



# NI-9222

## Calibration Procedure



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# 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](http://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

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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](http://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

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Consult the following documents for information about the NI 9222/9223, NI-DAQmx, and your application software. All documents are available on [ni.com](http://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

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

# Test Conditions

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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  $\Omega$  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

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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

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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

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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

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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](http://ni.com/manuals).

## Worldwide Support and Services

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The National Instruments website is your complete resource for technical support. At [ni.com/support](http://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.

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