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PXIe-4322

CALIBRATION PROCEDURE
NI PXIe-4322

8-Channel, Isolated Voltage/Current Analog Output Module

Français	Deutsch	日本語	한국어	简体中文
		ni.com/manuals		

This document contains the verification and adjustment procedures for the National Instruments PXIe-4322 module. For more information about calibration solutions, visit `ni.com/calibration`.

Contents

Software

Calibrating the NI PXIe-4322 requires the installation of NI-DAQmx 9.7 or later on the calibration system. You can download NI-DAQmx from `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 ADE that you intend to use.

NATIONAL INSTRUMENTS™

Documentation

Consult the following documents for information about the NI PXIe-4322, NI-DAQmx, and your application software. All documents are available on ni.com and help files install with the software.

NI PXIe-4322 and TB-4322 Installation Guide and Terminal Block Specifications

Contains: NI-DAQmx installation and hardware setup

NI PXIe-4322 User Manual

Contains: NI PXIe-4322 specific information

NI PXIe-4322 Specifications

Contains: NI PXIe-4322 specifications and calibration interval

NI-DAQmx Readme

Contains: Operating system and application software support in NI-DAQmx

NI-DAQmx Help

Contains: Information about creating applications that use the NI-DAQmx driver

LabVIEW Help

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

NI-DAQmx C Reference Help

Contains: Reference information for NI-DAQmx C functions and NI-DAQmx C properties

NI-DAQmx .NET Help Support for Visual Studio

Contains: 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 and adjustment procedures. If the recommended equipment is not available, select a substitute using the requirements listed in Table 1.

Table 1. Recommended Equipment

| Equipment	Recommended Model	Requirements
DMM	NI PXI-4071	Use a DMM that can provide both voltage and current measurements. Accuracy of 20 ppm or better in the smallest range to measure 16 V, and offset error of 2.4 µV or better in the smallest range to measure 1 V. Accuracy of 165 ppm or better in the smallest range to measure 20 mA, and offset error of 3 nA or better in the smallest range to measure 100 µA.
PXI Express Chassis	NI PXIe-1062Q	—
Connection Accessory	TB-4322	—

Connecting the TB-4322

⚠ **Caution** Always have the NI PXI Express chassis powered off when inserting a module into the chassis.

The TB-4322 terminal block provides connections to the NI PXIe-4322. Figure 1 shows the connector location for each TB-4322 channel.

Figure 1. TB-4322 Pinout Locations
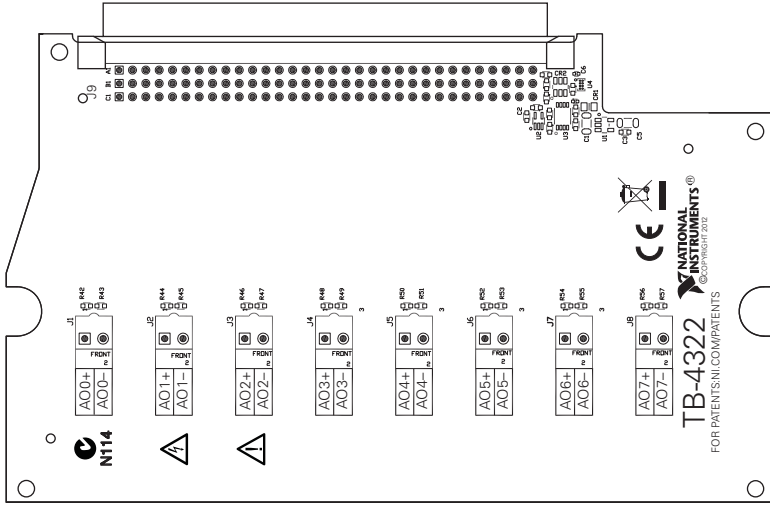
1. Connect the DMM to the TB-4322.

    •   For voltage verification and adjustment connect the DMM to the TB-4322 as shown in Figure 2 for each channel.

        or

    •   For current verification and adjustment connect the DMM to the TB-4322 as shown in Figure 3 for each channel.

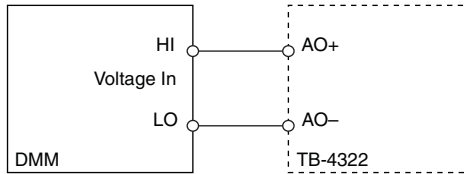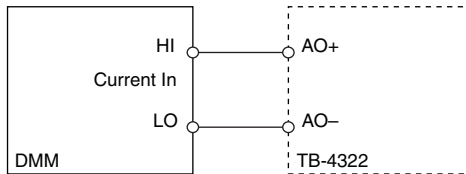**Figure 2.** DMM to TB-4322 Voltage Mode Connections

Figure 3. DMM to TB-4322 Current Mode Connections

Each channel consists of two terminal connections specific to that channel as shown in Table 2 and must be verified and adjusted individually. Do not make serial or parallel connections for verification or adjustment.

Table 2. TB-4322 Analog Signal Names

Signal Name	Signal Description
AO+	Positive output terminal
AO-	Negative output terminal

Test Conditions

The following setup and environmental conditions are required to ensure the NI PXIe-4322 meets published specifications.

- Keep connections to the NI PXIe-4322 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-4322 are secure.
- Use shielded copper wire for all cable connections to the TB-4322. Use twisted-pairs wire to eliminate noise.
- Maintain an ambient temperature of 23 °C ± 5 °C.
- The NI PXIe-4322 temperature will be greater than the ambient temperature.
- Keep relative humidity below 80%.
- Allow a warm-up time of at least 15 minutes to ensure that the NI PXIe-4322 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`.

Initial Setup

Refer to the *NI PXIe-4322 and TB-4322 Installation Guide and Terminal Block Specifications* 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

The following performance verification procedures describe the sequence of operation and provide test points required to verify the NI PXIe-4322. The verification procedures assume that adequate traceable uncertainties are available for the calibration references.

The NI PXIe-4322 has eight independent isolated analog output channels. Each channel can be configured as voltage output mode or current output mode. You can verify either voltage or current for any or all of the channels depending upon your desired test coverage.

Voltage Output Mode Accuracy Verification

Complete the following procedure to verify the voltage mode accuracy of the NI PXIe-4322:

1. Connect the DMM to the TB-4322 as shown in Figure 2 for the first channel you want to verify.
2. Use the information in Table 3 to configure the DMM.

Table 3. DMM Voltage Setup

Configuration	Value
Measurement	Voltage
Range	1 V (for 0 V test point)
	Minimum range to measure 16 V (for all other test points)
Digits Resolution	7.5
Aperture Time	100 ms
Autozero	On
ADC Calibration	On
Input Impedance Offset Nulling On	10 MΩ
DC Noise Rejection	High order
Number of Average	1
Power Line Frequency	Dependent upon the local power line characteristics.

3. Generate a voltage with the NI PXIe-4322.
   a. Create a task.
   b. Create and configure the AO channel according to the values found in Table 4.

Table 4. AO Voltage Mode Setup

Configuration	Value
Channel Name	`Dev1/aox`, where *x* refers to the channel number.
Task	AO Voltage
Maximum Value	16
Minimum Value	-16
Units	Volts

   c. Write the voltage value to the task.
   d. Use the DMM to read the voltage measurement value.
   e. Clear the task.
   f. Compare each measured value to the Upper Limit and Lower Limit values in Table 5.
4. Repeat step 3 for all voltage values listed in Table 5.

Table 5. Voltage Mode Accuracy Limits

Test Points (V)	Lower Limit (V)	Upper Limit (V)
-15.2	-15.2032	-15.1968
0	-0.00112	0.00112
15.2	15.1968	15.2032

5. Disconnect the DMM from the terminal block.
6. Repeat steps 3 through 5 for every channel.

Current Output Mode Accuracy Verification

Complete the following procedure to verify the current mode accuracy of the NI PXIe-4322:

1. Connect the DMM to the TB-4322 as shown in Figure 3 for the first channel you want to verify.
2. Set the DMM for current measurement and use the information in Table 6 to configure the DMM.

Table 6. DMM Current Setup

Configuration	Value
Measurement	Current
Range	100 µA (for 0 mA test point)
	Minimum range to measure 20 mA (for all other test points)
Digits Resolution	6.5
Aperture Time	100 ms
Autozero	On
ADC Calibration	On
DC Noise Reduction	High order
Number of Average	1
Power Line Frequency	Dependent upon the local power line characteristics.

3. Generate a current with the NI PXIe-4322.
   a. Create a task.
   b. Create and configure the AO channel according to the values in Table 7.

Table 7. AO Current Mode Setup

Configuration	Value
Channel Name	Dev1/aox, where x refers to the channel number.
Task	AO Current
Maximum Value	0.02
Minimum Value	-0.02
Units	Amps

c. Write the current value to task.

d. Use the DMM to read the current measurement value.

e. Clear the task.

f. Compare each measured value to the Upper Limit and Lower Limit values in Table 8.

4. Repeat step 3 for all current values listed in Table 8.

Table 8. Current Mode

Test Points (mA)	Lower Limit (mA)	Upper Limit (mA)
-19	-19.0101	-18.9899
0	-0.0038	0.0038
19	18.9899	19.0101

5. Disconnect the DMM from the terminal block.

6. Repeat steps 3 through 5 for every channel you want to verify.

Adjustment

The following performance adjustment procedures describe the sequence of operation required to adjust the NI PXIe-4322.

Voltage Output Mode Adjustment Procedure

Complete the following procedure to adjust the voltage mode accuracy of the NI PXIe-4322:

1. Connect the DMM to the TB-4322 as shown in Figure 2 for the channel you want to adjust.

2. Use the information in Table 9 to configure the DMM.

Table 9. DMM Voltage Setup

Configuration	Value
Measurement	Voltage
Range	Minimum range to measure 16 V (for the first to tenth test points)
	1 V (for the eleventh test point)
Digits Resolution	7.5
Aperture Time	100 ms
Autozero	On
ADC Calibration	On

Table 9. DMM Voltage Setup (Continued)

Configuration	Value
Input Impedance Offset Nulling On	10 MΩ
DC Noise Rejection	High order
Number of Averages	1
Power Line Frequency	Dependent upon the local power line characteristics.

3. Adjust the NI PXIe-4322 voltage output accuracy.

   a. Open a calibration session for the NI PXIe-4322. The default password is NI.

   b. Connect the DMM to the TB-4322 as shown in Figure 2 for one channel.

   c. Call the 4322 instance of the DAQmx Get SC Express Calibration Adjustment Point function to obtain 11 points for adjustment.

   d. Call the DAQmx Setup SC Express Calibration function and configure it as follows:

Physical Channels	Output Type	Output Value
Dev1aox	Voltage	The value obtained from step c.

   e. Measure the voltage using the DMM.

   f. Call the 4322 instance of the DAQmx Adjust SC Express Calibration function and configure it as follows:

Physical Channels	Reference Value
Dev1aox	The voltage value obtained in step e.

   g. For each adjustment point from first to tenth, repeat steps d to f.

   h. For eleventh point, change the DMM input range to 1 V then repeat steps d to f.

   i. Repeat steps b to h for every channel.

   j. Close the calibration session.

4. Disconnect the DMM from the terminal block.

Current Output Mode Adjustment Procedure

Complete the following procedure to adjust the mode accuracy performance of the
NI PXIe-4322:

1. Connect the DMM to the TB-4322 as shown in Figure 3 for the channel you want to adjust.

2. Set the DMM for current measurement and use the information in Table 10 to configure the DMM.

Table 10. DMM Current Setup

Configuration	Value
Measurement	Current
Range	Minimum range to measure 20 mA (for the first to tenth test points)
	100 µA (for the eleventh test point)
Digits Resolution	6.5
Aperture Time	100 ms
Autozero	On
ADC Calibration	On
DC Noise Rejection	High order
Number of Averages	1
Power Line Frequency	Dependent upon the local power line characteristics.

3. Adjust the NI PXIe-4322 current output accuracy.

    a. Open a calibration session for the NI PXIe-4322. The default password is NI.

    b. Connect the DMM to the TB-4322 as shown in Figure 3 for each channel.

    c. Call the 4322 instance of the DAQmx Get SC Express Calibration Adjustment Point function to obtain 11 points for adjustment.

    d. Call the DAQmx Setup SC Express Calibration function and configure it as follows:

Physical Channels	Output Type	Output Value
Dev1aox	Current	The value obtained from step c.

e. Measure the current using the DMM.

f. Call the 4322 instance of the DAQmx Adjust SC Express Calibration function and configure it as follows:

Physical Channels	Reference Value
Dev1aox	The current value obtained in step e.

g. For each adjustment point from the first to the tenth, repeat steps d to f.

h. For the eleventh point, change the DMM input range to 100 μA then repeat steps d to f.

i. Repeat steps b to h for every channel.

j. Close the calibration session.

4. Disconnect the DMM from the terminal block.

EEPROM Update

When an adjustment procedure is completed, the NI PXIe-4322 internal calibration memory (EEPROM) is immediately updated.

If you do not want to perform an adjustment, you can update the calibration date and onboard calibration temperature without making any adjustments by initializing an external calibration, and closing the external calibration.

Re-Verification

Repeat the *Verification* section to determine the As-Left status of the device.

> **Note** If any test fails Re-Verification after performing an adjustment, verify that you have met the *Test Conditions* before returning your device to NI. Refer to *Where to Go for Support* for assistance in returning the device to NI.

Specifications

Refer to the *NI PXIe-4322 Specifications* for detailed specification information.

Where to Go for Support

The National Instruments Web site 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.

National Instruments corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. National Instruments also has offices located around the world to help address your support needs. For telephone support in the United States, create your service request at `ni.com/support` and follow the calling instructions or dial 512 795 8248. For telephone support outside the United States, visit the Worldwide Offices section of `ni.com/niglobal` to access the branch office Web sites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.