InfiniiVision 6000 X-Series Oscilloscopes

Need More Memory, Bandwidth, Analysis Capability, or Bits?

Consider the Infiniium EXR-Series

- Bandwidths of up to 500 MHz to 6 GHz on all 4 or 8 analog channels
- 16 GSa/s Sample Rate
- 100 Mpts standard memory, up to 1.6 Gpts Mpts optional (half channel)
- 4 or 8 channels + 16 digital channels (MSO or upgrade)
- 10 bits of vertical resolution, up to 16 with high resolution
- 15.6-inch full HD touch display
- Widest range of applications including serial compliance, jitter analysis and more

See www.keysight.com/find/exr for details.

KEYSIGHT

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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 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 environmental-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

Overview of the Keysight InfiniiVision X-Series oscilloscopes

	InfiniiVision 1000 X-Series	InfiniiVision 2000 X-Series	InfiniiVision 3000G X-Series	InfiniiVision 4000 X-Series	InfiniiVision 6000 X-Series
Analog channels	2 and 4	2 and 4	2 and 4	2 and 4	2 or 4
Bandwidth (upgradable)	50, 70, 100, 200 MHz	70, 100, 200 MHz	100, 200, 350, 500 MHz, 1 GHz	200, 350, 500 MHz, 1 GHz, 1.5 GHz	16 (MSO models or upgrade)
Digital channels	External trigger can be used as a 3rd digital channel for 2 channel model	8 (MSO models or upgrade) 1	16 (MSO models or upgrade)	16 (MSO models or upgrade)	1, 2.5, 4, 6 GHz
Maximum sample rate	2 GSa/s	2 GSa/s	5 GSa/s	5 GSa/s	20 GSa/s
Maximum memory depth	Up to 2 Mpts standard	1 Mpt/channel	4 Mpts	4 Mpts	4 Mpts
Waveform update rate	Up to 200,000 wfms/sec	> 200,000 wfms/sec	> 1,000,000 wfms/sec	> 1,000,000 wfms/sec	> 450,000 wfms/sec
Display	7-inch display	8.5-inch display	8.5-inch capacitive touch display	12.1-inch capacitive touch display	12.1-inch, capacitive touch, gesture enabled display
Zone touch trigger	No	No	Standard	Standard	Standard
Voice Control	No	No	No	No	Standard
WaveGen 20-MHz function/ arbitrary waveform generator	Single-channel function only (standard on G models)	Single-channel function only (option)	Single-channel AWG (standard)	Dual-channel AWG (option)	Dual-channel AWG (option)
Integrated digital voltmeter (standard)	Yes	Yes	Yes	Yes	Yes
Integrated hardware counter (standard)	5-digit frequency counter	5-digit frequency counter (8 digits with external 10 MHz clock reference)	8-digit frequency counter or totalizer	5-digit frequency counter	10-digit frequency, period, or totalizer counter
Serial protocol analysis	I2C, UART (standard on all models) SPI, CAN/LIN (standard on DSO models)	Yes (optional: CAN, LIN, I²C, SPI, RS232/UART) 1	Yes (standard: I2C, SPI, RS232/422/485/ UART, I2S, USB PD, optional: ARINC 429, CAN/CAN-dbc/CAN-FD/LIN/LIN symbolic, SENT, FlexRay, LIN, MIL-STD-1553, SPI, CXPI, Manchester/NRZ)	Yes (optional: ARINC 429, CAN/CAN-dbc/CAN-FD/LIN/LIN symbolic, SENT, FlexRay, I2C, I2S, LIN, MIL-STD-1553, SPI, UART/RS232, USB 2.0, CXPI, Manchester/NRZ)	Yes (optional: I2C, SPI, UART/RS232, CAN/CAN-dbc/CAN-FD/LIN/LIN symbolic, SENT, FlexRay, I2S, MIL-STD1553, CXPI, ARINC429, USB 2.0, Manchester/NRZ, USB PD)
Segmented memory	Yes (standard on DSO model)	Standard	Standard	Standard	Standard
Mask/limit testing	Yes (standard on DSO model)	Option	Standard	Option	Option
Histograms	No	No	Standard	No	Standard
Power analysis	No	No	Standard	Option	Option
USB 2.0 signal quality test	No	No	No	Option	Option
HDTV analysis	No	No	Standard	Option	Option
Advanced waveform math	No	Standard	Standard	Standard	Standard
Connectivity	Standard USB 2.0, LAN	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)	Standard USB2.0, LAN, video out (GPIB option)

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 a brickwall filter response, the sample rate must be at least 2.5 times higher than 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.

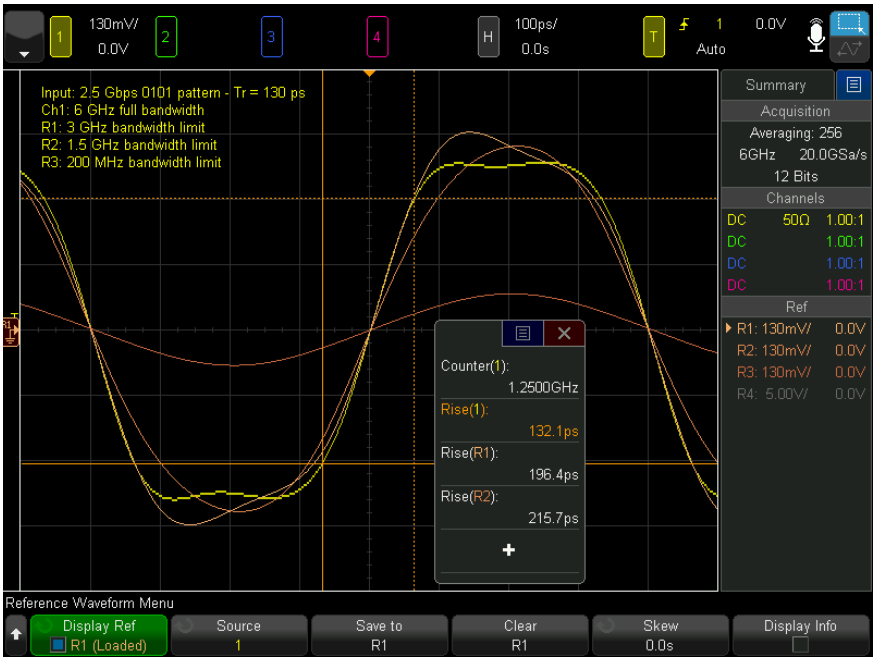


Figure 1. Measuring the rise time of a 130-ps rise-time edge (10 to 90%). The rise time measurement by

- 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

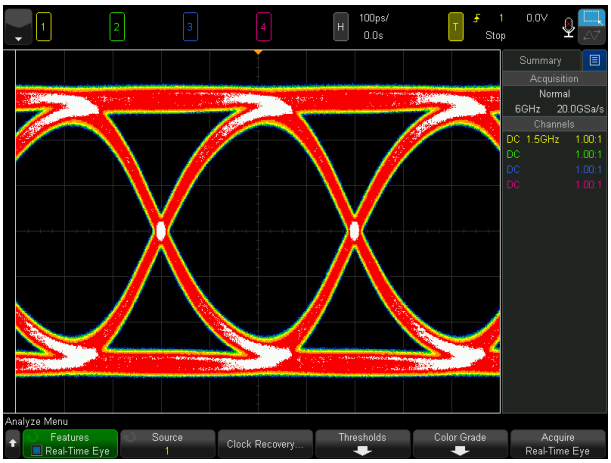


Figure 2. An oscilloscope with 1.5-GHz bandwidth captures only the fundamental frequency of a 2.5-Gbps PRBS signal.

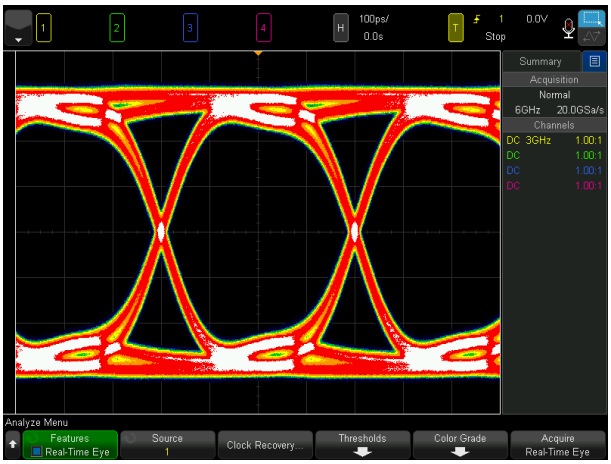


Figure 3. An oscilloscope with 3-GHz bandwidth sees some of the 3rd harmonic of a 2.5-Gbps PRBS signal.

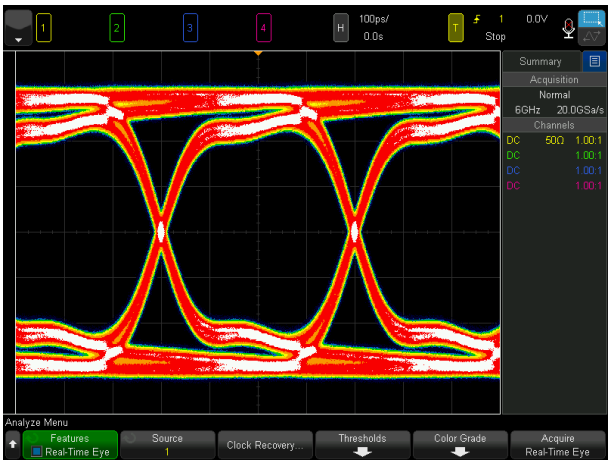


Figure 4. An oscilloscope with 6-GHz bandwidth sees up to the 5th harmonic of the 2.5-Gbps PRBS signal. You see the true signal integrity of your waveform.

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.

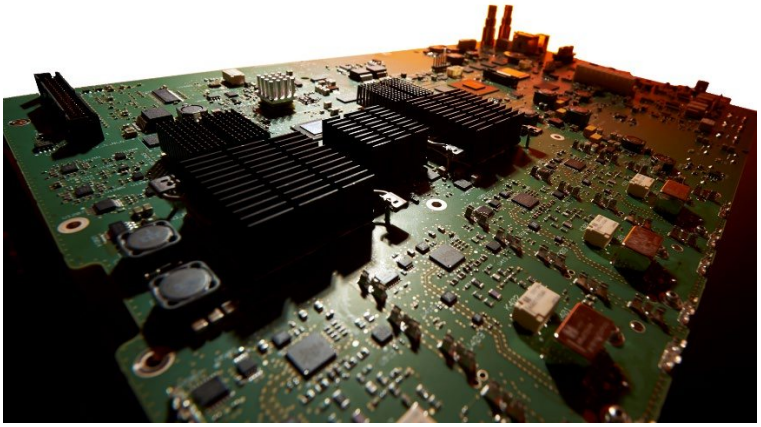


Figure 5. The new 6-GHz front-end design.

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.

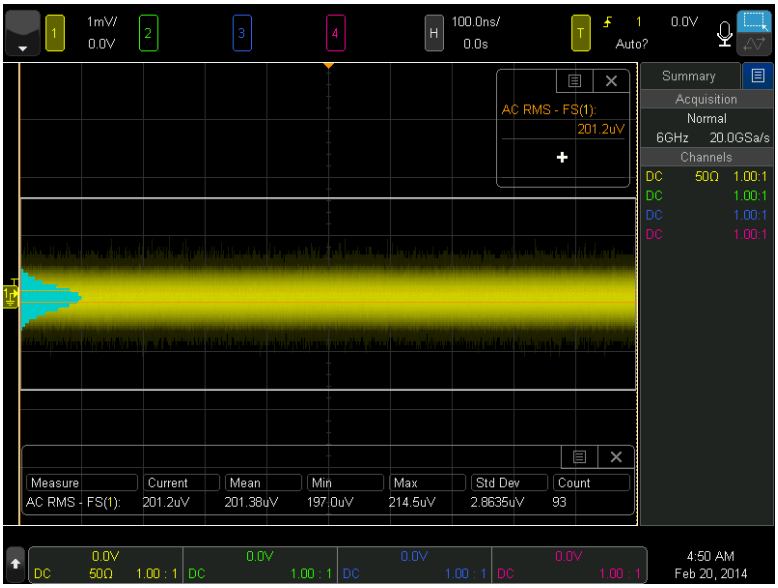


Figure 6. Measuring the noise floor of a 6-GHz scope at 1 mV/div.

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.

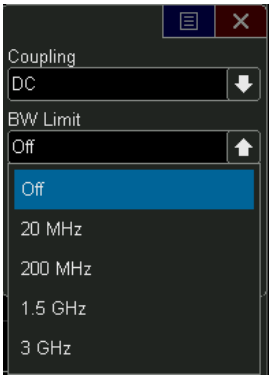


Figure 7. You can set the hardware bandwidth limit control interface per channel at any time.

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

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.

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.

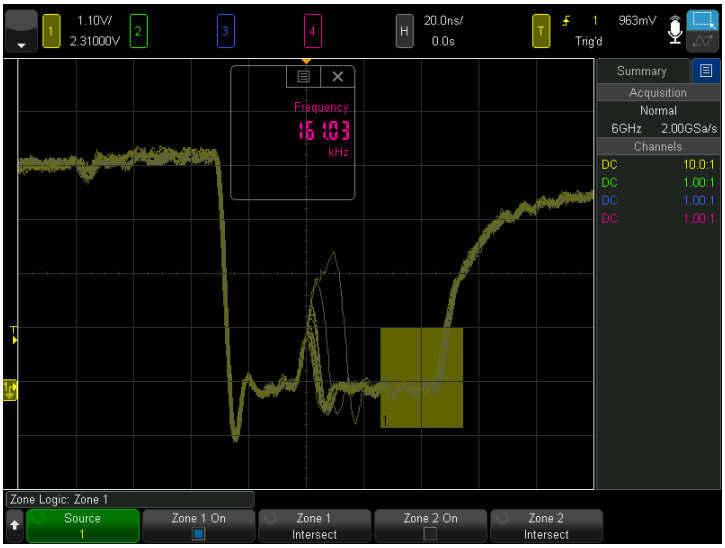


Figure 12. Hardware zone triggers immediately.

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.

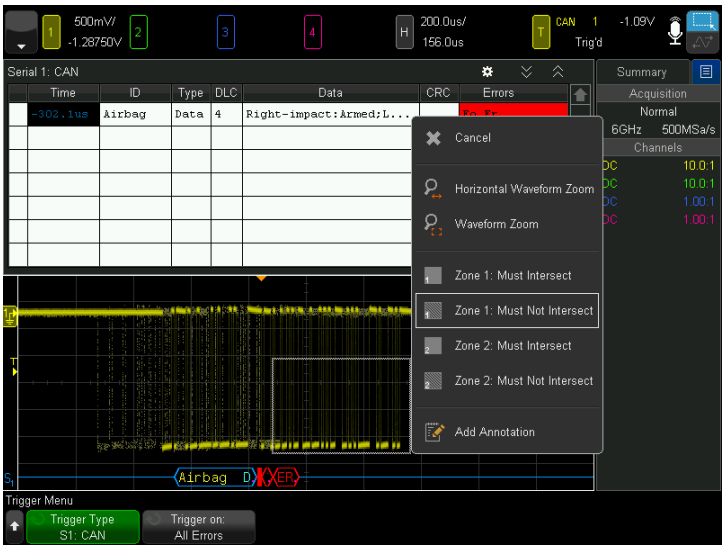


Figure 13. Setting up the zone trigger in addition to a CAN bus error packet trigger.

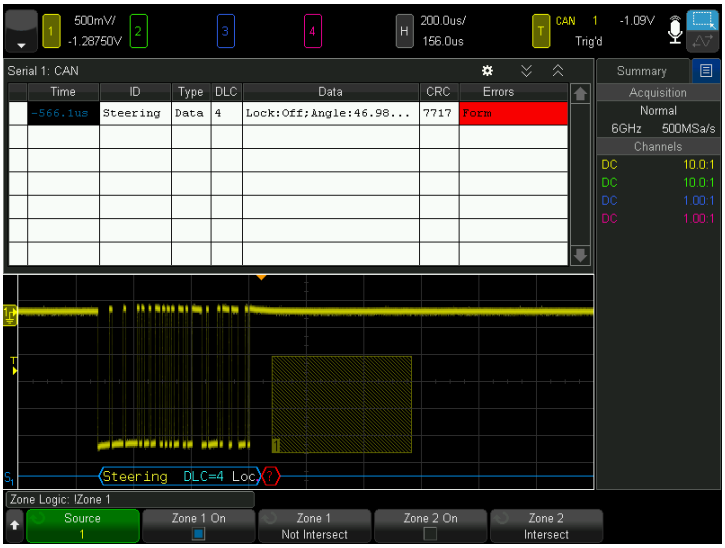


Figure 14. Now you have isolated steering errors from all other CAN bus errors.

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.

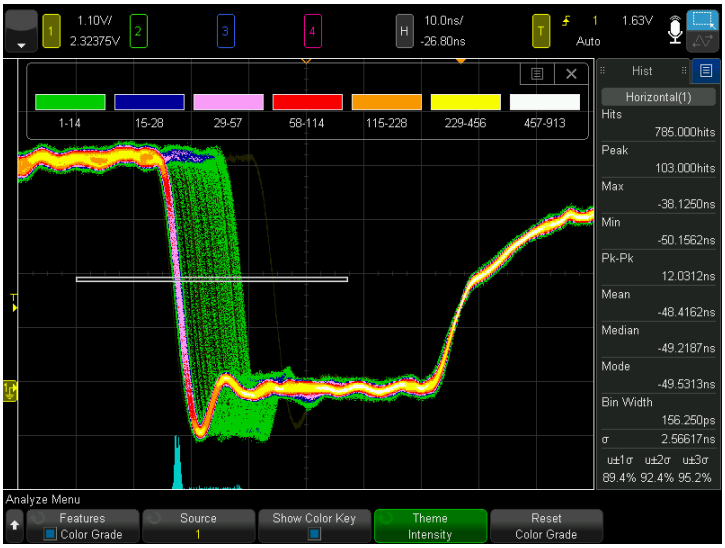


Figure 15. Color grade and histogram on a jittery clock edge.

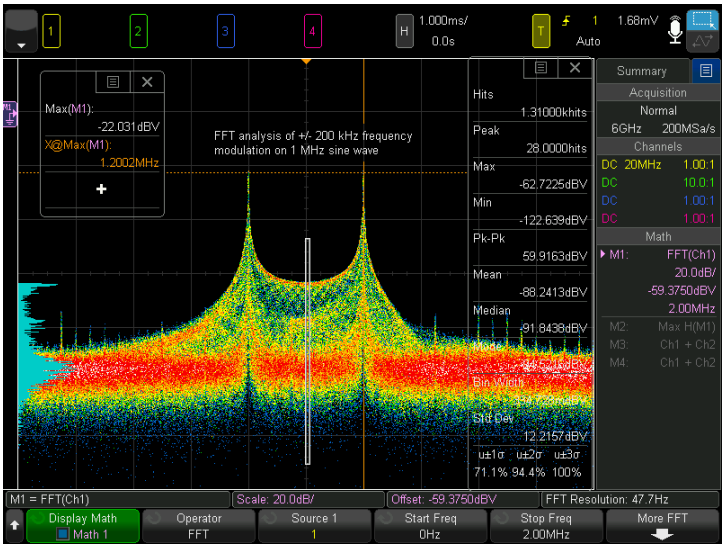


Figure 16a. Color grade and histogram on an FFT function.

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

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 jitter analysis capability (included in the D6000USBB and D6000BDLB software packages) 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 17. Press the jitter button on the front panel to directly access the jitter menu.

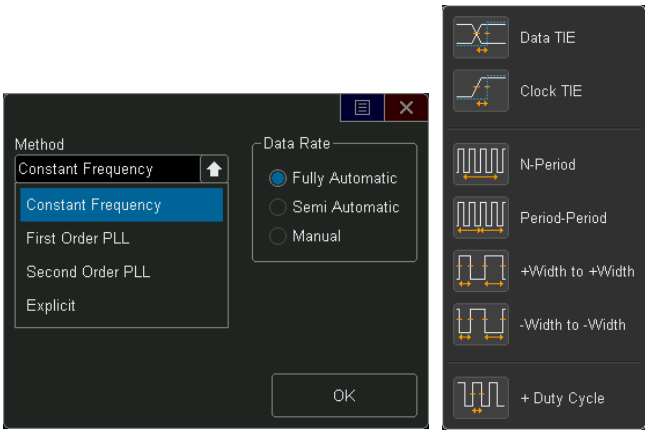


Figure 18. Clock recovery menu and jitter measurement menu.

Figure 19 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.

To learn more about jitter analysis, go to https://www.keysight.com/us/en/product/D6000USBB/usb-2-0-triggering-analysis-6000-x-series.html

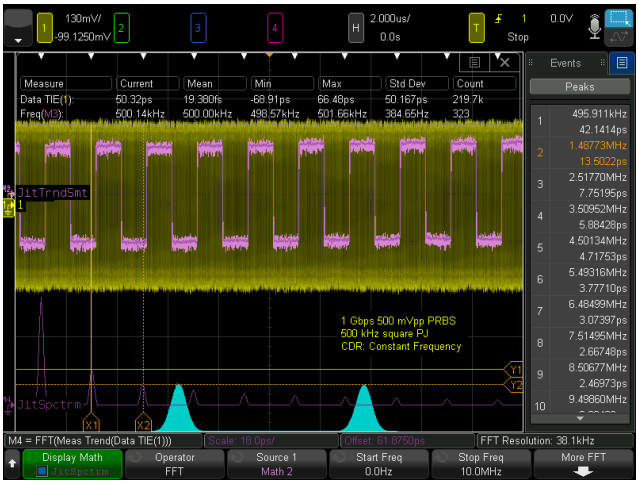


Figure 19. Analyzing periodic jitter (square) on a 1-Gbps PRBS signal.

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 D6000USBB or D6000BDLB software packages). 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.

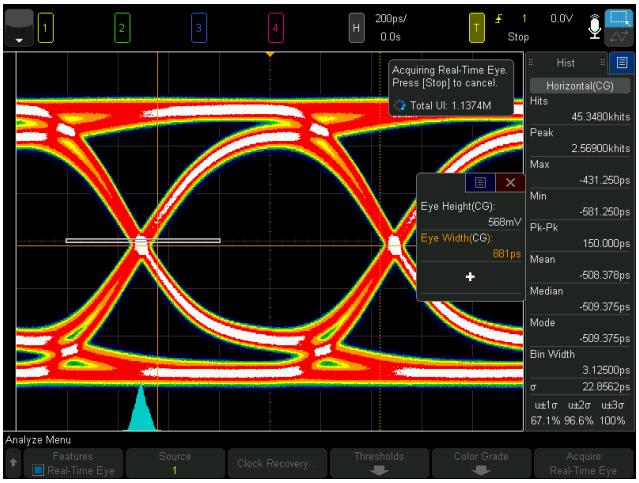


Figure 20. A real-time eye diagram measurement of a clean 1-Gbps PRBS embedded clock signal. The histogram measured about 22-ps rms jitter.

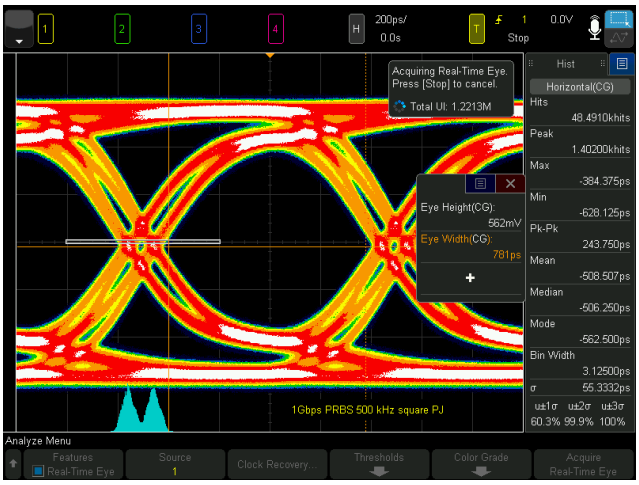


Figure 21. A real-time eye diagram measurement of a jittery 1-Gbps PRBS embedded clock signal. The histogram indicates a bimodal distribution and measured about 55-ps rms jitter.

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.

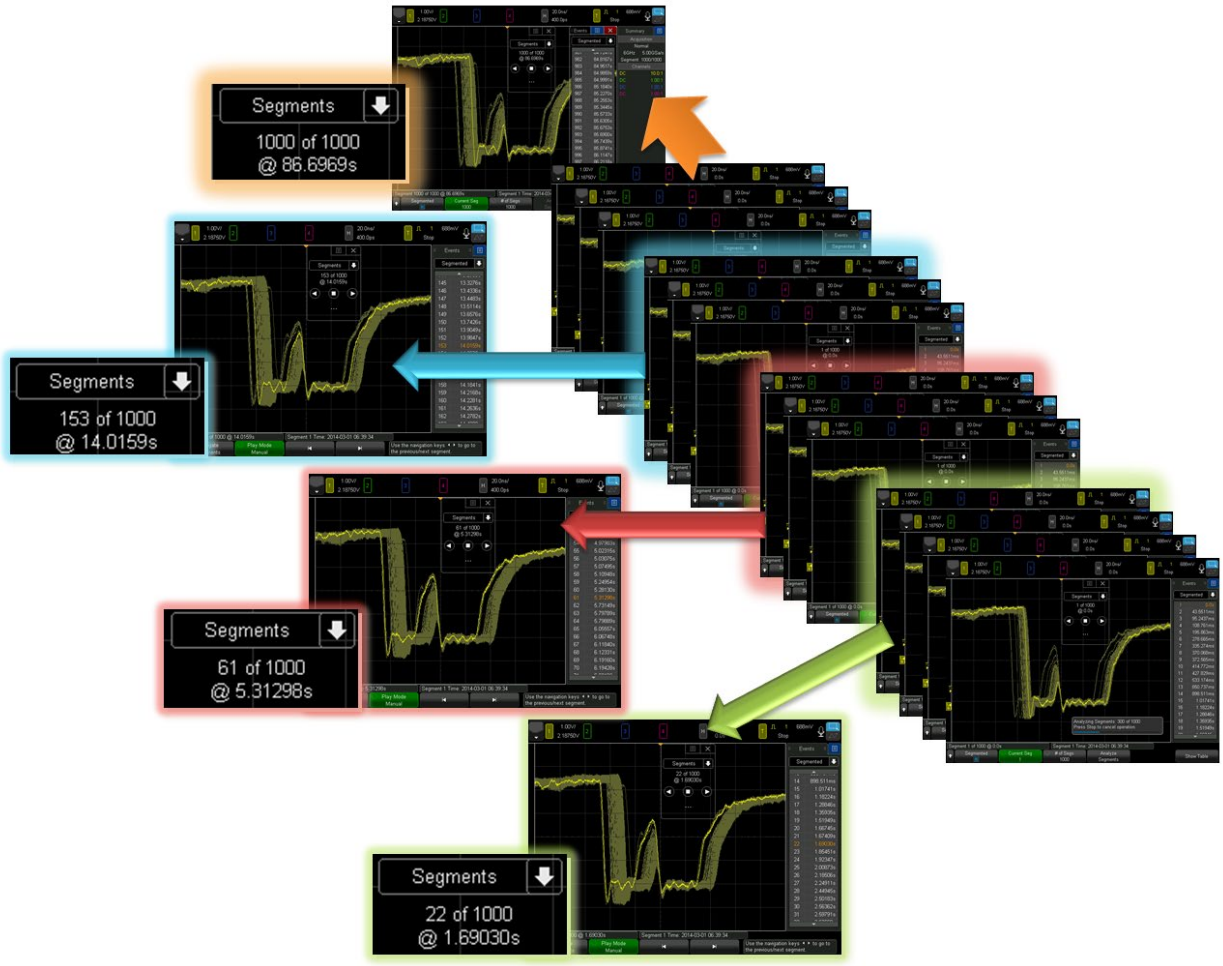


Figure 22. Segmented memory graphical representation.

Figure 23. Segmented memory and color grade.

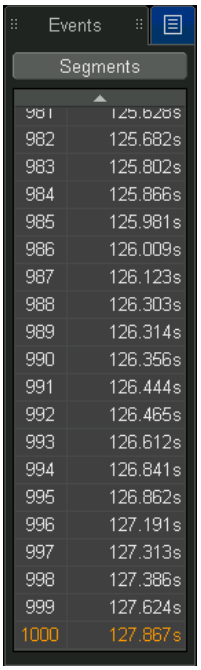


Figure 24. Segmented memory time-tag lister.

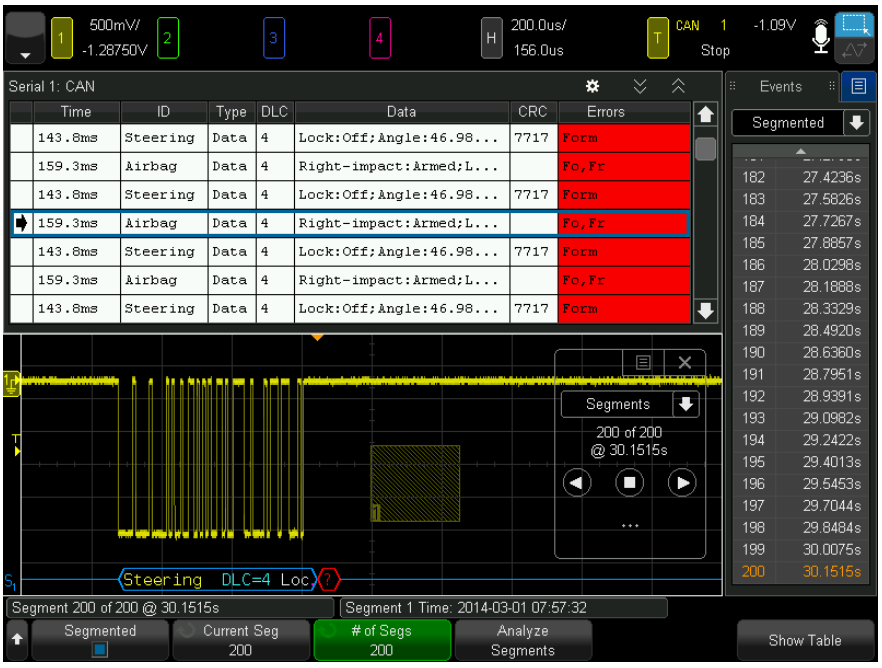


Figure 25. Segmented memory + serial bus decode + zone trigger.

Integration

Take advantage of a new oscilloscope application bundle that will enable ALL software options for one low price (Ultimate software package D6000BDLB)

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 (Bode plot)
- 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.

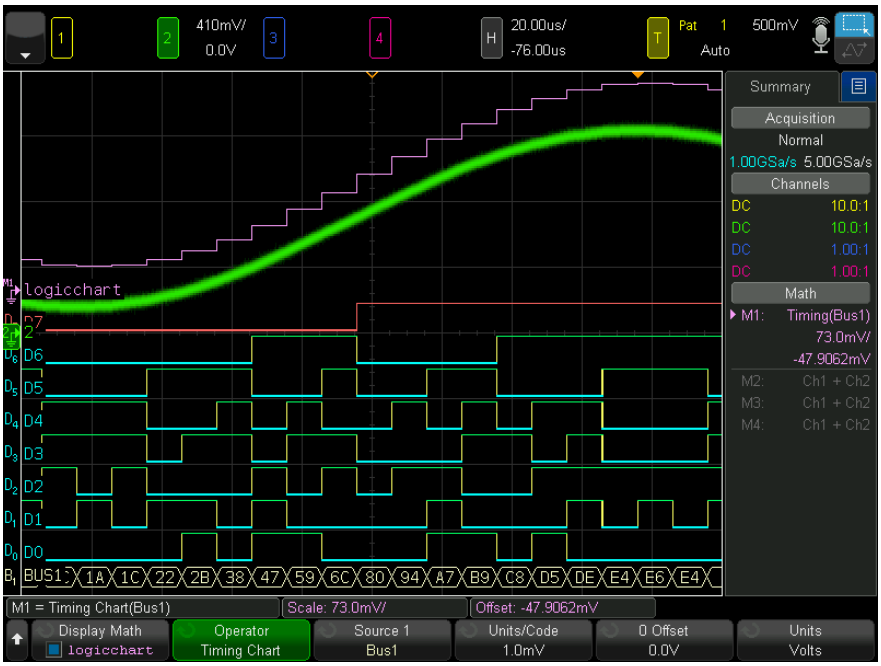


Figure 26. Analog and digital signals displayed together with the logic timing chart function.

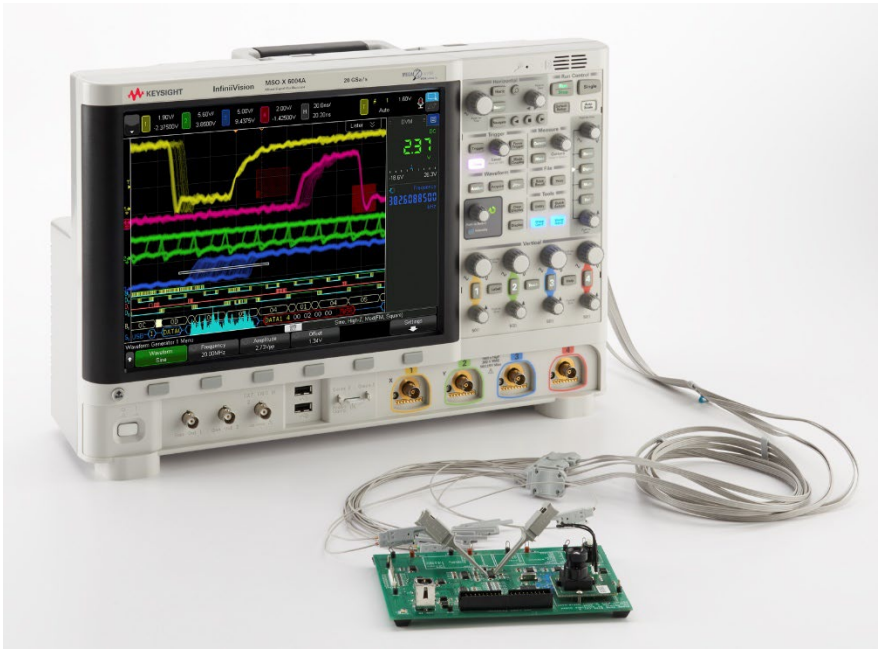


Figure 27. MSO with a new digital channel cable.

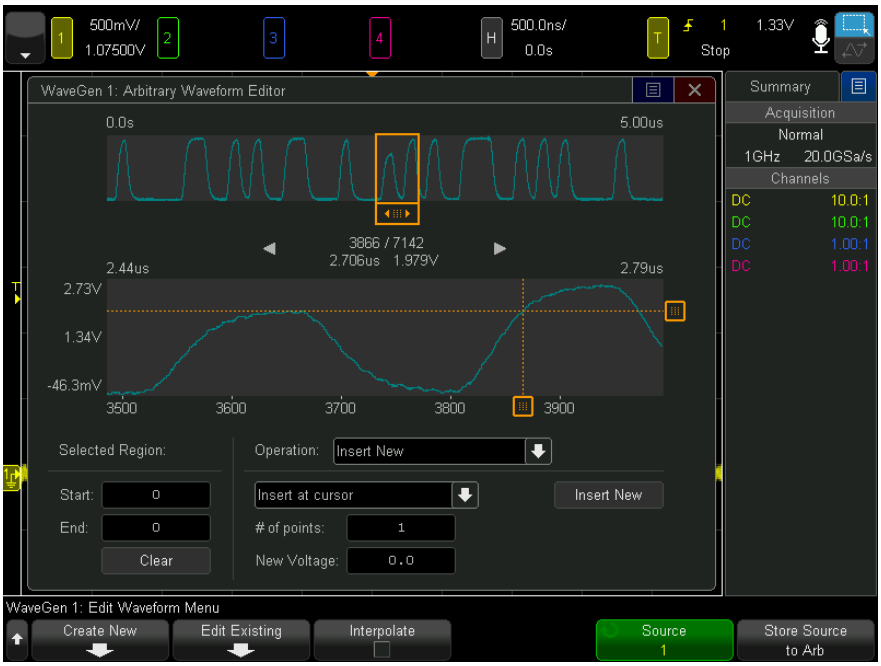


Figure 28. Arbitrary waveform generation signal editing screen.

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

Keysight 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 support 15 serial protocols including:

- I^2C
- SPI
- UART (RS232/422/485)
- I^2S
- USB 2.0 (low-, full-, and hi-speed)
- USB PD
- CAN (symbolic with .dbc file)
- CAN FD (symbolic with .dbc file)

- LIN (symbolic with .ldf file)
- FlexRay
- CXPI
- PSI5 (User-definable Manchester)
- User-definable NRZ
- MIL-STD 1553
- ARINC 429

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

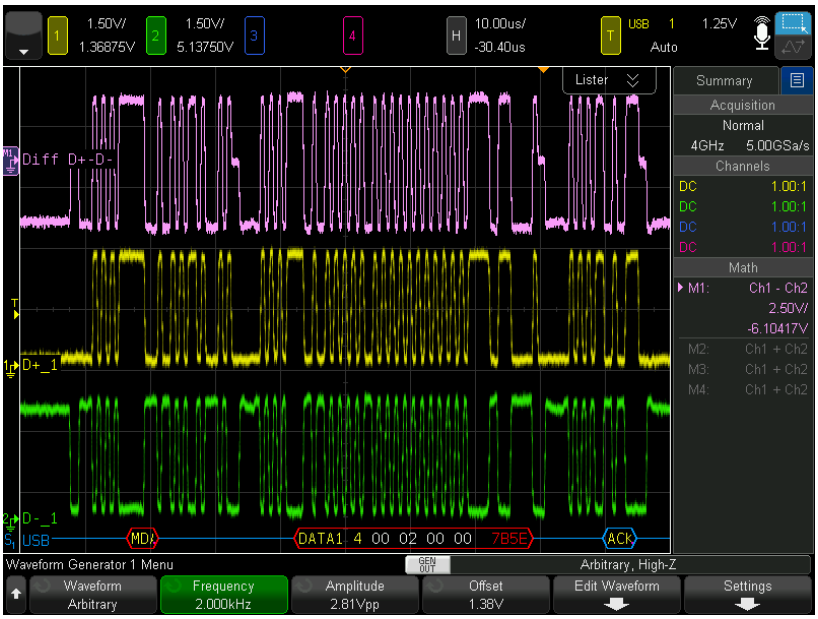


Figure 29. Dual-channel generator generating a differential signal.

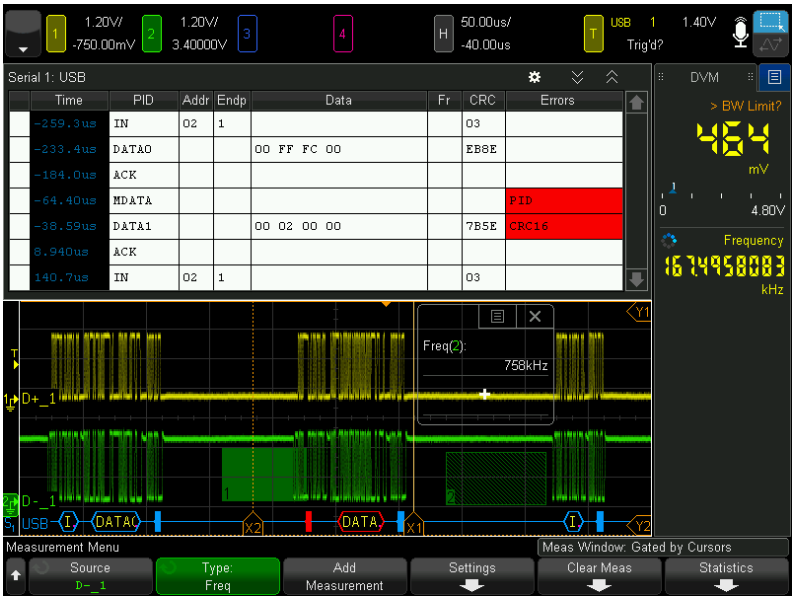
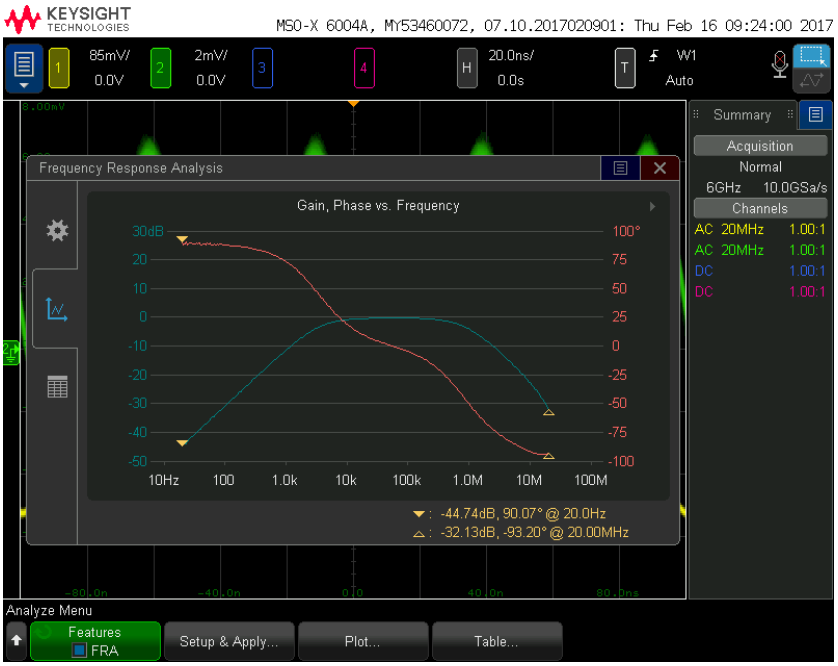


Figure 30. USB 2.0 protocol trigger and decode option display.

Frequency Response Analysis (optional)

Frequency Response Analysis (FRA) is an often-critical measurement used to characterize the frequency response (gain and phase versus frequency) of a variety of today's electronic designs, including passive filters, amplifier circuits, and negative feedback networks of switch mode power supplies (loop response). InfiniiVision 6000 X-Series oscilloscopes use the oscilloscope's built-in waveform generator (WaveGen) to stimulate the circuit under test at various frequency settings and capture the input and output signals using two oscilloscope channels. At each test frequency, the oscilloscope measures, computes, and plots gain (20LogVout/Vin) and phase logarithmically.



DSOXBODE bode plot training kit (optional)

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

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.

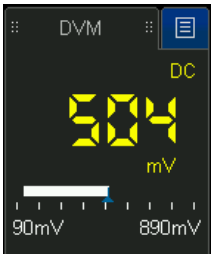


Figure 31. DVM display.

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 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.

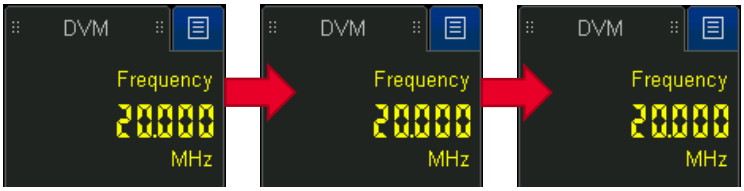


Figure 33. The precise 10-digit counter found the true frequency of a clock to be a little less than 20 MHz.

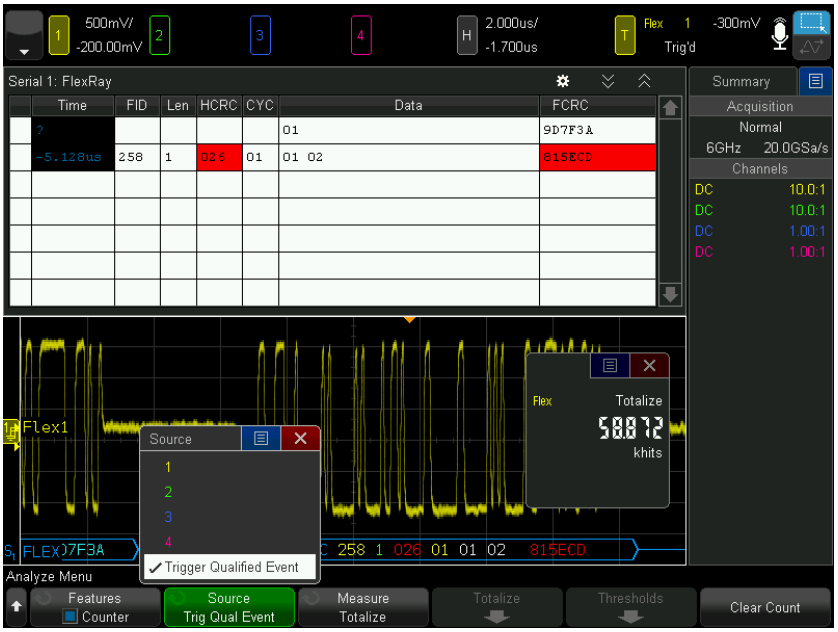


Figure 34. Totalizing the number of CAN errors.

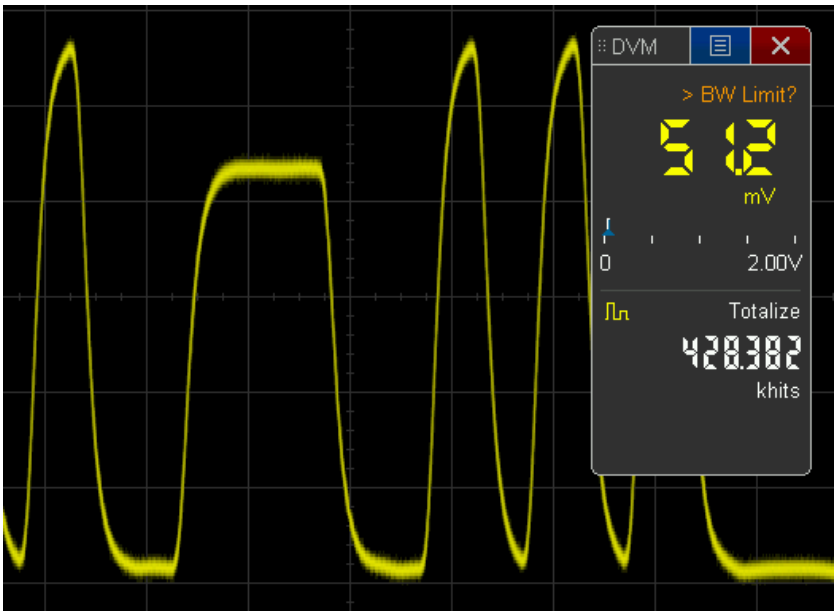


Figure 35. Totalizing the number of runt errors.

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.

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

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).

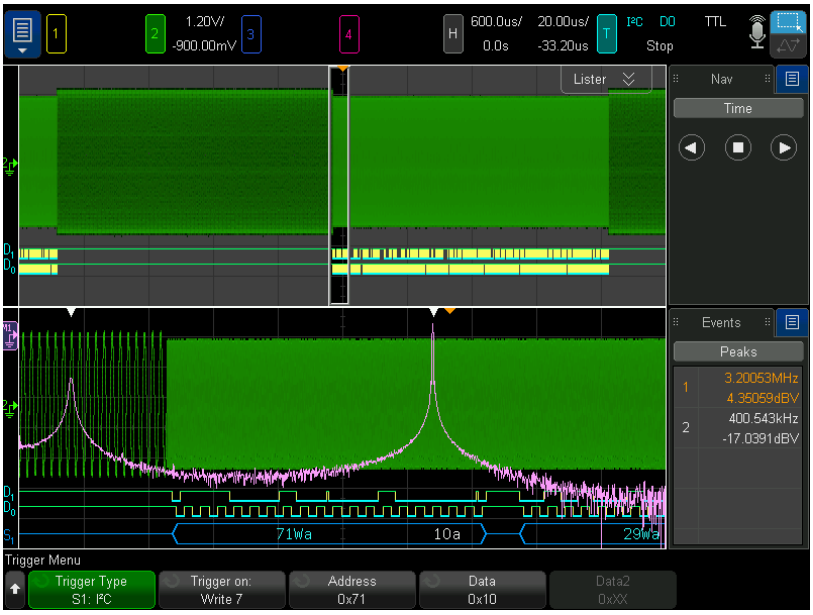


Figure 37b. Gated FFT time correlating the FSK frequency hopping with an I2C command (write 7 at 0x71 data 10).

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.

Optional mask and measurement testing

Whether you are performing pass/fail tests to specified standards in manufacturing or testing for infrequent signal anomalies, mask limit testing and measurement limit testing enabled in all optional software packages 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.

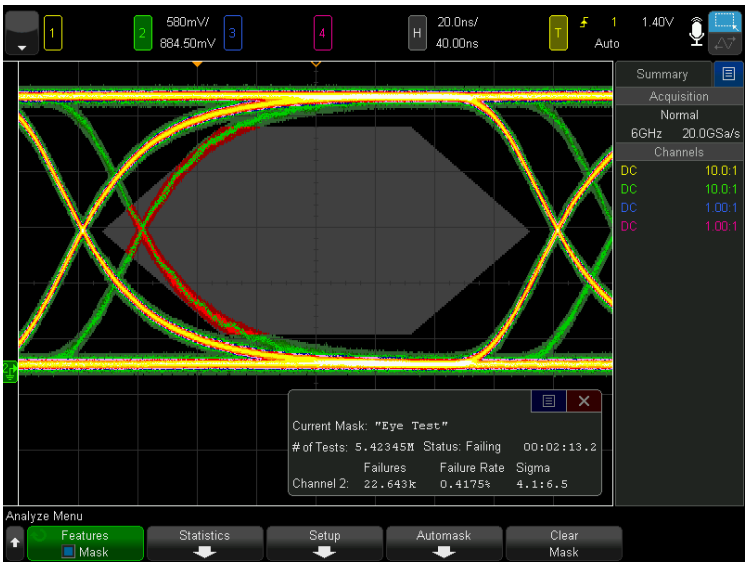


Figure 41. Mask testing of serial data.

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.

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

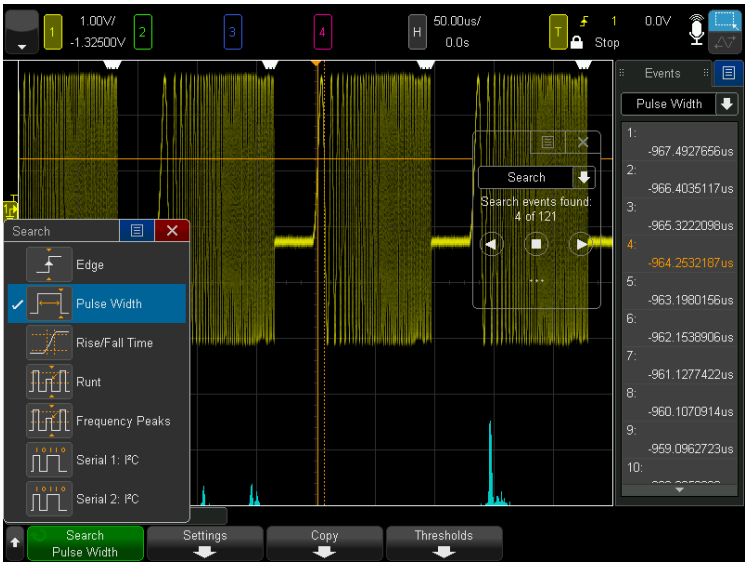


Figure 42. Searching for and navigating to a specific pulse width.

Optional power measurements and analysis

When you are working with switching power supplies and power devices, the power measurement software package (D6000PWRB or D6000BDLB) provides a full suite of power measurements and analysis in the oscilloscope.

To learn more about power supply testing, go to https://www.keysight.com/us/en/product/D6000PWRB/power-measurements-6000-x-series.html

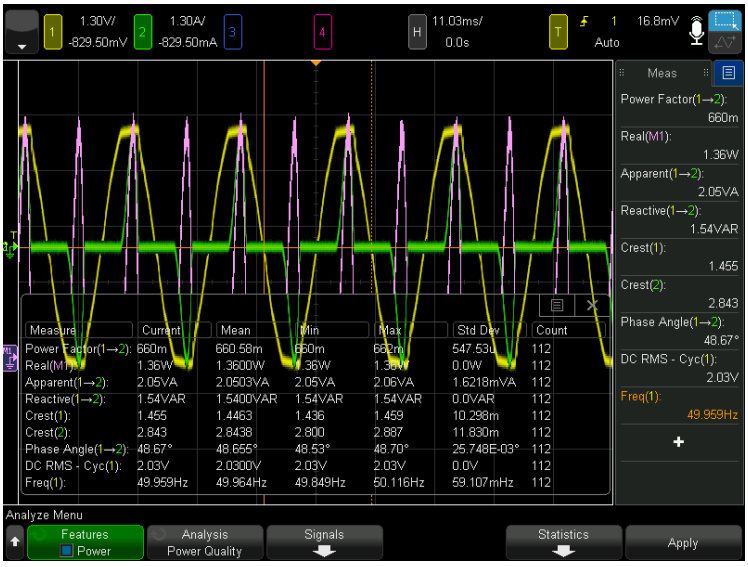


Figure 43. Power quality analysis screenshot.

Automate your testing with optional USB 2.0 signal quality analysis

With the USB 2.0 signal quality test (included in the D6000USBB USB software package and the D6000BDLB ultimate bundle software package), 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.

To learn more about USB 2.0 signal quality testing, go to https://www.keysight.com/us/en/product/D6000USBB/usb-2-0-triggering-analysis-6000-x-series.html

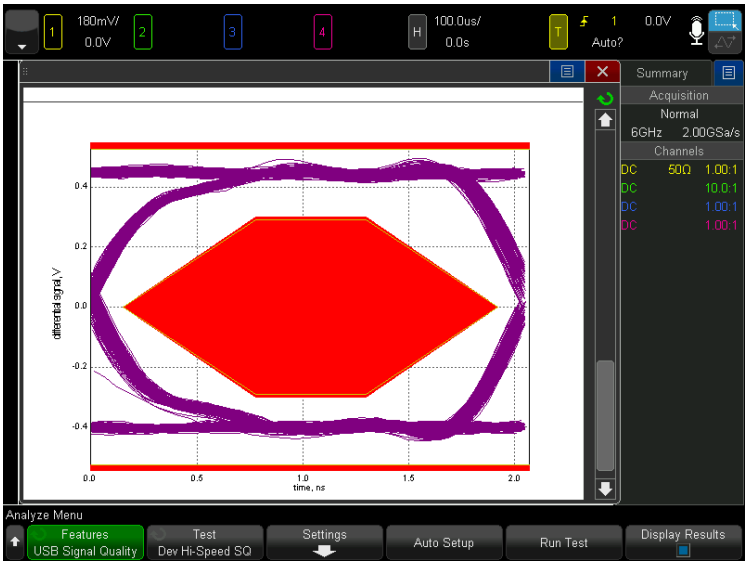


Figure 44. USB 2.0 Hi-speed near-end eye pattern test.

Optional HDTV video triggering and analysis

Whether you are debugging consumer electronics with HDTV or characterizing a design, enhanced video analysis (included in the D6000AERB aero software package, the D6000GENB embedded software package, and the D6000BDLB ultimate bundle software package) 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.

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.

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)
- Chart serial signal (CAN, CAN FD, LIN, and SENT)
- Clock recovery

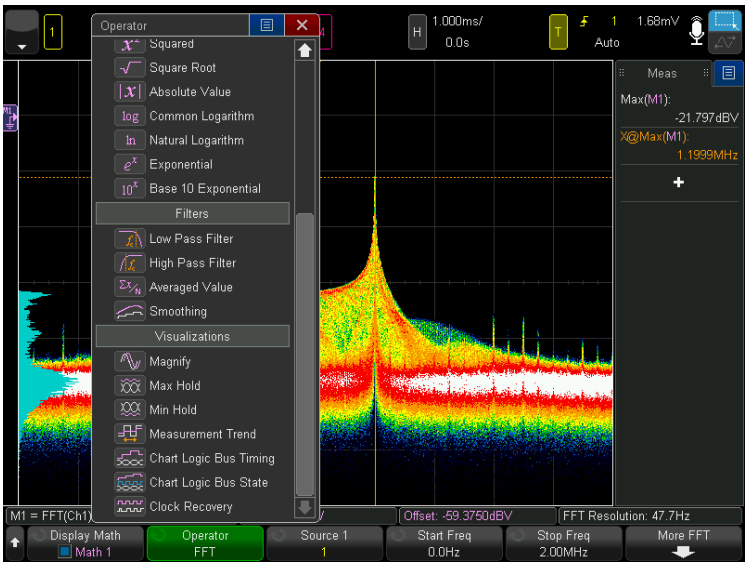


Figure 47. Function selection menu. Swipe and double touch to select.

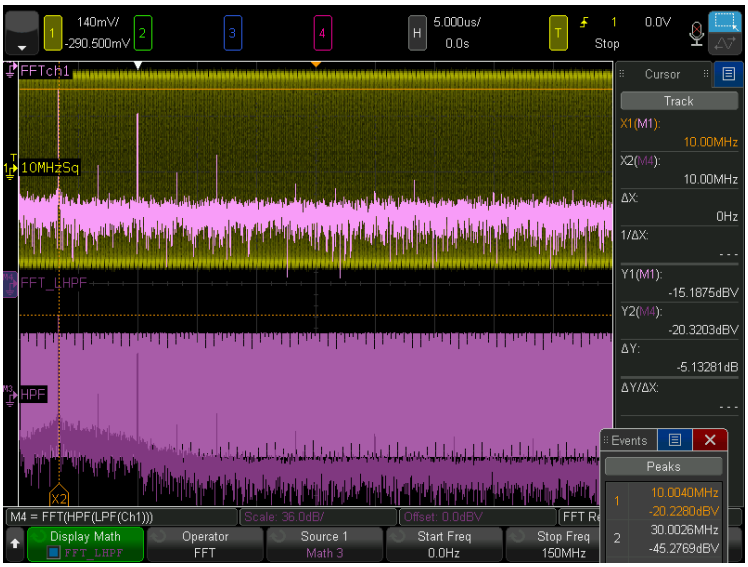


Figure 48. Four math functions used simultaneously (three turned on).

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.

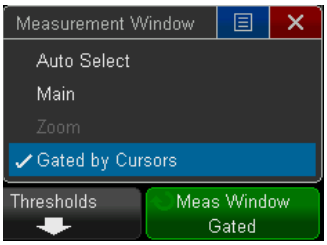


Figure 49. Measurement gating screen.

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.

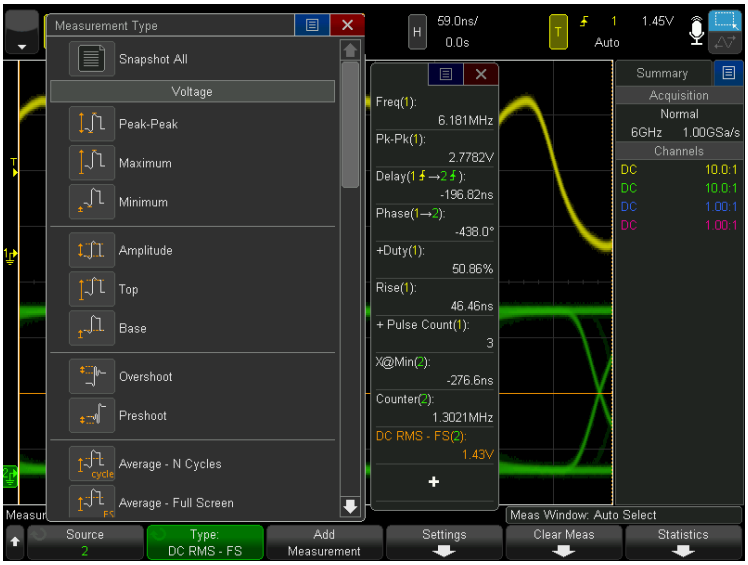


Figure 50. Measurement selection menu. Swipe and double touch to select.

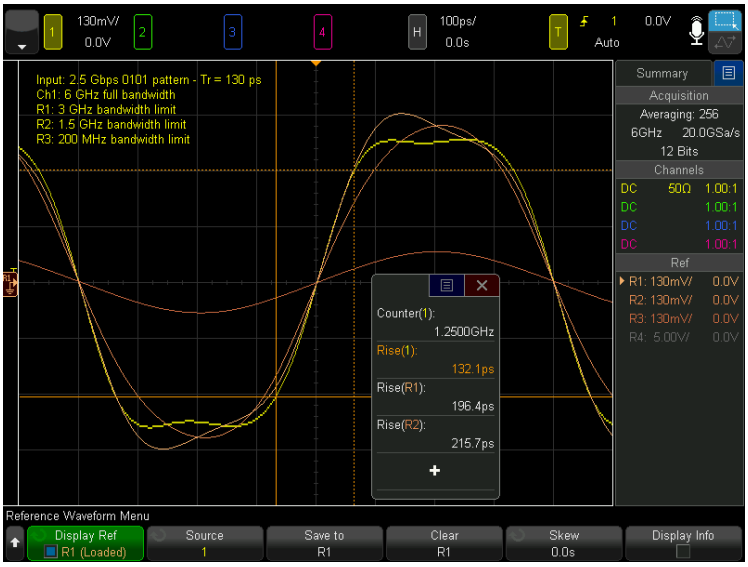


Figure 51. Reference waveforms.

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 BenchVue oscilloscope control and automation PC-based software (standard with the purchase of each InfiniiVision X-Series oscilloscope) 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.

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.

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

Figure 54. Quick Freeze Display preserves the persistence.

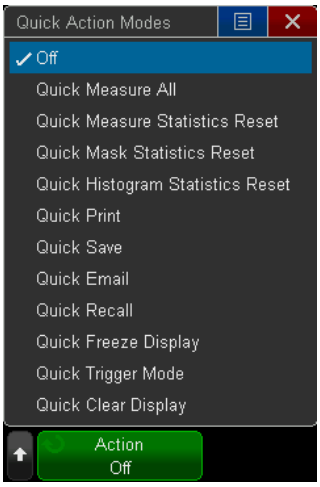


Figure 55. QuickAction menu.

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 ideal solution. The new N7020A Power Rail Probe is 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.

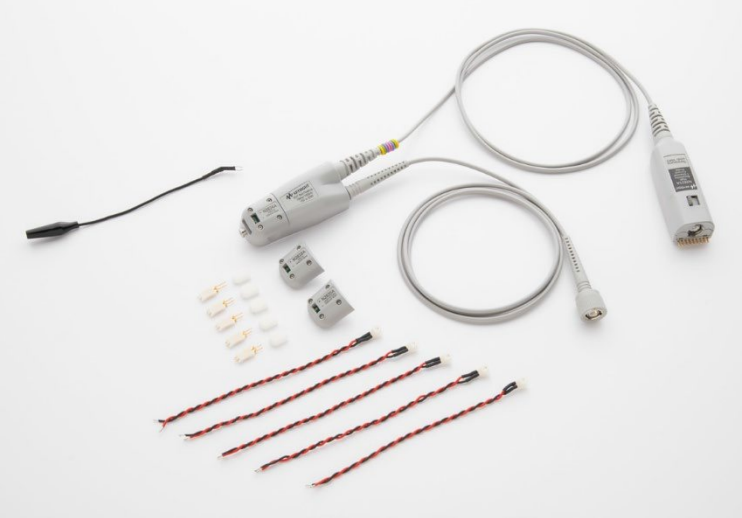


Figure 56. N2820A Series high-sensitivity current probe.

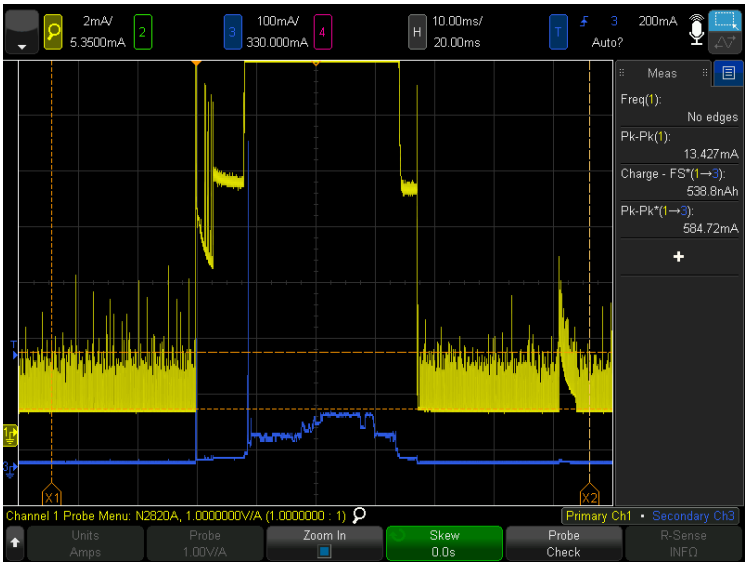


Figure 57. Capturing both zoom out and zoom in view of a cell phone's current consumption inside and outside of its sleep state.

Figure 58. N7020A Power Rail Probe.

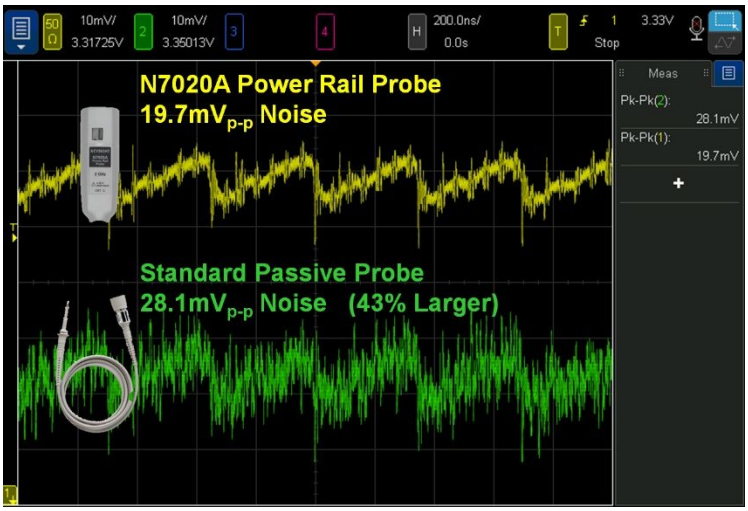


Figure 59. N7020A Power Rail Probe vs. standard 10:1 passive probe.

Infiniium Offline oscilloscope analysis software

Keysight's Infiniium Offline PC-based oscilloscope analysis software (D9010BSEO) allows you to do additional signal viewing, analysis, and documentation tasks away from your oscilloscope. Capture waveforms, save to a file, and recall the waveforms into 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.

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.

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.

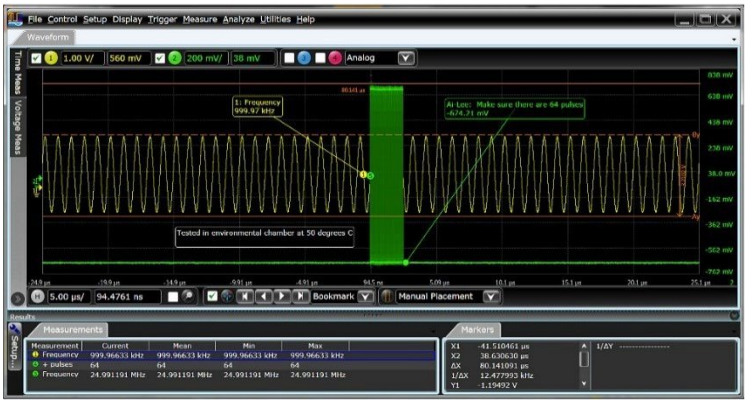


Figure 60. N8900A Infiniium Offline software.

Figure 61. Storage compartment.

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**.

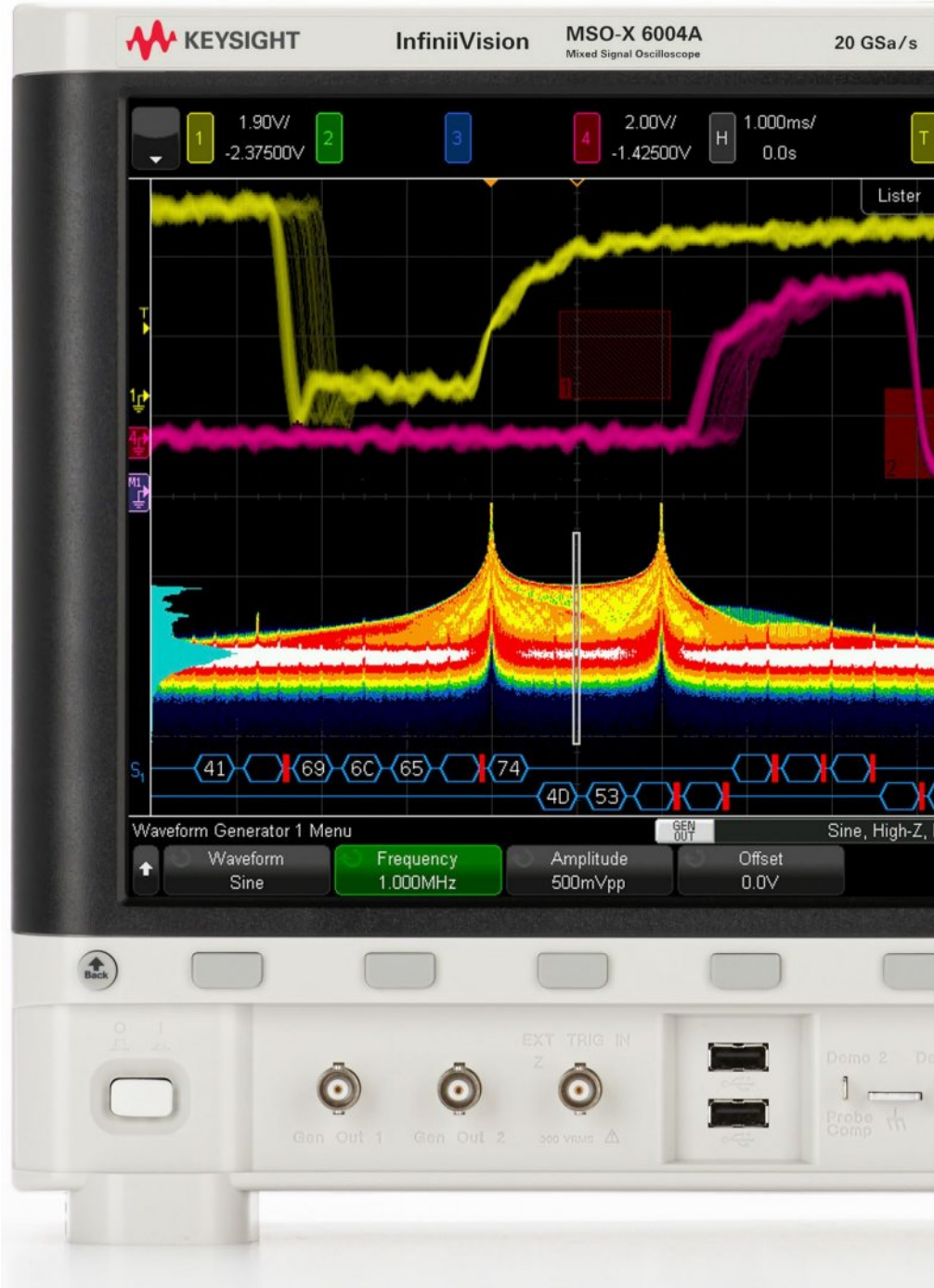
Zone touch trigger. If you can see it, you can trigger on it by drawing a zone box.

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 panel**s 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.

Provides **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	DSOX6002A-02G	DSOX6002A-04G	DSOX6002A-06G
	For 4 channel models	Default	DSOX6004A-02G	DSOX6004A-04G	DSOX6004A-06G
* Examples			If you want 1 GHz, 4 + 16 channels, the model configuration will be MSOX6004A only		
			If you want 4 GHz, 4 + 16 channels, the model configuration will be MSOX6004A and DSOX6004A-04G		

Step 3. Select hardware upgrades

Hardware Upgrade	Description	Model number to order
WaveGen	Built-in dual-channel 20 MHz function/AWG waveform generator	DSOX6WAVEGEN2
Enhanced Security Option	Disable non-volatile memory, USB, LAN, and firmware upgrades	DSOX6SECA

Step 4. Select software

Licensed Software	Description	Model number to order
Embedded Software Package	I^2C, SPI, UART (RS232/422/485), I^2S, and USB PD serial trigger & decode, plus Measurement Limit Testing, Mask Limit Testing, Frequency Response Analysis (Bode plots), and Enhanced Video Analysis	D6000GENB
Automotive Software Package	CAN (symbolic with .dbc file), CAN FD (symbolic with .dbc file), LIN (symbolic with .ldf file), FlexRay, SENT, CXPI, PSI5 (user-definable Manchester), and User-definable NRZ serial trigger & decode, plus Measurement Limit Testing, Mask Limit Testing (CAN/CAN FD mask files available to download) and Frequency Response Analysis (Bode plots)	D6000AUTB
Aero Software Package	MIL-STD 1553 and ARINC 429 serial trigger & decode, plus Measurement Limit Testing, Mask Limit Testing (standard mask files available to download), Frequency Response Analysis (Bode plots), and Enhanced Video Analysis	D6000AERB
USB Software Package[1]	USB 2.0 Low-, Full-, & Hi-speed, USB PD trigger & decode, plus USB 2.0 Signal Quality Test, Jitter & Real-time Eye Analysis, Measurement Limit Testing, Mask Limit Testing, and Frequency Response Analysis (Bode plots)	D6000USBB
Power Software Package	Power quality, current harmonics, switching loss, transient response, turn-on/off time, output ripple, efficiency, loop response, PSRR, etc., plus Measurement Limit Testing, Mask Limit Testing and Frequency Response Analysis (Bode plots), and USB PD serial trigger & decode	D6000PWRB
Ultimate Bundle Software Package	I^2C, SPI, UART, I^2S, CAN, CAN FD, LIN, FlexRay, CXPI, PSI5 (User-definable Manchester), User-definable NRZ, USB 2.0 low-, full-, & hi-speed[1], USB PD, MIL-STD 1553, and ARINC 429 serial trigger & decode, plus USB 2.0 Signal Quality Test[1], Jitter & Real-time Eye Analysis, Power Analysis, Measurement Limit Testing, Mask Limit Testing, Frequency Response Analysis (Bode plots), and Enhanced Video Analysis	D6000BDLB

[1] USB 2.0 hi-speed signal quality tests supported on ≥ 2.5-GHz models only.

Step 5. Choose your probes.

For a complete list of compatible probes, see Keysight InfiniiVision Probe Selection Guide

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
N2818A 200 MHz, 10:1 differential probe, 1 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 6. Choose your accessories, calibration plans, and additional productivity software

Recommended accessories, calibration plans and PC software	Model number
Bode plot training kit	DSOXBODE
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
BV0004B BenchVue Oscilloscope Application PC software	Standard
33503A BenchLink Waveform Builder Pro and Basic PC Software	Optional
D9010BSEO Infiniium Offline Oscilloscope Analysis PC Software	Optional
D9010UDAA User-definable Application (UDA) software	Optional
89601B (version 20.20 and higher) Vector Signal Analyzer (VSA) software	Optional

After-purchase upgrades

After-purchase hardware upgrades	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 (license with MSO logic cable/probes)	DSOX6MSO
Built-in dual-channel 20 MHz function/AWG waveform generator	DSOX6WAVEGEN2
Enhanced security option	DSOX6SECA

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		4 Mpts half channels, 2 Mpts all channels			
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	30 Vrms or ±40 Vmax (DC + Vpeak); Probing technology allows testing of higher voltages. The included N2894A 10:1 probe supports 300 Vrms or ±400 Vmax (DC + Vpeak)

Vertical system analog channels

		No transient overvoltage allowed in either the 50Ω or 1 MΩ path, with or without probes. Use this instrument only for measurements within its specified measurement category (not rated for CAT II, III, IV).	
	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
	1 mV/div	115 µVrms	150 µVrms
	10 mV/div	330 µVrms	355 µVrms
	100 mV/div	3.15 mVrms	3.25 mVrms
	1 V/div	31.5 mVrms	32.5 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.

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.

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		
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		
	1 GHz bandwidth	≤ 10 mV/div	DC to 1 GHz	Greater of 1 div or 5 mVpp

Trigger system

Trigger sensitivity (internal) [1]	2.5, 4, and 6 GHz bandwidth	> 10 mV/div	DC to 1 GHz	0.6 div
		≤ 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

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
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

Trigger type selections

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.

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
	Vertical	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 Y at X
	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 time at edge

Waveform measurements

	Count	Positive pulse count, negative pulse count, rising edge count, falling edge count
	Mixed	Area-N cycles, area-full screen slew rate
	Jitter	Option D6000USBB or D6000BDLB required Data TIE, clock TIE, N-period, period-period, + width to + width, - width to - width
	Real-time eye	Option D6000USBB or D6000BDLB 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.

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)
Mask limit test		Provides pass/fail analysis on selected parametric measurements based on user-defined maximum and minimum limits with selectable stop-on-failure capability
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

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.

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.

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

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

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; 3962 m Max
	Maximum Relative Humidity (non-condensing): 80%RH up to 40 °C
	From 40 °C to 50 °C, the maximum % Relative Humidity follows the line of constant dew point
Electromagnetic compatibility	Meets EMC Directive (2004/108/EC), meets or exceeds IEC 61326-1:2005/EN
	61326-1:2006 Group 1 Class A requirement
	CISPR 11/EN 55011
	IEC 61000-4-2/EN 61000-4-2
	IEC 61000-4-3/EN 61000-4-3
	IEC 61000-4-4/EN 61000-4-4
	IEC 61000-4-5/EN 61000-4-5
	IEC 61000-4-6/EN 61000-4-6
	IEC 61000-4-11/EN 61000-4-11
	Canada: ICES-001:2004
	Australia/New Zealand: AS/NZS
Safety	ANSI/UL Std. No. 61010-1:2012; CAN/CSA-C22.2 No. 61010-1-12
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.)

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	Soft copy of Certificate of Calibration (CoC) with measurement results downloadable from https://service.keysight.com/infoline/public/details.aspx?i=DOC , 2-year calibration interval
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
Power Software Package - Data Sheet	5992-3925EN
Automotive Software Package - Data Sheet	5992-3912EN
Embedded Software Packag - Data Sheet	5992-3924EN
Aero Software Package - Data Sheet	5992-3910EN
USB Software Package - Data Sheet	5992-3920EN
Ultimate Bundle Software Package - Data Sheet	5992-3918EN

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