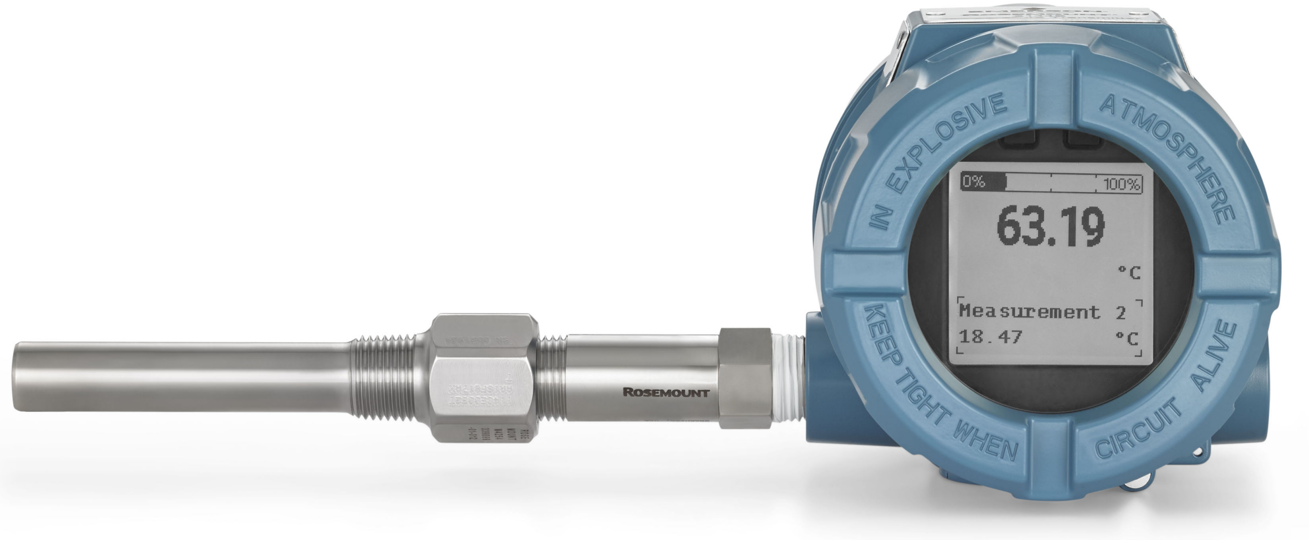
Manual
MS-00809-0100-6184, Rev AB
November 2025

Rosemount™ 3144S Temperature Transmitter

with 4-20 mA HART® Protocol and Rosemount X-well™ Technology



ROSEMOUNT™

EMERSON™

Safety messages

NOTICE

Read this manual before working with the product. For personal and system safety and for optimum product performance, ensure that you thoroughly understand the contents before installing, using, or maintaining this product. When cover is removed, protect the interior of the transmitter from external contamination exceeding that of a Pollution Degree 2 environment.

⚠ WARNING

Failure to follow these installation guidelines could result in death or serious injury.

Ensure only qualified personnel perform installation or service.

⚠ WARNING

Electrical shock could cause death or serious injury.

Use extreme caution when making contact with the leads and terminals.

⚠ WARNING

Explosions could result in death or serious injury.

Do not remove the transmitter cover in explosive atmospheres when the circuit is live.
Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
All transmitter covers must be fully engaged to meet explosion-proof requirements.

⚠ WARNING

Process leaks could result in death or serious injury.

Do not remove the thermowell while in operation.
Install and tighten thermowells or sensors before applying pressure.

⚠ 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.

NOTICE

The products described in this document are NOT designed for nuclear-qualified applications.

Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

For information on Emerson nuclear-qualified products, contact your local Emerson Sales Representative.

Contents

1 Introduction

1.1 Features and benefits

Improved ease of use

- With Bluetooth® connectivity, quickly configure, service, and troubleshoot at speeds up to 10 times faster than traditional HART® connections.
- **Quick Service** buttons provide straightforward menus and built-in configuration, allowing you to quickly commission the device.
- ReadyConnect™ technology allows for sensor configuration with the push of a button, automatically detecting the sensor type, number of wires, and Callendar-Van Dusen coefficients, to save you configuration and commissioning time while delivering the best accuracy.

Full diagnostic coverage from sensor to control room

- Identify issues before they impact operations or compromise safety with complete diagnostic coverage from your temperature sensor to your control room with sensor health diagnostics, dual input capabilities, and continuous electrical loop monitoring.
- The **Loop Integrity** diagnostic continuously monitors the electrical loop to detect issues that affect the communication signal and will alert you to corrosion, water in the housing, or an unstable power supply.
- **RTD Measurement Protection** seamlessly switches from a 4-wire to a 3-wire RTD sensor input configuration if one of the four sensor wires becomes broken, corroded, or loose anywhere from the sensor element to the transmitter terminal connections. Your measurement will be maintained without process disruption, and a maintenance alert will be generated.
- Diagnostic logging capability stores up to 100 events, providing historical insight into device health.
- Improve visibility to your operations with the **Process Alert** capability that provides variable dynamic tracking within alarm limits.

Reset measurement expectations with Ultra Performance Class

- Control closer to your setpoint with 0.05 °C accuracy.
- Extend calibration intervals with 20-year stability.
- Have confidence in your measurement reliability with 20-year limited warranty.
- Ensure the most accurate dual sensor measurement with dual 4-wire input.

Eliminate thermowell challenges with Rosemount X-well™ Technology

- Non-intrusive solution provides accurate and reliable process temperature measurement in applications up to 1202 °F (650 °C).
- Remote mount capability provides installation flexibility.
- Single model configuration greatly reduces specification complexity.

1.2 Rosemount 3144S revisions

This table defines the NAMUR NE-53 hardware and software revisions for products assembled with the 3144S HART® feature board.

Software release date	Identify device			Field device driver		Review instructions
	NAMUR software revision	NAMUR hardware revision	HART software revision	HART universal revision	Device revision	Manual document number
2025	01.00.00	01.00.00	1	7	1	MS-00809-0100-6184

1.3 Related product training

To ensure that your training efforts continually evolve with technology, Emerson offers a broad portfolio of different solutions and delivery methods that can be easily adapted to help meet your business needs. Our scalable, customizable training packages let you match the right training solutions to your operational needs and budget.

To learn more, visit Emerson Training.

For the best user experience, log into MyEmerson.com.

2 Installation

2.1 Installation considerations

2.1.1 General

Electrical temperature sensors, such as RTDs and thermocouples (T/Cs), produce low-level signals proportional to temperature.

The Rosemount 3144S Temperature Transmitter converts these low-level signals to digital information, then transmits the signals to the control system via two power/signal wires and HART®.

Only qualified personnel should install the transmitter. No special installation is required in addition to the standard installation practices outlined in this document.

Always ensure a proper seal by installing the electronics housing covers so that metal contacts metal.

The transmitter accepts male conduit fittings with ½-14 NPT or M20 x 1.5 (CM20). You can use optional mounting brackets to mount the transmitter to a flat surface (using the *L* mounting bracket, option code B5 or BH) or a 2-inch (51 mm) diameter pipe (using the *U* mounting bracket, option code B4 or BE).

The transmitter may require supplementary support under high-vibration conditions, particularly if used with extensive thermowell lagging or long extension fittings. Emerson recommends using pipe-stand mounting with one of the optional mounting brackets in high-vibration conditions.

2.1.2 Software compatibility

Verify that the latest device driver (DD) is loaded on your systems to ensure proper communications.

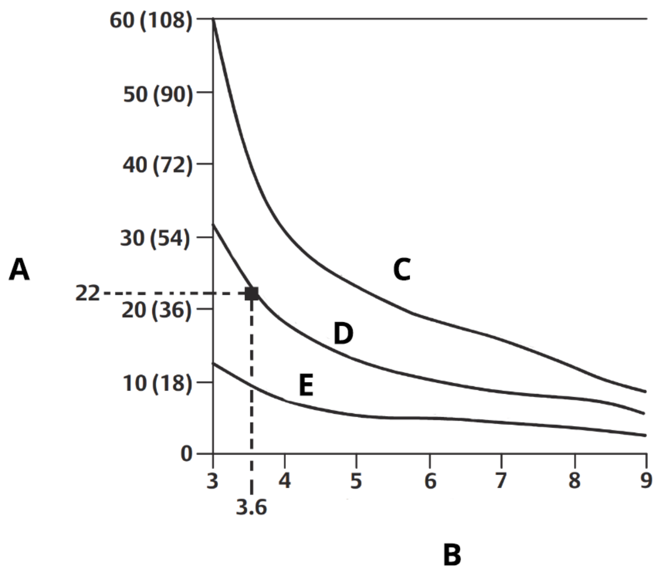
To download a new DD, visit Software & Drivers.

2.1.3 Temperature effects

The transmitter will operate within specifications for ambient temperatures between -40 and +185 °F (-40 and +85 °C). Since heat from the process is transferred from the thermowell to the transmitter housing, if the expected process temperature is near or beyond specification limits, consider using additional thermowell lagging, an extension nipple, or a remote mounting configuration to isolate the transmitter from the process.

Figure 2-1 details the relationship between housing temperature rise and extension length.

Figure 2-1: Transmitter Housing Temperature Rise versus Extension Length for a Test Installation



A. Housing temperature rise above ambient: °C (°F)
B. Extension length (in.)
C. 1500 °F (815 °C) oven temperature
D. 1004 °F (540 °C) oven temperature
E. 482 °F (250 °C) oven temperature

Example

You can calculate the maximum permissible housing temperature rise (T) by subtracting the maximum ambient temperature (A) from the transmitter's ambient temperature specification limit (S). For instance, if A = 40 °C.

T = S – A

T = 85 °C – 40 °C

T = 45 °C

For a process temperature of 1004 °F (+540 °C), an extension length of 3.6 in. (91 mm) yields a housing temperature rise (R) of 40 °F (22 °C), providing a safety margin of 41 °F (23 °C). A 6-inch (152 mm) extension length (R = 18 °F [10 °C]) offers a higher safety margin (63 °F [35 °C]) and reduces temperature-effect errors but would probably require extra transmitter support. Gauge the requirements for individual applications along this scale. If using a thermowell with lagging, you can reduce the extension length by the length of the lagging.

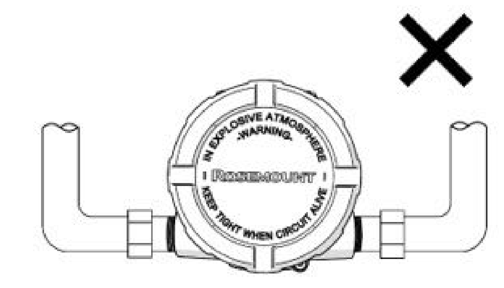
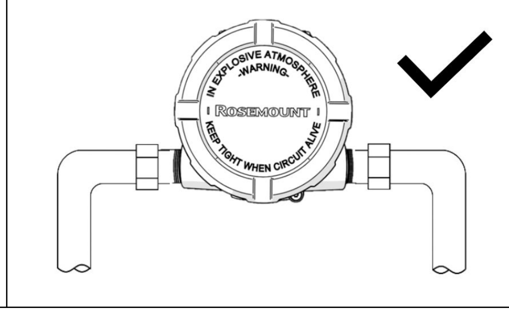
2.1.4 Humid or corrosive environments

The Rosemount 3144S Transmitter has a highly reliable dual compartment housing designed to resist moisture and corrosion. The sealed electronics module is mounted in a compartment that is isolated from the terminal side with conduit entries. O-ring seals protect the interior when the covers are properly installed. In humid environments, however, it is possible for moisture to accumulate in conduit lines and drain into the housing.

2.1.5 Location and position considerations

When choosing an installation location and position, consider how you will access the transmitter.

Table 2-1: Mounting Location

Incorrect	Correct
	

NOTICE

The terminal compartment could fill with water if the transmitter is mounted at a low point in the conduit run.

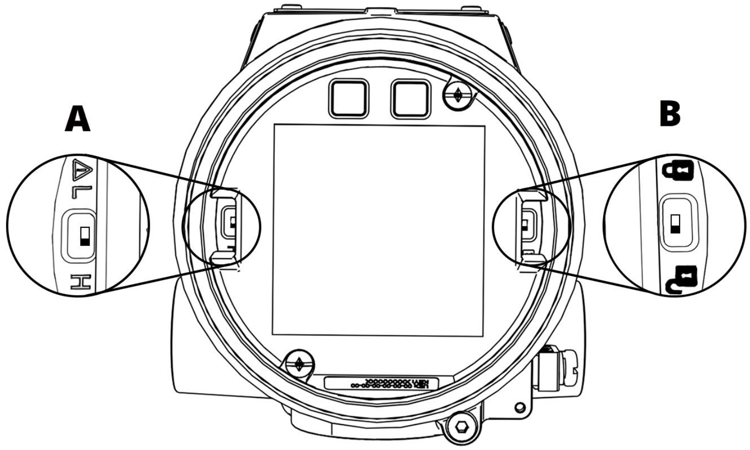
If possible, mount the transmitter at a high point in the conduit run so moisture from the conduits will not drain into the housing.

Ensure that the transmitter mounting location allows you to access both the terminal and circuit side, providing adequate clearance for cover removal. Additional room is required for LCD display installation on the circuit side.

⚠ WARNING

Each transmitter is marked with a nameplate indicating the product certifications. Install the transmitter according to all applicable installation codes and approval and installation drawings. Verify that the operating atmosphere of the transmitter is consistent with the hazardous locations certifications. Once a device labeled with multiple protection types is installed, it may not be reinstalled using any of the other labeled protection types. To ensure this, permanently mark the nameplate to indicate the protection type used.

2.2 Verify configuration and set the switches



A. ***Alarm*** *switch*
B. ***Security*** *switch*

2.2.1 Setting the loop to Manual

Set the process application loop to Manual when sending or requesting data that would disrupt the loop or change the output of the transmitter.

The field communicator or AMS Device Manager will prompt to set the loop to manual, when necessary. Acknowledging the prompt does not set the loop to manual; it is only a reminder. Setting the loop to manual is a separate operation.

2.2.2 **Security** switch

The transmitter is equipped with a **Write-Protect/Security** switch that can be positioned to prevent accidental or deliberate change of configuration data.

2.2.3 **Alarm** switch

An automatic diagnostic routine monitors the transmitter during normal operation. If the diagnostic routine detects a sensor failure or an electronics failure, the transmitter goes into alarm (High or Low depending on the position of the **Alarm** switch).

The analog alarm and saturation values used by the transmitter depend on whether it is configured to standard or NAMUR-compliant operation. These values are also custom-configurable in both the factory and the field using HART® communication. The limits are:

- $20.2 \leq I \leq 23.0$ for high alarm
- $20.1 \leq I \leq 22.9$ for high saturation
- $3.67 \leq I \leq 3.90$ for low saturation
- $3.57 \leq I \leq 3.80$ for low alarm

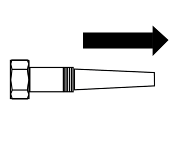
Note
A minimum of 0.1 mA separation between low saturation and low alarm, as well as high saturation and high alarm, is required.

2.3 Direct mount installation

Procedure

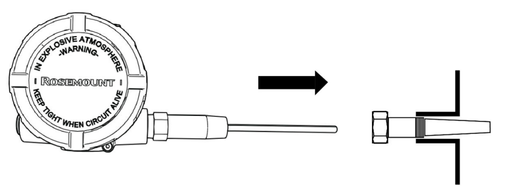
1. Mount the thermowell to the process container wall.
2. Install and tighten thermowell.

Figure 2-2: Thermowell Installation



3. Perform a leak check.
4. Attach any necessary unions, couplings, and extension fittings. Seal the fitting threads with an approved thread sealant, such as silicone or PTFE tape (if applicable).
5. Screw the sensor (and transmitter, if factory assembled) into the thermowell or directly into the process (depending on installation requirements).

Figure 2-3: Direct Mount Installation



6. Verify all sealing requirements.
7. Attach the transmitter to the thermowell/sensor assembly (if not factory assembled). Seal all threads with an approved thread sealant, such as silicone or PTFE tape (if required).
8. Install field wiring conduit into the open transmitter conduit entry and feed wires into the transmitter housing.
9. Pull the field wiring leads into the terminal side of the housing.
10. Attach the sensor leads to the transmitter sensor terminals.

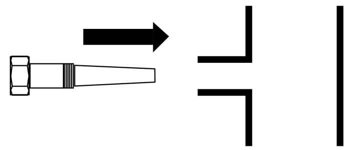
    The wiring diagram is located on the terminal block.

2.4 Remote mount installation

Procedure

1. Mount the thermowell to the process container wall.
2. Install and tighten the thermowells.

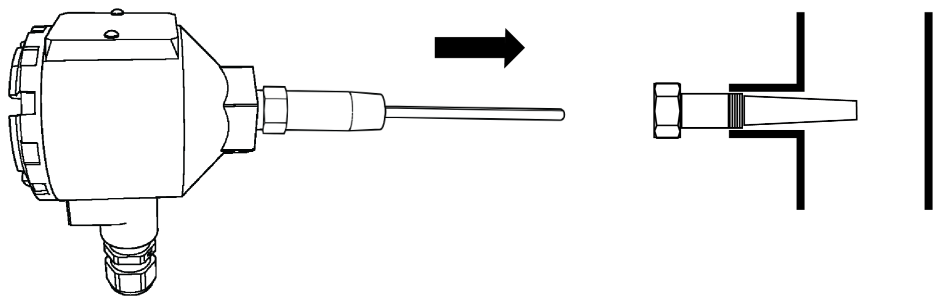
Figure 2-4: Thermowell Installation



3. Perform a leak check.
4. Wire the sensor to the connection head.

   The wiring diagram is located inside the connection head.
5. Insert the connection head and sensor assembly into the thermowell.

Figure 2-5: Remote Mount Installation

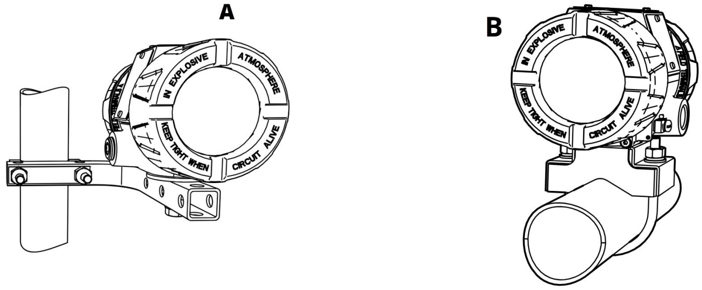


6. Mount the transmitter to a 2-inch (51 mm) pipe or panel using one of the optional mounting brackets shown in Figure 2-6.
7. Attach cable glands to the cable running from the connection head to the transmitter conduit entry.
8. Run the cable from the opposite conduit entry on the transmitter back to the control room.
9. Insert cable leads through the cable entries into the connection head/transmitter. Connect and tighten cable glands.
10. Connect the cable leads to the connection head terminals (located inside the connection head) and to the sensor wiring terminals (located inside the transmitter housing).

Figure 2-6: Remote Mount Installation

A

B



A. "L" mounting bracket
B. "U" mounting bracket

2.5 Rosemount X-well™ Technology installation

Refer to Rosemount X-well™ Technology.

2.6 Wiring

2.6.1 Field wiring

An external power supply is required to operate the transmitter. The power to the transmitter is supplied over the signal wiring. Signal wiring does not need to be shielded, but use twisted pairs for best results.

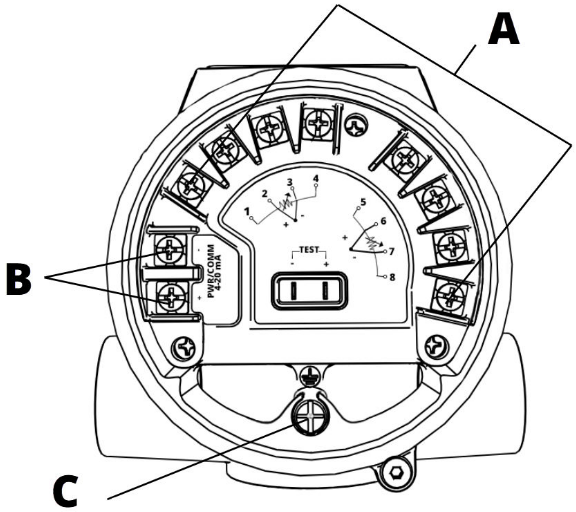
⚠ WARNING

Do not run unshielded signal wiring in conduit or open trays with power wiring or near heavy electrical equipment, because high voltage may be present on the leads and may cause an electrical shock.

NOTICE

High voltage can damage the device.

Do not apply high voltage (such as, AC line voltage) to the power or sensor terminals.



A. Sensor terminals (1-8)
B. Power terminals
C. Ground screw

Procedure

1. Remove the transmitter covers.

⚠ WARNING

Do not remove the transmitter covers in an explosive atmosphere when the circuit is live.

2. Connect the positive power lead to the terminal marked "+" and the negative power lead to the terminal marked "–".

   Crimped lugs are recommended when wiring to screw terminals.
3. Tighten the terminal screws to ensure good contact is made.
4. Replace the transmitter covers, making sure both transmitter covers are fully engaged to meet explosion-proof requirements.

2.6.2 Connect power and current loop

Use copper wire of a sufficient size to ensure that the voltage across the transmitter power terminals does not go below 11.5 Vdc for Classic Performance and 16.7 Vdc for Ultra Performance.

1. Connect the current signal leads.
2. Recheck the polarity and connections.
3. Turn the power ON.

NOTICE

The voltage present on the power/signal leads may permanently damage the reverse-polarity protection diode built into the test clips.

Do not connect the power/signal wiring to the test clips.

Note
You can ground the signal wire at any point or leave it ungrounded.

Note
You can connect AMS Device Manager software or a Field Communicator at any termination point in the signal loop. The signal loop must have between 250 and 1100 ohms for communication.

2.6.3 Wiring diagrams

Wiring diagrams are located on the terminal block.

Terminals 1-4 correspond to Measurement 1, and Terminals 5-8 correspond to Measurement 2. See Figure 2-7 and Figure 2-8 for sensor configurations.

See Verify Rosemount X-well™ sensor wiring for Rosemount X-well™ wiring information.

Figure 2-7: Single Sensor Wiring Diagram

2-wire RTD	3-wire RTD	4-wire RTD	Thermocouple

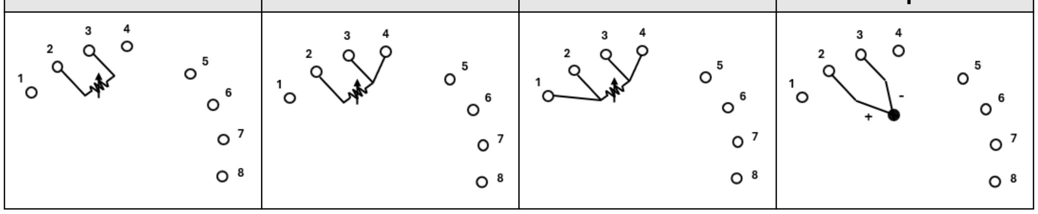
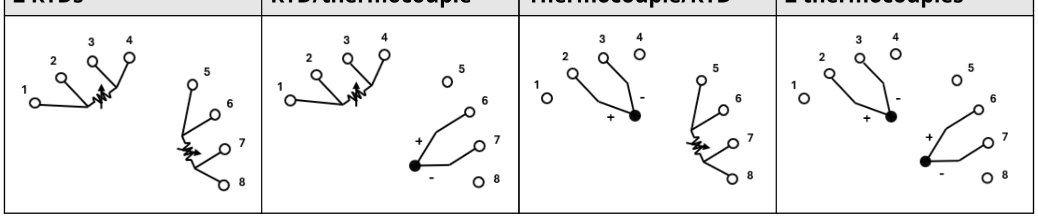


Figure 2-8: Dual Sensor Wiring Diagram

2 RTDs	RTD/thermocouple	Thermocouple/RTD	2 thermocouples



2.7 Power supply

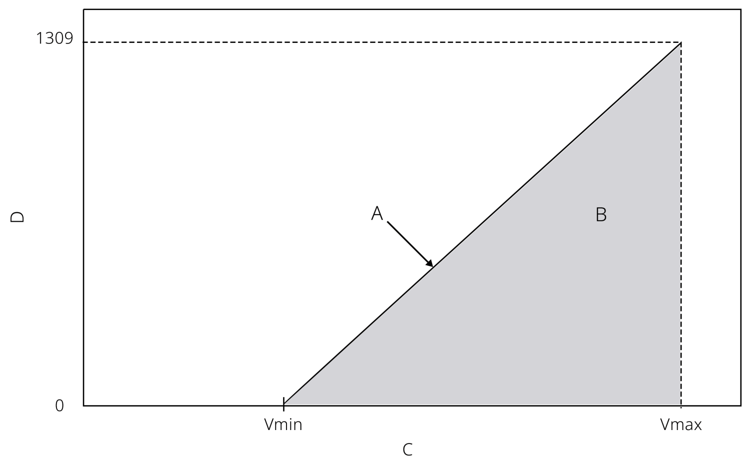
The voltage required across the transmitter power terminals is dependent on loop resistance and product performance class (as listed in the model code).

Voltage input range	Classic Performance (see Figure 2-9): 11.5 to 42.4 Vdc Ultra Performance (see Figure 2-10): 16.7 to 42.4 Vdc

The combination of power supply voltage and total loop resistance must be within the operating regions shown in Figure 2-9 and Figure 2-10. At least 250 ohms of resistance in the loop are required for reliable HART® communication.

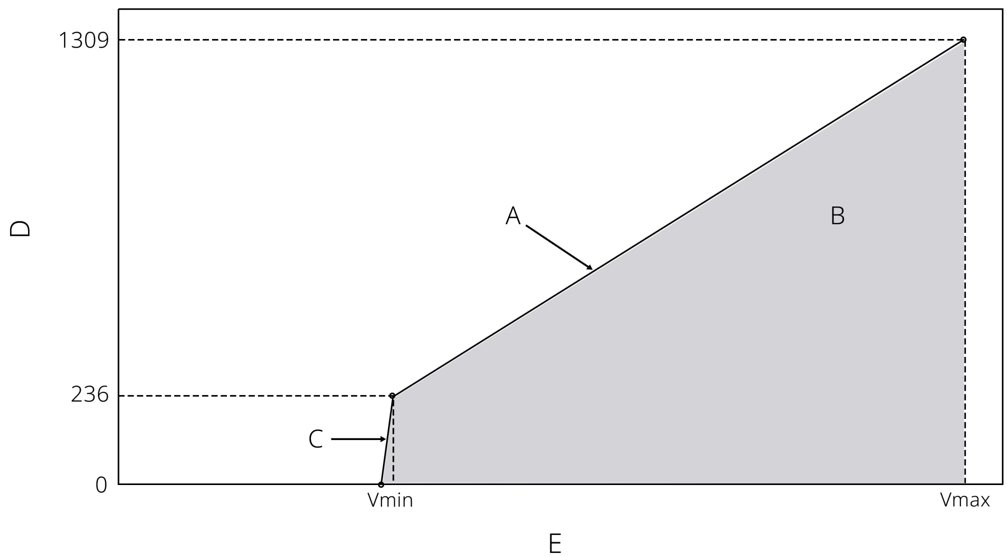
Load line equations	Load line 1: Supply voltage = (loop resistance * 0.0236) + 11.5 V Load line 2: Supply voltage = (loop resistance * 0.0016) + 16.7 V

Figure 2-9: Classic Performance



A. *Load line 1*
B. *Operating region*
C. *Power supply voltage (V)*
D. *Loop resistance (ohms)*

Figure 2-10: Ultra Performance



A. *Load line 1*
B. *Operating region*
C. *Load line 2*
D. *Loop resistance (ohms)*
E. *Power supply voltage (V)*

Load line 1 > 236 ohms

Load line 2 < 236 ohms

2.7.1 Surges/transients

NOTICE

The transmitter will withstand electrical transients of the energy level usually encountered in static discharges or induced switching; however, high-voltage transients, such as those induced from nearby lightning strikes, can damage both the transmitter and sensor.

The integral transient protection terminal block (option code `T1`) protects against high-voltage transients. The integral transient protection terminal block is available as an ordered option.

2.8 Grounding

Each process installation has different requirements for grounding. Use the grounding option recommended by the facility for the specific sensor type or begin with grounding option 1 (the most common).

2.8.1 Sensor shielding

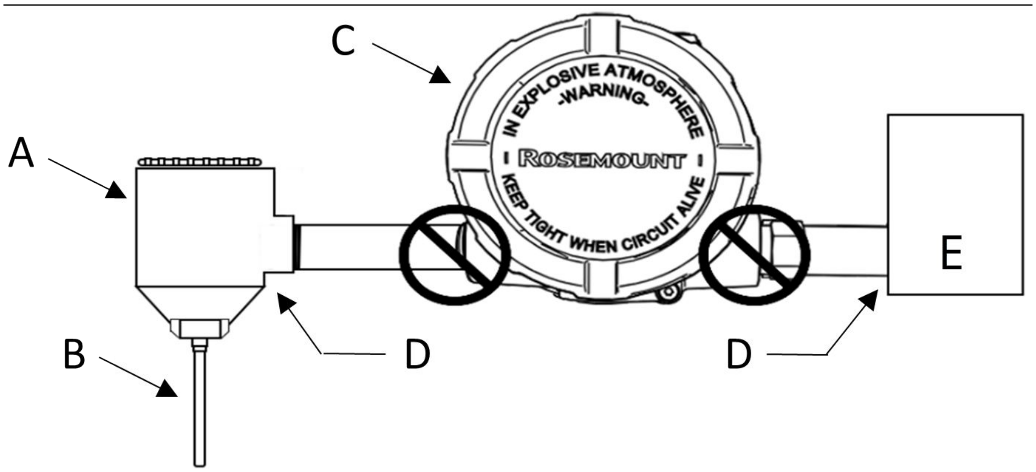
NOTICE

The currents in the leads induced by electromagnetic interference can be reduced by shielding. Shielding carries the current to ground and away from the leads and electronics. If the ends of the shields are adequately grounded, only a small amount of current will actually enter the transmitter.

If the ends of the shield are left ungrounded, voltage is created between the shield and the transmitter housing and also between the shield and earth at the element end. The transmitter may not be able to compensate for this voltage, causing it to lose communication and/or go into alarm. Instead of the shield carrying the currents away from the transmitter, the currents will now flow through the sensor leads into the transmitter circuitry where it will interfere with the circuit operation.

2.8.2 Ground the transmitter: option 1

Emerson recommends this option for ungrounded transmitter housing.



A. *Remote sensor housing*
B. *Sensor*
C. *Transmitter*
D. *Shield ground points*
E. *Distributed control system (DCS)*

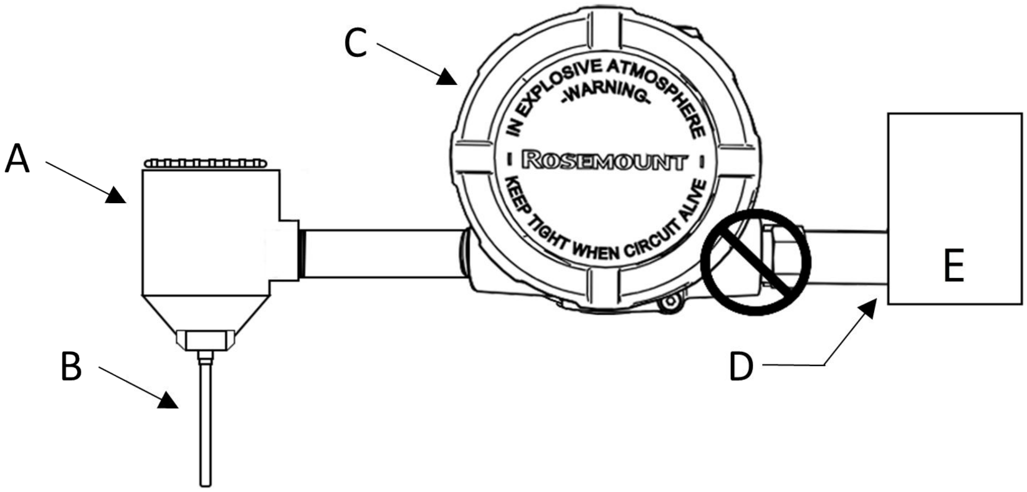
Procedure

1. Connect signal wiring shield to the sensor wiring shield.
2. Ensure the two shields are tied together and electrically isolated from the transmitter housing.

3. Ground shield at the power supply end only.
4. Ensure that the sensor shield is electrically isolated from the surrounding grounded fixtures.

2.8.3 Ground the transmitter: option 2

Emerson recommends this method for grounded transmitter housing.



A. *Remote sensor housing*
B. *Sensor*
C. *Transmitter*
D. *Shield ground point*
E. *Distributed control system (DCS)*

Procedure

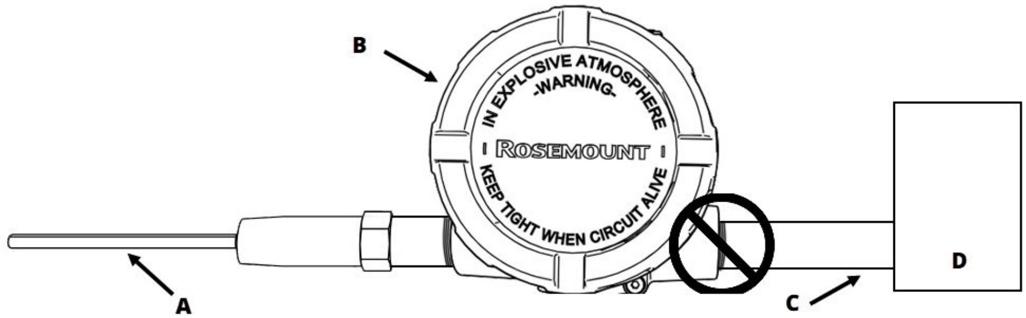
1. Connect sensor wiring shield to the transmitter housing.

NOTICE

Perform this step only if the housing is grounded.

2. Ensure that the sensor is electrically isolated from surrounding fixtures that may be grounded.
3. Ground signal wiring shield at the power supply end.

2.8.4 Ground the transmitter: option 3

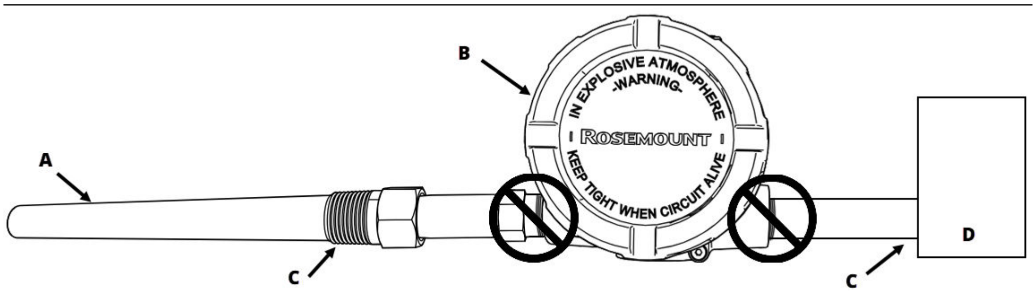


A. Sensor
B. Transmitter
C. Shield ground point
D. Distributed control system (DCS)

Procedure

1. If possible, ground sensor wiring shield at the sensor.
2. Ensure the sensor wiring and signal wiring shields are electrically isolated from the transmitter housing and other grounded fixtures.
3. Ground signal wiring shield at the power supply end.

2.8.5 Ground the transmitter: option 4



A. Sensor
B. Transmitter
C. Shield ground points
D. Distributed control system (DCS)

Procedure

1. Ground sensor wiring shield at the sensor.
2. Ensure the sensor wiring and signal wiring shields are electrically isolated from the transmitter housing.
3. Do not connect the signal wiring shield to the sensor wiring shield.
4. Ground signal wiring shield at the power supply end.

2.8.6 Transmitter housing

Ground the transmitter housing according to local or site electrical requirements.

An internal ground terminal is standard. You can also order an optional external ground lug assembly (option code G1), if needed. An external ground lug assembly is included when required by selected hazardous location protection types.

3 Standard configuration

3.1 Configuration overview

This section contains information on commissioning and tasks that must be performed on the bench prior to installation, as well as tasks performed after installation. This section also provides instructions on configuring using any communication device, including:

- Communication device, such as AMS Trex
- HART® host, such as AMS Device Manager
- AMS Device Configurator Bluetooth® app
- **Quick Service** buttons

3.1.1 Configuring using a communication device

For more detailed information about AMS Trex, see AMS Trex Device Communicator.

It is critical that the latest device drivers (DDs) are loaded onto the communication device to ensure full functionality.

3.1.2 Configuring using AMS Device Manager

For more detailed information about AMS Device Manager, see the AMS Device Manager product page.

It is critical that the latest device drivers (DDs) are loaded onto the AMS Device Manager to ensure full functionality.

3.1.3 Configuring using AMS Device Configurator Bluetooth® app

For more detailed information about the AMS Device Configurator Bluetooth app, see Configure via Bluetooth® wireless technology.

3.1.4 Configuring using **Quick Service** buttons

You can use the **Quick Service** buttons for the following configuration and maintenance tasks.

- **View Configuration** shows the current device configuration.
- **ReadyConnect Technology** detects the sensor type, number of sensor wires, and Callendar-Van Dusen coefficients of a connected Rosemount 214C ReadyConnect™-enabled temperature sensor. With the push of a button in the ***Quick Service Buttons*** menu, the transmitter automatically updates to match the sensor details, allowing for quick, easy, and error-free configuration.
- **Sensor Configuration** provides the ability to locally configure temperature sensor parameters into the transmitter to ensure accurate measurement.
- **Loop Test** will verify that the 4-20 mA loop is working properly. This is a common task performed when commissioning the transmitter.

- **Rotate Display** provides the ability to rotate the transmitter display in 90-degree increments to ensure proper display orientation.

Quick Service buttons are located on the LCD display. To access these buttons, remove the housing cover. Hold both buttons for three seconds to enter the ***Quick Service Buttons*** menu. See Figure 3-1 for button locations.

Figure 3-1: Quick Service Button Locations

3.2 Configuration

The transmitter must have certain basic variables configured to operate.

In many cases, Emerson pre-configures these variables at the factory. For a list of the factory default variable settings, see Configuration tables. You may need to configure the transmitter to revise the configuration variables.

3.2.1 Review configuration data

Before operating the transmitter in an actual installation, review all the factory-set configuration data to ensure that it reflects the current application. To review these parameters:

Procedure

Go to **Device Settings** → **Setup Overview**.

This displays device and security information, details for Measurement 1 and Measurement 2, alarm and saturation values, and current device output information (primary variable and damping). **Setup Overview** enables you to perform all basic setup functions without having to access multiple screens and menus in the user interface. All basic device configuration information is located in one central spot, meaning for simple configuration applications, you may only need to visit this one screen to have a functional device.

Verify configuration using Quick Service buttons

Procedure

1. Locate the Quick Service buttons.
   See Figure 3-1.
2. Hold both buttons for three seconds until the menu appears.
3. Use the buttons to navigate to the ***View Config*** screen.
   There are several parameters displayed on the ***View Configuration*** menu.
4. Select **Next** to navigate through the screens and view the parameters.
5. Select **Done** to return to the main menu.

3.2.2 Check output

Before performing other transmitter online operations, review the configuration of the transmitter's digital output parameters to ensure the transmitter is operating properly.

Procedure

Go to **Process Variables** → **Device Overview**.

The process variables provide the transmitter output. The ***Device Overview*** menu displays the process variables, including temperature, percent range, and analog output. These process variables are continuously updated.

3.2.3 Variable Mapping

The ***Variable Mapping*** menu displays the sequence of the process variables.

Variable mapping is predetermined based on model structure and factory configuration. See Transmitter custom configuration for preconfigured variable mapping.

The Rosemount 3144S single and dual-sensor input configurations allow you to select the primary variable (PV), secondary variable (SV), tertiary variable (TV), and quaternary variable (QV). Variable choices are:

- Measurement 1
- Measurement 2
- Terminal Temperature (SV, TV, or QV only)
- Differential Temperature
- Average Temperature
- Hot Backup™ (PV only)
- Average with Hot Backup (PV only)
- Sensor 1 (SV, TV, or QV only)(1)
- Sensor 2 (SV, TV, or QV only)(1)

Procedure

1. To change the primary variable:

(1) *Sensor 1 and Sensor 2 variables are only available with X-well enabled devices (Measurement Functionality 3 or 4) and allows operators to monitor a standard surface temperature value alongside the X-well process temperature value.*

a) Go to **Device Settings → Setup Overview → Output**.

b) In the **Primary Variable** drop-down menu, select the desired variable.

2. To change the secondary, tertiary, or quarternary variable:
   a) Go to **Device Settings → Communication → HART → Variable Mapping**.

   b) For each field, select the desired variable in the drop-down menu.

3.2.4 Sensor configuration

Each sensor must be properly configured for the correct sensor type and connection to ensure the best accuracy. To change the sensor type, connection, or units:

Procedure

1. Go to **Device Settings → Setup Overview**.
   Under **Measurement 1** or **Measurement 2**, **Sensor Type**, **Connection**, and **Units** are displayed.
2. To change the **Sensor Type**, **Connection**, or **Units**, select the drop-down menu for the desired parameter; then select the new value.
   - The following sensor types and connections are available:
     — 2, 3, or 4-wire Pt 100, Pt 200, Pt 500, Pt 1000 (platinum) RTDs (α = 0.00385 Ω/Ω/°C)
     — 2, 3, or 4-wire Pt 100 (platinum) RTDs (α = 0.00385 Ω/Ω/°C) with Callendar-Van Dusen
     — 2, 3, or 4-wire Pt 100, Pt 200 (platinum) RTDs (α = 0.003916 Ω/Ω/°C)
     — 2, 3, or 4-wire Pt 50, Pt 100 (platinum) RTDs (α = 0.00391 Ω/Ω/°C)
     — 2, 3, or 4-wire Ni 120 (nickel) RTDs
     — 2, 3, or 4-wire Cu 50, Cu 100 (copper) RTDs (α = 0.00426 Ω/Ω/°C)
     — 2, 3, or 4-wire Cu 50, Cu 100 (copper) RTDs (α = 0.00428 Ω/Ω/°C)
     — 2, 3, or 4-wire Cu 10 (copper) RTDs
     — IEC/National Institute of Standards and Technology (NIST) Type B, E, J, K, N, R, S, T Thermocouples
     — DIN Type L, U Thermocouples
     — ASTM Type W5Re/W26Re Thermocouples
     — GOST Type L Thermocouples
     — -10 to 100 millivolts
     — 2, 3, or 4-wire 0 to 2000 ohms
     — Rosemount X-well™: Standard and Extended Range

     Contact an Emerson representative for information on temperature sensors, thermowells, and accessory mounting hardware available through Emerson.
   - Set the transmitter output to one of the following engineering units:
     — Degrees Celsius
     — Degrees Fahrenheit
     — Degrees Rankine

- Kelvin
- Ohms
- Millivolts

Sensor configuration using Quick Service buttons

Procedure

1. Locate the **Quick Service** buttons.

   See Figure 3-1.
2. Hold both buttons for three seconds until the menu appears.
3. Use the buttons to navigate to the ***Sensor Config*** screen.

   Sensor types available in this menu include PT100 RTD (α = 385) and Type J, K, E, and T Thermocouples.
4. Follow the prompts to configure the desired sensor.
5. Select **Done** once complete to return to the main menu.

3.2.5 Sensor serial numbers

The serial number is useful for identifying sensors and tracking sensor calibration information. To edit the sensor serial numbers:

Procedure

1. Go to **Device Settings** → **Output** → **Measurement 1 or 2**.
2. Under ***Measurement 1 Setup*** or ***Measurement 2 Setup***, enter the desired **Serial Number**.

3.2.6 2-Wire RTD Offset

The **2-Wire Offset** setting allows the measured lead wire resistance to be input, which results in the transmitter adjusting its temperature measurement to correct the error caused by this resistance. Because of a lack of lead wire compensation within the RTD, temperature measurements made with a 2-wire RTD are often inaccurate.

Set 2-Wire RTD Offset

Procedure

1. Go to **Device Settings** → **Measurement 1 or 2** → **Measurement 1 or 2 Setup**.
2. In the **2-Wire Offset** field, enter the amount of resistance in ohms to subtract from the reading to account for lead resistance effects.

3.2.7 Terminal Temperature

View Terminal Temperature

The **Terminal Temperature** indicates the temperature at the transmitter terminals.

To view the **Terminal Temperature**:

Procedure

Go to **Device Settings** → **Output** → **Terminal Temperature**.

The **Terminal Temperature** is listed under ***Readings***.

Change Terminal Temperature Units

Procedure

1. Go to **Device Settings** → **Output** → **Terminal Temperature**.
2. Under ***Setup***, select the **Terminal Temperature Units** drop-down menu and select the desired units.

3.2.8 Dual-sensor configuration

Dual-sensor configuration allows for increased measurement and variable functionality, including differential temperature, average temperature, and diagnostic capabilities.

Change configuration from single to dual

Procedure

1. Go to **Device Settings** → **Setup Overview**.
2. Under ***Measurement 2***, select the proper **Sensor Type**, **Connection**, and **Units** using the respective drop-down menus.

Change sensor configuration from dual to single

Procedure

1. Go to **Device Settings** → **Setup Overview**.
2. Under ***Measurement 2***, select **Not Used** in the **Sensor Type** drop-down menu.

Configuring Average or Differential temperature

Dual-sensor configuration enables the **Differential** and **Average** temperature variables.

The transmitter configured for a dual sensor can accept any two inputs and then display the **Differential** or **Average** temperature between them. Use the following procedure to configure the transmitter to measure **Differential** or **Average** temperature as the primary variable.

Procedure

1. Go to **Device Settings** → **Output** → **Calculated Outputs**.
2. In the **Calculated Output Variables** drop-down menu, select **Enabled**.
3. Go to **Device Settings** → **Setup Overview** → **Output**.
4. Under the **Primary Variable** drop-down menu, select **Differential** or **Average**.

The transmitter determines the **Differential** temperature by subtracting the reading of **Measurement 2** from **Measurement 1** (M1-M2). Ensure this order of subtraction is consistent with the desired reading for the application. To assign the average or differential temperature to the secondary, tertiary, or quaternary variable, refer to Variable Mapping.

3.2.9 Configure via Bluetooth® wireless technology

Bluetooth wireless technology enables faster commissioning and improved ease of use.

Procedure

1. Launch AMS Device Configurator.
   See AMS Device Configurator for Emerson Field Devices available on Emerson.com.
2. Select the device you want to connect to.
3. On first connection, enter the key for this device.
   See Figure 3-2
4. At the top left, click the menu icon to navigate the desired device menu.
5. Verify and configure according to the parameters.

Disable Bluetooth® communication

Emerson configures Bluetooth on the device at the factory.

To disable Bluetooth communication:

Procedure

1. Go to **Device Settings** → **Communication** → **Bluetooth**.
2. Under ***Radio***, select the drop-down menu and then select **Disable**.
3. To re-enable, select **Enable** from the ***Radio*** drop-down menu.

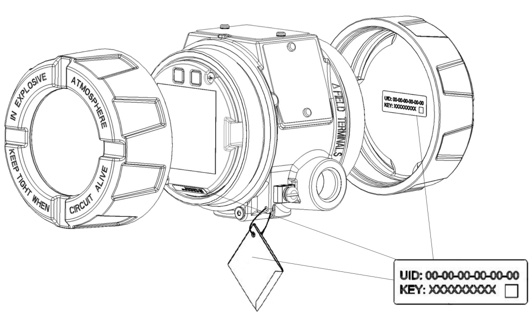
Bluetooth® unique identifier (UID) and Key

The **UID** is the identification number unique to the Bluetooth radio on the device.

The **UID** will be advertised when Bluetooth functionality is enabled on the output board. The **Key** is the required passkey to access the device. The information is only available in the tags located as shown in Figure 3-2. Emerson does not retain copies of this information. You can find the **UID** and **Key** in the following locations:

- Disposable paper tag attached to the device
- Label inside the terminal block cover
- Label on the display unit

Figure 3-2: Bluetooth Security Information



3.2.10 Configure via ReadyConnect™

You must order the Rosemount 3144S with the Ultra Performance Class option to use ReadyConnect technology.

ReadyConnect technology offers sensor configuration with the push of a button, eliminating the need to manually input sensor information and Callendar Van-Dusen (CVD) coefficients. When the 3144S Temperature Transmitter is wired to a ReadyConnect Rosemount 214C Sensor, you can prompt the transmitter to use ReadyConnect technology to detect and automatically configure temperature sensor parameters.

ReadyConnect 214C Sensors are built with a sensor ID tag, which contains the following sensor details:

1. Sensor type: any RTD or thermocouple
2. Number of wires (2, 3, or 4)
3. CVD coefficients

To initiate sensor configuration, follow the steps below. The transmitter will detect the information from the sensor ID tag and automatically update the transmitter configuration.

Procedure

1. Go to **Device Settings** → **Output** → **Measurement 1 or 2 Setup** → **Configure with ReadyConnect**.
2. Follow the prompts to complete the configuration process.

Using ReadyConnect™ with Quick Service buttons

Procedure

1. Locate the **Quick Service** buttons.

   See Figure 3-1.
2. Hold both buttons for three seconds until the menu appears.
3. Use the buttons to navigate to the ***ReadyConnect*** screen.
4. Follow the prompts to initiate ReadyConnect for one or both sensors.
5. Once the screen shows **ReadyConnect Complete**, select **Done** to return to the main menu.

3.2.11 Device Configuration Checksum

The **Device Configuration Checksum** function provides a checksum value of configuration parameters that affect the analog output. The checksum can be used to identify changes in device configuration.

Procedure

1. Go to **Device Settings** → **Setup Overview**.
2. Run the **Device Configuration Checksum** method.

3.3 Device output configuration

Device output configuration contains primary variable (PV) range values, alarm and saturation levels, and analog output. You can set the transmitter's lower and upper range values using limits of expected readings.

The range of expected readings is defined by the **Lower Range Value (LRV)** and **Upper Range Value (URV)**. You can reset the transmitter range values as often as necessary to reflect changing process conditions. To change either range limit:

Procedure

1. Go to **Device Settings** → **Setup Overview**.
2. Under ***Output***, select **Upper Range Value** or **Lower Range Value** and enter the desired value.

Reranging the transmitter sets the measurement range to the limits of the expected readings, which maximizes transmitter performance; the transmitter is most accurate when operated within the expected temperature range for the application.

Changing the rerange values on the transmitter should not be confused with performing a sensor trim. Although reranging the transmitter matches a sensor input to a 4-20 mA output, as in conventional calibration, it does not affect the transmitter's interpretation of the input.

3.3.1 Process Variable Damping

Damping changes transmitter's response time to smooth variations in output readings caused by rapid changes in input.

Determine the appropriate damping setting based on the necessary response time, signal stability, and other requirements of the loop dynamics of the system.

When set to zero, the damping function is off, and the transmitter output reacts to changes in input as quickly as the intermittent sensor algorithm allows. Increasing the damping value increases transmitter response time.

The default damping value is five seconds, and the maximum damping value allowed is 60 seconds.

To set a damping value:

1. Go to **Device Settings** → **Output** → **Measurement 1 or 2**.
2. Under ***Output***, enter the desired damping value.

Note
If Measurement 1 or Measurement 2 is the primary variable, you change the damping by going to **Device Settings** → **Setup Overview** → **Output**.

3.3.2 Configure Alarm and Saturation Values

Specific alarm and saturation values can be configured from the factory or altered in the field. To change the alarm and saturation values:

Procedure

1. Go to **Device Settings** → **Setup Overview**.
2. Under ***Alarm and Saturation Values***, select **Configure Alarm and Saturation Values**.

3. Select **Rosemount**, **NAMUR**, or **Custom Alarms**.
4. Follow prompts to enter the desired values.

   For custom alarm limits, the values must fall within the following guidelines:

   - The **Low Alarm** value must be between 3.57 and 3.8 mA.
   - The **High Alarm** value must be between 20.2 and 23.0 mA.
   - The **Low Saturation** level must be between 3.67 and 3.9 mA and 0.1 mA above the **Low Alarm** value.
   - The **High Saturation** level must be between 20.1 and 22.9 mA and 0.1 mA below **High Alarm**.

   Example

   The **Low Alarm** value has been set to 3.7 mA. Therefore, the **Low Saturation** level, S, must be 3.8 ≤ S ≤ 3.9 mA.
5. Use the **Alarm** switch on the front side of the electronics to set whether the output will be driven to **High Alarm** or **Low Alarm** in case of failure.

Related information

Verify configuration and set the switches

3.3.3 Configure HART® Output

You can make changes to the **Multidrop Address**, **Burst Mode**, or **Burst** options.

Procedure

1. Go to **Device Settings** → **Communication** → **HART**.
2. Under ***Communication Settings***, select **Change Polling Address** to make changes to the multidrop/polling address.
3. Under ***Burst Mode Configuration***, select the **Burst Mode** drop-down menu and then select **On** or **Off**.
4. Under ***Burst Mode Configuration***, select **Configure Advanced Messages** to view or configure **Burst Messages**.

3.4 LCD display information

Local digital displays provide operators and maintenance staff with visibility to real-time process conditions, device status, and diagnostic alerts at the measurement point without having to access or communicate with the control room.

The Rosemount 3144S offers a graphical, backlit display that provides greater resolution and improved visibility. The graphical display enables both multilingual capability and the use of icons, including Rosemount X-well™ and NE 107 status.

The display continuously shows the primary variable, and a secondary area cycles through additional parameters selected.

You can change the LCD display settings to reflect necessary configuration parameters when adding an LCD display or reconfiguring the transmitter.

NE 107 Status	X-well
	

3.4.1 Configure additional parameters

The LCD display contains two areas to give insight to process variables: the top area, which always displays the primary variable and the bottom area, which cycles through additional parameters selected.

To view or change the current parameters:

Procedure

1. Go to **Device Settings** → **Display** → **Display**.
   Under ***Additional Parameters***, the selected parameters are marked with checked boxes.
2. To add or remove a parameter, check or uncheck the box next to it.

Additional parameters include the following:

- Measurement 1
- Measurement 2
- Average Temperature
- Differential Temperature
- Loop Current
- Percent of Range
- Terminal Temperature
- Alarm Switch State
- Security Status
- HART® Long Tag
- Bluetooth® Status

3.4.2 Rotate LCD display

You can rotate the LCD display orientation to accommodate various installation angles. To rotate the LCD display:

Procedure

1. Go to **Device Settings** → **Display** → **Display**.
2. Under ***Rotation***, select the desired rotation from the drop-down menu.

   The rotation options are:

   - 0 degrees clockwise
   - 90 degrees clockwise
   - 180 degrees clockwise
   - 270 degrees clockwise

Rotate LCD display using Quick Service buttons

Procedure

1. Locate the **Quick Service** buttons.

   See Figure 3-1.
2. Hold both buttons for three seconds until the menu appears.
3. Use buttons to navigate to the ***Rotate Display*** screen.
4. Select **Rotate** to turn the screen 90 degrees clockwise. Repeat until the display shows the desired orientation; then select **Done** to return to the main menu.

The screen will display **Task Complete**.

3.4.3 Change device language

The LCD display can display seven languages. To change the device language:

Procedure

1. Go to **Device Settings** → **Display** → **Advanced Display**.
2. Under ***Display Language***, select the desired language from the drop-down menu.

   The display language options are:

   - Chinese (simplified)
   - English
   - French
   - German
   - Italian
   - Portuguese
   - Spanish

3.4.4 Configure other LCD display options

There are several additional options on the LCD display that can be changed.

Backlight

Emerson ships the transmitter with the display back light on by default. To modify the **Light** status:

Procedure

1. Go to **Device Settings** → **Display** → **Advanced Display**.
2. Under ***Light***, select either On or Off from the drop-down menu.

Decimal Separator

The **Decimal Separator** can be either a period or a comma. To change the **Decimal Separator**:

Procedure

1. Go to **Device Settings** → **Display** → **Advanced Display**.
2. Under ***Decimal Separator***, select either Period or Comma from the drop-down menu.

Decimal Places

The optimal number of digits shown to the right of the decimal is automatically determined by the device. To adjust the number of digits shown for a particular variable:

Procedure

1. Go to **Device Settings** → **Display** → **Advanced Display**.
2. Under **Decimal Places**, select either 1 Additional Decimal Digit, Automatic, or 1 Fewer Decimal Digit from the drop-down menu for the desired variable (***Measurement 1***, ***Measurement 2***, ***Average Temperature***, or ***Differential Temperature***).

3.5 Device information

The following is a list of transmitter information variables, including device identifiers, factory-set configuration variables, and other information. The transmitter serial number, model code, and Bluetooth® Radio **Unique Identifier (UID)** are also shown in this menu. To view device information:

Go to **Device Settings** → **Device Information** → **Identification**.

Tag This is the easiest way to identify and distinguish between transmitters in multi-transmitter environments. Use it to label transmitters electronically according to the application requirements. The **Tag** may be up to eight characters long and has no impact on the transmitter's primary variable readings.

Long Tag Similar to **Tag**, but can be up to 32 characters instead of eight characters in traditional **Tag**.

Date	User-defined variable that provides a place to save the date of the last revision of configuration information. It has no impact on the operation of the transmitter.
Descriptor	Provides a longer user-defined electronic label to assist with more specific transmitter identification than is available with the **Tag** variable. The **Descriptor** may be up to 16 characters long and has no impact on the operation of the transmitter.
Message	Provides the most specific user-defined means for identifying individual transmitters in multi-transmitter environments. It allows for 32 characters of information and is stored with other configuration data. The **Message** variable has no impact on the operation of the transmitter.

3.6 Perform Loop Test

The **Loop Test** action verifies the output of the transmitter, proper loop wiring, the integrity of the loop, transmitter output, and the operations of any recorders or similar devices installed in the loop.

Only perform the **Loop Test** after you install the transmitter.

Procedure

1. Go to **Diagnostics** → **Simulation** → **Loop Test**.
2. Choose the **Analog Output** level and follow the prompts.

3.6.1 Perform a Loop Test using Quick Service buttons

Procedure

1. Locate the **Quick Service** buttons.

   See Figure 3-1.
2. Hold both buttons for three seconds until the menu appears.
3. Use the buttons to navigate to the ***Loop Test*** screen.
4. Follow the prompts.
5. Select **Done** to return to the main menu.

3.7 Device Restart and Device Configuration Reset

To restart the device or reset configuration parameters:

Procedure

1. Go to **Device Settings** → **Restore/Restart**.
2. Select:
   - **Device Restart** to reset power to the device and preserve the current device configuration
   - **Device Configuration Reset** to reset configuration parameters that affect the analog output and restart the device

4 Diagnostics configuration

4.1 Diagnostics overview

The Rosemount 3144S provides complete coverage from your temperature sensor to your control room with sensor health diagnostics, dual input capabilities, and continuous electrical loop monitoring.

These capabilities help identify issues before they impact operations or compromise safety.

4.1.1 RTD Measurement Protection

RTD Measurement Protection will seamlessly switch from a 4-wire to a 3-wire RTD sensor input configuration if one of the four sensor wires becomes broken, corroded, or loose anywhere from the sensor element to the transmitter terminal connections.

The measurement will be maintained with no process disruption, and a maintenance alert will be generated.

4.1.2 Thermocouple Degradation Diagnostic

The **Thermocouple Degradation Diagnostic** provides real time resistance monitoring of the thermocouple sensor loop, alerting operators of conditions that could indicate wire thinning, sensor degradation, moisture intrusion, or corrosion.

Degraded sensors/sensor wiring can result in measurement drift and inaccurate readings. By identifying these degraded conditions prior to failure, you can take action to prevent process downtime and protect against controlling your process based on incorrect values and possible unsafe conditions.

Once configured, the **Thermocouple Degradation Diagnostic** runs at least once per second, monitoring the resistance of the thermocouple sensor. As the resistance increases, the diagnostic can detect when the resistance exceeds the threshold. When this happens, the diagnostic will provide an alert. This feature is not intended to be a precise measurement of thermocouple status, but it is a general indicator of thermocouple sensor health by providing trending over time. The **Thermocouple Degradation Diagnostic** does not detect shorted thermocouples.

4.1.3 Hot Backup™ capability

Hot Backup capability requires dual-sensor configuration. If a primary sensor fails, **Hot Backup** automatically switches from a failed sensor to a backup sensor without impact to the analog output signal. With **Hot Backup** configured as the primary variable, the transmitter shows the process alert and the temperature reading from the secondary sensor, so the analog output remains uninterrupted. This improves process availability by preventing a failure of the primary sensor from disrupting process control or causing a shutdown.

4.1.4 Sensor Drift Alert

Sensor Drift Alert requires dual-input configuration and can be used with both RTDs and thermocouples and provides real-time monitoring of the difference in temperature readings between a primary and secondary sensor.

The diagnostic will alert you via HART® alert or Analog Output alarm if the difference in temperature readings exceeds a user-defined threshold. By identifying a drifting sensor before it fails, you can take action to ensure you are operating with the most accurate temperature measurements at all times.

4.1.5 Loop Integrity

The **Loop Integrity** diagnostic detects issues that may jeopardize the integrity of the electrical loop.

Issues may include:

- water entering the wiring compartment and making contact with the terminals
- an unstable power supply nearing end of life
- heavy corrosion on the terminals

The technology is based on the premise that once a transmitter is installed and powered up, the electrical loop has a baseline characteristic that reflects the proper installation. If the transmitter terminal voltage deviates from the baseline and outside the user-configured threshold, the transmitter can generate a HART® alert or analog alarm.

4.1.6 Process Alerts

Process Alerts allow you to configure the transmitter to output a HART® message when the configured threshold is exceeded.

You can set **Process Alerts** for any device variable. The transmitter will output a **Process Alert** if the monitored variable exceeds the user-defined threshold. An alert will be displayed on a Field Communicator, AMS Device Manager status screen, and the LCD display. The alert will reset once the value returns to within the range.

You do not need to set up the monitored variable as the primary variable, and you can set up each of the two available **Process Alerts** to monitor different variables if desired. You can also customize the name of each alert.

You can reference the **Minimum/Maximum Tracking** functionality at any time in the **Process Alerts** section. It is no longer a stand-alone diagnostic functionality.

4.2 RTD Measurement Protection

RTD Measurement Protection (formerly **Ever Connect**) automatically changes a 4-wire RTD sensor input configuration to 3-wire if a wire is broken or damaged, avoiding loss of measurement point while generating an alert.

This menu will only appear if the sensor is a 4-wire RTD. Once the sensor has been repaired, **RTD Measurement Protection** will automatically reset the device to read a 4-wire RTD.

4.2.1 Configure **RTD Measurement Protection**

Procedure

1. Go to **Device Settings** → **Output** → **Measurement 1 or 2** → **Ever Connect**.
2. In the ***Configuration*** drop-down menu, select On.

4.2.2 Disable **RTD Measurement Protection**

Procedure

1. Go to **Device Settings** → **Output** → **Measurement 1 or 2** → **Ever Connect**.
2. In the ***Configuration*** drop-down menu, select Off.

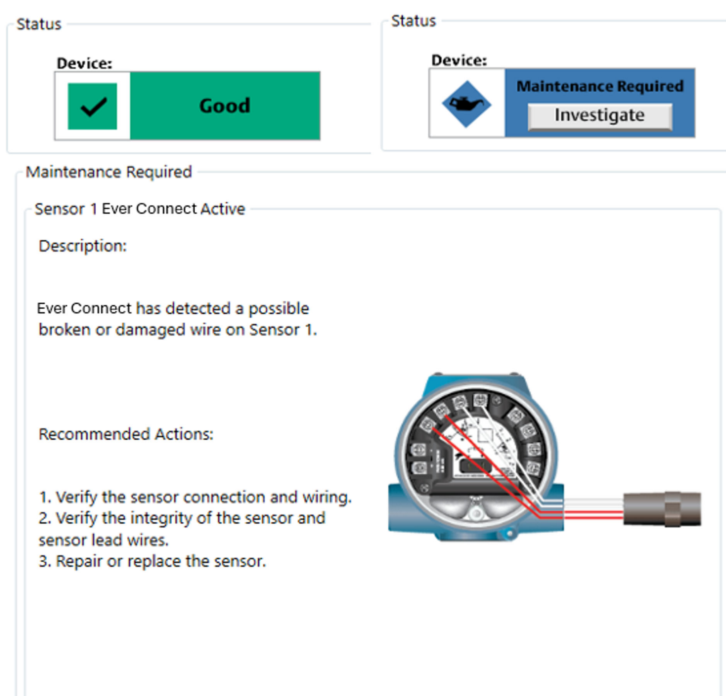
4.2.3 LCD display messages

The LCD display on the transmitter will display: `Sensor 1 Possible Lead Wire Loss` or `Sensor 2 Possible Lead Wire Loss`.

4.2.4 Device driver (DD) messages

Under **Process Variables** → **Device Overview** → **Status**, the device status is listed.

When both sensors are working properly, the status is shown as Good. When **RTD Measurement Protection** detects a loose, broken, or corroded sensor wire, the status is shown as Maintenance Required. Select the **Investigate** button to view more details, including recommended actions for fixing the issue. For **RTD Measurement Protection**, this will say: `Ever Connect has detected a possible broken or damaged wire on Sensor 1` or `Ever Connect has detected a possible broken or damaged wire on Sensor 2`.



4.3 Thermocouple Degradation Diagnostic

The **Thermocouple Degradation Diagnostic** acts as a gauge of general thermocouple health and is indicative of any major changes in the status of the thermocouple or the thermocouple sensor loop.

Once the sensor has been repaired and the sensor loop resistance returns to within the threshold limit, the **Thermocouple Degradation Diagnostic** will automatically reset.

Your device must have Diagnostic Functionality "C" in the model code in order to utilize the Thermocouple Degradation Diagnostic.

4.3.1 Configure **Thermocouple Degradation Diagnostic**

Procedure

1. Go to **Diagnostics** → **Alerts** → **Thermocouple Diagnostic**.
2. Under ***Measurement 1*** or ***Measurement 2*** (whichever is a thermocouple), select **Baseline Measurement 1 Resistance**. The current sensor loop resistance will serve as the baseline.
3. Follow the prompts to continue.

   The resistance must be baselined in order to use the diagnostic.

   A new ***T/C Degradation Diagnostic*** menu will appear. This window displays the **T/C Degradation Mode**, **Threshold Level**, **Resistive Threshold**, **Baseline Resistance**, and **Real-Time Resistance**.
4. In the **T/C Degradation Mode** drop-down menu, select **HART Status Alert**.
5. The **Threshold Level** will default to Low. To change the **Threshold Level**, select the desired option from the **Threshold Level** drop-down menu. Options include:
   - Low
   - Medium
   - High
   - Custom

   Note
   If **Custom Threshold Level** is selected, a prompt opens requesting the desired **Resistive Threshold** value be entered.

4.3.2 Disable **Thermocouple Degradation Diagnostic**

Procedure

1. Select **Diagnostics** → **Alerts** → **Thermocouple Diagnostic**.
2. Under the ***T/C Degradation Mode*** drop-down menu, select **Disable Diagnostic**.

4.3.3 Verify **Thermocouple Degradation Diagnostic** is configured

Procedure

Go to **Diagnostics** → **Alerts** → **Thermocouple Diagnostic**.

In the ***T/C Degradation Mode*** drop-down menu, **HART Status Alert** should be selected.

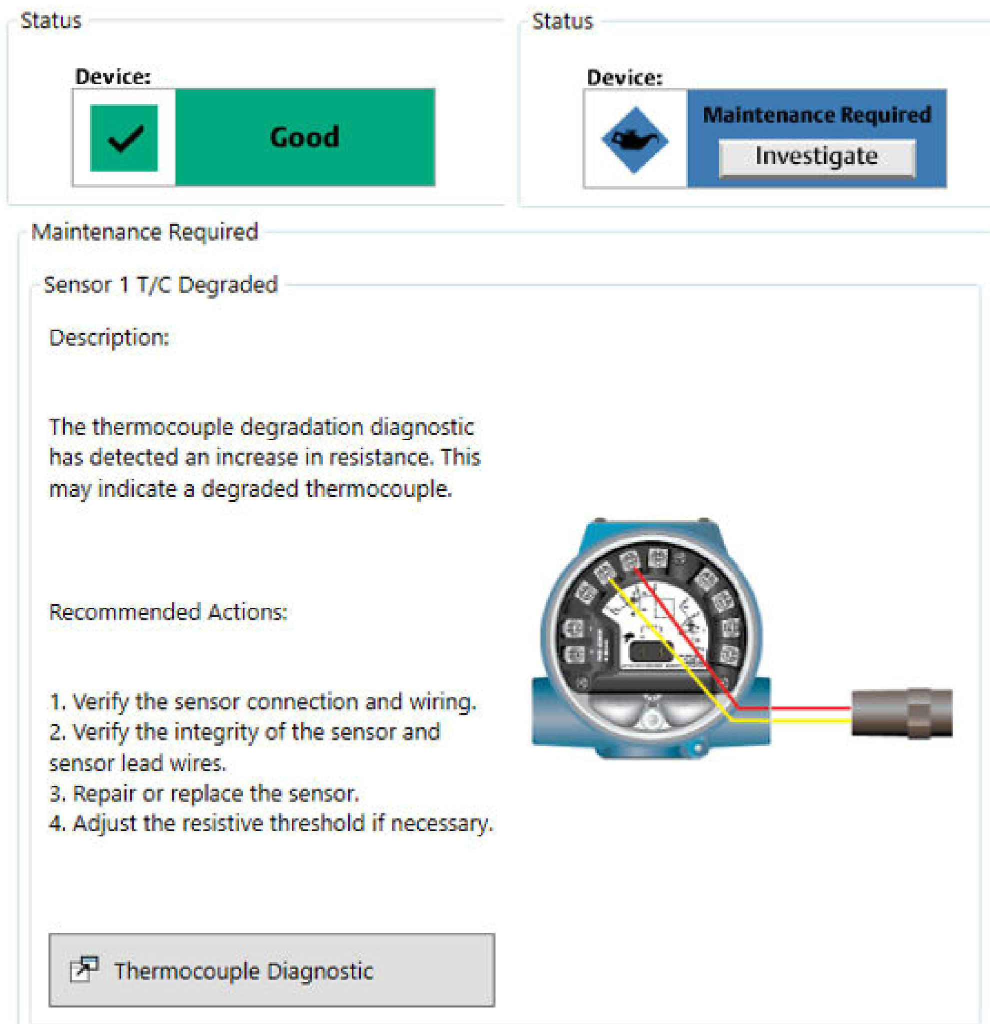
4.3.4 LCD display messages

The LCD display on the transmitter will say `Sensor 1 Degraded` or `Sensor 2 Degraded`.

4.3.5 Device driver (DD) messages

Under **Process Variables** → **Device Overview** → **Status**, the device status is listed.

When both sensors are working properly, the status is shown as Good. When the **Thermocouple Degradation Diagnostic** is activated, the status is shown as Maintenance Required. Select the **Investigate** button to view more details, including recommended actions for fixing the issue. For **Thermocouple Degradation Diagnostic**, this will say `The thermocouple degradation diagnostic has detected an increase in resistance. This may indicate a degraded thermocouple.`



4.4 Hot Backup™ capability

The Hot Backup feature allows the transmitter to automatically use a secondary sensor as the primary sensor if the primary sensor fails, which prevents process disruption due to a lost measurement.

The Rosemount 3144S offers two variables that use Hot Backup capability: **Hot Backup** and **Average with Hot Backup**.

Important
Hot Backup is only enabled if either of these variables (**Hot Backup** or **Average with Hot Backup**) are selected as the PV. This differs from historic **Hot Backup** configuration on the Rosemount 3144P, where either **First Good Temperature** or **Average Temperature** was required to be the PV to utilize **Hot Backup** in addition to the general feature configuration.

When the PV is set to **Hot Backup**, the transmitter reading will be Measurement 1. If one of the sensors fail, an alert will be generated but the transmitter will continue to generate an output. Once the failed sensor is repaired, the alert will automatically reset.

When the PV is set to **Average with Hot Backup**, the output is the average of Measurement 1 and Measurement 2. If one of the sensors fail, an alert will be generated, and the transmitter output will represent the measurement that is still working. Once the failed sensor is repaired, the alert will automatically reset and the output will once again represent the average of the two readings.

If a sensor fails with either **Hot Backup** or **Average with Hot Backup** as the PV, the 4-20 mA signal is not disrupted, and a status is sent to the control system (through HART® protocol) that the sensor has failed. An LCD display, if attached, displays the failed sensor status.

If both sensors fail, the transmitter will go into alarm, and the status available (via HART) states that both **Measurement 1** and **Measurement 2** have failed.

4.4.1 Set Hot Backup™ as the primary variable

To set Hot Backup as the primary variable (PV):

Procedure

1. Go to **Device Settings** → **Setup Overview** → **Output**.
2. Under the ***Primary Variable*** drop-down menu, select **Hot Backup** or **Average with Hot Backup**.

4.4.2 Change **Hot Backup** units

Procedure

1. Go to **Device Settings** → **Output** → **Calculated Outputs** → **Hot Backup Measurement** → **Setup**.
2. Select the desired units from the drop-down menu.

4.4.3 Change **Average with Hot Backup** units

Procedure

1. Go to **Device Settings** → **Output** → **Calculated Outputs** → **Average Temperature** → **Setup**.
2. Select the desired units from the drop-down menu.

4.4.4 View **Hot Backup** status

Procedure

1. Go to **Device Settings** → **Output** → **Calculated Outputs**.
2. Verify the ***Calculated Output Variables*** drop-down displays Enabled.
    - ***Calculated Output Variables*** require **Measurement 1** units, **Measurement 2** units, **Differential Temperature** units, **Hot Backup Measurement** units, and **Average Temperature** units to be selected as temperature units or the same raw unit (mV or Ohms).
3. View **Hot Backup Measurement**.
   Under **Readings**, the variable status is listed.

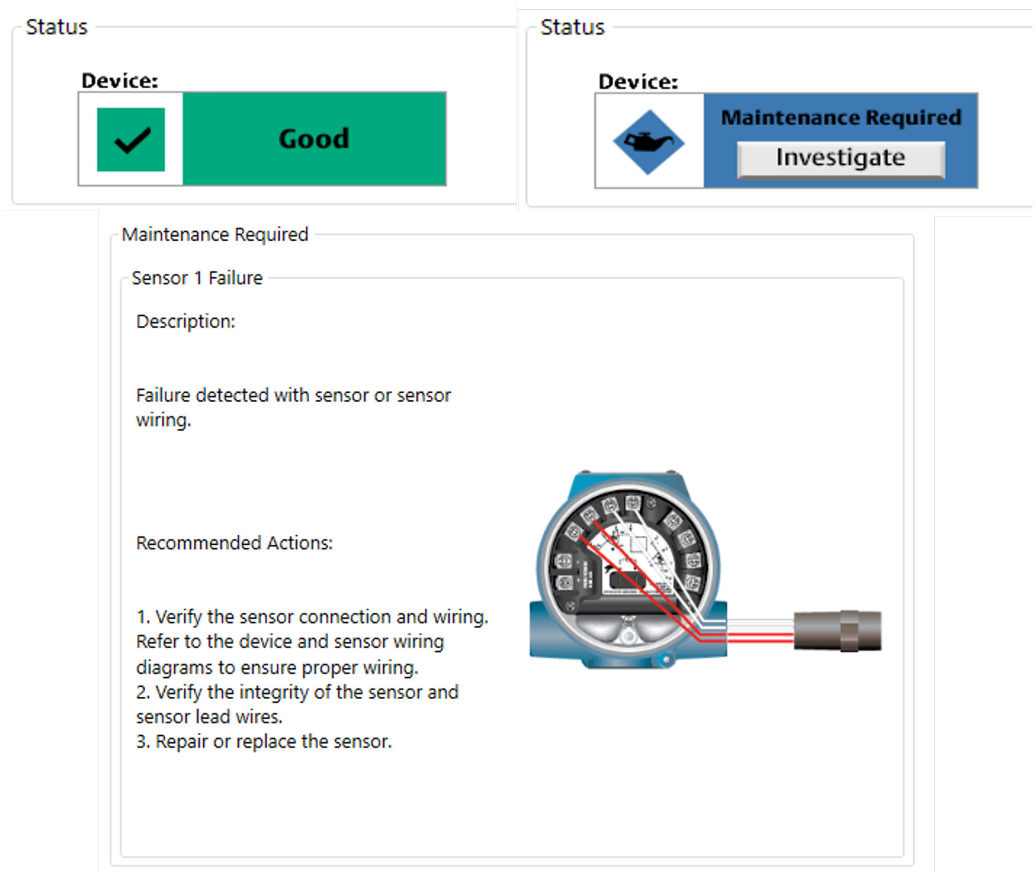
4.4.5 LCD display messages

The LCD display message on the transmitter will cycle between displaying `Sensor 1 Failure` or `Sensor 2 Failure` and the output of the secondary sensor that has taken over the process.

4.4.6 Device driver (DD) messages

Under **Process Variables** → **Device Overview** → **Status**, the device status is listed.

When both sensors are working properly, the status is shown as `Good`. When Hot Backup is activated, the status is shown as `Maintenance Required`. For more details, select **Investigate**, including recommended actions for fixing the issue. For Hot Backup, this will say: `Failure detected with sensor or sensor wiring.`



4.5 Sensor Drift Alert

The **Sensor Drift Alert** diagnostic allows the transmitter to set a warning status or go into analog alarm when the absolute value of the temperature difference between **Measurement 1** or **Measurement 2** exceeds a user-defined limit.

Sensor Drift Alert does not indicate which sensor is failing; rather, the diagnostic provides an indication of a sensor drifting. To determine which sensor is failing, view the individual sensor output trends. Once the sensor has been repaired or the temperature difference between the sensors no longer exceeds the threshold, **Sensor Drift Alert** will automatically reset.

4.5.1 Configure **Sensor Drift Alert**

Procedure

1. Go to **Diagnostics** → **Alerts** → **Sensor Diagnostics** → **Sensor Drift Alert**.
2. From the ***Mode*** drop-down menu, select either **HART Status Alert** (warning mode) or **Analog Output Alarm** (alarm mode).
3. Under ***Threshold***, enter the desired temperature differential prior to triggering **Sensor Drift Alert**.
4. Under ***Damping***, enter the desired damping value for **Sensor Drift Alert**.

4.5.2 Disable **Sensor Drift Alert**

Procedure

1. Go to **Diagnostics** → **Alerts** → **Sensor Diagnostics** → **Sensor Drift Alert**.
2. Under the ***Mode*** drop-down menu, select **Disable Alert**.

4.5.3 Verify **Sensor Drift Alert** is configured

Procedure

Go to **Diagnostics** → **Alerts** → **Sensor Diagnostics** → **Sensor Drift Alert**.

In the ***Mode*** drop-down menu, either **HART Status Alert** (warning mode) or **Analog Output Alarm** (alarm mode) is selected if **Sensor Drift Alert** is configured.

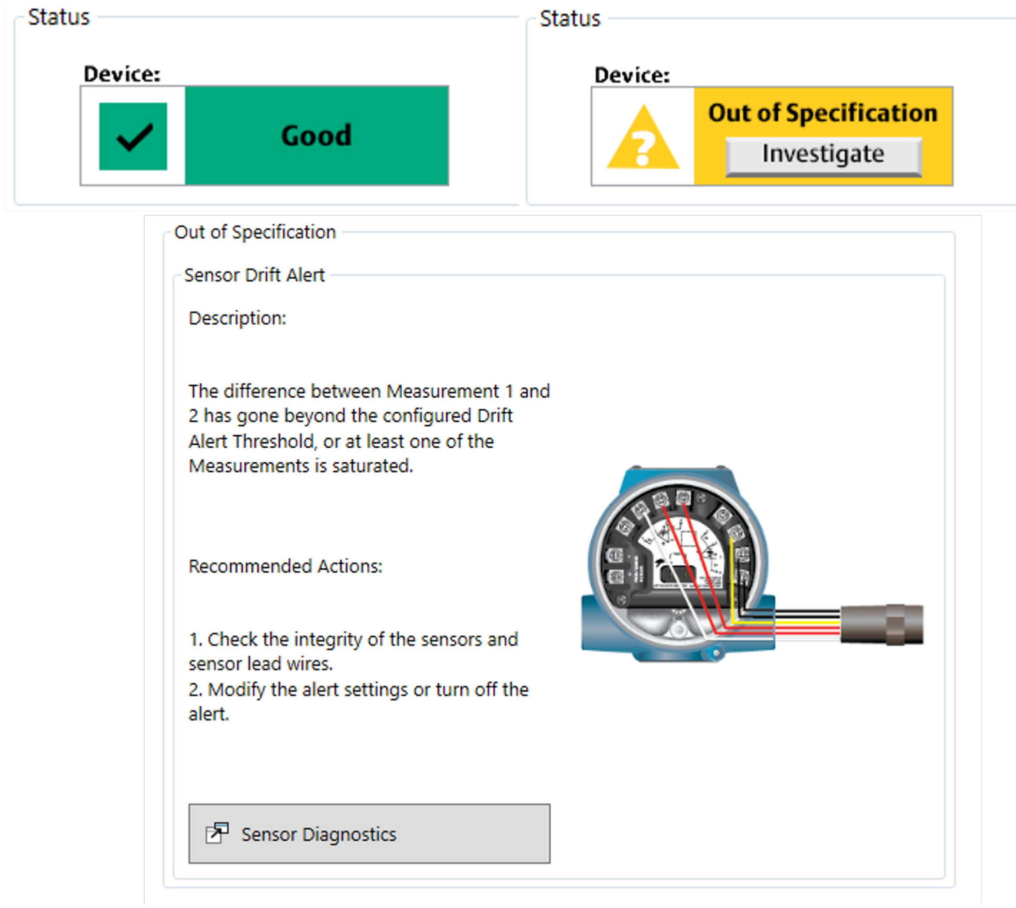
4.5.4 LCD display messages

The LCD display on the transmitter will cycle between displaying `Sensor Drift Alert` and the current primary variable (PV) output.

4.5.5 Device driver (DD) messages

Under **Process Variables** → **Device Overview** → **Status**, the device status is listed.

When both sensors are working properly, the status is shown as `Good`. When **Sensor Drift Alert** is activated, the status is shown as `Out of Specification`. Select **Investigate** to view more details, including recommended actions for fixing the issue. For **Sensor Drift Alert**, this will say: `The difference between Measurement 1 and Measurement 2 has gone beyond the configured Drift Alert Threshold, or at least one of the Measurements is saturated.`



4.6 Loop Integrity

Emerson ships the transmitter with **Loop Integrity** off as default and without any loop characterization performed. Once you have installed and powered up the transmitter, you must perform a loop characterization for the **Loop Integrity** diagnostic to function. When you initiate a loop characterization, the transmitter will check to see if the loop has sufficient power for proper operation. Then the transmitter will drive the analog output to both 4 and 20 mA to establish a baseline and determine the maximum allowable terminal voltage deviation. Once this is complete, you enter a sensitivity threshold called **Terminal Voltage Deviation Limit**, and a check is in place to ensure this threshold value is valid. Once you have characterized the loop and set the **Terminal Voltage Deviation Limit**, the **Loop Integrity** diagnostic actively monitors the electrical loop for deviations from the baseline. If the terminal voltage has changed relative to the expected baseline value (exceeding the configured **Terminal Voltage Deviation Limit**), the transmitter can generate an alert or alarm.

Note

The **Loop Integrity** diagnostic in the Rosemount 3144S Temperature Transmitter monitors and detects changes in the terminal voltage from expected values to detect common failures. It is not possible to predict and detect all types of electrical failures on the 4-20 mA output. Therefore, Emerson cannot absolutely warrant or guarantee that the **Loop Integrity** diagnostic will accurately detect failures under all circumstances.

4.6.1 Configure **Loop Integrity** diagnostic

To use the diagnostic, first create a baseline characteristic for the electrical loop after installing the transmitter. The loop is automatically characterized with the push of a button. This creates a linear relationship for expected terminal voltage values along the operating region from 4-20 mA.

Procedure

1. Go to **Diagnostics** → **Alerts** → **Loop Integrity Diagnostic**.
2. Run the **Configure Loop Integrity** method.
3. Follow the prompts to perform a loop characterization. See Loop Characterization.
4. Enter the desired voltage deviation limit (±) that is tolerated before the **Loop Integrity** diagnostic is triggered.
5. Enter the desired **Notification Mode**. Select from
   - **Disable Diagnostic** (no alert)
   - **HART Status Alert**
   - **Analog Output Alarm**
6. Follow the prompts to finish.

NOTICE

Changes in electrical loop

Severe changes in the electrical loop may inhibit HART® communication or the ability to reach alarm values. Therefore, Emerson cannot absolutely warrant or guarantee that the correct **Failure Alarm** level (High or Low) can be read by the host system at the time of annunciation.

4.6.2 Terminal Voltage

The **Terminal Voltage** field shows the current terminal voltage value in volts.

The terminal voltage is a dynamic value and is directly related to the mA output value. To view the **Terminal Voltage**:

Procedure

Go to **Diagnostics** → **Alerts** → **Loop Integrity Diagnostic** → **Settings**.

4.6.3 Set **Terminal Voltage Deviation Limit**

The **Terminal Voltage Deviation Limit** will be set while running the **Configure Loop Integrity** method but can be changed after the initial loop characterization. This value should be large enough that the expected voltage changes do not cause false failures.

To set the **Terminal Voltage Deviation Limit**:

Procedure

1. Go to **Diagnostics** → **Alerts** → **Loop Integrity Diagnostic** → **Settings** → **Terminal Voltage Deviation**.
2. In the **Voltage Deviation Limit** field, enter the desired value.

4.6.4 View **Resistance**

The **Resistance** value is the calculated resistance of the electrical loop (in Ωs) measured during the characterize loop procedure.

Changes in the resistance may occur due to changes in the physical condition of the loop installation. You can compare baseline and previous baselines to see how much resistance has changed over time. To view the baseline resistance and power supply:

Procedure

Go to **Diagnostics** → **Alerts** → **Loop Integrity Diagnostic** → **Loop Power Characterization** → **Resistance**.

4.6.5 View **Power Supply**

The **Power Supply** value is the calculated power supply voltage of the electrical loop (in volts) measured during the **Loop Power Characterization** procedure.

Changes in this value may occur due to the degraded performance of the power supply. You can compare baseline and previous baselines to see how much the power supply has changed over time. To view the baseline resistance and power supply:

Procedure

Go to **Diagnostics** → **Alerts** → **Loop Integrity Diagnostic** → **Loop Power Characterization** → **Power Supply**.

4.6.6 Loop Characterization

In order to use this diagnostic, you must initiate loop characterization after installing the transmitter for the first time or after intentionally altering electrical loop characteristics.

Examples include:

- Modifying power supply level or loop resistance of the system.
- Changing the terminal block on the transmitter.
- Adding the Wireless THUM™ Adapter to the transmitter.

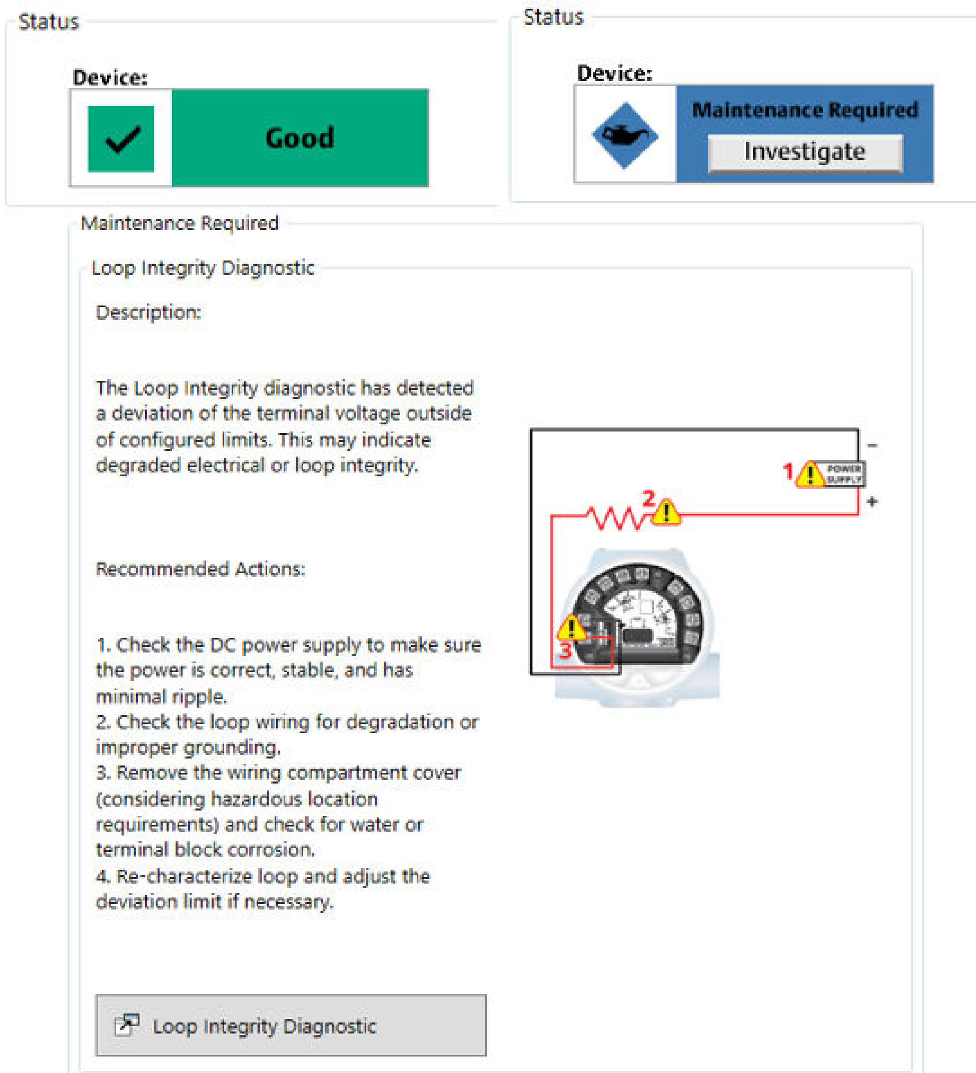
4.6.7 LCD display messages

The LCD display on the transmitter will display `Loop Integrity Diagnostic`.

4.6.8 Device driver (DD) messages

Under **Process Variables** → **Device Overview** → **Status**, the device status is listed.

When the loop is working properly, the **Status** is shown as Good. When the **Loop Integrity** diagnostic detects a change in the loop, the status is shown as Maintenance Required. Select the **Investigate** button to view more details, including recommended actions for fixing the issue. For **Loop Integrity** diagnostic, this will say: `The Loop Integrity diagnostic has detected a deviation of the terminal voltage outside of configured limits. This may indicate degraded electrical or loop integrity.`



4.7 Process alerts

There are two process alerts that you can configure to use with any of the following variables:

- Measurement 1
- Measurement 2
- Terminal Temperature
- Hot Backup
- Differential Temperature
- Average Temperature
- Sensor 1(2)

(2) Only available with X-well Technology devices.

- Sensor 2(2)

The process alerts are independent of each other. You can use these alerts to receive notifications via **HART Status Alert** or via **Analog Output** alarm. Process alerts can be triggered with any variable, regardless of HART® variable assignments. This means an Analog Output Alarm can be triggered by any of the process variables listed previously, even if they are not assigned to be the HART primary variable.

The **Minimum/Maximum Tracking** functionality is now embedded in the process alerts. The minimum and maximum values will be recorded for the variables selected in the configured process alerts. These values will be recorded for the minimum and maximums obtained since the last reset; this is not a logging function.

4.7.1 Configure a **Process Alert**

Procedure

1. Go to **Diagnostics** → **Alerts** → **Process Alert 1 or 2** → **Alert Settings**.
2. Run the **Configure Process Alert 1 or Configure Process Alert 2** method.
3. Select the desired notification mode (HART Status Alert or Analog Output Alarm).
4. Select the desired variable from the ***Variable*** drop-down menu.
5. Select when to activate **Process Alert** from the following:
   - Above high side
   - Below low side
   - Outside window
   - Inside window
6. Set the **High** and **Low** alert values as applicable.
7. Select method for reducing sporadic alerts:
   - **None**
   - **Deadband**
     Deadband refers to specifying the region from the alert value where alert deactivation will not occur.
   - **Time delay**
     Time delay refers to specifying an amount of time the alert must stay active before the device will report the alert.
8. Set the **Alert Name**.

4.8 View active alerts

You can view active alerts for any diagnostic in the Rosemount 3144S device drivers (DDs).

These alerts give additional insight to process conditions and provide guidance on how to remedy the issue.

Procedure

Go to **Diagnostics** → **Alerts** → **Active Alerts**.

Any active alerts are displayed on this screen. If there are no active alerts, the screen will display `No Active Alerts`.

5 Operation and maintenance

5.1 Calibration

Calibrating the transmitter increases the precision of the measurement system.

You may use one or more of a number of trim functions when calibrating. To understand the trim functions, it is necessary to realize that HART® protocol transmitters operate differently from analog transmitters. An important difference is that smart transmitters are factory-characterized; Emerson ships them with a standard sensor curve stored in the transmitter firmware. In operation, the transmitter uses this information to produce a process variable output, dependent on the sensor input. The trim functions allow you to make adjustments to the factory-stored characterization curve by digitally altering the transmitter's interpretation of the sensor input. For details on calculating calibration frequency, see Calculating calibration frequency on page 101.

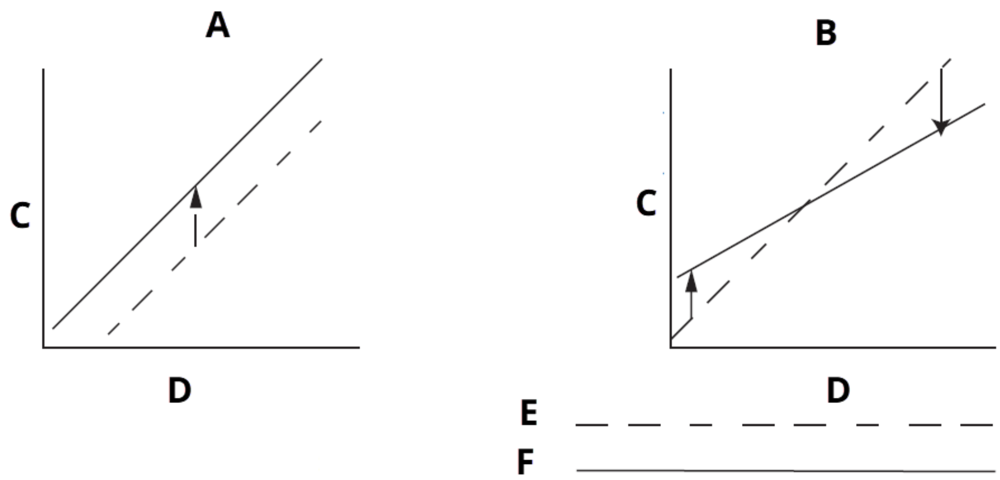
Calibration of the Rosemount 3144S Transmitter may include:

- Sensor input trim: Digitally alter the transmitter's interpretation of the input signal
- Transmitter-sensor matching: Generates a special custom curve to match that specific sensor curve, as derived from the Callendar-Van Dusen (CVD) constants
- Output trim: Calibrates the transmitter to a 4–20 mA reference scale
- Scaled output trim: Calibrates the transmitter to a user-selectable reference scale

5.2 Trim the transmitter

Do not confuse the trim functions with changing the range limits. Although changing the range limits matches a sensor input to a 4-20 mA output, as in conventional calibration, it does not affect the transmitter's interpretation of the input.

Figure 5-1: Trim



A. Single-point trim
B. Two-point trim
C. Raw measurement (Ohms or mV)
D. Temperature
E. Transmitter system curve
F. Site-standard curve

5.2.1 Sensor input trim

The **Sensor Trim** function allows for alteration of the transmitter's interpretation of the input signal as shown in Figure 5-1 . The **Sensor Trim** function trims, in engineering (°F, °C, °R, K) or raw (Ω, mV) units, the combined sensor and transmitter system to a site standard using a known temperature source. Sensor trim is suitable for validation procedures or for applications that require profiling the sensor and transmitter together.

Perform a **Sensor Trim** if the transmitter's digital value for the primary variable does not match the plant's standard calibration equipment. Unless the site-standard input source is National Institute of Standards and Technology (NIST)-traceable, the trim functions will not maintain the NIST-traceability of your system.

Perform Lower Trim

Procedure

1. Go to **Maintenance** → **Calibration** → **Sensor 1 or Sensor 2**.
2. Under ***Calibration***, select **Lower Sensor 1 or 2 Trim**.
3. Follow the prompts to complete the sensor trim.

Perform Upper Trim

Procedure

1. Go to **Maintenance** → **Calibration** → **Sensor 1 or Sensor 2**.
2. Under ***Calibration***, select **Upper Sensor 1 or 2 Trim**.
3. Follow the prompts to complete the sensor trim.

5.2.2 Disable Sensor Pulsing (formerly Active Calibrator Mode)

The transmitter operates with a pulsing sensor current in order to perform sensor diagnostics and while switching between multiple sensors. Although it is becoming less common, some calibration equipment requires a steady sensor current to function properly. You can accomplish this within the transmitter by disabling the sensor pulsing functionality during calibration.

Disabling sensor pulsing temporarily sets the transmitter to provide steady sensor current to a single sensor during calibration. During that time, the other sensor will be temporarily disabled, and some sensor diagnostics will not function. Ensure sensor pulsing is re-enabled before putting the transmitter back into the process. **Disabled Sensor Pulsing** status is volatile and will automatically be re-enabled when a master reset is performed (through HART® protocol) or when the power is cycled. If sensor pulsing is not re-enabled or transmitter is not reset or power-cycled, it will automatically re-enable after a 60-minute timeout in the transmitter.

5.2.3 Transmitter-sensor matching

The transmitter accepts Callendar-Van Dusen (CVD) constants from a calibrated RTD schedule and generates a special custom curve to match that specific sensor's resistance vs. temperature performance.

Matching the specific sensor curve with the transmitter significantly enhances the temperature measurement accuracy. The matching process allows the operator to enter four sensor-specific CVD constants into the transmitter. The transmitter uses these sensor-specific constants in solving the CVD equation to match the transmitter to that specific sensor, thus providing outstanding accuracy.

System accuracy comparison

The following table compares the total probably error of two assemblies: one with Callendar-Van Dusen (CVD) matching and one without.

Table 5-1: System Accuracy Comparison at 302 °F (150 °C) Using a Pt 100 (α = 0.00385) RTD with a Span of 32 to 392 °F (0 to 200 °C)

Error type	Matched RTD	Standard RTD
Transmitter error	±0.05 °C	±0.05 °C
Sensor error	±0.18 °C	±1.05 °C
Total probable error of system(1)	±0.19 °C	±1.05 °C

(1) Calculated using root-summed-squared (RSS) statistical method.

Configure transmitter-sensor matching

Procedure

1. Go to **Device Settings** → **Output** → **Measurement 1 or 2** → **Measurement 1 or 2 Setup**.
2. In the **Sensor Type** drop-down menu, select **Callendar-Van Dusen**.
3. Select **Save**.
   The current CVD coefficients for the sensor will be displayed.
4. To set the CVD coefficients, select **Set Sensor 1 or 2 CVD Coefficients**.
5. Select which set of CVD coefficients you would like to enter for that sensor.
   - R0, A, B, C
   - R0, Alpha, Beta, Delta
6. When prompted, enter each constant and select **Next**.
   Once completed, a summary screen with all the coefficient values needed for the CVD equation will be displayed.
7. Review this information and select **OK**.

When transmitter-sensor matching is disabled, the transmitter reverts to factory sensor curve.

View the set Callendar-Van Dusen (CVD) coefficients

Procedure

Go to **Device Settings** → **Output** → **Measurement 1 or 2**.

The current CVD coefficients for the sensor will be displayed under ***Transmitter Sensor Matching (CVD)***.

5.2.4 Output Trim or Scaled Output Trim

Perform a digital to analog (D/A) **Output Trim** (**Scaled Output Trim**) if the digital value for the primary variable matches the plant standard, but the transmitter's analog output does not match the digital value on the output device (such as the ammeter).

The **Output Trim** function calibrates the transmitter analog output to a 4-20 mA reference scale; the **Scaled Output Trim** function calibrates to a user-selectable reference scale. To determine the need for an **Output Trim** or a **Scaled Output Trim**, perform a loop test.

Related information

Perform Loop Test

Output Trim

The **Output Trim** function allows you to alter the transmitter's conversion of the input signal to a 4-20 mA output.

Calibrate the analog output signal at regular intervals to maintain measurement precision.

Procedure

1. Go to **Maintenance** → **Calibration** → **Analog Output**.
2. Under **Calibration**, select Analog Calibration.
3. Select **Digital to Analog Trim**.
4. Connect a reference meter to the device and follow the prompts.

Scaled Output Trim

The **Scaled Output Trim** function matches the 4 and 20 mA points to a user-selectable reference scale other than 4 and 20 mA (2 to 10 volts, for example).

Before performing a **Scaled Output Trim**, ensure an accurate reference meter is connected to the transmitter.

Procedure

1. Go to **Maintenance** → **Calibration** → **Analog Output**.
2. Under ***Calibration***, select Analog Calibration.
3. Select **Digital to Analog Trim**.
4. Follow the prompts to complete the trim.

5.3 Measurement filtering

5.3.1 AC Power Filter

The **AC Power Filter** (also known as **Line Voltage Filter** or **50/60 Hz Filter**) variable sets the transmitter electronic filter to reject the AC power supply frequency in the plant; this frequency can cause erroneous readings.

You can set the **AC Power Filter** to 50 Hz, 60 Hz, or a dual notch 50/60 Hz setting.

Procedure

1. Go to **Device Settings** → **Output** → **Measurement Filtering**.
2. In the **AC Power Filter** drop-down menu select one of the following:
   - 50 Hz
   - 60 Hz
   - 50/60 Hz

5.3.2 Transient Filter

The **Transient Filter** (also known as **Intermittent Sensor Detect**) filters out short duration transient spikes that influence the output (where condition lasts less than one update.

By default, Emerson ships the transmitter with this feature enabled. This is the recommended feature setting unless rapid response is necessary. The transmitter's output normally tracks update-to-update process temperature changes (ΔT) within the threshold values. A ΔT greater than the threshold value activates the **Transient Filter**, which prevents the transmitter from outputting that value until it is validated.

To view or change the status of the **Transient Filter Threshold**:

Procedure

1. Go to **Device Settings** → **Output** → **Measurement Filtering** → **Advanced Filtering**.
2. In the **Transient Filter Threshold** drop-down menu, select Enabled or Disabled.

5.3.3 Open Sensor Holdoff Filter

The **Open Sensor Holdoff Filter**, when enabled via Normal setting, prevents high voltage intermittent transient signals from creating a false open sensor condition.

This is accomplished by having the transmitter perform additional verification of the Open Sensor status prior to activating the transmitter alarm. If the additional verification indicates that the Open Sensor condition is not valid, the transmitter will not go into alarm. If you want a more immediate output response, you can change the **Open Sensor Holdoff** option to the Fast setting, which in turn disables the functionality. On this setting, the transmitter reports an Open Sensor condition without additional verification of the open condition, which could result in false Open Sensor alarm conditions.

To view or change the **Open Sensor Holdoff** feature:

Procedure

1. Go to **Device Settings** → **Output** → **Measurement Filtering** → **Advanced Filtering**.
2. In the **Open Sensor Holdoff Mode** drop-down menu, select either:
    - Normal (enabled)
    - Fast (disabled)

5.3.4 Electric and Magnetic Field (EMF) Compensation

In temperature measurement loops using RTDs, small voltages, called EMFs, can be induced on the sensor wires, increasing the effective resistance and causing false temperature readings. For example, a 12 mV reading equates to 390 °F or 60 Ω error for a PT1000 RTD. Emerson's patented **EMF Compensation** detects these externally induced voltages and eliminates the erroneous voltages from the transmitter's calculations.

Externally induced voltages come from motors, calibration devices (dry block calibrator), etc. Emerson has designed the transmitter to compensate for the induced voltage up to 12 mV and provide a corrected temperature value. Beyond 12 mV, the transmitter will notify the operator that excess EMF is present and warn them of possible inaccuracies in the temperature measurement due to excessive induced voltage on the RTD sensor loop. In case of excessive EMF in the transmitter, Emerson recommends identifying the external sources of electromagnetic interference and isolating them from the transmitter and RTD sensor wiring.

5.4 Logging capabilities

Logging is the process of collecting and storing data and/or events over a period of time.

The transmitter can log a variety of process and measurement data, including diagnostics, calibration history, and proof testing. In general, logging can help ensure compliance with industry-specific regulations and quality and environmental control procedures, while also providing a historical record that can be used for troubleshooting and process optimization.

The integrated logging functionality on the Rosemount 3144S creates and stores log entries for a variety of critical process and transmitter maintenance events. This functionality is designed to create a convenient means of accessing diagnostic calibration and proof test logs at the device. You can access these event logs by connecting a communicator, such as an AMS Trex, AMS Device Manager, or AMS Configurator, to the transmitter.

5.4.1 *Calibration Log*

The **Calibration Logging** functionality arms operators with the ability to access and manage prior calibration events locally at the device. When the transmitter undergoes any type of digital or analog calibration, the transmitter automatically captures the sensor and analog trim adjustments, along with the sensor verifications when there is no trim needed; the transmitter also logs a correlated time stamp of this event at time of calibration.

When accessing the ***Calibration Log***, operators will see calibration data organized in a stacked form with useful columns:

- Time since last calibration event
- What type of action was taken
- Source of interface
- Value as found pre-event
- Value as left post-event

The maximum number of individual ***Calibration Logs*** within the transmitter is 20. The transmitter automatically deletes logs on a first-in, first-out basis.

Note
The ***Calibration Log*** is cleared if the sensor type is changed.

View *Calibration Log*

Procedure

1. Go to **Maintenance** → **Calibration** → **Sensor 1 or 2** → **Calibration History**.
2. Select **View Sensor 1 or 2 Calibration Log**.

Clear *Calibration Log*

Procedure

1. Go to **Maintenance** → **Calibration** → **Sensor 1 or 2** → **Calibration History**.
2. Select **Clear Sensor 1 or 2 Calibration Log**.

5.4.2 *Proof Test Log*

The ***Proof Test Log*** records the results of proof tests for safety applications.

The log stores 10 proof test results locally in the transmitter. This automatic documentation of proof tests creates an accurate historical record that includes the time and date of test performed, type of test (partial or comprehensive), and pass/fail status. For more detatils, refer to the Rosemount 3144S Safety Manual available on www.Emerson.com.

View *Proof Test Log*

Procedure

1. Go to **Maintenance** → **Calibration** → **Proof Test** → **Proof Test History**.
2. Select **View Proof Test Log**.

Clear *Proof Test Log*

Procedure

1. Go to **Maintenance** → **Calibration** → **Proof Test** → **Proof Test History**.
2. Select **Clear Proof Test Log**.

5.4.3 *Diagnostic Log*

The ***Diagnostic Log*** records all events when a diagnostic alert is triggered. This allows for better understanding of the device health and can be used in conjunction with device troubleshooting.

The log records up to 100 device status events on a first-in, first-out basis, each associated with the time stamp of when the event occurred.

View *Diagnostic Log*

Procedure

1. Go to **Diagnostics** → **Alerts** → **History**.
2. Select **View 10 most Recent Diagnostic Events** or **View 100 most Recent Diagnostic Events**.

Clear *Diagnostic Log*

Procedure

1. Go to **Diagnostics** → **Alerts** → **History**.
2. Select **Clear Diagnostic Log**.

5.5 Maintenance

⚠ WARNING

If the sensor is installed in a high-voltage environment and a fault condition or installation error occurs, the sensor leads and transmitter terminals could carry lethal voltages.

Use extreme caution when making contact with the leads and terminals.

The transmitter has no moving parts, requires a minimum amount of scheduled maintenance, and features a modular design for easy maintenance.

If you suspect a malfunction, check for an external cause before performing the following procedures.

5.5.1 Test clips

The test clips are the positive (+) and negative (−) clips in the center of the terminal block and accept Minigrabber® or alligator clips to facilitate in-process checks.

The test clips are connected across a diode through the loop signal current. The current measuring equipment shunts the diode when connected across the test clips. So as long as the voltage across the clips is kept below the diode threshold voltage, no current passes through the diode. To ensure there is no leakage current through the diode while making a test reading or while an indicating meter is connected, make sure the resistance of the test connection or meter does not exceed 10 ohms. A resistance value of 30 ohms will cause an error of approximately 1.0 percent of reading.

5.5.2 Electronics housing

⚠ WARNING

Do not remove the covers in explosive atmospheres with a live circuit.

⚠ WARNING

Electrical shock

Electrical shock can result in death or serious injury.

Avoid contact with the leads and terminals. High voltage that may be present on leads could cause electrical shock.

Emerson designed the transmitter with a dual-compartment housing. One compartment contains the electronics housing, and the other contains all wiring terminals and communication terminals.

The transmitter electronics module is located in the compartment opposite the wiring terminals.

The electronics module is a non-repairable unit. If a malfunction occurs, the entire unit must be replaced.

Remove electronics module

Procedure

1. Disconnect power to the transmitter.
2. Remove the cover from the electronics side of the transmitter housing.

   ⚠ WARNING

   Do not remove the covers in explosive atmospheres with a live circuit.

3. Remove the LCD display if applicable.
4. Loosen the two screws anchoring the electronics module assembly to the transmitter housing.
5. Firmly grasp the screws and assembly and pull straight out of the housing, taking care not to damage the interconnecting pins.

Replace electronics module

Procedure

1. Examine the electronics module to ensure that the **Alarm** and **Security** switches are in the desired positions.

2. Carefully insert the electronics module, lining up the interconnecting pins with the necessary receptacles on the electronics board.
3. Tighten the two mounting screws to a torque of 7 in-lbs.
4. Replace the LCD display, if applicable.
5. Replace the cover. Tighten one revolution after the cover begins to compress the O-ring.

⚠ WARNING

Both transmitter covers must be fully engaged to meet explosion-proof requirements.

5.5.3 Remove terminal block

Electrical connections are located on the terminal block in the compartment labeled `FIELD TERMINALS`.

Procedure

1. Remove the housing cover from the field terminal side.
2. Loosen the three small screws located on the assembly in the 1, 4, and 8 o'clock positions relative to the top of the transmitter.
3. Pull the entire terminal block out to remove it.

5.5.4 Replace terminal block

Procedure

1. Gently slide the terminal block into place, making sure connector from the electronics housing properly engages with that on the terminal block.

⚠ WARNING

Electrical shock

Electrical shock can result in death or serious injury.

Avoid contact with the leads and terminals. High voltage that may be present on leads could cause electrical shock.

2. Tighten the captive screws to a torque of 15 in-lbs.
3. Replace the electronics housing cover.

⚠ WARNING

Explosions

Explosions could result in death or serious injury.

The transmitter covers must be fully engaged to meet explosion-proof requirements.

6 Troubleshooting

This section provides summarized troubleshooting suggestions for the most common operating problems.

If you suspect malfunction despite the absence of any diagnostic messages on the Field Communicator display, consider using HART® 4-20 mA basic troubleshooting to identify any potential problem.

6.1 HART® 4-20 mA basic troubleshooting

Four major symptoms are listed with specific suggestions to solve problems.

Always deal with the most likely and easiest-to-check conditions first.

6.1.1 Transmitter communication

Transmitter does not communicate with Field Communicator

Potential cause

Loop wiring

Recommended actions

1. Check the revision level of the transmitter device drivers (DDs) stored in your communicator.

   Contact Emerson Customer Central for assistance.

2. Check for a minimum of 250 ohms resistance between the power supply and Field Communicator connection.
3. Check for adequate voltage to the transmitter.

   If a Field Communicator is connected and 250 ohms resistance is properly in the loop, then the transmitter requires a minimum of 11.5 V for Classic Performance devices and 16.7 V for Ultra Performance devices at the terminals to operate (over entire 3.5 to 23.0 mA operating range) and 12.5 V minimum to communicate digitally.

4. Check for intermittent shorts, open circuits, and multiple grounds.

6.1.2 High output

Potential cause

Sensor input failure or connection

Recommended actions

1. Connect a Field Communicator and use the test terminals to check for a sensor failure.
2. Check for a sensor open or short circuit.
3. Check the process variable to see if it is out of range.

Potential cause

Loop wiring

Recommended actions

Check for dirty or defective terminals, interconnecting pins, or receptacles.

Potential cause

Power supply

Recommended actions

Check the output voltage of the power supply at the transmitter terminals.

It should be 11.5 to 42.4 Vdc for Classic Performance devices or 16.7 to 42.4 Vdc for Ultra Performance devices (over entire 3.5 to 23.0 mA operating range).

Potential cause

Electronics module

Recommended actions

Connect a Field Communicator and check the sensor limits to ensure calibration adjustments are within the sensor range.

6.1.3 Erratic output

Potential cause

Loop wiring

Recommended actions

1. Check for adequate voltage to the transmitter.

   It should be 11.5 to 42.4 Vdc for Classic Performance devices or 16.7 to 42.4 Vdc for Ultra Performance devices (over entire 3.5 to 23.0 mA operating range).

2. Check for intermittent shorts, open circuits, and multiple grounds.
3. Connect a Field Communicator and enter the **Loop Test** mode to generate signals of 4 mA, 20 mA, and user-selected values.

Potential cause

Electronics module

Recommended actions

Connect a Field Communicator and use the test terminals to check for a sensor failure.

6.1.4 Low or no output

Potential cause

Sensor element

Recommended actions

1. Connect a Field Communicator and use the test terminals to check for a sensor failure.
2. Check the process variable to see if it is out of range.

Potential cause

Loop wiring

Recommended actions

1. Check for adequate voltage to the transmitter.

   It should be 11.5 to 42.4 Vdc for Classic Performance devices or 16.7 to 42.4 Vdc for Ultra Performance devices (over entire 3.5 to 23.0 operating range).
2. Check for shorts and multiple grounds.
3. Check for proper polarity at the signal terminal.
4. Check the loop impedance.
5. Connect a Field Communicator and enter the **Loop Test** mode.
6. Check wire insulation to detect possible shorts to ground.

Potential cause

Electronics module

Recommended actions

1. Connect a Field Communicator and check the sensor limits to ensure calibration adjustments are within the sensor range.
2. Connect a Field Communicator and use the test terminals to check for a sensor failure.

6.2 Diagnostic alerts

6.2.1 Failure status

`Electronics Board Failure`

A failure has been detected in the electronics circuit board.

Recommended action

Replace the electronics circuit board.

`Terminal Block Failure`

A failure has been detected in the terminal block.

Recommended actions

1. Check the ambient temperature to ensure it is within specification.
2. Replace the terminal block.
3. Replace the electronic circuit board.

`Incompatible Terminal Block`

The electronics circuit board has detected a terminal block that is incompatible with the system.

Recommended action

Replace the incompatible terminal block.

6.2.2 Function Check status

`Primary Variable Simulated`

The primary variable is being simulated and does not represent the process measurement.

Recommended actions

1. Verify that Primary Variable Simulation is no longer required.
2. Disable Primary Variable Simulation or restart the device.

`Loop Test Current Fixed`

The analog output is fixed and does not represent the process measurement due to the device being set to Loop Test mode.

Recommended actions

1. Verify that the Loop Test is no longer required.
2. Disable Loop Test mode or restart the device.

6.2.3 Out of Specification status

`Loop Current Saturated`

The loop current is saturated due to the analog value being outside low or high saturation values or the primary variable being saturated.

Recommended actions

1. Verify the conditions of the process where the device is installed.
2. Verify the settings for the 4 mA and 20 mA range points and readjust if necessary.
3. Verify the integrity of the sensors and sensor lead wires.
4. Repair or replace the sensors.

`Sensor 1 Out of Limits`

The measured temperature has exceeded the sensor's limit.

Recommended actions

1. Verify the conditions of the process where the specified sensor is installed.
2. Verify the sensor is properly wired and connected to the terminals.
3. Verify the integrity of the sensor and sensor wire lead wires.
4. Repair or replace the specified sensor.

`Sensor 2 Out of Limits`

The measured temperature has exceeded the sensor's limits.

Recommended actions

1. Verify the conditions of the process where the specified sensor is installed.
2. Verify the sensor is properly wired and connected to the terminals.
3. Verify the integrity of the sensor and sensor lead wires.

4. Repair or replace the specified sensor.

`Terminal Temperature Out of Limits`

The terminal block temperature has exceeded its normal operating range.

Recommended actions

1. Check the ambient temperature to ensure it is within specification.
2. Replace the terminal block.

`Sensor Drift Alert`

The difference between Measurement 1 and 2 has gone beyond the configured **Drift Alert Threshold**, or at least one of the measurements is saturated.

Recommended actions

1. Check the integrity of the sensors and sensor lead wires.
2. Modify the alert settings or turn off the alert.

6.2.4 Maintenance required

`Process Alert 1`

The device has detected a change in the monitored variable that exceeds the configured thresholds for **Process Alert 1**.

Recommended actions

1. Verify that the monitored variable is beyond the alert values.
2. Modify the alert settings or turn off the alert.

`Process Alert 2`

The device has detected a change in the monitored variable that exceeds the configured thresholds for **Process Alert 2**.

Recommended actions

1. Verify that the monitored variable is beyond the alert values.
2. Modify the alert settings or turn off the alert.

`Display Button Stuck`

At least one button on the device display is stuck.

Recommended actions

1. Remove the front housing cover (considering hazardous location requirements) and ensure buttons are not depressed.
2. If display buttons will not be used, disable the buttons.
3. Replace the display.

`Display Communication Failure`

The electronic circuit board has lost communication with the display. Note that the contents being displayed may not be correct.

Recommended actions

1. Remove the front housing cover (considering hazardous location requirements) and check that the display assembly is properly seated and connected to the electronic circuit board.
2. Replace the display.
3. Replace the electronic circuit board.

Loop Integrity Diagnostic

The **Loop Integrity Diagnostic** has detected a deviation of the terminal voltage outside of the configured limits. This may indicate degraded electrical or loop integrity.

Recommended actions

1. Check the DC power supply to make sure the power is correct, stable, and has minimal ripple.
2. Check the loop wiring for degradation or improper grounding.
3. Remove the wiring compartment cover (considering hazardous location requirements) and check for water or terminal block corrosion.
4. Re-characterize the loop and adjust the deviation limit if necessary.

Sensor 1 Failure

Failure detected with sensor or sensor wiring.

Recommended actions

1. Verify the sensor connection and wiring.

   Refer to the device and sensor wiring diagrams to ensure proper wiring.
2. Verify the integrity of the sensor and sensor lead wires.
3. Repair or replace the sensor.

Sensor 2 Failure

Failure detected with sensor or sensor wiring.

Recommended actions

1. Verify the sensor connection and wiring.

   Refer to the device and sensor wiring diagrams to ensure proper wiring.
2. Verify the integrity of the sensor and sensor lead wires.
3. Repair or replace the sensor.

Sensor 1 T/C Degraded

The **Thermocouple Degradation** diagnostic has detected an increase in resistance. This may indicate a degraded thermocouple.

Recommended actions

1. Verify the sensor connection and wiring.
2. Verify the integrity of the sensor and sensor lead wires.
3. Repair or replace the sensor.
4. Adjust the resistive threshold if necessary.

`Sensor 2 T/C Degraded`

The **Thermocouple Degradation** diagnostic has detected an increase in resistance. This may indicate a degraded thermocouple.

Recommended actions

1. Verify the sensor connection and wiring.
2. Verify the integrity of the sensor and sensor lead wires.
3. Repair or replace the sensor.
4. Adjust the resistive threshold if necessary.

`Sensor 1 Ever Connect Active` or `Sensor 1 Possible Lead Wire Loss`

RTD Measurement Protection has detected a possible broken or damaged wire on sensor 1.

Recommended actions

1. Verify the sensor connection and wiring.
2. Verify the integrity of the sensor and sensor lead wires.
3. Repair or replace the sensor.

`Sensor 2 Ever Connect Active` or `Sensor 2 Possible Lead Wire Loss`

RTD Measurement Protection has detected a possible broken or damaged wire on sensor 2.

Recommended actions

1. Verify the sensor connection and wiring.
2. Verify the integrity of the sensor and sensor lead wires.
3. Repair or replace the sensor.

`Calculated Output Variables Incompatible Units`

Calculated Output Variables (**Differential Temperature**, **Hot Backup Measurement**, and **Average Temperature**) are enabled but can't be calculated because **Measurement 1** units are incompatible with **Measurement 2** units or one of the calculated output variable's units are incompatible with **Measurement 1** and **Measurement 2** units.

Recommended actions

1. Correct the unit misconfiguration by reconfiguring **Measurement 1**, **Measurement 2**, **Differential Temperature**, **Hot Backup Measurement**, and/or **Average Temperature** units.
2. If **Differential Temperature**, **Hot Backup Measurement**, and **Average Temperature** are not being used, disable **Calculated Output Variables**.

`ReadyConnect Terminal Block Not Installed`

The device has detected a terminal block that is not compatible with ReadyConnect™.

Recommended action

Remove the housing cover on terminal compartment side (considering hazardous location requirements) and connect a terminal block with ReadyConnect capability.

`Sensor 1 Excessive EMF`

The **Electric and Magnetic Field (EMF)** diagnostic has detected excessive voltage levels. The accuracy of the measurement may be impacted.

Recommended actions

1. Inspect all terminals for loose connections or corrosion. Clean and tighten the terminals if necessary.
2. Identify any external sources of electromagnetic interference and isolate them from the device and sensor wiring.
3. Verify the integrity of the sensor and sensor lead wires.
4. Repair or replace the sensor.

`Sensor 2 Excessive EMF`

The **Electric and Magnetic Field (EMF)** diagnostic has detected excessive voltage levels. The accuracy of the measurement may be impacted.

Recommended actions

1. Inspect all terminals for loose connections or corrosion. Clean and tighten the terminals if necessary.
2. Identify any external sources of electromagnetic interference and isolate them from the device and sensor wiring.
3. Verify the integrity of the sensor and sensor lead wires.
4. Repair or replace the sensor.

`Bluetooth Functionality Limited`

The device is unable to send device data over Bluetooth® due to an internal error. The device will continue to function despite this Bluetooth alert.

Recommended actions

1. Remove the front housing cover (considering hazardous location requirements) and check that the display assembly is properly seated and connected to the electronic circuit board.
2. Replace the display (which contains the Bluetooth electronics).

`Bluetooth Electronics Error`

Device internal diagnostics detected a Bluetooth® electronics error. This error will likely result in reduced or no communication capacity; however, the device will continue to function despite this Bluetooth alert.

Recommended action

Remove the front housing cover (considering hazardous location requirements) and replace the display which contains the Bluetooth electronics. Then restart the device.

7 Rosemount X-well™ Technology

Rosemount X-well Technology can only be utilized on devices that specify Measurement Functionality 3 or 4 in the model code.

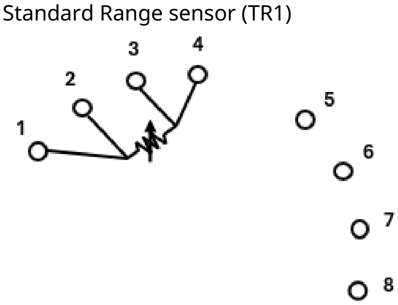
7.1 Verify Rosemount X-well™ sensor wiring

Wiring diagrams are located inside the terminal block cover. Emerson ships X-well assemblies from the factory pre-wired. Verify the sensor wiring matches the expected configuration (standard or extended range). Standard Range sensors are only available with direct mount configuration, and therefore must be wired to terminals 1-4 (single sensor configuration). For standard sensor wiring (non-X-well measurement), refer to Figure 2-7.

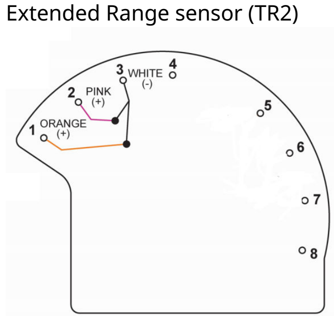
See Connect power and current loop.

Figure 7-1: Single Sensor Wiring

Standard Range sensor (TR1)



Extended Range sensor (TR2)

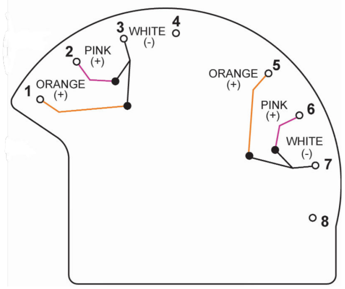


Terminal 1	Orange
Terminal 2	Pink
Terminal 3	White

The Rosemount 3144S Temperature Transmitter can be wired and configured in the field with two independent remote mounted Extended Range sensors. This allows for dual input functionality, such as Hot Backup™, differential temperature, average temperature, and diagnostic capabilities.

Figure 7-2: Dual Sensor Wiring

Extended Range sensor (TR2)



Terminal 1	Orange
Terminal 2	Pink
Terminal 3	White
Terminal 5	Orange
Terminal 6	Pink
Terminal 7	White

7.2 Rosemount X-well™ Technology installation

7.2.1 Technology considerations

Rosemount X-well™ Technology is for temperature monitoring applications and is not intended for control or custody transfer.

X-well Technology will only work as specified with factory-supplied and assembled pipe mount sensors available through the Rosemount 3144S, 3144P, and 648 Temperature Transmitters or Rosemount 214XW Temperature Sensor. It will not work as specified with other sensors.

NOTICE

Installing and using the incorrect sensor will result in inaccurate process temperature calculations.

It is important that you adhere to the following requirements and installation steps to ensure X-well Technology works as specified.

7.2.2 Installation considerations

Follow pipe mount sensor installation best practices as well as the specific Rosemount X-well™ Technology requirements noted below:

- Ensure that the pipe surface is clean of debris. When using Extended Range sensor, smooth pipe mount surface with 800 grit sandpaper to remove any oxidation, paint, or coatings.

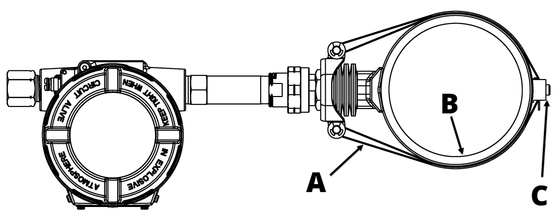
- Install the assembly away from dynamic external temperature sources, such as a boiler or heat tracing.
- Mount the sensor on the outside section of the pipe where the process medium is in contact with the inside of the pipe wall. Avoid mounting sensor over vapor space.
- Ensure the pipe mount sensor makes direct contact with the pipe surface. Moisture buildup between the sensor and the pipe surface can cause inaccurate process temperature calculations.

Standard range/direct mount configuration

For Rosemount X-well™ Technology to properly function with the Standard Range sensor, it is necessary to directly mount the transmitter on a pipe mount sensor.

Figure 7-3 displays a transmitter/pipe mount assembly that is in a direct mount configuration.

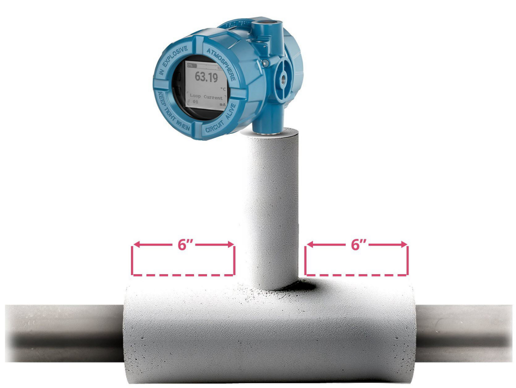
Figure 7-3: Pipe Mount Assembly in Direct Mount Configuration



A. *Banding*
B. *Pipe*
C. *Buckle and screw*

Insulation at least ½ in. (13 mm) thick (with R-value of > 0.42 m^2 x K/W) is required over the sensor mount assembly and the sensor extension to prevent heat loss and ensure accurate measurement. When using the Standard Range sensor, insulation should cover the entire sensor extension, up to the transmitter head. Apply a minimum of 6 in. (152 mm) of insulation on each side of the pipe mount sensor. Take care to minimize air gaps between insulation and pipe.

Figure 7-4: Insulation Requirements for Direct Mount/Standard Range Configuration



NOTICE

Over-insulation

Do not apply insulation over the transmitter head, as this may result in longer response times and may damage the transmitter electronics.

Extended range/remote mount configuration

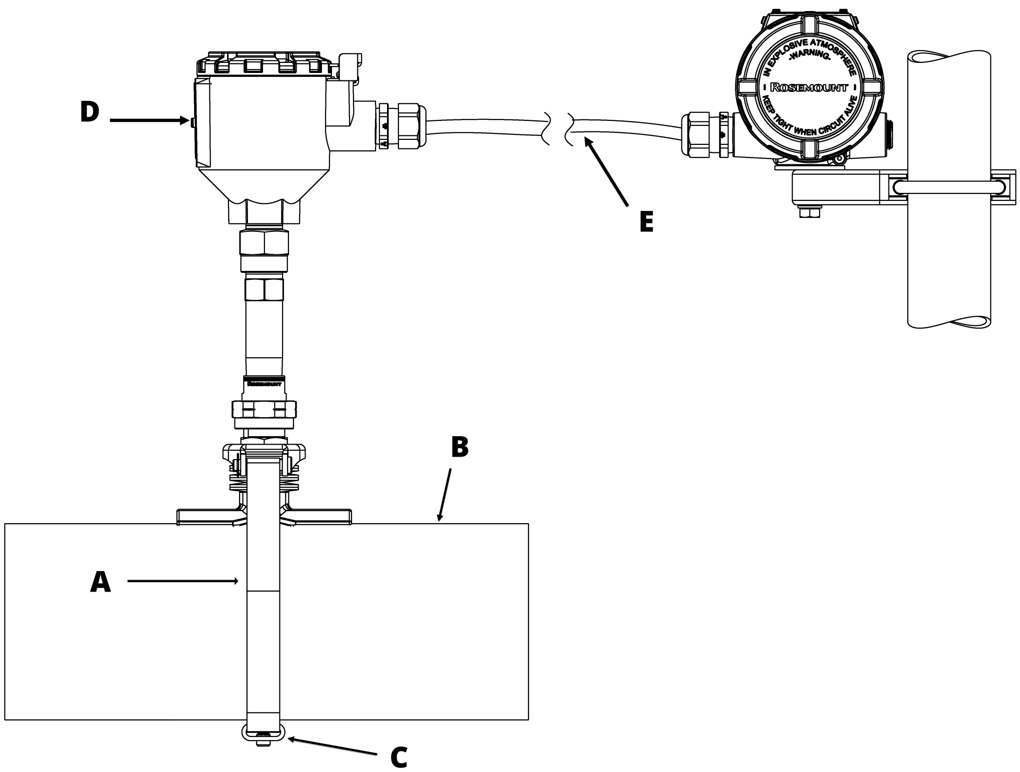
Emerson requires remote mounting the transmitter from the pipe mount sensor when using Rosemount X-well™ Technology with the Extended Range sensor.

NOTICE

Failure to remote mount with an Extended Range sensor may lead to transmitter head overheating and electronics failure.

Figure 7-5 displays a transmitter/pipe mount assembly that is in a remote mount configuration.

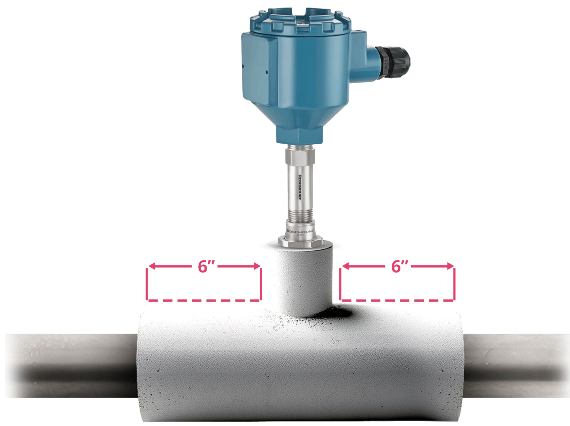
Figure 7-5: Remote Mount Configuration



A. Banding
B. Pipe
C. Buckle and screw
D. Connection head
E. Remote mount cable

Insulation at least ½ in. (13 mm) thick (with R-value of > 0.42 m^2 x K/W) is required over the sensor mount assembly and the sensor extension to prevent heat loss. When using the Extended Range sensor, insulation should cover the nipple union of the extension. Apply a minimum of 6 in. (152 mm) of insulation on each side of the pipe mount sensor. Take care to minimize air gaps between insulation and pipe.

Figure 7-6: Insulation Requirements for Remote Mount/Extended Range Configuration



NOTICE

Over-insulation

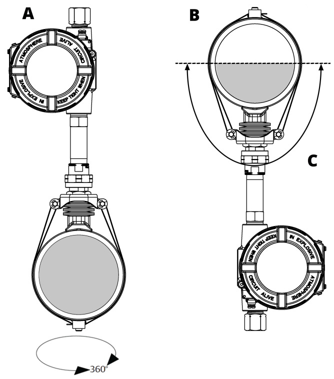
Do not apply insulation above the union, as this may result in damage to sensor components due to overheating.

Horizontal orientation

Emerson recommends mounting the pipe mount sensor on the upper half of the pipe.

Only consider bottom mounting when there is partial pipe flow in order to maintain accurate measurement.

Figure 7-7: Horizontal Orientation

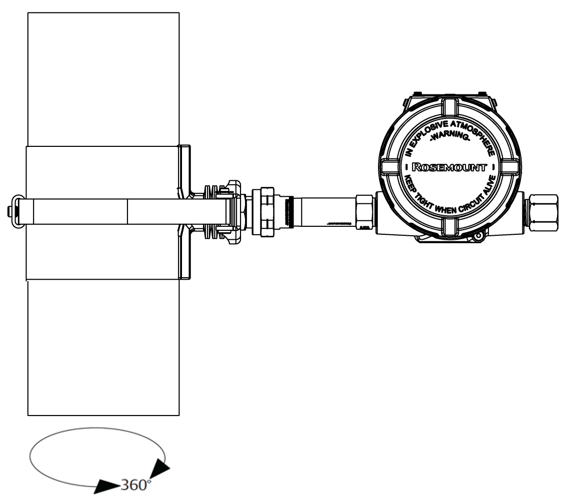


A. Full pipe flow
B. Partial pipe flow
C. Recommended zone

Vertical orientation

The pipe clamp sensor can be installed in any position around the circumference of the pipe.

Figure 7-8: Vertical Orientation



7.2.3 Install Universal Pipe Mount

Prerequisites

The tools required for installation are:

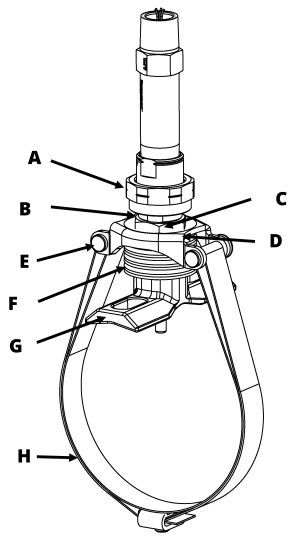
- Hand-crank banding tensioner tool
- 4 mm Allen wrench
- 1 1/16-inch or 27 mm open-ended wrench

Universal Pipe Mount installation video

⚠ CAUTION

Emerson recommends wearing safety glasses and gloves during this process.

Figure 7-9: Universal Pipe Mount Component Overview



A. Union
B. Threaded stem
C. Tension nut
D. Tensioner plate
E. Removable tension rods
F. Springs
G. Mount foot
H. Banding and buckle

Procedure

1. Place mount and banding on pipe.

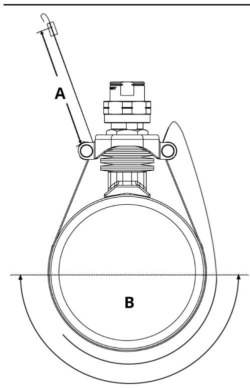
   Loosen collar to remove mount assembly from transmitter and sensor.

   Place the mount foot onto the pipe surface; then run the banding around the pipe and through the inside of the tensioner plate, making sure that the **screw side of the buckle is facing inward**, as shown.

2. Install banding loosely.

   Bend the banding down around the rods of the tensioner plate. The end of the band with the buckle attached should be bent at a length that allows the buckle to sit near the bottom side of the pipe, opposite to the mount assembly. Acceptable location for the buckle is anywhere on the lower half of the pipe, opposite to the mount. The buckle must not fall within the distance between the tensioner plate and the pipe.

   A. Slack length
   B. Ideal buckle location

   Due to limited surface area of small pipes, it can be challenging to judge the amount of banding slack length required to land the buckle on bottom side of pipe. For these small pipes, refer to the following tables for suggested slack length from buckle to bend over rod based on line size.

   Table 7-1: Slack Length (English)

Pipe size	Length to first bend (A)
2 in.	4.7 in.
2.5 in.	5.5 in.

Table 7-1: Slack Length (English) *(continued)*

Pipe size	Length to first bend (A)
3 in.	6.2 in.
4 in.	7.5 in.
5 in.	9 in.
6 in.	10.6 in.
8 in.	13.6 in.
10 in.	16.7 in.

Table 7-2: Slack Length (Metric)

Pipe size	Length to first bend (A)
DN50	120 mm
DN65	140 mm
DN80	157 mm
DN100	192 mm
DN125	228 mm
DN150	254 mm
DN200	346 mm
DN250	424 mm

3. Temporarily secure banding.

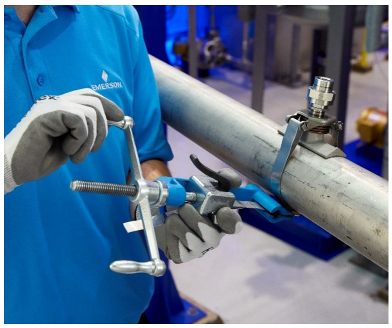
   Wrap the free end of the band around the pipe and through the buckle. Fold back loose end at least 90° to temporarily secure the band in place. Then pull the banding snug and bend it so that it is perpendicular to the pipe.

4. Prepare banding for tensioning.

   Place banding within tensioner tool. Place nose of tensioner tool against the buckle, and slide banding into tool.

   Note
   The position of the mount assembly may be moved after the banding has been tensioned, so the mount does not need to be in the final position during this step. Emerson recommends that the mount be positioned to allow for the most ergonomic use of the tensioner tool for this step.

5. Tension banding and mount.

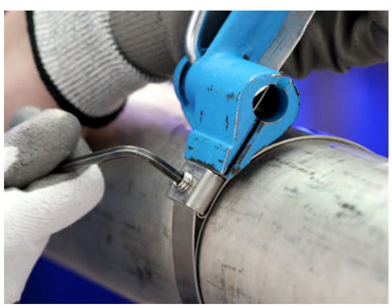
   Turn the crank on the tensioner tool to tighten the banding.

   This will slowly compress the tensioner plate and spring.

   Tighten the banding until the tension nut can be moved freely.

6. Lock banding and tighten buckle.

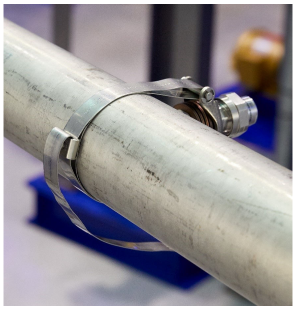
   Using a 4 mm Allen wrench, tighten the set screw on the buckle to lock the banding in place.

7. Remove tension tool.

   Once the banding is secured, reduce tension on the tensioner tool by spinning the crank counter-clockwise and remove the tool. Then bend the loose end of the banding over top of the buckle.

   Note
   Emerson recommends leaving enough length of banding to allow for re-tensioning of the banding if ever necessary. If you choose to trim any excess banding, be sure to remove any sharp edges or burrs.

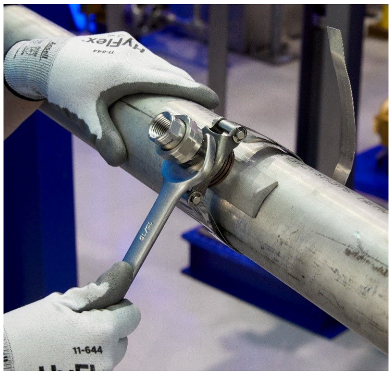
   

8. Final positioning.

   With the banding tensioned, the mount assembly may now be moved to its desired location.

   Using a 1 1⁄16-inch or a 27 mm open-ended wrench, turn the tension nut clockwise on the threaded stem until it contacts the tensioner plate.

   Continue to tighten the tension nut to compress the springs until the banding loses tension and the mount may be freely moved around the pipe.

9. Finalize installation location and tension.

   Once the Universal Pipe Mount is in its desired position, loosen the tension nut to decompress the spring to return tension to the banding. When loosening, return the tension nut to the top of the threaded stem.

If the Universal Pipe Mount is properly installed, the distance from bottom of union stem head to top of tension plate should be set at 0.47 in. (±0.01 in.) or 11.9 mm (±0.25 mm).

For instructions on uninstalling and reinstalling the Universal Pipe Mount, refer to Uninstall and reinstall Universal Pipe Mount

7.2.4 Uninstall and reinstall Universal Pipe Mount

Procedure

1. Using a 1 1/16-inch or 27 mm open-ended wrench, turn the tension nut clockwise on the threaded stem until it contacts the tensioner plate. Continue to tighten the tension nut to compress the springs until the banding loses tension and you can freely move the mount around the pipe.
2. Using a pair of pliers, pull off each e-clip and slide out each tension rod from the tensioner plate to remove the banding loop from the assembly. Reattach the tension rods and e-clips to the tensioner plate.
3. If reinstalling on the same-sized pipe, reverse these steps to reassemble the universal pipe mount and form a banding loop. If reinstalling on a new pipe, proceed to Step 4.
4. If reinstalling on a new-sized pipe, ensure top of tension nut is in line with bottom of black indicator mark before reinstallation. If it is not, put mount foot assembly in vice and adjust tension nut to correct height using a 1 1/16-inch or 27 mm open-ended wrench. If tension nut is at the correct height, proceed to standard installation instructions.

Related information

Install Universal Pipe Mount

7.2.5 Install Small Pipe Mount

Procedure

1. Place the mount foot assembly on the pipe with the slots running perpendicular to the pipe.

2. Insert U-bolt around the pipe and through the slots.

   Emerson ships all Small Pipe Mounts with two short washers and two tall spacers. For installation on line sizes ½-inch (DN15) to 1-inch (DN25), use only the spacers. For line sizes 1¼-inch (DN32) to 1½-inch (DN40), use only the washers.
3. Place first washer/spacer through threads of U-bolt to sit on top of foot mount assembly; then loosely tighten nut onto the same U-bolt thread.
4. Repeat step 3 for other side of U-bolt.
5. Incrementally tighten the nuts in an alternating manner until assembly sits squarely against the pipe.
6. Install transmitter and sensor assembly into foot mount assembly. During sensor installation, stabilize the Small Pipe Mount by placing 1⅛-inch (29 mm) wrench on the flats of the foot mount.

7.2.6 Configure Rosemount X-well™ Technology

Emerson may configure X-well Technology at the factory, or you can configure it in the field. To configure X-well Technology on the Rosemount 3144S:

Procedure

1. Go to **Device Settings** → **Output**.
2. Select measurement.
   - Select **Measurement 1** if your X-well is wired to sensor terminals `1-4`.
   - Select **Measurement 2** if your X-well is wired to sensor terminals `5-8`.
3. Select **Sensor Type**.
   - Select **Rosemount X-well** if using a Standard Range sensor (TR1).
   - Select **Rosemount X-well Extended Range** if using an Extended Range sensor (TR2).
4. Under ***Rosemount X-well Configuration***, select your **Pipe Material**, **Line Size**, and **Pipe Schedule** from the associated drop-down menus.

   If your pipe material is not listed, contact your local Emerson representative to obtain your coefficients for configuration. If your line size or schedule is not listed, manually enter your pipe thickness and units under **Pipe Thickness**.

NOTICE

It is important to verify that the device is configured for the proper pipe material, size, and schedule prior to installation. Installing and using the incorrect configured pipe material, size, or schedule will result in accurate process temperature calculations.

7.2.7 Calibrate Rosemount X-well™ Technology

Treat X-well Technology similarly to other temperature measurements when determining calibration frequency or need.

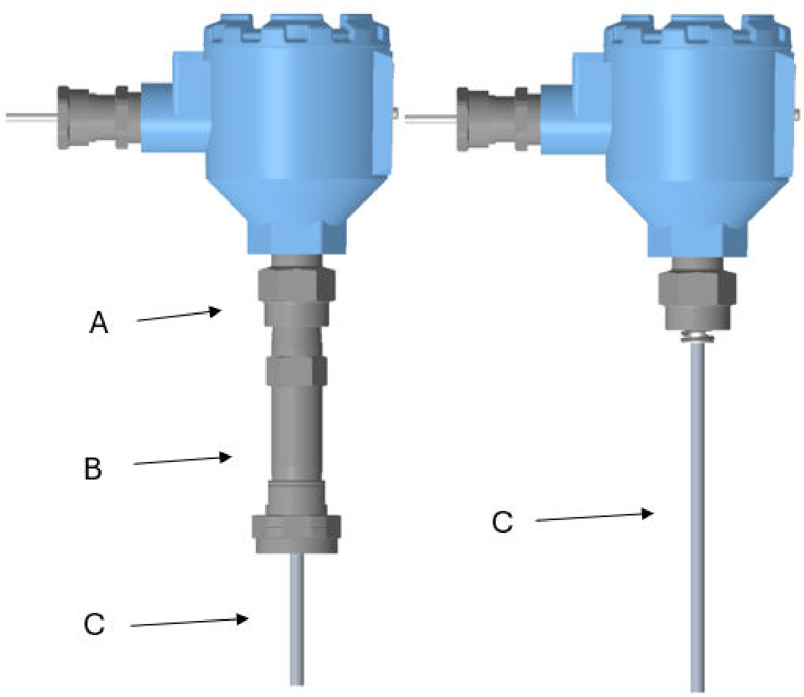
X-well calibration procedure trims are based on the uncorrected surface measurement. This trim does not calibrate or change the algorithm or its coefficients. To calibrate or trim the transmitter:

Procedure

1. Go to **Maintenance** → **Calibration**.
2. Select **Sensor 1** if your X-well sensor is wired to sensor terminals `1-4` or **Sensor 2** if it is wired to sensor terminals `5-8`.
3. Under ***Calibration***, select your desired procedure:
   - **Verify Calibration**
   - **Lower Sensor Trim**
   - **Upper Sensor Trim**
4. During the trimming process, make sure to fully immerse the sensor in the temperature calibrator.

   Rosemount X-well Technology calibration closely follows the steps of a standard temperature calibration.
5. For Extended Range X-well Sensors (TR2), Emerson recommends fully removing the sensor from the sensor assembly to allow for greatest insertion depth of the primary and secondary sensors, both of which reside in the same sensor sheath. To do this, loosen and remove spring loaded adapter from connection head.

Figure 7-10: Extended Range Sensor Assembly Components



A. Connection head adapter
B. Spring loaded adapter
C. Sensor

6. Follow the prompts to complete the sensor trim.

7.2.8 Troubleshooting Rosemount X-well™ Technology

If your device's output does not represent the expected process temperature of the application:

Recommended actions

1. Verify correct sensor type is selected.

   Refer to Configure Rosemount X-well™ Technology for more details.

   - **Rosemount X-well** if using a Standard Range sensor (TR1)
   - **Rosemount X-well Extended Range** if using an Extended Range sensor (TR2)

   Transmitter's display will include an X-well icon if configured for an X-well sensor. See Figure 7-11.

   Figure 7-11: X-well Icon

2. Verify sensor is wired properly.

   Refer to Verify Rosemount X-well™ sensor wiring for more details.

3. Verify sensor and mount are insulated properly.

   Refer to Installation considerations for more details.

4. Verify pipe surface is clean/prepped, sensor makes direct contact with section of pipe in contact with process fluid, and there are no external heat sources or heat sinks present.

   Refer to Installation considerations for more details.

5. Variable map or view the raw surface temperature (Sensor 1 or 2) of the pipe mount sensor to verify the measured surface temperature is as expected.

   - Refer to Variable Mapping for instructions on how to map Sensor 1 or 2.
   - To view Sensor 1 or 2, go to **Process Variables** → **Variables**.

   Note

   Sensor 1 and Sensor 2 refer to the raw surface temperature. Measurement 1 and Measurement 2 refer to the process temperature reading as determined by the X-well algorithm.

8 Safety Instrumented Systems (SIS)

The Rosemount 3144S is Safety Integrity Level (SIL)2 certified and SIL3 capable.

For information on SIS, refer to the Rosemount 3144S Safety Manual available on www.Emerson.com.

A Reference data

A.1 Ordering information, specifications, and drawings

To view current Rosemount 3144S ordering information, specifications, and drawings, follow these steps:

Procedure

1. Go to the Rosemount 3144S page.
2. Scroll as needed to the green menu bar and click **Documents & Drawings**.
3. For installation drawings, click **Drawings & Schematics** and select the appropriate document.
4. For ordering information, specifications, and dimensional drawings, click **Data Sheets & Bulletins** and select the appropriate Product Data Sheet.

A.2 Product certifications

Procedure

To view current Rosemount 3144S product certifications, see the Rosemount 3144S Quick Start Guide available on www.Emerson.com.

B Install LCD display

If you order a transmitter with the LCD display option (code M6 or M7), Emerson ships it with the LCD display installed.

Prerequisites

To install the LCD on a transmitter after market, you will need a small instrument screwdriver and the LCD display kit, which includes:

- LCD display assembly
- cover with O-ring
- captive screws (2)
- interconnection header

To install the LCD display:

Procedure

1. If the transmitter is installed in a loop, set the loop to Manual and disconnect the power.
2. **⚠ WARNING**

   Explosions

   Explosions could result in death or serious injury.

   Do not remove the transmitter cover in explosive atmospheres when the circuit is live.

   Remove the housing cover from the electronics side of the transmitter.
3. Plug in the LCD display assembly; then thread and tighten the LCD display screws into the holes on the electronics module.
4. **⚠ WARNING**

   Explosions

   Explosions could result in death or serious injury.

   Both transmitter covers must be fully engaged to meet explosion-proof requirements.

   Attach the extended cover; tighten at least one-third turn after the O-ring contacts the transmitter housing.
5. Apply power and set the loop to **Automatic** control.

C Quick Service buttons

If you press one button for 1 second, the message `Hold both buttons to enter menu` appears. If you take no action for 15 seconds, the message disappears, and the regular LCD parameters are shown.

Hold both buttons for 3 seconds to enter the menu. If you take no action within 120 seconds (2 minutes), the menu disappears, and the regular LCD parameters are shown.

While operating in the **Quick Service** buttons menu, during any 10 second span where the buttons don't return to their released state, the `Display Button Stuck` message will appear on the LCD display.

Menu title	Menu screens
View Config	• **PV (Primary Variable) and PV Damping** • **PV Upper Range Value (URV) and Lower Range Value (LRV)** • **Sensor 1 Type and Connection** • **Sensor 2 Type and Connection** • **Analog Output (AO) Alarm** • **High (HI) and Low (LO) Saturation**
ReadyConnect	• **Initiate ReadyConnect?** • **Sensor 1 ReadyConnect Read (Complete or Fail)** • **Sensor 2 ReadyConnect Read (Complete or Fail)**
Sensor Config	Only certain sensors available in this menu • **Configure Sensor 1?** • **Select Sensor 1 Type** • **Select Sensor 1 Connection** (number of wires) • **Configure Sensor 2?** • **Select Sensor 2 Type** • **Select Sensor 2 Connection** (number of wires) • **Task Complete**
Loop Test	• **Loop Current with Increment from 4 mA to 20 mA** • **Loop Current is now 4 mA** • **Loop Current is now 8 mA** • **Loop Current is now 12 mA** • **Loop Current is now 16 mA** • **Loop Current is now 20 mA** • **Loop Test Complete**
Rotate Display	• **Rotate Display?** • **Task Complete**

D Configuration tables

D.1 Standard configuration

You may change both standard and custom configuration settings.

Unless otherwise specified, Emerson ships the transmitter as follows:

Standard configuration	
4 mA value/lower range (HART®/4-20 mA)	0
20 mA value/upper range (HART/4-20 mA)	100
Units	C
Damping	5 seconds
Failure Mode (HART/4-20 mA)	Rosemount High (22.5 mA)
Line Voltage Filter	60 Hz
Hardware Security Switch	Off
Software Security	Off
RTD Measurement Protection	Off
Open Sensor Holdoff	Enabled
Transient Filter Threshold	Enabled
Optional graphical display	
Rotation	0 Degrees Clockwise
Display Language	English
Decimal Separator	Period
Light	On
Display Buttons	On
Bluetooth (option with display)	On
Primary Screen	Primary Variable (PV)/Measurement 1
Secondary Screen	Loop Current
Single-sensor option (Measurement Functionality 1)	
Sensor Type	4-wire Pt 100 α = 0.00385 RTD
Primary Variable (HART/4-20 mA)	Measurement 1
Secondary Variable	Terminal Temperature
Tertiary Variable	Terminal Temperature
Quaternary Variable	Terminal Temperature
Dual-sensor option (Measurement Functionality 2)	
Sensor Type	Two 3-wire Pt 100 α = 0.00385 RTD
Primary Variable (HART/4-20 mA)	Measurement 1
Secondary Variable	Measurement 2

Tertiary Variable	Terminal Temperature
Quaternary Variable	Terminal Temperature
Rosemount X-well™ assembly option (Measurement Functionality 3)	
Sensor Type	Selected in model code
Primary Variable (HART/4-20 mA)	Measurement 1
Secondary Variable	Terminal Temperature
Tertiary Variable	Terminal Temperature
Quaternary Variable	Terminal Temperature
Line Size	Defined by model option code
Pipe Material	Carbon Steel
Pipe Schedule	40
X-well transmitter only option (Measurement Functionality 4)	
Sensor Type	4-wire PT100 α = 0.00385 RTD
Primary Variable (HART/4-20 mA)	Measurement 1
Secondary Variable	Terminal Temperature
Tertiary Variable	Terminal Temperature
Quaternary Variable	Terminal Temperature

D.2 Transmitter custom configuration

You can order the transmitter with custom configuration via the C1 option code. Refer to the Configuration Data Sheet on www.Emerson.com for more details. The following table lists variable mapping defaults for U-code configurations.

Table D-1: Dual Input Option (Measurement Functionality 2, 4) U Code Default Variable Mapping

U1 Hot Backup™	
Primary Variable (HART®/4-20 mA)	Hot Backup
Secondary Variable	Measurement 1
Tertiary Variable	Measurement 2
Quaternary Variable	Terminal Temperature
U2 Average Temperature with Hot Backup and Sensor Drift Alert - Warning Mode	
Primary Variable (HART/4-20 mA)	Average with Hot Backup
Secondary Variable	Measurement 1
Tertiary Variable	Measurement 2
Quaternary Variable	Terminal Temperature
U3 Average Temperature with Hot Backup and Sensor Drift Alert - Alarm Mode	
Primary Variable (HART/4-20 mA)	Average with Hot Backup
Secondary Variable	Measurement 1
Tertiary Variable	Measurement 2

Table D-1: Dual Input Option (Measurement Functionality 2, 4) U Code Default Variable Mapping *(continued)*

Quaternary Variable	Terminal Temperature
U4 Two Independent Sensors	
Primary Variable (HART/4-20 mA)	Measurement 1
Secondary Variable	Measurement 2
Tertiary Variable	Terminal Temperature
Quaternary Variable	Terminal Temperature
U5 Differential Temperature	
Primary Variable (HART/4-20 mA)	Differential
Secondary Variable	Measurement 1
Tertiary Variable	Measurement 2
Quaternary Variable	Terminal Temperature
U6 Average Temperature	
Primary Variable (HART/4-20 mA)	Average
Secondary Variable	Measurement 1
Tertiary Variable	Measurement 2
Quaternary Variable	Terminal Temperature

E Calculating calibration frequency

Calibration frequency can vary greatly depending on the application, performance requirements, and process conditions. Use the following procedure to determine calibration frequency that meets the needs of your application.

Procedure

1. Determine the required performance.
2. Calculate total probable error (TPE) using the following components.
   - Digital accuracy = °C
   - Digital to analog (D/A) accuracy = (% of transmitter span) x (process temperature change)
   - Digital temperature effects = (°C per 1.0 °C change in ambient temperature) x (ambient temperature - reference temperature)
   - D/A effects = (% of span) x (process temperature range)
   - Sensor accuracy = °C

$$\text{TPE}=\sqrt{(\text{DigitalAccuracy})^2+(\text{D/AAccuracy})^2+(\text{DigitalTempEffects})^2+(\text{D/AEffects})^2+(\text{SensorAccuracy})^2}$$

3. Calculate stability per month.
   Stability per month = (% drift per months) x (operating temperature)
4. Calculate Calibration Frequency.

$$\text{CalFreq}=\frac{(\text{RequiredPerformance-TPE})}{\text{StabilityPerMonth}}$$

Example for a Rosemount 3144S Pt 100 (a = 0.00385) with the following conditions

Reference temperature	20 °C
Process temperature change	100 °C
Ambient temperature	30 °C
Operating temperature	120 °C

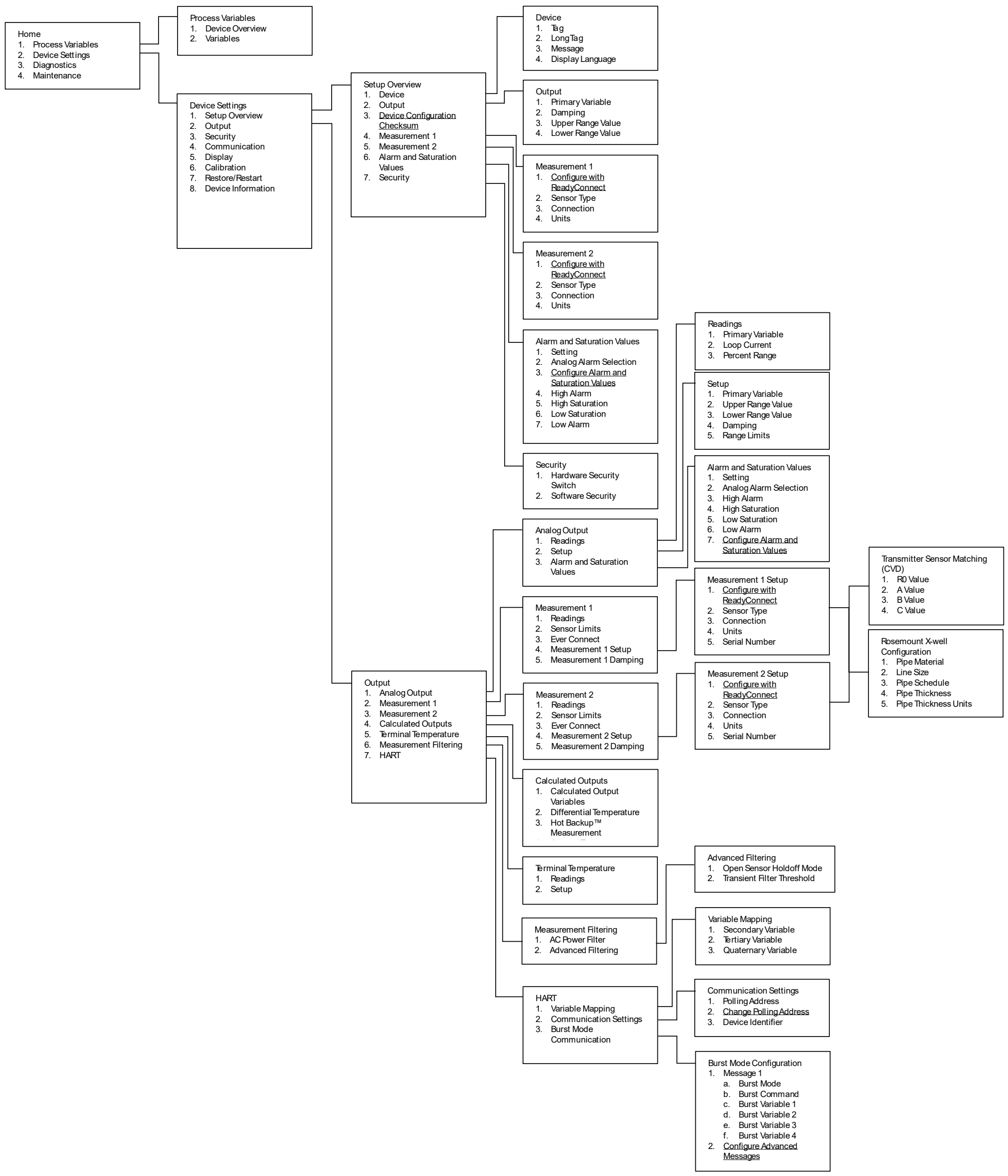
1. Required performance: ±0.35 °C
2. TPE = 0.11 °C
   a. Digital accuracy = 0.05 °C
   b. D/A accuracy = (0.0125%) x (100 °C) = ±0.0125 °C
   c. Digital temperature effects = (0.0015 °C/°C) x (30 - 20) °C = 0.015 °C
   d. D/A effect = (0.00063%) x (100 °C) = 0.00063 °C
   e. Sensor accuracy = 0.0975 °C at 120 °C for a class A RTD sensor with Callendar-Van Dusen constants
   f. TPE =

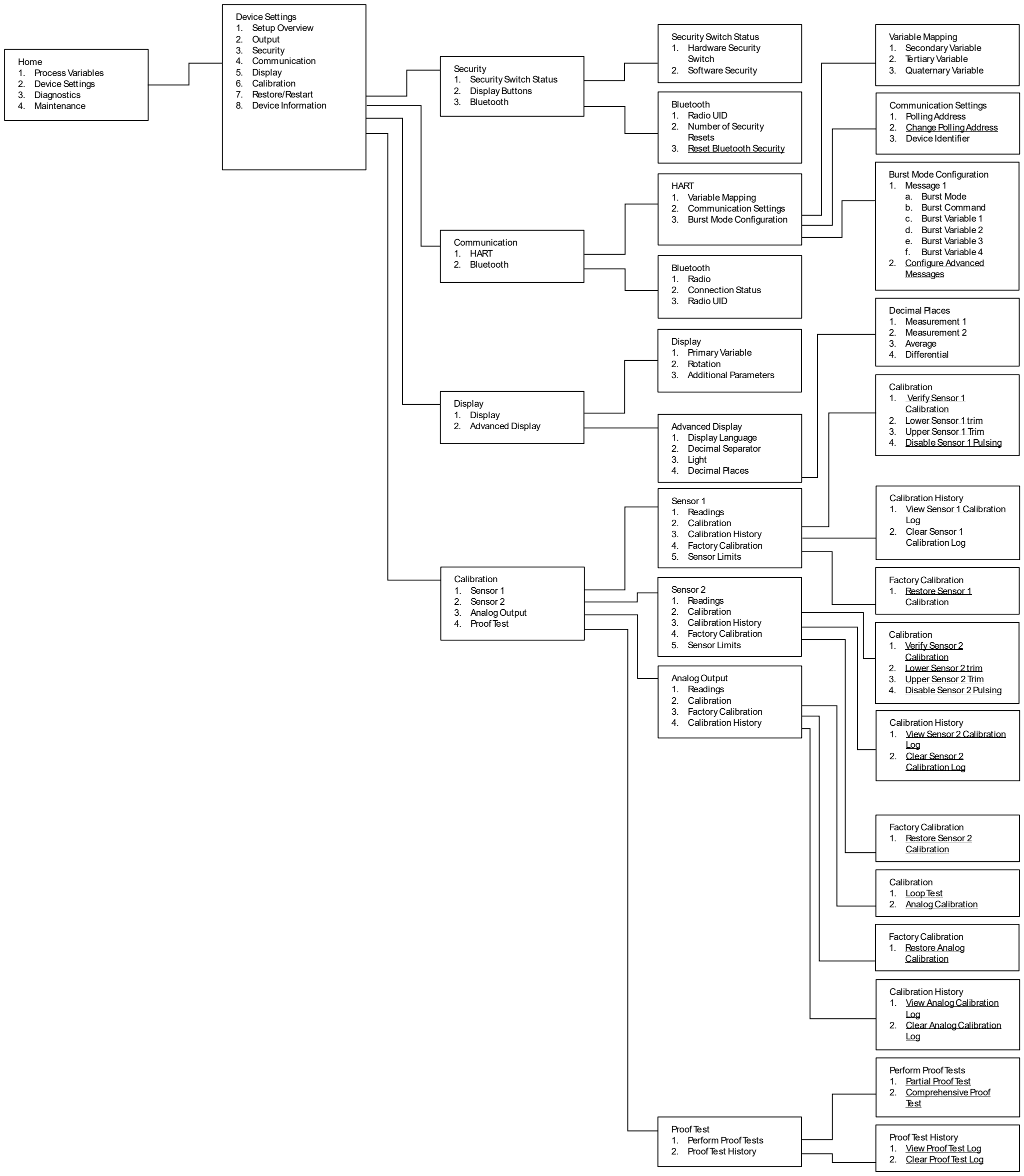
$$\sqrt{(0.05)^2+(0.0125)^2+(0.015)^2+(0.00063)^2+(0.0975)^2}=0.11^{\circ}\text{C}$$

3. Stability per month: (0.25%/240 months) x (120 °C) = 0.00125 °C
4. Calibration frequency: (0.35 - 0.11)/0.00125 = 191 months

F Menu trees

Note
Underlined: process button

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4. Factory Calibration
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2. Comprehensive Proof Test
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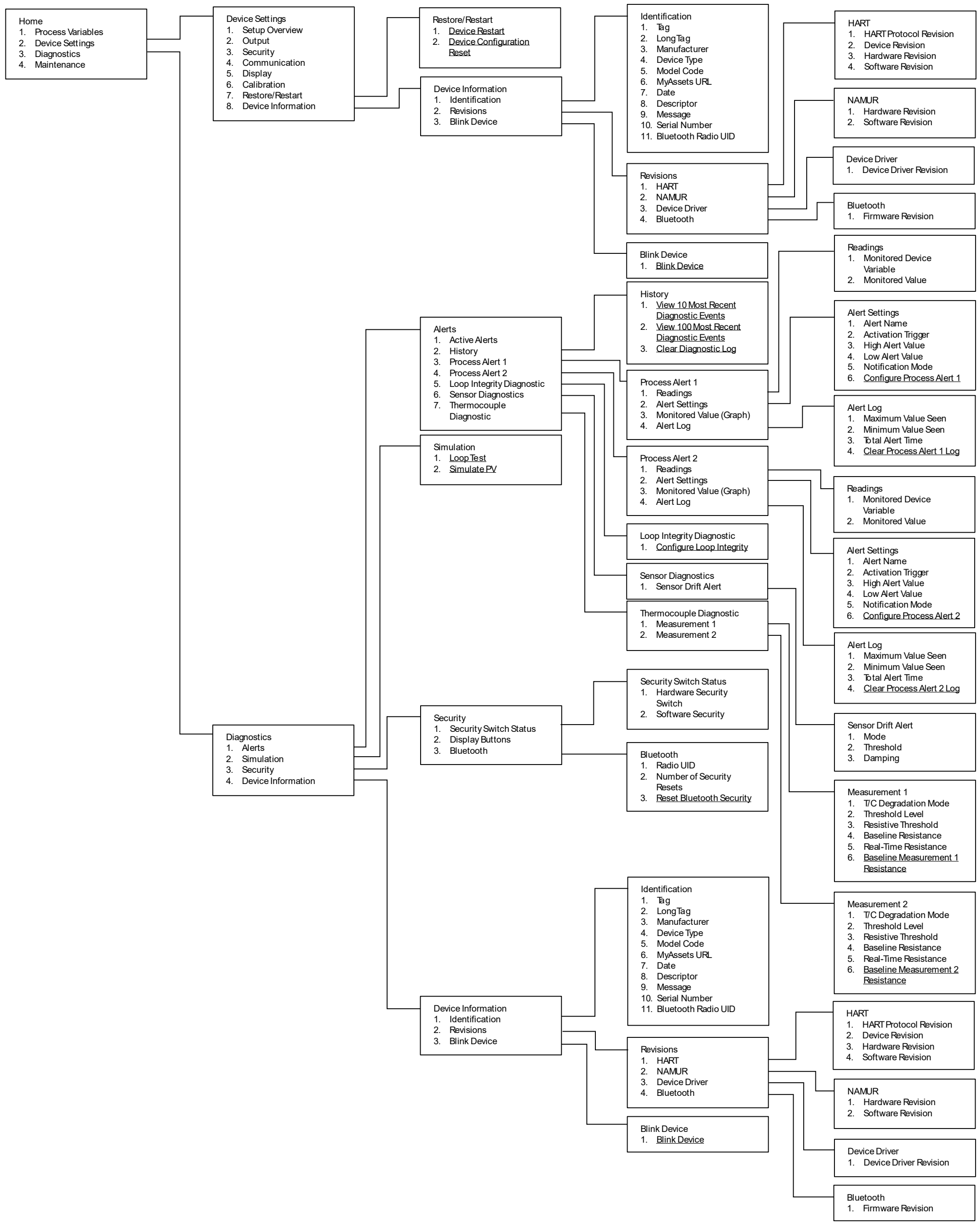
2. Clear Proof Test Log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1. Blink Device
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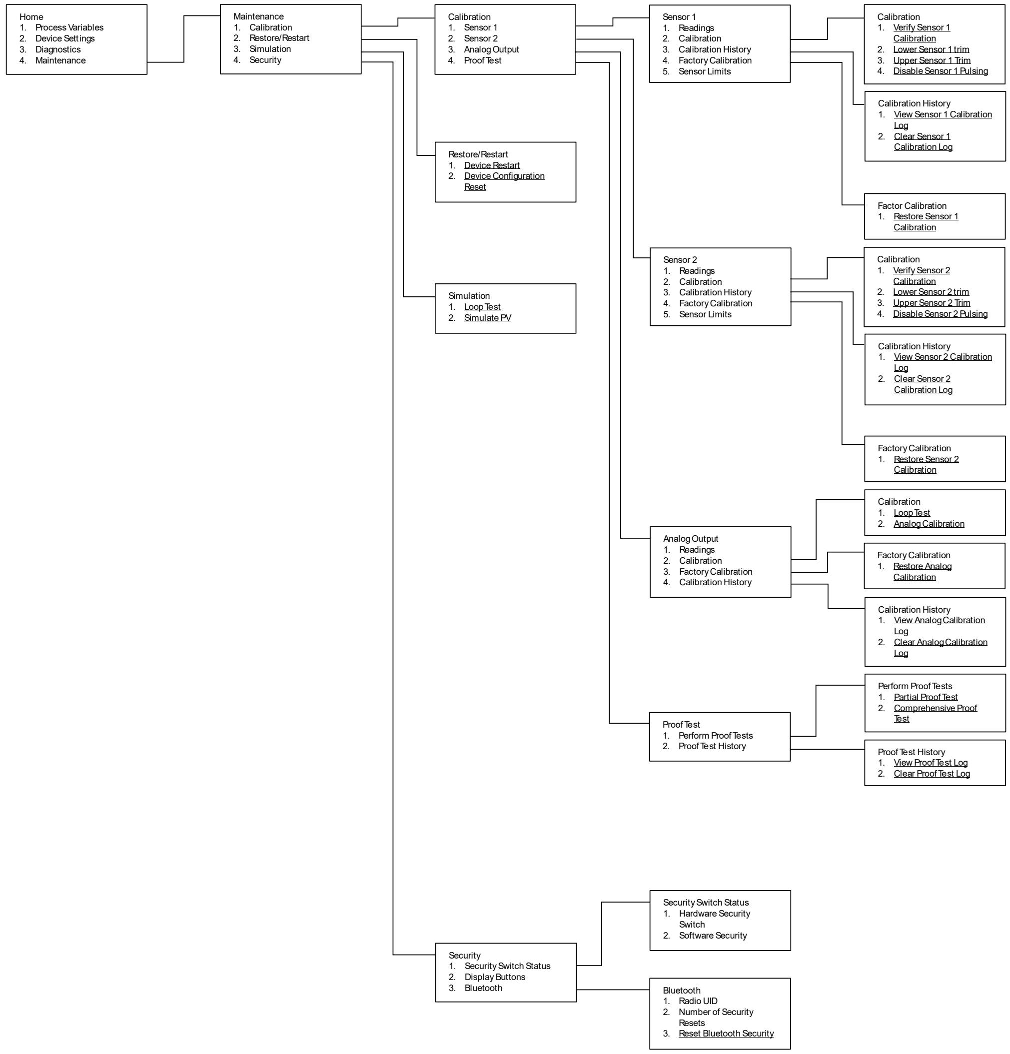

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MS-00809-0100-6184
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