WORCESTER POLYTECHNIC INSTITUTE

MECHANICAL ENGINEERING DEPARTMENT

Engineering Experimentation
ME-3901, D'2012

Laboratory #1

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General information

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General information

<u>Please refer to handout:</u>
"Laboratory 1: Digital Ohm Meter"

Objectives

The objectives of this laboratory are:

- To expose the user to LabVIEW Software;
- To understand the technicalities of analog to digital conversion (A/D conversion). Additionally, items created and/or displayed from this software will need to be placed in a variety of documents: WORD, PowerPoint, and/or Excel. Consequently, each user must be exposed to these software tools, utilities and directories;
- The user needs to configure a system so that external inputs (voltage, etc.) can be read by the DAQ system;
- The user will create a Virtual Instrument (VI) to measure analog inputs;
- Display in analog and digital forms and create a file of resistor values;
- The digital readings will be transferred to a spreadsheet for statistical analysis;
- You will also observe the temperature versus resistance characteristics of a batch of ten carbon resistors.

Background

The background information of this lab involves two very broad areas of study in instrumentation:

- graphical computer programming; and
- analog-to-digital conversion.

Both areas can be extensive, however, the following short introduction allows one to take simple measurements.

Graphical computer programming: example

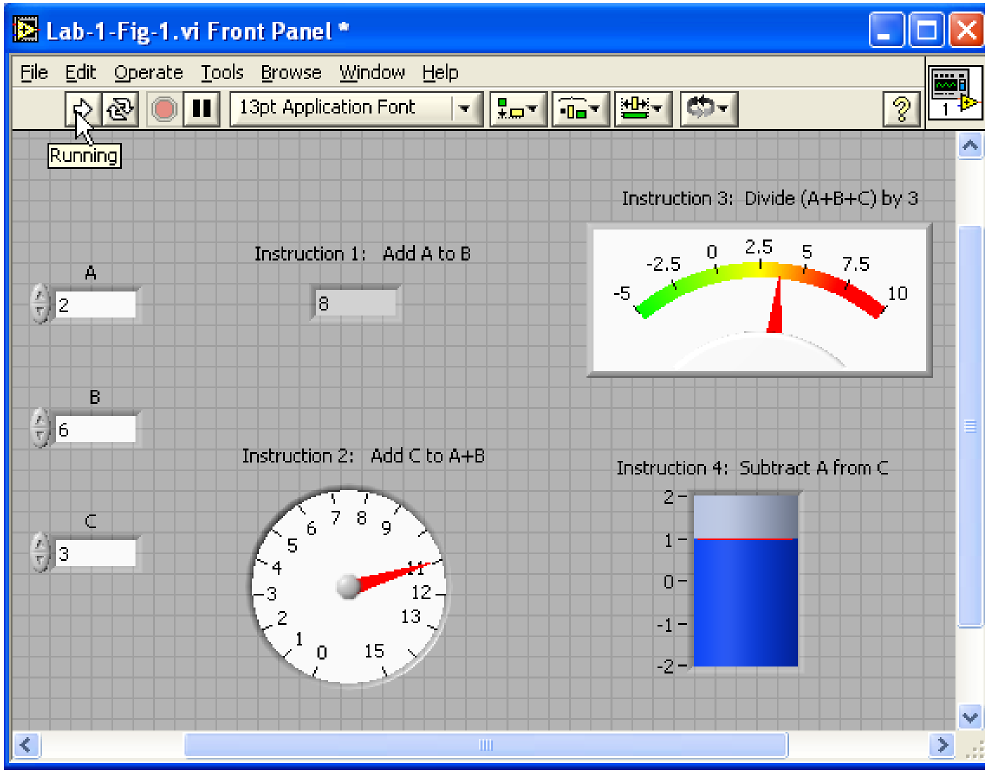
Write LabVIEW program to perform the following operations:

1. Add **A** to **B**
2. Add **C** to Sum of **A** and **B**
3. Divide Sum of **A**, **B**, and **C** by 3
4. Subtract **A** from **C**

Fig. 1-1a. Sequence of instructions to be programmed in a computer.

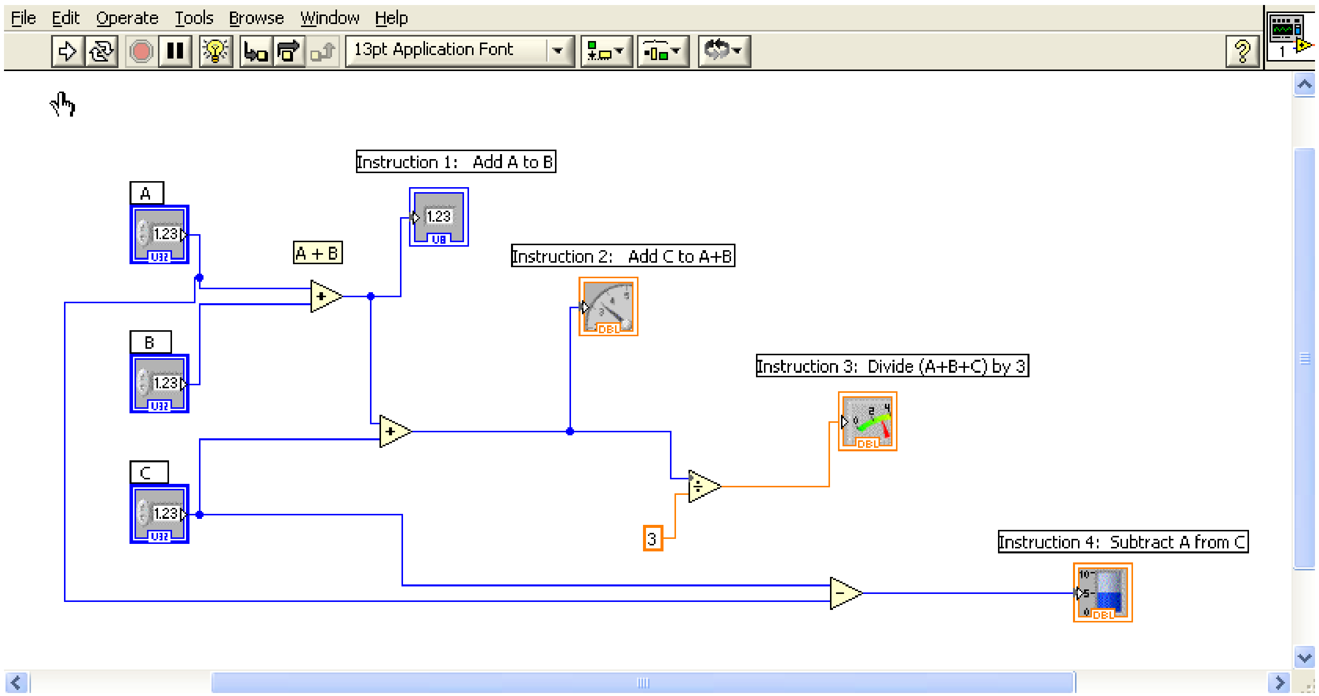
Graphical computer programming: example

Front panel



Graphical computer programming: example

Block diagram



Can you draw electronic diagram used for measurement of electrical resistance?

See an actual Ohm meter and measure electrical resistance

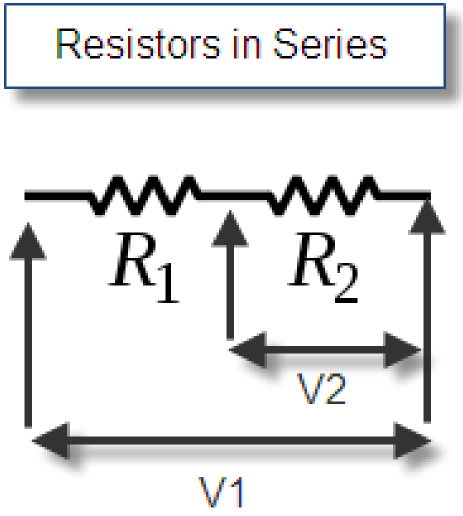
Ohms law

Ohm's law provides the relationship between Voltage, ***V*** [volts], current, ***I*** [amps], and resistance, ***R*** [Ohms].

$$V = I \cdot R$$

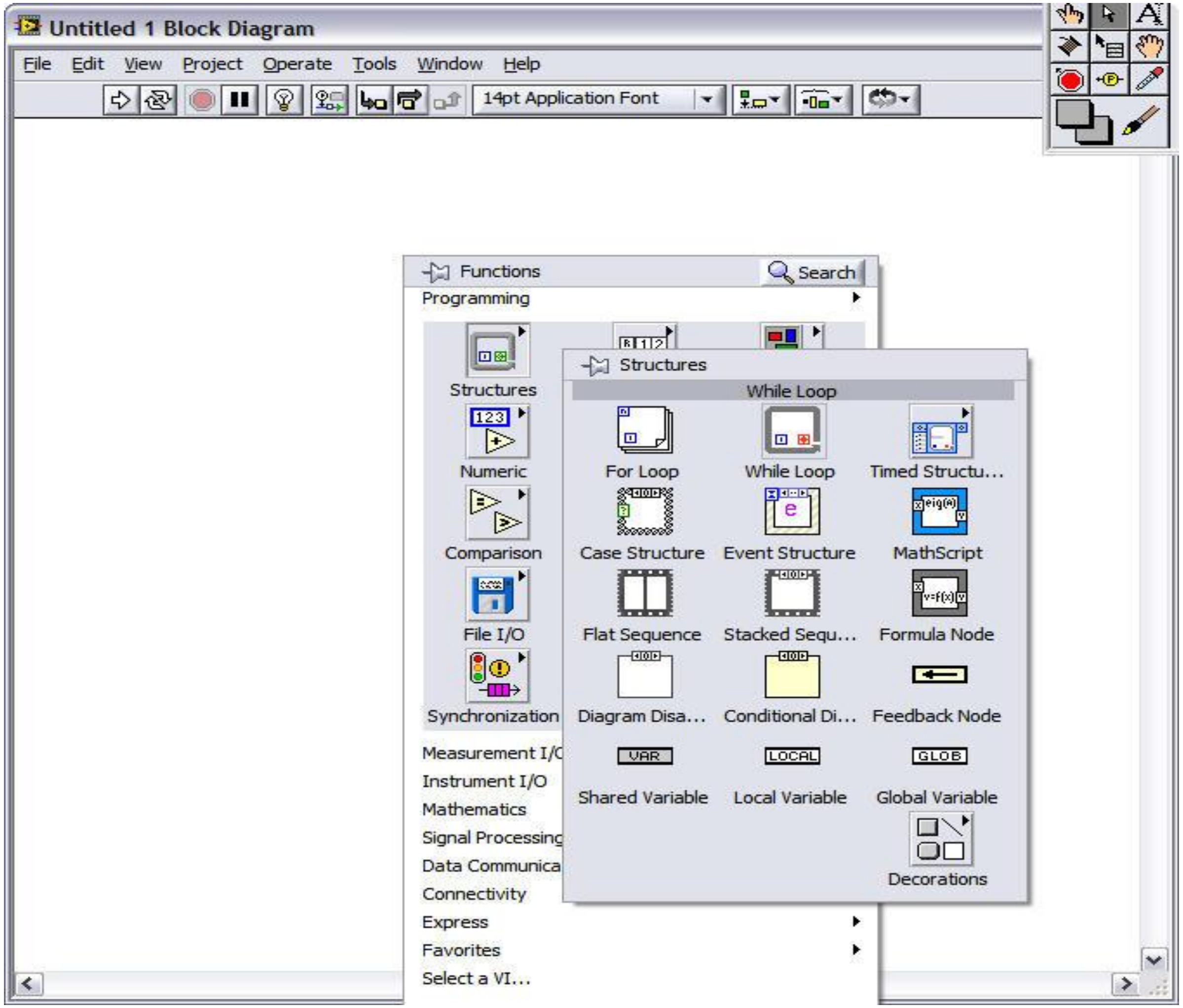
Measuring Resistance

Our hardware is capable of generating (analog out) and measuring voltages (analog in). We will create a circuit as shown in the figure below with two resistors in series, ***R1*** and ***R2***. ***R1*** will be known and ***R2*** will be unknown. By applying a voltage, ***V1***, across the two resistors and measuring the voltage, ***V2***, across the unknown resistor, ***R2***, we can compute the unknown resistance.

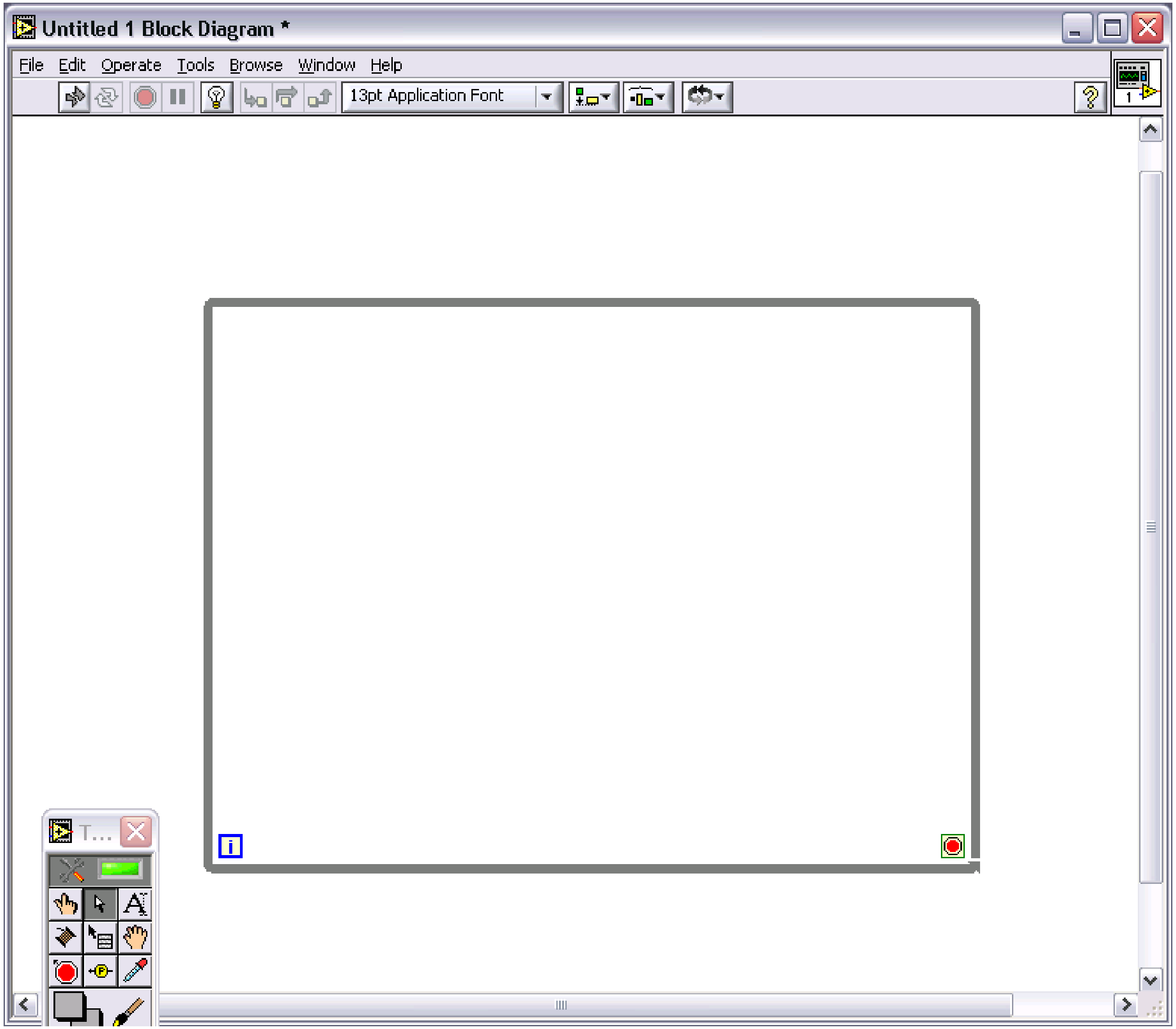


The resistors in series on the left form a voltage divider. The voltage ***V1*** is applied to an equivalent resistor of magnitude (***R1*** + ***R2***). The voltage ***V2*** is proportional to the ratio ***R2***/(***R1*** + ***R2***). Hence you can compute ***R2*** from the measured values of ***R1***, ***V1*** and ***V2***.

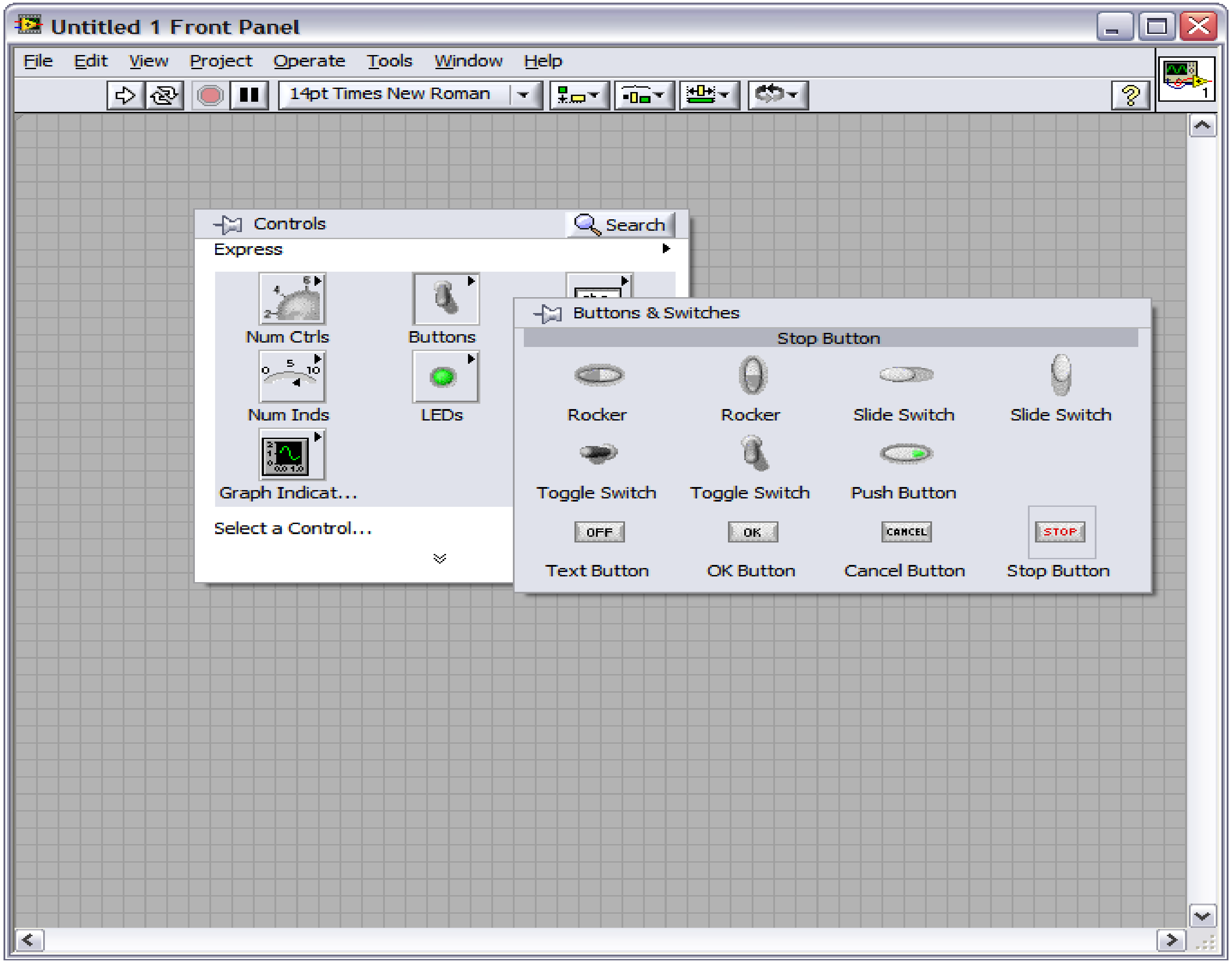
Building an Ohm meter: start from a "blank" VI
Right-click and add a "while" loop



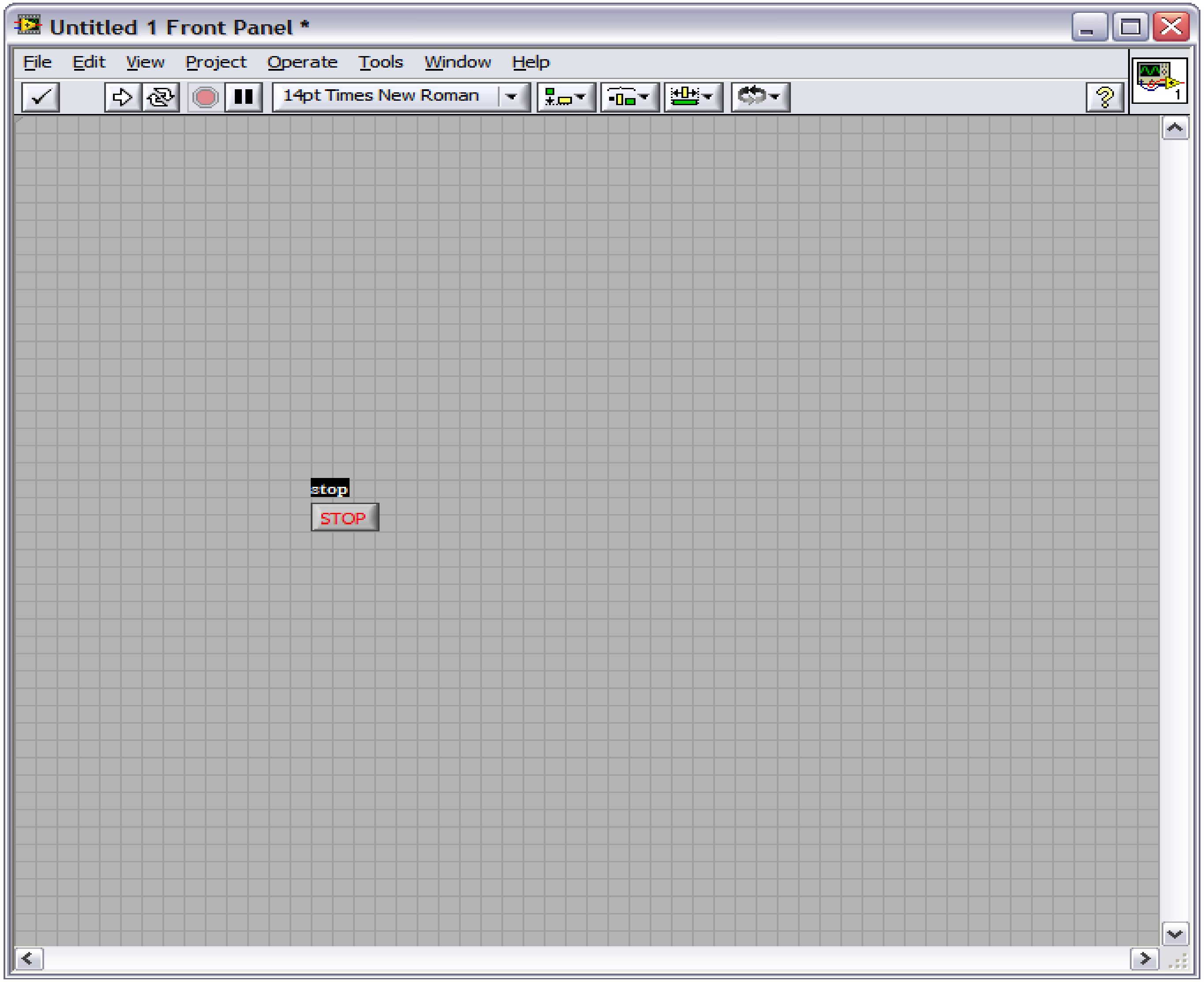
Build an Ohm meter: add a “while” loop



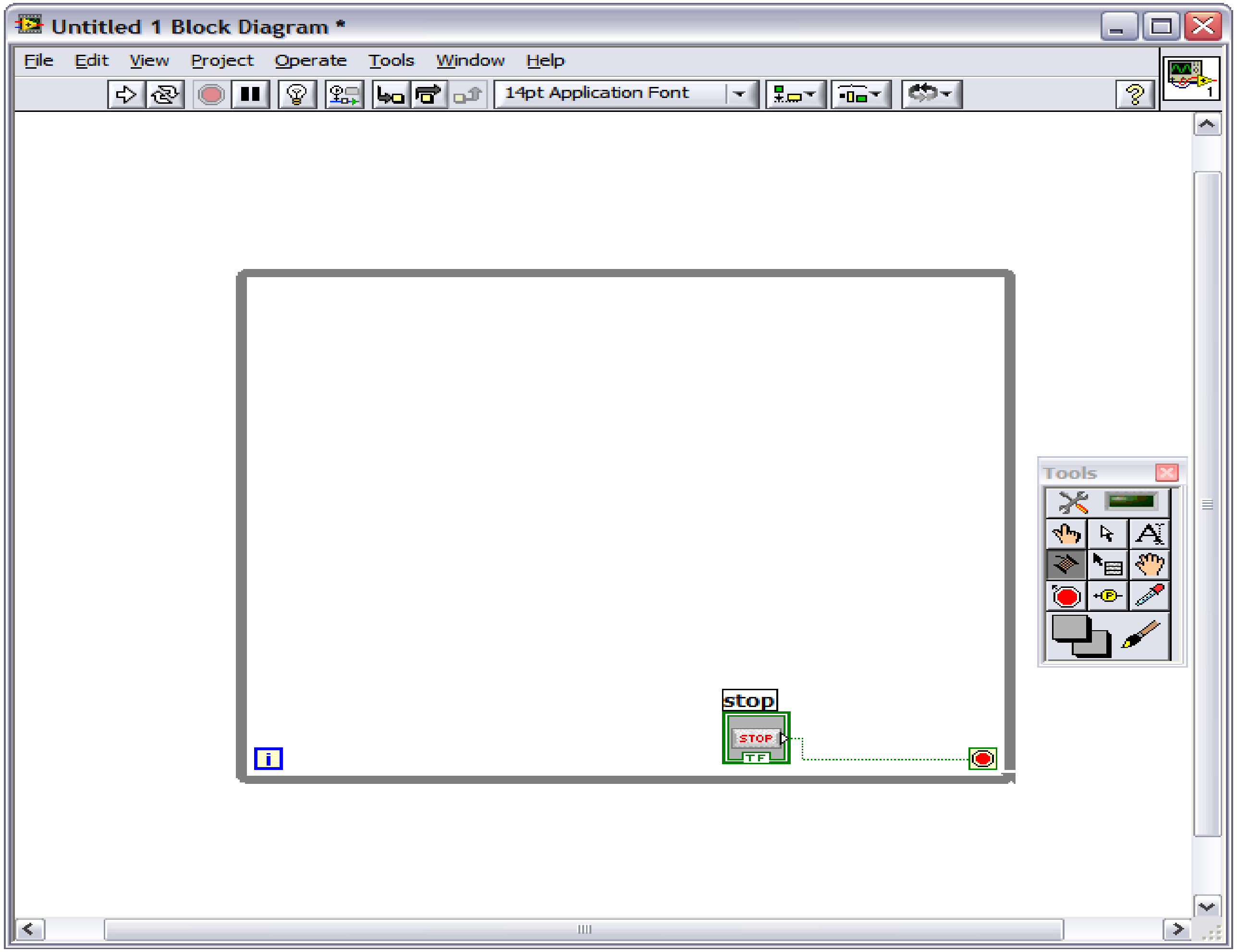
Add a "Stop Button" on the Front Panel



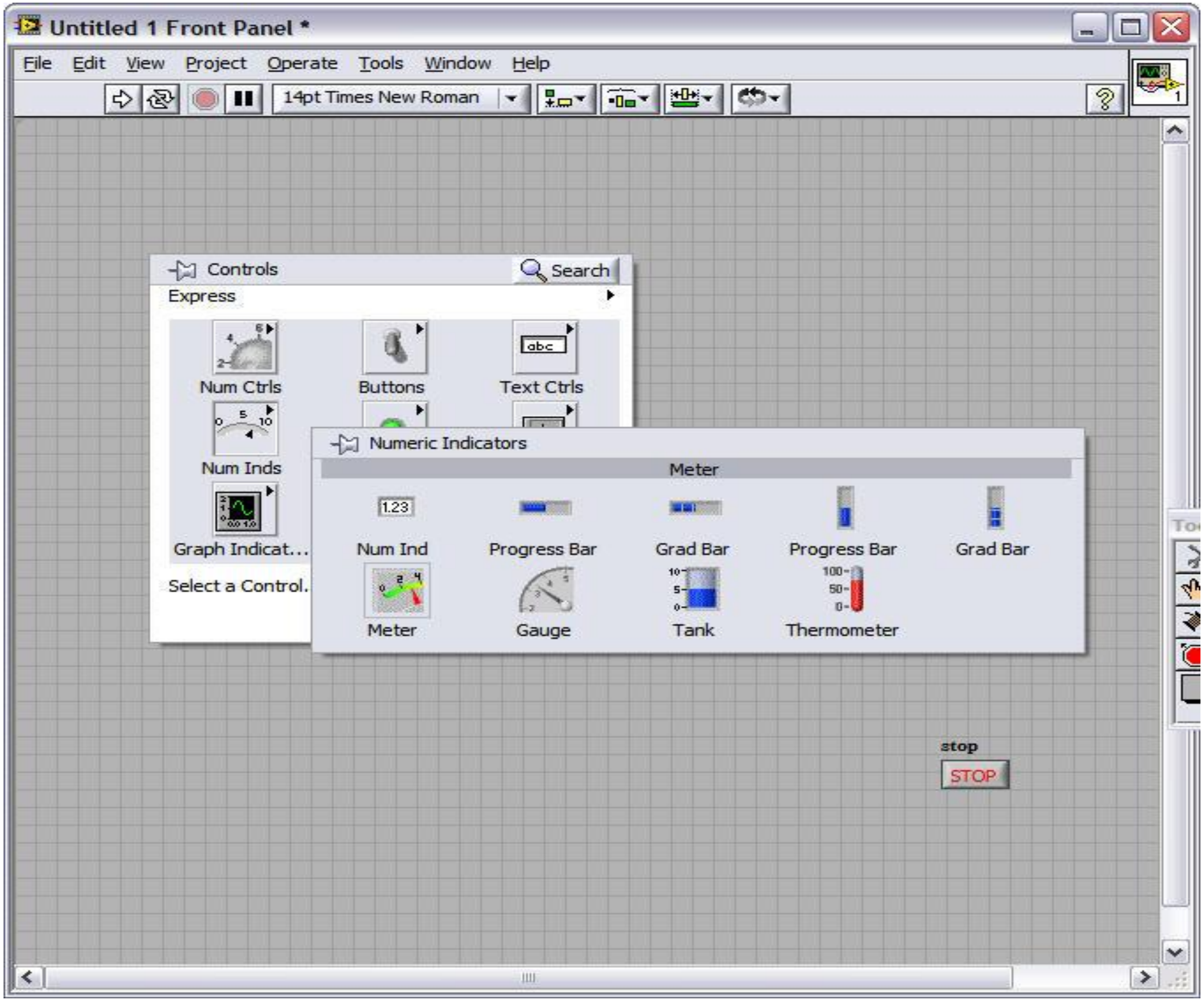
Front Panel showing "Stop Button"



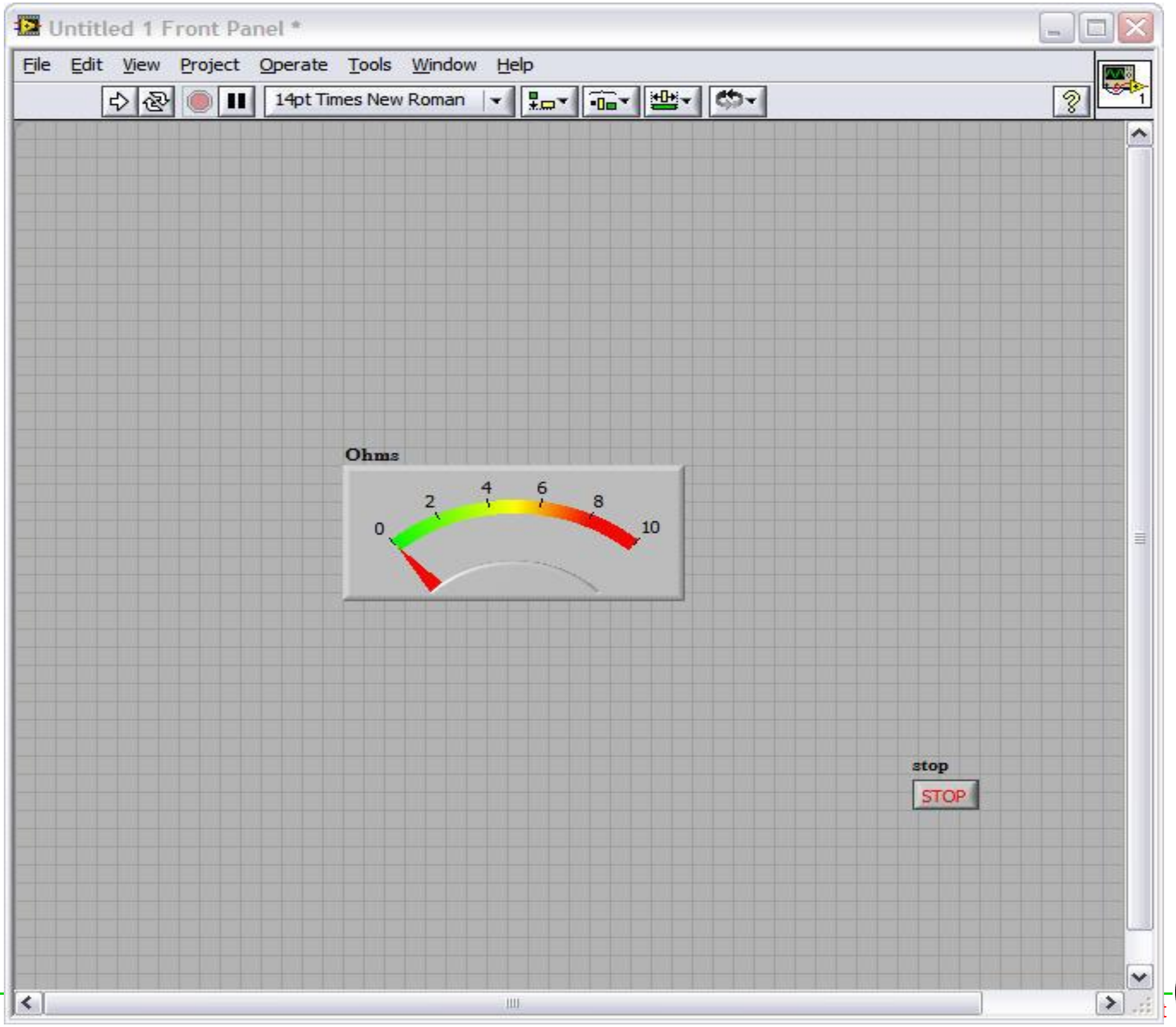
In the block panel, wire the "Stop Button"



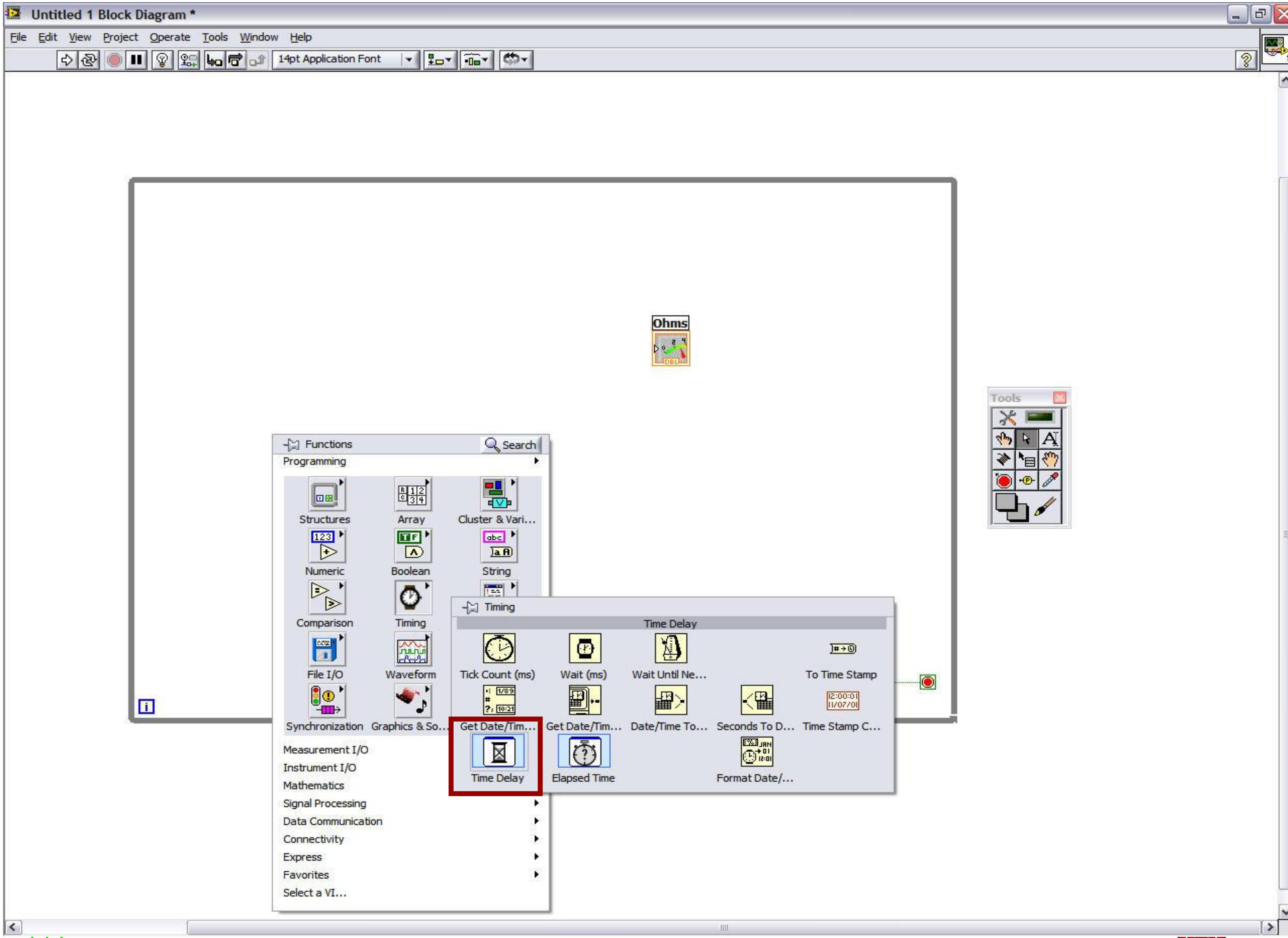
Create a "Display" on the front panel



Front Panel. Change properties, as necessary

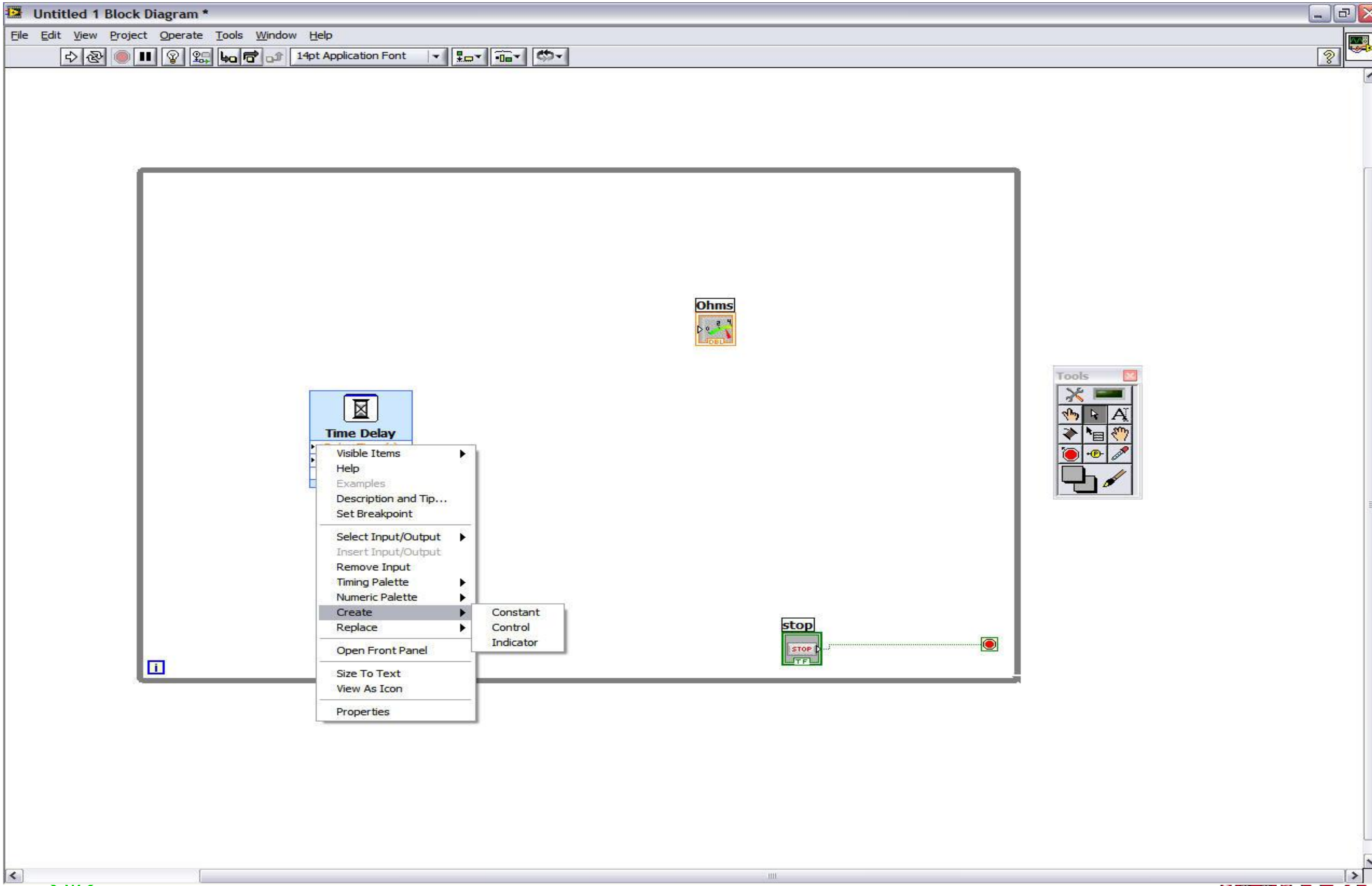


Add a "Timer"

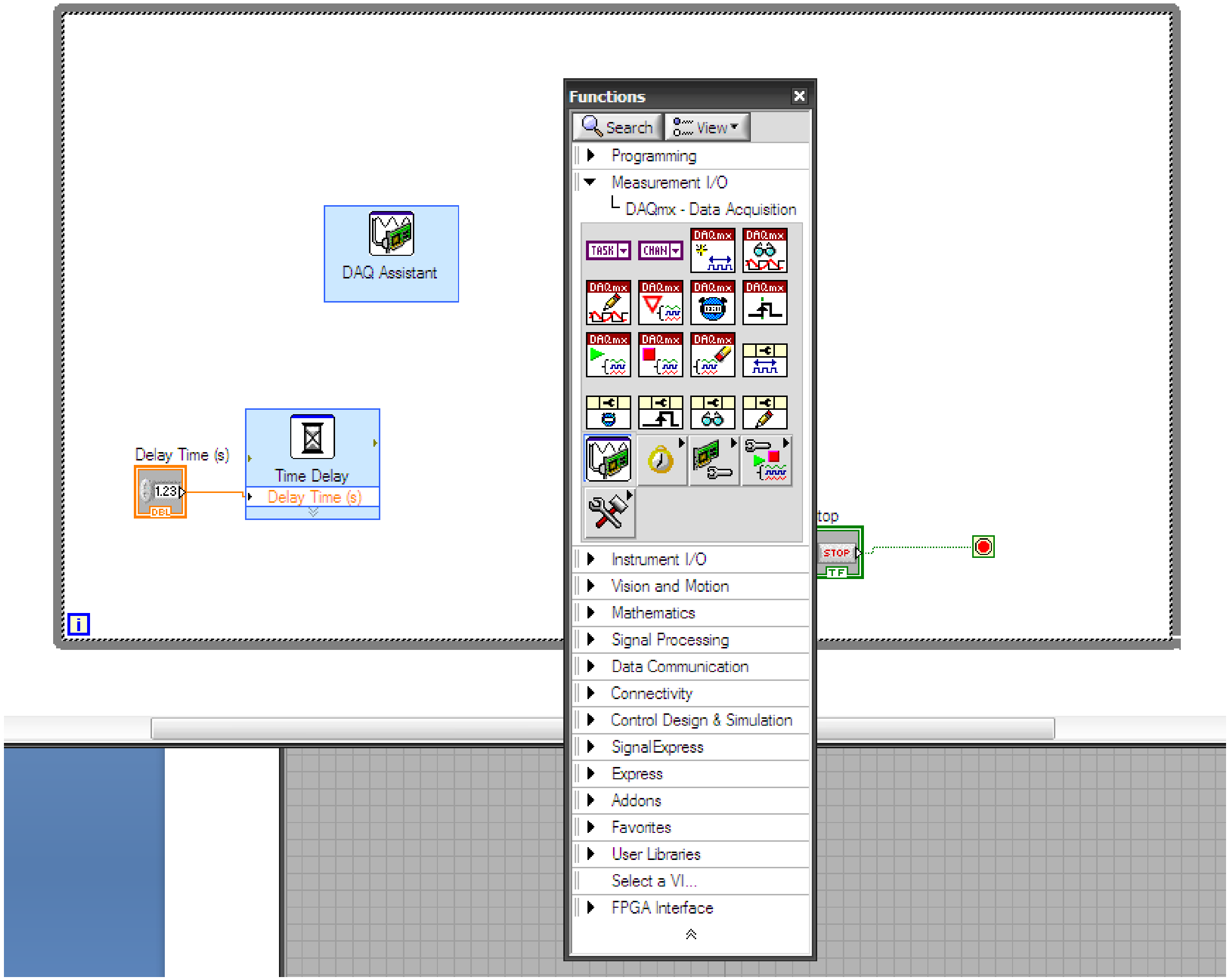


Untitled 1 Block Diagram *
File Edit View Project Operate Tools Window Help
14pt Application Font
Ohms
Tools
Functions
Search
Programming
Structures
Array
Cluster & Vari...
Numeric
Boolean
String
Comparison
Timing
File I/O
Waveform
Synchronization
Graphics & So...
Measurement I/O
Instrument I/O
Mathematics
Signal Processing
Data Communication
Connectivity
Express
Favorites
Select a VI...
Timing
Time Delay
Tick Count (ms)
Wait (ms)
Wait Until Ne...
To Time Stamp
Get Date/Tim...
Get Date/Tim...
Date/Time To...
Seconds To D...
Time Stamp C...
Time Delay
Elapsed Time
Format Date/...

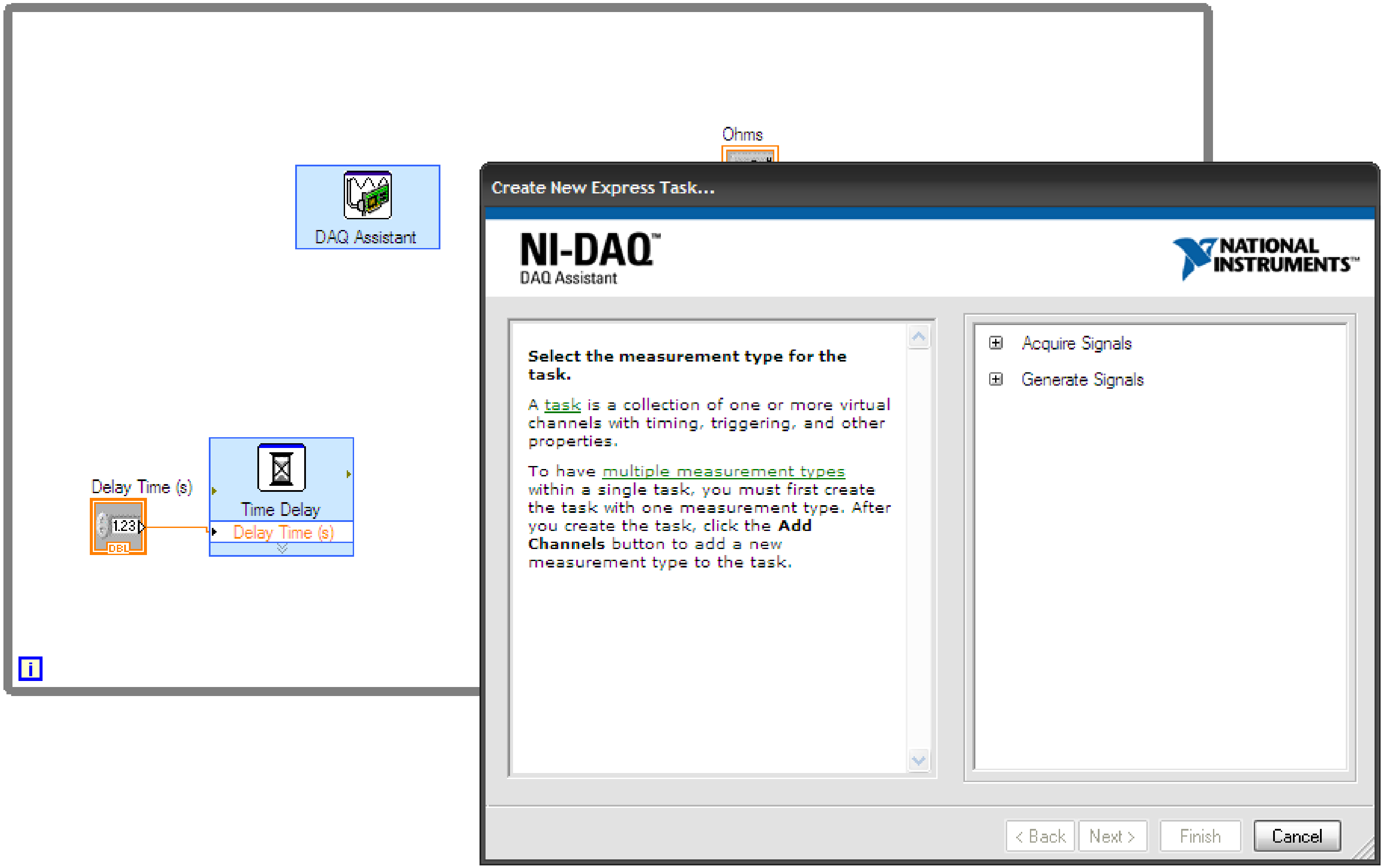
Add "Timer" control: right-click (in select mode) -> Create -> Control



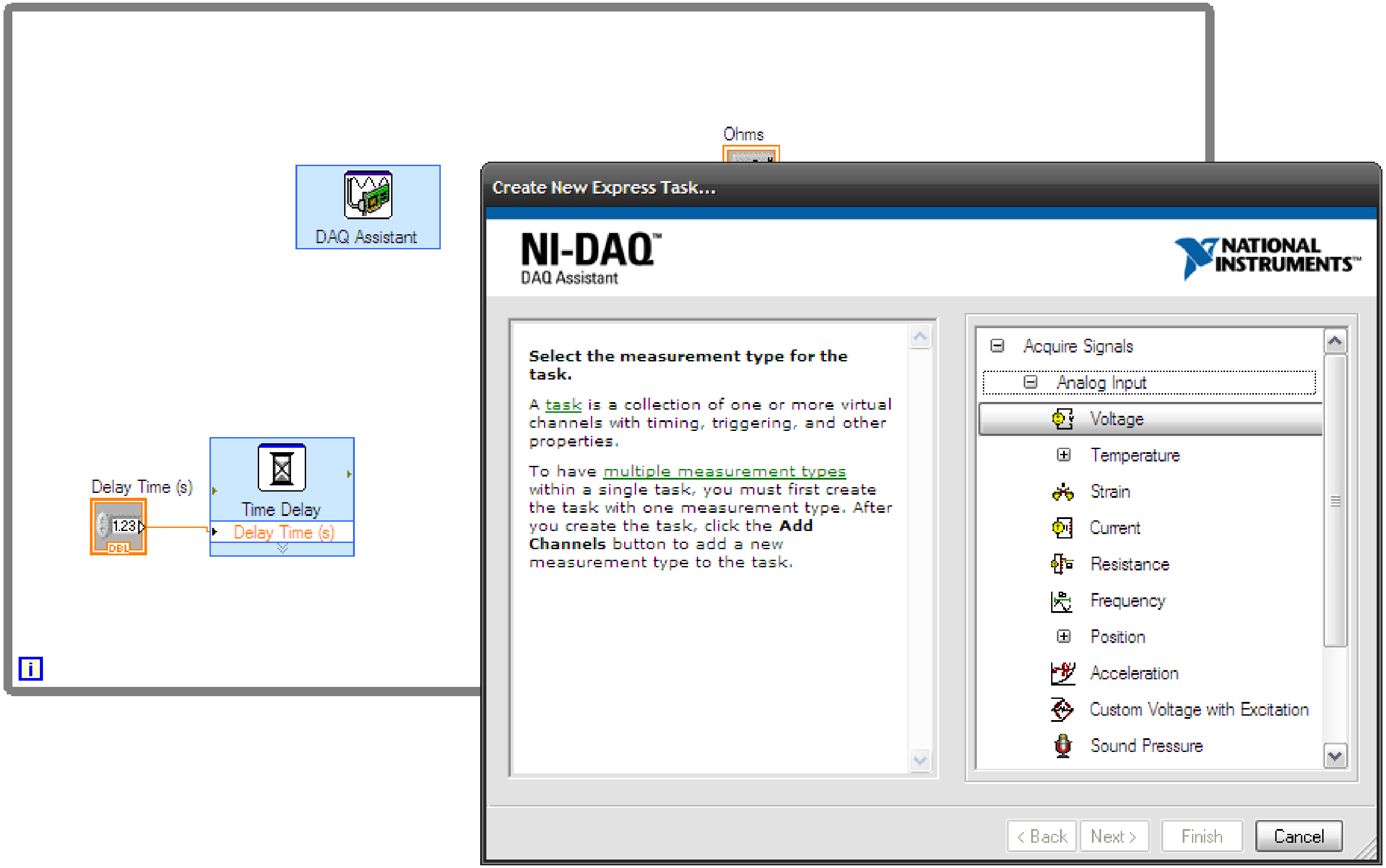
Add an “Analog Input” Channel by dragging the DAQ assistant icon to the block diagram



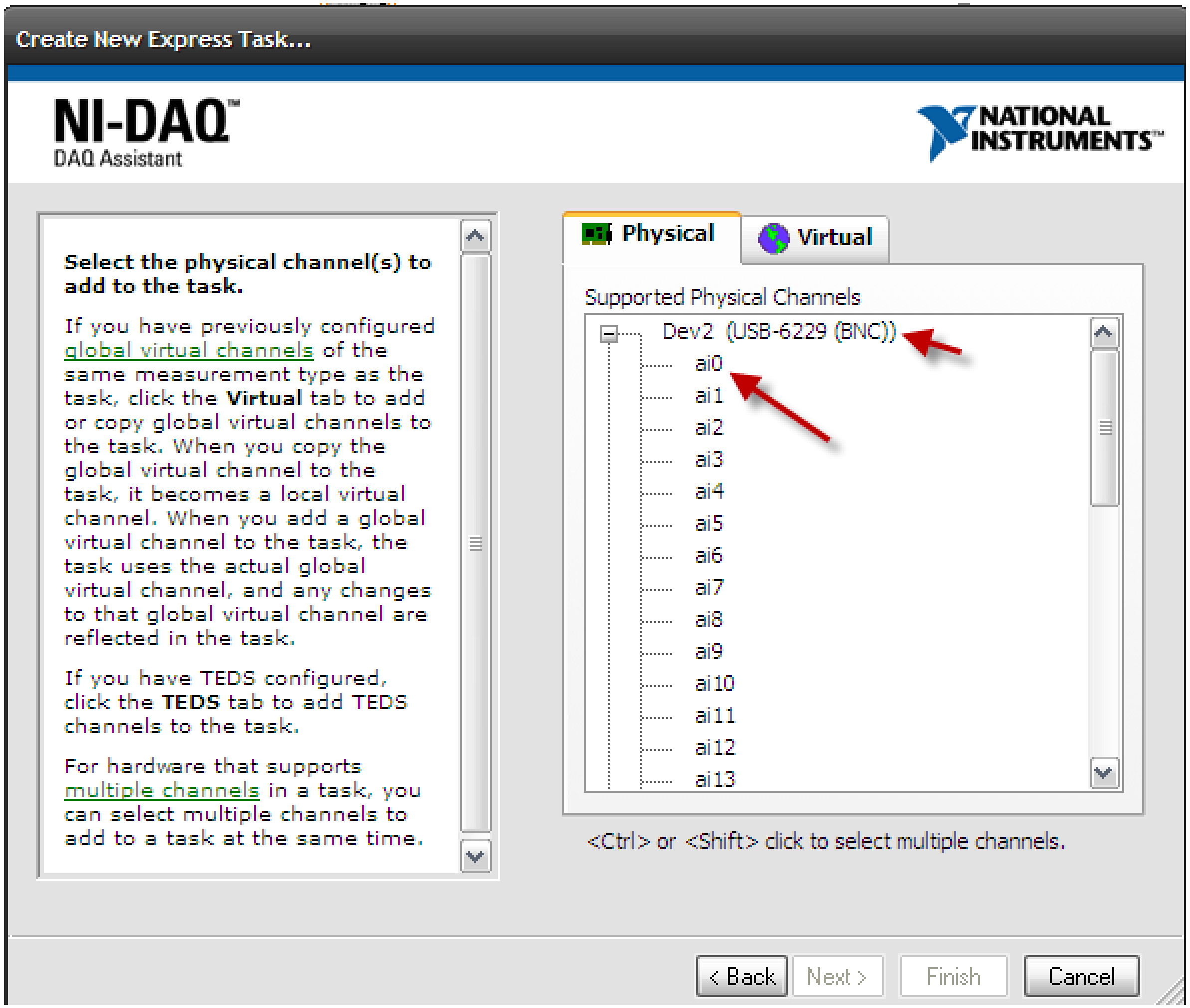
Configure Voltage input channel
Use the DAQ Assistant Tool



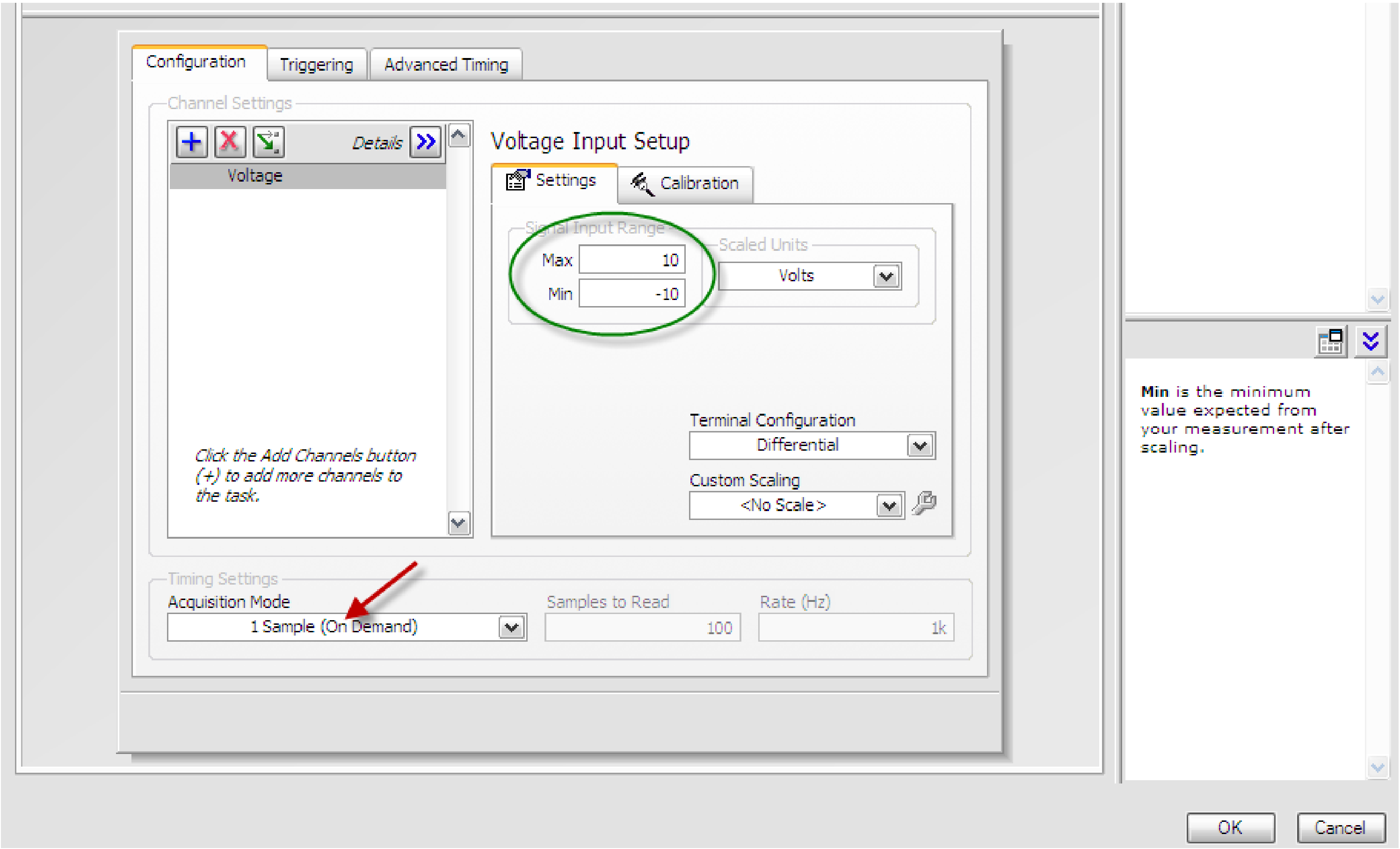
Configure Resistance Channel
Use the DAQ Assistant Tool



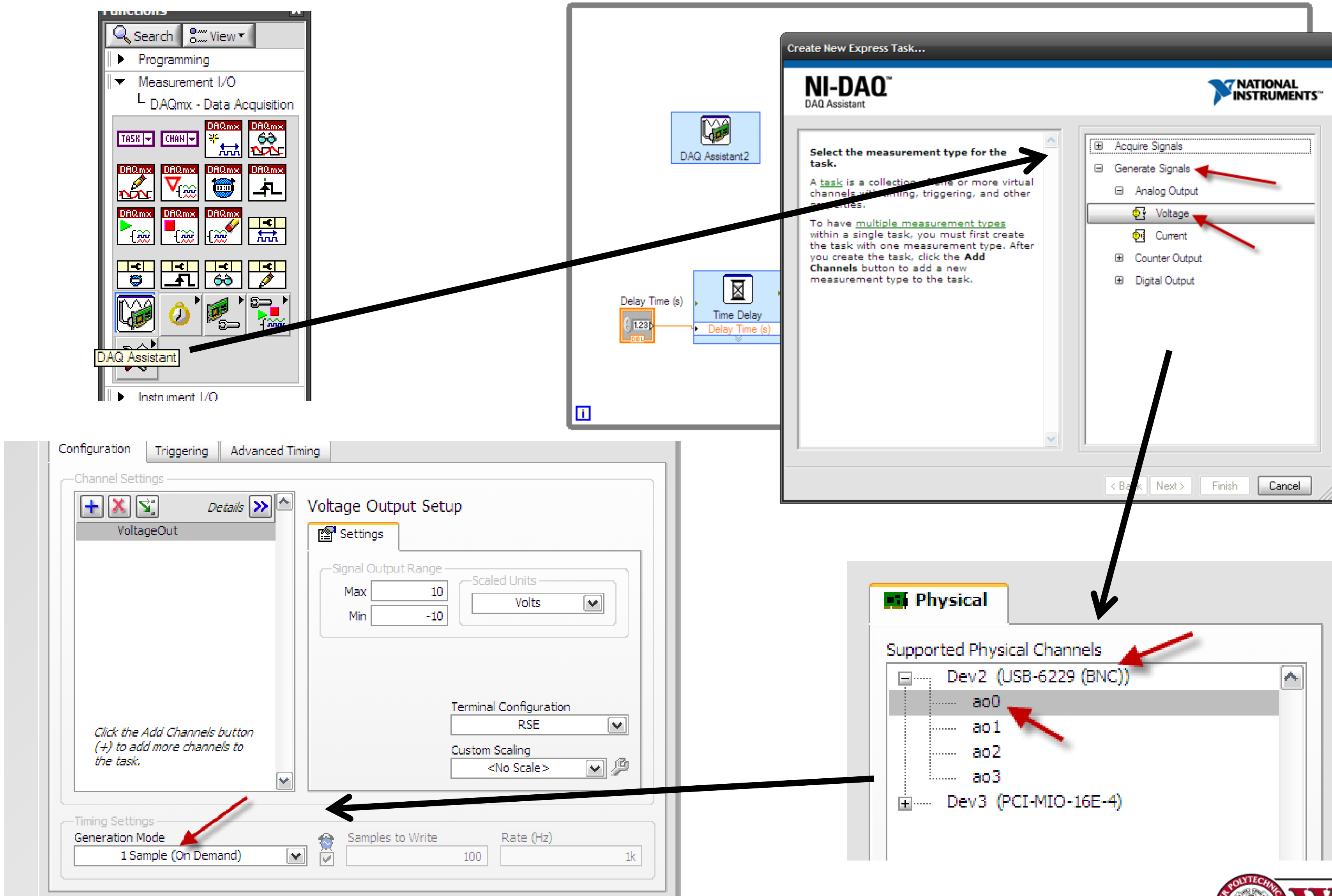
Configure Resistance Channel Number 0 in the USB-6229 signal conditioner. Other Channels can also be used



Set the properties for the channel - 1 Sample on Demand
Notice the voltage range

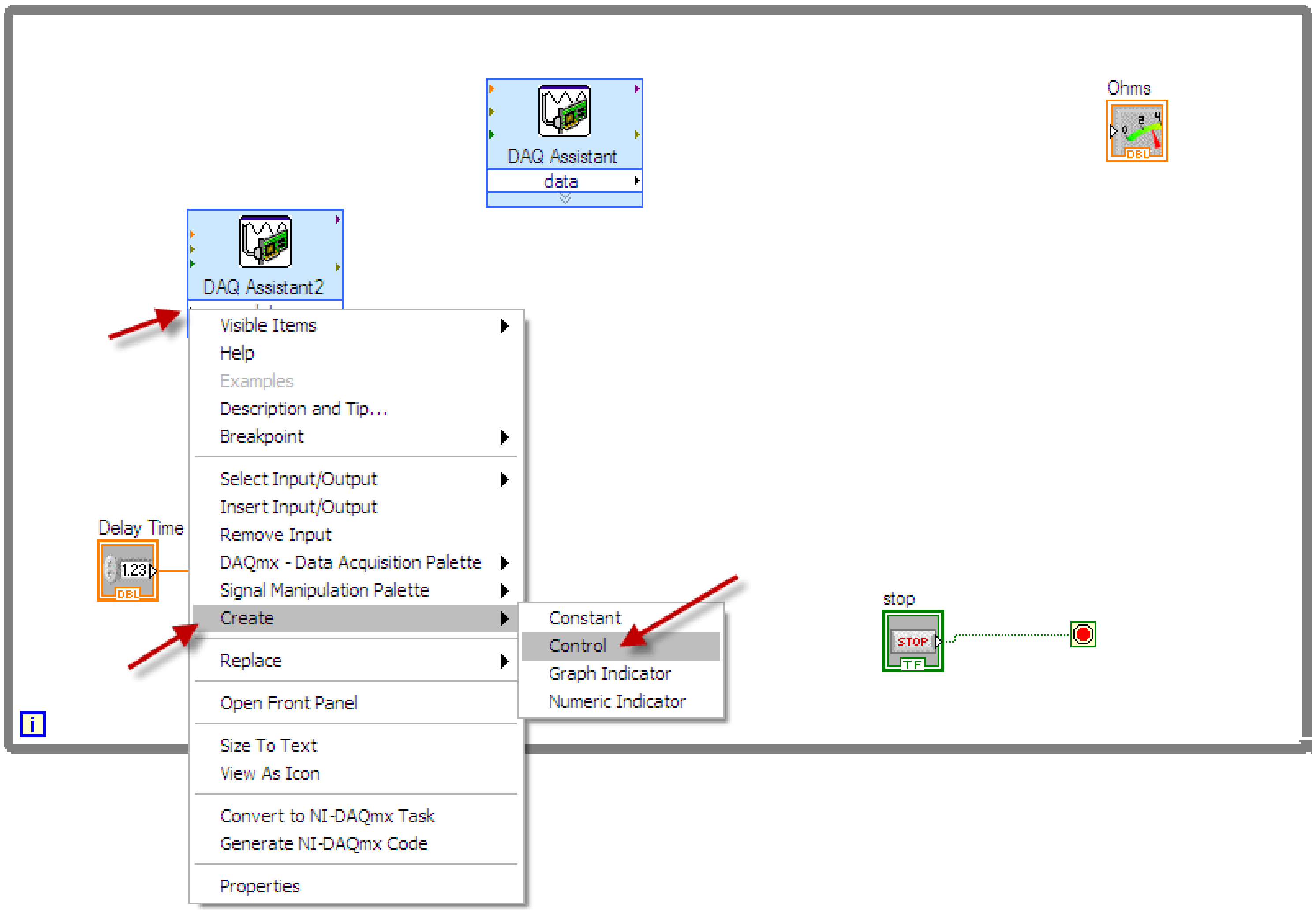


Create one more DAQ assistant block – this time make it analog output with 1 sample on demand option

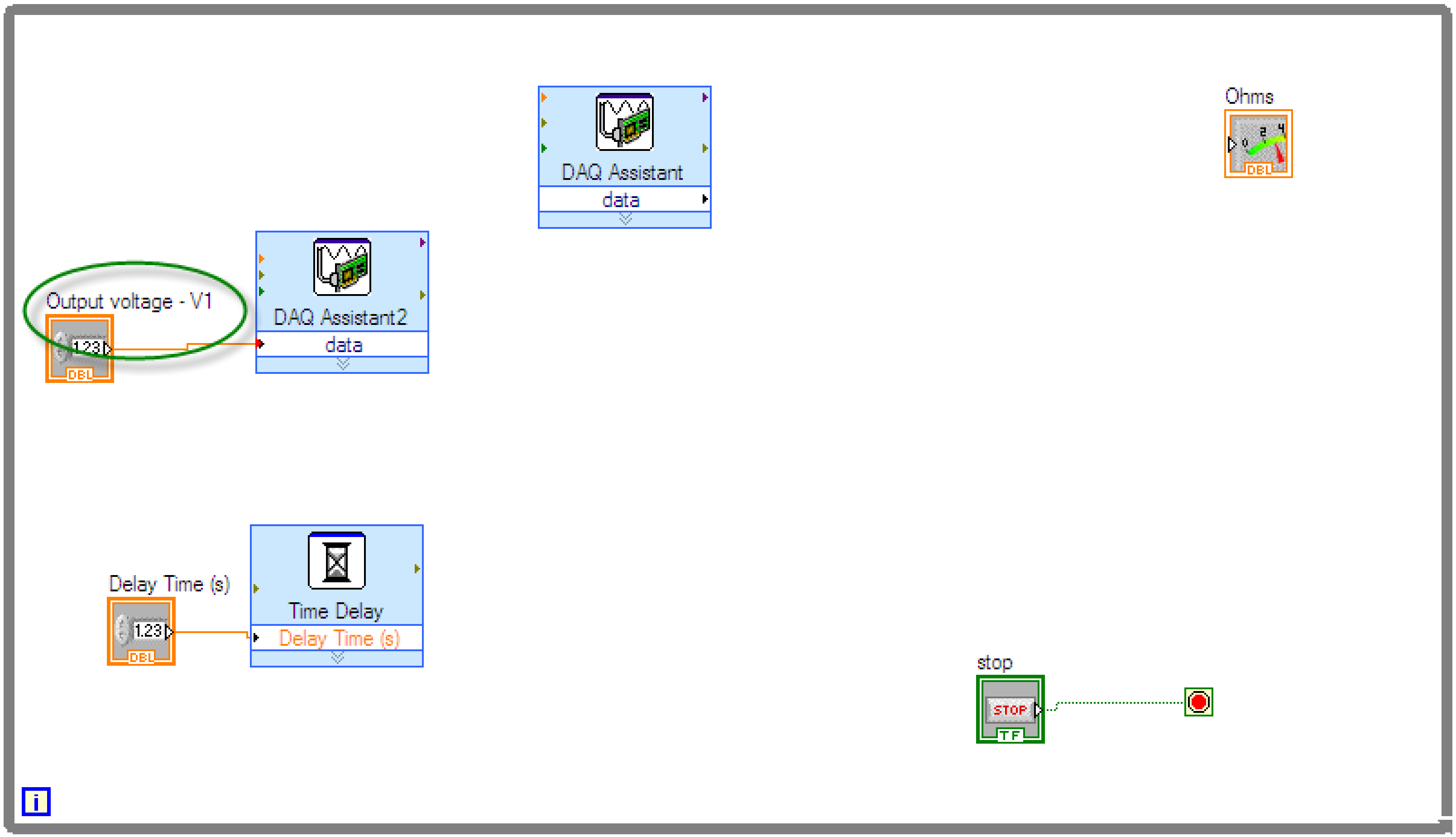


Create a control for the second DAQ Assistant block

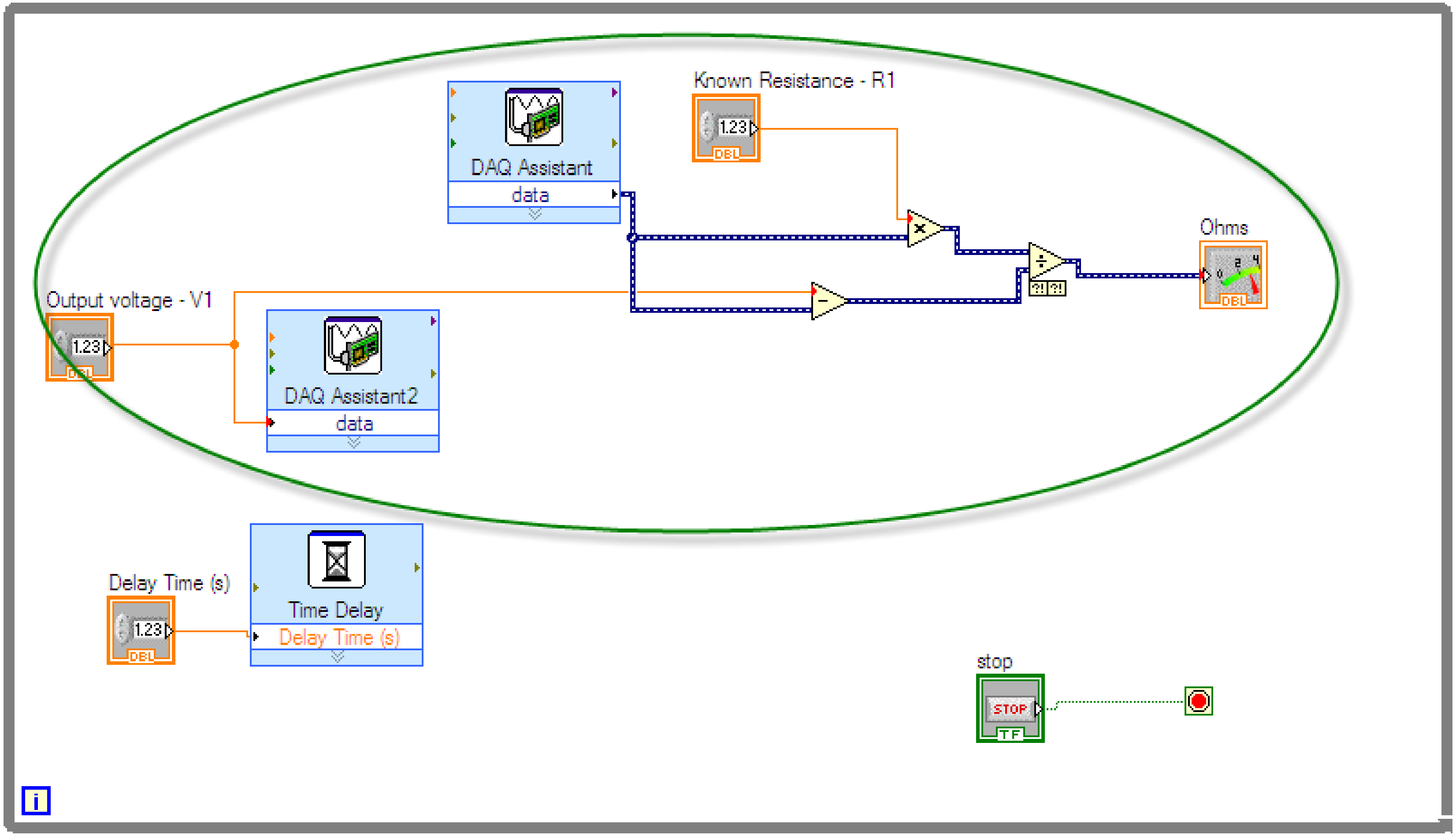
This allows you to control the input voltage – V1



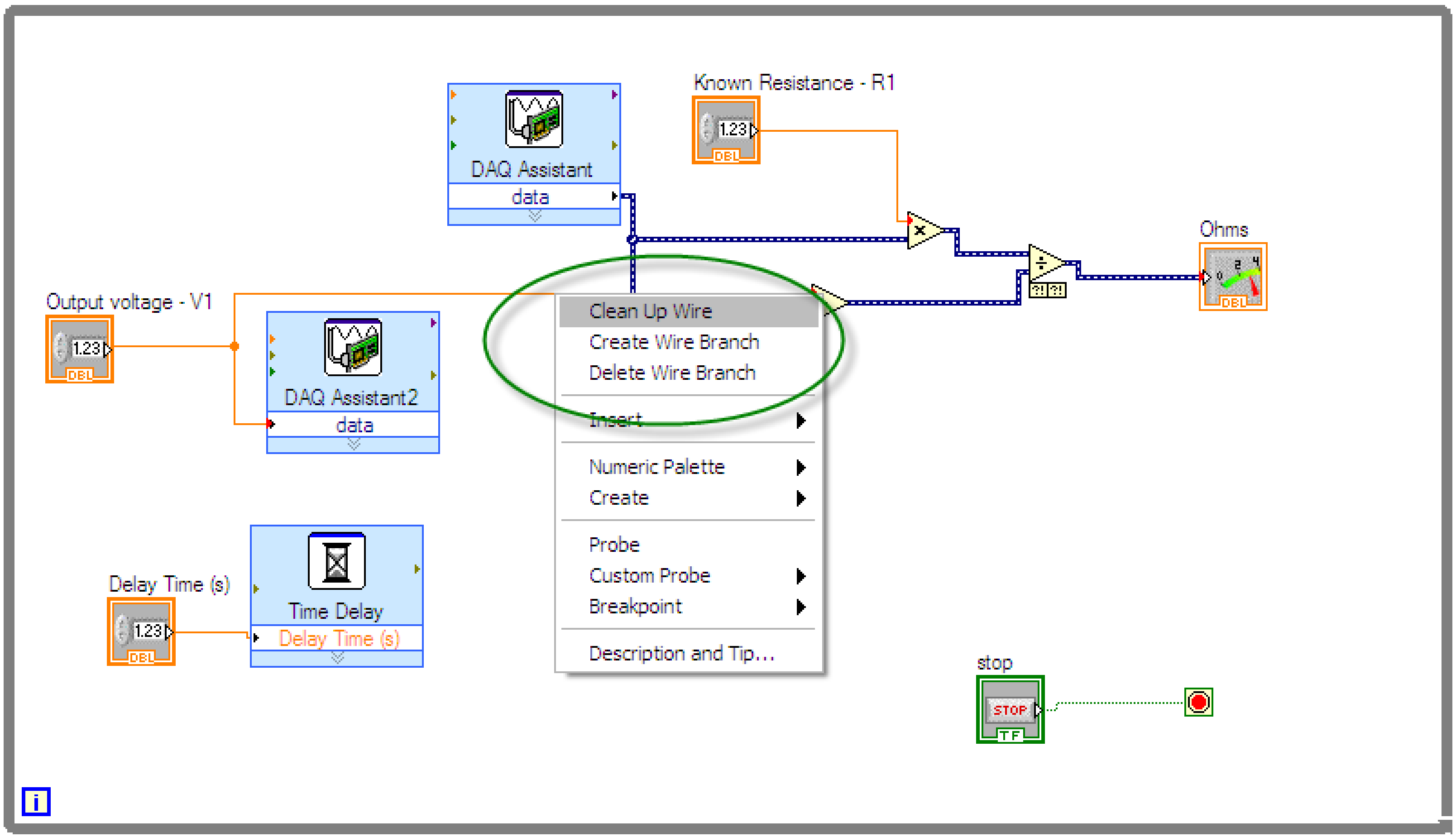
Label the newly created control properly



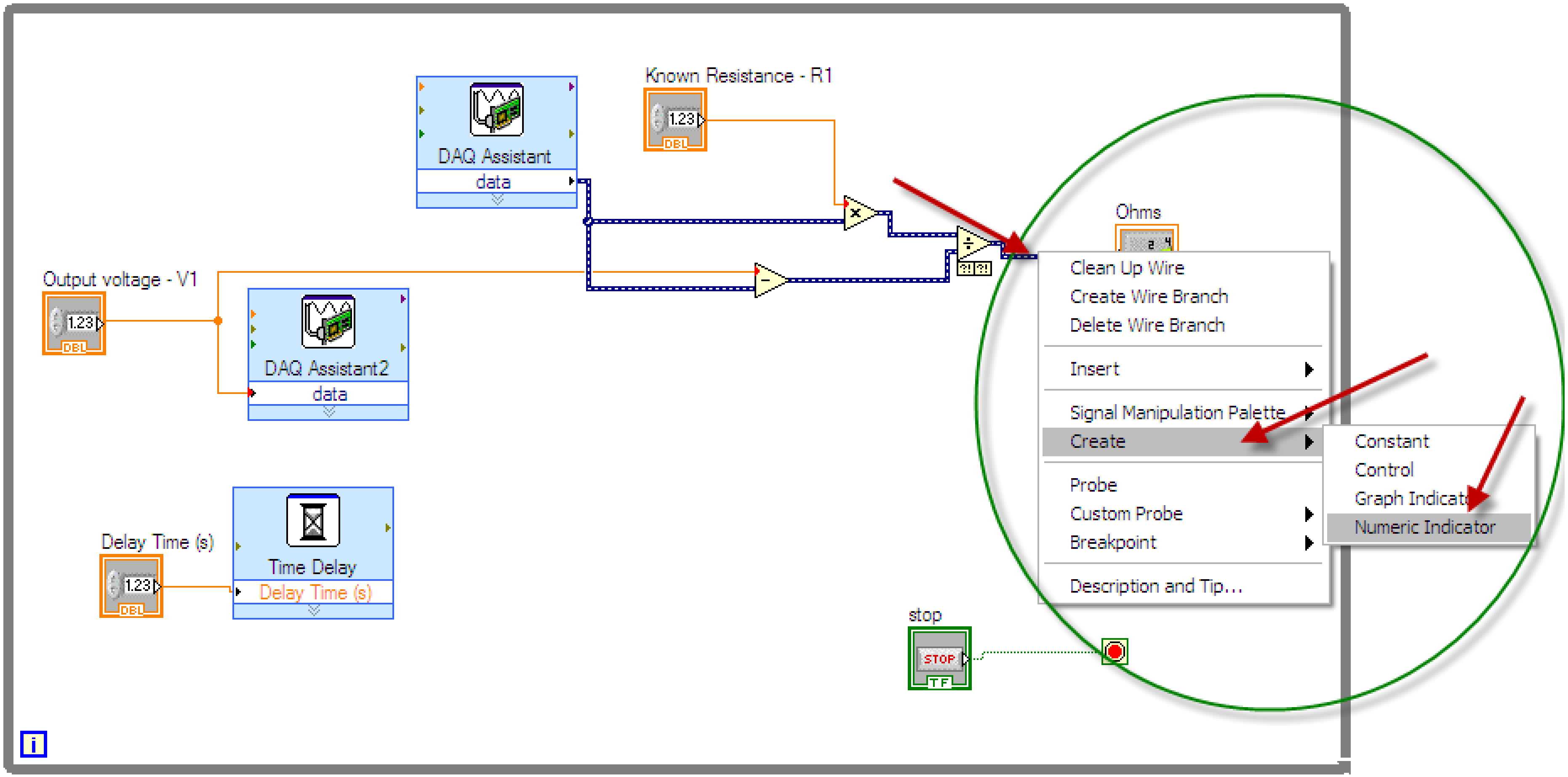
Create a block diagram to calculate the resistance R2 knowing V1,V2 and R1 and using the voltage divider properties. Again, label properly.



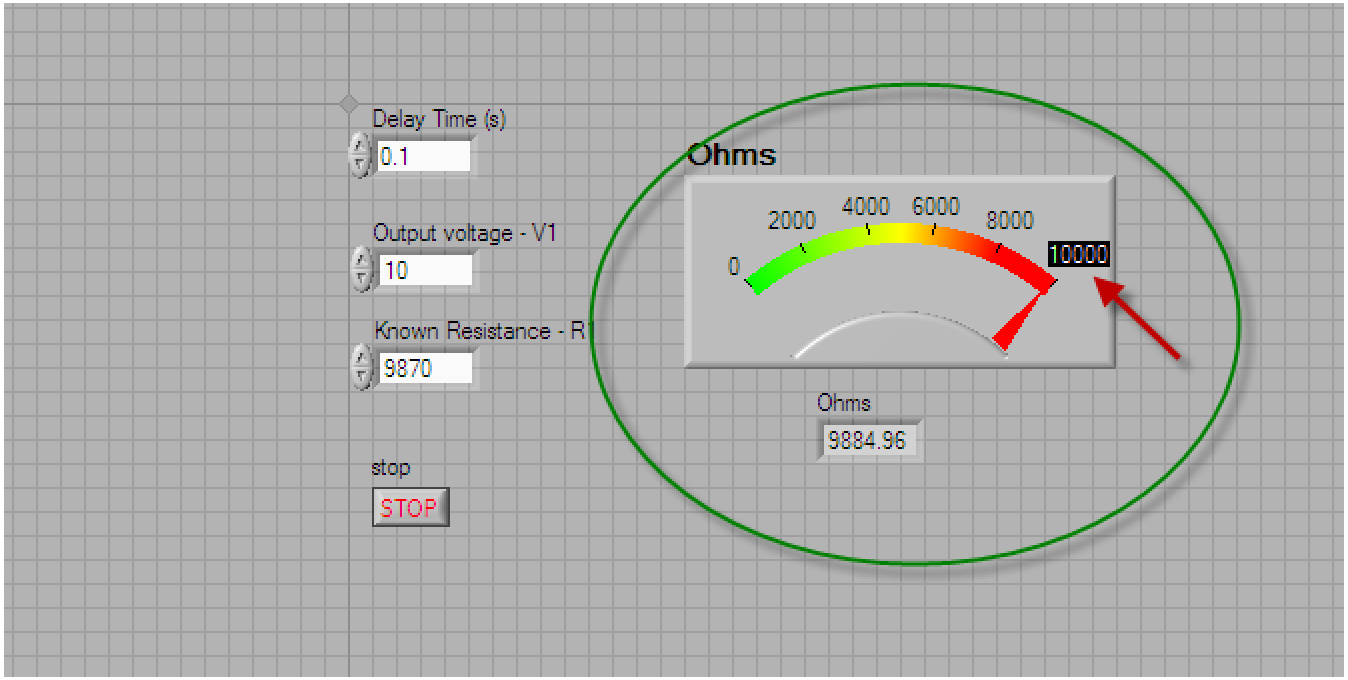
When wiring, a useful feature is the 'Clean Up Wire'- just right-click on the messy wire.



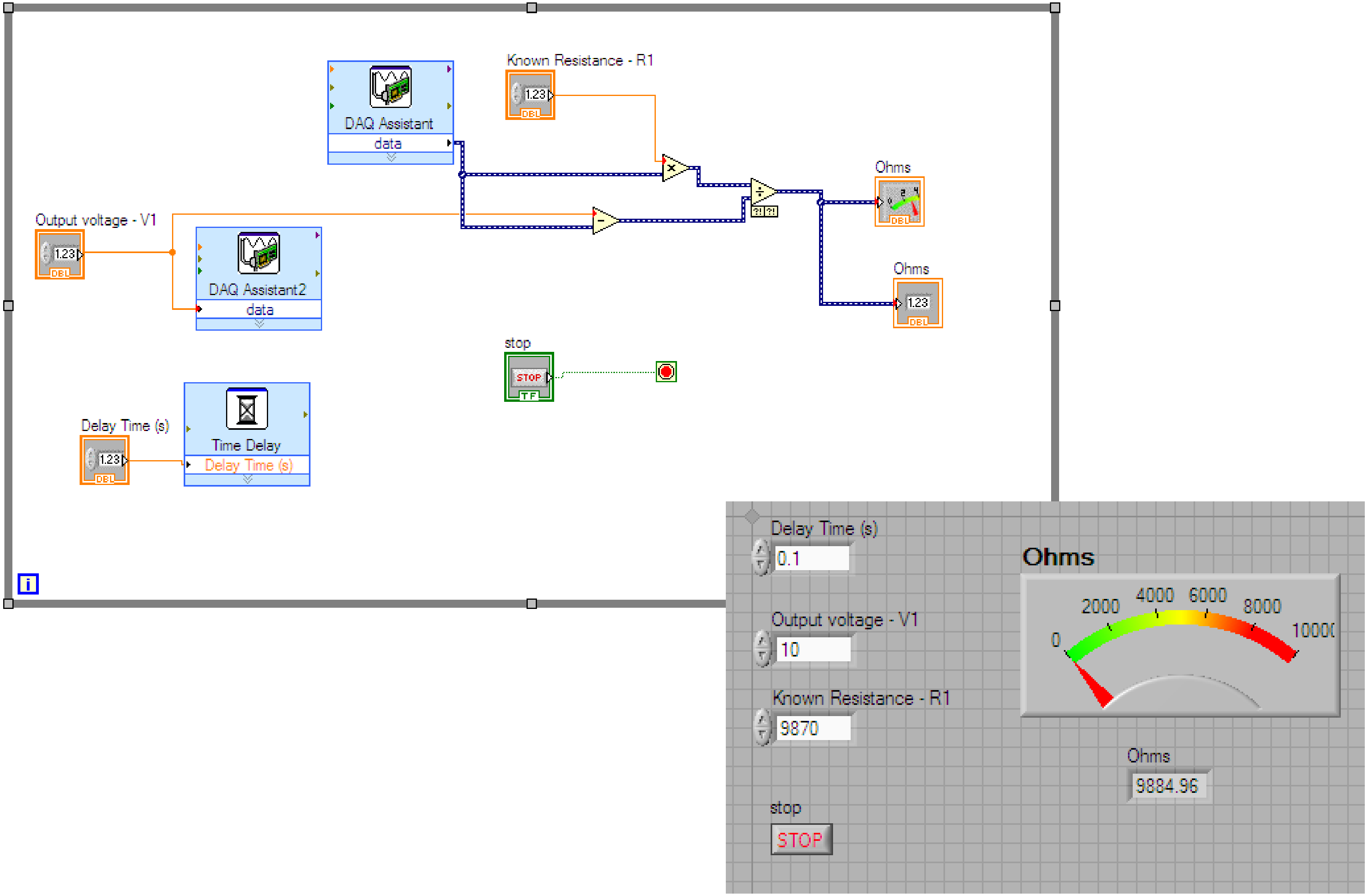
Create a numeric indicator at the output of the VI for more convenient reading



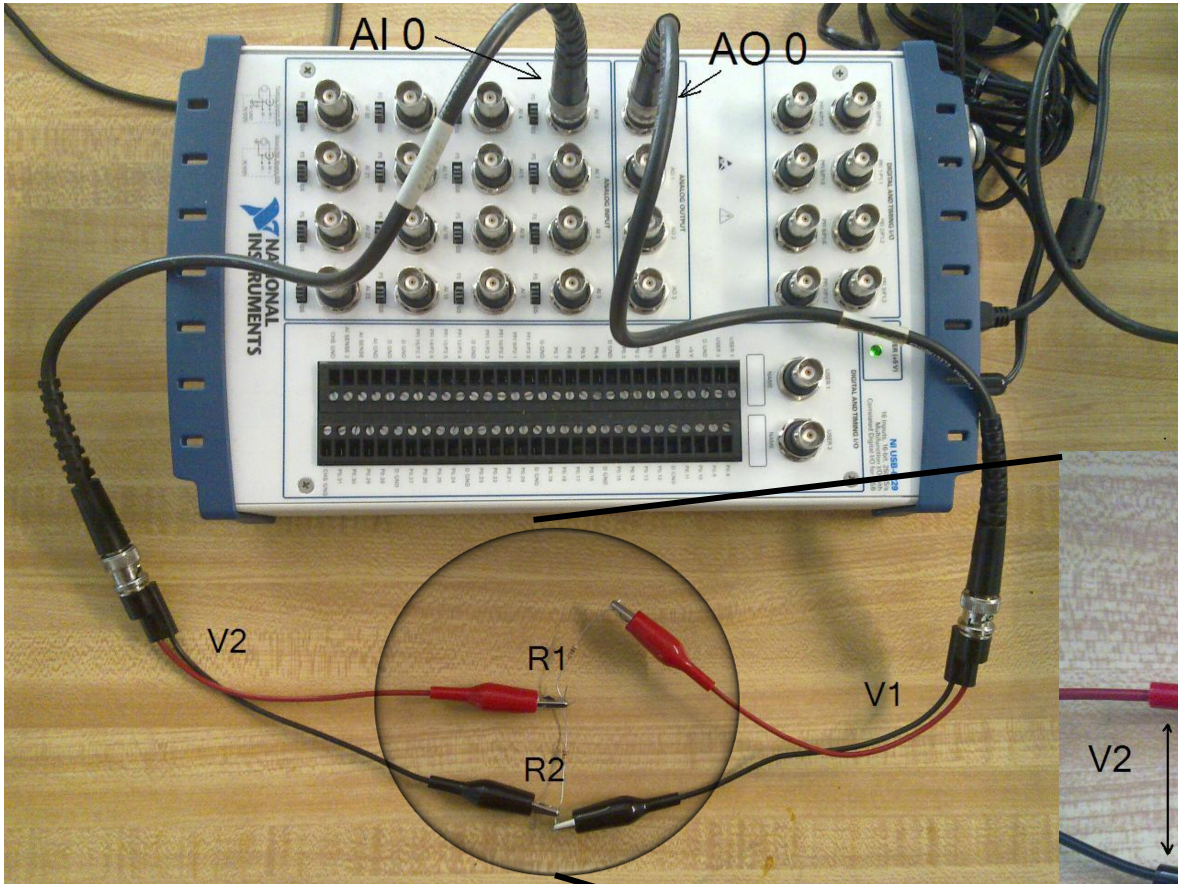
Make sure you change the scale of the meter indicator to accommodate your readings

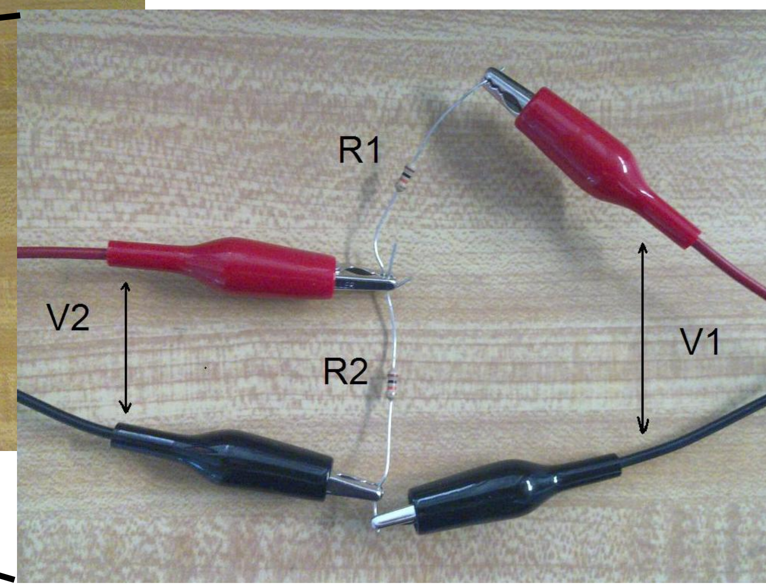


Final view of the front panel and the block diagram



Experimental setup

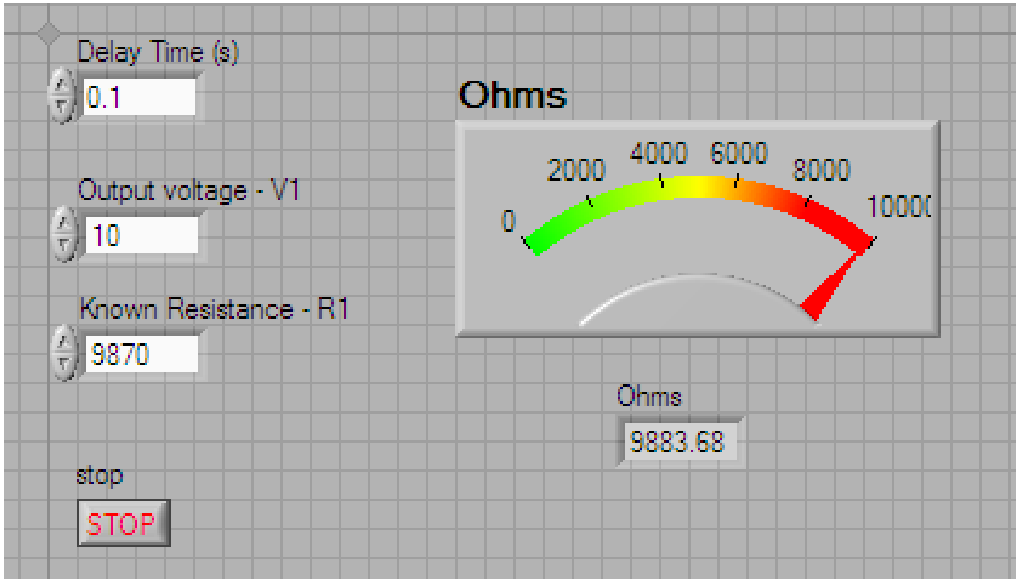




Make sure to know how to decipher / read "bands" on electrical circuits of interest… see Handout

Measurements on a 10 kΩ±5% resistor: 9887.53 Ω, is this correct? Discuss.

(Recall: digital resolution; uncertainties in both, equipment used and resistors)



Next lab: update VI program to write data to a "File"

We will be doing error and statistical analysis.

We will also use Chauvenet's criterion for "data rejection"