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CALIBRATION PROCEDURE

NI 9251 with mini XLR

2 AI, 3 Vrms, 24 Bit, 102.4 kS/s/ch Simultaneous, AC/DC Coupling

This document contains the verification and adjustment procedures for NI 9251 with mini XLR. For more information about calibration solutions, visit *ni.com/calibration*.

Contents

Software

Calibrating the NI 9251 with mini XLR requires the installation of NI-DAQmx 16.1 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 9251 with mini XLR, 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 9251 with mini XLR Getting Started Guide

NI 9251 with mini XLR connection information

NI 9251 with mini XLR Datasheet

NI 9251 with mini XLR 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 5502A, Fluke 5522A, Fluke 5530A	Use a high-precision voltage source with gain error of <100 ppm and offset error <0.1 mV.
BNC (F) to Banana Adapter	Pomona Electronics 1269	—

Table 1. Recommended Equipment (Continued)

Equipment	Recommended Model	Requirements
BNC (M) to BNC (M) Coupler	Pomona Electronics 3533	Characteristic impedance : 50 Ω
BNC F-F-F-T-Connector	Pomona Electronics 3284	Characteristic impedance : 50 Ω
mXLR to BNC (M) Cable (quantity 2)	NI 140150A-XXX • 0R46 for 0.46 m • 0R91 for 0.91 m • 2R4 for 2.4 m	—
Chassis	NI cDAQ-9178	—

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 °C ± 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 device measurement circuitry is at a stable operating temperature.

Initial Setup

Complete the following steps to set up the NI 9251 with mini XLR.

1. Install NI-DAQmx.
2. Make sure that the NI cDAQ-9178 power source is not connected to the chassis.
3. Connect the NI 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 NI 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 NI cDAQ-9178 chassis. Leave slots 1 through 7 of the NI cDAQ-9178 chassis empty.

5. Connect the NI cDAQ-9178 chassis to your host computer.

6. Connect the power source to the NI 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.
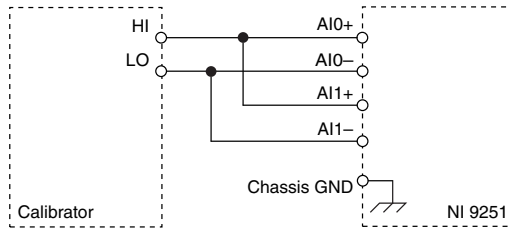
Verification

The following performance verification procedure describes the sequence of operation and provides test points required to verify the NI 9251 with mini XLR. 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 9251 with mini XLR.

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

2. Connect the NI 9251 with mini XLR to the calibrator as shown in the following figure.

Figure 1. Analog Input Verification Connections

> **Note** The chassis ground lug connection to ground is the NI 9251 with mini XLR ground connection.

3. Set the calibrator voltage to a Test Point value indicated in the *NI 9251 with mini XLR Verification Test Limits* table.

4. Set the calibrator to Operate mode (OPR).

5. Acquire and average samples for each channel.
   a) Create and configure an AI voltage task according to the following *NI 9251 with mini XLR AI Voltage Task Configuration* table.

Table 2. NI 9251 with mini XLR AI Voltage Task Configuration

Minimum (V)	Maximum (V)	Scaled Units	Physical Channels	Channel Configuration
-4.243	4.243	Volts	AI0:1	DC Coupled

b) Configure the task timing according to the following *NI 9251 with mini XLR Timing Configuration* table.

Table 3. NI 9251 with mini XLR Timing Configuration

Sample Mode	Samples Per Channel	Rate (kS/s)
Finite Samples	10240	102.4

c) Start the task.
d) Read the samples from the NI 9251 with mini XLR.
e) Average the samples for each AI channel.
f) Clear the task.

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

7. Compare the averaged samples to the limits in the *NI 9251 with mini XLR Verification Test Limits* table to verify the input accuracy. If the value is within these limits, the device passes the test.

8. Repeat steps 3 through 7 for each test point in the *NI 9251 with mini XLR Verification Test Limits* table.

9. Disconnect the calibrator from the device.

Table 4. NI 9251 with mini XLR Verification Test Limits

Test Point		2-Year Limits	
Location	Value (V)	Lower Limit (VDC)	Upper Limit (VDC)
Minimum	-1.9	-1.905161	-1.894839
Mid-scale	0	-0.002885	0.002885
Maximum	1.9	1.894839	1.905161

Note The test limits listed in the *NI 9251 with mini XLR Verification Test Limits* table are derived using values from the *NI 9251 with mini XLR Accuracy Under Calibration Conditions* table.

Adjustment

The following performance adjustment procedure describes the sequence of operation required to adjust the NI 9251 with mini XLR.

Accuracy Adjustment

Complete the following procedure to adjust the accuracy performance of the NI 9251 with mini XLR.

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

2. Connect the NI 9251 with mini XLR to the calibrator as shown in the *Accuracy Verification* section.

3. Adjust the NI 9251 with mini XLR.
    a) Initialize a calibration session on the NI 9251 with mini XLR. The default password is `NI`.
    b) Input the external temperature in degrees Celsius.
    c) Call the NI 9251 with mini XLR get C Series adjustment points function to obtain an array of recommended calibration voltages for the NI 9251 with mini XLR.
    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 9251 with mini XLR adjustment function according to *NI 9251 with mini XLR Adjustment Configuration* table.

Table 5. NI 9251 with mini XLR Adjustment Configuration

Physical Channel	Reference Value
cDAQ1Mod8/AI0:1	The actual value of the voltage output of the calibrator

    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.
4. Disconnect the NI 9251 with mini XLR from the calibrator.

EEPROM Update

When an adjustment procedure is completed, the NI 9251 with mini XLR 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 °C ± 5 °C
- NI 9251 with mini XLR installed in slot 8 of an NI cDAQ-9178 chassis
- Slots 1 through 7 of the NI cDAQ-9178 chassis are empty

Table 6. NI 9251 with mini XLR Accuracy under Calibration Conditions

Device	Percent of Reading (Gain Error)	Percent of Range[1]
NI 9251 with mini XLR	±0.1198%	±0.0680%

Note For operational specifications, refer to the most recent *NI 9251 with mini XLR 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 NI Factory Installation Services, repairs, extended warranty, and other services.

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

A Declaration of Conformity (DoC) is our claim of compliance with the Council of the European Communities using the manufacturer's declaration of conformity. This system affords the user protection for electromagnetic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting *ni.com/certification*. If your product supports calibration, you can obtain the calibration certificate for your product at *ni.com/calibration*.

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[1] Range equals 4.243 V.