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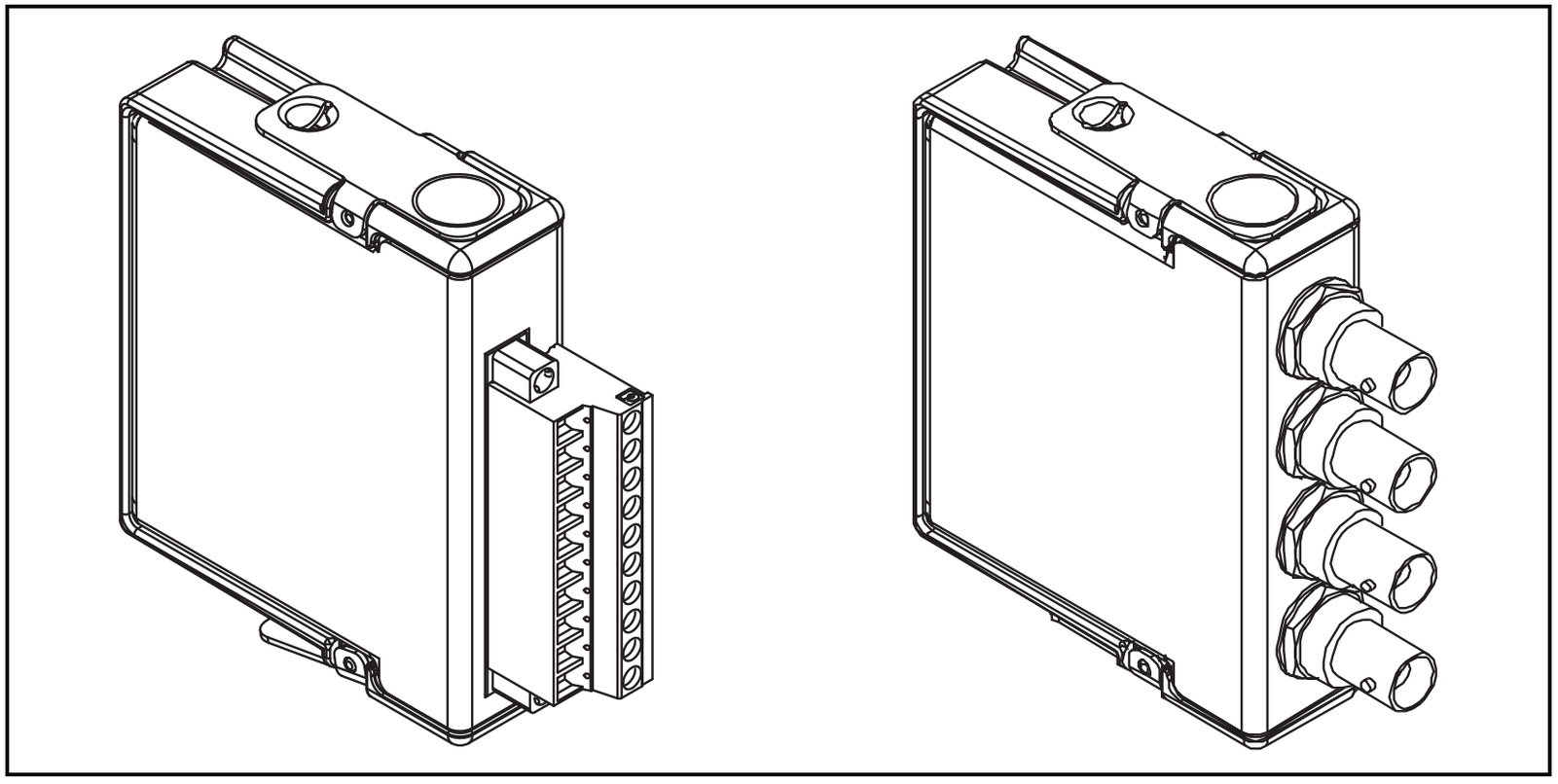
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Find the *National Instruments NI 9215 / cRIO-9215* at our website: *Click HERE*

OPERATING INSTRUCTIONS

CompactRIO™ cRIO-9215

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



NATIONAL INSTRUMENTS™

These operating instructions describe how to use the National Instruments cRIO-9215. In this document, the cRIO-9215 with screw terminal and cRIO-9215 with BNC are referred to inclusively as the cRIO-9215. For information about installing, configuring, and programming the CompactRIO system, refer to the *CompactRIO Bookshelf* at **Start»All Programs»National Instruments»CompactRIO»Search the CompactRIO Bookshelf**.

Safety Guidelines

Operate the cRIO-9215 only as described in these operating instructions.



Hot Surface This icon denotes that the component may be hot. Touching this component may result in bodily injury.

Safety Guidelines for Hazardous Locations

The cRIO-9215 is suitable for use in Class I, Division 2, Groups A, B, C, and D hazardous locations; Class 1, Zone 2, AEx nC IIC T4 and Ex nC IIC T4 hazardous locations; and nonhazardous locations only. Follow these guidelines if you are installing the cRIO-9215

in a potentially explosive environment. Not following these guidelines may result in serious injury or death.



Caution Do *not* disconnect I/O-side wires or connectors unless power has been switched off or the area is known to be nonhazardous.



Caution Do *not* remove modules unless power has been switched off or the area is known to be nonhazardous.



Caution Substitution of components may impair suitability for Class I, Division 2.



Caution For Zone 2 applications, install the CompactRIO system in an enclosure rated to at least IP 54 as defined by IEC 60529 and EN 60529.

Special Conditions for Safe Use in Europe

This equipment has been evaluated as EEx nC IIC T4 equipment under DEMKO Certificate No. 03 ATEX 0324020X. Each module is marked ⟨Ex⟩ II 3G and is suitable for use in Zone 2 hazardous locations.

Safety Guidelines for Hazardous Voltages

You can connect hazardous voltages only to the cRIO-9215 with screw terminal. Do not connect hazardous voltages to the cRIO-9215 with BNC.

If *hazardous voltages* are connected to the module, take the following precautions. A hazardous voltage is a voltage greater than 42.4 V_{peak} or 60 VDC to earth ground.



Caution Ensure that hazardous voltage wiring is performed only by qualified personnel adhering to local electrical standards.



Caution Do *not* mix hazardous voltage circuits and human-accessible circuits on the same module.



Caution Make sure that devices and circuits connected to the module are properly insulated from human contact.



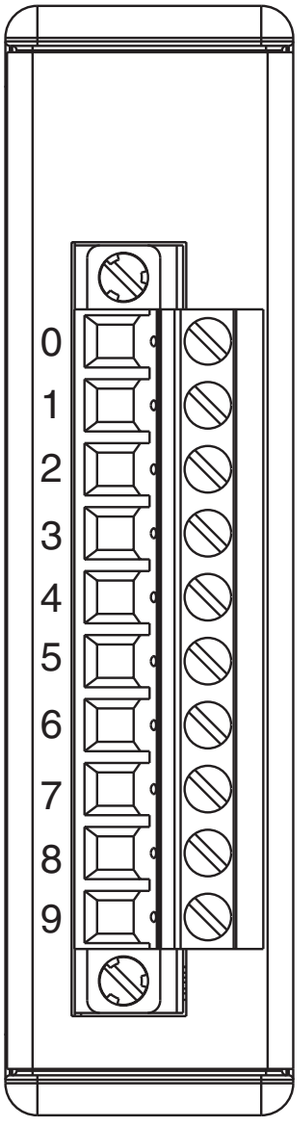
Caution When module terminals are live with hazardous voltages, make sure that the connectors are *not* accessible. You can use the cRIO-9932 connector kit or put the CompactRIO chassis in a suitably rated enclosure.

Wiring the cRIO-9215

The cRIO-9215 provides connections for four differential analog input channels. The cRIO-9215 with screw terminal has a 10-terminal detachable screw-terminal connector. The cRIO-9215 with BNC has four BNC connectors.

Each channel of the cRIO-9215 has a terminal or center pin to which you can connect the positive voltage signal, AI+, and a terminal or shield to which you can connect the negative voltage signal, AI–. The cRIO-9215 with screw terminal also has a common terminal, COM, that is internally connected to the isolated ground reference of the module. Refer to Table 1 for the terminal assignments of the cRIO-9215 with screw terminal. Refer to Figure 1 for the pin assignments of the cRIO-9215 with BNC.

Table 1. Terminal Assignments

Module	Terminal	Signal
	0	AI0+
	1	AI0–
	2	AI1+
	3	AI1–
	4	AI2+
	5	AI2–
	6	AI3+
	7	AI3–
	8	No Connection
	9	Common (COM)

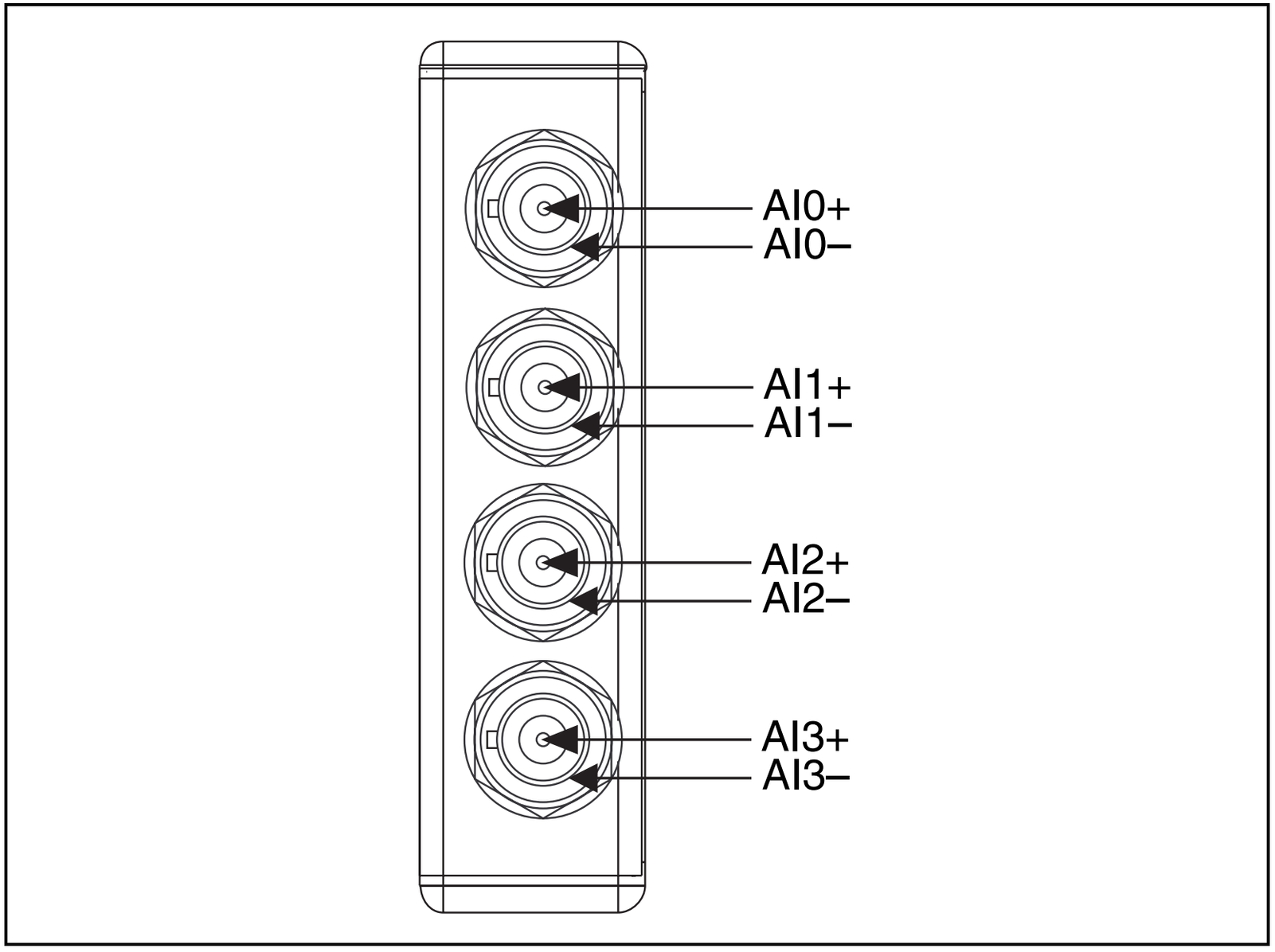


Figure 1. BNC Connector Assignments

Connecting Differential Voltage Signals to the cRIO-9215

For grounded differential signals, connect the positive voltage signal to AI+ and the negative signal to AI–. For the cRIO-9215

with screw terminal, connect the signal reference to the COM terminal.

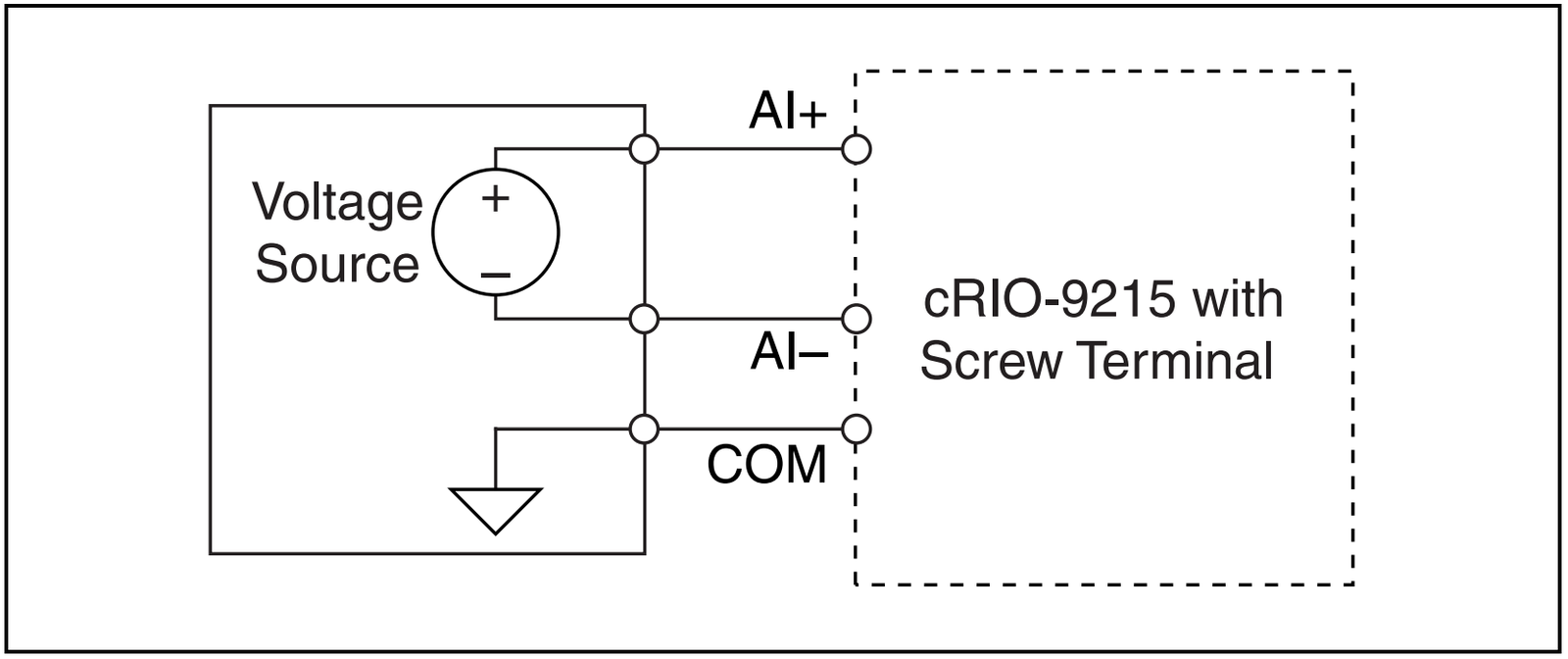


Figure 2. Connecting a Grounded Differential Voltage Signal to the cRIO-9215 (cRIO-9215 with Screw Terminal Shown)

For floating differential signals, the voltage source may go outside of the common-mode signal range of the cRIO-9215 with screw terminal. If the voltage source is outside of the common-mode range, data read by the cRIO-9215 is not accurate. To keep the voltage source within the common-mode range, connect the negative lead of the signal to COM through a 1 MΩ resistor, as shown in Figure 3. The cRIO-9215 with BNC has internal circuitry that keeps the voltage source within the common-mode range.

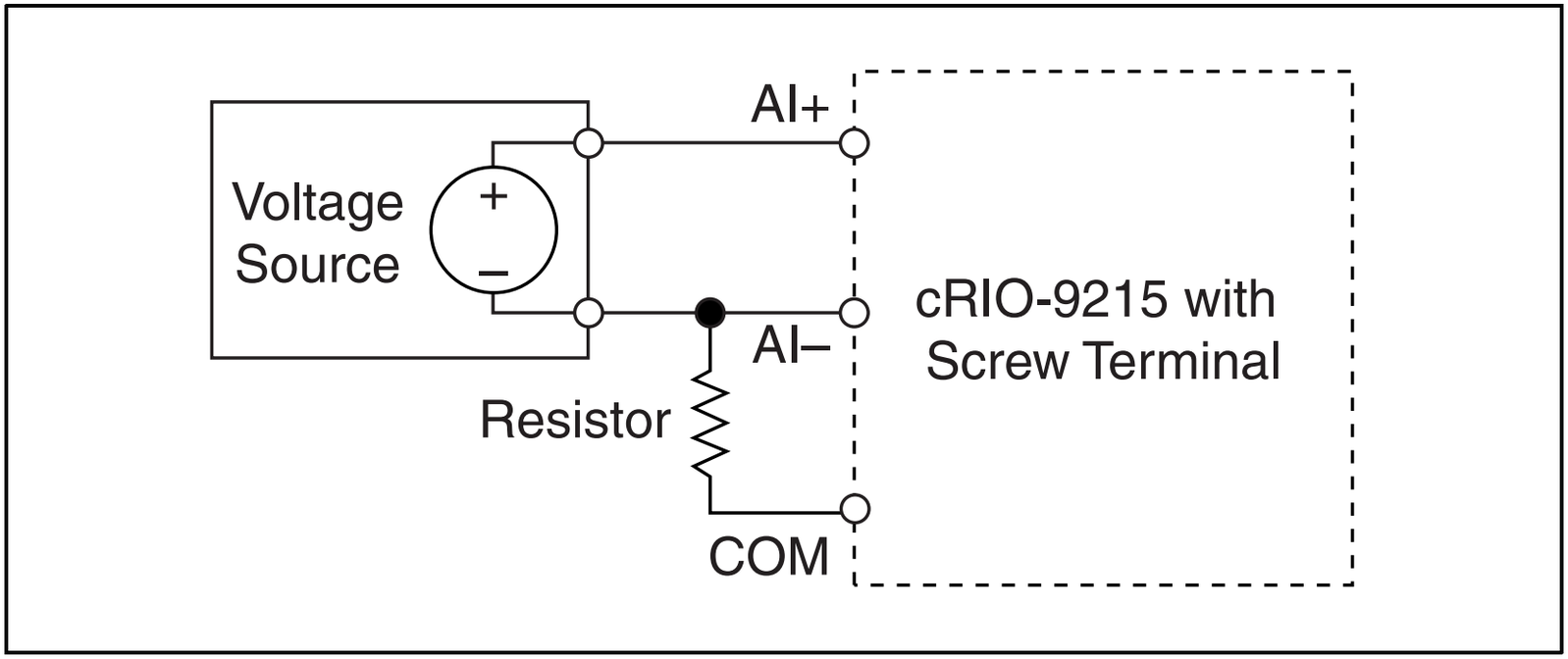


Figure 3. Connecting a Floating Differential Voltage Signal (cRIO-9215 with Screw Terminal Shown)

Connecting Single-Ended Voltage Signals to the cRIO-9215

Connect the positive voltage signal to AI+. Connect the ground signal to AI–. For the cRIO-9215 with screw terminal, you must also connect the ground signal to the COM terminal to keep the common-mode voltage in the specified range. For more information about the common-mode voltage range, refer to the *Specifications* section.

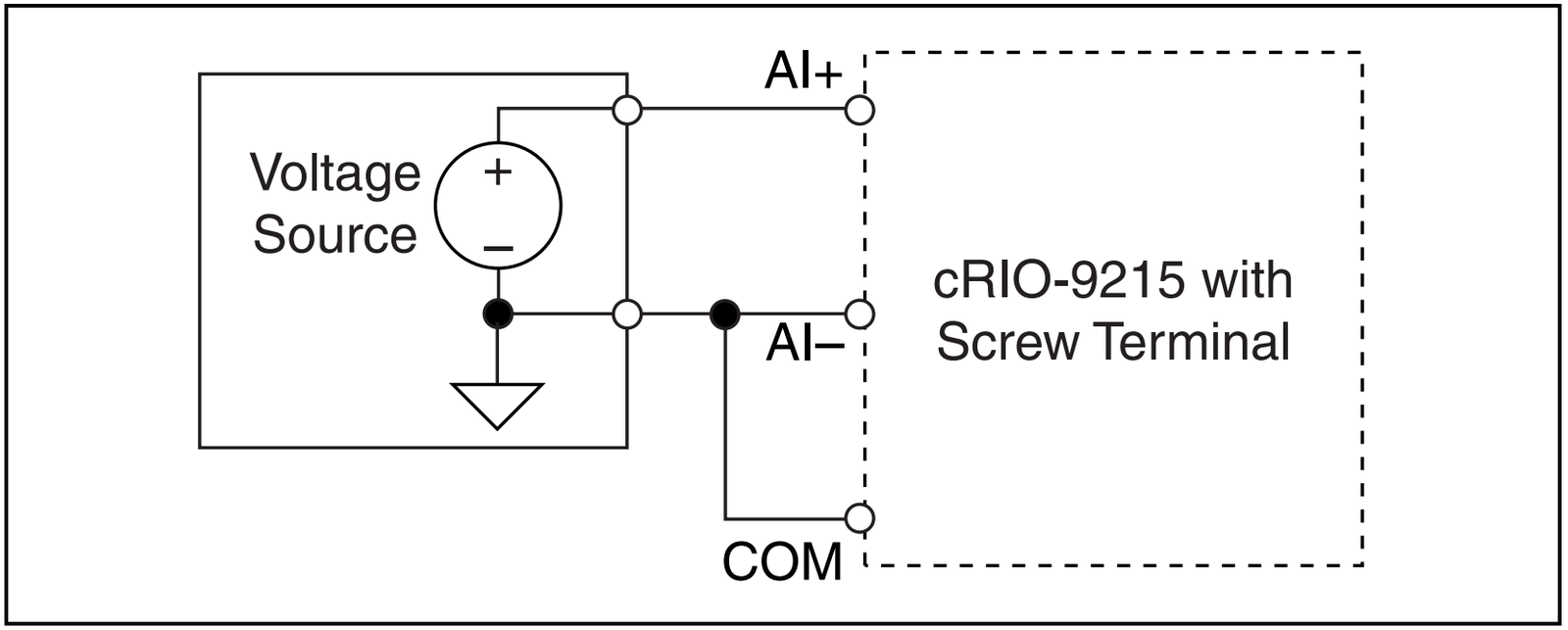


Figure 4. Connecting a Single-Ended Voltage Signal to the cRIO-9215 (cRIO-9215 with Screw Terminal Shown)

cRIO-9215 Circuitry

The cRIO-9215 channels share a common ground that is isolated from other modules in the CompactRIO system. The cRIO-9215 protects each channel from overvoltages. For more information about overvoltage protection, refer to the *Specifications* section. The signal 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. The cRIO-9215 returns uncalibrated, binary data.

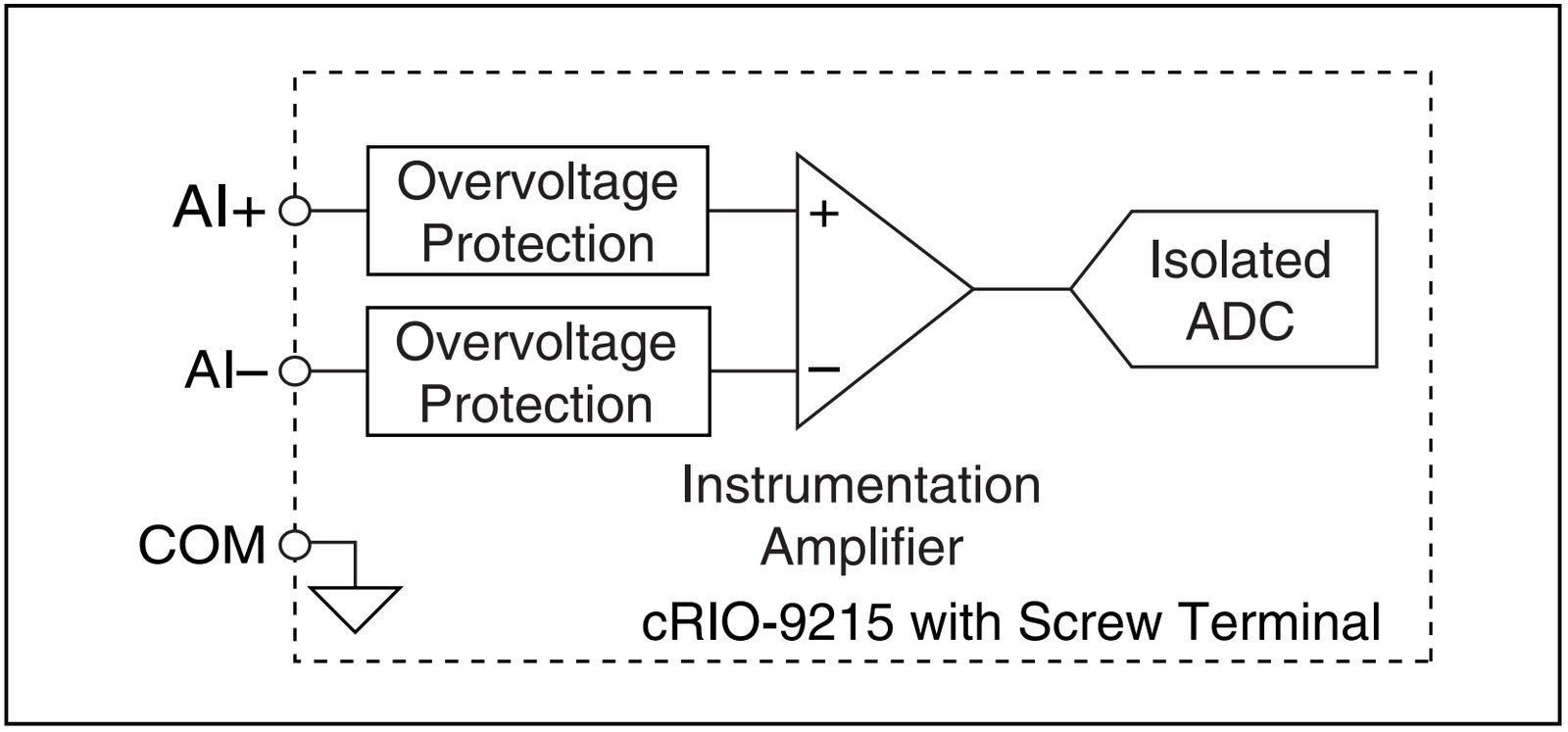


Figure 5. Input Circuitry for One Channel on the cRIO-9215 with Screw Terminal

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

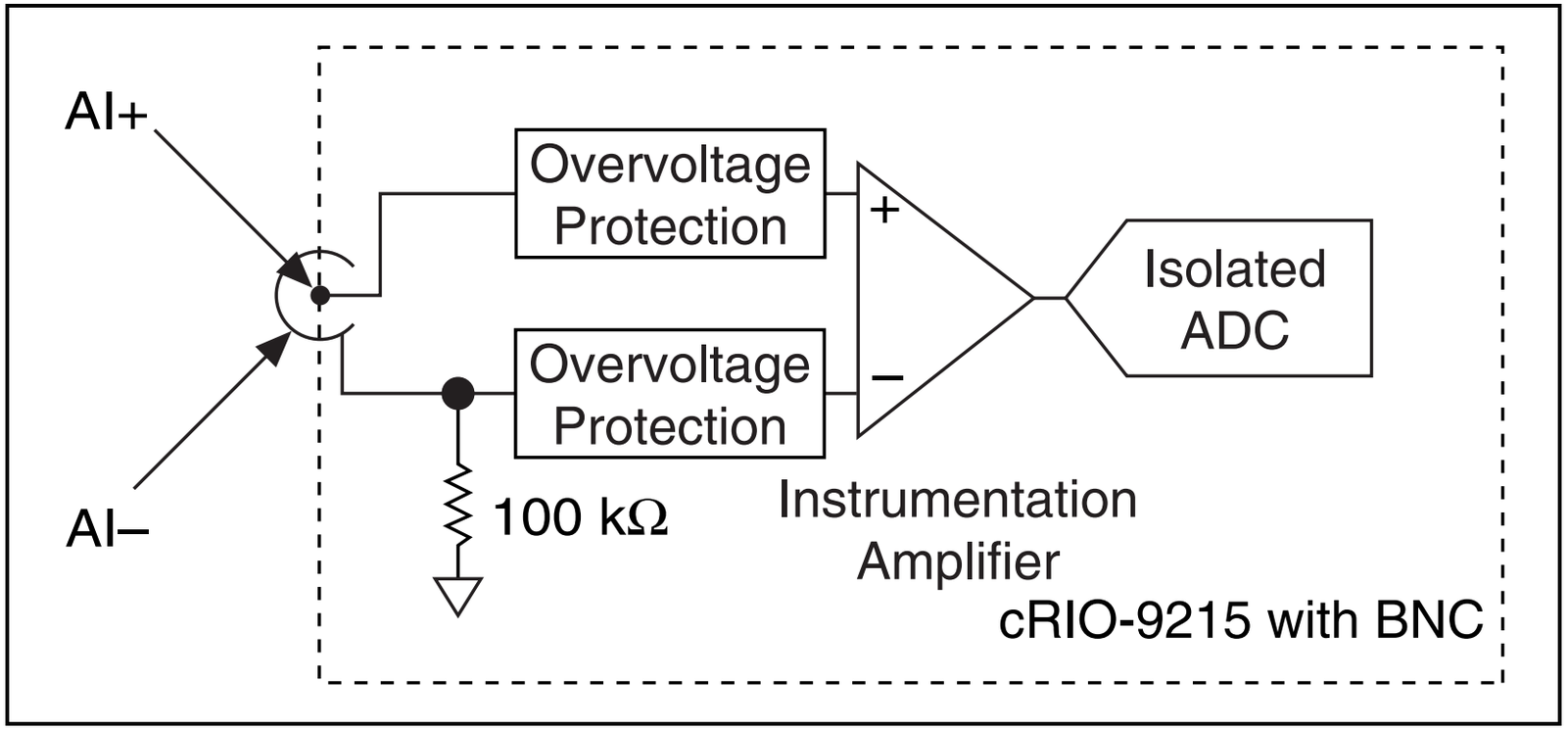


Figure 6. Input Circuitry for One Channel on the cRIO-9215 with BNC

Sleep Mode

You can enable sleep mode for the CompactRIO system in software. In sleep mode, the system consumes less power and may dissipate less heat. Typically, when a system is in sleep mode, you cannot communicate with the modules. Refer to the *Specifications* section for more information about power consumption and thermal dissipation. Refer to the *CompactRIO Bookshelf* for more information about enabling sleep mode in software.

NI-RIO Software

For information about determining which software you need for the modules you are using, go to `ni.com/info` and enter `rdniriosoftware`.

Specifications

The following specifications are typical for the range –40 to 70 °C unless otherwise noted.

Input Characteristics

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

ADC resolution ..... 16 bits

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

Operating voltage range (AI+ to AI–)

Typical	±10.4 V
Minimum[1]	±10.2 V
Maximum	±10.6 V

Maximum working voltage (signal +common mode)

cRIO-9215 with screw terminal	Each channel must remain within ±10.2 V of common
cRIO-9215 with BNC	All inputs must remain within ±10.2 V of the average AI– inputs

Overvoltage protection	±30 V

Conversion time

One channel	4.4 µs
Two channels	6 µs
Three channels	8 µs
Four channels	10 µs

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[1] The *minimum operating voltage range* is the largest voltage the cRIO-9215 can accurately measure.

Accuracy

Error	Percent of Reading	Percent of Range*
Calibrated max (–40 to 70 °C)	0.2%	0.082%
Calibrated typ (25 °C, ±5 °C)	0.02%	0.014%
Uncalibrated max (–40 to 70 °C)	1.05%	0.82%
Uncalibrated typ (25 °C, ±5 °C)	0.6%	0.38%
* Range equals 10.4 V		

Stability

Offset drift ..... 60 µV/ºC

Gain drift ..... 10 ppm/ºC

CMRR (at 60 Hz)..... –73 dB min

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

Input impedance

Resistance

cRIO-9215 ..... 1 GΩ

cRIO-9215 with BNC
(Between any two
AI– terminals) ..... 200 kΩ

Capacitance ..... 25 pF

Input bias current ..... 10 nA

Input noise

RMS ..... 1.2 LSB_{rms}

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

Crosstalk ..... –80 dB

Settling time (to 2 LSBs)

cRIO-9215 with screw terminal

10 V step ..... 10 µs

20 V step ..... 15 µs

cRIO-9215 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 6, Method 1, Case 3, Limited Part Stress Method



Note Contact NI for Bellcore MTBF specifications at other temperatures or for MIL-HDBK-217F specifications. Go to `ni.com/certification` and search by model number or product line for more information about MTBF and other product certifications.

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 70 °C)

- Active mode ..... 560 mW max
- Sleep mode ..... 25 µW max

Physical Characteristics

If you need to clean the module, wipe it with a dry towel.

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

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

Weight

cRIO-9215 with screw terminal ..... Approx. 150 g (5.3 oz)

cRIO-9215 with BNC..... Approx. 173 g (6.1 oz)

Safety

cRIO-9215 with Screw Terminal Safety Voltages

Connect only voltages that are within these limits.

Channel-to-COM ..... ±30 V max

Isolation

Channel-to-channel ..... No isolation between channels

Channel-to-earth ground

Withstand ..... 2,300 V_{rms}, 1 minute max

Continuous ..... 250 V_{rms}, Measurement Category II

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). Do not use this module with Measurement Category III or IV voltages.

cRIO-9215 with BNC Safety Voltages

Connect only voltages that are within these limits.

AI+-to-AI–..... ±30 V max

Isolation

Channel-to-channel ..... No isolation between channels

Channel-to-earth ground

Withstand ..... 1,500 V_{rms}, 1 minute max

Continuous ..... 60 VDC, Measurement Category I

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. Do not use this module with Measurement Category II, III, or IV voltages.

Safety Standards

The cRIO-9215 is designed to meet the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1
- CAN/CSA-C22.2 No. 61010-1



Note For UL and other safety certifications, refer to the product label, or visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

Hazardous Locations

U.S. (UL) ..... Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, AEx nC IIC T4

Canada (C-UL) ..... Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, Ex nC IIC T4

Europe (DEMKO)..... EEx nC IIC T4

Environmental

CompactRIO modules are intended for indoor use only. For outdoor use, mount the CompactRIO system in a suitably rated enclosure. Refer to the installation instructions 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 70 °C

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

Ingress protection..... IP 40

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

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

Maximum altitude..... 2,000 m

Pollution Degree (IEC 60664) 2

Shock and Vibration

To meet these specifications, you must panel mount the CompactRIO system and, for the cRIO-9215 with screw terminal, you must affix ferrules to the ends of the terminal wires.

Operating vibration,
random (IEC 60068-2-64) ..... 5 g_{rms}, 10 to 500 Hz

Operating shock
(IEC 60068-2-27)..... 30 g, 11 ms half sine,
50 g, 3 ms half sine,
18 shocks at 6 orientations

Operating vibration,
sinusoidal (IEC 60068-2-6) ..... 5 g, 10 to 500 Hz

Electromagnetic Compatibility

Emissions..... EN 55011 Class A at 10 m
FCC Part 15A above 1 GHz

Immunity..... Industrial levels per EN 61326-1:1997 + A2:2001, Table A.1

EMC/EMI ..... CE, C-Tick, and FCC Part 15 (Class A) Compliant

Note For EMC compliance, operate this device with shielded cabling.

FCC Compliance

Go to `ni.com/info` and enter `rdcriofcc` for information on using this product in compliance with FCC regulations.

CE Compliance

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

Low-Voltage Directive (safety)..... 73/23/EEC

Electromagnetic Compatibility Directive (EMC) 89/336/EEC

Note Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance

information. To obtain the DoC for this product, visit ni.com/certification, search by model number or product line, and click the appropriate link in the Certification column.

Calibration

You can obtain the calibration certificate for the cRIO-9215 at ni.com/calibration.

Calibration interval ..... 1 year

National Instruments Contact Information

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