# Keysight Technologies
# InfiniiVision 4000 X-Series Oscilloscopes

Data Sheet




KEYSIGHT TECHNOLOGIES

Unlocking Measurement Insights

# 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 InfiniiScan 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 InfiniiScan 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 five instruments in one: oscilloscope channels, logic channels, digital voltmeter (DVM), dual-channel WaveGen function/arbitrary waveform generator, 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
  - InfiniiScan 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.

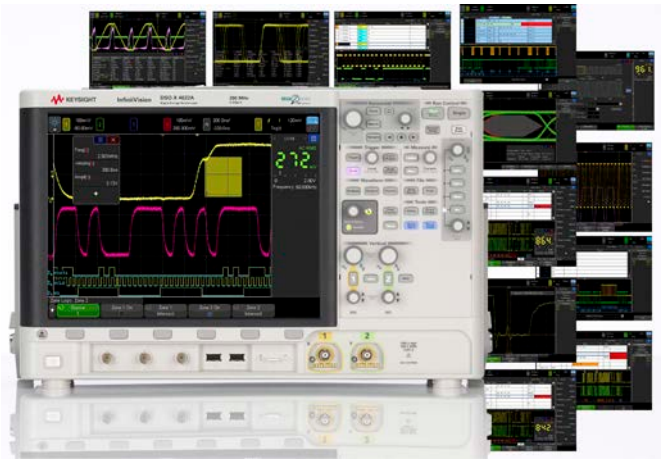


Figure 2. Take advantage of a new oscilloscope application bundle that will enable ALL software applications (including DVM and WaveGen) for one low price (Option DSOX4APPBNDL).

# 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 |
|---|---|---|---|---|
| Analog channels | 2 or 4 | 2 or 4 | 2 or 4 | 2 or 4 |
| Digital channels | 16 (MSO models or upgrade) | 16 (MSO models or upgrade) | 16 (MSO models or upgrade) | 8 (MSO models or upgrade) |
| 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 |
| Max sample rate | 20 GSa/s | 5 GSa/s | 5 GSa/s | 2 GSa/s |
| Max memory depth | 4 Mpts | 4 Mpts | 4 Mpts | 100 kpts (standard)<br>1 Mpts (option) |
| Max waveform update rate | > 450,000 wfms/sec | > 1,000,000 wfms/sec | > 1,000,000 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 |
| Zone touch trigger | Standard | Standard | Standard | No |
| Voice control | Standard | 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) |
| Integrated DVM | Option | Option | Option | Option |
| Integrated hardware counter | 5 digits (standard), 10 digits + totalizer (option) | 5 digits (standard) | 5 digits (standard), 8 digits + totalizer (option) | 5 digits (standard) |
| Search and navigate | Standard, lister supported | Standard, lister supported | Standard, lister supported | Serial only |
| Segment memory | Standard | Standard | Standard | Option |
| Mask/limit test | Option | Option | Option | Option |
| Serial protocol analysis options | $I^2C$/SPI, UART/RS232, CAN/CAN-dbc/CAN-FD/LIN/LIN symbolic, SENT, FlexRay, $I^2S$, MIL-STD1553, ARINC429, USB 2.0 | $I^2C$/SPI, UART/RS232, CAN/CAN-dbc/CAN-FD/LIN/LIN symbolic, SENT, FlexRay, $I^2S$, MIL-STD1553, CXPI, ARINC429, USB 2.0 | $I^2C$/SPI, UART/RS232, CAN/CAN-dbc/CAN-FD/LIN/LIN symbolic, SENT, FlexRay, $I^2S$, MIL-STD1553, CXPI, ARINC429 | $I^2C$/SPI, UART, CAN/LIN (will not operate simultaneously with digital channels) |
| Advanced analysis options | Power analysis, USB 2.0 signal quality test, HDTV analysis, FPGA | Power analysis, USB 2.0 signal quality test, HDTV analysis, FPGA | Power analysis, HDTV analysis | No |
| Color grade | Standard | No | No | No |
| Histogram | Standard | No | No | No |
| FFT | Standard enhanced FFT | Standard enhanced FFT | Standard enhanced FFT | Standard |
| Multi-domain analysis | Gated FFT | Gated FFT | Gated FFT | No |
| Jitter analysis with clock recovery | Option | No | No | No |
| Realtime eye diagram | Option | No | No | No |
| Advanced math | Standard, display four functions simultaneously | 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 |



## 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

## 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

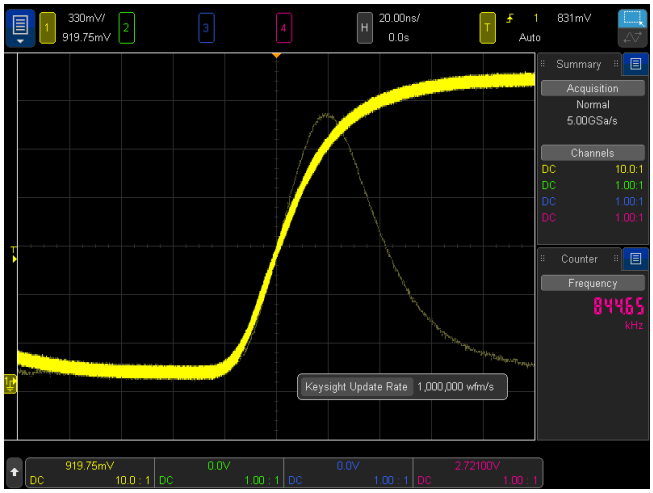



Figure 3. The 4000 X-Series captures a glitch occurring once in a million waveform cycles.

## 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.

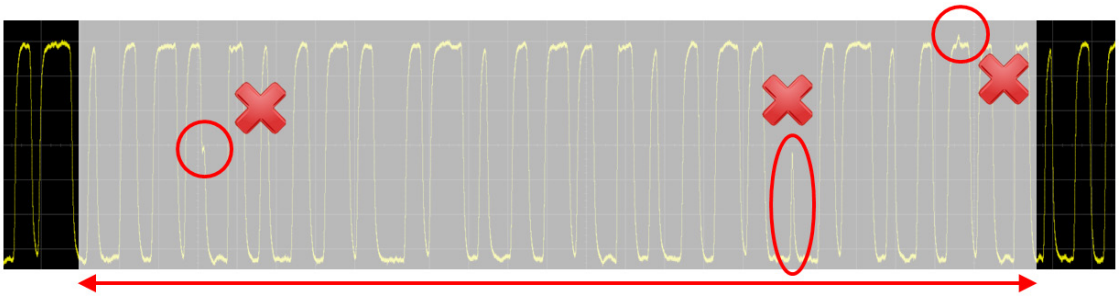


Figure 4. Other vendor's oscilloscope with 50,000 waveforms/second. A long dead time decreases your chances of capturing infrequent events.

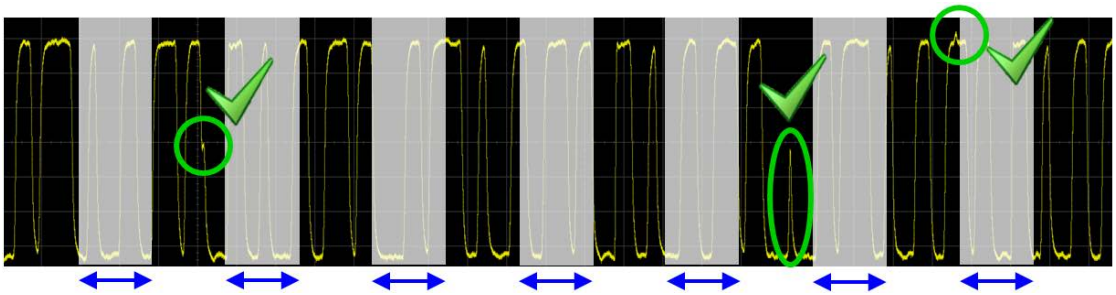


Figure 5. InfiniiVision 4000 X-Series with 1,000,000 waveforms/second. A short dead time increases your chances of capturing infrequent events.

# 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.

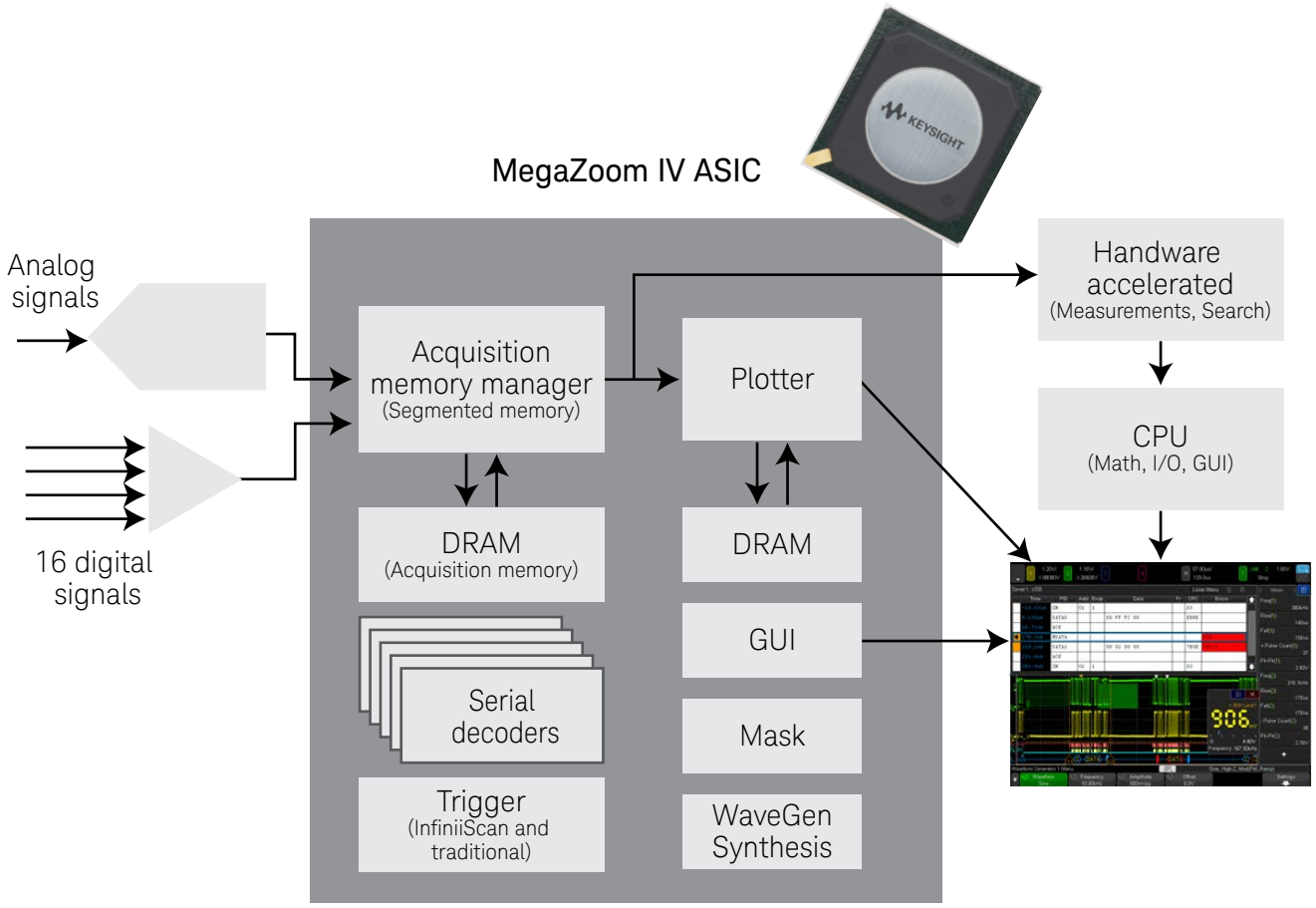



Figure 6. The 4000 X-Series oscilloscopes' uncompromised responsiveness, speed and waveform update rate is enabled by the MegaZoom IV, smart memory ASIC. The CPU is not used for core waveform operations.

# 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.

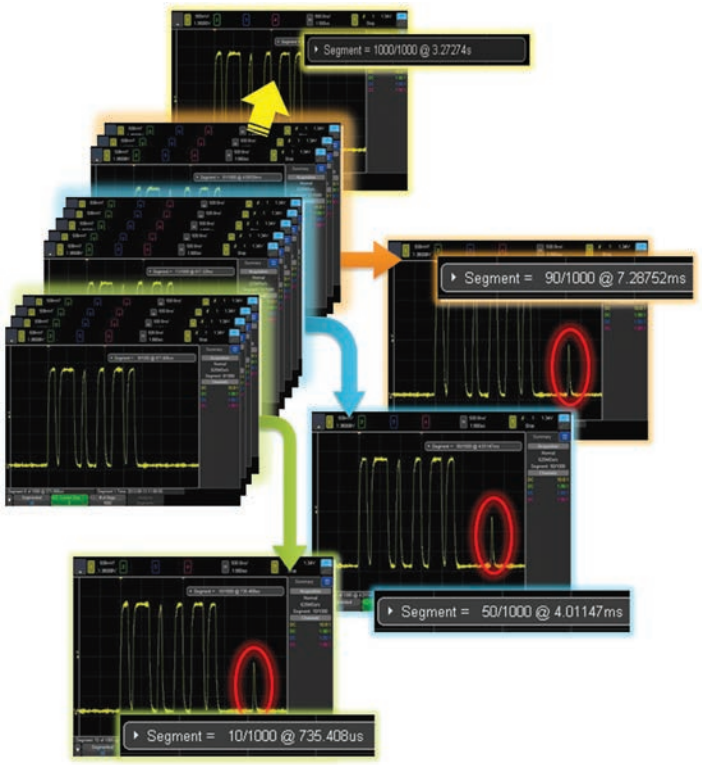



Figure 7. Segmented memory efficiently manages the memory to capture up to 1,000 segments of interest to you, making it an effective ultra-deep memory oscilloscope that can easily capture infrequent events and anomalies.

## 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.

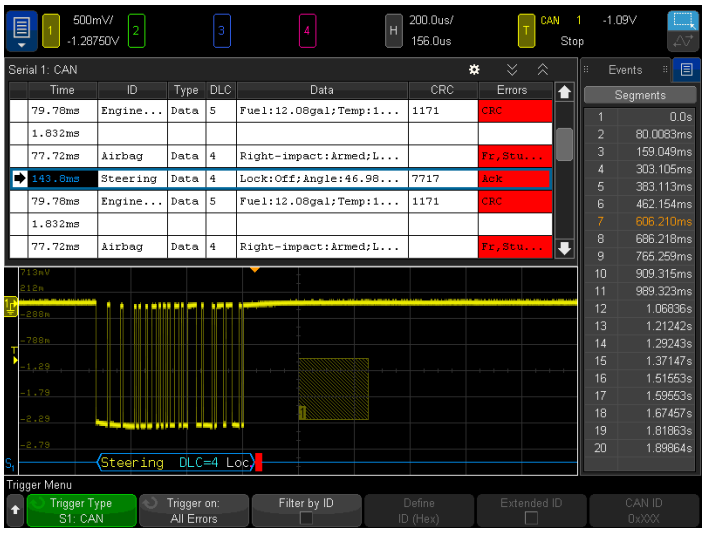



Figure 8. Segmented memory being used in conjunction with serial decode resulting in maximum insight into serial bus.

# 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.

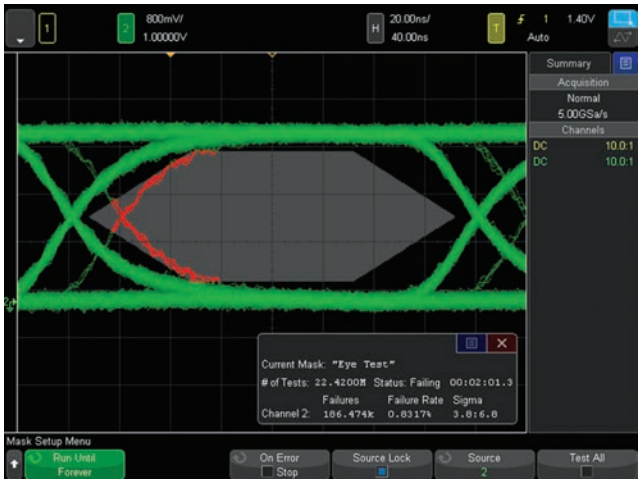



Figure 9. Mask testing evaluated > 22 M waveforms in just 2 minutes.

## 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.

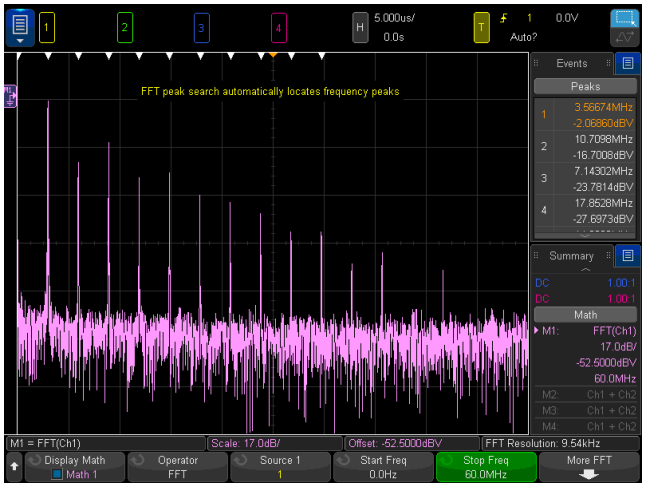



Figure 10b. The 4000 X-Series was set up to capture clock signals for FFT analysis. Using the search and navigation capability, the scope found, marked (white triangles) and quickly navigated to the first 11 frequency peaks occurrences. You can sort it in the order of frequency or amplitude.

# 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.

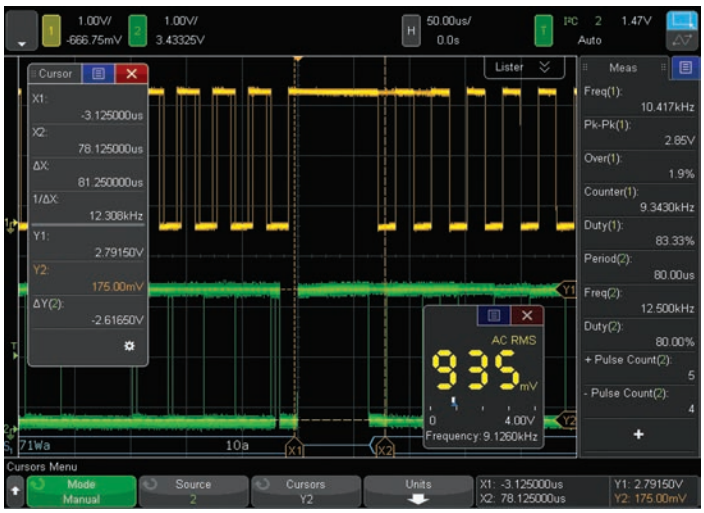



Figure 13. See 10 measurements, cursor information, and the DVM simultaneously by dragging the desired docking panel to any open area.

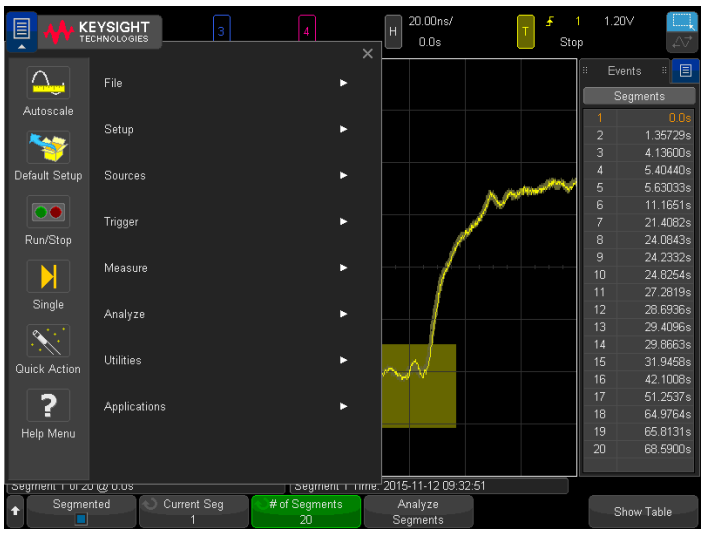



Figure 14. Use the Keysight pull-down menu for Windows-like operation.

# Oscilloscope Experience Redefined: Experience the Usability (Continued)

## InfiniiScan 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, InfiniiScan 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.

InfiniiScan 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.

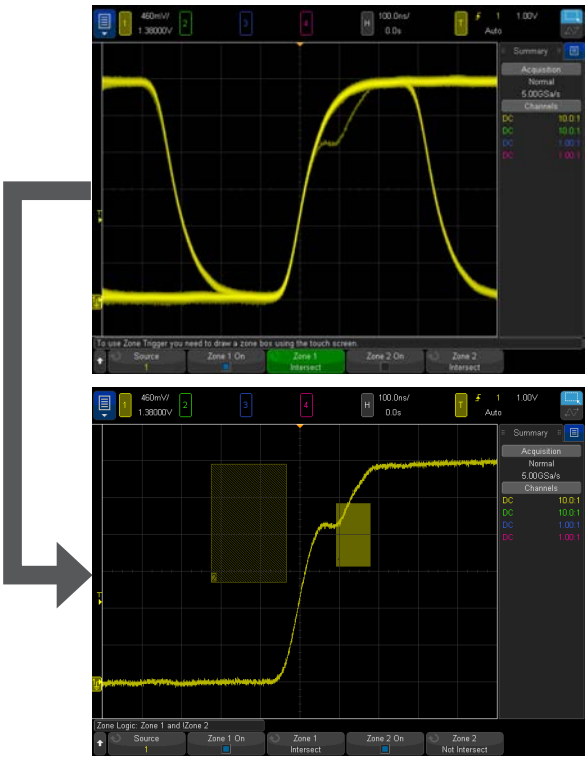


Figure 15. When you see anomalies, all you have to do is draw a zone box to trigger on them.

## InfiniiScan Zone touch trigger + segment memory: a whole new experience

The combination of the industry's only hardware-based InfiniiScan 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.

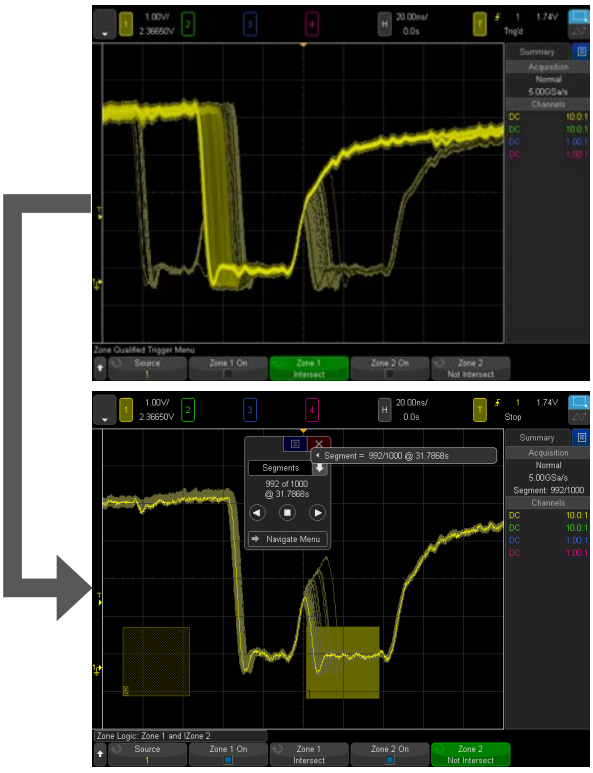


Figure 16. Combination of the InfiniiScan Zone touch trigger and segmented memory.

# Oscilloscope Experience Redefined: Experience the Integration

## Investment protection through a fully-upgradable 5-in-1 instrument

The InfiniiVision 4000 X-Series redefines the oscilloscope experience with unprecedented integration. This 5-in-1 instrument provides:

- Oscilloscope
- 16 digital channels
- Serial protocol analyzer
- Dual-channel WaveGen 20 MHz function/ arbitrary waveform generator
- 3-digit voltmeter




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

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

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

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




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

# Oscilloscope Experience Redefined: Experience the Integration (Continued)

## Mixed signal oscilloscope (MSO): Integrated 16 digital channels

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

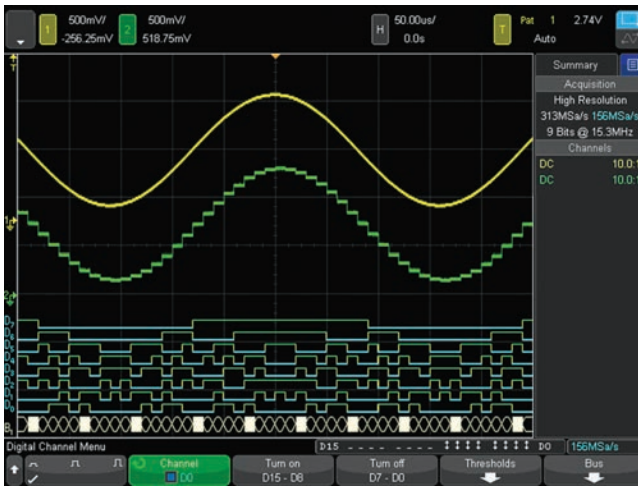


Figure 19. Digital channels are captured and displayed time-correlated with analog channels in MSOs or upgraded DSOs.

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

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

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

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

The 4000 X-Series has: SENT, I²C, SPI, USB 2.0, RS232/UART, CAN, CAN FD, LIN, FlexRay, CXPI, MIL-STD 1553, ARINC 429, and I²S. (See page 22)



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 an integrated 3-digit voltmeter (DVM) and 5-digit frequency counter inside the oscilloscope (DSOXDVM). 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.

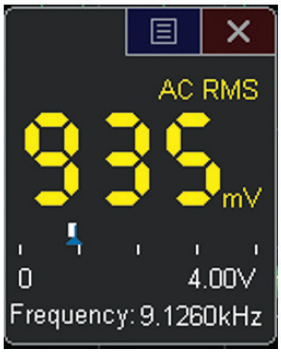



Figure 25. DVM 3-digit voltage and 5-digit frequency measurements always at your fingertips.




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

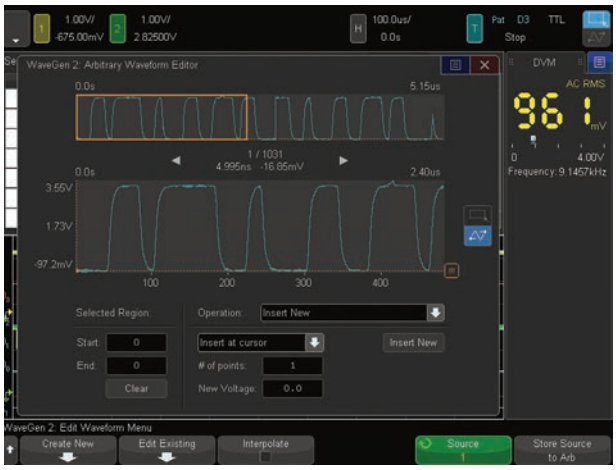



Figure 23. WaveGen arbitrary waveform editing screen.




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.

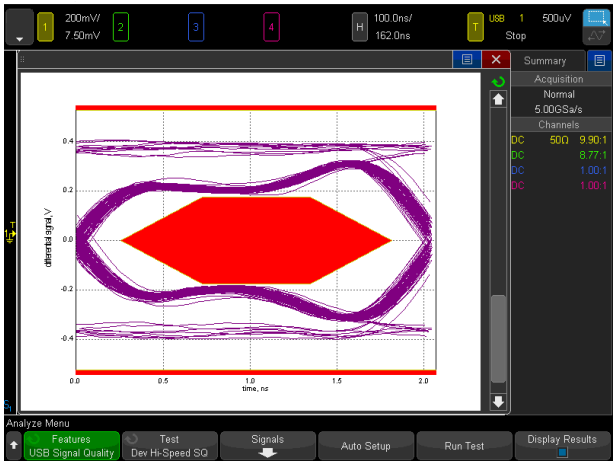



Figure 28. Perform automatic signal quality testing on USB 2.0 low-speed, full-speed, and hi-speed signals.

# Oscilloscope Experience Redefined: Other Key Productivity Tools (Continued)

## The Xilinx FPGA dynamic probe

The Xilinx FPGA Dynamic Probe for the 4000 X-Series (DSOX4FPGAX) allows internal FPGA signal activity to be correlated to external signal activity. Running on an external PC, it allows the user to switch between up to 64 signals inside the FPGA for each debug pin on the outside of the FPGA in seconds, all while automatically mapping internal signal names to the oscilloscope channel labels. The DSOX4FPGAX supports the Virtex-6 series, Virtex-5 series, Virtex-4 series, Virtex-II Pro series, Virtex-II series, and Spartan-3 series devices.

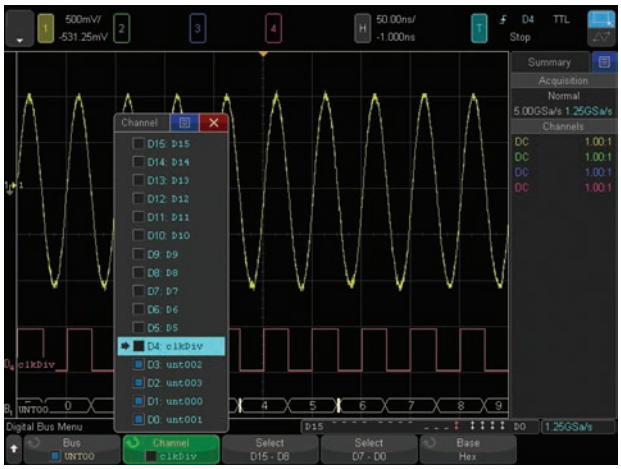



Figure 29. FPGA dynamic probe routing out internal FPGA signals, to be captured by the 4000 X-Series, correlated with this external analog sine wave in the design.

## 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 (DSOXEDK). This 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. DSOXEDK gets both students and experienced users efficiently using the 4000 X-Series.

# 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

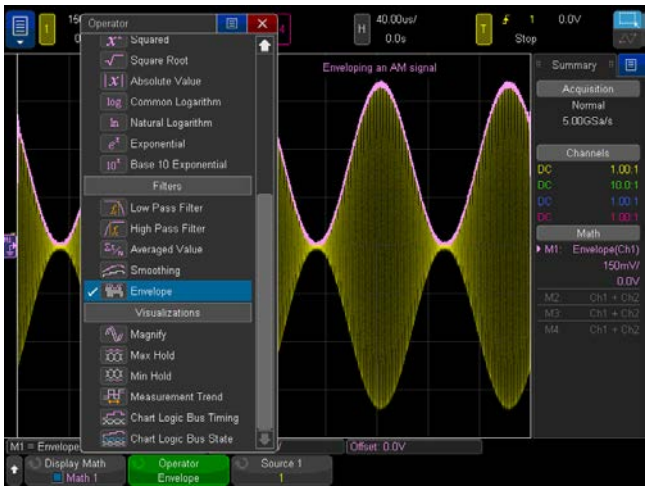



Figure 31. A variety of advanced math functions are standard in the 4000 X-Series.

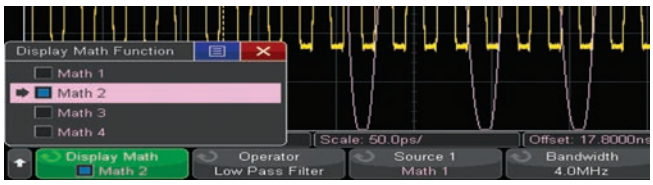



Figure 32. Four math functions can be created and nested with one resultant math function.

## 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.

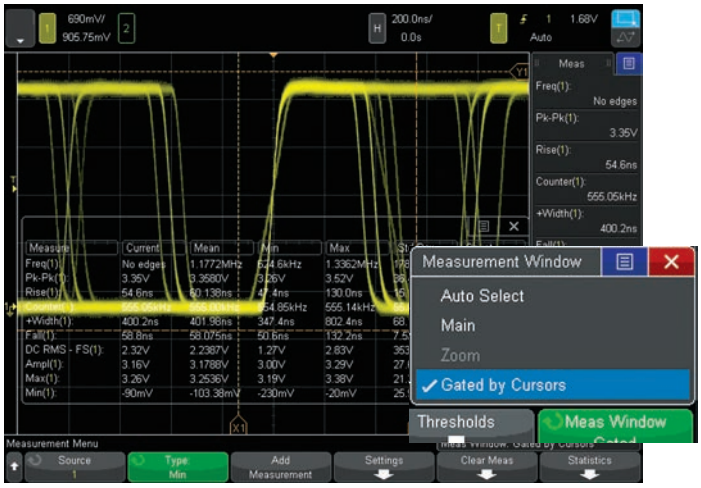



Figure 33. Up to 10 automated measurements displayed simultaneously. Measurements can be gated by cursors.

# 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.

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



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

## 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.

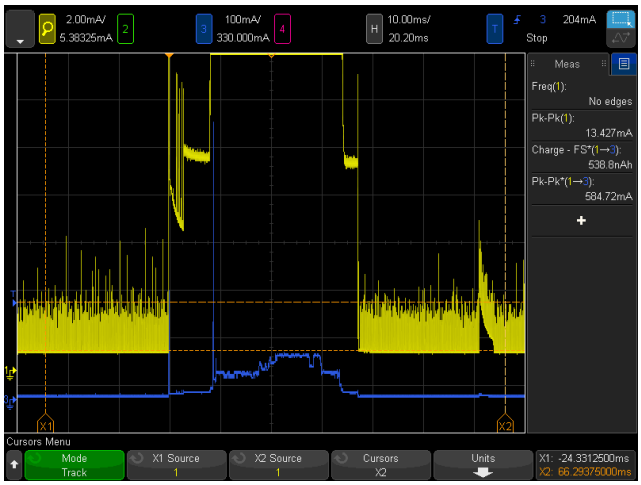



Figure 36. The 4000 X-Series and N2820A Series high-sensitivity current probe measuring > 500 mA and < 1 mA current simultaneously.

# Oscilloscope Experience Redefined: Other Key Productivity Tools (Continued)

## 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).

BV0000A BenchVue lets you visualize the 4000 X-Series and multiple measurements simultaneously. 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. Learn more at **www.keysight.com/find/BenchVue.**

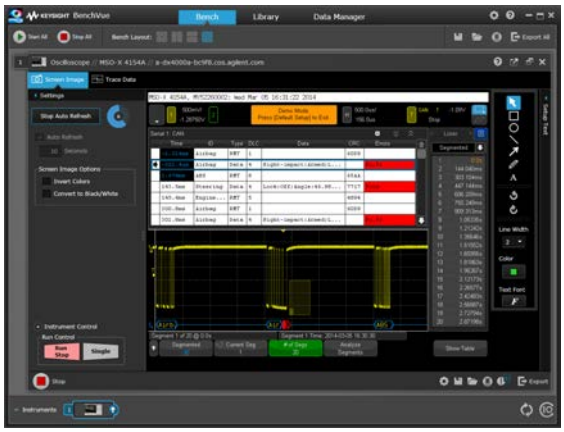


Figure 37. BV0000A BenchVue.

## 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 InfiniiScan 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.

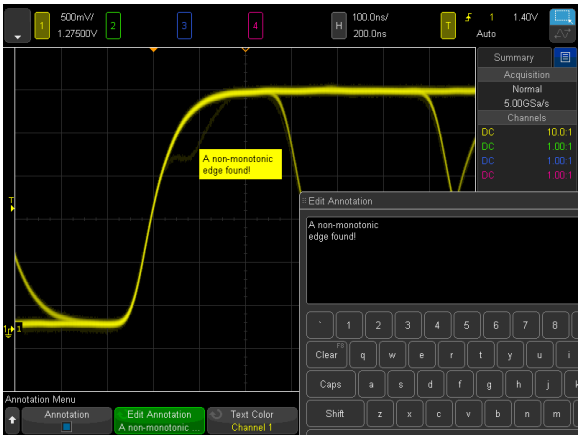



Figure 39(a). Annotation and keypad.

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.

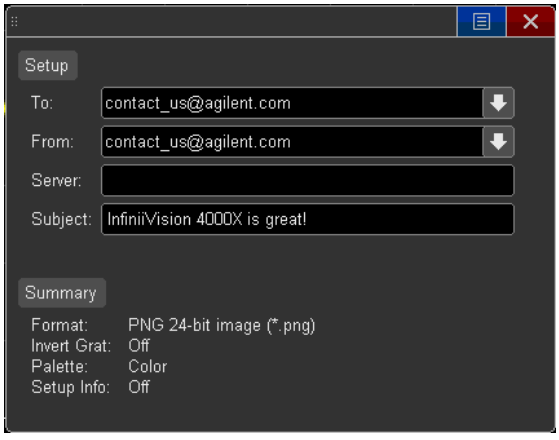



Figure 39(b). E-mail configuration screen.

# 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**.

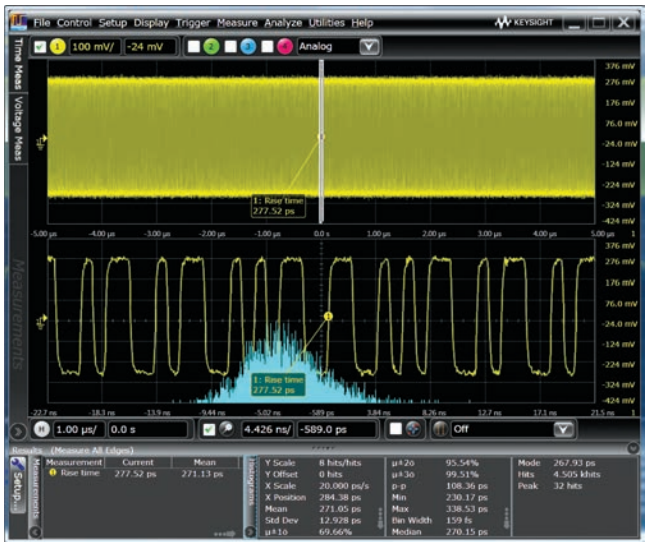



Figure 40. Infiniium Offline enables a variety of advanced signal analysis while providing extensive, yet intuitive, waveform documentation.

## Keysight spectrum visualizer (AKSV software)

KSV PC-based software package (64997A) connects to the oscilloscope via USB or Ethernet connection. KSV provides affordable advanced FFT frequency-domain analysis and spectrum and spectrogram analysis with an intuitive user interface familiar to RF engineers.

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

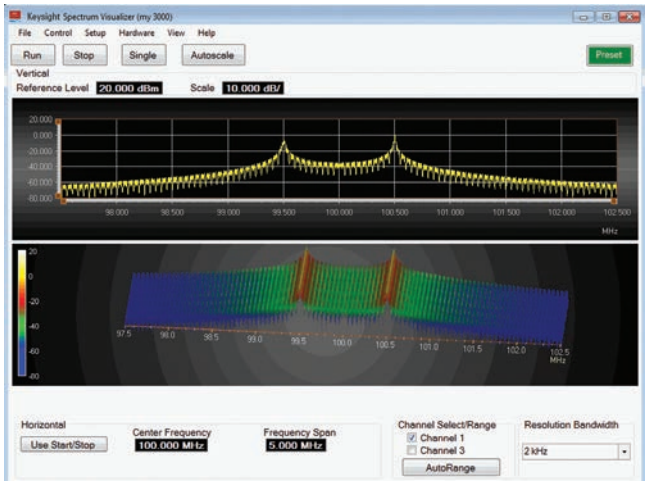



Figure 41. Waterfall view for KSV spectrogram measurements.

## 3-year standard warranty, 2-year calibration interval

Through improved quality processes and rigorous testing, the Keysight InfiniiVision 4000 X-Series oscilloscopes are able to perform at guaranteed specification for two years without calibration, thereby reducing your cost of ownership. These oscilloscopes come with a standard factory 3-year warranty.

## 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 uVrms noise floor at 1 mV/div, 100 us/div setting.

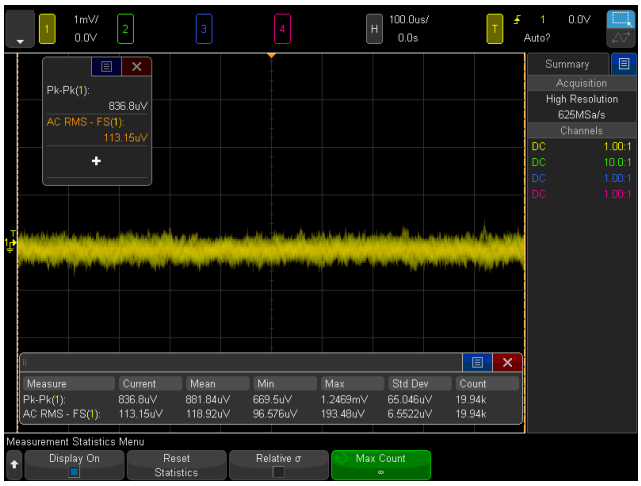



Figure 42. Getting 113 uVrms noise floor at 1 mV/div with the high resolution mode.

## 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 InfiniiScan 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) |
| **Measurement applications** | |
| Dual-channel WaveGen 20 MHz arbitrary/function generator | DSOX4WAVEGEN2(-WAV) |
| 3-digit voltmeter (DVM) | DSOXDVM(-DVM) |
| Power analysis application | DSOX4PWR(-PWR) |
| Mask limit testing | DSOX4MASK(-MSK) |
| Enhanced video/TV application package | DSOX4VID(-VID) |
| FPGA dynamic probe option for Xilinx | DSOX4FPGAX(-FPX) |
| USB 2.0 signal quality test option | DSOX4USBSQ(-U2Q) [2] |
| **Productivity tools** | |
| Education training kit | DSOXEDK(-EDK) |
| Infiniium Offline oscilloscope analysis software | N8900A |
| Keysight spectrum visualizer (KSV) | 64997A |
| Vector signal analyzer software (version 16 and higher) | 89601B |
| BenchVue Software | BV0000A |

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 33 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 |
| N6450-60001 or 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 |

## 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 and warranty plans

| Calibration and warranties | | |
|---|---|---|
| D/MSOX3000T-A6J | ANSI Z540-1-1994 calibration | Optional |
| D/MSOX3000T-AMG | ISO17025 compliant calibration with accreditation | Optional |
| R-51B-001-5F | Warranty Assurance Plan - Return to Keysight - 5 years | 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 |

| **Vertical 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 | 300 Vrms, 400 Vpk; transient overvoltage 1.6 kVpk. Frequency derating (assumes sine wave input): 400 Vpk until 40 kHz. Then derates at 20 db/dec until 6 Vpk |
| | 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; transient overvoltage 800 Vpk |
| 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<br>– 12 bits: ≥ 50 µs/div<br>– 11 bits: ≥ 20 µs/div<br>– 10 bits: ≥ 10 us/div<br>– 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 InfiniiScan Zone = 65 us 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.<br>Supported modes: normal, peak detect, high resolution.<br>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.<br>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<br>– Minimum duration setting: 2 ns (500 MHz, 1 GHz, 1.5 GHz), 4 ns (350 MHz), 6 ns (200 MHz)<br>– Maximum duration setting: 10 s<br>– 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.<br>– Minimum duration setting: 2 ns (500 MHz, 1 GHz, 1.5 GHz), 4 ns (350 MHz), 6 ns (200 MHz)<br>– 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<br>– Minimum: 1 ns (500 MHz, 1 GHz, 1.5 GHz model), 2 ns (350 MHz model), 3 ns (200 MHz model)<br>– 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<br>– 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 (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 | |
| 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 (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) | |
| **Waveform measurements and cursors** | | |
| DC vertical accuracy/cursors [2] | | Single cursor accuracy: ± [DC vertical gain accuracy + DC vertical offset accuracy + 0.21% full scale]<br>Dual cursor accuracy: + [DC vertical gain accuracy + 0.42% full scale] [1] |
| Cursors | | 2 pairs of XY cursors<br>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 | |

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.<br>Modulation types: AM, FM, FSK<br>Carrier waveforms: Sine, Ramp, Sine Cardinal, Exponential Rise, Exponential Fall, and Cardiac.Modulation Source: Internal (no external modulation capability)<br><br>AM:<br>Modulation: Sine, Square, Ramp<br>Modulation frequency: 1 Hz to 20 kHz<br>Depth: 0% to 100%<br>FM:<br>Modulation: Sine, Square, Ramp<br>Modulation frequency: 1 Hz to 20 kHz<br>Minimum carrier frequency: 10 Hz<br>Deviation: 1 Hz to carrier frequency or ($2e^{12}$/carrier frequency), whichever is smaller<br>FSK:<br>Modulation: 50% duty cycle square wave<br>FSK rate: 1 Hz to 20 kHz<br>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 ± 10% auto ranging |
| Temperature | Operating | 0 to +50 °C |
| | Non-operating | –30 to +70 °C |
| Humidity | Operating | 50% to 95% RH at 40 °C for 5 days |
| | Non-operating | 90% RH at 65 °C for 24 hr |
| Altitude | Operating | Up to 3,000 m |
| | Non-operating | Up to 15,300 m |
| 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 | | UL61010-1 2nd edition, CAN/CSA22.2 No. 61010-1-04 |
| 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 |

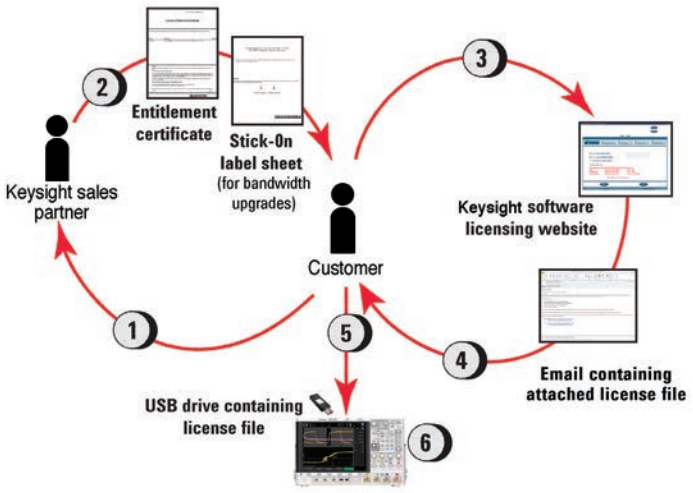
| Included standard with oscilloscope | |
|---|---|
| Factory warranty | 3-year warranty (90 days for unserialized accessories such as passive probes) |
| Calibration | Certificate of Calibration, 2-year calibration interval |
| Probes | One per channel N2894A 700 MHz passive probe (10:1 attenuation) |
| | N6450-60001 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



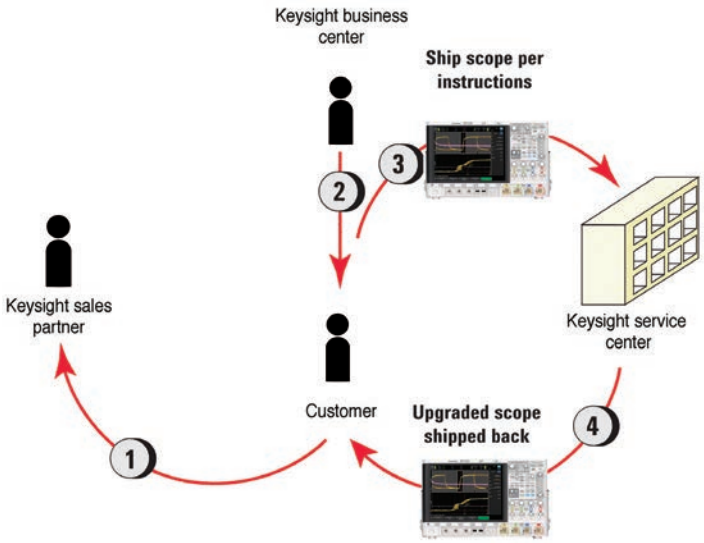

| 4000 X-Series bandwidth upgrade models | | |
|---|---|---|
| **Model number** | **Description** | **Type** |
| DSOX4B3T52U | 350 MHz ~ 500 MHz, 2 ch | License only |
| DSOX4B3T54U | 350 MHz ~ 500 MHz, 4 ch | License only |

| 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 |
| 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) |
| DSOX4WAVEGEN2 | Dual-channel WaveGen 20 MHz arbitrary/function generator |
| DSOXDVM | 3-digit voltmeter (DVM) |
| DSOX4PWR | Power analysis application |
| DSOX4MASK | Mask Limit Testing |
| DSOX4VID | Enhanced video/TV application package |
| DSOX4FPGAX | FPGA dynamic probe option for Xilinx |
| DSOXEDK | Education and training kit |
| DSOXPERFMSO | 4000 X-Series oscilloscope MSO upgrade (N6450-60001 MSO cable is shipped separately) |

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

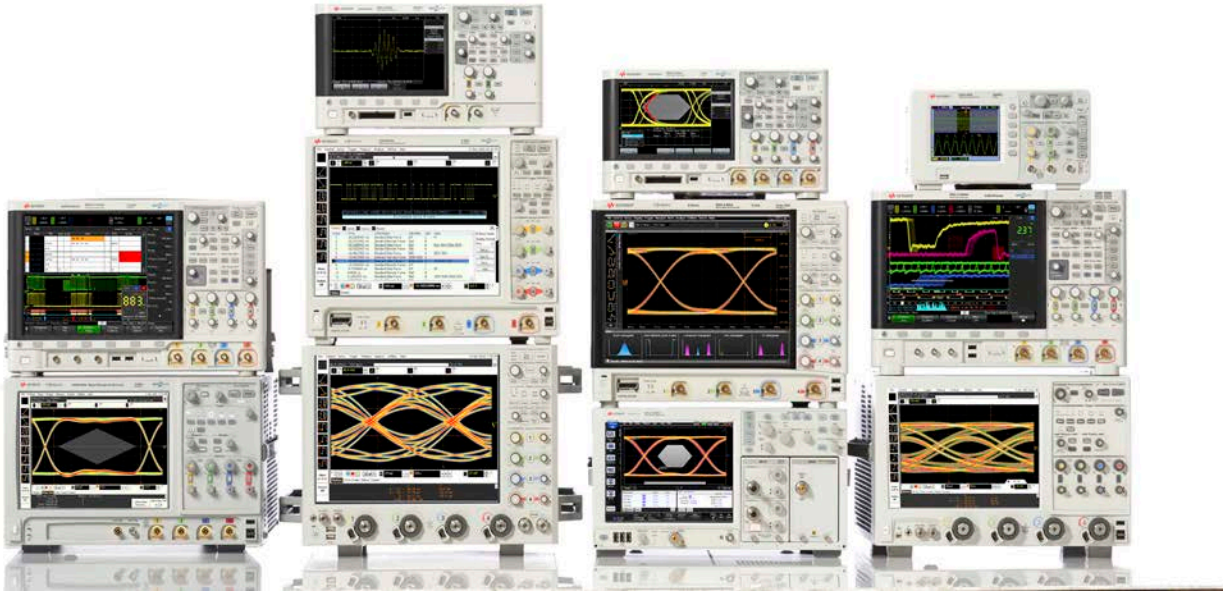
| Process description | |
|---|---|
| 1 | Place order for a license-only upgrade or measurement application product with a Keysight sales partner. |
| 2 | For measurement applications, you will receive a paper or electronic .pdf entitlement certificate. For bandwidth upgrades only, you will receive a 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

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.

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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.

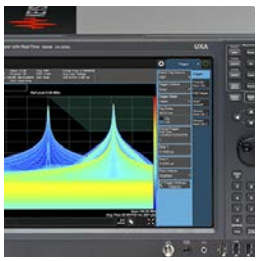
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