Toturial:
Software - Data Acquisition (DAQ)
MEC100x-Lectures 11

Energy, Power and Intelligent Control
School of Electronics, Electrical Engineering and Computer Science
Ashby Building
Queen's University Belfast

Aims

1. DAQ Software :
2. NI Device Monitor
   - Digital input test
   - Digital output test
   - Analog input test
   - Analog output test
3. MATLAB/SIMULINK and Hardware in Loop with DAQ
   - Digital input
   - Digital output

   } **AND and XOR gate in simulink**

   - Analog input
   - Analog output

   } **Closed-loop control and PID controller in Simulink**

DAQ SOFTWARE : INSTALLATION

1- First; Download DAQNavi-offline software from the Advantech website:

https://www.advantech.com/en/support/details/driver?id=1-1YXX1AO

2- Second; Install DAQNavi-offline software.

DAQ SOFTWARE : NI DEVICE MONITOR/ TEST

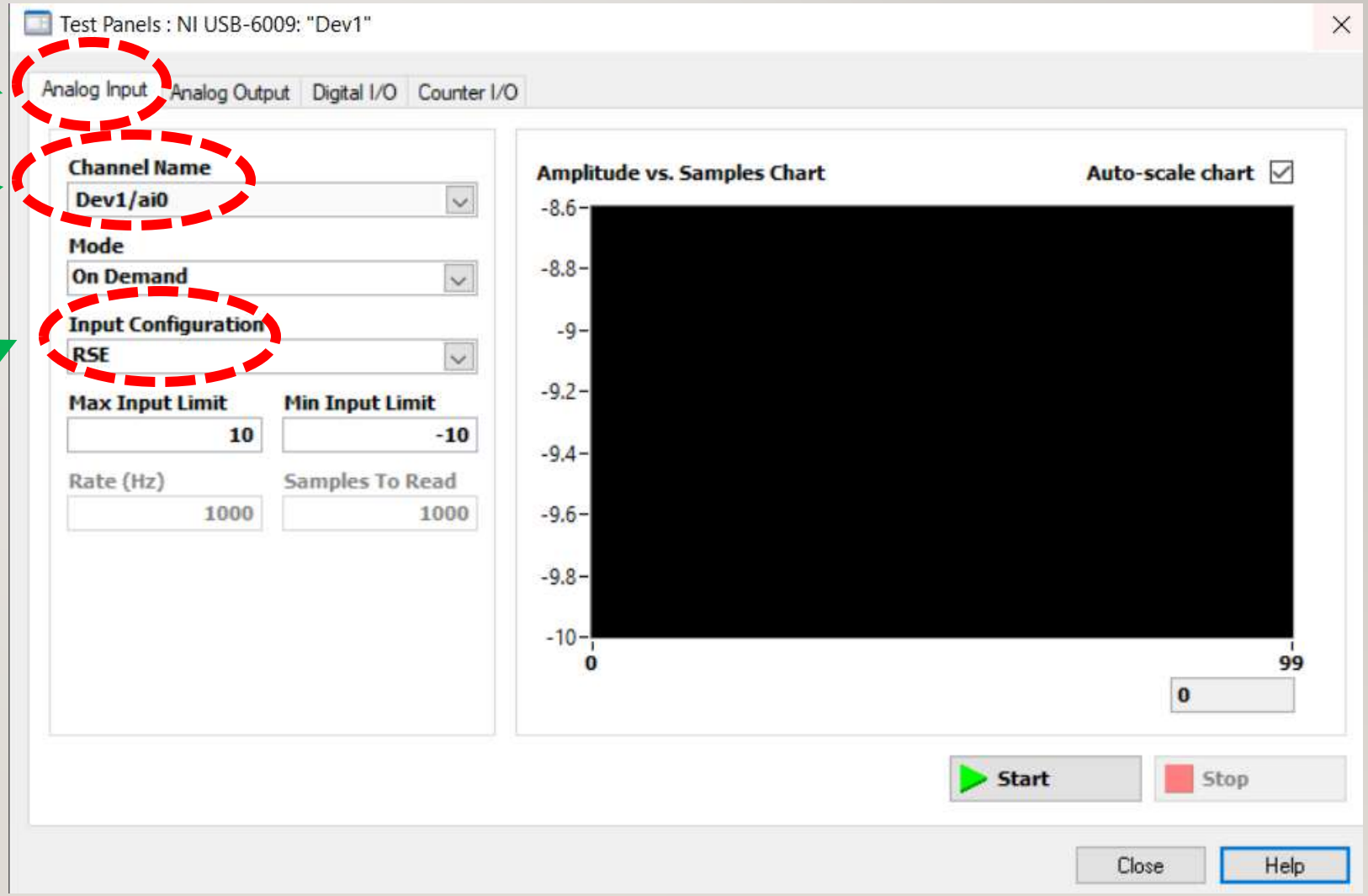
TEST NI USB 6009

ANALOG INPUT TAB:

Channel selection

Type of input:

- **Differential type**
- **Single ended type**

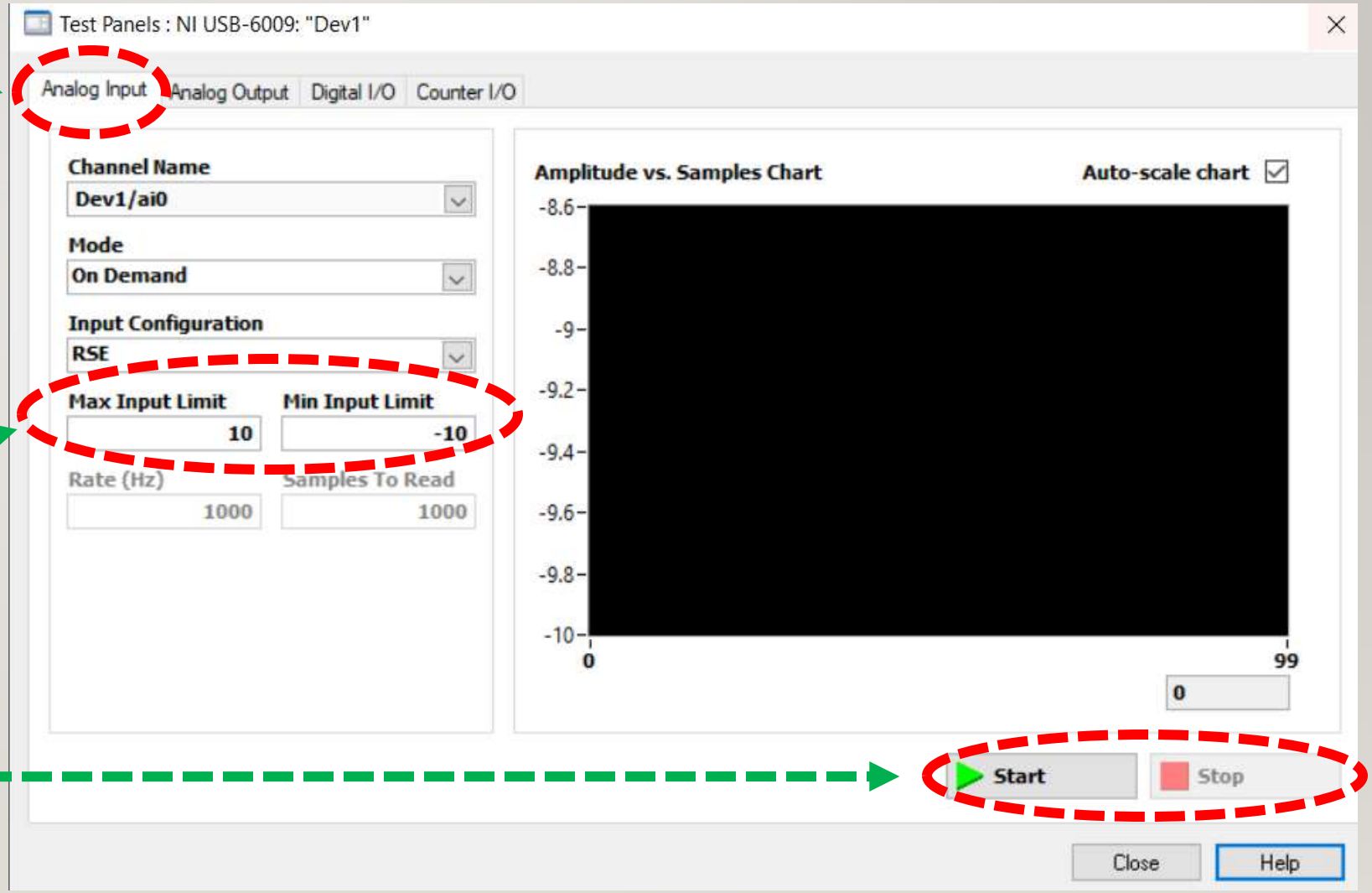


TEST NI USB 6009

ANALOG INPUT TAB:

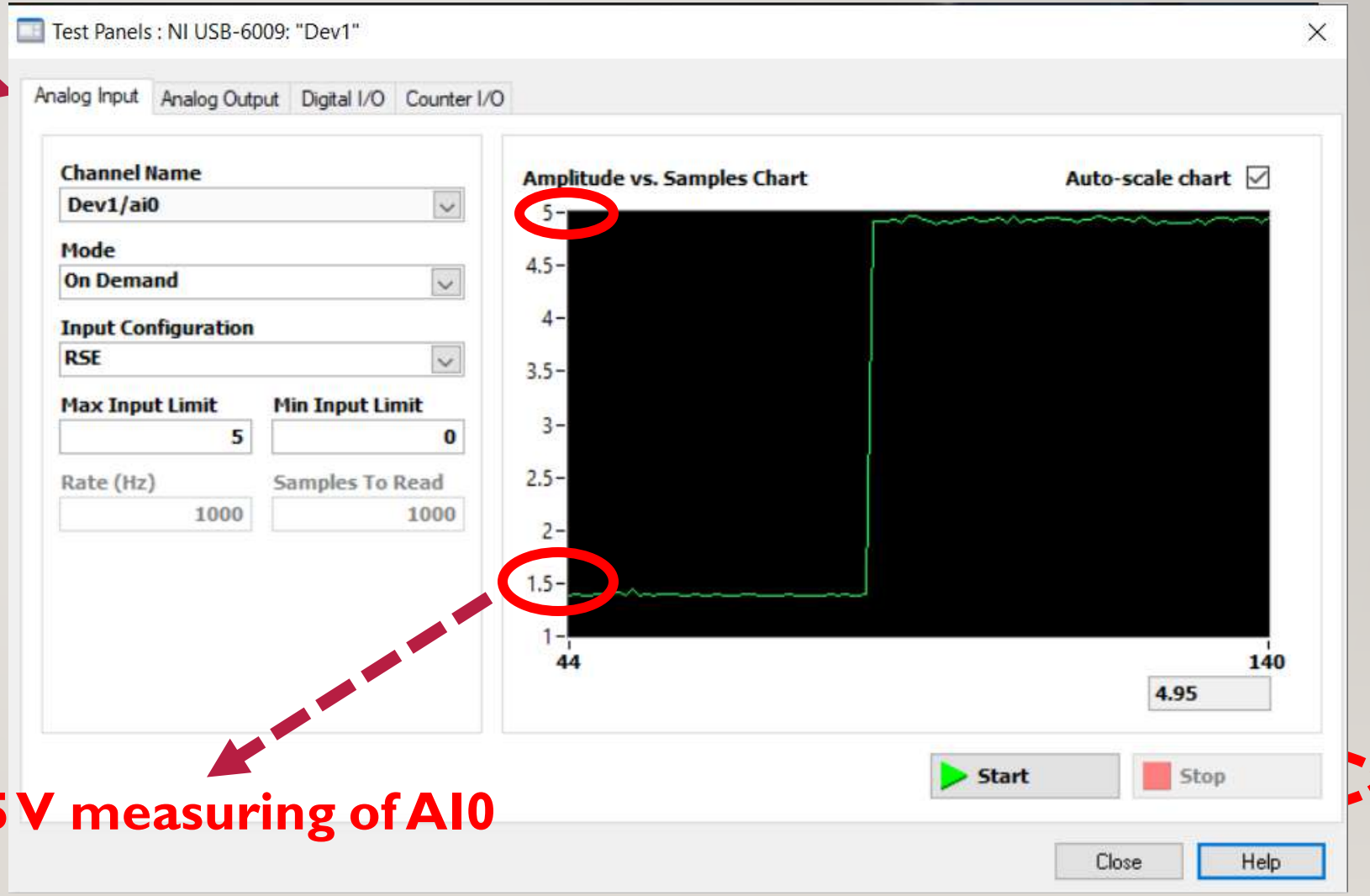
Input range limitation:

Start and stop for test:



TEST NI USB 6009

ANALOG INPUT TAB:



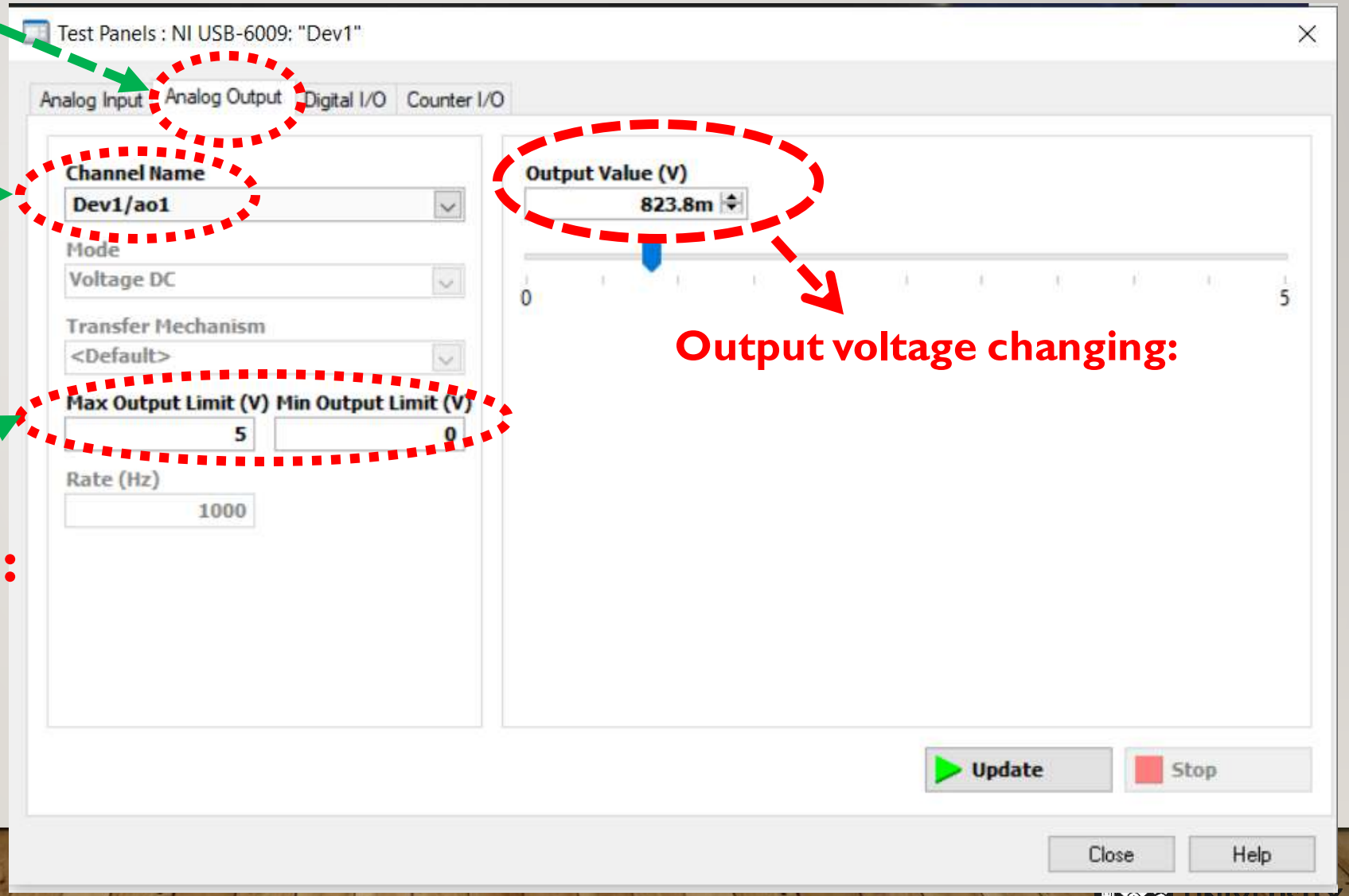
1.4V to 5V measuring of AI0

TEST NI USB 6009

ANALOG OUTPUT TAB:

Channel selection

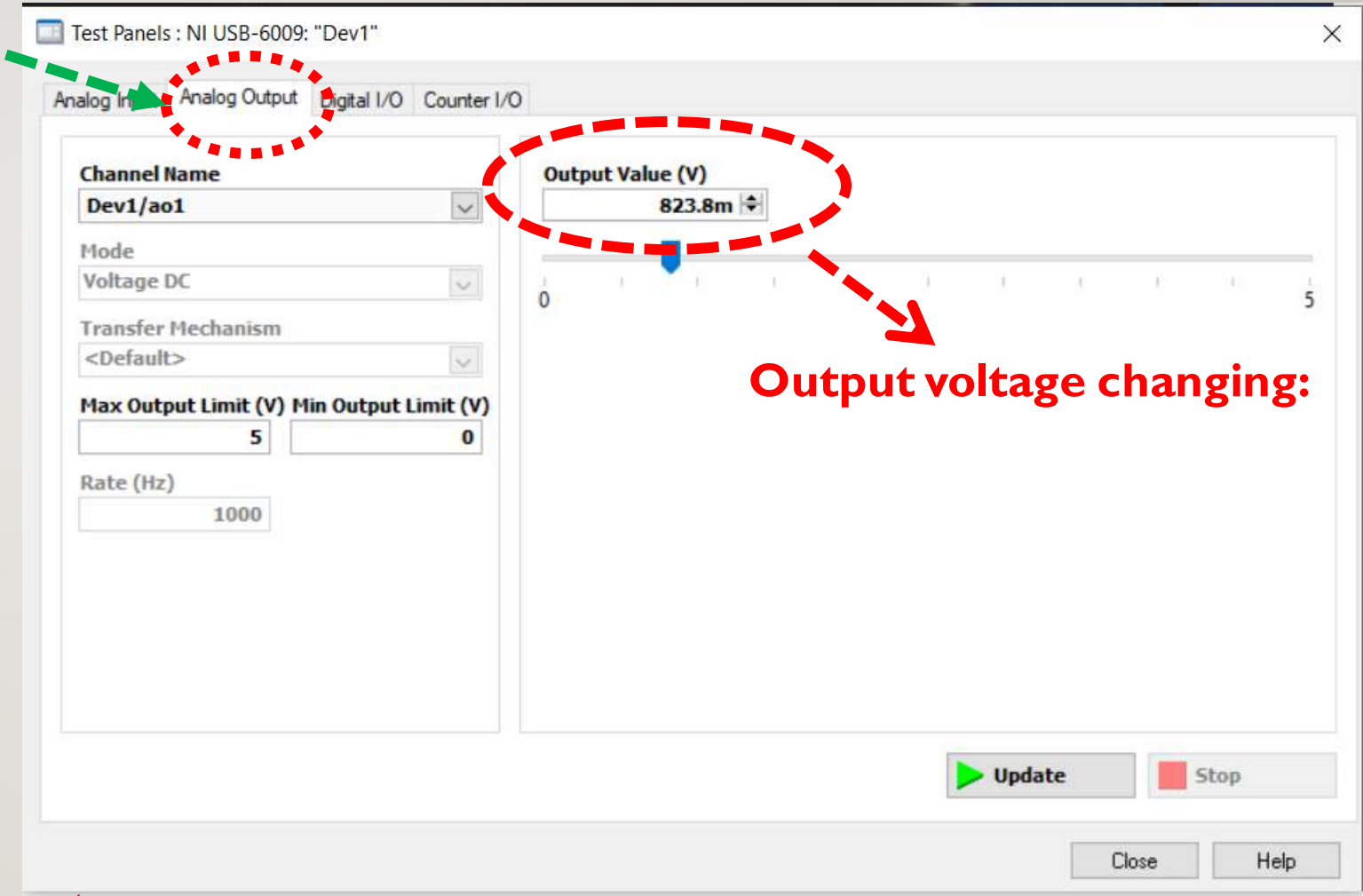
Output range limitation:



Output voltage changing:

TEST NI USB 6009

ANALOG OUTPUT TAB:



Output voltage changing:

Output voltage and LED module test

TEST NI USB 6009

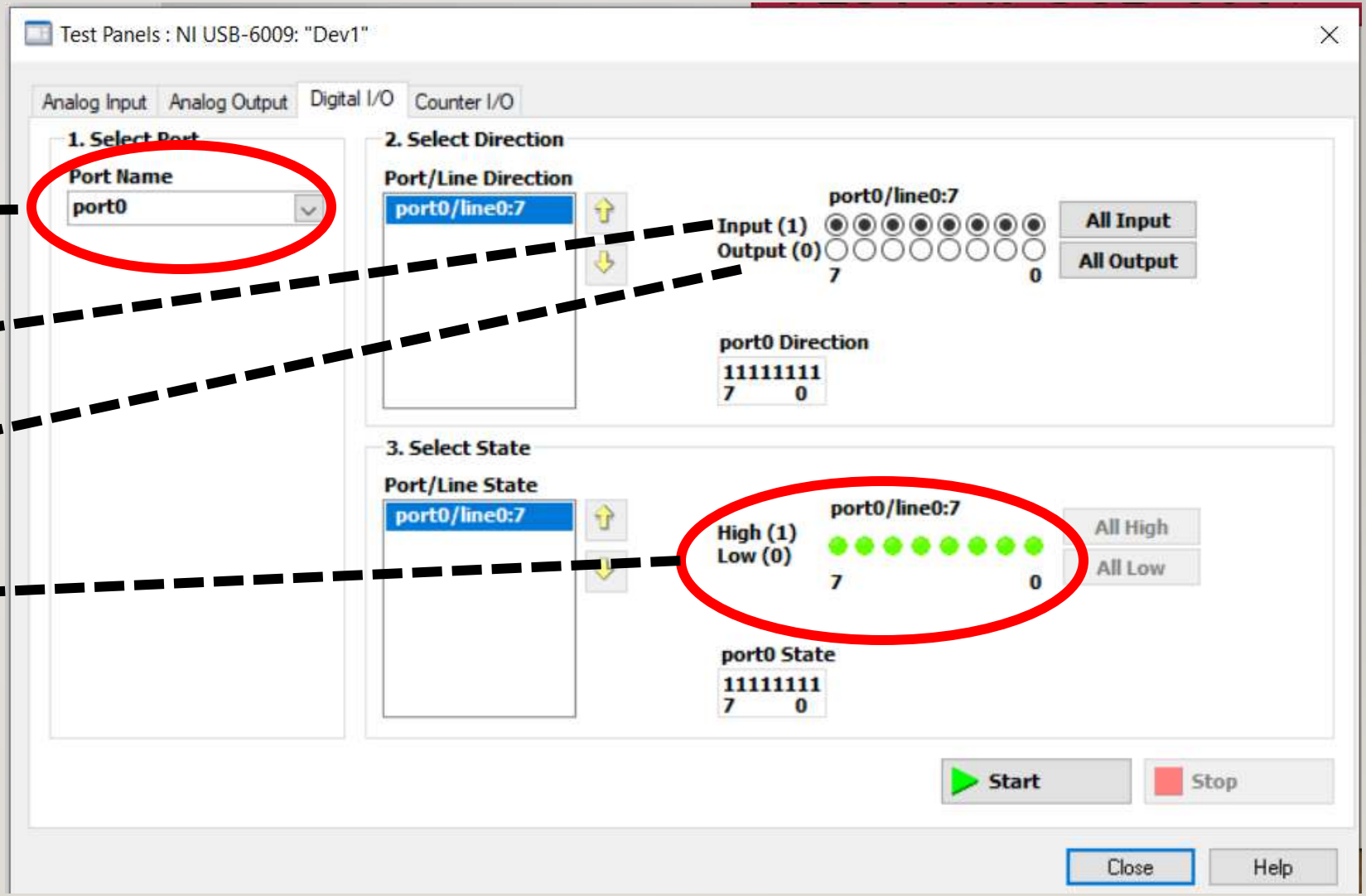
DIGITAL I/O TAB

Port 0/1 selection

Digital Input selection

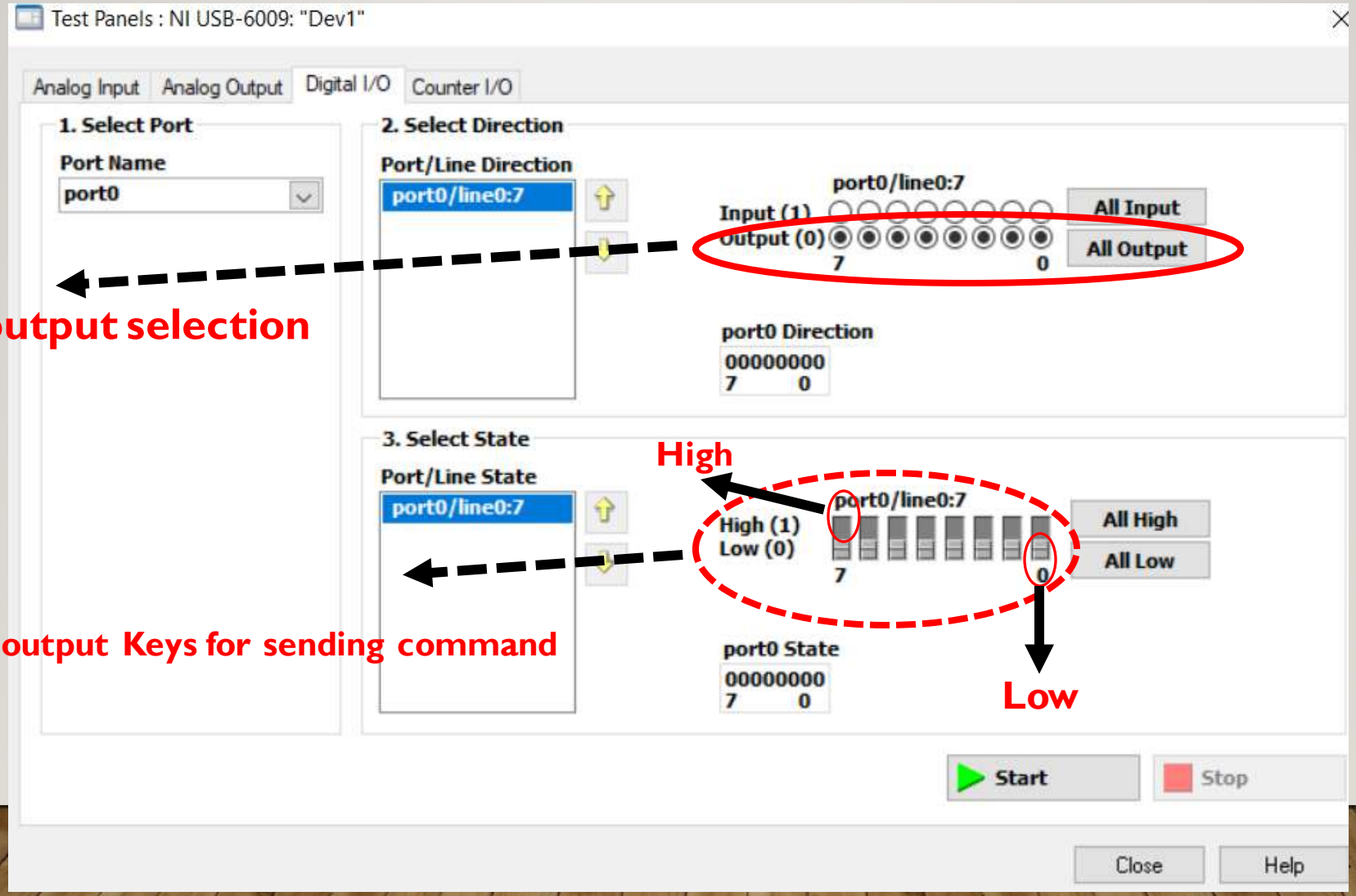
Digital output selection

Digital Input indicators



TEST NI USB 6009

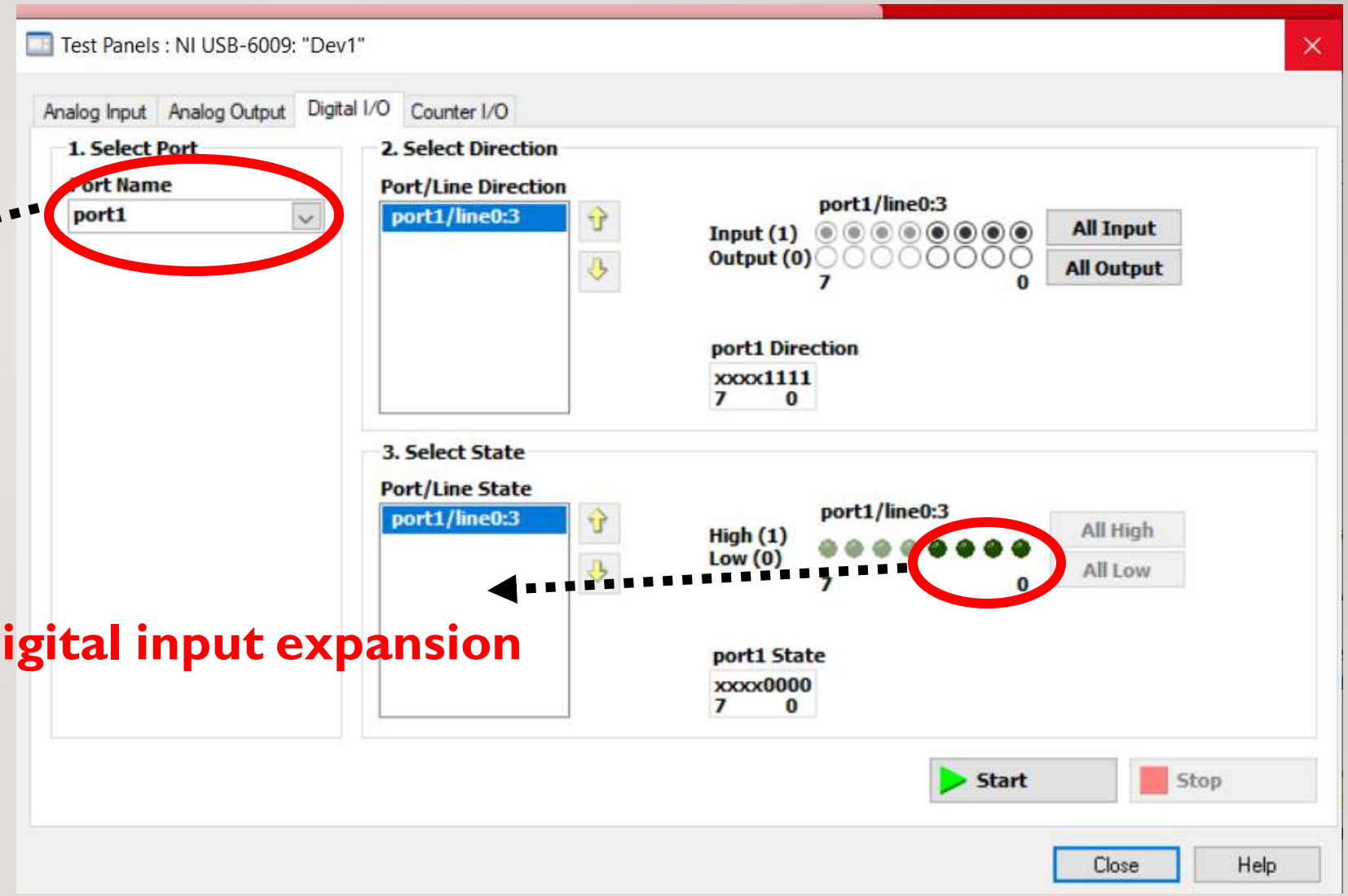
DIGITAL I/O TAB



TEST NI USB 6009

DIGITAL I/O EXPANSION

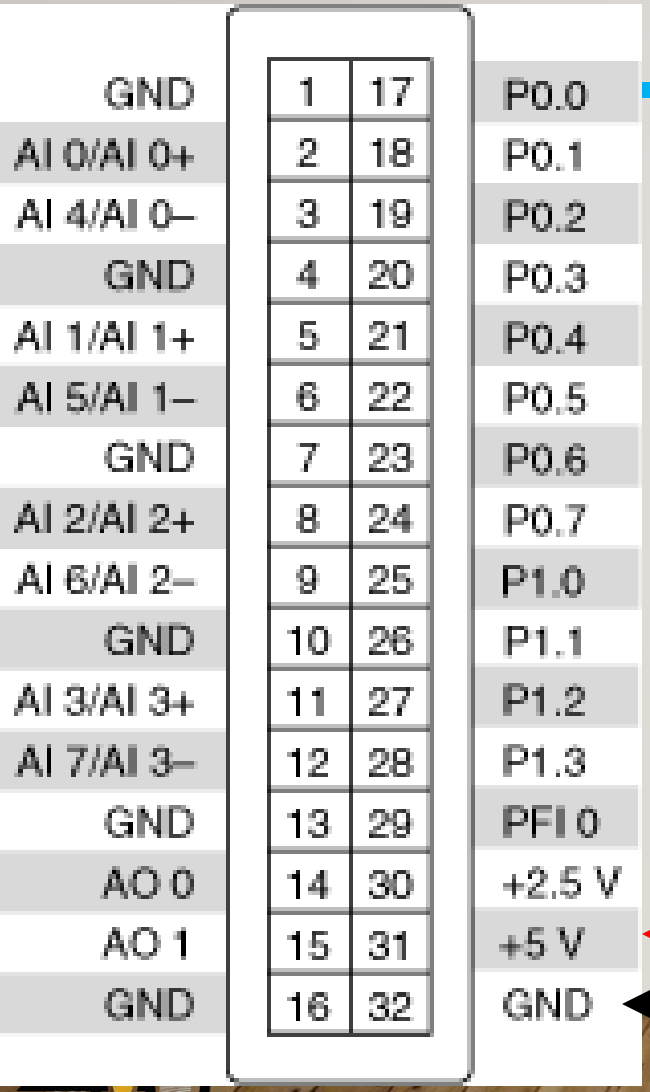
Digital output port I



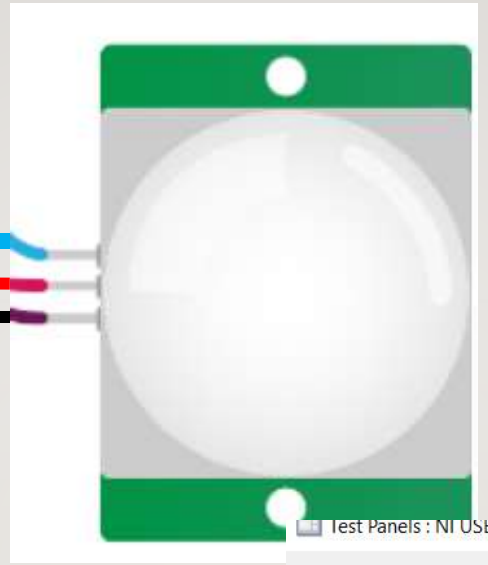
Digital input expansion

PIR motion sensor and DAQ Navi

Digital Input 0



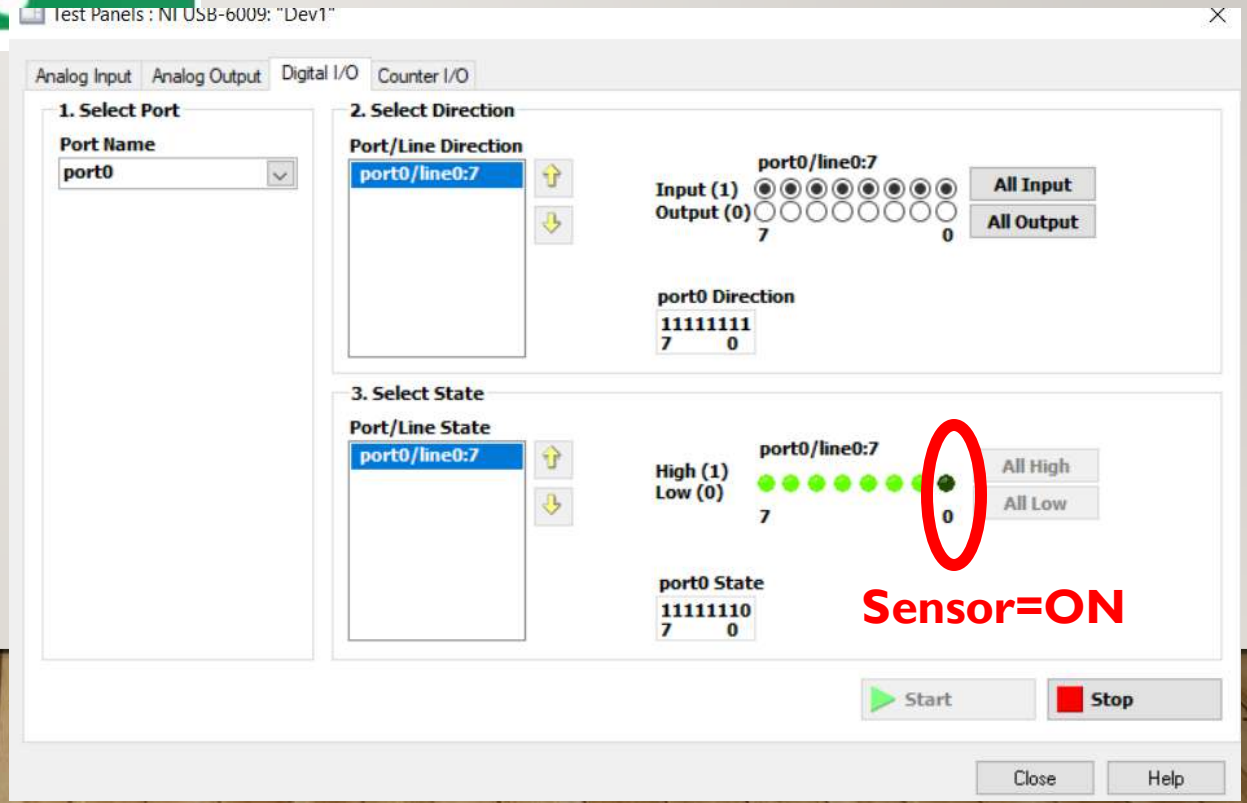
S: signal



PIR sensor

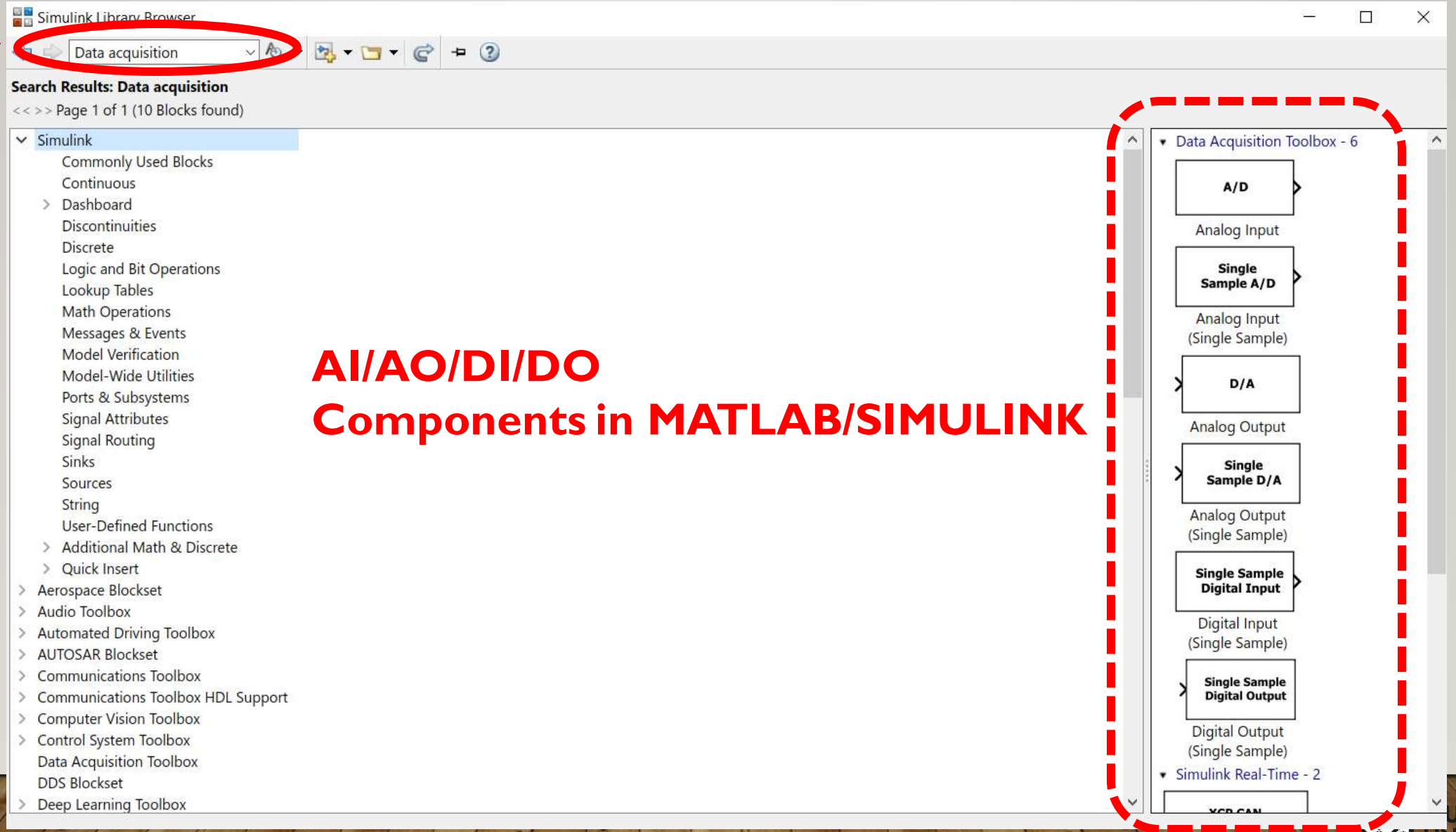
5V

GND



DAQ SOFTWARE: MATLAB / SIMULINK

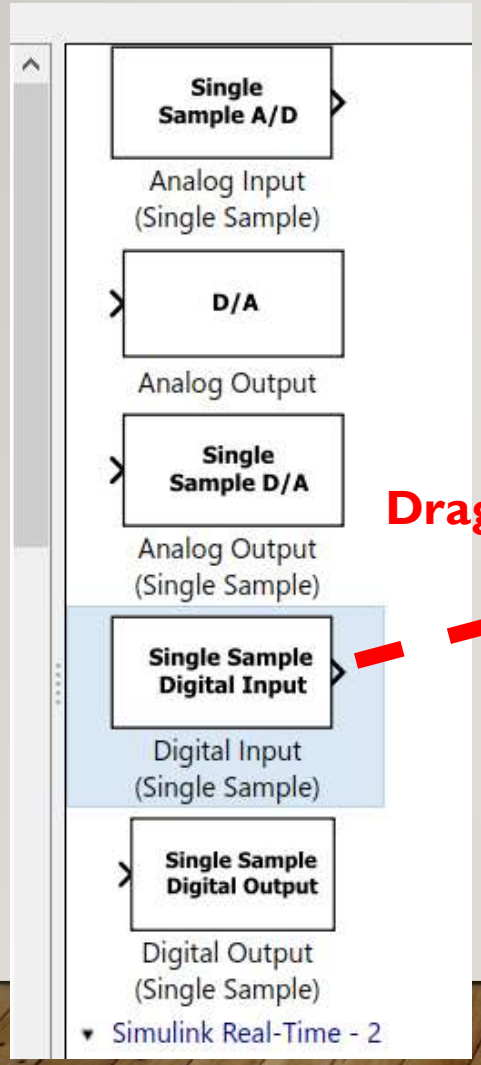
Data acquisition search in the SIMULINK/ Library



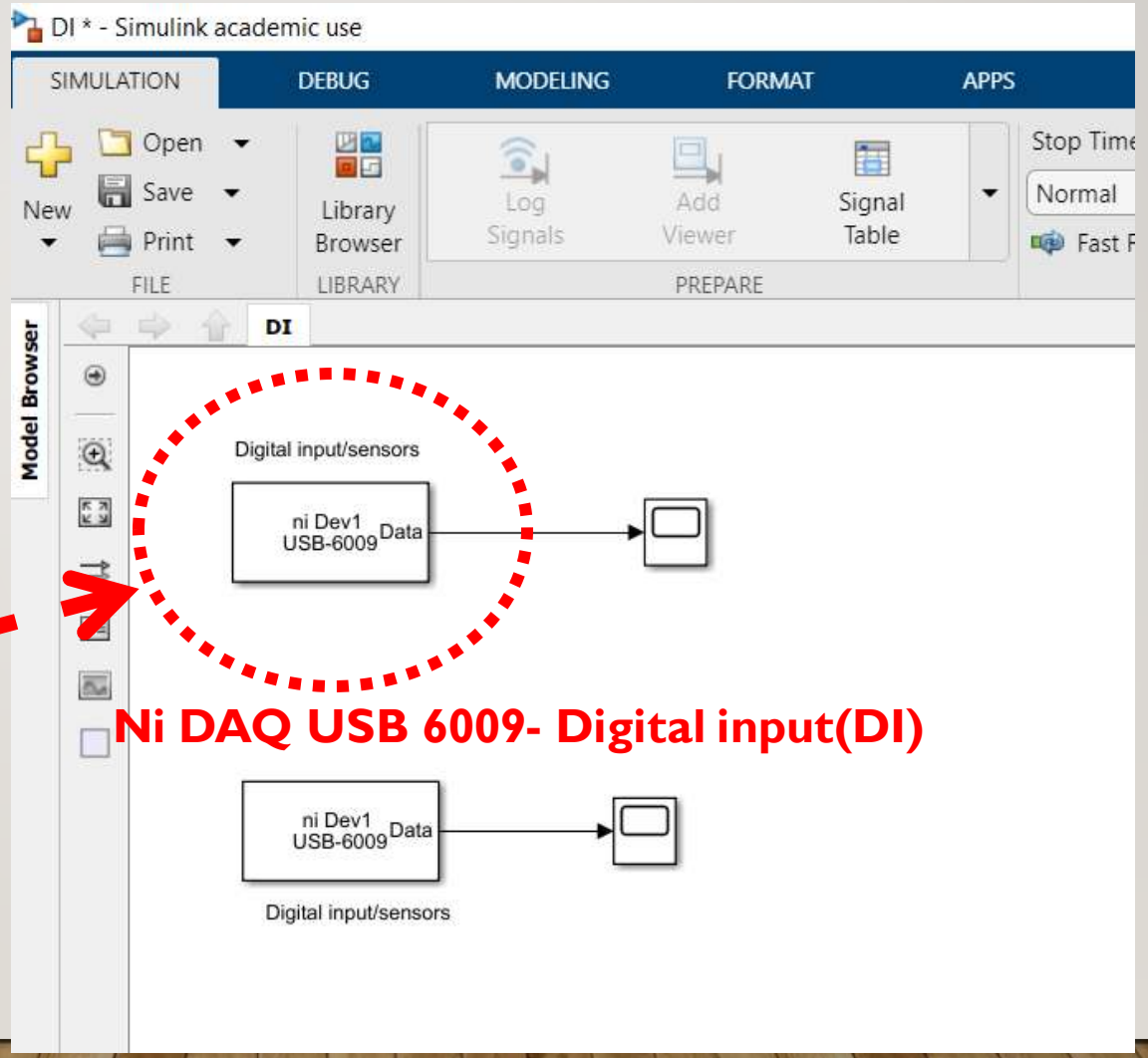
AI/AO/DI/DO Components in MATLAB/SIMULINK

DAQ SOFTWARE: MATLAB / SIMULINK

I- Digital input(DI)

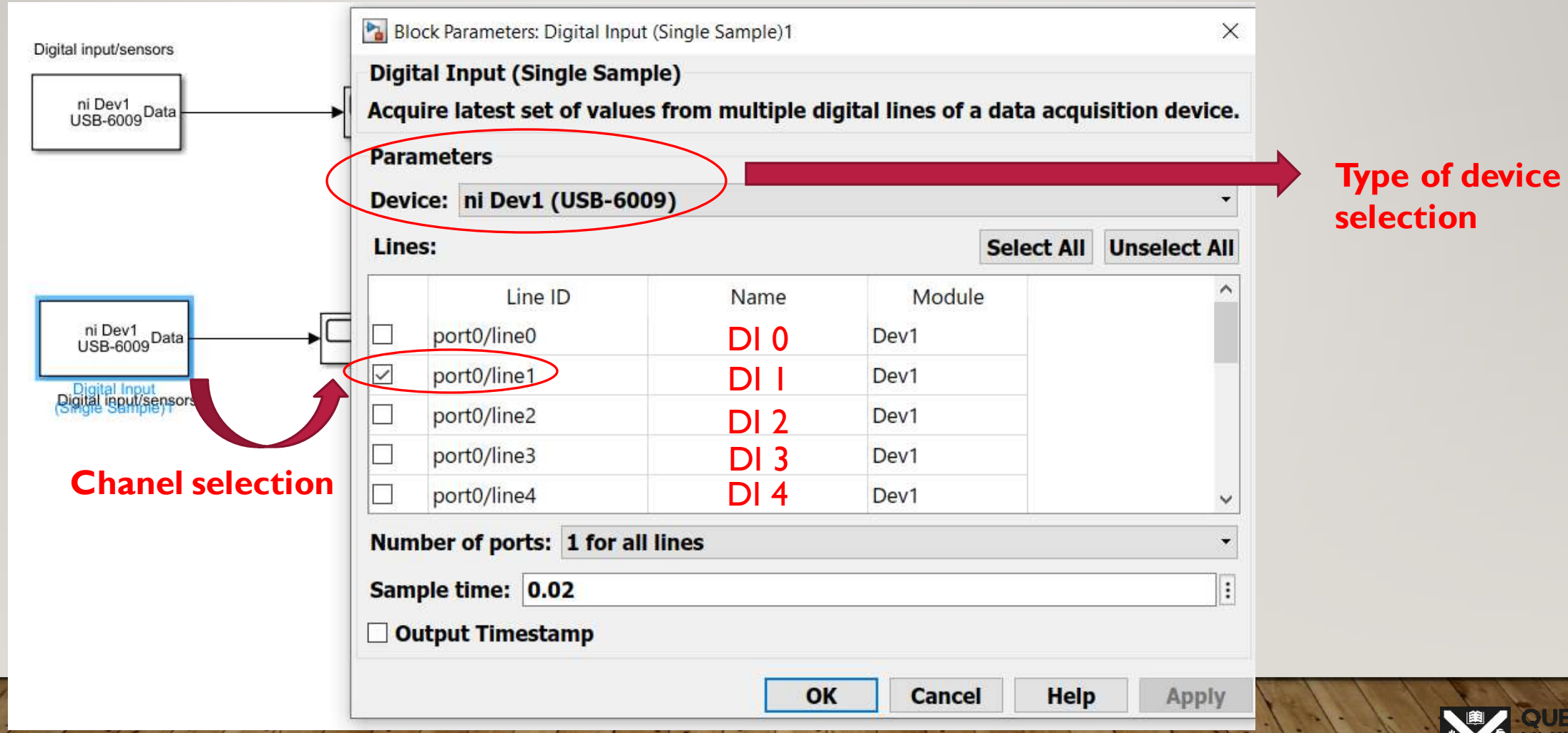


Drag and drop



DAQ SOFTWARE: MATLAB / SIMULINK

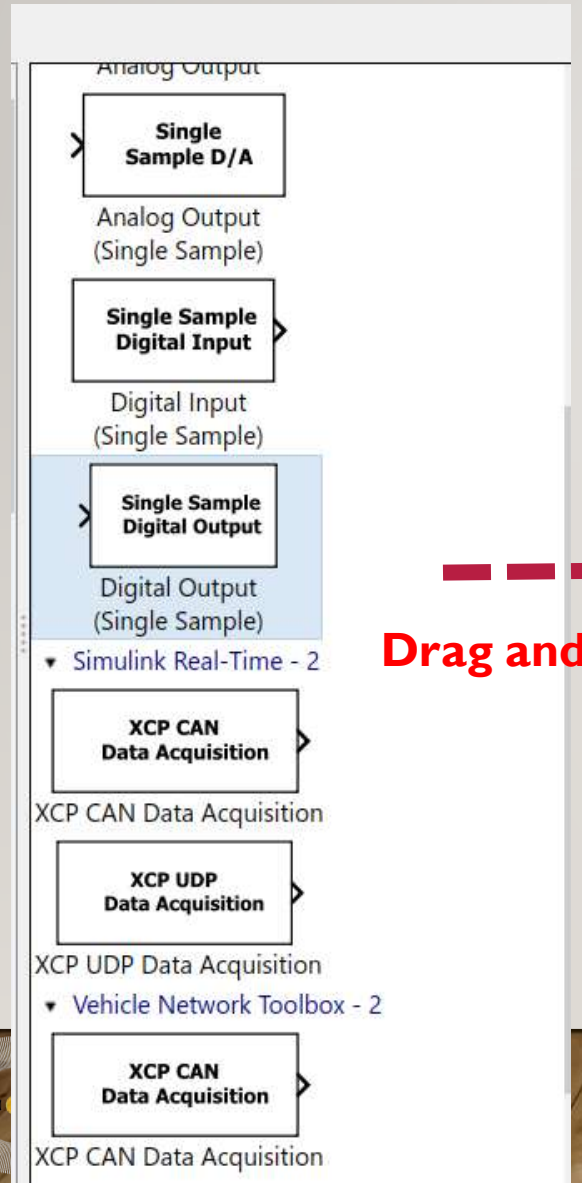
Digital input (DI) configuration:



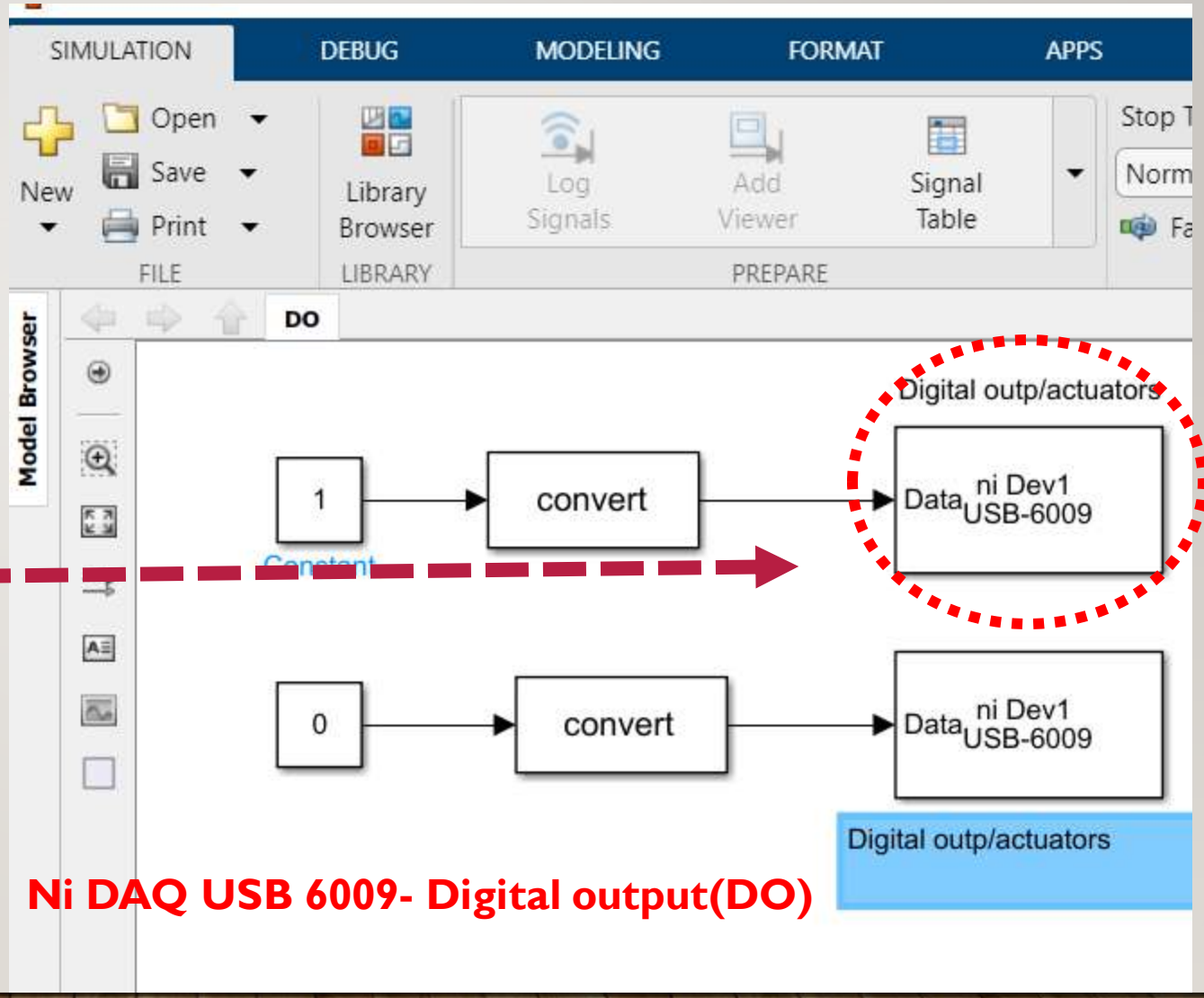
Open "DI.slx" file in "DAQ Simulink files" folder

DAQ SOFTWARE: MATLAB / SIMULINK

2- Digital output (DO)



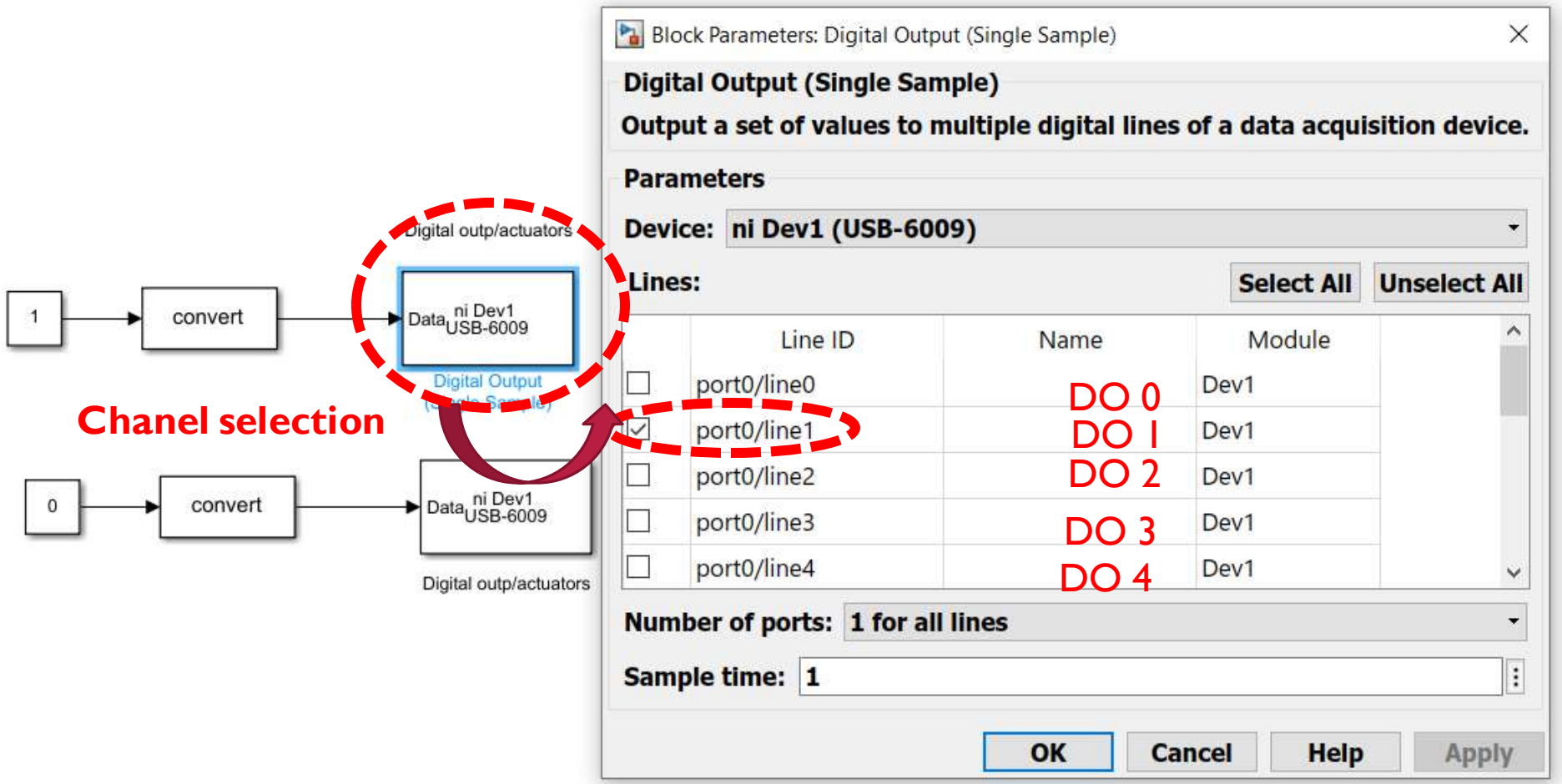
Drag and drop



Ni DAQ USB 6009- Digital output(DO)

DAQ SOFTWARE: MATLAB / SIMULINK

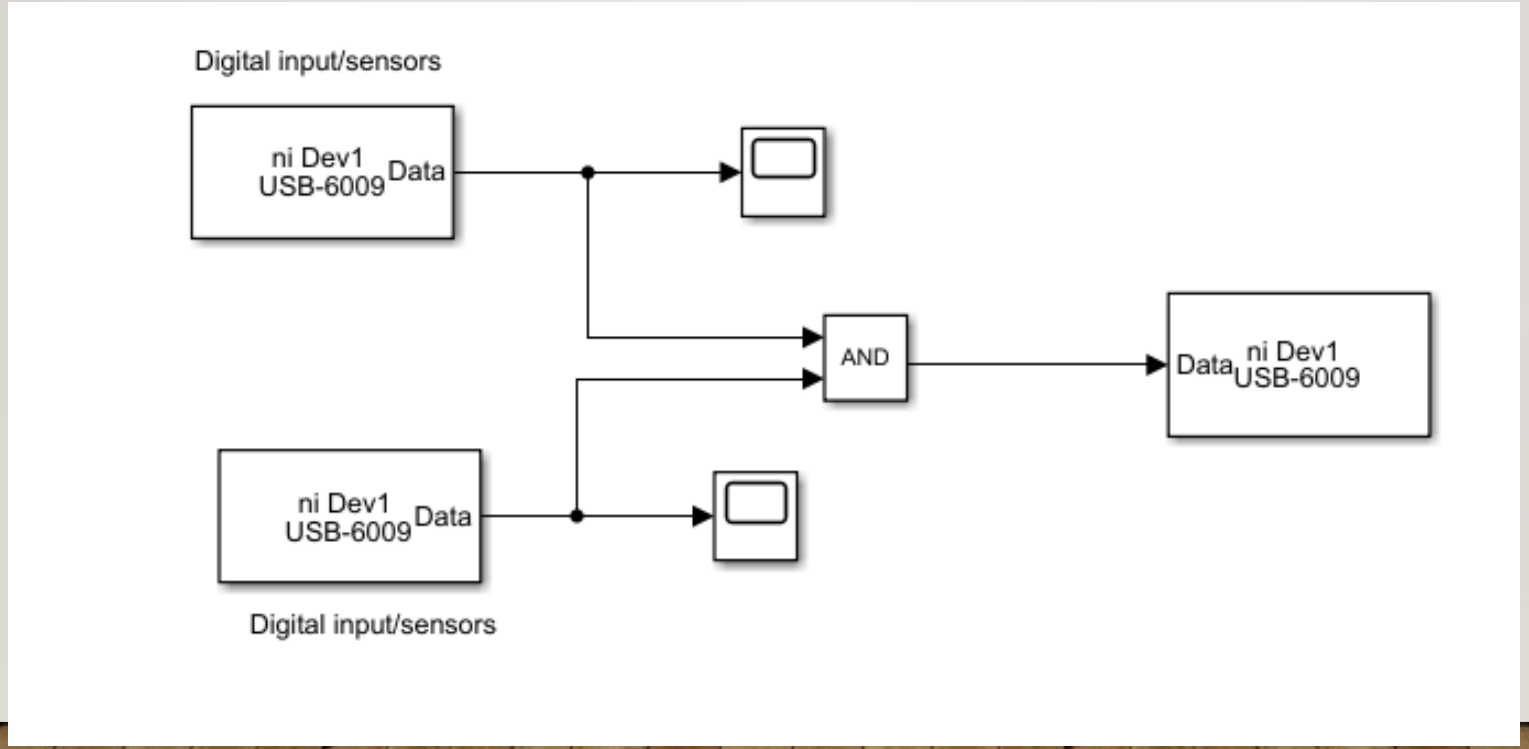
Digital output (DO) configuration:



Open "DO.slx" file in "DAQ Simulink files" folder

EXAMPLE 1

1- **IF** "sensor 1 (PIR motion sensor) and sensor 2 (water vapor sensor) are activated, **THEN** LED digital output should light up".

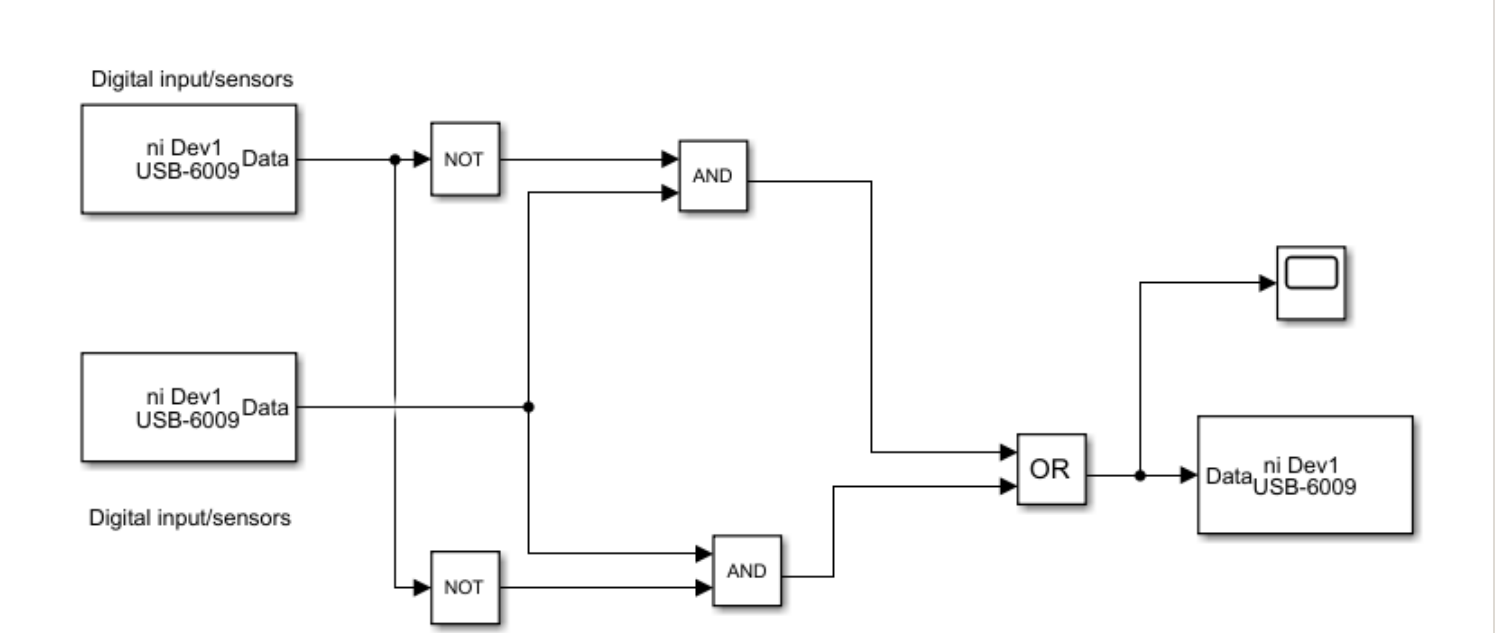


EXAMPLE 2

2- **IF** "sensor1 (PIR motion sensor) is activated **and** sensor 2 (water vapor sensor) is not activated

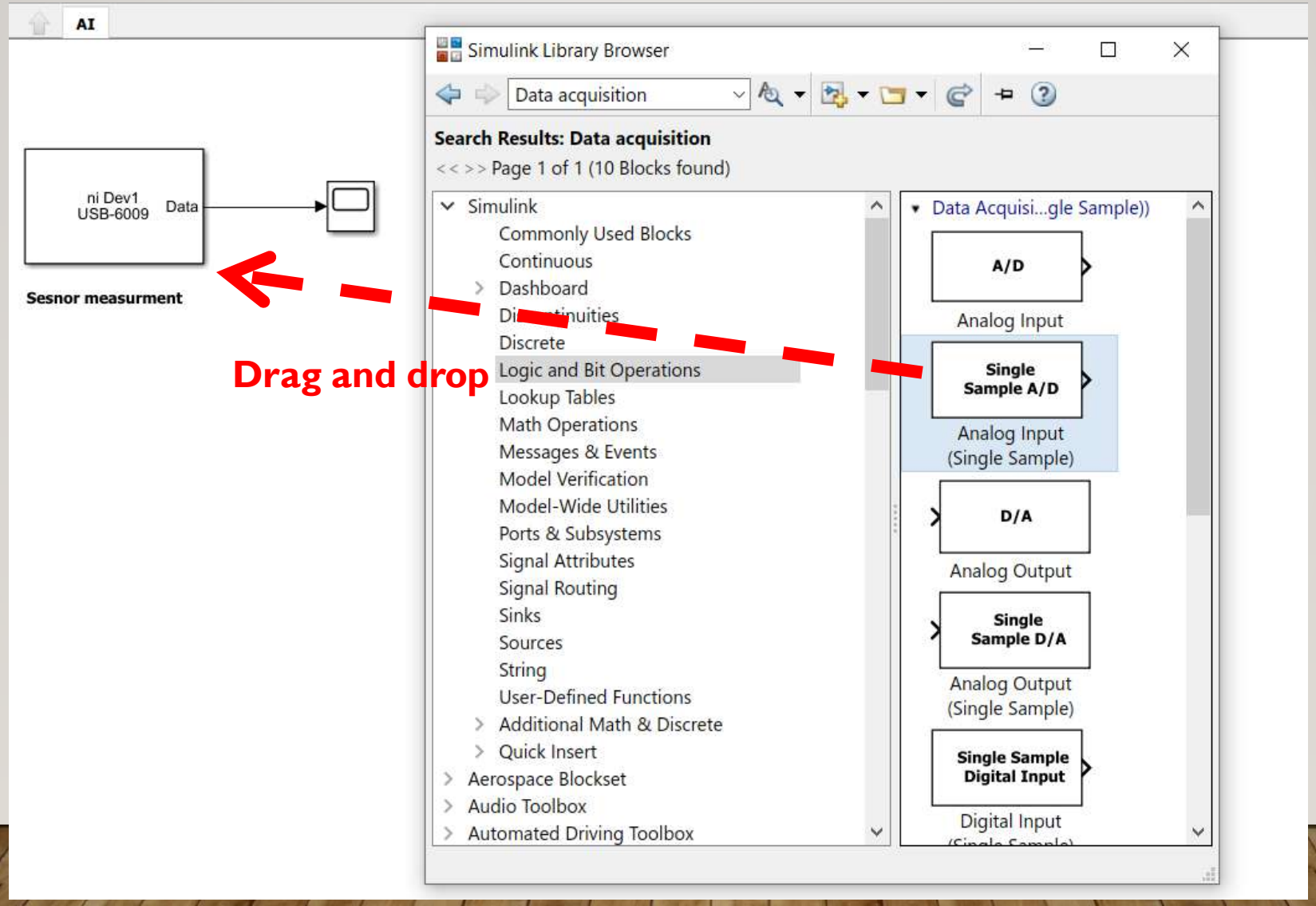
OR

"sensor1 (PIR motion sensor) is not activated **and** sensor 2 (water vapor sensor) is activated **THEN,** the **LED digital output** should light up".



DAQ SOFTWARE: MATLAB / SIMULINK

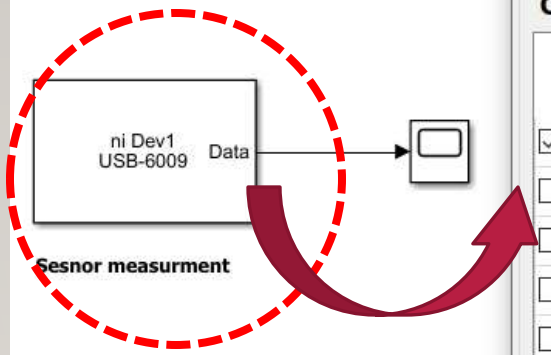
3- Analog Input (AI)



DAQ SOFTWARE: MATLAB / SIMULINK

Analog input (AI) configuration:

Single-ended/ differential type measuring



Chanel selection

Block Parameters: Analog Input (Single Sample)

Analog Input (Single Sample)

Acquire single sample from multiple analog channels of a data acquisition device every simulation time step.

Parameters

Device: ni Dev1 (USB-6009)

Measuring type

Voltage range

Channels: Select All | Unselect All

	Channel ID	Name	Module	Measurement Type	Terminal Config	Input Range	Coupling
☑	ai0		Dev1	Voltage	SingleEnded	-5.0 to +5.0 Volts	DC
☐	ai1		Dev1	Voltage	Differential	-20 to +20 Volts	DC
☐	ai2		Dev1	Voltage	Differential	-20 to +20 Volts	DC
☐	ai3		Dev1	Voltage	Differential	-20 to +20 Volts	DC
☐	ai4		Dev1	Voltage	SingleEnded	-10 to +10 Volts	DC
☐	ai5		Dev1	Voltage	SingleEnded	-10 to +10 Volts	DC
☐	ai6		Dev1	Voltage	SingleEnded	-10 to +10 Volts	DC
☐	ai7		Dev1	Voltage	SingleEnded	-10 to +10 Volts	DC

Number of ports: 1 for all channels

Sample time: 0.01

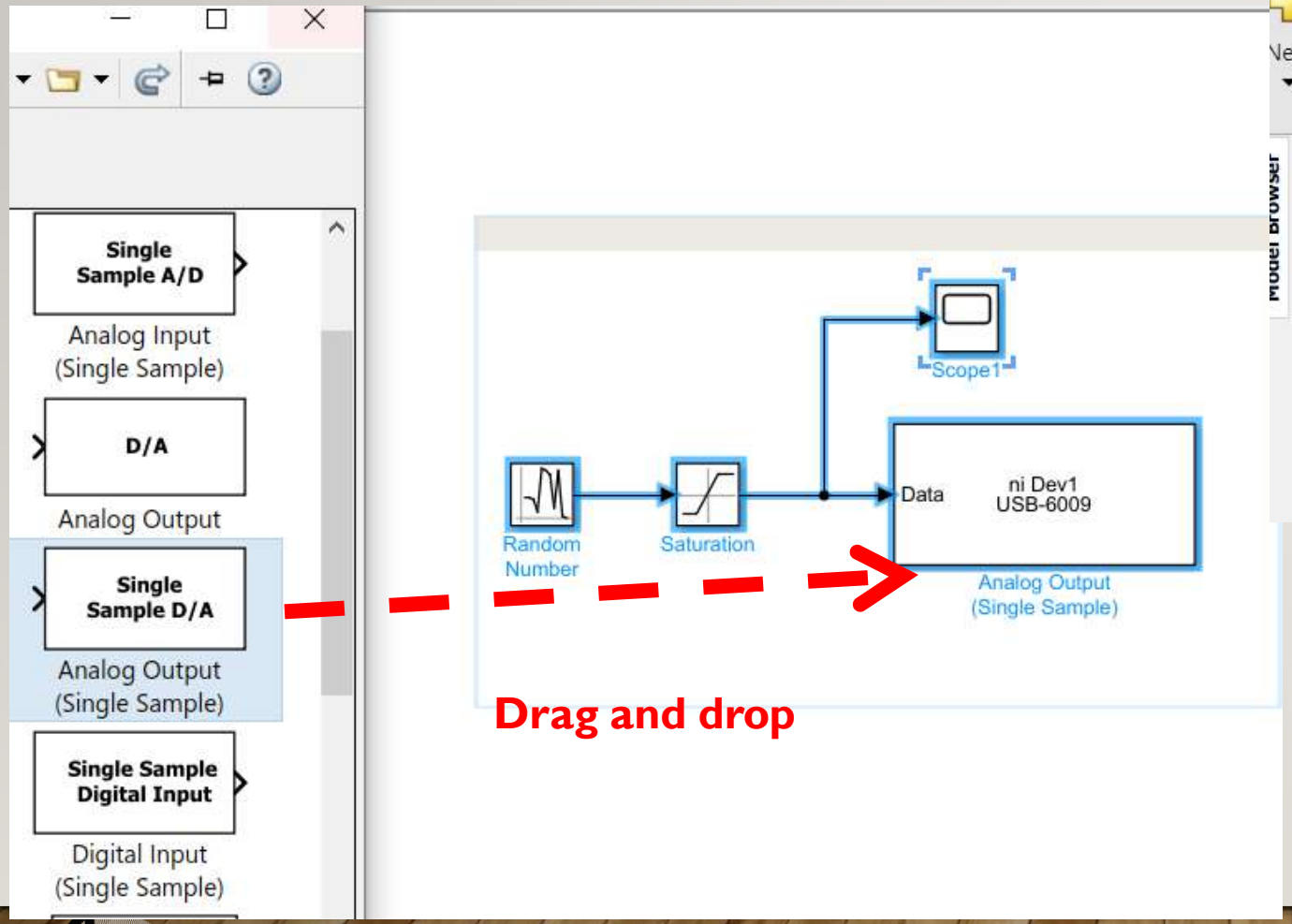
☐ **Output Timestamp**

OK | Cancel | Help | Apply

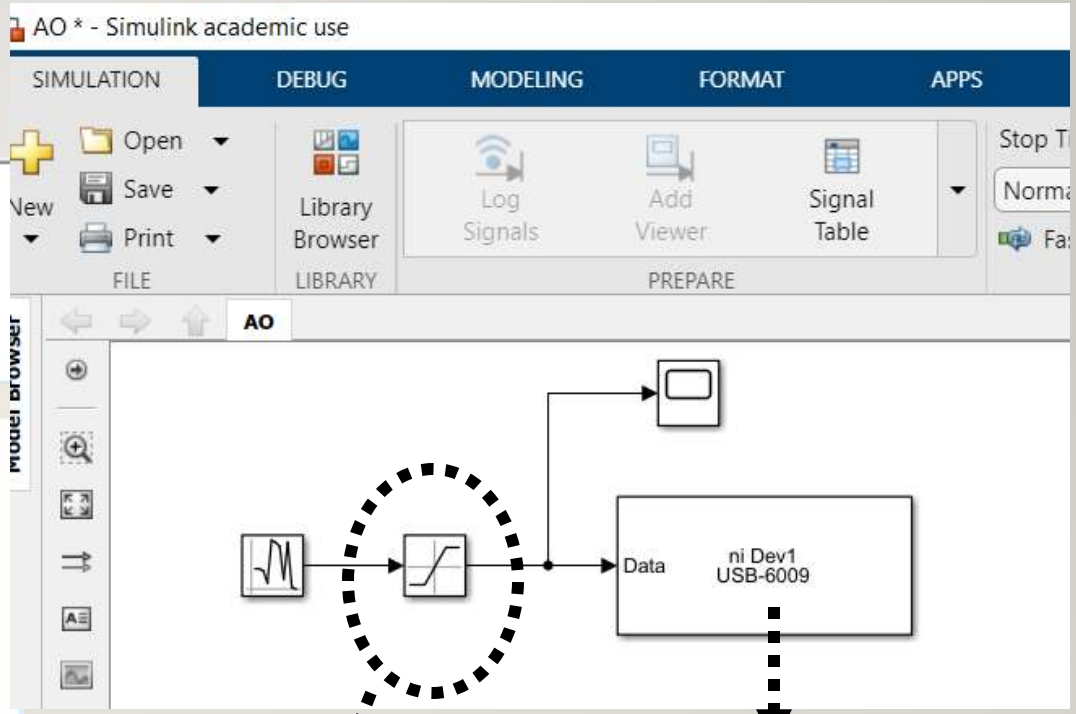
Open "AI.slx" file in "DAQ Simulink files" folder

DAQ SOFTWARE: MATLAB / SIMULINK

4- Analog output (AO)



Drag and drop

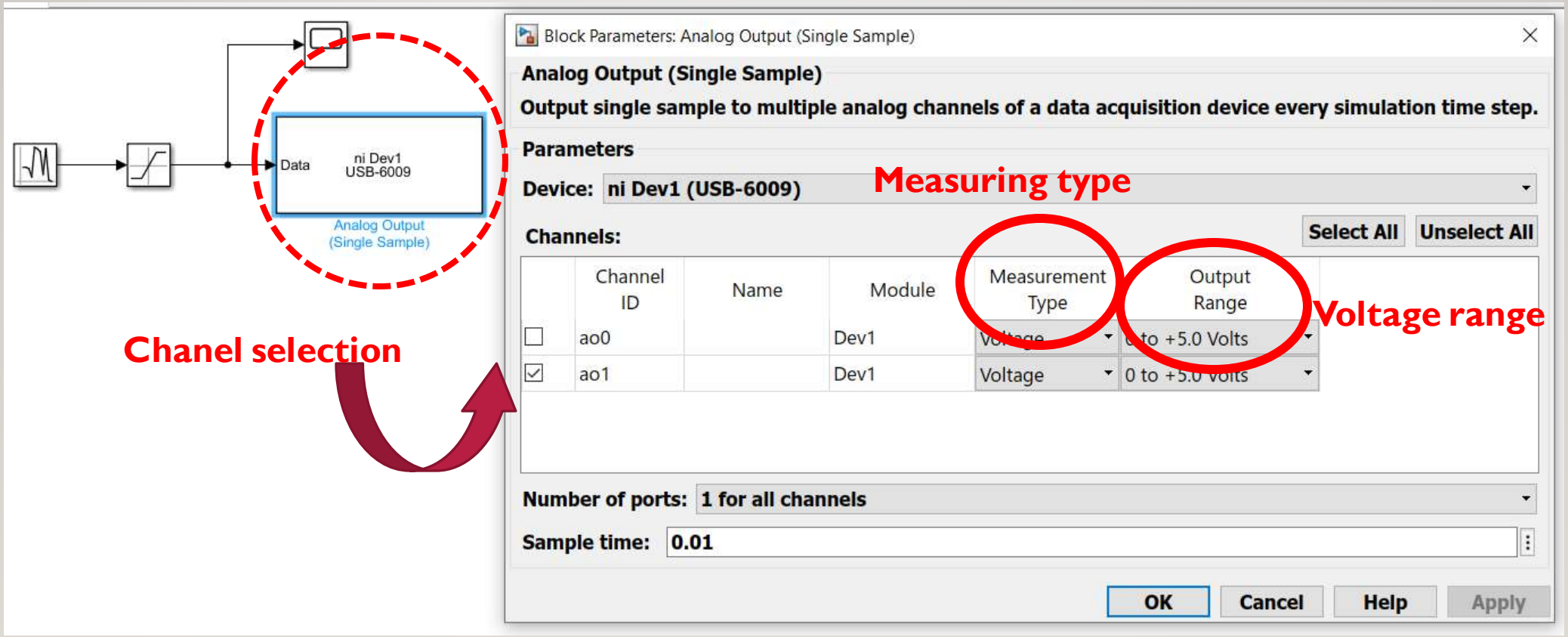


Analog Output- Channel 1

Output voltage limitation

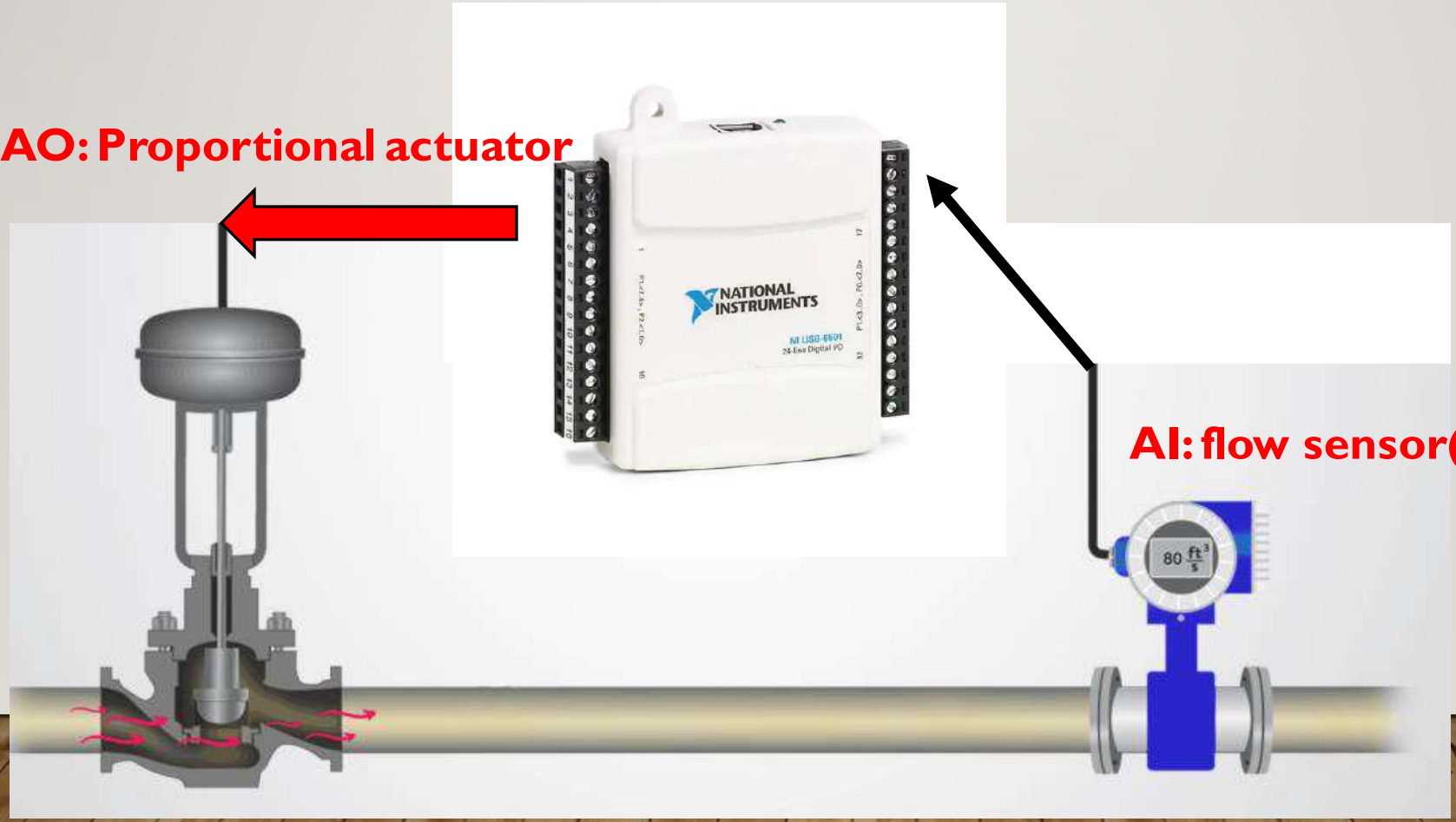
DAQ SOFTWARE: MATLAB / SIMULINK

Analog output (AO) configuration:

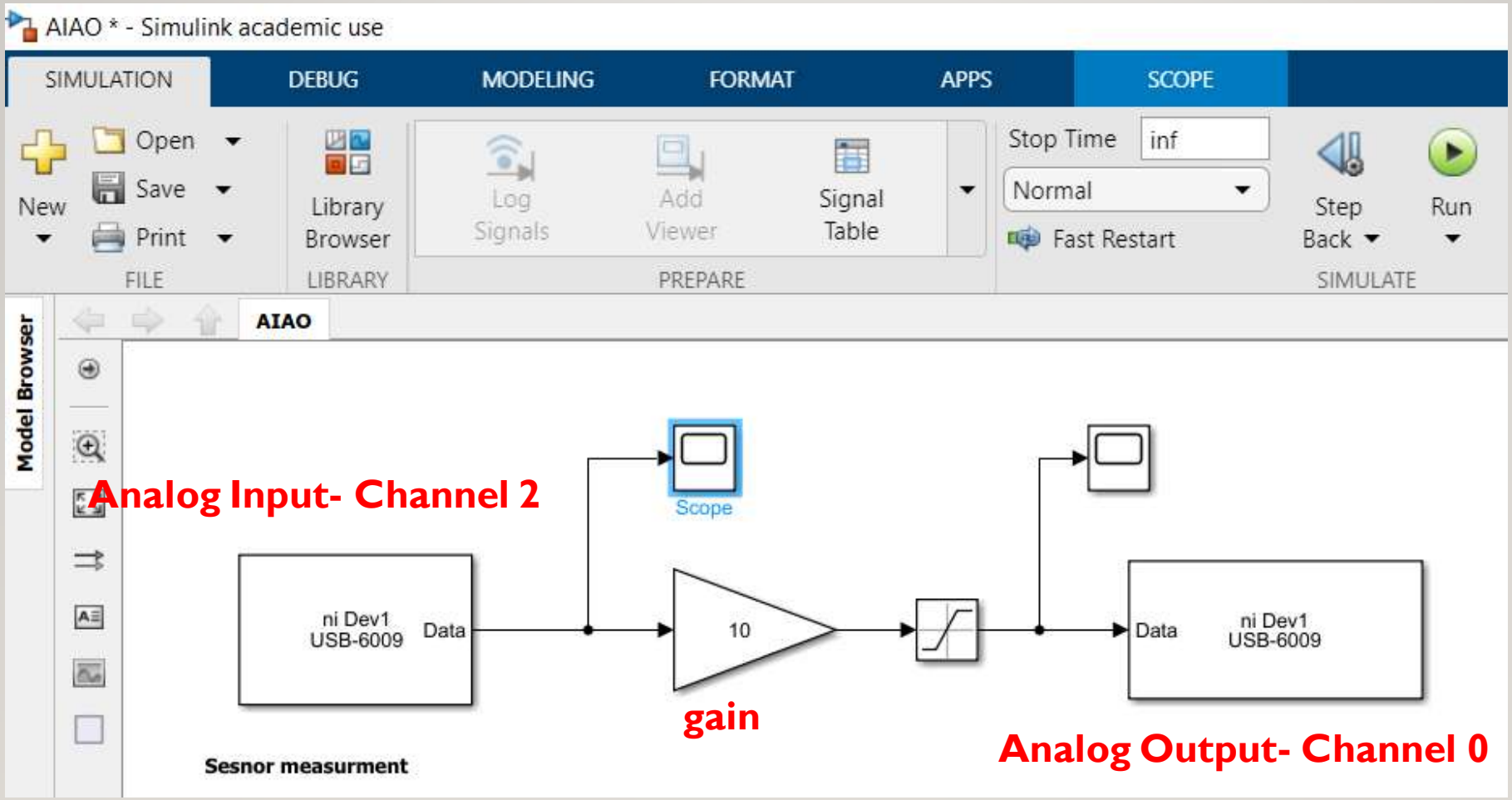


EXAMPLE 3

- Let's measure the flow sensor(Analog input) then the measured signal should amplify and then send a command to the Analog output (Proportional actuator).

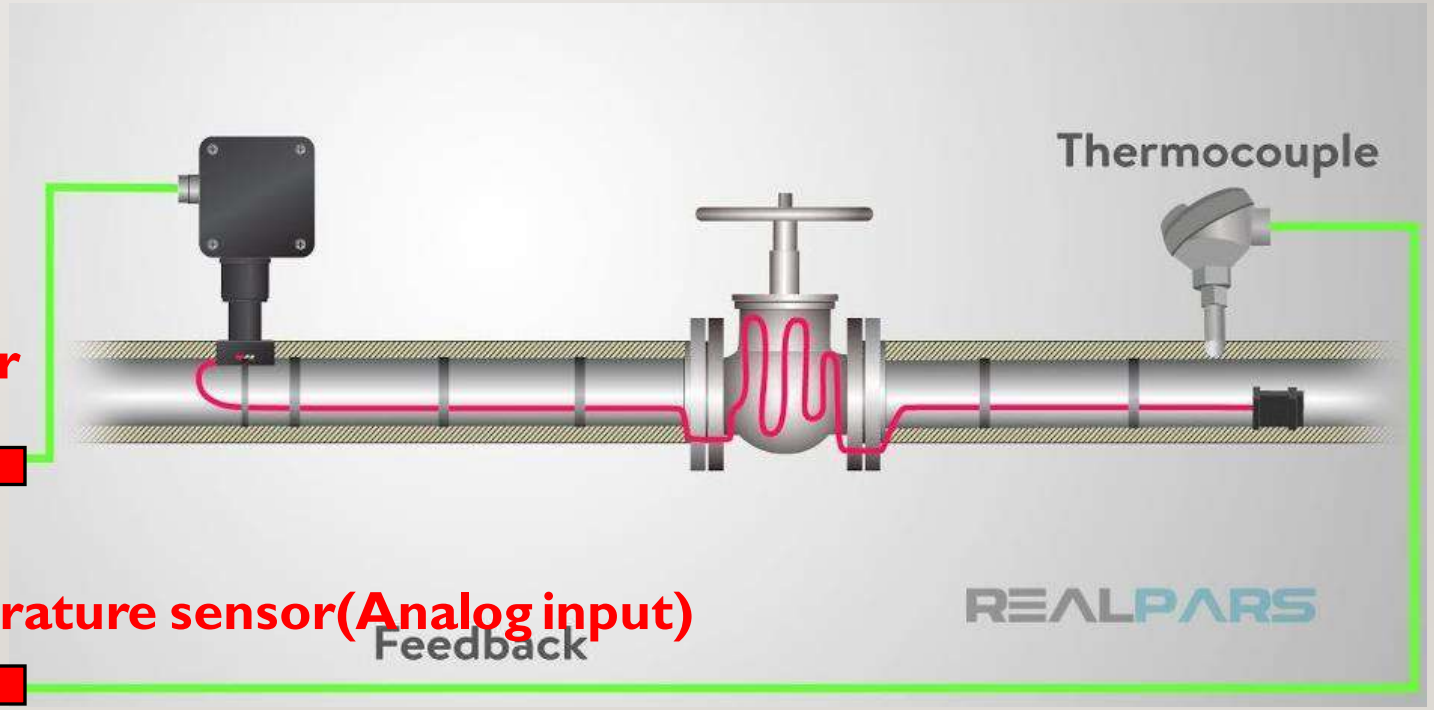


EXAMPLE 3

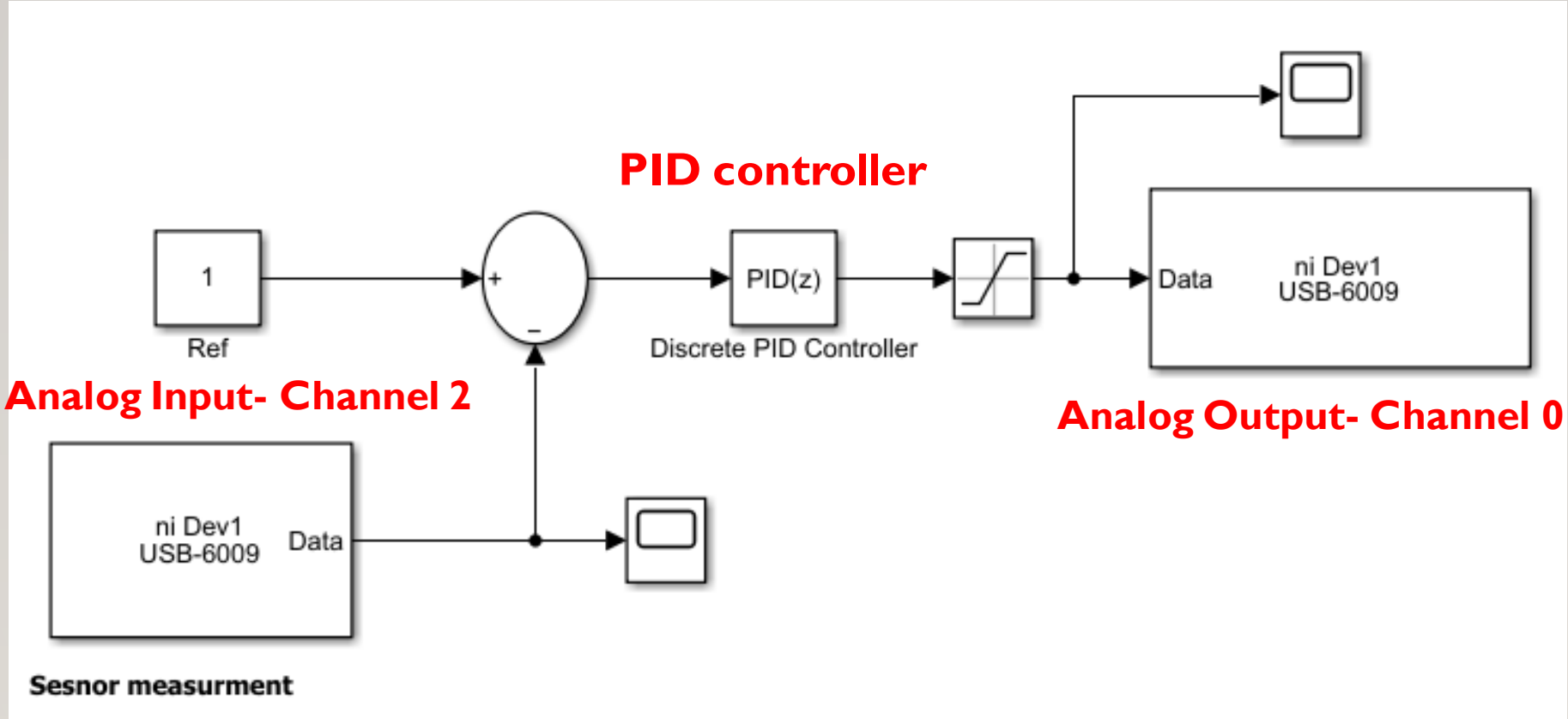

AIAO * - Simulink academic use
SIMULATION
DEBUG
MODELING
FORMAT
APPS
SCOPE
New
Open
Save
Print
FILE
Library Browser
LIBRARY
Log Signals
Add Viewer
Signal Table
PREPARE
Stop Time
inf
Normal
Fast Restart
Step Back
Run
SIMULATE
Model Browser
AIAO
Analog Input- Channel 2
Scope
ni Dev1 USB-6009
Data
10
gain
Data
ni Dev1 USB-6009
Analog Output- Channel 0
Sesnor measurment

EXAMPLE 4

- Here is a closed-loop control system that used a PID control to generate a control signal:
- The temperature sensor (analog input) measures temperature then PID control sends a command to the analog output (heater driver) to control the heat.



EXAMPLE 4


PID controller
1
Ref
+
−
PID(z)
Discrete PID Controller
Data
ni Dev1
USB-6009
Analog Input- Channel 2
Analog Output- Channel 0
ni Dev1
USB-6009
Data
Sesnor measurment

Thank You For Your Attention!

Any Question?