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# NI-9214

# Getting Started

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# NI-9214 Getting Started

## NI-9214 Connection Guidelines

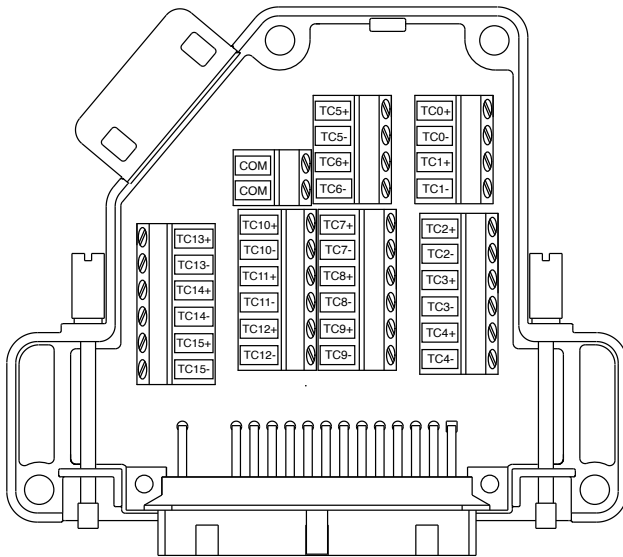
- Make sure that devices you connect to the NI-9214 are compatible with the module specifications.
- The shield grounding methodology can vary depending on the application.
- Refer to your thermocouple documentation or the thermocouple wire spool to determine which wire is the positive lead and which wire is the negative lead.

## Minimizing Thermal Gradients

Changes in the ambient air temperature near the front connector or a thermocouple wire conducting heat directly to terminal junctions can cause thermal gradients. Observe the following guidelines to minimize thermal gradients and improve the system accuracy.

- Use small-gauge thermocouple wire. Smaller wire transfers less heat to or from the terminal junction.
- Run thermocouple wiring together near the TB-9214 to keep the wires at the same temperature.
- Avoid running thermocouple wires near hot or cold objects.
- Minimize adjacent heat sources and air flow across the terminals.
- Keep the ambient temperature as stable as possible.
- Make sure the NI-9214 terminals are facing forward or upward.
- Keep the NI-9214 in a stable and consistent orientation.
- Allow the thermal gradients to settle after a change in system power or in ambient temperature. A change in system power can happen when the system powers on, the system comes out of sleep mode, or you insert/remove modules.
- If possible, use the foam pad in the TB-9214 opening to restrict airflow around the terminals.

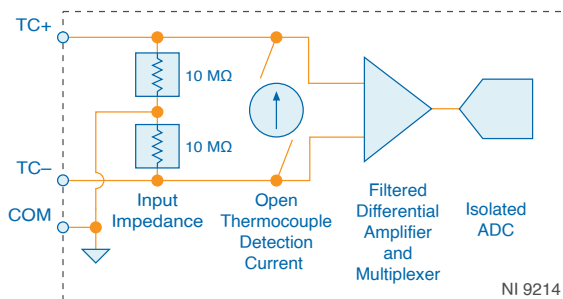
## TB-9214 Pinout



**Table 1.** Signal Descriptions

Signal	Description
COM	Common reference connection
TC+	Positive thermocouple connection
TC-	Negative thermocouple connection

## NI-9214 Block Diagram



- Each channel passes through a differential filter and a multiplexer before being sampled by a 24-bit ADC.

- The channels share a common ground, COM, that is isolated from other modules in the system.

## Common-Mode Voltage

The NI-9214 common-mode range is the maximum voltage between any channel and COM. If COM is left floating, the internal common-mode voltage of the input circuitry is the average of all the inputs. The NI-9214 measures the common-mode voltage level of each channel and returns a warning in the software if the signal is outside the common-mode voltage range.

## Open Thermocouple Detection

Each channel has an open thermocouple detection (OTD) circuit, which consists of a current source between the TC+ and TC- terminals. If an open thermocouple is connected to the channel, the current source forces a full-scale voltage across the terminals.

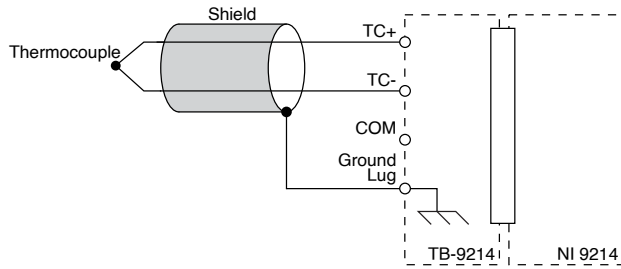
## Input Impedance

Each channel has a resistor that produces an input impedance between the TC and COM terminals. The gain and offset errors resulting from the source impedance of connected thermocouples are negligible for most applications. Thermocouples with a higher lead resistance can introduce more significant errors.

## Timing Modes

The NI-9214 supports high-resolution and high-speed timing modes. High-resolution timing mode optimizes accuracy and noise and rejects power line frequencies. High-speed timing mode optimizes sample rate and signal bandwidth.

## Thermocouple Connections



For most applications, you do not need to connect COM. Connecting to COM is not necessary for the following configurations:

- All thermocouples are floating
- All thermocouples are referenced to the same common-mode voltage
- One thermocouple is reference to a common-mode voltage and all other thermocouples are floating

When COM is floating, the internal common-mode voltage of the input circuitry is the average of all the inputs.



**Note** When two or more thermocouples are referenced to different common-mode voltages, connect COM to a common-mode voltage reference that is within  $\pm 1.2$  V of the common-mode voltages of all thermocouple inputs.

## Thermocouple Measurement Accuracy

Thermocouple measurement errors depend partly on the following factors.

- Type of thermocouple
- Accuracy of the thermocouple
- Temperature that you are measuring
- Resistance of the thermocouple wires
- Cold-junction temperature

For the best accuracy performance, follow these guidelines:

- Set up the NI-9214 to minimize thermal gradients across the terminals.
- Null the lead-wire resistance to compensate for offset errors.
- Use the autozero channel to compensate for offset errors.

### Cold-Junction Accuracy

Heat dissipated by adjacent C Series modules or nearby heat sources can cause errors in thermocouple measurements by heating the NI-9214 terminals to a different temperature than the cold-junction compensation sensor. Thermal gradient across the terminals can cause the terminals of different NI-9214 channels to be at different temperatures, which creates accuracy errors and affects the relative accuracy between channels.

The temperature measurement accuracy specifications include errors caused by the thermal gradient across the NI-9214 terminals for configurations with the NI-9214 terminals facing forward or upward.

### Autozero Channel

The NI-9214 has an internal autozero channel, which can be subtracted from each thermocouple reading to compensate for offset errors. Use of the autozero channel is optional, however the NI-9214 specifications assume that autozero is applied to every sample. Refer to the documentation for the software that you are using with the NI-9214 for information about using the autozero channel.

## Installing the TB-9214

### What to Do

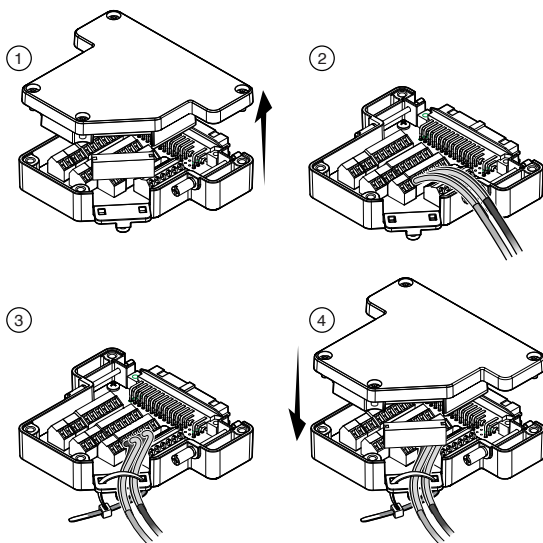
1. Connect the TB-9214 to the NI-9214 front connector.
2. Tighten the jackscrews to a maximum torque of 0.4 N · m (3.6 lb · in.). Do not overtighten the jackscrews.

# Wiring the TB-9214

## What to Use

- TB-9214
- 0.05 mm to 0.5 mm (30 AWG to 20 AWG) wire with 5.1 mm (0.2 in.) of the inner insulation stripped and 51 mm (2.0 in.) of the outer insulation stripped
- Zip tie
- Screwdriver

## What to Do



1. Loosen the captive screws on the TB-9214 and remove the top cover and foam pad.
2. Insert the stripped end of the wire fully into the appropriate terminal and tighten the screw for the terminal. Make sure no exposed wire extends past the screw terminal.
3. Route the wire through the TB-9214 opening, remove slack from the wiring, and secure the wires using a zip tie.



4. Replace the foam pad in the TB-9214 opening, reinstall the top cover, and tighten the captive screws.