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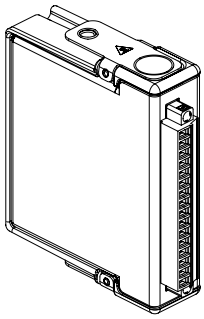
OPERATING INSTRUCTIONS AND SPECIFICATIONS

NI 9217

4-Channel, 24-Bit, 100Ω RTD Analog Input Module

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 9217 and includes specifications and terminal assignments for the NI 9217. 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 9217. 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 9217 only as described in these operating instructions.

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

Safety Guidelines for Hazardous Voltages

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 9939 connector backshell kit to ensure that the terminals are *not* accessible.

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Figure 1 shows the NI 9939 connector backshell.

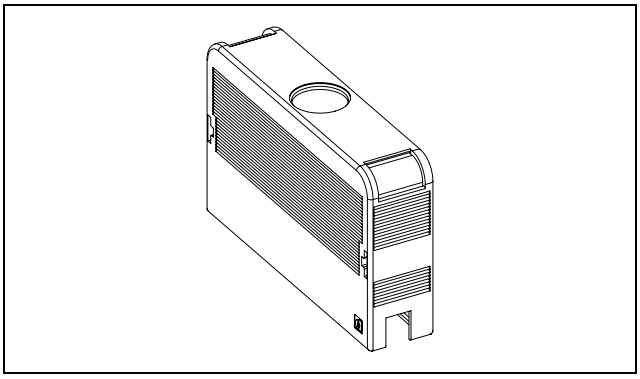


Figure 1. NI 9939 Connector Backshell

Safety Guidelines for Hazardous Locations

The NI 9217 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

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only. Follow these guidelines if you are installing the NI 9217 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 µF max

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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 9217 in Gas Group IIC hazardous locations or in ambient temperatures of –40 °C ≤ Ta ≤ 70 °C, you must use the device in an NI chassis that has been evaluated as 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 9217

The NI 9217 has a 16-terminal, detachable screw-terminal connector that provides connections for four RTD channels.

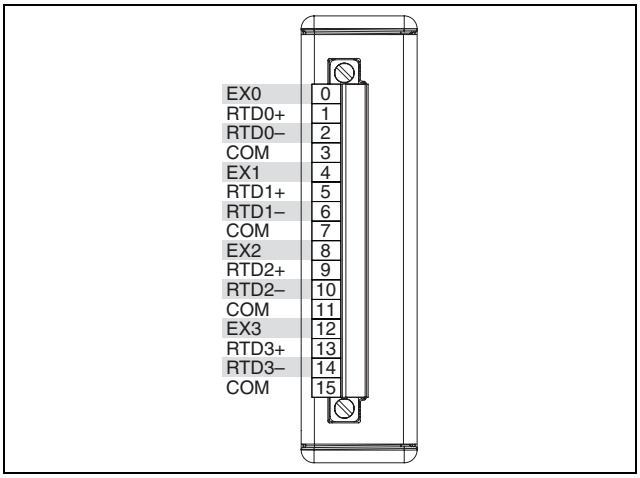


Figure 2. NI 9217 Terminal Assignments

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You can connect any combination of 3-wire or 4-wire RTDs to the NI 9217. Each NI 9217 channel contains circuitry that automatically detects the type of RTD connected to the channel. The NI 9217 scans all four input channels and automatically configures each channel for the appropriate mode. In 4-wire mode, the EX terminal is a 1 mA current source. In 3-wire mode, the RTD+ terminal is a 1 mA current source. The NI 9217 compensates for the error that lead resistance causes in 3-wire mode. Refer to Figure 3 for an example of the input circuitry for one channel of the NI 9217 in 4-wire mode.

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 9217.

The NI 9217 channels share a common ground that is isolated from other modules in the system. Each channel is filtered and then sampled by a 24-bit analog-to-digital converter (ADC).

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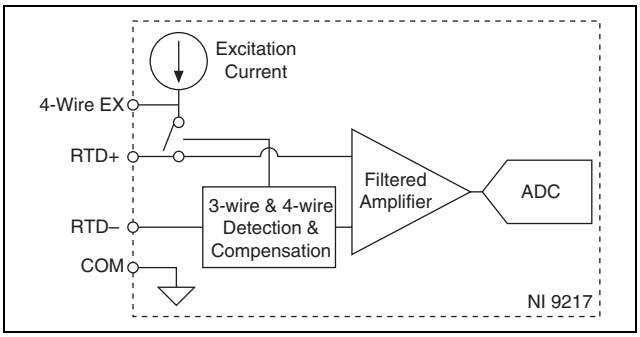


Figure 3. Input Circuitry for One Channel of the NI 9217 in 4-Wire Mode

Each channel has one terminal, RTD+, to which you connect the positive lead of the RTD signal and one terminal, RTD–, to which you connect the negative lead of the RTD signal. Each channel also has a common terminal, COM, and an excitation current source terminal, EX. You must connect the COM terminal to RTD–. All four COM terminals are internally connected to the isolated ground reference of the module. If you are using shielded wiring, connect one end of the shield to the COM terminal. Refer to Figure 4 for an illustration of how to connect an RTD to the NI 9217.

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If you are using a 4-wire RTD, connect EX to the positive lead of the RTD. If you are using a 3-wire RTD, do not connect the RTD to the EX terminal. For the best measurement results when using the NI 9217 with a 3-wire RTD, use equal-length wires between the RTD+ terminal and the RTD and between the COM terminal and the RTD. Also, keep the lead resistance within 5% of the nominal RTD value. The NI 9217 accuracy specifications account for this lead error. Refer to the *Specifications* section for more information about accuracy.

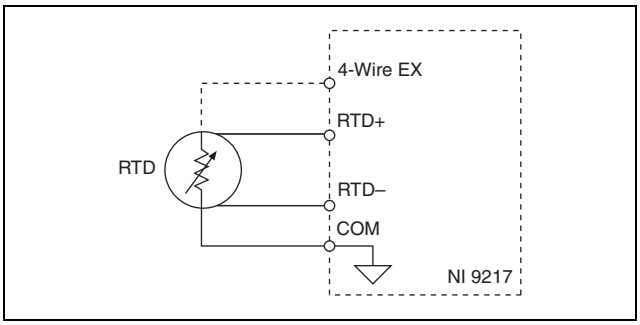


Figure 4. Connecting an RTD to the NI 9217

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Wiring for High-Vibration Applications

If an application 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 9939 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 9939 connector backshell.

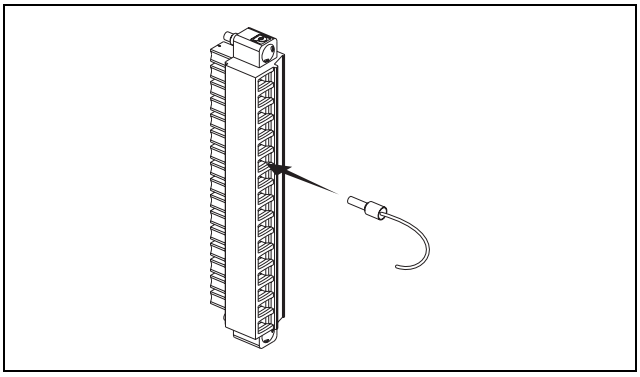


Figure 5. 16-Terminal Detachable Screw-Terminal Connector with Ferrule

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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.

All specifications given in °C are specific to 100 Ω platinum RTDs.

Input Characteristics

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

ADC resolution ..... 24 bits

Type of ADC ..... Delta-sigma

Sampling mode ..... Scanned

Measurement range

- Temperature ..... –200 to 850 °C
- Resistance ..... 0 to 400 Ω

Common-mode range

- COM-to-earth ground ..... ±250 V_{rms}
- Channel-to-COM ..... 50 mV

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Conversion time

High-resolution mode..... 200 ms per channel,
800 ms total for all channels

High-speed mode..... 2.5 ms per channel,
10 ms total for all channels

Temperature accuracy (including noise)[1], 4-wire mode

Measured Value	Typical (25 °C)	Maximum (–40 to 70 °C)
–200 to 150 °C	0.15 °C	0.35 °C
150 to 850 °C	0.20 °C	1.0 °C

Temperature accuracy (including noise)[1], 3-wire mode

Measured Value	Typical (25 °C)	Maximum (–40 to 70 °C)
–200 to 150 °C	0.20 °C	0.50 °C
150 to 850 °C	0.30 °C	1.0 °C

[1] For high-speed mode, add a 0.1 °C error.

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Noise
- High-resolution mode ..... 0.003 °C
- High-speed mode ..... 0.02 °C

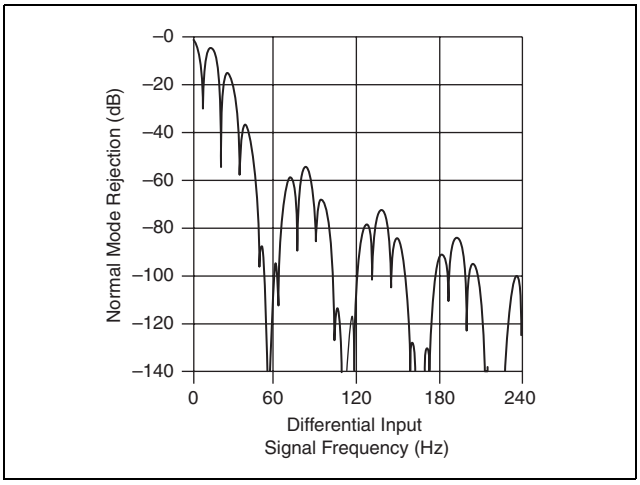
Excitation current ..... 1 mA per channel

Noise rejection
- Normal mode (50/60 Hz)
  - High-resolution mode ..... 85 dB min
  - High-speed mode ..... None
- Common-mode rejection, channel to earth ground (50/60 Hz)
  - High-resolution mode ..... 170 dB min
  - High-speed mode ..... 155 dB

Input bandwidth
(high-resolution mode) ..... 3.3 Hz

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High-resolution filter response[1,2]



[1] This image is provided courtesy of Linear Technology Corp.

[2] High-speed filter response has the same characteristics as the high-resolution filter response except that the first notch is at 14 kHz.

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Overvoltage protection ..... ±30 V between inputs

MTBF ..... 891,597 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.

Power Requirements

Power consumption from chassis

- Active mode ..... 350 mW max
- Sleep mode ..... 1 mW max

Thermal dissipation (at 70 °C)

- Active mode ..... 350 mW max
- Sleep mode ..... 1 mW max

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Physical Characteristics

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

Screw-terminal wiring ..... 16 to 28 AWG copper conductor wire with 7 mm (0.28 in.) of insulation stripped from the end

Torque for screw terminals ..... 0.22 to 0.25 N · m (1.95 to 2.21 lb · in.)

Ferrules ..... 0.25 mm^2 to 0.5 mm^2

Weight ..... 142 g (5.0 oz)

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Safety

Maximum Voltage[1]

Connect only voltages that are within the following limits.

All terminals-to-COM.....±30 V

Isolation Voltages

Channel-to-channel.....None

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.

[1] The maximum voltage that can be applied between any channel or V_{sup} terminal and a COM terminal without damaging the module or other devices.

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Caution Do *not* connect the NI 9217 to signals or use for measurements within Measurement Categories 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.

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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

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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 and either affix ferrules to the ends of the terminal wires or use the NI 9939 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

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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

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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.

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Calibration

You can obtain the calibration certificate and information about calibration services for the NI 9217 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.

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