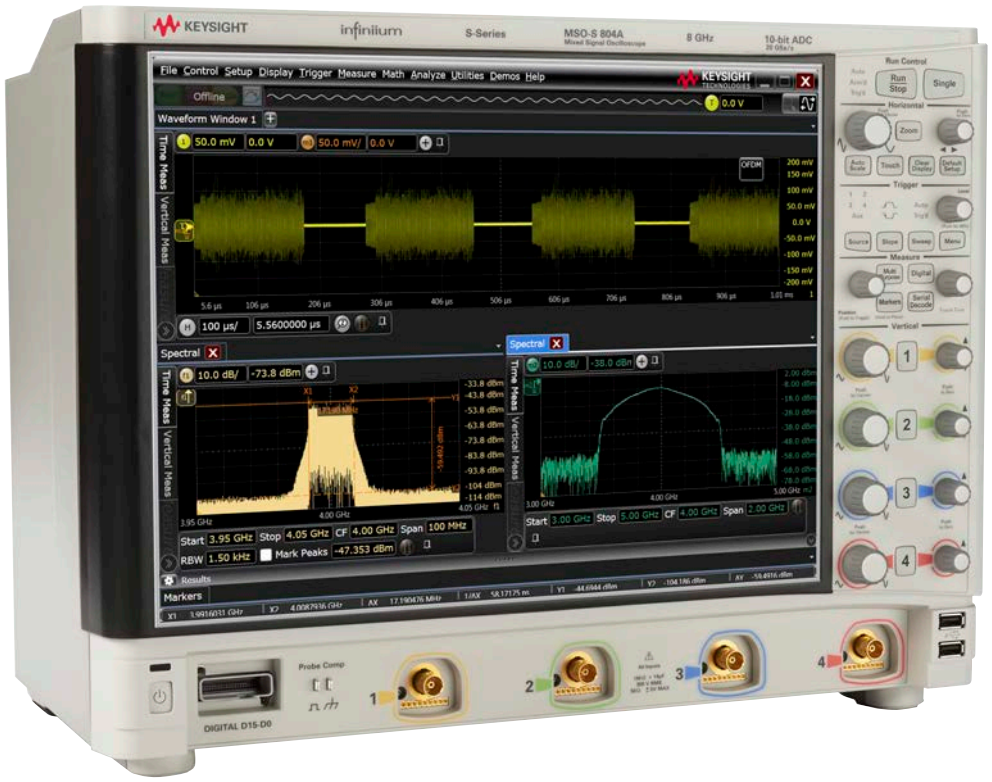
Keysight Technologies
Infiniium S-Series High-Definition Oscilloscopes

Data Sheet



The New Standard for Superior Measurements

KEYSIGHT TECHNOLOGIES

Unlocking Measurement Insights

Welcome to the Next Generation of Oscilloscope Technology

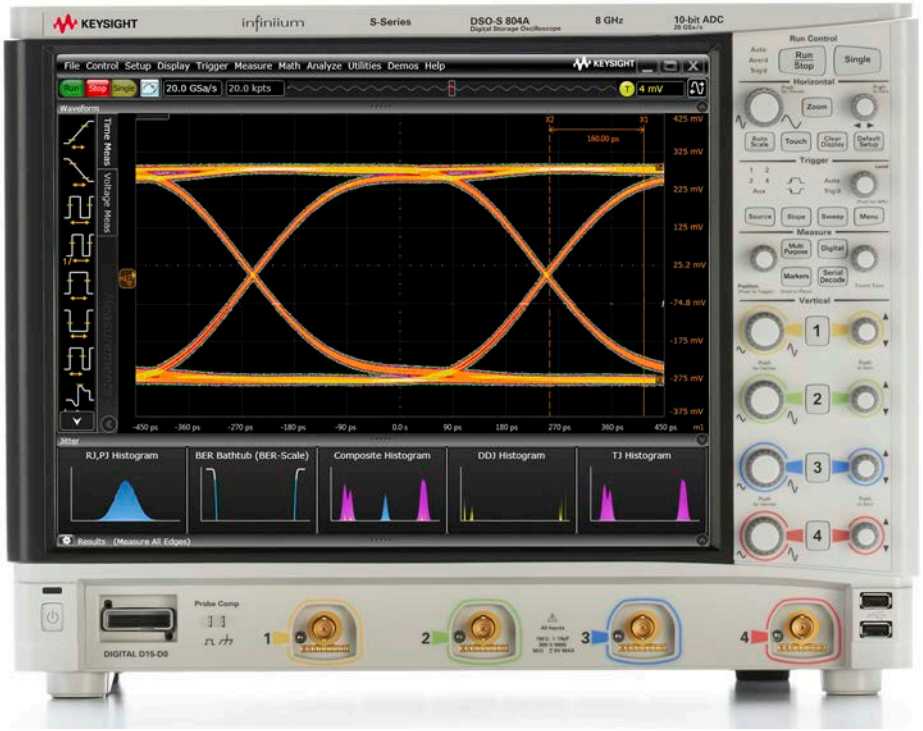
Infiniium S-Series oscilloscopes incorporate innovative technology designed to deliver superior measurements.

Our new 10-bit ADC and low-noise front-end technology work together to provide up to 8 GHz performance with the industry's best signal integrity. We put these in an advanced frame with a solid state drive for fast boot-up, capacitive 15" display for easy touch capability, and a high-powered motherboard for fast processing. It's all compatible with a myriad of Keysight Technologies, Inc. probes and Infiniium applications.

There is no better way to experience that superiority of the Infiniium S-Series oscilloscopes than to use one.

Contact Keysight today to request a demo.

Or visit,
www.keysight.com/find/S-Series





The Infiniium S-Series offers bandwidths from 500 MHz up to 8 GHz. Each model, equipped with a large 15" XGA capacitive touch screen, comes in a quiet package that is just 9" (23 cm) deep.

		Scope channels				
DSO models 4 scope channels	**MSO models 4 scope channels + 16 digital channels**	**Analog bandwidth**	**Max sample rate**	**ADC bits**	**Standard memory depth**	**User-installed bandwidth upgrades**
DSOS054A	MSOS054A	500 MHz	20 GSa/s (2 channels) 10 GSa/s (4 channels)	10	100 Mpts (2 channels) 50 Mpts (4 channels)	Yes
DSOS104A	MSOS104A	1 GHz				
DSOS204A	MSOS204A	2 GHz				
DSOS254A	MSOS254A	2.5 GHz				
DSOS404A	MSOS404A	4 GHz				
DSOS604A	MSOS604A	6 GHz [1]				
DSOS804A	MSOS804A	8 GHz [1]				

1. 6 GHz and 8 GHz bandwidth supported in 2-channel mode. If all four channels are on, a maximum bandwidth of 4 GHz is supported.

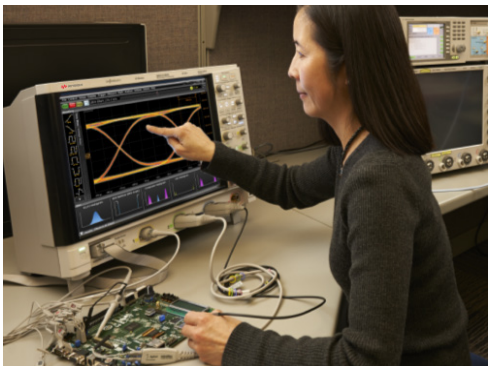
The New Standard for Superior Measurements

Industry's best signal integrity



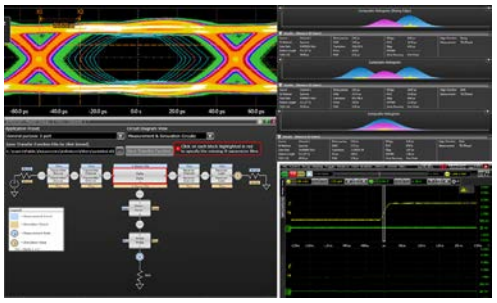
- 10-bit ADC up to 8 GHz for additional vertical resolution
- Low-noise front end for precision signal viewing
  - Only 90 uV noise at 1 mV/div and 1 GHz bandwidth
  - System ENOB values in excess of 8
  - SFDR values down to –73 dBC
  - 2 mV/div vertical scaling supported in hardware
  - HW bandwidth limit filters on both 50 Ω and 1 MΩ paths
- Correction filters ensure flat frequency magnitude and phase response
- Low intrinsic jitter (100 fs (typical) for excellent jitter characterization)
- Precision BNCs with > 8 GHz bandwidth

Most advanced platform



- Powerful, flexible Infiniium user interface
- Capacitive touch screen with multi-touch, easy-grab handles, and re-sizing touch fields
- Powerful Intel i5 motherboard with 8 GB RAM for fast processing
- Removable solid state drive (SSD) for fast boot-up and increased reliability and security
- Fast data offload (up to 200 MB/s) via USB 3.0

Broadest range of capability



- 16 digital channels on MSO models
- Standard feature rich software with > 50 automated measurements, 16 math functions, gating, and spectral viewer
- Expandable with optional software applications and flexible licensing:
  - Add protocol decode and triggering for a wide variety of serial buses
  - Choose from a large selection of analysis applications including eye diagrams and measurements with SDA, jitter, InfiniiScan, and de-embedding
  - Test to ensure adherence to industry standards with compliance apps
- Support for > 100 probes – current and voltage, active and passive, 1 MΩ and 50 Ω inputs

Industry's Best Signal Integrity

S-Series next-generation technology blocks enable superior measurements

The heart of the oscilloscope is a 20-layer acquisition board with 16 custom ASICs and FPGAs. New technology blocks deliver superior signal integrity. You'll get superior measurements that you won't get with any other portable scope on the market.

10-bit ADC

Each model incorporates the industry's fastest 10-bit ADC with a sample rate of 40 GSa/s. This yields 2 channels at 20 GSa/s or 4 channels at 10 GSa/s.

- 4X more vertical resolution than 8-bit oscilloscopes
- ADC ENOB up to 8.7 contributes to high system ENOB values
- Up to 12 bits of resolution with high-res mode
- SNR are better than historical 8-bit ADC architectures
- Vertical scaling as low as 2 mV/div supported in hardware



Keysight's new 10-bit ADC

- 65 nm CMOS (9 mm x 14 mm)
- 130 nm BiCMOS buffer IC
- Custom 33 mm BGA package

Superior low-noise front end

- 10-bit ADC's usefulness is dependent on the low-noise front end that supports the additional quantization levels. Each S-Series oscilloscope incorporates the industry's lowest noise front end for portable oscilloscopes with bandwidth up to 8 GHz
- 50 Ω and 1 MΩ input support, each path with bandwidth limit filter support
- Analog and DSP bandwidth limit filters to reduce unwanted noise
- 90 uV noise at 1 GHz bandwidth allows viewing of small signal detail
- 2 mV/div vertical scaling in hardware (in combination with ADC)
- HW bandwidth limit filters on both 50 Ω and 1 MΩ paths
- Gold-plated precision BNCs rated in excess of 8 GHz bandwidth
- Electronic attenuators for decreased noise and increased reliability
- Lower bandwidth models are upgradable to any higher bandwidth model with an instant user-installed software license



S-Series front-end includes three new custom ICs including a 130 nm BiiCMOS IC that incorporates user-selectable analog filters and bandwidth upgrades via a software license.

Industry's Best Signal Integrity (Continued)

S-Series next-generation technology blocks enable superior measurements (Continued)

Superior time base

Time scale accuracy is critical, especially for deep-memory applications.

Measurement of jitter is necessary for ensuring high-speed system reliability. Intrinsic jitter associated with an oscilloscope includes the jitter measurement internal to the scope. The lower the value, the better you'll be able to characterize your device. S-Series scopes achieve precise time accuracy with a next-generation time base architecture.

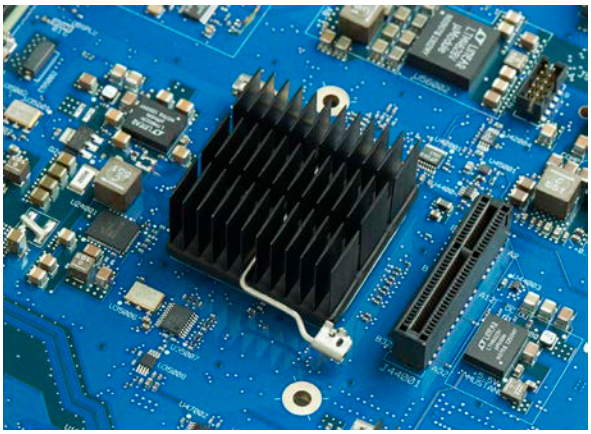
- Best-in-industry time scale accuracy of 12 parts per billion after calibration for accurate deep-memory measurements
- Low jitter measurement floor with 100 fs (typical) of intrinsic jitter



Signal processing in hardware

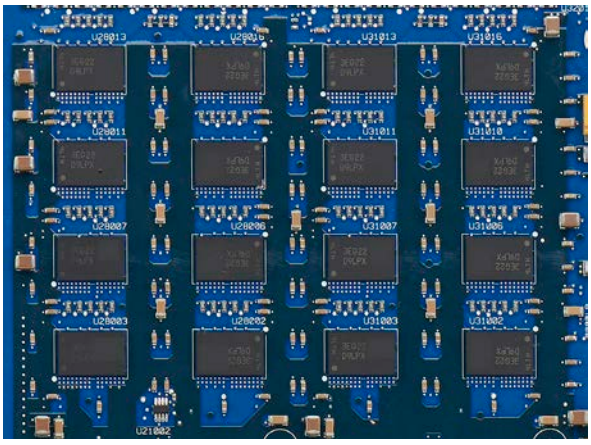
S-Series oscilloscopes are built with an advanced FPGA dedicated for fast and precise signal processing. The technology produces the fastest deep memory responsiveness in the industry and provides additional hardware filtering for superior measurements.

- Hardware-based algorithms for accelerated drawing to display (pixel placement) enable fast pan and zoom even with deep memory
- Frequency-response correction filters produce flat responses for both magnitude and phase for more accurate waveforms
- User-selectable hardware bandwidth-limiting correction filters from 500 MHz up to the oscilloscope's bandwidth reduce unwanted noise, plus additional front end filters for even more bandwidth limiting options
- Supports cabled 2-channel differential inputs (channels 1 to 3 or channels 2 to 4) without requiring a differential probe
- The DSP technology block supports rapid optional de-embedding technologies such as InfiniiSim, Precision Probe, and equalization



Responsive deep memory

S-Series oscilloscopes come with the industry's most responsive deep memory. With standard 50 Mpts/channel on all four channels simultaneously, capture long time periods while retaining fast sample rates. Fast update rates mean your oscilloscope will stay responsive with deep memory on to ensure precise representation of analog signals.



Most Advanced Platform

S-Series next-generation technology enables superior measurements

S-Series platform standard features

240 GB removable SSD

- Fast boot up
- Increased reliability
- Easy to remove for secure environments

Powerful motherboard

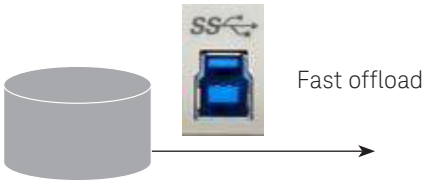
- 3 GHz Intel i5 quad core processor with 8 GB RAM for fast computations — even with advanced math and deep memory
- IO
  - Ethernet 10/100/1000bT
  - 6 USB device ports (2 in front, 4 on side two of which are USB 3.0)
  - DisplayPort and VGA video out. Drivers support up to two simultaneous displays



Fast data offload

Have an application that requires programmatically accessing oscilloscope data?

- USB 3.0 for up to 200 MB/s offload
- 1000bT Ethernet for up to 80 MB/s offload



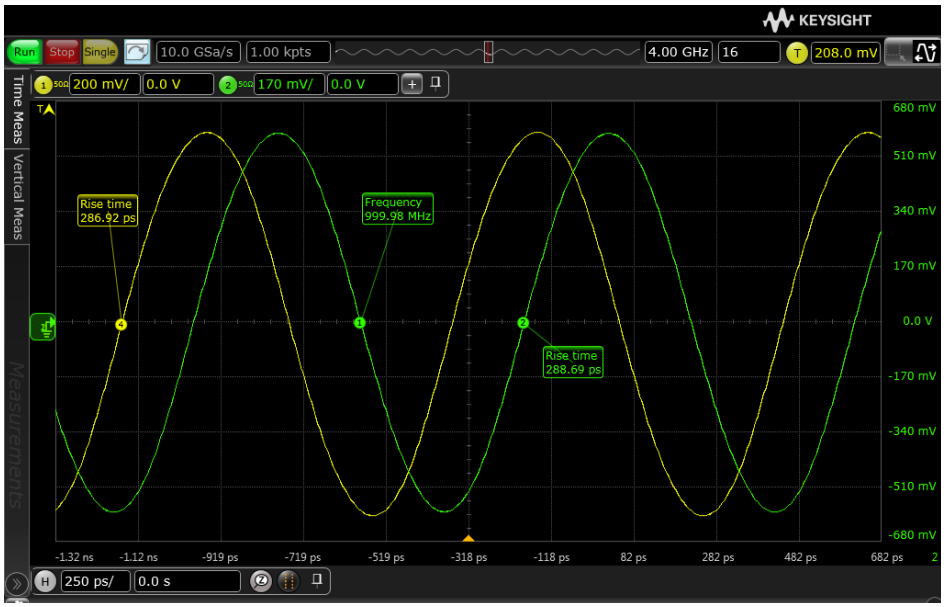
Touch-screen innovation

S-Series oscilloscopes incorporate a capacitive touch screen. In addition, Infiniium software includes a large number of touch-friendly enhancements including handles, enlarged touch fields when touch is enabled, and gestures (multi-touch).

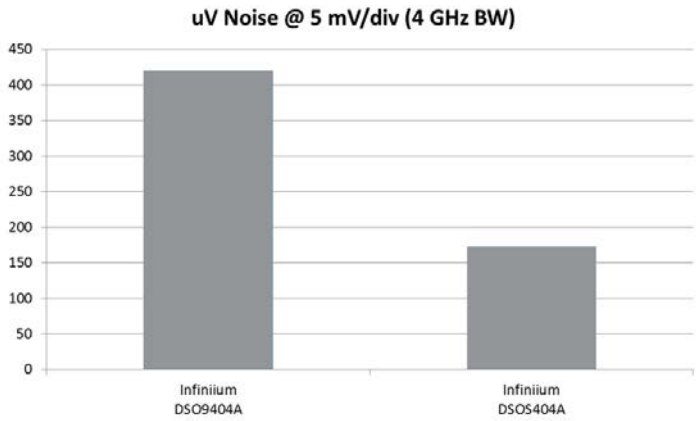


Oscilloscope Overview

With up to 8 GHz bandwidth, 20 GSa/s sample rate, a 10-bit ADC, and a low-noise front-end, see a precise representation of the analog characteristics of the signals you're testing.



Noise directly impacts vertical placement of each signal point. Oscillocopes with lower noise have more accurate vertical placement. S-Series oscilloscopes incorporate next-generation technology to deliver the lowest noise measurements in the industry. Here's a compare at 4 GHz with 5 mV/div scaling.



Superior signal integrity allows for more accurate measurements such as rise time values. Extremely low intrinsic jitter (100 fs) ensures the lowest possible contribution to jitter measurements from the scope itself so you're using your jitter budget on your design.



Oscilloscope Overview – Time Domain

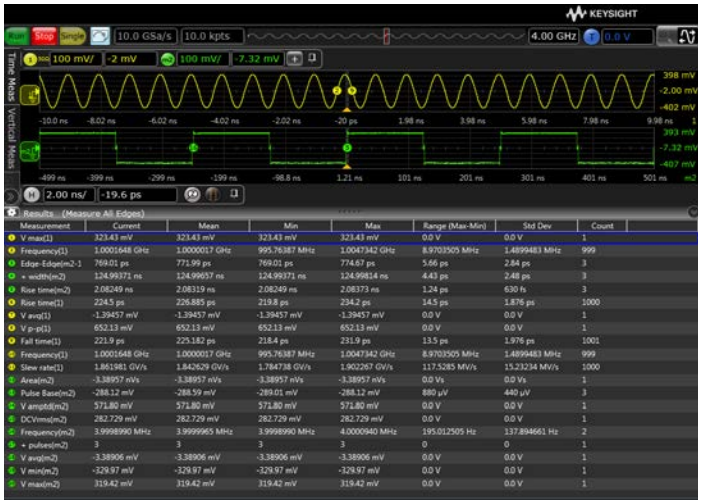
Display windows and scale annotations

Both horizontal and vertical axis values are annotated on the scales, leading to fast interpretation. Infiniium oscilloscopes uniquely offer 16 grids per waveform area, with up to 8 waveform areas.



Results window

See up to 20 measurement results simultaneously with statistics. Each result is color-coded to the source. Turn on measurement annotations for additional documentation capability.



Math and measurements

With > 50 standard automated measurements with statistics and 16 independent math functions, you'll be able to analyze a wide variety of tests. Use any of the industry-best 16 independent gates to narrow measurements or math to a specific time window.



Oscilloscope Overview – Frequency Domain

With a built-in spectral viewer, controls, gated FFTs, 10-bit ADCs, and excellent SFDR values, the S-Series oscilloscopes provide an excellent scope platform for FFT measurements.

FFTs

Need to see frequency domain in additional to time domain? The standard spectral viewer includes FFT controls like start/stop RBW and CF/span. Readout includes power and frequency axis annotation and a peak table.



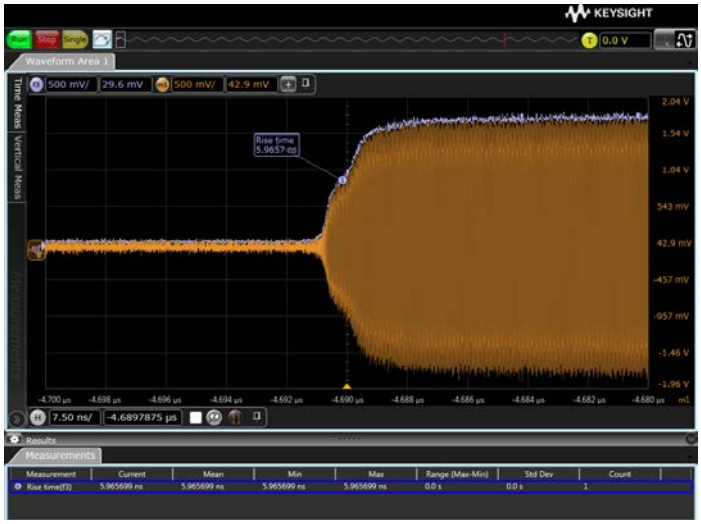
Gated FFTs

Infiniium supports gated math and analysis including FFTs. Use any of the standard 16 independent gates to narrow FFT computations to a specific time window. Drag the gate in the time domain, and see time correlated FFT measurements for specified time periods. The example at the right shows two simultaneously FFTs.



Envelope measurements

Need to see the rise time of a burst? Add a rise time measurement to an envelope function that provides an AM demodulation of a burst.

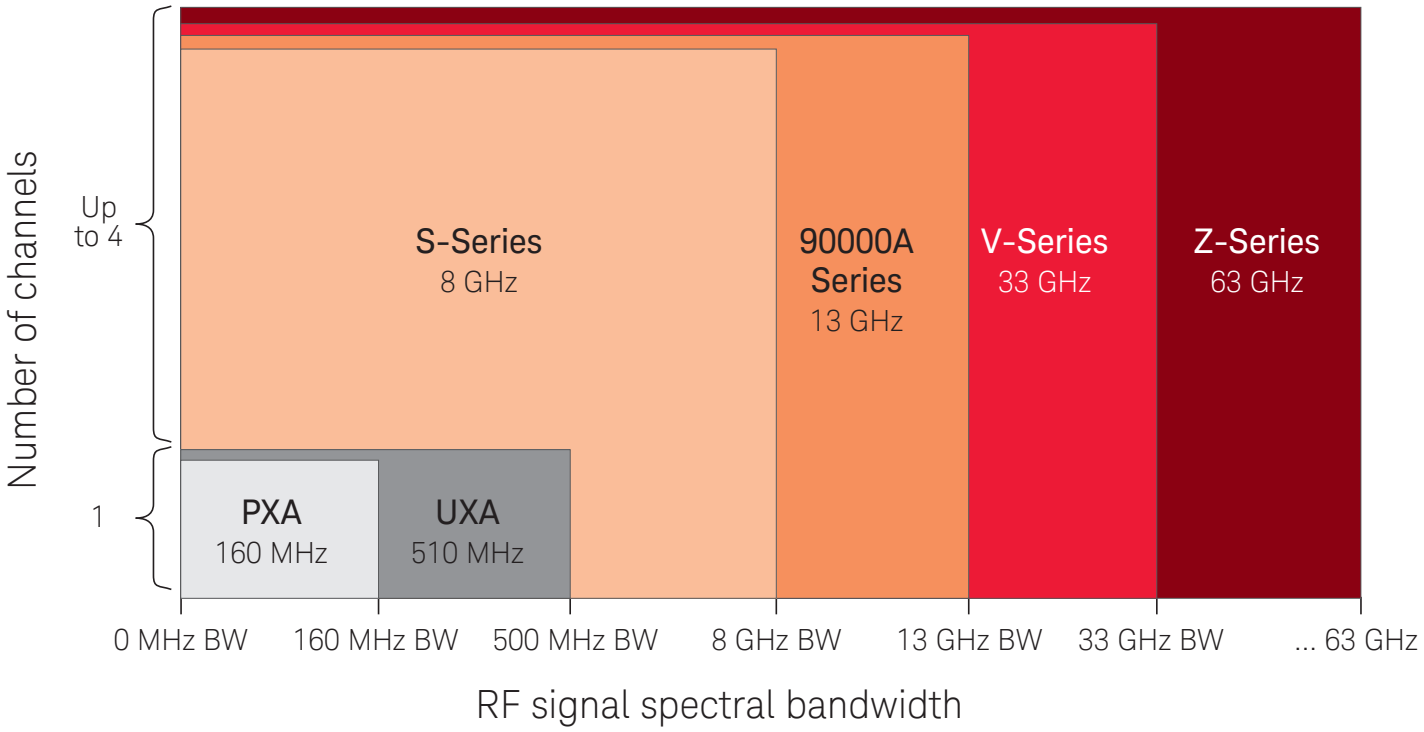


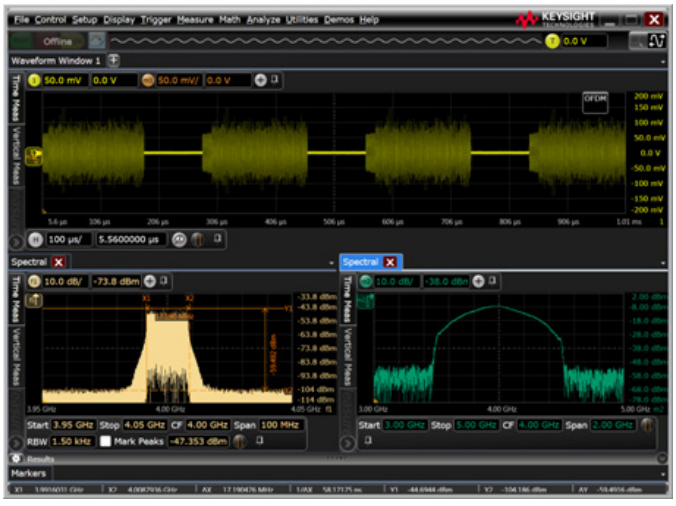
Oscilloscope Overview – Frequency Domain (Continued)

Wideband and multi-channel FFTs

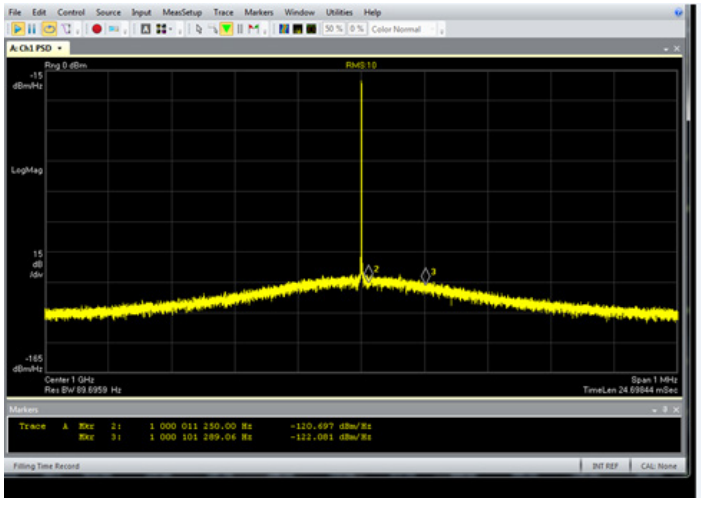
Need to see > 500 MHz signal spectral bandwidth and/or multiple FFTs simultaneously? Oscilloscopes offer wider bandwidth than spectrum analyzers and come standard with four ports (channels) per instrument.

Infiniium S-Series enables users to make wideband measurements up to 8 GHz and up to 16 simultaneous FFTs. Analyze even higher bandwidth signals by combining with a down converter.





Use Infiniium capture and analysis of radar bursts, as shown in this OFDM example.

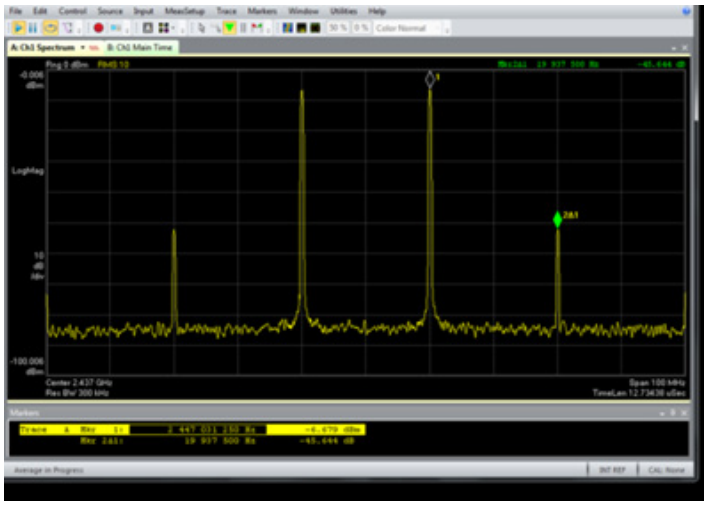


Use Infiniium capture and analysis of radar bursts, as shown in this OFDM example.

Oscilloscope Overview – Frequency Domain (Continued)

Trying to interpret traditional oscilloscope time-domain specifications can be challenging in determining if a specific scope can be recommended for RF/uW/mmW measurements. With correction filters, low-noise front end, and the 10-bit ADC, S-Series oscilloscopes can be used for wideband RF applications. Typical RF characteristics for the S-Series are listed below with graphs showing characterization results shown at the bottom of the page.

Typical RF characteristic values from measured results on an 8-GHz S-Series oscilloscope	
Sensitivity/noise density	–160 dBm/Hz
– 1 mV/div; –38 dBm range	
– Power spectral density measurement at 1.0001 GHz, 1.0001 GHz center frequency, 500 kHz span, and 3 kHz RBW	
Noise figure	14 dB
– Derived from measurement above	
Signal-to-noise ratio/dynamic range	108 dB
– 0 dBm 1 GHz input carrier, 0 dBm scope input range	
– 1 GHz center frequency, 100 MHz span, 1 kHz RBW, measurement at +20 MHz from center	
Absolute amplitude accuracy	± 1 dB
– 0 to 7.5 GHz	
Deviation from linear phase	± 7 deg
– 0 to 7.5 GHz	
Phase noise (at 1 GHz)	
– 10 kHz offset	–121 dBc/Hz
– 100 kHz offset	–122 dBc/Hz
EVM	–47 dB (0.47%)
– 802.121 2.4 GHz carrier, 20 MHz wide, 64 QAM	
Spurious responses (0 dBm signal, 0 dBm input range)	
Spur Free Dynamic Range (SFDR)	
– 1 GHz, 0 dBm signal present at input, FFT =5 GHz span, 3 GHz center, 100 kHz RBW	72 dB
2nd harmonic distortion	
– 1 GHz input, 0 dBm, 5 GHz span, 3 GHz center, 100 KHz RBW	–64 dBc
3rd harmonic distortion	
– 1 GHz input, 0 dBm, 5 GHz span, 3 GHz center, 100 KHz RBW	–46 dBc
Two-tone Third-Order Intermodulation (TOI) distortion	+21.5 dB
– 0 dBm input tones, 2.435 GHz and 2.439 GHz, 2 MHz separation, 2.437 GHz center frequency, 10 MHz span, 100 kHz RBW, 6 dBm input range	
Input match	
– < 50 mV/div, 0-7 GHz	–15 dB; 1.4 VSWR
– >= 50 mV/div, 0-7 GHz	–19 dB; 1.25 VSWR



Using data acquired from S-Series, VSA shows an excellent TOI value of 21.5 dB.



Using data acquired from S-Series, VSA shows an EVM for IEEE 802.11 QAM 64 of 0.47%.

Oscilloscope Overview – User Interface

Infiniium oscilloscopes have been consistently recognized for high usability. The next-generation Infiniium user interface that ships standard on S-Series oscilloscopes delivers even more capability.

Personalized viewing

- Determine how much space to give to results versus waveforms using sliders
- Undock and move a window to an external monitor using the tabbed layout
- Easily scale and see independent waveforms with user-selectable 1, 2, 4, or even 16 simultaneous grids in each waveform window



Faster and better documentation

- Quickly determine horizontal and vertical values as they are prominently displayed
- Add annotations using bookmarks, measurement callouts, and dynamic delta marker readouts
- Right-click to copy image without ever having to save to a file
- Use the multi-purpose button to save screen images easily with auto-incrementing file names
- Quickly save all waveforms, memories, functions, and setups in a single .osc file for later recall on an oscilloscope or PC
- Save screen images as .jpg, .png, .gif, or .tiff



Best usability, including touch screen

Extensive research testing led to several touch-screen innovations not found in other oscilloscopes. All the following are industry firsts.

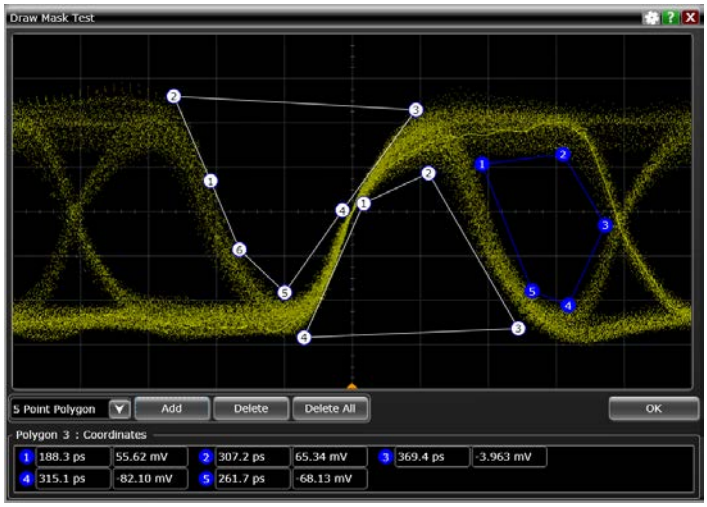
- Click once to see handles that enable touch manipulation of markers, trigger level, and waveform-tasks that previously required a mouse
- Multi-touch support for multi-touch (gestures) such as zooming and panning
- Auto-sizing when touch button is turned on/off optimizes fields for fingers or a mouse



Oscilloscope Overview – User Interface (Continued)

Custom mask editor

Drag and drop up to 15 points on screen to create mask files in seconds.



Analysis gallery

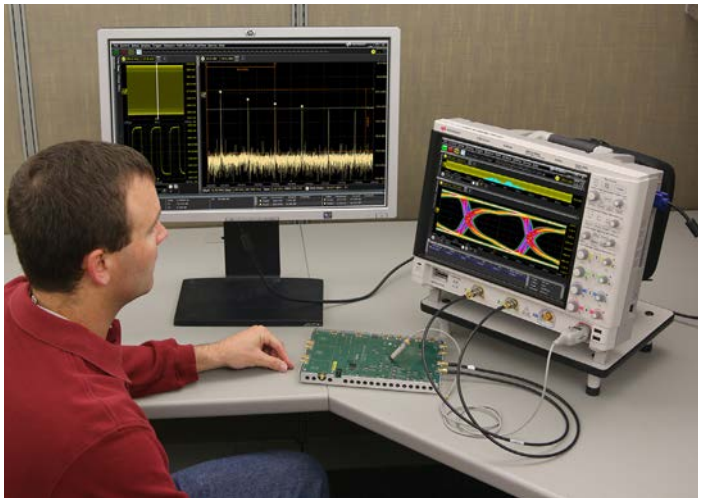
Easily find and run the test you need from the list of analysis/ measurement options represented graphically in the analysis gallery.



Using an External Monitor

Undock and move a window to an external monitor using tabbed layout.

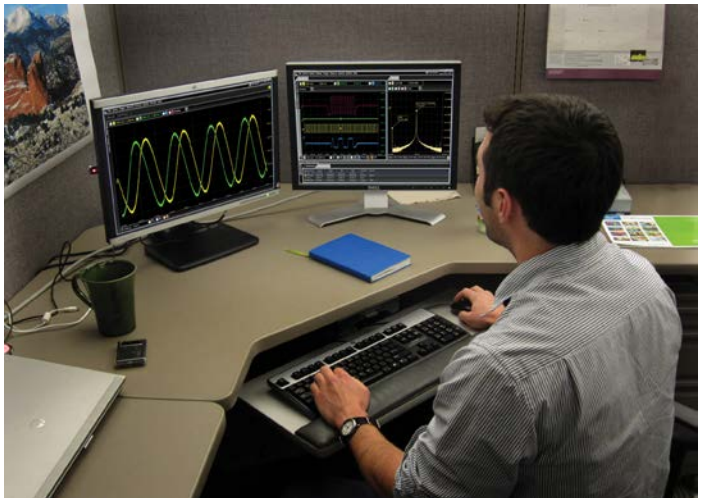
S-Series supports both VGA and DisplayPort IO.



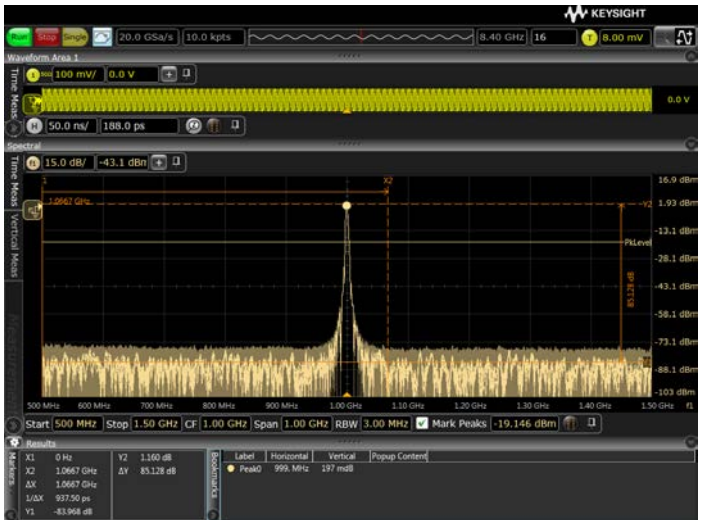
Infiniium Offline Application



View and analyze results at your desk. Save your oscilloscope file, then view and analyze on your PC without needing additional access to your scope.



Use waveform math, filtering, and FFT spectral analysis and to get more insight. Need to see protocol decode, analyze jitter, or view eye diagrams? Infiniium Offline helps you get insight into all of these areas.



MSO Overview

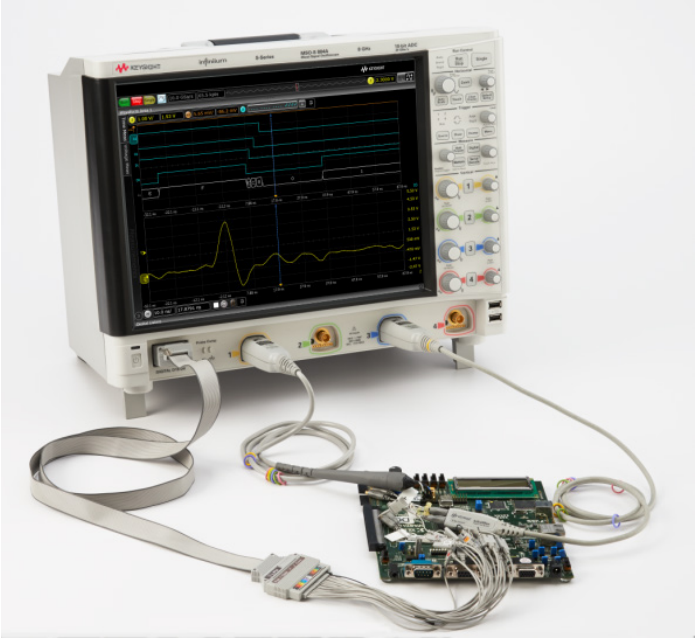
MSO models add 16 high-speed timing channels with standard 128 Mpts digital memory, allowing you to retain fast 2 GSa/s sample rates over long periods of time. All DSOs are user-upgradable to MSOs. The required upgrade time is less than 5 minutes.



Use the digital channels to evaluate control signal relationships and data buses up to 16 bits wide. Use symbols to quickly interpret waveforms.

MSO measurement applications

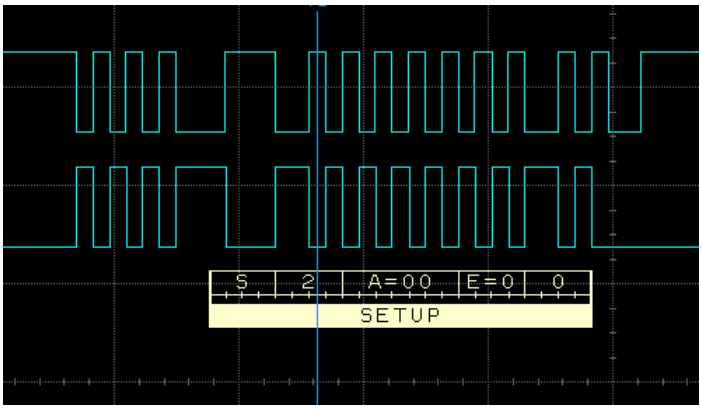
- Trigger on and view specific control or data flow events
- Use digital channels for protocol trigger and decode (I²C, SPI, RS-232, JTAG, USB and more)
- Capture data from FPGA debug ports
- Trigger on and monitor power rail sequencing timing relationships
- Combine with oscilloscope channels to trigger across up to 20 channels simultaneously

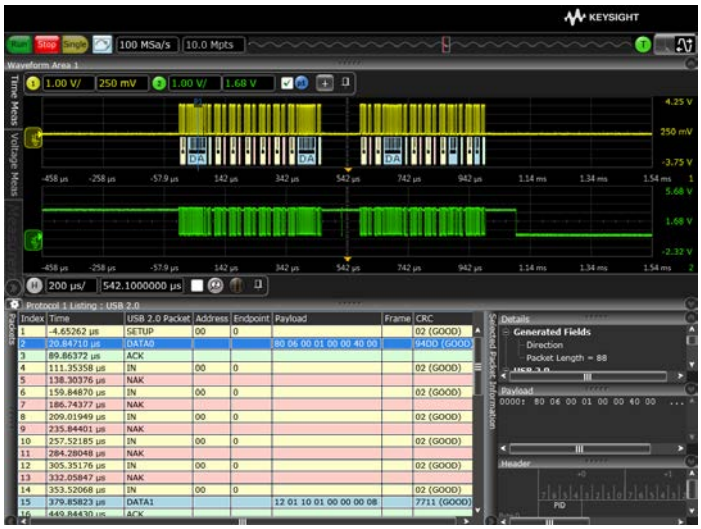


Protocol Applications

Does your design include a serial bus that is a key point for debug or test? Use one of Keysight's protocol decoding and triggering application packages for increased productivity. The software converts DSO or MSO physical layer acquisitions into packets for specific protocols. Specify trigger conditions at the packet level.

Quickly move between physical and protocol layer information using the time-correlated tracking marker. Display protocol content in waveforms and/or listing.





	License type		
	Fixed	Floating	
Optional application description	**Factory-installed** on new scope purchase or user-installed on existing scope	**User-installed transportable** license	**Server-based** license (N5435A option)
Protocol			
8B/10B	N5384A-1FP	N5384A-1TP	003
ARINC 429 and MIL-STD-1553 protocol	N/A	N8842A-1TP	106
CAN, LIN, FlexRay protocol decode and triggering	N8803B-1FP	N8803B-1TP	033
DVI	N5384A-1FP	N5384A-1TP	003
HDMI	N5384A-1FP	N5384A-1TP	003
I²C, SPI, and RS-232/UART protocol decode and triggering	N8800B-1FP	N8800B-1TP	N/A
I²C/SPI protocol decode	N5391B-1FP	N5391B-1TP	006
JTAG protocol decode	N8817B-1FP	N8817B-1TP	038
MIPI® CSI-3 (M-PHY®) protocol decode	N8820B-1FP	N8820B-1TP	N/A
MIPI DigRF v4	N8807B-1FP	N8807B-1TP	047
MIPI D-PHY™ protocol decode	N8802B-1FP	N8802B-1TP	036
MIPI LLI protocol decode	N8809B-1FP	N8809B-1TP	049
MIPI RFFE protocol decode	N8824B-1FP	N8824B-1TP	072
MIPI UniPro protocol decode	N8808B-1FP	N8808B-1TP	048
PCI Express® Gen1 and Gen2 protocol decode and triggering	N5463B-1FP	N5463B-1TP	032
RS-232/UART protocol decode and triggering	N5462B-1FP	N5462B-1TP	001
SATA/SAS protocol decode	N8801A-1FP	N8801A-1TP	035
SVID protocol decode	N8812B-1FP	N8812B-1TP	054
USB 2.0 protocol decode and triggering	N5464B-1FP	N5464B-1TP	034
USB 3.0 protocol decode	N8805B-1FP	N8805B-1TP	N/A
USB 3.0 SuperSpeed Inter-Chip (SSIC) protocol decode [1]	N8819B-1FP	N8819B-1TP	N/A
10/100 Ethernet protocol triggering and decode	N8825B-1FP	N8825B-1TP	088
USB 3.1 protocol triggering and decode	N8821A-1FP	N8821A-1TP	092
USB-PD protocol triggering and decode	N8837A-1FP	N8837A-1TP	096
Universal Flash Storage (UFS) protocol decode	N8818B-1FP	N8818B-1TP	063
eSPI and Quad eSPI protocol decode and trigger	N8835A-1FP	N8835A-1TP	091
CAN, LIN, FlexRay and CAN-FD protocol triggering and decode	N8803C-1FP	N8803C-1TP	103
Upgrade CAN, LIN, FlexRay with CAN-FD	N8803C-2FP	N8803C-2TP	N/A

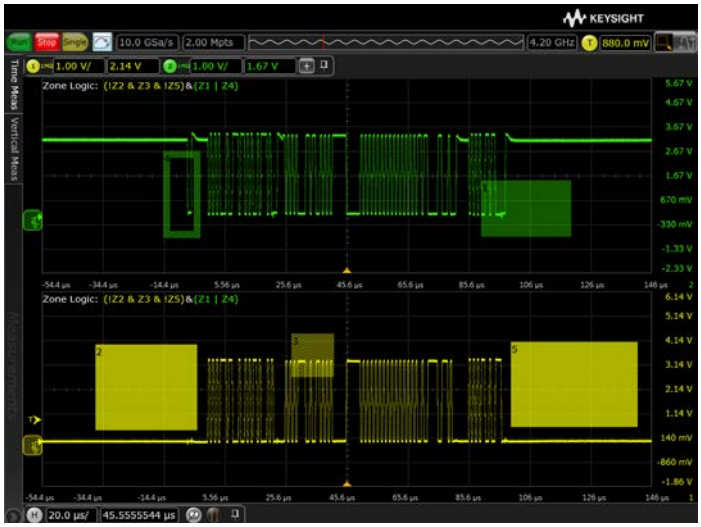
1. The server license runs on an external PC and can be checked out for 90 days by connecting to the server from the GUI. The floating or transportable license is moved from scope to scope using KLM and can be done online or with USB thumb drive.

Analysis Applications

A variety of analysis capabilities enable additional rapid insight

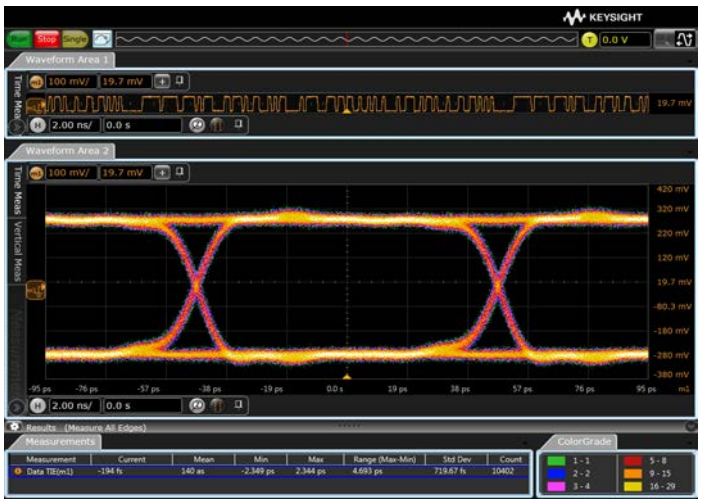
InfiniiScan

Rapidly trigger on complex events that you can see but are impossible to specify using hardware triggers. This innovative software quickly scans through thousands of acquired waveform cycles and isolated anomalous signal behavior. Select up to eight zones across scope channels are available.



SDA (Serial Data Analysis)

Quickly validate signal integrity for high-speed serial interfaces with embedded clocks. Recover embedded clocks, and build and validate eye diagrams. SDA also includes software-base trigger and decode for 8B/10B data.



EZJIT, EZJIT Plus, and EZJIT Complete

Characterize and evaluate most commonly needed jitter measurements. EZJIT Plus automates Rj/Dj separation, and EZJIT Complete additionally characterizes vertical noise.

See jitter data sheets for additional information.



Analysis Applications (Continued)

A variety of analysis capabilities enable additional rapid insight (Continued)

Crosstalk analysis

Quickly solve difficult crosstalk problems with the industry's first application software designed to measure both near end crosstalk (NEXT) and far end crosstalk (FEXT) on up to four signals (one victim and three aggressors) at once.

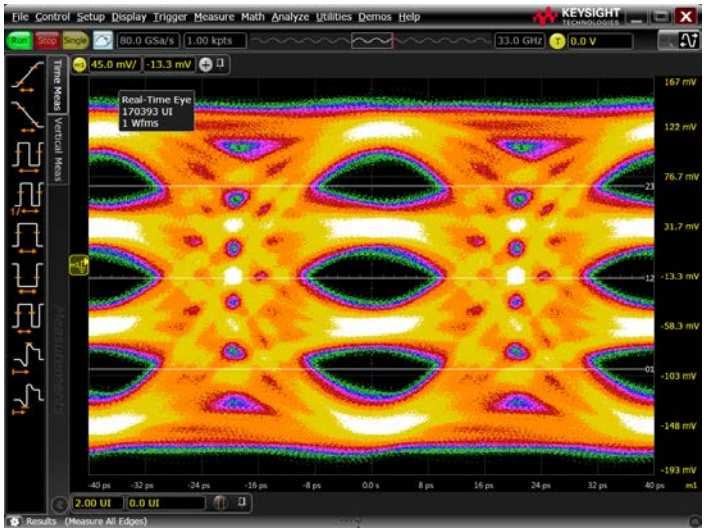
- Identify the aggressor and victim
- Report the amount of crosstalk
- Remove crosstalk and analyze

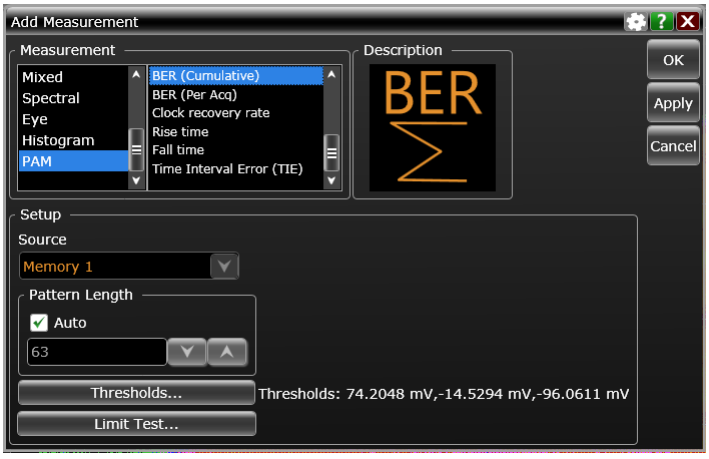


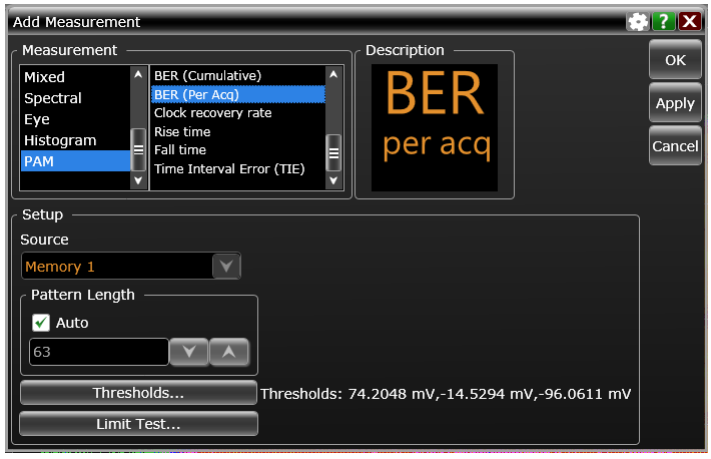
PAM-4 analysis

Easily make eye and level based measurements with the PAM-4 analysis tool. Measure eye width, eye height, eye skew, level mean, RMS, and thickness for each level, plus:

- Data time interval error for each threshold
- Rise/Fall times for each of the six PAM-4 transition types
- Support for CTLE, FFE, and DFE equalization
- Bit error rate measurements – cumulative and per acquisition





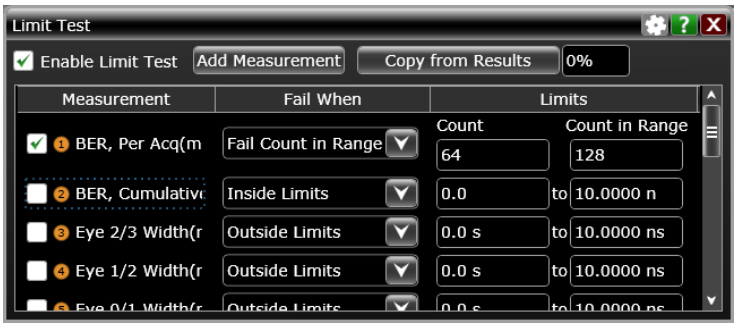


Analysis Applications (Continued)

A variety of analysis capabilities enable additional rapid insight (Continued)

PAM-4 analysis (Continued)

With the EZJIT and InfiniiScan applications, you can apply limit tests to find burst errors and view where errors happen on the waveform.



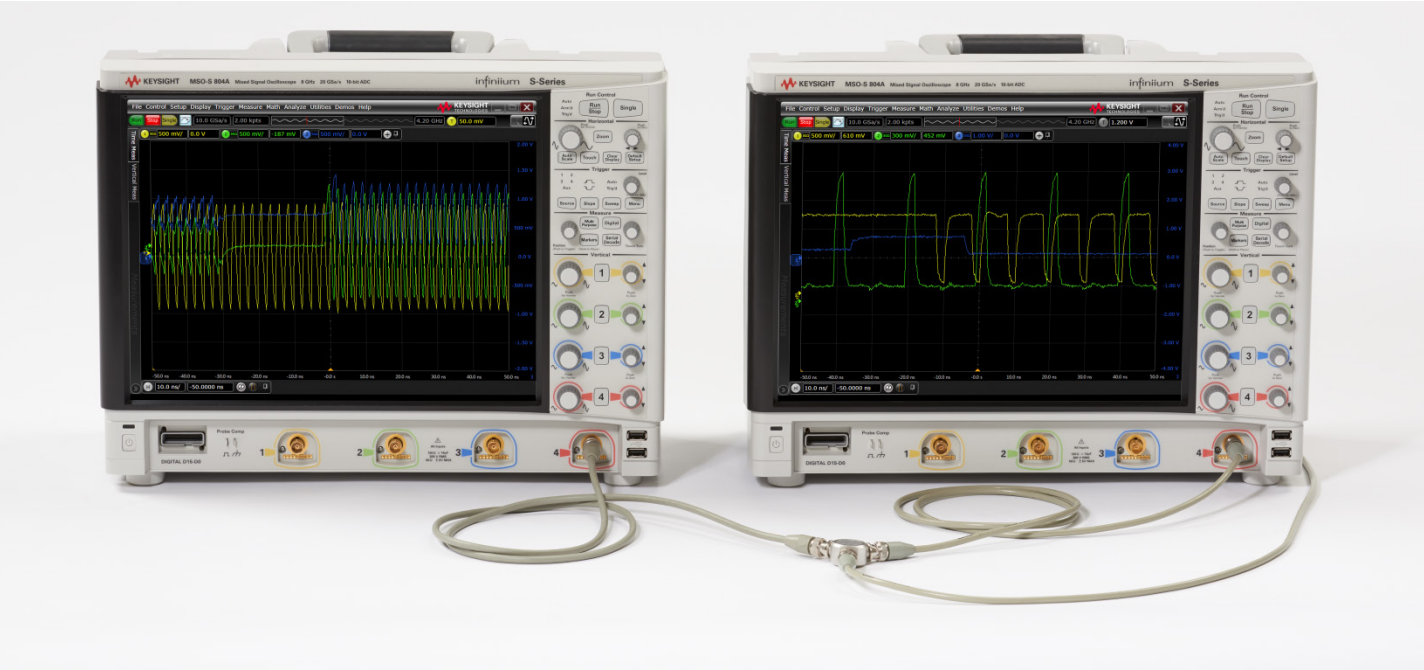


Analysis Applications (Continued)

A variety of analysis capabilities enable additional rapid insight (Continued)

MultiScope

View up to 40 analog channels simultaneously by linking multiple scopes together. Connect 2, 5, or 10 scopes together and calibrate to eliminate skew.



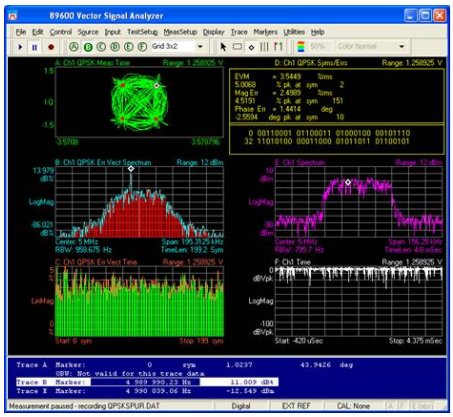
Other Popular Applications

National Instrument Drivers

LabVIEW Plug and Play and IVI-C drivers for S-Series are available on **ni.com/idnet**

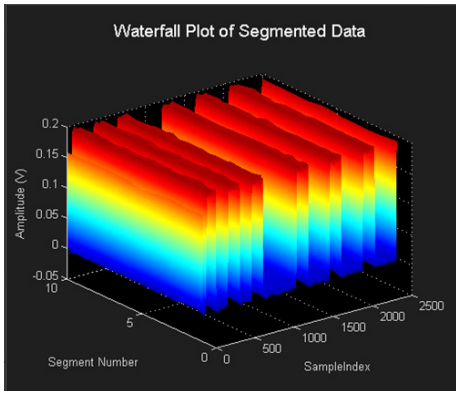
Vector Signal Analysis

Expand your oscilloscope with the 89601B vector signal analysis software. This application takes data from the scope and provides spectrum analysis and digital modulation analysis for wireless communication.



MATLAB integration with User Defined Functions

Install MATLAB on your oscilloscope, and add your favorite .m scripts as math function operators. Export and analyze oscilloscope data directly with MATLAB. The FFT waterfall spectrogram on the right is an example of processing that can be done in MATLAB. Order N8831A with option 001 for MATLAB Basic or option 002 for MATLAB advanced.



	License type		
	Fixed	Floating	
Optional application description	**Factory-installed** on new scope purchase or user-installed on existing scope	**User-installed transportable** license	**Server-based** license (N5435A option)
Analysis			
DSA (bundle with EZJIT Complete and SDA bundle)	DSOS000-DSA (new purchase only)	N/A	003 and 055
Equalization emulation	N5461B-1FP	N5461B-1TP	026
EZJIT	E2681B-1FP	E2681B-1TP	002
EZJIT Plus	N5400B-1FP	N5400B-1TP	001
EZJIT Complete vertical noise analysis	N8823B-1FP	N8823B-1TP	067
InfiniiScan	N5415B-1FP	N5415B-1TP	004
Infiniisim Basic	N5465B-3FP	N5465B-3TP	026
InfiniiSim Advanced	N5465B-1FP	N5465B-1TP	027
OSA (Oscilloscope Signal Analyzer)	W2650A	N/A	N/A
Power	U1882B-1FP	U1882B-1TP	N/A
PrecisionProbe	N2808A-1FP	N2808A-1TP	044
Serial data analysis	N5384A-1FP	N5384A-1TP	003
UDF (user-defined function for MATLAB integration)	N5430B-1FP	N5430B-1TP	005
User Defined Functions	N8833B-1FP	N8833B-1FP	084
Crosstalk analysis	N8833B-1FP	N8833B-1FP	084
PAM-4	N8836A-1FP	N8836A-1TP	094
MultiScope			
– 2 scopes	N8834A-AFP	N8834A-ATP	085
– 5 scopes	N8834A-BFP	N8834A-BTP	086
– 10 scopes	N8834A-CFP	N8834A-CTP	090

Infiniium S-Series Standard Features

15” XGA display makes it easier to view analog and digital signals as well as spectral and protocol views

Capacitive display makes for responsive touch control and supports multi-touch gestures

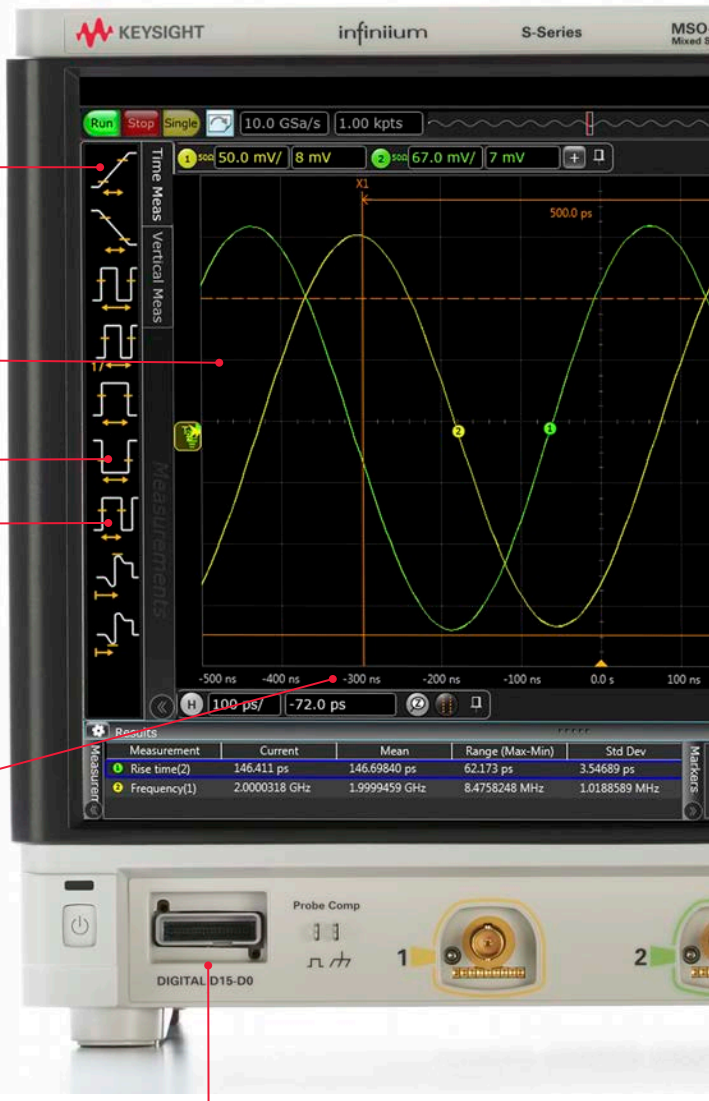
View: Up to 8 waveform windows. Each area can have up to 16 grids

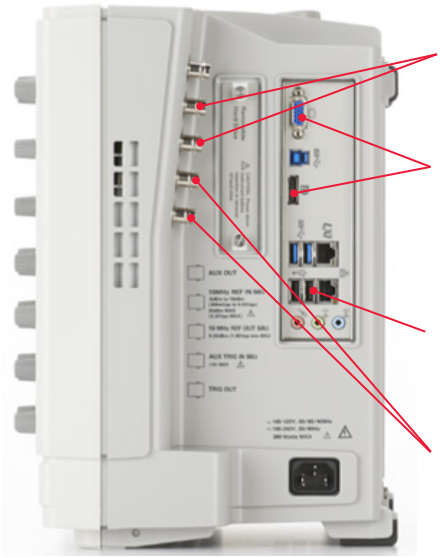
Drag and drop enables rapid measurements

Measurements
- Over 50 automated measurements
- View up to 20 simultaneously
- User-customizable result window
- (size, position, and information)
- X and Y markers with dynamic delta values

Analyze
- 20 math operators including FFT and filters
- Up to 16 independent/cascaded math functions

View windows: Analog, math, spectral, and measurement results (simultaneous, tabbed, or undocked)





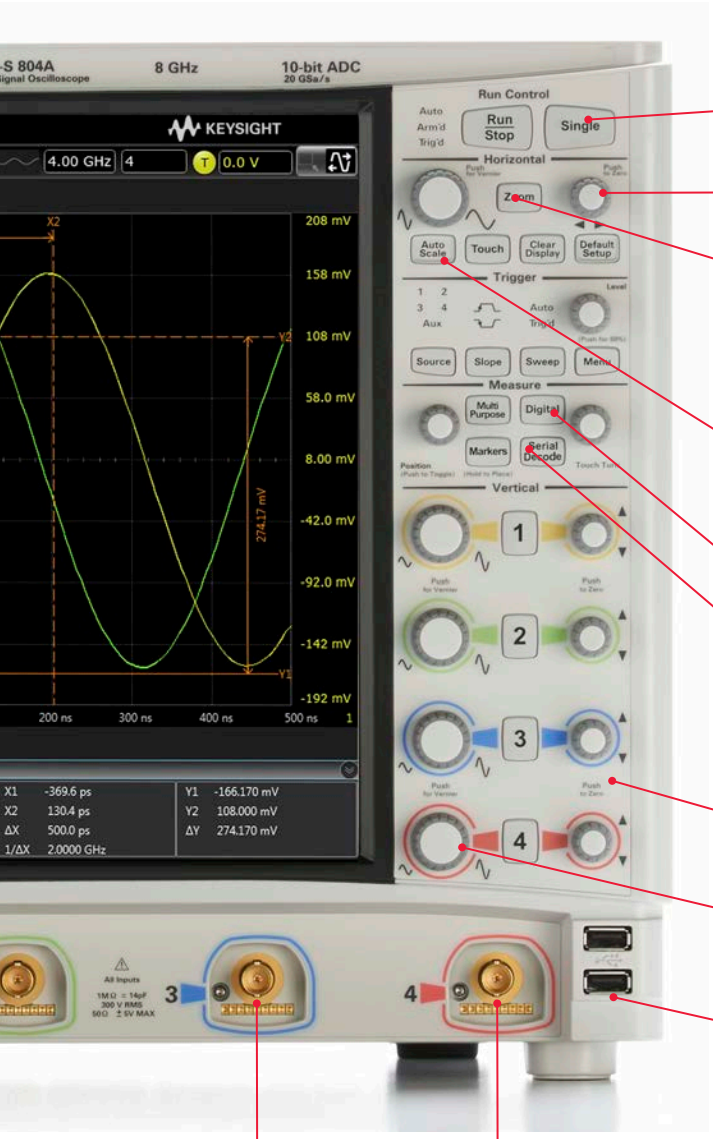
Built-in 10-MHz reference in/out ports synchronizes multiple measurement instruments in a system

XGA and DisplayPort video output ports let you add an external monitor

Standard USB 2.0 and 3.0 and LAN ports provide fast data offload, device support, and connectivity

Trig in/out ports provide an easy way to synchronize your oscilloscope to other instruments

Mixed-signal oscilloscope (MSO) models seamlessly integrate four analog scope channels with 16 digital channels



Dedicated single acquisition button provides better control to capture a unique event

Pressing horizontal delay knob sets the delay to zero

Zoom button provides quick access to two screen-zoom modes

Responsive deep memory allows you to pan and zoom quickly

Autoscale lets you rapidly display any analog or digital active signals, automatically setting the vertical, horizontal and trigger controls for the best display, while optimizing memory

Digital channel button provides quick setup access

Protocol decode button enables quick setup access

Dedicated per-channel front panel controls make it easy to access the vertical and horizontal scaling and offset

Quick access to fine/course control by pressing the horizontal and vertical sensitivity knobs

Built-in USB ports makes it easy to save your work and update your system software quickly

Gold-plated precision BNCs deliver > 8 GHz bandwidth through the connector

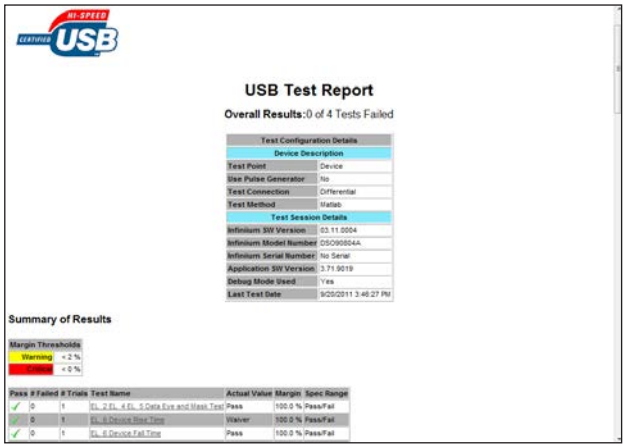
AutoProbe interface automatically configures the attenuation ratio of the probe and provides probe power for Keysight's active probes



Compliance Applications

Need to test adherence to an industry-standard serial bus?

The S-Series supports many compliance applications.



	License type			
	Fixed	Floating		
Optional application description	**Factory-installed** on new scope purchase or user-installed on existing scope	**User-installed transportable** license	**Server-based** license (N5435A option)	
Compliance (see individual application data sheets for additional information)				**Minimum bandwidth (GHz)**
BroadR-Reach	N6467B-1FP	N6467B-1TP	N5435A-062	1
DDR bundle - includes DDR1, 2, 3 and 4	N5459B-1FP	N/A	N/A	
DDR1 (200 to 1067 MT/s)	U7233B-1FP	U7233B-2FP	N5435A-021	1 to 4
DDR2 + LPDDR2 (400 to 1067 MT/s)	N5413C-1FP	N5413C-1TP	N5435A-037	2 to 4
DDR3 + LPDDR3 (800 to 1067 MT/s)	U7231C-1FP	U7231C-1TP	N5435A-053	4
eMMC	N6465B-1FP	N6465B-1TP	N5435A-061	1
Ethernet	N5392C-3FP	N5392C-3TP	N5435A-008	1
Ethernet + EEE	N5392C-1FP	N5392C-1TP	N5435A-060	1
10 GBase-T	U7236B-1FP	U7236B-1TP	N5435A-023	2.5
HDMI 1.4	N5399D-3FP	N5399D-3TP	N5435A-011	8
MHL 2.0	N6460C-3FP	N6460C-3TP	N5435A-050	8
MIPI D-PHY	U7238D-1FP	U7238D-1TP	N5435A-022	4
MIPI M-PHY®	U7249D-1FP	U7249D-1TP	N5435A-043	6
MOST	N6466B-1FP	N6466B-1TP	N5435A-068	1.5
PCI Express Gen1	N5393E-3FP	N5393E-3TP	N5435A-040	6
UDA (User-Defined Application)	N5467C-1FP	N5467C-1TP	N5435A-058	0.5
UHS-I	N7246B-1FP	N7246B-1TP	N/A	1
UHS-II	N6461B-1FP	N6461B-1TP	N5435A-052	6
USB 2.0	N5416B-1FP	N5416B-1TP	N5435A-017	2
HSIC	U7248C-1FP	U7248C-1TP	N5435A-042	2
XAUI	N5431B-1FP	N5431B-1TP	N5435A-018	6

Need to additionally test even higher-speed serial buses?

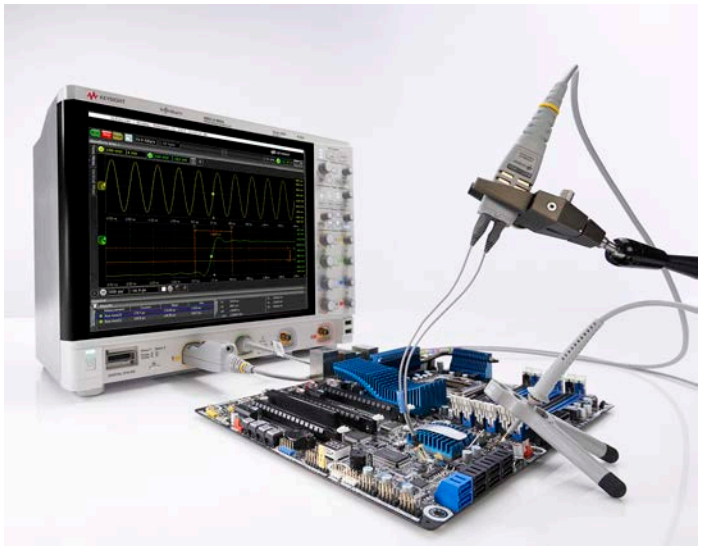
Consider Keysight's Z-Series, 90000A Series, or V-Series.

Probes Overview

S-Series oscilloscopes include both 1 MΩ and 50 Ω paths. This expands their flexibility by making them compatible with a wider range of probes than high-performance oscilloscopes that only support a 50 Ω path.

All S-Series oscilloscopes ship standard with four passive probes and support a wide range of about 100 compatible current and voltage probes. The table below highlights probes commonly used with the S-Series.

See
http://literature.cdn.keysight.com/litweb/pdf/5968-7141EN.pdf
for additional info on probes andaccessories.



Probe type	Ideal for measuring	Recommended probe model numbers
Passive probe	Single-ended voltage up to 500 MHz	N2873A (qty. 4 ship standard)
InfiniiMax active probe	Differential or single-ended voltage	1130A/31A/32A/34A, 1168A/69A
	Differential, single-ended or common mode voltage	N2830A/31A/32A (InfiniiMode)
InfiniiMode active probe	Single-ended, differential, or common mode voltage	N2750A-52A
Single-ended active probe	Single-ended voltage up to 2 GHz	N2795A, N2796A, N2797A (extreme temperature)
General purpose differential probes	High voltage differential signal up to 7 kV with high CMRR	N2790A, N2791A, N2818A, N2819A, N2891A
Current probe	High current, AC/DC (mA – 100's of A)	1146B, 1147B, N2780B-83B, N2893A
	High sensitivity current, AC/DC (10's of uA – A)	N2820A, N2821A
Passive probes	High voltage up to 4 kV peak pulse	10076B
	General purpose up to 1.5 GHz	N2870A – N2876A
Power rail probe	Single-ended up to 2 GHz with up to ± 24 V offset	N7020A

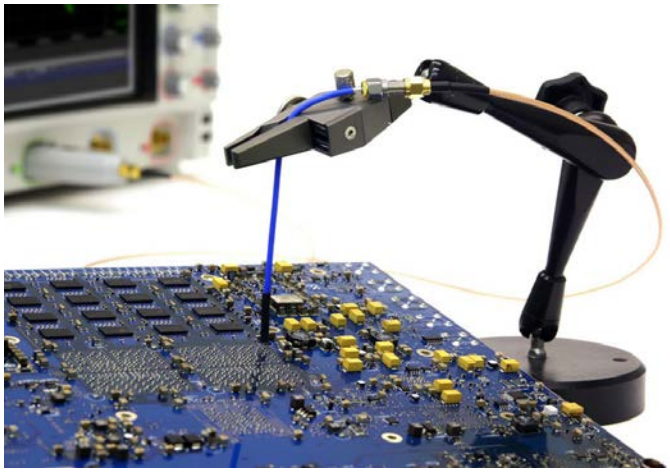
Probes and Accessories Overview

N7020A power rail probe

Do you need more offset than is available in your oscilloscope frame? Do you need to zoom in to view and analyze small signals like ripple on top of power rails? Do you need more input impedance than 50 Ω at DC to make more precise measurements? If so, the N7020A power rail probe has the feature set that will help you test more efficiently and precisely.

Developed specifically for power rail testing needs, the probe delivers 850 mV dynamic range with an impressive offset range of ± 24 volts. Low noise with a 1:1 attenuation ratio and 2 GHz bandwidth and low DC loading complements the probes ability to deliver superior power rail measurements.

Go to **www.keysight.com/find/N7020A** for additional information.



N2750A Series InfiniiMode active probes

These active probes offer 1.5/3.5/6 GHz bandwidth and InfiniiMode operation modes and provide convenient and quick access to various functions on the oscilloscope.

With wide dynamic range (10 Vpp at 10:1) and offset range (± 15 V), these probes can be used for a vast variety of measurements.

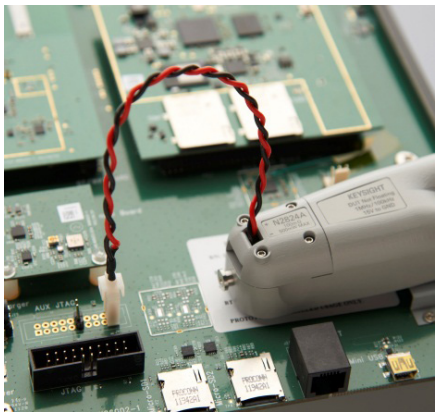
Go to **www.keysight.com/find/InfiniiMode** for additional information.



N2820A Series high-sensitivity current probes

Need to measure small currents? The N2820A Series high-sensitivity current probes can measure down to 50 uA and up to 5 amps. Combine with the S-Series for lower noise and 10-bit ADC high-definition current measurements. This probe can also be used to measure sensitive low voltages down to 3 uV.

Go to **www.keysight.com/find/N2820A** for additional information.



Keysight Portfolio Compare



	InfiniiVision	Infiniium		
Family	**6000 X-Series**	**9000 Series**	**S-Series**	**90000A Series**
Optimized for	Fastest update rate and lowest price up to 6 GHz	Measurements up to 4 GHz	Superior signal integrity up to 8 GHz	Superior signal integrity up to 13 GHz
Available bandwidths	500 MHz to 6 GHz	600 MHz to 4 GHz	500 MHz to 8 GHz	2.5 to 13 GHz
Standard memory depth/ch (2-ch)	4 Mpts	40 Mpts	100 Mpts	40 Mpts
ADC bits	8	8	10	8
Bandwidth filters	Yes	20 MHz (only on 1 MΩ input)	Yes. Extensive	Yes. Extensive
Bandwidth correction filters	No	No	Yes	Yes
Probe inputs	50 Ω and 1 MΩ	50 Ω and 1 MΩ	50 Ω and 1 MΩ	50 Ω
Motherboard and OS	None. Embedded	Intel Core 2 Duo. Win7	Intel i5 Quad-Core. Win7	Intel Core 2 Duo. Win7
Standard internal drive	None	HDD	Removable SSD	HDD
BNC inputs	Traditional	Traditional	Precision BNC	Precision BNC
MSO models	Yes	Yes	Yes	No
Frame volume comparison	1/2 X	X	X	2X



Infiniium S-Series blends high-performance oscilloscope capability with a wide range general-purpose features.

Accessories

Quickly remove your solid state drive for additional security

All S-Series models ship standard with a solid state drive. This gives you faster boot time, enhanced reliability, and the ability to quickly remove the solid state drive for safekeeping in secure environments. Need additional solid state drives for secure environments? N2746S provides an additional solid state drive with Windows 7.



Need to ship your oscilloscope or take it on an airplane?

Cruzer has created a custom case for Keysight's Infiniium S-Series oscilloscopes. Order the rugged hard-shell transit case directly from Cruzer (**http://www.casecruzer.com/oscilloscope/3f1312-0411j.html**) using the product number 3F1312-0411J. Shipping weight with an S-Series frame and no accessories is 51.5 lbs (23.4 kg).



Rack mount your oscilloscope

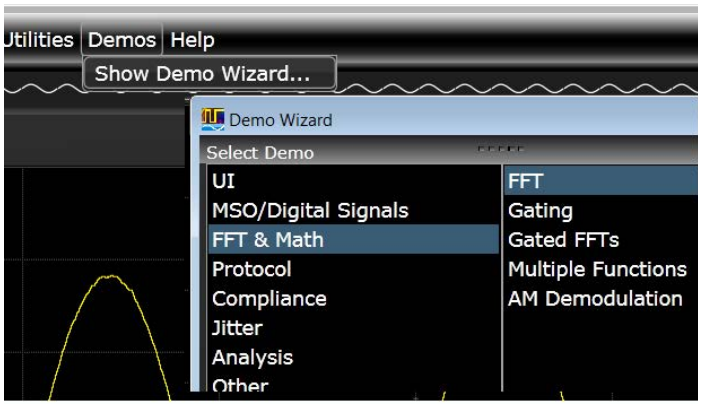
Mount your S-Series oscilloscope in an 8U high, 19" (487 mm) wide rack with the N2902B rack mount kit. The sturdy kit provides additional BNCs on the rack mount front panel for BNC in/out signals on the side of S-Series models.



Take a Quick Look Using Demo Wizard and USB Demo Board

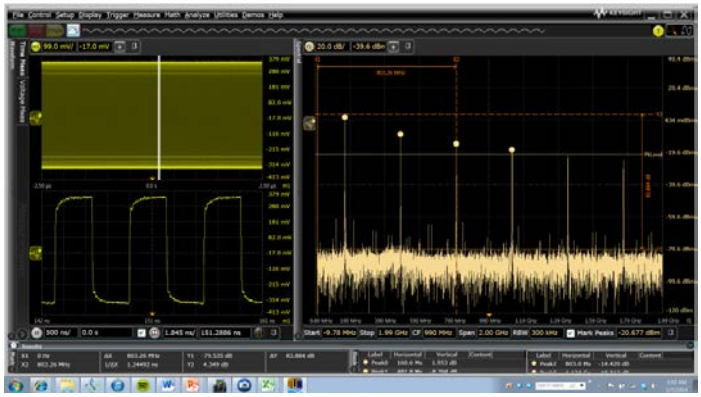
Evaluate using demo wizard waveforms

We've captured a variety of signals and measurements to speed your evaluation of S-Series oscilloscopes. Use the demo wizard to quickly evaluate the scope's capability without needing to create an array of live signals.



Measurement examples

For example, pull up an FFT and note the following: separate spectral viewer with annotated axis scales; dynamically updated X and Y marker delta values; a customizable results window that includes an FFT peak table.



N2867A USB demo board

Plug a mouse, USB drive, or any other device in one side and connect the other to your oscilloscope USB port. You now have easy access to a target for quick evaluation or training others on how to use the scope.

The board routes out D+, D-, 5 V, and ground, so you can use it to make voltage, current, power, or other measurements.



Investment Protection

Expand your oscilloscope's capability with additional memory, bandwidth, digital channels, or software applications.

Capture more time and keep faster sample rates as horizontal settings are slowed. Additional acquisition memory can be added to the initial purchase or after purchase.

Acquisition memory depth upgrade	Option # on new scope	N2113A Option # (for previously purchased scopes)
Increase to 100 Mpts/200 Mpts (4-ch/2-ch)	DSOS000-100	100
Increase to 200 Mpts/400 Mpts (4-ch/2-ch)	DSOS000-200	200
Increase to 400 Mpts/800 Mpts (4-ch/2-ch)	DSOS000-400	400

All S-Series oscilloscopes ship with the same hardware and are calibrated to 8 GHz on the production line. In less than 1 minute, any lower-bandwidth S-Series scope can be user-upgraded to any higher bandwidth.

	Bandwidth upgrades
DSOS8GBW	Upgrade to 8 GHz bandwidth
DSOS6GBW	Upgrade to 6 GHz bandwidth
DSOS4GBW	Upgrade to 4 GHz bandwidth
DSO2G5BW	Upgrade to 2.5 GHz bandwidth
DSOS2GBW	Upgrade to 2 GHz bandwidth
DSOS1GBW	Upgrade to 1 GHz bandwidth

Note: Customer-installable calibration is recommended and incurs additional charges.

Upgrade any DSO model to an MSO in less than 1 minute with the N2901E MSO upgrade kit.



S-Series Ordering Configuration

S-Series ordering configuration

1. Choose needed bandwidth
2. Choose MSO or DSO
3. Choose desired software applications
4. Choose memory depth upgrade
5. Choose any additional probes and accessories

Calibration and accessory options	
Precision BNC (M) to SMA (F) adapters (qty 2) (standalone PN: 54855-67604)	DSOS000-821
170225 compliant calibration	DSOS000-1A7
17025 compliant calibration with accreditation	DSOS000-AMG
ANSI Z540 complaint calibration	DSOS000-A6J
S-Series rackmount kit (8U high)	N2902B
Additional SSDs with Win7	N2746S
GPIB to LAN adapter	N4865A

		Scope channels				
DSO models 4 scope channels	**MSO models 4 scope channels + 16 digital channels**	**Analog bandwidth**	**Max sample rate**	**ADC bits**	**Standard memory depth**	**User-installed bandwidth upgrades**
DSOS054A	MSOS054A	500 MHz	20 GSa/s (2 channels) 10 GSa/s (4 channels)	10	100 Mpts (2 channels) 50 Mpts (4 channels)	Yes
DSOS104A	MSOS104A	1 GHz				
DSOS204A	MSOS204A	2 GHz				
DSOS254A	MSOS254A	2.5 GHz				
DSOS404A	MSOS404A	4 GHz				
DSOS604A	MSOS604A	6 GHz [1]				
DSOS804A	MSOS804A	8 GHz [1]				

1. 6 GHz and 8 GHz bandwidth supported in 2-channel mode. If all four channels are on, a maximum bandwidth of 4 GHz is supported.
2. For MSO upgrades, customer-installable calibration is recommended and incurs additional charges.





Standard accessories Included

All models ship standard with: 3-year warranty, four N2873A 500-MHz passive probes, probe accessory pouch, Keysight I/O libraries suite, localized power cord, front panel cover, 8 GHz BNC calibration cable, keyboard, and mouse.

User guide and programmer's guide ship on oscilloscope drive. Service guide available on Keysight.com. MSO models additionally ship with 16-channel flying lead set logic probe, MSO cable, and MSO calibration fixture.

Infiniium S-Series Performance Characteristics

Vertical

DSO/MSO models		S-054A	S-104A	S-204A	S-254A	S-404A	S-604A	S-804A
Vertical - scope channels								
Input channels		DSO models - 4 analog						
		MSO models - 4 analog + 16 digital						
Analog bandwidth (–3 dB)	50 Ω [1]	500 MHz	1 GHz	2 GHz	2.5 GHz	4 GHz	6 GHz [6]	8 GHz [6]
	1 MΩ	500 MHz	500 MHz	500 MHz	500 MHz	500 MHz	500 MHz	500 MHz
Vertical resolution [2, 3]		10 bits, up to 12 bits with high-resolution mode						
Typical rise time/fall time 10 to 90% [4]		860 ps	430 ps	215 ps	172 ps	107.5 ps	71.7 ps	53.8 ps
Typical rise time/fall time 20 to 80% [5]		620 ps	310 ps	155 ps	124 ps	77.5 ps	51.7 ps	33.8 ps
ENOB (typical)		8.1	7.8	7.5	7.4	7.2	6.8	6.4
Input impedance [1]		50 Ω: ± 3.5% (typical ± 1% at 25 °C)						
		1 MΩ: ± 1% (14 pF typical)						
Input sensitivity [3]		50 Ω: 1 mV/div to 1 V/div						
		1 MΩ: 1 mV/div to 5 V/div						
Input coupling		50 Ω: DC						
		1 MΩ: AC (> 11 Hz), DC						
Bandwidth limit filters (analog)		20 MHz, 200 MHz for both 50 Ω and 1 MΩ paths						
DSP bandwidth limit filters		Increments of 500 MHz up to rated scope bandwidth						
Channel-to-channel isolation		DC to 100 MHz: 50 dB						
		100 MHz to 1 GHz: 40 dB						
		> 1 GHz: 30 dB						
DC gain accuracy [1, 2, 3]		± 1% of full scale at full resolution (typical 5 mV to 1 V per division)						
		± 2% of full scale at full resolution [1]						
Max input voltage [1]		50 Ω: ± 5 V						
		1 MΩ: 300 Vrms or DC and ± 400 Vpp (DC+AC)						
Offset range	50 Ω				1 MΩ			
	Vertical sensitivity		Available offset		Vertical sensitivity		Available offset	
	All vertical ranges		± 12 divisions or ± 4 V, whichever is smallest		< 10 mV/div		± 2 V	
					≥ 10 mV/div		± 5 V	
					≥ 20 mV/div		± 10 V	
					≥ 100 mV/div		± 20 V	
					≥ 1 V/div		± 100 V	
Offset accuracy [1, 3]	± 0.1 div ± 2 mV ± 1% of offset setting for offsets < 2 V							
	± 0.1 div ± 2 mV ± 1.5% of offset setting for offsets ≥ 2 V							
Dynamic range [7]	50 Ω: ± 4 divisions from center screen				1 mV to 100 mV; 2nd harmonic distortion of –30 dBc			
	1 MΩ: ± 4 divisions from center screen				101 mV to 5 V; 2nd harmonic distortion of –20 dBc			
DC voltage measurement accuracy [2]	Dual cursor: ± [(DC gain accuracy) + (resolution)]							
	Single cursor: ± [(DC gain accuracy) + (offset accuracy) + (resolution/2)]							

1. Denotes warranted specifications, all others are typical. Specifications are valid after a 30-minute warm-up period and ± 5 °C from firmware calibration temperature. Input impedance is valid when V/div scaling is adjusted to show all waveform vertical values within the oscilloscope display.
2. Vertical resolution = 0.4% of full scale(≤ 5 GSa/s) or 0.1% of full scale(10 GSa/s or 20 GSa/s).
3. 50 Ω input: Full scale is defined as 8 vertical divisions. Magnification is used below 2 mV/div, full-scale is defined as 16 mV. The major scale settings are 5 mV, 10 mV, 20 mV, 50 mV, 100 mV, 200 mV, 500 mV, 1 V. Testing is at maximum sample rate.
   1 MΩ input: Full scale is defined as 8 vertical divisions. Magnification is used below 2 mV/div, full-scale is defined as 16 mV. The major scale settings are 5 mV, 10 mV, 20 mV, 50 mV, 100 mV, 200 mV, 500 mV, 1 V, 2 V, 5 V. Testing is at maximum sample rate.
4. Calculation based on Tr = 0.43/BW.
5. Calculation based on Tr = 0.31/BW.
6. 6 GHz and 8 GHz bandwidth supported in 2-channel mode. If all four channels are on, a maximum bandwidth of 4 GHz is supported.
7. For a 10:1 probe on the 1 MΩ input, vertical scaling is multiplied by 10.

Infiniium S-Series Performance Characteristics (Continued)

RMS noise floor (Vrms ac) on 50 Ω inputs

Vertical setting (Volts/div)	S-054A	S-104A	S-204A	S-254A	S-404A	S-604A	S-804A
1 mV/div	74 uV	90 uV	120 uV	130 uV	153 uV	195 uV	260 uV
2 mV/div	74 uV	90 uV	120 uV	130 uV	153 uV	195 uV	260 uV
5 mV/div	77 uV	94 uV	129 uV	135 uV	173 uV	205 uV	320 uV
10 mV/div	87 uV	110 uV	163 uV	172 uV	220 uV	256 uV	390 uV
20 mV/div	125 uV	163 uV	233 uV	254 uV	330 uV	446 uV	620 uV
50 mV/div	372 uV	456 uV	610 uV	650 uV	768 uV	1.3 mV	1.4 mV
100 mV/div	0.78 mV	0.96 mV	1.2 mV	1.3 mV	1.6 mV	2.3 mV	3.1 mV
200 mV/div	1.6 mV	2.0 mV	2.6 mV	2.8 mV	3.4 mV	4.9 mV	6.4 mV
500 mV/div	3.5 mV	4.2 mV	5.5 mV	6 mV	7.3 mV	10.0 mV	13.3 mV
1 V/div	5.1 mV	6.8 mV	9.2 mV	10.1 mV	12.5 mV	17.6 mV	24.1 mV

Vertical - digital channels	
Input channels	16 channels of timing
Analog bandwidth	400 MHz
Threshold selections	User-defined, TTL, 5.0 V CMOS, 3.3 V CMOS, 2.5 V CMOS, ECL, PECL
User-defined threshold range	± 8.00 V in 10 mV increments
Maximum input voltage	± 40 V peak
Threshold accuracy	± (100 mV + 3% of threshold setting)
Input dynamic range	± 10 V about threshold
Minimum input voltage swing	500 mV peak-to-peak
Input impedance	100 kΩ ± 2% (~ 8 pF) at probe tip
Channel-to-channel skew	500 ps (typical)
Resolution	1 bit

Infiniium S-Series Performance Characteristics (Continued)

Horizontal

Horizontal system: Oscilloscope channels			
Main timebase range	5 ps/div to 50 s/div		
Resolution	1 ps		
Modes	Main, Delayed, Roll • (200 ms/div to 200 s/div)		
Reference position	Continuously adjustable across horizontal display range		
Horizontal position range	0 to ± 500 sec		
Delayed sweep range	1 ps/div to current main time scale setting		
Time scale accuracy [1, 8]	± (12 ppb initial + 75 ppb/year aging)		
Oscilloscope channel de-skew range	–1 ms to +1 ms		
Intrinsic jitter [6] (Sample clock jitter)	**Acquired time range or delta-time interval**	**Internal reference**	**External reference**
	< 1 us (100 ns/div)	100 fs rms	100 fs rms
	10 us (1 us/div)	123 fs rms	123 fs rms
	100 us (10 us/div)	138 fs rms	138 fs rms
	1 ms (100 us/div)	145 fs rms	145 fs rms
	10 ms (1 ms/div)	200 fs rms	145 fs rms
Inter-channel intrinsic jitter [3]	100 fs rms		
Inter-channel skew drift [3, 7]	< 500 fs rms		
Jitter measurement floor [2]			
– Time interval error	$\sqrt{\left(\frac{Noise\ Floor}{Slew\ Rate}\right)^2 + (Intrinsic\ Jitter)^2}$		
– Period jitter	$\sqrt{2} \bullet \sqrt{\left(\frac{Noise\ Floor}{Slew\ Rate}\right)^2 + (Intrinsic\ Jitter)^2}$		
– Cycle-cycle/N-cycle jitter	$\sqrt{3} \bullet \sqrt{\left(\frac{Noise\ Floor}{Slew\ Rate}\right)^2 + (Intrinsic\ Jitter)^2}$		
Inter-channel jitter measurement floor [2, 3, 5]	$\sqrt{\left(\frac{Time\ Interval}{Error\ (Edge1)}\right)^2 + \left(\frac{Time\ Interval}{Error\ (Edge2)}\right)^2 + \left(\frac{Inter\ channel}{Intrinsic\ Jitter}\right)^2}$		

1. Denotes warranted specifications, all others are typical. Specifications are valid after a 30-minute warm-up period and ± 5 °C from firmware calibration temperature.
2. Sample rate at maximum. Noise and slew rate determined at fixed-voltage measurement threshold, near middle of signal. Displayed signal not vertically clipped. Slew rate of sine wave = (peak signal amplitude) • 2 • π • f, slew rate of fast step ~= (10 to 90% rise time).
3. Intra-channel = both edges on the same channel, Inter-channel = two edges on different channels. Time Interval Error(Edge1) = time-interval error measurement floor of first edge, Time Interval Error(Edge2) = time-interval error measurement floor of second edge.
4. Reading is the displayed Delta Time Measurement Accuracy measurement value. Do not double the listed Time Scale Accuracy value in Delta Time Measurement Accuracy formula.
5. Scope channels and signal interconnect de-skewed prior to measurement.
6. External timebase reference values measured using a Wenzel 501-04608A 10 MHz reference. Intrinsic jitter value depends on acquisition time range for Time Interval Error formula and depends on delta-time between edges for all two-edge formulas.
7. Skew between channels caused by ± 5 degrees C temperature change.
8. Initial = immediately after factory or user calibration.

Infiniium S-Series Performance Characteristics (Continued)

Horizontal (Continued)

Horizontal system: Oscilloscope channels (Continued)

Delta time measurement accuracy [2, 3, 4, 5]

– Intra-channel

– No averaging

$$\pm\left[5\bullet\sqrt{\left(\begin{matrix}\text{Time Interval}\\ \text{Error (Edge1)}\end{matrix}\right)^2+\left(\begin{matrix}\text{Time Interval}\\ \text{Error (Edge2)}\end{matrix}\right)^2}+\left(\left(\begin{matrix}\text{Time Scale}\\ \text{Accuracy}\end{matrix}\right)\bullet\left(\begin{matrix}\text{Delta}\\ \text{Time}\end{matrix}\right)\right)\right]$$

– 256 averages

$$\pm\left[\frac{5}{16}\bullet\sqrt{\left(\begin{matrix}\text{Time Interval}\\ \text{Error (Edge1)}\end{matrix}\right)^2+\left(\begin{matrix}\text{Time Interval}\\ \text{Error (Edge2)}\end{matrix}\right)^2}+\left(\left(\begin{matrix}\text{Time Scale}\\ \text{Accuracy}\end{matrix}\right)\bullet\left(\begin{matrix}\text{Delta}\\ \text{Time}\end{matrix}\right)\right)\right]$$

– Inter-channel

– No averaging

$$\pm\left[5\bullet\sqrt{\left(\begin{matrix}\text{Time Interval}\\ \text{Error (Edge1)}\end{matrix}\right)^2+\left(\begin{matrix}\text{Time Interval}\\ \text{Error (Edge2)}\end{matrix}\right)^2+\left(\begin{matrix}\text{Inter channel}\\ \text{Intrinsic Jitter}\end{matrix}\right)^2}+\left(\left(\begin{matrix}\text{Time Scale}\\ \text{Accuracy}\end{matrix}\right)\bullet\left(\begin{matrix}\text{Delta}\\ \text{Time}\end{matrix}\right)\right)+\left(\begin{matrix}\text{Inter channel}\\ \text{Skew Drift}\end{matrix}\right)\right]$$

– 256 averages

$$\pm\left[\frac{5}{16}\bullet\sqrt{\left(\begin{matrix}\text{Time Interval}\\ \text{Error (Edge1)}\end{matrix}\right)^2+\left(\begin{matrix}\text{Time Interval}\\ \text{Error (Edge2)}\end{matrix}\right)^2+\left(\begin{matrix}\text{Inter channel}\\ \text{Intrinsic Jitter}\end{matrix}\right)^2}+\left(\left(\begin{matrix}\text{Time Scale}\\ \text{Accuracy}\end{matrix}\right)\bullet\left(\begin{matrix}\text{Delta}\\ \text{Time}\end{matrix}\right)\right)+\left(\begin{matrix}\text{Inter channel}\\ \text{Skew Drift}\end{matrix}\right)\right]$$

2. Sample rate at maximum. Noise and slew rate determined at fixed-voltage measurement threshold, near middle of signal. Displayed signal not vertically clipped. Slew rate of sine wave = (peak signal amplitude) • 2 • π • f, slew rate of fast step ~= (10 to 90% rise time).
3. Intra-channel = both edges on the same channel, Inter-channel = two edges on different channels. Time Interval Error(Edge1) = time-interval error measurement floor of first edge, Time Interval Error(Edge2) = time-interval error measurement floor of second edge.
4. Reading is the displayed Delta Time Measurement Accuracy measurement value. Do not double the listed Time Scale Accuracy value in Delta Time Measurement Accuracy formula.
5. Scope channels and signal interconnect de-skewed prior to measurement.

Infiniium S-Series Performance Characteristics (Continued)

Acquisition and trigger

Acquisition - scope channels							
Maximum real time sample rate	4 x 10 GSa/s or 2 x 20 GSa/s						
Standard memory depth	50 Mpts x 4 channels, 100 Mpts x 2 channels						
Memory options	Option 100: 100 Mpts x 4 channels, 200 Mpts x 2 channels						
	Option 200: 200 Mpts x 4 channels, 400 Mpts x 2 channels						
	Option 400 (single/run mode)						
	Sample rate	**2 channels**	**4 channels**				
	20 GSa/s	800/400 Mpts	Not available				
	10 GSa/s	400/200 Mpts	400/200 Mpts				
	≤ 5 GSa/s	536/268 Mpts	400/200 Mpts				
Sampling modes	Real time						
	Real time with peak detect						
	High resolution (11 or 12 bit user selection)						
	Equivalent time						
	Segmented memory (minimum time between segments = 3.3 us)						
	Memory depth	**Maximum number of segments**					
	Standard (50 Mpts/ch)	16,384					
	100 Mpts/ch	32,768					
	200 Mpts/ch	65,536					
	400 Mpts/ch	65,536					
	Roll (200 ms to 1 ks per division)						
Filters	Sin(x)/x interpolation						
Acquisition - digital channels							
Maximum real time sample rate	2 GSa/s						
Max memory depth per channel	128/64 Mpts with 2 GSa/s, 64/32 Mpts with < 2 GSa/s (single/run mode)						
Minimum width glitch detect	2 ns						
DSO/MSO models	**S-054A**	**S-104A**	**S-204A**	**S-254A**	**S-404A**	**S-604A**	**S-804A**
Trigger – scope channels							
	Ch 1, 2, 3, 4, aux, and line						
Max trigger freq on 50 Ω path	Full bandwidth				3 GHz bandwidth		
Sensitivity (edge trigger)		**20 MHz**	**200 MHz**	**1 GHz**	**2.5 GHz**	**> 2.5 GHz**	
1 MΩ	< 5 mV/div	< 0.7 div			< 1.4 div (up to 500 MHz)		
	> 5 mV/div	< 0.3 div	< 0.5 div		< 0.8 div (up to 500 MHz)		
50 Ω	< 5 mV/div	< 0.15 div	< 0.2 div	< 0.3 div	< 0.45 div	< 1.6 div	
	> 5 mV/div	0 div	0 div	0 div	< 0.1 div	< 0.6 div	
Trigger level range - any channel	Ch 1, 2, 3, 4: 50 Ω: ± 4 divisions from center screen						
	Ch 1, 2, 3, 4: 1 MΩ: ± 4 divisions from center screen						
	Auxiliary: ± 5 V (50 Ω) (maximum input: 5 Vpp)						
Sweep modes	Auto, triggered, single						
Display jitter [2, 3, 4] (Trigger jitter)	520 fs rms						
Trigger hold off range	100 ns to 10 s						
Trigger actions	Specify an action to occur (and the frequency of the action) when a trigger condition occurs						
	Actions include: email on trigger and execute “multipurpose” user settings						
Trigger coupling	50 Ω and 1 MΩ: DC, or AC: (10 Hz) low frequency reject (50 kHz high pass filter), high frequency reject (50 kHz low pass filter)						

1. Denotes warranted specifications, all others are typical. Specifications are valid after a 30-minute warm-up period and ± 5 °C from firmware calibration temperature.
2. Internal edge trigger mode with JitterFree correction. Value depends on scope settings and trigger signal characteristics, and is equal to Time Interval Error value expressed in the formula above using the minimum Time Scale Accuracy value.
3. Value shown represents typical Display jitter for DSOS404A at 100 mV/div triggering on 500 mVpp 2 GHz sin wave signal.
4. Sample rate at maximum. Noise and slew rate determined at fixed-voltage trigger threshold, near middle of signal. Displayed signal not vertically clipped.

Infiniium S-Series Performance Characteristics (Continued)

Trigger

Trigger: digital channels MSO models		
Threshold range (user defined)	± 8.0 V in 10-mV increments	
Threshold accuracy	± (100 mV + 3% of threshold setting)	
Trigger modes		
Edge (analog and digital)	Triggers on a specified slope (rising, falling or alternating between rising and falling) and voltage level on any channel	
Edge transition (analog)	Trigger on rising or falling edges that cross two voltage levels in > or < the amount of time specified. Edge transition setting from 250 ps	
Edge then edge (time) (analog and digital)	The trigger is qualified by an edge. After a specified time delay between 10 ns to 10 s, a rising or falling edge on any one selected input will generate the trigger	
Edge then edge (event) (analog and digital)	The trigger is qualified by an edge. After a specified delay between 1 to 16,000,000 rising or falling edges, another rising or falling edge on any one selected input will generate the trigger	
Glitch (analog and digital)	Triggers on glitches narrower than the other pulses in your waveform by specifying a width less than your narrowest pulse and a polarity. Glitch range settings equal pulse width settings	
Pulse width (analog and digital)	Trigger on a pulse that is wider or narrower than specified. Pulse width range setting is 250 ps to 10 s for analog channels and 2 ns to 10 s for digital channels	
1 GHz and 500 MHz model	Minimum detectable pulse width	150 ps for analog channels
		1 ns for digital channels
2 GHz and 2.5 GHz model	Minimum detectable pulse width	100 ps for analog channels
		1 ns for digital channels
4 GHz, 6 GHz, 8 GHz model	Minimum detectable pulse width	50 ps for analog channels
		1 ns for digital channels
Runt (analog)	Triggers on a pulse that crosses one threshold but fails to cross a second threshold before crossing the first again. Runt settings equal pulse width settings	
Timeout (analog and digital)	Trigger when a channel stays high, low, or unchanged for too long	
	Timeout settings equal pulse width settings	
Pattern/pulse range	Triggers when a specified logical combination of the channels is entered, exited, present for a (analog and digital)	
	Specified period of time or is within a specified time range or times out. Each channel can have a value of High (H), Low (L) or Don't care (X)	
State (analog and digital)	Pattern trigger clocked by the rising, falling or alternating between rising and falling edge of one channel.	
Setup/hold (analog)	Triggers on setup, hold, or setup and hold violations in your circuit. Requires a clock and data signal on any two inputs (except aux or line) channels as trigger sources. Setup and/or hold time must then be specified.	
Window (analog)	Trigger on entering, exiting, or inside specified voltage range	
Protocol packets	Requires specified protocol option, I^2C, SPI, CAN, LIN, RS-232/UART, SVID, USB, PCIe® Gen 1	
Zone-qualified	Requires InfiniiScan software option. SW-based triggering across up to 8 user-drawn zones. For each zone, user specifies "must intersect" or "must not intersect." Zones can be drawn on multiple channels and combined using Boolean expressions	

Infiniium S-Series Performance Characteristics (Continued)

Measurements and math

Measurements and math	
Math functions can operate on any combination of channels, memories, or other functions	
Math functions	Up to 16 independent functions
Gates	Up to 16 (any function can be used as a gate)
Waveform measurements	Can be made on either main, zoom, or gated region with up to 20 simultaneous measurements
Waveform memories	Four for scope waveforms, one memory that includes all digital channels simultaneously
Voltage (scope channels)	Peak-to-peak, minimum, maximum, average, RMS, amplitude, base, top, overshoot, V overshoot, preshoot, V preshoot, upper, middle, lower, crossing point voltage , pulse top, pulse base, pulse amplitude
Time (digital channels)	Period, frequency, positive width, negative width, duty cycle, delta time
Time (scope channels)	Rise time, fall time, period, frequency, positive width, negative width, duty cycle, Tmin, Tmax, Tvolt, channel-to-channel delta time, channel-to-channel phase, count pulses, burst width, burst period, burst interval, setup time, hold time
Mixed (scope channels only)	Area, slew rate
Frequency domain	FFT frequency, FFT magnitude, FFT delta frequency, FFT delta magnitude
Level qualification	Any channels that are not involved in a measurement can be used to level-qualify all timing measurements
Eye-diagram measurements	Eye height, eye width, eye jitter, crossing percentage, Q factor, and duty-cycle distortion
Measurement modes	
Statistics	Displays the mean, standard deviation, minimum, maximum range, and number of measurement values for the displayed automatic measurements
Histograms	
Source	Waveform or measurement
Orientation	Vertical (for timing and jitter measurements) or horizontal (noise and amplitude change) modes, regions are defined using waveform markers
Measurements	Mean, standard deviation, mean ± 1, 2, and 3 sigma, median, mode, peak-to-peak, min, max, total hits, peak (area of most hits), X scale hits, and X offset hits
Marker modes	Manual markers, track waveform data, track measurements, and delta marker values can be displayed
Waveform math	
Operators	Absolute value, add, AM demodulation, average, gating, Butterworth [1], common mode, differentiate, divide, envelope, FFT magnitude, FFT phase, FIR [1], high pass filter, integrate, invert, LFE [1], low pass filter (4th-order Bessel Thompson filter), magnify, max, min, multiply, RT Eye [1], smoothing, SqrtSumOfSquare [1], square, square root, subtract, versus, chart (MSO models)
Automatic measurements	Measure menu access to all measurements, up to 20 measurements can be displayed simultaneously
Multipurpose	User-selectable for saving images when pressed or taking a series of measurements defined by the user, or other actions
Drag-and-drop measurement toolbar	Measurement toolbar with common measurement icons that can be dragged and dropped onto the displayed waveforms
FFT (FFT viewer is standard)	
Frequency range	DC to 10 GHz (at 20 GSa/s) or 5 GHz (at 10 GSa/s)
Frequency resolution	Resolution = sample rate/memory depth
Window modes	Hanning, flattop, rectangular, Blackman Harris, Hamming

1. Requires MATLAB software and license.

Infiniium S-Series Performance Characteristics (Continued)

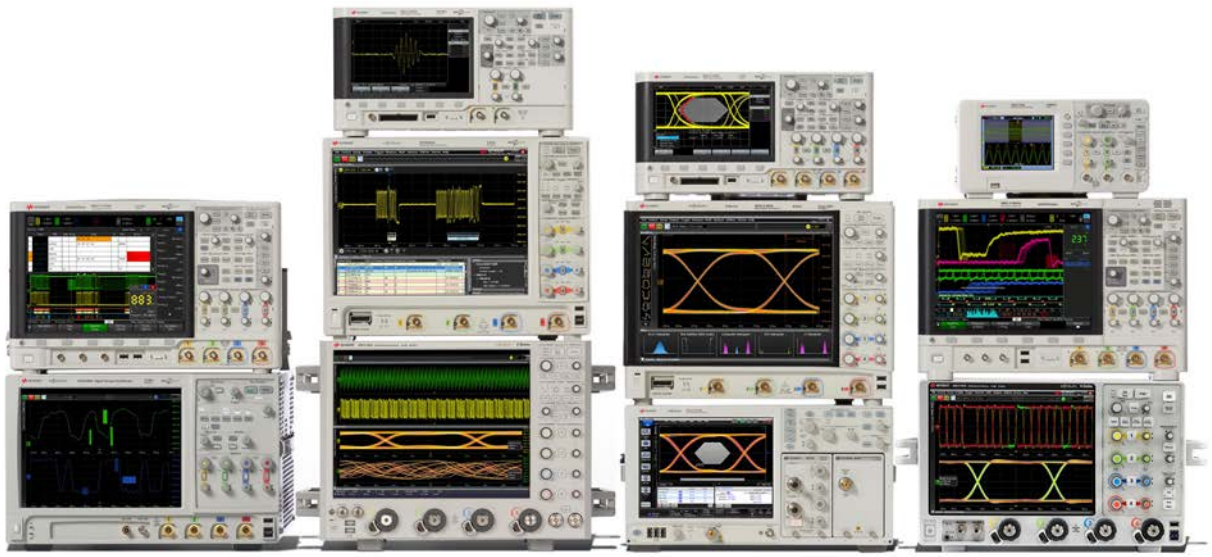
Display, computer system, and IO ports

Display	
Display	XGA 15” capacitive touch screen
Resolution	Infiniium application runs with 1024 pixels horizontally x 768 pixels vertically
Annotation	Up to 100 bookmarks can be inserted into the waveform area. Each can float or be tied to a specific waveform
Grids	Up to 16 grids per waveform area
Waveform windows	Up to 8
Waveform styles	Connected dots, dots, variable persistence, infinite persistence, color graded infinite persistence
Computer system and peripherals, I/O ports	
Computer system and peripherals	
Operating system	Windows 7 Embedded Standard
CPU	3 GHz Intel i5 quad core
PC system memory	8 GB RAM
Drives	≥ 240 GB removable SSD (solid state drive)
Peripherals	Optical USB mouse and compact keyboard supplied. All Infiniium models support any Windows-compatible input device with a USB interface
LXI compliance	LXI class C
IO Ports	
LAN	RJ-45 connector, supports 10Base-T, 100Base-T, and 1000Base-T. Enables Web-enabled remote control, email on trigger, data/file transfers and network printing
USB	7 total ports: – Two USB 2.0 ports on the front – Four USB ports on the side (two are USB 3.0 and two are USB 2.0) – One USB 3.0 port on side supporting up to 200 MB/s data offload
External display	Drivers support up to two simultaneous displays
	DisplayPort and VGA video out
Trigger out	TTL levels into high impedance load
Auxiliary output	DC (± 2.4 V), square wave
Time base reference output	Amplitude into 50 Ω: 1.65 Vpp ± 50 mV sine wave (8.3 dBm ± 0.3 dB) regardless of whether it is derived from the internal or the external reference
	Frequency from internal reference: 10 MHz ± 100 ppb if it has been calibrated within the last year
Time base external reference input (impedance into 50 Ω)	Frequency: 10 MHz ± 20 ppm
	Amplitude: 356 mVpp (–5 dBm) minimum to 5 Vpp (+18 dBm) maximum
File types	
Oscilloscope waveforms: Compressed Internal formats	*.wfm, *.bin, *.h5, and *.osc composite (setup and waveforms)
Larger formats	*.csv, *.tsv, and*.txt
Digital waveform	Support in .osc or .h5 formats
Images	.bmp, .tiff, .gif, .png or .jpg

Infiniium S-Series Performance Characteristics (Continued)

Environmental and general

Temperature	Operating 5 to 40°C
	Non-operating –40 to +65°C
Humidity	Operating up to 90% relative humidity (non-condensing) at +40 °C
	Non-operating up to 90% relative humidity (non-condensing) at +65 °C
Altitude	Operating up to 4,000 meters (12,000 feet)
	Non-operating up to 15,300 meters (50,000 feet)
Vibration	Operating random vibration 5 to 500 Hz, 10 minutes per axis, 0.3 g (rms)
	Non-operating random vibration 5 to 500 Hz, 10 minutes per axis, 2.41 g (rms); resonant search 5 to 500 Hz, swept sine, 1 octave/minute sweep rate, (0.75 g), 5 minute resonant dwell at 4 resonances per axis
Power	100 to 120 V, ± 10% 50/60/400 Hz
	100 to 240 V, ± 10% 50/60 Hz
	Max power dissipated: 380 W
Typical operator noise	35 dB at front of instrument
Weight	Frame: 12 kg (26.4 lbs). Shipping: 20 kg (44.1 lbs)
Dimensions (with feet retracted)	Height: 12.9 in (33 cm); width: 16.8 in (43 cm); depth: 9 in (23 cm)
Safety	CAN/CSA22.2 No. 61010-1-12 UL Std. 61010-1 (3rd Edition)
Electromagnetic compatibility standards	IEC 61326-1:2005/EN 61326-1:2006
	CISPR 11/EN 55011
	IEC 61000-4-2/EN 61000-4-2
	IEC 61000-4-3/EN 61000-4-3
	IEC 61000-4-4/EN 61000-4-4
MTBF (mean time before failure)	110,000 hours (typical)



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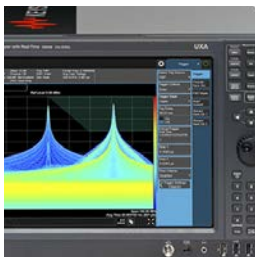
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