NI NI 9215 / cRIO-9215

Analog Input Module (Screw Terminal)

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4 Ch, 100 kS/s, 16-Bit, ±10 V Simultaneous Sampling C Series Analog Input Module

NI 9215

- 4 simultaneously sampled analog inputs, 100 kS/s
- -40 to 70 °C operating range
- NIST-traceable calibration
- Hot-swappable operation

Overview

The NI 9215 module for use with NI CompactDAQ and CompactRIO chassis includes four simultaneously sampled analog input channels and successive approximation register (SAR) 16-bit analog-to-digital converters (ADCs). The NI 9215 contains NIST-traceable calibration, a channel-to-earth ground double-isolation barrier for safety and noise immunity, and high common-mode voltage range.

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Requirements and Compatibility

OS Information

- Real-Time OS
- Windows

Driver Information

- NI-DAQmx
- NI-RIO

Software Compatibility

- LabVIEW
- LabVIEW SignalExpress
- LabWindows/CVI
- Measurement Studio
- Visual C++
- Visual Studio
- Visual Studio .NET

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Comparison Tables

Module	Signal Type	Channels	Sample Rate	Resolution (bits)
9201	Voltage	8	500 kS/s	12
9203	Current	8	200 kS/s	16
9205	Voltage	32 SE/16 DI	250 kS/s	16
9206	CAT I isolated voltage	16 DI	250 kS/s	16
9215	Voltage	4	100 kS/s per channel	16
9217	RTD	4	400 S/s	24

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Module	Signal Type	Channels	Sample Rate	Resolution (bits)
9221	Voltage	8	800 kS/s	12
9227	Current	4	50 kS/s per channel	24
9233	IEPE	4	50 kS/s per channel	24
9235/9236	Quarter-bridge	8	10 kS/s per channel	24
9237	Bridge	4	50 kS/s per channel	24

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Application and Technology

High-accuracy NI C Series analog input modules for NI CompactDAQ and CompactRIO provide high-performance measurements for a wide variety of industrial, in-vehicle, and laboratory sensors and signal types. Each module includes built-in signal conditioning and an integrated connector with screw terminal or cable options for flexible and low-cost signal wiring. All modules feature CompactRIO Extreme Industrial Certifications and Ratings.

C Series Compatibility

The C Series hardware family features more than 50 measurement modules and several chassis and carriers for deployment. With this variety of modules, you can mix and match measurements such as temperature, acceleration, flow, pressure, strain, acoustic, voltage, current, digital, and more to create a custom system. Install the modules in one of several carriers to create a single module USB, Ethernet, or Wi-Fi system, or combine them in chassis such as NI CompactDAQ and CompactRIO to create a mixed-measurement system with synchronized measurements. You can install up to eight modules in a simple, complete NI CompactDAQ USB data acquisition system to synchronize all of the analog output, analog input, and digital I/O from the modules. For a system without a PC, CompactRIO holds up to eight modules and features a built-in processor, RAM, and storage for an embedded data logger or control unit. For higher-speed control, CompactRIO chassis incorporate a field-programmable gate array (FPGA) that you can program with NI LabVIEW software to achieve silicon-speed processing on I/O data from C Series modules.

Advanced Features

When used with CompactRIO, C Series analog input modules connect directly to reconfigurable I/O (RIO) FPGA hardware to create high-performance embedded systems. The reconfigurable FPGA hardware within CompactRIO provides a variety of options for custom timing, triggering, synchronization, filtering, signal processing, and high-speed decision making for all C Series analog modules. For instance, with CompactRIO, you can implement custom triggering for any analog sensor type on a per-channel basis using the flexibility and performance of the FPGA and the numerous arithmetic and comparison function blocks built into the LabVIEW FPGA Module.

Key Features

- High-accuracy, high-performance analog measurements for any CompactRIO embedded system, R Series expansion chassis, or NI CompactDAQ chassis
- Screw terminals, BNC, D-Sub, spring terminals, strain relief, high voltage, cable, solder cup backshell, and other connectivity options
- Available channel-to-earth ground double-isolation barrier for safety, noise immunity, and high common-mode voltage range
- CompactRIO Extreme Industrial Certifications and Ratings
- Built-in signal conditioning for direct connection to sensors and industrial devices

Visit ni.com/compactrio or ni.com/compactdaq for up-to-date information on module availability, example programs, application notes, and other developer tools.

Connectivity Accessories

NI CompactDAQ and CompactRIO systems are designed to provide flexible options for low-cost field wiring and cabling. Most C Series modules have a unique connector block option that offers secure connections to your C Series system. Table 2 contains all of the connector blocks for C Series I/O modules.

Accessory	Description
NI 9932	10-position strain relief and high-voltage screw-terminal connector kit
NI 9933	37-pin D-Sub connector kit with strain relief and D-Sub shell
NI 9934	25-pin D-Sub connector kit with strain relief and D-Sub shell
NI 9935	15-pin D-Sub connector kit with strain relief and D-Sub shell
NI 9936	10-position screw-terminal plugs (quantity 10)
NI 9939	16-position connector kit with strain relief

Note: To meet shock and vibration requirements, you must affix ferrules to the ends of the wires on all screw-terminal connectors.

Table 2. Connector Blocks for C Series I/O Modules

Table 3 lists the recommended connector block accessories for each C Series analog input module.

C Series Analog Input Module	Recommended Module Accessory
NI 9201	NI 9932, NI 9936
NI 9201 with D-Sub	NI 9934[1]
NI 9211	NI 9932, NI 9936
NI 9215	NI 9932, NI 9936
NI 9217	NI 9939
NI 9221	NI 9932, NI 9936
NI 9221 with D-Sub	NI 9934[1]

[1]Requires a 25-pin D-Sub connector such as the NI 9934 accessory kit.

Table 3. Recommended Connector Block Accessories

The NI 9932 kit provides strain relief and operator protection from high-voltage signals for any 10-position screw-terminal module.

Figure 1. NI 9932 10-Position Strain Relief and High-Voltage Screw-Terminal Connector Kit

The NI 9933 includes a screw-terminal connector with strain relief as well as a D-Sub solder cup backshell for creating custom cable assemblies for any module with a 37-pin D-Sub connector.

Figure 2. NI 9933 37-Pin D-Sub Connector Kit with Strain Relief and D-Sub Shell

The NI 9934 includes a screw-terminal connector with strain relief as well as a D-Sub solder cup backshell for creating custom cable assemblies for any module with a 25-pin D-Sub connector.

Figure 3. NI 9934 25-Pin D-Sub Connector Kit with Strain Relief and D-Sub Shell

The NI 9935 includes a screw-terminal connector with strain relief as well as a D-Sub solder cup backshell for creating custom cable assemblies for any module with a 15-pin D-Sub connector.

Figure 4. NI 9935 15-Pin D-Sub Connector Kit with Strain Relief and D-Sub Shell

The NI 9936 consists of 10-position screw-terminal plugs for any 10-position screw-terminal module.

Figure 5. NI 9936 10-Position Screw-Terminal Plugs

Visit ni.com/compactrio or ni.com/compactdaq for up-to-date information on accessories.

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Ordering Information

For a complete list of accessories, visit the product page on ni.com.

Products	Part Number	Recommended Accessories	Part Number
NI 9215 Voltage Input Module			
NI 9215 with Screw Terminals	779011-01	No accessories required.	

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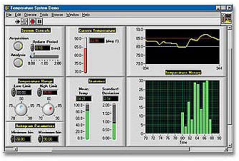
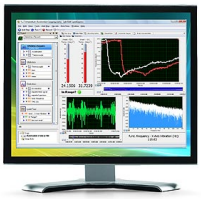
Software Recommendations

LabVIEW Professional Development System for Windows



- Advanced software tools for large project development
- Automatic code generation using DAQ Assistant and Instrument I/O Assistant
- Tight integration with a wide range of hardware
- Advanced measurement analysis and digital signal processing
- Open connectivity with DLLs, ActiveX, and .NET objects
- Capability to build DLLs, executables, and MSI installers

NI LabVIEW SignalExpress for Windows

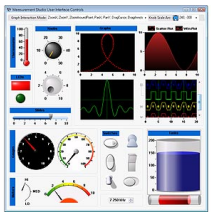


- Quickly configure projects without programming
- Control over 400 PC-based and stand-alone instruments
- Log data from more than 250 data acquisition devices
- Perform basic signal processing, analysis, and file I/O
- Scale your application with automatic LabVIEW code generation
- Create custom reports or easily export data to LabVIEW, DIAdem or Microsoft Excel

NI LabWindows™/CVI for Windows

- Real-time advanced 2D graphs and charts
- Complete hardware compatibility with IVI, VISA, DAQ, GPIB, and serial
- Analysis tools for array manipulation, signal processing statistics, and curve fitting
- Simplified cross-platform communication with network variables
- Measurement Studio .NET tools (included in LabWindows/CVI Full only)
- The mark LabWindows is used under a license from Microsoft Corporation.

NI Measurement Studio Professional Edition



- Support for Microsoft Visual Studio .NET 2010/2008/2005
- Customizable Windows Forms and Web Forms controls for test and measurement user interface design
- Hardware integration support with data acquisition and instrument control libraries
- Automatic code generation with data acquisition, instrument control, and parameter assistants
- Cross-platform communication with network variables
- Analysis libraries for array operations, signal

generation, windowing, filters, signal processing

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Support and Services

System Assurance Programs

NI system assurance programs are designed to make it even easier for you to own an NI system. These programs include configuration and deployment services for your NI PXI, CompactRIO, or Compact FieldPoint system. The NI Basic System Assurance Program provides a simple integration test and ensures that your system is delivered completely assembled in one box. When you configure your system with the NI Standard System Assurance Program, you can select from available NI system driver sets and application development environments to create customized, reorderable software configurations. Your system arrives fully assembled and tested in one box with your software preinstalled. When you order your system with the standard program, you also receive system-specific documentation including a bill of materials, an integration test report, a recommended maintenance plan, and frequently asked question documents. Finally, the standard program reduces the total cost of owning an NI system by providing three years of warranty coverage and calibration service. Use the online product advisors at ni.com/advisor to find a system assurance program to meet your needs.

Calibration

NI measurement hardware is calibrated to ensure measurement accuracy and verify that the device meets its published specifications. NI offers a number of calibration services to help maintain the ongoing accuracy of your measurement hardware. These services allow you to be completely confident in your measurements, and help you maintain compliance to standards like ISO 9001, ANSI/NCSL Z540-1 and ISO/IEC 17025. To learn more about NI calibration services or to locate a qualified service center near you, contact your local sales office or visit ni.com/calibration.

Technical Support

Get answers to your technical questions using the following National Instruments resources.

- **Support** - Visit ni.com/support to access the NI KnowledgeBase, example programs, and tutorials or to contact our applications engineers who are located in NI sales offices around the world and speak the local language.
- **Discussion Forums** - Visit forums.ni.com for a diverse set of discussion boards on topics you care about.
- **Online Community** - Visit community.ni.com to find, contribute, or collaborate on customer-contributed technical content with users like you.

Repair

While you may never need your hardware repaired, NI understands that unexpected events may lead to necessary repairs. NI offers repair services performed by highly trained technicians who quickly return your device with the guarantee that it will perform to factory specifications. For more information, visit ni.com/repair.

Training and Certifications

The NI training and certification program delivers the fastest, most certain route to increased proficiency and productivity using NI software and hardware. Training builds the skills to more efficiently develop robust, maintainable applications, while certification validates your knowledge and ability.

- **Classroom training in cities worldwide** - the most comprehensive hands-on training taught by engineers.
- **On-site training at your facility** - an excellent option to train multiple employees at the same time.
- **Online instructor-led training** - lower-cost, remote training if classroom or on-site courses are not possible.
- **Course kits** - lowest-cost, self-paced training that you can use as reference guides.
- **Training memberships** and training credits - to buy now and schedule training later.

Visit ni.com/training for more information.

Extended Warranty

NI offers options for extending the standard product warranty to meet the life-cycle requirements of your project. In addition, because NI understands that your requirements may change, the extended warranty is flexible in length and easily renewed. For more information, visit ni.com/warranty.

OEM

NI offers design-in consulting and product integration assistance if you need NI products for OEM applications. For information about special pricing and services for OEM customers, visit ni.com/oem.

Alliance

Our Professional Services Team is comprised of NI applications engineers, NI Consulting Services, and a worldwide National Instruments Alliance Partner program of more than 600 independent consultants and integrators. Services range from start-up assistance to turnkey system integration. Visit ni.com/alliance.

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Detailed 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 ranges (AI+ to AI–) [1]	
Minimum Measurement Voltage (V) [2]	±10.2
Typical Measurement Voltage (V)	±10.4
Maximum Measurement Voltage (V)	±10.6
Maximum working voltage (signal + common mode)	
With screw terminal	Each channel must remain within ±10.2 V of common
With BNC	All inputs must remain within ±10.2 V of the average AI– inputs
Overvoltage protection	±30 V
Conversion time	
Channel 0 only	4.4 µs
Channels 0 and 1	6 µs
Channels 0, 1, and 2	8 µs
Channels 0, 1, 2, and 3	10 µs

Accuracy		
Measurement Conditions	**Percent of Reading (Gain Error)**	**Percent of Range (Offset Error) [3]**
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%

Stability	
Offset drift	60 µV/ °C
Gain drift	10 ppm/ °C
CMRR (at 60 Hz)	–73 dB min
Input bandwidth (–3 dB)	420 kHz min
Input impedance	
Resistance	
With screw terminal	1 GΩ
With BNC (between any two AI– terminals)	200 kΩ
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)	
With screw terminal	
10 V step	10 µs
20 V step	15 µs
With BNC	
10 V step	25 µs
20 V step	35 µs
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
Suspend mode	25 µW, max
Thermal dissipation (at 70 °C)	
Active mode	560 mW, max
Suspend mode	25 µW, 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 mm^2 to 2.5 mm^2
Weight	
With screw terminal	150 g (5.3 oz)
With BNC	173 g (6.1 oz)

Safety

Safety Voltages

NI 9215 with Screw Terminal Safety Voltages

Connect only voltages that are within these 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 (MAINS [4]). This category refers to local-level electrical distribution, such as that provided by a standard wall outlet (for example, 115 AC voltage for U.S. or 230 AC voltage for Europe). Examples of Measurement Category II are measurements performed on household appliances, portable tools, and similar hardware.

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 these 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 [5] voltage. This category is for measurements of voltages from specially protected secondary circuits. Such voltage measurements include signal levels, special hardware, limited-energy parts of hardware, 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 the *Online Product Certification* section.

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 and IEC 60068-2-2)	–40 to 70 °C
Storage temperature	
(IEC 60068-2-1 and 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

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 cables.

CE Compliance

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

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

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

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.

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 for this device at ni.com/calibration.

Calibration interval	1 year

[1] Refer to the *Safety Guidelines* section of the *NI 9215 Operating Instructions and Specifications* for more information about safe operating voltages.
[2] The minimum measurement voltage range is the largest voltage the device is guaranteed to accurately measure.
[3] Range equals 10.4 V.
[4] MAINS is defined as a hazardous live electrical supply system that powers hardware. Suitably rated measuring circuits may be connected to the MAINS for measuring purposes.
[5] MAINS is defined as a hazardous live electrical supply system that powers hardware. Suitably rated measuring circuits may be connected to the MAINS for measuring purposes.

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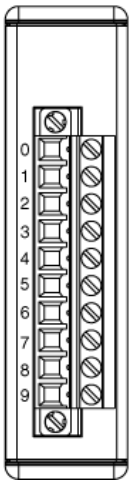
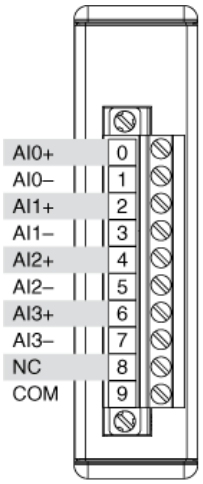
Pinouts/Front Panel Connections





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