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Find the *National Instruments NI 9228* at our website: ***Click HERE***

DATASHEET

NI 9228

8 AI, ±60 V, 24 Bit, 1 kS/s/ch Simultaneous



- Screw-terminal connectivity
- 50 Hz/60 Hz noise rejection
- 250 Vrms, CAT II, channel-to-channel isolation

The NI 9228 is an analog input module for use in CompactDAQ or CompactRIO systems. Each channel provides a ±60 V measurement range at a 24-bit resolution. The NI 9228 outputs 1 kS/s of data at the maximum sampling rate. Designed for both speed and accuracy, the NI 9228 is an effective general-purpose analog module because of its resolution, sample rate, and input range.

Kit Contents	• NI 9228 • NI 9228 Getting Started Guide
Accessories	• NI 9939 Screw Terminal Connector Backshell Kit

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NI C Series Overview



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.



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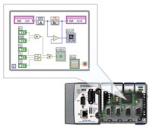
Software

LabVIEW Professional Development System for Windows



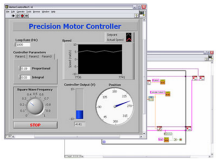
- Use advanced software tools for large project development
- Generate code automatically using DAQ Assistant and Instrument I/O Assistant
- Use advanced measurement analysis and digital signal processing
- Take advantage of open connectivity with DLLs, ActiveX, and .NET objects
- Build DLLs, executables,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

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

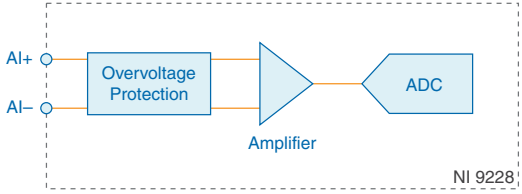
NI LabVIEW Real-Time Module



- 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

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NI 9228 Input Circuitry



- Input signals on each channel are conditioned, buffered, and then sampled by an ADC.
- Each AI channel provides an independent signal path and ADC, enabling you to sample all channels simultaneously.

Timing Modes

The NI 9228 supports high resolution, medium resolution, high speed, and medium speed timing modes. High resolution timing mode optimizes noise and rejects power line frequencies. Medium resolution timing mode has a higher sample rate when compared with high resolution, and also rejects power line frequencies. High speed timing mode optimizes sample rate and signal bandwidth, whereas medium speed timing mode has lower noise when compared to high speed timing mode.

NI 9228 Specifications

The following specifications are typical for the range -40 °C to 70 °C unless otherwise noted. All voltages are relative to the AI- signal on each channel unless otherwise noted.

Caution Do not operate the NI 9228 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	8 analog input channels
ADC resolution	24 bits
Type of ADC	Delta-Sigma
Sampling mode	Simultaneous

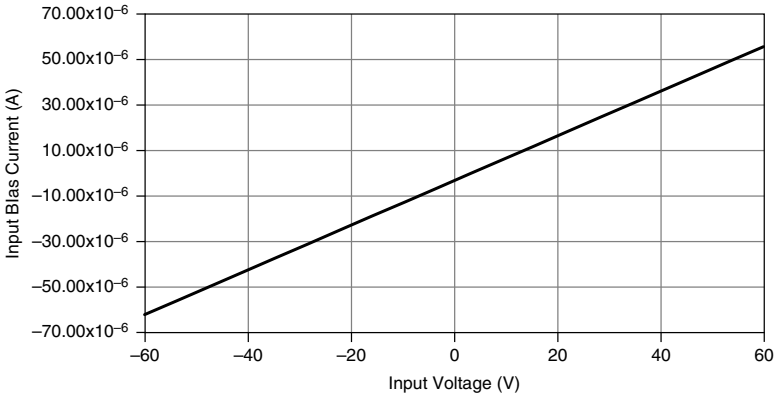
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Table 1. Conversion time (simultaneously sampled)

Timing Mode	Conversion Time (ms)	Sample Rate (S/s)
High resolution	500	2
Medium resolution	83.3	12
Medium speed	10	100
High speed	1	1000

Input voltage ranges, AI+ to AI-	
Typical	±63.8 V
Minimum	±63.2 V
Overvoltage protection, AI+ to AI-	250 Vrms
Input coupling	DC

Figure 1. Input Bias Current



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Table 2. NI 9228 Accuracy

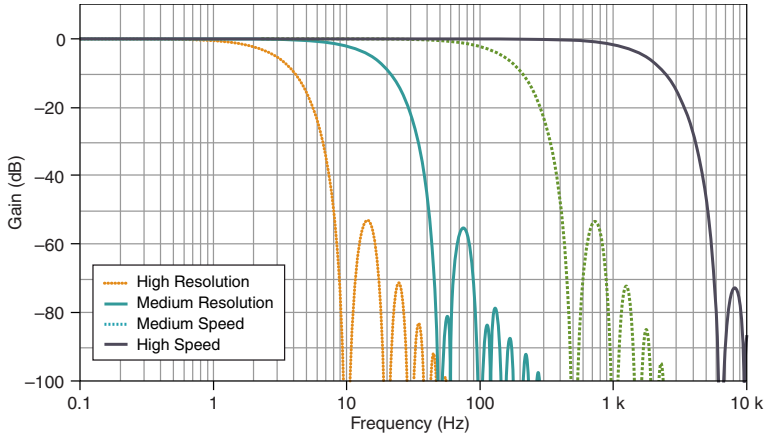
Measurement Conditions		Percent of Reading (Gain Error)	Percent of Range[1] (Offset Error)
Calibrated	Typical (25 °C, ±5 °C)	±0.11%	±0.02%
	Maximum (-40 °C to 70 °C)	±0.40%	±0.06%

Input noise	
High resolution	24 µVrms
Medium resolution	34 µVrms
Medium speed	78 µVrms
High speed	294 µVrms
Stability	
Gain drift	±16 ppm/°C
Offset drift	±96 µV/°C
Post-calibration gain match (f_{in} = 100 Hz)	±76 mdB maximum
Phase mismatch, channel-to-channel (f_{in} = 100 Hz)	±0.002 °/Hz maximum
Input delay	
High resolution	199.290 ms
Medium resolution	41.619 ms
Medium speed	3.696 ms
High speed	0.323 ms

[1] Range equals 63.8 V

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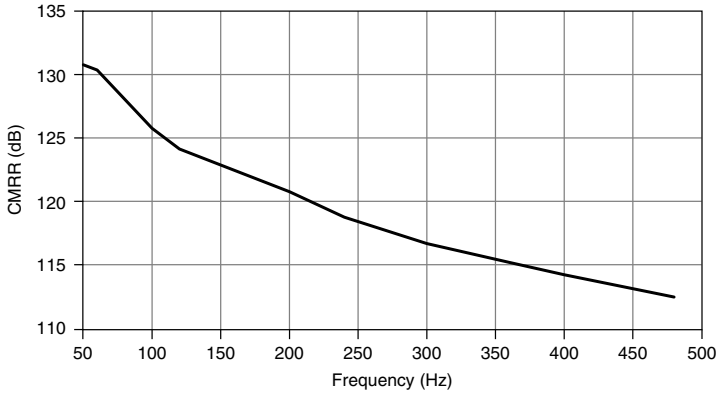
Figure 2. Filter Frequency Response



Signal input bandwidth, -3 dB	
High resolution	2.2 Hz
Medium resolution	11.8 Hz
Medium speed	115.3 Hz
High speed	1.3 kHz
Common-Mode Rejection Ratio (CMRR), rejection of channel-to-earth common-mode voltages	
High resolution (f_{in} = 50/60 Hz)	160 dB
Medium resolution (f_{in} = 50/60 Hz)	160 dB
Medium speed (f_{in} = 50/60 Hz)	130 dB
High speed	Refer to the following figure

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Figure 3. High speed CMRR (0 Hz to 500 Hz)



Normal-Mode Rejection Ratio (NMRR)	
High resolution (f_{in} = 50 Hz ±1 Hz or 60 Hz ±1 Hz)	120 dB minimum
Medium resolution (f_{in} = 50 Hz ±1 Hz or 60 Hz ±1 Hz)	80 dB minimum
Crosstalk (f_{in} = 1 kHz)	-120 dB
Alias hole rejection ((f_{in} = 614.4 kHz)	75 dB

Power Requirements

Power consumption from chassis	
Active mode	934 mW maximum
Sleep mode	53 µW maximum
Thermal dissipation	
Active mode	1.43 W maximum
Sleep mode	53 µW maximum

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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.

Screw-terminal wiring	
Gauge	0.05 mm^2 to 1.5 mm^2 (30 AWG to 14 AWG) copper conductor wire
Wire strip length	6 mm (0.24 in.) of insulation stripped from the end
Temperature rating	90 °C minimum
Torque for screw terminals	0.22 N · m to 0.25 N · m (1.95 lb · in. to 2.21 lb · in.)
Wires per screw terminal	One wire per screw terminal; two wires per screw terminal using a 2-wire ferrule
Ferrules	0.25 mm^2 to 1.5 mm^2
Connector securement	
Securement type	Screw flanges provided
Torque for screw flanges	0.2 N · m (1.80 lb · in.)
Weight	152 g (5.36 oz)

Safety Voltages

Connect only voltages that are within the following limits:

Channel-to-channel isolation	
Up to 2,000 m altitude	
Continuous	250 Vrms, Measurement Category II
Withstand	1,500 Vrms, verified by a 5 s dielectric test
Up to 5,000 m altitude	
Continuous	60 VDC, Measurement Category I
Withstand	1,000 Vrms, verified by a 5 s dielectric test
Channel-to-earth ground isolation	
Up to 2,000 m altitude	
Continuous	250 Vrms, Measurement Category II
Withstand	3,000 Vrms, verified by a 5 s dielectric test

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Up to 5,000 m altitude	
Continuous	60 VDC, Measurement Category I
Withstand	1,000 Vrms , verified by a 5 s dielectric 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 If using in Division 2 or Zone 2 hazardous locations applications, do not connect the NI 9228 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.

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 9228 to signals or use for measurements within Measurement Categories 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 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

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- 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
- AS/NZS CISPR 11: Group 1, 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, 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.

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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	IP40
Operating humidity (IEC 60068-2-78)	10% RH to 90% RH, noncondensing
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*.

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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 9228 at *ni.com/calibration*.

Calibration interval	2 years

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