NI-9235 and sbRIO-9235 Specifications

2024-08-13

Contents

NI-9235 and sbRIO-9236 Specifications

Connector Types

The NI-9235 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-9235 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.

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.

Related information:

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

Conditions

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

Input Characteristics

Number of channels	8 analog input channels
Quarter-bridge completion	120 Ω, 10 ppm/°C maximum
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	794 S/s
Maximum	10 kS/s
Data rate range (f_S) using external master timebase	
Minimum	195.3125 S/s
Maximum	10.547 kS/s

Data rates[1] (f_S)	$(f_M \div 256)/n$, n = {2; 4, 5, ..., 63}
Full-scale range	±29.4 mV/V (+62,500 με/-55,500 με)
Scaling coefficient	3.5062 nV/V per LSB
Overvoltage protection between any two terminals	±30 V

Table 1. Accuracy

Measurement Conditions		Percent of Reading[2] (Gain Error)	Percent of Range[3],[4] (Offset Error)	
			30 days after cal. (±5 °C)	1 year after cal. (±5 °C)
Calibrated	Typical (25 °C, ±5 °C)	0.02%	0.1%	0.15%
	Maximum (-40 °C to 70 °C)	0.07%	0.17%	0.4%
Uncalibrated[5]	Typical (25 °C, ±5 °C)	0.15%	1.25%	
	Maximum (-40 °C to 70 °C)	0.53%	2.14%	

Stability	
Gain drift	6 ppm/°C

1. The data rate must remain within the appropriate data rate range.
2. Exclusive of lead wire resistance error.
3. Range equals 29.4 mV/V.
4. Calibrated errors represent offset stability following unstrained measurement. Errors include the effect of completion resistor tolerance and drift.
5. 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.

Offset drift	2.2 µV/V/°C

Table 2. Channel-to-Channel Matching (Calibrated)

Input Signal Frequency (f_{in})	Gain		Phase
	Typical	Maximum	Maximum
0 to 1 kHz	0.08%	0.11%	0.34°/kHz * f_{in}
0 to 4 kHz	0.17%	0.32%	

Phase nonlinearity	
f_{in} = 0 to 1 kHz	±0.002°
f_{in} = 0 to 4 kHz	±0.1°
Input delay	(39 + 221/1024)/f_s + 12 µs
Passband	
Frequency	0.45 * f_s
Flatness (f_s = 10 kS/s)	33 mdB maximum
Stopband	
Frequency	0.55 * f_s
Rejection	100 dB

Alias-free bandwidth	0.45 * f_s
Oversample rate	64 * f_s
Rejection at oversample rate[6] (f_s = 10 kS/s)	80 dB @ 640 kHz
Input noise	
f_s = 1 kS/s	0.38 µV/V RMS
f_s = 10 kS/s	0.85 µV/V RMS
SFDR (1 kHz, -60 dBFS)	110 dB
THD (1 kHz, -20 dBFS)	-90 dB
Crosstalk (f_{in} = 1 kHz)	-100 dB
Common-mode voltage, all signals to earth ground	±60 VDC
CMRR (f_{in} = 0 to 60 Hz)	120 dB
MTBF	566,796 hours at 25 °C; Bellcore Issue 2, Method 1, Case 3, Limited Part Stress Method

6. Rejection by analog prefilter of signal frequencies at oversample rate.

Shunt Calibration Characteristics

Table 3. Shunt Calibration Accuracy

Measurement Conditions	Percent of Reading (Gain Error)
Typical (25 °C, ±5 °C)	0.09%
Maximum (-40 °C to 70 °C)	0.22%

Resistance	50 kΩ
Output value	-599.28 µV/V
Temperature drift	15 ppm/°C
Method	Shunt across completion resistor

Excitation Characteristics

Excitation type	Constant voltage
Excitation value	2.0 V ± 1%
Maximum output current	80 mA

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.

Safety Voltages

Connect only voltages that are within the following limits:

Between any two terminals	±30 V maximum
Isolation	
Channel-to-channel	None
Channel-to-earth ground	
Continuous	60 V DC, Measurement Category I
Withstand	1,000 V RMS, verified by a 5 s dielectric withstand test

Measurement Category I

Warning Do not connect the product 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 product 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 product 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 produit 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 produit 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 produit 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.

Power Requirements

Power consumption from chassis	
Active mode	735 mW maximum
Sleep mode	25 µW maximum
Thermal dissipation (at 70 °C)	
Active mode	735 mW maximum

Sleep mode	25 µW maximum

Physical Characteristics

Weight	
NI-9235 (black connector)	153 g (5.4 oz)
Push-in style NI-9235 (black/orange connector)	158 g (5.6 oz)
Dimensions	Visit ni.com/dimensions and search by module number.

(Black Connector)

The NI-9235 (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	0.8 mm^2 to 1.0 mm^2 (28 AWG to 18 AWG) copper conductor wire
Wire strip length	7 mm (0.276 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.)

Push-In Style (Black/Orange Connector)

The push-in spring style NI-9235 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	0.14 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 spring terminal; two wires per spring terminal using a 2-wire ferrule
Ferrules	
Single ferrule, uninsulated	0.14 mm^2 to 1.5 mm^2 (26 AWG to 16 AWG) 10 mm barrel length

Single ferrule, insulated	0.14 mm^2 to 1.0 mm^2 (26 AWG to 18 AWG) 12 mm barrel length
Two-wire ferrule, insulated	2x 0.34 mm^2 (2x 22 AWG) 12 mm barrel length
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-9235 at ni.com/calibration.

Calibration interval	1 year