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Find the *National Instruments NI 9210* at our website: ***Click HERE***

DATASHEET

NI 9210

4-Channel, 14 S/s Aggregate, ±80 mV C Series Temperature Input Module



- Mini-TC or spring terminal connectivity
- 50 Hz/60 Hz noise rejection
- 60 V DC, CAT I, channel-to-earth isolation (mini-TC); 250 V RMS, CAT II, channel-to-earth isolation(spring terminal)

Note In this document, the NI 9210 with mini-TC and the NI 9210 with spring terminal are referred to inclusively as the NI 9210.

The NI 9210 includes anti-aliasing filters, open-thermocouple detection, and cold-junction compensation for high-accuracy thermocouple measurements. The NI 9210 features NIST-traceable calibration and a channel-to-earth ground isolation barrier for safety, noise immunity, and high common-mode voltage range.

Kit Contents	• NI 9210 • NI 9210 Getting Started Guide
Accessories	• Thermocouple Connectors

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C Series Thermocouple Module Comparison

Product	Channels	Connectivity	Accuracy[1]	Max Sample Rate, Scanned[2]	Max Sample Rate, Simultaneous[3]	Max Sample Rate, All Filtered[4]	OTD[5]	Isolation[6]
NI 9210	4	Screw Terminal	0.8°C	14 S/s	–	2.3 Scans/s	Yes	Ch-Earth
		Mini-TC	0.84°C					
NI 9211	4	Screw Terminal	0.9°C	14 S/s	–	2.3 Scans/s	Yes	Ch-Earth
NI 9212	8	Screw Terminal	0.4°C	–	95 S/s/Ch	7.1 Scans/s	Yes	Ch-Ch
		Mini-TC	0.7°C					
NI 9213	16	Spring Terminal†	0.8°C	100 S/s	–	1.0 Scans/s	Yes	Ch-Earth
NI 9214	16	Screw Terminal	0.4°C	100 S/s	–	0.96 Scans/s	Select-able	Ch-Earth
NI 9219	4	Spring Terminal	1.6°C	–	50 S/s/Ch	7.1 Scans/s	No	Ch-Ch

[1] Typical at 23±5°C operating temperature, For J-type sensor measuring 100°C.
[2] This is the fastest rate of the module for a single channel. When scanning more than one channel, the sample rate is reduced, see data sheets for details.
[3] This is the fastest rate of the module; it can sample all channels simultaneously at this rate.
[4] This is the fastest rate of the module using all of its channels at the same time, with optimized rejection of standard power line frequencies. See data sheets for details about specific powerline frequencies.
[5] Open Thermocouple Detection.
[6] Ch-Ch isolation means that the channels are isolated from earth ground and from each other. Ch-Earth isolation means that the channels are isolated from earth ground but not from each other.
† These connectors feature tool-less wire entry, meaning that solid core wires (AWG 26 - AWG 16) can be inserted without using a tool.

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C Series Millivolt-Capable Module Comparison						
Product Name	Differential Channels	Connectivity	Accuracy[1]	Max Sample Rate, Scanned[2]	Max Sample Rate, Simultaneous[3]	Isolation[4]
NI 9210	4	Screw Terminal Mini-TC	20 uV + 0.1%	14 S/s	–	Ch-Earth
NI 9211	4	Screw Terminal	20 uV + 0.1%	14 S/s	–	Ch-Earth
NI 9212	8	Screw Terminal Mini-TC	14 uV + 0.12%	–	95 S/s/Ch	Ch-Ch
NI 9213	16	Spring Terminal†	6 uV + 0.15%	100 S/s	–	Ch-Earth
NI 9214	16	Screw Terminal	8 uV + 0.15%	100 S/s	–	Ch-Earth
NI 9219	4	Spring Terminal	90 uV + 0.18%	–	50 S/s/Ch	Ch-Ch
NI 9205	16	DSUB Spring Terminal	185 uV + 0.06%‡	250 kS/s	–	Ch-Earth
NI 9206	16	Spring Terminal	185 uV + 0.06%‡	250 kS/s	–	Ch-Earth
NI 9218	2	Lemo 1B DSUB	130 uV + 0.2%	–	51.2 kS/s/Ch	Ch-Ch
NI 9238	4	Screw Terminal	300 uV + 0.2%	–	50 kS/s/Ch	Ch-Ch

[1] Maximum over full operating temperature range of –40 to +70°C.
[2] This is the fastest rate of the module for a single channel. When scanning more than one channel, the sample rate is reduced, see data sheets for details.
[3] This is the fastest rate of the module; it can sample all channels simultaneously at this rate.
[4] Ch-Ch isolation means that the channels are isolated from earth ground and from each other. Ch-Earth isolation means that the channels are isolated from earth ground but not from each other.
† These connectors feature tool-less wire entry, meaning that solid core wires (AWG 26 - AWG 16) can be inserted without using a tool.
‡ Within ±5° of the last internal calibration.

NI C Series Overview



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NI provides more than 100 C Series modules for measurement, control, and communication applications. C Series modules can connect to any sensor or bus and allow for high-accuracy measurements that meet the demands of advanced data acquisition and control applications.

- Measurement-specific signal conditioning that connects to an array of sensors and signals
- Isolation options such as bank-to-bank, channel-to-channel, and channel-to-earth ground
- -40 °C to 70 °C temperature range to meet a variety of application and environmental needs
- Hot-swappable

The majority of C Series modules are supported in both CompactRIO and CompactDAQ platforms and you can move modules from one platform to the other with no modification.

CompactRIO



CompactRIO combines an open-embedded architecture with small size, extreme ruggedness, and C Series modules in a platform powered by the NI LabVIEW reconfigurable I/O (RIO) architecture. Each system contains an FPGA for custom timing, triggering, and processing with a wide array of available modular I/O to meet any embedded application requirement.

CompactDAQ

CompactDAQ is a portable, rugged data acquisition platform that integrates connectivity, data acquisition, and signal conditioning into modular I/O for directly interfacing to any sensor or signal. Using CompactDAQ with LabVIEW, you can easily customize how you acquire, analyze, visualize, and manage your measurement data.



Software

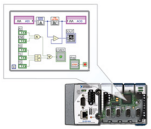
LabVIEW Professional Development System for Windows



- Use advanced software tools for large project development
- Generate code automatically using DAQ Assistant and Instrument I/O Assistant
- Use advanced measurement analysis and digital signal processing
- Take advantage of open connectivity with DLLs, ActiveX, and .NET objects
- Build DLLs, executables, and MSI installers

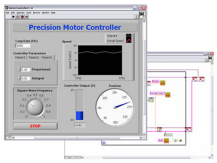
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NI LabVIEW FPGA Module



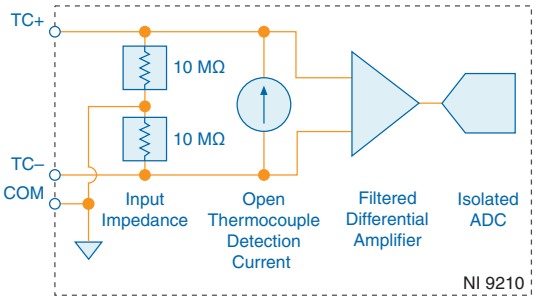
- Design FPGA applications for NI RIO hardware
- Program with the same graphical environment used for desktop and real-time applications
- Execute control algorithms with loop rates up to 300 MHz
- Implement custom timing and triggering logic, digital protocols, and DSP algorithms
- Incorporate existing HDL code and third-party IP including Xilinx IP generator functions
- Purchase as part of the LabVIEW Embedded Control and Monitoring Suite

NI LabVIEW Real-Time Module



- Design deterministic real-time applications with LabVIEW graphical programming
- Download to dedicated NI or third-party hardware for reliable execution and a wide selection of I/O
- Take advantage of built-in PID control, signal processing, and analysis functions
- Automatically take advantage of multicore CPUs or set processor affinity manually
- Take advantage of real-time OS, development and debugging support, and board support
- Purchase individually or as part of a LabVIEW suite

Circuitry



The channels of the NI 9210 share a common ground isolated from other modules in the system. Each channel passes through a filter and then a 24-bit analog-to-digital converter (ADC) samples the channel.

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Open Thermocouple Detection

Each channel has an open thermocouple detection (OTD) circuit, which consists of a current source between the TC+ and TC- terminals. If an open thermocouple is connected to the channel, the current source forces a full-scale voltage across the terminals.

Input Impedance

Each channel has a resistor that produces an input impedance between the TC and COM terminals. The gain and offset errors resulting from the source impedance of connected thermocouples are negligible for most applications. Thermocouples with a higher lead resistance can introduce more significant errors.

Thermocouple Measurement Accuracy

Thermocouple measurement errors depend partly on the following factors:

- Type of thermocouple
- Accuracy of the thermocouple
- Temperature that you are measuring
- Resistance of the thermocouple wires
- Cold-junction temperature

For the best accuracy performance, set up the NI 9210 according to the getting started guide on *ni.com/manuals* to minimize thermal gradients across the NI 9210 terminals.

Cold-Junction Accuracy

Heat dissipated by adjacent C Series modules or nearby heat sources can cause errors in thermocouple measurements by heating the NI 9210 terminals to a different temperature than the cold-junction compensation sensor. Thermal gradient across the terminals can cause the terminals of different NI 9210 channels to be at different temperatures, which creates accuracy errors and affects the relative accuracy between channels.

The temperature measurement accuracy specifications include errors caused by the thermal gradient across the NI 9210 terminals for configurations with the NI 9210 terminals facing forward or upward.

Autozero Channel

The NI 9210 has an internal autozero channel, which can be subtracted from each thermocouple reading to compensate for offset errors. Use the autozero channel if the ambient temperature is less than 15 °C or more than 35 °C. Refer to the documentation for the software that you are using for information about using the NI 9210 autozero channel.

NI 9210 Specifications

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

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Caution Do not operate the NI 9210 in a manner not specified in this document. Product misuse can result in a hazard. You can compromise the safety protection built into the product if the product is damaged in any way. If the product is damaged, return it to NI for repair.

Input Characteristics

Number of channels	4 thermocouple channels, 1 internal autozero channel, 1 internal cold-junction compensation channel
ADC resolution	24 bits
Type of ADC	Delta-Sigma
Sampling mode	Scanned
Voltage measurement range	±80 mV
Temperature measurement ranges	Works over temperature ranges defined by NIST (J, K, T, E, N, B, R, S thermocouple types)
Conversion time	70 ms per channel; 420 ms total for all channels including the autozero and cold-junction channels
Common-mode voltage range	
Channel-to-COM	±1.5 V
COM-to-earth ground	
NI 9210 with mini-TC	60 V RMS
NI 9210 with spring terminal	250 V RMS
Common-mode rejection ratio (0 Hz to 60 Hz)	
Channel-to-COM	95 dB
COM-to-earth ground	>170 dB
Input bandwidth (-3 dB)	15 Hz
Noise rejection (at 50 Hz and 60 Hz)	85 dB minimum
Overvoltage protection	
Between any input and COM	±30 V
Between any two inputs	±30 V
Differential input impedance	20 MΩ
Input current	50 nA
Input noise	1 µV RMS

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Gain error (at -40 °C to 70 °C)	0.06% typical 0.1% maximum
Offset error (with autozero channel on)	±15 µV typical ±20 µV maximum
Gain error from source impedance	Add 0.05 ppm per Ω when source impedance >50 Ω
Offset error from source impedance	Add ±0.05 µV typical, ±0.07 µV maximum per Ω when source impedance >50 Ω
Cold-junction compensation sensor accuracy	
NI 9210 with mini-TC	
23 °C, ±5 °C	0.35 °C typical
-40 °C to 70 °C	0.55 °C typical 0.95 °C maximum
NI 9210 with spring terminal	
23 °C ± 5 °C	0.55 °C typical
-40 °C to 70 °C	0.75 °C typical 1.5 °C maximum

Temperature Measurement Accuracy

Caution The input terminals of this device are not protected from electromagnetic interference. As a result, this device may experience reduced measurement accuracy or other temporary performance degradation when connected cables are routed in an environment with radiated or conducted radio frequency electromagnetic interference. To limit radiated emissions and to ensure that this device functions within specifications in its operational electromagnetic environment, take precautions when designing, selecting, and installing measurement probes and cables.

Measurement sensitivity[1]	
With autozero channel on	
Types J, K, T, E, N	<0.07 °C
Type B	<0.25 °C
Types R, S	<0.60 °C

[1] Measurement sensitivity represents the smallest change in temperature that a sensor can detect. It is a function of noise. The values assume the full measurement range of the standard thermocouple sensor according to ASTM E230-87.

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With autozero channel off	
Types J, K, T, E, N	<0.05 °C
Type B	<0.20 °C
Types R, S	<0.45 °C

The following figures show the typical and maximum errors for each thermocouple type when used with the NI 9210 over the full temperature range and autozero on as well as the typical errors at 23 °C, ±5 °C without autozero. The figures account for gain errors, offset errors, differential and integral nonlinearity, quantization errors, noise errors, and isothermal errors. The figures do not account for the accuracy of the thermocouple itself.

Figure 1. NI 9210 with Mini-TC Thermocouple Type J and N Errors

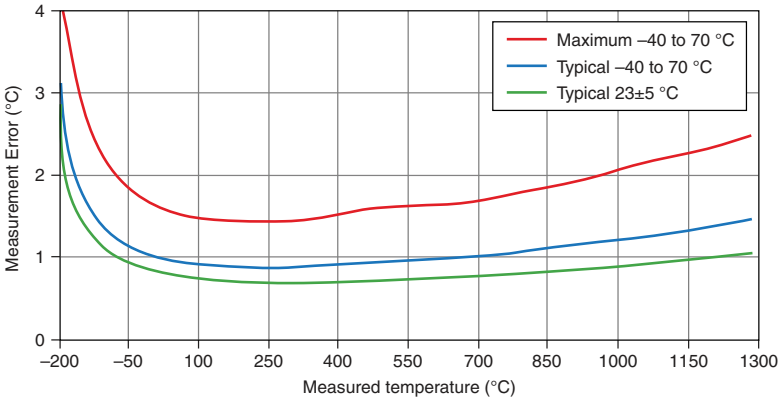
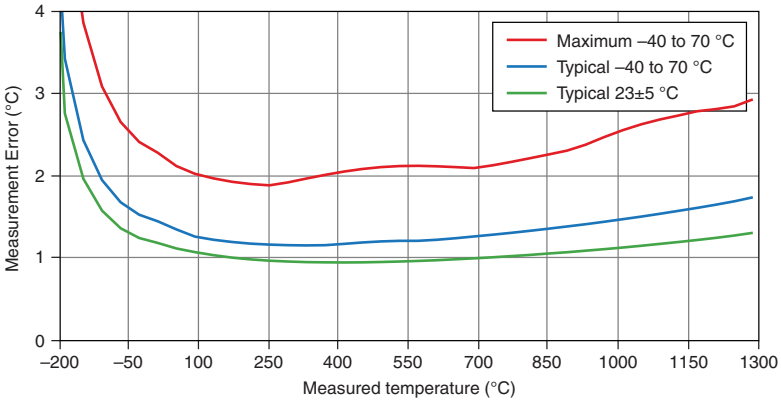


Figure 2. NI 9210 with Spring Terminal Thermocouple Type J and N Errors



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Figure 3. NI 9210 with Mini-TC Thermocouple Type K Errors

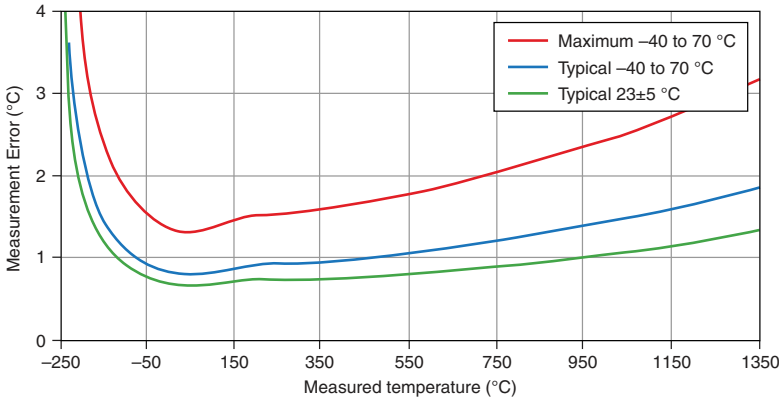
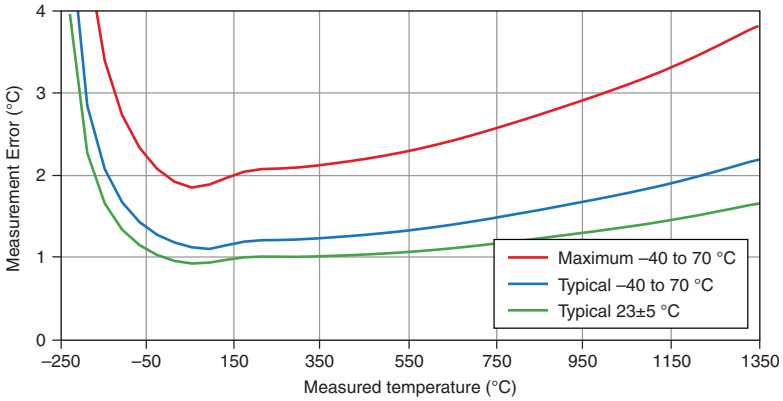


Figure 4. NI 9210 with Spring Terminal Thermocouple Type K Errors



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Figure 5. NI 9210 with Mini-TC Thermocouple Type T and E Errors

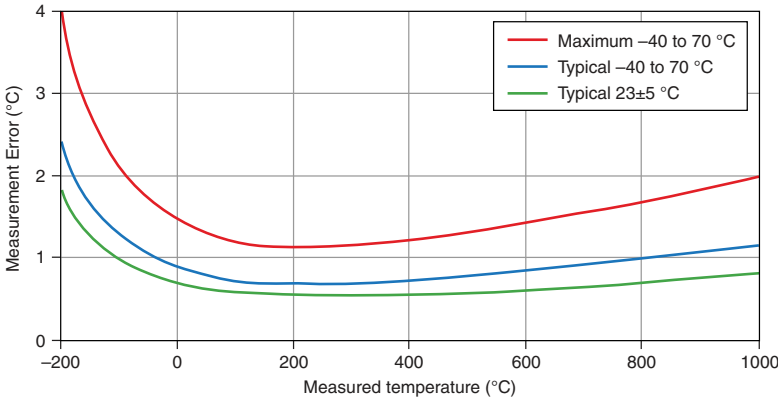
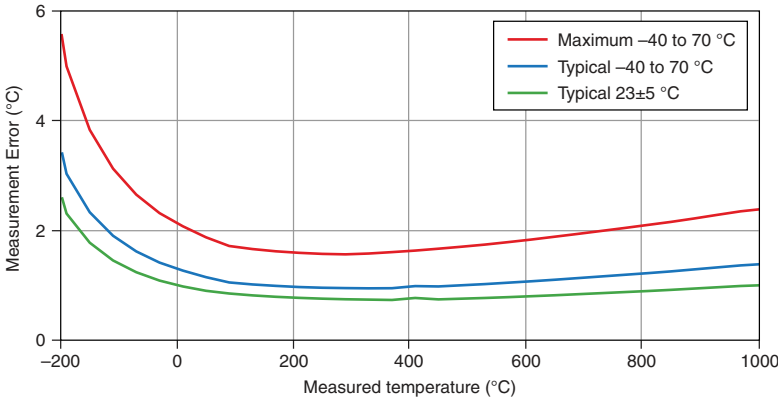


Figure 6. NI 9210 with Spring Terminal Thermocouple Type T and E Errors



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Figure 7. NI 9210 with Mini-TC Thermocouple Type B Errors

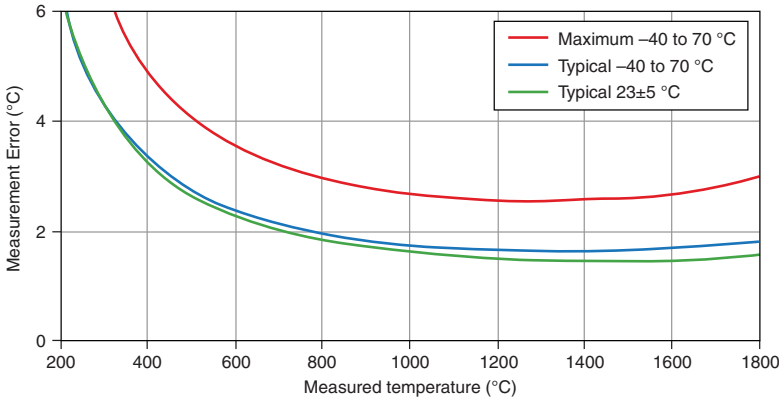
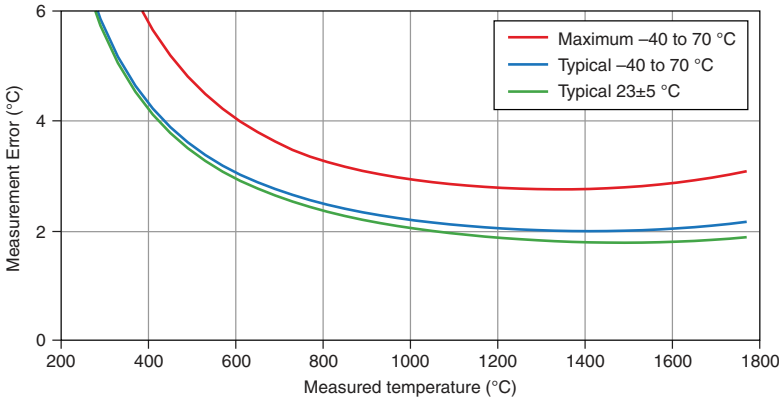


Figure 8. NI 9210 with Spring Terminal Thermocouple Type B Errors



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Figure 9. NI 9210 with Mini-TC Thermocouple Type R and S Errors

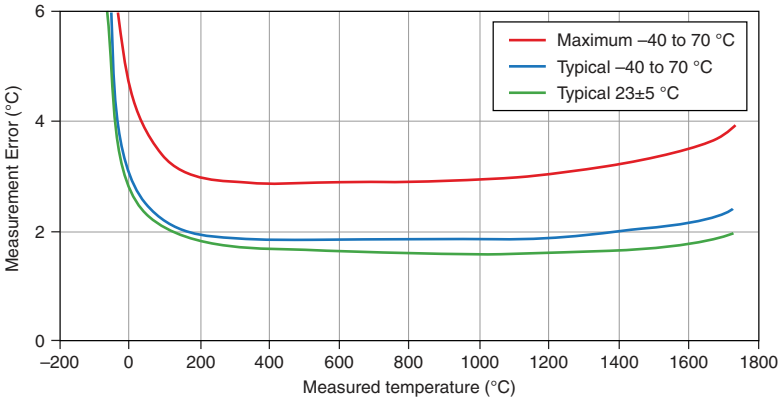
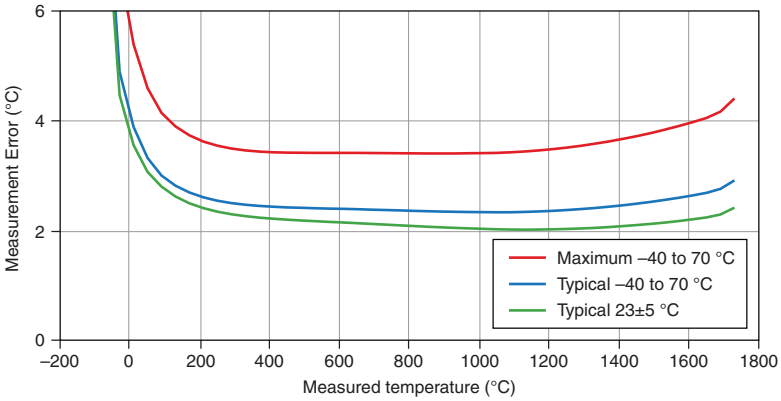


Figure 10. NI 9210 with Spring Terminal Thermocouple Type R and S Errors



Power Requirements

Power consumption from chassis	
Active mode	200 mW maximum
Sleep mode	10 mW maximum
Thermal dissipation (at 70 °C)	
Active mode	200 mW maximum
Sleep mode	10 mW maximum

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NI 9210 with Mini-TC Safety Voltages

Connect only voltages that are within the following limits:

Isolation	
Channel-to-channel	None
Channel-to-earth ground	
Continuous	60 V DC, Measurement Category I
Withstand	1,000 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 9210 with mini-TC to signals or use for measurements within Measurement Categories II, III, or IV.

Note Measurement Categories CAT I and CAT O are equivalent. These test and measurement circuits are for other circuits not intended for direct connection to the MAINS building installations of Measurement Categories CAT II, CAT III, or CAT IV.

NI 9210 with Spring Terminal Safety Voltages

Connect only voltages that are within the following limits:

Isolation	
Channel-to-channel	None
Channel-to-earth ground	
Continuous	250 V RMS, Measurement Category II
Withstand	3,000 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 9210 with spring terminal to signals or use for measurements within Measurement Categories III or IV.

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Physical Characteristics

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



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

NI 9210 with mini-TC

Input connection	
Miniature Thermocouple Jack	
Type	Universal
COM connection	
Spring terminal wiring	
Gauge	0.14 mm^2 to 1.5 mm^2 (26 AWG to 16 AWG) copper conductor wire
Wire strip length	10 mm (0.394 in.) of insulation stripped from the end
Temperature rating	90 °C, minimum
Wires per spring terminal	Two wires per spring terminal using a 2-wire ferrule
Connector securement	
Securement type	Screw flanges provided
Torque for screw flanges	0.2 N · m to 0.25 N · m (1.77 lb · in. to 2.21 lb · in.)
Weight	153 g (5.40 oz)

NI 9210 with spring terminal

Spring terminal wiring	
Gauge	0.2 mm^2 to 1.5 mm^2 (24 AWG to 16 AWG) thermocouple wire
Wire strip length	8 mm of insulation stripped from the end
Temperature rating	90 °C, minimum
Wires per spring terminal	One wire per spring terminal
Ferrules	
Single ferrule, uninsulated	0.2 mm^2 to 1 mm^2 (26 AWG to 18 AWG)
Single ferrule, insulated	0.2 mm^2 to 0.75 mm^2 (26 AWG to 18 AWG)

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Connector securement	
Securement type	Screw flanges provided
Torque for screw flanges	0.2 N · m (1.80 lb · in.)
Weight	162 g (5.71 oz)

Hazardous Locations

U.S. (UL)	Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, AEx nA IIC T4 Gc
Canada (C-UL)	Class I, Division 2, Groups A, B, C, D, T4; Ex nA IIC T4 Gc
Europe (ATEX) and International (IECEx)	Ex nA IIC T4 Gc

Safety and Hazardous Locations Standards

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

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA C22.2 No. 61010-1
- EN 60079-0:2012, EN 60079-15:2010
- IEC 60079-0: Ed 6, IEC 60079-15; Ed 4
- UL 60079-0; Ed 6, UL 60079-15; Ed 4
- CSA C22.2 No. 60079-0, CSA C22.2 No. 60079-15

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 61326-1 (IEC 61326-1): Class A emissions; Industrial immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- EN 55022 (CISPR 22): Class A emissions
- EN 55024 (CISPR 24): Immunity
- AS/NZS CISPR 11: Group 1, Class A emissions
- AS/NZS CISPR 22: Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

Note In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe,

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Canada, Australia and New Zealand (per CISPR 11) Class A equipment is intended for use only in heavy-industrial locations.

Note Group 1 equipment (per CISPR 11) is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for the treatment of material or inspection/analysis purposes.

Note For EMC declarations and certifications, and additional information, refer to the *Online Product Certification* section.

CE Compliance CE

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

- 2014/35/EU; Low-Voltage Directive (safety)
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)
- 2014/34/EU; Potentially Explosive Atmospheres (ATEX)

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

Shock and Vibration

To meet these specifications, you must panel mount the system.

Operating vibration	
Random (IEC 60068-2-64)	5 g_{rms}, 10 Hz to 500 Hz
Sinusoidal (IEC 60068-2-6)	5 g, 10 Hz 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

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 °C to 70 °C
Storage temperature (IEC 60068-2-1, IEC 60068-2-2)	-40 °C to 85 °C
Ingress protection (with COM plug mated)	IP40
Operating humidity (IEC 60068-2-78)	10% RH to 90% RH, noncondensing

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Storage humidity (IEC 60068-2-78)	5% RH to 95% RH, noncondensing
Pollution Degree	2
Maximum altitude	5,000 m

Indoor use only.

Environmental Management

NI 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 *Minimize Our Environmental Impact* 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 the product life cycle, all NI products must be disposed of according to local laws and regulations. For more information about how to recycle NI products in your region, visit *ni.com/environment/weee*.

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 9210 at *ni.com/calibration*.

Calibration interval	1 year

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