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**cDAQ-9178**

# CALIBRATION PROCEDURE

# NI 9207

16-channel,  $\pm 2$ - mA/ $\pm 10$  V, 24-bit Analog Input Module

Français    Deutsch    日本語    한국어    简体中文  
[ni.com/manuals](http://ni.com/manuals)

This document contains the verification and adjustment procedures for the National Instruments 9207. For more information about calibration solutions, visit [ni.com/calibration](http://ni.com/calibration).

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## Software

Calibrating the NI 9207 requires the installation of NI-DAQmx 9.1 or later on the calibration system. 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 9207, 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 9207 Operating Instructions and Specifications*

NI 9207 specific information, specifications, and calibration interval



*NI DAQmx Help*

Information about creating applications that use the NI-DAQmx driver



*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

<b>Equipment</b>	<b>Recommended Model</b>	<b>Minimum Requirements</b>
Source	Fluke 5700A	Use a source with an accuracy $\leq 100$ ppm.
cDAQ Chassis	NI cDAQ-9178	—
Connection Accessory	NI 9923	—

# Test Conditions

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The following setup and environmental conditions are required to ensure the NI 9207 meets published specifications.

- Keep connections to the device as short as possible. Long cables and wires act as antennas, picking up extra noise that can affect measurements.
- Verify that all connections to the device are secure.
- Use shielded copper wire for all cable connections to the device. Use twisted-pairs wire to eliminate noise and thermal offsets.
- Maintain an ambient temperature of  $23 \pm 5$  °C. The device 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 9207 measurement circuitry is at a stable operating temperature.

## Initial Setup

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Complete the following steps to set up the NI 9207.

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

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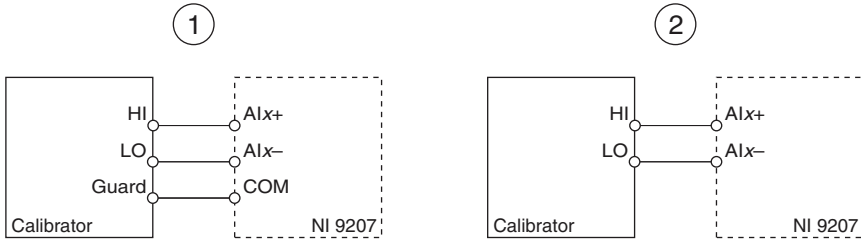
The following performance verification procedures describe the sequence of operation and test points required to verify the NI 9207 and assumes that adequate traceable uncertainties are available for the calibration references.

# Voltage Accuracy Verification

Complete the following procedure to determine the As-Found status of the NI 9207.

1. Set the calibrator to Standby mode (STBY).
2. Connect the NI 9207 to the calibrator as shown in Figure 1.

**Figure 1. Voltage Accuracy 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 task on the NI 9207 according to Table 2.

**Table 2. NI 9207 Configuration for Voltage Accuracy Verification**

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

- b. Configure the AI voltage task according to Table 3. Set the ADC timing mode to high-resolution.

**Table 3. NI 9207 Voltage Timing Configuration**

ADC Timing Mode	Sample Mode	Samples to Read
High-Resolution	N Samples	5
High-Speed	N Samples	75

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

- Compare the average to the limits in Table 4.

**Table 4. NI 9207 Verification Test Limits for Voltage Accuracy**

Range (V)		Test Point		1-Year Limits	
Minimum	Maximum	Location	Value (V)	Lower Limit (V)	Upper Limit (V)
-10.00000	10.00000	Pos FS	10.00000	9.98792	10.01208
-10.00000	10.00000	Mid	0.00000	-0.00208	0.00208
-10.00000	10.00000	Neg FS	-10.00000	-10.01208	-9.98792

- Repeat step 5 and 6 with the ADC timing mode on the NI 9207 set to high-speed.
- Set the calibrator to Standby mode (STBY).
- Repeat steps 3 through 8 for each test point listed in Table 4.
- Disconnect the calibrator from the device.
- Repeat steps 1 through 10 for each voltage channel on the NI 9207.

## Current Accuracy Verification

Complete the following procedure to determine the As-Found status of the NI 9207.

- Set the calibrator to Standby mode (STBY).
- Connect the NI 9207 to the calibrator as shown in Figure 2.

**Figure 2. Current Accuracy Connections**



**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.

- Set the calibrator current to a Test Point value indicated in Table 7.
- Set the calibrator to Operate mode (OPR).

5. Acquire and average samples.
  - a. Create and configure an AI voltage task on the NI 9207 according to Table 5.

**Table 5.** NI 9207 Configuration for Current Accuracy Verification

Input Range		Scaled Units	Terminal Configuration
Min	Max		
-0.02	0.02	Amps	RSE

- b. Configure the AI current task according to Table 6. Set the ADC timing mode to high-resolution.

**Table 6.** Current Timing Configuration

ADC Timing Mode	Sample Mode	Samples to Read
High-Resolution	N Samples	5
High-Speed	N Samples	75

- c. Start the task.
      - d. Average the readings.
      - e. Clear the task.
6. Compare the average to the limits in Table 7.
7. Repeat steps 5 and 6 with the ADC timing mode on the NI 9207 set to high-speed.
8. Set the calibrator to Standby mode (STBY).
9. Repeat steps 3 through 8 for each test point in Table 7.
10. Disconnect the calibrator from the device.
11. Repeat steps 1 through 10 for each current channel on the NI 9207.

**Table 7.** NI 9207 Test Limits for Current Accuracy Verification

Range (A)		Test Point		1-Year Limits	
Minimum	Maximum	Location	Value (A)	Lower Limit (A)	Upper Limit (A)
-0.020000	0.020000	Pos FS	0.021000	0.020970	0.021030
-0.020000	0.020000	Mid	0.000000	-0.000002	0.000002
-0.020000	0.020000	Neg FS	-0.021000	-0.021030	-0.020970

# Adjustments

The following performance adjustment procedures describe the sequence of operation required to adjust the NI 9207.

## Voltage Accuracy Adjustment

Complete the following procedure to adjust the voltage accuracy performance of the NI 9207.

1. Set the calibrator to Standby mode (STBY).
2. Connect the NI 9207 to the calibrator as shown in Figure 1.
3. Adjust the NI 9207 voltage accuracy.
  - a. Initialize a calibration session on the NI 9207. The default password is NI.
  - b. Input the external temperature in degrees Celsius.
  - c. Call the NI 9207 get C Series adjustment points function to obtain an array of recommended calibration voltages for the NI 9207.
  - 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 9207 gain instance of the adjustment function according to Table 8.

**Table 8.** Gain 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. Disconnect the calibrator from the NI 9207.
  - j. Short the voltage channel to the 9207 AIGND.
  - k. Call the NI 9207 offset instance of the adjustment function for the physical channel.
  - l. Close the calibration session.
4. Remove the connections from the NI 9207.
  5. Repeat steps 1 through 4 for each voltage channel on the NI 9207.



# Current Accuracy Adjustment

Complete the following procedure to adjust the current accuracy performance of the NI 9207.

1. Set the calibrator to Standby mode (STBY).
2. Connect the NI 9207 to the calibrator as shown in Figure 2.
3. Adjust the NI 9207 current accuracy.
  - a. Initialize a calibration session on the NI 9207. The default password is NI.
  - b. Input the external temperature in degrees Celsius.
  - c. Call the NI 9207 get C Series adjustment points function to obtain an array of recommended calibration currents for the NI 9207.
  - 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 9207 gain instance of the adjustment function according to Table 9.

**Table 9.** Gain 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 current in the array.
  - i. Disconnect the calibrator from the NI 9207. Ensure that there are no connections to the NI 9207.
  - j. Call the NI 9207 offset instance of the adjustment function for the current channel.
  - k. Close the calibration session.
4. Remove the connections from the NI 9207.
5. Repeat steps 1 through 4 for each current channel on the NI 9207.

## EEPROM Update

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When an adjustment procedure is completed, the NI 9207 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  $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$
- NI 9207 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 7 are derived using the values in Table 10.

**Table 10.** NI 9207 Accuracy Under Calibration Conditions

Input Channels	Percentage of Reading	Percentage of Range*
Voltage	0.100%	0.020%
Current	0.150%	0.012%

\* Range equals 10.4 V for voltage and 22 mA for current.



**Note** For operational specifications, refer to the most recent *NI 9207 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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