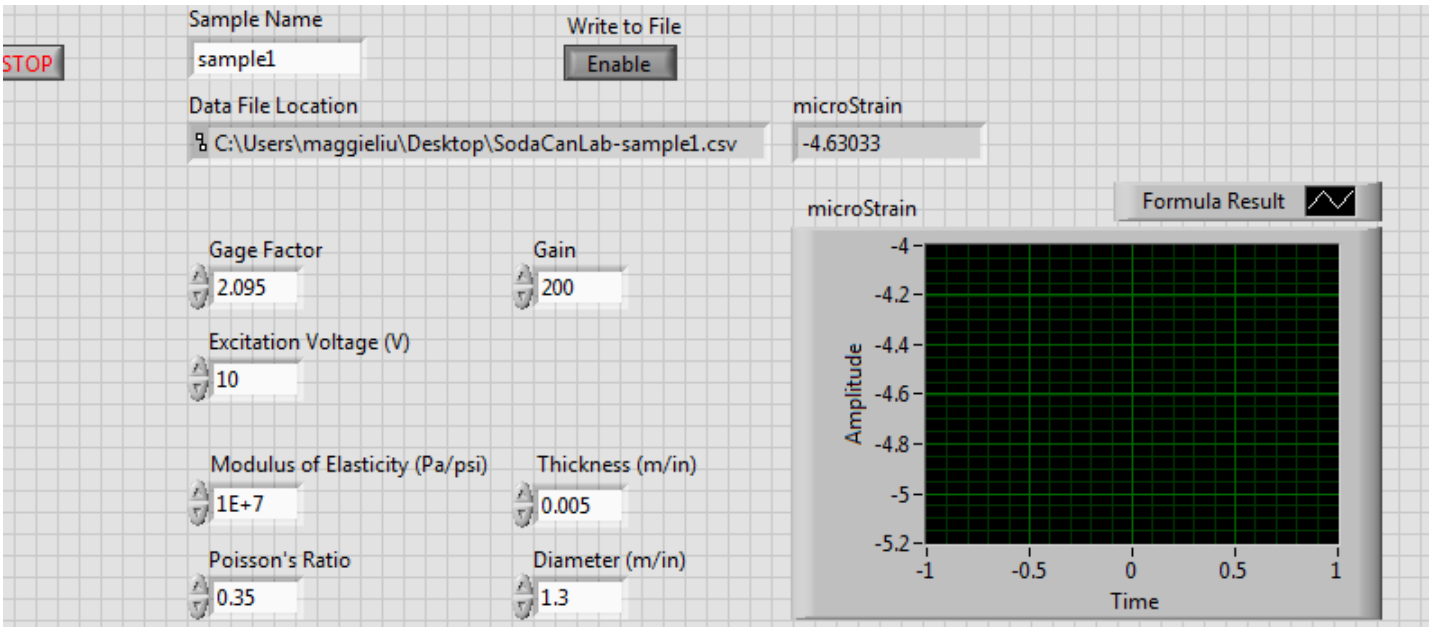
Strain and Pressure Measurement Laboratory

LabVIEW Program Construction Tutorial

This sample LabVIEW program for the Strain and Pressure Laboratory acquires the voltage input from connected NI DAQ device, calculates and indicates real-time strains experienced by the strain gauge, then calculates and saves dynamic values of internal pressure of the can, stress in both circumferential and axial directions of the can to a .csv file in the same folder where the LabVIEW program is saved, along with the micro strain readings. Around 30 sets of readings are taken each second.

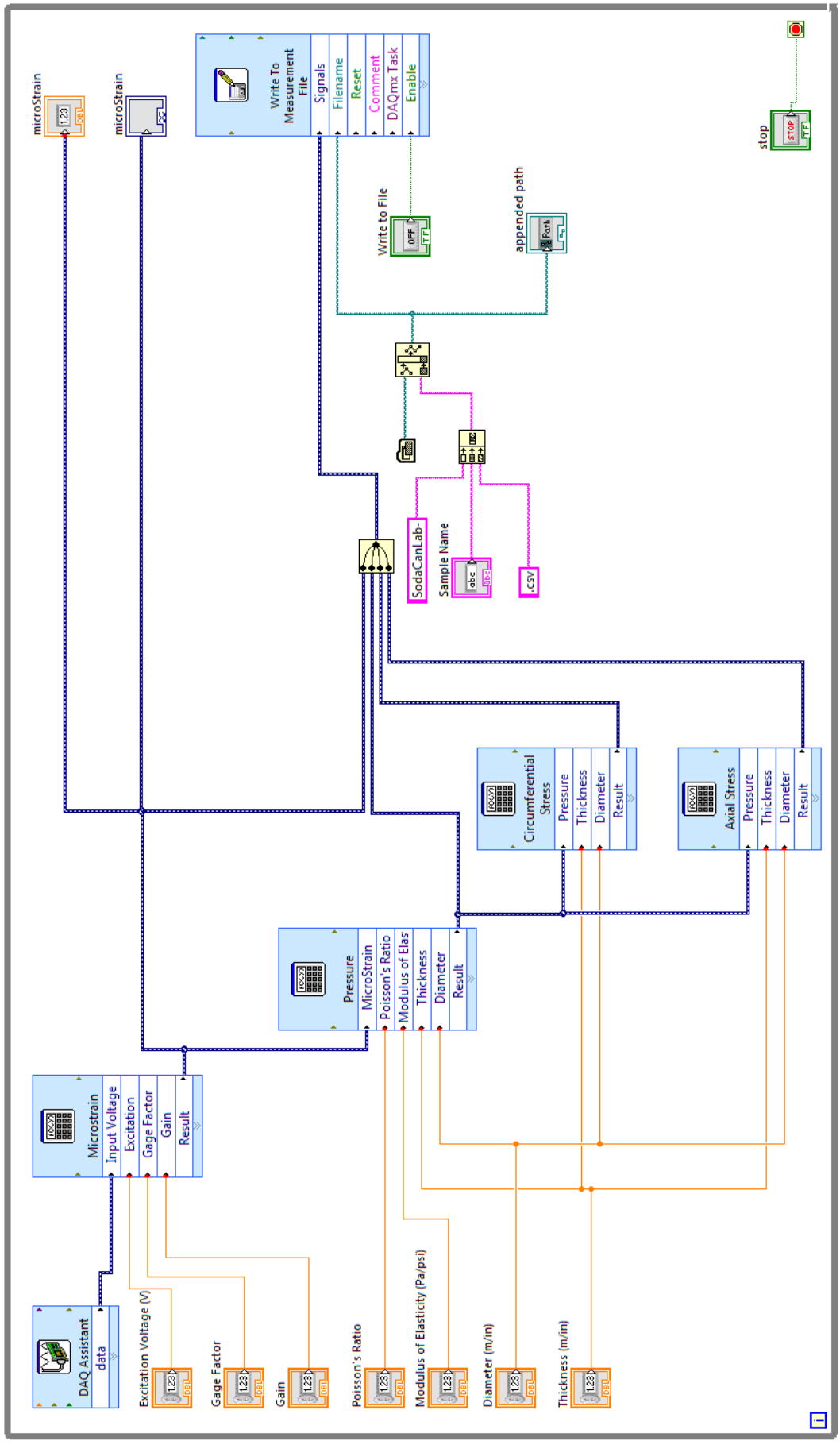
The front panel of the program is shown below. The block diagram is shown on page 2. This document walks through the steps of constructing this program.



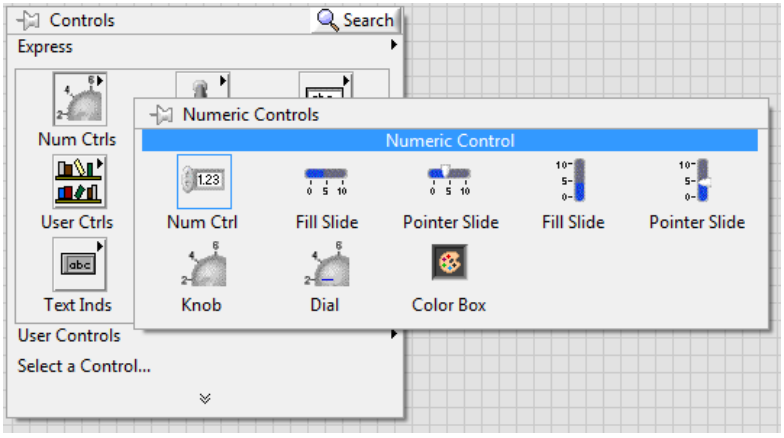
Part 1: Building the Front Panel

Before opening LabVIEW program, make sure that the NI DAQ device is probably connected to the desktop and turned on.

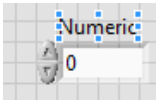
On *Tools Palette*, make sure that *Automatic Tools Selection* is enabled (the box/button on top of the palette). This setting automatically selects the appropriate pointer tools from the palette based on the mouse-over object.


microStrain
microStrain
Write To Measurement File
Signals
Filename
Reset
Comment
DAQmx Task
Enable
stop
Write to File
appended path
SodaCanLab-
Sample Name
.CSV
Circumferential Stress
Pressure
Thickness
Diameter
Result
Axial Stress
Pressure
Thickness
Diameter
Result
Pressure
MicroStrain
Poisson's Ratio
Modulus of Elas
Thickness
Diameter
Result
Microstrain
Input Voltage
Excitation
Gage Factor
Gain
Result
DAQ Assistant
data
Excitation Voltage (V)
Gage Factor
Gain
Poisson's Ratio
Modulus of Elasticity (Pa/psi)
Diameter (m/in)
Thickness (m/in)

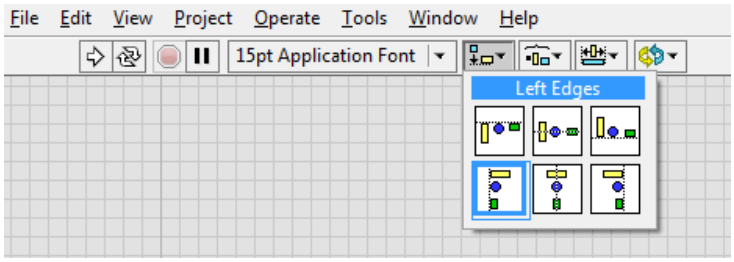
On *Front Panel*, right click on a blank location and access the *Controls Palette*, under *Express* menu find *Numeric Controls*, then select a *Num Ctrl* by left clicking. The control can also be found through *Search* tool in the *Controls Palette*. After selecting the icon, move the pointer to desired location and left click to position the control on front panel.



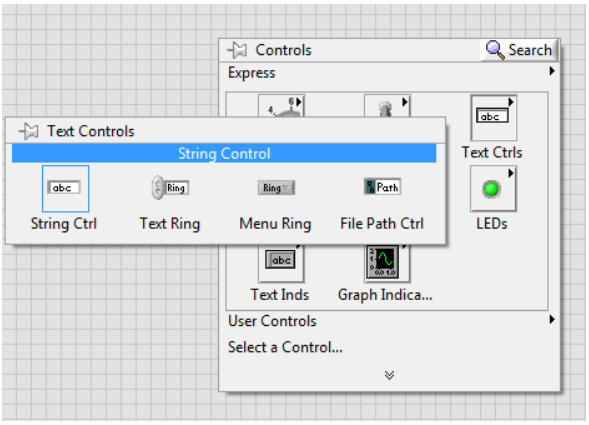
Then, click on the text above the control and edit the name of the control.



In the same way, create all the numeric controls needed for this program. The objects can be arranged with the tools on the top tool bar, alignment, distribution and resizing tools can be used on selected objects.



Add the String Control for Sample Name. The control is located at *Control Palette* ➔ *Express* ➔ *Text Controls* ➔ *String Control*.



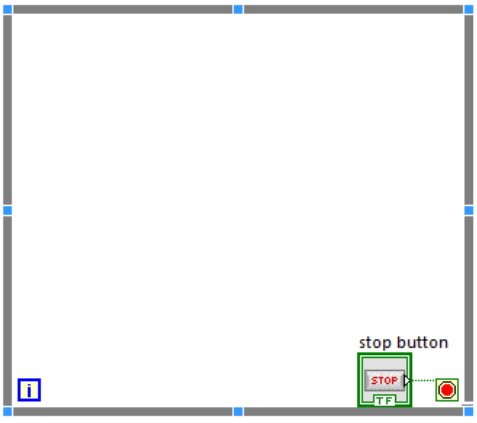
Add *Numeric Indicator* and *Waveform Graph* for Micro Strain readings. The path for *Numeric Indicator* is *Control Palette* ➔ *Express* ➔ *Numeric Indicators* ➔ *Numeric Indicator*. The path for *Waveform Graph* is *Control Palette* ➔ *Express* ➔ *Graph Indicators* ➔ *Graph*.

Add Path Indicator for Data File Location (*Control Palette* ➔ *Express* ➔ *Text Indicators* ➔*File Path Indicator*), *Text Button* for Enable Write to File (*Control Palette* ➔ *Express* ➔ *Buttons* ➔ *Text Button*), and *Stop Button* to end the program (*Control Palette* ➔ *Express* ➔ *Buttons* ➔ *Stop Button*).

After arranging the objects for a desirable layout, the front panel is completed.

Part 2: Building the Block Diagram

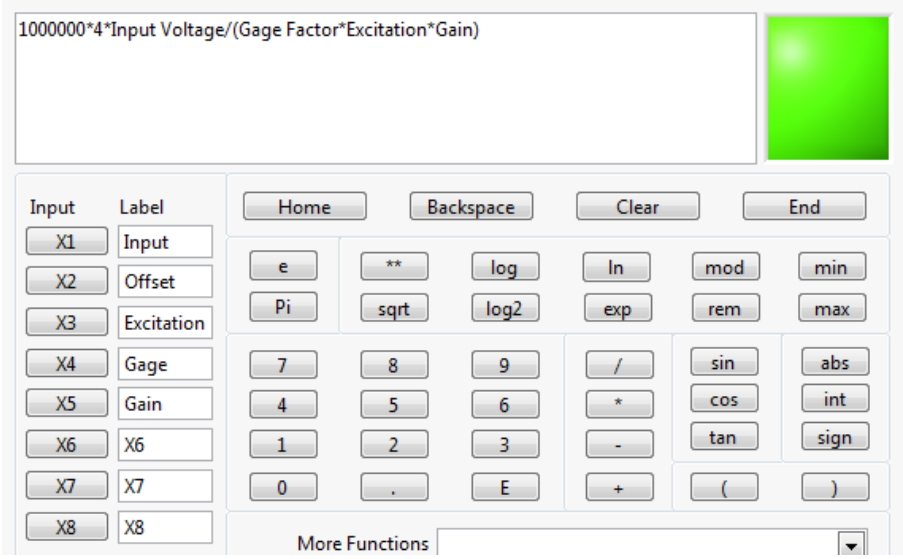
Add a *While Loop* and connect the (already created) *Stop Button* with the *Loop Condition* icon. (*Functions Palette* ➔ *Programming* ➔ *Structures* ➔*While Loop*).



Add a *DAQ Assistant* in the *While Loop* and configure the subVI with the wizard. (*Functions Palette* ➔ *Measurement I/O* ➔ *NI DAQ mx* ➔ *DAQ Assistant*). For the measurement type, select *Acquire Signals* ➔ *Analog Input* ➔ *Voltage*. For the physical channel, select the channel of incoming signal. Since channel AI0 of NI 6229 is connected to the input, select this specific channel. Next, configure the channel settings: input -10V

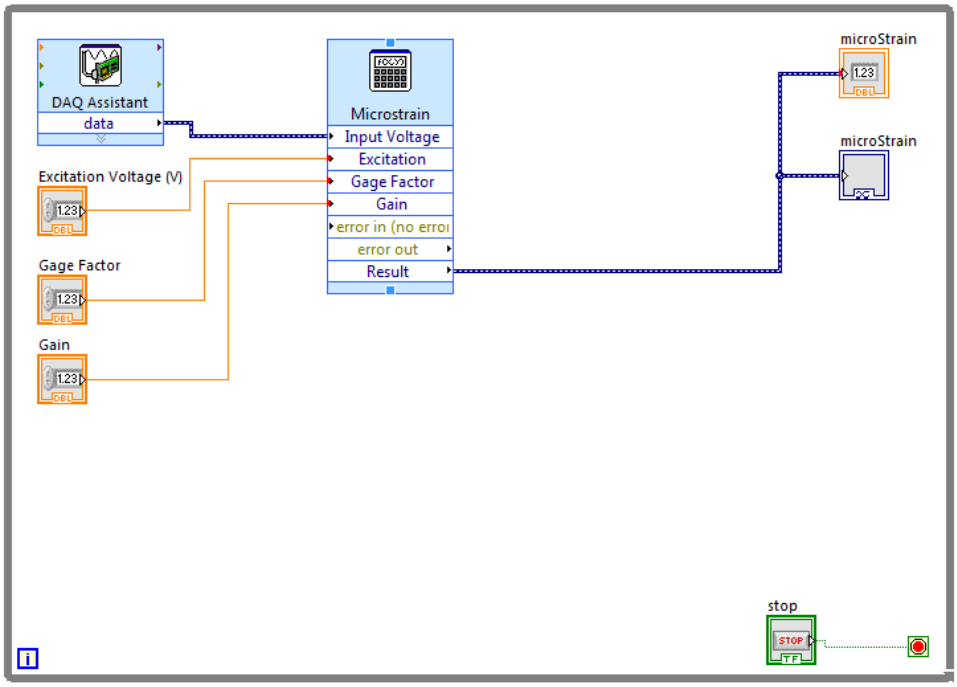
to 10V for input signal range, and *1 Sample (On Demand)* for acquisition mode. Note that the DAQ box needs to be connected to the computer and turned on before starting of LabVIEW program. Save the work and restart the program if the module fails to initialize.

The next step is to transfer the input voltage signal to strain, in the unit of micro strain, and then display it in numerical and graphical form. Create a *Formula* (*Function Palette*➔ *Express*➔*Arithmetic & Comparison*➔*Formula*), set "Input Voltage", "Excitation", "Gage Factor" and "Gain" as input labels, then click "OK" to close the configuration wizard. Input the formula as shown in the figure below.

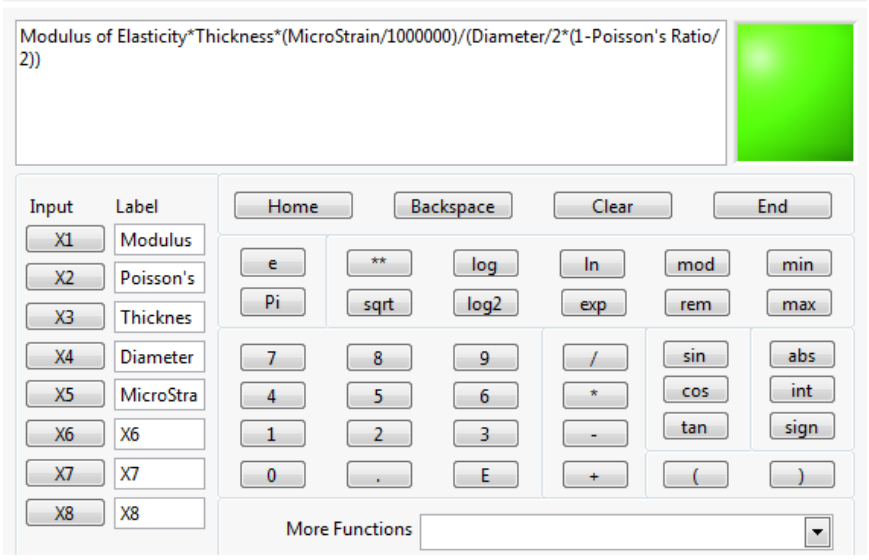


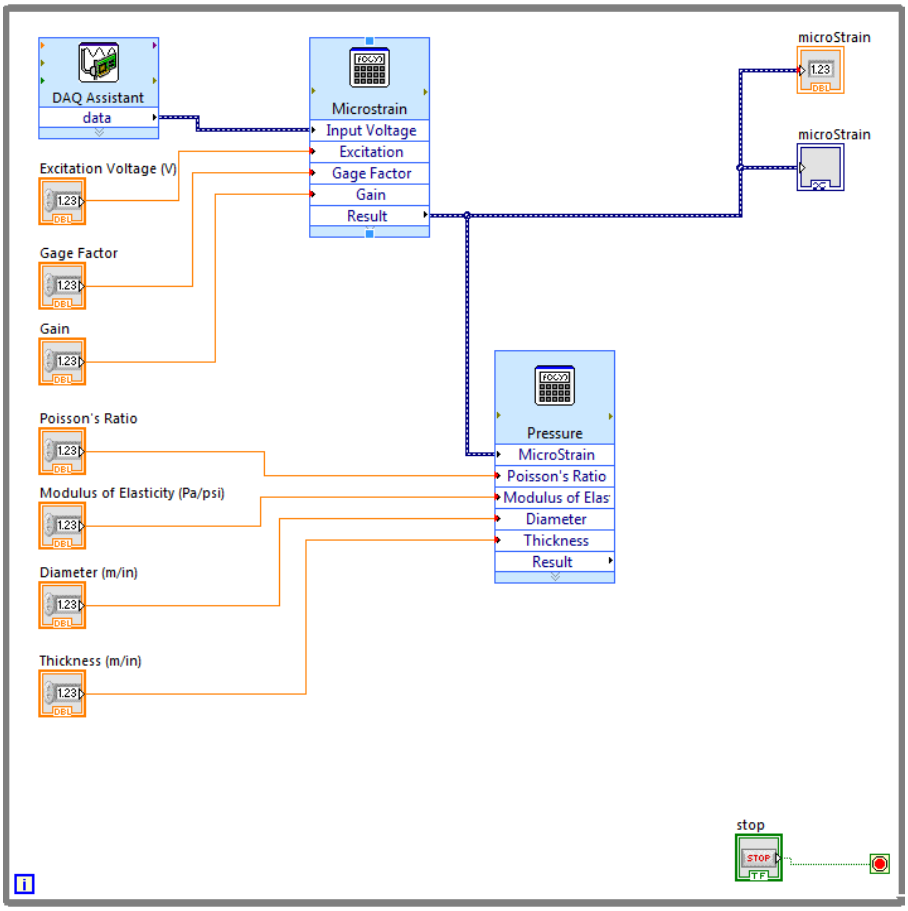
On the block diagram, drag down the arrow on the bottom of the *Formula* icon to expand the input/output menu. To change the order of the elements, right click on an element and select "select input/output", then click on the input/output desired for the position. Connect the *data* output of the *DAQ*

Assistant, and the *Numerical Controls* for excitation voltage, gage factor and gain to the corresponding inputs of the *Formula*. Connect the *Numeric Control* and *Wave Graph* for micro strain to the *result* output of *Formula*. Then click on the text under the icon to change the label to "micro strain".

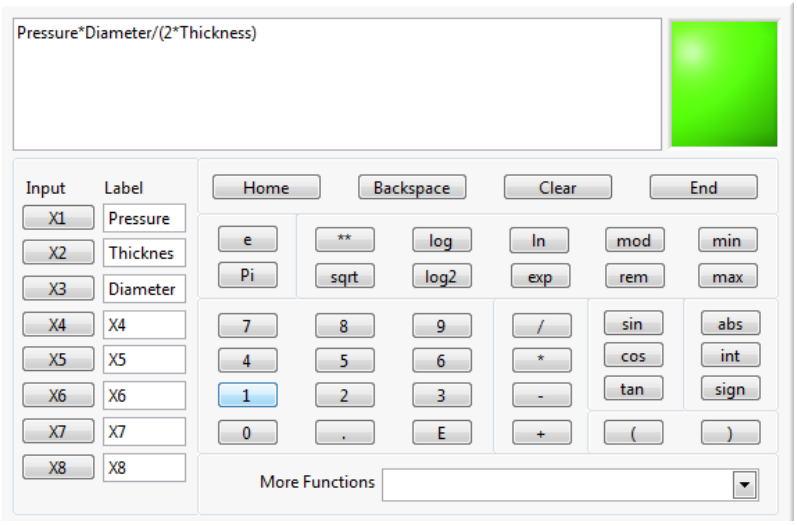


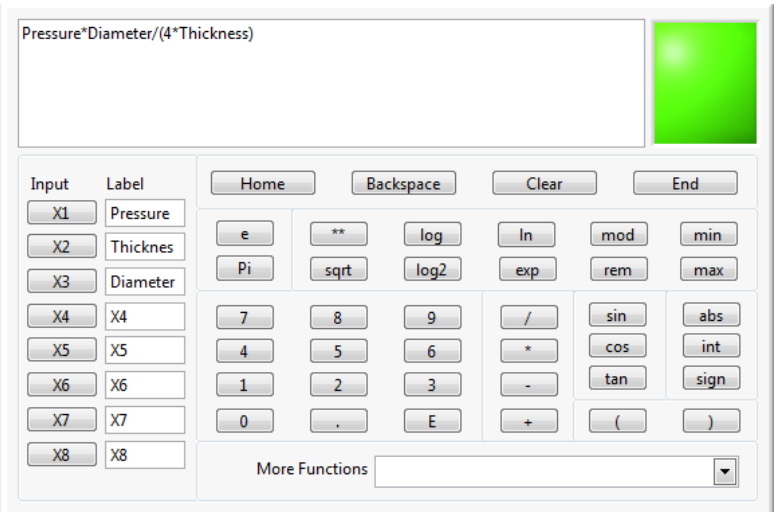
In similar ways, internal pressure can be calculated from strain and other properties of the can. Use *Formula* to calculate internal pressure based on micro strain results from previous *Formula*, inputs from *Numeric Controls* for material's modulus of elasticity, material's Poisson's ratio, thickness of the can wall, and diameter of the can. The formula is shown in the figure below.



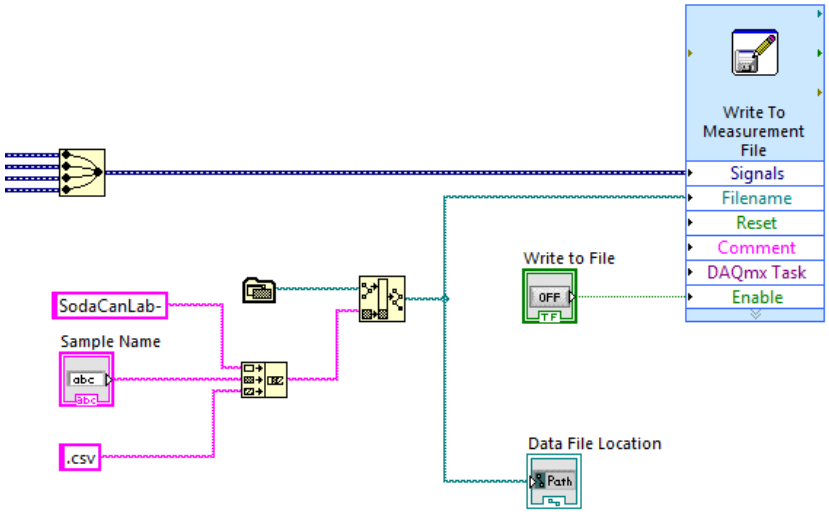


Calculated pressure, diameter and thickness are used to calculate circumferential stress and axial stress. The formulas are shown in the two figures below.

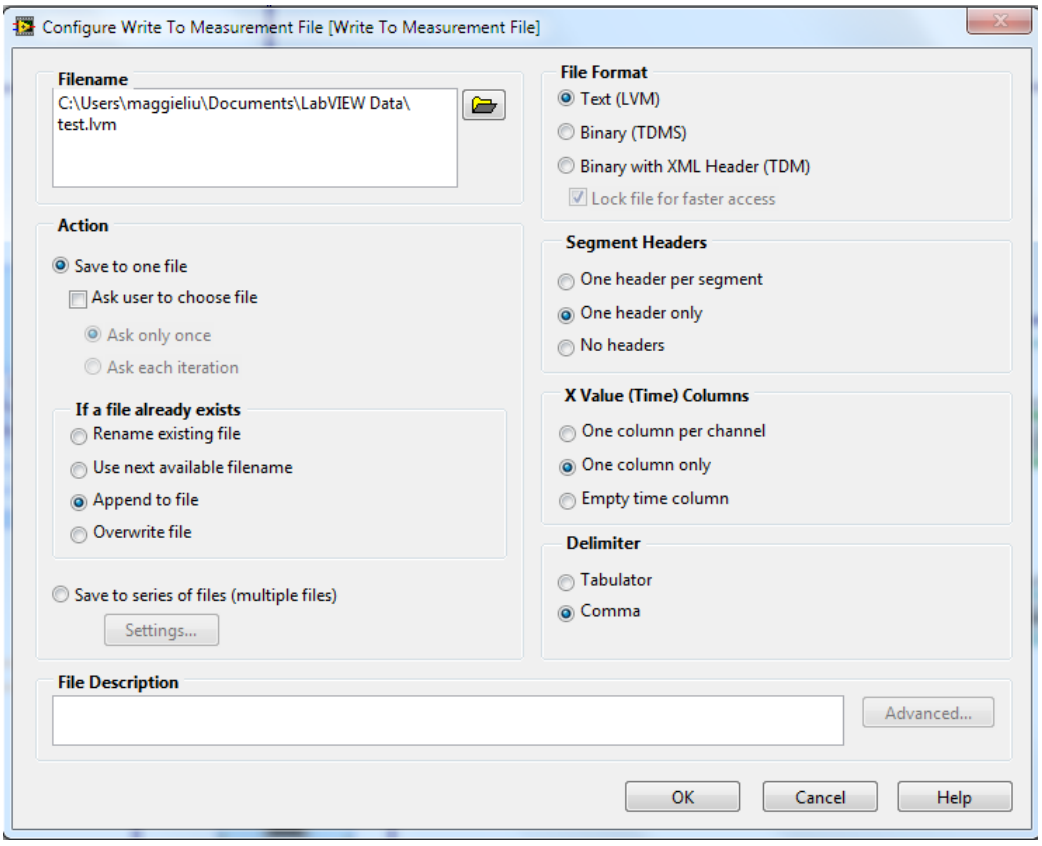




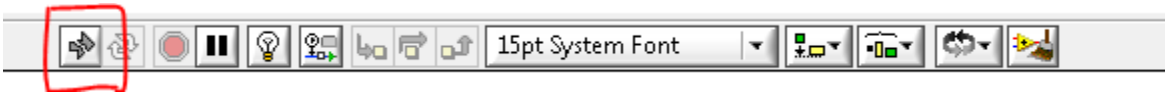
Dynamic data of micro strain, pressure, circumferential and axial stress are then combined with *Merge Signal* function and then written to file with a *Write to Measurement File* function. The merged signal should be connected to *Signal* Input of the *Write to Measurement File* function. The *Filename* can be constructed with *Build Path* function. It builds the file path with an *Application Directory* function, which points to the folder where the VI is saved, and a concatenated string (Use *Concatenate String* function in *String Palette*) which consists of the lab name, the user inputted sample name, and a ".csv" (comma separated values) as file extension, so that the data file can be opened with Microsoft Excel.

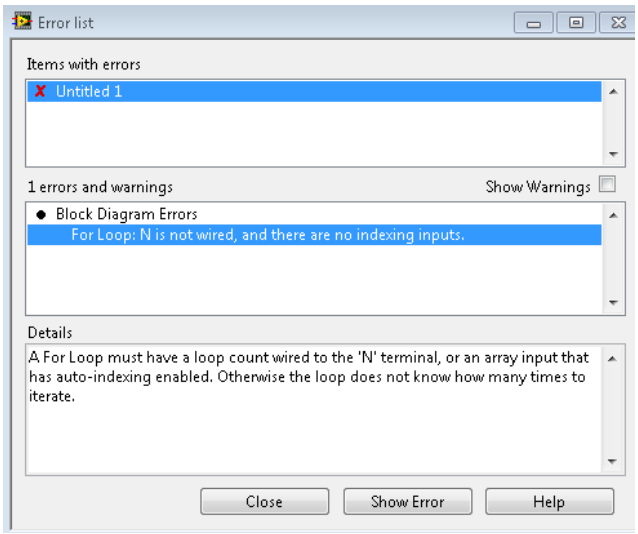


The *Write to Measurement File* should be configured as shown below. The filename in this wizard will be overwritten by the input; it should "save to one file"; the format should be text, with one header only or no headers; there should be only one time column; and the delimiter should be comma.



Now we have completed constructing the VI. If there is any error in the program, the run button will appear "broken" as shown in the figure below. Click on the button to view the error list, the "details" should explain the error. Debug until all errors are resolved; use other debugging functions on the menu bar if needed.





When the run button appears as a rightward arrow, enter appropriate parameters on the *Front Panel*, connect a BNC cable to AI0 of the DAQ device with two idle clips (this will provide some varied voltage

inputs), and test run the program. Use *Edit➔ Make current values default* to save the entered parameters as default values. If there is no error interrupting the run, we can check the data file under the specified directory for satisfactory results. Trouble shoots until the program is ready for use.

Now the VI is ready for the Soda Can Laboratory. Can you make it better?