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# NI-9228

# Specifications

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# NI-9228 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.

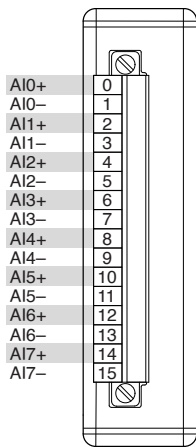
### Related information:

- [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. All voltages are relative to the AI- signal on each channel unless otherwise noted.

## NI-9228 Pinout



**Table 1.** Signal Descriptions

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

## Safety Voltages

Connect only voltages that are within the following limits:

Channel-to-channel isolation	
Up to 2,000 m altitude	
Continuous	250 V RMS, Measurement Category II
Withstand	1,500 V RMS, verified by a 5 s dielectric test
Up to 5,000 m altitude	
Continuous	60 V DC, Measurement Category I
Withstand	1,000 V RMS, verified by a 5 s dielectric test

Division 2 and Zone 2 hazardous locations applications		60 V DC, Measurement Category I
<b>Channel-to-earth ground isolation</b>		
<b>Up to 2,000 m altitude</b>		
Continuous	250 V RMS, Measurement Category II	
Withstand	3,000 V RMS, verified by a 5 s dielectric test	
<b>Up to 5,000 m altitude</b>		
Continuous	60 V DC, Measurement Category I	
Withstand	1,000 V RMS , verified by a 5 s dielectric test	
Division 2 and Zone 2 hazardous locations applications		60 V DC, Measurement Category I

## Measurement Categories

### 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.

## Measurement Category II



**Caution** If using in explosive atmospheres, do not connect the NI-9228 to signals or use for measurements within Measurement Categories II, III, or IV.



**Attention** S'il est utilisé dans des atmosphères explosibles, ne pas

connecter le NI-9228 à des signaux ou l'utiliser pour effectuer des mesures dans les catégories de mesure II, III ou IV.



**Caution** Do not connect the product to signals or use for measurements within Measurement Categories III or IV.



**Attention** Ne pas connecter le produit 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
<b>Shock and Vibration</b>	
<b>Operating vibration</b>	
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

<b>Power consumption from chassis</b>	
Active mode	934 mW maximum
Sleep mode	53 $\mu$ W maximum
<b>Thermal dissipation</b>	
Active mode	1.43 W maximum
Sleep mode	53 $\mu$ W maximum

# Physical Characteristics

If you need to clean the module, wipe it with a dry towel.

Dimensions	Visit <a href="https://ni.com/dimensions">ni.com/dimensions</a> and search by module number.	
<b>Screw-terminal wiring</b>		
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>	
<b>Connector securement</b>		
Securement type	Screw flanges provided	
Torque for screw flanges	0.2 N · m (1.80 lb · in.)	
Weight	152 g (5.36 oz)	

## Input Characteristics

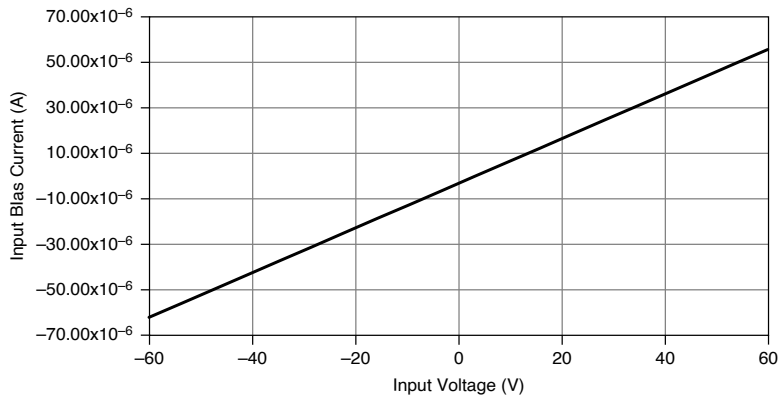
Number of channels	8 analog input channels
ADC resolution	24 bits
Type of ADC	Delta-Sigma
Sampling mode	Simultaneous

**Table 2.** Conversion time (simultaneously sampled)

Timing Mode	Conversion Time (ms)	Sample Rate (S/s)
High resolution	500	2
Medium resolution	83.3	12
Medium speed	10	100
High speed	1	1000

Input voltage ranges, AI+ to AI-	
Typical	$\pm 63.8$ V
Minimum	$\pm 63.2$ V
Overvoltage protection, AI+ to AI-	250 Vrms
Input coupling	DC

**Figure 1. Input Bias Current**



**Table 3. NI-9228 Accuracy**

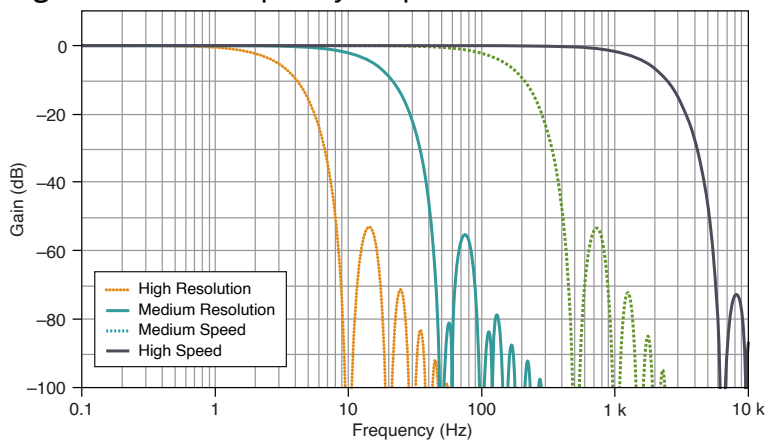
Measurement Conditions		Percent of Reading (Gain Error)	Percent of Range <sup>1</sup> (Offset Error)
Calibrated	Typical (25 °C, ±5 °C)	±0.11%	±0.02%
	Maximum (-40 °C to 70 °C)	±0.40%	±0.06%

Input noise	
High resolution	24 µVrms
Medium resolution	34 µVrms
Medium speed	78 µVrms
High speed	294 µVrms
Stability	
Gain drift	±16 ppm/°C

1. Range equals 63.8 V

Offset drift	$\pm 96 \mu\text{V}/^\circ\text{C}$
Post-calibration gain match ( $f_{in} = 100 \text{ Hz}$ )	$\pm 76 \text{ dB}$ maximum
Phase mismatch, channel-to-channel ( $f_{in} = 100 \text{ Hz}$ )	$\pm 0.002^\circ/\text{Hz}$ maximum
<b>Input delay</b>	
High resolution	199.290 ms
Medium resolution	41.619 ms
Medium speed	3.696 ms
High speed	0.323 ms

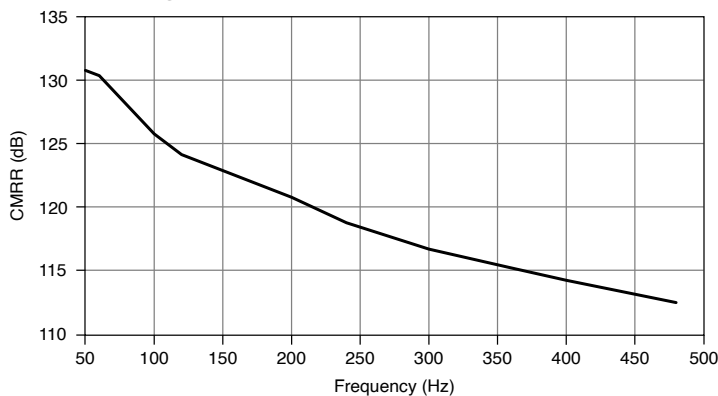
**Figure 1. Filter Frequency Response**



<b>Signal input bandwidth, -3 dB</b>	
High resolution	2.2 Hz

Medium resolution	11.8 Hz
Medium speed	115.3 Hz
High speed	1.3 kHz
<b>Common-Mode Rejection Ratio (CMRR), rejection of channel-to-earth common-mode voltages</b>	
High resolution ( $f_{in} = 50/60$ Hz)	160 dB
Medium resolution ( $f_{in} = 50/60$ Hz)	160 dB
Medium speed ( $f_{in} = 50/60$ Hz)	130 dB
High speed	Refer to the following figure

**Figure 1.** High speed CMRR (0 Hz to 500 Hz)



<b>Normal-Mode Rejection Ratio (NMRR)</b>	
High resolution ( $f_{in} = 50$ Hz $\pm$ 1 Hz or 60 Hz $\pm$ 1 Hz)	120 dB minimum

Medium resolution ( $f_{in} = 50 \text{ Hz} \pm 1 \text{ Hz}$ or $60 \text{ Hz} \pm 1 \text{ Hz}$ )	80 dB minimum
Crosstalk ( $f_{in} = 1 \text{ kHz}$ )	-120 dB
Alias hole rejection ( $f_{in} = 614.4 \text{ kHz}$ )	75 dB

## Calibration

You can obtain the calibration certificate and information about calibration services for the NI-9228 at [ni.com/calibration](https://ni.com/calibration).

Calibration interval	2 years
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