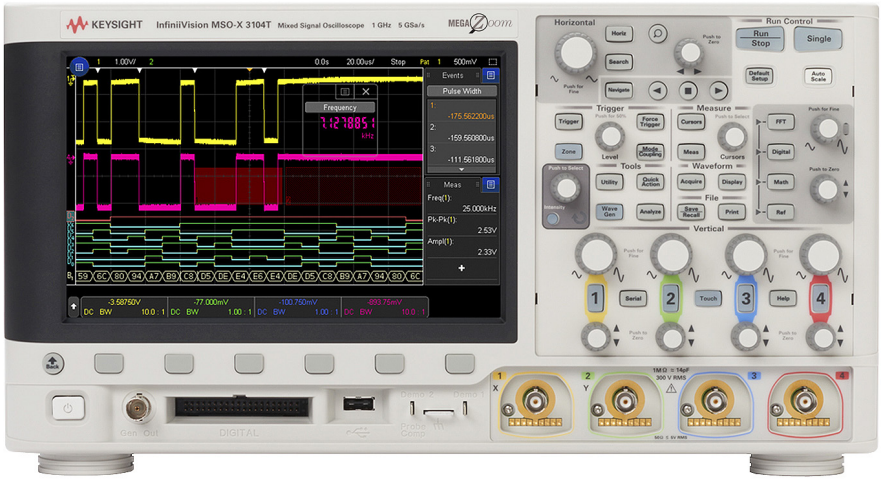
Keysight
InfiniiVision 3000T X-Series Oscilloscopes

Data Sheet



KEYSIGHT TECHNOLOGIES

Touch, Discover, Solve

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

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

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

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

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

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

Figure 1: InfiniiVision 3000 X-Series with MagaZoom IV smart memory technology

Touch: Designed-for-touch interface and capacitive touch screen simplify use

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

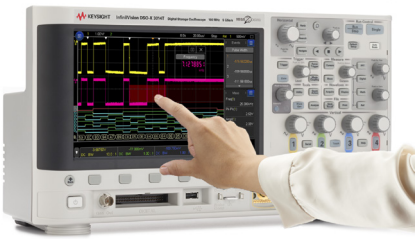


Figure 2: The industry's first 8.5" capacitive touch display with large, touchable targets.

Capacitive touch screen technology enables productivity

The user interface allows you to use the alphanumeric pad for quick annotation, place waveforms or cursors in exact positions and drag docking panels across the screen to see more measurement information.

The 3000T X-Series offers three ways to access key menus and features: touch GUI for those that prefer tablet or smart phone touch interfaces, front panel buttons and knobs for the traditional oscilloscope users, and Keysight Insight pull down menu for users who prefer Windows-like operations. The 3000T X-Series also offers a "touch off" button as well as USB mouse and keyboard support.

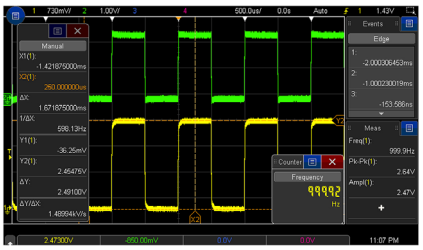


Figure 3: Side bar with movable docks allows information to be placed on the screen precisely where you want it for documentation.

Touch interface simplifies documentation

The availability of up to 4 annotations on screen makes it easy to highlight key items on screen shots. Streamline documentation with the ability to input information via a pop-up soft keyboard on the touch screen or a USB keyboard. A sidebar displays additional information without covering the waveform graticule, and allows you to dock and scroll through multiple measurement values. Touch gestures (like flicking) make navigating lists or moving between segment waveforms easy.

In addition to the benefits of touch, free BenchVue software provides documentation across multiple instruments at once. USB, LAN (optional) and GPIB (optional) connectivity make oscilloscope control or pulling data and screenshots easy. And the built-in ability to send emails when connected to the LAN allows you to email yourself a screenshot or data file with just the press of a button.

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

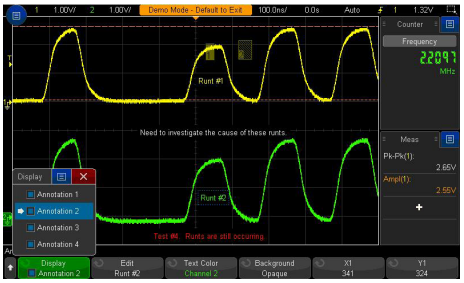


Figure 5: See up to four annotations on screen at once for documentation. The standard touch screen makes inputting notes simple.

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

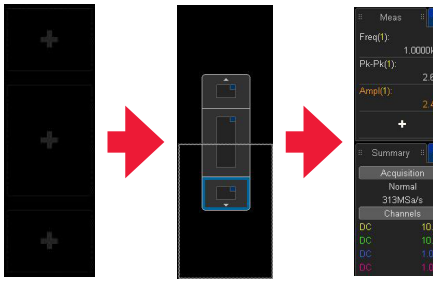


Figure 7: A dock-able sidebar allows you to customize how you view your measurements.

Redefine your remote Web control oscilloscope experience.

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

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

Discover: The industry's fastest uncompromised update rate increases the chance of finding anomalies

Industry-Leading Uncompromised Update Rate

If you can't see the problem, you can't fix the problem. With an industry-leading update rate of over one million waveforms per second, the InfiniiVision 3000T X-Series gives you the highest probability of capturing random and infrequent events that you would miss on an oscilloscope with a lower waveform update rate.

Powered by MegaZoom IV smart memory technology, the InfiniiVision 3000T X-Series not only lets you see more waveforms, but it has the uncompromised ability to find the most difficult problems in your design under any conditions. Unlike other oscilloscopes, uncompromised ability means:

- Always-fast, responsive operation
- No slowdown with logic channels on
- No slowdown with protocol decoding on
- No slowdown with math functions on
- No slowdown with measurements on
- No slowdown with vectors on
- No slowdown with sinx/x interpolation on

What is waveform update rate?

As oscilloscopes acquire data, process it, and plot it to the screen, there is inevitable "dead time," or the time oscilloscopes miss signals completely. In general, the faster the waveform update rate, the shorter the dead time. The shorter the dead time, the more likely an oscilloscope is to capture anomalies and infrequent events. This is why it is important to select an oscilloscope with a fast waveform update rate. Figures 7 and 8 demonstrate the difference between a slower update rate and a faster update rate.

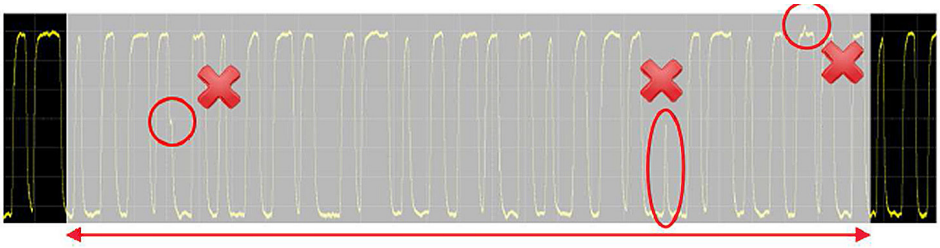


Figure 9: Other vendor's oscilloscope with 50,000 waveforms/second. A long dead time decreases your chances of capturing infrequent events.

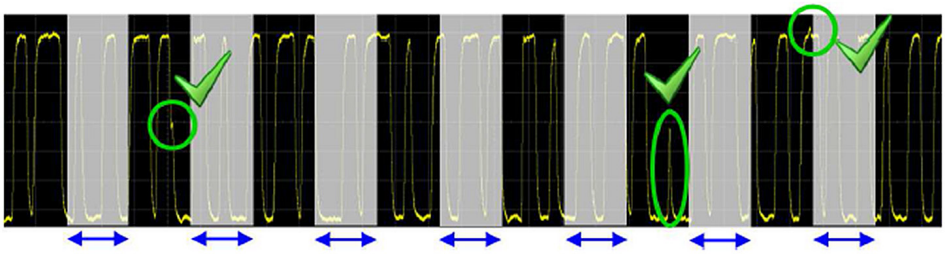


Figure 10: InfiniiVision 30000T X-Series with 1,000,000 waveforms/second. A short dead time increases your chancs of capturing infrequent events.

But all specs aren't equal.

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

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

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

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

Why is an uncompromised update rate important?

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

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

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

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

MegaZoom IV smart memory technology enables uncompromised update rate

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

The InfiniiVision 3000T X-Series requires minimum support from a CPU, as most core operations are handled by Keysight proprietary technology, the MegaZoom IV smart memory ASIC. MegaZoom includes hardware serial decoders and hardware mask/limit testing capability, plots analog and digital data directly to the display, supports GUI operation, and integrates additional instruments like the WaveGen function/arbitrary waveform generator.

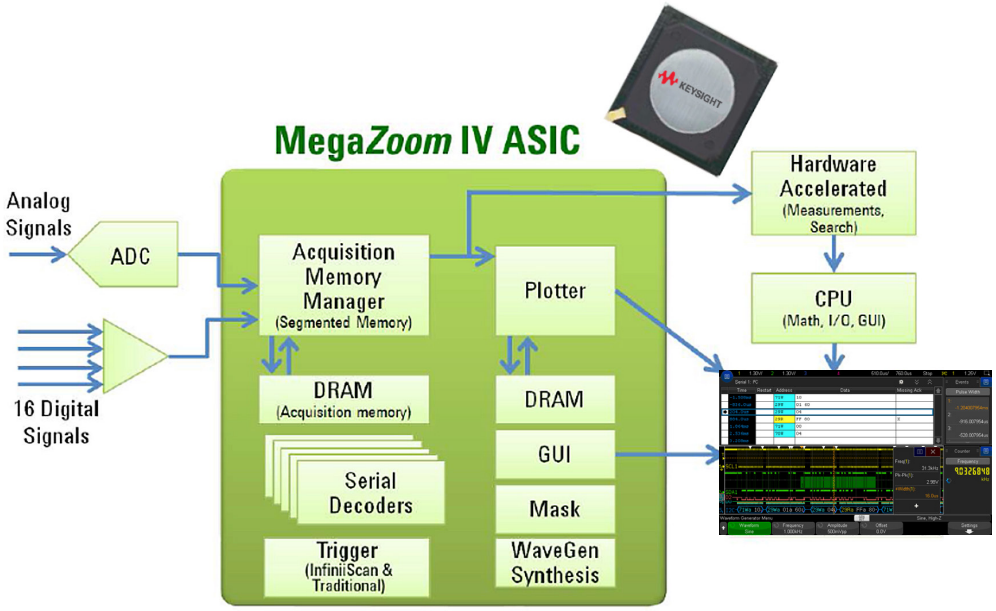


Figure 11. The 3000T X-Series oscilloscopes' uncompromised responsiveness, speed and waveform update rate are enabled by the MegaZoom IV, smart memory ASIC. The CPU is not used for core waveform operations.

Discover: Excellent signal integrity allows you to see more signal detail

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

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

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

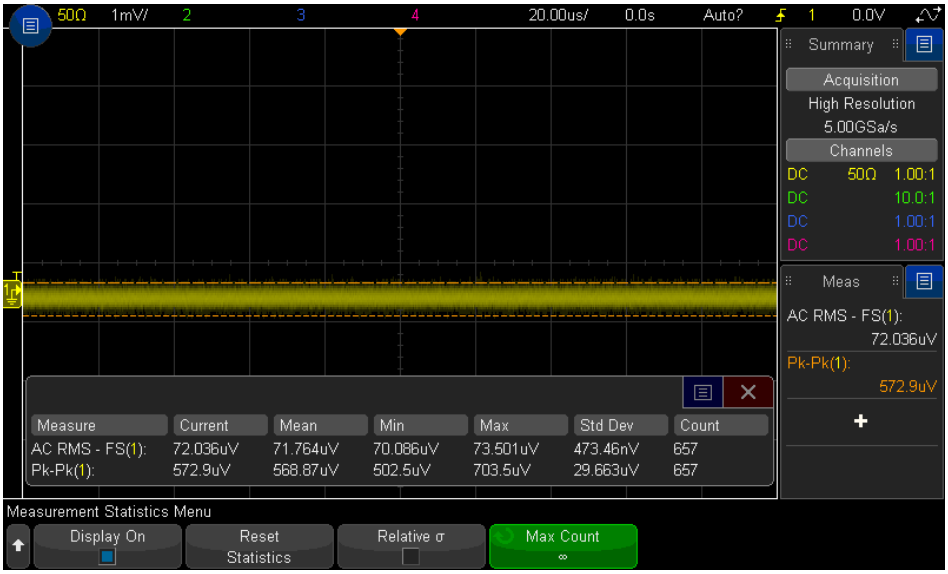


Figure 12: High resolution mode allows you to lower your noise and increase your resolution up to 12-bits

	50 Ω 1 GHz Bandwidth Vrms measurement (units = mV)		
Vertical setting	**Normal mode**	**High resolution mode**	**Notes**
1 mV	0.277	0.072	Some scopes' bandwidth automatically limited to 150 MHz
2 mV	0.277	0.072	Some scopes' bandwidth automatically limited to 350 MHz
5 mV	0.297	0.081	Some scopes' bandwidth automatically limited to 500 MHz
10 mV	0.352	0.810	
20 mV	0.597	0.102	
50 mV	1.500	0.340	
100 mV	2.560	0.480	
200 mV	5.500	1.050	
500 mV	15.200	3.630	
1 V	26.000	4.830	

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

Discover: Industry exclusive zone touch trigger makes triggering simple

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

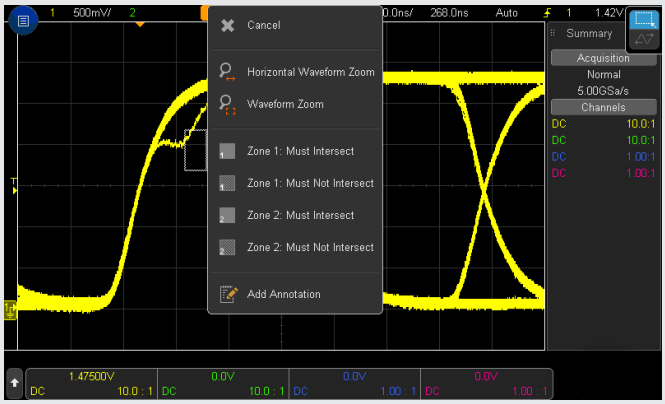
Zone touch trigger eliminates the complexity of setting up advanced triggers. Now, if you can see the event on the display of the oscilloscope, you can trigger on it just by drawing a box on the signal you want to isolate.

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

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

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

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



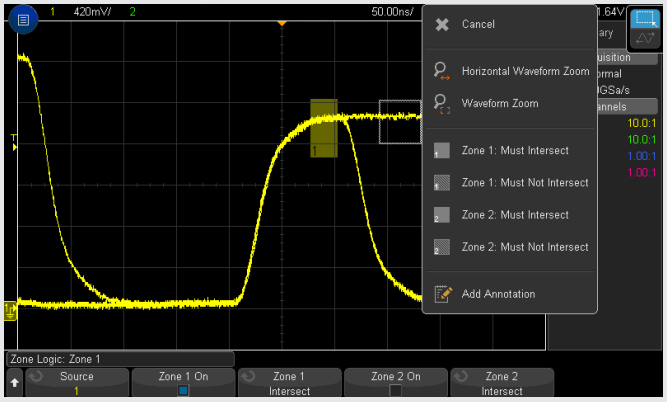
Traditional Scopes with Advanced Triggers (assuming the update rate is fast enough to see what you want to trigger on):

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

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

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

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



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

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

Discover: Standard segmented smart memory allows you to capture longer periods of time at high sample rates

Acquisition memory size is an essential oscilloscope specification because it determines sustainable sample rate and the amount of time you can capture in a single acquisition. In general, longer memory is better. However, no memory will always be long enough to capture all the signals you need, especially when capturing infrequent anomalies, data bursts, or multiple serial bus packets. Segmented memory acquisition lets you selectively capture and store important signal activity without capturing unimportant signal idle time. In addition, it provides a time stamp of each segment relative to the first trigger event to enable analysis of the frequency of the event. Segmented memory comes standard on the 3000T X-Series.

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

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

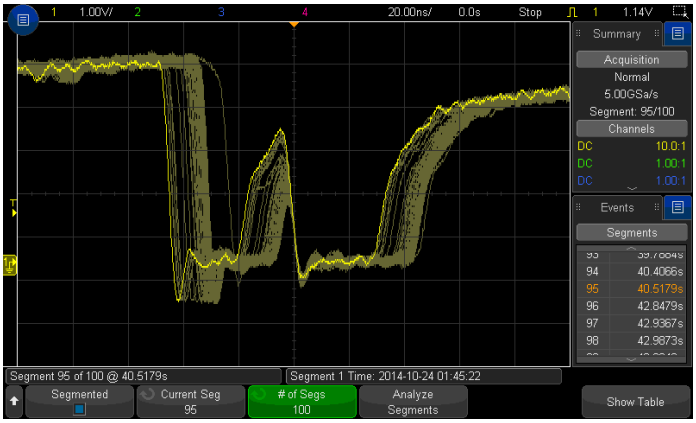


Figure 13a: Screen showing an overlay of all 100 segments for worst case waveform analysis.

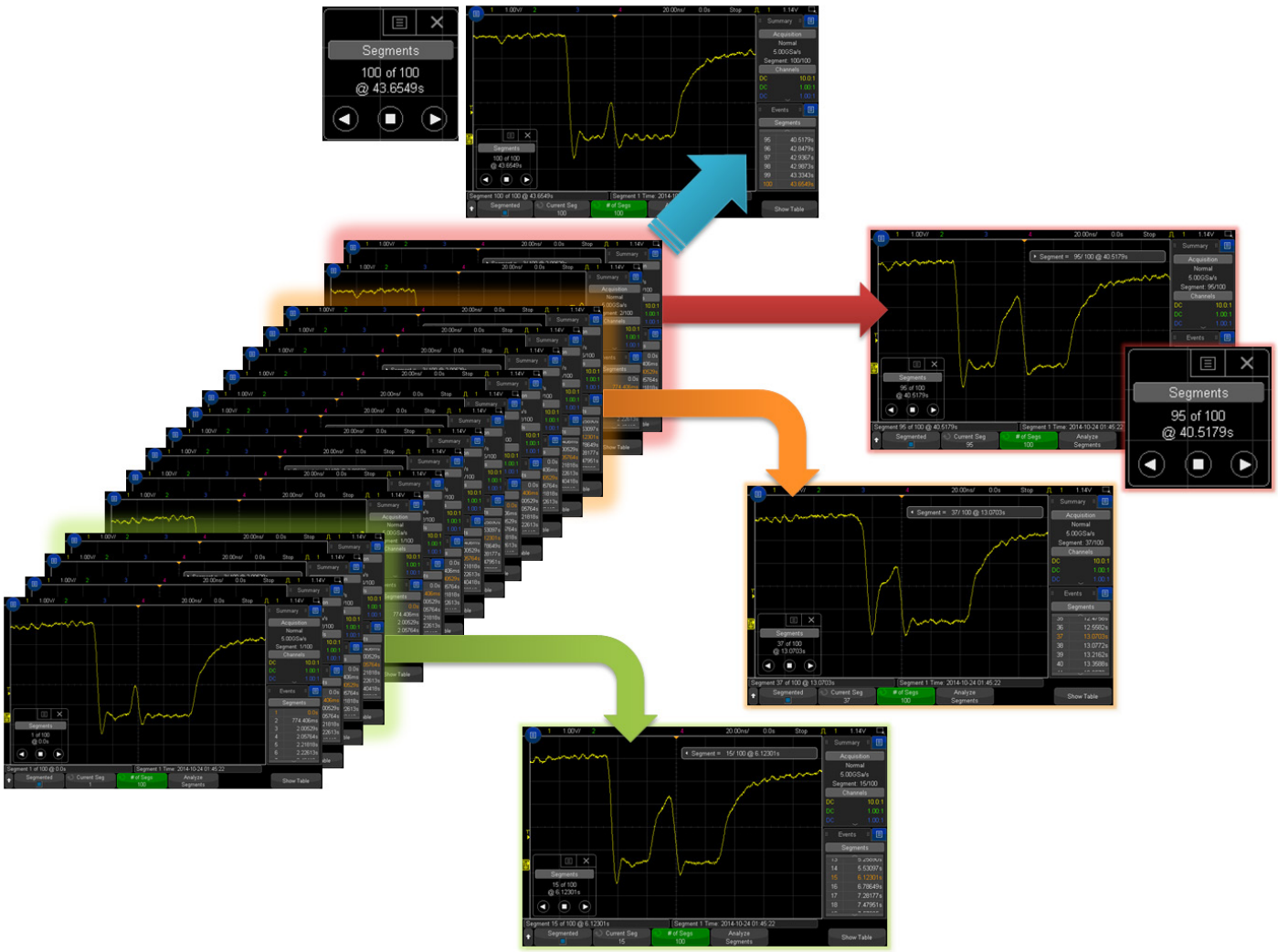


Figure 13. Segmented memory reveals different types of glitches are taking place.

Discover: Dedicated search and navigation helps you navigate deep memory

Parametric and serial bus search and navigation comes standard on the 3000T X-Series oscilloscopes. When you are capturing long, complex waveforms using an oscilloscope's acquisition memory, manually scrolling through stored waveform data to find specific events of interest can be slow and cumbersome. With automatic search and navigation capability, you can easily set up specific search criteria and then quickly navigate to "found and marked" events. Available search criteria include edges, pulse width (time-qualified), rise/fall times (time-qualified), runt pulses (time-and level-qualified), frequency peaks (FFT function, threshold and excursion qualified), and serial bus frames, packets, and errors.

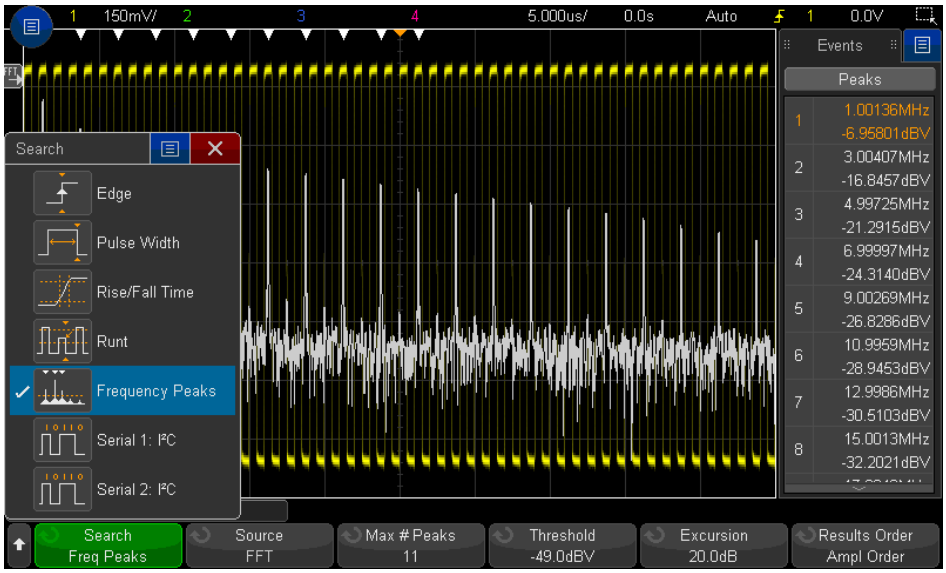


Figure 14: The 3000T X-Series was set up to capture clock signals for FFT analysis. Using the search and navigation capability, the scope was able to find, mark (white triangles) and quickly navigate to the first 11 frequency peaks occurrences. You can sort it in the order of frequency or amplitude.

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

Solve: Integrated hardware-based serial decoding and triggering (option) makes easy work of low speed serial buses

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

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

Serial protocol decoding can be used simultaneously with segmented memory and Zone touch triggering. The 3000T X-Series has the most decode/trigger options in this class of instrument including: I²C, SPI, RS232/422/485/UART, CAN, CAN-FD, CAN-dbc, LIN, LIN symbolic, SENT, FlexRay, MIL-STD 1553, ARINC 429, and I²S.

SERIAL DECODE AND TRIGGER OPTIONS

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

- I²C
- SPI (2/3/4 wire)
- RS232/422/485/UART
- CAN
- CAN-dbc
- CAN-FD
- LIN
- LIN symbolic
- SENT
- FlexRay
- MIL-STD 1553
- ARINC 429
- I²S

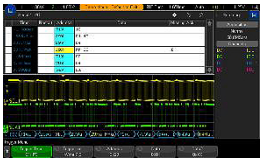


Figure 15: I²C decode and trigger

Figure 16: RS232 decode and trigger

Figure 17: CAN-FD decode and trigger

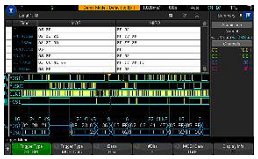


Figure 18: SPI 4wire decode and trigger

Figure 19: Multi-bus time aligned decode

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

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

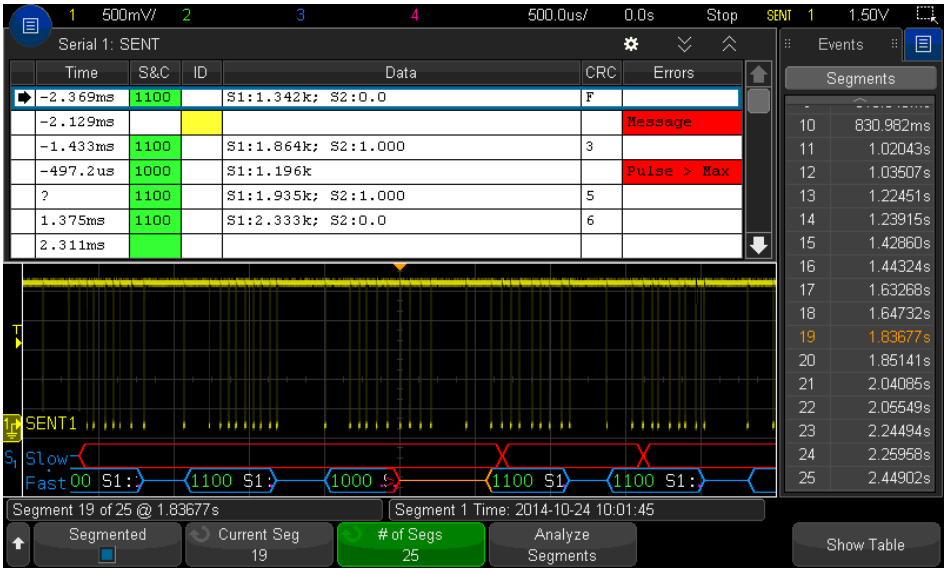


Figure 20: Segmented memory being used in conjunction with SENT bus serial decode resulting in maximum insight to the serial bus

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

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

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

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

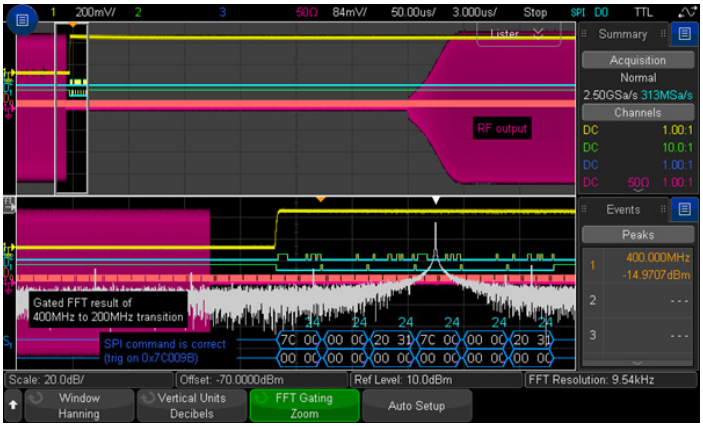


Figure 21a: Triggered on a SPI command, the RF signal is still at 400 MHz as indicated in the frequency peak search result lister

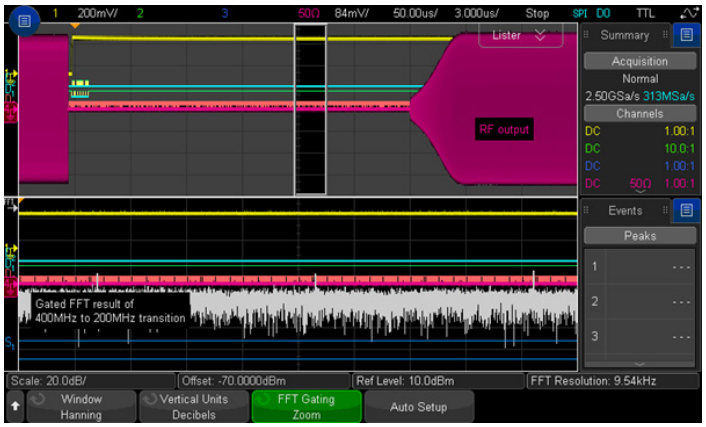


Figure 21b: No RF activities in this zoomed time

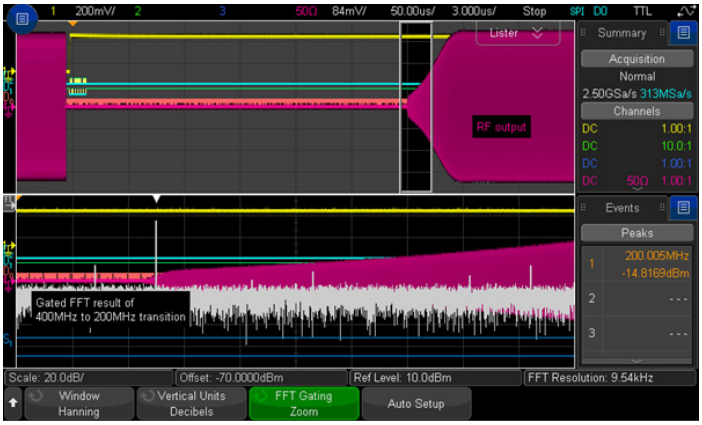


Figure 21c: Start observing the RF signal at 200 MHz. You can validate this from the RF analog waveform as well

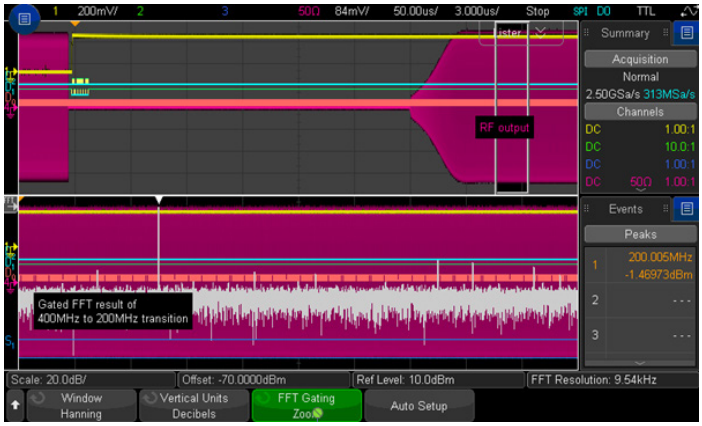


Figure 21d: RF signal settled down at 200 MH as indicated in the search lister

Solve: Standard advanced math capabilities allow new views of signals

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

ADVANCED MATH

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

Operators
- Add, subtract, multiply, divide

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

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

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

Solve: Class leading measurements provide quick answers

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

MEASUREMENTS

The 3000T X-Series supports 38 automated measurements:

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

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

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

Area- N cycles, area- full screen

Counter
- Built-in frequency counter

Solve: 6-in-1 integration allows new measurement possibilities

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

Integrated mixed signal oscilloscope (MSO - optional)

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

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

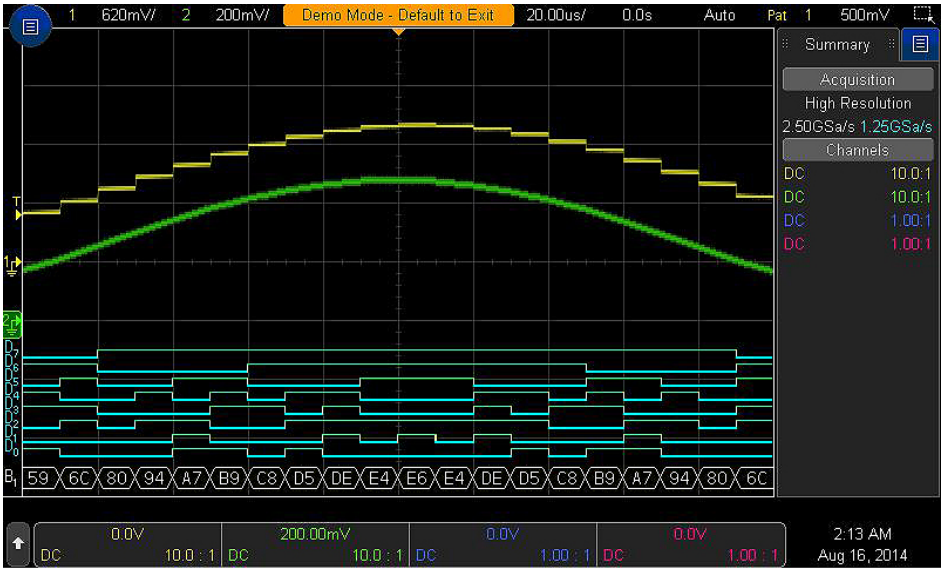


Figure 24: Optional digital channels allow a timing view of up to 16 channels. Tightly integrated, they work with the analog triggers and serial triggers/decoding

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

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

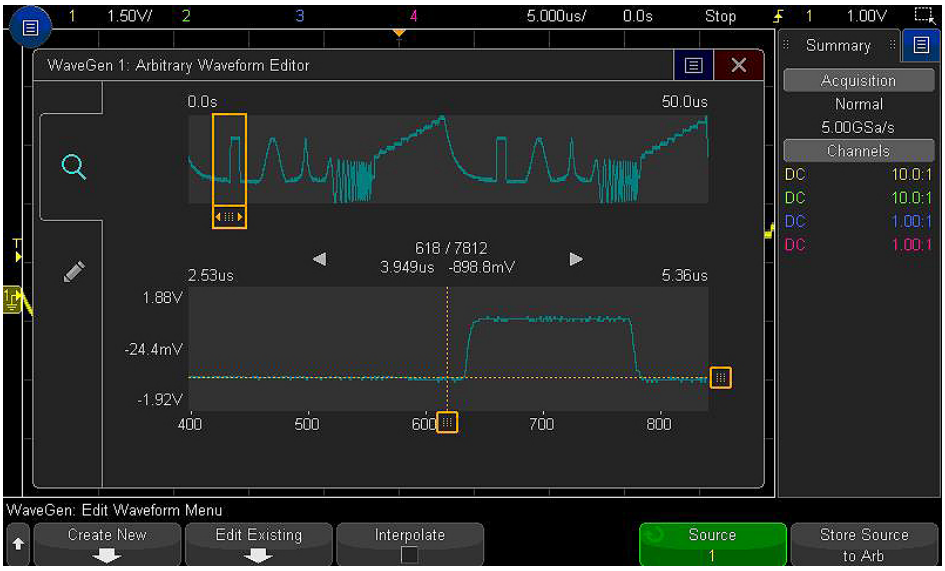


Figure 25: Optional arbitrary waveform generator provides easy access to stimulus. The integrated arbitrary waveform generator makes capturing, modifying and replaying signals simple.

Integrated DVM: Optional quick tester - 3-digit digital voltmeter

You can add an integrated 3-digit voltmeter (part of the DSOXT3DVMCTR option) to your 3000T X-Series oscilloscope. The voltmeter operates through the same probes as the oscilloscope channels. However, the DVM measurements are made independently from the oscilloscope acquisition and triggering system so you can make both the DVM and triggered oscilloscope waveform captures with the same connection. The voltmeter results are always displayed, keeping these quick characterization measurements at your fingertips.

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

Integrated frequency measurements: Optional 8-digit counter and totalizer

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

With the 3000T X-Series' optional 8-digit counter (part of the DSOXT3DVMCTR option), 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 totalizer feature of the DSOXT3DVMCTR counter option adds another valuable capability to the oscilloscope. It can count the number of events (totalize), and it also can monitor the number of trigger-condition-qualified events. The trigger-qualified events totalizer does not require an actual trigger to occur. It only requires a trigger-satisfying event to take place. In other words, the totalizer can monitor events faster than the trigger rate of a scope, as fast as 25 million events per second (a function of the oscilloscope's holdoff time, which has the minimum of 40 ns). Figures 27 shows example of a totalizer counting the number of CAN-FD CRC delimiter bit error packets that took place in a design.

See www.keysight.com/find/DSOXDVMT3CTR for more information

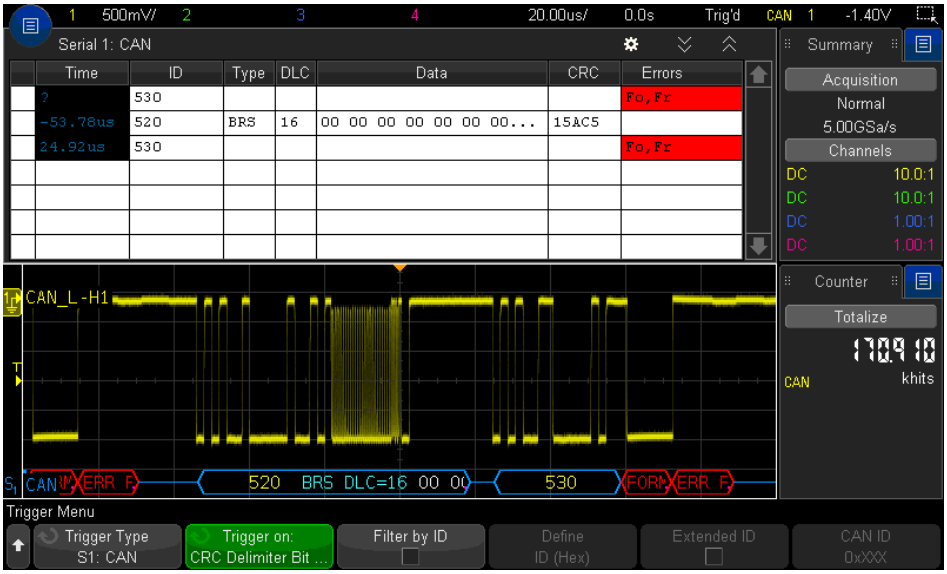


Figure 27: Totalizer counts the number of events. In addition, it can count the number of trigger-condition-qualified events as fast as 25 million events a second

Solve: Hardware accelerated mask/limit testing (option) makes it easy to see the performance of your device

Whether you are performing pass/fail tests to specified standards in manufacturing or testing for infrequent signal anomalies, mask/limit testing can be a valuable productivity tool (DSOX3MASK). The 3000T X-Series features powerful hardware-based mask testing that can perform up to 270,000 tests per second. You can select multiple test criteria, including the ability to run tests for a specific number of acquisitions, a specified time, or until detection of a failure.

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

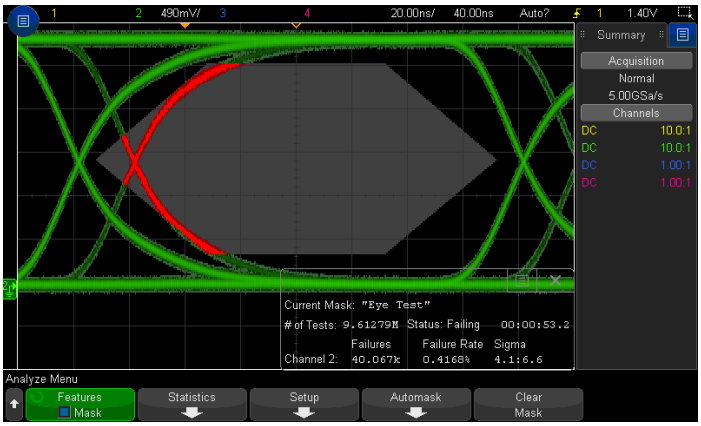


Figure 28: Hardware accelerated mask testing allows testing against a golden waveform or user created mask to find violations. In this example we captured over 5M tests in only 30 seconds

Solve: Integrated power measurements and analysis (option) make short work of power measurements

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

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

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

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

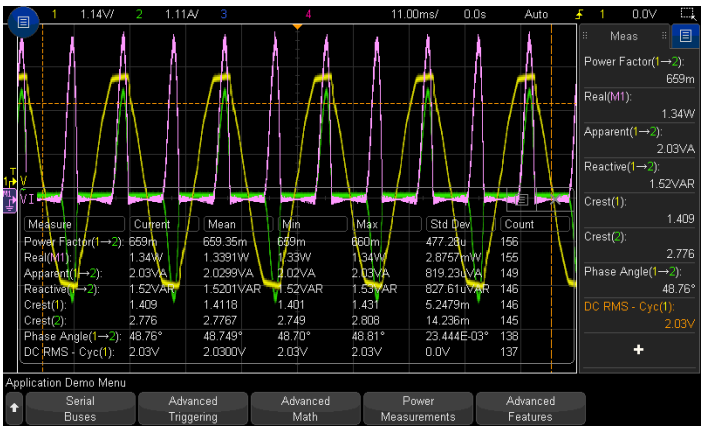


Figure 29a: Integrated power measurements make quick work of analyzing power producing and power consuming devices

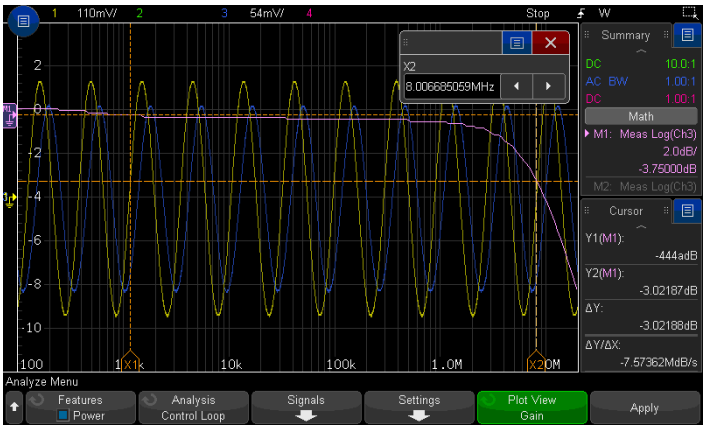


Figure 29b: New control loop response analysis (bode plot) shows the gain/phase plot over frequency sweep

Solve: Innovative power rail probe (option) allows enhanced views.

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

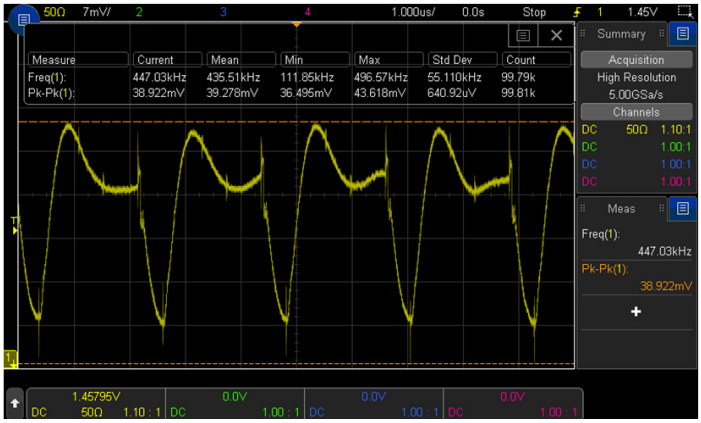


Figure 30a: 3000T X-Series and N7020A acquire not only the power rail ripples but the high frequency transients as well.

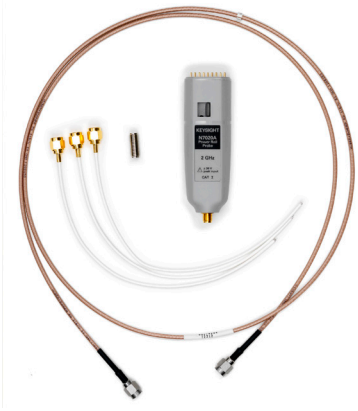


Figure 30b: N7020A Power Rail Probe

Solve: Video analysis (option)

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

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

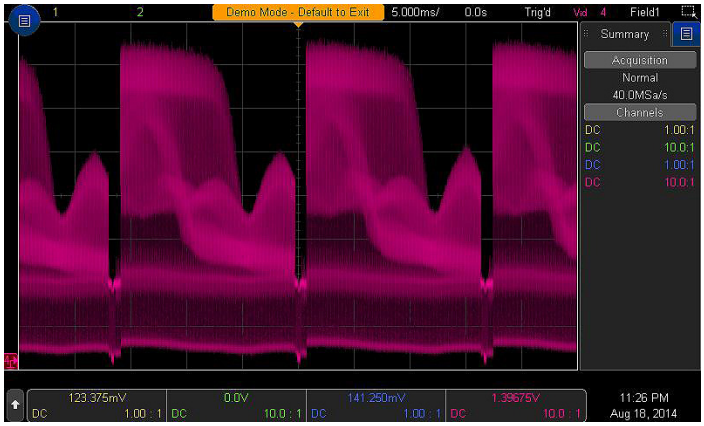


Figure 31

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

Total cost of ownership:

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

Educator and Training Kit:

Have new hires that need to quickly become familiar with the scope? Or are you a professor that wants to teach your students what an oscilloscope is and how to perform basic measurements? The optional Educator’s Oscilloscope Training Kit (DSOXEDK) makes that easy. It includes training tools created specifically for electrical engineering and physics undergraduate students and professors. It contains an array of built-in training signals, a comprehensive oscilloscope lab guide and tutorial written specifically for the undergraduate student and an oscilloscope fundamentals PowerPoint slide set for professors and lab assistants.

For more information, refer to: www.keysight.com/find/EDK.

Built-in features to help the infrequent user:

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

30-day trial license:

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

Next generation probing:

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

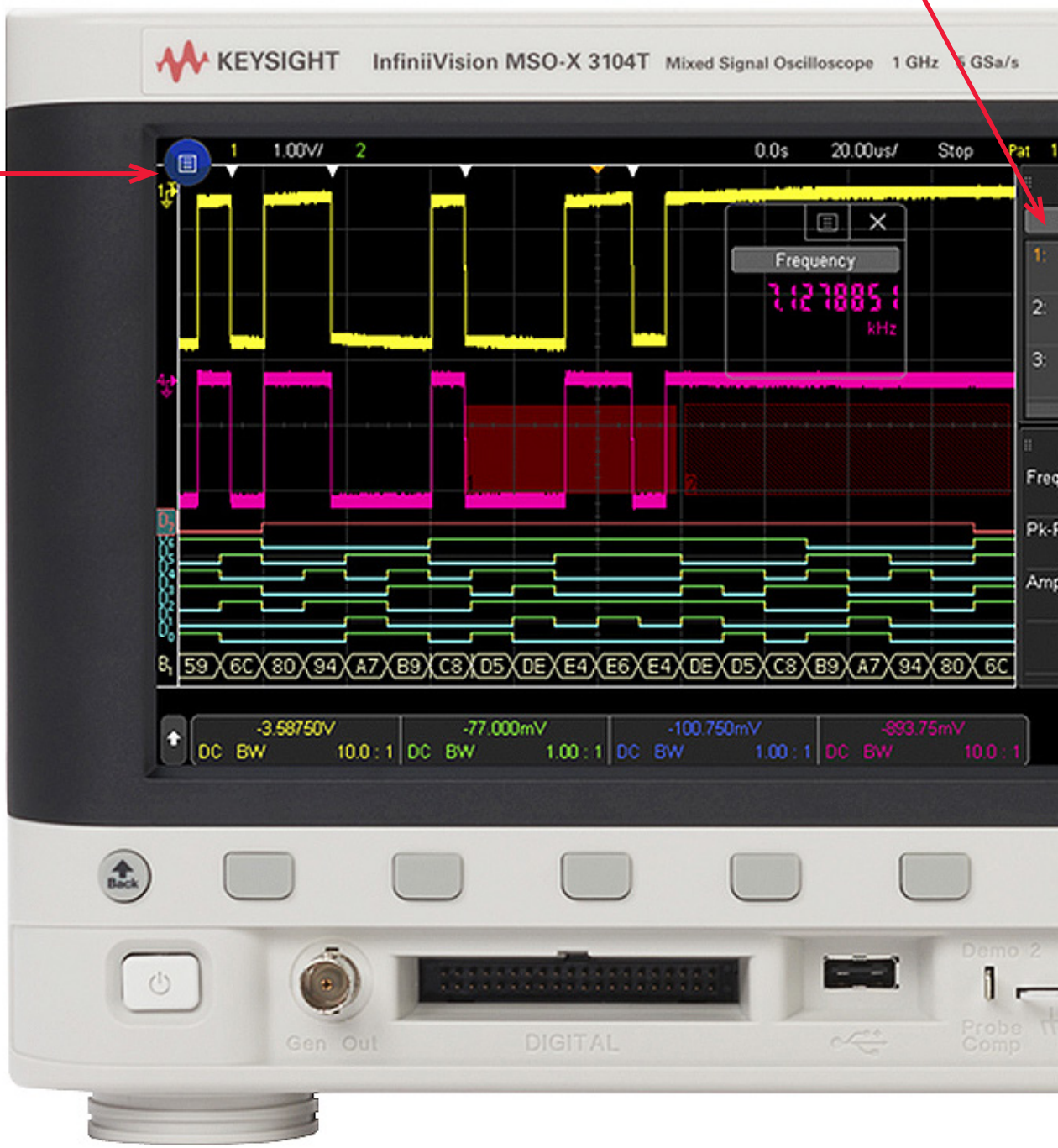
LOCALIZED GUI AND FRONT PANEL OPTIONS

The 3000T X-Series supports 15 different languages:

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

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

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



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

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

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

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

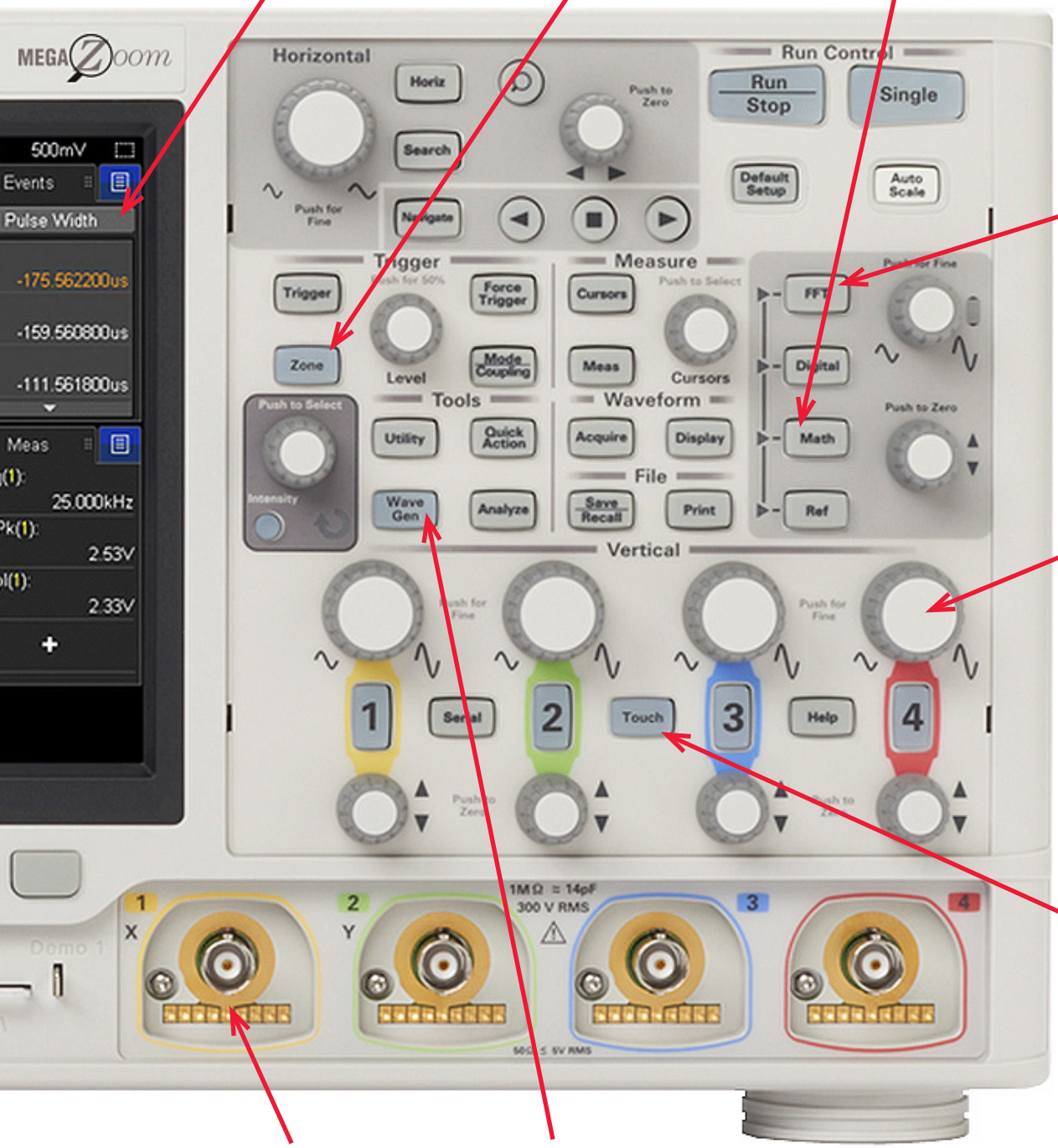
Both ***USB keyboard and mouse*** are supported in 3000T X-Series for additional ease of use.

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

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

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

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



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

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

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

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

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

Configuration

Step 1.

Choose your bandwidth and number of channels

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

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

Step 2.

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

Description	Model number
Oscilloscope features	
MSO upgrade	DSOXT3MSO*
Serial protocols	
Embedded serial triggering and analysis (I²C, SPI)	DSOX3EMBD (-LSS)
Computer serial triggering and analysis (RS232/UART)	DSOX3COMP (-232)
Sensor triggering and analysis (SENT)	DSOXT3SENSOR (-SEN)*
Automotive serial triggering and analysis (CAN/CAN-FD/CAN-dbc/LIN/LIN symbolic)	DSOXT3AUTO (-AMS)*
FlexRay serial triggering and analysis	DSOX3FLEX (-FLX)
Audio serial triggering and analysis (I²S)	DSOX3AUDIO (-SND)
MIL-STD 1553 and ARINC 429 serial triggering and analysis	DSOX3AERO (-AER)
Measurement applications	
WaveGen 20 MHz arbitary/function generator	DSOX3WAVEGEN (-001)
Integrated digital voltmeter and 8-digit counter	DSOXT3DVMCTR (-DVM)*
Power analysis application	DSOX3PWR (-PWR)
Mask limit testing	DSOX3MASK (-LMT)
Enhanced video/TV application package	DSOX3VID (-VID)
Productivity tools	
Education and training kit	DSOXEDK (-EDK)
Infiniium Offline oscilloscope analysis software	N8900A
BenchVue for data capture Free Download	34840B (version 2.6 and higher)
Vector signal analyzer software	89601B (version 20 and higher)
Benchlink waveform builder pro and basic	33503A
Application bundle	
	DSOXT3APPBNDL* (include DSOX3AERO, DSOX3AUDIO, DSOXT3AUTO, DSOX3COMP, DSOX3EMBD, DSOX3FLEX, DSOX3MASK, DSOX3PWR, DSOXT3SENSOR, DSOX3VID, DSOX3WAVEGEN, DSOXT3DVMCTR, DSOXEDK)

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

Configuratiion

Step 3.

Choose your probes

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

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

Step 4.

Add the final touches

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

Performance characteristics

DSO and MSO 3000 X-Series oscilloscopes

3000T X-Series specification overview											
		3012T	**3014T**	**3022T**	**3024T**	**3032T**	**3034T**	**3052T**	**3054T**	**3102T**	**3104T**
Bandwidth [1] (-3dB)		100 MHz		200 MHz		350 MHz		500 MHz		1 GHz	
Calculated rise time (10-90%)		≤ 3.5 ns		≤ 1.75 ns		≤ 1 ns		≤ 700 ps		≤ 450 ps	
Input channels	DSOX	2	4	2	4	2	4	2	4	2	4
	MSOX	2 + 16	4 + 16	2 + 16	4 + 16	2 + 16	4 + 16	2 + 16	4 + 16	2 + 16	4 + 16
Maximum sample rate		5 GSa/s half channels, 2.5 GSa/s all channels									
Maximum memory depth		Standard 4 Mpts, Standard segmented memory									
Display size and type		8.5-inch capacitive touch gesture-enabled display									
Waveform update rate		> 1,000,000 waveforms per second									

Vertical system analog channels	
Hardware bandwidth limits	Approximately 20 MHz (selectable)
Input coupling	AC, DC
Input impedance	Selectable: 1 MΩ ± 1% (14 pF), 50 Ω ± 1.5%
Input sensitivity range	100 MHz ~ 500 MHz models: 1 mV/div to 5 V/div[2] (1 MΩ and 50 Ω) 1 GHz models: 1 mV/div to 5 V/div[2] (1 MΩ), 1 mV/div to 1 V/div (50 Ω)
Vertical resolution	8 bits (measurement resolution is 12 bits with averaging)
Maximum input voltage	300 Vrms, 400 Vpk; transient overvoltage 1.6 kVpk With N2843A 10:1 probe: 300 Vrms Frequency de-rating (assumes sine wave input): 400 Vpk until 40 kHz. Then de-rates at 20 db/dec until 6 Vpk
DC vertical accuracy	±[DC vertical gain accuracy + DC vertical offset accuracy + 0.25% full scale][2]
DC vertical gain accuracy[1]	± 2.0% full scale[2]
DC vertical offset accuracy	± 0.1 div ± 2 mV ± 1% of offset setting
Channel-to-channel isolation	> 100:1 from DC to maximum specified bandwidth of each model (measured with same V/div and coupling on channels)
Offset range	± 2 V (1 mV/div to 200 mV/div) ± 50 V (> 200 mV/div to 5 V/div)

Vertical system digital channels	
Digital input channels	16 digital (D0 to D15. pod 1: D7 ~ D0, Pod 2: D15 ~ D8)
Thresholds	Threshold per pod
Threshold selections	TTL (+1.4 V), 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 CAT I; transient overvoltage 800 Vpk
Threshold accuracy[1]	± (100 mV + 3% of threshold setting)
Maximum input dynamic range	± 10 V about threshold
Minimum voltage swing	500 mVpp
Input impedance	100 kΩ ± 2% at probe tip
Input capacitance	~8 pF
Vertical resolution	1 bit

1. Denotes warranted specifications, all others are typical.
2. Specifications are valid after a 30-minute warm-up period and ± 10 °C from firmware calibration temperature. 1 mV/div and 2 mV/div are a magnification of 4 mV/div setting. For vertical accuracy calculations, use full scale of 32 mV for 1 mV div and 2 mV/div sensitivity setting.

Performance characteristics

3000T X-Series specification overview											
		3012T	3014T	3022T	3024T	3032T	3034T	3052T	3054T	3102T	3104A
Time base range		5 ns/div to 50 s/div		2 ns/div to 50 s/div				1 ns/div to 50 s/div		500 ps/div to 50 s/div	
Time base accuracy[1]		±1.6 ppm + aging factor (1st year: ±0.5 ppm, 2nd year: ±0.7 ppm, 5 years: ±1.5 ppm, 10 years: ±2.0 ppm)									
Time base delay time range	Pre-trigger	Greater of 1 screen width or 250 µs									
	Post-trigger	1 s to 500 s									
Channel-to-channel deskew range		± 100 ns									
Δ Time accuracy (using cursors)		± (time base acc. x reading) ± (0.0016 x screen width) ± 100 ps									
Modes		Main, zoom, roll, XY									
XY		On channels 1 and 2 only. Z Blanking on Ext Trigger Input, 1.4 V threshold. Bandwidth: Maximum bandwidth. Phase error at 1 MHz: < 0.5 degree.									
Horizontal System Digital Channels											
Minimum detectable pulse width		5 ns									
Channel-to-channel skew		2 ns (typical); 3 ns (maximum)									
Acquisition System											
Maximum analog channels sample rate		5 GSa/s half channel interleaved, 2.5 GSa/s all channel									
Maximum analog channels record length		4 Mpts half channel interleaved, 2 Mpts all channel									
Maximum digital channels sample rate		1.25 GSa/s all pods									
Maximum digital channels record length		2 Mpts (with digital channels only)									
Acquisition mode	Normal	Default mode									
	Peak detect	Capture glitches as narrow as 250 ps at all time base settings									
	Averaging	Selectable from 2, 4, 8, 16, 64, ... to 65,536									
	High resolution	Real time boxcar averaging reduces random noise and effectively increases vertical resolution 12 bits of resolution when ≥ 10 µs/div at 5 GSa/s or ≥ 20-µs/div at 2.5 GSa/s									
	Segmented	Segmented memory optimizes available memory for data streams that have long dead times between activity. Maximum segments = 1000. Re-arm time = 1 µs (minimum time between trigger events).									
Time mode	Normal	Default mode									
	Roll	Displays the waveform moving across the screen from right to left. Available at the time base 50 ms/div or slower									
	XY	Displays the volts-versus-volts display. Time base can be set from 200 ns/div to 50 ms/div.									

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

Performance characteristics

Trigger system	
Trigger sources	Analog channel (1~4), digital channel (D0~D15), line, external, WaveGen (1 or mod) (FM/FSK)
Trigger modes	Normal (triggered): requires trigger event for scope to trigger Auto: triggers automatically in absence of trigger event Single: triggers only once on a trigger event, press **[Single]** again for scope to find another trigger event, or press **[Run]** to trigger continuously in either Auto or Normal mode Force: front panel button that forces a trigger
Trigger coupling	DC: DC coupled trigger AC: AC coupled trigger, cutoff frequency: < 10 Hz (internal); <50 Hz (external) HF Reject: High frequency reject, cutoff frequency ~ 50 kHz LF Reject: Low frequency reject, cutoff frequency ~ 50 kHz Noise Reject: Selectable OFF or ON, decreases sensitivity 2x
Trigger holdoff range	40 ns to 10.00 s
Trigger sensitivity	
Internal[1]	< 10 mV/div: greater of 1 div or 5 mV; ≥ 10 mV/div: 0.6 div
External[1]	200 mVpp from DC to 100 MHz 350 mVpp 100 MHz to 200 MHz
Trigger level range	
Any channel	± 6 div from center screen
External	± 8 V
Trigger type selections	
Zone (HW zone qualifier)	Trigger on user-defined zones drawn on the display. Applies to one analog channel at a time. Specify zones as either "must intersect" or "must not intersect." Up to two zones. > 200,000 scans/sec update rate. Supported modes: normal, peak detect, high resolution Also works simultaneously with the serial trigger and mask/limit test.
Edge	Trigger on a rising, falling, alternating or either edge of any source
Edge then edge (B trigger)	Arm on a selected edge, wait a specified time, then trigger on a specified count of another selected edge
Pulse width	Trigger on a pulse on a selected channel, whose time duration is less than a value, greater than a value, or inside a time range Minimum duration setting: 2 ns (500 MHz, 1 GHz), 4 ns (350 MHz), 6 ns (200 MHz), 10 ns (100 MHz) Maximum duration setting: 10 s Range minimum: 10 ns
Runt	Trigger on a position runt pulse that fails to exceed a high level threshold. Trigger on a negative runt pulse that fails to exceed a low level threshold. Trigger on either polarity runt pulse based on two threshold settings. Runt triggering can also be time-qualified (< or >) with a minimum time setting of 2~10 ns and maximum timesetting of 10 s. Minimum time setting: 2 ns (500 MHz, 1 GHz), 4 ns (350 MHz), 6 ns (200 MHz). 10 ns (100 MHz)
Setup and hold	Trigger and clock/data setup and/or hold time violation. Setup time can be set from –7 s to 10 s. Hold time can be set from 0 s to 10 ns.
Rise/fall time	Trigger on rise-time or fall-time edge speed violations (< or >) based on user-selectable threshold. Select from (< or >) and time settings range between Minimum: 1 ns (500 MHz, 1 GHz), 2 ns (350 MHz), 3 ns (200 MHz), 5 ns (100 MHz) Maximum: 10 s

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

Performance characteristics

Trigger type selections	
N^{th} edge burst	Trigger on the Nth (1 to 65535) edge of a pulse burst. Specify idle time (10 ns to 10 s) for framing.
Pattern	Trigger when a specified pattern of high, low, and don't care levels on any combination of analog, digital, or trigger channels is [entered | exited]. Pattern must have stabilized for a minimum of 2 ns to qualify as a valid trigger condition. Minimum duration setting: 2 ns (500 MHz, 1 GHz), 4 ns (350 MHz), 6 ns (200 MHz), 10 ns (100 MHz) Maximum duration setting: 10 s Range minimum: 10 ns
Or	Trigger on any selected edge across multiple analog or digital channels
Video	Trigger on all lines or individual lines, odd/even or all fields from composite video, or broadcast standards (NTSC, PAL, SECAM, PAM-M)
Enhanced Video (optional)	Trigger on lines and fields of enhanced and HDTV standards (480p/60, 567p/50, 720p/50, 720p/60, 1080p/24, 1080p/25, 1080p/30, 1080p/50, 1080p/60, 1080i/50, 1080i/60).
USB	Trigger on start of packet, end of packet, reset complete, enter suspend, or exit suspend. Support USB low-speed and full-speed.
I^2C (optional)	Trigger at a start/stop condition or user defined frame with address and/or data values. Also trigger on missing acknowledge, address with no accq, restart, EEPROM read, and 10-bit write.
SPI (optional)	Trigger on SPI (Serial Peripherial Interface) data pattern during a specific framing period. Supports positive and negative Chip Select framing as well as clock Idle framing and user-specified number of bits per frame. Supports MOSI and MISO data.
RS-232/422/485/UART (optional)	Trigger on Rx or Tx start bit, stop bit or data content or parity error.
I^2S (optional)	Trigger on 2's complement data of audio left channel or right channel (=, ≠, <, >, > <, < >, increasing value, or decreasing value)
CAN (optional)	Trigger on CAN (controller area network) version 2.0A,2.0B, and CAN-FD (Flexible Data-rate) signals. Trigger on the start of frame (SOF), the end of frame (EOF), data frame ID, data frame ID and data (non-FD), data frame ID and data (FD), remote frame ID, remote or data frame ID, error frame, acknowledge error, from error, stuff error, CRC error, spec error (ack or form or stuff or CRC), all errors, BRS Bit (FD), CRC delimiter bit (FD), ESI bit active (FD), ESI bit passive (FD), overload frame., message, message and signal (non-FD), message and signal (FD, first 8 bytes only)
LIN (optional)	Trigger on LIN (Local Interconnect Network) sync break, sync frame ID, or frame ID and data, parity error, checksum error, frame (symbolic), frame and signal (symbolic)
FlexRay (optional)	Trigger on frame ID, frame type (sync, start-up, null, normal), cycle-repetitive, cycle-base, and errors.
MIL-STD 1553 (optional)	Trigger on MIL-STD 1553 signals based on word type (Data or Command/Status), Remote Terminal Address, data, and errors (parity, sync, Manchester encoding).
ARINC 429 (optional)	Trigger 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.
SENT (optiional)	Trigger and decode on SENT bus. start of fast channel message, start of slow channel message, fast channel SC & data, slow channel message ID, slow channel message ID &data, tolerance violation, fast channel CRC error, slow channel CRC error, all CRC errors, pulse period error, successive sync pulses error (1/64)

Performance characteristics

Waveform measurements		
Cursors[2]		Single cursor accuracy: ±[DC vertical gain accuracy + DC vertical offset accuracy + 0.25% full scale] Dual cursor accuracy: ±[DC vertical gain accuracy + 0.5% full scale][1] Units: Seconds(s), Hz (1/s), Phase (degrees), Ratio (%)
Automatic measurements		Measurements continuously updated with statistics. Cursors track last selected measurement. Select up to eight measurements from the list below: Snapshot All: measure all single waveform measurements (31) Voltage: peak-to-peak, maximum, minimum, amplitude, top, base, overshoot, pre-shoot, average- N cycles, average- full screen, DC RMS- N cycles, DC RMS- full screen, AC RMS- N cycles, AC RMS- full screen (std deviation), ratio- N cycle, ratio- full screen Time: period, frequency, counter, + width, - width, burst width, +duty cycle, -duty cycle, bit rate, rise time, fall time, delay, phase, X at min Y, X at max Y Count: positive pulse count, negative pulse count, rising edge count, falling edge count Mixed: area- N cycles, area- full screen
Counter (see pg 32 for 8-digit precision counter)		Built-in frequency counter: Source: on any analog or digital channel Resolution: 5 digits Maximum frequency: bandwidth of scope
Waveform math		
Number of math functions		Two, displays FFT and one math simultaneously. Can be cascaded.
Arithmetic		Add, subtract, multiply, divide, differentiate, integrate, FFT, Ax + B, squared, square root, absolute value, common logarithm, natural logarithm, exponential, base 10 exponential, low pass filter, high pass filter, averaged value, smoothing, envelope, magnify, max hold, min hold, measurement trend, chart logic bus (Timing or State)
Enhanced FFT	Record size	Up to 64 kpts resolution
	Window types	Hanning, Flat Top, Rectangular, Blackman-Harris
	Time gated FFT	Gate the time range of data for FFT analysis in the zoom view. For time and frequency domain correlated analysis.
	Waveforms	FFT, max hold, min hold, average
	Peak search	Max 11 peaks, threshold and excursion control.
Search, navigate, and lister		
Type		Edge, pulse width, rise/fall, runt, frequency peak, serial bus 1, serial bus 2
Copy		Copy to trigger, copy from trigger
Frequency peak	Source	Math functions
	Max # of peaks	11
	Control	Results order in frequency or amplitude
Result display		Event lister or navigation. Manual or auto scroll via navigation or touch event lister entry to jump to a specific event.
Display characteristics		
Display		8.5-inch capacitive touch / gesture enabled display
Resolution		800 (H) x 480 (V) pixel format (screen area)
Graticules		8 vertical divisions by 10 horizontal divisions with intensity controls.
Format		YT, XY, and Roll
Maximum waveform update rate		> 1,000,000 wfms/s
Persistence		Off, infinite, variable persistence (100 ms - 60 s)
Intensity gradation		64 intensity levels

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

Performance characteristics

WaveGen – Built-in function/arbitrary waveform generator (specifications are typical)	
WaveGen out	Front-panel BNC connector
Waveforms	Sine, Square, Ramp, Pulse, DC, Noise, Sine Cardinal (Sinc), Exponential Rise, Exponential Fall, Cardiac, Gaussian Pulse, and Arbitrary.
Modulation	Modulation types: AM, FM, FSK Carrier waveforms: sine, ramp, sine cardinal, exponential rise, exponential fall, and cardiac. Modulation source: internal (no external modulation capability) AM: Modulation: sine, square, ramp Modulation frequency: 1 Hz to 20 kHz Depth: 0% to 100% FM: Modulation: sine, square, ramp Modulation frequency: 1 Hz to 20 kHz Minimum carrier frequency: 10 Hz Deviation: 1 Hz to carrier frequency or (2e12 / carrier frequency), whichever is smaller FSK: Modulation: 50% duty cycle square wave FSK rate: 1 Hz to 20 kHz Hop frequency: 2 x FSK rate to 10 MHz
Sine	Frequency range: 0.1 Hz to 20 MHz Amplitude flatness: ±0.5 dB (relative to 1 kHz) Harmonic distortion: –40 dBc Spurious (non harmonics): –40 dBc Total harmonic distortion: 1% SNR (50 Ω load, 500 MHz BW) : 40 dB (Vpp > = 0.1 V); 30 dB (Vpp < 0.1V)
Square wave /pulse	Frequency range: 0.1 Hz to 10 MHz Duty cycle: 20 to 80% Duty cycle resolution: Larger of 1% or 10 ns Pulse width: 20 ns minimum Rise/fall time: 18 ns (10 to 90%) Pulse width resolution: 10 ns or 5 digits, whichever is larger Overshoot: < 2% Asymmetry (at 50% DC): ±1% ± 5 ns Jitter (TIE RMS): 500 ps
Ramp/triangle wave	Frequency range: 0.1 Hz to 200 kHz Linearity: 1% Variable symmetry: 0 to 100% Symmetry resolution: 1%
Noise	Bandwidth: 20 MHz typical
Sine Cardinal (Sinc)	Frequency range: 0.1 Hz to 1.0 MHz
Exponential Rise/Fall	Frequency range: 0.1 Hz to 5.0 MHz
Cardiac	Frequency range: 0.1 Hz to 200.0 kHz
Gaussian Pulse	Frequency range: 0.1 Hz to 5.0 MHz
Arbitrary	Waveform length: 1 to 8k points Amplitude Resolution: 10 bits (including sign bit)[1] Repetition Rate: 0.1Hz to 12 MHz Sample Rate: 100 MSa/s Filter Bandwidth: 20 MHz

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

Performance characteristics

WaveGen – Built-in function/arbitrary waveform generator (specifications are typical) ***(continued)***	
Frequency	Sine wave and ramp accuracy: 130 ppm (frequency < 10 kHz) 50 ppm (frequency > 10 kHz) Square wave and pulse accuracy: [50+frequency/200] ppm (frequency < 25 kHz) 50 ppm (frequency ≥ 25 kHz) Resolution: 0.1 Hz or 4 digits, whichever is larger
Amplitude	Range: 20 mVpp to 5 Vpp into Hi-Z[1] 10 mVpp to 2.5 Vpp into 50 Ω[1] Resolution: 100 µV or 3 digits, whichever is higher Accuracy: 2% (frequency = 1 kHz)
DC offset	Range: ±2.5 V into Hi-Z[1] ±1.25 V into 50 Ω [1] Resolution: 100 µV or 3 digits, whichever is higher Accuracy (waveform modes): ± 1.5% of offset setting ± 1% of amplitude ± 1 mV Accuracy (DC mode): ± 1.5% of offset setting ± 3 mV
Trigger output	Trigger output available on Trig out BNC
Main Output	Impedance : 50 Ω typical Isolation: not available, main output BNC is grounded Protection: overload automatically disables output
Output mode	Normal Single-shot (arbitrary, sine, ramp, sine cardinal, exp rise/fall, cardiac, Gaussian pulse)

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

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

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

Performance characteristics

Connectivity	
Standard ports	One USB 2.0 hi-speed device port on rear panel. Supports USBTMC protocol. Two USB 2.0 hi-speed host ports, front and rear panel Supports memory devices, printers and keyboards
Optional ports	GPIB, LAN (10/100Base-T), WVGA video out
Trigger out	BNC connector on the rear panel. Supported modes: triggers, mask, and waveform generator sync pulse
General and environmental characteristics	
Power line consumption	Max 100 watts
Power voltage range	100-120V, 50/60/400 Hz; 100-240V, 50/60 Hz ± 10% auto ranging
Temperature	Operating: 0 to +55 °C Nonoperating: –30 to +71 °C
Humidity	Operating: Up to 80% RH at or below +40 °C; up to 45% RH up to +50 °C Non-operating: Up to 95% RH up to 40 °C; up to 45% RH up to 50 °C
Altitude	Operating: up to 4,000 m, Non-operating 15,300 m
Electromagnetic compatibility	Meets EMC Directive (2004/108/EC), meets or exceeds IEC 61326-1:2005/EN 61326-1:2006 Group 1 Class A requirement CISPR 11/EN 55011 IEC 61000-4-2/EN 61000-4-2 IEC 61000-4-3/EN 61000-4-3 IEC 61000-4-4/EN 61000-4-4 IEC 61000-4-5/EN 61000-4-5 IEC 61000-4-6/EN 61000-4-6 IEC 61000-4-11/EN 61000-4-11 Canada: ICES-001:2004 Australia/New Zealand: AS/NZS
Safety	UL61010-1 2nd edition, CAN/CSA22.2 No. 61010-1-04
Vibration	Meets IEC60068-2-6 and MIL-PRF-28800; class 3 random
Shock	Meets IEC 60068-2-27 and MIL-PRF-28800; class 3 random; (operating 30 g, ½ sine. 11 ms duration, 3 shocks/axis along major axis, total of 18 shocks
Dimensions	381 mm (15 in) W x 204 mm (8 in) H x 142 mm (5.6 in) D
Weight	Net: 4.0 kg (9.0 lbs), shipping: 4.2 kg (9.2 lbs)

Performance characteristics

Nonvolatile storage		
Reference waveform display		Two internal waveforms or USB thumb drive. Displays 1 reference waveform at a time.
Data/file save	Setup / image	Setup (*.scp), 8 or 24-bit Bitmap image (*.bmp), PNG 24-bit image (*.png),
	Waveform data	CSV data (*.csv), ASCII XY data (*.csv), Binary data (*.bin), Lister data (*.csv), Reference waveform data (*.h5), multi-channel waveform data (*.h5), Arbitrary Waveform data (*.csv)
	Application data	Mask (*.msk), Power harmonics data (*.csv), USB signal quality (*.html & *.bmp)
	Analysis results (*.csv)	Cursor data, measurement results, mask test statistics, search, segmented timestamps
Max USB flash drive size		Supports industry standard flash drives
Set ups without USB flash drive		10 internal setups
Set ups with USB flash drive		Limited by size of USB drive

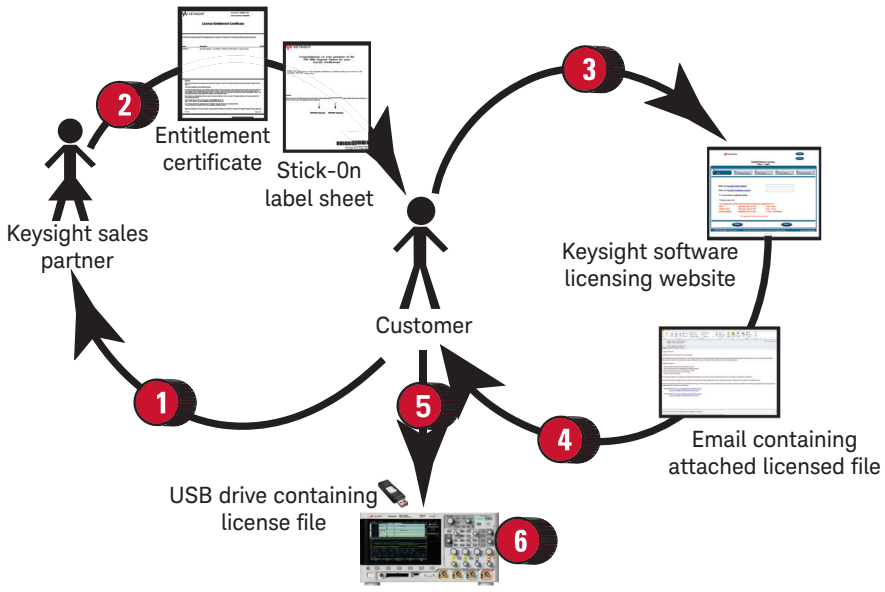
Included standard with oscilloscope	
Factory warranty	3-year warranty (90 days for unserialized accessories such as passive probes)
Calibration	Certificate of calibration, 3-year calibration interval
Mean time before failure (MTBF)	>250,000 hours
Standard secure erase	
Probes	
N2843A Passive probe 500 MHz 10:1 attenuation	1 per channel
N2756A 16 digital channel MSO cable	1 per scope included on all MSO models and DSOXT3MSO
Interface and built-in help language support English, Chinese (simplified), Chinese (traditional), Czech, French, German, Italian, Japanese, Korean, Portuguese, Russian, Spanish, Polish, Thai, Turkish	
Documentation	CD containing localized user's guide, service guide, and programmer's manual
Localized power cord and overlay	

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

Related literature

Publication title	**Publication type**	**Publication number**
Serial Bus Applications for Keysight InfiniiVision 3000 X-Series Oscilloscopes	Data sheet	5990-6677EN
Power Measurements for Keysight InfiniiVision 3000 X-Series oscilloscope	Data sheet	5990-8869EN
Mask/Waveform Limit Testing For Keysight InfiniiVision Series Oscilloscopes	Data sheet	5990-3269EN
Using an Oscilloscope Time Gated Fast Fourier Transforms for Time Correlated Mixed Domain Analysis	Application note	5992-0244EN
Keysight InfiniiVision 3000T X-Series versus Danaher-Tektronix MDO3000 Series Oscilloscopes	Competitive comparison	5992-0116EN
Keysight InfiniiVision 3000T X-Series Oscilloscopes Product Fact Sheet	Product fact sheet	5992-0150EN
Triggering on Infrequent Anomalies and Complex Signals using Zone triggering	Application note	5991-1107EN

License-only bandwidth upgrades and measurement applications

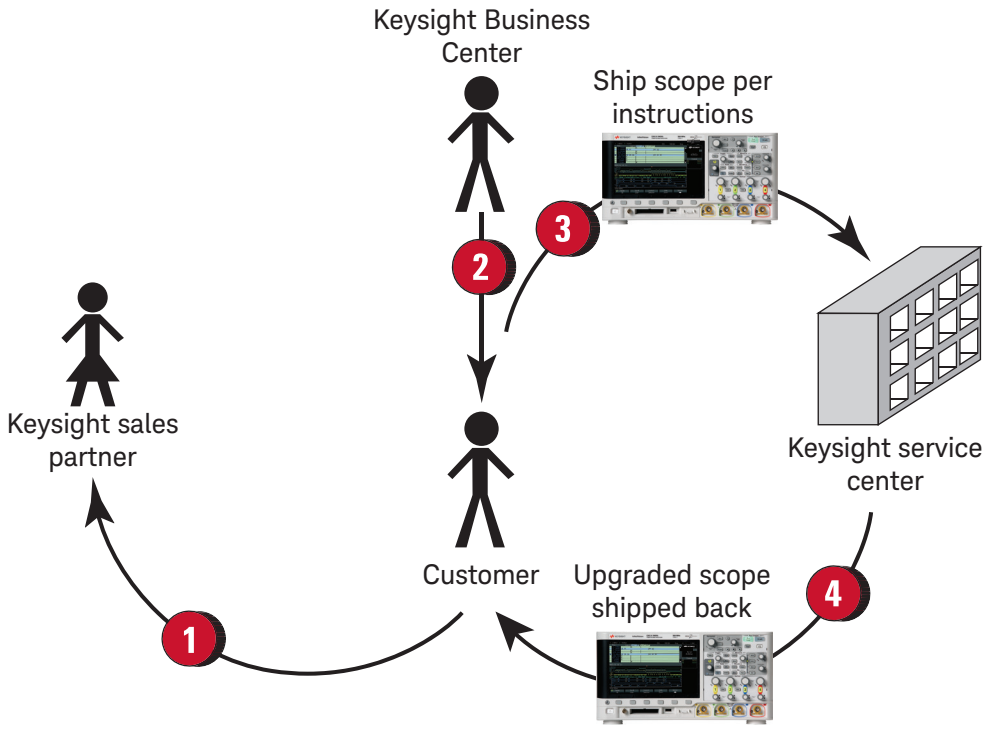


License Only Bandwidth Upgrade Models	
3000T X-Series	
DSOXT3B1T22	License only 100MHz to 200MHz upgrade, 2ch
DSOXT3B1T24	License only 100MHz to 200MHz upgrade, 4ch
DSOXT3B3T52	License only 350MHz to 500MHz upgrade, 2ch
DSOXT3B3T54	License only 350MHz to 500MHz upgrade, 4ch
Measurement Applications	
DSOX3AERO	MIL-STD 1553 & ARINC 429 serial triggering & analysis
DSOX3AUDIO	Audio serial triggering and analysis (I^2S)
DSOXT3AUTO	Automotive serial triggering and analysis (CAN/CAN-FD/LIN)
DSOX3COMP	Computer serial triggering and analysis (RS232/UART)
DSOX3EMBD	Embedded serial triggering and analysis (I^2C, SPI)
DSOX3FLEX	FlexRay serial triggering and analysis
DSOX3MASK	Mask Limit Testing
DSOXT3MSO	MSO upgrade: add 16 digital timing channels (N2756A MSO cable delivered separately)
DSOX3PWR	Power analysis application
DSOXT3SENSOR	Single Edge Nibble Transmission (SENT) trigger and decode
DSOX3VID	Enhanced video/TV application package
DSOX3WAVEGEN	WaveGen 20 MHz AWG
DSOXT3DVMCTR	Integrated digital voltmeter / 8 digit counter
DSOXEDK	Education and training kit
DSOXT3APPBNDL	SW application bundle license for 3000T X-Series

1. Place order for a license only bandwidth upgrade or measurement application product to a Keysight sales partner. If multiple bandwidth upgrade steps are needed, order all the corresponding upgrade products required to get from current bandwidth to desired bandwidth.
2. For measurement applications, you will receive a paper or electronic .pdf Entitlement Certificate. For bandwidth upgrades only, you will receive a stick-on label document indicating upgraded bandwidth specification in addition to a paper Entitlement Certificate.
3. Use Entitlement Certificate containing instructions and certificate number needed to generate a license file for a particular 3000T X-Series oscilloscope model number and serial number unit.
4. Receive the licensed file and installation instructions via email.
5. Copy license file (.lic extension) from email to a USB drive and follow instructions in email to install the purchased bandwidth upgrade or measurement application on the oscilloscope.
6. For bandwidth upgrades only, attach bandwidth upgraded stick-on label to front and rear panels of the oscilloscope. Model number and serial number of the oscilloscope do not change.

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

Return-to-Keysight Service Center Bandwidth Upgrades



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

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

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