
NI-9250

Specifications

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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.

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]	$34/f_s + 2.7 \mu\text{s}$	
Oversvoltage protection	$\pm 30 \text{ V}$ maximum on one channel at a time	
Input impedance		
AI+ to chassis	$2 \text{ M}\Omega \parallel 280 \text{ pF}$	
AI- to chassis	50Ω	
Input voltage range		
Minimum	$\pm 5 \text{ Vpk}$	
Typical	$\pm 5.1 \text{ Vpk}$	
Scaling coefficient	608,896 pV/LSB	
Maximum input voltage		
AI+ to Ground	$\pm 5.14 \text{ Vpk}$	
AI- to Ground (Common Mode)	$\pm 0.11 \text{ V}$	
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 voltage ^[2]	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

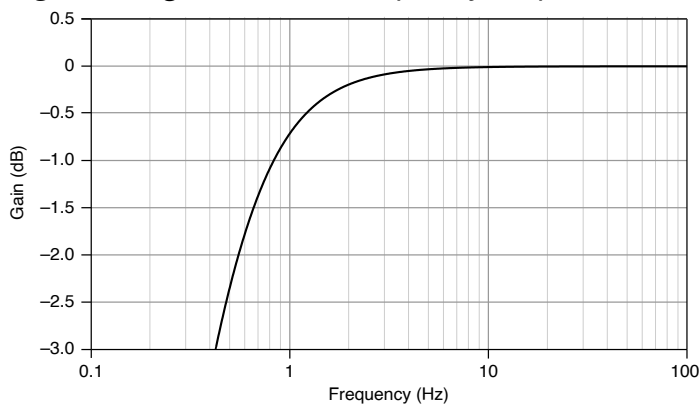


Table 1. Accuracy in DC Coupling

Measurement Conditions	Percent of Reading (Gain Error)	Percent of Range ^[3] (Offset Error)
Maximum (-40 °C to 70 °C)	±0.20%	±0.15%
Typical (23 °C, ±5 °C)	±0.05%	±0.025%

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

Gain drift	5.5 ppm/°C	
Offset drift	33 μ V/°C	
Passband, -0.1 dB		
Frequency	0.4 * f_s	
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	
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)	$f_{in} * 0.035^\circ$ maximum
Stopband	
Frequency	$0.499 * f_s$
Rejection	105 dB
Alias free bandwidth	$0.5 * f_s$
Alias rejection, at oversample rate	
$f_s = 102.4 \text{ kS/s}$	100 dB at 3.2768 MHz
$f_s = 267 \text{ S/s}$	80 dB at 273 kHz

Table 2. 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
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 2. Spectral Noise Density versus Frequency

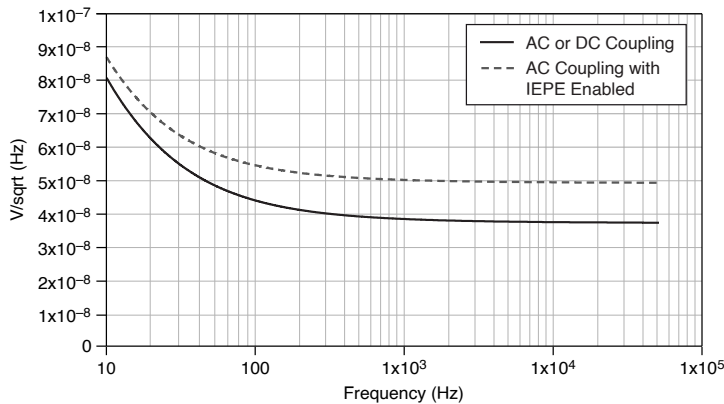


Table 3. Dynamic Range (At 1 kHz Input Frequency, -60 dBFS amplitude, BW=0.5 * f_s)

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

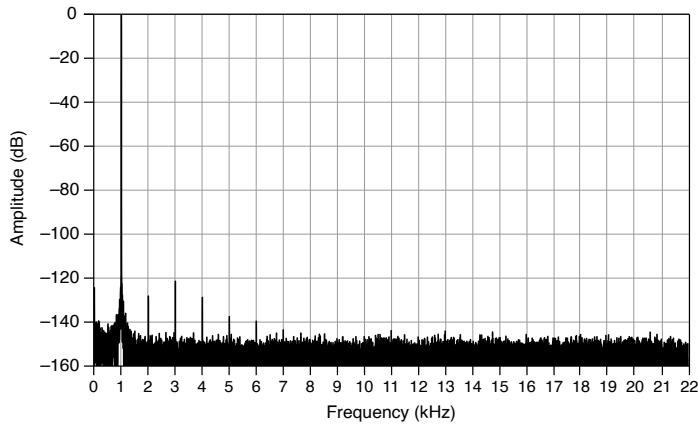


Figure 4. FFT of -1 dBFS, 8 kHz Tone Sampled at 102.4 kS/s (Unaveraged Computation of 262,144 Samples)

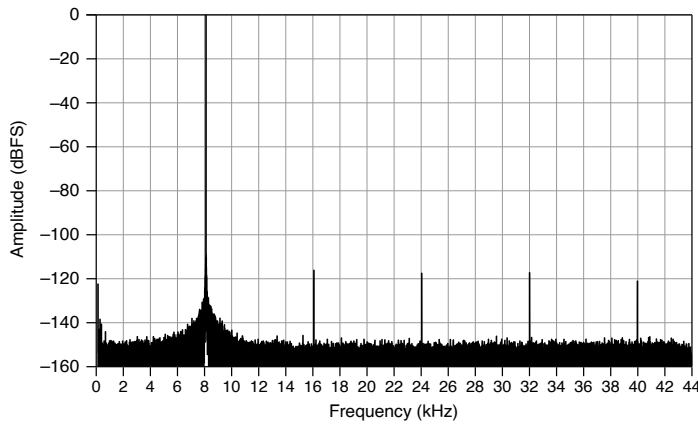
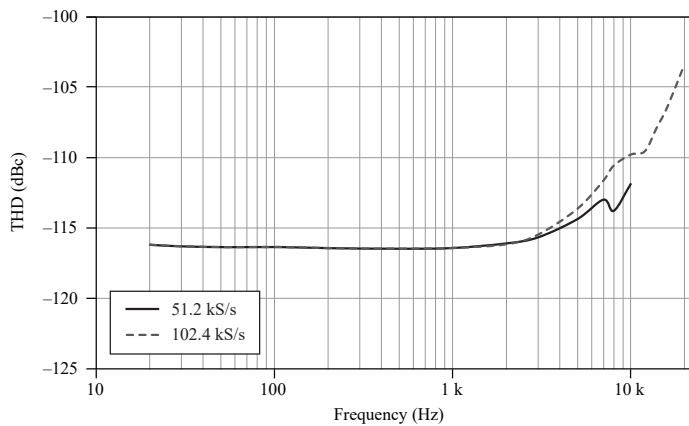


Figure 5. THD versus Frequency

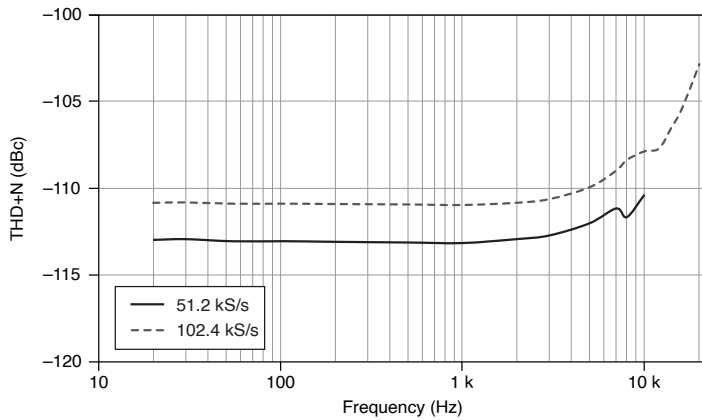


Total Harmonic Distortion + Noise (THD+N) at -1 dBFS

$f_s = 51.2 \text{ kS/s}$

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 6. THD+N versus Frequency



Power Requirements

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

Sleep mode	0.36 W maximum
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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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