NI-9205 Specifications

2023-03-03

Contents

NI-9205 Datasheet

- DSUB or spring terminal connectivity
- 250 V RMS, CAT II, channel-to-earth isolation (spring terminal); 60 V DC, CAT I, channel-to-earth isolation (DSUB)

The NI-9205 is a C Series module for use with any CompactDAQ or CompactRIO system. Each channel has programmable input ranges of ±200 mV, ±1 V, ±5 V, and ±10 V. To protect against signal transients, the NI-9205 includes ±30 V of overvoltage protection between input channels and common (COM). In addition, the NI-9205 also includes a channel-to-earth-ground isolation barrier for safety, noise immunity, and high common-mode voltage range.

Kit Contents	• NI 9205 • NI 9205 Getting Started Guide
Accessories	**Spring-Terminal** • NI 9940 Backshell Kit (779567-01)
	DSUB Front-Mount • NI 9923 Screw-Terminal Block (780179-01) Cable • DSUB Cable, 1 m (778621-01) • 37-Pin DSUB to Screw-Terminal Block with Horizontal DIN-Rail Mount (778673-01)

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

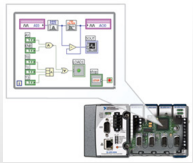
LabVIEW Professional Development System for Windows

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

LabVIEW Professional Development System for Windows

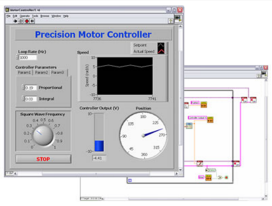
- Build DLLs, executables, and MSI installers

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

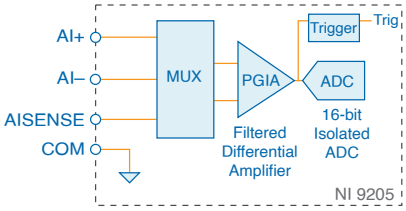


- Design deterministic real-time applications with LabVIEW graphical programming
- Download to dedicated NI or third-party hardware for reliable execution and a wide selection of I/O
- Take advantage of built-in PID control, signal processing, and analysis functions
- Automatically take advantage of multicore CPUs or set processor affinity manually

NI LabVIEW Real-Time Module	
	▪ Take advantage of real-time OS, development and debugging support, and board support ▪ Purchase individually or as part of a LabVIEW suite

NI-9205 Block Diagram

The NI-9205 channels share a common ground (COM) that is isolated from other modules in the system. All channels share a programmable gain instrumentation amplifier and are multiplexed to an ADC. Each channel also has ±30 V overvoltage protection.



NI-9205 Specifications

The following specifications are typical for the range -40 °C to 70 °C unless otherwise noted. All voltages are relative to COM unless otherwise noted.

> **Caution** Do not operate the NI-9205 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.

MTBF	775,832 hours at 25 °C; Bellcore Issue 6, Method 1, Case 3, Limited Part Stress Method

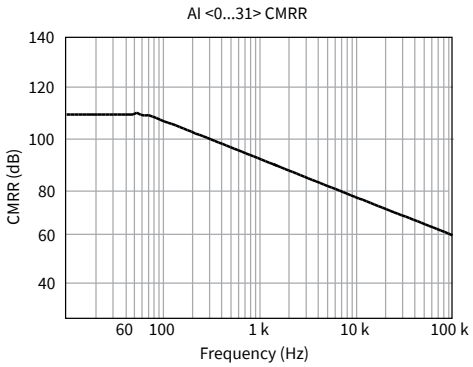
Analog Input Characteristics

Number of channels	16 differential/32 single-ended channels
ADC resolution	16 bits
DNL	No missing codes guaranteed
Conversion time (maximum sampling rate)	
CompactRIO & CompactDAQ chassis	4.00 µs (250 kS/s)
R Series Expansion chassis	4.50 µs (222 kS/s)
Input coupling	DC
Nominal input ranges	±10 V, ±5 V, ±1 V, ±0.2 V
Minimum overrange, ±10 V range	4%

Maximum working voltage for analog inputs (signal + common mode)	Each channel must remain within ±10.4 V of COM
Input impedance (AI-to-COM)	
Powered on	>10 GΩ in parallel with 100 pF
Powered off/overload	4.7 kΩ minimum
Input bias current	±100 pA
Crosstalk, at 100 kHz	
Adjacent channels	-65 dB
Non-adjacent channels	-70 dB
Analog bandwidth	370 kHz
Overvoltage protection	
AI channel, 0 to 31	±30 V, one channel only
AISENSE	±30 V
Settling time for multichannel measurements, accuracy, all ranges	
±120 ppm of full-scale step, ±8 LSB	4 µs convert interval
±30 ppm of full-scale step, ±2 LSB	8 µs convert interval
Analog triggers	
Number of triggers	1
Resolution	10 bits, 1 in 1,024
Bandwidth, -3 dB	370 kHz

Accuracy	±1% of full scale
Scaling coefficients	
±10 V range	328 µV/LSB
±5 V range	164.2 µV/LSB
±1 V range	32.8 µV/LSB
±0.2 V range	6.57 µV/LSB
CMRR, DC to 60 Hz	100 dB

Figure 1. CMRR, AI+ to AI-



Analog Input Absolute Accuracy

The following values are based on calibrated scaling coefficients, which are stored in the onboard EEPROM.

Range	Accuracy at Full Scale[1]	Random Noise[2], σ	Sensitivity[3]
±10 V	6,230 µV	237 µV RMS	96.0 µV
±5 V	3,230 µV	121 µV RMS	46.4 µV
±1 V	692 µV	29 µV RMS	10.4 µV

Range	Accuracy at Full Scale[1]	Random Noise[2], σ	Sensitivity[3]
±0.2 V	175 µV	15 µV RMS	4.0 µV

Table 1. Absolute accuracy

Residual gain error	
±10 V range	115 ppm of reading
±5 V range	135 ppm of reading
±1 V range	155 ppm of reading
±0.2 V range	215 ppm of reading
Gain tempco	11 ppm/°C
Reference tempco	5
Residual offset error	
±10 V range	20 ppm of range
±5 V range	20 ppm of range
±1 V range	25 ppm of range
±0.2 V range	40 ppm of range
Offset tempco	
±10 V range	44 ppm of range/°C
±5 V range	47 ppm of range/°C
±1 V range	66 ppm of range/°C

±0.2 V range	162 ppm of range/°C
INL error	76 ppm of range

Analog Input Accuracy Formulas

Absolute Accuracy = **Reading** * **Gain Error** + **Range** * **Offset Error** + **Noise Uncertainty**

- where
- **Gain Error** = **Residual Gain Error** + **Gain Tempco** * **Temp Change from Last Internal Cal** + **Reference Tempco** * **Temp Change from Last External Cal**
- **Offset Error** = **Residual Offset Error** + **Offset Tempco** * **Temp Change from Last Internal Cal** + **INL Error**
- **Noise Uncertainty** = (**Random Noise** * 3) / √100 for a coverage factor of 3 σ and averaging 100 points

Absolute accuracy at full scale on the analog input channels is determined using the following assumptions:

- **Temp Change from Last External Cal** = 70 °C
- **Temp Change from Last Internal Cal** = 1 °C
- **Number of Readings** = 100
- **Coverage Factor** = 3 σ

For example, on the ±10 V range, the absolute accuracy at full scale is as follows:

- **Gain Error** = 115 ppm + 11 ppm * 1 + 5 ppm * 70
- **Gain Error** = 476 ppm
- **Offset Error** = 20 ppm + 44 ppm * 1 + 76 ppm
- **Offset Error** = 140 ppm
- **Noise Uncertainty** = (237 µV * 3) / √100

- **Noise Uncertainty** = 72 µV
- **Absolute Accuracy** = 10 V * 476 ppm + 10 V * 140 ppm + 72 µV
- **Absolute Accuracy** = 6,231 µV, rounds to 6,230 µV

Digital Characteristics

Number of channels	1 digital input channel, 1 digital output channel
Overvoltage protection	±30 V
Digital logic levels	
Input high, V_{IH}	
Minimum	2.0 V
Maximum	3.3 V
Input low, V_{IL}	
Minimum	0 V
Maximum	0.34 V
Output high, V_{OH}, sourcing 75 µA	
Minimum	2.1 V
Maximum	3.3 V
Output low, V_{OH}, sinking 250 µA	
Minimum	0 V
Maximum	0.4 V
External digital triggers	

Source	PFI0
Delay	100 ns maximum

Power Requirements

Power consumption from chassis	
Active mode	625 mW maximum
Sleep mode	15 mW
Thermal dissipation (at 70 °C)	
Active mode	625 mW maximum
Sleep mode	15 mW

Physical Characteristics

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.

Spring-terminal wiring	
Gauge	copper conductor wire
Wire strip length	of insulation stripped from the end
Temperature rating	
Wires per spring terminal	

Connector securement	
Securement type	Screw flanges provided
Torque for screw flanges	
Weight	
NI-9205 with spring terminal	158 g (5.8 oz)
NI-9205 with DSUB	148 g (5.3 oz)

Safety Voltages

Connect only voltages that are within the following limits:

Maximum voltage[5]	
Channel-to-COM	±30 V DC

NI-9205 with Spring Terminal (Black Connector) Isolation Voltages

Channel-to-channel	None
Channel-to-earth ground	
Continuous	250 V RMS, Measurement Category II
Withstand up to 2,000 m	3,000 V RMS, verified by a 5 s dielectric withstand test

NI-9205 with DSUB Isolation Voltages

Channel-to-channel	None
Channel-to-earth ground	
Continuous	60 V DC, Measurement Category I
Withstand up to 2,000 m	1,000 V RMS, verified by a 5 s dielectric withstand test
Withstand up to 5,000 m	500 V RMS

Hazardous Locations

U.S. (UL)	; ,
Canada (C-UL)	;
Europe (ATEX) and International (IECEx)	DEMKO ATEX IECEx

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

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	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 **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-9205 at ni.com/calibration.

Calibration interval	2 years

[1] Absolute accuracy values at full scale on the analog input channels assume the device is operating within 70 °C of the last external calibration and are valid for averaging 100 samples immediately following self-calibration.

[2] Differential mode

[3] Sensitivity is a function of noise and indicates the smallest voltage change that can be detected.

[4] The digital output channel is supported only in CompactRIO Systems with the FPGA Interface..

[5] The maximum voltage that can be applied or output between AI and COM without creating a safety hazard.