# 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

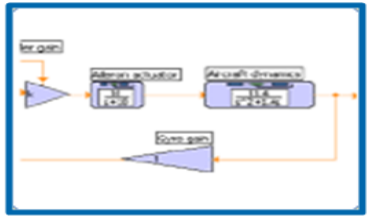
## High-Level Design Tools

### Configuration

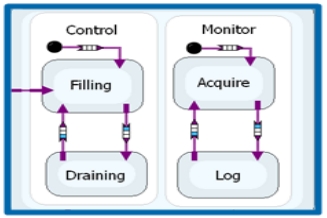
### Textual Math

```
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

### Desktop Platform

Linux®

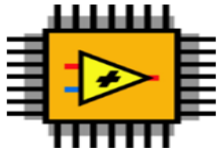
Macintosh

Windows

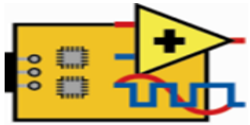

### Embedded Platform

Real-Time

FPGA



MPU

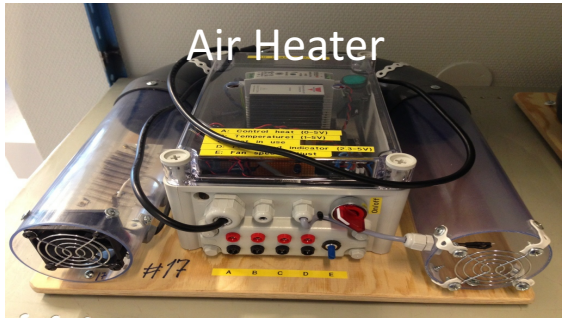


# Hardware

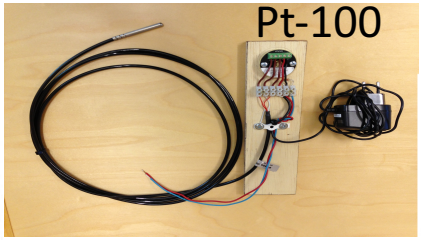
Water Tank

USB-6008


Wi-Fi DAQ



Air Heater

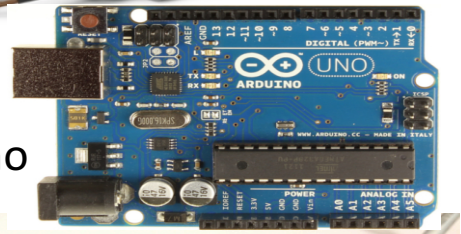

Pt-100



TC-01



ZigBee



Arduino


cRIO



NOx Sensor

Vision System


# LabVIEW Training

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


# What is DAQ?

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# DAQ Hardware Examples

## NI TC-01 Thermocouple Temperature Measurements

We will use this device

## NI USB-6008 I/O Module

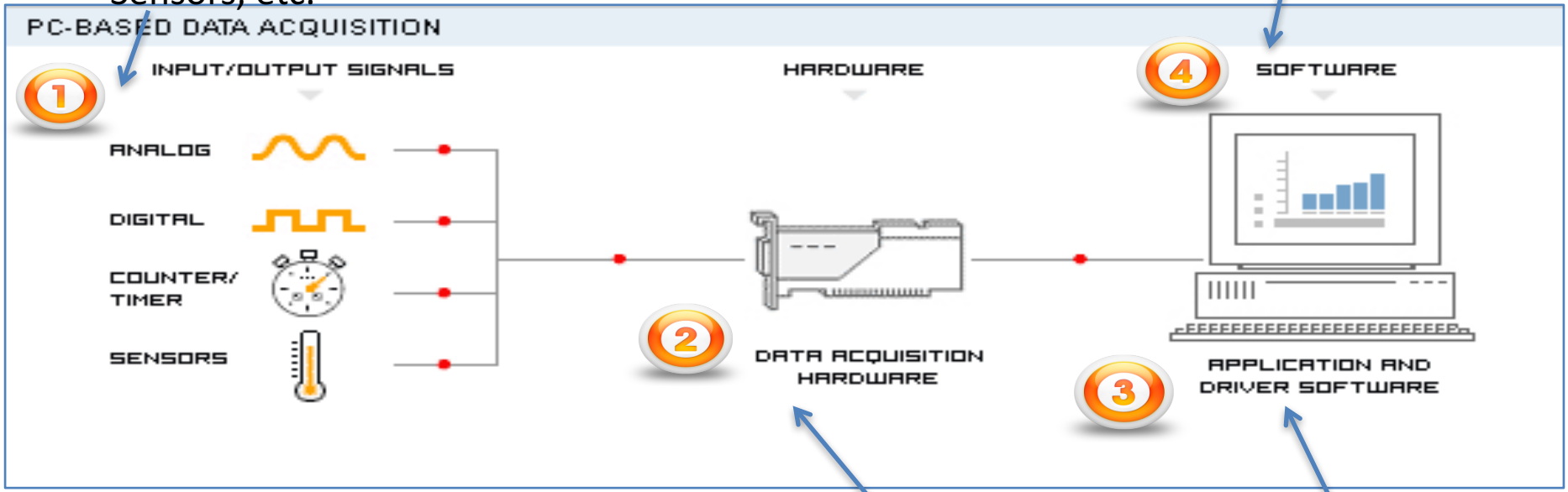

Analog/Digital Inputs/Outputs

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

# DAQ – Data Acquisition

Your App created with LabVIEW

Sensors, etc.




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

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# TC-01

## How-To use TC-01 with LabVIEW


Connect device to
PC using USB

USB

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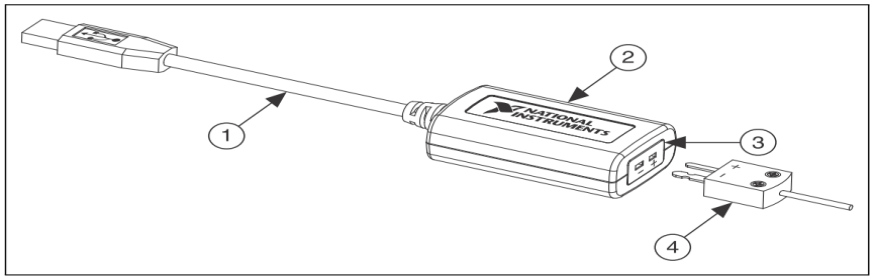
# NI TC-01

Temperature (Thermocouple) Device

Used to log Temperature Data using the LabVIEW software

**DAQmx** Driver needed!

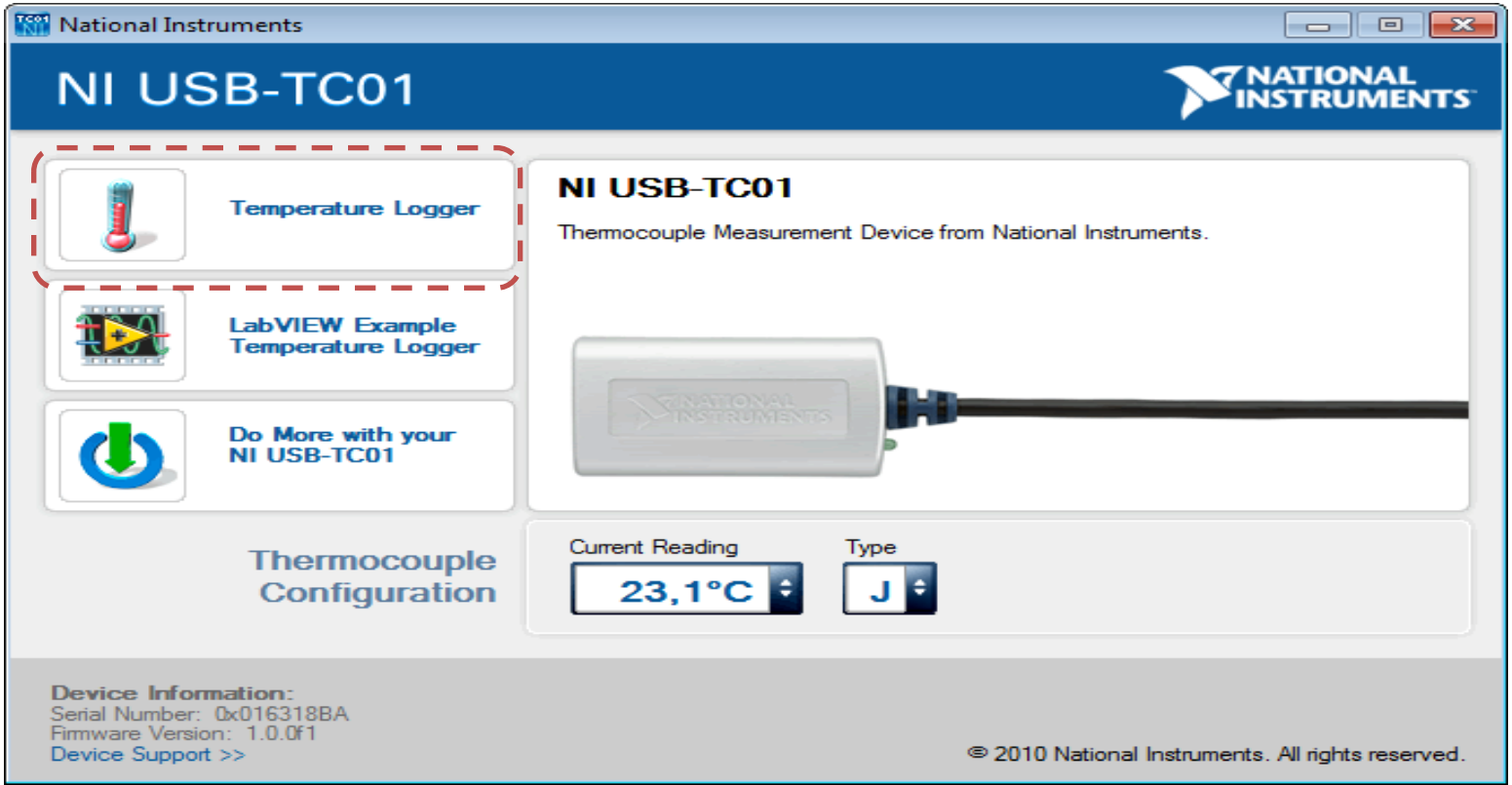



| | | | |
|---|---|---|---|
| 1 | USB Cable | 3 | Thermocouple Input |
| 2 | NI USB-TC01 Device | 4 | Minithermocouple Connector |

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.

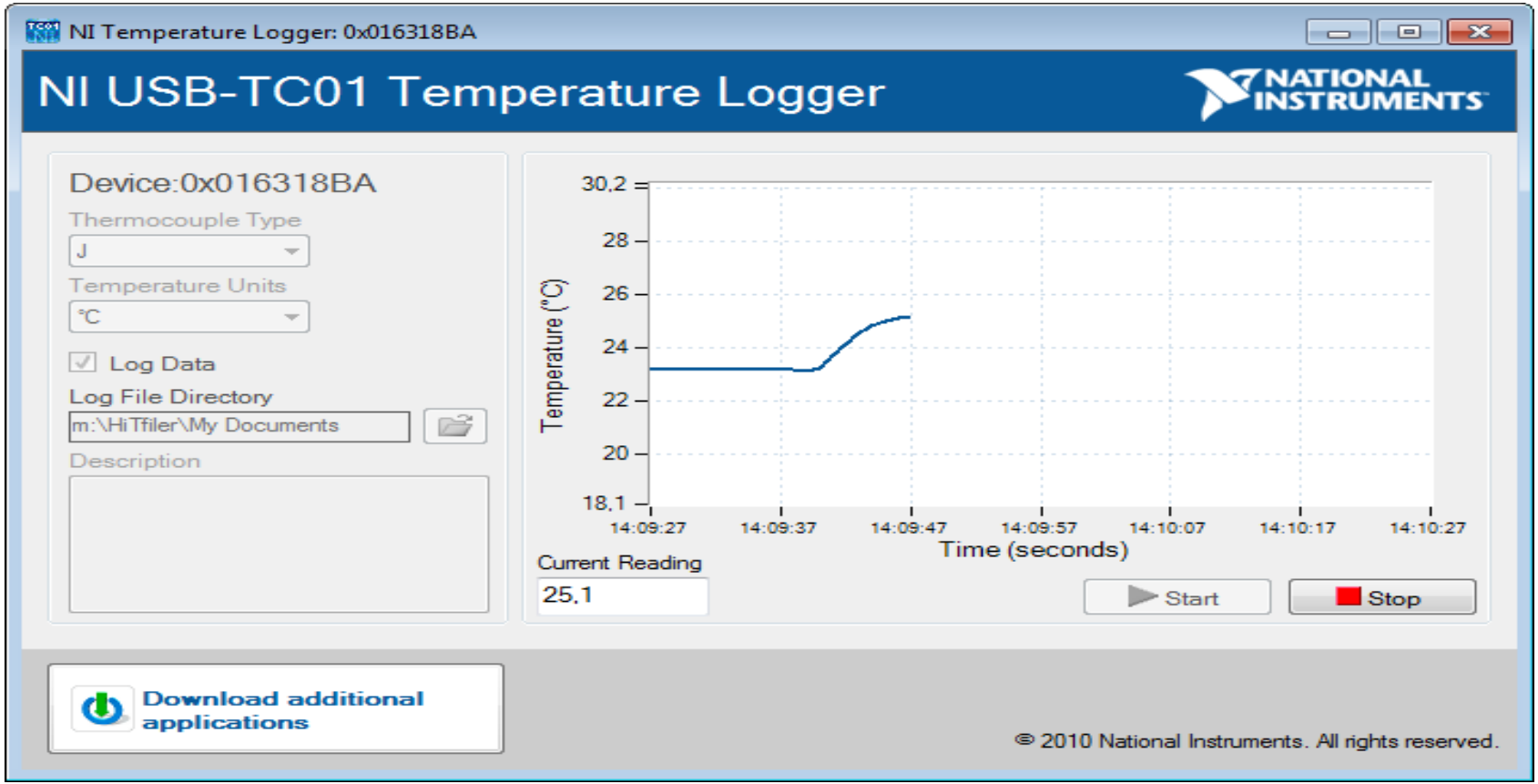
# Getting Started with TC-01

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”):

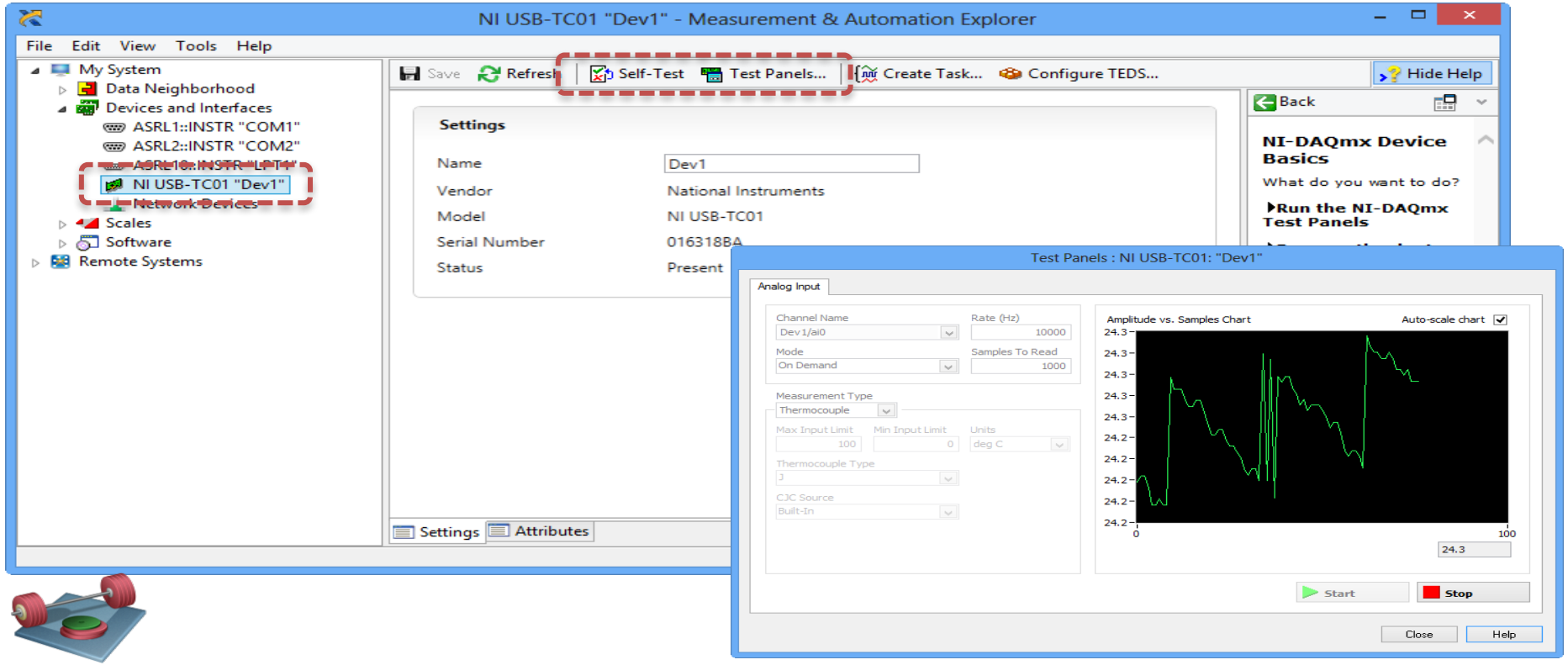


# NI TC-01 Built-in Temperature Logger


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



# MAX – Measurement & Automation Explorer

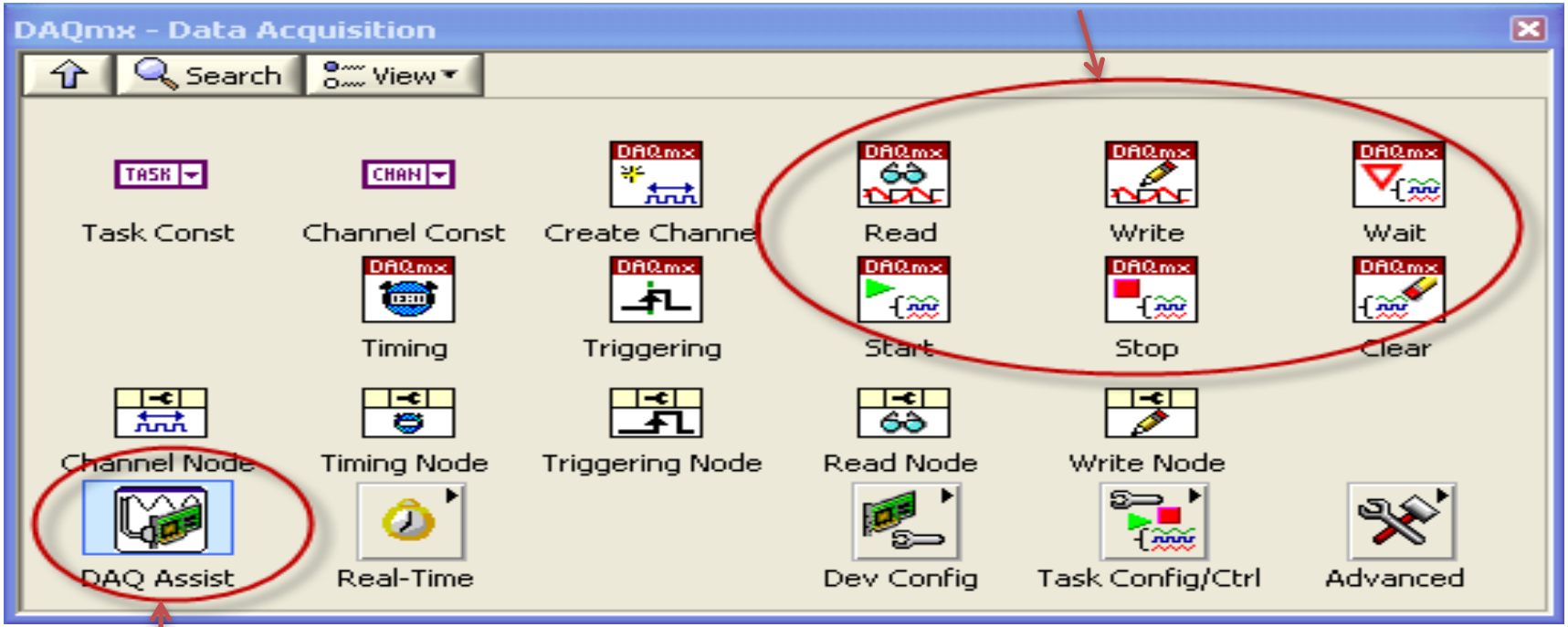



Make sure that your device can be located in MAX. Run a “Self-Test” and use the “Test Panels” to make sure the device works properly.

# Data Acquisition Palette in LabVIEW

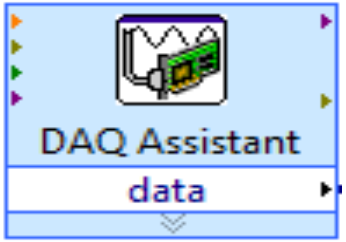
Functions Palette: “Measurement I/O” -> “NI DAQmx”

For more “advanced” DAQ we use these functions

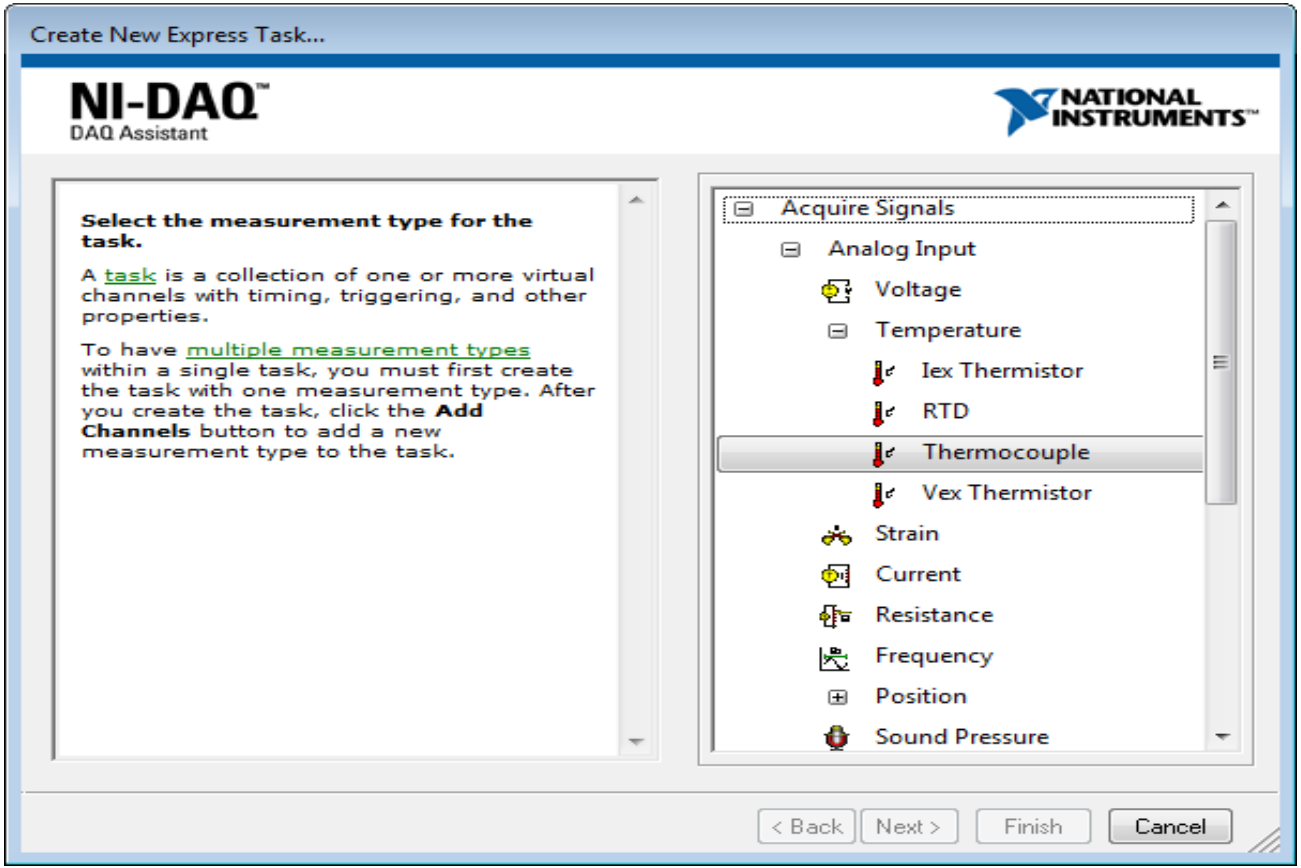



For basic DAQ we use the **DAQ Assistant**

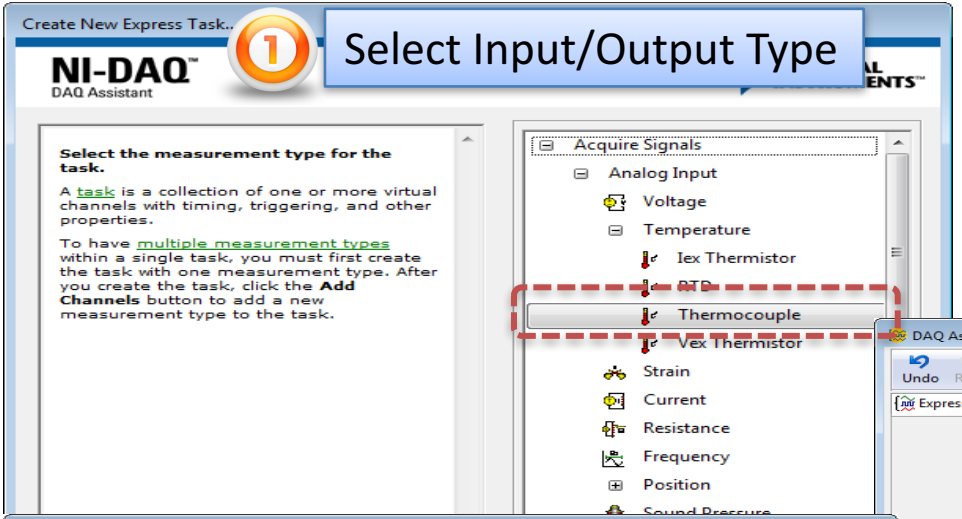
# LabVIEW DAQ Assistant

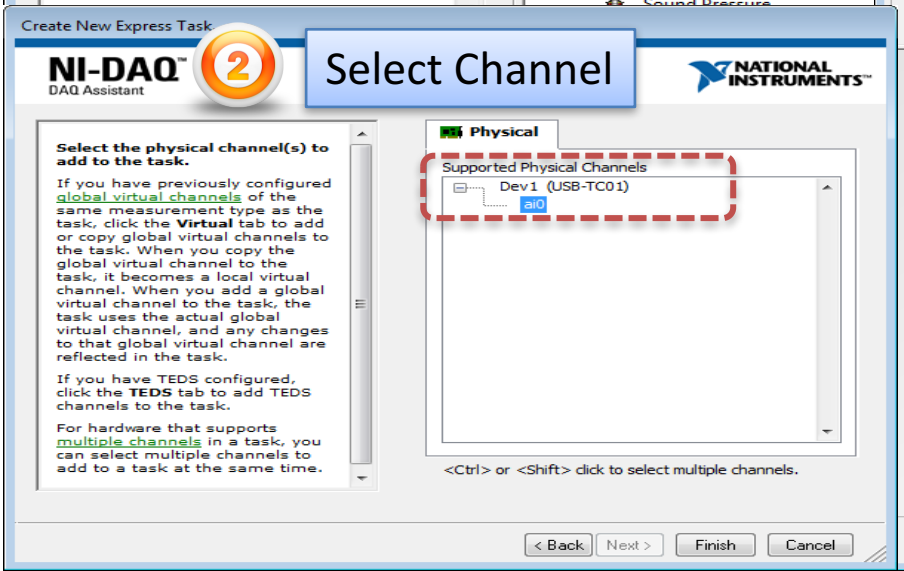


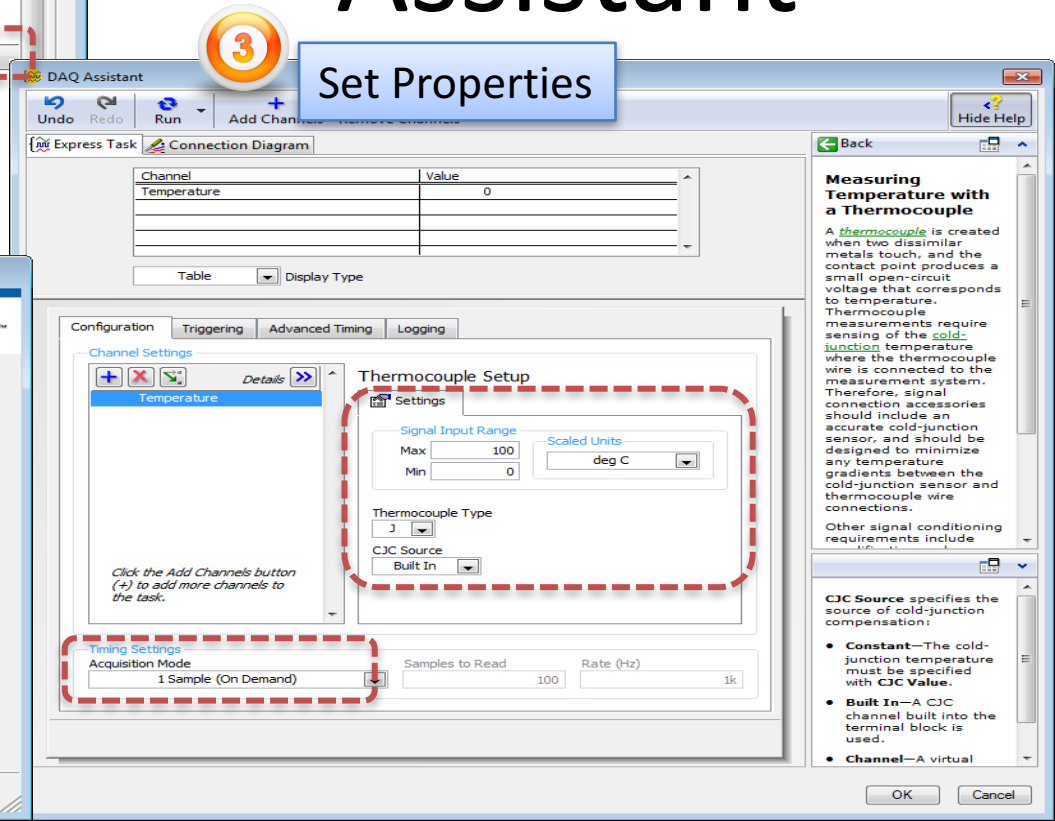

When you place the **DAQ Assistant** on the Block Diagram, a Wizard automatically pops up where you configure what you want to do, i.e., if you want to Read or Write Data, Analog or Digital signals, which channel you want to use, etc.



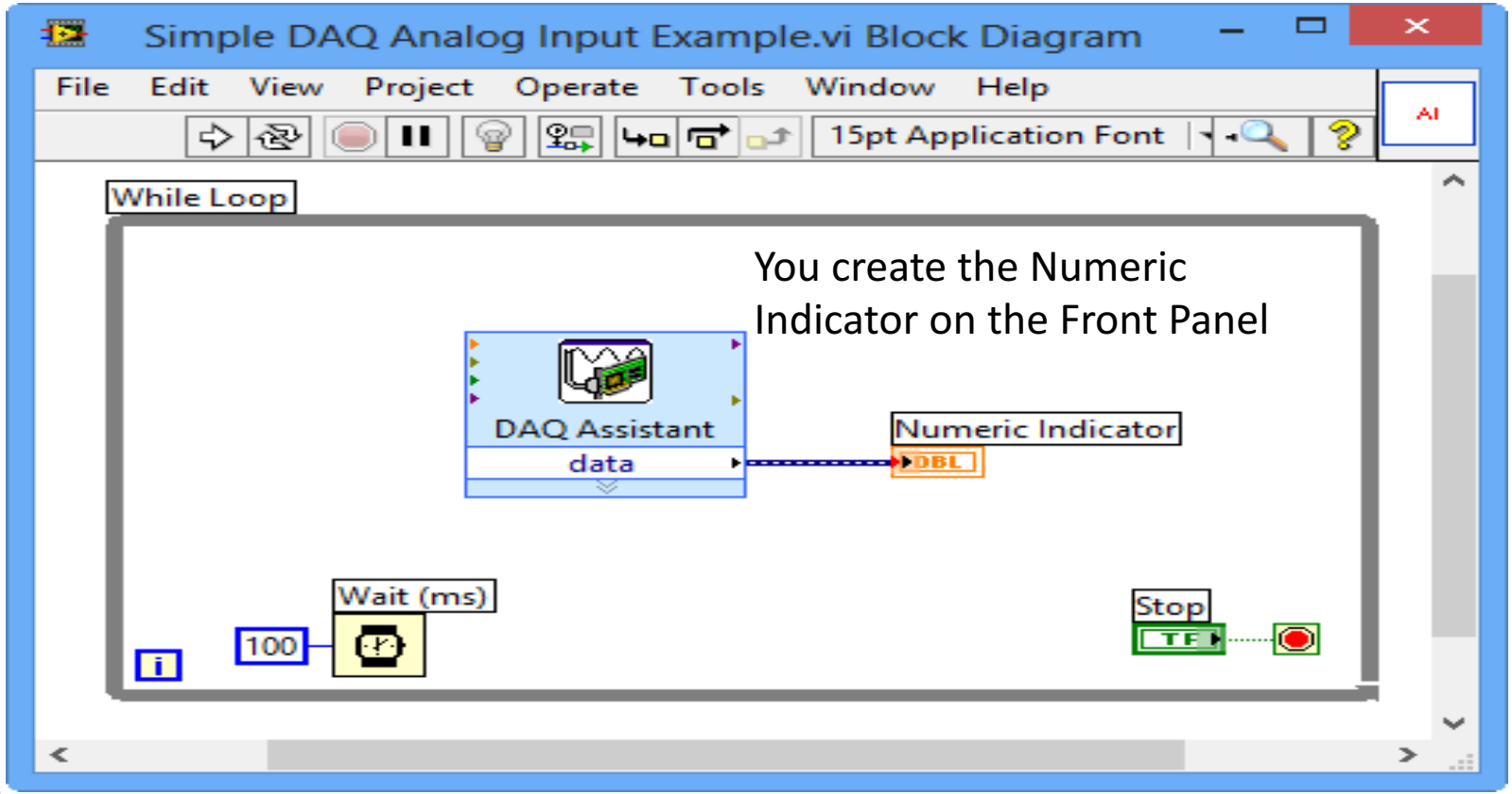
# LabVIEW DAQ Assistant

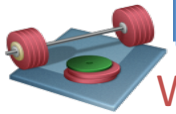


# Read Data from TC-01 Device



We will Create this Example and Run the Program

NATIONAL INSTRUMENTS LabVIEW

# Plotting Data from the DAQ Device

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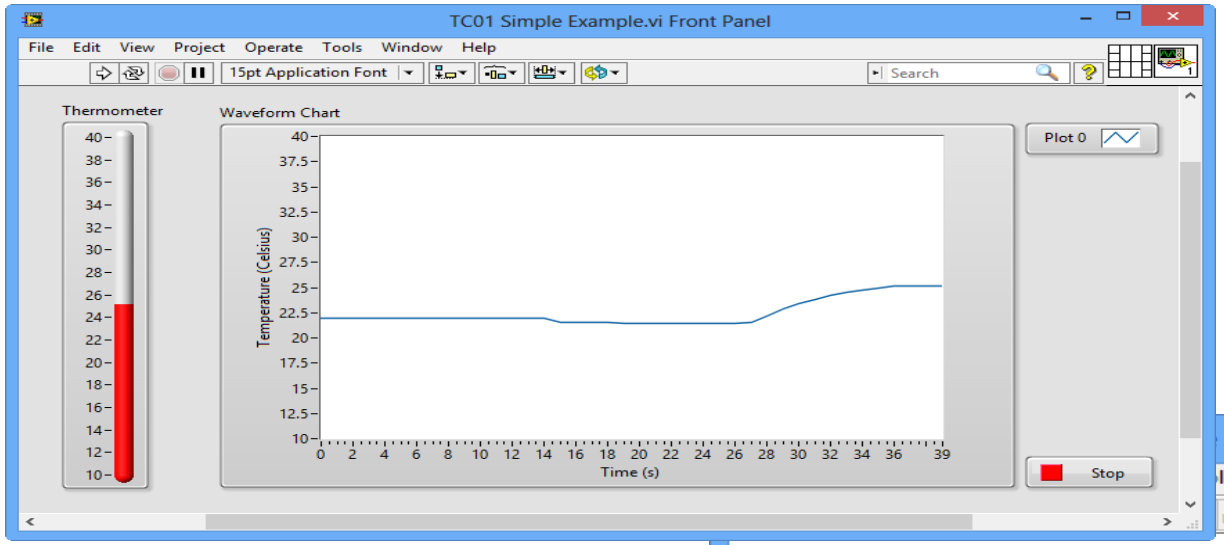
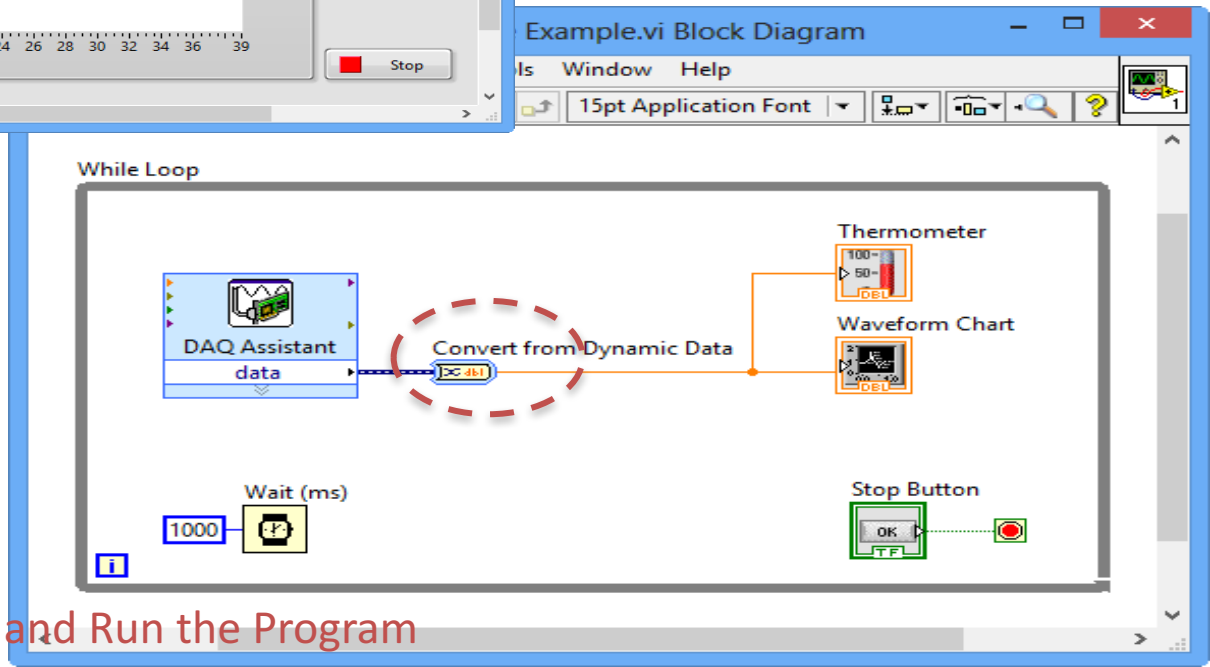
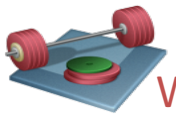
# Plotting Temperature Data

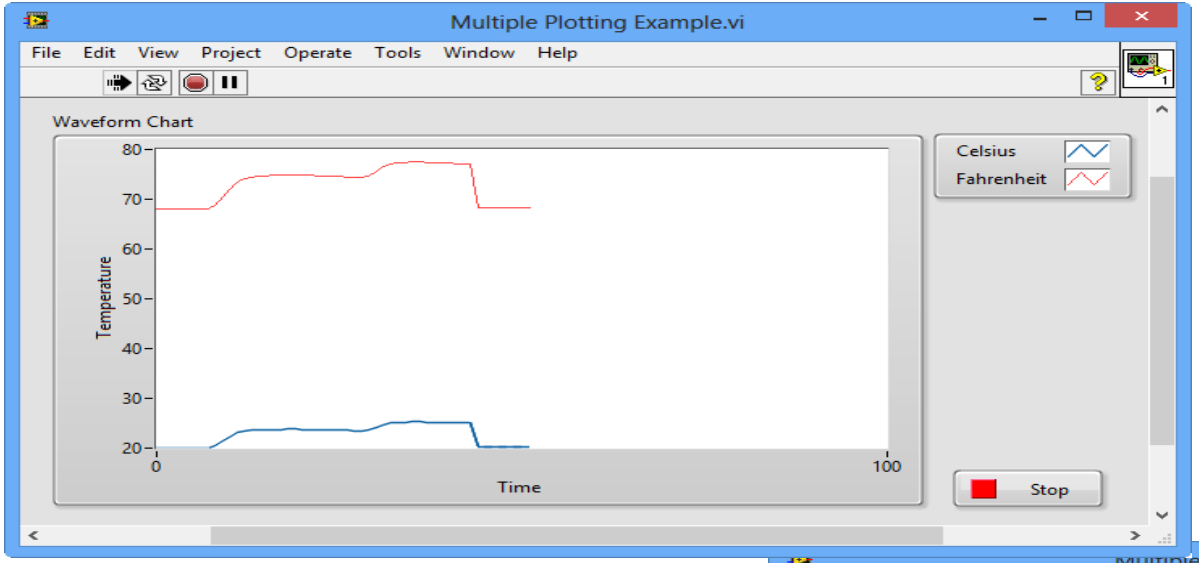


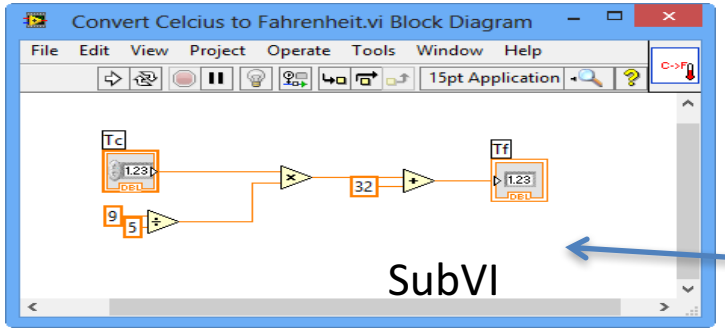



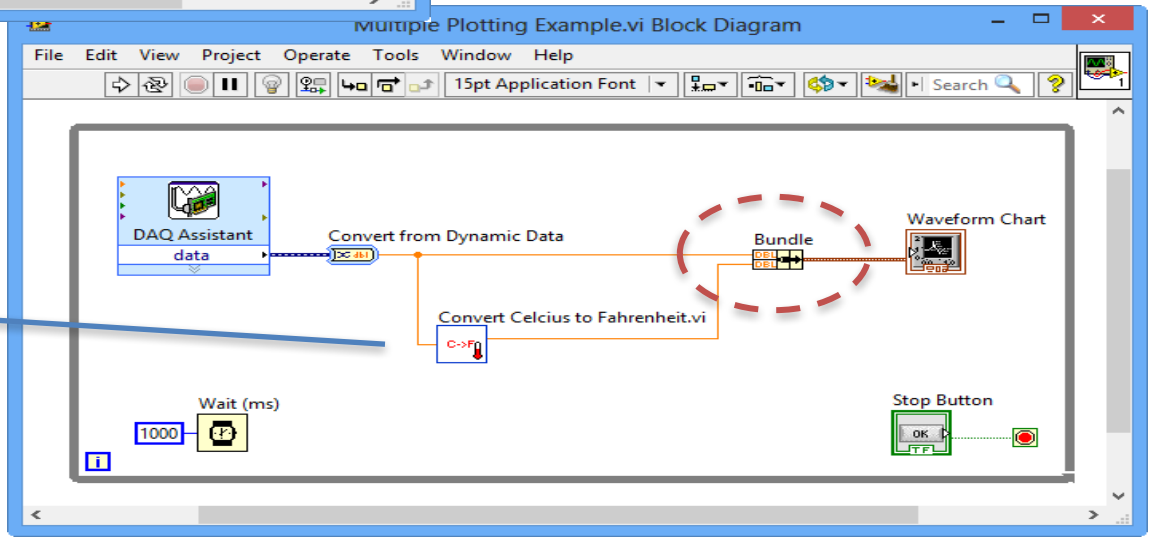



We will Create this Example and Run the Program

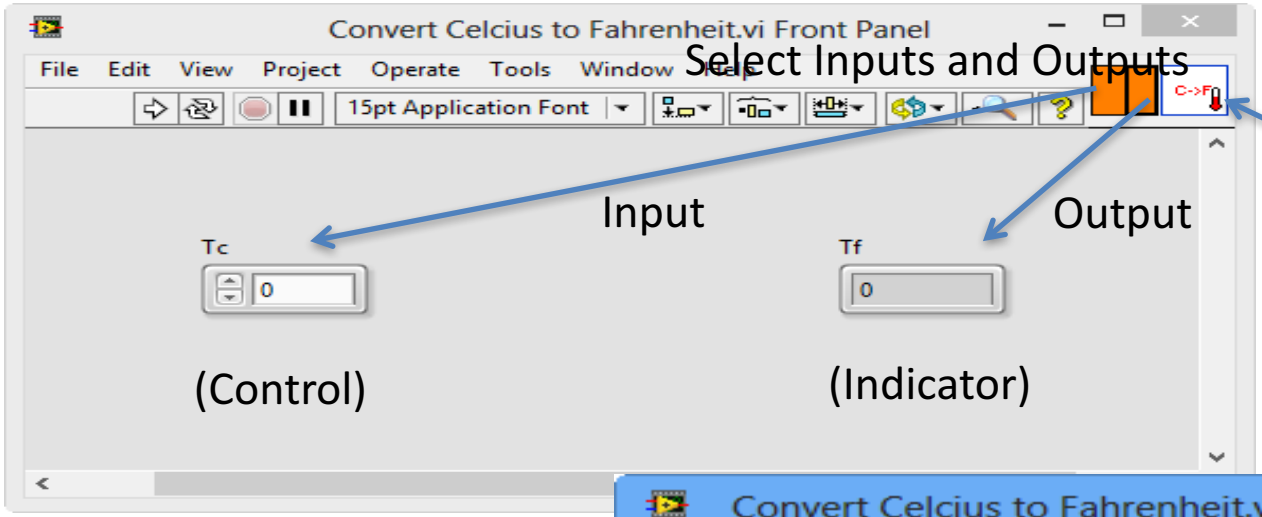
# Multiple Plotting and using SubVIs



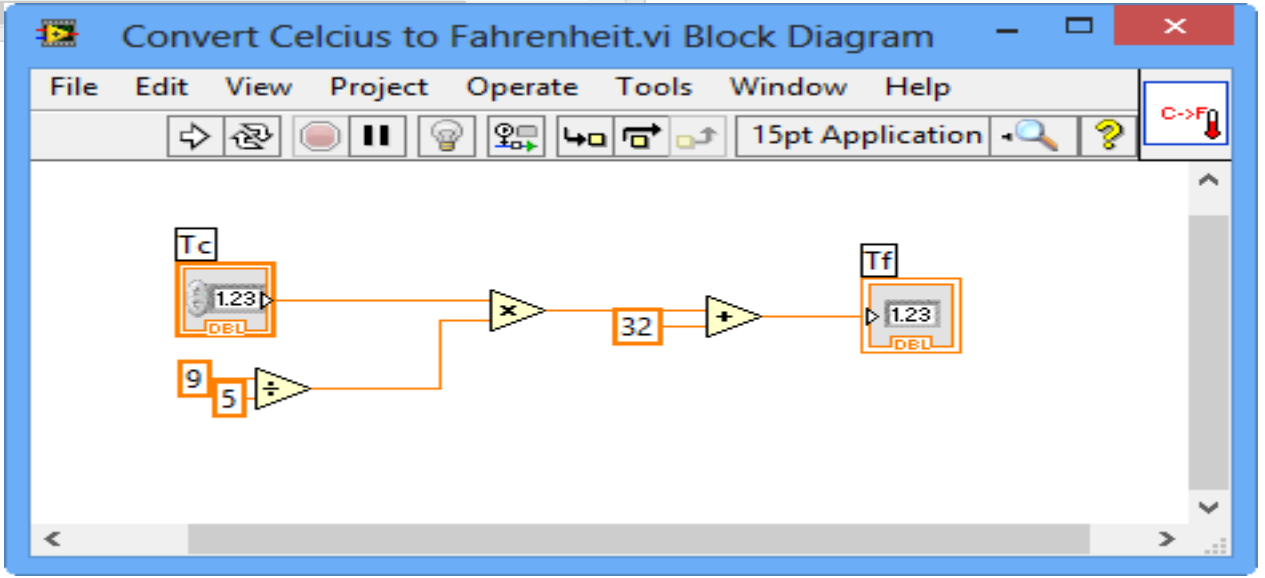
# SubVI




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

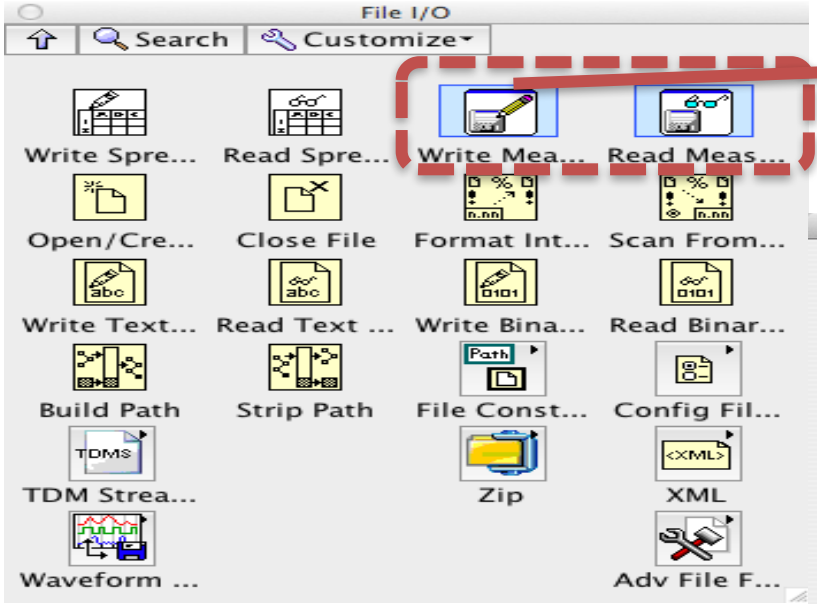
$$T_F = \frac{9}{5} T_C + 32$$




# Datalogging to File

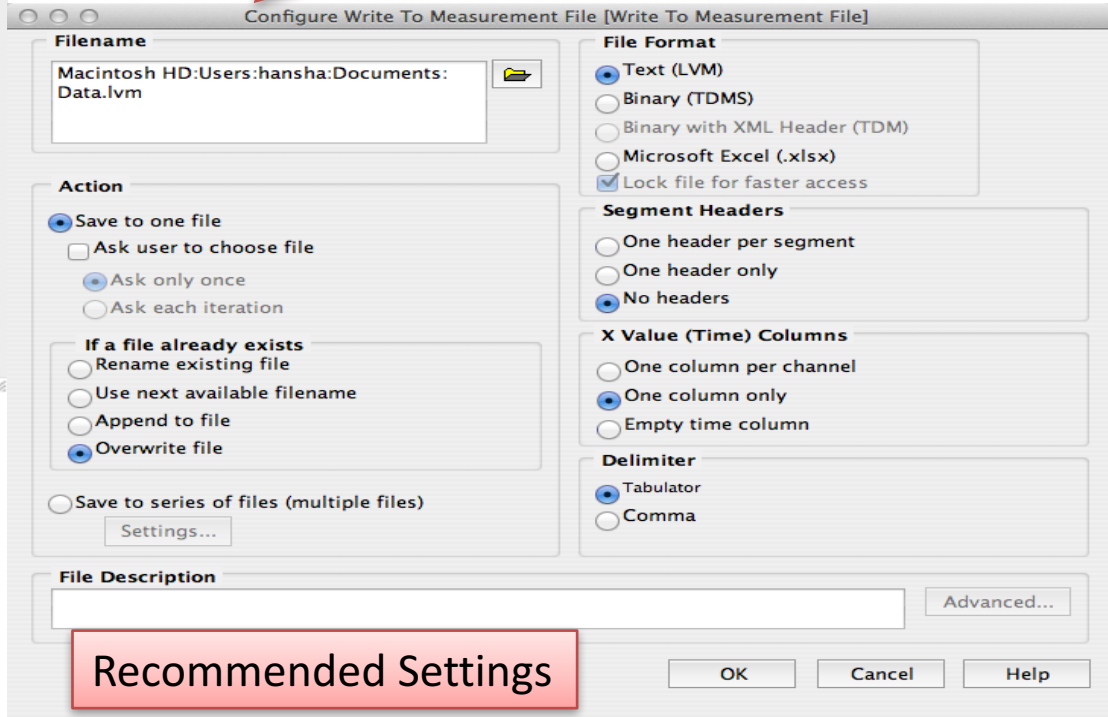
Hans-Petter Halvorsen, M.Sc.

# Save Data to File (Datalogging)

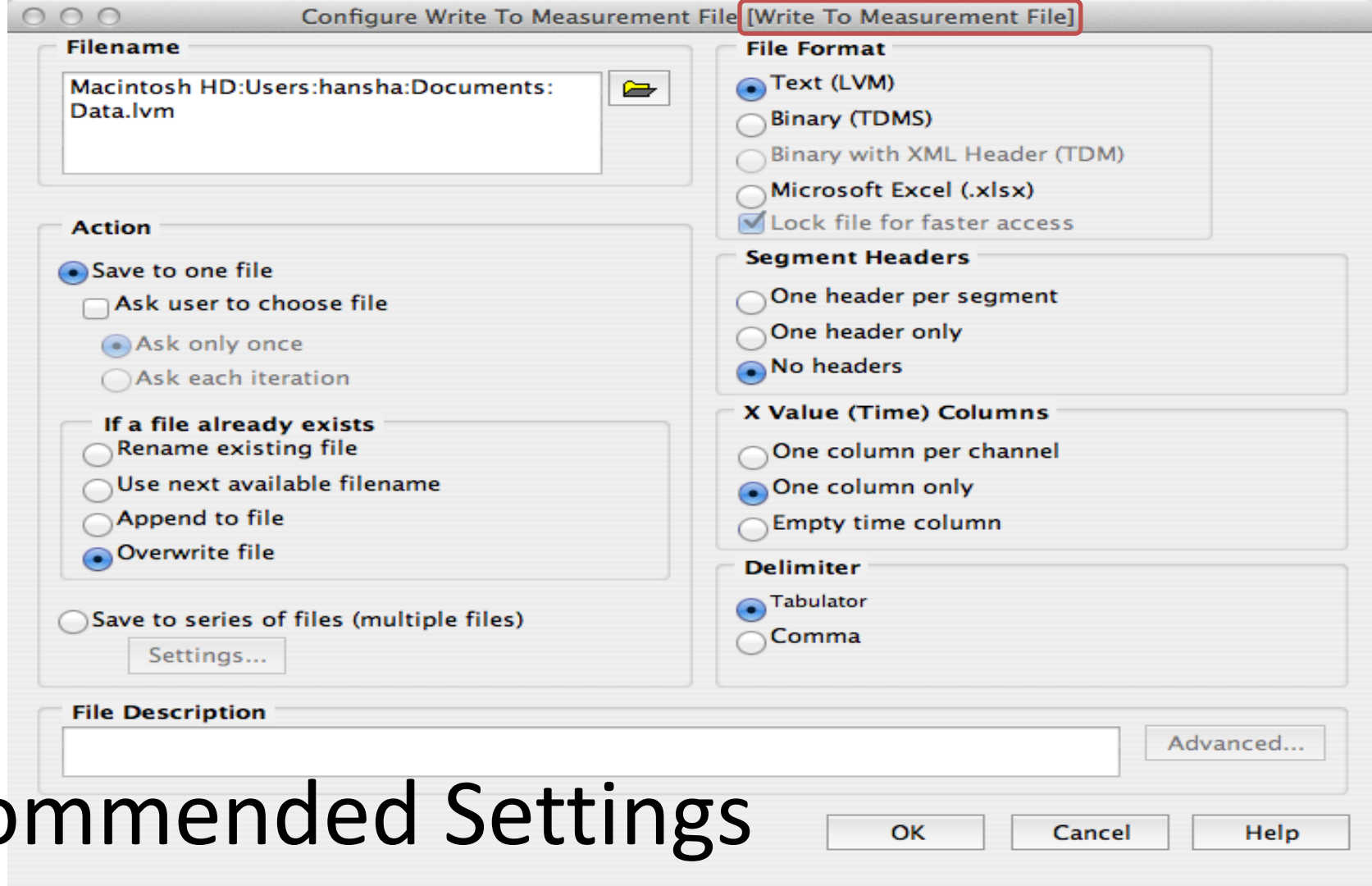




Right-click-Properties

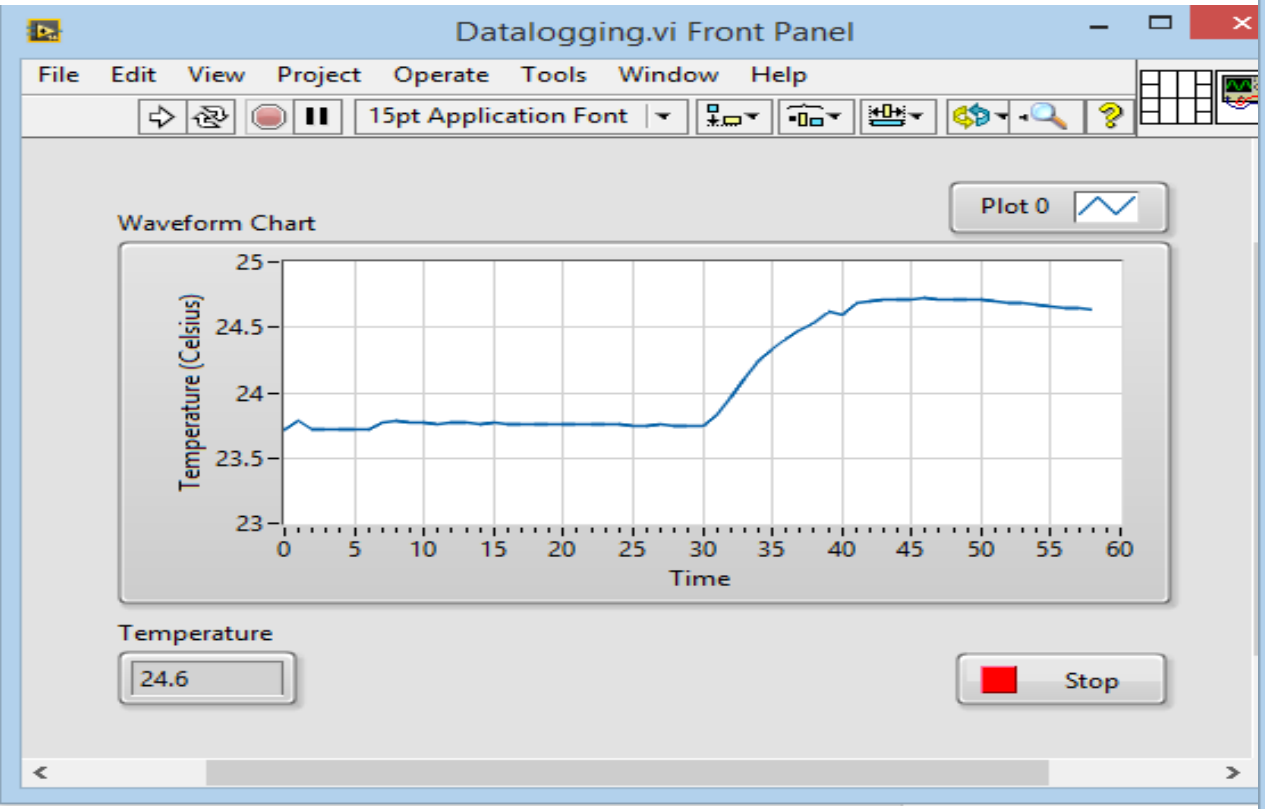


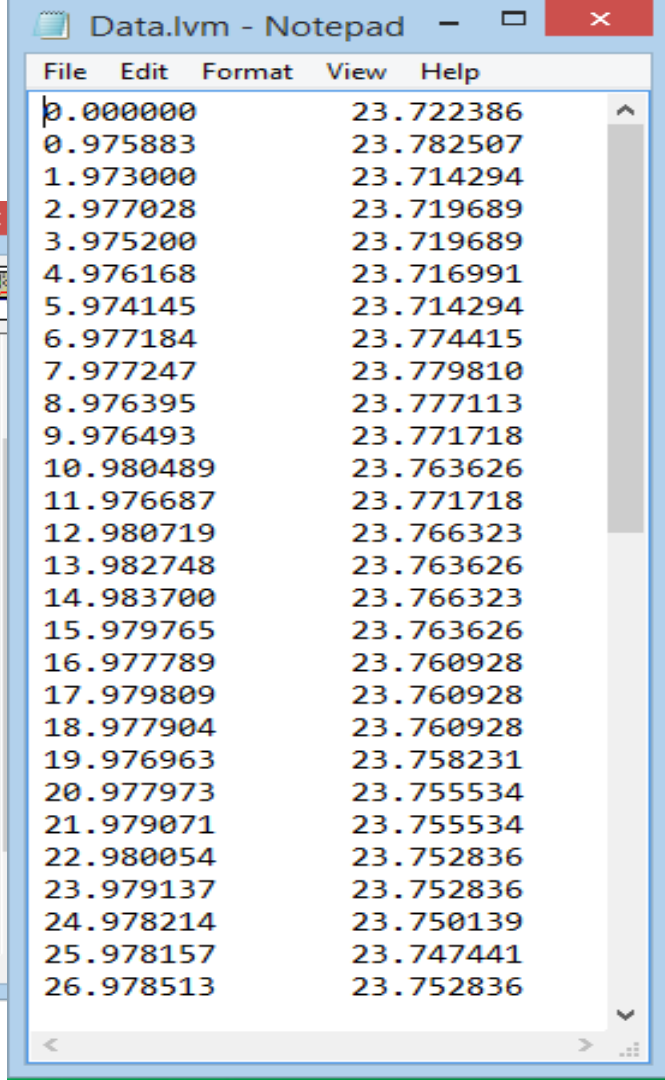

Recommended Settings



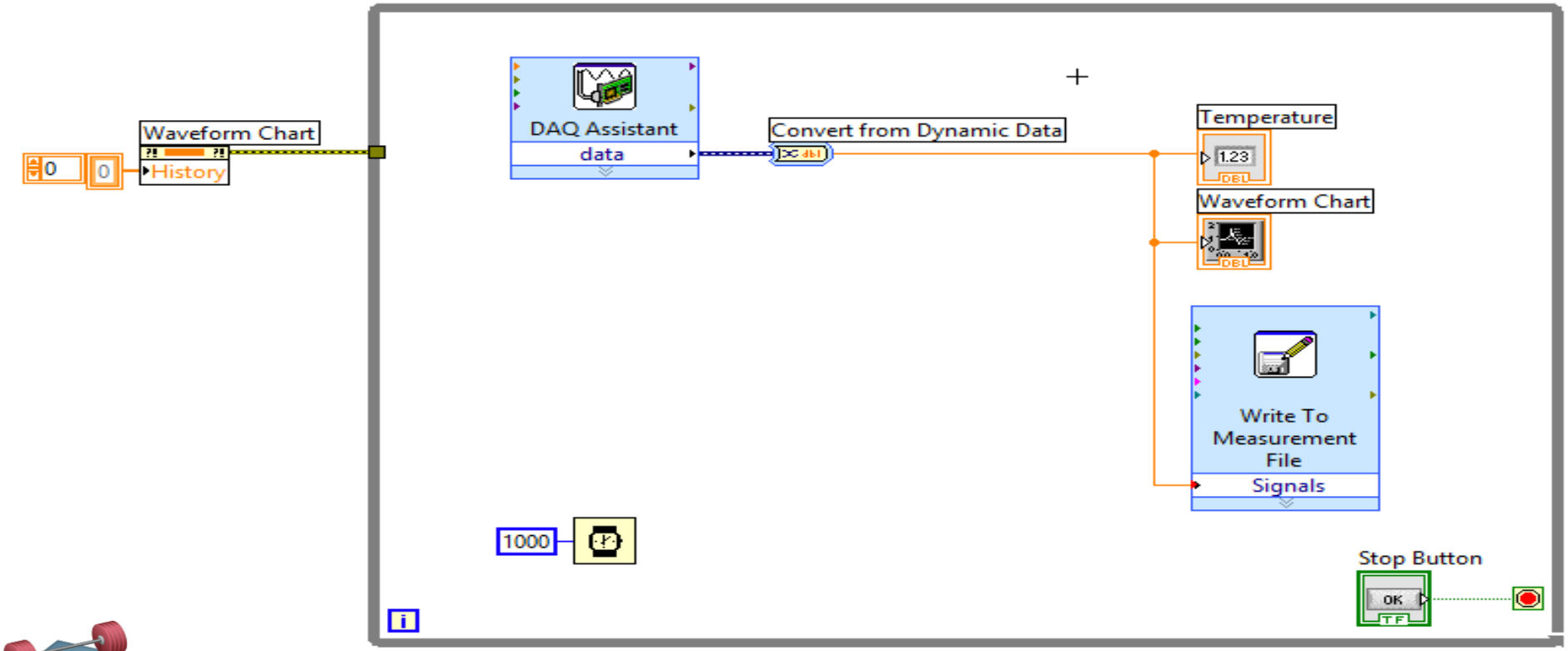

# Recommended Settings

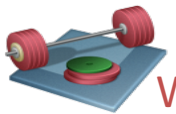
# Datalogging Example



# Datalogging Example – Block Diagram



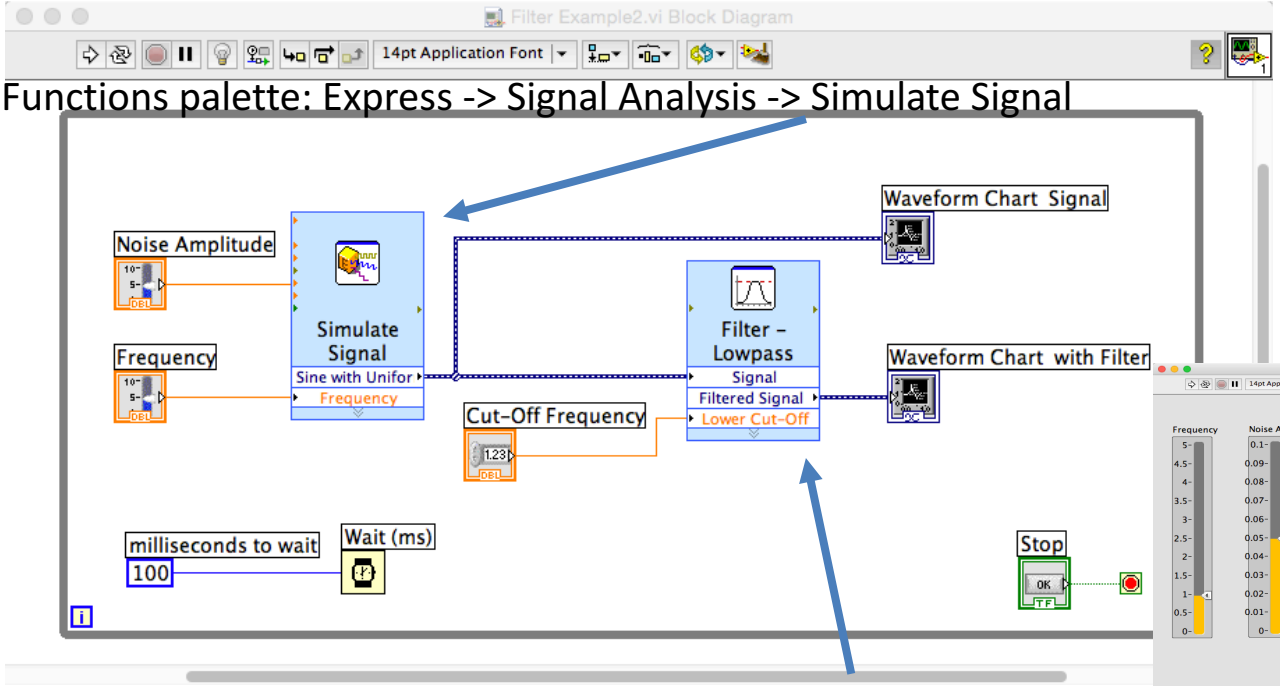



We will Create this Example and Run the Program

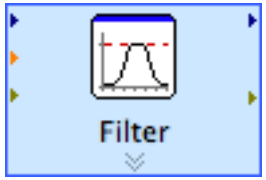

# Measurement Filter

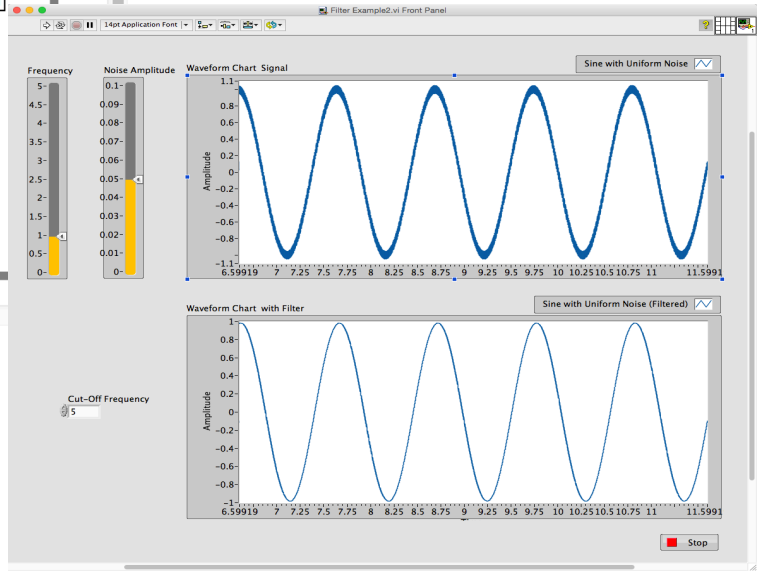
Hans-Petter Halvorsen, M.Sc.

# Using a Lowpass Filter to reduce Noise

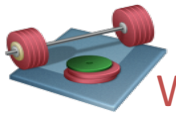



Functions palette: Express -> Signal Analysis -> Simulate Signal




Functions palette: Express -> Signal Analysis -> Filter



We will Create this Example and Run the Program

# Properties

Configure Simulate Signal [Simulate Signal]

**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

Run as fast as possible

Number of samples: 2000

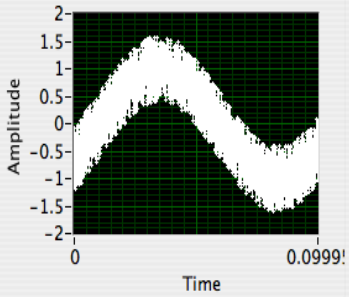
Automatic

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

Configure Filter [Filter - Lowpass]

**Filtering Type**

Lowpass

**Filter Specifications**

Cutoff Frequency (Hz): 1500

High cutoff frequency (Hz): 400

Finite impulse response (FIR) filter

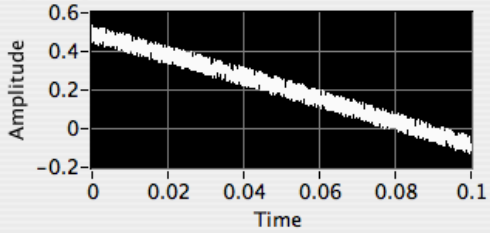
Taps: 29

Infinite impulse response (IIR) filter

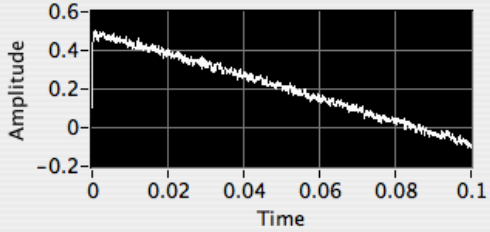
Topology: Butterworth

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!


# LabVIEW Training

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

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