CALIBRATION PROCEDURE
NI 9230/9232

This document contains the verification and adjustment procedures for the NI 9230 and NI 9232. For more information on calibration, visit ni.com/calibration.

Contents

Software

Calibrating the NI 9230/9232 requires the installation of NI-DAQmx on the calibration system. Table 1 shows the necessary versions for each connector variation.

Table 1. Calibration System Software Requirements

Connector Variation	Version Requirements
Screw-Terminal	NI-DAQmx 14.5 or later
BNC	NI-DAQmx 15.5 or later

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 application software that you intend to use.

NATIONAL INSTRUMENTS™

Documentation

Consult the following documents for information about the NI 9230/9232, NI-DAQmx, and your application software. All documents are available on ni.com and help files install with the software.

NI cDAQ-9174/9178 USB Chassis Quick Start

NI-DAQmx installation and hardware setup

NI 9230 Getting Started Guide

NI 9230 specific information

NI 9230 Datasheet

NI 9230 specifications and calibration interval

NI 9232 Getting Started Guide

NI 9232 specific information

NI 9232 Datasheet

NI 9232 specifications, and calibration interval

NI-DAQmx Readme

Operating system and application software support in NI-DAQmx

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 2 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 2.

Table 2. Recommended Equipment

Equipment	Recommended Model	Parameter Measured	Requirements
Calibrator	Fluke 5700A	Accuracy, Adjustment	Use a high-precision voltage source with an accuracy ≤100 ppm.
Chassis	NI cDAQ-9178	All	—

Test Conditions

The following setup and environmental conditions are required to ensure the NI 9230/9232 meets published specifications.

- Keep connections to the device 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 device are secure.
- Use shielded copper wire for all cable connections to the device. Use twisted-pairs wire to eliminate noise and thermal offsets.
- Maintain an ambient temperature of 23 °C ±5 °C. The device temperature will be greater than the ambient temperature.
- Keep relative humidity below 80%.
- Allow a warm-up time of at least 10 minutes to ensure that the NI 9230/9232 measurement circuitry is at a stable operating temperature.

Initial Setup

Complete the following steps to set up the NI 9230/9232.

1. Install NI-DAQmx.
2. Make sure the NI cDAQ-9178 chassis power source is not connected to the chassis.
3. Connect the NI cDAQ-9178 chassis to the system safety ground.
   a. Attach a ring lug to a 14 AWG (1.6 mm) wire.
   b. Connect the ring lug to the ground terminal on the side of the NI cDAQ-9178 chassis using the ground screw.
   c. Attach the other end of the wire to the system safety ground.
4. Install the module in slot 8 of the NI cDAQ-9178 chassis. Leave slots 1 through 7 of the NI cDAQ-9178 chassis empty.
5. Connect the NI cDAQ-9178 chassis to your host computer.

6. Connect the power source to the NI cDAQ-9178 chassis.

7. Launch Measurement & Automation Explorer (MAX).

8. Right-click the device name and select **Self-Test** to ensure that the module is working properly.

Verification

The following performance verification procedures describe the sequence of operation and provide test points required to verify the NI 9230/9232. The verification procedures assume that adequate traceable uncertainties are available for the calibration references.

Accuracy Verification

Complete the following procedure to determine the As-Found status of the NI 9230/9232.

1. Set the calibrator to Standby mode (STBY).

2. Connect the NI 9230/9232 to the calibrator as shown in Figure 1.

Figure 1. Accuracy Verification Connections
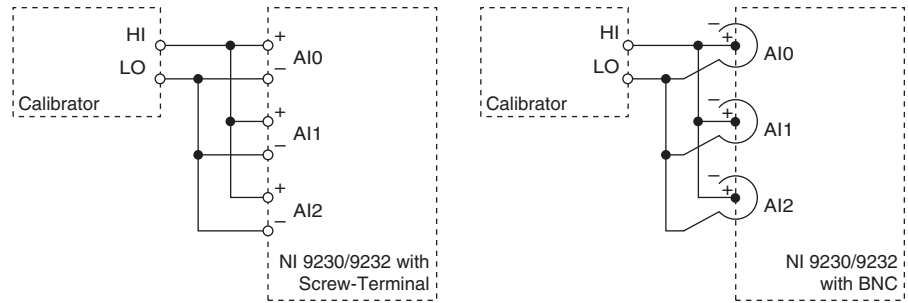
3. Set the calibrator voltage to a Test Point value indicated in Table 5.

4. Set the calibrator to Operate mode (OPR).

5. Acquire and average samples of each channel.

   a. Create and configure an AI voltage task on the NI 9230/9232 according to Table 3.

Table 3. NI 9230/9232 Configuration for Accuracy Verification

Min (V)	Max (V)	Scaled Units	Physical Channels	Channel Configuration
-30	30	Volts	AI0:2	DC Coupled

b.   Configure the AI voltage task timing according to Table 4.

Table 4. NI 9230/9232 Timing Configuration

Sample Mode	Samples Per Channel	Rate kS/s
NI 9230 Finite Samples	1280	12.8
NI 9232 Finite Samples	10240	102.4

c.   Start the task.

d.   Average the samples acquired for each channel.

e.   Stop and Clear the task.

6.   Compare the average to the limits in Table 5.

Table 5. NI 9230/9232 Verification Test Limits for Accuracy

Range		Test Point		1-Year Limits	
Min (V)	Max (V)	Location	Value (V)	Lower Limit (V)	Upper Limit (V)
-30	30	Max	28.5	28.46853	28.53147
		Mid	0.00	-0.007245	0.007245
		Min	-28.5	-28.53147	-28.46853

Note   The test limits listed in Table 5 are derived using the values in Table 7.

Note   The uncertainty of the calibration standard is not included in these limits.

7.   Set the calibrator to Standby mode (STBY).

8.   Repeat steps 3 through 7 for each test point in Table 5.

9.   Disconnect the calibrator from the device.

Adjustment

The following performance adjustment procedure describes the sequence of operation required to adjust the NI 9230/9232.

Accuracy Adjustment

Complete the following procedure to adjust the accuracy performance of the NI 9230/9232.

1.   Set the calibrator to Standby mode (STBY).

2.   Connect the NI 9230/9232 to the calibrator as shown in Figure 1.

3.   Adjust the NI 9230/9232.

a.   Initialize a calibration session on the NI 9230/9232. The default password is NI.

b.   Input the external temperature in degrees Celsius.

c. Call the NI 9230/9232 DAQmx Get C Series Calibration Adjustment Points function to obtain an array of recommended calibration voltages for the NI 9230/9232.

d. Set the calibrator to a reference value determined by the array of recommended calibration voltages.

e. Set the calibrator to Operate mode (OPR).

f. Call and configure the NI 9230/9232 adjustment function according to Table 6.

Table 6. Adjustment Configuration

Physical Channel	Reference Value
cDAQMod8/ai$x$	The reference value from the array of adjustment points

g. Set the calibrator to Standby mode (STBY).

h. Repeat steps d through g for each calibration voltage in the array.

i. Close the calibration session.

4. Disconnect the NI 9230/9232 from the calibrator.

EEPROM Update

When an adjustment procedure is completed, the NI 9230/9232 internal calibration memory (EEPROM) updates immediately.

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, setting the C Series calibration temperature, and closing the external calibration.

Reverification

Repeat the *Verification* section 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.

Accuracy Under Calibration Conditions

The following calibration specifications are valid under the following conditions:

• Ambient temperature 23 ±5 °C

• NI 9230/9232 installed in slot 8 of an NI cDAQ-9178 chassis

• Slots 1 through 7 of the NI cDAQ-9178 chassis are empty

Note The test limits listed in Table 5 are derived using the values in Table 7.

Table 7. NI 9230/9232 Accuracy Under Calibration Conditions

Percent of Reading (Gain Error)	Percent of Range[*] (Offset Error)
0.085%	0.023%
[*] Range equals 31.5 V	

Note For operational specifications, refer to the most recent *NI 9230 Datasheet* or *NI 9232 Datasheet* online at ni.com/manuals.

Worldwide Support and Services

The National Instruments 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 National Instruments product. Product registration facilitates technical support and ensures that you receive important information updates from NI.

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