



Introduction to DAQ with LabVIEW

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Contents

- What is LabVIEW?
- What is DAQ?
- Using TC-01 Thermocouple Device in LabVIEW
- Plotting Data from DAQ Device
- Logging Data from DAQ Device to File
- Use a Measurement Filter to reduce Noise

Software

You need the following Software

- **LabVIEW** (LabVIEW Professional Development System 32-Bit: English)
- **NI-DAQmx** (Hardware Driver for NI USB-6008, NI TC-01, etc.)

All LabVIEW Software can be downloaded from: www.ni.com/download

Hardware



<http://www.ni.com/datasheet/pdf/en/ds-215>

NI TC-01 Thermocouple DAQ Device

High-Level Design Tools

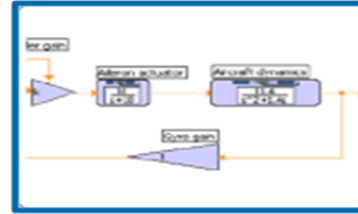
Configuration



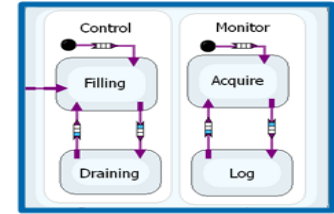
Textual Math

```
1 c = 0.285 + 0.013i;  
2 [X Y] = meshgrid(x, y);  
3 z = X + i*Y;  
4 for k=1:30  
5   z = z.^2 + c;  
6 end
```

Simulation



Statechart



LabVIEW

Graphical Programming

Linux®



Macintosh



Windows

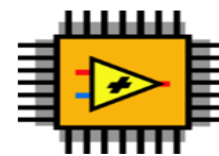


Desktop Platform

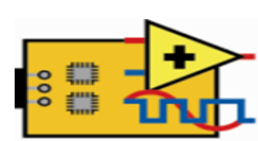
Real-Time



FPGA

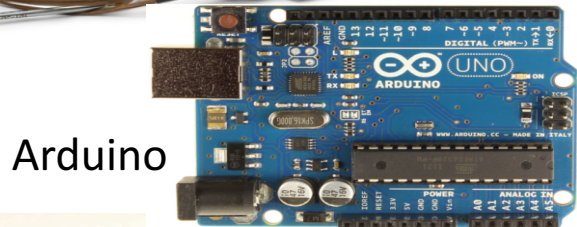
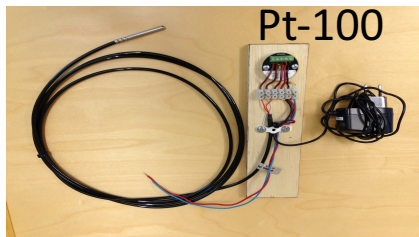
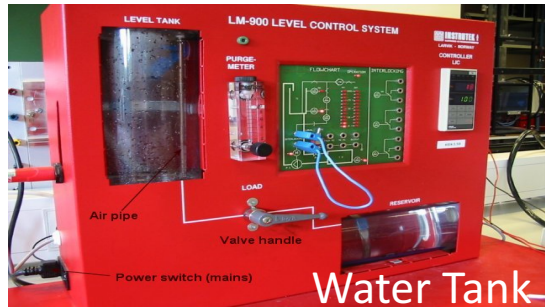


MPU



Embedded Platform

Hardware





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LabVIEW

LabVIEW Training

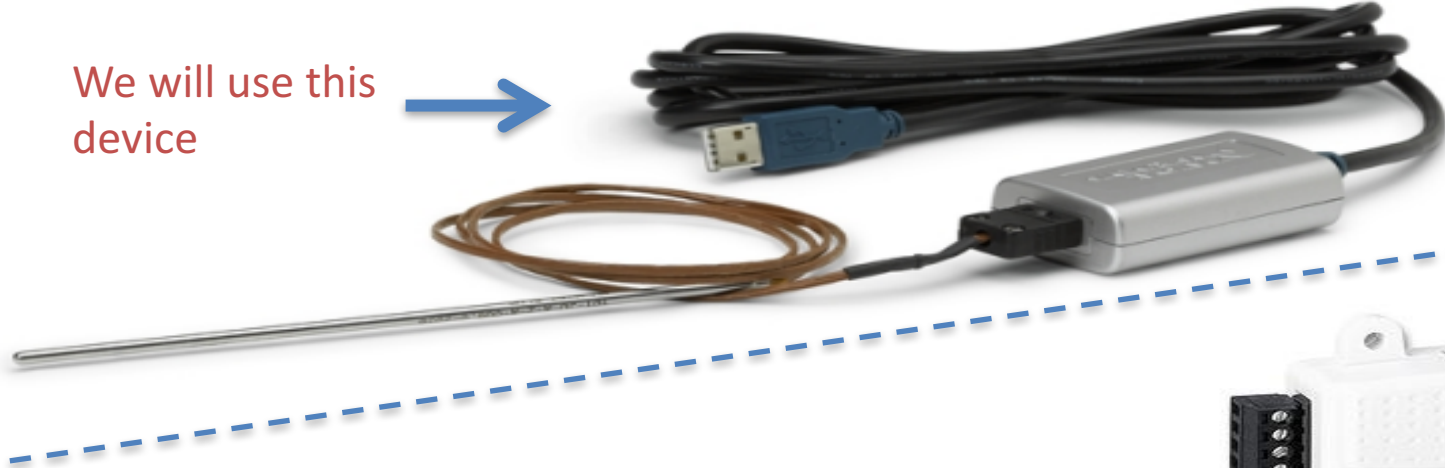
<http://home.hit.no/~hansha/documents/labview/labview.htm>

What is DAQ?

DAQ Hardware Examples

NI TC-01 Thermocouple Temperature Measurements

We will use this
device



NI USB-6008 I/O Module

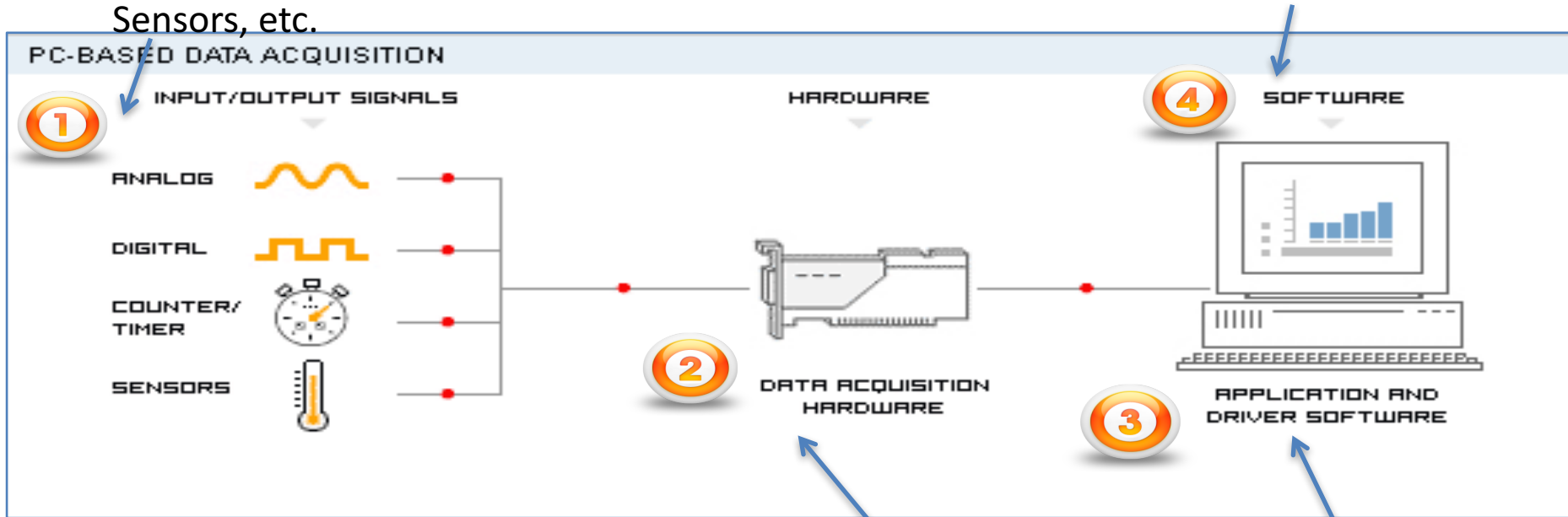
Analog/Digital Inputs/Outputs



Note! The **DAQmx** Driver is needed in order to use them inside LabVIEW!!

DAQ – Data Acquisition

Your App created with LabVIEW



A DAQ System consists of 4 parts:

1. Physical input/output signals, sensors
2. DAQ device/hardware
3. Driver software
4. Your software application (Application software)

NI TC-01 Thermocouple Device
or
NI USB 6008 DAQ Device

NI DAQmx Driver

Using TC-01 in LabVIEW

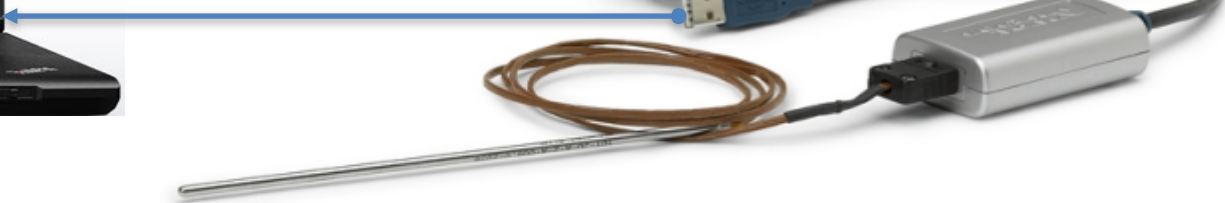
TC-01

How-To use TC-01 with LabVIEW



Connect device to
PC using USB

USB



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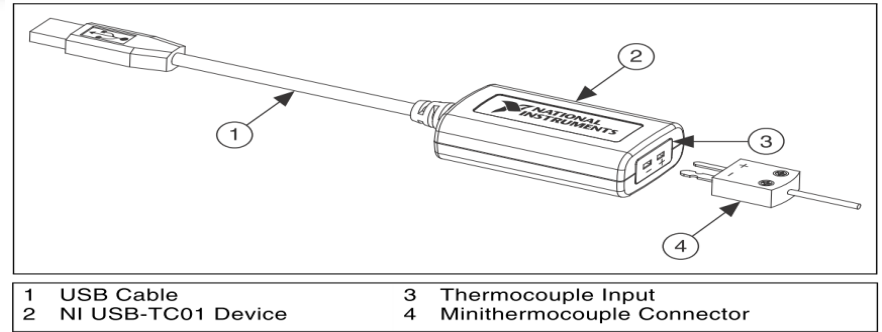
NI TC-01

Temperature (Thermocouple) Device

Used to log Temperature Data using the LabVIEW software



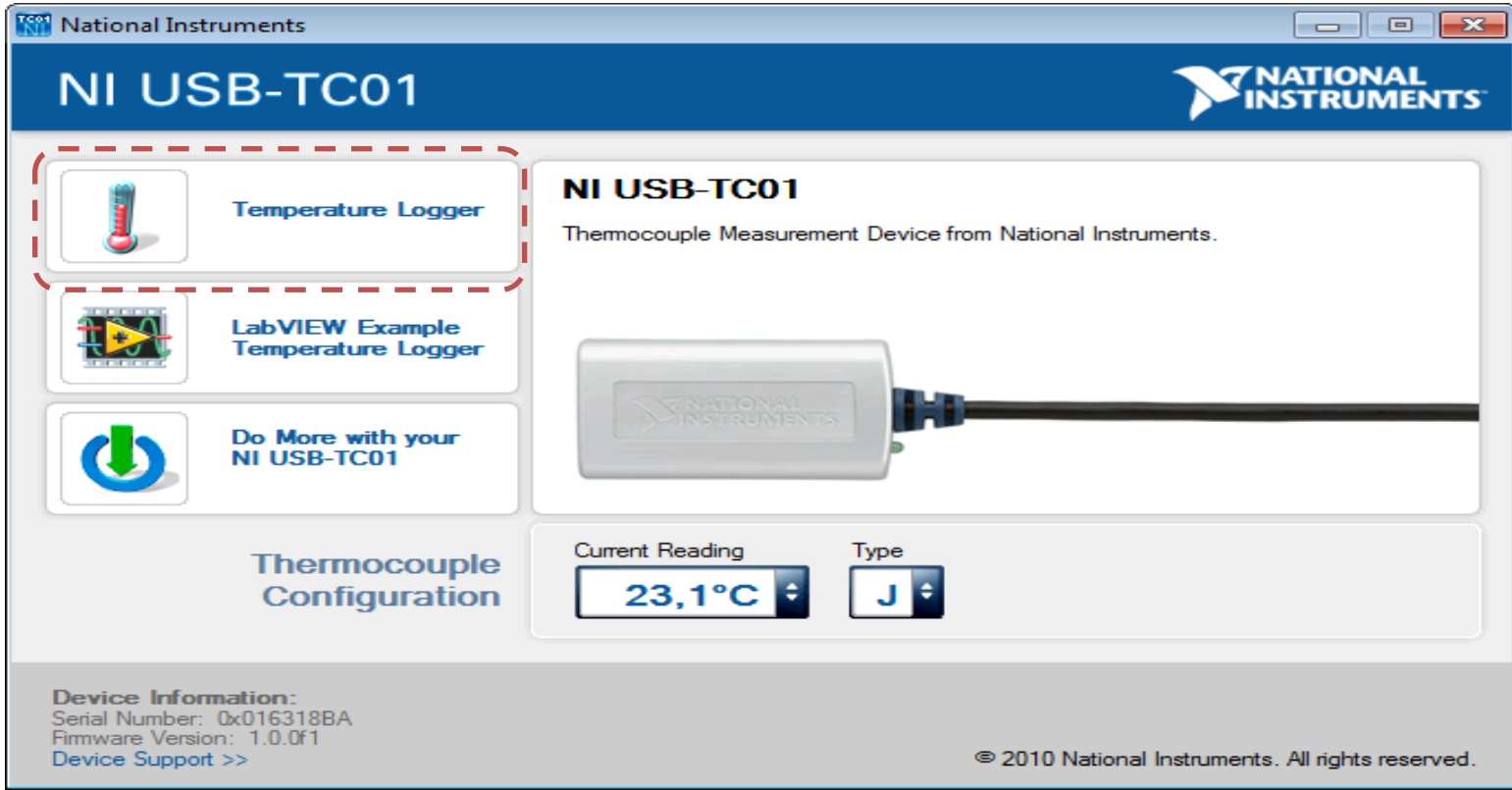
DAQmx Driver needed!



The NI USB-TC01 provides connections for one thermocouple. Thermocouple types J, K, R, S, T, N, E, and B are supported. At TUC we will use the J type.

Getting Started with TC-01

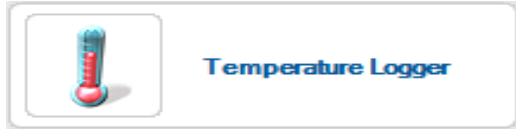
The following window should pop up automatically when you plug in your NI USB-TC01 device in your USB port (if not, select “TC01Launcher.exe”):



The screenshot shows the NI USB-TC01 software interface. The window title is "National Instruments". The main header is "NI USB-TC01" with the National Instruments logo. The interface is divided into several sections:

- Left Sidebar:** Contains three buttons: "Temperature Logger" (highlighted with a red dashed border), "LabVIEW Example Temperature Logger", and "Do More with your NI USB-TC01".
- Right Panel:** Displays "NI USB-TC01" and "Thermocouple Measurement Device from National Instruments." Below this is an image of the device.
- Configuration Section:** Shows "Thermocouple Configuration" with two dropdown menus: "Current Reading" set to "23,1°C" and "Type" set to "J".
- Bottom Section:** Contains "Device Information:" with details: "Serial Number: 0x016318BA", "Firmware Version: 1.0.Of1", and "Device Support >>".
- Footer:** Copyright notice: "© 2010 National Instruments. All rights reserved."

NI TC-01 Built-in Temperature Logger



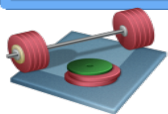
Built-in Temperature Logger (No Driver or programming needed)

The screenshot shows the NI USB-TC01 Temperature Logger software interface. The window title is "NI Temperature Logger: 0x016318BA". The main header is "NI USB-TC01 Temperature Logger" with the National Instruments logo. On the left, there are configuration options: "Device: 0x016318BA", "Thermocouple Type" set to "J", "Temperature Units" set to "°C", a checked "Log Data" box, and a "Log File Directory" of "m:\HiTfiler\My Documents". A "Description" field is empty. The central graph plots "Temperature (°C)" on the y-axis (ranging from 18.1 to 30.2) against "Time (seconds)" on the x-axis (ranging from 14:09:27 to 14:10:27). The graph shows a blue line that is constant at approximately 23.1°C until 14:09:37, then rises to about 25.1°C by 14:09:47. Below the graph, the "Current Reading" is displayed as "25.1". There are "Start" and "Stop" buttons at the bottom right. At the bottom left, there is a "Download additional applications" button with a green download icon. The footer text reads "© 2010 National Instruments. All rights reserved."

MAX – Measurement & Automation Explorer

The screenshot displays the NI Measurement & Automation Explorer (MAX) interface. The main window is titled "NI USB-TC01 'Dev1' - Measurement & Automation Explorer". The left pane shows a tree view of the system hierarchy, with "NI USB-TC01 'Dev1'" selected under "Devices and Interfaces". The right pane shows the "Settings" for the selected device, including Name (Dev1), Vendor (National Instruments), Model (NI USB-TC01), Serial Number (016318BA), and Status (Present). The "Test Panels" button is highlighted with a red dashed box. A secondary window titled "Test Panels: NI USB-TC01: 'Dev1'" is open, showing the "Analog Input" configuration. The "Channel Name" is set to "Dev1/ai0", the "Rate (Hz)" is 10000, and the "Measurement Type" is "Thermocouple". The "Amplitude vs. Samples Chart" displays a green waveform on a black background, with the y-axis ranging from 24.2 to 24.3 and the x-axis from 0 to 100. The chart is labeled "Amplitude vs. Samples Chart" and has an "Auto-scale chart" checkbox checked. The "Start" and "Stop" buttons are visible at the bottom of the chart area.

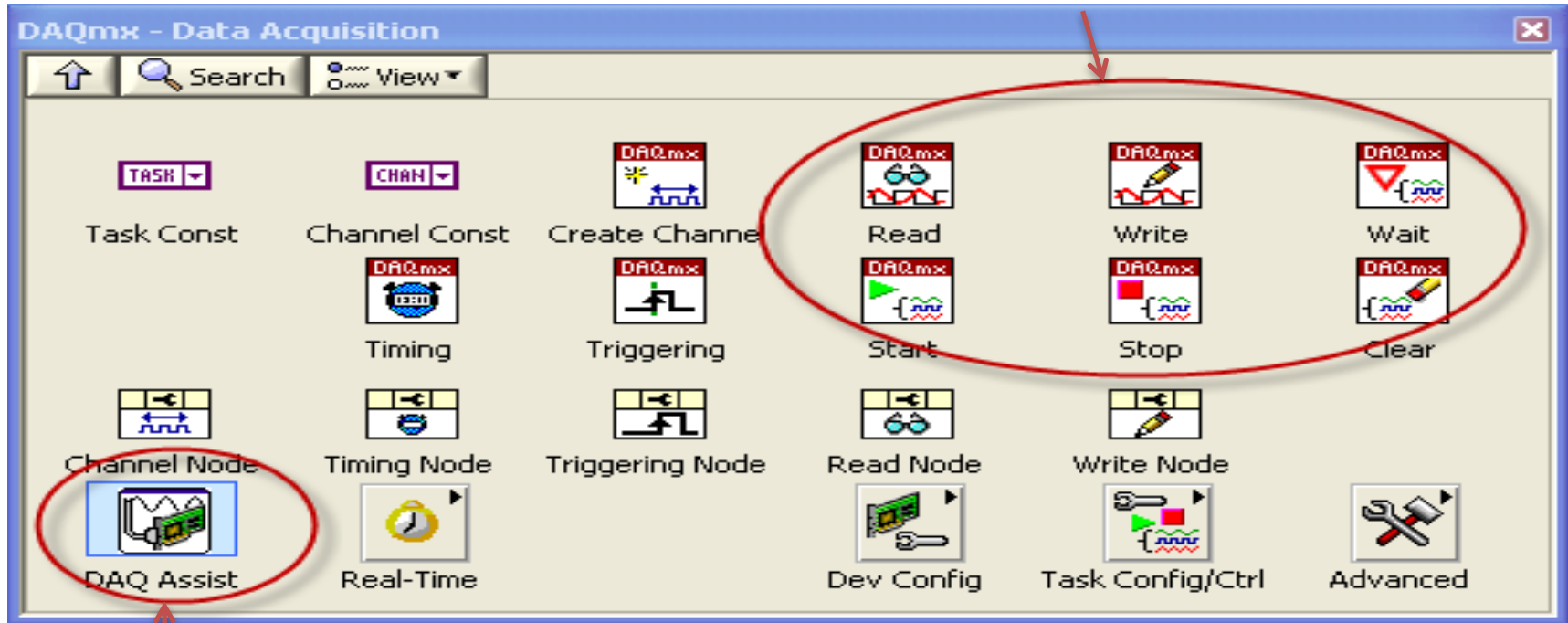
Make sure that your device can be located in MAX. Run a “Self-Test” and use the “Test Panels” to make sure the device works properly.



Data Acquisition Palette in LabVIEW

Functions Palette: "Measurement I/O" -> "NI DAQmx"

For more "advanced" DAQ we use these functions

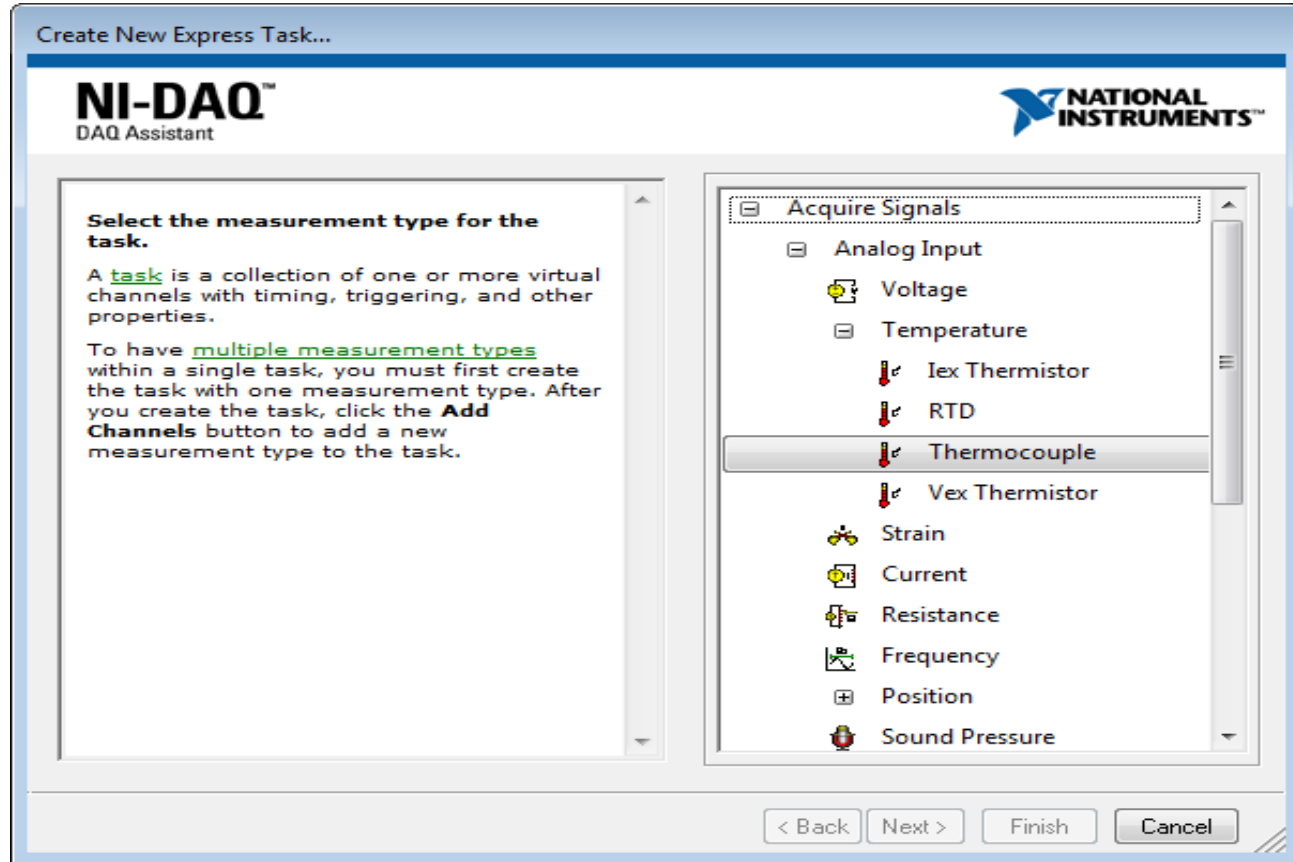


For basic DAQ we use the **DAQ Assistant**

LabVIEW DAQ Assistant



When you place the **DAQ Assistant** on the Block Diagram, a Wizard automatically pops up where you configure what you want to do, i.e., if you want to Read or Write Data, Analog or Digital signals, which channel you want to use, etc.



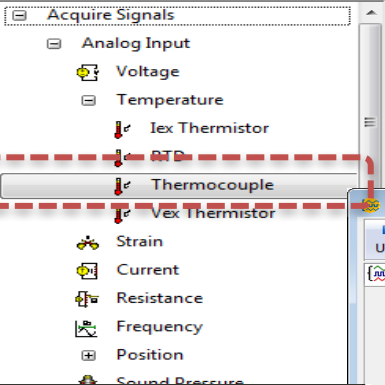
1

Select Input/Output Type

Select the measurement type for the task.

A **task** is a collection of one or more virtual channels with timing, triggering, and other properties.

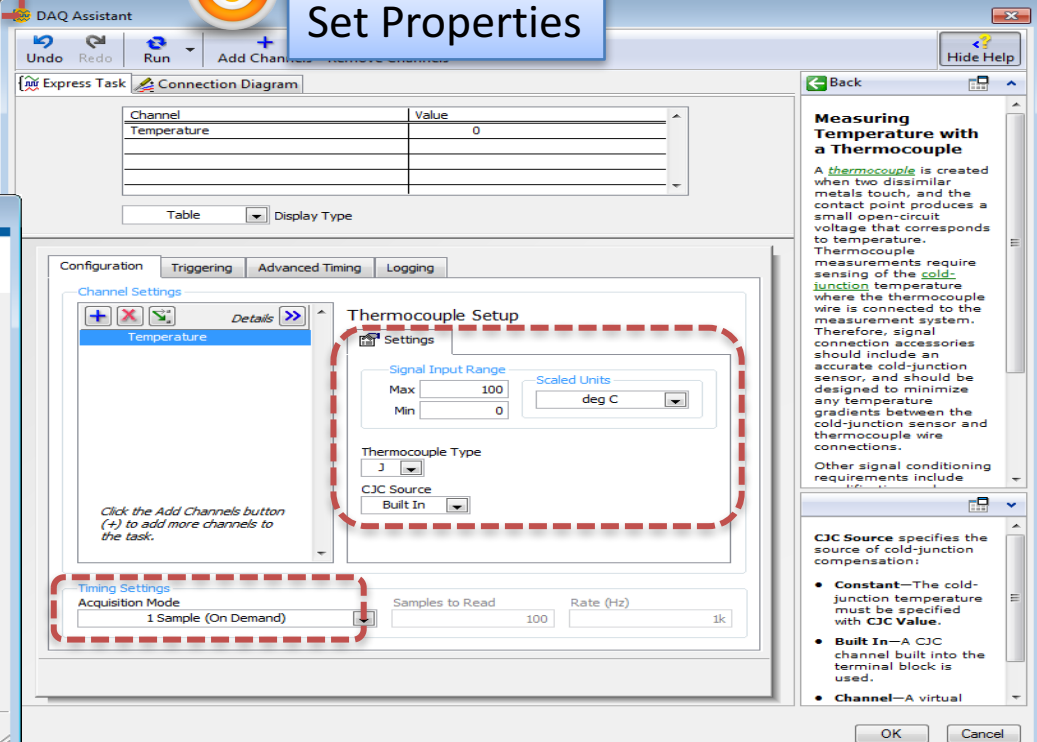
To have **multiple measurement types** within a single task, you must first create the task with one measurement type. After you create the task, click the **Add Channels** button to add a new measurement type to the task.



LabVIEW DAQ Assistant

3

Set Properties



2

Select Channel

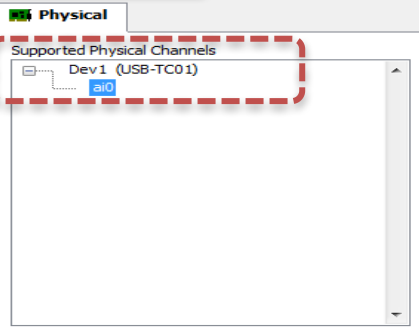


Select the physical channel(s) to add to the task.

If you have previously configured **global virtual channels** of the same measurement type as the task, click the **Virtual** tab to add or copy global virtual channels to the task. When you copy the global virtual channel to the task, it becomes a local virtual channel. When you add a global virtual channel to the task, the task uses the actual global virtual channel, and any changes to that global virtual channel are reflected in the task.

If you have TEDS configured, click the **TEDS** tab to add TEDS channels to the task.

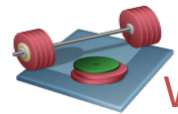
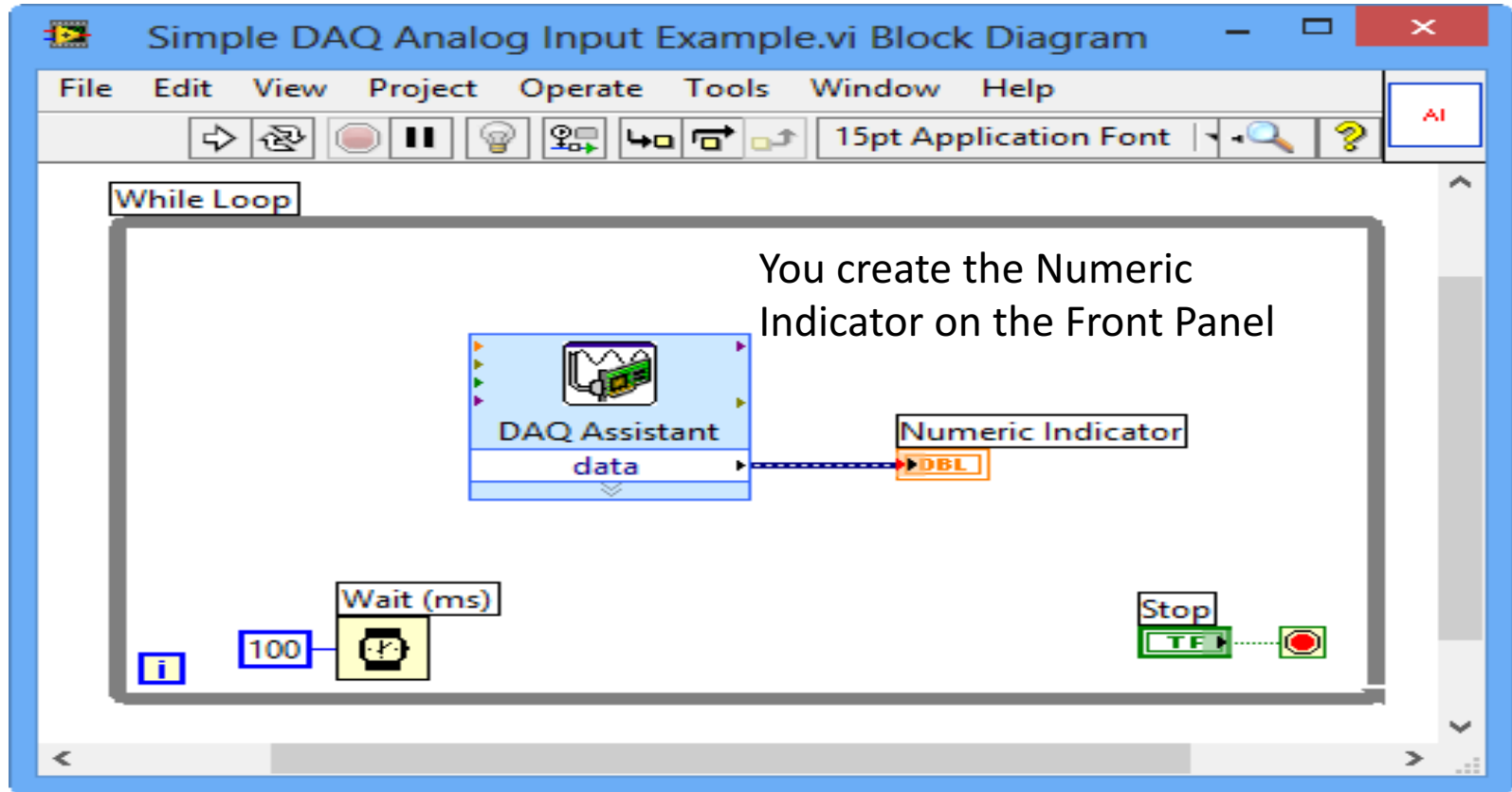
For hardware that supports **multiple channels** in a task, you can select multiple channels to add to a task at the same time.



<Ctrl> or <Shift> click to select multiple channels.

< Back Next > Finish Cancel

Read Data from TC-01 Device



We will Create this Example and Run the Program



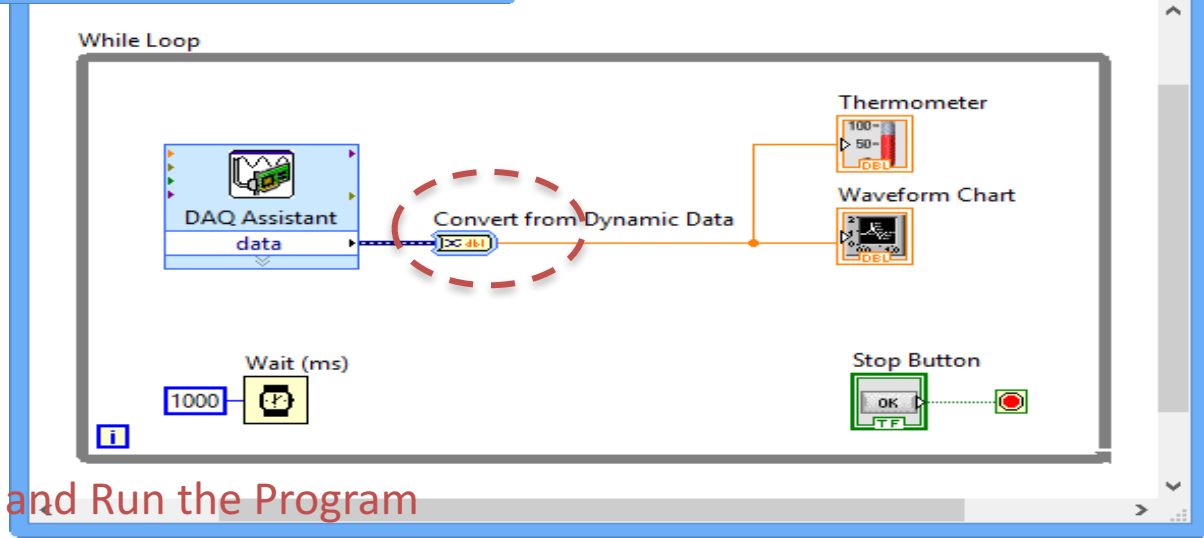
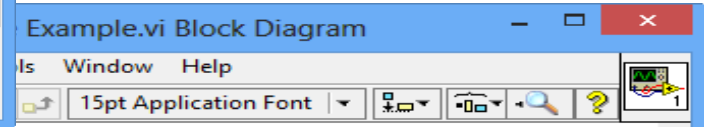
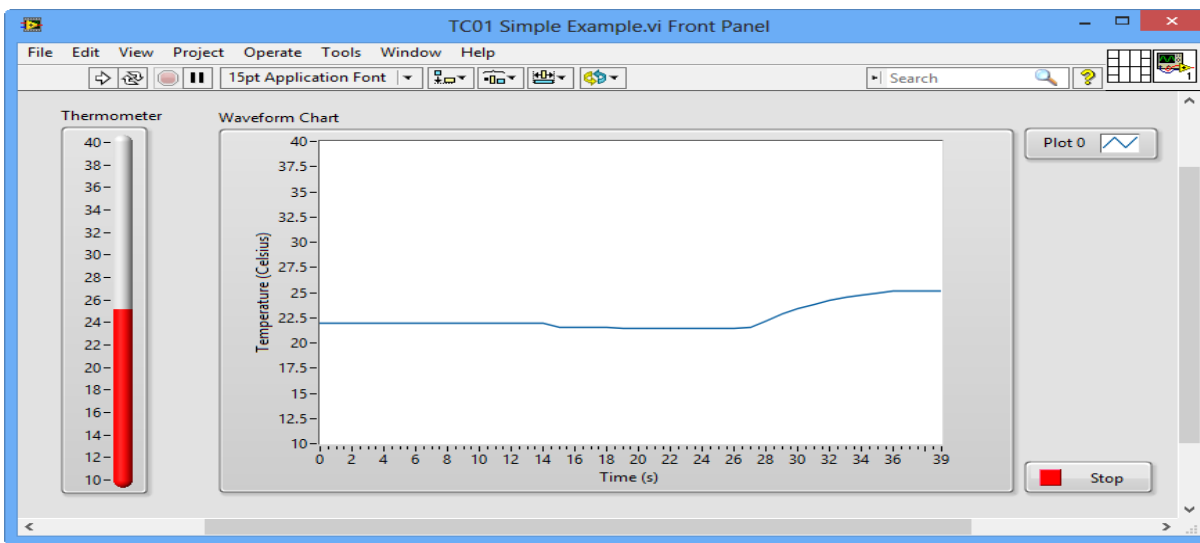
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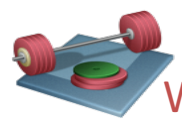
Plotting Data from the DAQ Device

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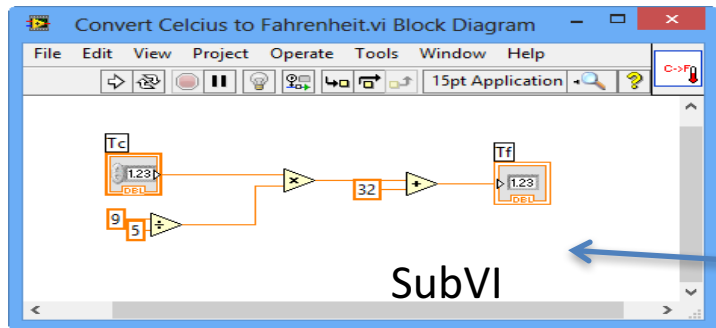
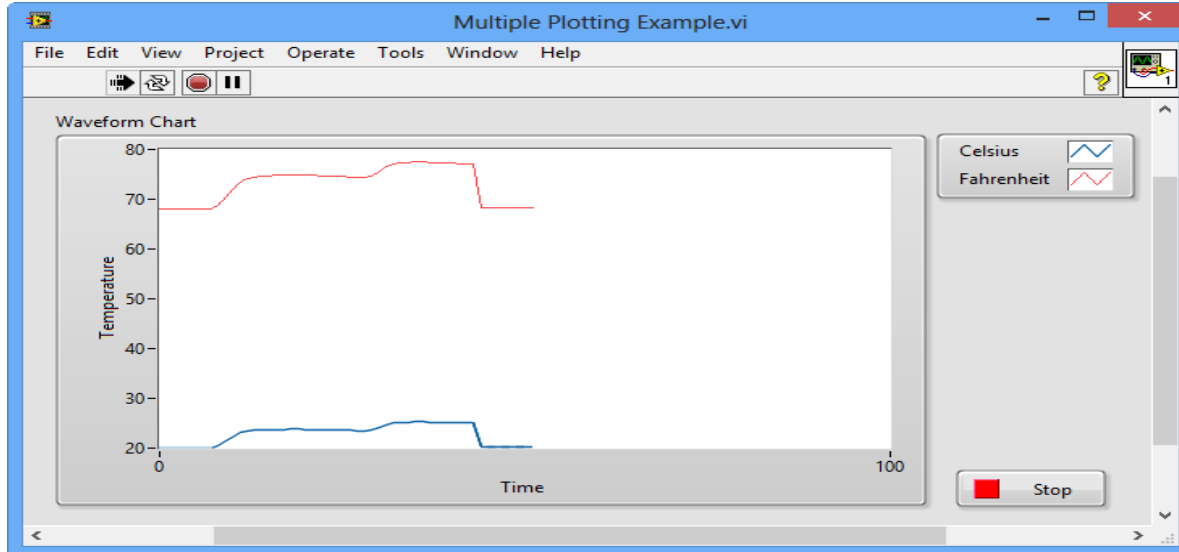
Plotting Temperature Data



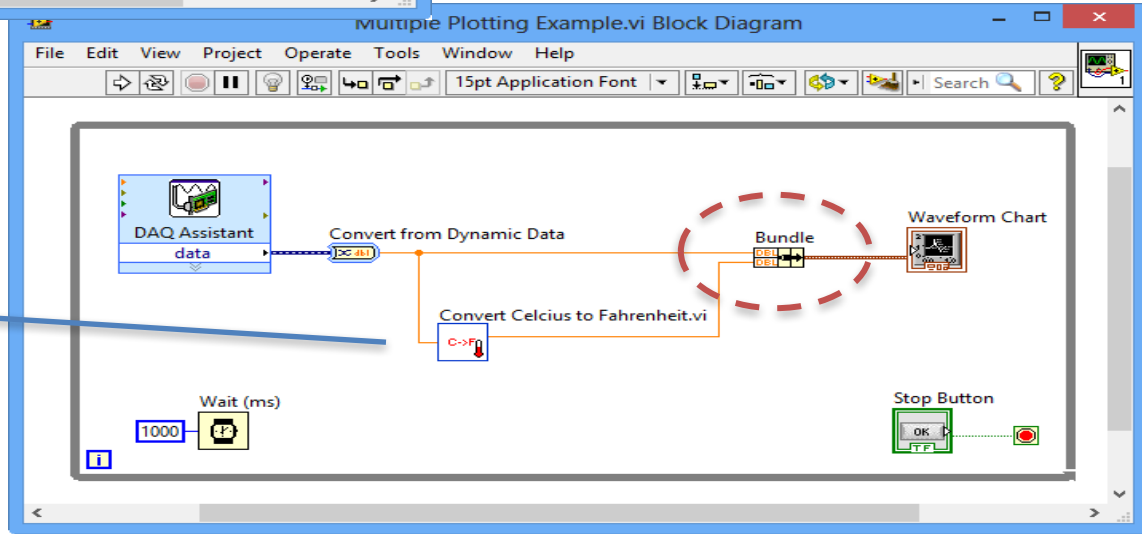
We will Create this Example and Run the Program

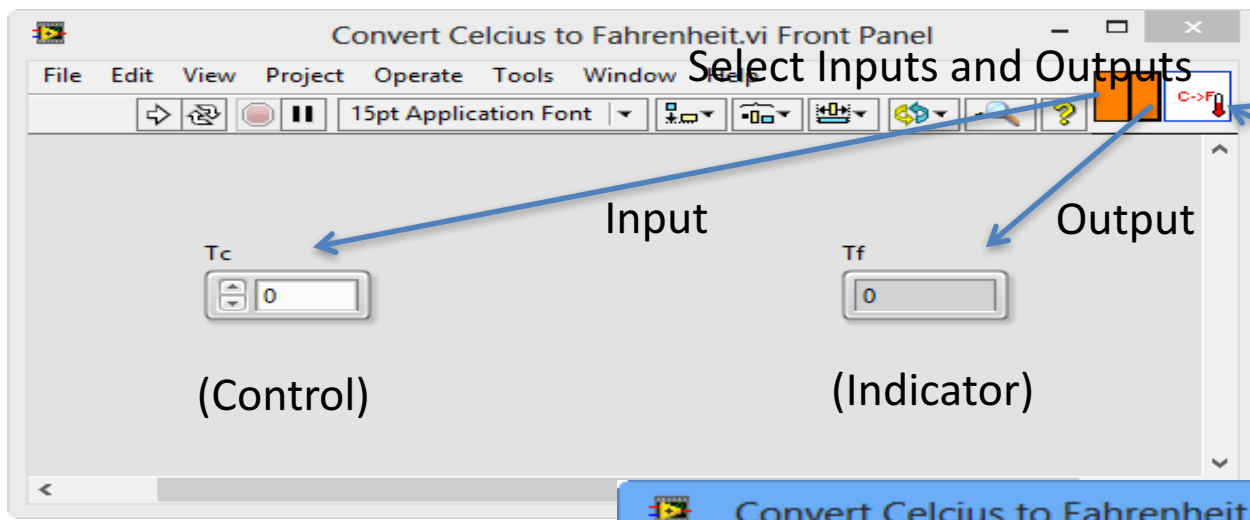


Multiple Plotting and using SubVIs



SubVI



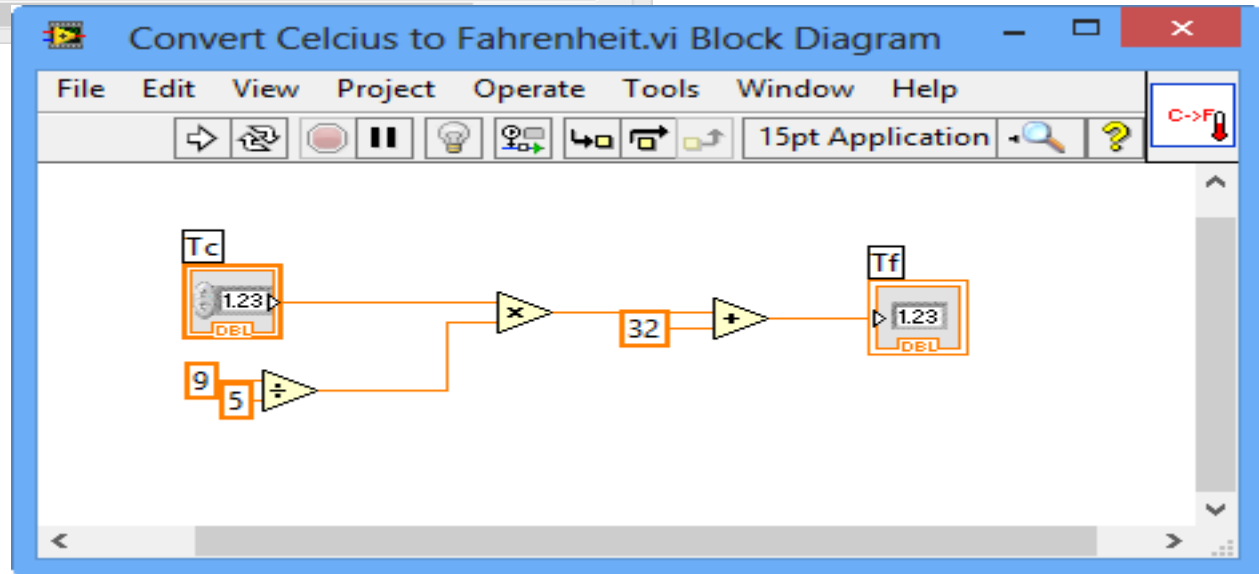


SubVI

Icon that makes it easier to understand what the SubVI is doing

A SubVI is the same as a function or a method used in other languages

$$T_F = \frac{9}{5} T_C + 32$$





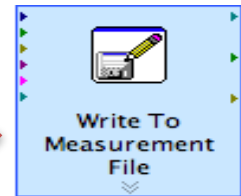
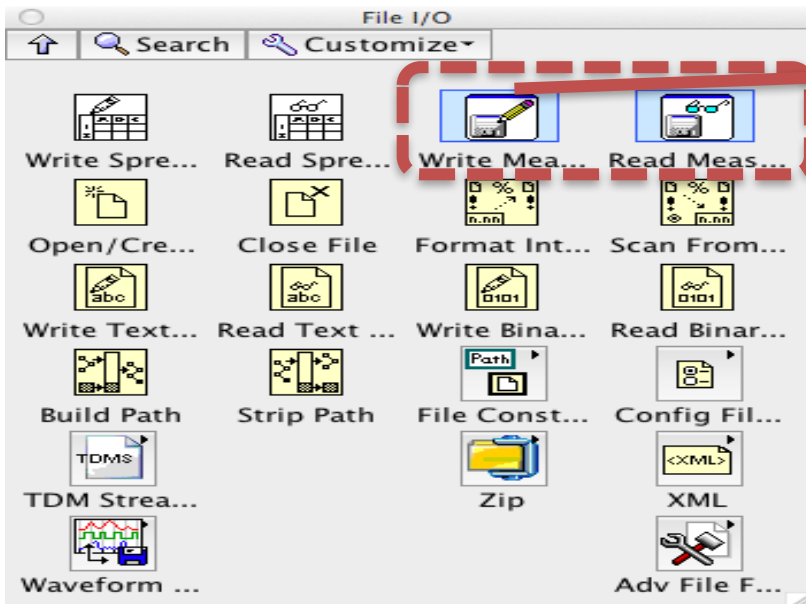
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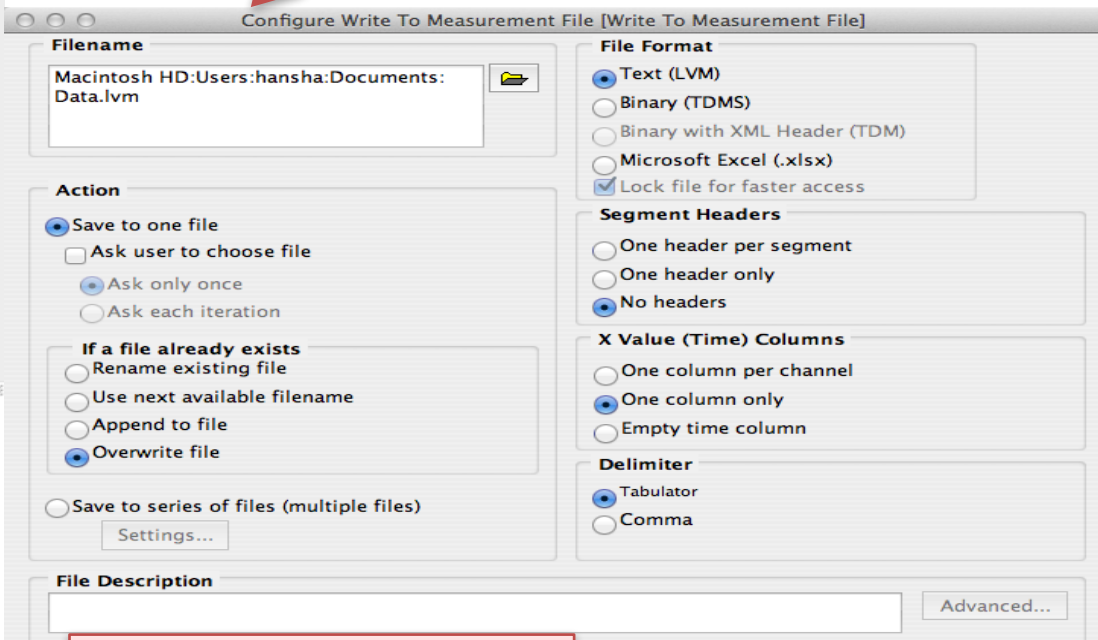
Datalogging to File

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Save Data to File (Data logging)

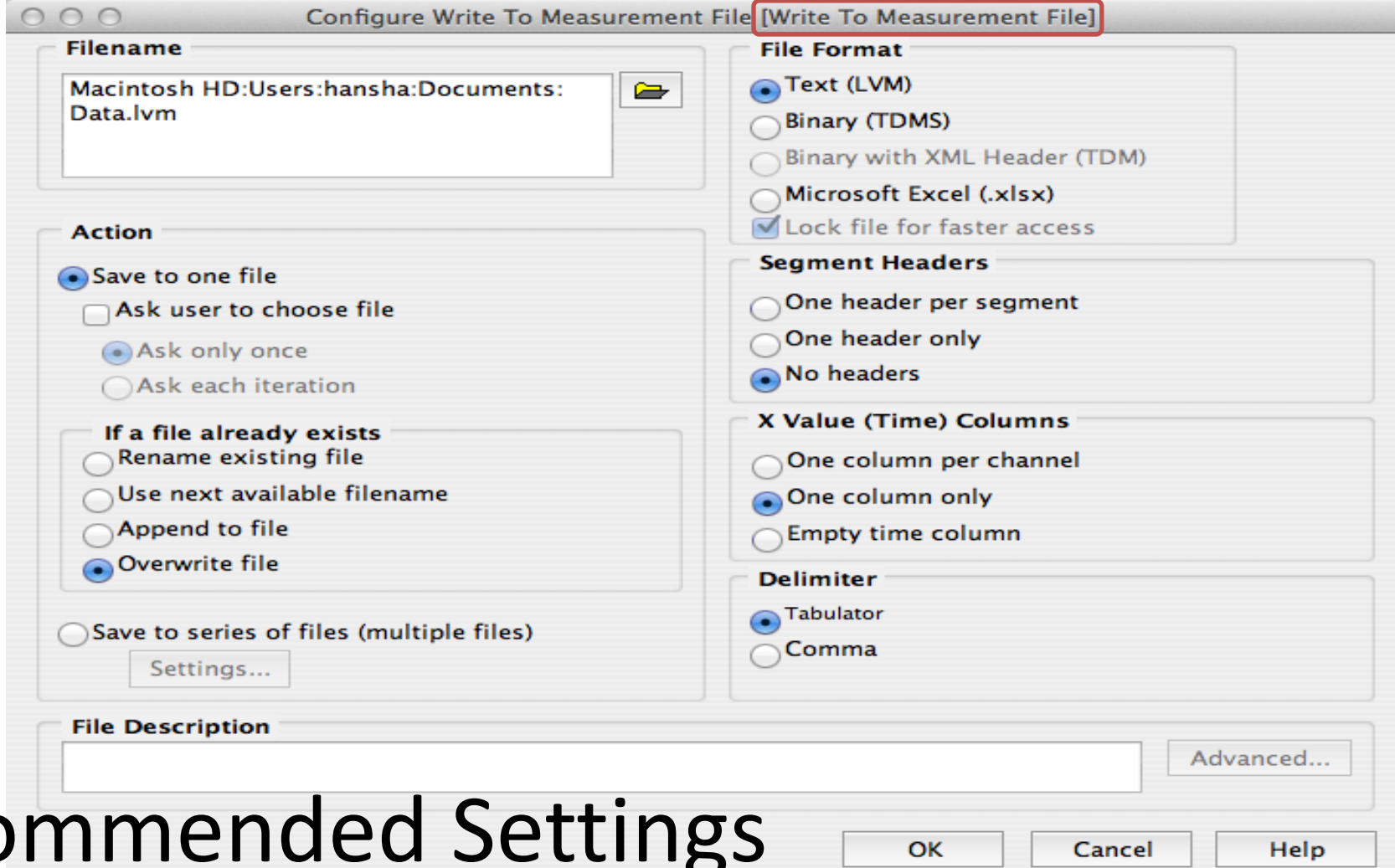


Right-click-Properties



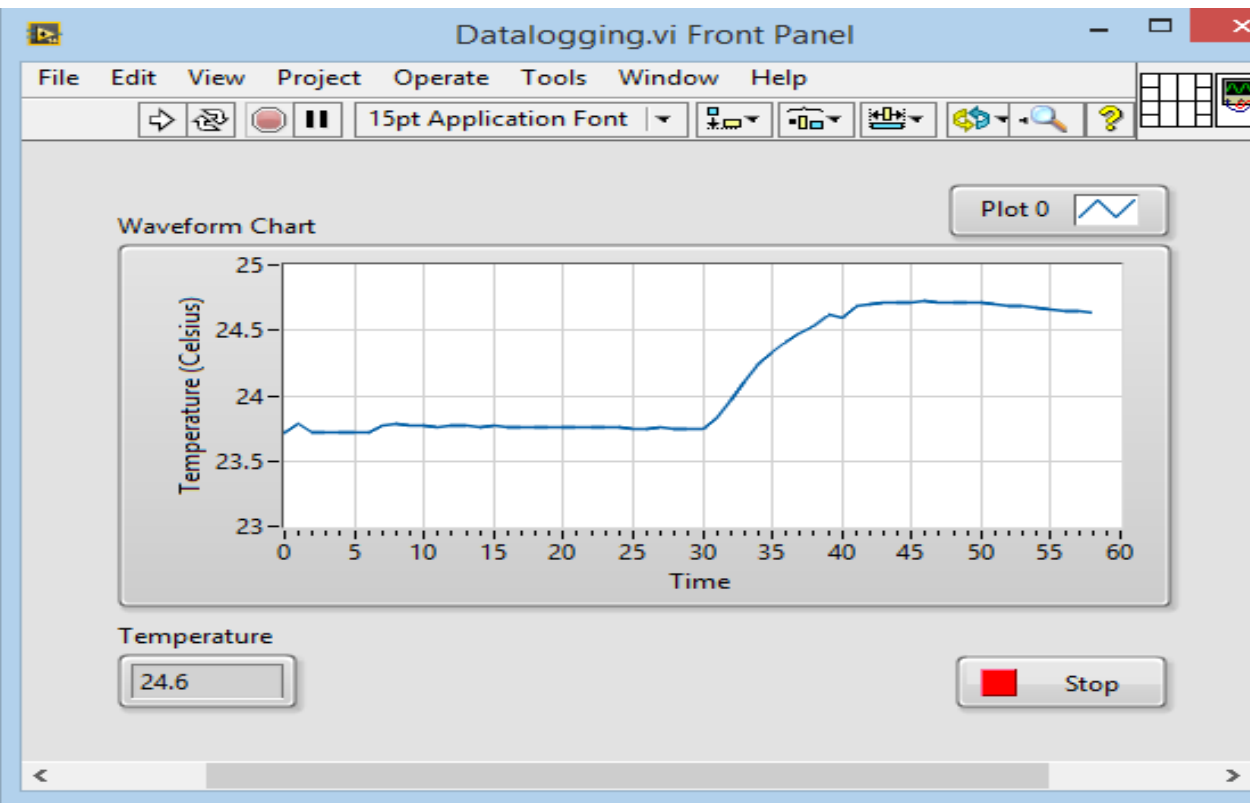
Recommended Settings

OK Cancel Help



Recommended Settings

Datalogging Example

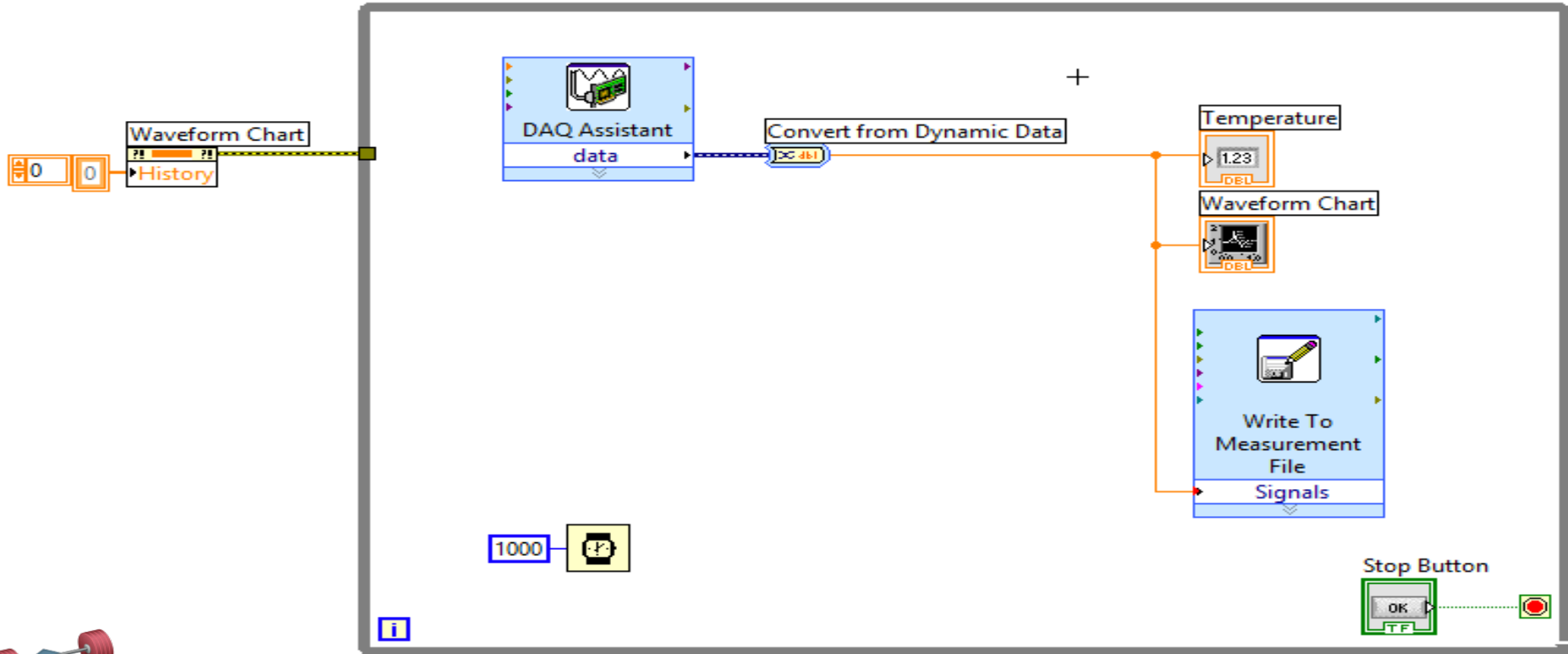


Data.lvm - Notepad

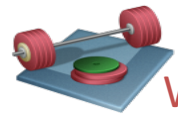
File Edit Format View Help

0.000000	23.722386
0.975883	23.782507
1.973000	23.714294
2.977028	23.719689
3.975200	23.719689
4.976168	23.716991
5.974145	23.714294
6.977184	23.774415
7.977247	23.779810
8.976395	23.777113
9.976493	23.771718
10.980489	23.763626
11.976687	23.771718
12.980719	23.766323
13.982748	23.763626
14.983700	23.766323
15.979765	23.763626
16.977789	23.760928
17.979809	23.760928
18.977904	23.760928
19.976963	23.758231
20.977973	23.755534
21.979071	23.755534
22.980054	23.752836
23.979137	23.752836
24.978214	23.750139
25.978157	23.747441
26.978513	23.752836

Datalogging Example – Block Diagram



We will Create this Example and Run the Program





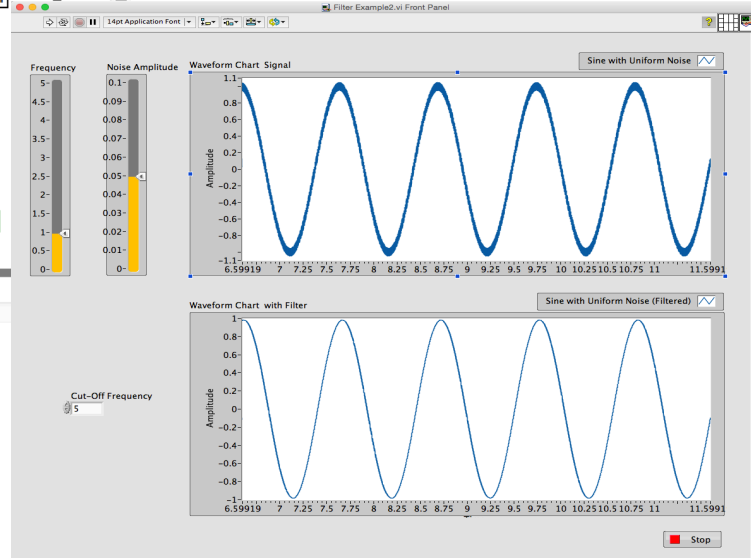
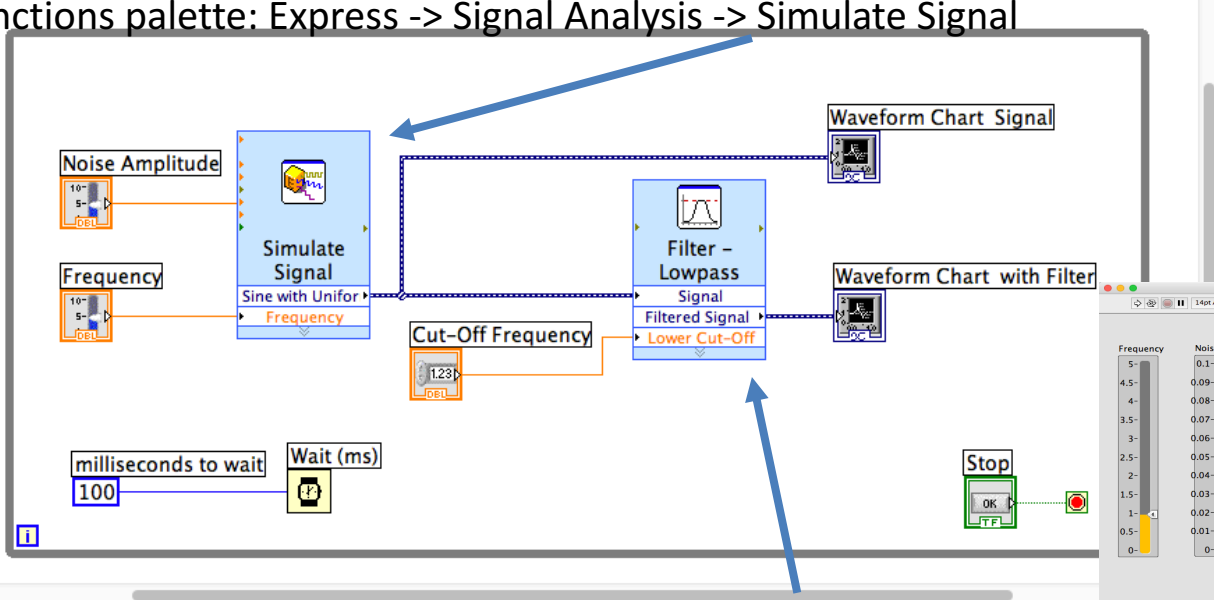
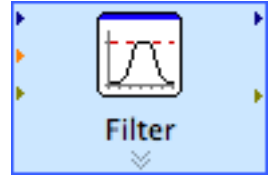
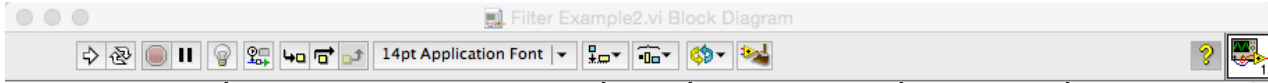
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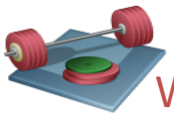
Measurement Filter

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Using a Lowpass Filter to reduce Noise



Functions palette: Express -> Signal Analysis -> Filter



We will Create this Example and Run the Program

Signal

Signal type

Sine

Frequency (Hz)

10.3

Phase (deg)

0

Amplitude

1

Offset

0

Duty cycle (%)

50

 Add noise

Noise type

Uniform White Noise

Noise amplitude

0.6

Seed number

-1

Trials

1

Timing

Samples per second (Hz)

20000

 Simulate acquisition timing

Number of samples

2000

 Run as fast as possible Automatic Integer number of cycles

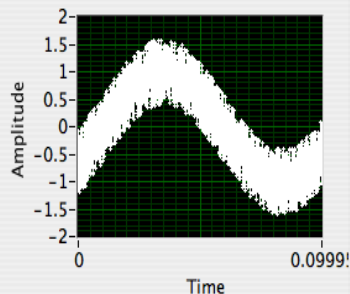
Actual number of samples

2000

Actual frequency

10.3

Result Preview



Time Stamps

 Relative to start of measurement Absolute (date and time)

Reset Signal

 Reset phase, seed, and time stamps Use continuous generation

Signal Name

 Use signal type name

Signal name

Sine with Uniform Noise

OK

Cancel

Help

Properties

Filtering Type

Lowpass

Filter Specifications

Cutoff Frequency (Hz)

1500

High cutoff frequency (Hz)

400

 Finite impulse response (FIR) filter

Taps

29

 Infinite impulse response (IIR) filter

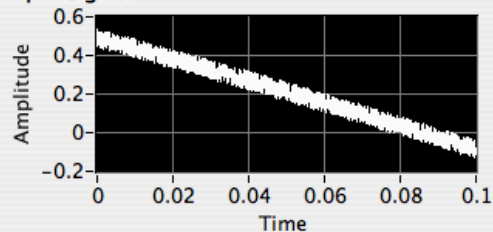
Topology

Butterworth

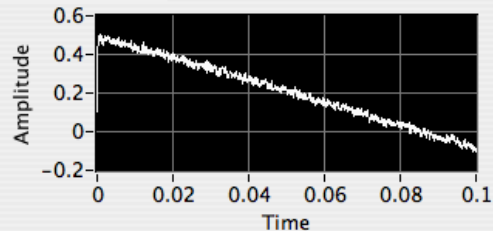
Order

1

Input Signal



Result Preview



View Mode

 Signals Show as spectrum Transfer function

Scale Mode

 Magnitude in dB Frequency in log

OK

Cancel

Help

Thank You!



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LabVIEW

LabVIEW Training

<http://home.hit.no/~hansha/documents/labview/labview.htm>

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