

Topic 14:
Design, implementation and programming of the
PhotoInterrupter Interface
for the Slow Control System MPD-NICA,
on the NImyRIO and LabView platforms.¹

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(Accepted June, 2018)

15 PhotoInterrupter

A PhotoInterrupter, also called a photogate, combines an infrared LED emitter to produce an optical light path and an infrared detector to sense when the light path is broken. A PhotoInterrupter serves as the basis for position and speed measurement when combined with timers and suitable targets of alternating opacity and transparency. Figure 14.1 pictures the NImyRIO StarterKit PhotoInterrupter.

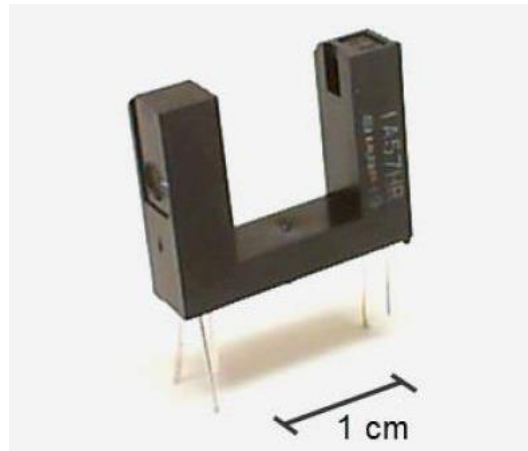


Figure 15-1; NImyRIO StarterKit PhotoInterrupter

15.1 Learning Objectives:

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

- [a] Size the current-limiting resistor for the infrared emitter,
- [b] Apply software-based edge detection to count PhotoInterrupter events.

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

15.2 Component Demonstration

Follow these steps to demonstrate correct operation of the photointerrupter.

15.2.1 Select these parts from the NIMyRIO StarterKit:

- [a] PhotoInterrupter,

<http://sharpmicroelectronics.com/download/gp1a57hr-epdf>

- [b] Resistor, 470 Ω
- [c] Breadboard
- [d] Jumper wires, M-F (3x)

15.2.2 Build the interface circuit:

Refer to the schematic diagram and recommended breadboard layout shown in Figure 14.2. The PhotoInterrupter interface circuit requires three connections to NIMyRIO MXP Connector B (see Figure A.1 Appendix):

- [a] +5-volt supply \rightarrow B/+5 V (pin 1)
- [b] Ground \rightarrow B/GND (pin 6)
- [c] PhotoInterrupter output \rightarrow B/DIO 0 (pin 11)

15.3 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 PhotoInterrupter demo.lvproj contained in the subfolder PhotoInterrupter demo,
- [d] Expand the hierarchy button (a plus sign) for the myRIO item and then open Main.vi by double-clicking,
- [e] Confirm that NIMyRIO is connected to your computer,
- [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 NIMyRIO before the VI starts running.

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

15.3.1 Expected results:

The demo VI displays the state of the photointerrupter output and an event count. The state should normally be high. Block the PhotoInterrupter optical path with an opaque card, your finger tip, and a sheet of paper. How much opacity does the photointerrupter require to trigger the event counter?

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

15.3.2 Troubleshooting tips:

Not seeing the expected results? Confirm the following points:

- [a] Glowing power indicator LED on NIMyRIO,
- [b] Black Run button on the toolbar signifying that the VI is in runmode,
- [c] Correct MXP connector terminals—ensure that you are using Connector B and that you have the correct pin connections,

- [d] Correct resistor value – ensure that you have a 470 Ω resistor (yellow-violet-brown) and not a 470 kΩ resistor (yellow-violet-yellow).

15.4 Interface Theory

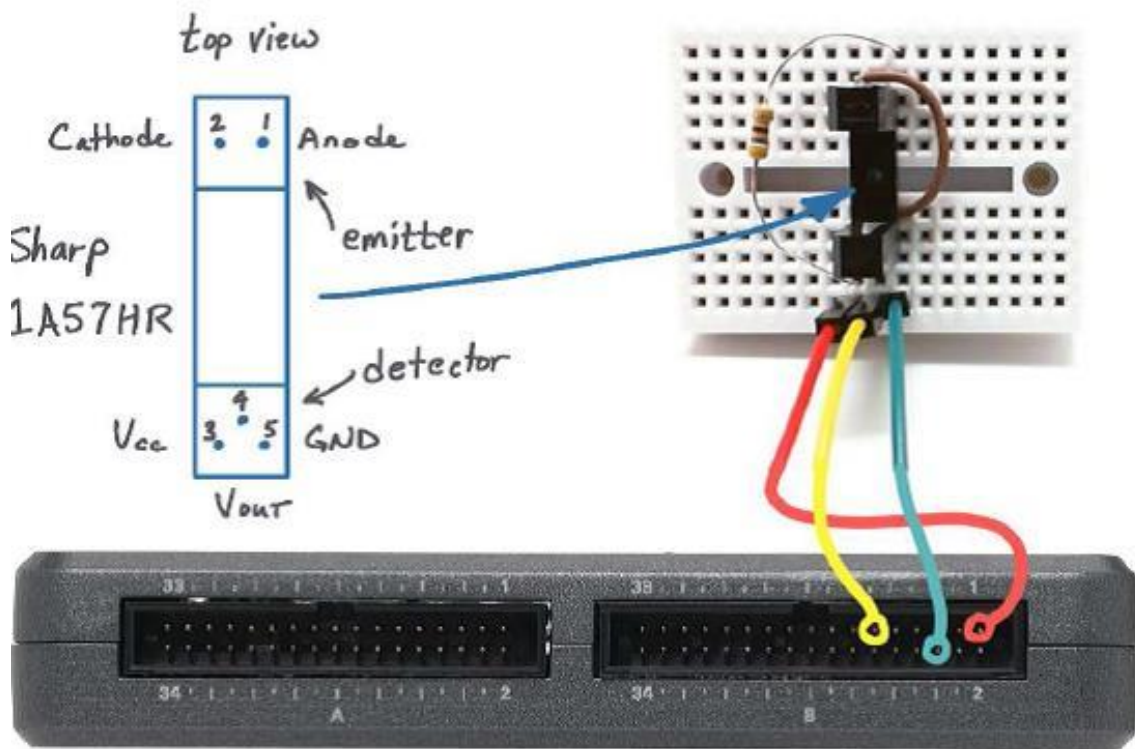
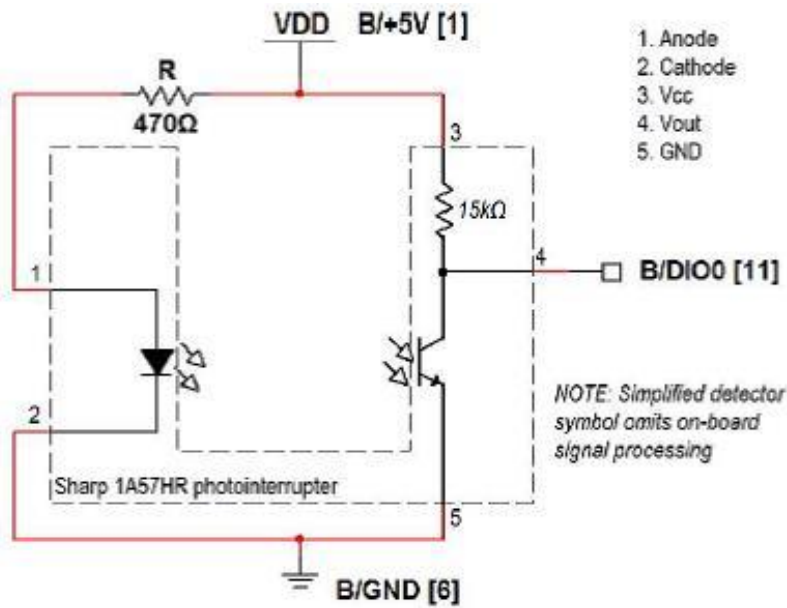


Figure 15-2; Demonstration circuit for PhotoInterrupter: schematic diagram, recommended breadboard layout, and connection to NlmyRIOMXP Connector B.

15.4.1 Interface circuit:

The PhotoInterrupter places an infrared LED as the photo emitter on one side of the gap and a photodetector with signal conditioning circuitry on the other. The output is normally 5 volts and drops to zero volts when the optical path is blocked. The photointerrupter output may be connected directly to any NI myRIO digital input (MXP and MSP connectors).

Study the video *Photointerrupter Characteristics* (4:59)

<https://www.youtube.com/watch?v=u1FVfEvSdqg&feature=youtu.be>

to learn more about the PhotoInterrupter characteristics including the voltage output details and requirements for sizing the current-limiting resistor for the infrared LED emitter.

15.4.2 LabVIEW programming:

Study the video *Digital Input Low-Level VIs* (4:09)

<https://www.youtube.com/watch?v=4nzt7THqU8U&feature=youtu.be>

to learn how to use the low-level *Digital Input VIs* to sense the state of the PhotoInterrupter.

15.5 Basic Modifications

Study the video *PhotoInterrupter Demo Walk-Through* (3:22)

<https://www.youtube.com/watch?v=yuzNb1ZDbv4&feature=youtu.be>

- [a] to learn the design principles of PhotoInterrupter demo, and then try making these modifications to the block diagram of *Main.vi*:
- [b] Add the on board LED Express VI (myRIO | Onboard subpalette) as an indicator on the output of the edge detector (the AND gate). Confirm that the LED flashes briefly when you block the PhotoInterrupter optical path.
- [c] Measure and display the elapsed time between PhotoInterrupter events – use the Elapsed Time Express VI (Programming | Timing subpalette) inside a case structure with the selector terminal connected to the edge detector output.

15.6 Integrated Project Ideas

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

- [a] Tachometer (Topic 49)

15.7 For More Information

- [b] How do I set up photogates for data collection? by Vernier ~ Review of various ways to use a PhotoInterrupter to take time-based measurements such as elapsed time and speed:

<http://vernier.com/tit/1623>

- [c] Switch Tips: PhotoInterrupter switches by Machine Design ~ Replace mechanical pushbuttons with a photointerrupter-based pushbutton to improve reliability and maximize equipment life:

<http://machinedesign.com/archive/switch-tips-photointerrupter-switches>

Bibliography:

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- [j] <http://vernier.com/til/1623>
- [k] <http://machinedesign.com/archive/switch-tips-photointerrupter-switches>