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# NI-9204

# Specifications

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# NI-9204 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.

## Conditions

Specifications are valid for the range -40 °C to 70 °C unless otherwise noted. All voltages are relative to COM unless otherwise noted.

## NI-9204 with Push-in Style Spring Terminal (Black/Orange Connector) Pinout

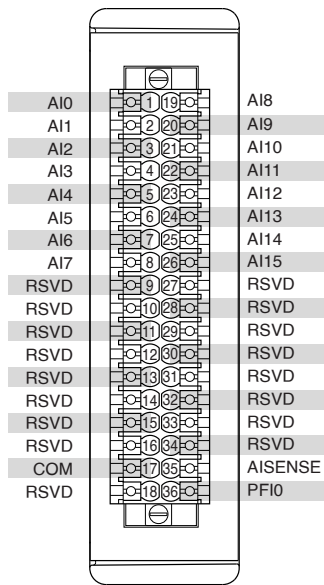


Table 1. Signal Descriptions

| Signal  | Description                                                      |
|---------|------------------------------------------------------------------|
| AI      | Analog input signal connection                                   |
| AISENSE | Reference connection for NRSE measurements                       |
| COM     | Common reference connection to isolated ground                   |
| PFI     | Programmable function interface, digital input signal connection |
| RSVD    | Reserved connection; do not connect any signal                   |

## NI-9204 with DSUB Pinout

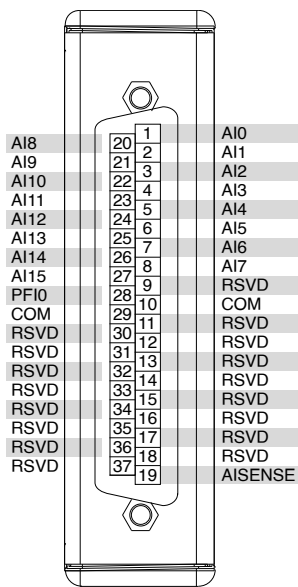


Table 2. Signal Descriptions

| Signal  | Description                                                      |
|---------|------------------------------------------------------------------|
| AI      | Analog input signal connection                                   |
| AISENSE | Reference connection for NRSE measurements                       |
| COM     | Common reference connection to isolated ground                   |
| PFI     | Programmable function interface, digital input signal connection |
| RSVD    | Reserved connection; do not connect any signal                   |

## Connector Types

The NI-9204 has more than one connector type: NI-9204 with spring terminal and NI-9204 with DSUB. Unless the connector type is specified, NI-9204 refers to all connector types.

## Analog Input Characteristics

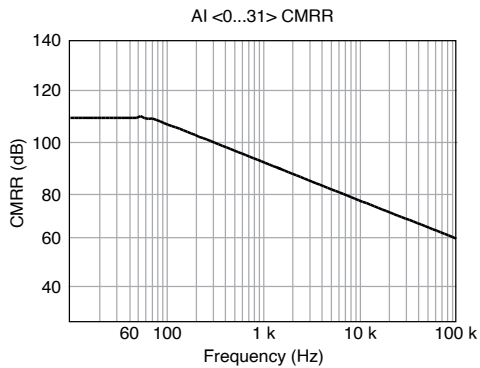
|                    |                                         |
|--------------------|-----------------------------------------|
| Number of channels | 8 differential/16 single-ended channels |
|--------------------|-----------------------------------------|

|                                                                  |                                                     |
|------------------------------------------------------------------|-----------------------------------------------------|
| ADC resolution                                                   | 16 bits                                             |
| DNL                                                              | No missing codes guaranteed                         |
| <b>Conversion time (maximum sampling rate)</b>                   |                                                     |
| CompactRIO & CompactDAQ chassis                                  | 4.00 $\mu$ s (250 kS/s)                             |
| R Series Expansion chassis                                       | 4.50 $\mu$ s (222 kS/s)                             |
| Input coupling                                                   | DC                                                  |
| Nominal input ranges                                             | $\pm 10$ V, $\pm 5$ V, $\pm 1$ V, $\pm 0.2$ V       |
| Minimum overrange, $\pm 10$ V range                              | 4%                                                  |
| Maximum working voltage for analog inputs (signal + common mode) | Each channel must remain within $\pm 10.4$ V of COM |
| <b>Input impedance (AI-to-COM)</b>                               |                                                     |
| Powered on                                                       | $>10$ G $\Omega$ in parallel with 100 pF            |
| Powered off/overload                                             | 4.7 k $\Omega$ minimum                              |
| Input bias current                                               | $\pm 100$ pA                                        |
| <b>Crosstalk, at 100 kHz</b>                                     |                                                     |

|                                                                   |                         |        |
|-------------------------------------------------------------------|-------------------------|--------|
| Adjacent channels                                                 |                         | -65 dB |
| Non-adjacent channels                                             |                         | -70 dB |
| Analog bandwidth                                                  | 370 kHz                 |        |
| Overvoltage protection                                            |                         |        |
| AI channel, 0 to 15                                               | ±30 V, one channel only |        |
| AISENSE                                                           | ±30 V                   |        |
| Settling time for multichannel measurements, accuracy, all ranges |                         |        |
| ±120 ppm of full-scale step, ±8 LSB                               | 4 μs convert interval   |        |
| ±30 ppm of full-scale step, ±2 LSB                                | 8 μs convert interval   |        |
| Analog triggers                                                   |                         |        |
| Number of triggers                                                | 1                       |        |
| Resolution                                                        | 10 bits, 1 in 1,024     |        |
| Bandwidth, -3 dB                                                  | 370 kHz                 |        |
| Accuracy                                                          | ±1% of full scale       |        |
| Scaling coefficients                                              |                         |        |

|                   |                                |
|-------------------|--------------------------------|
| $\pm 10$ V range  | 328 $\mu\text{V}/\text{LSB}$   |
| $\pm 5$ V range   | 164.2 $\mu\text{V}/\text{LSB}$ |
| $\pm 1$ V range   | 32.8 $\mu\text{V}/\text{LSB}$  |
| $\pm 0.2$ V range | 6.57 $\mu\text{V}/\text{LSB}$  |
| CMRR, DC to 60 Hz | 100 dB                         |

**Figure 1. CMRR, AI+ to AI-**



## Analog Input Absolute Accuracy

The following values are based on calibrated scaling coefficients, which are stored in the onboard EEPROM.

**Table 3. Absolute Accuracy**

| Range  | Accuracy at Full Scale <sup>1</sup> |                       | Random Noise, <sup>4</sup> σ | Sensitivity <sup>5</sup> |
|--------|-------------------------------------|-----------------------|------------------------------|--------------------------|
|        | 2 Years <sup>2</sup>                | 10 Years <sup>3</sup> |                              |                          |
| ±10 V  | 6,230 μV                            | 7280 μV               | 237 μV RMS                   | 96.0 μV                  |
| ±5 V   | 3,230 μV                            | 3750 μV               | 121 μV RMS                   | 46.4 μV                  |
| ±1 V   | 692 μV                              | 800 μV                | 29 μV RMS                    | 10.4 μV                  |
| ±0.2 V | 175 μV                              | 195 μV                | 15 μV RMS                    | 4.0 μV                   |

| Residual Gain Error (ppm of Reading) |                      |                       |
|--------------------------------------|----------------------|-----------------------|
|                                      | 2 Years <sup>6</sup> | 10 Years <sup>7</sup> |
| ±10 V range                          | 115 ppm              | 220 ppm               |
| ±5 V range                           | 135 ppm              | 240 ppm               |
| ±1 V range                           | 155 ppm              | 260 ppm               |
| ±0.2 V range                         | 215 ppm              | 320 ppm               |

|                              |           |
|------------------------------|-----------|
| Gain tempco                  | 11 ppm/°C |
| Reference tempco             | 5 ppm/°C  |
| <b>Residual offset error</b> |           |

1. Absolute accuracy values at full scale on the analog input channels assume the device is operating within 70 °C of the last external calibration and are valid for averaging 100 samples immediately following self-calibration.
2. 2 Years and 10 Years are the estimated specifications drift in time and does not constitute any recommendations on calibration interval.
3. 2 Years and 10 Years are the estimated specifications drift in time and does not constitute any recommendations on calibration interval.
4. Differential mode.
5. Sensitivity is a function of noise and indicates the smallest voltage change that can be detected.
6. 2 Years and 10 Years are the estimated specifications drift in time and does not constitute any recommendations on calibration interval.
7. 2 Years and 10 Years are the estimated specifications drift in time and does not constitute any recommendations on calibration interval.

|                      |                     |
|----------------------|---------------------|
| ±10 V range          | 20 ppm of range     |
| ±5 V range           | 20 ppm of range     |
| ±1 V range           | 25 ppm of range     |
| ±0.2 V range         | 40 ppm of range     |
| <b>Offset tempco</b> |                     |
| ±10 V range          | 44 ppm of range/°C  |
| ±5 V range           | 47 ppm of range/°C  |
| ±1 V range           | 66 ppm of range/°C  |
| ±0.2 V range         | 162 ppm of range/°C |
| INL error            | 76 ppm of range     |

## Analog Input Accuracy Formulas

***Absolute Accuracy = Reading \* Gain Error + Range \* Offset Error + Noise Uncertainty***

where

- ***Gain Error = Residual Gain Error + Gain Tempco \* Temp Change from Last Internal Cal + Reference Tempco \* Temp Change from Last***

### External Cal

- **Offset Error** = **Residual Offset Error** + **Offset Tempco** \* **Temp Change from Last Internal Cal** + **INL Error**
- **Noise Uncertainty** = (**Random Noise** \* 3) /  $\sqrt{100}$  for a coverage factor of 3  $\sigma$  and averaging 100 points

Absolute accuracy at full scale on the analog input channels is determined using the following assumptions:

- **Temp Change from Last External Cal** = 70 °C
- **Temp Change from Last Internal Cal** = 1 °C
- **Number of Readings** = 100
- **Coverage Factor** = 3  $\sigma$

For example, on the  $\pm 10$  V range, the absolute accuracy at full scale is as follows:

- **Gain Error** = 115 ppm + 11 ppm \* 1 + 5 ppm \* 70
- **Gain Error** = 476 ppm
- **Offset Error** = 20 ppm + 44 ppm \* 1 + 76 ppm
- **Offset Error** = 140 ppm
- **Noise Uncertainty** = (237  $\mu$ V \* 3) /  $\sqrt{100}$
- **Noise Uncertainty** = 72  $\mu$ V
- **Absolute Accuracy** = 10 V \* 476 ppm + 10 V \* 140 ppm + 72  $\mu$ V
- **Absolute Accuracy** = 6,231  $\mu$ V, rounds to 6,230  $\mu$ V

## Digital Characteristics

|                        |                         |
|------------------------|-------------------------|
| Number of channels     | 1 digital input channel |
| Overvoltage protection | $\pm 30$ V              |
| Digital logic levels   |                         |
| Input high, $V_{IH}$   |                         |

|                                       |                |
|---------------------------------------|----------------|
| Minimum                               | 2.0 V          |
| Maximum                               | 3.3 V          |
| <b>Input low, <math>V_{IL}</math></b> |                |
| Minimum                               | 0 V            |
| Maximum                               | 0.34 V         |
| <b>External digital triggers</b>      |                |
| Source                                | PFI0           |
| Delay                                 | 100 ns maximum |

## Safety Voltages

Connect only voltages that are within the following limits:

|                                    |          |
|------------------------------------|----------|
| <b>Maximum voltage<sup>8</sup></b> |          |
| Channel-to-COM                     | ±30 V DC |

8. The maximum voltage that can be applied or output between AI and COM without creating a safety hazard.

## NI-9204 with Push-in Style Spring Terminal (Black/Orange Connector) Isolation Voltages

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

## NI-9204 with DSUB Isolation Voltages

|                                |                                                          |
|--------------------------------|----------------------------------------------------------|
| Channel-to-channel             | None                                                     |
| <b>Channel-to-earth ground</b> |                                                          |
| Continuous                     | 60 V DC, Measurement Category I                          |
| Withstand up to 2,000 m        | 1,000 V RMS, verified by a 5 s dielectric withstand test |
| Withstand up to 5,000 m        | 500 V RMS                                                |

## Measurement Category

### Measurement Category I



**Caution** Do not connect the NI-9204 with DSUB to signals or use for measurements within Measurement Categories II, III, or IV.



**Attention** Ne pas connecter le NI-9204 with DSUB 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 NI-9204 with DSUB 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 NI-9204 with DSUB 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 NI-9204 with DSUB 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 NI-9204 with DSUB 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 NI-9204 with DSUB 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 NI-9204 with DSUB 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** Do not connect the NI-9204 with spring terminal to signals or use for measurements within Measurement Categories III or IV.



**Attention** Ne pas connecter le NI-9204 with spring terminal 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

|                                       |                |
|---------------------------------------|----------------|
| <b>Power consumption from chassis</b> |                |
| Active mode                           | 625 mW maximum |
| Sleep mode                            | 15 mW          |
| <b>Thermal dissipation (at 70 °C)</b> |                |

|             |                |
|-------------|----------------|
| Active mode | 625 mW maximum |
| Sleep mode  | 15 mW          |

## Physical Characteristics

### Dimensions and Weight

|                                                                     |                                                                                              |                |
|---------------------------------------------------------------------|----------------------------------------------------------------------------------------------|----------------|
| Dimensions                                                          | Visit <a href="https://ni.com/dimensions">ni.com/dimensions</a> and search by module number. |                |
| Weight                                                              |                                                                                              |                |
| NI-9204 with push-in style spring terminal (black/orange connector) |                                                                                              | 163 g (5.7 oz) |
| NI-9204 with DSUB                                                   |                                                                                              | 148 g (5.3 oz) |

### NI-9204 with Push-In Style Spring Terminal (Black/Orange Connector)

The push-in spring style NI-9204 with spring terminal 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.

|                               |                                                                                      |
|-------------------------------|--------------------------------------------------------------------------------------|
| <b>Spring-terminal wiring</b> |                                                                                      |
| Gauge                         | 0.13 mm <sup>2</sup> to 1.5 mm <sup>2</sup> (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 screw terminal; two wires per screw terminal using a 2-wire ferrule |
| Ferrules                    | 0.14 mm <sup>2</sup> to 1.5 mm <sup>2</sup>                                      |
| <b>Connector securement</b> |                                                                                  |
| Securement type             | Screw flanges provided                                                           |
| Torque for screw flanges    | 0.2 N · m (1.8 lb · in.)                                                         |

## Calibration

You can obtain the calibration certificate and information about calibration services for the NI-9204 at [ni.com/calibration](https://ni.com/calibration).

|                      |         |
|----------------------|---------|
| Calibration interval | 2 years |
|----------------------|---------|