

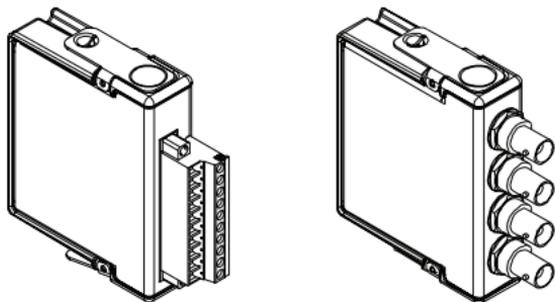
OPERATING INSTRUCTIONS AND SPECIFICATIONS

NI 9215

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

Français Deutsch 日本語 한국어 简体中文

ni.com/manuals



This document describes how to use the National Instruments 9215 and includes specifications and terminal assignments for the NI 9215. In this document, the NI 9215 with screw terminal and NI 9215 with BNC are referred to inclusively as the NI 9215. 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.



Note The safety guidelines and specifications in this document are specific to the NI 9215. The other components in the system might not meet the same safety ratings and specifications. Refer to the documentation for each component in the system to determine the safety ratings and specifications for the entire system. Visit ni.com/info and enter `cseriesdoc` for information about C Series documentation.

Safety Guidelines

Operate the NI 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 Voltages

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

If hazardous voltages are connected to the module, take the following precautions. A hazardous voltage is a voltage greater than $42.4 V_{pk}$ 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 hazardous voltage LIVE ($>42.4 V_{pk}/60$ VDC), you must ensure that devices

and circuits connected to the module are properly insulated from human contact. You must use the NI 9932 connector backshell kit to ensure that the terminals are *not* accessible.

Figure 1 shows the NI 9932 connector backshell.



Note You can use the NI 9932 connector backshell only with the NI 9215 with screw terminal.

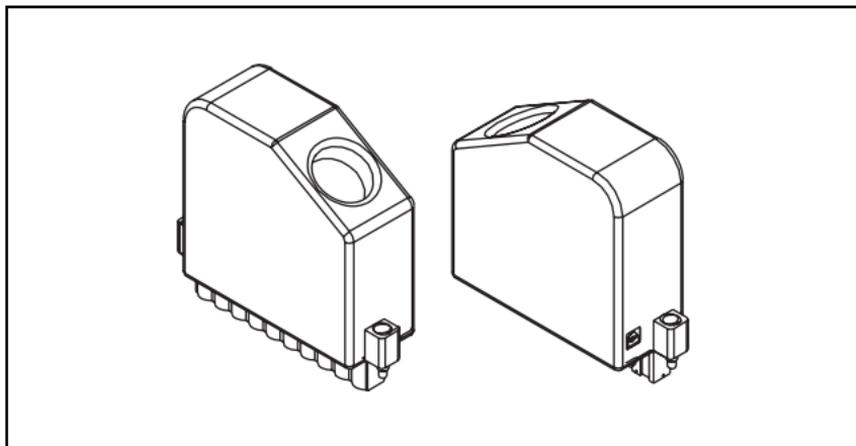


Figure 1. NI 9932 Connector Backshell

Safety Guidelines for Hazardous Locations

The NI 9215 is suitable for use in Class I, Division 2, Groups A, B, C, D, and T4 hazardous locations; Class I, 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 NI 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 system in an enclosure rated to at least IP 54 as defined by IEC 60529 and EN 60529.



Caution For Zone 2 applications, connected signals must be within the following limit:

Capacitance 0.2 μ F max

Special Conditions for Hazardous Locations 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. If you are using the NI 9215 in Gas Group IIC hazardous locations or in ambient temperatures of $-40\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$, you must use the device in an NI chassis that has been evaluated as Ex nA IIC T4 equipment.

Special Conditions for Marine Applications

Some modules are Lloyd's Register (LR) Type Approved for marine applications. To verify Lloyd's Register certification, go to ni.com/certification and search for the LR certificate, or look for the Lloyd's Register mark on the module.



Caution To meet radio frequency emission requirements for marine applications, use shielded cables and install the system in a metal enclosure. Suppression ferrites must be installed on power supply inputs near power entries to modules and controllers. Power supply and module cables must be separated on opposite sides of the enclosure, and must enter and exit through opposing enclosure walls.

Connecting the NI 9215

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

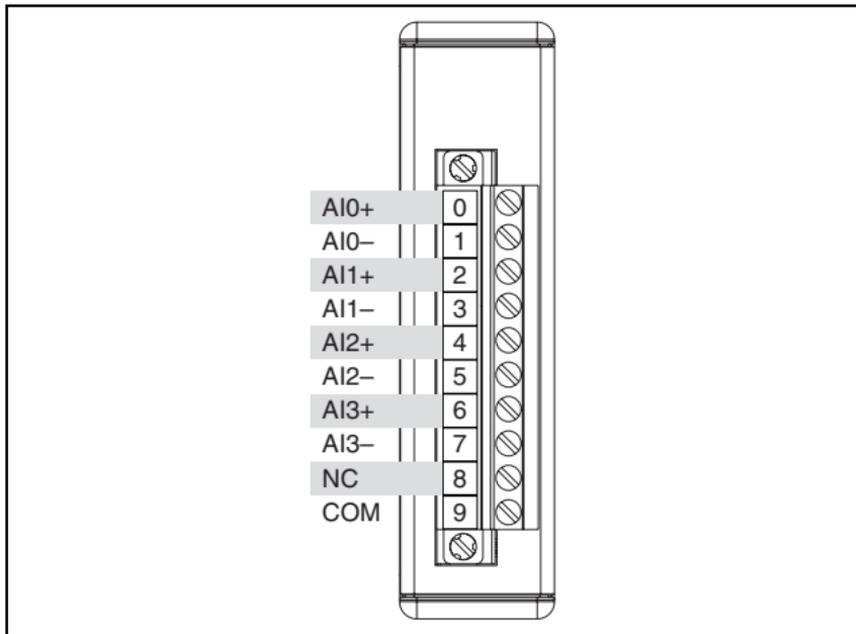


Figure 2. Terminal Assignments of the NI 9215 with Screw Terminal

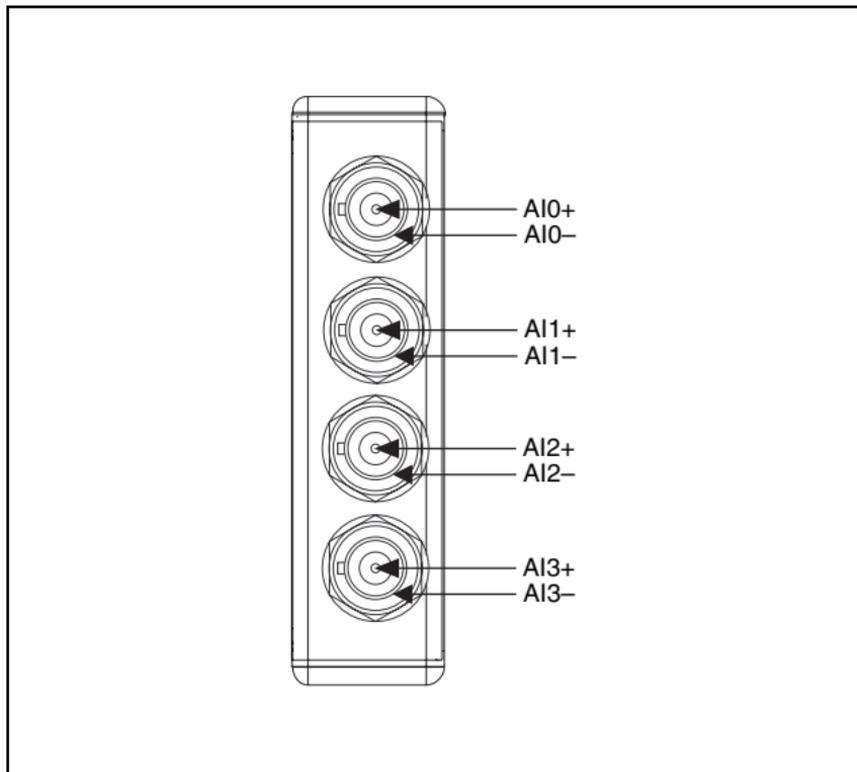


Figure 3. Connector Assignments of the NI 9215 with BNC

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

Each channel of the NI 9215 has an AI+ terminal or shield 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 9215 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 9215 with screw terminal.

Connecting Differential Voltage Signals to the NI 9215

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

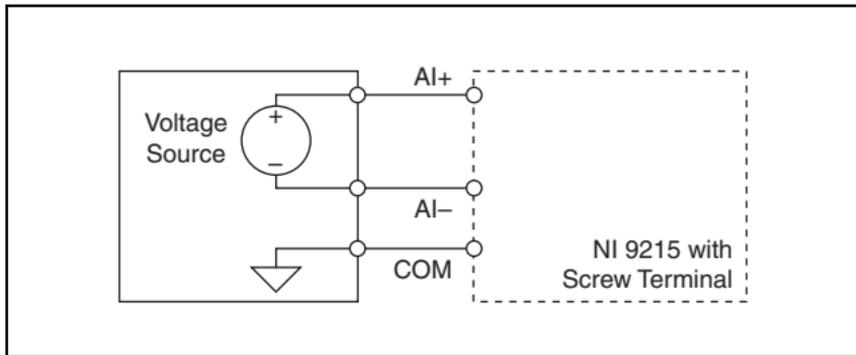


Figure 4. Connecting a Grounded Differential Voltage Signal to the NI 9215 with Screw Terminal

To connect floating differential signals to the NI 9215 with screw terminal, you must connect the negative lead of the signal to COM through a 1 M Ω 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 9215 does not read data accurately. The NI 9215 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.

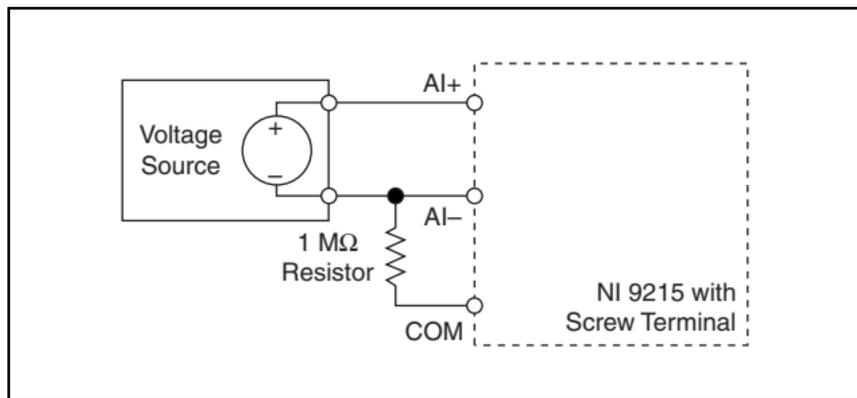


Figure 5. Connecting a Floating Differential Voltage Signal to the NI 9215 with Screw Terminal

Connecting Single-Ended Voltage Signals to the NI 9215

To connect single-ended voltage signals to the NI 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, as shown in Figure 6. For more information about the common-mode voltage range, refer to the [Specifications](#) section.

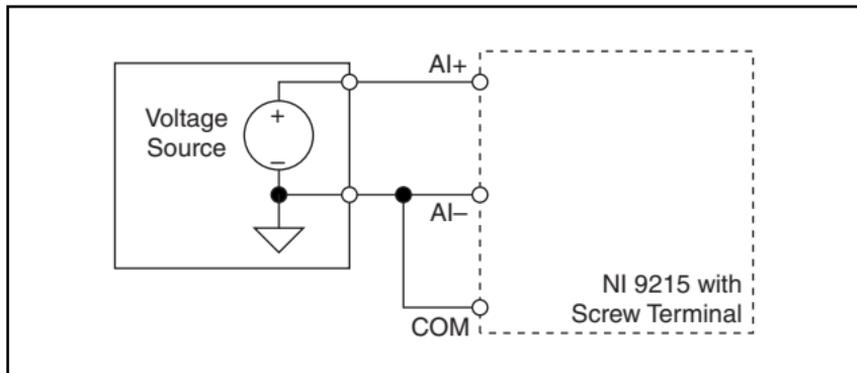


Figure 6. Connecting a Single-Ended Voltage Signal to the NI 9215 with Screw Terminal

Wiring for High Vibration Applications

If an application using the NI 9215 with screw terminal is subject to high vibration, National Instruments recommends that you either use ferrules to terminate wires to the detachable screw-terminal connector or use the NI 9932 backshell kit to protect the connections. Refer to Figure 7 for an illustration of using ferrules. Refer to Figure 1 for an illustration of the NI 9932 connector backshell.

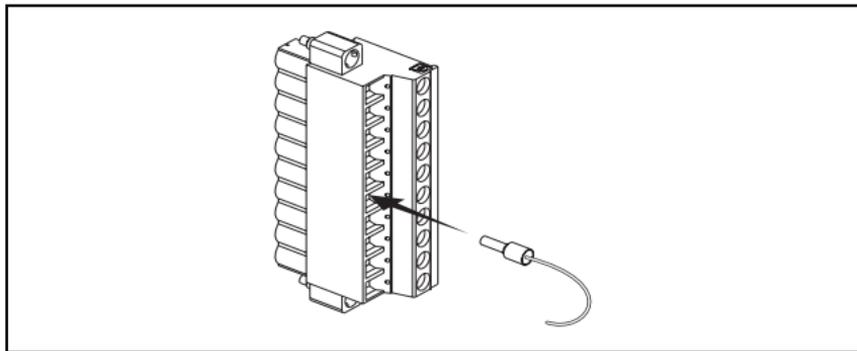


Figure 7. 10-Terminal Detachable Screw-Terminal Connector with a Ferrule

NI 9215 Circuitry

The NI 9215 channels share a common ground that is isolated from other modules in the system. The NI 9215 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 8 and 9 for input circuitry illustrations of the NI 9215 with screw terminal and the NI 9215 with BNC.

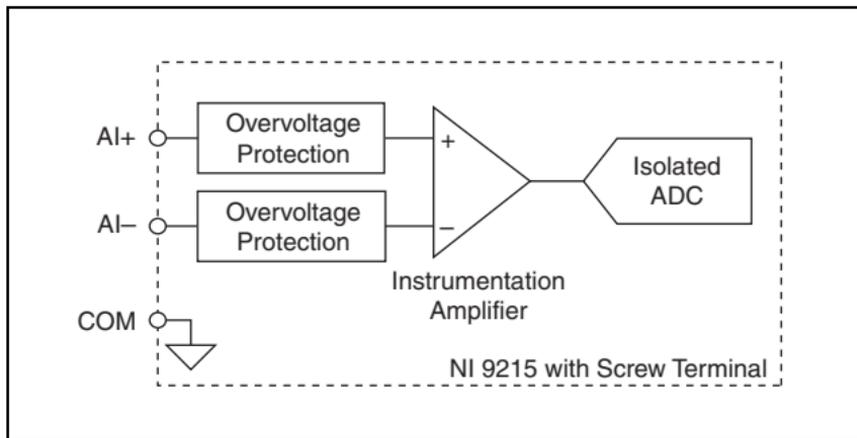


Figure 8. Input Circuitry for One Channel on the NI 9215 with Screw Terminal

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

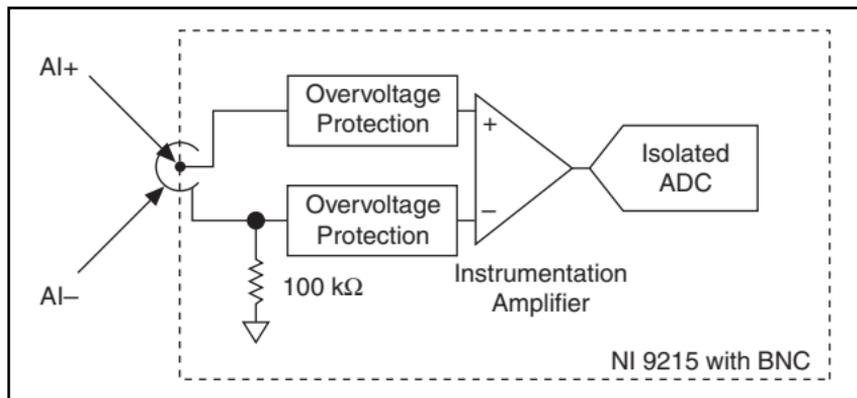


Figure 9. Input Circuitry for One Channel on the NI 9215 with BNC

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.

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)
Input range	± 10.0 V

Input voltage ranges¹

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 <i>minimum measurement voltage range</i> is the largest voltage the NI 9215 is guaranteed to accurately measure.				

¹ Refer to the [Safety Guidelines](#) section for more information about safe operating voltages.

Overvoltage protection ± 30 V

Conversion time

Channel 0 only 4.4 μ s

Channels 0 and 1 6 μ s

Channels 0, 1, and 2 8 μ s

Channels 0, 1, 2, and 3 10 μ s

Accuracy

Measurement Conditions	Percent of Reading (Gain Error)	Percent of Range* (Offset Error)
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

Gain drift 10 ppm/°C

Offset drift 60 μ V/°C

CMRR ($f_{in} = 60$ Hz)	-73 dB min
Input bandwidth (-3 dB).....	420 kHz min
Input impedance	
Resistance	
NI 9215 with	
screw terminal	1 G Ω
NI 9215 with BNC	
(Between any two	
AI- terminals)	200 k Ω
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)	
NI 9215 with screw terminal	
10 V step	10 μ s
20 V step	15 μ s

NI 9215 with BNC

10 V step	25 μ s
20 V step	35 μ s
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.

Power Requirements

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

Active mode	560 mW max
Sleep mode	25 μ W max

Thermal dissipation (at 70 °C)

Active mode	560 mW max
Sleep mode	25 μ W 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.)

Ferrules 0.25 mm² to 2.5 mm²

Weight

NI 9215 with screw terminal	150 g (5.3 oz)
NI 9215 with BNC	173 g (6.1 oz)

Safety

NI 9215 with Screw Terminal Safety Voltages

Connect only voltages that are within the following limits.

Channel-to-COM ± 30 V max

Isolation

Channel-to-channel No isolation between channels

Channel-to-earth ground

Continuous 250 V_{rms},
Measurement Category II

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

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 9215 with screw terminal to signals or use for measurements within Measurement Categories III or IV.

NI 9215 with BNC Safety Voltages

Connect only voltages that are within the following limits.

AI+-to-AI- ± 30 V max

Isolation

Channel-to-channel No isolation between channels

Channel-to-earth ground

Continuous 60 VDC,
Measurement Category I

Withstand 1,500 V_{rms}, verified by a
5 s dielectric withstand test

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 9215 with BNC to signals or use for measurements within Measurement Categories II, III, or IV.

Safety Standards

This product 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, CSA 61010-1



Note For UL and other safety certifications, refer to the product label, or visit ni.com/certification, search by module 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

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 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 system. If you are using the NI 9215 with screw terminal, you must also either affix ferrules to the ends of the terminal wires or use the NI 9932 backshell kit to protect the connections.

Operating vibration

Random (IEC 60068-2-34).....	5 g _{rms} , 10 to 500 Hz
Sinusoidal (IEC 60068-2-6)	5 g, 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
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Electromagnetic Compatibility

This product is designed to meet the requirements of the following standards of EMC for electrical equipment for measurement, control, and laboratory use:

- EN 61326 EMC requirements; Industrial Immunity
- EN 55011 Emissions; Group 1, Class A
- CE, C-Tick, ICES, and FCC Part 15 Emissions; Class A



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

CE Compliance

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

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)



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 module number or product line, and click the appropriate link in the Certification column.

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 not only to the environment but also 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.

电子信息产品污染控制管理办法（中国 RoHS）



中国客户 National Instruments 符合中国电子信息产品中限制使用某些有害物质指令 (RoHS)。关于 National Instruments 中国 RoHS 合规性信息，请登录 ni.com/environment/rohs_china。(For information about China RoHS compliance, go to ni.com/environment/rohs_china.)

Calibration

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

Calibration interval 1 year

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:

Australia 1800 300 800, Austria 43 662 457990-0,
Belgium 32 (0) 2 757 0020, Brazil 55 11 3262 3599,
Canada 800 433 3488, China 86 21 5050 9800,
Czech Republic 420 224 235 774, Denmark 45 45 76 26 00,
Finland 358 (0) 9 725 72511, France 01 57 66 24 24,
Germany 49 89 7413130, India 91 80 41190000,
Israel 972 3 6393737, Italy 39 02 413091, Japan 0120 527196,
Korea 82 02 3451 3400, Lebanon 961 (0) 1 33 28 28,
Malaysia 1800 887710, Mexico 01 800 010 0793,
Netherlands 31 (0) 348 433 466, New Zealand 0800 553 322,
Norway 47 (0) 66 90 76 60, Poland 48 22 3390150,
Portugal 351 210 311 210, Russia 7 495 783 6851,
Singapore 1800 226 5886, Slovenia 386 3 425 42 00,
South Africa 27 0 11 805 8197, Spain 34 91 640 0085,
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Taiwan 886 02 2377 2222, Thailand 662 278 6777,
Turkey 90 212 279 3031, United Kingdom 44 (0) 1635 523545

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