



NI-9250

Specifications



Provided by:

Test & Measurement Automation

Embedded Control & Monitoring

Cyth Systems
9939 Via Pasar
San Diego, CA 92126

phone (858) 537-1960
support@cyth.com



Authorized
Distributor



Integration
Partner

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NI-9250 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.

NI-9250 Pinout

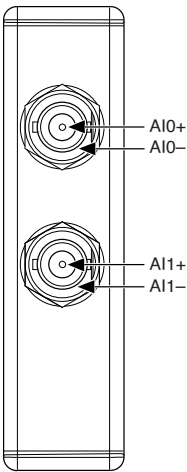


Table 1. Signal Descriptions

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

Input Characteristics

Number of channels	2 analog input channels
ADC resolution	24 bits
Type of ADC	Delta-Sigma with analog prefiltering
Sampling mode	Simultaneous
Input coupling	Software-selectable AC/DC

Type of TEDS supported	IEEE 1451.4 TEDS Class I
TEDS capacitive drive	5,000 pF
Internal master timebase (f_M)	
Frequency	13.1072 MHz
Accuracy	± 100 ppm maximum
Data rate range (f_s)	
Using internal master timebase	
Minimum	267 S/s
Maximum	102.4 kS/s
Using external master timebase	
Minimum	244.141 S/s
Maximum	102.734 kS/s
Data rate	$f_s = \frac{f_M}{4 \times a \times b}$
Input delay ¹	$34/f_s + 2.7 \mu\text{s}$

1. $2.7 \mu\text{s}$ is applicable for DC to 40 kHz in DC coupling and 50 Hz to 40 kHz in AC coupling.

Overvoltage protection		±30 V maximum on one channel at a time
Input impedance		
AI+ to chassis	2 MΩ 280 pF	
AI- to chassis	50 Ω	
Input voltage range		
Minimum	±5 Vpk	
Typical	±5.1 Vpk	
Scaling coefficient	608,896 pV/LSB	
Maximum input voltage		
AI+ to Ground		±5.14 Vpk
AI- to Ground (Common Mode)		±0.11 V
IEPE excitation current (software-selectable on/off)		
Minimum	2 mA	
Typical	2.1 mA	
IEPE excitation noise		70 nArms at 102.4 kS/s

IEPE compliance voltage² If you are using an IEPE sensor, use the following equation to make sure your configuration meets the IEPE compliance voltage range. $(V_{\text{common-mode}} + V_{\text{bias}} \pm V_{\text{full-scale}})$ must be 0 V to 19 V where • $V_{\text{common-mode}}$ is the common-mode voltage applied to the NI-9250 • V_{bias} is the bias voltage of the IEPE sensor • $V_{\text{full-scale}}$ is the full-scale voltage of the IEPE sensor		19 V maximum
High pass filter cutoff frequency (AC)		
-3 dB	0.43 Hz	
-0.1 dB	2.77 Hz	

Figure 1. High Pass Filter Frequency Response

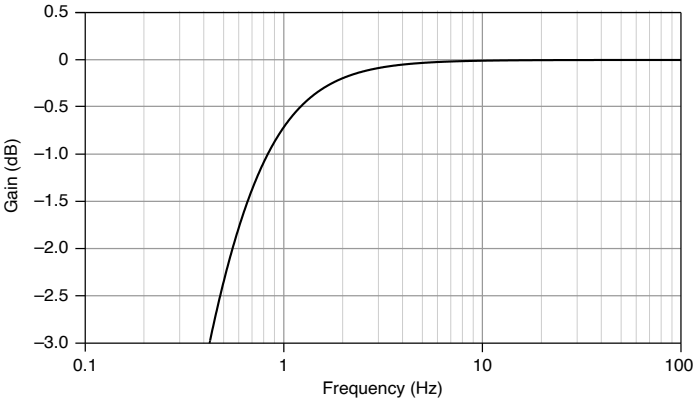


Table 2. Accuracy in DC Coupling

Measurement Conditions	Percent of Reading (Gain Error)	Percent of Range ³ (Offset Error)
Maximum (-40 °C to 70 °C)	±0.20%	±0.15%

- 2.
- 3. Range equals 5 Vpk

Measurement Conditions	Percent of Reading (Gain Error)	Percent of Range (Offset Error)
Typical (23 °C, ±5 °C)	±0.05%	±0.025%

Offset error (AC coupling)	±0.025%
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Stability of Accuracy

Gain drift	5.5 ppm/°C
Offset drift	33 µV/°C

Passband, -0.1 dB

Frequency	$0.4 * f_s$
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Flatness (peak-to-peak)

DC to 20 kHz	0.03 dB maximum, 0.02 dB typical
DC to 40 kHz	0.09 dB maximum, 0.06 dB typical

Phase linearity**DC coupling**

DC to 20 kHz	0.03° maximum
DC to 40 kHz	0.21° maximum

AC coupling

100 Hz to 40 kHz	0.21° maximum
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Channel-to-channel mismatch			
Gain			
DC to 20 kHz		0.065 dB maximum	
DC to 40 kHz		0.11 dB maximum	
Phase (f _{in} in kHz)		f _{in} * 0.035° maximum	
Stopband			
Frequency		0.499 * f _s	
Rejection		105 dB	
Alias free bandwidth			0.5 * f _s
Alias rejection, at oversample rate			
f _s = 102.4 kS/s		100 dB at 3.2768 MHz	
f _s = 267 S/s		80 dB at 273 kHz	

Table 3. Idle Channel Noise

Data Rate (S/s)	ADC Decimation Ratio	AC or DC Coupling (μVrms)	IEPE Mode with AC Coupling (μVrms)
102,400	32	9.9	13.2
51,200	64	6.7	8.7
25,600	128	4.7	6.1

Data Rate (S/s)	ADC Decimation Ratio	AC or DC Coupling (μVrms)	IEPE Mode with AC Coupling (μVrms)
12,800	256	3.4	4.3
6,400	512	2.5	3.1
3,200	1,024	2.0	2.3



Note The noise specifications assume the NI-9250 is using the internal master timebase frequency of 13.1072 MHz.

Spectral noise density	
AC or DC coupling	$\frac{38 \text{ nV}}{\sqrt{\text{Hz}}}$ at 1 kHz
IEPE mode with AC coupling	$\frac{50 \text{ nV}}{\sqrt{\text{Hz}}}$ at 1 kHz

Figure 1. Spectral Noise Density versus Frequency

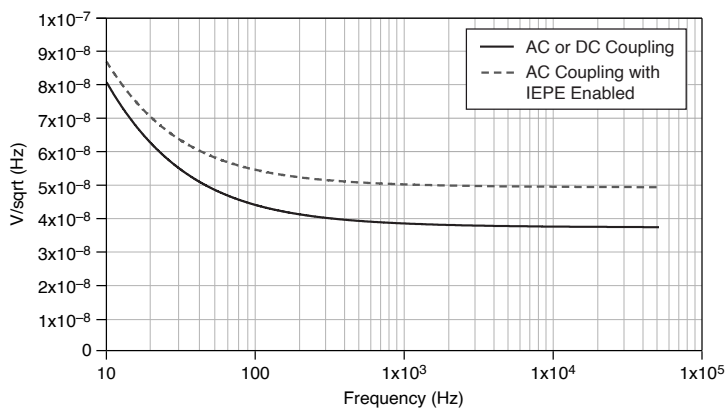


Table 4. Dynamic Range (At 1 kHz Input Frequency, -60 dBFS amplitude, $\text{BW}=0.5 * f_s$)

Data Rate (S/s)	ADC Decimation Ratio	AC or DC Coupled (dBFS)	IEPE Mode with AC Coupling (dBFS) ⁴
102,400	32	111	108
51,200	64	114	112

4. Excluding IEPE current noise

Data Rate (S/s)	ADC Decimation Ratio	AC or DC Coupled (dBFS)	IEPE Mode with AC Coupling (dBFS)
25,600	128	117	115
12,800	256	120	118
6,400	512	123	121
3,200	1,024	125	123

Crosstalk (CH to CH)	
$f_{in} \leq 1 \text{ kHz}$	-145 dB
$f_{in} \leq 20 \text{ kHz}$	-125 dB
$f_{in} \leq 40 \text{ kHz}$	-120 dB
CMRR, $f_{in} \leq 1 \text{ kHz}$	53 dB minimum
Intermodulation distortion (IMD) ⁵	
SMPTE 60 Hz + 7 kHz	-101 dB
CCIF 14 kHz + 15 kHz	-103 dB
Non-harmonic SFDR ⁶	138 dBFS

5. Test standards:

- SMPTE 60 Hz + 7 kHz, amplitude ratio 4:1 with total amplitude at 0 dBFS
- CCIF 14 kHz + 15 kHz, amplitude ratio 1:1 with each tone amplitude at -6 dBFS

Up to fifth order harmonic

6. Tested with 1 kHz-60 dBFS input at 102.4 kS/s

Total Harmonic Distortion (THD) at -1 dBFS	
$f_s = 51.2 \text{ kS/s}$	
1 kHz	-111 dBc
20 Hz to 22 kHz	-109 dBc
$f_s = 102.4 \text{ kS/s}$	
8 kHz	-107 dBc
20 Hz to 44 kHz	-100 dBc

Figure 1. FFT of -1 dBFS, 1 kHz Tone Sampled at 51.2 kS/s (Unaveraged Computation of 65,536 Samples)

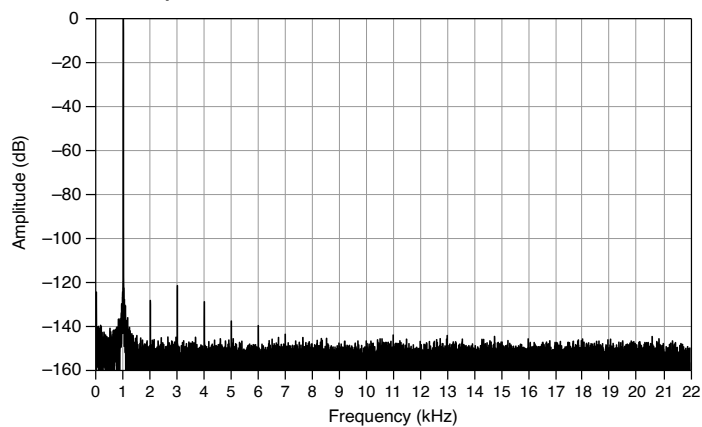


Figure 1. FFT of -1 dBFS, 8 kHz Tone Sampled at 102.4 kS/s (Unaveraged Computation of

262,144 Samples)

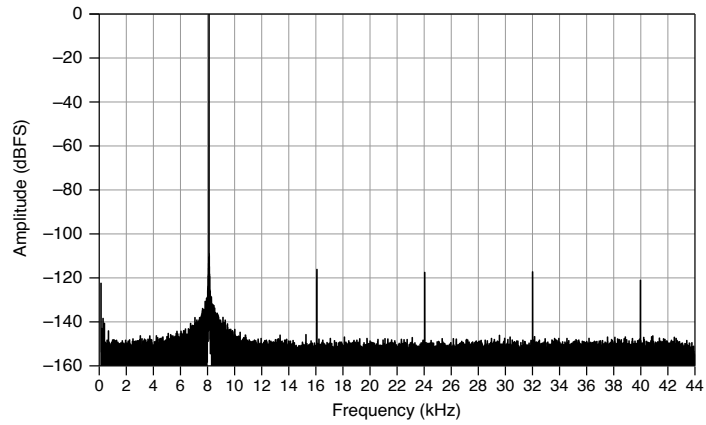
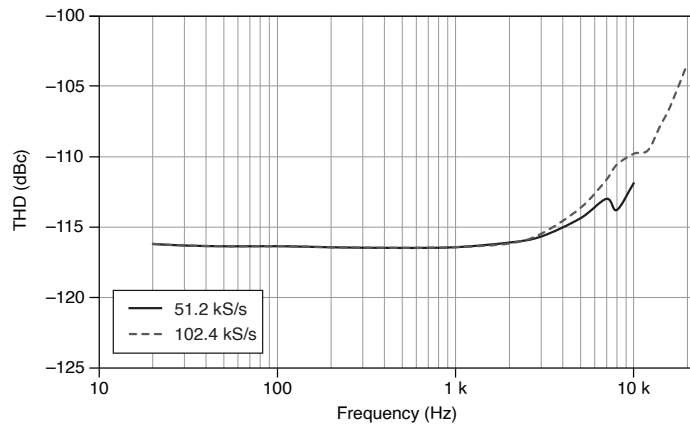
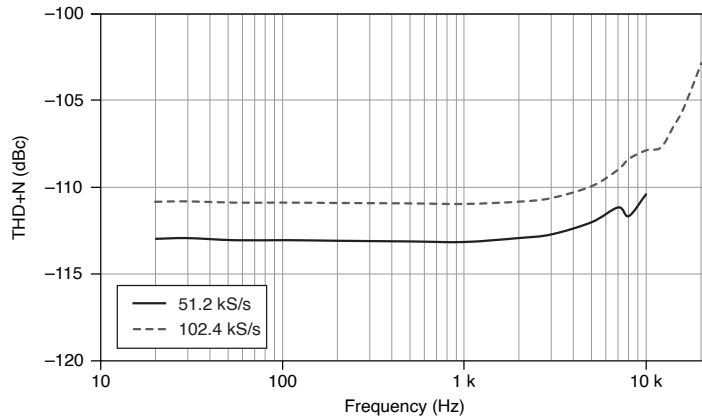


Figure 1. THD versus Frequency



Total Harmonic Distortion + Noise (THD+N) at -1 dBFS	
$f_s = 51.2 \text{ kS/s}$	
1 kHz	-110 dBc
20 Hz to 22 kHz	-108 dBc
$f_s = 102.4 \text{ kS/s}$	
8 kHz	-106 dBc
20 Hz to 44 kHz	-100 dBc

Figure 1. THD+N versus Frequency

Power Requirements

Power consumption from chassis	
Active mode	0.96 W maximum
Sleep mode	53 μ W maximum
Thermal dissipation (at 70 °C)	
Active mode	1.30 W maximum
Sleep mode	0.36 W maximum

Physical Characteristics

Dimensions	Visit ni.com/dimensions and search by module number.
Weight	140 g (4.9 oz)

Safety Voltages

Connect only voltages that are within the following limits:

Channel-to-earth ground	±30 V maximum, Measurement Category I
Isolation	
Channel-to-channel	None
Channel-to-earth ground	None

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-9250 at ni.com/calibration.

Calibration interval	2 years
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