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CALIBRATION PROCEDURE
NI 9203

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ni.com/manuals

This document contains the verification and adjustment procedures for the National Instruments 9203. For more information about calibration solutions, visit `ni.com/calibration`.

Contents

Software

Calibrating the NI 9203 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/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 9203, 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 9203 Operating Instructions and Specifications

NI 9203 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 5700A	If this instrument is unavailable, use a high-precision current source with an accuracy <100 ppm.
Chassis	NI cDAQ-9178	—

Test Conditions

The following setup and environmental conditions are required to ensure the NI 9203 meets published specifications.

- Keep connections to the NI 9203 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 9203 are secure.
- Use shielded copper wire for all cable connections to the NI 9203. Use twisted-pairs wire to eliminate noise and thermal offsets.
- Maintain an ambient temperature of 23 °C ±5 °C. The NI 9203 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 9203 measurement circuitry is at a stable operating temperature.

Initial Setup

Complete the following steps to set up the NI 9203.

1. Install NI-DAQmx.
2. Make sure the NI cDAQ-9178 power source is not connected.
3. Install the module in slot 8 of the NI cDAQ-9178 chassis. Leave slots 1 through 7 of the NI cDAQ-9178 chassis empty.
4. Connect the NI cDAQ-9178 chassis to your host computer.
5. Connect the power source to the NI cDAQ-9178 chassis.
6. Launch Measurement & Automation Explorer (MAX).
7. Right-click the device name and select **Self-Test** to ensure that the module is working properly.

Verification

The following performance verification procedures describes the sequence of operation and test points required to verify the NI 9203 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 9203.

1. Set the calibrator to Standby mode (STBY).
2. Connect the NI 9203 to the calibrator. Refer to Figure 1 for a connection diagram.

Figure 1. Accuracy Connections for the NI 9203
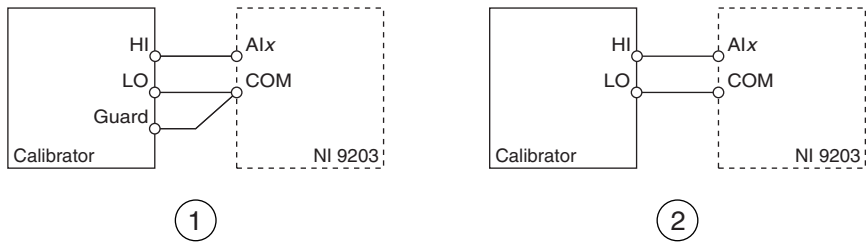
1   Connections when using a calibrator with a guard connection.

2   Connections when using a calibrator with no guard connection.

> **Note**   If the calibrator outputs are truly floating, connect the negative output to a quiet earth ground as well as COM to give the entire system a ground reference.

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

Table 2. NI 9203 AI Voltage Channel Configuration

Input Range	Input Range		Scaled Units	Terminal Configuration
	Min	**Max**		
Unipolar	0.000	0.020	Amps	RSE
Bipolar	-0.020	0.020	Amps	RSE

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

Table 3. NI 9203 Timing Configuration

Samples Per Channel	Acquisition Mode	Rate (S/s)
10k	Finite	20k

c. Start the task.

d. Read samples from the NI 9203.

e. Average the samples.

f. Clear the task.

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

Table 4. NI 9203 Test Limits

Input Range	Range (V)		Test Point		1-Year Limits	
	Min	Max	Location	Value (A)	Lower Limit (A)	Upper Limit (A)
Unipolar	0.000	0.020	Max	0.020000	0.019980	0.020020
	0.000	0.020	Mid	0.010000	0.009988	0.010012
	0.000	0.020	Min	0.000000	-0.000004	0.000004
Bipolar	-0.020	0.020	Max	0.020000	0.019969	0.020031
	-0.020	0.020	Mid	0.000000	-0.000014	0.000014
	-0.020	0.020	Min	-0.020000	-0.020031	-0.019969

7. Repeat steps 4 through 6 for each Test Point in Table 4.

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

9. Disconnect the NI 9203 from the calibrator.

Adjustment

The following performance adjustment procedure describes the sequence of operation required to adjust the NI 9203.

Gain Accuracy Adjustment

Complete the following procedure to adjust the gain accuracy performance of the NI 9203.

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

2. Connect the NI 9203 to the calibrator. Refer to Figure 1 for a connection diagram.

3. Adjust the NI 9203.

    a. Initialize a calibration session on the NI 9203. The default password is NI.

    b. Input the external temperature in degrees Celsius.

c. Call and configure the NI 9203 get C Series adjustment points function according to Table 5 to obtain an array of recommended calibration voltages for both the Unipolar and Bipolar Input Range.

Table 5. Get Adjustment Points Configuration

	Range	
Input Range	**Min**	**Max**
Unipolar	0.000	0.020
Bipolar	-0.020	0.020

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

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

f. Call and configure the NI 9203:Gain adjustment function according to Table 6 to adjust the gain for both the Unipolar and Bipolar ranges.

Table 6. Gain Adjustment Configuration

Input Range	Range		Physical Channel	Reference Value
	Min	**Max**		
Unipolar	0.000	0.020	cDAQMod8/ai*x*	The reference value from the array of adjustment points
Bipolar	-0.020	0.020	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. Disconnect the calibrator from the NI 9203.

j. Close the calibration session.

4. Disconnect the NI 9203 from the calibrator.

5. Repeat steps 2 through 4 for each channel on the NI 9203.

Offset Accuracy Adjustment

Complete the following procedure to adjust the offset accuracy performance of the NI 9203.

1. On the NI 9203, connect AI3 to COM.
2. Adjust the NI 9203.
   a. Initialize a calibration session on the NI 9203. The default password is NI.
   b. Input the external temperature in degrees Celsius.
   c. Call and configure the NI 9203:Offset adjustment function according to Table 7 to adjust the offset for both the Unipolar and Bipolar ranges.

Table 7. Offset Adjustment Configuration

	Range		
Input Range	**Min**	**Max**	**Physical Channel**
Unipolar	0.000	0.020	cDAQMod8/ai*x*
Bipolar	-0.020	0.020	cDAQMod8/ai*x*

   d. Close the calibration session.
3. Disconnect AI3 from COM on the NI 9203.

EEPROM Update

When an adjustment procedure is completed, the NI 9203 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 *Worldwide Support and Services* 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 9203 installed in slot 8 of an NI cDAQ-9178 chassis
- Slots 1 through 7 of the NI cDAQ-9178 chassis are empty

Table 8. NI 9203 Accuracy Under Calibration Conditions

Input Range	Percent of Reading (Gain Error)	Percent of Range* (Offset Error)
Unipolar	0.080% max	0.019%[†] max
Bipolar	0.082% max	0.033% max

* Range equals 21.5 mA for Unipolar and 43 mA (±21.5 mA) for Bipolar.

[†] This specification is lower than the Percent of Range typical specification in the *NI 9203 Operating Instructions and Specifications* because the typical specification shows digits only to the hundredth place.

Note For operational specifications, refer to the most recent *NI 9203 Operating Instructions/User Guide and Specifications* 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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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.