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NI-9223

CALIBRATION PROCEDURE

NI 9222/9223

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ni.com/manuals

This document contains the verification and adjustment procedures for the National Instruments 9222 and National Instruments 9223. For more information on calibration, visit ni.com/calibration. In this document, the NI 9222/9223 with screw terminal and NI 9222/9223 with BNC are referred to inclusively as the NI 9222/9223.

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Software

Calibrating the NI 9222/9223 with screw terminal requires the installation of NI-DAQmx 9.2 or later on the calibration system. Calibrating the NI 9222/9223 with BNC requires the installation of NI-DAQmx 9.9 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.

Documentation

Consult the following documents for information about the NI 9222/9223, 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 9222/9223 Operating Instructions and Specifications

NI 9222/9223 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 ≤ 15 ppm and an output impedance $\leq 50 \Omega$.
Chassis	NI cDAQ-9178	—

Test Conditions

The following setup and environmental conditions are required to ensure the NI 9222/9223 meets published specifications.

- Keep connections to the NI 9222/9223 as short as possible. Long cables and wires act as antennas, picking up extra noise that can affect measurements.
- For the NI 9222/9223 screw terminal, use shielded copper wire for all cable connections to the device. Use twisted-pairs wire to eliminate noise and thermal offsets.
- Use 50 Ω BNC coaxial cable to connect signals to NI 9222/9223 with BNC.
- Verify that all connections to the NI 9222/9223 are secure.
- Maintain an ambient temperature of 23 \pm 5 $^{\circ}$ C. The NI 9222/9223 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 9222/9223 measurement circuitry is at a stable operating temperature.

Initial Setup

Complete the following steps to set up the NI 9222/9223.

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 verify the NI 9222/9223 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 9222/9223.

1. Set the calibrator to Standby mode (STBY).
2. Connect the NI 9222/9223 to the calibrator as shown in Figure 1.

Figure 1. NI 9222/9223 Terminal Assignments



Note If the calibrator outputs are truly floating, the negative output must be connected to a quiet earth ground as well as AI- to give the entire system a ground reference.

3. Set the calibrator voltage to a Test Point value indicated in Tables 4 or 5.
4. Set the calibrator to Operate mode (OPR).
5. Acquire and average samples.
 - a. Create and configure an AI voltage task on the NI 9222/9223 according to Table 2.

Table 2. NI 9222/9223 Configuration for Accuracy Verification

Min (V)	Max (V)	Scaled Units	Terminal Configuration
-10	10	Volts	Differential

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

Table 3. Timing Configuration

Module	Sample Mode	Samples per Channel	Rate
NI 9222	Finite Sample	50 k	500 k
NI 9223	Finite Sample	100 k	1 M

- c. Start the task.
 - d. Average the readings.
 - e. Clear the task.

- Compare the average to the limits in Tables 4 or 5.

Table 4. NI 9222 Verification Limits for Accuracy

Range (V)		Test Point		1-Year Limits (V)	
Minimum	Maximum	Location	Value (V)	Lower Limit	Upper Limit
-10.000	10.000	Positive FS	9.500000	9.494589	9.505411
-10.000	10.000	Mid	0.000000	-0.002466	0.002466
-10.000	10.000	Negative FS	-9.500000	-9.505411	-9.494589

Table 5. NI 9223 Verification Limits for Accuracy

Range (V)		Test Point		1-Year Limits (V)	
Minimum	Maximum	Location	Value (V)	Lower Limit	Upper Limit
-10.000	10.000	Positive FS	9.500000	9.493485	9.506515
-10.000	10.000	Mid	0.000000	-0.002430	0.002430
-10.000	10.000	Negative FS	-9.500000	-9.506515	-9.493485



Note The test limits listed in Tables 4 or 5 are derived using the values in Table 7.

- Set the calibrator to Standby mode (STBY).
- Repeat steps 3 through 6 for each test point.
- Disconnect the calibrator from the device.
- Repeat steps 2 through 9 for each channel.

Adjustment

The following performance adjustment procedure describes the sequence of operation required to adjust the NI 9222/9223.

Accuracy Adjustment

Complete the following procedure to adjust the accuracy performance of the NI 9222/9223.

- Set the calibrator to Standby mode (STBY).
- Connect the NI 9222/9223 to the calibrator as shown in Figure 1.



Note If the calibrator outputs are truly floating, the negative output must be connected to a quiet earth ground as well as AI- to give the entire system a ground reference.

3. Adjust the NI 9222/9223.
 - a. Initialize a calibration session on the NI 9222/9223. The default password is NI.
 - b. Input the external temperature in degrees Celsius.
 - c. Call the NI 9222/9223 get C Series adjustment points function to obtain an array of recommended calibration voltages for the NI 9222/9223.
 - 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 9222/9223 adjustment function according to Table 6.

Table 6. Adjustment Configuration

Physical Channel	Reference Value
cDAQMod8/air	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 9222/9223 from the calibrator.
5. Repeat steps 1 through 4 for each channel on the NI 9222/9223.

EEPROM Update

When an adjustment procedure is completed, the NI 9222/9223 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 [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 9222/9223 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 Tables 4 and 5 are derived using the values in Table 7.

Table 7. NI 9222/9223 Accuracy Under Calibration Conditions

Module	Gain Error	Offset Error (mV)
NI 9222	0.031%	2.466
NI 9223	0.043%	2.430



Note For operational specifications, refer to the most recent *NI 9222/9223 Operating Instructions 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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