NI-9238

Calibration Procedure

Authorized Distributor

Integration Partner

NI 9238

4-Channel, ±0.5 V, 24-Bit Simultaneous, Channel-to-Channel Isolated Analog Input Module

This document contains the verification and adjustment procedures for the NI 9238. For more information about calibration solutions, visit `ni.com/calibration`.

Contents

Software

Calibrating the NI 9238 requires the installation of NI-DAQmx 14.1 or later on the calibration system. You can download NI-DAQmx from `ni.com/downloads`. NI-DAQmx supports LabVIEW, LabWindows™/CVI™, ANSI C, Microsoft Visual C++, Microsoft Visual Basic .NET, and Microsoft Visual C#. When you install NI-DAQmx, you only need to install support for the application software that you intend to use.

Documentation

Consult the following documents for information about the NI 9238, NI-DAQmx, and your application software. All documents are available on ni.com and help files install with the software.

NI cDAQ-9174/9178 Quick Start

NI-DAQmx installation and hardware setup

NI 9238 Operating Instructions and Specifications

NI 9238 specific information, 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 mapping C enums to .NET enums

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
Calibrator	Fluke 5500A	Use a high-precision voltage source with an accuracy of ≤60 ppm and offset error ≤6 µV.
Chassis	NI cDAQ-9178	—

Test Conditions

The following setup and environmental conditions are required to allow the NI 9238 to meet the performance levels shown in Table 2:

- Keep connections to the NI 9238 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 9238 are secure.
- Use shielded copper wire for all cable connections to the NI 9238. Use twisted-pairs 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 10 minutes to ensure that the NI 9238 measurement circuitry is at a stable operating temperature.

Initial Setup

Refer to the *NI cDAQ-9174/9178 Quick Start* for information about how to install the software and hardware and how to configure the device in Measurement & Automation Explorer (MAX).

Complete the following steps to set up the NI 9238.

1. Install NI-DAQmx.
2. Make sure the NI cDAQ-9178 power source is not connected.
3. Connect the NI cDAQ-9178 to the system safety ground.
   a. Attach a ring lug to a 14 AWG (1.6 mm) wire.
   b. Use the ground screw to connect the ring lug to the ground terminal on the side of the NI cDAQ-9178.
   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 MAX.
8. Right-click the device name and select **Self-Test** to ensure that the module is working properly.
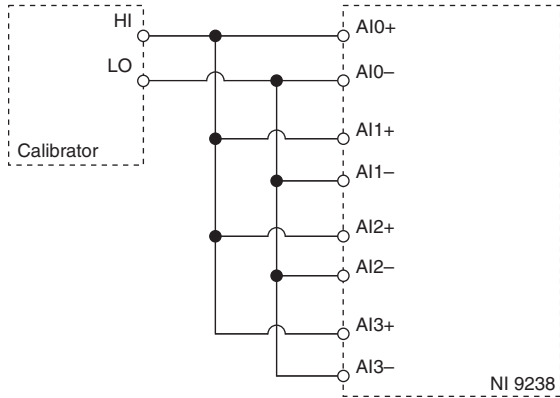
Verification

The following performance verification procedure describes the sequence of operation and test points required to verify the NI 9238. The verification procedure assumes that the calibration references have traceable uncertainties that meet the requirements listed in the *Test Equipment* section.

Accuracy Verification

Complete the following procedure to determine the As-Found status of the NI 9238.

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

2.   Connect the NI 9238 to the calibrator, as shown in Figure 1.

Figure 1. NI 9238 Calibration Connections

3.   Set the calibrator voltage to a selected Test Point value in Table 2.

A properly functioning NI 9238, when calibrated according to the conditions described in this document, can be expected to have gain and offset errors within the limits shown.

The following accuracy table is valid for calibration under the following conditions:

•   Ambient temperature 23 °C ± 5 °C

•   Slot 8 of the NI cDAQ-9178 chassis is occupied by the NI 9238

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

Table 2. NI 9238 Accuracy Verification Test Limits

Range			1-Year Limits	
Minimum (V)	Maximum (V)	Test Point (V)	Upper Limit (V)	Lower Limit (V)
-0.5	0.5	-0.45	-0.44956	-0.45044
		0	0.00006	-0.00006
		0.45	0.45044	0.44956

✎ **Note** Values in Table 2 should be used for calibration verification only. These values only apply under the specific calibration conditions described in this document, and are not to be construed as general operational specifications of the NI 9238. For operational specifications, refer to the most recent *NI 9238 Operating Instructions and Specifications* at ni.com/manuals.

4. Set the calibrator to Operate mode (OPR).
5. Acquire and average samples.
   a. Create and configure an AI voltage task according to Table 3.

Table 3. NI 9238 Voltage Task Configuration

	Range	
Physical Channels	Minimum (V)	Maximum (V)
AI0:3	-0.5	0.5

   b. Configure the task timing according to Table 4.

Table 4. NI 9238 Task Timing Configuration

Sample Mode	Samples per Channel	Rate (kS/s)
Finite Samples	5000	50

   c. Start the task.
   d. Read samples from the NI 9238.
   e. Average the samples.
   f. Clear the task.
6. Compare the per-channel averages to the limits in Table 2.
7. Set the calibrator to Standby mode (STBY).
8. Repeat steps 3 through 7 for each test point in Table 2.
9. Disconnect the NI 9238 from the calibrator.

Adjustment

The following performance adjustment procedure describes the sequence of operation required to adjust the NI 9238.

Complete the following procedure to adjust the accuracy performance of the NI 9238.

1. Set the calibrator to Standby mode (STBY).
2. Connect the NI 9238 to the calibrator, as shown in Figure 1.
3. Adjust the NI 9238.
   a. Initialize a calibration session on the NI 9238. The default password is NI.
   b. Input the external temperature in degrees Celsius using the set temperature C Series function.
   c. Call the NI 9238 get C Series adjustment points function to obtain an array of recommended calibration voltages for the NI 9238.
   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 9238 adjustment function according to Table 5.

Table 5. Accuracy Adjustment Configuration

Physical Channel	Reference Value
cDAQMod8/ai*x*	A reference value from the array of adjustment points.

✑ **Note** The module acquisition starts each time the adjust function is called.

   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.
   j. Clear the task.
4. Disconnect the NI 9238 from the calibrator.

EEPROM Update

When an adjustment procedure is completed, the NI 9238 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, 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 conditions listed in the *Test Conditions* section before returning your device to NI. Refer to the *Where to Go for Support* section for assistance in returning the device to NI.

Where to Go for Support

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.

National Instruments corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. National Instruments 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.