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NI-9220

CALIBRATION PROCEDURE

NI 9220

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ni.com/manuals

This document contains the verification and adjustment procedures for the National Instruments 9220. In this document, the NI 9220 with spring terminal and the NI 9220 with DSUB are referred to inclusively as the NI 9220. For more information about calibration solutions, visit ni.com/calibration.

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Software Requirements

Calibrating the NI 9220 requires the installation of NI-DAQmx 9.6 or later on the calibration system. You can download NI-DAQmx from ni.com/downloads. NI-DAQmx supports LabVIEW, LabWindows™/CVI™, ANSI C, and .NET. 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 9220, 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 9220 User Guide and Specifications

NI 9220 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	Use a high-precision voltage source with an accuracy of ≤ 15 ppm and an output impedance of $\leq 50 \Omega$.
Chassis	NI cDAQ-9178	—
DSUB Connection Accessory	NI 9923	—

Test Conditions

The following setup and environmental conditions are required to ensure the NI 9220 meets published specifications.

- Keep connections to the NI 9220 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 9220 are secure.
- Use shielded copper wire for all cable connections to the NI 9220. Use twisted-pairs wire to eliminate noise and thermal offsets.
- Maintain an ambient temperature of $23 \text{ }^\circ\text{C} \pm 5 \text{ }^\circ\text{C}$.
- Keep relative humidity below 80%.
- Allow a warm-up time of at least 10 minutes to ensure that the NI 9220 measurement circuitry is at a stable operating temperature.

Initial Setup

Complete the following steps to set up the NI 9220.

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 procedure describes the sequence of operation and test points required to check the NI 9220 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 9220.

1. Set the calibrator to Standby mode (STBY).
2. Connect the NI 9220 to the calibrator as shown in Figure 1.

Figure 1. Accuracy Verification Connections



- 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 voltage 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 9220 AI Voltage Channel Configuration

Input Range		Scaled Units	Terminal Configuration
Min	Max		
-10	10	Volts	Differential

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

Table 3. NI 9220 Timing Configuration

Samples Per Channel	Acquisition Mode	Rate (kS/s)
10,000	Finite	100

- c. Start the task.
 - d. Read samples from the NI 9220.
 - e. Average the samples.
 - f. Clear the task.
6. Compare the average of the samples to the test limits in Table 4.

Table 4. NI 9220 Test Limits

Range (V)		Test Point		1-Year Limits	
Min	Max	Location	Value (V)	Lower Limit (V)	Upper Limit (V)
-10.000	10.000	Max	9.500000	9.498485	9.501515
-10.000	10.000	Mid	0.000000	-0.00028	0.00028
-10.000	10.000	Min	-9.500000	-9.501515	-9.498485



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

7. Repeat steps 3 through 6 for each Test Point in Table 4.
8. Set the calibrator to Standby mode (STBY).
9. Disconnect the NI 9220 from the calibrator.
10. Repeat steps 1 through 9 for each channel on the NI 9220.

Adjustment

The following performance adjustment procedure describes the sequence of operation required to adjust the NI 9220.

Accuracy Adjustment

Complete the following procedure to adjust the accuracy performance of the NI 9220.

1. Set the calibrator to Standby mode (STBY).
2. Connect the NI 9220 to the calibrator as shown in Figure 1.
3. Adjust the NI 9220.
 - a. Initialize a calibration session on the NI 9220. The default password is NI.
 - b. Input the external temperature in degrees Celsius.

- c. Call the NI 9220 get C Series adjustment points function to obtain an array of recommended calibration voltages for the NI 9220.
- 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 9220 adjustment function according to Table 5.

Table 5. Adjustment Configuration

Physical Channel	Reference Value
cDAQMod8/aix	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 9220 from the calibrator.
 5. Repeat steps 1 through 4 for each channel on the NI 9220.

EEPROM Update

When an adjustment procedure is completed, the NI 9220 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* section 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 9220 installed in slot 8 of an NI cDAQ-9178 chassis
- Slots 1 through 7 of the NI cDAQ-9178 chassis are empty



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

Table 6. NI 9220 Accuracy Under Calibration Conditions

Gain Error	Offset Error
0.013%	0.28 mV



Note For operational specifications, refer to the most recent *NI 9220 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.

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