

## **Getting Started with the Digilent Electronics Explorer Board**

This tutorial provides a very basic overview of the Digilent Electronics Explorer (EE) Board.

## 1. EE Board Physical Description

A top view of the Digilent EE board is shown in Figure 1. Primary sections of the board are as follows:

- a. **USB connection:** provides interface between EE board and your Personal Computer.
- b. **On/Off switch:** Turns EE board on or off.
- c. **Power connection:** Connects EE board to AC power adapter.
- d. **Oscilloscope section:** Provides connections to the four-channel on-board oscilloscope.
- e. **Analog section:** Provides connections to two low-power (reference) voltage supplies ( $V_{REF}$ ), two Arbitrary Waveform Generator (AWG) channels, and four on-board Voltage meters ( $V_{MTR}$ )
- f. **Power section:** Provides connections to the on-board power supplies. Power supplies include a positive variable power supply (VP+), a negative variable power supply (VP-), and a fixed, bi-level, power supply ( $V_{CC}$ ).
- g. **The main breadboard:** A solderless breadboard providing a working space for the construction of electrical circuits.
- h. **The digital section:** will not be addressed in this tutorial.

Note:

All power supplies and measurements on the breadboard are relative to a “board ground”. Connections to this board ground are provided in the **Oscilloscope**, **Analog**, and **Power** sections of the EE board. Holes connecting to the board ground are indicated by a solid bar at one end of the strip and an arrow at the other end.

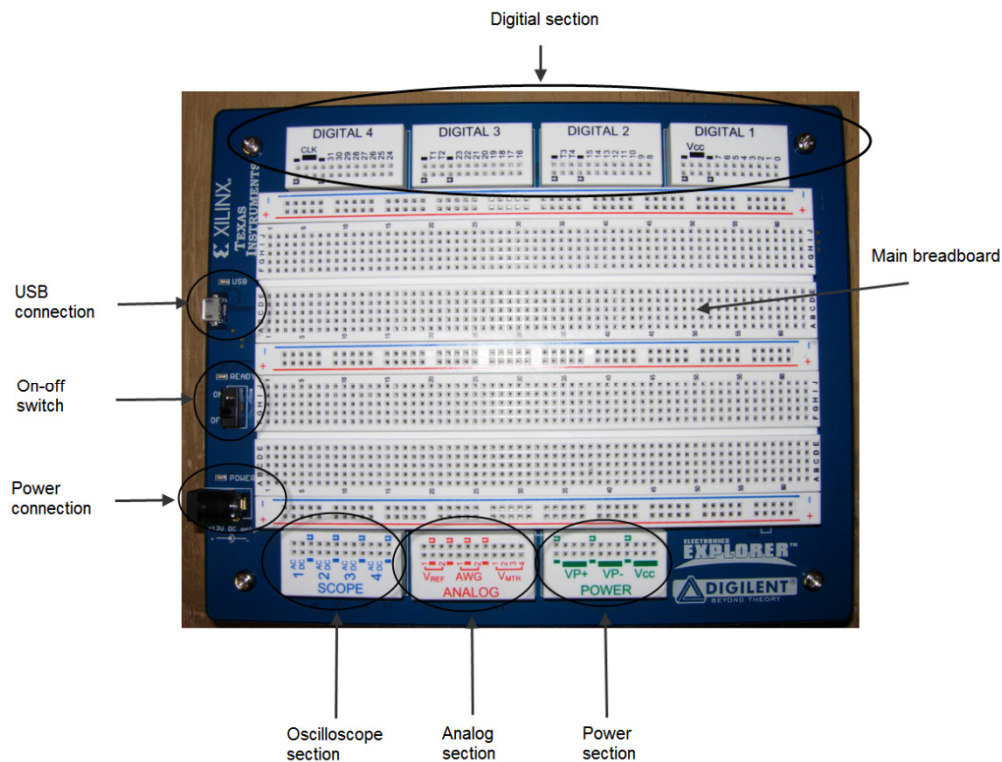


Figure 1. EE board top view.

## 2. EE Board Setup and WaveForms Software Installation

- a. **Software Installation:** The WaveForms software used to interface the EE board to your Personal Computer can be obtained at <http://www.digilentinc.com/eeboard>. Download and install the software on your PC.
- b. **Providing Power to the EE Board:** Plug in the AC adapter that came with your EE Board and connect it to the EE board power connection (see Figure 1).
- c. **PC-to-EE Board Connection:** Use the USB connector that came with your EE board to connect the EE Board USB connection to your PC.
- d. **Turn on the EE board:** Switch the On/Off switch to “ON”.
- e. **Run Software:** Start the WaveForms software. One approach (using, for example, Windows XP) is the sequence **Start – All Programs – Digilent – WaveForms – Waveforms**. The WaveForms software should connect to your EE board and the WaveForms main window should open, as shown in Figure 2.

### Note:

At this point, the status bar at the bottom of the main window should display the serial number of the board to which the WaveForms software is connected. Also, the LED on the EE board should be illuminated, indicating that the board is enabled.

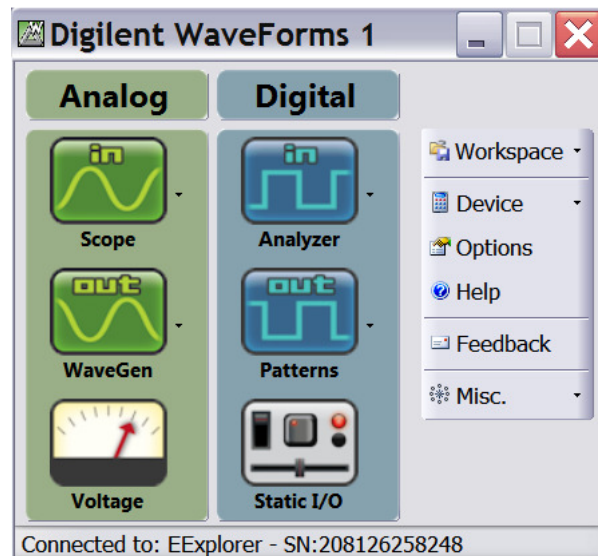


Figure 2. WaveForms main window.

### 3. Selecting an Instrument

The WaveForms main window allows you to select the various instruments available on the EE board. The instruments fall into two broad categories: Analog and Digital. This tutorial will address only the Analog instruments.

Three categories of analog instruments are available:

- the oscilloscope (**Scope**) which measures and displays time-varying waveforms
- arbitrary waveform generators (**WaveGen**) which provide time varying signals to the board, and
- constant (DC) power supplies and voltmeters (**Voltage**)

To open an instrument, click on the button corresponding to that category of instrument. The main window corresponding to that instrument will open (or brought to the front and activated, if it is already open). The instrument is controlled from its main window. Main windows controlling the oscilloscope, arbitrary waveform generators, and DC power supplies and voltmeters are discussed in sections 5, 6, and 7. Before discussing instruments, however, we will provide background information relative to use of the breadboard to create prototype circuits.

Note:

Instruments are calibrated at the factory. Re-calibration of the instruments can be performed from the WaveForms main window by clicking on the **Device** drop-down menu and selecting **Manager**. Click on the **Calibrate** tab. (If no **Calibrate** tab appears, you may need to select “Show advanced features” in order to see this tab.) Instructions for calibrating specific instruments can be found in the WaveForms on-line help.

#### 4. Solderless Breadboard

The solderless breadboard provided as part of the EE board is the large white plastic component with rows and columns of holes occupying most of the top of the EE board. The breadboard is indicated in Figure 1, Figure 3 provides a more detailed view of the breadboard. The breadboard provides a working space where temporary circuits can easily be built. The holes in the breadboard provide an easy way to connect electrical components by pushing the leads of the components into the breadboard holes.

The EE board's breadboard has four rows of five holes that are electrically connected into a single circuit *node* – the holes always have the same voltage. A central groove or channel generally separates two banks of these holes. The overall situation is illustrated in Figure 3. The holes on either side of this channel are not electrically connected.

When a component lead is inserted into one of the five connected holes, the remaining four holes are connected to that lead as well. Therefore, component leads or *jumper wires* (small gauge wires that have been stripped of insulation at both ends) that are inserted into a row with other component leads or wires will form a single circuit node. Using a breadboard allows components and interconnections to be rapidly added, studied, and modified.

In addition to the sets of five connected holes, the breadboard provides six 50 hole-strips. All fifty holes in each of these strips are electrically connected. These strips are oriented horizontally in Figure 3; each fifty-hole strip has either a red or blue line that runs next to it. The fifty-hole strips provide locations where large numbers of connections can be made to a single node. This is useful, for example, when providing power supplies or grounds to multiple locations in a circuit.

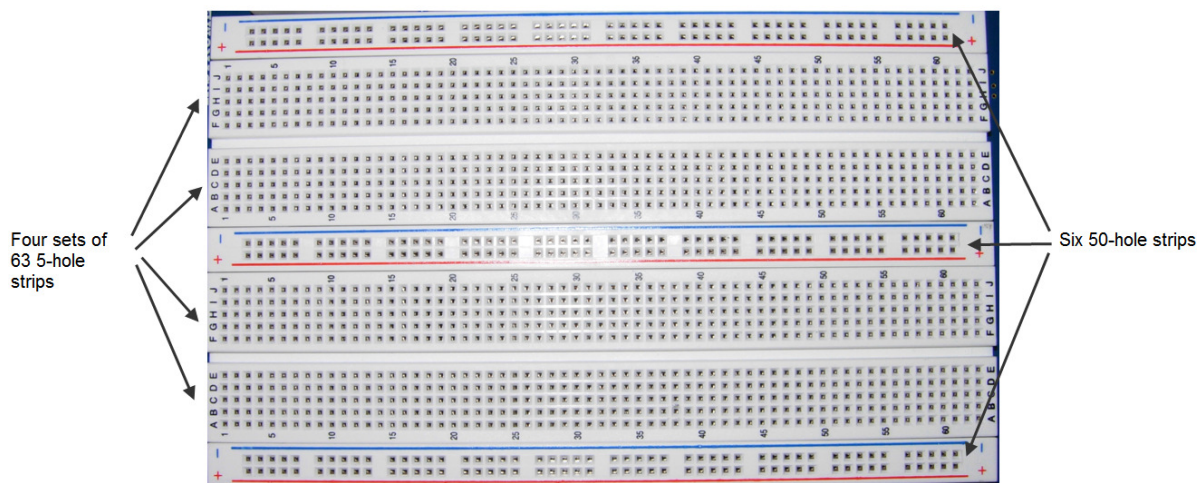


Figure 3. EE board solderless breadboard.

#### Related Video Material:

The Lab 0 video at <http://www.digilentinc.com/eeboard/realanalog> provides a demonstration of the breadboard and its operation.

## 5. Power Supplies and Voltmeters

The Power Supplies and Voltmeters instrument is activated by clicking on the button labeled Voltage on the WaveForms main window (see Figure 2). Figure 4 shows the main window of the Power Supplies and Voltmeters instrument with annotations indicating primary features of the window.

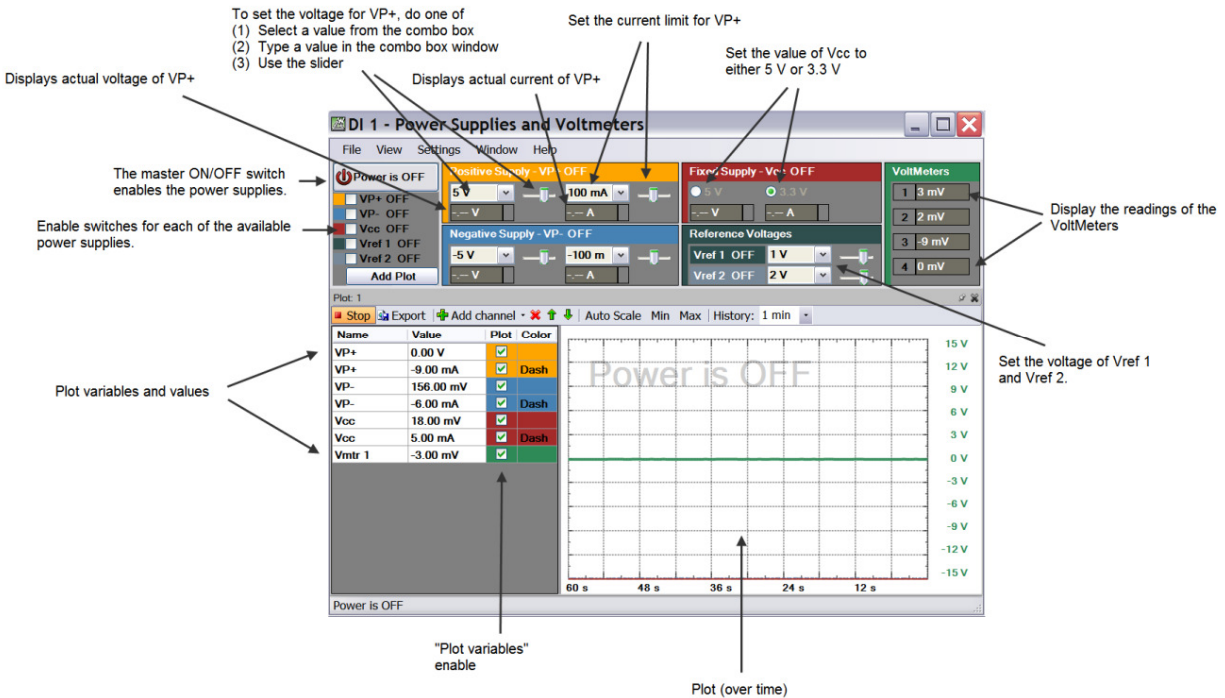


Figure 4. Power supplies and voltmeters window.

The power supplies and voltmeters window is used primarily to provide constant (or DC) power levels to the solderless breadboard. The voltages and currents provided by this instrument do not change without active intervention on the part of the user. (For example, voltage levels will change only as a result of the user changing the voltage level.)

Physical access to the power supplies and voltmeters controlled by this window are provided in the **Analog** and **Power** sections of the breadboard, as indicated in Figure 1. Close-up views of these sections are shown in Figure 5 below. The power levels which can be controlled by the window are the positive and negative adjustable power supplies (**VP+** and **VP-**), the fixed, bi-level, power supply (**V<sub>CC</sub>**), and the two low-power reference voltages (**V<sub>REF1</sub>** and **V<sub>REF2</sub>**). The four voltage meters (**V<sub>MTR1</sub>** through **V<sub>MTR4</sub>**) are also controlled with the power supplies and voltmeters window.

### Related Video Material:

The Lab 0 video at <http://www.digilentinc.com/eeboard/realanalog> provides a demonstration of basic use of the Power Supplies and Voltmeters instrument.

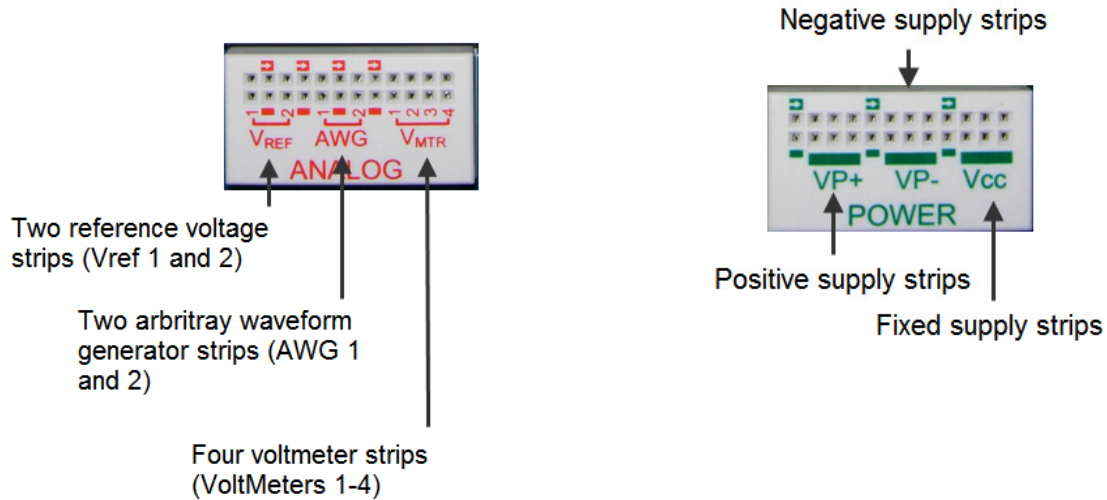


Figure 5. Sections of the EE board used by the Power Supplies and Voltmeters instrument.

Power Supply and Voltmeter Specifications:

- The fixed power supply 3.3/5 V can provide up to 2 A.
- The positive power supply has a range of 0 to 9 V and 0 to 1.5 A current limit.
- The negative power supply has a range of 0 to -9 V and 0 to -1.5 A current limit.
- The reference voltage supplies can provide only limited current, up to 10 mA. i>The disabled reference voltage output is not in high impedance but should be close to zero volts.
- Floating voltmeters will not measure zero volts.

Note:

Recall that all power supplies provide power relative to the EE board's ground. Likewise, all measurements made with the voltmeters are relative to this ground.