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4-Channel, 24-Bit Analog Input Modules

NI 9229, NI 9239





- 250 Vrms channel-to-channel isolation
- 50 kS/s/ch simultaneous inputs
- Antialias filter
- NI 9229: ±60 V input range; NI 9239: ±10 V input range

Overview

The NI 9229 is a four-channel, 24-bit C Series analog input module for use in any NI CompactDAQ or CompactRIO chassis. The NI 9229, designed to be both high-speed and accurate, is an effective general-purpose analog module because of its resolution, sample rate, and input range. The NI 9239 is a four-channel, 24-bit C Series analog input module for use in any NI CompactDAQ or CompactRIO chassis. The NI 9239 is similar to the NI 9229 in functionality except for the input range. You can find detailed specifications for the NI 9229 and NI 9239 in the same manual for comparison.

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Requirements and Compatibility

OS Information

Real-Time OS
Windows

Driver Information

NI-DAQmx
NI-RIO

Software Compatibility

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

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Comparison Tables

Family	C Series Compatibility	Channels	Resolution	Isolation	Max Range	Isolation Level	Sample Rate	Simultaneous
NI 9225	CompactRIO, NI CompactDAQ	3	24	Channel-to-channel	300 Vrms	600 Vrms	50 kS/s/ch	Yes
NI 9229	CompactRIO, NI CompactDAQ, USB carrier	4	24	Channel-to-channel	±60 VDC	250 Vrms	50 kS/s/ch	Yes
NI 9239	CompactRIO, NI CompactDAQ, USB carrier	4	24	Channel-to-channel	±10 VDC	250 Vrms	50 kS/s/ch	Yes

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Application and Technology

Safety and Accuracy with Channel-to-Channel Isolation

Isolation is needed for safe operation around high voltages. With channel-to-channel isolation, your entire system, including the device under test, is protected from harmful voltage spikes up to the isolation rating. In addition to safety, isolation eliminates measurement errors caused by ground loops because the front end of the module is floating.

Elimination of Unwanted Signals with Built-In Antialias Filters

For dynamic measurements, it is important to filter out unwanted signals. Without some form of filtering, unwanted high-frequency signals can alias the signal you are measuring, causing incorrect readings. To prevent these phenomena, the NI 9225 has built-in antialiasing filters that adjust to the selected sample rate and ensure that the signal you are measuring has no interference from signals beyond the Nyquist frequency.

Synchronous Measurements with Multiple ADCs

The NI 9225 uses four 24-bit analog-to-digital converters (ADCs) for true simultaneous sampling at 50 kS/s. Phase angle is an important factor for power quality measurements, so you must sample all data simultaneously to calculate a true phase offset between phases of voltage and current. For more channels, use multiple modules in an NI C Series chassis, such as NI CompactDAQ or CompactRIO. You can synchronize all channels within the same chassis through the backplane or to external chassis through exported clocks.

Connectivity Accessories

The NI 9229 uses four of the two-position screw-terminal connectors. The module includes all four connectors, and you can order more as replacements or for easy test equipment changes among devices under test. Those connectors are listed as model NI 9976.

NI 9971 - strain-relief backshells for signal wire security and high-voltage protection (qty 4)

NI 9976 - extra connectors for two-position connector modules (qty 10)



Figure 1. High-Voltage Backshells (sold separately in quantities of four as NI 9971)

C Series Chassis

NI CompactDAQ Platform

NI CompactDAQ delivers the simplicity of USB to sensor and electrical measurements on the benchtop, in the field, and on the production line. By combining the ease of use and low cost of a data logger with the performance and flexibility of modular instrumentation, NI CompactDAQ offers fast, accurate measurements in a small, simple, and affordable system. Flexible software options make it easy to use NI CompactDAQ to log data for simple experiments or to develop a fully automated test or control system. The modular design can measure up to 256 channels of electrical, physical, mechanical, or acoustical signals in a single system. In addition, per-channel ADCs and individually isolated modules ensure fast, accurate, and safe measurements.



Figure 2. NI CompactDAQ Platform

NI CompactRIO Platform

When used with the small, rugged CompactRIO embedded control and data acquisition system, C Series analog input modules connect directly to reconfigurable I/O (RIO) field-programmable gate array (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 input 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 NI LabVIEW FPGA Module.



Figure 3. NI CompactRIO Platform

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Ordering Information

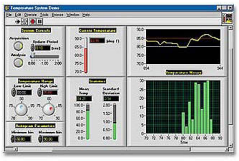
For a complete list of accessories, visit the product page on ni.com.

Products	Part Number	Recommended Accessories	Part Number
		No accessories required.	
		No accessories required.	

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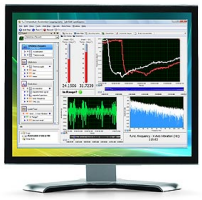
Software Recommendations

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

SignalExpress for Windows



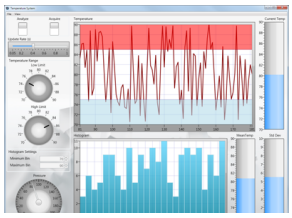
Quickly configure projects without programming
Control over 400 PC-based and stand-alone instruments
Log data from more than 250 data acquisition devices
Perform basic signal processing, analysis, and file I/O
Scale your application with automatic LabVIEW code generation
Create custom reports or easily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



Customizable graphs and charts for WPF, Windows Forms, and ASP.NET Web Forms UI design
Analysis libraries for array operations, signal generation, windowing, filters, signal processing
Hardware integration support with native .NET data acquisition and instrument control libraries
Automatic code generation for all NI-DAQmx data acquisition hardware
Intelligent and efficient data-logging libraries for streaming measurement data to disk
Support for Microsoft Visual Studio .NET 2012/2010/2008

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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. To ensure the ongoing accuracy of your measurement hardware, NI offers basic or detailed recalibration service that provides ongoing ISO 9001 audit compliance and confidence in your measurements. 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 700 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. All voltages are relative to the AI– signal on each channel unless otherwise noted. The specifications are the same for the NI 9229 and the NI 9239 unless otherwise noted.

Input Characteristics	
Number of channels	4 analog input channels
ADC resolution	24 bits
Type of ADC	Delta-Sigma (with analog prefiltering)
Sampling mode	Simultaneous
Internal master timebase (f_M)	
Frequency	12.8 MHz
Accuracy	±100 ppm max
Data rate range (f_s) using internal master timebase	
Minimum	1.613 kS/s
Maximum	50 kS/s

Data rate range (f_s) using external master timebase	
Minimum	390.625 S/s
Maximum	51.2 kS/s
Data rates [1]	$\frac{f_M \div 256}{n}, n = 1, 2, \ldots, 31$

Input voltage ranges (AI+ to AI–) [2]			
Module	**Nominal (V)**	**Typical (V)**	**Minimum (V)**
NI 9229	±60	±62.64	±61.5
NI 9239	±10	±10.52	±10.3

Overvoltage protection	±100 V
Input coupling	DC
Input impedance (AI+ to AI–)	1 MΩ

Accuracy, NI 9229		
Measurement Conditions	**Percent of Reading (Gain Error)**	**Percent of Range [3] (Offset Error)**
Calibrated max (–40 to 70 °C)	±0.13%	±0.05%
Calibrated typ (25 °C, ±5 °C)	±0.03%	±0.008%
Uncalibrated max (–40 to 70 °C)	±1.2%	±0.55%
Uncalibrated typ (25 °C, ±5 °C)	±0.3%	±0.11%

Accuracy, NI 9239		
Measurement Conditions	**Percent of Reading (Gain Error)**	**Percent of Range [4] (Offset Error)**
Calibrated max (–40 to 70 °C)	±0.13%	±0.06%
Calibrated typ (25 °C, ±5 °C)	±0.03%	±0.008%
Uncalibrated max (–40 to 70 °C)	±1.4	±0.70%
Uncalibrated typ (25 °C, ±5 °C)	±0.3%	±0.11%

Input noise	
NI 9229	320 μV_{rms}
NI 9239	70 μV_{rms}
Stability	
Gain drift	±5 ppm/°C
Offset drift	
NI 9229	±150 µV/°C
NI 9239	±26 µV/°C
Post calibration gain match (ch-to-ch, 20 kHz)	0.22 dB max
Crosstalk (1 kHz)	–130 dB
Phase mismatch (ch-to-ch)	
NI 9229	0.045°/kHz max
NI 9239	0.075°/kHz max
Phase mismatch (module-to-module, max)	
NI 9229	0.045°/kHz max +360° · f_{in}/f_M
NI 9239	0.075°/kHz max +360° · f_{in}/f_M
Phase nonlinearity (f_s = 50 kS/s)	0.11° max
Input delay	
NI 9229	38.4/f_s + 2.6 µs

NI 9239	38.4/f_s + 3 µs
Passband	
Frequency	0.453 · f_s
Flatness (f_s = 50 kS/s)	±100 mdB max
Stopband	
Frequency	0.547 · f_s
Rejection	100 dB
Alias-free bandwidth	0.453 · f_s
–3 dB prefilter bandwidth (f_s = 50 kS/s)	24.56 kHz
CMRR (f_{in} = 60 Hz)	
NI 9229	116 dB
NI 9239	126 dB
SFDR (1 kHz, –60 dBFS)	–128 dBFS
Total Harmonic Distortion (THD)	
1 kHz, –1 dBFS	–99 dB
1 kHz, –20 dBFS	–105 dB
MTBF	662,484 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	740 mW max
Sleep mode	25 µW max
Thermal dissipation (at 70 °C)	
Active mode	760 mW max
Sleep mode	16 mW max

Physical Characteristics

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	147 g (5.2 oz)

Safety

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

Safety Voltages

Connect only voltages that are within the following limits.

Channel-to-earth ground isolation	
Continuous	250 V_{rms}, Measurement Category II
Withstand	2,300 V_{rms}, verified by a 5 s dielectric withstand test
Channel-to-channel isolation	
Continuous	250 V_{rms}, Measurement Category II
Withstand	1,390 V_{rms}, verified by a 5 s dielectric withstand test
Zone 2 hazardous locations applications in Europe	
Maximum voltage (channel-to-earth ground and channel-to-channel)	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 [5] voltage. 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 to signals or use for measurements within Measurement Categories II, III, or IV.

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 (e.g., 115 V for U.S. or 230 V for Europe). Examples of Measurement Category II are measurements performed on household appliances, portable tools, and similar products.

Caution Do *not* connect 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 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 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

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 (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 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

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.

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 for this device at ni.com/calibration.

Calibration interval	1 year

[1] The data rate must remain within the appropriate data rate range. Refer to the *Understanding NI 9229/9239 Data Rates* section of the *NI 9229/9239 Operating Instructions and Specifications* for more information.

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

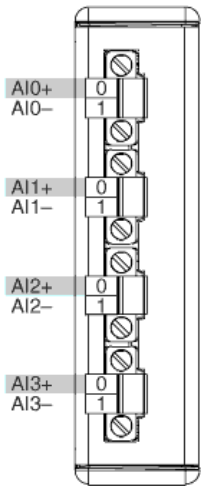
[3] Range equals 62.64 V

[4] Range equals 10.52 V

[5] MAINS is defined as the (hazardous live) electrical supply system to which equipment is designed to be connected for the purpose of powering the equipment. 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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