

Topic 7:
Design, implementation and programming of the
Potentiometer Interface
for the Slow Control System MPD-NICA,
on the NImyRIO and LabView platforms.¹

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7 Potentiometer

A Potentiometer is a three-terminal variable resistor. When connected to a power supply to form a voltage divider a potentiometer acts as a proportional rotation sensor. Figure 7.1 pictures the NImyRIO StarterKit Potentiometer.



Figure 7-1: NImyRIO StarterKit Potentiometer.

7.1 Learning Objectives:

After completing the activities in this chapter you will be able to:

- [a] Discuss how the potentiometer can be used as either one variable resistor or two series-connected complementary variable resistors,
- [b] Connect a potentiometer as a voltage divider to produce a voltage proportional to rotation angle,
- [c] Select the potentiometer resistance to minimize power consumption and to minimize loading effects.

¹ Developed on the basis of educational materials: National Instruments, IBM, Reichle & De-Massari, Microsoft, Warsaw University of Technology, Joint Nuclear Institute Research

7.2 Component Demonstration

Follow these steps to demonstrate correct operation of the potentiometer.

Select these parts from the NI myRIO Starter Kit:

- [a] Potentiometer, 10 k Ω ,

<http://www.supertech.com.tw/electronic/resistors/potentiometers/PDF/rotary3/23/R0904N.pdf>

- [b] Breadboard
- [c] Jumper wires, M-F (3x)

7.2.1 Build the interface circuit:

Refer to the schematic diagram and recommended breadboard layout shown in Figure 7.2

TIP: Flatten the two tabs on either side of the potentiometer so that it sits flush on the breadboard surface.

The potentiometer interface circuit requires three connections to NI myRIO MXP Connector B (see Figure A.1 Appendix)

- [a] Pot Terminal 1 \rightarrow B/GND (pin 16)
- [b] Pot Terminal 2 \rightarrow B/AIO (pin 3)
- [c] Pot Terminal 3 \rightarrow B/+5V (pin 1)

7.2.2 Run the demonstration VI:

- [a] Download

<http://www.ni.com/academic/myrio/project-guide-vis.zip>

- [b] if you have not done so previously and unpack the contents to a convenient location,
- [c] Open the project Potentiometer demo.lvproj contained in the subfolder Potentiometer demo,
- [d] Expand the hierarchy button (a plus sign) for the myRIO item and then open Main.vi by double-clicking,
- [e] Confirm that NI myRIO is connected to your computer, and
- [f] Run the VI either by clicking the Run button on the toolbar or by pressing Ctrl+R.

Expect to see a “Deployment Process” window showing how the project compiles and deploys (downloads) to NI myRIO before the VI starts running.

NOTE: You may wish to select the “Close on successful completion” option to make the VI start automatically.

7.2.3 Expected results:

The demo VI displays the voltage on the analog input B/AIO. Turn the potentiometer dial and you should observe a corresponding change in the voltage sensed on the analog input. Because the potentiometer acts as an adjustable voltage divider between ground and the +5-volt supply, you should observe that a full rotation of the potentiometer dial from one extreme to the other causes the voltage to change from 0 to 5 volts.

Click the Stop button or press the escape key to stop the VI and to reset NI myRIO.

7.2.4 Troubleshooting tips:

Not seeing the expected results? Confirm the following points:

- [a] Glowing power indicator LED on NI myRIO,
- [b] Black Run button on the toolbar signifying that the VI is in runmode, and

- [c] Correct MXP connector terminals—ensure that you are using Connector B and that you have the correct pin connections.

7.3 Interface Theory

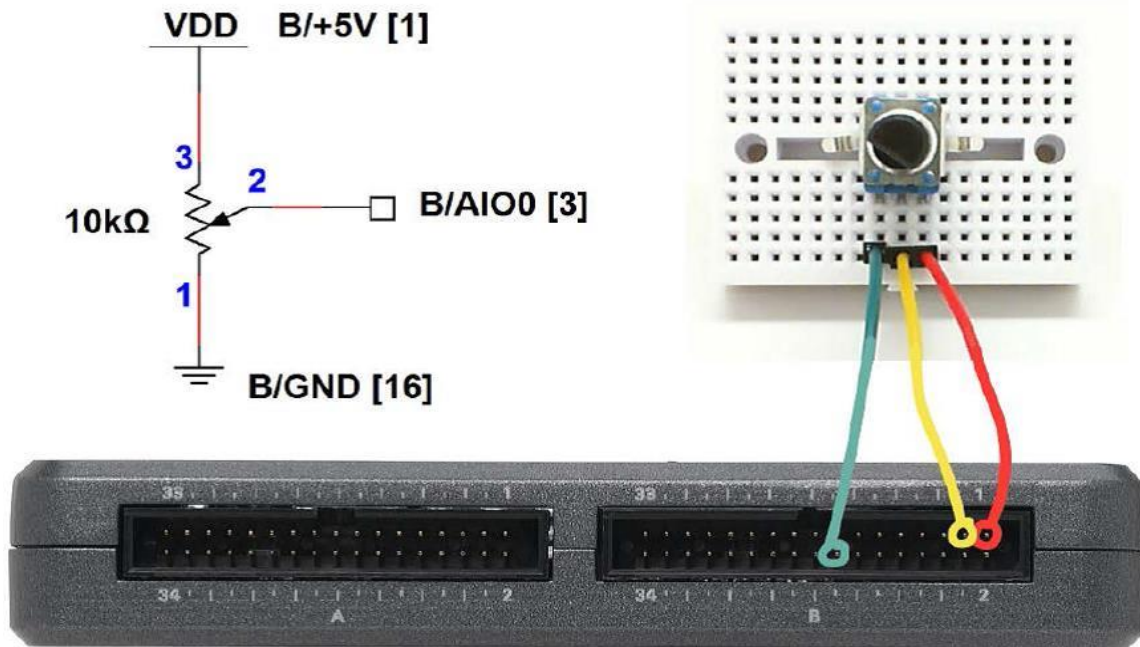


Figure 7-2; Demonstration circuit for potentiometer: schematic diagram, recommended breadboard layout, and connection to NI myRIO MXP Connector B.

7.4 Interface circuit:

The potentiometer provides a fixed resistance between the two outer terminals, while the middle terminal connects to a movable contact point that effectively makes the potentiometer appear as two variable resistors. As one resistor increases in value, the other resistor decreases by the same amount. Wiring the potentiometer between ground and the power supply produces a voltage divider with voltage output proportional to the position of the contact. Connecting this variable voltage to the NI myRIO analog input provides a convenient sensing technique for angular position.

Study the video *Potentiometer Characteristics* (7:51)

https://www.youtube.com/watch?v=3gwwF9rF_zU&feature=youtu.be

to learn about the potentiometer as a variable voltage source, and also to learn about proper sizing of the potentiometer to minimize power required and also to minimize loading effects that could distort the measurement.

7.4.1 LabVIEW programming:

Study the video *Analog Input Express VI* (2:00)

<https://www.youtube.com/watch?v=N6Mi-VjBlmc>

to learn how to use *Analog Input Express VI* to measure the voltage divider output voltage.

7.5 Basic Modifications

Study the video *Potentiometer Demo Walk-Through* (3:07)

<https://www.youtube.com/watch?v=RYeKluU6DX8>

to learn the design principles of *Potentiometer demo*, and then try making these modifications to the block diagram of *Main.vi*:

- [a] Make the front-panel control selectable,
- [b] Replace dial indicator with another type of indicator,
- [c] Connect to a DIO input and monitor it's state inside a loop; adjust the pot voltage to locate the hysteresis edges of the digital input, and
- [d] Make a bar graph indicator of the pot wiper position with onboard LEDs.

7.6 Integrated Project Ideas

Now that you know how to use the potentiometer consider integrating it with other devices to create a complete system, for example:

- [a] Steer By Wire (Topic 43)

a. For More Information

Potentiometer by Resistor guide - Describes a variety of potentiometer types and characteristics:

<http://www.resistorguide.com/potentiometer>

Bibliography:

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