Interfacing a DAQ Unit with a Phantom Camera

Abstract:
In this tutorial, a Phantom camera is interfaced with a National Instruments USB 6361 Data Acquisition Unit (DAQ). The first part of this tutorial involves interfacing the DAQ unit with a PC, followed by the procedure for connecting both a DAQ unit and a PC to a Phantom camera. Provided is a simple experiment you can perform to ensure your system is functioning as expected before proceeding to more complex DAQ-related applications. By following this simple tutorial, you will be able to acquire an analogue input signal from a pickle switch using freely downloadable National Instruments (NI) test software. Then, we show how the Phantom Camera Control (PCC) software can be used to complete the same task, but where a cine and analogue input signal can be recorded simultaneously and thus synchronized in time. We also briefly show how the acquired DAQ data can be exported from the PCC software to an Excel file for post processing.

Hardware Needed:

- NI USB 6361 Data Acquisition Unit
- Power Cable for DAQ Unit
- UBS Connector Cable for DAQ Unit
- BNC T-connector (×1) – male end to two female ends
- BNC-to-pigtail Cables (×3) – male end and exposed wires (+/-)
- Pickle Switch
- Phantom camera

Software Needed:

- PCC version 3.1.772.0
- NI-DAQmx 17.6.0

Note: NI-DAQmx 17.6.0 driver software can be downloaded from the NI website:
www.ni.com/download/ni-daqmx-17.6/7169/en/

This download does not include multiple critical updates, which should be downloaded after the initial download is complete by exploring the "NI Update Service" application that came with the NI-DAQmx 17.6.0 installation. If these updates are not installed, the software/hardware will not perform as described.

Step 1: Testing DAQ/Computer Communication

1.1. Plug USB and Power cables into the NI USB 6361 Data Acquisition Unit, and power on the device by pressing the switch located on the back.

1.2. Connect the other end of the USB cable to your PC. If the NI software has already been successfully installed, your PC should detect this device and prompt you with the NI USB-6361 message box shown to the right.

1.3. Activate the "Test this device" function by pressing "Go". This will allow you to measure an analogue input signal using your DAQ unit.

Step 2: Connecting BNC Cables to a DAQ Unit and Phantom Camera

2.1. Connect power and ethernet cables to the Phantom camera. Ensure PCC software and camera are communicating by finding the camera listed underneath the management tab. Consult the *PCC help file*, section 5.5, pg. 55.

2.2. Connect the male end of a BNC cable to the READY/P port, see ***Figure 1A***. Then, insert and then screw down the positive and negative leads of the opposite end in pinouts 74 & 90 on the DAQ, respectively, see ***Figure 1B***.

2.3. Connect the male end of another BNC cable to the STROBE/P port, see ***Figure 1A***. Then, screw down the positive and negative leads of the opposite end in pinouts 73 & 88, respectively, see ***Figure 1B***.

2.4. Connect the male end of the BNC-T-connector to the TRIGGER port, and then connect the males ends of a Pickle switch and a third BNC cable to the two female ports of the T-connector, see ***Figure 1A***. Finally, insert and screw down the positive and negative ends of the BNC cable to pinouts 1 & 2, respectively, see ***Figure 1B***.

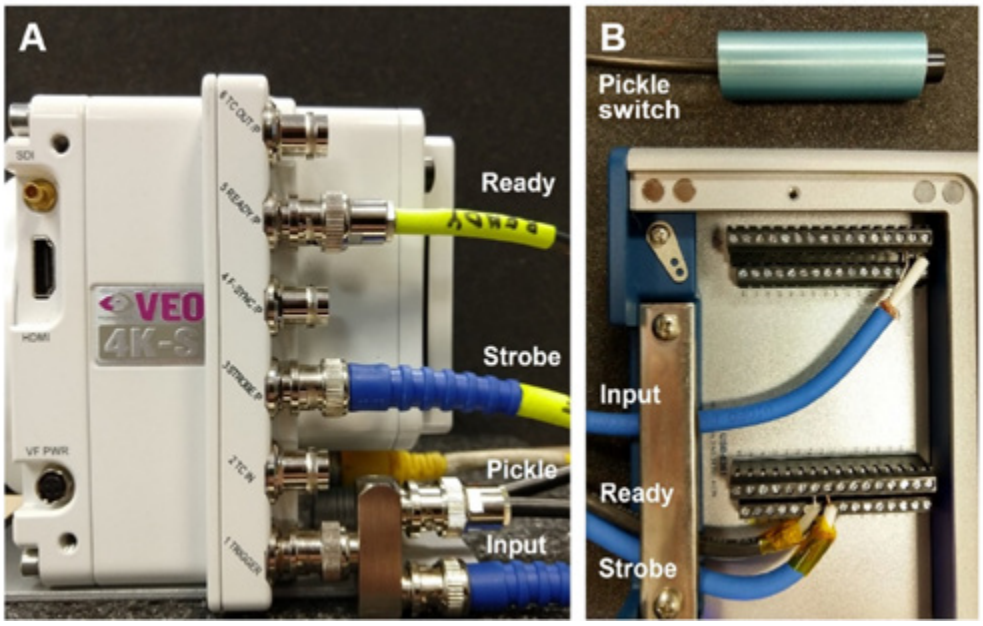


Figure 1. *Configuration of the (A) BNC cables into the Phantom VEO 4K-S and the corresponding (B) DAQ pinouts.*

Step 3: Using the NI Test Panel Interface to Measure Trigger Input Signal

In this step, we illustrate how the NI test panel can be used to monitor the analogue input from the camera/DAQ/pickle-switch configuration in ***Figure 1***. If the NI test panel was closed out, simply unplug and re-plug the USB cable into your PC to bring it back.

3.1. Ensure *Test Panel* dropdown tab is set to "Analog Input", see left side of ***Figure 2***.

3.2. Set *Channel Name* to "Dev1/ai0", which corresponds to pinouts 1 & 2 (Pickle Switch).

3.3. Set the *Mode* to *"On Demand"*, which allows for real-time signal monitoring.

3.4. Set the *Input Configuration* to *Differential*.

Note: *For floating source analogue inputs (e.g., from thermocouples) the RSE configuration can be selected, but pin-outs 1 & 3 (AI0+/AI GND) should be used. Or, the differential setup can be used if additional resistors need be. Please see the Appendix of this document of various input configurations. It is also important to know that sensors such as accelerometers, strain gauges, and photoresistors require signal conditioning hardware in between the sensor and the DAQ unit.*

3.5. Because the expected voltage drop at the trigger port is from ~4.2 and 0 V, set the *Max Input Limit* to 5 V and the *Min Input Limit* to -1 V. Click on the Start button.

3.6. Toggle the pickle switch. You should see a rising and falling edge, like in ***Figure 2***.

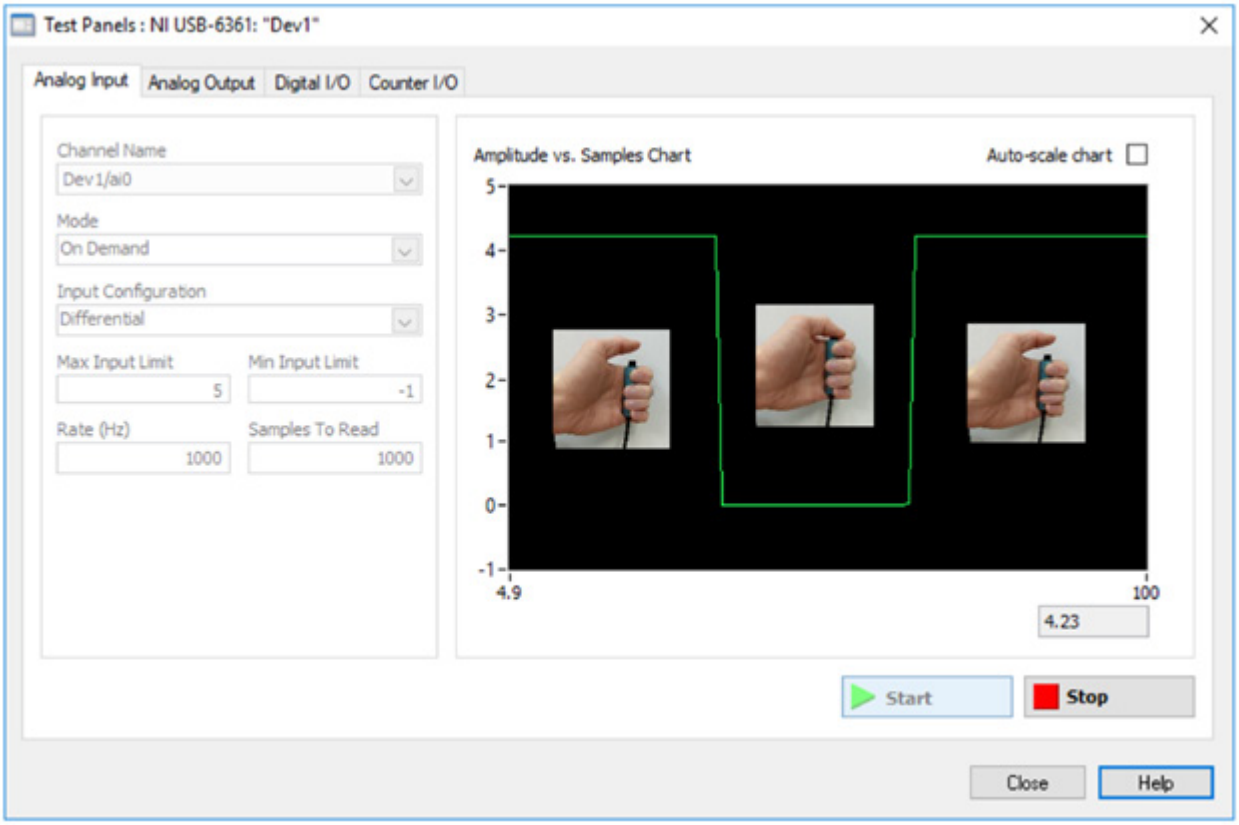


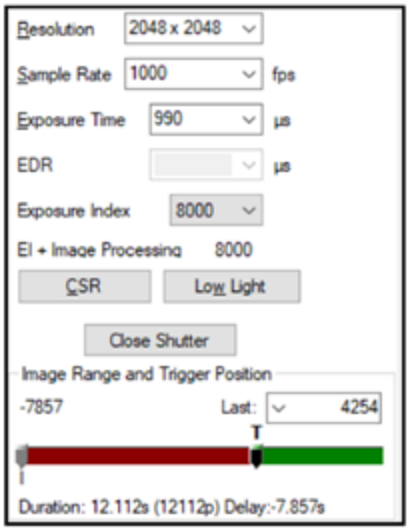
Figure 2. Graphical output measured in the NI Test Panel. We show that when the pickle switch is not activated (trigger button not pressed) a constant ~4.2 V is measured, and 0 V is measured when activated (trigger button pressed).

Step 4: Synchronizing Analogue Input Signals with Recorded Cines

In the next series of steps, the PCC software (instead of the NI test panel) will record and display the analogue signals from the Pickle switch activation.

4.1. Close the NI test panel, otherwise, you will receive an error window when in PCC.

4.2. Open PCC, select desired camera and cine settings. The settings for this tutorial are shown to the right. We selected 1000 fps so the cine is only 12s long, and set the camera to capture many pre-trigger frames to easily visualize the voltage profile before and after the trigger signal.



4.3. In PCC, click on the drop-down menu entitled "Advanced Settings". Near the bottom of this dropdown Menu, you should find a header entitled "DAQ Signals", and under that, a button labelled *Configure*. Click it.

Note: *If a Cine is already saved to the RAM, you will not be able to set the DAQ Signal parameters. You can simply press* Capture *to delete the Cine in the RAM, and again press the* Configure *button.*

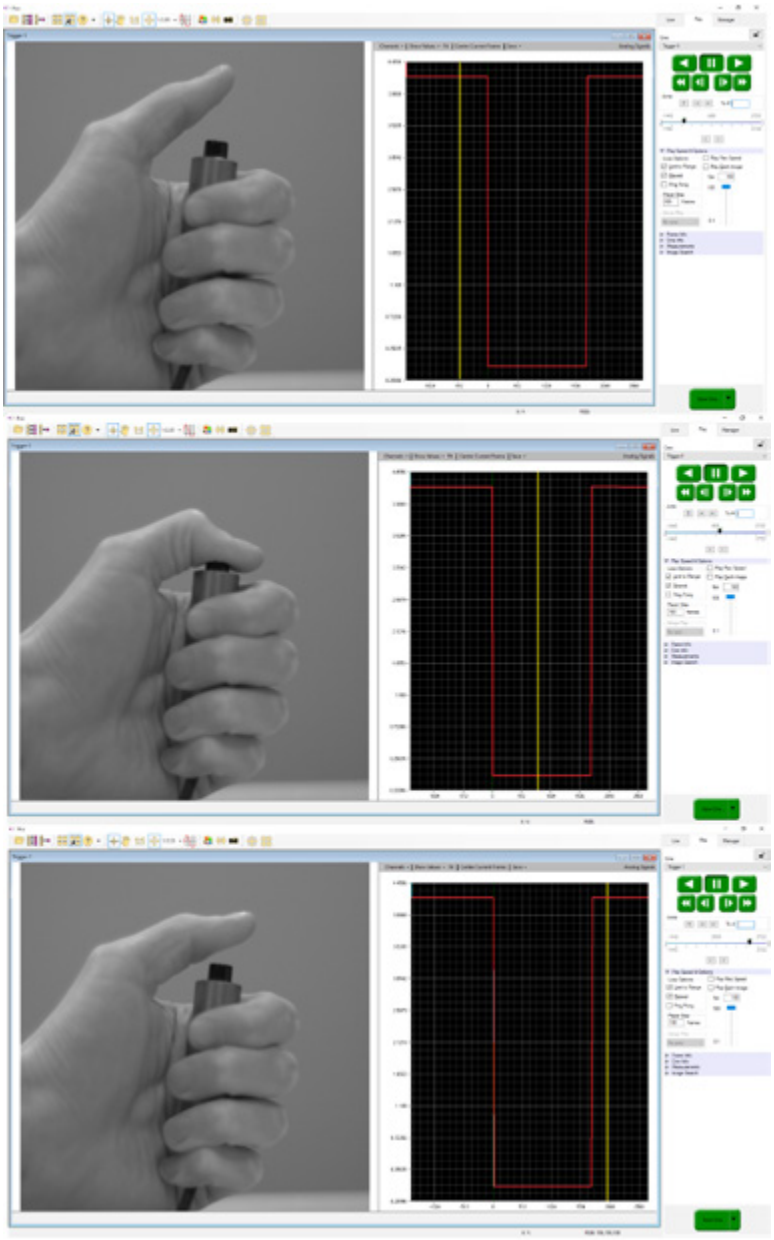
4.4. After clicking *Configure*, the window below will open. In this window, check off the Differential input box and change the number of *Used* Analog Channels from 0 to 1. If desirable, you can change the name of the channel, here we called it "Trigger" and gave it the unit "Volts". Click OK.

Note: *If you have a relatively small analogue input signal, you can amplify the signal by increasing the values in the AnaGain box.*

Note: *If you desire more than one data point per frame, increase the number in the "Samples-per-image" box on the bottom-right of the box below.*

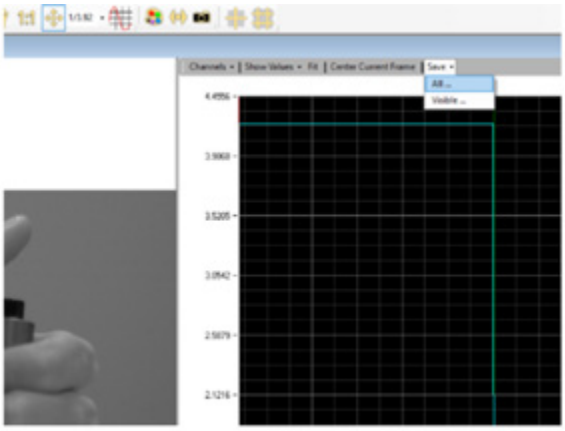
4.5. Focus the camera at your hand holding the pickle switch. Once the pre-trigger buffer is full (bar goes from red to completely pink), activate the pickle switch and then release. Once the cine completes, you can visualize the graphical data by clicking on the "graphics" button on the top of PCC (icon within the red dashed square below):

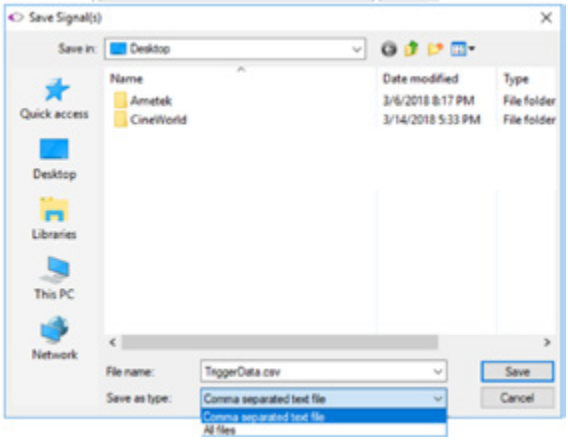
4.6. From the series of screenshots below, when the pickle switch is not activated, the voltage remains at 4.2 V. When the pickle switch is activated, the voltage drops to 0 V. Upon releasing the switch, the voltage again immediately recovers back to 4.2 V.



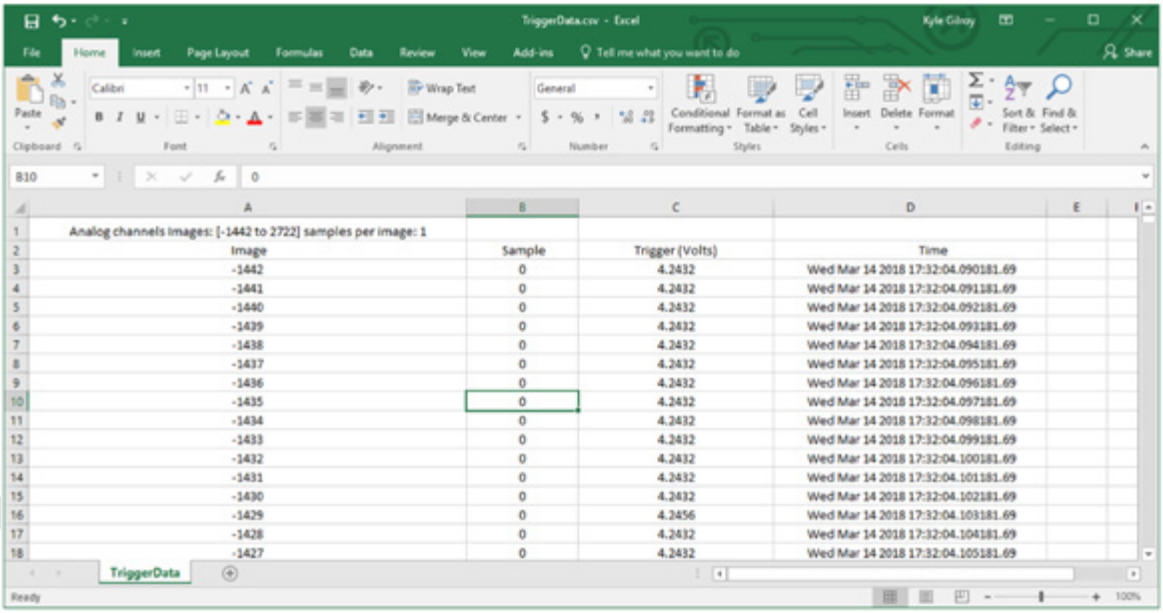
Step 5: Post-Processing: Taking a Closer Look at the Data

5.1. For more in-depth analyses, export the data by clicking the Save button from the dropdown tab as shown below, and then press "All ..." (left figure below), make sure to save as Comma separated text file (right figure below).





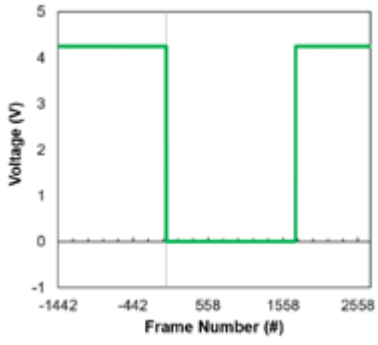
5.2. The data should be distributed among columns as shown below:



TriggerData.csv - Excel

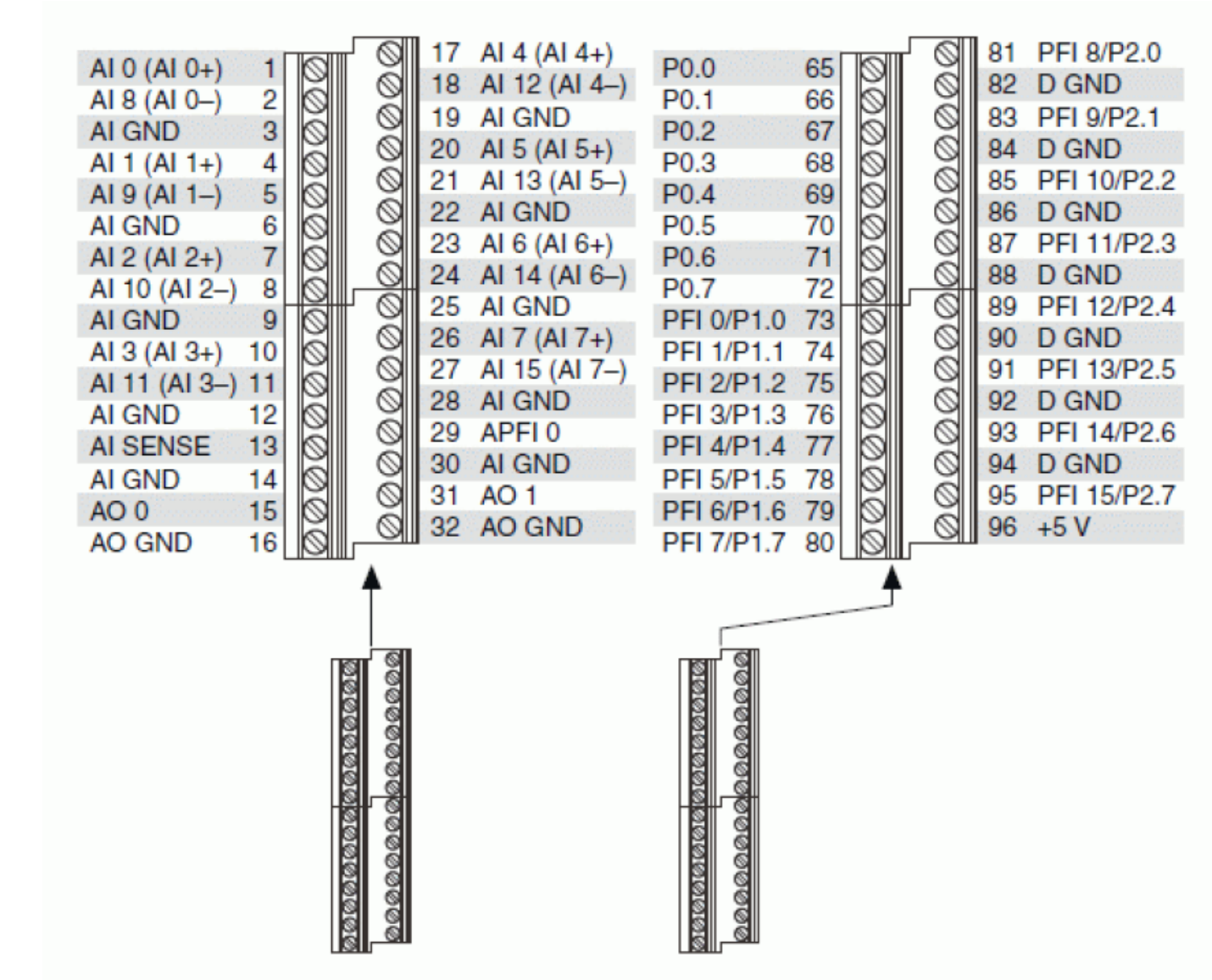
	A	B	C	D
1	Analog channels images: [-1442 to 2722] samples per image: 1			
2	Image	Sample	Trigger (Volts)	Time
3	-1442	0	4.2432	Wed Mar 14 2018 17:32:04.090181.69
4	-1441	0	4.2432	Wed Mar 14 2018 17:32:04.091181.69
5	-1440	0	4.2432	Wed Mar 14 2018 17:32:04.092181.69
6	-1439	0	4.2432	Wed Mar 14 2018 17:32:04.093181.69
7	-1438	0	4.2432	Wed Mar 14 2018 17:32:04.094181.69
8	-1437	0	4.2432	Wed Mar 14 2018 17:32:04.095181.69
9	-1436	0	4.2432	Wed Mar 14 2018 17:32:04.096181.69
10	-1435	0	4.2432	Wed Mar 14 2018 17:32:04.097181.69
11	-1434	0	4.2432	Wed Mar 14 2018 17:32:04.098181.69
12	-1433	0	4.2432	Wed Mar 14 2018 17:32:04.099181.69
13	-1432	0	4.2432	Wed Mar 14 2018 17:32:04.100181.69
14	-1431	0	4.2432	Wed Mar 14 2018 17:32:04.101181.69
15	-1430	0	4.2432	Wed Mar 14 2018 17:32:04.102181.69
16	-1429	0	4.2456	Wed Mar 14 2018 17:32:04.103181.69
17	-1428	0	4.2432	Wed Mar 14 2018 17:32:04.104181.69
18	-1427	0	4.2432	Wed Mar 14 2018 17:32:04.105181.69

5.3. By selecting (or highlighting) the data in columns A and C only; pressing *Insert* from the dropdown menu, followed by pressing the scatter plot icon, you can create custom plot as shown:



APPENDIX

Pinouts for the **NI 6361**. This schematic was reprinted from the "DEVICE SPECIFICATIONS NI 6361" from the National Instruments Webpage: **www.ni.com/pdf/manuals/374650c.pdf**



INPUT CONFIGURATIONS FOR THE DAQ UNIT

Input configurations for the DAQ unit. This schematic was reprinted from a National Instruments White Paper entitled, "Field Wiring and Noise Considerations for Analog Signals": **http://www.ni.com/white-paper/3344/en/**

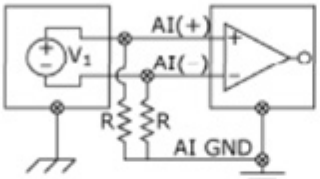
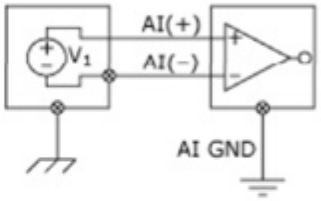
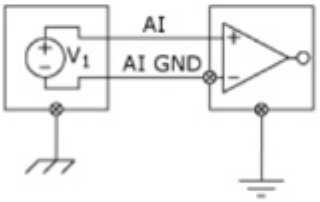
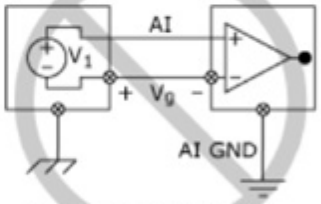
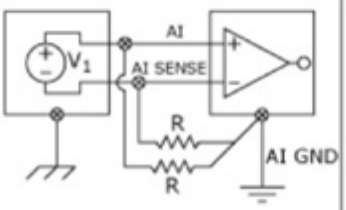
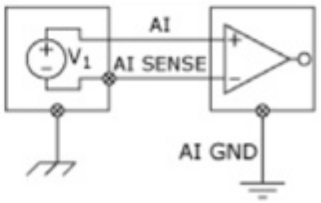
Input Configuration	Signal Source Type	
	Floating Signal Source (Not Connected to Building Ground)	**Grounded Signal Source**
	Examples • Thermocouples • Signal Conditioning with Isolated Outputs • Battery Devices	Examples • Plug-in Instruments with Nonisolated Inputs
Differential (DIFF)	 Two resistors (10 kΩ<R<100 kΩ) provide return paths to ground for bias currents	
Single-Ended – Ground Referenced (RSE)		NOT RECOMMENDED  Ground-loop losses, V_g, are added to measured signal.
Single-Ended – Nonreferenced (NRSE)		

Table 1. Analog Input Connections

LIST OF SUPPORTED DAQS

USB X Series

- ✓ NI USB-6341
- ✓ NI USB-6343
- ✓ NI USB-6351
- ✓ NI USB-6353
- ✓ NI USB-6356
- ✓ NI USB-6361
- ✓ NI USB-6363 BNC
- ✓ NI USB-6366

USB M Series

- ✓ NI USB-6212 BNC
- ✓ NI USB-6216 BNC
- ✓ NI USB-6218 BNC
- ✓ NI USB-6221
- ✓ NI USB-6221 BNC
- ✓ NI USB-6229
- ✓ NI USB-6229 BNC
- ✓ NI USB-6225
- ✓ NI USB-6251 BNC
- ✓ NI USB-6259 BNC

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https://phantomhighspeed-service.force.com/?section=Support

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