Tektronix Innovation Forum

Enabling Innovation in the Digital Age

移动多媒体及工业应用标 准测试解决方案

泰克设计与制造仪器产品部











Agenda

- MIPI[®] Standards Overview
- Tek Strategic Involvement in MIPI
- D-Phy/M-Phy testing
 - Tx, & CSI-DSI Decode
 - Rx
- MHL/HDMI-TX/RX
- MHL/HDMI-Protocol Analyze
- ThunderBolt/SAS/SATA/PCIE/USB3.0





MIPI Standards Overview

Example Mobile Device Block Diagram



Tek Strategic Involvement with MIPI Alliance & UNH-IOL

- Tektronix is a **Contributor Member** of the MIPI Alliance
- Tektronix is actively-participating in several MIPI Working Groups
- Tektronix has a close working relationship with UNH-IOL.
- Combined Tek Press-Release with UNH & MIPI Alliance in Sept-2010:
 - <u>http://www2.tek.com/cmswpt/prdetails.lotr%3Fct%3DPR%26cs%3DNews%2BRel</u>
 <u>ease%26ci%3D17639%26lc%3DEN&urlhash=HZu6</u>
 - "......Tektronix is spurring the adoption of D-PHY and M-PHY specifications. Tektronix is aiding the adoption of the new M-PHY interface by giving designers the testing tools they need to ensure signal integrity and verify performance of increasingly complex designs."
 - Joel Huloux, Chairman of the MIPI Alliance.
- "Tektronix has been supportive of UNH-IOL's collaborative efforts.....,"
 - Andy Baldman, Senior technical staff, R&D, UNH-IOL.



Tek Tools are listed on MIPI Alliance Webpage and CTS





Tek MIPI setup used by UNH-IOL

🕽 InterOperability Laborator... 🛛 🗙 🔪 🕁

🕈 \mid 🔇 www.iol.unh.edu/services/testing/mipi/equipment.php

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Through a collaborative agreement with Tektronix, the UNH-IOL is using the Tektronix DSA72004B Digital Serial Analyzer for MIPI testing. Combined with UNH-IOL's D-PHYGUI softare, this platform provides the ability to capture and analyze D-PHY signalling, in order to perform the UNH-IOL D-PHY Transmitter Physical Layer Conformance Test Suite.

For more information on the Tektronix DSA72004B please visit http://www.tek.com



Waiting for www.iol.unh.edu...

The Moving Pixel Company P331 MIPI D-PHY Probe is used to implement many protocol layer tests for both CSI-2 and DSI for up to 4 lanes.

For more information on the P331 MIPI D-PHY Provbe, visit http://www.movingpixel.com/main.pl?products.html

UNH-IOL (University of New Hampshire) is a 3rd party test house for MIPI testing



What is D-PHY ?

- It's a PHY standard for interfacing Camera (CSI) & Display (DSI)
- Two modes of transmission
 - High Speed (HS) and Low Power (LP)
- Modes are mixed during the operation
 - Transitions from LP to HS and back to LP on the fly
- Maximum Data Rate
 - High Speed mode: 80 Mbps 1.5 Gbps, Typically at ~500 Mbps.
 - Low Power mode: Up to 10 Mbps
- Bus termination
 - 50 ohms in HS
 - Hi-Z in LP





D-PHY Testing Challenges

- Logo testing is not required, but Optional.
 - MIPI is Chip-to-Chip/ Chip-to-Peripheral interface, similar to a DDR bus.
 - Mobile Phones do not need compliance logo, unlike USB/SATA devices
- No two MIPI devices are the same
 - Variable Data Rates
 - Up to 4 lanes of Data traffic,
 - Multiple different data formats
 - Specification enables custom limits.
- Characterization is significantly important
 - Mobile OEMs select the suppliers based on characterization reports.

Test Equipment &Setups need to be Very Flexible



D-PHY Tx : Opt.D-PHYTX Conformance Test Solution

Opt.D-PHYTX : D-PHY Automated Solution

- TekExpress option for Fully-Automated testing
- Provides Conformance and Characterization Testing
- Based on D-PHY Base Spec v1.0 and UNH's Conformance Test Suite v0.98.
- Runs on 7K/C and 70K/B/C scopes
- Opt.TEKEXP is Pre-Requisite
- Differentiation
 - Un-parallel Automation
 - Using Automatic cursor finding of Test Regions
 - <u>100%</u> Widest Test Coverage
 - For Conformance testing to Latest CTS (v0.98)
 - Based on Latest Base spec (v1.0)
 - Fully-Automated <u>Temperature Chamber</u> testing
- Value proposition
 - Custom-limits/ Limits-Editing on the fly
 - Test Reports
 - Pass/Fail Summary with Margin details & Zoom-in waveform captures
 - Tek 3.5GHz scope is the minimal configuration for accurate testing

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D-PHY Tx : Opt.D-PHYTX Conformance Test Solution Features & Benefits

Feature	Benefit
Unparallel- Automated Testing	 Performs <u>Single-button Fully-Automated testing</u> for set of Transmitter measurements Enables designers to test devices faster
Comprehensive Tests coverage	 <u>100% Coverage</u> 49 out of 49 total CTS tests
Fully-Automated Temperature Chamber testing	 Validate All High Speed tests using differential probes, Socket XL cables, High-Temperature Tips and Standard Filter Files.
Clock Continuous mode	Allows selective tests run in Clock Continuous mode
Escape mode	Allows to perform ULPS &Normal Mode tests
Characterization/ Margin Testing	 Allows <u>custom-limits or limits-editing</u> to perform Margin testing. Performs characterization of your design.
Detailed Test-Reports	 Provides Pass/Fail summary table, <u>margin details</u> on each test, and waveform screenshot of the testing region for each test.



D-PHY Tx : Opt.D-PHY Debug and Analysis Solution

- Opt.D-PHY : D-PHY Essentials
 - DPOJET option for Setup Library & MOI
 - Provides Debug Analysis and Characterization Testing
 - Based on D-PHY Base Spec v0.9 and UNH's Conformance Test Suite v0.08.
 - Runs on 7K/C and 70K/B/C scopes
- Opt.DJA is Pre-Requisite
- Differentiation
 - Flexible for Debug Analysis & Characterization
 - Breadth of Tests Coverage
- Value proposition
 - DPOJET Detailed Test Reports
 - DPOJET Scalable for early start on M-PHY (Next Generation Standard)
 - Tek 3.5GHz scope is the minimal configuration for accurate testing

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D-PHY Tx : Recommended Test Setup

www.tek.com/applications/computing/serial/recommended_equipment.html#mipi

Scope

 Recommend: DPO7354/C or DPO/DSA/MSO70404/B/C or higher for risetime accuracies.

Probes

- For 7Ks: 4x TAPxx/ P6245/ P6249, or 3x TDP3500
- For 70Ks: 4x P7240 or 3x P73xx with 020-3035-00 tips/ 3x P75xx.

Scope Software

- Opt.D-PHYTX on TEKEXP For Conformance Test
- Opt.D-PHY on DPOJET for Debug, Analysis & Characterization



DSI/CSI Decode (New)

Probe using Analog, Digital or Mixed Channels





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DSI/ CSI Decode (New) Mix of Analog and Digital Channels

Analog Clock, Digital Data



- Flexible, high performance MSO channels allow simultaneous probing of DSI and CSI buses
- Working on multi-lane solution, MSO70k is the only product on the market that could do this

14 designinsight onsite Oscilloscope Fundamentals - © 2011 Tektronix 3/11

Digital Clock, Analog Data



D-PHY Rx : Test Solution Overview

- 100% Complete solution for D-PHY Compliance testing
 - Meets all the requirements in UNH-IOL document (v0.98)
 - PG3A is only 4 channel solution available
- System set up is quick and easy
 - No complex VXI system, just stand alone instruments, a probe and a coupler
- Cost effective solution
 - Approx 66% lower list price than competition
- No extra equipment required for protocol testing
 - PG3A is only 4 channel solution for complete CSI and DSI protocol testing
- 15 designinsight onsite

- PG3A Pattern Generator provides
 - Controls clock and signaling to establish link with DUT
 - Adjusts voltage levels, packet type, etc to stress test receiver
- AWG7082C Arbitrary Waveform Generator
 - Adds jitter and interference to the D-PHY signals





What is M-PHY ?

- M-PHY is a flexible architecture that allows the implementer to support high data rates at minimal power, cost & I/O redesign, for applications such as High Definition Video
- A Fast, Scalable, Serial Communications Architecture
 - Link Connects M-PHY Transmitter to an M-PHY Receiver
 - Sub-link Manage one or more lanes
 - Lane Operation defined in the protocol (DSI, CSI, UniPro, DigRF)

		D-PHY	M-PHY
Min. # of pins per direction		4	2
Min. # of pins for Min.	_	4	4
configuration		only unidir or half-duplex	dual-simplex
Data rate per lane	HS	>80 Mb/s (Practical limit 1Gb/s)	~ 1½ , 2½ , 5 Gb/s ~ 1½ , 3 , 6 Gb/s
	LS	< 10 Mb/s	10k-600Mb/s
Electrical clanaling	HS	Diff (200mVpk)	Diff (200/120mVpk)
Electrical signaling	LS	LVCMOS1.2V	Diff (400/240mVpk)
HS Clocking method		DDR Source-Sync Clk	Custom Clk
Line coding		None or 8b9b	8b10b
Power - Energy/bit		Low	Lower





M-PHY Testing Challenges

Signaling Mode	Speed	Level (V)	Impedance
MPHY-PWM	576Mbps	500e-3/250e-3	10k/50 ohms
		260e-3/130e-3	
MPHY-SYS	576Mbps	500e-3/250e-3	10k/50 ohms
		260e-3/130e-3	
MPHY-HS	5.83Gbps	250e-3/130e-3	50 ohms

Higher data rate will increase importance of Signal Integrity of links

- Acquisition capability of oscilloscope will need to increase
- More emphasis on timing/jitter and noise (signal integrity)
- Receiver testing will be needed to stress-test resulting BER
- Termination
 - Two types of terminations Restive terminated, and not Terminated.
 - LS mode can operate either terminated or not terminated
 - HS mode it is always terminated, so the swing are halved.



Tektronix M-PHY Testing Solution

- Tektronix is Industry 1st tools for M-PHY measurements & Decode
 - Its announced in September 2010, during MIPI Conference in Athens
- Tek is Only tools available today for M-PHY Measurements & Decode
- <u>PSD</u> (Power Spectral Density) measurements are Uniquely supported

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CANADA EN FRANÇAIS Press Release	Source: Tektronix	FF Times	
Tektronix Introduces Industry's First Test Tools for M	IPI M-PHY	europe	www.electronics-eetimes.com
Monday September 27, 9:00 am ET Support for New High-Speed M-PHY Specification Includes DPOJET	toolset, and M-	New Products Tektronix delivers	for MIPI M-PHY
PHY DIGREVA Decode for Textronix Oscilloscopes			September 30, 2010 Phil Ling 222903926
BEAVERTON, OR(Marketwire - 09/27/10) - Tektronix, Inc., the world's leading manufacturer introduced the industry's first testing tools for the MIPI® Alliance M-PHY standard, allowing cus get started with performance verification and debug for this important new specification using <u>DPO/DSA/MSO70000B</u> Series oscilloscopes.	of <u>oscilioscopes</u> , today stomers to immediately Tektronix	Tektr debug DPOJ	onix has introduced what it claims are the industry's first test tools for MIPI M-PHY g and validation. Support for the new high-speed M-PHY specification includes ET toolset and M-PHY DigRFv4 Decode for its oscilloscopes, allowing customers to diately det started with performance verification and debug. The announcement
The announcement was made in conjunction with the MIPI Alliance All-Members meeting taking Athens, Greece. The M-PHY specification is an essential part of the MIPI Alliance's vision for m Interfaces on mobile devices. Compared to the current D-PHY specification, M-PHY supports f connections while addressing table and nower dissipation concerns. By moving quickly to offer.	g place this week in nore efficient high-speed faster chip-to-chip M-PHY testing tools	was n Greec	nade in conjunction with the recent MIPI Alliance All-Members meeting in Athens, e.
Tektronix is stepping up to help ensure rapid delivery of next-generation mobile devices incorp physical layer.	porating M-PHY at the	The M-PHY specification is an esse mobile devices. Compared to the cu addressing EMI and power dissipat	ntial part of the MIPI Alliance's vision for more efficient high-speed interfaces on urrent D-PHY specification, M-PHY supports faster chip-to-chip connections while tion concerns

"As an active MIPI contributor, Tektronix brings its test and measurement knowledge to the organization, spurring the adoption of D-PHY and M-PHY specifications," said Joel Huloux, chairman of the MIPI Alliance. "Tektronix is aiding the adoption of the new M-PHY interface by giving designers the testing tools they need to ensure signal integrity and verify performance of increasingly complex designs."

Based on the newly ratified MIPI Alliance M-PHY specification, the new Tektronix M-PHY test offering includes a setup library for the popular <u>DPOJET</u> jitter analysis software and methods of implementation (MOI) developed in the close cooperation with <u>UNH-IOL</u>. The solution also includes probing and protocol support from Tektronix partner, <u>The Moving</u> <u>Pixel Company</u>, as well as M-PHY DigRF(SM)v4 decode and verification. By moving quickly to offer M-PHY testing tools, Tektronix is striving to help ensure rapid delivery of next-generation mobile devices incorporating M-PHY at the physical layer.

"As an active MIPI contributor, Tektronix brings its test and measurement knowledge to the organization, spurring the adoption of D-PHY and M-PHY specifications," said Joel Huloux, chairman of the MIPI Alliance. "Tektronix is aiding the adoption of the new M-PHY interface by giving designers the testing tools they need to ensure signal integrity and verify performance of increasingly complex designs."

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Oscilloscope Fundamentals - © 2011 Tektronix 3/11





M-PHY Tx : Opt.M-PHY Testing Solution

- Opt.M-PHY: M-PHY Essentials
 - DPOJET option for Setup Library & MOI
 - Provides <u>Debug Analysis and Characterization</u> Testing
 - Based on M-PHY Base Spec <u>v0.8</u> and Conformance Test Suite <u>v0.1</u>.
 - Runs on 70K/B/C scopes (6 GHz and above)
- Opt.DJA is Pre-Requisite
- Differentiation
 - Industry 1st Testing Tool
 - Flexible for Debug Analysis & Characterization
- Value proposition
 - One powerful tool (DPOJET) for all MIPI Debug &Characterization needs using Opt.M-PHY & Opt.D-PHY
 - Comprehensive DPOJET Reports.





M-PHY Decode: Opt.MPHYVIEW DigRFv4 Decode

- Automated Decoding:
 - Automatically recognizes data speeds, disassembles, and displays the decoded data in different readable-data formats
- 4 Lanes Decoding:
 - Acquires up to 4 lanes of data traffic at a time.
- On-line, Offline and Remote Analysis:
 - Uses TekVisa to connect to a scope.
 - Remote execution through LAN network.
- Filter Tab:
 - Fillter the records in the listing based on user criteria.
- Search Tab:
 - Searching & highlight records that satisfy given criteria
- Options Tab:
 - Set display, disassembly, and configuration options.



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Summary - Tektronix MIPI Solutions



- Tektronix is 1st to Market for M-PHY testing, announced in Sept, 2010
- Tektronix is a Contributor Member of the MIPI Alliance
- Tektronix is actively-participating in MIPI PHY &other Working Groups
- Tektronix has a close working relationship with UNH-IOL

v	<u>Tekt</u> www.Tektronix.com/application	ronix MIPI Solutions s/computing/serial/re	<u>Portfolio</u> ecommended_equipme	ent.html#mipi
Standard	Physical Layer Trasmitter	Physical Layer Receiver	Protocol Analysis & Decode	Stimulus
	1x DP07354 or DP070404B Oscilloscope	1x PG3ACAB PatternGenerator	1x TLA7012 or TLA7016 TLA	1x PG3ACAB or PG3AMOD
	4x P7240, TAPxx, P6245 or P6249 probes, OR	1x P331 D-PH Y Probe for PG	1x LA ModuleTLA7BBx	1x P331 D-PH Y Probe for PG
י <u>א</u> [¥]	3x P73xx with 020-3035-00 or TDP3500	1x PGR emote SW	1x P6980 LA Probe	1x PGRemote SW
Id SI SI	1x TEKEXP Opt.D-PHYTX, or DPOJET Opt.D-PHY	1x AWG7082C or above	1x D-PHY to P6980 Adapter	
-	No Fixtures required for Live-Setups	1x D-PHY Coupler	1x CSI or DSI SW for TLA (Free)	
	UNH Fixtures for Non-Live setups			12
. 9	1xDPO70604 for GEAR1. 1x DPO70804 for others	1x AWG7122C with option#6		-25
CSI ₹ ₹	2x P73xx, P73xxSMA, or P75xx Probes per Lane	1x SerialXpress SW		
gRI	1x Opt.M-PHY for Tx Debug, Analysis &Validation	1x **Early-Market AWG files Kit		
DSI	1x Opt. MPHYVIEW DigRFv4 Decode SW	for PRBS, PWM &other patterns		

Notes:

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Opt.D-PHYTX: Fully-Automated Single-button Solution for D-PHY Conformance & Characaterization

Opt.D-PHY: D-PHY Debug Analysis and Characterization

Opt.M-PHY: M-PHY Debug Analysis and Characterization

Opt.MPHYVIEW: M-PHY DigRFv4 Decode Solution



Physical Layer Analysis



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Protocol & Digital Analysis CSI, DSI, DigRF, UniPro, SLIMbus Signal Generation D-PHY/ M-PHY

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Tektronix MHL Solution



Mobile High-Definition Link





Tektronix is a **contributor** adopter for MHL CTS

Welcome MHL Adopters

BizLink Technologies, Inc.

www.bizlinktech.com

Cable Assemblies and Wiring Harnesses

Compal Electronics Inc.

www.compal.com

Electronics manufacturer of notebook computers and monitors

Explore Microelectronics, Inc.

http://www.epmi.com.tw

Fabless company developing high-speed interface ICs

Fairchild Semiconductor

www.fairchildsemi.com

Delivers semiconductor solutions for power and mobile designs

Hosiden Corporation

www.hosiden.com

Manufactures and sells electronic components, electromechanical parts and LCD

elements

Johnson Component and Equipment Co., Ltd.

www.jcecable.com

Cable Manufacturer

Niketech Electronic Corporation

www.niketech.com.tw

Provider of connectors for the electronics industry

Parade Technologies, Inc.

www.paradetech.com

Develops and supplies advanced and cost-effective high-speed display interface solutions

Sumitomo Electric Industries, Ltd.

global-sei.com

Designs, manufactures and sells cable and components and advanced electronic

devices

Sunplus Technology Co., Ltd.

www.sunplus.com

Provider of multimedia IC solutions Sure-Fire Electrical Corporation

www.sure-fire.com.tw

Global OEM/ODM supplier of cables, connectors and devices

Synopsys

www.synopsys.com

Provider of electronic design automation (EDA) software, IP and services

Tektronix

www.tek.com

Test, measurement and monitoring solutions

YFC-BonEagle Electric Co., Ltd

www.cables.com.tw

Manufactures power cord sets, LAN cable, patch cords and networking accessories

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Official : <u>http://www.mhlconsortium.org/adopter.aspx</u>



• 移动设备品牌厂商

*Nokia, Samsung, Sony Ericsson, HTC, Acer, LG, Lenovo, Meizu, OPPO

• 显示设备品牌厂商

*Samsung, Sony, Toshiba, LG, Funai

• OEM制造或服务提供厂商

*Compal, Foxconn, Ever Win

• 芯片或IP授权方案厂商

*Silicon Image, Explore, Fairchild, Mstar, Novatek, Parade, SMSC, Sunplus, Synopsys

• MHL到HDMI转换器制造厂商

*Adaptertek, Amphenol, Bizlink, Chiang-Yu, Primax, Freeport, Hosiden, JCE, Master Hill, Niketech, Space Shuttle, Sumitomo, Sure-Fire, Yeonhab, YFC-BonEagle

• 测试设备提供厂商



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What is Compliance Test?

MHL Authorized Test Centers (ATC)

Samsung www.samsungmhl.com

Simplay Labs, LLC www.simplaylabs.com

Sony www.sony.net/Products/ATC/MHL/



HDMI briefing



Clock

- 1 lane differential clock
- $T_{clcck} = 10 * T_{BIT}$

Data

- 3 lanes TMDS differential data
- DDC / EDID
 - DDC (Display Data Channel) is used by the Source to read the Sink's E-EDID (Extended Display Identification Data) in order to discover the Sink's configuration and/or capabilities.



HDMI Source Testing





Typical Source Test Configuration Differential Measurement





AWG7000B with Direct Synthesis Significantly Reduces Test Time HDMI Jitter Tolerance Test with Direct Synthesis

27 MHz to 340 MHz



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MHL Introduction

Mobile HD Link (MHL) technology is a low pin count HD audio and video interface that connects portable electronics devices such as mobile phones, digital cameras, camcorders and portable media players, to HDTVs.

The technology allows mobile devices to output digital 1080 Full HD resolution via the existing mobile connector without the real estate and cost of another dedicated video connector.

Together with an MHL-to-HDMI bridge, the MHL-enabled mobile device becomes a fully compliant HDMI source and can connect to the television's standard HDMI input port.



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Difference between HDMI and MHL

HDMI

- Four lanes
 - One differential clock lane
 - Three differential TMDS data lanes
- DDC
- Max. 3.4GHz data rate/per lane
 @ 340MHz clock
- HDMI connector
- Max. resolution 4096 x 2160p24
- Not support PackedPixel mode
- For home multimedia
- CTS 1.4

MHL

- Only one lane
 - One differential TMDS data lane
 - Clock is embedded
- C-Bus
- Max. 2.225GHz data rate @ 74.25MHz clock
- Compatible with uUSB
- Max. resolution 1920 x 1080i60Hz
- Support PackedPixel mode

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- For mobile device
- CTS 1.1 (June 2011)
- CTS 1.2 (Mar 2012)

MHL Transmitter and Receiver block diagram



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MHL Signal Complexity

- Clock rate / Date rate
 - Max. 75MHz MHL clock rate and 2.25GHz date rate (1080i/60Hz)
 - TMDS (Transition Minimized Differential Signaling) encoding in the Source converts the 8 bits of data into a 10 bit
 - Pack 3 data lanes and 1 clock lane into one lane
- Video mode minimum support requirement
 - 720x480p / 60Hz or 720x576p / 50Hz



MHL Signal (D+ and D-)



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TMDS Test Equipment

Digital Oscilloscope

- TMDS measurements require a High-bandwidth Digital Oscilloscope.
- -3dB Bandwidth : DC to 8GHz or greater
- Sampling rate > 25G sample/sec, when 4 channels are simultaneously sampling.
- Sample memory : more than 20M samples per channel.

Differential Probe

- -3dB Bandwidth : DC to 8GHz or greater
- Termination: 3.3V

MHL Pattern Generator (For Sink Test)

- Generate MHL clock and data for all MHL defined format
- Maximum output data bit rate > 3Gbps
- Internal clock and data jitter generation (optional)
 - Two independent jitters
 - Jitter tolerance : 100KHz to 20MHz
 - Jitter amplitude : maximum 1 UI for 750Mbps ~ 3Gbps with 0.05 UI granulites

MHL Cable Emulator

The MHL Cable Emulator shell represent the differential and common-mode insertion losses

Transition Time Converter (TTC)

– 120ps TTC is required

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Tektronix MHL test Setup

- •DPO/DSA/MSO 70804C Real Time oscilloscope with BW >/= 8GHz
- •MHL Compliance software –Option MHD
- •Probes : Qty.2 P7313SMA and Qty.1 P7240
- •MHL Protocol Analyzer Software **TEK-PGY-MHL-PA-SW**
- •MHL Test fixture- Available from Wilder Technologies our fixture partner

•AWG7122C with Opt 01, 02 or 06, 08 for innovative direct synthesis based MHL Rx/Dongle testing performed manually using AWG MHL patterns and MOI

•C-Bus Sink and Source board is needed and is available from Simplaylabs

•DSA8300 or Equivalent with 80E03/80E04 and I-Connect software for MHL cable testing (performed manually using MOIs)



Tektronix MHL Tx measurement



MHL Compliance Software for Tx test - Option MHD



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Tektronix MHL Tx Setup



Also same setup is used for MHL Protocol Testing

C-Bus Sink and Source Board is needed for hand shaking and is available from Simplaylabs.

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Tektronix MHL Rx measurement



Tektronix MHL solution setup for Sink and Dongle Testing- MOI based

- MHL Sink and Dongle Test setup based on Direct Synthesis capability of AWG7122C series shown below
 - Simple setup
 - Easy to use



AWG Pattern Verification setup





Common Test setup for all Dongle Tests



Common Test setup for all Sink Tests

Tektronix MHL solution setup for Sink and Dongle Testing- MOI based



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Innovative MHL Protocol Analyser Solution

- Introducing Tektronix' MHL Protocol solution





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Tektronix MHL/HDMI Protocol Analysis Solution

- MHL Protocol Analysis software running on the Tektronix REAL TIME Oscilloscope.
 - Unique value proposition as the same real time scope is used for both Physical layer testing and Protocol testing.
 - Gives the seamless transition from Phy layer to Protocol.
 - Cost effective solution.
- Features
 - Multi View support
 - Bus Analysis
 - Image Viewer
 - Event Viewer
 - Protocol Viewer
 - Linked to the analog waveform
- Tektronix Nomenclature TEK-PGY-MHL-PA-SW
- Tektronix Nomenclature TEK-PGY-HDMI-PA-SW



Tek MHL Protocol Analyser

🐼 TEK-PGY MHL Pr	otocol Analysis solutior	n - Beta		About	2 🔿 🛞
	Mode	<u>Displays</u>	List Of Tests		Run
Select Configure View Capture	MHL	 Image Viewer Protocol Viewer Bus Viewer Event Viewer Data Packet Viewer Clear All 	 Source Protocol Tests Legal Codes Basic Protocol Packet Types Source video Video Formats Test Video Quantization Ranges AVI InfoFrame Source audio Audio Test Audio Clock Generation Audio InfoFrame 		Single Repetitive No Acq Analyze Export Report
Version :0.8.0					

🚳 ТЕК-РБҮ МН	L Protocol Analysis solution - Beta				About	
	Signal Source	Video Format			22 Mb W	Run
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Tek MHL Protocol Analyzer - Unique Multi View analysis

Frame	2 b				
Frame :1	Bus Viewer		हत्व 	Event Viewer	
Frame :1				Test Name	Result
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	Data Island Data Gu	Control Period Data	Unknown	Regar Codes lest	Pass V
	Active Video Video C	Control Period Video		Pixel Event Descrip	tion
	H Store			O FAIL: IEC 609	58 / IEC 61937 - No Audio
	- H Sync			O FAIL: ACR - N	o ACR Packet found.
	V Sync			38749 FAIL: Video Q	uantization Error - Date
	Data 0 011/C2B:h3	ь1011001100/GB	6101	38749 FAIL: Video Q	uantization Error - Date
				38749 FAIL: Video Q	uantization Error - Date
	Data 1 011 / C2B :h1	60100110011/GB	6010	38750 FAIL: Video Q	uantization Error - Data
					<u>></u>
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				HB : 82 02 0D	
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	-0.61			Display values in: Hex	
				Type D0 Data	DI Data D2 Data
	94514 94514 94515 94515	94515 94515 94515 94515 94516	94516 94516	Control h2AB	hAB h354
				Video Gu h2CC	h133 h2CC
				Video Gu h2CC	h133 h2CC
				Active V h1F0	h1F0 h1F0
				Active V h10F	h10F h10F
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MHL Compliance test analysis

All the tests's pass/ fail depends on <u>one frame data</u> or <u>maximum of two</u> <u>continuous frame data at a time</u>. So with multiple acquisition the protocol analyzer can produce the same result as 2 sec data as per CTS requirement.

- Source Protocol Tests
 - Legal codes
 - Basic Protocol
 - Packet Types
- Source Video Test
 - Required Video formats
 - Optional Video formats
 - Required Pixel Encoding
 - Optional Pixel Encoding
 - Video Quantization ranges
 - AVI Infoframe
- Source Audio
 - IEC 60958/IEC 61937
 - Audio Clock Regeneration
 - Audio InfoFrame



Conclusion

- Tektronix MHL Physical Layer Tx test setups are easy to use and automated.
 - Simple test setups common for most tests.
 - Vterm provided by scope itself.
 - MHL fixtures are available from our fixture partner Wilder Technologies.
- Tektronix MHL Physical Layer Rx test setups are easy to use (MOI based).
 - TRUE MHL SIGNAL Generation as there is no need for external combiners/Filters
 - No need for external ISI boards as we leverage our AWG direct Synthesis Capability with common setups for Sink and Dongle testing
- Tektronix introduces an innovative combined solution for Physical Layer Testing and **Protocol Testing:**
 - 1. Providing seamless link between PHY and Link layer testing.
 - 2. An economical MHL test solution.
 - ONE BOX solution for PHY and Protocol testing.
 - 3. Easy access to legacy P/A/V data format.
- Tektronix also offers complete MHL solution with •
 - DSA8200 or Equivalent Sampling scope with 80E03/04 and I-connector S/W for MHL • Cable testing (performed manually using MOIs)
 - Low Bandwidth Oscilloscopes,
 - Keithley Source Meter (Now part of Tektronix)
 - Programmable Power Supply
 - Digital Multi-meters



其他相关主流工业标准 Thundbolt/SAS/SATA/PCIE/USB3



Thunderbolt概述

- PC使用的高速总线
 - 英特尔/苹果于2011年推向市场
 - 能够与DisplayPort互操作
- Thunderbolt信令是双NRZ (64/66b编码)
 - 10.3125 Gb/s数据速率
 - 它采用SFP+技术,有两对不同的Tx和Rx



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Thunderbolt电接口验证



自动Thunderbolt Tx测试

Oscilloscope



推荐设备

- DPO/DSA/MSO71604 (≥ 16 GHz带宽)
- BSA125C (串扰源)
- 选项DJA (DPOJET)
- 选项TBT-TX (TekExpress)
- TF-TB-TPA-P (插头夹具)和 TBT-TPA-UH (端口微控制器)





Storage Timelines and Solutions Development



12G+ Design Problem: 1000mV, FFE, Crosstalk, DFE, 50mV

- Crosstalk and signal loss problems are the largest design challenge today.
- Significant advances in high tap count Decision Feedback Equalization are key to operating at 12G+.

SAS-3 PHY Transmitter Solution – Option SAS3

Test0	Parameter	Conformance Min/Max
5.1.1	Maximum Noise During OOB IDLE	< 120 mV
5.1.2	OOB Burst Amplitude	> 240 mV
5.1.3	OOB Offset Delta	+/- 25 mV
5.1.4	OOB Common Mode Delta	+/- 50 mV
5.2.1	SSC Modulation Type	Center-, No- and Down-spreading
5.2.2	SSC Modulation Frequency	30 kHz < SSC _{freq} < 33 kHz
5.2.3	SSC Modulation Deviation	+/- 1000 ppm (center), 0 ppm (no spread) or
		+0/-1000 ppm (down)
5.2.4	SSC DFDT	850 ppm/μs
5.3.1	Physical Link Rate Long Term Stability	+/- 100 ppm
5.3.2	Common Mode RMS Voltage	< 30 mV
5.3.3	Common Mode Spectrum Mask Hits	Below Spectrum Limit Lines (0.1 to 6 GHz)
5.3.4	Peak to Peak Voltage	850 mV < Vpk-pk < 1200 mV
5.3.5	VMA	> 80 mV
5.3.6	Rise Time	> 20.8 ps
5.3.7	Fall Time	> 20.8 ps
5.3.8	Random Jitter	0.15 UI (12.5 ps)
5.3.9	Total Jitter	0.25 UI (20.8 ps)
5.3.10	SAS3_EYEOPENING	> 55 %
5.3.11	Pre Cursor Equalization	1 V/V < R _{pre} < 1.67 V/V
5.3.12	Post Cursor Equalization	1 V/V < R _{post} < 3.33 V/V

SAS3 12 Gb/s Tx Test Software

Common Mode Spectrum Measurement

PCIe 3.0 Transmitter Compliance Testing

- Compliance testing is based on the CEM Specification, which is under development
- New compliance 128b/130b data pattern
- Two Tests
 - Electrical: Eye Height and Width must pass one pre-set value
 - Preset Test: all Pre-sets are tested to be within their limits
- Measurements are taken after the Compliance channel and RX Equalization using the Compliance Base or Load Board

Add-In Card Compliance Signal Acquisition and Processing

Signal Acquired from Compliance Board ▲

Embed the Add-In Card Compliance Channel Closed Eye due to the Channel Apply the Base Specification CTLE + Dfe for Long Channel

Open Eye for Measurements

System Board Eye Limits ¹

Parameter	Min	Мах	Units
V _{TXS} V _{TXS_d}	34 34	1200 1200	mV mV
T _{TXS}	41.25		ps

Add-In Card Eye Limits $^{\rm 1}$

Parameter	Min	Мах	Units	
V _{TXA} V _{TXA_d}	34 34	1200 1200	mV mV	
T _{TXA}		41.25	ps	

1 Measurement Limits Under CEM Review

Serial Data Link Analysis

- De-embed the effects of a fixture
- Embed the effects of the channel
- Equalize the waveform using CTLE, FFE, and/or Dfe

🛃 🛛 Tektronix Serial	Data Link Analysis		
Signal Path Setup			🔿 View 💿 GPIB
Oscilloscope Source Math 1 v Bit Rate (Gb/s) 8 Average	Tx Rx Tx Fixture TpA M2 TpA M2 Fixture Emphasis TpB M3 Channel TpC M4	Save Recall Standards	Apply > Plot Analyze
25 SR: 50GS/s	O% Clk R3 100% Press Apply to update filter	Help	About

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Stressed Jitter Pattern Generation

Similar requirements as the Stressed Voltage Eye

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55W-26933-0

USB 3.0 Key Considerations

- Receiver testing now required
 - Jitter tolerance
 - SSC, Asynchronous Ref Clocks can lead to interoperability issues
- Channel considerations
 - Need to consider transmission line effects
 - Software channel emulation for early designs
- New Challenges
 - 12" Long Host Channels
 - Closed Eye at Rx
 - Equalization
 - De-emphasis at Tx
 - Continuous Time Linear Equalizer (CTLE) at Rx

Source: USB 3.0 Rev 1.0 Specification

USB 3.0 Transmitter Measurement Overview

- Voltage and Timing
 - Eye Height
 - Pk to Pk Differential Voltage
 - RJ
 - DJ
 - TJ
 - Slew Rate
- Low Frequency Periodic Signaling (LFPS)
 - Pk to Pk Differential Voltage
 - Rise / Fall Time
 - AC Common Mode
 - tBurst
 - tRepeat
 - tPeriod
- SSC
 - Modulation Rate
 - Deviation

Generic USB 3.0 RX Test Configuration

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BERTScope USB 3.0 RX Test Configuration

THANK YOU

