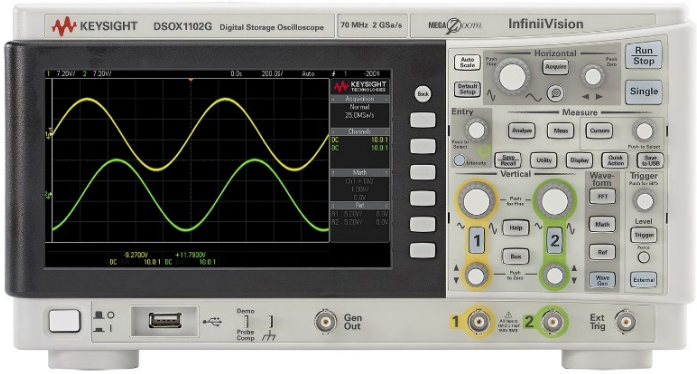
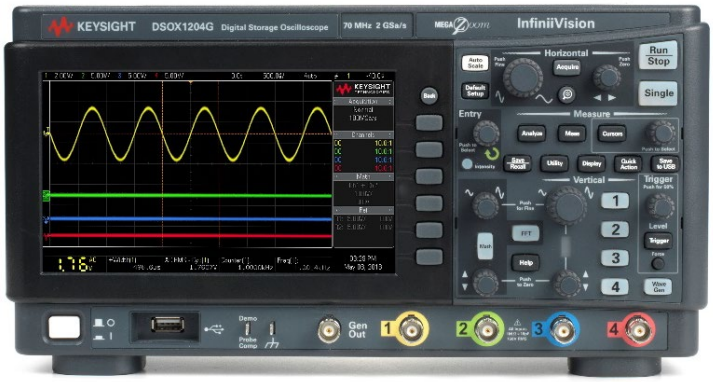
DATA SHEET

InfiniiVision 1000 X-Series Oscilloscopes



2 Channel: EDUX1002A; EDUX1002G; DSOX1102A; DSOX1102A



4 Channel: DSOX1204A; DSOX1204G

KEYSIGHT TECHNOLOGIES

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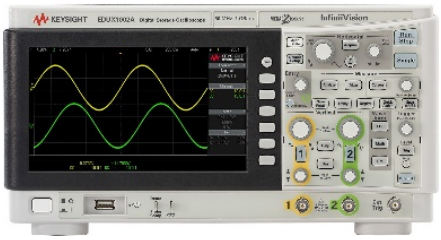
Leading technology in a value-priced oscilloscope

Keysight's InfiniiVision 1000 X-Series oscilloscopes are engineered to give you quality, industry-proven technology at unbelievably low prices. Now it's easy to get professional measurements and accessible expertise at your fingertips. Don't settle for less – and test to impress.

- 70 to 200 MHz
- Frequency Response Analysis (Bode gain & phase plots), included in models with WaveGen
- See more signal detail with 50,000 wfms/sec update rate
- Have confidence in your measurements with Keysight-custom technology that leverages more than 60 years of oscilloscope expertise
- Test quickly and easily with a simple, intuitive user interface and built-in help and training signals
- Get professional-level functionality with industry-leading software analysis and 6-in-1 instrument integration



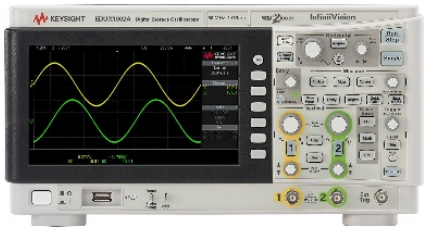
	DSOX1102A 70/100 MHz, 2 channel	DSOX1102G 70/100 MHz, 2 channel with function generator	DSOX1204A 70/100/200 MHz, 4 channel	DSOX1204G 70/100/200 MHz, 4 channel with function generator
Analog channels	2	2	4	4
External trigger	1(can be used as a 3rd digital channel at the front)	1 (can be used as a 3rd digital channel at the front)	1 (back)	1 (back)
Bandwidth	70 MHz (base)	70 MHz (base)	70 MHz (base)	70 MHz (base)
	100 MHz (DSOX1B7T102)	100 MHz (DSOX1B7T102)	100 MHz (D1200BW1A) 200 MHz (D1200BW2A)	100 MHz (D1200BW1A) 200 MHz (D1200BW2A)
Maximum sample rate	2 GSa/s (all channels)	2 GSa/s (all channels)	2 GSa/s (half channels) 1 GSa/s (all channels)	2 GSa/s (half channels) 1 GSa/s (all channels)
Maximum memory depth	1 Mpts	1 Mpts	1 Mpts	1 Mpts
Segmented memory	Standard	Standard	Standard	Standard
Mask/limit testing	Standard	Standard	Standard	Standard
WaveGen	Not available	20-MHz function generator (includes Bode plot test)	Not available	20-MHz function generator (includes Bode plot test)
Serial protocol analysis	Option: I²C, SPI, UART/RS-232 - (DSOX1EMBD) CAN, LIN - (DSOX1AUTO)		Option: I²C, SPI, UART/RS-232 - (D1200EMBA) CAN, LIN - (D1200AUTA)	
Waveform math	Add, subtract, multiply, divide, FFT (magnitude and phase), low pass filter			
Integrated digital voltmeter	Free with product registration			
Display	7-inch TFT LCD WVGA			
Waveform update rate	50,000 waveforms per second			
Connectivity	USB 2.0 (host and device)		USB 2.0 (host and device) LAN	

Leading technology in a value-priced oscilloscope (education model)

EDUX1002A and EDU1002G

Provide a quality education for students and prepare for the industry with professional level instruments. The 1000 X-Series leverages the same technology as our higher-end oscilloscopes, allowing students to learn on the same hardware and software being used in leading R&D labs. Don't settle for less – set your students up for success

- Built-in training signals that enable students to quickly learn to capture and analyze signals.
- The educator's resource kit includes dynamic teaching labs; a comprehensive lab guide; a tutorial written specifically for undergraduate students; and an oscilloscope fundamentals PowerPoint slide set for professors and lab assistants.
- IoT systems design applied courseware. The 1000 X-Series oscilloscope can be used with the U3800A Internet of Things(IoT) Systems Design Applied Courseware.
- Bode plots are fundamental concepts. The 1000 X-Series' frequency response analyzer capability is the perfect tool to help students understand the gain and phase performance of passive LRC circuits or active op-amps.
- BenchVue Software with the BV0004B BenchVue Oscilloscope app lets you control and visualize the 1000X-Series and multiple measurements simultaneously.



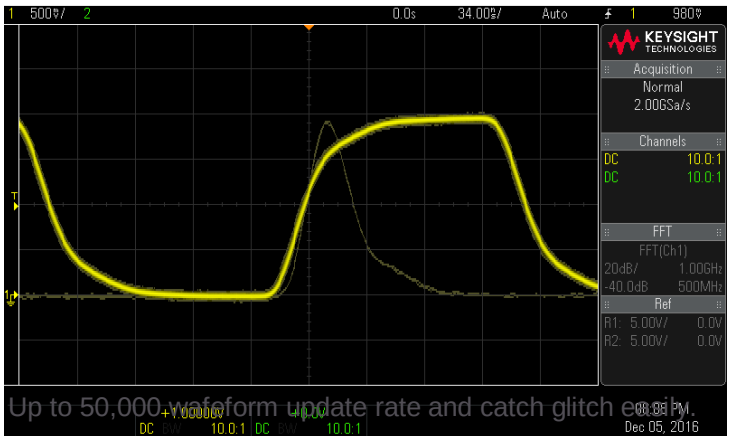
	EDUX1002A 50 MHz, 2 channel	EDUX1002G 50 MHz, 2 channel with function generator
Analog channels	2	2
External trigger (or 3rd digital channel)	1	1
Bandwidth	50 MHz	50 MHz
Maximum sample rate	1 GSa/s	1 GSa/s
Maximum memory depth	100 kpts	100 kpts
WaveGen	Not available	20-MHz function generator (includes Bode plot test)
Serial protocol analysis	Option: I²C, UART/RS-232 - (EDUX1EMBD)	
Waveform math	Add, subtract, multiply, divide, FFT (magnitude and phase), low pass filter	
Display	7-inch TFT LCD WVGA	
Waveform update rate	50,000 waveforms per second	
Connectivity	USB 2.0 (host and device)	

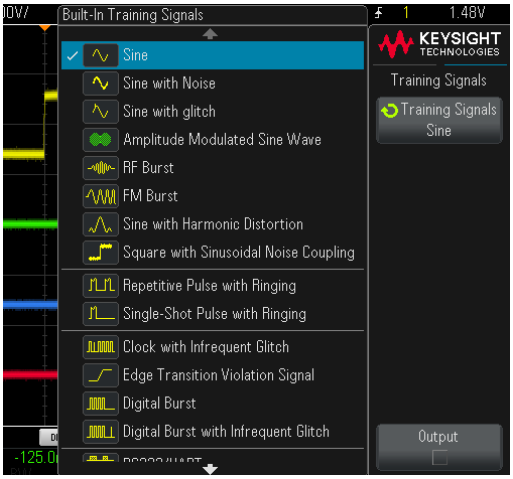
Leading Technologies

(Click on ▷ below, you will be redirected to VIDEO on Keysight Youtube channel)

Have confidence in your measurements with Keysight-custom technology that leverages more than 60 years of oscilloscope expertise.

Low-cost oscilloscopes don't have to be low quality. Designing premier test solutions has been the goal and passion of Keysight Technologies ever since we made our first oscillator in 1939, and now we're bringing you a professional-quality oscilloscope for a fraction of the price.



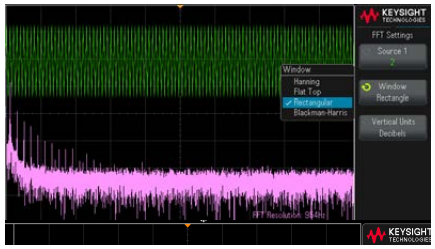


▷ **Training Signals**

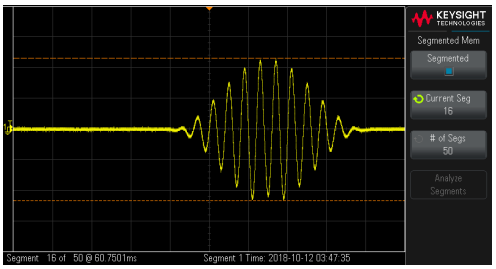
▷ **Superior Measurements**

▷ **Memory Performance**

▷ **FFT**



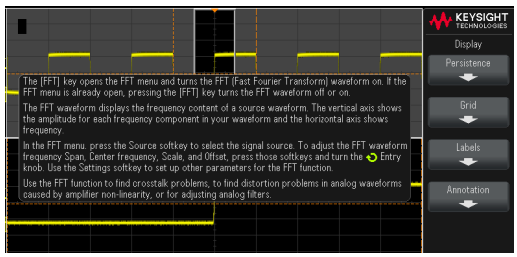
MegaZoom IV ASIC

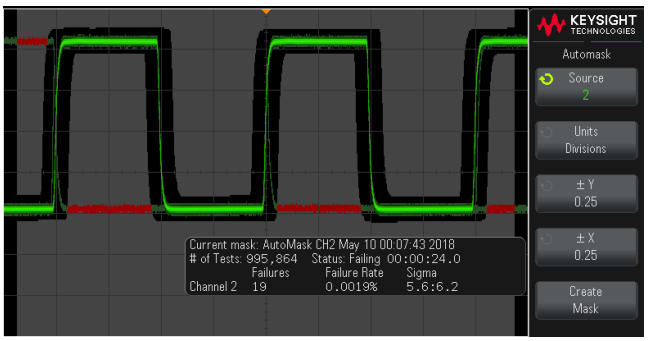


Segment Memory.

▷ **Mask test**

▷ **Intuitive Controls / Built-in Help**





6-in-1 instrument integration

Get professional-level oscilloscope functionality with industry-leading software analysis and 6-in-1 instrument integration. The 1000 X-Series gives you the following functionality, so you can save money and valuable bench space.

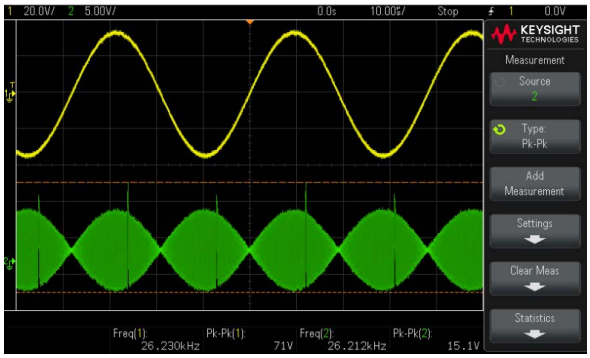
OSCILLOSCOPE

The 1000 X-Series is a family of low-cost oscilloscopes that don't compromise on quality. Each has measurement and software analysis capability that rivals oscilloscopes 3x the price.

WaveGen (built-in 20 MHz function generator with modulation capability)

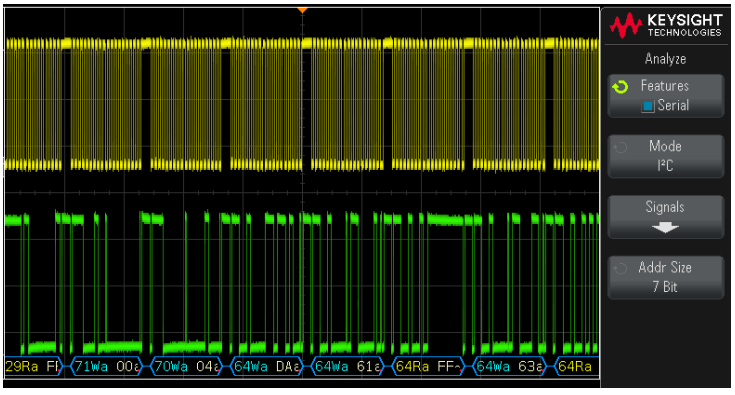
(EDUX1002G, DSOX1102G, and DSOX1204G models only)

The 1000 X-Series offers an integrated 20 MHz function generator with a signal modulation capability. It's ideal for educational or design labs where bench space and budget are at a premium. The integrated function generator provides stimulus output of sine, square, ramp, pulse, DC and noise waveforms to your device under test Add modulation to the signal with customizable AM, FM and FSK settings. No need to buy a separate function generator when you can get one integrated into your new oscilloscope. WaveGen is available on EDUX1002G, DSOX1102G, and DSOX1204G models only.



The WaveGen function enables the definition of multiple waveforms including amplitude modulated signals

Hardware-based serial protocol decode and triggering

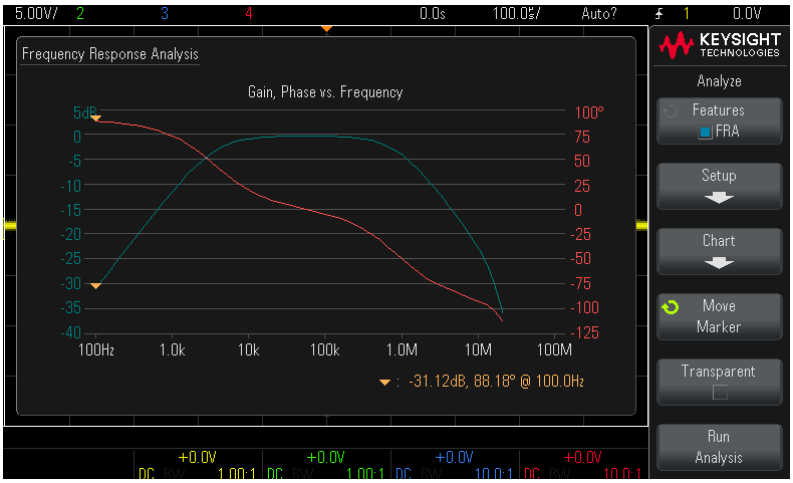


When you add optional software, the 1000 X-Series is a powerful protocol analyzer that can do powerful decode and hardware-based triggering that enables specialized serial communication analysis. Other vendors' oscilloscopes use software post-processing techniques that slow down the waveform and decode update rate, but the 1000 X-Series has faster decoding by using hardware-based technology that enhances scope usability and the probability of capturing infrequent serial communication errors.

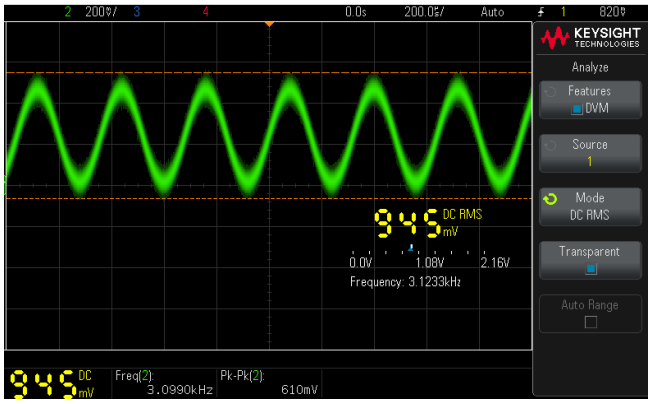
6-in-1 instrument integration (continued)

Frequency Response Analyzer (EDUX1002G, DSOX1102G, and DSOX1204G models only)

Frequency response analysis is a critical measurement to characterize the stability of feedback networks and switch-mode power supplies. Bode plots are fundamental concepts that every electrical engineering student must know. The 1000 X-Series' frequency response analyzer capability is the perfect tool to help students understand the gain and phase performance of passive LRC circuits or active op-amps. This capability is achieved with a gain and phase measurement versus frequency (Bode plot). Vector network analyzers (VNAs) and low-cost frequency response analyzers are typically used for these measurements, but now an easy-to-use gain and phase analysis is possible by utilizing the 1000 X-Series' built-in WaveGen. (EDUX1002G, DSOX1102G, and DSOX1204G models only).



Digital Voltmeter



The 1000 X-Series has an integrated 3-digit voltmeter (DVM) inside each oscilloscope. The voltmeter operates through probes connected to the oscilloscope channels, but its measurement is decoupled from the oscilloscope triggering system so both the DVM and triggered oscilloscope measurements can be made with the same connection. You can quickly measure AC RMS, DC, and DC RMS without configuring the oscilloscope capture. The voltmeter results are always displayed, keeping these quick characterization measurements at your fingertips. Turn on the DVM capability for no additional cost by registering your oscilloscope.

Frequency Counter

An integrated 5-digit frequency counter inside each oscilloscope. It operates through probes connected to the oscilloscope channels, but its measurement is decoupled from the oscilloscope triggering system, so both the counter and triggered oscilloscope measurements can be made with the same connection. You can quickly measure frequency without configuring the oscilloscope capture. The voltmeter results are always displayed, keeping these quick characterization measurements at your fingertips. Turn on the counter capability for no additional cost by registering your oscilloscope.

More productivity tools

Localized GUI and help

Operate the oscilloscope in the language most familiar to you. The graphical user interface (GUI), built-in help system, front panel overlays, and user's manual are available in English, Simplified Chinese, Traditional Chinese, Japanese, Korean, French, German, Italian, Portuguese, Russian and Spanish. The GUI and front panel overlay are also available in Polish, Thai, and Czech, and the built-in help is also available in Polish and Thai During operation. Access the built-in help system by simply pressing and holding any button.

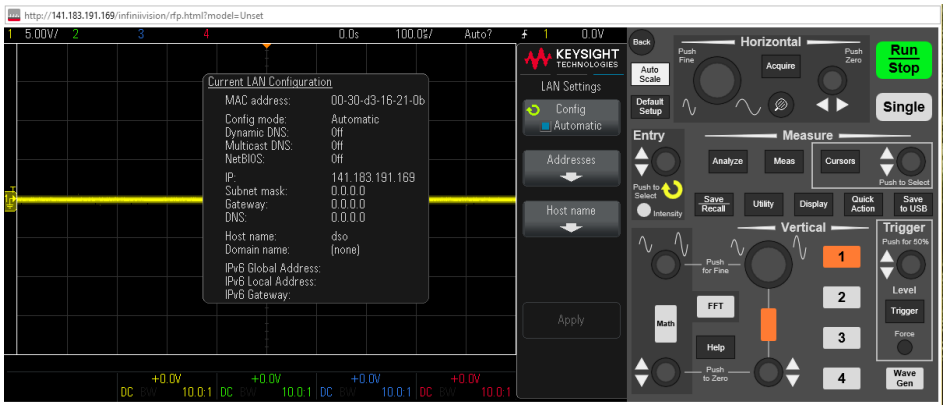
Probe solutions

Get the most out of your 1000 X-Series oscilloscope by using the right probes and accessories for your application. Keysight offers a complete family of innovative probes and accessories for the InfiniiVision 1000 X-Series.

Connectivity and remote control (LAN connectivity for DSOX1204A/G only)

Built-in USB host and USB device ports make PC connectivity easy. BenchVue Software with the BV0004B BenchVue Oscilloscope app lets you control and visualize the 1000 X-Series and multiple measurements simultaneously. Build automated test sequences just as easy as using your front panel. Save time with the ability to export measurement data to Excel, Word, and MATLAB in three clicks. Monitor and control your 1000 X-Series with a mobile device from anywhere.

Standard LAN port in the 4-channel models (DOSX1204A/G series) supports remote web-based virtual front panel to control and to save data or images.



Web-based virtual front panel. (DSOX1204A/G model only).

More productivity tools (continued)

Offline oscilloscope analysis software

Keysight's N8900A Infiniium Offline PC-based oscilloscope analysis software lets you do additional signal viewing, analysis, and documentation tasks while you're away from your oscilloscope. You can capture waveforms on your scope, save to a file and recall the waveforms into the Infiniium Offline software on your PC

BenchVue oscilloscope app

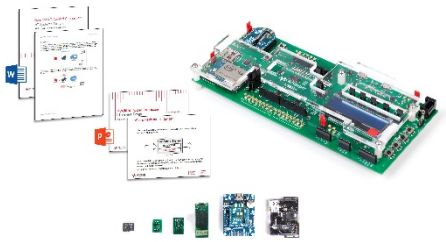
The Oscilloscope App within BenchVue enables control of oscilloscopes to quickly capture and annotate screen images, record trace data and data log measurements (included in model BV0000A) Build automated test sequences just as easy as using your front panel. Save time with the ability to export measurement data to Excel, Word, and MATLAB in three clicks. Monitor and control your 1000 X-Series with a mobile device from anywhere.

Oscilloscope basic courseware

The Educator's Oscilloscope Training Kit provides an array of built-in training signals so that electrical engineering and physics students can learn what an oscilloscope does and how they can perform basic oscilloscope measurements. Also included in the kit is a comprehensive oscilloscope lab guide and tutorial written specifically for the undergraduate student. Keysight also provides a PowerPoint slide-set that professors and lab assistants can use as a pre-lab lecture on oscilloscope fundamentals. This lecture takes about 30 minutes and should be presented before electrical engineering and physics students begin their first circuits lab. Note that this PowerPoint slide-set also includes a complete set of speaker notes.

IoT systems design courseware

The 1000 X-Series oscilloscope can be used with the U3800A Internet of Things (IoT) Systems Design Applied Courseware, which is designed to give students the opportunity to work with industry-grade test and measurement instruments The IoT Systems Design Applied Courseware is a ready-to-teach package that equips students with the knowledge on how to design and develop an embedded system with IoT capabilities. Designed as a resource for educators, the courseware consists of teaching slides and a training kit and integrates hands-on industry-relevant experiences and real-world applications in IoT systems design and testing.



A real oscilloscope

Measurements

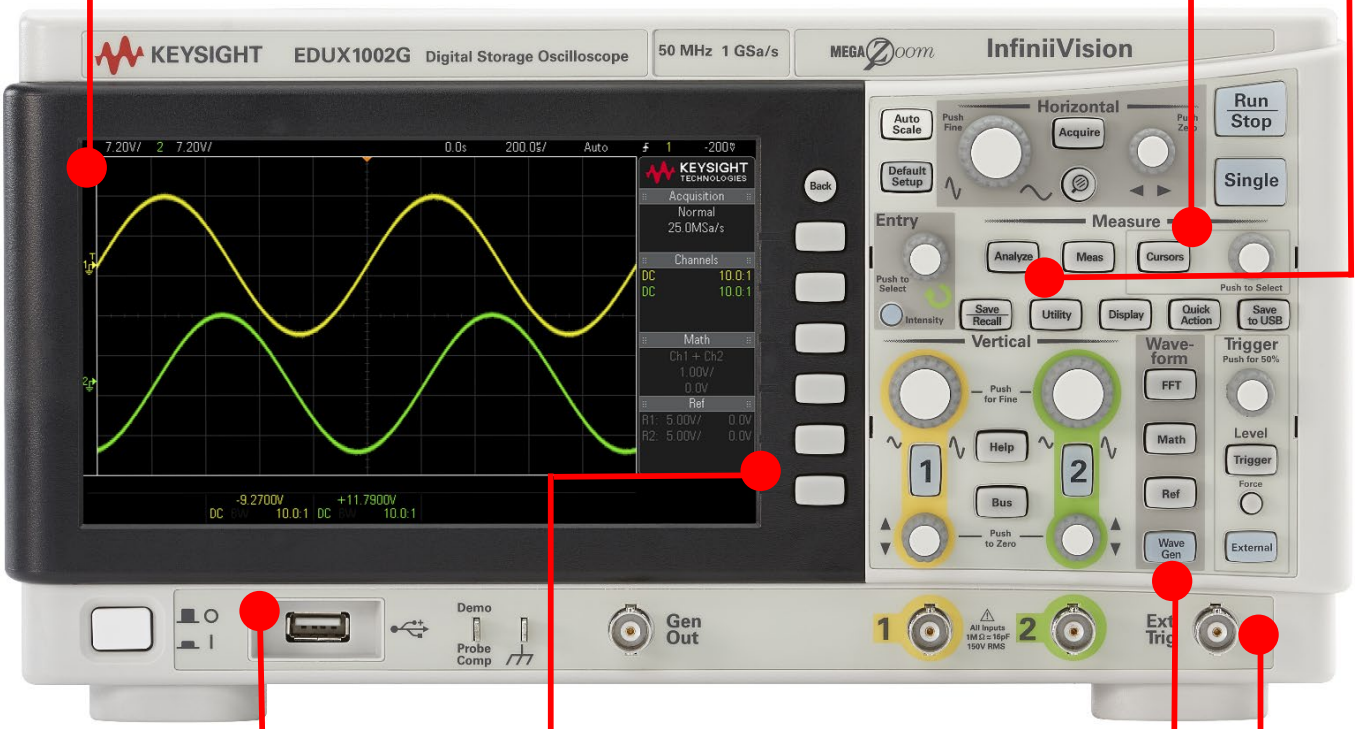
Press the measure key to access 24 built-in automatic measurements

Built-in localized-help

All buttons provide instant access to language-localized help by simply holding down the button you want explained

Cursors

Custom measurements are easily accomplished by cursors. Measure any value or the difference using four powerful cursors



USB save

Screenshots and date can be saved easily and fast with built-in USB port and your USB storage device.

Waveform Tools

Quick access to waveform math (+ – × ÷) and FFT. Reference Waveforms allow quick comparison of stored waveforms

Industry leading user Interface

Fast and easy operation with the common oscilloscope controls right at your fingertips.

External Trigger

It can be used for triggering or displayed as a 3rd channel for a digital signal. It can also be used to create a 3-channal bus-type display

Fast Waveform Update Rate

Fast 50,000 waveforms/sec update rate helps you quickly see random and infrequent signal glitches and errors

Analyze Features

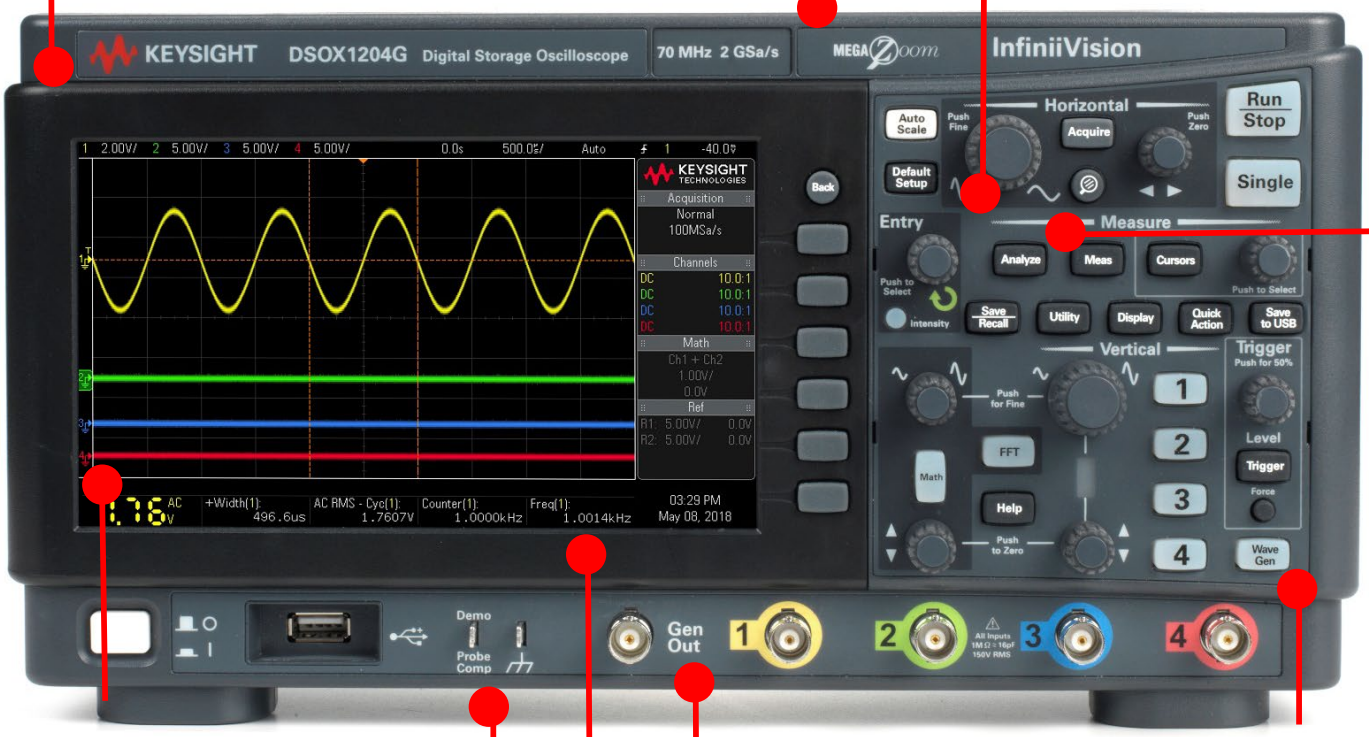
Mask Limit Testing DVM
Frequency Response Analysis
Serial Bus Decode

Compact Size with Big Screen

314 mm × 165 mm × 130 mm
(12.4” × 6.5” × 5.1”) 7” WVGA

Remote Control

USB
LAN (DSOX1204 model only)



Includes four 1:1/10:1 switchable probes

Digital Voltmeter

Integrated 3-digit voltmeter
5-digit frequency counter

Function Generator

Built-in generator enables you to generate the signals you need to quickly simulate your design.

Training Signals

Standard in all models so you can quickly learn how to troubleshoot many common signal problems

Frequency Response Analysis

Built-in generators are easily synchronized for measuring stimulus/response testing including Bode Plot for Gain & Phase

Configuring Your InfiniiVision 1000X-Series Oscilloscope

Step 1 Choose your oscilloscope

EDUX1002A	50 MHz, 2 channel
EDUX1002G	50 MHz, 2 channel with function generator
DSOX1102A	70/100 MHz, 2 channel
DSOX1102G	70/100 MHz, 2 channel with function generator
DSOX1204A	70/100/200 MHz, 4 channel
DSOX1204G	70/100/200 MHz, 4 channel with function generator

Step 2 Select bandwidth upgrades

Model: DSOX1102A/G

DSOX1B7T102	Upgrade bandwidth from 70 to 100MHz	Compatible with DSOX1102A or DSOX1102G

Model: DSOX1204A/G

D1200BW1A	Upgrade bandwidth from 70 to 100MHz	Compatible with DSOX1204A or DSOX1204G
D1200BW2A	Upgrade bandwidth from 70 to 200MHz	Compatible with DSOX1204A or DSOX1204G
D1200BW3A	Upgrade bandwidth from 100 to 200MHz	Compatible with DSOX1204A or DSOX1204G

Step 3 Add desired decodes

Model: EDUX1002A/G

EDUX1EMBD	Decodes and analysis for I^2C, UART(RS-232) protocols	Compatible with EDUX1002A or EDUX1002G

Model: DSOX1102A/G

DSOX1EMBD	Decodes and analysis for I^2C, SPI, UART(RS-232) protocols	Compatible with DSOX1102A or DSOX1102G
DSOX1AUTO	Decodes and analysis for CAN, LIN protocols	Compatible with DSOX1102A or DSOX1102G

Model: DSOX1204A/G

D1200EMBA	Decodes and analysis for I^2C, SPI, UART(RS-232) protocols	Compatible with DSOX1204A or DSOX1204G
D1200AUTA	Decodes and analysis for CAN, LIN protocols	Compatible with DSOX1204A or DSOX1204G

Configuring Your InfiniiVision 1000X-Series Oscilloscope (continued)

Step 4 Choose probes, accessories, and additional software options

Passive Probes

N2142A	1:1, 10:1 switchable 75 MHz passive probe	2 probes included standard with EDUX1002A/G
N2140A	1:1, 10:1 switchable 200 MHz passive probe	2 probes included standard with DSOX1102A/G 4 probes included standard with DSOX1204A/G
N2842A	10:1, 300 MHz passive probe	Option
N2889A	1:1, 10:1 switchable 350 MHz passive probe	Option
10070D	1:1, 20 MHz passive probe	Option
N2870A	1:1, 35 MHz passive probe	Option
N7007A	10:1 400 MHz extreme temperature passive probe	Option
10076C	100:1 500 MHz 3.7 KV high voltage passive probe	Option

Differential Probes

N2791A	25 MHz, 10:1, 100:1 switchable high voltage up to ± 700V	Option
N2891A	70 MHz, 100:1, 1000:1 switchable high voltage up to ± 7000V	Option

Current Probes

1146B	100 kHz, 100A, AC/DC current probe	Option
N2780B	2 MHz, 500A, AC/DC current probe (with N2779A power supply)	Option
N2781B	10 MHz, 150A, AC/DC current probe (with N2779A power supply)	Option
N2783B	50 MHz, 30A, AC/DC current probe (with N2779A power supply)	Option
N2783B	100 MHz, 30A, AC/DC current probe (with N2779A power supply)	Option
N7040A	23 MHz, 3 kA, AC current probe (Rogowski coil)	Option
N7041A	30 MHz, 600A, AC current probe (Rogowski coil)	Option
N7042A	30 MHz, 300A, AC current probe (Rogowski coil)	Option

Software Application

N5467B/C	User-defined Application (UDA) software	Option
BV0004B	BenchVue oscilloscope application	Option
N8900A	Infiniium Offline Oscilloscope Analysis Software	Option

Other Accessories

N2137A	User's Guide for InfiniiVision DSOX1204A/G model	Option, Compatible with DSOX1204A/G
N2132A	User's Guide for InfiniiVision EDUX1002A/G model and DSOX1102A/G model	Option, Compatible with EDUX1002A/G, DSOX1102A/G
N2738A	Soft carrying case for 1000 X-Series oscilloscopes	Option
N2133A	Rackmount kit for 1000 X-Series oscilloscopes (white)	Option
N2138A	Rackmount kit for 1000 X-Series oscilloscopes (black)	Option

Configuring Your InfiniiVision 1000X-Series Oscilloscope (continued)

Step 5 Select language options (hard copy of user guide is not included unless ordered)

Model: EDUX1002A/G and DSOX1102A/G

	Front panel overlay	User's guide
English	Standard	N2132A-ABA
Chinese (Simplified)	DSOX1000-AB2	N2132A-AB2
Chinese (Traditional)	DSOX1000-AB0	N2132A-AB0
Czech	DSOX1000-AKB	Not available
French	DSOX1000-ABF	N2132A-ABF
German	DSOX1000-ABD	N2132A-ABD
Italian	DSOX1000-ABZ	N2132A-ABZ
Japanese	DSOX1000-ABJ	N2132A-ABJ
Korean	DSOX1000-AB1	N2132A-AB1
Polish	DSOX1000-AKD	Not available
Portuguese	DSOX1000-AB9	N2132A-AB9
Russian	DSOX1000-AKT	N2132A-AKT
Spanish	DSOX1000-ABE	N2132A-ABE
Thai	DSOX1000-AB3	Not available
Turkish	DSOX1000-AB8	Not available

Model: DSOX1204A/G

	Front panel overlay	User's guide
English	Standard	N2137A-ABA
Chinese (Simplified)	DSOX1200-AB2	N2137A-AB2
Chinese (Traditional)	DSOX1200-AB0	N2137A-AB0
Czech	DSOX1200-AKB	Not available
French	DSOX1200-ABF	N2137A-ABF
German	DSOX1200-ABD	N2137A-ABD
Italian	DSOX1200-ABZ	N2137A-ABZ
Japanese	DSOX1200-ABJ	N2137A-ABJ
Korean	DSOX1200-AB1	N2137A-AB1
Polish	DSOX1200-AKD	Not available
Portuguese	DSOX1200-AB9	N2137A-AB9
Russian	DSOX1200-AKT	N2137A-AKT
Spanish	DSOX1200-ABE	N2137A-ABE
Thai	DSOX1200-AB3	Not available
Turkish	DSOX1200-AB8	Not available

Included standard

Standard passive probes (Two N2142A for EDUX1002A/G; Two N2140A for DSOX1102A/G; Four N2140A for DSOX1204A/G)
Standard secure erase
Interface language support GUI: English, Japanese, Simplified Chinese, Traditional Chinese, Korean, German, French, Spanish, Russian, Portuguese, Italian, Polish, Czech, Thai, and Turkish
Built-in help language support for English, Japanese, Simplified Chinese, Traditional Chinese, Korean, German, French, Spanish, Russian, Portuguese, Italian, Polish, and Thai
Localized Power cord
Certificate of calibration

Performance Characteristics

Oscilloscopes overview

	EDUX1002A/EDUX1002G	DSOX1102A/DSOX1102G	DSOX1204A/DSOX1204G
Bandwidth (–3 dB) [1, 2]	50 MHz	70 MHz	70 MHz
		100 MHz (option DSOX1B7T102)	100 MHz (option D1200BW1A)
			200 MHz (option D1200BW2A)
Calculated rise time (10 to 90%)	≤ 7 ns	≤ 5 ns (70 MHz model)	≤ 5 ns (70 MHz model)
		≤ 3.5 ns (100 MHz model)	≤ 3.5 ns (100 MHz model)
			≤ 1.7 ns (200 MHz model)
Input channels	2	2	4
Maximum sample rate	1 GSa/s	2 GSa/s	2 GSa/s half-channel interleaved 1 GSa/s per channel
Maximum memory depth	100 kpts	1 Mpts	1 Mpts
Waveform update rate	≥ 50,000 waveforms/sec	≥ 50,000 waveforms/sec	≥ 50,000 waveforms/sec

Vertical system analog channels

	EDUX1002A/EDUX1002G/DSOX1102A/DSOX1102G/DSOX1204A/DSOX1204G
Input coupling	DC, AC (10 Hz cutoff frequency)
Input impedance/capacitance	1 MΩ ± 2%/16 pF ±3 pF
Input sensitivity range [3]	500 µV/div to 10 V/div
Standard probes	N2142A 1/10 switchable 75 MHz (2 included in EDUX1002A/EDUX1002G) N2140A 1/10 switchable 200 MHz (2 included in DSOX1002A/DSOX1002G) N2140A 1/10 switchable 200 MHz (4 included in DSOX1204A/DSOX1204G)
Probe attenuation factor	0.1X to 1000X in 1-2-5 sequence; (–20 dB to +80 dB in 0.1 dB steps)
Hardware bandwidth limits	Approximately 20 MHz (selectable)
Vertical resolution	8 bits
Invert signal	Selectable
Maximum input voltage	150 Vrms, 200 Vpk
DC vertical accuracy	± [DC vertical gain accuracy + DC vertical offset accuracy + 0.25% full scale]
DC vertical gain accuracy [1]	+3% full scale (> 10 mV/div)
	+4% full scale (< 10 mV/div)
DC vertical offset accuracy	± 0.1 div ± 2 mV ± 1% of offset setting
Skew	Channel to channel: 1 ns (without deskew)
	Channel to external: 2 ns (without deskew)
Offset range	500 uV/div to 200 mV/div: +2 V
	> 200 mV/div to 10 V/div: +100 V

1. Denotes warranted specifications; All others are typical. Specifications are valid after a 30-minute warm-up period and from ± 10 °C user calibration temperature.
2. For 1 mV/div to 10 V/div settings, bandwidth is 20 MHz at the 500 µV/div setting.
3. 500 µV/div is a magnification of 1 mV/div setting.

Performance Characteristics (continued)

Horizontal system analog channels

	All Models
Time base range	5 ns/div to 50 s/div
Horizontal resolution	2.5 ps
Time base accuracy [4]	50 ppm ± 5 ppm per year (aging)
Time base delay time range	Pre-trigger: Greater of 1 screen width or 200 µs
	Post-trigger: 1 to 500 s
Channel to channel deskew range	± 100 ns
Δ Time accuracy (using cursors)	± (time base acc. x reading) ± (0.0016 x screen width) ± 200 ps (same channel)
Modes	Main, zoom, roll, XY
XY	X = channel 1, Y = channel 2, Z = external trigger, 1.4 V blanking
	Bandwidth: Maximum bandwidth. Phase error at 1 MHz: < 0.5 degree

Acquisition system

		EDUX1002A/EDUX1002G	DSOX1102A/DSOX1102G DSOX1204A/DSOX1204G
Maximum sample rate		1 GSa/s	2 GSa/s
Maximum analog channels record length		100 kpts	1 Mpts
Acquisition mode	Normal	Default mode	Default mode
	Peak Detect	Capture glitches as narrow as 10 ns at all time base settings	Capture glitches as narrow as 10 ns at all time base settings
			Capture glitches as narrow as 5 ns at all time base settings (100 MHz model) 2.5 ns at all time base setting (200 MHz model)
	Averaging	Selectable from 2, 4, 8, 16, 64, ... to 65,536	Selectable from 2, 4, 8, 16, 64, ... to 65,536
	High Resolution	Real-time boxcar averaging reduces random noise and effectively increases vertical resolution to 12 bits of resolution when ≥ 20 µs/div at 1 GSa/s	Real-time boxcar averaging reduces random noise and effectively increases vertical resolution to 12 bits of resolution when ≥ 20 µs/div at 2 GSa/s
	Segmented	Not available	Segmented memory optimizes available memory for data streams that have long dead times between activity. Maximum segments = 50. Re-arm time = 19µs (minimum time between trigger events)
Time mode	Normal	Default mode	Default mode
	Roll	Displays the waveform moving across the screen from right to left. Available at the time base 50 ms/div or slower	Displays the waveform moving across the screen from right to left. Available at the time base 50 ms/div or slower
	XY	Displays the volts-versus-volts display	Displays the volts-versus-volts display
		X = Channel 1, Y = Channel 2	X = Channel 1, Y = Channel 2
		Z = External trigger, 1.4 V blanking	Z = External trigger, 1.4 V blanking
		Phase error at 1 MHz: < 0.5 degree	Phase error at 1 MHz: < 0.5 degree
Autoscale		Finds and displays all active channels and external trigger. Sets edge trigger mode on external trigger first then highest numbered active channel. Sets vertical sensitivity. Sets time base to display ~ 1.8 periods. Requires minimum voltage of 10 mVpp (channel)	Finds and displays all active channels and external trigger. Sets edge trigger mode on external trigger first then highest numbered active channel. Sets vertical sensitivity. Sets time base to display ~ 1.8 periods. Requires minimum voltage of 10 mVpp (channel)

4. Denotes warranted specifications; All others are typical. Specifications are valid after a 30-minute warm-up period and from ± 10 °C user calibration temperature.

Performance Characteristics (continued)

Trigger system

	All Models
Trigger sources	Analog channels, line [5], external, WaveGen, WaveGen modulation FM/FSK
Trigger modes	Normal (triggered): Requires trigger event for oscilloscope to trigger
	Auto: Triggers automatically in absence of a trigger event
	Single: Triggers only once on a trigger event
	Force: Front panel button that forces a trigger
Trigger coupling	DC: DC coupled trigger
	AC: AC coupled trigger, cutoff frequency: ~ 10 Hz
	HF reject: High frequency reject, cutoff frequency ~ 50 kHz
	LF reject: Low frequency reject, cutoff frequency ~ 50 kHz
	Noise reject: Selectable OFF or ON, decreases sensitivity 2x
Trigger holdoff range	60 ns to 10 s

Trigger sensitivity

	EDUX1002A/EDUX1002G	DSOX1102A/DSOX1102G	DSOX1204A/DSOX1204G
Internal [6]	Greater of: 0.6 div or 2.5 mV (≤ 10 MHz) 0.9 div or 3.8 mV (10 to 50 MHz)	Greater of: 0.6 div or 2.5 mV (≤ 10 MHz) 0.9 div or 3.8 mV (10 to 70 MHz) 1.2 div or 5 mV (70 to 100 MHz)	Greater of: 0.6 div or 2.5 mV (≤ 10 MHz) 0.9 div or 3.8 mV (10 to 70 MHz) 1.2 div or 5 mV (70 to 200 MHz)
External	≤ 10 MHz: 250 mVpp	≤ 10 MHz: 50 mVpp (1.6 V range) 250 mVpp (8 V range)	≤ 10 MHz: 20 mVpp (1.6 V range) 100 mVpp (8 V range)
	10 to 50 MHz: 500 mVpp	10 to 100 MHz: 100 mVpp (1.6 V range) 500 mVpp (8 V range)	10 to 200 MHz: 100 mVpp (1.6 V range) 500 mVpp (8 V range)

Trigger level range

	EDUX1002A/EDUX1002G	DSOX1102A/DSOX1102G DSOX1204A/DSOX1204G
Internal	± 6 div from center screen	± 6 div from center screen
External [7]	± 8 V	± 1.6 V or ± 8 V selectable

5. Line trigger to ≤ 60 Hz.
6. Denotes warranted specifications; All others are typical. Specifications are valid after a 30-minute warm-up period and from ± 10 °C firmware calibration temperature.
7. Input voltage must remain within these limits for proper operation.

Performance Characteristics (continued)

Trigger type selections

	EDUX1002A/EDUX1002G	DSOX1102A/DSOX1102G DSOX1204A/DSOX1204G
Trigger types	Edge, pulse width, video, pattern/state	Edge, pulse width, video, rise/fall time, setup and hold, pattern/state
Edge	Trigger on a rising, falling, alternating or either edge of any source	
Pattern/state	Trigger when a specified pattern/state on any combination inputs is entered[8]	
Pulse width	Trigger on a pulse of a selected channel with a time duration that is 'less than a value,' 'greater than a value' or 'inside a time range' Range minimum: 10 ns, 10 s max	
Setup and hold	Not available	Trigger and clock/data setup and/or hold time violation. Setup time can be set from –7 ns to 10 s. Hold time can be set from 0 s to 10 ns
Rise/fall time	Not available	Trigger on rise-time or fall-time edge speed violations (< or >) based on a user-selectable threshold
		Select from (< or >) and time settings range between Minimum: 5 ns Maximum: 10 s
Video	Trigger on all lines or individual lines; odd/even or all fields from the composite video; or broadcast standards (NTSC, PAL, SECAM, and PAM-M)	
I^2C – EDUX1EMBD option – DSOX1EMBD option – D1200EMBA option	Trigger at a start/stop condition or user-defined frame with address and/or data values. Also, trigger on missing acknowledge, restart, EEPROM read and 10-bit write	
RS-232/422/485/UART – EDUX1EMBD option – DSOX1EMBD option – D1200EMBA option	Trigger on Rx or Tx start bit, stop bit, data content or parity error	
SPI – DSOX1EMBD option – D1200EMBA option	Not available	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. Supports MOSI or MISO (4-channel models) data as half duplex data
CAN – DSOX1AUTO option – D1200AUTA option	Not available	Trigger on CAN (controller area network) version 2.0A and 2.0B signals. Trigger on the start of frame (SOF) bit, remote frame ID (RTR), data frame ID (~RTR), remote or data frame ID, data frame ID and data, error frame, all errors, acknowledge error, and overload frame.
LIN – DSOX1AUTO option – D1200AUTA option	Not available	Trigger on LIN (Local Interconnect Network) sync break, sync frame ID or frame ID and data, parity error, checksum error and frame

8. The pattern must have stabilized for a minimum of 5 ns to qualify as a valid trigger condition.

Performance Characteristics (continued)

Waveform measurements

	All Models
Cursors	Single cursor accuracy: ± [DC vertical gain accuracy + DC vertical offset accuracy + 0.25% full scale]
	Dual cursor accuracy: ± [DC vertical gain accuracy + 0.5% full scale]
	Units: Seconds(s), Hz (1/s), phase (degrees)
Automatic measurements	Measurements continuously updated with statistics.
	Cursors track last selected measurement. Select up to four measurements from the list below:
	Snapshot: Measure all single waveform measurements (24)
	Voltage:
	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)
	Time:
	Period, frequency, counter, + width, - width, +duty cycle, -duty cycle, bit rate, rise time, fall time, delay, phase,
	X at min Y, X at max Y
	Automatic measurement logging:
	Available via BenchVue BV0004B

Waveform math

	All Models
Arithmetic	Add, subtract, multiply, divide, FFT (magnitude), FFT (phase), low-pass filter
FFT	Record Size: Up to 64 kpts resolution
	Window types: Hanning, Flat top, Rectangular, Blackman-Harris

Performance Characteristics (continued)

WaveGen – Built-in function generator (specifications are typical)

Note: Only available on WaveGen models EDUX1002G, DSOX1102G, and DSOX1204G. WaveGen is not upgradeable.

	EDUX1002G/ DSOX1102G/ DSOX1204G
WaveGen out	Front-panel BNC connector
Waveforms	Sine, square, ramp, pulse, DC, noise
Modulation	Modulation types: AM, FM, FSK
	Carrier waveforms: Sine, ramp
	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 (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
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 bandwidth): 40 dB (typical); 30 dB (min)
Square wave /pulse	Frequency range: 0.1 Hz to 10 MHz
	Duty cycle: 20 to 80%
	Duty cycle resolution: Larger of 1% or 10 ns
	Pulse width: 20 ns minimum
	Rise/fall time: 18 ns (10 to 90%)
	Pulse width resolution: 10 ns or 5 digits, whichever is larger
	Overshoot: < 2%
	Asymmetry (at 50% DC): ± 1% ± 5 ns
	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%
Noise	Bandwidth: 20 MHz typical

Performance Characteristics (continued)

WaveGen – Built-in function generator (specifications are typical) (continued)

Note: Only available on WaveGen models EDUX1002G, DSOX1102G, and DSOX1204G. WaveGen is not upgradeable.

	EDUX1002G/ DSOX1102G/ DSOX1204G
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	Square, Pulse, Ramp:
	2 mVpp to 20 Vpp into Hi-Z (offset ≤ ±0.4 V)
	1 mVpp to 10 Vpp into 50 Ω (offset ≤ ±0.4 V)
	50 mVpp to 20 Vpp into Hi-Z (offset > ±0.4 V)
	25 mVpp to 10 Vpp into 50 Ω (offset > ±0.4 V)
	Sine:
	2 mVpp to 12 Vpp into Hi-Z (offset ≤ ± 0.4 V)
	1 mVpp to 9 Vpp into 50 Ω (offset ≤ ± 0.4 V)
	50 mVpp to 12 Vpp into Hi-Z (offset > ± 0.4 V)
	25 mVpp to 9 Vpp into 50 Ω (offset > ± 0.4 V)
	Resolution: ≤ 1% of the amplitude
	Accuracy: 2% (Frequency = 1 kHz)
DC offset	Square, Pulse, Ramp:
	± [10 V – ½ amplitude] into Hi-Z
	± [5 V – ½ amplitude] into 50 Ω
	Sine:
	± [8 V – ½ amplitude] into Hi-Z
	± [4.5 V – ½ amplitude] into 50 Ω
	Resolution: Larger of 250 uV or 3 digits
	Accuracy: ± 1.5% of offset setting ± 1.5% of amplitude ± 1 mV
Main output	Impedance: 50 Ω typical
	Isolation: Not available, main output BNC is grounded
	Protection: Overload automatically disables output
	Sine, square, ramp, pulse, DC, noise

Performance Characteristics (continued)

Digital voltmeter (specifications are typical)

	All Models
Functions	ACrms, DC, DCrms
Resolution	ACV/DCV: 3 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

Frequency counter (specifications are typical)

	All Models
Functions	Frequency
Resolution	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

Frequency response analysis (Bode plot) (specifications are typical)

	EDUX1002G/ DSOX1102G/ DSOX1204G
Dynamic range	> 80 dB (typical)
Input and output sources	Output: WaveGen out
	Input 1 and 2 can be assigned to any channel
Frequency range	10 Hz to 20 MHz
Number of test points	Up to 1,000 total points
Test amplitude	10 mVpp to 9 Vpp into 50-Ω
	Fixed amplitude across the entire sweep
Test results	Logarithmic overlaid gain and phase plot
Manual measurements	A single pair of tracking gain and phase markers
Plot scaling	Auto-scaled during test and manual

Environmental

Connectivity

	EDUX1002A/EDUX1002G/DSOX1102A/DSOX1102G
Standard Ports	One USB 2.0 hi-speed device port on rear panel. Supports USBTMC protocol
	One USB 2.0 hi-speed host port on front panel. Supports memory devices, printers, and keyboards

	DSOX1204A/DSOX1204G
Standard Ports	One USB 2.0 hi-speed device port on rear panel. Supports USBTMC protocol
	One USB 2.0 hi-speed host port on front panel. Supports memory devices
	One Ethernet 1 Gb/s networking: RJ-45

General and environmental characteristics

	All Models
Power line consumption	50 W max
Power voltage range	100 to 120 V, 50/60/400 Hz; 100 to 240 V, 50/60 Hz
Environmental rating	0 to +50 °C, 3,000 m Max
	Maximum Relative Humidity (non-condensing): 95% RH up to 40°C, decreases linearly to 45% RH at 50°C [9]
Electromagnetic compatibility	Meets EMC directive (2004/108/EC), meets or exceeds IEC 61326-1:2005/EN61326-1:2013 (basic)
	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 61000-4-8/EN 61000-4-8
	IEC 61000-4-11/EN 61000-4-11
	Canada: ICES/NMB-001:2006
	Australia/New Zealand: AS/NZS CISPER 11:2011
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
Dimensions (W x H x D)	314 mm (12.4 in) x 165 mm (6.5 in) x 130 mm (5.1 in)
Weight	Net: 3.23 kg (7.1 lbs), shipping: 4.2 kg (9.2 lbs)
Display	7.0" diagonal color TFT LCD WVGA

Nonvolatile storage

	All Models
Reference waveform display	Two internal waveforms or USB thumb drive
Waveform storage	Set up, .bmp, .png, .csv, ASCII XY, reference waveforms, .bin, mask, HDF5
Max USB flash drive size	Supports industry standard flash drives
Setups without USB flash drive	10 internal setups
USB drive format	FAT32
	NTFS, EXT2/3/4 (DSOX1204A/G only)

9. From 40 °C to 50 °C, the maximum % Relative Humidity follows the line of constant dew point.

DATA SHEET

InfiniiVision 2000 X-Series Oscilloscopes

KEYSIGHT TECHNOLOGIES

Table of Contents

Want to Touch operation to Discover and Solve your problem?

See the InfiniiVision 3000T X-Series.

- First in class 8.5-inch capacitive touch display
- Zone touch trigger capability
- 100 MHz to 1 GHz DSO and MSO models
- > 1,000,000 wfms/sec
- Standard segmented memory
- Fully upgradable 6 instrument in 1
  - Digital channels (MSO)
  - Protocol analysis including new CAN-FD and SENT bus support
  - 20 MHz WaveGen with arbitrary waveform and modulation support
  - 3-digit digital voltmeter (DVM)
  - 5-digit counter/8-digit totalizer
- N7020A Power Rail Probe and N2820A High Sensitivity Current Probe support
- Standard time gated FFT feature

See **www.keysight.com/find/3000TX-Series** for more details.

Breakthrough Technology For Budget Conscious Customers

Overview of the Keysight InfiniiVision X-Series oscilloscopes

	InfiniiVision 1000 X-Series	InfiniiVision 2000 X-Series	InfiniiVision 3000T X-Series	InfiniiVision 4000 X-Series
Analog channels	2	2 and 4	2 and 4	2 and 4
Bandwidth (upgradable)	50, 70, 100 MHz	70, 100, 200 MHz	100, 200, 350, 500 MHz, 1 GHz	200, 350, 500 MHz, 1 GHz, 1.5 GHz
Digital channels	Not available	8 (MSO models or upgrade) [1]	16 (MSO models or upgrade)	16 (MSO models or upgrade)
Maximum sample rate	2 GSa/s	2 GSa/s	5 GSa/s	5 GSa/s
Maximum memory depth	100 kpts/channel on EDU models 1 Mpt/channel on DSO models	1 Mpt/channel (standard)	4 Mpts (standard)	4 Mpts (standard)
Waveform update rate	50,000 wfms/sec	> 200,000 wfms/sec	> 1,000,000 wfms/sec	> 1,000,000 wfms/sec
Display	7 inch display	8.5-inch display	8.5-inch capacitive touch display	12.1-inch capacitive touch display
Zone touch trigger	No	No	Standard	Standard
WaveGen 20-MHz function/ arbitrary waveform generator	Single-channel function only (standard on G models)	Single-channel function only (option)	Single-channel AWG (option)	Dual-channel AWG (option)
Integrated digital voltmeter (standard)	Free with registration	Yes	Yes	Yes
Integrated hardware counter (standard)	5-digits	5-digits	5-digits, 8-digits - totalizer	5-digits
Search and navigate	No	Yes (serial)	Yes	Yes
Serial protocol analysis	Yes (optional: I^2C, SPI, UART, CAN, LIN)	Yes (optional: CAN, LIN, I^2C, SPI, RS232/UART) [1]	Yes (optional: ARINC 429, CAN/CAN-dbc/CAN-FD/ LIN/LIN symbolic, SENT, FlexRay, I^2C, I^2S, LIN, MIL-STD-1553, SPI, UART/ RS232, CXPI, Manchester/ NRZ)	Yes (optional: ARINC 429, CAN/CAN-dbc/CAN-FD/ LIN/LIN symbolic, SENT, FlexRay, I^2C, I^2S, LIN, MIL-STD-1553, SPI, UART/ RS232, USB 2.0, CXPI, Manchester/NRZ)
Segmented memory	Yes (standard on DSO model)	Standard	Standard	Standard
Mask/limit testing	Yes (standard on DSO model)	Yes (option)	Yes (option)	Yes (option)
Power analysis	No	No	Yes (option)	Yes (option)
USB 2.0 signal quality test	No	No	No	Yes (option)
HDTV analysis	No	No	Yes (option)	Yes (option)
Advanced waveform math	No	Standard	Standard	Standard
Connectivity	Standard USB 2.0	Standard USB 2.0 (LAN/ video option) (GPIB option)	Standard USB2.0 (LAN/ video option) (GPIB option)	Standard USB2.0, LAN, video out (GPIB option)

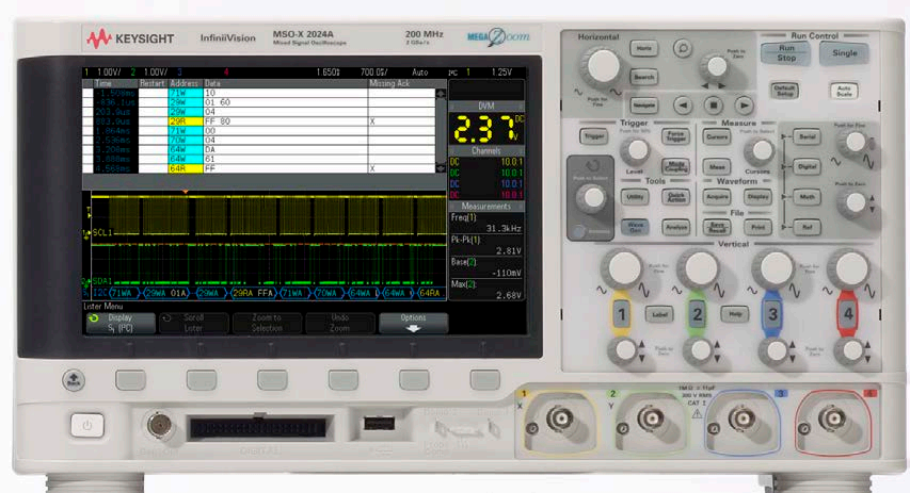
1. The digital channels and serial protocol analysis cannot be used simultaneously on 2000 X-Series.

More Scope

The InfiniiVision 2000 X-Series offers entry-level price points to fit your budget with superior performance and optional capabilities that are not available in any other oscilloscope in its class. This Keysight Technologies, Inc. breakthrough technology delivers more scope for the same budget.

With more scope, you can:

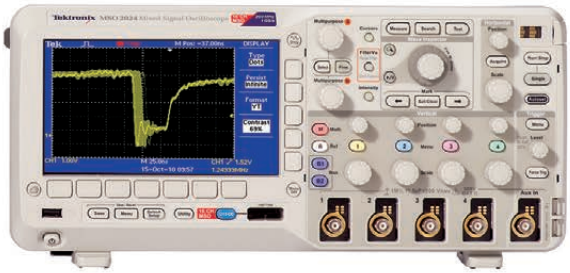
- See more of your signal more of the time with the largest screen in its class, the deep memory and the fastest waveform update rates
- Do more with the power of 5 instruments in 1: Oscilloscope, logic timing analyzer, WaveGen built-in 20 MHz function generator (optional), serial protocol triggering and decode (optional), and digital voltmeter (optional)
- Get more investment protection with the classes only fully upgradable scope, including memory and bandwidth.



See More Of Your Signal, More Of The Time

Largest display

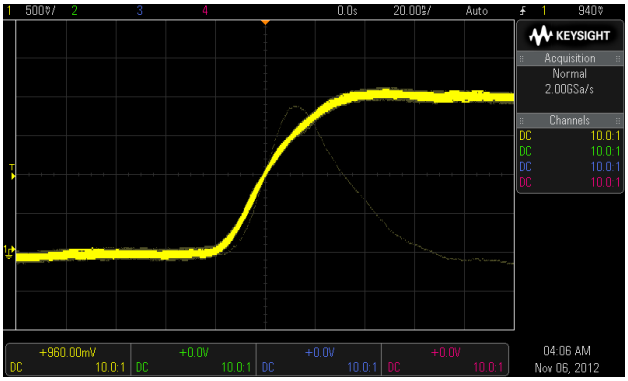
Engineering for the best signal visibility starts with the largest display. Our 8.5-inch WVGA display offers 50% more viewing area with 3.5 times the resolution (WVGA 800 x 480 versus 7-inch WQVGA 480 x 234).



Notice that the Keysight 2000 X-Series allows you to see more of your signals, and captures the infrequent glitch that you are unable to see on other oscilloscopes in this class.

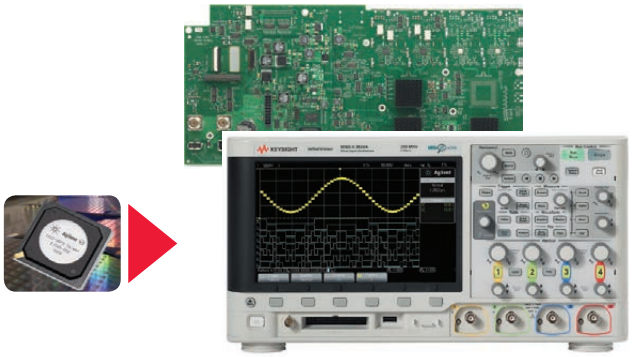
Fastest update rate

With Keysight-designed *MegaZoom IV* custom ASIC technology, the InfiniiVision 2000 X-Series family delivers up to 200,000 waveforms per second. With this speed you can see signal detail and infrequent anomalies more of the time.



How does Keysight do that?

Keysight-designed *MegaZoom IV* custom ASIC technology combines the capabilities of an oscilloscope, logic analyzer, and WaveGen built-in function generator in a compact form factor at an affordable price. 4th generation *MegaZoom* technology enables the industry's fastest waveform update rate with responsive deep memory acquisitions.



Do More With The Power Of 5 Instruments In 1

Best-in-class oscilloscope

The InfiniiVision 2000 X-Series features Keysight's patented MegaZoom IV smart memory technology that is always enabled and always responsive providing the industry's fastest update rate at up to 200,000 waveforms per second, with no compromise if you turn on measurements or add digital channels. In addition, the 2000 X-Series offers 25 automated measurements such as voltage, time, and frequency as well as 18 waveform math functions including add, subtract, multiply, divide, and FFT.

Industry's first economy-class mixed signal oscilloscope (MSO)

The 2000 X-Series is the first instrument in its class to offer an integrated logic timing analyzer. Digital content is everywhere in today's designs and with an additional 8 integrated digital timing channels, you now have up to 12 channels of time-correlated triggering, acquisition and viewing on the same instrument. Buy a 2 or 4 channel DSO and at any time, upgrade it yourself to a MSO with a license to turn on those integrated 8 digital timing channels.

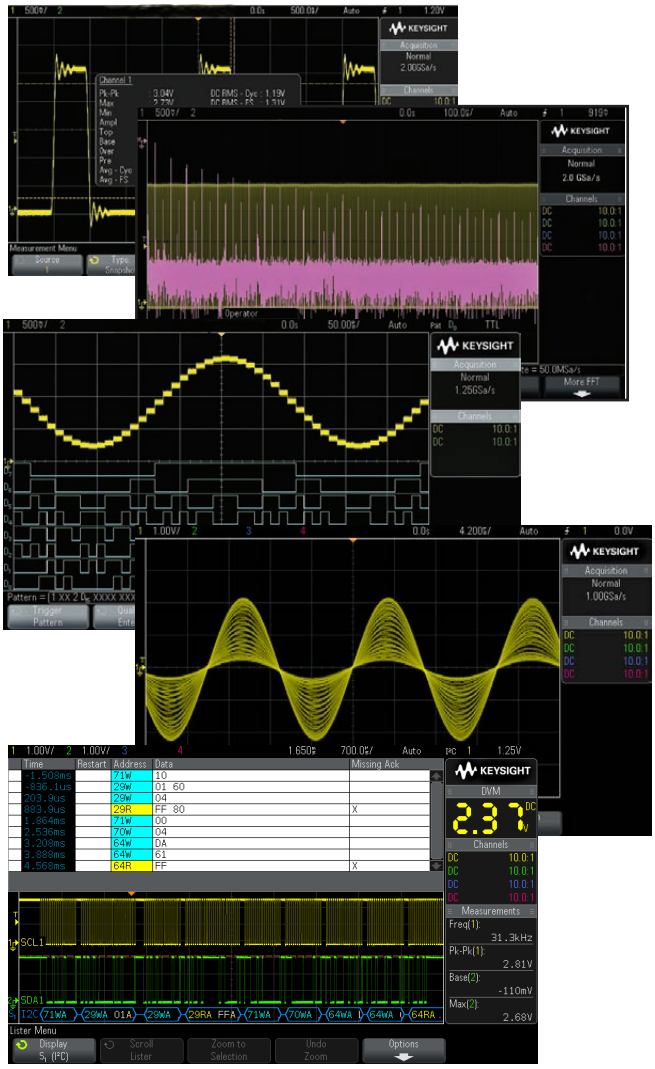
Industry's first WaveGen built-in 20 MHz function generator with a modulation capability

An industry first, the 2000 X-Series offers an integrated 20 MHz function generator, now available with the signal modulation capability. Ideal for educational or design labs where bench space and budget are at a premium, the integrated function generator provides stimulus output of sine, square, ramp, pulse, DC and noise waveforms to your device under test. No need to buy a separate function generator when you can get one integrated in your new oscilloscope. Turn on WaveGen at any time by ordering the DSOX2WAVEGEN option and install the license yourself.

Hardware-based serial protocol decode and triggering

- Embedded serial triggering and analysis (I²C, SPI)
- Computer serial triggering and analysis (RS232/422/485/UART)
- Automotive and industrial serial triggering and analysis (CAN, LIN)

Keysight's InfiniiVision Series oscilloscopes are the industry's first scopes to use hardware-based serial protocol decoding. Other vendors' oscilloscopes use software post-processing techniques that slow down both waveform and decode update rate. That's especially true when using deep memory, which is often required to capture multiple packetized serial bus signals. Faster decoding with hardware-based technology enhances scope usability and, more importantly, the probability of capturing infrequent serial communication errors.



After capturing a serial bus communication, you can easily perform a search-and-navigation operation based on specific criteria of your interest. Note, the digital channels and serial protocol analysis cannot be used simultaneously.

Integrated digital voltmeter

An industry first, the 2000 X-Series offers an integrated 3-digit voltmeter (DVM) and 5-digit frequency counter inside the oscilloscopes. The voltmeter operates through the same probes as the oscilloscope channels, however, the measurements are de-coupled from the oscilloscope triggering system so that both the DVM and triggered oscilloscope measurements can be made with the same connection. The voltmeter results are always displayed, keeping these quick characterization measurements at your fingertips. The DVM is included standard on all InfiniiVision oscilloscopes.

Get More Investment Protection with the Industry's Only Fully Upgradable Oscilloscope

Upgradability

Project needs change, but traditional oscilloscopes are fixed – you get what you pay for at the time of purchase. With the 2000 X-Series, your investment is protected. If you need more bandwidth (up to 200 MHz), digital channels, WaveGen, or serial decodes in the future, you can easily add them all after the fact.

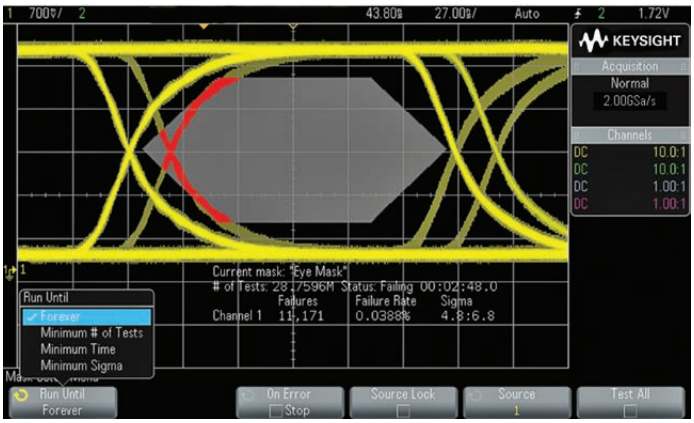
See page 21 for more information on upgradable products.

Add at the time of your purchase or upgrade later:

- Bandwidth
- Digital channels (MSO)
- Memory
- WaveGen built-in 20 MHz function generator
- Integrated digital voltmeter (DVM)
- Serial protocol analysis
- Mask testing

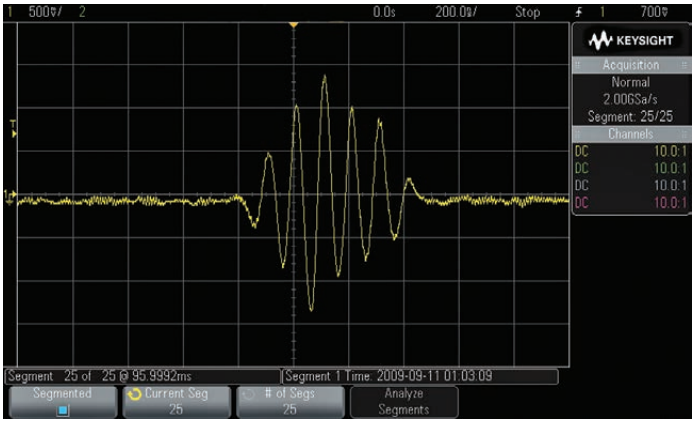
Mask testing

Whether performing pass/fail tests to specified standards in manufacturing or testing for infrequent signal anomalies in R&D debug, the mask test option can be a valuable productivity tool. The 2000 X-Series features hardware-based mask testing and can perform up to 200,000 tests per second.



Segmented memory

When capturing low-duty cycle pulses or data bursts, you can use segmented memory acquisition to optimize acquisition memory. Segmented memory acquisition lets you selectively capture and store important segments of signals without capturing unimportant signal idle/dead-time. Segmented memory acquisition is ideal for applications including packetized serial pulses, pulsed laser, radar bursts and high-energy physics experiments. Up to 250 segments can be captured on the 2000 X-Series models with a minimum re-arm time under 5 µs.



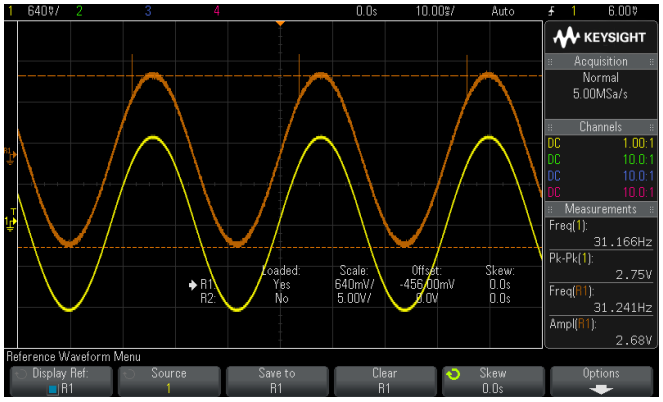
30-day trial license

The 2000 X-Series comes with a one-time 30-day all-optional-features trial license. You can choose to start the 30-day trial at any time. In addition you can redeem individual optional feature 30-day trial licenses at any time by visiting **www.keysight.com/find/30daytrial**. This enables you to receive in effect 60 days of trial license of each optional feature.

Other Productivity Tools

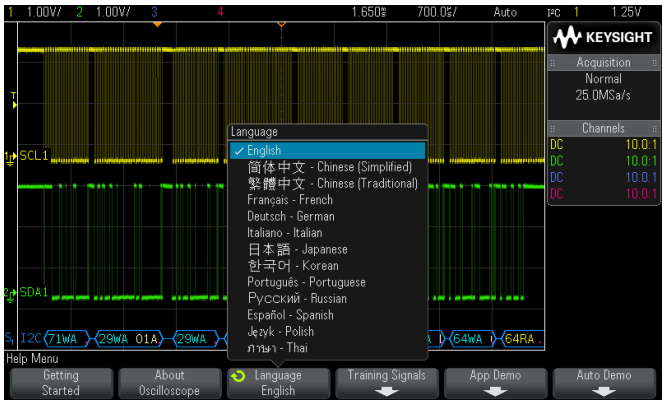
Reference waveforms

Store up to two waveforms in the scope's non-volatile reference waveform memory locations. Compare these reference waveforms with live waveforms, and perform post analysis and measurements of stored data. You can also store waveform data on a removable USB memory device that can be recalled back into one of the available two reference memories of the scope for full waveform measurement and analysis. Save and/or transfer waveforms as XY data pairs in a comma-separated values format (*.csv) for PC analysis. Save screen images to a PC for documentation purposes in a variety of formats including: 8-bit bitmaps (*.bmp), 24-bit bitmaps (*.bmp), and PNG 24-bit images (*.png).



Localized GUI and help

Operate the scope 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 13 languages. Choose from: English, Japanese, simplified Chinese, traditional Chinese, Korean, German, French, Spanish, Russian, Portuguese, Thai, Polish and Italian. During operation, access the built-in help system just by pressing and holding any button.



Probe solutions

Get the most out of your 2000 X-Series scope, by using the right probes and accessories for your application. Keysight offers a complete family of innovative probes and accessories for the InfiniiVision 2000 X-Series scopes. For the most up-to-date and complete information about Keysight's probes and accessories, please visit our Web site at **www.keysight.com/find/scope_probes**.

Autoscale

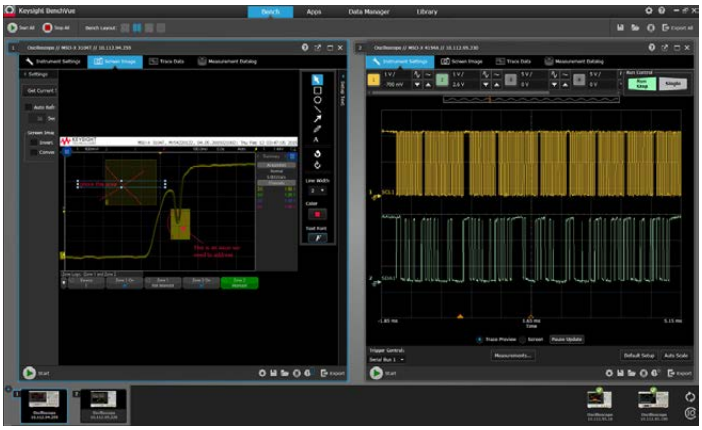
Quickly display any active signals and automatically set the vertical, horizontal and trigger controls for optimal viewing with the press of the autoscale button. (This feature can be disabled or enabled for the education environment via a USB thumb drive file with a SCPI remote comand).

Other Productivity Tools (Continued)

Connectivity and LXI compatibility

Built-in USB host (one front, one back) and USB device ports make PC connectivity easy. Operate the scope from your PC and save and recall stored waveforms as well as set-up files via LAN. An optional LAN/VGA module gives you network connectivity and complete LXI class C support as well as the ability to connect to an external monitor. An optional GPIB module is also available. Only one module may be used at a time.

BenchVue Software with the BV0004B BenchVue Oscilloscope app lets you control and visualize the 2000 X-Series and multiple measurements simultaneously. Build automated test sequences just as easy as using your front panel. Save time with the ability to export measurement data to Excel, Word and MATLAB in three clicks. Monitor and control your 2000 X-Series with a mobile device from anywhere. Simplify your testing with BenchVue software. Learn more at **www.keysight.com/find/BenchVue**.



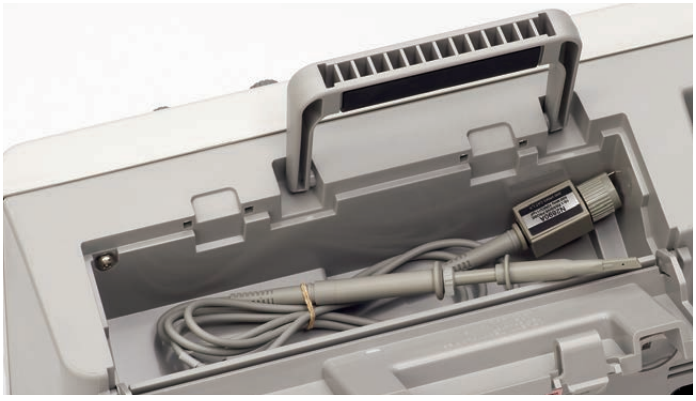
View Scope enables simple and free time-correlated me asurements between a 2000 X-Series oscilloscope and a Keysight 16900 or 16800 Series logic analyzer.

Virtual front panel

In addition to the traditional VNC virtual front panel remote operation through your favorite PC Web browser, the InfiniiVision X-Series supports remote oscilloscope control from your tablet devices. The tablet virtual front panel looks and acts as the real front panel on the oscilloscope. Control the setting, save/recall data, get image, and more.

Secure erase

The secure erase feature comes standard with all InfiniiVision X-Series models. At the press of a button, internal nonvolatile 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.



Other Productivity Tools (Continued)

Infiniium Offline oscilloscope analysis software (N8900A)

Keysight's Infiniium Offline PC-based analysis oscilloscope software allows you to do additional signal viewing, analysis and documentation tasks away from your scope. Capture waveforms on your scope, 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

- Pan and zoom to anywhere in the data record. Navigate in time, or between bookmarks.

View

- Up to 8 waveforms simultaneously, 1, 2, or 4 grids (stacked, side by side, custom layout, zoom)

Measurements

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

Analyze

- 20 math operators including FFT and filters
- Up to four independent/cascaded math functions
- Measurement histogram

View windows

- Analog, math, spectral, measurement results (simultaneous, tabbed, or undocked)

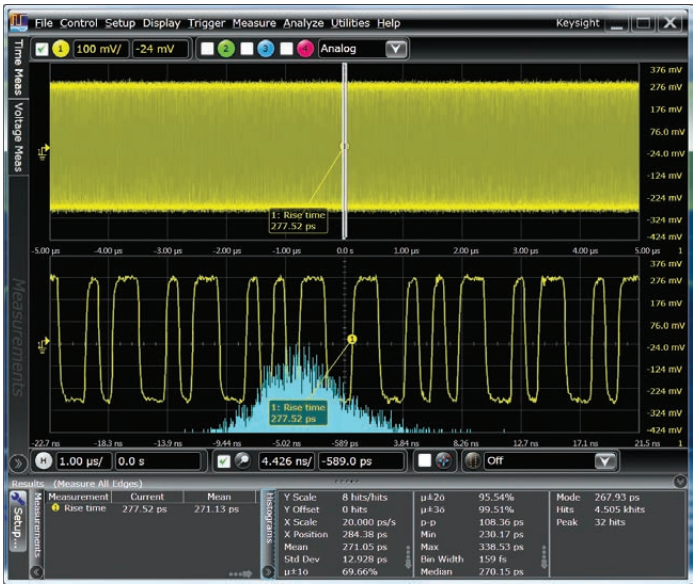
Documentation

- Right-click to copy
- Up to 100 bookmarks
- Annotated axis values
- Markers with dynamic delta value updates when moved
- One step save/load setup and all waveforms

Analysis upgrades (optional)

- Protocol decode for I2C/SPI, RS232/UART, CAN/ LIN/ FlexRay, SATA, 8B/10B, digRF v4, JTAG, MIPI® D-PHY℠, SVID, Ethernet 10G KR, PCIe 1, 2, 3, USB 2, 3, HSIC
- Jitter analysis
- Serial data analysis

View and analyze away from your scope and target system



Use familiar scope controls to quickly navigate and zoom in to any event of interest.

Add bookmarks and call outs to produce friendly and useful documentation.

Designed With Education In Mind

Quickly and easily set up or upgrade a teaching lab

Teach your students what an oscilloscope is and how to perform basic measurements with the Educator's Oscilloscope Training Kit. It 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 the undergraduate student, and an oscilloscope fundamentals PowerPoint slide set for professors and lab assistants. For more information, refer to **www.keysight.com/find/EDK**. Also available are DreamCatcher's full semester application-specific courseware written around Keysight test and measurement equipment: www.dreamcatcher.asia/cw. With features such as the ability to disable autoscale and the 50-Ω input data path, the InfiniiVision X-Series is a perfect choice for education.

Get your students to quickly put the scope to work

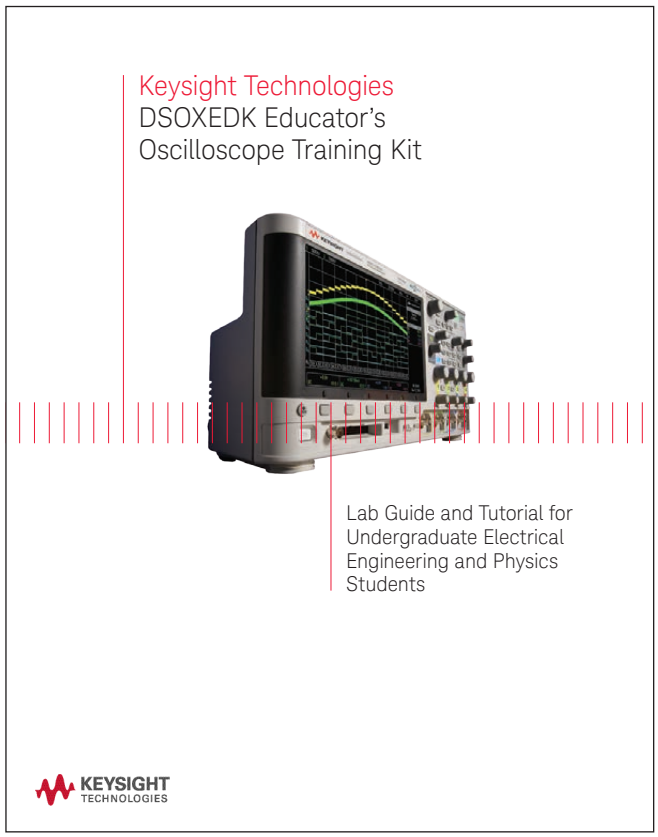
Intuitive localized front panel design with pushable knobs for quick access to commonly used oscilloscope functions helps students spend more time learning the concepts and less time learning how to use the oscilloscope. Enable your students to answer their own questions with the localized built-in help system that provides quick access by simply pressing and holding any button.

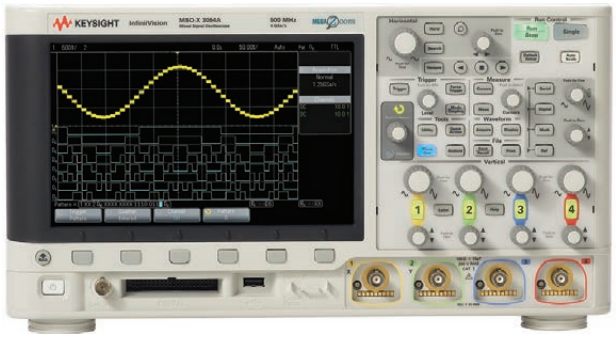
Stretch your budget over the long term

Save money with an industry-exclusive built-in 20 MHz WaveGen, instead of a separate function generator. Buy what you need today and protect your investment in the future with the only oscilloscopes in this class with upgradable bandwidth, 8 digital channels (MSO), WaveGen, integrated digital voltmeter and measurement applications. Get long scope life and keep repair costs to a minimum, and an instrument reliability you've come to expect from the leader in test and measurement equipment.

Optimize lab bench space

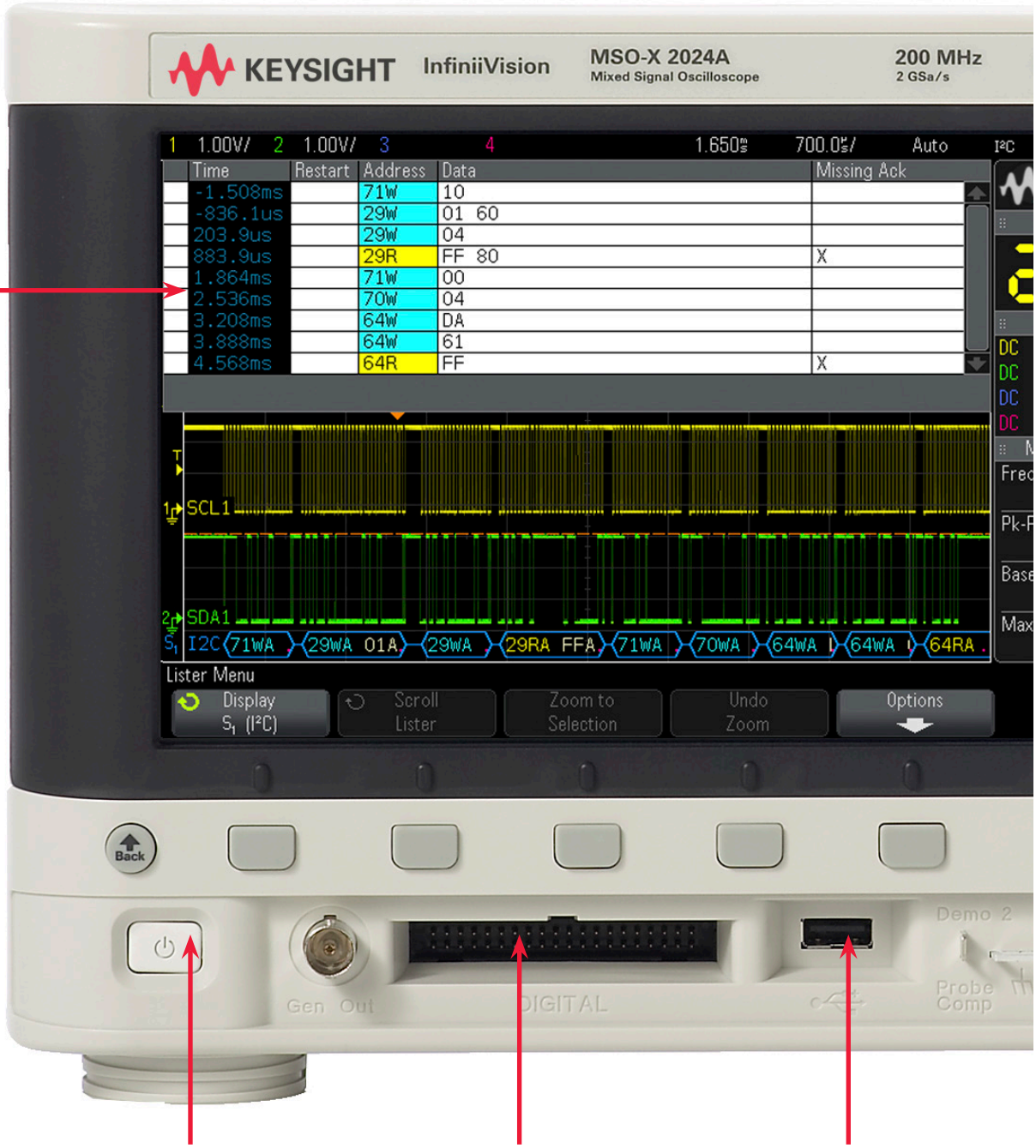
With 5 instruments in 1, you will save on precious lab bench space by getting an oscilloscope, logic timing analyzer, serial protocol analyzer, WaveGen function generator and integrated digital voltmeter all in one innovative instrument with a footprint that is only 5.57 inches deep. With the large 8.5-inch WVGA display, you can easily view all signals on one screen with enough viewing area for more than one student to view.





Oscilloscope Shown Actual Size

8.5-inch high resolution wide screen display reveals subtle details that most scopes don't show you



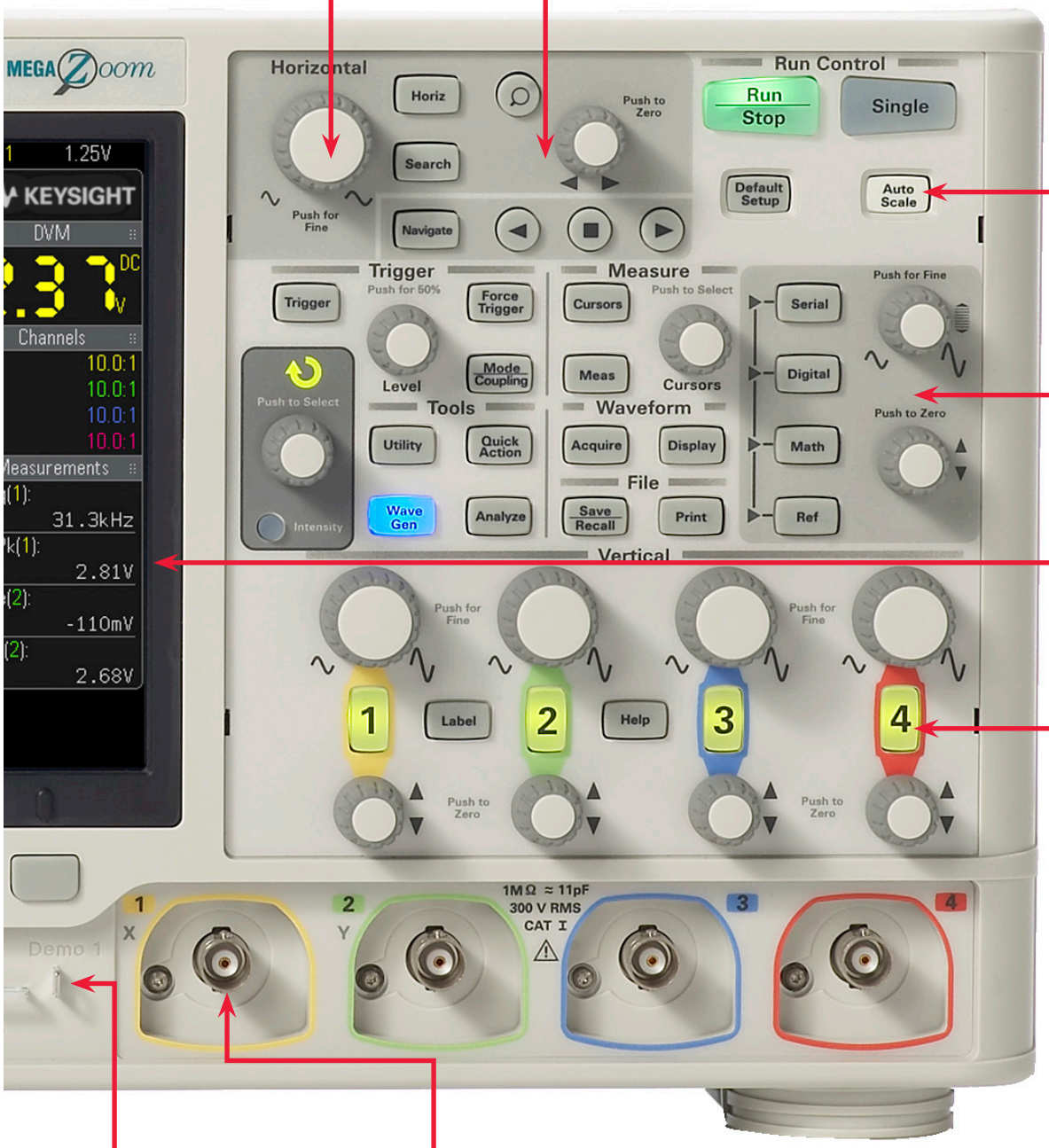
WaveGen – Industry first built-in function generator

Get up to eight integrated digital channels

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

Navigation front panel controls make it easy to play, stop, rewind and fast forward through waveforms

Quickly pan and zoom for analysis with ***MegaZoom*** IV's instant response and optimum resolution



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

Dedicated keys for quick access to digital channels, serial analysis, math functions and reference waveforms

Quick summary display of sample rate, channel settings and measurements

All front panel knobs are pushable

Demo and training signals

Integrated digital voltmeter

Configuring Your InfiniiVision X-Series Oscilloscope

Step 1. Choose your bandwidth and channel count

InfiniiVision 2000 X-Series scopes							
		2002A	2004A	2012A	2014A	2022A	2024A
Bandwidth [1] (–3 dB)		70 MHz		100 MHz		200 MHz	
Calculated rise time (10 to 90%)		≤ 5 ns		≤ 3.5 ns		≤ 1.75 ns	
Input channels	DSOX	2	4	2	4	2	4
	MSOX	2 + 8	4 + 8	2 + 8	4 + 8	2 + 8	4 + 8

Step 2. Tailor your scope with measurement applications to save time and money [2]

Application	2000 X-Series
Embedded serial triggering and analysis (I²C, SPI)	DSOX2EMBD (-LSS) [3]
Computer serial triggering and analysis (RS232/422/485/UART)	DSOX2COMP (-232) [3]
Automotive serial triggering and analysis (CAN, LIN)	DSOX2AUTO (-AMS) [3]
WaveGen (built-in function generator)	DSOX2WAVEGEN (-001)
Mask testing	DSOX2MASK (-LMT)
InfiniiView oscilloscope analysis software	N8900A
1 Megapoint memory upgrade	DSOX2PLUS (-010) [5]
Segmented memory	DSOX2PLUS (-SGM) [5]
Application bundle	DSOX2APPBNDL (includes DSOX2EMBD, DSOX2COMP, DSOX2AUTO, DSOX2WAVEGEN, DSOX2MASK, DSOX2SGM, DSOX2MEMUP)
Enhancement suite	DSOX2PLUS (includes DSOX2MEMUP, DSOX2SGM, and more, see footnote for details)

Step 3. Choose your probes [4]

Probes		2000 X-Series
N2841A	150 MHz 10:1 passive probe	Standard one per channel for 70 and 100 MHz models
N2842A	300 MHz, 10:1 passive probe	Standard one per channel for 200 MHz models
N2755A	8-channel logic probe and accessory kit	Standard on MSO models or with DSOX2MSO upgrade
N2889A	350 MHz 10:1/1:1 passive probe	Optional
10070D	20 MHz 1:1 passive probe with probe ID	Optional
10076A	250 MHz 100:1, 4 kV high-voltage passive probe with probe ID	Optional
N2791A	25 MHz, ± 700 V high-voltage differential probe	Optional
1146A	1146A 100 kHz, 100 A, AC/DC current probe	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

1. For example, if you chose 100 MHz, 2+8 channels, the model number will be MSOX2012A.
2. See pages 20 to 21 for more detailed information on upgradability, and installation process.
3. Serial trigger and decode application will not run simultaneously with digital channels.
4. See page 20 for probe compatibilty table. For more information on probes and accessories, see the Keysight literature 5968-8153EN.
5. Oscilloscopes purchased after March 5, 2018 have DSOX2MEMUP and DSOX2SGM standard. Users wishing to upgrade a scope purchased before that date should consider DSOX2PLUS.

Step 4. Add the final touches

Recommended accessories	2000 X-Series
LAN/VGA connection module	DSOXLAN
GPIB connection module	DSOXGPIB
Rack mount kit	N6456A
Soft carrying case and front panel cover	N6457A
Hard copy manual	N6458A
Front panel cover (only)	N2747A
ANSI Z540-1-1994 Calibration	MSOX or DSOX2000-A6J
BenchVue Oscilloscope application	BV0004B
User-defined Application (UDA) software	N5467B/C

Performance Characteristics

Specification overview							
		2002A	2004A	2012A	2014A	2022A	2024A
Bandwidth [1] (–3 dB)		70 MHz		100 MHz		200 MHz	
Calculated rise time (10 to 90%)		≤ 5 ns		≤ 3.5 ns		≤ 1.75 ns	
Input channels	DSOX	2	4	2	4	2	4
	MSOX	2 + 8	4 + 8	2 + 8	4 + 8	2 + 8	4 + 8
Maximum sample rate [1]		2 GSa/s half-channel interleaved, 1 GSa/s per channel					
Maximum memory depth		1 Mpt per channel (standard)					
Display size and type		8.5-inch WVGA with 64 levels of intensity grading					
Waveform update rate		200,000 waveforms per second					
Vertical system analog channels							
Input coupling		AC, DC					
Input sensitivity range		1 mV/div to 5 V/div [2]					
Input impedance		1 MΩ ± 2% (11 pF)					
Vertical resolution		8 bits (measurement resolution is 12 bits with averaging)					
Dynamic range		± 8 divisions from center screen					
Maximum input voltage		135 Vrms; 190 Vpk					
		Probing technology allows testing of higher voltages. For example, the included N2841A or N2842A 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					
DC vertical accuracy		± [DC vertical gain accuracy + DC vertical offset accuracy + 0.25% full scale] [2]					
DC vertical gain accuracy [1]		± 3% full scale (≥ 10 mV/div); ± 4% full scale (< 10 mV/div) [2]					
DC vertical offset accuracy		± 0.1 div ± 2mV ± 1% of offset setting					
Channel-to-channel isolation		≥ 40 dB from DC to maximum specified bandwidth of each model					
Position/offset range	1 MΩ	1 mV to 200 mV/div: ± 2 V, > 200 mV to 5 V/div: ± 50 V					
Hardware bandwidth limits		Approximately 20 MHz (selectable)					
Horizontal system analog channels							
		2002A	2004A	2012A	2014A	2022A	2024A
Time base range		5 ns/div to 50 s/div				2 ns/div to 50 s/div	
Time base accuracy [1]		25 ppm ± 5 ppm per year (aging)					
Time base delay time range	Pre-trigger	Greater of 1 screen width or 200 µs (400 µs in interleaving mode)					
	Post-trigger	1 s to 500 s					
Channel-to-channel deskew range		± 100 ns					
Δ Time accuracy (using cursors)		± (time base accuracy [1] reading) ± (0.0016 [1] screen width) ± 100 ps					

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

Performance Characteristics (Continued)

Acquisition modes	
Normal	
Peak detect	Capture glitch as narrow as 500 ps at all timebase settings
Averaging	Select from 2, 4, 8, 16, 64... to 65,536
High resolution mode	12 bits of resolution when ≥ 20 µs/div
Segmented	Re-arm time= 19 µs (minimum time between trigger events)
Trigger system	
Trigger modes	– Normal (triggered): Requires trigger event for scope to trigger – Auto: Triggers automatically in absence of trigger event – Single: Triggers only once on a trigger event, press [Single] again for scope to find another trigger event, or press [Run] to trigger continuously in either Auto or Normal mode – Force: Front panel button that forces a trigger
Trigger coupling	Coupling selections: AC, DC, noise reject, LF reject and HF reject
Trigger source	Each analog channel, each digital channel (MSO models or DSOX2MSO upgrade, Ext, WaveGen, line)
Trigger sensitivity (internal) [1]	< 10 mV/div: greater of 1 div or 5 mV; ≥ 10 mV/div: 0.6 div
Trigger sensitivity (external) [1]	200 mV (DC to 100 MHz); 350 mV (100 to 200 MHz)
External trigger input	Included on all models
Trigger type selections	
	All 2000 X-Series models
Edge	Trigger on a rising, falling, alternating or either edge of any source
Edge then edge (B trigger)	Arm on a selected edge, wait a specified time, then trigger on a specified count of another selected edge
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 to 10 ns (depends on bandwidth) – Maximum duration setting: 10 s
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.
Video	Trigger on all lines or individual lines, odd/even or all fields from composite video, or broadcast standards (NTSC, PAL, SECAM, PAM-M)
Runt Trigger	on a position 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 6~10 ns (depending on bandwidth) and maximum timesetting of 10 s.
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 3-5 ns (depending on bandwidth) and 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. 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: 6-10 ns (depending on bandwidth) and 10 s Or: Trigger on any selected edge across multiple analog or digital channels
I²C (optional)	Trigger on I²C (Inter-IC bus) serial protocol at a start/stop condition or user defined frame with address and/or data values. Also trigger on missing acknowledge, address with no accq, restart, EEPROM read, and 10-bit write.
SPI (optional)	Trigger on SPI (Serial Peripherial Interface) data pattern during a specific framing period. Supports positive and negative Chip Select framing as well as clock Idle framing and userspecified number of bits per frame.
CAN (optional)	Trigger on CAN (controller area network) version 2.0A and 2.0B signals. Trigger on the start of frame (SOF) bit (standard). Remote frame ID (RTR), data frame ID (~RTR), remote or data frame ID, data frame ID and data, error frame, all errors, acknowledge error and overload frame.
LIN (optional)	Trigger on LIN (Local Interconnect Network) sync break, sync frame ID, or frame ID and data
RS232/422/485/UART (optional)	Trigger on Rx or Tx start bit, stop bit or data content

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

Performance Characteristics (Continued)

Cursors	
Types	Amplitude, time , frequency (FFT), manual, tracking, binary, HEX
Measurements	ΔT, 1/ΔT, ΔV/X, 1/ΔX, ΔY, Phase and Ratio
Cursors [2]	– Single cursor accuracy: ± [DC vertical gain accuracy + DC vertical offset accuracy + 0.25% full scale] – Dual cursor accuracy: ± [DC vertical gain accuracy + 0.5% full scale] [1]
Automatic waveforms measurements	
Voltage	Snapshot all, maximum, minimum, peak-to-peak, top, base, amplitude, overshoot, preshoot, average- N cycles, average-full screen, DC RMS- N cycles, DC RMS- full screen, AC RMS- N cycles, AC RMS- full screen (std dev)
Time	Period, frequency, rise time, fall time, + width, – width, duty cycle, delay A→B (rising edge), delay A→B (falling edge), phase A→B (rising edge,) and phase A→B (falling edge), bit rate
Waveform math	
Operators	Add, subtract, multiply, divide, FFT, Ax + B, Square, Absolute, Common Log, Natural Log, Exponential, Base 10 Exponential, LP Filter, HP Filter, Magnify, Measurement Trend, Chart Logic Bus (Timing or State)
FFT	Windows: Hanning, flat top, rectangular; Blackman-Harris - up to 64 kpts resolution
Sources	Math functions available between any two channels
Display characteristics	
Display	8.5-inch WVGA color TFT LCD
Resolution	800 (H) x 480 (V) pixel format (screen area)
Interpolation	Sin(x)/x interpolation (using FIR filter; used when there is less than one sample per column of the display)
Persistence	Off, infinite, variable persistence (100 ms to 60 s)
Intensity gradation	64 intensity levels
Modes	Normal XY - XY mode changes the display from voltage versus time scale to a volts versus volts scale Roll – Displays the waveform moving across the screen from right to left much like a strip chart recorder
MSO (digital channels)	
Upgradable from DSO	Yes
MSO channels	8 channels (D0 to D7)
Maximum sample rate	1 GSa/s
Maximum record length	500 kpts per channel (digital channels only) 125 kpts per channel (analog and digital channels)
Threshold selections	TTL (+1.4 V), CMOS (+2.5 V), ECL (–1.3 V), User-definable (± 8.0 V in 10 mV stops)
Threshold accuracy [1]	± (100 mV + 3% of threshold settings)
Maximum input voltage	± 40 V peak CAT I
Maximum input dynamic range	± 10 V about threshold
Minimum voltage swing	500 mVpp
Input impedance	100 kΩ ± 2% at probe tip, ~8 pF
Minimum detectable pulse width	5 ns
Channel-to-channel skew	2 ns (typical), 3 ns (maximum)

1. Denotes warranted specifications, all others are typical. Specifications are valid after a 30-minute warm-up period and from ± 10 °C 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 2 mV/div sensitivity setting.

Performance Characteristics (Continued)

WaveGen – built-in function generator (Specifications are typical)	
Waveforms	Sine, square, pulse, triangle, ramp, noise, DC
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 10 MHz – Duty cycle: 20 to 80% – Duty cycle resolution: Larger of 1% or 10 ns – Pulse width: 20 ns minimum – Pulse width resolution: 10 ns or 5 digits, whichever is larger – Rise/fall time: 18 ns (10 to 90%) – Overshoot: < 2% – Asymmetry (at 50% DC): ± 1% ± 5 ns – Jitter (TIE RMS): 500 ps
Ramp/triangle wave	– Frequency range: 0.1 Hz to 100 kHz – Linearity: 1% – Variable symmetry: 0 to 100% – Symmetry resolution: 1%
Noise	Bandwidth: 20 MHz typical

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:
	  – 20 mVpp to 5 Vpp into Hi-Z
	  – 10 mVpp to 2.5 Vpp into 50 Ω
	– Resolution: 100 µV or 3 digits, whichever is larger
	– Accuracy: 2% (frequency = 1 kHz)

DC offset	– Range:
	  – ± 2.5 V into Hi-Z
	  – ± 1.25 V into 50 ohms
	– Resolution: 100 µV or 3 digits, whichever is larger
	– Accuracy: ± 1.5% of offset setting ± 1.5% of amplitude ± 1 mV

Trigger output	Trigger output available on Trig out BNC

Performance Characteristics (Continued)

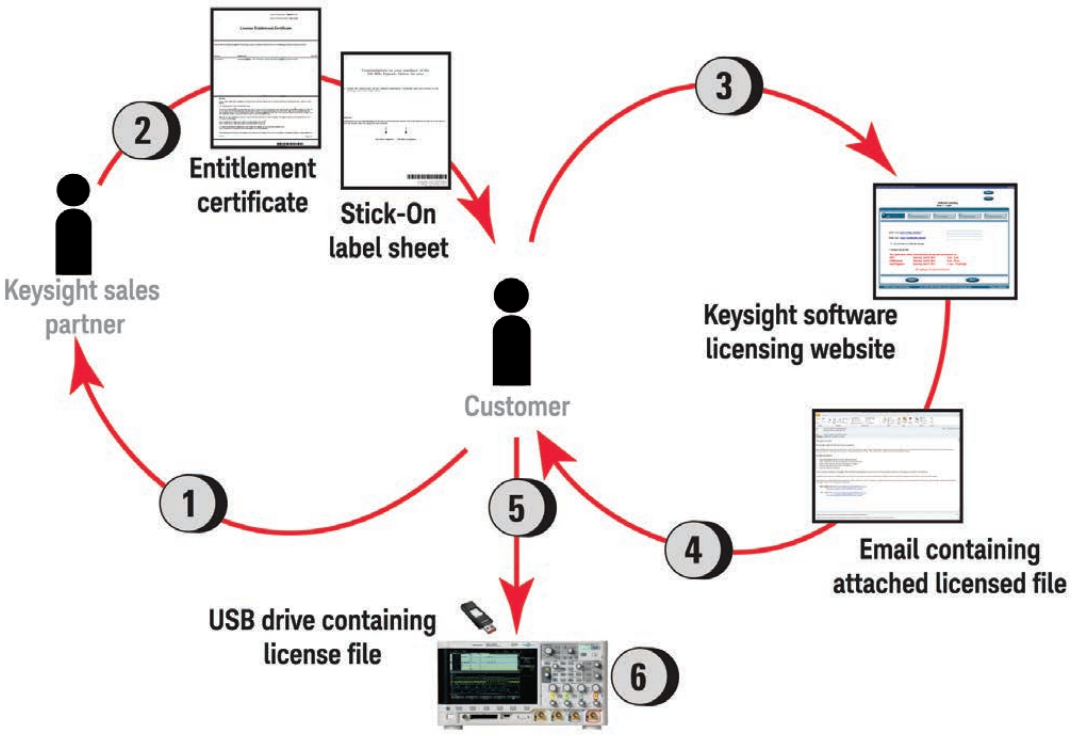
WaveGen – built-in function generator (Specifications are typical) (Continued)	
Modulation	Modulation types: AM, FM, FSK Carrier waveforms: Ssine, ramp Modulation source: Internal (no external modulation capability) AM: Modulation waveform: Sine, square, ramp Modulation frequency (1 Hz to 20 kHz) Depth: 0 to 100% FM: Modulation: Sine, square, ramp (1 Hz to 20 kHz) Modulation frequency (1 Hz to 20 kHz) Minimum carrier frequency: 10 kHz Minimum deviation: 1 Hz Maximum deviation: 100 kHz or (carrier frequency - 9 kHz), whichever is smaller FSK: Modulation: 50% duty cycle square wave FSK rate: 1 Hz to 20 kHz Minimum carrier frequency: 10 kHz Minimum hop frequency: 2 x FSK rate to 10 MHz
Integrated digital voltmeter (Specifications are typical)	
Functions	ACrms, DC, DCrms, frequency
Resolution	ACV/DCV: 3 digits 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
Measurement range (Specifications are typical)	
	Frequency range
ACRms	20 Hz to 100 kHz
DCRms	20 Hz to 100 kHz
DC	NA
Frequency counter	1 Hz – BW of Scope

InfiniiVision X-Series Physical Characteristics

Connectivity	
Standard ports	One USB 2.0 hi-speed device port on rear panel. Supports USBTMC protocol Two USB 2.0 hi-speed host ports, front and rear panel Supports memory devices, printers and keyboards
Optional ports	GPIB, LAN, WVGA video out
General and environmental characteristics	
Power line consumption	100 W
Power voltage range	100 to 120 V, 50/60/400 Hz; 100 to 240 V, 50/60 Hz ± 10%
Environmental rating	5 to 55 °C, 4000 m max Maximum Relative Humidity (non-condensing): 95%RH up to 40 °C, decreases linearly to 45%RH at 55 °C From 40 °C to 55 °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
Dimensions (W x H x D)	381 mm (15 in) x 204 mm (8 in) x 142 mm (5.6 in)
Weight	Net: 3.9 kg (8.5 lbs), shipping: 4.1 kg (9.0 lbs)
Nonvolatile storage	
Reference waveform display	2 internal waveforms or USB thumb drive
Waveform storage	Set up, .bmp, .png, .csv, ASCII, XY, reference waveforms, .alb, .bin, lister, mask, HDFS
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	
Standard secure erase	
Standard probe	
– N2841A 150 MHz 10:1 passive probe	Standard one per channel for 70 and 100 MHz models
– N2842A 300 MHz, 10:1 passive probe	Standard one per channel for 200 MHz models
– N2755A 8-channel logic probe and accessory kit	Standard on MSO models or with DSOX2MSO upgrade
Built-in help language support for English, Japanese, simplified Chinese, traditional Chinese, Korean, German, French, Spanish, Russian, Portuguese and Italian, Certificate of Calibration, Documentation CD	
Interface language support GUI menus: English, Japanese, simplified Chinese, traditional Chinese, Korean, German, French, Spanish, Russian, Portuguese, Thai, Polish and Italian	
Localized power cord	

For MET/CAL procedures, click on the Cal Labs solutions link below Cal Labs Solutions **http://www.callabsolutions.com/products/Keysight/**.
These procedures are FREE to customers.

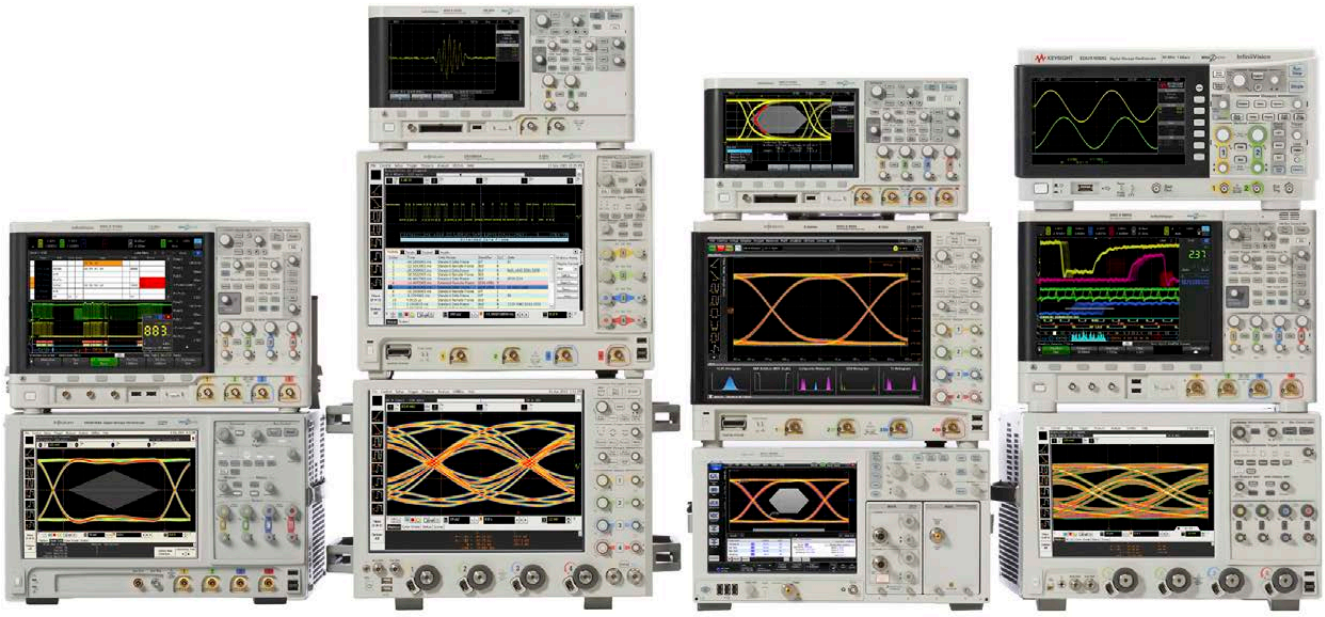
License-only Bandwidth Upgrades And Measurement Applications



Bandwidth upgrade models	
2000 X-Series	
DSOX2BW12	70 to 100 MHz, 2 ch, License only
DSOX2BW14	70 to 100 MHz, 4 ch, License only
DSOX2BW22	100 to 200 MHz, 2 ch, License only
DSOX2BW24	100 to 200 MHz, 4 ch, License only

Measurement applications	
DSOX2PLUS	Performance enhancements for any 2000 X-Series purchased before March 5th, 2018
DSOX2MEMUP	Upgrade to 1 Mpts/ch (replaced by DSOX2PLUS)
DSOX2COMP	Computer serial triggering and analysis (RS232/422/485/UART)
DSOX2AUTO	Automotive serial triggering and analysis (CAN, LIN)
DSOX2EMBD	Embedded serial triggering and analysis (I^2C, SPI)
DSOX2WAVEGEN	WaveGen (built-in function generator)
DSOX2MASK	Mask testing
DSOX2SGM	Segmented memory (replaced by DSOX2PLUS)
DSOX2MSO	Upgrade to 8 digital timing channels

Process description	
1	Place order for a license only bandwidth upgrade or measurement appliction product to a Keysight sales partner. If multiple bandwidth upgrade steps are needed, order all the corresponding upgrade products required to get from current bandwidth to desired bandwidth. In the case where the new bandwidth requires higher bandwidth passive probes, they are included with the upgrade. For the DSOX2BW22 and DSOX2BW24, the N2842A 10:1 300 MHz passive probes (1 per channel) will be sent with the upgrade.
2	Receive a paper or electronic .pdf Entitlement Certificate document for any of the orderable measurement applications For bandwidth upgrades only, you receive a stick-on label document indicating upgraded bandwidth specification.
3	Use Entitlement Certificate or electronic .pdf document containing instructions and certificate number needed to generate a license file for a particular 2000 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.



Keysight Oscilloscopes

Multiple form factors from 20 MHz to > 90 GHz | Industry leading specs | Powerful applications

www.axiestandard.org

AdvancedTCA® Extensions for Instrumentation and Test (AXIe) is an open standard that extends the AdvancedTCA for general purpose and semiconductor test. The business that became Keysight was a founding member of the AXIe consortium. ATCA®, AdvancedTCA®, and the ATCA logo are registered US trademarks of the PCI Industrial Computer Manufacturers Group.

www.lxistandard.org

LAN eXtensions for Instruments puts the power of Ethernet and the Web inside your test systems. The business that became Keysight was a founding member of the LXI consortium.

www.pxisa.org

PCI eXtensions for Instrumentation (PXI) modular instrumentation delivers a rugged, PC-based high-performance measurement and automation system.

Download your next insight

Keysight software is downloadable expertise. From first simulation through first customer shipment, we deliver the tools your team needs to accelerate from data to information to actionable insight.

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www.keysight.com/find/contactus

KEYSIGHT TECHNOLOGIES

Keysight Technologies
Streamline Series
P924xA USB Oscilloscopes

Compact InfiniiVision 1 GHz Oscilloscope Technology

Data Sheet

Compact Form. Zero compromise.

Keysight is taking USB instrumentation to a whole new level

Keysight Streamline Series USB oscilloscopes
- P9241A USB oscilloscope – 200 MHz bandwidth
- P9242A USB oscilloscope – 500 MHz bandwidth
- P9243A USB oscilloscope – 1 GHz bandwidth

KEYSIGHT TECHNOLOGIES

Overview

The Keysight Streamline Series P924xA USB oscilloscopes bring the InfiniiVision usability and performance to USB oscilloscopes. Keysight Streamline Series USB oscilloscopes provide maximum investment protection and are built with technology that leverages decades of Keysight's high-performance oscilloscope expertise.

Performance
- 200 MHz, 500 MHz or 1 GHz bandwidths available to match your measurement application
- Advanced triggering enables capture and analysis of complex signals
- Visual triggers (zone touch and mask) make trigger and capture of signal errors quick and easy
- Serial protocol analysis and triggering for most common protocols
- Automated FFT and waveform math extend analysis to match your needs
- Segmented memory can analyze 1000 events without ever offloading to a PC

Measurement capability
- Support for a variety of probing solutions
  - Differential and single-ended active probes
  - High-voltage probes
- 30+ automated measurements provide simple-to-access analysis

Multiple instruments in one
- Oscilloscope support for up to 1 GHz bandwidth with 5 GSa/s
- DVM (Digital voltmeter) 3-digit using the same scope probes
- 8-digit counter for integrated totalizer/frequency counter measurements
- Protocol analyzer for I²C, UART, CAN, LIN, CXPI and more
- Spectrum analysis with FFT and channel power measurements
- 20-MHz arbitrary waveform generator

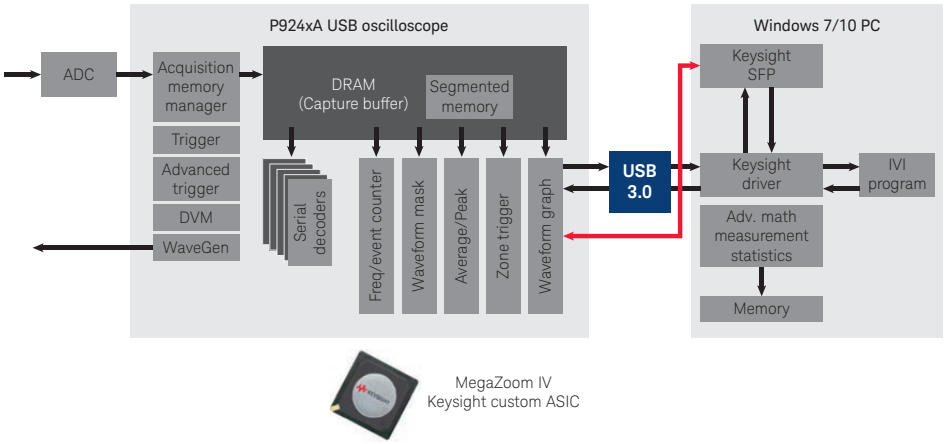
Capturing up to 1,000,000 waveforms/sec makes it easy to find anomalies like this glitch that occur very rarely.

www.keysight.com/find/usb-scope

Uncompromising Analysis Capability

Many USB users have been using digitizer hardware with software that simulates an oscilloscope for test and troubleshoot implementation. The limitations of this configuration are often overlooked, but they can cause signification problems. When a instrument says it has a high waveform update rate, people usually expect it to have a higher probability of catching random and infrequent glitches, but this isn't the case for those instruments. In addition, common measurements like waveform averaging and advanced waveform triggers are not available.

The Keysight Streamline Series USB oscilloscopes USB oscilloscopes require minimum support from a central processing unit (CPU), as most of their core operations are handled by the MegaZoom IV smart memory ASIC, which is Keysight proprietary technology. MegaZoom includes hardware serial decoders and hardware mask/limit testing capability; supports GUI operation; and integrates additional instruments like a WaveGen function/arbitrary waveform generator.

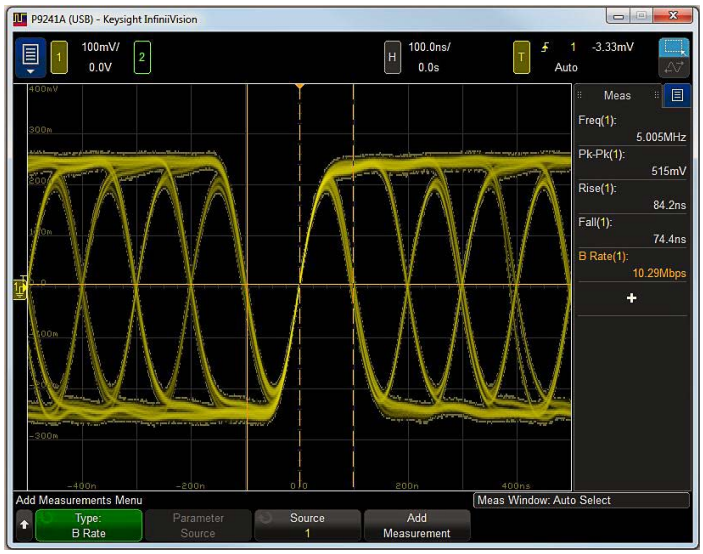


The P924xA USB oscilloscopes utilize hardware to perform many of the functions traditional digitizers do with software on the CPU. By doing more in hardware, P924xA Series oscilloscopes can analyze more of the signal than ever before.

Key to the oscilloscope operation is that the acquisition does the triggering and most of the analysis utilizing onboard hardware. For example, to accomplish 1million waveforms/sec, the waveforms are captured and plotted into hardware on the scope and then the waveform is transferred to the PC for display.

Industry-exclusive Zone Touch Trigger Makes Triggering Simple

Zone touch triggering eliminates the complexity of setting up advanced triggers. If you have a touch-enabled display on your controller, you can trigger on events by simply drawing a box with your finger on the display of the signal you want to isolate. Keysight pioneered the zone touch trigger, which allows easy capture of difficult-to-define trigger events.



Capturing a serial data stream using a simple edge trigger.

Zone Trigger enable quick and easy isolation of the data pattern of interest.

The P924xAs' high, uncompromised update rate increases your chance of seeing random and infrequent signal anomalies, and zone touch trigger helps you isolate the signals. Now your testing can be faster and more thorough.

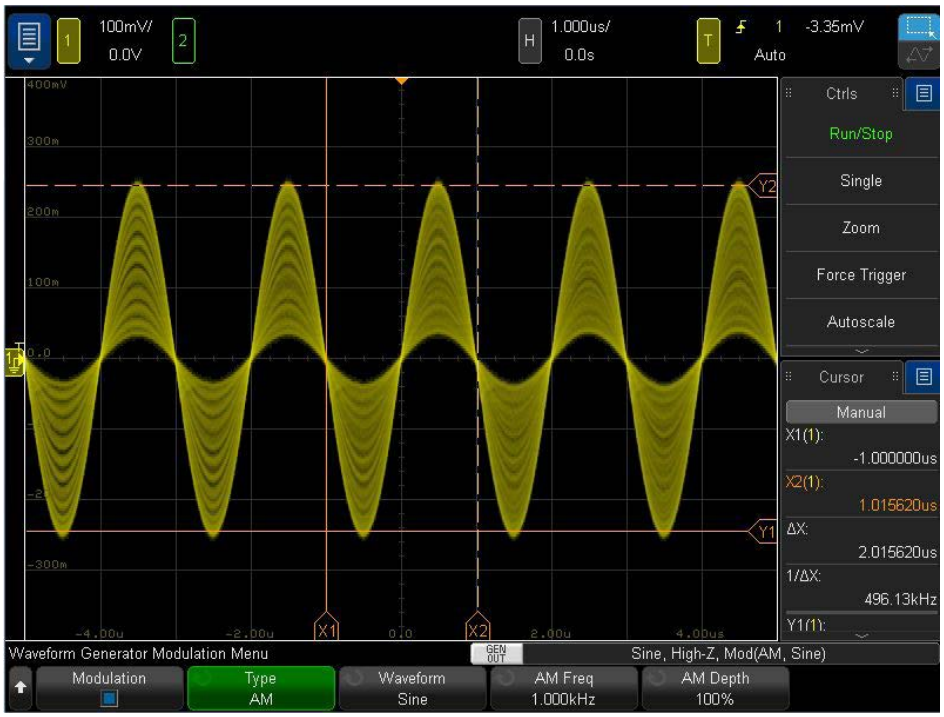
Other touch-based operation

Just like Keysight's touch-enabled InfiniiVision benchtop oscilloscopes (3000T, 4000 and 6000 X-Series), the P924xA Keysight Streamline Series USB oscilloscopes also uses touch capability to interact with signal display. In addition to zone touch trigger, these oscilloscopes also let you move the waveform up/down; adjust the time offset and zoom; and define one of the two touch zone triggers. All that is required is a touch-enabled display connected to your USB scope.

Additional Software for Added Functionality

P9240BDLA Application Bundle for Keysight USB oscilloscopes

Take advantage of a new oscilloscope application bundle that will enable ALL software applications (including Wavegen) on your Keysight USB oscilloscope for a huge discount over buying the options individually. See a complete list of applications in Step 2 of the configuration table. (page 10)



P9240AWGA WaveGen 20 MHz function/arbitrary waveform generator

The P924xA Streamline Series USB oscilloscopes offer a 20-MHz built-in function/arbitrary waveform generator. The WaveGen provides standard stimulus output waveforms to your device under test as well as user-definable frequencies, amplitudes, offset and pulse widths and arbitrary waveform capability. The WaveGen output is routed to a MMCX connector on the front panel of the oscilloscope.

Use the built-in waveform editor to create custom waveforms to output on the oscilloscope's WaveGen. It is also possible to capture a known good or 'golden' waveform on a scope channel and then save that to the ARB so you can generate it to stimulate your system under test.

P9240FRAA frequency response analyzer

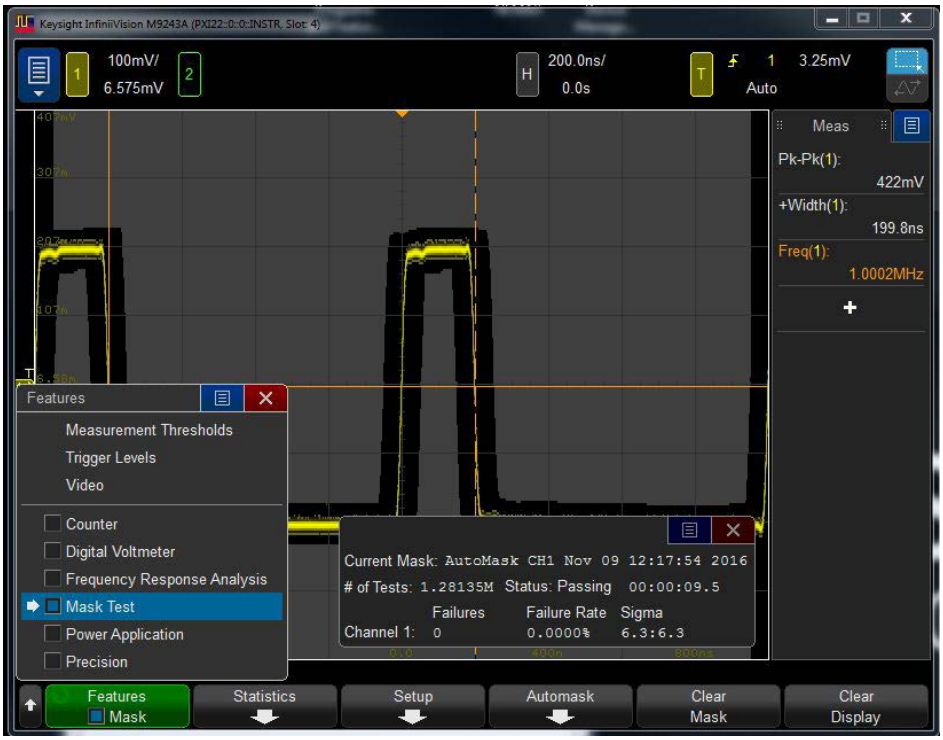
Frequency response analysis is a critical measurement to characterize the stability of feedback networks and switch-mode power supplies. This capability is achieved with a gain and phase measurement versus frequency (Bode plot). By using the waveform generator output to stimulate your design and probing the input and output signals on channels 1 and 2, the oscilloscope provides a clear report on the gain and phase operation of the system.

Additional Software for Added Functionality (Continued)

P9240MSKA mask limit testing

With the mask limit testing measurement application, you can quickly test more than 200,000 waveforms per second to a known good waveform with quick go/no-go test results, saving you valuable test time while providing you with more confidence in test results. Test your signals to specified standards, and uncover unexpected signal anomalies.

Mask testing on other oscilloscopes is usually based on software-intensive processing technology, which tends to be slow. Keysight's InfiniiVision oscilloscopes' mask test option is based on hardware-based technology. This means P924xA oscilloscopes can perform more than 200,000 real-time waveform pass/fail tests per second. This provides testing throughput that is orders of magnitude faster than what is available on other oscilloscope mask test solutions, making valid pass/fail statistics almost instantly.



P9240VIDA enhanced video/TV application package

The P924XA oscilloscopes support a video IRE display grid, as well as cursors measurements performed in video IRE units for the NTSC and PAL standards. This new capability is standard on P924xA oscilloscopes. The P9240VIDA software provides an array of additional HDTV triggering standards. The additional triggering options provided by the P9240VIDA software speed debug and characterization for engineers working on HDTV video applications.

Additional Software for Added Functionality (Continued)

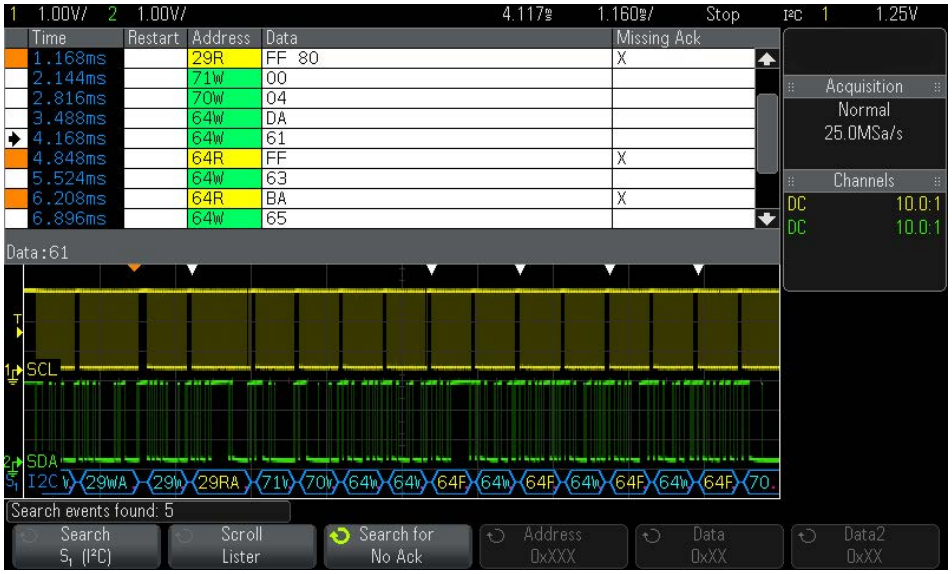
P9240NFCA NFC triggering

Testing NFC-enabled devices is essential during the design validation and manufacturing test phases to ensure quality and reliability of data transmission. This is especially important when you consider that the data being transferred/exchanged between NFC-enabled devices is often secured financial transactions. The P9240NFCA NFC trigger application enables easy configuration to capture the signals of interest for NFC-A, NFC-B and NFC-F messages.

Decodes

P9240EMBA embedded serial triggering and analysis (I²C)

The I²C serial decode software option for P924xA Streamline Series USB oscilloscopes displays responsive, time-aligned, on-screen decode of Inter-Integrated Circuit (I²C) serial communication. Because this capability is hardware-based, it provides the fastest throughput solution for triggering on and analyzing I²C serial buses found in a wide variety of embedded designs. You can easily isolate serial packets to find sources of errors due to hardware- or software-related problems. Sometimes it may be necessary to correlate data from one serial bus to another. Keysight's P924xA oscilloscopes can decode two serial buses simultaneously using hardware-based decoding.



P9240CMPA computer serial trigger/analysis (RS232/422/485/UART)

The RS232/422/485/UART serial triggering and decode option for P924xA oscilloscopes displays responsive, time-aligned, on-screen decode of RS-232/422/485 and other UART serial buses. It provides triggering capabilities on specified transmit or receive values, as well as on parity errors. Trigger on and acquire RS-232/422/485/UART signals using either oscilloscope or logic channels. Hardware-based decode means the scope stays responsive and fast when decode is turned on. Real-time counters continually count transmit and receive frames and errors.

P9240ATOA automotive serial triggering and analysis (CAN, CAN-dbc, CAN FD, LIN)

The automotive serial triggering and analysis (CAN, LIN) option for P924xA oscilloscopes allows you to trigger on either standard or extended CAN message IDs, including the message ID of a remote transfer request frame. It supports triggering on a data frame and allows you to specify message IDs, data and data length for filtering messages of interest. Triggering on active error frames is also supported. In addition, it supports triggering on LIN frame IDs and data and includes color-coded parity and check sums errors. You can easily isolate serial packets to find sources of errors due to hardware- or software-related problems.

Decodes (Continued)

P9240SNSA SENT (single edge nibble transmission) trigger and analysis

The SENT (single edge nibble transmission) is a point-to-point serial bus that interfaces sensors to ECUs and is used primarily in automotive applications. Keysight's P9240SNSA SENT software option for the P924xA Series oscilloscopes provides decoding of fast and slow channel serial data and also offers extensive triggering selections, including the ability to trigger on various error conditions that can accelerate efficiency in debugging this bus.

Keysight's P924xA Streamline USB oscilloscopes can display captured data from multiple buses in a time-interleaved "lister" display. Sometimes it may be necessary to correlate data from one serial bus to another, such as CAN to SENT.

P9240CXPA CXPI trigger and decode

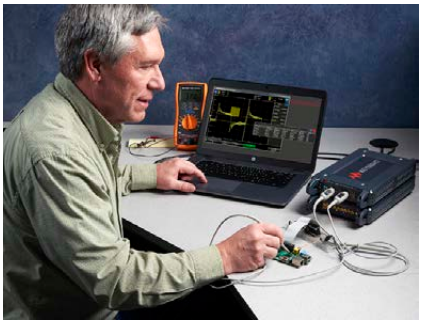
CXPI (clock extension peripheral interface) is the next-generation automotive communication protocol intended to reduce the number and weight of wiring harnesses by making multiplexing possible even in advanced, multifunction HMI (human machine interface) automotive systems. In many cases, CXPI is an alternative serial bus used in place of many of today's LIN serial bus applications for automotive body control.

Keysight's P9240CXPA CXPI software for P924xA oscilloscopes provides decoding of standard and long CXPI frames and also offers extensive triggering selections, including the ability to trigger on various error conditions that can accelerate the engineer's efficiency in debugging this bus.

Keysight's P924xA oscilloscopes can display captured data from multiple buses in a time-interleaved "lister" display. This allows correlation of data being passed through gateways, such as CAN to CXPI.

P9240AROA MIL-STD 1553 and ARINC 429 aerial triggering and analysis

The MIL-STD 1553 serial bus is primarily used to interconnect avionics equipment in military aircrafts. This bus is based on tri-level signaling (high, low and idle) and requires dual-threshold triggering, which the P924xA Streamline Series USB oscilloscopes support. This bus is also implemented as a redundant multi-lane bus (dual-bus analysis), which is also supported.



The ARINC 429 serial bus is used to interconnect avionics equipment in civilian aircrafts. This bus is also based on tri-level signaling (high, low and null) and requires dual-threshold triggering. Since ARINC 429 is a point-to-point bus, multi-lane analysis is also required to capture both send and receive data.

P9240NRZA user-definable Manchester and NRZ trigger and analysis

Keysight's Manchester and NRZ decode and trigger software supports user-defined protocols, offering flexibility and preventing the need to define multiple specific protocol decoding and triggering. This trigger and decode software application is geared toward automotive customers, who commonly use Manchester and NRZ encoded buses (ex: Profibus PA, DALI, PSI5, etc.).

P9240UPDA USB power delivery (USB PD) triggering and analysis

The USB Type-C connection has broadened the range of USB usability by incorporating a dynamic power system called USB Power Delivery (USB PD). Negotiating required power between various USB devices is achieved over the USB's Type-C connector's CC line utilizing a serial protocol based on bi-phase marked coding (BMC). The USB PD protocol option (P9240UPDA) for USB oscilloscopes provides an easy way to debug the 300 kbps signal to provide protocol-level debug information of the USB PD serial bus. This option includes enhanced serial analysis capability for decode and listing window view, triggering, and post-acquisition searching

Configuration

Step 1. Choose your bandwidth

P9241A – 2 channel, 200 MHz
P9242A – 2 channel, 500 MHz
P9243A – 2 channel, 1 GHz

Step 2. Tailor your oscilloscope with integrated capabilities and measurement applications

Model #	Description
P9240BDLA	Application bundle includes all applications listed below
P9240AWGA	WaveGen 20 MHz function/arbitrary waveform generator
P9240FRAA	Frequency response analyzer
P9240MSKA	Mask limit testing
P9240VIDA	Enhanced video/TV Application Package
P9240NFCA	NFC triggering
P9240EMBA	Embedded serial triggering and analysis (I^2C)
P9240CMPA	Computer serial triggering and analysis (RS232/422/485/UART)
P9240ATOA	Automotive serial triggering and analysis (CAN, CAN-dbc, CAN FD, LIN)
P9240SNSA	SENT (single edge nibble transmission) triggering and analysis
P9240CXPA	CXPI trigger and decode
P9240AROA	MIL-STD 1553 and ARINC 429 serial triggering and analysis
P9240NRZA	User-definable Manchester and NRZ trigger and analysis
P9240UPDA	USB-PD (Power Delivery) triggering and analysis

Software licenses offer multiple options. Typically users purchase the fixed permanent license that enables the software for as long as the oscilloscope is installed where the software license is located. All licenses install on the oscilloscope hardware and will be available regardless of connected PC hardware.

There are other alternatives:

1. Fixed permanent license (described above)
2. Fixed time-based license – Enabled license for a limited time period

www.keysight.com/find/usb-scope

Step 3. Choose your probes

The P924xA Series oscilloscopes includes 2 N2843A 500 MHz passive probes.

Other probes are supported but must be purchased as separate products. Please note that only passive probes are supported on the P924xA Streamline Series USB oscilloscopes.

Probe solutions

Complete family of innovative probes and accessories for the InfiniiVision USB scopes.

Probes	Description	P924xA Oscilloscopes
N2843A	500 MHz 10:1 passive probe	2 included standard with all models
N2842A	300 MHz 10:1 passive probe	Optional
N2841A	150 MHz 10:1 passive probe	Optional
N2840A	50 MHz 10:1 passive probe	Optional
N2894A	700 MHz 10:1 passive probe	Optional
N2142A	75 MHz 1:1, 10:1 switchable passive probe	Optional
N2140A	200 MHz 1:1, 10:1 switchable passive probe	Optional
N2862B	150 MHz 10:1 passive probe	Optional
N2863B	300 MHz, 10:1 passive probe	Optional
N2889A	350 MHz 10:1/1:1 passive probe	Optional
10070D	20 MHz 1:1 passive probe with probe ID	Optional
10076A	250 MHz 100:1, 4 kV high-voltage passive probe with probe ID	Optional
N2791A	25 MHz, ± 700 V high-voltage differential probe	Optional
1146B	1146A 100 kHz, 100 A, AC/DC current probe	Optional
N7040A	23 MHz, 3 kA, AC current probe - Rogowski	Optional
N7041A	30 MHz, 600 A, AC current probe - Rogowski	Optional
N7042A	30 MHz, 300 A, AC current probe - Rogowski	Optional
N7026A	150 MHz high sensitivity clamp-on current probe	Optional

Additional Accessories

Model	Description
Option AMG	Calibration uncertainties/guardbanding (accredited)
N2150A	CD, P92xxA oscilloscope software including electronic manuals and IO Libraries[1]
Y1700A	1U side by side rackmount kit for Streamline Series
Y1710A	Transit case for Streamline Series

1. All software and manuals are available for immediate download from the product website

Performance Characteristics

P924xA Keysight Streamline Series USB oscilloscopes

P924xA USB oscilloscopes overview			
	P9241A	**P9242A**	**P9243A**
Bandwidth (–3 dB) [1]	200 MHz	500 MHz	1 GHz
Calculated rise time (10 to 90%)	≤ 1.75 ns	≤ 700 ps	≤ 450 ps
Input channels	2	2	2
Maximum sample rate	5 GSa/s one channel, 2.5 GSa/s two channels		
Maximum memory depth	Standard 4 Mpts, standard segmented memory		
Waveform update rate	≥ 1,000,000 waveforms/sec [2]		

Vertical system analog channels				
		P9241A	**P9242A**	**P9243A**
Hardware bandwidth limits		Approximately 20 MHz (selectable)		
Input coupling		AC, DC		
Input impedance		Selectable: 1 MΩ ± 1% (15 pF), 50 Ω ± 3%		
Input sensitivity range		1 mV/div to 5 V/div (1 MΩ and 50 Ω)		1 mV/div to 5 V/div (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		135 Vrms		
		Probing technology allows testing of higher voltages. For example the included N2843A 10:1 probe supports testing of up to 300 Vrms.		
DC vertical accuracy		± [DC vertical gain accuracy + DC vertical offset accuracy + 0.21% full scale] [3]		
DC vertical gain accuracy [1]		± 2.0% full scale		
DC vertical offset accuracy		± 0.1 div ± 2 mV ± 1% of offset setting		
Channel-to-channel skew		> 100:1 from DC to maximum specified bandwidth of each model (measured with same V/div and coupling on channels)		
Offset range		± 2 V (1 mV/div to 200 mV/div)		
		± 50 V (> 200 mV/div to 5 V/div)		
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]	Pre-trigger	± 1.6 ppm + aging factor (1st year: ± 0.5 ppm, 2nd year: ± 0.7 ppm, 5 years: ± 1.5 ppm, 10 years: ± 2.0 ppm)		
Time base delay time range	Post-trigger	Greater of 1 screen width or 250 µs		
		1 to 500 s		
Channel-to-channel deskew range		± 100 ns		
Δ Time accuracy (using cursors)		± (time base acc. x reading) ± (0.0016 x screen width) ± 100 ps		
Modes		Main, Zoom, XY, and Roll		
XY mode		Z Blanking on Ext Trigger Input, 1.4 V threshold Bandwidth = Max oscilloscope bandwidth, Phase error at 1 MHz < 0.5 degree		

1. Denotes warranted specifications. All others are typical.
2. Requires infinite persistence in order to visually display 1,000,000 wfm/sec.
3. Specifications are valid after a 30-minute warm-up period and ± 10 °C from firmware calibration temperature. 1 mV/div and 2 mV/div are 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.

Performance Characteristics (Continued)

Acquisition system				
		P9241A	**P9242A**	**P9243A**
Maximum analog channels sample rate		5 GSa/s half channel interleaved, 2.5 GSa/s all channel		
Maximum analog channels record length		4 Mpts half channel interleaved, 2 Mpts all channel		
Acquisition mode	Normal	Default mode		
	Peak detect	Capture glitches as narrow as 250 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 to 12 bits of resolution when ≥ 10 µs/div at 5 GSa/s or ≥ 20 µs/div at 2.5 GSa/s		
	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)		
Time mode	Normal	Default mode		

Trigger system			
	P9241A	**P9242A**	**P9243A**
Trigger sources	Analog channel (1-2), external, WaveGen (1 or mod) (FM/FSK)		
Trigger modes	Normal (triggered): Requires trigger event for scope to trigger		
	Auto: Triggers automatically in absence of trigger event		
	Single: Triggers only once on a trigger event, press [Single] again for scope to find another trigger event, or press [Run] to trigger continuously in either Auto or Normal mode		
	Force: Trigger immediately and display acquisition		
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: Selectable OFF or ON, decreases sensitivity 2x		
Trigger holdoff range	40 ns to 10.00 s		
Trigger sensitivity			
Internal [1]	< 10 mV/div: Greater of 1 div or 5 mV; ≥ 10 mV/div: 0.6 div		
External [1]	200 mVpp from DC to 100 MHz		
	350 mVpp 100 to 200 MHz		
Trigger level range			
Any channel	± 6 div from center screen		
External	± 8 V		

1. Denotes warranted specifications. All others are typical.

Performance Characteristics (Continued)

Trigger type selections			
	P9241A	P9242A	P9243A
Zone touch trigger	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 scans/sec update rate		
	Supported modes: normal, peak detect, high resolution		
	Also works simultaneously with the serial trigger and mask/limit test		
Edge	Trigger on a rising, falling, alternating or either edge of any source		
Edge then edge (B trigger)	Arm on a selected edge, wait a specified time, then trigger on a specified count of another selected edge		
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), 6 ns (200 MHz)		
	Maximum duration setting: 10 s		
	Range minimum: 10 ns		
Runt	Trigger on a position 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 2~10 ns and maximum timesetting of 10 s		
	Minimum time setting: 6 ns (200 MHz), 2 ns (500 MHz, 1 GHz)		
Setup and hold	Trigger and clock/data setup and/or hold time violation. Setup time can be set from –7 to 10 s. Hold time can be set from 0 s to 10 ns		
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), 3 ns (200 MHz)		
	Maximum: 10 s		
N^{th} edge burst	Trigger on the Nth (1 to 65535) edge of a pulse burst. Specify idle time (10 ns to 10 s) for framing		
Pattern	Trigger when a specified pattern of high, low and don't care levels on any combination of analog 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), 6 ns (200 MHz)		
	Maximum duration setting: 10 s		
	Range minimum: 10 ns		
Or	Trigger on any selected edge across multiple analog channels		
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 (optional)	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)		
I^2C (optional)	Trigger at a start/stop condition or user defined frame with address and/or data values. Also trigger on missing acknowl-edge, address with no accq, restart, EEPROM read, and 10-bit write		
RS-232/422/485/UART (optional)	Trigger on Rx or Tx start bit, stop bit or data content or parity error		
CAN (optional)	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)		
LIN (optional)	Trigger on LIN (local interconnect network) sync break, sync frame ID, or frame ID and data, parity error, checksum error, frame (symbolic), frame and signal (symbolic)		
MIL-STD 1553 (optional)	Trigger on MIL-STD 1553 signals based on word type (data or command/status), remote terminal address, data and errors (parity, sync, Manchester encoding)		
ARINC 429 (optional)	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		

Performance Characteristics (Continued)

Trigger type selections (Continued)			
	P9241A	P9242A	P9243A
SENT (optional)	Trigger and decode 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)		
CXPI (optional)	Trigger and decode on CXPI data. Trigger on frame, PTYPE, frame ID or error by type. Decodes all message types and errors		
NFC (optional)	Trigger for NFC-A, NFC-B,and NFC-F		

Waveform measurements				
		P9241A	P9242A	P9243A
Cursors		Single cursor accuracy: ± [DC vertical gain accuracy + DC vertical offset accuracy + 0.21% full scale]		
		Dual cursor accuracy [1]: ± [DC vertical gain accuracy + 0.42% full scale]		
		Units: Seconds(s), Hz (1/s), phase (degrees), ratio (%)		
Automatic measurements		Measurements continuously updated with statistics. Cursors track last selected measurement. Select up to eight measurements from the list below: – Snapshot all: Measure all single waveform measurements (31) – Voltage: 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 (std deviation), ratio-N cycle, ratio-full screen – Time: Period, frequency, counter, + width, - width, burst width, +duty cycle, -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: Area-N cycles, area-full screen		
Automatic measurement logging		Available via BenchVue		
Counter		Built-in frequency counter		
		Source: On any analog		
		Resolution: 8 digits		
		Maximum frequency: Bandwidth of scope		
Waveform math				
Number of math functions		Two, displays FFT and one math simultaneously. Can be cascaded		
Arithmetic		Add, subtract, multiply, divide, differentiate, integrate, FFT, Ax + B, squared, square root, absolute value, common logarithm, natural logarithm, exponential, base 10 exponential, low pass filter, high pass filter, averaged value, smoothing, envelope, magnify, max hold, min hold, measurement trend, chart logic bus (timing or state)		
Enhanced FFT	Record size	Up to 64 kpts resolution		
	Window types	Hanning, Flat Top, Rectangular, Blackman-Harris		
	Time gated FFT	Gate the time range of data for FFT analysis in the zoom view. For time and frequency domain correlated analysis		
	Waveforms	FFT, max hold, min hold, average		
	Peak search	Max 11 peaks, threshold and excursion control		
	Channel power	Power across one frequency range		
	Occupied bandwidth	Percentage of the total power, centered on an assigned channel frequency as specified by user		
	Adjacent channel power ratio	Ratio the power in the main frequency range to the power contained in one or more sidebands		
	Total harmonic distortion	Ratio the power in the fundamental frequency to the power contained in the rest of the harmonics and noise		

1. Denotes warranted specifications. All other are typical.

Performance Characteristics (Continued)

Search, navigate and lister				
		P9241A	P9242A	P9243A
Type		Edge, pulse width, rise/fall, runt, frequency peak, serial bus 1, serial bus 2		
Copy		Copy to trigger, copy from trigger		
Frequency peak	Source	Math functions		
	Max # of Peaks	11		
	Control	Results order in frequency or amplitude		
Result display		Event lister or navigation. Manual or auto scroll via navigation or touch event lister entry to jump to a specific event		

WaveGen – Built-in function/arbitrary waveform generator (specifications are typical)			
	P9241A	P9242A	P9243A
WaveGen out	Front-panel MMCX connector		
Waveforms	Sine, square, ramp, pulse, DC, noise, sine cardinal (sinc), exponential rise, exponential fall, cardiac, Gaussian pulse and arbitrary		
Modulation	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 (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		
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 bandwidth): 40 dB (Vpp > = 0.1 V); 30 dB (Vpp < 0.1 V)		
Square wave /pulse	Frequency range: 0.1 Hz to 10 MHz		
	Duty cycle: 20 to 80%		
	Duty cycle resolution: Larger of 1% or 10 ns		
	Pulse width: 20 ns minimum		
	Rise/fall time: 19 ns (10 to 90%)		
	Pulse width resolution: 10 ns or 5 digits, whichever is larger		
	Overshoot: < 2%		
	Asymmetry (at 50% DC): ± 1% ± 5 ns		
	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%		

Performance Characteristics (Continued)

WaveGen – Built-in function/arbitrary waveform generator (specifications are typical)			
	P9241A	**P9242A**	**P9243A**
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 8k points		
	Amplitude resolution: 10 bits (including sign bit) [1]		
	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: – 20 mVpp to 5 Vpp into Hi-Z – 10 mVpp to 2.5 Vpp into 50 Ω		
	Resolution: 100 µV or 3 digits, whichever is higher		
	Accuracy: 2% (frequency = 1 kHz)		
DC offset	Range: – ± 2.5 V into Hi-Z – ± 1.25 V 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		
	Accuracy (DC mode): ± 1.5% of offset setting ± 3 mV		
Trigger output	Trigger output available on trig out MMCX		
Main output	Impedance: 50 Ω typical		
	Isolation: Not available		
	Protection: Overload automatically disables output		
Output mode	Normal		
	Single-shot (arbitrary, sine, ramp, sine cardinal, exp rise/fall, cardiac, Gaussian pulse)		

1. Full resolution is not available at output due to internal attenuator stepping.

Note: Gaussian pulse: 4 Vpp maximum into Hi-Z; 2 Vpp maximum into 50 Ω.

Performance Characteristics (Continued)

Digital voltmeter (specifications are typical)				
		P9241A	P9242A	P9243A
Functions		ACrms, DC, DCrms		
Resolution		ACV/DCV: 3 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		

Precision counter/totalizer (specifications are typical)				
		P9241A	P9242A	P9243A
Counter	Source	Any analog channel or trigger qualified event		
	Resolution	8 digits (for trigger qualified event)		
	Max frequency	1 GHz		
	Trig qual events	1/(trigger hold off time) for trigger qualified events (max 25 MHz, minimum dead time of 40 ns)		
Measurement		Frequency, period, totalize		
Totalizer	Counter size	64-bit totalizing counter		
	Edge	Rise or fall		
	Gating	Positive or negative level. Select from analog channels except the source		

Connectivity

Physical and virtual connections			
P9241A	P9242A	P9243A	
Probe	50 Ω /1 MΩ		
WaveGen connector	MMCX		
External trigger	MMCX 30Vrms/60Vdc max		
Auxiliary output	MMCX		
Reference I/O	MMCX		

General and Environmental Characteristics

General and environmental			
	P9241A	**P9242A**	**P9243A**
Power consumption	35 W (typical) power from included external power adapter (no power is used from the USB connection)		
	+ 3.3 V 3.2 A (typical)		
	+ 12 V 2.0 A (typical)		
	Operating	**Storage**	
Temperature	0 to 55 °C	–40 to 70 °C	
Altitude	Up to 3000 m	Up to 4500 m	
Humidity	Type tested 95% RH @ 40C non-condensing (on second line) decreasing linearly to 50% RH at 55 °C		
Dimensions	177 mm X 335 mm X 50 mm (WxDxH)		
Weight	2.5 Kg		
Safety	UL61010-1 3rd edition, CAN/CSA-C22.2 No. 61010-1-12		
Electromagnetic compatibility	Meets EMC directive (2004/108/EC), meets or exceeds IEC 61326-1:2005/EN61326-1:2013 (basic)		
	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 61000-4-8/EN 61000-4-8 IEC 61000-4-11/EN 61000-4-11		
	Canada: ICES/NMB-001:2006		
	Australia/New Zealand: AS/NZS CISPER 11:2011		

System requirements			
	P9241A	**P9242A**	**P9243A**
Operating systems	Windows 10 (64-bit)		
	Windows 7 SP1 (64-bit)		
Processor speed	1 GHz 64-bit (x64)		
Memory	Available memory 1.5 GB minimum		
Disk	Available disk space 2.5 GB available hard disk space		
Required application	Keysight IO Libraries Suite 2018 Update 1.0		
	Microsoft .NET Framework		
Display minimum	1024 x 768, 96 or 120 DPI		

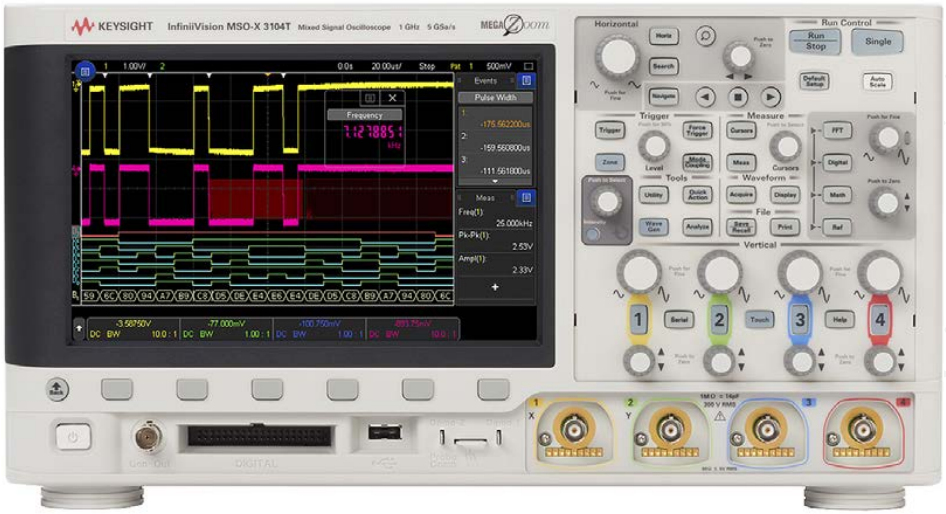
Included standard with oscilloscope			
	P9241A	**P9242A**	**P9243A**
Calibration	2 year		

Related literature

Publication title	Publication number
Mask/Waveform Limit Testing For InfiniiVision Series Oscilloscopes - Data Sheet	5990-3269EN
Serial Bus Options for InfiniiVision X-Series Oscilloscopes - Data Sheet	5990-6677EN
Triggering on Infrequent Anomalies and Complex Signals using Zone Trigger - Application Note	5991-1107EN
Using an Oscilloscope Time Gated Fast Fourier Transforms for Time Correlated Mixed Domain Analysis - Application Note	5992-0244EN

DATA SHEET

InfiniiVision 3000T X-Series Oscilloscopes



KEYSIGHT TECHNOLOGIES

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Touch, Discover, Solve

The InfiniiVision 3000A X-Series redefined oscilloscopes. It saw the most signal detail, provided more functionality than any other oscilloscope, and gave you maximum investment protection. It was also the most successful oscilloscope in Hewlett Packard, Agilent and Keysight Technologies, Inc.'s history. The 3000T X-Series continues that legacy.

The 3000T X-Series takes everything that was revolutionary about the A model and adds a capacitive touch screen, a user interface designed for **touch**, and the exclusive zone touch trigger, all combined with an industry-leading uncompromised update rate of 1 million wfm/s to give you the confidence that you're seeing all of your signal detail, and the ability to **discover** any issues. And the addition of new analysis capabilities help you **solve** your hardest problems quickly.

The 3000T X-Series once again redefines what you can expect in a general purpose oscilloscope by providing all of the performance and capability you need to get to measurement insights faster:

Touch:
- 8.5-inch capacitive touch screen
- Designed for touch interface

Discover:
- Industry's fastest uncompromised waveform update rate
- Exclusive zone touch trigger

Solve:
- Wide range of serial decodes
- 7-in-1 instrument integration
- Time/frequency domain correlation

Figure 1. InfiniiVision 3000 X-Series with MegaZoom IV smart memory technology.

Touch: Designed-For-Touch Interface and Capacitive Touch Screen Simplify Use

From the start of product development, we designed every aspect of this oscilloscope to be seamlessly driven by a touch interface. Large, easy-to-touch targets, a graphical user interface that adapts to show you more and be easier to touch, and a large, sensitive, capacitive touch screen all combine to make operation quick and natural, just like your favorite tablet devices.

Figure 2. The industry's first 8.5" capacitive touch display with large, touchable targets.

Capacitive touch screen technology enables productivity

The user interface allows you to 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 3000T 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 buttons and knobs for the traditional oscilloscope users, and Keysight Insight pull down menu for users who prefer Windows-like operations. The 3000T X-Series also offers a "touch off" button as well as USB mouse and keyboard support.

Figure 3. Side bar with movable docks allows information to be placed on the screen precisely where you want it for documentation.

Touch interface simplifies documentation

The availability of up to 10 annotations on screen makes it easy to highlight key items on screen shots. Streamline documentation with the ability to input information via a pop-up soft keyboard on the touch screen or a USB keyboard. A sidebar displays additional information without covering the waveform graticule, and allows you to dock and scroll through multiple measurement values. Touch gestures (like flicking) make navigating lists or moving between segment waveforms easy.

In addition to the benefits of touch, built-in USB host and USB device ports make PC connectivity easy. The BV0004B oscilloscope control and automation application within BenchVue lets you control and visualize the 3000T 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 3000T X-Series with a mobile device from anywhere. Simplify your testing with BenchVue software. Learn more at **www.keysight.com/find/BenchVue**.

Figure 4. Use BenchVue for remotely logging and plotting measurement data.

Touch: Designed-For-Touch Interface and Capacitive Touch Screen Simplify Use (Continued)

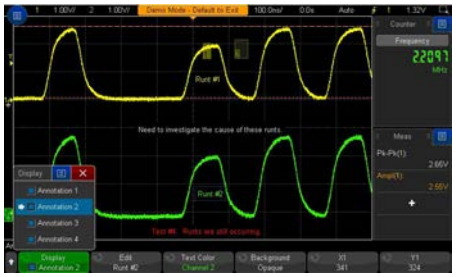


Figure 5. See up to ten annotations on screen at once for documentation. The standard touch screen makes inputting notes simple.

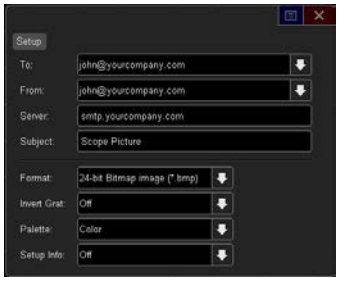


Figure 6. With the optional LAN/ VGA module you can email yourself setups, data and screenshots.

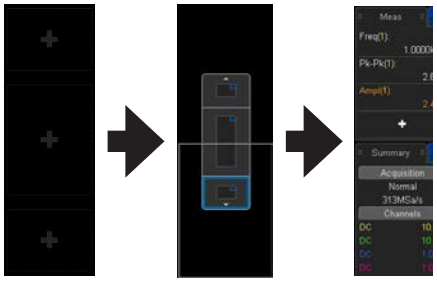


Figure 7. A dock-able sidebar allows you to customize how you view your measurements.

Redefine your remote Web control oscilloscope experience

The 3000T X-Series offers traditional control via a PC Web browser, but also supports remote control through popular tablet devices when using the optional LAN/VGA interface.

Figure 8. Remotely control the 3000T X-Series via tablet device.

Discover: The Industry's Fastest Uncompromised Update Rate Increases the Chance of Finding Anomalies

Industry-leading uncompromised update rate

If you can't see the problem, you can't fix the problem. With an industry-leading update rate of over one million waveforms per second, the InfiniiVision 3000T 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 3000T X-Series not only lets you see more waveforms, but it has the uncompromised ability to find the most difficult problems in your design under any conditions. 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 on
- No slowdown with measurements on
- No slowdown with vectors on
- No slowdown with sinx/x interpolation on

What is waveform update rate?

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 important to select an oscilloscope with a fast waveform update rate. Figures 7 and 8 demonstrate the difference between a slower update rate and a faster update rate.

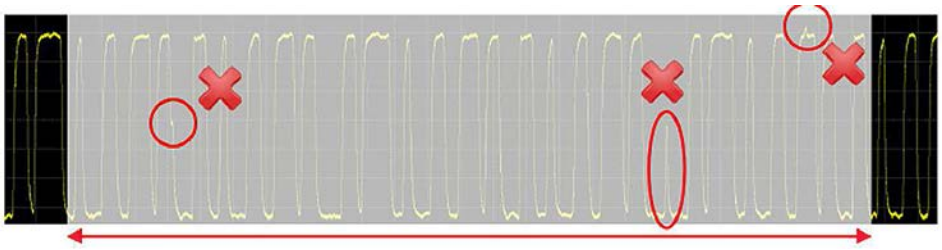


Figure 9. Other vendor's oscilloscope with 50,000 waveforms/second. A long dead time decreases your chances of capturing infrequent events.

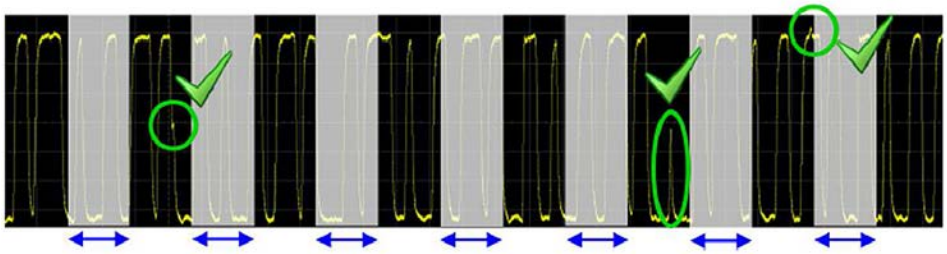


Figure 10. InfiniiVision 30000T X-Series with 1,000,000 waveforms/second. A short dead time increases your chancs of capturing infrequent events.

Discover: The Industry's Fastest Uncompromised Update Rate Increases the Chance of Finding Anomalies (Continued)

But all specs aren't equal.

Many vendors claim an update rate specification, but that is only in a special mode, or without any features turned on. Table 1 shows the 3000T X-Series' update rate versus a competing oscilloscope.

While all scopes update rate will vary to some degree by the timebase setting, it is critical that the update rate remain constant regardless of the functionality you are using within the oscilloscope.

Table 1. Measured update rate between the 3000T X-Series and the Danaher Tektronix MDO3000. Note how the update rate fluctuates wildly on the MDO3000 based on different settings/features.

	10 ns/div			
	Keysight 3000T X-Series		**Tektronix MDO3000 Series**	
	Update rate	Probability	Update rate	Probability
Max with no features on	1,114,000	94%	281,000	50%
Max with digital ch on	1,101,000	94%	132	0.03%
Max with measurements on	1,114,000	94%	2,200	0.55%
Max with FFT on	1,114,000	94%	2,200	0.55%
Max with serial on	1,100,000	94%	1,800	0.45%
Max with search on	1,113,000	94%	2,200	0.55%
Max with ref wfms on	1,113,000	94%	2,200	0.55%

Why is an uncompromised update rate important?

When debugging or troubleshooting a project, it is important that you see as much signal detail as possible. A fast update rate is just part of the overall equation to determine the likelihood of seeing an anomaly. The frequency of the anomaly, the timebase setting of the oscilloscope and the amount of time you allow the oscilloscope to see the anomaly all come in to play:

$$P_t = 100 \times (1-[1-RW]^{(U \times t)})$$

where

P_t = Probability of capturing anomaly in "t" seconds
t = Observation time
U = Scope's measured waveform update rate
R = Anomalous event occurance rate
W = Display acquisition window = Timebase setting x 10

Therefore, it is important to select an oscilloscope with the fastest uncompromised update rate to allow enough time to increase your chances of seeing the glitch. In Table 1, in addition to the measured update rate, we show the probability of seeing a glitch that happens 5 times a second while allowing the oscilloscope to acquire for 5 seconds. With the 3000T X-Series you maximize your chances of seeing the infrequent glitch. With the competing scope, if you are using any of the other features like measurements, or search or digital channels, the update rate slows considerably. The only option you have in this case is to allow the oscilloscope to run longer. For example, if you are using digital channels you'll have to let the scope run over 8,000 times longer to get a similar probability to the uncompromised update rate of the 3000T X-Series. That's almost 12 hours of time versus 5 seconds!

Discover: The Industry's Fastest Uncompromised Update Rate Increases the Chance of Finding Anomalies (Continued)

MegaZoom IV smart memory technology enables uncompromised update rate

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 3000T 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 WaveGen function/arbitrary waveform generator.

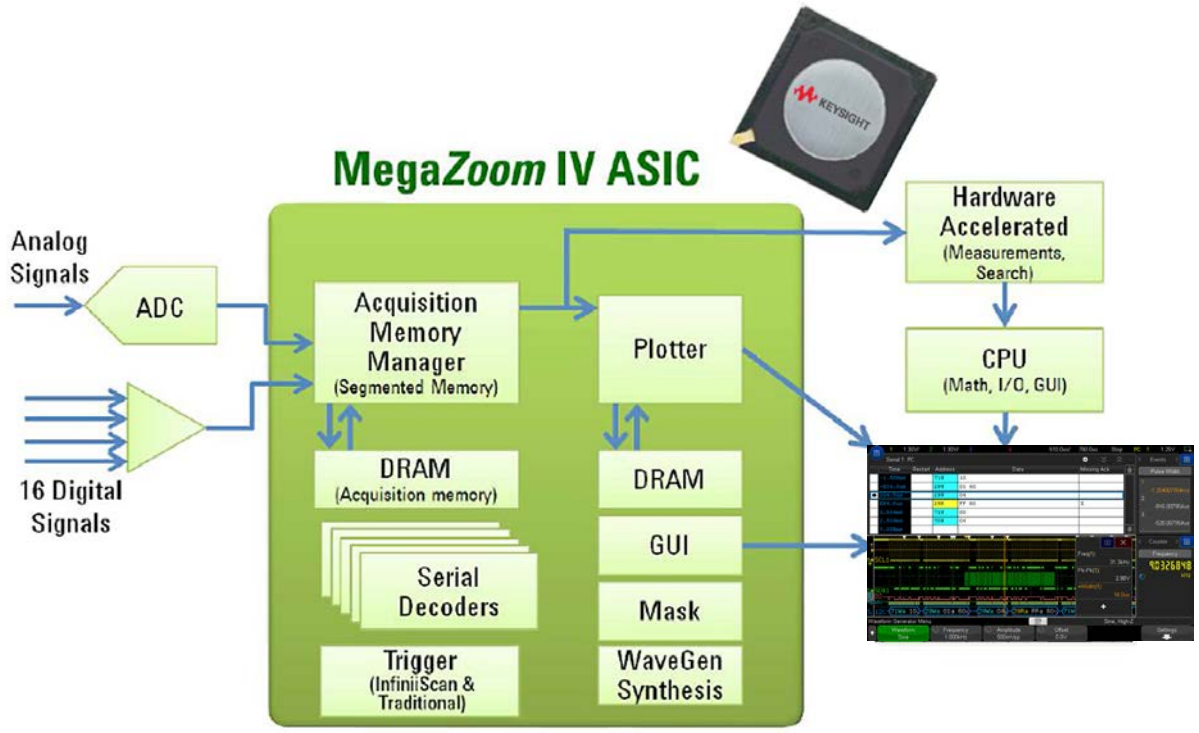


Figure 11. The 3000T X-Series oscilloscopes' uncompromised responsiveness, speed and waveform update rate are enabled by the MegaZoom IV, smart memory ASIC. The CPU is not used for core waveform operations.

Discover: Excellent Signal Integrity Allows you to See More Signal Detail

The 3000T X-Series has excellent signal integrity, including full bandwidth to 1 mV/div and the ability to get up to 12-bits of resolution using the high resolution acquisition mode.

Some oscilloscopes in this class limit their bandwidth at smaller volt-per-division settings without on-display user notifications. This is likely to keep the noise acceptable at lower volt-per-division settings.

Table 2 shows a comparison of the typical noise floor at 20 µ/div between the normal and high resolution mode. You will notice that the noise floor performance improves as much as five times.

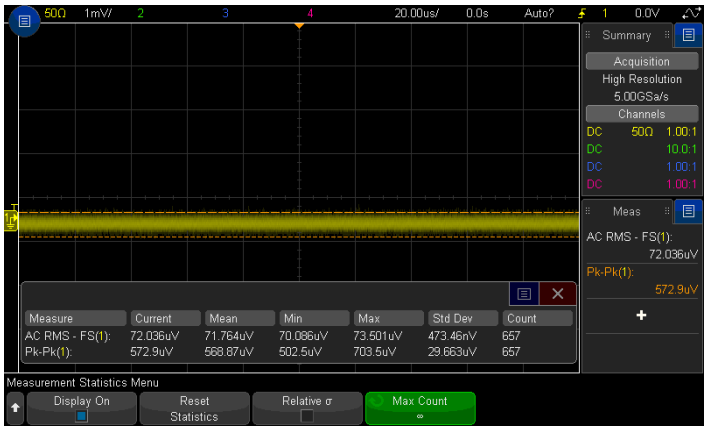


Figure 12. High resolution mode allows you to lower your noise and increase your resolution up to 12-bits.

Table 2. Noise comparison between the normal and high-resolution mode at 20 µ/div.

	50 Ω 1 GHz bandwidth Vrms measurement (units = mV)		
Vertical setting	**Normal mode**	**High resolution mode**	**Notes**
1 mV	0.277	0.072	Some other manufacturers will limit their bandwidth significantly at these vertical settings, but the Keysight 3000T X-Series provides full bandwidth at all settings.
2 mV	0.277	0.072	
5 mV	0.297	0.081	
10 mV	0.352	0.081	
20 mV	0.597	0.102	
50 mV	1.500	0.340	
100 mV	2.560	0.480	
200 mV	5.500	1.050	
500 mV	15.200	3.630	
1 V	26.000	4.830	

Discover: Industry Exclusive Zone Touch Trigger Makes Triggering Simple

An uncompromised update rate allows you to see an anomaly, but to continue the debug process you have to isolate it. Setting up a trigger has been a challenge since oscilloscopes introduced a triggered waveform. While oscilloscopes have added more and more triggering capability over the years, setting up triggers has remained complex at best and impossible at worst.

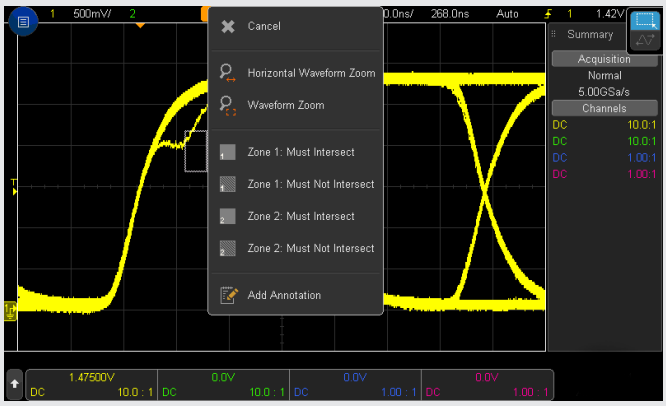
Zone touch trigger eliminates the complexity of setting up advanced triggers. Now, if you can see the event on the display of the oscilloscope, you can trigger on it just by drawing a box on the signal you want to isolate.

See how easy Zone touch triggering can be with these examples.

Steps to isolate a non-monotonic edge: 3000T X-Series:

- Draw box on non-monotonic edge
- Select “must intersect”

In some cases you may have to select the appropriate source if it wasn’t already selected.



Traditional Scopes with Advanced Triggers (assuming the update rate is fast enough to see what you want to trigger on):

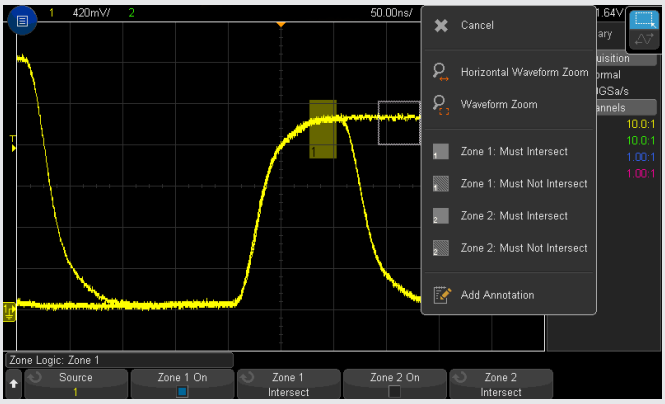
1. Determine what trigger makes the most sense for the signal you are trying to isolate. In this case, we’ll try a rise-time trigger first.
2. Select cursors
3. Move cursor a to 10% level
4. Move cursor b to 90% level on the non-monotonic edge
5. Obtain the delta time (rise time) between the cursors
6. Select trigger menu
7. Press trigger type
8. Select Rise/Fall time Trigger
9. Select your source
10. Select your slope
11. Select when you want it to trigger – is it less than, greater than, equal to, not equal to. We’ll select greater than.
12. Dial in the “greater than” setting to the measured rise time
13. Adjust your low threshold to the 10% level
14. Adjust your high threshold to the 90% level

Discover: Industry Exclusive Zone Touch Trigger Makes Triggering Simple (Continued)

Steps to trigger on a runt signal: 3000T X-Series:

1. Draw box on the runt
2. Select “must intersect”
3. Draw a second box if needed to further isolate the runt from other runts
4. Select “must intersect” or “must not intersect”

In some cases you may have to select the appropriate source if it wasn’t already selected.



Traditional Scopes with Advanced Triggers (assuming the update rate is fast enough to see what you want to trigger on):

1. Determine what trigger makes the most sense for the signal you are trying to isolate. In this case, we’ll use a runt trigger first.
2. Select trigger menu
3. Press trigger type
4. Select runt Trigger
5. Select your source
6. Select the runt’s polarity
7. Adjust your low threshold to below the runt
8. Adjust your high threshold to above the runt
9. Select when you’ll trigger – in this case, we want to trigger on the exact pulse width of the runt
10. Select cursors
11. Move cursor a to the rising edge of the pulse at the 50% mark
12. Move cursor b to the falling edge of the pulse at the 50% mark
13. Obtain the delta time (pulse width) between the cursors
14. Adjust the runt width to be equal to the pulse width that was measured

Discover: Standard Segmented Smart Memory Allows you to Capture Longer Periods of Time at High Sample Rates

Acquisition memory size is an essential oscilloscope specification because it determines sustainable sample rate and the amount of time you can capture in a single acquisition. In general, longer memory is better. However, no memory will always be 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. In addition, it provides a time stamp of each segment relative to the first trigger event to enable analysis of the frequency of the event. Segmented memory comes standard on the 3000T X-Series.

Figure 13 shows segmented memory successfully capturing 100 small and large glitch events at 5 GSa/s in 47 seconds. Traditional memory architecture would require almost 203 Gpts of memory to accomplish the same result! This memory is not available on any scope in the market.

Furthermore, segmented memory discovered that the worst offender glitch happened 40 seconds from the first trigger event, or at the 95th glitch. It also found out a unique glitch took place 13 seconds after the first glitch. As shown in figure 13a, you can overlay all segments to have a comprehensive view as well.

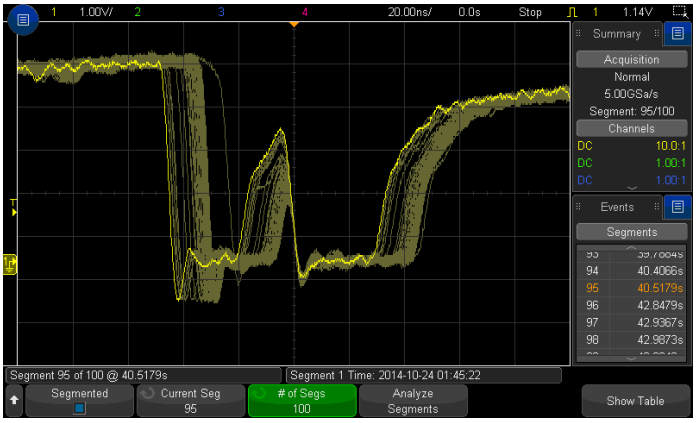


Figure 13a. Screen showing an overlay of all 100 segments for worst case waveform analysis.

Figure 13. Segmented memory reveals different types of glitches are taking place.

Discover: Dedicated Search and Navigation Helps you Navigate Deep Memory

Parametric and serial bus search and navigation comes standard on the 3000T X-Series oscilloscopes. When you are capturing long, complex waveforms using an oscilloscope's 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.

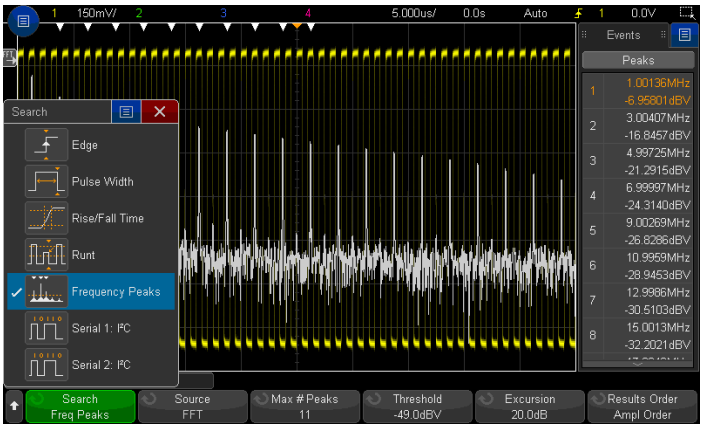


Figure 14. The 3000T X-Series was set up to capture clock signals for FFT analysis. Using the search and navigation capability, the scope was able to find, mark (white triangles) and quickly navigate to the first 11 frequency peaks occurrences. You can sort it in the order of frequency or amplitude.

Close-up on buttons on the front panel of the scope. Alternatively, you also can use the touch navigation control.

Solve: Integrated Hardware-Based Serial Decoding and Triggering (Option) Makes Easy Work of Low Speed Serial Buses

Keysight InfiniiVision oscilloscopes, including the new 3000T X-Series, use hardware-based serial protocol decoding. Some other vendors 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 3000T 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 3000T X-Series has the most decode/trigger options in this class of instrument including: I²C, SPI, RS232/422/485/UART, CAN, CAN-FD (CAN-FD ISO), CAN-dbc, LIN, LIN symbolic, SENT, CXPI, FlexRay, MIL-STD 1553, ARINC 429, and I²S.

SERIAL DECODE AND TRIGGER OPTIONS

The 3000T X-Series supports a range of different serial decode and trigger options including:

- I²C
- SPI (2/3/4 wire)
- RS232/422/485/UART
- CAN
- CAN-dbc
- CAN-FD (CAN-FD ISO)
- LIN
- LIN symbolic
- SENT
- CXPI
- FlexRay
- MIL-STD 1553
- ARINC 429
- USB PD
- I²S
- User-definable Manchester
- User-definable NRZ

Figure 15. I²C decode and trigger.

Figure 16. RS232 decode and trigger.

Figure 17. CAN-FD decode and trigger.

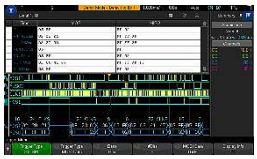


Figure 18. SPI 4wire decode and trigger.

Figure 19. Multi-bus time aligned decode.

Solve: Segmented Smart Memory Combined With Protocol Analysis Enables Insights Over Long Periods Of Time

Segmented memory works in conjunction with any of the optional serial protocol decodes. For example, by setting the trigger condition to “SENT serial bus error,” segmented memory captures and stores only SENT pulse period error packets and stitches together each segment for easy viewing of the decoded data in the lister. You can quickly compare time tags to discover time intervals between errors.

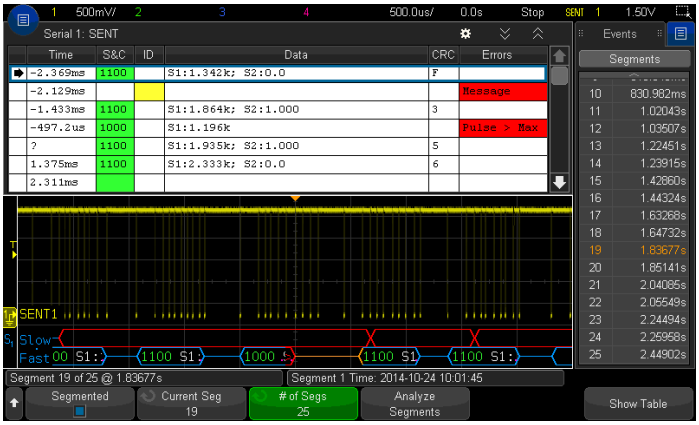


Figure 20. Segmented memory being used in conjunction with SENT bus serial decode resulting in maximum insight to the serial bus.

Solve: Dedicated Frequency/Spectrum Analysis Allows you to Time-Correlate Analog, Digital, and frequency Domain Signals in a Single Instrument

Viewing the frequency content of waveforms is greatly simplified by a dedicated FFT button and level adjustment knobs. Pop up keypads make inputting start, stop, span and center frequency easy. And the new problem solving feature called “gated FFT”, unique in this class of instrument, 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 21a through 21d show a simple gated FFT example observing a RF signal frequency transition from 400 MHz to 200 MHz, time correlated to both the SPI controlling signal (digital) and a VCO enable signal (analog). Note, you can also visualize the RF signal itself in the time domain to gain additional insight such as a gap in the RF time domain waveform.

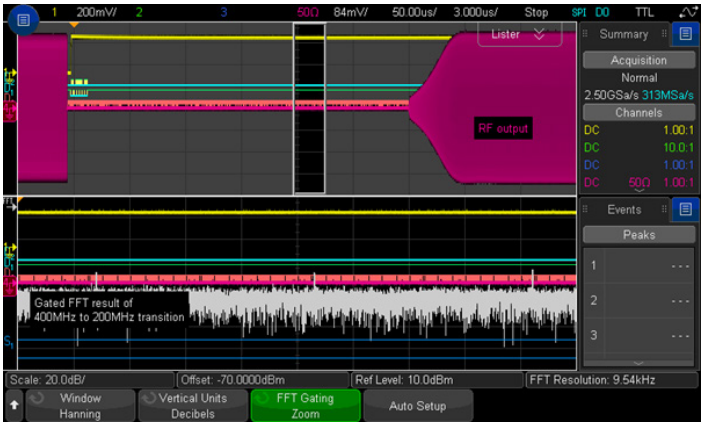


Figure 21b. No RF activities in this zoomed time.

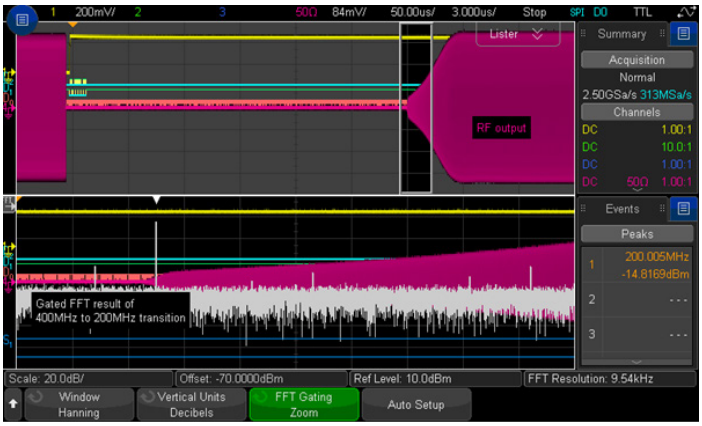


Figure 21c. Start observing the RF signal at 200 MHz. You can validate this from the RF analog waveform as well.

Figure 21a. Triggered on a SPI command, the RF signal is still at 400 MHz as indicated in the frequency peak search result lister.

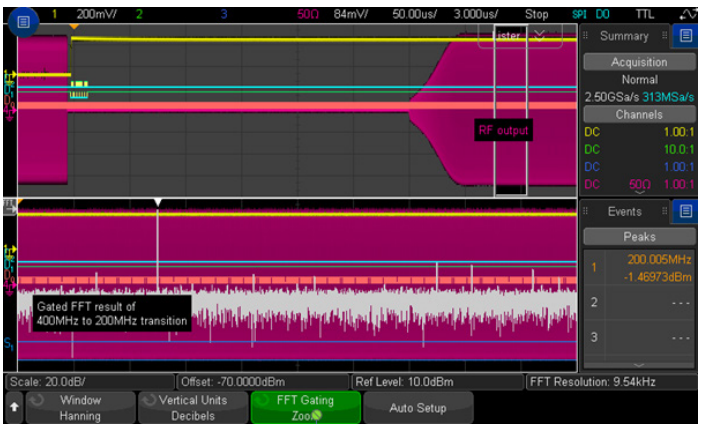


Figure 21d. RF signal settled down at 200 MH as indicated in the search lister.

Solve: Standard Advanced Math Capabilities Allow New Views of Signals

Advanced math analysis provides a variety of additional math functions and comes standard on the 3000T X-Series. Additionally, math functions can be nested to provide additional insight into your designs. You can create up to two math functions, with one math function and FFT displayed at a time.

ADVANCED MATH

The 3000T X-Series supports up to two math functions with an assortment of operators, transforms, filters and visualizations:

Operators
- Add, subtract, multiply, divide

Transforms
- Differentiate, integrate
- FFT (magnitude and phase)
- 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 and min hold
- Measurement trend
- Chart logic bus timing, chart logic bus state
- Maximum and minimum
- Peak-Peak

Solve: Class Leading Measurements Provide Quick Answers

Automatic measurements are the essential tool of an oscilloscope. In order to make quick and efficient measurements, the 3000T X-Series provides 37 powerful automatic measurements and can display up to 8 at a time. Measurements can be gated by auto select, main window, zoom window, or cursors and include full statistics.

MEASUREMENTS

The 3000T X-Series supports 38 automated measurements:

Voltage
- 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- N cycles, ratio- full screen

Time
- 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
- Area- N cycles, area- full screen

Counter
- Built-in frequency counter

Solve: 7-in-1 Integration Allows New Measurement Possibilities

In addition to the class leading oscilloscope and powerful serial protocol analysis capabilities, the 3000T X-Series offers five additional integrated instrument capabilities not always found in this class of oscilloscope.

Integrated mixed signal oscilloscope (MSO - optional)

The 3000T X-Series offers 16 optional, integrated and upgradable digital channels. Digital content is everywhere in today's designs and traditional 2 and 4 channel oscilloscopes do not always provide enough channels for the job at hand.

With an additional 16 integrated digital channels, you now have up to 20 channels of time-correlated acquisition and viewing on the same instrument. In addition to offering powerful triggering across the analog and digital channels, this also gives you additional channels to use for serial decode and triggering. And if you buy a 2 or 4 channel DSO, you can upgrade it at any time to an MSO with a software license.

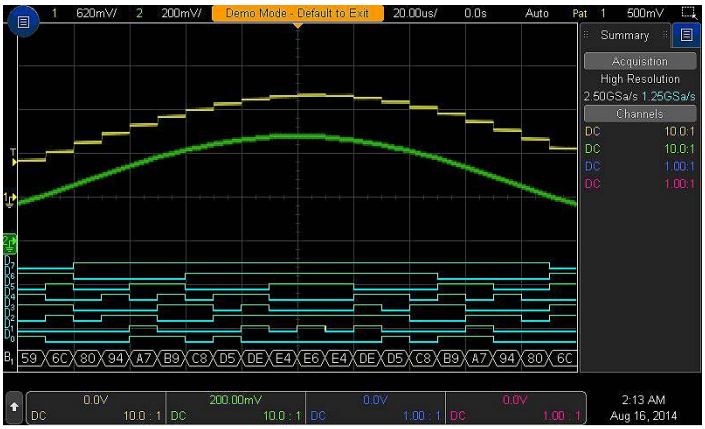
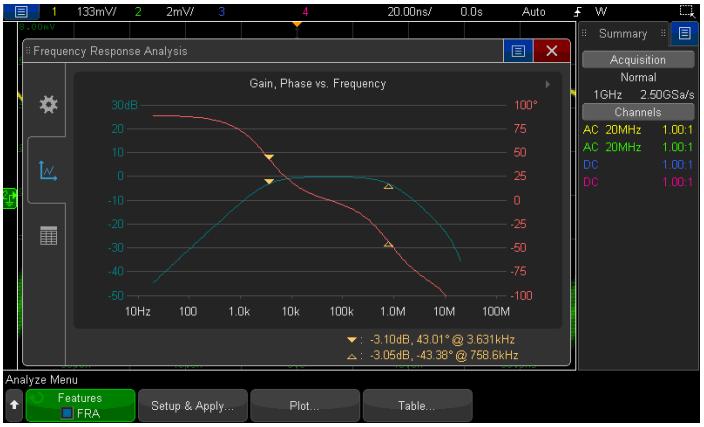


Figure 24. Optional digital channels allow a timing view of up to 16 channels. Tightly integrated, they work with the analog triggers and serial triggers/decoding.

Frequency Response Analysis (FRA) Option

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 3000T X-Series oscilloscopes licensed with the DSOXT3FRA option 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.



Integrated WaveGen: Built-in 20 MHz function/ arbitrary waveform generator (optional)

The 3000T X-Series offers an integrated 20 MHz function/ arbitrary waveform generator, available with modulation support (DSOX3WAVEGEN). The function generator provides stimulus output of sine, square, ramp, pulse, DC, Sinc (x), exponential rise/fall, cardiac, Gaussian Pulse and noise waveforms to your device under test. The modulation feature supports AM, FM, and FSK modulations with modulation shapes of sine, square, and ramp. The generator can output a continuous or a single-shot waveform. With AWG functionality, you can store waveforms from analog channels or reference memory to the arbitrary memory and output from WaveGen. Then easily create or edit the waveform using the built-in editor via touch and the large screen or by using Keysight's Benchlink Waveform Builder software: **www.keysight.com/find/33503**.

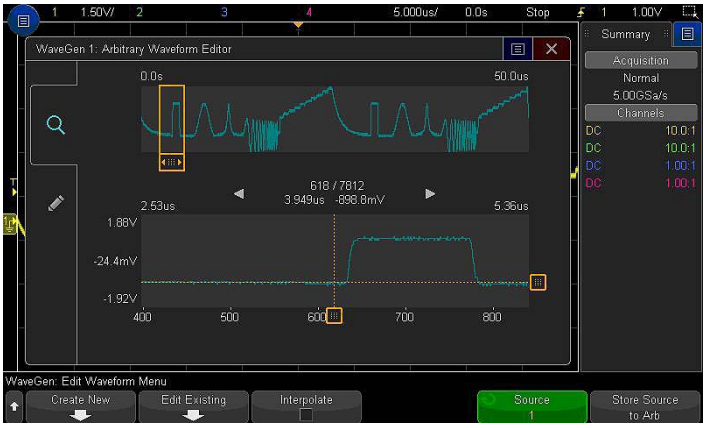


Figure 25. Optional arbitrary waveform generator provides easy access to stimulus. The integrated arbitrary waveform generator makes capturing, modifying and replaying signals simple.

Solve: 7-in-1 Integration Allows New Measurement Possibilities (Continued)

Integrated DVM: Standard 3-digit digital voltmeter

An integrated 3-digit voltmeter is included standard on your 3000T X-Series oscilloscope. The voltmeter operates through the same probes as the oscilloscope channels. However, the DVM measurements are made independently from the oscilloscope acquisition and triggering system so you can make both the DVM and triggered oscilloscope waveform captures with the same connection. The voltmeter results are always displayed, keeping these quick characterization measurements at your fingertips.

Figure 26. DVM and counter takes advantage of separate signal paths to provide measurements without a trigger, while still using the scope probes.

Integrated frequency measurements: Standard 8-digit counter and totalizer

Traditional oscilloscope counter measurements offer only five or six digits of resolution, which may not be enough for the most critical frequency measurements are being made.

With the 3000T X-Series' standard 8-digit counter, you can see your measurements with the precision you would normally expect only from a standalone counter. Because the integrated counter measures frequencies up to a wide bandwidth of 1.0 GHz, you can use it for many high-frequency applications as well.

The counter's totalizer feature adds another valuable capability to the oscilloscope. It can count the number of events (totalize), and it also can monitor the number of trigger-condition-qualified events. The trigger-qualified events totalizer does not require an actual trigger to occur. It only requires a trigger-satisfying event to take place. In other words, the totalizer can monitor events faster than the trigger rate of a scope, as fast as 25 million events per second (a function of the oscilloscope's holdoff time, which has the minimum of 40 ns). Figures 27 shows example of a totalizer counting the number of CAN-FD CRC delimiter bit error packets that took place in a design.

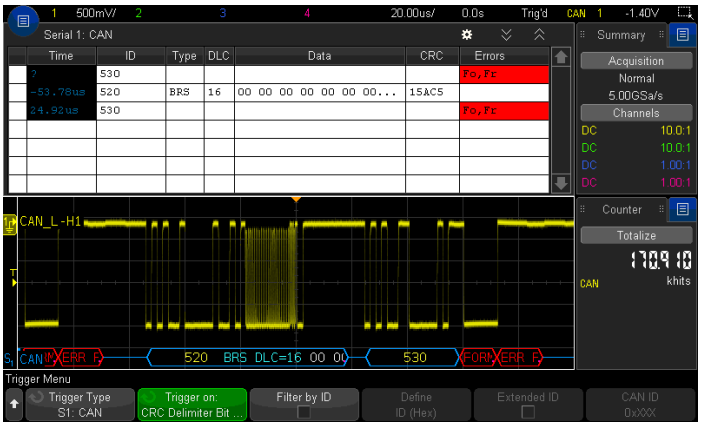


Figure 27. Totalizer counts the number of events. In addition, it can count the number of trigger-condition-qualified events as fast as 25 million events a second.

Solve: Hardware Accelerated Mask/Limit Testing (Option) Makes It Easy to See the Performance of your Device

Whether you are performing pass/fail tests to specified standards in manufacturing or testing for infrequent signal anomalies, mask/limit testing can be a valuable productivity tool (DSOX3MASK). The 3000T X-Series features powerful hardware-based mask testing that 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.

See **www.keysight.com/find/DSOX3MASK** for more information.

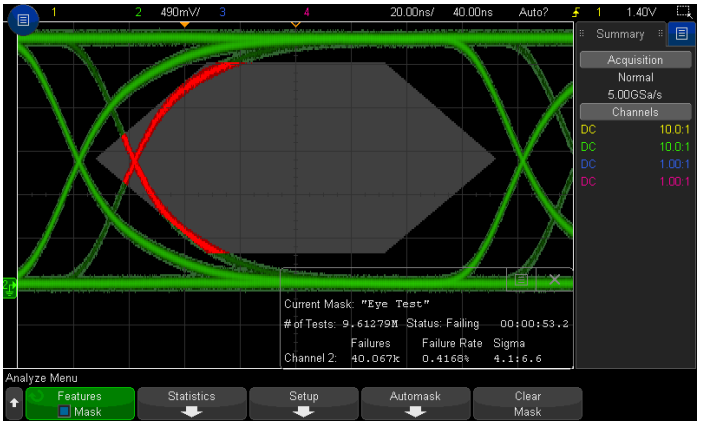


Figure 28. Hardware accelerated mask testing allows testing against a golden waveform or user created mask to find violations. In this example we captured over 5M tests in only 30 seconds.

Solve: Integrated Power Measurements and Analysis (Option) Make Short Work of Power Measurements

When you are working with switching power supplies and power devices, the power measurements application (DSOX3PWR) provides a full suite of power measurements and analysis in the oscilloscope.

Included with the DSOX3PWR is a license for the U1881A PC-based power analysis software package, which provides additional offline measurements and report generation.

See **www.keysight.com/find/DSOX3PWR** for more information.

In addition there are several power specific probes that make analysis of your power supplies (e.g. switch mode power supplies) and power consuming devices (e.g. batteries) easy.

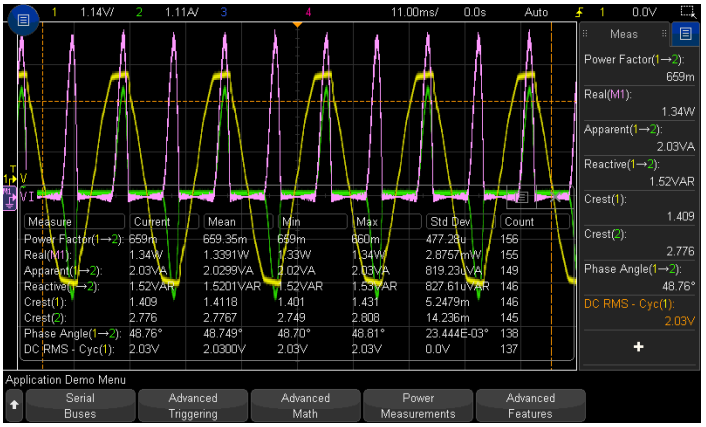


Figure 29a. Integrated power measurements make quick work of analyzing power producing and power consuming devices.

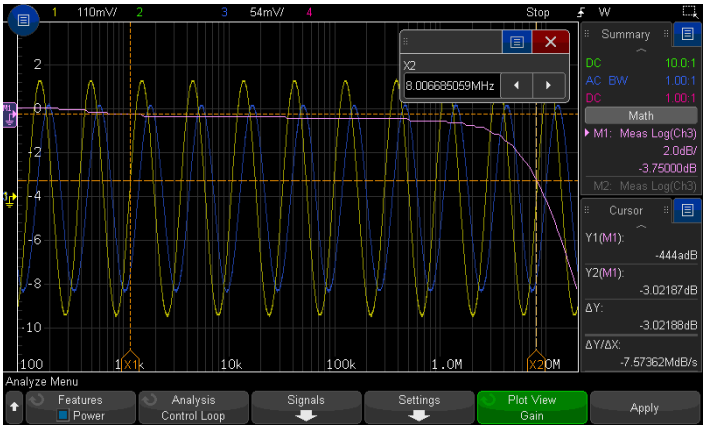


Figure 29b. New control loop response analysis (bode plot) shows the gain/phase plot over frequency sweep.

Solve: Innovative Power Rail Probe (Option) Allows Enhanced Views

The power rail noise, ripple, and transients measurements can be challenging due to required offset range and mV sensitivity. With its ± 24 V offset range, ultra-low noise 1:1 attenuation ratio, and 2-GHz bandwidth, the N7020A power rail probe is for users making critical power integrity measurements that need mV sensitivity on their DC power rails.

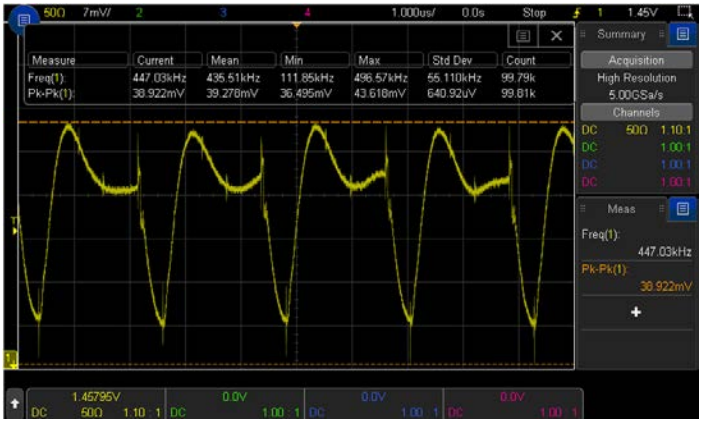


Figure 30a. 3000T X-Series and N7020A acquire not only the power rail ripples but the high frequency transients as well.

Figure 30b. N7020A Power Rail Probe.

Solve: Video Analysis (Option)

Whether you are debugging consumer electronics with HDTV or characterizing a design, the HDTV measurement application (DSOX3VID) provides support for a variety of HDTV standards for triggering and analysis.

See **www.keysight.com/find/DSOX3VID** for more information.

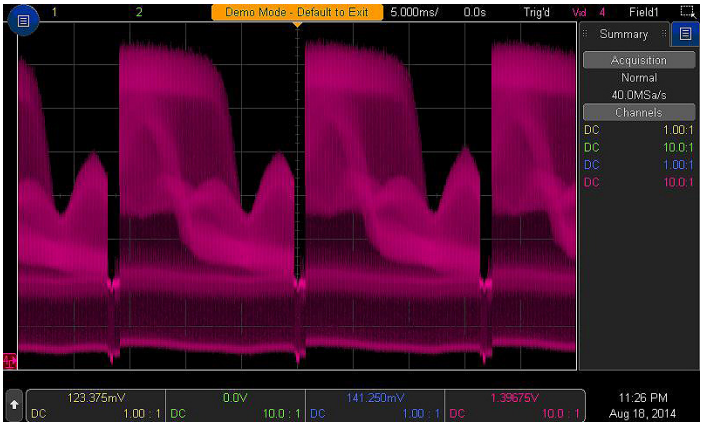


Figure 31.

While the “Touch, Discover, Solve” elements of the scope highlight the key features that will make it easy to debug and troubleshoot your device, there are other features that you may also want to consider when choosing your next oscilloscope.

Total cost of ownership

The 3000T X-Series offers an extremely low cost of ownership. Between an industry leading mean time between failure (MTBF) of over 250,000 hours and a market-leading calibration period of 3 years, you can rest assured that your investment in a 3000T X-Series will be protected for years to come. In addition, because needs change over time, you can purchase just what you need today and then upgrade the scope’s bandwidth or measurement application easily over time as your projects evolve.

Educator and training kit

Have new hires that need to quickly become familiar with the scope? Or are you a professor that wants to teach your students what an oscilloscope is and how to perform basic measurements? The Educator’s Oscilloscope Training Kit makes that easy. It 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 the undergraduate student and an oscilloscope fundamentals PowerPoint slide set for professors and lab assistants. The built-in training signals are included standard on the oscilloscope, while the lab guide and slide set are available to download at **www.keysight.com/find/dsoxedk**.

Built-in features to help the infrequent user

In addition to the educator’s training kit, the oscilloscope includes a localized front panel and GUI available in 15 languages, along with an integrated (and localized) help system. Just hold any hard key or soft panel button and a brief overview will appear that explains how to use that feature.

30-day trial license

The 3000T X-Series comes with a one-time 30-day, all optional-features trial license. You can choose to start the 30-day trial at any time. In addition you can redeem individual optional feature 30-day trial licenses at any time by visiting **www.keysight.com/find/30daytrial**. This enables you to receive in effect 60 days of trial license of each optional feature.

Next generation probing

All 3000T X-Series come standard with a newly designed, very robust 500 MHz 10:1 passive probe per channel. In addition, MSOs include a newly designed cable with a flexible cable management system that makes probing with the 16-digital channels easy.

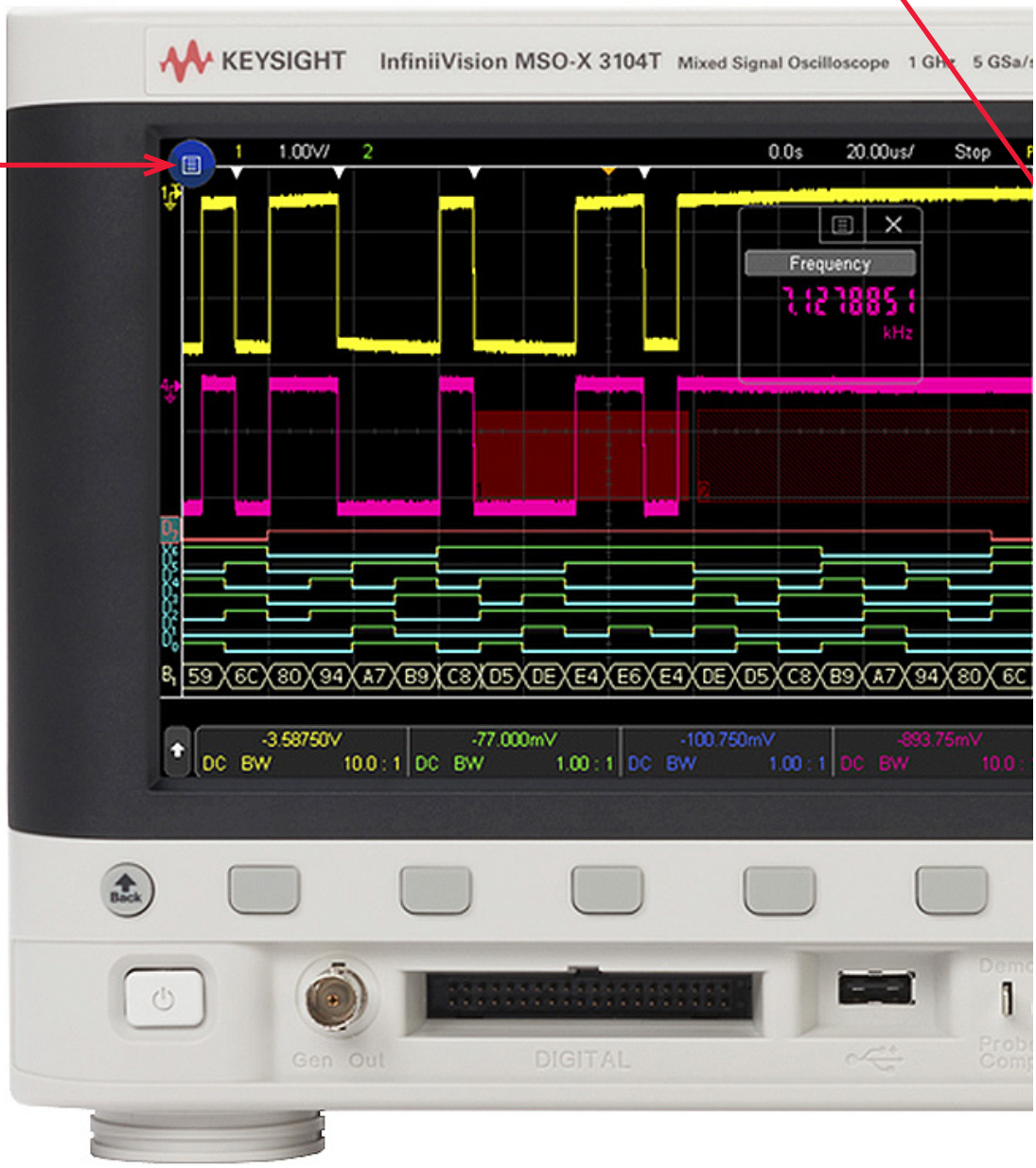
LOCALIZED GUI AND FRONT PANEL OPTIONS

The 3000T X-Series supports 15 different languages:

- English
- Japanese
- Simplified Chinese
- Traditional Chinese
- Thai
- Korean
- German
- French
- Spanish
- Russian
- Portuguese
- Italian
- Polish
- Czech
- Turkish

7-in-1 instruments helps you solve your problems: oscilloscope channels digital channels, frequency response analysis, serial protocol analysis, WaveGen, DVM, and 8-digit counter-totalizer. ***Fully upgradeable*** including bandwidth.

"Designed for Touch". ***8.5 inch capacitive touch screen with gesture support.***



Uncompromised 1,000,000 waveform per second update rate minimize the dead-time for maximum probability of capturing infrequent events and anomalies.

Built-in features to help the infrequent user - ***GUI available in 15 languages.***

Display up to ***8 measurements*** simultaneously, without compromising other key info. 38 automatic measurements. ***Gated by cursors*** supported.

Integrated DVM and ***8-digit counter with totalizer.*** Wide coverage of application and serial protocol solutions including ***CAN-FD and SENT trigger and decode.***

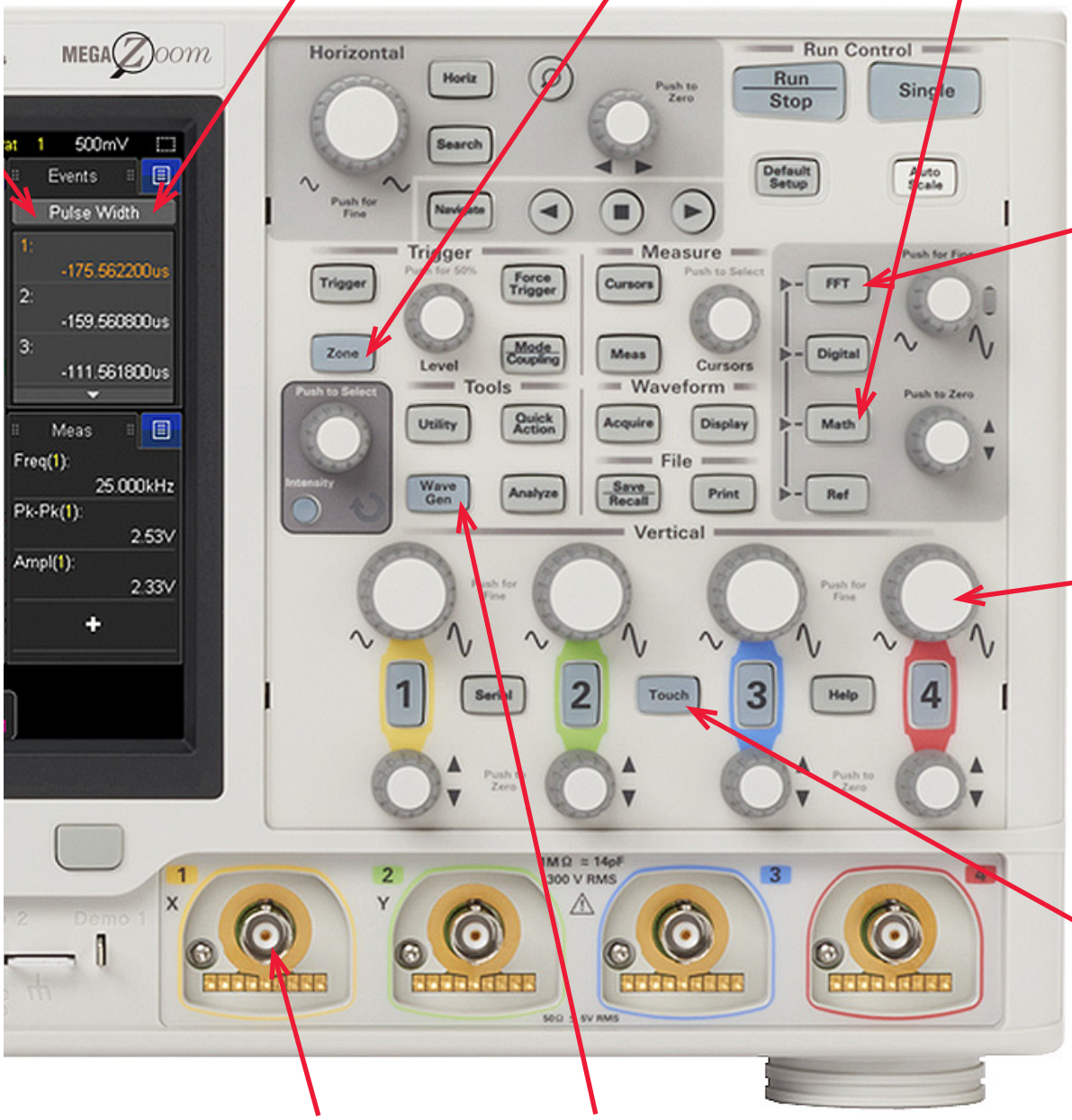
Both ***USB keyboard and mouse*** are supported in 3000T X-Series for additional ease of use.

Standard segment memory with event lister powered by ***MegaZoom IV*** smart memory technology intelligent capture of just the signals of interest.

Reconfigurable Docking panels with the capacitive touch screen adds a new dimension to the usability.

Zone touch trigger, if you can see it, you can trigger on it by drawing a box.

Standard advanced math displays ***FFT and one math functions*** for your deep analysis.



Standard ***Gated FFT*** for your time correlated analog, digital, and frequency domain signal analysis.

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

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

AutoProbe interface supports various active, differential, and current probes.

Build in WaveGen function/arbitrary generator allows you to capture and regenerate the signals immediately.

Configuration

Step 1.

Choose your bandwidth and number of channels.

3000 X-Series specification overview											
		3012T	3014T	3022T	3024T	3032T	3034T	3052T	3054T	3102T	3104T
Bandwidth (–3 dB)		100 MHz		200 MHz		350 MHz		500 MHz		1 GHz	
Calculated rise time (10 to 90%)		≤ 3.5 ns		≤ 1.75 ns		≤ 1 ns		≤ 700 ps		≤ 450 ps	
Input channels	DSOX	2	4	2	4	2	4	2	4	2	4
	MSOX	2 + 16	4 + 16	2 + 16	4 + 16	2 + 16	4 + 16	2 + 16	4 + 16	2 + 16	4 + 16

For example, if you chose 1 GHz, 4+16 channels, the model number will be MSOX3104T.

Step 2.

Tailor your oscilloscope with integrated capabilities and measurement applications to save time and money. After purchase upgrade model numbers are listed below (values in parentheses are factory-installed option numbers).

Description	Model number
Oscilloscope features	
MSO upgrade	DSOXT3MSO [1]
Serial protocols	
Embedded serial triggering and analysis (I²C, SPI)	DSOX3EMBD
Computer serial triggering and analysis (RS232/UART)	DSOX3COMP
Sensor triggering and analysis (SENT)	DSOXT3SENSOR [1]
Automotive serial triggering and analysis (CAN/CAN-FD (CAN-FD ISO)/CAN-dbc/LIN/LIN symbolic)	DSOXT3AUTO [1]
CXPI serial triggering and analysis	DSOXT3CXPI
FlexRay serial triggering and analysis	DSOX3FLEX
Audio serial triggering and analysis (I²S)	DSOX3AUDIO
MIL-STD 1553 and ARINC 429 serial triggering and analysis	DSOX3AERO
USB-PD serial triggering and analysis	DSOXT3UPD
User-definable Manchester/NRZ	DSOXT3NRZ
Measurement applications	
WaveGen 20 MHz arbitary/function generator	DSOX3WAVEGEN
Power analysis application	DSOX3PWR
Frequency Response Analysis (FRA)	DSOXT3FRA
Near field communication testing	DSOXT3NFC
Mask limit testing	DSOX3MASK
Enhanced video/TV application package	DSOX3VID
Productivity tools	
Infiniium Offline oscilloscope analysis software	N8900A
User-defined Application (UDA) software	N5467B/C
BenchVue oscilloscope application	BV0004B
Vector signal analyzer software	89601B (version 20.20 and higher)
Benchlink waveform builder pro and basic	33503A
Application bundle	
	DSOXT3APPBNDL [1] (include DSOX3AERO, DSOX3AUDIO, DSOXT3AUTO, DSOX3COMP, DSOX3EMBD, DSOX3FLEX, DSOX3MASK, DSOX3PWR, DSOXT3SENSOR, DSOX3VID, DSOX3WAVEGEN, DSOXT3NFC, DSOXT3CXPI, DSOXT3NRZ, DSOXT3FRA)

1. These options are compatible with the 3000T X-Series, but are not compatible with the 3000A X-Series.

Configuration (Continued)

Step 3.

Choose your probes.

For a complete list of compatible probes, visit **www.keysight.com/find/scope_probes**. In general, the 3000T X-Series supports up to two active probes simultaneously with some exceptions. Contact Keysight for more detail.

Probes		
N2843A	Passive probe 500 MHz, 10:1, 1 MΩ, 11 pF	Standard (1 per channel)
N2756A	16 digital channel MSO cable	Standard on MSOX models & DSOXT3MSO
N2870A	Passive probe 35 MHz, 1:1, 1 MΩ	Optional
10076C	Passive probe 500 MHz 100:1 attenuation (4 kV)	Optional
N2804A	300 MHz 100:1 differential probe, 4 MΩ, 4 pF, ± 300 V DC+peak AC	Optional
N2805A	200 MHz 100:1 differential probe, 4 MΩ, 4 pF, ± 100 V, 5 m cable	Optional
N2790A	100 MHz 50:1/500:1 high voltage differential probe, 8 MΩ, 3.5 pF, ± 1,400 V	Optional
N2795A	Active single-ended probe 1 GHz 1 pF 1 MΩ with AutoProbe	Optional
N2797A	Active single-ended probe 1.5 GHz extreme temperature	Optional
N2750A	InfiniiMode differential probe 1.5 GHz 700 fF 200 kΩ with AutoProbe	Optional
N2790A	Differential active probe 100 MHz, ± 1.4 kV with auto probe	Optional
N2791A	Differential active probe 25 MHz, ± 700 V	Optional
N2818A	200 MHz 10:1 differential probe with AutoProbe	Optional
N2819A	800 MHz 10:1 differential probe with AutoProbe	Optional
1147B	AC/DC current probe 50 MHz 15 A with auto probe	Optional
N2893A	AC/DC current probe 100 MHz 15 A with auto probe	Optional
N2820A	2-channel high-sensitivity current probe 50 µA to 5 A	Optional
N2821A	1-channel high-sensitivity current probe 50 µA to 5 A	Optional
N7020A	Power rail probe 2 GHz, 1:1, ± 24 V offset range at 50 Ω	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	AC/DC high-sensitivity current probe 150 MHz, 40 Apk with AutoProbe interface	Optional

Step 4.

Choose your accessories.

Recommended accessories		
DSOXLAN	LAN/VGA connection module	Optional
DSOXGPIB	GPIB connection module	Optional
N2747A	Front panel cover	Optional
N6456A	Rack mount kit	Optional
N6457A	Soft carrying case with front panel cover	Optional
Hard transit case	CaseCruzer 3F1112-1510J (available from **http://www.casecruzer.com/**)	Optional

Step 5.

Calibration plans.

Calibration and warranties		
D/MSOX3000T-A6J	ANSI Z540-1-1994 calibration	Optional
D/MSOX3000T-AMG	ISO17025 compliant calibration with accreditation	Optional

Performance Characteristics

DSO and MSO 3000 X-Series oscilloscopes

3000T X-Series specification overview											
		3012T	**3014T**	**3022T**	**3024T**	**3032T**	**3034T**	**3052T**	**3054T**	**3102T**	**3104T**
Bandwidth [1] (–3 dB)		100 MHz		200 MHz		350 MHz		500 MHz		1 GHz	
Calculated rise time (10 to 90%)		≤ 3.5 ns		≤ 1.75 ns		≤ 1 ns		≤ 700 ps		≤ 450 ps	
Input channels	DSOX	2	4	2	4	2	4	2	4	2	4
	MSOX	2 + 16	4 + 16	2 + 16	4 + 16	2 + 16	4 + 16	2 + 16	4 + 16	2 + 16	4 + 16
Maximum sample rate		5 GSa/s half channels, 2.5 GSa/s all channels									
Maximum memory depth		Standard 4 Mpts, Standard segmented memory									
Display size and type		8.5-inch capacitive touch gesture-enabled display									
Waveform update rate		> 1,000,000 waveforms per second									
Vertical system analog channels											
Hardware bandwidth limits		Approximately 20 MHz (selectable)									
Input coupling		AC, DC									
Input impedance		Selectable: 1 MΩ ± 1% (14 pF), 50 Ω ± 1.5%									
Input sensitivity range		100 MHz ~ 500 MHz models: 1 mV/div to 5 V/div [2] (1 MΩ and 50 Ω)									
		1 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		135 Vrms; 190 Vpk									
		Probing technology allows testing of higher voltages. For example, the included N2843A 10:1 probe supports testing up to 300Vrms									
		Use this instrument only for measurements within its specified measurement category (not rated for CAT II, III, IV). No transient overvoltage allowed									
DC vertical accuracy		± [DC vertical gain accuracy + DC vertical offset accuracy + 0.25% full scale] [2]									
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		> 100:1 from DC to maximum specified bandwidth of each model (measured with same V/div and coupling on channels)									
Offset range		± 2 V (1 mV/div to 200 mV/div)									
		± 50 V (> 200 mV/div to 5 V/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.
2. Specifications are valid after a 30-minute warm-up period and ± 10 °C from firmware calibration temperature. 1 mV/div and 2 mV/div are 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.

Performance Characteristics (Continued)

Horizontal system analog channels											
		3012T	**3014T**	**3022T**	**3024T**	**3032T**	**3034T**	**3052T**	**3054T**	**3102T**	**3104A**
Time base range		5 ns/div to 50 s/div		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]		± 1.6 ppm + aging factor (1st year: ± 0.5 ppm, 2nd year: ± 0.7 ppm, 5 years: ± 1.5 ppm, 10 years: ± 2.0 ppm)									
Time base delay time range	Pre-trigger	Greater of 1 screen width or 250 µs									
	Post-trigger	1 s to 500 s									
Channel-to-channel deskew range		± 100 ns									
Δ Time accuracy (using cursors)		± (time base acc. x reading) ± (0.0016 x screen width) ± 100 ps									
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									
Horizontal system digital channels											
Minimum detectable pulse width		5 ns									
Channel-to-channel skew		2 ns (typical); 3 ns (maximum)									
Acquisition system											
Maximum analog channels sample rate		5 GSa/s half channel interleaved, 2.5 GSa/s all channel									
Maximum analog channels record length		4 Mpts half channel interleaved, 2 Mpts all channel									
Maximum digital channels sample rate		1.25 GSa/s all pods									
Maximum digital channels record length		2 Mpts (with digital channels only)									
Acquisition mode	Normal	Default mode									
	Peak detect	Capture glitches as narrow as 250 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 of resolution when ≥ 10 µs/div at 5 GSa/s or ≥ 20-µs/div at 2.5 GSa/s									
	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)									
Time mode	Normal	Default mode									
	Roll	Displays the waveform moving across the screen from right to left. Available at the time base 50 ms/div or slower									
	XY	Displays the volts-versus-volts display. Time base can be set from 200 ns/div to 50 ms/div									

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.

Performance Characteristics (Continued)

Trigger system	
Trigger sources	Analog channel (1 ~ 4), digital channel (D0 ~ D15), line, external, WaveGen (1 or mod) (FM/FSK)
Trigger modes	Normal (triggered): Requires trigger event for scope to trigger
	Auto: Triggers automatically in absence of trigger event
	Single: Triggers only once on a trigger event, press **[Single]** again for scope to find another trigger event, or press **[Run]** 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: Selectable OFF or ON, decreases sensitivity 2x
Trigger holdoff range	40 ns to 10.00 s
Trigger sensitivity	
Internal [1]	< 10 mV/div: Greater of 1 div or 5 mV; ≥ 10 mV/div: 0.6 div
External [1]	200 mVpp from DC to 100 MHz
	350 mVpp 100 MHz to 200 MHz
Trigger level range	
Any channel	± 6 div from center screen
External	± 8 V
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 scans/sec update rate
	Supported modes: normal, peak detect, high resolution
	Also works simultaneously with the serial trigger and mask/limit test
Edge	Trigger on a rising, falling, alternating or either edge of any source
Edge then edge (B trigger)	Arm on a selected edge, wait a specified time, then trigger on a specified count of another selected edge
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), 4 ns (350 MHz), 6 ns (200 MHz), 10 ns (100 MHz)
	Maximum duration setting: 10 s
	Range minimum: 10 ns
Runt	Trigger on a position 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 ~ 10 ns and maximum timesetting of 10 s
	Minimum time setting: 2 ns (500 MHz, 1 GHz), 4 ns (350 MHz), 6 ns (200 MHz)
	10 ns (100 MHz)
Setup and hold	Trigger and clock/data setup and/or hold time violation. Setup time can be set from –7 to 10 s. Hold time can be set from 0 s to 10 ns
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), 2 ns (350 MHz), 3 ns (200 MHz), 5 ns (100 MHz)
	Maximum: 10 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.

Performance Characteristics (Continued)

Trigger type selections	
N^{th} edge burst	Trigger on the Nth (1 to 65535) edge of a pulse burst. Specify idle time (10 ns to 10 s) for framing
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), 4 ns (350 MHz), 6 ns (200 MHz), 10 ns (100 MHz)
	Maximum duration setting: 10 s
	Range minimum: 10 ns
Or	Trigger on any selected edge across multiple analog or digital channels
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 (optional)	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)
USB	Trigger on start of packet, end of packet, reset complete, enter suspend, or exit suspend. Support USB low-speed and full-speed
I^2C (optional)	Trigger at a start/stop condition or user defined frame with address and/or data values. Also trigger on missing acknowledge, address with no accq, restart, EEPROM read, and 10-bit write
SPI (optional)	Trigger on SPI (Serial Peripherial 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
RS-232/422/485/UART (optional)	Trigger on Rx or Tx start bit, stop bit or data content or parity error
I^2S (optional)	Trigger on 2's complement data of audio left channel or right channel (=, ≠, <, >, > <, < >, increasing value, or decreasing value)
CAN (optional)	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)
LIN (optional)	Trigger on LIN (Local Interconnect Network) sync break, sync frame ID, or frame ID and data, parity error, checksum error, frame (symbolic), frame and signal (symbolic)
CXPI (optional)	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
FlexRay (optional)	Trigger on frame ID, frame type (sync, start-up, null, normal), cycle-repetitive, cycle-base, and errors.
MIL-STD 1553 (optional)	Trigger on MIL-STD 1553 signals based on word type (Data or Command/Status), Remote Terminal Address, data, and errors (parity, sync, Manchester encoding)
ARINC 429 (optional)	Trigger 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
SENT (optional)	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 (optional)	Trigger on start-of-frame (SOF), bus value, and Manchester errors
USB PD (optional)	Trigger on preamble, EDP, ordered sets, preamble errors, CRC errors, header content (control messages, data messages, extended messages and value in HEX)

Performance Characteristics (Continued)

Waveform measurements		
Cursors [2]		Single cursor accuracy: ± [DC vertical gain accuracy + DC vertical offset accuracy + 0.25% full scale]
		Dual cursor accuracy: ± [DC vertical gain accuracy + 0.5% full scale] [1]
		Units: Seconds(s), Hz (1/s), phase (degrees), ratio (%)
Automatic measurements		Measurements continuously updated with statistics. Cursors track last selected measurement. Select up to eight measurements from the list below: Snapshot All: Measure all single waveform measurements (31) Voltage: 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 (std deviation), ratio- N cycle, ratio- full screen Time: Period, frequency, counter, + width, - width, burst width, +duty cycle, -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: Area- N cycles, area- full screen
Automatic measurement logging		Available via BenchVue
Counter		Built-in frequency counter
		Source: On any analog or digital channel
		Resolution: 5 digits
		Maximum frequency: Bandwidth of scope
Waveform math		
Number of math functions		Two, displays FFT and one math simultaneously. Can be cascaded
Arithmetic		Add, subtract, multiply, divide, differentiate, integrate, FFT, Ax + B, squared, square root, absolute value, common logarithm, natural logarithm, exponential, base 10 exponential, low pass filter, high pass filter, averaged value, smoothing, envelope, magnify, max hold, min hold, measurement trend, chart logic bus (Timing or State)
Enhanced FFT	Record size	Up to 64 kpts resolution
	Window types	Hanning, Flat Top, Rectangular, Blackman-Harris, Bartlett
	Time gated FFT	Gate the time range of data for FFT analysis in the zoom view. For time and frequency domain correlated analysis.
	Waveforms	FFT, max hold, min hold, average
	Peak search	Max 11 peaks, threshold and excursion control
Search, navigate, and lister		
Type		Edge, pulse width, rise/fall, runt, frequency peak, serial bus 1, serial bus 2
Copy		Copy to trigger, copy from trigger
Frequency peak	Source	Math functions
	Max # of peaks	11
	Control	Results order in frequency or amplitude
Result display		Event lister or navigation. Manual or auto scroll via navigation or touch event lister entry to jump to a specific event
Display characteristics		
Display		8.5-inch capacitive touch/gesture enabled TFT LCD
Resolution		800 (H) x 480 (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 wfms/s
Persistence		Off, infinite, variable persistence (100 ms to 60 s)
Intensity gradation		64 intensity levels

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.

Performance Characteristics (Continued)

WaveGen – Built-in function/arbitrary waveform generator (specifications are typical)	
WaveGen out	Front-panel BNC connector
Waveforms	Sine, Square, Ramp, Pulse, DC, Noise, Sine Cardinal (Sinc), Exponential Rise, Exponential Fall, Cardiac, Gaussian Pulse, and Arbitrary
Modulation	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 (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
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 < 0.1V)
Square wave /pulse	Frequency range: 0.1 Hz to 10 MHz
	Duty cycle: 20 to 80%
	Duty cycle resolution: Larger of 1% or 10 ns
	Pulse width: 20 ns minimum
	Rise/fall time: 18 ns (10 to 90%)
	Pulse width resolution: 10 ns or 5 digits, whichever is larger
	Overshoot: < 2%
	Asymmetry (at 50% DC): ± 1% ± 5 ns
	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%
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 8k points
	Amplitude resolution: 10 bits (including sign bit) [1]
	Repetition rate: 0.1 Hz to 12 MHz
	Sample rate: 100 MSa/s
	Filter bandwidth: 20 MHz

1. Full resolution is not available at output due to internal attenuator stepping.

Performance Characteristics (Continued)

WaveGen – Built-in function/arbitrary waveform generator (specifications are typical) (Continued)		
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: 20 mVpp to 5 Vpp into Hi-Z [1] 10 mVpp to 2.5 Vpp into 50 Ω [1]
		Resolution: 100 µV or 3 digits, whichever is higher
		Accuracy: 2% (frequency = 1 kHz)
DC offset		Range: ± 2.5 V into Hi-Z [1] ± 1.25 V into 50 Ω [1]
		Resolution: 100 µV or 3 digits, whichever is higher
		Accuracy (waveform modes): ± 1.5% of offset setting ± 1% of amplitude ± 1 mV
		Accuracy (DC mode): ± 1.5% of offset setting ± 3 mV
Trigger output		Trigger output available on Trig out BNC
Main output		Impedance: 50 Ω typical
		Isolation: Not available, main output BNC is grounded
		Protection: Overload automatically disables output
Output mode		Normal
		Single-shot (arbitrary, sine, ramp, sine cardinal, exp rise/fall, cardiac, Gaussian pulse)
Digital voltmeter (Specifications are typical)		
Functions		ACrms, DC, DCrms
Resolution		ACV/DCV: 3 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
Precision counter/totalizer (Specification are typical)		
Counter	Source	Any analog channel or trigger qualified event
	Resolution	8 digits (8 digits for trigger qualified event)
	Max frequency	1 GHz
	Trig qual events	1/(trigger hold off time) for trigger qualified events (max 25 MHz, minimum dead time of 40 ns)
Measurement		Frequency, period, totalize
Totalizer	Counter size	64 bit totalizing counter
	Edge	Rise or fall
	Gating	Positive or negative level. Select from analog channels except the source

1. Gaussian Pulse: 4 Vpp maximum into Hi-Z; 2 Vpp maximum into 50 Ω.

Performance Characteristics (Continued)

Connectivity	
Standard ports	One USB 2.0 hi-speed device port on rear panel. Supports USBTMC protocol
	Two USB 2.0 hi-speed host ports, front and rear panel
	Supports memory devices, printers and keyboards
Optional ports	GPIB, LAN (10/100Base-T), WVGA video out
Trigger out	BNC connector on the rear panel. Supported modes: triggers, mask, and waveform generator sync pulse
General and environmental characteristics	
Power line consumption	Max 100 W
Power voltage range	100 to 120 V, 50/60/400 Hz; 100 to 240 V, 50/60 Hz
Environmental rating	5 to 55°C, 4000 m max Maximum Relative Humidity (non-condensing): 95%RH up to 40°C, decreases linearly to 45%RH at 55°C From 40°C to 55°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
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)	381 mm (15 in) x 204 mm (8 in) x 142 mm (5.6 in)
Weight	Net: 4.0 kg (9.0 lbs), shipping: 4.2 kg (9.2 lbs)

Performance Characteristics (Continued)

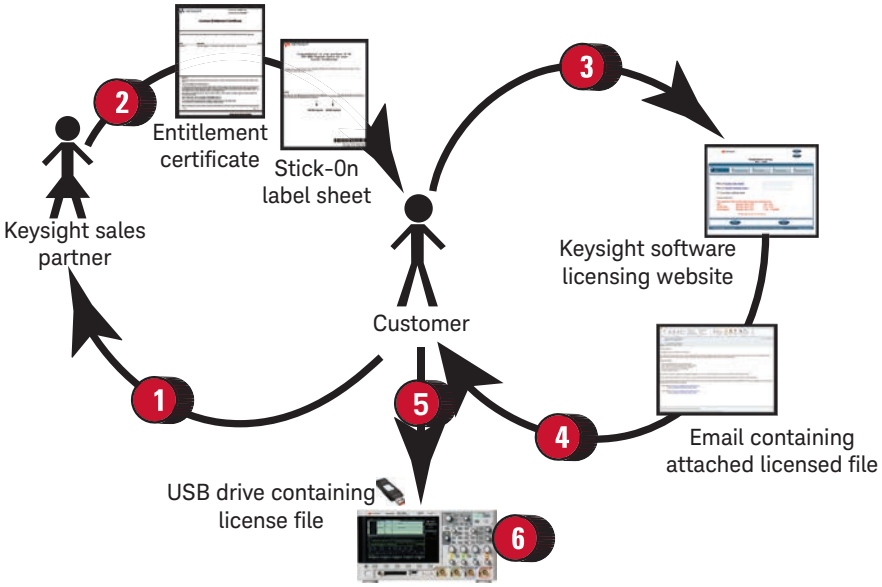
Nonvolatile storage		
Reference waveform display		Two internal waveforms or USB thumb drive. Displays 1 reference waveform at a time
Data/file save	Setup/image	Setup (*.scp), 8 or 24-bit Bitmap image (*.bmp), PNG 24-bit image (*.png)
	Waveform data	CSV data (*.csv), ASCII XY data (*.csv), Binary data (*.bin), Lister data (*.csv), Reference waveform data (*.h5), multi-channel waveform data (*.h5), Arbitrary Waveform data (*.csv)
	Application data	Mask (*.msk), Power harmonics data (*.csv), USB signal quality (*.html & *.bmp)
	Analysis results (*.csv)	Cursor data, measurement results, mask test statistics, search, segmented timestamps
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		Certificate of calibration, 3-year calibration interval
Mean time before failure (MTBF)		> 250,000 hours
Standard secure erase		
Probes		
N2843A Passive probe 500 MHz 10:1 attenuation		1 per channel
N2756A 16 digital channel MSO cable		1 per scope included on all MSO models and DSOXT3MSO
Interface and built-in help language support		English, Chinese (simplified), Chinese (traditional), Czech, French, German, Italian, Japanese, Korean, Portuguese, Russian, Spanish, Polish, Thai, Turkish
Documentation		CD containing localized user's guide, service guide, and programmer's manual
Localized power cord and overlay		

For MET/CAL procedures, click on the Cal Labs solutions link **http://www.callabsolutions.com/products/Keysight/**. These procedures are FREE to customers.

Related literature

Publication title	Publication number
Mask/Waveform Limit Testing For InfiniiVision Series Oscilloscopes - Data Sheet	5990-3269EN
Serial Bus Options for InfiniiVision X-Series Oscilloscopes - Data Sheet	5990-6677EN
DSOX3PWR/DSOX4PWR/DSOX6PWR Power Measurement Options - Data Sheet	5990-8869EN
Triggering on Infrequent Anomalies and Complex Signals using Zone Trigger - Application Note	5991-1107EN
InfiniiVision 3000T X-Series versus Danaher-Tektronix MDO3000 Series Oscilloscopes - Competitive Comparison	5992-0116EN
InfiniiVision 3000T X-Series Oscilloscopes - Product Fact Sheet	5992-0150EN
Using an Oscilloscope Time Gated Fast Fourier Transforms for Time Correlated Mixed Domain Analysis - Application Note	5992-0244EN
DSOXT3NFC/DSOX4NFC Automated NFC Test Software, N2116A/N2134A/N2135A Programmable NFC 3-in-1 Antenna - Data Sheet	5992-1593EN
DSOXT3FRA/DSOX4FRA/DSOX6FRA Frequency Response Analyzer (FRA) Option - Data Sheet	5992-2209EN

License-Only Bandwidth Upgrades and Measurement Applications

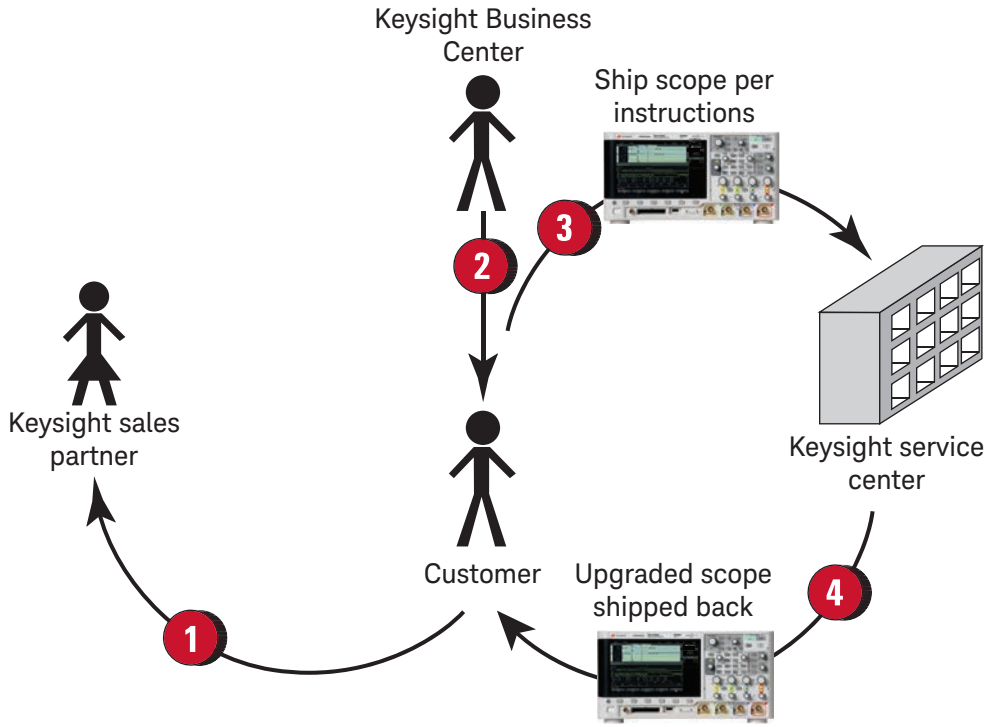


License only bandwidth upgrade models	
3000T X-Series	
DSOXT3B1T22	License only 100 to 200 MHz upgrade, 2 ch
DSOXT3B1T24	License only 100 to 200 MHz upgrade, 4 ch
DSOXT3B3T52	License only 350 to 500 MHz upgrade, 2 ch
DSOXT3B3T54	License only 350 to 500 MHz upgrade, 4 ch
Measurement applications	
DSOX3AERO	MIL-STD 1553 & ARINC 429 serial triggering and analysis
DSOX3AUDIO	Audio serial triggering and analysis (I^2S)
DSOXT3AUTO	Automotive serial triggering and analysis (CAN/CAN-FD/LIN)
DSOXT3CXPI	CXPI serial triggering and decode
DSOX3COMP	Computer serial triggering and analysis (RS232/UART)
DSOX3EMBD	Embedded serial triggering and analysis (I^2C, SPI)
DSOX3FLEX	FlexRay serial triggering and analysis
DSOX3MASK	Mask limit testing
DSOXT3NFC	Near field communication automated PC-based test software and NFC triggering
DSOXT3FRA	Frequency Response Analysis (FRA)
DSOXT3NRZ	User-definable Manchester and NRZ serial triggering and decode
DSOXT3MSO	MSO upgrade: Add 16 digital timing channels (N2756A MSO cable delivered separately)
DSOX3PWR	Power analysis application
DSOXT3SENSOR	Single Edge Nibble Transmission (SENT) trigger and decode
DSOXT3UPD	USB PD serial triggering and decode
DSOX3VID	Enhanced video/TV application package
DSOX3WAVEGEN	WaveGen 20 MHz AWG
DSOXT3APPBNDL	SW application bundle license for 3000T X-Series

1. Place order for a license only bandwidth upgrade or measurement application product to a Keysight sales partner. If multiple bandwidth upgrade steps are needed, order all the corresponding upgrade products required to get from current bandwidth to desired bandwidth.
2. For measurement applications, 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 3000T 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 label to front and rear panels of the oscilloscope. Model number and serial number of the oscilloscope do not change.

1. See next page for return-to-Keysight service center upgrade process for these products.

Return-to-Keysight Service Center Bandwidth Upgrades



Return-to-Keysight bandwidth upgrade models	
3000T X-Series	
DSOXT3B1T32U	Service center 100 to 350 MHz upgrade, 2 ch
DSOXT3B1T52U	Service center 100 to 500 MHz upgrade, 2 ch
DSOXT3B1T102U	Service center 100 to 1 GHz upgrade, 2 ch
DSOXT3B1T34U	Service center 100 to 350 MHz upgrade, 4 ch
DSOXT3B1T54U	Service center 100 to 500 MHz upgrade, 4 ch
DSOXT3B1T104U	Service center 100 to 1 GHz upgrade, 4 ch
DSOXT3B2T32U	Service center 200 to 350 MHz upgrade, 2 ch
DSOXT3B2T52U	Service center 200 to 500 MHz upgrade, 2 ch
DSOXT3B2T102U	Service center 200 MHz to 1 GHz upgrade, 2 ch
DSOXT3B2T34U	Service center 200 to 350 MHz upgrade, 4 ch
DSOXT3B2T54U	Service center 200 to 500 MHz upgrade, 4 ch
DSOXT3B2T104U	Service center 200 MHz to 1 GHz upgrade, 4 ch
DSOXT3B3T102U	Service center 350 MHz to 1 GHz upgrade, 2 ch
DSOXT3B3T104U	Service center 350 MHz to 1 GHz upgrade, 4 ch
DSOXT3B5T102U	Service center 500 MHz to 1 GHz upgrade, 2 ch
DSOXT3B5T104U	Service center 500 MHz to 1 GHz upgrade, 4 ch

1. Place order for a return-to-Keysight Service Center bandwidth upgrade product to a Keysight sales partner. 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.

www.axiestandard.org

AdvancedTCA® Extensions for Instrumentation and Test (AXIe) is an open standard that extends the AdvancedTCA for general purpose and semiconductor test. The business that became Keysight was a founding member of the AXIe consortium. ATCA®, AdvancedTCA®, and the ATCA logo are registered US trademarks of the PCI Industrial Computer Manufacturers Group.

www.lxistandard.org

LAN eXtensions for Instruments puts the power of Ethernet and the Web inside your test systems. The business that became Keysight was a founding member of the LXI consortium.

www.pxisa.org

PCI eXtensions for Instrumentation (PXI) modular instrumentation delivers a rugged, PC-based high-performance measurement and automation system.

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
- 20 GSa/s
- 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 Technologies, Inc. 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 5-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, 8-digit hardware counter, and serial protocol analyzer including USB. All are upgradable, including bandwidth, for the ultimate investment protection.

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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 5 instruments in 1
  - Industry's first fully upgradable 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 a new oscilloscope application bundle that will enable ALL software applications (including serial decode and WaveGen) for one low price (Option DSOX4APPBNDL).

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
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
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 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 (standard)	1 Mpts
Max waveform update rate	> 450,000 wfms/sec	> 1,000,000 wfms/sec	> 1,000,000 wfms/sec	> 200,000 wfms/sec	> 50,000 wfms/sec
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	**Free with registration**
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
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/SPI, UART, CAN/LIN
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
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, 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

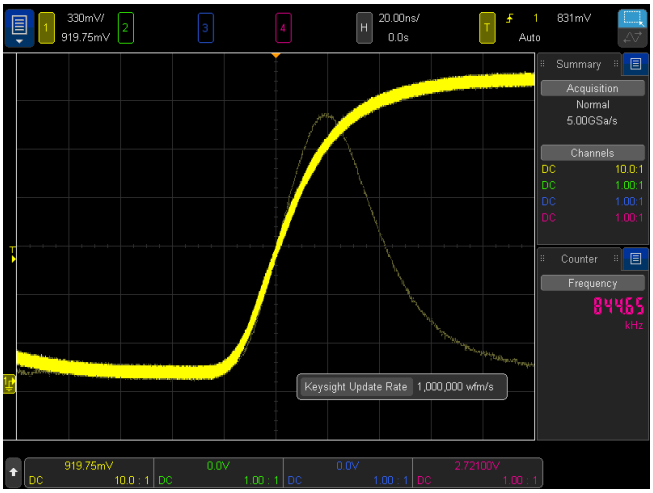


Figure 3. The 4000 X-Series captures a glitch occurring once in a million waveform cycles.

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.

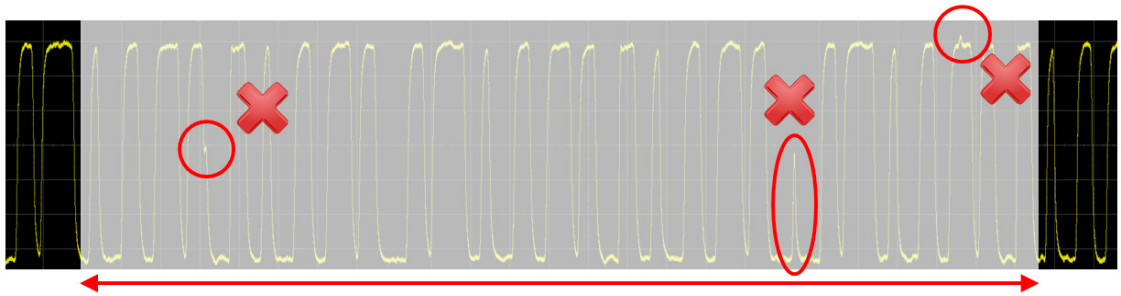


Figure 4. Other vendor's oscilloscope with 50,000 waveforms/second. A long dead time decreases your chances of capturing infrequent events.

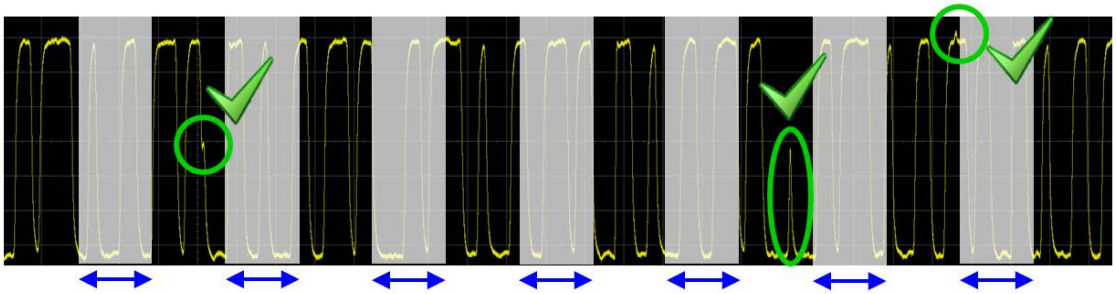


Figure 5. InfiniiVision 4000 X-Series with 1,000,000 waveforms/second. A short dead time increases your chances of capturing infrequent events.

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.

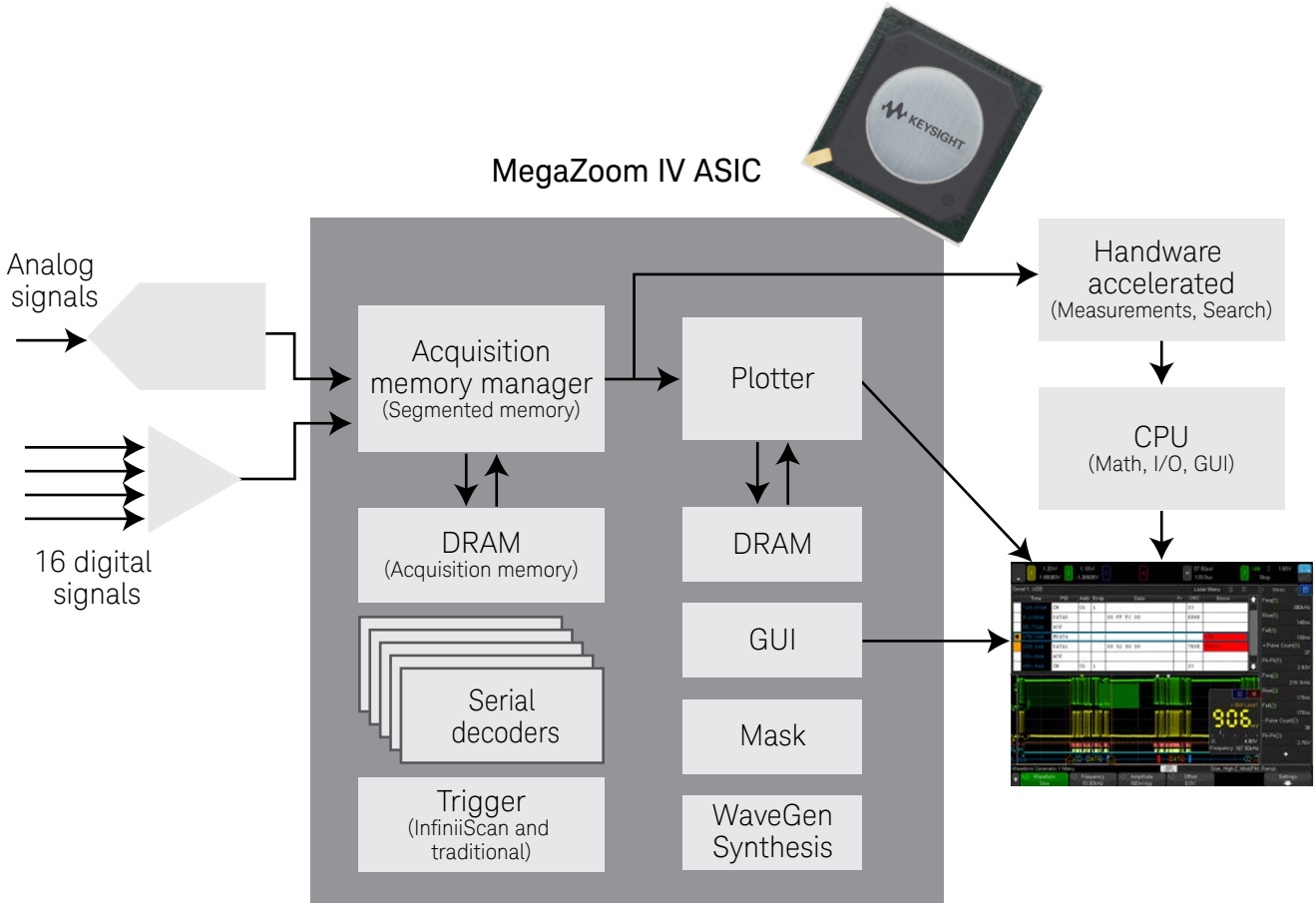


Figure 6. The 4000 X-Series oscilloscopes' uncompromised responsiveness, speed and waveform update rate is enabled by the MegaZoom IV, smart memory ASIC. The CPU is not used for core waveform operations.

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.

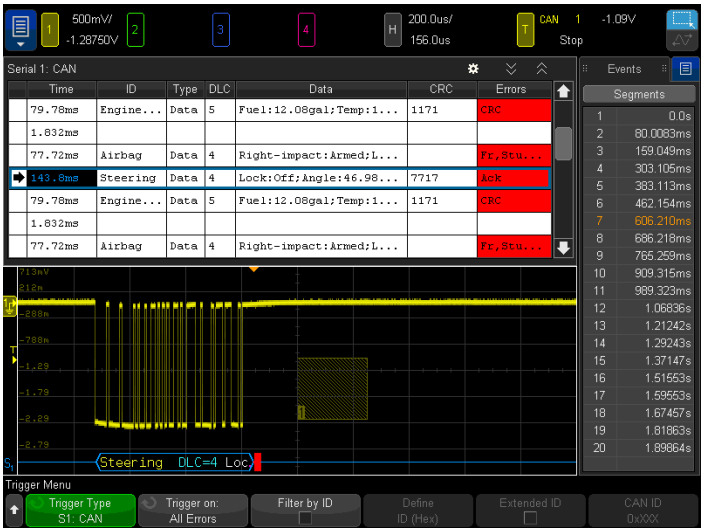


Figure 8. Segmented memory being used in conjunction with serial decode resulting in maximum insight into serial bus.

Oscilloscope Experience Redefined: Experience the Speed (Continued)

Mask/limit testing (option)

Whether you are performing pass/fail tests to specified standards in manufacturing or testing for infrequent signal anomalies, mask/limit testing can be a valuable productivity tool (DSOX4MASK). 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.

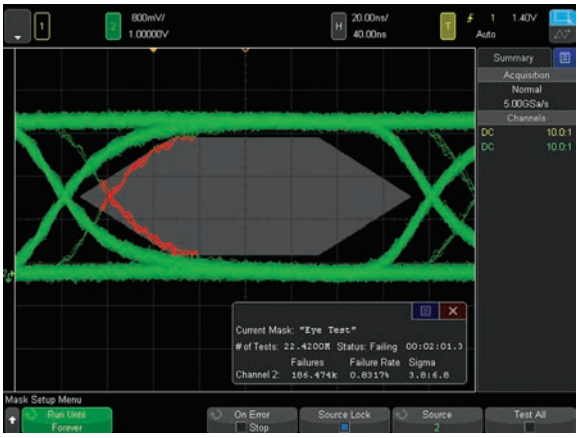


Figure 9. Mask testing evaluated > 22 M waveforms in just 2 minutes.

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.

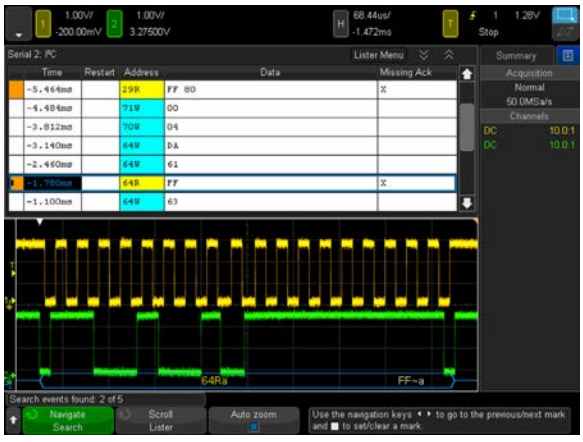


Figure 11. Using the error condition search, the 4000 X-Series quickly found 5 places with a missing acknowledgment in an I²C serial bus. The navigation feature moves between the errors and zooms automatically to show the error packet.

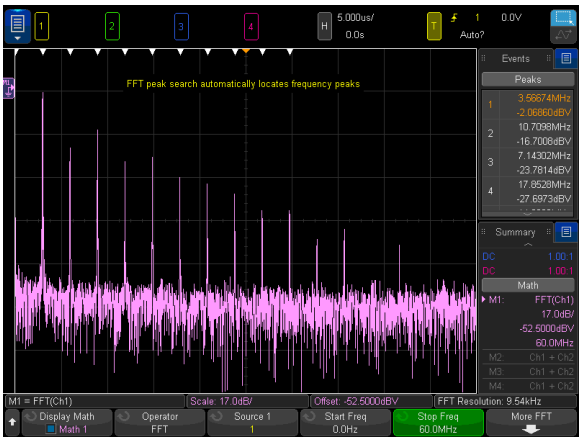


Figure 10b. The 4000 X-Series was set up to capture clock signals for FFT analysis. Using the search and navigation capability, the scope found, marked (white triangles) and quickly navigated to the first 11 frequency peaks occurrences. You can sort it in the order of frequency or amplitude.

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.

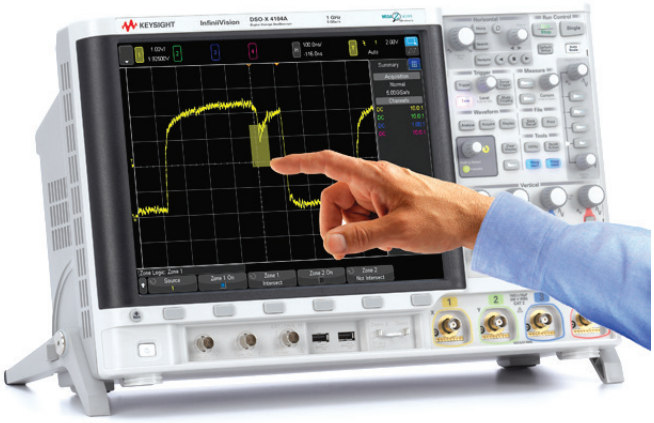


Figure 12. The industry's largest 12.1-inch display and capacitive touch screen technology with large, touchable targets.

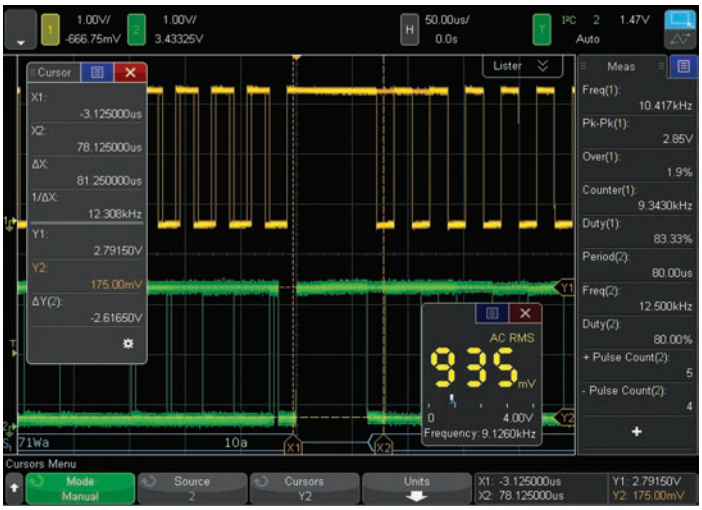


Figure 13. See 10 measurements, cursor information, and the DVM simultaneously by dragging the desired docking panel to any open area.

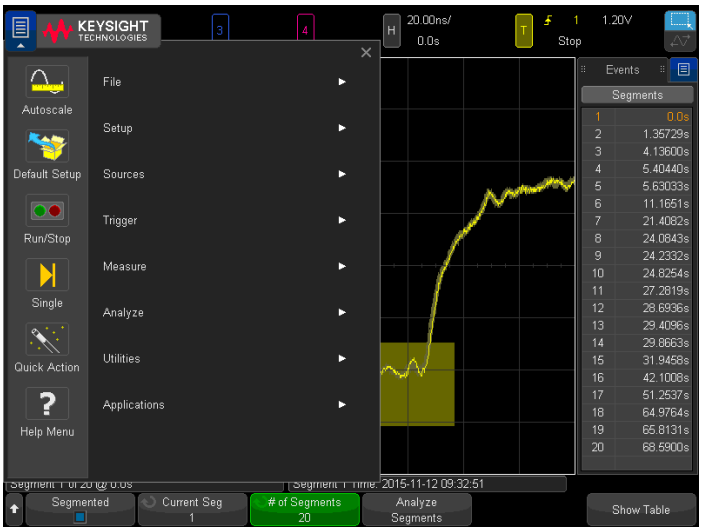


Figure 14. Use the Keysight pull-down menu for Windows-like operation.

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.

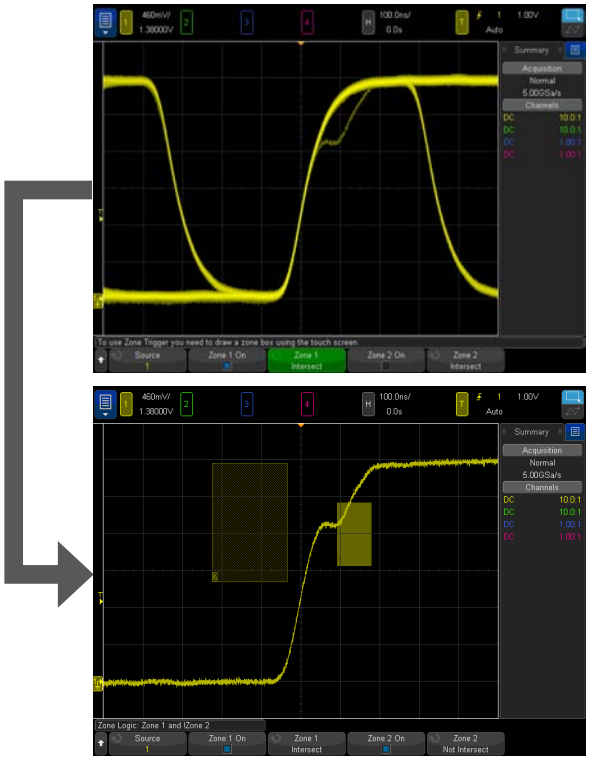


Figure 15. When you see anomalies, all you have to do is draw a zone box to trigger on them.

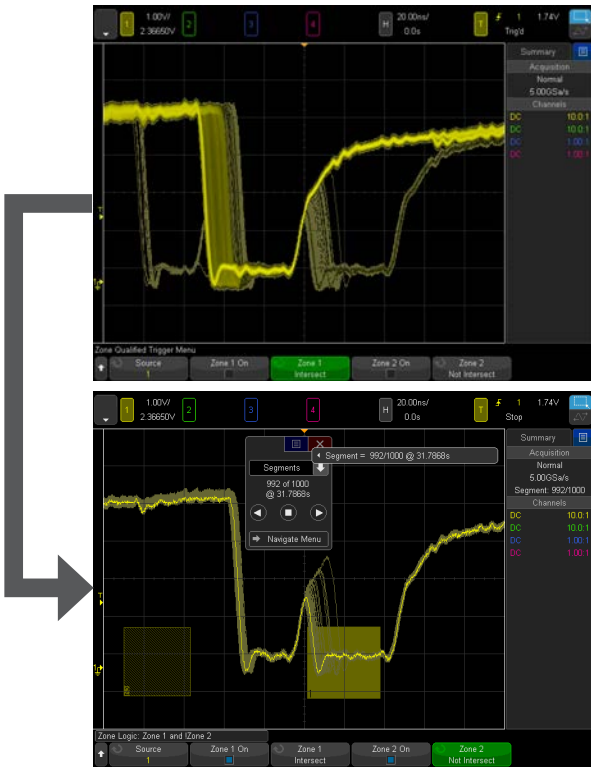


Figure 16. Combination of the zone touch trigger and segmented memory.

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
- 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 I^2C 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)

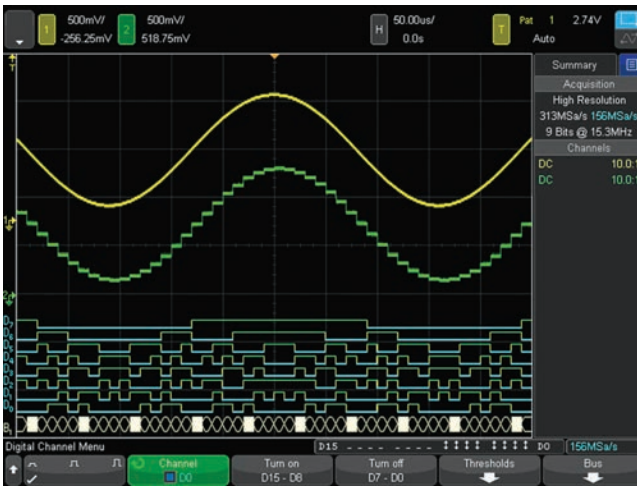


Figure 19. Digital channels are captured and displayed time-correlated with analog channels in MSOs or upgraded DSOs.

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 has: SENT, I^2C, SPI, USB 2.0, RS232/UART, CAN, CAN FD, LIN, FlexRay, CXPI, MIL-STD 1553, ARINC 429, I^2S, 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: Industry-exclusive

The 4000 X-Series offers the industry's only 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 free 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 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.

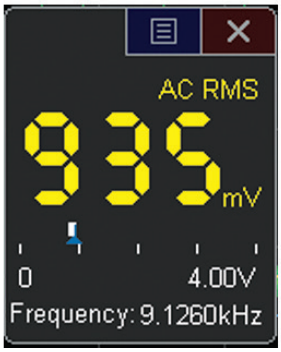


Figure 25. DVM 3-digit voltage and 5-digit frequency measurements always at your fingertips.

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

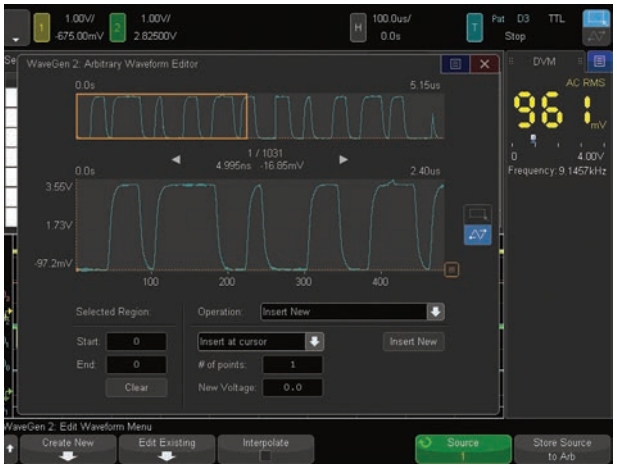


Figure 23. WaveGen arbitrary waveform editing screen.

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 measurements application (DSOX4PWR) provides a full suite of power measurements and analysis in the oscilloscope.

Included with the DSOX4PWR is a license for the U1881A PC-based power analysis software package, which provides additional offline measurements and report generation.

See **www.keysight.com/find/DSOX4PWR** for more information.

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, the HDTV measurement application (DSOX4VID) provides support for a variety of HDTV standards for triggering and analysis.

See **www.keysight.com/find/DSOX4VID** for more information.

Figure 27. Triggering on 1080p HDTV signal analysis.

USB 2.0 signal quality analysis

With the USB 2.0 signal quality test option (DSOX4USBSQ), designers of systems with USB interfaces can now perform automated signal quality testing. This option supports low-speed, full-speed, and hi-speed applications (hi-speed tests require 1.5 GHz models). 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.

See **www.keysight.com/find/DSOX4USBSQ** for more information.

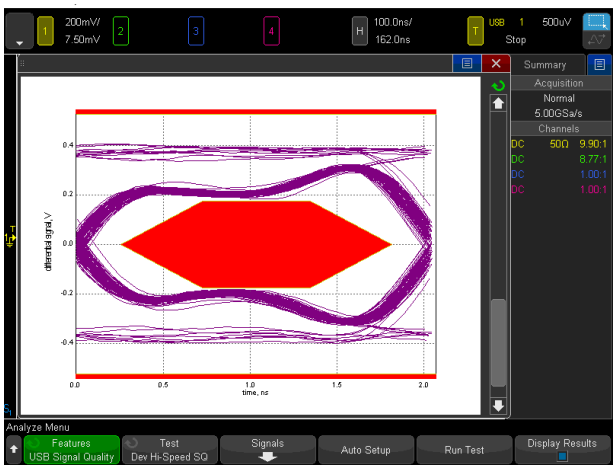


Figure 28. Perform automatic signal quality testing on USB 2.0 low-speed, full-speed, and hi-speed signals.

Oscilloscope Experience Redefined: Other Key Productivity Tools (Continued)

Frequency Response Analysis (FRA) option

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 licensed with the DSOX4FRA option 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.

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

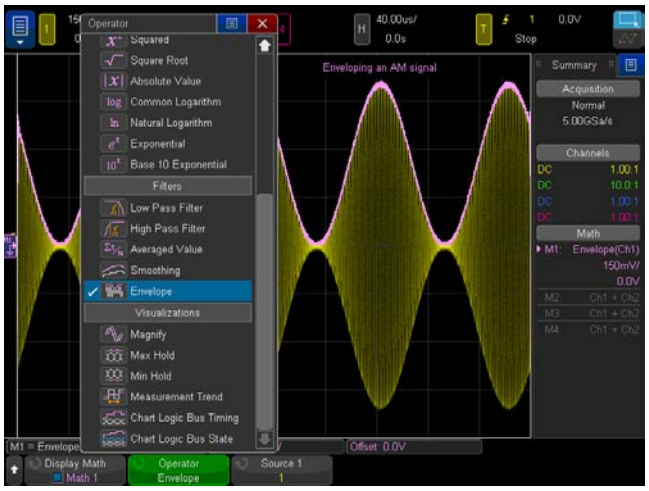


Figure 31. A variety of advanced math functions are standard in the 4000 X-Series.

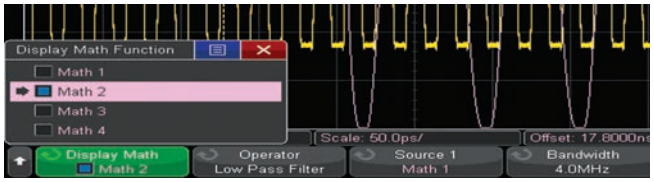


Figure 32. Four math functions can be created and nested with one resultant math function.

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.

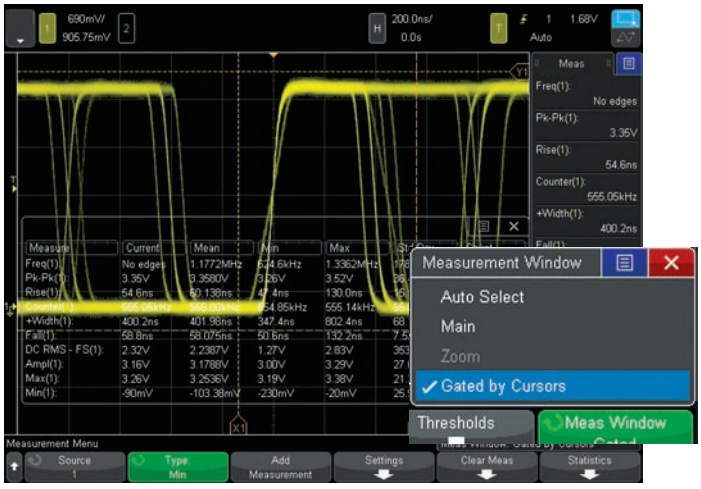


Figure 33. Up to 10 automated measurements displayed simultaneously. Measurements can be gated by cursors.

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 measurement, 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.

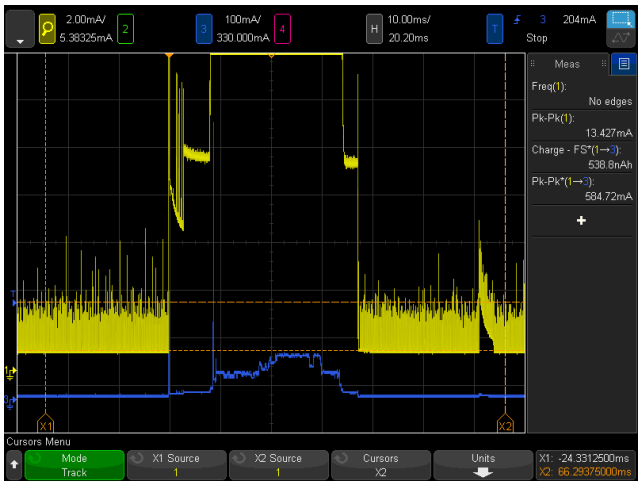


Figure 36. The 4000 X-Series and N2820A Series high-sensitivity current probe measuring > 500 mA and < 1 mA current simultaneously.

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 application within BenchVue 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.**

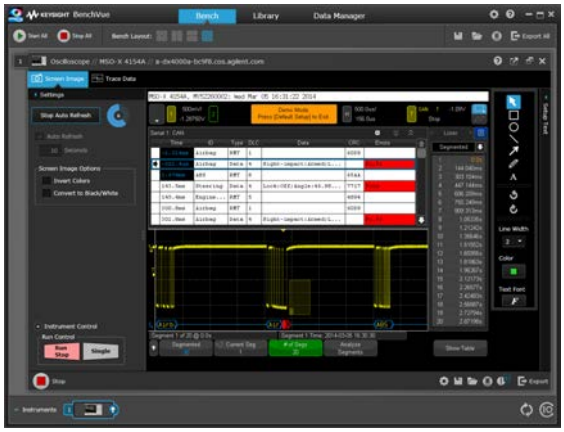


Figure 37. BV0004B BenchVue.

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.

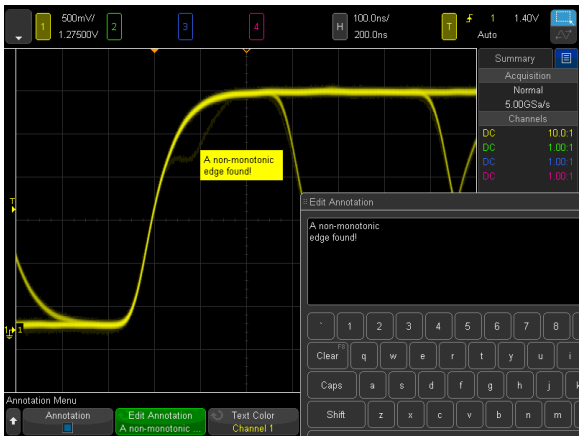


Figure 39(a). Annotation and keypad.

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.

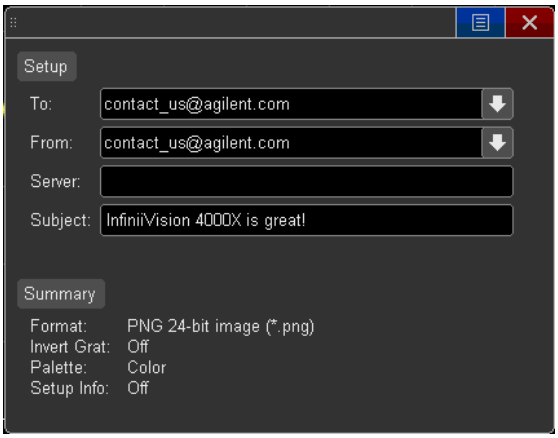


Figure 39(b). E-mail configuration screen.

Oscilloscope Experience Redefined: Other Key Productivity Tools (Continued)

Infinium Offline oscilloscope analysis software

Keysight's Infiniium Offline PC-based oscilloscope analysis software (N8900A) 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.

For more information, go to: **www.keysight.com/find/N8900A**.

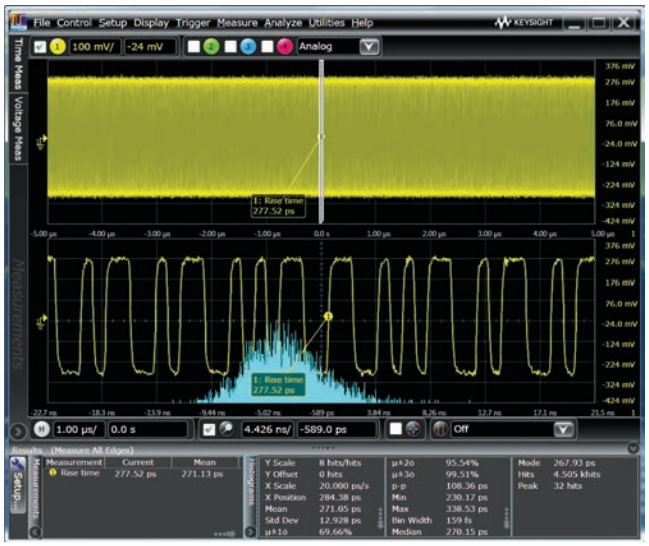


Figure 40. Infiniium Offline enables a variety of advanced signal analysis while providing extensive, yet intuitive, waveform documentation.

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.

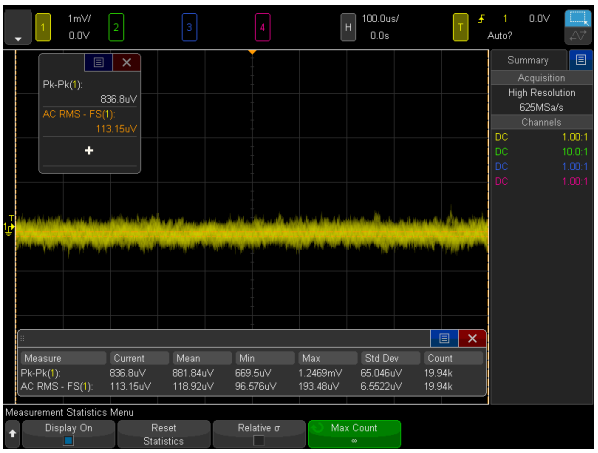


Figure 42. Getting 113 uVrms noise floor at 1 mV/div with the high resolution mode.

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.

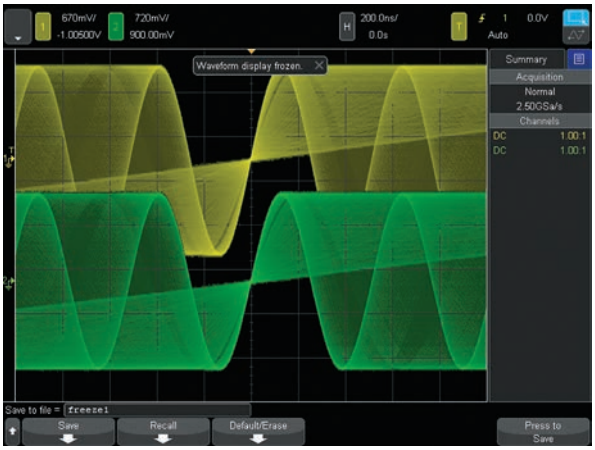


Figure 44. The "freeze screen" feature keeps the intensity-grading information while stopping the waveform acquisition.

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. Tailor your oscilloscope with integrated capabilities and measurement applications to save time and money. After purchase upgrade model numbers are listed below (values in parentheses are factory-installed option numbers)

Description	Model number
Enables all software options listed below	DSOX4APPBNDL
Serial protocols	
Embedded serial triggering and decode (I²C, SPI)	DSOX4EMBD(-EMB)
Computer serial triggering and decode (RS232/UART)	DSOX4COMP(-CMP)
USB 2.0 Full/Low Speed serial triggering and decode	DSOX4USBFL(-USF)
USB 2.0 Hi-Speed serial triggering and decode	DSOX4USBH(-U2H) [1]
Automotive serial triggering and decode CAN/CAN-FD/CAN-dbc/LIN/LIN symbolic	DSOX4AUTO(-AMS)
FlexRay serial triggering and decode	DSOX4FLEX(-FLX)
Single edge nibble transmission triggering and decode (SENT)	DSOX4SENSOR(-SEN)
CXPI serial triggering and decode	DSOX4CXPI(-CXP)
Audio serial triggering and decode (I²S)	DSOX4AUDIO(-SND)
Aerospace and defence serial triggering and decode (MIL-STD 1553, ARINC 429)	DSOX4AERO(-AER)
User-definable Manchester/NRZ triggering and decode	DSOX4NRZ
USB PD serial triggering and decode	DSOX4UPD
Measurement applications	
Dual-channel WaveGen 20 MHz arbitrary/function generator	DSOX4WAVEGEN2(-WAV)
Power analysis application	DSOX4PWR(-PWR)
Frequency Response Analysis (FRA)	DSOX4FRA
Mask limit testing	DSOX4MASK(-MSK)
Enhanced video/TV application package	DSOX4VID(-VID)
USB 2.0 signal quality test option	DSOX4USBSQ(-U2Q) [2]
NFC trigger and automated test software	DSOX4NFC
Productivity tools	
Infiniium Offline oscilloscope analysis software	N8900A
User-definable Application (UDA) PC-based test automation software	N5467B/C
Vector signal analyzer software (version 16 and higher)	89601B
BenchVue Software	BV0004B

1. DSOX4USBH is only available for 1 GHz and 1.5 GHz models.
2. USB 2.0 hi-speed tests require 1.5 GHz models.

See page 35 for more detailed upgradability and installation process information.

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

Step 3. 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
N2792A differential active probe 200 MHz, ± 20 V	Optional
N2793A 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 4. Choose your accessories

Recommended accessories	4000 X-Series
GPIB-to-LAN external adapter	N4865A
Rack mount kit	N2763A
Soft carrying case	N2733B
Hard copy manual	N6455A

Step 5. Calibration plans

Calibration		
D/MSOX4000-A6J	ANSI Z540-1-1994 calibration	Optional
D/MSOX4000-AMG	Calibration + Uncertainties + Guardbanding (Accredited)	Optional

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	Standard 4 Mpts, standard segmented memory								
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 300Vrms					
				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 us/div – 9 bits: ≥ 5 us/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							
	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	
InfiniiScan 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

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

Trigger type selections		
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
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)
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:
	Voltage	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	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	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		Standard 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)
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)	
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, decreases linearly to 50%RH at 50°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

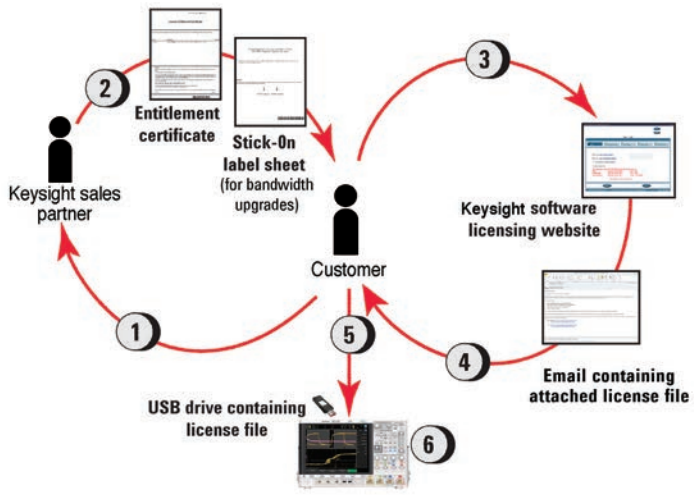
Included standard with oscilloscope	
Calibration	Certificate of Calibration, 2-year calibration interval
Probes	One per channel N2894A 700 MHz passive probe (10:1 attenuation)
	N2756A 16-digital-channel MSO cable (1 per oscilloscope included on all MSO models and DSOXPERFMSO)
Localized interface	English, 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
Oscilloscope Memory Architectures – Why All Acquisition Memory is Not Created Equal - Application Note	5991-1024EN
Triggering on Infrequent Anomalies and Complex Signals using Zone Trigger - Application Note	5991-1107EN
Switch Mode Power Supply Measurements - Application Note	5991-1117EN
Characterizing Hi-Speed USB 2.0 Serial Buses In Embedded Designs - Data Sheet	5991-1148EN

Oscilloscope Experience Redefined: License-only Bandwidth Upgrades and Measurement Applications



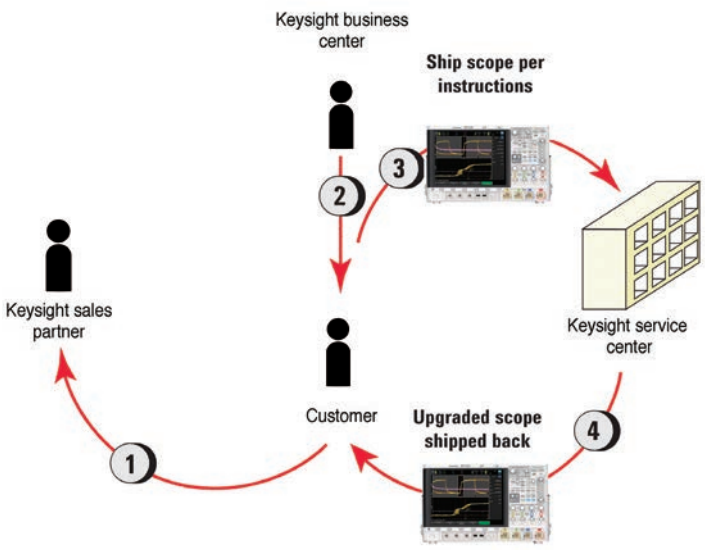
4000 X-Series bandwidth upgrade models		
Model number	**Description**	**Type**
DSOX4B3T52U	350 MHz ~ 500 MHz, 2 ch	License only
DSOX4B3T54U	350 MHz ~ 500 MHz, 4 ch	License only

Model number	Description
DSOX4EMBD	Embedded serial triggering and analysis (I²C, SPI)
DSOX4COMP	Computer serial triggering and analysis (RS232/UART)
DSOX4USBFL	USB 2.0 Full/Low Speed serial decode and triggering
DSOX4USBH [1]	USB 2.0 Hi-Speed serial decode and triggering
DSOX4USBSQ	USB 2.0 signal quality test
DSOX4UPD	USB PD serial triggering and decode
DSOX4AUTO	Automotive serial triggering and analysis (CAN/CAN-dbc/LIN)
DSOX4FLEX	FlexRay serial triggering and analysis
DSOX4CXPI	CXPI serial triggering and decode
DSOX4AUDIO	Audio serial triggering and analysis (I²S)
DSOX4AERO	Aerospace and defence serial triggering and decode (MIL-STD 1553 and ARINC 429)
DSOX4NRZ	User-definable Manchester and NRZ triggering and decode
DSOX4WAVEGEN2	Dual-channel WaveGen 20 MHz arbitrary/function generator
DSOX4PWR	Power analysis application
DSOX4FRA	Frequency Response Analysis (FRA)
DSOX4MASK	Mask Limit Testing
DSOX4VID	Enhanced video/TV application package
DSOXPERFMSO	4000 X-Series oscilloscope MSO upgrade (N2756A MSO cable is shipped separately)
DSOX4NFC	NFC triggering and automated test software

1. DSOX4USBH is available only for 1 GHz and 1.5 GHz models.

Process description	
1	Place order for a license-only upgrade or measurement application product with a Keysight sales partner.
2	For measurement applications, 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.

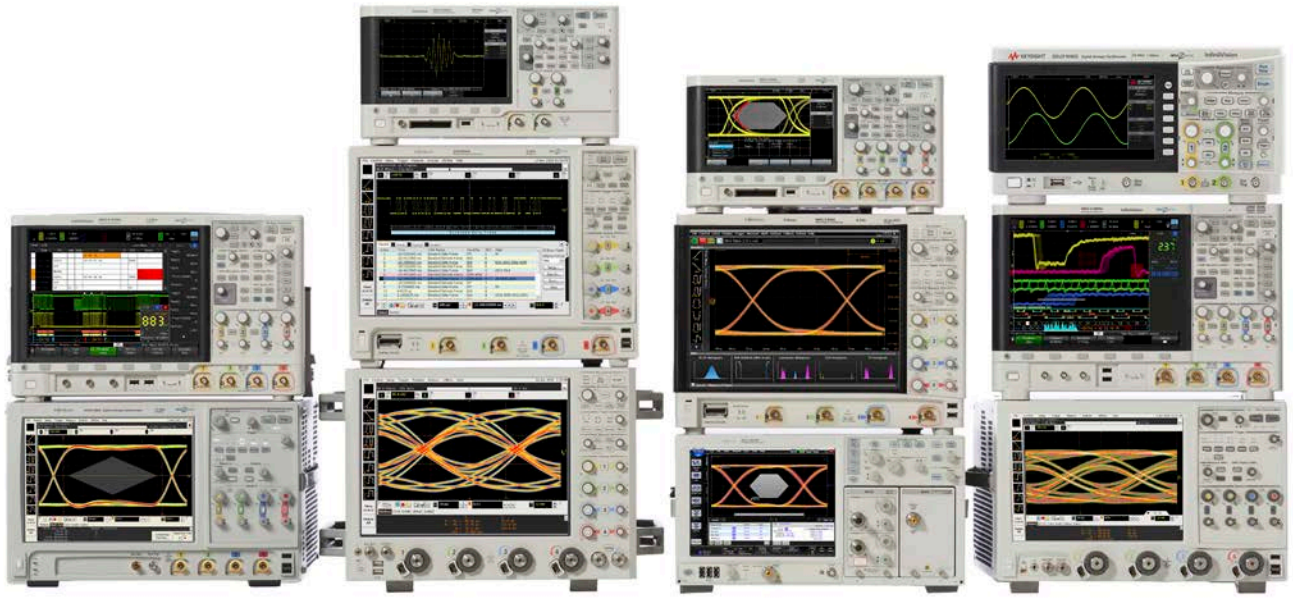
Oscilloscope Experience Redefined: Return-to-Keysight Service Center Bandwidth Upgrades



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 20 MHz to > 90 GHz | Industry-leading specs | Powerful applications

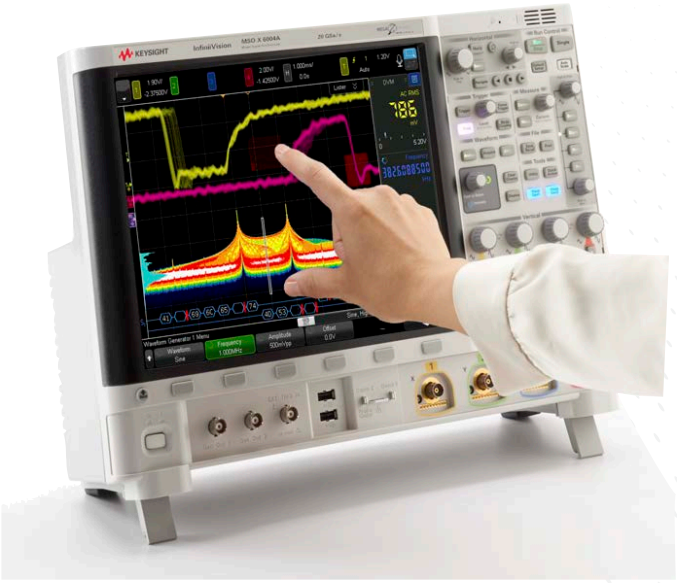
Learn more at: www.keysight.com

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 6000 X-Series Oscilloscopes



KEYSIGHT TECHNOLOGIES

Table of Contents

Need more memory, bandwidth, analysis capability, or bits?

Consider the Infiniium S-Series

- 500 MHz, 1 GHz, 2 GHz, 2.5 GHz, 4 GHz, 6 GHz, 8 GHz
- 20 GSa/s
- 100 Mpts standard, up to 800 Mpts optional (half channel)
- 4 channels + 16 digital channels (MSO or upgrade)
- 10 bits of vertical resolution
- Industry's largest 15-inch touch display
- Widest range of applications including serial compliance, jitter analysis and more

See **www.keysight.com/find/S-Series** for details.

New Standard for Price Performance: Bandwidth, Visualization, and Integration

In the past, if you wanted an oscilloscope with exceptional performance, you could expect to pay a premium. Not anymore. The InfiniiVision 6000 X-Series oscilloscopes combine price and performance to set a new standard in the portable oscilloscope world. Imagine a 6 GHz bandwidth oscilloscope that sees and triggers on everything, helps you visualize complex waveforms and grows with your projects.

The InfiniiVision 6000 X-Series oscilloscopes are designed for the most demanding engineers who want bandwidth, visualization power and the flexibility that comes with integrated capabilities – but with portability, a familiar embedded OS user interface, and an affordable price.

New bandwidth standard: Capture higher-frequency waveforms

An oscilloscope's bandwidth determines the maximum frequency content it can acquire and visualize. In today's budget-challenged environment, engineers frequently are forced to make compromises between more bandwidth and limited budget. The 6000 X-Series delivers the answer with an affordable 6-GHz bandwidth and an incredibly low noise floor of 210 µVrms at 1 mV/div to help you make the most accurate measurements.

New visualization standard: Isolate waveforms of interest

The new InfiniiVision 6000 X-Series' 450,000 waveforms-per-second update rate coupled with the exclusive hardware-based zone touch trigger provide unprecedented visualization power to help you isolate your waveforms of interest. Add a whole new depth of "visualization" to your designs with features like the industry's first 12-inch multi-touch capacitive touch screen with gesture support, the first embedded-OS-oscilloscope optional jitter/real-time eye analysis, and standard histogram and color grade.

New integration standard: Make your job easier

The 6000 X-Series has 7-in-1 integration, combining digital channels, serial protocol analysis, a built-in dual-channel waveform generator, frequency response analysis, built-in digital multimeter, and built-in 10-digit counter with totalizer. It also integrates multi-language voice control for the first time in an oscilloscope. It weighs only 6.8 kg, measures only 15.4 cm deep, and consumes only 200 W, making the 6000 X-Series the world's most environmentally-friendly multi-GHz portable oscilloscope.

The InfiniiVision 6000 X-Series sets the new standard.

Key features of the 6000 X-Series oscilloscopes

New bandwidth standard:

- Portable, 6-GHz, 20-GSa/s
- 210-µVrms noise floor at 1 mV/div (6 GHz)
- 115-µVrms noise floor at 1 mV/div (1 GHz)

New visualization standard:

- > 450,000 wfms/sec update rate
- Hardware zone touch trigger
- 12.1-inch capacitive multi-touch screen
- Histogram, color grade, jitter analysis (option), real-time eye diagram analysis (option), and more

New integration standard:

- 7 instruments in 1 (now with 10-digit counter)
- Standard multi-language voice control
- Bandwidth and options are upgradable

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Overview of the 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
Digital channels (MSO)	16	16	16	8	External trigger can be used as a 3rd digital channel
Bandwidth (upgradable)	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 MHz
Max sampling 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	Up to 1 Mpts standard
Max waveform update rate	> 450,000 waveforms/sec	> 1,000,000 waveforms/sec	> 1,000,000 waveforms/sec	> 200,000 waveforms/sec	> 50,000 waveforms/sec
Display	12.1 inches, capacitive, multi-touch, gesture enabled	12.1 inches, capacitive	8.5 inches, capacitive	8.5 inches	7 inches
Zone trigger	Standard	Standard	Standard	No	No
Voice control	Standard	No	No	No	No
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 (standard on G models)
Integrated DVM	Standard	Standard	Standard	Standard	**Free with registration**
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	8-digit frequency counter
Search and navigate	Standard with lister	Standard with lister	Standard with lister	Standard	No
Segment memory	Standard	Standard	Standard	Standard	Standard on DSO models
Mask/limit test	Option	Option	Option	Option	Standard on DSO models
Serial protocol analysis options	I^2C/SPI, UART, CAN/CAN-FD, LIN, FlexRay, SENT, I^2S, MIL-STD1553/ ARINC429, USB 2.0, CXPI, Manchester/NRZ, USB PD	I^2C/SPI, UART, CAN/CAN-FD, LIN, FlexRay, SENT, I^2S, MIL-STD1553/ ARINC429, USB 2.0, CXPI, Manchester/NRZ, USB PD	I^2C/SPI, UART, CAN/ CAN-FD, LIN, FlexRay, SENT, I^2S, MIL-STD1553/ARINC429, CXPI, Manchester/ NRZ, USB PD	I^2C/SPI, UART, CAN/ LIN (will not operate simultaneously with digital channels)	I^2C/SPI, UART, CAN/ LIN
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
Color grade	Standard	No	No	No	No
Histogram	Standard	No	No	No	No
Spectrum analysis	Standard enhanced FFT	Standard enhanced FFT	Standard enhanced FFT	Standard	Standard
Multi-domain analysis	Gated FFT	Gated FFT	Gated FFT	No	No
Jitter analysis	Option	No	No	No	No
Real-time 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, USB keyboard support

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Bandwidth

Superior signal integrity with total-cost- of-ownership leadership 6 GHz, 20 GSa/s

When you choose your next oscilloscope, bandwidth is the most important specification to consider, as it defines the maximum frequency content your oscilloscope can acquire. Acquiring signals with faster edge rates or faster fundamental frequencies requires higher-bandwidth scopes to make the most accurate measurements. However, the higher the bandwidth of your oscilloscope, the higher the price is likely to be.

Sample rate is the second important specification, as it determines the time span between each acquired sample point, and it ultimately becomes the limiting factor of the oscilloscope's bandwidth. In a modern oscilloscope with Brickwall filter response, the sample rate must be at least 2.5 times higher the bandwidth. So a scope with 6-GHz bandwidth requires a sample rate of at least 15 GSa/s to avoid aliasing.

With the InfiniiVision 6000 X-Series, you can get up to 6-GHz bandwidth and a 20-GSa/s sampling rate so you can confidently measure signals with rise times faster than 150 ps or signals with higher than 2-Gbps NRZ (non-return to zero) data signal rates.

Explore Figures 1 through 4 to see the power extra bandwidth delivers to your measurements.

Figure 1. Measuring the rise time of a 130-ps rise-time edge (10 to 90%). The rise time measurement by

- Channel 1 at 6-GHz bandwidth (yellow): 132 ps
- Reference 1 (R1) at 3-GHz bandwidth limit: 196 ps
- Reference 2 (R2) at 1.5-GHz bandwidth limit: 216 ps

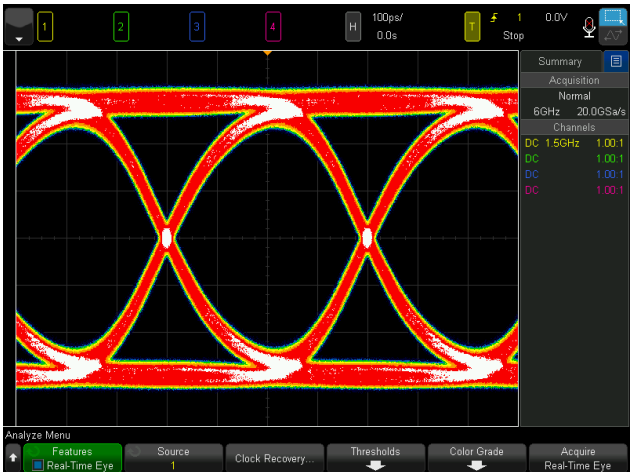


Figure 2. An oscilloscope with 1.5-GHz bandwidth captures only the fundamental frequency of a 2.5-Gbps PRBS signal.

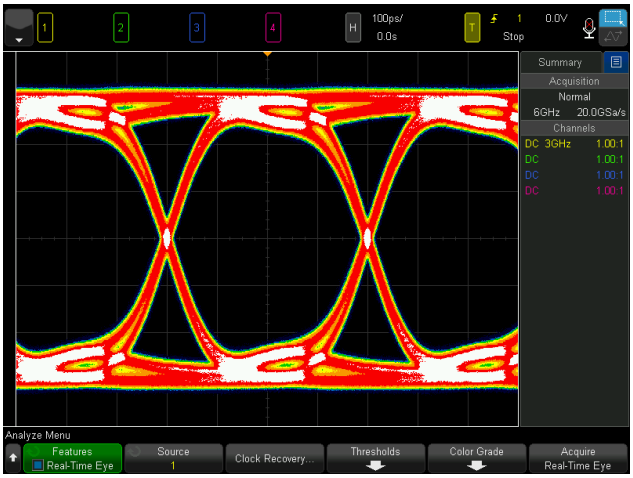


Figure 3. An oscilloscope with 3-GHz bandwidth sees some of the 3rd harmonic of a 2.5-Gbps PRBS signal.

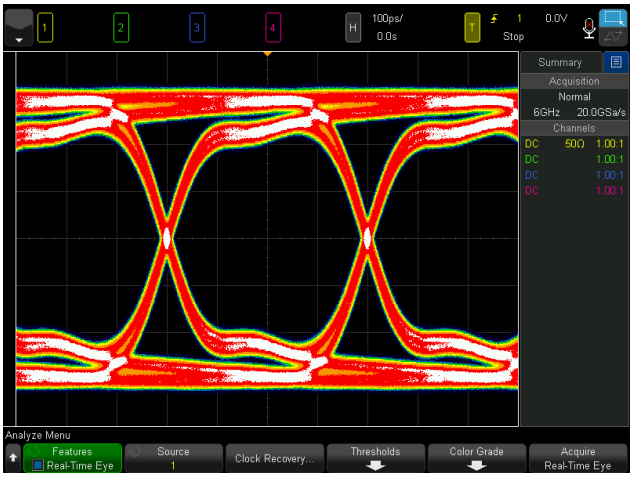


Figure 4. An oscilloscope with 6-GHz bandwidth sees up to the 5th harmonic of the 2.5-Gbps PRBS signal. You see the true signal integrity of your waveform.

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Bandwidth (Continued)

6 GHz Noise floor: 210 µVrms at 1 mV/div

Accurate signal integrity measurements with an oscilloscope start with a low noise floor. With an innovative all-new front-end ASIC, the 6000 X-Series achieves a 210-µVrms noise floor at 1 mV/div for 6-GHz bandwidth or 115-µVrms noise floor at 1 mV/div for 1-GHz bandwidth, helping you to make the most precise measurements.

More bandwidth may not be the best solution when you are making low-noise measurements, as the additional bandwidth captures additional high-frequency noise along with high-frequency signal content. To make the best measurements, you need the appropriate bandwidth for your application. The 6000 X-Series oscilloscopes have standard hardware bandwidth limit filters in addition to software low-pass math function filters, so you can set the best bandwidth for your application.

An added bonus: the new front-end technology allows you to upgrade bandwidth from any bandwidth point with a simple software license installation.

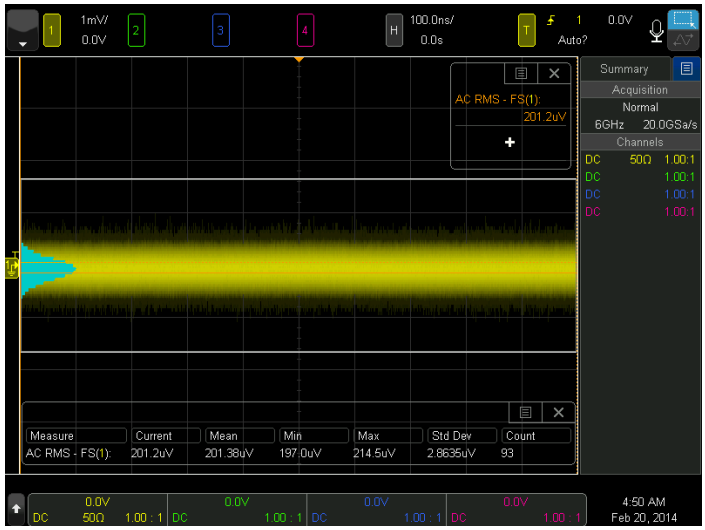


Figure 6. Measuring the noise floor of a 6-GHz scope at 1 mV/div.

Superior form factor: 6 GHz, 6 inches deep

Have you carried around your 6-GHz oscilloscope lately? With the 6000 X-Series, the multi-GHz bandwidth no longer necessitates enormous size, weight, and power consumption. At only 6 inches (154 mm) deep and 15 lbs. (6.8 kg), the ultra-compact form factor consumes a maximum of only 200 watts, so you can enjoy portability and performance at the same time.

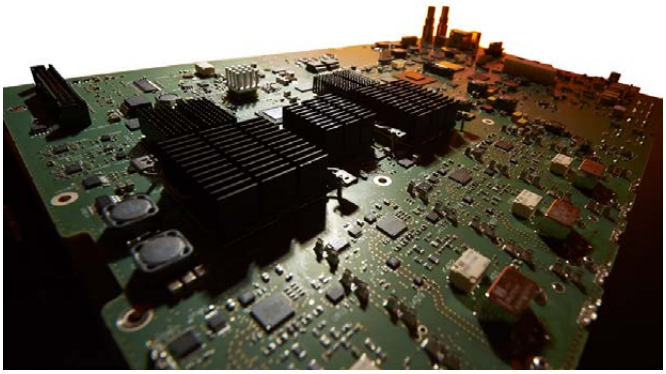


Figure 5. The new 6-GHz front-end design.

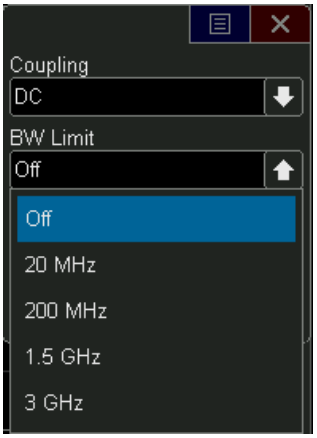


Figure 7. You can set the hardware bandwidth limit control interface per channel at any time.

Figure 8. One- gigahertz-per-inch form factor: 6 GHz, 6 inches deep.

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Visualization

The power of visualization: If you can't see it, you can't fix it

Troubleshooting always starts with an acknowledgment of the problem, and a visual confirmation adds confidence in engineering troubleshooting. The feature-rich 6000 X-Series oscilloscopes include numerous visualization features offered for the first time in embedded-OS-class oscilloscopes.

Use the 6000 X-Series' 12.1-inch multi-touch screen just like you use your tablet or smartphone

See your waveforms clearly on the large 12.1-inch display and discover how easy it is to troubleshoot your designs with a multi-touch screen with gesture controls. Use the large, easily touchable targets on the capacitive display and enjoy the fast, responsive user interface. Pinch and zoom with your fingers to control your signals and functions. Swipe and stop waveforms and menus for easy operation.

Visualize the anomalies: More than 450,000 waveforms-per-second update rate

Finding infrequent anomalies is a tedious task. With the ultrafast 450,000 waveforms-per-second update rate, the InfiniiVision 6000 X-Series gives you the highest probability of capturing random and infrequent events that you would miss on oscilloscopes with lower waveform update rates.

Powered by MegaZoom IV technology, the 6000 X-Series lets you see more waveforms and find the most difficult problems in your design. Unlike other oscilloscopes, uncompromised waveform update rate delivers:

- Quick, responsive operation at all times
- Fast update rate
  - with the digital channels on
  - with the protocol decoding on
  - with the math functions turned on
  - with the measurements turned on

Figure 9. Multi-touch operation.

Figure 10. The ultrafast waveform update rate of the 6000 X-Series revealed the existence of rare glitches.

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Visualization (Continued)

Visualize by ultimate isolation: The 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, setting them up can slow you down. The 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 with your finger. What used to take 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 6000 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. Unlike other software-based graphical trigger solutions, the hardware-based zone triggering maintains the fast update rate of 160,000 waveforms per second. In other words, if you can see it, you can trigger on it.

Figure 11. Draw a zone (box) around the anomaly.

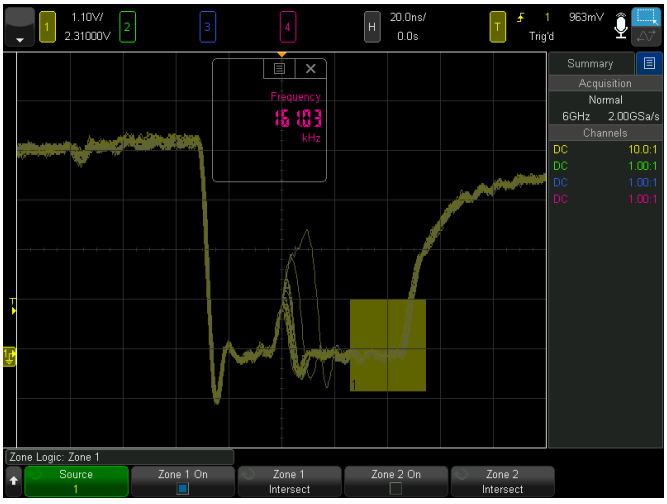


Figure 12. Hardware zone triggers immediately.

Visualize by protocol isolation: Serial protocol trigger + the zone trigger

If isolating signal anomalies is challenging, isolating analog signal phenomenon in relation to specific serial protocol packets is a doubly difficult task. You can trigger on CAN bus errors if your oscilloscope has a CAN serial bus trigger and decode option, but how would you isolate a specific CAN error message from all others?

Use the hardware-based zone trigger along with serial protocol triggers. In Figures 13 and 14, we isolated a CAN steering bus error message.

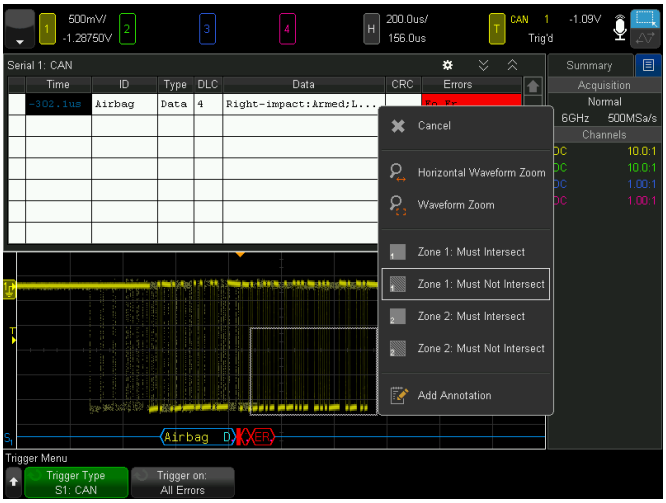


Figure 13. Setting up the zone trigger in addition to a CAN bus error packet trigger.

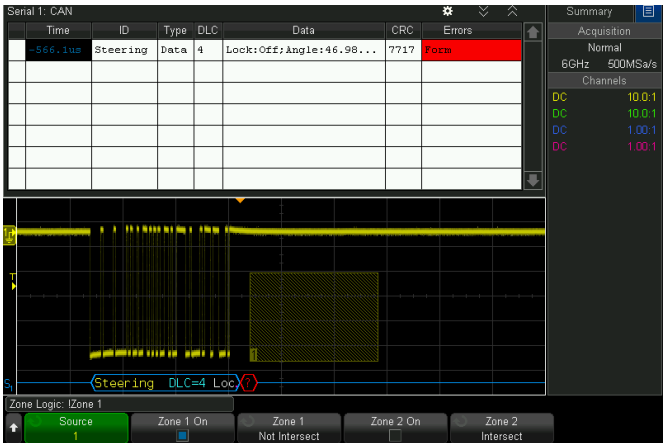


Figure 14. Now you have isolated steering errors from all other CAN bus errors.

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Visualization (Continued)

Visualize distribution and intensity: Add depth to your analysis with color grade and histograms

Color and graphical representations add depth to your signal analysis. With the standard color grade and histogram features, the 6000 X-Series oscilloscopes can quickly reveal just how often a particular event of interest occurs by providing a three-dimensional quantitative view of the waveforms. Because the 6000 X-Series' color grade operates like a separate function with its own database, you can apply the color grade to an analog channel, a reference waveform, or a math function such as an FFT.

You also can turn on the histogram to an analog channel, a reference waveform, or a math function. Apply it to a measurement result to see graphical distributions and quickly discover potential outliers. The measurement result histogram display offers more insights than standard measurement statistics can.

Figure 15. Color grade and histogram on a jittery clock edge.

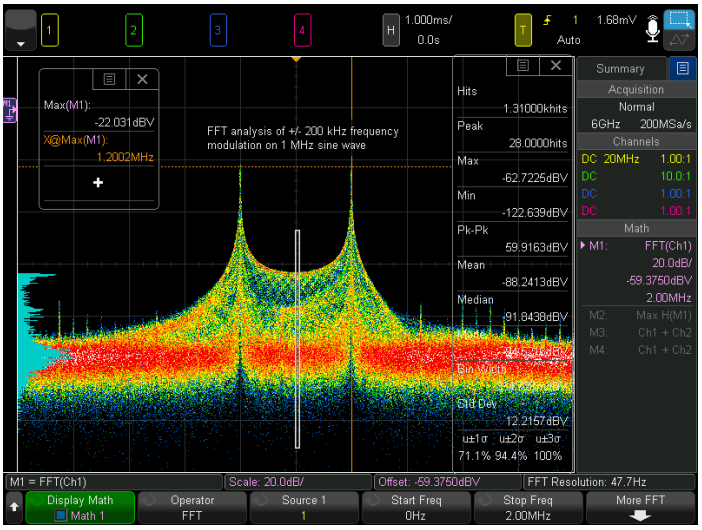


Figure 16a. Color grade and histogram on an FFT function.

Figure 16b. Histogram plotting the results of the pulse width measurement.

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Visualization (Continued)

Visualize signal integrity: Optional jitter analysis and real-time eye diagram analysis

Jitter measurement has become a popular debugging technique. However, traditional jitter analysis options are often costly and focused on characterizations that may not be suited for real-time debugging. The 6000 X-Series DSOX6JITTER option focuses on real-time debugging for your everyday jitter analysis. Start your analysis with the dedicated jitter button.

- The integrated oscilloscope feature ensures the best real-time user debugging experience, unlike a separate software package
- Flexible clock recovery, supporting
  - Constant frequency
  - First-order PLL (loop bandwidth)
  - Second-order PLL (loop bandwidth and damping factor)
  - Explicit clock
- Flexible jitter measurements
  - Data TIE
  - Clock TIE
  - N-period
  - Period-period
  - + width to + width
  - - width to - width
  - + duty cycle
- Flexible jitter and jitter component graphical representations
  - Jitter measurement histogram
  - Displays the distribution of the jitter
- Jitter measurement trend
  - Graphically represents the jitter value time-correlated to the input clock data signal under test
  - Smoothing can be applied
- Jitter spectrum
  - FFT analysis of the jitter trend to determine the frequency component of the jitter

Figure 19 is an example of a data TIE (time interval error) analysis on a 1-Gbp PRBS (pseudo-random bit sequence) signal. The data TIE measured 50-ps rms TIE jitter. The jitter trend and trend smoothing plot quickly revealed the injected jitter to be square periodic jitter. The jitter spectrum plot and frequency peak search found the main jitter component to be near 500 kHz, contributing 42 ps. The event table also listed higher harmonic components and their jitter contribution values. Finally, the histogram shape showed a clear bimodal distribution indicating the presence of deterministic jitter.

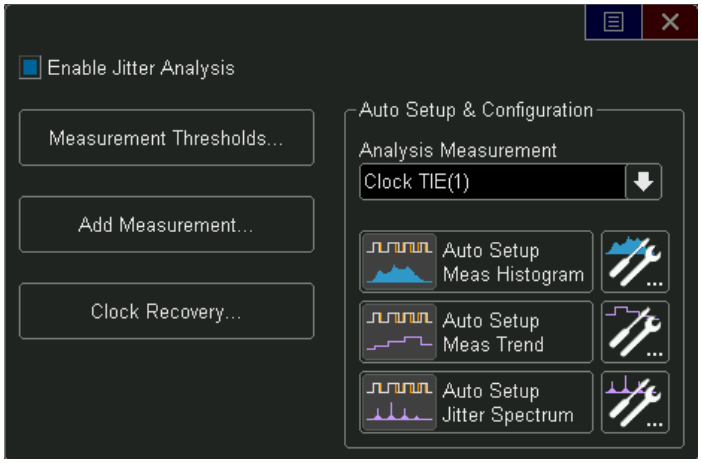


Figure 17. Press the jitter button on the front panel to directly access the jitter menu.

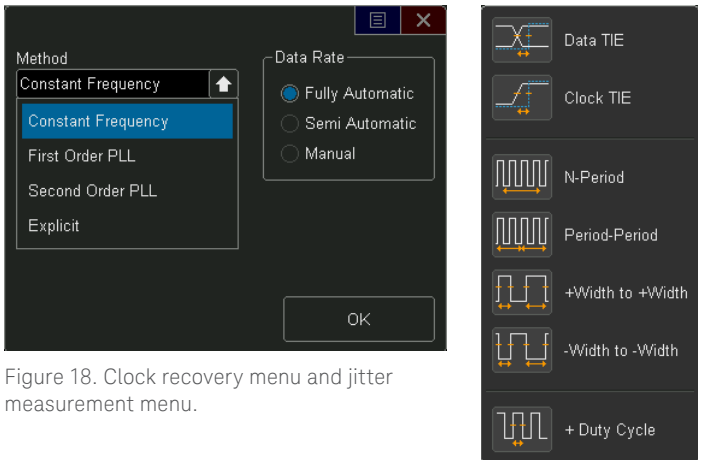


Figure 18. Clock recovery menu and jitter measurement menu.

Figure 19. Analyzing periodic jitter (square) on a 1-Gbps PRBS signal.

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Visualization (Continued)

Visualize signal integrity: Optional jitter analysis and real-time eye diagram analysis (Continued)

The real-time eye diagram with clock recovery is another powerful and visual way to understand the signal integrity of your waveforms (requires Option DSOX6JITTER). It quickly provides information like eye width, eye height, and jitter and shows you any signal anomalies. When you have an embedded clock or explicit clock design, the real-time eye diagram might be the only way to visualize what the input signal looks like from your receiver's perspective.

- Flexible clock recovery supporting
  - Constant frequency
  - First-order PLL (loop bandwidth)
  - Second-order PLL (loop bandwidth and damping factor)
  - Explicit clock
- Displays total UIs analyzed
- Automatic measurements
  - Eye height
  - Eye width

You can combine real-time eye diagram analysis with histogram analysis to get further insight into your design.

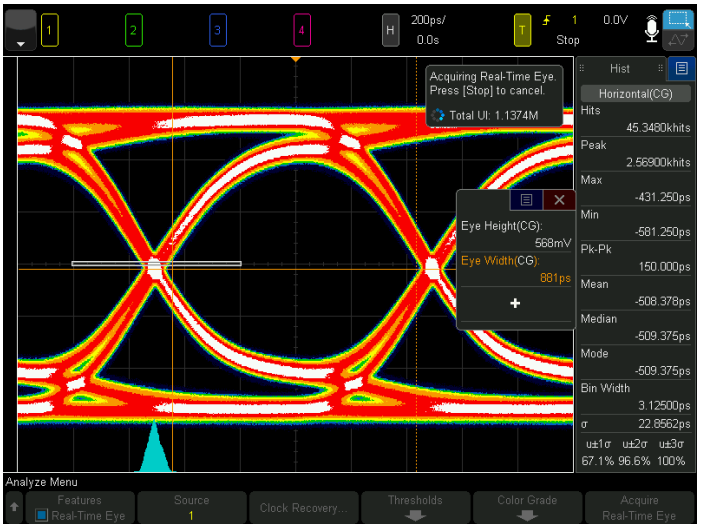


Figure 20. A real-time eye diagram measurement of a clean 1-Gbps PRBS embedded clock signal. The histogram measured about 22-ps rms jitter.

Figure 21. A real-time eye diagram measurement of a jittery 1-Gbps PRBS embedded clock signal. The histogram indicates a bimodal distribution and measured about 55-ps rms jitter.

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Visualization (Continued)

Visualize burst events: Segmented memory – the smart and efficient way

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 or rare critical serial bus error packets. Also, user interface responsiveness typically slows down dramatically with the long memory operations. Segmented memory acquisition lets you selectively capture and store important signal activity without capturing unimportant signal idle time, with a time stamp of each segment relative to the first trigger event.

For example, we have captured 1000 rare glitches over a time span of 128 seconds with 5-GSa/s resolution in Figures 22 through 24. Automatically scrolling through all segments, we found segment 22 at 1.7 seconds after the trigger, segment 61 at 5.3 seconds after trigger, and segment 153 at 14 seconds after the trigger contained some of the worst glitches. The new event lister of time stamps provides quick insight into the time gap between glitches. With traditional unsegmented memory, 640 Gpts of memory is required to do similar analysis.

With the 6000 X-Series, you can combine the segmented memory with the color grade and histogram features as well.

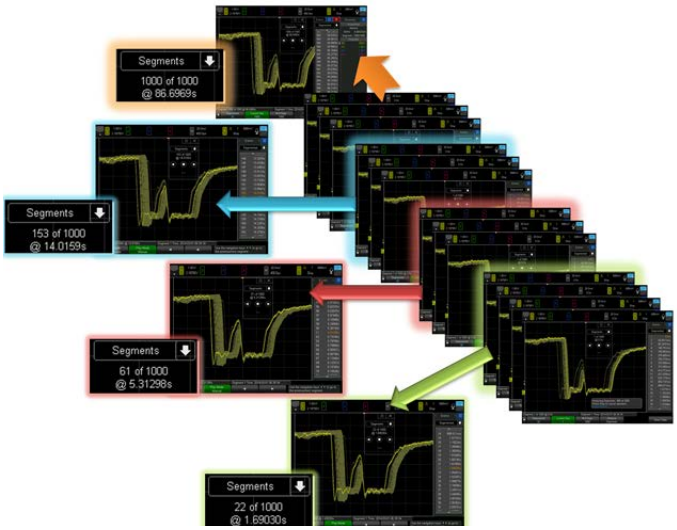


Figure 22. Segmented memory graphical representation.

Figure 23. Segmented memory and color grade.

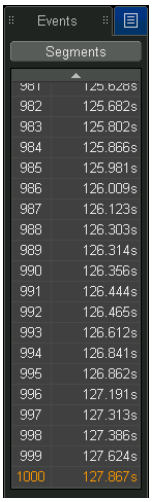


Figure 24. Segmented memory time-tag lister.

Visualize and isolate burst events: Zone touch trigger and segmented memory

The combination of the hardware-based zone touch trigger with the 6000 X-Series' segmented memory simplifies your debugging tasks. In Figure 25, the 6000 X-Series' serial bus trigger, zone touch trigger, and segmented memory isolated and captured 200 CAN steering and airbag errors over a 30-second time span at 6.1-MSa/s sampling rate in the segmented memory. This time duration equates to 192 Mpts of traditional memory.

Captured error packets are displayed chronologically at the side of the screen in the event lister so you can easily look up time stamps. You can independently save the time stamp information as well.

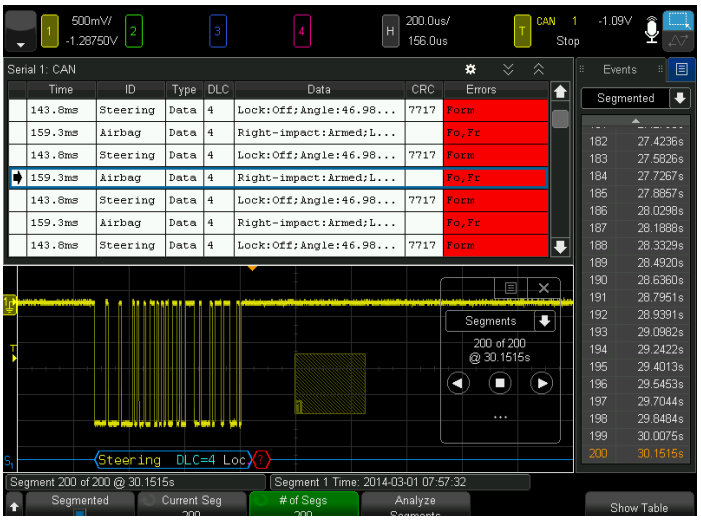


Figure 25. Segmented memory + serial bus decode + zone trigger.

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Integration

Take advantage of a new oscilloscope application bundle that will enable ALL software applications (including serial decode and WaveGen) for one low price (Option DSOX6APPBNDL).

More than just an oscilloscope, it's 7 instruments in 1

Keysight Technologies, Inc. pioneered multiple-instrument integration with the release of the mixed signal oscilloscope (MSO) in 1996. The InfiniiVision 2000/3000/4000X-Series took the concept to the next level by integrating five instruments in one in 2011. The InfiniiVision 6000 X-Series now integrates seven instruments in one to establish a new integration standard.

- Oscilloscope
- 16 digital channels (mixed signal)
- Serial protocol analyzer
- Dual-channel 20-MHz function/arbitrary waveform generator
- Frequency response analysis
- 3-digit voltmeter
- 10-digit counter with totalizer

All features and bandwidth are upgradable.

Integrate a digital bus: Optional mixed signal oscilloscope (MSO models)

With an additional optional 16 integrated digital channels (Option DSOX6MSO) probed by a newly designed digital channel cable, you now have up to 20 channels of time-correlated triggering, acquisition, and viewing on the same instrument. This capability is especially important in today's embedded designs with sophisticated digital control circuitry.

Integrate a generator: Optional dual-channel 20-MHz function/arbitrary waveform generator

An optional integrated dual-channel 20-MHz function/arbitrary waveform generator (Option DSOX6WAVEGEN2) is available for the 6000 X-Series. The integrated generator can provide stimulus outputs of sine, square, ramp, pulse, DC, noise, sine, cardinal (sinc), exponential rise, exponential fall, cardiac, Gaussian pulse and arbitrary waveforms to your device under test. Signal modulation capability is also available.

With the arbitrary waveform functionality, you can store waveforms from analog channels or reference memories to the arbitrary memories with a single touch and output from WaveGen.

Easily create and edit the waveform using the built-in waveform editor or export the data in a .csv file and edit it with your favorite editing tool.

Figure 26. Analog and digital signals displayed together with the logic timing chart function.

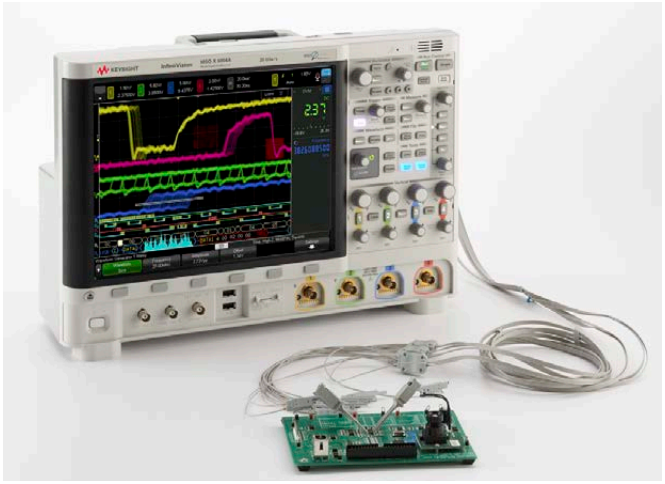


Figure 27. MSO with a new digital channel cable.

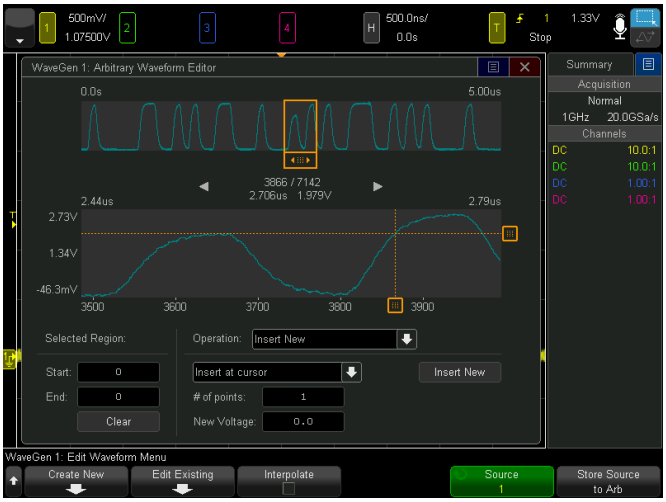


Figure 28. Arbitrary waveform generation signal editing screen.

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Integration (Continued)

Integrate protocol analysis: Optional hardware-based serial bus protocol decode and trigger

Keysight Technologies, Inc. InfiniiVision X-Series scopes are the only oscilloscopes that use hardware-based serial protocol decoding. Other vendors' oscilloscopes use software post-processing techniques to decode serial packets/frames. Software implementations have slow waveform and decode capture rates and can miss critical events and errors due to long dead-times. Faster decoding with hardware-based technology enhances your probability of capturing infrequent serial communication errors. Some serial protocol decodes come with a standard event counter, which is another benefit of the hardware-based implementation.

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 6000 X-Series can decode two serial buses simultaneously using hardware-based decoding, and display the captured data in a time interleaved lister display. The 6000 X-Series has eight options supporting 10 different serial protocols, including I²C, SPI [1], USB 2.0, RS232/UART, CAN (CAN-dbc), CAN-FD (ISO and non-ISO), LIN, LIN symbolic, SENT, FlexRay, MIL-STD 1553, ARINC 429, I²S, user-definable Manchester, user-definable NRZ, and USB PD (see page 26).

1. SPI trigger and decode requires 4, 2+16, or 4+16 channel 6000 X-Series.

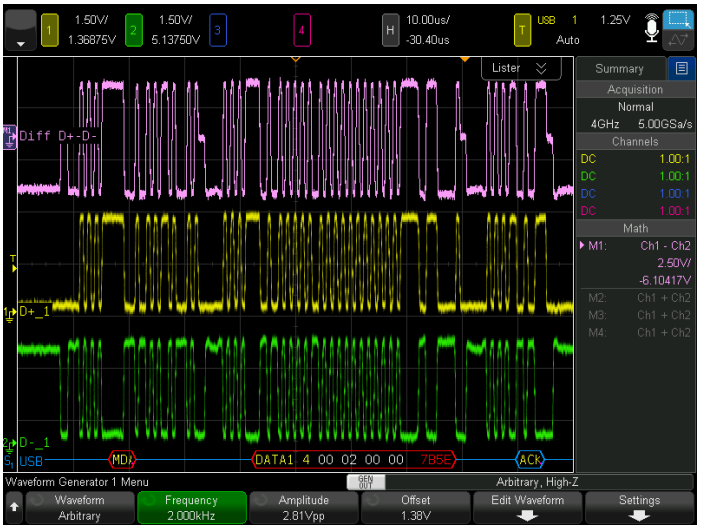


Figure 29. Dual-channel generator generating a differential signal.

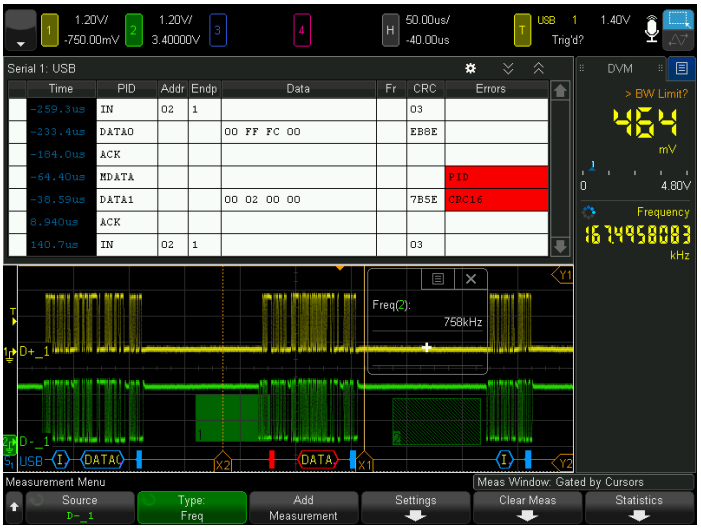


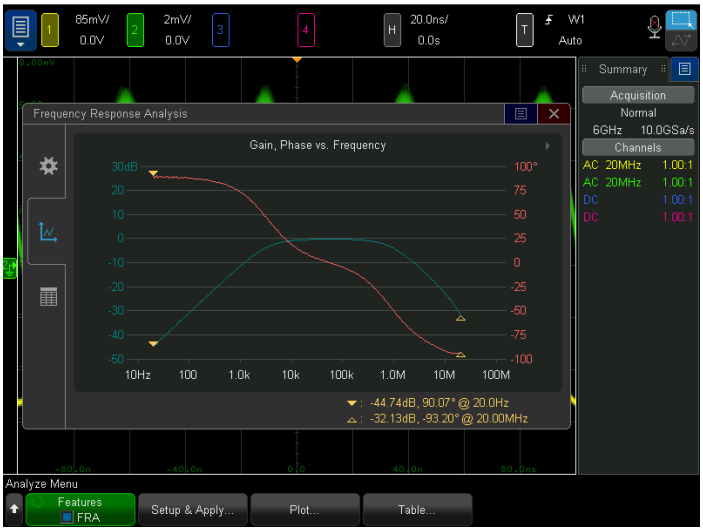
Figure 30. USB 2.0 protocol trigger and decode option display.

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Integration (Continued)

Frequency Response Analysis (FRA) Option

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 6000 X-Series oscilloscopes licensed with the DSOX6FRA option 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.



Integrate a quick tester: Standard 3-digit digital voltmeter

There is a standard built-in 3-digit voltmeter (DVM) on your 6000 X-Series oscilloscope. The voltmeter operates through the same probes as the oscilloscope channels. However, the DVM measurements are made independently from the oscilloscope acquisition and triggering system so you can make both the DVM and triggered oscilloscope waveform captures with the same connection. The voltmeter results are always displayed, keeping these quick characterization measurements at your fingertips.

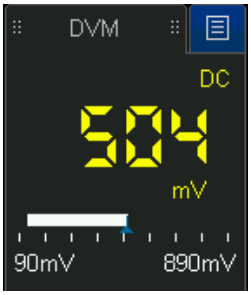


Figure 31. DVM display.

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Integration (Continued)

Integrate frequency measurements: Standard 10-digit counter and totalizer

With the 6000 X-Series' standard 10-digit counter, your expectations of an oscilloscope counter will be redefined. Traditional oscilloscope counter measurements offer only five or six digits of resolution. While this level of precision is fine for quick measurements, it falls short of expectations when the most critical frequency measurements are being made. With the integrated 10-digit counter in the 6000 X-Series, you can see your measurements with the precision you would normally expect only from a standalone counter. Because the integrated counter measures frequencies up to a wide bandwidth of 3.2 GHz, you can use it for many high-frequency applications as well. If you are looking for the ultimate precision, you can optionally connect your 6000 X-Series oscilloscope to your most trusted 10-MHz reference source to share a common 10-MHz clock.

The totalizer feature of the counter option adds another valuable capability to the oscilloscope. It can count the number of events (totalize), and it also can monitor the number of trigger-condition-qualified events. Note, the trigger-qualified events totalizer does not require an actual trigger to occur. It only requires a trigger-satisfying event to take place. In other words, the totalizer can monitor events faster than the trigger rate of a scope, as fast as 25 million events per second (a function of the oscilloscope's holdoff time, which has the minimum of 40 ns). Figures 34 and 35 show examples of a totalizer counting the number of FlexRay error packets and the number of runt signals that took place in a design.

Figure 32. 10-digit counter making precise frequency measurement on a 2.5-GHz signal.

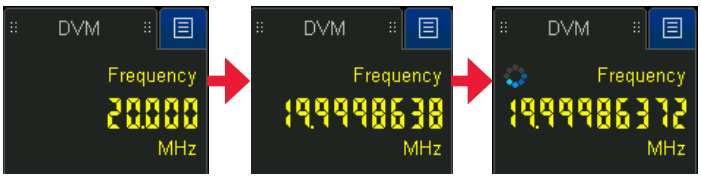


Figure 33. The precise 10-digit counter found the true frequency of a clock to be a little less than 20 MHz.

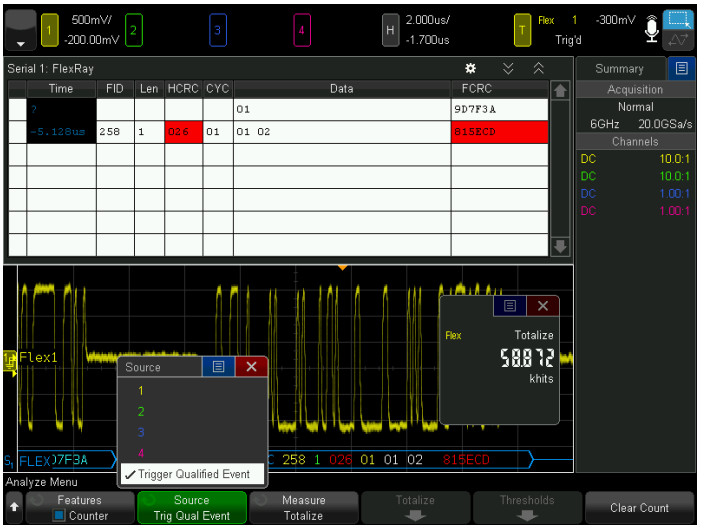


Figure 34. Totalizing the number of CAN errors.

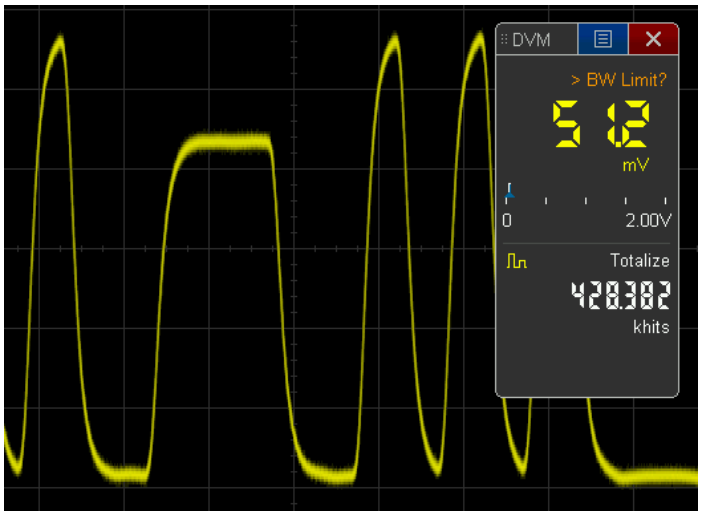


Figure 35. Totalizing the number of runt errors.

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Integration (Continued)

Spectrum analysis and Multi-domain analysis: Enhanced color FFT function with peak search

The enhanced color FFT takes your experience of oscilloscope-based spectrum analysis to the next level.

- Color grade immediately shows you the frequency and amplitude distributions of your signal.
- The frequency peak search eliminates tedious cursor measurements.
- The peak search event lister provides frequency and amplitude information for up to 11 peaks, sorting them in the order of the frequency or the amplitude.
- Set frequencies in “start and stop” or “center and span.”
- FFT max hold, min hold, and frequency average plots are also available through the math functions. Displays up to four functions simultaneously.

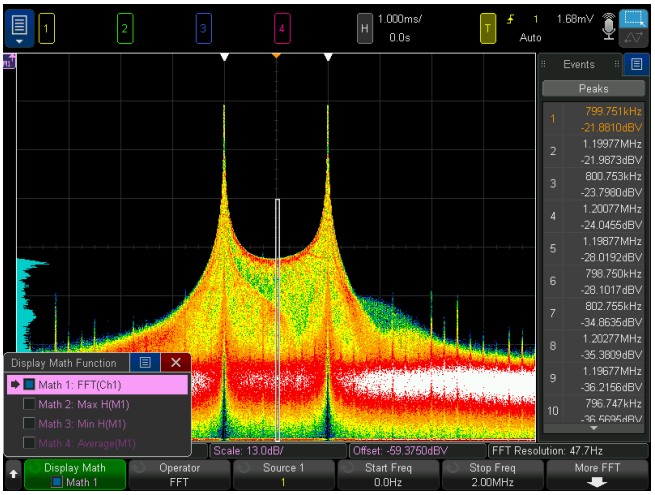


Figure 36. Enhanced color FFT with an automatic peak search and FFT histogram turned on. Min/max hold and average FFT also available.

Multi-domain time correlated measurements with Gated FFT

The new problem solving feature called “gated FFT” lets you time correlate the analog, digital, and frequency domain to aid in analysis and debug. When the 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. Touch and move/flick the zoom box through the acquisition to investigate how the spectrum components change over time, correlating the RF phenomenon with the analog and digital signals.

Figure 37a shows the Gated FFT correlating the turn-on of a PLL with an associated SPI command and the spectrum contents at a given time (the boxed area in the top/main window). By moving the Gated FFT zoom box, you can quickly see the spectrum contents at another time slot. Note, unlike the scopes with the RF input, you can actually see the RF signal in the time domain (channel 4 magenta trace) to quickly grasp its amplitude information as well.

Figure 37b shows the Gated FFT correlating the FSK frequency hop from 400 kHz to 3.2 MHz and its related I²C command. Again, the Gated FFT revealed the relationship of the hopping signal to the control command (I²C).

Figure 37a. Gated FFT time correlating the PLL voltage, SPI command and spectrum content at a given time span.

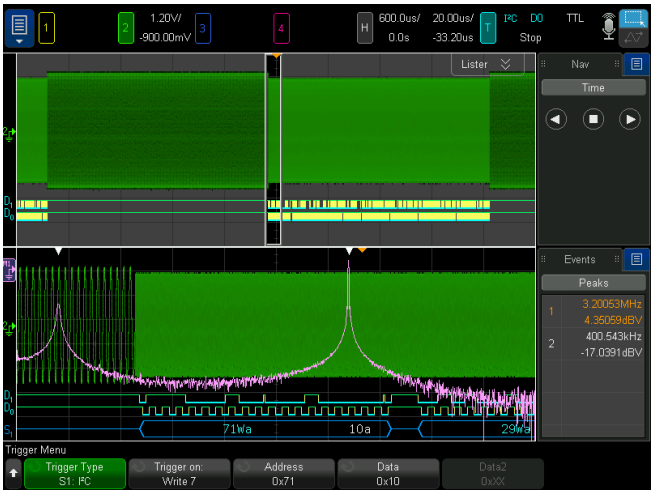


Figure 37b. Gated FFT time correlating the FSK frequency hopping with an I²C command (write 7 at 0x71 data 10).

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Integration (Continued)

Talk to me: Multi-language voice control powered by Nuance

Today's devices operate with voice controls. Your smartphone and car navigation system respond to your voice commands. Why not your oscilloscopes? The 6000 X-Series oscilloscopes' new voice control capability not only listens to you, but it understands you in your native language. Experience hands-free oscilloscope operation by running familiar commands like "run," "stop," "single," and "auto scale." It supports 20 commands in 14 different languages and is powered by the Nuance Communications, Inc. voice recognition engine.

You can operate the 6000 X-Series in the language most familiar to you. The graphical user interface, built-in help system, front panel overlays, and user's manuals are available in 11 languages. During operation, access the built-in help system just by pressing and holding any button or touching and holding any related icons.

Using the built-in speaker, the 6000 X-Series beeps to alert you to various events like a single trigger, mask test failure, calibration setup, and more.

Figure 38. Language list.

Figure 39. Voice control microphone and speaker.

Figure 40. Limit testing of infrequent glitch.

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Integration (Continued)

Optional mask/limit testing

Whether you are performing pass/fail tests to specified standards in manufacturing or testing for infrequent signal anomalies, mask/limit testing (Option DSOX6MASK) can be a valuable productivity tool. The 6000 X-Series features powerful hardware-based mask testing and can perform up to 130,000 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. You can set the 6000 X-Series to beep when the mask fails.

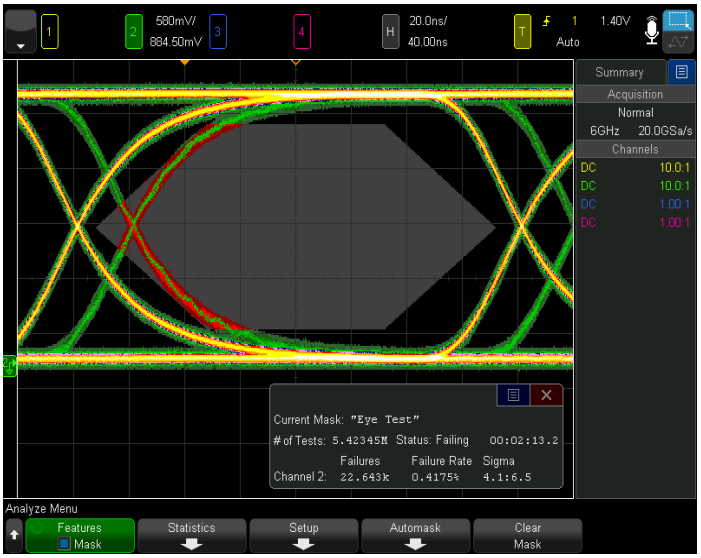


Figure 41. Mask testing of serial data.

Find events faster with search and navigation features

Parametric and serial bus search and navigation features come standard on the 6000 X-Series oscilloscopes. When you are capturing long, complex waveforms using an oscilloscope's acquisition memory, manually scrolling through stored waveform data to find specific events of interest can be slow and cumbersome. With automatic search, navigation, and listing, 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 (up to 11 peaks), and serial bus frames, packets, and errors. The side-bar lister gives you an overview of the time tag of each found event relative to the trigger location.

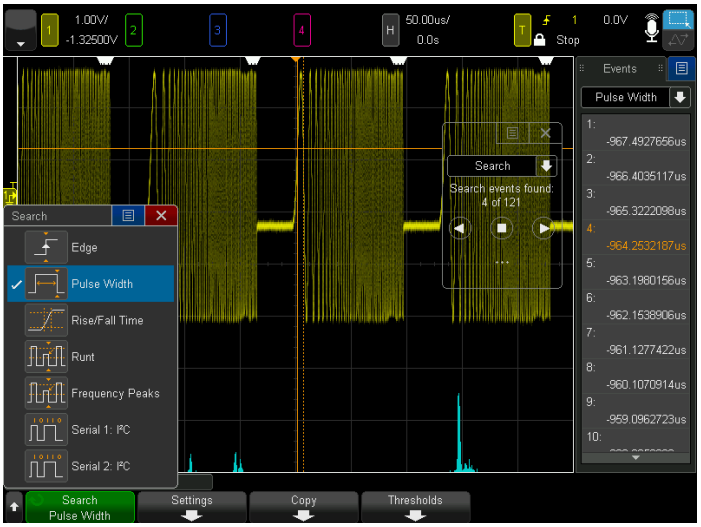


Figure 42. Searching for and navigating to a specific pulse width.

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Integration (Continued)

Optional power measurements and analysis

When you are working with switching power supplies and power devices, the power measurements application (Option DSOX6PWR) provides a full suite of power measurements and analysis in the oscilloscope. Included with Option DSOX6PWR is a license for the U1881A PC-based power analysis software package, which provides additional offline measurements and report generation.

See **www.keysight.com/find/DSOX6PWR** for more information.

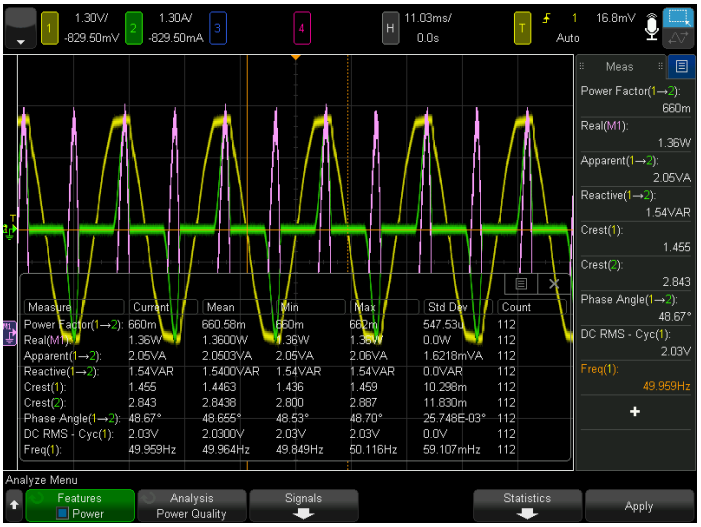


Figure 43. Power quality analysis screenshot.

Automate your testing with optional USB 2.0 signal quality analysis

With the USB 2.0 signal quality test option (Option DSOX6USBSQ), designers of systems with USB interfaces can automate signal quality testing. This option supports low-speed, full-speed, and hi-speed applications (hi-speed tests require an oscilloscope with a bandwidth of at least 1.5 GHz). 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.

See **www.keysight.com/find/DSOX6USBSQ** for more information.

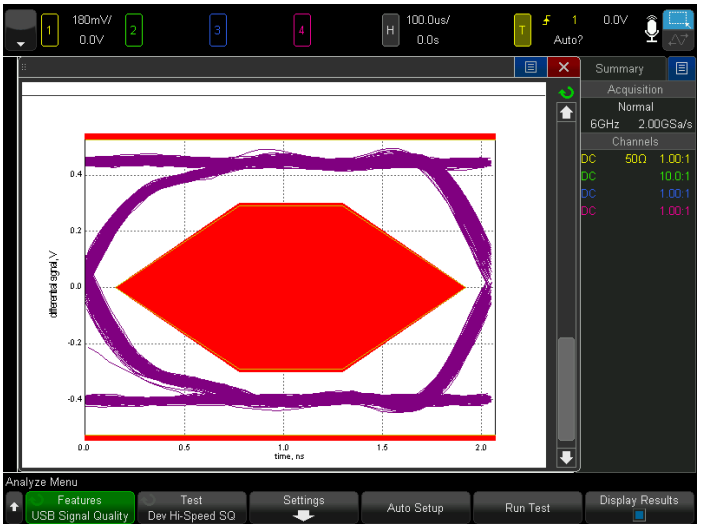


Figure 44. USB 2.0 Hi-speed near-end eye pattern test.

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Integration (Continued)

Optional HDTV video triggering and analysis

Whether you are debugging consumer electronics with HDTV or characterizing a design, the HDTV measurement application (Option DSOX6VID) provides support for a variety of HDTV standards for triggering and analysis. The 450,000 waveforms/sec capture rate of the 6000 X-Series, coupled with its intensity-graded view of the signal, provides even more details than a traditional analog oscilloscope.

See **www.keysight.com/find/DSOX6VID** for more information.

Figure 45. Triggering on a 1080p/60 signal.

Hardware and software bandwidth limit filters (low-pass filters)

More bandwidth generally enhances your measurements except when you want to limit excess noise coming from additional bandwidth. The 6000 X-Series oscilloscopes provide two standard bandwidth-limiting filters, one in the hardware and the other implemented in software (a math function). Now you can select the optimal bandwidth for your measurement.

Hardware bandwidth filter	1 MΩ	20 MHz, 200 MHz
	50 Ω	20 MHz, 200 MHz, 1.5 GHz [1], 3 GHz [2]
Software bandwidth filter (low pass filter function)		1 Hz through bandwidth of scope

1. With 2.5 GHz, 4 GHz, or 6 GHz licensed 6000 X-Series only.
2. With 4 GHz or 6 GHz licensed 6000 X-Series only.

High-resolution mode for viewing signal details

To gain 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 6000 X-Series oscilloscopes. 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.

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Integration (Continued)

Advanced math functions – display four simultaneously

The 6000 X-Series provides the most advanced math analysis in an embedded-OS-based oscilloscope. You can nest together multiple math functions and display up to four math functions simultaneously. You also can apply color grade capability and histograms to a math function to gain further insights.

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 (requires MSO)
- Clock recovery (requires Option DSOX6JITTER)

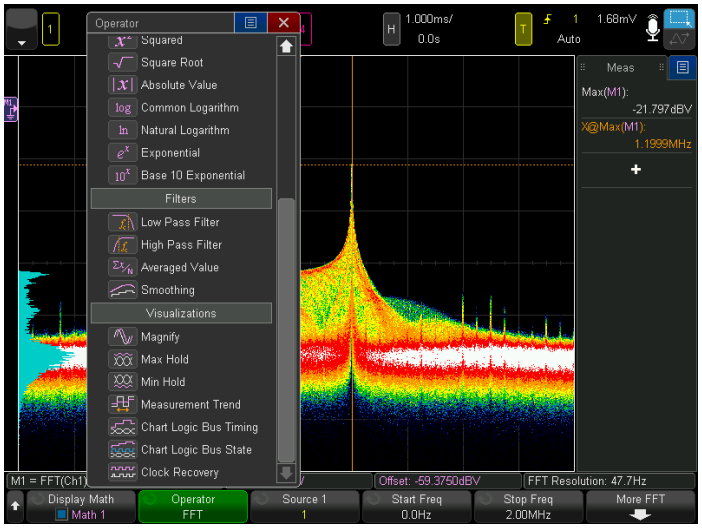


Figure 47. Function selection menu. Swipe and double touch to select.

Figure 48. Four math functions used simultaneously (three turned on).

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Integration (Continued)

56 automatic measurements – display up to 10 simultaneously

Automatic measurements are an essential tool for an oscilloscope. In order to make quick and efficient measurements, the 6000 X-Series provides 56 powerful automatic measurements and can display up to 10 at a time along with measurement statistics. Measurements can be gated by auto select, main window, zoom window, or cursors. The oscilloscope can also automatically select the best gating. Some automatic measurements require an option installation or specific probe connection.

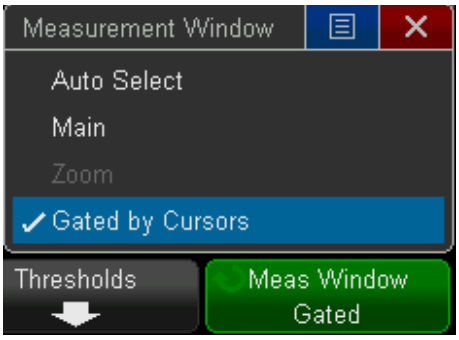


Figure 49. Measurement gating screen.

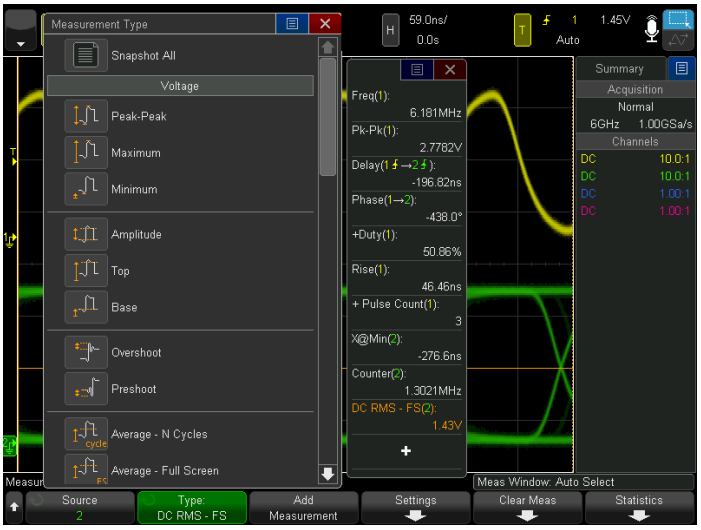


Figure 50. Measurement selection menu. Swipe and double touch to select.

Reference waveforms – display four simultaneously

Store up to four waveforms in the oscilloscope's nonvolatile 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 the oscilloscope's reference waveform memory later. Save 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.

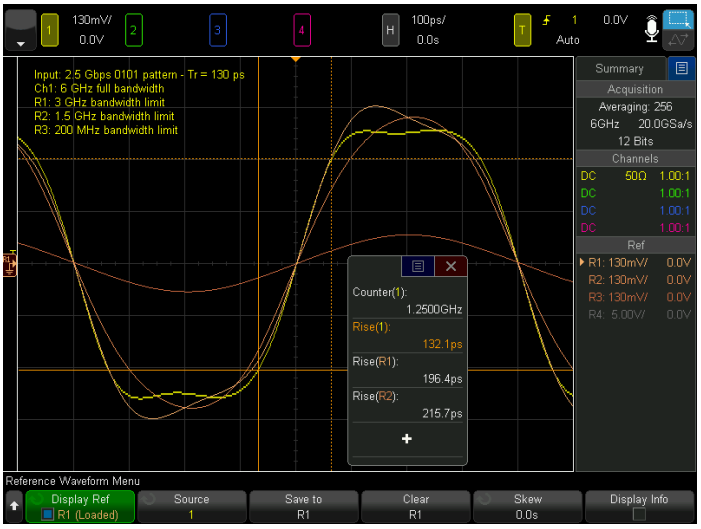


Figure 51. Reference waveforms.

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Integration (Continued)

Connectivity and LXI compatibility

Standard USB 2.0 hi-speed host ports (two on front, one on back) and device ports (one on back) make PC connectivity easy. Operate the oscilloscope 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 the VGA output, standard with the 6000 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 application within BenchVue lets you control and visualize the 6000 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 6000 X-Series with a mobile device from anywhere. Simplify your testing with BenchVue software. Learn more at **www.keysight.com/find/benchvue**.

Figure 52. Connectivity section on the back panel.

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Integration (Continued)

Visual front panel

The 6000 X-Series' innovative capacitive touch screen is compatible with the latest tablet technologies. In addition to the traditional VNC-based virtual front panel remote operation through your favorite PC Web browser, the 6000 X-Series supports remote oscilloscope control from your tablet devices. The tablet virtual front panel is identical to the 6000 X-Series' touch GUI so you can touch icons, swipe, draw zone touch trigger zones, and drag slide panels as if you are sitting in front of the actual oscilloscope.

Figure 53. Controlling the 6000 X-Series via tablet device.

Documentation and email without connecting to your PC

Annotation is a simple task with 6000 X-Series oscilloscopes. Bring up the annotation (up to 10 annotations) on your scope display and edit it using the keypad, then drag it to the desired location. Quick email allows you to email the data you want instantly to your inbox. Send out screenshots, waveform data, or even a USB signal quality test report — all without the hassle of connecting your PC to your oscilloscope.

QuickAction key

The QuickAction key lets you assign your favorite operation to a customizable front panel key. With a push of a button, save your waveforms, capture your screen, toggle trigger mode, resets, statistics, and more.

Figure 54. Quick Freeze Display preserves the persistence.

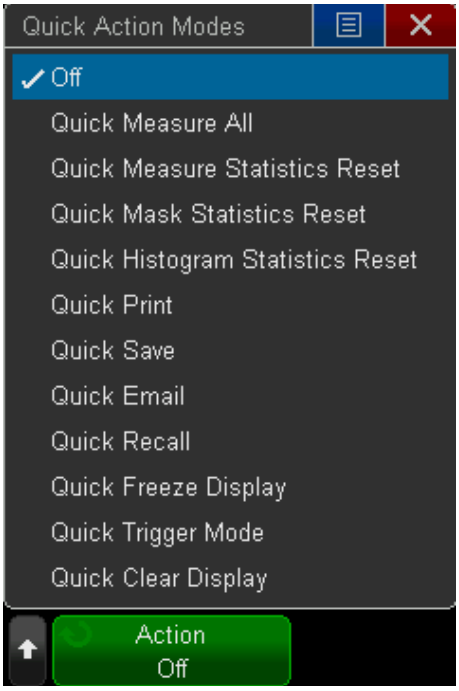


Figure 55. QuickAction menu.

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Powerful probe solutions and compatibility

Get the most out of your 6000 X-Series oscilloscope by using Keysight's complete family of innovative probes and accessories for your application. The 6000 X-Series supports up to four active probes simultaneously with its full AutoProbe interface [1].

All 6000 X-Series oscilloscopes come standard with probes for each channel. The 700-MHz bandwidth, 10-MΩ input passive probes give you 700-MHz system bandwidth when used in conjunction with the 6000 X-Series.

Also available is the N2750/51/52A InfiniiMode differential probe (1.5 to 6 GHz) and N2795A/96A/97A single-ended active probe for high-signal-fidelity measurements without the high price (1 to 2 GHz).

For ultra-low current measurements on your mobile or IoT devices, the N2820A Series high sensitivity current probes are the best solution in the industry. The new N7020A Power Rail Probe is the industry's only probe designed and developed to solve your toughest power integrity problems.

For the most up-to-date and complete information about Keysight's probes and accessories, visit our website at **www.keysight.com/ind/scope_probes** or refer to the InfiniiVision Probes and Accessories Data Sheet, Keysight publication number 5968-8153EN.

1. Some restrictions may apply. Contact Keysight for details.

Figure 58. N7020A Power Rail Probe.

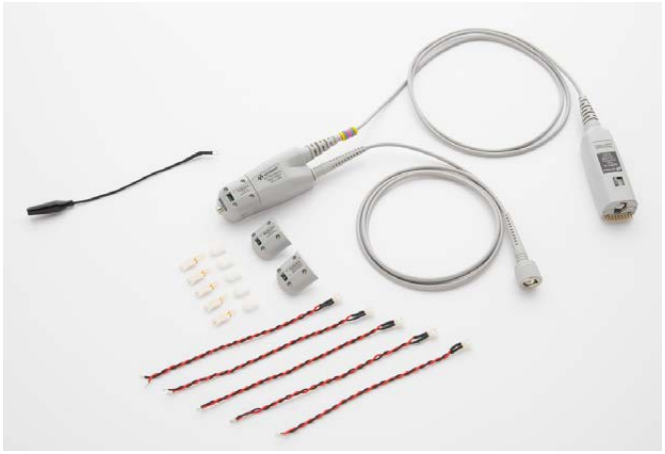


Figure 56. N2820A Series high-sensitivity current probe.

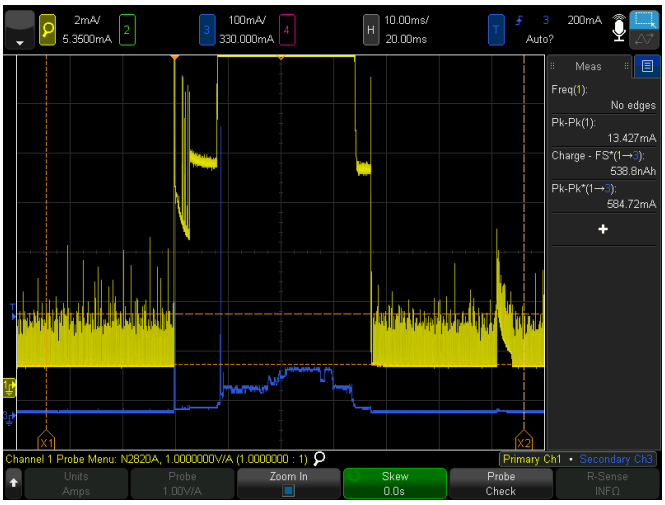


Figure 57. Capturing both zoom out and zoom in view of a cell phone's current consumption inside and outside of its sleep state.

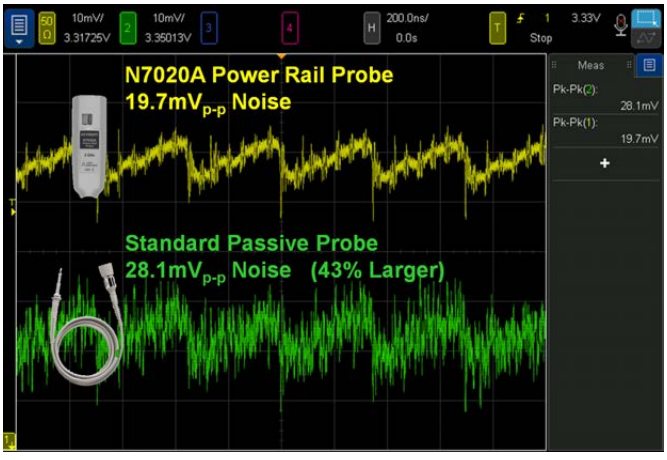


Figure 59. N7020A Power Rail Probe vs. standard 10:1 passive probe.

New Standard for Price Performance: Bandwidth, Visualization, and Integration

Infiniium Offline oscilloscope analysis software

Keysight's Infiniium Offline PC-based oscilloscope analysis software (N8900A) 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 InfiniiView. 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. For more information, visit **www.keysight.com/find/InfiniiumOffline**.

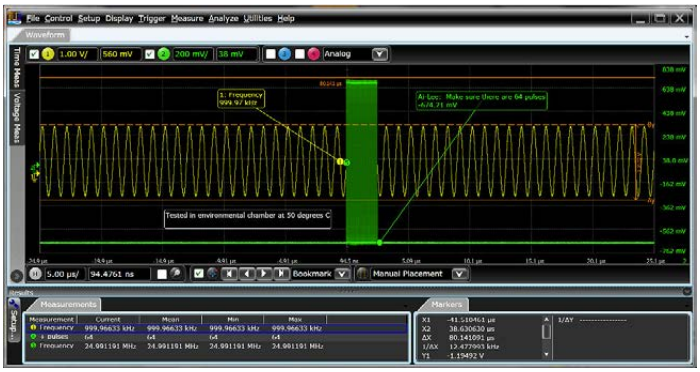


Figure 60. N8900A Infiniium Offline software.

Probe and accessories storage compartment

Probes and cables get lost easily. When we packaged 6 GHz of bandwidth in the shallowest form factor, we left enough room for you to store your daily probes and small accessories.

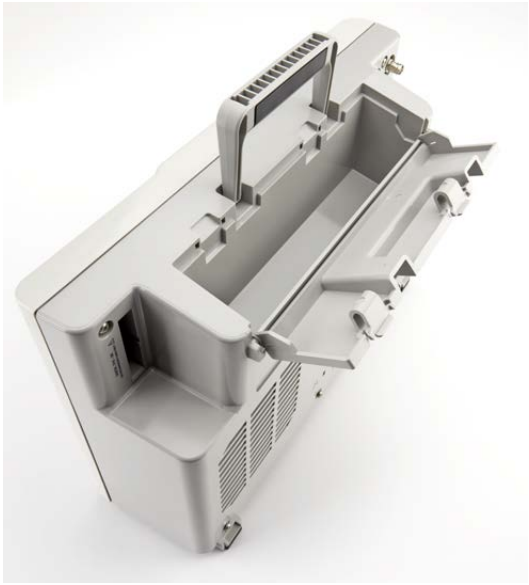


Figure 61. Storage compartment.

2-year calibration interval

Through improved quality processes and rigorous testing, the Keysight InfiniiVision 6000 X-Series oscilloscope is able to perform at the guaranteed specifications for two years without calibration, thereby reducing your cost of ownership. It also has an impressive 120,000 hours of operation MTBF (mean time before failure) specification.

Ensure the highest level of security with secure erase

The secure erase feature comes standard with all 6000 X-Series models. At the press of a button, the oscilloscope's internal nonvolatile memory is cleared of all setup information, reference waveforms, and user preferences.

New Standard for Price Performance: Bandwidth, Visualization, and Integration

The portable oscilloscope class-leading ***6 GHz upgradable bandwidth*** expands your application coverage including PCI Express.

Designed for Touch. ***12.1-inch capacitive multi-touch screen with gesture support*** sets a new visualization standard.

Not a touch screen fan? You can ***turn off the touch screen***.

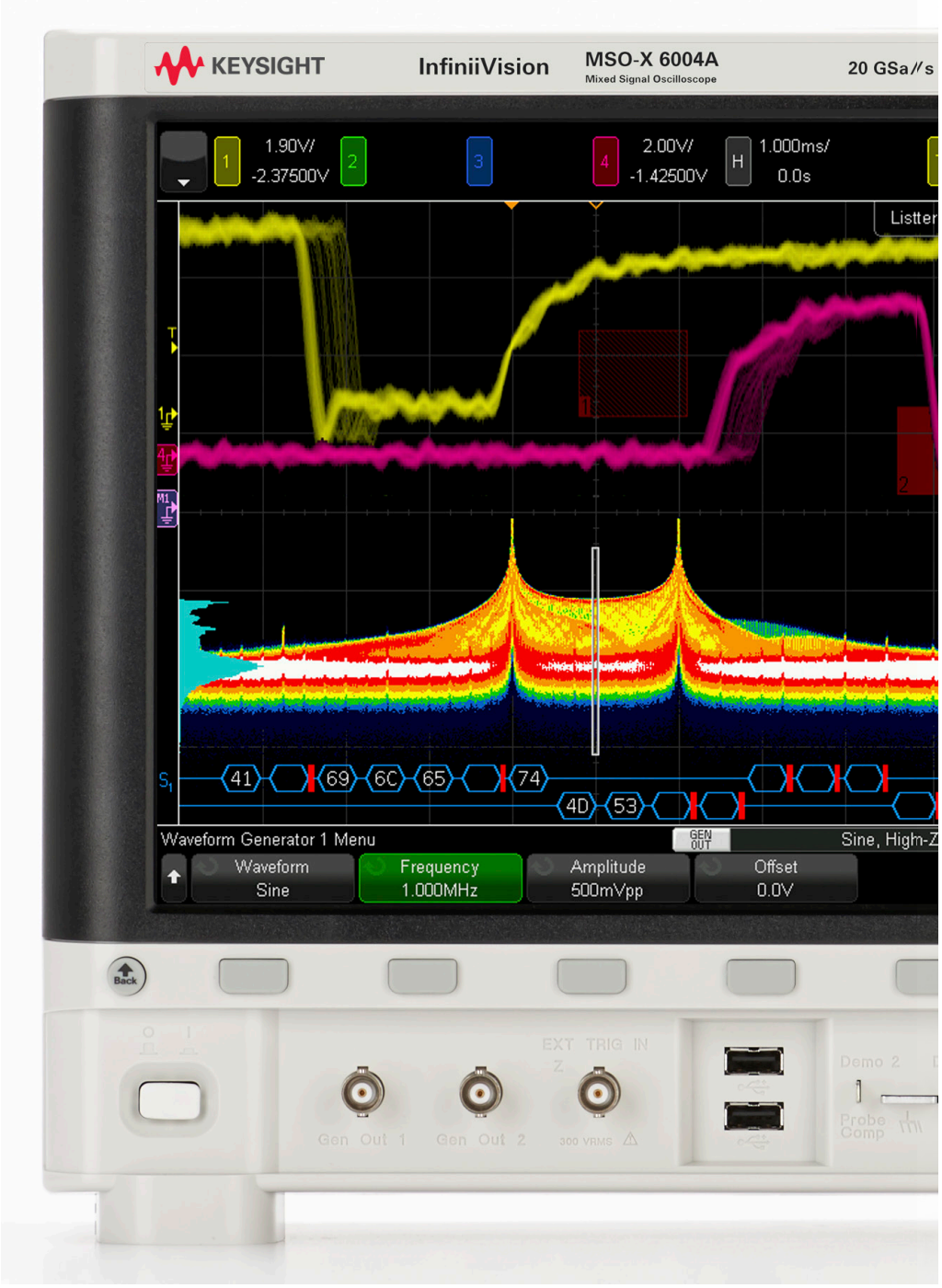
Zone touch trigger. If you can see it, you can trigger on it by drawing a zone box.

7-in-1 instrument sets a new integration standard: oscilloscope channels, digital channels, serial protocol analysis, dual-channel WaveGen, frequency response analysis, digital voltmeter, and 10-digit counter-totalizer. ***Fully upgradable***, including bandwidth.

Standard color grade and ***histogram*** on a waveform, measurement, or math function adds statistical view.

Jitter and real-time eye diagram analysis is available for the first time ever in an embedded-OS-platform oscilloscope.

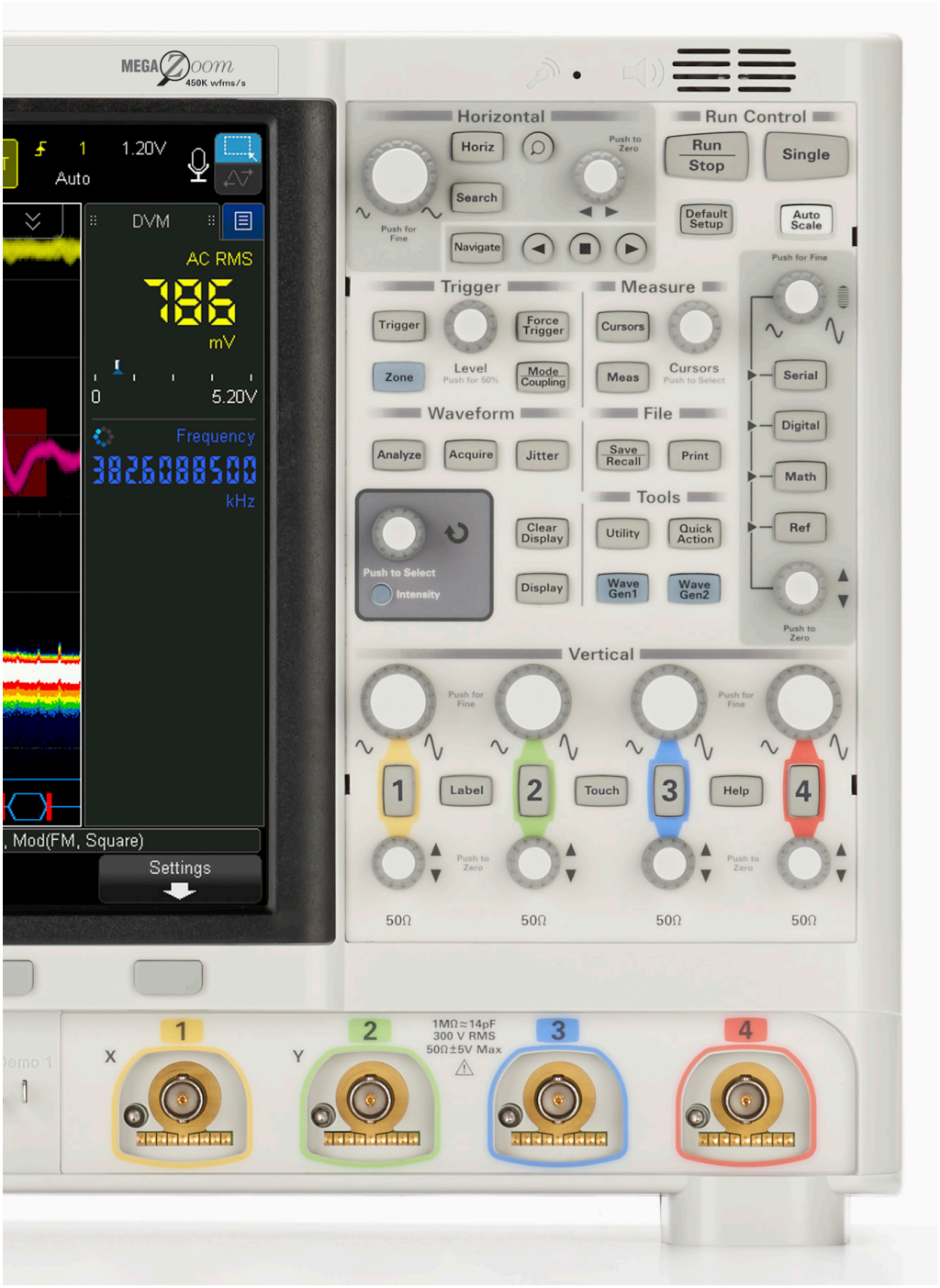
Dual-channel WaveGen function/arbitrary generator allows you to generate differential, clock and data, two channel modulation, and IQ signals. Modulation capability included.



Both ***USB keyboard and mouse*** are supported in 6000 X-Series for additional ease of use.

450,000 waveforms per second *update* rate minimizes the dead-time for maximum probability of capturing infrequent events and anomalies.

Multi-language voice control enables hands-free operation while you are holding probes.



Using ***docking panels*** with the capacitive touch screen adds a new dimension of usability. Move automatic measurements, cursors information, event lister, histogram, navigation, DVM, and the counter pane anywhere on the screen. ***Transparent*** panes are supported.

Standard advanced math displays ***four functions simultaneously*** for the most sophisticated signal analysis.

Display up to *10* ***measurements*** with statistics simultaneously without compromising other key information. Supports 56 automatic measurements and *gating by cursors*.

Industry's only ***integrated digital voltmeter and 10-digit counter with totalizer***.

Independent knobs per channel for fast operation. All front-panel knobs are push-able for access to common controls such as fine and coarse control.

Standard segment memory with event lister is powered by ***MegaZoom IV*** smart memory technology to intelligently capture only the signals of interest.

Wide coverage of application and serial protocol solutions including USB 2.0 ***signal quality analysis***.

Four AutoProbes (active and current probes) are supported simultaneously for demanding applications.

Configure your InfiniiVision 6000 X-Series Oscilloscope

Step 1. Choose your number of channels

InfiniiVision 6000 X-Series oscilloscopes		
Input channels	DSOX6002A	2
	DSOX6004A	4
	MSOX6002A	2 + 16
	MSOX6004A	4 + 16

Step 2. Choose your bandwidth

Bandwidth options		1 GHz	2.5 GHz	4 GHz	6 GHz
	For 2 channel models	Default	DSOX6B10T252BW	DSOX6B10T402BW	DSOX6B10T602BW
	For 4 channel modes	Default	DSOX6B10T254BW	DSOX6B10T404BW	DSOX6B10T604BW
* Examples	If you want 1 GHz, 4 + 16 channel, the model configuration will be MSOX6004A only				
	If you want 4 GHz, 4 + 16 channel, the model configuration will be MSOX6004A and DSOX6B10T404BW				

Step 3. Tailor your oscilloscope with measurement applications to save time and money

Bandwidth, feature, and application upgrades	**Model number**
Application bundle	
Software application bundle	DSOX6APPBNDL (includes DSOX6EMBD, DSOX6COMP, DSOX6USBFL, DSOX6USBH, DSOX6AUTO, DSOX6FLEX, DSOX6AUDIO, DSOX6AERO, DSOX6JITTER, DSOX6WAVEGEN2, DSOX6PWR, DSOX6MASK, DSOX6USBSQ, DSOX6VID, DSOX6SENSOR, DSOX6CXPI, DSOX6NRZ, DSOX6FRA)
Serial protocols	
MIL-STD 1553 and ARINC 429 serial triggering and analysis	DSOX6AERO
Audio serial triggering and analysis (I^2S)	DSOX6AUDIO
Automotive serial triggering and analysis (CAN, CAN-dbc, CAN-FD, LIN)	DSOX6AUTO
Computer serial triggering and analysis (RS232/UART)	DSOX6COMP
Embedded serial triggering and analysis (I^2C, SPI) (SPI requires 4, 2+16, or 4+16 channel 6000 X-Series)	DSOX6EMBD
FlexRay serial triggering and analysis	DSOX6FLEX
SENT (Single Edge Nibble Transmission) triggering and analysis	DSOX6SENSOR
CXPI triggering and decode	DSOX6CXPI
USB 2.0 Full/Low Speed serial decode and triggering	DSOX6USBFL
USB 2.0 Hi-Speed serial decode and triggering	DSOX6USBH
USB PD serial decode and triggering	DSOX6UPD
User-definable Manchester/NRZ triggering and decode	DSOX6NRZ
Measurement applications	
Jitter and real time eye diagram analysis	DSOX6JITTER
Mask limit testing	DSOX6MASK
Frequency Response Analysis (FRA)	DSOX6FRA
Power analysis application	DSOX6PWR
USB 2.0 signal quality test	DSOX6USBSQ
Enhanced video/TV application package	DSOX6VID
Dual channel WaveGen 20 MHz AWG	DSOX6WAVEGEN2
Productivity tools	
Infiniium offline oscilloscope analysis software	N8900A
User-defined Application (UDA) PC software	N5467B/C
BenchVue oscilloscopes application	BV0004B

Configure your InfiniiVision 6000 X-Series Oscilloscope (Continued)

Step 4. Choose your probes. For a complete list of compatible probes, see Keysight document 5968-8153EN

Probes	Standard/Optional
N2894A passive probe 700 MHz, 10:1, 9.5 pF, 10 MΩ	Included standard; 1 per channel
N2756A 16 digital channel MSO cable	Included standard on MSOX models and DSOX6MSO
N2870A passive probe 35 MHz, 1:1, 1 MΩ	Optional
10076B high-voltage passive probe (4 kV)	Optional
N2796A active single-ended probe 2 GHz, 1 pF, 1 MΩ with AutoProbe	Optional
N2797A active single-ended probe 1.5 GHz, extreme temperature	Optional
N2750A InfiniiMode differential probe 1.5 GHz, 700 fF, 200 kΩ with AutoProbe	Optional
N2751A InfiniiMode differential probe 3.5 GHz, 700 fF, 200 kΩ with AutoProbe	Optional
N2752A InfiniiMode differential probe 6.0 GHz, 700 fF, 200 kΩ with AutoProbe	Optional
N2790A differential active probe 100 MHz, ± 1.4 kV, 4 MΩ with AutoProbe	Optional
N2819A 800-MHz, 10:1 differential probe, 200 kΩ with AutoProbe	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 µA to 5 A	Optional
54855-67604 Precision BNC to SMA adapter	Optional
N7020A power rail probe 2 GHz, 1:1, 50 kΩ, ± 24 V offset range	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 and calibration plans

Recommended accessories and calibration plans	Model number
GPIB connection module	N4865A
Rack mount kit	N2111A
Soft carrying case	N2733B
Hard copy manual	N2112A
Hard transit case - available from Case Cruzer (**http://www.casecruzer.com/oscilloscope/3a1311-2710j.html)**	3A1311-2710J
ANSI Z540-1-1994 calibration	D/MSOX6000-A6J
ISO17025 compliant calibration with accreditation	D/MSOX6000-AMG

After-purchase bandwidth and digital channel upgrades

Recommended accessories	Model number
1.0 to 2.5 GHz bandwidth upgrade, 2 ch, fixed perpetual license	DSOX6B10T252BW
1.0 to 4.0 GHz bandwidth upgrade, 2 ch, fixed perpetual license	DSOX6B10T402BW
1.0 to 6.0 GHz bandwidth upgrade, 2 ch, fixed perpetual license	DSOX6B10T602BW
2.5 to 4.0 GHz bandwidth upgrade, 2 ch, fixed perpetual license	DSOX6B25T402BW
2.5 to 6.0 GHz bandwidth upgrade, 2 ch, fixed perpetual license	DSOX6B25T602BW
4.0 to 6.0 GHz bandwidth upgrade, 2 ch, fixed perpetual license	DSOX6B40T602BW
1.0 to 2.5 GHz bandwidth upgrade, 4 ch, fixed perpetual license	DSOX6B10T254BW
1.0 to 4.0 GHz bandwidth upgrade, 4 ch, fixed perpetual license	DSOX6B10T404BW
1.0 to 6.0 GHz bandwidth upgrade, 4 ch, fixed perpetual license	DSOX6B10T604BW
2.5 to 4.0 GHz bandwidth upgrade, 4 ch, fixed perpetual license	DSOX6B25T404BW
2.5 to 6.0 GHz bandwidth upgrade, 4 ch, fixed perpetual license	DSOX6B25T604BW
4.0 to 6.0 GHz bandwidth upgrade, 4 ch, fixed perpetual license	DSOX6B40T604BW
InfiniiVision 6000 X-Series oscilloscope MSO upgrade	DSOX6MSO

Performance Characteristics

DSOX/MSO 6000 X-Series digital storage/mixed signal oscilloscopes

6000 X-Series specification overview					
Half channel bandwidth [1] (–3 dB)		1 GHz	2.5 GHz	4 GHz	6 GHz
Full channel bandwidth [1] (–3 dB)		1 GHz	2.5 GHz	4 GHz	4 GHz
Full channel equivalent time bandwidth [1] (–3 dB)		N/A	N/A	N/A	6 GHz
Calculated rise time (10 to 90%)		≤ 350 ps	≤ 140 ps	≤ 112.5 ps	≤ 75 ps
Input channels	DSOX6002A	2			
	DSOX6004A	4			
	MSOX6002A	2 + 16			
	MSOX6004A	4 + 16			
Maximum sample rate		20 GSa/s half channels, 10 GSa/s full channels			
Maximum memory depth		Standard 4 Mpts, Standard segment memory			
Display size and type		12.1-inch capacitive multi-touch/gesture-enabled display			
Waveform update rate		> 450,000 waveforms per second			
Typical noise floor at 1 mV/div, 50 Ω		115 µVrms	150 µVrms	150 µVrms	210 µVrms

Vertical system analog channels					
Hardware bandwidth limits	1 MΩ	20 MHz, 200 MHz (selectable per channel)			
	50 Ω	20 MHz, 200 MHz, 1.5 GHz, 3 GHz (selectable per channel)			
Input coupling		AC, DC			
Input impedance		Selectable: 1 MΩ ± 1% (14 pF), 50 Ω ± 3%			
Input sensitivity range	1 MΩ	1 mV/div to 5 V/div [2] (200 MHz bandwidth limit at ≤ 2 mV/div)			
	50 Ω	1 mV/div to 1 V/div [2]			
Vertical resolution		8 bits (measurement resolution is 12 bits with averaging)			
Maximum input voltage	1 MΩ	145 Vrms; 205 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: ± 5Vpk max			
DC vertical gain accuracy [1]		± 3 div: 1.5% of full scale (typical)			
		± 4 div: 2.5% of full scale (warranted) [2]			
DC vertical offset accuracy		± 0.1 div ± 2 mV ± 1% of offset setting (valid for an offset of ≤ ± 12 divisions)			
Channel-to-channel isolation		≥ 100:1 (DC to 1 GHz), ≥ 30:1 (> 1 GHz)			
Offset range	1 MΩ	± 5 V (1 to < 10 mV/div), ± 20 V (10 to ≤ 200 mV/div), ± 100 V (> 200 mV/div)			
	50 Ω	± 12 div or ± 0.8 V, whichever is smallest (≤ 100 mV/div) ± 12 div or ± 4 V, whichever is smallest (> 100 mV/div)			
Dynamic range	1 MΩ	± 8 divisions from center screen (≤ 100 mV/div), 2nd harmonic distortion of - 40 dbc ± 4 divisions from center screen (> 101 mV/div), 2nd harmonic distortion of - 23 dbc (For a 10:1 probe on the 1 MΩ input, vertical scaling is multiplied by 10)			
	50 Ω	± 8 divisions from center screen			
Noise floor at 50 Ω		1 GHz	2.5 GHz	4 GHz	6 GHz
	1 mV/div	115 µVrms	150 µVrms	150 µVrms	210 µVrms
	10 mV/div	330 µVrms	355 µVrms	350 µVrms	395 µVrms
	100 mV/div	3.15 mVrms	3.25 mVrms	3.20 mVrms	3.35 mVrms
	1 V/div	31.5 mVrms	32.5 mVrms	32 mVrms	33.5 mVrms
ESD tolerance		± 2 kV (on input BNCs)			

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 is a magnification of 2 mV/div setting. For vertical accuracy calculations, use full scale of 16 mV for 1 mV/div sensitivity setting.

Performance Characteristics (Continued)

DSOX/MSO 6000 X-Series digital storage/mixed signal oscilloscopes (Continued)

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), 5V 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
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

Horizontal system analog channels					
		1 GHz	**2.5 GHz**	**4 GHz**	**6 GHz**
Time base range		500 ps/div to 50 s/div	100 ps/div to 50 s/div	100 ps/div to 50 s/div	100 ps/div to 50 s/div
Time base accuracy [1]		± 1.6 ppm + aging factor (1 year: ± 0.5 ppm, 2 years: ± 0.7 ppm, 5 years: ± 1.5 ppm, 10 years: ± 2.0 ppm)			
Time base resolution		2.5 ps			
Time base delay time range	Pre-trigger	Greater of 1 screen width or 50 µs			
	Post-trigger	1 s to 500 s			
Channel-to-channel deskew range		± 100 ns			
Δ time accuracy (using cursors)		Same channel: ± (time base accuracy x reading) ± (0.0016 x screen width) ± 10 ps Channel-to-channel: ± (time base accuracy x reading) ± (0.0016 x screen width) ± 15 ps			
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			

Horizontal system digital channels	
Minimum detectable pulse width	2 ns
Channel-to-channel skew	2 ns (typical); 3 ns (maximum)

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.

Performance Characteristics (Continued)

Acquisition system						
		1 GHz	2.5 GHz	4 GHz	6 GHz	
Maximum analog channels sample rate		20 GSa/s half channel interleaved, 10 GSa/s all channel				
Analog channels equivalent sample rate		Not available				400 GSa/s
Maximum analog channels record length	≤ 2 GSa/s	4 Mpts half channel interleaved, 2 Mpts all channel				
	> 2 GSa/s	1 Mpts half channel interleaved, 500 kpts all channel				
Maximum digital channels sample rate		2 GSa/s half pods interleaved, 1 GSa/s all pods				
Maximum digital channels record length		4 Mpts half pods interleaved, 2 Mpts all pods				
Acquisition mode	Normal	Default mode				
	Peak detect	Analog channels: Capture glitches as narrow as 500 ps (half channel), 1 ns (all channel)				
		Digital channels: Capture glitches as narrow as 500 ps (half pods), 1 ns (all pods)				
	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: ≥ 20 µs/div at 2 GSa/s or ≥ 50 µs/div at 1 GSa/s				
	Segmented	Segmented memory optimizes available memory for data streams that have long dead times between activity. Maximum segments = 1000. Re-arm time = As fast as 1 µs (minimum time between trigger events)				
Data acquisition mode	Real time	Default mode (> 135,000 waveforms/sec)				
	Max update rate	Enhanced real-time mode for the fastest waveform update rate of > 450,000 waveforms/sec. Up to 2 GSa/s. Returns to a normal real-time mode at > 2 GSa/s				
	Equivalent	Available with 6-GHz bandwidth license. The time base must be at 20 ns/div or faster. 2.5-ps fine interpolator resolution yields a maximum effective sample rate of 400 GSa/s				
Time mode	Normal	Default mode				
	Roll	Displays the waveform moving across the screen from right to left. Available at time bases 50 ms/div or slower				
	XY	Shows the volts-versus-volts display. Time base can be set from 200 ns/div to 50 ms/div				

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 but not synchronized to the input 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 forces a synchronous 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

Performance Characteristics (Continued)

Trigger system				
Trigger jitter		< 1.0-ps rms with the jitter-free trigger		
		< 3.0-ps rms without the jitter-free trigger		
Trigger bandwidth	Edge	500 MHz, 1 GHz, 2.5 GHz models: bandwidth of oscilloscope. 4-GHz and 6-GHz models: 3.5 GHz		
	Other modes	Bandwidth of oscilloscope or 1 GHz, whichever is smaller		
Trigger sensitivity (internal) [1]	1 GHz bandwidth	≤ 10 mV/div	DC to 1 GHz	Greater of 1 div or 5 mVpp
		> 10 mV/div	DC to 1 GHz	0.6 div
	2.5, 4, and 6 GHz bandwidth	≤ 10 mV/div	DC to 2 GHz	Greater of 1 div or 5 mVpp
			2.0 to 3.5 GHz	Greater of 1.5 div or 5 mVpp
		> 10 mV/div	DC to 2 GHz	0.6 div
			2.0 to 3.5 GHz	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.

Trigger type selections	
InfiniiScan Zone (hardware 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. > 160,000 wfm/sec update rate Supported modes: Normal, peak detect, high resolution, max update rate Also works simultaneously with the serial decodes and mask/limit test
Edge	Trigger on a rising and falling edge of any source, alternating or either edge of analog and digital channels
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 – 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 – Maximum duration setting: 10 s
Or	Trigger on any selected edges from available sources (analog and digital channels only). Bandwidth is 500 MHz

Performance Characteristics (Continued)

Trigger type selections (Continued)	
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 – 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 position runt pulse that fails to exceed a high-level threshold. Trigger on a negative runt pulse that fails to drop below 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 ns
Setup and hold	Trigger on setup/hold violations. Setup time can be set from –7 s 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
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***, resume***, reset***, packets (token, data, handshake, or special), and errors (PID, CRC5, CRC16, glitch, bit stuff***, SE1***). Supports USB 2.0 low-speed, full- speed, and hi-speed implementations. (Hi-speed is supported on ≥ 1-GHz models only)
SENT (Option)	Trigger and decode 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
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
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)

1. Suspend, resume, reset, bit stuff error, and SE1 error are USB 2.0 low- and full-speed only.

Performance Characteristics (Continued)

Search, navigate, and lister		
Type		Edge, pulse width, rise/fall, runt, frequency peak, serial bus 1, serial bus 2
Copy		Copy to trigger, copy from trigger
Frequency peak	Source	Math functions
	Max number of peaks	11
	Control	Threshold, excursion, results order (frequency or amplitude)
Result display		Event lister or navigation. Manual or autoscroll via navigation or touch event lister entry to jump to a specific event

Waveform measurements		
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]
Number of measurements		56 automatic measurements, maximum of 10 displayed at a time
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 10 measurements from the list below:
	Snapshot	Makes a snapshot of 31 most popular measurements. Touchable target to populate the measurement side bar
	Voltage/current	Peak-to-peak, maximum, minimum, amplitude, top, base, overshoot, preshoot, 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-N cycles, ratio-full screen
	Time	Period, frequency, counter, + width, - width, burst width, + duty cycle, - 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	Area-N cycles, area-full screen
	Jitter	Option DSOX6JITTER required Data TIE, clock TIE, N-period, period-period, + width to + width, - width to - width
	Real-time eye	Option DSOX6JITTER required Eye width, eye height
	Dual-channel (requires N2820A probe)	Charge-N cycles, charge-full screen, peak-peak, amplitude, DC RMS-N cycles, DC RMS-full screen, AC RMS- N cycles, AC RMS-full screen (standard deviation), average-N cycles, average-full screen, base
Automatic measurement logging		Available via BV0004B BenchVue
Counter		Built-in frequency counter (see “Precision counter/totalizer section” for the 10-digit counter)
	Source	Any analog and digital channel
	Resolution	5 digits
	Max frequency	1 GHz (1.2 GHz typical)

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 is a magnification of 2 mV/div setting. For vertical accuracy calculations, use full scale of 16 mV for 1 mV/div sensitivity setting.

Performance Characteristics (Continued)

Waveform math		
Number of math functions		Four, displays all four simultaneously. Can be cascaded
Arithmetic		Add, subtract, multiply, divide, differentiate, integrate, FFT, Ax + B, squared, square root, absolute value, common logarithm, natural logarithm, exponential, base 10 exponential, low-pass filter, high-pass filter, averaged value, magnify, max hold, min hold, measurement trend, chart logic bus (timing or state), clock recovery
Enhanced FFT	Record size	Up to 1-Mpts resolution via precision mode
	Window types	Hanning, flat top, rectangular, Blackman-Harris, Bartlett
	Display	Color grade or monochrome
	Waveforms	FFT, max hold, min hold, average
	Peak search	Max 11 peaks, threshold and excursion control

Waveform analysis		
Mask/limit test (Option)		Standard mask/limit test capability provides pass/fail comparison of a signal under test to a predefined mask template or automask template. Predefined mask templates or edits to an automask template can be made via a text editor. > 130,000 mask tests per second (waveform update rate)
Histogram		Provides a statistical view of a waveform or a measurement
	Source	Any analog channels, math functions, reference waveforms, measurements
	Types	Horizontal, vertical, or measurement
	Measurements	Hits, peak, max, min, peak to peak, mean, median, mode, bin width, standard deviation, 1~3 sigma
	Modes	All modes supported except zoom, ZY, and roll
Color grade		Provides a 3-dimensional view of waveform intensity
	Source	Any analog channels, math functions, reference waveforms, real-time eye
	Color themes	Temperature and intensity
	Modes	All modes supported except zoom, ZY, and roll
Jitter (Option)		Measures the variance of a measurement over time
	Jitter measurement floor	600 fs rms at 6 GHz sine wave (typical)
	Source	Any analog channels, math functions, and reference waveforms
	Clock recovery	Constant frequency, first-order phase lock loop (PLL), second-order PLL, explicit
		Data rate: Fully automatic, semi-automatic, manual
Real-time eye (Option)		Provides the color graded eye pattern analysis based on the recovered clock. Data bits are folded on top of each other per clock cycle to give a 3-dimensional view
	Source	Any analog channels, math functions, and reference waveforms
	Clock recovery	Constant frequency, first-order phase lock loop (PLL), second-order PLL, explicit
		Data rate: Fully automatic, semi-automatic, manual
	Color mode	Color grade
	Measurements	Eye height, eye width
Precision mode		Increase the analysis record length. Minimum: 100 kpts; maximum 1 Mpts

Performance Characteristics (Continued)

Precision counter/totalizer (Specifications are typical) (option)		
Counter	Source	Any analog channel or trigger qualified event
	Resolution	10 digits (8 digits for trigger qualified event)
	Max frequency	Up to 3.2 GHz (4 GHz typical). With Hi-speed USB 2.0 decoding, 1 GHz (1.2 GHz typical)
	Trig-qual events	1/(trigger holdoff time) for trigger qualified events (max 25 MHz, minimum dead time of 40 ns)
Measurement		Frequency, period, totalize
Totalizer	Counter size	64-bit totalizing counter
	Edge	Rise or fall
	Gating	Positive or negative level. Select from analog channels except the source
Time reference		Internal or external 10 MHz reference clock

Integrated digital voltmeter (Specification are typical) (option)	
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
Auto ranging	Automatic adjustment of vertical amplification to maximize the dynamic range of measurements
Range meter	Graphical display of most recent measurement, plus extreme over the previous 3 seconds

Dual-channel WaveGen – built-in function/arbitrary waveform generator (Specification are typical) (Option)	
WaveGen outputs/ Output modes	Two (front-panel BNC connectors) Both waveform generator outputs can be frequency tracked, amplitude tracked, or completely tracked. Phase adjustable. [1] A generator's output can be inverted to create a differential signal Output modes: Normal (continuous) or single-shot (limited to arbitrary, sine, ramp, sine cardinal, exp rise/fall, cardiac, Gaussian pulse)
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.C176 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 (2e12/carrier frequency), whichever is smaller FSK: Modulation: 50% duty cycle square wave FSK rate: 1 Hz to 20 kHz| Hop frequency: 2x FSK rate to 10 MHz

1. Only the following combination of wave shapes can be frequency tracked or completely tracked:
   a. Sine, ramp, sine cardinal, cardiac, and Gaussian pulse.
   b. Square wave, and pulse.
   c. Exponential rise and exponential fall.
   d. Arbitrary.

Performance Characteristics (Continued)

Dual-channel WaveGen – built-in function/arbitrary waveform generator (Specification are typical) (Continued)		
Sine	Frequency range	0.1 Hz to 20 MHz
	Amplitude flatness	± 0.5 dB (relative to 1 kHz)
	Harmonic distortion	–40 dBc
	Spurious (nonharmonics)	–40 dBc
	Total harmonic distortion	1%
	SNR (50 Ω load, 500 MHz BW)	40 dB (Vpp ≥ 0.1 V); 30 dB (Vpp < 0.1V)
Square wave/pulse	Frequency range	0.1 Hz to 10 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% ± 5 ns
	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) [1]
	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

1. Full resolution is not available at output due to internal attenuator stepping.

Performance Characteristics (Continued)

Dual-channel WaveGen – built-in function/arbitrary waveform generator (Specification are typical) (Continued)		
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)
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	

Quick action customization key	
Quick measure all	Displays a popup containing a snapshot of all the single waveform measurements
Quick measure statistics reset	Resets all measurement statistics and the measurement count
Quick mask statistics reset	Resets mask statistics and counters
Quick histogram statistics reset	Zeros the histogram counters
Quick print	Print the current screen image
Quick save	Saves the current setup, screen image, or data file as specified in the settings menu
Quick email	Emails the current setup, screen image, or data file as specified in the settings menu
Quick recall	Recalls setup, mask, or reference waveform
Quick freeze display	Freezes the display without stopping running acquisitions or unfreezes the display if currently frozen. Waveform intensity preserved
Quick trigger mode	Toggles the trigger mode between auto and normal
Quick clear display	Clears the display

Display characteristics	
Display	12.1-inch capacitive multi-touch/gesture enabled color TFT LCD
Display mode	Zone/zoom/annotation mode and waveform placement mode
Resolution	800 (H) x 600 (V) pixel format (screen area)
Graticules	8 vertical divisions by 10 horizontal divisions with intensity controls
Format	YT and XY
Maximum waveform update rate	> 135,000 wfm/s (real time)
	> 450,000 wfm/s (real time max update rate)
Persistence	Off, infinite, variable persistence (100 ms to 60 s)
Intensity gradation	256 intensity levels

1. Sinc, cardiac and Gaussian pulse: ± 1.25 V into Hi-Z; ± 625 mV into 50 Ω.

Performance Characteristics (Continued)

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, mice, and USB microphones	
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	10/100/1000 Base-T port on rear panel. LXI IPv6 extended function	
Web remote control	VNC Web interface (via major Web browsers)	
Video-out port	VGA out on rear panel. Connect oscilloscope display to an external monitor or projector	
GPIB port	N4865A GPIB-to-LAN adapter (option)	
10-MHz reference		BNC connector on the rear panel
	Support mode	Output and input off, output on (10-MHz out) input on (10-MHz in)
	In mode	50 Ω, 356 mVpp to 4.48 Vpp (–5 dBm to 17 dBm), 6.32-Vpp max (20-dBm max) Recommended input signal accuracy: better than ± 10 ppm
	Out mode	50 Ω, 1.65 Vpp square wave
Trigger out	BNC connector on the rear panel. Supported modes: triggers, mask, waveform generator 1 sync pulse, and waveform generator 2 sync pulse	

General and environmental characteristics	
Power line consumption	Maximum 200 W
Power voltage range	100-120 V, 50/60/400 Hz; 100-240 V, 50/60 Hz
Environmental rating	0 to +50 °C; 4000 m Max
	Maximum Relative Humidity (non-condensing): 90%RH up to 40 °C, decreases linearly to 50%RH at 50 °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
Vibration	Meets IEC60068-2-6 and MIL-PRF-28800; class 3 random
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)
Mean Time Before Failure (MTBF)	> 120,000 hours
Dimensions	425 mm W x 288 mm H x 148 mm D
Weight	Net: 6.8 kg (15 lbs.), Shipping: 11.3 kg (25 lbs.)

Performance Characteristics (Continued)

Non-volatile storage		
Reference waveform display		Four internal waveforms or USB thumb drive. Displays up to 4 reference waveforms simultaneously
Data/file save	Setup/image	Setup (*.scp), 8 or 24-bit bitmap image (*.bmp), PNG 24-bit image (*.png)
	Waveform data	CSV data (*.csv), ASCII XY data (*.csv), binary data (*.bin), lister data (*.csv), reference waveform data (*.h5), multichannel waveform data (*.h5), arbitrary waveform data (*.csv)
	Application data	Mask (*.msk), power harmonics data (*.csv), USB signal quality (*.html and *.bmp)
	Analysis results (*.csv)	Cursor data, measurement results, histogram statistics, mask test statistics, color grade bin, search, segmented timestamps
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	Certificate of calibration, 2-year calibration interval
Probe	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 DSOX6MSO upgrade option)
Interface language support/built-in help	English, Chinese (simplified and traditional), French, German, Italian, Japanese, Korean, Portuguese, Russian, and Spanish localized front-panel overlays, interface, and built-in help system
Voice control support	English (American), English (British), English (Indian), Chinese Simplified (Mainland), Chinese Simplified (Cantonese), Chinese Traditional (Taiwan), Chinese Traditional (Cantonese), French, German, Italian, Japanese, Korean, Portuguese, Russian, Spanish (Latin America) and Spanish (Castilian)
Power cord	Localized power cord
Front-panel protection	Front-panel cover
Documentation	CD containing localized user's guide, service guide, and programmer's manual

Related literature

Publication title	Publication number
Jitter Analysis - Application Note	5991-4000EN
Automotive Serial Bus Testing Using Keysight's InfiniiVision X-Series and Infiniium S-Series Oscilloscopes - Application Note	5991-4038EN
Physical Layer Testing of the USB 2.0 Serial Bus Using InfiniiVision 6000 X-Series and Infiniium Series Oscilloscopes - Application Note	5991-4167EN
Evaluating Oscilloscopes for Low-Power Measurements - Application Note	5991-4268EN
InfiniiVision and Infiniium Oscilloscopes - Product Fact Sheet	5991-4273EN
Evaluating Current Probe Technologies for Low-Power Measurements - Application Note	5991-4375EN

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