# CALIBRATION PROCEDURE
# NI 9211

| 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 9211. For more information about calibration solutions, visit ni.com/calibration.

# Contents

# Software

Calibrating the NI 9211 requires the installation of NI-DAQmx 9.2 or later on the calibration system. You can download NI-DAQmx from ni.com/downloads. NI-DAQmx supports LabVIEW, LabWindows™/CVI™, C++, and .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 9211, 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 9211 Operating Instructions and Specifications*

NI 9211 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 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 |
|---|---|---|
| Calibrator | Fluke 5520A locked in the 3.3 V range | A high-precision voltage source with ≤7 μV of uncertainty at 75 mV and ≤2 μV of uncertainty at 0 V and an output impedance <5 Ω. |
| Chassis | NI cDAQ-9178 | — |
| Connection Accessory | NI 9932 | — |

# Test Conditions

The following setup and environmental conditions are required to ensure the NI 9211 meets published specifications.

- Keep connections to the NI 9211 as short as possible. Long cables and wires act as antennae, picking up extra noise that can affect measurements.
- Verify that all connections to the NI 9211 are secure.
- Use shielded copper wire for all cable connections to the NI 9211. 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 9211 measurement circuitry is at a stable operating temperature.

# Initial Setup

Complete the following steps to set up the NI 9211.

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. Connect the ring lug to the ground terminal on the side of the NI cDAQ-9178 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 procedure describes the sequence of operation and test points required to verify the NI 9211 and assumes 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 9211.

1. Set the calibrator to Standby mode (STBY).
2. Connect the NI 9211 to the calibrator as shown in Figure 1.

**Figure 1.** Accuracy Verification Connections
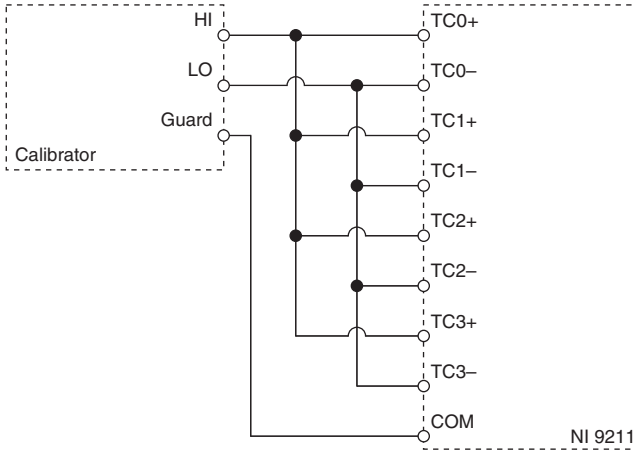


3. Set the calibrator output to a Test Point value indicated in Table 4.
4. Set the calibrator to Operate mode (OPR).
5. Acquire and average samples.
   a. Create and configure an AI voltage channel according to Table 2.

**Table 2.** NI 9211 AI Voltage Channel Configuration

| Input Terminal Configuration | Minimum Value (V) | Maximum Value (V) | Physical Channels | Units | Autozero |
|---|---|---|---|---|---|
| Differential | -0.08 | 0.08 | cDAQMod8/ai0:3 | Volts | Every Sample |

   b. Configure the AI voltage channel timing according to Table 3.

**Table 3.** NI 9211 Timing Configuration

| Samples Per Channel | Sample Mode | Rate (S/s) |
|---|---|---|
| 100 | Finite | 7 |

   c. Start the task.
   d. Read samples from the NI 9211.
   e. Average the samples for each channel.
   f. Clear the task.

6. Compare the average sample for each channel to the test limits in Table 4.

**Table 4.** NI 9211 Test Limits

| Test Point | | 1-Year Limits | |
| --- | --- | --- | --- |
| Location | Value (V) | Lower Limit (V) | Upper Limit (V) |
| Max | 0.075000 | 0.074959 | 0.075041 |
| Mid | 0 | -0.000013 | 0.000013 |
| Min | -0.075000 | -0.075041 | -0.074959 |

**Note** The test limits listed in Table 4 are derived using the values in Table 6.

7. Set the calibrator to Standby mode (STBY).
8. Repeat steps 3 through 7 for each test point in Table 4.
9. Disconnect the calibrator from the NI 9211.

# Adjustment

The following performance adjustment procedure describes the sequence of operation required to adjust the NI 9211.

## Accuracy Adjustment

Complete the following procedure to adjust the accuracy performance of the NI 9211.

1. Set the calibrator to Standby mode (STBY).
2. Connect the NI 9211 to the calibrator as shown in Figure 1.
3. Set the calibrator output to 0.07 V.
4. Set the calibrator to Operate mode (OPR).
5. Adjust the NI 9211.
    a. Open a calibration session on the NI 9211.
    b. Input the external temperature in degrees Celsius.
    c. Call and configure the NI 9211 adjustment function according to Table 5.

**Table 5.** Adjustment Configuration

| Physical Channels | Reference Value |
| --- | --- |
| cDAQMod8/ai0:3 | 0.07 |

    d. Close the calibration session.
6. Set the calibrator to Standby mode (STBY).
7. Disconnect the calibrator from the NI 9211.

# EEPROM Update

When an adjustment procedure is completed, the NI 9211 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.

# 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.

# Accuracy Under Calibration Conditions

The values in the following table are based on calibrated scaling coefficients, which are stored in the onboard EEPROM.

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

- Ambient temperature 23 °C ±5 °C
- NI 9211 installed in slot 8 of an NI cDAQ-9178 chassis
- Slots 1 through 7 of the NI cDAQ-9178 chassis are empty

**Table 6.** NI 9211 Accuracy Under Calibration Conditions

| Gain Error | Offset Error |
|:---:|:---:|
| 370 ppm | 13 µV |

> **Note** For operational specifications, refer to the most recent *NI 9211 Operating Instructions/User Guide and Specifications* online at ni.com/manuals.

# 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.