DATA SHEET

Infiniium EXR-Series

Powerful. Easy to Own. Intuitive to Use.

KEYSIGHT TECHNOLOGIES

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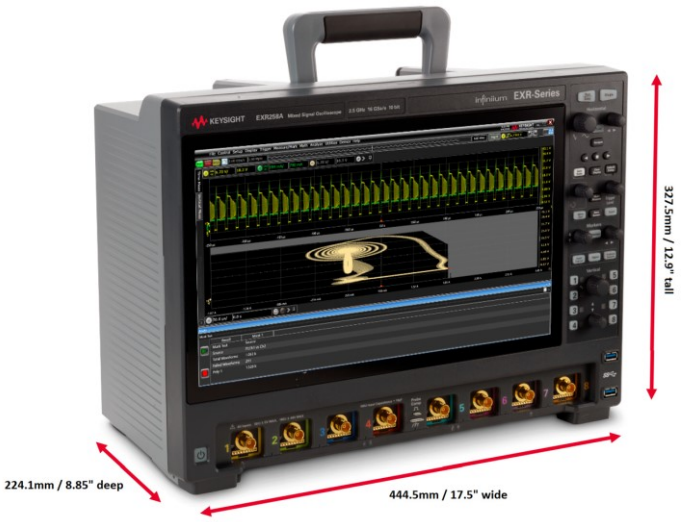
Meet the Infiniium EXR-Series

Welcome to your all-new Infiniium EXR-Series. With eight models ranging in performance from 500 MHz to 2.5 GHz, 4 or 8 analog channels, and dozens of hardware and software options, your Infiniium EXR-Series is powerful, easy to own, and intuitive to use.

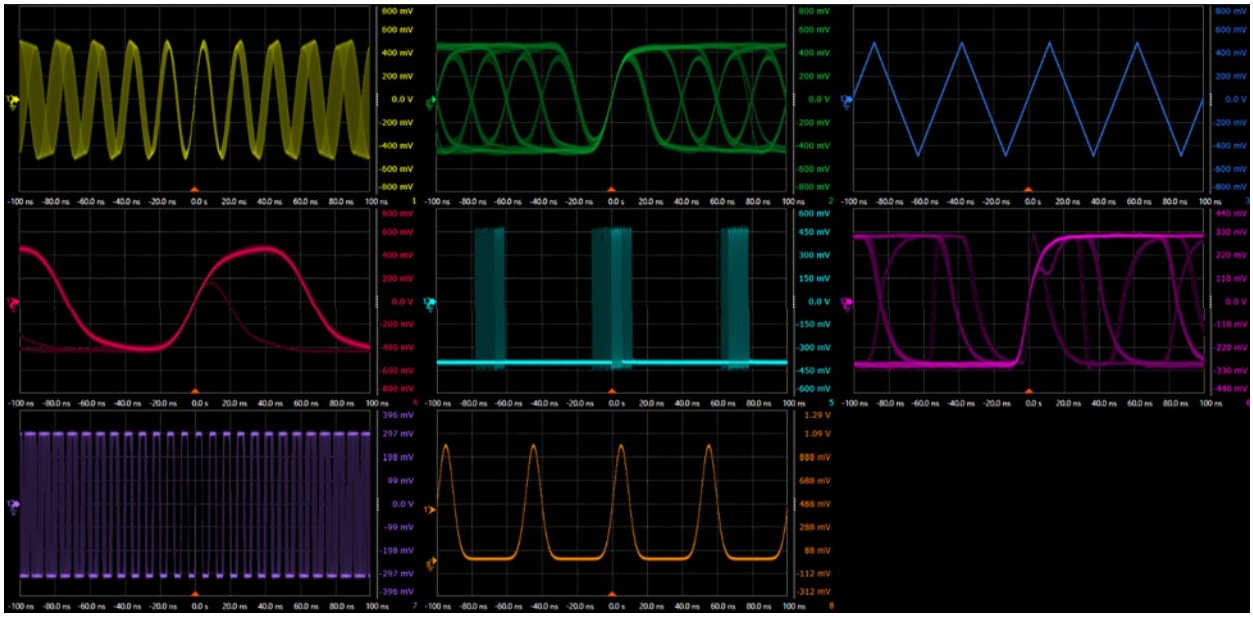


Infiniium MXR-Series Specifications	
Analog channels	4 or 8, *upgradeable*
Bandwidth	500 MHz to 2.5 GHz, *upgradeable*
Sample rate	16 GSa/s on every channel
Memory	100 Mpts, upgradeable to 400 Mpts or new 1.6 Gpts flexible memory [1]
Resolution	10 bits, up to 16 with high resolution
Digital logic channels	16, dedicated input, *upgradeable*
Update rate	> 200,000 wfm/s
Screen display	15.6” touch, full HD, dual screen support

1. See data sheet spec tables to learn more about the all-new 1.6 Gpts combined flexible memory option.

Model numbers	4 Channels	8 Channels
500 MHz	EXR054A	EXR058A
1 GHz	EXR104A	EXR108A
2 GHz	EXR204A	EXR208A
2.5 GHz	EXR254A	EXR258A

Integrated Tools	Option
16 digital channels	EXR2MSO
50 MHz waveform generator	EXR2WAV
4-digit DVM, 10-digit counters	Standard
Protocol analysis	Various
Bode plotter	Included with D9010PWRA or EXR2WAV



See More in the Time Domain with Eight Analog Channels

The Infiniium EXR-Series offers up to 2.5 GHz bandwidth and 16 GSa/s sample rate on every single one of its four or eight channels. Combined with 100 Mpts of standard memory per channel, flexible three-stage triggering, over 50 standard measurements, a massive library of application specific packages, and ASIC-accelerated testing, the Infiniium EXR-Series lets you see more of your signal than ever before.

See More with World-Class Signal Integrity

Each model incorporates a 10-bit ADC with a sample rate of 16 GSa/s available on all channels simultaneously. A high-resolution ADC's usefulness is dependent on the low-noise front end that supports the additional quantization levels. Our low noise front end includes custom ICs, like the 130 nm BiCMOS IC that incorporates user-selectable analog filters and bandwidth upgrades via a software license. This gives you:

- Four times more vertical resolution than 8-bit oscilloscopes
- Up to 16 bits with high-res mode
- As low as 43 µV of noise, 9.0 bits system ENOB with hardware filtering

See More Information with History Mode and Segmented Memory

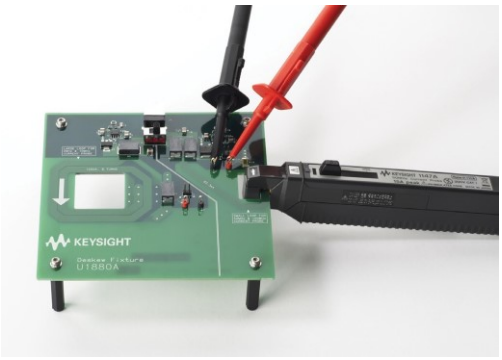
Your Infiniium EXR-Series comes standard with two useful tools that allow you to look forward and backward in time. With history mode, simply stop the oscilloscope at any time to review up to 1,024 previous trigger events. With segmented memory, you can capture >100,000 events post-trigger for analysis, with no limit between events. If your design has an elusive event that only seems to happen when you're not around, these tools can help you arm the oscilloscope to look for it, then let you review what gets captured at your leisure. And with a full HD screen of 1920x1080 pixels, and support for a second, independent external monitor, that data can be organized and displayed however is best for you.

Powerful Measurement Capabilities

Switch Mode Supplies – D9010PWRA

The Power Measurements Software Package enables a broad range of automated power supply characterization measurements on your EXR-Series oscilloscopes including unique frequency response analysis for performing control loop response and power supply rejection ratio (PSRR) measurements.

While designed to measure the rigorous operating parameters of switched mode power supplies, the measurements can also be used as a toolkit of measurements for any power converter and/or inverter. These measurements provide an ideal method to document the performance parameter of your power system. Each measurement has a Setup Wizard that makes setup of connections and analysis as simple as possible. Check the D9010PWRA data sheet for descriptions of each of the measurements outlined in the table below.



The Keysight U1880A allows you to quickly deskew your voltage and current probes, enabling accurate and precise power measurements.

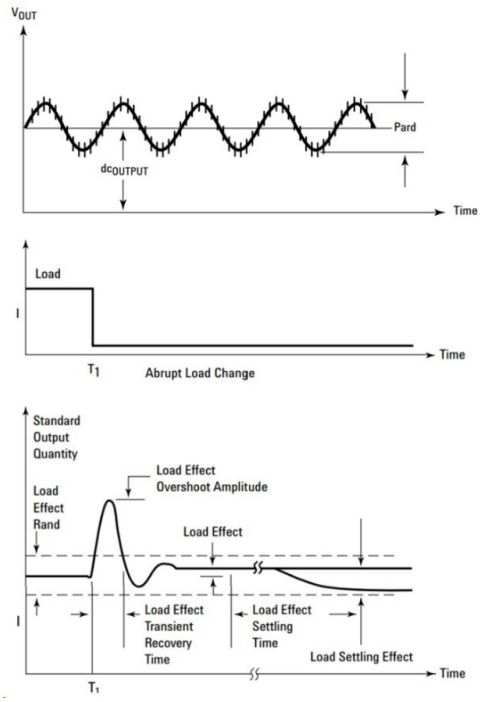
Input Analysis	Switching Device Analysis	Output Analysis	Frequency Response Analysis
Real Power	Switching Loss	Output Ripple	PSRR
Apparent Power	RDS(ON)	Turn On/Off Time	Control Loop Response
Reactive Power	VCE(SAT)	Efficiency	Bode Plots
Power Factor	Slew Rate	Transient Response	
Crest Factor	Modulation Analysis		
Phase Angle	Safe Operating Area		
Current Harmonics			
Inrush Current			

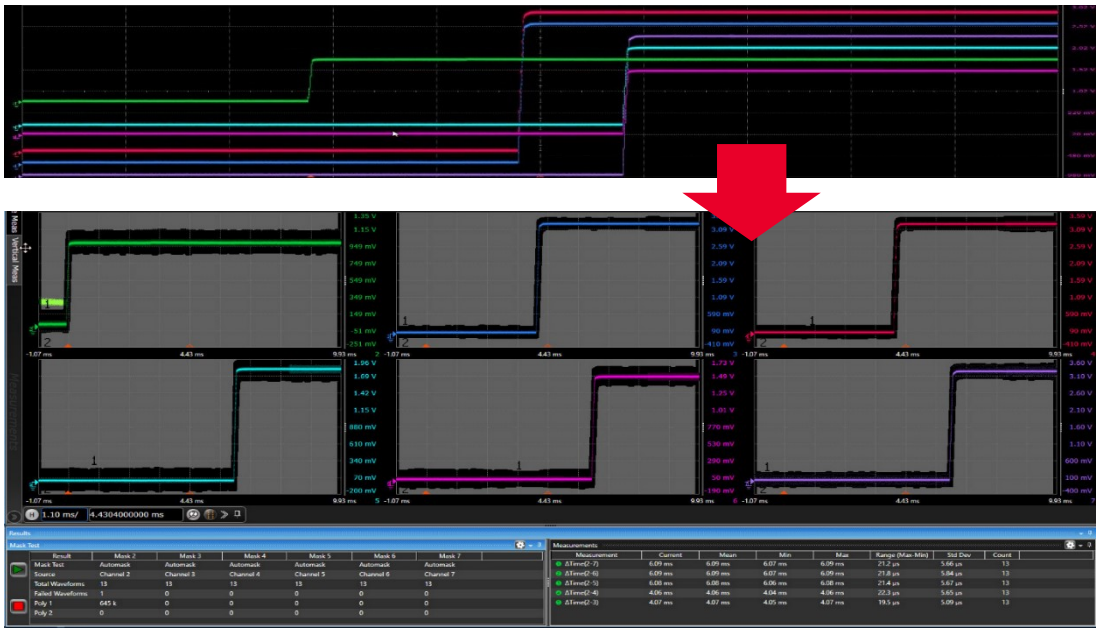
Power Rail and PMIC Integrity – D9010POWA

The increased functionality, higher density, and higher frequency operation of many modern electronic products has driven the need for lower supply voltages. It is common in many designs today to have 3.3, 1.8, 1.5, and even 1.1 V DC supplies—each of them having tighter tolerances than in previous product generations.

Power supply induced jitter (PSIJ) can be one of the largest sources of clock and data jitter in digital systems. Similarly, noise on DC supplies is often caused by switching currents from the transitions of clock and data in these systems. Wouldn't you like a relatively easy method of determining how much of your systems' data jitter is PSIJ and/or how much of the noise on the DC supplies is coming from specific clocks, data lines or other toggling sources? You have the tools for that in the Infiniium EXR-Series.

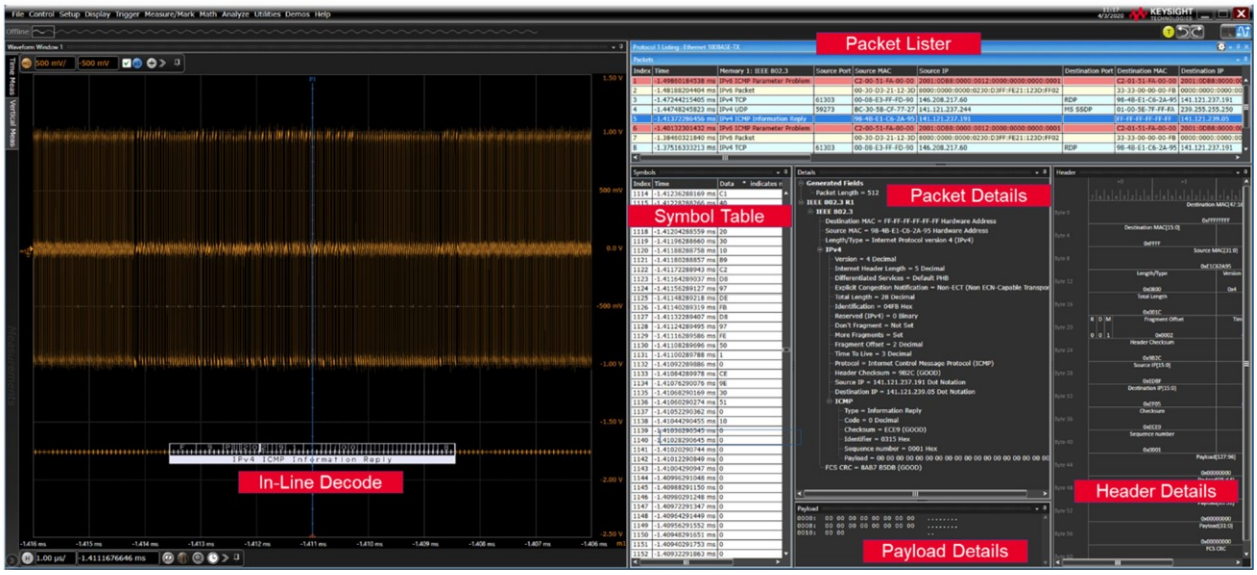
D9010POWA is a tool for analyzing power supply induced jitter or switching current loads on a DC supply and can analyze adverse interactions and their effects without the need for simulation or complex modeling. Together with the N7020A or N7024A Power Rail Probe, you have an even more powerful means of measuring and analyzing power integrity. And with standard mask testing on every channel, automatic delta time measurements, and a flexible user interface, PMIC analysis is simpler than ever.





With waveforms separated into grids and independent mask tests possible on every channel, you can continuously test these six power rails over thousands of startup cycles. Notice how there are mask test and measurement results on screen for a single screen shot test report.

Protocol Layer Testing

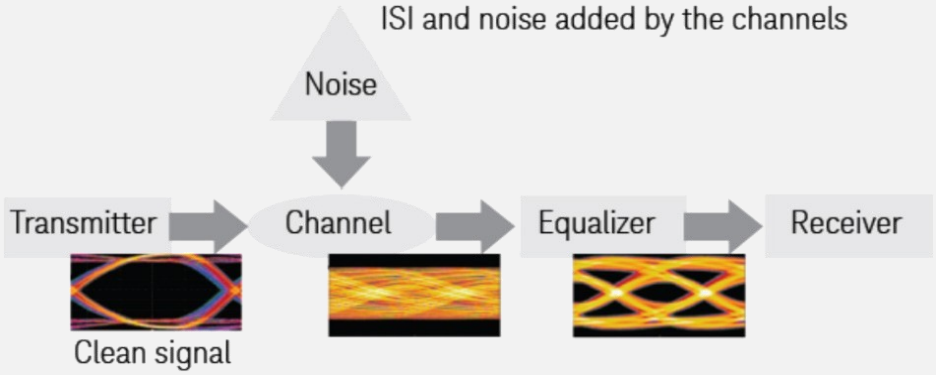


Protocol trigger and decode packages make it easy to debug and test digital designs. Get access to a rich set of integrated protocol level triggers specific to each serial bus. When serial triggering is selected, the application enables special real-time triggering hardware inside the scope. Hardware-based triggering ensures that the scope never misses a trigger event when armed. This hardware takes signals acquired using either scope or digital channels and reconstructs protocol frames. It then inspects these protocol frames against specified protocol-level trigger conditions and triggers when the condition is met. Find the web pages and data sheets for the packages to learn more – available triggers and decodes are in the configuration guide section of this document. You may want to consider D9011BDLP, which enables dozens of protocol triggers and decodes into one affordable and easy to order bundle!

Physical Layer Testing

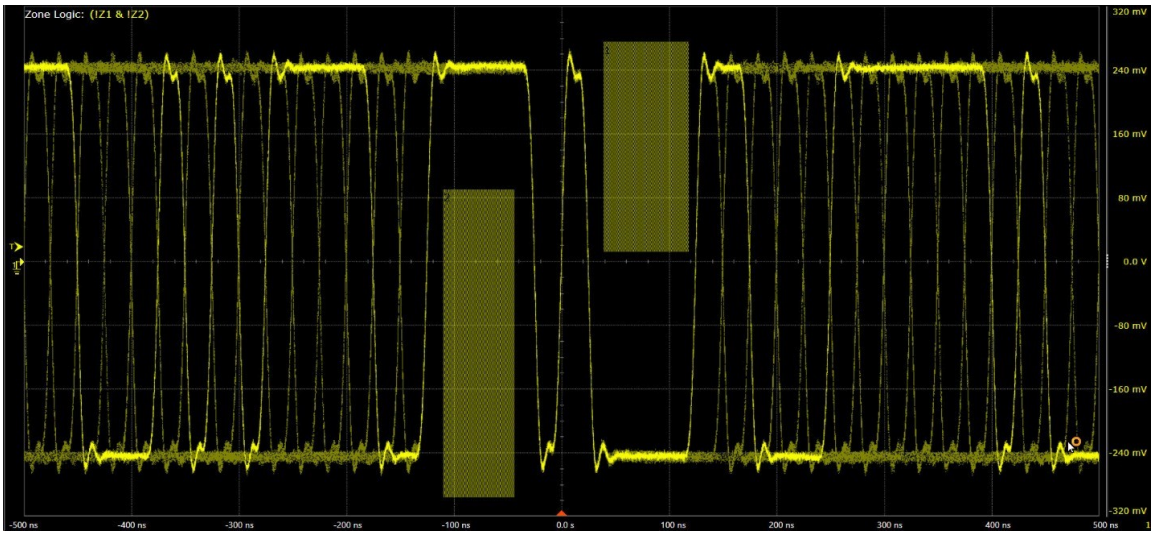
As data rates go up, the signal deteriorates from the transmitter to the receiver due to ISI, noise, and other factors. A high data rate coupled with a lossy channel will cause an open eye at a transmitter to be closed at the receiver. As eyes get more and more closed, it ultimately leads to significant data corruption and errors. Being able to analyze and find the root cause of these problems can help you develop a more robust design, leading to shorter time to market and lower failure rates in the field. Your Infiniium EXR-Series offers applications of various levels of depth to help you get the answers you need to improve your design.

The simplest of physical layer tests is a standard feature called “Fault Hunter”. Read about that feature of your EXR-Series oscilloscope later in this data sheet.



InfiniiScan Advanced and Zone Triggering – D9010SCNA

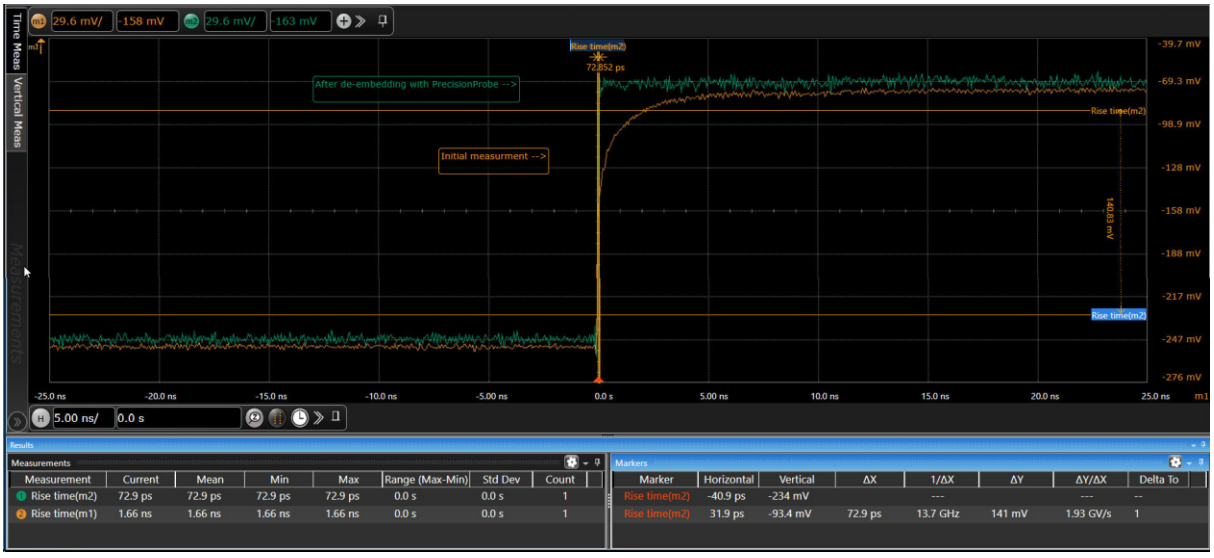
This package allows you to create a three-stage trigger to identify signal integrity issues that hardware triggering is unable to find in your electronic designs. This innovative software scans through thousands of acquired waveforms per second to help you isolate signal anomalies, saving you precious troubleshooting time. Trigger by drawing on-screen regions for a signal to hit or miss, based on measured parameters.



Vertical, Timing, and Phase Noise Analysis – D9010JITA

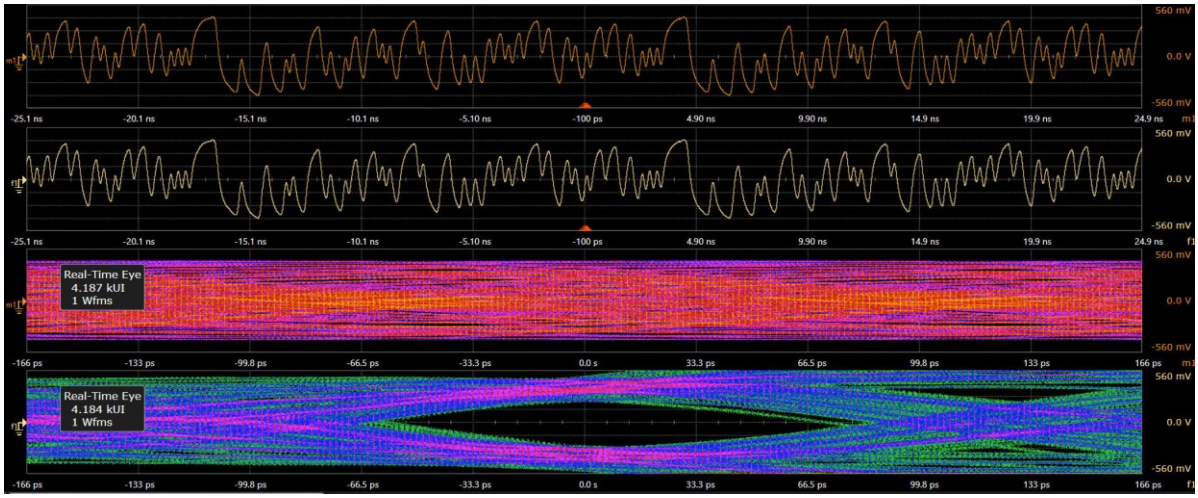
This package offers advanced statistical analysis of high-speed digital interfaces in the vertical (voltage) and horizontal (time) domains, as well as phase noise analysis. The result: the industry's most complete jitter and noise analysis software for real-time oscilloscopes.

De-embedding – D9010DMBA



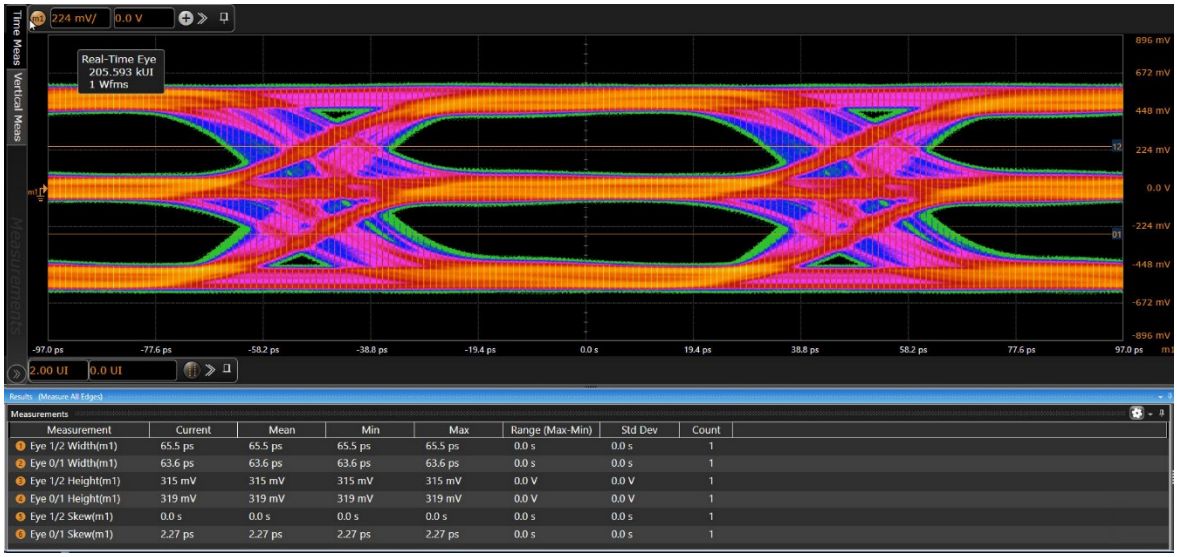
This package includes PrecisionProbe and InfiniiSim Basic, two tools designed to de-embed the effect of cables and fixtures from measurements. PrecisionProbe allows you to characterize the response of a probe, cable, or fixture; InfiniiSim lets you model them out of a measurement.

Equalization and Crosstalk – D9020ASIA



This package is intended for anyone working in high speed digital applications where eyes are closed. Equalization, InfiniiSim, and Crosstalk/Power Integrity packages enable deep analysis as to why an eye is closed, what it will take to open it, and simulating the results.

PAM-3 and PAM-4 Analysis – D9010PAMA



This package quickly sets up clock recovery and measurements for a PAM encoded signal. The software is also able to accurately set the individual threshold levels of your PAM signal and render each individual eye. It also includes BER/SER measurements and statistics. Note that PAM-3 or PAM-4 can be used for encoding signals in applications other than ethernet and the highest bandwidth frequency of the EXR-Series is 2.5 GHz.

Ease of Ownership

Save Budget and Bench Space with Instrument Integration

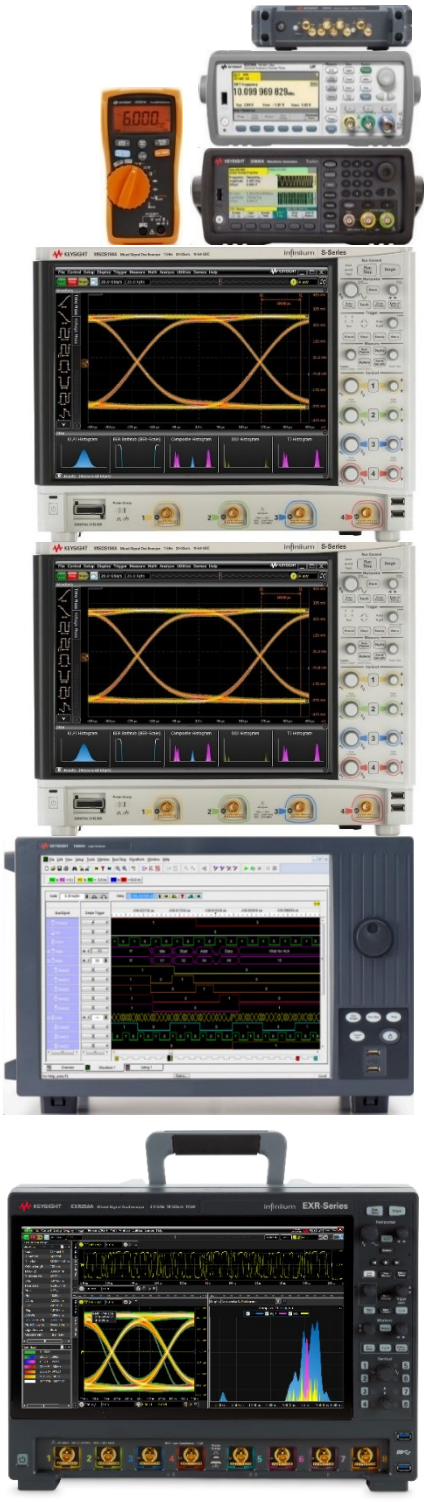
Your Infiniium EXR-Series is more than just an oscilloscope - it's 7 instruments in 1. Keysight pioneered multiple-instrument integration with the release of the mixed signal oscilloscope (MSO) in 1996. The InfiniiVision 2000/3000/4000 X-Series took the concept to the next level by integrating five instruments in one in 2011. The Infiniium EXR-Series integrates seven instruments in one. They are pictured on the right of this page, to scale, next to an EXR258A.

- 8 high-speed analog oscilloscope channels
- 16 digital channels (logic analyzer)
- 50 MHz arbitrary waveform generator
- 50 MHz frequency response analyzer
- 10-digit counter
- 4-digit voltmeter
- Protocol analyzer

Having all these tools integrated into your oscilloscope has many benefits aside from the obvious space and budget simplifications. One user interface means a lower learning curve when you need to use one of the integrated tools. It also means fewer pieces of instrumentation to store, calibrate, and keep updated on firmware.

The counter and DVM are standard features, and special because they use a separate signal path, different than the captured waveform, to make their measurements. This makes them much more accurate, flexible, and user friendly than standard on-screen measurements. Simply connect a probe or cable to an unused channel – no need to scale, trigger, or otherwise set the signal up on screen to make basic frequency and voltage measurements!

The logic analysis, AWG, and FRA can be purchased at any time for permanent installation to your EXR-Series. The variety of protocol analysis capabilities can be purchased for different lengths of time, to best fit your budget and project needs at the moment, or permanently.



Product sizes to scale!

Completely Upgradeable

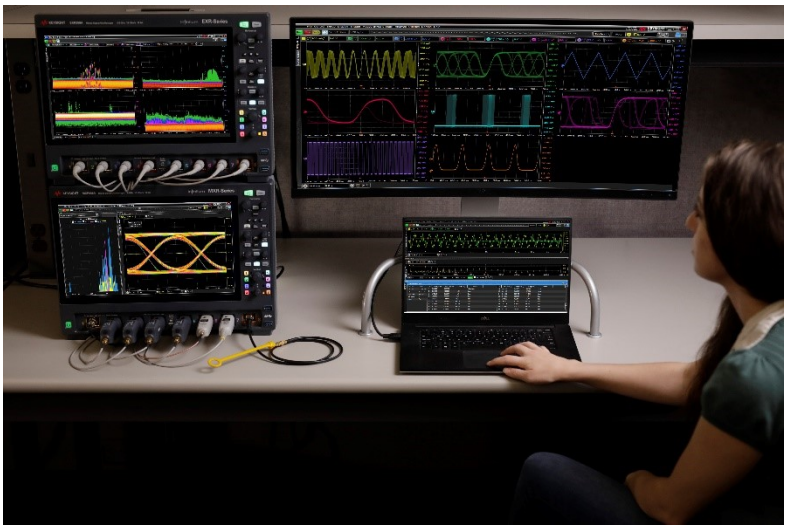
Assume that today's project requires 4 channels of 1 GHz analysis bandwidth. What if your next project needs 8 channels and 2 GHz of analysis bandwidth? And a waveform generator? This is no problem with the Infiniium EXR-Series, which is fully upgradeable – no exceptions. The Infiniium EXR gives you the flexibility to use capital or operating expense budgets more intelligently when making your purchase now and in the future.

Keysight is the world's only oscilloscope manufacturer to offer an upgrade from 4 to 8 analog channels, and it is always more affordable than purchasing a new 8 channel oscilloscope. Along with this, you can upgrade bandwidth, memory, integrated equipment, applications and more after purchase, with just a license key. No matter how your needs change, the Infiniium EXR-Series protects your investment by growing with your lab's needs of tomorrow.

Post-Purchase Upgrades	Model
Add analog bandwidth, up to 2.5 GHz	EXR2BW
Add analog channels, 4 to 8	EXR28CH
Add memory, 400 Mpts/ch or 1.6 Gpts/ch flexible memory	EXR2MEM
Add waveform generator, 50 MHz	EXR2WAV
Add MSO, 16 channels	EXR2MSO

Combine Two Oscilloscopes For 16 Channel Test With Multiscope

With software 11.10 or greater, you can combine two EXR-Series oscilloscopes together using a cabling system to perform 16 channel tests. This gives you the ability to have individual 4 or 8 channel oscilloscopes when needed and combine oscilloscopes on the fly when higher channel density measurements are required. All channels from each oscilloscope can be viewed and analyzed on a designated “leader” oscilloscope or managed from your PC using Infiniium Offline.



Multiscope is a standard feature of the EXR-Series oscilloscope and of Infiniium Offline – the only requirement to combine two oscilloscopes is the cabling kit. Specifications for frame-to-frame jitter, setup instructions, and ordering information can be found in the Multiscope Brochure and User’s Guide. Simply search for “Multiscope” on our website or look in the technical documentation on your oscilloscope model’s product page.

Maximize Test Flexibility with Infiniium Offline

You depend on your oscilloscope to capture an accurate picture of what’s happening in your design. But in today’s environment, you may find yourself in a variety of situations where access to an oscilloscope is limited. you may be sharing the instrument with others in the lab, have limited site access, or are trying to collaborate with a colleague remotely. Infiniium Offline can solve all of these problems, and more.

Infiniium Offline is a copy of the same powerful software provided on your Infiniium EXR- Series oscilloscope, just without the oscilloscope hardware. If you wish to control an oscilloscope remotely from the comfort of your desk or home office, the hosted mode can connect and control a single EXR-Series, or many EXR-Series with the MultiScope application outlined above. When access to the oscilloscope is limited, you can capture waveforms on your scope, save to a file, and recall the waveforms into Infiniium Offline from any PC. In addition, the application supports a variety of popular waveform formats from multiple oscilloscope vendors. Now you can view, analyze, share, and document scope measurements anywhere your PC goes. Find model numbers in the configuration guide at the end of this document.

Intuitive to Use

Visualize Rare Phenomena Automatically with Exclusive ASIC Technology

Many oscilloscopes claim impressive specifications, but behind the scenes, require special setups from the user. Or, they rely on special modes that compromise the performance of the oscilloscope in ways you may not be aware of. For example, some oscilloscopes claim fast triggering when in a special mode that may severely restrict memory and/or sample rate, or only when using segmented memory. With the EXR-Series, we made maximizing performance automatic, always-on, and with no guesswork from you.

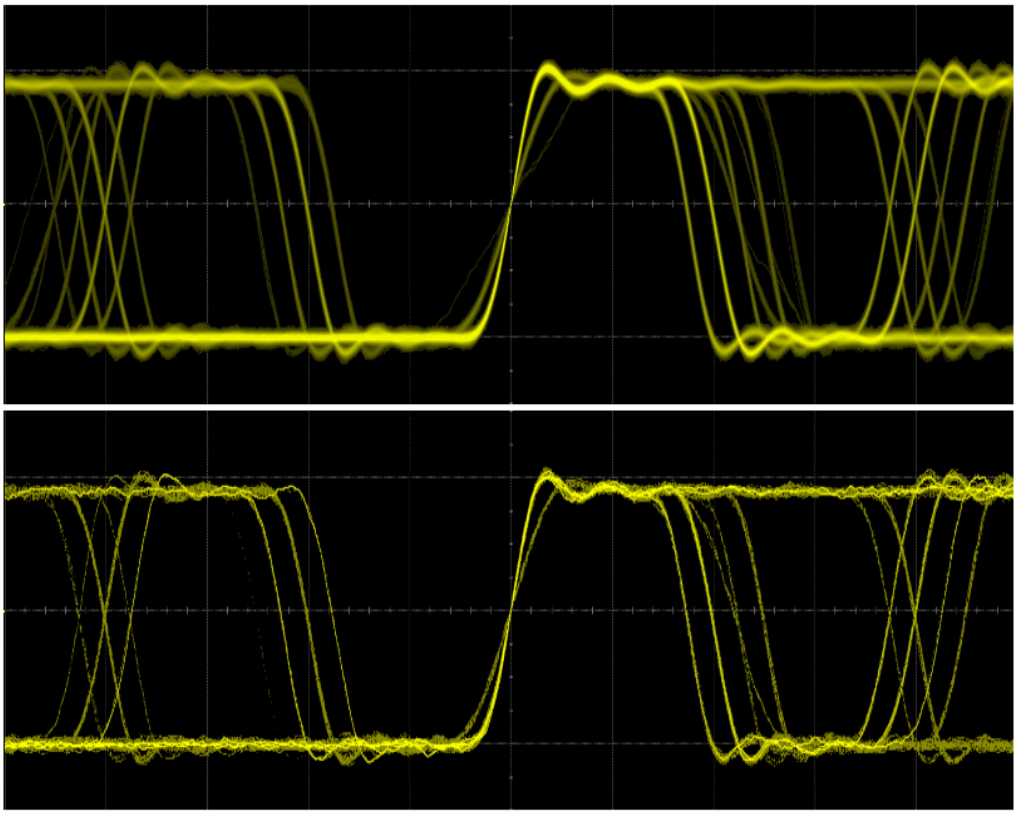
And since memory depth, sample rate, bits of resolution, and update rate are automatically optimized based on your measurement setup, there is no extra work required. Just press Auto Scale and go!

The Infiniium EXR-Series leverages a 100M+ gate CMOS ASIC from our UXR-Series oscilloscope, which acts as an “oscilloscope on a chip”. With many core oscilloscope features done in hardware, performance of some features improved by 100x or more over previous generations, including:

Metric	Why You Care	Infiniium EXR-Series	Comparable Scopes
Update rate (wfm/s)	See more of your signal	> 200,000 **(> 200x faster)**	< 1,000
Averaging (wfm/s)	Noise reduction on repetitive signals	> 12,000 **(> 100x faster)**	< 100
Measurements (meas/s)	Reach 6σ quicker	> 300,000 **(20% faster)**	< 250,000
Eye plotting (UI/s)	Identify transients and jitter	> 750,000 **(> 50x faster)**	< 15,000

wfm/s = waveforms per second.
meas/s = measurements per second.
UI/s = Unit Intervals per second.

Below is a comparison of the EXR-Series (top) vs. another oscilloscope, each viewing the same signal, and identical settings. The lower photo is an oscilloscope triggering under 1,000 wfm/s, with one second of persistence enabled. How many signal details would you have missed if you were using the oscilloscope on the bottom instead of the EXR-Series?



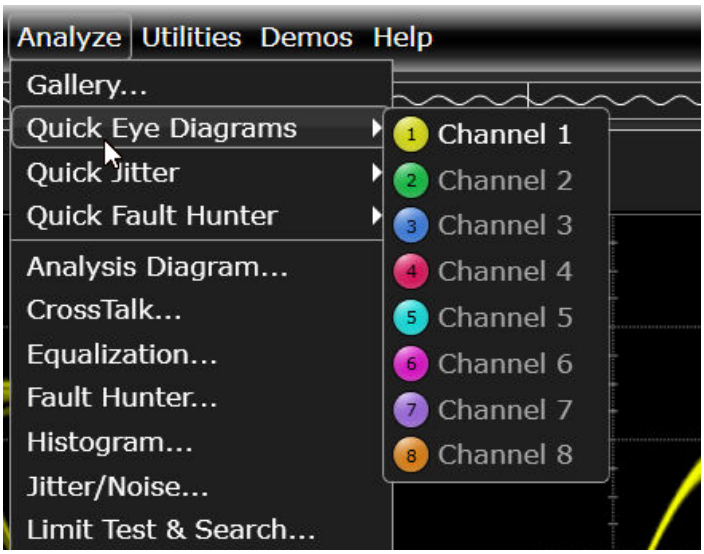
Identify Errors in One Click using Fault Hunter

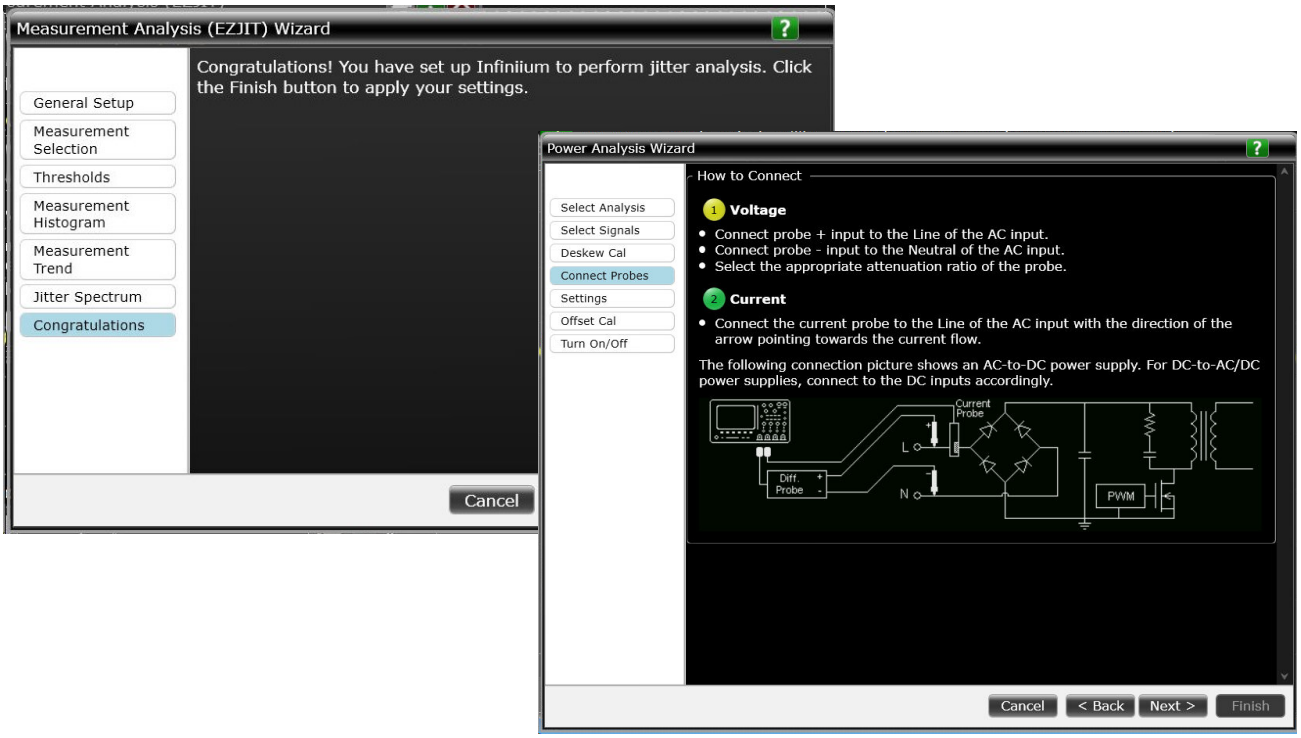
Fault Hunter is a new and innovative expert system for inspecting digital systems and can be ran with a single button press on the front panel of your EXR-Series oscilloscope. It automatically evaluates your signal's characteristics against user-definable criteria, quickly finding and saving errors for your review. It's flexible; you can define the test duration from 60 seconds up to 48 hours. Set up your device under test on a Friday afternoon, and return Monday morning with a full test report to review, with billions of tests complete thanks to our always-on fast triggering speeds of > 200,000 wfm/s.

Configure Complex Measurements Simply with Setup Wizards

Today's oscilloscopes, especially in this class, are complex tools with hundreds of functions and features available. Keysight has gone to great lengths to ensure these tools are accessible to you simply and repeatably, in easy to find locations, without limiting the power or scope of the analysis.

Quick Setups are available to enable common measurements, trigger/decodes for serial buses, eye diagrams, jitter decomposition, and fault hunter. With one click, the scope will do most or all of the work for you.





For more complex tests, there are Setup Wizards. These step driven dialog boxes walk you through fine tuning your analysis even further, explaining different features and settings in more detail. These are available for power analysis, power integrity, Real Time Eye diagrams, jitter decomposition, measurement analysis (trends, histograms, etc), crosstalk, and more.

Finally, you might notice a green question mark at the top right of any dialog box. This will act as a shortcut to the built-in help system for that feature, explaining in even further detail what you can adjust in that dialog box.

Complete Control of Your User Interface

When you connect an external monitor to most oscilloscopes, it simply duplicates the built-in screen. This can be helpful for when the built-in monitor is small or in an inconvenient place, but not so helpful when you wish to use that extra screen space to visualize waveforms or analysis. With the Infiniium EXR-Series, a second monitor can be used to effectively extend the amount of space you can use to view data thanks to the flexibility of the Infiniium user interface. You can organize your waveforms and traces into tabs, separate windows, separate grids, overlay waveforms on top of each other, move data onto separate monitors and more all with a few swipes and taps of your mouse or fingertip.

You can also remotely control your EXR-Series remotely from another Windows 10 PC, with the proper network setup, using the standard Windows 10 feature Remote Desktop Connection. Simply enter the oscilloscope's IP address, default username and password (see the user's guide) and go! You can also use most available VNC software without issue. This gives you complete control of the interface, as if you were sitting in front of the oscilloscope itself.

Explore the Keysight Real-Time Oscilloscope Portfolio

Keysight engineers have been creating reliable, insightful products for more than 80 years. We are continually looking for new ways to help you shape the future with innovative products and test solutions. From high performance to extreme value, and bandwidths ranging from 50 MHz to more than 110 GHz, we have the oscilloscope solutions to meet your evolving needs. Below is a small sample of our portfolio; check our website for the latest information.

Product Series	1000 X-Series	3000T X-Series	EXR-Series	S-Series	V-Series	Z-Series	UXR-Series
Analog channels	2 or 4	2 or 4	4 or 8, *upgradeable*	4	4	4	1, 2 or 4, *upgradeable*
Bandwidth, all channels	200 MHz	1 GHz	2.5 GHz	4 GHz	16 GHz	33 GHz	110 GHz
Sample rate, all channels	1 GSa/s	2.5 GSa/s	16 GSa/s	10 GSa/s	40 GSa/s	80 GSa/s	256 GSa/s
Max memory, all channels	1 Mpts	2 Mpts	400 Mpts	400 Mpts	2 Gpts	2 Gpts	2 Gpts
Resolution	8 bits	8 bits	10 bits	10 bits	8 bits	8 bits	10 bits
Timebase accuracy	50 ppm	1.6 ppm	8 ppb	12 ppb	100 ppb	100 ppb	25 ppb
Intrinsic Jitter	–	–	118 fs	100 fs	100 fs	50 fs	25 fs
Lowest noise (1 mV/div)	–	113 µV	43 µV	74 µV	210 µV	210 µV	150 µV
Max ENOB	–	–	9.0	8.1	6.6	6.6	6.8
Logic analysis	–	16 ch.	16 ch.	16 ch.	16 ch.	16 ch.	–
Hardware plotting	Yes	Yes	Yes	No	No	–	Yes
Screen display	7” WVGA	8.5” WVGA	15.6” Full HD	15.6” XGA	12.1” XGA	12.1” XGA	15.4” XGA

Performance Characteristics

Analog channel specifications					
		EXR05xA	EXR10xA	EXR20xA	EXR25xA
Bandwidth (-3 db)	50 Ω [1]	500 MHz	1 GHz	2 GHz	2.5 GHz
	1 MΩ	500 MHz	500 MHz	500 MHz	500 MHz
Typical rise/fall time [4]	10/90%	860 ps	430 ps	215 ps	172 ps
	20/80%	620 ps	310 ps	155 ps	124 ps
Input channels		4 or 8 channels analog, 16 channels digital (optional)			
Sample rate, real-time		16 GSa/s, all analog channels [1]			
Sample resolution		62.5 ps (divide by interpolation factor, if enabled)			
Vertical resolution [3]		10 bits, up to 16 bits with high-resolution mode			
Real-time update rate		> 200,000 waveforms/sec			
Memory depth [1]	Standard	100 Mpts/channel, all channels			
	Optional	400 Mpts/channel, all channels (400 Mpts/ch option) 1.6 Gpts shared between channels 1-4, 5-8 (1.6 Gpts Combined Flexible Memory option) [6]			
Input impedance	50 Ω [1]	± 3.5% (typically ± 1% at 25 °C)			
	1 MΩ	± 1% (14 pF typical)			
Input sensitivity [3]	50 Ω [1]	1 mV/div to 1 V/div			
	1 MΩ	1 mV/div to 5 V/div			
Input coupling	50 Ω [1]	DC			
	1 MΩ	DC, AC (> 11 Hz)			
Bandwidth limit filters	Analog	20 MHz, 200 MHz			
	Digital [5]	14.7 MHz up to scope bandwidth, increments of one decimal point. Filter options: Brick Wall, 4th Order Bessel, or Bandpass			
Max input voltage	50 Ω	± 5 V_{MAX} [1]			
	1 MΩ	30 V_{RMS} or ± 40 V_{MAX} (DC + V_{PEAK})			
	Notes	Probing technology allows for testing of higher voltages; the included N2873A 10:1 probe supports 300 V_{RMS} or ± 400 V_{MAX} (DC + V_{PEAK}). No transient overvoltage allowed in either the 50 Ω or 1 MΩ path, with or without probes.			
Offset range	50 Ω [1]	≤ 55 mV/div: ± 0.8 V ≤ 120 mV/div: ± 1.6 V ≤ 260 mV/div: ± 3.2 V > 260 mV/div: ± 4 V			
	1 MΩ	< 10 mV/div: ± 5 V ≤ 200 mV/div: ± 20 V > 200 mV/div: ± 40 V			
Offset accuracy [1, 3]		< 2 V: ±0.1 div ± 2 mV ± 1%; > 2 V: ± 0.1 div ± 2 mV ± 1.5%			
Dynamic range		± 4 divisions from center screen			
DC gain accuracy [1, 2, 3]		± 2% full scale (± 1% typical)			
DC voltage measurement accuracy [2]		Dual cursor: ± [(DC gain accuracy) + (resolution)] Single cursor: ± [(DC gain accuracy) + (offset accuracy) + (resolution/2)]			
Channel-channel isolation		Adjacent Channels: ≤ -60 dB (DC to 2 GHz), ≤ -50 dB (over 2 GHz) Non-Adjacent Channels: ≤ -85 dB (DC to 2 GHz), ≤ -65 dB (over 2 GHz)			

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. Full scale is defined as 8 vertical divisions. Magnification is used below 2 mV/div, full-scale is defined as 16 mV. Testing is at maximum sample rate.
3. 50 Ω input: The major scale settings are 5 mV, 10 mV, 20 mV, 50 mV, 100 mV, 200 mV, 500 mV, and 1 V per division. 1 MΩ input: The major scale settings are 5 mV, 10 mV, 20 mV, 50 mV, 100 mV, 200 mV, 500 mV, 1 V, 2 V, and 5 V per division. For a 10:1 probe, vertical scaling is multiplied by 10.
4. 10/90 calculation based on Tr = 0.43/BW. 20/80 calculation based on Tr = 0.31/BW.
5. You may adjust bandwidth limits up to the bandwidth of the scope when using Brick Wall filter. When using 4th Order Bessel, maximum bandwidth limit is roughly 2/3 the bandwidth of oscilloscope. Bandpass is designed for use in our Phase Noise Analysis application and not designed for general purpose use. Contact Keysight if more information is needed.
6. Combined flexible memory shares 1.6 Gpts of memory between channels 1 through 4. This means you can have 1 channel with 1.6 Gpts, two channels with 800 Mpts, or three channels with 533 Mpts memory (on top of 400 Mpts on all channels). Double those channel counts for 8 channel models, as the same logic applies to channels 5-8.

High-resolution mode (standard)		
Bits of resolution	**Sample rate**	**Bandwidth [1]**
10	Up to 16 GSa/s	2.5 GHz
11	6.4 GSa/s	2.4 GHz
12	3.2 GSa/s	1.2 GHz
13	1.6 GSa/s	600 MHz
14	800 MSa/s	300 MHz
15	400 MSa/s	165 MHz
16	200 MSa/s	82.5 MHz
16	100 MSa/s	41.3 MHz
16	50 MSa/s	20.6 MHz

1. Up to bandwidth specified or oscilloscope model bandwidth, whichever is lower.

RMS noise floor ($V_{RMS\ AC}$) on 50 Ω inputs						
Vertical setting	**20 MHz [1]**	**200 MHz [1]**	**500 MHz [1]**	**1 GHz [1]**	**2 GHz [1]**	**2.5 GHz**
1, 2 mV/div	43 µV	59 µV	63 µV	73 µV	91 µV	100 µV
5 mV/div	40 µV	61 µV	70 µV	81 µV	102 µV	112 µV
10 mV/div	46 µV	69 µV	81 µV	99 µV	131 µV	144 µV
20 mV/div	59 µV	99 µV	122 µV	156 µV	209 µV	233 µV
50 mV/div	210 µV	278 µV	328 µV	401 µV	520 µV	569 µV
100 mV/div	452 µV	582 µV	681 µV	821 µV	1.06 mV	1.17 mV
1 V/div	2.95 mV	4.10 mV	5.07 mV	6.33 mV	8.4 mV	9.31 mV

1. High-resolution is used for bandwidths 2 GHz and below. Keysight recommends this to maximize signal to noise ratio and still meet the system bandwidth requirements you need for your measurement.

ENOB on 50 Ω inputs, 50 mV/div							
20 MHz	**200 MHz**	**250 MHz**	**350 MHz**	**500 MHz**	**1 GHz**	**2 GHz**	**2.5 GHz**
9.0	8.5	8.4	8.3	8.2	8.0	7.6	7.5

High resolution on the Infiniium EXR-Series works like no other oscilloscope before it. Instead of setting high-resolution bits automatically with no user control, you select ADC bits or a system bandwidth, and let the scope optimize around that. This means the resolution of your data isn't changing without your explicit request. ADC resolution and bandwidth limit filters work in tandem to produce the best measurement results possible.

All Infiniium EXR-Series scopes come from the factory calibrated to 2.5 GHz, and leverage brickwall filters to achieve each model bandwidth. Thus, the noise and ENOB data above is applicable from 20 MHz up to the bandwidth of your oscilloscope model when using the built-in global bandwidth limit feature.

Analog channel specifications (horizontal)			
Acquisition modes	Sample Mode	Sequential sampling with up to 32-point sin(x)/x interpolation	
	Averaging	2 to 1,048,575 averages, up to 12,000 avg/sec (HW accelerated)	
	Peak detect	Oversamples at 16 GSa/s, saving min and max voltages, to detect glitches or aliasing	
	Segmented	Up to 78,953 future acquisitions	
	History mode	Up to 1,024 previous acquisitions	
	Roll mode	Scrolls waveform across the display, right to left	
Timebase range	Roll mode	50 ms/div to 1000 s /div	
	Other modes	5 ps/div to 200 s/div	
	Zoom window	1 ps/div to current main time scale setting	
Horizontal position range		0 s to ± 200 s, Continuously adjustable	
Horizontal position resolution	Main window	40 fs (granularity of horizontal position of waveform on screen)	
	Zoom window	8 fs	
De-skew range		± 1 ms, in steps of 100 fs	
Time scale accuracy [1, 7]		± (8 ppb initial + 75 ppb/year aging)	
Intra-channel intrinsic jitter[3, 5]		4 channel models	8 channel models
	100 ns/div	118 fs_{RMS}	150 fs_{RMS}
	1 µs/div	130 fs_{RMS} [9]	156 fs_{RMS}
	10 µs/div	140 fs_{RMS} [9]	172 fs_{RMS} [10]
	100 µs/div	145 fs_{RMS} [9]	175 fs_{RMS} [10]
	1 ms/div	155 fs_{RMS} [9]	181 fs_{RMS} [10]
Inter-channel intrinsic jitter [3]		100 fs_{RMS}	
Inter-channel skew drift [3, 6]		< 500 fs_{MAX}	
Intra-channel jitter measurement floor [2, 3]	Time interval error	$\sqrt{\left(\frac{\text{noise floor}}{\text{slew rate}}\right)^2 + (\text{intrinsic jitter})^2}$	
	Periodic	$\sqrt{2} \times \sqrt{\left(\frac{\text{noise floor}}{\text{slew rate}}\right)^2 + (\text{intrinsic jitter})^2}$	
	Cycle-cycle / N-cycle	$\sqrt{3} \times \sqrt{\left(\frac{\text{noise floor}}{\text{slew rate}}\right)^2 + (\text{intrinsic jitter})^2}$	
Inter-channel jitter measurement floor [2, 3, 4]		$\sqrt{\left(\frac{\text{Time interval}}{\text{error (edge 1)}}\right)^2 + \left(\frac{\text{Time interval}}{\text{error (edge 2)}}\right)^2 + \left(\frac{\text{inter}-\text{channel}}{\text{intrinsic jitter}}\right)^2}$	
Delta time measurement accuracy [2, 3, 4, 8]	Intra-channel	$\pm\left[\frac{5}{n} \times \sqrt{\left[\frac{\text{Time interval}}{\text{error (edge 1)}}\right]^2 + \left[\frac{\text{Time interval}}{\text{error (edge 2)}}\right]^2} + \left(\left(\frac{\text{Time scale}}{\text{accuracy}}\right) \times \left(\frac{\text{Delta}}{\text{time}}\right)\right)\right]$	
	Inter-channel	$\pm\left[\frac{5}{n} \times \sqrt{\left[\frac{\text{Time interval}}{\text{error (edge 1)}}\right]^2 + \left[\frac{\text{Time interval}}{\text{error (edge 2)}}\right]^2 + \left[\frac{\text{Interchannel}}{\text{intrinsic jitter}}\right]^2} + \left(\left(\frac{\text{Time scale}}{\text{accuracy}}\right) \times \left(\frac{\text{Delta}}{\text{time}}\right)\right) + \left(\frac{\text{Intechannel}}{\text{skew drift}}\right)\right]$	

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 floor 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) x 2πf; slew rate of fast edge = 0.8 * amplitude / (risetime 10-90%).
3. Intra-channel = both edges on the same channel, Inter-channel = two edges on different channels.
4. Scope channels and signal interconnect de-skewed prior to measurement.
5. 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.
6. Skew between channels caused by ± 5 degrees C temperature change.
7. Initial = immediately after factory or user calibration.
8. 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.'n' represents the square root of the number of averages taken; e.g. n=1 is no averaging, n=16 is 256 averages. Averaging allows for more accurate delta time measurement accuracy.
9. 120 fs_{RMS} possible with external reference.
10. 161 fs_{RMS} possible with external reference.

Analog channel triggering	
Trigger sources	Edge Trigger on all analog channels, aux-in, power supply line
	Other Trigger operations as outlined below
Max edge trigger frequency (50 Ω)	2.5 GHz
Trigger level range	± 4 divisions from center screen (auxiliary: ± 5 V, max input 5 V_{PP})
Trigger sensitivity	Analog channels: see next table
	Aux trigger input: 200 mV_{PP}, DC to 2.5 GHz
Trigger hold off range	25 ns to 10 s, fixed or random
Trigger coupling	DC, AC, LF reject (50 kHz HPF), HF reject (50 kHz LPF)
Sweep modes	Auto, triggered, single
Trigger jitter	4 channel models: 523 fs_{RMS}
	8 channel models: 531 fs_{RMS}
Minimum trigger re-arm time	< 5 µs

Trigger edge sensitivity, analog channels					
Bandwidth (HW or SW limit)		20 MHz	200 MHz	1 GHz	2.5 GHz
1 MΩ path	< 5 mV/div	< 0.7 div	< 1.0 div	< 1.4 div to BW limit (500 MHz)	
	≥ 5 mV/div	< 0.3 div	< 0.5 div	< 0.8 div to BW limit (500 MHz)	
50 Ω path	< 5 mV/div	< 0.15 div	< 0.2 div	< 0.3 div	< 0.45 div
	≥ 5 mV/div	0 div	< 0.1 div	< 0.1 div	< 0.1 div

Digital channel specifications (optional)	
Analog bandwidth	300 MHz
Maximum sample rate	8 GSa/s, all channels
Maximum memory depth	At 8 GSa/s: 250 Mpts/ch
	Under 8 GSa/s: 125 Mpts/ch
Minimum detectable glitch	2 ns
Max input voltage	± 40 V_{PEAK}
Input dynamic range	±10 V about threshold
Minimum input voltage swing	500 mV_{PP}
Input impedance	100 kΩ ± 2% (~8 pF) at probe tip
Resolution	1 bit
Channel to channel skew	200 ps (typical)
Threshold selections	TTL, CMOS (5.0 V, 3.3 V, 2.5 V), ECL, PECL, User-defined (± 8 V in 10 mV increments)
Threshold accuracy	± (100 mV + 3% of threshold setting)

Available triggers (standard, unless otherwise noted)		
Trigger type	**Channels available on**	**Description**
Edge	Channels 1-8, digital, line, aux	Triggers on a specified slope (rising, falling or alternating between rising and falling) and voltage level on any channel or auxiliary trigger.
Edge transition	Channels 1-4	Triggers on rising or falling edges that cross two voltage levels in > or < the amount of time specified. Edge transition setting from 75 ps to 10 s.
Edge then edge (time)	Channels 1-4, digital	The trigger is qualified by an edge. After a specified time-delay between 1.5 ns to 20 s, a rising or falling edge on any one selected input will generate the trigger.
Edge then edge (event)	Channels 1-4, digital	The trigger is qualified by an edge. After a specified delay between 1 to 65,000,000,000 rising or falling edges, another rising or falling edge on any one selected input will generate the trigger.
Pulse width	Channels 1-4, digital	Triggers on a pulse that is wider or narrower than the other pulses in your waveform by specifying a pulse width and a polarity. Pulse width range settings 75 ps to 20 s. Trigger point can be configured for “end of pulse” or “time out”.
Glitch	Channels 1-8, 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: < 75 ps to < 10 s.
Runt	Channels 1-4	Triggers on a pulse that crosses one threshold but fails to cross a second threshold before crossing the first again. Can be time qualified with a range of 75 ps to 10 s.
Timeout	Channels 1-4, digital	Triggers the oscilloscope when the waveform has been at a higher voltage than the voltage specified by the Level control for too long (High Too Long), when the waveform has been at a lower voltage than the Level voltage for too long (Low Too Long), or when the waveform has taken too long to pass through the Level voltage (Unchanged Too Long). Timeout settings from 75 ps to 20 s.
Pattern/State	Channels 1-4, digital	Identifies a trigger condition by looking for a specified pattern or a pattern and an edge (state) across the input channels.
Setup / hold	Channels 1-4	Triggers on violations of setup time, hold time, or both setup and hold time. Setup times from 75 ps to 20 s and hold times from 75 ps to 100 ns.
Window	Channels 1-4	Specifies a voltage range and then trigger when the waveform either exits this range, enters this range, stays outside the range for too long or too short, or stays inside the range for too long or too short. Range setting from 75 ps to 20 s.
Protocol	Bus dependent	Trigger on certain packets or patterns in protocol-based data. *Requires a protocol trigger/decode option, for example D9010LSSP*
Generic Protocol	Channels 1-8	Software triggers on NRZ or 8 b/10 b-encoded data up to 6 Gbps, up to 80-bit pattern. Support multiple clock data recovery methods including constant frequency, 1st-order PLL, 2nd-order PLL, explicit clock, explicit 1st-order PLL, explicit 2nd-order PLL, Fibre Channel, FlexRay receiver, FlexRay transmitter.
Burst	Channels 1-4	Triggers on the Nth edge of a burst that occurs after an idle time from 1.5 ns to 20 s.
Nth Edge	Channels 1-8	Triggers on the Nth edge
OR’d Edges	Channels 1-4	Identifies a trigger condition by looking for selected edges on up to four channels
InfiniiScan Zone	Channels 1-8	Qualified trigger across up to 8 user-drawn zones. For each zone, user specifies “must intersect” or “must not intersect.” Zones can be drawn on analog channels and combined using Boolean logic. *Requires option D9010SCNA*
Measurement limit	Channels 1-8, digital, line, aux	Software triggers on the results of the measurement values. For example, when the “time interval error (TIE)” is measured, InfiniiScan can trigger on a specific TIE value. *Requires option D9010SCNA*
Non-monotonic edge	Channels 1-8	Software triggers on the non-monotonic edge. The non-monotonic edge is specified by setting a hysteresis value. *Requires option D9010SCNA*

Serial Data Analysis (standard)	
Real-Time Eye displays	>750,000 Unit Intervals per second Unfolding of eye diagram BER eye contours (contact Keysight) Recovered clock display
Clock recovery methods	1st or 2nd order PLL, explicit clock, Golden PLL (for PCI Express)
Automation	One-click quick setup Complete setup wizard Custom mask templates, mask editor

Fault Hunter (standard)	
Auto Setup	30 second statistical measurement analysis of incoming signal
Result information	Test failure automatically saved in memory. Fault condition can be copied to trigger for further testing
Test results	Automatic identification of common digital signal errors: Positive glitch, negative glitch, slow rising edge, slow falling edge, positive runt, negative runt

Measurements (standard, unless otherwise noted)	
Maximum at once	20 in either main, zoom, or gated region (up to 16 gates)
Maximum rate	> 300,000 measurements/second (any number of measurements on, “measure all edges” enabled)
Voltage (analog)	Amplitude, average, base, crossing point, maximum, minimum, overshoot and preshoot (as a percentage or voltage), V_{PP} contrast, peak to peak, pulse (amplitude, base, top), RMS, top, thresholds (lower, middle, upper), voltage @ time
Time (analog)	Rise time, fall time, period, frequency, pulse width (+/-), duty cycle, T_{MIN}, T_{MAX}, crossing point time, delta time, pulse count, bursts (width, period, interval), s/h time
Time (digital)	Period, frequency, pulse width (+/-), duty cycle, delta time
Mixed (analog)	Area, slew rate, charge. *Requires N282xA probe*
Frequency domain	FFT frequency and magnitude, channel power, power spectral density, occupied bandwidth
Level qualification	Make timing measurements only when other input signal level conditions are true. Any channels not involved in a measurement can be used to qualify all timing measurements. *Requires D9010SCNA*
Eye diagrams	Eye height, eye width, eye jitter, crossing percentage, Q factor, duty-cycle distortion > 750,000 UI/second (for eye diagrams, with hardware acceleration enabled)
Statistic modes	Mean, standard deviation, minimum, maximum, count

Math (standard, unless otherwise noted)		
Sources		Any analog or digital channel, waveform memory, or other math functions
Maximum at once		16
Functions	Math	Add, subtract, multiply, divide, FFT (magnitude and phase), absolute value, average, common mode, delay, differentiate, integrate, invert, max, min, square, square root
	Filters	High pass filter, low pass filter, smoothing
	Visualizations	Amplitude demodulation, bus chart, envelope, gating, histogram, pattern average, measurement log, measurement trend, magnify / duplicate, XY mode (Z-Qualified)
	MATLAB	Preinstalled scripts: Butterworth, FIR, LFE, RTEye, and SqrtSumOfSquare User Defined: The input source data is passed to a MATLAB script you create. The processed data is passed back to Infiniium to be displayed as a function. *Requires a MATLAB license*
FFT	Range	DC to Nyquist frequency
	Horizontal Scale	Linear, logarithmic
	Vertical Units	dBm, dBmV, dBuV, V_{RMS}, Watts

	Controls	Start and stop frequency, span and center frequency, resolution bandwidth
	Peak detect	Automatically find and annotate up to 25 peaks of a user-defined level
	Windows	Flattop, rectangular, Hanning, Blackman Harris, Hamming
Histograms	Sources	Any waveform or measurement below
	Orientation	Horizontal (timing and jitter) or vertical (noise and amplitude)
	Measurements	Peak-to-peak, min, max, mean, median, mode, standard deviation, mean ±1σ/2σ/3σ, total hits, peak (area of most hits), bin width, FWHM (histogram width at half maximum)

Digital Voltmeter (standard, specifications are typical)	
Functions	AC_{RMS}, DC, DC_{RMS}
Resolution	4 digits
Measuring rate	100/sec
Auto Range	Automatic adjustment of vertical amplification to maximize the dynamic range of measurements
Range Meter	Graphical display of most recent measurement, plus extrema over the previous 3 seconds

Counter / Totalizer (standard, specifications are typical)	
Available counters	Counter A and B: General purpose (Channels 1-4)
	Counter C: Trigger qualified (trigger channel)
Measurements	Frequency, period, totalize, ratio (ratio of A/B, mathematical)
Resolution	General purpose: 5 to 10-digits
	Trigger qualified: 5 to 8 digits
Accuracy	± (8 ppb initial ± 75 ppb/year aging)
Uncertainty	± 0.1 digits
Minimum pulse width	75 ps [1]
Maximum frequency	General purpose: 2.5 GHz
	Trigger qualified: 1/(trigger hold off time)
Totalizer	Counter size: 64 bits
	Edge: Rise or fall

Waveform Generator (optional, specifications are typical)		
Output	Connector	BNC, rear panel
	Voltage range, 50 Ω	1 mV_{PP} [1] to 5 V_{PP} [2]
	Voltage range, 1 MΩ	2 mV_{PP} [1] to 10 V_{PP} [2]
	Presets	TTL, CMOS (5 V), CMOS (3.3 V), CMOS (2.5 V), ECL
	Vertical resolution	100 µV
	Vertical accuracy	2% (< 1 kHz)
	Frequency resolution [3]	12.5 mHz
	Frequency accuracy [4]	Square/pulse: 1 ppm (f ≥ 8 kHz), [f/25000] ppm (f < 8 kHz)
		Other waveforms: 1 ppm (f ≥ 5 kHz), 3 ppm (f < 5 kHz)
	Modes	Normal, single shot (all but square, pulse, noise, DC)
	Waveforms	DC, sine, square, pulse, triangle/ramp, noise, sinc, exponential rise/fall, cardiac, Gaussian pulse, PRBS, arbitrary
	Protection	Overload automatically disables output
	Isolation	Not available, main output BNC is grounded
DC offset	Range	± (8 V_{DC} – Peak AC) into 1 MΩ
		± (4 V_{DC} – Peak AC) into 50 Ω
	Resolution	100 µV or 3 digits, whichever is higher
	Accuracy	Waveform modes: ± 1.5% of offset setting ± 1% of amplitude ± 1 mV
		DC mode: ± 1.5% of offset setting ± 3 mV
Sine	Frequency range	12.5 mHz to 50 MHz
	Amplitude flatness	± 0.5 dB (≤ 20 MHz), ± 1 dB (> 20 MHz)
	Harmonic distortion	Harmonic distortion: -40 dBc [5]
	SFDR	Spurious (non-harmonic): -40 dBc [6]
	THD	1% [7]
	SNR	40 dB [8]
Square / pulse	Frequency range	Frequency range: 0.0125 Hz to 20 MHz
	Duty cycle	Duty cycle: 20 to 80%, resolution of 1% or 1 ns [9], whichever is larger
	Pulse width	Pulse width: 10 ns minimum, 1 ns resolution [9]
	Rise/fall time	Rise/fall time: 9 ns (10 to 90%)
	Overshoot	Overshoot: < 10%
	Asymmetry (at 50% DC)	± 1% ± 5 ns
	Jitter (TIE RMS)	100 ps [10, 6]
Triangle (ramp)	Frequency range	12.5 mHz to 200 kHz
	Linearity	1%
	Symmetry	0 to 100%, 1% resolution
Noise	Bandwidth	40 MHz
Sine Cardinal (Sinc)	Frequency range	12.5 mHz to 1.0 MHz
Exponential Rise/Fall	Frequency range	12.5 mHz to 10.0 MHz
Cardiac	Frequency range	12.5 mHz to 200.0 kHz

Gaussian Pulse	Frequency range	12.5 mHz to 5.0 MHz	
PRBS	Pattern length	2^7, 2^15, 2^23, 2^31	
	Bit rate	100 bps to 40 Mbps (speeds of 200 MHz divided by an integer value)	
	Encoding	NRZ	
Arbitrary	Waveform Length	1 to 122,070 points	
	Repetition Rate	12.5 mHz to 12 MHz	
	Sample Rate	200 MSa/s	
	Filter Bandwidth	40 MHz	
	Editor	On-screen editor; import/export of data to and from channels/memories, import/export data to and from a file (.csv)	
Modulation	Types	AM, FM, FSK	
	Carriers	Sine, ramp, sine cardinal, exponential rise, exponential fall, and cardiac	
	Source	Internal (no external modulation capability)	
	AM	Profile	Sine, square, ramp
		Frequency	1 Hz to 20 kHz
		Depth	0% to 100%
	FM	Profile	Sine, square, ramp
		Frequency	1 Hz to 20 kHz
		Minimum carrier	10 Hz
		Deviation	1 Hz to carrier frequency or (2e12 / carrier frequency), whichever is smaller
	FSK	Modulation	50% duty cycle square wave
		FSK rate	1 Hz to 20 kHz
		Hop frequency	2 x FSK rate to 10 MHz

1. 10 mV_{PP} (1 MΩ) / 5 mV_{PP} (50 Ω) minimum if | DC + Peak AC | ≥ 400 mV
2. 8 V_{PP} (1 MΩ) / 4 V_{PP} (50 Ω) maximum for Gaussian waveshape
3. Resolution is Freq/25000 Hz for square and pulse waveforms < 8 kHz
4. Include (add) external reference clock frequency error, if applicable
5. For amplitude ≤ 1 V_{PP} at 50 MHz, ≤2 V_{PP} at 40 MHz, ≤ 5 V_{PP} at ≤ 30 MHz, into 50 Ω load
6. For amplitude ≥ 5 mV_{PP} into 50 Ω load
7. For amplitude ≤ 1 V_{PP} at 50 MHz, ≤ 2 V_{PP} at 40 MHz, ≤ 5 V_{PP} at ≤ 30 MHz, into 50 Ω load
8. ≥ 35 mV_{PP}, 0 V offset, into 50 Ω
9. 5 nS if frequency is < 8 kHz
10. Amplitude ≥ 20 mV_{PP} into 50 Ω load

Display	
Size	15.6” capacitive multi-touch
Resolution	Full HD (1920 x 1080)
Annotations	Up to 100, floating or anchored
Grids and Windows	Up to 16 grids on up to 8 waveform windows
Waveform modes	Connected samples (sin(x)/x interpolated or lines), dots only
Persistence modes	Infinite, variable, color graded

Computer system	
Operating system	Windows 10
CPU	Intel Core i5-6500, 3.2 GHz
System memory	8 GB
Hard drives	500 GB removeable SSD, upgradeable to 1 TB SSD, additional of either are available
Peripherals	Optical USB mouse and full-siz e keyboard provided
LXI compliance	Class C

I/O	
LAN	RJ-45 connector, supports 10/100/1000Base-T. Enables Web-enabled remote control, email on trigger, data/file transfers and network printing (supports up to 80 MB/s data offloading)
USB	4x USB 2.0 host ports (2x front panel, 2x side panel), 2x USB 3.0 host ports (side panel), 1x USB 3.0 device port (side panel, supports up to 200 MB/s data offloading)
Audio	Microphone, line in, line out
Display out	DisplayPort and VGA (supports up to two simultaneous displays)
Trigger out	TTL levels, high impedance load
Auxiliary out	Configurable: DC level, probe compensation, trigger out, or a demo signal
Timebase reference output	Amplitude into 50 Ω: 1.65 ± 0.05 V_{pp} (8.3 ± 0.3 dBm) sine wave (internal or external timebase reference selected)
	Frequency: 10 MHz ± (8 ppb initial + 75 ppb/year aging) when internal timebase reference is selected; external reference frequency when external timebase reference is selected
Timebase reference input	Amplitude into 50 Ω: 356 mV_{PP} (-5 dBm) to 5 V_{PP} (+18 dBm) sine, 285 mV_{PP} to 4 V_{PP} square
	Frequency: 10 MHz ± 5 ppm

Supported file types		
Infiniium setup files	.set	Infiniium settings only
	.osc	settings and waveform data
Waveform files, compressed	wfm	binary, Infiniium format
	.bin	binary, approx. 5x smaller than larger XY format
	.h5	open source, Infiniium or InfiniiVision format
	.mat	MATLAB
Waveform files, raw data	.csv	XY values, comma-separated
	.tsv	XY values, tab-separated
	.txt	Y values
Image files	png	24-bit color
	.jpg	24-bit color
	.bmp	24-bit color
	.gif	8-bit color
	.tif	8-bit color
	All images may be saved or printed with waveforms only, inverted backgrounds, with setup info, and/or in a compressed format.	

Environmental, safety and dimensions		
Temperature	Operating	+5 to +40 °C
	Non-operating	-40 to +70 °C
Humidity	Operating	≤ 80% relative humidity (non-condensing) at +40 °C
	Non-operating	≤ 90% relative humidity (non-condensing) up to +70 °C
Altitude	Operating	Up to 3,000 m (9,842 ft)
	Non-operating	Up to 15,300 m (50,196 ft)
Power	100 to 120 V @ 50/60/400 Hz	
	100 to 240 V @ 50/60 Hz	
	Max power dissipated	4 channel models: 450 Watts
		8 channel models: 650 Watts
Acoustic Noise	Operator position (standing, 0.5 m height at 0.25 m away)	4 channel models: 45.5 dB
		8 channel models: 49.9 dB
	Bystander position (1 m height at 1 m away)	4 channel models: 39.4 dB
		8 channel models: 42.9 dB
Weight	Frame	4 channel models: 13.75 kg (30.3 lbs.)
		8 channel models: 14.50 kg (32.0 lbs.)
	Shipping	4 channel models: 20.95 kg (46.2 lbs.)
		8 channel models: 21.90 kg (48.3 lbs.)
		Package: 7.2 kg (15.9 lbs.)
Dimensions	Height	327 mm (12.9 in) with feet retracted
	Width	443 mm (17.5 in)
	Depth	223 mm (8.8 in) including knobs and rear feet
Safety	IEC 61010-1:2017	
	IEC 61010-2-030:2017	
	UL 61010-1:2012 (3rd edition)	
	UL 61010-2-030:2018	
	CAN/CSA-22.2 No. 61010-1-12	
	CAN/CSA-22.2 No. 61010-2-030-17	
EM standards	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	
	IEC61326-1:2012/EN61326-1:2013	

Ordering Guide and Upgrade Information

Ordering your EXR-Series oscilloscope couldn't be easier. Contact your Keysight representative or authorized partner for more information, or to place an order: www.keysight.com/find/contactus

Standard accessories

Description	Part	Quantity
Passive Probe, 10:1, 500 MHz	N2873A	4 or 8
50 Ω Calibration Cable, 1 meter	54609-61609	1
Accessory Pouch	54925-62301	1
Protective Front Cover	54925-44101	1
Local Power Cord	Varies	1
Full-Size Keyboard	0960-3245	1
Optical Scroll Wheel Mouse	0960-3246	1
1 Year Factory Calibration Certificate	–	1
Safety Leaflets, if Applicable	–	1
Probe Selection Guide	–	1

Main model configuration

This page is intended for configuring a new unit. For post-purchase upgrades, see the last page.

Channel bandwidth	4 channels	8 channels
500 MHz	EXR054A	EXR058A
1 GHz	EXR104A	EXR108A
2 GHz	EXR204A	EXR208A
2.5 GHz	EXR254A	EXR258A

Integrated instruments	Model
4-digit digital voltmeter, 10-digit counters	Standard
Arbitrary Waveform Generator, 50 MHz	EXR2WAV
Logic Analysis, 16 Channels (includes N2756A probe)	EXR2MSO
Frequency Response Analyzer, 50 MHz (Bode plotter)	Part of D9010PWRA Or included in EXR2WAV
Phase Noise Analyzer	Part of D9010JITA
Protocol Analyzer	Various, see next pages

Performance upgrades	Model
Memory Upgrade, 200 Mpts/ch	EXR2MEM-001
Memory Upgrade, 400 Mpts/ch	EXR2MEM-002
Memory Upgrade, 1.6 Gpts Combined Flexible Memory	EXR2MEM-004
Upgrade to 1 TB Removable SSD	EXR2SSD-01T
ISO 17025 Calibration (Not Accredited)	EXR000-1A7
ISO 17025 Calibration (Accredited)	EXR000-AMG

Additional equipment	Model
Rackmount Kit, 8U	EXR2RACK
Additional Removable SSDs, 500 GB or 1 TB	EXR2SSD
Hard Shell Transit Case, Sold by CaseCruzer	3F2002-1910C [1]
BNC(m) to SMA(f) Adapters, DC-10 GHz	54855-67604
GPIB Adapter, Sold by ICS Electronics	4865B [1]

1. Parts available from third party vendors listed in description, not sold by Keysight.

Probes and Accessories

The Infiniium EXR-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 models ship standard with an N2873A 500 MHz passive probe per channel and support a wide range of about 100 compatible current and voltage probes.

Additionally, legacy probes from Tektronix may be used on the EXR-Series with the proper adapter, listed below. See the data sheet for a list of compatible probes.

The table below highlights probes commonly used with the Infiniium EXR- Series. Read *The Infiniium Oscilloscope Probes and Accessories Guide* for additional information, or visit the Probe Resource Center at prc.keysight.com.

Category	Models	Description
Passive	N2870A-76A	2.5 mm probe tip diameter for fine pitch component probing, easily replaceable spring-loaded or solid probe tip, 10-25 pF input C (high-Z, 10:1) covers wide range of scope input, 7 probes and 4 accessory kits available, N2873A shipped with Infiniium EXR series
Hi-Z+ Passive *All New!*	PP0001A-03A	Three passive probes that, with the help of an adapter, can achieve best-in-class bandwidth, voltage, and loading specifications, up to 1 GHz or 1.2 kV.
Digital	N2756A	Ships with EXR2MSO option. 16 flying leads with grabbers, ground leads, and other accessories.
Single-ended Active	N2795A-97A	Up to 2 GHz, low cost, high impedance input (1 MΩ at DC), wide dynamic/offset range, headlight, -40 to +85 C of extreme temp range for chamber testing (N2797A)
Differential low voltage	N2750A-52A	Up to 6 GHz, 200 kΩ input, InfiniiMode for Diff, SE, CM probing, built-in multifunction scope control, headlight
Differential high voltage	DP0001A	400 MHz, 2 kV input, high CMRR >80 dB at DC, UL safety certified
Current	N7026A	150 MHz, 30 ARMS, 1 mV/div sensitivity clamp-on, AutoProbe interface
High sensitivity current	N2820A/21A	3 MHz, measurable down to 100 µA AC/DC, provides wide dynamic range, ideal for capturing low level current flow
Power rail	N7020A	2 GHz, low noise for power rail noise measurement, high offset voltage, 50 kΩ loading at DC
Adapter	N2744A	Adapter for using legacy Tektronix TekProbe oscilloscopes. See data sheet for compatible models.

Analysis software packages

Software	Description	Data sheet
Signal integrity		
InfiniiScan Zone Trigger	InfiniiScan visual and measurement-based triggering	D9010SCNA
EZJit Complete	Timing jitter, vertical noise, and phase noise analysis	D9010JITA
De-Embedding	Modeling and simulating out cables, probes and fixtures	D9010DMBA
Advanced Signal Integrity	Opening closed eye diagrams	D9020ASIA
Power		
Power Integrity, Rails, PMICs	Power Integrity Analysis (PSIJ, SSN, victim/aggressor, etc.)	D9010POWA
Switch Mode Supplies	Power Supply Analysis (Input, Switching, Output, PSRR)	D9010PWRA
Additional packages		
PAM	PAM-4 measurements	D9010PAMA
User Defined Application	Remote measurement automation and test reports	D9010UDAA

Protocol decode and trigger software packages

Package	Description	Data sheet
Low Speed Serial	I^2C, SPI, Quad SPI, eSPI, RS232, UART, JTAG, I^2S, SVID, Manchester, MDIO	D9010LSSP
Embedded	USB 2.0, 10/100 Mb/s Ethernet, USB-PD, eUSB2, DisplayPort AUX	D9010EMBP
Low Speed Automotive	CAN, CAN-FD, LIN, SENT, FlexRay	D9010AUTP
MIPI Low Speed	RFFE, I^3C, SPMI	D9010MPLP
Military	ARINC 429, MIL-STD 1553, SpaceWire	D9010MILP
High Speed Automotive	100BASE-T1 Automotive Ethernet	D9020AUTP
Basic Protocol Bundle	Contains all packages above, except D9020AUTP	D9011BDLP

Offline testing

View and analyze test results at your desk! Save an oscilloscope file, then view and analyze on your PC using the full Infiniium user interface without needing additional access to your scope. Infiniium Offline uses the exact same code as your Infiniium EXR-Series.

Use waveform math, filtering, FFT, protocol decoding, jitter analysis, eye diagrams and more to get more insight. Infiniium offline is a truly powerful software tool to help you get your job done faster while freeing up precious hardware resources. See the Infiniium Offline data sheet to learn more.

Description	Details	Option
Infiniium Offline	Required as baseline software. Prerequisite to all other options.	D9010BSEO
EZJit Complete	Timing jitter, vertical noise, and phase noise analysis.	D9010JITO
Advanced Signal Integrity	Equalization, InfiniiSim, PAM-N analysis, and crosstalk	D9010ASIO
Low Speed Protocol Package	I^2C, SPI, SR232/UART, JTAG, CAN, CAN-FD, LIN, FlexRay, SVID, USB 2.0, USB-PD, MIPI RFFE, eSPI, I^2S, Ethernet 10/100BaseT, SpaceWire, SPMI, 100BASE-T1, Manchester, ARINC429, MIL-STD1553)	D9010LSPO
High Speed Protocol Package	DDR2/3/4, LPDDR2/3/4, Ethernet 10GBASE-KR 64/66, Ethernet 100Base KR/CR, MIPI [CSI-3, DigRF v4, D-PHY, LLI, RFFE, UniPro], PCIe Gen 1/2/3, SATA/SAS, UFS, USB 2.0, USB 3.0, USB 3.0 SSIC, USB 3.1, C-PHY	D9010HSPO

Post-purchase upgrades

Hardware options	Model
Add logic analysis, 16 channels (includes N2756A probe)	EXR2MSO
Add arbitrary waveform generator, 50 MHz	EXR2WAV
Rackmount Kit, 8U	EXR2RACK
Additional Removable SSD, 500 GB	EXR2SSD-500
Additional Removable SSD, 1 TB	EXR2SSD-01T

Memory upgrades			
	…to 200 Mpts/ch	…to 400 Mpts/ch	…to 1.6 Gpts/ Combined Flexible Memory
From 100 Mpts/ch…	EXR2MEM-001	EXR2MEM-002	EXR2MEM-004
From 200 Mpts/ch…	-	EXR2MEM-003	EXR2MEM-005
From 400 Mpts/ch….	-	-	EXR2MEM-006

Bandwidth upgrades		4 channels	8 channels
From 500 MHz…	…to 1 GHz	EXR2BW-001	EXR2BW-007
	…to 2 GHz	EXR2BW-002	EXR2BW-008
	…to 2.5 GHz	EXR2BW-003	EXR2BW-009
From 1 GHz…	…to 2 GHz	EXR2BW-004	EXR2BW-010
	…to 2.5 GHz	EXR2BW-005	EXR2BW-011
From 2 GHz…	…to 2.5 GHz	EXR2BW-006	EXR2BW-012

1. Every model is calibrated to 2.5 GHz from the factory, so bandwidth upgrades require no further calibration outside of the standard recommended interval.

Analog channel upgrades	Model
Channel upgrade from 4 to 8 channels, 500 MHz	EXR28CH-001
Channel upgrade from 4 to 8 channels, 1 GHz	EXR28CH-002
Channel upgrade from 4 to 8 channels, 2 GHz	EXR28CH-003
Channel upgrade from 4 to 8 channels, 2.5 GHz	EXR28CH-004

1. Requires return to Keysight service center. Model and serial number are kept. Cost of upgrade does not include shipping.

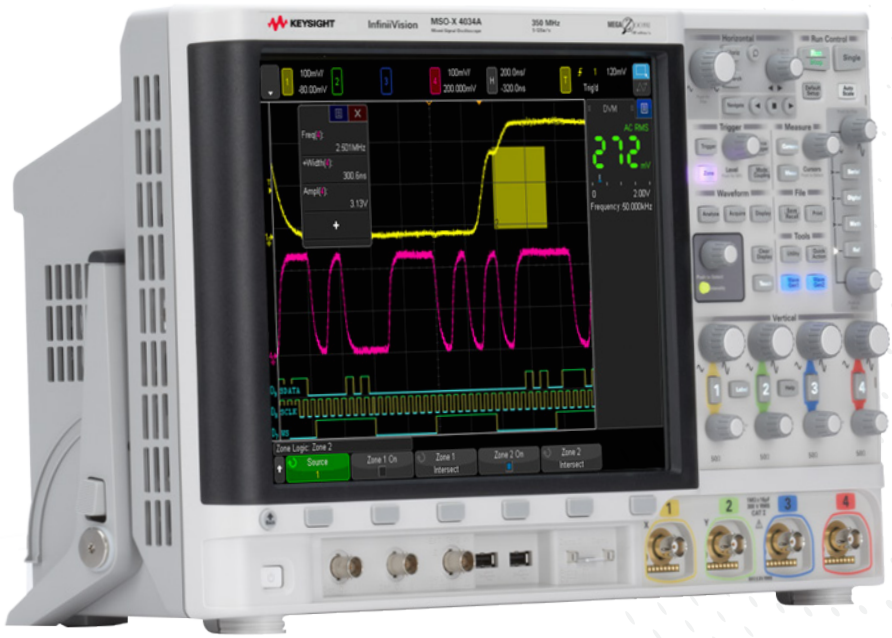
Learn more at: www.keysight.com

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at: www.keysight.com/find/contactus

KEYSIGHT TECHNOLOGIES

DATA SHEET

InfiniiVision 4000 X-Series Oscilloscopes



KEYSIGHT TECHNOLOGIES

Table of Contents

Need more bandwidth, sampling rate, and analysis?

Consider the Infiniium 6000 X-Series
- 1, 2.5, 4, and 6 GHz bandwidth
- 20 GSa/s sample rate
- Ultra-low noise at 1 mV/div
- 12.1-inch multi-touch capacitive display with gesture support
- Standard color grade, histogram, and enhanced FFT
- Optional jitter and real-time eye diagram analysis

See www.keysight.com/find/6000X-Series for more details.

Oscilloscope Experience Redefined: Experience the Speed, Usability, and Integration

Imagine an oscilloscope that sees everything, triggers on anything, has the ease-of-use of a tablet device...and grows with your projects.

The Keysight 4000 X-Series oscilloscopes are engineered for next-generation performance, delivering waveform update rates 20 times faster than the competition to display the most signal detail. An industry-leading 12.1-inch capacitive touch screen with innovative hardware-based zone touch triggering provides the most intuitive interface to get you answers faster. The 4000 X-Series provides maximum investment protection with fully upgradable 7-instruments-in-1.

Experience the speed

Anomalies and elusive events are the toughest to debug. The 4000 X-Series oscilloscope redefines your debugging experience with MegaZoom IV smart memory technology. The industry-leading 1-million-waveforms-per-second update rate, means you see more of your signal behavior and can feel more confident in your design.

Experience the usability

You may be surprised just how easy it is to use the InfiniiVision 4000 X-Series. A 12.1-inch capacitive touch screen – the industry's largest – works just like your favorite tablet or smart phone, so debugging your devices is faster than ever before. Innovative zone touch triggering makes triggering on anything a snap. Just draw a box around signals of interest and the oscilloscope triggers on them. So, if you can see it, you can trigger on it.

Experience the integration

The 4000 X-Series further redefines your oscilloscope experience by integrating the capabilities of seven instruments in one: oscilloscope channels, logic channels, digital voltmeter (DVM), dual-channel WaveGen function/arbitrary waveform generator, frequency response analyzer (Bode plots), 8-digit hardware counter, and serial protocol analyzer including USB. All are upgradable, including bandwidth, for the ultimate investment protection.

4000 X-Series – Oscilloscope experience redefined

Key features:

- Experience the speed:
  - One million waveforms per second update rate
  - MegaZoom IV smart memory technology
  - Standard segmented memory
- Experience the usability:
  - Industry's first capacitive touch screen
  - Industry's largest 12-inch display
  - Zone touch trigger
- Experience the integration:
  - Industry's first 7 instruments in 1
  - Industry's first fully upgradable oscilloscope including bandwidth to 1.5 GHz
  - Industry's leading application solutions

Figure 1. MegaZoom IV smart memory technology enables the speed, usability, and integration.

Figure 2. Take advantage of the Ultimate Bundle Software Package that enables ALL software applications (including serial decode, and for one low price (D4000BDLA).

Oscilloscope Experience Redefined: Experience the Speed, Usability, and Integration (Continued)

Overview of Keysight InfiniiVision X-Series oscilloscopes

InfiniiVision	6000 X-Series	4000 X-Series	3000T X-Series	2000 X-Series	1000 X-Series
Analog channels	2 or 4	2 or 4	2 or 4	2 or 4	2 or 4
Digital channels	16 (MSO models or upgrade)	16 (MSO models or upgrade)	16 (MSO models or upgrade)	8 (MSO models or upgrade)	External trigger can be used as a 3rd digital channel for 2 channel model
Bandwidth	1, 2.5, 4, 6 GHz	200, 350, 500 MHz, 1, 1.5 GHz	100, 200, 350, 500 MHz, 1 GHz	70, 100, 200 MHz	50, 70, 100, 200 MHz
Max sample rate	20 GSa/s	5 GSa/s	5 GSa/s	2 GSa/s	2 GSa/s
Max memory depth	4 Mpts	4 Mpts	4 Mpts	1 Mpts	2 Mpts (DSOX models)
Max waveform update rate	> 450,000 wfms/sec	> 1,000,000 wfms/sec	> 1,000,000 wfms/sec	> 200,000 wfms/sec	> 200,000 wfms/sec (DSOX models)
Display	12.1-inch, capacitive touch	12.1-inch, capacitive touch	8.5-inch, capacitive touch	8.5-inch	7 inch
Zone touch trigger	Standard	Standard	Standard	No	No
Voice control	Standard	No	No	No	No
WaveGen 20-MHz function/arbitrary waveform generator	Dual-channel AWG (option)	Dual-channel AWG (option)	Single-channel AWG (option)	Single-channel function (option)	Single-channel function (on G models)
Integrated DVM	Standard	Standard	Standard	Standard	Standard
Integrated hardware counter (standard)	10-digit frequency, period, or totalizer counter	5-digit frequency or period counter (8 digits with external 10 MHz clock reference)	8-digit frequency, period, or totalizer counter	5-digit frequency counter	5 digits
Search and navigate	Standard, lister supported	Standard, lister supported	Standard, lister supported	Serial only	No
Segment memory	Standard	Standard	Standard	Standard	Standard on DSO models
Mask limit test	Option	Option	Option	Option	Standard on DSO models
Measurement limit test	Option	Option	Option	No	No
Serial protocol analysis options	I^2C/SPI, UART/RS232, CAN/CAN-dbc/CAN-FD/ LIN/LIN symbolic, SENT, FlexRay, I^2S, MIL-STD1553, CXPI, ARINC429, USB 2.0, Manchester/NRZ, USB PD	I^2C/SPI, UART/RS232, CAN/CAN-dbc/CAN-FD/ LIN/LIN symbolic, SENT, FlexRay, I^2S, MIL-STD1553, CXPI, ARINC429, USB 2.0, Manchester/NRZ, USB PD	I^2C/SPI, UART/RS232, CAN/CAN-dbc/CAN-FD/ LIN/LIN symbolic, SENT, FlexRay, I^2S, MIL-STD1553, CXPI, ARINC429, Manchester/ NRZ, USB PD	I^2C/SPI, UART, CAN/ LIN (will not operate simultaneously with digital channels)	I^2C, UART (standard on all models) SPI, CAN/LIN (standard on DSO models)
Advanced analysis options	Power analysis, USB 2.0 signal quality test, HDTV analysis, FRA	Power analysis, USB 2.0 signal quality test, HDTV analysis, FRA, NFC	Power analysis, HDTV analysis, FRA, NFC	No	FRA (Bode plots)
Color grade	Standard	No	No	No	No
Histogram	Standard	No	No	No	No
FFT	Standard enhanced FFT	Standard enhanced FFT	Standard enhanced FFT	Standard	Standard
Multi-domain analysis	Gated FFT	Gated FFT	Gated FFT	No	No
Jitter analysis with clock recovery	Option	No	No	No	No
Realtime eye diagram	Option	No	No	No	No
Advanced math	Standard, display four functions simultaneously	Standard, display one function	Standard, display one function	Standard, display one function	No
Connectivity	Standard USB 2.0, LAN, video (GPIB option), USB mouse and keyboard support	Standard USB 2.0, LAN, video (GPIB option), USB mouse and keyboard support	Standard USB 2.0 (LAN/ video/GPIB option), USB mouse and keyboard support	Standard USB 2.0 (LAN/ video/GPIB option), USB keyboard support	Standard USB 2.0, LAN, USB keyboard support

Oscilloscope Experience Redefined: Experience the Speed

One million waveforms per second update rate

If you can't see the problem, it is hard to troubleshoot it. With an industry-leading one million waveforms per second update rate, the InfiniiVision 4000 X-Series gives you the highest probability of capturing random and infrequent events that you would miss on an oscilloscope with a lower waveform update rate.

Powered by MegaZoom IV smart memory technology, the InfiniiVision 4000 X-Series not only lets you see more waveforms, but it has the uncompromised ability to find the most difficult problems in your design. Unlike other oscilloscopes, uncompromised ability means:

- Always-fast, responsive operation
- No slowdown with logic channels on
- No slowdown with protocol decoding on
- No slowdown with math functions turned on
- No slowdown with measurements turned on

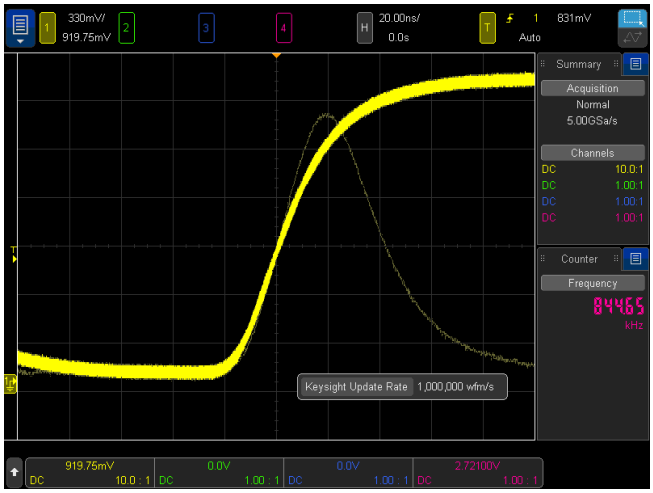


Figure 3. The 4000 X-Series captures a glitch occurring once in a million waveform cycles.

What is waveform update rate and why is it important?

As oscilloscopes acquire data, process it, and plot it to the screen, there is inevitable "dead time," or the time oscilloscopes miss signals completely. In general, the faster the waveform update rate, the shorter the dead time. The shorter the dead time, the more likely an oscilloscope is to capture anomalies and infrequent events. This is why it is critical to select an oscilloscope with a fast waveform update rate.

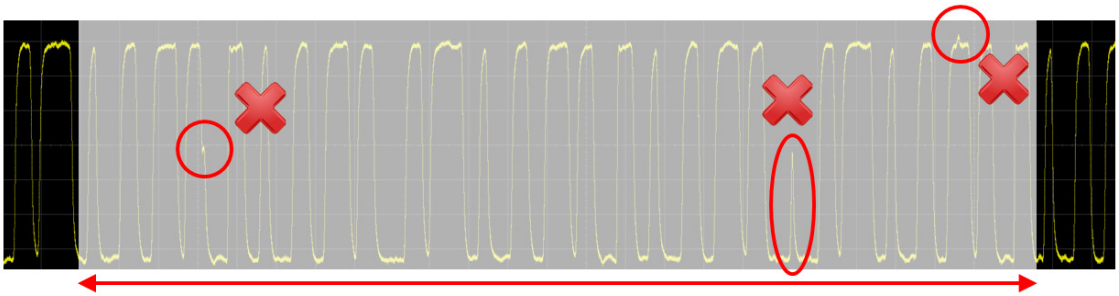


Figure 4. Other vendor's oscilloscope with 50,000 waveforms/second. A long dead time decreases your chances of capturing infrequent events.

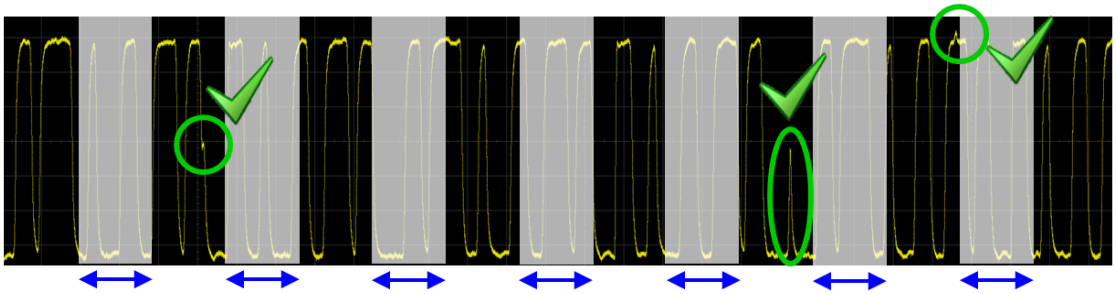


Figure 5. InfiniiVision 4000 X-Series with 1,000,000 waveforms/second. A short dead time increases your chances of capturing infrequent events.

Oscilloscope Experience Redefined: Experience the Speed (Continued)

Keysight achieves this industry-leading waveform update rate with MegaZoom IV smart memory technology

Traditionally, CPU processing was the major bottleneck for oscilloscope waveform update rate and responsiveness. Typically, the CPU handles interpolations, logic channel plotting, serial bus decoding, measurements and more, and the waveform update rate drops dramatically as these features are turned on.

The InfiniiVision 4000 X-Series requires minimum support from a CPU, as most core operations are handled by Keysight proprietary technology, the MegaZoom IV smart memory ASIC. MegaZoom includes hardware serial decoders and hardware mask limit testing capability, plots analog and digital data directly to the display, supports GUI operation, and integrates additional instruments like the dual-channel WaveGen function/arbitrary waveform generator.

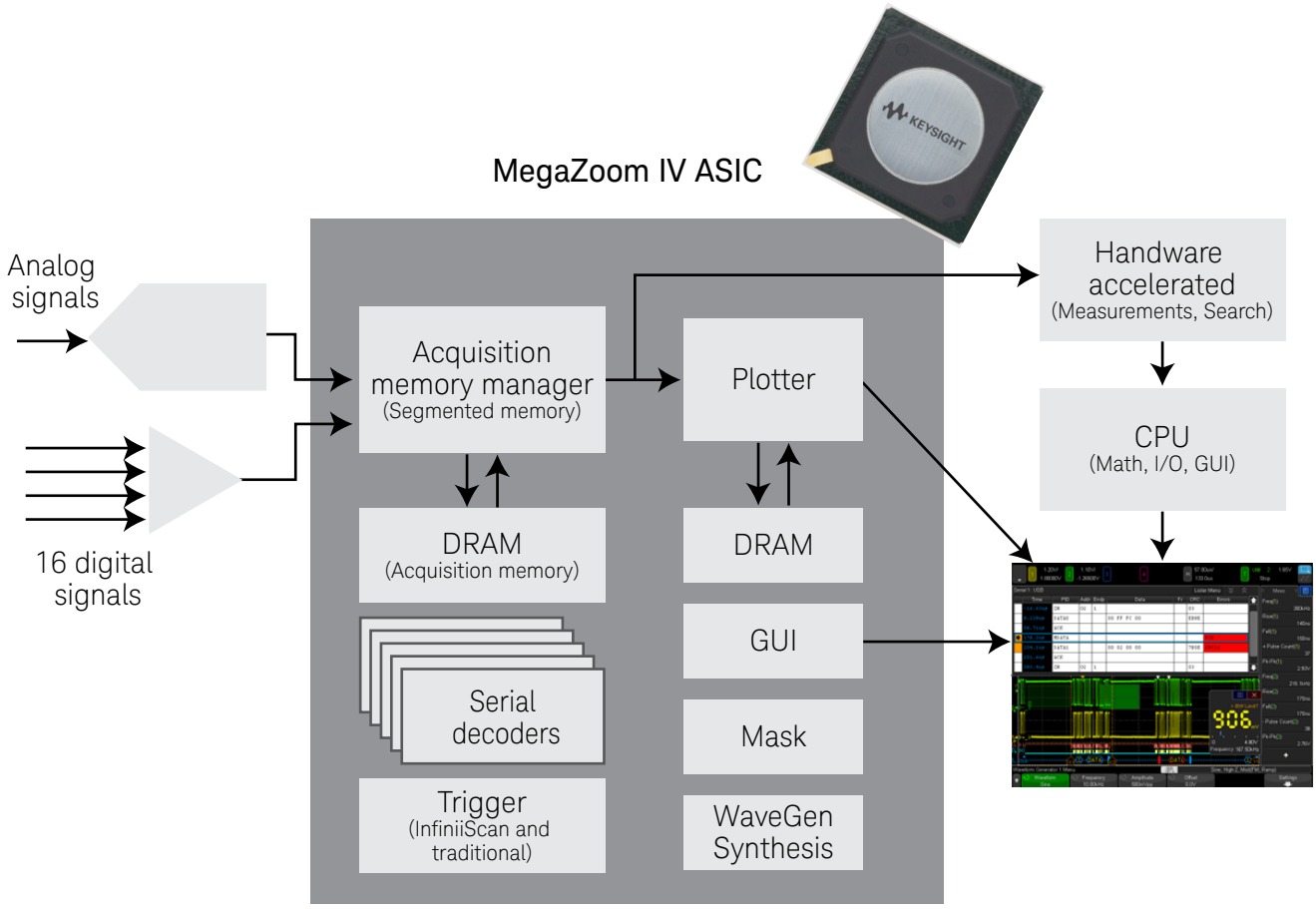


Figure 6. The 4000 X-Series oscilloscopes' uncompromised responsiveness, speed and waveform update rate is enabled by the MegaZoom IV, smart memory ASIC. The CPU is not used for core waveform operations.

Oscilloscope Experience Redefined: Experience the Speed (Continued)

Segmented memory: A smart and efficient way to capture waveforms

Acquisition memory size is an essential oscilloscope specification because it determines the amount of data you can capture in a single acquisition. In general, longer memory is better. However, no memory is always long enough to capture all the signals you need, especially when capturing infrequent anomalies, data bursts, or multiple serial bus packets. Segmented memory acquisition lets you selectively capture and store important signal activity without capturing unimportant signal idle time with the time stamp of each segment relative to the first trigger event. Segmented memory comes standard in the 4000 X-Series.

Figure 7 shows segmented memory successfully capturing 1,000 events in 3.27274 seconds. Traditional memory architecture would require 2.7 Gpts of memory to accomplish the same result. This memory is not available on any scope in the market.

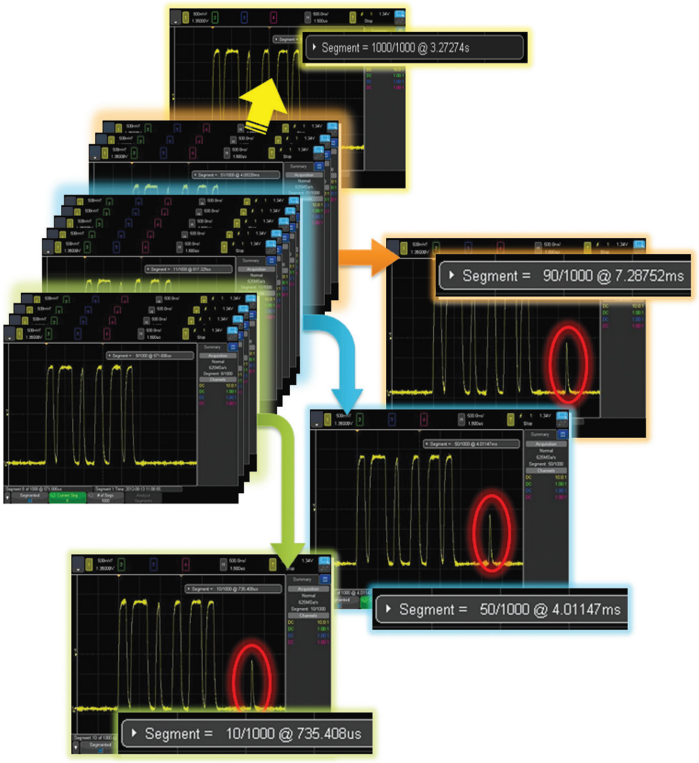


Figure 7. Segmented memory efficiently manages the memory to capture up to 1,000 segments of interest to you, making it an effective ultra-deep memory oscilloscope that can easily capture infrequent events and anomalies.

Segmented memory + serial decode

Segmented memory works in conjunction with serial protocol decode. For example, by setting the trigger condition to “CAN serial bus error,” segmented memory captures and stores only CAN error packets and stitches together each segment for easy viewing. You can quickly compare time tags in the event lister to discover time intervals between errors.

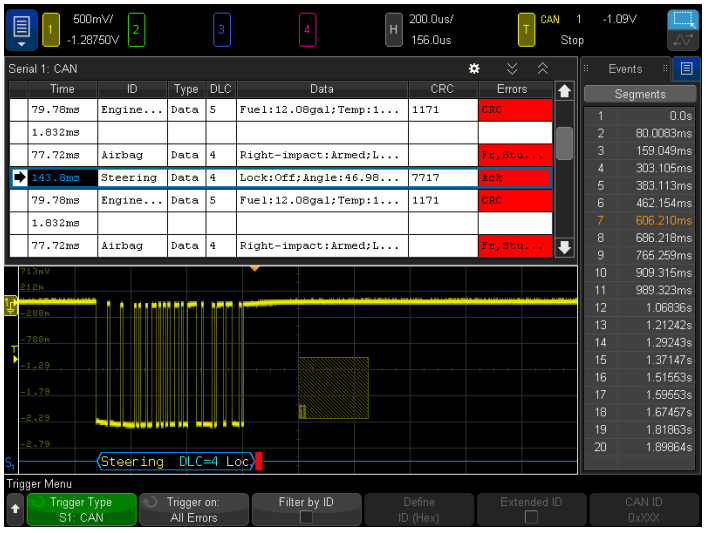


Figure 8. Segmented memory being used in conjunction with serial decode resulting in maximum insight into serial bus.

Oscilloscope Experience Redefined: Experience the Speed (Continued)

Mask and measurement limit testing (option)

Whether you are performing pass/fail tests to specified standards in manufacturing or testing for infrequent signal anomalies, mask and measurement limit testing can be a valuable productivity tool. The 4000 X-Series features powerful hardware-based mask testing and can perform up to 270,000 tests per second. You can select multiple test criteria, including the ability to run tests for a specific number of acquisitions, a specified time, or until detection of a failure.

With the optional measurement limit testing capability, you can perform pass/fail testing based on user-defined maximum and minimum limits on any parametric measurement that has been selected and turned on. Stop-on-failure is also available.

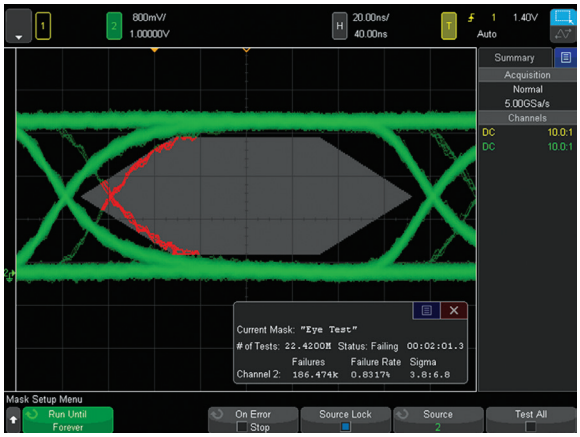


Figure 9. Mask testing evaluated > 22 M waveforms in just 2 minutes.

Search and navigation

The parametric and serial bus search and navigation feature comes standard on the 4000 X-Series oscilloscopes. When you are capturing long, complex waveforms using an oscilloscope's deep acquisition memory, manually scrolling through stored waveform data to find specific events of interest can be slow and cumbersome. With automatic search and navigation capability, you can easily set up specific search criteria and then quickly navigate to "found and marked" events. Available search criteria include edges, pulse width (time-qualified), rise/fall times (time-qualified), runt pulses (time-and level-qualified), frequency peaks (FFT function, threshold and excursion qualified), and serial bus frames, packets, and errors.

Figure 10a. The 4000 X-Series was set up to capture data signals with various rise time edges. Using the search and navigation capability, the oscilloscope was able to find, mark (white triangles), and quickly navigate to 16 occurrences of "out of compliance" rise-time edges.

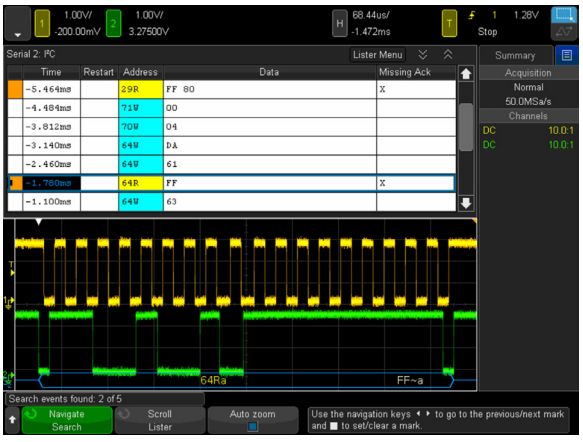


Figure 11. Using the error condition search, the 4000 X-Series quickly found 5 places with a missing acknowledgment in an I²C serial bus. The navigation feature moves between the errors and zooms automatically to show the error packet.

Figure 10b. The 4000 X-Series was set up to capture clock signals for FFT analysis. Using the search and navigation capability, the scope found, marked (white triangles) and quickly navigated to the first 11 frequency peaks occurrences. You can sort it in the order of frequency or amplitude.

Oscilloscope Experience Redefined: Experience the Usability

Industry's largest 12.1-inch display

From the start of product development, we designed every aspect of this oscilloscope for a touch interface. Large, easily touchable targets on the industry's largest 12.1-inch display with capacitive touch screen technology mean operation is quick and natural, just like your favorite tablet devices.

Capacitive touch screen technology

Capacitive touch screen technology provides enhanced productivity. Use the alphanumeric pad for quick annotation, place waveforms or cursors in exact positions and drag docking panels across the screen to see more measurement information.

The 4000 X-Series offers three ways to access key menus and features: touch GUI for those that prefer tablet or smart phone touch interfaces, front panel keypads for the traditional oscilloscope users, and Keysight pull down menu for users who prefer Windows-like operations. The 4000 X-Series also offers a "touch off" button as well as USB mouse and keyboard support.

Redefine your remote Web control oscilloscope experience. The 4000 X-Series not only supports traditional control via a PC Web browser, but also supports remote control through popular tablet devices.

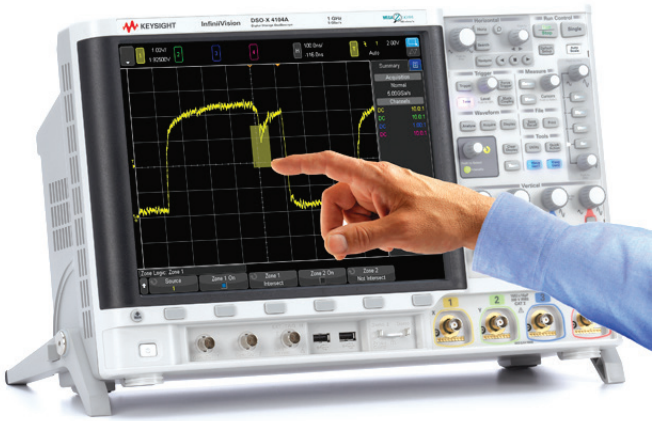


Figure 12. The industry's largest 12.1-inch display and capacitive touch screen technology with large, touchable targets.

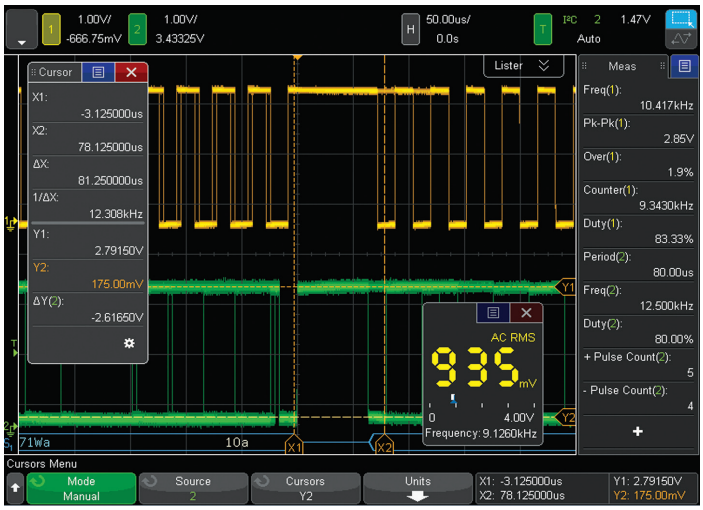


Figure 13. See 10 measurements, cursor information, and the DVM simultaneously by dragging the desired docking panel to any open area.

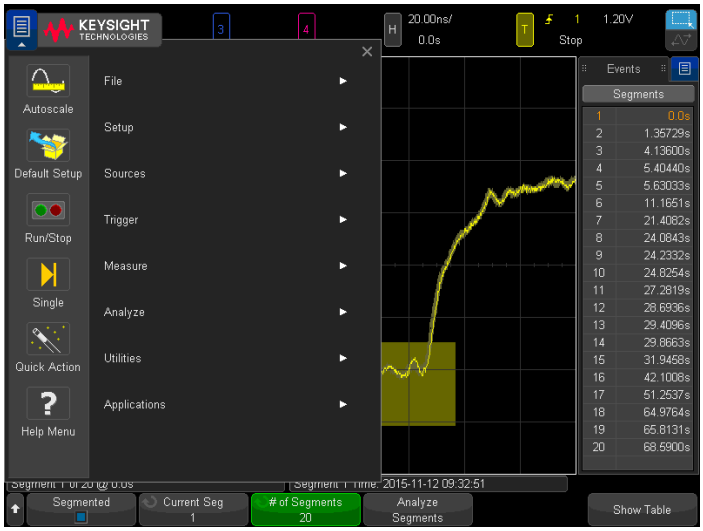


Figure 14. Use the Keysight pull-down menu for Windows-like operation.

Oscilloscope Experience Redefined: Experience the Usability (Continued)

Zone touch trigger

One of the biggest challenges of using an oscilloscope is setting up an advanced trigger to isolate a signal of interest. While advanced triggers are powerful features, zone touch trigger provides a turnkey trigger solution.

You simply observe the signal of interest on the display, and draw a zone (box) around it. What used to be hours of work can now take just a few seconds. If you want to move your zones to another location, just drag them over. The 4000 X-Series can be set up to easily trigger on one or two zone boxes simultaneously with either must intersect or must not intersect conditions.

Zone triggering does not compromise the waveform update rate; the 4000 X-Series will still maintain an ultra-fast 200,000 waveforms per second or more, even with additional features turned on. In other words, the oscilloscope that sees everything can easily trigger on anything.

Zone touch trigger + segment memory: A whole new experience

The combination of the industry's only hardware-based zone touch trigger with the 4000 X-Series' segment memory simplifies and enhances your debugging experience. In Figure 16, the 4000 X-Series has isolated and captured 1,000 metastable signals, showing the critical bit errors over a 32-second time span at 5 GS/s sampling rate in the segment memory. The segment memory also allows you to overlay all segments to identify the worst-case signal.

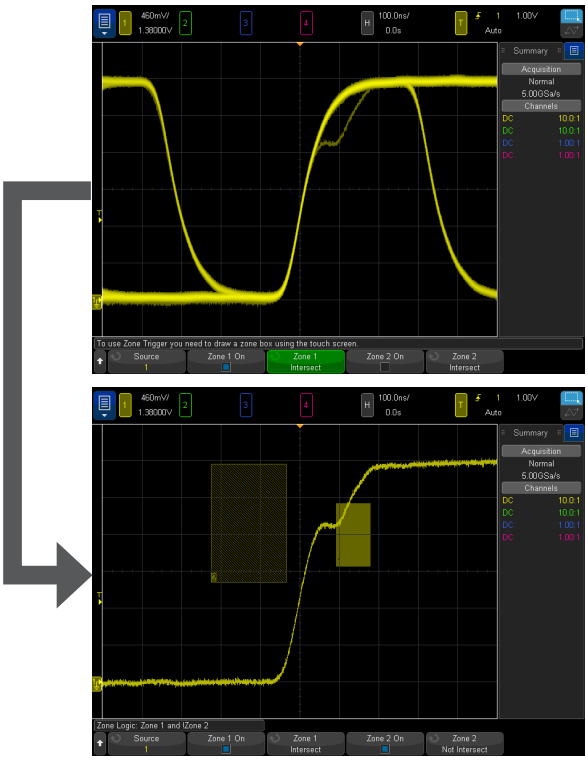


Figure 15. When you see anomalies, all you have to do is draw a zone box to trigger on them.

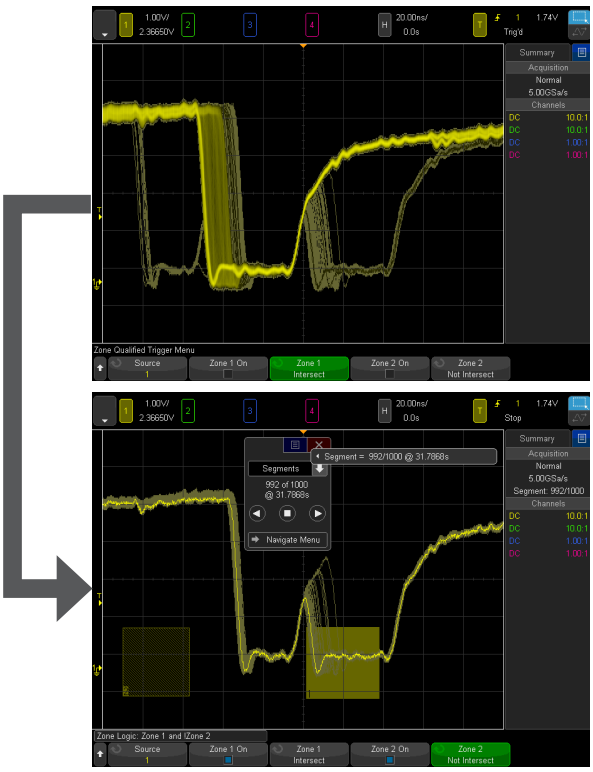


Figure 16. Combination of the zone touch trigger and segmented memory.

Oscilloscope Experience Redefined: Experience the Integration

Investment protection through a fully-upgradable 7-in-1 instrument

The InfiniiVision 4000 X-Series redefines the oscilloscope experience with unprecedented integration. This 7-in-1 instrument provides:

- Oscilloscope
- 16 digital channels
- Serial protocol analyzer
- Dual-channel WaveGen 20 MHz function/ arbitrary waveform generator
- 3-digit voltmeter
- Frequency response analysis (Bode plots)
- 8-digit hardware counter with totalizer

Figure 17. The 4000 X-Series provides the capabilities of five instruments seamlessly integrated into one.

Multi-domain analysis: Time-correlate analog, digital, and frequency domain signals

Viewing the frequency content of waveforms is greatly simplified by a touch screen operation. Pop up keypads make inputting start, stop, span and center frequency easy. And the new problem solving feature called “gated FFT” lets you time correlate the analog, digital, and frequency domain to aid in analysis and debug. In addition, there are new capabilities for peak searching, max and min hold and averaging of FFTs to increase dynamic range.

When gated FFT is on, the oscilloscope goes into zoom mode. The FFT analysis shown in the zoomed (bottom) window is taken from the period of time indicated by the zoom box in the main (top) window. In the gated FFT mode, touch and flick the zoom box through the acquisition to investigate how the FFT analysis changes over time, correlating the RF phenomenon with the analog and digital phenomenon.

Figure 18. Gated FFT successfully correlated the hopping of the FSK modulation with the analog and I²C control command.

Oscilloscope Experience Redefined: Experience the Integration (Continued)

Mixed signal oscilloscope (MSO): Integrated 16 digital channels

With an additional 16 integrated digital channels, you now have up to 20 channels of time-correlated triggering, acquisition and viewing on the same instrument. This is especially important in today's embedded designs with sophisticated digital control circuitry. Unlike other oscilloscopes in this class, you can buy a 2- or 4-channel DSO and enable the 16 digital channels already in the instrument at any time to make it an MSO. (DSOXPERFMSO)

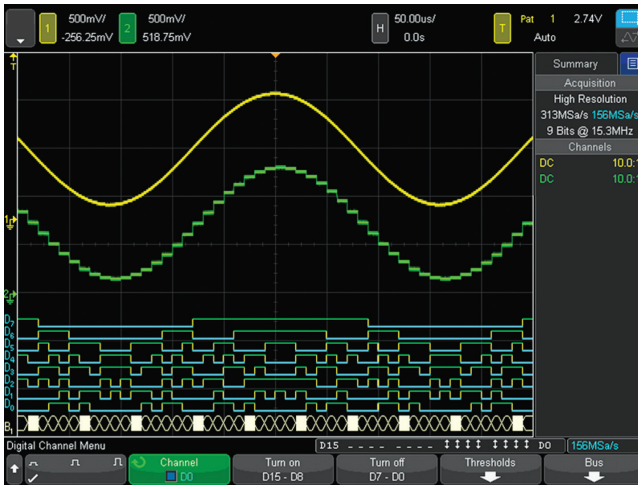


Figure 19. Digital channels are captured and displayed time-correlated with analog channels in MSOs or upgraded DSOs.

Serial protocol analysis: Hardware-based serial protocol decode and triggering

Keysight InfiniiVision Series, including the new 4000 X-Series, are the only oscilloscopes to use hardware-based serial protocol decoding. Other vendors' oscilloscopes use software post-processing techniques to decode serial packets/frames, and therefore have slow waveform and decode capture rates and could miss critical events and errors due to a long dead-time. Faster decoding with hardware-based technology enhances the probability of capturing infrequent serial communication errors.

After capturing serial bus communication, you can easily perform a search operation based on specific criteria and then quickly navigate to bytes/frames of serial data that satisfy that search criteria. The 4000 X-Series can decode two serial buses simultaneously using hardware-based decoding, and display the captured data in a time interleaved "lister"display.

Serial protocol decoding can be used simultaneously with segmented memory and zone touch triggering.

The 4000 X-Series supports: SENT, I²C, SPI, USB 2.0, RS232/UART, CAN, CAN FD, LIN, FlexRay, CXPI, MIL-STD 1553, ARINC 429, I²S, user-definable Manchester, user-definable NRZ, and USB PD. (See page 23)

Figure 20. Dual serial bus CAN and LIN decode and interleaved "lister" display.

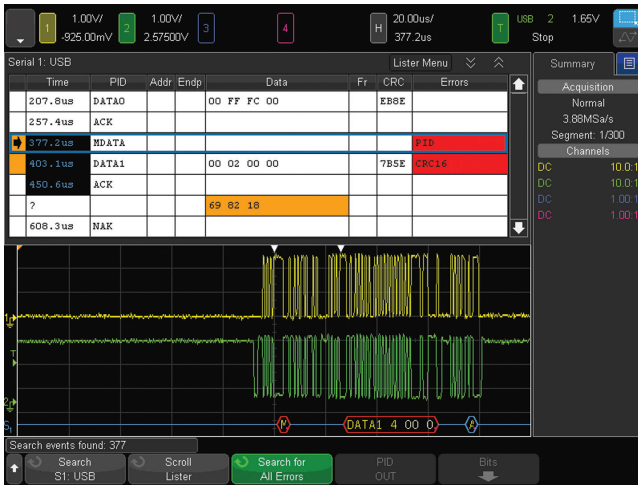


Figure 21. USB 2.0 trigger, decode and "lister" display.

Oscilloscope Experience Redefined: Experience the Integration (Continued)

Dual-channel WaveGen 20-MHz function/arbitrary waveform generator

The 4000 X-Series offers the industry's first dual-channel, integrated 20-MHz function/arbitrary waveform generator. (DSOX4WAVEGEN2) The integrated generator provides stimulus output of sine, square, ramp, pulse, DC, noise, sine cardinal (sinc), exponential rise, exponential fall, cardiac, Gaussian pulse and arbitrary waveforms (AWG) to your device under test. Signal modulation capability is also available.

With AWG functionality, you can store waveforms from analog channels or reference memory to the arbitrary memory and output from WaveGen. Easily create and edit the waveform using the built-in editor or Keysight's BenchLink Waveform Builder Basic software: www.keysight.com/find/33503.

With dual channels, you can generate differential signals to: output arbitrary clock and data signals to simulate serial buses, create complex modulations (more than the standard modulation feature), output IQ signals and more. The two channels can be tracked together as well (identical frequency, amplitude, offset and duty cycle).

3-digit voltmeter

The 4000 X-Series offers a standard integrated 3-digit voltmeter (DVM) and 5-digit frequency counter (8-digit with external reference) inside the oscilloscope. The voltmeter operates through the same probes as the oscilloscope channels. However, the DVM measurements are de-coupled from the oscilloscope triggering system so that both the DVM and triggered oscilloscope waveform capture can be made with the same connection. The voltmeter results are always displayed, keeping these quick characterization measurements at your fingertips.

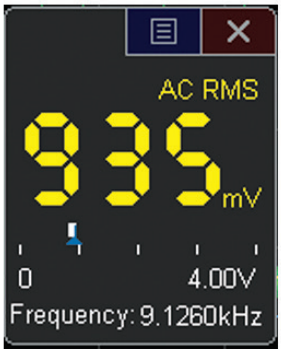


Figure 25. DVM 3-digit voltage and 5-digit frequency measurements always at your fingertips.

Figure 22. WaveGen sine wave output with and without added AM modulation.

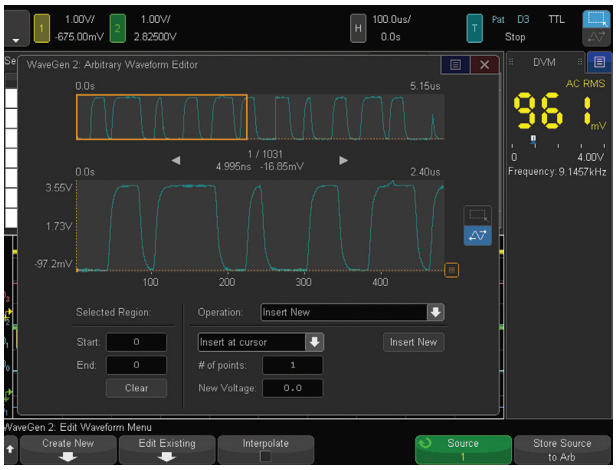


Figure 23. WaveGen arbitrary waveform editing screen.

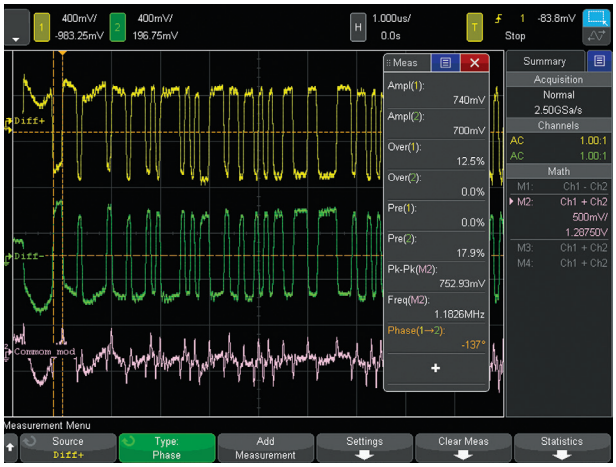


Figure 24. Dual channel WaveGen output of differential arbitrary signals. Common mode is shown as a math function.

Oscilloscope Experience Redefined: Other Key Productivity Tools

Power measurements and analysis

When you are working with switching power supplies and power devices, the Power Software Package (D4000PWRA) provides a full suite of power measurements and analysis in the oscilloscope.

To learn more about power supply testing, go to www.keysight.com/find/D4000PWRA.

Figure 26. Power quality measurement, one of many in the power measurements application.

HDTV video triggering and analysis

Whether you are debugging consumer electronics with HDTV or characterizing a design, Enhanced Video Analysis (optional) provides support for a variety of HDTV standards for triggering and analysis.

Figure 27. Triggering on 1080p HDTV signal analysis.

USB 2.0 signal quality analysis

In addition to triggering on and decoding low-speed, full-speed, and hi-speed USB 2.0 signals (hi-speed trigger & decode require a 1.0 or 1.5 GHz model), the optional USB Software Package (D4000USBA) also supports USB 2.0 signal quality testing (hi-speed tests require the 1.5 GHz model). The USB 2.0 signal quality test with HTML pass/fail report generation includes eye-diagram mask testing, jitter analysis, EOP bit-width, signaling rate, edge monotonicity, and rise/fall times; all based on official USB-IF algorithms embedded in the oscilloscope.

To learn more about USB signal quality testing, go to www.keysight.com/find/D4000USBA.

Figure 28. Perform automatic signal quality testing on USB 2.0 low-speed, full-speed, and hi-speed signals.

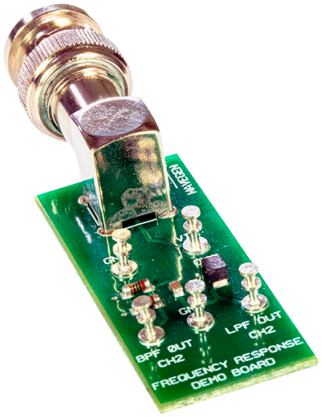
Oscilloscope Experience Redefined: Other Key Productivity Tools (Continued)

Frequency Response Analysis (Optional)

Frequency Response Analysis (FRA) is an often-critical measurement used to characterize the frequency response (gain and phase versus frequency) of a variety of today's electronic designs, including passive filters, amplifier circuits, and negative feedback networks of switch mode power supplies (loop response). InfiniiVision 4000 X-Series oscilloscopes use the oscilloscope's built-in waveform generator (WaveGen) to stimulate the circuit under test at various frequency settings and capture the input and output signals using two oscilloscope channels. At each test frequency, the oscilloscope measures, computes, and plots gain (20LogVout/Vin) and phase logarithmically.

DSOXBODE bode plot training kit (optional)

The DSOXBODE Bode plot training kit consists of a series R-L-C circuit board with a BNC input that attaches directly to the output of the oscilloscope's WaveGen function generator. There are clearly labeled test points for probing VIN and BPFOUT (bandpass filter output) or LPFOUT (low-pass filter output). Also included with this training kit is a comprehensive tutorial and lab guide that engineering students and professors can download. The DSOXBODE Bode plot training kit is compatible with all InfiniiVision 6000 X-Series oscilloscopes licensed with any software option.



Educator's oscillocope training kit

Teach your students what an oscilloscope is and how to perform basic measurements with the Educator's Oscilloscope Training Kit. This complimentary kit includes training tools created specifically for electrical engineering and physics undergraduate students and professors. It contains an array of built-in training signals, a comprehensive oscilloscope lab guide and tutorial written specifically for undergraduate students and an oscilloscope fundamentals PowerPoint® slide set for professors and lab assistants. Also available is an advanced triggering guide to help even the most experienced oscilloscope users to get the most out of their 4000 X-Series oscilloscope.

See www.keysight.com/find/dsoxedk for more information.

Figure 30. The Educators Training Kit helps both students and experienced users quickly get up to speed on oscilloscope usage.

Oscilloscope Experience Redefined: Other Key Productivity Tools (Continued)

Advanced math analysis provides a variety of additional math functions and comes standard on the 4000 X-Series. Additionally, math functions can be nested to provide additional insight into your designs. You can create up to four math functions, with one resultant math function displayed at a time.

Operators
- Add, subtract, multiply, divide

Transforms
- Differentiate, integrate
- FFT
- Ax + B
- Squared, square root
- Absolute value
- Common logarithm, natural logarithm
- Exponential, base 10 exponential

Filters
- Low-pass filter, high-pass filter
- Averaged value, smoothing, envelope

Visualizations
- Magnify
- Max hold, min hold
- Measurement trend
- Chart logic bus timing, chart logic bus state

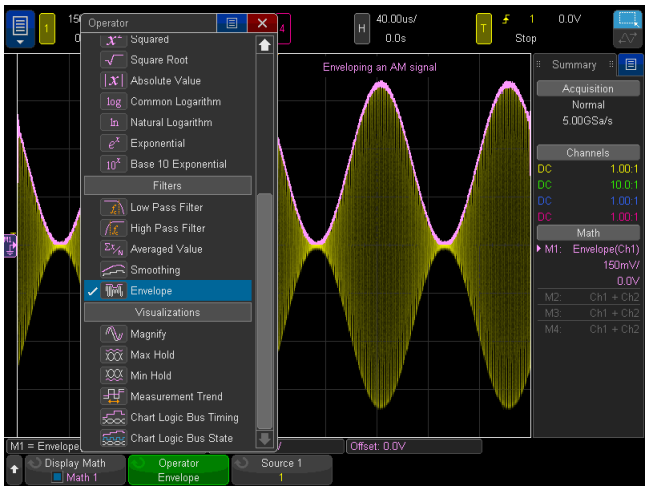


Figure 31. A variety of advanced math functions are standard in the 4000 X-Series.

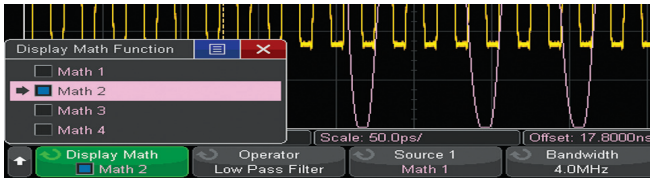


Figure 32. Four math functions can be created and nested with one resultant math function.

36 automatic measurements

Automatic measurements are the essential tool of an oscilloscope. In order to make quick and efficient measurements, the 4000 X-Series provides 36 powerful automatic measurements and can display up to 10 at a time. Measurements can be gated by auto select, main window, zoom window, or cursors.

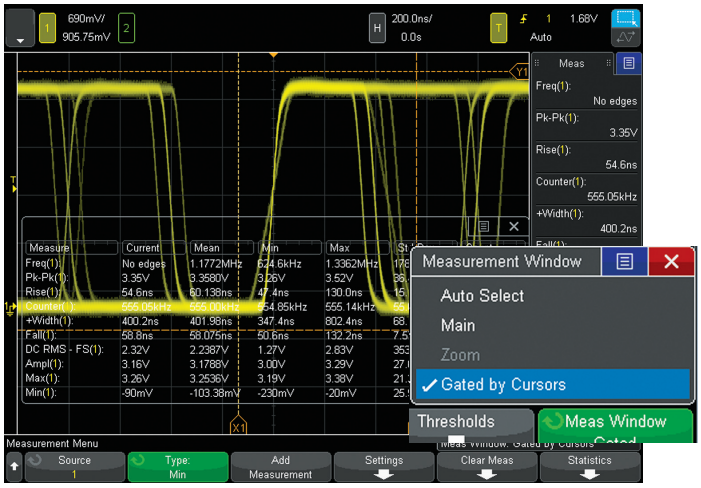


Figure 33. Up to 10 automated measurements displayed simultaneously. Measurements can be gated by cursors.

Oscilloscope Experience Redefined: Other Key Productivity Tools (Continued)

Reference waveforms

Store up to four waveforms in the scope's non-volatile reference waveform memory. Compare reference waveforms with live waveforms, and perform post analysis and measurements on stored data. You can also store waveforms on a removable USB memory device in *.h5 format and recall them back into oscilloscope's reference waveform memory later. Save and/or transfer waveforms to a PC as XY data pairs in a comma-separated values format (*.csv) or store bitmap images and transfer them to a PC for documentation purposes in a variety of image formats.

Figure 34. Store and recall up to four reference waveforms.

Powerful probe solutions and compatibility

Get the most out of your 4000 X-Series scope, by using Keysight's complete family of innovative probes and accessories for your application. The 4000 X-Series supports up to four active probes simultaneously with its full AutoProbe interface. [1]

All 4000 X-Series scopes come standard with a 700 MHz bandwidth, 10 MΩ input passive probe per each channel and gives you 700 MHz system bandwidth when used in conjunction with the 4000 X-Series 1 GHz/1.5 GHz models.Also available is the N2750A InfiniiMode differential probe and N2795A/96A single-ended active probe for high signal fidelity measurements without the high price. For ultra low current measurements, the N2820A Series high-sensitivity current probes are the best solution in the industry. For power rail measurements, the N7020A Power Rail Probe provides the unmatched measurement accuracy.

For the most up-to-date and complete information about Keysight's probes and accessories, visit our Web site at www.keysight.com/find/scope_probes or refer to the InfiniiVision Probes and Accessories data sheet with the Keysight literature number 5968-8153EN.

Figure 35. N7020A Power Rail Probe is the industry's only probe designed and developed to solve your toughest power integrity problems.

1. Some restriction may apply. Contact Keysight for more details.

Oscilloscope Experience Redefined: Other Key Productivity Tools (Continued)

Localized front panel, GUI and help

Operate the oscilloscope in the language most familiar to you. The graphical user interface, built-in help system, front panel overlays, and user's manual are available in 11 languages. During operation, access the built-in help system just by pressing and holding any button.

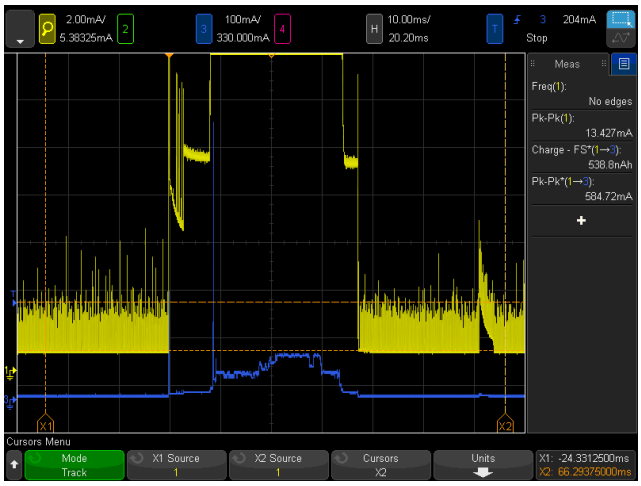


Figure 36. The 4000 X-Series and N2820A Series high-sensitivity current probe measuring > 500 mA and < 1 mA current simultaneously.

Connectivity and LXI compatibility

Standard USB 2.0 hi-speed host (two on front, one on back) and device (one on back) ports make PC connectivity easy. Operate the scope from your PC and save/recall stored waveforms and setup files via standard LAN (LXI IPv6 Extended Function). Connect your projector or external monitor through VGA output, standard with the 4000 X-Series, when sharing and presenting screen information. An optional external GPIB-to-LAN adapter is also available (N4865A).

The BV0004B oscilloscope control and automation PC-based software (standard with the purchase of each InfiniiVision X-Series oscilloscope) lets you control and visualize the 4000 X-Series and multiple measurements simultaneously. It lets you build automated test sequences just as easily as you can with the front panel. Save time with the ability to export measurement data to Excel, Word and MATLAB in three clicks. Monitor and control your 4000 X-Series with a mobile device from anywhere. Simplify your testing with BenchVue software.

Learn more at www.keysight.com/find/BenchVue.

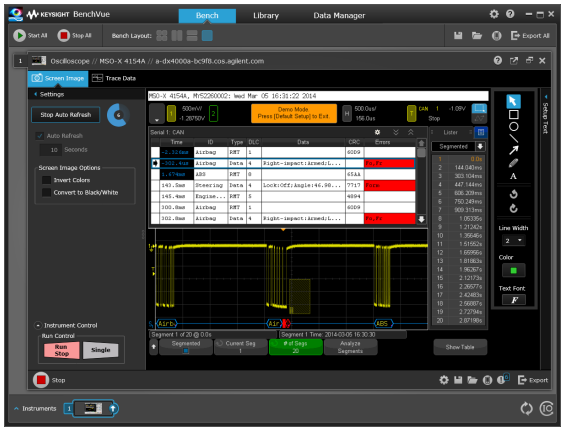


Figure 37. BV0004B BenchVue.

Oscilloscope Experience Redefined: Other Key Productivity Tools (Continued)

Virtual front panel

The 4000 X-Series' innovative capacitive touch screen matches perfectly with the latest tablet technologies. In addition to the traditional virtual front panel remote operation through your favorite PC Web browser, the 4000 X-Series supports remote oscilloscope control from your tablet devices (and smart phones with enough resolution). The tablet virtual front panel is identical to the 4000 X-Series' touch GUI so you can touch icons, draw zone touch trigger zones and drag slide panels as if you are sitting in front of the actual oscilloscope.

Figure 38. Tablet virtual front panel control.

Documentation and e-mail

Annotation becomes a simple task. Bring up the annotation menu and start editing it using the keypad, and then drag it to the desired location.

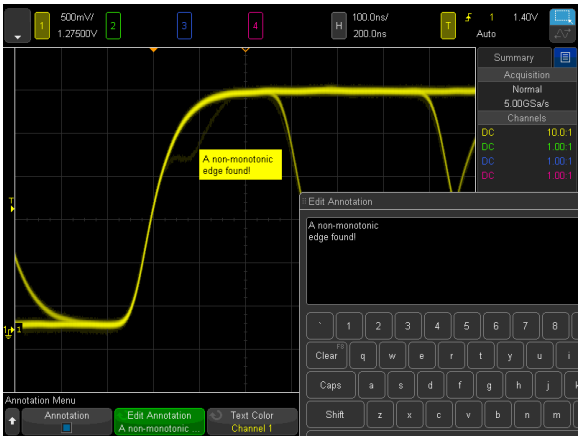


Figure 39(a). Annotation and keypad.

Quick e-mail allows you to e-mail the data you want instantly to your inbox. Send out the screenshot, waveform data, or even a USB signal quality test report. This removes the hassle of connecting your PC to your oscilloscope.

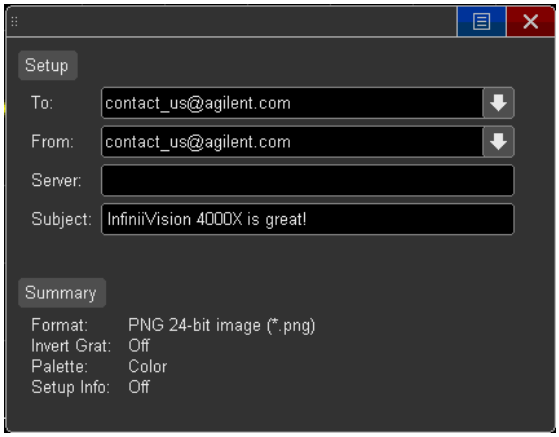


Figure 39(b). E-mail configuration screen.

Oscilloscope Experience Redefined: Other Key Productivity Tools (Continued)

Infinium Offline oscilloscope analysis software

Keysight's Infiniium Offline PC-based oscilloscope analysis software (D9010BSEO) allows you to do additional signal viewing, analysis and documentation tasks away from your oscilloscope.

Capture waveforms, save to a file, and recall the waveforms into Infiniium Offline. The application supports a variety of popular waveform formats from multiple oscilloscope vendors and includes the following features: navigate, view, measurements, analyze, view windows, documentation, and optional analysis upgrades.

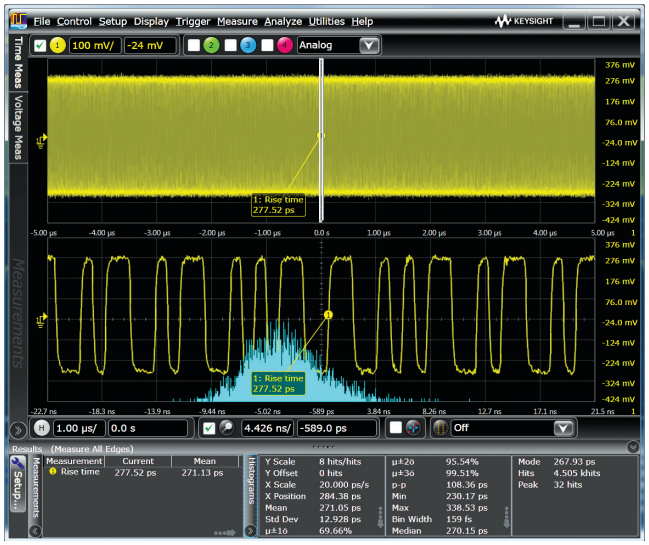


Figure 40. Infiniium Offline enables a variety of advanced signal analysis while providing extensive, yet intuitive, waveform documentation.

Secure erase

The secure erase feature comes standard with all 4000 X-Series models. At the press of a button, internal non-volatile memory is clear of all setup, reference waveforms, and user preferences, ensuring the highest level of security in compliance with National Industrial Security Program Operation Manual (NISPOM) Chapter 8 requirements.

Oscilloscope Experience Redefined: Other Key Productivity Tools (Continued)

High-resolution mode for viewing signal details

To build more confidence in your designs, sometimes you need to look into more signal detail than you can see with the standard 8-bit vertical resolution of the 4000 X-Series.

High-resolution mode offers additional resolution and insight into the signal, without requiring a repetitive signal. Using real-time boxcar averaging, high-resolution mode reduces random noise and effectively increases vertical resolution, up to 12 bits. For example, it achieves the 113 µVrms noise floor at 1 mV/div, 100 µs/div setting.

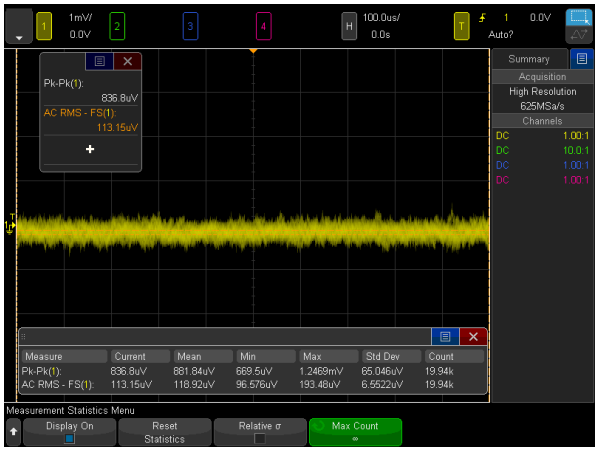


Figure 42. Getting 113 uVrms noise floor at 1 mV/div with the high resolution mode.

Advanced parametric triggering

With today's more complex signals, you often need to trigger on complex signal conditions to synchronize the oscilloscope's acquisition on specific events. The 4000 X-Series oscilloscope can trigger on the following conditions: edge, edge then edge, pulse width (time-qualified), pattern, or, rise/fall time, Nth edge burst, runt, setup and hold, video, and various serial buses (optional).

Figure 43. Wide array of advanced parametric trigger modes.

Freeze display

Perhaps you need to share with others an infrequent event you found. With the "freeze display" feature, you can keep intensity information on the screen while the oscilloscope is stopped or before saving a screen shot.

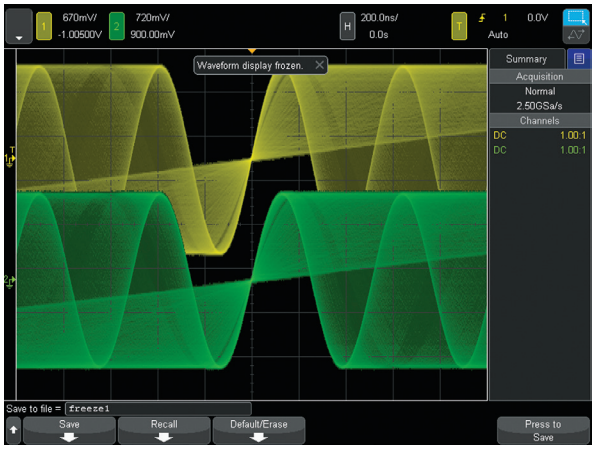


Figure 44. The "freeze screen" feature keeps the intensity-grading information while stopping the waveform acquisition.

Oscilloscope Experience Redefined

"Designed for touch." Industry's first and largest **12.1 inch capacitive touch screen** to redefine your oscilloscope experience. The way an oscilloscope was meant to be driven, with a designed-for-touch interface.

The new zone touch trigger, if you can see it, you can trigger on it by just drawing a box.

5-in-1 instruments redefines the integration experiences: oscilloscope channels, digital channels, serial protocol analysis, dual-channel WaveGen, and DVM. All features are **fully upgradeable**, including bandwidth.

Industry-leading coverage of serial protocol including **USB 2.0 trigger and decode**.

Industry's first **dual-channel WaveGen** function/arbitrary generator now allows you to generate differential, clock and data, two channel modulation, and IQ signals. Modulation of any signal is also included.

The class leading **1.5 GHz upgradeable bandwidth** expands your application coverage, including USB 2.0 hi-speed signal integrity testing.

Both **USB keyboard and mouse** are supported for additional ease of use.

Industry-leading **1 million waveform per second update rate** minimizes the dead-time for maximum probability of capturing infrequent events and anomalies.

Docking panels with the capacitive touch screen add a new dimension of usability. See setup summary, automatic measurements, cursor info, DVM, and navigation pane in any combination, anywhere on the screen.

Standard advanced math and **four cascade-able math functions** enable even the most sophisticated signal analysis.

Display up to **10 measurements** simultaneously, without compromising other key info. 35 automatic measurements can be **gated by cursors**.

Not a touch screen fan? **Turn off the touch screen** from a front panel button if desired.

Independent knobs per channel for fast operation. All front panel knobs are push-able for access to common controls.

Standard segmented memory powered by **MegaZoom IV** smart memory technology provides intelligent capture of just the signal of interest.

Industry's **first integrated DVM**. Asynchronous from the 4 analog triggered waveforms.

Simultaneous 1GHz bandwidth across all 4 channels.

Four AutoProbe (active or current probes) are supported simultaneously for demanding applications.

Oscilloscope Experience Redefined: Configuring Your InfiniiVision 4000 X-Series Oscilloscope

Step 1. Choose your bandwidth and number of channels

InfiniiVision 4000 X-Series scopes oscilloscopes									
		4022A	4024A	4032A	4034A	4052A	4054A	4104A	4154A
Bandwidth [1] (–3 dB)		200 MHz		350 MHz		500 MHz		1 GHz	1.5 GHz
Calculated rise time (10 to 90%)		≤ 1.75 ns		≤ 1 ns		≤ 700 ps		≤ 450 ps	≤ 300 ps
Input channels	DSOX	2	4	2	4	2	4	4	4
	MSOX	2 + 16	4 + 16	2 + 16	4 + 16	2 + 16	4 + 16	4 + 16	4 + 16

1. For example, if you chose 1 GHz, 4+16 channels, the model number will be MSOX4104A.

Step 2. Select hardware upgrades

Hardware Upgrade	Description	Model number to order
WaveGen	Built-in dual-channel 20 MHz function/AWG waveform generator	DSOX4WAVEGEN2
Enhanced Security Option	Disable non-volatile memory, USB, LAN, and/or firmware upgrade	DSOX4SECA

Step 3. Select licensed software

Licensed Software	Description	Model number to order
Embedded Software Package	I^2C, SPI, UART (RS232/422/485), I^2S, and USB PD serial trigger & decode, plus Measurement Limit Testing, Mask Limit Testing, Frequency Response Analysis (Bode plots), and Enhanced Video Analysis	D4000GENA
Automotive Software Package	CAN (symbolic with .dbc file), CAN FD (symbolic with .dbc file), LIN (symbolic with .ldf file), FlexRay, SENT, CXPI, PSI5 (user-definable Manchester), and User-definable NRZ serial trigger & decode, plus Measurement Limit Testing, Mask Limit Testing (CAN/CAN FD mask files available to download) and Frequency Response Analysis (Bode plots)	D4000AUTA
Aero Software Package	MIL-STD 1553 and ARINC 429 serial trigger & decode, plus Measurement Limit Testing, Mask Limit Testing (standard mask files available to download), Frequency Response Analysis (Bode plots), and Enhanced Video Analysis	D4000AERA
USB Software Package[1]	USB 2.0 Low-, Full-, & Hi-speed, USB PD trigger & decode, plus USB 2.0 Signal Quality Test, Jitter & Real-time Eye Analysis, Measurement Limit Testing, Mask Limit Testing, and Frequency Response Analysis (Bode plots)	D4000USBA
Power Software Package	Power quality, current harmonics, switching loss, transient response, turn-on/off time, output ripple, efficiency, loop response, PSRR, etc., plus Measurement Limit Testing, Mask Limit Testing and Frequency Response Analysis (Bode plots), and USB PD serial trigger & decode	D4000PWRA
NFC Software Package	NFC trigger and PC-based automated NFC test software	D4000NFCA
Ultimate Bundle Software Package	I^2C, SPI, UART, I^2S, CAN, CAN FD, LIN, FlexRay, CXPI, PSI5 (User-definable Manchester), User-definable NRZ, USB 2.0 low-, full-, & hi-speed [1], USB PD, MIL-STD 1553, and ARINC 429 serial trigger & decode, plus USB 2.0 Signal Quality Test [2], Power Analysis, Measurement Limit Testing, Mask Limit Testing, Frequency Response Analysis (Bode plots), Enhanced Video Analysis, NFC trigger & automated test software	D4000BDLA

1. USB 2.0 hi-speed signal trigger and decode on ≥ 1.0-GHz models only.
2. USB 2.0 hi-speed signal quality tests supported on 1.5-GHz models only.

Oscilloscope Experience Redefined: Configuring Your InfiniiVision 4000 X-Series Oscilloscope (Continued)

Step 4. Choose your probes – For a complete list of compatible probes, visit www.keysight.com/find/scope_probes

Probes	4000 X-Series
N2894A passive probe 700 MHz, 10:1, 10 MΩ	Included standard. 1 per channel
N2756A 16 digital channel MSO cable	Included on MSOX models and DSOXPERFMSO
10076B high-voltage passive probe 250 MHz 4 kV	Optional
N2795A active single-ended probe 1-GHz 1-pF 1-MΩ with AutoProbe	Optional
N2796A active single-ended probe 2-GHz 1-pF 1-MΩ with AutoProbe	Optional
N2750A InfiniiMode differential probe 1.5-GHz 700-fF 200-kΩ with AutoProbe	Optional
N2797A extreme temperature active probe 1.5-GHz 1-pF 1-MΩ with AutoProbe	Optional
N2790A differential active probe 100 MHz, ± 1.4 kV with AutoProbe	Optional
N2791A differential active probe 25 MHz, ± 700 V	Optional
N2818A differential active probe 200 MHz, ± 20 V	Optional
N2819A differential active probe 800 MHz, ± 15 V	Optional
1147B AC/DC current probe 50 MHz 15 A with AutoProbe	Optional
N2893A AC/DC current probe 100 MHz 15 A with AutoProbe	Optional
N2820A 2-channel high-sensitivity current probe 50 uA to 5 A	Optional
N7020A power rail probe 2-GHz, 1:1, 50 kΩ, ± 24 V offset range	Optional
N2805A high voltage differential probe, 200 MHz, ± 100 V (DC + peak AC), 50:1, 4-MΩ, 4 pF	Optional
N2804A high voltage differential probe, 300 MHz, ± 300 V (DC + peak AC), 100:1, 4-MΩ, 4 pF	Optional
N7040A 23 MHz, 3 kA, AC current probe	Optional
N7041A 30 MHz, 600 A, AC current probe	Optional
N7042A 30 MHz, 300 A, AC current probe	Optional
N7026A 150 MHz, 40 Apk, AC/DC high-sensitivity current probe with AutoProbe	Optional

Step 5. Choose your accessories

Recommended accessories and PC software	4000 X-Series
Bode plot training kit	DSOXBODE
Rack mount kit	N2763A
Soft carrying case	N2733B
Hard copy manual	N6455A

Step 6. Calibration plans and additional productivity software

Calibration		
D/MSOX4000-A6J	ANSI Z540-1-1994 calibration	Optional
D/MSOX4000-AMG	Calibration + Uncertainties + Guardbanding (Accredited)	Optional
BV0004B	BenchVue Oscilloscope Application PC Software	Standard
33503A	BenchLink Waveform Builder Pro and Basic PC Software	Optional
D9010BSEO	Infiniium Offline Oscilloscope Analysis PC Software	Optional
D9010UDAA	User-definable Application (UDA) Software	Optional
89601B (version 20.20 and higher)	Vector Signal Analyzer (VSA) Software	Optional

Configure your InfiniiVision 4000 X-Series Oscilloscope (Continued)

Flexible Software Licensing and KeysightCare Software Support Subscriptions

Keysight offers a variety of flexible licensing options to fit your needs and budget. Choose your license term, license type, and KeysightCare software support subscription.

License Terms

- **Perpetual** – Perpetual licenses can be used indefinitely.
- **Time-based** – Time-based licenses can be used through the term of the license only (6, 12, 24, or 36 months).

License Types

- **Node-locked** – All software licenses for the InfiniiVision 6000 X-Series oscilloscopes are node-locked to the oscilloscope

KeysightCare Software Support Subscriptions

Perpetual licenses are sold with a 12 (default), 24, 36, or 60-month software support subscription. Support subscriptions can be renewed for a fee after that.

Time-based licenses include a software support subscription through the term of the license.

Selecting your license:

Step 1. Choose your Software Package (Ex: D4000BDLA).
Step 2. Choose your license term: perpetual or time-based.
Step 3. Depending on the license term, choose your support subscription duration.

Examples

If you selected:	**Your quote will look like:**	
	Part Number	**Description**
D4000BDLA node-locked perpetual license with a 12-month support subscription	D4000BDLA R-B5K-001-A R-B6K-001-L	Ultimate Bundle Software Package for 4000 X-Series Node-locked perpetual license 12-month software support subscription
D4000AUTA node-locked 6-month time-based license	D4000AUTA R-B4K-001-F	Automotive Software Package for 4000 X-Series 6-month time-based, node-locked license with standard 6-month software support subscription

KeysightCare Software Support Subscription provides peace of mind amid evolving technologies.

- Ensure your software is always current with the latest enhancements and measurement standards.
- Gain additional insight into your problems with live access to our team of technical experts.
- Stay on schedule with fast turnaround times and priority escalations when you need support.

Oscilloscope Experience Redefined: InfiniiVision 4000 X-Series Performance Characteristics

DSO and MSO 4000 X-Series oscilloscopes

4000 X-Series specification overview									
		4022A	**4024A**	**4032A**	**4034A**	**4052A**	**4054A**	**4104A**	**4154A**
Bandwidth [1] (–3 dB)		200 MHz		350 MHz		500 MHz		1 GHz	1.5 GHz [3]
All-channel real-time bandwidth		200 MHz		350 MHz		500 MHz		1 GHz	1 GHz
Calculated rise time (10 to 90%)		≤ 1.75 ns		≤ 1 ns		≤ 700 ps		≤ 450 ps	≤ 300 ps
Input channels	DSOX	2	4	2	4	2	4	4	4
	MSOX	2 + 16	4 + 16	2 + 16	4 + 16	2 + 16	4 + 16	4 + 16	4 + 16
Maximum sample rate	5 GSa/s half channel, 2.5 GSa/s all channel								
Maximum memory depth	4 Mpts half channels, 2 Mpts all channels								
Display size and type	12.1-inch high-definition capacitive touch display								
Waveform update rate	> 1 million waveforms per second								
System bandwidth with N2894A standard passive probe		200 MHz	200 MHz	350 MHz	350 MHz	500 MHz	500 MHz	700 MHz	700 MHz

System analog channels		
Hardware bandwidth limits		Approximately 20 MHz (selectable)
Input coupling		AC, DC
Input impedance		Selectable: 1 MΩ ± 1% (16 pF), 50 Ω ± 1.5%
Input sensitivity range		200 MHz ~ 500 MHz models: 1 mV/div to 5 V/div [2] (1 MΩ and 50 Ω)
		1 and 1.5 GHz models: 1 mV/div to 5 V/div [2] (1 MΩ), 1 mV/div to 1 V/div (50 Ω)
Vertical resolution		8 bits (measurement resolution is 12 bits with averaging)
Maximum input voltage	1 MΩ	135 Vrms; 190 Vpk
		Probing technology allows testing of higher voltages. For example, the included N2894A 10:1 probe supports testing up to 300 Vrms
		Use this instrument only for measurements within its specified measurement category (not rated for CAT II, III, IV). No transient overvoltage allowed
	50 Ω	50 Ω: ≤ 5 Vrms max
DC vertical gain accuracy [1]		± 2.0% full scale [2]
DC vertical offset accuracy		± 0.1 div ± 2 mV ± 1% of offset setting
Channel-to-channel isolation	200 MHz~1 GHz	≥ 40 dB from DC to maximum specified bandwidth of each model
	1.5 GHz	≥ 40 dB from DC to 1 GHz, ≥ 35 dB from 1 to 1.5 GHz
Offset range		± 5 V (< 10 mV/div), ± 20 V (10 to 200 mV/div), ± 75 V (> 200 mV/div)

Vertical system digital channels	
Digital input channels	16 digital (D0 to D15. Pod 1: D7 ~ D0, Pod 2: D15 ~ D8)
Thresholds	Threshold per pod
Threshold selections	TTL (+1.4 V), 5 V CMOS (+2.5 V), ECL (–1.3 V), user-defined (selectable by pod)
User-defined threshold range	± 8.0 V in 10 mV steps
Maximum input voltage	± 40 V peak CAT I
Threshold accuracy [1]	± (100 mV + 3% of threshold setting)
Maximum input dynamic range	± 10 V about threshold
Minimum voltage swing	500 mVpp
Input impedance	100 kΩ ± 2% at probe tip
Input capacitance	~8 pF
Vertical resolution	1 bit

1. Denotes warranted specifications, all others are typical. Specifications are valid after a 30-minute warm-up period and ± 10 °C from firmware calibration temperature.
2. 1 mV/div and 2 mV/div is a magnification of 4 mV/div setting. For vertical accuracy calculations, use full scale of 32 mV for 1 mV/div and 2 mV/div sensitivity setting.
3. 1.5 GHz real time bandwidth in half-channel mode or full channel equivalent time mode.

Oscilloscope Experience Redefined: InfiniiVision 4000 X-Series Performance Characteristics (Continued)

Horizontal system analog channels									
		4022A	**4024A**	**4032A**	**4034A**	**4052A**	**4054A**	**4104A**	**4154A**
Time base range		2 ns/div to 50 s/div				1 ns/div to 50 s/div		500 ps/div to 50 s/div	
Time base accuracy [1]		± 10 ppm							
Time base delay time range	Pre-trigger	Greater of 1 screen width or 200 µs (400 µs in interleaving mode)							
	Post-trigger	1 to 500 s							
Channel-to-channel deskew range		± 100 ns							
Δ Time accuracy (using cursors)		± 0.001% of reading ± 0.16% screen width ± 30pS							
Modes		Main, zoom, roll, XY							
XY		On channels 1 and 2 only. Z Blanking on Ext Trigger Input, 1.4 V threshold							
		Bandwidth: Maximum bandwidth. Phase error at 1 MHz: < 0.5 degree							
		Time base: 200 ns/div to 50 ms/div							
Horizontal system digital channels									
Minimum detectable pulse width		2 ns							
Channel-to-channel skew		2 ns (typical); 3 ns (maximum)							
Acquisition system									
		4022A	**4024A**	**4032A**	**4034A**	**4052A**	**4054A**	**4104A**	**4154A**
Maximum analog channels sample rate		5 GSa/s half channel interleaved, 2.5 GSa/s all channels							
Analog channels equivalent sample rate		N/A						128 Gsa/s	
Maximum analog channels record length		4 Mpts half channel interleaved, 2 Mpts all channel							
Maximum digital channels sample rate		1.25 GSa/s							
Maximum digital channels record length		2 Mpts (with digital channels only)							
Modes	Normal	Default mode							
	Peak detect	Capture glitches as narrow as 200 ps at all time base settings							
	Averaging	Selectable from 2, 4, 8, 16, 64, ... to 65,536							
	High resolution	Real-time boxcar averaging reduces random noise and effectively increases vertical resolution – 12 bits: ≥ 50 µs/div – 11 bits: ≥ 20 µs/div – 10 bits: ≥ 10 µs/div – 9 bits: ≥ 5 µs/div							
	Segmented	Segmented memory optimizes available memory for data streams that have long dead times between activity. Maximum segments = 1000. Re-arm time = 1 µs (minimum time between trigger events). Re-arm time when used with the zone touch trigger = 65 µs or faster (typical)							
	Roll	Displays the waveform moving across the screen from right to left. Available at the time base 50 ms/div or slower							
	Digitizer	Allows independent selection of sample rate and memory depth							
	Equivalent time	1 GHz and 1.5 GHz models only. 7.8 ps fine interpolator resolution yields a maximum effective sample rate of 128 GSa/s							

1. Denotes warranted specifications, all others are typical. Specifications are valid after a 30-minute warm-up period and ± 10 °C from firmware calibration temperature.

Oscilloscope Experience Redefined: InfiniiVision 4000 X-Series Performance Characteristics (Continued)

Trigger system		
Trigger sources		Analog channel (1 ~ 4), digital channel (D0 ~ D15), line, external, WaveGen (1, 2, or Mod) (FM/FSK)
Trigger modes	Normal	Requires trigger event for oscilloscope to trigger
	Auto	Triggers automatically in absence of trigger event
	Single	Front panel button that triggers only once on a trigger event. Press [Single] button again for oscilloscope to find another trigger event, or press [Run] front-panel button to trigger continuously in either auto or normal mode
	Force	Front panel button that forces a trigger
Trigger coupling	DC	DC coupled trigger
	AC	AC coupled trigger, cutoff frequency: < 10 Hz (internal); < 50 Hz (external)
	HF reject	High-frequency reject, cutoff frequency ~ 50 kHz
	LF reject	Low-frequency reject, cutoff frequency ~ 50 kHz
	Noise reject	Adds hysteresis to the trigger circuitry. Selectable OFF or ON, decreases sensitivity 2x
Trigger holdoff range		40 ns to 10.00 s
Trigger sensitivity (internal) [1]	200 MHz ~ 1 GHz	< 10 mV/div: greater of 1 div or 5 mV; ≥ 10 mV/div: 0.6 div
	1.5 GHz	DC to 1 GHz: < 10 mV/div: Greater of 1 div or 5 mV; ≥ 10 mV/div: 0.6 div
		1 to 1.5 GHz: < 10 mV/div: Greater of 1.5 div or 5 mV; ≥ 10 mV/div: 1.0 div
Trigger sensitivity (external) [1]	± 1.6 V	40 mVpp DC to 100 MHz, 70 mVpp 100 to 200 MHz
	± 8 V	200 mVpp DC to 100 MHz, 350 mVpp 100 to 200 MHz
Trigger level range	Any channel	± 6 div from center screen
	External	8 V range = ± 8 V, 1.6 V range = ± 1.6 V

1. Denotes warranted specifications, all others are typical. Specifications are valid after a 30-minute warm-up period and ± 10 °C from firmware calibration temperature.

Oscilloscope Experience Redefined: InfiniiVision 4000 X-Series Performance Characteristics (Continued)

Trigger type selections	
Zone (HW zone qualifier)	Trigger on user-defined zones drawn on the display. Applies to one analog channel at a time. Specify zones as either "must intersect" or "must not intersect." Up to two zones. > 200,000 wfm/sec update rate. Supported modes: normal, peak detect, high resolution. Also works simultaneously with the serial decodes and mask limit test.
Edge	Trigger on a rising, falling, alternating, or either edge of analog channels, digital channels, or an external signal. Trigger on a rising or falling of a line signal.
Edge then edge (B trigger)	Arm on a selected edge, wait a specified time, then trigger on a specified count of another selected edge. Minimum 4 ns
Pulse width	Trigger on a pulse on a selected channel, whose time duration is less than a value, greater than a value, or inside a time range – Minimum duration setting: 2 ns (500 MHz, 1 GHz, 1.5 GHz), 4 ns (350 MHz), 6 ns (200 MHz) – Maximum duration setting: 10 s – Range minimum: 10 ns
Pattern	Trigger when a specified pattern of high, low, and don't-care levels on any combination of analog, digital, or trigger channels is [entered | exited]. Pattern must have stabilized for a minimum of 2 ns to qualify as a valid trigger condition. – Minimum duration setting: 2 ns (500 MHz, 1 GHz, 1.5 GHz), 4 ns (350 MHz), 6 ns (200 MHz) – Maximum duration setting: 10 s
Or	Trigger on any selected edges from available sources (analog and digital channels only up to 500 MHz)
Rise/fall time	Trigger on rise-time or fall-time edge speed violations (< or >) based on user-selectable threshold. Select from (< or >) and time settings range between – Minimum: 1 ns (500 MHz, 1 GHz, 1.5 GHz model), 2 ns (350 MHz model), 3 ns (200 MHz model) – Maximum: 10 s
Nth edge burst	Trigger on the Nth (1 to 65535) edge of a pulse burst. Specify idle time (10 ns to 10 s) for framing
Runt	Trigger on a positive runt pulse that fails to exceed a high-level threshold. Trigger on a negative runt pulse that fails to exceed a low-level threshold. Trigger on either polarity runt pulse based on two threshold settings. Runt triggering can also be time-qualified (< or >) with a minimum time setting of 2 ~ 6 ns and maximum time setting of 10 s – Minimum time setting: 2 ns (500 MHz, 1 GHz, 1.5 GHz), 4 ns (350 MHz), 6 ns (200 MHz)
Setup and hold	Trigger on setup/hold violations. Setup time can be set from –7 to 10 s. Hold time can be set from 0 s to 10 ns. Minimum window (setup time + hold time) must be 3 ns or greater
Video	Trigger on all lines or individual lines, odd/even or all fields from composite video, or broadcast standards (NTSC, PAL, SECAM, PAM-M)
Enhanced video (HDTV) (Option)	Trigger on lines and fields of enhanced and HDTV standards (480p/60, 567p/50, 720p/50, 720p/60, 1080p/24, 1080p/25, 1080p/30, 1080p/50, 1080p/60, 1080i/50, 1080i/60)
ARINC429 (Option)	Trigger and decode on ARINC429 data. Trigger on word start/stop, label, label + bits, label range, error conditions (parity, word, gap, word or gap, all), all bits (eye), all 0 bits, all 1 bits
CAN (Option)	Trigger on CAN (controller area network) version 2.0A,2.0B, and CAN-FD (Flexible Data-rate) signals. Trigger on the start of frame (SOF), the end of frame (EOF), data frame ID, data frame ID and data (non-FD), data frame ID and data (FD), remote frame ID, remote or data frame ID, error frame, acknowledge error, from error, stuff error, CRC error, spec error (ack or form or stuff or CRC), all errors, BRS Bit (FD), CRC delimiter bit (FD), ESI bit active (FD), ESI bit passive (FD), overload frame., message, message and signal (non-FD), message and signal (FD, first 8 bytes only)
FlexRay (Option)	Trigger on frame ID or specific error condition, along with cycle-base and repetition-cycle filtering. Can also trigger on specific events such as BSS, TSS, FES, and wake up
I²C (Option)	Trigger at a start/stop condition or user defined frame with address and/or data values. Also trigger on missing acknowledge, address with no acq, restart, EEPROM read, and 10-bit write
I²S (Option)	Trigger on 2's complement data of audio left channel or right channel (=, ≠, <, >, > <, < >, increasing value, or decreasing value)
LIN (Option)	Trigger on LIN (local interconnect network) sync break, sync frame ID, frame ID and data, parity error, or checksum error
CXPI (Option)	Trigger on the start of frame (SOF), the end of frame (EOF), PTYPE, frame ID, data and info frame ID, data and info frame ID (long frame), CRC field error, parity error, inter-byte space error, inter-frame space error, framing error, data length error, sample error, all errors, sleep frame, wakeup pulse

Oscilloscope Experience Redefined: InfiniiVision 4000 X-Series Performance Characteristics (Continued)

Trigger type selections		
MIL-STD1553 (Option)		Trigger on MIL-STD 1553 signals on data word start/stop, command/status start/stop, RTA, RTA + 11 bits, and error conditions (parity, sync, Manchester)
SPI (Option)		Trigger on SPI (serial peripheral interface) data pattern during a specific framing period. Supports positive and negative chip select framing as well as clock Idle framing and user-specified number of bits per frame. Supports MOSI and MISO data
UART/RS232/422/485 (Option)		Trigger on Rx or Tx start bit, stop bit, data content, or parity error
USB (Option)		Trigger on start of packet (SOP), end of packet (EOP), suspend [3], resume [3], reset [3], packets (token, data, handshake, or special), and errors (PID, CRC5, CRC16, glitch, bit stuff [3], SE1 [3]). Supports USB 2.0 low speed, full speed, and hi-speed (hi-speed is supported on 1 GHz and 1.5 GHz models only)
SENT (Option)		Trigger on SENT bus. start of fast channel message, start of slow channel message, fast channel SC and data, slow channel message ID, slow channel message ID and data, tolerance violation, fast channel CRC error, slow channel CRC error, all CRC errors, pulse period error, successive sync pulses error (1/64)
User-definable Manchester/NRZ (Option)		Trigger on start-of-frame (SOF), bus value, and Manchester errors
USB PD (Option)		Trigger on preamble, EDP, ordered sets, preamble errors, CRC errors, header content (control messages, data messages, extended messages and value in HEX)
NFC (Option)		Trigger on NFC-A, NFC-B, NFC-F (212 kbps), and NFC-F (424 kbps)
Waveform measurements and cursors		
DC vertical accuracy/cursors [2]		Single cursor accuracy: ± [DC vertical gain accuracy + DC vertical offset accuracy + 0.21% full scale] Dual cursor accuracy: + [DC vertical gain accuracy + 0.42% full scale] [1]
Cursors		2 pairs of XY cursors Automatic measurement of positions, ΔX, 1/ΔX, ΔY, and ΔY/ΔX
Automatic measurements		Measurements continuously updated with statistics. Cursors track last selected measurement. Select up to four measurements from the list below:
	Vertical "Y at X"	Peak-to-peak, maximum, minimum, amplitude, top, base, overshoot, pre-shoot, average- N cycles, average- full screen, DC RMS- N cycles, DC RMS- full screen, AC RMS- N cycles, AC RMS- full screen (standard deviation), ratio (RMS1/RMS2)
	Time at edge	Period, frequency, counter, + width, - width, burst width, duty cycle, bit rate, rise time, fall time, delay, phase, X at min Y, X at max Y
	Count	Positive pulse count, negative pulse count, rising edge count, falling edge count
	Mixed slew rate	Area- N cycles, area- full screen
Automatic measurement logging		Available via BenchVue
Counter		Built-in frequency counter
	Source	Any analog or digital channel
	Resolution	5 digits. Up to 8 digits with an external reference 10 MHz input
	Max frequency	Bandwidth of oscilloscope
Mask limit test option		Mask limit test capability that provides easy, fast pass/fail comparison of a signal under test to a predefined mask template or auto-mask template. Predefined mask templates or edits to an auto-mask template can be made via a simple text editor. > 270,000 mask tests per second (waveform update rate)
Measurement limit test (Option)		Provide pass/fail analysis on selected parametric measurements based on user-defined maximum and minimum limits with selectable stop-on-failure capability

Waveform math	
Number of math functions	Four (display one at a time)
Arithmetic	Add, subtract, multiply, divide, differentiate, integrate, FFT, Ax + B, squared, square root, absolute, common log, natural log, exponential, base 10 exponential, LP filter, HP filter, averaged value, smoothing, envelope, magnify, max hold, min hold, measurement trend, chart logic bus (timing or state) , chart serial signal (CAN, CAN FD, LIN, and SENT)
FFT	Up to 64 kpts resolution. FFT window types: Hanning, flat top, rectangular, Blackman-Harris, Bartlett

1. Denotes warranted specifications, all others are typical. Specifications are valid after a 30-minute warm-up period and ± 10 °C from firmware calibration temperature.
2. 1 mV/div and 2 mV/div is a magnification of 4 mV/div setting. For vertical accuracy calculations, use full scale of 32 mV for 1 mV/div and 2 mV/div sensitivity setting.
3. Suspend, resume, reset, bit stuff error, and SE1 error are USB 2.0 low and full speed only.

Oscilloscope Experience Redefined:
InfiniiVision 4000 X-Series Performance Characteristics (Continued)

Display characteristics	
Display	12.1-inch capacitive touch/gesture enabled color TFT LCD
Resolution	800 (H) x 600 (V) pixel format (screen area)
Graticules	8 vertical divisions by 10 horizontal divisions with intensity controls
Format	YT, XY and Roll
Maximum waveform update rate	> 1,000,000 wfm/s
Persistence	Off, infinite, variable persistence (100 ms to 60 s)
Intensity gradation	64 intensity levels
Connectivity	
USB 2.0 hi-speed host port	USB 2.0 hi-speed host ports x3, two front and one real panel. Supports memory devices, printers, keyboards and mice
USB 2.0 hi-speed device port	One USB 2.0 hi-speed device port on rear panel. USB Test and Measurement Class (USBTMC) compatible
LAN port	10/100Base-T port on rear panel. LXI IPv6 extended function
Web remote control	VNC Web interface (via major Web browsers)
Video out port	SVGA out on rear panel. Connect oscilloscope display to an external monitor or projector
GPIB port	N4865A GPIB-to-LAN adapter (optional)
10 MHz out/in	BNC connector on the rear panel. Supported modes: Off, 10 MHz out, or reference signal mode (10 MHz in)
Trigger out	BNC connector on the rear panel. Supported modes: triggers, mask, waveform generator 1 sync pulse, and waveform generator 2 sync pulse
Dual-channel WaveGen built-in function/arbitary waveform generator (specifications are typical)	
WaveGen outputs	Two (front-panel BNC connectors)
	Both waveform generator outputs can be frequency tracked, amplitude tracked, or completely tracked.* A generator's output can be inverted to create a differential signal
Waveforms	Sine, square, ramp, pulse, DC, noise, sine cardinal (sinc), exponential rise, exponential fall, cardiac, Gaussian pulse, and arbitrary
Modulation	Modulation is available on channel 1 only. Modulation is not available when tracking mode is enabled. Modulation types: AM, FM, FSK Carrier waveforms: Sine, Ramp, Sine Cardinal, Exponential Rise, Exponential Fall, and Cardiac.Modulation Source: Internal (no external modulation capability) AM: Modulation: Sine, Square, Ramp Modulation frequency: 1 Hz to 20 kHz Depth: 0% to 100% FM: Modulation: Sine, Square, Ramp Modulation frequency: 1 Hz to 20 kHz Minimum carrier frequency: 10 Hz Deviation: 1 Hz to carrier frequency or ($2e^{12}$/carrier frequency), whichever is smaller FSK: Modulation: 50% duty cycle square wave FSK rate: 1 Hz to 20 kHz Hop frequency: 2 x FSK rate to 10 MHz

1. Only the following combination of wave shapes can be frequency tracked or completely tracked:
   1) Sine, ramp, sine cardinal, cardiac, and Gaussian pulse.
   2) Square wave and pulse.
   3) Exponential rise and exponetial fall.
   4) Arbitrary.

Oscilloscope Experience Redefined:
InfiniiVision 4000 X-Series Performance Characteristics (Continued)

Dual-channel WaveGen built-in function/arbitary waveform generator (specifications are typical)		
Sine	Frequency range	0.1 Hz to 20 MHz
	Amplitude flatness	± 0.5 dB (relative to 1 kHz)
	Harmonic distortion	–40 dBc
	Spurious (non harmonics)	–40 dBc
	Total harmonic distortion	1%
	SNR (50-Ω load, 500-MHz BW)	40 dB (Vpp ≥ 0.1 V); 30 dB (Vpp < 0.1 V)
Square wave/pulse	Frequency range	0.1 Hz to 20 MHz
	Duty cycle	20 to 80%
	Duty cycle resolution	Larger of 1% or 10 ns
	Rise/fall time	19 ns (10 to 90%)
	Overshoot	< 2%
	Asymmetry (at 50% DC)	± 1% ± 5ns
	Jitter (TIE RMS)	500 ps
Ramp/triangle wave	Frequency range	0.1 Hz to 200 kHz
	Linearity	1%
	Variable symmetry	0 to 100%
	Symmetry resolution	1%
Pulse	Frequency range	0.1 Hz to 10 MHz
	Pulse width	20 ns minimum
	Pulse with resolution	10 ns
	Edge time	Fixed at 19 ns (not variable)
	Overshoot	< 2%
Noise	Bandwidth	20 MHz typical
Sine cardinal (Sinc)	Frequency range	0.1 Hz to 1.0 MHz
Exponential rise/fall	Frequency range	0.1 Hz to 5.0 MHz
Cardiac	Frequency range	0.1 Hz to 200.0 kHz
Gaussian pulse	Frequency range	0.1 Hz to 5.0 MHz
Arbitrary	Waveform length	1 to 8,192 points
	Amplitude resolution	10 bits (including sign bit) [2]
	Repetition rate	0.1 Hz to 12 MHz
	Sample rate	100 MSa/s
	Filter bandwidth	20 MHz
Frequency	Sine wave and ramp accuracy	130 ppm (frequency < 10 kHz)
		50 ppm (frequency > 10 kHz)
	Square wave and pulse accuracy	[50 + frequency/200] ppm (frequency < 25 kHz)
		50 ppm (frequency ≥ 25 kHz)
	Resolution	0.1 Hz or 4 digits, whichever is larger
Amplitude	Range: Minimum	20 mVpp if |offset| ≤ 0.5 Vpp into Hi-Z [1]
		10 mVpp if |offset| ≤ 0.5 Vpp into 50 Ω [1]
	Range: Maximum	10 Vpp except, 9 Vpp if Sinc or Cardiac, 7.5 Vpp if Gaussian pulse into Hi-Z; 5 Vpp/4.5 Vpp into 50 Ω
	Resolution	100 µV or 3 digits, whichever is higher
	Accuracy	1.5% (frequency = 1 kHz)

1. Sinc, cardiac and Gaussian pulse: ± 1.25 V into Hi-Z; ± 625 mV into 50 Ω.
2. Full resolution is not available at output due to internal attenuator stepping.

Oscilloscope Experience Redefined:
InfiniiVision 4000 X-Series Performance Characteristics (Continued)

Dual channel WaveGen - built-in function/arbitary waveform generator		
DC offset	Range	± 5 V into Hi-Z, except ± 4 V if sine wave, ± 2.5 V if sinc, cardiac, or Gaussian pulse into Hi-Z
		± 2.5 V into Hi-Z, except ± 2 V if sine wave, ± 1.25 V if sinc, cardiac, or Gaussian pulse into 50 Ω
	Resolution	Larger of 250 uV or 3 digits
	Accuracy (waveform modes)	± 1.5% of offset setting ± 1% of amplitude ± 1 mV
	Accuracy (DC mode)	± 1.5% of offset setting ± 3 mV
Main output	Impedance	50 Ω typical
	Isolation	Not available, main output BNC is grounded
	Protection	Overload automatically disables output
Trigger output	Trigger output available on trig-out BNC	

Digital voltmeter (specifications are typical)	
Source	Analog channels only (1-4)
Functions	ACrms, DC, DCrms, frequency
Resolution	ACV/DCV: 3 digits
	Counter frequency: 5.5 digits
Measuring rate	100 times/second
Autoranging	Automatic adjustment of vertical amplification to maximize the dynamic range of measurements
Range meter	Graphical display of most recent measurement, plus extrema over the previous 3 seconds

General and environmental characteristics	
Power line consumption	Maximum 120 W
Power voltage range	100 to 120 V, 50/60/400 Hz; 100 to 240 V, 50/60 Hz
Environmental rating	0 to 50 °C, 3000 m max, Maximum Relative Humidity (non-condensing): 95%RH up to 40 °C From 40 °C to 50 °C, the maximum % Relative Humidity follows the line of constant dew point
Electromagnetic compatibility	Meets EMC Directive (2004/108/EC), meets or exceeds IEC 61326-1:2005/EN
	61326-1:2006 Group 1 Class A requirement
	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
	IEC 61000-4-5/EN 61000-4-5
	IEC 61000-4-6/EN 61000-4-6
	IEC 61000-4-11/EN 61000-4-11
	Canada: ICES-001:2004
	Australia/New Zealand: AS/NZS
Safety	ANSI/UL Std. No. 61010-1:2012; CAN/CSA-C22.2 No. 61010-1-12
	ANSI/UL Std. No. 61010-2-030:2012; CAN/CSA-C22.2 No. 61010-2-030-12
Vibration	Meets IEC60068-2-6 and MIL-PRF-28800; class 3 random

Oscilloscope Experience Redefined: InfiniiVision 4000 X-Series Performance Characteristics (Continued)

General and environmental characteristics	
Shock	Meets IEC 60068-2-27 and MIL-PRF-28800; class 3 random; (operating 30 g, ½ sine. 11 ms duration, 3 shocks/axis along major axis, total of 18 shocks)
Dimensions (W x H x D)	454 mm x 275 mm x 156 mm
Weight	Net: 6.3 kg (13.9 lbs), shipping: 11.4 kg (25 lbs)
Kensington style lock	Rear-panel security slot connects to standard Kensington-style lock

Nonvolatile storage	
Reference waveform display	4 internal waveforms or USB thumb drive
Save formats	Setup (*.scp), 8- or 24-bit bitmap image (*.bmp), PNG 24-bit image (*.png), CSV data (*.csv), ASCII XY data (*.csv), binary data (*.bin), lister data (*.csv), reference waveform data (*.h5), multi-channel waveform data (*.h5), mask (*.mask), arbitrary waveform data (*.csv), power harmonics data (*.csv), USB signal quality (*.html & *.bmp)
Max USB flash drive size	Supports industry-standard flash drives
Set ups without USB flash drive	10 internal setups
Set ups with USB flash drive	Limited by size of USB drive

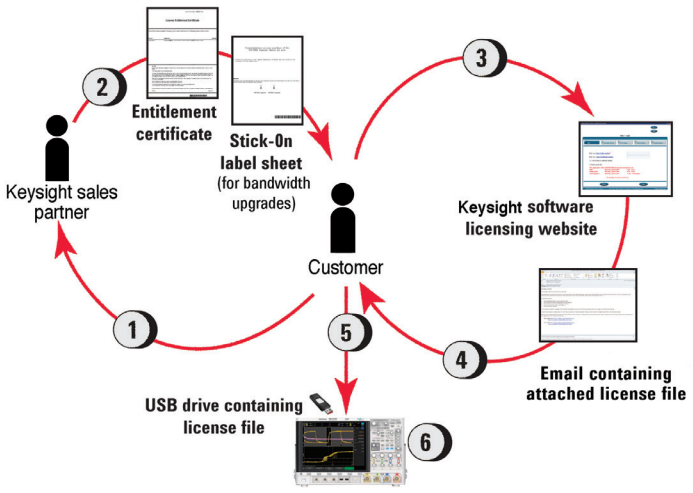
Included standard with oscilloscope	
Calibration	Soft copy of Certificate of Calibration (CoC) with measurement results downloadable from https://service.keysight.com/infoline/public/details.aspx?i=DOC, 2-year calibration interval
Probes	One per channel N2894A 700 MHz passive probe (10:1 attenuation)
	N2756A 16-digital-channel MSO cable (1 per oscilloscope included on all MSO models and DSOXPERFMSO)
Localized interface	English, Chinese (simplfied and traditional), French, German, Italian, Japanese, Korean, Portuguese, Russian, and Spanish localized front panel overlays, interface, and built-in help system
Power cord	Localized power cord
Front panel protection	Front panel cover
Documentation	CD containing localized user's guide, service guide, and programmer's manual

For MET/CAL procedures, visit the Cal Lab Solutions website: http://www.callabsolutions.com/products/Keysight/.

Related literature

Publication title	Publication number
Power Software Package - Data Sheet	5992-3925EN
Automotive Software Package - Data Sheet	5992-3912EN
Embedded Software Package - Data Sheet	5992-3924EN
Aero Software Package - Data Sheet	5992-3910EN
USB Software Package - Data Sheet	5992-3920EN
NFC Software Package - Data Sheet	5992-3911EN
Ultimate Bundle Software Package - Data Sheet	5992-3918EN

Oscilloscope Experience Redefined: After-purchase License-only Upgrades



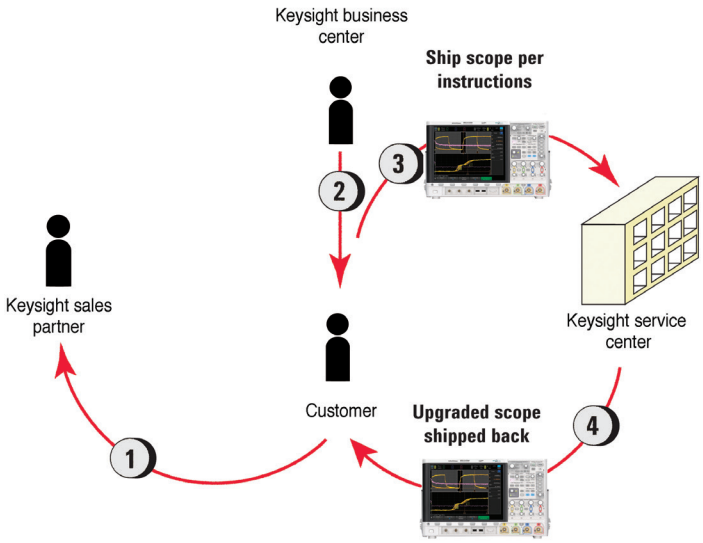
Hardware Upgrades		
Model number	**Description**	**Type**
DSOX4WAVEGEN2	Built-in 20 MHz function/AWG waveform generator upgrade	License only
DSOXPERFMSO	MSO upgrade: Add 16s digital timing channels	License + N2756A MSO cable delivered separately.
DSOX4SECA	Enhanced Security option	License only

Model number	Description
D4000GENA	Embedded Software Package: I^2C, SPI, UART (RS232/422/485), I^2S, and USB PD serial trigger and decode, plus Measurement Limit Testing, Mask Limit Testing, Frequency Response Analysis (Bode plots), and Enhanced Video Analysis
D4000AUTA	Automotive Software Package: CAN, CAN FD, LIN, FlexRay, SENT, CXPI, PSI5 (User-definable Manchester), and User-definable NRZ serial trigger & decode, plus Measurement Limit Testing, Mask Limit Testing and Frequency Response Analysis (Bode plots)
D4000AERA	Aero Software Package: MIL-STD 1553 and ARINC 429 serial trigger and decode, plus Measurement Limit Testing, Mask Limit Testing, Frequency Response Analysis (Bode plots), and Enhanced Video Analysis
D4000USBA [1, 2]	USB Software Package: USB 2.0 Low-, Full-, & Hi-speed, USB PD trigger & decode, plus USB 2.0 Signal Quality Test, Measurement Limit Testing, Mask Limit Testing, and Frequency Response Analysis (Bode plots)
D4000PWRA	Power Software Package: Power quality, current harmonics, switching loss, turn-on/off time, transient response, loop response, PSRR, & more, plus Measurement Limit Testing, Mask List Testing, Frequency Response Analysis (Bode plots), and USB PD serial trigger & decode
D4000NFCA	NFC Software Package: NFC triggering and PC-based NFC automated test software
D4000BDLA	Ultimate Bundle Software Package: I^2C, SPI, UART, I^2S, CAN, CAN FD, LIN, FlexRay, CXPI, PSI5 (User-definable Manchester), User-definable NRZ, USB 2.0 low-, full-, & hi-speed [1], USB PD, MIL-STD 1553, and ARINC 429 serial trigger & decode, plus USB 2.0 Signal Quality Test2, Power Analysis, Measurement Limit Testing, Mask Limit Testing, Frequency Response Analysis (Bode plots), Enhanced Video Analysis, NFC trigger & automated test software

1. USB 2.0 hi-speed trigger & decode supported on ≥ 1-GHz models only.
2. USB 2.0 hi-speed signal quality tests supported on 1.5-GHz models only.

Process description	
1	Place order for a license-only upgrade with a Keysight sales partner.
2	For software packages, you will receive a paper or electronic .pdf entitlement certificate. For bandwidth upgrades only, you will receive a stick-on label document indicating upgraded bandwidth specification in addition to a paper entitlement certificate.
3	Use entitlement certificate containing instructions and certificate number needed to generate a license file for a particular 4000 X-Series oscilloscope model number and serial number unit.
4	Receive the licensed file and installation instructions via email.
5	Copy license file (.lic extension) from email to a USB drive and follow instructions in email to install the purchased bandwidth upgrade or measurement application on the oscilloscope.
6	For bandwidth upgrades only, attach bandwidth upgraded stick-on labels to front and rear panels of the oscilloscope. Model number and serial number of the oscilloscope do not change.

Oscilloscope Experience Redefined: Return-to-Keysight Service Center Bandwidth Upgrades

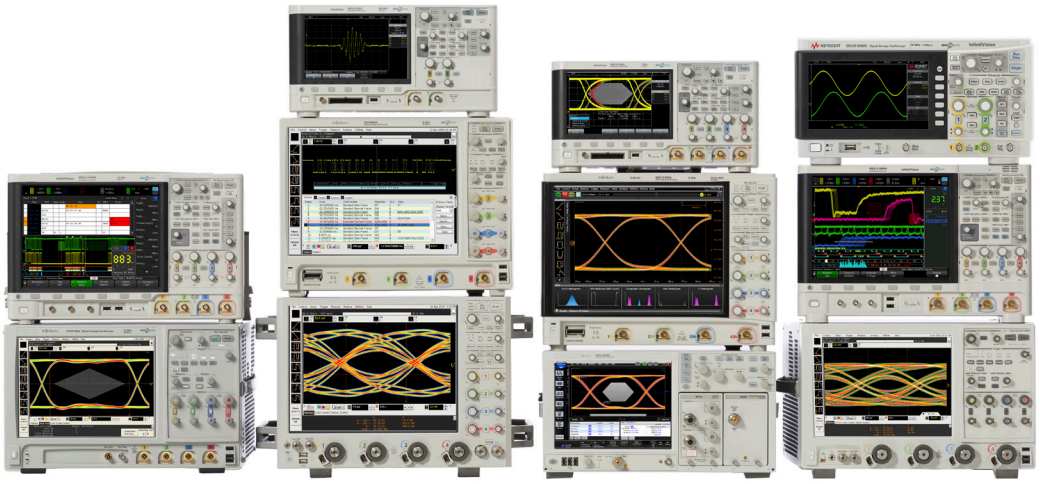


4000 X-Series bandwidth upgrade models		
Model number	**Description**	**Type**
DSOX4B2T32U	200 MHz ~ 350 MHz , 2 ch	Service center
DSOX4B2T34U	200 MHz ~ 350 MHz , 4 ch	Service center
DSOX4B5T104U	500 MHz ~ 1 GHz , 4 ch	Service center
DSOX4B1T154U	1 GHz ~ 1.5 GHz , 4 ch	Service center
DSOX4B2T52U	200 MHz ~ 500 MHz , 2 ch	Service center
DSOX4B2T54U	200 MHz ~ 500 MHz , 4 ch	Service center
DSOX4B2T104U	200 MHz ~ 1 GHz , 4 ch	Service center
DSOX4B2T154U	200 MHz ~ 1.5 GHz , 4 ch	Service center
DSOX4B3T104U	350 MHz ~ 1 GHz , 4 ch	Service center
DSOX4B3T154U	350 MHz ~ 1.5 GHz , 4 ch	Service center
DSOX4B5T154U	500 MHz ~ 1.5 GHz , 4 ch	Service center

Process description	
1	Place order for a return-to-Keysight service center bandwidth upgrade product to a Keysight sales partner. Serivce Center installation, calibration, shipment costs are in addition to bandwidth upgrade product price.
2	Keysight Business Center will contact you regarding process and timing of the service center installation. Continue to use oscilloscope until contacted again later when parts are available at service center.
3	Ship the oscilloscope per provided instructions to service center.
4	Service center ships back upgraded oscilloscope with stick-on labels applied to front and rear panels indicating upgraded bandwidth specification. Model number and serial number of the oscilloscope do not change.

Keysight Oscilloscopes

Multiple form factors from 50 MHz to > 110 GHz | Industry leading specs | Powerful applications



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