Using the Agilent Technologies MSO-X 2012A Mixed Signal Oscilloscope

1) Initial Turn-On Procedure

To turn on the oscilloscope, press the power button in the lower left hand corner of the device. The machine will take about 30 seconds or so to boot up. The scope will power up to the state that it was last in when it powered off. To restore the factory defaults, press the "Default Setup" button in the upper right hand corner. Factory default screen should look like the image in Figure 1.

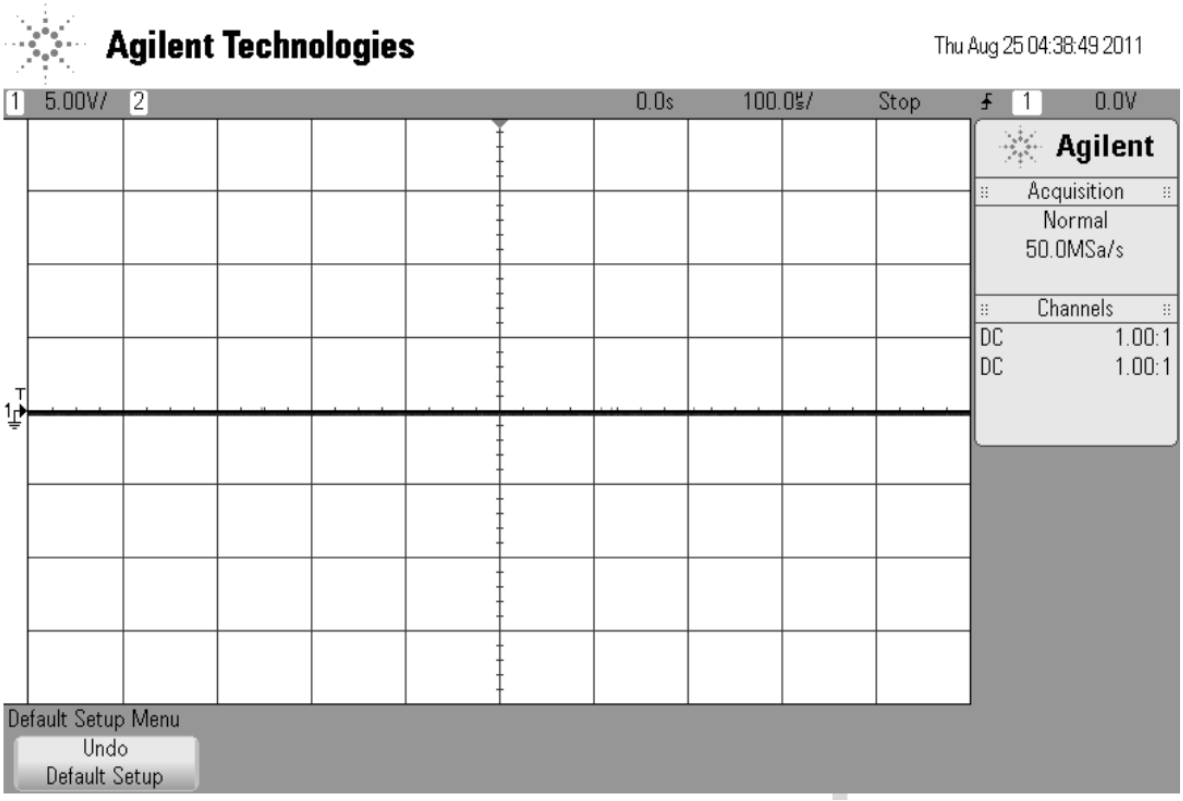


Figure 1: The factory default screen

The nameless buttons located under the screen are referred to as "soft keys". Press these keys to perform the action labeled on the screen above the key. For example, the button functionality will change if you hit the "Horiz" button in the upper left hand corner of the scope, and you will see the screen shown in Figure 2.

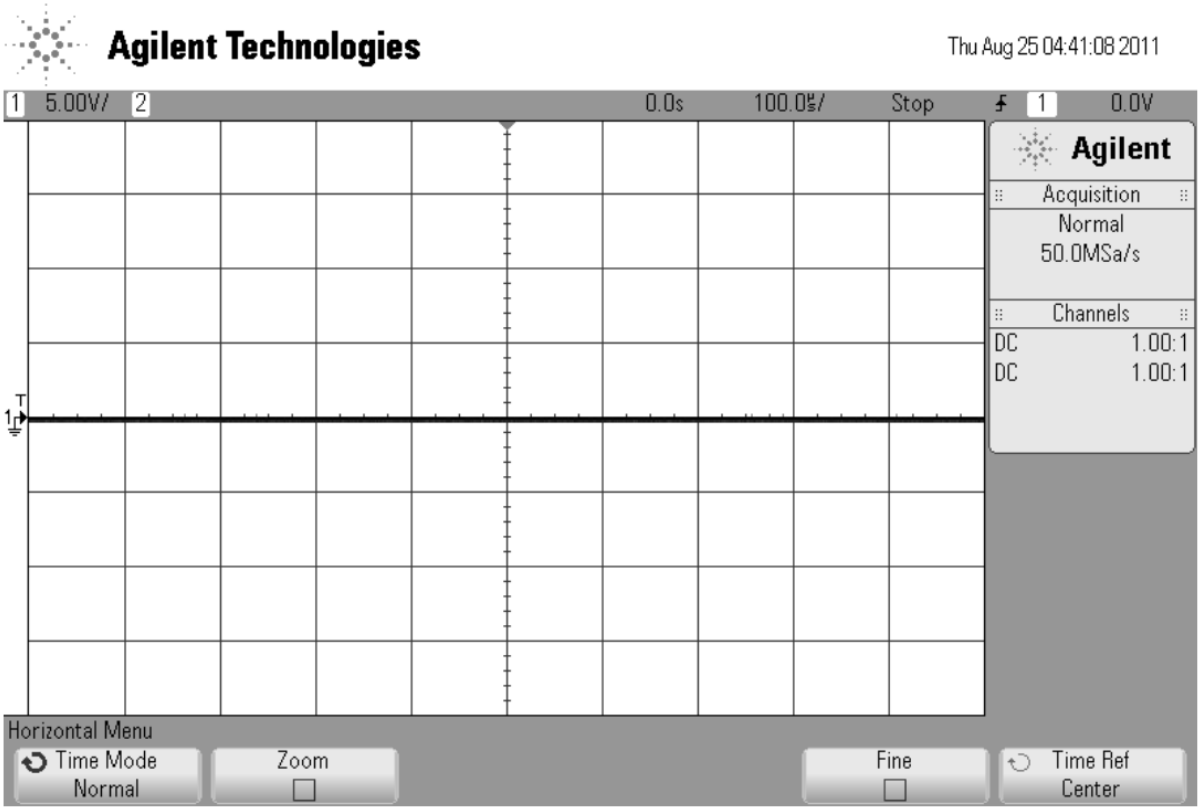


Figure 2: The “Horiz” screen

In this menu, the soft keys ordered left to right will perform the following actions: Adjust the Time Mode, Zoom, Nothing, Nothing, Turn on Fine control, and change the time reference. If at any time you are unsure of what one of these options mean, you can press and hold the corresponding soft key for a couple seconds and a help menu will describe the option.

2) Testing the Scope

The BNC cables are used to connect the scope to your circuit. The scope has two channels which can be used to simultaneously display two different waveforms. You can test the oscilloscope by attaching a BNC cable to channel 1 and then attach the black probe to the "ground" pin on the front of the scope and then attaching the red probe to the "Demo 2" pin on the front of the scope. Do this and hit the "Auto Scale" button in the upper right hand corner of the device and you should see an image similar to the one Figure 3.

The "Auto Scale" button is arguably the most useful button on the scope. This button will attempt to automatically scale the input waveform to an image that is easy to view. The shape of the input waveform can be manually adjusted with the Horizontal and Vertical controls.

3) Vertical Controls

The Vertical Control knobs are located above and below the "1" and "2" buttons to the right of the main display. The smaller knobs below these buttons control the vertical position of the waveforms on channels 1 and 2. The knobs above the 1 and 2 buttons control the vertical scale of the waveforms (e.g., whether the vertical divisions on the grid represent 1mV, 100mV, 1V, etc...).

4) Horizontal Controls

The Horizontal Control knob located next to the upper right hand corner of the screen controls the time scale (x-axis) of the oscilloscope. The "Horiz" button located next to this knob brings up soft key options that are useful for finely tuning the horizontal display.

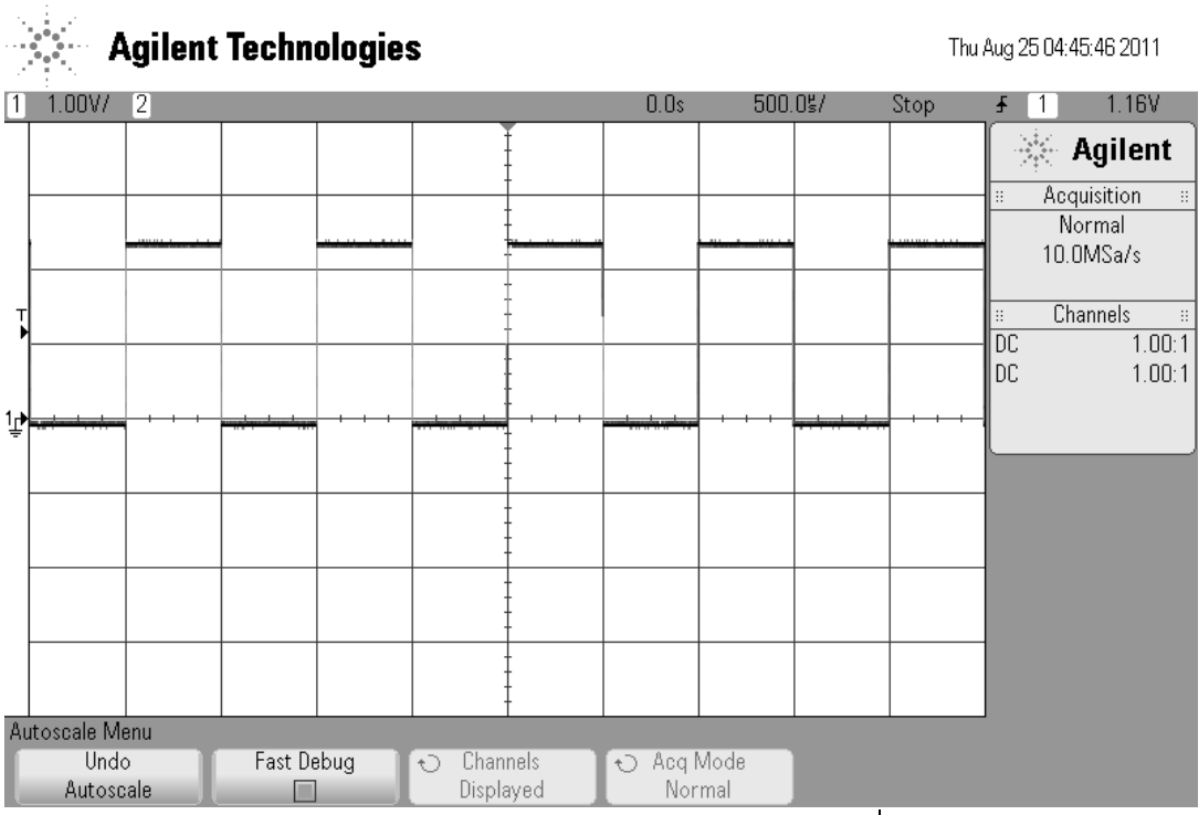
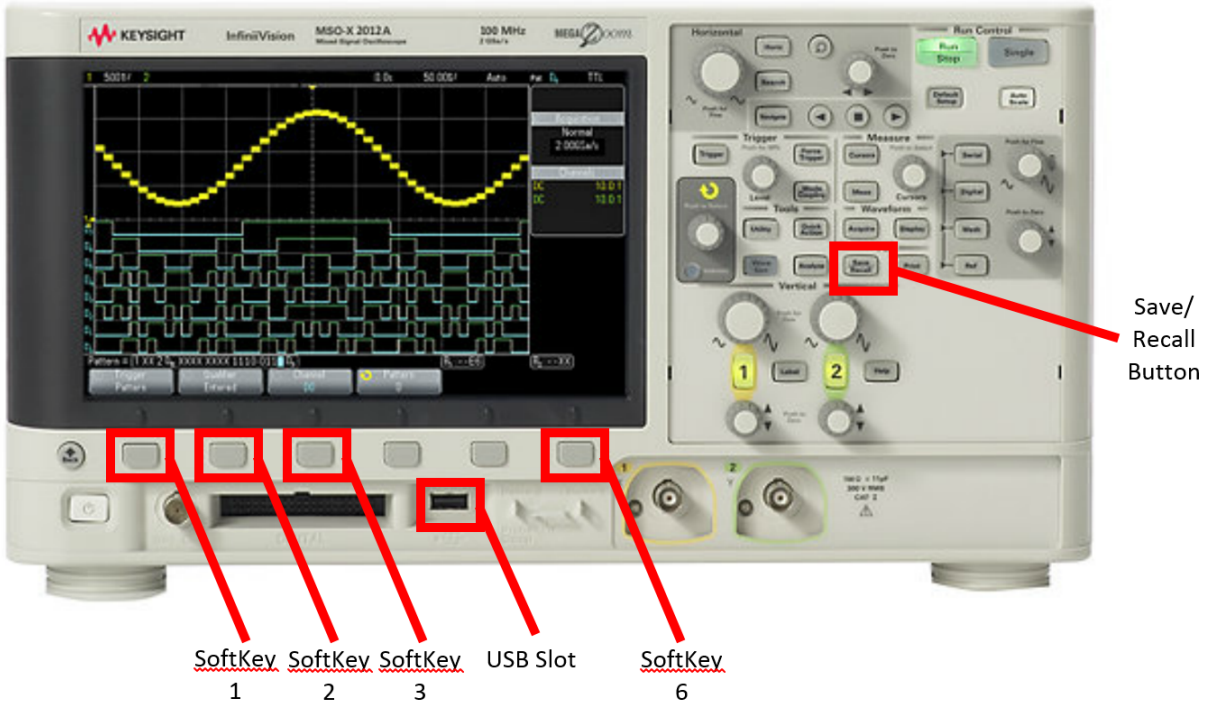


Figure 3: The waveform for Demo 2

Triggering

A scope requires a trigger input. A **trigger** is an event that tells the scope when to start recording data. This event is usually set to occur when one of the scope inputs crosses a threshold. For example, you could set the trigger to be when CH1 has a rising edge that crosses 1.65V. At that point in the scope will begin recording data and displaying it on the screen.

This is a subtle and often overlooked detail of getting good looking results with your scope. Remember to try to identify a single event that occurs once in the data you are looking to capture. If your event occurs multiple times, you will see your data overlapping on the screen.



To find these settings, press the "Trigger" button under the Trigger label on the scope. This will bring up the necessary softkeys.

Softkey 1: Allows you to select when the scope triggers. Typically, you will set this to "Edge".

Softkey 2: Allows you to select your triggering source. You can use this to select either Source 1 or Source 2 (when using the analog functionality of the scope), or to select any triggering source D0-D7 (when using the digital functionality).

Softkey 3: Allows you to select the triggering event to occur on either the rising or falling edge of the source signal.

For cases where you are monitoring digital data, it is often handy to trigger on the falling edge of the MSB of the counter. This results in the scope taking a fresh picture of the inputs once per cycle of the count.

<place holder>

5) Cursors

The "Cursors" button under the Measurement section of the scope controls allows you to draw cursors on the display to make measurements such as period and amplitude. The different cursors can be selected by hitting the soft key third from the left (after hitting the cursors button) and then using the multipurpose knob to select which cursor you would like to view. Once you have selected a cursor, use the knob located next to the “Cursors” button to adjust the cursor. Figure 4 shows how cursors X1 and X2 can be positioned to measure the rise time of the square wave from the Demo 2 waveform. On the right side of the display the ΔX value gives the difference between X1 and X2 cursors (In this case about 1.2μs). (*Note: I used the Horizontal and Vertical controls to make the waveform more readable. You can also increase the *boldness* of the waveform by pressing the small round “Intensity” button located just underneath the multipurpose knob.)

6) Measurements

While the Cursors allow you to manually make measurements on the screen, the scope also has features to automatically make common measurements. To access these features, press the “Meas” button near the middle of the device. You can press the “Type” softkey to choose what type of measurement and press the “Add Measurement” softkey to display that measurement on the screen. The measurement options may be more convenient than manually adjusting the cursors, but sometimes they are a little bit unreliable. For example, Measuring the rise time of the Demo 2 waveform gives a result that is not as exact as manually adjusting the cursors (see Figure 5).

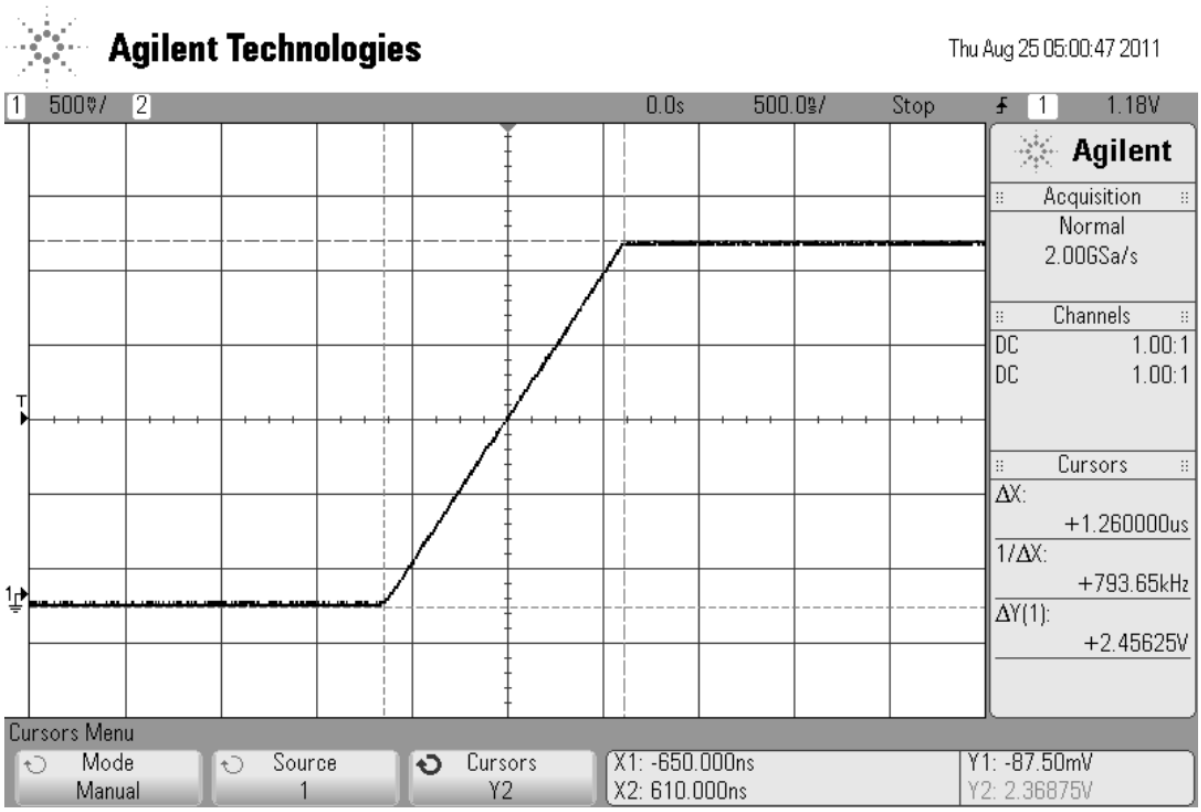


Figure 4: Adjusting the cursors to measure the rise time of the Demo 2 waveform

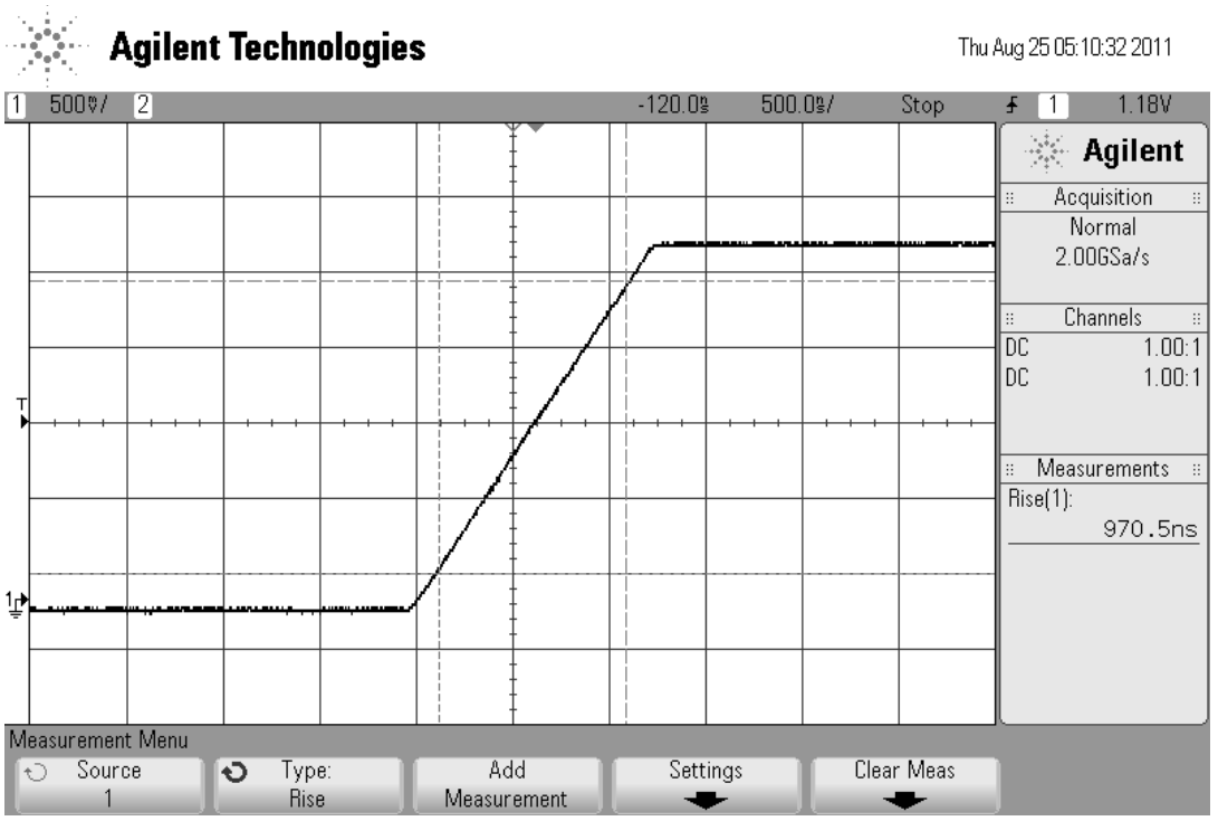


Figure 5: Using the automatic measurements to measure the rise time of the Demo 2 waveform. This is not as exact as using cursors.

7) Working with Digital Signals

The scope has the ability to conveniently display multiple digital waveforms. To measure digital signals, take the following steps:

1. Connect the digital probe cable to the DIGITAL connector on the front panel of the scope. The digital probe cable is keyed so you can connect it only one way. You do not need to power-off the oscilloscope.

2. Connect the ground lead on each set of channels (each pod), using a probe grabber. The ground lead improves signal fidelity to the oscilloscope, ensuring accurate measurements. This is shown in Figure 6.

3. Connect other grabbers to probes, and then connect a grabbers to the nodes you would like to test. This is shown in Figures 7 and 8.

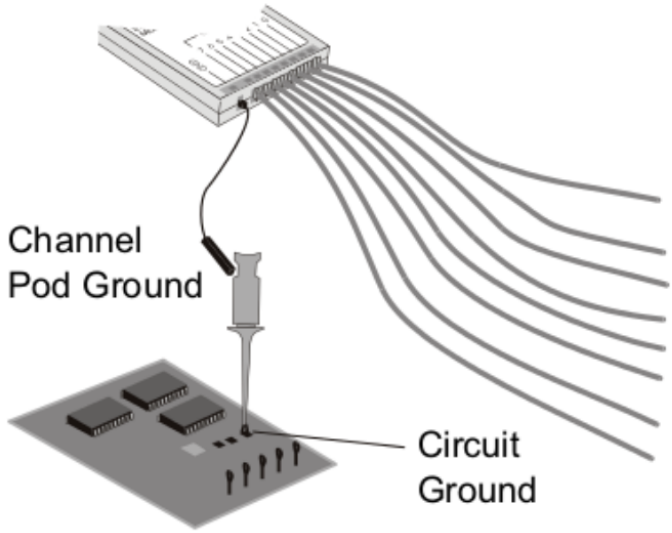


Figure 6: Connecting the ground lead to circuit ground

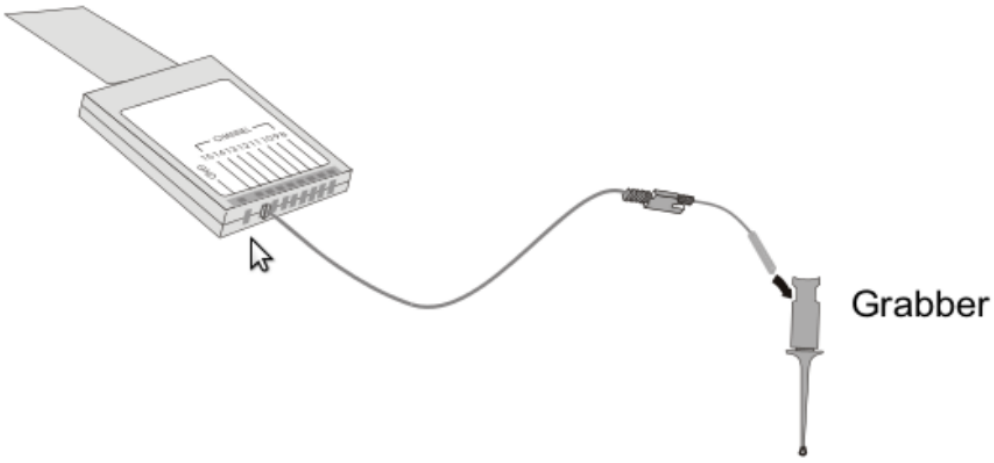


Figure 7: Connect a probe to a grabber

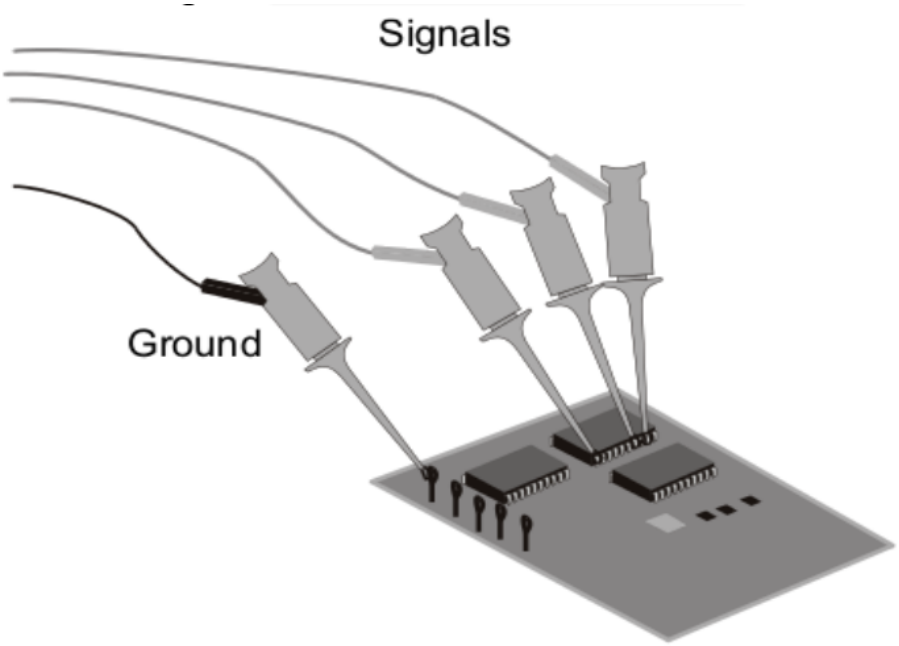


Figure 8: Connect the grabbers to the nodes

4. Press the “Digital” button on the right hand side of the scope and then “Auto Scale” to acquire the waveform. The display of digital signals will look similar to the image in Figure 9.

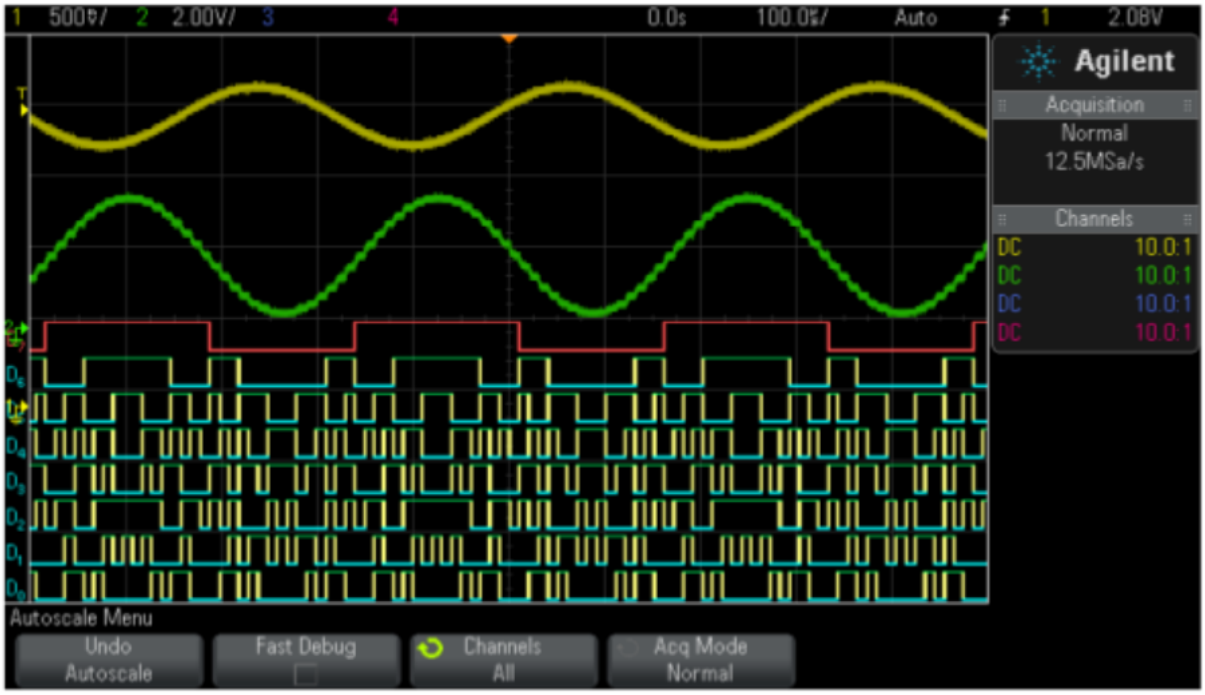


Figure 9: Digital waveforms

You may need to make some adjustments to display other channels (or to hide unwanted ones). To accomplish this, you need to push the “Digital” button on the righthand side of the scope, and then press Softkey 2 to show which channels are hidden and displayed.

8) Capturing Images from the Oscilloscope

There are two different ways to capture data from the oscilloscope. First you can use a USB stick plugged directly into the front of the scope, or you can open data in the computer using the provided software. Both are covered here, although the USB capture is usually preferred.

Capturing Data to the USB Stick (Highly recommended method)

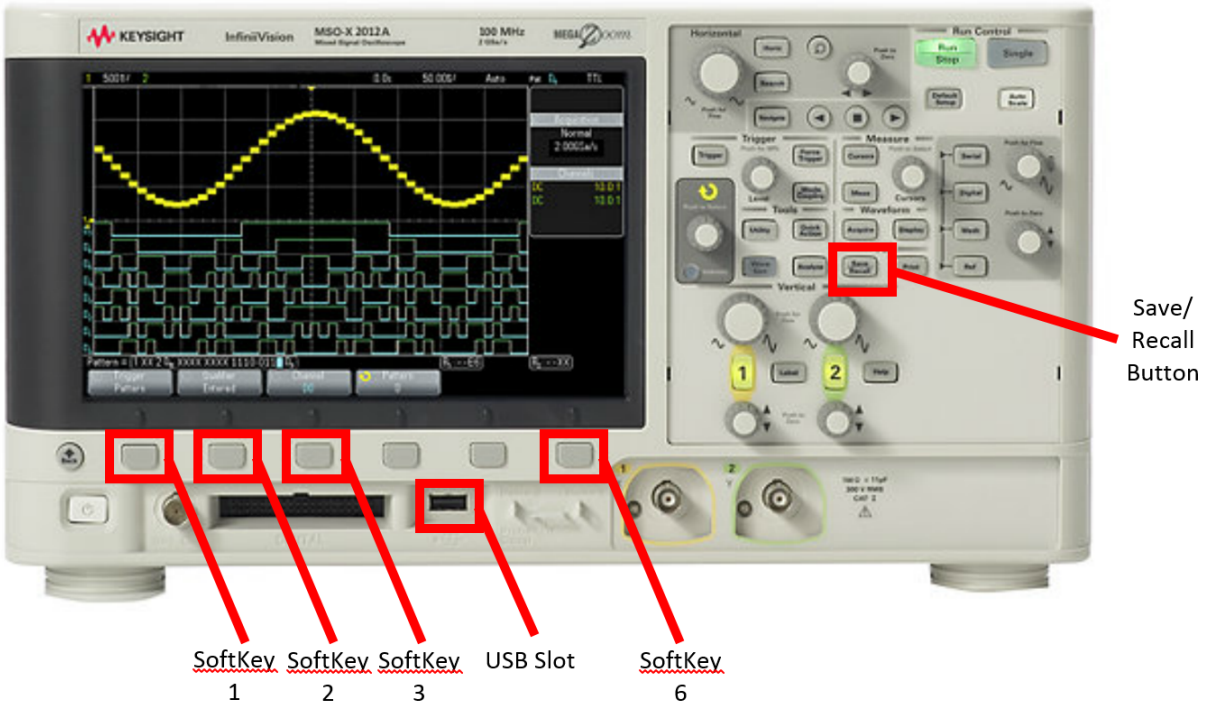


Figure 10: Front view of the oscilloscope

When you have a screen ready to capture (note that if you capture the .png file, the screen will be captured *exactly* as you see it), plug in your USB flash drive into the lower front portion of the oscilloscope. Press the Save/Recall button under “File”.

Softkey 1: Allows you to select file type to save as. Often, it is good to save twice, once as .csv filetype, and again as .png. Both are not always required, so if you choose not to save both, make sure you save what is needed.

Softkey 2: Allows you to change your save folder destination.

Softkey 3: Allows you to change your filename. Make sure that whatever you name your file will be clear to you later.
Softkey 6: Saves the file.

Capturing Data via the Computer (Works, but not preferable)

The scope comes with software that allows you to transfer images and even raw data to the computer. To capture images or data, double click the "**Agilent Data Capture**" icon on the desktop or the executable located at

C:\Program Files (x86)\Agilent\Intuilink\Data Capture\agtDtCpt2.exe.

The Agilent IntuiLink Data Capture will start with a screen similar to the one shown in Figure 11. Verify that the USB cable is connected to the computer and to the front of the scope, then click the "**Get Data**" button.

Two windows should appear. One should be the exact image recorded from the scope, and the other should be a graphed image of the data recorded from the scope. To save either the image or the data, simply click anywhere in the respective window and then click File->Save. Or you can just Copy/Paste to your report document. In most cases, you only need to include "waveform image" (window names ScreenX) in your report. Note that the resolution of the image follows the size of "Agilent IntuiLink Data Capture" window. If you need images with higher resolutions, enlarge the "Agilent IntuiLink Data Capture" window and "**Get Data**" again.

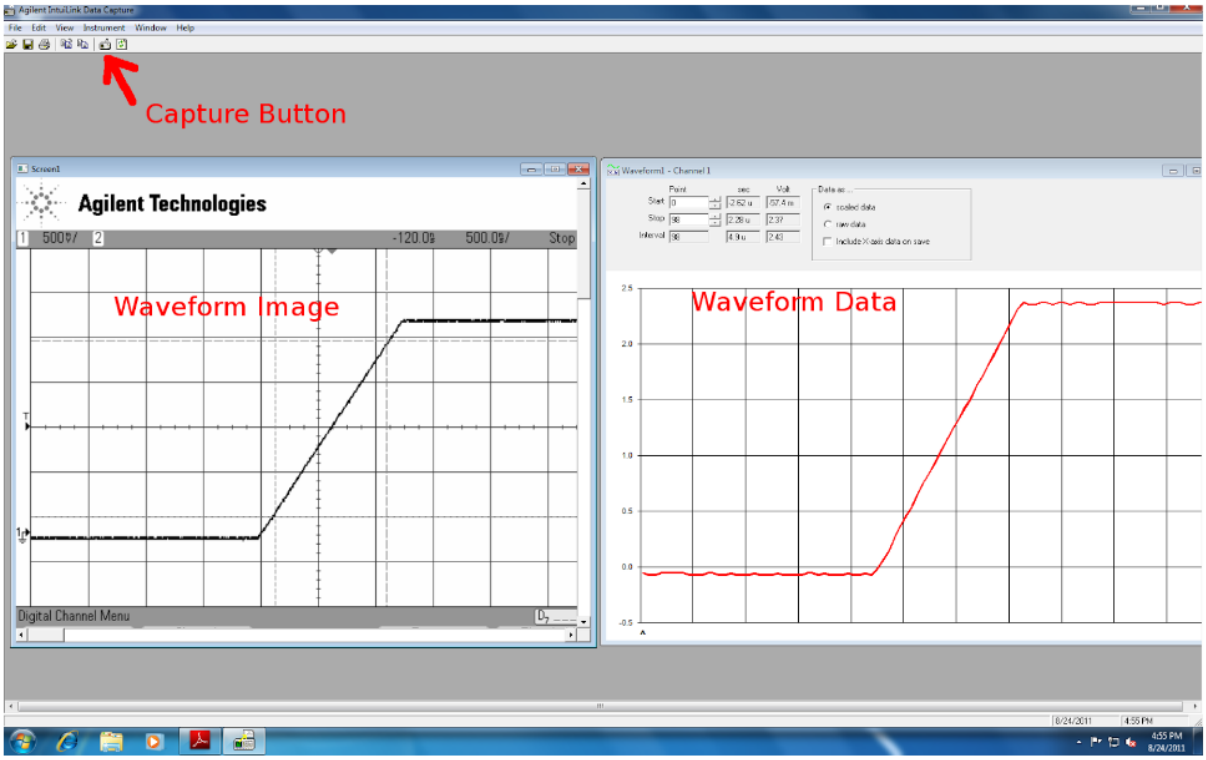


Figure 11: The Agilent IntuiLink Data Capture

If the connection between the computer and oscilloscope were not established, a one-time setting is required. Select **Agilent 2000/3000 X-Series** under **Instrument** drop-down menu.

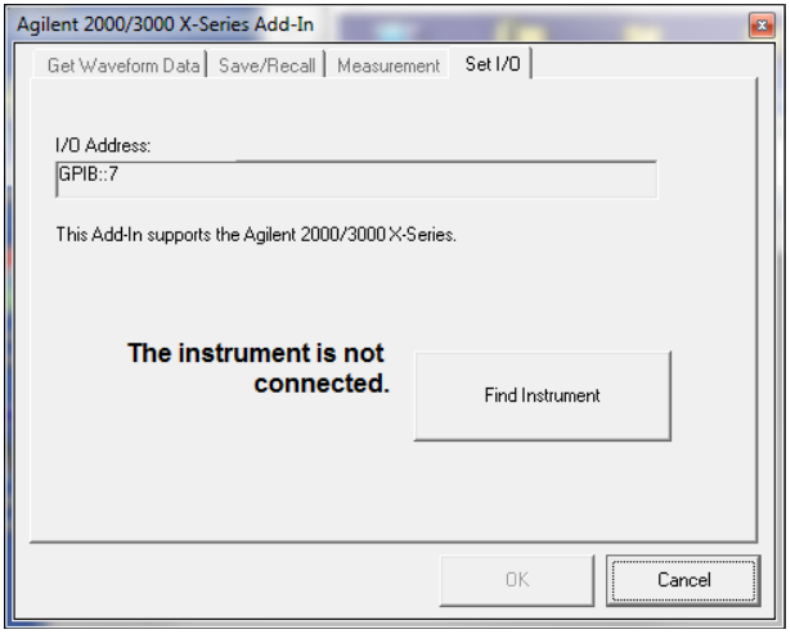


Figure 12: Find Instruments screen to locate the oscilloscope

Click **Find Instrument** and double-click the address with USB prefix on the left.

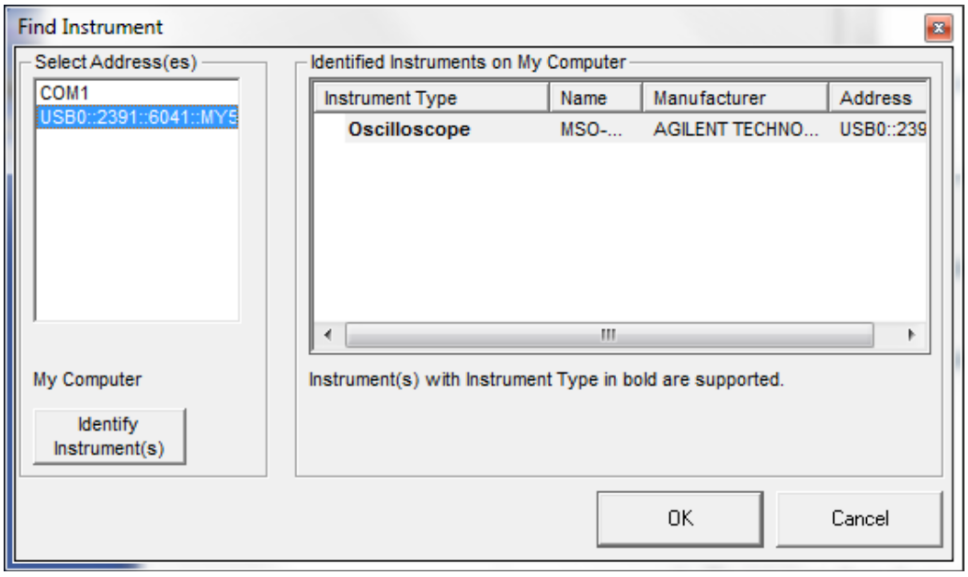
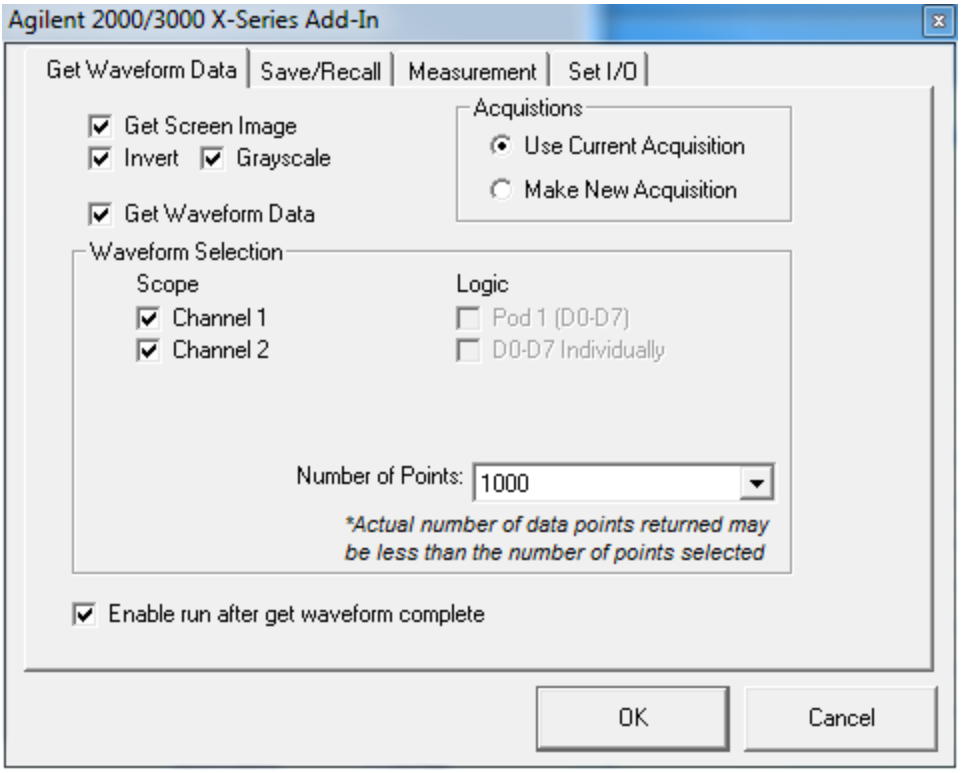


Figure 13: Verification of found instrument

Click **Ok** and the software is now ready to perform data capture.

9. Capture Setup

While in the data capture program, navigate to **"Instrument > Agilent 2000/3000 X-series"** and a window should appear.



Under **"Get Waveform Data,"** make sure to select both channels of the scope (Channel 1 and 2) and change the number of points to 1000.

Click **OK** and your capture setup is complete.