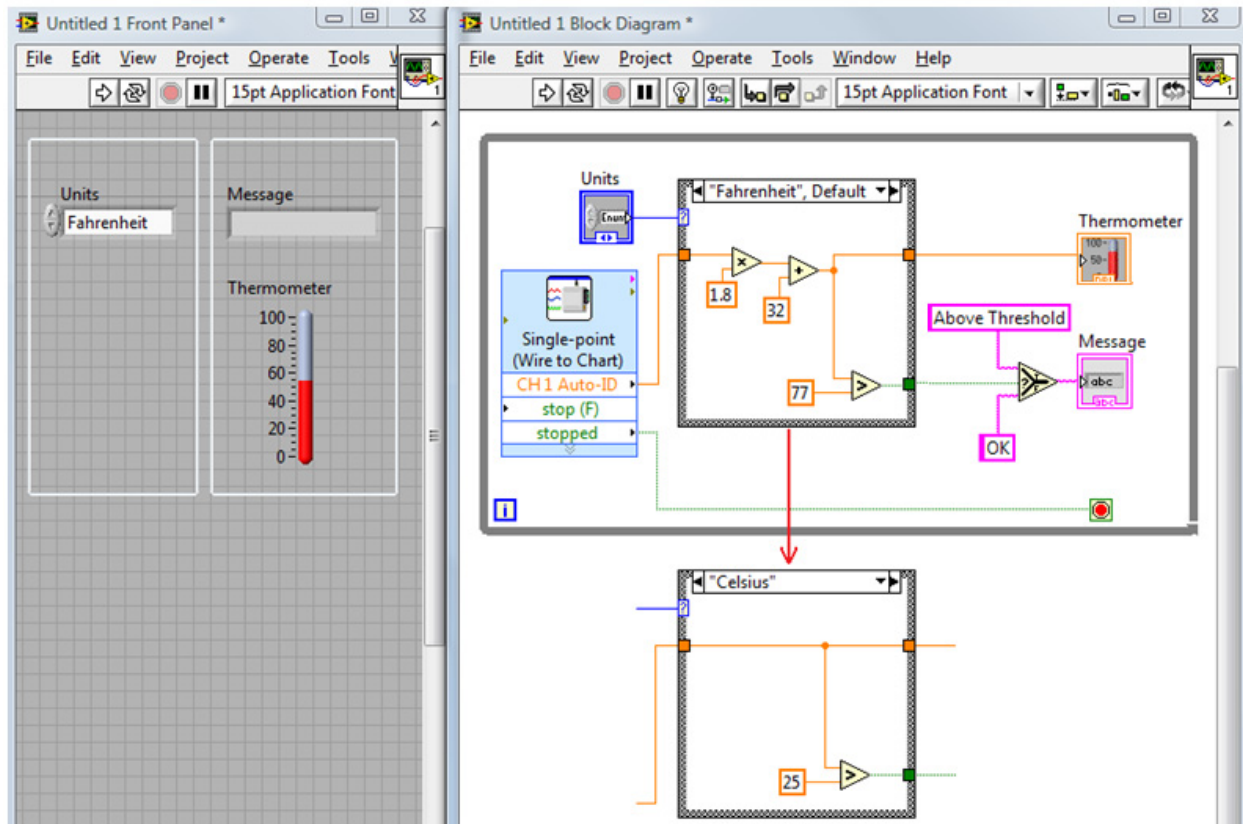# Above Threshold Warning of Temperature Data

Completed front panel and block diagram. The hidden case "Celsius" is also shown in this picture.

In the following exercise, you will create a program using the Analog Express VI that records temperature data. The code will allow the user to display the data in Celsius or Fahrenheit units. In addition, a threshold value is compared to the temperature measurement and a message is displayed to alert the user when the temperature is above the threshold.

OBJECTIVES

In this exercise, you will

- Create a LabVIEW VI to collect temperature data.
- Become familiar with an Enumerated control.
- Warn the user when the temperature is above a threshold value.
- Incorporate code that makes decisions based on user input and numeric comparison.

MATERIALS

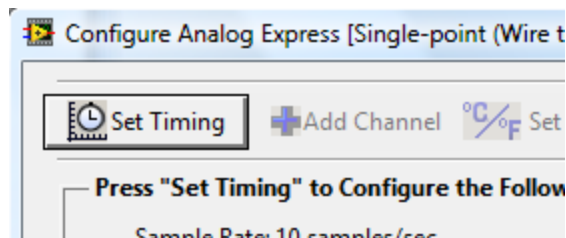|	
SensorDAQ or LabQuest interface	LabVIEW
USB cable	Vernier Stainless Steel Temperature Probe
computer	

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.

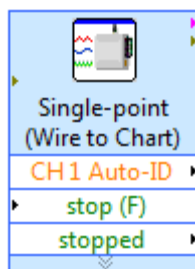3. Connect the Temperature Probe to Ch. 1.

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 using the <Ctrl-E> shortcut.

7. Click and drag the Analog Express VI from the SensorDAQ or LabQuest pallet to the block diagram. Access this palette by right-clicking the block diagram workspace.

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 window.
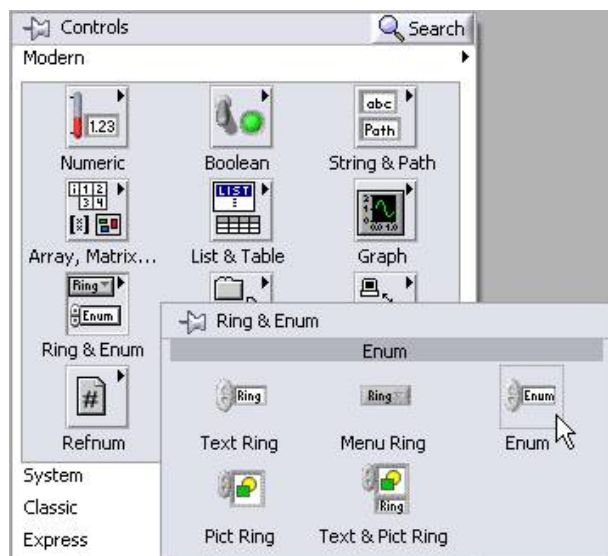

10. Set the timing with a length of 20 seconds and a sample rate of 2 samples/second.

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

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

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

14. Place an Enum control on the front panel. This control is located in Controls ► Modern ► Ring & Enum. Rename the control "Units."
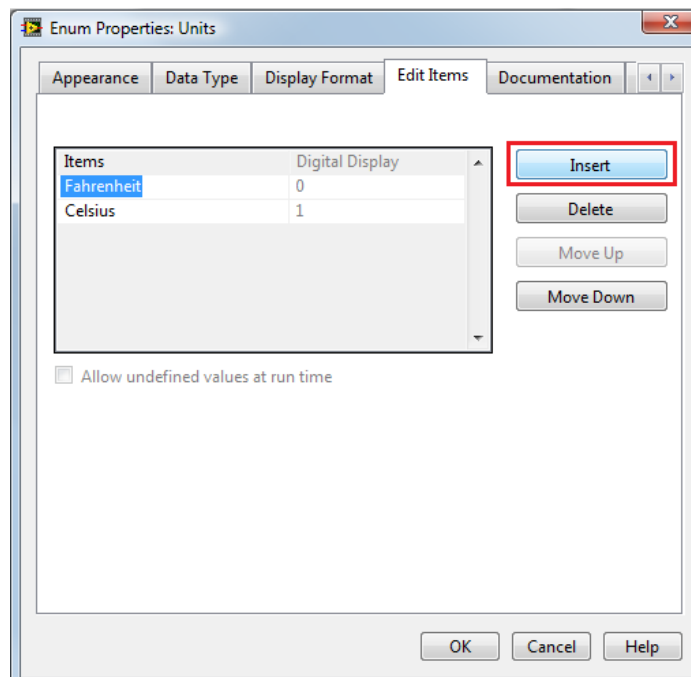

Tip: An enumerated type control, or Enum, contains lists of strings through which you can cycle. When you wire an enumerated type control to the selector terminal of a Case structure, LabVIEW matches the cases to the string values of items in the control, not the numeric values. In addition, you can right-click the Case Structure, and select Add Case for Every Value, to create a case for the string value of each item in the control.
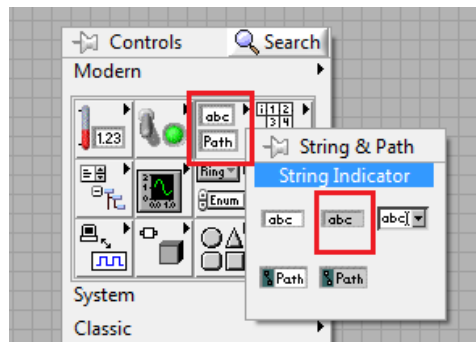
15. Right-click the Enum and select Edit Items from the menu.

16. Click the Insert button and add the following Items: Celsius and Fahrenheit.
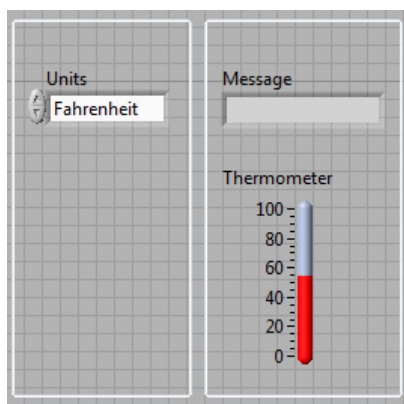

17. Click OK.

18. Add a string indicator to the front panel and name it "Message".
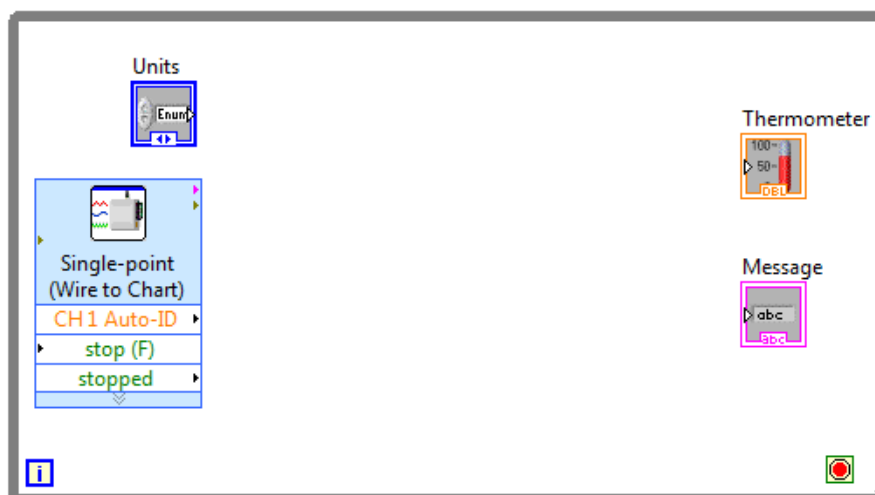

19. Add a thermometer indicator to the front panel.
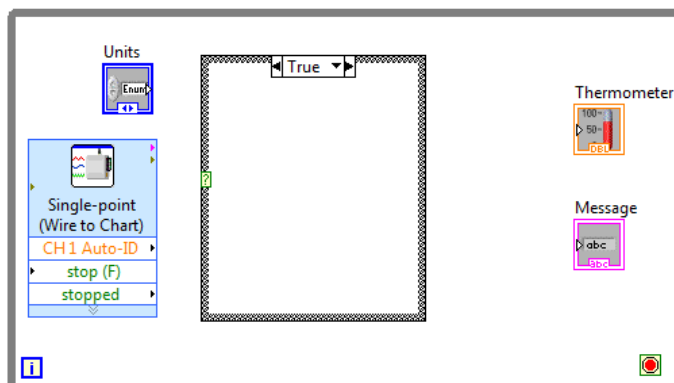
20. Clean up your front panel control and indicators.

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

22. Encircle all of the code with a While Loop and move the two indicators to the right side of the loop. Move the Analog Express VI and Units control to the left side of the loop.
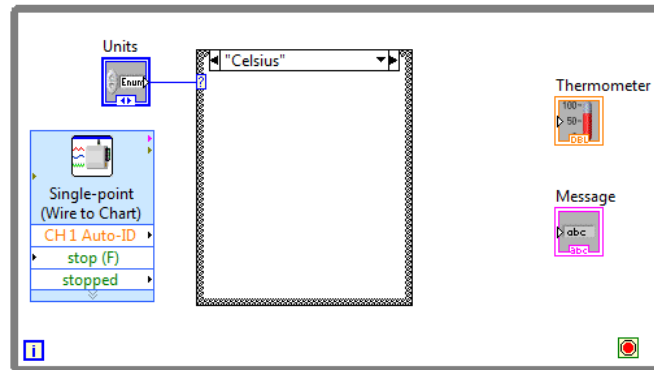

23. Add a Case Structure.

24. Click and drag the selector terminal (the small question mark (?) on the left side of the case structure) up to the upper-left corner of the Case Structure to be closer to the Units control.
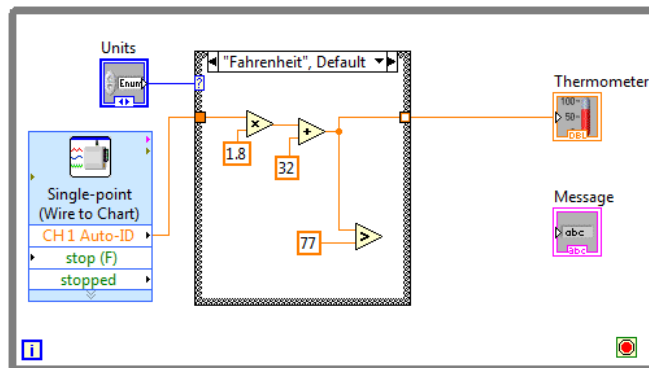
Wire the Units control to the Case Structure, and note how the name of the two cases changes to match the input.
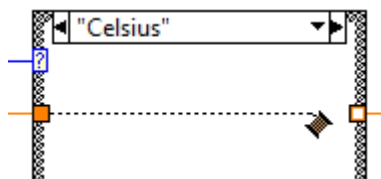

25. Go to the Fahrenheit case and add code to change the measurement value to Fahrenheit. Wire the result to the Thermometer. In addition, perform a greater than comparison of the reading to a value of 77 (degrees Fahrenheit).
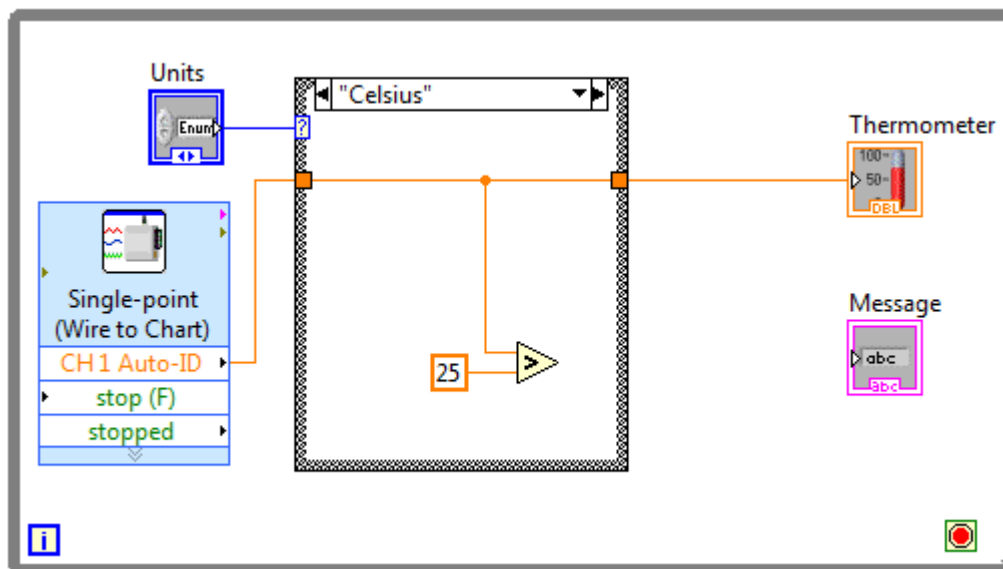
    Tip: The tunnel of a Case Structure must be solid. A solid tunnel signifies that every case has data wired out of the Case Structure. A Case Structure cannot allow some cases to pass data out of the structure, while other cases do not. All cases must wire data out of the tunnel; otherwise, the tunnel will appear hollow and the VI will have a broken arrow and will not run.
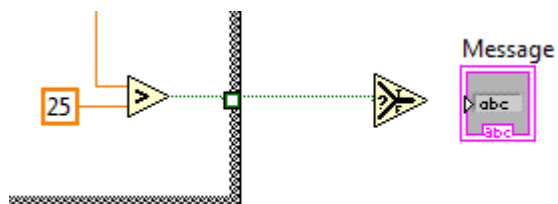

26. Change to the Celsius case and create a wire path from the input tunnel (where the measurement enters the case structure) to the output tunnel (where it exits). The tunnel will change from appearing hollow to appearing solid in color.

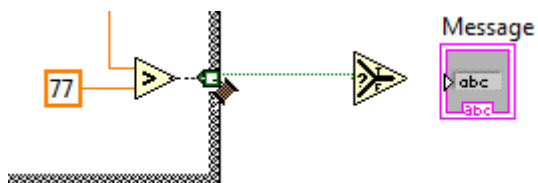*Hands-On Introduction to NI LabVIEW with Vernier*

27. Add code to the Celsius case to perform a greater than comparison of the reading to a value of 25 (degrees Celsius).

28. Add a Select function (found in the Programming ► Comparison palette) to the right of the Case Structure, in front of the Message indicator. Wire the result of the Greater? function in the Celsius case to the conditional input of the Select Function.
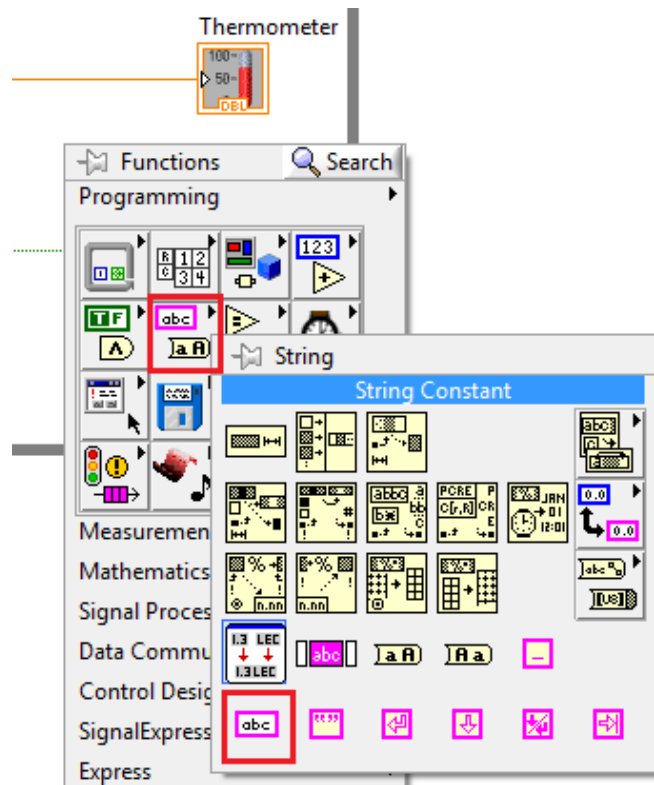

29. Go to the Fahrenheit case and wire the result of the Greater? function to the output tunnel. The tunnel will change from appearing hollow to appearing solid in color.
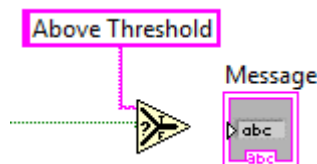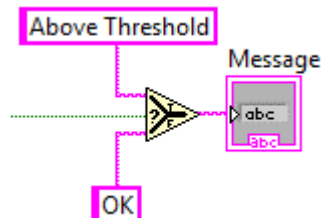
30. Add a String Constant function to the block diagram workspace next to the Select function. A String Constant is found in the Programming ► String palette.

31. When the String Constant is placed on the block diagram workspace, it will not contain any text. Type the words "Above Threshold" and wire the String Constant to the "t" input of the Select function.
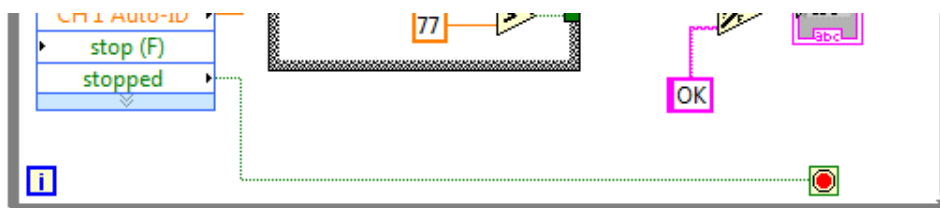

32. Add a second String Constant with "OK" and wire it to the "f" input of the Select function. Wire the result of the Select function to the Message indicator.
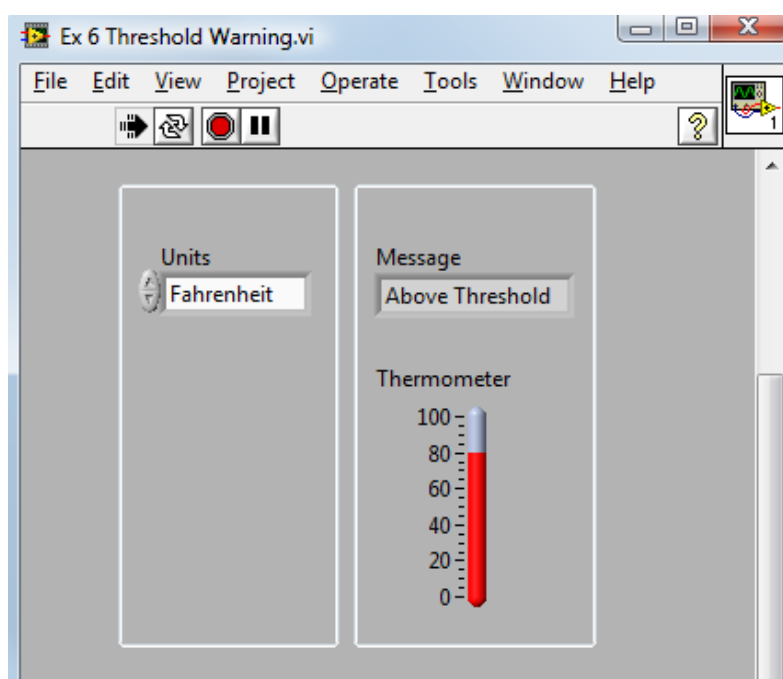
33. Wire the Analog Express VI's stopped output terminal to the While Loop's conditional terminal.

Tip: In this example, a STOP button is not wired into the Express VI's "stop (F)" input terminal. This means the Express VI will only send a Boolean true value when data collection is completed (as configured by the user in the Express VI). A STOP button may be added to provide the user with a means to cancel data collection prematurely.

34. Go to the front panel and run the VI. Change the Units and observe the reading on the Thermometer. Heat and cool the Temperature Probe so that the reading goes above and below the threshold.

EXTENSIONS

1. The threshold limit value is currently a numeric constant to compare against the Celsius reading, and a second constant to compare against the Fahrenheit reading. Modify the program so that there is only a single threshold value in degrees Celsius, and it is a front panel user control. Provide a front panel indicator that shows the threshold value in degrees Fahrenheit.

2. Add a lower limit threshold control and a lower limit message of "Below Threshold". There will now be a total of three possible messages: Above Threshold, OK, and Below Threshold.