NI-9212 with TB-9212 Specifications

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Contents

NI-9212 with TB-9212 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

These specifications are for the NI-9212 used in conjunction with a TB-9212. Specifications are valid under the following conditions unless otherwise noted.

- Ambient temperature range -40 °C to 70 °C
- 15 minutes of warm-up time. The warm-up time assumes the module is not in sleep mode, is facing forward or upward, and is in a constant ambient temperature. NI recommends allowing the full warm-up time.

NI-9212 with TB-9212 Nomenclature

In this article, the TB-9212 with screw terminal and the TB-9212 with mini TC are referred to inclusively as the TB-9212. The information in this article applies to all versions of the TB-9212 unless otherwise specified.

Input Characteristics

Number of channels	
NI-9212	8 isolated thermocouple channels
TB-9212	2 internal cold-junction compensation channels
ADC resolution	24 bits
Type of ADC	Delta-Sigma
Sampling mode	Simultaneous
Voltage measurement range	±78.125 mV
Temperature measurement ranges	Works over temperature ranges defined by NIST (J, K, T, E, N, B, R, and S thermocouple types)

Table 1. Conversion Time (Simultaneously Sampled)

Timing Mode	Conversion Time (ms)	Sample Rate (S/s)
High-resolution	550	1.8
Best 50 Hz rejection	140	7.1

Timing Mode	Conversion Time (ms)	Sample Rate (S/s)
Best 60 Hz rejection	120	8.3
High-speed	10.5	95

Common-mode voltage range	
Channel-to-channel	See ***Isolation Voltages*** for more information
Channel-to-earth ground	See ***Isolation Voltages*** for more information
Common-mode rejection ratio (0 Hz to 1,000 Hz)	
Rejection of channel-to-channel common mode voltages	
High-resolution, best 50 Hz rejection, best 60 Hz rejection	160 dB
High-speed	145 dB
Rejection of channel-to-earth ground common mode voltages	
High-resolution, best 50 Hz rejection, best 60 Hz rejection	145 dB
High-speed	125 dB
Thermocouple signal input bandwidth	
High-resolution	1.0 Hz
Best 50 Hz rejection	4.0 Hz
Best 60 Hz rejection	4.7 Hz

High-speed	31 Hz
Open thermocouple settling time	0.75 s
Noise rejection	
High-resolution (at 50/60 Hz)	74 dB
Best 50 Hz rejection	80 dB
Best 60 Hz rejection	85 dB
Overvoltage protection	±30 V between TC+ and TC-
Differential input impedance	5 MΩ
Input noise	
High-resolution, RMS	85 nV RMS
Best 50 Hz rejection, best 60 Hz rejection, RMS	150 nV RMS
High-speed, RMS	1 µV RMS
Gain error	
23 °C± 5 °C	0.02%, typical

-40 °C to 70 ° C	0.12%, maximum
Offset error	
23 °C± 5 °C	5 µV. typical
-40 °C to 70 °C	14 µV, maximum
Offset error from source impedance with OTD, at 23 °C ±5 °C	Add 37.4 nV per Ω
Input OTD bias current, at 23 °C±5 °C	37.4 nA
Input OTD bias current drift	±12 pA/°C, maximum
Cold-junction compensation accuracy	
TB-9212 with screw terminal	
23 °C ±5 °C	0.25 °C, typical
-20 °C to 70 °C	0.6 °C, maximum
-40 °C to 70 °C	1.1 °C, maximum
TB-9212 with mini TC	
23 °C ±5 °C	0.6 °C, typical
-20 °C to 70 °C	1.2 °C, maximum

-40 °C to 70 °C	1.7 °C, maximum

Temperature Measurement Accuracy

Measurement sensitivity[1]	
High-resolution	
Types J, K, T, E, N	0.01 °C
Types R, S	0.02 °C
Type B	0.03 °C
Best 50/60 Hz rejection	
Types J, K, T, E, N	0.02 °C
Types R, S	0.04 °C
Type B	0.06 °C
High-speed	
Types J, K, T, E	0.05 °C
Type N	0.07 °C
Types R, S	0.18 °C

Type B	0.26 °C

The following thermocouple measurement tables and graphs show the module accuracy for each thermocouple type at 0 V common mode voltage. The tables include all measurement errors of the module and terminal block including RMS noise. The tables do not include the accuracy of the thermocouple itself.

Table 2. TB-9212 with Screw Terminal Thermocouple Type J/N Measurement Accuracy (°C)

Temperature	High-Resolution/Best 50 Hz Rejection/ Best 60 Hz Rejection			High-Speed		
	Typical	Maximum		Typical	Maximum	
	23 °C ± 5 °C	-20 °C to 70 °C	-40 °C to 70 °C	23 °C ± 5 °C	-20 °C to 70 °C	-40 °C to 70 °C
-100 °C	0.57	1.69	1.69	0.59	1.83	2.26
0 °C	0.45	1.27	1.36	0.46	1.37	1.82
100 °C	0.39	1.04	1.29	0.41	1.13	1.70
300 °C	0.36	1.08	1.30	0.38	1.17	1.69
500 °C	0.38	1.25	1.50	0.40	1.31	1.89
700 °C	0.38	1.43	1.58	0.41	1.51	1.91
900 °C	0.41	1.68	1.82	0.44	1.76	2.15
1100 °C	0.46	1.96	2.15	0.50	2.05	2.54

1. ***Measurement sensitivity*** is a function of noise and represents the smallest change in temperature that a sensor can detect. The values assume the maximum of the full measurement range of the standard thermocouple sensor according to NIST Monograph 175.

Table 3. TB-9212 with Mini TC Thermocouple Type J/N Measurement Accuracy (°C)

Temperature	High-Resolution/Best 50 Hz Rejection/ Best 60 Hz Rejection			High-Speed		
	Typical	Maximum		Typical	Maximum	
	23 °C ± 5 °C	-20 °C to 70 °C	-40 °C to 70 °C	23 °C ± 5 °C	-20 °C to 70 °C	-40 °C to 70 °C
-100 °C	1.02	2.52	2.52	1.05	2.65	2.97
0 °C	0.81	1.94	1.94	0.83	2.04	2.40
100 °C	0.71	1.62	1.79	0.73	1.71	2.20
300 °C	0.69	1.61	1.81	0.70	1.68	2.20
500 °C	0.71	1.82	2.01	0.73	1.89	2.40
700 °C	0.67	1.88	2.02	0.69	1.96	2.37
900 °C	0.69	2.12	2.24	0.72	2.21	2.60
1100 °C	0.78	2.51	2.64	0.81	2.58	3.04

Table 4. TB-9212 with Screw Terminal Thermocouple Type K Measurement Accuracy (°C)

Temperature	High-Resolution/Best 50 Hz Rejection/ Best 60 Hz Rejection			High-Speed		
	Typical	Maximum		Typical	Maximum	
	23 °C ± 5 °C	-20 °C to 70 °C	-40 °C to 70 °C	23 °C ± 5 °C	-20 °C to 70 °C	-40 °C to 70 °C
-100 °C	0.51	1.46	1.48	0.53	1.56	2.03
0 °C	0.38	1.01	1.12	0.39	1.09	1.55
100 °C	0.37	0.90	1.19	0.38	1.00	1.60
300 °C	0.40	1.13	1.40	0.41	1.21	1.82
700 °C	0.45	1.59	1.84	0.48	1.68	2.26
900 °C	0.50	1.91	2.15	0.54	2.00	2.60
1100 °C	0.56	2.26	2.50	0.60	2.36	2.98
1400 °C	0.67	2.84	3.10	0.72	2.96	3.63

Table 5. TB-9212 with Mini TC Thermocouple Type K Measurement Accuracy (°C)

Temperature	High-Resolution/Best 50 Hz Rejection/ Best 60 Hz Rejection			High-Speed		
	Typical	Maximum		Typical	Maximum	
	23 °C ± 5 °C	-20 °C to 70 °C	-40 °C to 70 °C	23 °C ± 5 °C	-20 °C to 70 °C	-40 °C to 70 °C
-100 °C	0.98	2.27	2.27	1.00	2.37	2.75
0 °C	0.73	1.64	1.68	0.75	1.72	2.10
100 °C	0.71	1.51	1.73	0.73	1.58	2.14
300 °C	0.74	1.73	1.94	0.76	1.81	2.35
700 °C	0.79	2.19	2.37	0.82	2.27	2.79
900 °C	0.86	2.53	2.70	0.89	2.62	3.15
1100 °C	0.94	2.92	3.09	0.98	3.02	3.56
1400 °C	1.09	3.57	3.75	1.14	3.70	4.28

Table 6. TB-9212 with Screw Terminal Thermocouple Type T/E Measurement Accuracy (°C)

Temperature	High-Resolution/Best 50 Hz Rejection/ Best 60 Hz Rejection			High-Speed		
	Typical	Maximum		Typical	Maximum	
	23 °C ± 5 °C	-20 °C to 70 °C	-40 °C to 70 °C	23 °C ± 5 °C	-20 °C to 70 °C	-40 °C to 70 °C
-100 °C	0.55	1.63	1.63	0.57	1.75	2.11
0 °C	0.39	1.10	1.12	0.41	1.18	1.54
100 °C	0.33	0.84	1.03	0.34	0.91	1.38
300 °C	0.29	0.89	1.05	0.31	0.95	1.37
500 °C	0.31	1.07	1.23	0.33	1.12	1.54
700 °C	0.35	1.32	1.48	0.37	1.38	1.79
900 °C	0.39	1.61	1.76	0.42	1.67	2.09

Table 7. TB-9212 with Mini TC Thermocouple Type T/E Measurement Accuracy (°C)

Temperature	High-Resolution/Best 50 Hz Rejection/ Best 60 Hz Rejection			High-Speed		
	Typical	Maximum		Typical	Maximum	
	23 °C ± 5 °C	-20 °C to 70 °C	-40 °C to 70 °C	23 °C ± 5 °C	-20 °C to 70 °C	-40 °C to 70 °C
-100 °C	1.06	2.59	2.59	1.08	2.70	2.84
0 °C	0.77	1.81	1.81	0.78	1.89	2.09
100 °C	0.64	1.43	1.48	0.65	1.49	1.83
300 °C	0.57	1.38	1.47	0.58	1.43	1.78
500 °C	0.58	1.56	1.63	0.60	1.61	1.94
700 °C	0.62	1.82	1.88	0.64	1.88	2.20
900 °C	0.67	2.12	2.18	0.70	2.19	2.51

Table 8. TB-9212 with Screw Terminal Thermocouple Type R/S Measurement Accuracy (°C)

Temperature	High-Resolution/Best 50 Hz Rejection/ Best 60 Hz Rejection			High-Speed		
	Typical	Maximum		Typical	Maximum	
	23 °C ± 5 °C	-20 °C to 70 °C	-40 °C to 70 °C	23 °C ± 5 °C	-20 °C to 70 °C	-40 °C to 70 °C
0 °C	1.17	3.64	3.64	1.25	4.05	4.08
100 °C	0.85	2.60	2.60	0.91	2.90	3.10
300 °C	0.71	2.31	2.31	0.76	2.56	2.71
500 °C	0.68	2.36	2.36	0.74	2.59	2.71
700 °C	0.67	2.44	2.44	0.73	2.66	2.77
900 °C	0.66	2.52	2.52	0.72	2.73	2.82
1100 °C	0.66	2.62	2.62	0.71	2.82	2.89
1400 °C	0.68	2.90	2.90	0.75	3.11	3.16

Table 9. TB-9212 with Mini TC Thermocouple Type R/S Measurement Accuracy (°C)

Temperature	High-Resolution/Best 50 Hz Rejection/ Best 60 Hz Rejection			High-Speed		
	Typical	Maximum		Typical	Maximum	
	23 °C ± 5 °C	-20 °C to 70 °C	-40 °C to 70 °C	23 °C ± 5 °C	-20 °C to 70 °C	-40 °C to 70 °C
0 °C	1.58	4.41	4.41	1.66	4.82	4.82
100 °C	1.15	3.18	3.18	1.21	3.47	3.47
300 °C	0.95	2.77	2.77	1.00	3.02	3.02
500 °C	0.90	2.79	2.79	0.96	3.02	3.02
700 °C	0.88	2.85	2.85	0.93	3.07	3.07
900 °C	0.85	2.90	2.90	0.91	3.11	3.11
1100 °C	0.84	2.98	2.98	0.90	3.18	3.18
1400 °C	0.86	3.25	3.25	0.93	3.46	3.46

Table 10. TB-9212 with Screw Terminal Thermocouple Type B Measurement Accuracy (°C)

Temperature	High-Resolution/Best 50 Hz Rejection/ Best 60 Hz Rejection			High-Speed		
	Typical	Maximum		Typical	Maximum	
	23 °C ± 5 °C	-20 °C to 70 °C	-40 °C to 70 °C	23 °C ± 5 °C	-20 °C to 70 °C	-40 °C to 70 °C
300 °C	1.55	5.27	5.27	1.70	5.93	5.93
500 °C	0.97	3.39	3.39	1.05	3.80	3.80
700 °C	0.77	2.74	2.74	0.84	3.05	3.05
900 °C	0.63	2.41	2.41	0.69	2.66	2.66
1100 °C	0.57	2.30	2.30	0.62	2.52	2.52
1400 °C	0.53	2.32	2.32	0.59	2.52	2.52

Table 11. TB-9212 with Mini TC Thermocouple Type B Measurement Accuracy (°C)

Temperature	High-Resolution/Best 50 Hz Rejection/ Best 60 Hz Rejection			High-Speed		
	Typical	Maximum		Typical	Maximum	
	23 °C ± 5 °C	-20 °C to 70 °C	-40 °C to 70 °C	23 °C ± 5 °C	-20 °C to 70 °C	-40 °C to 70 °C
300 °C	1.57	5.38	5.38	1.72	6.04	6.04
500 °C	0.98	3.46	3.46	1.07	3.87	3.87
700 °C	0.77	2.79	2.79	0.84	3.10	3.10
900 °C	0.63	2.45	2.45	0.69	2.71	2.71
1100 °C	0.57	2.33	2.33	0.63	2.55	2.55
1400 °C	0.54	2.35	2.35	0.59	2.55	2.55

Figure 1. TB-9212 with Screw Terminal Thermocouple Error Typical (High-Resolution, Best 50/60 Hz Rejection), 23 °C ±5 °C

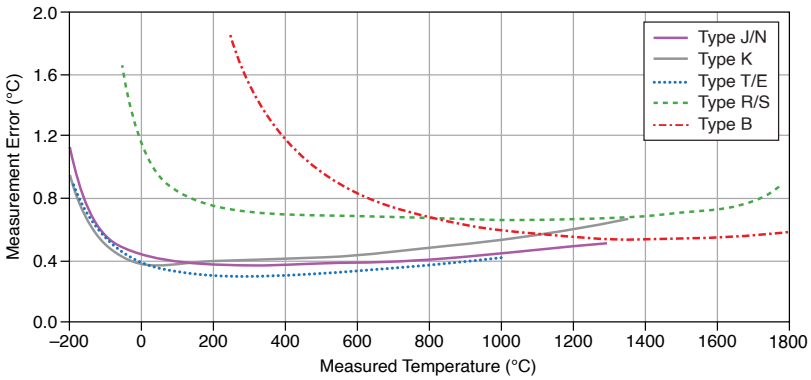


Figure 2. TB-9212 with Mini TC Thermocouple Error Typical (High-Resolution, Best 50/60 Hz Rejection), 23 °C ±5 °C

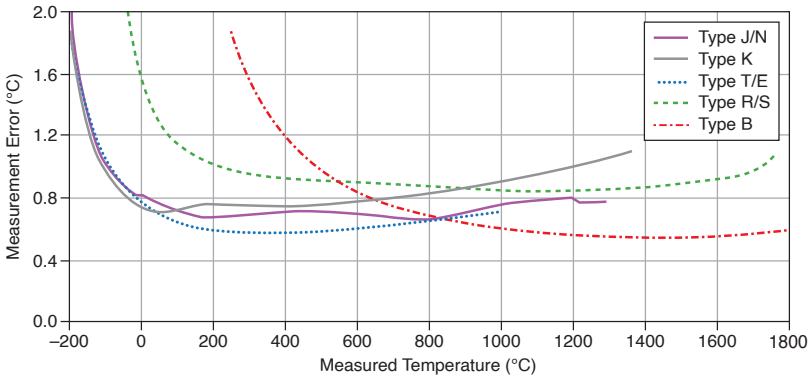


Figure 3. TB-9212 with Screw Terminal Thermocouple Error Typical (High-Speed), 23 °C ±5 °C

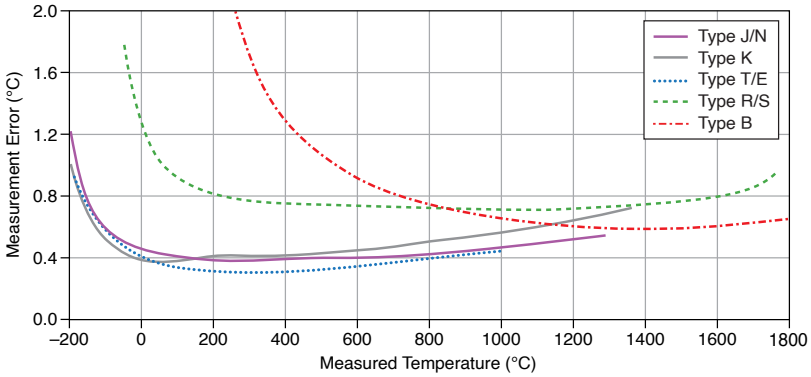


Figure 4. TB-9212 with Mini TC Thermocouple Error Typical (High-Speed), 23 °C ±5 °C

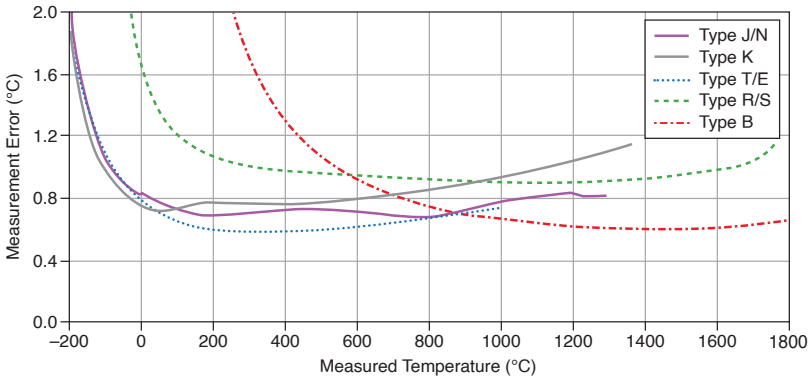


Figure 5. TB-9212 with Screw Terminal Thermocouple Error Maximum (High-Resolution, Best 50/60 Hz Rejection), -20 °C to 70 °C

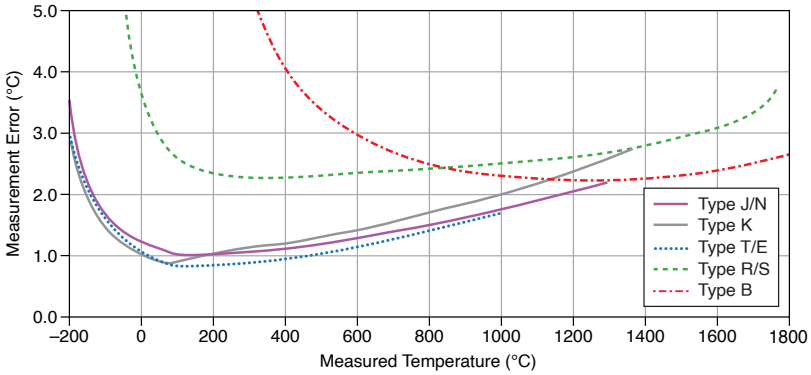


Figure 6. TB-9212 with Mini TC Thermocouple Error Maximum (High-Resolution, Best 50/60 Hz Rejection), -20 °C to 70 °C

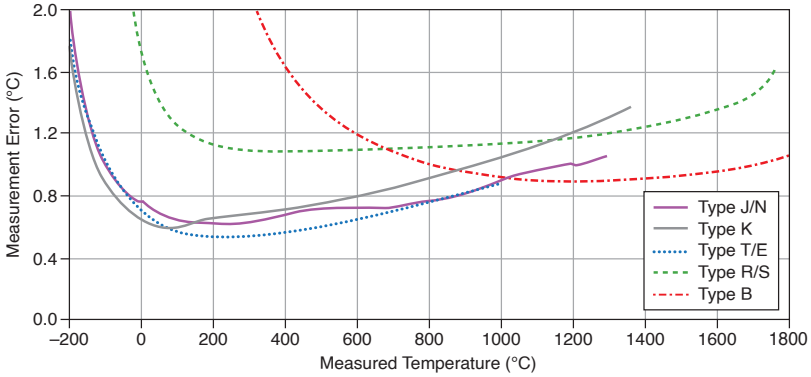


Figure 7. TB-9212 with Screw Terminal Thermocouple Error Maximum (High-Speed), -20 °C to 70 °C

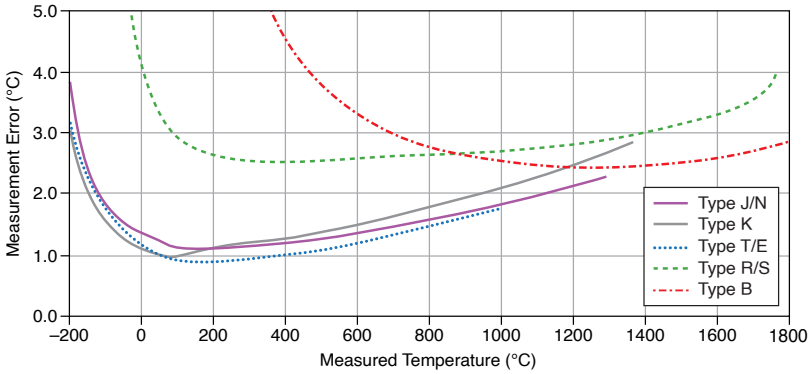
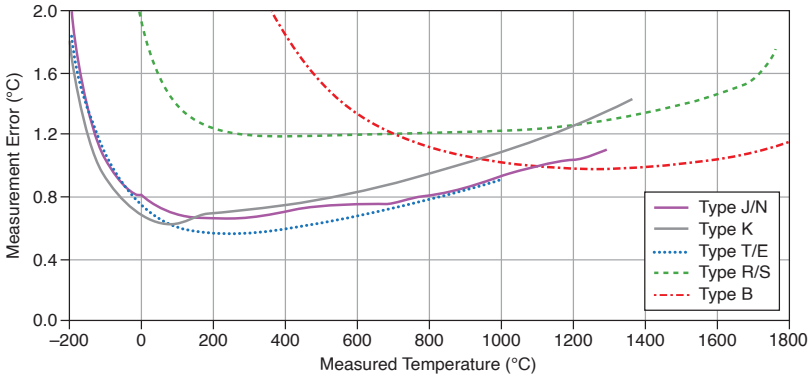


Figure 8. TB-9212 with Mini TC Thermocouple Error Maximum (High-Speed), -20 °C to 70 °C



Isolation Voltages

NI-9212 and TB-9212 with Screw Terminal Isolation Voltages

Connect only voltages that are within the following limits:

Channel-to-channel isolation	
Up to 2,000 m altitude	
Continuous, for use in nonexplosive atmospheres	250 V RMS, Measurement Category II
Continuous, for use in explosive atmospheres	60 V DC, Measurement Category I
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
Channel-to-earth ground isolation	
Up to 2,000 m altitude	
Continuous, for use in nonexplosive atmospheres	250 V RMS, Measurement Category II
Continuous, for use in explosive atmospheres	60 V DC, Measurement Category I
Withstand	3,000 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

NI-9212 and TB-9212 with Mini TC Isolation Voltages

Connect only voltages that are within the following limits:

Channel-to-channel isolation, up to 5,000 m altitude	
Continuous	60 V DC, Measurement Category I
Withstand	1,000 V RMS
Channel-to-earth ground isolation, up to 5,000 m altitude	

Continuous	60 V DC, Measurement Category I
Withstand	1,000 V RMS

Measurement Category

Measurement Category I

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

Attention Ne pas connecter le produit à des signaux dans les catégories de mesure II, III ou IV et ne pas l'utiliser pour effectuer des mesures dans ces catégories.

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 For use in explosive atmospheres, do not connect the NI-9212 and TB-9212 with screw terminal to signals or use for measurements within Measurement Categories II, III, or IV.

Attention Lorsque vous utilisez le NI-9212 et TB-9212 avec bornier à vis dans des atmosphères explosibles, ne le connectez pas à des signaux et ne l'utilisez pas 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
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.

Power Requirements

Power consumption from chassis	
Active mode	670 mW maximum
Sleep mode	30 µW maximum
Thermal dissipation (at 70 °C)	
Active mode	1090 mW maximum
Sleep mode	480 mW maximum

Physical Characteristics

Screw-terminal wiring	
Gauge	0.05 mm^2 to 0.5 mm^2 (30 AWG to 20 AWG) copper conductor wire
Wire strip length	

Outer insulation	51 mm (2.0 in.) of insulation stripped from the end
Inner insulation	5.1 mm (0.2 in.) of insulation stripped from the end
Temperature rating	90 °C minimum
Torque for screw terminals	0.3 N · m (2.66 lb · in.)
Wires per screw terminal	One wire per screw terminal
TB-9212 securement	
Securement type	Jackscrews provided
Torque for jackscrews	0.4 N · m (3.6 lb · in.)
Dimensions	Visit ni.com/dimensions and search by module number.
Weight	
NI-9212	150 g (5.29 oz)
TB-9212 with screw terminal	92 g (3.25 oz)
TB-9212 with mini TC	120 g (4.23 oz)

Calibration

You can obtain the calibration certificate and information about calibration services for the NI-9212 at ni.com/calibration.

Calibration interval	1 year