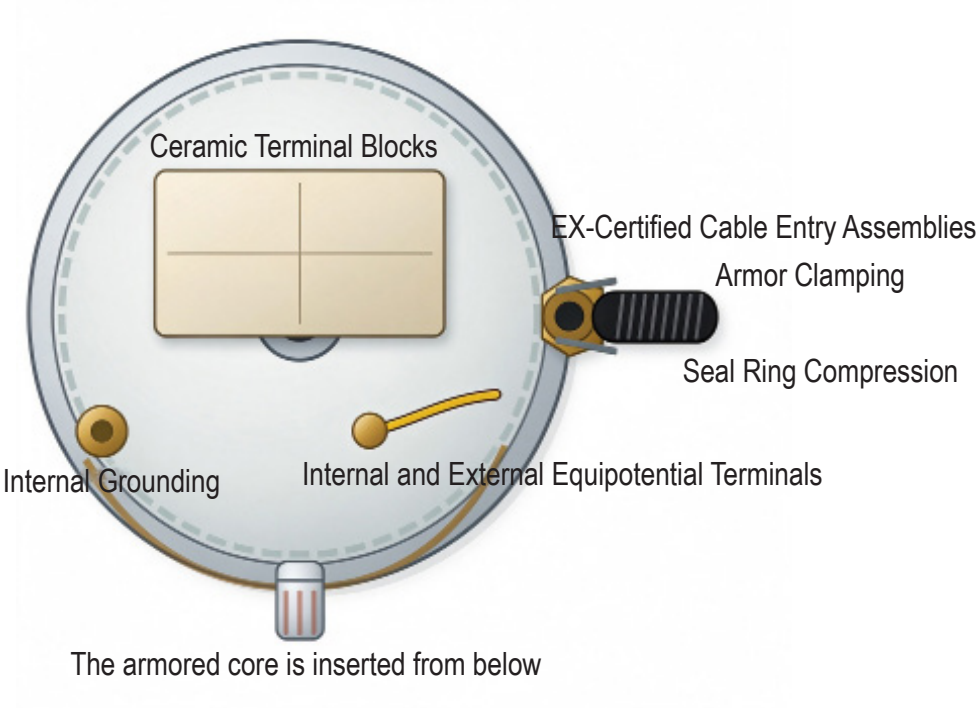
Explosion-Proof Temperature Sensor: Wiring Guidelines

This guide is intended for on-site wiring verification after opening the junction box cover of an explosion-proof armored temperature sensor. First, determine whether the input port is connected to a resistance temperature detector (RTD), a thermocouple, or an integrated temperature transmitter; then verify the terminal numbers, wire colors, explosion-proof type, and cable entry device.

The circular junction boxes shown in the figures are schematic top views of their internal structures. T1 through T4 are temporary designations used for explanatory purposes and do not represent any manufacturer's specific terminal numbers. Actual wiring must be based on the equipment nameplate, labels inside the enclosure, and the corresponding model's instruction manual.



Key Points for Explosion-Proof Wiring:

1. When the enclosure is marked EX d, use the corresponding EX db-certified cable glands or plugs.
2. Ensure a reliable connection between the armor/metal enclosure and the equipotential bonding system; ground the shield as shown in the drawings.
3. Unused cable entries must be sealed with certified plugs.
4. Screw the box cover all the way down and lock the safety latch. The sealing surface must not be damaged or coated with insulating grease.
5. Do not open the cover while energized in an explosive atmosphere. Opening the cover for maintenance must be performed in a safe area.
6. Verify the temperature class, maximum ambient temperature, and process temperature against the explosion-proof certificate.

Isolation Bees Are Not a Universal Substitute

Use them only when the certificate or installation instructions require pipe sealing or a specific gland configuration.

Standard waterproof glands cannot replace explosion-proof certified glands.

First, determine which section of the circuit the term “wiring configuration” refers to. ?

The terms “2-wire,” “3-wire,” and “4-wire” used on-site may refer to thermoresistor inputs or to the 4–20 mA loop of a self-contained transmitter. The two should not be confused. Table 1 provides a method for direct identification.

Port or Component	Number of Wires to Look for	Correct Understanding	This is not the correct interpretation.
Single-element RTD	2, 3, or 4	Temperature Sensor Input Configuration	It is not a 4–20 mA loop.
Single-element thermocouple (TC)	2	One positive and one negative wire	It cannot be measured using the three-wire or four-wire RTD method.
Two-element thermocouple (TC)	4 in total	Two independent two-wire channels	It is not a four-wire thermocouple.
Integrated temperature transmitter	2, 3, or 4 on the sensor side; 2 on the loop side	Input and output are two separate interfaces	A two-wire loop is not the same as a two-wire RTD.

Four Key Points to Verify Before Wiring

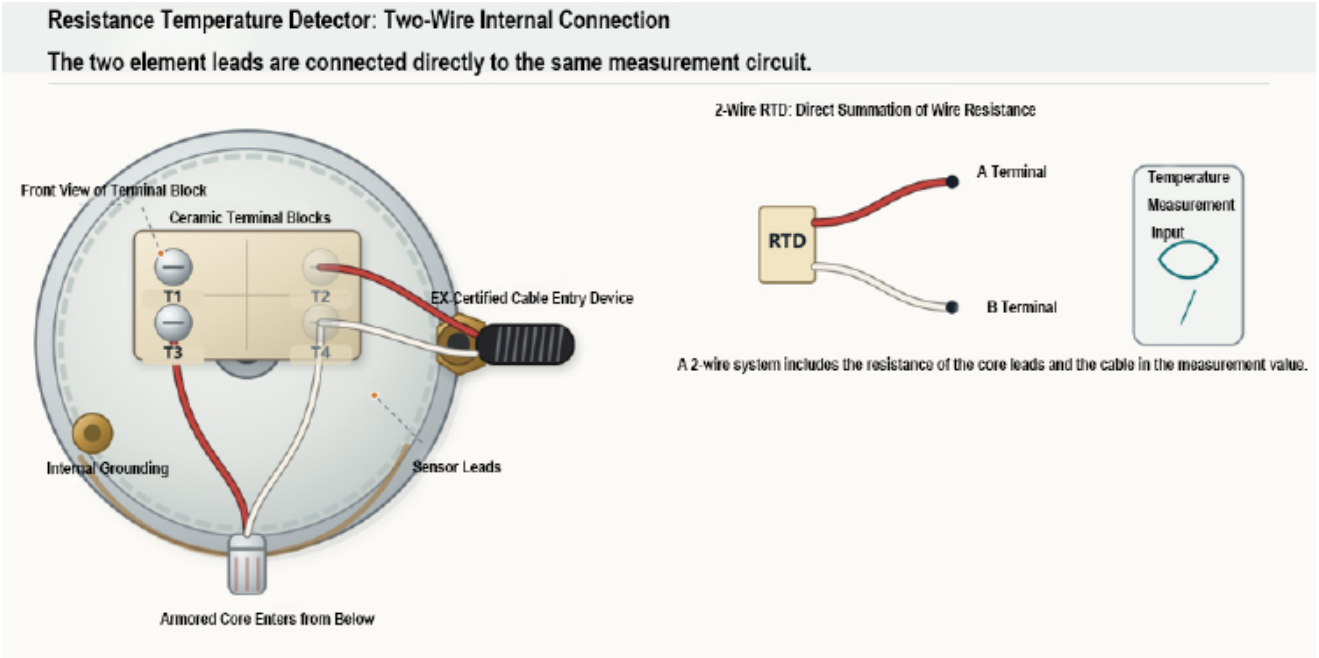
01 Sensor Type Confirm whether the sensor is a resistance temperature detector (RTD) such as Pt100 or Pt1000, or a thermocouple such as K, J, or N; for dual-channel devices, also verify whether the two channels are independent.
02 Internal Components of the Junction Box Confirm whether the box contains ceramic terminals, jumper wires, or a pre-installed temperature transmitter; do not rely solely on the external appearance of the junction box.
03 Terminal Diagram Refer to the official wiring diagram for the specific model and order number. Wire colors, terminal numbers, and input methods may vary between different models.
04 Explosion-Proof Markings Record the type (e.g., Ex d, Ex i) and the complete explosion-proof marking; cable entry devices, cable glands, plugs, and circuit parameters must match these markings.

Priority of Information Used in This Guide

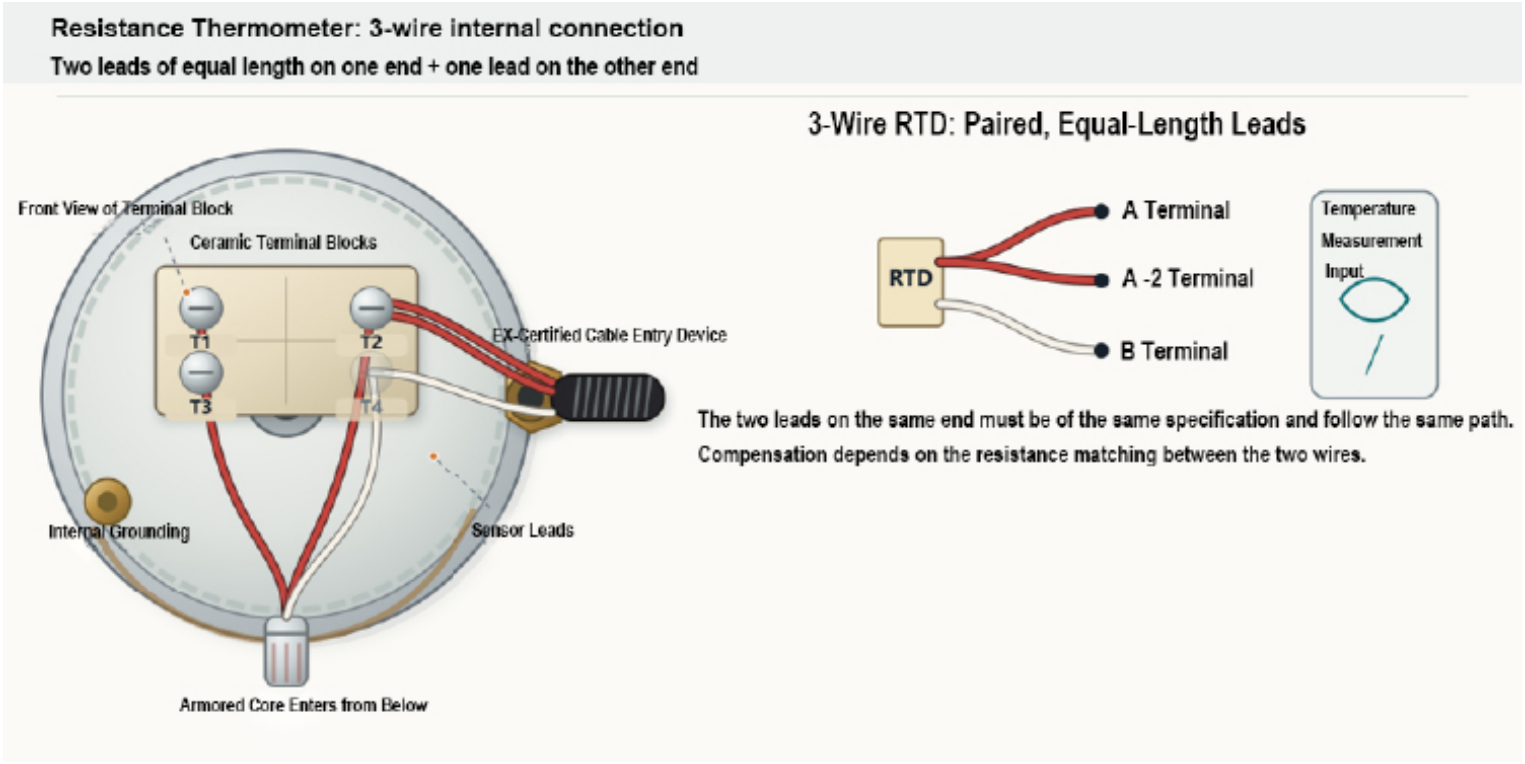
Documents from standards organizations are used to determine measurement principles and explosion-proof limits; original manufacturer technical documentation and explosion-proof certificates are used to confirm actual terminal and cable requirements and permissible temperatures; application notes are used to explain wire resistance errors in two-wire systems. Online articles and distributor drawings are not used to determine terminal wiring in this guide.

Resistance Temperature Detectors: 2-Wire and 3-Wire Systems

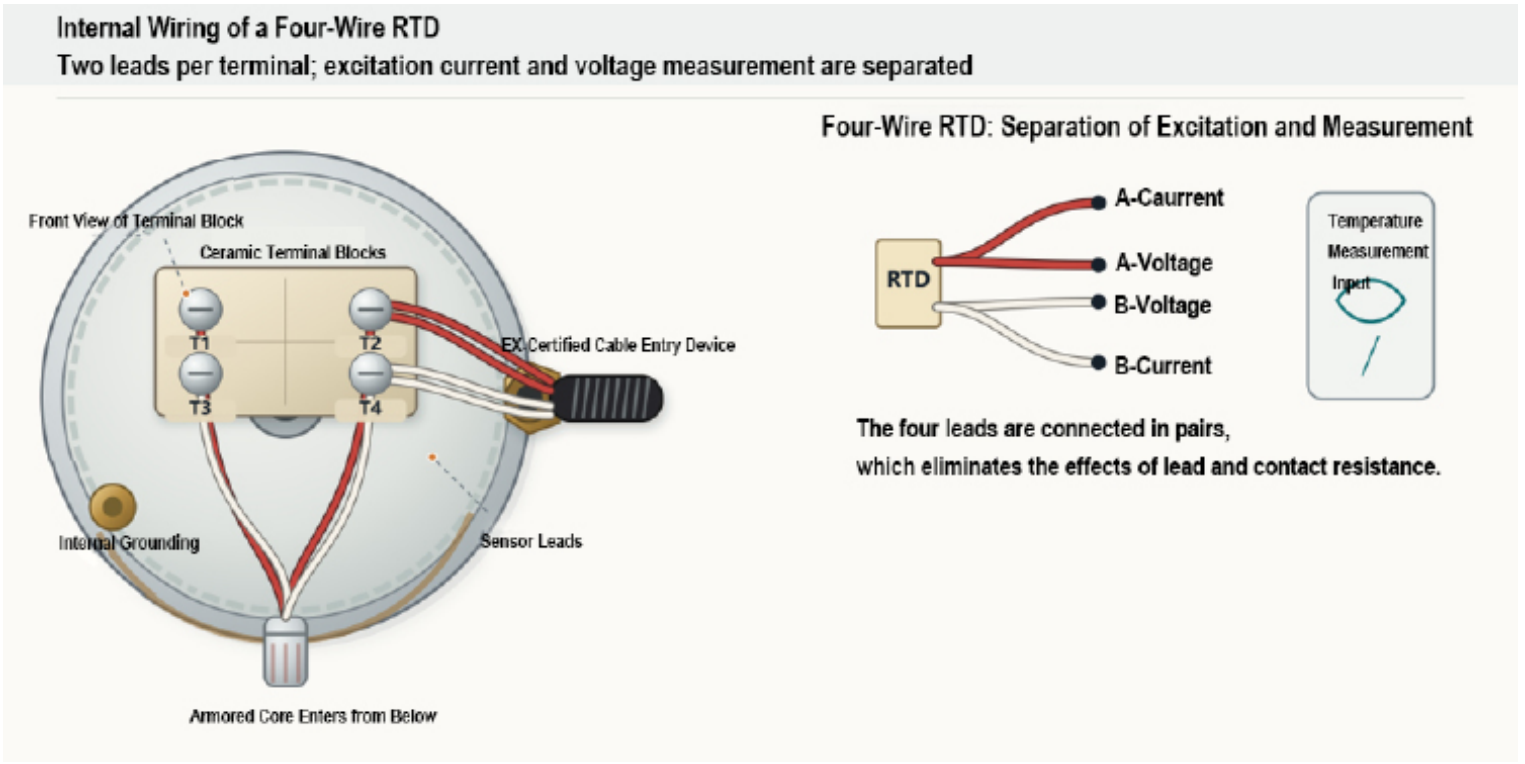
The resistance value of a resistance temperature detector (RTD) varies with temperature, and the reading depends on the accurate measurement of the element’s resistance. Lead resistance is superimposed on the element’s resistance; therefore, the number of leads and the measuring instrument’s compensation capability directly determine the error.



Two-wire wiring is the simplest and least expensive. The resistance of both the component leads and the field cables is factored into the measurement, making it suitable for short distances or applications where high accuracy is not required. NI's wiring instructions clearly state that two-wire RTDs do not provide lead resistance compensation, and their accuracy is significantly lower than that of three-wire and four-wire systems.



RTD: 4-wire



The four-wire method separates the current excitation circuit from the voltage measurement circuit. The voltage measurement input impedance is very high, so voltage drops caused by lead and contact resistance do not affect the measurement results; therefore, this method is preferred for applications involving long cables and high precision.

Selecting Wiring for Resistance Temperature Detectors

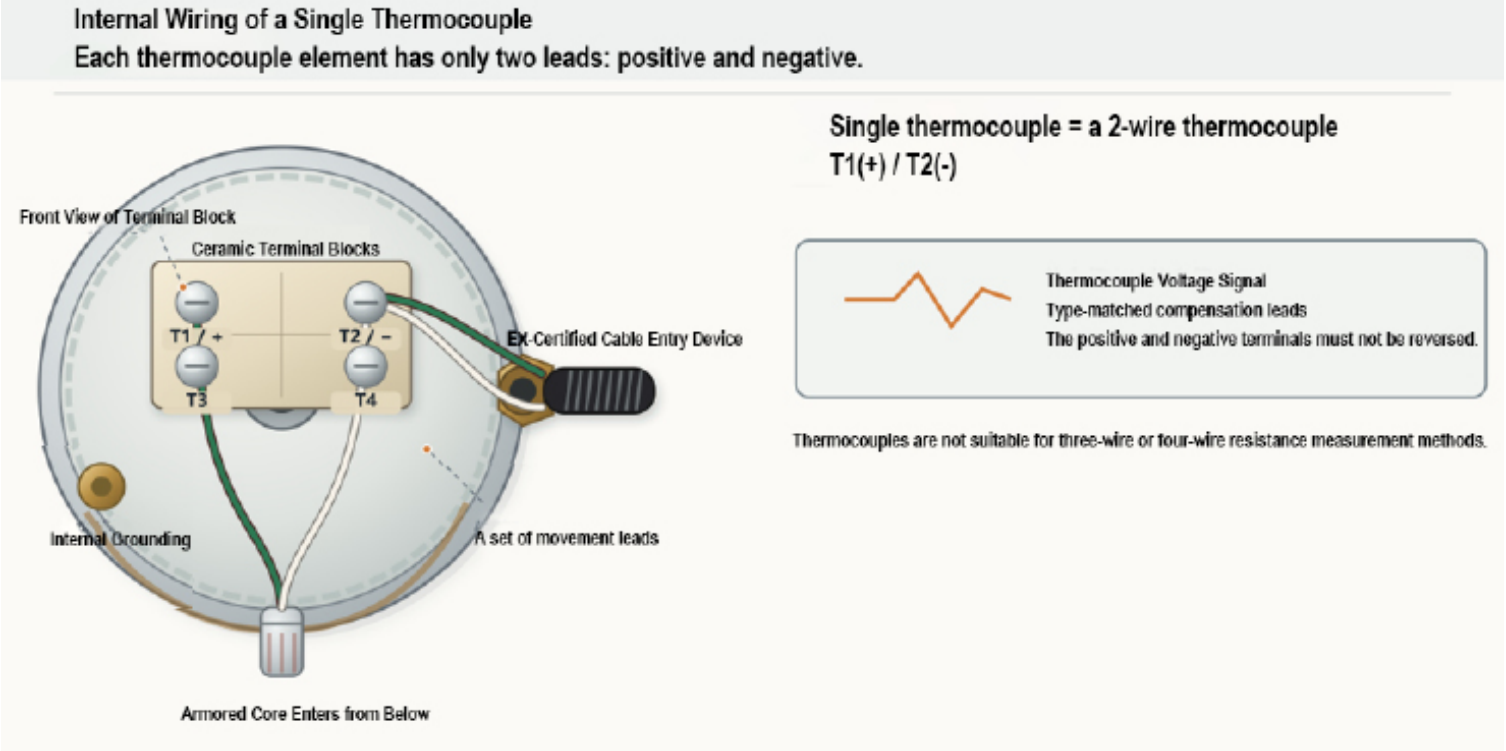
Wiring Configuration	Error Control	Applications	Key Points for On-Site Verification
Two-wire system	Do not compensate for lead resistance	Short cables, low-precision applications, or applications used solely for trend monitoring	Confirm that the instrument supports two-wire input; do not mistake the two-wire loop for an RTD two-wire connection.
Three-wire system	Compensate for approximately equal lead resistances	Common industrial measurement points, medium distances	The two wires on the same end must be of the same specification and follow the same path; ensure reliable terminal contact.
Four-wire system	Eliminate lead and contact resistance	High-precision, long-distance, or calibration-grade measurement points	Identify the two wires on the same end as a pair; the input instrument must be set to four-wire mode.

Converting a four-terminal component to a three- or two-terminal connection is permitted only when the instrument manual explicitly allows the corresponding short-circuit configuration. Unused terminals must not be grounded arbitrarily, nor should paired leads at the same terminal be identified based solely on wire color. Use continuity between terminals to verify the relationship between the two ends of the component.

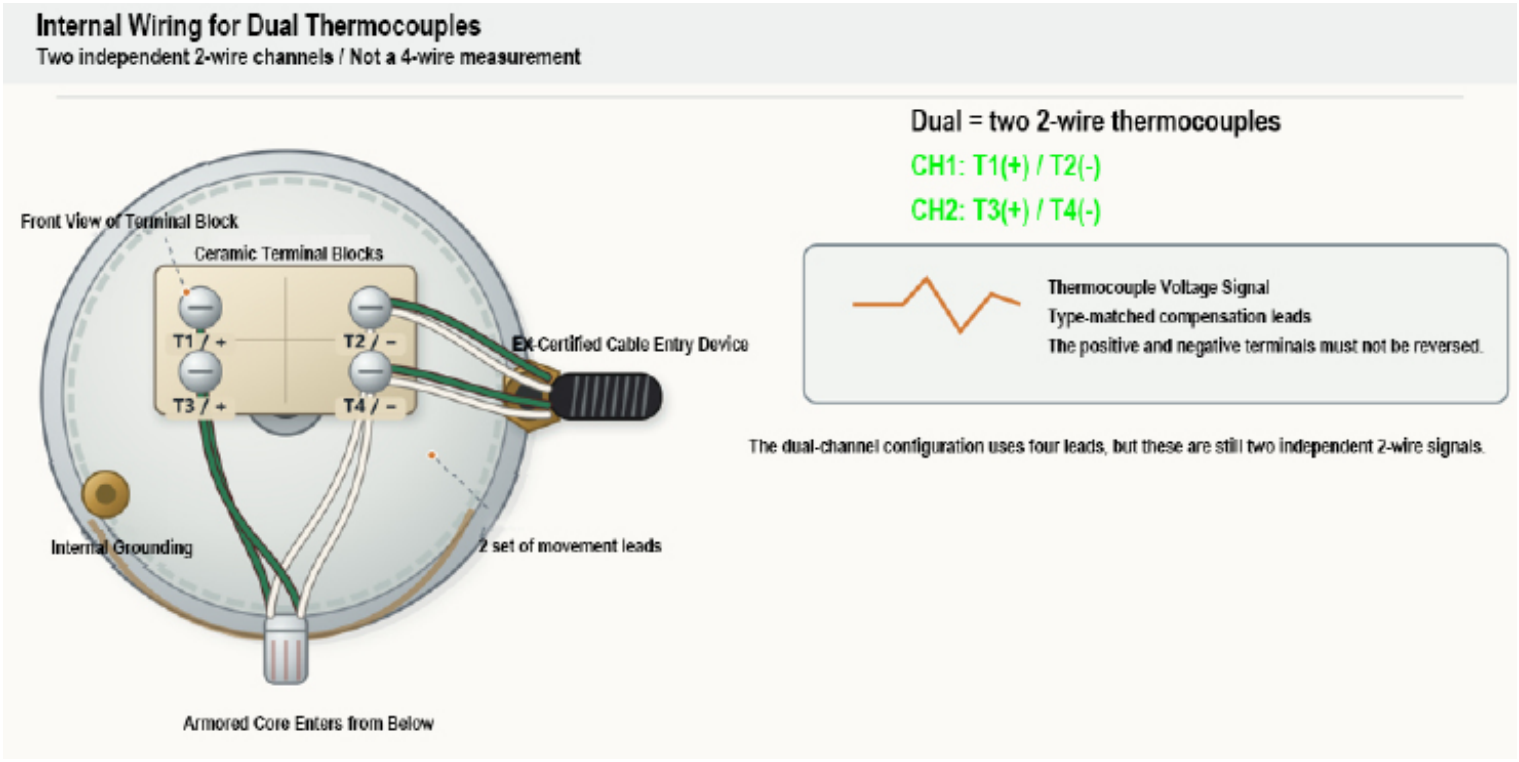
The red and white wires shown in the diagrams in this guide are used to represent the two ends of a component and paired leads; they do not represent a universal color standard. The product diagrams for TST41N and TR61 from E+H provide examples of red and white terminals; however, the actual colors depend on the device under test.

Thermocouples: Single-element and Dual-element

A thermocouple consists of two different conductors joined at one end to form a measuring junction, which generates a millivolt signal at the cold junction corresponding to the temperature difference. Each thermocouple element has only two leads—positive and negative—so it is connected directly using a two-wire system; there is no three-wire or four-wire resistance compensation as with resistance temperature detectors (RTDs).



Compensation leads must match the thermocouple type and maintain the same polarity. Standard copper leads may only be used after the thermocouple signal has been converted to a standard signal such as 4–20 mA; when directly extending a millivolt signal, the appropriate type of compensation lead must be used.

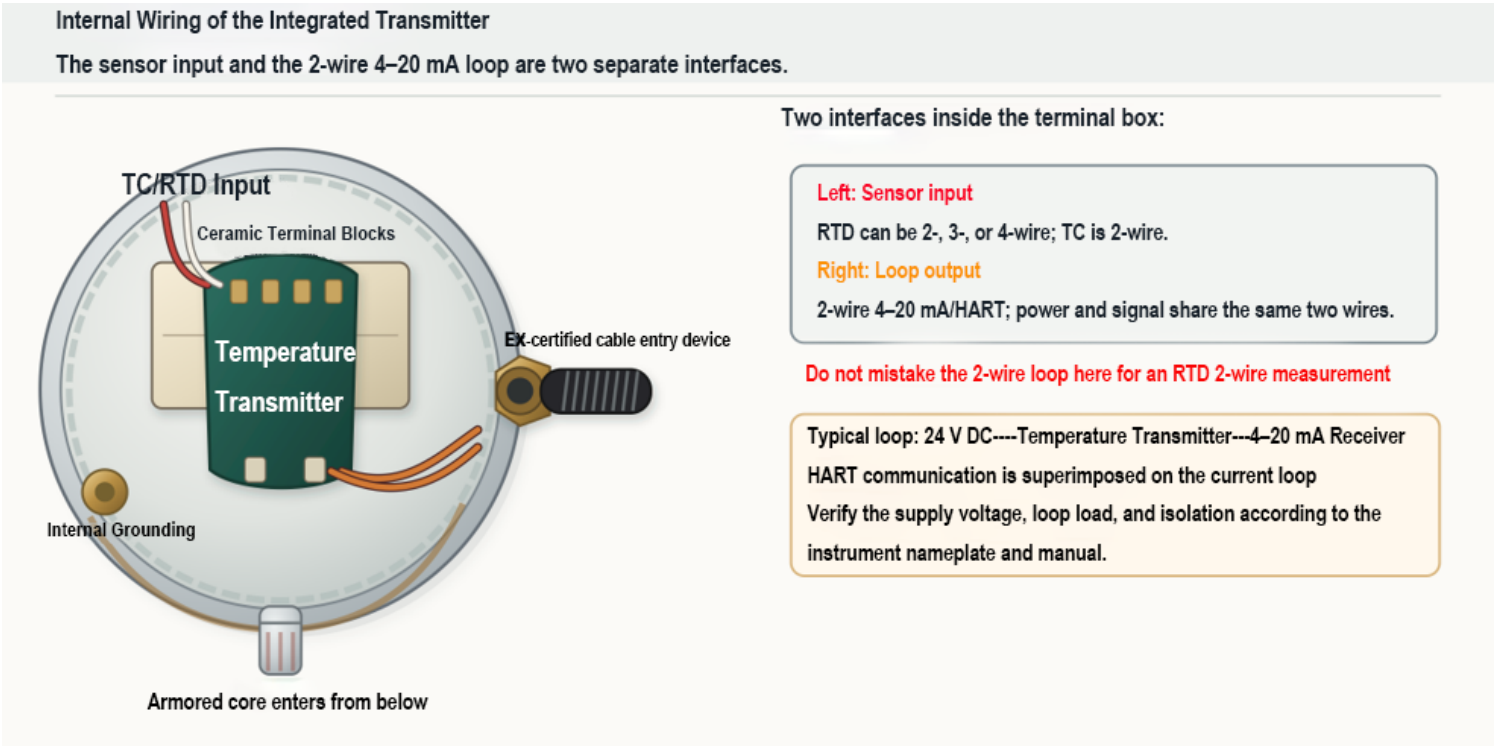


Thermocouple Color Codes

Wire color standards depend on the region where the equipment is located, the year of manufacture, and the ordering specifications. The colors listed below correspond only to the common conventions specified in IEC 60584 and ASTM E230; when wiring, you must still verify the markings on the cable and the nameplate.

Index Number	IEC 60584	ASTM E230	Polarity Check
J	Black (+) / White (−)	White (+) / Red (−)	Both ends have different colors; check the standard first, then the markings.
K	Green (+) / White (−)	Yellow (+) / Red (−)	Type K is common; do not substitute it with Type J compensation leads.
N	Pink (+) / White (−)	Orange (+) / Red (−)	Type N and Type K have different scale divisions and must not be used interchangeably.

Integrated Temperature Transmitters: Do Not Treat a Two-Wire Loop as a Two-Wire RTD



Integrated transmitters convert sensor signals into outputs such as 4–20 mA, HART, PROFIBUS PA, or FOUNDATION Fieldbus. On the sensor side, wiring remains specific to the component type: RTDs can be two-wire, three-wire, or four-wire, while TCs use two wires (positive and negative); the term “two-wire system” commonly used on the loop side simply means that power and the signal share the same two field cables.

Verify the loop positive and negative terminals, power supply, load, and HART resistance against the transmitter manual; two-wire loops do not require two separate power supply wires.

Post-Wiring Inspection Procedures:

01 Verify Model and Nameplate Record the sensor type, calibration code, number of elements, wiring configuration, explosion-proof rating, and temperature class.
02 Isolate and Confirm Power Is Off Perform maintenance only in a non-explosive environment or after obtaining a hot work or cover-opening permit; confirm that the circuit is de-energized and test for voltage according to procedure.
03 Check Element Terminal Connections Use resistance or continuity measurements to identify the two RTD leads connected to the same terminal; for thermocouples, verify the positive and negative markings.
04 Check Insulation and Short Circuits Measure insulation between leads and the housing, as well as between channels, using the voltage specified in the equipment manual; do not use a high-voltage insulation tester to check RTD elements.
05 Wire According to Terminals and Mode Ensure the transmitter’s input mode, three-wire/four-wire configuration, and terminal numbers all match; do not simply connect the wires correctly while neglecting software configuration.
06 Complete Shielding and Equipotential Bonding Connect the armor, housing, and ground terminal according to the drawings; do not use the shield as a substitute for protective grounding.
07 Verify Loop Polarity and Power Supply Confirm that the loop positive and negative terminals, supply voltage, load, and HART resistance comply with the transmitter manual.
08 Reinstall Seals and Housing Cover Replace any damaged O-rings; install gland nuts and plugs as required; tighten the housing cover and secure the safety latch.
09 Power On and Compare Readings Compare temperature readings, stabilization trends, and known operating conditions; check for fluctuations, drift, and open-circuit/short-circuit diagnostics.
10 Document and Hand Over Save photos of the terminals, wire colors, instrument configuration, and measurement records for future maintenance.

Common Errors and Solutions:

Symptoms	Check the following first:	Troubleshooting
RTD readings are high and vary with cable temperature	Whether two wires have been connected by mistake; whether the wires in a three-wire pair are of unequal length	Verify the instrument’s input mode; change to three-wire or four-wire mode as specified in the manual.
RTD readings fluctuate or indicate an open circuit	Loose terminals, oxidized leads, incorrect three-wire pairing	After powering down, test for continuity; rework the terminals and reconnect them according to the pair-by-pair configuration.
TC readings are significantly reversed or low	Compensation wire polarity, scale factor, or cold-junction compensation	Verify IEC/ASTM color codes and cable markings; correct polarity and configuration
Only one channel of a dual-channel transmitter is functioning normally	Whether two channels are connected in series or share a single return wire	Restore two independent channels; reconnect according to the dual-input wiring diagram
No 4–20 mA signal on the loop	Loop power supply, polarity, load, transmitter configuration	Verify each item against the manual; confirm that power and signal share two wires
Water or moisture is found inside the unit after opening the cover	Gland seal, unused ports, enclosure gasket	Replace seals and certified plugs; check that the cable outer diameter matches