NI-9235 Getting Started

2025-03-22

Contents

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Connector Types

The NI-9235 is available in two types: push-in spring terminal and spring terminal. The push-in type spring terminal connector is black and orange. The spring terminal connector is black. NI-9235 refers to both types unless the two types are specified. Differences between the two types of spring terminal connectors are noted by the connector color.

Connecting the NI-9235

The NI-9235 provides connections for eight 120 Ω quarter-bridge input channels.

NI-9235 Pinout

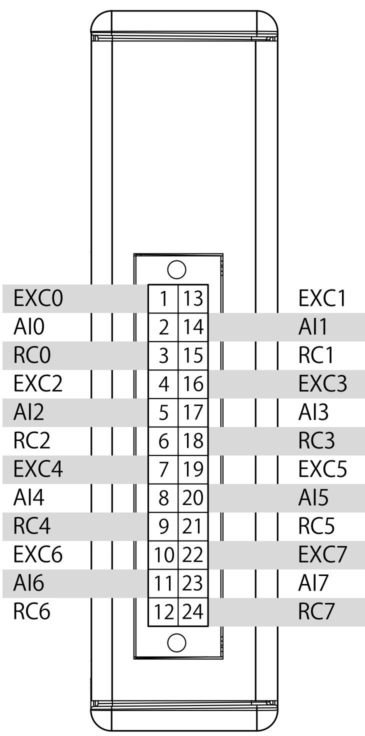


Table 1. Signal Descriptions

Signal	Description
AI	Analog input signal connection
EXC	Excitation source connection
RC	Quarter-bridge completion connection

NI-9235 Pinout (Push-in Spring Terminal)

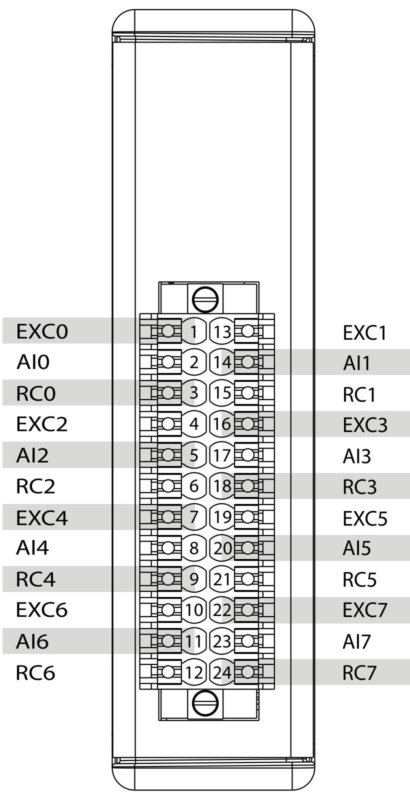
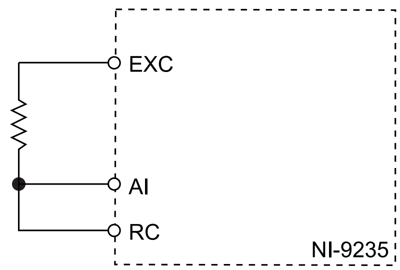


Table 2. Signal Descriptions

Signal	Description
AI	Analog input signal connection
EXC	Excitation source connection
RC	Quarter-bridge completion connection

Connecting a Quarter-Bridge Sensor

You can connect quarter-bridge sensors to the NI-9235.



You must connect each EXC terminal to only one strain gage to maintain the channel-to-channel crosstalk performance of the module.

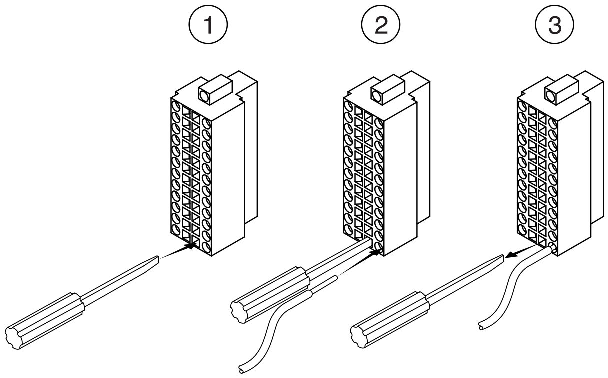
For the best system accuracy, observe the following conditions when connecting to the NI-9235.

- Set up the connections to EXC and RC with equal lengths of an identical wire type and gauge.
- Connect the AI terminal directly at the sensor instead of shorting AI to RC directly at the terminals.

Connecting to a Spring-Terminal Connector

What to Do

Complete the following steps to connect wires to the spring-terminal connector.



1. Insert the screwdriver into a spring clamp activation slot to open the corresponding connector terminal.
2. Press a wire into the open connector terminal.
3. Remove the screwdriver from the activation slot to clamp the wire into place.

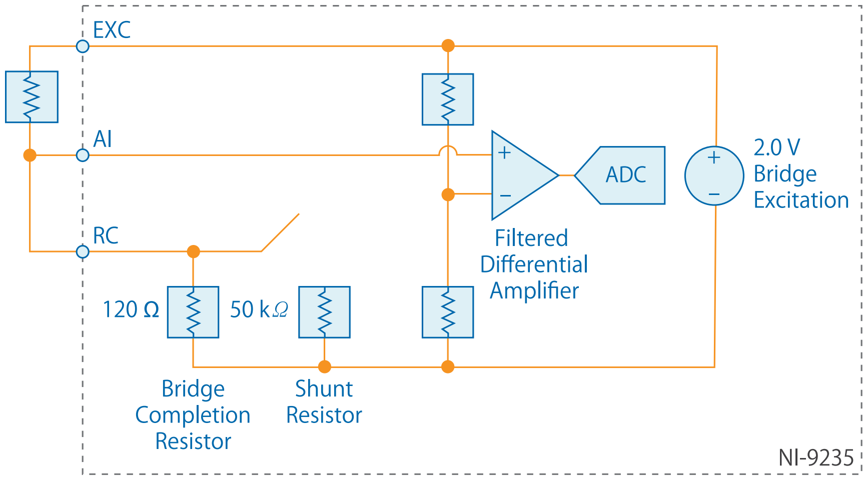
NI-9235 Connection Guidelines

- Make sure that devices you connect to the NI-9235 are compatible with the module specifications.
- You must use 2-wire ferrules to create a secure connection when connecting more than one wire to a single terminal on the NI-9235.
- Push the wire into the terminal when using a solid wire or a stranded wire with a ferrule.
- Open the terminal by pressing the push button when using stranded wire without a ferrule.

High-Vibration Application Connections

If your application is subject to high vibration, NI recommends that you use the NI-9965 backshell kit to protect connections to the NI-9235.

NI-9235 Block Diagram



- Each channel on the NI-9235 has an independent 24-bit ADC and input amplifier that enables you to sample signals from all eight channels simultaneously.
- The NI-9235 is isolated from earth ground. However, the individual channels are not isolated from each other. The EXC terminals all connect internally to a common excitation supply.

Lead Wire Desensitization

Quarter-bridge measurements are inherently sensitive to accuracy degradation due to the lead resistance of wiring from the sensor to the measurement device. For a given change in the gage resistance, the total effective resistance changes slightly less. Accordingly, the measured mV/V reading is less than its true value. However, you can use shunt calibration to quantify the lead wire resistance, and can then design the software application to correct subsequent readings for this gain error. The gain error caused by a lead wire equals R_L/R_G, where R_L is the lead wire resistance, and R_G is the quarter-bridge completion resistance.

Shunt Calibration

Shunt calibration simulates strain input by shunting, or connecting, a large resistor across one arm of the bridge, a specific change occurs in the bridge voltage ratio.

The NI-9235 shunt calibration circuitry consists of a precision resistor and a software-enabled switch, connected across the internal quarter-bridge completion resistor. Each input channel has a unique shunt calibration resistor that can operate independently. With the connected sensor in a stable, typically unloaded state, you can measure the output of the bridge before and after the shunt calibration. You can compare the measured reading change to the shunt calibration output value to verify system setup or compensate for quarter-bridge lead wire resistance error. Visit ni.com/info and enter `lwcomp` for information about lead wire compensation.

Excitation Voltage

The NI-9235 provides a constant excitation supply voltage to each channel. The excitation supply provides sufficient output current to power all eight channels at minimum resistance. The excitation supply retains regulation even if one channel experiences a gage short. If more than one channel has a gage short, the excitation supply enters a current limit state and the excitation voltage falls accordingly.

Filtering

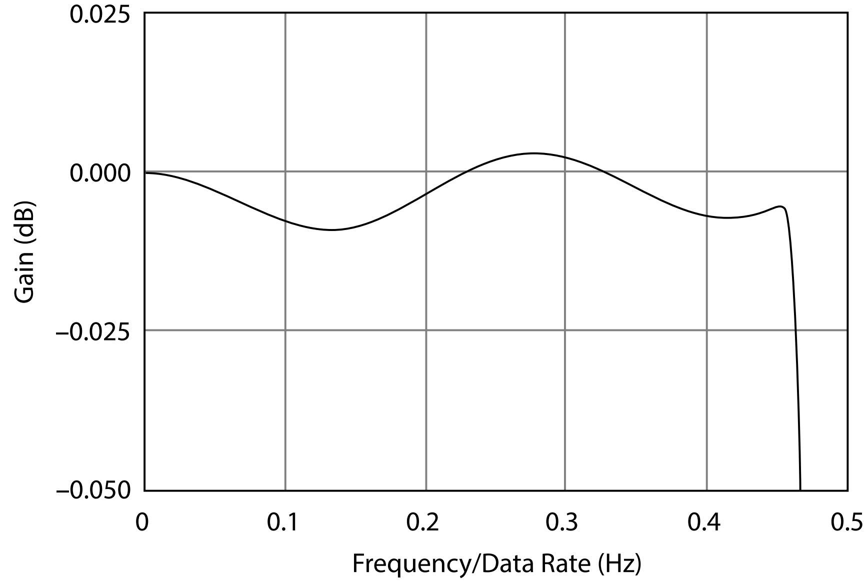
The NI-9235 uses a combination of analog and digital filtering to provide an accurate representation of in-band signals and reject out-of-band signals. The filters discriminate between signals based on the frequency range, or bandwidth, of the signal. The three important bandwidths to consider are the passband, the stopband, and the anti-imaging bandwidth.

The NI-9235 represents signals within the passband, as quantified primarily by passband ripple and phase nonlinearity. All signals that appear in the alias-free bandwidth are either unaliased signals or signals that have been filtered by at least the amount of the stopband rejection.

Passband

The signals within the passband have frequency-dependent gain or attenuation. The small amount of variation in gain with respect to frequency is called the passband flatness. The digital filters of the NI-9235 adjust the frequency range of the passband to match the data rate. Therefore, the amount of gain or attenuation at a given frequency depends on the data rate.

Figure 1. Typical Passband Response for the NI-9235



Stopband

The filter significantly attenuates all signals above the stopband frequency. The primary goal of the filter is to prevent aliasing. Therefore, the stopband frequency scales precisely with the data rate. The stopband rejection is the minimum amount of attenuation applied by the filter to all signals with frequencies within the stopband.

Alias-Free Bandwidth

Any signals that appear in the alias-free bandwidth are not aliased artifacts of signals at a higher frequency. The alias-free bandwidth is defined by the ability of the filter to reject frequencies above the stopband frequency. The alias-free bandwidth is equal to the data rate minus the stopband frequency.

Data Rates

The frequency of a master timebase (f_M) controls the data rate (f_S) of the NI-9235. The NI-9235 includes an internal master timebase with a frequency of 12.8 MHz, but the module also can accept an external master timebase or export its own master timebase. To synchronize the data rate of an NI-9235 with other modules that use master timebases to control sampling, all of the modules must share a single master timebase source.

The following equation provides the available data rates of the NI-9235:

$$f_s = \frac{f_M \div 256}{n}$$

where n is any integer from 2 to 63.

However, the data rate must remain within the appropriate data rate range. When using the internal master timebase of 12.8 MHz, the result is data rates of 10 kS/s, 8.333 kS/s, 7.143 kS/s, and so on down to 794 S/s, depending on the value of n. When using an external timebase with a frequency other than 12.8 MHz, the NI-9235 has a different set of data rates.

Note The NI-9151 R Series Expansion chassis does not support sharing timebases between modules.

Excitation Voltage

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