
Configuring the Mixed-Signal Oscilloscope

This section describes how to configure the following items for the Mixed-Signal Oscilloscope, including changing the logic threshold for input signals.

To display digital channels using Autoscale

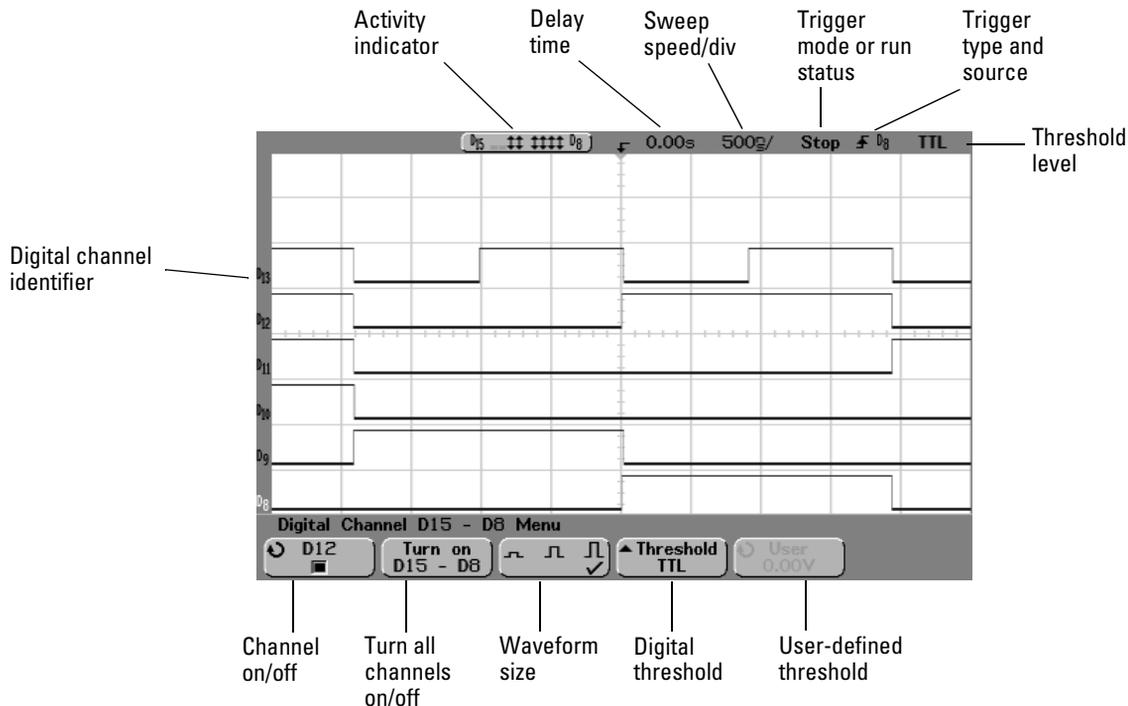
When signals are connected to the digital channels, Autoscale quickly configures and displays the digital channels.

- 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.
- To set the instrument to the factory-default configuration, press the **Save/Recall** key, then press the **Default Setup** softkey.



Interpreting the digital waveform display

The following figure shows a typical display with digital channels.



Activity indicator

When any digital channels are turned on, an activity indicator is displayed in the status line at the top of the display. A digital channel can be always high (■), always low (■), or actively toggling logic states (↕). Any channel that is turned off will be grayed out in the activity indicator.

To display and rearrange the digital channels

- 1 Press the **D15 Thru D8** key or **D7 Thru D0** key to turn the display of the digital channels on or off.

Digital channels are displayed when the **D15 Thru D8** or **D7 Thru D0** key is illuminated.

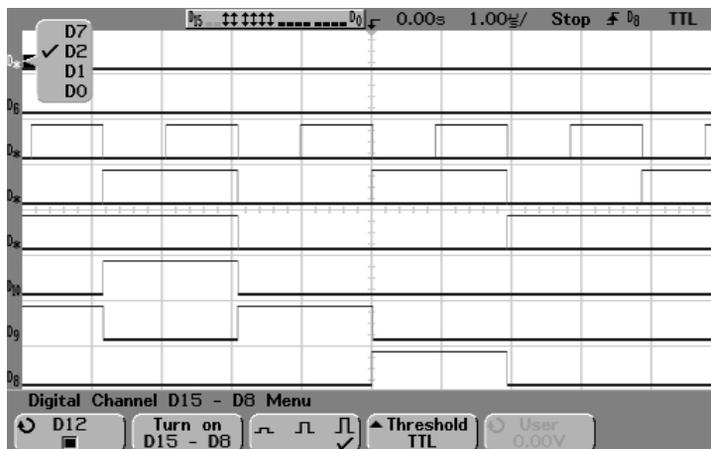
- 2 Turn the Digital Channel Select knob to select a digital channel.

As you turn the Channel Select knob, the selected channel number is highlighted on the left side of the display.

- 3 Turn the Digital position knob to reposition the selected channel on the display.

If two or more channels are displayed at the same vertical position, the channel number will be shown as **D*** on the left side of the display. When you use the Channel Select knob to select this channel, a pop up will appear showing the list of overlaid channels. Continue turning the Channel Select knob until the desired channel within the pop up is selected. You can also use this feature to bus several signals together on the display.

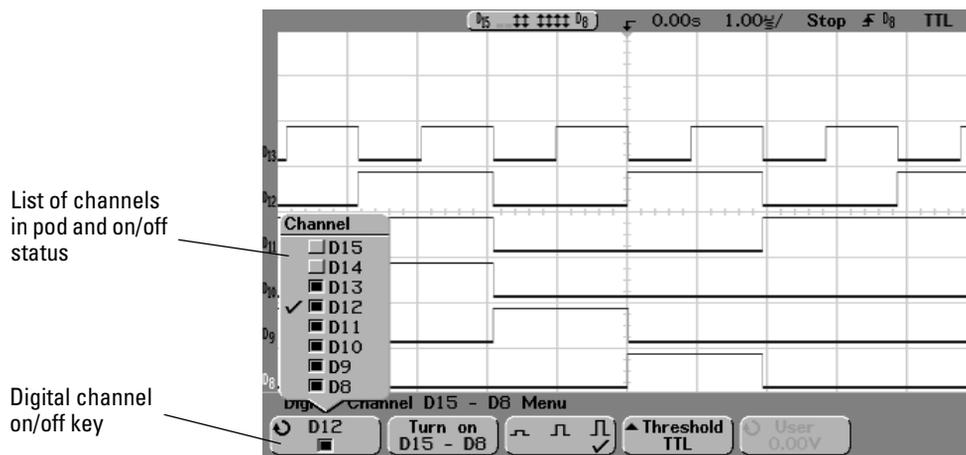
List of stacked channels



To turn individual channels on and off

Individual channels within the pod group can be turned on or off.

- 1 Press the **D15 Thru D8** key or **D7 Thru D0** key.
- 2 Turn the Entry knob to select a digital channel to turn on or off.
If the **User** threshold softkey was previously selected, make sure you press the digital channel on/off softkey to assign it to the Entry knob.



- 3 After you have selected the channel, press the channel on/off key to turn the channel on or off.

When the channel is on, the box in the channel on/off softkey is filled (■); when channel is off, the box is not filled (□).

To force all channels on or all channels off

- 1 Press the **D15 Thru D8** key or **D7 Thru D0** key.
- 2 Press the **Turn on** (or **Turn off**) softkey.

Each time you press this softkey, the softkey toggles between **Turn on** and **Turn off**. When pressed, this softkey forces all digital channels in the selected pod to be turned on or to be turned off.

To turn one or more of the individual channels back off or on, turn the Entry knob to select the desired channel, then press the channel on/off softkey to turn the channel on or off.

Turn on/Turn off softkey and D15 Thru D8/D7 Thru D0 key differences

The **Turn on/Turn off** softkey toggles the on/off state of the channels. The **D15 Thru D8/D7 Thru D0** front-panel key toggles the display state of the channels. Toggling the display state means you can setup what channels you want to see, then quickly hide or display the channels by pressing the **D15 Thru D8/D7 Thru D0** key.

To change the display size of the digital channels

- 1 Press the **D15 Thru D8** key or **D7 Thru D0** key.
- 2 Press the size (  ) softkey to select how the digital channels are displayed.

The sizing control allows you to spread out or compress the digital traces vertically on the display for more convenient viewing. Setting the size in either digital channel menu determines the size for all displayed digital channels.

Select  to display 8 channels or  to display 16 channels full screen.

Select  to display 16 channels in half of the display.

To change the logic threshold for digital channels

- 1 Press the **D15 Thru D8** key or **D7 Thru D0** key.
- 2 Press the **Threshold** softkey, then select a logic family preset or select **User** to define your own threshold.

Logic family	Threshold Voltage
TTL	1.4 V
CMOS	2.5 V
ECL	-1.3 V
User	Variable from -8 V to +8 V

The threshold you set applies to all channels within the selected **D15 Thru D8** or **D7 Thru D0** group. Each of the two channel groups can be set to a different threshold, if desired.

Values greater than the set threshold are high (H) and values less than the set threshold are low (L).

- 3 When the **Threshold** softkey is set to **User**, press the **User** softkey, then turn the **Entry** knob to set the logic threshold voltage for the channel group.

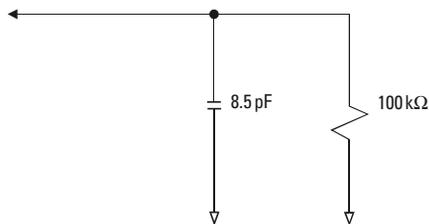
Using Digital Channels to Probe Circuits

You may encounter problems when using the mixed-signal oscilloscope that are related to probing. These problems fall into two categories: probe loading and probe grounding. Probe loading problems generally affect the circuit under test, while probe grounding problems affect the accuracy of the data to the measurement instrument. The design of the probes minimizes the first problem, while the second is easily addressed by good probing practices.

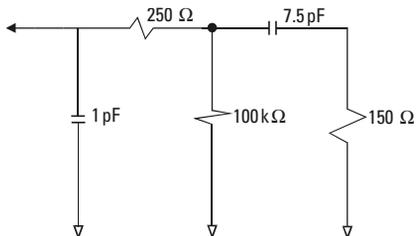
Input Impedance

The logic probes are passive probes, which offer high input impedance and high bandwidths. They usually provide some attenuation of the signal to the oscilloscope, typically 20 dB.

Passive probe input impedance is generally specified in terms of a parallel capacitance and resistance. The resistance is the sum of the tip resistor value and the input resistance of the test instrument (see the following figure). The capacitance is the series combination of the tip compensating capacitor and the cable, plus instrument capacitance in parallel with the stray tip capacitance to ground. While this results in an input impedance specification that is an accurate model for DC and low frequencies, the high-frequency model of the probe input is more useful (see the following figure). This high-frequency model takes into account pure tip capacitance to ground as well as series tip resistance, and the cable's characteristic impedance (Z_0).

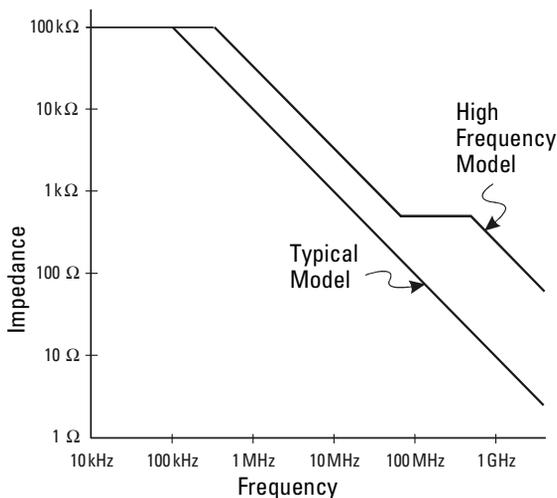


DC and Low-Frequency Probe Equivalent Circuit



High-Frequency Probe Equivalent Circuit

The impedance plots for the two models are shown in these figures. By comparing the two plots, you can see that both the series tip resistor and the cable's characteristic impedance extend the input impedance significantly. The stray tip capacitance, which is generally small (1 pF), sets the final break point on the impedance chart.



Impedance versus Frequency for Both Probe Circuit Models

The logic probes are represented by the high-frequency circuit model shown above. They are designed to provide as much series tip resistance as possible. Stray tip capacitance to ground is minimized by the proper mechanical design of the probe tip assembly. This provides the maximum input impedance at high frequencies.

MegaZoom Concepts and Oscilloscope Operation

Using Digital Channels to Probe Circuits

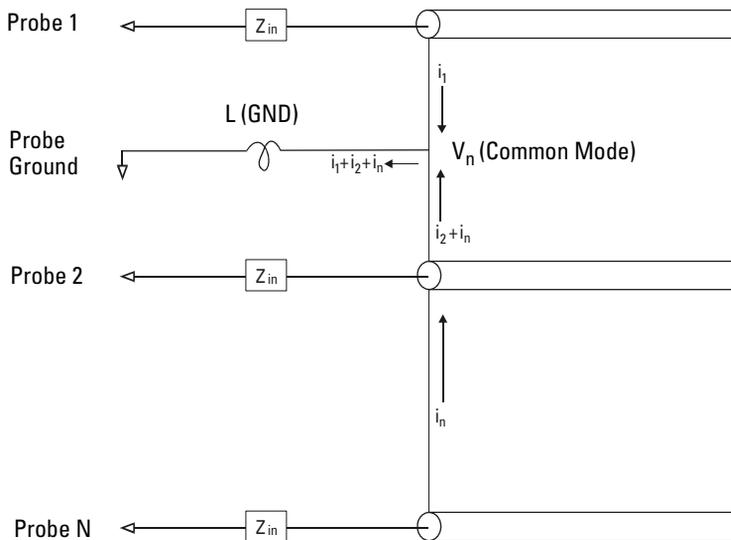
Probe Grounding

A probe ground is the low-impedance path for current to return to the source from the probe. Increased length in this path will, at high frequencies, create large common mode voltages at the probe input. The voltage generated behaves as if this path were an inductor according to the equation:

$$V = L \frac{di}{dt}$$

Increasing the ground inductance (L), increasing the current (di) or decreasing the transition time (dt), will all result in increasing the voltage (V). When this voltage exceeds the threshold voltage defined in the oscilloscope, a false data measurement will occur.

Sharing one probe ground with many probes forces all the current that flows into each probe to return through the same common ground inductance of the probe whose ground return is used. The result is increased current (di) in the above equation, and, depending on the transition time (dt), the common mode voltage may increase to a level that causes false data generation.



Common Mode Input Voltage Model

In addition to the common mode voltage, longer ground returns also degrade the pulse fidelity of the probe system. Rise time is increased, and ringing, due to the undamped LC circuit at the input of the probe, is also increased. Because the digital channels display reconstructed waveforms, they do not show ringing and perturbations. You will not find ground problems through examination of the waveform display. In fact, it is likely you will discover the problem through random glitches or inconsistent data measurements. Use the analog channels to view ringing and perturbations.

Best Probing Practices

Because of the variables L , di , and dt , you may be unsure how much margin is available in your measurement setup. The following are guidelines for good probing practices:

- The ground lead from each digital channel group (D15–D8 and D7–D0) should be attached to the ground of the circuit under test if any channel within the group is being used for data capture.
- When capturing data in a noisy environment, every third digital channel probe's ground should be used in addition to the channel group's ground.
- High-speed timing measurements (rise time < 3 ns) should make use of each digital channel probe's own ground.

When designing a high-speed digital system, you should consider designing dedicated test ports that interface directly to the instrument's probe system. This will ease measurement setup and ensure a repeatable method for obtaining test data. The 01650-61607 16-channel logic probe and termination adapter is designed to make it easy to connect to industry-standard, 20-pin board connectors. This probe consists of a 2 m logic analyzer probe cable and a 01650-63203 termination adapter that provides the proper RC networks in a very convenient package. Three 20-pin, low-profile, straight board connectors are included. Additional board connectors can be ordered from Agilent Technologies.

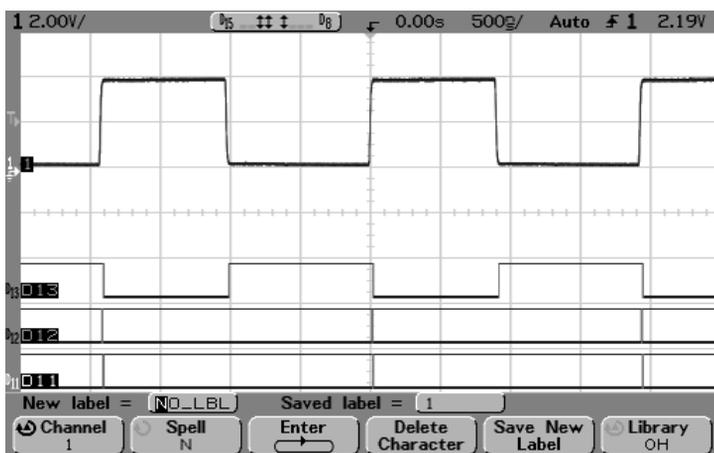
Using Labels on the Mixed-Signal Oscilloscope

The Mixed-Signal Oscilloscopes allow you to define and assign labels to each input channel, or you can turn labels off to increase the waveform display area.

To turn the label display on or off

- 1 Press the **Label** key in the Digital section of the front panel.

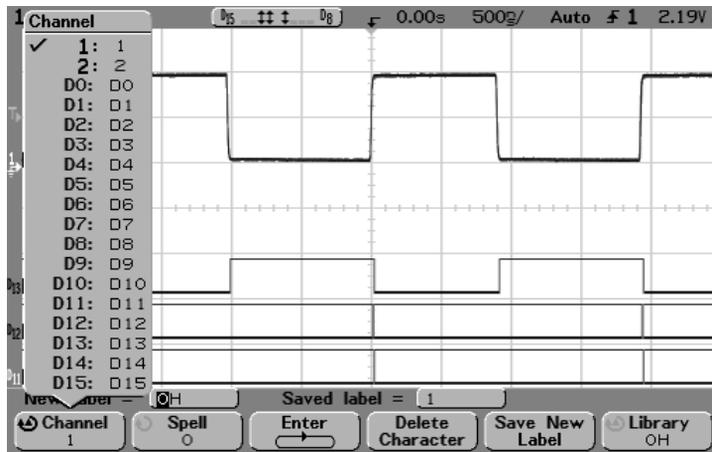
This turns on display labels for the analog and digital channels. When the **Label** key is illuminated, the labels for displayed channels are displayed on the left side of the displayed traces. When labels are on, the label is also displayed in softkeys for the selected channel or source. The figure below shows an example of the default labels assigned when you turn the label display on. The channel labels default to their channel number.



- 2 To turn the labels off, press the **Label** key until it is not illuminated.

To assign a predefined label to a channel**To assign a predefined label to a channel**

- 1 Press the **Label** key.
- 2 Press the **Channel** softkey, then turn the Entry knob or successively press the softkey to select a channel for label assignment.



The figure above shows the list of channels and their default labels. The channel does not have to be turned on to have a label assigned to it.

- 3 Press the **Library** softkey, then turn the Entry knob or successively press the **Library** softkey to select a predefined label from the library.
- 4 Press the **Save New Label** softkey to assign the label to your selected channel.
- 5 Repeat the above procedure for each predefined label you want to assign to a channel.

To define a new label

- 1 Press the **Label** key.
- 2 Press the **Channel** softkey, then turn the Entry knob or successively press the softkey to select a channel for label assignment.
The channel does not have to be turned on to have a label assigned to it.
- 3 Press the **Spell** softkey, then turn the Entry knob to select the first character in the new label.
Turning the Entry knob selects a character to enter into the highlighted position shown in the "**New label =**" line above the softkeys and in the **Spell** softkey. Labels can be up to six characters in length.
- 4 Press the **Enter** softkey to enter the selected character and to go to the next character position.
You may position the highlight on any character in the label name by successively pressing the **Enter** softkey.
- 5 To delete a character from the label, press the **Enter** softkey until the letter you want to delete is highlighted, then press the **Delete Character** softkey.
- 6 When you are done entering characters for the label, press the **Save New Label** softkey to assign the label to the selected channel.
When you define a new label, it is added to the non-volatile label list.

Label Assignment Auto-Increment Features

When you assign a label ending in a digit, such as ADDR0 or DATA0, the oscilloscope automatically increments the digit and displays the modified label in the "New label" field after you press the **Save New Label** softkey. Therefore, you only need to select a new channel and press the **Save New Label** softkey again to assign the label to the channel. Only the original label is saved in the label list. This feature makes it easier to assign successive labels to numbered control lines and data bus lines.

To define a new label

Label List Management

When you press the **Library** softkey, you will see a list of the last 75 labels used. The list does not save duplicate labels. Labels can end in any number of trailing digits. As long as the base string is the same as an existing label in the library, the new label will not be put in the library. For example, if label A0 is in the library and you make a new label called A12345, the new label is not added to the library.

When you save a new user-defined label, the new label will replace the oldest label in the list. Oldest is defined as the longest time since the label was last assigned to a channel. Any time you assign any label to a channel, that label will move to the newest in the list. Thus, after you use the label list for a while, your labels will predominate, making it easier to customize the instrument display for your needs.

When you reset the label library list (see next topic), all of your custom labels will be deleted, and the label list will be returned to its factory configuration.

To reset the label library to the factory default

- 1 Press the **Utility** key, then press the **Options** softkey.

CAUTION

Pressing the Default Library softkey will remove all user-defined labels from the library and set the labels back to the factory default. Once deleted, these user-defined labels cannot be recovered.

- 2 Press the **Default Library** softkey.

This will delete all user-defined labels from the library and set the labels in the library back to the factory default. However, this does not default the labels currently assigned to the channels (those labels that appear in the waveform area).

Defaulting labels without erasing the default library.

Selecting **Default Setup** in the **Save/Recall** menu will set all channel labels back to the default labels (1, 2, D15-D0), but does not erase the list of user-defined labels in the Library.