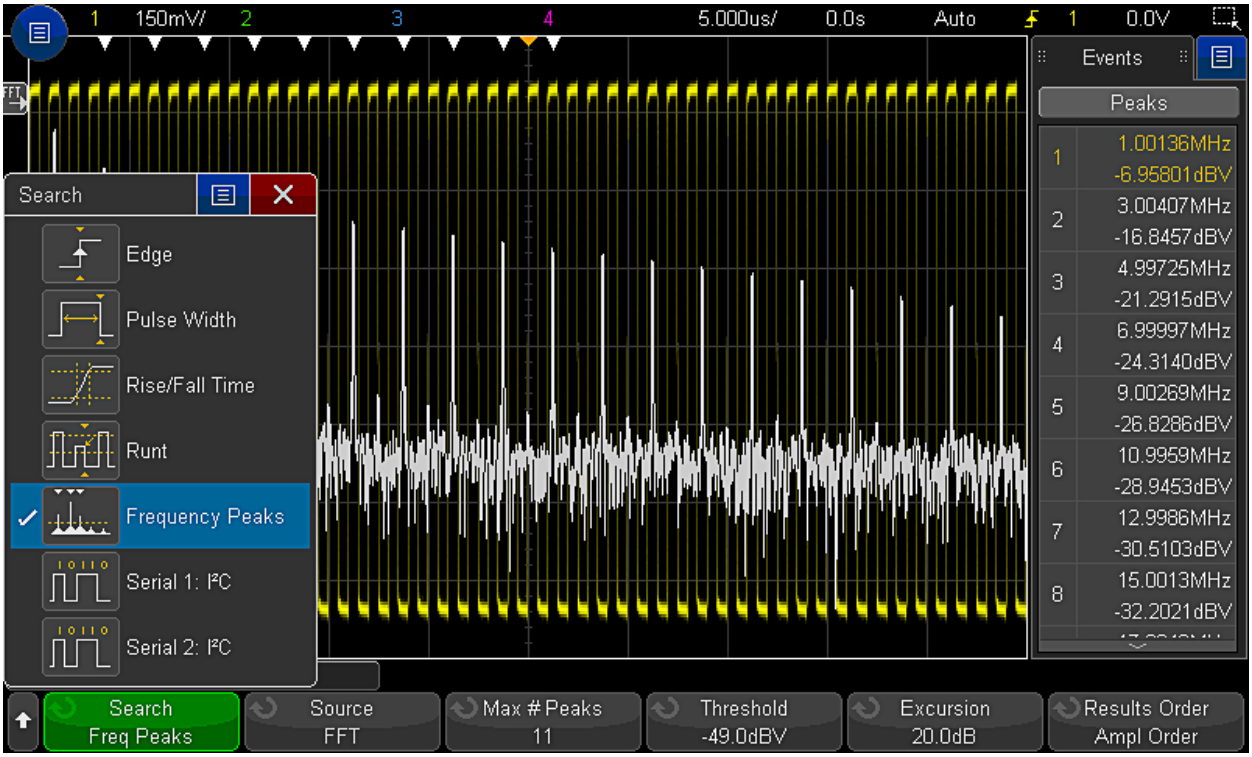


Figure 15. The InfiniiVision 3000G X-Series was set up to capture clock signals for FFT analysis. Using the search and navigation capability, the scope was able to find, mark (white triangles) and quickly navigate to the first 11 frequency peak occurrences. You can select to sort the search results in the order of frequency or amplitude.

Solve: Analyze waveform data quickly with advanced features

Hardware-based serial decode & triggering makes easy work of low-speed serial buses

Keysight InfiniiVision oscilloscopes, including the new 3000G X-Series, use hardware-based serial protocol decoding. Most other vendors use software post-processing techniques to decode serial packets⁄frames, and therefore have slow waveform and decode capture rates and could miss critical events and errors due to a long dead-time. Faster decoding with hardware-based technology enhances the probability of capturing infrequent serial communication errors.

After capturing serial bus communication, you can easily perform a search operation based on specific criteria and then quickly navigate to bytes/frames of serial data that satisfy that search criteria. The 3000G X-Series can decode two serial buses simultaneously using hardware-based decoding and display the captured data in a time-interleaved “lister” display.

Serial protocol decoding can be used simultaneously with segmented memory and Zone triggering. The 3000G X-Series has the most decode/trigger capabilities in this class of instrument including I²C, SPI, RS232/422/485/UART, I²S, CAN, CAN FD, LIN, SENT, CXPI, FlexRay, MIL-STD 1553, ARINC 429, USB PD, and USB 2.0 low- & full-speed.

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Optional and standard supported serial bus protocols

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

- I^2C (standard)
- SPI (2/3/4 wire, standard)
- RS232/422/485/UART (standard)
- USB 2.0 low- and full-speed
- CAN (symbolic with .dbc file)
- CAN FD (symbolic with .dbc file)
- LIN (symbolic with .ldf file)
- SENT
- CXPI
- FlexRay
- MIL-STD 1553
- ARINC 429
- USB PD (standard)
- I^2S (standard)
- User-definable Manchester
- User-definable NRZ

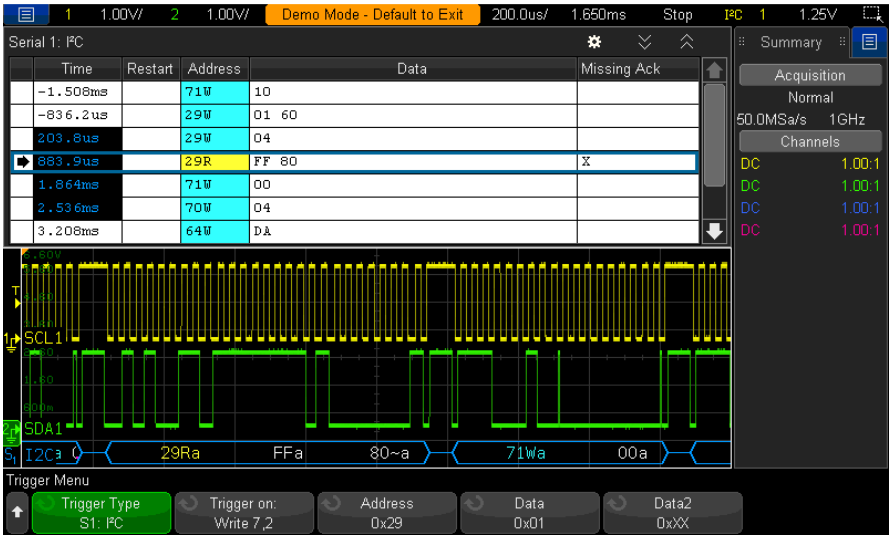


Figure 16. I^2C decode and trigger.

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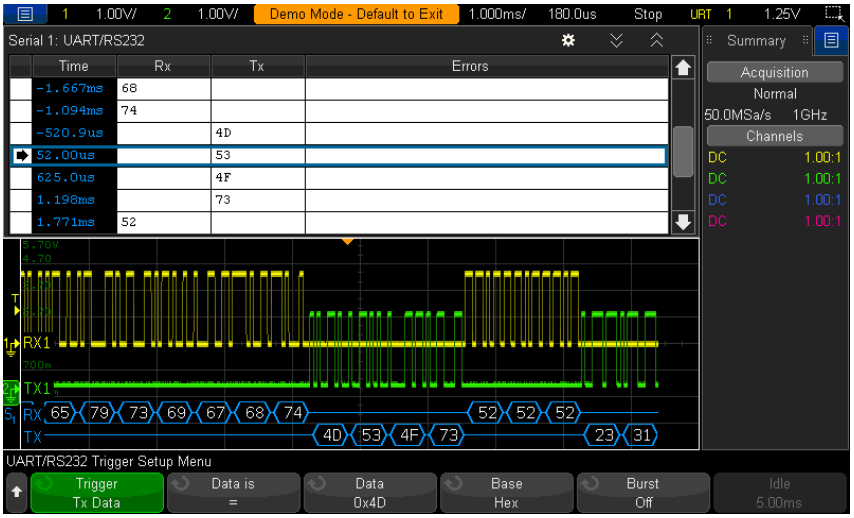


Figure 17: UART/RS232/RS485 trigger and decode.

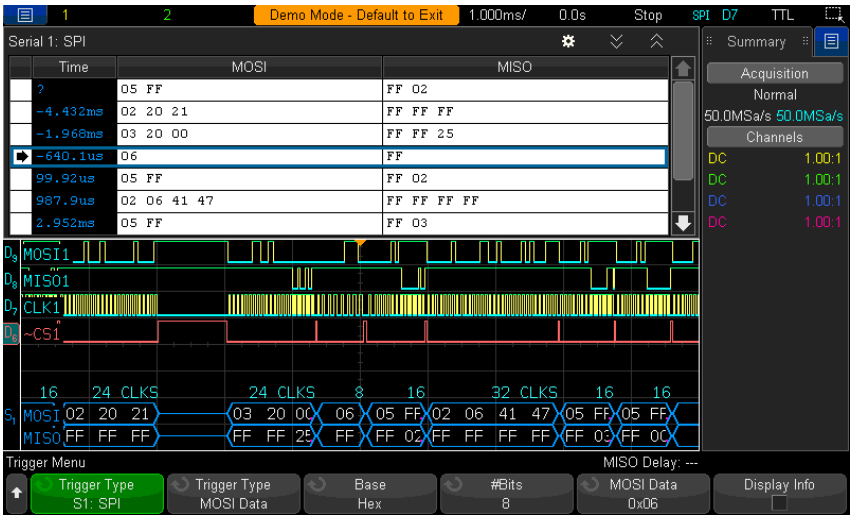


Figure 18: SPI trigger and decode.

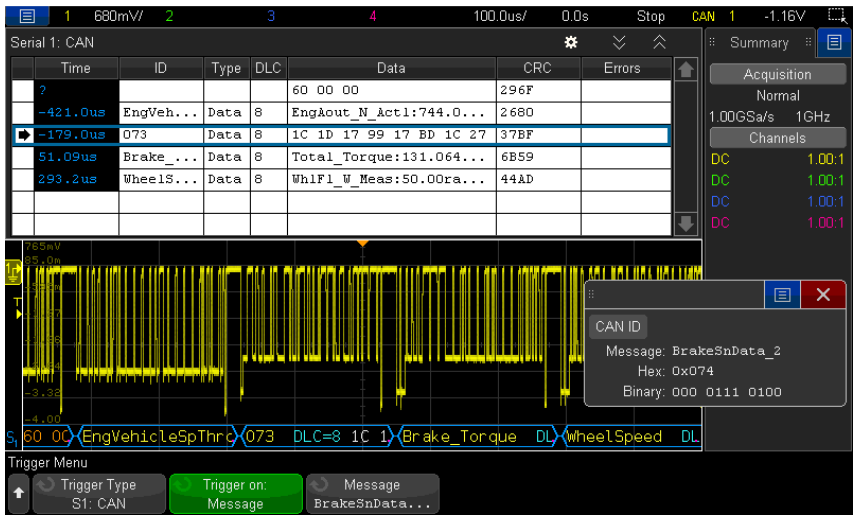


Figure 19: CAN trigger and decode with symbolic .dbc file.

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Segmented memory combined with protocol analysis enables insights over long periods of time

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

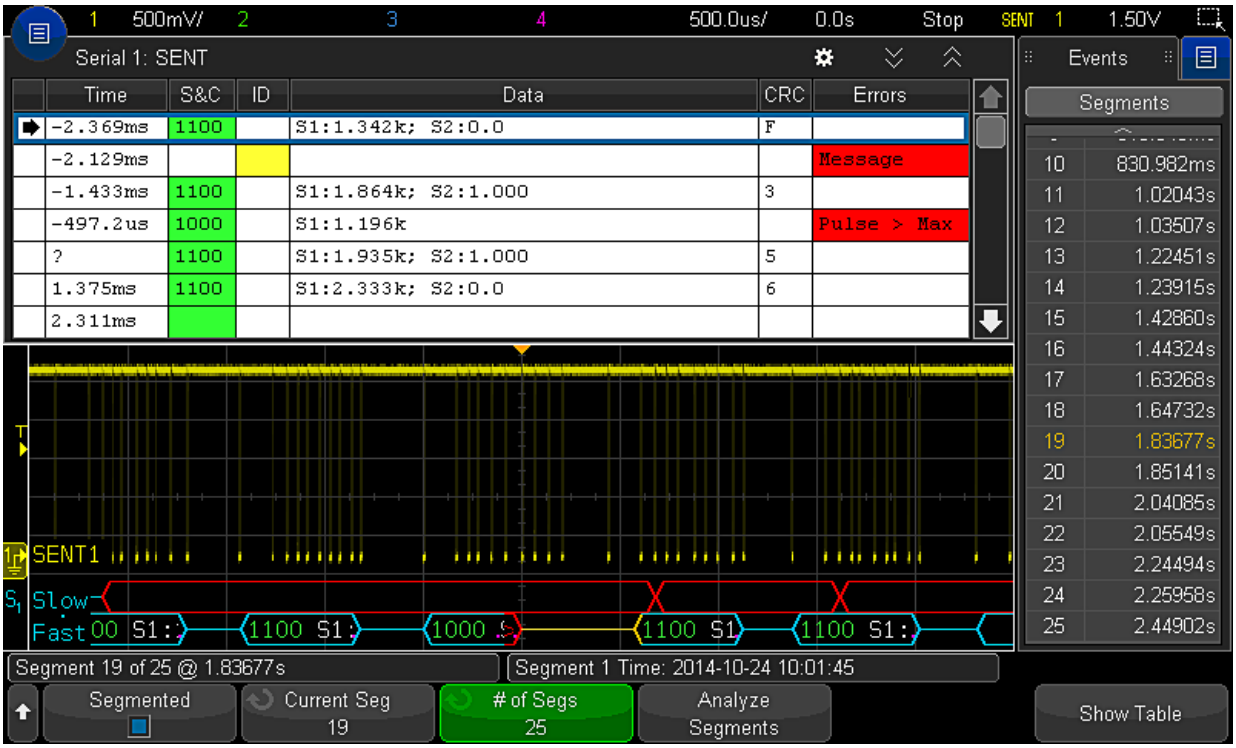


Figure 20. Segmented memory being used in conjunction with SENT bus serial decode resulting in maximum insight to the serial bus.

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Dedicated frequency/spectrum analysis allows you to time-correlate analog, digital, and frequency-domain waveforms in a single instrument

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

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

Figure 21 through 25 show a simple gated FFT example observing a RF signal frequency transition from 400 MHz to 200 MHz, time correlated to both the SPI controlling signal (digital) and a VCO enable signal (analog). Note, you can also visualize the RF signal itself in the time-domain to gain additional insight such as a gap in the RF time domain waveform.



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

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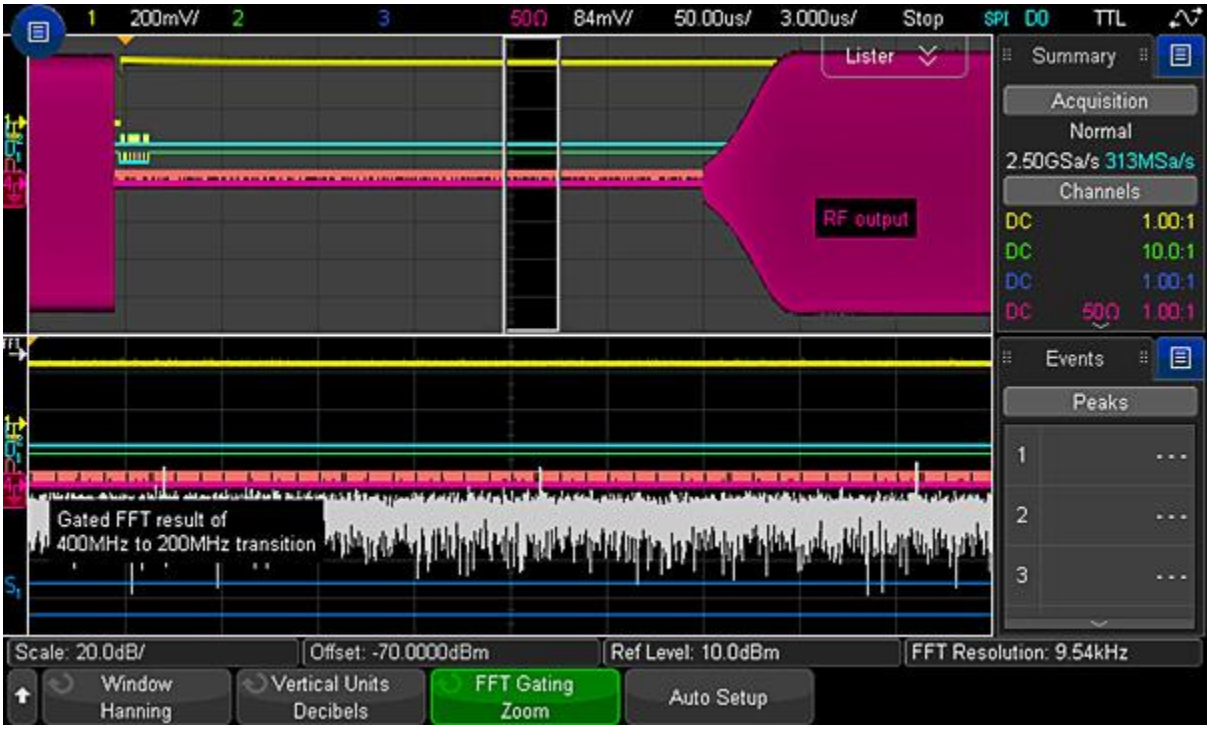


Figure 22. No RF activities in this zoomed time.



Figure 23. Start observing the RF signal at 200 MHz. You can validate this from the RF analog waveform as well.

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Figure 24. RF signal settled down at 200 MHz as indicated in the search lister.

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Analyze statistical distribution of jitter and noise with waveform and measurement histograms

Using the oscilloscope's touch screen, you can draw a rectangular "slice" across a horizontal or vertical segment of a repetitively captured and updated waveform to view a statical histogram of timing jitter or vertical noise along with statistical results as shown in Figures 25 and 26.

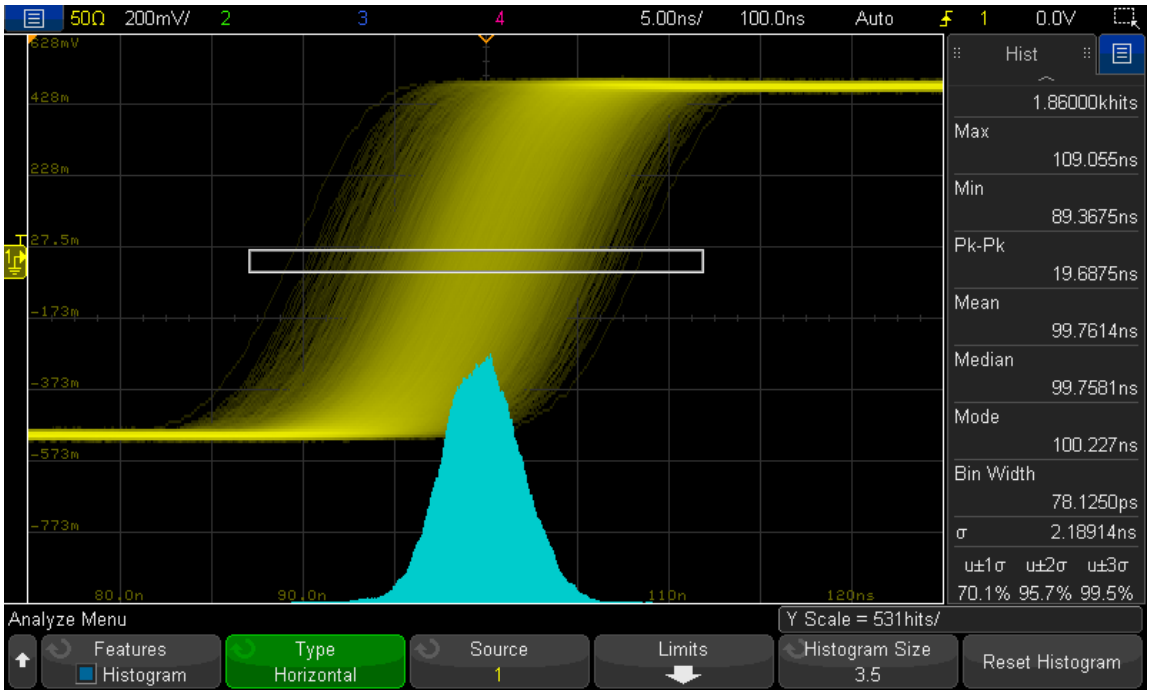


Figure 25. Horizontal waveform histogram reveals Gaussian jitter with standard deviation of 2.2 ns.

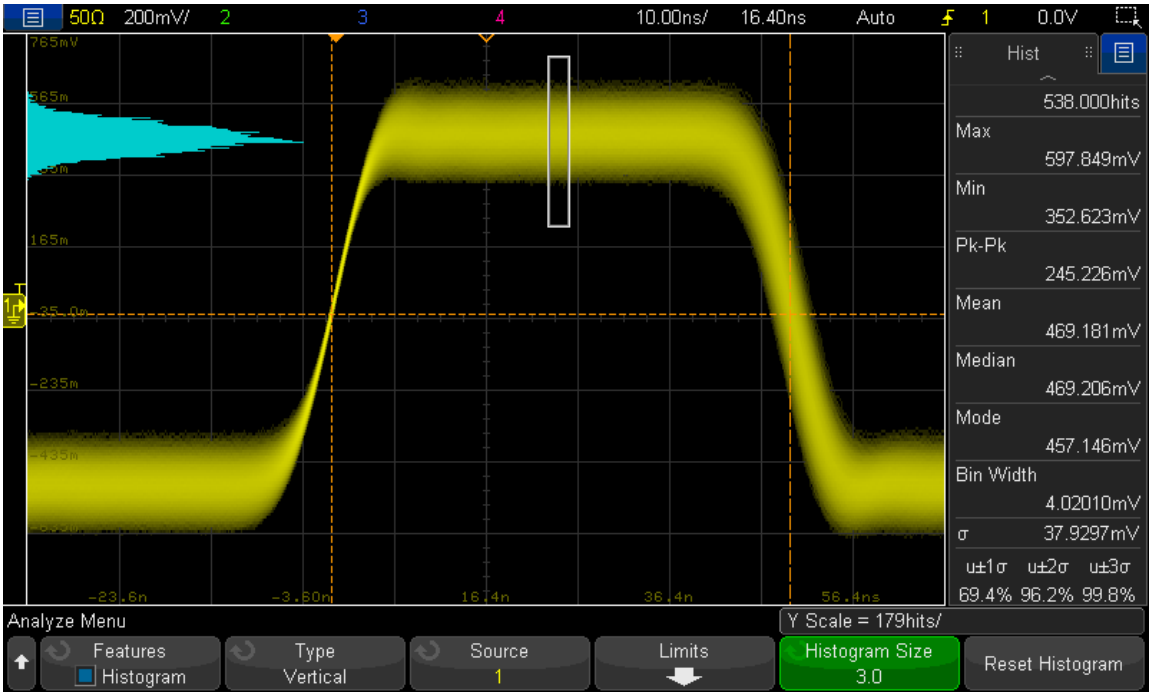


Figure 26. Vertical waveform histogram reveals Gaussian noise with standard deviation of 38 ns.

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Advanced waveform math functions

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

The InfiniiVision 3000G X-Series supports up to two cascaded math functions with an assortment of operators, transforms, filters, and visualization functions:

Operators

- Add, subtract, multiply, divide

Transforms

- Differentiate, integrate
- FFT (magnitude and phase)
- Ax + B
- Squared, square root
- Absolute value
- Common logarithm, natural logarithm
- Exponential, base 10 exponential

Filters

- Low-pass filter, high-pass filter, band-pass filter
- Averaged value
- Smoothing
- Envelope

Visualizations

- Magnify
- Max and min hold
- Measurement trend
- Chart logic bus timing, chart logic bus state
- Chart serial signal (CAN, CAN FD, LIN, and SENT)
- Maximum and minimum
- Peak-Peak

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Automatic parametric measurements provide quick answers

Automatic measurements are the essential tool of an oscilloscope. To make quick and efficient measurements, the InfiniiVision 3000G X-Series provides 44 powerful automatic measurements and can display up to 8 at a time. Measurements can be gated by auto select, main window, zoom window, or cursors, and include full statistics.

Vertical

- Peak-to-peak, maximum, minimum, Y at X, amplitude, top, base, overshoot, pre-shoot, average N-cycles, average full-screen, DC RMS-N cycles, DC RMS-full screen, AC RMS-N cycles, AC RMS full-screen (standard deviation), ratio N-cycles, ratio full-screen

Time

- Period, frequency, counter, + width, - width, burst width, + duty cycle, - duty cycle, bit rate, rise time, fall time, time at edge, delay, phase, X at min Y, X at max Y

Count

- Positive pulse count, negative pulse count, rising edge count, falling edge count

Mixed

- Area N-cycles, area full-screen, slew rate

Power

- Channel power, occupied power, adjacent power ratio, total harmonic distortion

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7-in-1 instrument integration provides synergistic measurements

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

Integrated mixed signal oscilloscope (MSO – optional)

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

With an additional 16 integrated digital channels, you now have up to 20 channels of time-correlated acquisition and viewing on the same instrument. In addition to offering powerful triggering across the analog and digital channels, this also gives you additional channels to use for serial decode and triggering. You can either purchase an MSO model that comes standard with the 16 additional digital/logic channel and a logic probe or purchase a DSO model and then upgrade it at any time to an MSO with a software license (DSOXG3MSO) that ships with the 16-channel logic probe.

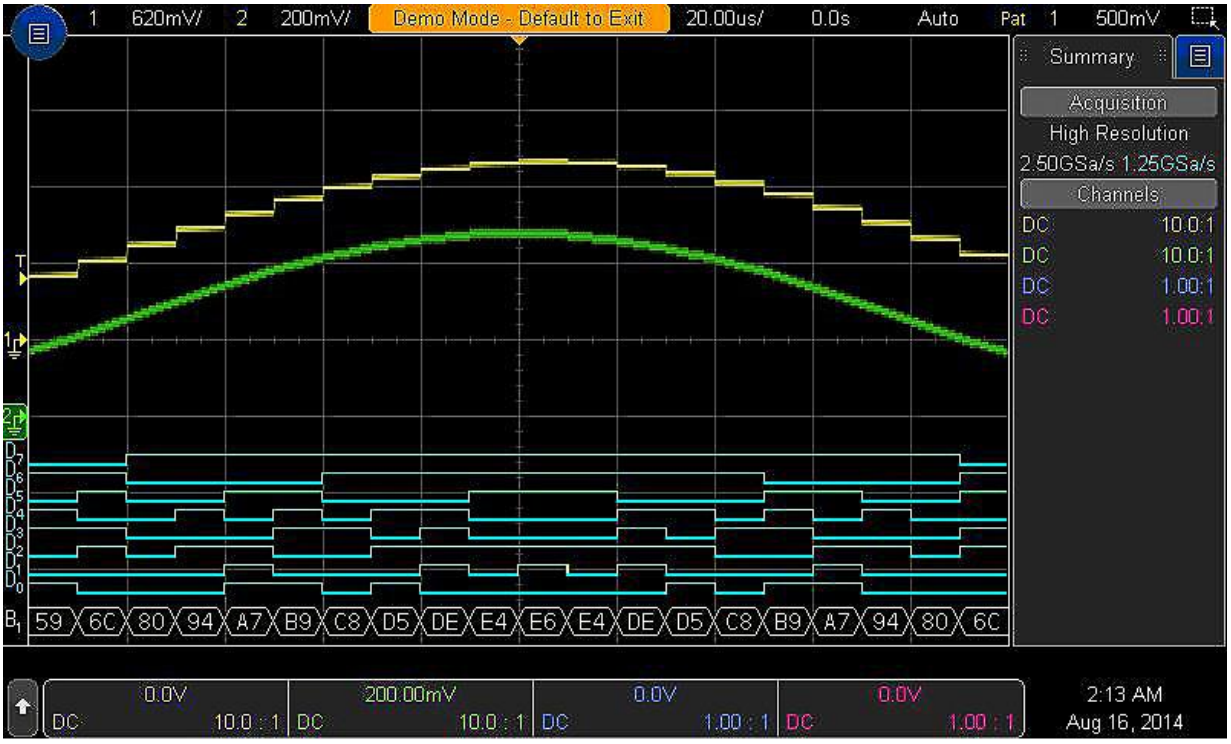


Figure 27. Optional digital channels allow a timing view of up to 16 channels. Tightly integrated, they work with the analog triggers and serial triggers/decoding.

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Frequency response analysis (Bode plots, standard)

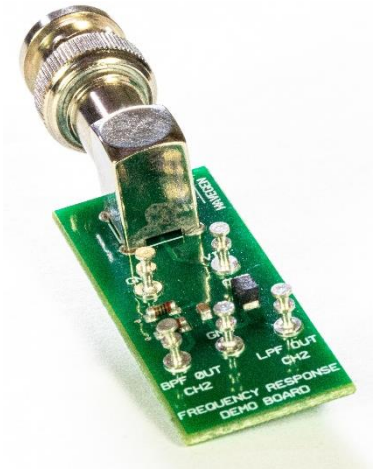
Frequency Response Analysis (FRA) is an often-critical measurement used to characterize the frequency response (gain and phase versus frequency) of a variety of today's electronic designs, including passive filters, amplifier circuits, and negative feedback networks of switch mode power supplies (loop response). InfiniiVision 3000G 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.



Figure 28. Frequency response analysis plot (Bode gain & phase) of a bandpass filter.

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 3000G X-Series oscilloscopes.



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

The InfiniiVision 3000G X-Series comes standard with an integrated 20 MHz function/arbitrary waveform generator (WaveGen) that also support modulation. The function generator provides stimulus output of sine, square, ramp, pulse, DC, Sinc (x), exponential rise/fall, cardiac, Gaussian Pulse and noise waveforms to your device under test. The modulation feature supports AM, FM, and FSK modulations with modulation shapes of sine, square, and ramp. The generator can output a continuous or a single-shot waveform. With AWG functionality, you can store waveforms from analog channels or reference memory to the arbitrary memory and output from WaveGen. Then easily create or edit the waveform using the built-in editor via touch and the large screen or by using Keysight's BenchLink Waveform Builder software: www.keysight.com/find/33503

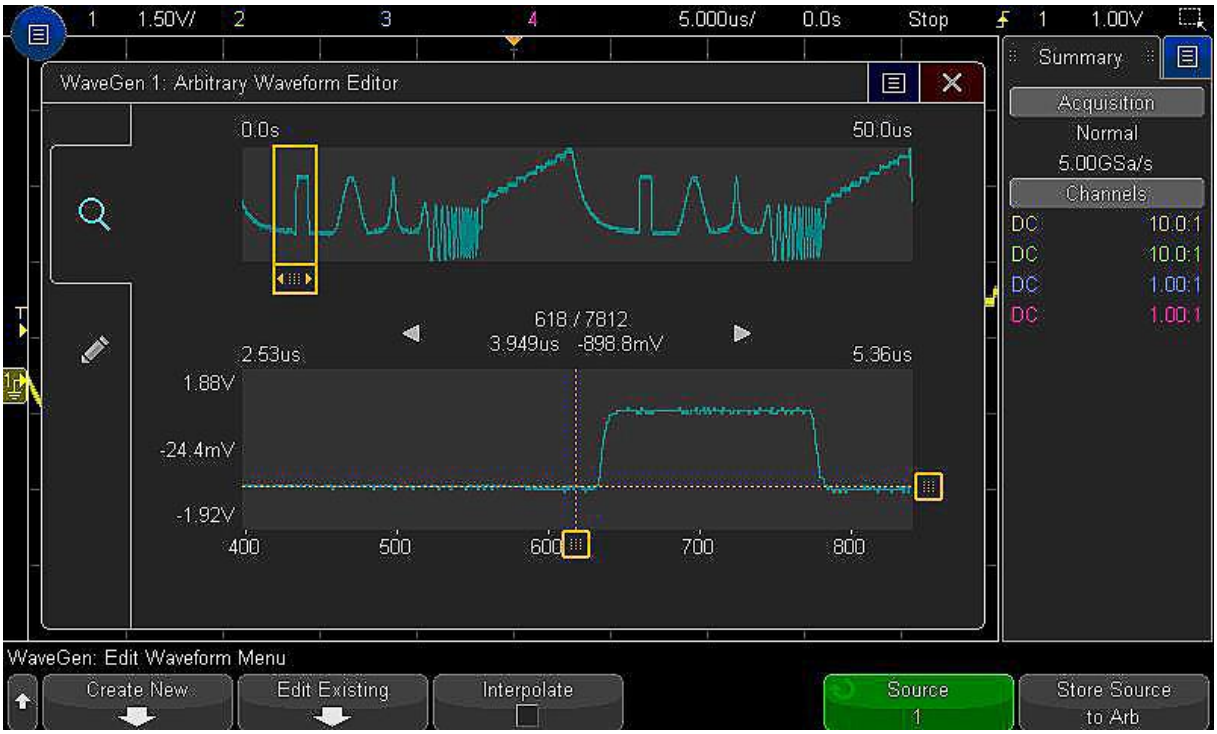


Figure 29. Standard arbitrary waveform generator provides easy access to stimulus. The integrated arbitrary waveform generator makes capturing, modifying, and replaying signals simple.

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Integrated DVM: Standard 3-digit digital voltmeter

An integrated 3-digit voltmeter is included standard on your InfiniiVision 3000G 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 30. DVM and counter takes advantage of separate signal paths to provide measurements without a trigger, while still using the scope probes.

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Integrated frequency measurements: Standard 8-digit counter and totalizer

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

With the InfiniiVision 3000G X-Series' standard 8-digit counter, you can see your measurements with the precision you would normally expect only from a standalone counter. Because the integrated counter measures frequencies up to a wide bandwidth of 1.0 GHz, you can use it for many high-frequency applications as well.

The counter's totalizer feature adds another valuable capability to the oscilloscope. It can count the number of events (totalize), and it also can monitor the number of trigger-condition-qualified events. The trigger-qualified events totalizer does not require an actual trigger to occur. It only requires a trigger-satisfying event to take place. In other words, the totalizer can monitor events faster than the trigger rate of a scope, as fast as 25 million events per second (a function of the oscilloscope's holdoff time, which has the minimum of 40 ns). Figures 31 shows example of a totalizer counting the number of CAN FD CRC delimiter bit error packets that took place in a design.

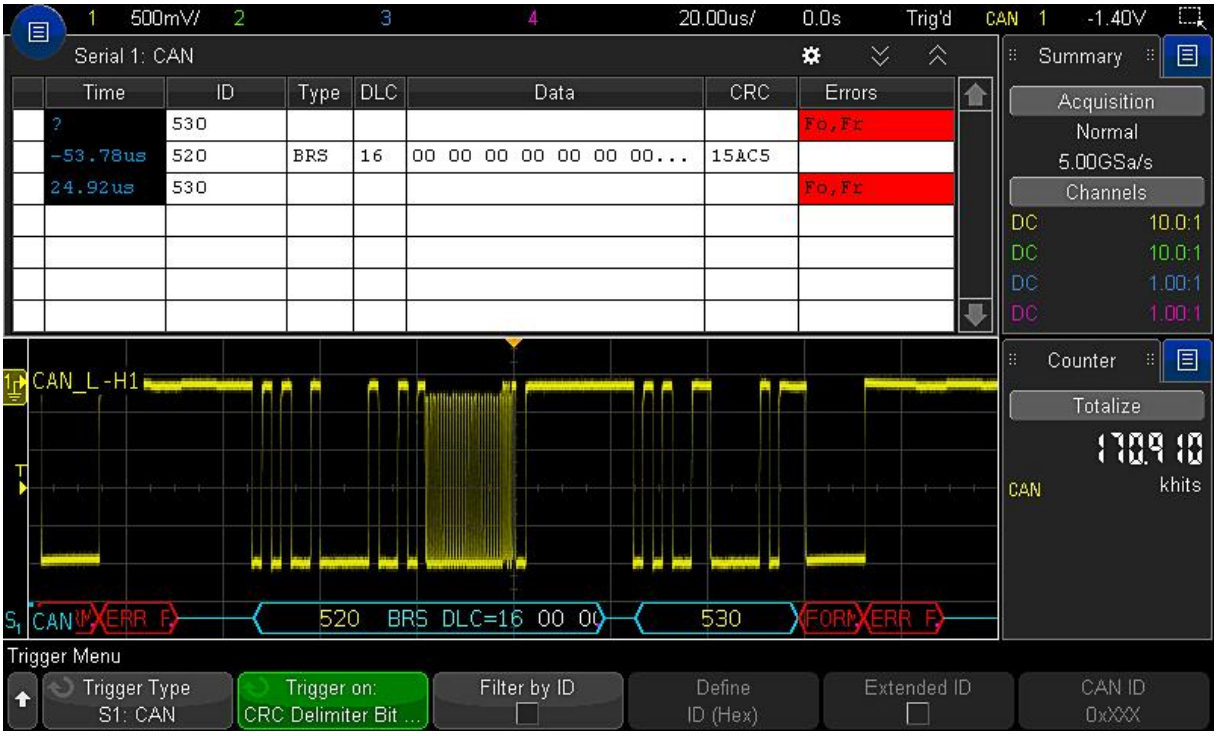


Figure 31. Totalizer counts the number of events. In addition, it can count the number of trigger-condition-qualified events as fast as 25 million events a second.

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Other Advanced Measurements and Features

Hardware-based mask limit & measurement limit testing (standard) for quick pass/fail testing

Whether you are performing pass/fail tests to specified standards in manufacturing or testing for infrequent signal anomalies, mask limit and measurement limit testing can be a valuable productivity tool. The InfiniiVision 3000G X-Series features powerful hardware-based mask testing that can perform up to 270,000 tests per second. You can select multiple test criteria, including the ability to run tests for a specific number of acquisitions, a specified time, or until detection of a failure.

With the standard 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 32. Hardware accelerated mask testing allows testing against a golden waveform or user created mask to find violations. In this example we captured over 9M tests in only 53 seconds.

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