OPERATING INSTRUCTIONS AND SPECIFICATIONS

NI 9222/9223

4-Channel, ±10 V, 16-Bit Simultaneous, Channel-to-Channel Isolated Analog Input Modules

Français Deutsch 日本語 한국어 简体中文

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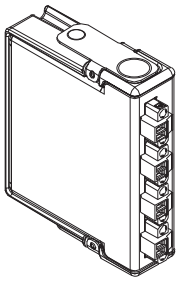

NATIONAL INSTRUMENTS

This document describes how to use the National Instruments 9222 and National Instruments 9223 and includes specifications and terminal assignments for the NI 9222 and NI 9223. In this document, the NI 9222 and NI 9223 are referred to inclusively as the NI 9222/9223.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. Visit `ni.com/info` and enter `compatibility` for information about chassis and carrier compatibility for the modules you are using.

Note The safety guidelines and specifications in this document are specific to the NI 9222/9223. 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 9222/9223 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 NI 9222/9223 is suitable for use in Class I, Division 2, Groups A, B, C, D, T4 hazardous locations; Class I, Zone 2, AEx nA IIC T4, and Ex nA IIC T4 hazardous locations; and nonhazardous locations only. Follow these guidelines if you are installing the NI 9222/9223 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.

Special Conditions for Hazardous Locations Use in Europe

This equipment has been evaluated as Ex nA IIC T4 equipment under DEMKO Certificate No. 07 ATEX 0626664X. Each module is marked Ⓔx II 3G and is suitable for use in Zone 2 hazardous locations, in ambient temperatures of –40 °C ≤ Ta ≤ 70 °C. If you are using the NI 9222/9223 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.

Electromagnetic Compatibility Guidelines

This product was tested and complies with the regulatory requirements and limits for electromagnetic compatibility (EMC) as stated in the product specifications. These requirements and limits are designed to provide reasonable protection against harmful interference when the product is operated in its intended operational electromagnetic environment. There is no guarantee that interference will not occur in a particular installation. To minimize the potential for the product to cause interference to radio and television reception or to experience unacceptable performance degradation, install and use this product in strict accordance with the instructions in the product documentation.

The following statements contain important information needed before installing and using this product:

Caution This product is intended for use in industrial locations. As a result, this product may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.

Caution Emissions that exceed the regulatory requirements may occur when this product is connected to a test object.

Caution Changes or modifications not expressly approved by National Instruments could void the user's authority to operate the hardware under the local regulatory rules.

Special Guidelines for Marine Applications

Some products are Lloyd's Register (LR) Type Approved for marine (shipboard) applications. To verify Lloyd's Register certification for a product, visit `ni.com/certification` and search for the LR certificate, or look for the Lloyd's Register mark on the product label.

Caution In order to meet the EMC requirements for marine applications, install the product in a shielded enclosure with shielded and/or filtered power and input/output ports. In addition, take precautions when designing, selecting, and installing measurement probes and cables to ensure that the desired EMC performance is attained.

Connecting the NI 9222/9223

The NI 9222/9223 provides connections for four simultaneously sampled, isolated analog input channels.

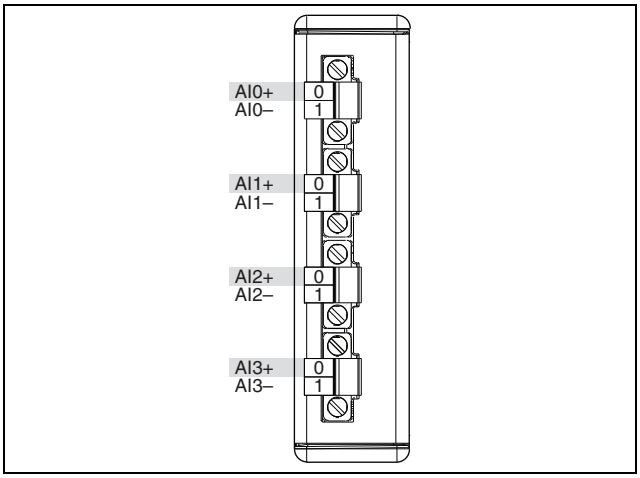

Figure 1. NI 9222/9223 Terminal Assignments

Caution Electrostatic Discharge (ESD) can damage this product. To prevent damage, use industry-standard ESD prevention measures during installation, maintenance, and operation.

The NI 9222/9223 has four 2-terminal detachable screw-terminal connectors.

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 9222/9223.

You can connect ground-referenced or floating signal sources to the NI 9222/9223. Connect the positive signal of the signal source to the AI+ terminal, and connect the negative signal of the signal source to the AI– terminal. If you make a ground-referenced connection between the signal source and the NI 9222/9223, make sure the voltage on the AI+ and AI– connections are in the channel-to-earth safety voltage range to ensure proper operation of the NI 9222/9223. Refer to the *Specifications* section for more information about operating voltages and overvoltage protection. Refer to Figures 2 and 3 for illustrations of how to connect grounded and floating signal sources to the NI 9222/9223.

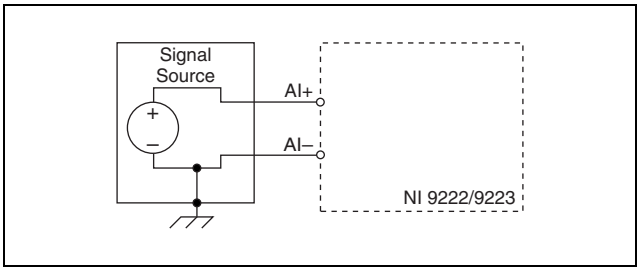

Figure 2. Connecting a Grounded Signal Source to the NI 9222/9223

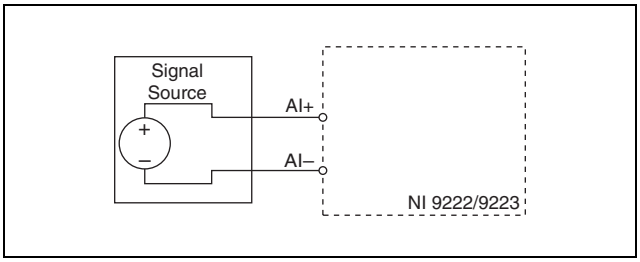

Figure 3. Connecting a Floating Signal Source to the NI 9222/9223

The NI 9222/9223 analog input channels are floating with respect to earth ground and each other. The incoming analog signal on each channel is buffered, conditioned, and then sampled by a 16-bit successive approximation register ADC.

Each channel provides an independent signal path and ADC, enabling you to sample all four channels simultaneously. Refer to Figure 4 for an illustration of the circuitry for one channel.

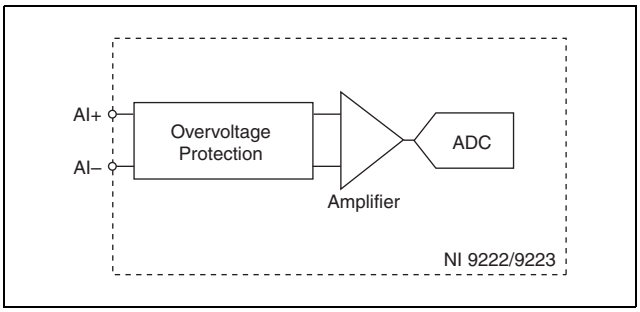

Figure 4. Input Circuitry for One Channel of the NI 9222/9223

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 9971 backshell kit to protect the connections. Refer to Figure 5 for an illustration of wiring a terminal using ferrules.

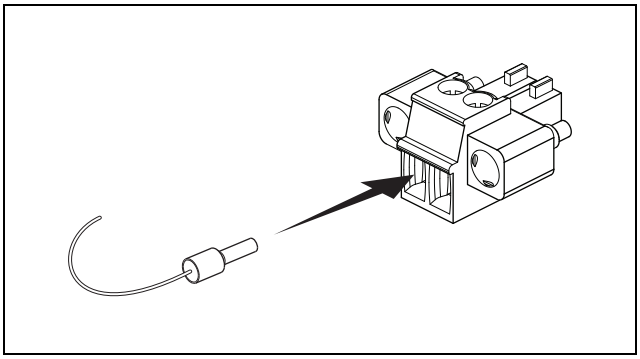

Figure 5. 2-Terminal Detachable Screw-Terminal Connector with Ferrule

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. All voltages are relative to the AI– signal on each channel unless otherwise noted. The specifications are the same for the NI 9222 and the NI 9223 unless otherwise noted.

Input Characteristics

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

ADC resolution ..... 16 bits

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

Input voltage ranges[1]

Measurement Voltage, AI+ to AI–		
Minimum*	**Typical**	**Maximum**
±10.5 V	±10.6 V	±10.7 V
* The *minimum measurement voltage range* is the largest voltage the NI 9222/9223 is guaranteed to accurately measure.		

Overvoltage protection ..... ±30 V

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

Maximum Sampling Rate

Module	CompactDAQ	RIO	
	NI-DAQmx	FPGA User-Controlled I/O Sampling*	FPGA I/O Nodes
NI 9222	500 kS/s	500 kS/s	300 kS/s
NI 9223	1 MS/s	1 MS/s	350 kS/s

* FPGA User-Controlled I/O Sampling provides low level access to sample acquisition and transfer, and higher sample rates. Visit `ni.com/info` and enter `samplerate` for information about FPGA User-Controlled I/O Sampling for the NI 9222/9223.

Accuracy

Measurement Conditions	Percent of Reading (Gain Error)	Percentage of Range* (Offset Error)
Calibrated, max (–40 to 70 °C)	±0.20%	±0.10%
Calibrated, typ (23 °C, ±5 °C)	±0.02%	±0.01%
Uncalibrated, max (–40 to 70 °C)	±0.40%	±0.40%
Uncalibrated, typ (23 °C, ±5 °C)	±0.20%	±0.10%
* Range equals 10.6 V		

Stability

Gain drift ..... 6 ppm/°C

Offset drift ..... 29 µV/°C

CMRR (f_{in} = 60 Hz) ..... 100 dB

–3 dB bandwidth

NI 9222..... >500 kHz

NI 9223..... >1 MHz

Input impedance..... >1 GΩ

Noise ..... 0.75 LSB_{rms}

Total Harmonic Distortion (THD)
(20 V_{pp} at 10 kHz) ..... –85 dB

Crosstalk (20 V_{pp} at 1 kHz) ..... –100 dB

MTBF ..... Contact NI for Bellcore MTBF or MIL-HDBK-217F specifications.

Power Requirements

Power consumption from chassis

- Active mode ..... 1 W max
- Sleep mode ..... 5 mW max

Thermal dissipation (at 70 °C)

- Active mode ..... 1.3 W max
- Sleep mode ..... 430 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.

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 ..... 138 g (4.9 oz)

Safety

Safety Voltages

Connect only voltages that are within the following limits.

Isolation

- Channel-to-channel
  - Continuous ..... 60 VDC, Measurement Category I
  - Withstand ..... 1000 V_{rms}, verified by a 5 s dielectric withstand test
- Channel-to-earth ground
  - Continuous ..... 60 VDC, Measurement Category I
  - Withstand ..... 1000 V_{rms}, verified by a 5 s dielectric withstand test

Division 2 and Zone 2 hazardous locations applications

- (Channel-to-channel and channel-to-earth ground) ..... 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.

Caution Do *not* connect the NI 9222/9223 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 nA IIC T4
Canada (C-UL)	Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, Ex nA IIC T4
Europe (DEMKO)	Ex nA IIC T4

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 61326-1 (IEC 61326-1): 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

Caution When operating this product, use shielded cables and accessories.

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

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

To obtain product certifications and the Declaration of Conformity (DoC) for this product, visit `ni.com/certification`, search by module 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 and either affix ferrules to the ends of the terminal wires or use the NI 9971 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

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

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 *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 the product life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste and Electronic Equipment, 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 9222/9223 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 41309277, 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 22 328 90 10,
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,
Sweden 46 (0) 8 587 895 00, Switzerland 41 56 2005151,
Taiwan 886 02 2377 2222, Thailand 662 278 6777,
Turkey 90 212 279 3031, United Kingdom 44 (0) 1635 523545

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