NI-9239 Specifications

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Contents

NI 9239 Datasheet

- BNC or screw terminal connectivity
- Anti-alias filters
- 250 V RMS, CAT II, channel-to-channel isolation (screw terminal); 60 V DC, CAT I, channel-to-channel isolation (BNC)

The NI-9239 is an analog input module for use in NI CompactDAQ or CompactRIO systems. Each channel provides a ±10 V measurement range at a 24-bit resolution. The NI-9239 outputs 50 kS/s of data at the maximum sampling rate. Designed for both speed and accuracy, the NI-9239 is an effective general-purpose analog module because of its resolution, sample rate, and input range.

Kit Contents	• NI 9239 • NI 9239 Getting Started Guide
Accessories	• NI 9971 Backshell Connector Kit (Screw Terminal) • EMI Suppression Ferrite (BNC)

C SERIES DIFFERENTIAL INPUT MODULE COMPARISON						
Product Name	Signal Levels	Channels	Sample Rate	Simultaneous	Resolution	Connectivity
NI 9215	±10 V	4	100 kS/s/ch	Yes	16-Bit	Screw-Terminal, Spring-Terminal, BNC
NI 9220	±10 V	16	100 kS/s/ch	Yes	16-Bit	Spring-Terminal, DSUB
NI 9222	±10 V	4	500 kS/s/ch	Yes	16-Bit	Screw-Terminal, BNC
NI 9223	±10 V	4	1 MS/s/ch	Yes	16-Bit	Screw-Terminal, BNC
NI 9224	±10 V	8	1 kS/s/ch	Yes	24-Bit	Screw-Terminal
NI 9228	±60 V	8	1 kS/s/ch	Yes	24-Bit	Screw-Terminal
NI 9229	±60 V	4	50 kS/s/ch	Yes	24-Bit	Screw-Terminal, BNC
NI 9239	±10 V	4	50 kS/s/ch	Yes	24-Bit	Screw-Terminal, BNC

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.

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

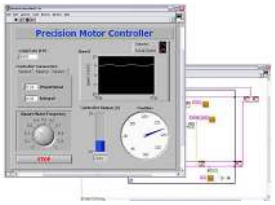
LabVIEW Professional Development System for Windows

- 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

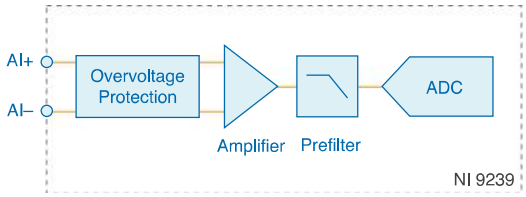
- Design FPGA applications for NI RIO hardware
- Program with the same graphical environment used for desktop and real-time applications
- Execute control algorithms with loop rates up to 300 MHz
- Implement custom timing and triggering logic, digital protocols, and DSP algorithms
- Incorporate existing 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

NI-9239 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.

Filtering

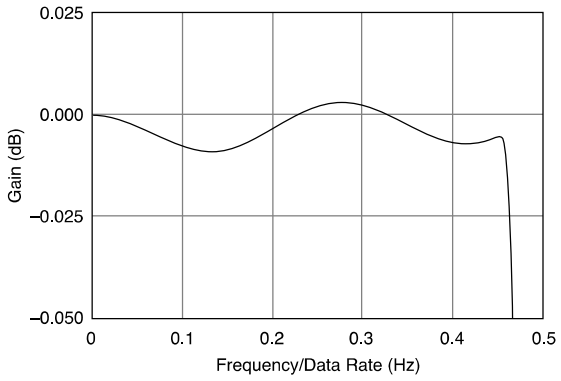
The NI-9239 uses a combination of analog and digital filtering to provide an accurate representation of in-band signals and reject out-of-band signals. The filters discriminate between signals based on the frequency range, or bandwidth, of the signal. The three important bandwidths to consider are the passband, the stopband, and the anti-imaging bandwidth.

The NI-9239 represents signals within the passband, as quantified primarily by passband ripple and phase nonlinearity. All signals that appear in the alias-free bandwidth are either unaliased signals or signals that have been filtered by at least the amount of the stopband rejection.

Passband

The signals within the passband have frequency-dependent gain or attenuation. The small amount of variation in gain with respect to frequency is called the passband flatness. The digital filters of the NI-9239 adjust the frequency range of the passband to match the data rate. Therefore, the amount of gain or attenuation at a given frequency depends on the data rate.

Figure 1. Typical Passband Response for the NI-9239



Stopband

The filter significantly attenuates all signals above the stopband frequency. The primary goal of the filter is to prevent aliasing. Therefore, the stopband frequency scales precisely with the data rate. The stopband rejection is the minimum amount of attenuation applied by the filter to all signals with frequencies within the stopband.

Alias-Free Bandwidth

Any signals that appear in the alias-free bandwidth are not aliased artifacts of signals at a higher frequency. The alias-free bandwidth is defined by the ability of the filter to reject frequencies above the stopband frequency. The alias-free bandwidth is equal to the data rate minus the stopband frequency.

Data Rates

The frequency of a master timebase ($\mathbf{f_M}$) controls the data rate ($\mathbf{f_S}$) of the NI-9239. The NI-9239 includes an internal master timebase with a frequency of 12.8 MHz, but the module also can accept an external master timebase or export its own master timebase. To synchronize the data rate of an NI-9239 with other modules that use master timebases to control sampling, all of the modules must share a single master timebase source.

The following equation provides the available data rates of the NI-9239:

$$f_s = \frac{f_M \div 256}{n}$$

$$f_s = \frac{f_M \div 256}{n}$$

where **n** is any integer from 1 to 31.

However, the data rate must remain within the appropriate data rate range. When using the internal master timebase of 12.8 MHz, the result is data rates of 50 kS/s, 25 kS/s, 16.667 kS/s, and so on down to 1.613 kS/s, depending on the value of **n**. When using an external timebase with a frequency other than 12.8 MHz, the NI-9239 has a different set of data rates.

> **Note** The NI 9151 R Series Expansion chassis does not support sharing timebases between modules.

NI-9239 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-9239 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 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 maximum
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

Figure 2. Data Rates[1] (**f_S**)

$$\frac{f_M \div 256}{n}, n = 1, 2, \ldots, 31 \quad \frac{f_M \div 256}{n}, n = 1, 2, \ldots, 31$$

Input voltage ranges (AI+ to AI-)	
Nominal	±10 V
Typical	±10.52 V
Minimum	±10.3 V
Overvoltage protection	±100 V

Input coupling	DC
Input impedance (AI+ to AI-)	1 MΩ

Measurement Conditions		Percent of Reading (Gain Error)	Percent of Range[2] (Offset Error)
Calibrated	Typical (25 °C, ±5 °C)	±0.03%	±0.008%
	Maximum (-40 °C to 70 °C)	±0.13%	±0.06%
Uncalibrated[3]	Typical (25 °C, ±5 °C)	±0.3%	±0.11%
	Maximum (-40 °C to 70 °C)	±1.4%	±0.70%

Table 1. NI-9239 Accuracy

Input noise	70 µVrms
Stability	
Gain drift	±5 ppm/°C
Offset drift	±26 µV/°C
Post-calibration gain match (channel-to-channel, 20 kHz)	0.22 dB maximum
Phase mismatch	
Channel-to-channel	0.075°/kHz maximum
Module-to-module	(0.075°/kHz · $\mathbf{f_{in}}$) + (360° · $\mathbf{f_{in}}/\mathbf{f_M}$)
Phase nonlinearity ($\mathbf{f_s}$ = 50 kS/s)	0.11° maximum

Figure 3. Input delay

$40\frac{5}{512}/f_s + 3.3\ \mu s$ $40\frac{5}{512}/f_s + 3.3\ \mu s$

Passband	
Frequency	0.453 · $\mathbf{f_s}$
Flatness ($\mathbf{f_s}$ = 50 kS/s)	±100 mdB maximum
Stopband	
Frequency	0.547 · $\mathbf{f_s}$
Rejection	100 dB

Alias-free bandwidth	0.453 · $\mathbf{f_s}$
-3 dB prefilter bandwidth ($\mathbf{f_s}$ = 50 kS/s)	24.56 kHz
Crosstalk (1 kHz)	-130 dB
CMRR ($\mathbf{f_{in}}$ = 60 Hz)	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	
NI-9239 with screw terminal	662,484 hours at 25 °C; Bellcore Issue 6, Method 1, Case 3, Limited Part Stress Method

NI-9239 with BNC	864,132 hours at 25 °C; Bellcore Issue 6, Method 1, Case 3, Limited Part Stress Method

Power Requirements

Power consumption from chassis

Active mode

NI-9239 with screw terminal	740 mW maximum
NI-9239 with BNC	800 mW maximum
Sleep mode	25 µW maximum

Thermal dissipation

Active mode

NI-9239 with screw terminal	760 mW maximum
NI-9239 with BNC	820 mW maximum
Sleep mode	16 mW maximum

Physical Characteristics

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.)

NI-9239 with Screw Terminal Safety Voltages

Connect only voltages that are within the following limits:

Isolation

Channel-to-channel

Continuous	250 V RMS, Measurement Category II
Withstand	1,390 V, verified by a 5 s dielectric withstand test

Channel-to-earth ground

Continuous	250 V RMS, Measurement Category II
Withstand	2,300 V, verified by a 5 s dielectric withstand test

Explosive atmospheres

Channel-to-channel	60 V DC, Measurement Category I
Channel-to-earth ground	60 V DC, Measurement Category I

NI-9239 with BNC Safety Voltages

Connect only voltages that are within the following limits:

Isolation

Channel-to-channel

Continuous	60 V DC, Measurement Category I
Withstand	1,000 V, verified by a 5 s dielectric withstand test

Channel-to-earth ground

Continuous	60 V DC, Measurement Category I
Withstand	1,000 V, verified by a 5 s dielectric withstand test

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 DEMKO 07 ATEX 0626664X

	IECEx UL 14.0089X

Safety Compliance 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, EN 60079-7
- IEC 60079-0, IEC 60079-7
- UL 60079-0, UL 60079-7
- CSA C22.2 No. 60079-0, CSA C22.2 No. 60079-7

> **Note** For safety certifications, refer to the product label or the Product Certifications and Declarations section.

Electromagnetic Compatibility

- EN 61326-1 (IEC 61326-1): Class A emissions; Industrial immunity

CE Compliance CE

- 2014/34/EU; Potentially Explosive Atmospheres (ATEX)

Product Certifications and Declarations

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for NI products, visit ni.com/product-certifications, search by model number, and click the appropriate link.

Shock and Vibration

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

Operating vibration	
Random	5 g RMS, 10 Hz to 500 Hz
Sinusoidal	5 g, 10 Hz to 500 Hz
Operating shock	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 60068-2-30)	10% RH to 90% RH, noncondensing
Storage humidity (IEC 60068-2-30)	5% RH to 95% RH, noncondensing
Pollution Degree	2
Maximum altitude	2,000 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 **Engineering a Healthy Planet** 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.

EU and UK Customers

- **Waste Electrical and Electronic Equipment (WEEE)**—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 RoHS**— NI 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 NI 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-9239 at ni.com/calibration.

Calibration interval	1 year

[1] The data rate must remain within the appropriate data rate range.

[2] Range equals 10.52 V

[3] Uncalibrated accuracy refers to the accuracy achieved when acquiring in raw or unscaled modes where the calibration constants stored in the module are not applied to the data.