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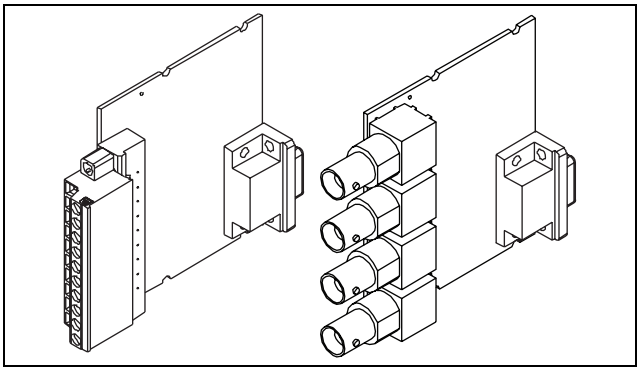
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OPERATING INSTRUCTIONS AND SPECIFICATIONS

NI 9215E

4-Channel, ±10 V, 16-Bit Simultaneous Analog Input Module



NATIONAL INSTRUMENTS

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This document describes how to use the National Instruments 9215E and includes dimensions, terminal assignments, and specifications for the NI 9215E. In this document, the NI 9215E with screw terminal and NI 9215E with BNC are referred to inclusively as the NI 9215E. Visit `ni.com/info` and enter `rdsoftwareversion` to determine which software you need for the modules you are using. For information about installing, configuring, and programming the system, refer to the system documentation. Visit `ni.com/info` and enter `cseriesdoc` for information about C Series documentation.

Caution National Instruments makes no electromagnetic compatibility (EMC) or CE marking compliance claims for the NI 9215E. The end-product supplier is responsible for conformity to any and all compliance requirements.

Caution The NI 9215E must be installed inside a suitable enclosure prior to use. Hazardous voltages may be present.

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NI 9215E Dimensions

The following figure shows the dimensions of the NI 9215E.

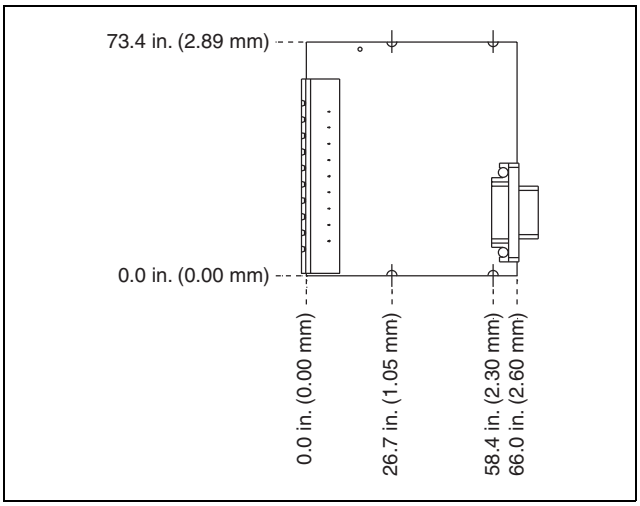


Figure 1. NI 9215E Dimensions in Millimeters (Inches)

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Connecting the NI 9215E

The NI 9215E provides connections for four differential analog input channels.

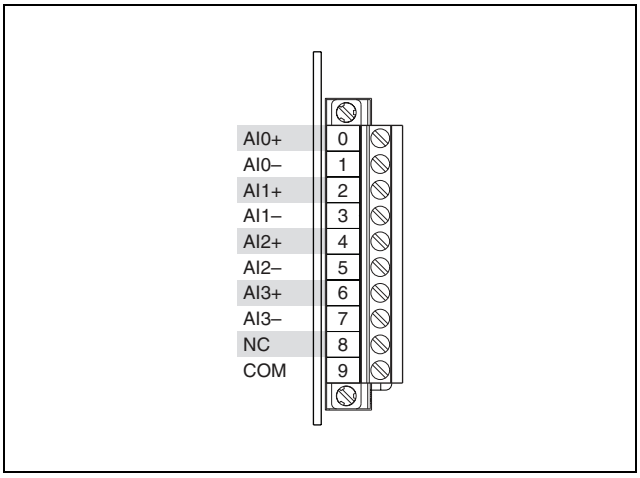


Figure 2. Terminal Assignments of the NI 9215E with Screw Terminal

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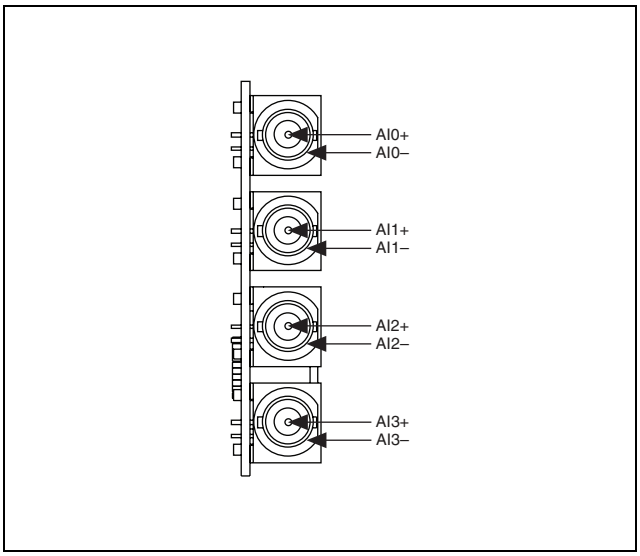


Figure 3. Connector Assignments of the NI 9215E with BNC

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The NI 9215E with screw terminal has a 10-terminal detachable screw-terminal connector. The NI 9215E with BNC has four BNC connectors.

Each channel of the NI 9215E has an AI+ terminal to which you can connect the positive voltage signal, and an AI– terminal or shield to which you can connect the negative voltage signal. The NI 9215E with screw terminal also has a common terminal, COM, that is internally connected to the isolated ground reference of the module.

Note You must use 2-wire ferrules to create a secure connection when connecting more than one wire to a single terminal on the NI 9215E with screw terminal.

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Connecting Differential Voltage Signals to the NI 9215E

You can connect grounded or floating differential signals to the NI 9215E. Connect the positive voltage signal to AI+ and the negative voltage signal to AI–. To connect grounded differential signals to the NI 9215E with screw terminal, you must also connect the signal reference to the COM terminal, as shown in Figure 4.

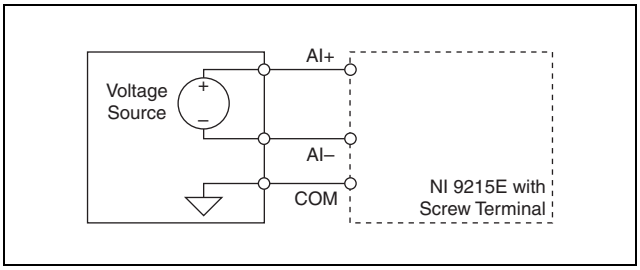


Figure 4. Connecting a Grounded Differential Voltage Signal to the NI 9215E with Screw Terminal

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To connect floating differential signals to the NI 9215E with screw terminal, you must connect the negative lead of the signal to COM through a 1 MΩ resistor to keep the voltage source within the common-mode voltage range, as shown in Figure 5. If the voltage source is outside of the common-mode range, then the NI 9215E does not read data accurately. The NI 9215E with BNC has internal circuitry that keeps the voltage source within the common-mode range. For more information about the common-mode voltage range, refer to the *Specifications* section.

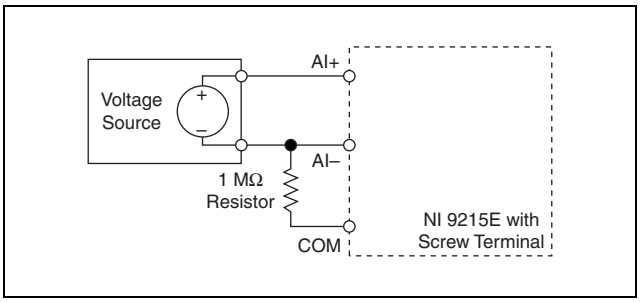


Figure 5. Connecting a Floating Differential Voltage Signal to the NI 9215E with Screw Terminal

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Connecting Single-Ended Voltage Signals to the NI 9215E

To connect single-ended voltage signals to the NI 9215E with screw terminal, you must also connect the ground signal to the COM terminal to keep the common-mode voltage in the specified range, as shown in Figure 6. For more information about the common-mode voltage range, refer to the *Specifications* section.

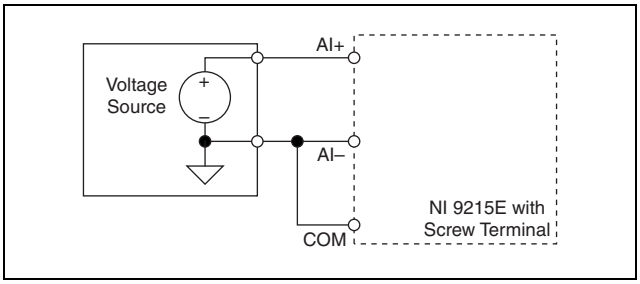


Figure 6. Connecting a Single-Ended Voltage Signal to the NI 9215E with Screw Terminal

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NI 9215E Circuitry

The NI 9215E channels share a common ground that is isolated from other modules in the system. The NI 9215E protects each channel from overvoltages. For more information about overvoltage protection, refer to the *Specifications* section.
The incoming analog signal on each channel is buffered and conditioned by the instrumentation amplifier and is then sampled by a 16-bit ADC. The channels have independent track-and-hold amplifiers that allow you to sample all four channels simultaneously. Refer to Figures 7 and 8 for input circuitry illustrations of the NI 9215E with screw terminal and the NI 9215E with BNC.

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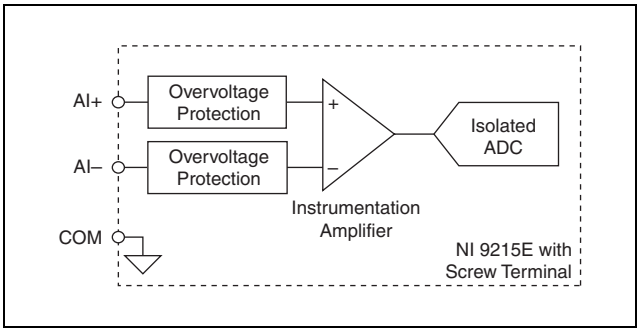


Figure 7. Input Circuitry for One Channel on the NI 9215E with Screw Terminal

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The NI 9215E with BNC has a resistor that ensures the input voltage does not drift outside of the common-mode range.

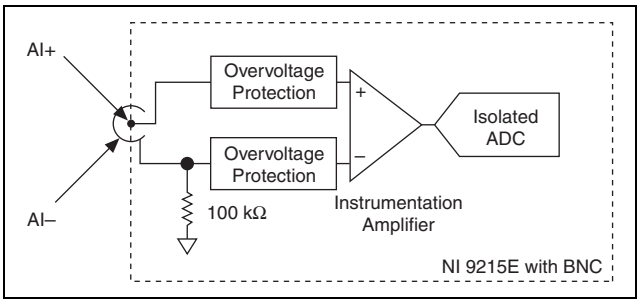


Figure 8. Input Circuitry for One Channel on the NI 9215E with BNC

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Sleep Mode

This module supports a low-power sleep mode. Support for sleep mode at the system level depends on the chassis that the module is plugged into. Refer to the chassis manual for information about support for sleep mode. If the chassis supports sleep mode, refer to the software help for information about enabling sleep mode. Visit `ni.com/info` and enter `cseriesdoc` for information about C Series documentation.

Typically, when a system is in sleep mode, you cannot communicate with the modules. In sleep mode, the system consumes minimal power and may dissipate less heat than it does in normal mode. Refer to the *Specifications* section for more information about power consumption and thermal dissipation.

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Specifications

The following specifications are typical for the range –40 to 85 °C internal to any enclosures unless otherwise noted.

Input Characteristics

Number of channels ..... 4 analog input channels

ADC resolution ..... 16 bits

Type of ADC ..... Successive approximation register (SAR)

Input range ..... ±10.0 V

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Input voltage ranges

Measurement Voltage, AI+ to AI–			**Maximum Voltage (Signal + Common Mode)**	
Minimum* (V)	**Typical (V)**	**Maximum (V)**	**Screw Terminal**	**BNC**
±10.2	±10.4	±10.6	Each channel must remain within ±10.2 V of common.	All inputs must remain within 10.2 V of the average AI– inputs.
* The *minimum measurement voltage range* is the largest voltage the NI 9215E is guaranteed to accurately measure.				

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Overvoltage protection ..... ±30 V

Conversion time

- Channel 0 only ..... 4.4 µs
- Channels 0 and 1 ..... 6 µs
- Channels 0, 1, and 2 ..... 8 µs
- Channels 0, 1, 2, and 3 ..... 10 µs

Accuracy

Measurement Conditions	Percent of Reading (Gain Error)	Percent of Range* (Offset Error)
Calibrated, max (–40 to 85 °C)	0.2%	0.082%
Calibrated, typ (25 °C, ±5 °C)	0.02%	0.014%
Uncalibrated, max (–40 to 85 °C)	1.05%	0.82%
Uncalibrated, typ (25 °C, ±5 °C)	0.6%	0.38%
* Range equals 10.4 V		

Stability

- Gain drift ..... 10 ppm/°C
- Offset drift ..... 60 µV/°C

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CMRR (f_{in} = 60 Hz) ..... 73 dB min

Input bandwidth (–3 dB)..... 420 kHz min

Input impedance resistance

NI 9215E (Between any AI+ and AI– terminals) ..... 1 GΩ

NI 9215E with BNC (Between any two AI– terminals) ..... 200 kΩ

Input bias current ..... 10 nA

Input noise

RMS ..... 1.2 LSB_{rms}

Peak-to-peak..... 7 LSB

Crosstalk ..... –80 dB

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Settling time (to 2 LSBs)

NI 9215E with screw terminal

10 V step ..... 10 µs

20 V step ..... 15 µs

NI 9215E with BNC

10 V step ..... 25 µs

20 V step ..... 35 µs

No missing codes ..... 15 bits guaranteed

DNL ..... –1.9 to 2 LSB max

INL ..... ±6 LSB max

MTBF ..... 1,167,174 hours at 25 °C; Bellcore Issue 2, Method 1, Case 3, Limited Part Stress Method

Note Contact NI for Bellcore MTBF specifications at other temperatures or for MIL-HDBK-217F specifications.

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Power Requirements

Power consumption from chassis (full-scale input, 100 kS/s)

Active mode ..... 560 mW max

Sleep mode ..... 25 µW max

Thermal dissipation (at 85 °C)

Active mode ..... 560 mW max

Sleep mode ..... 25 µW max

Physical Characteristics

Use a dry, low-velocity stream of air to clean the module. If needed, use a soft-bristle brush for cleaning around components.

Note For two-dimensional drawings and three-dimensional models of the C Series module and connectors, visit `ni.com/dimensions` and search by module number.

Screw-terminal wiring ..... 12 to 24 AWG copper conductor wire with 10 mm (0.39 in.) of insulation stripped from the end

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Torque for screw terminals ..... 0.5 to 0.6 N · m (4.4 to 5.3 lb · in.)

Ferrules ..... 0.25 mm^2 to 2.5 mm^2

Weight

NI 9215E with screw terminal.... 65 g (2.3 oz)

NI 9215E with BNC..... 71 g (2.5 oz)

Safety

NI 9215E with Screw Terminal Safety Voltages

Connect only voltages that are within the following limits.

Channel-to-COM ..... ±30 V max

Isolation

Channel-to-channel ..... None

Channel-to-earth ground

Continuous ..... 250 V_{rms}, Measurement Category II, (Double Insulation)

Withstand ..... 2,300 V_{rms}, verified by a 5 s dielectric withstand test

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Measurement Category II is for measurements performed on circuits directly connected to the electrical distribution system. This category refers to local-level electrical distribution, such as that provided by a standard wall outlet, for example, 115 V for U.S. or 230 V for Europe.

Caution Do *not* connect the NI 9215E with screw terminal to signals or use for measurements within Measurement Categories III or IV.

NI 9215E with BNC Safety Voltages

Connect only voltages that are within the following limits.

AI+-to-AI– ..... ±30 V max

Isolation

- Channel-to-channel ..... None
- Channel-to-earth ground
  - Continuous ..... 60 VDC, Measurement Category I, (Double Insulation)
  - Withstand ..... 1,500 V_{rms}, verified by a 5 s dielectric withstand test

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Measurement Category I is for measurements performed on circuits not directly connected to the electrical distribution system referred to as *MAINS* voltage. MAINS is a hazardous live electrical supply system that powers equipment. This category is for measurements of voltages from specially protected secondary circuits. Such voltage measurements include signal levels, special equipment, limited-energy parts of equipment, circuits powered by regulated low-voltage sources, and electronics.

Caution Do *not* connect the NI 9215E with BNC to signals or use for measurements within Measurement Categories II, III, or IV.

Safety Standards

This product meets the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use when installed in a suitable enclosure:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1

Note For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

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Online Product Certification

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for this product, visit `ni.com/certification`, search by module number or product line, and click the appropriate link in the Certification column.

Environmental

National Instruments C Series modules are intended for indoor use only but may be used outdoors if installed in a suitable enclosure. Refer to the manual for the chassis you are using for more information about meeting these specifications.

Operating temperature
(IEC 60068-2-1, IEC 60068-2-2) ..... –40 to 85 °C

Storage temperature
(IEC 60068-2-1, IEC 60068-2-2) ..... –40 to 85 °C

Operating humidity
(IEC 60068-2-56)..... 10 to 90% RH, noncondensing

Storage humidity
(IEC 60068-2-56)..... 5 to 95% RH, noncondensing

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Maximum altitude..... 2,000 m

Pollution Degree (IEC 60664) 2

Environmental Management

National Instruments is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the *NI and the Environment* Web page at `ni.com/environment`. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

Waste Electrical and Electronic Equipment (WEEE)



EU Customers At the end of their life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers and National Instruments WEEE initiatives, visit `ni.com/environment/weee.htm`.

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Calibration

You can obtain the calibration certificate and information about calibration services for the NI 9215E at `ni.com/calibration`.

Calibration interval ..... 1 year

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Where to Go for Support

The National Instruments Web site 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.

National Instruments corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. National Instruments also has offices located around the world to help address your support needs. For telephone support in the United States, create your service request at `ni.com/support` and follow the calling instructions or dial 512 795 8248. For telephone support outside the United States, contact your local branch office:

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