

EE105 Lab Experiments

Agilent DSO5014A Oscilloscope Tutorial

Contents

1	Introduction	1
2	Quick Notes (to get started fast)	1
3	Trigger	2
4	Interface Details	2
4.1	Auto Scale Button	2
4.2	Analog Section	3
4.3	Horizontal Section	3
4.4	Display Button	4
4.5	Measure Section	4
4.6	Cursors	4
5	Examples	5
5.1	Measuring the Peak-to-Peak Voltage (V_{pp}) of a Waveform	5
5.2	Measuring Frequency of a Waveform	5
5.3	Measuring Voltage with Cursors	5
5.4	Using Averaging	6
5.5	Measuring a Transfer Characteristic	6

1 Introduction

The Agilent DSO5014A is an oscilloscope, and it is used to measure voltages that vary with time. There are four independent input channels available on the DSO5014A; thus, it can be used to simultaneously measure and compare four different waveforms (e.g. input and output waveforms of an amplifier).

The default mode of the oscilloscope plots time on the horizontal axis and voltage on the vertical. The scaling of the axes can then be adjusted for each input signal. Scaling can either be done manually or with the “Auto Scale” button. There are other modes of operation for the oscilloscope as well, such as the XY mode that plots one channel against the other in a Voltage-Voltage plot. However, in these labs, you will primarily use the default mode.

This tutorial starts with quick notes on the most vital information. So, if you feel somewhat comfortable using the oscilloscopes, you can check over the quick notes and figure out the details on your own. Otherwise, please also read the later sections, which include more detailed descriptions of the Agilent DSO5014A interface as well as examples of common measurement procedures.

2 Quick Notes (to get started fast)

- After connecting the probes, try the “Auto Scale” button. It will generally provide a good axis scaling if the waveform is not too irregular, small, or at a high-frequency.

- Each channel has an independent control knob to allow the manual setting of the vertical scale. Each channel only has one scale reading, which is displayed to the left of the corresponding channel number at the top of the screen. To adjust the scale, simply turn the knob in the ANALOG section. These knobs are located above the numbered buttons; there is one vertical scaling knob for each input channel.
- To conduct measurements (e.g. measuring V_{pp}), press the “Quick Measure” button in the MEASURE section of the panel. Notice the softkeys that appear on the bottom of the screen. Select the desired source and measurement using the first two menu buttons below the screen (e.g. Source 1, Pk-Pk). Then initiate the measurement by pressing the third menu button (i.e. Measure).
- Cursors can be activated by pressing the “Cursor” button. Use the menu buttons below the screen to adjust the settings, and use the entry knob next to the “Cursor” button to move the cursors.
- AC coupling will remove any DC bias (offset) from the measured signal. This feature can be selected using the menu button below the screen; note that this can only be done in the channel menu. Press the corresponding numbered button (e.g. 2) in the ANALOG section to have the channel menu appear on the bottom of the screen.
- The oscilloscope’s ground is **earth-grounded**, so the black alligator wires on the probes are connected together. Since the function generator is also earth-grounded, the oscilloscope probe grounds are connected to the function generator ground. To avoid shorts to ground, you should **always connect the oscilloscope ground clips to the same node**. Do not try to use the probes to measure floating signals (as you can with the DMM).

3 Trigger

The Agilent DSO5014A has a TRIGGER section on its interface panel. Triggers are used to synchronize the oscilloscope with an external signal so that measurements can be taken at the right moment. For example, to capture a single voltage pulse, one might use a trigger input to signal the oscilloscope to take measurements at the pulse arrival. Triggers can also be used with periodic inputs. However, you will generally not need to use oscilloscope triggering in these labs.

4 Interface Details

The power button is in the lower-left corner of the front panel. Press it to turn on the oscilloscope.

The oscilloscope screen should now display a coordinate system. At the top of the screen, vertical and horizontal scaling units are displayed. The default mode will display vertical scaling for each input in volts/div and horizontal scaling in seconds/div. Note that these units correspond to the respective lines that make up the square grid.

The buttons below the screen are referred to as “menu buttons” or “context buttons” in this tutorial. Their functionality changes with the selection of other buttons (e.g. by pushing the “Quick Measure” button). Each button’s current function is labeled on the screen by the text immediately above the button. These menu buttons are essential to taking measurements and performing more complex functions on the oscilloscope.

The following sections cover the front interface panel in the general order you would consider them when making waveform measurements. At the end of the tutorial, there are examples of common measurement procedures.

Please refer to a photo of the Agilent DSO5014A in Figure 1; this might help in locating the mentioned controls/buttons.

4.1 Auto Scale Button

The “Auto Scale” button has the oscilloscope “guess” a good axis scaling based on the input waveform. This button is always a good first pass for scaling, and often, it will be the only scaling that you will need. You

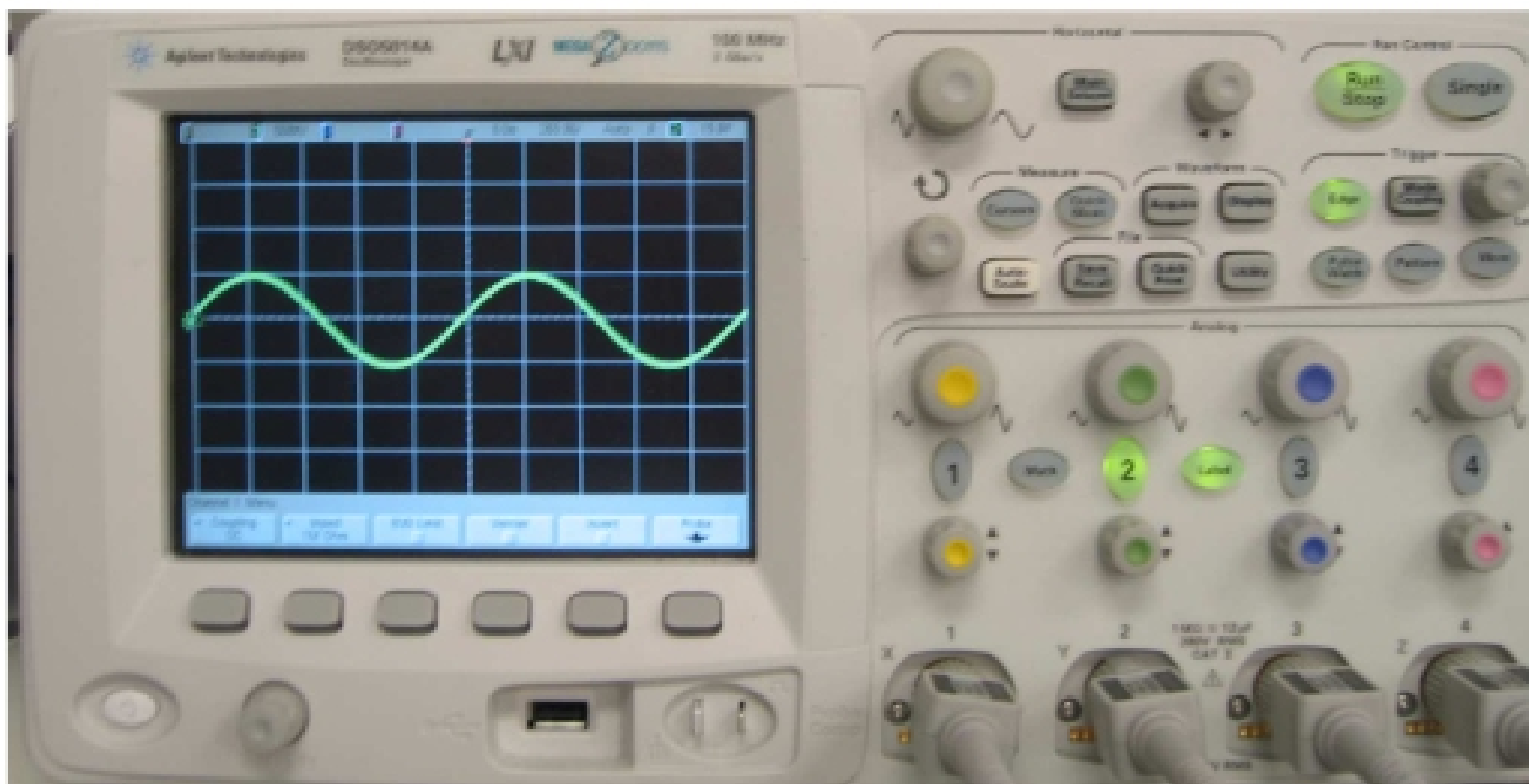


Figure 1: Agilent DSO5014A Front Panel

can also tune the scaling manually with the ANALOG and HORIZONTAL controls, which are described below.

4.2 Analog Section

The controls of the ANALOG section adjust the vertical scaling and position of each independent channel signal. Note that the controls for each channel are aligned vertically with respect to the input port.

- The knobs above the numbered buttons set the vertical scaling (vertical zoom) on the display.
- The “1”, “2”, “3”, and “4” (numbered buttons) toggle showing their respective inputs.
- The position knob is located below the numbered buttons and have up and down arrow markings next to them. These knobs control the voltage offset against the display axes. The horizontal axis does not represent 0 volts, but instead, the 0 volt position for each input is designated by a numbered ground symbol on the left side of the screen. When you adjust the offset with the position knob, you will see the corresponding channel’s ground symbol move vertically.
- The “Math” button can combine inputs with one of the following arithmetic operators: subtraction and multiplication. The operation can be selected with the menu buttons below the screen after pushing the “Math” button.

When using the ANALOG section (e.g. after pushing “1” or “2”), the menu buttons below the screen correspond to various options related to the probe inputs. The list below assumes that the “1” button has been pressed.

Menu 1

- 1: ON/OFF - Toggles the display of input 1.
- Imped: 50 Ω /1 M Ω - Toggles the input impedance of the channel input. Should usually be set at 1 M Ω .
- Coupling: DC/AC - Sets the coupling for the channel input: DC will show both DC and AC values. AC will only give time-varying voltage values and remove any offset.