

Rosemount 402 and 402VP

Contacting Conductivity Sensors



Safety messages

Read this page before proceeding!

Emerson designs, manufactures, and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you must properly install, use, and maintain them to ensure they continue to operate within their normal specifications. You must adhere to the following instructions and integrate them into your safety program when installing, using, and maintaining Emerson's Rosemount products.

WARNING

Failure to follow the proper instructions may cause any one of the following situations to occur: loss of life, personal injury, property damage, damage to this instrument, and warranty invalidation.

Read all instructions prior to installing, operating, and servicing the product.

If you do not understand any of the instructions, contact your Emerson representative for clarification.

Follow all warnings, cautions, and instructions marked on and supplied with the product. Inform and educate your personnel in the proper installation, operation, and maintenance of the product.

Install equipment as specified in the installation instructions of the appropriate Quick Start Guide and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.

Use only qualified personnel to install, operate, program, and maintain the product.

When replacement parts are required, ensure that qualified people use replacement parts specified by Emerson.

Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified people, to prevent electrical shock and personal injury.

WARNING

Physical access

Unauthorized personnel may potentially cause significant damage to and/or misconfiguration of end users' equipment. This could be intentional or unintentional and needs to be protected against.

Physical security is an important part of any security program and fundamental in protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

CAUTION

Sensor/process application compatibility

The wetted sensor materials may not be compatible with process composition and operating conditions.

Application compatibility is entirely the operator's responsibility.

NOTICE

The Rosemount 402 and 402VP sensors are retractable

Before retracting the sensor, be absolutely certain that the process pressure is less than 64 psi (5.4 bar) and the process temperature is at a safe level!

NOTICE

The information contained in this document is subject to change without notice.

Contents

Installation..... 5

Wiring..... 12

Calibration and maintenance.....18

Troubleshooting..... 19

1 Installation

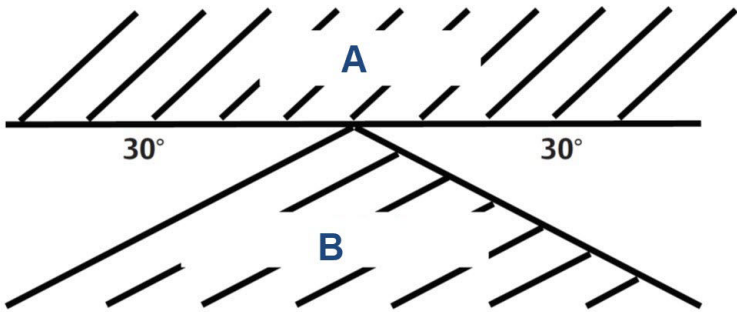
1.1 Unpack and inspect

Procedure

1. Inspect the outside of the carton for any damage.
If you detect damage, contact the carrier immediately.
2. Inspect the instrument and hardware.
Make sure all items on the packing list are present and in good condition. Notify the factory if any part is missing.

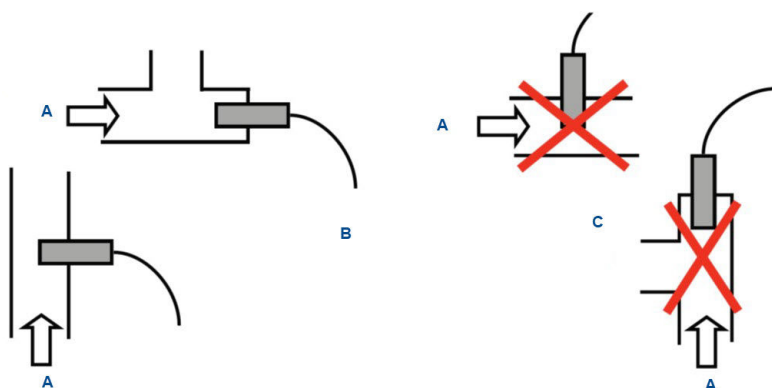
1.2 Sensor installation

Figure 1-1: Sensor orientation



A. Trapped air

B. Trapped sludge

Figure 1-2: Recommended installation

Keep ¼ in. (6 mm) clearance between electrodes and piping. The electrolytes must be completely submerged in the process liquid (to the upper edge of the guard, [Figure 1-3](#)).

- A. Flow
- B. Recommended
- C. Not recommended

1.3 Sensor installation and retraction

⚠ WARNING

Sensor in pressurized system.

Can cause severe impact or spray injury.

Carefully restrain sensor during retraction.

Provide adequate working area.

Maximum retraction pressure: 64 psi (5.4 bar)

Do not exceed temperature and operating pressure specifications.

See instructions for retraction procedures.

⚠ WARNING

For all installations:

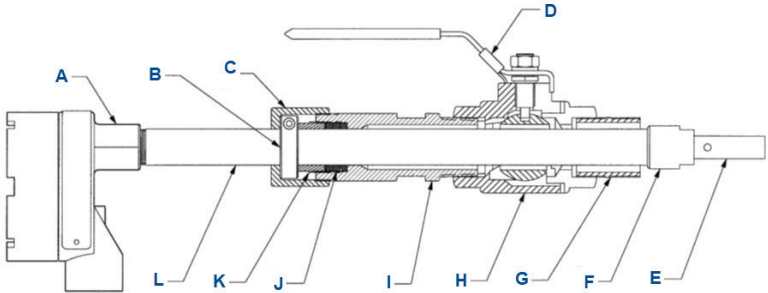
Place the label on the sensor tube near the cable or junction box.

Warning side must face the cable or junction box end of the sensor.

1.3.1 Install sensor

Retraction assembly kit (PN 23765-00) consists of the items shown in [Figure 1-3](#) as well as a hex key and pipe tape.

Figure 1-3: Sensor with retraction assembly kit



- A. Junction box
- B. Clamp (PN 33579-00)
- C. Retainer (PN 33577-00)
- D. Handle lock
- E. Sensing element
- F. Guard
- G. Nipple (PN 4342M)
- H. Ball valve (PN 9340078)
- I. Packing adapter (PN 33578-00/01)
- J. Packing rings (PN 9160410)
- K. Packing bushing (PN 4357M)
- L. Sensor tube

Prerequisites

Make sure the system is shut down and there is no residual pressure.

Procedure

1. Attach the ball valve to the process piping using the 1¼-in. female NPT (FNPT) port or the 1¼-in. NPT nipple. Use pipe thread on male threads.
2. Slide the handle lock up on the ball valve handle and close the ball valve.

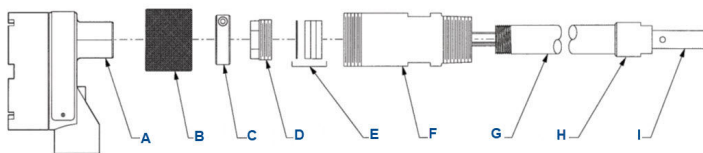
If you are planning to restart the process before installing the sensor, make sure the system pressure is at or below 64 psi (5.4 bar) before proceeding. If you are not planning to restart

the system until after installing the sensor, leave the valve in the open position.

3. If the sensor includes a junction box, you must remove it from the sensor to install the retraction assembly kit. Disconnect the sensor wires inside the junction box prior to disassembly.
4. Follow [Figure 1-4](#) to assemble the sensor and retraction assembly.

Keep items B-F in the proper sequence. Items D, E, and F are factory assembled.

Figure 1-4: Sensor installation



- A. Junction box
- B. Retainer (PN 33577-00)
- C. Clamp (PN 33579-00)
- D. Packing bushing (PN 4357M)
- E. Packing rings (PN 9160410)
- F. Packing adapter (PN 33578-00/01)
- G. Sensor tube
- H. Guard
- I. Sensing element

5. Position the sensor tube so that the electrodes are completely withdrawn inside the packing adapter. If it is difficult to slide the sensor through the packing rings, loosen the packing bushing.
6. Position the clamp on the sensor tube so that the electrodes will be completely immersed in the process liquid when the sensor is fully inserted through the ball valve.

See [Figure 1-3](#).

7. Use the hex key to secure the clamp to the sensor tube.
8. Slide the retainer onto the sensor tube.
9. Screw the junction box hand-tight onto the sensor tube.

NOTICE

Do not over tighten.

10. Use two to three wraps of pipe tape on the tube threads if a NEMA® 4 seal is required at the junction box.
11. Apply pipe tape to the packing adapter threads and screw the packing adapter onto the ball valve.
12. Check to ensure that the packing bushing has been tightened. You should be able to push the sensor tube against the resistance provided by the packing rings.
13. Open the ball valve.
There may be some leakage around the packing bushing.
14. Tighten the packing bushing to stop the leak. Use the junction box or sensor rear to push the sensor through the valve until the clamp rests against the packing bushing.
15. To secure the sensor tube in place, tighten (hand tighten only) the retainer against the back of the packing adapter.
16. If the sensor tube retracts when you increase the system pressure, reduce the pressure to 64 psi (5.4 bar) or less, remove the retainer, and tighten the screw in the clamp.

1.3.2 Retract sensor

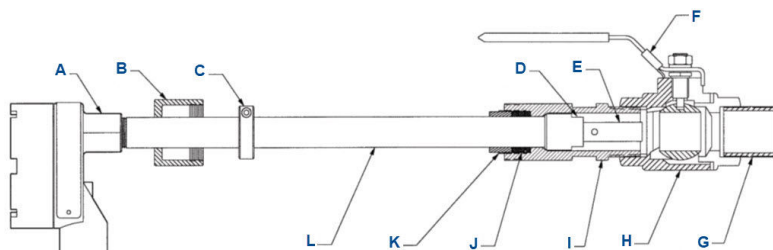
Prerequisites

▲ WARNING

Make sure the system pressure is at or below 64 psi (5.4 bar) at the valve before proceeding.

Provide adequate working area for retraction.

Figure 1-5: Rosemount 402 Contacting Conductivity Sensor in retracted position



- A. Junction box
- B. Retainer (PN 33577-00)
- C. Clamp (PN 33579-00)
- D. Guard
- E. Sensing element
- F. Handle lock
- G. Nipple (PN 43242M)
- H. Ball valve (PN 9340078)
- I. Packing adapter (PN 33578-00/01)
- J. Packing rings (PN 9160410)
- K. Packing bushing (PN 4357M)
- L. Sensor tube

Procedure

1. Unscrew the retainer from the packing adapter.
If it is difficult to unscrew the retainer, system pressure may be forcing the clamp into the retainer. The packing bushing may not be tight enough to hold the sensor tube in place. To prevent a sudden retraction of the sensor tube as you remove the retainer, hold onto the junction box or sensor rear to restrain the sensor.
2. If the sensor tube does not slide back as you unscrew the retainer, pull back on the junction box or sensor tube to retract the sensor.
3. If you cannot retract the sensor tube, loosen the clamp using the hex key. Pull the clamp and slowly loosen the packing bushing in $\frac{1}{8}$ -turn increments. System pressure may cause the tube to retract. If it does not, pull back on the junction box or sensor tube to withdraw the sensor.
4. Withdraw the sensor tube until the guard contacts the stop inside the packing adapter.

The electrodes are now inside the packing adapter. See [Figure 1-5](#).

5. Slide the handle lock up on the valve handle and close the ball valve (H).

NOTICE

Failure to withdraw the sensor completely may cause damage to the electrodes when the valve is closed.

-
6. Unscrew the packing adapter from the ball valve to remove the sensor retraction assembly.

2 Wiring

For other wiring diagrams not shown below, please refer to [Liquid Transmitter Wiring Diagrams](#).

Table 2-1: Wire color and connections in sensor

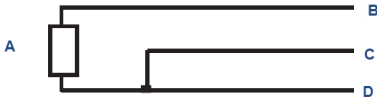
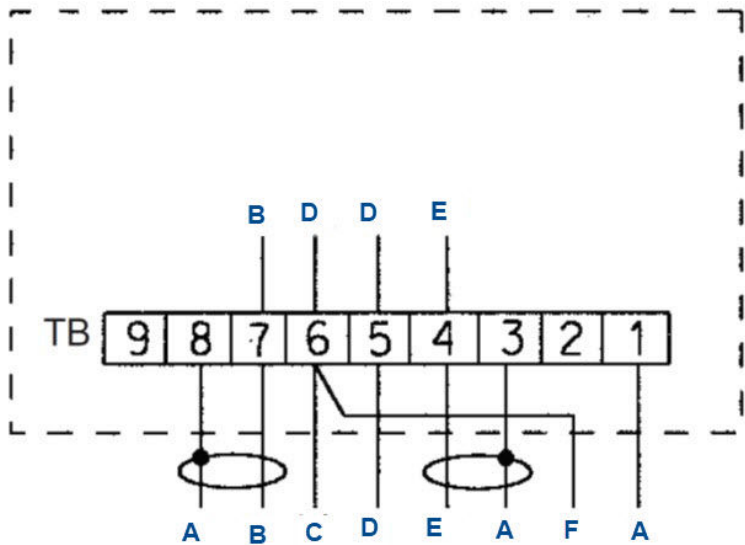
Color	Function
Gray	Connects to outer electrode
Clear	Coaxial shield for gray wire
Orange	Connects to inner electrode
Clear	Coaxial shield for orange wire
Red	 A. RTD B. RTD in C. RTD sense D. RTD return
White with red stripe	
White	
Clear	Shield for all RTD lead wires

Figure 2-1: Wiring for integral junction box



Terminals in junction box are not wired.

Table 2-2: Wiring for integral junction box

Terminal number	Letter	Wire color
1	A	Clear
2	N/A	N/A
3	A	Clear
4	E	Gray
5	D	Red
6	C and F	White and white/red
7	B	Orange
8	A	Clear
9	N/A	N/A

Figure 2-2: Wiring for Rosemount 56 and 1056 Transmitters

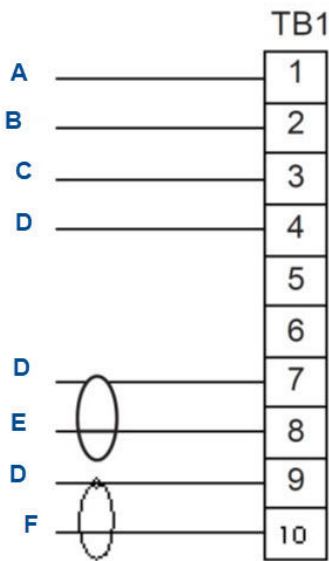


Table 2-3: Wiring for Rosemount 56 and 1056 Transmitters

Terminal number	Letter	Wire color	Description
1	A	White	RTD return
2	B	White/red	RTD sense
3	C	Red	RTD in
4	D	Clear	RTD shield
5	N/A	N/A	4 count B
6	N/A	N/A	4 count A
7	D	Clear	Shield, 2 count
8	E	Orange	Sensor, 2 count B
9	D	Clear	Shield, 2 count
10	F	Gray	Sensor, 2 count A

Figure 2-3: Wiring for Rosemount 1066 Transmitter



Table 2-4: TB2

Letter	Wire color	Description
A	White	Return
B	White/red	Sense
C	Red	RTD in
D	Clear	Shield

Table 2-5: TB1

Letter	Wire color	Description
N/A	N/A	Receive B
N/A	N/A	Receive A
D	Clear	Receive shield
E	Gray	Drive B
F	Orange	Drive A
D	Clear	Drive shield

Figure 2-4: Wiring for Rosemount 5081 Transmitter

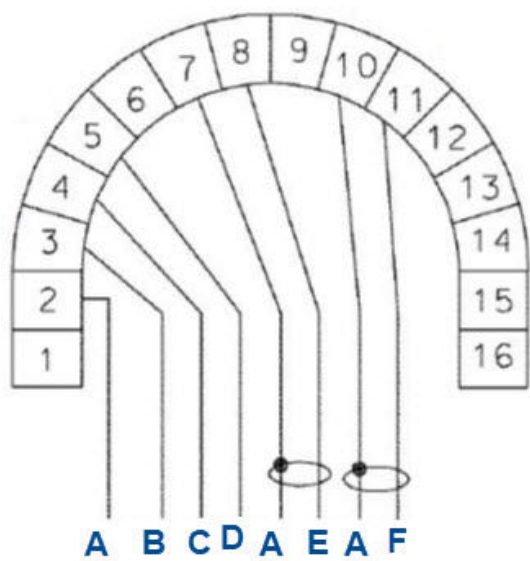


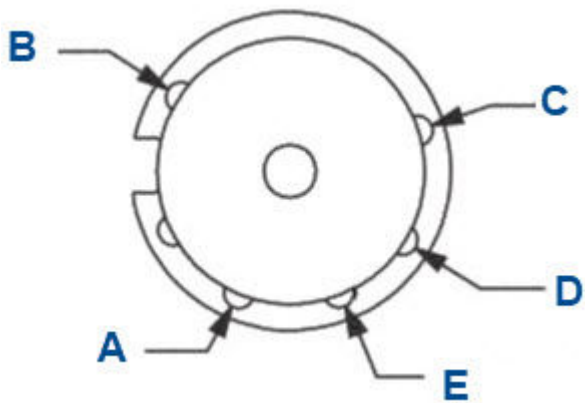
Table 2-6: Wiring for Rosemount 5081 Transmitter

Terminal number	Letter	Wire color	Description
1	N/A	N/A	Reserved
2	A	Clear	RTD shield
3	B	White	RTD common
4	C	White/red	RTD sense
5	D	Red	RTD in
6	N/A	N/A	Receive shield
7	A	Clear	Receive common
8	E	Orange	Receive
9	N/A	N/A	Drive shield
10	A	Clear	Drive common
11	F	Gray	Drive
12	N/A	N/A	N/A
13	N/A	N/A	N/A
14	N/A	N/A	N/A

Table 2-6: Wiring for Rosemount 5081 Transmitter (continued)

Terminal number	Letter	Wire color	Description
15	N/A	N/A	HART®/FOUNDATION™ Fieldbus (-)
16	N/A	N/A	HART/FOUNDATION Fieldbus (+)

Figure 2-5: Wiring through a junction box



If you make wiring connections through a remote junction box (PN 23550-00), wire point-to-point. Use interconnecting cable 23747-00 (factory-terminated) or 9200275 (no termination).

- A. RTD sense
- B. Inner electrode
- C. RTD in
- D. RTD return
- E. Outer electrode

3 Calibration and maintenance

3.1 Clean the sensor

Procedure

Use a warm detergent solution and a soft brush or pipe cleaner to remove oil and scale.

You can also use isopropyl alcohol to remove oily films. Avoid using strong mineral acids to clean conductivity sensors.

3.2 Calibrate the sensor

Emerson calibrates Rosemount 402 sensors at the factory, so you do not need to calibrate them when first placing them into service.

Simply enter the cell constant printed on the label into the transmitter.

After a period of service, the sensor may require calibration. You can calibrate the sensor against a solution having a known conductivity or against a referee meter and sensor.

If using a standard solution, choose one having conductivity in the recommended operating range for the sensor cell constant. Refer to the transmitter Reference Manual or Product Data Sheet for recommended ranges.

NOTICE

Standard solutions having a conductivity less than about 100 $\mu\text{S}/\text{cm}$ are susceptible to contamination by atmospheric carbon dioxide, which can alter the conductivity by a variable amount as great as 1.2 $\mu\text{S}/\text{cm}$ (at 77 °F [25 °C]).

Do not use standard solutions having a conductivity less than about 100 $\mu\text{S}/\text{cm}$.

Because 0.01/cm sensors must be calibrated in low conductivity solutions, it is best to calibrate them against a referee meter and sensor in a closed system.

For more information about calibrating, refer to [Calibrating Conductivity Sensors Application Data Sheet](#).

4 Troubleshooting

Note

For any repair or warranty inquiries, please contact our Customer Care group.

4.1 Off-scale reading

Potential cause

Wiring is incorrect.

Recommended action

Verify and correct wiring.

Potential cause

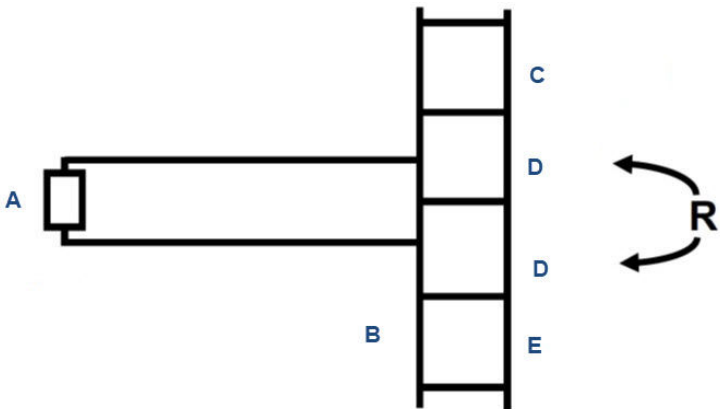
Temperature element is open or shorted.

Recommended action

Check temperature element for open or short circuits.

See [Figure 4-1](#).

Figure 4-1: Checking the temperature element



- A. RTD
- B. Terminal strip in sensor junction box
- C. Orange
- D. Red
- E. Gray

Potential cause

Sensor is not in process stream.

Recommended action

Submerge sensor completely in process stream.

Potential cause

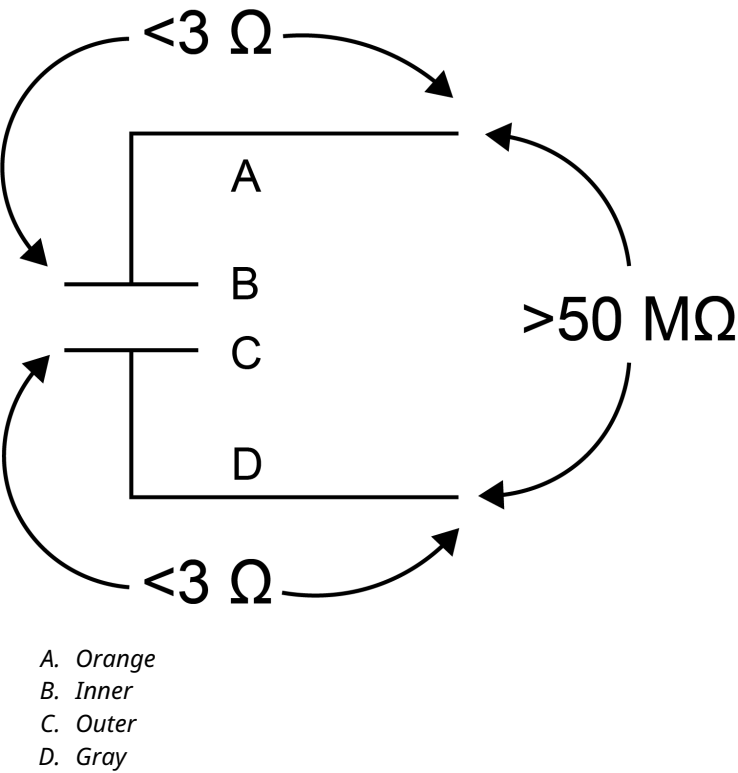
Sensor has failed.

Recommended action

Perform isolation checks.

See [Figure 4-2](#).

Figure 4-2: Checking the continuity and leakage



4.2 Noisy reading

Potential cause

Sensor is improperly installed in process stream.

Recommended action

Submerge sensor completely in process stream.

Potential cause

Variopol cable is not properly seated.

Recommended action

Loosen connector and reseal.

4.3 Reading seems wrong (lower or higher than expected)

Potential cause

Bubbles trapped in sensor.

Recommended actions

1. Ensure the sensor is properly oriented in pipe or flow cell.
See [Figure 1-1](#).
2. Apply back pressure to flow cell.

Potential cause

Wrong temperature correction algorithm is being used.

Recommended action

Check that the temperature correction is appropriate for the sample.

See transmitter Reference Manual for more information.

Potential cause

Wrong cell constant.

Recommended action

Verify that the correct cell constant has been entered in the transmitter and that the cell constant is appropriate for the conductivity of the sample.

See transmitter Reference Manual.

4.4 Sluggish response

Potential cause

Electrodes are fouled.

Recommended action

Clean electrodes.

Potential cause

Sensor is installed in dead area in piping.

Recommended action

Move sensor to a location more representative of the process liquid.

4.5 Check the temperature element

Procedure

Disconnect leads and measure resistance shown.

The measured resistance should be close to the value in the following table.

Temperature (°C)	Resistance in ohms	
	Pt 100	Pt 1000
0	100.0	1000
10	103.9	1039
20	107.8	1078
30	111.7	1117
40	115.5	1155
50	119.4	1194

See [Figure 4-1](#).

4.6 Check the continuity and leakage

Procedure

Disconnect electrode leads and measure resistance and continuity as shown in [Figure 4-2](#).

The sensor must be dry when checking resistance between electrode leads.



Quick Start Guide
00825-0100-3402, Rev. AB
October 2023

For more information: [Emerson.com/global](https://emerson.com/global)

©2023 Emerson. All rights reserved.

Emerson Terms and Conditions of Sale are available upon request. The Emerson logo is a trademark and service mark of Emerson Electric Co. Rosemount is a mark of one of the Emerson family of companies. All other marks are the property of their respective owners.

ROSEMOUNT™

