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cDAQ-9174

CALIBRATION PROCEDURE

NI 9202

±10 V, 10 kS/s, 24-Bit, 16-Channel C Series Voltage Input Module

This document contains the verification and adjustment procedures for NI 9202. For more information about calibration solutions, visit ni.com/calibration.

Contents

Software.....	1
Documentation.....	1
Test Equipment.....	2
Test Conditions.....	3
Initial Setup.....	3
Verification.....	4
Accuracy Verification.....	4
Adjustment.....	5
Accuracy Adjustment.....	5
EEPROM Update.....	6
Reverification.....	6
Accuracy under Calibration Conditions.....	7
Worldwide Support and Services.....	7

Software

Calibrating the NI 9202 requires the installation of NI-DAQmx 17.6 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 9202, 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 9202 Getting Started Guide

NI 9202 connection information



NI 9202 Datasheet

NI 9202 circuitry and specifications



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

The following table 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.

Table 1. Recommended Equipment

Equipment	Recommended Model	Requirements
Calibrator	Fluke 5500A	Use a high-precision voltage source with a gain error of <57 ppm and an offset error of <2 mV.
Chassis	cDAQ-9178 (part number 781156-01)	—
DSUB Connection Accessory ¹	NI 9923 (part number 781503-01)	—

Test Conditions

The following setup and environmental conditions are required to ensure the device 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 $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$.
- Keep relative humidity below 80%.
- Allow a warm-up time of at least 10 minutes to ensure that the device measurement circuitry is at a stable operating temperature.

Initial Setup

Complete the following steps to set up the NI 9202.

1. Install NI-DAQmx.
2. Make sure that the cDAQ-9178 power source is not connected to the chassis.
3. Connect the cDAQ-9178 chassis to the system safety ground.
 - a) Attach a ring lug to a 14 AWG (1.6 mm) wire.
 - b) Connect the ring lug to the ground terminal on the side of the cDAQ-9178 using the ground screw.
 - c) Attach the other end of the wire to the system safety ground.
4. Install the module in slot 8 of the cDAQ-9178 chassis. Leave slots 1 through 7 of the cDAQ-9178 chassis empty.

¹ For NI 9202 with DSUB variant

5. Connect the cDAQ-9178 chassis to your host computer.
6. Connect the power source to the cDAQ-9178 chassis.
7. Launch Measurement & Automation Explorer (MAX).
8. 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 provides test points required to verify the NI 9202. The verification procedure 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 9202.

1. Set the calibrator to Standby mode (STBY).
2. Connect the NI 9202 to the calibrator as shown in the following figure.

Figure 1. Analog Input 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 the *NI 9202 Verification Test Limits* table.
4. Set the calibrator to Operate mode (OPR).
5. Acquire and average samples.
 - a) Create and configure an AI voltage channel according to the following *NI 9202 AI Voltage Task* table.

Table 2. NI 9202 AI Voltage Task

Physical Channels	Range	Terminal Configuration
cDAQMod8/AI0:15	±10.5 V	Differential

- b) Configure the AI voltage channel timing according to the following *NI 9202 Task Timing* table.

Table 3. NI 9202 Task Timing

Samples Per Channel	Acquisition Mode	Rate (kS/s)
1000	Finite Samples	10

- c) Set the filter frequency to 625 Hz using the Channel Property (**Analog Input»General Properties»Digital Filter»Notch»Center Frequency**).
 - d) Start the task.
 - e) Read the samples from the NI 9202.
 - f) Average the samples.
 - g) Clear the task.
6. Compare the averaged samples to the limits in the *NI 9202 Verification Test Limits* table to verify the input accuracy. If the values are within these limits, the device passes the test.
 7. Set the calibrator to Standby mode (STBY).
 8. Repeat steps 3 through 7 for each test point in the *NI 9202 Verification Test Limits* table.
 9. Disconnect the calibrator from the device.

Table 4. NI 9202 Verification Test Limits

Test Points	Device Under Test Settings/Configuration					Standard Settings/Configuration
	Data Rate (kS/s)	Samples Per Channel	Filter Frequency (Hz)	Lower Limit (V DC)	Upper Limit (V DC)	Output Voltage (V)
1	10	1000	625	-10.0298	-9.9701	-10.0000
2	10	1000	625	-0.0158	0.0158	0.0000
3	10	1000	625	9.9701	10.0298	10.0000



Note The test limits listed in the *NI 9202 Verification Test Limits* table are derived using values from the *NI 9202 Accuracy Under Calibration Conditions* table.

Adjustment

The following performance adjustment procedure describes the sequence of operation required to adjust the NI 9202.

Accuracy Adjustment

Complete the following procedure to adjust the accuracy performance of the NI 9202.

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

2. Connect the NI 9202 to the calibrator as shown in the *Accuracy Verification* section.
3. Adjust the NI 9202.
 - a) Initialize a calibration session on the NI 9202. The default password is NI.
 - b) Input the external temperature in degrees Celsius.
 - c) Call the NI 9202 get C Series adjustment points function to obtain an array of recommended calibration voltages for the NI 9202.
 - 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 9202 adjustment function according to *NI 9202 Adjustment Configuration* table.

Table 5. NI 9202 Adjustment Configuration

Physical Channel	Reference Value
cDAQ1Mod8/AI0:15	The actual value of the voltage output of the calibrator



Note The module acquisition is started each time the adjust function is called. There is a delay of approximately 550 μ s from the acquisition start until module data becomes available.

- g) Set the calibrator to Standby mode (STBY).
 - h) Repeat steps d through g for each point in the array.
 - i) Close the calibration session.
 - j) Clear the task.
4. Disconnect the NI 9202 from the calibrator.

EEPROM Update

When an adjustment procedure is completed, the NI 9202 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 the *Worldwide Support and Services* section 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 $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$
- NI 9202 installed in slot 8 of a cDAQ-9178 chassis
- Slots 1 through 7 of the cDAQ-9178 chassis are empty

Table 6. NI 9202 Accuracy under Calibration Conditions

Device	Percent of Reading (Gain Error)	Percentage of Range (Offset Error) ²
NI 9202	0.14%	0.15%



Note For operational specifications, refer to the most recent *NI 9202 Datasheet* online at ni.com/manuals.

Worldwide Support and Services

The NI 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 information about the services NI offers.

Visit ni.com/register to register your NI product. Product registration facilitates technical support and ensures that you receive important information updates from NI.

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² Range equals 10.58 V.

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