measurement*6	Measurements Range	2 mW to 150 W (+3 to +51.76 dBm)				
	Maximum Power*1	150 W average				
	Measurement Uncertainty*2	± (Base Average Power Uncertainty)				
	Spread-spectrum Measurement Uncertainty	± (Base Average Power Uncertainty + 15% + 400 mW)				
Complementary Cumulative Distribution Function (CCDF)	Measurement Uncertainty*7	±0.2%				
	Threshold Range	2 mW to 300 mW (+3 to +54.77 dBm)				
	Accuracy of Threshold	± (Base Average Power Uncertainty + 5% + 500 mW)				
Burst Average Power	Measurement Uncertainty (User Mode)	Same as Base Average Power Uncertainty except Zero Set, Zero Drift and Noise are divided by duty cycle (t/T)				
	Measurement Uncertainty (Auto Mode)*8	± (Base Average Power Uncertainty except Zero Set, Zero Drift and Noise are divided by duty cycle (t/T) ±2%)				
Combination Measurements	Reflection Measurement Uncertainty	± (Base Average Power Uncertainty + Reverse Power Measurement Uncertainty)				
	Crest Factor Uncertainty	± (Base Average Power Uncertainty + Forward Peak Power Measurement Uncertainty)				
System	Measurand	Forward/Reverse True-RMS/Average power	Peak Power	Crest Factor	Burst Average Power	CCDF
	Measurement Resolution	0.01 dB				0.01%
	Offset Range	100 dB				100%
	Averaging Range	1 to 512				
	Measurement Speed (typ.)	1.7 meas. per second	2.5 meas. per second	1.4 meas. per second	0.7 meas. per second	1.6 meas. per second
	Interface	USB 2.0				
	Host Operating System (PowerXpert™ version 2.11 compatibility)	Microsoft Window 7, Windows Vista, Windows XP, and Windows 2000				

Continued on next page

General	USB	Current (via host USB)*10	180 mA (typ.) at 5 V
	Dimensions*9	87 (W) × 102 (H) × 30 (D) mm	
	Mass	535 g (1.18 lb)	
Environmental*11	Operating Temperature Range	0° to +50°C	
	Storage Temperature Range	–51° to +71°C	
	Humidity	45% relative humidity at +55°C (non-condensing) 75% relative humidity at +40°C (non-condensing) 95% relative humidity at +30°C (non-condensing)	
	Shock	30 g's half-sine, 11 ms duration	
	Vibration	Sinusoidal: 5 Hz to 55 Hz, 3 g's max. Random: 10 Hz to 500 Hz Power Spectral Density: 0.03 g^2/Hz	
	CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN61010-1 RoHS: 2011/65/EU	

All specs are applicable after twenty minutes warm-up at room temperature and after zeroing unless specified otherwise.

*1: Expanded uncertainty with K = 2 for power measurements of a CW signal with a matched load. Measurement results referenced to the input side of the sensor.

*2: Expanded uncertainty with K = 2 after zero operation when measured with 128 averages for 5 minutes. In high aperture time mode, noise is 50 µW and 12 mW in range 1 and range 2 respectively.

*3: After one hour warm-up and zero operation. Measured with 128 averages for one hour keeping the temperature within ±1°C.

*4: Measurement uncertainty with reference to a CW signal of equal power and frequency at 25°C.

*5: All measurement errors "Effects" should be RSSed before directly added to "Base" error for overall measurement uncertainty.

*6: 150 mA max.

*7: Maximum power depends upon the system SWR and frequency of operation (see Figure 3)

*8: Not including N connector.

*9: Measurement speed is the rate at which the measurement or calculation is updated in a data log.

*10: Pulse Power > +37 dBm, T >50 µs (Full BW), T >400 µs (200 kHz BW), T >20 ms (4 kHz BW)

*11: Average Power > +33 dBm, Pulse width >5 µs (Full BW), Pulse Width >40 µs (200 kHz BW), Pulse Width >2 ms (4 kHz BW)

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names.

The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main Frame
MA24105A	Inline Peak Power Sensor
	Available Options
MA24105A-098	Option 98, Standard calibration to Z540, ISO-17025
MA24105A-099	Option 99, Premium calibration to Z540, ISO-17025
	Included Accessories
2000-1606-R	1.8 m USB 2.0 A to Micro-B cable
10585-00021	Quick Start Guide
	Optional Accessories
	Calibrated Torque Wrenches
01-200	Calibrated torque wrench for N connector
	Power Attenuators
3-1010-122	DC to 12.4 GHz, 20 dB, 5 W, 50Ω, N (m) to N (f)
3-1010-123	DC to 8.5 GHz, 30 dB, 50 W, 50Ω, N (m) to N (f)
3-1010-124	DC to 8.5 GHz, 40 dB, 100 W, 50Ω, N (m) to N (f)
42N50-20	DC to 18 GHz, 20 dB, 5 W, 50Ω, N (m) to N (f)
42N50A-30	DC to 18 GHz, 30 dB, 50 W, 50Ω, N (m) to N (f)
1010-121	DC to 18 GHz, 40 dB, 100 W, 50Ω, N (m) to N (f)
1010-127-R	DC to 3 GHz, 30 dB, 150 W, 50Ω, N (m) to N (f)
1010-128-R	DC to 3 GHz, 40 dB, 150 W, 50Ω, N (m) to N (f)
	Precision Terminations
	(To be used in conjunction with appropriate Power Attenuators)
28N50-3	DC to 8.6 GHz, 50Ω, N (m)
28N50-2	DC to 18 GHz, 40 dB, 50Ω, N (m)
28NF50-2	DC to 18 GHz, 40 dB, 50Ω, N (f)
	Precision Coaxial Adapters
510-90	DC to 3.3 GHz, N (m) to 7/16 DIN (f)
510-91	DC to 3.3 GHz, N (f) to 7/16 DIN (f)
510-92	DC to 3.3 GHz, N (m) to 7/16 DIN (m)
510-93	DC to 3.3 GHz, N (f) to 7/16 DIN (m)
33NFNF50B	DC to 18 GHz, N (f) to N (f)
33NNF50B	DC to 18 GHz, N (m) to N (f)
33NN50B	DC to 18 GHz, N (m) to N (m)
34AN50	DC to 18 GHz, GPC-7 to N (m)
34ANF50	DC to 18 GHz, GPC-7 to N (f)
34NFK50	DC to 18 GHz, N (f) to K (m)
34NFKF50	DC to 18 GHz, N (f) to K (f)
34NK50	DC to 18 GHz, N (m) to K (m)
34NKF50	DC to 18 GHz, N (m) to K (f)

USB Power Sensors

MA24106A/MA24108A/MA24118A/MA24126A

50 MHz to 6 GHz/10 MHz to 8 GHz/10 MHz to 18 GHz/10 MHz to 26 GHz

Low Cost, Compact, and Highly Accurate Power Sensors for RF and Microwave Applications

MA24106A

MA24118A

MA24108A

MA24126A

Anritsu USB power sensors eliminate the need of traditional benchtop power meters. These are highly accurate, standalone instruments that communicate with a PC via USB. The power measurement capability of these sensors is intended to mimic that of a traditional thermal (thermo-electric) power sensor with a wider dynamic range. These sensors are ideal for measuring average power of CW, modulated RF waveforms such as 3G, 4G, OFDM, and multi-tone signals. In other words, these sensors measure true RMS power regardless of the type of the input signal.

The presence of a micro-controller along with signal conditioning circuitry, ADC, and power supply in the sensors makes them a complete miniature power meter. These Anritsu USB power sensors come standard with application software (PowerXpert™) for use with PC that mimics the user interface of a power meter.

In addition to the average power measurement capability, the MA24108A, MA24118A and MA24126A sensors have internal and external triggering capability that facilitates individual slot power measurements of TDMA waveforms as well as burst power measurements of periodic and non-periodic waveforms.

These capabilities can be invoked in the power sensor by operating the sensor in Scope or Time slot mode.

Anritsu USB power sensors are compatible with most Anritsu RF and microwave handheld instruments. The high accuracy power meter software option (e.g., Option 19) may be required.

Features and Benefits

- Broad frequency range (10 MHz to 26 GHz)
  - Covers all major cellular bands
- True RMS measurements over 63 dB or more of dynamic range enables accurate modulated power measurements
- NIST Traceable calibrations
  - Provides traceable measurements needed for aerospace applications
- Compatible with Anritsu handhelds
  - No base unit needed
- Built-in internal and external trigger (only used with PC)
  - Facilitates multi-slot measurement of TDD waveforms (e.g. GSM, WiMAX, and TD-SCDMA)
- High power handling (+33 dBm)
  - Provides protection from overpowering the sensors
- 1 mW calibration need eliminated
  - Reduces test time and handling in production
- Worldwide calibration and service centers
  - Ensure reduced downtime and quick support

MA24106A Specifications

Sensor	Frequency Range	50 MHz to 6 GHz
	Dynamic Range	–40 to +23 dBm
	Input Return Loss	>26 dB (50 MHz to <2 GHz) >20 dB, (2 GHz to 6 GHz)
	Measurement Ranges	Range 1, –40 to –5 dBm Range 2, –5 to +23 dBm
	Signal Channel Bandwidth	100 Hz (typ.)
Measurement Uncertainty	Linearity	±0.13 dB (power level <+18 dBm) ±0.18 dB (power level ≥+18 dBm)
	Calibration Factor*1	±0.06 dB
	Noise*2	<2.5 nW (–40 to –5 dBm) <0.6 µW (–5 to +23 dBm)
	Zero Set	<10 nW (–40 to –5 dBm) <1.7 µW (–5 to +23 dBm)
	Zero Drift*3	<3.0 nW (–40 to –5 dBm) <0.5 µW (–5 to +23 dBm)
	Temperature Compensation*4 (0° to 50°C)	±0.06 dB
	Effect of Digital Modulation*4	±0.02 dB (power level <+18 dBm) ±0.10 dB (power level ≥+18 dBm)
System	Measurand	True-RMS/Average power
	Measurement Resolution	0.01 dB
	Offset Range	±100 dB
	Averaging Range	1 to 256
	Measurement Speed*5	10 measurement per second (typ.)
	Range	Auto ranging between Range 1 and Range 2
	Interface	USB 2.0
	Host Operating System (Anritsu Power Meter PC application compatibility)	Microsoft® Windows 7, Windows Vista®, Windows XP and Windows 2000
General	Current (via host USB)*6	100 mA typical at 5 V
	Maximum DC Voltage at RF Port	±25 V
	Maximum CW Power	+33 dBm
	Dimensions*7	60.4 (W) × 22.2 (H) × 84.2 (D) mm (typ.) (2.37 × 0.87 × 3.31 in)
	Mass	180 grams (typ.) (6.4 oz.)
Environmental*8	Operating Temperature Range	0° to +50°C
	Storage Temperature Range	–51° to +71°C
	Humidity	45% relative humidity at +55°C (non-condensing) 75% relative humidity at +40°C (non-condensing) 95% relative humidity at +30°C (non-condensing)
	Shock	30 g half-sine, 11 ms duration
	Vibration	Sinusoidal: 5 Hz to 55 Hz, 3 g max. Random: 10 Hz to 500 Hz, Power Spectral Density 0.03 g^2/Hz
	CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN61010-1 RoHS: 2011/65/EU

Notes: All specs are applicable after twenty minutes warm-up at room temperature unless specified otherwise.

*1: Expanded uncertainty with K = 2 for absolute power measurements on CW signal at 0 dBm calibration level from 50 MHz to 6 GHz.
*2: Expanded uncertainty with K = 2 after zero operation when measured with 128 averages for 5 minutes.
In high aperture time mode, noise is 1.3 nW and 0.3 µW in range 1 and range 2 respectively.
*3: After one hour warm-up and zero operation. Measured with 128 averages for one hour keeping the temperature within ±1°C.
*4: Measurement error with reference to a CW signal of equal power and frequency at 25°C.
*5: One measurement per second, typical in high aperture time mode.
*6: 150 mA max.
*7: Not including N connector.
*8: Tests were performed per MIL-PRF-28800F (Class 2)

MA24108A/MA24118A/MA24126A Specifications

Model		MA24108A	MA24118A	MA24126A
Sensor	Frequency Range	10 MHz to 8 GHz	10 MHz to 18 GHz	10 MHz to 26 GHz
	Dynamic Range (CW)	–40 to +20 dBm		
	Dynamic Range (Timeslot)	–40 to +20 dBm		
	Dynamic Range (Scope)	–40 to +20 dBm		
	SWR	<1.17, 10 MHz to 150 MHz <1.12, 150 MHz to 2 GHz <1.22, 2 GHz to 8 GHz	<1.17, 10 MHz to 150 MHz <1.12, 150 MHz to 2 GHz <1.22, 2 GHz to 12 GHz <1.25, 12 GHz to 18 GHz	<1.90, 10 MHz to 50 MHz <1.17, 50 MHz to 150 MHz <1.12, 150 MHz to 2 GHz <1.22, 2 GHz to 12 GHz <1.25, 12 GHz to 18 GHz <1.35, 18 GHz to 26 GHz
	Signal Channel Rise Time	8 µs (typ.)		
	Video Bandwidth	50 kHz (typ.)		
	Sampling Rate	140 ks/s (typ.)		
	Measurement Ranges	Range 1, +20 to –7 dBm (typ.) Range 2, –7 to –40 dBm (typ.) Auto ranging between range 1 and 2		
Measurement Uncertainty	Linearity	<3%		
	Cal Factor*1	<2.3% at 10 MHz <1.5%, 50 MHz to 8 GHz	<2.3% at 10 MHz <1.5%, 50 MHz to 18 GHz	<3.5% at 10 MHz <2.0%, 50 MHz to 2 GHz <2.5%, 3 GHz to 8 GHz <3.0%, 9 GHz to 15 GHz <3.5%, 16 GHz to 26 GHz
	Noise*2	<8 µW, Range 1 <40 nW, Range 2		
	Zero Set*3	<1 µW, Range 1 <10 nW, Range 2		
	Zero Drift*4	<0.5 µW, Range 1 <3 nW, Range 2		
	Effect of Temperature	<1.4%		
	Effect of Digital Modulation*5	<0.5%, <+18 dBm <1.4%, >+18 dBm		
System	Measurand	Average power		
	Measurement Resolution*6	0.01 dB max via PowerXpert, 0.001 dB max via remote command		
	Offset Correction*7	–100 to +150 dB		
	Averaging	Auto, Manual		
	Type	Moving, Repeat		
	Number of Averages (manual)*8	1 to 40,000		
	Auto Average	Resolution*9: 1 dB, 0.1 dB, 0.01 dB, 0.001 dB Source (slot # or scope data point number) Timeslot: 1 to 128 Scope: 1 to 1024		
Continuous Average Mode	Duty Cycle Correction	0.01% to 100%		
	Aperture Time	0.01 ms to 300 ms		
	Measurement Time*10	N × (Capture Time × 2.5) + T_d + T_{com}		
Scope Mode	Capture Time	0.01 ms to 300 ms		
	Data Points	1 to 1024		
	Resolution	0.007 ms, max via remote command 0.01 ms, max via PowerXpert		
	Measurement Time*11	N × (Capture Time × 3.75) +(P_n × T_{dp}) + T_{com}		
Timeslot Mode	Maximum Number of Slots	128		
	Slot with	0.01 ms to 100 ms		
	Maximum Capture Time	300 ms (slot width × number of slots)		
	Resolution	0.007 ms, max via remote command 0.01 ms, max via PowerXpert		
	Exclusion Periods	Start Exclusion: 0 ms to 10 ms End Exclusion: 0 ms to 10 ms		
	Measurement Time*11	N × (Capture Time × 3.75) + (P_n × T_{dp}) + T_{com}		

Continued on next page

Model		MA24108A	MA24118A	MA24126A
Trigger	Source*12	Bus, Continuous, Internal and External		
	Internal Trigger	Dynamic Range: –20 to +20 dBm Level Accuracy: ± 0.5 dB (typ.) Slope: Positive or negative Delay Range: –5 ms to +10 s Delay Resolution: 10 μs		
	External Trigger	Impedance: 100kΩ Type: TTL/CMOS Slope: Positive or negative Delay Range: –5 ms to +10 s Delay Resolution: 10 μs Positive Threshold Voltage: 2.0 V (typ.) Negative Threshold Voltage: 1.2 V (typ.) Hysteresis: 0.8 V (typ.)		
General	RF Connector	N (m), K (m) (MA24126A)		
	Interface to Host	USB 2.0 full speed (compatible with USB 1.0 and 1.1)		
	Current Consumption	150 mA (typ.)		
	External Trigger Input	MCX (f), 12 V max		
	Damage Levels at RF Port	+33 dBm, ±20 V DC		
	Dimensions	110 (W) × 45 (H) × 25 (D) mm, (25 × 45 × 110 mm) excluding N connector and silicone protective covering		
	Mass	230 g (0.51 lb)		
Environmental*13	Operating Temperature Range	0° to +55°C		
	Storage Temperature Range	–51° to +71°C		
	Humidity	45% relative humidity at 55°C (non-condensing) 75% relative humidity at 40°C (non-condensing) 95% relative humidity at 30°C (non-condensing)		
	Shock	30 g half-sine, 11 ms duration		
	Vibration	Sinusoidal: 5 Hz to 55 Hz, 3 g max. Random: 10 Hz to 500 Hz Power Spectral Density: 0.03 g^2/Hz		
	CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN61010-1 RoHS: 2011/65/EU		
PowerXpert v2.0 (PC requirements)	Processor and RAM	Minimum: Equivalent to Intel® Pentium® III with 1 GB RAM or Intel® Pentium® IV with 512 MB RAM Recommended: Equivalent to Intel® Pentium® IV with 1 GB RAM		
	Operating System	Microsoft® Windows 7, Windows Vista®, Windows XP and Windows 2000		
	Hard-disk Free Space	100 MB, minimum		
	Display Resolution	1024 × 768, minimum		
	Interface	USB 2.0 full speed (compatible with USB 1.0 and 1.1)		

Notes: All specs are applicable after twenty minutes warm-up at room temperature unless specified otherwise.

*1: Expanded uncertainty with K = 2 for absolute power measurements on CW signal at 0 dBm and calibration frequencies 10 MHz, 50 MHz, 100 MHz, 300 MHz, 500 MHz, and 1 GHz to 8 GHz (for MA24108A), or to 18 GHz (MA24118A) or to 26 GHz (for MA24126A) in 1 GHz increments.
*2: Expanded uncertainty with K = 2 after zero operation when measured with 1 average, and 20 ms aperture time for 5 minutes. Effect of Noise can be reduced by increasing the number of averages and/or increasing the aperture time. Noise goes down as square root of number of averages and aperture time.
For example with 128 averages, the Noise is 3.5 nW (40 nW divided by √128). Effect of increased aperture time is calculated in the same way.
*3: Expanded uncertainty with K = 2 after zero operation when measured with 1 average, and 20 ms aperture time for 5 minutes.
*4: Expanded uncertainty with K = 2 after one hour warm-up and zero operation, 1 average, 20 ms aperture time, and keeping the temperature within ±1°C.
*5: Measurement error with reference to a CW signal of equal power and frequency at 25°C.
*6: Resolution in PowerXpert application is 2 digits after the decimal. Native resolution of the sensor is 3 digits after the decimal.
*7: Offset correction feature is available only through PowerXpert application. There is no remote command for it in the sensor firmware.
*8: Maximum number of averages allowed in Continuous Average mode and Timeslot mode is 40,000. In scope, the maximum number of averages is equal to 8231936 divided by data points.
*9: Averaging resolution of 0.001 dB is not available with PowerXpert application. It is defined as the place after the decimal to which the reading becomes stable. E.g. if 0.01 is selected then the reading will typically be stable ±0.01 dB. Please refer to the remote operation chapter in the user guide for information regarding access to this feature.
*10: Speed is defined as the data throughput at the "A" end of the USB A to Micro-B Cable (p/n 2000-1606-R). T_d is the delay compensation for smaller Capture Times, T_d = 0 for Capture Time >9 ms, T_d = 3 ms for 2 ms <Capture Time <9 ms, T_d = 5 ms for Capture Time <2 ms, T_{com} = 5 ms, command processing time.
*11: Speed is defined as the data throughput at the "A" end of the USB A to Micro-B Cable (p/n 2000-1606-R). Where N is the number of repeat averages, N = 1 for moving average mode, P_n = Number of points, T_{dp} = 0.05 ms (Communication delay (approx) due to each point), T_{com} = 5 ms, command processing time.
*12: Bus trigger not available in PowerXpert application.
*13: Tests were performed per MIL-PRF-28800F (Class 2).

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Main Frame
MA24106A	True-RMS USB Power Sensor, 50 MHz to 6 GHz
	Included Accessories
2000-1566-R	1.8 m USB A to Mini-B Cable
10585-00021	Quick Start Guide
	Available Options
MA24106A-097	Option 97, Accredited calibration to ISO17025 and ANSI/NCSL Z540. Test report and uncertainty data included
MA24106A-098	Option 98, Standard calibration to ISO17025 and ANSI/NCSL Z540
MA24106A-099	Option 99, Premium calibration to ISO17025 and ANSI/NCSL Z540. Test report and uncertainty data included
	Optional Accessories
2000-1593-R	3.0 m USB A to Mini-B cable
2000-1594-R	5.0 m USB A to Mini-B cable
01-200	Calibrated torque wrench for N connector
01-204	Calibrated torque wrench for K and V connectors
3-1010-123	N (m) to N (f), DC to 8.5 GHz, 30 dB, 50 W, 50Ω
3-1010-124	N (m) to N (f), DC to 8.5 GHz, 40 dB, 100 W, 50Ω
3-1010-122	N (m) to N (f), DC to 12.4 GHz, 20 dB, 5 W, 50Ω
42N50-20	N (m) to N (f), DC to 18 GHz, 20 dB, 5 W, 50Ω
42N50-30	N (m) to N (f), DC to 18 GHz, 30 dB, 50 W, 50Ω
510-90	N (m) to 7/16 DIN (f), DC to 3.3 GHz
510-91	N (f) to 7/16 DIN (f), DC to 3.3 GHz
510-92	N (m) to 7/16 DIN (m), DC to 3.3 GHz
510-93	N (f) to 7/16 DIN (m), DC to 3.3 GHz
33NFNF50B	N (f) to N (f), DC to 18 GHz
33NNF50B	N (m) to N (f), DC to 18 GHz
33NN50B	N (m) to N (m), DC to 18 GHz
34AN50	GPC-7 to N (m), DC to 18 GHz
34ANF50	GPC-7 to N (f), DC to 18 GHz
34NFK50	N (f) to K (m), DC to 18 GHz
34NFKF50	N (f) to K (f), DC to 18 GHz
34NK50	N (m) to K (m), DC to 18 GHz
34NKF50	N (m) to K (f), DC to 18 GHz
2300-528	Sensor calibration utility, MA24106A CalXpert™

Model/Order No.	Name
	Main Frame
MA24108A	10 MHz to 8 GHz USB Power Sensor
MA24118A	10 MHz to 18 GHz USB Power Sensor
MA24126A	10 MHz to 26 GHz USB Power Sensor
	Included Accessories
10585-00021	Quick Start Guide
2000-1605-R	1.5 m BNC (m) to MCX (m) cable
2000-1606-R	1.8 m USB A to Micro-B cable with latch
	Available Options
MA24108A-097	Option 97, Accredited calibration to ISO17025 and ANSI/NCSL Z540. Test report and uncertainty data included
MA24108A-098	Option 98, Standard calibration to ISO17025 and ANSI/NCSL Z540
MA24108A-099	Option 99, Premium calibration to ISO17025 and ANSI/NCSL Z540. Test report and uncertainty data included
MA24118A-097	Option 97, Accredited calibration to ISO17025 and ANSI/NCSL Z540. Test report and uncertainty data included
MA24118A-098	Option 98, Standard calibration to ISO17025 and ANSI/NCSL Z540
MA24118A-099	Option 99, Premium calibration to ISO17025 and ANSI/NCSL Z540. Test report and uncertainty data included
MA24126A-097	Option 97, Accredited calibration to ISO17025 and ANSI/NCSL Z540. Test report and uncertainty data included
MA24126A-098	Option 98, Standard calibration to ISO17025 and ANSI/NCSL Z540
MA24126A-099	Option 99, Premium calibration to ISO17025 and ANSI/NCSL Z540. Test report and uncertainty data included
	Optional Accessories
01-200	Calibrated torque wrench for N connector
01-204	Calibrated torque wrench for K and V connectors
2000-1614-R	Cable, 5.0 m USB A to Micro-B cable with latch
3-1010-123	N (m) to N (f), DC to 8.5 GHz, 30 dB, 50 W, 50Ω
3-1010-124	N (m) to N (f), DC to 8.5 GHz, 40 dB, 100 W, 50Ω
3-1010-122	N (m) to N (f), DC to 12.4 GHz, 20 dB, 5 W, 50Ω
42N50-20	N (m) to N (f), DC to 18 GHz, 20 dB, 5 W, 50Ω
42N50-30	N (m) to N (f), DC to 18 GHz, 30 dB, 50 W, 50Ω
41KB-3	Power attenuator, DC to 26.5 GHz, 3 dB, 50Ω, K (m) to K (f)
41KB-6	Power attenuator, DC to 26.5 GHz, 6 dB, 50Ω, K (m) to K (f)
41KB-10	Power attenuator, DC to 26.5 GHz, 10 dB, 50Ω, K (m) to K (f)
41KB-20	Power attenuator, DC to 26.5 GHz, 20 dB, 50Ω, K (m) to K (f)
43KB-3	Power attenuator, DC to 26.5 GHz, 3 dB, 50Ω, K (m) to K (f)
43KB-6	Power attenuator, DC to 26.5 GHz, 6 dB, 50Ω, K (m) to K (f)
43KB-10	Power attenuator, DC to 26.5 GHz, 10 dB, 50Ω, K (m) to K (f)
43KB-20	Power attenuator, DC to 26.5 GHz, 20 dB, 50Ω, K (m) to K (f)
510-90	N (m) to 7/16 DIN (f), DC to 3.3 GHz
510-91	N (f) to 7/16 DIN (f), DC to 3.3 GHz
510-92	N (m) to 7/16 DIN (m), DC to 3.3 GHz
510-93	N (f) to 7/16 DIN (m), DC to 3.3 GHz
33NFNF50B	N (f) to N (f), DC to 18 GHz
33NNF50B	N (m) to N (f), DC to 18 GHz
33NN50B	N (m) to N (m), DC to 18 GHz
34AN50	GPC-7 to N (m), DC to 18 GHz
34ANF50	GPC-7 to N (f), DC to 18 GHz
34NFK50	N (f) to K (m), DC to 18 GHz
34NFKF50	N (f) to K (f), DC to 18 GHz
34NK50	N (m) to K (m), DC to 18 GHz
34NKF50	N (m) to K (f), DC to 18 GHz
1091-26	Precision coaxial adapter, DC to 18 GHz, N (m) to SMA (m)
1091-27	Precision coaxial adapter, DC to 18 GHz, N (m) to SMA (f)
1091-80-R	Precision coaxial adapter, DC to 18 GHz, N (f) to SMA (m)
1091-81-R	Precision coaxial adapter, DC to 18 GHz, N (f) to SMA (f)

Microwave Universal USB Power Sensors

MA24208A/MA24218A

True-RMS, 10 MHz to 18 GHz

Remote Control
USB

Low Cost, Compact, and Highly Accurate Power Sensors for RF and Microwave Applications

The Universal USB Power sensors MA24208A and MA24218A are designed to provide accurate average power measurements from 10 MHz to 8 GHz and 18 GHz, respectively, over 80 dB of dynamic range.
The sensors employ a patented "triple path" architecture that provides True-RMS measurements over the entire frequency and dynamic range (similar to thermal sensors), enabling users to make highly accurate average power measurements for CW, multi-tone, and digitally modulated signals up to 18 GHz.

Features and Benefits

- Broad Frequency Range (10 MHz to 18 GHz): Ideal for general purpose, aerospace and satellite and wireless communications applications
- True RMS Measurements over 80 dB Dynamic Range: Enables average power measurement on CW, multi-tone, and digitally modulated signals - independent of modulation bandwidth
- Best-in-Class Damage Protection (+30 dBm CW, +34 dBm peak < 10 µs): Protects instrumentation investment
- No Zeroing Required (for signals > –45 dBm) and Elimination of 1 mW Reference Calibration: Reduces test time and handling in production while maintaining absolute accuracy
- Advanced Trigger Capabilities: Facilitates time dependent power measurements (for example, GSM, WiMAX, TD-SCDMA, and LTE)
- NIST Traceable Calibration: Provides high-accuracy measurements
- Easy to Use with PC or Select Anritsu Handheld Instruments: No benchtop power meter unit needed
- Silicone Protective Covering (removable): Provides additional field durability
- External Trigger Latching: For pulses as narrow as 20 ns

Definitions

All specifications and characteristics apply under the following conditions, unless otherwise stated:

Warm-Up Time	60 minutes
Operating Temperature Range	0° to 50°C
Characteristic Performance	Characteristic specifications are not tested and are not warranted.
ISO GUM Measurement Uncertainty	Zero and Noise uncertainty expressed with three sigma confidence level. Average and Relative Power uncertainty expressed with two sigma confidence level.
Calibration Cycle	Anritsu recommended calibration interval is 12 months. All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site: www.anritsu.com

Notes: MA24208A and MA24218A sensors may have degraded performance when dropped without the removable protective covering.
This cover is required for warranted operation.

Sensor Specifications

Frequency

MA24208A	10 MHz to 8 GHz
MA24218A	10 MHz to 18 GHz

Power Measurement

Dynamic Range	–60 to +20 dBm			
	≤150 MHz	>150 MHz to 2 GHz	>2 GHz to 12.4 GHz	>12.4 GHz to 18 GHz
VSWR, max	1.17:1	1.12:1	1.22:1	1.25:1
Measurement Range 1	+20 to +4 dBm approximate			
Measurement Range 2	<+4 to –16 dBm approximate			
Measurement Range 3	<–16 to –60 dBm approximate Auto and fixed ranging available			
Damage Levels at RF Port	+30 dBm, ±20 V DC (+34 dBm peak < 10 µs pulse and 10% duty cycle), minimum			

Response

Signal Channel Rise Time	8 µs characteristic
Sampling Rate	140 kS/s

Trigger

Source*1	Bus, Continuous, Internal, External
Arm Type (for Internal/External)	Auto, Single, Multiple, Standby

Internal Trigger

Dynamic Range	–35 to +20 dBm
Level Accuracy	±0.5 dB characteristic
Slope	Positive or Negative
Delay Range	–5 ms to +10 s
Delay Resolution	10 µs
Hysteresis	0 to 10 dB, with 0.1 dB resolution
Trigger Hold Off	0 to 10 sec, with 0.01 ms resolution

External Trigger

External Trigger Input	MCX (f), 5.5 V (max.)
Impedance	4kΩ (nom.)
Type	TTL/CMOS
Slope	Positive or Negative
Delay Range	–5 ms to +10 s
Delay Resolution	10 µs
High Level Input Voltage	2.3 V (min.), 3.0 V (max.)
Low Level Input Voltage	1.3 V (min.), 1.6 V (max.)
Latency*2	7.1 µs (max.)
Trigger Pulse Width	20 ns (min.)
Trigger Repetition Period	7.1 µs (min.)
Trigger Hold Off	0 to 10 s with 0.01 ms resolution

*1: Bus trigger is not available in PowerXpert application.
*2: Latency is defined as the time delay between the defined edge of the applied trigger and the sensor switching into the triggered state.

Measurement Uncertainty

Average Power (dB)*1

	Over 0° to 50°C ambient temperature range:			
Range (dBm)	≤0.05 GHz	>0.05 GHz to 2 GHz	>2 GHz to 12.4 GHz	>12.4 GHz to 18 GHz
–60 to <–16	0.14	0.14	0.14	0.17
–16 to <+4	0.14	0.14	0.13	0.13
+4 to +20	0.14	0.15	0.15	0.14
	Over 20° to 30°C ambient temperature range:			
Range (dBm)	≤0.05 GHz	>0.05 GHz to 2 GHz	>2 GHz to 12.4 GHz	>12.4 GHz to 18 GHz
–60 to <–16	0.13	0.12	0.14	0.14
–16 to <+4	0.11	0.10	0.13	0.11
+4 to +20	0.11	0.10	0.10	0.11

Relative Power (dB)*1

≤0.05 GHz:

	Over 0° to 50°C			Over 20° to 30°C		
Range (dBm)	+4 to +20	–16 to <+4	–60 to <–16	+4 to +20	–16 to <+4	–60 to <–16
–60 to <–16	0.14	0.13	0.03	0.08	0.09	0.03
–16 to <+4	0.14	0.04	0.13	0.06	0.03	0.09
+4 to +20	0.05	0.14	0.14	0.05	0.06	0.08

>0.05 GHz to 2 GHz:

	Over 0° to 50°C			Over 20° to 30°C		
Range (dBm)	+4 to +20	–16 to <+4	–60 to <–16	+4 to +20	–16 to <+4	–60 to <–16
–60 to <–16	0.16	0.16	0.03	0.11	0.12	0.03
–16 to <+4	0.17	0.05	0.16	0.09	0.04	0.12
+4 to +20	0.06	0.17	0.16	0.06	0.09	0.11

>2 GHz to 12.4 GHz:

	Over 0° to 50°C			Over 20° to 30°C		
Range (dBm)	+4 to +20	–16 to <+4	–60 to <–16	+4 to +20	–16 to <+4	–60 to <–16
–60 to <–16	0.16	0.16	0.04	0.12	0.14	0.04
–16 to <+4	0.17	0.05	0.16	0.10	0.04	0.14
+4 to +20	0.06	0.17	0.16	0.07	0.10	0.12

>12.4 GHz to 18 GHz:

	Over 0° to 50°C			Over 20° to 30°C		
Range (dBm)	+4 to +20	–16 to <+4	–60 to <–16	+4 to +20	–16 to <+4	–60 to <–16
–60 to <–16	0.14	0.15	0.04	0.12	0.14	0.04
–16 to <+4	0.11	0.06	0.15	0.10	0.05	0.14
+4 to +20	0.06	0.11	0.14	0.06	0.10	0.12

Zero*2

	Set		Drift	
Range (dBm)	Watts	dBm	Watts	dBm
–60 to <–16	3.32E-10	–64.78	3.44E-10	–64.64
–16 to <+4	3.87E-08	–44.12	4.29E-08	–43.67
+4 to +20	1.07E-06	–29.70	9.96E-07	–30.02

Noise*3

Range (dBm)	Watts
–60 to <–16	1.23E-10
–16 to <+4	1.01E-08
+4 to +20	8.56E-07

Effect of Digital Modulation*4

Range (dBm)	dB
–60 to <–16	–0.048 to 0.080
–16 to <+4	–0.038 to 0.088
+4 to +20	–0.055 to 0.067

*1: Power uncertainty expressed with two sigma confidence level for CW measurement after zero operation Includes calibration factor and linearity over temperature uncertainties, but not the effects of mismatch, zero set and drift, or noise.

*2: Zero uncertainty expressed with three sigma confidence level. One hour warm-up followed by a Zero operation. Measured with 256 averages and 40 ms aperture and with the temperature kept within ±1°C. Zero Set: Average of the reported power over one hour. Zero Drift: Two sigma value of the reported power over one hour.

*3: Two sigma noise at 10.2 seconds of integration time (integration time = aperture time x averaging number). Effect of noise can be reduced by increasing the number of averages and/or increasing the aperture time. Noise is inversely proportional to the square root of number of ADC samples used per measurement; the number of ADC samples per measurement is the product of the sample rate, aperture time, and number of averages used. Noise uncertainty is expressed with three sigma confidence level.

*4: Measurement error with reference to a CW signal of equal power and frequency between 20° to 30°C in Normal mode and average power ≤+20 dBm.
In general, the error caused by modulation depends on the peak to average power ratio and RF bandwidth of the signal.

PowerXpert™

PC Requirements (version 3.0 or greater)

Processor and RAM	Minimum: Equivalent to Intel® Pentium® III with 1 GB RAM or Intel® Pentium® IV with 512 MB RAM Recommended: Equivalent to Intel® Pentium® IV with 1 GB RAM
Operating System	Microsoft® Windows® 8, Windows® 7, and Windows® XP
Hard-Disk Free Space	100 MB minimum
Display Resolution	1024 × 768 minimum
Interface	USB 2.0 high speed

System

Measurand	Average power
Measurement Resolution	0.01 dB max via PowerXpert™, 0.001 dB max via remote command
Offset Correction*1	–100 to +150 dB
Averaging	Auto, Manual
Type	Moving, Repeat
Number of Averages (Manual)*2	1 to 65,536
Auto Average Resolution*3	1 dB, 0.1 dB, 0.01 dB
Auto Average Source	Timeslot Number: 1 to 128 Scope Data Point Number: 1 to 16,384

Continuous Average Mode

Duty Cycle Correction	0.01 to 100%
Aperture Time	0.01 ms to 1 s
Measurement Time*4	N × (aperture time × C_t) + 0.375 ms + T_{com} Continuous: >1,600 readings/s (minimum aperture, one average) Buffered: >11,000 readings/s (minimum aperture, one average)
Buffer Size	8192

Scope Mode

Capture Time	0.01 ms to 1 s
Data Points	1 to 16,384
Resolution	0.01 ms max
Measurement Time*5	N × (capture time × C_t) + (P_n × 0.042 ms) + T_{com}

Timeslot Mode

Maximum Number of Slots	128
Slot Width	0.01 ms to 100 ms
Maximum Capture Time	1000 ms (slot width × number of slots)
Resolution	0.01 ms max via remote command 0.01 ms max via PowerXpert™
Exclusion Periods	Start Exclusion: 0 ms to 10 ms End Exclusion: 0 ms to 10 ms
Measurement Time*6	N × (slot width × number of slots × C_t) + (P_n × 0.064 ms) + T_{com}

List Mode

Number of Measurements	1 to 1000
Input Parameters	Frequency (GHz), aperture time (ms), averages

*1: Offset correction feature is available only through the PowerXpert application. There is no remote command for it in the sensor firmware.

*2: Maximum number of averages allowed in Continuous Average mode and Timeslot mode is 65,536. In Scope mode, the maximum number of averages is equal to 16,777,216 divided by the number of data points.

*3: Averaging resolution of 0.001 dB is not available with the PowerXpert application. It is defined as the place after the decimal to which the reading becomes stable. For example, if 0.01 is selected, then the reading will typically be stable within ±0.01 dB. Please refer to the remote operation chapter in the user guide for information regarding access to this feature.

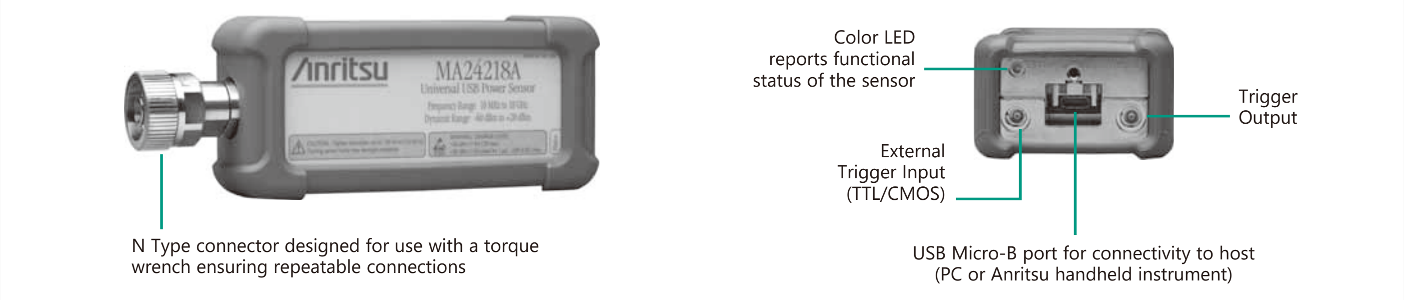
*4: Speed is defined as the data throughput at the "A" end of the USB A to Micro-B Cable (p/n 2000-1816-R), where:
Number of Repeat Averages = N (N = 1 for moving average mode)
Capture Time Coefficient = Ct = 1.62
Command Processing Time = Tcom = 0.2 ms
Speed may vary depending on the speed of and load on the CPU controlling the sensor. Specified results obtained with Intel® Core™ i5-3550 CPU running at 3.30 GHz

*5: Speed is defined as the data throughput at the "A" end of the USB A to Micro-B Cable (p/n 2000-1816-R), where:
Number of Repeat Averages = N (N = 1 for moving average mode)
Capture Time Coefficient = Ct = 1.645
Number of Points = Pn
Command Processing Time = Tcom = 0.24 ms

*6: Speed is defined as the data throughput at the "A" end of the USB A to Micro-B Cable (p/n 2000-1816-R), where:
Number of Repeat Averages = N (N = 1 for moving average mode)
Capture Time Coefficient = Ct = 1.625
Number of Points = Pn
Command Processing Time = Tcom = 0.29 ms

General

RF Connector	N male
Interface to Host	USB 2.0 high speed
Current Consumption	410 mA to 450 mA characteristic (20° to 30°C)
Dimensions	110 (W) × 46 (H) × 25.6 (D) mm, excluding N connector and silicone protective covering
Mass	397 g (0.88 lb)
Warranty	1 year



Operational Requirements

Tests were performed per MIL-PRF-28800F (Class 3).

Operating Temperature Range	0° to +50°C
Storage Temperature Range	–40° to +71°C
Relative Humidity	45% relative humidity at 50°C (non-condensing) 75% relative humidity at 40°C (non-condensing) 95% relative humidity at 30°C (non-condensing)
Altitude	4600 m operational max
Shock	30 g_n half-sine, 11 ms duration
Vibration	Sinusoidal: 5 Hz to 55 Hz, 3 g max Random: 10 Hz to 500 Hz, 2.34 g rms Power Spectral Density: 0.01 g^2/Hz
CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN61010-1 RoHS: 2011/65/EU
RCM	Australia and New Zealand: RCM AS/NZS 4417-2012
KCC	South Korea: KCC-REM-A21-0004

Training at Anritsu

Anritsu has designed courses to help you stay up to date with technologies important to your job. For available training courses, visit: www.anritsu.com/training

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Available Models
MA24208A	8 GHz USB Universal Power Sensor
MA24218A	18 GHz USB Universal Power Sensor
	Included Accessories
10585-00021	Quick Start Guide
2000-1605-R	1.5 m BNC (m) to MCX (m) cable
2000-1816-R	1.8 m USB A to Micro-B cable
	Available Options
MA24208A-097	Option 97: ISO/IEC 17025 and ANSI/NCSL Z540-1 or ANSI/NCSLI Z540.3 (includes test report, uncertainty data, and accreditation symbol)
MA24208A-098	Option 98: Standard calibration ISO/IEC 17025 and ANSI/NCSL Z540-1
MA24208A-099	Option 99: Premium calibration ISO/IEC 17025 and ANSI/NCSL Z540-1 (includes test report and uncertainty data)
MA24218A-097	Option 97: ISO/IEC 17025 and ANSI/NCSL Z540-1 or ANSI/NCSLI Z540.3 (includes test report, uncertainty data, and accreditation symbol)
MA24218A-098	Option 98: Standard calibration ISO/IEC 17025 and ANSI/NCSL Z540-1
MA24218A-099	Option 99: Premium calibration ISO/IEC 17025 and ANSI/NCSL Z540-1 (includes test report and uncertainty data)
	Optional Accessories
	Calibrated Torque Wrenches
01-200	Calibrated torque wrench for N connector
01-204	Calibrated torque wrench for K and V connectors

Model/Order No.	Name
	Power Attenuators
3-1010-123	DC to 8.5 GHz, 30 dB, 50 W, 50Ω, N (m) to N (f)
3-1010-124	DC to 8.5 GHz, 40 dB, 100 W, 50Ω, N (m) to N (f)
3-1010-122	DC to 12.4 GHz, 20 dB, 5 W, 50Ω, N (m) to N (f)
42N50-20	DC to 18 GHz, 20 dB, 5 W, 50Ω, N (m) to N (f)
42N50A-30	DC to 18 GHz, 30 dB, 50 W, 50Ω, N (m) to N (f)
41KB-3	DC to 26.5 GHz, 3 dB, 50Ω, K (m) to K (f)
41KB-6	DC to 26.5 GHz, 6 dB, 50Ω, K (m) to K (f)
41KB-10	DC to 26.5 GHz, 10 dB, 50Ω, K (m) to K (f)
41KB-20	DC to 26.5 GHz, 20 dB, 50Ω, K (m) to K (f)
43KB-3	DC to 26.5 GHz, 3 dB, 50Ω, K(m) to K (f)
43KB-6	DC to 26.5 GHz, 6 dB, 50Ω, K (m) to K (f)
43KB-10	DC to 26.5 GHz, 10 dB, 50Ω, K (m) to K (f)
43KB-20	DC to 26.5 GHz, 20 dB, 50Ω, K (m) to K (f)
	Precision Coaxial Adapters
510-90-R	DC to 3.3 GHz, N (m) to 7/16 DIN (f)
510-91-R	DC to 3.3 GHz, N (f) to 7/16 DIN (f)
510-92-R	DC to 3.3 GHz, N (m) to 7/16 DIN (m)
510-93-R	DC to 3.3 GHz, N (f) to 7/16 DIN (m)
33NFNF50B	DC to 18 GHz, N (f) to N (f)
33NNF50B	DC to 18 GHz, N (m) to N (f)
33NN50B	DC to 18 GHz, N (m) to N (m)
34AN50	DC to 18 GHz, GPC-7 to N (m)
34ANF50	DC to 18 GHz, GPC-7 to N (f)
34NFK50	DC to 18 GHz, N (f) to K (m)
34NFKF50	DC to 18 GHz, N (f) to K (f)
34NK50	DC to 18 GHz, N (m) to K (m)
34NKF50	DC to 18 GHz, N (m) to K (f)
1091-26-R	DC to 18 GHz, N (m) to SMA (m)
1091-27-R	DC to 18 GHz, N (m) to SMA (f)
1091-80-R	DC to 18 GHz, N (f) to SMA (m)
1091-81-R	DC to 18 GHz, N (f) to SMA (f)

Microwave CW USB Power Sensors

MA24330A

10 MHz to 33 GHz

MA24340A

10 MHz to 40 GHz

MA24350A

10 MHz to 50 GHz

Low Cost, Compact, and Highly Accurate Power Sensors for RF and Microwave Applications

The Microwave CW USB Power Sensors MA243x0A series employ a single-path diode architecture to provide fast, accurate average power measurements from 10 MHz up to 50 GHz with 90 dB of dynamic range.

Key Features

- Broad Frequency Range (10 MHz up to 50 GHz): Ideal for general purpose, aerospace, satellite and wireless communications applications
- Accurate Power Measurements with over 90 dB Dynamic Range
- Best-in-Class Damage Protection (+26 dBm CW, +32 dBm peak <10 µs): Protects instrumentation investment
- No Zeroing Required (for signals >–50 dBm) and Elimination of 1 mW Reference Calibration: Reduces test time and handling in production while maintaining absolute accuracy
- Advanced Trigger Capabilities: Facilitates time dependent power measurements
- NIST Traceable Calibration: Provides high-accuracy measurements and ensures absolute accuracy
- Calibration Traceable to SI Units via National Metrology Institutes
- Easy to Use with PC or Select Anritsu Handheld Instruments: No benchtop power meter unit needed
- Silicone Protective Covering (removable): Provides additional field durability
- External Trigger Latching: For pulses as narrow as 20 ns

Definitions

All specifications and characteristics apply under the following conditions, unless otherwise stated:

Warm-Up Time	60 minutes
Operating Temperature Range	0° to 50°C
Characteristic Performance	Characteristic specifications are not tested and are not warranted.
ISO GUM Measurement Uncertainty	Zero and Noise uncertainty expressed with coverage factor of k = 3. Average and Relative Power uncertainty expressed with coverage factor of k = 2.
Calibration Cycle	Anritsu recommended calibration interval is 12 months. All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site: www.anritsu.com

Notes: Sensors may have degraded performance when dropped without the removable protective covering.
This cover is required for warranted operation.

MA243x0A Specifications

Sensor Specifications

Frequency	10 MHz to 33 GHz, K (m) Connector (MA24330A) 10 MHz to 40 GHz, K (m) Connector (MA24340A) 10 MHz to 50 GHz, V (m) Connector (MA24350A)								
Power Measurement	VSWR	<50 MHz	50 MHz to 150 MHz	>0.15 GHz to 2 GHz	>2 GHz to 6 GHz	>6 GHz to 18 GHz	>18 GHz to 33 GHz	>33 GHz to 40 GHz	>40 GHz to 50 GHz
		1.9:1	1.17:1	1.08:1	1.16:1	1.21:1	1.29:1	1.44:1	1.5:1
	Dynamic Range	–70 to +20 dBm							
	Damage Levels at RF Port	+26 dBm, ±20 V DC (+32 dBm peak < 10 µs pulse and 10% duty cycle), minimum							
Response	Signal Channel Rise Time	8 µs characteristic							
	Sampling Rate	140 kS/s							
Trigger	Source[*1]	Bus, Continuous, Internal, External							
	Arm Type (for Internal/External)	Auto, Single, Multiple, Standby							

Continued on next page

Internal Trigger	Dynamic Range	–35 to +20 dBm
	Level Accuracy	±0.5 dB characteristic
	Slope	Positive or Negative
	Delay Range	–5 ms to +10 s
	Delay Resolution	10 µs
	Hysteresis	0 to 10 dB, with 0.1 dB resolution
	Trigger Hold Off	0 to 10 s, with 0.01 ms resolution
External Trigger	External Trigger Input	MCX (f), 5.5 V maximum
	Input Impedance	4kΩ (nom.)
	Type	TTL/CMOS
	Slope	Positive or Negative
	Delay Range	–5 ms to +10 s
	Delay Resolution	10 µs
	High Level Input Voltage	2.3 V min, 3.0 V max
	Low Level Input Voltage	1.3 V min, 1.6 V max
	Latency*2	7.1 µs max
	Trigger Pulse Width	20 ns min
	Trigger Repetition Period	7.1 µs min
	Trigger Holdoff	0 to 10 s with 0.01 ms resolution

*1: Bus trigger is not available in PowerXpert application.
*2: Latency is defined as the time delay between the defined edge of the applied trigger and the sensor switching into the triggered state.

Measurement Uncertainty

		30° to 50°C		10° to <30°C		0° to <10°C	
Average Power (dB)*3	Range (dBm)	≤18 GHz	>18 GHz	≤18 GHz	>18 GHz	≤18 GHz	>18 GHz
	–70 to <+15	0.12	0.14	0.14	0.16	0.15	0.17
	+15 to +20	0.14	0.17	0.16	0.19	0.18	0.21

		Set		Drift	
Zero*4	Range (dBm)	Watt	dBm	Watt	dBm
	–70 to –20	9.68E-11	–70.14	8.90E-11	–70.50
	>–20 to 0	4.95E-09	–53.05	4.14E-09	–53.83
	>0 to +20	1.56E-08	–48.08	1.72E-08	–47.65

Noise*5	Range (dBm)	Watt	dBm
	–70 to –20	3.53E-11	–74.52
	>–20 to 0	6.51E-11	–71.86
	>0 to +20	6.30E-10	–62.01

*3: Power uncertainty expressed with coverage factor of k = 2 for CW measurement after zero operation. Includes calibration factor and linearity over temperature uncertainties, but not the effects of mismatch, zero set and drift, or noise.
*4: Zero uncertainty expressed with coverage factor of k = 3. One hour warm-up followed by a Zero operation. Measured with 256 averages and 40 ms aperture and with the temperature kept within ±1°C.
Zero Set: Average of the reported power over one hour.
Zero Drift: Two sigma value of the reported power over one hour.
Specified Zero Set, Drift and Noise are valid at 30° ±5°C.
*5: Two sigma noise at 10.2 seconds of integration time (integration time = aperture time × averaging number). Effect of noise can be reduced by increasing the number of averages and/or increasing the aperture time. Noise is inversely proportional to the square root of number of ADC samples used per measurement; the number of ADC samples per measurement is the product of the sample rate, aperture time, and number of averages used. Noise uncertainty is expressed with coverage factor of k = 3.

PowerXpert™

PC Requirements (version 3.0 or greater)	Processor and RAM	Minimum: Equivalent to Intel® Pentium® III with 1 GB RAM or Intel® Pentium® IV with 512 MB RAM Recommended: Equivalent to Intel® Pentium® IV with 1 GB RAM
	Operating System	Microsoft® Windows® 8, Windows® 7, and Windows® XP
	Hard-Disk Free Space	100 MB minimum
	Display Resolution	1024 × 768 minimum
	Interface	USB 2.0 high speed
System	Measurand	Average power
	Measurement Resolution	0.01 dB max via PowerXpert™, 0.001 dB max via remote command
	Offset Correction*6	–100 to +150 dB
	Averaging	Auto, Manual
	Type	Moving, Repeat
	Number of Averages (Manual)*7	1 to 65,536
	Auto Average Resolution*8	1, 0.1, 0.01 dB
	Auto Average Source	Scope Data Point Number: 1 to 16,384
Continuous Average Mode	Duty Cycle Correction	0.01% to 100%
	Aperture Time	0.01 ms to 1 s
	Measurement Time*9	N × (aperture time × C_t) + T_{com} Continuous: >2,100 readings/s (minimum aperture, one average) Buffered: >5,600 readings/s (minimum aperture, one average)
	Buffer Size	8192

Continued on next page

Scope Mode	Capture Time	0.01 ms to 1 s
	Data Points	1 to 16,384
	Resolution	0.01 ms max
	Measurement Time*10	$N \times (\text{capture time} \times C_t) + (P_n \times 0.038\ \text{ms}) + T_{com}$
List Mode	Number of Measurements	1 to 1000
	Input Parameters	Frequency (GHz), aperture time (ms), averages
General	RF Connector	K (m) (MA24330A, MA24340A) V (m) (MA24350A)
	Interface to Host	USB 2.0 high speed
	Current Consumption	410 mA to 450 mA characteristic (+20° to +30°C)
	Dimensions	110 (W) × 46 (H) × 25.6 (D) mm, excluding K or V connector and silicone protective covering
	Mass	397 g (0.88 lb)
	Warranty	1 year
Operational Requirements Tests were performed per MIL-PRF-28800F (Class 3).	Operating Temperature Range	0° to +50°C
	Storage Temperature Range	–40° to +71°C
	Humidity	45% relative humidity at +50°C (non-condensing) 75% relative humidity at +40°C (non-condensing) 95% relative humidity at +30°C (non-condensing)
	Altitude	4600 m operational max
	Shock	30 g_n half-sine, 11 ms duration
	Vibration	Sinusoidal: 5 Hz to 55 Hz, 3 g max Random: 10 Hz to 500 Hz Power Spectral Density: 0.03 g^2/Hz
	CE	EMC: 2014/30/EU, EN61326-1, EN61000-3-2 LVD: 2014/35/EU, EN61010-1 RoHS: 2011/65/EU
	RCM	Australia and New Zealand: RCM AS/NZS 4417-2012
	KCC	South Korea: KCC-REM-A21-0004

*6: Offset correction feature is available only through the PowerXpert application. There is no remote command for it in the sensor firmware.

*7: Maximum number of averages allowed in Continuous Average mode is 65,536. In Scope mode, the maximum number of averages is equal to 16,777,216 divided by the number of data points.

*8: Averaging resolution of 0.001 dB is not available with the PowerXpert application. It is defined as the place after the decimal to which the reading becomes stable. For example, if 0.01 is selected, then the reading will typically be stable within ±0.01 dB. Please refer to the remote operation chapter in the user guide for information regarding access to this feature.

*9: Speed is defined as the data throughput at the "A" end of the USB A to Micro-B Cable (p/n 2000-1816-R), where:
Number of Repeat Averages = N (N = 1 for moving average mode)
Capture Time Coefficient = C_t = 8.238
Command Processing Time = T_{com} = 0.347 ms
Speed may vary depending on the speed of and load on the CPU controlling the sensor. Specified results obtained with Intel® Core™ i5-3550 CPU running at 3.30 GHz

*10: Speed is defined as the data throughput at the "A" end of the USB A to Micro-B Cable (p/n 2000-1816-R), where:
Number of Repeat Averages = N (N = 1 for moving average mode)
Capture Time Coefficient = C_t = 8.238
Number of Points = P_n
Command Processing Time = T_{com} = 0.289 ms

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Available Models
MA24330A	33 GHz USB Power Sensor
MA24340A	40 GHz USB Power Sensor
MA24350A	50 GHz USB Power Sensor
	Included Accessories
10585-00021	Quick Start Guide
2000-1605-R	1.5 m BNC (m) to MCX (m) cable
2000-1816-R	1.8 m USB A to Micro-B cable
	Available Options
MA24330A-097 MA24340A-097	ISO/IEC 17025 and ANSI/NCSL Z540-1 or ANSI/NCSLI Z540.3 (includes test report, uncertainty data, and accreditation symbol)
MA24330A-098 MA24340A-098 MA24350A-098	Standard calibration ISO/IEC 17025 and ANSI/NCSL Z540-1
MA24330A-099 MA24340A-099 MA24350A-099	Premium calibration ISO/IEC 17025 and ANSI/NCSL Z540-1 (includes test report and uncertainty data)

Model/Order No.	Name
	Optional Accessories
	Calibrated Torque Wrenches
01-201	Calibrated torque wrench for K and V connectors
	Precision Fixed Attenuators
41KB-3	DC to 26.5 GHz, 3 dB, 50Ω, K (m) to K (f)
41KB-6	DC to 26.5 GHz, 6 dB, 50Ω, K (m) to K (f)
41KB-10	DC to 26.5 GHz, 10 dB, 50Ω, K (m) to K (f)
41KB-20	DC to 26.5 GHz, 20 dB, 50Ω, K (m) to K (f)
41KC-3	DC to 40 GHz, 3 dB, 50Ω, K (m) to K (f)
41KC-6	DC to 40 GHz, 6 dB, 50Ω, K (m) to K (f)
41KC-10	DC to 40 GHz, 10 dB, 50Ω, K (m) to K (f)
41KC-20	DC to 40 GHz, 20 dB, 50Ω, K (m) to K (f)
41V-3	DC to 60 GHz, 3 dB, 50Ω, V (m) to V (f)
41V-6	DC to 60 GHz, 6 dB, 50Ω, V (m) to V (f)
41V-10	DC to 60 GHz, 10 dB, 50Ω, V (m) to V (f)
41V-20	DC to 60 GHz, 20 dB, 50Ω, V (m) to V (f)
43KB-3	DC to 26.5 GHz, 3 dB, 50Ω, K (m) to K (f)
43KB-6	DC to 26.5 GHz, 6 dB, 50Ω, K (m) to K (f)
43KB-10	DC to 26.5 GHz, 10 dB, 50Ω, K (m) to K (f)
43KB-20	DC to 26.5 GHz, 20 dB, 50Ω, K (m) to K (f)
43KC-3	DC to 40 GHz, 3 dB, 50Ω, K (m) to K (f)
43KC-6	DC to 40 GHz, 6 dB, 50Ω, K (m) to K (f)
43KC-10	DC to 40 GHz, 10 dB, 50Ω, K (m) to K (f)
43KC-20	DC to 40 GHz, 20 dB, 50Ω, K (m) to K (f)
	Precision Coaxial Adapters
33KFKF50B	DC to 40 GHz, 50Ω, K (f) to K (f)
33KKF50B	DC to 40 GHz, 50Ω, K (m) to K (f)
33VFVF50C	DC to 70 GHz, 50Ω, V (f) to V (f)
33VVF50C	DC to 70 GHz, 50Ω, V (m) to V (f)
34NKF50	DC to 18 GHz, 50Ω, N (m) to K (f)
34NFKF50	DC to 18 GHz, 50Ω, N (f) to K (f)

mmWave Power Analyzer

MA24507A/MA24510A Power Master™

9 kHz to 70 GHz, 9 kHz to 110 GHz

Frequency Selectable mmWave Power Analyzer

NEW
MA24510A

Excellent Eco Product
MA24507A

MA24507A

MA24510A

Power Master is the world's first frequency selectable mmWave power analyzer. It is an ultraportable USB-powered instrument that measures the RF power of signals up to 70 GHz and as low as –90 dBm.
Unlike spectrum analyzers that are bulky, expensive, and complex or power meters that are not frequency dependent and have limited dynamic range, Power Master enables simple, numeric, frequency-based amplitude measurements of up to six signals from 9 kHz to 70 GHz in a package slightly larger than a cell phone and at an extremely affordable price.

Power Master is an ultraportable, USB-powered mmWave power analyzer that enables simple, numeric, frequency-based measurement of RF power from 9 kHz to 110 GHz and as low as –90 dBm. Traditional power meters are broadband and have limited power ranges, so engineers and technicians are using spectrum analyzers that include many unneeded features, cost hundreds of thousands of dollars, and take up half the test bench just to make simple, frequency-based RF amplitude measurements. The Power Master MA24510A enables those measurements in a USB-powered device slightly bigger than a smartphone and at a fraction of the price of a spectrum analyzer.

Key Features

MA24507A

- Able to measure very low power signals as low as –100 dBm
- Excellent for over-the-air testing, especially with mmWave signals that have high propagation loss
- User settings to control measurement speeds and noise floor
- New Channel Monitor mode in PowerXpert for monitoring up to six frequency channels at once
- New Power Hunter mode in PowerXpert for searching up to six signals within a frequency range
- Mounting holes for direct mounting to probes for on-wafer testing

MA24510A

- Low power capability to measure signals as low as –90 dBm
- Excellent for over-the-air testing, especially with mmWave signals that have high propagation loss
- User settings to control measurement speeds and noise floor Channel Monitor mode in
- PowerXpert for monitoring up to six frequency channels at once Power Hunter mode in
- PowerXpert for searching up to six signals within a frequency range
- Mounting holes for direct mounting to connect probes for over-the-air or on-wafer testing
- Microwave Components and Device Characterization

Definitions

All specifications and characteristics apply under the following conditions, unless otherwise stated:

Warm-Up Time	30 minutes
Operating Temperature Range	0° to 50°C
Typical Performance	Typical performance indicates the measured performance of an average unit. Typical performance does not include guard-bands and is not covered by the product warranty. Typical specifications are shown in parenthesis, such as (–102 dB), or noted as Typical.
Characteristic Performance	Characteristic performance indicates a performance designed-in and verified during the design phase. Characteristic performance is not covered by the product warranty.
ISO GUM Measurement Uncertainty	Uncertainty expressed with coverage factor of k = 2.
Calibration Cycle	Anritsu recommended calibration interval is 12 months.
Specifications Subject to Change	All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site: www.anritsu.com

Specifications

Frequency

Range	MA24507A: 9 kHz to 70 GHz, V (m) Connector (1.85 mm) MA24510A: 9 kHz to 110 GHz, W1(m) Connector (1.0 mm)
Internal Reference	Accuracy: ±0.2 ppm (0° to 50°C) Aging: ±1.0 ppm/year aging
Continuous Mode Span	30 kHz to 2 GHz max. in Channel Power Measurement 10 kHz to Full Span in CW Max. Measurement
Channel Monitor Mode Span	1 kHz to 20 MHz

Power Measurement

Maximum Amplitude

Frequency	Max. Power*
≤6.15 GHz	+15 dBm
>6.15 GHz	+10 dBm

*: Characteristic

Average Noise Floor

Channel Power Measurement	Channel Span	Noise Floor*1
	30 kHz	–88 dBm
	10 MHz	–64 dBm
	1 GHz	–40 dBm
CW Max. Measurement	Resolution	NoiseFloor*2
	High	–100 dBm
	Medium	–90 dBm
	Low	–80 dBm

*1: Measured at 1 GHz center frequency
*2: Measured at 1 GHz center frequency; 3 MHz span

Damage Level

Continuous	+30 dBm CW, ±10 VDC max.

Ranges*

Lower	≤–10 dBm
Upper	>–10 dBm

*: Power Master allows the user to define the operating range. To avoid clipping or saturating signals, the upper range is recommended for signals above –10 dBm. Signals at or below –10 dBm will typically be able to use the lower range.

Input Match (typical)

Frequency	V Connector		W1 Connector	
	VSWR	Return Loss	VSWR	Return Loss
9 kHz to ≤12.4 GHz	1.29:1	18 dB	1.29:1	18 dB
>12.4 GHz to 26.5 GHz	1.43:1	15 dB	1.67:1	12 dB
>26.5 GHz to 40 GHz	1.58:1	13 dB	1.67:1	12 dB
>40 GHz to 50 GHz	1.67:1	12 dB	1.67:1	12 dB
>50 GHz to 70 GHz	2.10:1	9 dB	2.10:1	9 dB
>70 GHz to 110 GHz	—	—	2.10:1	9 dB

Measurement Speed (readings/s, characteristic)

		Span*		
		300 kHz	20 MHz	1 GHz
Channel Power Measurement		7	20	10
CW Max. Measurement	High	0.8	15	6
	Medium	4	25	10
	Low	20	25	10

*: Measured at 1 GHz center frequency; no averages

Trigger Source

Bus
Continuous

Measurement Uncertainty

Power Measurements

Amplitude Accuracy*

Frequency	20° to 30°C (after 30 minute warm-up)		0° to 50°C (after 60 minute warm-up)	
	Maximum	Typical	Maximum	Typical
9 kHz to 644 MHz	±1.3 dB	±0.5 dB	±2.0 dB	±0.5 dB
>644 MHz to 40 GHz	±1.8 dB	±0.5 dB	±3.0 dB	±1.0 dB
>40 GHz to 70 GHz	±2.0 dB	±0.5 dB	±3.0 dB	±1.0 dB
>70 GHz to 90 GHz	±2.2 dB	±0.5 dB	±3.0 dB	±1.0 dB
>90 GHz to 110 GHz	±2.5 dB	±0.5 dB	±3.0 dB	±1.0 dB

*: Accuracy excludes effects of Noise and Mismatch uncertainty.
Characteristic values between 67 GHz and 70 GHz.

Relative Power Accuracy

Frequency	Accuracy
9 kHz to <6.15 GHz	±0.3 dB
6.15 GHz to <40 GHz	±0.3 dB
40 GHz to ≤110 GHz	±0.3 dB (typical with W1 connector)

PowerXpert™

PC Requirements (version 4.0 or greater)

Processor and RAM	Equivalent to Quad Core i5 fourth generation or higher CPU, 8 GB RAM
Operating System	Microsoft® Windows® 10, 8.1, or 7; 64-bit
Hard-Disk Free Space	100 MB minimum
Display Resolution	1024 × 768 minimum
Interface	USB 3.0

System

Measurand	Channel power, CW peak power
Measurement Resolution	0.01 dB max. via PowerXpert, 0.01 dB max. via remote command
Offset Correction*	–100 dB to +150 dB
Units	dBm, nW, µW, mW, W
Averaging	Manual
Averaging Type	Moving
Number of Averages	1 to 1,000

*: Offset correction feature is available only through the PowerXpert application. There is no remote command for it in the analyzer firmware.

Dimensions

Measurements	Channel power, CW max.
Center Frequency	9.5 kHz to (70 GHz – 500 Hz)
Span	30 kHz to 2 GHz (Channel power), 1 kHz to Full span (CW max.)
Resolution	High, medium, low

Power Hunter Mode

Measurement	CW max. only
Start Frequency	9 kHz to (70 GHz – 1 kHz)
Stop Frequency	10 kHz to 70 GHz
Set Minimum Power Range	–130 to 0 dBm

Channel Monitor Mode

Measurements	Channel power, CW max.
Channel Frequencies	(9 kHz + Span/2) to (70 GHz – Span/2)
Span	1 kHz to 20 MHz
Number of Channels	Up to 6

General

RF Connector	MA24507A: V male (1.85 mm) MA24510A: W1 male (1.0 mm)
Interface to Host	USB 3.0
Current Consumption	900 mA max.
Dimensions	84 (W) × 155 (H) × 27 (D) mm (6.1 × 3.3 × 1.1 in)
Mass	282 g (0.62 lb)
Warranty	1 year

Operational Requirements

Tests were performed per MIL-PRF-28800F (Class 3).

Operating Temperature Range	0° to +50°C
Storage Temperature Range	–40° to +71°C
Relative Humidity (non-condensing)	45% at +50°C 75% at +40°C 95% at +30°C
Altitude	4600 m operational max.
Shock	30 g half-sine, 11 ms duration
Vibration	Sinusoidal: 5 Hz to 55 Hz, 3 g max. Random: 10 Hz to 500 Hz, 2.34 g rms Power Spectral Density: 0.01 g^2/Hz

Compliance

CE	EMC: 2014/30/EU, EN61326-1, EN610003-2 LVD: 2014/65/EU, EN61010-1 RoHS: 2011/65/EU Australia and New Zealand RCM AS/NZS 4417:2012 South Korea KCC-REM-A21-0004

Ordering Information

Please specify the model/order number, name and quantity when ordering.

The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Mainframe
MA24507A	9 kHz to 70 GHz mmWave Power Analyzer
MA24510A	9 kHz to 110 GHz mmWave Power Analyzer
	Included Accessories
2000-1605-R	1.5 m BNC (m) to MCX (m) cable
2000-1859-R	USB 3.0 Type C to Type A Cable, 1 m
	Available Options
MA24507A-098	Standard Calibration ISO/IEC 17025 and ANSI/NCSL Z540-1
MA24507A-099	Premium Calibration ISO/IEC 17025 and ANSI/NCSL Z540-1 (includes test report and uncertainty data)
MA24510A-098	Standard Calibration ISO/IEC 17025 and ANSI/NCSL Z540-1
MA24510A-099	Premium Calibration ISO/IEC 17025 and ANSI/NCSL Z540-1 (includes test report and uncertainty data)
	Optional Accessories
	Calibrated Torque Wrenches
01-201	Calibrated torque wrench for K and V connectors
	Precision Fixed Attenuators
41V-3	DC to 60 GHz, 3 dB, 50Ω, V (m) to V (f)
41V-6	DC to 60 GHz, 6 dB, 50Ω, V (m) to V (f)
41V-10	DC to 60 GHz, 10 dB, 50Ω, V (m) to V (f)
41V-20	DC to 60 GHz, 20 dB, 50Ω, V (m) to V (f)
	Precision Coaxial Adapters
33VFVF50C	DC to 70 GHz, 50Ω, V (f) to V (f)
33VVF50C	DC to 70 GHz, 50Ω, V (m) to V (f)
34WV50	DC to 65 GHz, W1 (m) to V (m), 50Ω
34WVF50	DC to 65 GHz, W1 (m) to V (f), 50Ω
34WFV50	DC to 65 GHz, W1 (f) to V (m), 50Ω
34WFVF50	DC to 65 GHz, W1 (f) to V (f), 50Ω
33WW50	DC to 110 GHz, W1 (m) to W1 (m), 50Ω
33WWF50	DC to 110 GHz, W1 (m) to W1 (f), 50Ω
33WFWF50	DC to 110 GHz, W1 (f) to W1 (f), 50Ω
	Waveguide to Coaxial Adapters (right angle)
35WR22VF	33 GHz to 50 GHz, WR22 to V (f)
35WR19VF	40 GHz to 60 GHz, WR19 to V (f)
35WR15VF	50 GHz to 65 GHz, WR15 to V (f)
35WR10WF	75 GHz to 110 GHz, WR10 to W1 (f)
SC7442	60 GHz to 90 GHz, WR12 to W1 (f)
	Waveguide to Coaxial End Launch Adapters (straight through)
1091-460-R	17.6 GHz to 26.7 GHz, WR42 to V (f)
1091-459-R	26.4 GHz to 40.1 GHz, WR28 to V (f)
1091-458-R	33.0 GHz to 50.1 GHz, WR22 to V (f)
1091-457-R	39.3 GHz to 59.7 GHz, WR19 to V (f)
1091-456-R	49.9 GHz to 67.0 GHz, WR15 to V (f)
1091-402-R	49.9 GHz to 75.8 GHz, WR15 to W1 (f)
1091-401-R	60.5 GHz to 92.0 GHz, WR12 to W1 (f)
1091-400-R	73.8 GHz to 110 GHz, WR10 to W1 (f)
	Directional Horn Antennas
2000-1867-R	17.6 GHz to 26.7 GHz, WR42, 25 dBi gain
2000-1868-R	26.4 GHz to 40.1 GHz, WR28, 25 dBi gain
2000-1869-R	33.0 GHz to 50.1 GHz, WR22, 25 dB gain
2000-1870-R	39.3 GHz to 59.7 GHz, WR19, 25 dBi gain
2000-1871-R	49.9 GHz to 75.8 GHz, WR15, 25 dBi gain
2000-1872-R	60.0 GHz to 90.0 GHz, WR12, 25 dBi gain
2000-1873-R	75.0 GHz to 110.0 GHz, WR10, 25 dBi gain
	USB Cable Extenders
2000-1888-R	USB 3.0 Powered Cable Extender, 10 m, (32 ft) (up to two can be used in series for a total length of 20 m)

COMPONENTS

RF Fuse Holder

MP612A

DC to 1 GHz

Fuse Element

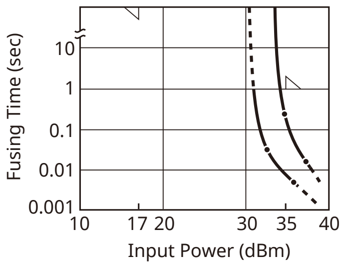
MP613A

The RF Fuse Holder MP612A protects measuring instruments by preventing internal damage (parts burnout, etc.). The Fuse Element MP613A uses a vacuum-deposited metal resin film for low melting point and excellent high-frequency characteristics. The high fuse performance is designed to prevent damage even to 1/16 W small resistors commonly found in measuring instruments and offers superior protection for high-frequency measuring instruments, such as Frequency Counters and Spectrum Analyzers, against excessive input power or Signal Generators, against reverse input power.

Specifications

RF Fuse Holder	MP612A (without fuse elements)
Frequency Range	DC to 1 GHz
Impedance	50Ω, unbalanced
VSWR	≤1.2 (50Ω termination)
Connector	N-P, N-J
Insertion Loss	≤0.5 dB
Rated Power	17 dBm (50Ω load)
Max. Fuse Rated Power	≤35 dBm (50Ω load)
Operating Temperature Range	0° to 45°C
Dimensions and Mass	20ø × 65 mm, ≤110 g
CE	RoHS: 2011/65/EU, EN50581

Fuse Element: MP613A (5 pcs/set)



Fusing time (sec) and Input power (dBm) characteristics

Fixed Attenuators for High Power Measurement

J0063, J0078, J0395, B0472

DC to 9 GHz/12.4 GHz/18 GHz

J0063

Specifications

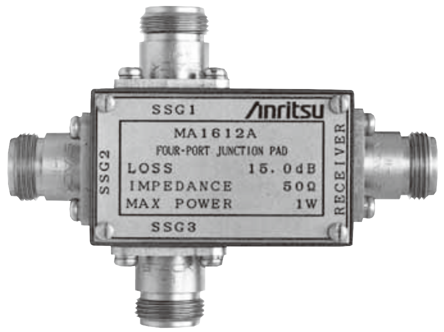
Model	J0063	J0078
Frequency Range	DC to 12.4 GHz	DC to 18 GHz
Attenuation	30 dB	20 dB
Attenuation Accuracy	±0.7 dB	±0.5 dB
VSWR (max.)	1.06 + 0.02f (GHz)	1.15 (DC to 4.0 GHz) 1.20 (4.0 GHz to 8.0 GHz) 1.25 (8.0 GHz to 12.4 GHz) 1.40 (12.4 GHz to 18.0 GHz)
Maximum Allowable Power	10 W (40 dBm)	
Connector	N-type, 50Ω	

Model	J0395	B0472
Frequency Range	DC to 9 GHz	DC to 18 GHz
Attenuation	30 dB	30 dB
Attenuation Accuracy	±0.5 dB	±1.0 dB
VSWR (max.)	1.2 (DC to 4.0 GHz) 1.3 (4.0 GHz to 9.0 GHz)	1.25 (DC to 8.0 GHz) 1.35 (8.0 GHz to 12.4 GHz) 1.45 (12.4 GHz to 18.0 GHz)
Maximum Allowable Power	30 W (44.7 dBm)	100 W (50 dBm)
Connector	N-type, 50Ω	
CE	RoHS: 2011/65/EU, EN50581	

Four-Port Junction Pad

MA1612A

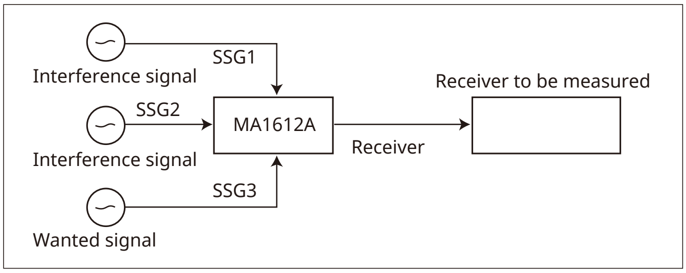
5 MHz to 3 GHz



The MA1612A are used as an impedance matching box applying the mixed output of three RF signal generators to a receiver input terminal for measurement of three-signal characteristics (such as receiver SINAD performance).

Specifications

Frequency Range	5 MHz to 3 GHz
Insertion Loss	15 ±1.0 dB (<1 GHz) 15 ±1.5 dB (≥1 GHz)
Impedance Characteristics	50Ω VSWR: ≤1.4 (<1 GHz) ≤2.0 (≥1 GHz)
Connector	N (S)-J
Isolation	SSG1-SSG2, SSG1-SSG3: ≥30 dB (<1 GHz) ≥25 dB (<2 GHz) ≥20 dB (≤3 GHz) SSG2-SSG3: ≥20 dB
Maximum Allowable Power	1 W
Operating Temperature Range	0° to 50°C
CE	RoHS: 2011/65/EU, EN50581



2Way/4Way Low Amplitude Error Divider

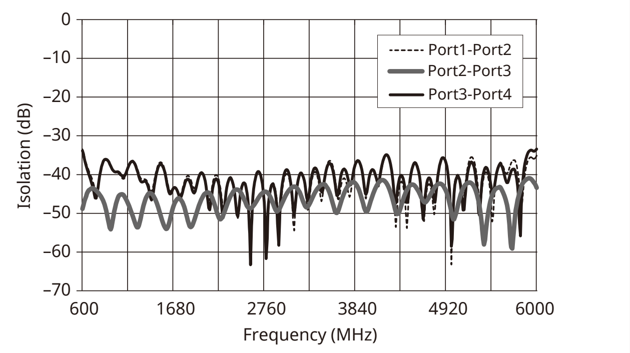
J1941A/J1942A

0.6 GHz to 6 GHz

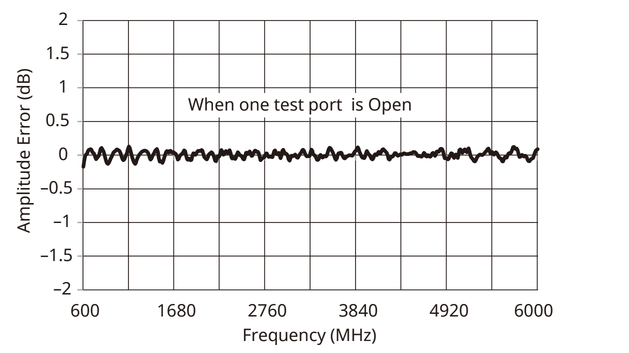
Specifications

Model	J1941A	J1942A
Frequency Range	0.6 GHz to 6 GHz	
Divide Number	2	4
Ports Unbalance	≤0.1 dB (0.6 GHz to 4 GHz) ≤0.15 dB (4 GHz to 6 GHz)	
Amplitude Error	≤0.5 dB	
Insertion Loss	≤0.5f + 7 dB	≤0.5f + 10 dB
VSWR (Common port)	<1.5	
VSWR (Test port)	<1.3	
Input Level (Max.)	+38 dBm (max., Duty ≤50%, ≤30°C)	
Connector	SMA (J)	
CE	RoHS: 2011/65/EU, EN50581	

J1941A/J1942A of low amplitude error 2 divider/4 divider is a divider that suppresses occurrence of amplitude error even if there is an open end on the test port side.



J1942A Isolation Performance (Actual measurement value)



J1942A Amplitude Error Performance (Actual measurement value)

Resistive Power Tap

J1640A

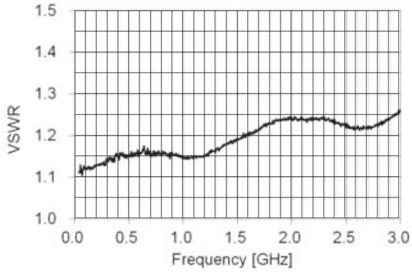
DC to 3000 MHz

The Resistive Power Tap J1640A is used to branch the transmitted signal when measuring the spurious characteristics of a transmitter with a field strength meter or spectrum analyzer. It has flat attenuation frequency characteristics over DC to 3000 MHz, eliminating the need to consider frequency characteristics when making measurements.
The maximum allowable input power is 16 Watts.

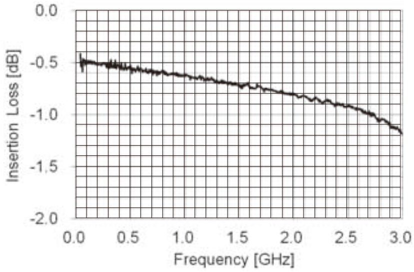
Specifications

Frequency Range	DC to 3000 MHz
Impedance	50Ω (nom.)
VSWR	≤1.35 (DC to 3000 MHz) (IN, OUT1, OUT2)
Maximum Allowable Power	16 W (IN-OUT1)
Insertion Loss (IN-OUT1)	≤1.0 dB (DC to 1000 MHz) ≤1.2 dB (1000 MHz to 1700 MHz) ≤1.5 dB (1700 MHz to 3000 MHz)
Branching Attenuation	40 dB ±1 dB (100 MHz) (IN-OUT2)
Frequency Characteristics of Branching Attenuation (IN-OUT2)	±0.5 dB (DC to 300 MHz) ±1.0 dB (300 MHz to 1000 MHz) ±1.5 dB (1000 MHz to 1700 MHz) ±2.5 dB (1700 MHz to 3000 MHz)
Connectors	N (f)
Operating Temperature Range	0° to +45°C
CE	RoHS: 2011/65/EU, EN50581

Characteristics



VSWR Characteristics: IN



Insertion Loss Characteristics: IN-OUT1

Precision RF & Microwave Components

The Industry Leader for High Frequency Components

Precision Components-Precision Measurements

Anritsu is a leader in the design and production of precision microwave components.

- Precision Coaxial Connector Systems to 145 GHz
- Precision Coaxial and Waveguide to Coax Adapters
- RF Detectors
- Precision Terminations and Air lines
- Precision Fixed Attenuators
- Precision Step Attenuators
- Precision Power Dividers and Splitters
- Precision Bias Tees
- Broadband Microwave Limiters

Connector Design Leadership

Anritsu is the leader of high frequency microwave connector technology and is driven by an ongoing commitment to exceed customer needs. Anritsu created and trademarked the K Connector® with coverage to 40 GHz, along with a complete family of 40 GHz test equipment. It was an immediate success and today is used on many commercial components, and test fixtures.

The V Connector® offers coaxial coverage to 65 GHz and uses a 1.85 mm geometry endorsed by the International Electrotechnical Commission (IEC). It mates with commercially available 2.4 mm connectors.

The W1 Connector™ provides mode-free performance to 110 GHz and uses a 1.00 mm coaxial connector front side interface.

The W1 Connector™ provides mode-free performance to 145 GHz and uses a 0.8 mm coaxial connector front side interface.

Coaxial and Waveguide to Coax Adapters

A series of precision measurement adapters are available to adapt one connector type to another. Poor adapter VSWR (or poor return loss) can be a major source of measurement error and, therefore adapters must be carefully selected. Anritsu precision adapters typically have 6-12 dB better return loss than competitive units. Coaxial adapters are available to 145 GHz. Waveguide-to-Coax adapters are available to 110 GHz.

Precision Terminations and Air Lines

Anritsu is recognized as the leader in the field of impedance standards. Anritsu air lines and terminations are unsurpassed for accuracy and impedance match. Not only do these products increase measurement accuracy, they also provide the only method of certifying the performance of SWR Autotesters, bridges, directional couplers, and other devices.

Precision Fixed Attenuators

Anritsu attenuators offer superior performance in a low cost package. The low VSWR (excellent return loss) minimizes signal reflections and simultaneously reduces ripple effects in the output frequency response. This assures flat, consistent attenuation characteristics regardless of other devices reflection characteristics. One of the simplest ways to improve impedance match is to insert a precision attenuator between the device under test and the source or RF detector. The 41K and 41V Series attenuators are specifically designed for such applications where accuracy is a basic requirement.

In addition to being available as individual units of 3, 6, 10, or 20 dB, the 41K and 41V Series Fixed Attenuators are also available in sets with certified calibration data. Available frequency ranges cover DC to 26.5, 40, or 60 GHz.

Many other attenuator applications have as their principal objective the reduction of power. Since the attenuator might not be inserted at a measurement point, the measurement precision discussed earlier is not required. In such a power-reducing system application, attenuators are often required in large quantities, making price an important consideration. The 43K Series includes models covering DC to 26.5 GHz, and DC to 40 GHz. All are available with 3, 6, 10, or 20 dB attenuation values. All have the Anritsu K Connectors and are compatible with SMA connectors.

Whatever your fixed attenuator needs might be, Anritsu provides the solution.

Precision Step Attenuators

Anritsu offers low loss, high precision step attenuators.
These programmable step attenuators are available with 10 dB steps from 0 to 70 dB or 0 to 110 dB ranges. DC to 40 GHz frequency range ensures the broadest attenuation and frequency coverage available. Contact Anritsu for needs above 40 GHz or for custom step sizes.

Precision Power Dividers and Splitters

Anritsu produces precision V Connector® dividers and splitters to 65 GHz and precision K Connector® dividers and splitters to 40 GHz.

All Anritsu power dividers are 3-resistor symmetrical designs with excellent amplitude and phase tracking. Anritsu power splitters are 2-resistor designs, used to accurately split signals for ratio measurements.

Precision Bias Tees

Anritsu Bias Tees are used to combine DC and RF for active device measurements. Low RF throughline loss and low SWR ensure negligible effect on measurements from 50 kHz to 65 GHz.

Broadband Microwave Limiters

Anritsu broadband microwave limiters provide the widest frequency range available in a limiter. Designed to protect sensitive microwave equipment, these limiters incorporate unique single-side limiting to provide soft limiting characteristics over 10 MHz to 26.5 GHz.

RF Detectors

Just as directivity is the principal error contributor in reflection measurements, the impedance match of the signal source and RF detector is a significant error contributor in transmission measurements.

Anritsu offers a complete line of coaxial RF detectors covering from 10 MHz to 50 GHz with the lowest SWR available. The excellent impedance match of the detectors, along with that of the test port on the SWR Autotesters and bridges, minimize errors when making simultaneous transmission and measurements.

Calibration and Verification Kits

Anritsu offers calibration kits which contain all of the precision components and tools required to calibrate an Anritsu VNA in a connector style of your choice.

Specials

Anritsu also manufactures assemblies and components to meet specific customer requirements in both coaxial and waveguide structures. These include such components as Connectors, Bias Tee, Step Attenuator, Detector, Power Sensors, Waveguide, Coaxial Adapters, and RF Cables etc.

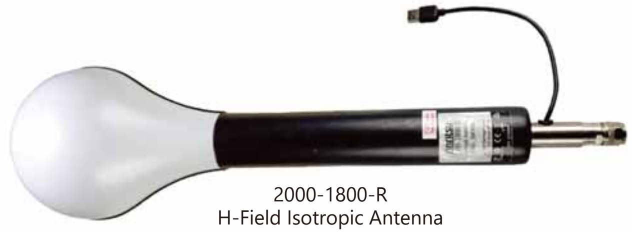
When requesting quotations on special assemblies, as a minimum please provide this information: frequency range, electrical characteristics, mechanical details and outline dimensions if any.

H-Field/E-Field Isotropic Antenna

2000-1800-R/2000-1792-R EMF Option 444

ElectroMagnetic Field Measurements

The Isotropic Antennas are Tri-axis with Integrated RF Switches.



2000-1800-R
H-Field Isotropic Antenna
9 kHz to 300 MHz

2000-1791-R
E-Field Isotropic Antenna
700 MHz to 6 GHz

2000-1792-R
E-Field Isotropic Antenna
30 MHz to 3 GHz

Anritsu's ElectroMagnetic Field (EMF) Measurements are designed to measure radiation compliance with various national standards for personal safety set by governmental regulatory authorities. Many countries have mandated EMF safety testing in areas where cellular or other high power transmission antennas are located.

The EMF option is primarily targeted to both cellular operators and government regulators. Additionally, contractors and small service companies perform building inspections and field surveys to monitor radiation exposure intensities in areas situated near transmission antennas.

Anritsu's EMF Measurements are designed to be easy to use, while providing the user with numerous automated features which will enable them to do their job quickly and more efficiently. ElectroMagnetic field measurements (EMF, Option 444) are available on the following Anritsu Spectrum Master™, Cell Master™ and LMR Master™ products: MS2711E, MS2712E, MS2713E, MS2720T, MT8212E, MT8213E and S412E. Firmware version 1.56 or later is required for the MS2711E/12E/13E and MT8212E/13E.

For the MS2720T and S412E firmware version 1.12 or later is required. EMF Option (444) provides the capability to measure electromagnetic field radiation when used in conjunction with an Anritsu isotropic antenna. Automated measurements can be taken using user-definable time intervals.

EMF Measurements Key Features and Benefits

- Limit lines that are user-settable at various power levels across the spectrum
- Limits can be saved for recall at a later time
- Axis dwell time is user-settable (time that each axis [X, Y, and Z] measures radiation before switching to next axis)
- Pass/Fail indicators on screen for immediate feedback on test results
- Automatic save feature for easy storage of measurement results to internal memory (autologging) or USB stick
- Results provided for maximum, minimum, average of all measurements conducted
- Clear display of measurement status, measurement time, number of measurements taken, and most other user settings
- Measurement time is user-configurable
- Pre-amp standard for measurements of low-level signals (optional for MS2711E)

Available field strength units include the following:
(S412E Supports Spectrum Analyzer and LTE Modes ONLY)

Spectrum Analyzer Mode: dBm/m^2, dBmV/m, dBuV/m, V/m, W/m^2, dBW/m^2, A/m, dBA/m, W/cm^2

- LTE and TD-LTE Mode: dBm/m^2, V/m, W/m^2
- W-CDMA Mode: dBm/m^2, V/m, W/m^2, % of Limit (V/m), % of Limit (W/m^2)

For wideband radiation measurements, the EMF option operates in Spectrum Analyzer mode. Total radiation from all sources can be measured over the frequency band desired. The EMF option will also conduct radiation measurements of demodulated signals in specific frequency bands. In this way, measurements can be extrapolated assuming a fully-loaded traffic channel in order to present a worst-case analysis. Option 444 will work with demodulated signals of the following types:
(S412E Supports LTE ONLY)

- W-CDMA
- LTE

If the user desires to measure EMF with a demodulated signal, the appropriate demodulation option also will need to be purchased. Additionally, Option 9 (demodulation) will need to be purchased if not offered as standard with the Spectrum Analyzer being used. Customers with Spectrum Analyzers purchased previously may upgrade their units with the EMF Option 444. If EMF demodulation measurements are required, the appropriate demodulation option will also need to be purchased and installed.

Isotropic Antenna

In order to conduct EMF measurements, an Anritsu isotropic antenna is required. Anritsu offers three isotropic antennas covering a frequency range from 9 kHz to 6 GHz. These antennas along with their corresponding frequency ranges are shown below.

- 9 kHz to 300 MHz H-Field Isotropic Antenna (Anritsu part number: 2000-1800-R)
- 30 MHz to 3 GHz E-Field Isotropic Antenna (Anritsu part number: 2000-1792-R)
- 700 MHz to 6 GHz E-Field Isotropic Antenna (Anritsu part number: 2000-1791-R)

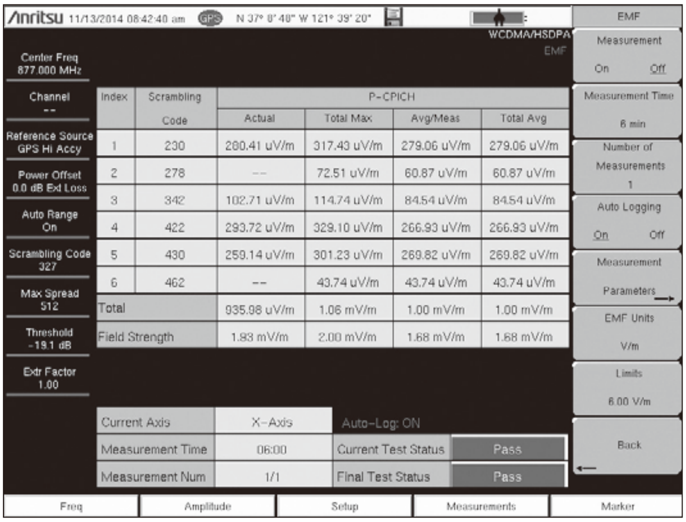
Each antenna contains a tri-axis sensor with an integrated RF switch device, microcontroller and memory. Each of the three sensors is situated orthogonally inside the antenna housing to transmit and receive a spherical radiation pattern. In this way, all radiation at the antenna's geographical position is measured, regardless of direction of arrival.

EMF Measurements on Demodulated Signals

Users may purchase the EMF option in order to make radiation power measurements in Spectrum Analyzer mode. These are power measurements for either narrowband or wideband field strength measurements across the frequency range of the Spectrum Analyzer and isotropic antenna being used. Additionally, EMF testing can be conducted on demodulated signals in various cellular channels. This includes the LTE, TD-LTE, and W-CDMA standards.
To measure demodulated W-CDMA signals, Option 35 is required for the MS2712E/13E and MT8212E/13E platforms. For MS2720T, Option 81 is required for W-CDMA. Option 9 is also required for the MS2712E/13E and MS2720T platforms for W-CDMA demodulation capability. The field strength of the pilot channel (P-CPICH) is measured for all such signals present. Results are then displayed for each individual scrambling code as well as for total power levels for all measurements combined. Additionally, the analog signal strength across the channel is measured and displayed for comparison. In order to present a "worst case" result, extrapolation factors can be automatically calculated and displayed where a fully loaded traffic channel is assumed.

For LTE and TD-LTE, options 546 and 556 respectively are required for the MS2712E/13E and MT8212E/13E platforms. Option 83 is required for either LTE or TD-LTE on the MS2720T platform. Option 9 is also required for the MS2712E/13E and MS2720T platforms for LTE or TD-LTE demodulation capability. For LTE only, options 31 and 546 are required for the S412E. Primary Synchronization Signals (P-SS), Secondary Synchronization Signals (S-SS), and Reference Signals (RS) are measured and displayed based on each Cell ID received. In addition, the total radiation field resulting from all cell site signals combined is calculated and displayed. The analog signal strength across the channel is also measured and displayed for comparison. In order to present a "worst case" result, extrapolation factors can be automatically calculated and displayed where a fully loaded traffic channel is assumed. See the picture below for a sample display of an LTE EMF measurement. The display for the TD-LTE EMF measurement is identical.

The RF switch, microcontroller, and memory inside the antenna are controlled by firmware in the Spectrum Analyzer via a USB cable. The microcontroller operates the RF switch, controlling which probe is active. Once all three probes are switched, a composite RMS calculation is made. The memory inside the antenna is used to store parameters associated with that particular antenna. This includes serial number, E-Field Isotropic Antenna 30 MHz to 3 GHz 2000-1792-R date of calibration, antenna frequency range, and calibration factors.
Each isotropic antenna is calibrated over its entire frequency range. The antenna factors are stored in the antenna's memory and automatically downloaded into the Spectrum Analyzer once the antenna USB cable is inserted.

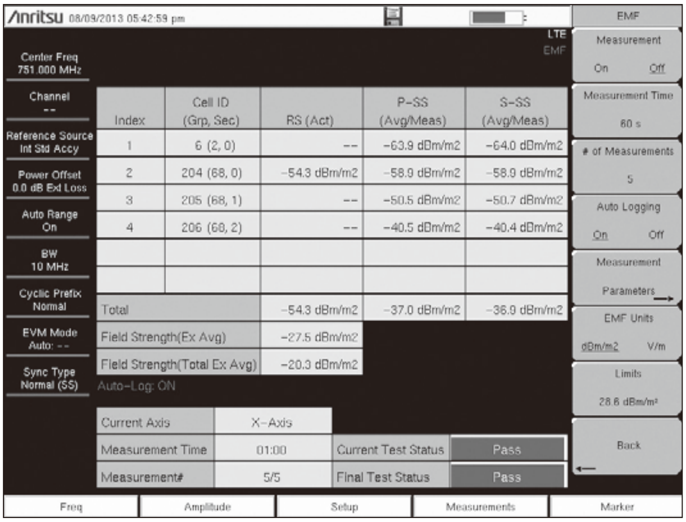


Center Freq 877.000 MHz
Channel --
Reference Source GPS Hi Accy
Power Offset 0.0 dB Ext Loss
Auto Range On
Scrambling Code 327
Max Spread 512
Threshold -19.1 dB
Extr Factor 1.00

Index	Scrambling Code	P-CPICH			
		Actual	Total Max	Avg/Meas	Total Avg
1	230	280.41 uV/m	317.43 uV/m	279.06 uV/m	279.06 uV/m
2	278	--	72.51 uV/m	60.87 uV/m	60.87 uV/m
3	342	102.71 uV/m	114.74 uV/m	84.54 uV/m	84.54 uV/m
4	422	293.72 uV/m	329.10 uV/m	266.93 uV/m	266.93 uV/m
5	430	259.14 uV/m	301.23 uV/m	269.82 uV/m	269.82 uV/m
6	462	--	43.74 uV/m	43.74 uV/m	43.74 uV/m
Total		935.98 uV/m	1.06 mV/m	1.00 mV/m	1.00 mV/m
Field Strength		1.83 mV/m	2.00 mV/m	1.68 mV/m	1.68 mV/m

Current Axis X-Axis
Auto-Log: ON
Measurement Time 06:00
Current Test Status Pass
Measurement Num 1/1
Final Test Status Pass

Sample Display of W-CDMA Measurement



Center Freq 751.000 MHz
Channel --
Reference Source Int Std Accy
Power Offset 0.0 dB Ext Loss
Auto Range On
BW 10 MHz
Cyclic Prefix Normal
EVM Mode Auto: --
Sync Type Normal (SS)

Index	Cell ID (Grp, Sec)	RS (Act)	P-SS (Avg/Meas)	S-SS (Avg/Meas)
1	6 (2, 0)	--	-63.9 dBm/m2	-64.0 dBm/m2
2	204 (68, 0)	-54.3 dBm/m2	-58.9 dBm/m2	-58.9 dBm/m2
3	205 (68, 1)	--	-50.5 dBm/m2	-50.7 dBm/m2
4	206 (68, 2)	--	-40.5 dBm/m2	-40.4 dBm/m2
Total		-54.3 dBm/m2	-37.0 dBm/m2	-36.9 dBm/m2
Field Strength(Ex Avg)		-27.5 dBm/m2		
Field Strength(Total Ex Avg)		-20.3 dBm/m2		

Auto-Log: ON
Current Axis X-Axis
Measurement Time 01:00
Current Test Status Pass
Measurement# 5/5
Final Test Status Pass

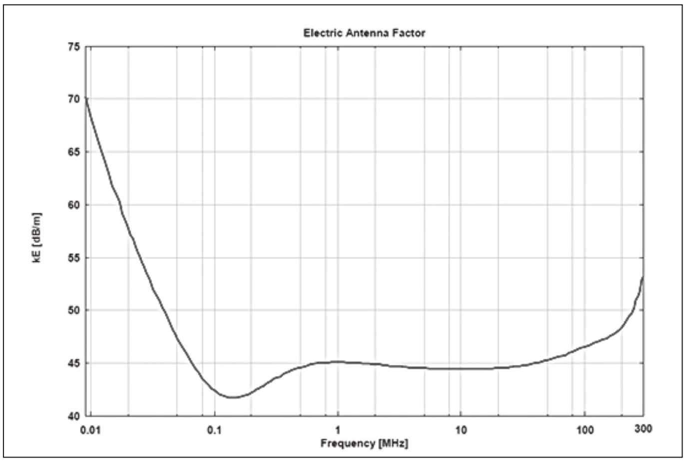
Sample Display of EMF LTE Measurement

Isotropic Antenna Specifications

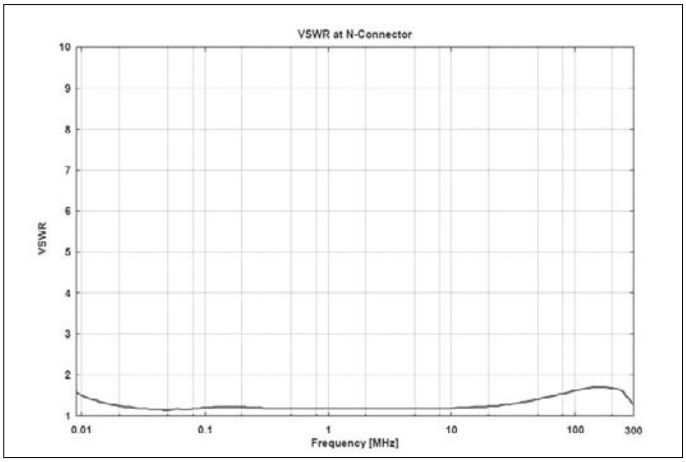
The 2000-1800-R isotropic antenna is a tri-axis H-Field sensor with an integrated RF switch. The RF switch is controlled by the analyzer via a USB port. Each antenna comes with a calibration certificate and supporting test data.

Electrical Characteristics (2000-1800-R)

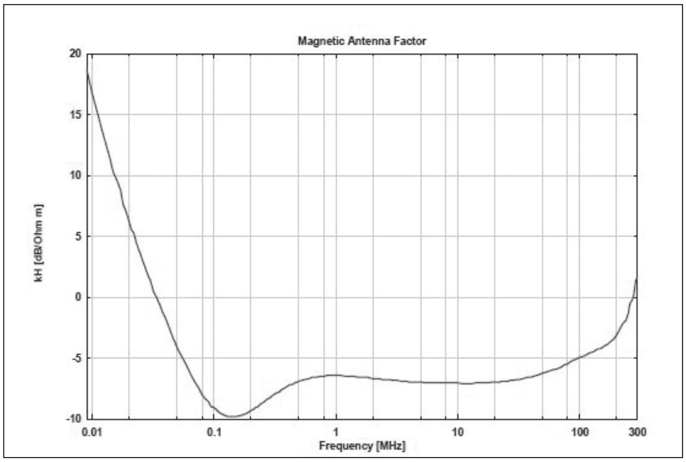
2000-1800-R	H-Field sensor
Sensor Type	Three Axis sensor with scanned axes
Frequency Range	9 kHz to 300 MHz
1 dB Compression Point at Output	118 dBµV (typ.)
Decoupling of the Axis	>20 dB (typ.)
VSWR	<1.5 (20 kHz to 50 MHz) (typ.)
RF Connector	N-Connector (m), 50Ω
Supply and Control	USB



Antenna Factors (typ.)



VSWR (typ.)



Magnetic Antenna Factor (typ.)

Mechanical Characteristics (2000-1800-R)

Color	Body: B-39047 “Light Grey” Handle: “Black”
Mass	850 g
Environmental Conditions	–10° to +50°C, IP54
Mechanical Compliancy	Operating: 7M3 (IEC 60721-3)
Dimensions	550 × 146 mm

EU Standards (CE Marking)

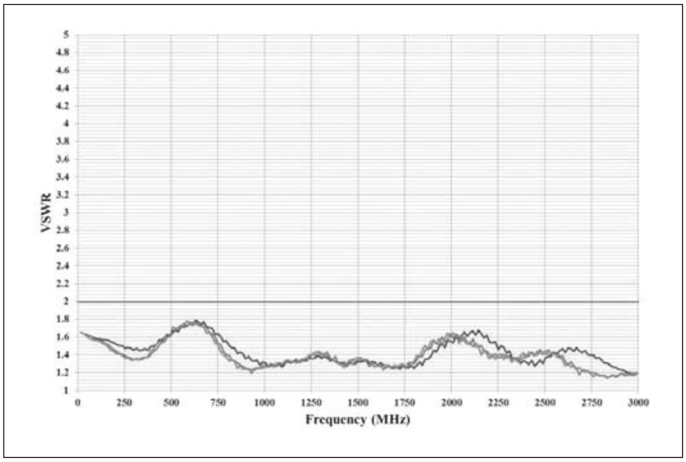
2011/65/EU

Isotropic Antenna Specifications

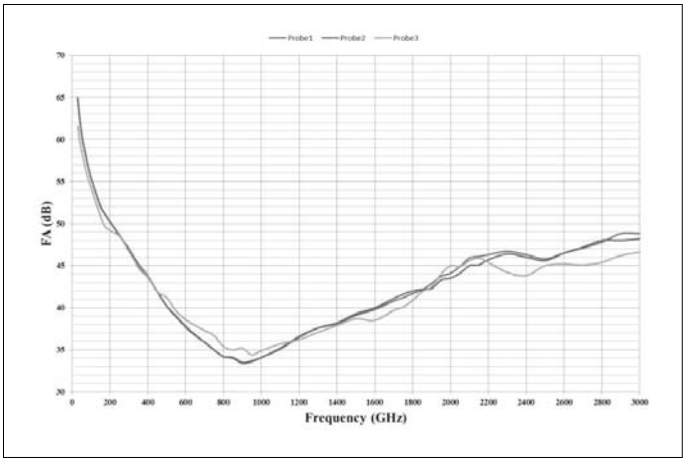
The 2000-1792-R isotropic antenna is a tri-axis E-Field sensor with an integrated RF switch. The RF switch is controlled by the analyzer via a USB port. Each antenna comes with a calibration certificate and supporting test data.

Electrical Characteristics (2000-1792-R)

2000-1792-R	E-Field sensor
Sensor Type	Three Axis sensor with scanned axes
Frequency Range	30 MHz to 3 GHz
Typical 3D Isotropy	<±1.5 dB (300 MHz to 1 GHz) <±2.3 dB (1 GHz to 3 GHz)
Dynamic Range (with 1 kHz RBW)	0.1 mV/m to 200 V/m (typ.) 25 µV at 900 MHz 35 µV at 1800 MHz 50 µV at 3000 MHz
Maximum Field Strength	500 V/m (destruction limit)
Switching Time	<10 µs
RF Connector	N-Connector (m), 50Ω
Supply and Control	USB



VSWR (typ.)



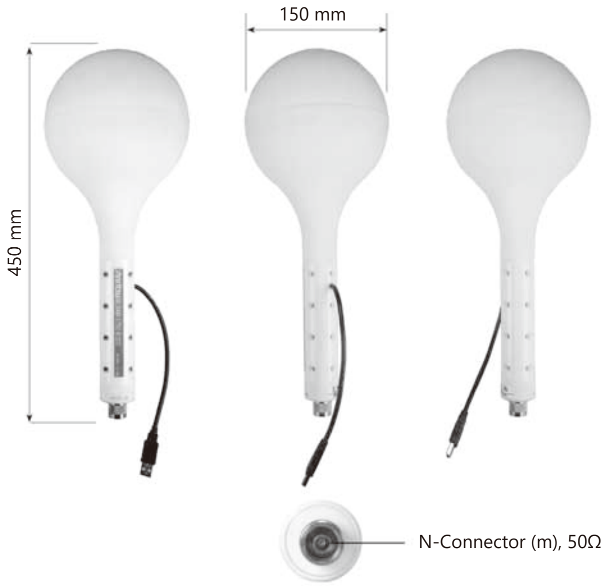
Antenna Factors (typ.)

Mechanical Characteristics (2000-1792-R)

Radome Material	ABS	
Color	Body: B-39047 "Light Grey" Handle: B-39042 "Dark Grey"	
Mass	800 g	
Climatic Compliancy	Operating: 7K3 (IEC 60721-3)	
Mechanical Compliancy	Operating: 7M3 (IEC 60792-3)	
Operating Temperature Range	–25° to +70°C	
Humidity	100% at +40°C for up to 96 hours	
Dimensions	Maximum Length	Maximum Width
	450 mm ±5 mm (with connector)	150 mm ±1 mm

EU Standards (CE Marking)

2011/65/EU



Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Required Instrument Options and Accessories
MS2711E-0444	EMF Option 444 for MS2711E
MS2712E-0444	EMF Option 444 for MS2712E
MS2713E-0444	EMF Option 444 for MS2713E
MS2720T-0444	EMF Option 444 for MS2720T
MT8212E-0444	EMF Option 444 for MT8212E
MT8213E-0444	EMF Option 444 for MT8213E
S412E-0444	EMF Option 444 for S412E
2000-1800-R	Isotropic Antenna, 9 kHz to 300 MHz, N Connector (m), 50Ω
2000-1792-R	Isotropic Antenna, 30 MHz to 3 GHz, N Connector (m), 50Ω
2000-1791-R	Isotropic Antenna, 700 MHz to 6 GHz, N Connector (m), 50Ω
200-1528-R	GPS Antenna, SMA (m) with 15 ft cable
	Related Instrument Options
MS2712E-0009	20 MHz Bandwidth Demodulation for MS2712E
MS2713E-0009	20 MHz Bandwidth Demodulation for MS2713E
MS2720T-0009	20 MHz Bandwidth Demodulation for MS2720T
MS2712E-0035	W-CDMA OTA Measurements for MS2712E*
MS2713E-0035	W-CDMA OTA Measurements for MS2713E*
MS2720T-0881	W-CDMA OTA Measurements for MS2720T*
MT8212E-0035	W-CDMA OTA Measurements for MT8212E
MT8213E-0035	W-CDMA OTA Measurements for MT8213E
MS2712E-0546	LTE OTA Measurements for MS2712E*
MS2713E-0546	LTE OTA Measurements for MS2713E*
MS2720T-0883	LTE OTA Measurements for MS2720T*
MT8212E-0546	LTE OTA Measurements for MT8212E
MT8213E-0546	LTE OTA Measurements for MT8213E
MS2712E-0556	TD-LTE OTA Measurements for MS2712E*
MS2713E-0556	TD-LTE OTA Measurements for MS2713E*
MS2720T-0883	TD-LTE OTA Measurements for MS2720T*
MT8212E-0556	TD-LTE OTA Measurements for MT8212E
MT8213E-0556	TD-LTE OTA Measurements for MT8213E
S412E-0006	6 GHz Coverage for S412E Spectrum Analyzer
S412E-0031	GPS Receiver for S412E (Requires suitable GPS Antenna)
S412E-0546	LTE OTA Measurement for S412E (Requires Option 31)

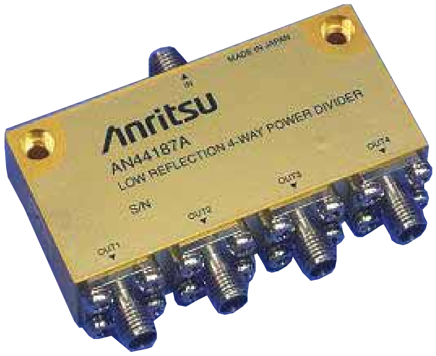
*: Requires Option 9, 20 MHz Bandwidth Demodulation

Cell Master MT8213E
with 2000-1800-R
Isotropic Antenna

Spectrum Master MS2712E
with 2000-1792-R
Isotropic Antenna

Low Reflection 4-Way Power Divider

AN44187A



RoHS Compliant Part

Features

Output Port: 4-outputs
Wideband: DC to 40 GHz
Insertion Loss: 12 dB (typ.)
Skew: <3 ps
Low Reflection: >15 dB
I/O Interface: K-connector
Package size: 59 (W) × 14 (H) × 28.5 (D) mm

Application

Signal distribution for multi-channel system and comparative evaluation.

Absolute Maximum Ratings

Items	Symbols	Conditions	Units	Ratings	
				Min.	Max.
Input Power	P_{in}	—	dBm	—	30
Operating Temperature	T_a	Ambient Temperature	°C	0	+70
Storage Temperature	T_{stg}	—	°C	–40	+85

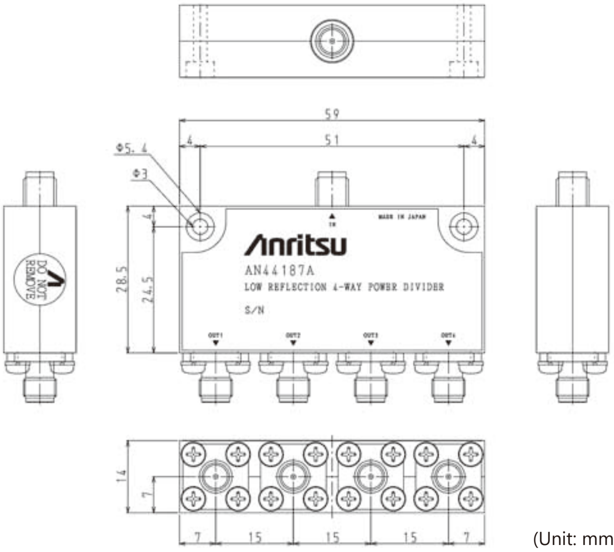
*: Excess over the absolute maximum ratings may cause device failure.

Specifications

(Ta = 25°C, Zin = 50Ω, Zout =50Ω)

Items	Conditions	Units	Specifications		
			Min.	Typ.	Max.
Frequency Range	—	GHz	DC	—	40
Insertion Loss	@DC	dB	—	12	14
	@40 GHz		—	13	15
Input Return Loss	DC to 20 GHz	dB	15	20	—
	20 GHz to 40 GHz		10	15	—
Output Return Loss	DC to 20 GHz	dB	15	20	—
	20 GHz to 40 GHz		10	15	—
Group Delay	DC to 40 GHz	ps	—	±50	—
Isolation	Out1 (3) to Out2 (4)	dB	—	6	—
	Others		—	18	—
Skew	—	ps	—	3	—

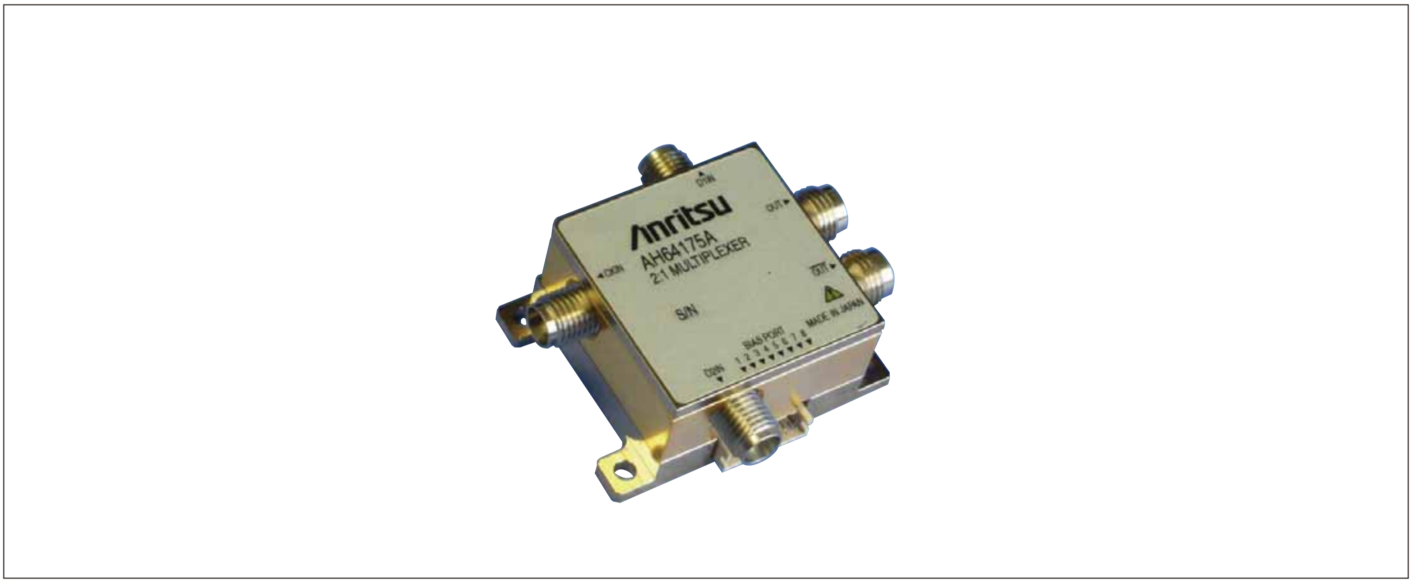
Dimensions



(Unit: mm)

2:1 Multiplexer

AH64175A



RoHS Compliant Part

Features

Operating bitrate: DC to 64 Gbit/s
Half-rate clock input
Differential output
Power consumption: 1.2 W (typ.)
Package size: 28 (W) × 17 (H) × 28 (D) mm

Applications

Testing for high speed digital communications/Testing for high speed semiconductors

Absolute Maximum Ratings

Items	Symbols	Conditions	Units	Ratings	
				Min.	Max.
Input Signal Voltage	Vin	—	V	–1	0.7
Supply Voltage	VEE	–3.5 V	V	–3.7	0.5
Operating Temperature	Tc	Case temperature	°C	+5	+50
Storage Temperature	Tstg	—	°C	0	+60

*: Excess over the absolute maximum ratings may cause device failure.

Specifications

(Tc = 25°C, VEE = –3.5 V, Zin = 50Ω, Zout =50Ω)

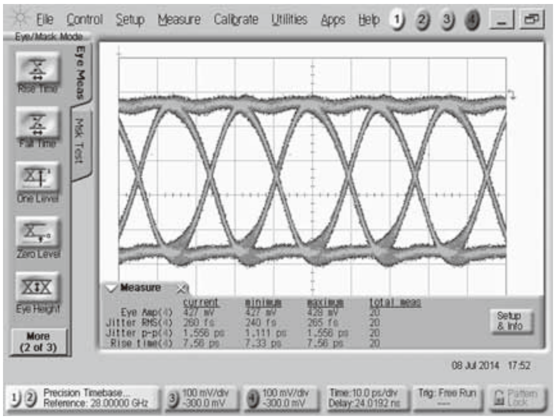
Items	Conditions	Units	Specifications		
			Min.	Typ.	Max.
Bitrate	—	Gbit/s	DC	—	64
Input Voltage	D1, D2, CK	Vp-p	0.2	0.5	0.7
Output Voltage	Vin = 0.5 Vp-p @64 Gbit/s	Vp-p	0.3	0.5	—
Jitter*	to 56 Gbit/s	fs rms	—	250	—
	to 64 Gbit/s		—	350	—
Rise Time/Fall Time*	20 to 80%	ps	—	7	—
Supply Current	VEE = –3.5 V	mA	—	350	450
Power Consumption	—	W	—	1.2	—

*: The specifications are based on the measurement using the Keysight 86118A 70 GHz Remote sampling head and 86107A Precision time base.

Electrical Characteristics

Pulse response

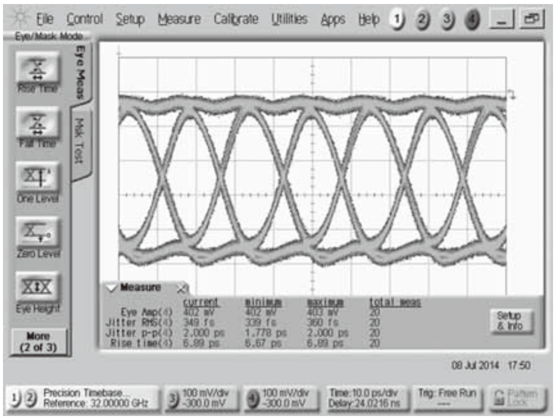
56 Gbit/s



```
               current    minimum    maximum    total meas
   Eye Amp(4)  427 mV     427 mV     428 mV     20
Jitter RMS(4)  260 fs     240 fs     265 fs     20
Jitter p-p(4)  1.556 ps   1.111 ps   1.556 ps   20
 Rise time(4)  7.56 ps    7.33 ps    7.56 ps    20
```

08 Jul 2014 17:52

64 Gbit/s

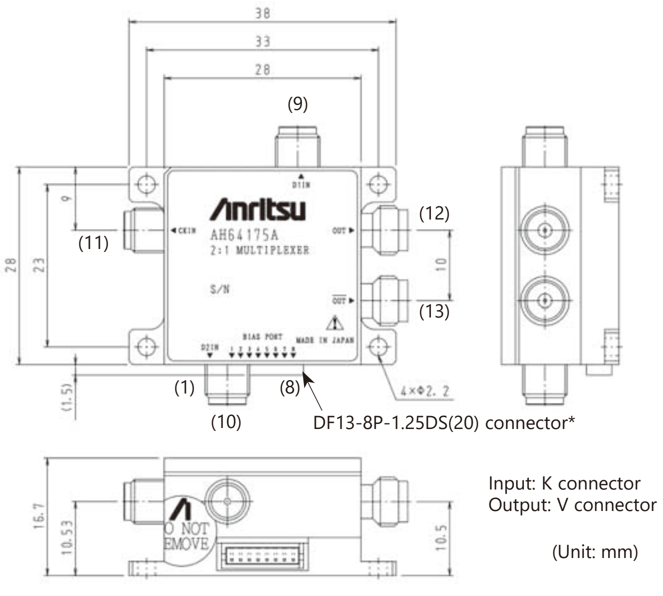


```
               current    minimum    maximum    total meas
   Eye Amp(4)  402 mV     402 mV     403 mV     20
Jitter RMS(4)  349 fs     339 fs     360 fs     20
Jitter p-p(4)  2.000 ps   1.778 ps   2.000 ps   20
 Rise time(4)  6.89 ps    6.67 ps    6.89 ps    20
```

08 Jul 2014 17:50

V: 0.1 V/div H: 10 ps/div

Dimensions



Input: K connector
Output: V connector

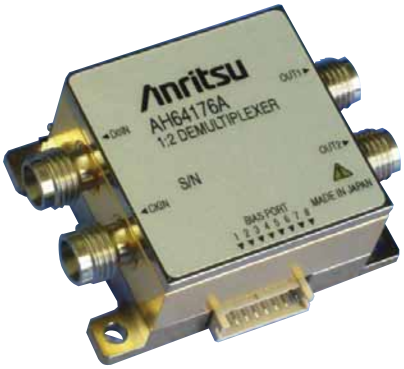
(Unit: mm)

No.	Symbols	Functions	Remarks
1	D2ref	Data2 input reference	–0.25 V
2	CKref	Clock input reference	–0.25 V
3	D1ref	Data1 input reference	–0.25 V
4	GND	Ground	—
5	VEE	Power supply	–3.5 V
6	NC	—	—
7	NC	—	—
8	NC	—	—
9	D1IN	Data1 Input port	+0 V/–0.5 V
10	D2IN	Data2 Input port	+0 V/–0.5 V
11	CKIN	Clock Input port	+0 V/–0.5 V
12	OUT	Output port (non-invert)	—
13	$\overline{\text{OUT}}$	Output port (invert)	—

*: Please utilize attached DF13-8S-1.25C connector to supply DC power.

1:2 Demultiplexer

AH64176A



RoHS Compliant Part

Features

Operating bitrate: DC to 64 Gbit/s
Half-rate clock input
Single-ended data/clock input
Data input sensitivity: <50 mVp-p
Power consumption: 1.5 W (typ.)
Package size: 28 (W) × 17 (H) × 28 (D) mm

Applications

Testing for high speed digital communications/Testing for high speed semiconductors

Absolute Maximum Ratings

Items	Symbols	Conditions	Units	Ratings	
				Min.	Max.
Input Signal Voltage	Vin	—	V	–1	0.7
Supply Voltage	VEE	–3.5 V	V	–3.7	0.5
Operating Temperature	Tc	Case temperature	°C	+5	+50
Storage Temperature	Tstg	—	°C	0	+60

*: Excess over the absolute maximum ratings may cause device failure.

Specifications

(Tc = 25°C, VEE = –3.5 V, Zin = 50Ω, Zout = 50Ω)

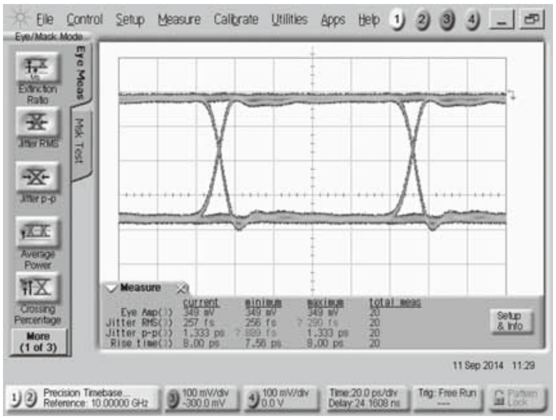
Items	Conditions	Units	Specifications		
			Min.	Typ.	Max.
Bitrate	—	Gbit/s	DC	—	64
Data Input Voltage	D0	Vp-p	0.05	—	0.7
Clock Input Voltage	CK	Vp-p	—	0.5	—
Output Voltage	Vin = 0.5 Vp-p @64 Gbit/s	Vp-p	0.25	0.35	—
Jitter*	—	fs rms	—	300	—
Rise Time/Fall Time*	20 to 80%	ps	—	8	—
Supply Current	VEE = –3.5 V	mA	—	430	500
Power Consumption	—	W	—	1.5	—

*: The specifications are based on the measurement using the Keysight 86118A 70 GHz Remote sampling head and 86107A Precision time base.

Electrical Characteristics

Pulse response

Input: 20 Gbit/s, Output: 10 Gbit/s

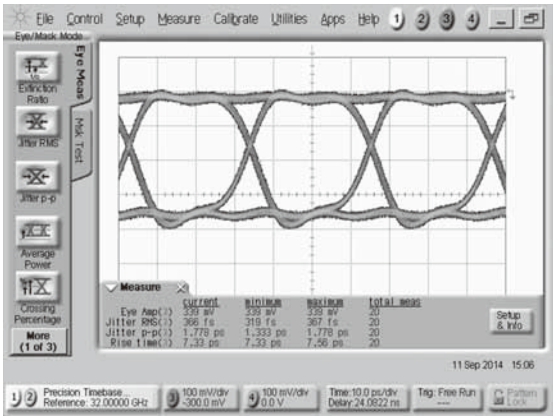


```
                current     minimum     maximum     total meas
   Eye Amp(3)   349 mV      349 mV      349 mV      20
Jitter RMS(3)   257 fs      256 fs    ? 290 fs      20
Jitter p-p(3)   1.333 ps  ? 889 fs      1.333 ps    20
 Rise time(3)   8.00 ps     7.56 ps     8.00 ps     20
```

11 Sep 2014 11:29

V: 0.1 V/div H: 20 ps/div

Input: 64 Gbit/s, Output: 32 Gbit/s

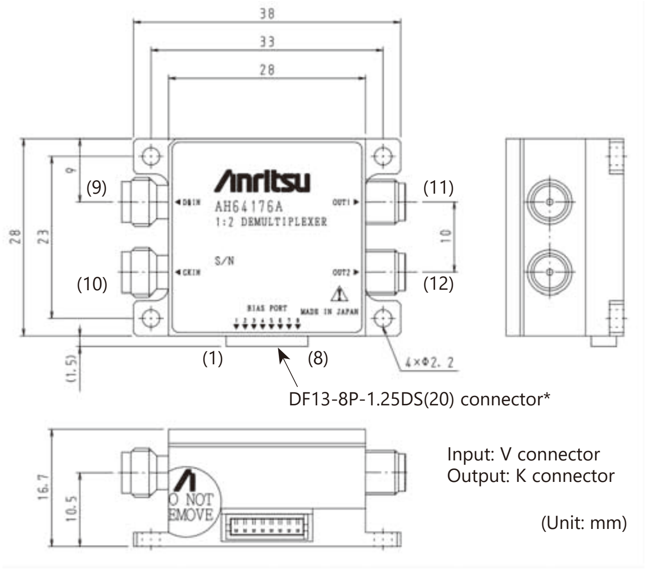


```
                current     minimum     maximum     total meas
   Eye Amp(3)   339 mV      339 mV      339 mV      20
Jitter RMS(3)   366 fs      319 fs      367 fs      20
Jitter p-p(3)   1.778 ps    1.333 ps    1.778 ps    20
 Rise time(3)   7.33 ps     7.33 ps     7.56 ps     20
```

11 Sep 2014 15:06

V: 0.1 V/div H: 10 ps/div

Dimensions



DF13-8P-1.25DS(20) connector*

Input: V connector
Output: K connector

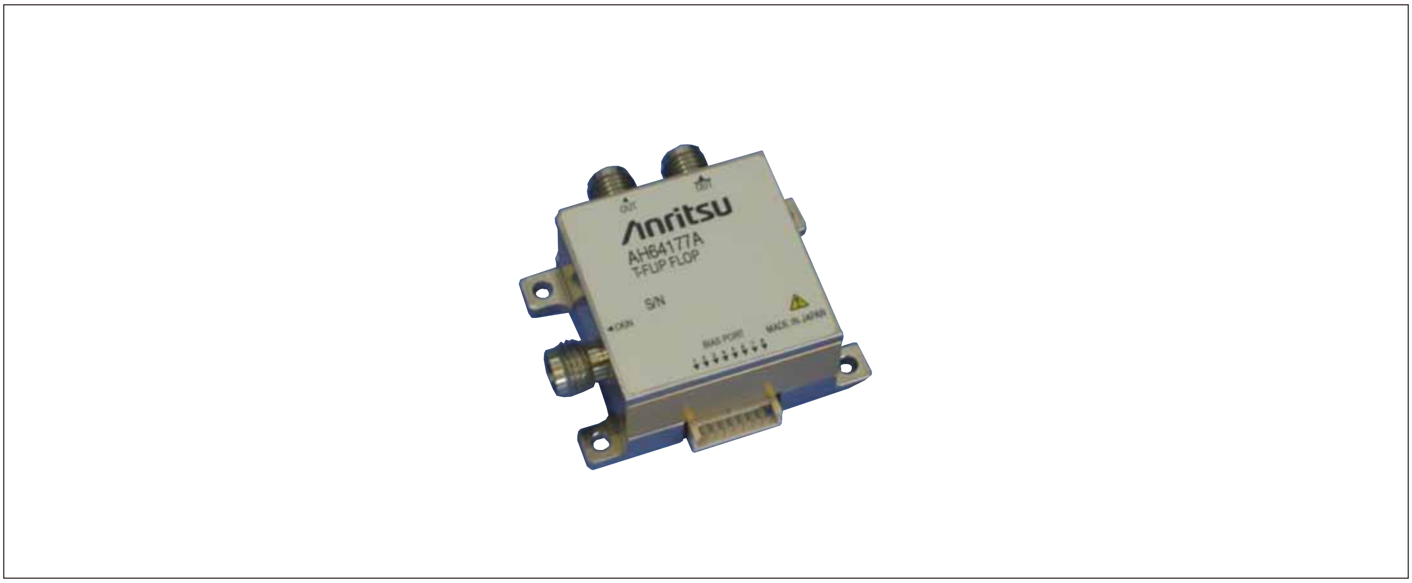
(Unit: mm)

No.	Symbols	Functions	Remarks
1	CKref	Clock input reference	–0.25 V
2	D0ref	Data input reference	–0.25 V
3	NC	—	—
4	GND	Ground	—
5	VEE	Power supply	–3.5 V
6	NC	—	—
7	NC	—	—
8	NC	—	—
9	D0IN	Data Input port	+0 V/–0.5 V
10	CKIN	Clock Input port	+0 V/–0.5 V
11	OUT1	Output1 port	+0 V/–0.5 V
12	OUT2	Output2 port	+0 V/–0.5 V

*: Please utilize attached DF13-8S-1.25C connector to supply DC power.

T-Flip Flop

AH64177A



RoHS Compliant Part

Features

Operating frequency: DC to 60 GHz
Single-ended input
Differential output
Power consumption: 0.9 W (typ.)
Package size: 28 (W) × 17 (H) × 28 (D) mm

Applications

Testing for high speed digital communications/Testing for high speed semiconductors

Absolute Maximum Ratings

Items	Symbols	Conditions	Units	Ratings	
				Min.	Max.
Input Signal Voltage	Vin	—	V	–1	0.7
Supply Voltage	VEE	–3.5 V	V	–3.7	0.5
Operating Temperature	Tc	Case temperature	°C	+5	+50
Storage Temperature	Tstg	—	°C	0	+60

*: Excess over the absolute maximum ratings may cause device failure.

Specifications

(Tc = 25°C, VEE = –3.5 V, Zin = 50Ω, Zout = 50Ω)

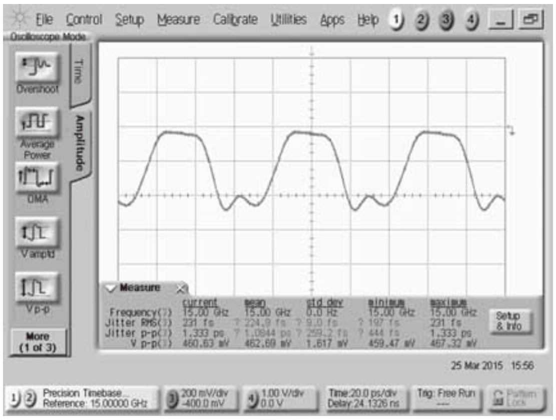
Items	Conditions	Units	Specifications		
			Min.	Typ.	Max.
Frequency	Input	GHz	DC	—	60
	Output		DC	—	30
Clock Input Voltage	CKin	Vp-p	0.2	0.5	—
Output Voltage	Vin = 0.5 Vp-p @60 GHz	Vp-p	0.3	0.5	—
Jitter*	—	fs rms	—	250	—
Supply Current	VEE = –3.5 V	mA	—	250	350
Power Consumption	—	W	—	0.9	—

*: The specifications are based on the measurement using the Keysight 86118A 70 GHz Remote sampling head and 86107A Precision time base.

Electrical Characteristics

Pulse response

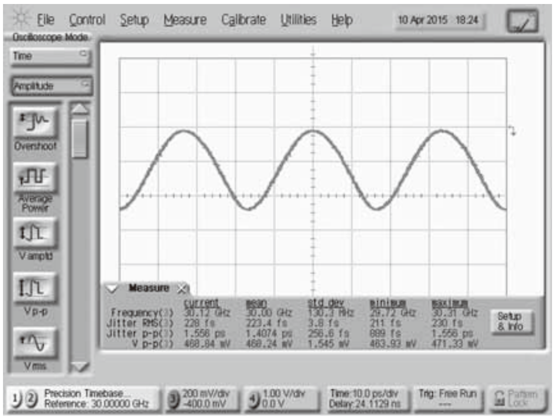
Input: 30 GHz, Output: 15 GHz



```
               current      mean          std dev      minimum      maximum
 Frequency(3)  15.00 GHz    15.00 GHz     0.0 Hz       15.00 GHz    15.00 GHz
Jitter RMS(3)  231 fs     ? 224.9 fs   ? 9.0 fs     ? 197 fs      231 fs
Jitter p-p(3)  1.333 ps   ? 1.0844 ps  ? 259.2 fs   ? 444 fs      1.333 ps
     V p-p(3)  460.63 mV    462.69 mV     1.617 mV     459.47 mV    467.32 mV
```

V: 0.2 V/div H: 20 ps/div

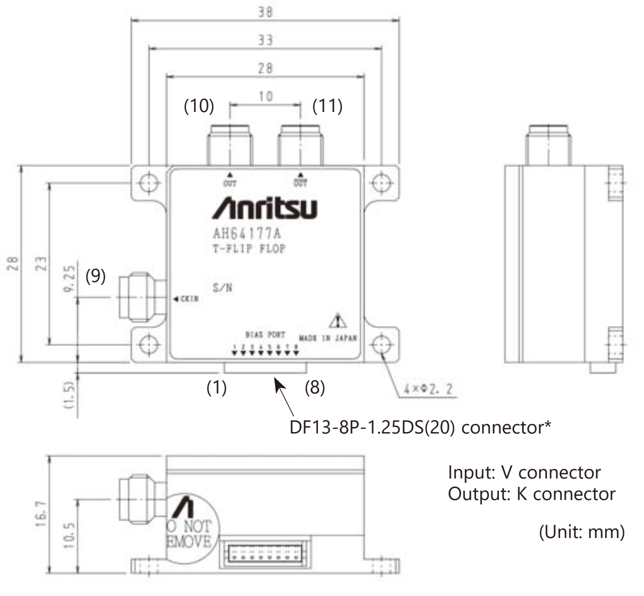
Input: 60 GHz, Output: 30 GHz



```
               current      mean         std dev      minimum      maximum
 Frequency(3)  30.12 GHz    30.00 GHz    130.3 MHz    29.72 GHz    30.31 GHz
Jitter RMS(3)  228 fs       223.4 fs     3.8 fs       211 fs       230 fs
Jitter p-p(3)  1.556 ps     1.4074 ps    256.6 fs     889 fs       1.556 ps
     V p-p(3)  468.84 mV    468.24 mV    1.545 mV     463.93 mV    471.33 mV
```

V: 0.2 V/div H: 10 ps/div

Dimensions



DF13-8P-1.25DS(20) connector*

Input: V connector
Output: K connector

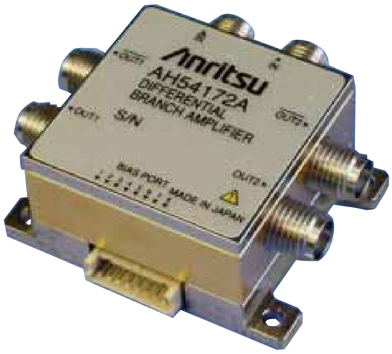
(Unit: mm)

No.	Symbols	Functions	Remarks
1	NC	—	—
2	NC	—	—
3	NC	—	—
4	GND	Ground	—
5	VEE	Power supply	–3.5 V
6	NC	—	—
7	NC	—	—
8	NC	—	—
9	CKIN	Clock Input port	—
10	OUT	Output port (non-invert)	+0 V/–0.5 V
11	$\overline{\text{OUT}}$	Output port (invert)	+0 V/–0.5 V

*: Please utilize attached DF13-8S-1.25C connector to supply DC power.

Differential Branch Amplifier

AH54172A



RoHS Compliant Part

Features

Wideband: 30 kHz to 40 GHz
Low power consumption: 0.60 W (typ.)
Built-in DC blocking capacitors (Standard type)
Package size: 28 (W) × 17 (H) × 28 (D) mm

Applications

Data/Clock branch buffer amplifier for evaluation system

Absolute Maximum Ratings

Items	Symbols	Conditions	Units	Ratings	
				Min.	Max.
Input Signal Voltage	Vin	—	V	–1	0.7
Supply Voltage	VEE	–3.5 V	V	–3.8	0.5
Operating Temperature	Tc	Case temperature	°C	+5	+50
Storage Temperature	Tstg	—	°C	0	+60

*: Excess over the absolute maximum ratings may cause device failure.

Specifications

(Tc = 25°C, VEE = –3.5 V, Zin = 50Ω, Zout = 50Ω)

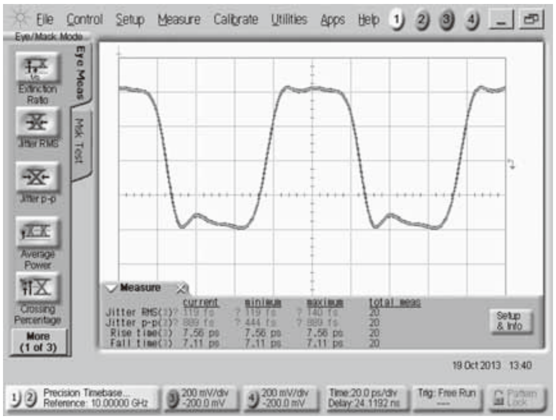
Items	Conditions	Units	Specifications		
			Min.	Typ.	Max.
Small Signal Bandwidth	Low end	kHz	—	30	100
	High end	GHz	—	40	—
Input Voltage	Single-end	Vp-p	0.2	0.5	0.7
	Differential		0.1	0.25	0.35
Output Voltage	Vin = 0.5 Vp-p @30 GHz	Vp-p	0.5	0.8	—
Jitter*	—	fs rms	—	300	—
Rise Time/Fall Time*	20 to 80%	ps	—	6	—
Input Return Loss	40 MHz to 30 GHz	dB	—	10	—
Output Return Loss	40 MHz to 30 GHz	dB	—	10	—
Supply Current	VEE = –3.5 V	mA	—	170	250
Power Consumption	—	W	—	0.60	—

*: The specifications are based on the measurement using the Keysight 86118A 70 GHz Remote sampling head and 86107A Precision time base.

Electrical Characteristics

Pulse response

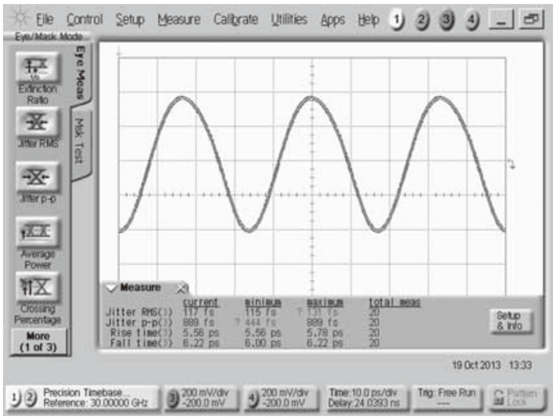
Vout = 850 mVp-p @10 GHz



```
               current    minimum    maximum    total meas
Jitter RMS(3)? 119 fs   ? 119 fs   ? 140 fs     20
Jitter p-p(3)? 889 fs   ? 444 fs   ? 889 fs     20
 Rise time(3)  7.56 ps    7.56 ps    7.56 ps    20
 Fall time(3)  7.11 ps    7.11 ps    7.11 ps    20
```

V: 0.2 V/div   H: 20 ps/div

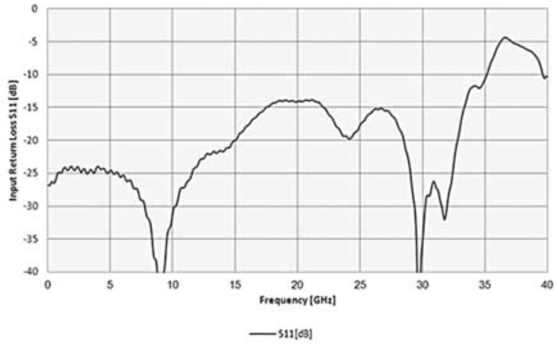
Vout = 780 mVp-p @30 GHz

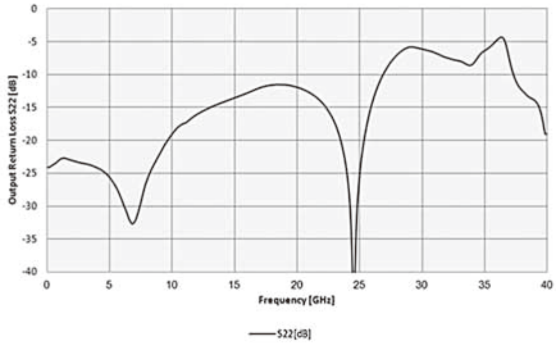


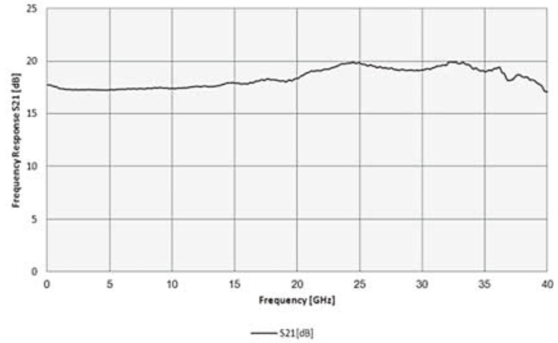
```
               current    minimum    maximum    total meas
Jitter RMS(3)  117 fs     115 fs   ? 131 fs     20
Jitter p-p(3)  889 fs   ? 444 fs     889 fs     20
 Rise time(3)  5.56 ps    5.56 ps    5.78 ps    20
 Fall time(3)  6.22 ps    6.00 ps    6.22 ps    20
```

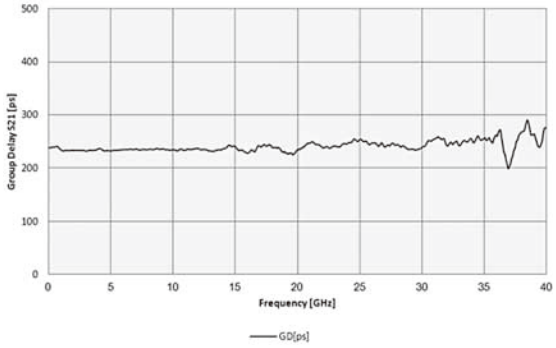
V: 0.2 V/div   H: 10 ps/div

Frequency response (small signal)







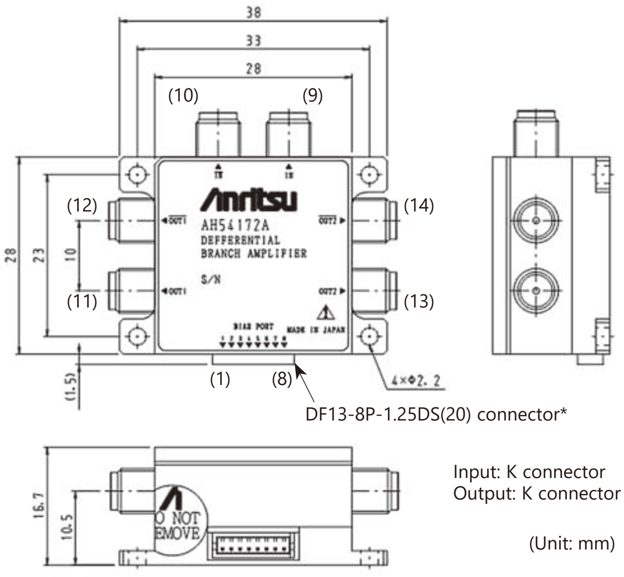


Ordering Information

Model: AH54172A – ΔΔ
└ **Option**

#	Model name	Option	Connector type	Notes
1	AH54172A	none	K-F	AC coupling (Standard)
2	AH54172A	– 01	K-F	DC coupling

Dimensions



Input: K connector
Output: K connector

(Unit: mm)

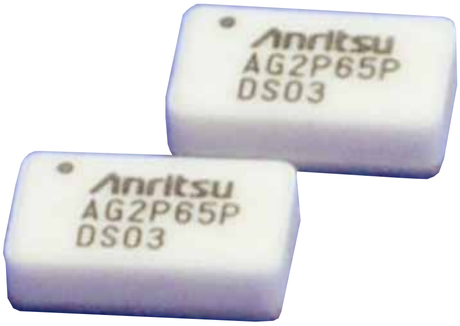
No.	Symbols	Functions	Remarks
1	NC		
2	NC		
3	NC		
4	GND	Ground	
5	VEE	Power supply	–3.5 V
6	NC		
7	NC		
8	NC		
9	IN	Input port (non-invert)	
10	$\overline{\text{IN}}$	Input port (invert)	
11	OUT1	Output 1 port (non-invert)	
12	$\overline{\text{OUT1}}$	Output 1 port (invert)	
13	OUT2	Output 2 port (non-invert)	
14	$\overline{\text{OUT2}}$	Output 2 port (invert)	

*: Please utilize attached DF13-8S-1.25C connector to supply DC power.

28 Gbaud Quad Linear EA Driver

AG2P65P

NEW



RoHS Compliant Part

Features

Circuit number: 4 circuits
Output voltage: 1.1 Vp-p typ./ch
Power consumption: 0.28 W typ./ch
Input interface: Differential
Output interface: Single-end
40 pin QFN package: 7 × 4 × 2 mm
Output Bias-T included

Applications

Driver for 400 GbE(PAM4) EA modulators

Absolute Maximum Ratings

Items	Symbols	Conditions	Units	Ratings	
				Min.	Max.
Input Signal Voltage*	Vin	AC coupled	Vp-p	—	1.0
Supply Voltage	V_{CC}	—	V	–0.5	3.6
Output amplitude control voltage	V_{amp}	—	V	–1.0	3.0
Storage Temperature	Tstg	—	°C	–40	90

*: The value is amplitude into each port (IN / $\overline{\text{IN}}$).

Recommended Conditions

Items	Symbols	Units	Specifications		
			Min.	Typ.	Max.
Supply Voltage	V_{CC}	V	2.6	—	2.8
Driver Choke Bias	V_{DRV}	V	2.6	—	2.8
Output Amplitude Control Voltage	V_{amp}	V	1.8	—	2.4
EAM Bias Current	I_{EAM}	mA	—	—	100
Case Temperature Backside	T_C	°C	–5	—	85

Specifications

Electrical characteristics

T_C = 25°C, V_{CC} = 2.6 V, V_{DRV} = 2.6 V, V_{amp} = 2.4 V, Z_{in} = 50Ω, Z_{out} = 50Ω

Items	Conditions	Units	Specifications		
			Min.	Typ.	Max.
Baud Rate	—	Gbaud	—	28	—
Input Signal Voltage	AC coupled*1 each-port	Vp-p	0.2	—	0.45
Max. Output Voltage	V_{in} = 0.45 Vp-p*2	Vp-p	—	1.1	—
Output Polarity	OUT1, OUT2 port	—	inverted		
	OUT3, OUT4 port	—	Non-inverted		
Input Return Loss	40 MHz to 20 GHz	dB	—	10	—
Output Return Loss	40 MHz to 20 GHz	dB	—	10	—

*1: External blocking capacitor is required
*2: Adjusted by supplied voltage to V_{amp}

Power Supplies

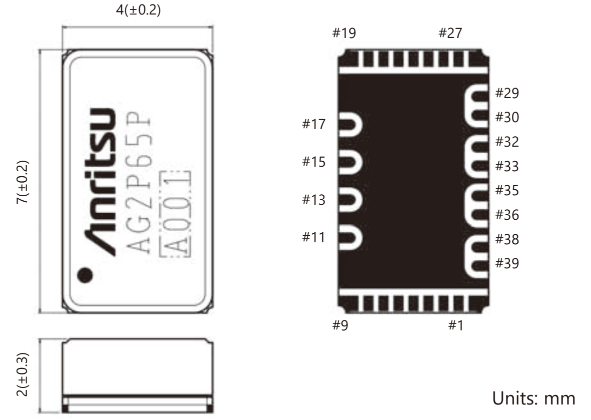
V_{CC} = 2.6 V to 2.8 V, V_{DRV} = 2.6 V to 2.8 V, V_{amp} = 2.4 V

Items	Conditions	Units	Specifications		
			Min.	Typ.	Max.
Current Consumption	I_{CC}	mA	—	68	86
	I_{DRV}	mA	—	32	42
	I_{amp}	mA	—	6.5	10
Power Consumption	/ch	W	—	0.28	—

Power-up/Shut-down Sequence

For power-up, supply voltage (V_{CC}, V_{DRV}) at first, next (V_{amp}).
For shut-down, (V_{amp}) at first, next (V_{CC}, V_{DRV}).

Dimensions



PERIPHERAL EQUIPMENT

Coaxial Cords, Adapters

List of Principal Coaxial Cables

Coaxial Cable	Characteristic Impedance	Nominal Attenuation (10 MHz)	Nominal Capacitance	Finished Diameter	Mass (g/m)	Remarks
3C-2V	75 ±3Ω (10 MHz)	0.042 dB/m	67 pF/m	5.8 mm	48	Single outer conductor, PVC covered
3C-2W				6.5 mm	75	Double outer conductor, PVC covered
3C-2Z				3.8 mm	28	Single outer conductor, No PVC covered
3C-2T		(0.013 dB/m, 1 MHz)		7.4 mm	110	Triple outer conductor, PVC covered
3C-2WS	75 ±1Ω (10 MHz)	0.048 dB/m		6.6 mm	76	Double outer conductor, PVC covered
5C-2V	75 ±3Ω (10 MHz)	0.027 dB/m		7.8 mm	75	Single outer conductor, PVC covered
5C-2W				8.5 mm	110	Double outer conductor, PVC covered
5C-2Z				5.8 mm	48	Single outer conductor, No PVC covered
3D-2W	50 ±2Ω (10 MHz)	0.047 dB/m	100 pF/m	6.4 mm	75	Double outer conductor, PVC covered
5D-2V		0.031 dB/m		7.5 mm	85	Single outer conductor, PVC covered
5D-2W				8.2 mm	120	Double outer conductor, PVC covered
RG-55/U	53.5 ±2.5Ω (4 MHz)	0.0328 dB/m	93.5 pF/m	5.25 mm	55	Double outer conductor, PE covered
RG-58/U				4.95 mm	50	Single outer conductor, PVC covered
RG-58A/U	50 ±2Ω (10 MHz)	0.0427 dB/m				

Connecting Cords

J0576B/D

Coaxial cord: 1 m (J0576B)
2 m (J0576D)
N-P · 5D-2W · N-P
Impedance: 50Ω

J0133A/C

Coaxial cord: 1 m (J0133A)
2 m (J0133C)
3CA-P2 · RG-58A/U · 3CA-P2
Impedance: 50Ω

J0025A/B

Coaxial cord: 1 m (J0025A)
10 m (J0025B)
S-5DWP · 5D-2W · S-5DWP
Impedance: 50Ω

J0030A/B

Coaxial cord: 1 m (J0030A)
2 m (J0030B)
P-5CP · 5C-2W · P-5CP
Impedance: 75Ω

Conversion Connectors

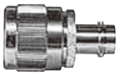
J0038

Coaxial adapter
N-P · N-P
Impedance: 50Ω

J0039

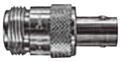
Coaxial adapter
N-J · N-J
Impedance: 50Ω

J0040



Coaxial adapter
N-P · BNC-J
Impedance: 50Ω

J0044

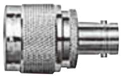


Coaxial adapter
N-J · BNC-J
Impedance: 50Ω

J0043

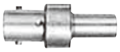
Coaxial adapter
N-J · BNC-P
Impedance: 50Ω

J0055



Coaxial adapter
NC-P · BNC-J
Impedance: 75Ω

J0052



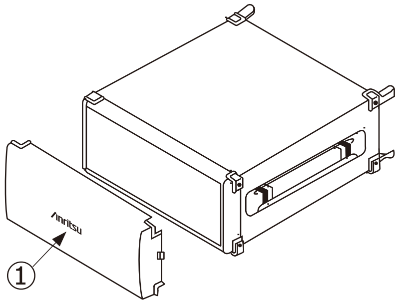
Coaxial adapter
SP-3CP · 3C-J (BNC-J)
Impedance: 75Ω
RoHS non-compliant

Accessories for F-Series Cabinets

Anritsu's F-series cabinet was designed using basic dimensions that conform to EIA and IEC racking specifications, permitting compatible equipment to be easily stacked up to form a system, or to be mounted on the EIA/IEC standard rack.
The accessories of the F-series cabinet are easy to mount and use, and blend with the design of the cabinet. The F-series can be identified by its green feet.

Protective Cover

Protects front of cabinet

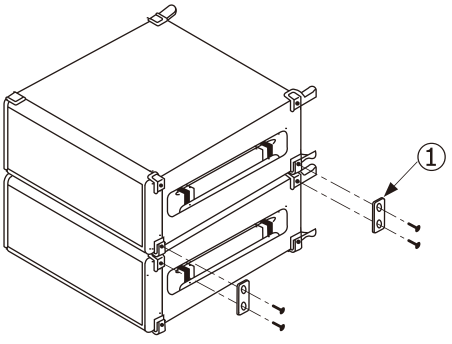


No.	Description	Quantity
①	Protective cover	1

Item	Order No.
Protective cover 3/4MW4U	B0329G
Protective cover 1/2MW2U	B0329L

Coupler

To mount two or more F-series cabinets in a stack

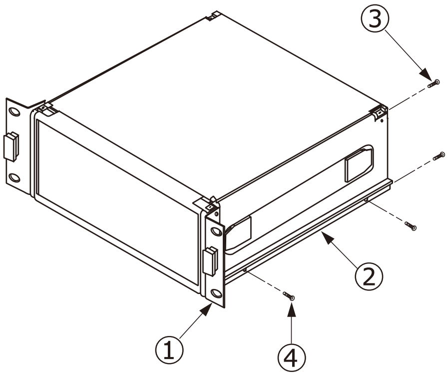


No.	Description	Quantity
①	Coupler	4

Item	Order No.
Coupler	B0332

Rack Mount Kit

The rack mount accessory is for use with 1MW450D cabinet.
For EIA/IEC standard rack

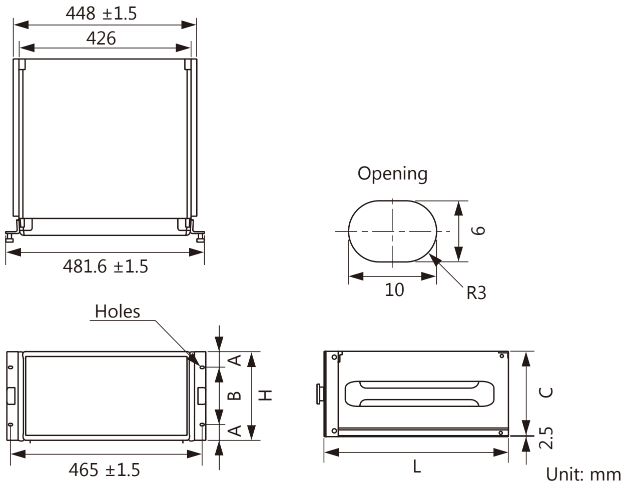


No.	Description	Quantity
①	Rack flange	2
②	Side rail	2
③	5NPS25S7 + SW	2
④	4NPS6S7 + SW	4

Item	Order No.
Rack mount kit 2U	B0333A*
Rack mount kit 4U	B0333C
Rack mount kit 7U	B0333F*
Rack mount kit 5U	B0333G

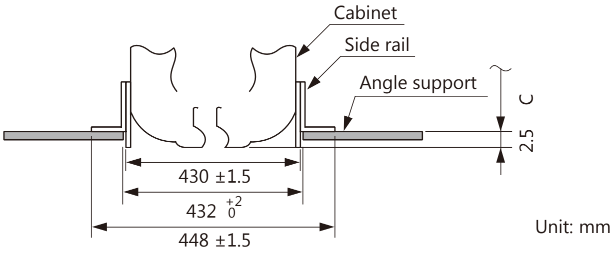
*: RoHS not supported at B0333A, B0333F.

F-series Cabinet Rack Mount Dimensions



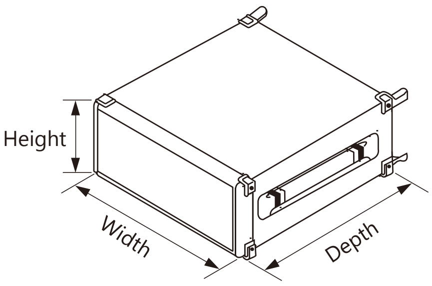
Cabinet height	H	A	B	C	L
2U	88	5.9	76.2	85.5	451
4U	177	37.7	101.6	174.5	451
7U	310.5	37.7	235.1	308	501
5U	221.5	37.7	146.1	219	499

Cabinet Angle Support Dimensions



Note: Merely attaching the equipment to the rack with rack mount kit does not provide enough support. Use either angle supports or shelves to provide the necessary support.

Symbol and Dimensions of F-series Cabinet



Width

Symbol	Dimension (mm)
1MW	426
3/4MW	320
2/3MW	284
1/2MW	213

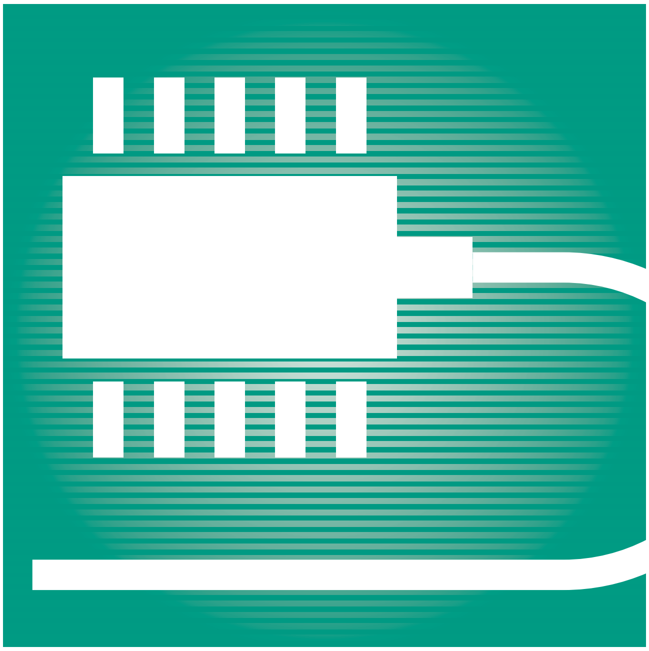
Height

Symbol	Dimension (mm)
2U	88
3U	132.5
4U	177
5U	221.5
6U	266

Depth

Symbol	Dimension (mm)
250D	251
350D	351
450D	451

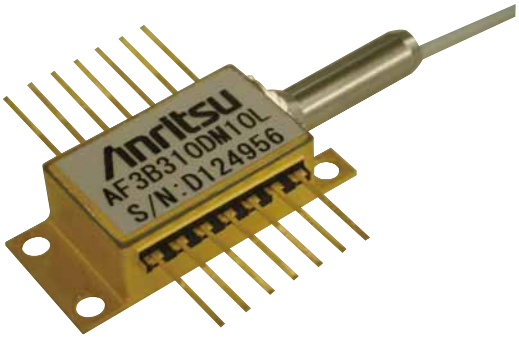
Note: Knobs, handles, and feet are not included in cabinet external dimensions.



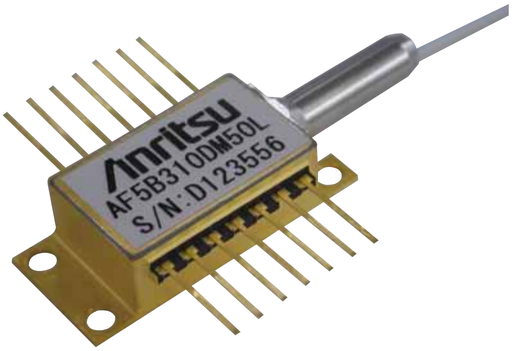
OPTICAL DEVICES

1.31/1.55 µm LD Module

AF3B310DM10L/AF5B310DM50L



AF3B310DM10L



AF5B310DM50L

RoHS Compliant Part

1.31 µm/1.55 µm laser diode modules designed for optical measurement and communication.
The laser is packaged in a 14-pin butterfly package with optical isolator, monitor photodiode and thermo-electric cooler (TEC).

Features

- High optical output: 100 mW/≤500 mA
- PMF output (fiber: ø0.9 mm)
- Built-in optical isolator
- Internal monitor PD and TEC

Absolute Maximum Ratings

Item	Symbol	Rating Unit
LD Forward Current	I_F	900 mA
LD Reverse Voltage	V_R	2 V
PD Forward Current	I_{FD}	10 mA
PD Reverse Voltage	V_{RD}	20 V
Operating Case Temperature	T_C	–20° to +70°C
Storage Temperature	T_{stg}	–40° to +85°C
Cooler Current	I_C	2 A

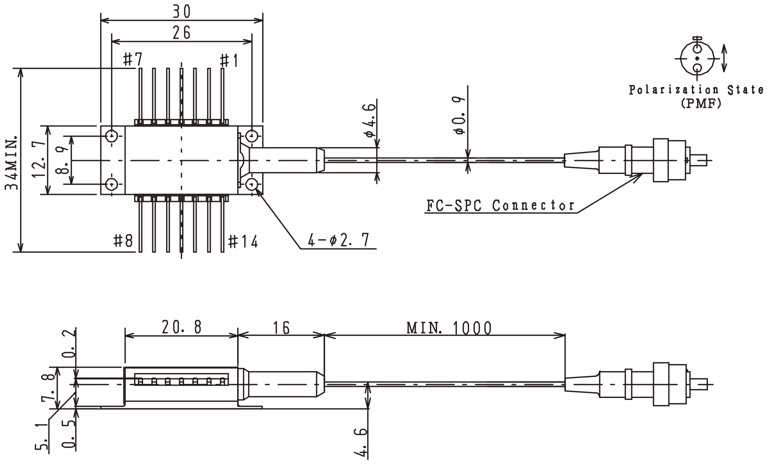
*: Excess over the absolute maximum ratings may cause device failure.

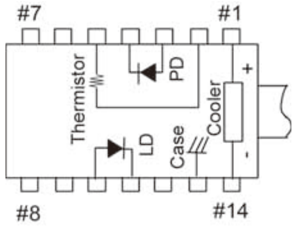
Optical and Electrical Characteristics (T_{LD} = 25°C, T_C = 25°C)

Item	Symbol	Test condition	AF3B310DM10L			AF5B310DM50L		
			Min.	Typ.	Max.	Min.	Typ.	Max.
Forward Voltage	V_F	I_F = 500 mA	—	2.0 V	2.5 V	—	2.0 V	2.5 V
Threshold Current	I_{th}		—	30 mA	60 mA	—	30 mA	60 mA
Optical Output Power	P_f	I_F = 500 mA	100 mW	—	—	100 mW	—	—
Center Wavelength	λ_C	I_F = 500 mA, RMS (–20 dB)	1295 nm	1310 nm	1325 nm	1535 nm	1550 nm	1565 nm
Spectral Width	$\Delta\lambda$	I_F = 500 mA, RMS (–20 dB)	—	4 nm	8 nm	—	5 nm	10 nm
Monitor Current	I_m	I_F = 500 mA, V_{RD} = 5 V	100 µA	400 µA	—	100 µA	400 µA	—
PD Dark Current	I_d	V_{RD} = 5 V	—	—	0.1 µA	—	—	0.1 µA
Tracking Error	ΔP_f	I_m = const, T_C = –20° to +70°C	—	—	0.5 dB	—	—	0.5 dB
Cooler Voltage	V_c	I_F = 600 mA, T_C = +70°C	—	—	3.2 V	—	—	3.2 V
Cooler Current	I_c	I_F = 600 mA, T_C = +70°C	—	—	1.2 A	—	—	1.2 A
Thermistor Resistance	R_{th}	T_{LD} = 25°C, B = 3900 ±100K	9.5 kΩ	10 kΩ	10.5 kΩ	9.5 kΩ	10 kΩ	10.5 kΩ
Optical Isolation	R_o	T_{LD} = 25°C	—	30 dB	—	—	30 dB	—
Extinction Ratio	Xp	I_F = 500 mA	17 dB	—	—	17 dB	—	—

Note: Polarization state of LD is aligned parallel to the slow axis.

Dimensions





Top View

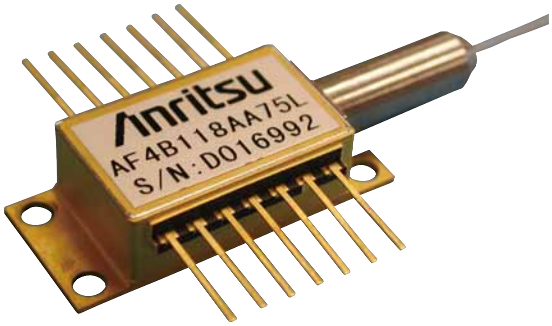
No.	Function	No.	Function
1	Cooler anode	8	NC
2	Thermistor	9	NC
3	PD anode	10	LD anode
4	PD cathode	11	LD cathode
5	Thermistor	12	NC
6	NC	13	Case
7	NC	14	Cooler cathode

Pin Configuration

1.48 µm LD Module

AF4B Series

Type A: 120 mW to 180 mW, Type B: 200 mW to 250 mW, Type C: 300 mW to 400 mW, Type D: 420 mW to 500 mW



Type A

RoHS Compliant Part

The AF4B Series is 1.48 µm high power laser diode modules designed for Er doped fiber amplifier. The laser is packaged in a 14-pin butterfly package with optical isolator, monitor photodiode and thermo-electric cooler (TEC).

Features

- Optical Output
  - Type A:
    - 120 mW (I_F ≤500 mA) AF4B112AA75L/AF4B112AD75L
    - 140 mW (I_F ≤550 mA) AF4B114AA75L/AF4B114AD75L
    - 160 mW (I_F ≤600 mA) AF4B116AA75L/AF4B116AD75L
    - 180 mW (I_F ≤600 mA) AF4B118AA75L/AF4B118AD75L
  - Type B:
    - 200 mW (I_F ≤700 mA) AF4B120EA75L/AF4B120ED75L
    - 220 mW (I_F ≤700 mA) AF4B122EA75L/AF4B122ED75L
    - 250 mW (I_F ≤800 mA) AF4B125EA75L/AF4B125ED75L
  - Type C:
    - 300 mW (I_F ≤1100 mA) AF4B130CA75L/AF4B130CD75L
    - 350 mW (I_F ≤1400 mA) AF4B135CA75L/AF4B135CD75L
    - 400 mW (I_F ≤1400 mA) AF4B140CA75L/AF4B140CD75L
  - Type D:
    - 420 mW (I_F ≤1600 mA) AF4B142FA75L/AF4B142FD75L
    - 460 mW (I_F ≤1700 mA) AF4B146FA75L/AF4B146FD75L
    - 500 mW (I_F ≤1800 mA) AF4B150FA75L/AF4B150FD75L
- Fiber
  - SMF output (UV coating fiber: ø0.25 mm)
  - PMF output (UV coating fiber: ø0.25 mm)
- 14-pin Butterfly Package
- Built-in Optical Isolator
- Internal Monitor PD and TEC
- Low Power Consumption (Type B, C)
- Operating Case Temperature 75°C (Type A)
- Operating Case Temperature 70°C (Type B, C, D)

Absolute Maximum Ratings (T_{LD} = 25°C)

Item	Symbol	Rating					
		Type A	Type B	Type C			Type D
				AF4B130CA75L AF4B130CD75L	AF4B135CA75L AF4B135CD75L	AF4B140CA75L AF4B140CD75L	
LD Forward Current	I_F	1100 mA	1300 mA	1500 mA	1700 mA		2200 mA
LD Reverse Voltage	V_R	2 V					
PD Forward Current	I_{FD}	10 mA					
PD Reverse Voltage	V_{RD}	20 V					
Operating Case temperature	T_C	–20° to +75°C	–20° to +70°C				
Storage Temperature	T_{stg}	–40° to +85°C					
Cooler Current	I_C	2 A		5.8 A			

*: Excess over the absolute maximum ratings may cause device failure.

Optical and Electrical Characteristics (T_{LD} = 25°C, T_C = 25°C)

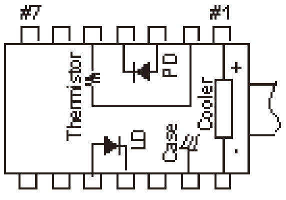
Item	Symbol	Test condition	Type A			
			AF4B112AA75L AF4B112AD75L	AF4B112AD75L AF4B114AD75L	AF4B116AA75L AF4B116AD75L	AF4B118AA75L AF4B118AD75L
Output Power	P_f		120 mW	140 mW	160 mW	180 mW
Forward Voltage	V_F	At Output Power	Max. 2.5 V			
Threshold Current	I_{th}		Max. 50 mA			
Forward Current (BOL)	I_F	At Output Power	Max. 500 mA	Max. 550 mA	Max. 600 mA	
Center Wavelength	λ_C	At Output Power	Min. 1460 nm, Typ. 1475 nm, Max. 1490 nm			
Spectral Width	$\Delta\lambda$	At Output Power RMS (–20 dB)	Typ. 4 nm, Max. 8 nm			
Monitor Current	Im	At Output Power V_{RD} = 5 V	Min. 100 µA, Typ. 400 µA, Max. 800 µA			
PD Dark Current	I_d	V_{RD} = 5 V	Max. 0.1 µA			
Tracking Error	ΔP_f	I_m = const, Tc = –20° to +75°C	Max. 0.5 dB			
Cooler Voltage	V_C	IF = □EOL, Tc = 75°C	Max. 3.5 V			
Cooler Current	I_C	IF = □EOL, Tc = 75°C	Max. 1.2 A	Max. 1.4 A		
Thermistor Resistance	R_{th}	T_{LD} = 25°C B = 3900 ±100K	Min. 9.5 kΩ, Typ. 10 kΩ, Max. 10.5 kΩ			
Optical Isolation	R_O	T_{LD} = 25°C	Typ. 30 dB			
Extinction Ratio**	X_p	At Output Power	Min. 17 dB			

Item	Symbol	Test condition	Type B			Type C		
			AF4B120EA75L AF4B120ED75L	AF4B122EA75L AF4B122ED75L	AF4B125EA75L AF4B125ED75L	AF4B130CA75L AF4B130CD75L	AF4B135CA75L AF4B135CD75L	AF4B140CA75L AF4B140CD75L
Output Power	P_f		200 mW	220 mW	250 mW	300 mW	350 mW	400 mW
Forward Voltage	V_F	At Output Power	Max. 2 V			Max. 2 V		
Threshold Current	I_{th}		Typ. 70 mA, Max. 150 mA			Typ. 100 mA, Max. 150 mA		
Forward Current (BOL)	I_F	At Output Power	Max. 700 mA		Max. 800 mA	Max. 1100 mA	Max. 1400 mA	
Center Wavelength	λ_C	At Output Power	Min. 1460 nm, Typ. 1475 nm, Max. 1490 nm			Min. 1460 nm, Typ. 1475 nm, Max. 1490 nm		
Spectral Width	$\Delta\lambda$	At Output Power RMS (–20 dB)	Typ. 5 nm, Max. 10 nm			Typ. 5 nm, Max. 10 nm		
Monitor Current	Im	At Output Power V_{RD} = 5 V	Min. 100 µA, Max. 1000 µA			Min. 100 µA, Max. 2000 µA		
PD Dark Current	I_d	V_{RD} = 5 V	Max. 0.1 µA			Max. 0.1 µA		
Tracking Error	ΔP_f	I_m = const, Tc = –20° to +75°C	Max. 0.5 dB			Max. 0.5 dB		
Cooler Voltage	V_C	IF = □EOL, Tc = 75°C	Max. 3.1 V			Max. 2.9 V	Max. 3.1 V	
Cooler Current	I_C	IF = □EOL, Tc = 75°C	Max. 1.3 A		Max. 1.5 A	Max. 2.7 A	Max. 3 A	
Thermistor Resistance	R_{th}	T_{LD} = 25°C B = 3900 ±100K	Min. 9.5 kΩ, Typ. 10 kΩ, Max. 10.5 kΩ			Min. 9.5 kΩ, Typ. 10 kΩ, Max. 10.5 kΩ		
Optical Isolation	R_O	T_{LD} = 25°C	Typ. 30 dB			Typ. 30 dB		
Extinction Ratio**	X_p	At Output Power	Min. 17 dB					

Item	Symbol	Test condition	Type D		
			AF4B142FA75L AF4B142FD75L	AF4B146FA75L AF4B146FD75L	AF4B150FA75L AF4B150FD75L
Output Power	P_f		420 mW	460 mW	500 mW
Forward Voltage	V_F	At Output Power	Max. 2.2 V		
Threshold Current	I_{th}		Typ. 70 mA, Max. 180 mA		
Forward Current (BOL)	I_F	At Output Power	Max. 1600 mA	Max. 1700 mA	Max. 1800 mA
Center Wavelength	λ_C	At Output Power	Min. 1460 nm, Typ. 1475 nm, Max. 1490 nm		
Spectral Width	$\Delta\lambda$	At Output Power RMS (–20 dB)	Typ. 5 nm, Max. 10 nm		
Monitor Current	Im	At Output Power V_{RD} = 5 V	Min. 100 µA, Max. 2000 µA		
PD Dark Current	I_d	V_{RD} = 5 V	Max. 0.1 µA		
Tracking Error	ΔP_f	I_m = const, Tc = –20° to +75°C	Max. 0.5 dB		
Cooler Voltage	V_C	IF = □EOL, Tc = 75°C	Max. 3.2 V	Max. 3.4 V	Max. 3.6 V
Cooler Current	I_C	IF = □EOL, Tc = 75°C	Max. 2.7 A	Max. 2.9 A	Max. 3.1 A
Thermistor Resistance	R_{th}	T_{LD} = 25°C B = 3900 ±100K	Min. 9.5 kΩ, Typ. 10 kΩ, Max. 10.5 kΩ		
Optical Isolation	R_O	T_{LD} = 25°C	Typ. 30 dB		
Extinction Ratio**	X_p	At Output Power	Min. 17 dB		

*: EOL = BOL × 1.2
**: Only PMF

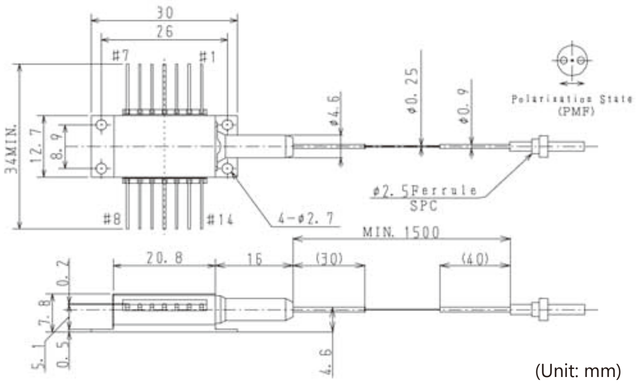
Pin Configuration



Top View

No.	Function	No.	Function
1	Cooler anode	8	NC
2	Thermistor	9	NC
3	PD anode	10	LD anode
4	PD cathode	11	LD cathode
5	Thermistor	12	NC
6	NC	13	Case
7	NC	14	Cooler cathode

Dimensions



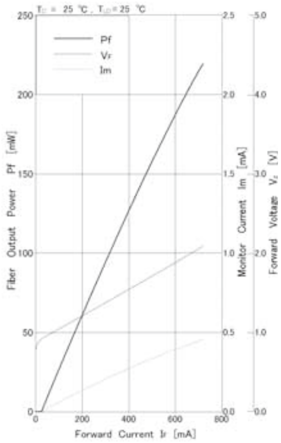
(Unit: mm)

Polarization state of LD is aligned parallel to the slow axis.

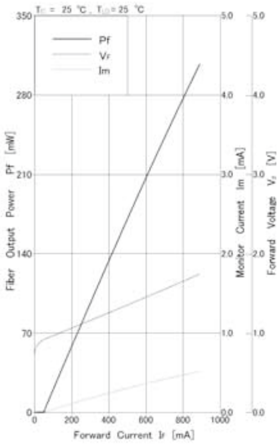
AF4B Series Typical Characteristics

Fiber Output Power/Monitor Current/Voltage-Forward Current Characteristics

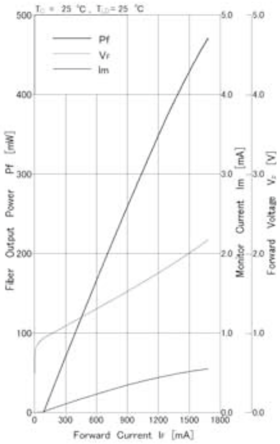
AF4B118AA75L



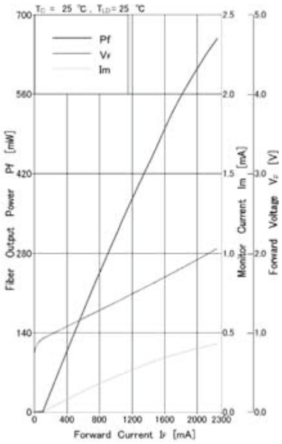
AF4B125EA75L



AF4B140CA75L

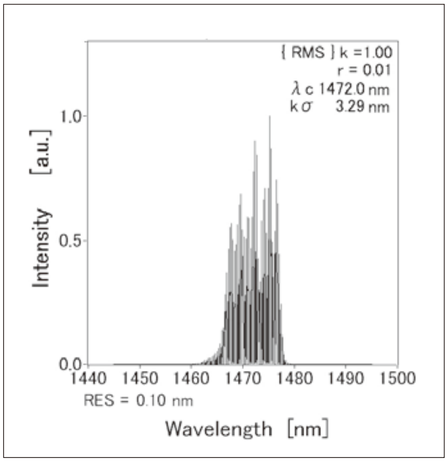


AF4B150FA75L

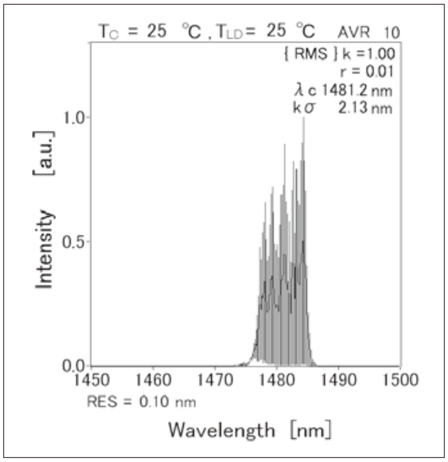


Emission Spectrum

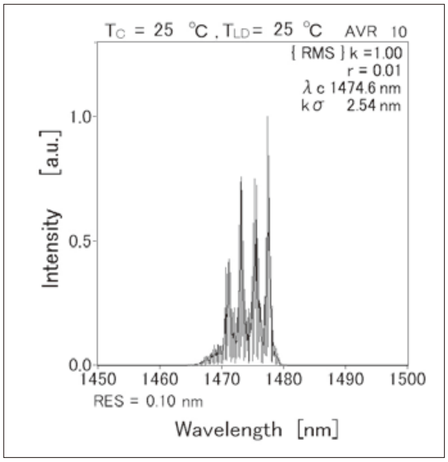
AF4B118AA75L



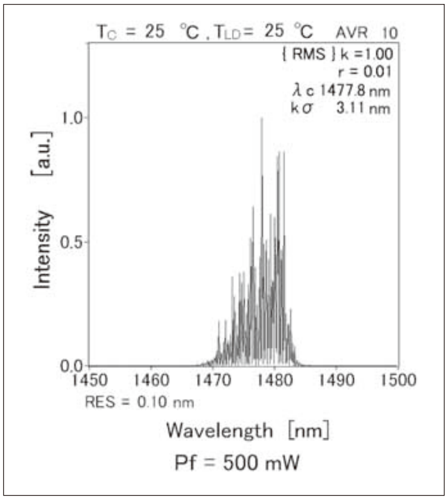
AF4B125EA75L



AF4B140CA75L



AF4B150FA75L



Ordering Information

Model: AF4B1 ### # ## #

Center Wavelength range
L: ±15 nm, M: ±20 nm, K: ±10 nm

Center Wavelength
75: 1475 nm, 80: 1480 nm,
70: 1470 nm, 65: 1465 nm

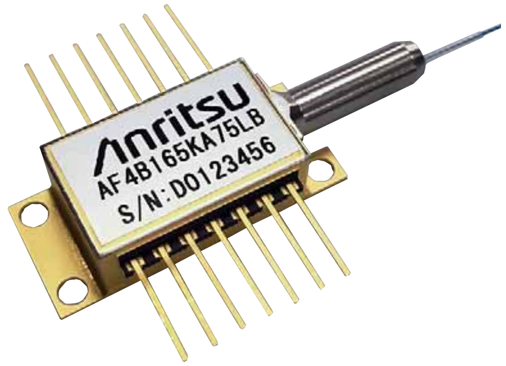
Fiber and Connector
A: SMF Ferrule, D: PMF Ferrule,
G: SMF FC/PC, K: PMF FC/PC

Optical Output Power
- Type A
  - 12A: 120 mW
  - 14A: 140 mW
  - 16A: 160 mW
  - 18A: 180 mW
- Type B
  - 20E: 200 mW
  - 22E: 220 mW
  - 25E: 250 mW
- Type C
  - 30C: 300 mW
  - 35C: 350 mW
  - 40C: 400 mW
- Type D
  - 42F: 420 mW
  - 46F: 460 mW
  - 50F: 500 mW

1.48 μm LD Module

AF4B Series type E

NEW



RoHS Compliant Part

AF4B SERIES type E is 1.48 μm high power laser diode modules designed for Er doped fiber amplifier. The laser is packaged in a 14 pin butterfly package with optical isolator, monitor photodiode and thermo-electric cooler (TEC).

Features

- Optical output power: AF4B155KA/KD75LB: 550 mW
  AF4B160KA/KD75LB: 600 mW
  AF4B165KA/KD75LB: 650 mW
- Fiber (UV coating fiber: ø0.25 mm)
- 14 pin butterfly Package
- Built-in optical isolator
- Internal monitor PD and TEC
- LD operating temperature: 35°C

Application

- for Er doped Fiber Amplifier.

Absolute Maximum Ratings

Item	Symbol	Ratings
LD Forward Current	I_F	2800 mA
LD Reverse Voltage	V_R	2 V
PD Forward Current	I_{FD}	10 mA
PD Reverse Voltage	V_{RD}	20 V
Operating Case Temperature	T_C	–5° to +70°C
Storage Temperature	T_{stg}	–40° to +85°C
Cooler Current	I_C	5.8 A

*: Excess over the absolute maximum ratings may cause device failure.

Optical and Electrical Characteristics (T_{LD} = 35°C, T_C = 25°C)

Item	Symbol	Test Condition	Min.	Typ.	Max.
Threshold Current	I_{th}	—	—	—	250 mA
Center Wavelength	λ_C	At Output Power, RMS (–20 dB)	1460 nm	1475 nm	1490 nm
Spectral width	$\Delta\lambda$	At Output Power –20 dB	—	5 nm	10 nm
Monitor Current	I_m	At Output Power	300 μA	—	3000 μA
PD Dark Current	I_d	V_{RD} = 5 V	—	—	0.1 μA
Tracking Error	ΔP_f	I_m = const., T_C = –5° to 70°C	—	—	0.5 dB
Isolation	R_O	T_{LD} = 35°C	—	30 dB	—
Extinction Ratio*	X_P	At Output Power	17 dB	—	—
Thermistor Resistance	R_{th}	T_{LD} = 35°C	—	6.5 kΩ	—
		T_{LD} = 25°C	—	10.0 kΩ	—

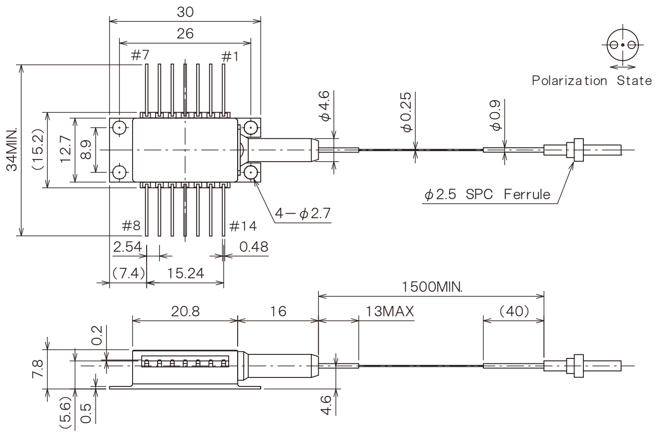
*: PMF Only

Optical Output Power/Cooler/Consumption Power

Item		Forward Current (Max.)	Forward Voltage (Max.)		Cooler Current (Max.)	Cooler Voltage (Max.)	Total Consumption Power (Max.)
Symbol		I_F	V_F		I_C	V_C	P_{total}
Test Condition		At Output Power			I_F = EOL*, T_C = 70°C		
At Output Power	550 mW	1980	2.00	2.24	2.30	2.85	11.0
	600 mW	2170	2.05	2.30	2.60	3.15	13.0
	650 mW	2400	2.15	2.41	2.90	3.45	15.5
Unit		BOL [mA]	BOL [V]	EOL [V]	EOL [A]	EOL [V]	EOL [W]

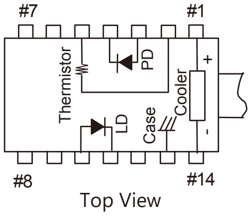
*: EOL = BOL × 1.12

Dimensions



(Unit: mm)

(Note) Polarization state of LD is Aligned parallel to the slow axis.

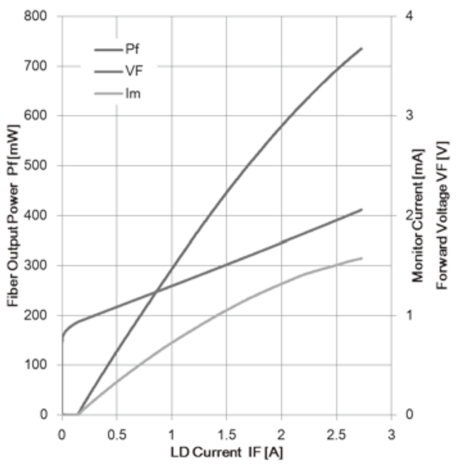


No.	Function	No.	Function
1	Cooler anode	8	NC
2	Thermistor	9	NC
3	PD anode	10	LD anode
4	PD cathode	11	LD cathode
5	Thermistor	12	NC
6	NC	13	Case
7	NC	14	Cooler cathode

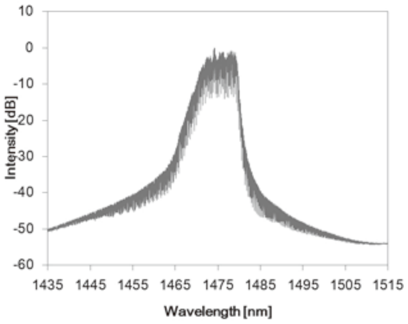
Pin Configuration

Typical Characteristics

Output Power/Monitor Current/Forward Voltage [AF4B165KA75LB]



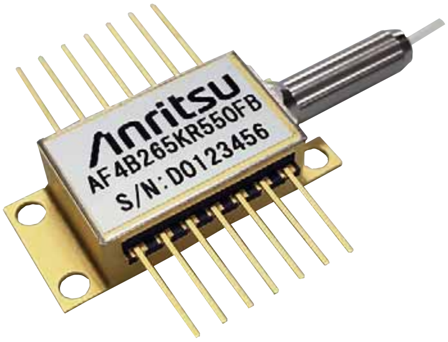
Emission spectrum



1.4 μm FBG LD Module

AF4B2 Series type GE

NEW



RoHS Compliant Part

The AF4B2 Series type GE is designed for Raman amplifier.

Features

- Optical output power: AF4B255KRxxxFB: 550 mW
  AF4B260KRxxxFB: 600 mW
  AF4B265KRxxxFB: 650 mW
- Range of Wavelength: 1420.0 nm to 1470.0 nm
  eg: xxx = 550 λ = 1455.0 nm (0.5 nm spacing is available)
- Fiber
  PMF output (UV coating fiber: ø0.25 mm)
- 14 pin butterfly Package
- Internal monitor PD and TEC
- LD operating temperature: 35°C

Application

- Pump Laser for Raman Amplifier

Absolute Maximum Ratings

Item	Symbol	Ratings
LD Forward Current	I_F	2800 mA
LD Reverse Voltage	V_R	2 V
PD Forward Current	I_{FD}	10 mA
PD Reverse Voltage	V_{RD}	20 V
Operating Case Temperature	T_C	–5° to +70°C
Storage Temperature	T_{stg}	–40° to +85°C
Cooler Current	I_C	5.8 A

*: Excess over the absolute maximum ratings may cause device failure.

Optical and Electrical Characteristics (T_{LD} = 35°C, T_{FBG} = 25°C, T_C = 25°C)

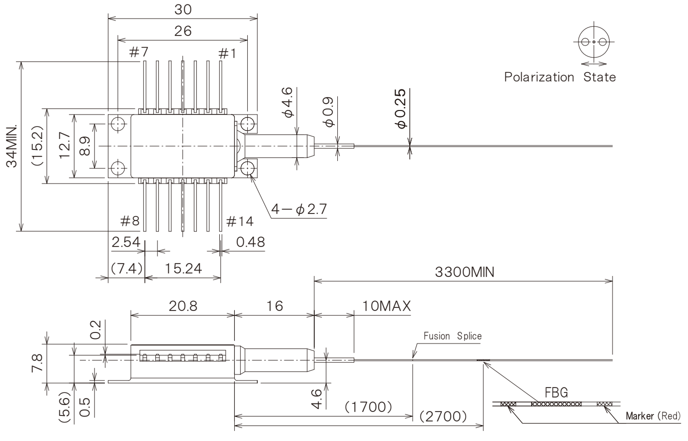
Item	Symbol	Test Condition	Min.	Typ.	Max.
Threshold Current	I_{th}	—	—	—	250 mA
Center Wavelength	λ_C	At Output Power, RMS (–20 dB)	λ – 1.0 nm	λ nm	λ + 1.0 nm
Spectral width	Δλ	At Output Power –10 dB	—	—	3.5 nm
Monitor Current	I_m	At Output Power	300 μA	—	3000 μA
PD Dark Current	I_d	V_{RD} = 5 V	—	—	0.1 μA
Tracking Error	ΔP_f	I_m = const., T_C = –5° to 70°C	—	—	0.5 dB
Extinction Ratio	X_P	At Output Power	17 dB	—	—
Thermistor Resistance	R_{th}	T_{LD} = 35°C	—	6.5 kΩ	—
		T_{LD} = 25°C	—	10.0 kΩ	—

Optical Output Power/Cooler/Consumption Power

Item		Forward Current (Max.)	Forward Voltage (Max.)		Cooler Current (Max.)	Cooler Voltage (Max.)	Total Consumption Power (Max.)
Symbol		I_F	V_F		I_C	V_C	P_{total}
Test Condition		At Output Power			I_F = EOL*, T_C = 70°C		
At Output Power	550 mW	1980	2.00	2.24	2.30	2.85	11.0
	600 mW	2170	2.05	2.30	2.60	3.15	13.0
	650 mW	2400	2.15	2.41	2.90	3.45	15.5
Unit		BOL [mA]	BOL [V]	EOL [V]	EOL [A]	EOL [V]	EOL [W]

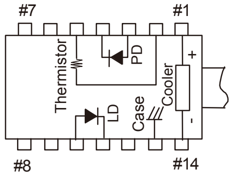
*: EOL = BOL × 1.12

Dimensions



(Unit: mm)

(Note) Polarization state of LD is Aligned parallel to the slow axis.



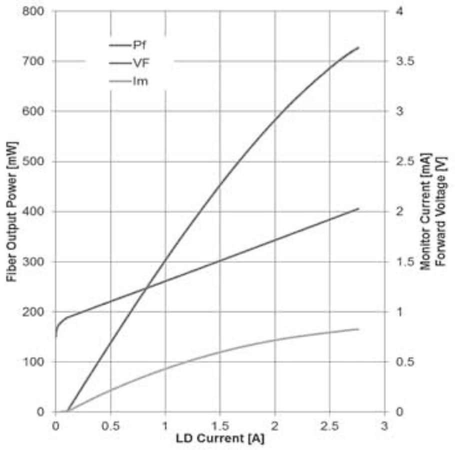
Top View

No.	Function	No.	Function
1	Cooler anode	8	NC
2	Thermistor	9	NC
3	PD anode	10	LD anode
4	PD cathode	11	LD cathode
5	Thermistor	12	NC
6	NC	13	Case
7	NC	14	Cooler cathode

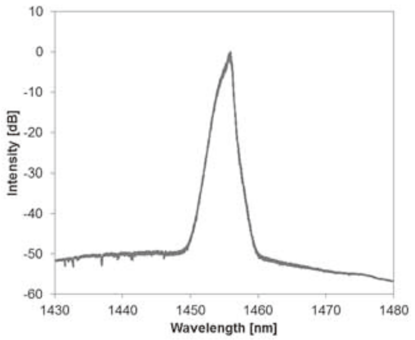
Pin Configuration

Typical Characteristics

Output Power/Monitor Current/Forward Voltage [AF4B265KR550FB]



Emission spectrum



1.48 µm Cylindrical Module

AF4Y108GA85J/AF4Y115HA85J

AF4Y108GA85J

AF4Y115HA85J

RoHS Compliant Part

This LD is 1.48 µm high power laser diode module designed for Er doped fiber amplifier. The laser is packaged in a cylindrical package without isolator, monitor photodiode and thermoelectric cooler (TEC).

Features

- Uncooled (TEC less) coaxial module
- Low power consumption

Absolute Maximum Ratings (T_C = 70 deg.C)

Item	Symbol	AF4Y108GA85J	AF4Y115HA85J
LD Forward Current	I_F	600 mA	1000 mA
LD Reverse Voltage	V_R	2.0 V	
Operating Case Temperature*	T_C	–5° to +70°C	
Storage Temperature	T_{stg}	–40° to +85°C	

*: Wavelength begins to be distributed under the cut-off (1450 nm) when operated below 30 deg.C

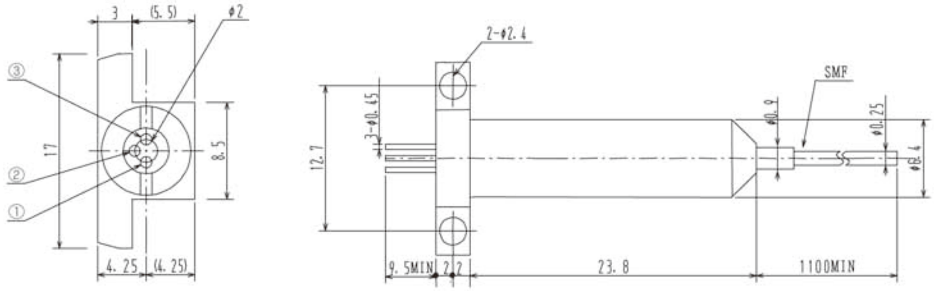
*: Excess over the absolute maximum ratings may cause device failure.

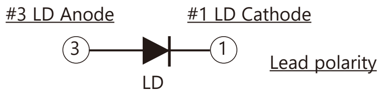
Optical and Electrical Characteristics (T_C = 70 deg.C)

Item	Symbol	Test condition	AF4Y108GA85J			AF4Y115HA85J		
			Min.	Typ.	Max.	Min.	Typ.	Max.
Threshold Current	I_{th}		—	45 mA	55 mA	—	130 mA	—
Forward Current (BOL)	I_F	*2	—	350 mA	400 mA	—	—	800 mA
Center Wavelength*1	λ_C	*2, RMS (–20 dB)	1478 nm	—	1490 nm	1478 nm	—	1490 nm
Forward Voltage	V_F	*2	—	1.4 V	1.8 V	—	—	2.0 V

*1: Center wavelength is measured under no reflected light condition
*2: AF4Y108GA85J (P_F = 80 mW), AF4Y115HA85J (P_F = 150 mW)

Dimensions



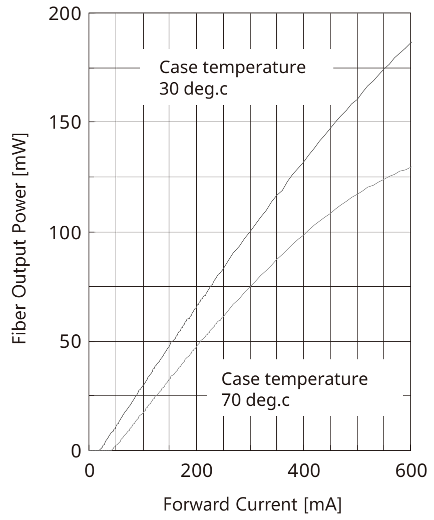


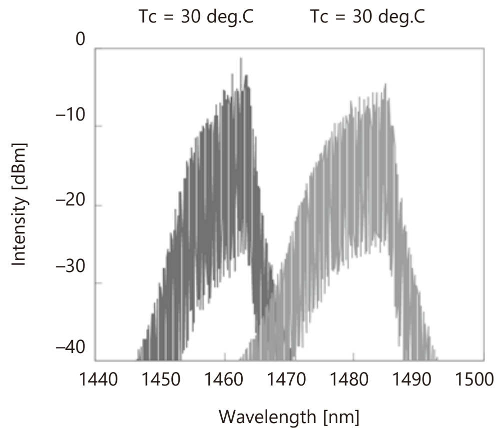
No.	Function
1	LD Cathode
2	NC (Case)
3	LD Anode

Pin Configuration

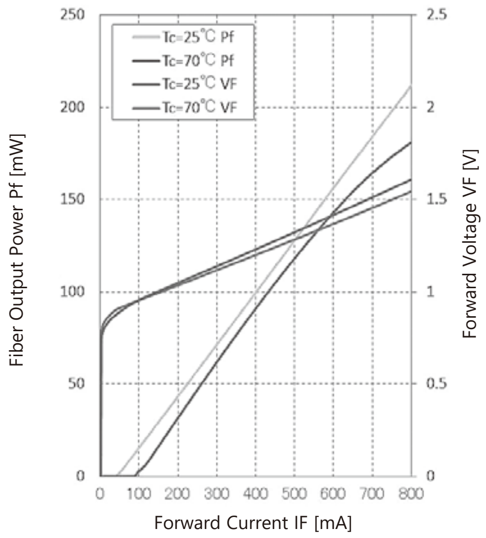
IL Characteristics & Spectrum

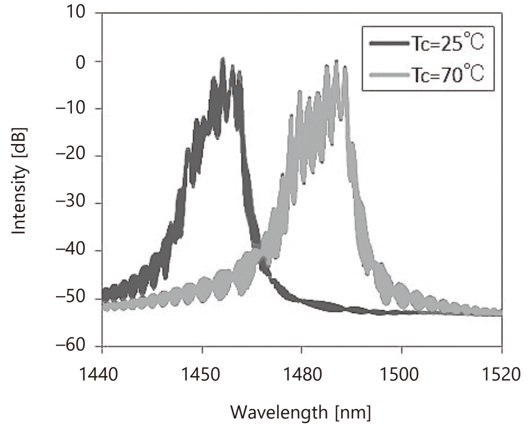
AF4Y108GA85J





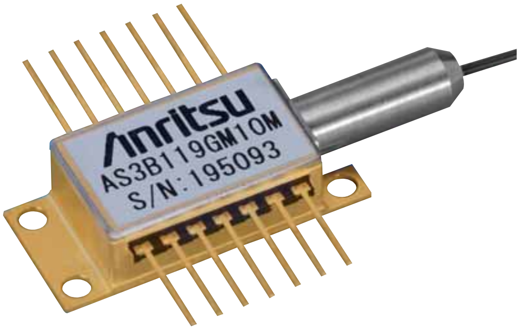
AF4Y115HA85J





1.31/1.55/1.65 µm SLD Module

AS3B119GM10M/AS5B125EM50M/AS6B118GM50M



AS3B119GM10M

RoHS Compliant Part

The AS3B/5B/6B series are 1.55 µm SLD (Super-Luminescent Diode) modules developed as incoherent light sources for various optical measurements. The device emits incoherent light having wide spectral half width and high output power from PMF (polarization-maintaining fiber).

Applications

- Optical sensor
- Optical Coherent Tomography (OCT)
- Optical measurement

Features

- High optical output: 15 mW/≤400 mA (AS3B)
  25 mW/≤500 mA (AS5B)
  10 mW/≤350 mA (AS6B)
- Wide spectral half width: Δλ = 55 nm (typ., AS3B)
  Δλ = 60 nm (typ., AS5B)
  Δλ = 70 nm (typ., AS6B)
- Built-in optical isolator
- Internal monitor PD and TEC

Absolute Maximum Ratings (T_{SLD} = 25 deg.C)

Item	Symbol	Rating		
		AS3B119GM10M	AS5B125EM50M	AS6B118GM50M
SLD Forward Current	I_F	480 mA	600 mA	420 mA
SLD Reverse Voltage	V_R	2 V		
PD Forward Current	I_{FD}	10 mA		
PD Reverse Voltage	V_{RD}	10 V		
Operating Case Temperature	T_C	–20° to +75°C		
Storage Temperature	T_{stg}	–40° to +85°C		
Cooler Current	I_C	2 A		

*: Excess over the absolute maximum ratings may cause device failure.

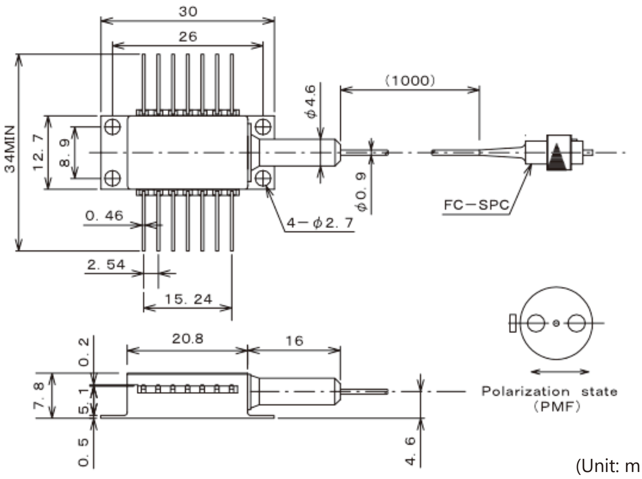
Optical And Electrical Characteristics (T_{SLD} = 25 deg.C, T_C = 25 deg.C)

Item	Symbol	Test condition	AS3B119GM10M			AS5B125EM50M			AS6B118GM50M		
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.
Forward Voltage	V_F	*1	—	—	2.5 V	—	—	2.4 V	—	—	2.5 V
Forward Current (BOL)	I_F	*1	—	—	400 mA	—	—	500 mA	—	—	350 mA
Center Wavelength	λ_C	*1, –3 dB	1290 nm	1310 nm	1330 nm	1530 nm	1550 nm	1570 nm	1630 nm	1650 nm	1670 nm
Spectral Width	$\Delta\lambda$	*1, –3 dB	50 nm	55 nm	—	55 nm	60 nm	—	65 nm	70 nm	—
Spectral Ripple	M	*1, res = 0.1 nm	—	—	0.6 dB	—	—	0.6 dB	—	—	0.8 dB
Monitor Current	I_m	*1, V_{RD} = 5 V	100 μA	—	2000 μA	400 μA	—	2000 μA	100 μA	—	2000 μA
PD Dark Current	I_d	V_{RD} = 5 V	—	—	0.1 μA	—	—	0.1 μA	—	—	0.1 μA
Tracking Error	ΔP_f	I_m = const, T_C = –20° to +70°C	—	—	0.5 dB	—	—	0.5 dB	—	—	0.5 dB
Cooler Voltage	V_c	I_F = I_F (EOL), T_C = 75°C	—	—	3.5 V	—	—	3.5 V	—	—	3.5 V
Cooler Current	I_c	I_F = I_F (EOL), T_C = 75°C	—	—	1.2 A	—	—	1.2 A	—	—	1.2 A
Thermistor Resistance	R_{th}	T_{SLD} = 25°C, B = 3900 ±100K	9.5 kΩ	10 kΩ	10.5 kΩ	9.5 kΩ	10 kΩ	10.5 kΩ	9.5 kΩ	10 kΩ	10.5 kΩ
Optical Isolation	R_o	*2, T_{SLD} = 25°C	—	30 dB	—	—	30 dB	—	—	30 dB	—

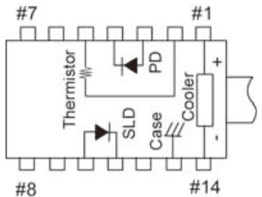
*1: AS3B119GM10M (P_f = 15 mW), AS5B125EM50M (P_f = 25 mW), AS6B118GM50M (P_f = 10 mW)
*2: AS3B119GM10M (λ = 1310nm), AS5B125EM50M (λ = 1550nm), AS6B118GM50M (λ = 1650 nm)

Note: I_F (EOL) = I_F (BOL) × 1.2
Polarization state of SLD is aligned parallel to the slow axis.

Dimensions



(Unit: mm)



Top View

No.	Function	No.	Function
1	Cooler anode	8	NC
2	Thermistor	9	NC
3	PD anode	10	SLD anode
4	PD cathode	11	SLD cathode
5	Thermistor	12	NC
6	NC	13	Case
7	NC	14	Cooler cathode

Pin Configuration

1.3 µm SOA Module

AA3F215CA

RoHS Compliant Part

AA3F215CA is 1.3 µm high gain and low polarization dependent gain SOA (Semiconductor Optical Amplifier) module with optical isolator and thermo-electric cooler (TEC).

Features

- Gain: ≥15 dB
- Polarization Dependent Gain (PDG) : ≤1.5 dB
- Built-in optical isolator (input side)
- Low power consumption : 1.0 W (typ.) (T_C = 75°C)

Applications

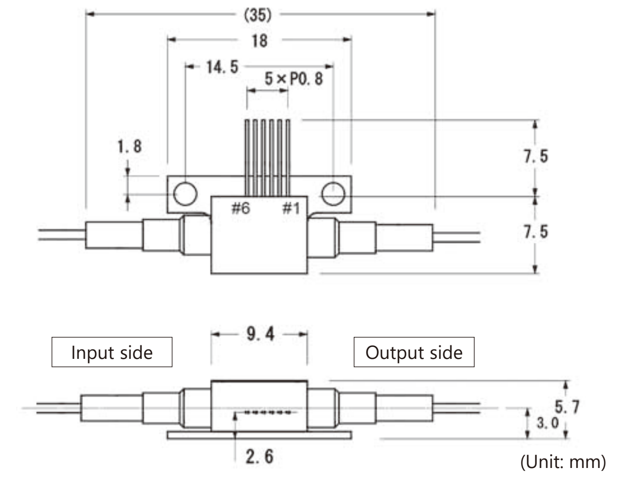
- 100GBASE-ER4 CFP/CFP2 transceiver
- Preamplifier

Absolute Maximum Ratings (T_{SOA} = 25°C)

Item	Symbol	Rating Unit
SOA Forward Current	I_F	150 mA
SOA Reverse Voltage	V_R	2 V
Operating Case Temperature	T_C	–5° to +75°C
Storage Temperature	T_{stg}	–40° to +85°C
Cooler Current	I_C	1.0 A
Cooler Voltage	V_C	2.5 V

*: Excess over the absolute maximum ratings may cause device failure.

Dimensions



(Unit: mm)

Optical And Electrical Characteristics (T_{SOA} = 25°C, T_C = 25°C)

Item	Symbol	Test condition	Min.	Typ.	Max.
Optical Gain	G	I_F = 120 mA*1, *2, *3	15 dB	—	—
Polarization Dependent Gain	PDG	I_F = 120 mA*1, *2, *3	—	—	1.5 dB
Forward Current	I_F	—	100 mA	—	150 mA
Forward Voltage	V_F	I_F = 120 mA	—	—	2.0 V
Wavelength Range	λ	I_F = 120 mA	1294 nm	—	1311 nm
Saturation Power	P_S	I_F = 120 mA*4	—	7 dBm	—
Noise Figure	NF	I_F = 120 mA*1, *2, *3, *5	—	7 dB	—
Cooler Current	I_C	G = (BOL), T_C = 75°C	—	—	0.6 A
Cooler Voltage	V_C	G = (BOL), T_C = 75°C	—	—	2.2 V
Thermistor Resistance	R_{th}	T_{SOA} = 25°C, B = 3435 ±105K	9.5 kΩ	10 kΩ	10.5 kΩ

*1: Optical input signal condition: Continuous Wave (CW)
*2: Optical input signals are 4 ranges of wavelength listed below. Characteristics are measured for each wavelength range.
Wavelength range of optical input signals are as follows:
λ 0: 1294.5 nm to 1296.6 nm, λ 1: 1299.0 nm to 1301.1 nm, λ 2: 1303.5 nm to 1305.7 nm, λ 3: 1308.0 nm to 1310.2 nm
*3: Optical Input signal Power (Pin) = –25 dBm
*4: Saturation power is measured by using single wavelength (λ = 1310 nm).
*5: Without polarization adjustment.

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