

CALIBRATION PROCEDURE

NI 9218

2-Channel, 24-Bit, Universal Analog Input Module

This document contains information for calibrating the National Instruments 9218. For more information on calibration, visit ni.com/calibration.

Contents

Software.....	1
Documentation.....	2
Test Equipment.....	3
Test Conditions.....	4
Initial Setup.....	5
Verification.....	5
Current Accuracy Verification, 20 mA mode.....	6
Voltage Accuracy Verification, 60 V mode.....	7
Voltage Accuracy Verification, 16 V mode.....	9
Voltage Accuracy Verification, 65 mV mode.....	10
Voltage Accuracy Verification, IEPE 5 V mode.....	12
Bridge Accuracy Verification, 22 mV/V mode.....	14
Adjustment.....	17
Voltage Accuracy Adjustment, 16 V mode.....	17
Voltage Accuracy Adjustment, 60 V mode.....	18
Voltage Accuracy Adjustment, 65 mV mode.....	19
Current Accuracy Adjustment, 20 mA mode.....	20
Voltage Accuracy Adjustment, IEPE 5 V mode.....	20
Bridge Accuracy Adjustment, 22 mV/V mode.....	21
EEPROM Update.....	23
Reverification.....	23
Accuracy Under Calibration Conditions.....	23
Worldwide Support and Services.....	24
Pinout Signals.....	25

Software

Calibrating the NI 9218 requires the installation of NI-DAQmx 15.1 or later on the calibration system. 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 9218, 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 9218 Getting Started Guide
NI 9218 connection information



NI 9218 Datasheet
NI 9218 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

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	Where Used		Minimum Requirements
		Verification	Adjustment	
Calibrator	Fluke 5700A	± 60 V, ± 16 V, ± 65 mV mode	± 16 V, ± 65 mV mode	Use a device that can source voltages as high as ± 50 V and meets the following specifications: ≤ 100 ppm gain error. ≤ 3 μ V offset error. < 3 μ V offset at voltages less than 60 mV. < 200 mV offset at voltages less than 15 V. < 1 mV offset at voltages less than 60 V.
		± 20 mA mode	—	Use a device that can source currents as high as ± 15 mA, < 200 ppm gain error, and offset error < 1 μ A.
		IEPE ± 5 V mode	IEPE ± 5 V mode	Use a device that can source 1 kHz, 3 V _{rms} AC sinusoidal signals with amplitude uncertainty of 200 ppm or less.
DMM (x2)	NI 4071	—	± 60 V mode	Use a DMM with < 40 Ω of error at resistances < 400 k Ω .
		Bridge, ± 22 mV/V mode	Bridge, ± 22 mV/V mode	For DMM1, use one DMM with < 50 ppm gain error, and < 50 μ V of offset error at voltages < 3.5 V. For DMM2, use a second DMM with < 50 ppm gain error, and < 2 μ V of offset error at voltages < 50 mV.

Table 1. Recommended Equipment (Continued)

Equipment	Recommended Model	Where Used		Minimum Requirements
		Verification	Adjustment	
Discrete Resistors	—	Bridge, ± 22 mV mode	Bridge, ± 22 mV mode	TCR: <25 ppm/ $^{\circ}$ C Resistor values: 10 k Ω (2x), 249 Ω
cDAQ Chassis	NI cDAQ-9178	All	All	—
Measurement Adapter	NI 9982 (x2)	± 16 V, ± 65 mV, Bridge ± 22 mV/V, IEPE ± 5 V mode	± 60 V, ± 16 V, ± 65 mV, Bridge ± 22 mV/V, IEPE ± 5 V mode	—
	NI 9983 (x2)	± 20 mA mode	—	—
	NI 9987 (x2)	± 60 V mode	—	—

Test Conditions

The following setup and environmental conditions are required to ensure the NI 9218 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 ± 5 $^{\circ}$ 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 9218 measurement circuitry is at a stable operating temperature.
- Only one of each NI 9982, NI 9983, and NI 9987 is sufficient for this calibration procedure.

Initial Setup

Complete the following steps to set up the NI 9218.

1. Install NI-DAQmx.
2. Make sure the NI cDAQ-9178 power source is not connected.
3. Connect the NI cDAQ-9178 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.
9. Ensure that the ambient temperature of your test environment is $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$.

Verification

This section provides instructions for verifying the NI 9218 specifications. The following performance verification procedures describe the sequence of operations and test points required to verify the NI 9218 and assumes that adequate traceable uncertainties are available for the calibration references.



Note Each verification procedure requires the software configuration of a measurement adapter. The software configuration is done through Measurement & Automation Explorer. See KB 6T8GKTUX for how to configure your measurement adapter in MAX.



Caution Each verification may have different wiring schemes. Consult the diagram on your measurement adapter or Figure 10 and 11 for the most appropriate connection diagram.



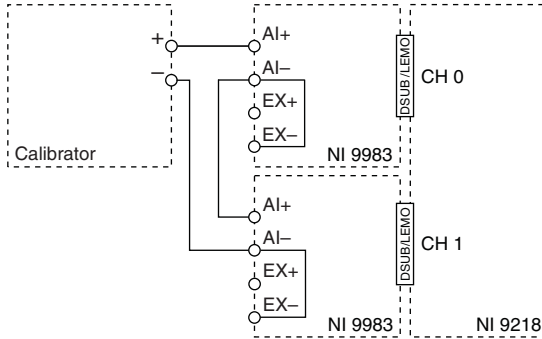
Caution The analog inputs on the NI 9218 are not grounded (floating). Ensure that a single point in the test system is connected to ground to prevent the entire system from floating.

Current Accuracy Verification, 20 mA mode

Complete the following procedure to determine the As-Found status of the NI 9218.

1. Set the calibrator to Standby mode (STBY).
2. Connect the NI 9218 to the calibrator as shown in Figure 1.

Figure 1. Current Accuracy Verification Connections



3. Set the calibrator current to a Test Point value indicated in Table 4.
4. Set the calibrator to Operate mode (OPR).
5. Configure the NI 9218 for the NI 9983 measurement adapters using MAX.
6. Acquire and average samples.
 - a. Create an AI current task on the NI 9218 according to Table 2.

Table 2. NI 9218 Configuration for Accuracy Verification

Min (mA)	Max (mA)	Scaled Units	Channel Configuration
-20	20	Amps	DC Coupled

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

Table 3. NI 9218 Timing Configuration

Sample Mode	Samples Per Channel	Rate (kHz)
Finite Samples	512 k	51.2

- c. Start the task.
 - d. Average the readings and record the average.
 - e. Stop and clear the task.
7. Set the calibrator to Standby mode (STBY).

8. Compare the average to the limits in Table 4.
9. Repeat steps 3 through 8 for each test point in Table 4.

Table 4. NI 9218 Verification Test Limits for Accuracy

Test Point		2-Year Limits	
Location	Value (mA)	Lower Limit (mA)	Upper Limit (mA)
Max	15	14.929	15.071
Mid	0	-0.008	0.008
Min	-15	-15.071	-14.929



Note The test limits listed in Table 4 are derived using the values in Table 32.



Note The uncertainty of the calibration standard is not included in these limits.

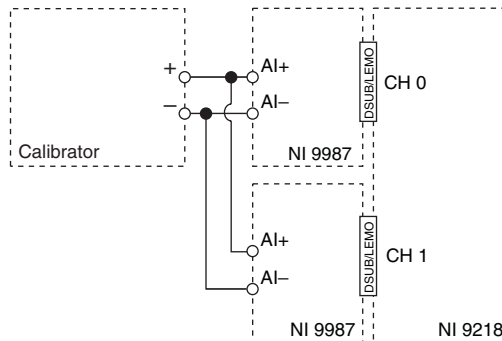
10. Disconnect the calibrator from the NI 9218.

Voltage Accuracy Verification, 60 V mode

Complete the following procedure to determine the As-Found status of the NI 9218.

1. Set the calibrator to Standby mode (STBY).
2. Connect the NI 9218 to the calibrator as shown in Figure 2.

Figure 2. Voltage Accuracy Verification Connections



3. Set the calibrator voltage to a Test Point value indicated in Table 7.
4. Set the calibrator to Operate mode (OPR).
5. Configure the NI 9218 for the 9987 measurement adapters using MAX.

6. Acquire and average samples.
 - a. Create an AI voltage task on the NI 9218 according to Table 5.

Table 5. NI 9218 Configuration for Accuracy Verification

Min (V)	Max (V)	Scaled Units	Channel Configuration
-60	60	Volts	DC Coupled

- b. Configure the AI voltage task timing according to Table 6.

Table 6. NI 9218 Timing Configuration

Sample Mode	Samples Per Channel	Rate (kHz)
Finite Samples	512 k	51.2

- c. Start the task.
 - d. Average the readings and record the average.
 - e. Stop and clear the task.
7. Set the calibrator to Standby mode (STBY).
8. Compare the average to the limits in Table 7.
9. Repeat steps 3 through 8 for each test point in Table 7.

Table 7. NI 9218 Verification Test Limits for Accuracy

Test Point		2-Year Limits	
Location	Value (V)	Lower Limit (V)	Upper Limit (V)
Max	50	49.827	50.173
Mid	0	-0.008	0.008
Min	-50	-50.173	-49.827



Note The test limits listed in Table 7 are derived using the values in Table 32.



Note The uncertainty of the calibration standard is not included in these limits.

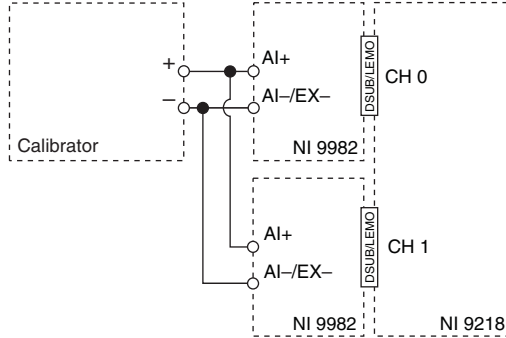
10. Disconnect the calibrator from the device.

Voltage Accuracy Verification, 16 V mode

Complete the following procedure to determine the As-Found status of the NI 9218.

1. Set the calibrator to Standby mode (STBY).
2. Connect the NI 9218 to the calibrator as shown in Figure 3.

Figure 3. Voltage Accuracy Verification Connections



3. Set the calibrator voltage to a Test Point value indicated in Table 10.
4. Set the calibrator to Operate mode (OPR).
5. Configure the NI 9218 for the 9982 measurement adapters using MAX.
6. Acquire and average samples.
 - a. Create an AI voltage task on the NI 9218 according to Table 8.

Table 8. NI 9218 Configuration for Accuracy Verification

Min (V)	Max (V)	Scaled Units	Channel Configuration
-16	16	Volts	DC Coupled

- b. Configure the AI voltage task timing according to Table 9.

Table 9. NI 9218 Timing Configuration

Sample Mode	Samples Per Channel	Rate (kHz)
Finite Samples	512 k	51.2

- c. Start the task.
 - d. Average the readings and record the averages.
 - e. Stop and clear the task.
7. Set the calibrator to Standby mode (STBY).

8. Compare the averages to the limits in Table 10.
9. Repeat steps 3 through 8 for each test point in Table 10.

Table 10. NI 9218 Verification Test Limits for Accuracy

Test Point		2-Year Limits	
Location	Value (V)	Lower Limit (V)	Upper Limit (V)
Max	12	11.987	12.013
Mid	0	-0.002	0.002
Min	-12	-12.013	-11.987



Note The test limits listed in Table 10 are derived using the values in Table 32.



Note The uncertainty of the calibration standard is not included in these limits.

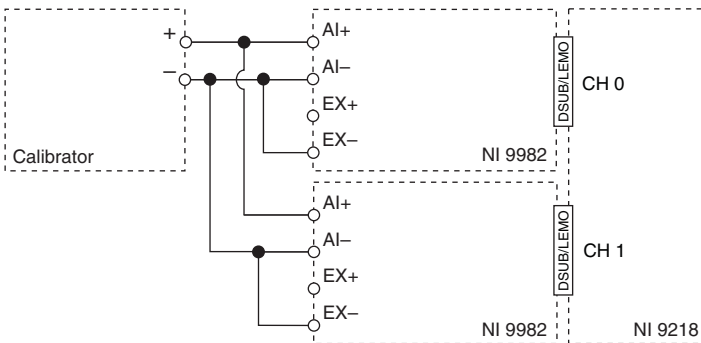
10. Disconnect the calibrator from the device.

Voltage Accuracy Verification, 65 mV mode

Complete the following procedure to determine the As-Found status of the NI 9218.

1. Set the calibrator to Standby mode (STBY).
2. Connect the NI 9218 to the calibrator as shown in Figure 4.

Figure 4. Voltage Accuracy Verification Connections



3. Set the calibrator voltage to a Test Point value indicated in Table 13.
4. Set the calibrator to Operate mode (OPR).
5. Configure the NI 9218 for the NI 9982 measurement adapters using MAX.

6. Acquire and average samples.
 - a. Create an AI voltage task on the NI 9218 according to Table 11.

Table 11. NI 9218 Configuration for Accuracy Verification

Min (mV)	Max (mV)	Scaled Units	Channel Configuration
-65	65	Volts	DC Coupled

- b. Configure the AI voltage task timing according to Table 12.

Table 12. NI 9218 Timing Configuration

Sample Mode	Samples Per Channel	Rate (kHz)
Finite Samples	512 k	51.2

- c. Start the task.
 - d. Average the readings and record the averages.
 - e. Stop and clear the task.
7. Set the calibrator to Standby mode (STBY).
8. Compare the averages to the limits in Table 13.
9. Repeat steps 3 through 8 for each test point in Table 13.

Table 13. NI 9218 Verification Test Limits for Accuracy

Test Point		2-Year Limits	
Location	Value (mV)	Lower Limit (mV)	Upper Limit (mV)
Max	50	49.906	50.094
Mid	0	-0.024	0.024
Min	-50	-50.094	-49.906



Note The test limits listed in Table 13 are derived using the values in Table 32.



Note The uncertainty of the calibration standard is not included in these limits.

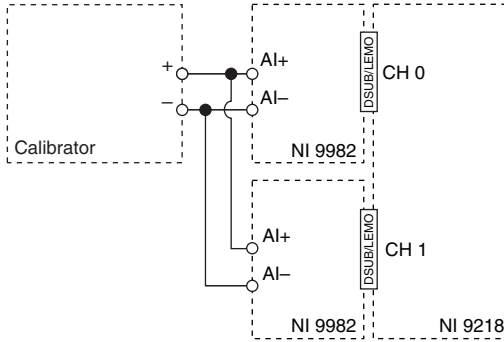
10. Disconnect the calibrator from the device.

Voltage Accuracy Verification, IEPE 5 V mode

Complete the following procedure to determine the As-Found status of the NI 9218.

1. Connect the NI 9218 to the calibrator as shown in Figure 5.

Figure 5. Voltage Accuracy Verification Connections



2. Configure calibrator according to Table 14.

Table 14. NI 9218 Verification Test Limits for Accuracy

Test Point			2-Year Limits	
Signal Type	Frequency (kHz)	Amplitude (Vrms)	Lower Limit (Vrms)	Upper Limit (Vrms)
Sine wave	1	1	0.998	1.002
		3	2.994	3.006



Note The test limits listed in Table 14 are derived using the values in Table 32.



Note The uncertainty of the calibration standard is not included in these limits.

3. Configure the NI 9218 for the NI 9982 measurement adapters using MAX.
4. Acquire and calculate the AC magnitude.
 - a. Create an AI voltage task on the NI 9218 according to Table 15.

Table 15. NI 9218 Configuration for Phase Matching Verification

Min (V)	Max (V)	Scaled Units	Channel Configuration
-5	5	Volts	AC Coupled

5. Use the DAQmx Channel Property node to configure the following properties:
 - a. AI.Coupling: AC
 - b. AI.Excit.Src: Internal
 - c. AI.Excit.VoltageorCurrent: Current
 - d. AI.Excit.Val: 0.002
6. Configure the AI voltage task timing according to Table 16.

Table 16. NI 9218 Timing Configuration

Sample Mode	Samples Per Channel	Rate (kHz)
Finite Samples	512 k	51.2

- a. Set the calibrator to Operate mode (OPR).
- b. Commit the task using DAQmx Control Task Function/VI.



Note Wait 6 seconds for the AC coupling filter on the NI 9218 to settle before acquiring samples.

- c. Start the task.
- d. Calculate and record the AC magnitude for each channel on the NI 9218. NI recommends using the Extract Single Tone Information VI to calculate the magnitude.



Note The output of the Extract Single Tone Information is in Vpk. To convert to RMS, use the following equation:

$$V_{rms} = (V_{pk}) \div (\sqrt{2})$$

- e. Disable the calibrator.
 - f. Stop and clear the task.
7. Compare the AC magnitude to the limits in Table 14.
 8. Repeat steps 2 through 7 for each test point in Table 14.
 9. Disable the output of the calibrator and disconnect it from the NI 9218.

Bridge Accuracy Verification, 22 mV/V mode

Complete the following steps to verify the full-bridge accuracy of an NI 9218.

1. Connect a resistor network to the NI 9218 and two DMMs as shown in Figures 6, 7, or 8 for the appropriate test point value indicated in Table 17. Observe the following conditions when connecting the equipment to the NI 9218.
 - Connect the leads of DMM2 as close as possible to the AI+ and AI- terminals on the NI 9982.
 - Connect the leads of DMM1 as close as possible to the RS+ and RS- leads of the NI 9982.

Figure 6. Bridge Accuracy Verification Connections (Configuration 1)

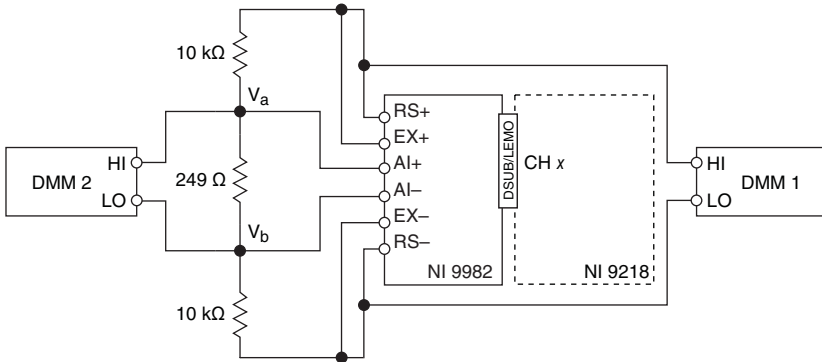


Figure 7. Bridge Accuracy Verification Connections (Configuration 2)

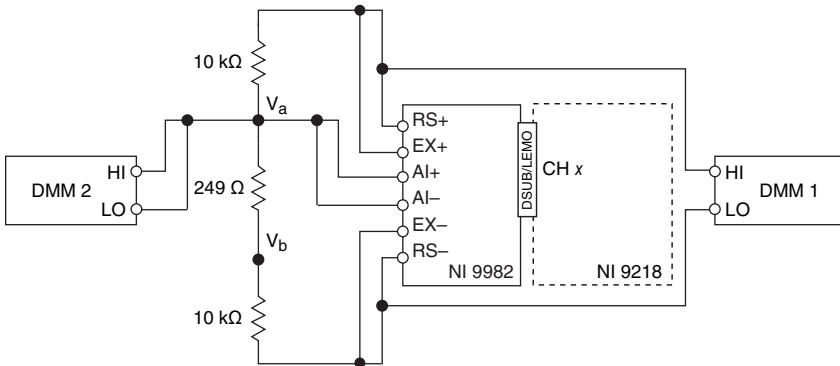


Figure 8. Bridge Accuracy Verification Connections (Configuration 3)

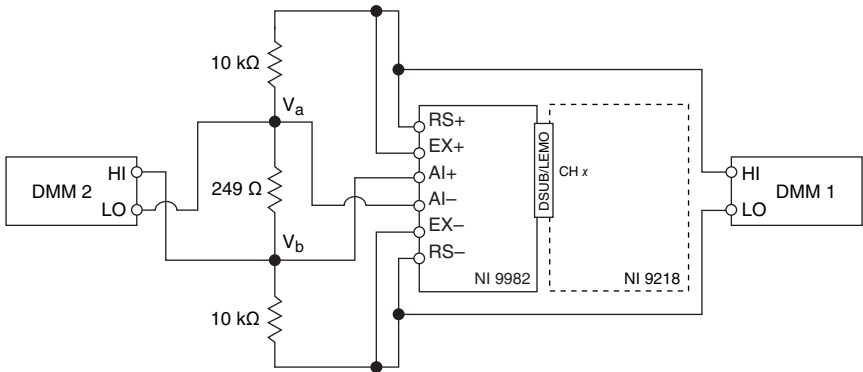


Table 17. NI 9218 Verification Test Limits for Accuracy

Excitation Value	Test Point		2-Year Limits	
	Location	Value	Lower Limit (mV/V)	Upper Limit (mV/V)
2 V	Max	Configuration 1	-0.050	0.050
	Mid	Configuration 2	-0.036	0.036
	Min	Configuration 3	-0.050	0.050
3.3 V	Max	Configuration 1	-0.022	0.022
	Mid	Configuration 2	-0.007	0.007
	Min	Configuration 3	-0.022	0.022



Note The test limits listed in Table 17 are derived using the values in Table 32.



Note The uncertainty of the calibration standard is not included in these limits.

2. Configure DMM1 for a voltage measurement in the 10 V range.
3. Enable autozero on DMM1.
4. Configure DMM2 for a voltage measurement in the 100 mV range.
5. Enable autozero on DMM2.
6. Configure the NI 9218 for the NI 9982 measurement adapters using MAX.

7. Acquire and average samples.
 - a. Create an AI bridge with excitation task on the NI 9218 according to Table 18.

Table 18. NI 9218 Configuration for Accuracy Verification

Min (V/V)	Max (V/V)	Channel Configuration	Excitation Value (V)	Excitation Source	Bridge Configuration
-0.022	0.022	DC Coupled	2	Internal	Full-Bridge
			3.3		

- b. Configure the AI Bridge with excitation task timing according to Table 19.

Table 19. NI 9218 Timing Configuration

Sample Mode	Samples Per Channel	Rate (kHz)
Finite Samples	512 k	51.2

- c. Start the task.
 - d. Record the DMM1 measurements as V_{DMM1} .
 - e. Record the DMM2 measurement as V_{DMM2} .



Note Perform the DMM measurements and the NI 9218 measurements as simultaneously as possible in order to reduce error from drift in the resistors.

- f. Average the NI 9218 readings and record the average as $Ratio_{channel}$.
 - g. Perform the following calculation using the two DMM measurements.

$$Ratio_{ref} = \frac{V_{DMM2}}{V_{DMM1}}$$

- h. Perform the following calculation using the recorded $Ratio_{ref}$ and $Ratio_{channel}$ values.

$$Accuracy = Ratio_{channel} - Ratio_{ref}$$

- i. Compare the result of step h to the limits in Table 17.
 - j. Stop and clear the task.
8. Repeat steps 2 through 7 for each test point in Table 17.
9. Repeat steps 1 through 8 for each excitation value specified in Table 17.
10. Disconnect the DMMs and resistors from the NI 9218.
11. Repeat steps 1 through 10 for each channel on the NI 9218.

Adjustment

The following performance adjustment procedures describe the sequence of operation required to adjust the NI 9218.

Voltage Accuracy Adjustment, 16 V mode

Complete the following procedure to adjust the accuracy performance of the NI 9218.

1. Set the calibrator to Standby mode (STBY).
2. Connect the NI 9218 to the calibrator as shown in Figure 3.
3. Configure the NI 9218 for the 9982 measurement adapters using MAX.
4. Adjust the NI 9218.
 - a. Initialize a calibration session on the NI 9218. The default password is NI.
 - b. Input the external temperature in degrees Celsius using the DAQmx Set Temperature C Series Calibration function.
 - c. Call and configure the DAQmx Setup 9218 Calibration function according to Table 20.

Table 20. Setup Configuration for 16 V Accuracy Adjustment

Min (V)	Max (V)	Physical Channels	Measurement Type
-16	16	cDAQMod8/AIx	Voltage

- d. Call the DAQmx Get 9218 Calibration Adjustment Points function to obtain an array of recommended calibration voltages for the NI 9218.
- e. Set the calibrator to a reference value determined by the array of recommended calibration voltages.
- f. Set the calibrator to Operate mode (OPR).
- g. Call and configure the DAQmx Adjust 9218 Calibration function according to Table 21.

Table 21. Adjustment Configuration

Physical Channel	Reference Value
cDAQMod8/AIx	The recommended calibration voltage



Note The NI 9218 acquisition starts each time the adjustment function is called.

- h. Set the calibrator to Standby mode (STBY).
- i. Repeat steps e through h for each point in the array of recommended calibration voltages.

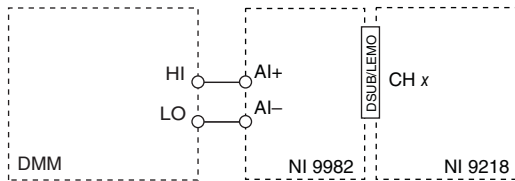
- j. Use the DAQmx Close External Calibration to close and commit the calibration session.
 - k. Repeat steps c through j for each channel.
5. Disconnect the NI 9218 from the calibrator.

Voltage Accuracy Adjustment, 60 V mode

Complete the following procedure to adjust the accuracy performance of the NI 9218.

1. You must complete the *Voltage Accuracy Adjustment, 16 V mode* section before starting this section.
2. Connect the NI 9218 to the DMM as shown in Figure 9.
3. Configure the NI 9218 for the NI 9982 measurement adapters using MAX.

Figure 9. Voltage Accuracy Adjustment Connections



4. Adjust the NI 9218.
 - a. Initialize a calibration session on the NI 9218. The default password is NI.
 - b. Input the external temperature in degrees Celsius using the DAQmx Set Temperature C Series Calibration function.
 - c. Call and configure the DAQmx Setup 9218 Calibration function according to Table 22.

Table 22. Setup Configuration for 60 V Accuracy Adjustment

Min (V)	Max (V)	Physical Channels	Measurement Type
-60	60	cDAQMod8/AIx	Voltage

- d. Set the DMM to the most appropriate range for 390 kΩ resistance measurement.
- e. Measure the resistance.
- f. Call and configure the DAQmx Adjust 9218 Calibration function according to Table 23.

Table 23. Adjustment Configuration

Physical Channel	Reference Value
cDAQMod8/AIx	The reading from the DMM

- g. Use the DAQmx Close External Calibration to close and commit the calibration session.
 - h. Repeat steps c through g for each channel.
5. Disconnect the DMM from the NI 9218.

Voltage Accuracy Adjustment, 65 mV mode

Complete the following procedure to adjust the accuracy performance of the NI 9218.

1. Set the calibrator to Standby mode (STBY).
2. Connect the NI 9218 to the calibrator as shown in Figure 4.
3. Configure the NI 9218 for the NI 9982 measurement adapters using MAX.
4. Adjust the NI 9218.
 - a. Initialize a calibration session on the NI 9218. The default password is NI.
 - b. Input the external temperature in degrees Celsius using the DAQmx Set Temperature C Series Calibration function.
 - c. Call and configure the DAQmx Setup 9218 Calibration function according to Table 24.

Table 24. Setup Configuration for 65 mV Accuracy Adjustment

Min (V)	Max (V)	Physical Channels	Measurement Type
-0.065	0.065	cDAQMod8/AIx	Voltage

- d. Call the DAQmx Get 9218 Calibration Adjustment Points function to obtain an array of recommended calibration voltages for the NI 9218.
- e. Set the calibrator to a reference value determined by the array of recommended calibration voltages.
- f. Set the calibrator to Operate mode (OPR).
- g. Call and configure the DAQmx Adjust 9218 Calibration function according to Table 25.

Table 25. Adjustment Configuration

Physical Channel	Reference Value
cDAQMod8/AIx	The recommended calibration voltage



Note The NI 9218 acquisition starts each time the adjustment function is called.

- h. Set the calibrator to Standby mode (STBY).
- i. Repeat steps e through h for each point in the array of recommended calibration voltages.

- j. Use the DAQmx Close External Calibration to close and commit the calibration session.
 - k. Repeat steps c through j for each channel.
5. Disconnect the NI 9218 from the calibrator.

Current Accuracy Adjustment, 20 mA mode

Complete the following procedure to adjust the accuracy performance of the NI 9218.

1. You must complete the *Voltage Accuracy Adjustment, 65 mV mode* section before starting this section.
2. Adjust the NI 9218.
 - a. Initialize a calibration session on the NI 9218. The default password is NI.
 - b. Input the external temperature in degrees Celsius using the DAQmx Set Temperature C Series Calibration function.
 - c. Call and configure the DAQmx Setup 9218 Calibration function according to Table 26.

Table 26. Setup Configuration for 20 mA Accuracy Adjustment

Min (A)	Max (A)	Physical Channels	Measurement Type
-0.02	0.02	cDAQMod8/Alx	Current

- d. Call and configure the DAQmx 9218 Adjustment Calibration function according to Table 27.

Table 27. Adjustment Configuration

Physical Channel	Reference Value
cDAQMod8/Alx	0

- e. Use the DAQmx Close External Calibration to close and commit the calibration session.
- f. Repeat steps c through e for each channel.

Voltage Accuracy Adjustment, IEPE 5 V mode

Complete the following procedure to adjust the accuracy performance of the NI 9218.

1. Connect the NI 9218 to the calibrator as shown in Figure 5.
2. Configure the NI 9218 for the NI 9982 measurement adapters using MAX.
3. Adjust the NI 9218.
 - a. Initialize a calibration session on the NI 9218. The default password is NI.
 - b. Input the external temperature in degrees Celsius using the DAQmx Set Temperature C Series Calibration function.

- c. Call and configure the DAQmx Set up 9218 Calibration function according to Table 28.

Table 28. Setup Configuration for IEPE 5 V Accuracy Adjustment

Min (V)	Max (V)	Physical Channels	Measurement Type
-5	5	cDAQMod8/aix	Voltage

- d. Call the DAQmx Get 9218 Calibration Adjustment Points function to obtain an array of recommended calibration amplitudes for the NI 9218.



Note This function provides values in terms of Vrms. A conversion is needed if your Calibrator API requires a different signal description.

- e. Set the calibrator to a reference value determined by the array of recommended calibration amplitudes. The signal should be a 1 kHz sine wave.
- f. Call and configure the DAQmx Adjust 9218 Calibration function according to Table 29.

Table 29. Adjustment Configuration

Physical Channel	Reference Value
cDAQMod8/AIx	The recommended calibration amplitude



Note The NI 9218 acquisition starts each time the adjustment function is called.

- g. Repeat steps e through f for each point in the array of recommended calibration value.
 - h. Use the DAQmx Close External Calibration to close and commit the calibration session.
 - i. Repeat steps c through h for each channel.
4. Disconnect the NI 9218 from the calibrator.

Bridge Accuracy Adjustment, 22 mV/V mode

Complete the following steps to adjust the full-bridge accuracy of the NI 9218.

1. Connect the NI 9218 and DMMs to the resistor network as shown in Figures 6, 7, or 8 depending on the test point.
2. Configure the NI 9218 for the NI 9982 measurement adapters using MAX.
3. Adjust the NI 9218.
 - a. Initialize a calibration session on the NI 9218. The default password is NI.
 - b. Input the external temperature in degrees Celsius using the DAQmx Set Temperature C Series Calibration function.

- c. Call and configure the DAQmx Setup 9218 Calibration function according to Table 30.

Table 30. Setup Configuration for Bridge Accuracy Adjustment

Min (V/V)	Max (V/V)	Physical Channels	Measurement Type
-0.022	0.022	cDAQMod8/aix	Bridge

- d. Configure DMM1 for a voltage measurement in the 10 V range.
- e. Enable autozero on DMM1.
- f. Configure DMM2 for a voltage measurement in the 100 mV range.
- g. Enable autozero on DMM2.
- h. Call the DAQmx Get 9218 Calibration Adjustment Points function to obtain an array of recommended calibration points for the NI 9218. The adjustment points can be achieved by observing the following conditions.
- The max test point is achieved by following the diagram in Figure 6.
 - The mid test point is achieved by following the diagram in Figure 7.
 - The min test point is achieved by following the diagram in Figure 8.
- i. Acquire voltage measurements with both DMMs. Perform the following calculation using the two DMM measurements.

$$Ratio_{ref} = \frac{V_{DMM2}}{V_{DMM1}}$$



Note Perform the DMM measurements simultaneously in order to reduce error from drift in the resistors.

- j. Call and configure the DAQmx Adjust 9218 Calibration function according to Table 31.

Table 31. Adjustment Configuration

Physical Channel	Reference Value
cDAQMod8/AIx	Ratio _{ref}



Note The NI 9218 acquisition starts each time the adjustment function is called.

- k. Repeat steps d through j for every value in the array.
- l. Close and commit the calibration session.
4. Repeat steps 3c through 3l for each channel on the NI 9218.
5. Disconnect the DMMs and the resistors from the NI 9218.

EEPROM Update

When an adjustment procedure is completed, the NI 9218 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](#) and have run verification with another measurement adapter 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 $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$
- NI 9218 installed in slot 8 of an NI cDAQ-9178 chassis
- Slots 1 through 7 of the NI cDAQ-9178 chassis are empty

Table 32. NI 9218 Accuracy Under Calibration Conditions*

Mode	Percent of Reading (Gain Error)	Offset Error
20 mA	0.42%	8 μA
60 V	0.33%	8 mV
16 V	0.09%	2 mV
65 mV	0.14%	24 μV
IEPE 5 V	0.20%	—
Bridge 22 mV/V, 2 V	0.12%	36 $\mu\text{V/V}$
Bridge 22 mV/V, 3.3 V	0.12%	7.2 $\mu\text{V/V}$

* The accuracy is inclusive of the NI 9982, NI 9983, and NI 9987.



Note For operational specifications, refer to the most recent *NI 9218 Datasheet* 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.

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.

National Instruments corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. National Instruments also has offices located around the world. For telephone support in the United States, create your service request at ni.com/support or dial 1 866 ASK MYNI (275 6964). For telephone support outside the United States, visit the Worldwide Offices section of ni.com/niglobal to access the branch office websites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

Pinout Signals

Figure 10. NI 9218 with DSUB Pinout and Pin Assignments

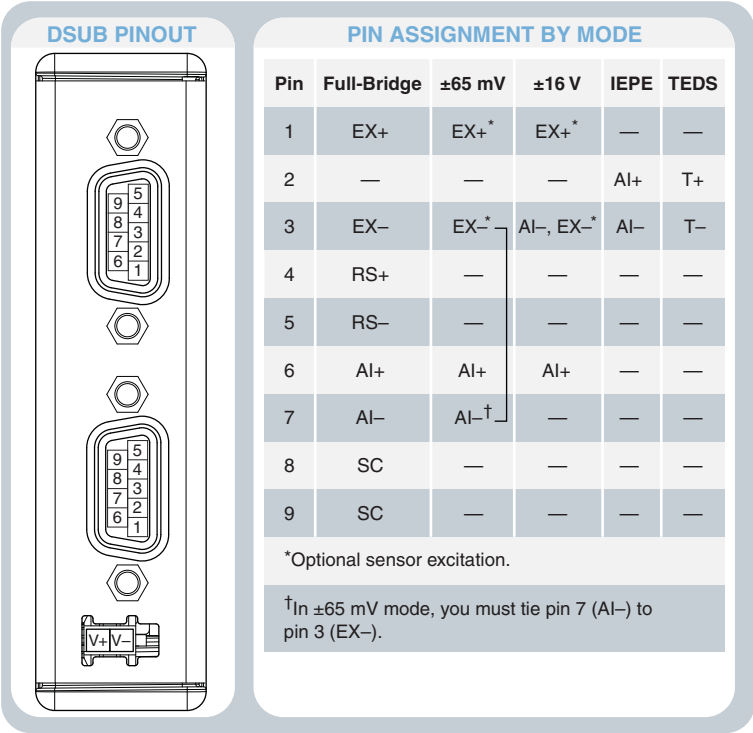
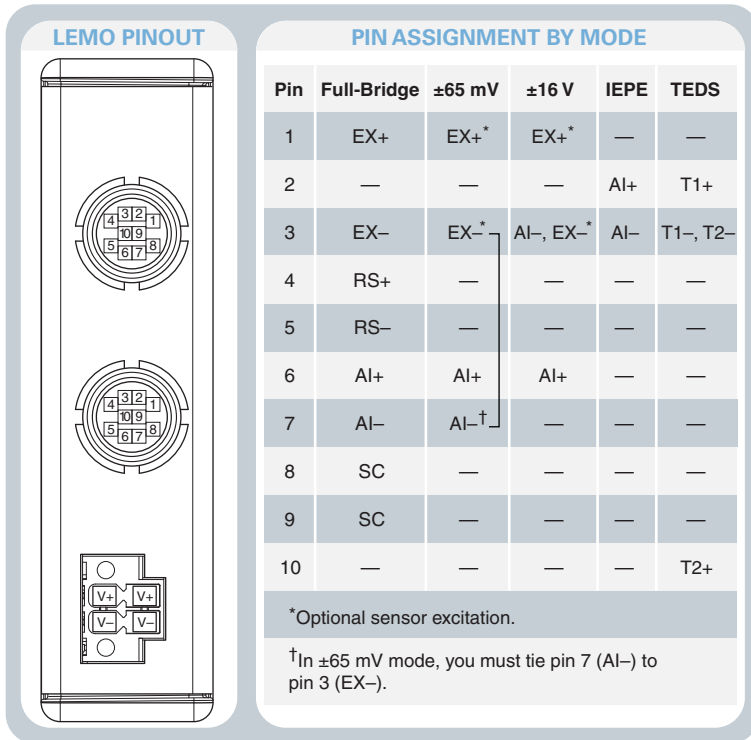


Figure 11. NI 9218 with LEMO Pinout and Pin Assignments



Refer to the *NI Trademarks and Logo Guidelines* at ni.com/trademarks for more information on NI trademarks. Other product and company names mentioned herein are trademarks or trade names of their respective companies. For patents covering NI products/technology, refer to the appropriate location: **Help»Patents** in your software, the `patents.txt` file on your media, or the *National Instruments Patents Notice* at ni.com/patents. You can find information about end-user license agreements (EULAs) and third-party legal notices in the `readme` file for your NI product. Refer to the *Export Compliance Information* at ni.com/legal/export-compliance for the NI global trade compliance policy and how to obtain relevant HTS codes, ECCNs, and other import/export data. NI MAKES NO EXPRESS OR IMPLIED WARRANTIES AS TO THE ACCURACY OF THE INFORMATION CONTAINED HEREIN AND SHALL NOT BE LIABLE FOR ANY ERRORS. U.S. Government Customers: The data contained in this manual was developed at private expense and is subject to the applicable limited rights and restricted data rights as set forth in FAR 52.227-14, DFAR 252.227-7014, and DFAR 252.227-7015.

© 2015–2016 National Instruments. All rights reserved.