Analog Discovery Arbitrary Function Generator for Windows 7
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Starting the Analog Discovery

1. Install the Waveforms software from the Digilent Incorporated website.

2. Attach the Analog Discovery to one of the USB ports on your computer. The device drivers will install automatically.

3. Launch the Waveforms software
   Start -> Programs -> Digilent -> WaveForms
   (You will probably want to make a shortcut)

Note: When closing, the WaveForms software stores the last configuration, if set to do so. To make sure that you have the factory default settings (even if somebody previously saved a different WaveForms configuration on your computer), click “Options” in the WaveForms main window, then “Erase configuration” in the Options window. Close the Options window.
What if the software doesn’t find the Analog Discovery?

• You may see a pop-up that states that you are in Demo mode because the software did not find the scope.
  – Click **OK** to use Demo mode.
    • Check to make sure that you plugged the Analog Discovery into one of your computer’s USB ports.
  – Next, click on **Demo** on the Device Manager window that pops up, then click **Select**.
Connect to the Analog Discovery

• Click
  -> Device Manager
  -> Digilent Discovery
  -> Select

• A red LED will light up inside the case of the Analog Discovery when the scope is attached, powered on, and is ready to use.
  – Each Analog Discovery has its own unique Serial Number.

• If “Digilent Discovery” does not appear in the list, uninstall and reinstall the WaveForms software.
Cables

• The Analog Discovery comes with a wire assembly with 30 wires, which plug into the connector on the side of the black case.
  
  – The individual wires can be inserted into a header with sets of male pins, which can then be plugged into the breadboard. The output signals from the arbitrary function generator can be wired from the correct pin on the header to the appropriate point in the circuit.
Output Pins for the Arbitrary Function Generator

- The outputs of the function generators are marked W1 and W2.
  - Looking at the Analog Discovery in the photo to the left, these are the fifth (5\textsuperscript{th}) wires from the bottom on the connector.
    - W1 is located along the upper row of connector (pin 5 - yellow wire)
    - W2 is located along the bottom row of the connector (pin 20 - yellow wire with white marking).
Complete Pin-Out for Analog Discovery

Note notch in connector
The calibration of Arbitrary Waveform Generator (AWG) can be initiated through the Device Manager, which can be launched from the main Waveforms control window.

In Device Manager, click on the words *Show Advanced Features*
Run Calibration

- Click on **Calibrate** and then double click on the row for AWG 1 or 2 from the drop down menu that appears.

Given that many of the experiments require both function generators, it is best to calibrate both AWG 1 and AWG 2 each time you launch the Analog Discovery Wave Generator.
Launch the Arbitrary Waveform Generator

- Go back to the main control window.

Click on the \[button.\]

This will cause a new window to open immediately. Or, click on the arrow to the left of this button and select **Open New**.
• Select one or both arbitrary waveform generators, Channel 1 (AWG 1) and Channel 2 (AWG 2), and set the parameters of operation.
  – Note that AWG 1 corresponds to output W1 and AWG 2 to output WG2.
Signal Generator built into the Analog Discovery

- Wave Gen generates sine, square, and triangle waveforms, plus other functions. Select the waveform type with the **buttons**.

- Select Frequency, Amplitude, and DC offset ranges with the **menus**, then adjust the actual value with the **slider** or type the values into the boxes.
  - Similarly, you can select the Symmetry and Phase, which will be covered in another lecture.

- The generator output (automatically **graphed** on the right) is set for a 1000Hz, 10Vpp sine wave with a 0 V DC offset.
You can select the maximum and minimum allowable frequencies, amplitudes, dc offset, symmetry of the signal shape, and phase angle with respect to a reference signal.

When you click on the arrow next to the words Max and Min, you can select the maximum (or minimum) values for the slider for the particular parameter in the specific box.

In this case, 10 kHz has been selected as the maximum frequency that can be set using the slider for the frequency of operation of the sinusoidal signal.

You can also type in a value for the maximum and minimum frequencies into the boxes next to the words Max and Min.

So, you could type 10 kHz into the box that currently has 50 kHz displayed instead of using the drop-down menu. Values not listed in the drop-down menu can be entered this way.
Actual Value Menu

In this example, 6 kHz and 8 kHz have been typed into the boxes next to the words Min and Max as the range for the Frequency of the Sine wave.

To set the value of the frequency of the sine wave that will be outputted by the Arbitrary Waveform Generator:

1. The slider can be moved to the desired frequency. The value will be displayed in the box below Frequency.

2. Or, a value between the Min and Max values can be typed into the box below Frequency.

   If the value is larger than the Max or smaller than the Min values, then the Max or Min value will be displayed instead.

3. Or, select a value from the drop-down menu available by clicking on the arrow.

   The range of values listed in the drop-down menu is determined by the size of the Max-Min range.
Other Settings

- For the first experiments, leave the default settings for the other parameters – Trig (None), Wait (none), and Run (continuous) in the left-hand side of the controls for the Arbitrary Waveform Generator and Components (Auto scale) on the right-hand side. Also, keep the Offset at 0V, the Symmetry at 50% and Phase at 0 deg.
  - There are instructions on how to use the other settings for the Arbitrary Waveform Generator in the Advanced_AWG presentation.
Next?

- To start and stop the function generator output, Toggle the Run AWG 1 button or the Run All button. The latter will turn on AWG 2 also if both channels were selected.
  - Connect pin 5 (W1) to the circuit to apply power to the node.
  - Connect one of the grounds to complete the circuit (black wires - pin 3, 6, 18, or 21)
    - Make your DC current and voltage measurements using the DMM.
    - Make your voltage measurements as a function of time using the oscilloscope.
Fixed DC Outputs

The Analog Discovery can also output a constant DC signal of +5V and/or -5V. Click on the **Voltage** icon. Click the toggle buttons on the window that opens. +5V is applied to pin 4 on the connector, the red wire, when Power is ON and VP+ ON. -5V is applied to pin 19 on the connector, the white wire, when Power is ON and VP- ON. VP+ and VP- may be turned on simultaneously.

D. Fritz and E. Robertson
To generate a DC output from the Digilent Analog Discovery, make a sine wave with a 0V **amplitude** and then use the **offset** to move the signal to the DC voltage needed (3 V in this example). Note that the graphical display of the output for AWG 1 is a straight line equal to 3 V.
Enabling the Waveform Generator

• The default for the Arbitrary Waveform Generators is Disabled, which means that there is no signal being outputted from the Analog Discovery to W1 pin for AWG 1. The setting must be changed to Enabled so that the signal that has been set using the control window is available on pin 5 (W1) for AWG 1 [or pin 20 (W2) for AWG 2]. Click on the word Disabled to toggle the Waveform Generator to Enabled.

  – The default idle output is the initial value of the sine wave. In this case, the output of the AWG 1 was set to $2\, \text{V sin}[7\, \text{kHz (t)}] + 1.5\, \text{V}$. Since $t = 0\, \text{s}$, the initial value is the offset voltage ($1.5\, \text{V}$), which is the signal that is now the signal available on pin 4.
  • This is another way to obtain a DC output using the Arbitrary Waveform Generator.