NI-9253 Specifications

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Contents

NI-9253 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-9253 Safety Voltages

Connect only voltages that are within the following limits:

AI-to-COM and V_{sup}-to-COM	±30 V DC maximum

Channel-to-channel isolation	None
Channel-to-earth ground isolation[1]	
Continuous	250 V RMS, Measurement Category II
Withstand	3,000 V RMS, verified by a 5 s dielectric withstand test
Overvoltage protection	±30 V, between any two pins of the connector[2]

Caution Do not connect the NI-9253 to signals or use for measurements within Measurement Categories III or IV.

Attention Ne connectez pas le NI-9253 à des signaux et ne l'utilisez pas pour effectuer des mesures dans les catégories de mesure III ou IV.

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

1. Channels include V_{sup} and COM.
2. Only 1 channel at a time.

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

Power Requirements

Power consumption from chassis	
Active mode	798 mW maximum

Sleep mode	48 µW maximum
Thermal dissipation (at 70 °C)	
Active mode	1.5 W maximum
Sleep mode	751 mW maximum

Physical Characteristics

Spring terminal wiring	
Gauge	0.14 mm^2 to 1.5 mm^2 (26 AWG to 16 AWG) copper conductor wire
Wire strip length	10 mm (0.394 in.) of insulation stripped from the end
Temperature rating	90 °C, minimum
Wires per spring terminal	One wire per spring terminal; two wires per spring terminal using a 2-wire ferrule
Ferrules	
Single ferrule, uninsulated	0.14 mm^2 to 1.5 mm^2 (26 AWG to 16 AWG) 10 mm barrel length
Single ferrule, insulated	0.14 mm^2 to 1.0 mm^2 (26 AWG to 18 AWG) 12 mm barrel length
Two-wire ferrule, insulated	2x 0.34 mm^2 (2x 22 AWG) 12 mm barrel length

Connector securement	
Securement type	Screw flanges provided
Torque for screw flanges	0.2 N · m (1.80 lb · in.)

Weight	158 g (5.6 oz)

Input Characteristics

Number of channels	8 analog input channels
ADC resolution	24 bits
Type of ADC	Delta-Sigma with analog prefiltering
Sampling mode	Simultaneous
Internal master timebase (f_M)	
Frequency	12.8 MHz
Accuracy	±50 ppm maximum
CompactRIO & CompactDAQ chassis data rate range (f_s)	
Using internal master timebase	
Minimum	10 S/s

Maximum	50 kS/s
Using external master timebase	
Minimum	0.78 S/s
Maximum	51.367 kS/s
R Series Expansion chassis data rate range (f_s)	
Using internal master timebase	
Minimum	10 S/s
Maximum	25 kS/s
Data rate	$f_s = \frac{f_M}{128 \times a}$
Overvoltage protection[3]	±30 V
Input resistance (AIx to COM)	79 Ω
Input current range	
Minimum	±21.6 mA
Typical	±21.9 mA

3. Only 1 channel at a time.

Scaling coefficients	2615 pA/LSB
Butterworth filter	
Filter order	2nd or 4th order
Cut-off frequencies[4]	$\frac{f_c \times f_M}{12.8\ MHz}$
Flatness[5]	$\frac{f_F \times f_M}{12.8\ MHz}$
Input delay[6]	$\left(t_D - 2.31\ \mu s\right) \times \left(\frac{12.8\ MHz}{f_M}\right) + 2.31\ \mu s$
Input delay tolerance	±200 ns

Table 1. Butterworth Filter Cut-off Frequencies and Flatness

Master Timebase Clock (f_M)	Cut-off Frequencies (f_c)	2nd Order		4th Order	
		0.1% Flatness (f_F) at 0.0087 dB	1% Flatness (f_F) at 0.087 dB	0.1% Flatness (f_F) at 0.0087 dB	1% Flatness (f_F) at 0.087 dB
12.8 MHz	4000 Hz	740 Hz	1445 Hz	1125 Hz	2295 Hz
	2000 Hz	415 Hz	750 Hz	875 Hz	1210 Hz
	1000 Hz	215 Hz	380 Hz	430 Hz	615 Hz
	500 Hz	105 Hz	190 Hz	225 Hz	305 Hz
	250 Hz	55 Hz	95 Hz	115 Hz	155 Hz

4. Refer to Table 1 for the values of f_c and f_M.
5. Refer to Table 1 for the values of f_F and f_M.
6. Refer to Table 2 for the values of t_D and f_M.

Master Timebase Clock (f_M)	Cut-off Frequencies (f_C)	2nd Order		4th Order	
		0.1% Flatness (f_F) at 0.0087 dB	1% Flatness (f_F) at 0.087 dB	0.1% Flatness (f_F) at 0.0087 dB	1% Flatness (f_F) at 0.087 dB
	125 Hz	25 Hz	45 Hz	60 Hz	75 Hz

Note The specifications in Table 1 scale linearly with the master timebase frequency as indicated by the formulas shown in the Butterworth filter section. For example, on a 2nd Order Butterworth filter, for a master timebase clock of 13.1072 MHz, the cut-off frequency is 4096 Hz and 757.7 Hz of 0.1% Flatness instead of the cut-off frequency of 4000 Hz and 740 Hz of 0.1% Flatness at the 12.8 MHz default internal master timebase clock.

Table 2. Butterworth Filter Input Delay

Master Timebase Clock (f_M)	Cut-off Frequencies (f_C)	2nd Order		4th Order	
		DC Delay (t_D)	Maximum Delay (t_D)	DC Delay (t_D)	Maximum Delay (t_D)
12.8 MHz	4000 Hz	98.1 µs	104.7 µs	136.2 µs	158.1 µs
	2000 Hz	153.7 µs	167.0 µs	238.8 µs	282.7 µs
	1000 Hz	266.3 µs	293.0 µs	449.2 µs	538.9 µs
	500 Hz	491.3 µs	544.5 µs	861.6 µs	1038.1 µs
	250 Hz	941.4 µs	1047.8 µs	1700.3 µs	2059.8 µs
	125 Hz	1841.6 µs	2054.3 µs	3347.0 µs	4055.5 µs

Note The specifications in Table 2 scale with the master timebase frequency as indicated by the formulas shown in the Butterworth filter section. For example, a master timebase clock of 13.1072 MHz, the 2nd order Butterworth filter with a 4096 Hz cut-off will have a 98.855 µs input DC delay.

Figure 1. Butterworth Filter Input Delay (4th Order, with 12.8 MHz Timebase, 4000 Hz, 2000 Hz, 1000

Hz)

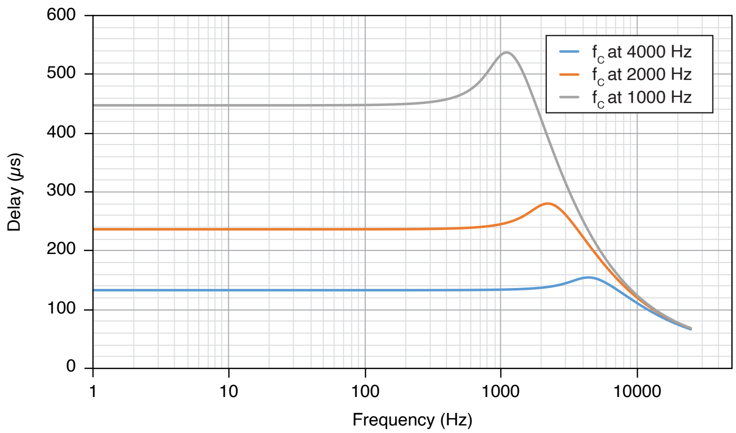


Figure 2. Butterworth Filter Input Delay (4th Order, with 12.8 MHz Timebase, 500 Hz, 250 Hz, 125 Hz)

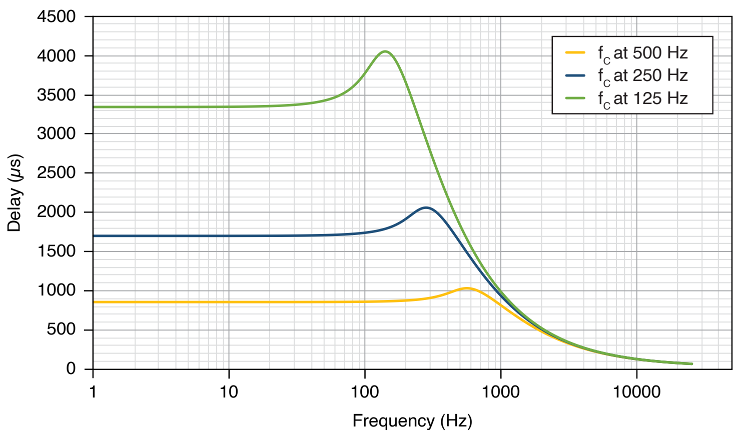


Figure 3. Butterworth Filter Input Delay (2nd Order, with 12.8 MHz Timebase, 4000 Hz, 2000 Hz, 1000 Hz)

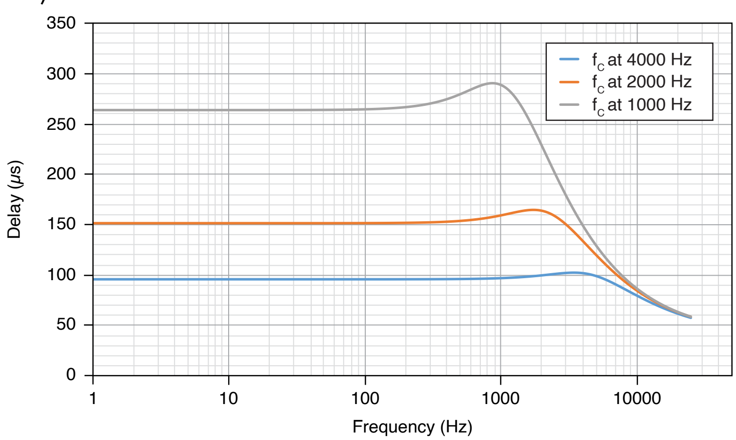
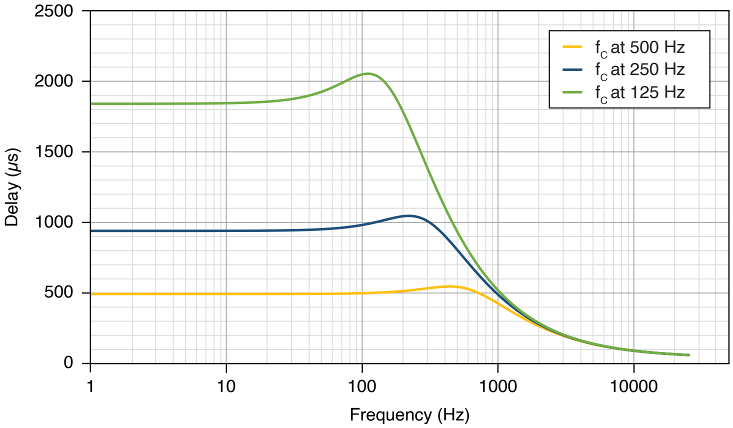


Figure 4. Butterworth Filter Input Delay (2nd Order, with 12.8 MHz Timebase, 500 Hz, 250 Hz, 125 Hz)



Comb filter	
Programmable first notch	f_S, $f_S/2$, $f_S/4$, $f_S/8$, $f_S/16$
Input delay with comb filter [7] 7	$\frac{(A+B)}{f_s} + 2.31\ \mu s$
Settling time with comb filter [7]	$\frac{2(A+B)}{f_s} + 2.31\ \mu s$

Table 3. Input Delay with Comb Filter

Variable	Value
A	2.4 for f_S = 50000
	1.8 for f_S = 14285.71 to 33333.33
	1 for f_S = 2777.78 to 12500
	0.6 for f_S = all other output data rates
B	0 for filter first notch at f_S
	0.5 for filter first notch at $f_S/2$
	1.5 for filter first notch at $f_S/4$
	3.5 for filter first notch at $f_S/8$

7. Refer to the Table 3 table for the values of A and B.

Variable	Value
	7.5 for filter first notch at $f_s/16$

Table 4. DC Accuracy

Measurement Conditions	Percent of Reading (Gain Error)	Percent of Range[8] (Offset Error)
Maximum (-40 °C to 70 °C)	±0.41%	±0.08%
Typical (23 °C, ±5 °C)	±0.14%	±0.02%

Non-linearity	12 ppm
Stability of Accuracy	
Gain drift	12 ppm/°C
Offset drift	81 nA/°C
Passband, -3 dB	Refer to the -3 dB graphs in the ***Filtering*** section
Delay linearity (f_{in} ≤ 24.9 kHz)	11.16 ns maximum
Channel-to-channel mismatch (f_{in} ≤ 24.9 kHz)	
Gain	±0.116 dB maximum
Delay	166.67 ns/kHz maximum
Module-to-module mismatch (f_{in} ≤ 24.9 kHz)	

8. Range equals 21.9 mA

Delay	$166.67\ ns / kHz + \frac{1}{f_M}$
Attenuation @ 2 x oversample rate (23° C)	104 dB

Idle Channel Noise	
Comb filter with first notch at f_S	
f_S = 50 kS/s	130 nA
f_S = 10 kS/s	64 nA
$f_S \leq$ 1 kS/s	39 nA
Butterworth filter, f_S = 50 kS/s	
f_C = 4 kHz	68 nA
f_C = 1 kHz	42 nA
f_C = 125 Hz	30 nA

Note The noise specifications assume the NI-9253 is using the internal master timebase frequency of 12.8 MHz.

Crosstalk (CH to CH)	
f_{in} < 100 Hz	100 dB

f_{in} < 15 kHz	90 dB
Normal mode rejection ratio (NMRR) using internal or external master timebase of 12.8 MHz[9]9	
60 S/s, f_{in} = 60 Hz ± 1 Hz	35 dB minimum
50 S/s, f_{in} = 50 Hz ± 1 Hz	33 dB minimum
10 S/s, f_{in} = 50 Hz/60 Hz ± 1 Hz	35 dB minimum
Normal mode rejection ratio (NMRR) using external master timebase of 13.1072 MHz[9]	
60 S/s, f_{in} = 60 Hz ± 1 Hz	34 dB minimum
50 S/s, f_{in} = 50 Hz ± 1 Hz	33 dB minimum
10 S/s, f_{in} = 50 Hz/60 Hz ± 1 Hz	35 dB minimum
Common mode sensitivity to earth ground	
f_{in} ≤ 60 Hz	0.1 nA/V_{peak}[10]
Field side power detection threshold	
Minimum	7.2 V[11]
Maximum	8.1 V[12]

9. Only applicable for comb filter.
10. This value is how much the module readings change when common mode voltage is applied between the channels and earth ground.

Input Limit Programming Resolution	30.5176 µA

Calibration

You can obtain the calibration certificate and information about calibration services for the NI-9253 at ni.com/calibration.

Calibration interval	2 years

11. Field side power will never be detected if it is below this value.
12. Field side power will always be detected if it is above this value.