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**PXIe-4610**

# CALIBRATION PROCEDURE

# NI PXIe-4610

## Power Amplifier

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[ni.com/manuals](http://ni.com/manuals)

This document contains the verification procedures for the National Instruments PXIe-4610. For more information about calibration solutions, visit [ni.com/calibration](http://ni.com/calibration).

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## Software

NI-DAQmx 9.8 added support for the NI PXIe-4610. Ensure the version of NI-DAQmx on the calibration system supports the NI PXIe-4610. 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 NI PXIe-4610, NI-DAQmx, and your application software. All documents are available on [ni.com](http://ni.com) and help files install with the software.



## *NI PXIe-4610 Getting Started Guide*

NI-DAQmx installation and hardware setup.



## *NI PXIe-4610 Specifications*

NI PXIe-4610 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.

# Test Equipment

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

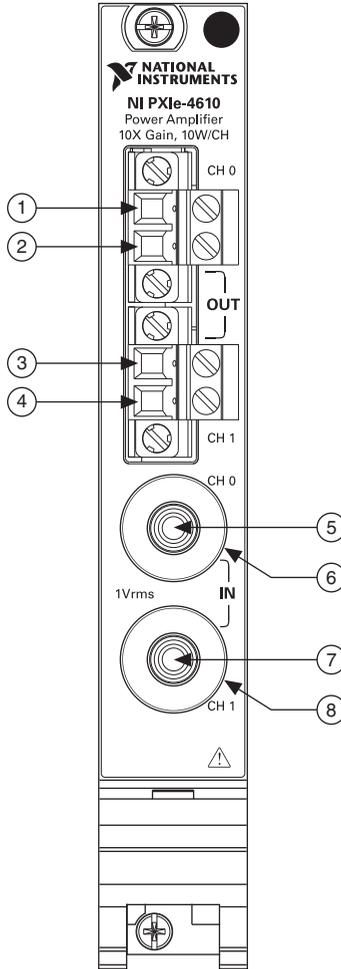
**Table 1.** Recommended Equipment

<b>Equipment</b>	<b>Recommended Models</b>	<b>Where Used</b>	<b>Requirements</b>
DMM	NI PXI-4070	Gain and Residual Offset Verification	If this instrument is unavailable, use a digitizer capable of measuring $\pm 10 V_{pk}$ sine waves at 1 kHz with an amplitude uncertainty of 0.1 dB or less, a linearity error of 100 ppm or less and an offset measurement uncertainty of 100 $\mu V$ or less.
Function Generator	NI PXI-4461	Gain and Residual Offset Verification	If this instrument is unavailable, use a function generator capable of sourcing $\pm 1.0 V_{pk}$ sine waves at 1 kHz with an amplitude uncertainty of 0.1 dB or less and a frequency uncertainty of 1% or less.
PXI Express Chassis	NI PXIe-1062Q	—	—

# Connecting the NI PXIe-4610

The NI PXIe-4610 provides connections for 2 channels. Refer to Figure 1 for the connection pinout.

**Figure 1. NI PXIe-4610 Pinout**



1	OUT CH0+	3	OUT CH1+	5	IN CH0+	7	IN CH1+
2	OUT CH0-	4	OUT CH1 -	6	IN CH0-	8	IN CH1-

# Test Conditions

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The following setup and environmental conditions are required to ensure the NI PXIe-4610 meets published specifications.

- Keep connections to the NI PXIe-4610 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 NI PXIe-4610 are secure.
- Use 50  $\Omega$  BNC coaxial cables for all connections to the NI PXIe-4610 inputs.
- Maintain an ambient temperature of 23 °C  $\pm$  5 °C. The NI PXIe-4610 temperature will be greater than the ambient temperature.
- Keep relative humidity below 90%.
- Allow a warm-up time of at least 15 minutes to ensure that the NI PXIe-4610 measurement circuitry is at a stable operating temperature.
- Allow adequate warm-up time for all of the instruments and equipment according to the manufacturer instructions.
- 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

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Refer to the *NI PXIe-4610 Getting Started Guide* for information about how to install the software and hardware and how to configure the device in Measurement & Automation Explorer (MAX).



**Note** When a device is configured with MAX, it is assigned a device identifier. Each function call uses this identifier to determine which DAQ device to verify or, verify and adjust.

## Verification

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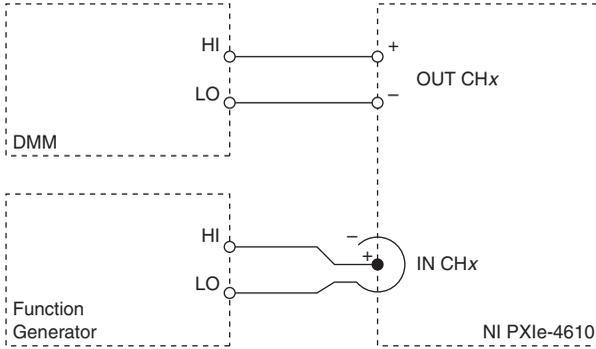
The following performance verification procedures describe the sequence of operations and provide test points required to verify the NI PXIe-4610. The verification procedures assume that adequate traceable uncertainties are available for the calibration references.

# Gain and Residual Offset Verification

Complete the following procedure to verify the gain accuracy and residual offset of the NI PXIe-4610:

1. Connect the NI PXIe-4610 channel to be verified as shown in Figure 2.

**Figure 2.** Gain and Residual Offset Verification Connections



2. Configure the function generator as shown in Table 2.

**Table 2.** Function Generator Configuration for Gain and Residual Offset Verification

Signal Type	Amplitude	Frequency
Sine Wave	0.9 V <sub>pk</sub>	1 kHz

3. Enable the function generator.
4. Enable the NI PXIe-4610 outputs. Additional information about enabling the outputs is available in the *NI PXIe-4610 Getting Started Guide*.
5. Allow at least 10 s for the input AC Coupling filter to fully settle.

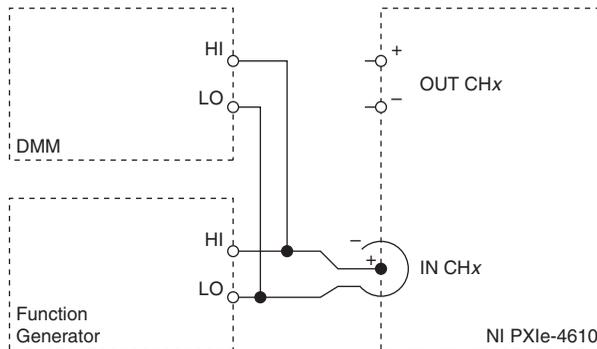
- Configure the DMM in digitizer mode as shown in Table 3.

**Table 3. DMM Configuration for Gain and Residual Offset Verification**

Configuration	Value
Measurement	Voltage
Range	10 V
Waveform Coupling	DC
Acquisition Mode	Waveform
Acquisition Rate	1.8 MS/s
Samples to Acquire	180,000

- Acquire samples using the DMM.
- Calculate the amplitude of the acquired signal and record as  $Amplitude_{OUT}$ . NI recommends using the Extract Single Tone Information VI to calculate the amplitude.
- Calculate the residual offset of the acquired signal and record as  $ResidualOffset$ . NI recommends using the Extract Single Tone VI to export the residual signal. The residual offset is the average of the residual signal.
- Connect the DMM as shown in Figure 3.

**Figure 3. DMM Connections**



- Repeat steps 7 and 8, and record the amplitude of the acquired waveform as  $Amplitude_{IN}$ .
- Perform the following calculation using the recorded  $Amplitude_{OUT}$  from step 8 and  $Amplitude_{IN}$  values for step 11.

$$UnadjustedGain = \frac{Amplitude_{OUT}}{Amplitude_{IN}}$$

13. Convert the unadjusted gain to decibels.

$$\text{UnadjustedGain (dB)} = 20 \cdot \log (\text{UnadjustedGain})$$

14. Disable the NI PXIe-4610 outputs.  
 15. Disable the function generator.  
 16. Read the gain constant of the channel being verified with the AO.PowerAmp.Gain DAQmx property and convert the gain to decibels.

$$\text{CalibrationGain (dB)} = 20 \cdot \log (\text{GainEEPROM})$$

17. Perform the following calculation using the *UnadjustedGain (dB)* calculated in step 13 and the *CalibrationGain (dB)* calculated in step 16, and record the result as *AdjustedGain (dB)*.

$$\text{AdjustedGain (dB)} = 20 \text{ dB} + (\text{UnadjustedGain (dB)} - \text{CalibrationGain (dB)})$$

18. Repeat steps 1 through 17 for each channel.  
 19. Compare the recorded *UnadjustedGain (dB)* and *AdjustedGain (dB)* of each channel to the limits in Table 4.

**Table 4.** NI PXIe-4610 2-Year Verification Test Limits for Gain

Input Signal Source	Lower Limit (dB)	Upper Limit (dB)
Unadjusted	19.969	20.031
Adjusted*	19.989	20.011

\*Input signal source gain adjusted using the gain calibration constant stored in the EEPROM.



**Note** The test limits listed are derived using the values in Table 7.

20. Compare the recorded residual offset for each channel to the limits in Table 5.

**Table 5.** NI PXIe-4610 2-Year Verification Test Limits for Residual Offset

Lower Limit (mV)	Upper Limit (mV)
-1	+1



**Note** The test limits listed are derived using the values in Table 8.

If the NI PXIe-4610 is outside the limits found in Tables 4 and 5, refer to [World Wide Support and Services](#) for assistance in returning the device to NI.

# EEPROM Update

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After completing a verification procedure, complete the following steps:

1. Open a calibration session for the NI PXIe-4610. The default password is NI.
2. Store the calibration temperature.
  - a. Record the ambient temperature.
  - b. Call the DAQmx Set Temperature DSA Calibration function to store the calibration temperature measured in step a.
3. Store the calibration constants.
  - a. Perform steps 1 through 9 of the *Gain and Residual Offset Verification* section to calculate the *ResidualOffset* of each channel for which you want to update the offset calibration constant.
  - b. Continue with steps 10 through 12 of the *Gain and Residual Offset Verification* section to calculate the *UnadjustedGain* of each channel for which you want to update the gain calibration constant.
  - c. Call the DAQmx Adjust DSA Power Amplifier Calibration function for the NI PXIe-4610 and configure it as shown in Table 6.

**Table 6.** DAQmx Adjust DSA Power Amplifier Calibration Configuration

Physical Channel	Gain	Offset
Dev1/chx	The value obtained from step a.	The value obtained from step b.

- d. Repeat steps a through c for each channel for which you want to store a calibration constant.
4. Close the calibration session.

## Accuracy Under Calibration Conditions

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The following calibration specifications are valid for the following conditions:

- Ambient temperature is  $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ .
- PXI Express chassis fan speed is set to HIGH and has clean fan filters.
- Empty slots have filler panels installed.



**Note** The test limits listed in Table 4 and 5 are derived using the values in Table 6 and 7, respectively.

**Table 7.** NI PXIe-4610 Gain Accuracy Under Calibration Conditions

Input Signal Source	Gain Accuracy ( $\pm$ dB)
Unadjusted	0.031
Adjusted*	0.011

\*Input signal source gain adjusted using the gain calibration constant stored in the EEPROM.

**Table 8.** NI PXIe-4610 Residual Offset Under Calibration Conditions

Residual Offset
$\pm 1$ mV



**Note** For operational specifications, refer to the most recent *NI PXIe-4610 Specifications* document at [ni.com/manuals](http://ni.com/manuals).

## World Wide Support and Services

The National Instruments website is your complete resource for technical support. At [ni.com/support](http://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.

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