

# CALIBRATION PROCEDURE

# PXIe-4310

8-channel, 16-bit, 400 kS/s/ch, Ch-Ch Isolated Analog Input Module

This document contains the verification and adjustment procedures for the PXIe-4310 module.



**Note** To maintain forced air cooling in the PXI Express system, refer to the *Maintain Forced-Air Cooling Note to Users*.

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## Software

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Calibrating the PXIe-4310 requires the installation of NI-DAQmx on the calibration system. Driver support for calibrating the PXIe-4310 was first available in NI-DAQmx 17.1. For the list of devices supported by a specific release, refer to the *NI-DAQmx Readme*, available on the version-specific download page or installation media.

You can download NI-DAQmx from [ni.com/downloads](http://ni.com/downloads). NI-DAQmx supports LabVIEW, LabWindows™/CVI™, C/C++, C#, and Visual Basic .NET. When you install NI-DAQmx, you only need to install support for the application software that you intend to use.

# Documentation

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Consult the following documents for information about the PXIe-4310, NI-DAQmx, and your application software. All documents are available on [ni.com](http://ni.com), and help files install with the software.



*PXIe-4310 and TB-4310 (10V)/TB-4310 (600V) Getting Started Guide and Terminal Block Specifications*

NI-DAQmx driver software installation and hardware setup.



*PXIe-4310 User Manual*

PXIe-4310 usage and reference information.



*PXIe-4310 Specifications*

PXIe-4310 specifications and calibration interval.



*NI-DAQmx Readme*

Operating system and application software support in NI-DAQmx.



*NI-DAQmx Help*

Information about creating applications that use the NI-DAQmx driver.



*LabVIEW Help*

LabVIEW programming concepts and reference information about NI-DAQmx VIs and functions.



*NI-DAQmx C Reference Help*

Reference information for NI-DAQmx C functions and NI-DAQmx C properties.



*NI-DAQmx .NET Help Support for Visual Studio*

Reference information for NI-DAQmx .NET methods and NI-DAQmx .NET properties, key concepts, and a C enum to .NET enum mapping table.

# PXIe-4310 Verification and Adjustment

This section provides information for verifying and adjusting the PXIe-4310.

## Test Equipment

Table 1 lists the equipment recommended for the performance verification procedures of the PXIe-4310. If the recommended equipment is not available, select a substitute using the requirements listed in Table 1.

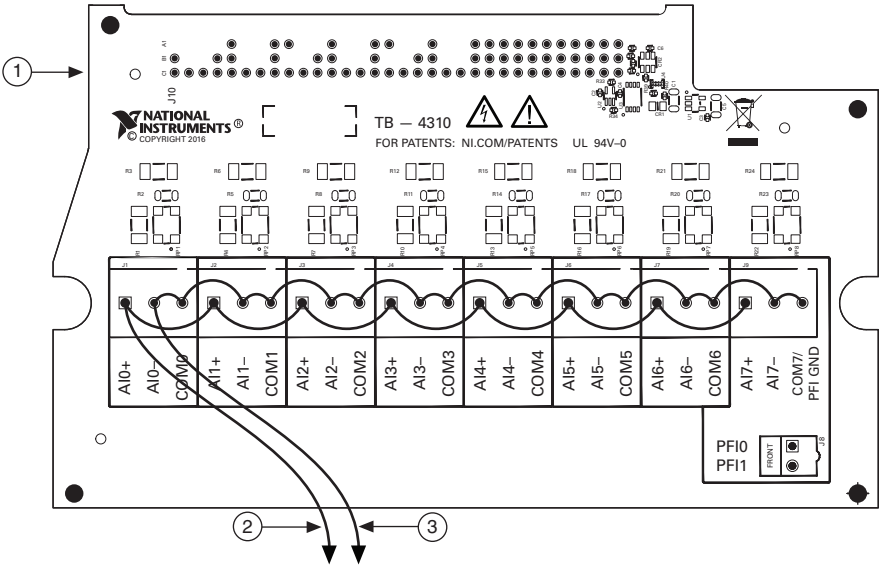
**Table 1.** Recommended Equipment for PXIe-4310 Verification

<b>Equipment</b>	<b>Recommended Model</b>	<b>Requirements</b>
Calibrator	Fluke 5700A	If this instrument is unavailable, use a high-precision voltage source with an accuracy of at least 15 ppm for adjustment and verification. The source needs an output range of at least $\pm 10$ V and an output impedance of $\leq 50 \Omega$ .
PXI Express Chassis	PXIe-1062Q	If this chassis is unavailable, use another PXI Express chassis, such as the PXIe-1082 or PXIe-1078.
Connection Accessory	TB-4310 (10V)	—

# Connecting the TB-4310 (10V)

The TB-4310 (10V) provides connections for the PXIe-4310. Figure 1 shows the pin assignments of the TB-4310 (10V).

**Figure 1.** TB-4310 (10V) Circuit Board Parts Locator Diagram



1 TB-4310 (10V)

2 To Calibrator +

3 To Calibrator -

Each channel consists of two terminal connections specific to that channel as shown in Table 2. You can verify the accuracy for any or all channels depending on the desired test coverage.

Refer to Table 2 for the analog signal names of the TB-4310 (10V).

**Table 2.** TB-4310 (10V) Analog Signal Names

Signal Names	Reference	Direction	Description
COM <0..7>	—	—	Analog Input Isolated Ground—These terminals are the reference point for differential analog input measurements.
AI <0..7>+, AI <0..7>-	COM <0..7>	Input	Analog Input Channels 0 to 7—AI+ and AI- are the positive and negative inputs of a differential analog input.

# Test Conditions

The following setup and environmental conditions are required to ensure the PXIe-4310 meets published specifications.

- Review and become familiar with the entire procedure before beginning the calibration process.
- Keep connections to the PXIe-4310 as short as possible. Long cables and wires act as antennas, picking up extra noise that can affect measurements.
- Verify that all connections to the TB-4310 (10V) are secure.
- Use shielded copper wire for all cable connections to the TB-4310 (10V). Use twisted-pair wire to eliminate noise and thermal offsets.
- Maintain an ambient temperature of  $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ . The PXIe-4310 temperature will be greater than the ambient temperature.
- Keep relative humidity below 80%.
- For valid test limits, maintain the device temperature within  $\pm 1\text{ }^{\circ}\text{C}$  from the last self-calibration and  $\pm 10\text{ }^{\circ}\text{C}$  from the last external calibration. The device temperature will be greater than the ambient temperature. Refer to the [Checking Device Temperature Changes](#) section for more information about verification and adjustment temperatures and temperature drift.
- Allow a warm-up time of at least 15 minutes to ensure that the PXIe-4310 measurement circuitry is at a stable operating temperature.
- Ensure that the PXI/PXI Express chassis fan speed is set to HIGH, that the fan filters are clean, and that the empty slots contain filler panels. For more information, refer to the *Maintain Forced-Air Cooling Note to Users* document available at [ni.com/manuals](http://ni.com/manuals).

## Initial Setup

Refer to the *PXIe-4310 and TB-4310 (10V)/TB-4310 (600V) Getting Started Guide and Terminal Block Specifications* for information about how to install the software and hardware and how to configure the device in NI Measurement & Automation Explorer (MAX).



**Note** When a device is configured in MAX, it is assigned a device identifier. Each function call uses this identifier to determine which DAQ device to verify. This document uses `Dev1` to refer to the device name. In the following procedures, use the device name as it appears in MAX.

## Self-Calibration

A self-calibration must be performed before performing device verification. Perform a self-calibration after the device has warmed up for the recommended time period of 15 minutes.

You can initiate self-calibration using MAX, by completing the following steps.

1. Launch MAX.
2. Select **My System»Devices and Interfaces»PXIe-4310**.

3. Initiate self-calibration using one of the following methods:
  - Click **Self-Calibrate** in the upper right corner of MAX.
  - Right-click **NI PXIe-4310** and select **Self-Calibrate** from the drop-down menu.



**Note** Once self-calibration is completed, maintain the device temperature within  $\pm 1$  °C of the self-calibration temperature.



**Note** NI recommends self-calibrating using MAX, although you can also self-calibrate programmatically.

## Checking Device Temperature Changes

Device temperature changes (greater than  $\pm 10$  °C since the previous external calibration or greater than  $\pm 1$  °C since the previous self-calibration) can cause you to incorrectly verify and adjust your device. After self-calibrating your device as described in the [Self-Calibration](#) section, complete the following steps to compare the current device temperature to the temperatures measured during the last self-calibration and external calibration in MAX.

1. Launch MAX.
2. Select **My System»Devices and Interfaces»PXIe-4310**.
3. Click the **Settings** tab. Temperature information is displayed in the Self-Calibration and External Calibration sections of the **Settings** tab.

## Accuracy Verification

This section provides instructions for verifying the PXIe-4310 specifications.

Throughout the verification process, use Table 4 to determine if your device needs to be adjusted.

Since PXIe-4310 modules have many different ranges, you must check measurements for each available range. You must perform verification on all ranges of all analog input channels of PXIe-4310 modules in differential mode.



**Note** The test limits used in this document assume a maximum temperature drift of  $\pm 10$  °C from the last external calibration, and a maximum temperature drift of  $\pm 1$  °C from the last self-calibration. Refer to the [Checking Device Temperature Changes](#) section for more information and instructions on reading your device temperature and comparing it against the device temperature during the last external calibration.

Complete the following steps to verify the analog input:



**Note** The TB-4310 (600V) cannot be used for verification or adjustment of the PXIe-4310.

1. Connect the output of the calibrator to the TB-4310 (10V) as shown in Figure 1.
2. Connect the TB-4310 (10V) to the PXIe-4310.

Table 4 shows all acceptable values for the PXIe-4310. NI recommends that you verify all ranges.

3. Set the calibrator voltage to the test value indicated in Table 4.
4. Create and configure a DAQmx task using the settings in Table 3. Set the range corresponding to the selected test value from Table 4.
5. Start the acquisition.
6. Average the voltage values that you acquired.
7. Compare the resulting average to the upper and lower limits listed in Table 4. If the result is between these values, the device passes the test.
8. Clear the acquisition task.
9. For each value in Table 4 repeat steps 3 through 8.
10. Disconnect the calibrator from the device.

You have finished verifying the analog input specification on your device.



**Note** If verification results are within the *24-Hour Limits* listed in Table 4 an adjustment is not required, but is still recommended. If you do not want to perform an adjustment, you can update the calibration date without making any adjustments by initializing an external calibration and closing the external calibration.

**Table 3.** AI Voltage Configuration

<b>Configuration</b>	<b>Value</b>
Physical Channels	Dev1/ai0:7
Sample Mode	Finite number of samples.
Sample Clock Rate	100000
Samples per Channel	10000
Measurement Type	Voltage
Units	V
Terminal Configuration	Differential
Sample Timing Type	Sample Clock

**Table 4. PXIe-4310 Analog Input Values**

Range (V)		Test Point		24-Hour Limits		2-Year Limits	
Min	Max	Location	Value (V)	Lower Limit (V)	Upper Limit (V)	Lower Limit (V)	Upper Limit (V)
-10	10	Pos FS	9.980000	9.978177	9.981823	9.977508	9.982492
-10	10	Neg FS	-9.980000	-9.981823	-9.978177	-9.982492	-9.977508
-5	5	Neg FS	-4.990000	-4.990947	-4.989053	-4.991276	-4.988724
-5	5	Pos FS	4.990000	4.989053	4.990947	4.988724	4.991276
-2	2	Pos FS	1.996000	1.995567	1.996433	1.995439	1.996561
-2	2	Neg FS	-1.996000	-1.996433	-1.995567	-1.996561	-1.995439
-1	1	Neg FS	-0.998000	-0.998265	-0.997735	-0.998323	-0.997677
-1	1	Pos FS	0.998000	0.997735	0.998265	0.997677	0.998323
-10	10	0.000000	0.000000	-0.000765	0.000765	-0.000765	0.000765
-5	5	0.000000	0.000000	-0.000408	0.000408	-0.000408	0.000408
-2	2	0.000000	0.000000	-0.000207	0.000207	-0.000207	0.000207
-1	1	0.000000	0.000000	-0.000140	0.000140	-0.000140	0.000140

## Adjustment

Following the adjustment procedure automatically updates the calibration date and temperature, and adjusts the analog input calibration constants and stores them in the EEPROM of the PXIe-4310.

Complete the following steps to perform device adjustment using a calibrator:

1. Connect the output of the calibrator to the TB-4310 (10V) as shown in Figure 1.
2. Set your calibrator to output a voltage of 7.5 V.
3. Open an external calibration session on your device using the DAQmx Initialize External Calibration function with the following parameters:

**deviceName:** Dev1

**password**<sup>1</sup>: NI

**calHandle:** &calHandle

4. Call the 4310 instance of the DAQmx Adjust SC Express Calibration function with the following parameters:

**calHandle:** calHandle

**referenceVoltage:** 7.5

<sup>1</sup> The default password is NI, which can be changed. Refer to the *NI-DAQmx Help* for details.



5. Save the adjustment constants to the EEPROM, using the DAQmx Close External Calibration function with the following parameters:

**calHandle:** calHandle

**action:** DAQmx\_Val\_Action\_Commit

This function also saves the date, time, and temperature of the adjustment to the onboard memory.



**Note** If an error occurs during adjustment, no constants will be written to the EEPROM.

6. Place the calibrator in Standby.
7. Disconnect the calibrator from the device.

The device is now adjusted with respect to your external source.

## Reverification

Repeat the *Accuracy Verification* section using the *24-Hour Limits* in Table 4 to determine the as-left status of the device.



**Note** If any test fails Reverification after performing an adjustment, verify that you have met the *Test Conditions* before returning your device to NI. Refer to *Worldwide Support and Services* for assistance in returning the device to NI.

## Specifications

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Refer to the *PXIe-4310 Specifications* document for detailed PXIe-4310 specification information.

## Worldwide Support and Services

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The NI website is your complete resource for technical support. At [ni.com/support](https://ni.com/support), you have access to everything from troubleshooting and application development self-help resources to email and phone assistance from NI Application Engineers.

Visit [ni.com/services](https://ni.com/services) for information about the services NI offers.

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