# NI-9213 Specifications

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# Contents

# NI-9213 Specifications

## Connector Types

The NI-9213 is available in two types: push-in spring terminal and spring terminal. The push-in type spring terminal connector is black and orange. The spring terminal connector is black. NI-9213 refers to both types unless the two types are specified. Differences between the two types of spring terminal connectors are noted by the connector color.

### Related information:

- Software Support for CompactRIO, CompactDAQ, Single-Board RIO, R Series, and EtherCAT

## 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.

## Input Characteristics

| | |
|---|---|
| Number of channels | 16 thermocouple channels, 1 internal autozero channel, 1 internal cold-junction compensation channel |

| | |
|---|---|
| ADC resolution | 24 bits |
| Type of ADC | Delta-Sigma |
| Sampling mode | Scanned |
| Voltage measurement range | ±78.125 mV |
| Temperature measurement ranges | Works over temperature ranges defined by NIST (J, K, T, E, N, B, R, S thermocouple types) |

**Table 1.** Timing Modes

| Timing Mode | Conversion Time (Per Channel) | Sample Rate[1] (All Channels[2]) |
|---|---|---|
| High-resolution | 55 ms | 1 S/s |
| High-speed | 740 µs | 75 S/s |

| | |
|---|---|
| **Common-mode voltage range** | |
| Channel-to-COM | ±1.2 V minimum |
| COM-to-earth ground | ±250 V |
| **Common-mode rejection ratio** | |
| **High-resolution mode (at DC and 50 Hz to 60 Hz)** | |
| Channel-to-COM | 100 dB |
| COM-to-earth ground | >170 dB |
| **High-speed mode (at 0 Hz to 60 Hz)** | |
| Channel-to-COM | 70 dB |

[1] If you are using fewer than all channels, the sample rate might be faster. The maximum sample rate = 1/(Conversion Time x Number of Channels), or 100 S/s, whichever is smaller. Sampling faster than the maximum sample rate may result in the degradation of accuracy.

[2] Including the autozero and cold-junction channels.

| | |
|---|---|
| COM-to-earth ground | >150 dB |
| **Input bandwidth** | |
| High-resolution mode | 14.4 Hz |
| High-speed mode | 78 Hz |
| High-resolution noise rejection (at 50 Hz and 60 Hz) | 60 dB |
| Overvoltage protection | ±30 V between any two inputs |
| Differential input impedance | 78 MΩ |
| Input current | 50 nA |
| **Input noise** | |
| High-resolution mode | 200 nV RMS |
| High-speed mode | 7 µV RMS |
| **Gain error** | |
| **High-resolution mode** | |
| at 25 °C | 0.03% typical |
| at -40 °C to 70 °C | 0.07% typical, 0.15% maximum |
| **High-speed mode** | |
| at 25 °C | 0.04% typical |
| at -40 °C to 70 °C | 0.08% typical, 0.16% maximum |
| **Offset error** | |

| | |
|---|---|
| High-resolution mode | 4 µV typical, 6 µV maximum |
| High-speed mode | 14 µV typical, 17 µV maximum |
| Offset error from source impedance | Add 0.05 µV per Ω, when source impedance >50 Ω |
| **Cold-junction compensation accuracy** | |
| 0 °C to 70 °C | 0.8 °C typical, 1.7 °C maximum |
| -40 °C to 70 °C | 1.1 °C typical, 2.1 °C maximum |
| MTBF | 852,407 hours at 25 °C;<br>Bellcore Issue 2, Method 1, Case 3, Limited Part Stress Method |

# Temperature Measurement Accuracy

| | |
|---|---|
| **Measurement sensitivity[3]** | |
| **High-resolution mode** | |
| Types J, K, T, E, N | <0.02 °C |
| Types B, R, S | <0.15 °C |
| **High-speed mode** | |
| Types J, K, T, E | <0.25 °C |
| Type N | <0.35 °C |
| Type B | <1.2 °C |

[3] Measurement sensitivity represents the smallest change in a temperature that a sensor can detect. It is a function of noise. The values assume the full measurement range of the standard thermocouple sensor according to ASTM E230-87.

| | |
|---|---|
| Types R, S | <2.8 °C |

The following figures show the errors for each thermocouple type when connected to the NI-9213 with the autozero channel on. The figures display the maximum errors over a full temperature range and typical errors at room temperature. The figures account for gain errors, offset errors, differential and integral nonlinearity, quantization errors, noise errors, 50 Ω lead wire resistance, and cold-junction compensation errors. The figures do not account for the accuracy of the thermocouple itself.

**Figure 1.** Thermocouple Types J and N Errors

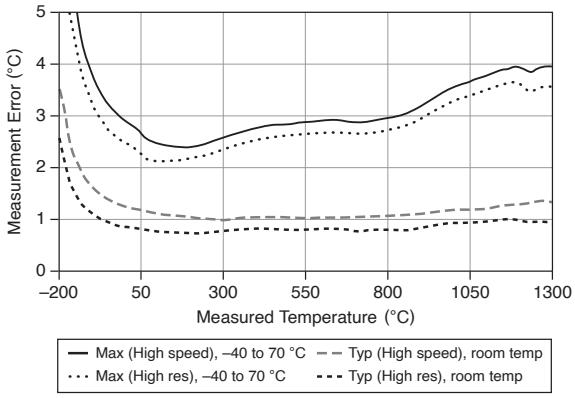



**Figure 2.** Thermocouple Type K Errors

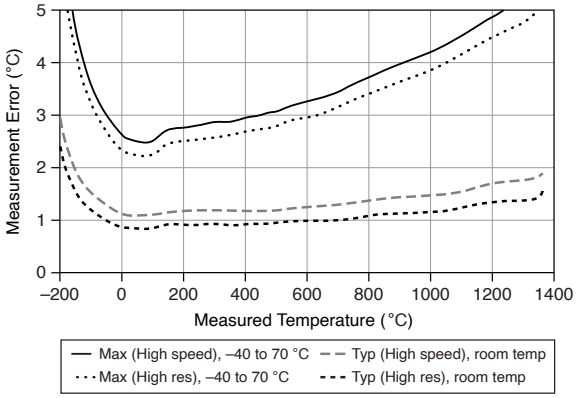


**Figure 3.** Thermocouple Types T and E Errors

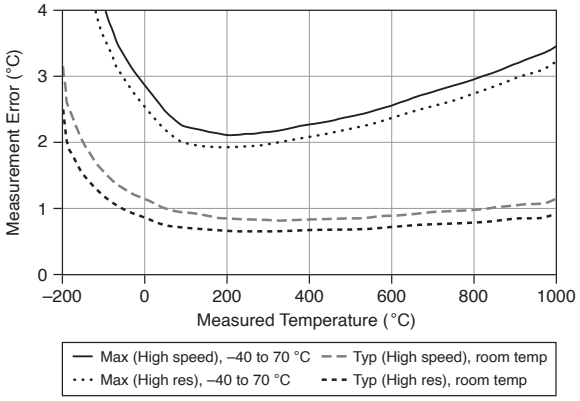



**Figure 4.** Thermocouple Type B Errors

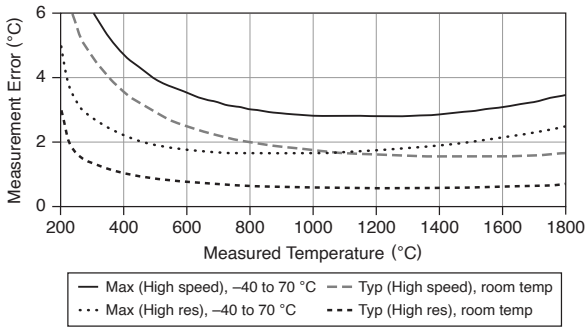
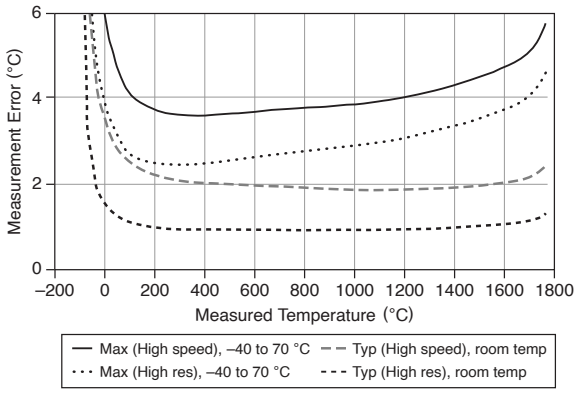



**Figure 5.** Thermocouple Types R and S Errors




# Power Requirements

| **Power consumption from chassis** | |
|---|---|
| Active mode | 490 mW maximum |

| | |
|---|---|
| Sleep mode | 25 µW maximum |
| **Thermal dissipation (at 70 °C)** | |
| Active mode | 840 mW maximum |
| Sleep mode | 710 mW maximum |

# Physical Characteristics

| **Weight** | |
|---|---|
| NI-9213 (black connector) | 159 g (5.6 oz) |
| NI-9213 (black/orange connector) | 164 g (5.8 oz) |
| Dimensions | Visit ni.com/dimensions and search by module number. |

## Black Connector

The NI-9213 (black connector) requires a flathead screwdriver with a 2.3 mm × 1.0 mm (0.09 in. × 0.04 in.) blade for signal connection; insert the screwdriver into a spring clamp activation slot to open the corresponding connector terminal, press a wire into the open connector terminal, and then remove the screwdriver from the activation slot to clamp the wire into place.

| **Spring terminal wiring** | |
|---|---|
| Gauge | 0.08 mm to 1.0 mm (28 AWG to 18 AWG) copper conductor wire |
| Wire strip length | 7 mm (0.28 in.) of insulation stripped from the end |

| | |
|---|---|
| Temperature rating | 90 °C minimum |
| Wires per spring terminal | One wire per spring terminal |
| **Connector securement** | |
| Securement type | Screw flanges provided |
| Torque for screw flanges | 0.2 N · m (1.80 lb · in.) |

## Black/Orange Connector

The push-in spring style NI-9213 does not require a tool for signal connection; push the wire into the terminal when using solid wire or stranded wire with a ferrule, or by pressing the push button when using stranded wire without a ferrule.

| | |
|---|---|
| **Spring terminal wiring** | |
| Gauge | 0.14 mm to 1.5 mm (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 | 0.14 mm to 1.5 mm |
| **Connector securement** | |
| Securement type | Screw flanges provided |
| Torque for screw flanges | 0.2 N · m (1.80 lb · in.) |

# 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** | |
| NI-9213 (black connector) | 2,000 m |
| NI-9213 (black/orange connector) | 4,000 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;<br>18 shocks at 6 orientations |

To meet these shock and vibration specifications, you must panel mount the system.

# NI-9213 (Black Connector) Safety Voltages

Connect only voltages that are within the following limits:

| | |
|---|---|
| Between any two terminals | ±30 V maximum |
| **Isolation** | |
| Channel-to-channel | None |
| **Channel-to-earth ground** | |
| Continuous | 250 V RMS, Measurement Category II |
| Withstand | 2,300 V RMS, verified by a 5 s dielectric withstand test |

# NI-9213 (Black/Orange Connector) Safety Voltages

Connect only voltages that are within the following limits:

| | |
|---|---|
| Channel-to-channel | None |
| **Channel-to-earth ground** | |
| Continuous | 250 V RMS, Measurement Category II |
| Withstand up to 4,000 m | 3,000 V RMS, verified by a 5 s dielectric withstand test |

# Calibration

You can obtain the calibration certificate and information about calibration services for the NI-9213 at ni.com/calibration.

| | |
|---|---|
| Calibration interval | 1 year |

# Conditions

Specifications are valid under the following conditions unless otherwise noted.

- Ambient temperature range -40 °C to 70 °C
- 15 minutes of warm-up time