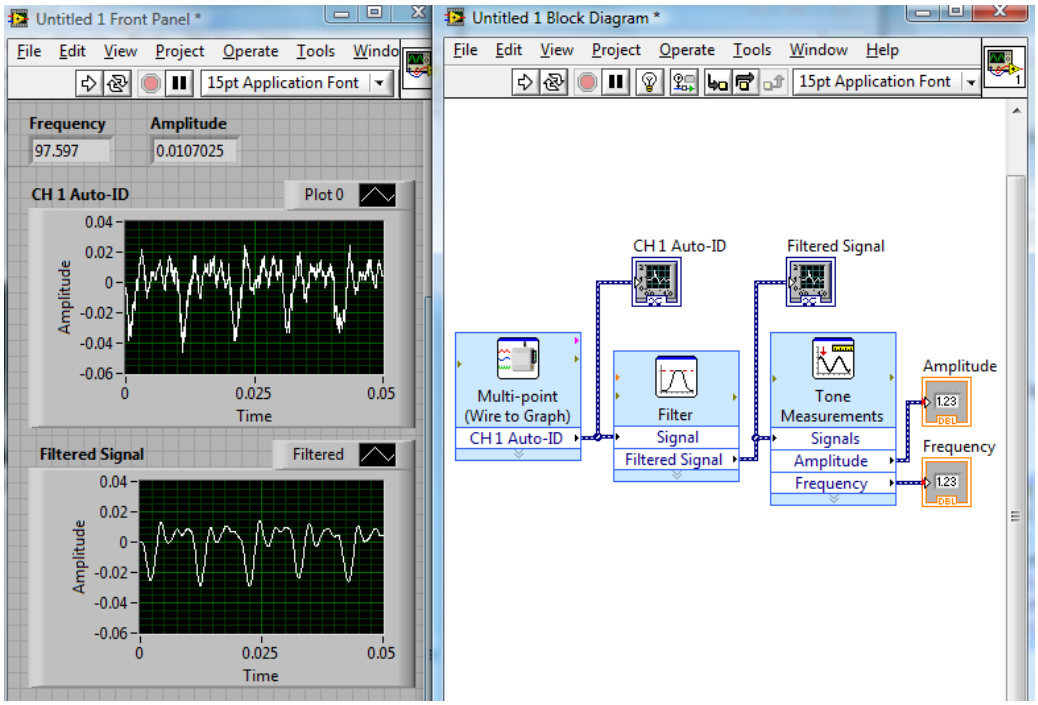
Exercise
3

Analyze Microphone Data



Completed front panel and block diagram

In the following steps, you will create a program using the Analog Express VI to collect microphone data for a length of 0.05 second at a rate of 10,000 samples/second. The raw microphone data will be displayed on a graph. The program will then apply a low-pass filter to the raw data to reduce the amplitude of the high frequency noise, thus smoothing out the data set. The filtered data are then analyzed to determine the frequency and amplitude of the tone. The filtering and analysis will be programmed using LabVIEW Signal Analysis Express VIs.

OBJECTIVES

In this exercise, you will

- Create a LabVIEW VI.
- Incorporate LabVIEW Express Analysis functions.
- Use the Execution Highlight feature to study data flow.
- Display data using numeric and graphical indicators.

MATERIALS

SensorDAQ or LabQuest interface
USB cable
computer
LabVIEW
Vernier Microphone

PROCEDURE

Part I Connect Equipment

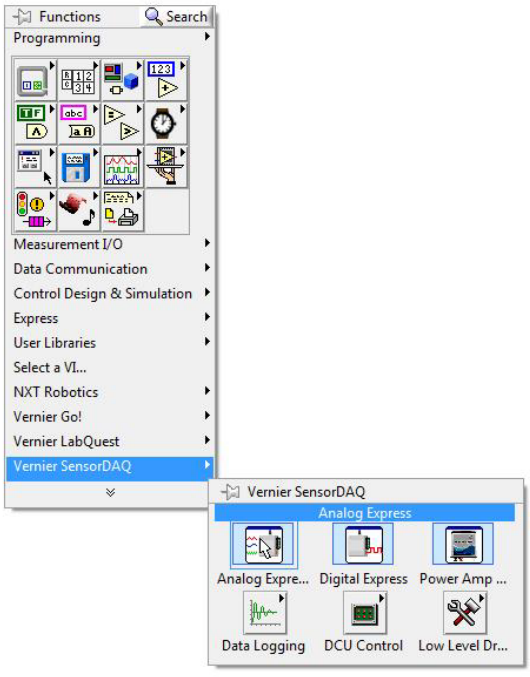
1. Connect the USB cable to the SensorDAQ or LabQuest interface.
2. Connect the other end of the USB cable to any available USB port on your computer. If you are using a LabQuest interface with a power button, turn it on.
3. Connect the Microphone to Ch. 1.

Part II Start LabVIEW and Create a VI to Collect Data

4. Start LabVIEW.
5. In the Getting Started window, click the Blank VI link in the New category.
6. View the block diagram by choosing Show Block Diagram from the Window menu (or use the <Ctrl-E> shortcut).
7. Place an Analog Express VI in the block diagram workspace.

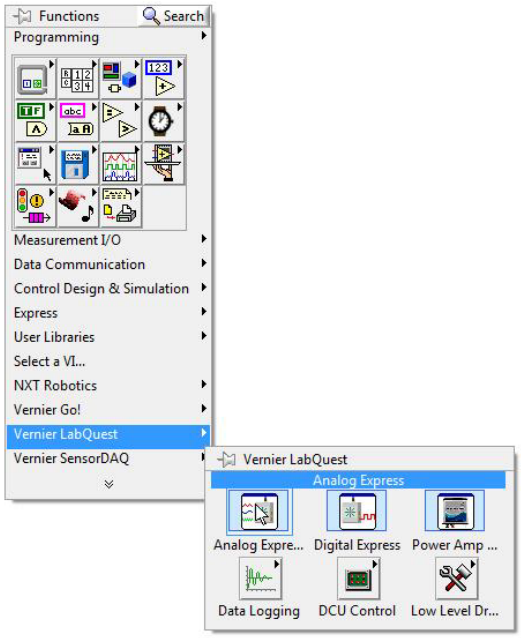
SensorDAQ

If you are using a SensorDAQ, right-click in the block diagram workspace and select Vernier SensorDAQ from the Functions palette. Click and drag the Analog Express VI to the block diagram workspace.



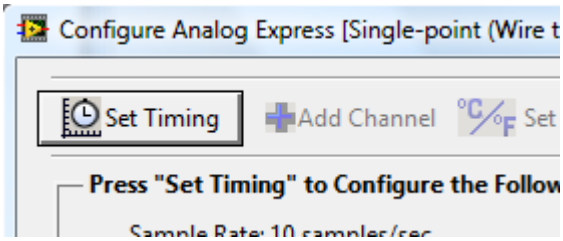
LabQuest Interface

If you are using a LabQuest interface, right-click in the block diagram workspace and select Vernier LabQuest from the Functions palette. Click and drag the Analog Express VI to the block diagram.



8. After dragging the Express VI from the palette to the block diagram workspace, the Express VI's configuration popup will open. Note that this step can be slow, depending on your computer.

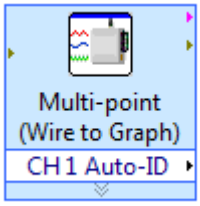
9. Click the Set Timing button, located in the upper-left corner of the configuration dialog.



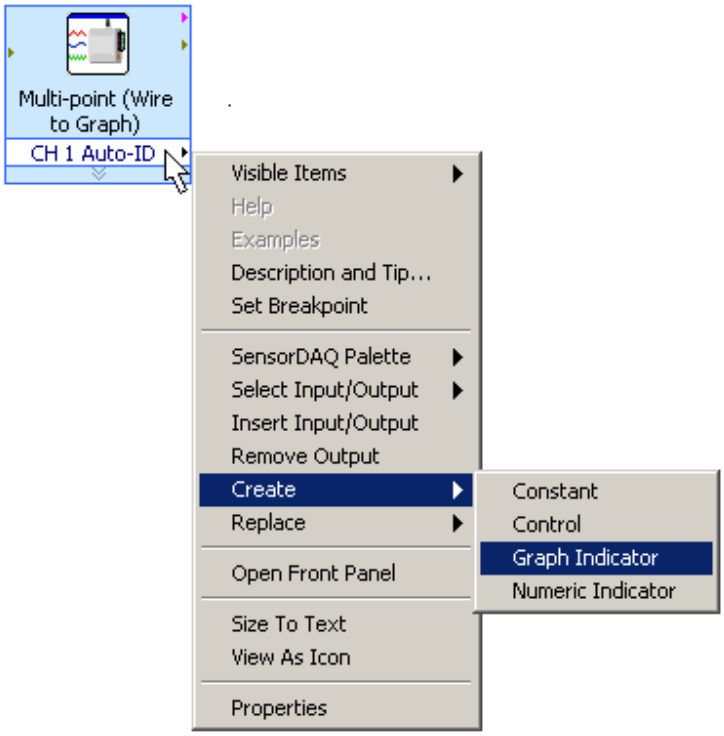
10. Set up the timing with a length of 0.05 second and a sample rate of 10,000 samples/second.

11. Click Done to close the Set Timing window. The Express VI Configuration should now be updated with the new settings.

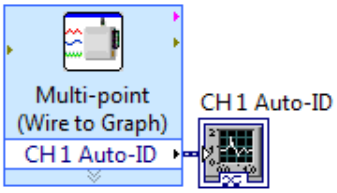
12. Select OK to close the Express VI's Configuration window. The Express VI will now be located in your block diagram workspace.



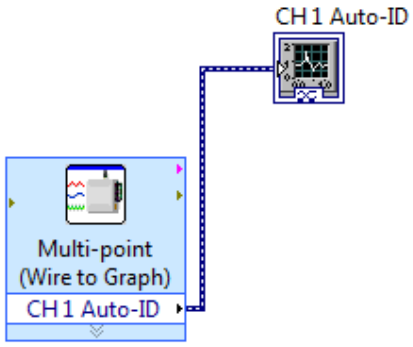
13. Create a graph for the front panel. This can be done by going to the front panel and selecting a graph from the Controls Palette. It can also be created in the block diagram workspace. To create it from the block diagram, right-click on the Express VI's "CH 1 Auto-ID" output terminal, and select Create ► Graph Indicator from the shortcut menu.



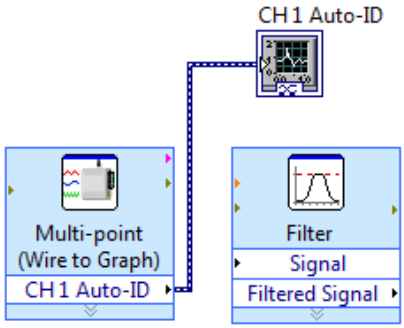
14. The graph is created, labeled and wired.



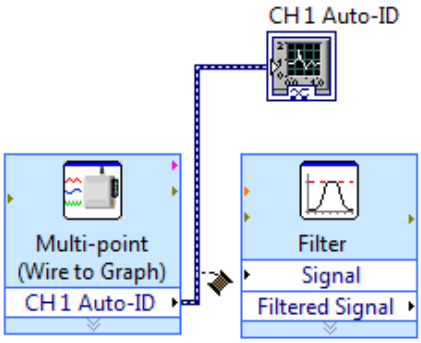
15. Move the graph terminal (click and drag to move an object) to make room to branch off of the wire.



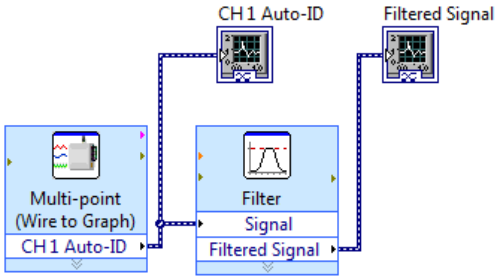
16. Place the Filter Express VI to the right of the Analog Express VI on the block diagram. From the Functions palette, choose Express ► Signal Analysis ► Filter and place it on the block diagram. When the configuration dialog opens, select "LowPass" as the Filtering Type, and 300 Hz for the Cutoff Frequency value. Click OK.



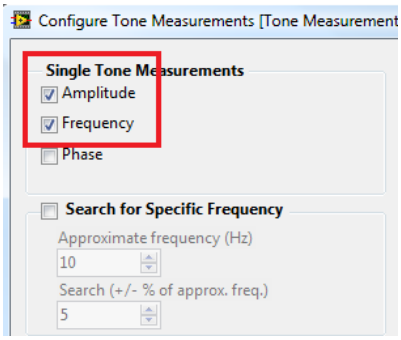
17. Bring the cursor to the wire. When the cursor changes to the Connect Wire tool, click and drag to create a wire branch from the wire to the Signal input terminal.



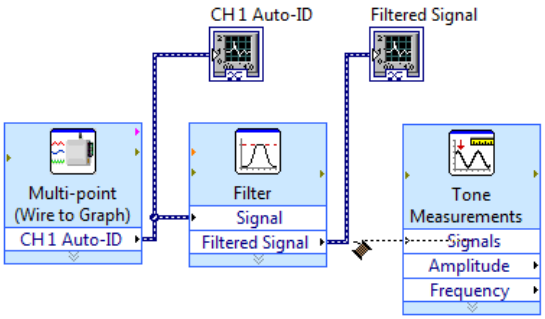
18. Create a graph indicator for the Filtered Signal output by right-clicking the Filtered Signal terminal and selecting Create ► Graph Indicator from the shortcut menu.



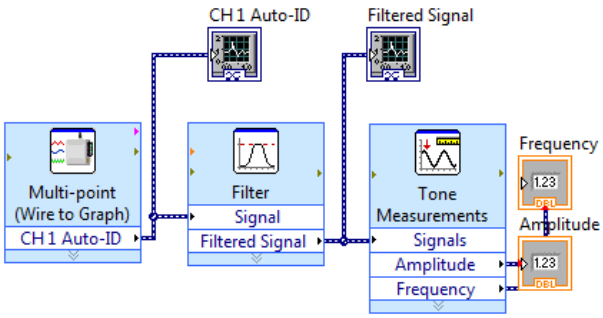
19. Place a Tone Measurements Express VI on the block diagram (Express ► Signal Analysis ► Tone Measurements). In the configuration dialog, choose Amplitude and Frequency measurements in the Single Tone Measurements section. Click OK.



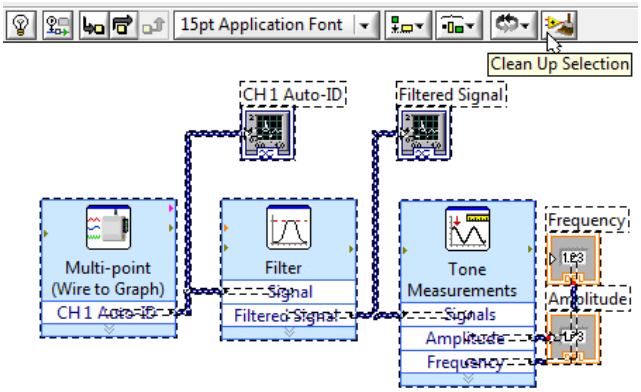
20. Wire the Filtered Signal to the Signals input terminal.



21. Create indicators for the amplitude and frequency measurements by right-clicking on each of the terminals of the Tone Measurements Express VI and selecting Create ► Numeric Indicator.

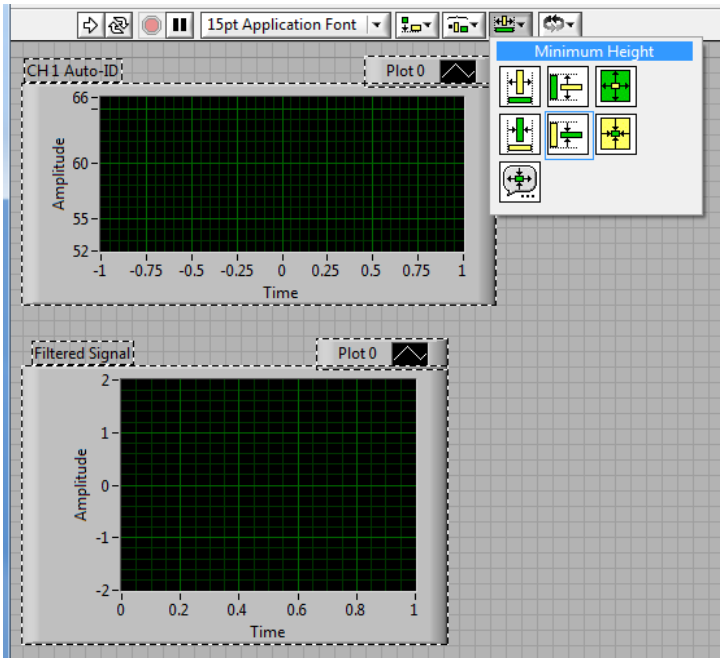


22. The block diagram objects and wires should be cleaned up. Select all, or a portion, of the block diagram and click the Clean Up Diagram toolbar button. Otherwise, manually move objects and wires.

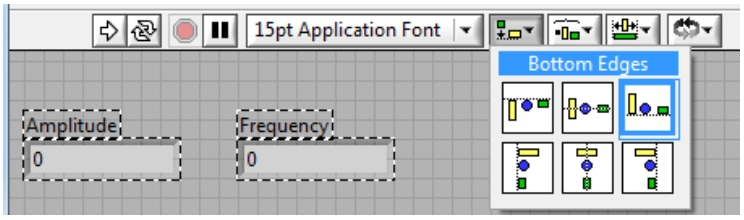


23. View the front panel using the shortcut <Ctrl-E>.

24. Resize one graph to increase the width and decrease the height. Then select both graphs and use the Resize Object toolbar button to make the other graph match your changes to the first graph (select Maximum Width and Minimum Height).

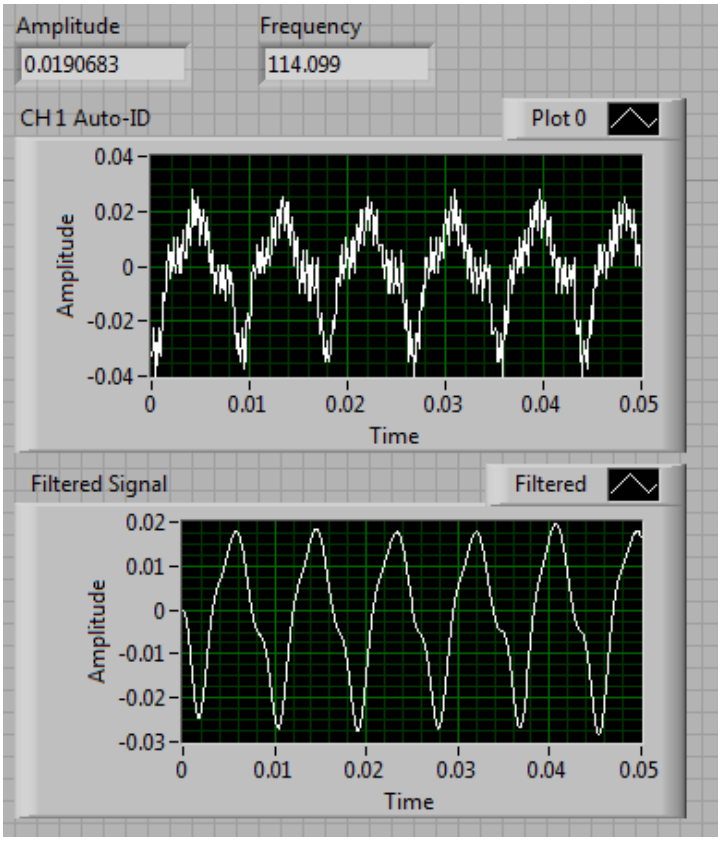


25. Move the two numeric indicators above the top graph and increase their width the same amount. Make sure they are lined up by using the Align Objects toolbar button to align their bottom edges.



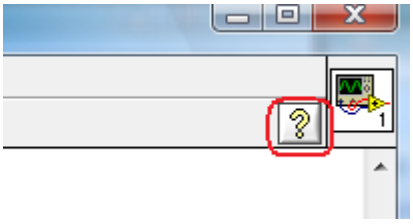
26. Begin humming into the microphone.

27. Click the white Run arrow on the left side of the Toolbar to run the program.



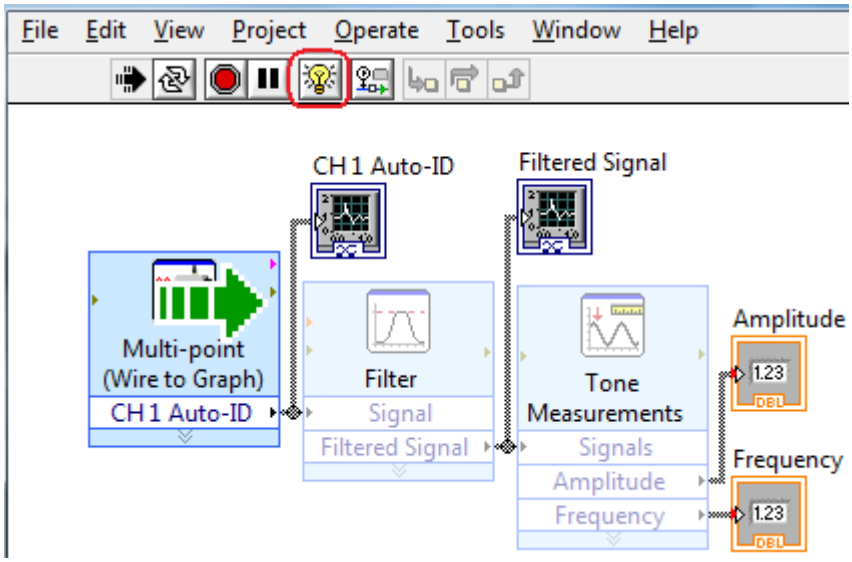
28. View the block diagram using the shortcut <Ctrl-E>.

29. Activate the Context Help Window (if it is not already) by clicking the Context Help Window button in the Toolbar.



30. Hover the cursor over the 3 Express VIs to view the Context Help Window information. Close the Context Help Window using the shortcut <Ctrl-H>.

31. Click the Highlight Execution debugging tool and then run the VI from the block diagram workspace by clicking on the white Run arrow. The order of execution, data flow, and data values should all be visible as the program runs.



EXTENSIONS

1. Turn highlight execution off. Display the value of a wire as the program runs at full speed using the Probe tool.

2. Run the VI continuously and experiment with sounds, such as vowel sounds or playing a musical instrument.

3. Modify the format of the front panel numeric indicators to provide one digit of precision for the Frequency and three digits of precision for the Amplitude.

4. Modify the filter configuration to observe how it affects the signal.