Mixed Signal Oscilloscope

Agilent's Mixed Signal Oscilloscopes (MSOs) allow you to trigger on and view up to 20 time-correlated channels. For a small per-channel cost, 16 digital channels can be integrated with any 6000 Series

These digital channels give you insight into today's complex hybrid analog-digital designs that traditional 2- and 4-channel oscilloscopes cannot.

All Agilent MSOs come with proprietary MegaZoom display and memory technology to give you the most analog-like performance available. And no other oscilloscopes give you more options for the analysis and debug of digital serial busses.

With an MSO, you are able to see multiple time-aligned analog, parallel, digital, and serially decoded waveforms on the same display. MSOs allow you to trigger on any combination of analog and digital signals – and in the case of the 6000 Series, on many popular serial bus protocols. You can do all of this with a single, easy-to-use oscilloscope interface.

Features

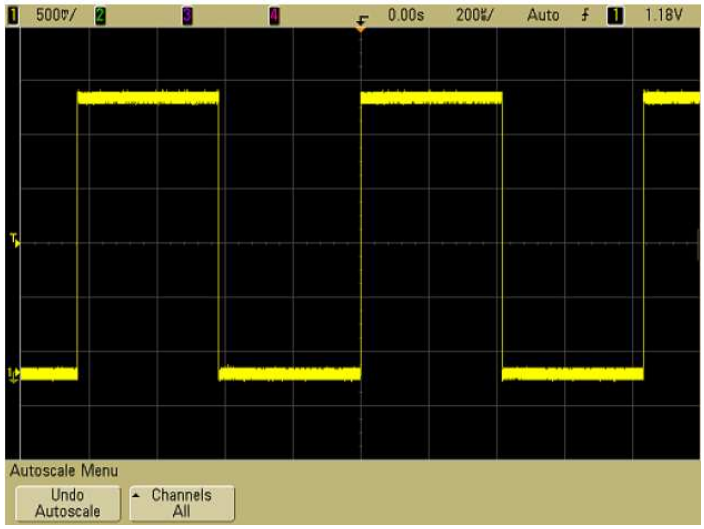
- Unique 2+16-channel and 4+16-channel mixed signal oscilloscopes (MSOs) models 2- or 4-channel DSO models
- MegaZoom III technology provides industry-leading performance with the:
- Most responsive deep memory
- Highest definition color display
- Fastest waveform update rates, uncompromised
- Powerful triggering including analog HDTV, I2C, SPI, LIN, CAN and USB
- More connectivity choices - LAN, USB, GPIB and XGA video are all included standard

Basic Oscilloscope Operations:

- à To verify basic oscilloscope operations we need to press the **Save/Recall** on the front panel and the press the default setup soft key. [This makes the Oscilloscope to be configured with default settings].

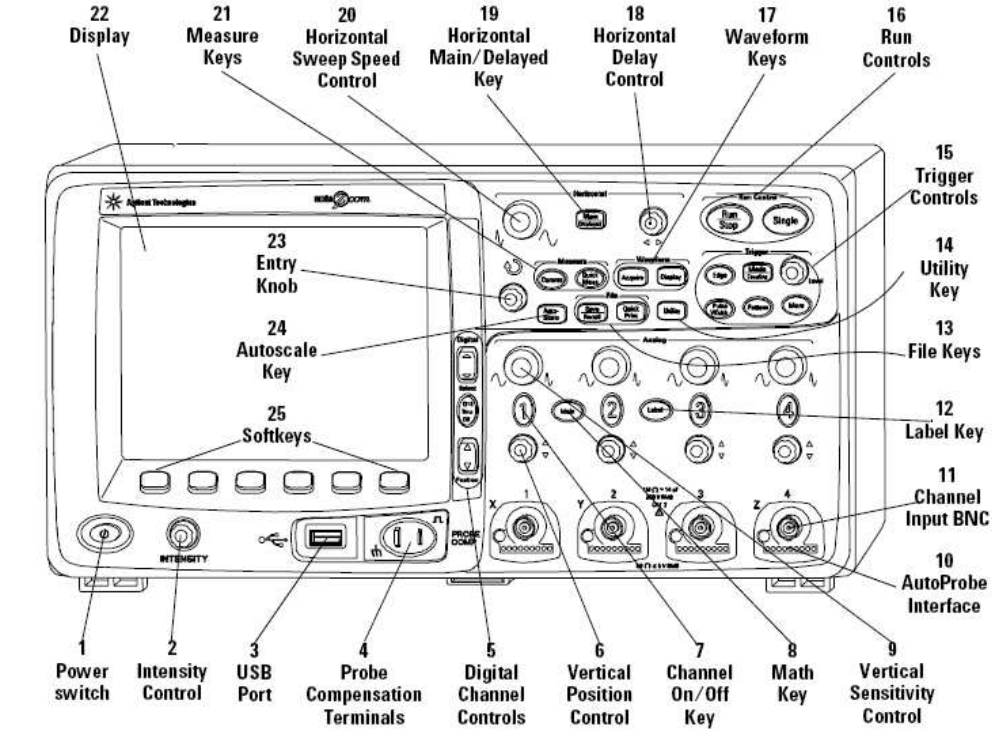
- à Connect the Oscilloscope probe from channel 1 to the **Probe Comp** signal terminal on the front panel. Connect the probe's ground to the ground terminal.

- à Press **Auto scale soft key** to see a basic waveform. The same procedure must be continued to verify the over and under compensated waveform in all the channels.



- à When we connect a probe that can be calibrated the **Calibrate probe Softkey** will be active then connecting the probe in the probe comp terminal will help us to calibrate the probes.

Some of the important front panel controls:



à **Probe Compensation Terminals** Use the signal at these terminals to match each probe's characteristics to the oscilloscope channel to which it is connected.

à **Digital Channel Controls** These controls switch the digital channels on/off, and can be used to select a digital channel for repositioning on the display

à **Vertical Position Control** Use this knob to change the channel's vertical position on the display. There is one Vertical Position control for each channel.

à **Channel On/Off Key** Use this key to switch the channel on or off, or to access the channel's menu in the soft keys.

à **Math Key** The Math key provides access to FFT (Fast Fourier Transform), multiply, subtract, differentiate, and integrate functions.

à **Vertical Sensitivity** Use this knob to change the vertical sensitivity (gain) of the channel.

à **AutoProbe Interface** When you connect a probe to the oscilloscope, the AutoProbe Interface attempts to determine the type of probe and set its parameters in the Probe menu accordingly.

à **Channel Input BNC Connector** Attach the oscilloscope probe or BNC cable to the BNC connector.

à **Utility Key** Press this key to access the Utility menu, which lets you configure the oscilloscope's I/O settings

à **File Keys** Press the File key to access file functions such as save or recall a waveform or setup.

à **Trigger Controls** These controls determine how the oscilloscope triggers to capture data.
à **Run Controls** Press Run/Stop to make the oscilloscope begin looking for a trigger. The Run/Stop key will illuminate in green. If the trigger mode is set to "Normal," the display will not update until a trigger is found. If the trigger mode is set to "Auto," the oscilloscope looks for a trigger, and if none is found, it will automatically trigger, and the display will immediately show the input signals.
à **Waveform Keys** The Acquire key lets you set the oscilloscope to acquire in Normal, Peak Detect, Averaging, or High Resolution modes and lets you turn Real-time sampling off or on
à **Horizontal Delay Control** When the oscilloscope is running, this control lets you set the acquisition window relative to the trigger point.
à **Horizontal Main/Delayed Key** Press this key to access the menu where you can split the oscilloscope display into Main and Delayed sections, and where you can select XY and Roll modes
à **Horizontal Sweep Speed Control** Turn this knob to adjust the sweep speed. These changes the time per horizontal division on the display.

Display Interpretation:

To display digital channels using Autoscale:

When signals are connected to the digital channels, Autoscale quickly configures and displays the digital channels.
• To configure the instrument quickly, press the **Autoscale** key. Any digital channel with an active signal will be displayed. Any digital channels without active signals will be turned off.

• To undo the effects of Autoscale, press the **Undo Autoscale** Softkey before pressing any other key. This is useful if you have unintentionally pressed the **Autoscale** key or do not like the settings Autoscale has selected.

To change the displayed size of the digital channels:

1 Press the **D15 Thru D0** key.
2 Press the size softkey to select how the digital channels are displayed.

To reposition a digital channel:

1 The **Digital Select** key is located on the front panel, just to the right of the display. Press either the up symbol or the down symbol on the **Digital Select** key to select the channel you want to move. The selected channel is highlighted in red. The "select" feature can also be used to highlight one of the digital channels for easy viewing.
2 Press either the up symbol or the down symbol on the **Digital Position** key, which is located below the **Digital Select** and **D15 Thru D0** keys. This moves the displayed channel up or down.

To change the logic threshold for digital channels:

1 Press the **D15 Thru D0** key so that the Digital Channel Menu is displayed.
2 Press the **Thresholds** softkey
3 Press the **D15 - D8** or **D7 - D0** softkey, then select a logic family preset or select **User** to define your own threshold.

Triggering Features:

The Agilent 6000 Series oscilloscopes provide a full set of features to help automate your measurement tasks. MegaZoom technology lets you capture and examine untriggered Waveforms. With these oscilloscopes you can:
• Modify the way the oscilloscope acquires data.
• Set up simple or complex trigger conditions as needed, to capture only the sequence of events you want to examine.
Triggering Features
• Trigger modes [Auto, Normal, Coupling (DC, AC, low frequency rejection) , Noise rejection , High frequency rejection]
• Trigger types: Edge (slope), Pulse width (glitch), Pattern, CAN , Duration, I2C, Nth Edge Burst, LIN, Sequence, SPI, TV, USB

To select the Mode and Coupling menu:

• Press the **Mode/Coupling** key in the Trigger section of the front panel.

Trigger modes: Normal and Auto:

1 Press the **Mode/Coupling** key.
2 Press the **Mode** softkey, then select **Normal** or **Auto**.
• **Normal** mode displays a waveform when the trigger conditions are met, otherwise the oscilloscope does not trigger and the display is not updated.
• **Auto** mode is the same as Normal mode, except it forces the oscilloscope to trigger if the trigger conditions are not met.

To select trigger Coupling:

1 Press the **Mode/Coupling** key.
2 Press the **Coupling** softkey, then select **DC, AC,** or **LF Reject** coupling.
• **DC** coupling allows DC and AC signals into the trigger path.
• **AC** coupling places a 10 Hz (3.5 Hz in 100 MHz bandwidth models) high-pass filter in the trigger path removing any DC offset voltage from the trigger waveform. The high-pass filter in the External Trigger input path is 3.5 Hz for all models. Use AC coupling to get a stable edge trigger when your waveform has a large DC offset.
• **LF** (low frequency) **Reject** coupling places a 50 kHz high-pass filter in series with the trigger waveform. Low frequency reject removes any unwanted low frequency components from a trigger waveform, such as power line frequencies, that can interfere with proper triggering. Use this coupling to get a stable edge trigger when your waveform has low frequency noise.
• **TV** coupling is normally grayed-out, but is automatically selected when TV trigger is enabled in the Trigger More menu.

To select trigger Noise Rejection and HF rejection:
1 Press the **Mode/Coupling** key.
2 Press the **Noise Rej** softkey to select noise reject or press the **HF Reject** softkey to select high frequency reject.
• **Noise Rej** adds additional hysteresis to the trigger circuitry. When noise reject is on, the trigger circuitry is less sensitive to noise but may require a greater amplitude waveform to trigger the oscilloscope.
• **HF Reject** adds a 50 kHz low-pass filter in the trigger path to remove high frequency components from the trigger waveform. You can use HF Reject to remove high-frequency noise, such as AM or FM broadcast stations or noise from fast system clocks, from the trigger path.

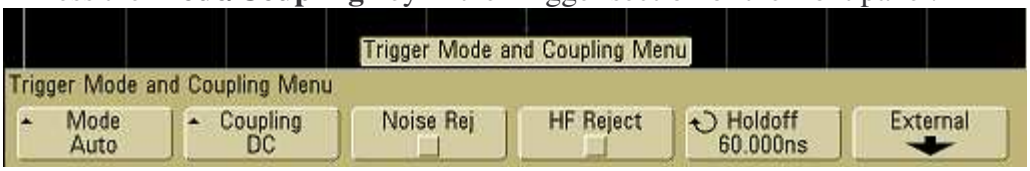
To set Holdoff:

1 Press the **Mode/Coupling** key.
2 Turn the Entry knob to increase or decrease the trigger Holdoff time shown in the **Holdoff** softkey.
Holdoff sets the amount of time that the oscilloscope waits before re-arming the trigger circuitry. Use Holdoff to stabilize the display of complex waveforms.

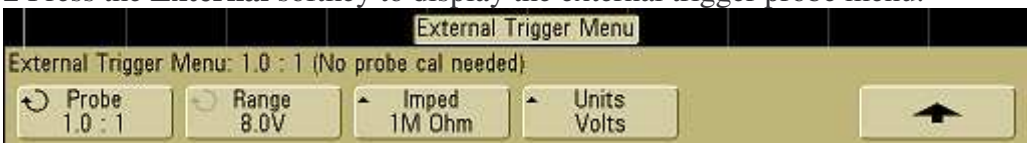
To Select External Trigger:

2-Channel oscilloscope External Trigger input
External Trigger Probe Settings

1 Press the **Mode/Coupling** key in the Trigger section of the front panel.

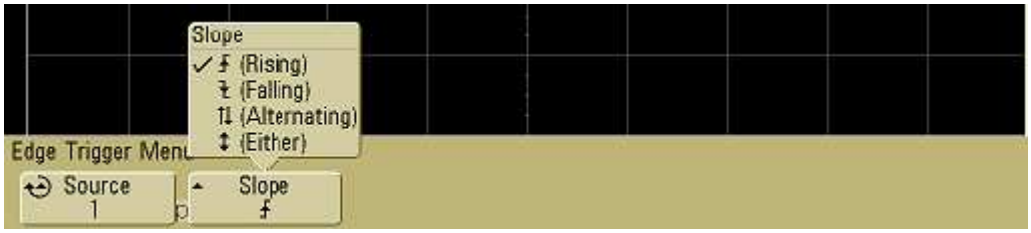


2 Press the **External** softkey to display the external trigger probe menu.



To use Edge triggering:

The Edge trigger type identifies a trigger by looking for a specified edge (slope) and voltage level on a waveform. You can define the trigger source and slope in this menu. The slope can be set to rising edge or falling edge, and can be set to alternating edges or either edge on all sources except Line. The trigger type, source, and level are displayed in the upper-right corner of the display.
1 Press the **Edge** key in the Trigger section of the front panel to display the Edge trigger menu.
2 Press the **Slope** softkey and select rising edge, falling edge, alternating edges, or either edge. The selected slope is displayed in the upper-right corner of the display.
3 Select the trigger source. You can select analog channel 1 or 2, Ext, or Line as the trigger source on any Agilent 6000 Series oscilloscope. The trigger source can also be set to channel 3 and 4 on the 4-channel oscilloscopes, or digital channels D15 through D0 on the mixed-signal oscilloscopes. The selected trigger source is indicated in the upper-right corner of the display next to the slope symbol:
1 through **4** = analog channels
D0 through **D15** = digital channels
E = External trigger
L = Line trigger



To use Pulse Width triggering:

Pulse Width (glitch) triggering sets the oscilloscope to trigger on a positive or negative pulse of a specified width. If you want to trigger on a specific timeout value, use **Duration** trigger in the Trigger **More** menu.

1 Press the **Pulse Width** key in the Trigger section of the front panel to display the Pulse Width trigger menu.

2 Press the **Source** softkey (or rotate the Entry knob on mixed-signal oscilloscopes) to select a channel source for the trigger.

3 Press the pulse polarity softkey to select positive or negative polarity for the pulse width you want to capture.

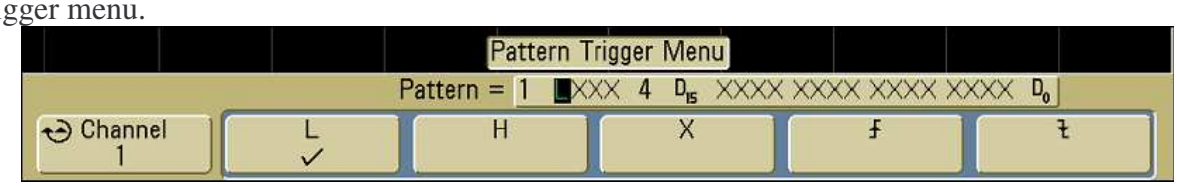
4 Press the qualifier softkey (**< > ><**) to select the time qualifier.

5 Select the qualifier time set softkey (**<** or **>**), then rotate the Entry knob to set the pulse width qualifier time.

To use Pattern triggering:

The Pattern trigger identifies a trigger condition by looking for a specified pattern. This pattern is a logical AND combination of the channels. Each channel can have a value of high (H), low (L), don't care (X). A rising or falling edge can be specified for one channel included in the pattern.

1 Press the **Pattern** key in the Trigger section of the front panel to display the Pattern trigger menu.



2 For each analog or digital channel you want to include in the desired pattern, press the **Channel** softkey to select the channel.

3 For each channel you select, press one of the condition softkeys to set the condition for that channel in the pattern

To use CAN triggering:

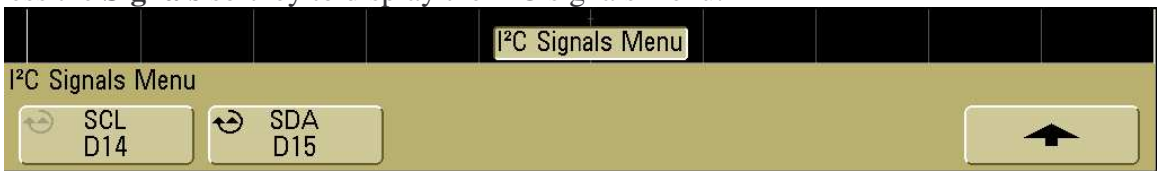
Controller Area Network (CAN) trigger will trigger on CAN version 2.0A and 2.0B signals. Setup consists of connecting the oscilloscope to a CAN signal. Press the **Settings** softkey to specify baud rate, signal source, and signal type to trigger on.
1 Press the **More** key in the Trigger section of the front panel, rotate the Entry knob until **CAN** is displayed in the **Trigger** softkey, then press the **Settings** softkey to display CAN trigger menu.

2 Press the **Baud** softkey to set the CAN signal baud rate to match your CAN bus signal.
3 Press the **Trigger:** softkey to select the trigger condition.
4 Press the **Signal** softkey to set the type and polarity of the CAN signal.
5 Press the **Source** softkey to select the channel connected to the CAN signal line.

To use I2C triggering:

An I2C (Inter-IC bus) trigger setup consists of connecting the oscilloscope to the serial data (SDA) line and the serial clock (SCL) line, then triggering on a stop/start condition, a restart, a missing acknowledge, an EEPROM data read, or on a read/write frame with a specific device address and data value.
1. Press the **More** key in the Trigger section of the front panel, rotate the Entry knob until **I2C** is displayed in the **Trigger** softkey, then press the **Settings** softkey to display the I2C trigger menu.

2 Press the **Signals** softkey to display the I2C signals menu.



3 Connect an oscilloscope channel to the SCL (serial clock) line in the circuit under test, then set the **SCL** clock channel softkey to that channel.
4 Connect an oscilloscope channel to the SDA (serial data) line in the circuit under test, then set the **SDA** data channel softkey to that channel.
5 Return to the previous menu; then, press the **Trigger**

To use SPI triggering:

Serial Peripheral Interface (SPI) trigger setup consists of connecting the oscilloscope to a clock, data, and framing signal. You can then trigger on a data pattern that occurs at the start of a frame. The serial data string can be specified to be from 4 to 32 bits long
1 Press the **Signals** softkey to access SPI trigger settings for clock source and slope, data source, and frame type and source.

2 Press the **Clock** softkey or turn the Entry knob to select the channel connected to the SPI serial clock line.
3 Press the slope softkey ( ) to select rising edge or falling edge for the selected Clock source.
4 Press the **Data** softkey or turn the Entry knob to select the channel that is connected to the SPI serial data line.
5 Press the **Frame by** softkey to select a framing signal that the oscilloscope will use for determining which clock edge is the first clock edge in the serial stream.
6 Press the up-arrow softkey to return to the previous menu.

Modes Of operation:

To use the XY horizontal mode:

The XY horizontal mode converts the oscilloscope from a volts-versus-time display to a volts-versus-volts display using two input channels. Channel 1 is the X-axis input; channel 2 is the Y-axis input. You can use various transducers so the display could show strain versus displacement, flow versus pressure, volts versus current, or voltage versus frequency. This exercise shows a common use of the XY display mode by measuring the phase difference between two signals of the same frequency with the Lissajous method.
1 Connect a sine wave signal to channel 1, and a sine wave signal of the same frequency but out of phase to channel 2.
2 Press the **Autoscale** key, press the **Main/Delayed** key, then press the **XY** softkey.
3 Center the signal on the display with the channel 1 and 2 position ( ) knobs. Use the channel 1 and 2 volts/div knobs and the channel 1 and 2 **Vernier** softkeys to expand the signal for convenient viewing.
4 Press the **Cursors** key.
5 Set the Y2 cursor to the top of the signal, and set Y1 to the bottom of the signal.
6 Move the Y1 and Y2 cursors to the intersection of the signal and the Y axis.
7 Calculate the phase difference

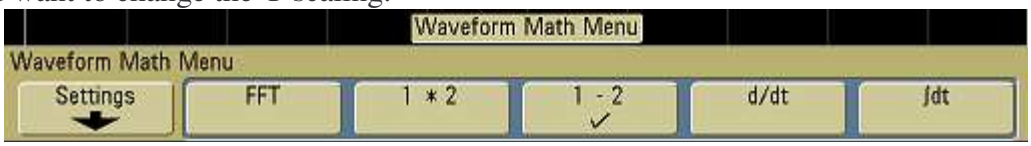
Math Functions:

The Math menu lets you display math functions on analog channels. You can:
• subtract (–) or multiply (*) the signals acquired on analog channels 1 and 2, and then display the result.

• integrate, differentiate, or perform an FFT on the signal acquired on any analog channel or on math functions 1 * 2, 1 – 2, or 1 + 2, then display the result.

To access math functions:

1 Press the **Math** key on the front panel to display the Math menu. After selecting a math function, press the **Settings** softkey to display settings for the selected math function if you want to change the Y scaling.



2 Customized scale and offset can be given to the signals. The math operations that can be done with the signals are FFT, Convolution, difference signal, Differentiation, Integration