NI-9205 and sbRIO-9205 Specifications

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Contents

NI-9205 and sbRIO-9205 Specifications

Definitions

Warranted specifications describe the performance of a model under stated operating conditions and are covered by the model warranty.

Characteristics describe values that are relevant to the use of the model under stated operating conditions but are not covered by the model warranty.

- ***Typical*** specifications describe the performance met by a majority of models.
- ***Nominal*** specifications describe an attribute that is based on design, conformance testing, or supplemental testing.

Specifications are ***Typical*** unless otherwise noted.

Conditions

Specifications are valid for the range -40 °C to 70 °C unless otherwise noted. All voltages are relative to COM unless otherwise noted.

Connector Types

The NI-9205 has more than one connector type: NI-9205 with spring terminal and NI-9205 with DSUB. Unless the connector type is specified, NI-9205 refers to all connector types.

The NI-9205 with spring terminal is available in two types: push-in spring terminal and spring terminal. The push-in type spring terminal connector is black and orange. The spring terminal connector is black. NI-9205 with spring terminal refers to both types unless the two types are specified. Differences between the two types of spring terminal connectors are noted by the connector color.

Related information:

- Software Support for CompactRIO, CompactDAQ, Single-Board RIO, R Series, and EtherCAT

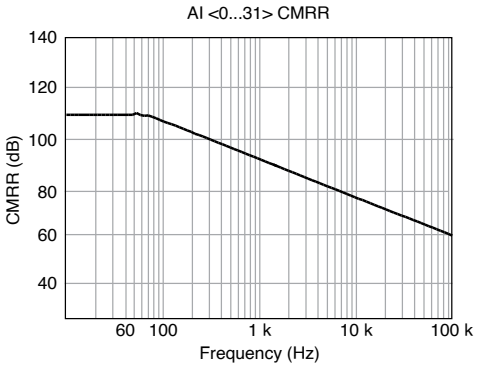
Analog Input Characteristics

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.

Table 1. Absolute accuracy

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
±0.2 V	175 µV	15 µV RMS	4.0 µV

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 ppm/°C

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.

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[4]
Overvoltage protection	±30 V

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

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

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 Push-in Style Spring Terminal (Black/Orange Connector) Isolation Voltages

Channel-to-channel	None
Channel-to-earth ground	
Continuous	250 V RMS, Measurement Category II

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

Withstand up to 5,000 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

Measurement Category

Measurement Category I

Caution Do not connect the NI-9205 with DSUB to signals or use for measurements within Measurement Categories II, III, or IV.

Attention Ne pas connecter le NI-9205 with DSUB à des signaux dans les catégories de mesure II, III ou IV et ne pas l'utiliser pour effectuer des mesures dans ces catégories.

Warning Do not connect the NI-9205 with DSUB to signals or use for measurements within Measurement Categories II, III, or IV, or for measurements on MAINs circuits or on circuits derived from Overvoltage Category II, III, or IV which may have transient overvoltages above what the product can withstand. The NI-9205 with DSUB must not be connected to

circuits that have a maximum voltage above the continuous working voltage, relative to earth or to other channels, or this could damage and defeat the insulation. The NI-9205 with DSUB can only withstand transients up to the transient overvoltage rating without breakdown or damage to the insulation. An analysis of the working voltages, loop impedances, temporary overvoltages, and transient overvoltages in the system must be conducted prior to making measurements.

Mise en garde Ne pas connecter le NI-9205 with DSUB à des signaux dans les catégories de mesure II, III ou IV et ne pas l'utiliser pour des mesures dans ces catégories, ou des mesures sur secteur ou sur des circuits dérivés de surtensions de catégorie II, III ou IV pouvant présenter des surtensions transitoires supérieures à ce que le produit peut supporter. Le NI-9205 with DSUB ne doit pas être raccordé à des circuits ayant une tension maximale supérieure à la tension de fonctionnement continu, par rapport à la terre ou à d'autres voies, sous peine d'endommager et de compromettre l'isolation. Le NI-9205 with DSUB peut tomber en panne et son isolation risque d'être endommagée si les tensions transitoires dépassent la surtension transitoire nominale. Une analyse des tensions de fonctionnement, des impédances de boucle, des surtensions temporaires et des surtensions transitoires dans le système doit être effectuée avant de procéder à des mesures.

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.

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

Caution Do not connect the NI-9205 with spring terminal to signals or use for measurements within Measurement Categories III or IV.

Attention Ne pas connecter le NI-9205 with spring terminal à des signaux dans les catégories de mesure III ou IV et ne pas l'utiliser pour effectuer des mesures dans ces catégories.

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.

Environmental Characteristics

Temperature	
Operating	-40 °C to 70 °C
Storage	-40 °C to 85 °C
Humidity	
Operating	10% RH to 90% RH, noncondensing
Storage	5% RH to 95% RH, noncondensing
Ingress protection	IP40
Pollution Degree	2

Maximum altitude	5,000 m
Shock and Vibration	
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

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

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

Dimensions and Weight

Dimensions	Visit ni.com/dimensions and search by module number.

Weight	
NI-9205 with push-in style spring terminal (black/orange connector)	163 g (5.7 oz)
NI-9205 with spring terminal (black connector)	158 g (5.8 oz)
NI-9205 with DSUB	148 g (5.3 oz)

NI-9205 with Push-In Style Spring Terminal (Black/Orange Connector)

The push-in spring style NI-9205 with spring terminal does not require a tool for signal connection; push the wire into the terminal when using solid wire or stranded wire with a ferrule, or by pressing the push button when using stranded wire without a ferrule.

Spring-terminal wiring	
Gauge	0.13 mm^2 to 1.5 mm^2 (26 AWG to 16 AWG) copper conductor wire
Wire strip length	10 mm (0.394 in.) of insulation stripped from the end
Temperature rating	90 °C minimum

Wires per spring terminal	One wire per screw terminal; two wires per screw terminal using a 2-wire ferrule
Ferrules	0.14 mm^2 to 1.5 mm^2
Connector securement	
Securement type	Screw flanges provided
Torque for screw flanges	0.2 N · m (1.8 lb · in.)

NI-9205 with Spring Terminal (Black Connector)

The NI-9205 with spring terminal (black connector) requires a flathead screwdriver with a 2.3 mm × 1.0 mm (0.09 in. × 0.04 in.) blade for signal connection; insert the screwdriver into a spring clamp activation slot to open the corresponding connector terminal, press a wire into the open connector terminal, and then remove the screwdriver from the activation slot to clamp the wire into place.

Spring-terminal wiring	
Gauge	0.08 mm^2 to 1.0 mm^2 (28 AWG to 18 AWG) copper conductor wire
Wire strip length	7 mm (0.28 in.) of insulation stripped from the end
Temperature rating	90 °C minimum
Wires per spring terminal	One wire per spring terminal
Connector securement	

Securement type	Screw flanges provided
Torque for screw flanges	0.2 N · m (1.80 lb · in.)

Calibration

You can obtain the calibration certificate and information about calibration services for the NI-9205 at ni.com/calibration.

Calibration interval	2 years