# LabForms User Manual (rev. 2.0)

## Installing WaveForms:

For computers with no or obsolete WaveForms installed:

1. Install WaveForms from: <http://digilentinc.com/Products/Detail.cfm?NavPath=2,66,849&Prod=WAVEFORMS>

The project was tested with WaveForms Version 2.6.2 32bit (2013/10/1).

## Installing or copying LabForms:

For running only on computers with no LabView2013 installed:

1. Install LabView Run-Time Engine 2103 from <http://www.ni.com/download/labview-run-time-engine-2013/4059/en/> (you need to register with NI - free)
2. Unzip LabFormsExe.zip
3. Connect any number of Analog Discovery (to a PC USB port or to a POWERED USB hub) and/or Electronics Explorer devices (make sure EE board is powered and switched ON).
4. Run LabForms.exe from LabFormsExe folder

For running only on computers with LabView 2013 already installed:

1. Unzip LabFormsExe.zip
2. Connect any number of Analog Discovery (to a PC USB port or to a POWERED USB hub) and/or Electronics Explorer devices (make sure EE board is powered and switched ON).
3. Run LabForms.exe from LabFormsExe folder

For viewing/editing code on computers with LabView 2013 already installed:

1. Unzip LabFormsExe.zip
2. Open LabForms.lvproj from LabFormsLvproj folder
3. Connect any number of Analog Discovery (to a PC USB port or to a POWERED USB hub) and/or Electronics Explorer devices (make sure EE board is powered and switched ON).
4. Open and run GUI Main.vi

## Using LabForms:

In the GUI Main.vi window:

1. Select the used device in the Device Select drop list.
   1. If no supported device connected, the list only contains the Cancel option
   2. If a single device is connected, this is shown by default
   3. If a device is listed with the text “Used by another application” the device is not available and the OK button is disabled. The other application might be a WaveForms instance or another application which used WaveForms SDK to open the device.
2. Click the OK button
3. In the GUI Main.vi, the Selected Device indicator shows the selected device and the OK button is disabled.
4. Two instruments are available: Scope and Signal Generator.
   * 1. Launch each instrument with the associated Start button.
     2. A single instance is allowed for each instrument. Once that is running, the associated Start button is disabled on the GUI Main.vi window.
     3. After an instrument is closed (with the STOP button in its’ own window) it can be re-open from the GUI Main.vi window.
     4. The GUI Main.vi window can be closed (the STOP button becomes active) only after closing all instruments (with the STOP buttons in their own window).

Controls for both Signal Generator and Scope windows:

1. Push buttons (Enable, Run, Single)
2. Enable and Run buttons are latched
3. Single button is not latched
4. Drop Lists (Function, Trigger Mode/Channel/Cond)
5. Knobs (Frequency, Amplitude, Offset, Symmetry, Phase, (trigger) Level, (horizontal) Position, (time) Base, (channel) Offset, (channel) Range)
6. All knobs have dynamic range from Min to Max values (controls overlapping the min/max values on the knob scale).
7. The user can set the Min/Max values, within the legal boundaries. Legal boundaries are set by the used device limits and other (related) parameters.
   * 1. Example: the Scope horizontal position is limited to +/- 5 times the (time) Base (for trigger event time to be within the visible window).
     2. Example: the Signal Generator Amplitude and Offset are limited by device output range (+/-5V for Analog Discovery, +/-10V for Electronics Explorer board)
     3. Example: Min<Max for a knob
8. Use Min/Max values to reduce the parameter range for convenience in using the rotary knob.
9. The Min/Max values can be set:
   * 1. with the up/down arrows in the numerical control (left/right - below the knob)
     2. with the mouse wheel after clicking the selected digit in the numerical control
     3. typing in a digital value
     4. in all cases, the value is constrained to legal limits
10. The value of the parameter can be set:
    * 1. with the rotary knob
      2. with the up/down arrows in the numerical control (above the knob)
      3. with the mouse wheel after clicking the selected digit in the numerical control (above the knob)
      4. typing in a digital value
      5. in all cases, the value is constrained to Min/Max limits

In the Signal Generator window.

1. Enable/Disable one or both channels. Associate controls appear on the GUI when enabled.
2. Set the parameters of the desired signal.
3. Run/Stop a channel clicking Run
4. Modify the parameters

In the Scope window.

1. Enable/Disable scope channels. Associate controls appear on the GUI when enabled.
2. There are two scope channels for Analog Discovery, four channels for Electronics Explorer
3. Set the parameters for trigger and channels.
4. Run/Stop the scope clicking Run or Single
5. Enable/Disable vertical scales for individual channels (click on Y Scales buttons)
6. Read:
7. Last Acquisition time
8. Current acquisition Status
9. Acquired graphical waveforms
10. Modify the parameters

## Closing LabForms application:

1. Click STOP in both Signal Generator and Scope Windows
2. The Scope and Signal Generator windows close.
3. The STOP button in GUI Main.vi becomes active.
4. Click STOP in GUI Main.vi window
5. GUI Main can be Run again (start from 13) or Closed.

## Examining/Editing the LabView code

The code uses the digilent.lvlib. A set of Vis were generated using the Import Shared Library wizard, based on

* dwf.dll (C:\Windows\System32) and
* dwf.h (C:\Program Files (x86)\Digilent\WaveFormsSDK\inc)

A single vi was modified, to change a data type:

* F Dwf Analog In Status Data.vi

was changed to:

* F Dwf Analog In Status Data Doru.vi

See the comments within the modified vi

The WaveForms SDK User's Manual.pdf installs at: C:\Program Files (x86)\Digilent\WaveFormsSDK

The code is structured in:

1. GUI Main.vi:
   1. Enumerates supported Digilent devices
   2. Interrogates enumerated devices
   3. Selects a device
   4. Opens and resets the open device
   5. Allows user to launch GUI Scope.vi and GUI SignalGen.vi
   6. Waits for both above to close
   7. Waits for STOP button
   8. Closes the device
2. GUI SignalGen.vi
   1. Resets the Analog Out function
   2. Interrogates for device parameter values
   3. Runs a while loop (exit with the STOP button)
      1. Instantiate knob controls (re-entrant CtrlGenKnob.vi)
      2. Instantiate drop list controls (re-entrant CtrlGenDrop.vi)
      3. Instantiates Run and Enable push buttons
      4. Turns channels controls enabled/visible or disabled/invisible as
      5. Generate events for
         1. SetChange1/SetChange2 – any change in channel 1/2 controls
         2. Run1/Run2 – any change in channel 1/2 Run buttons
         3. Enable1/Enable 2 – any change in channel 1/2 Enable buttons
      6. Uses Event structures for:
         1. Enabling/disabling channels
         2. Reconfigure channels
3. GUI Scope.vi
   1. Resets the Analog In function
   2. Interrogates for device parameter values
   3. Enables and makes visible the appropriate number of channels (upon used device)
   4. Runs a while loop (exit with the STOP button)
      1. Instantiate knob controls (re-entrant CtrlGenKnob.vi)
      2. Instantiate drop list controls (re-entrant CtrlGenDrop.vi)
      3. Instantiates Run and Enable push buttons
      4. Turns channels controls enabled/visible or disabled/invisible as
      5. Generate events for
         1. SetChange – any change in any control
         2. Run – any change in Run button
         3. Single – any change in Single button
         4. Status – any change in acquisition Status
      6. Uses Event structures for:
         1. Reconfigure scope
         2. Display the time of the last acquisition (when Status is Done)
      7. Reads acquisition status
      8. Use a case structure (Status - Done) for:
         1. Getting acquired data from the device
         2. Build waveforms
         3. Display Waveform Graph
4. CtrlGenKnob.vi (Preallocated clone reentrant execution)
   1. Checks for First Iteration (for loading default values for Min/Max and Value)
   2. Instantiate Min/Max and Value controls
   3. Verify and enforces limits
   4. Sets capture text and colors
5. CtrlGenDrop.vi (Preallocated clone reentrant execution)
   1. Checks for First Iteration (for loading default values for Min/Max and Value)
   2. Instantiate Value control
   3. Sets capture text and colors
   4. Sets control size