NI-9230 Specifications

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Contents

NI-9230 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.

NI-9230 Overview

In this article, the NI-9230 with screw terminal and NI-9230 with BNC are referred to inclusively as the NI-9230. The information in this document applies to all versions of the NI-9230 unless otherwise specified.

Related information:

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

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	3000 pF
Internal master timebase (f_M)	
Frequency	13.1072 MHz
Accuracy	±100 ppm
Data rate range (f_S) using internal master timebase	
Minimum	0.985 kS/s
Maximum	12.8 kS/s
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)

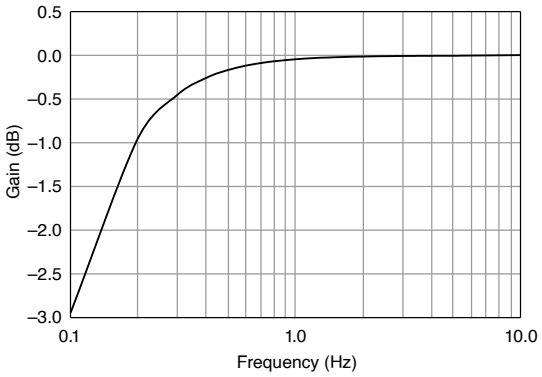
$$\frac{f_M}{2 \times m \times n}$$

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)
AC cutoff frequency	
-3 dB	0.1 Hz
-0.1 dB	0.87 Hz maximum

Figure 2. AC Cutoff Frequency Response



DC voltage input range	
Minimum	±30.87 V

Typical	±31.5 V
Maximum	±32.13 V
AC voltage full-scale range[1]	
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
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

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

where

- $V_{\text{common-mode}}$ is the channel-to-channel common-mode voltage across two or more channels
- V_{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.

IEPE fault detection[2]	
Short circuit	V AI < 1.5 V
Open loop	V AI > 24 V
Overvoltage protection	±45 V for a low impedance source connected between any two terminals
Input delay	
64x decimation	$30/f_s$ + 3.0 µs
128x decimation	$29/f_s$ + 3.0 µs
256x decimation	$28/f_s$ + 3.0 µs

Table 1. Accuracy

Measurement Conditions		Percent of Reading (Gain Error)	Percent of Range[3] (Offset Error)[4]
Calibrated	Maximum (-40 °C to 70 °C)	±0.60%	±0.23%
	Typical (23 °C, ±5 °C)	±0.10%	±0.023%
Uncalibrated[5]	Maximum (-40 °C to 70 °C)	±1.50%	±0.59%
	Typical (23 °C, ±5 °C)	±0.40%	±0.12%

Stability	
Gain drift	±25 ppm/°C
Offset drift (DC coupled)	±320 µV/°C

Table 2. Gain Matching (Calibrated)

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

Table 3. Phase Matching (Maximum)

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

Passband frequency	$0.4 \cdot f_s$

Table 4. Flatness (Peak-to-Peak)

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

Table 5. Phase Nonlinearity (Maximum)

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

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 $256 \cdot f_s$
Rejection at oversample rate[6]	
f_s = 10.24 kS/s	95 dB at 1.311 MHz
f_s = 12.8 kS/s	118 dB at 3.277 MHz
Crosstalk (f_{in} = 1 kHz)	-125 dB
CMRR	

Channel-to-channel (f_{in} ≤ 1 kHz)	56 dB
Channel-to-earth (f_{in} = 60 Hz)	107 dB
SFDR (f_{in} = 1 kHz, -60 dBFS)	
f_s = 12.8 kS/s	122 dBFS
f_s = 11.38 kS/s	118 dBFS
f_s = 10.24 kS/s	120 dBFS

Table 6. Input Noise

Data Rate	12.8 kS/s	11.38 kS/s	10.24 kS/s
AC coupled	106 µV RMS	169 µV RMS	117 µV RMS
DC coupled	97 µV RMS	164 µV RMS	111 µV RMS

Table 7. 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

Input impedance	
Differential	324 kΩ
AI- to isolated ground	50 Ω

Table 8. Total Harmonic Distortion (THD)

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

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 µW maximum

Thermal dissipation (at 70 °C)	
Active mode	1 W maximum
Active mode (BNC variant)	1.5 W maximum
Sleep mode	25 µW 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.)
Dimensions	Visit ni.com/dimensions 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.

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.

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.

Calibration

You can obtain the calibration certificate and information about calibration services for the NI-9230 at ni.com/calibration.

Calibration interval	1 year