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UltraVision III

UltraVision III Oscilloscope Waveform Visualization Modes

A look at modern visualization tools available for signal analysis in the UltraVision II and UltraVision III Oscilloscopes from RIGOL

Introduction

Modern digital oscilloscopes provide a number of visualization and analysis tools to ensure that engineers can make the most of the memory and debugging capabilities built inside these advanced instruments. RIGOL's newest DHOs, digital high-resolution oscilloscopes, enhance and extend these methods as our best visualization scope to date. These oscilloscopes start with a 10.1" HD display. With 12-bit resolution and ultra-low noise floor they also provide excellent signal fidelity. But an equally important innovation is the ability to visualize critical signals for debugging and analysis. RIGOL's UltraVision III high resolution oscilloscopes provide the broadest set of visualization modes of any of our oscilloscopes. Let's look at how these modes function and differ and how they improve upon the previous generation.

Continuous Capture

First, the simplest method for waveform visualization is to utilize the deep memory in a continuous capture. This makes it possible to analyze gapless data over relatively long time periods. This chart shows the max continuous time capture with 1 channel at maximum sampling with standard and optional memory (**figure 1**).

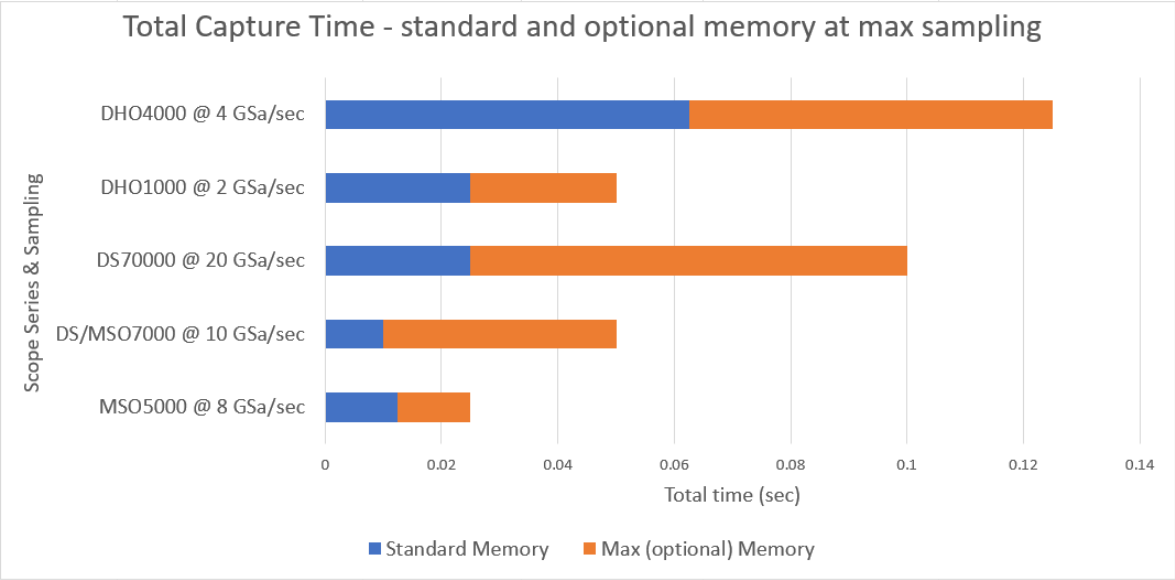

Figure 1: Memory Configurations

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Figure 2: Zoom View

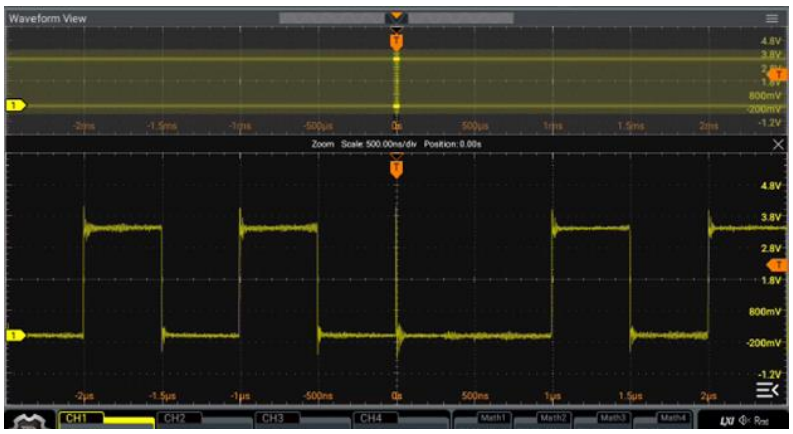

Figure 3: 1 million X zoom

Figure 4: Search Event Table View

The DHO4000 Series can capture up to 1/8th of a second at full sample rate with no gaps. For all these scopes, the time can be extended by reducing the sample rate. This is typically done by extending the horizontal time base on the Oscilloscope.

There are several common analysis tools that can use continuous capture data like this. Zoom is the most basic of these tools (see **figure 2**).

Utilizing the deep memory of up to 500 MPts, engineers can zoom in more than 1 million times as shown here from a 5 ms/div capture to a 5 ns/div zoom window. Zoom can show signal features with context of the surrounding signals as shown in **figure 3**.

Search makes it possible to identify multiple Edge or Pulse events within a single capture. By moving between the events, we can see how they are correlated in time in **figure 4**. This makes it easier to find causation for complex events. Within one continuous data capture, search identifies all of the points in time that meet the edge or pulse parameters. The UltraVision II Oscilloscopes actually have more search capabilities including searching and marking events using Edge, Pulse, Runt, Slope, RS232, I2C, or SPI parameters. The best use case is to then enable zoom mode and the event table. In this view, users can highlight the event in the table and the zoom window will jump to that event in the list.

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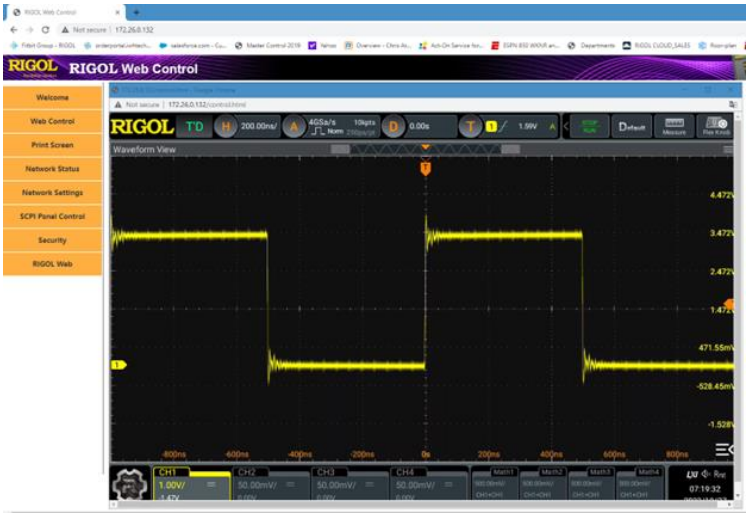

Figure 5: Remote Web Control

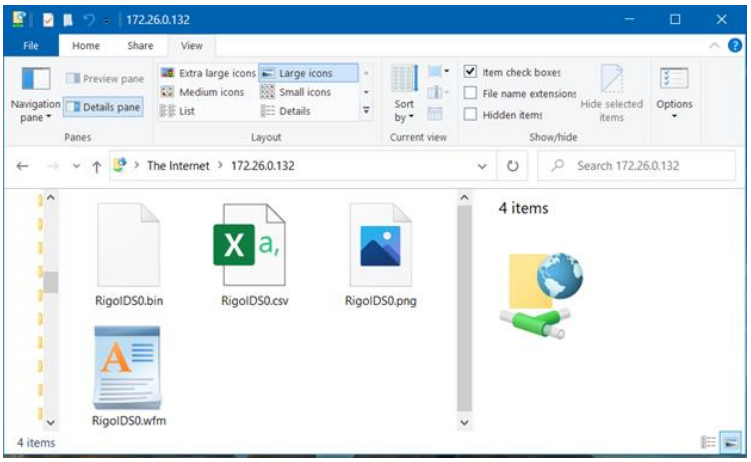

Figure 6: FTP Server

Figure 7: Color Grade View

Data Availability

These new UltraVision III Oscilloscopes have new capabilities that make offline analysis easier as well. You can control the instrument remotely using the new high speed web browser control (**figure 5**).

Use the storage menu to save directly to the internal drive on the instrument. Data saved to the internal drive appears directly on the ftp service. Then, move the data to your computer from the FTP service by dragging and dropping as shown in **figure 6**.

Segmented Data

Persistence, zoom, and search work with a large continuous data capture. There are also a number of ways to divide up or segment the memory for capturing multiple events and visualize them over time in different ways. These visualization modes work better for signal anomalies with longer gaps between them or in debugging applications where viewing subtle changes in a sequence is very helpful. The most common method for visualizing these types of signals is to use the normal triggering functions with Persistence. Both UltraVision II and UltraVision III Oscilloscopes have an additional display mode called “color grade”, that when enabled, highlights the infrequent signals as shown in **figure 7**.

The green trace shows up here immediately even though it is relatively infrequent. The combination of persistence, high waveform capture rate, and color grading make this error immediately obvious to the engineer. The UltraVision II Oscilloscopes actually operate more quickly in this particular mode:

Series	waveform rate (waves/sec)
DS70000	1,000,000
MSO8000	680,000
MSO7000	600,000
MSO5000	500,000
DHO1000	50,000
DHO4000	50,000

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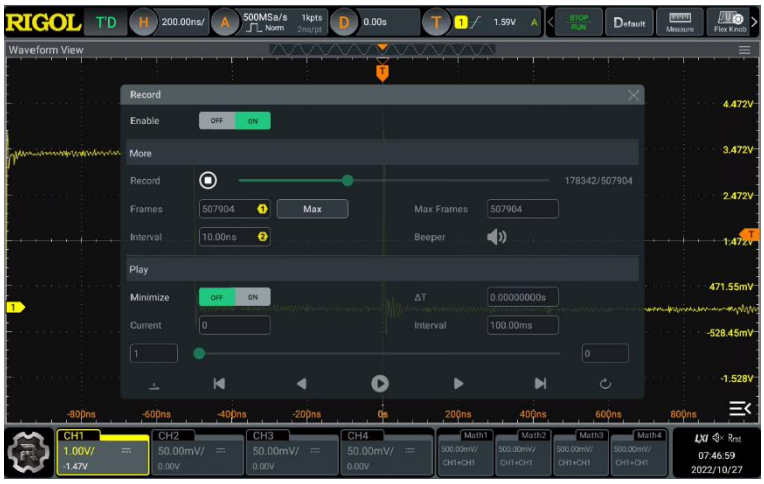

Figure 8: Record Mode Functions

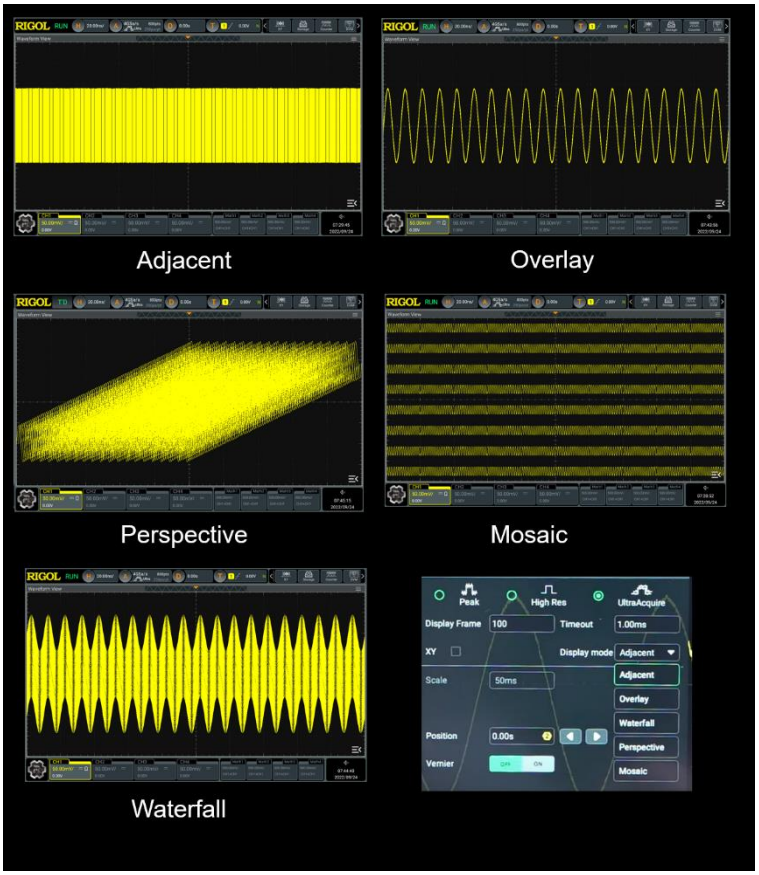

Figure 9: UltraAcquire Visualization Options

Record Mode

This mode is ideal for quick visualization of unwanted signals. Once you find the error, then you can set up more complex triggering to isolate and correlate the signal with possible causes. This works best for isolated events that occur in a larger series. For example, a rare power rail fluctuation during bootup or an extra bit on a serial bus. Record mode captures events as 'frames' so they can be viewed individually or played back over time. The DHO4000 can capture up to 507,904 frames in this mode. The record function menu is shown in **figure 8**. Depending on the application, engineers can configure the number of points in each frame and the number of frames to allocate the total memory pool based on the test requirement. They can be played back as a movie, scanned through, or played at high-speed using the playback tools. This is how the oscilloscope series compare in terms of maximum number of recorded frames:

Series	Record Mode Maximum Frames
DS70000	2,000,000
DHO4000	500,000
DHO1000	500,000
MSO8000	450,000
MSO7000	450,000
MSO5000	450,000

One of the downsides to record mode is that there can be a processing delay between captures. Therefore, some events that occur quickly one after another could be missed. The newest visualization mode, UltraAcquire, addresses this problem directly.

UltraAcquire

UltraAcquire enhances record mode in three significant ways and is only available on the DHO1000 and DHO4000 Oscilloscopes. First, it reduces the trigger rearm time, or the time between the end of one capture and the start of the next significantly. In UltraAcquire mode this rearm time can be as low as 400 nanoseconds. This makes it possible for UltraAcquire to capture frames at an equivalent speed of more than 1.5 million waves per second. Second, UltraAcquire visualizes these waves in 5 different ways for engineers to view the signal in context. This is best done by viewing about 100 waves at a time. Thousands of waves can be captured in this mode. About 100 can be viewed in real time or engineers can use the Frame Segment playback to view these in sets of 100. The 5 views are shown here with the configure window in **figure 9**.

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Figure 10: UltraAcquire Playback

Here, the frame segment viewer is being used to find the infrequent signal by setting the number of frames to view at a time and viewing them as a set. This playback mode is shown in **figure 10**.

This playback tool can also be used on search events that we worked with above in continuous captures. By working in this way UltraAcquire addresses oscilloscope 'dead time' or the time when an oscilloscope can't store data between captures directly.

This combination of analysis methods and capabilities makes RIGOL Oscilloscopes incredibly powerful debugging tools. For events in fast succession engineers can capture continuously for 100s of milliseconds to thousands of seconds depending on the sample rate and memory. Use the search tools to find events within the captured data. For infrequent events, use persistence mode to quickly visualize and capture data. Then setup record mode to capture maximum data and playback captures at higher speed. For signals that require more context for debugging and may require fast rearm times, use UltraAcquire to quickly determine the nature of the signal anomalies.

This table summarizes all of the modes and configurations available in RIGOL UltraVision II and UltraVision III Oscilloscopes:

Series	Technology	Max Record Frames	Max Waves per second	Max Memory Points (option)	Max Sampling	Minimum Rearm time*
DS70000	UltraVision III	2,000,000	1,000,000	2,000,000,000	20 GSa/sec	~ 900 nanoseconds
MSO8000	UltraVision II	450,000	680,000	500,000,000	10 GSa/sec	~ 1.4 µsec
7000	UltraVision II	450,000	600,000	500,000,000	10 GSa/sec	~ 1.6 µsec
MSO5000	UltraVision II	450,000	500,000	200,000,000	8 GSa/sec	~ 1.9 µsec
DHO4000	UltraVision III	500,000	50,000	500,000,000	4 GSa/sec	< 400 nanoseconds
DHO1000	UltraVision III	500,000	50,000	100,000,000	2 GSa/sec	< 400 nanoseconds

*Rearm time based on highest waveform capture mode available. High Resolution scopes are measured at 50 nsec/div in UltraAcquire mode. All other scopes are measured at 10 nsec/div in max waveform capture mode (Standard Mode). Record Mode rearm time adds additional delays. For example, the MSO8000 at 10 nsec/div and 100 MHz sine wave makes the rearm time approximately 8-9 µsec. The DHO4000 in record mode under similar conditions has a rearm time of 30-40 µsec.

For more information on our oscilloscopes or other RIGOL products, please go to rigolna.com or contact us directly at help@rigol.com or call us toll free at 877-4-RIGOL-1.

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