N6831A VLF-HF Wideband Receiver

Digital Wideband Acquisition System

Background

Keysight has a significant history in the development of HF receivers, delivering the industry's first-ever revolutionary digital wideband HF acquisition system in the late 1990s. The HP (and following Agilent) E3238S system came to market at that time with a proprietary 23-bit analog-to-digital converter (ADC) coupled with a unique software solution providing users with a comprehensive signals development capability that required no coding. These systems saw use globally in many settings and applications and were used extensively to fill gaps in the capabilities of existing systems operating in various regions of the world.

Keysight's new HF receiver provides benefits in size, weight, and power, and includes the features of the original N6830A VXI receiver module, along with some key enhancements. Further, E3238S users made significant investments in the software (in terms of funding), and in the development of signal detectors (in terms of time and effort). This new receiver provides a path forward for those users, offering software and hardware updates that make the most of what has already been invested.

HF search, monitor, and signals development

Modernize the Agilent E3238S systems in your inventory with this new HF workhorse receiver from Keysight. Stay ahead of the rapidly developing HF environment and evolving standards being developed, deployed, and modified for special purposes.

KEYSIGHT

General Description

The N6831A receiver will communicate with the N6820ES Surveyor 4D software on a VITA-49 streaming interface, also making it compatible with other software packages capable of processing that form of data. It will need to be paired with an appropriate server to support the applications. The built-in GPS receiver (L1) provides frequency and time references for accurate time stamping to support precision time-dependent applications.

This receiver is designed to process the full VLF-HF band (9 kHz to 32 MHz) with 16-bit resolution making use of a 1-million-point FFT for remarkable speed and resolution. Several thoughtfully placed pre-selection filters optimize the sensitivity and integrity of the spectral content. The user manually controls these filters. Additionally, 128 DDC channels provide a robust narrowband signal processing capability to classify signal candidates, make recordings, tip, and source data to other systems.

An important design goal was to match the sampling rates of the N6830A VXI receiver to make previously created USD (Universal Signal Detector) wideband detectors work properly with the new N6831A hardware. This detail may save significant effort in updating existing E3238S systems. Another important design goal was to satisfy the frequency ranges called out in Recommendation ITU-R SM.377 and 378 for frequency and bandwidth measurement in the VLF through HF spectrums.

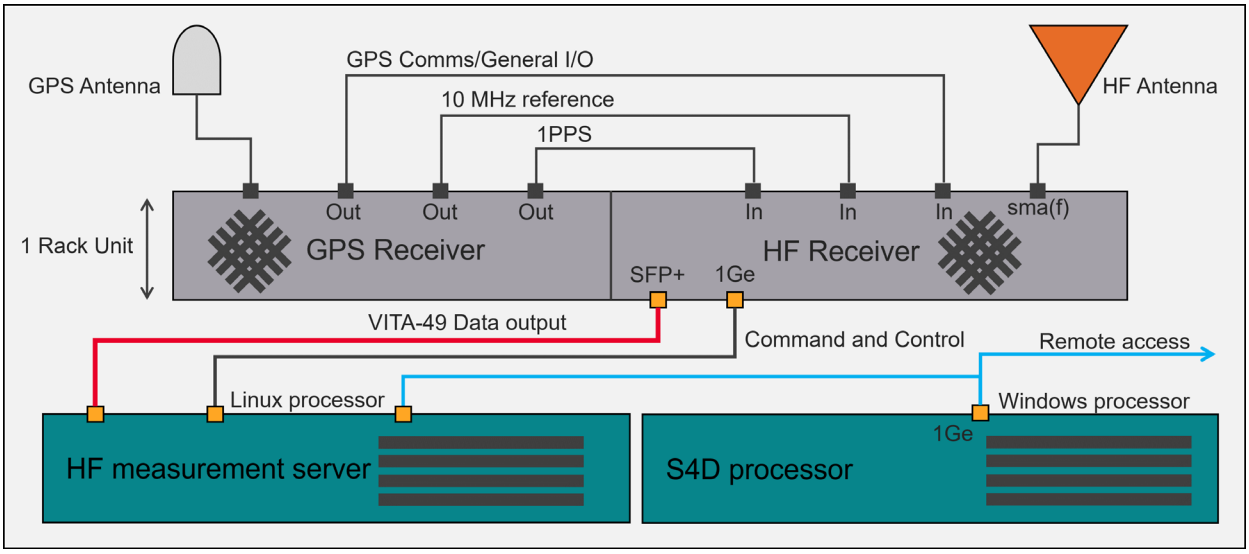


Figure 1. Connection diagram of the N6831A. Source: Keysight.com

As shown in Figure 1, the system has two basic inputs – the HF antenna, and the GPS antenna. The 10 MHz and 1PPS references on the HF receiver can come from either the embedded GPS receiver or from external references. There are two network connections between the HF receiver and the measurement server – the Gigabit Ethernet carries command and control, and the high-speed SFP+ connection carries the data output, including FFT spectral, and DDC narrowband streaming data. The interfaces are compliant with VITA 49.2.

Specifications

This section lists the specifications and supplemental information that applies to the N6831A HF receiver. The measurement hardware consists of a 1U standard rack-mounted unit. The specifications are based on 10 separate tests on 10 different units at room temperature.

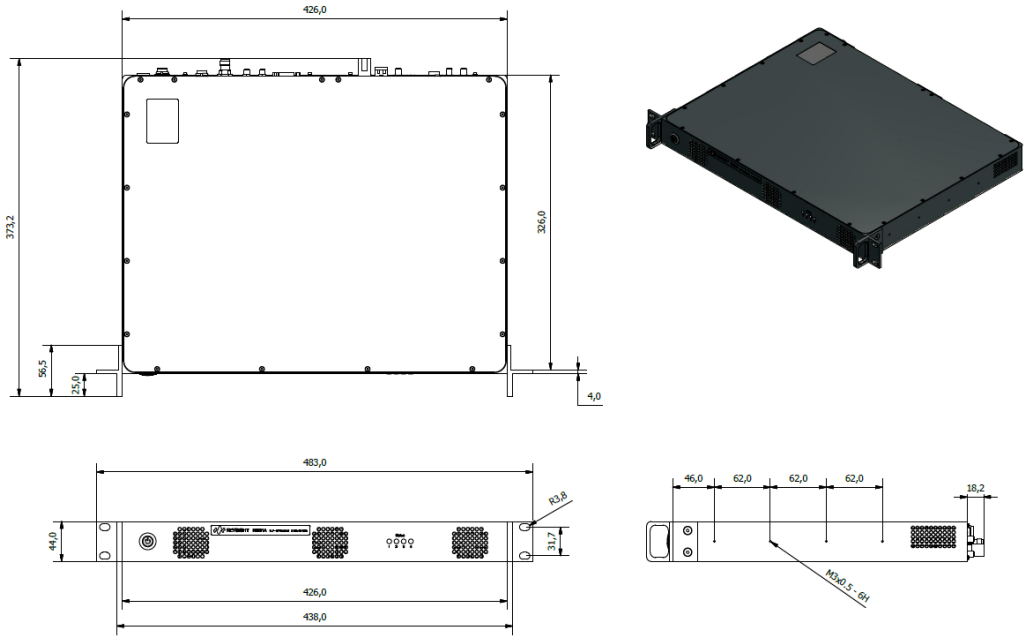
Frequency tuning range	9 kHz to 32 MHz
Usable IF bandwidth	Up to 32 MHz (full band)
DDC tuning resolution	1 Hz steps
Frequency Specifications	
Frequency reference	N6831A can use the internal GPS disciplined oscillator or external 10 MHz and 1PPS references.
Frequency reference accuracy	+/- 20 ppb (typical, with internal GPS reference)
Frequency span	Up to 32 MHz
DDC bandwidths	400 Hz to 800 kHz (on up to 128 narrowband channels)
Snapshot bandwidth	400 Hz to 4.096 MHz (wideband acquisition)
Snapshot memory	64 MB 3.27 seconds at 4 MHz bandwidth 9.3 hours at 400 Hz bandwidth
RBW (Resolution bandwidths)	Filters and shape factors • Hanning window – 9.0:1 (best selectivity) • Gausstop window – 4.0:1 • Flattop window – 2.6:1 (best amplitude accuracy)
RBW range (for 9.0:1 shape factor)	60 Hz to 40 kHz in 2x steps
Number of frequency points in spectrum display (at minimum RBW)	1,048,576
Phase Noise	100 Hz offset: < -92 dBc/Hz 1 kHz offset: < -118 dBc/Hz 10 kHz offset: < -146 dBc/Hz 100 kHz offset: < -157 dBc/Hz 1 MHz offset: < -160 dBc/Hz
Amplitude Specifications (all at maximum gain, minimum attenuation without pre-selection unless otherwise noted)	
Analog-to-Digital-Converter	16-bit at 40.96 MSa/second (complex)
Full-scale level (ADC overload level) at RF input	+19.5 dBm (max attenuation, min gain)
Gain control range	47 dB (gain 33 dB, attenuation 14 dB)
Amplitude accuracy	+/- 2.3 dB (15 kHz to 32 MHz)
Noise figure (at maximum gain, minimum attenuation)	8 dB (5 MHz to 32 MHz) 10 dB (50 kHz to 4.9 MHz) 24 dB (9 to 49kHz)
Third-order intercept (TOI)	+3 dBm (0.5 MHz to 32 MHz)
Second-order intercept (SOI)	+40 dBm (0.5 MHz to 32 MHz)
Image rejection	110 dBc (9kHz to 32 MHz)
Single tone SFDR @ >2 MHz	>100 dBc, center frequency > 2 MHz, ignoring harmonics
Residual spurs	-110 dBm
Antenna radiation	-108 dBm
Inputs and outputs	
RF input connector	SMA (female) 50 ohm
VSWR	< 1.3:1 (without pre-selection)
Pre-selection filtering (Chosen manually & saved with the N6820ES state file)	High Pass Filter 9 kHz, 1.5 MHz, 3 MHz, 5 MHz, 9 MHz, and 15 MHz Low Pass Filter 5 MHz, 15 MHz, and 32 MHz
Absolute Maximum Input Power	+27 dBm at minimum gain, maximum attenuation
Data interface (FFT, IQ time series)	VITA-49.2

General	
Size	426 mm wide x 373 mm deep x 31.7 mm high
Weight	4.6 kg (10.1 lbs.)
Power	< 65 Watts typical
Operating altitude	10,000 ft (3 km)
Operating temperature	0 to 55 degrees C [Class GP ETM 757]
Storage temperature	-40 to 70 degrees C [Class GP ETM 757]
Humidity	Maximum Relative Humidity (non-condensing): 95%RH up to 40°C, decreases linearly to 45%RH at 55°C *
Altitude	3000 m

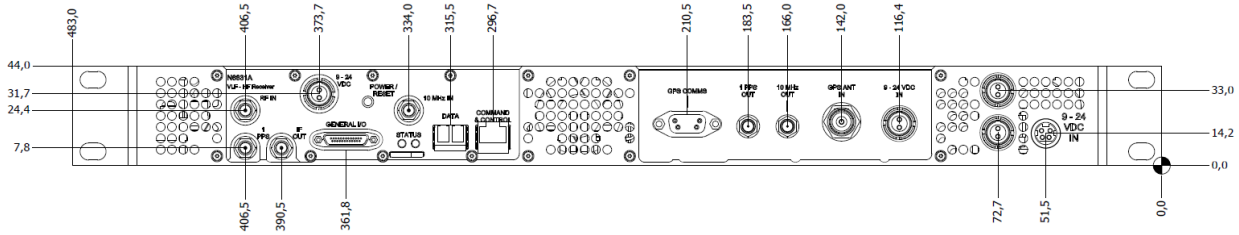
*From 40°C to 55°C, the maximum % Relative Humidity follows the line of constant dew point

Dimensional drawings

The Keysight N6831A is a reasonable size, weight, and power for use in fixed or mobile applications requiring efficient use of rack space.



The front of the N6841A has only a power switch and status lights. The rear panel has all connections as shown below including those related to RF input, GPS input, power, time, and frequency references.



VITA-49 Radio Access (VRA)

The N6831A is controlled through a comprehensive API referred to as the VITA Radio Access (VRA). The purchase of the receiver includes the VRA.

Updating the HP/Agilent 35688E or N6820E software

The N6820ES Surveyor 4D software is a commercially available version of the 35688E software that works with an assortment of different hardware platforms. The N6820HFPE feature provides the needed drivers and measurement server application to make the N6831A work with the Surveyor 4D (version E.4.5 or later) software and comes in two parts. One driver is available on a server with LINUX OS (Centos 7) to communicate with the N6831A. The other driver is available on a Windows OS PC to run the Surveyor 4D software. The N6820HFPE includes some preconfigured applications designed to run in the HF band.

Additionally, the N6820ES subscription service provides a “snap-to” service for customers that have earlier versions of the HP or Agilent 35688E or N6820E software licenses (i.e., E3.4 or previous). This service will update the license file, and software to the latest release, including supported options that were part of the original license (if available). The existing license file (to be replaced) must be copied and sent to Keysight for conversion to the new software. If the license is on a FLEX ID=9 USB key, that key must be exchanged for a new FLEX ID=10 USB key compatible with the current license system.