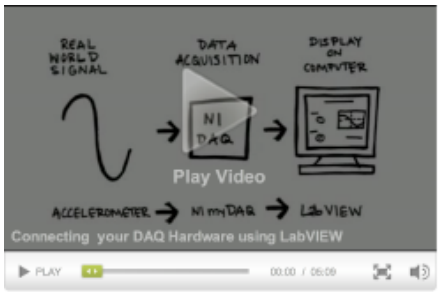
1. Connecting Hardware



Before using NI LabVIEW software to take measurements with an NI data acquisition device, you need to set up and configure the device. This module explains how to install the proper driver and connect, configure, and test your device using NI Measurement & Automation Explorer (MAX) software. It also describes the setup process with the NI myDAQ measurement and control tool, but the same process applies to other USB multifunction DAQ devices such as the NI Educational Laboratory Virtual Instrumentation Suite (NI ELVIS) II or NI USB-6009.

Detailed Explanation

Step-by-Step Procedure

Download the Step-by-Step Procedure PDF

Analog Input Digital I/O Counter I/O
Analog Output

Use this section with the video to test and validate that your NI data acquisition device, such as an NI myDAQ or NI ELVIS II, is working properly. Before proceeding, you must open the test panels for the device.

- Open NI Measurement & Automation Explorer (MAX).
- Navigate to **Start»Programs»National Instruments»Measurement & Automation Explorer**.
- Open test panels.
- Expand **My System.**
- Expand **Devices and Interfaces.**
- Right-click your device of interest and select **Test Panels.**

You can now use test panels to ensure that the analog input, analog output, digital I/O, and counter I/O are all functioning correctly. In this example, test the NI myDAQ.

Analog Input

By default, the test panels open to analog input. You can choose the channel you want to test (Note that you can access the audio input channels as well as the digital multimeter here.), the input range of the channel, the sample mode, and the input terminal configuration. For this test, leave them as default values and just press **Start**.

Note: If you do not have any signals connected to an input line, the signal *floats* and does not hold steady. This is expected behavior.

To verify that the analog input is reading correctly, input a known voltage. You can use any known signal such as a AA battery, but, in this case, use the + rail on the device:

- Connect the **+5 V** rail to the **ai0+** terminal with a wire.
- Connect the **DGND** terminal to the **ai0-** terminal with a wire.
- In the MAX test panel, navigate to the **Analog Input** tab.
- Select **DevX/ai0** for the input channel, where **X** is the device number for your device.
- Select **On Demand** for the **Mode.**
- Select **Differential** for the **Input Configuration.**
- Enter **10** for **Max Input Limit** and **-10** for **Min Input Limit.**
- Press the **Start** button and observe the voltage.
- The graph should display between 4.7 and 5.0 VDC.

Note: This voltage is dependent on the power of the USB hub, so it may not read exactly 5 V, but it holds steady.

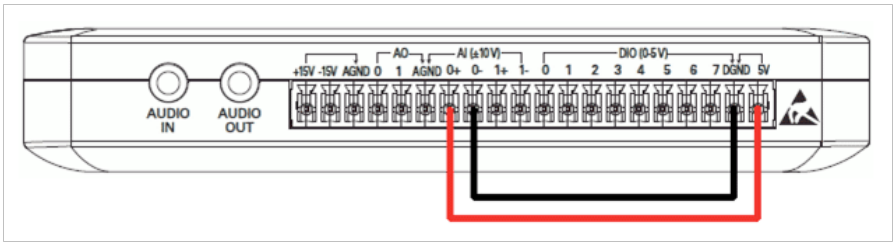


Figure 13. Analog Input Wiring

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Analog Output

Testing the analog output requires looping the analog output back to the analog input to verify the voltage. Start by configuring the physical device.
NOTE: If you have not verified the analog input, do that now and then return to this section.

- Connect **ao0** to the **ai0+** terminal with a wire.
- Connect **AGND** to the **ai0-** terminal with a wire.
- Navigate to the **Analog Output** tab in the MAX test panels.
- Select **DevX/ao0** for the input channel, where **X** is the device number for your device.
- Select **Sinewave Generation** for the **Mode**.
- Select **<Default>** for the **Transfer Mechanism**.
- Enter **10** for **Max Output Limit** and **-10** for **Min Output Limit**.
- Enter **1k** or **1000** for **rate (Hz)**.
- Enter **5** for **Sinewave Amplitude**.
- Press the **Start** button to begin outputting the sine wave.

Now use the analog input to verify the analog output. Configure the analog input according to the analog input section. After pressing **Run**, you can see a sine wave on the graph indicator with a 5 V amplitude, 10 Vpk-pk.

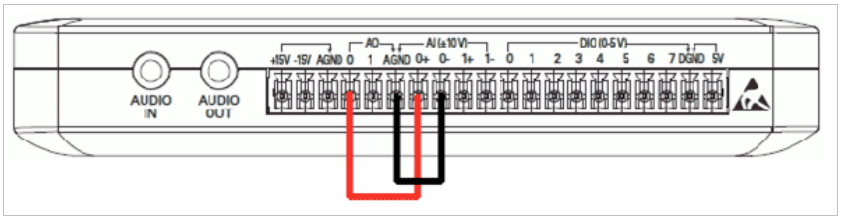

Figure 14. Analog Output Wiring

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Digital I/O

To test the digital I/O, connect DIO0 to DIO4, DIO1 to DIO5, DIO2 to DIO6, and DIO3 to DIO7, with a wire for each pair, which equals four wires total (see Figure 15). After connecting the wires, navigate back to the test panels in MAX.

- Navigate to the **Digital I/O** tab in the MAX test panels.
- Select **DevX/ctr0** for the input channel, where **X** is the device number for your device.
- Select **Port0** for the **Port Name**.
- Select **Port0/line0:7** for the **Port/Line Direction**.
- Toggle lines 0-3 to be input and lines 4-7 to be output.
- Press the **Start** button.
- Toggle the software switches for lines 0-3 to observe the software LEDs change for lines 4-7.

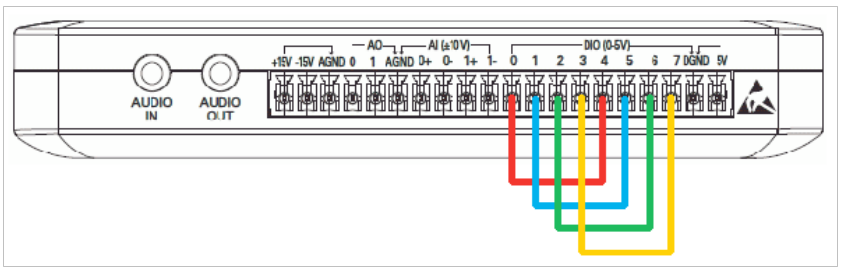

Figure 15. Digital I/O Wiring

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Counter I/O

A counter can both input and output a digital signal deterministically. First, test the input by applying a 5 V to 0 V pulse train; the counter can detect a transition from high to low or low to high.
NOTE: If you do not have a single-pole double-throw (SPDT) switch, you can simply connect a wire into **PFI3** and then connect and disconnect the other end of the wire to the **+5 V** terminal.

- Connect a 330 Ω resistor, SPDT switch in series to terminal **DIO 3** as seen in Figure 16.
- Connect one pole of the SPDT switch to the **DGND** terminal and the other pole to the **+5 V** terminal.
- Navigate to the **Counter I/O** tab in the MAX test panels.
- Select **DevX/ctr0** for the input channel, where **X** is the device number for your device.
- Select **Edge Counting** for the **Mode.**
- Select **/DevX/PFI3** for the **Edge Source.**
- Press the **Start** button and toggle the SPDT switch to begin counting edges.

NOTE: If there is any noise on the signal, multiple edges may be counted for each transition of the SPDT switch.

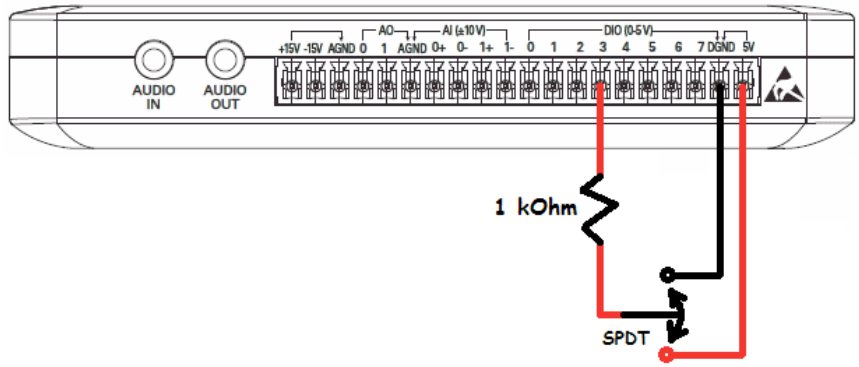

Figure 16. Counter Input Wiring

Now test the output of the counter pulse train, which is a series of digital high and low pulses often used to trigger an event such as a sample clock for data acquisition. To output a pulse train, you must

- Connect a 330 Ω resistor and an LED in series between terminal **DIO 3** and the **+5 V** terminal as seen in Figure 17.
- Navigate to the **Counter I/O** tab in the MAX test panels.
- Select **DevX/ctr0** for the input channel, where **X** is the device number for your device.
- Select **Pulse Train Generation** for the **Mode**.
- **/DevX/PFI3** is the only option for the **Pulse Terminal**.
- Enter 1 for the **Frequency.**
- This outputs a high and low pulse every 1 second or 1 Hz.
- Press the **Start** button to observe the LED blink at a rate of 1 Hz.

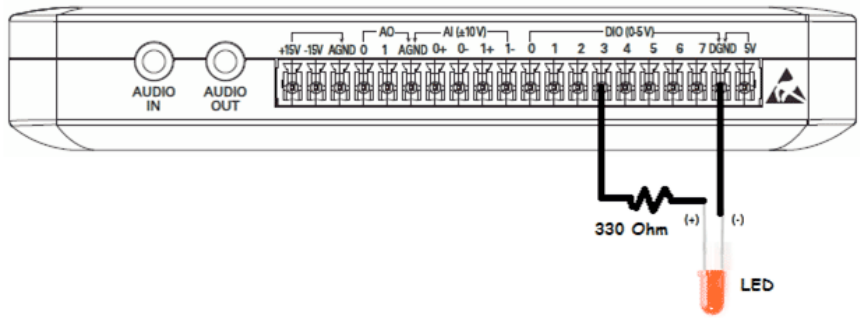

Figure 17. Counter Output Wiring

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Module Quiz: Connecting Hardware

Take the short quiz below to evaluate your understanding of the concepts taught in the Connecting Hardware video and detailed explanation.

1. _____ performs a basic functionality test of the device to see if it is communicating with the driver correctly.
   - ○ Test Panels
   - ○ Device Pinouts
   - ○ Reset Device

- Self-Test

2. _____ clears all associated tasks and references to the DAQ device.
   - Test Panels
   - Device Pinouts
   - Reset Device
   - Self-Test

3. _____ provide a low-level testing environment to verify that all input and output is working as expected.
   - Test Panels
   - Device Pinouts
   - Reset Device
   - Self-Test

4. _____ show all of the pin and terminal assignments for your DAQ device.
   - Test Panels
   - Device Pinouts
   - Reset Device
   - Self-Test

Cumulative Exam: LabVIEW and DAQ

Evaluate your understanding of LabVIEW and the basics of DAQ. This exam is recommended after you complete all of the modules for *LabVIEW Basic Concepts* and *LabVIEW Basic Tasks*. There are 26 multiple choice questions on the exam.

Take the exam

Cumulative Project: LabVIEW and DAQ

Assess your working knowledge of building a complete system by acquiring, processing, and displaying data with LabVIEW and a DAQ device. This project is recommended after you complete all of the modules for *LabVIEW Basic Concepts* and *LabVIEW Basic Tasks*.

Start the project

What Do You Want to Learn Next?

1. Connect to Hardware
2. Acquire and Generate Data
   - Taking a Measurement
   - Generating a Signal
   - Using Counters and Digital I/O
   - Implementing Closed-Loop Control
   - Triggering Data Acquisition
3. Analyze
   - Signal Processing Analysis
   - Monitoring and Alarming
   - Integrating Text-Based Programming
4. Present and Log Data
   - Adding Data Logging
   - Building a User Interface
   - Using Graphs and Charts