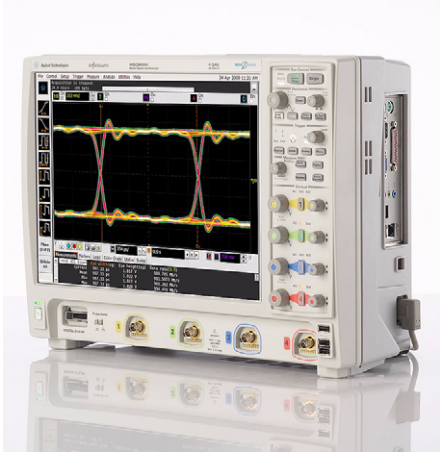
Agilent Infiniium 9000 Series Oscilloscopes



Evaluation Guide

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Agilent Technologies

Notices

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CAUTION

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Agilent Infiniium 9000 Series Oscilloscope Evaluation Guide

Does your job require an oscilloscope that can adapt to a wide variety of debug and test challenges? Agilent engineers developed the Infiniium 9000 Series oscilloscopes with the industry's broadest measurement capability. What gives the Infiniium 9000 Series the industry's broadest measurement capability?

1. Best Fit for Workspace

Oscilloscopes are visual tools and large, high-resolution displays make the product better. Largest in the industry, the 15" XGA screen makes it easier to view analog, digital, or serial signals, especially when you need to view multiple signals simultaneously.

Limited bench space? Not a problem. To achieve the thinnest depth, lightest weight, and smallest footprint in its class, Agilent engineers developed a single-acquisition board oscilloscope that extends up to 4 GHz bandwidth. A precision-engineered dense 20-layer printed circuit board, 27 custom ASICs, and multiple FPGAs, enables the instrument's innovative form factor.

2. Three Instruments in One

With superior oscilloscope specifications and rich built-in analysis, the Infiniium 9000 Series extends oscilloscope-centric testing with logic and protocol analysis capabilities. Mixed-signal oscilloscope (MSO) models add integrated 2 GSa/s digital channels. Infiniium 9000 Series oscilloscopes incorporate hardware-based protocol triggering, protocol decode, and the industry's first oscilloscope-based protocol viewer that extends to PCI Express and USB.

3. Widest Range of Debug and Compliance Application Software

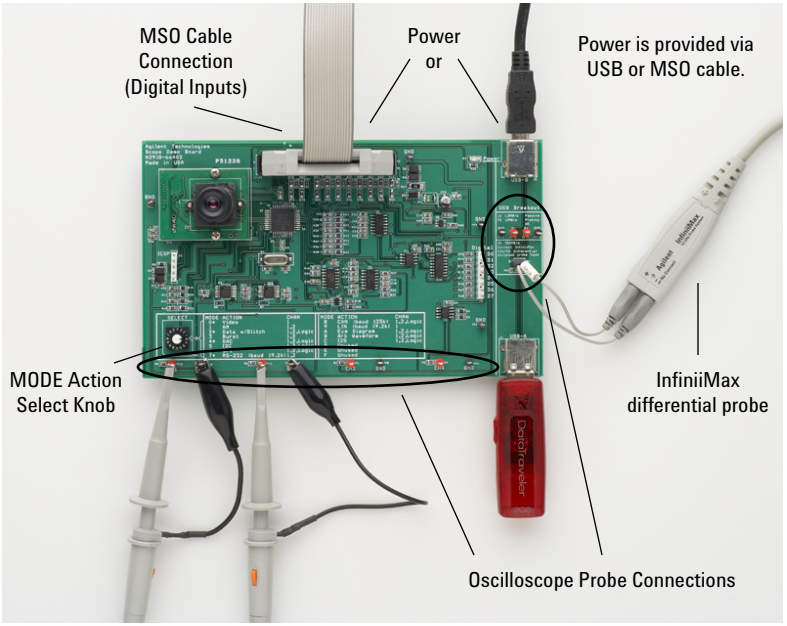
Expand your oscilloscope's capabilities with our powerful lineup of applications.

Agilent wants to help you get fast, accurate answers to your measurement questions. That's why the Infiniium 9000 Series oscilloscopes offer the largest range of software applications engineered to quickly and easily provide exceptional insight into technology-specific testing.

Required Equipment

- Agilent Infiniium 9000 Series oscilloscope.
- Two passive probes.
- Demo kit with demo board and USB cable.

Demo board connections:

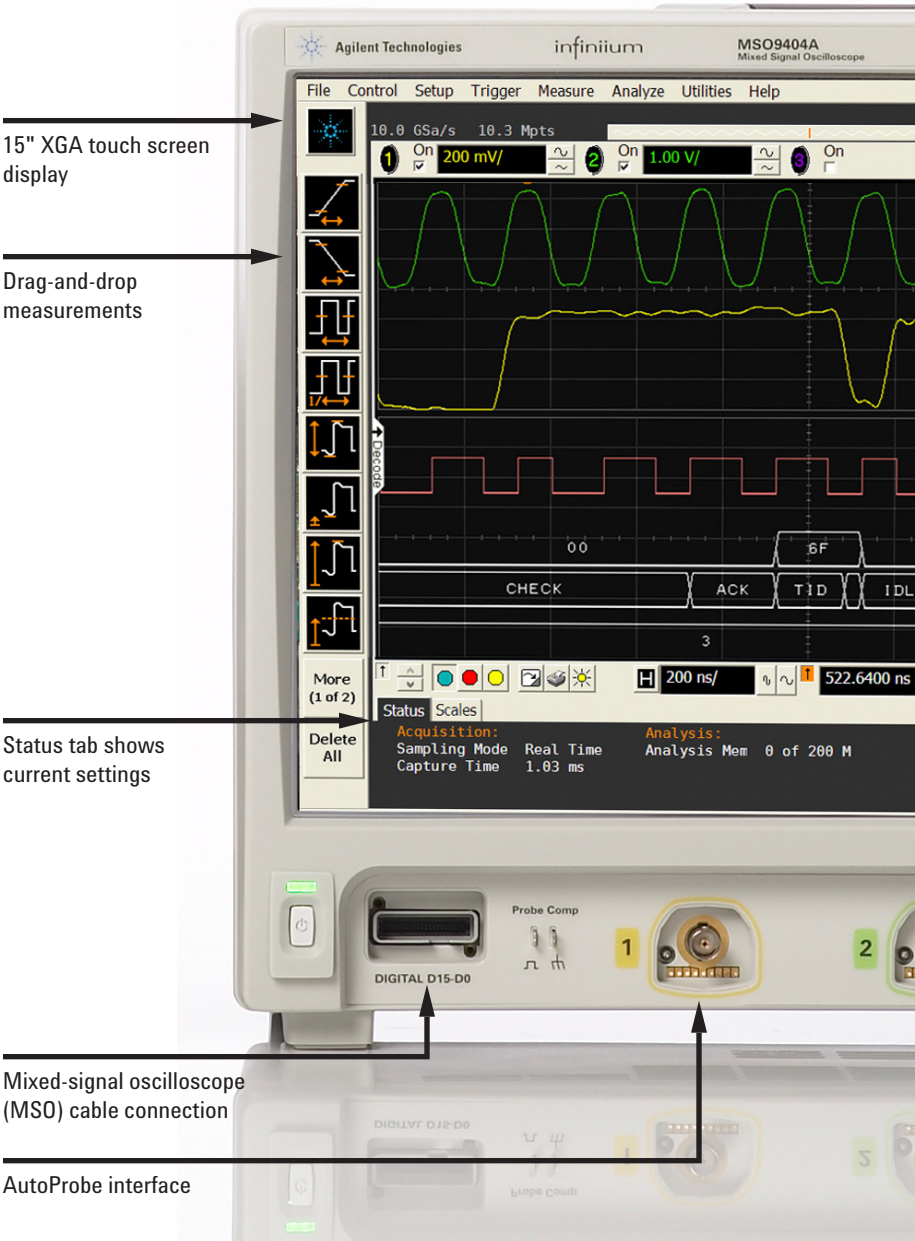


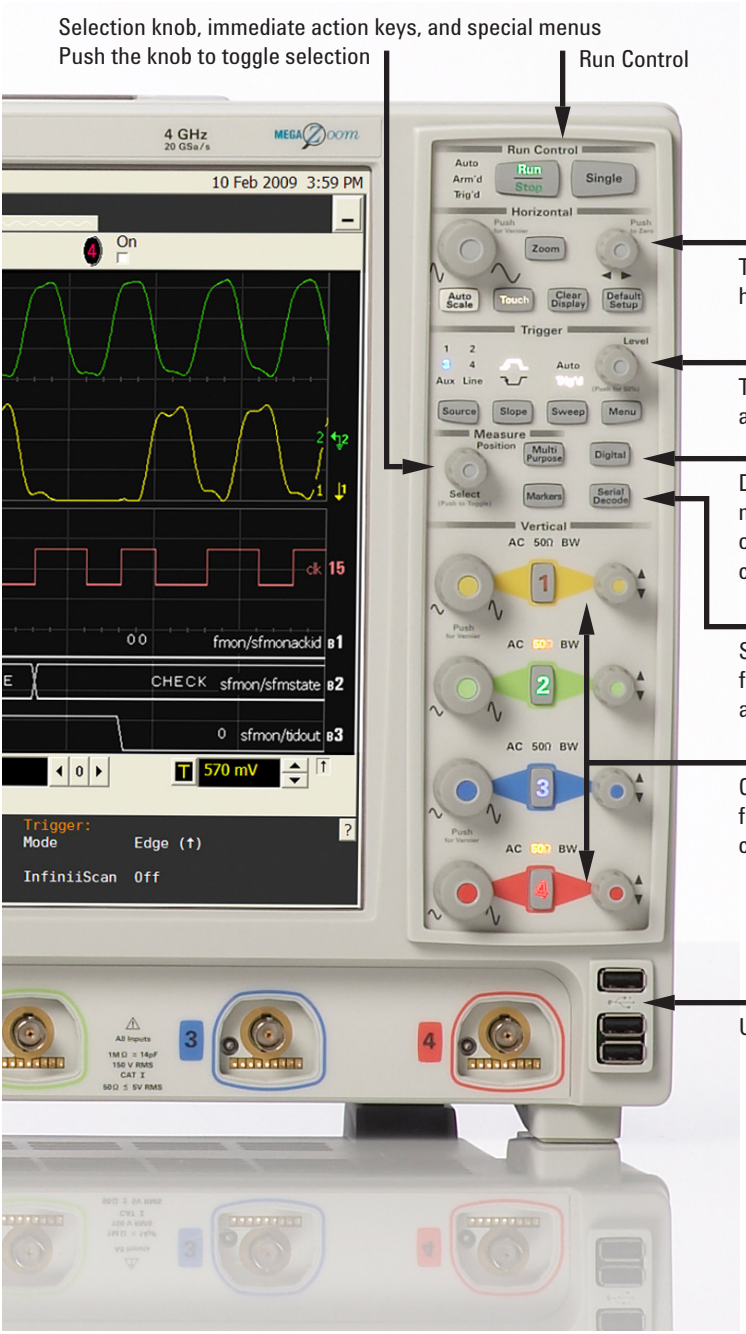
In This Guide

If you are experiencing the Infiniium 9000 Series oscilloscope for the first time, begin with Lab 1, the Getting Started Guide. If you have a basic knowledge of the Infiniium 9000 Series oscilloscope's front-panel controls, begin with Lab 2.

1 Getting Started

If you are not familiar with the Agilent Infiniium 9000 Series oscilloscopes, please first look over the main sections of the front panel as illustrated and then follow the exercises.


15" XGA touch screen display
Drag-and-drop measurements
Status tab shows current settings
Mixed-signal oscilloscope (MSO) cable connection
AutoProbe interface
Agilent Technologies
infiniium
MSO9404A
Mixed Signal Oscilloscope
File Control Setup Trigger Measure Analyze Utilities Help
10.0 GSa/s 10.3 Mpts
200 mV/
1.00 V/
CHECK
ACK
TID
More (1 of 2)
Delete All
200 ns/
522.6400 ns
Status
Scales
Acquisition:
Sampling Mode Real Time
Capture Time 1.03 ms
Analysis:
Analysis Mem 0 of 200 M
DIGITAL D15-D0
Probe Comp


Selection knob, immediate action keys, and special menus
Push the knob to toggle selection
Run Control
Time/div and position horizontal controls
Trigger level knob and controls
Digital button for mixed-signal oscilloscope (MSO) channels D0 – D15
Serial Decode button for quick decode access
Color-coded controls for each oscilloscope channel
USB ports
4 GHz
20 GSa/s
10 Feb 2009 3:59 PM
Run Control
Horizontal
Trigger
Measure
Vertical
Zoom
Single
Run
Stop
Auto Scale
Touch
Clear Display
Default Setup
Source
Slope
Sweep
Menu
Multi Purpose
Digital
Markers
Serial Decode
Select
570 mV
Trigger:
Mode Edge (↑)
InfiniiScan Off

Capturing and Viewing a Simple Signal

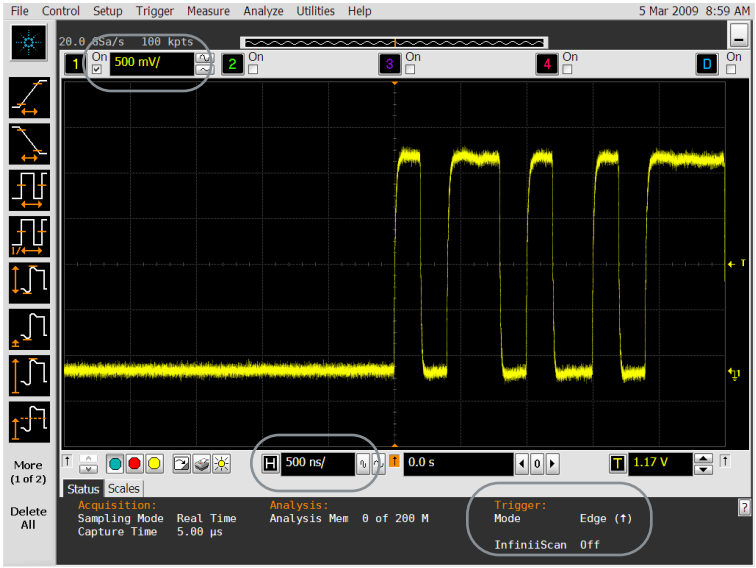
1. To power the demo board, connect a USB cable between it and the Agilent Infiniium 9000 Series oscilloscope.

   You can also apply power by connecting the oscilloscope's MSO cable to the demo board's 40-pin connector.
2. Connect the scope channel 1 probe to demo board CH1 and GND.
3. Turn the SELECT switch to position 3 (Burst).
4. Press the **[Default Setup]** key on the front panel.

The oscilloscope is now set in the default configuration. Because the oscilloscope may have been used in a variety of applications by a variety of people, it is a good measurement procedure to put the oscilloscope in a known starting mode (Default Setup). This will make it easy to duplicate measurements as no special conditions will be set.

5 Press [**AutoScale**].

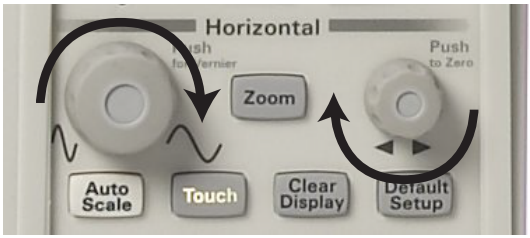
The oscilloscope will analyze all active channels, turning them on and setting the time base, V/div, and trigger conditions for an initial display.



Horizontal Control

1. Turn the large Horizontal scale knob clockwise and counter-clockwise to control the time/div setting of the horizontal axis. Observe the changes in the displayed signal. The current time base setting is displayed in the lower middle of the screen.
2. Turn the small Horizontal position knob to move the waveform horizontally from the trigger point. Push this knob to center (zero) the trigger point.

Turn to control time/div



Turn to control horizontal position

3. Set the time base to 1 ms/div.
4. Press the **[Zoom]** key.
5. Turn the large Horizontal scale knob counter-clockwise to make the window on top larger.

6. Press the **[Zoom]** key again to return to the original display.

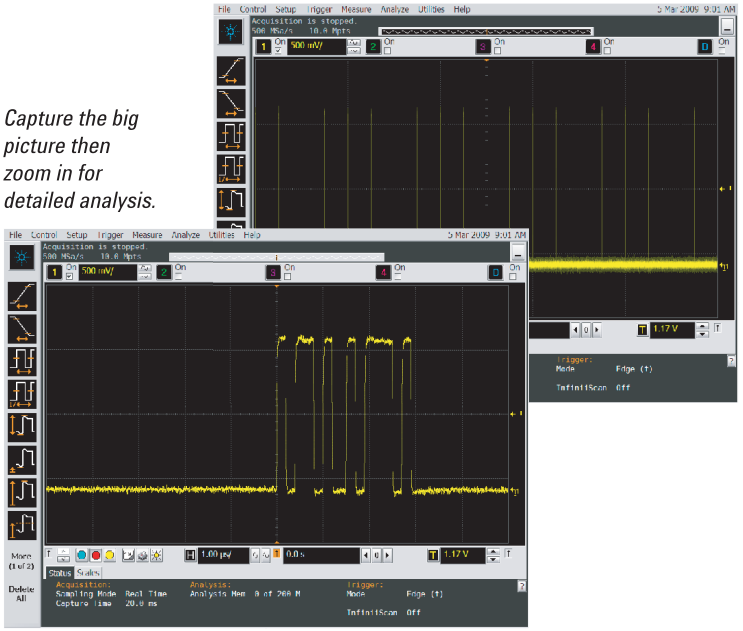
Note: At any time, to return to the original setup, press [AutoScale].

Run Control

When the oscilloscope is turned on, or if **[AutoScale]** is pressed, the acquisition will be set to **[Run]**. At any time, you may **[Stop]** the acquisition process to examine a signal in detail or to save it.

1. Press **[AutoScale]** to return to simple setup.
2. Set the time base to 2 ms/div.
3. Press the **[Single]** key to make a single acquisition and stop the acquisition process.
4. Use the large Horizontal scale knob to zoom in on the waveform.

Capture the big picture then zoom in for detailed analysis.

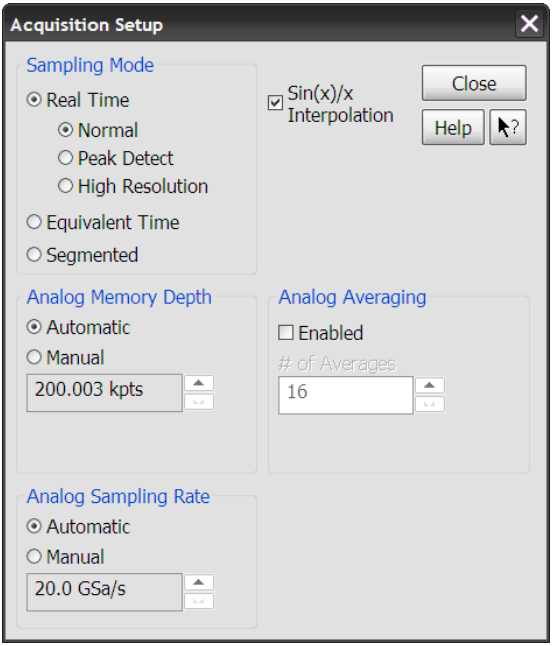


Acquisition Controls

1 From the on-screen main menu, choose **Setup>Acquisition...**.

Note the sampling mode, manual memory depth, averaging, and manual sampling rate options.

2 Click **Close**.



Vertical Controls

1. Press [**AutoScale**] to return to simple setup.
2. Turn the large channel 1 (yellow) Vertical scale knob to control the V/div setting.

   The V/div setting is displayed at the top of the screen for each channel.

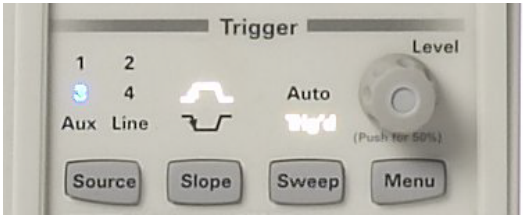
   Knobs are color coded to match the waveform color.

   Push the vertical scale knob for vernier fine adjustment.

3. Press the [**1**] key to turn the channel off. Press [**1**] again to turn the channel on.
4. Turn the small channel 1 (yellow) Vertical position knob to control the offset position of the waveform, moving it up or down.

Trigger Controls

1. Press [**AutoScale**] to return to a simple setup.
2. Set the time base to 50 ns/div.
3. Rotate the **trigger level knob** up and down. The trigger level is displayed while it is adjusted.



Move trigger level up and down on signal

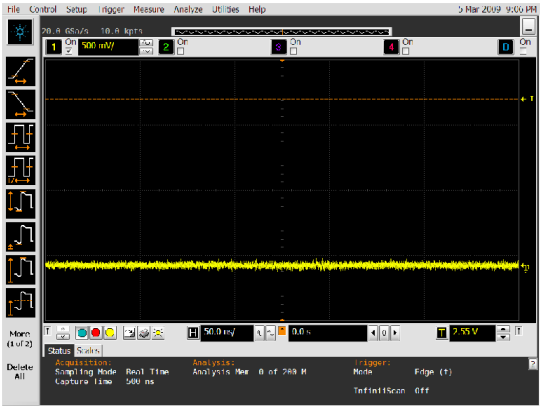
If the trigger level is above or below the signal, the oscilloscope will force a trigger and display a waveform when in Auto mode. Auto is a useful trigger mode to use when unsure of the exact waveform, as activity will be displayed making it easy to better configure the oscilloscope's settings and trigger level.

When triggers are forced, the white **Auto** LED (in the Run Control section) is lit. When the oscilloscope finds the trigger event, the white **Trig'd** LED is lit.

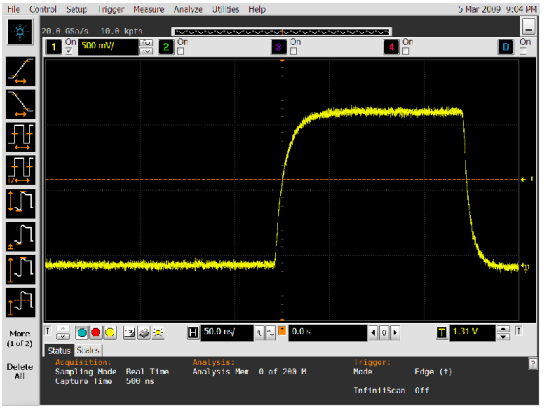
4. Press the [**Sweep**] key in the trigger section to toggle from **Auto** mode to **Trig'd** mode.
5. Now, move the trigger level up and down.

   The oscilloscope only triggers when a valid trigger condition exists. Use the **Trig'd** mode when you want to set a specific trigger condition and capture waveforms only when those conditions are met.

   When waiting for trigger, only the white **Arm'd** LED is lit. When the oscilloscope finds the trigger event, the white **Trig'd** LED is also lit.



Auto mode forces triggers if the trigger conditions are not met and shows untriggered waveform activity.



Trig'd mode waits for a waveform that meets the trigger conditions before displaying any activity.

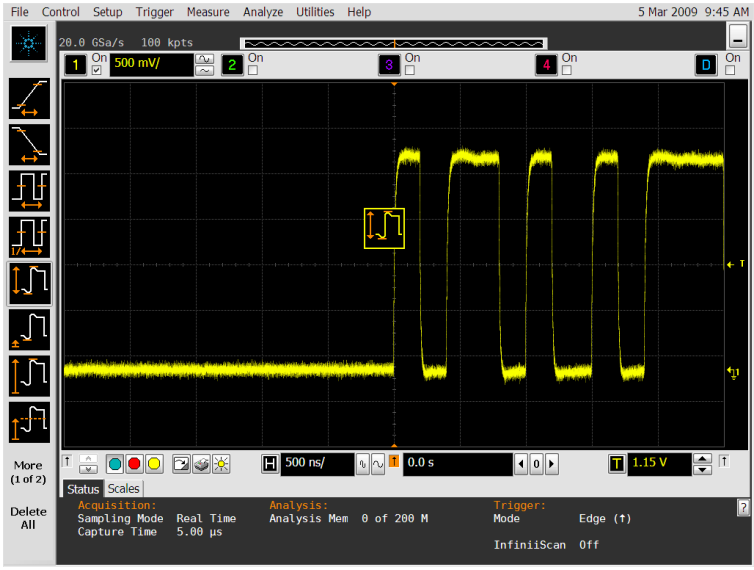
Making Measurements

The easiest way to make measurements is to drag-and-drop measurement icons.

1 Press [**AutoScale**] to return to a simple setup.

2 Drag a measurement icon from the left-hand side of the screen to a waveform.

3 When the icon border changes to the color of the desired waveform, drop the icon.

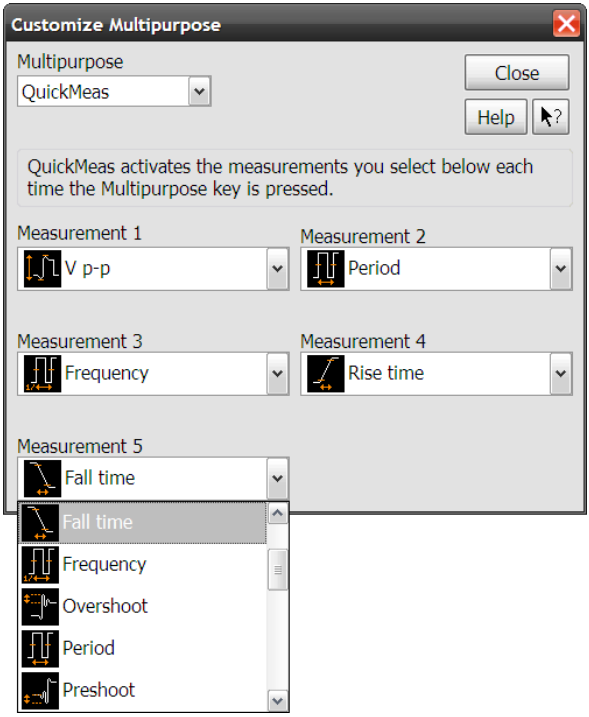


After dropping the measurement icon on a waveform, markers for the measurement appear on screen, and the measurement data appears in the bottom portion of the screen.

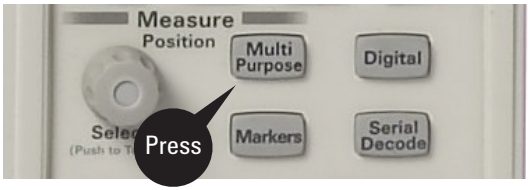
You can also set up the **[Multi Purpose]** key to display quick measurements. To do this:

1 From the on-screen main menu, choose **Utilities>Customize Multipurpose...**.

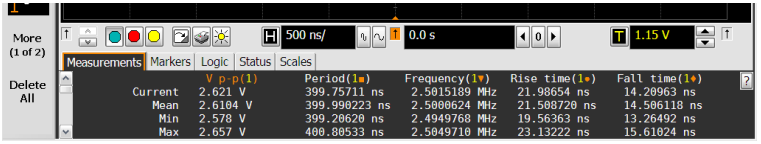
2 In the Customize Multipurpose dialog, select **QuickMeas** from the top drop-down; then, select the quick measurements you want, and click **Close**.



3 Now, press the **[Multi Purpose]** key.



The quick measurement data appears in the bottom portion of the screen.

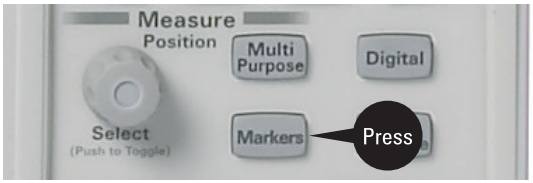


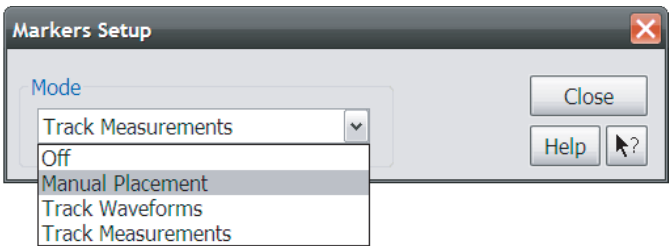
Note that the **[Multi Purpose]** key can also be customized to:

- QuickPrint — to print the screen image.
- QuickScreen — to save the screen image to a file.
- QuickSetup — to load a setup file.
- QuickWaveform — to save waveform data.
- QuickExecute — to run a program.

Using Markers

1 Press the **[Markers]** key on front panel. Horizontal (Ax and Bx) and Vertical (Ay and By) markers can be positioned on the waveform to measure time or volts of interest.



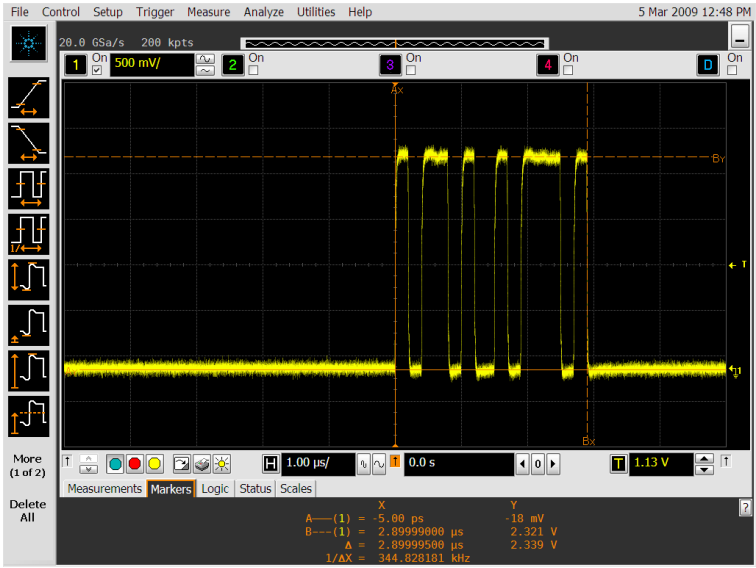


2 For example, in the Markers Setup dialog, select Manual Placement from the drop-down, and click **Close** (or press **[Markers]** again).

3 Drag the Ax marker to the leading edge on the CH1 waveform.

4 Drag the Bx marker to the last edge on the CH1 waveform.

The bottom portion of the screen shows the values of each marker and their deltas.



Saving Data, Setups, or Images

You can save images, waveform data, or setups to a variety of media including the local hard drive or USB host ports.

From the on-screen main menu, choose **File>Save>** and then the type of file you want to save.

You can also print to printers set up in the Windows operation system.

For online assistance, choose **Help>Contents...**.

2 Viewing Complex Signals

Video signals have been the ultimate display challenge for digitizing oscilloscopes. These complex signals have long been considered the display standard by which the display performance of digitizing oscilloscopes have been compared to analog oscilloscope display technology.

Video signals, due to their complexity, demand an oscilloscope with high resolution, a fast display update rate, and a high sample rate to avoid aliasing.

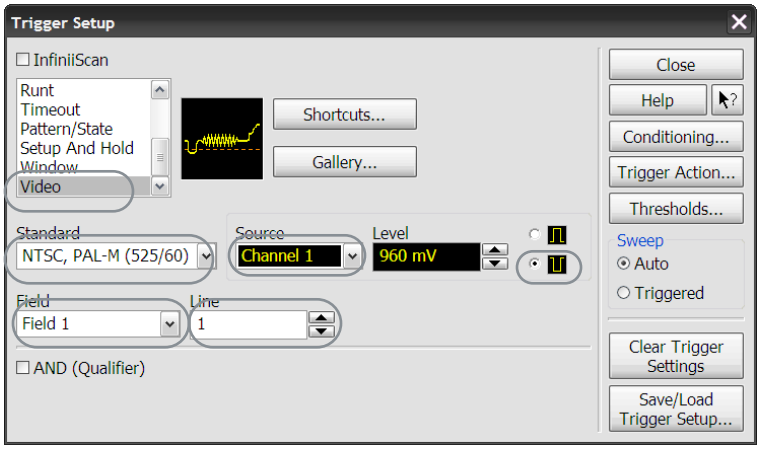
Make connections and perform initial setup:

1. To power the demo board, connect a USB cable between it and the Agilent Infiniium 9000 Series oscilloscope.

   You can also apply power by connecting the oscilloscope's MSO cable to the demo board's 40-pin connector.
2. Connect the scope channel 1 probe to demo board CH1 and GND.
3. Turn the SELECT switch to position 0 (Video).
4. Remove the cap from the video camera lens.
5. Press **[Default Setup]**.
6. Press **[AutoScale]**.
7. Set the time base to 10 ms/div.

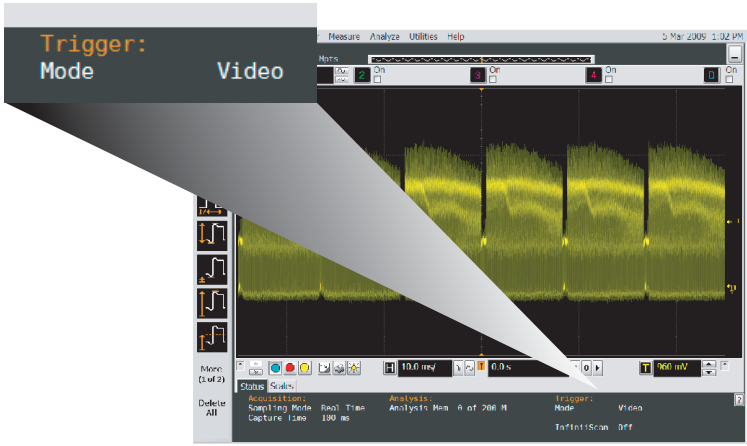
Set up the trigger:

8. From the on-screen main menu, choose **Trigger>Setup Trigger...** (or press **[Menu]** in the front panel Trigger controls).
9. In the Trigger Setup dialog, select:



Then, click **Close**.

10 Adjust the volts/div setting to 500 mV/div.



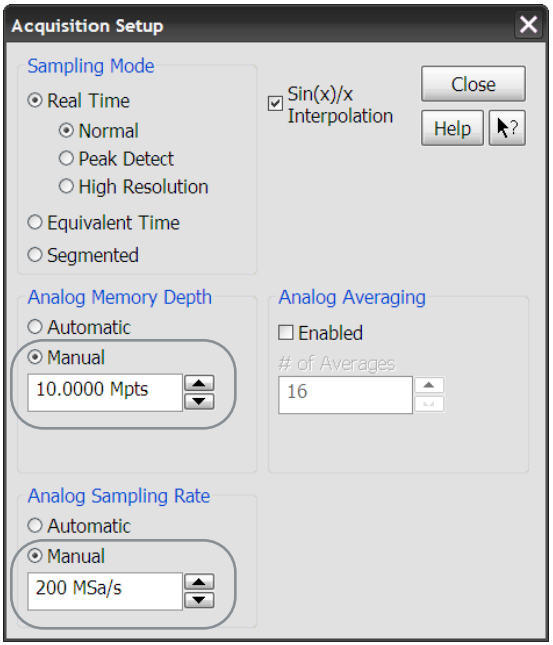
The trigger conditions are in the lower right corner of the display.

11 Wave your hand over the demo board's video camera lens to observe the good display update rate of the oscilloscope.

Set acquisition options:

12 From the on-screen main menu, choose **Setup>Acquisition...**.

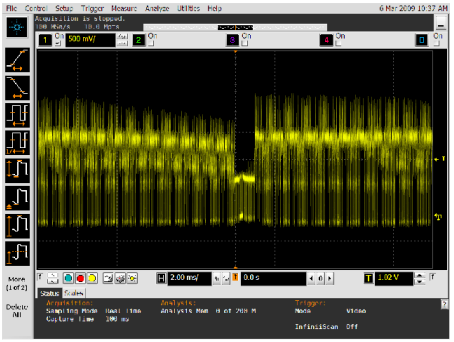
13 In the Acquisition Setup dialog, select:



Then, click **Close**.

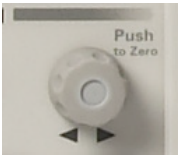
14 Press **[Single]** to obtain one acquisition using the maximum memory depth of the oscilloscope.

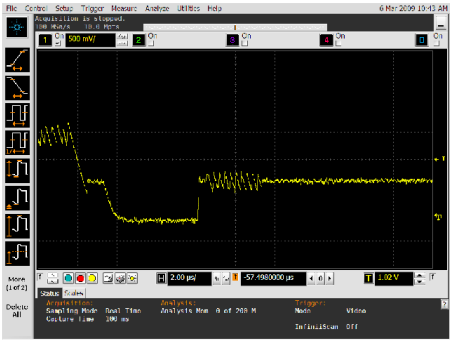
15 Using the large Horizontal scale knob, adjust the time base setting down to 2 µs/div to zoom in on the color burst.



With deep memory, we are able to zoom in by a **factor of 5,000** from the original waveform to analyze details of the color burst of this video signal.

Use the Horizontal position knob to move a color burst to center screen.





Then zoom in on a color burst from the low-cost video camera.

5000x magnification

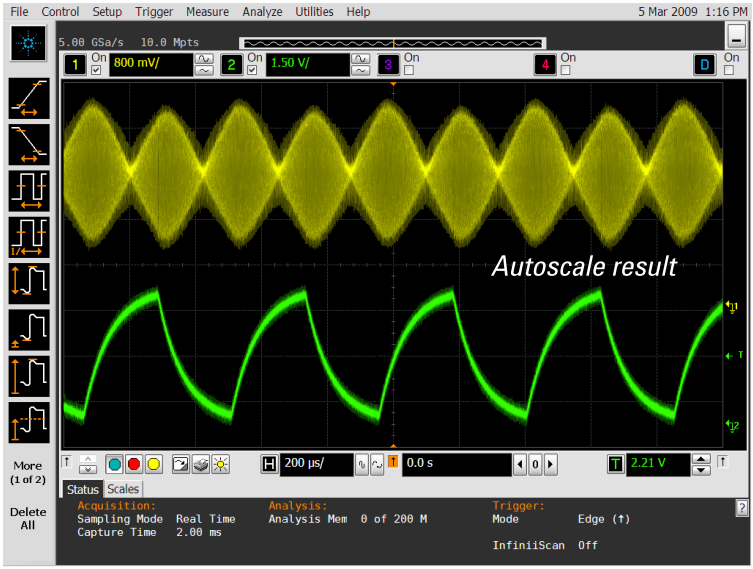
3 Uncovering Signal Anomalies with Responsive Deep Memory

An amplitude modulated (AM) signal is a very complex modulated waveform where a high-definition display and deep memory are needed for successful capture, viewing and analysis. In this lab, we will capture an AM signal that includes an embedded anomaly (a glitch). With the Infiniium 9000 Series **Mega*Zoom*** technology, the display system will clearly show this glitch while the deep memory will allow us to zoom in for detailed analysis of the glitch after capture.

Make connections and perform initial setup:

1. To power the demo board, connect a USB cable between it and the Agilent Infiniium 9000 Series oscilloscope.

   You can also apply power by connecting the oscilloscope's MSO cable to the demo board's 40-pin connector.
2. Connect the scope channel 1 probe to demo board CH1 and GND.
3. Connect the scope channel 2 probe to demo board CH2 and GND.
4. Turn the SELECT switch to position 1 (AM).
5. Press **[Default Setup]**.
6. Press **[AutoScale]**.



In this lab, a stable trigger is accomplished by triggering on the synchronization signal on channel 2. In the absence of a synchronization signal, trigger holdoff can be used to achieve a stable trigger (see Appendix A).

7 Turn **off** the channel 2 display (still the trigger source) by pressing the **[2]** key.

8 Re-adjust channel 1's vertical scale to 500 mV/div and its vertical position to 2.3 V offset to optimize viewing of the complex channel 1 signal.

9 Set the time base to 100 µs/div.

Note that there is a glitch present in every other envelope.

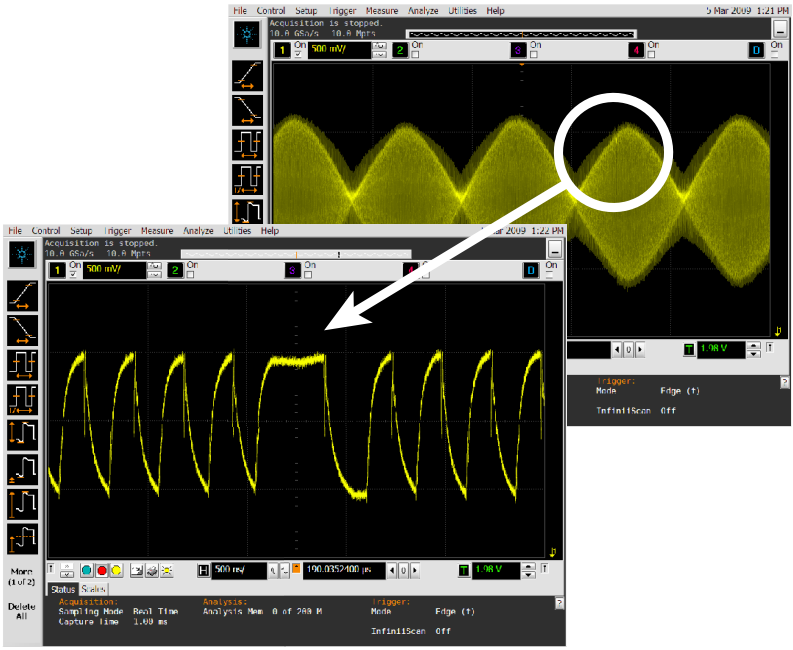
10 Press **[Single]** to capture a single shot acquisition of this complex waveform.

Take advantage of deep memory: zoom in on one of the glitches to see the details:

Step 1: Using the small Horizontal position knob, move one of the glitches to the center of the display.

Step 2: Using the large Horizontal time/div knob, set the time base to 500 ns/div (turn clockwise) to see characteristics of the glitch in detail.

With up to 10 Mpts of deep memory you are able to see the big picture (envelope of the entire AM signal) as well as zoom in on the details of this anomaly while maintaining a high sample rate.



4 InfiniiScan Triggering

Capturing infrequent or hard to describe anomalies such as random glitches requires oscilloscopes with innovative technology. InfiniiScan is a software-based post-processing technology that makes it easy to isolate anomalies.

This lab requires an InfiniiScan option license.

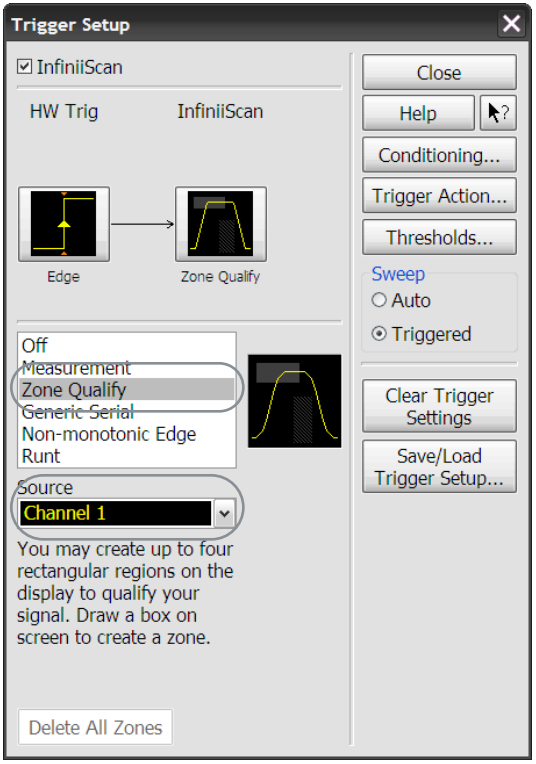
Make connections and perform initial setup:

1. To power the demo board, connect a USB cable between it and the Agilent Infiniium 9000 Series oscilloscope.

   You can also apply power by connecting the oscilloscope's MSO cable to the demo board's 40-pin connector.
2. Connect the scope channel 1 probe to demo board CH1 and GND.
3. Make sure all other probes are disconnected from the oscilloscope.
4. Turn the SELECT switch to position 3 (Burst).
5. Press **[Default Setup]**.
6. Press **[AutoScale]**.
7. Set the time base to 1 µs/div.

Set up the trigger:

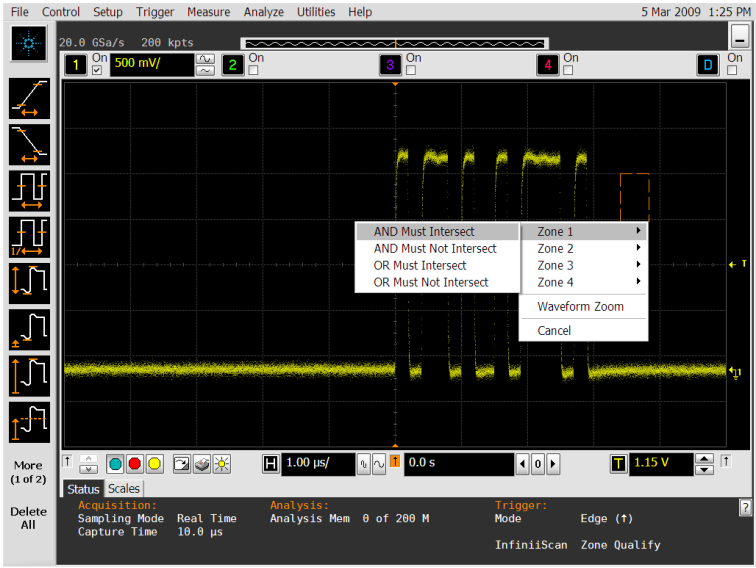
8. From the on-screen main menu, choose **Trigger> InfiniiScan...** (or press **[Menu]** in the front panel Trigger controls).
9. In the Trigger Setup dialog, select:



Then, click **Close**.

10 In the waveform area, draw a box around the area where an occasional glitch occurs.

11 Release the mouse button and select **Zone 1>AND Must Intersect**.



The oscilloscope now triggers and captures only waveforms where the glitch occurs.

InfiniiScan can be extremely effective in isolating cycles such as DDR reads and writes, or in triggering on events that are difficult to describe with traditional oscilloscope triggers.

5 Mixed-Signal Oscilloscope (MSO)

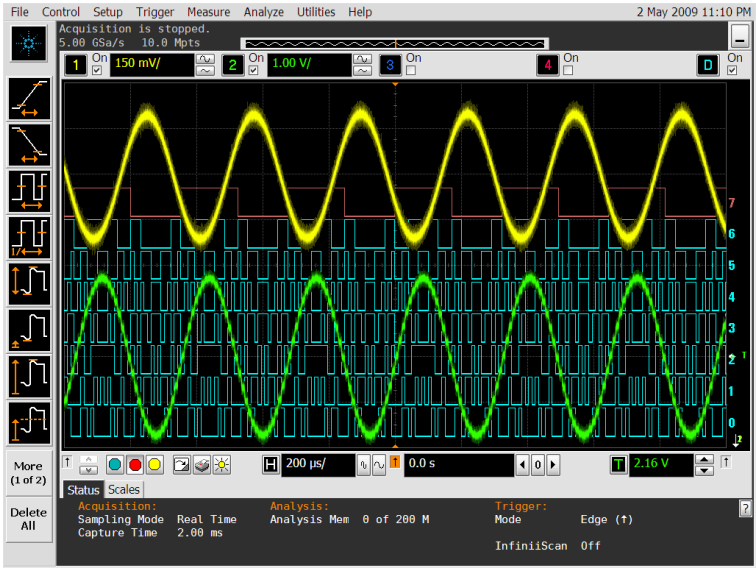
In mixed analog and digital designs, it is often important to view multiple analog and digital channels, which is significantly beyond the capability of a 2- or 4-channel oscilloscope. With 2 or 4 oscilloscope channels plus 16 logic timing channels, the unique 2+16 or 4+16 channel Mixed Signal Oscilloscope (MSO) affords the opportunity to view more signals and to make time-correlated measurements across all channels.

Make connections and perform initial setup:

1. Connect the MSO cable between the oscilloscope and the demo board's 40-pin connector.

   This powers the demo board and probes its digital signals.

   Normally, you would use flying leads to probe digital signals in your device under test (DUT). The demo board 40-pin connector was designed with built-in terminations.
2. Connect the scope channel 1 probe to demo board CH1 and GND.
3. Connect the scope channel 2 probe to demo board CH2 and GND.
4. Turn the SELECT switch to position 4 (DAC).
5. Press [**Default Setup**].
6. Press [**AutoScale**].



The channel 1 signal (yellow) is the filtered version of the output.

The channel 2 signal (green) shows the stair-step output of a microcontroller-based Digital-to-Analog Converter (DAC).

Channels D0 – D7 (blue) are the input control lines to the DAC.

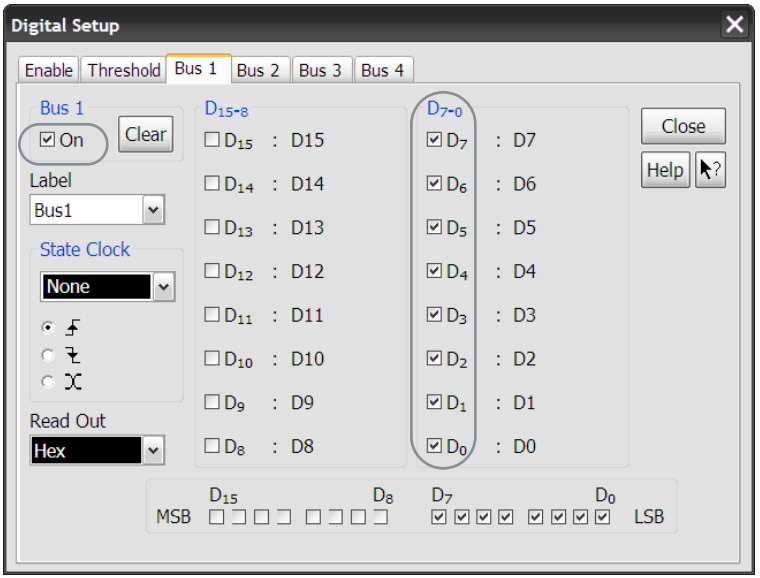
We were able to easily trigger on channel 2. However, what if we wanted to trigger on a specific voltage instruction based on the input to the DAC using pattern trigger?

Set up digital channels:

7 From the on-screen main menu, choose **Setup>Digital...**.

8 In the Digital Setup dialog's Enable tab, disable the D7-D0 display by unchecking the $\mathbf{D_{7-0}}$ enable selection.

9 In the Digital Setup dialog's Bus 1 tab, select:



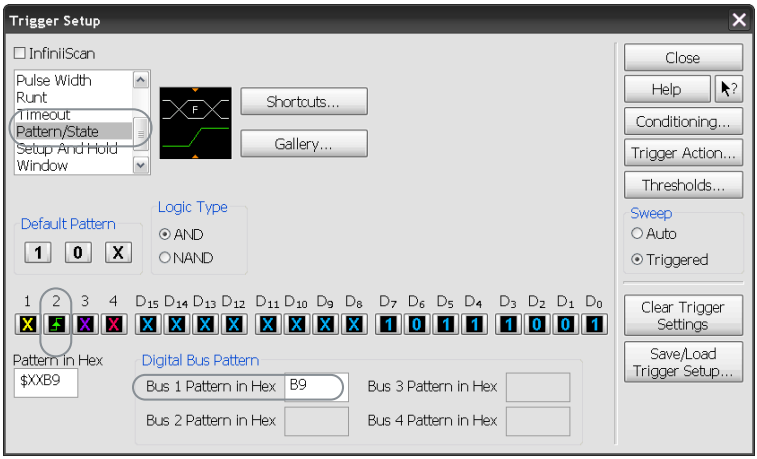
Then, click **Close**.

Set up the trigger:

To trigger on a bus value:

10 Choose **Trigger>Setup Trigger...** (or press **[Menu]** in the front panel Trigger controls).

11 In the Trigger Setup dialog, select:



Then, click **Close**.

12 Set the time base to 20 µs/div.

At center screen, notice the Bus 1 value.

6 USB

Agilent offers a USB compliance package as well as a USB protocol triggering and decode application. The compliance package tests for signal conformance to USB-IF industry standard while the protocol triggering and decode application targets rapid debug.

For this exercise, a USB protocol application option license is required.

USB is a differential serial bus and can run at low-, full-, or high-speed data rates. Example devices for each:

Data rate	Devices	Required probes
Low speed (1.5 Mbps)	USB mouse or USB keyboard	2 single-ended
Full speed (12 Mbps)	Older USB hub	2 single-ended
High-speed(480 Mbps)	Current thumb drives or USB mass storage	1 differential

This lab includes examples from each speed category.

USB Low-Speed Capture

Make connections and perform initial setup:

1. Connect the demo board USB-B port to your 9000 Series oscilloscope using a USB A to B cable.
2. Plug mouse into USB-A port on the lower right side of the demo board.

   The mouse will create USB low-speed traffic that the scope probes will monitor.
3. Connect the scope channel 1 probe to demo board D+ probe loop and GND (on the right-side of the demo board).

4 Connect the scope channel 2 probe to demo board D- probe loop and GND.

5 Remove all other probes and connections.

6 If you have the MSO cable connected to the demo board's 40-pin connector, turn the SELECT switch to position 0 (so digital channels aren't captured).

7 Press [**Default Setup**].

8 Press [**AutoScale**].

You are now viewing low-speed serial traffic between a mouse and the PC in the oscilloscope.

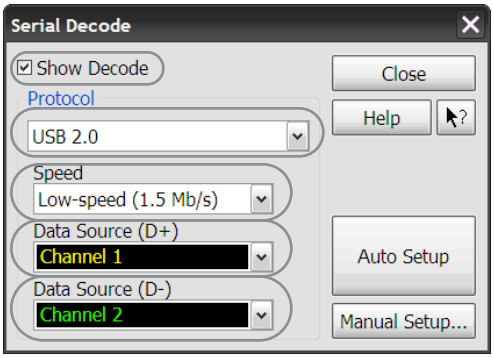
9 Set the time base to 20 µs/div to see a single packet.

Move the mouse and you can see additional traffic.

Set up serial decode:

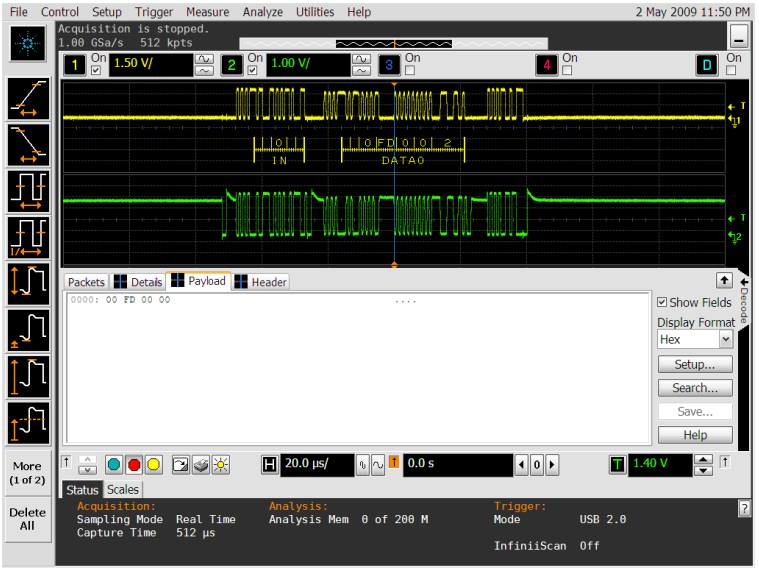
10 Choose **Setup>Serial Decode...**.

11 In the Serial Decode dialog, select:



Then, click **Auto Setup** and **Close**.

Here's the associated protocol view. Select the **Payload** tab. The data packets include X-Y coordinates that were transmitted when you moved the mouse.



Move the mouse and see the X-Y coordinate information change in the Payload tab.

USB Full-Speed Capture

Make connections and perform initial setup:

12 Disconnect the mouse from the demo board USB-A port.

13 Connect a full-speed device to the USB-A connector on the demo board.

Full speed hubs or older thumb drives make ideal candidates.

14 Press **[Default Setup]**.

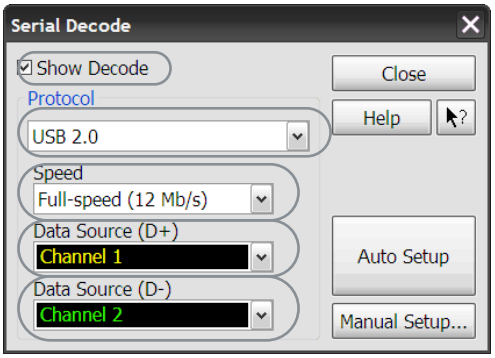
15 Press **[AutoScale]**.

You are now viewing full-speed serial traffic between the full-speed device and the PC in the oscilloscope.

Set up serial decode:

16 Choose **Setup>Serial Decode...**.

17 In the Serial Decode dialog, select:



Then, click **Auto Setup** and **Close**.

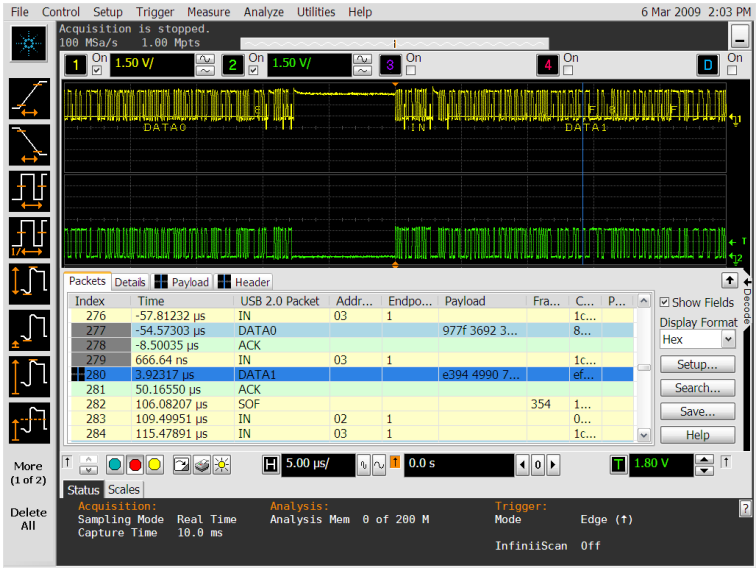
Auto Setup sets the sample rate, memory depth, measurement thresholds, trigger levels, and holdoff to correctly decode the specified protocol.

You are now viewing USB full speed traffic. To make the protocol decode more interesting, let's watch traffic that is more varied.

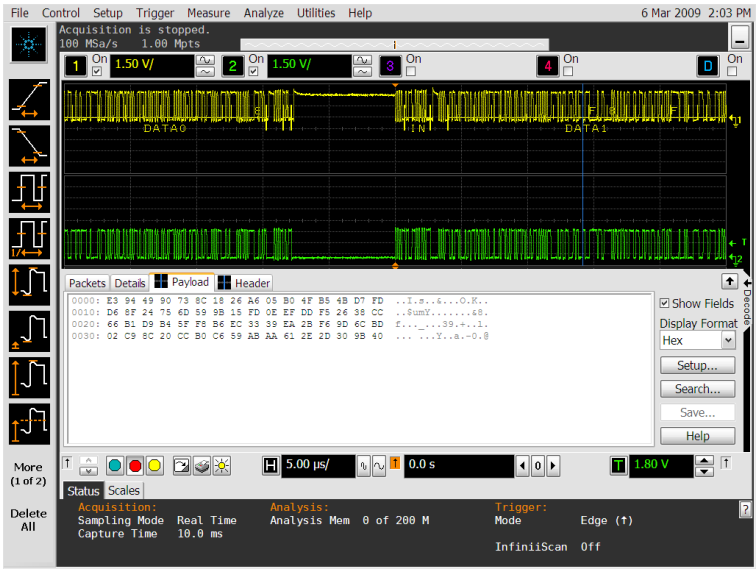
18 Copy any large file (a 100M file generates about 2 minutes of traffic works well) from a thumb drive (+full speed hub) plugged into the demo board to the Infiniium 9000 Series desktop (or vice versa).

Note: Most new thumb drives are high speed USB. To convert the traffic into full speed, use a full speed hub.

19 Press **[Single]** to capture a single trace.



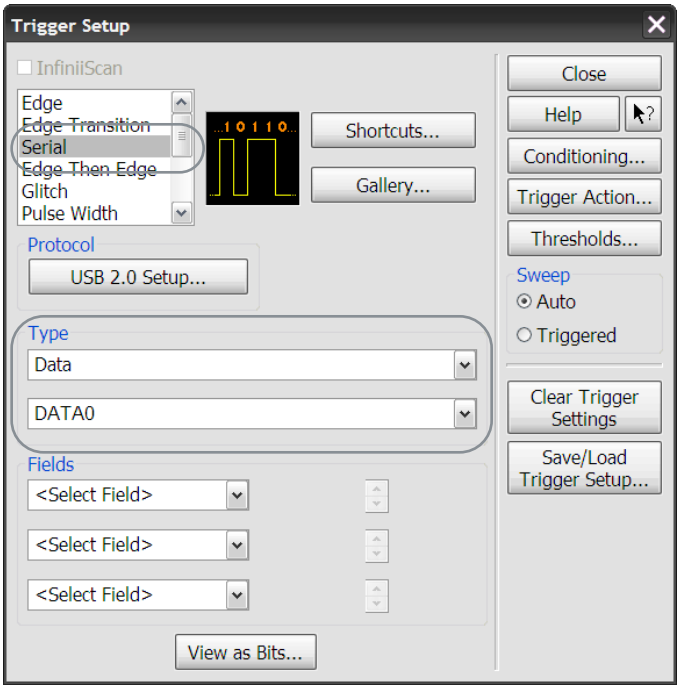
20 Click on either a Data 1 or a Data 0 packet row; then, select the Payload tab to see the packet contents.



Set up the trigger:

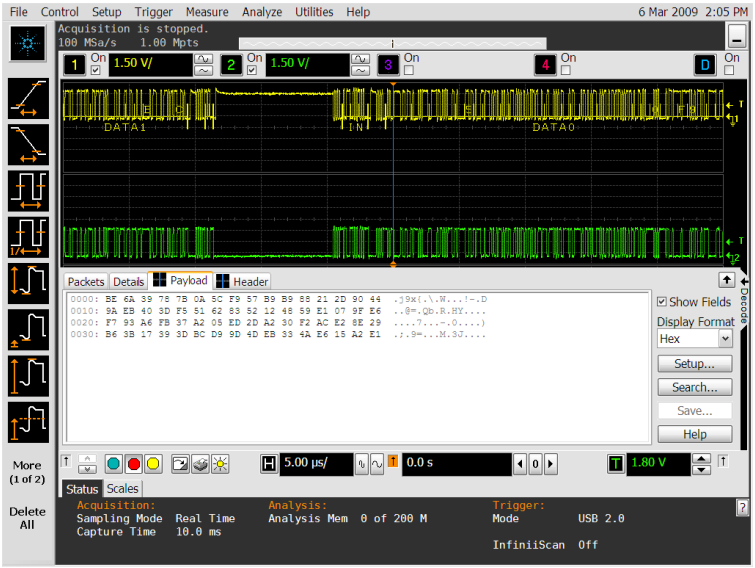
21 Choose **Trigger>Setup Trigger...** (or press **[Menu]** in the front panel Trigger controls).

22 In the Trigger Setup dialog, select:



Then, click **Close**.

23 Press **[Single]** and note that the oscilloscope triggers when it sees the first DATA0 packet.



USB High-Speed Capture

Make connections and perform initial setup:

24 Connect a high speed storage device to the USB-A connector on the demo board.

Most recent thumb drives make excellent devices for this.

25 Connect an InfiniiMax differential probe with socketed probe head adapter to the demo board's USB high-speed connector. Use oscilloscope channel 3.

This connection has built-in 82 ohm termination. The posts are 20 mil and they accept the socketed probe head adapter without any additional termination.

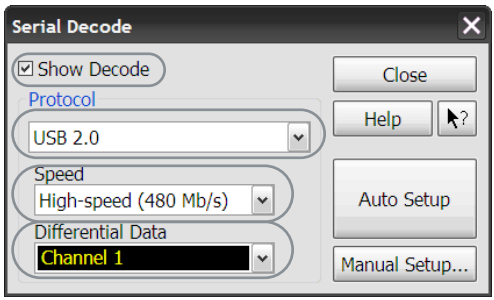
26 Press [**Default Setup**].

27 Press [**AutoScale**].

Set up serial decode:

28 Choose **Setup>Serial Decode...**.

29 In the Serial Decode dialog, select:

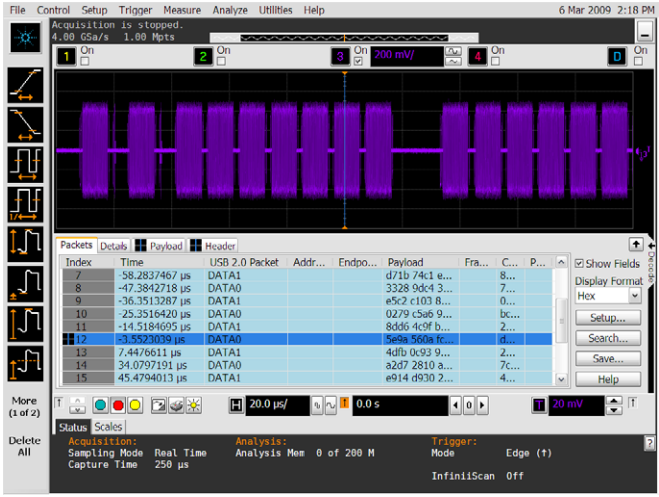


Then, click **Auto Setup** and **Close**.

You are now viewing USB high speed traffic. To make the protocol decode more interesting, let's watch traffic that is more varied.

30 Copy any large file (a 100M file generates just a few seconds of traffic and works well) from a thumb drive plugged into the demo board to the Infiniium 9000 Series desktop (or vice versa).

31 Press **[Single]** to capture a single trace.

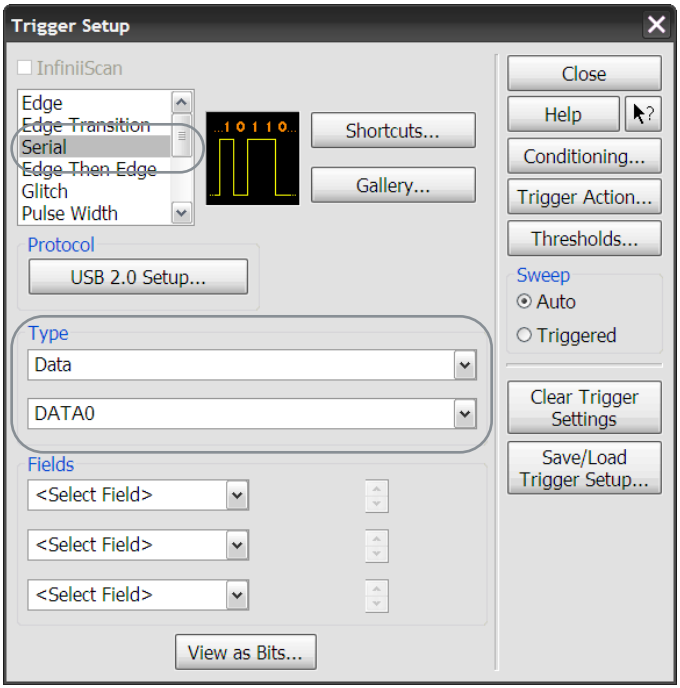


32 Click on either a Data 1 or a Data 0 packet and click on the payload tab to see the contents.

Set up the trigger:

33 Choose **Trigger>Setup Trigger...** (or press **[Menu]** in the front panel Trigger controls).

34 In the Trigger Setup dialog, select:



Then, click **Close**.

35 Press **[Single]**.

The oscilloscope triggers when it sees the first DATA0 packet.

7 I²C

To enable I²C serial decode, your oscilloscope has to have the I²C/SPI protocol option installed. (The installed options are listed in the **Help>About Infiniium...** dialog.)

Make connections and perform initial setup:

1. To power the demo board, connect a USB cable between it and the Agilent Infiniium 9000 Series oscilloscope.

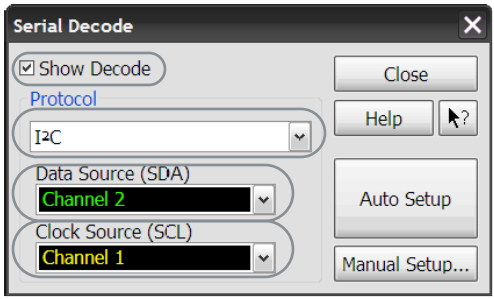
   You can also apply power by connecting the oscilloscope's MSO cable to the demo board's 40-pin connector.
2. Connect the scope channel 1 probe to demo board CH3 (SCL) and GND.
3. Connect the scope channel 2 probe to demo board CH4 (SDA) and GND.
4. **Make sure all other probes are disconnected from the oscilloscope**.

   This exercise can also be done using digital channels 14 and 15 or a combination of oscilloscope and digital channels.
5. Turn the SELECT switch to position 5 (I²C).
6. Press [**Default Setup**].
7. Press [**AutoScale**].

Set up serial decode:

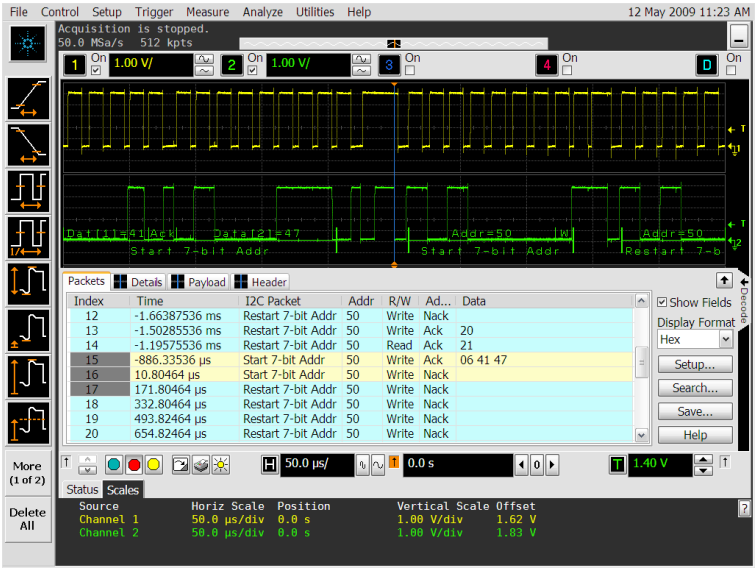
8. Choose **Setup>Serial Decode...**.

9 In the Serial Decode dialog, select:



Then, click **Auto Setup** and **Close**.

10 Press **[Single]**.



11 Set the time base to 1 ms/div.

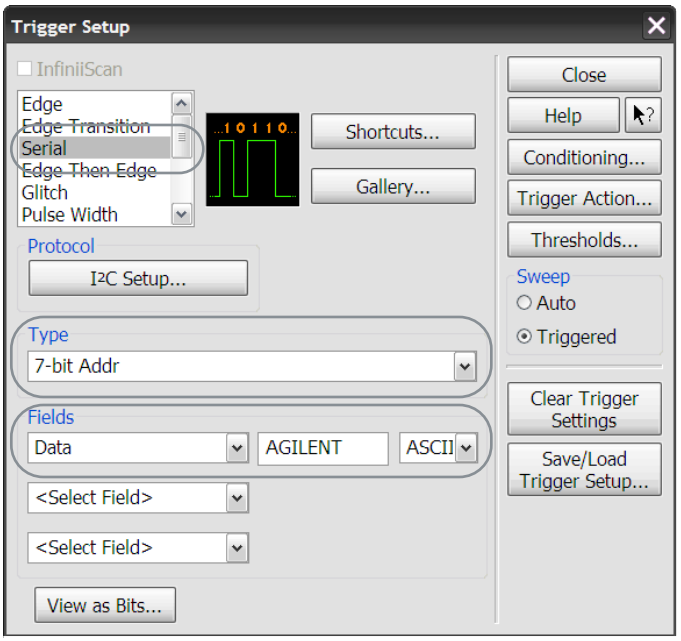
As you move the blue vertical marker in the waveform display, it tracks in the protocol viewer window.

As you click on rows in the protocol viewer, the blue marker shows the exact associated time in the waveform menu.

Set up the trigger:

12 Choose **Trigger>Setup Trigger...** (or press **[Menu]** in the front panel Trigger controls).

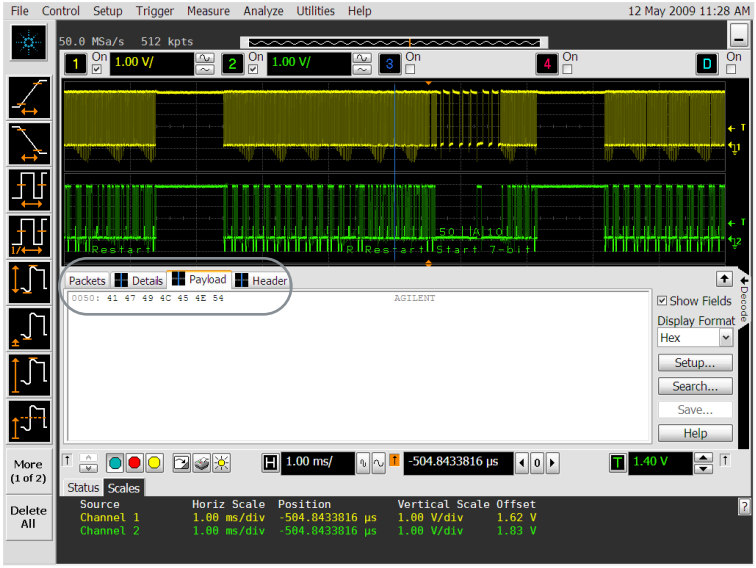
13 In the Trigger Setup dialog, select:



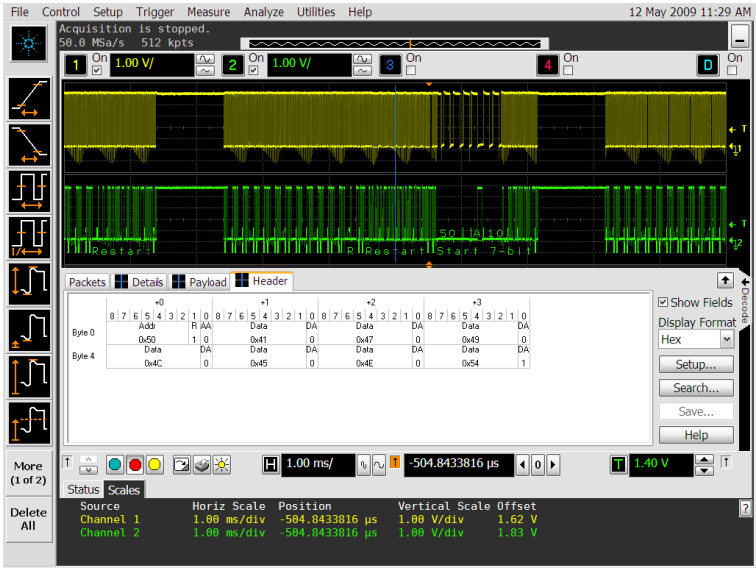
Then, click **Close**.

14 Press **[Single]** or **[Run]**.

15 In the protocol decode viewer, select the **Payload** tab.



16 Select the **Header** tab to see a data sheet view of the acquired protocol.



8 SPI

To enable SPI serial decode, your oscilloscope has to have the I^2C/SPI option installed. (The installed options are listed in the **Help>About Infiniium...** dialog.)

Make connections and perform initial setup:

1 Connect the MSO cable between the oscilloscope and the demo board's 40-pin connector.

This powers the demo board and probes its digital signals.

Normally, you would use flying leads to probe digital signals in your device under test (DUT). The demo board 40-pin connector was designed with built-in terminations.

2 **Disconnect all oscilloscope probes** from the demo board. *This is a digital signal only demo*.

3 Turn the SELECT switch to position 6 (SPI).

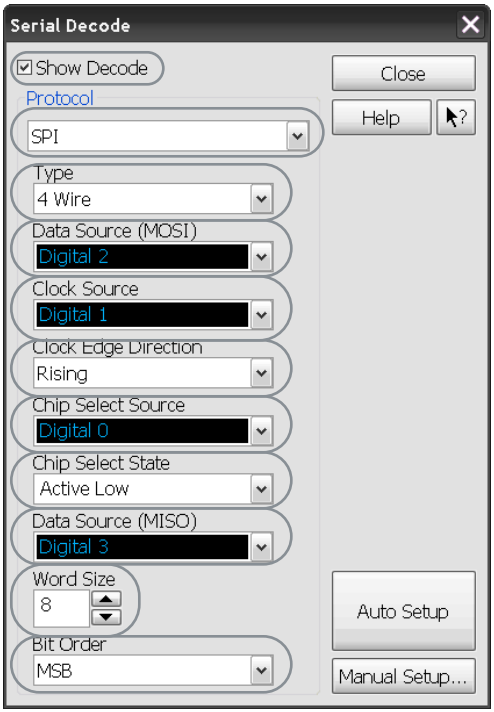
4 Press [**Default Setup**].

5 Press [**AutoScale**].

Set up serial decode:

6 Choose **Setup>Serial Decode...**.

7 In the Serial Decode dialog, select:

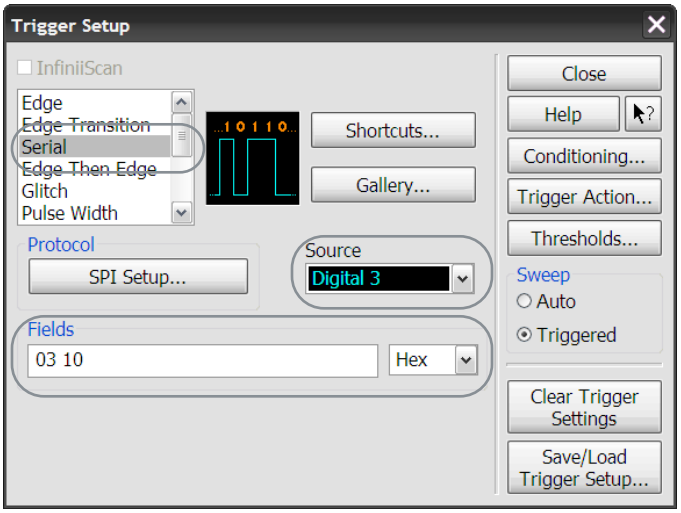


Then, click **Auto Setup** and **Close**.

Set up the trigger:

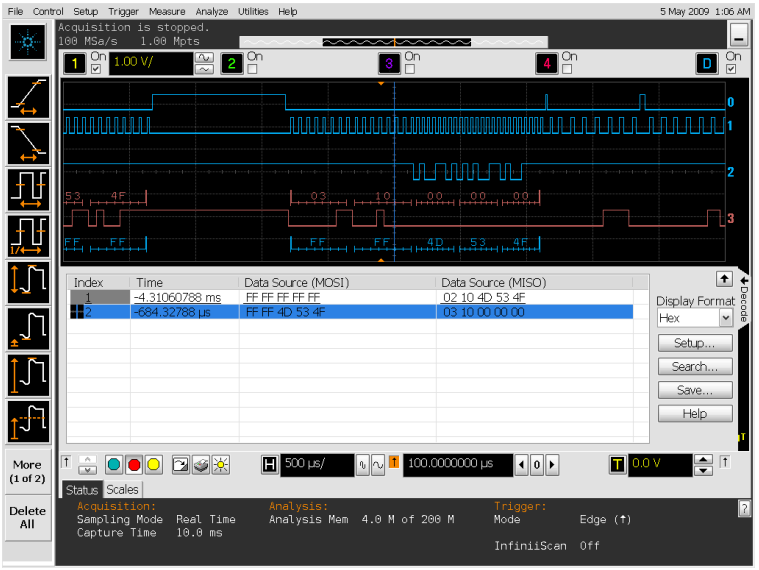
8 Choose **Trigger>Setup Trigger...** (or press **[Menu]** in the front panel Trigger controls).

9 In the Trigger Setup dialog, select:



Then, click **Close**.

10 Change the time base setting to 500 µs/div to easily see the serial decode.



As you move the blue vertical marker in the waveform display, it tracks in the protocol viewer window.

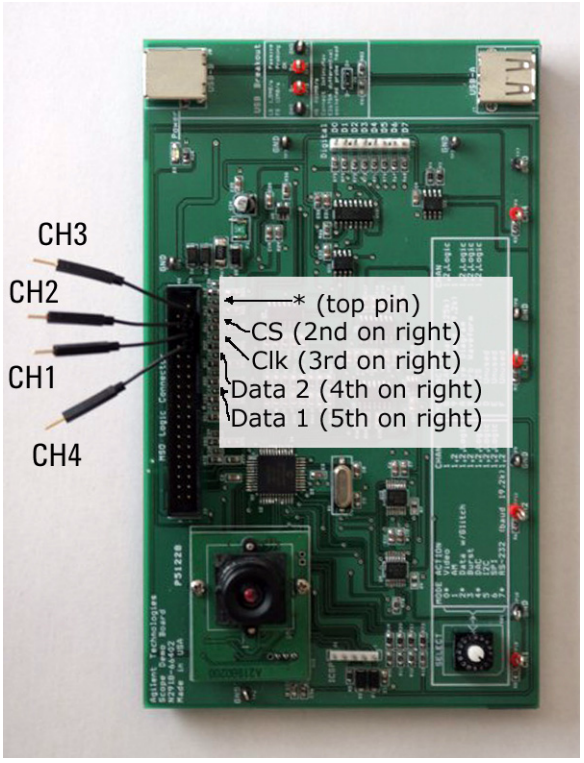
As you click on rows in the protocol viewer, the blue marker shows the exact associated time in the waveform menu.

SPI Using Analog Channels

You can also capture SPI signals by connecting the oscilloscope's analog channels to the proper signals on the demo board's 40-pin connector.

Make connections and perform initial setup:

1. To power the demo board, connect a USB cable between it and the Agilent Infiniium 9000 Series oscilloscope.
2. Connect the scope analog channel probes to pins on the demo board's 40-pin connector:



3 Turn the SELECT switch to position 6 (SPI).

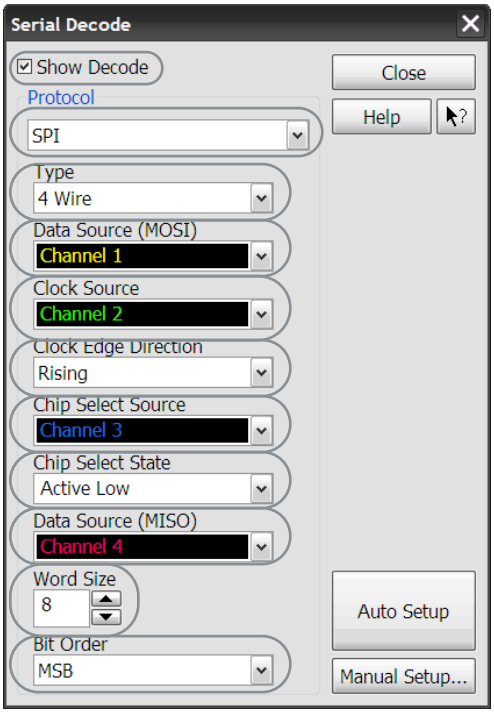
4 Press [**Default Setup**].

5 Press [**AutoScale**].

Set up serial decode:

6 Choose **Setup>Serial Decode...**.

7 In the Serial Decode dialog, select:

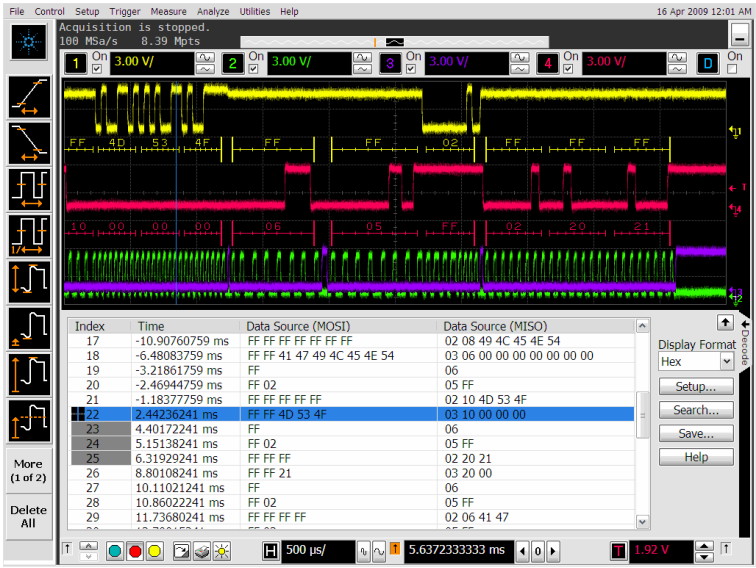


Then, click **Auto Setup** and **Close**.

Set up the trigger:

8 Set up the trigger the same as in the previous section.

9 Change the time base setting to 500 µs/div to easily see the serial decode.



9 CAN

To enable CAN serial decode, your oscilloscope has to have the CAN/FlexRay serial bus protocol option installed. (The installed options are listed in the **Help>About Infiniium...** dialog.)

Make connections and perform initial setup:

1 To power the demo board, connect a USB cable between it and the Agilent Infiniium 9000 Series oscilloscope.

   You can also apply power by connecting the oscilloscope's MSO cable to the demo board's 40-pin connector.

2 Connect the scope channel 1 probe to demo board CH1 and GND.

3 Turn the SELECT switch to position 8 (CAN).

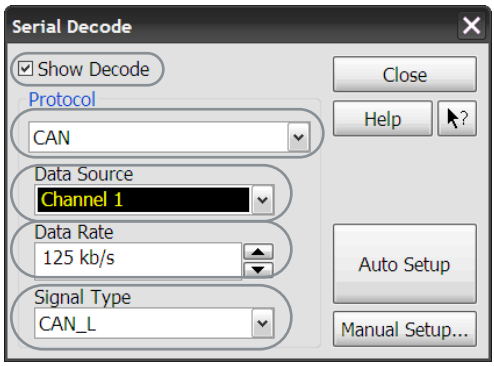
4 Press **[Default Setup]**.

5 Press **[AutoScale]**.

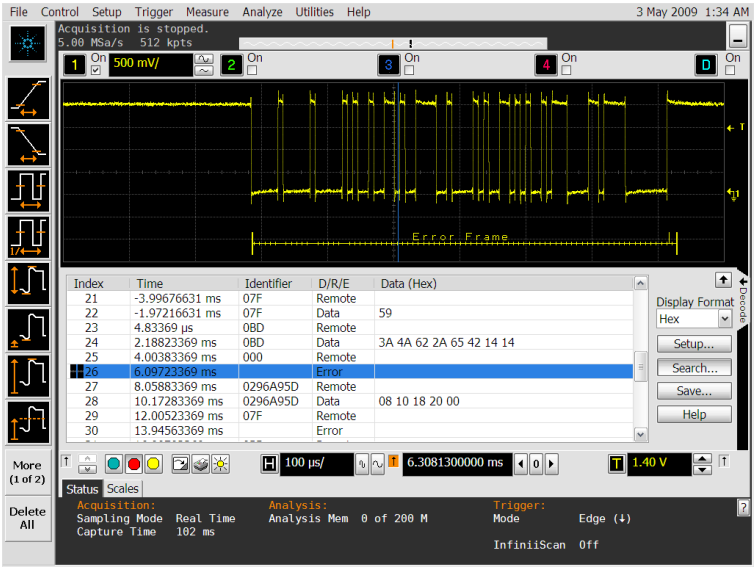
Set up serial decode:

6 Choose **Setup>Serial Decode...**.

7 In the Serial Decode dialog, select:



Then, click **Auto Setup** and **Close**.

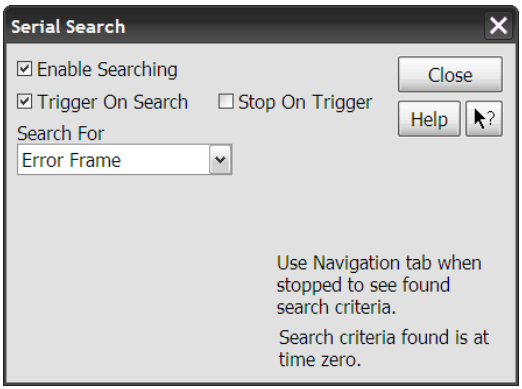


8 Press **[Single]**.

9 Move the mouse pointer over the serial decode symbols; then, click and drag the decode symbols below the waveform.

10 In the Decode window, click **Search...**.

11 In the Serial Search dialog, enable searching and triggering on error frames:



Then, click **Close**.

12 Press **[Run]**.

10 RS-232

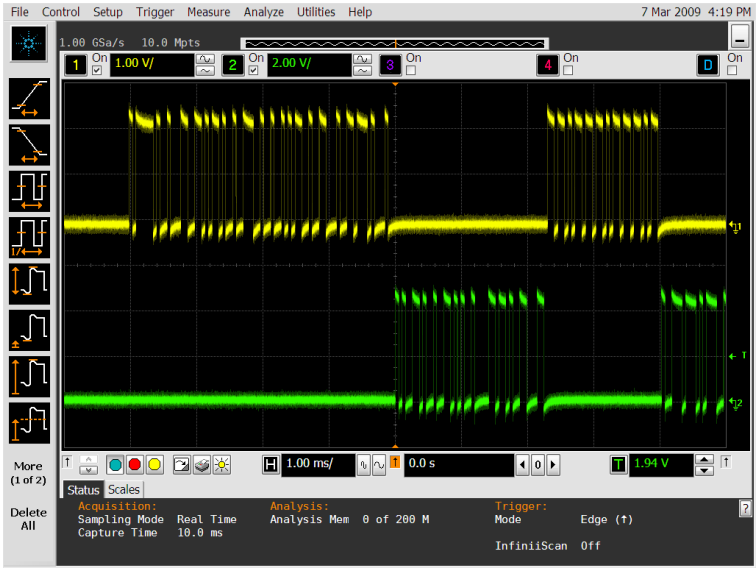
The RS-232/UART serial triggering and decode option displays responsive, time-aligned, on-screen decode of RS-232 and other UART serial buses. It provides triggering capabilities on specified transmit or receive values, as well as on parity errors.

To enable RS-232/UART serial decode, your oscilloscope must have the RS-232 option installed. (The installed options are listed in the **Help>About Infiniium...** dialog.)

Make connections and perform initial setup:

1. To power the demo board, connect a USB cable between it and the Agilent Infiniium 9000 Series oscilloscope.

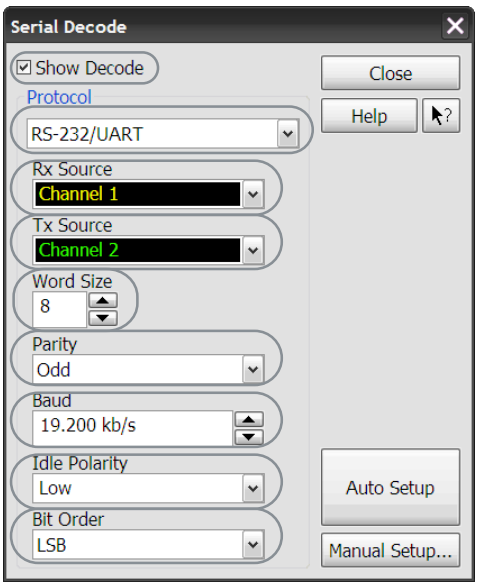
   You can also apply power by connecting the oscilloscope's MSO cable to the demo board's 40-pin connector.
2. Connect the scope channel 1 probe to demo board CH1 and GND.
3. Connect the scope channel 2 probe to demo board CH2 and GND.
4. Turn the SELECT switch to position 7 (RS-232).
5. Press **[Default Setup]**.
6. Press **[AutoScale]**.



Set up serial decode:

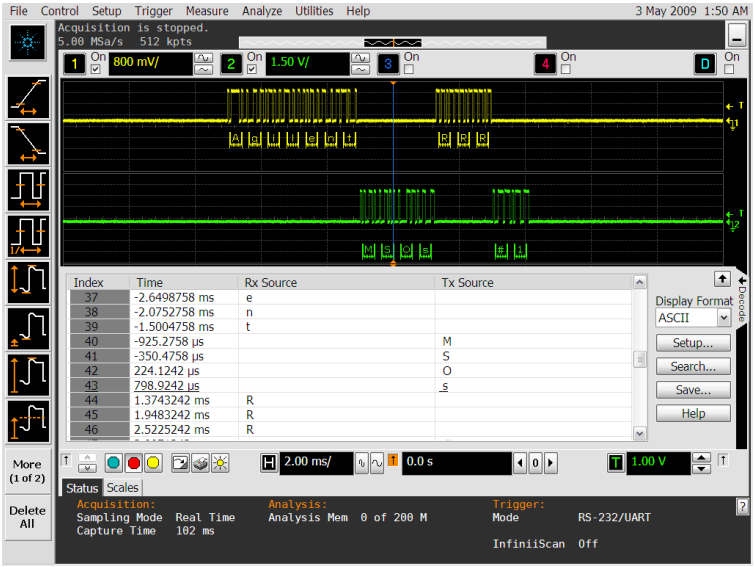
7 Choose **Setup>Serial Decode...**.

8 In the Serial Decode dialog, select:



Then, click **Auto Setup** and **Close**.

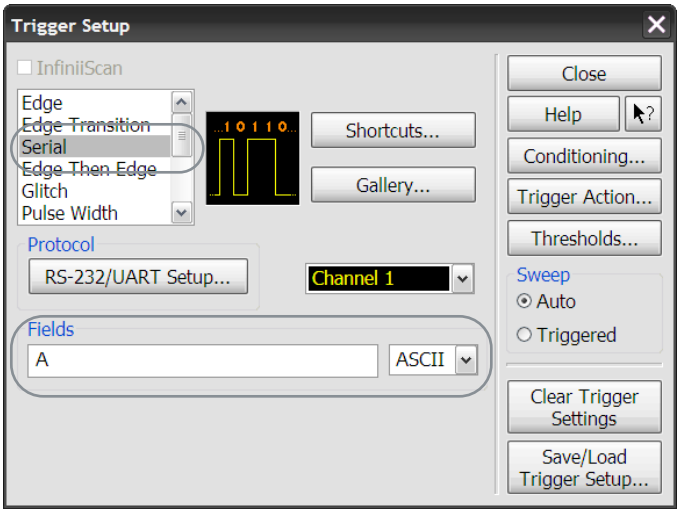
9 In the Decode window, select the **ASCII** display format.



Set up the trigger:

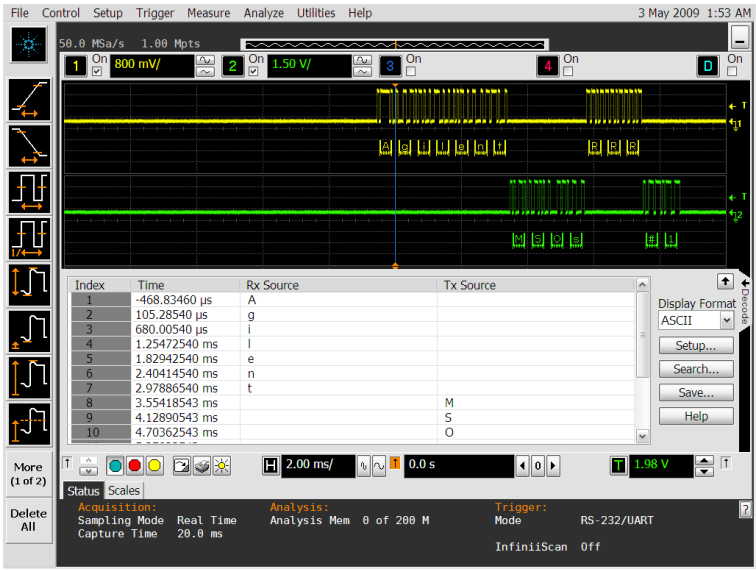
10 Choose **Trigger>Setup Trigger...** (or press **[Menu]** in the front panel Trigger controls).

11 In the Trigger Setup dialog, select:



Then, click **Close**.

12 Press **[Run]**.



11 Segmented Memory

Agilent's segmented memory feature can optimize your oscilloscope's acquisition memory, allowing you to capture more selective signal details with less memory and then easily view all captured waveforms and scroll through each individual waveform segment.

Make connections and perform initial setup:

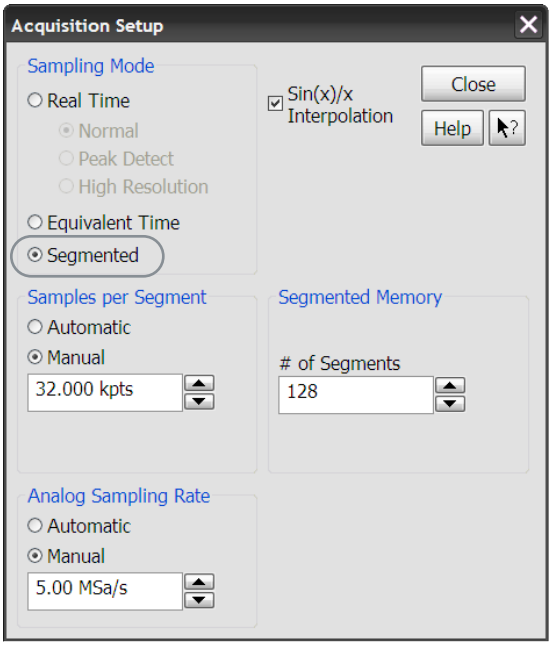
1. To power the demo board, connect a USB cable between it and the Agilent Infiniium 9000 Series oscilloscope.

   You can also apply power by connecting the oscilloscope's MSO cable to the demo board's 40-pin connector.
2. Connect the scope channel 1 probe to demo board CH1 and GND.
3. Connect the scope channel 2 probe to demo board CH2 and GND.
4. Connect the MSO cable between the oscilloscope and the demo board's 40-pin connector.
5. Turn the SELECT switch to position 6 (SPI).
6. Press **[Default Setup]**.
7. Press **[AutoScale]**.
8. Set the time base to 1 ms/div.
9. Press **[Single]**.

Set acquisition options:

10. From the on-screen main menu, choose **Setup>Acquisition...**.

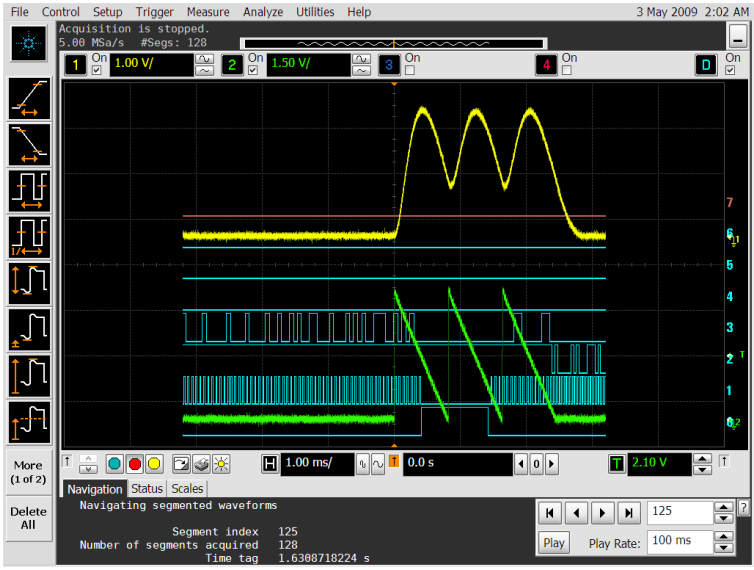
11 In the Acquisition Setup dialog, select:



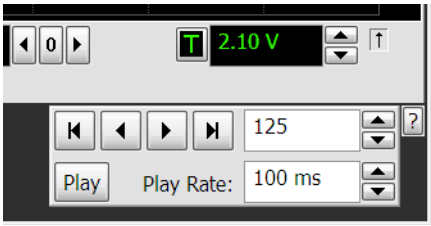
Then, click **Close**.

12 Press **[Single]** to capture the desired number of segments.

After the acquisition completes, notice the bottom portion of the screen has a tab for navigating through the segmented memory waveforms.

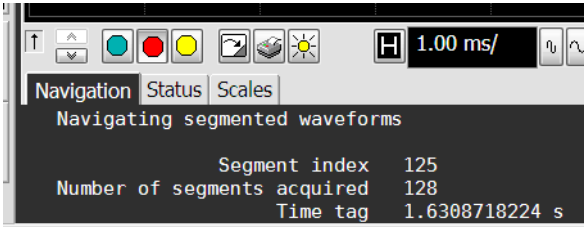


13 Use the forward, back, start, and end buttons to play through the acquired segments one by one.



14 Enter a play rate of 100 ms, and click **Play** to play back all the captured segments.

Note that time tags are kept for each segment.



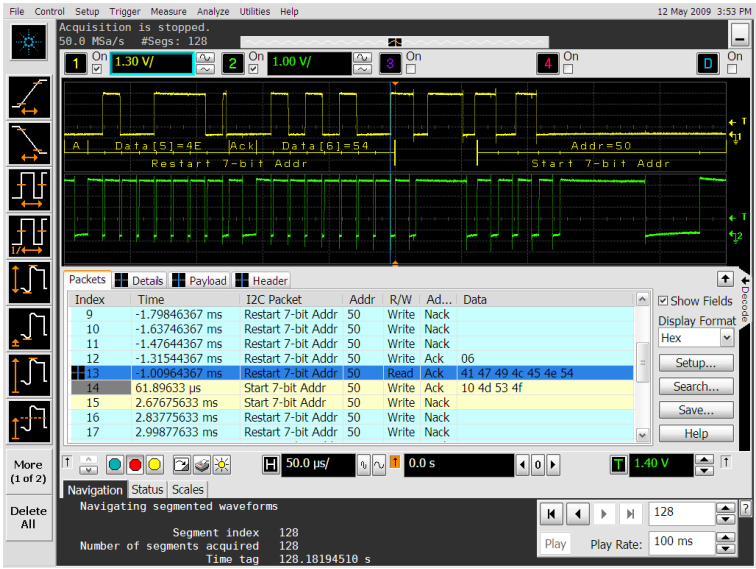
Combining Segmented Memory with Serial Triggering and Decode

Many serial buses have long periods of inactivity between bursts of packets. Using segmented memory with serial decode and triggering enables the oscilloscope to maximize the captured time window.

1 Make the I^2C demo board connections, perform initial setup, set up serial decode, and set up the trigger as shown in "I^2C" on page 45.

2 Set up the segmented memory acquisition as shown in "Set acquisition options:" on page 61.

3 Press **[Single]**.



You can see the number of segments acquired in upper left portion of the screen.

4 Part way through the acquisition, disconnect power to the demo board to stop I^2C traffic.

5 Wait a minute, and then re-apply power to the demo board.

When you finish acquiring segments, you will have acquired over a minute of capture with the help of segmented memory. Time tags between segments time out at 6.5 days.

12 Histograms

Histograms give you an easy way to evaluate statistics associated with waveforms. The low-cost demo board produces noise that appears as thick traces for any oscilloscope that captures its signals. Use a histogram to measure the amount of this noise.

Make connections and perform initial setup:

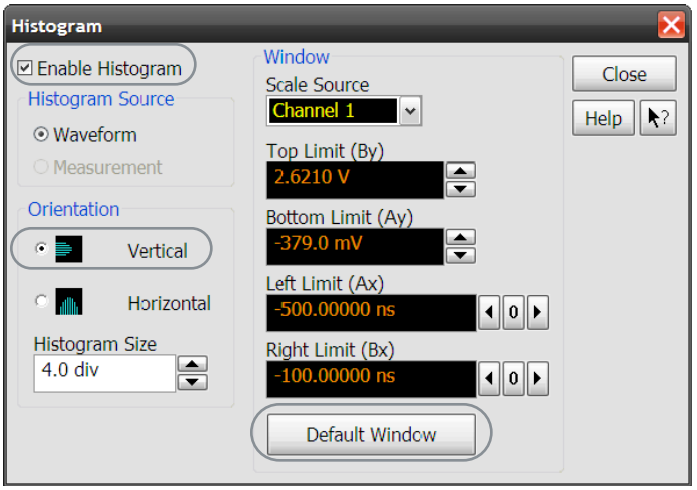
1. To power the demo board, connect a USB cable between it and the Agilent Infiniium 9000 Series oscilloscope.

   You can also apply power by connecting the oscilloscope's MSO cable to the demo board's 40-pin connector.
2. Connect the scope channel 1 probe to demo board CH1 and GND.
3. Make sure all other probes are disconnected from the oscilloscope.
4. Turn the SELECT switch to position 7 (RS-232).
5. Press **[Default Setup]**.
6. Press **[AutoScale]**.
7. Adjust the horizontal position to -300 ns.
8. Set the time base to 50 ns/div.
9. Adjust the channel 1 vertical scale to 500 mV/div.

Set up the histogram:

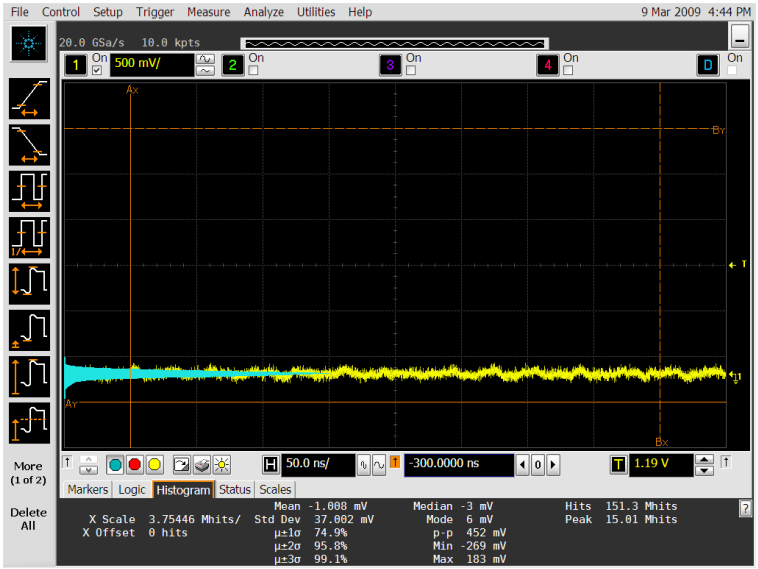
10. From the on-screen main menu, choose **Analyze>Histogram...**.

11 In the Histogram dialog, select:



Then, click **Close**.

Note the standard deviation and the number of total hits analyzed.



A
Using Trigger Holdoff to Synchronize Acquisition/Display on Complex Signals

Triggering on simple repetitive signals is easy using standard edge triggering. But if you need to synchronize your oscilloscope's acquisitions/display on more complex signals, such as an amplitude-modulated signal, you will need to use your oscilloscope's trigger hold-off capability unless there is an external synchronization signal available. This lab shows you how to use trigger holdoff to achieve a stable trigger in the absence of a synchronization signal.

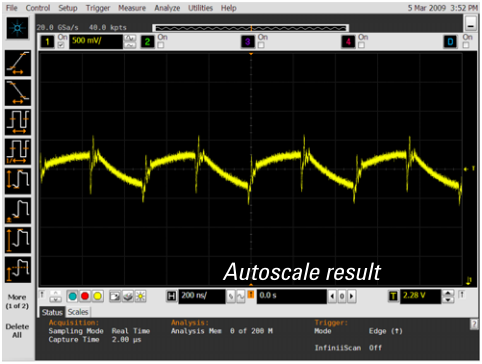
Make connections and perform initial setup:

1. To power the demo board, connect a USB cable between it and the Agilent Infiniium 9000 Series oscilloscope.

   You can also apply power by connecting the oscilloscope's MSO cable to the demo board's 40-pin connector.
2. Connect the scope channel 1 probe to demo board CH1 and GND.
3. **Make sure all other probes are disconnected from the oscilloscope**.
4. Turn the SELECT switch to position 1 (AM).
5. Press [**Default Setup**].

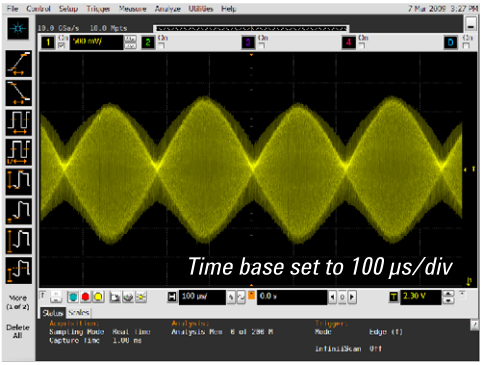
6 Press **[AutoScale]**.

Note that AutoScale sets up the triggering and horizontal display based on the carrier signal. However, our desire is to set up the oscilloscope's triggering based on the envelope of this complex AM signal.



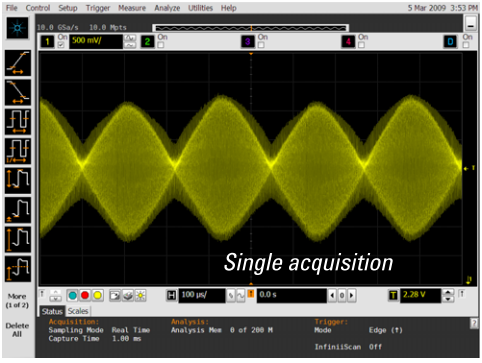
7 Change **time base setting** to 100 µs/div.

Note that the oscilloscope will appear to be untriggered.

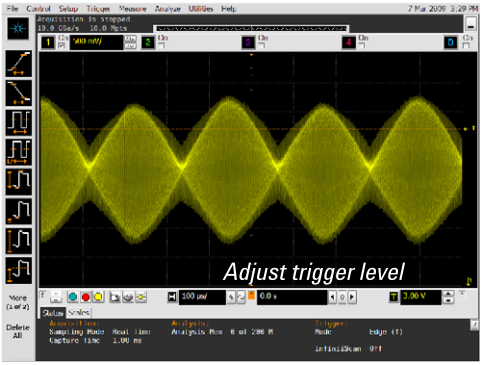


8 Press the **[Run/Stop]** key.

This will stop acquisitions and display the last acquisition on screen—the expected AM signal is now displayed on a single acquisition when stopped. Now let's set up the holdoff trigger value to achieve a stable trigger.

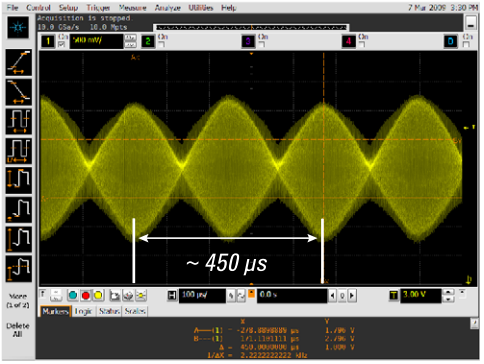


9 Adjust trigger level to approximately 3 volts, which is down approximately 1/3 below the highest peak. Using this level will provide potential re-arm times during the valleys of the envelope.



10 Estimate the cycle time of this complex signal – note that there are two unique envelopes per cycle time (use markers if you wish). Note that the cycle time is approximately 450 µs. On the front panel, press **[Markers]**, Manual Placement, and set Ax to top of peak of small envelope and Bx to top of the peak of the next small envelope. The delta is approximately 450 µs.

The correct holdoff time to achieve stable trigger on this signal is a value slightly less than this cycle time. Note that 400 µs should work.



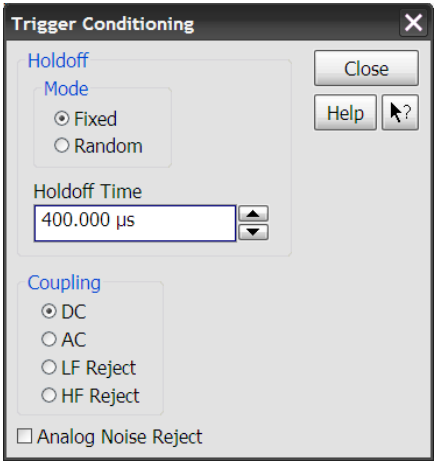
11 Press **[Run/Stop]** key to start unstable acquisitions again.

Set up the trigger:

12 From the on-screen main menu, choose **Trigger>Setup Trigger...** (or press **[Menu]** in the front panel Trigger controls).

13 In the Trigger Setup dialog, click **Conditioning...**.

14 In the Trigger Conditioning dialog, select the **Fixed** holdoff mode and enter a holdoff time of **400 µs**.



15 Click **Close** to close the open dialogs.

Holdoff is an under-utilized tool that can achieve stable trigger conditions on complex signals. The idea is that the trigger will arm on the first edge of the small envelope and will then ignore the rising edges of the large envelope as it will not rearm until 400 µs later and then trigger on the second small envelope.

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金属扣件 Metal fasteners	O	O	X	X	O	O
机械部件 Machined parts	X	O	O	O	O	O
连接器 Connectors	X	O	O	X	O	O
电缆 Cables	X	O	O	O	O	O
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