PH2150

LabVIEW Course

Exercises 1-5

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Exercise 1 – Convert °C to °F

Build a VI

Complete the following steps to create a VI that takes a number representing degrees Celsius and converts it to a number representing degrees Fahrenheit.

If the **Tools** or **Controls** palette isn't visible when the front panel is active select **View»Tools (**or **Controls) Palette**. Similar applies for the **Functions** palette when viewing the diagram.

Front Panel

1. Select **Blank VI** to open a new front panel.
2. (Optional) Select **Window»Tile Left and Right** to display the front panel and block diagram side by side.
3. Create a numeric digital control. You will use this control to enter the value for degrees Centigrade.

    Select the *numeric control* on the **Modern»Numeric** palette. Move the control to the front panel and click to place the control.

    a. Type deg C inside the label and click outside the label or click the **Enter** button on the toolbar. If you do not type the name immediately, LabVIEW uses a default label. You can edit a label at any time by using the Labeling tool.
4. Create a numeric digital indicator. You will use this indicator to display the value for degrees Fahrenheit.

    a. Select the *numeric indicator* on the **Modern»Numeric** palette.
    b. Move the indicator to the front panel and click to place the indicator.
    c. Type deg F inside the label and click outside the label or click the **Enter** button.

LabVIEW creates corresponding control and indicator terminals on the block diagram. The terminals represent the data type of the control or indicator. For example, a DBL terminal represents a double-precision floating-point numeric control or indicator.
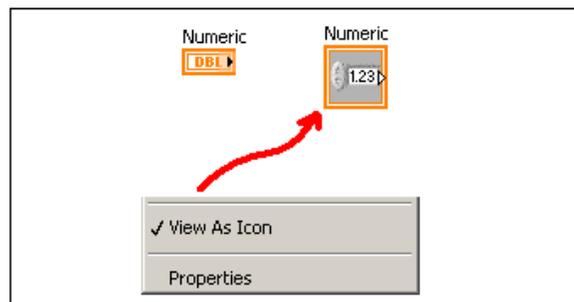
Note Control terminals have a thicker border than indicator terminals.

Block Diagram

5. Display the block diagram by clicking it or by selecting **Window»Show Diagram**.
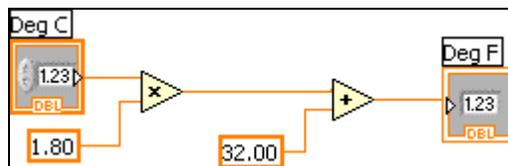
Note: Block Diagram terminals can be viewed as icons or as terminals. To change the way LabVIEW displays these objects right click on a terminal and select **View as Icon**.

6. Select the Multiply and Add functions on the **Programming»Numeric** palette and place them on the block diagram. If the **Functions** palette is not visible, right-click an open area on the block diagram to display it.

7. Select the numeric constant on the **Programming»Numeric** palette and place two of them on the block diagram. When you first place the numeric constant, it is highlighted so you can type a value.

8. Type 1.8 in one constant and 32.0 in the other.
    If you moved the constants before you typed a value, use the Labeling tool to enter the values.

9. Use the Wiring tool to wire the icons as shown in the previous block diagram.

    - To wire from one terminal to another, use the Wiring tool to click the first terminal, move the tool to the second terminal, and click the second terminal, as shown in the following illustration. You can start wiring at either terminal.
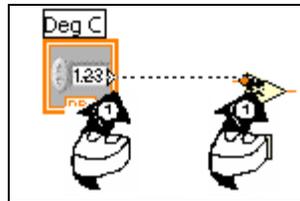
    - You can bend a wire by clicking to tack the wire down and moving the cursor in a perpendicular direction. Press the spacebar to toggle the wire direction.
    - To identify terminals on the nodes, right-click the Multiply and Add functions and select **Visible Items»Terminals** from the shortcut menu to display the connector pane. Return to the icons after wiring by right-clicking the functions and selecting **Visible Items»Terminals** from the shortcut menu to remove the checkmark.
    - When you move the Wiring tool over a terminal, the terminal area blinks, indicating that clicking will connect the wire to that terminal and a tip strip appears, listing the name of the terminal.

- To cancel a wire you started, press the <Esc> key, right-click, or click the source terminal.

10. Display the front panel by clicking it or by selecting **Window»Show Front Panel**.(or use ctrl-E to switch between the front pane and the diagram)

11. Save the VI because you will use this VI later in the course.

    a. Select **File»Save**.

    b. Navigate to your home directory and create a folder to store the Vis you create.

Note Save all the VIs you edit in this course to your directory.

    c. Type Convert C to F.vi in the dialog box.

    d. Click the **Save** button.

12. Enter a number in the digital control and run the VI.

    a. Use the Operating tool or the Labeling tool to double-click the digital control and type a new number.

    b. Click the **Run** button to run the VI.

    c. Try several different numbers and run the VI again.

13. Select **File»Close** to close the Convert C to F VI.
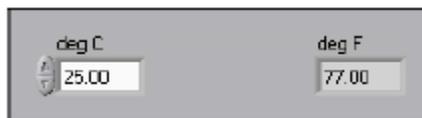

End of Exercise

Exercise 2 – Create a SubVI

Front Panel

1. Select **File»Open** and open the VI Convert C to F.vi.

   If you closed all open VIs, click the **Open…** button on the **LabVIEW** dialog box.

Tip Click the arrow next to **Open…** button on the **LabVIEW** dialog box to open recently opened files, such as Convert C to F.vi.
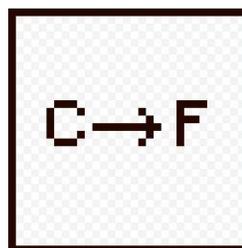
   The following front panel appears.

2. Right-click the icon in the upper right corner of the front panel and select **Edit Icon** from the shortcut menu. The **Icon Editor** dialog box appears.
3. Select **Edit»Clear All** to remove the existing icon.
4. Double-click the Rectangle tool to redraw the border.
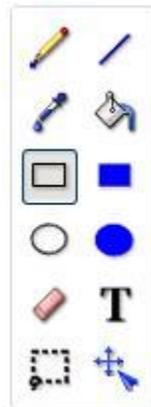
5. Create the following icon.

a. Use the Text tool (**T**) and click on the edit area.

b. Type 'C' and 'F'.

c. Use the Pencil tool to create the arrow.

Note To draw horizontal or vertical straight lines, press the <Shift> key while you use the Pencil tool to drag the cursor.

d. Use the Select tool and the arrow keys to move the text and arrow you created.

e. When the icon is complete, click the **OK** button to close the **Icon Editor** dialog box. The icon appears in the upper right corner of the front panel and block diagram.

6. Right-click the icon on the front panel and select **Show Connector** from the shortcut menu to define the connector pane terminal pattern. By default, LabVIEW will present the standard twelve-terminal pattern, but only two terminals are used in this VI. Right-click the connector pane and select **Patterns** and choose the fourth pattern on the top row.

7. Assign the terminals to the digital control and digital indicator.

a. Click the left terminal in the connector pane. The tool automatically changes to the Wiring tool, and the terminal turns black.

b. Click the **deg C** control. The left terminal turns orange, and a marquee highlights the control.

c. Click an open area of the front panel. The marquee disappears, and the terminal changes to the data type color of the control to indicate that you connected the terminal.

d. Click the right terminal in the connector pane and click the **deg F** indicator. The right terminal turns orange.

e. Click an open area on the front panel. Both terminals are orange.

f. Move the cursor over the connector pane. The **Context Help** window shows that both terminals are connected to floating-point values.

8. Select **File»Save** to save the VI because you will use this VI later in the course.

9. Select **File»Close** to close the Convert C to F VI.

End of Exercise

Exercise 3 – Simulated Data Acquisition

To complete this exercise, you will need to use the VI *thermo_input.vi*. This can be copied from the PH2150 web page and saved in your Labview directory.

Front Panel

1. Select **File»New** to open a new front panel.
2. Create the thermometer indicator, as shown on the following front panel.
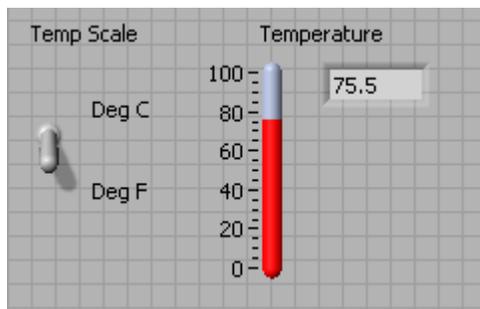
a. Select the *thermometer* on the **Modern»Numeric** palette and place it on the front panel.
b. Type Temperature inside the label and click outside the label or click the **Enter** button on the toolbar.
c. Right-click the thermometer and select **Visible Items»Digital Display** from the shortcut menu to display the digital display for the thermometer.
3. Create the vertical switch control.
a. Select the *vertical toggle switch* on the **Modern»Boolean** palette.
b. Type Temp Scale inside the label and then click outside the label or click the **Enter** button.

c. Use the Labeling tool to place a free label, deg C, next to the
TRUE position of the switch, as shown in the previous front
panel (or double click front panel empty space).

d. Place a free label, deg F, next to the FALSE position of the
switch.

Block Diagram

4. Select **Window»Show Block Diagram** to display the block diagram.

5. Build the following block diagram.
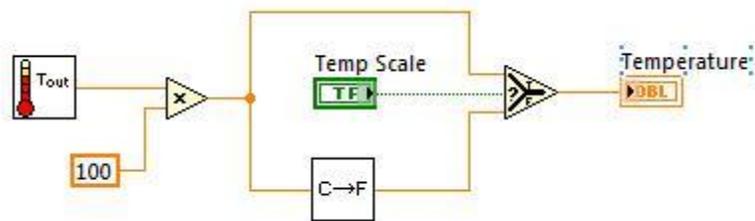
a. Select the function palette **Select a VI…** and navigate to the
Thermometer Sim.vi that was downloaded from the web page. This
VI generates some simulated temperature data.

b. Place the *multiply* function located on the **Programming»Numeric**
palette. This will scale the output from Thermo Input to Celsius.

c. Select **Select a VI…** and navigate to the Convert C to F VI, which
you built in Exercise 2, and place the VI on the block diagram. This
VI converts the Celsius value to Fahrenheit.

d. Place the *Select* function located on the
Programming»Comparison palette. This function returns either
the Fahrenheit (FALSE) or Celsius (TRUE) temperature value,
depending on the position of **Temp Scale** switch.

e. Right-click the **y** terminal of the *Multiply* function, select
Create»Constant, type 100, and press the <Enter> key to create
the constant.

f.   Use the Positioning tool to place the icons as shown in the previous block diagram and use the Wiring tool to wire them together.

6.   Display the front panel by clicking it or by selecting **Window»Show Front Panel**.

7.   Click the **Continuous Run** button, shown at left, to run the VI continuously.

8.   Click the **Continuous Run** (or the red Stop) button again to stop the VI.

9.   Create the following icon, so you can use the Temperature VI as a sub-VI.
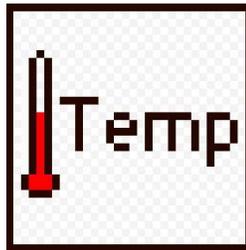
Right-click the icon in the upper right corner of the front panel and select **Edit Icon** from the shortcut menu. The **Icon Editor** dialog box appears.

10. Select **Edit»Clear All** to remove the existing icon. Double-click the Rectangle tool to redraw the border. Use the Pencil tool to draw an icon that represents the thermometer. Use the Foreground and Fill tools to color the thermometer red.

Note To draw horizontal or vertical straight lines, press the <Shift> key while you use the Pencil tool to drag the cursor.

a.   Double-click the Text tool, shown at left, and change the font to **Small Fonts** and ensure font size is 11.

b.   When the icon is complete, click the **OK** button. The icon appears in the upper right corner of the front panel.

11. Assign terminals to the Temperature display and C/F switch. Use a two-terminal connector as in the previous exercise. Right click on the icon

and show connector. Wire the right-hand terminal to Temperature and the left-hand terminal to the switch.

12. Select **File»Save** and save the VI as Thermometer.vi.

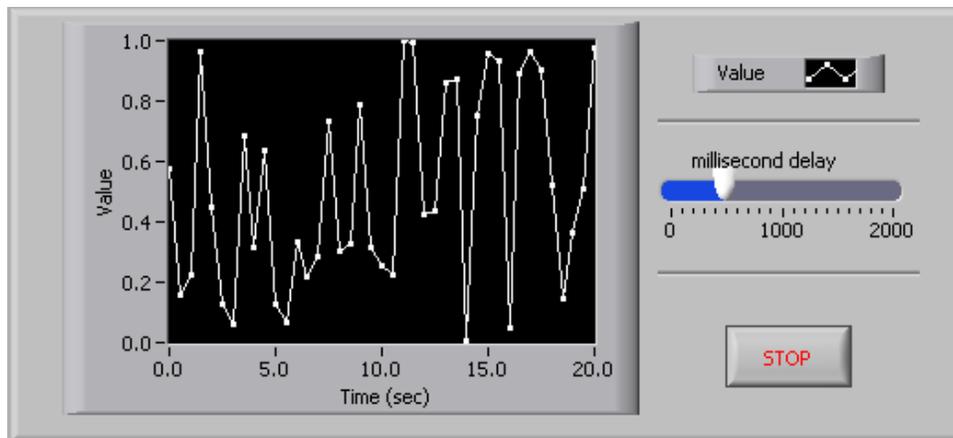13. Select **File»Close** to close the VI.

End of Exercise

Exercise 4 – Using Loops

Use a while loop and a waveform chart to build a VI that demonstrates software timing.

Front Panel

1. Open a new VI.
2. Build the following front panel.

a. Select the *Horizontal Pointer Slide* on the **Modern»Numeric** palette and place it on the front panel. You will use the slide to change the software timing.

b. Type milliseconds delay inside the label and click outside the label or click the **Enter** button on the toolbar, shown at left.

c. Place a *Stop Button* from the **Modern»Boolean** palette.

d. Select a W*aveform Chart* on the **Modern»Graph Indicators** palette and place it on the front panel. The waveform chart will display the data in real time.

e. Type Value History inside the label and click outside the label or click the **Enter** button.

f. The waveform chart legend labels the plot Plot 0. Use the Labeling tool to triple-click Plot 0 in the chart legend, type Value, and click outside the label or click the **Enter** button to re-label the legend.

g. The random number generator generates numbers between 0 and 1, in a classroom setting you could replace this with a data acquisition VI. Use the Labeling tool to double-click 10.0 in the y-axis, type 1, and click outside the label or click the **Enter** button to rescale the chart.

h. Change −10.0 in the y-axis to 0.

i. Label the y-axis Value and the x-axis Time (sec).

Block Diagram

3. Select **Window»Show Block Diagram** to display the block diagram.

4. Enclose the two terminals in a While Loop, as shown in the following block diagram.
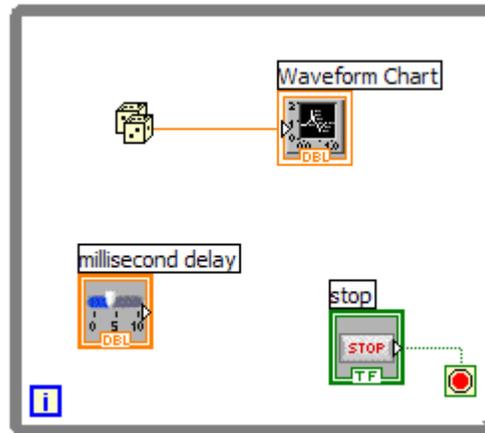
a. Select the *While Loop* on the **Programming»Structures** palette.

b. Click and drag a selection rectangle around the two terminals.

c. Use the Positioning tool to resize the loop, if necessary.

5. Select the *Random Number (0-1)* on the **Programming»Numeric** palette. Alternatively you could use a VI that is collecting data from an external sensor.
6. Wire the block diagram objects as shown in the previous block diagram.
7. Save the VI as Use a Loop.vi because you will use this VI later in the course.
8. Display the front panel by clicking it or by selecting **Window»Show Front Panel**.
9. Run the VI.

   The section of the block diagram within the While Loop border executes until the specified condition is TRUE. For example, while the STOP button is not pressed, the VI returns a new number and displays it on the waveform chart.
10. Click the STOP button to stop the acquisition. The condition is now TRUE, and the loop stops executing.
11. Format and customize the X and Y scales of the waveform chart.
    a. Right-click the chart and select **Properties** from the shortcut menu. The following dialog box appears.
    b. Click the **Scale** tab and select different styles for the y-axis. You also can select different mapping modes, grid options, scaling factors, and formats and precisions. Notice that these will update interactively on the waveform chart
    c. Select the options you desire and click the **OK** button.
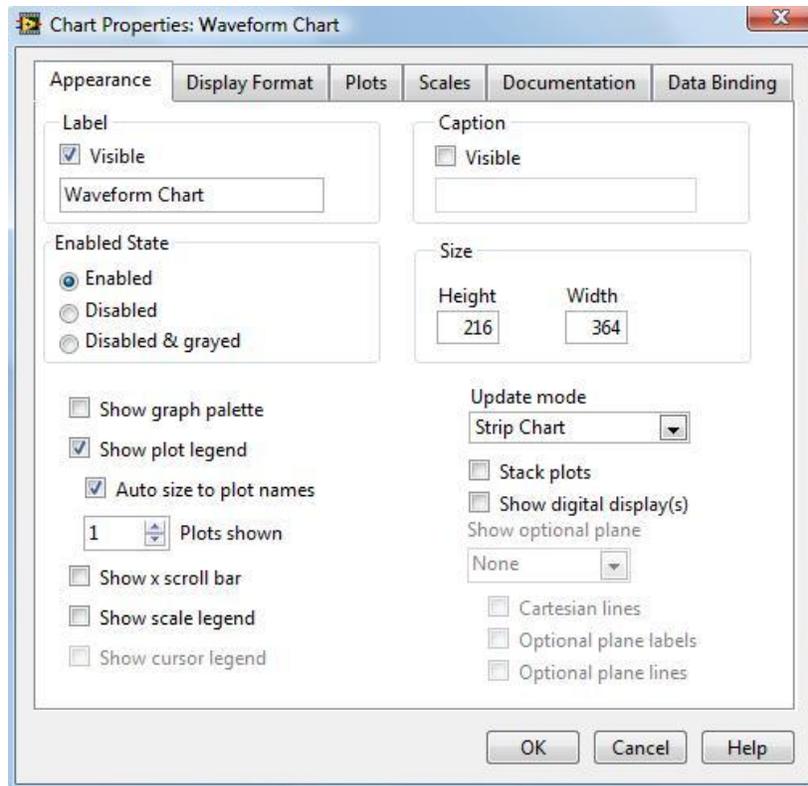
12. Right-click the waveform chart and select **Data Operations»Clear Chart** from the shortcut menu to clear the display buffer and reset the waveform chart. If the VI is running, you can select **Clear Chart** from the shortcut menu.

Adding Timing

When this VI runs, the While Loop executes as quickly as possible. Complete the following steps to take data at certain intervals, such as once every half-second, as shown in the following block diagram.
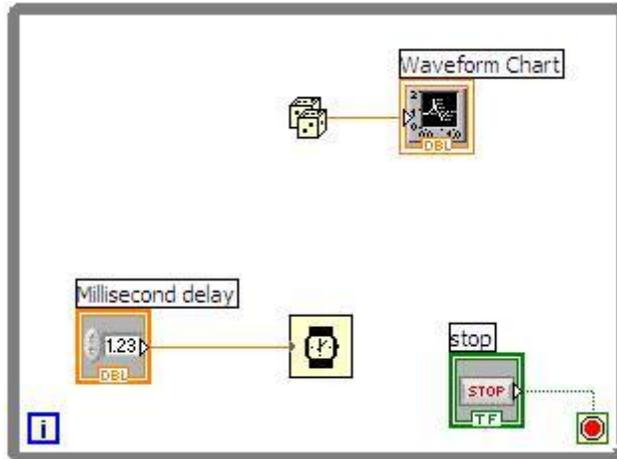
      a. Add the *wait (ms)* located on the **Programming»Timing** palette to your VI

      b. This will allow you to adjust the speed of the execution from the pointer slide on the front panel.

13. Save the VI as *Thermometer Chart.vi*, because you will use this VI later in the course.

14. Run the VI.

15. Try different values for the second delay and run the VI again. Notice how this affects the speed of the number generation and display.

16. Close the VI.

End of Exercise

Exercise 5 - Analyzing and Logging Data

Complete the following steps to build a VI that measures temperature every 0.25s for 10s. During the acquisition, the VI displays the measurements in real time on a waveform chart. After the acquisition is complete, the VI plots the data on a graph and calculates the minimum, maximum, and average temperatures. The VI displays the best fit of the temperature graph.

Front Panel

1. Open a new VI and build the following front panel using the following tips.
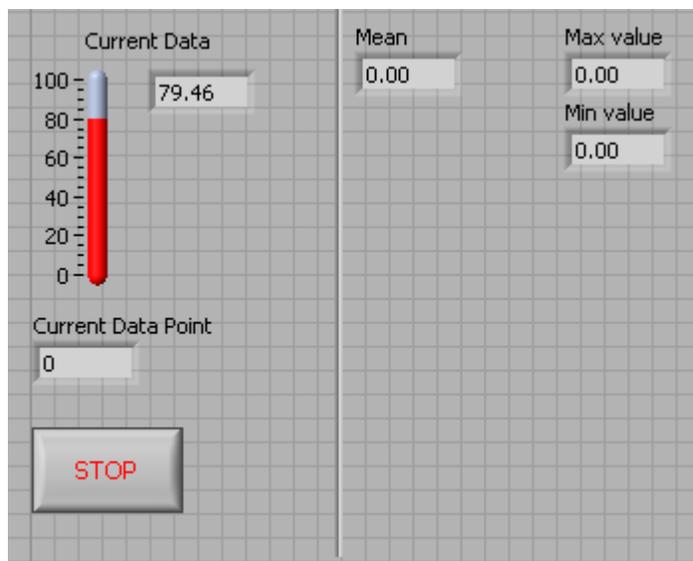
- Do not create the **Mean**, **Max**, and **Min** indicators yet. Create them on the Block Diagram by right clicking on the functions and choosing Create Indicator. Then position them on the Front Panel.
- Add the *Digital Display* to the thermometer as in Exercise 3.
- Right-click *Current Data Point* and change representation to I32.

Block Diagram

2. Build the following block diagram.
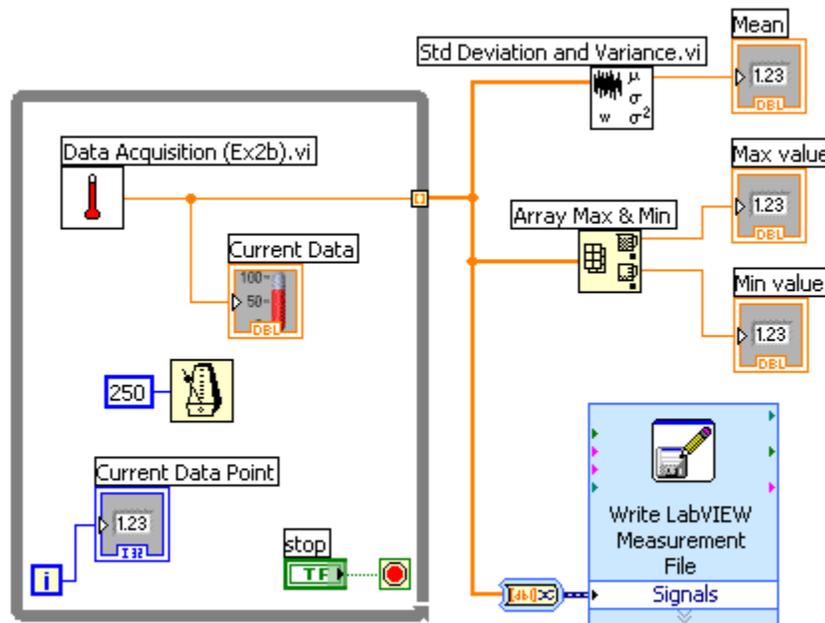
a. Select **Select a VI…** and choose *Thermometer.vi* (from exercise 3).

b. Place the *Wait Until Next ms* Multiple function located on the **Programming»Timing** palette and create a constant of 250. This causes the For Loop to execute every 0.25s (250ms).

c. **IMPORTANT:** Ensure the output tunnel from the While loop generates an array: right click the tunnel and select *enable indexing*.

d. Place the *Array Max & Min* function located on the **Programming»Array** palette. This function returns the maximum and minimum temperature.

e. Place the *Mean VI* located on the **Mathematics»Probability and Statistics** palette. This VI returns the average of the temperature measurements.

f. Right-click the output terminals of the Array Max & Min function and Mean VI and select **Create»Indicator** from the shortcut menu to create the **Max**, **Min**, and **Mean** indicators.

g. Place the *Write to Spreadsheet File* located on the **File I/O** palette. Connect the temperature data to the *1D* data input.

3. Save the VI as Temperature Logger.vi.

4. Display the front panel and run the VI.

5. After pressing STOP a dialog box will appear. Enter the name of the file to save the spreadsheet, with the extension .txt

6. Check the data-file contains valid data by opening it in *Excel* or a text editor such as *Notepad*.

End of Exercise