Programming Tektronix OpenChoice Oscilloscopes with LabVIEW

Introduction

LabVIEW is a graphical development environment for acquiring, analyzing and presenting data. This makes it a good companion to your TDS OpenChoice oscilloscope with its own data acquisition and analysis abilities.

Tektronix has worked with National Instruments to provide a LabVIEW add-on, which highlights some of the advantages of using LabVIEW with Tektronix OpenChoice Oscilloscopes. This add-on is preinstalled on each scope along with an evaluation version of LabVIEW. This add-on can also be used with a full development version of LabVIEW.

The add-on consists of the following components:

- A National Instruments book titled “Getting Started with LabVIEW and Tektronix Open Windows Oscilloscopes”. This article highlights some key contents of that book.
- A Scope Analysis demo which demonstrates some of the analysis capabilities of LabVIEW working with Tektronix scopes
- Several LabVIEW examples with full source code which show different programming techniques
- Scope specific function palettes which are described in more detail later in this article

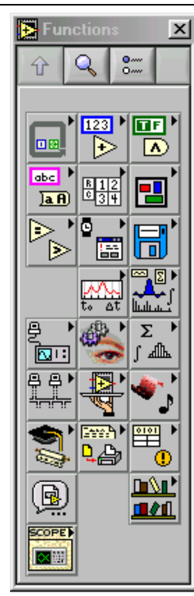
Please refer to the installation instructions available on the LabVIEW add-on CD to determine the order in which the various components should be installed.

You use LabVIEW to create virtual instruments, also known as VIs. A LabVIEW VI consists of a front panel and a block diagram.

The front panel provides the user interface for your program. Use the front panel to input data and view outputs. Build the front panel with graphical representations of controls and indicators. A control could be a knob or a switch. An indicator could be a graticule on which to display oscilloscope-style waveforms.

The block diagram contains the VI's underlying code. Build your block diagram with functions, other VIs and wires. The wires connect the block diagram objects to each other. You can draw upon LabVIEW's libraries for data collection, analysis, presentation, and storage.

To help you create and edit your program's front panel and block diagram, LabVIEW provides palettes. These are shown in the table shown below.

Palette	Appearance	Description
Tools		Use this palette with both the front panel and the block diagram. The tools in this palette let you operate and modify the front panel and block diagram objects. To display this palette, go to the front panel or block diagram menu bar and click on: **Windows -> Show Tools Palette**
Controls		Use this palette with the front panel. It provides your front panel's controls and indicators. To display this palette, go to the font panel menu bar and click on: **Windows -> Show Controls Palette**
Functions		Use this palette with the block diagram. It provides your block diagram's functions and VIs. To display this palette, go to the block diagram menu bar and click on: **Windows -> Show Functions Palette**

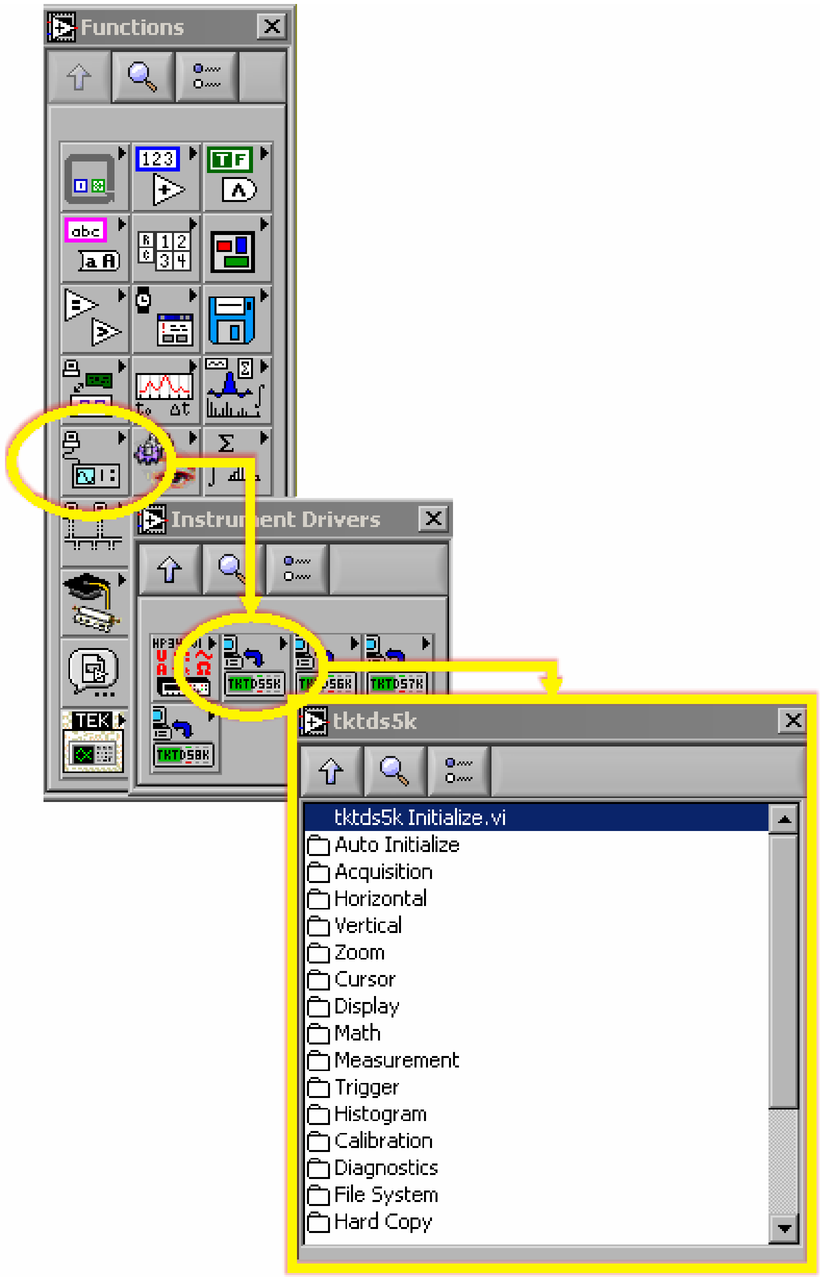
The functions palette includes oscilloscope-specific sub-palettes for each of the TDS5000, 6000, 7000, and 8000 series open Windows oscilloscopes. You can use them to manage waveform transfer between your LabVIEW applications and your TDS open Windows oscilloscope.

Programming Options

You can use either VISA I/O functions or VXI*plug&play* instrument drivers to communicate with your oscilloscope.

Advanced users can use VISA to send and receive text based messages to the oscilloscope directly. You may want to use this method if you need complete control of how the instrument is programmed. This method has a higher learning curve than using an instrument driver. However, there are some opportunities for optimization if you are familiar with the GPIB command set.

Most users should use VXI*plug&play* driver to access all the scope functionality from LabVIEW. Tektronix has worked with National Instruments to provide LabVIEW wrappers that are customized for all Tektronix OpenChoice oscilloscopes. Note that the instrument drivers have to be installed after installing LabVIEW. These LabVIEW wrappers provide a convenient way of accessing the different functions in the driver. You can access these wrappers from the Functions->Instrument Drivers palette as show in the following illustration:



Another option is to use calls to VIs on the Functions->Tektronix palette. You can also mix calls to these VIs with calls to VISA and instrument drivers.

These VIs communicate with the scope through the standard Tektronix VXI*plug&play* instrument drivers and simplify tasks, such as transferring waveforms, timing and scaling information to and from LabVIEW.

The scope specific VIs simplify these tasks by grouping related operations. For example, The Simple Get Waveform VIs can acquire waveform signals from a live source such as a channel, reference or math source or from a file. This article provides step by step instructions on building an example using these scope specific VIs.

Another option for communicating with your instrument is to use ActiveX. You can work with TVC and IVI-COM drivers using the ActiveX support provided by LabVIEW. An article in the SDK (*Using the TekScope IVI-COM Driver in LabVIEW*) provides step by step instructions on how to set up a sample VI in LabVIEW using a Tektronix IVI-COM driver. Unlike the Plug and Play drivers, customized wrappers are not provided for Tektronix IVI-COM drivers.

3. Scope Analysis Overview

You can observe LabVIEW's potential for problem solving by running the LabVIEW Scope Analysis Demo.

This LabVIEW add-on for your open Windows oscilloscope provides acquisition, analysis, and presentation features. It runs independently of the LabVIEW development environment and does not require LabVIEW to be installed on your oscilloscope.

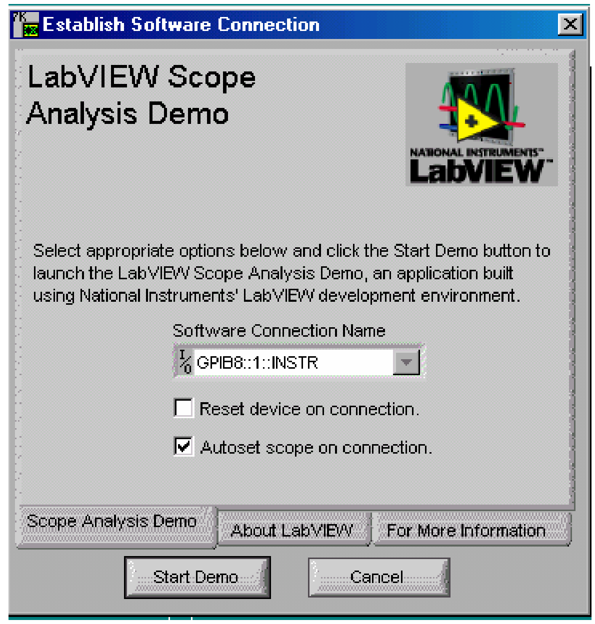
To run, click on:

Start->Programs->National Instruments->LabVIEW TDS#k Scope Demo->LabVIEW Scope Analysis Demo (TDS#k),

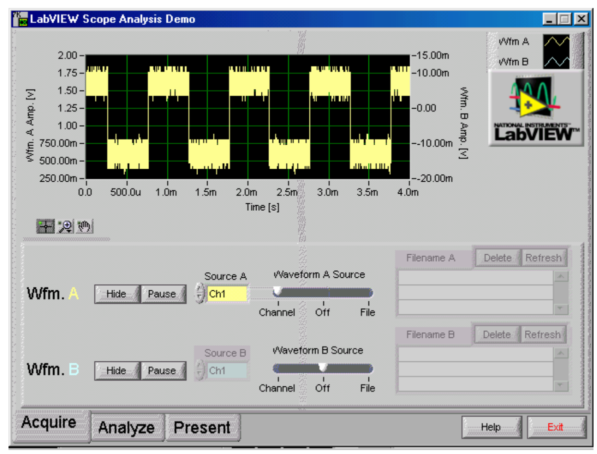
where # represents the number of your open Windows oscilloscope series.

The **LabVIEW Scope Analysis Demo** screen should appear, as shown to the rights. Check the **Software Connection Name**. The default value of **GPIB8::1::INSTR** applies to LabVIEW applications running on your open Windows oscilloscope. If you are running the demo from a computer connected to your oscilloscope remotely, you should consult with the TekVISA Resource Manager to locate the correct value for your oscilloscope. Use of this Resource Manager is documented elsewhere in your OpenChoice Software Development kit.

The LabVIEW Scope Analysis Demo screen should appear, as shown to the right. Check the Software Connection Name, The default value of **GPIB8::1::INSTR** applies to LabVIEW applications running on your open Windows oscilloscope. If you are running the demo from a computer connected to your oscilloscope remotely, you should consult with the TekVISA Resource Manager to locate the correct value for your oscilloscope. Use of this Resource Manager is documented elsewhere in your OpenChoice Software Development kit.



Click on the **Start Demo** button to begin the application. A screen similar to the one to the right should appear. Use the **Acquire**, **Analyze**, and **Present** tabs at the bottom of the screen to peruse the various demo features.

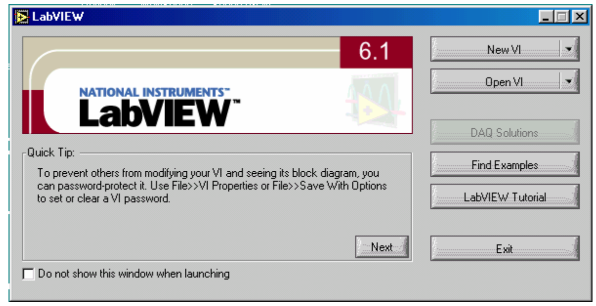


4. A Simple LabVIEW Demo

The purpose of this demo is to familiarize you with creating a LabVIEW virtual instrument on your open Windows oscilloscope. The input is a simple probe compensation signal. The output is a graph of that signal. The demo assumes that you have an open Windows TDS5000, 6000, or 7000 series oscilloscope with LabVIEW installed on it, and a cable connecting your oscilloscope's probe compensation signal to channel 1. Press the oscilloscope's front-panel **AUTOSET** button to obtain a clear view of the probe compensation signal. Minimize the oscilloscope application.

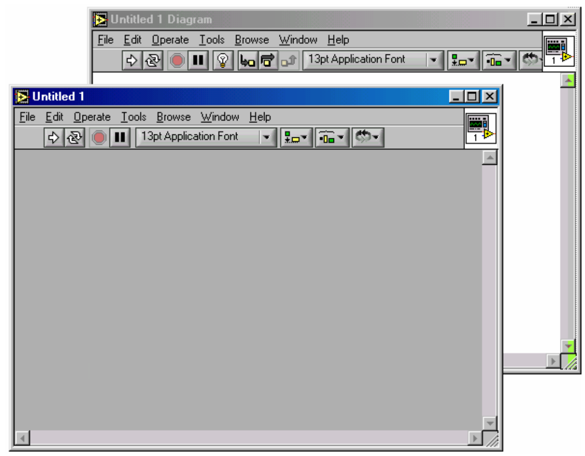
a. Start **LabVIEW** from Windows by clicking on:
Start -> **National Instruments** -> **LabVIEW 6.1** -> **LabVIEW**

You should see a LabVIEW window, as shown in the figure to the right



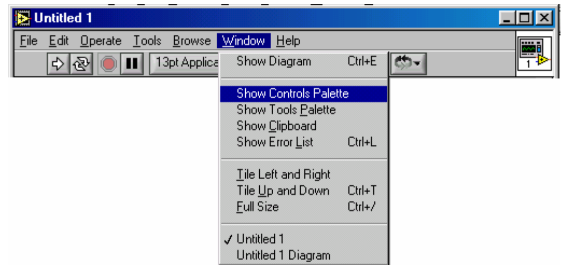
b. VI Creation

Click the button labeled **New VI**. This brings up a blank front panel and a blank block diagram, as shown to the right.



c. Front Panel Creation

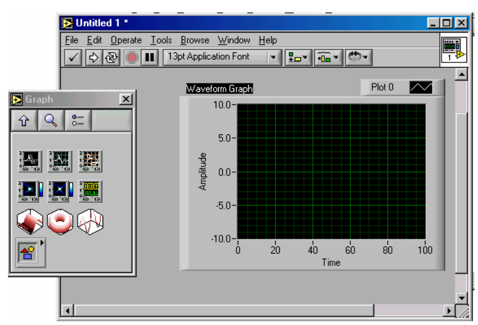
Create your virtual instrument's user interface. In this demo, you will do that by creating a front panel with an oscilloscope display on it. To do this, click, on the front panel's menu bar, **Window->Show Controls Palette**, as shown to the right.



This will bring up the Controls palette.

Then select the **Graph** icon in the palette. This brings up the **Graph** sub-palette.

Click on the **Waveform Graph** control from the sub-palette. Then click on the front panel to place the **Waveform Graph** on the front panel, as shown to the right.

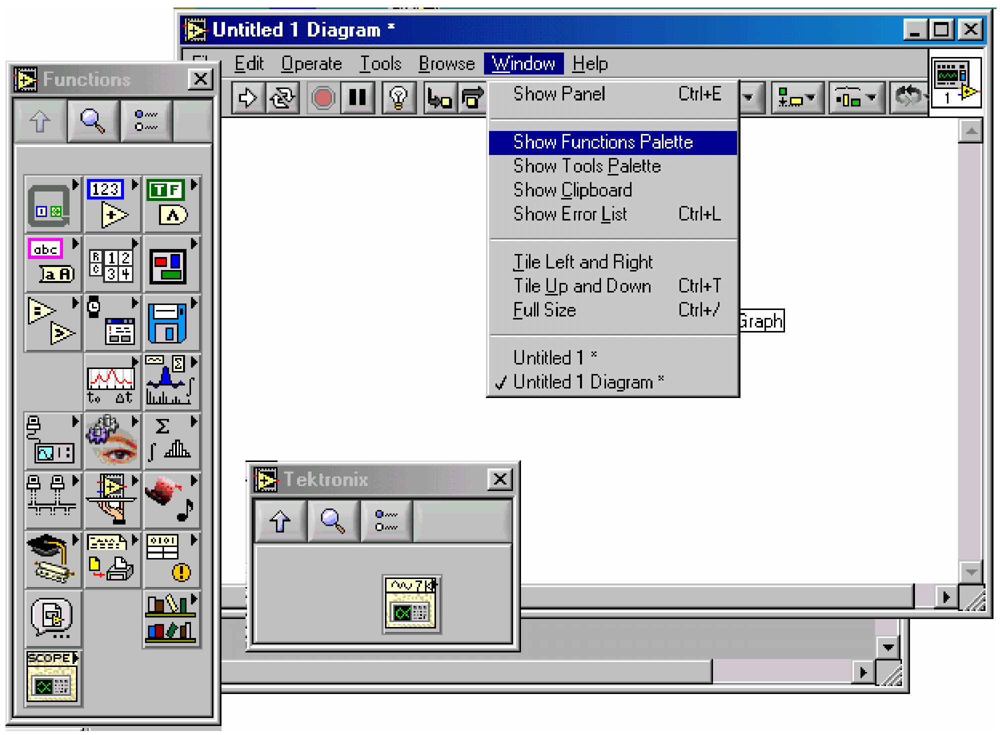


Move the indicator in your front panel as desired. To do that, bring up the Positioning tool . Do this by selecting **Show Tools Palette** from the **Window** pull-down menu on the front panel window. Click on the positioning icon in that palette.

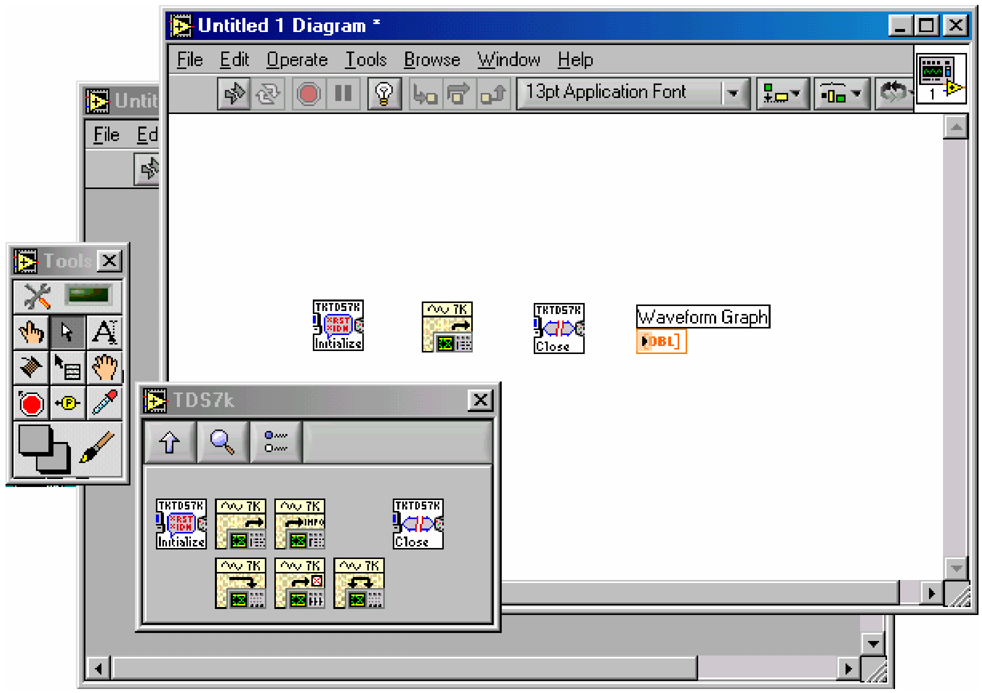
Use the positioning cursor to position the **Waveform Graph** as you want on the front panel window.

d. Block Diagram Creation

Create your instruments underlying code by developing the block diagram. On the Block Diagram window's menu bar, click on **Window->Show Functions Palette** to bring up the **Functions** palette. Then click on the **Tektronix** item in the palette to bring up the **Tektronix** palette. It should contain an icon for your series of TDS open Windows oscilloscope.



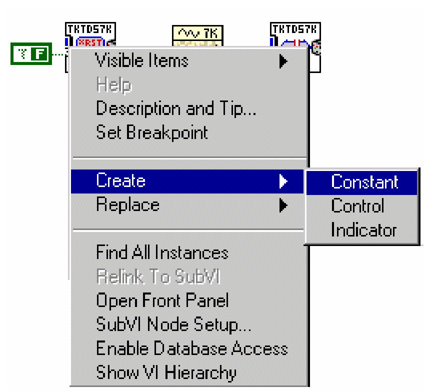
Put the VIs for the oscilloscope functions you want to use on your block diagram. Do this by clicking on each of the **Initialize**, **Simple Get Waveform**, and **Close** functions in the Tektronix Functions palette and then clicking on your block diagram, as shown in the figure below.



If you want, you can further position the function blocks with the position tool from the Tools palette.

e. Set Values

Now define a constant of a function to set. Do this by first selecting the **Wiring** tool from the **Tools** palette. Then move it to the input (left side) of the **Initialize VI** labeled **reset device**. Right-click your mouse and select **Create-Constant** from the resulting menu, as shown below.



Now set the value of that constant. Do this by selecting the **Operating** tool from the **Tools** palette.

Then click on the **reset device** constant. Set the value to **F**, for false.

Now, set another value. Once again select the **Wiring** tool from the **Tools** palette. Then right-click the **VISA resource name** input on the left side of the **Initialize VI**. Select **Create-Constant** from the menu. If **GPIB8::1::INSTR** does not appear, check that your TekScope application is running.

You have now added all the VIs (objects) on your block diagram needed to process the data.

f. Wiring the VI
The next step is to enable the VIs on your block diagram to communicate with each other. To do this, use the Wiring tool from the Tools palette.

Select the Wiring tool. Wire the following connections:

1. **Connect the Instrument Handle Out terminal of the Initialize VI to the Instrument Handle In terminal of the Get Waveform VI.**

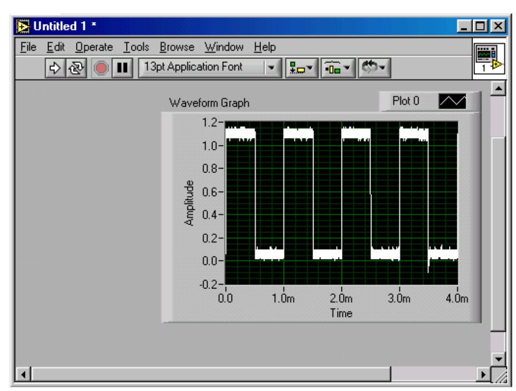
2. **Connect the Waveform output terminal of the Get Waveform VI to the Waveform Graph indicator terminal.**

3. **Connect the Instrument Handle Out terminal of the Get Waveform VI to the Instrument Handle terminal of the Close VI.**

g. Running the VI

The last step is to start the program running. To do this, simply click on the **Run** button.

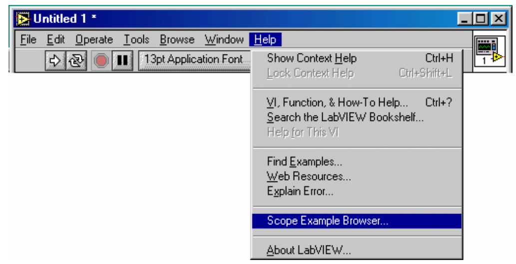
In this demo, a waveform should then appear on the front panel waveform indicator, as shown to the right.



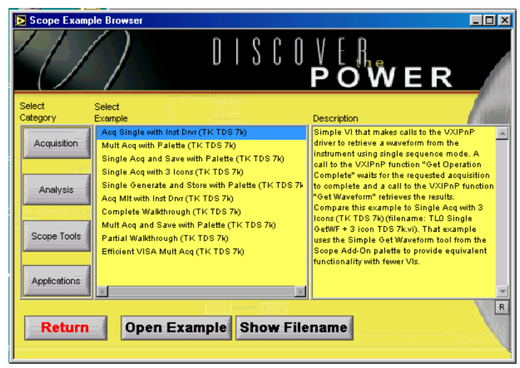
More Scope-Specific Examples

To see more examples of LabVIEW used with your open Windows oscilloscope, call up the Scope Example Browser.

To call up the Scope Example Browser, click on the Help menu item in your front panel or block diagram. Then select **Scope Example Browser**, as shown below.



The **Scope Example Browser** should appear, as shown to the right. Select an example of interest from the list. If desired, click on the **Acquisition**, **Analysis**, **Scope Tools**, or **Applications** tabs to find added examples. View them by clicking on the **Open Example** button.



The examples in the Scope Example browser illustrate a wide range of LabVIEW programming techniques. The Acquisition section shows different examples for getting and storing waveforms from the scope. It includes VXI*plug&play* driver examples as well as VISA examples. The last example (Efficient VISA MultAcq) shows how you can optimize waveform transfer programming directly with VISA.

The Analysis Section contains several examples, which highlight LabVIEW's analysis capability. Example include IIR filters, FFT, Tone detection, Total Harmonic Distortion, Averaged DC-RMS etc. You can use this example as a starting point and substitute your own analysis function.

The Scope Tool section contains several examples for controlling and manipulating scope parameters and features.

Finally, the Applications section contains different utilities for working with scopes including the ability to generate HTML reports, a soft front panel which provides the capability to control basic scope parameters, a setup sequencer which allows you to go through a sequence of setups and store the resulting waveforms and measurements in a report.