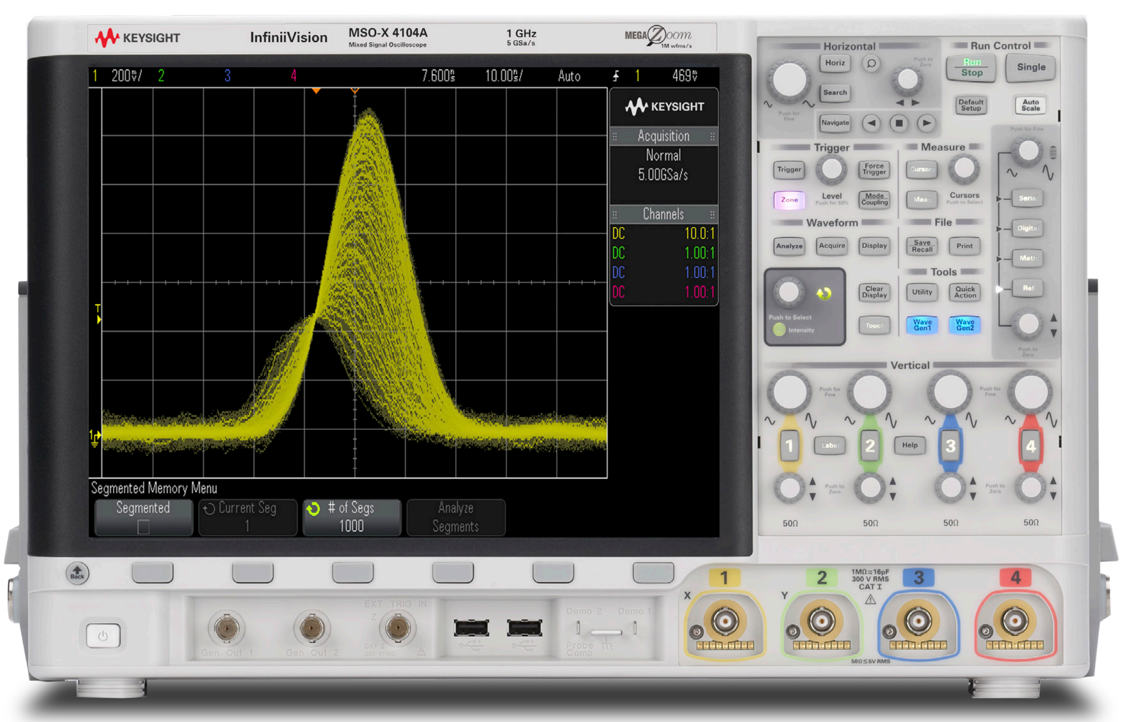
Keysight Technologies
Segmented Memory Acquisition for InfiniiVision Series Oscilloscopes

Data Sheet



KEYSIGHT
TECHNOLOGIES

Unlocking Measurement Insights

Introduction

Capture more signal detail with less memory using segmented memory acquisition

Features:
- Optimized acquisition memory
- Capture up to 2,000 successive waveform segments
- Fast re-arm time
- Down to 10 ps time-tag resolution
- Segments include all analog and digital channels of acquisition
- Segments include serial bus decoding

If the signals that you need to capture have relatively long idle times between low-duty-cycle pulses or bursts of signal activity, then the segmented memory option for Keysight Technologies, Inc. InfiniiVision Series oscilloscopes can optimize your scope's acquisition memory, allowing you to capture more selective signal details with less memory. With segmented memory, the scope's acquisition memory is divided into multiple smaller memory segments. This enables your scope to capture up to 2,000 successive single-shot waveforms with a very fast re-arm time–without missing any important signal information.

After a segmented memory acquisition is performed, you can easily view all captured waveforms overlaid in an infinite-persistence display and quickly scroll through each individual waveform segment. And with a minimum 10 ps time-tagging resolution, you will know the precise time between each captured waveform segment. Common applications for this type of oscilloscope acquisition include high-energy physics measurements, laser pulse measurements, radar burst measurements, and packetized serial bus measurements.

Even in applications that don't actually require segmented memory acquisition to optimize memory, using segmented memory acquisition on Keysight's InfiniiVision oscilloscopes can enhance post-analysis navigation through low-duty-cycle signals, burst signals, and serially packetized signals. And the Keysight InfiniiVision Series oscilloscopes are the only scopes in the industry that not only provide segmented memory acquisitions simultaneously on all analog channels (up to four analog channels) and logic channels (up to 16 digital channels) of acquisition, but they also are the only scopes that provide hardware-based serial decoding on packetized serial data for each captured waveform segment.

High-Energy Physics and Laser Pulse Applications

Segmented memory acquisition in an oscilloscope is commonly used for capturing electrical pulses generated by high-energy physics (HEP) experiments, such as capturing and analyzing laser pulses. With segmented memory acquisition, the scope is able to capture every consecutive laser pulse (up to a maximum of 2,000 pulses), even if the pulses are widely separated.

Figure 1 shows the capture of 300 successive laser pulses with a pulse separation time of approximately 12 µs and an approximate pulse width of 3.3 ns. All 300 captured pulses are displayed in the infinite-persistence gray color, while the current selected segment is shown in the channel's assigned color (yellow for channel 1). Note that the 300th captured pulse occurred exactly 3.62352380 ms after the first captured pulse, as indicated by the segment time-tag shown in the lower left-hand region of the scope's display. With the scope sampling at 4 GSa/s, capturing this amount of time would require more than 14 Megapoints of conventional acquisition memory. If these laser pulses were separated by 12 ms, the amount of conventional acquisition memory to capture nearly 4 seconds of continuous acquisition time would be more than 14 Gigapoints. Unfortunately, there are no oscilloscopes on the market today that have this much acquisition memory. But since segmented memory only captures a small and selective segment of time around each pulse while shutting down the scope's digitizers during signal idle time, the Keysight InfiniiVision scopes can easily capture this much information using just 8 Megapoints of memory (7000 Series).

A similar high-energy physics application involves the measurement of energy and pulse shapes of signals generated from subatomic particles flying around an accelerator ring (particle physics). Assuming that sub-atomic particles have been slung around a 3-km accelerator ring at a speed approaching the speed of light (299,792,458 meters/s), electrical pulses generated at a single detector at one location along the 3 km ring would occur approximately every 10 µs. With segmented memory, you can easily capture, compare and analyze successive pulses generated by the subatomic particles with precise time-tagging.

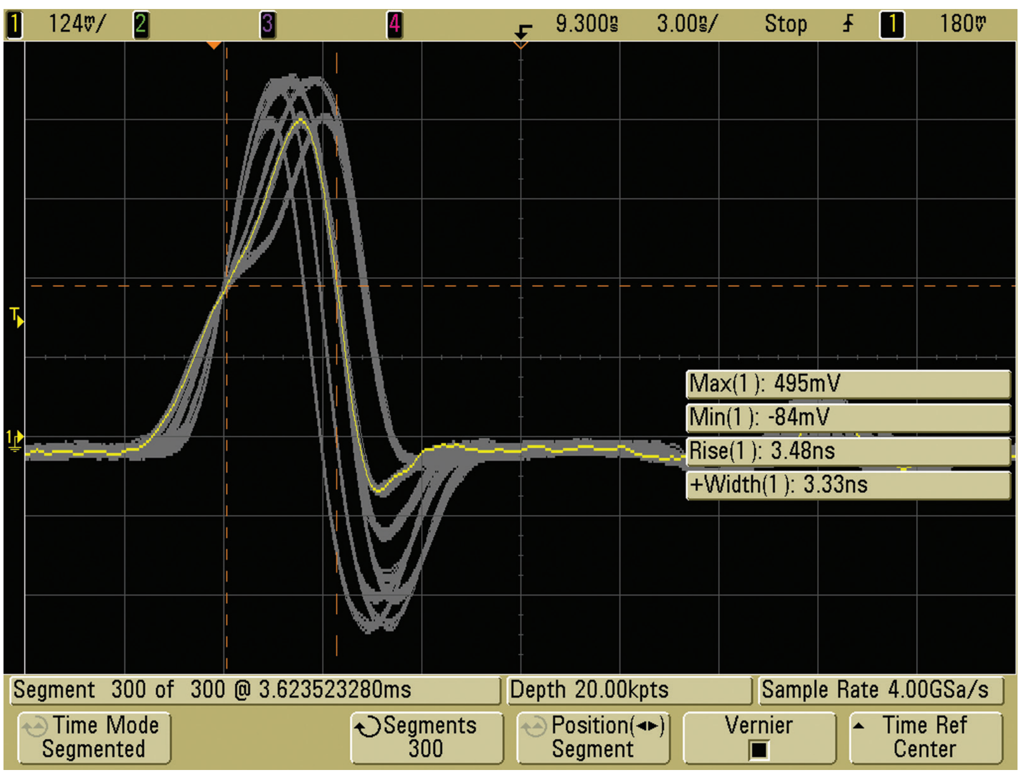


Figure 1. Segmented memory acquisition captures 300 consecutive laser pulses for analysis.

Radar and Sonar Burst Applications

Engineers often require segmented memory acquisition mode in an oscilloscope when they measure radar and/or sonar bursts. Figure 2 shows an example where we captured 725 consecutive 50-MHz RF burst signals using a Keysight InfiniiVision scope's segmented memory acquisition mode. Engineers often need to compare sent and received signals and compare signal degradation from echo signals. These types of RF burst applications also require precise time-tagging in order to accurately compute distances. Distance and time between bursts can often be very long, for example, when you are analyzing satellite communications. If a satellite is located 100 miles in space away from an Earth transmitter/receiver station, a radar echo time (more than 200 miles round trip) would be approximately 1.07 ms. Using the 50-MHz RF burst shown in Figure 2, you could easily capture 725 consecutive bursts separated by 1.07 ms using segmented memory. Capturing this much time (775 ms) using conventional oscilloscope acquisition at 1 GSa/s would require nearly 1 Gigapoints of acquisition memory. But with the segmented memory option in the Keysight InfiniiVision Series, this scopecan easily capture this amount of signal data.

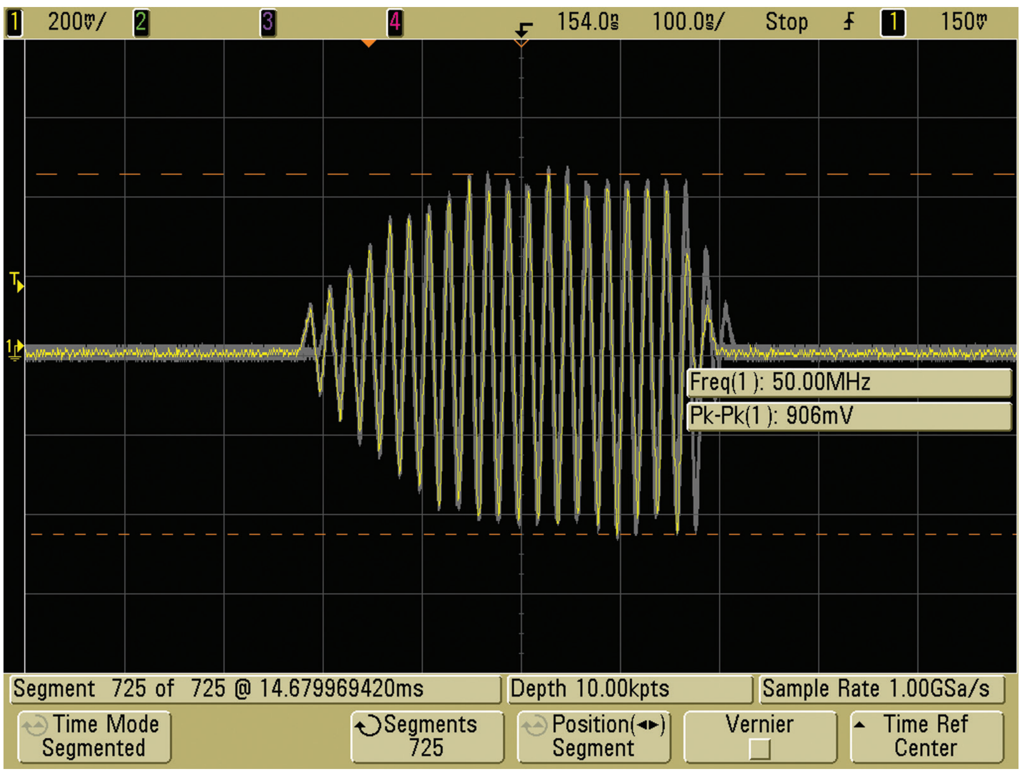


Figure 2. Capturing consecutive RF bursts with precise time-tagging using segmented memory.

Mixed-Signal and Serial Bus Applications

Serial bus measurements are another application area where segmented memory acquisition is useful. You can optimize the number of packetized serial communication frames that can be captured consecutively by selectively ignoring (not digitizing) unimportant idle time between frames. As mentioned earlier, the Keysight InfiniiVision Series oscilloscopes are the only scopes on the market today that not only can acquire segments of up to four analog channels of acquisition, but also can capture time-correlated segments on digital channels of acquisition (using an MSO model), along with hardware-based serial bus protocol decoding. The segmented memory option on the Keysight InfiniiVision Series oscilloscopes is compatible with all of the following serial bus triggering and decoding options:

- I²C/SPI
- RS-232/UART
- USB
- CAN/LIN
- I²S
- MIL-STD 1553/ARINC 429
- FlexRay

To illustrate how segmented memory acquisition can enhance serial bus measurements, we will examine a mixed-signal automotive CAN bus measurement application. Figure 3 shows a CAN bus measurement with the scope set up to trigger on every start-of-frame (SOF) condition. Using this triggering condition with the segmented memory acquisition mode turned on, the scope easily captures 1,000 consecutive CAN frames for a total acquisition time of 2.4 seconds. After acquiring the 1000 segments/CAN frames, we can easily scroll through all frames individually to look for any anomalies or errors. In addition, we can easily make latency timing measurements between frames using the segmented memory's time-tagging.

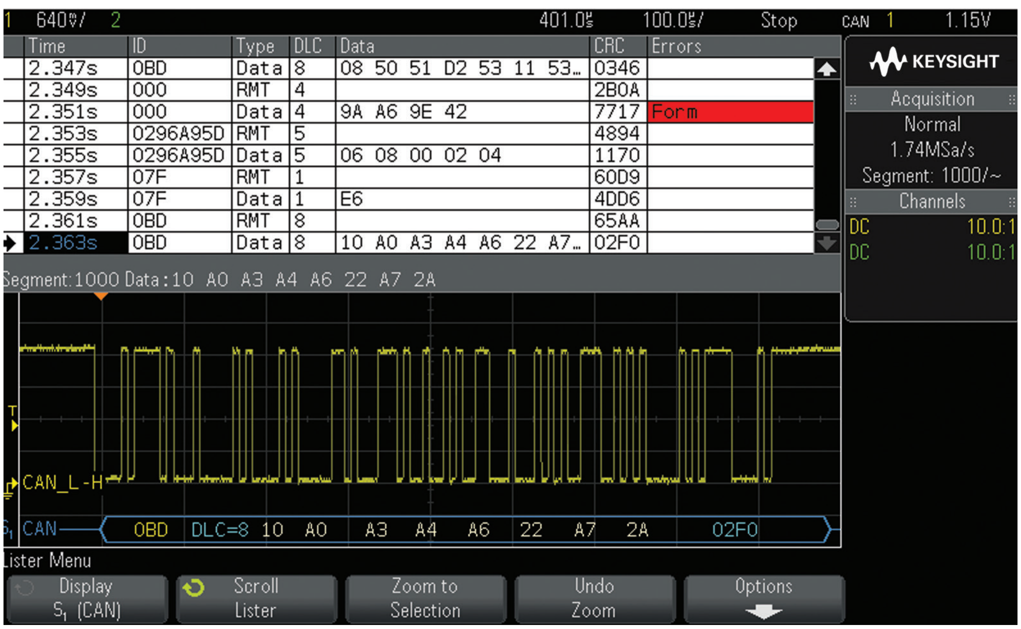


Figure 3. Capturing 1,000 consecutive decoded CAN frames using segmented memory.

Mixed-Signal and Serial Bus Applications

Figures 4a and 4b show examples of capturing 1,000 consecutive remote and data frames with the ID code of $07F_{HEX}$. This was accomplished by setting the trigger condition to trigger on either remote or data frames with this specific frame ID. Now we can easily measure the timing latency between each remote transfer request frame with a frame ID of $07F_{HEX}$ and its associated data frame response with the same frame ID. In this measurement example, the latency between segment 4 (remote frame) and segment 5 (data frame) was 4.821 ms. Also note that although not shown, the time-tag on the last captured segment (segment 1,000) was approximately 9.5 seconds. Capturing this much time using conventional oscilloscope acquisition memory at this sample rate would require 16 Megapoints of memory.

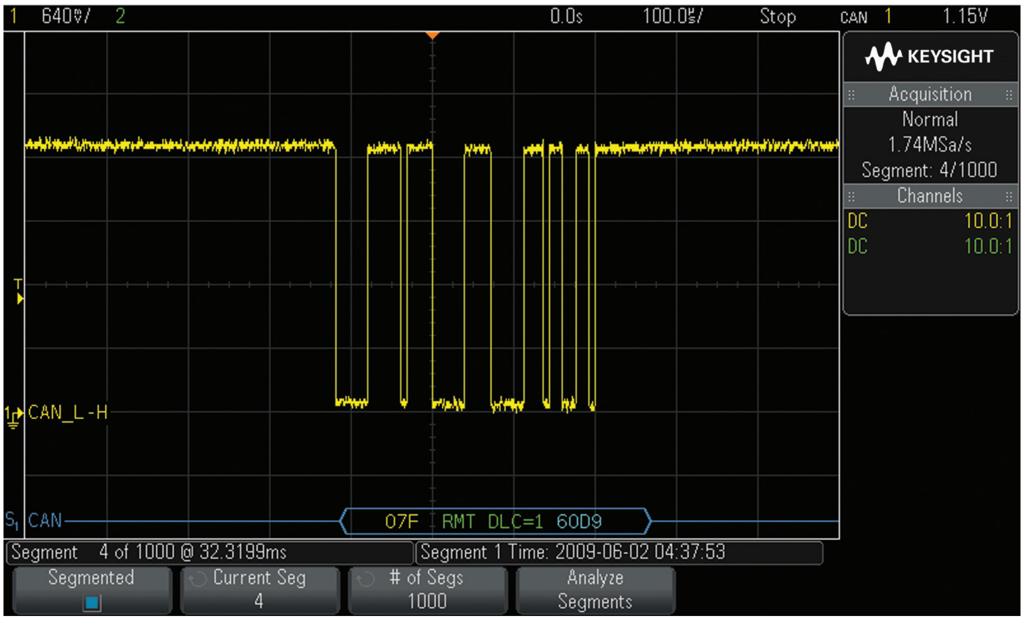


Figure 4a. Remote frame $07F_{HEX}$ captured as segment 4 has a time-tag of 32.3199 ms.

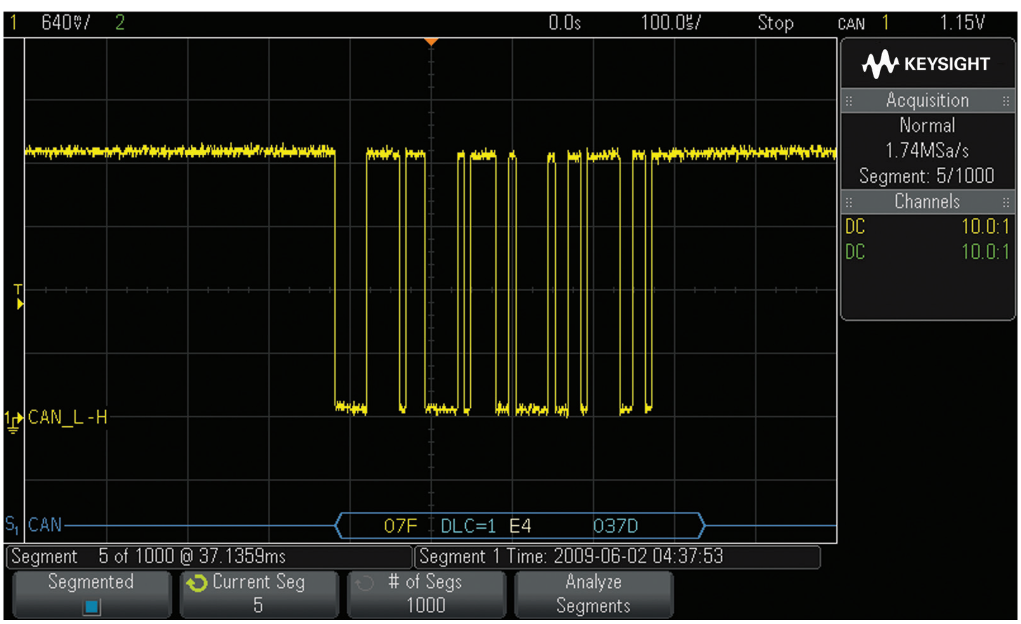


Figure 4b. Data frame $07F_{HEX}$ captured as segment 5 is time-tagged at 37.1359 ms indicating a latency of 4.816 ms.

Mixed-Signal and Serial Bus Applications (Continued)

While scrolling through the various segments/frames, we could see that errors were occurring randomly. So the next step in this CAN measurement application was to capture and store only frames that contain errors. To do this, we set up the scope's triggering to trigger specifically on any occurrence of any "form error" or "flagged error frame" regardless of its ID code. Figure 5 shows how the segmented memory acquisition mode captured 500 consecutive error frames with a total capture time (time-tag of the segment 500) of more than 50 seconds. Capturing this many frames at this sample rate using conventional oscilloscope memory would require more than 100 MB of acquisition memory. But with the segmented memory option, our InfiniiVision 3000 X-Series oscilloscope was able to capture more than 50 seconds of selective signal detail using its 4 Megapoints of memory.

Once we have captured consecutive CAN error frames, we can easily dial through all of the individual frames to discover why these errors might be occurring.

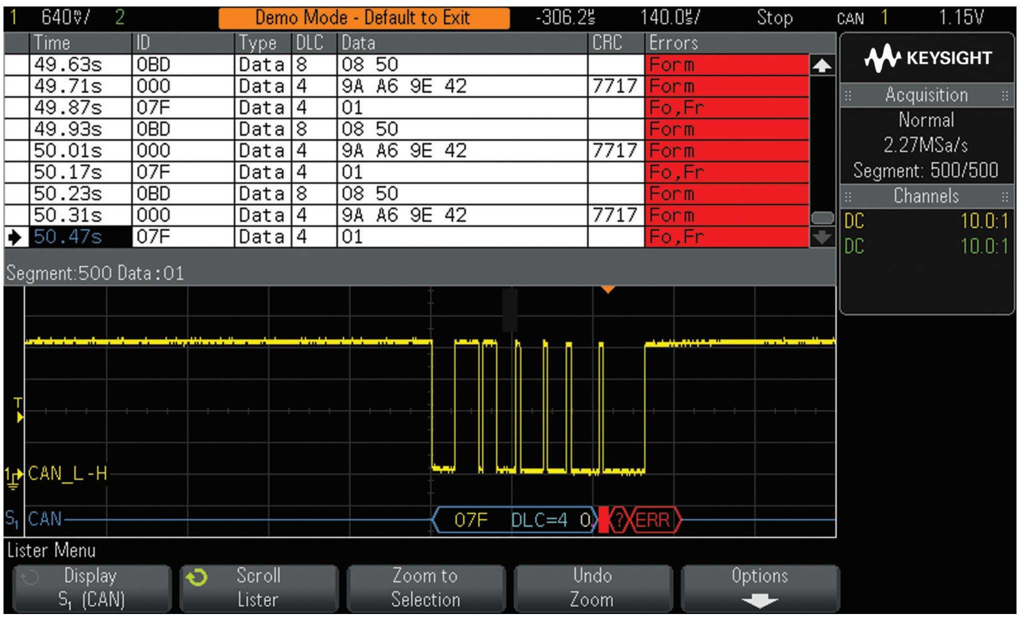


Figure 5. Segmented memory captures 500 consecutive CAN frames over a 50-second time span.

Performance Characteristics

Segment source	Analog channels 1 and 2 (on two-channel DSO models)
	+ Analog channels 3 and 4 (on four-channels DSO models)
	+ Digital channels D0 to D15 (on MSO models)
	+ Serial decode (on models with serial decode options)
Number of segments	1 to 2000 (5000, 6000, and 7000 Series)
	1 to 1000 (3000, 4000, and 6000 X-Series)
	1 to 250 (2000 X-Series)
Minimum segment size	500 points (+ Sin(x)/x reconstructed points on faster timebase settings)
Re-arm time (minimum time between trigger events)	5000, 6000, 7000: 6 µs
	6000 and 3000T X-Series: 7.5 µs
	3000 and 4000 X-Series: 1 µs
	2000 X-Series: 20 µs
Time-tag resolution	10 ps or 6 digits (whichever is greater)

Ordering Information

The segmented memory option is compatible with all Keysight InfiniiVision Series oscilloscopes. This option is available as a factory-installed option if ordered as Option SGM along with a specific oscilloscope model, or existing InfiniiVision Series oscilloscope users can order this option as an after-purchase product upgrade.

Model number–user installed	Option number–factory installed	Description
N5454A	SGM	Segmented memory for 5000, 6000, and 7000 Series oscilloscopes
DSOX2SGM	SGM	Segmented memory for 2000 X-Series oscilloscopes
DSOX3SGM	SGM	Segmented memory for 3000 X-Series oscilloscopes
Standard	N/A	Segmented memory for 3000T, 4000 and 6000 X-Series oscilloscopes

Related Keysight Literature

Publication title	Publication number
InfiniiVision 2000 X-Series Oscilloscopes - Data Sheet	5990-6618EN
InfiniiVision 3000T X-Series Oscilloscopes - Data Sheet	5992-0140EN
InfiniiVision 4000 X-Series Oscilloscopes - Data Sheet	5991-1103EN
InfiniiVision 6000 X-Series Oscilloscopes - Data Sheet	5991-4087EN
InfiniiVision 7000B Series Oscilloscopes - Data Sheet	5990-4769EN
Oscilloscope Waveform Update Rate Determines Ability to Capture Elusive Events - Application Note	5989-7885EN
Evaluating Oscilloscopes to Debug Mixed-Signal Designs - Application Note	5989-3702EN
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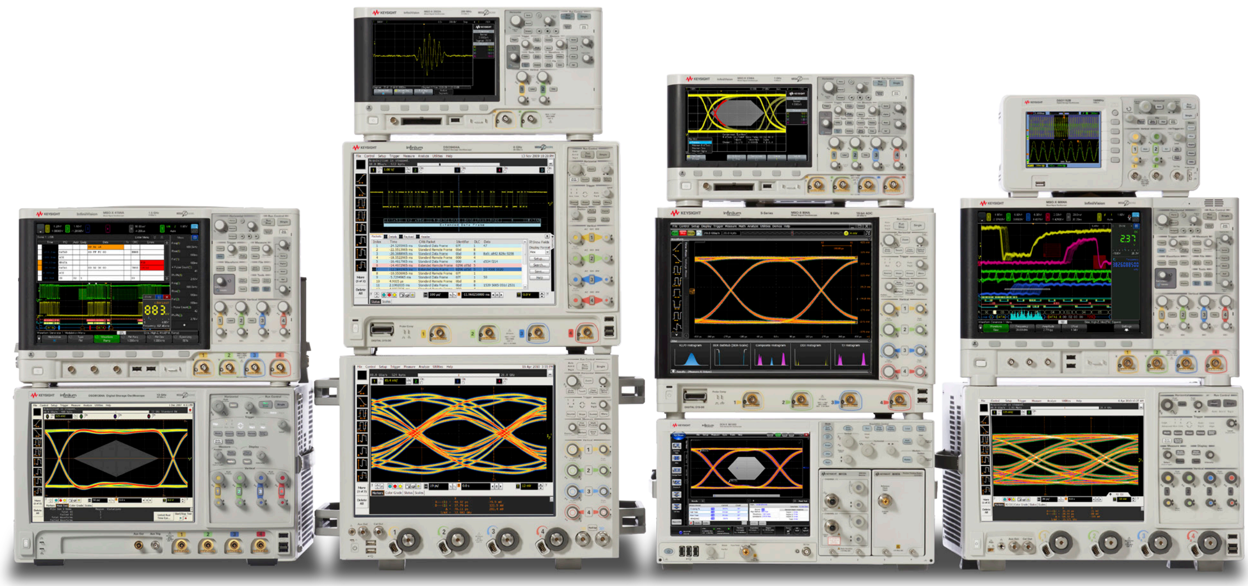
Evaluating Oscilloscope Vertical Noise Characteristics - Application Note	5989-3020EN
Using Oscilloscope Segmented Memory for Serial Bus Applications - Application Note	5990-5817EN



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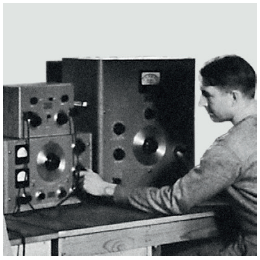 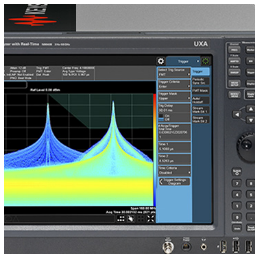 

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