APEX WAVES
COMPREHENSIVE SERVICES
We offer competitive repair and calibration services, as well as easily accessible documentation and free downloadable resources.
SELL YOUR SURPLUS
We buy new, used, decommissioned, and surplus parts from every NI series. We work out the best solution to suit your individual needs.
Sell For Cash
Get Credit
Receive a Trade-In Deal
OBSOLETE NI HARDWARE IN STOCK & READY TO SHIP
We stock New, New Surplus, Refurbished, and Reconditioned NI Hardware.
Bridging the gap between the manufacturer and your legacy test system.
1-800-915-6216
www.apexwaves.com
sales@apexwaves.com
All trademarks, brands, and brand names are the property of their respective owners.
Request a Quote
CLICK HERE
PXIe-4330

CALIBRATION PROCEDURE

PXIe-4330/4331

This document contains information about verifying and adjusting National Instruments PXIe-4330/4331 modules using NI-DAQmx 9.1 and later. For more information about calibration, visit ni.com/calibration.

Contents

Software

Install NI-DAQmx 9.1 or later on the calibration computer. NI-DAQmx includes high-level function calls to simplify the task of writing software to calibrate modules. You must have the proper module driver installed on the calibration system before calibrating the module.

Note NI recommends that you install the NI-DAQmx driver software before physically installing the PXIe-4330/4331. NI-DAQmx, available at `ni.com/downloads`, configures and controls the PXIe-4330/4331.

NI-DAQmx supports a number of programming languages, including LabVIEW, LabWindows™/CVI™, C/C++, C#, and Visual Basic .NET.

Documentation

The following documents are your primary references for writing your calibration utility with NI-DAQmx. You can download the latest version of these documents from the NI Web site at `ni.com/manuals`.

- The *NI SC Express 4330/4331 Installation Guide and Terminal Block Specifications* provides instructions for installing and configuring the NI PXIe-4330/4331 module.
- The *NI PXIe-4330/4331 User Manual* describes how to use the NI PXIe-4330/4331.
- The *NI PXIe-4330/4331 Specifications* lists the specifications for the NI PXIe-4330/4331.
- The *NI-DAQmx Help* includes information about creating applications that use the NI-DAQmx driver.
- The *NI-DAQmx C Reference Help* includes information about the functions in the driver.

Calibration Interval

National Instruments recommends a calibration interval of one year for the PXIe-4330/4331. Adjust and verify the PXIe-4330/4331 at the recommended calibration interval based on the measurement accuracy demands of your application.

Test Equipment

National Instruments recommends that you use the equipment in Table 1 for calibrating an PXIe-4330/4331 module.

Table 1. Recommended Equipment

Equipment	Recommended Model(s)	Requirements
Multifunction calibrator	Fluke 5520A	If this instrument is unavailable, use a calibrator that can provide resistance values in the range of 120 Ω to 1 k Ω with 0.01 Ω resolution, an accuracy of 90 ppm or better, automatic lead wire compensation, and 2-wire output compensation.
DMMs (x2)	PXI-4071	If this instrument is unavailable, use multiranging 6 1/2 digit DMMs with a DC voltage accuracy of 40 ppm or better of reading +6 ppm of range for the 10 V and 1 V ranges, and 4-wire resistance measurement capability with resistance accuracy of 80 ppm or better of reading +6 ppm range for the 100 k Ω range
Chassis	PXIe-1062Q	If this chassis is unavailable, use another PXIe chassis
Switch modules (x2)	PXIe-2737	4x64 2-wire relay module
160-Pin DIN to 160-Pin DIN cable for PXIe-2737 (x2)	NI Part Number: 782417-02	Cable for connecting the PXIe-2737s to the CAL-4330
CAL-4330 to PXIe-4330/4331 calibration cable	NI Part Number: 787003-01	Cable and included standoffs for connecting the PXIe-4330/4331 DUT to the CAL-4330
Connection accessory	CAL-4330, NI Part Number 786988-01	Calibration Fixture to enable automated calibration of the PXIe-4330/4331
Banana-to-banana patch cables (x10)	Five Pomona 1440-36-0 black banana plug patch cords (cables) Five Pamona 1440-36-1 red banana plug patch cords (cables)	—

Test Conditions

The following setup and environmental conditions are required to ensure the NI device meets published specifications.

- Keep connections to the module as short as possible. Long cables and wires act as antennae, picking up extra noise that can affect measurements.
- Use shielded copper wire for all cable connections to the module. Use twisted-pair wire to eliminate noise and thermal offsets.
- Maintain an ambient temperature of 23 °C ±5 °C.
- Keep relative humidity below 80%.
- Allow a warm-up time of at least 15 minutes to ensure that the measurement circuitry is at a stable operating temperature.
- Ensure that the 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`.
- Warm-up time for test equipment may vary depending on the manufacturer. Please refer to the equipment's Operators Manual for specified warm-up time.
- To meet Fluke 5520A specifications, zero the Calibrator every 7 days, or when the Calibrator ambient temperature changes by more than 5 °C. Warm-up time for Fluke 5520A is 30 minutes.

Calibration Procedure

This section provides instructions for verifying the performance of the PXIe-4330/4331. The calibration process consists of the following steps:

1. *Initial Setup*—Install the module and configure it in Measurement & Automation Explorer (MAX).
2. *Verification Procedures*—Verify the existing operation of the module. This step confirms whether the module is operating within the published specifications—gain accuracy, input offset, shunt quarter-bridge calibration, shunt calibration resistance, and excitation—prior to adjustment.
3. *Gain and Offset Adjustment Procedure*—If necessary, perform an external calibration that adjusts the module calibration constants with respect to a known calibration source.
4. *Reverification*—Repeat the verification procedure to ensure that the module is operating within the published specifications after adjustment.

Initial Setup

You must configure the module in MAX to communicate with NI-DAQmx.

Complete the following steps to configure a module in MAX. Refer to the *NI SC Express 4330/4331 Installation Guide and Terminal Block Specifications* for complete installation instructions.

1. Install the NI-DAQmx, 9.1 or later, driver software.

Caution Always have the PXI Express chassis turned off when inserting a module.

2. Insert the module into an available slot in the PXI Express chassis.
3. Power on the chassis.
4. Launch MAX.
5. Expand **Devices and Interfaces** to confirm that MAX detects the module.
6. Right-click the module name and select **Self-Test** to ensure that the module is working properly.

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

Connecting the Equipment

The CAL-4330 and two switch modules provide the ability to programmatically connect the required module connections as needed for the various verification and calibration steps. Refer to the specific verification or calibration procedure section for information describing the required switch connections. Detailed connection paths for each of the verification calibration steps are shown in *Appendix A: Connection Path Details*. Before connecting or disconnecting the calibrator from the module, always set the calibrator to standby mode (STBY).

Refer to Figure 1 for a block diagram of the equipment connections. Figure 2 and Figure 3 show the front and rear connectors on the CAL-4330.

Figure 1. Block Diagram

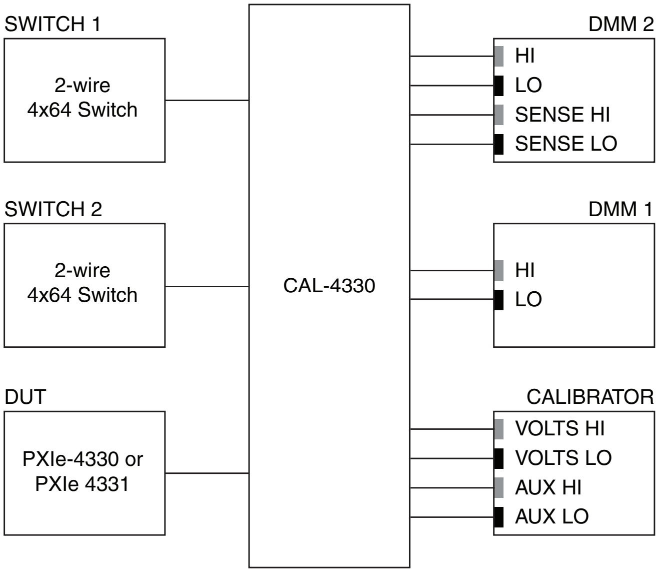
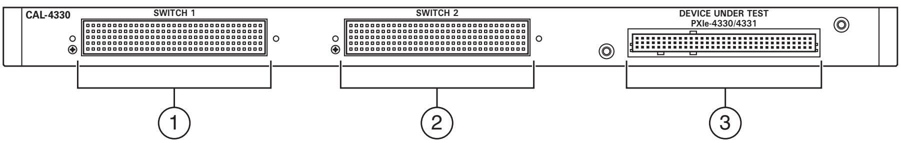
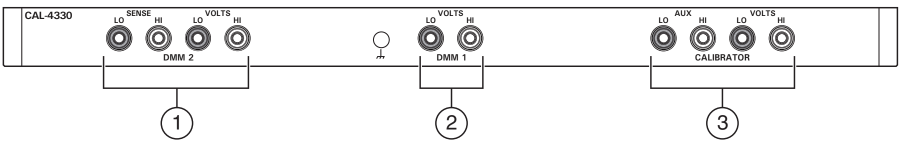


Figure 2. Front Connectors



1	SWITCH 1	2	SWITCH 2	3	DEVICE UNDER TEST

Figure 3. Rear Connectors



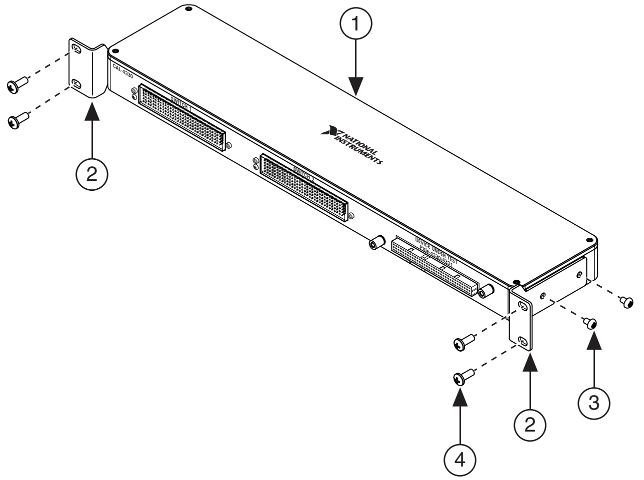
1	DMM 2	2	DMM 1	3	CALIBRATOR

Install the CAL-4330 Into a Rack (Optional)

To install the CAL-4330 into a rack, complete the following steps:

1. Attach the two rack-mount brackets to the sides of the CAL-4330. The brackets and screws are included with the CAL-4330.

Figure 4. Using the Rack-Mount Brackets



1	CAL-4330	3	Rack-Mount Bracket Mounting Screws (4)
2	Rack-Mount Brackets (2)	4	Rack-Mounting Screws (4)

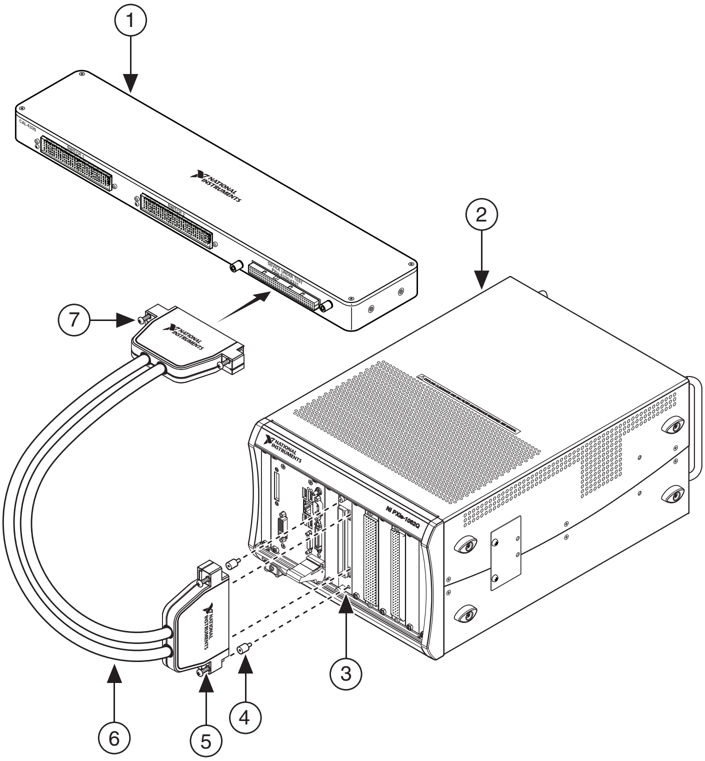
2. Place the CAL-4330 in the desired position in your rack.
3. Install and tighten the four rack-mounting screws that are included with the CAL-4330.

If the chassis is not already installed in the rack (optional), complete the following steps:

1. Attach the PXIe chassis rack-mount hardware to the PXIe chassis. Refer to your rack-mount kit installation guide for more details.
2. Mount the PXIe chassis in the rack in the desired position. Refer to your rack-mount kit installation guide for more details.

Connect the Calibration and Switch Cables

Figure 5. Connecting the Calibration Cable



1	CAL-4330	5	Jack Screws (2)
2	PXI Chassis	6	CAL-4330 to PXIe-4330/4331 Calibration Cable
3	PXIe-4330/4331 (DUT)	7	Jack Screws (2)
4	Standoffs (2)		

1. Screw the two standoffs into the PXIe-4330/4331 module and tighten the standoffs to 1.30 N · m (11.5 lb · in.), as shown in Figure 5.
2. Connect the male end of the calibration cable to the CAL-4330 and tighten the two jack screws to 0.90 N · m (8.0 lb · in.), as shown in Figure 5.
3. Connect the female end of the calibration cable to the PXIe-4330/4331 and tighten the two jack screws to 0.90 N · m (8.0 lb · in.), as shown in Figure 5.

4. Connect the two 160-Pin DIN to 160-Pin DIN cables from the CAL-4330 to the two PXIe-2737 modules and tighten all the jack screws to 0.56 N · m (5.0 lb · in.), as shown in Figure 6 and Figure 7.

Figure 6. Connecting the Switch 2 Cable

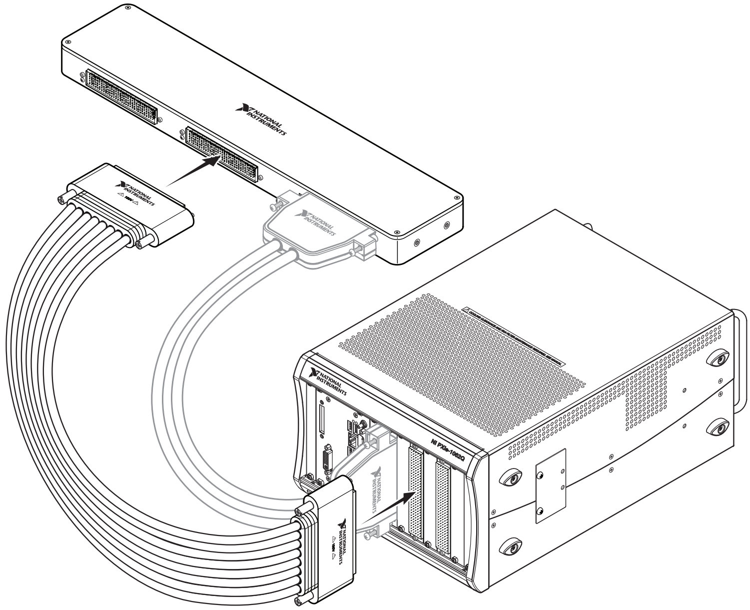
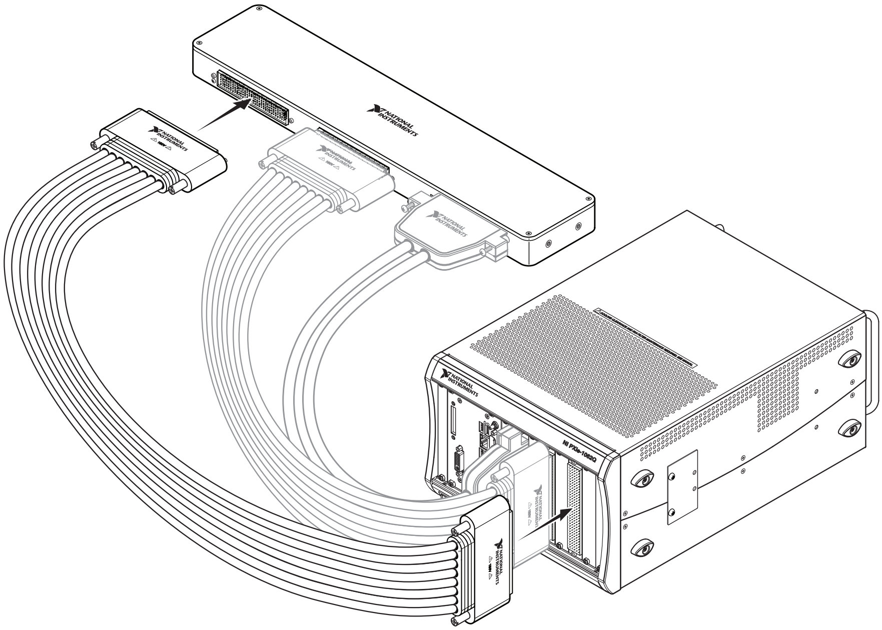


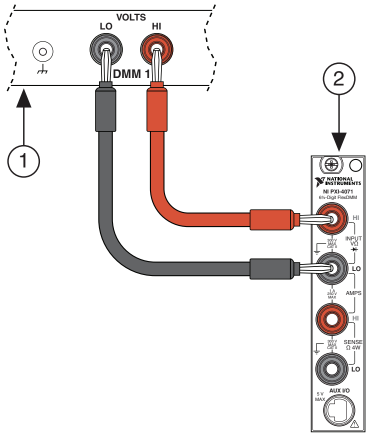
Figure 7. Connecting the Switch 1 Cable



Connect the DMM and Multifunction Calibrator Cables

1. Connect DMM 1 on the back of the CAL-4330 to a PXI-4071 as shown in Figure 8.

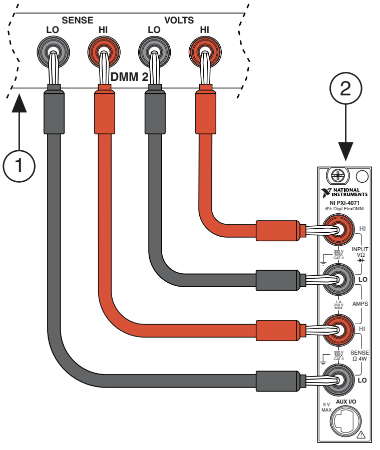
Figure 8. DMM 1



1	CAL-4330	2	PXI-4071

2. Connect DMM 2 on the back of the CAL-4330 to another PXI-4071 as shown in Figure 9.

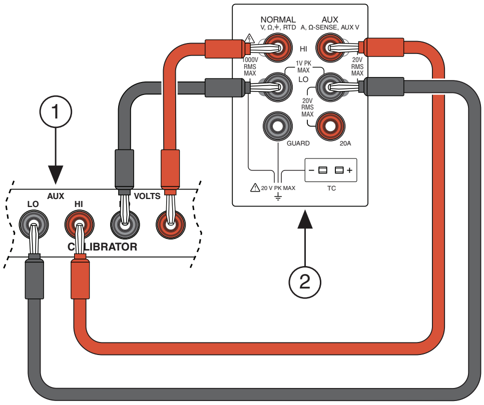
Figure 9. DMM 2



1	CAL-4330	2	PXI-4071

3. Connect the CALIBRATOR on the back of the CAL-4330 to a Fluke 5520A multifunction calibrator as shown in Figure 10.

Figure 10. CALIBRATOR



1 CAL-4330	2 Fluke 5520A

Verification Procedures

This section provides instructions for verifying the PXIe-4330/4331 specifications. The PXIe-4330/4331 has eight independent analog input channels. You can conduct verification on any or all of them, depending upon your desired test coverage.

You can verify the following for PXIe-4330/4331 modules:

- *Gain Accuracy Verification*
- *Input Offset Verification*
- *Shunt Quarter-Bridge Calibration Accuracy Verification*
- *Shunt Calibration Resistance Accuracy Verification*
- *Excitation Voltage Verification*

Gain Accuracy Verification

This section provides instructions for verifying the PXIe-4330/4331 gain accuracy specifications. Table 8 shows all the settings for the PXIe-4330/4331. Throughout the gain accuracy verification, use Tables 12 through 23 to determine if the module is operating within its specified range.

Complete the following steps to test the gain accuracy of the module.

1. Configure the switch modules to connect to the 350 Ω bridge completion resistor on the CAL-4330. Refer to Table 2 for the specific switch column and row configuration. The connection paths are shown in Figure 11 in *Appendix A: Connection Path Details*.
2. Measure the 350 Ω bridge completion resistor with DMM 2 configured for 4-wire resistance with offset ohms compensation enabled. Divide the measured resistance by 350 and record the result as R_{adj}.

3. Set the calibrator to standby mode (STBY).
4. Configure the switch modules to connect to the channel you want to verify. Refer to Table 3 for the specific switch column and row configuration. The connection paths are shown in Figure 12 in *Appendix A: Connection Path Details*.

Note Only one channel can be connected to the calibrator at a time.

Table 2. Bridge Completion Resistor Measurement

Switch 1
`r0->c2, r1->c55, r0->c8, r1->c9`

Table 3. Gain Accuracy Verification Switch Settings

Channel	Switch 1	Switch 2
0	`r0->c0,r1->c1,r0->c2,r1->c3, r3->c7,r3->c16`	`r0->c0,r1->c1,r0->c2,r1->c3, r0->c14,r1->c16`
1	`r0->c0,r1->c1,r0->c2,r1->c3, r3->c7,r3->c21`	`r0->c0,r1->c1,r0->c2,r1->c3, r0->c19,r1->c21`
2	`r0->c0,r1->c1,r0->c2,r1->c3, r3->c7,r3->c26`	`r0->c0,r1->c1,r0->c2,r1->c3, r0->c24,r1->c26`
3	`r0->c0,r1->c1,r0->c2,r1->c3, r3->c7,r3->c31`	`r0->c0,r1->c1,r0->c2,r1->c3, r0->c29,r1->c31`
4	`r0->c0,r1->c1,r0->c2,r1->c3, r3->c7,r3->c36`	`r0->c0,r1->c1,r0->c2,r1->c3, r0->c34,r1->c36`
5	`r0->c0,r1->c1,r0->c2,r1->c3, r3->c7,r3->c41`	`r0->c0,r1->c1,r0->c2,r1->c3, r0->c39,r1->c41`
6	`r0->c0,r1->c1,r0->c2,r1->c3, r3->c7,r3->c46`	`r0->c0,r1->c1,r0->c2,r1->c3, r0->c44,r1->c46`
7	`r0->c0,r1->c1,r0->c2,r1->c3, r3->c7,r3->c51`	`r0->c0,r1->c1,r0->c2,r1->c3, r0->c49,r1->c51`

5. Zero the calibrator with the ohms-only zero (OHMS ZERO) operation. Refer to the calibrator documentation for more information about zeroing the calibrator.
6. Set the calibrator output for 2-wire compensation (COMP 2-wire). This automatically compensates for the lead wire resistance in series with the HI and LO terminals of the calibrator.
7. Set the calibrator resistance output to a *Calibrator Output* value for the appropriate range beginning with the 0 V/V nominal value, 350 Ω, indicated in Table 12 for excitation voltages >2.5 V or Table 13 for excitation voltages ≤2.5 V for $f_s \leq 51.2$ kHz. Use Tables 14 through 23 for $f_s > 51.2$ kHz and their specific excitation voltages.

8. If this is the first test point, set the calibrator to operate mode (OPR) to enable the output.
9. Create a DAQmx task.
10. Create and configure an AI Bridge (V/V) channel.
11. Configure the properties for the acquisition as described in Table 8.
12. Commit the task to enable the latest excitation voltage.
13. Start the task.
14. Read 10,000 samples of data for f_s = 25600. Read 40,000 samples of data for f_s = 102400.
15. Average the readings that you acquired in step 14 and record the result as *Test Result*, which is used in step 18.
16. Clear the task.
17. Repeat steps 7 through 16 for all calibrator output values. NI recommends that you verify all values, although you can save time by verifying only the values used in your application.
18. Perform the following calculation for each test result value other than 0 V/V, using the results you recorded in step 15.

$$V_r = \text{Test Result} - 0\text{ V/V Test Result}$$

19. Compare the compensated result (V_r) for each value to the *Upper Limit (V/V)* and *Lower Limit (V/V)* values in Table 12 for excitation voltages >2.5 V or Table 13 for excitation voltages ≤ 2.5 V for $f_s \leq 51.2$ kHz. Use Tables 14 through 23 for $f_s > 51.2$ kHz and the excitation value specified in each table. If the result is between these values, the module passes the test.

Note You can analyze data in V/V form or convert it to strain using the standard quarter-bridge equation:

Note $$\text{strain } (\varepsilon) = \frac{-4 \times V_r}{GF\ (1 + (2 \times V_r))}$$

where V_r is the compensated reading from the PXIe-4330/4331 and *GF* is a gage factor of 2.

20. If calibrating an NI PXIe-4331, repeat steps 7 through 19 using a sample rate of 102.4 kHz and the appropriate test limits from Tables 14 through 23.
21. Repeat steps 7 through 20 for every excitation setting you want to verify.
22. Set the calibrator to standby mode (STBY).
23. Repeat steps 3 through 22 for every channel you want to verify.
24. Disconnect the calibrator from the module.

Input Offset Verification

This section provides instructions for verifying the PXIe-4330/4331 input offset specifications. Table 8 shows all settings for the PXIe-4330/4331. Throughout the input offset verification, use Tables 24 and 25 to determine if the module is operating within its specified range.

Complete the following steps to test the input offset accuracy of the module.

1. Configure the switch modules to connect to the channel you want to verify. Refer to Table 4 for the specific switch column and row configuration. The connection paths are shown in Figure 13 in *Appendix A: Connection Path Details*.

Table 4. Offset Verify Switch Settings

Channel	Switch 1	Switch 2
0	`r2->c4,r2->c11,r3->c12, r3->c16`	`r0->c4,r1->c5,r0->c6,r1->c7, r0->c14,r1->c16`
1	`r2->c4,r2->c11,r3->c12, r3->c21`	`r0->c4,r1->c5,r0->c6,r1->c7, r0->c19,r1->c21`
2	`r2->c4,r2->c11,r3->c12, r3->c26`	`r0->c4,r1->c5,r0->c6,r1->c7, r0->c24,r1->c26`
3	`r2->c4,r2->c11,r3->c12, r3->c31`	`r0->c4,r1->c5,r0->c6,r1->c7, r0->c29,r1->c31`
4	`r2->c4,r2->c11,r3->c12, r3->c36`	`r0->c4,r1->c5,r0->c6,r1->c7, r0->c34,r1->c36`
5	`r2->c4,r2->c11,r3->c12, r3->c41`	`r0->c4,r1->c5,r0->c6,r1->c7, r0->c39,r1->c41`
6	`r2->c4,r2->c11,r3->c12, r3->c46`	`r0->c4,r1->c5,r0->c6,r1->c7, r0->c44,r1->c46`
0	`r2->c4,r2->c11,r3->c12, r3->c51`	`r0->c4,r1->c5,r0->c6,r1->c7, r0->c49,r1->c51`

2. Create a DAQmx task.
3. Create and configure an AI Bridge (V/V) channel.
4. Configure the properties for the acquisition as described in Table 8.
5. Start the task.
6. Read 10,000 samples of data if f_s = 25600. Read 40,000 samples of data if f_s = 102400
7. Average the readings that you acquired and record the result.
8. Clear the task.
9. Compare the final result to the *Upper Limit* and *Lower Limit* values in Table 24 for $f_s \leq$ 51.2 kHz and Table 25 for $f_s >$ 51.2 kHz. If the result is between these values, the module passes the test.

10. If calibrating a PXIe-4331, repeat steps 2 through 9 using a sample rate of 102.4 kHz.
11. Repeat steps 1 through 10 for each channel you want to verify.

Shunt Quarter-Bridge Calibration Accuracy Verification

This section provides instructions for verifying the PXIe-4330/4331 shunt quarter-bridge calibration accuracy. Table 10 shows all settings for the PXIe-4330/4331. Throughout the shunt quarter-bridge calibration accuracy verification, use Table 26 to determine if the module is operating within its specified range. If the module is not operating within the specified values, refer to the *Worldwide Support and Services* section for assistance in returning the PXIe-4330/4331 to NI.

Complete the following steps to test the accuracy of the module shunt quarter-bridge calibration.

1. Configure the switch modules to connect to the channel you want to verify. Refer to Table 5 for the specific switch column and row configuration. The connection paths are shown in Figure 14 in *Appendix A: Connection Path Details*.

Note Only one channel can be connected to the calibrator at a time.

Table 5. Shunt Quarter-Bridge Calibration Accuracy Verification

Channel	Switch 1
0	`r1->c0,r0->c1,r1->c15,r3->c16,r0->c17,r3->c18`
1	`r1->c0,r0->c1,r1->c20,r3->c21,r0->c22,r3->c23`
2	`r1->c0,r0->c1,r1->c25,r3->c26,r0->c27,r3->c28`
3	`r1->c0,r0->c1,r1->c30,r3->c31,r0->c32,r3->c33`
4	`r1->c0,r0->c1,r1->c35,r3->c36,r0->c37,r3->c38`
5	`r1->c0,r0->c1,r1->c40,r3->c41,r0->c42,r3->c43`
6	`r1->c0,r0->c1,r1->c45,r3->c46,r0->c47,r3->c48`
7	`r1->c0,r0->c1,r1->c50,r3->c51,r0->c52,r3->c53`

2. Set the calibrator output for 2-wire compensation (COMP 2-wire). This automatically compensates for the lead wire resistance in series with the HI and LO terminals of the calibrator.
3. Set the calibrator resistance output to 120 Ω, 350 Ω, or 1000 Ω, depending on the quarter-bridge configuration you want to verify. This must match the configuration setting made in step 7.
4. Set the calibrator to operate mode (OPR).
5. Create the DAQmx task.
6. Create and configure an AI Bridge (V/V) channel.
7. Configure the properties for the acquisition as described in Table 10.

8. Disable shunt calibration for the channel.
9. Commit the task to enable the latest excitation voltage.
10. Start the task.
11. Read 10,000 samples of data.
12. Average the readings that you acquired and record the result as $Result_{SCD}$.
13. Stop the task.
14. Set the shunt calibration resistance for the channel using the Shunt Cal A Resistor Value property with one of the following values: 33,333 Ω, 50,000 Ω, or 100,000 Ω.
15. Enable shunt calibration for the channel.
16. Start the task.
17. Read 10,000 samples of data.
18. Average the readings that you acquired and record the result as $Result_{SCE}$.
19. Stop the task.
20. Perform the following calculation using the results you recorded in steps 12 and 18:

$$V_r = \text{Result}_{SCE} - \text{Result}_{SCD}$$

where $Result_{SCE}$ = result with shunt calibration enabled in step 18

$Result_{SCD}$ = result with shunt calibration disabled in step 12

21. Compare the final result (V_r) to the *Upper Limit* and *Lower Limit* values in Table 26. If the result is between these values, the module passes the test.

Note You can analyze data in V/V form or convert it to strain using the standard quarter-bridge equation:

$$\text{strain } (\varepsilon) = \frac{-4 \times V_r}{GF\ (1 + (2 \times V_r))}$$

where V_r is the compensated reading from the PXIe-4330/4331 and *GF* is a gage factor of 2.

22. Repeat steps 3 through 21 for each combination of quarter-bridge completion and shunt calibration resistance settings you want to verify.
23. Set the calibrator to standby mode (STBY).
24. Repeat steps 1 through 23 for each channel you want to verify.
25. Disconnect the calibrator from the module.

Shunt Calibration Resistance Accuracy Verification

This section provides instructions for verifying the PXIe-4330/4331 shunt resistance accuracy. Table 10 shows all settings for the PXIe-4330/4331. Throughout the shunt resistance accuracy verification, use Table 27 to determine if the module is operating within its specified range. If the module is not operating within the specified values, refer to the *Worldwide Support and Services* section for assistance in returning the terminal block to NI.

Complete the following steps to test the accuracy of the module shunt resistances.

1. Configure the switch modules to connect to the channel you want to verify. Refer to table 6 for the specific switch column and row configuration. The connection paths are shown in Figure 15 in *Appendix A: Connection Path Details*.

Table 6. Shunt Resistance Accuracy Verification

Channel	Switch 1
0	`r3->c8,r2->c9,r2->c14,r3->c15`
1	`r3->c8,r2->c9,r2->c19,r3->c20`
2	`r3->c8,r2->c9,r2->c24,r3->c25`
3	`r3->c8,r2->c9,r2->c29,r3->c30`
4	`r3->c8,r2->c9,r2->c34,r3->c35`
5	`r3->c8,r2->c9,r2->c39,r3->c40`
6	`r3->c8,r2->c9,r2->c44,r3->c45`
7	`r3->c8,r2->c9,r2->c49,r3->c50`

2. Create the DAQmx task.
3. Create and configure an AI Bridge (V/V) channel.
4. Enable shunt calibration for the channel. Configure the properties for the acquisition as described in Table 9.
5. Set the shunt calibration resistance for the channel using the Shunt Cal A Resistor Value property with one of the following values: 33,333 Ω, 50,000 Ω, or 100,000 Ω.
6. Commit the task to enable the specified shunt resistor.
7. Take a reading of the shunt calibration resistance from the DMM using the 4-wire measurement configuration and record the result.
8. Compare the result from step 7 to the *Upper Limit* and *Lower Limit* values in Table 27 for the applicable resistance value. If the result is between these values, the module passes the test.
9. Repeat steps 5 through 8 for each shunt calibration resistance you want to verify.
10. Clear the task.
11. Repeat steps 1 through 10 for each channel you want to verify.
12. Disconnect the DMM from the module.

Excitation Voltage Verification

This section provides instructions for verifying the PXIe-4330/4331 excitation voltage specifications. Table 28 in the *Test Limits* section shows all acceptable excitation voltage settings for the PXIe-4330/4331. Throughout the excitation voltage verification, use Table 28 to determine if the module is operating within its specified range.

Complete the following steps to test the performance of the module.

1. Configure the switch modules to connect to the channel you want to verify. Refer to Table 7 for the specific switch column and row configuration.The connection paths are shown in Figure 16 in *Appendix A: Connection Path Details*.

Table 7. Excitation Verify Switch Settings

Channel	Switch 1	Switch 2
0	`r3->c4,r3->c6`	`r0->c8,r0->c14`
1	`r3->c4,r3->c6`	`r0->c8,r0->c19`
2	`r3->c4,r3->c6`	`r0->c8,r0->c24`
3	`r3->c4,r3->c6`	`r0->c8,r0->c29`
4	`r3->c4,r3->c6`	`r0->c8,r0->c34`
5	`r3->c4,r3->c6`	`r0->c8,r0->c39`
6	`r3->c4,r3->c6`	`r0->c8,r0->c44`
7	`r3->c4,r3->c6`	`r0->c8,r0->c49`

2. Create the DAQmx task.
3. Create and configure an AI Bridge (V/V) channel.
4. Configure the properties for the task configuration as described in Table 8.

Note Set the sample rate and samples to read to 25,600 and 10,000 respectively for the excitation voltage verification.

5. Commit the task.
6. Take a reading of the excitation voltage from the DMM and record the result.
7. Compare the result from step 6 to the *Upper Limit* and *Lower Limit* values indicated in Table 28 for the applicable excitation setting.
8. Clear the task.
9. Repeat steps 2 through 8 for all excitation voltage settings.
10. Repeat steps 1 through 9 for all channels.
11. Disconnect the DMM from the module.

Table 8. Configuration Settings for Full-Bridge Operation

Property	Value
Channel Name	Use channel names specific to your application.
Acquisition Mode	Finite number of samples
Rate (Hz)	25,600 or 102,400[*]
Samples to Read	10,000 or 40,000[†]
Measurement Type	Bridge
Max Input Limit	0.025 or 0.10[**]
Min Input Limit	-0.025 or -0.10[**]
Units	V/V
Bridge Type	Full Bridge
Nominal Bridge Resistance	350 Ω
Vex Source	Internal
Vex Value	0.625, 1.0, 1.5, 2.0, 2.5, 2.75, 3.3, 5.0, 7.5, or 10.0[*]

[*] Use the excitation value and rate that corresponds to the configuration being verified.
[†] Read 10,000 samples when verifying at the 25,600 Hz rate. Read 40,000 samples when verifying at the 102,400 Hz rate.
[**] Use -0.025 and 0.025 for excitation >2.5 V. Use -0.10 and 0.10 for excitation ≤2.5 V.

Table 9. Configuration Settings for Shunt Calibration Resistance Accuracy Verification

Property	Value
Channel Name	Use channel names specific to your application.
Acquisition Mode	Finite number of samples
Rate (Hz)	25,600
Samples to Read	10,000
Measurement Type	Bridge
Max Input Limit	0.10
Min Input Limit	-0.10
Units	V/V
Bridge Type	Full Bridge
Nominal Bridge Resistance	350 Ω

Table 9. Configuration Settings for Shunt Calibration Resistance Accuracy Verification (Continued)

Property	Value
Vex Source	Internal
Vex Value	2.5

Table 10. Configuration Settings for Quarter-Bridge Operation

Property	Value
Channel Name	Use channel names specific to your application.
Acquisition Mode	Finite number of samples
Rate (Hz)	25,600
Samples to Read	10,000
Measurement Type	Bridge
Max Input Limit	0.10
Min Input Limit	-0.10
Units	V/V
Bridge Type	Quarter Bridge
Nominal Bridge Resistance	120 Ω, 350 Ω, 1 kΩ*
Vex Source	Internal
Vex Value	2.5

* Use the bridge resistance value that corresponds to the configuration being verified.

Gain and Offset Adjustment Procedure

Use the adjustment procedure to adjust the gain and offset calibration constants for each channel and excitation. At the end of each calibration procedure, these new constants are stored in the external calibration area of the EEPROM.

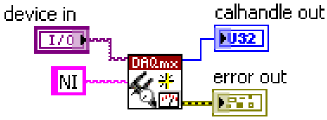
Complete the following steps to perform module adjustment.

1. Configure the switch modules to connect to the channel you want to verify. Refer to Table 11 for the specific switch column and row configuration.The connection paths are shown in Figure 17 in *Appendix A: Connection Path Details*.

Table 11. Gain and Offset Adjust Switch Settings

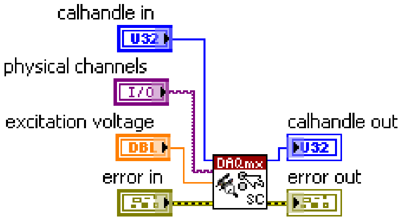
Channel	Switch 1	Switch 2
0	r0->c0,r1->c1,r0->c2,r1->c3, r2->c4,r2->c5,r3->c6,r3->c7, r3->c16	r0->c0,r1->c1,r0->c2,r1->c3, r0->c14,r1->c16
1	r0->c0,r1->c1,r0->c2,r1->c3, r2->c4,r2->c5,r3->c6,r3->c7, r3->c21	r0->c0,r1->c1,r0->c2,r1->c3, r0->c19,r1->c21
2	r0->c0,r1->c1,r0->c2,r1->c3, r2->c4,r2->c5,r3->c6,r3->c7, r3->c26	r0->c0,r1->c1,r0->c2,r1->c3, r0->c24,r1->c26
3	r0->c0,r1->c1,r0->c2,r1->c3, r2->c4,r2->c5,r3->c6,r3->c7, r3->c31	r0->c0,r1->c1,r0->c2,r1->c3, r0->c29,r1->c31
4	r0->c0,r1->c1,r0->c2,r1->c3, r2->c4,r2->c5,r3->c6,r3->c7, r3->c36	r0->c0,r1->c1,r0->c2,r1->c3, r0->c34,r1->c36
5	r0->c0,r1->c1,r0->c2,r1->c3, r2->c4,r2->c5,r3->c6,r3->c7, r3->c41	r0->c0,r1->c1,r0->c2,r1->c3, r0->c39,r1->c41
6	r0->c0,r1->c1,r0->c2,r1->c3, r2->c4,r2->c5,r3->c6,r3->c7, r3->c46	r0->c0,r1->c1,r0->c2,r1->c3, r0->c44,r1->c46
7	r0->c0,r1->c1,r0->c2,r1->c3, r2->c4,r2->c5,r3->c6,r3->c7, r3->c51	r0->c0,r1->c1,r0->c2,r1->c3, r0->c49,r1->c51

2. Zero the calibrator with the ohms-only zero (OHMS ZERO) operation. Refer to the calibrator documentation for more information about zeroing the calibrator.
3. Set the calibrator output for 2-wire compensation (COMP 2-wire). This automatically compensates for the lead wire resistance in series with the HI and LO terminals of the calibrator.
4. Set the calibrator resistance output to 350 Ω
5. Set the calibrator to operate mode (OPR).
6. Open a calibration session on your module using the DAQmx Initialize External Calibration VI. The default password is `NI`.

<table>
<tr><th>LabVIEW Block Diagram</th><th>NI-DAQmx Function Call</th></tr>
<tr><td>
</td><td>Call <code>DAQmxInitExtCal</code> with the following parameters:

deviceName: <code>Dev1</code>
password: <code>NI</code>
calHandle: <code>&calHandle</code></td></tr>
</table>

7. For the channel and excitation setting you want to adjust, set up the calibration on the PXIe-4330/4331 with the DAQmx Setup 433x Calibration VI.

<table>
<tr><th>LabVIEW Block Diagram</th><th>NI-DAQmx Function Call</th></tr>
<tr><td>
</td><td>Call <code>DAQmxSetup433xCal</code> with the following parameters:

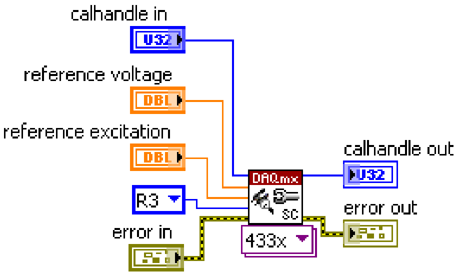
calHandle: <code>calHandle</code>
channelNames: <code>Dev1/ai</code>x, where x refers to the channel number.
excitationVoltage: <code>0.625</code>, <code>1.0</code>, <code>1.5</code>, <code>2.0</code>, <code>2.5</code>, <code>2.75</code>, <code>3.3</code>, <code>5.0</code>, <code>7.5</code>, or <code>10.0</code>*</td></tr>
<tr><td colspan="2">*Use the excitation value that corresponds to the configuration being adjusted.</td></tr>
</table>

Note Executing the DAQmx setup cal function commits the task and enables the latest excitation settings.

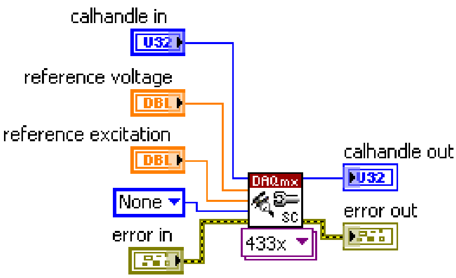
8. Wait one minute after executing the DAQmx setup cal function to allow the bridge element temperatures to stabilize.
9. Set the calibrator to output a resistance of 241.50 Ω for excitation settings ≤2.5 V, or 319.20 Ω for excitation settings >2.5 V.
10. Acquire voltage readings from DMM1 and DMM2 and record the results.

Note The calibration software uses the ratio of the measurements from the DMMs as a ratiometric reference signal. Using two DMMs allows measurement of the excitation voltage and the input voltage to be made closely spaced in time to optimize the accuracy of the ratiometric signal.

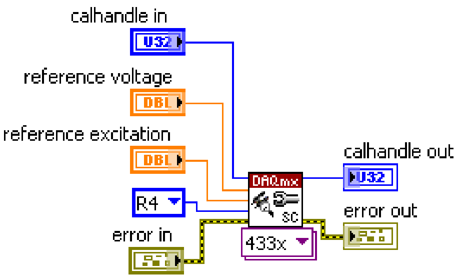
11. Call the DAQmx Adjust 433x Calibration VI.

LabVIEW Block Diagram	NI-DAQmx Function Call
	Call `DAQmxAdjust433xCal` with the following parameters: **calHandle**: `calHandle` **refVoltage**: *`DMM Reading 1`* **refExcitation**: *`DMM Reading 2`* **shuntLocation**: `DAQmx_Val_R3`

12. Set the calibrator to output a resistance of 350 Ω.
13. Acquire voltage readings from DMM1 and DMM2 and record the results.
14. Call the DAQmx Adjust 433x Calibration VI.

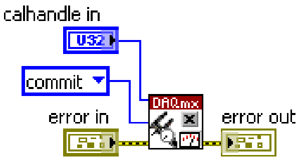
LabVIEW Block Diagram	NI-DAQmx Function Call
	Call `DAQmxAdjust433xCal` with the following parameters: **calHandle**: `calHandle` **refVoltage**: *`DMM Reading 1`* **refExcitation**: *`DMM Reading 2`* **shuntLocation**: `DAQmx_Val_None`

15. Set the calibrator to output a resistance of 509.60 Ω for excitation settings ≤2.5 V, or 385.00 Ω for excitation settings >2.5 V.
16. Acquire voltage readings from DMM1 and DMM2 and record the results.
17. Call the DAQmx Adjust 433x Calibration VI.

LabVIEW Block Diagram	NI-DAQmx Function Call
	Call `DAQmxAdjust433xCal` with the following parameters: **calHandle**: `calHandle` **refVoltage**: *`DMM Reading 1`* **refExcitation**: *`DMM Reading 2`* **shuntLocation**: `DAQmx_Val_R4`

18. Set the calibrator to output a resistance of 350 Ω.
19. Save the adjustment constants to the EEPROM using the DAQmx Close External Calibration VI. This VI 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.

LabVIEW Block Diagram	NI-DAQmx Function Call
	Call DAQmxCloseExtCal with the following parameters: **calHandle**: `calHandle` **action**: `DAQmx_Val_Action_Commit`

20. Repeat steps 6 through 19 for every excitation setting you want to adjust.
21. Repeat steps 1 through 20 for every channel you want to adjust.
22. Disconnect the calibrator and DMMs from the module.

The module is now adjusted with respect to your external source. After adjusting the module, you must reverify the accuracy of the module. To do this, repeat the *Verification Procedures* section.

Test Limits

Tables 12 through 28 list the test limits that the PXIe-4330/4331 should meet if it has been one year between calibrations. The following definitions describe how to use the information from the test limits tables:

- **Calibrator Output**—The *Calibrator Output* is the calibrator resistance output entered for verification.
- **Nominal Value**—The *Nominal Value* is the approximate value that the module should read, given the corresponding calibrator output.
- **1-Year Limits**—The *1-Year Limits* column contains the *Upper Limits* and *Lower Limits* for the test results. That is, when the module is within its 1-year calibration interval, the test results should fall between these upper and lower limit values.

  For accuracy verification, *Upper Limits* and *Lower Limits* are given in units of V/V for verification and units of με for reference.

Gain Accuracy Test Limits

Table 12. PXIe-4330/4331 Gain Accuracy Verification Test Limits, $f_s \leq$ 51.2 kHz, V_{ex} > 2.5 V

Calibrator Output (Ω)	Nominal Value (V/V)	Nominal Value (με)	1-Year Limits			
			Lower Limit (V/V)	Upper Limit (V/V)	Lower Limit (με)	Upper Limit (με)
350.00 * R_{adj}	0	0.0	—	—	—	—
319.20 * R_{adj}	0.0230126	-44,000.0	0.0230010	0.0230241	-44,022.0	-43978.0
332.50 * R_{adj}	0.0128205	-25,000.0	0.0128141	0.0128269	-25,012.5	-24987.5
341.25 * R_{adj}	0.0063291	-12,500.0	0.0063259	0.0063323	-12,506.3	-12493.8
358.75 * R_{adj}	-0.0061728	12,500.0	-0.0061759	-0.0061698	12,493.8	12506.3
367.50 * R_{adj}	-0.0121951	25,000.0	-0.0122012	-0.0121890	24,987.5	25012.5
380.80 * R_{adj}	-0.0210728	44,000.0	-0.0210833	-0.0210623	43,978.0	44022.0
385.00 * R_{adj}	-0.0238095	50,000.0	-0.0238214	-0.0237976	49,975.0	50025.0

Table 13. PXIe-4330/4331 Gain Accuracy Verification Test Limits, $f_s \leq$ 51.2 kHz, $V_{ex} \leq$ 2.5 V

Calibrator Output (Ω)	Nominal Value (V/V)	Nominal Value (με)	1-Year Limits			
			Lower Limit (V/V)	Upper Limit (V/V)	Lower Limit (με)	Upper Limit (με)
350.00 * R_{adj}	0	0.0	—	—	—	—
241.50 * R_{adj}	0.0917160	-155,000.0	0.0916701	0.0917618	-155,077.5	-154,922.5
295.75 * R_{adj}	0.0420054	-77,500.0	0.0419844	0.0420264	-77,538.8	-77,461.3
341.25 * R_{adj}	0.0063291	-12,500.0	0.0063259	0.0063323	-12,506.3	-12,493.8
358.75 * R_{adj}	-0.0061728	12,500.0	-0.0061759	-0.0061698	12,493.8	12,506.3
367.50 * R_{adj}	-0.0121951	25,000.0	-0.0122012	-0.0121890	24,987.5	25,012.5
458.50 * R_{adj}	-0.0670996	155,000.0	-0.0671331	-0.0670660	154,922.5	155,077.5
509.60 * R_{adj}	-0.0928339	228,000.0	-0.0928803	-0.0927875	227,886.0	228,114.0

Table 14. PXIe-4331 Gain Accuracy Verification Test Limits, f_s > 51.2 kHz, V_{ex} = 0.625 V

Calibration Output (Ω)	Nominal Value (V/V)	Nominal Value (με)	1-Year Limits			
			Lower Limit (V/V)	Upper Limit (V/V)	Lower Limit (με)	Upper Limit (με)
350.00 * R_{adj}	0	0.0	—	—	—	—
241.50 * R_{adj}	0.0917160	-155,000.0	0.0916151	0.0918169	-155,170.5	-154,829.5
295.75 * R_{adj}	0.0420054	-77,500.0	0.0419592	0.0420516	-77,585.3	-77,414.8
341.25 * R_{adj}	0.0063291	-12,500.0	0.0063222	0.0063361	-12,513.8	-12,486.3
358.75 * R_{adj}	-0.0061728	12,500.0	-0.0061796	-0.0061660	12,486.3	12,513.8
367.50 * R_{adj}	-0.0121951	25,000.0	-0.0122085	-0.0121817	24,972.5	25,027.5
458.50 * R_{adj}	-0.0670996	155,000.0	-0.0671734	-0.0670258	154,829.5	155,170.5
509.60 * R_{adj}	-0.0928339	228,000.0	-0.0929360	-0.0927318	227,749.2	228,250.8

Table 15. PXIe-4331 Gain Accuracy Verification Test Limits, f_s > 51.2 kHz, V_{ex} = 1 V

Calibration Output (Ω)	Nominal Value (V/V)	Nominal Value (με)	1-Year Limits			
			Lower Limit (V/V)	Upper Limit (V/V)	Lower Limit (με)	Upper Limit (με)
350.00 * R_{adj}	0	0.0	—	—	—	—
241.50 * R_{adj}	0.0917160	-155,000.0	0.0916357	0.0917962	-155,135.6	-154,864.4
295.75 * R_{adj}	0.0420054	-77,500.0	0.0419687	0.0420422	-77,567.8	-77,432.2
341.25 * R_{adj}	0.0063291	-12,500.0	0.0063236	0.0063347	-12,510.9	-12,489.1
358.75 * R_{adj}	-0.0061728	12,500.0	-0.0061782	-0.0061674	12,489.1	12,510.9
367.50 * R_{adj}	-0.0121951	25,000.0	-0.0122058	-0.0121845	24,978.1	25,021.9
458.50 * R_{adj}	-0.0670996	155,000.0	-0.0671583	-0.0670409	154,864.4	155,135.6
509.60 * R_{adj}	-0.0928339	228,000.0	-0.0929151	-0.0927526	227,800.5	228,199.5

Table 16. PXIe-4331 Gain Accuracy Verification Test Limits, f_s > 51.2 kHz, V_{ex} = 1.5 V

Calibration Output (Ω)	Nominal Value (V/V)	Nominal Value (με)	1-Year Limits			
			Lower Limit (V/V)	Upper Limit (V/V)	Lower Limit (με)	Upper Limit (με)
350.00 * R_{adj}	0	0.0	—	—	—	—
241.50 * R_{adj}	0.0917160	-155,000.0	0.0916472	0.0917848	-155,116.3	-154,883.8
295.75 * R_{adj}	0.0420054	-77,500.0	0.0419739	0.0420369	-77,558.1	-77,441.9
341.25 * R_{adj}	0.0063291	-12,500.0	0.0063244	0.0063339	-12,509.4	-12,490.6
358.75 * R_{adj}	-0.0061728	12,500.0	-0.0061775	-0.0061682	12,490.6	12,509.4
367.50 * R_{adj}	-0.0121951	25,000.0	-0.0122043	-0.0121860	24,981.3	25,018.8
458.50 * R_{adj}	-0.0670996	155,000.0	-0.0671499	-0.0670492	154,883.8	155,116.3
509.60 * R_{adj}	-0.0928339	228,000.0	-0.0929035	-0.0927643	227,829.0	228,171.0

Table 17. PXIe-4331 Gain Accuracy Verification Test Limits, f_s > 51.2 kHz, V_{ex} = 2 V

Calibration Output (Ω)	Nominal Value (V/V)	Nominal Value (με)	1-Year Limits			
			Lower Limit (V/V)	Upper Limit (V/V)	Lower Limit (με)	Upper Limit (με)
350.00 * R_{adj}	0	0.0	—	—	—	—
241.50 * R_{adj}	0.0917160	-155,000.0	0.0916529	0.0917790	-155,106.6	-154,893.4
295.75 * R_{adj}	0.0420054	-77,500.0	0.0419765	0.0420343	-77,553.3	-77,446.7
341.25 * R_{adj}	0.0063291	-12,500.0	0.0063248	0.0063335	-12,508.6	-12,491.4
358.75 * R_{adj}	-0.0061728	12,500.0	-0.0061771	-0.0061686	12,491.4	12,508.6
367.50 * R_{adj}	-0.0121951	25,000.0	-0.0122035	-0.0121867	24,982.8	25,017.2
458.50 * R_{adj}	-0.0670996	155,000.0	-0.0671457	-0.0670534	154,893.4	155,106.6
509.60 * R_{adj}	-0.0928339	228,000.0	-0.0928977	-0.0927701	227,843.3	228,156.8

Table 18. PXIe-4331 Gain Accuracy Verification Test Limits, f_s > 51.2 kHz, V_{ex} = 2.5 V

Calibration Output (Ω)	Nominal Value (V/V)	Nominal Value (με)	1-Year Limits			
			Lower Limit (V/V)	Upper Limit (V/V)	Lower Limit (με)	Upper Limit (με)
350.00 * R_{adj}	0	0.0	—	—	—	—
241.50 * R_{adj}	0.0917160	-155,000.0	0.0916564	0.0917756	-155,100.8	-154,899.3
295.75 * R_{adj}	0.0420054	-77,500.0	0.0419781	0.0420327	-77,550.4	-77,449.6
341.25 * R_{adj}	0.0063291	-12,500.0	0.0063250	0.0063332	-12,508.1	-12,491.9
358.75 * R_{adj}	-0.0061728	12,500.0	-0.0061769	-0.0061688	12,491.9	12,508.1
367.50 * R_{adj}	-0.0121951	25,000.0	-0.0122030	-0.0121872	24,983.8	25,016.3
458.50 * R_{adj}	-0.0670996	155,000.0	-0.0671432	-0.0670560	154,899.3	155,100.8
509.60 * R_{adj}	-0.0928339	228,000.0	-0.0928942	-0.0927735	227,851.8	228,148.2

Table 19. PXIe-4331 Gain Accuracy Verification Test Limits, f_s > 51.2 kHz, V_{ex} = 2.75 V

Calibration Output (Ω)	Nominal Value (V/V)	Nominal Value (με)	1-Year Limits			
			Lower Limit (V/V)	Upper Limit (V/V)	Lower Limit (με)	Upper Limit (με)
350.00 * R_{adj}	0	0.0	—	—	—	—
319.20 * R_{adj}	0.0230126	-44,000.0	0.0229885	0.0230366	-44,046.0	-43,954.0
332.50 * R_{adj}	0.0128205	-25,000.0	0.0128071	0.0128339	-25,026.1	-24,973.9
341.25 * R_{adj}	0.0063291	-12,500.0	0.0063225	0.0063357	-12,513.1	-12,486.9
358.75 * R_{adj}	-0.0061728	12,500.0	-0.0061793	-0.0061664	12,486.9	12,513.1
367.50 * R_{adj}	-0.0121951	25,000.0	-0.0122079	-0.0121824	24,973.9	25,026.1
380.80 * R_{adj}	-0.0210728	44,000.0	-0.0210948	-0.0210508	43,954.0	44,046.0
385.00 * R_{adj}	-0.0238095	50,000.0	-0.0238344	-0.0237846	49,947.7	50,052.3

Table 20. PXIe-4331 Gain Accuracy Verification Test Limits, f_s > 51.2 kHz, V_{ex} = 3.3 V

Calibration Output (Ω)	Nominal Value (V/V)	Nominal Value (με)	1-Year Limits			
			Lower Limit (V/V)	Upper Limit (V/V)	Lower Limit (με)	Upper Limit (με)
350.00 * R_{adj}	0	0.0	—	—	—	—
319.20 * R_{adj}	0.0230126	-44,000.0	0.0229906	0.0230345	-44,042.0	-43,958.0
332.50 * R_{adj}	0.0128205	-25,000.0	0.0128083	0.0128328	-25,023.9	-24,976.1
341.25 * R_{adj}	0.0063291	-12,500.0	0.0063231	0.0063352	-12,511.9	-12,488.1
358.75 * R_{adj}	-0.0061728	12,500.0	-0.0061787	-0.0061669	12,488.1	12,511.9
367.50 * R_{adj}	-0.0121951	25,000.0	-0.0122068	-0.0121835	24,976.1	25,023.9
380.80 * R_{adj}	-0.0210728	44,000.0	-0.0210929	-0.0210527	43,958.0	44,042.0
385.00 * R_{adj}	-0.0238095	50,000.0	-0.0238323	-0.0237868	49,952.3	50,047.7

Table 21. PXIe-4331 Gain Accuracy Verification Test Limits, f_s > 51.2 kHz, V_{ex} = 5 V

Calibration Output (Ω)	Nominal Value (V/V)	Nominal Value (με)	1-Year Limits			
			Lower Limit (V/V)	Upper Limit (V/V)	Lower Limit (με)	Upper Limit (με)
350.00 * R_{adj}	0	0.0	—	—	—	—
319.20 * R_{adj}	0.0230126	-44,000.0	0.0229941	0.0230310	-44,035.2	-43,964.8
332.50 * R_{adj}	0.0128205	-25,000.0	0.0128103	0.0128308	-25,020.0	-24,980.0
341.25 * R_{adj}	0.0063291	-12,500.0	0.0063241	0.0063342	-12,510.0	-12,490.0
358.75 * R_{adj}	-0.0061728	12,500.0	-0.0061778	-0.0061679	12,490.0	12,510.0
367.50 * R_{adj}	-0.0121951	25,000.0	-0.0122049	-0.0121854	24,980.0	25,020.0
380.80 * R_{adj}	-0.0210728	44,000.0	-0.0210897	-0.0210559	43,964.8	44,035.2
385.00 * R_{adj}	-0.0238095	50,000.0	-0.0238286	-0.0237905	49,960.0	50,040.0

Table 22. PXIe-4331 Gain Accuracy Verification Test Limits, f_s > 51.2 kHz, V_{ex} = 7.5 V

Calibration Output (Ω)	Nominal Value (V/V)	Nominal Value (με)	1-Year Limits			
			Lower Limit (V/V)	Upper Limit (V/V)	Lower Limit (με)	Upper Limit (με)
350.00 * R_{adj}	0	0.0	—	—	—	—
319.20 * R_{adj}	0.0230126	-44,000.0	0.0229964	0.0230287	-44,030.8	-43,969.2
332.50 * R_{adj}	0.0128205	-25,000.0	0.0128115	0.0128295	-25,017.5	-24,982.5
341.25 * R_{adj}	0.0063291	-12,500.0	0.0063247	0.0063335	-12,508.8	-12,491.3
358.75 * R_{adj}	-0.0061728	12,500.0	-0.0061772	-0.0061685	12,491.3	12,508.8
367.50 * R_{adj}	-0.0121951	25,000.0	-0.0122037	-0.0121866	24,982.5	25,017.5
380.80 * R_{adj}	-0.0210728	44,000.0	-0.0210875	-0.0210580	43,969.2	44,030.8
385.00 * R_{adj}	-0.0238095	50,000.0	-0.0238262	-0.0237929	49,965.0	50,035.0

Table 23. PXIe-4331 Gain Accuracy Verification Test Limits, f_s > 51.2 kHz, V_{ex} = 10 V

Calibration Output (Ω)	Nominal Value (V/V)	Nominal Value (με)	1-Year Limits			
			Lower Limit (V/V)	Upper Limit (V/V)	Lower Limit (με)	Upper Limit (με)
350.00 * R_{adj}	0	0.0	—	—	—	—
319.20 * R_{adj}	0.0230126	-44,000.0	0.0229976	0.0230275	-44,028.6	-43,971.4
332.50 * R_{adj}	0.0128205	-25,000.0	0.0128122	0.0128288	-25,016.3	-24,983.8
341.25 * R_{adj}	0.0063291	-12,500.0	0.0063250	0.0063332	-12,508.1	-12,491.9
358.75 * R_{adj}	-0.0061728	12,500.0	-0.0061769	-0.0061688	12,491.9	12,508.1
367.50 * R_{adj}	-0.0121951	25,000.0	-0.0122030	-0.0121872	24,983.8	25,016.3
380.80 * R_{adj}	-0.0210728	44,000.0	-0.0210865	-0.0210591	43,971.4	44,028.6
385.00 * R_{adj}	-0.0238095	50,000.0	-0.0238250	-0.0237940	49,967.5	50,032.5

Input Offset Test Limits

Table 24. PXIe-4330/4331 Input Offset Accuracy Verification Test Limits, $f_s \leq 51.2$ kHz

Excitation (V)	1-Year Limits	
	Lower Limit (μV/V)	**Upper Limit (μV/V)**
0.625	-268.8	268.8
1.0	-168.0	168.0
1.5	-112.0	112.0
2.0	-84.0	84.0
2.5	-67.2	67.2
2.75	-39.3	39.3
3.3	-32.7	32.7
5.0	-21.6	21.6
7.5	-14.4	14.4
10.0	-10.8	10.8

Table 25. PXIe-4331 Input Offset Accuracy Verification Limits, $f_s > 51.2$ kHz

Excitation (V)	1-Year Limits	
	Lower Value (μV/V)	**Upper Value (μV/V)**
0.625	-316.8	316.8
1	-198.0	198.0
1.5	-132.0	132.0
2	-99.0	99.0
2.5	-79.2	79.2
2.75	-50.0	50.0
3.3	-41.8	41.8
5	-27.6	27.6
7.5	-18.4	18.4
10	-13.8	13.8

Shunt Quarter-Bridge Calibration Test Limits

Table 26. PXIe-4330/4331 Shunt Quarter-Bridge Calibration Accuracy Verification Test Limits

Quarter Completion Resistance		Shunt Resistance (Ω)		
		33,333	**50,000**	**100,000**
120 Ω	**Nominal Value (μV/V)**	-898.38	-599.28	-299.82
	Lower Limit (μV/V)	-896.59	-598.08	-299.22
	Upper Limit (μV/V)	-900.18	-600.48	-300.42
350 Ω	**Nominal Value (μV/V)**	-2,611.29	-1,743.90	-873.47
	Lower Limit (μV/V)	-2,606.07	-1,740.41	-871.72
	Upper Limit (μV/V)	-2,616.51	-1,747.38	-875.22
1 kΩ	**Nominal Value (μV/V)**	-7,389.16	-4,950.50	-2,487.56
	Lower Limit (μV/V)	-7,374.38	-4,940.59	-2,482.59
	Upper Limit (μV/V)	-7,403.94	-4,960.40	-2,492.54

Shunt Calibration Resistance Test Limits

Table 27. PXIe-4330/4331 Shunt Calibration Resistance Verification Test Limits

Nominal Value (Ω)	Lower Limit (Ω)	Upper Limit (Ω)
33,333	33,300	33,367
50,000	49,950	50,050
100,000	99,900	100,100

Excitation Voltage Test Limits

Table 28. PXIe-4330/4331 Excitation Voltage Verification Test Limits

Excitation (V)	Lower Limit (V)	Upper Limit (V)
0.625	0.539	0.711
1.0	0.912	1.088
1.5	1.410	1.591
2.0	1.907	2.093
2.5	2.405	2.596
2.75	2.653	2.847
3.3	3.201	3.400
5.0	4.892	5.108
7.5	7.380	7.621
10.0	9.867	10.133

Appendix A: Connection Path Details

Figure 11. Bridge Completion Resistor Measurement

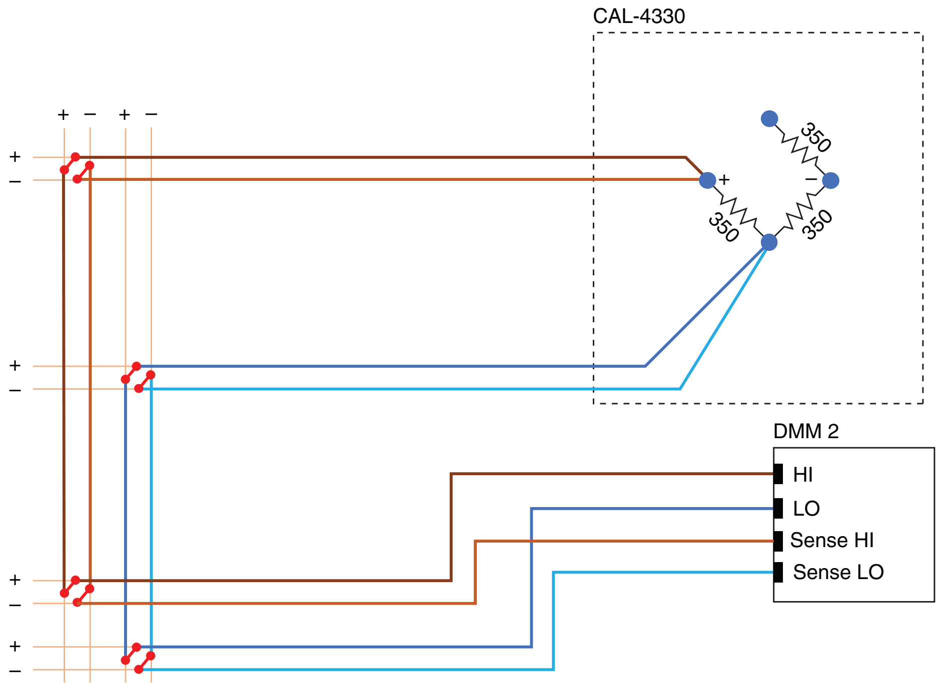


Figure 12. Gain Accuracy Verification

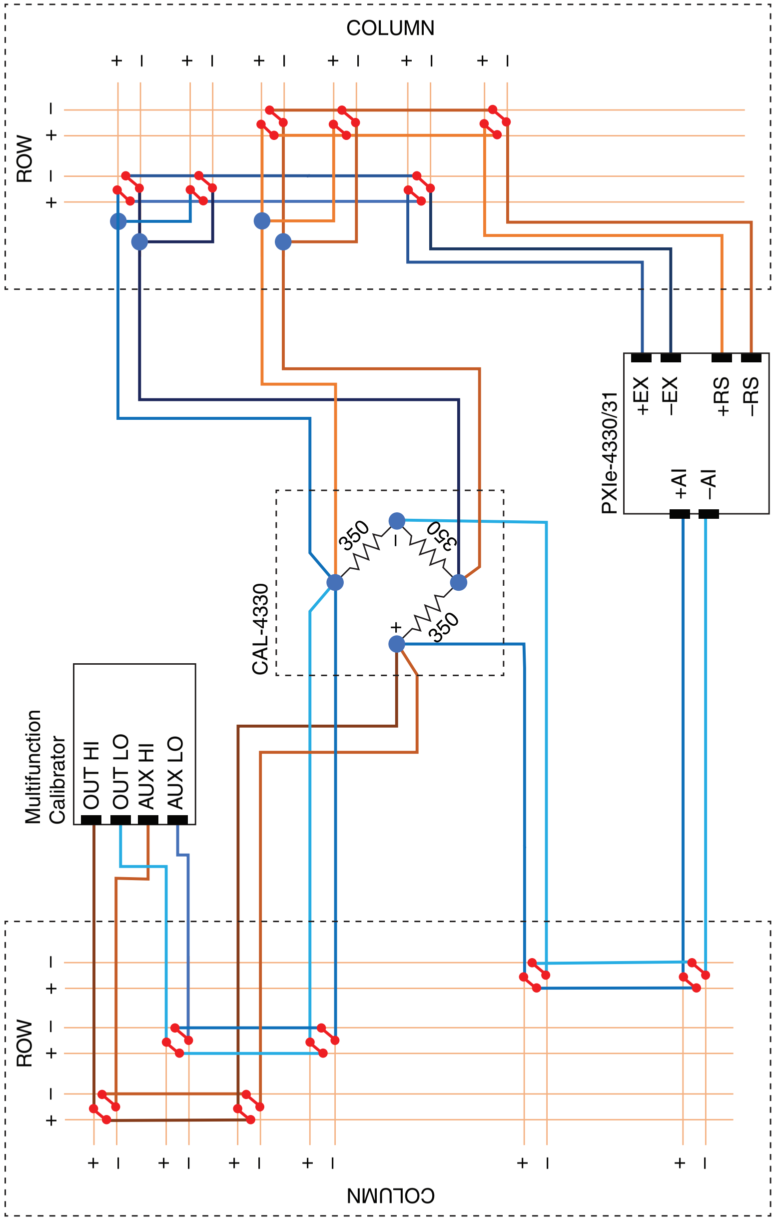


Figure 13. Input Offset Verification

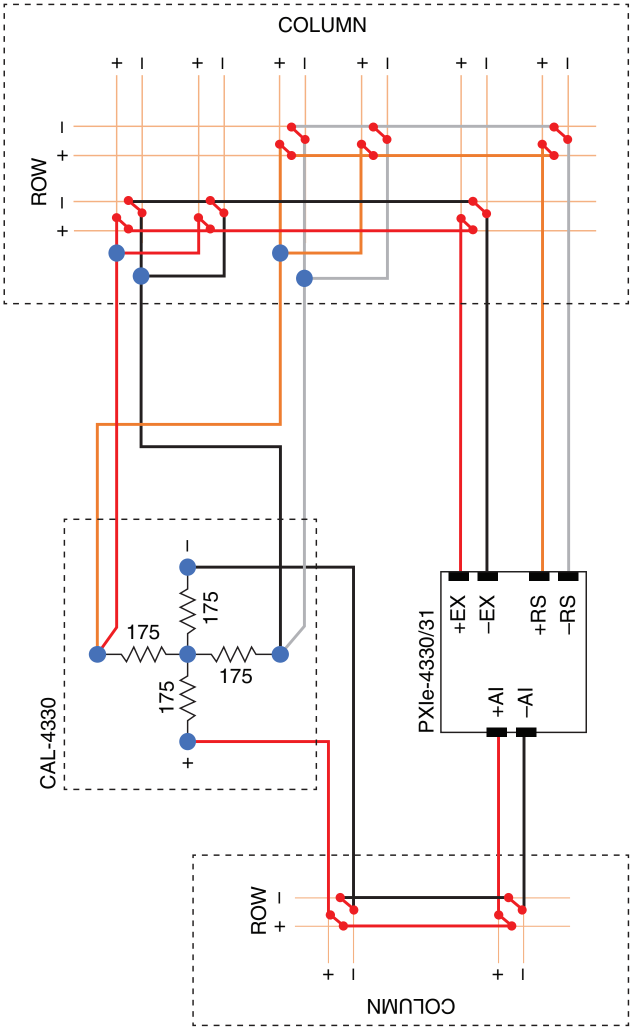


Figure 14. Shunt Quarter-Bridge Calibration Accuracy Verification

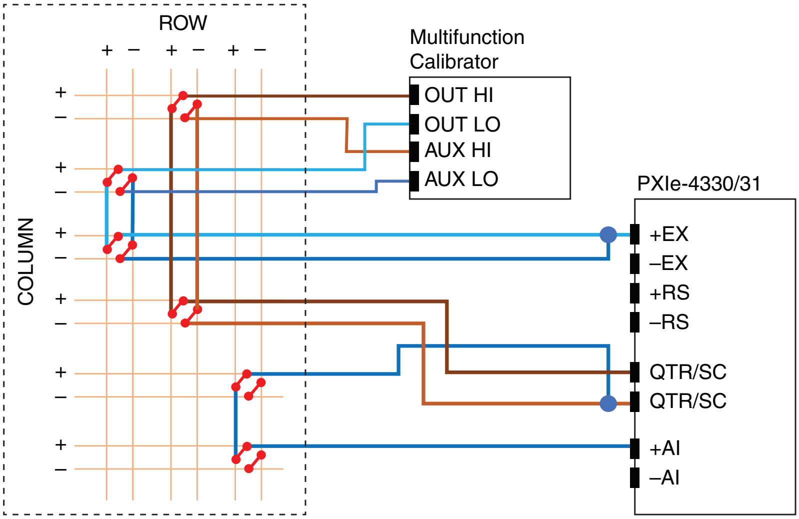


Figure 15. Shunt Calibration Resistance Accuracy Verification

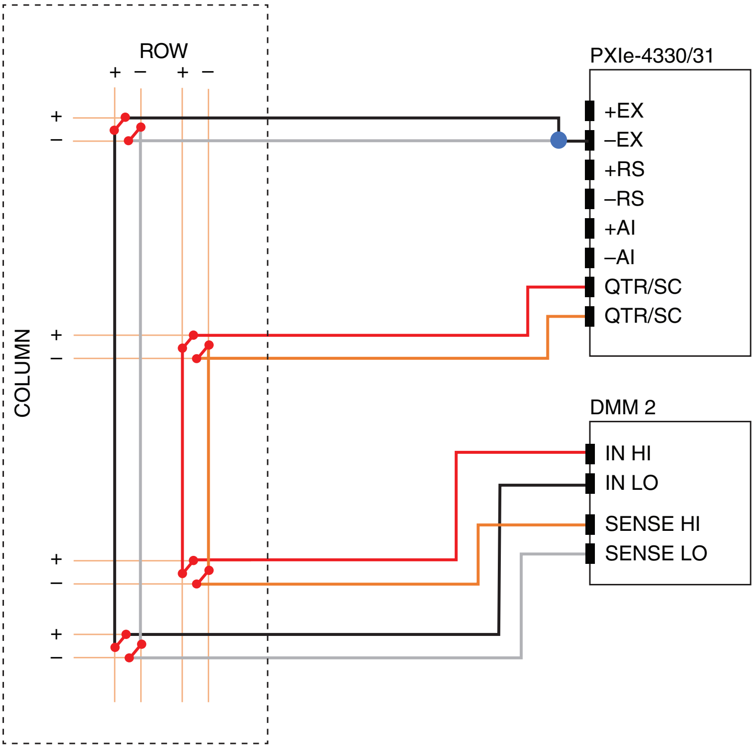


Figure 16. Excitation Voltage Verification

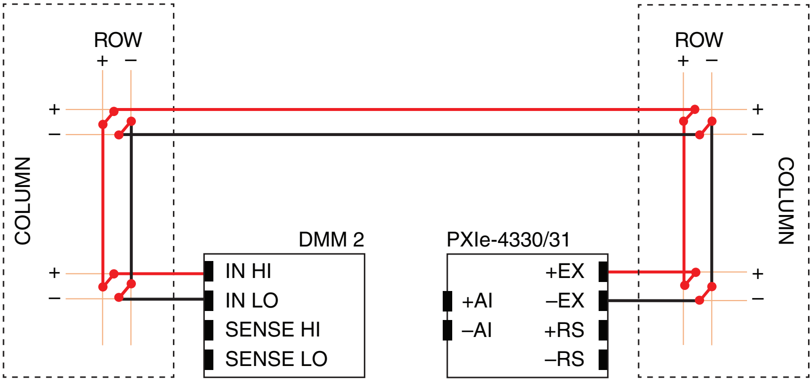
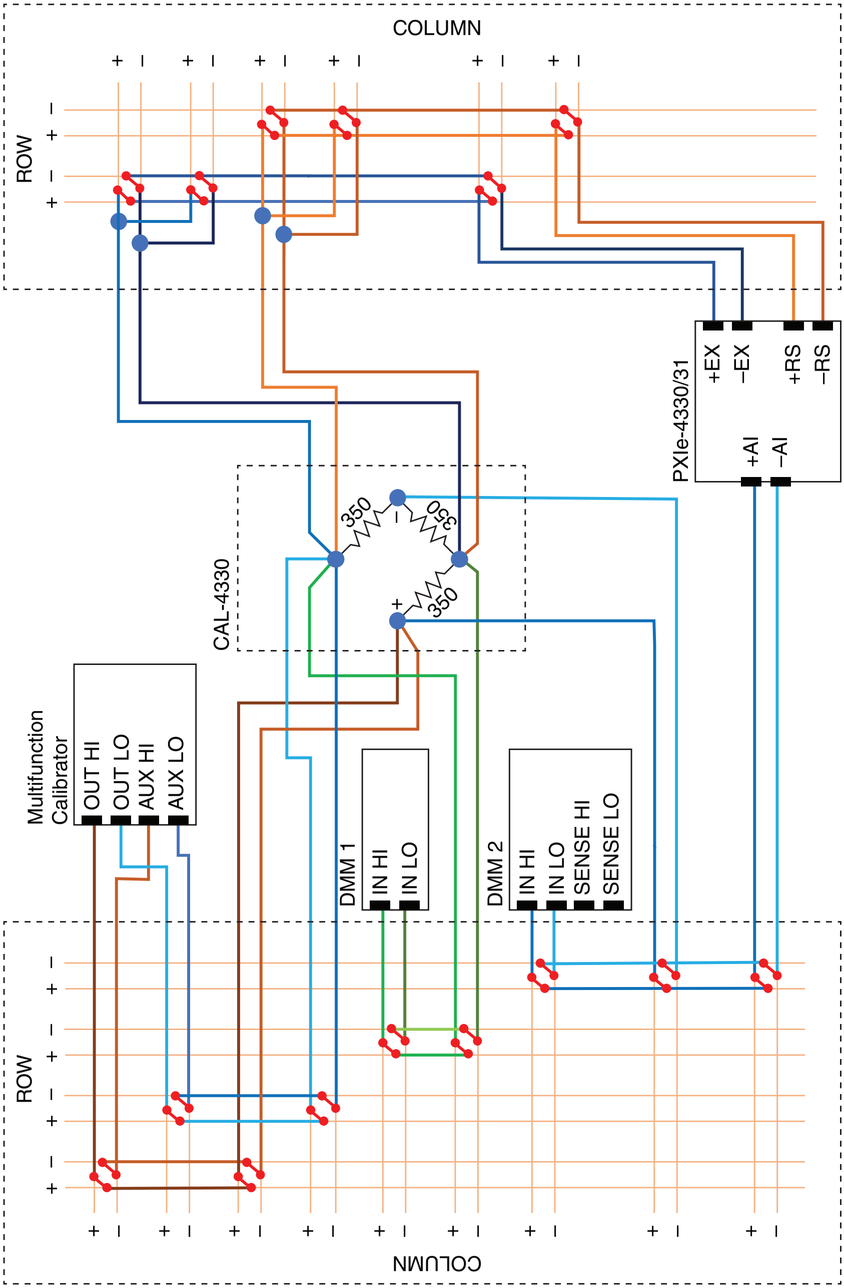


Figure 17. Gain and Offset Adjustment



Worldwide Support and Services

The NI website is your complete resource for technical support. At 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 for NI Factory Installation Services, repairs, extended warranty, and other services.

Visit ni.com/register to register your NI product. Product registration facilitates technical support and ensures that you receive important information updates from NI.

A Declaration of Conformity (DoC) is our claim of compliance with the Council of the European Communities using the manufacturer's declaration of conformity. This system affords the user protection for electromagnetic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting ni.com/certification. If your product supports calibration, you can obtain the calibration certificate for your product at ni.com/calibration.

NI corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. NI also has offices located around the world. For telephone support in the United States, create your service request at ni.com/support or dial 1 866 ASK MYNI (275 6964). For telephone support outside the United States, visit the Worldwide Offices section of ni.com/niglobal to access the branch office websites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

373150D-01 July19