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# NI-9230

# Specifications

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## NI-9230 Specifications

These specifications apply to the NI-9230.

### Revision History

Version	Date changed	Description
378858B-01	February 2025	Updated analog input accuracy tables.
378858A-01	December 2015	Initial release.

### Looking For Something Else?

For information not found in the specifications for your product, such as operating instructions, browse ***Related Information***.

#### Related information:

- [NI-9230 Getting Started](#)
- [Software Support for CompactRIO, CompactDAQ, Single-Board RIO, R Series, and EtherCAT](#)
- [NI-9230/9232 Calibration Procedure](#)
- [Calibration Services](#)
- [Software and Driver Downloads](#)
- [Dimensional Drawings](#)
- [Product Certifications](#)
- [Letter of Volatility](#)
- [Discussion Forums](#)
- [NI Learning Center](#)

### 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.

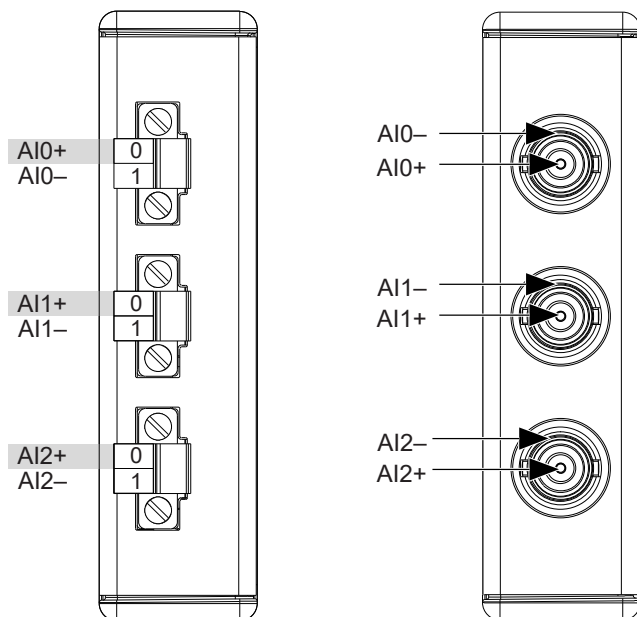
## Conditions

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

## Connector Types

The NI-9230 has more than one connector type: NI-9230 with screw terminal and NI-9230 with BNC. Unless the connector type is specified, NI-9230 refers to both connector types.

## NI-9230 Pinout





**Note** You must use 2-wire ferrules to create a secure connection when connecting more than one wire to a single terminal on the NI-9230 with screw terminal.

Each channel has a terminal to which you can connect a signal source. The AI+ terminal of the connector provides the DC excitation, when enabled, and the positive input signal connection. The AI- terminal provides the excitation return path and the signal ground reference.

Table 1. Signal Descriptions

Signal	Description
AI+	Positive analog input signal connection
AI-	Negative analog input signal connection

## Input Characteristics

Number of channels	3 analog input channels
ADC resolution	24 bits
Type of ADC	Delta-Sigma (with analog prefiltering)
Sampling mode	Simultaneous
Type of TEDS supported	IEEE 1451.4 TEDS Class I
TEDS capacitive drive	3,000 pF

Table 2. Internal master timebase ( $f_M$ )

Frequency	13.1072 MHz
Accuracy	$\pm 100$ ppm

Table 3. Data rate range ( $f_s$ ) using internal master timebase

Minimum	0.985 kS/s
Maximum	12.8 kS/s

Table 4. Data rate range (  $f_s$ ) using external master timebase

Minimum	0.977 kS/s
Maximum	12.84 kS/s

Figure 1. Data Rates ( $f_s$ )

$$\frac{f_M}{2 \times m \times n}$$

where

- for  $m = 64$ ,  $n = 9$  to  $25$
- for  $m = 128$ ,  $n = 5$  to  $25$
- for  $m = 256$ ,  $n = 2$  to  $26$

Input coupling	AC/DC (software-selectable)
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Table 5. AC cutoff frequency

-3 dB	0.1 Hz
-0.1 dB	0.87 Hz maximum

Figure 2. AC Cutoff Frequency Response

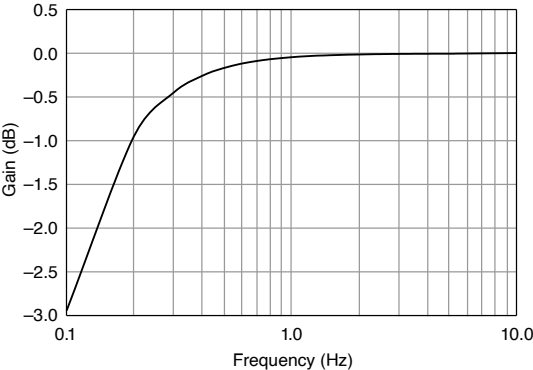


Table 6. DC voltage input range

Minimum	$\pm 30.87$ V
Typical	$\pm 31.5$ V
Maximum	$\pm 32.13$ V

Table 7. AC voltage full-scale range<sup>1</sup>

Minimum	±30.87 V peak
Typical	±31.5 V peak
Maximum	±32.13 V peak

Channel-to-channel common-mode voltage range (AI- to AI-)	±1 V maximum
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Table 8. IEPE excitation current (software-selectable on/off)

Minimum	4 mA
Typical	4.25 mA

IEPE excitation noise	100 nA rms
IEPE compliance voltage	22 V minimum

If you are using an IEPE sensor, use the following equation to make sure your configuration meets the IEPE compliance voltage range.

Figure 3. IEPE Compliance Voltage Range

$$(0.67 \times V_{\text{common-mode}} + V_{\text{bias}} \pm V_{\text{full-scale}})$$

where

- $V_{\text{common-mode}}$  is the channel-to-channel common-mode voltage across two or more channels
- $V_{\text{bias}}$  is the bias voltage of the IEPE sensor
- $V_{\text{full-scale}}$  is the full-scale voltage of the IEPE sensor



**Note** This equation must resolve to 0 V to 22 V.

1. The DC + AC voltage must be below the overvoltage protection of the NI-9230.

Table 9. IEPE fault detection<sup>2</sup>

Short circuit	$V_{AI} < 1.5 \text{ V}$
Open loop	$V_{AI} > 24 \text{ V}$

Overvoltage protection	$\pm 45 \text{ V}$ for a low impedance source connected between any two terminals
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Table 10. Input delay

64x decimation	$30/f_s + 3.0 \mu\text{s}$
128x decimation	$29/f_s + 3.0 \mu\text{s}$
256x decimation	$28/f_s + 3.0 \mu\text{s}$

Table 11. Accuracy

	Measurement Conditions	Within 1 Year of Calibration		Within 10 Years of Calibration	
		Percent of Reading Gain Error	Offset <sup>3</sup> (Percent of Range) <sup>4</sup>	Percent of Reading Gain Error	Offset <sup>5</sup> (Percent of Range) <sup>6</sup>
Calibrated	Typical (23 °C, $\pm 5$ °C)	0.10%	0.023%	0.31%	0.148%
	Maximum (-40 °C to 70 °C)	0.60%	0.230%	0.67%	0.269%
Uncalibrated <sup>7</sup>	Typical (23 °C, $\pm 5$ °C)	0.40%	0.120%	0.61%	0.245%
	Maximum (-40 °C to 70 °C)	1.50%	0.590%	1.57%	0.629%

2. Refer to the software help for information on reading the IEPE fault detection status.

3. DC coupled

4. Range equals 31.5 V

5. DC coupled

6. Range equals 31.5 V

7. Uncalibrated accuracy refers to the accuracy achieved when acquiring data in raw or unscaled modes and in which calibration constants that are stored in the module are not applied to the data.





**Note** NI recommends a calibration interval of 1 year and only provides calibration services referencing the 1-year specification limits. If you choose to calibrate less often, the 10-year column provides predicted performance over this extended interval. Choose an appropriate interval based on your application requirements. Longer calibration intervals are more likely to result in As-Found calibration failures when the device is sent back for calibration and compared against the 1-year specification limits.

Table 12. Stability

Gain drift	$\pm 25 \text{ ppm}/^\circ\text{C}$
Offset drift (DC coupled)	$\pm 320 \text{ }\mu\text{V}/^\circ\text{C}$

Table 13. Gain Matching (Calibrated)

Frequency Band	20 Hz to 5.12 kHz	
	Typical	Maximum
Channel-to-channel	25 mdB	120 mdB

Table 14. Phase Matching (Maximum)

Frequency Band	20 Hz to 5.12 kHz
Channel-to-channel	$(0.022^\circ/\text{kHz} \times f_{\text{in}}) + 0.045^\circ$
Module-to-module	$(0.022^\circ/\text{kHz} \times f_{\text{in}}) + 0.045^\circ + (360^\circ \times f_{\text{in}}/f_{\text{M}})$

Passband frequency	$0.4 \cdot f_{\text{S}}$
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Table 15. Flatness (Peak-to-Peak)

Frequency Band	20 Hz to 5.12 kHz
Typical	70 mdB
Maximum	75 mdB

Table 16. Phase Nonlinearity (Maximum)

Frequency Band	20 Hz to 5.12 kHz
AC Coupled	0.31°
DC Coupled	0.025°

Table 17. Stopband

Frequency	$0.5 \cdot f_s$
Rejection	120 dB

Alias-free bandwidth	$0.4 \cdot f_s$
Oversample rate	$64 \cdot f_s$ , $128 \cdot f_s$ , and $256 \cdot f_s$

Table 18. Rejection at oversample rate<sup>8</sup>

$f_s = 10.24 \text{ kS/s}$	95 dB at 1.311 MHz
$f_s = 12.8 \text{ kS/s}$	118 dB at 3.277 MHz

Crosstalk ( $f_{in} = 1 \text{ kHz}$ )	-125 dB
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Table 19. CMRR

Channel-to-channel ( $f_{in} \leq 1 \text{ kHz}$ )	56 dB
Channel-to-earth ( $f_{in} = 60 \text{ Hz}$ )	107 dB

Table 20. SFDR ( $f_{in} = 1 \text{ kHz}$ , -60 dBFS)

$f_s = 12.8 \text{ kS/s}$	122 dBFS
$f_s = 11.38 \text{ kS/s}$	118 dBFS
$f_s = 10.24 \text{ kS/s}$	120 dBFS

8. Rejection of analog prefilter at oversample rate.

Table 21. Input Noise

Data Rate	12.8 kS/s	11.38 kS/s	10.24 kS/s
AC coupled	106 $\mu$ V RMS	169 $\mu$ V RMS	117 $\mu$ V RMS
DC coupled	97 $\mu$ V RMS	164 $\mu$ V RMS	111 $\mu$ V RMS

Table 22. Dynamic range (  $f_{in} = 1$  kHz, -60 dBFS)

Data Rate	12.8 kS/s	11.38 kS/s	10.24 kS/s
AC coupled	106 dBFS	102 dBFS	106 dBFS
DC coupled	107 dBFS	103 dBFS	106 dBFS

Table 23. Input impedance

Differential	324 k $\Omega$
AI- to isolated ground	50 $\Omega$

Table 24. Total Harmonic Distortion (THD)

Input Amplitude	1 kHz
-10.5424 dBFS	-95 dB
-20 dBFS	-95 dB

Table 25. Intermodulation distortion (-10.5424 dBFS)

DIN 50 Hz/1 kHz4:1 amplitude ratio	-80 dB
CCIF 3.5 kHz/4 kHz1:1 amplitude ratio	-95 dB

## Power Requirements

Power consumption from chassis	
Active mode	1 W maximum
Sleep mode	25 $\mu$ W maximum

Thermal dissipation (at 70 °C)	
Active mode	1 W maximum
Active mode (BNC variant)	1.5 W maximum
Sleep mode	25 $\mu$ W maximum

## Physical Characteristics

Screw-terminal wiring	
Gauge	0.05 mm <sup>2</sup> to 1.5 mm <sup>2</sup> (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 <sup>2</sup> to 1.5 mm <sup>2</sup>
Connector securement	

Securement type		Screw flanges provided
Torque for screw flanges		0.2 N · m (1.80 lb · in.)
Dimensions	Visit <a href="https://ni.com/dimensions">ni.com/dimensions</a> and search by module number.	
Weight		
NI-9230 with screw terminal		142 g (5.0 oz)
NI-9230 with BNC		159 g (5.6 oz)

## Safety Voltages

Connect only voltages that are within the following limits.

<b>Isolation</b>		
Channel-to-channel		None
<b>Channel-to-earth ground</b>		
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.

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

## Calibration

You can obtain the calibration certificate and information about calibration services for the NI-9230 at [ni.com/calibration](https://ni.com/calibration).

Recommended calibration interval	1 year
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