# NI-9213 Specifications

# Contents

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These specifications apply to the NI-9213.

## Revision History

| Version | Date changed | Description |
|---|---|---|
| 378914B-01 | February 2025 | Updated gain error and offset error tables. |
| 378914A-01 | June 2023 | Initial release. |

## Looking For Something Else?

For information not found in the specifications for your product, such as operating instructions, browse **Related Information**.

**Related information:**

- NI-9213 Getting Started
- Software Support for CompactRIO, CompactDAQ, Single-Board RIO, R Series, and EtherCAT
- NI-9213 Calibration Procedure
- Calibration Services
- Software and Driver Downloads
- Dimensional Drawings
- Product Certifications
- Letter of Volatility
- Discussion Forums
- NI Learning Center

# 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.

# 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

# 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.
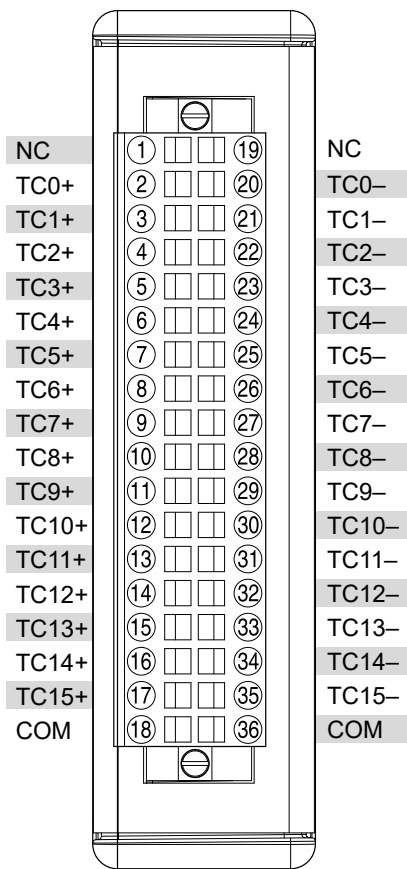
# NI-9213 (Black Connector) Pinout

| NC | ① | ⑲ | NC |
| TC0+ | ② | ⑳ | TC0– |
| TC1+ | ③ | ㉑ | TC1– |
| TC2+ | ④ | ㉒ | TC2– |
| TC3+ | ⑤ | ㉓ | TC3– |
| TC4+ | ⑥ | ㉔ | TC4– |
| TC5+ | ⑦ | ㉕ | TC5– |
| TC6+ | ⑧ | ㉖ | TC6– |
| TC7+ | ⑨ | ㉗ | TC7– |
| TC8+ | ⑩ | ㉘ | TC8– |
| TC9+ | ⑪ | ㉙ | TC9– |
| TC10+ | ⑫ | ㉚ | TC10– |
| TC11+ | ⑬ | ㉛ | TC11– |
| TC12+ | ⑭ | ㉜ | TC12– |
| TC13+ | ⑮ | ㉝ | TC13– |
| TC14+ | ⑯ | ㉞ | TC14– |
| TC15+ | ⑰ | ㉟ | TC15– |
| COM | ⑱ | ㊱ | COM |

Table 1. Signal Descriptions

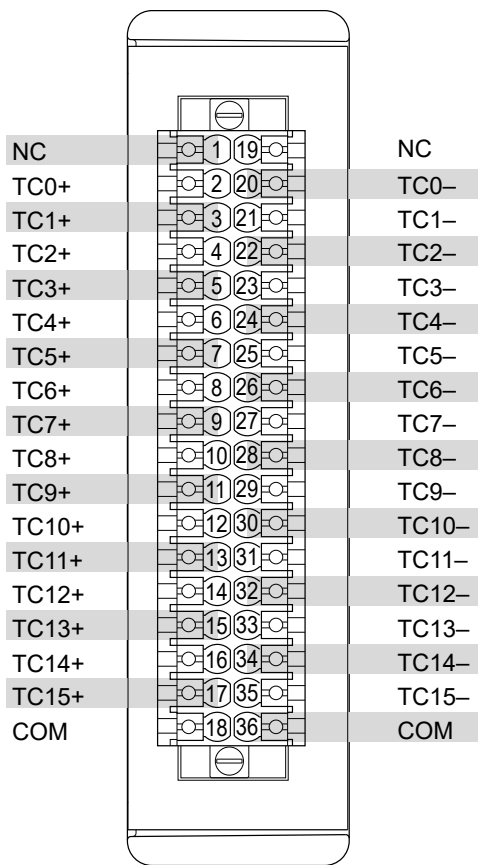| Signal | Description |
| --- | --- |
| COM | Common reference connection |
| NC | No connection |
| TC+ | Positive thermocouple connection |
| TC- | Negative thermocouple connection |

# NI-9213 (Black/Orange Connector) Pinout

| | | |
|---|---|---|
| NC | 1   19 | NC |
| TC0+ | 2   20 | TC0– |
| TC1+ | 3   21 | TC1– |
| TC2+ | 4   22 | TC2– |
| TC3+ | 5   23 | TC3– |
| TC4+ | 6   24 | TC4– |
| TC5+ | 7   25 | TC5– |
| TC6+ | 8   26 | TC6– |
| TC7+ | 9   27 | TC7– |
| TC8+ | 10   28 | TC8– |
| TC9+ | 11   29 | TC9– |
| TC10+ | 12   30 | TC10– |
| TC11+ | 13   31 | TC11– |
| TC12+ | 14   32 | TC12– |
| TC13+ | 15   33 | TC13– |
| TC14+ | 16   34 | TC14– |
| TC15+ | 17   35 | TC15– |
| COM | 18   36 | COM |

Table 2. Signal Descriptions

| Signal | Description |
|---|---|
| COM | Common reference connection |
| NC | No connection |
| TC+ | Positive thermocouple connection |
| TC- | Negative thermocouple connection |

# Input Characteristics

| | |
|---|---|
| Number of channels | 16 thermocouple channels, 1 internal auto-zero 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 3. 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 |

Table 4. Common-Mode Voltage Range

| Connection | Common-Mode Voltage Range |
|---|---|
| Channel-to-COM | ±1.2 V |
| COM-to-earth ground | ±250 V |

Table 5. Common-Mode Rejection Ratio (CMRR)

| Timing Mode | Measurement Conditions | Channel | CMRR |
|---|---|---|---|
| High-resolution | DC and 50 Hz to 60 Hz | Channel-to-COM | 100 dB |
| | | COM-to-earth ground | >170 dB |
| High-speed | 0 Hz to 60 Hz | Channel-to-COM | 70 dB |
| | | COM-to-earth ground | >150 dB |

Table 6. Input Bandwidth

| Timing Mode | Input Bandwidth |
|---|---|
| High-resolution | 14.4 Hz |
| High-speed | 78 Hz |

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 auto-zero and cold-junction channels.

| 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 |

Table 7. Input Noise

| Timing Mode | Input Noise |
|---|---|
| High-resolution | 200 nV RMS |
| High-speed | 7 µV RMS |

Table 8. Gain Error

| Timing Mode | Measurement Conditions | Within 1 Year of Calibration | | Within 10 Years of Calibration | |
|---|---|---|---|---|---|
| | | Typical | Maximum | Typical | Maximum |
| High-resolution | 25 °C | 0.03% | — | 0.08% | — |
| | -40 °C to 70 °C | 0.07% | 0.15% | 0.13% | 0.20% |
| High-speed | 25 °C | 0.04% | — | 0.09% | — |
| | -40 °C to 70 °C | 0.08% | 0.16% | 0.14% | 0.21% |

> **Note** NI recommends a calibration interval of 1 year and only provides calibration services referencing the 1-year specification limits. If you choose to calibrate less often, the 10-year column provides predicted performance over this extended interval. Choose an appropriate interval based on your application requirements. Longer calibration intervals are more likely to result in As-Found calibration failures when the device is sent back for calibration and compared against the 1-year specification limits.

Table 9. Offset Error

| Timing Mode | Within 1 Year of Calibration | | Within 10 Years of Calibration | |
|---|---|---|---|---|
| | Typical | Maximum | Typical | Maximum |
| High-resolution | 4 µV | 6 µV | 4 µV | 6 µV |

| Timing Mode | Within 1 Year of Calibration | | Within 10 Years of Calibration | |
|---|---|---|---|---|
| | **Typical** | **Maximum** | **Typical** | **Maximum** |
| High-speed | 14 µV | 17 µV | 14 µV | 17 µV |

| Offset error from source impedance | Add 0.05 µV per Ω, when source impedance >50 Ω |
|---|---|

Table 10. Cold-Junction Compensation Accuracy

| Measurement Conditions | Within 1 Year of Calibration | | Within 10 Years of Calibration | |
|---|---|---|---|---|
| | **Typical** | **Maximum** | **Typical** | **Maximum** |
| 0 °C to 70 °C | 0.8 °C | 1.7 °C | 0.8 °C | 1.7 °C |
| -40 °C to 70 °C | 1.1 °C | 2.1 °C | 1.1 °C | 2.1 °C |

| MTBF | 852,407 hours at 25 °C; Bellcore Issue 2, Method 1, Case 3, Limited Part Stress Method |
|---|---|

# Temperature Measurement Accuracy

Table 11. Measurement Sensitivity

| Timing Mode | Thermocouple Types | Measurement Sensitivity[3] |
|---|---|---|
| High-resolution | J, K, T, E, N | <0.02 °C |
| | B, R, S | <0.15 °C |
| High-speed | J, K, T, E | <0.25 °C |
| | N | <0.35 °C |
| | B | <1.2 °C |
| | R,S | <2.8 °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.

The following figures show the errors for each thermocouple type when connected to the NI-9213 with the auto-zero 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 non-linearity, 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
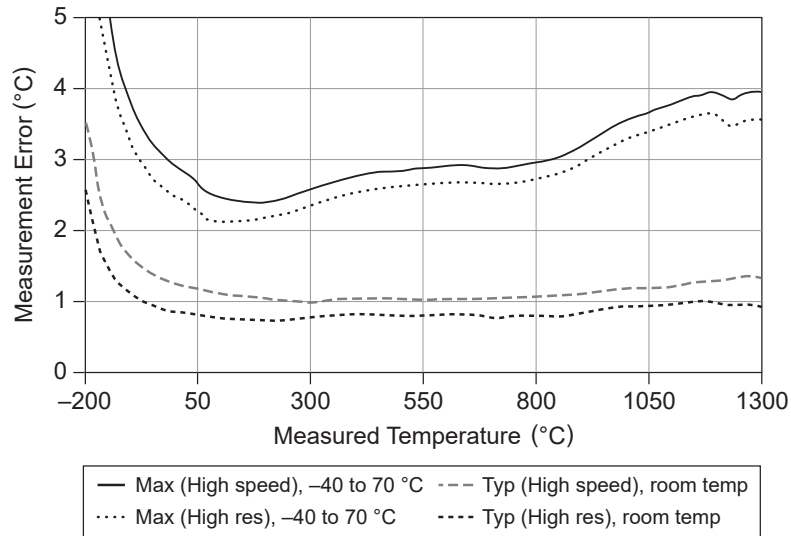


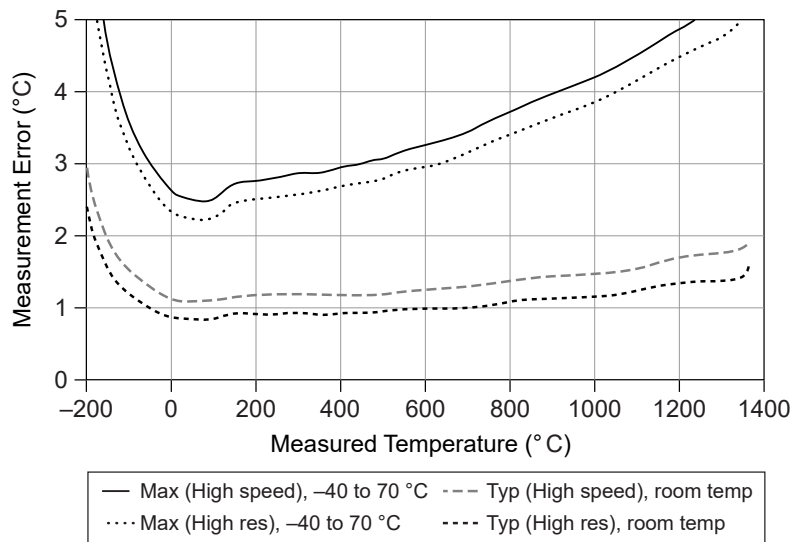Figure 2. Thermocouple Type K Errors

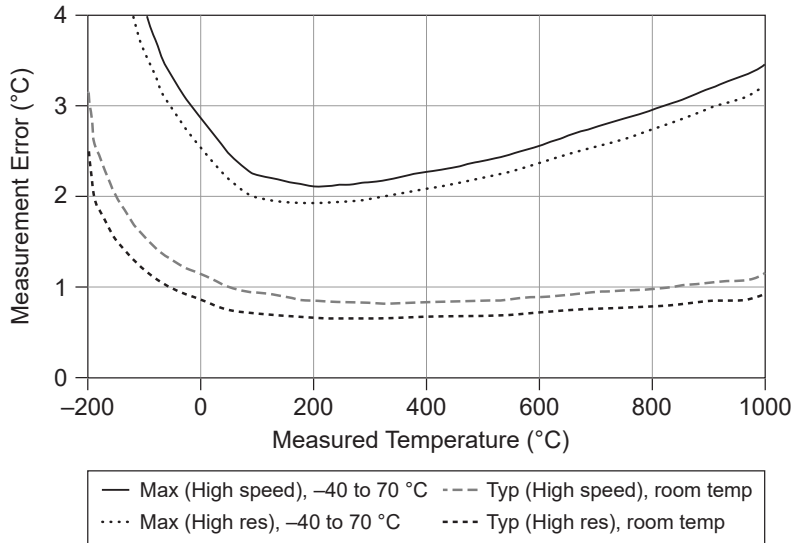Figure 3. Thermocouple Types T and E Errors
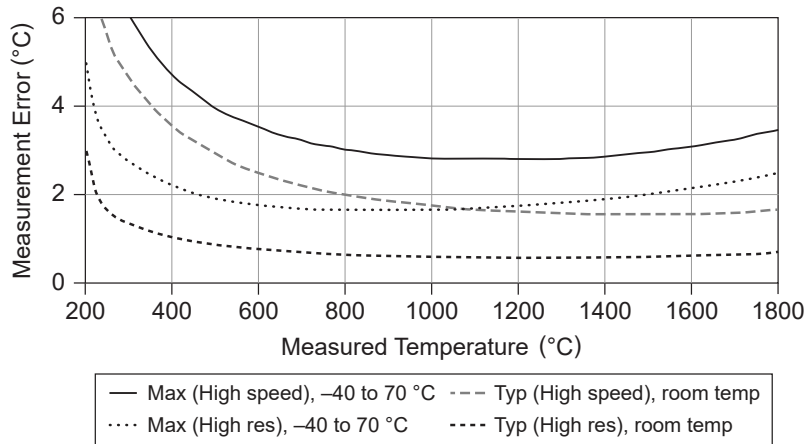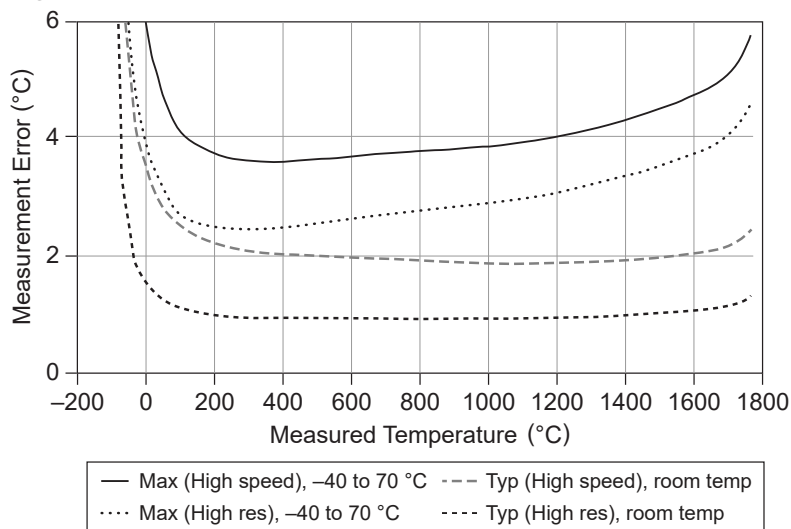


Figure 4. Thermocouple Type B Errors



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$^2$ to 1.0 mm$^2$ (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$^2$ 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 | 0.14 mm$^2$ to 1.5 mm$^2$ |

| 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; 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.

| Recommended calibration interval | 1 year |
|----------------------------------|--------|