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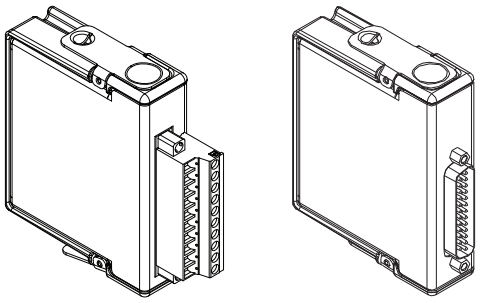
OPERATING INSTRUCTIONS AND SPECIFICATIONS

NI 9201/9221

8-Channel, 12-Bit Analog Input Modules

Français Deutsch 日本語 한국어 简体中文

ni.com/manuals



NATIONAL INSTRUMENTS

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This document describes how to use the National Instruments 9201 and National Instruments 9221 and includes specifications and terminal assignments for the NI 9201/9221. In this document, the NI 9201/9221 with screw terminal and NI 9201/9221 with DSUB are referred to inclusively as the NI 9201/9221. 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 9201/9221. 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.

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Safety Guidelines

Operate the NI 9201/9221 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 9201/9221 with screw terminal. Do *not* connect hazardous voltages to the NI 9201/9221 with DSUB.

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.

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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 9201/9221 with screw terminal.

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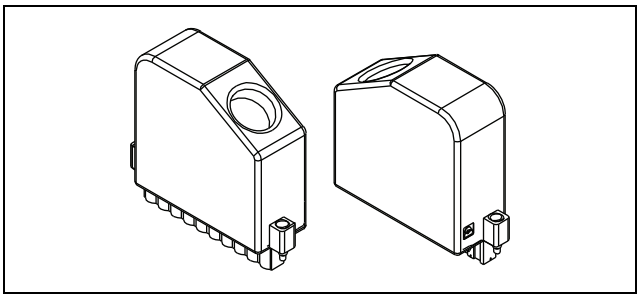


Figure 1. NI 9932 Connector Backshell

Safety Guidelines for Hazardous Locations

The NI 9201/9221 is suitable for use in Class I, Division 2, Groups A, B, C, D, 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 9201/9221 in a potentially explosive environment. Not following these guidelines may result in serious injury or death.

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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, install a protection device between the input signal and the NI 9201/9221 input terminal. The device must prevent the channel-to-COM voltage from exceeding 85 V if there is a transient overvoltage condition.

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

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locations, in ambient temperatures of –40 °C ≤ Ta ≤ 70 °C. If you are using the NI 9201/9221 in Gas Group IIC hazardous locations, you must use the device in an NI chassis that has been evaluated as Ex nC IIC T4, EEx nC IIC T4, Ex nA IIC T4, or Ex nL 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, visit `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.

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Connecting the NI 9201/9221

The NI 9201/9221 provides connections for eight analog input channels.

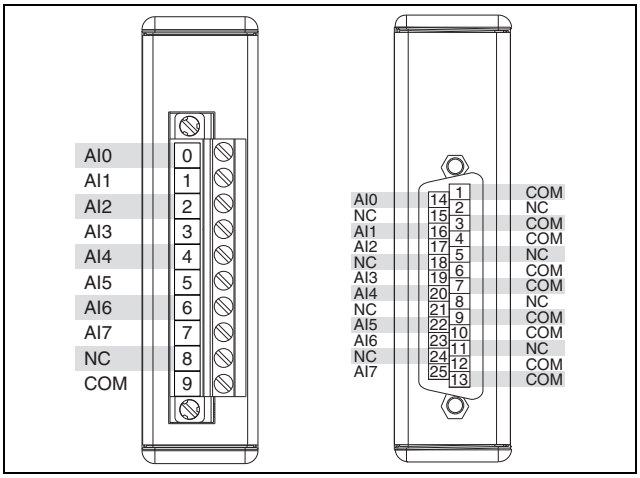


Figure 2. NI 9201/9221 Terminal and Pin Assignments

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The NI 9201/9221 with screw terminal has a 10-terminal, detachable screw-terminal connector. The NI 9201/9221 with DSUB has a 25-pin DSUB connector. Each channel has an AI terminal or pin to which you can connect a voltage signal. COM, the common terminal or pin, is internally connected to the isolated ground reference of the module.

The NI 9201/9221 channels are isolated from other modules in the system. The module protects each channel from overvoltages. Refer to the *Specifications* section for more information about overvoltage protection. The input signals are scanned, buffered, conditioned, and then sampled by a single 12-bit ADC. Refer to Figure 3 for an illustration of the input circuitry on the NI 9201/9221.

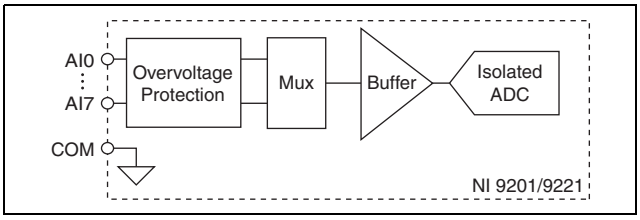


Figure 3. Input Circuitry on the NI 9201/9221

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You can connect single-ended voltage signals to the NI 9201/9221. Connect the positive lead of the voltage signal to AI. Connect the ground signal to COM. Refer to Figure 3 for an illustration of connecting a single-ended voltage signal to the NI 9201/9221.

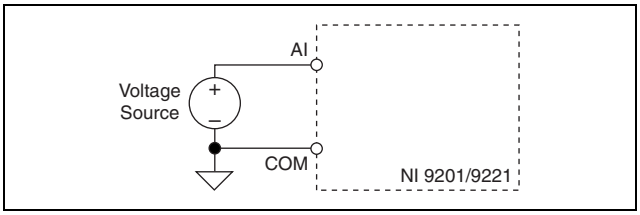


Figure 4. Connecting a Single-Ended Voltage Signal to the NI 9201/9221

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 9201/9221 with screw terminal.

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Wiring for High-Vibration Applications

If an application using the NI 9201/9221 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 5 for an illustration of using ferrules. Refer to Figure 1 for an illustration of the NI 9932 connector backshell.

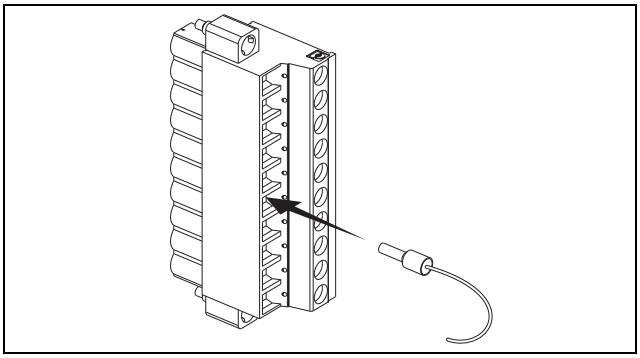


Figure 5. 10-Terminal Detachable Screw-Terminal Connector with Ferrule

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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 70 °C unless otherwise noted. All voltages are relative to COM unless otherwise noted. The specifications are the same for the NI 9201 and the NI 9221 unless otherwise noted.

Input Characteristics

Number of channels ..... 8 analog input channels

ADC resolution ..... 12 bits

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

Sample rate (aggregate)

Module	Maximum Sample Rate (R Series Expansion Chassis)	Maximum Sample Rate (All Other Chassis)
NI 9201, single channel	475 kS/s	800 kS/s
NI 9201, scanning	475 kS/s	500 kS/s
NI 9221	475 kS/s	800 kS/s

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Input range

NI 9201 ..... ±10 V

NI 9221 ..... ±60 V

Operating voltage ranges[1]

Module	Measurement Voltage, Channel-to-COM			Maximum Voltage, Channel-to-Earth Ground or COM-to-Earth Ground	
	Min (V)	Typ (V)	Max (V)	Screw Terminal	DSUB
NI 9201	±10.3	±10.53	±10.8	250 V_{rms}	±60 VDC
NI 9221	±61.4	±62.50	±63.8		

Overvoltage protection

(channel-to-COM) ..... ±100 V

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

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NI 9201 accuracy (excludes noise)

Measurement Conditions	Percent of Reading (Gain Error)	Percent of Range* (Offset Error)
Calibrated typ (25 °C, ±5 °C)	±0.04%	±0.07%
Calibrated max (–40 to 70 °C)	±0.25%	±0.25%
Uncalibrated typ (25 °C, ±5 °C)	±0.26%	±0.46%
Uncalibrated max (–40 to 70 °C)	±0.67%	±1.25%
* Range equals 10.53 V		

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NI 9221 accuracy (excludes noise)

Measurement Conditions	Percent of Reading (Gain Error)	Percent of Range* (Offset Error)
Calibrated typ (25 °C, ±5 °C)	±0.04%	±0.07%
Calibrated max (–40 to 70 °C)	±0.25%	±0.25%
Uncalibrated typ (25 °C, ±5 °C)	±0.26%	±0.43%
Uncalibrated max (–40 to 70 °C)	±0.67%	±1.06%
* Range equals 62.50 V		

Stability

Gain drift ..... ±34 ppm/°C

Offset drift

NI 9201 ..... ±100 µV/°C

NI 9221 ..... ±580 µV/°C

Input bandwidth (–3 dB)

NI 9201..... 690 kHz min

NI 9221..... 950 kHz min

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Input impedance

- Resistance ..... 1 MΩ
- Capacitance ..... 5 pF

Input noise (code-centered)

- RMS ..... 0.7 LSB_{rms}
- Peak-to-peak ..... 5 LSB

No missing codes ..... 12 bits

DNL ..... –0.9 to 1.5 LSB

INL ..... ±1.5 LSB

Crosstalk (at 10 kHz) ..... –75 dB

Settling time (to 1 LSB)

- NI 9201 ..... 2 µs
- NI 9221 ..... 1.25 µs

MTBF ..... 1,092,512 hours at 25 °C; Bellcore Issue 2, Method 1, Case 3, Limited Part Stress Method

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

Power Requirements

Power consumption from chassis

Active mode ..... 1 W max

Sleep mode ..... 1 mW max

Thermal dissipation (at 70 °C)

Active mode ..... 1 W max

Sleep mode ..... 32 mW max

Physical Characteristics

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

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.

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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 mm^2 to 2.5 mm^2

Weight

NI 9201/9221 with screw terminal ..... 150 g (5.3 oz)

NI 9201/9221 with DSUB..... 145 g (5.1 oz)

Safety

Safety Voltages

Connect only voltages that are within the following limits.

Channel-to-COM ..... ±60 VDC max

NI 9201/9221 with Screw Terminal Isolation Voltages

Channel-to-channel..... None

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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 9201/9221 with screw terminal to signals or use for measurements within Measurement Categories III or IV.

NI 9201/9221 with DSUB Isolation Voltages

Channel-to-channel..... None

Channel-to-earth ground

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

Withstand..... 1,000 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 9201/9221 with DSUB to signals or use for measurements within Measurement Categories II, III, or IV.

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

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Safety Standards

This product meets 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 the *Online Product Certification* section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326 (IEC 61326): Class A emissions; Industrial immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

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Note For the standards applied to assess the EMC of this product, refer to the *Online Product Certification* section.

Note For EMC compliance, operate this device with double-shielded cables.

CE Compliance CE

This product meets the essential requirements of applicable European Directives as follows:

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

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.

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Shock and Vibration

To meet these specifications, you must panel mount the system. If you are using the NI 9201/9221 with screw terminal, you also must 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 60068-2-64)..... 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

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

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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 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.

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Waste Electrical and Electronic Equipment (WEEE)



EU Customers At the end of the 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`.

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Calibration

You can obtain the calibration certificate and information about calibration services for the NI 9201/9221 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:

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