Practical #01

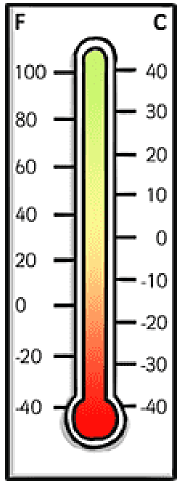
Measuring a biological property

Aims:

- Understanding what is LabVIEW and why we need it.
- Taking measurement of a biological quantity (**Hands-on exercise**).

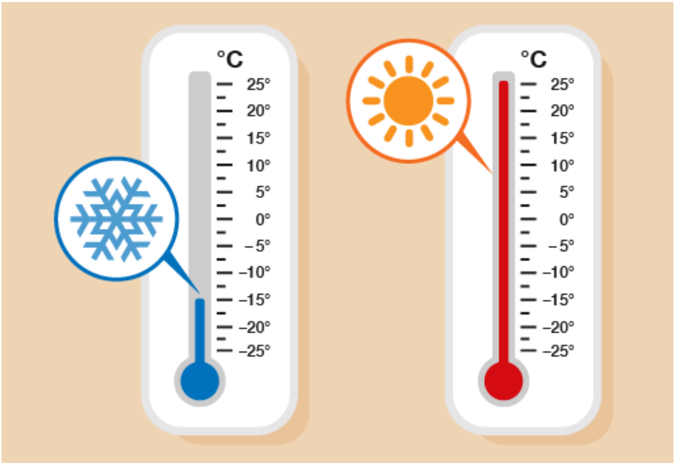
Operations in instrumentation:

Measure



Measure temperature

Analyze



Is it cold?

Control

Turn on the radiator

Relation between the three operations

Measure

Hardware

Physical world
(Measure temperature)

Analyze

Computation

Is it cold?

Control

Hardware

Physical world
(Turn on the radiator)

How these three operations are controlled?

Measure

Hardware

Analyze

Computation

Control

hardware

National Instruments

LabVIEW

LabVIEW or

Laboratory Virtual Instrumentation Engineering Workbench

An environment to ***measure*** and ***control*** physical world objects via ***computation***.

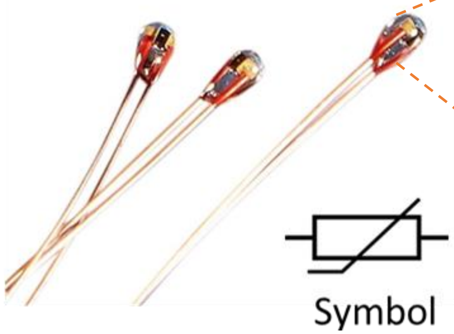
1. Extensive hardware integration
2. Graphical approach to programming (*Lecture 10*)

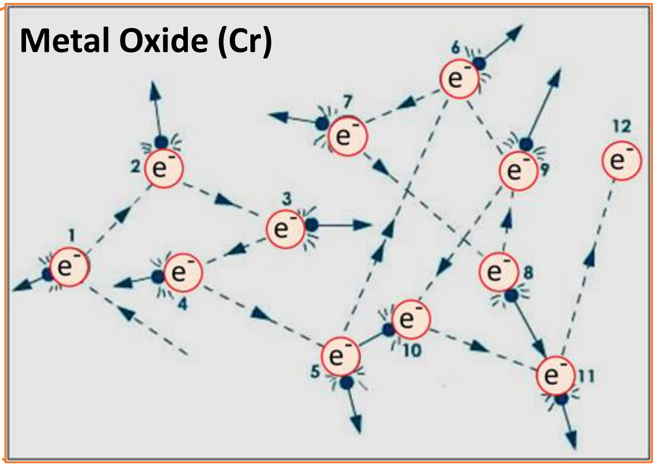
www.ni.com

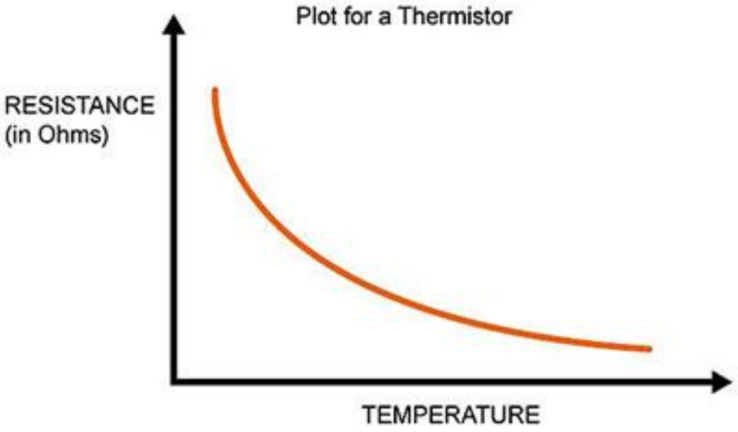
Example of Hardware integration with LabVIEW

Measuring temperature with a thermistor

To read temperature







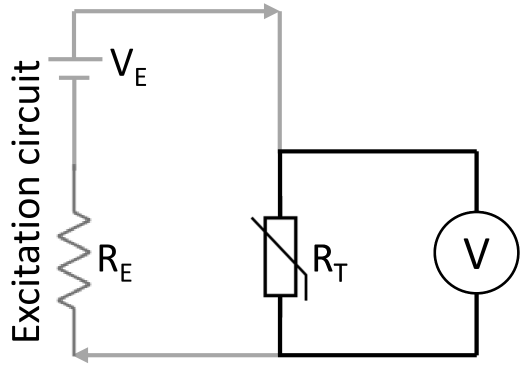
Thermistor

Higher conduction due to thermal agitation

Resistance change with temperature

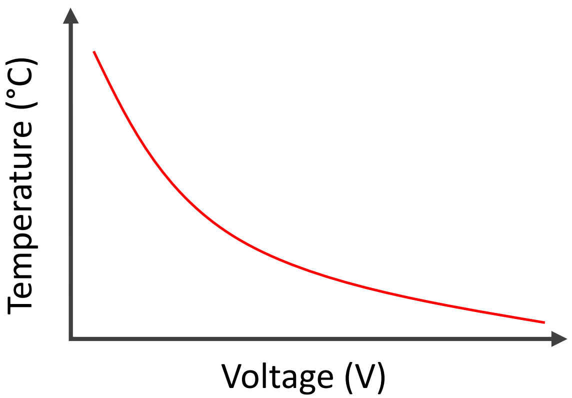
Example of Hardware integration with LabVIEW

Measuring temperature with a thermistor



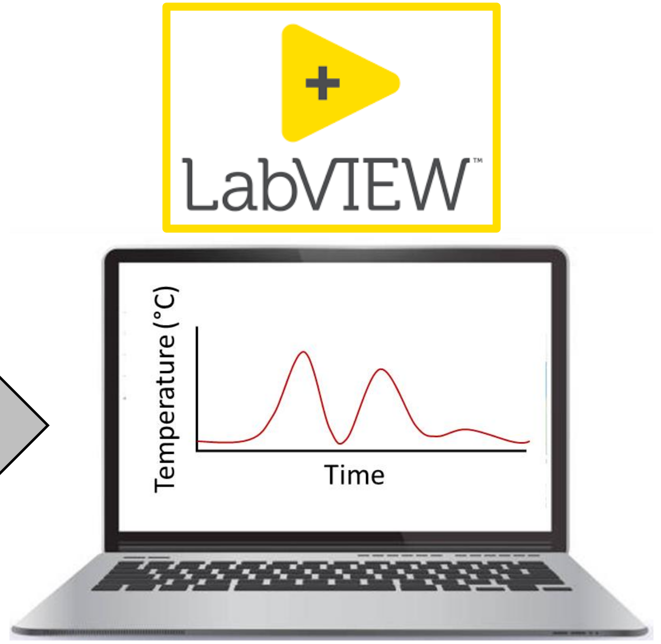
Circuit to read voltage difference (V) across the thermistor

Analog



Voltage (V) across the thermistor as temperature increases

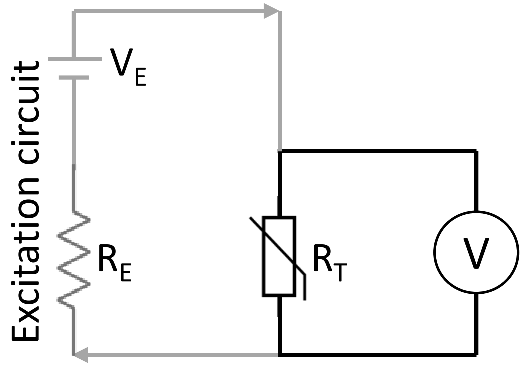
Digital



Voltage signals acquired in the computer for analysis

Example of Hardware integration with LabVIEW

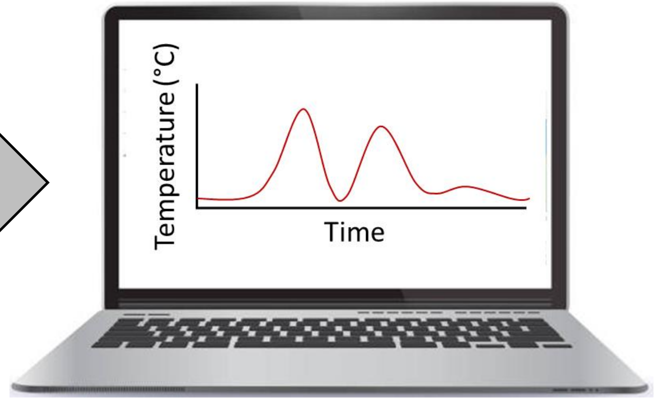
Converting analog signals to digital



Analog

Digital

LabVIEW



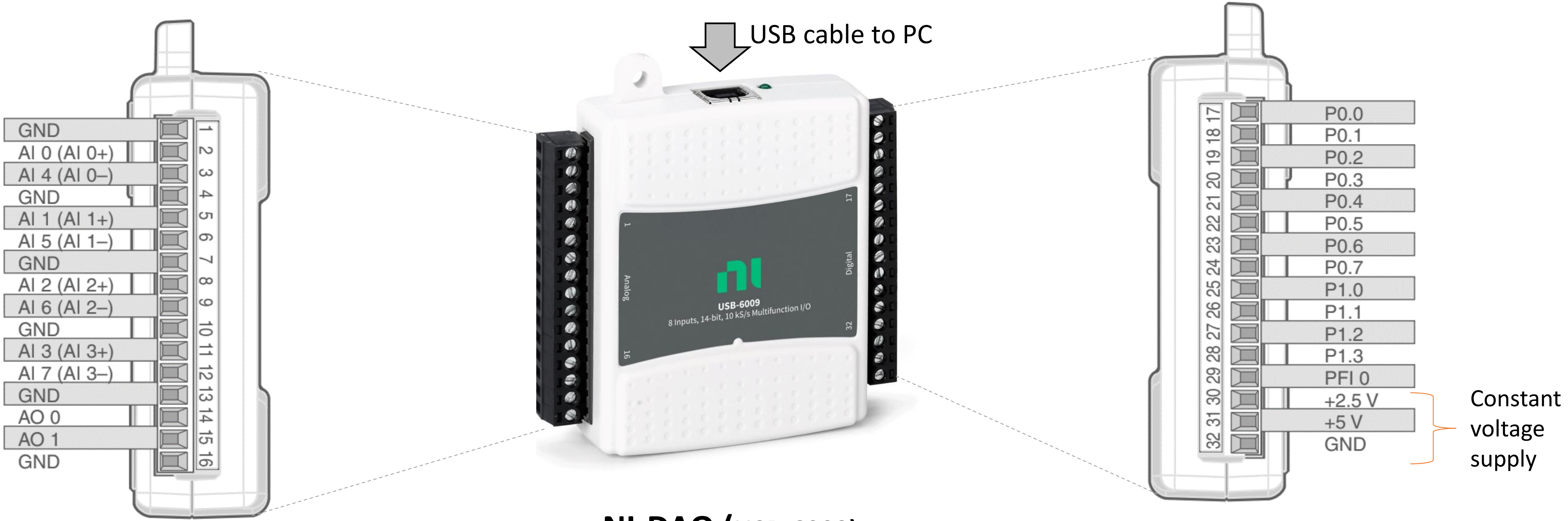
Circuit to read voltage difference (V) across the thermistor

NI-DAQ (USB-6009)

Voltage signals acquired in the computer for analysis

Example of Hardware integration with LabVIEW

NI DAQ (Data Acquisition system)



NI-DAQ (USB-6009)

Analog input (AI) and output (AO) channels [GND: Ground]

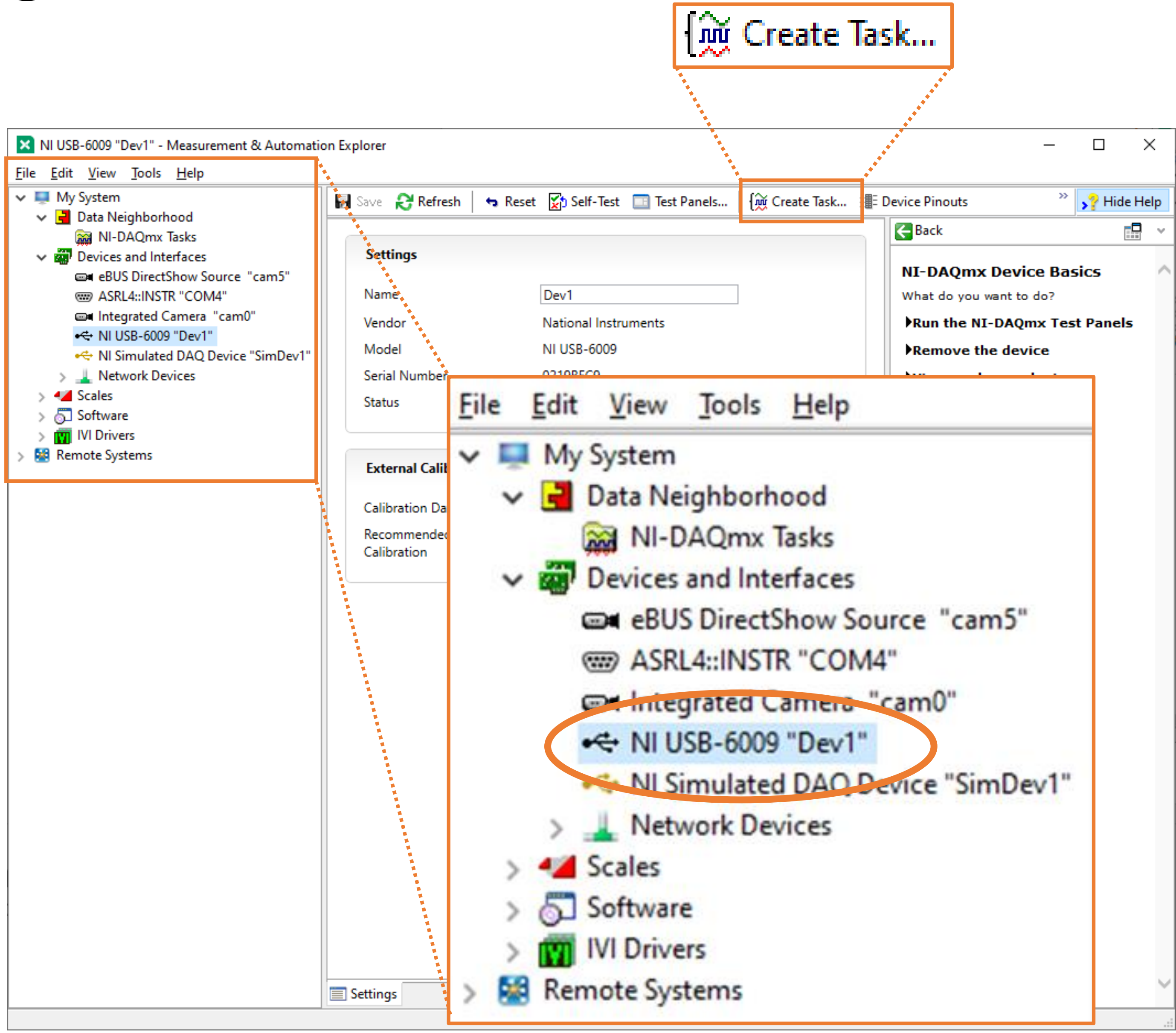
A device to establish communication between physical sensors (temperature, pressure, force, torque, stress, photons etc.) and the computer software.

Digital inputs / output channels

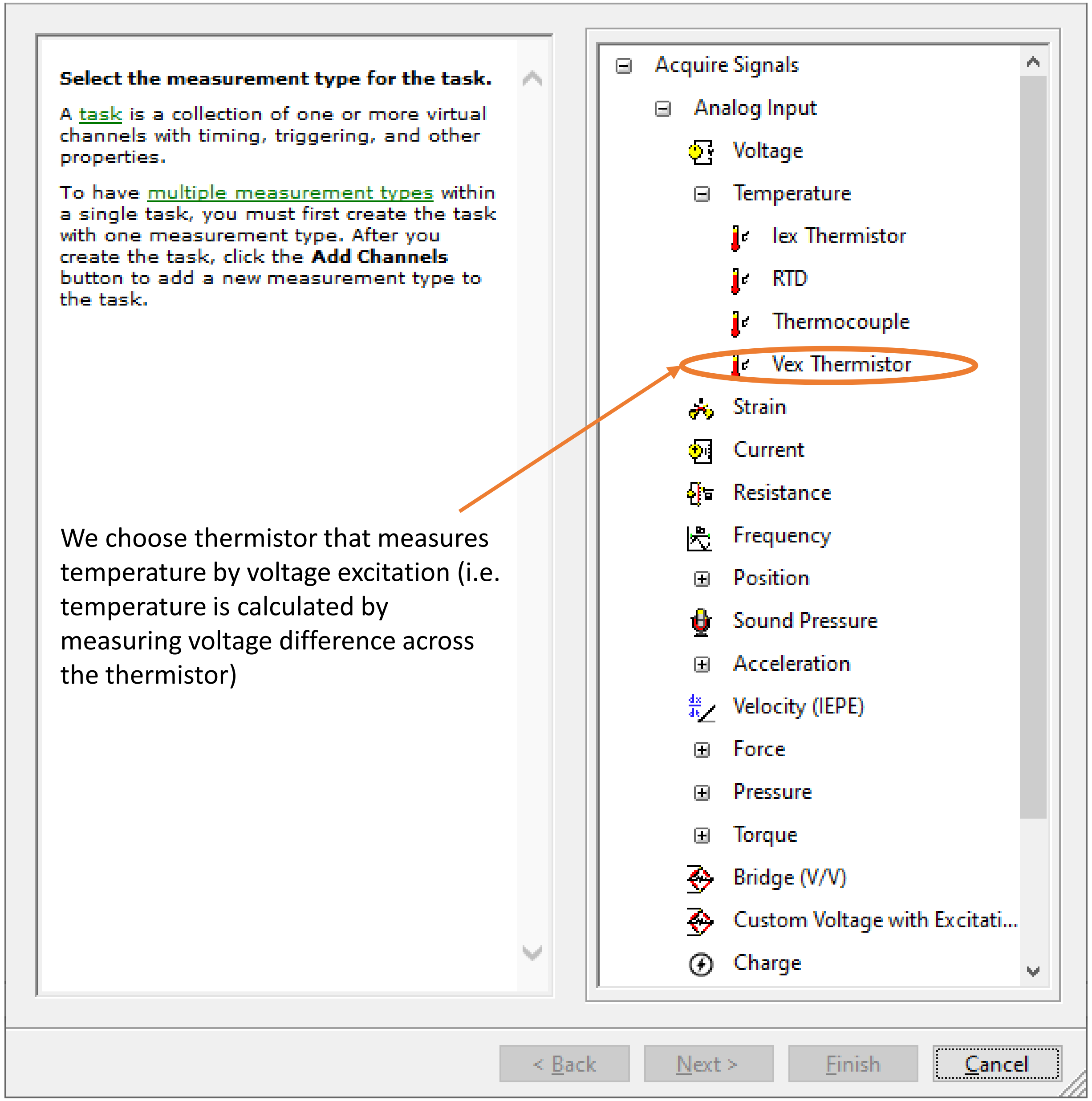
Connecting NI-DAQ to PC

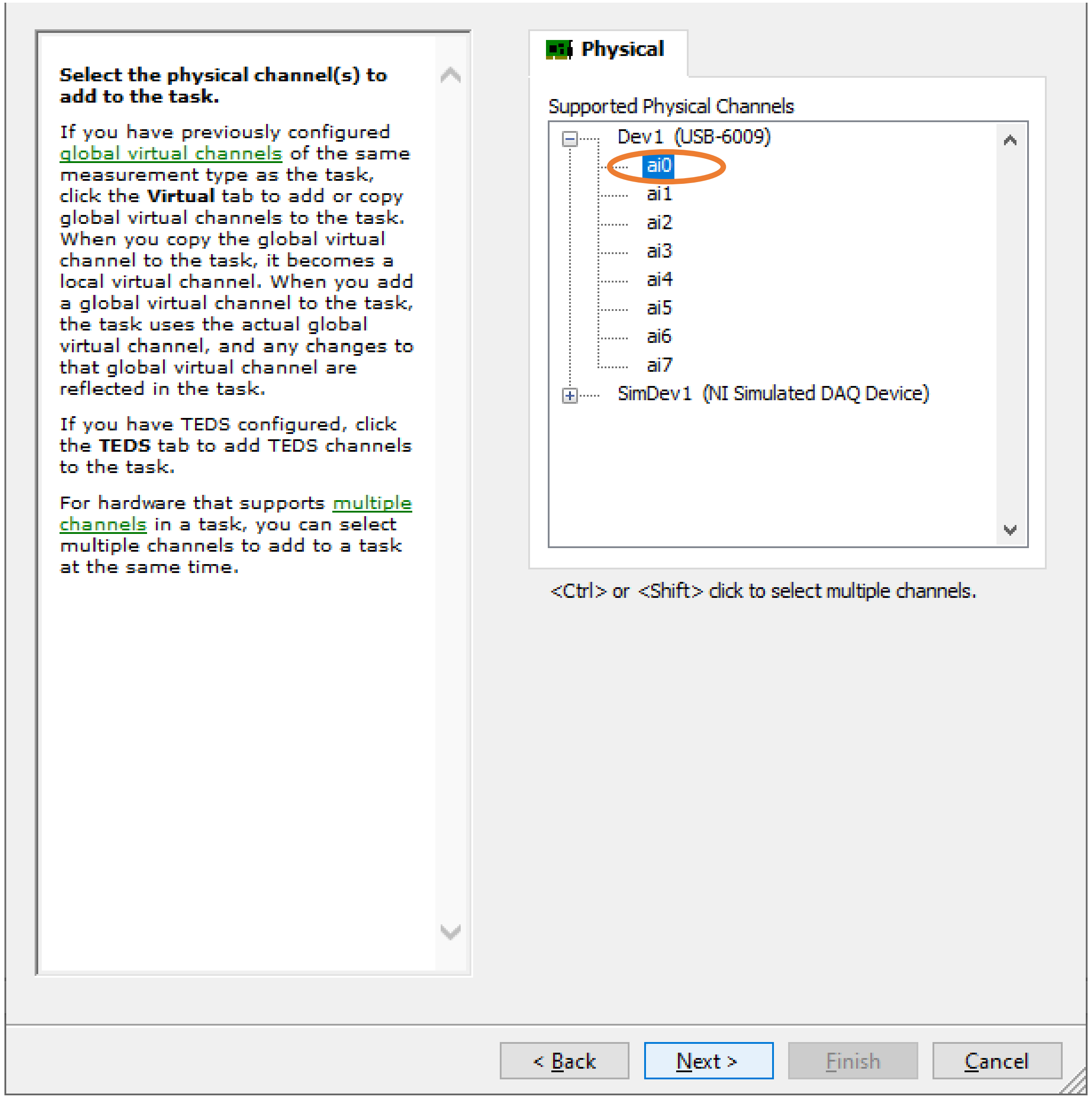
NI MAX
App

Connect the NI-DAQ to PC via USB cable and open **Measurement & Automation Explorer (NI MAX)**

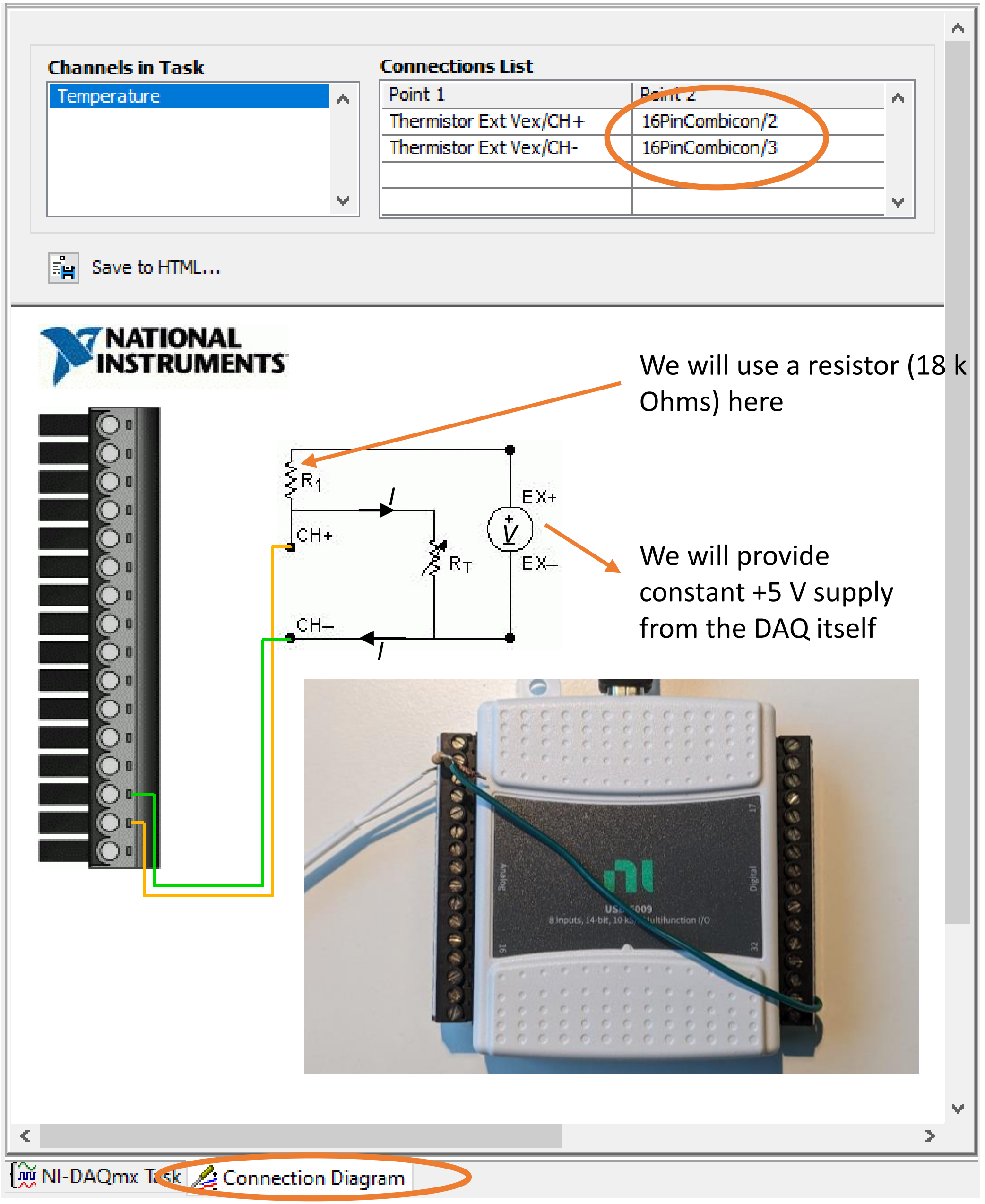


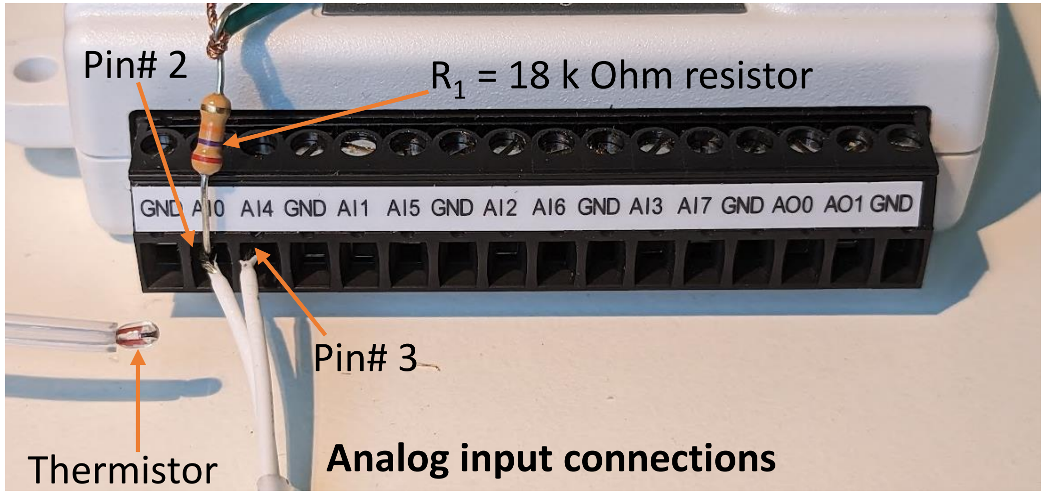
Configuring NI MAX

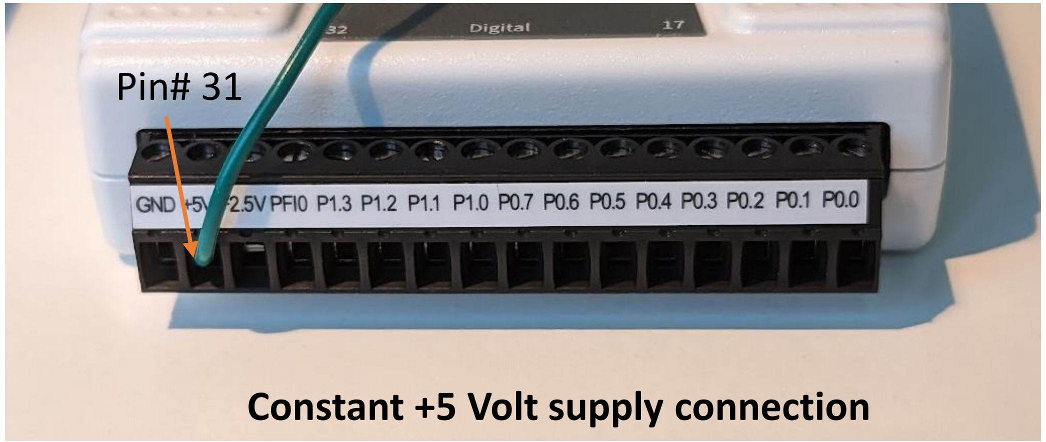




Connecting thermistor to NI-DAQ





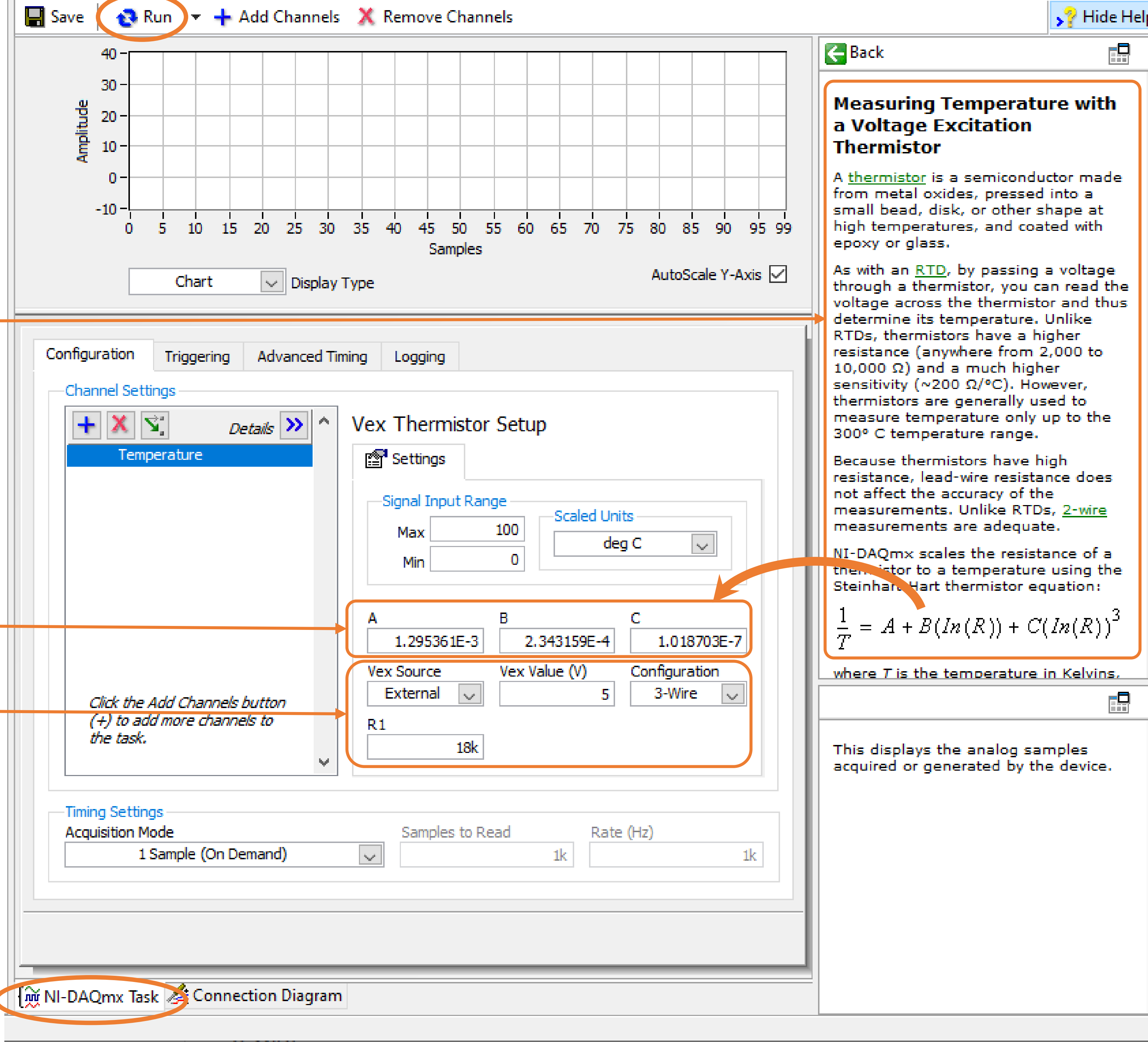


Measuring temperature with NI MAX

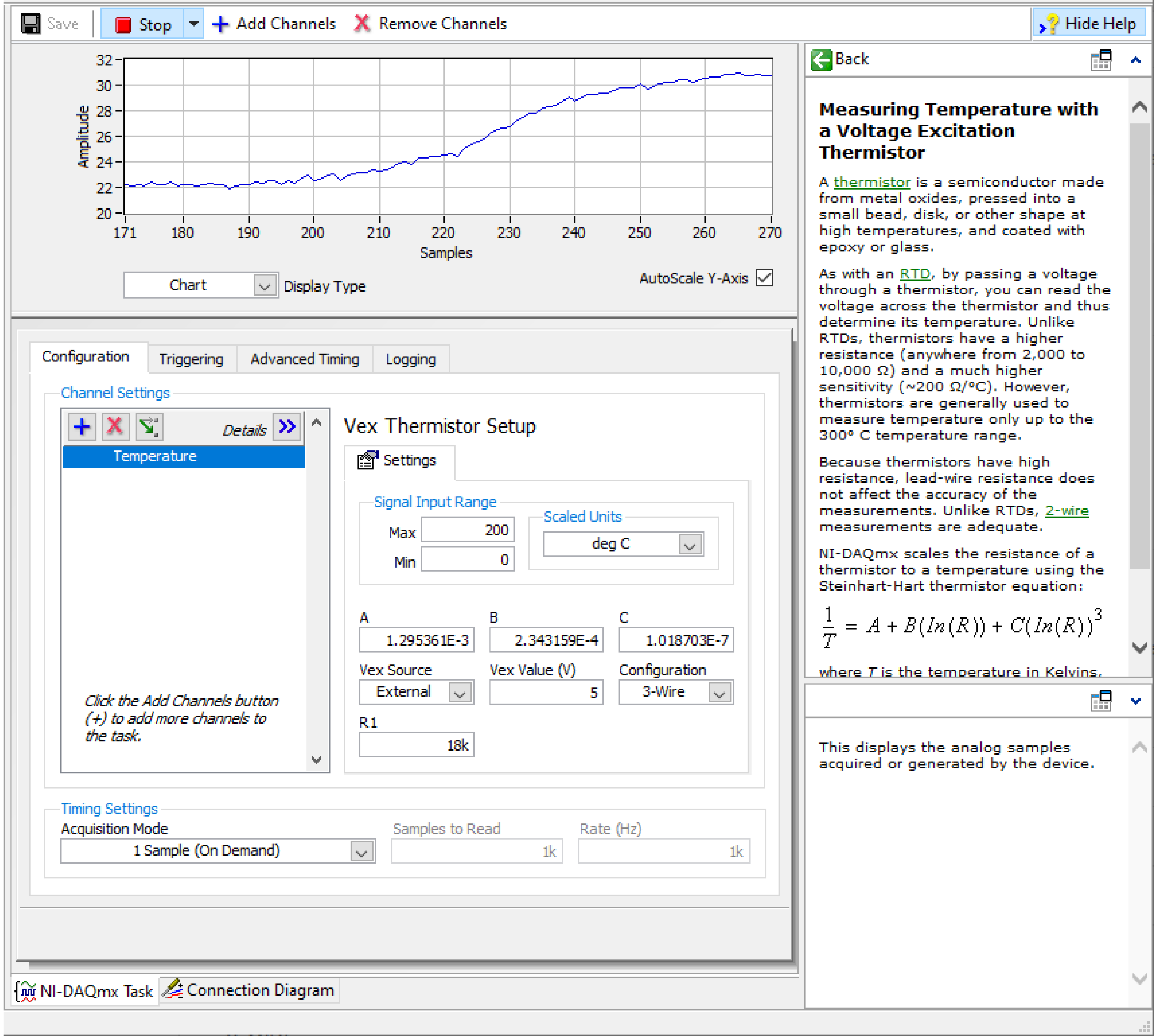
Thermistor theory

Internally defined parameters by NI DAQ on the basis of thermistor equation

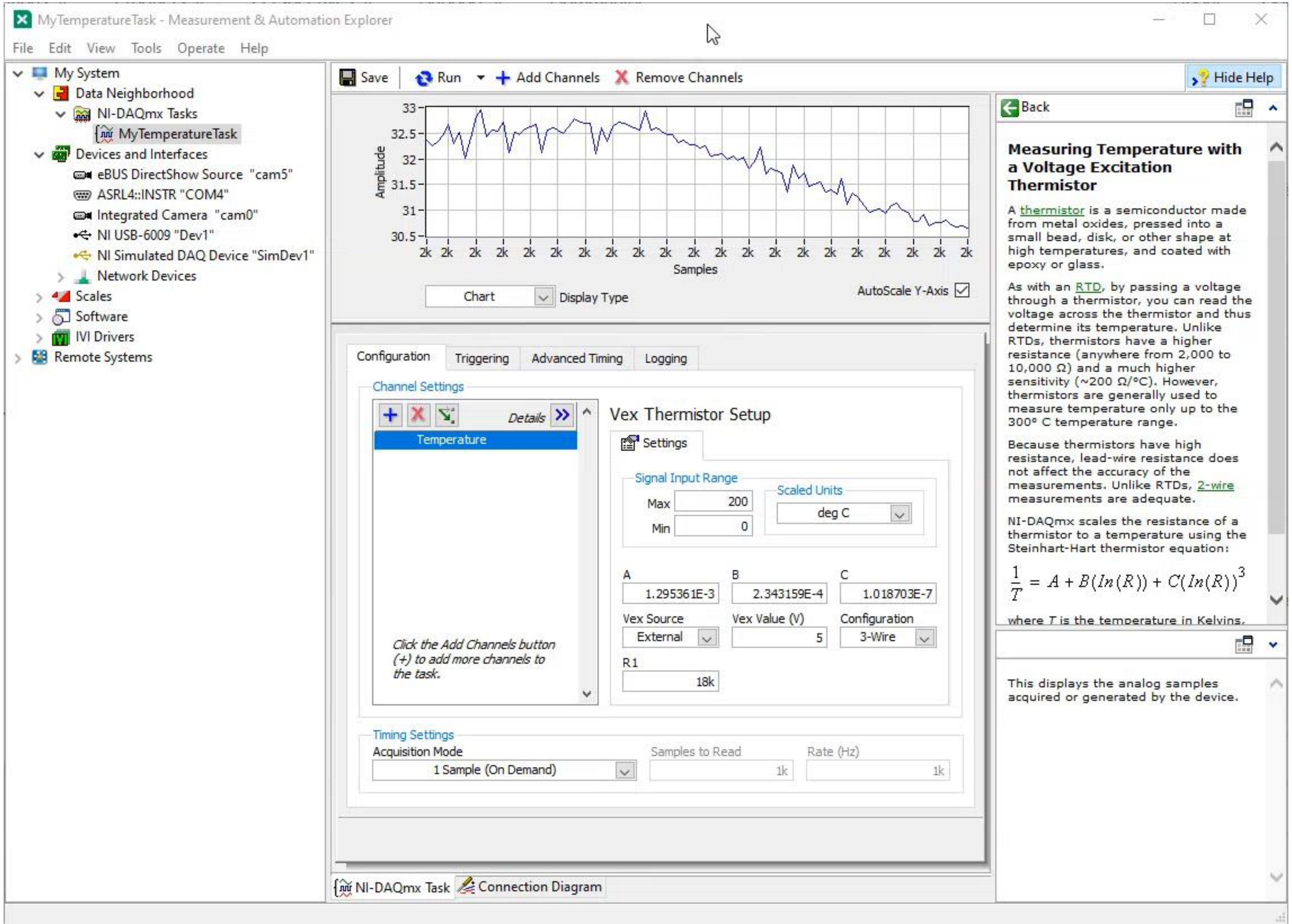
User defined parameters as used in the external circuit



Measuring temperature with NI MAX



Video: Measuring temperature with NI MAX



Further signal processing for noise reduction and data analysis can be done by ***writing a LabVIEW code*** *that we will learn in upcoming lectures*

Summary:

<u>Property measured</u>

- Body temperature

<u>Tools used</u>

- Thermistor (An electrical component whose resistance is dependent on temperature)
- NI-DAQ USB 6009 (A hardware device to acquire analog voltage singles from the thermistor and convert them to digital signals)
- NI-MAX (A software to read and show the digital signals from the NI-DAQ in real time)

<u>Alternative approaches</u>

- Similar to acquiring voltage difference across the thermistor to measure the temperature, the *voltage difference across a photosensor can be acquired to measure light intensity*. This instrumentation approach is widely used in biology to quantify various bio-assays, for e.g. qPCR systems, flow cytometers, plate readers, spectrophotometers, high-throughput screening platforms etc.

Hands on Exercise

Measuring temperature with NI-MAX using a thermistor