

Keysight Technologies

Infiniium S-Series High-Definition Oscilloscopes

Data Sheet



The New Standard for Superior Measurements

Welcome to the Next Generation of Oscilloscope Technology

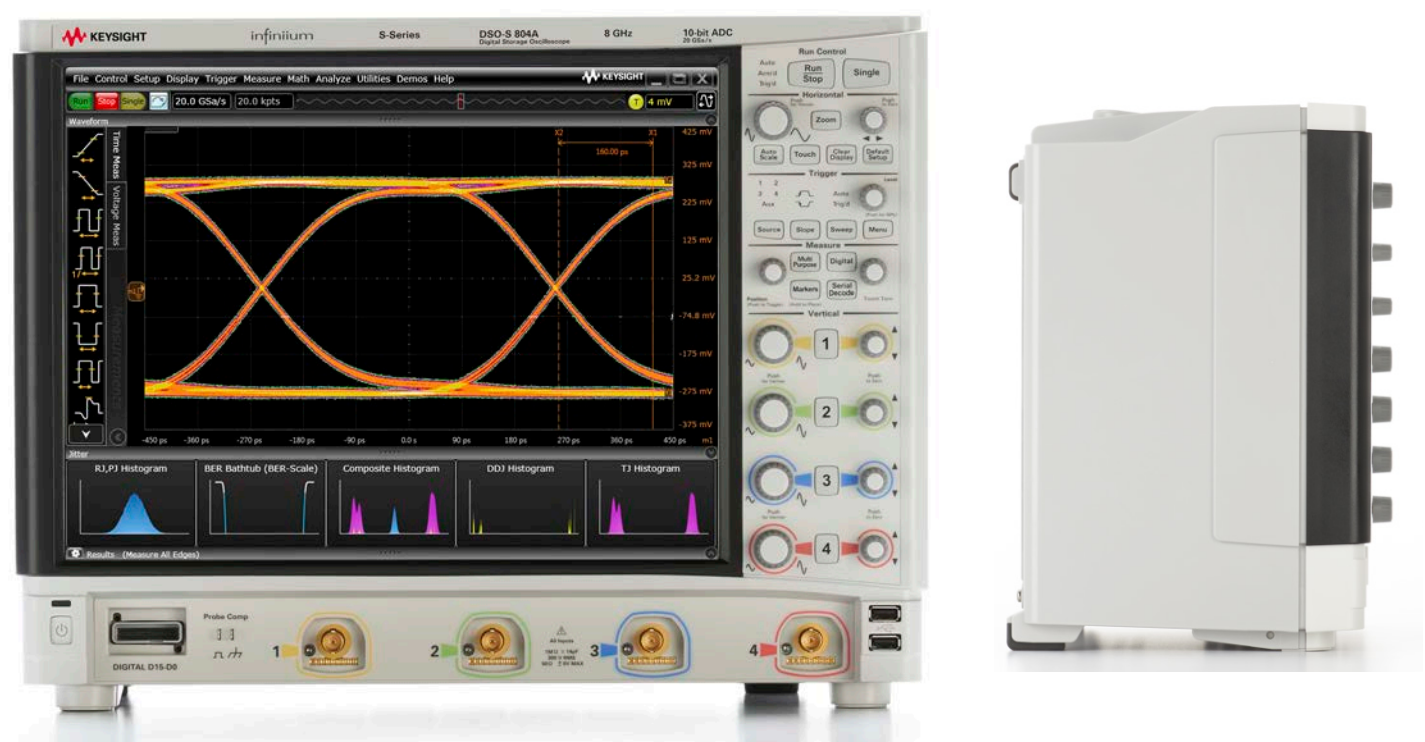
Infiniium S-Series oscilloscopes incorporate innovative technology designed to deliver superior measurements.

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.

| DSO models 4 scope channels | MSO models 4 scope channels + 16 digital channels | Scope channels | | ADC bits | Standard memory depth | User-installed bandwidth upgrades |
|--------------------------------|---|---------------------|--|-------------|---|--------------------------------------|
| | | Analog bandwidth | Max sample rate | | | |
| 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

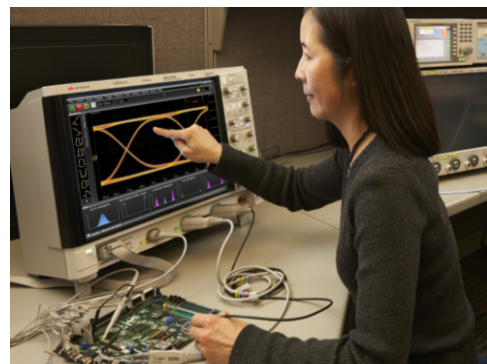
Industry's best signal integrity

- 10-bit ADC up to 8 GHz for additional vertical resolution
- Low-noise front end for precision signal viewing
 - Only 90 μ V 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 M Ω 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 M Ω 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 M Ω input support, each path with bandwidth limit filter support
- Analog and DSP bandwidth limit filters to reduce unwanted noise
- 90 μ V 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 M Ω 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 BiCMOS IC that incorporates user-selectable analog filters and bandwidth upgrades via a software license.

Industry's Best Signal Integrity (Continued)

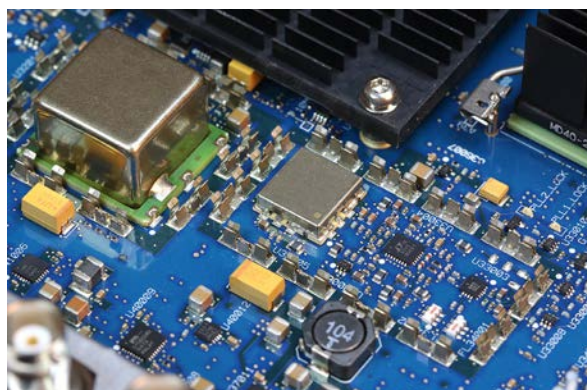
S-Series next-generation technology blocks enable superior measurements (Continued)

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.

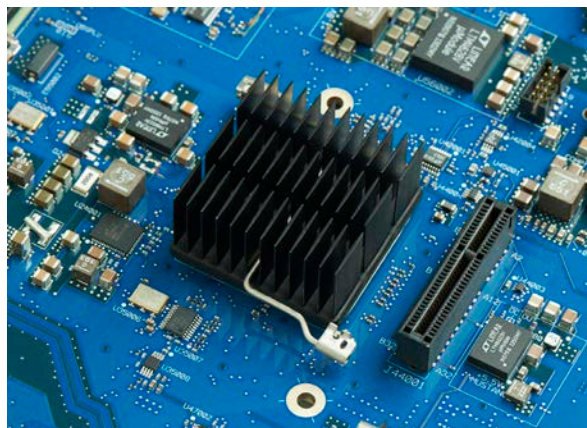
- Best-in-industry time scale accuracy of 12 parts per billion after calibration for accurate deep-memory measurements
- Low jitter measurement floor with 100 fs (typical) of intrinsic jitter



Signal processing in hardware

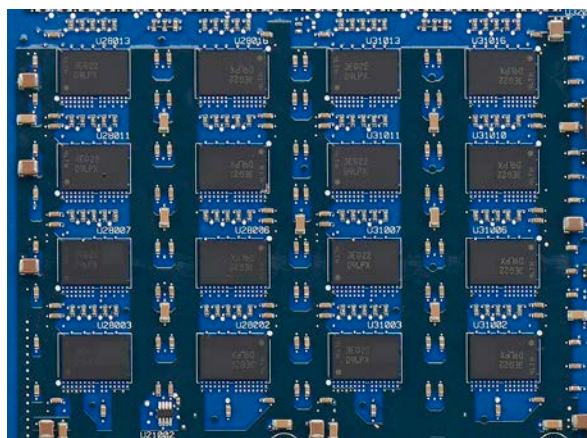
S-Series oscilloscopes are built with an advanced FPGA dedicated for fast and precise signal processing. The technology produces the fastest deep memory responsiveness in the industry and provides additional hardware filtering for superior measurements.

- 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

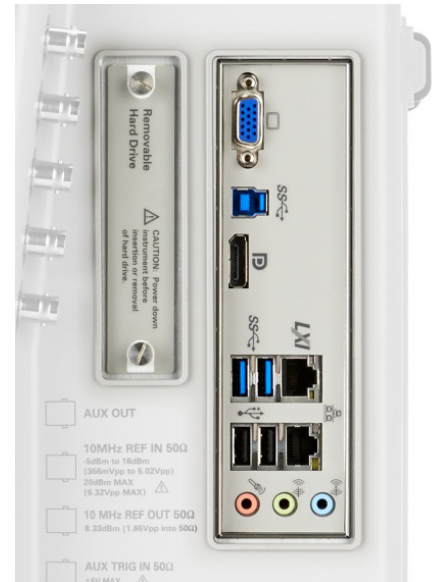
S-Series platform standard features

240 GB removable SSD

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

Powerful motherboard

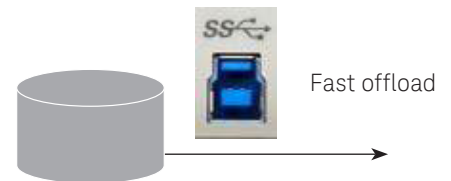
- 3 GHz Intel i5 quad core processor with 8 GB RAM for fast computations – even with advanced math and deep memory
- IO
 - Ethernet 10/100/1000bT
 - 6 USB device ports (2 in front, 4 on side two of which are USB 3.0)
 - DisplayPort and VGA video out. Drivers support up to two simultaneous displays



Fast data offload

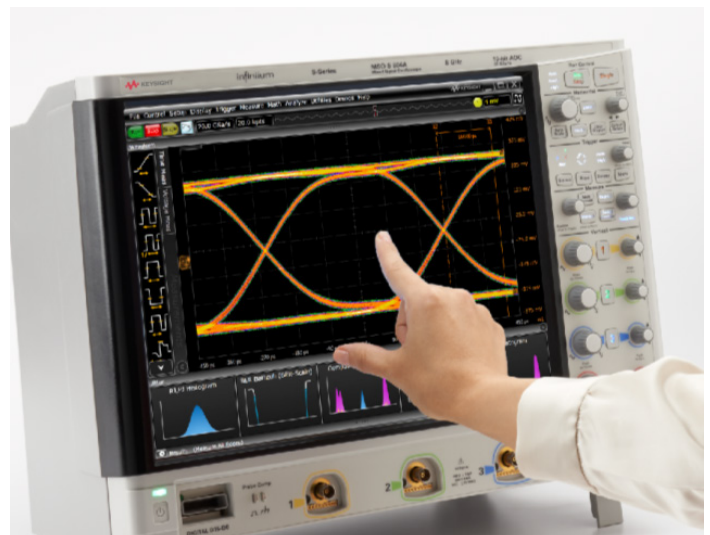
Have an application that requires programmatically accessing oscilloscope data?

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



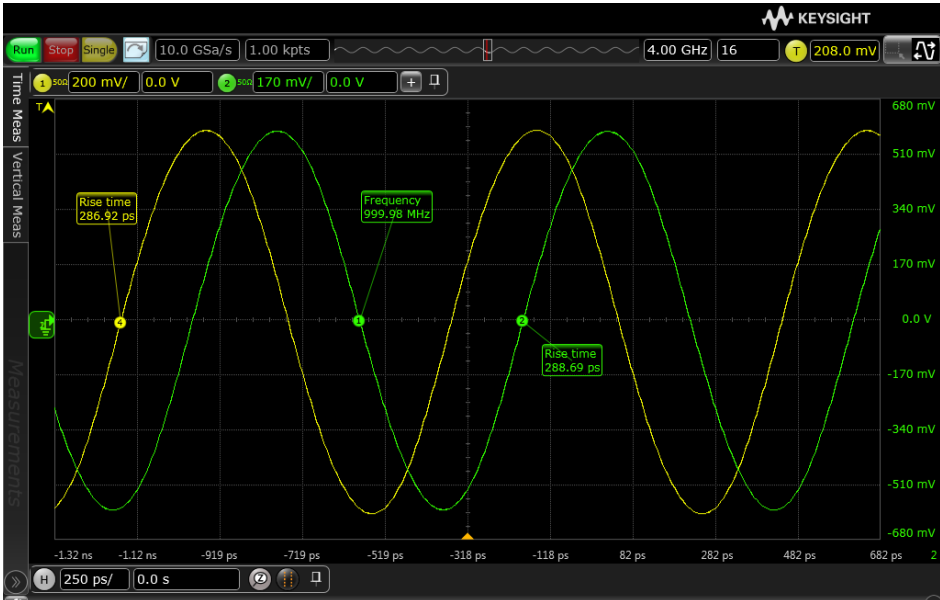
Touch-screen innovation

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).

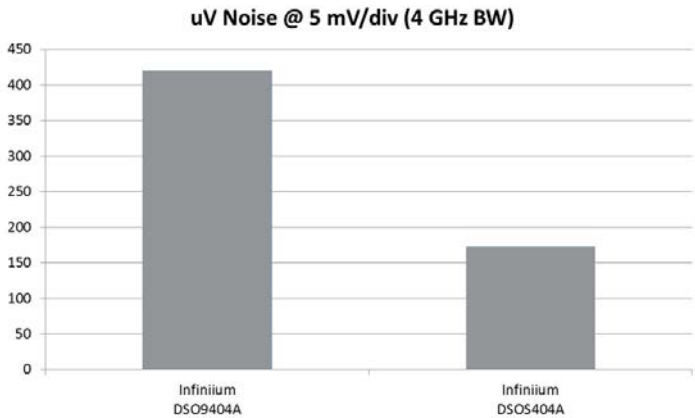


Oscilloscope Overview

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. Oscilloscopes 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 addition 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.



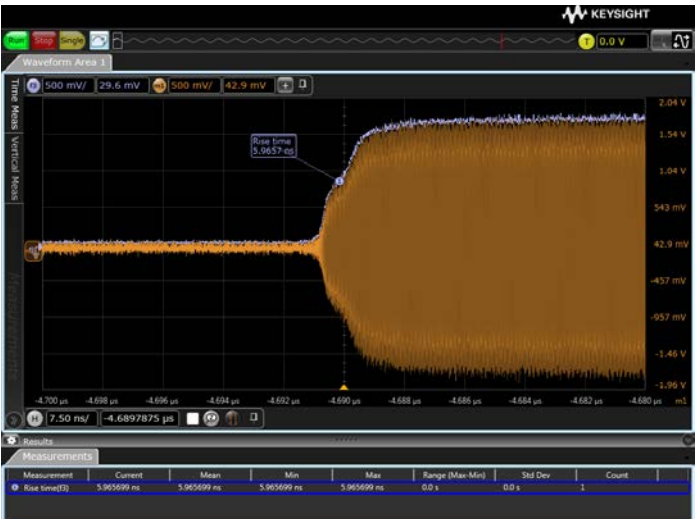
Gated FFTs

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.

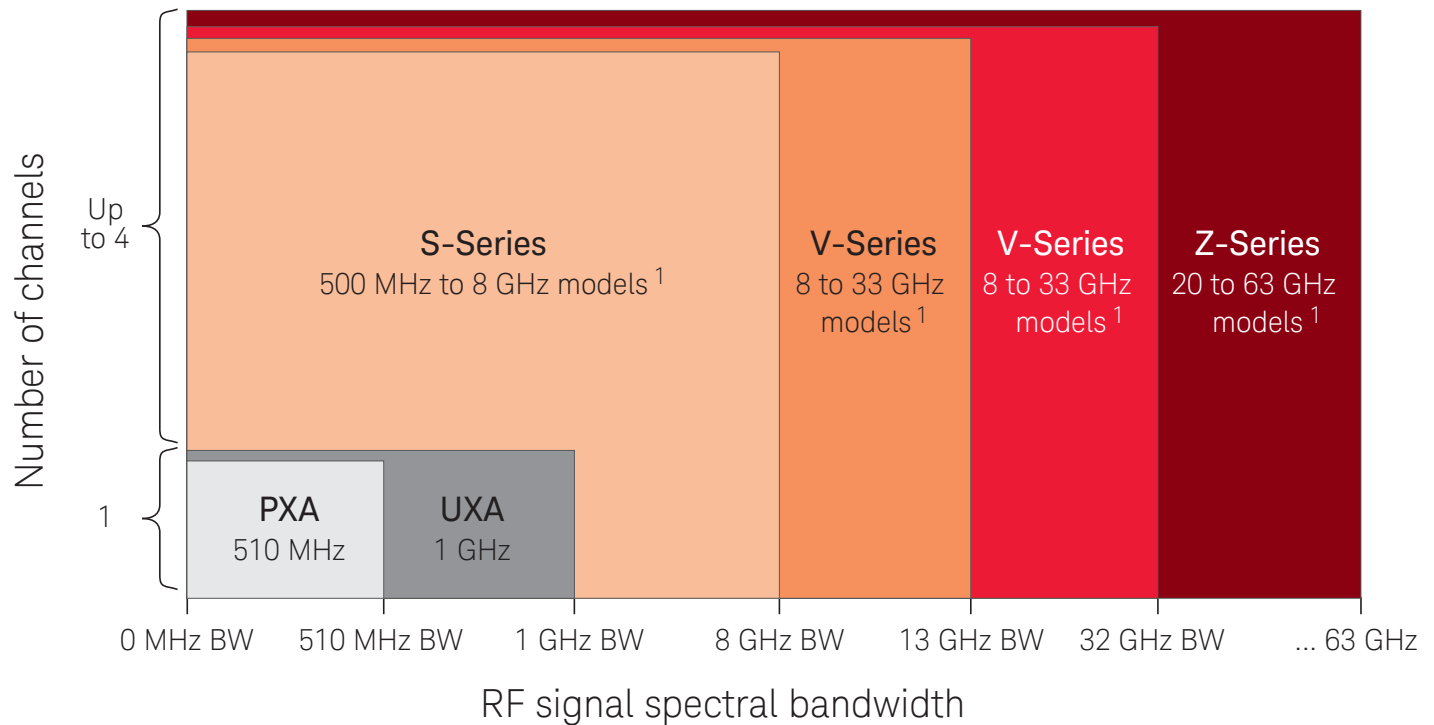


Oscilloscope Overview – Frequency Domain (Continued)

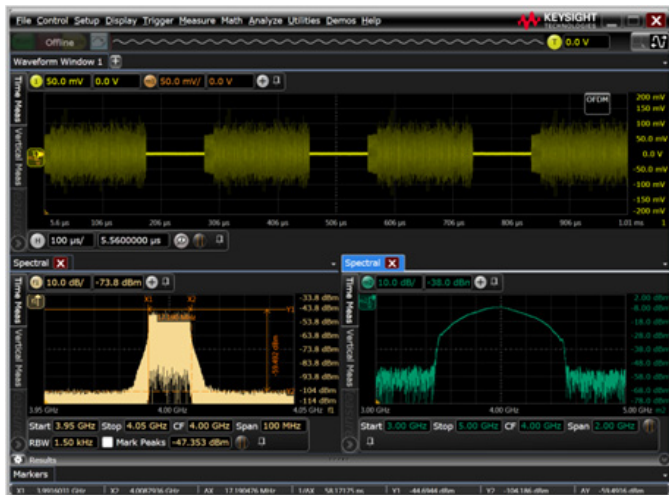
Wideband and multi-channel FFTs

Need to see > 1 GHz signal spectral bandwidth and/or multiple FFTs simultaneously? Oscilloscopes offer wider bandwidth than spectrum analyzers and come standard with four ports (channels) per instrument.

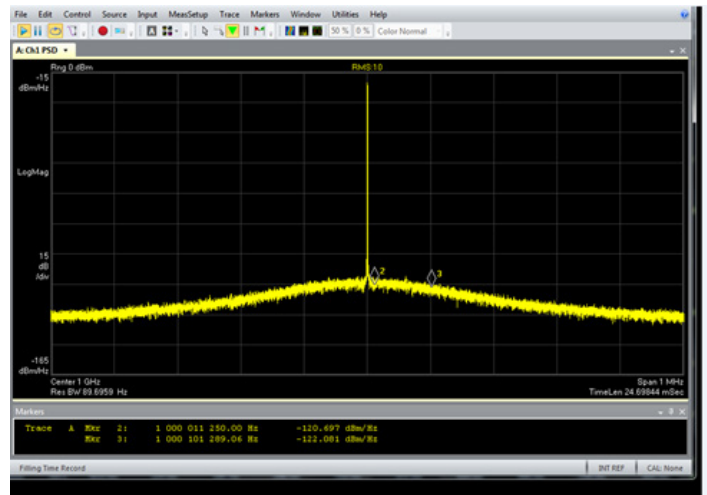
Infiniium S-Series enables users to make wideband measurements up to 8 GHz and up to 16 simultaneous FFTs. Analyze even higher bandwidth signals by combining with a down converter.



1. Full bandwidth on 2-channel operation, half bandwidth on 4-channel operation.



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

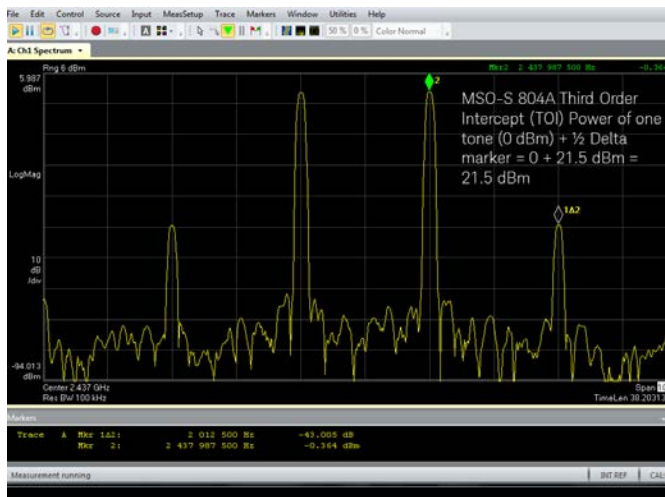


Use Infiniium capture and analysis of radar bursts, as shown in this OFDM example.

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 | |
| – 100 kHz offset | |
| | –121 dBc/Hz –122 dBc/Hz |
| EVM | –47 dB (0.47%) |
| – 802.11 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, 2.436 GHz and 2.438 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 | |
| – ≥ 50 mV/div, 0-7 GHz | |
| | –15 dB; 1.4 VSWR –19 dB; 1.25 VSWR |



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



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.

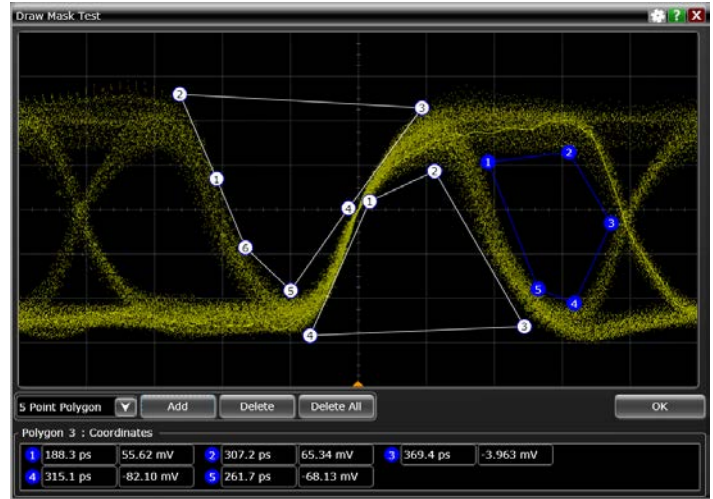
- Click once to see handles that enable touch manipulation of markers, trigger level, and waveform-tasks that previously required a mouse
- Multi-touch support for multi-touch (gestures) such as zooming and panning
- Auto-sizing when touch button is turned on/off optimizes fields for fingers or a mouse



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

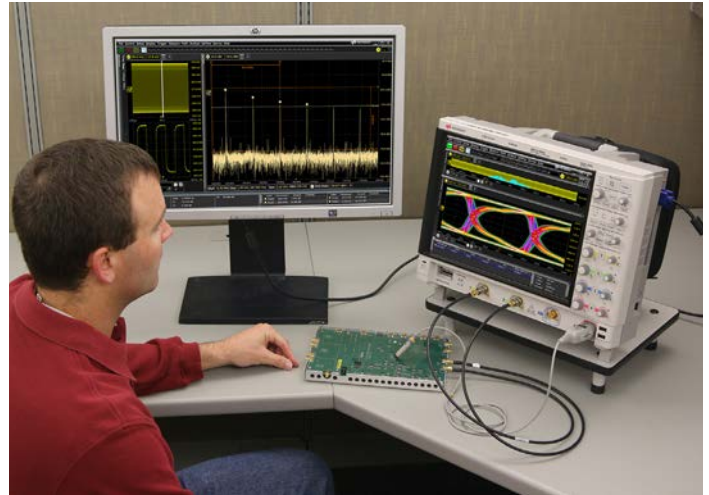
Easily find and run the test you need from the list of analysis/measurement options represented graphically in the analysis gallery.



Using an External Monitor

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

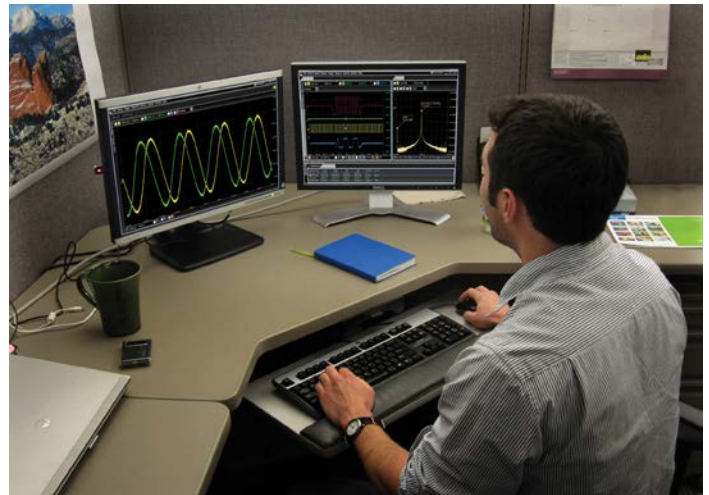
S-Series supports both VGA and DisplayPort IO.



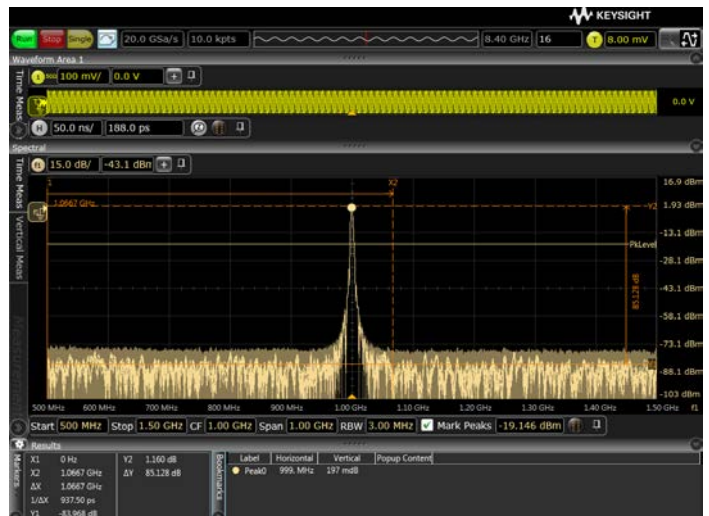
Infiniium Offline Application



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

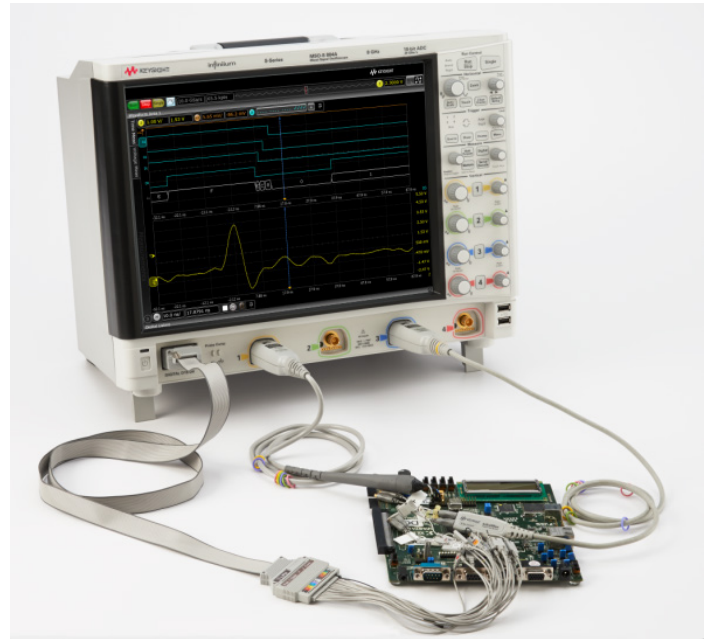
MSO models add 16 high-speed timing channels with standard 128 Mpts digital memory, allowing you to retain fast 2 GSa/s sample rates over long periods of time. All DSOs are user-upgradable to MSOs. The required upgrade time is less than 5 minutes.



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

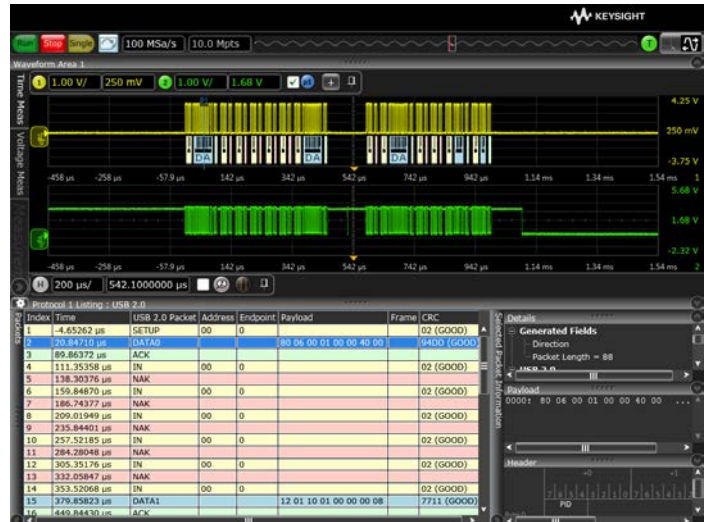
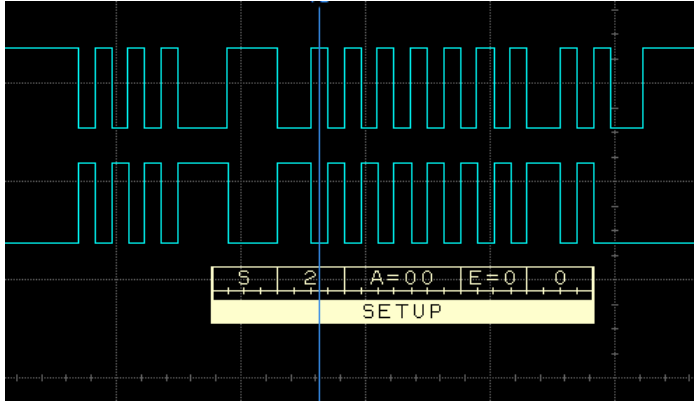
- Trigger on and view specific control or data flow events
- Use digital channels for protocol trigger and decode (I²C, SPI, RS-232, JTAG, USB and more)
- Capture data from FPGA debug ports
- Trigger on and monitor power rail sequencing timing relationships
- Combine with oscilloscope channels to trigger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



| Optional application description | License type | | |
|---|---|--------------------------------------|--------------------------------------|
| | Fixed | Floating | |
| Protocol | Factory-installed on new scope purchase or user-installed on existing scope | User-installed transportable license | Server-based license (N5435A option) |
| 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 |
| I ² C, SPI, and RS-232/UART protocol decode and triggering | N8800B-1FP | N8800B-1TP | N/A |
| I ² C/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 SM 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 SM 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

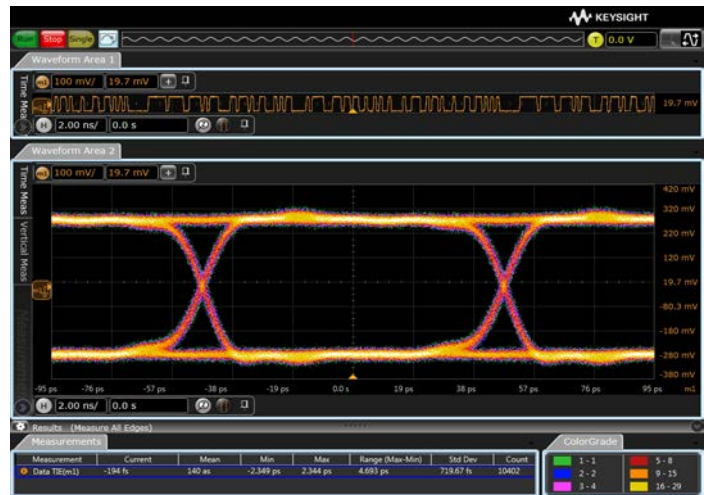
InfiniiScan

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.

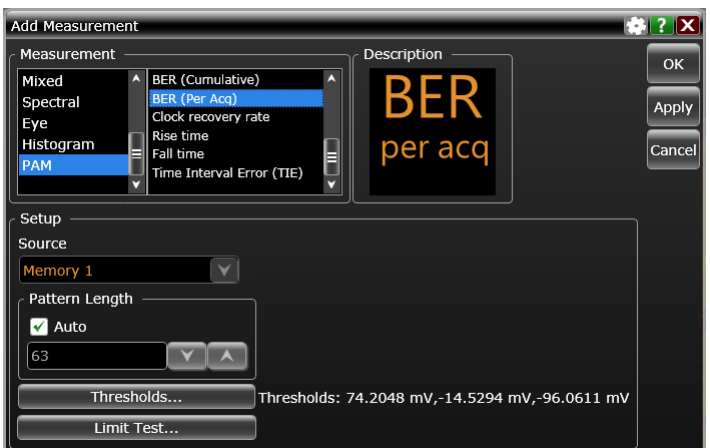
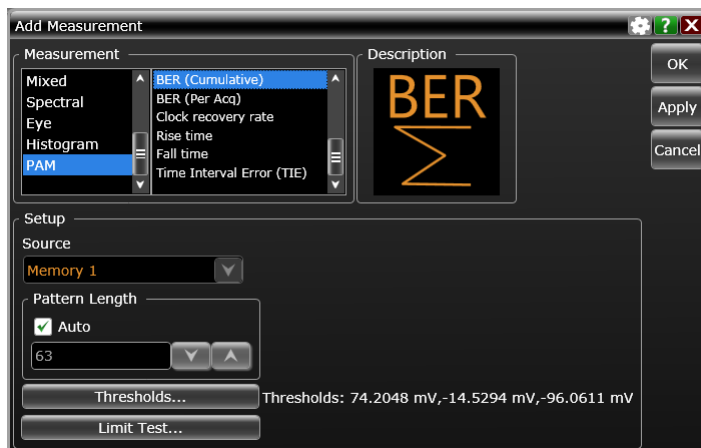
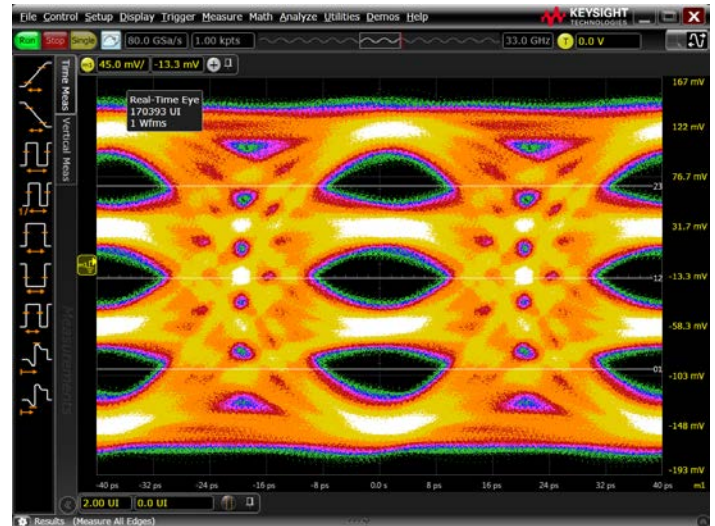
- Identify the aggressor and victim
- Report the amount of crosstalk
- Remove crosstalk and analyze



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

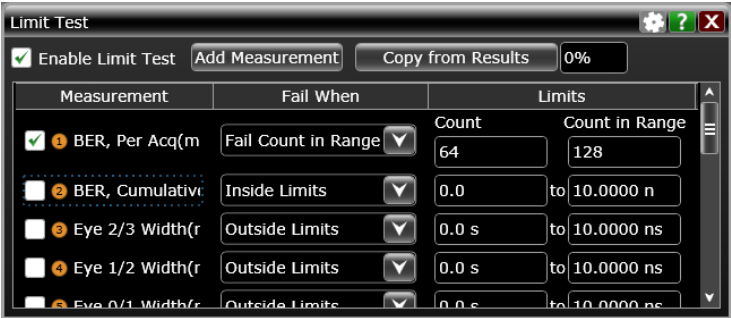


Analysis Applications (Continued)

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.

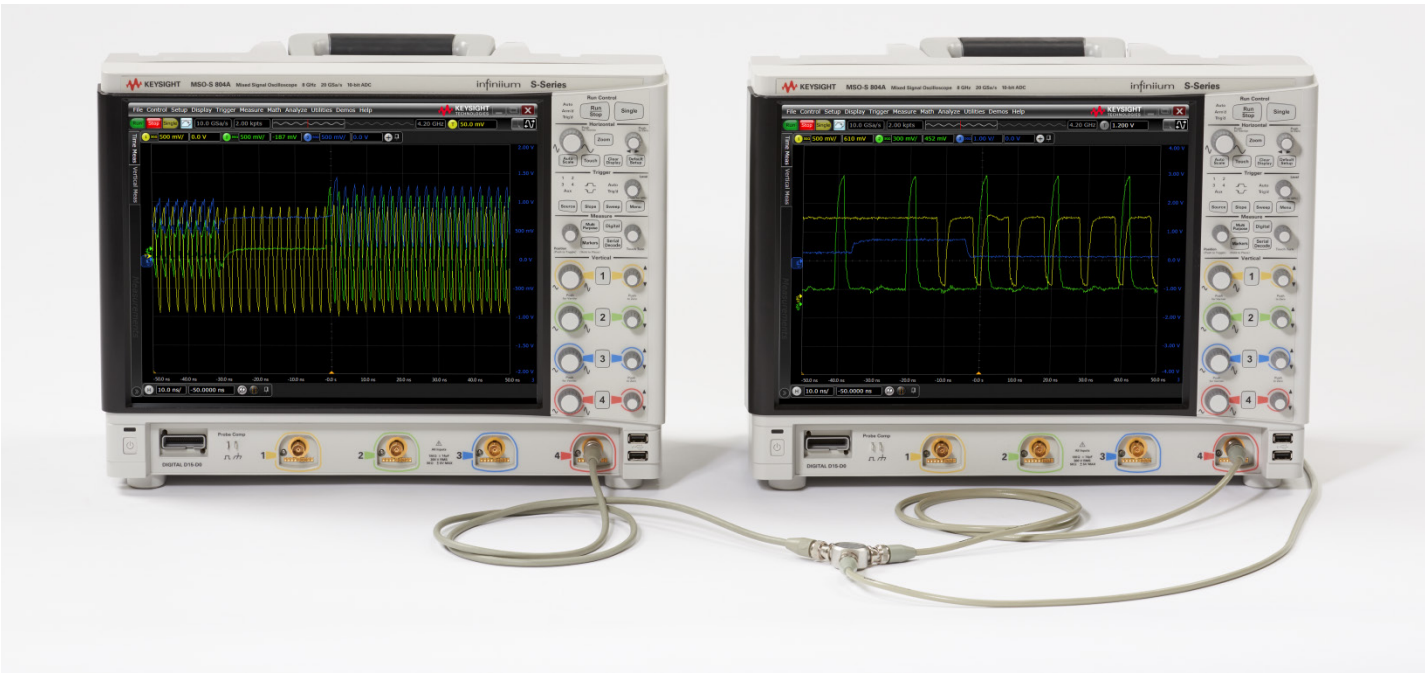


Analysis Applications (Continued)

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.



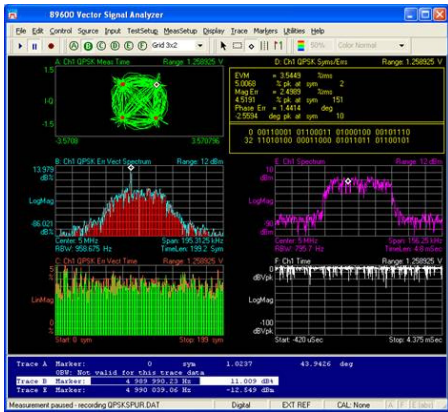
Other Popular Applications

National Instrument Drivers

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

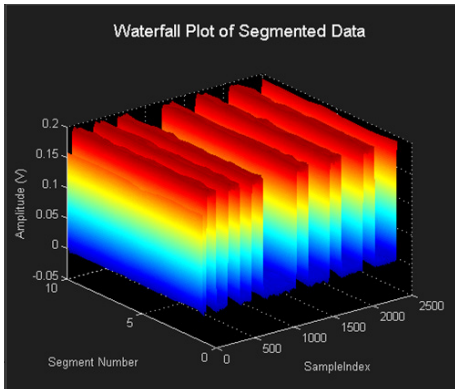
Vector Signal Analysis

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.



| Optional application description | License type | | |
|--|---|--------------------------------------|--------------------------------------|
| | Fixed | Floating | |
| | 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

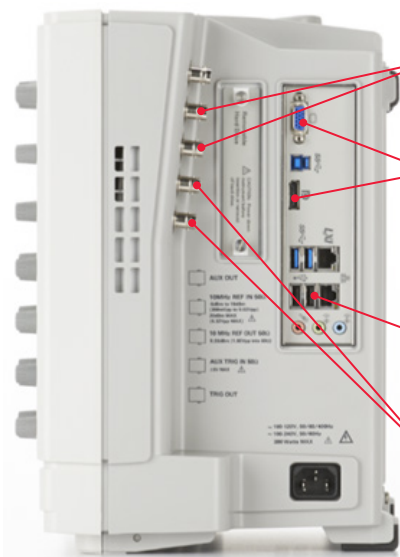
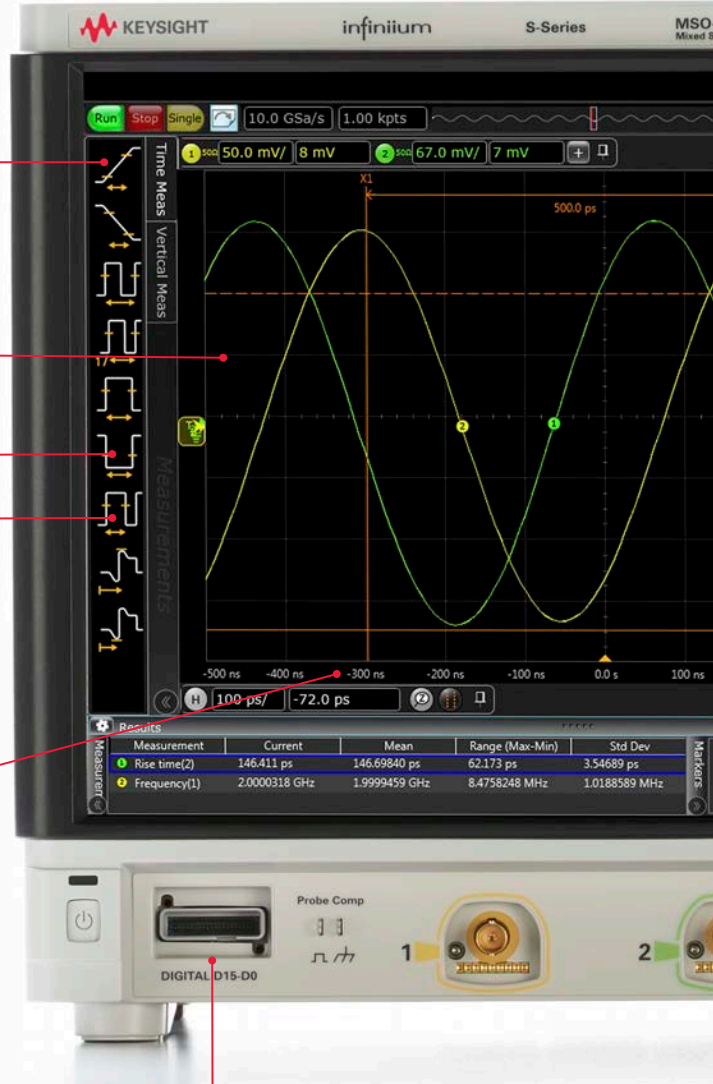
Measurements

- 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)



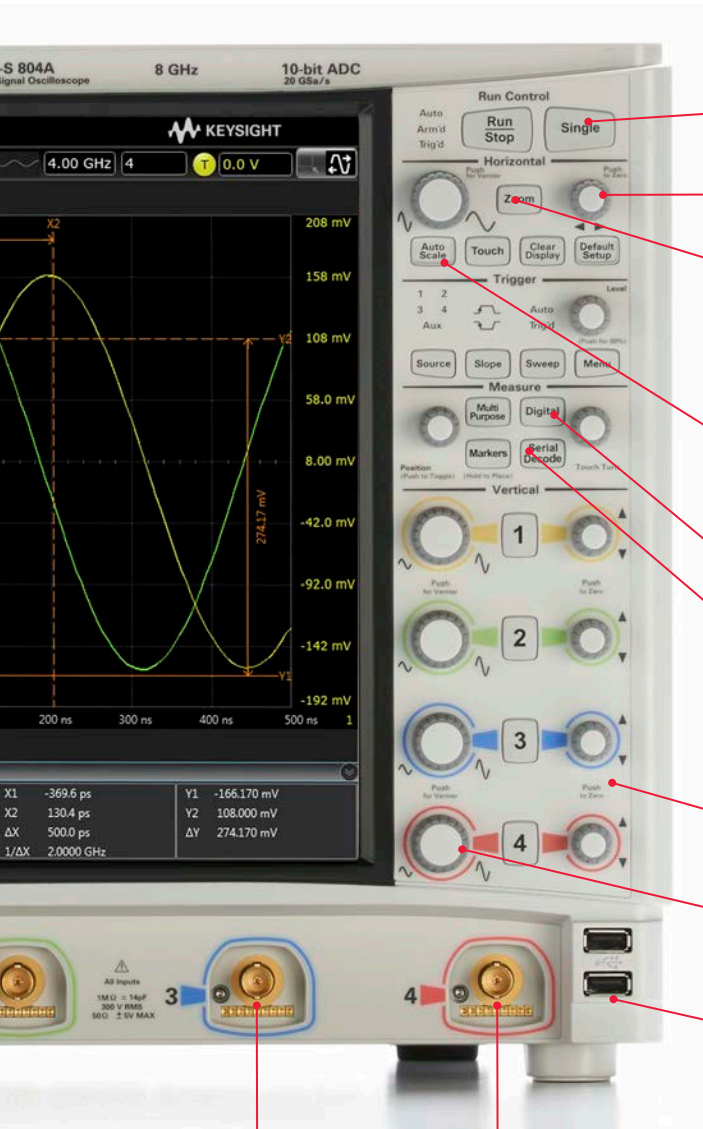
Built-in 10-MHz reference in/out ports synchronizes multiple measurement instruments in a system

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

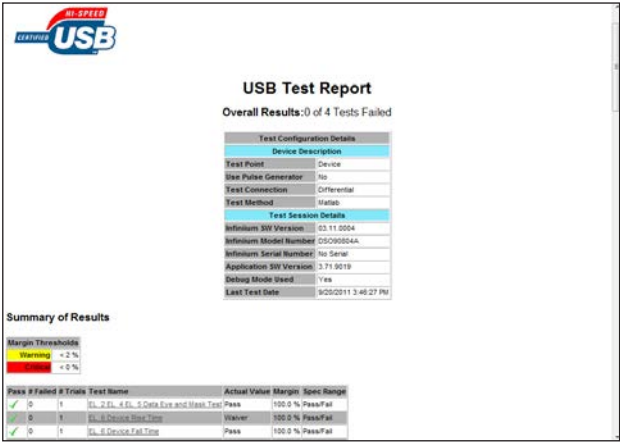
AutoProbe interface automatically configures the attenuation ratio of the probe and provides probe power for Keysight's active probes



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?

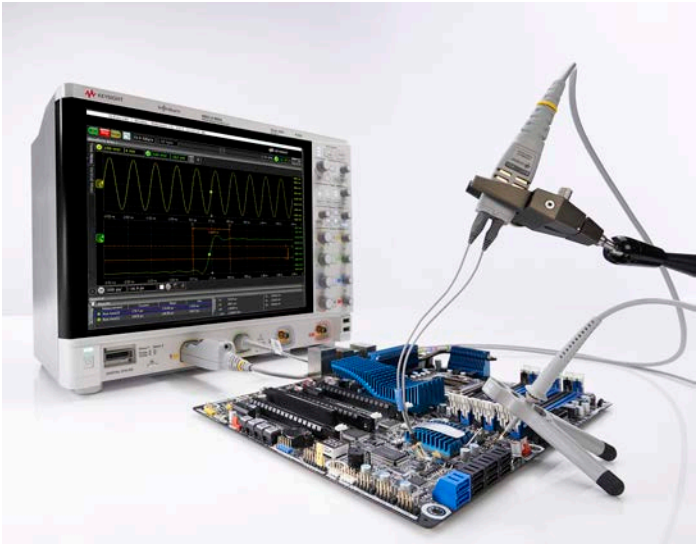
Consider Keysight’s Z-Series, 90000A Series, or V-Series.

Probes Overview

S-Series oscilloscopes include both 1 M Ω 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 and accessories.



| 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 \pm 24 V offset | N7020A |

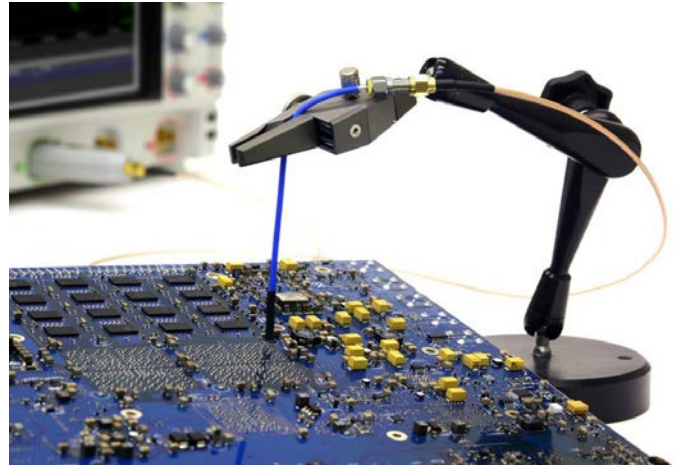
Probes and Accessories Overview

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 probe's 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.

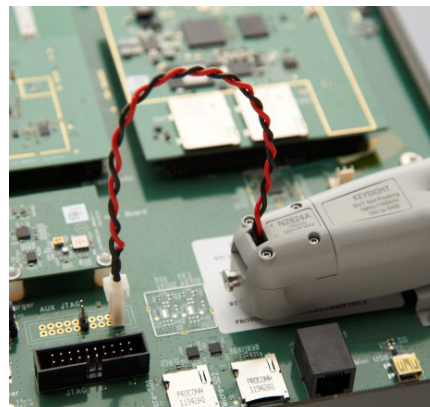
Go to www.keysight.com/find/InfiniiMode for additional information.



N2820A Series high-sensitivity current probes

Need to measure small currents? The N2820A Series high-sensitivity current probes can measure down to 50 μ A 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 μ V.

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



Keysight Portfolio Compare



| Family | InfiniiVision 6000 X-Series | Infiniium 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 M Ω input) | Yes. Extensive | Yes. Extensive |
| Bandwidth correction filters | No | No | Yes | Yes |
| Probe inputs | 50 Ω and 1 M Ω | 50 Ω and 1 M Ω | 50 Ω and 1 M Ω | 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 Cruzor (<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

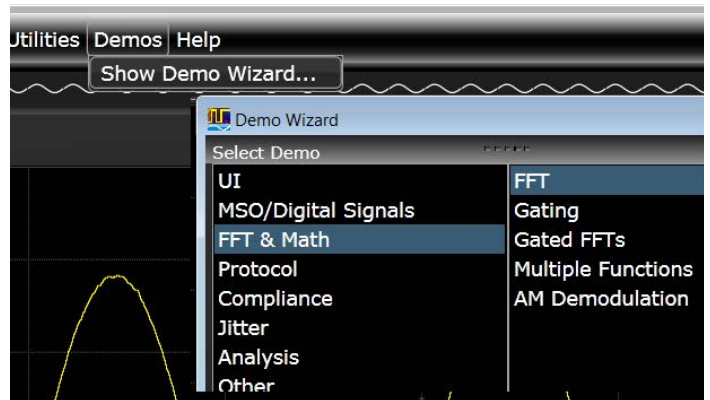
Mount your S-Series oscilloscope in an 8U high, 19" (487 mm) wide rack with the N2902B rack mount kit. The sturdy kit provides additional BNCs on the rack mount front panel for BNC in/out signals on the side of S-Series models.



Take a Quick Look Using Demo Wizard and USB Demo Board

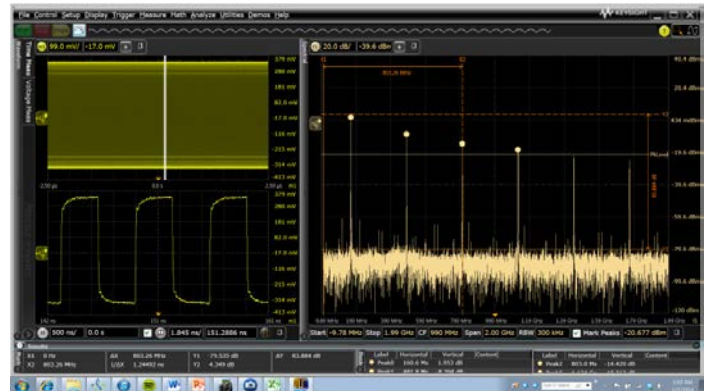
Evaluate using demo wizard waveforms

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.

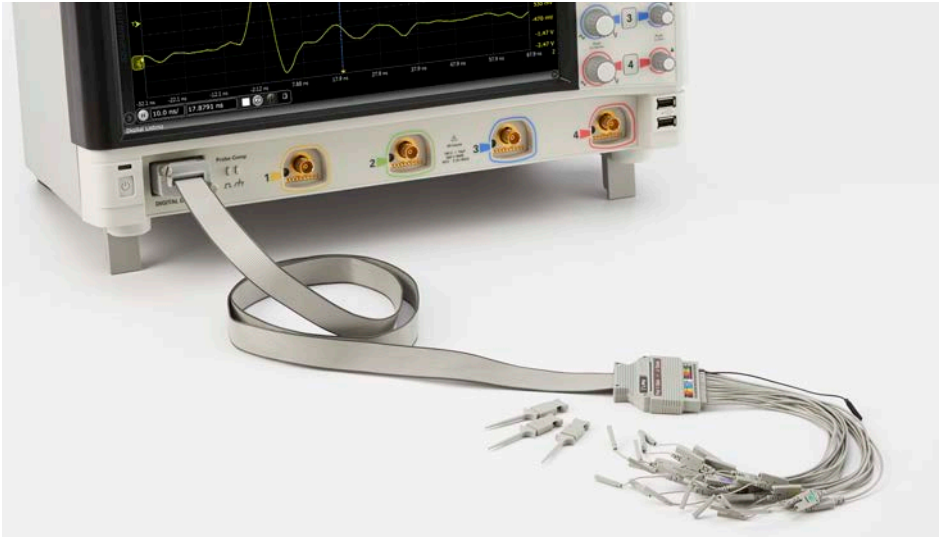
| Acquisition memory depth upgrade | Option # on new scope | N2113A Option # (for previously purchased scopes) |
|---|-----------------------|--|
| Increase to 100 Mpts/200 Mpts (4-ch/2-ch) | DSOS000-100 | 100 |
| Increase to 200 Mpts/400 Mpts (4-ch/2-ch) | DSOS000-200 | 200 |
| Increase to 400 Mpts/800 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 |
| DSOS2G5BW | 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 |
| GPIO to LAN adapter | N4865A |

| DSO models 4 scope channels | MSO models 4 scope channels + 16 digital channels | Scope channels | | ADC bits | Standard memory depth | User-installed bandwidth upgrades |
|--------------------------------|---|---------------------|--|----------|---|--------------------------------------|
| | | Analog bandwidth | Max sample rate | | | |
| 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 M 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, 2 V, 5 V. Testing is at maximum sample rate.

4. Calculation based on $\text{Tr} = 0.43/\text{BW}$.

5. Calculation based on $\text{Tr} = 0.31/\text{BW}$.

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 M Ω input, vertical scaling is multiplied by 10.

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 | $\sqrt{\left(\frac{\text{Noise Floor}}{\text{Slew Rate}}\right)^2 + (\text{Intrinsic Jitter})^2}$ | | |
| – Period jitter | $\sqrt{2} \cdot \sqrt{\left(\frac{\text{Noise Floor}}{\text{Slew Rate}}\right)^2 + (\text{Intrinsic Jitter})^2}$ | | |
| – Cycle-cycle/N-cycle jitter | $\sqrt{3} \cdot \sqrt{\left(\frac{\text{Noise Floor}}{\text{Slew Rate}}\right)^2 + (\text{Intrinsic Jitter})^2}$ | | |
| Inter-channel jitter measurement floor ^{2,3,5} | $\sqrt{\left(\frac{\text{Time Interval}}{\text{Error (Edge1)}}\right)^2 + \left(\frac{\text{Time Interval}}{\text{Error (Edge2)}}\right)^2 + (\text{Inter channel Intrinsic Jitter})^2}$ | | |

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

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

- 256 averages

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

-
- Inter-channel
 - No averaging

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

- 256 averages

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

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 (hardware serial trigger) | Requires specified protocol option, I²C, 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, T _{min} , T _{max} , T _{volt} , 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 \pm 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)

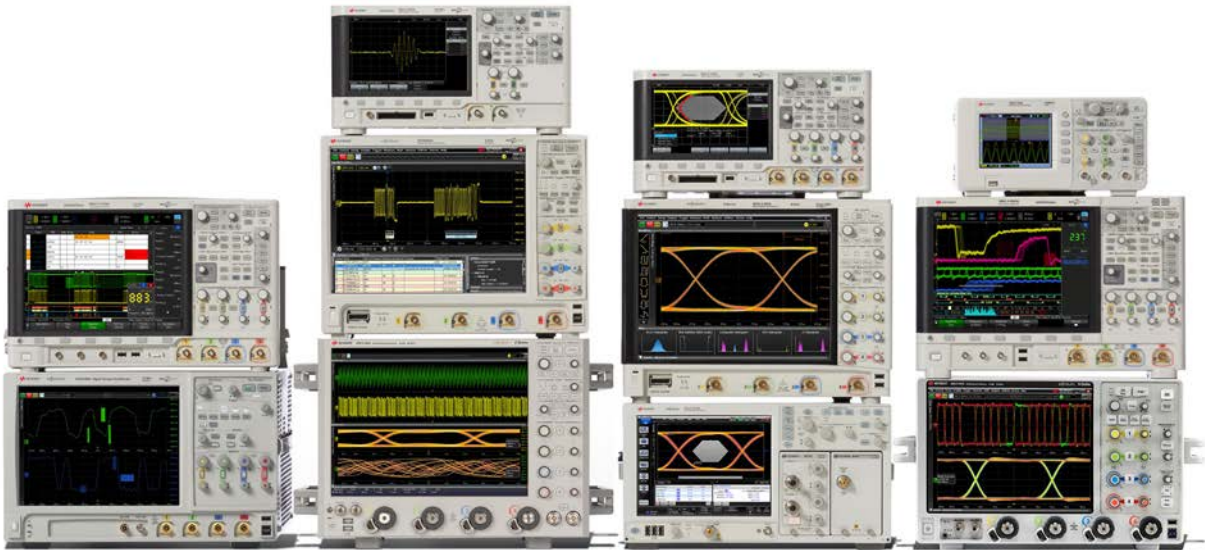
Display, computer system, and IO ports

| | |
|--|--|
| 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: <ul style="list-style-type: none"> – 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 \pm 50 mV sine wave (8.3 dBm \pm 0.3 dB) regardless of whether it is derived from the internal or the external reference Frequency from internal reference: 10 MHz \pm 100 ppb if it has been calibrated within the last year |
| Time base external reference input (impedance into 50 Ω) | Frequency: 10 MHz \pm 20 ppm Amplitude: 356 mVpp (–5 dBm) minimum to 5 Vpp (+18 dBm) maximum |
| File types | |
| Oscilloscope waveforms: | |
| Compressed | *.wfm, *.bin, *.h5, and *.osc composite (setup and waveforms) |
| Internal formats | |
| 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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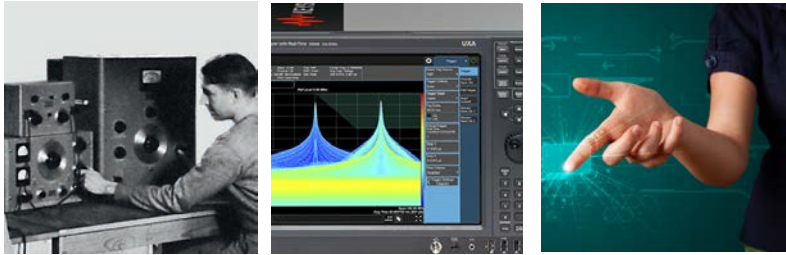


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