00809-0100-4728
English
Rev. FA

Models 644H and 644R Smart Temperature Transmitters

ROSEMOUNT®

FISHER-ROSEMOUNT™

Product Manual

Models 644H and 644R Smart Temperature Transmitters

HART Device Revision	**5.5.2, 5.5.3**
HART Communicator Field Device Revision	**Dev v5, DD v2**

NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product.

Within the United States, Rosemount Inc. has two toll-free assistance numbers:

Customer Central
Technical support, quoting, and order-related questions.

1-800-999-9307 (7:00 am to 7:00 pm CST)

North American Response Center
Equipment service needs.

1-800-654-7768 (24 hours—includes Canada)

Outside of the United States, contact your local Rosemount representative.

⚠CAUTION

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 Rosemount nuclear-qualified products, contact your local Rosemount Sales Representative.

Cover photo: 644C904

Rosmeount Inc.
8200 Market Boulevard
Chanhassen, MN 55317
USA
Tel 1-800-999-9307
Fax (952) 949-7001

Fisher Rosemount Limited
Heath Place
Bodnor Regis
West Sussex PO 22 9SH
England
Tel 44 (1243) 863 121
Fax 44 (1243) 867 5541

Fisher Rosemount
Singapre Pte Ltd.
1 Pandan Crescent
Singapore128461
Tel (65) 777 8211
Fax (65) 777-0947
AP.RMT-Specialist@frco.com

Product documentation available at...
www.rosemount.com

00809-0100-4728 Rev FA 10/00

Fisher-Rosemount satisfies all obligations coming from legislation to harmonise product requirements in the European Union.

ROSEMOUNT®
FISHER-ROSEMOUNT™

Table of Contents

Section 1

Introduction

SAFETY MESSAGES

Procedures and instructions in this manual may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the safety messages listed at the beginning of each section before performing an operation preceded by this symbol.

⚠WARNING

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

- Make sure only qualified personnel perform the installation.

Explosions could result in death or serious injury.

- Do not remove the connection head cover in explosive atmospheres when the circuit is live.
- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with instrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- All connection head covers must be fully engaged to meet explosion-proof requirements.

Process leaks could result in death or serious injury.

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

Electrical shock could cause death or serious injury.

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

TRANSMITTER OVERVIEW

Thank you for choosing the Model 644 Smart Temperature Transmitter. Features of the Model 644 include:

- Accepts inputs from a wide variety of sensors
- Configuration using HART protocol
- Electronics that are completely encapsulated in epoxy and enclosed in a metal housing, making the transmitter extremely durable and ensuring long-term reliability
- A compact size and two housing options allowing mounting flexibility for the control room or the field

Rosemount Inc. has a full range of compatible connection heads, sensors, and thermowells to provide complete assemblies for process temperature measurements. Refer to Volume 1 of the Rosemount Temperature Sensors and Assemblies Product Data Sheet (document number 00813-0100-2654) for thread mount sensors and accessories, or refer to Volume 2 (document number 00813-0100-2654) for DIN-style sensors and accessories.

MANUAL OVERVIEW

This manual is designed to assist in the installation, operation, and maintenance of Rosemount® Models 644H and 644R.

Section 2: Installation

- Tools for installation
- Mounting
- Installation
- Field wiring

Section 3: Operation

- Power Supply
- Communication
- Configuration

Section 4: Hardware and Software Maintenance and Troubleshooting

- Hardware maintenance
- Diagnostic messages

Appendix A: Reference Data

- Specifications
- Dimensional drawings
- Ordering Information

Appendix B: Approvals

- Locations Certifications
- Installation drawings

Appendix C: Models 644 and 244E Temperature Transmitters Manual Supplement

- Comparison between new and old Models 644 and 244E
- Specifications

CONSIDERATIONS

General

Electrical temperature sensors such as RTDs and thermocouples produce low-level signals proportional to their sensed temperature. The Model 644 converts the low-level sensor signal to a standard 4–20 mA dc signal that is relatively insensitive to lead length and electrical noise. This current signal is then transmitted to the control room via two wires.

Mechanical

When choosing an installation location and position, take into account the need for access to the transmitter.

Wiring Connections

Make wiring connections through the cable entry in the side of the connection head. Be sure to provide adequate clearance for cover removal.

Electrical

Proper electrical installation is necessary to prevent errors due to sensor lead resistances and electrical noise. Shielded cable should be used in electrically noisy environments.

Environmental

The transmitter electronics module is permanently sealed within the housing, resisting moisture and corrosive damage. Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

Section

2 Installation

SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠WARNING

Explosions could result in death or serious injury.

- Only qualified personnel should perform the installation
- Do not remove the connection head cover in explosive atmospheres when the circuit is live.
- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with instrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- All connection head covers must be fully engaged to meet explosion-proof requirements.

⚠WARNING

Process leaks could result in death or serious injury.

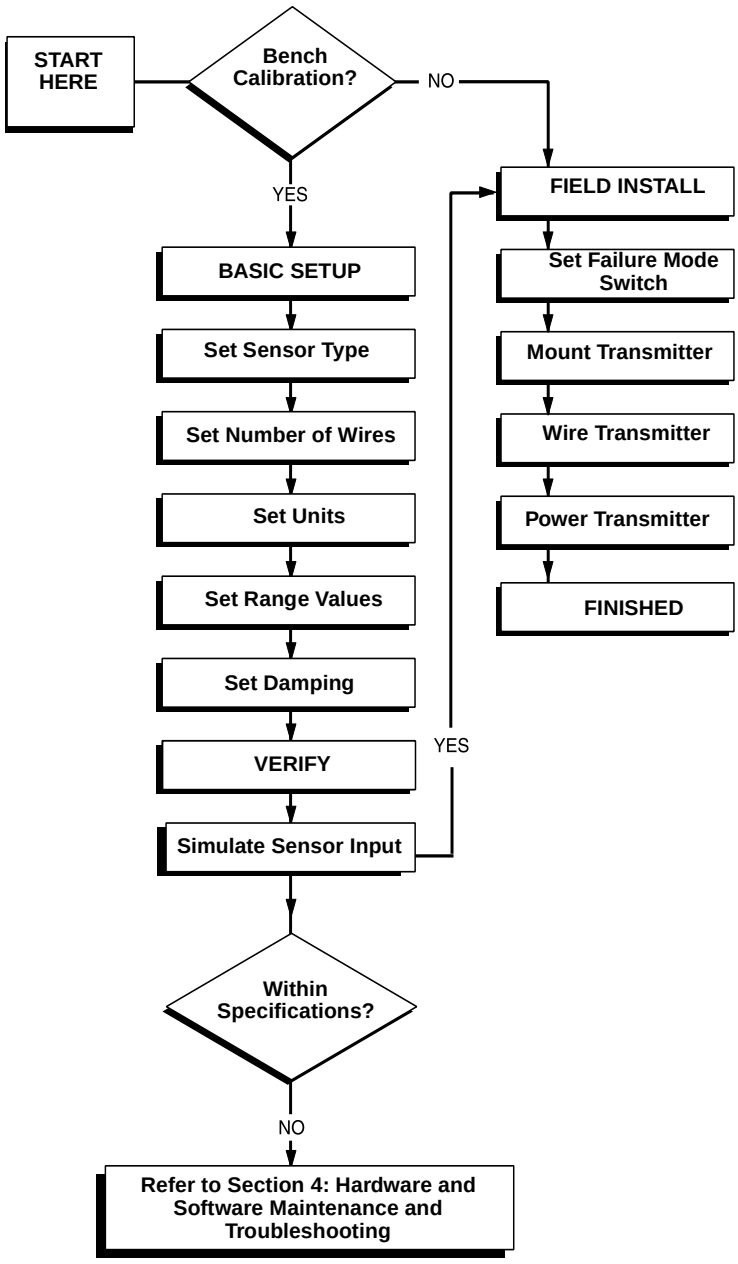
- Install and tighten thermowells and sensors before applying pressure, or process leakage may result.
- Do not remove the thermowell while in operation. Removing while in operation may cause process fluid leaks.

⚠WARNING

Electrical shock could cause death or serious injury. Under certain fault conditions, high voltage may be present on transmitter leads and terminals.

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

Figure 2-1. Installation Flowchart



TOOLS NEEDED FOR INSTALLATION

The tools needed for installation are as follows:

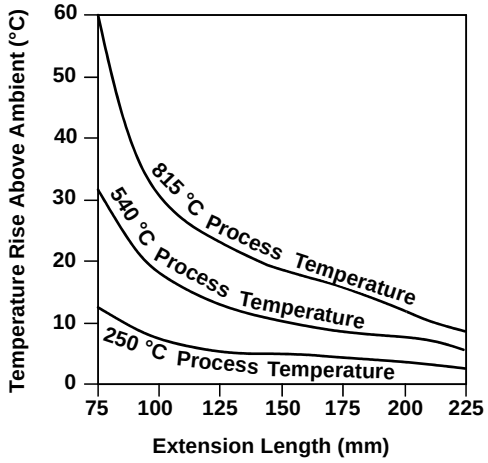
Models 644H and 644R	Model 275 HART Communicator
• Transmitter	• HART communicator
• Mounting apparatus	

MOUNTING

The Model 644H installs in a connection head or universal head mounted directly on a sensor assembly, apart from a sensor assembly using a universal head, or to a DIN rail using an optional mounting clip. The Model 244ER mounts directly to a wall or to a DIN rail.

In a direct mounting configuration using a Model 644H transmitter, process heat is transferred from the thermowell to the transmitter via the connection head. If the expected connection head temperature is near or beyond specification limits (for ambient temperatures between –40 and 185 °F (–40 and 85 °C)) consider the use of additional thermowell lagging, an extension nipple, or a remote mounting configuration to isolate the transmitter from excessive temperatures. Figure 2-2 provides an example of the relationship between transmitter housing temperature rise and extension length. Use this table as a guide for determining adequate thermowell extension length.

Figure 2-2. Model 644H Transmitter Connection Head Temperature Rise vs. Extension Length



3044-0123A

Example

The transmitter specification limit is 85 °C. If the ambient temperature is 55 °C and the process temperature to be measured is 800 °C, the maximum permissible connection head temperature rise is the transmitter specification limit minus the ambient temperature (85 to 55 °C), or 30 °C.

In this case, an extension of 100 mm meets this requirement, but 125 mm provides a margin of 8 °C, thereby reducing any temperature effects in the transmitter.

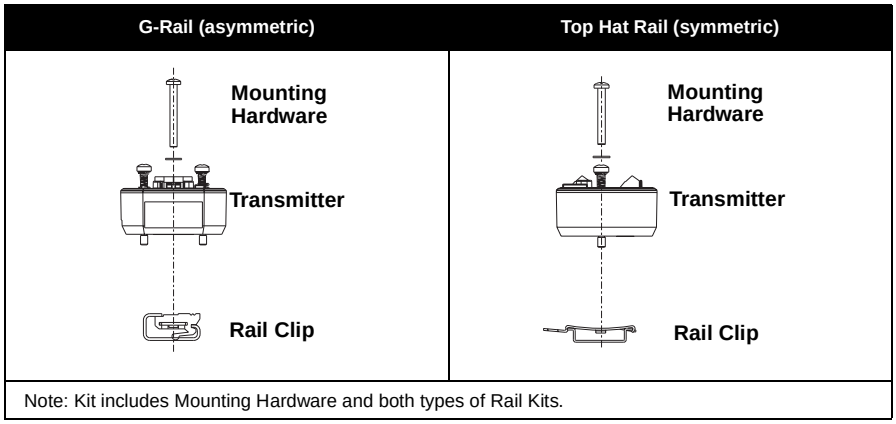
Special Mounting Considerations

Special mounting hardware is available for mounting a Model 644H head mount transmitter to a DIN rail, or assembling a new Model 644H to an existing threaded sensor connection head (former option code L1).

Mounting a Model 644H to a DIN Rail

To attach a head mount transmitter to a DIN rail, assemble the appropriate rail mounting kit (part number 00644-5301-0010) to the transmitter as shown in Figure 2-3, then follow the procedure under "Rail Mount Transmitter with Integral Mount Sensor" on page 2-7.

Figure 2-3. Assembling Rail Clip Hardware to a Model 644H

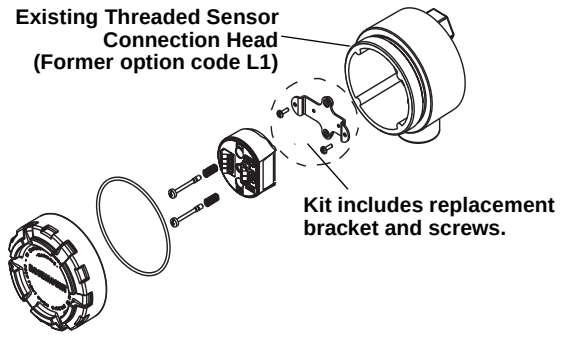


Note: Kit includes Mounting Hardware and both types of Rail Kits.

Retrofitting a Model 644H for Use in an Existing Threaded Sensor Connection Head

To mount a Model 644H in an existing threaded sensor connection head (former option code L1), order the Model 644H retrofit kit (part number 00644-5321-0010). The retrofit kit includes a new mounting bracket and all associated hardware necessary to facilitate the installation of the Model 644H in the existing head (see Figure 2-4).

Figure 2-4. Assembling Model 644H for Use in an Existing L1 Connection Head



INSTALLATION PROCEDURES

Transmitter

Refer to the appropriate procedure and the accompanying illustrations when installing the transmitter.

Head Mount Transmitter with DIN Plate Style Sensor

The least complicated assembly uses:

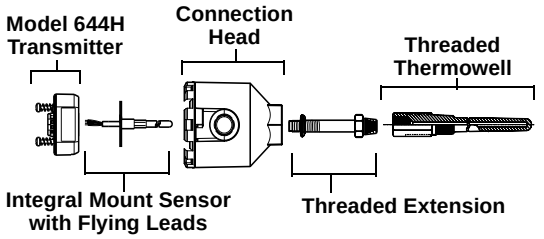
- an integral mount sensor with flying leads
- an integral DIN style connection head
- a standard extension
- a threaded thermowell

Refer to Volume 2 of the Rosemount Sensors Product Data Sheet (document number 00813-0101-2654) for complete sensor and mounting accessory information.

To complete the assembly, follow the steps described below.

1. Attach the thermowell to the pipe or process container wall. Install and tighten the thermowell before applying pressure.
2. Set the transmitter failure mode switch (see Figure 2-12 on page 2-11).
3. Assemble the transmitter to the sensor. Push the transmitter mounting screws through the sensor mounting plate and insert the snap rings (optional, part number 00644-4432-0001) into the groove of each transmitter mounting screw.
4. Insert the transmitter-sensor assembly into the connection head. Thread the transmitter mounting screw into the connection head mounting holes.
5. Assemble the extension to the connection head. Insert the assembly into the thermowell.
6. Attach a cable gland into the shielded cable.
7. Insert the shielded cable leads into the connection head through the cable entry. Connect and tighten the cable gland.
8. Connect the shielded cable leads to the transmitter power terminals. Avoid contact with leads and terminals.
9. Install and tighten the connection head cover. Enclosure covers must be fully engaged to meet explosion-proof requirements.

Figure 2-5. Typical Model 644H Mounting Configuration Using Integral Mount Sensor and Assembly



Head Mount Transmitter with Threaded Sensor

The least complicated assembly uses:

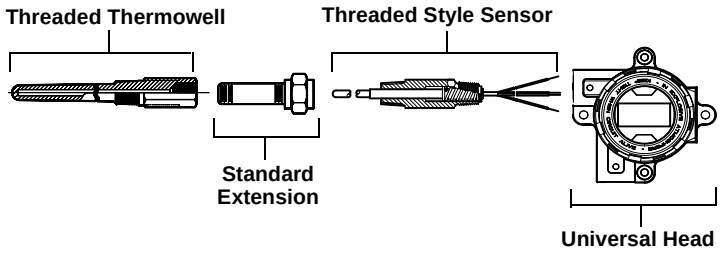
- a threaded sensor with flying leads
- the universal connection head
- a union and nipple extension assembly
- a threaded thermowell

Refer to Volume 1 of the Rosemount Sensors Product Data Sheet (document number 00813-0100-2654) for complete sensor and mounting accessory information.

To complete the assembly, follow the steps as described below.

1. Attach the thermowell to the pipe or process container wall. Install and tighten thermowells before applying pressure.
2. Attach necessary extension nipples and adapters. Seal the nipple and adapter threads with silicone tape.
3. Screw the sensor into the thermowell. Install drain seals if required for severe environments or to satisfy code requirements.
4. Set the transmitter failure mode switch (see Figure 2-12 on page 2-11).
5. Pull the sensor wiring leads through the extensions and adapters into the universal head. Mount the transmitter in the universal head by threading the transmitter mounting screws into the universal head mounting holes.
6. Mount the assembly into the thermowell. Seal adapter threads with silicone tape.
7. Install conduit for field wiring to the conduit entry of the universal head. Seal conduit threads with silicone tape.
8. Pull the field wiring leads through the conduit into the universal head. Attach the sensor and power leads to the transmitter. Avoid contact with leads and terminals.
9. Install and tighten the universal head cover. Enclosure covers must be fully engaged to meet explosion-proof requirements.

Figure 2-6. Typical Model 644H Transmitter Mounting Configuration Using Threaded Style Sensor and Assembly



Rail Mount Transmitter with Integral Mount Sensor

The least complicated assembly uses:

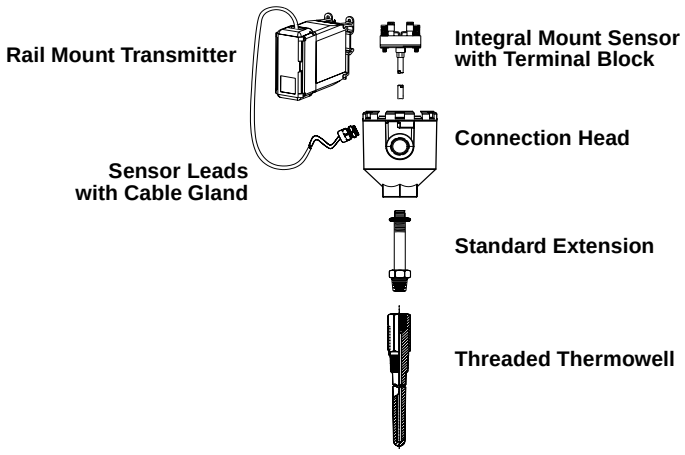
- an integral mount sensor with terminal block
- an integral DIN style connection head
- a standard extension
- a threaded thermowell

Refer to Volume 2 of the Rosemount Sensors Product Data Sheet (document number 00813-0101-2654) for complete sensor and mounting accessory information.

To complete the assembly, follow the procedure described below.

1. Attach the transmitter to a suitable rail or panel.
2. Attach the thermowell to the pipe or process container wall. Install and tighten the thermowell before applying pressure.
3. Attach the sensor to the connection head and mount the entire assembly to the thermowell.
4. Attach sufficient lengths of sensor lead wire to the sensor terminal block.
5. Attach and tighten the connection head cover. Enclosure covers must be fully engaged to meet explosion-proof requirements.
6. Run sensor lead wires from the sensor assembly to the transmitter.
7. Set the transmitter failure mode switch (see Figure 2-12 on page 2-11).
8. Attach the sensor and power leads to the transmitter. Avoid contact with leads and terminals.

Figure 2-7. Typical Rail Mount Transmitter Mounting Configuration Using Integral Mount Sensor and Assembly



Rail Mount Transmitter with Threaded Sensor

The least complicated assembly uses:

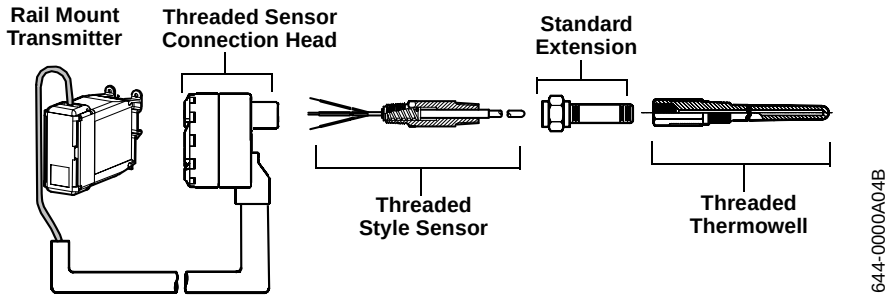
- a threaded sensor with flying heads
- a threaded sensor connection head
- a union and nipple extension assembly
- a threaded thermowell

Refer to Volume 1 of the Rosemount Sensors Product Data Sheet (document number 00813-0100-2654) for complete sensor and mounting accessory information.

To complete the assembly, follow the procedure described below.

1. Attach the transmitter to a suitable rail or panel.
2. Attach the thermowell to the pipe or process container wall. Install and tighten the thermowell before applying pressure.
3. Attach necessary extension nipples and adapters. Seal the nipple and adapter threads with silicone tape.
4. Screw the sensor into the thermowell. Install drain seals if required for severe environments or to satisfy code requirements.
5. Screw the connection head to the sensor.
6. Attach the sensor lead wires to the connection head terminals.
7. Attach additional sensor lead wires from the connection head to the transmitter.
8. Attach and tighten the connection head cover. Enclosure covers must be fully engaged to meet explosion-proof requirements.
9. Set the transmitter failure mode switch (see Figure 2-12 on page 2-11).
10. Attach the sensor and power leads to the transmitter. Avoid contact with leads and terminals.

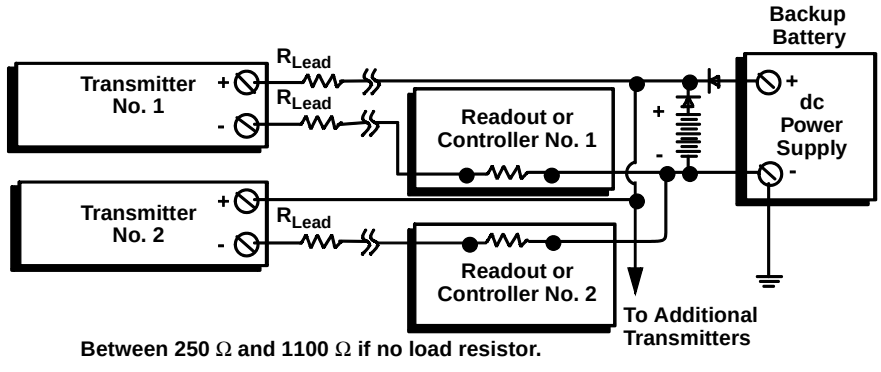
Figure 2-8. Typical Rail Mount Transmitter Mounting Configuration Using Threaded Style Sensor and Assembly



Multichannel Installations

You can connect several transmitters to a single master power supply, as shown in Figure 2-9. In this case, the system may be grounded only at the negative power supply terminal. In multichannel installations where several transmitters depend on one power supply and the loss of all transmitters would cause operational problems, consider an uninterrupted power supply or a back-up battery. The diodes shown in Figure 2-9 prevent unwanted charging or discharging of the back-up battery.

Figure 2-9. Multichannel Installations

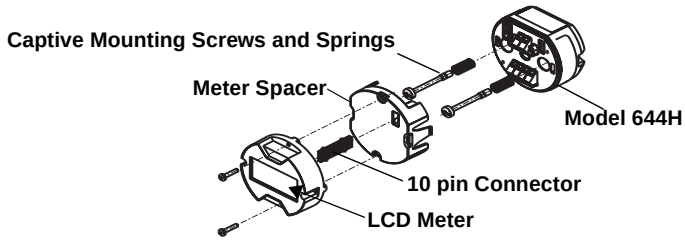


LCD Meter Installation

The LCD meter provides local indication of the transmitter output and abbreviated diagnostic messages governing transmitter operation. Transmitters ordered with the LCD meter are shipped with the meter installed. After-market installation of the meter can be performed the transmitter has a meter connector (transmitter revision 5.5.2 or later). After-market installation requires the meter kit (part number 00644-4430-0001), which includes:

- LCD meter assembly (includes LCD meter, meter spacer, and 2 screws)
- Meter cover with O-ring in place

Figure 2-10. Installing the LCD Meter



Use the following procedure to install the meter.

1. If the transmitter is installed in a loop, secure the loop and disconnect the power. If the transmitter is installed in an enclosure, remove the cover from the enclosure.
2. Decide meter orientation (the meter can be rotated in 90° increments). To change meter orientation, remove the screws located above and below the display screen. Lift the meter off the meter spacer. Remove the 8-pin plug and re-insert it in the location that will result in the desired viewing orientation.
3. Reattach the meter to the meter spacer using the screws. If the meter was rotated 90° from its original position it will be necessary to remove the screws from their original holes and re-insert them in the adjacent screws holes.
4. Line up the 10-pin connector with the 10-pin socket and push the meter into the transmitter until it snaps into place.
5. Attach the meter cover; tighten at least one-third turn after the O-ring contacts the transmitter housing. The cover must be fully engaged to meet explosion-proof requirements.
6. Use a Model 275 HART Communicator to configure the meter to the desired display. Refer to "LCD Meter Options (Model 644H Only)" on page 3-13 for information on configuring the LCD meter.

NOTE
Observe the following LCD meter temperature limits:
Operating: –4 to 185 °F (–20 to 85 °C)
Storage: –50 to 185 °F (–45 to 85 °C)

COMMISSIONING

Bench or in the Loop

You can commission the transmitter before or after installation. It may be useful to commission it on the bench, before installation, to ensure proper operation and to familiarize yourself with its functionality. Make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices before connecting a HART communicator in an explosive atmosphere.

FIELD WIRING

All power to the transmitter is supplied over the signal wiring. Use ordinary copper wire of sufficient size to ensure that the voltage across the transmitter power terminals does not drop below 12.0 V dc.

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.

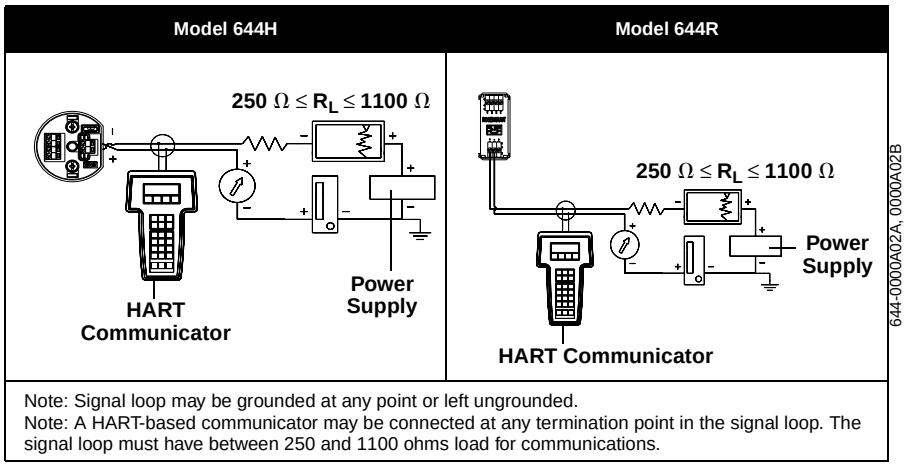
NOTE
Do not apply high voltage (e.g., ac line voltage) to the transmitter terminals. Abnormally high voltage can damage the unit. (Sensor and transmitter power terminals are rated to 42.4 V dc.)

For multichannel installations, see “Multichannel Installations” on page 2-9. The transmitters will accept inputs from a variety of RTD and thermocouple types. Refer to Figure 2-12 on page 2-11 when making sensor connections.

Use the following steps to wire the transmitter:

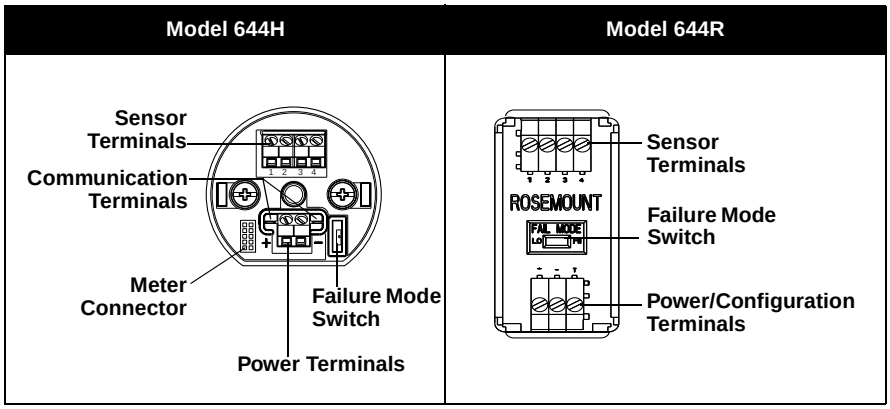
1. Connect the positive lead from the power supply to the transmitter terminal marked “**+**” and the negative lead to the transmitter terminal marked “**–**” (see Figure 2-11 and Figure 2-12).
2. Tighten the terminal compression screws to ensure adequate contact. No additional power wiring is required.
3. After making connections, recheck the polarity and correctness of connections, then turn the power on.

Figure 2-11. Connecting a Communicator to a Transmitter Loop



Note: Signal loop may be grounded at any point or left ungrounded.
Note: A HART-based communicator may be connected at any termination point in the signal loop. The signal loop must have between 250 and 1100 ohms load for communications.

Figure 2-12. Transmitter Power, Communication, and Sensor Terminals



Sensor Connections

The Model 644 is compatible with a number of RTD and thermocouple sensor types. Figure 2-13 shows the correct input connections to the sensor terminals on the transmitter. To ensure a proper sensor connection, anchor the sensor lead wires into the appropriate compression terminals and tighten the screws.

RTD or Ohm Inputs

The transmitters will accept a variety of RTD configurations, including 2-wire, 3-wire, 4-wire, and compensation loop designs. If the transmitter is mounted remotely from a 3-wire or 4-wire RTD, it will operate within specifications, without recalibration, for lead wire resistances of up to 10 ohms per lead (equivalent to 1,000 feet of 20 AWG wire). In this case, the leads between the RTD and transmitter should be shielded. If using only two leads, both RTD leads are in series with the sensor element, so significant errors can occur if the lead lengths exceed three feet of 20 AWG wire (approximately 0.05 °C/ft). For longer runs, attach a third or fourth lead as described above.

Sensor Lead Wire Resistance Effect

RTD Input

When using a 4-wire RTD, the effect of lead resistance is eliminated and has no impact on accuracy. However, a 3-wire sensor will not fully cancel lead resistance error because it cannot compensate for imbalances in resistance between the lead wires. Using the same type of wire on all three lead wires will make a 3-wire RTD installation as accurate as possible. A 2-wire sensor will produce the largest error because it directly adds the lead wire resistance to the sensor resistance. For 2- and 3-wire RTDs, an additional lead wire resistance error is induced with ambient temperature variations. The table and the examples shown below help quantify these errors.

TABLE 2-1. Examples of Approximate Basic Error

Sensor Input	Approximate Basic Error
4-wire RTD	None (independent of lead wire resistance)
3-wire RTD	± 1.0 Ω in reading per ohm of unbalanced lead wire resistance (Unbalanced lead wire resistance = maximum imbalance between any two leads.)
2-wire RTD	1.0 Ω in reading per ohm of lead wire resistance

Examples of Approximate Lead Wire Resistance Effect Calculations

Given:

Total cable length:	150 m
Imbalance of the lead wires at 20 °C:	1.5 Ω
Resistance/length (18 AWG Cu):	0.025 Ω/Ω °C
Temperature coefficient of Cu (α_{Cu}):	0.039 Ω/Ω °C
Temperature coefficient of Pt(α_{Pt}):	0.00385 Ω/Ω °C
Change in Ambient Temperature (ΔT_{amb}):	25 °C
RTD Resistance at 0 °C (R_o):	100 Ω (for Pt 100 RTD)

- Pt100 4-wire RTD: No lead wire resistance effect.
- Pt100 3-wire RTD:

$$\text{Basic Error} = \frac{\text{Imbalance of Lead Wires}}{(\alpha_{Pt} \times R_o)}$$

$$\text{Error due to amb. temp. variation} = \frac{(\alpha_{Cu}) \times (\Delta T_{amb}) \times (\text{Imbalance of Lead Wires})}{(\alpha_{Pt}) \times (R_o)}$$

Lead wire imbalance seen by the transmitter = 0.5 Ω

$$\text{Basic error} = \frac{0.5\ \Omega}{(0.00385\ \Omega / \Omega\ °C) \times (100\ \Omega)} = 1.3\ °C$$

Error due to amb. temp. var. of ± 25 °C

$$= \frac{(0.0039\ \Omega / \Omega\ °C) \times (25\ °C) \times (0.5\ \Omega)}{(0.00385\ \Omega / \Omega\ °C) \times (100\ \Omega)} = \pm 0.13\ °C$$

- Pt100 2-wire RTD:

$$\text{Basic Error} = \frac{\text{Lead Wire Resistance}}{(\alpha_{Pt} \times R_o)}$$

$$\text{Error due to amb. temp. variation} = \frac{(\alpha_{Cu}) \times (\Delta T_{amb}) \times (\text{Lead Wire Resistance})}{(\alpha_{Pt}) \times (R_o)}$$

Lead wire resistance seen by the transmitter = 150 m × 2 wires × 0.025 Ω/m = 7.5 Ω

$$\text{Basic error} = \frac{7.5\ \Omega}{(0.00385\ \Omega / \Omega\ °C) \times (100\ \Omega)} = 19.5\ °C$$

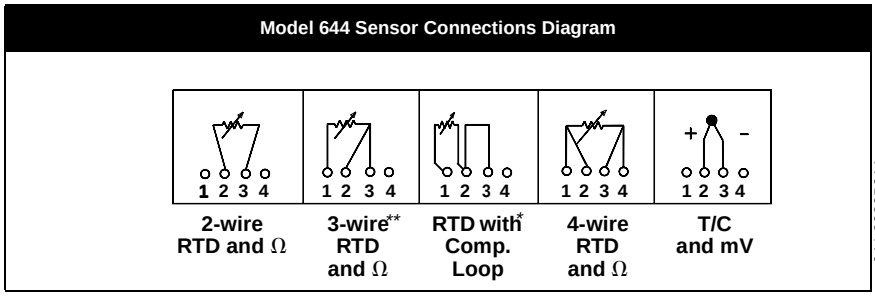
Error due to amb. temp. var. of ± 25 °C

$$= \frac{(0.0039\ \Omega / \Omega\ °C) \times (25\ °C) \times (7.5\ \Omega)}{(0.00385\ \Omega / \Omega\ °C) \times (100\ \Omega)} = \pm 1.9\ °C$$

Thermocouple or Millivolt Inputs

The thermocouple can be connected directly to the transmitter. Use appropriate thermocouple extension wire if mounting the transmitter remotely from the sensor. Make millivolt inputs connections with copper wire. Use shielding for long runs of wire.

Figure 2-13. Sensor Wiring Diagrams



** The transmitters must be configured for a 3-wire RTD in order to recognize an RTD with a compensation loop.*

*** Rosemount Inc. provides 4-wire sensors for all single element RTDs. You can use these RTDs in 3-wire configurations by leaving the unneeded leads disconnected and insulated with electrical tape.*

FAILURE MODE

As part of normal operation, each transmitter continuously monitors its own performance. This automatic diagnostics routine is a timed series of checks repeated continuously. If diagnostics detect an input sensor failure or a failure in the transmitter electronics, the transmitter drives its output to low or high depending on the position of the failure mode switch. Saturation levels are 3.90 mA for standard configuration (3.8 mA if configured for NAMUR-compliant operation) on the low end and 20.5 mA for standard or NAMUR-compliant configuration on the high end, if the sensor temperature is outside of range limits. These values are also custom configurable in both the factory and the field using the Model 275 HART Communicator.

The values to which the transmitter drives its output in failure mode depend on whether it is configured to standard, NAMUR-compliant, or custom operation. See Table A-1 on page A-2 for standard and NAMUR-compliant operation parameters.

To determine the failure mode configuration of your transmitter, review the failure mode options using a Model 275 HART Communicator.

Changing Switch Positions

To change the failure mode on the Model 644H or 644R transmitter, follow the steps described below.

1. If applicable, remove the enclosure cover.
2. Locate the orange failure mode switch. On the Model 644H the switch is located near the power terminals and located in the center of the front panel on the Model 644R (see Figure 2-12).
3. Move the switch to the desired alarm setting. To set the failure mode to high alarm, position the switch toward the “HI” mark on the terminal block. To set the failure mode to low alarm, position the switch in the opposite direction.
4. Replace the enclosure cover (if applicable). Enclosure covers must be fully engaged to meet explosion-proof requirements.

Section 3

Operation

SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠WARNING

Explosions may result in death or serious injury.

- Do not remove the instrument cover in explosive atmospheres when the circuit is live.
- Before connecting a HART-based communicator in an explosive atmosphere, make sure that the instruments in the loop are installed according to intrinsically safe or non-incendive field wiring practices.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.
- Do not make connections to the serial port or NiCad recharger jack in an explosive atmosphere.

⚠WARNING

Electrical shock could cause death or serious injury. Under certain fault conditions, high voltage may be present on transmitter leads and terminals.

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

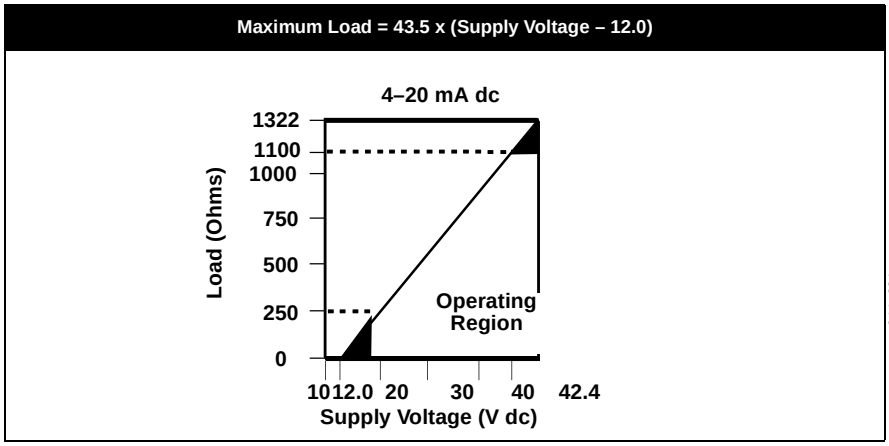
POWER SUPPLY

Proper electrical installation is necessary to prevent errors due to sensor lead resistance and electrical noise. Shielded cable should be used for best results in electrically noisy environments. A resistance between 250 and 1100 ohms must be present in the loop for communication with a HART-based communicator. Refer to Figure 2-13 on page 2-14 for sensor connections, and Figure 2-11 on page 2-11 for current loop connections.

To communicate with a transmitter, you will need a 17.75 V dc minimum power supply. The power supplied to the transmitter should not drop below the transmitter lift-off voltage (see Figure 3-1). If the power drops below the lift-off voltage while the transmitter is being configured, the transmitter may interpret the configuration information incorrectly.

The dc power supply should provide power with less than two percent ripple. The total resistance load is the sum of the resistance of the signal leads and the load resistance of any controller, indicator, or related pieces of equipment in the loop. Note that the resistance of intrinsic safety barriers, if used, must be included.

Figure 3-1. Load Limits



Surges/Transients

The transmitter will withstand electrical transients of the energy level encountered in static discharges or induced switching transients. However, high-energy transients, such as those induced in wiring from nearby lightning strikes, welding, heavy electrical equipment, or switching gears, can damage both the transmitter and the sensor. To protect against high-energy transients, install the transmitter into a suitable connection head with the Rosemount Model 470 Transient Protector. Refer to the Model 470 Transient Protector Product Data Sheet (document number 00813-0100-4191) for more information.

Grounding

The transmitter will operate with the current signal loop either floating or grounded. However, the extra noise in floating systems affects many types of readout devices. If the signal appears noisy or erratic, grounding the current signal loop at a single point may solve the problem. The best place to ground the loop is at the negative terminal of the power supply. Do not ground the current signal loop at more than one point.

The transmitter is electrically isolated to 500 V ac rms (707 V dc), so the input circuit may also be grounded at any single point. When using a grounded thermocouple, the grounded junction serves as this point.

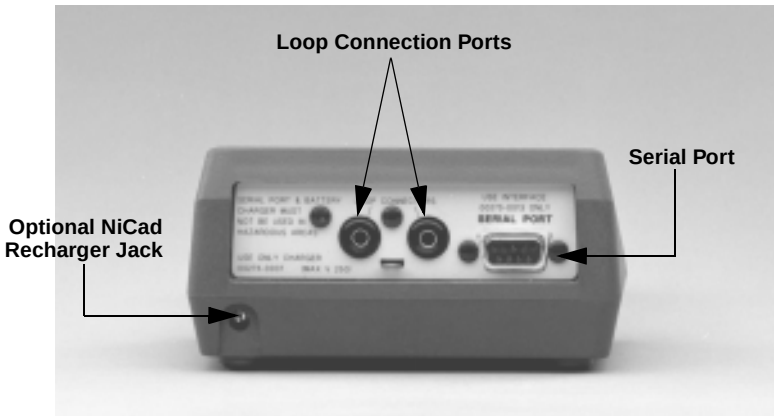
NOTE
Do not ground the signal wire at both ends.

COMMUNICATION TOOL

Connections and Hardware

The HART Communicator exchanges information with the transmitter from the control room, the instrument site, or any wiring termination point in the loop. To facilitate communication, connect the HART Communicator in parallel with the transmitter (see Figure 2-11). Use the loop connection ports on the rear panel of the HART Communicator (see Figure 3-2). The connections are non-polarized. Do not make connections to the serial port or the NiCad recharger jack in explosive atmospheres. Before connecting the HART communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

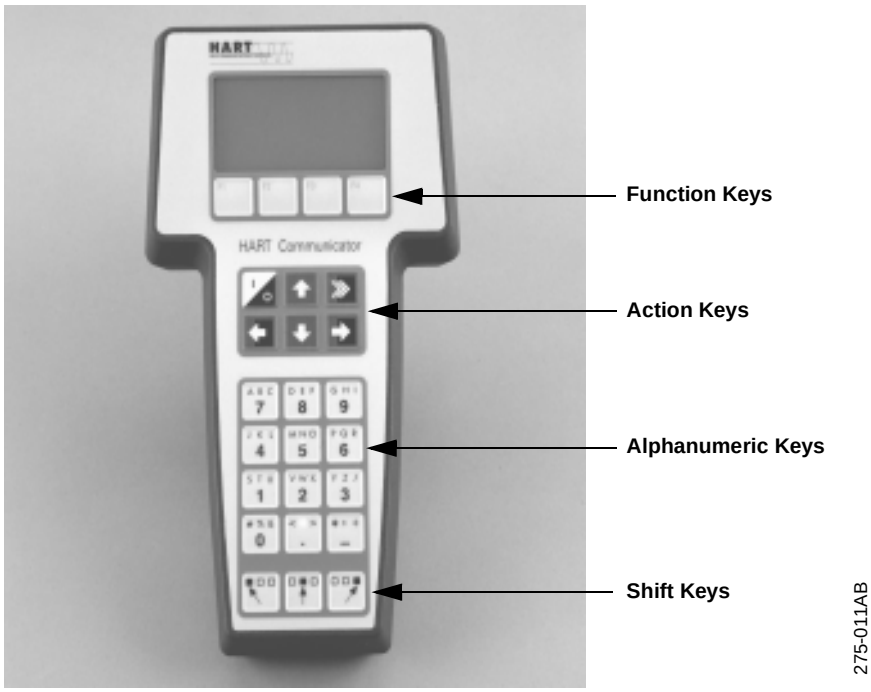
Figure 3-2. Rear Connection Panel with Optional NiCad Recharger Jack



Basic Features

The basic features of the HART Communicator include Action Keys, Function Keys, and Alphanumeric and Shift Keys.

Figure 3-3. Model 275 HART Communicator

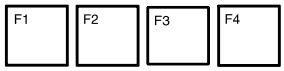


Action Keys

As shown in Figure 3-3, the action keys are the six blue, white, and black keys located above the alphanumeric keys. The function of each key is described as follows:

Key	Symbol	Description
ON/OFF Key		Use this key to power the HART Communicator. When the communicator is on, it searches for a transmitter on the 4–20 mA loop. If a device is not found, the communicator displays the message “No Device Found. Press OK.” If a HART-compatible device is found, the communicator displays the **ONLINE MENU** with device ID and tag.
Directional Key		Use these keys to move the cursor up, down, left, or right. The **RIGHT ARROW** key also selects menu options, and the **LEFT ARROW** key returns to the previous menu.
Hot Key		Use this key to quickly access important, user-selectable options when connected to a HART-compatible device. Pressing the **HOT KEY** turns the HART Communicator on and displays the Hot Key Menu. See “Customizing the Hot Key Menu” in the HART Communicator manual for more information.

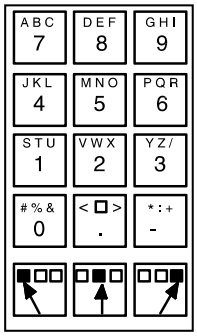
Function Keys



Use the four software-defined function keys, located below the LCD, to perform software functions. On any given menu, the label above a function key indicates the current function of that key. As you move among menus, different function key labels appear over the four keys. Press the key to activate the function. See your HART Communicator manual for details on specific function key definitions.

Alphanumeric and Shift Keys

Figure 3-4. HART Communicator Alphanumeric and Shift Keys



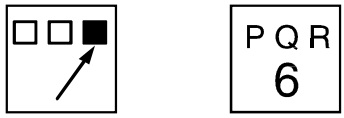
275-0383A

Data Entry

Some menus require data entry. Use the alphanumeric and shift keys to enter all alphanumeric information into the HART Communicator. If you press an alphanumeric key alone from within an edit menu, the bold character in the center of the key appears. These large characters include the numbers zero through nine, the decimal point (.), and the dash symbol (–).

To enter an alphabetic character, first press the shift key that corresponds to the position of the letter you want on the alphanumeric key. Then press the alphanumeric key. For example, to enter the letter “R”, first press the right shift key, then the “6” key (see Figure 3-5). Do not press these keys simultaneously, but one after the other.

Figure 3-5. Data Entry Key Sequence



275-0532A, 0343A

Fast Key Sequences

HART fast key sequences provide quick on-line access to transmitter variables and functions. Instead of stepping your way through the menu structure using the action keys, you can press a HART fast key sequence to move from the **ONLINE** menu to the desired variable or function. On-screen instructions guide you through the rest of the screens.

Fast Key Sequence Conventions

The fast key sequences for the Model 275 use the following conventions for their identification:

- **1 through 9**–Refer to the keys located directly below the dedicated keypad.
- **Left Arrow**–Refers to the **LEFT ARROW** directional key.

Fast Key Sequence Example

HART fast key sequences are made up of the series of numbers corresponding to the individual options in each step of the menu structure. For example, from the **ONLINE** menu you can change the date. Following the menu structure, press 1 to reach *Device Setup*, press 3 for *Configuration*, press 4 for *Device Info*, press 2 for *Date*. The corresponding HART fast key sequence is 3, 4, 2.

HART fast keys are operational only from the **ONLINE** menu. If you use them consistently, you will need to return to the **ONLINE** menu by pressing **HOME (F3)** when it is available. If you do not start at the **ONLINE** menu, the HART fast key sequences will not function properly.

Use Table 3-1, an alphabetical listing of every on-line function, to find the corresponding HART fast key sequences. These codes are applicable only to Model 644 transmitters and the HART Communicator.

Menus and Functions

The HART Communicator is a menu driven system. Each screen provides a menu of options that can be selected as outlined above, or provides direction for input of data, warnings, messages, or other instructions.

Main Menu

When the HART Communicator is turned on, one of two menus will appear. If the HART Communicator is connected to an operating loop, the communicator will find the device and display the **ONLINE** menu (see below). If it is not connected to a loop, the communicator will indicate that no device was found. When you press **OK (F4)**, it will display the **MAIN** menu.

The **MAIN** menu provides the following options:

- *Offline*–The Offline option provides access to offline configuration data and simulation functions.
- *Online*–The Online option checks for a device and if it finds one, brings up the **ONLINE** menu.
- *Transfer*–The Transfer option provides access to options for transferring data either from the HART Communicator (memory) to the transmitter (device) or vice versa. Transfer is used to move off-line data from the HART Communicator to the transmitter, or to retrieve data from a transmitter for off-line revision.

NOTE
Online communication with the transmitter automatically loads the current transmitter data to the HART Communicator. Changes in on-line data are made active by pressing **SEND (F2)**. The transfer function is used only for off-line data retrieval and sending.

- *Frequency Device*–The Frequency Device option displays the frequency output and corresponding pressure output of current-to-pressure transmitters.
- *Utility*–The Utility option provides access to the contrast control for the HART Communicator LCD screen and to the autopoll setting used in multidrop applications.

Once selecting a **MAIN** menu option, the HART Communicator provides the information you need to complete the operation. If further details are required, consult the HART Communicator manual.

Online Menu

The **ONLINE** menu can be selected from the **MAIN** menu as outlined above, or it may appear automatically if the HART Communicator is connected to an active loop and can detect an operating transmitter.

NOTE
The **MAIN** menu can be accessed from the **ONLINE** menu. Press the left arrow action key to deactivate the on-line communication with the transmitter and to activate the **MAIN** menu options.

When configuration variables are reset in the on-line mode, the new settings are not activated until the data is sent to the transmitter. Press **SEND (F2)** when it is activated to update the process variables of the transmitter.

On-line mode is used for direct evaluation of a particular meter, re-configuration, changing parameters, maintenance, and other functions. The **ONLINE** menu displays critical, up-to-date device information including primary variable, analog output, lower range value, and upper range value.

Device Setup

The *Device setup* option provides access to the Device Setup Menu. Configurable device parameters common to all HART-compatible devices can be accessed from this menu.

Primary Variable (PV)

The **ONLINE** menu displays the dynamic primary variable and the related engineering units. When the primary variable contains too many characters to display on the **ONLINE** menu, you can access the **PV** menu to view the primary variable and related engineering units.

Analog Output (AO)

The **ONLINE** menu displays the dynamic analog output and the related engineering units. The analog output is the signal on the 4–20 mA scale that corresponds to the primary variable. When the analog output contains too many characters to display on the **ONLINE** menu, you can access the **PV AO** menu to view the analog output and related engineering units.

Lower Range Value (LRV)

The **ONLINE** menu displays the current lower range value and the related engineering units. When the lower range value contains too many characters to display on the **ONLINE** menu, you can access the **PV LRV** menu to view the lower range value and related engineering units.

Upper Range Value (URV)

The **ONLINE** menu displays the current upper range value and the related engineering units. When the upper range value contains too many characters to display on the **ONLINE** menu, you can access the **PV URV** menu to view the upper range value and related engineering units.

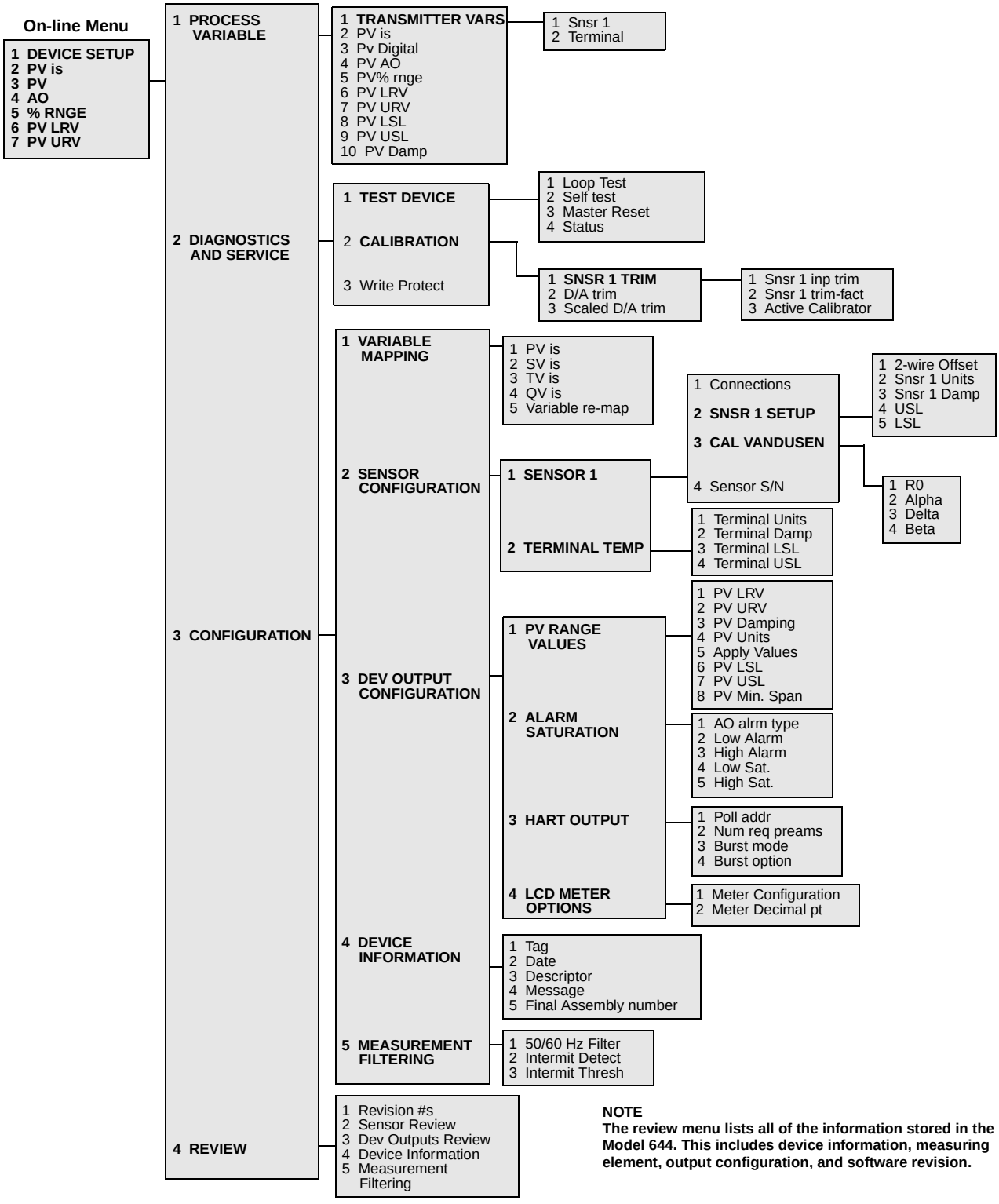
CONFIGURATION

The Model 644 transmitter can be configured either on-line or off-line. During on-line configuration, the transmitter is connected to a HART communicator. Data is entered in the working register of the communicator and sent directly to the transmitter.

Off-line configuration consists of storing configuration data in a HART Communicator while it is not connected to a transmitter. Data is stored in nonvolatile memory and can be downloaded to the transmitter at a later time.

Figure 3-6 displays a complete Model 644 menu tree for use with the Model 275 HART Communicator. Options listed in bold type indicate that a selection provides other options. For ease of operation, changing calibration and setup, such as sensor type, number of wires, and range values, can be completed in several locations.

Figure 3-6. HART Communicator Menu Tree



Fast Key Sequences

For your convenience, fast key sequences are listed for common transmitter functions.

NOTE:
The fast key sequences assume that you are using Device Descriptor Dev v5, DD v2. Some features apply only to the Model 644H, as noted in the following pages. Table 3-1 provides alphabetical function lists for all Model 275 HART Communicator tasks as well as their corresponding fast key sequences.

TABLE 3-1. Model 644 Fast Key Sequence

Function	HART Communicator Fast Keys
Active Calibrator	1, 2, 2, 1, 3
Alarm/Saturation	1, 3, 3, 2
AO Alarm Type	1, 3, 3, 2, 1
Burst Mode	1, 3, 3, 3, 3
Burst Option	1, 3, 3, 3, 4
Calibration	1, 2, 2
Callendar VanDusen	1, 3, 2, 1, 3
Configuration	1, 3
D/A Trim	1, 2, 2, 2
Damping Values	1, 1, 10
Date	1, 3, 4, 2
Descriptor	1, 3, 4, 3
Device Info	1, 3, 4
Device Output Configuration	1, 3, 3
Diagnostics and Service	1, 2
Filter 50/60 Hz	1, 3, 5, 1
Hardware Rev	1, 4, 1
Hart Output	1, 3, 3, 3
Intermittent Detect	1, 3, 5, 2
LCD Meter Options	1, 3, 3, 4
Loop Test	1, 2, 1, 1
LRV (Lower Range Value)	1, 1, 6
LSL (Lower Sensor Limit)	1, 1, 8
Measurement Filtering	1, 3, 5
Message	1, 3, 4, 4
Meter Configuring	1, 3, 3, 4, 1
Meter Decimal Point	1, 3, 3, 4, 2

Function	HART Communicator Fast Key
Num Req Preams	1, 3, 3, 3, 2
Percent Range	1, 1, 5
Poll Address	1, 3, 3, 3, 1
Process Temperature	1, 1
Process Variables	1, 1
PV Damping	1, 3, 3, 1, 4
PV Unit	1, 3, 3, 1, 3
Range Values	1, 3, 3, 1
Review	1, 4
Scaled D/A Trim	1, 2, 2, 3
Sensor Connection	1, 3, 2, 1, 1
Sensor 1 Setup	1, 3, 2, 1, 2
Sensor Serial Number	1, 3, 2, 1, 4
Sensor 1 Trim	1, 2, 2, 1
Sensor 1 Trim-Factory	1, 2, 2, 1, 2
Sensor Type	1, 3, 2, 1, 1
Software Revision	1, 4, 1
Status	1, 2, 1, 4
Tag	1, 3, 4, 1
Terminal Temperature	1, 3, 1, 2,
Test Device	1, 2, 1
URV (Upper Range Value)	1, 1, 7
USL (Upper Sensor Limit)	1, 1, 9
Variable Mapping	1, 3, 1
Variable Re-Map	1, 3, 1, 5
Write Protect	1, 2, 3
2-Wire Offset	1, 3, 2, 1, 2, 1

Review Configuration Data

Before operating the Model 644 in an actual installation, review all of the factory-set configuration data to ensure that it reflects the current application.

Review

HART Comm	1, 4

Review the transmitter configuration parameters set at the factory to ensure accuracy and compatibility with your particular application. After activating the review function, scroll through the configuration data list to check each variable. If changes to the transmitter configuration data are necessary, refer to "Configuration" below.

Check Output

Before performing other transmitter on-line operations, review the Model 644 digital output parameters to ensure that the transmitter is operating properly.

Process Variables

HART Comm	1, 1

The process variables for the Model 644 provide the transmitter output. The **PROCESS VARIABLE** menu displays process variables, including sensed temperature, percent range, analog output, and terminal temperature. These process variables are continuously updated. The primary variable is the 4–20 mA analog signal, and the secondary variable is the transmitter terminal temperature.

Configuration

The Model 644 must be configured for certain basic variables in order to be operational. In many cases, all of these variables are pre-configured at the factory. Configuration may be required if the transmitter is not configured or if the configuration variables need revision.

Variable Mapping

HART Comm	1, 3, 1

The Variable Mapping menu displays the sequence of the process variables. When using the Model 644H you can select *5 Variable Re-Map* to change this configuration. When the *Select PV* screen appears *Snsr 1* must be selected. Either *sensor 1*, *terminal temperature*, or *not used* can be selected for the remaining variables. The primary variable is the 4–20 mA analog signal.

Select Sensor Type

HART Comm	1, 3, 2, 1, 1

The *Connections* command allows you to select the sensor type and the number of sensor wires to be connected. Select from the following sensor types:

- 2-, 3-, or 4-wire Pt 100, Pt 200, Pt 500, Pt 1000 platinum RTDs: $\alpha = 0.00385\ \Omega/\Omega/°C$
- 2-, 3-, or 4-wire Pt 100: $\alpha = 0.003916\ \Omega/\Omega/°C$
- 2-, 3-, or 4-wire Ni 120 nickel RTDs
- 2-, 3-, or 4-wire Cu 10 RTDs
- IEC/NIST/DIN Type B, E, J, K, R, S, T thermocouples
- DIN type L, U thermocouples
- ASTM Type W5Re/W26Re thermocouple
- –10 to 100 millivolts
- 2-, 3-, or 4-wire 0 to 2000 ohms

A complete line of temperature sensors, thermowells, and accessory mounting hardware is available from Rosemount, Inc.

Set Output Units

HART Comm	1, 3, 2, 1, 2, 2

The *Snsr 1 Unit* command sets the desired primary variable units. Set the transmitter output to one of the following engineering units:

- Degrees Celsius
- Degrees Fahrenheit
- Degrees Rankine
- Kelvin
- Ohms
- Millivolts

LCD Meter Options (Model 644H Only)

644H HART Comm	1, 3, 3, 4

The *LCD Meter Option* command sets the meter options, including engineering units and decimal point. Change the meter settings to reflect necessary configuration parameters when adding a meter or reconfiguring the transmitter.

To customize variables that the meter displays, follow the steps below:

1. From the home screen select *1 Device Setup*, *3 Configuration*, *3 Dev Output Config*, *4 LCD Meter Options*, and *1 Meter Config*.
2. Use the F2 key to turn each of the following options **OFF** or **ON**: Sensor 1, Terminal Temp, Percent Range, Analog Output. As many outputs as desired an be turned **ON** at once.
3. Press F4, **ENTER**, and then F2, **SEND**, to send the information to the transmitter. The LCD meter will scroll through the outputs selected in step 2.

To change the decimal point configuration, perform the following steps:

1. From the home screen select *1 Device Setup*, *3 Configuration*, *3 Dev Output Config*, *4 LCD Meter Options*, and *1 Meter Decimal Pt*.
2. Choose from *Floating Precision* or *One-*, *Two-*, *Three-*, or *Four-Digit Precision* by pressing F4, **ENTER**. Press F2 to send the information to the transmitter.

50/60 Hz Filter

HART Comm	1, 3, 5, 1

The *50/60 Hz Filter* command sets the transmitter electronic filter to reject the frequency of the ac power supply in your plant.

Terminal Temperature

HART Comm	1, 3, 2, 2

The *Terminal Temp* command sets the terminal temperature units to indicate the temperature at the transmitter terminals.

Process Variable Damping

HART Comm	1, 3, 3, 1, 4

The *PV Damp* command changes the response time of the transmitter 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 your system. The default damping value is 5.0 seconds and can be reset to any value between 0 and 32 seconds.

The value chosen for damping affects the response time of the transmitter. When set to zero (or disabled), the damping function is effectively off and the transmitter output reacts to changes in input as quickly as the intermittent sensor algorithm allows (refer to Section 5: Functional Specifications for a description of the intermittent sensor algorithm). Increasing the damping value increases transmitter response time.

With damping enabled, if the temperature change is within 2 percent of the output range, the transmitter measures the change in input every 500 milliseconds and outputs values according to the following relationship:

$$\text{Damped Value} = (N - P) \times \left(\frac{2T - U}{2T + U}\right) + P$$

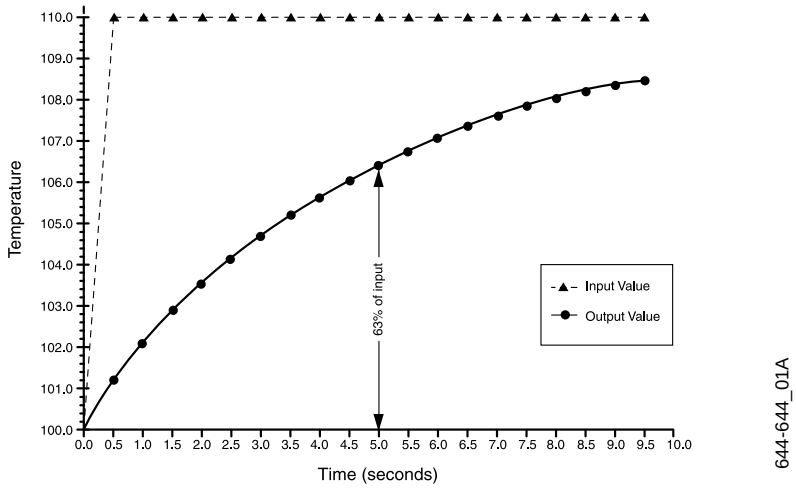
P = previous damped value
N = new sensor value
T = damping time constant
U = update rate

At the value to which the damping time constant is set, the transmitter output is at 63 percent of the input change, and it continues to approach the input according to the damping equation above.

For example, as illustrated in Figure 3-7, if the temperature undergoes a step change—within 2 percent of the output range—from 100 degrees to 110 degrees, and the damping is set to 5.0 seconds, the transmitter calculates and reports a new reading every 500 milliseconds using the damping equation. At 5.0 seconds, the transmitter outputs 106.3 degrees, or 63 percent of the input change, and the output continues to approach the input curve according to the equation above.

For information regarding the damping function when the input change is greater than 2 percent of the output range, refer to “Intermittent Sensor Algorithm and Damping” on page 1-17.

Figure 3-7. Change in Input vs. Change in Output with Damping Set to Five Seconds



2-Wire RTD Offset

HART Comm	1, 3, 2, 1, 2, 1

The 2-wire Offset command allows the user to input the measured lead wire resistance, which will result in the transmitter adjusting its temperature measurement to correct the error caused by this resistance. Due to a lack of lead wire compensation within the RTD, temperature measurement made with a 2-wire RTD are often inaccurate. See “Sensor Lead Wire Resistance Effect” on page 2-8 for more information.

To utilize this feature perform the following steps:

1. Measure the lead wire resistance of both RTD leads after installing the 2-wire RTD and the Model 644H.
2. From the HOME screen, select 1 *Device Setup*, *3 Configuration*, *2 Sensor Configuration, 1 Sensor 1, 2 Snsr 1 Setup,* and *1 2-Wire Offset*.
3. Enter the total measured resistance of the two RTD leads at the *2-Wire Offset* prompt. Enter this resistance as a negative (–) value to ensure proper adjustment.The transmitter then adjusts its temperature measurement to correct the error caused by lead wire resistance.

Information Variables

Access the transmitter information variables on-line using the HART Communicator or other suitable communications device. The following is a list of transmitter information variables. These variables include device identifiers, factory-set configuration variables, and other information. A description of each variable, the corresponding fast key sequence, and a review of its purposes are provided.

Tag

HART Comm	1, 3, 4, 1

The *Tag* variable is the easiest way to identify and distinguish between transmitters in multi-transmitter environments. Use it to label transmitters electronically according to the requirements of your application. The tag you define is automatically displayed when a HART-based communicator establishes contact with the transmitter at power-up. The tag may be up to eight characters long and has no impact on the primary variable readings of the transmitter.

Date

HART Comm	1, 3, 4, 2

The *Date* command is a 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 or the HART-based communicator.

Descriptor

HART Comm	1, 3, 4, 3

The *Descriptor* variable 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 or the HART-based communicator.

Message

HART Comm	1, 3, 4, 4

The *Message* variable 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 the other configuration data. The message variable has no impact on the operation of the transmitter or the HART-based communicator.

Sensor Serial Number

HART Comm	1, 3, 2, 1, 4

The *Sensor S/N* variable provides a location to list the serial number of the attached sensor. It is useful for identifying sensors and tracking sensor calibration information.

Test Device

HART Comm	1, 2, 1

The *Test Device* command initiates a more extensive diagnostics routine than that performed continuously by the transmitter. The *Test Device* menu lists the following options:

- *1 Loop test* verifies the output of the transmitter, the integrity of the loop, and the operations of any recorders or similar devices installed in the loop. See "Loop Test" below for more information.
- *2 Self Test* initiates a transmitter self test. Error codes are displayed if there is a problem.
- *3 Master Reset* sends out a command that restarts and tests the transmitter. A master reset is like briefly powering down the transmitter. Configuration data remains unchanged after a master reset.
- *4 Status* lists error codes. **ON** indicates a problem, and **OFF** means there are no problems.

Loop Test

HART Comm	1, 2, 1, 1

The *Loop Test* command verifies the output of the transmitter, the integrity of the loop, and the operations of any recorders or similar devices installed in the loop. To initiate a loop test, perform the following procedure:

1. Connect a reference meter to the transmitter. To do so, shunt the power to the transmitter through the meter at some point in the loop.
2. From the **HOME** screen, select *1 Device Setup*, *2 Diag/Serv*, *1 Test Device*, *1 Loop Test* before performing a loop test on the Model 644H. When using the Model 644R, select *1 Device Setup*, *2 Diagnostics and Service, 2 Loop Test*. Select **OK** after you set the control loop to manual. The communicator displays the loop test menu.
3. Select a discreet milliampere level for the transmitter to output. At the **CHOOSE ANALOG OUTPUT** prompt, select *1 4mA*, *2 20mA*, or select *3 other* to manually input a value between 4 and 20 milliamperes.
4. Check the current meter installed in the test loop to verify that it reads the value you commanded the transmitter to output. If the readings do not match, either the transmitter requires an output trim or the current meter is malfunctioning.

After completing the test procedure, the display returns to the loop test screen and allows you to choose another output value.

Active Calibrator

HART Comm	1, 2, 2, 1, 3

The *Active Calibrator Mode* command enables or disables the pulsating current feature. The transmitter ordinarily operates with pulsating current so that open sensor conditions can be safely detected, but some calibration equipment requires steady current to function properly. The transmitter automatically defaults to Active Calibrator Mode whenever performing a sensor trim. When the sensor trim is complete, the transmitter will automatically return Active Calibrator mode to the configuration used prior to the sensor trim. The Active Calibrator Mode is volatile and will automatically be disabled when power is cycled or when a Master Reset is performed using the HART communicator.

Signal Condition

HART Comm	1, 4, 2

The *Signal Condition* command allows you to view or change primary variable lower and upper range values, sensor percent range, and sensor damping.

Alarm and Saturation

HART Comm	1, 3, 3, 2

The *Alarm / Saturation* command allows you to view the alarm settings (Hi or Low). With this command you can also change the alarm and saturation values. To change the alarm values and saturation values, select the value you want to change, either *2 Low Alarm*, *3 High Alarm*, *4 Low Sat.*, or *5 High Sat*. Enter the desired new value. It must fall within the guidelines given below.

- The low alarm value must be between 3.30 and 3.75 mA
- The high alarm value must be between 21.0 and 23.0 mA
- The low saturation level must be between the low alarm value plus 0.1 mA and 3.9 mA.

  Example: The low alarm value has been set to 3.7 mA. Therefore, the low saturation level, S, must be as follows: $3.8 \leq S \leq 3.9$ mA.
- The high saturation level must be between 20.5 mA and the high alarm value minus 0.1 mA.

  Example: The high alarm value has been set to 20.8 mA. Therefore, the low saturation level, S, must be as follows: $20.5 \leq S \leq 20.7$ mA.

HART Output

HART Comm	1, 3, 3, 3

The *HART Output* command allows you to make changes to the multidrop address, specify the number of requested preambles, initiate burst mode, or make changes to the burst options.

Transmitter Security

HART Comm	1, 2, 3

After configuring a transmitter, you may want to protect the configuration data from unwarranted changes. The Model 644 software is equipped with a software security function that allows you to protect the transmitter configuration data. Use the following instructions to enable and disable this function electronically.

The *Write Protect* command allows you to protect the transmitter configuration data from accidental or unwarranted changes. To enable the write protect feature, perform the following procedure:

1. From the **HOME** screen select *1 Device Setup*, *2 Diag/Service*, *3 Write Protect*.
2. Select *Enable WP*.

NOTE
To disable write protect on the Model 644, repeat the procedure, replacing *Enable WP* with *Disable WP*.

Rerange

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

The rerange functions should not be confused with the trim functions. 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.

PV Range Values

HART Comm	1, 3, 3, 1

The *PV URV* and *PV LRV* commands, found in the *PV Range Values* menu screen, allow you to set the transmitter's lower and upper range values using limits of expected readings. See Table 5-1 on page 1-6 for unit and range setting limits. The range of expected readings is defined by the Lower Range Value (LRV) and Upper Range Value (URV). You may reset the transmitter range values as often as necessary to reflect changing process conditions. From the *PV Range Values* screen select *1 PV LRV* to change the lower range value and *2 PV URV* to change the upper range value.

Calibration

Calibrating the transmitter increases the precision of your 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 understand that smart transmitters operate differently from analog transmitters. An important difference is that smart transmitters are factory-characterized; they are shipped with a standard sensor curve stored in the transmitter firmware. In operation, the transmitter uses this information to produce a process variable output, in engineering units, dependent on the sensor input. The trim functions allow you to make corrections to the factory-stored characterization curve by digitally altering the transmitter's interpretation of the sensor input.

The trim functions should not be confused with the rerange functions. Although the rerange command 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.

Deciding Which Trim Procedure to Use

Sensor Trim

Perform a sensor trim if the transmitters digital value for the primary variable does not match that of your plant standard calibration equipment. The sensor trim function calibrates the sensor to the transmitter in temperature units or raw units. Unless your site-standard input source is NIST-traceable, the trim functions will not maintain the NIST-traceability of your system.

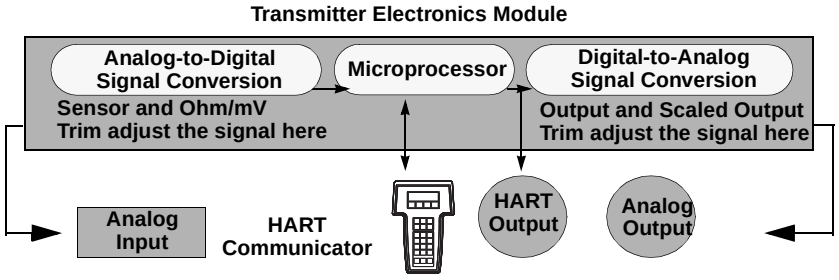
Transmitter-Sensor Matching

Perform the sensor matching procedure to enhance the temperature measurement accuracy of your system and if you have a sensor with Callendar-Van Dusen constants. Sensors with Callendar-Van Dusen constants are NIST-traceable when ordered from Rosemount Inc.

Output Trim or Scaled Output Trim

Perform an output trim or a scaled output trim if the digital value for the primary variable matches your plant standard, but the transmitter's analog output does not match the reading on your output device. The output trim function calibrates the transmitter 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 (see "Loop Test" on page 3-17).

Figure 3-8. Dynamics of Smart Temperature Measurement



Sensor Trim

HART Comm	1, 2, 2, 1, 1

The *Sensor Trim* command allows you to digitally alter the transmitter's interpretation of the input signal (see Figure 3-8). The sensor reference command 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 trimming is suitable for validation procedures or for applications that require calibrating the sensor and transmitter together.

To perform a sensor trim with a Model 644H, use the following procedure:

1. Connect the calibration device or sensor to the transmitter. Refer to Figure 2-7 on page 1-8 or inside of the transmitter terminal side cover for sensor wiring diagrams.
2. Connect the communicator to the transmitter loop.
3. From the Home screen, select *1 Device Setup*, *2 Diag/Service*, *2 Calibration*, *1 Sensor 1 Trim*, *1 Sensor 1 inp trim* to prepare to trim the sensor.
4. Select **OK** after you set the control loop to manual.
5. Select the appropriate sensor trim units at the **ENTER SNSR 1 TRIM UNITS** prompt.
6. Select *1 Lower Only* or *2 Lower and Upper* at the **SELECT SENSOR TRIM POINTS** prompt.
7. Adjust the calibration device to the desired trim value (must be within the selected sensor limits). If you are trimming a combined sensor and transmitter system, expose the sensor to a known temperature and allow the temperature reading to stabilize. Use a bath, furnace or isothermal block, measured with a site-standard thermometer, as the known temperature source.
8. Select **OK** once the temperature stabilizes.

The communicator displays the output value the transmitter associates with the input value provided by the calibration device.

9. Enter the lower or upper trim point, depending on your selection in Step 6.

The trim functions should not be confused with the rerange functions. Although the rerange command 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.

Transmitter-Sensor Matching

The Model 644 accepts Callendar-Van Dusen constants from a calibrated RTD schedule and generates a special custom curve to match that specific sensor curve. Matching the specific sensor curve with the transmitter significantly enhances the temperature sensor measurement accuracy. See the comparison below:

System Accuracy Comparison at 150 °C Using a PT 100 (α=0.00385) RTD with a Span of 0 to 200 °C			
Standard RTD		Matched RTD	
Model 644H	±0.15 °C	Model 644H	±0.15 °C
Standard RTD	±1.05 °C	Matched RTD	±0.18 °C
Total System(1)	±1.06 °C	Total System(1)	±0.23 °C

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

$$TotalSystemAccuracy = \sqrt{(TransmitterAccuracy)^2 + (SensorAccuracy)^2}$$

The following input constants, included with specially-ordered Rosemount temperature sensors, are required:

R_0 = Resistance at Ice Point
Alpha = Sensor Specific Constant
Beta = Sensor Specific Constant
Delta = Sensor Specific Constant

To input Callendar-Van Dusen constants, perform the following procedure:

1. From the **HOME** screen, select *1 Device Setup*, *3 Configuration*, *2 Sensor Config*, *1 Sensor 1*, *1 Connections*. Select **OK** after you set the control loop to manual.
2. Select *Cal VanDusen* at the **ENTER SENSOR TYPE** prompt.
3. Select the appropriate number of wires at the **ENTER SENSOR CONNECTION** prompt.
4. Enter the R_o, Alpha, Delta, and Beta values from the stainless steel tag attached to the special-order sensor when prompted.
5. Select **OK** after you return the control loop to automatic control.

To disable the transmitter-sensor matching feature from the **HOME** screen select *1 Device Setup*, *3 Configuration*, *2 Sensor Config*, *1 Sensor 1*, *1 Connections*. Choose the appropriate sensor type from the **ENTER SENSOR TYPE** prompt.

NOTE
When you disable transmitter-sensor matching, the transmitter reverts to either user or factory trim, whichever was used previously. Make certain the transmitter engineering units default correctly before placing the transmitter into service.

Callendar Van-Dusen constants can be viewed anytime by making the following selections:

- From the Home screen select *1 Device Setup*, *3 Configuration*, *2 Sensor Config*, *1 Sensor 1*, *3 Cal VanDusen*.

Output Trim

HART Comm	1, 2, 2, 3

The *D/A Trim* command allows you to alter the transmitter's conversion of the input signal to a 4–20 mA output (see Figure 3-8 on page 3-20). Adjust the analog output signal at regular intervals to maintain measurement precision. To perform a digital-to-analog trim, perform the following procedure:

1. From the **HOME** screen, select *1 Device setup*, *2 Diag/Service*, *2 Calibration*, *2 D/A trim*. Select **OK** after you set the control loop to manual.
2. Connect an accurate reference meter to the transmitter at the **CONNECT REFERENCE METER** prompt. To do so, shunt the power to the transmitter through the reference meter at some point in the loop. Select **OK** after connecting the reference meter.
3. Select **OK** at the **SETTING FLD DEV OUTPUT TO 4 MA** prompt. The transmitter outputs 4.00 mA.
4. Record the actual value from the reference meter, and enter it at the **ENTER METER VALUE** prompt. The communicator prompts you to verify whether or not the output value equals the value on the reference meter.
5. If the reference meter value equals the transmitter output value, then select *1 Yes* and go to step 6. If the reference meter value does not equal the transmitter output value, then select *2 No* and go to step 4.
6. Select **OK** at the **SETTING FLD DEV OUTPUT TO 20 MA** prompt and repeat steps 4 and 5 until the reference meter value equals the transmitter output value.
7. Select **OK** after you return the control loop to automatic control.

Scaled Output Trim

HART Comm	1, 2, 2, 4

The *Scaled D/A Trim* command matches the 4 and 20 mA points to a user-selectable reference scale other than 4 and 20 mA (2–10 volts, for example). To perform a scaled D/A trim, connect an accurate reference meter to the transmitter and trim the output signal to scale as outlined in the "Output Trim" procedure.

Multidrop Communication

Multidropping refers to the connection of several transmitters to a single communications transmission line. Communication between the host and the transmitters takes place digitally with the analog output of the transmitters deactivated. Many of the Rosemount SMART FAMILY® transmitters can be multidropped. With the HART communications protocol, up to 15 transmitters can be connected on a single twisted pair of wires or over leased phone lines.

The application of a multidrop installation requires consideration of the update rate necessary from each transmitter, the combination of transmitter models, and the length of the transmission line. Each transmitter is identified by a unique address (1–15) and responds to the commands defined in the HART protocol.

Figure 3-9. Typical Multidropped Network

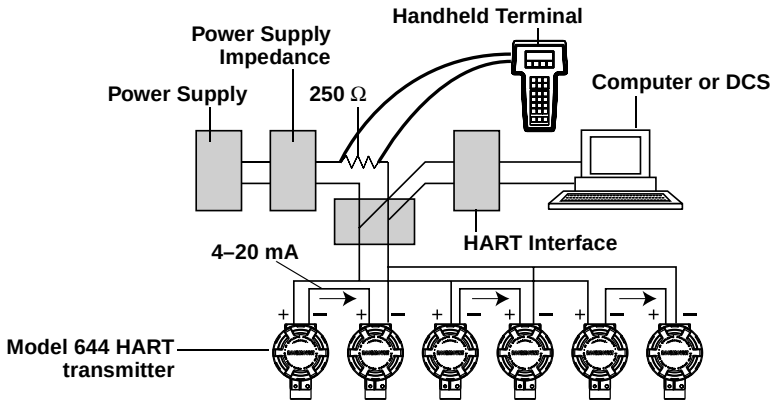


Figure 3-9 shows a typical multidrop network. Do not use this figure as an installation diagram. Contact Rosemount product support with specific requirements for multidrop applications.

A HART-based communicator can test, configure, and format a multidropped Model 644 transmitter in the same way as in a standard point-to-point installation.

NOTE
Model 644 transmitters are set to address 0 at the factory, allowing them to operate in the standard point-to-point manner with a 4–20 mA output signal. To activate multidrop communication, the transmitter address must be changed to a number between 1 and 15. This change deactivates the 4–20 mA analog output, sending it to 4 mA. The failure mode current also is disabled.

INTERMITTENT SENSOR ALGORITHM

The electronics of the Model 644 transmitter contains an intermittent sensor algorithm that monitors the input signal during operation. The signal diagnostics routine, which occurs at each temperature update (every 500 milliseconds), eliminates output pulsing in an intermittent open sensor condition. Further, it validates the input signal before the digital-to-analog (D/A) conversion takes place.

If the process temperature changes, the intermittent sensor algorithm causes the transmitter to respond according to one of the three cases described below. *Threshold value* is the maximum change in reading (as a percentage of output range) within one update cycle (500 ms). The default threshold value is 2% of output range and can be specified in the field using a HART Communicator.

Case Examples

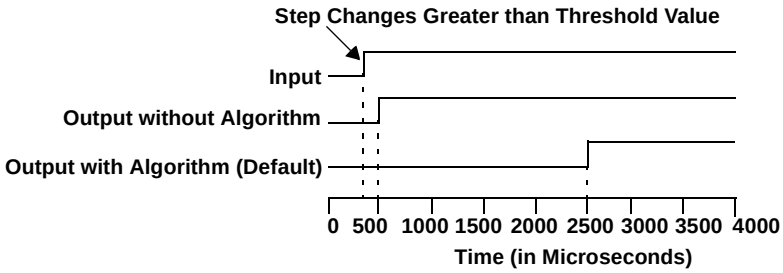
Case 1: Open Sensor

If the algorithm detects an open sensor, the transmitter immediately goes into alarm (high or low, depending on the position of the failure mode switch).

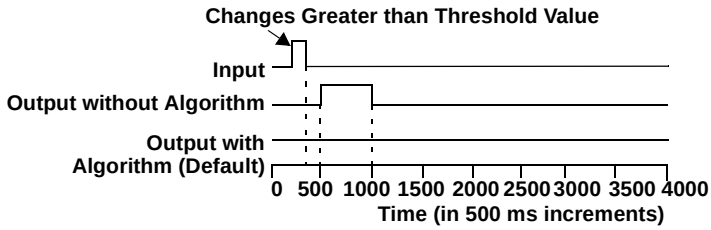
Case 2: Temperature Change Greater than the Threshold Value

If the algorithm detects a process temperature change (ΔT) greater than the threshold value, but which is not a true open sensor condition, the transmitter will go into a hold period. During the hold period, the transmitter determines whether or not this temperature measurement is valid by using the three additional measurement points. In the meantime, the output remains unchanged at the initial reading (Time = 0 ms).

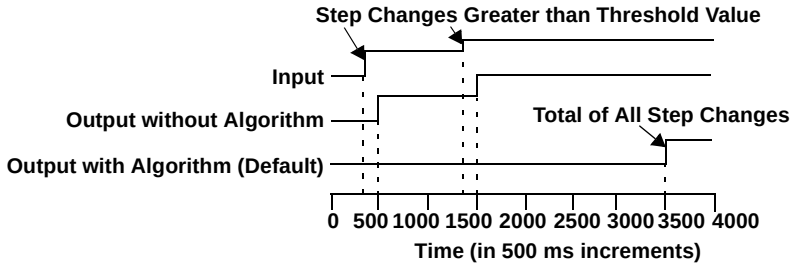
A) If these next three readings are within the new threshold value (at Time = 500 ms), this measurement is validated. The output changes to reflect this and the transmitter is no longer in a hold period. In this case, the output delay is 1.75 to 2.00 seconds.



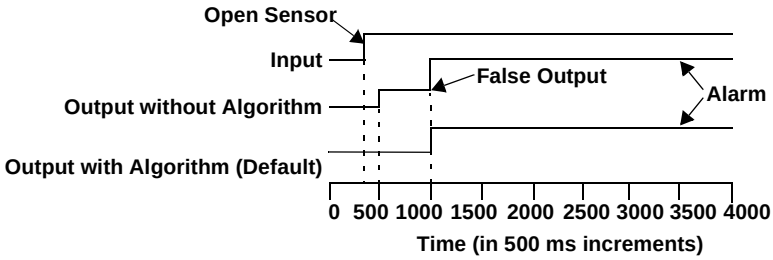
B) If the reading drops back within the original threshold value (at Time = 0 ms) during the hold period, the transmitter interprets the reading(s) outside the threshold value as a spike, and the output changes to reflect the latest reading. The transmitter is no longer in a hold period, and the spike is not seen at the output.



C) If any of the next three measurements is outside the new threshold value (at Time = 500 ms), the output remains unchanged at the initial reading (Time = 0 ms). the transmitter remains in a hold period until four consecutive measurements are within the threshold value of the first in the series.



D) If an open sensor is validated at the end of the first update cycle (Time = 500 ms), the output will go directly to alarm level. The original spike (at Time = 0 ms) will not be seen at the output.



Case 3: Temperature Change Within the Threshold Value

If the transmitter detects an input change that is within the threshold value, it reports the new value within one output cycle (500 ms).

Intermittent Sensor Algorithm and Damping

If the transmitter has both intermittent sensor detect and damping enabled, the output reading is calculated by the following formula:

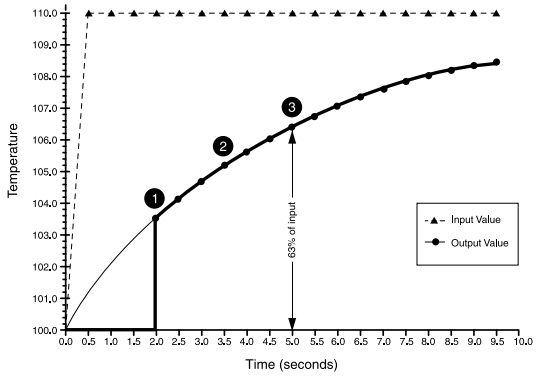
$$\text{Damped Value} = (P - N) \times \left(\frac{2T - U}{2T + U}\right) + N$$

P = previous damped value
N = new sensor value
T = damping time constant
U = update rate

The transmitter outputs the corresponding value on the damping curve within 1.75 to 2.0 seconds and updates the output reading every 500 ms thereafter, according to the damping equation above. At the value to which the damping time constant is set, the transmitter output is at 63% of the input change.

Figure 5-2 illustrates an example of intermittent sensor detect with damping enabled. If the temperature undergoes a step change greater than the threshold value, or from 100 degrees to 110 degrees, and the damping is set to 5.0 seconds, the transmitter calculates a new reading every 500 ms using the damping equation, but holds the output at 100 degrees for between 1.7 and 2.0 seconds. Within 1.75 and 2.0 seconds, the transmitter outputs the reading that corresponds to the damping curve at that time (❶), and continues to calculate and update the output reading every 500 ms thereafter (❷) according to the damping equation. After 5 seconds, the transmitter outputs 106.3 degrees, or 63% of the input change (❸), and the output continues to approach the input curve according to the equation above.

NOTE
If the damping time constant is set between 0 and 2 seconds, the transmitter does not report the output change until the intermittent sensor algorithm validates the input signal. After validating the input signal, the transmitter outputs the value that corresponds to the damping curve at that time.



644-644_02A

Figure 3-10. Damping Function when Input Change is Greater Than the Threshold Value

Intermittent Sensor Detect (Advanced Feature)

The Intermittent Sensor Detect feature is designed to guard against process temperature readings caused by intermittent open sensor conditions (an *intermittent* sensor condition is an open sensor condition that lasts less than 0.7 seconds). By default, the transmitter is shipped with the Intermittent Sensor Detect feature switched **ON** and the threshold value set at 2% of output range. The Intermittent Sensor Detect feature can be switched **ON** or **OFF** and the threshold value can be changed to any value between 0 and 100% of the output range with a HART communicator.

Transmitter Behavior with Intermittent Sensor Detect ON

When the Intermittent Sensor Detect feature is switched **ON**, the transmitter can eliminate the output pulse caused by intermittent open sensor conditions. Process temperature changes (ΔT) within the threshold value will be tracked normally by the transmitter's output. A ΔT greater than the threshold value will activate the intermittent sensor algorithm. True open sensor conditions will cause the transmitter to go into alarm. A detailed description of the intermittent sensor algorithm can be found under "Intermittent Sensor Algorithm" on page 5-15.

The threshold value of the Model 644H should be set at a level that allows the normal range of process temperature fluctuations; too high and the algorithm will not be able to filter out intermittent conditions; too low and the algorithm will be activated unnecessarily. The default threshold value is 2% of the output range.

Transmitter Behavior with Intermittent Sensor Detect OFF

When the Intermittent Sensor Detect feature is switched **OFF**, the transmitter tracks all process temperature changes, even if they are the consequence of an intermittent sensor. (The transmitter in effect behaves as though the threshold value had been set at 100%.)
The output delay due to the intermittent sensor algorithm will be eliminated.

Implementation

The following steps indicate how to turn the Intermittent Sensor Detect feature **ON** or **OFF** when the transmitter is connected to a Model 275 HART Communicator:

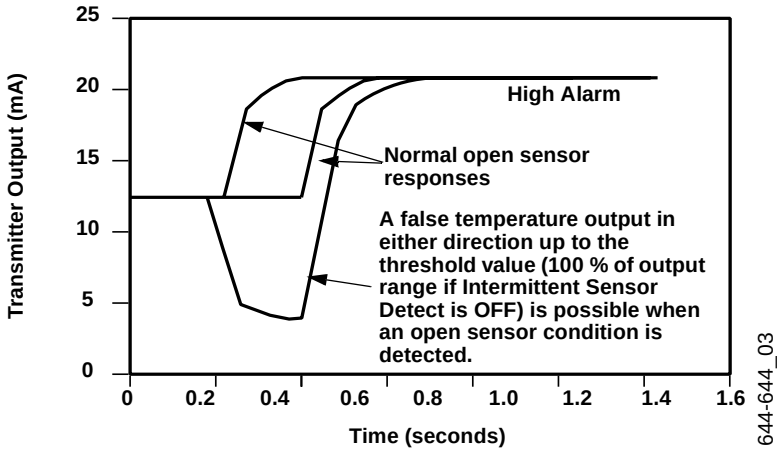
1. Select *1 Device Setup*
2. Select *3 Configuration*
3. Select *5 Measurement Filtering*
4. Select *2 Intermit Detect*
5. Choose **ON** or **OFF**.
   ON is the normal setting.

The threshold value can be changed from the default value of 2% by proceeding with the following steps:

1. Select *1 Device Setup*
2. Select *3 Configuration*
3. Select *5 Measurement Filtering*
4. Select *3 Intermit Thresh*

Turning the Intermittent Sensor Detect feature **OFF** or leaving it **ON** and increasing the threshold value above the default does not affect the time needed for the transmitter to output the correct alarm signal after detecting a true open sensor condition. However, the transmitter may briefly output a false temperature reading for less than 0.5 seconds in either direction (see Figure 5-3) up to the threshold value (100% of output range) if Intermittent Sensor Detect is **OFF**.

Figure 3-11. Open Sensor Response (Three Cases)



Unless rapid response rate is necessary, the suggested setting of the Intermittent Sensor Detect mechanism is **ON**.

Section 4

Hardware and Software Maintenance and Troubleshooting

SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠WARNING

Explosions could result in death or serious injury.

- Do not remove the enclosure covers in an explosive atmosphere when the circuit is live.
- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive wiring practices.
- Enclosure covers must be fully engaged to meet explosion-proof requirements.

Exposure to hazardous substances can cause death or serious injury.

- If a hazardous substance is identified, a Material Safety Data Sheet (MSDS), required by law to be available to people exposed to specific hazardous substances, must be included with the returned materials.

Process leaks could result in death or serious injury.

- Install and tighten thermowells or sensors before applying pressure, or process leakage may result.
- Do not remove the thermowell while in operation. Removing while in operation may cause process fluid leaks.

Electrical shock could cause death or serious injury. Under certain fault conditions, high voltage may be present on transmitter leads and wires.

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

HARDWARE MAINTENANCE

The Model 644H has no moving parts and require minimal scheduled maintenance. If you suspect a malfunction, check for an external cause before performing the diagnostics tests discussed later in this section.

Sensor Checkout

To determine whether the sensor is at fault, replace it with another sensor or connect a test sensor locally at the transmitter to test remote sensor wiring. Select any standard, off-the-shelf sensor for use with a Model 644, or consult the factory for a replacement special sensor and transmitter combination.

Return of Materials

If you must, return failed transmitters or parts to a Rosemount Service Center for inspection, repair, or replacement, call the Rosemount North American Response Center toll-free at 800-654-RSMT (7768) (USA). This center, available 24 hours a day, will assist you with any needed information or materials.

The center will ask for product model and serial numbers, and will provide a Return of Material Authorization (RMA) number. The center will also ask for the last process material to which the product was exposed, and will detail the additional information and procedures necessary to return goods exposed to hazardous substances. If you wish to have a failure analysis performed, the center will ask for additional application information.

In all other world areas, return the transmitter to your nearest Rosemount representative or service center.

DIAGNOSTIC MESSAGES

Hardware

If you suspect a malfunction despite the absence of diagnostics messages on the HART Communicator display, follow the procedures described in Table 4-1 to verify that transmitter hardware and process connections are in good working order. Under each of four major symptoms, specific suggestions are offered for solving the problem.

TABLE 4-1. Model 644H
Troubleshooting Chart

Symptom	Potential Source	Corrective Action
Transmitter Does Not Communicate with HART Communicator	Loop Wiring	• Check the revision level of the transmitter device descriptors (DDs) stored in the communicator. The communicator should report Dev v5, DD v2. • Check for a minimum of 250 ohms resistance between the power supply and HART-based communicator connection. • Check for adequate voltage to the transmitter. If a HART-based communicator is connected and 250 ohms resistance is in the loop, the transmitter requires a minimum of 12.0 V at the terminals to operate (over entire 3.75 to 23 mA operating range). • Check for intermittent shorts, open circuits, and multiple grounds. • Specify the transmitter by tag number. For certain non-standard transmitter installations, it may be necessary, because of excessive line length, to specify the transmitter tag number to initiate communications.
High Output	Sensor Input Failure or Connection	• Connect a HART-based communicator and enter the transmitter test mode to isolate a sensor failure. • Check for a sensor open or short circuit. • Check the process variable to see if it is out of range.
	Loop Wiring	• Check for dirty or defective terminals, interconnecting pins, or receptacles.
	Power Supply	• Check the output voltage of the power supply at the transmitter terminals. It should be 12.0 to 42.4 V dc (over entire 3.75 to 23 mA operating range).
	Electronics Module	• Connect a HART-based communicator and enter the transmitter status mode to isolate module failure. • Connect a HART-based communicator and check the sensor limits to ensure calibration adjustments are within the sensor range.
Erratic Output	Loop Wiring	• Check for adequate voltage to the transmitter. It should be 12.0 to 42.4 V dc at the transmitter terminals (over entire 3.75 to 23 mA operating range). • Check for intermittent shorts, open circuits, and multiple grounds. • Connect a HART-based communicator and enter the Loop test mode to generate signals of 4 mA, 20 mA, and user-selected values.
	Electronics Module	• Connect a HART-based communicator and enter the Transmitter test mode to isolate module failure.
Low Output or No Output	Sensor Element	• Connect a HART-based communicator and enter the Transmitter test mode to isolate a sensor failure. • Check the process variable to see if it is out of range.
	Loop Wiring	• Check for adequate voltage to the transmitter. It should be 12.0 to 42.4 V dc (over entire 3.75 to 23 mA operating range). • Check for shorts and multiple grounds. • Check for proper polarity at the signal terminal. • Check the loop impedance. • Connect a HART-based communicator and enter the Loop test mode. • Check wire insulation to detect possible shorts to ground.
	Electronics Module	• Connect a HART-based communicator and check the sensor limits to ensure calibration adjustments are within the sensor range. • Connect a HART-based communicator and enter the Transmitter test mode to isolate an electronics module failure.

Model 275 HART Communicator

Table 4-2 provides a guide to diagnostic messages used by the Model 275 HART Communicator (HC).

Variable parameters within the text of a message are indicated with the notation <*variable parameter*>. Reference to the name of another message is identified by the notation *[another message]*.

TABLE 4-2. Model 275 HART Diagnostics Messages

Message	Description
Add item for ALL device types or only for this ONE device type	Asks the user whether the hot key item being added should be added for all device types or only for the type of device that is connected.
Command Not Implemented	The connected device does not support this function.
Communication Error	Either a device sends back a response indicating that the message it received was unintelligible, or the HC cannot understand the response from the device.
Configuration memory not compatible with connected device	The configuration stored in memory is incompatible with the device to which a transfer has been requested.
Device Busy	The connected device is busy performing another task.
Device Disconnected	Device fails to respond to a command.
Device write protected	Device is in write-protect mode. Data can not be written.
Device write protected. Do you still want to shut off?	Device is in write-protect mode. Press YES to turn the HC off and lose the unsent data.
Display value of variable on hotkey menu?	Asks whether the value of the variable should be displayed adjacent to its label on the hotkey menu if the item being added to the hotkey menu is a variable.
Download data from configuration memory to device	Prompts user to press SEND softkey to initiate a memory to device transfer.
Exceed field width	Indicates that the field width for the current arithmetic variable exceeds the device- specified description edit format.
Exceed precision	Indicates that the precision for the current arithmetic variable exceeds the device- specified description edit format.
Ignore next 50 occurrences of status?	Asked after displaying device status. Softkey answer determines whether next 50 occurrences of device status will be ignored or displayed.
Illegal character	An invalid character for the variable type was entered.
Illegal date	The day portion of the date is invalid.
Illegal month	The month portion of the date is invalid.
Illegal year	The year portion of the date is invalid.
Incomplete exponent	The exponent of a scientific notation floating point variable is incomplete.
Incomplete field	The value entered is not complete for the variable type.
Looking for a device	Polling for multidropped devices at addresses 1–15.
Mark as read only variable on hotkey menu?	Asks whether the user should be allowed to edit the variable from the hotkey menu if the item being added to the hotkey menu is a variable.
No device configuration in configuration memory	There is no configuration saved in memory available to re-configure off-line or transfer to a device.
No Device Found	Poll of address zero fails to find a device, or poll of all addresses fails to find a device if auto-poll is enabled.
No hotkey menu available for this device.	There is no menu named “hotkey” defined in the device description for this device.
No offline devices available.	There are no device descriptions available to be used to configure a device offline.
No simulation devices available.	There are no device descriptions available to simulate a device.
No UPLOAD_VARIABLES in ddl for this device	There is no menu named “upload_variables” defined in the device description for this device. This menu is required for offline configuration.
No Valid Items	The selected menu or edit display contains no valid items.
OFF KEY DISABLED	Appears when the user attempts to turn the HC off before sending modified data or before completing a method.
Online device disconnected with unsent data. RETRY or OK to lose data.	There is unsent data for a previously connected device. Press RETRY to send data, or press OK to disconnect and lose unsent data.
Out of memory for hotkey configuration. Delete unnecessary items.	There is no more memory available to store additional hotkey items. Unnecessary items should be deleted to make space available.

Message	Description
Overwrite existing configuration memory	Requests permission to overwrite existing configuration either by a device-to-memory transfer or by an offline configuration. User answers using the softkeys.
Press OK.	Press the OK softkey. This message usually appears after an error message from the application or as a result of HART communications.
Restore device value?	The edited value that was sent to a device was not properly implemented. Restoring the device value returns the variable to its original value.
Save data from device to configuration memory	Prompts user to press SAVE softkey to initiate a device-to-memory transfer.
Saving data to configuration memory.	Data is being transferred from a device to configuration memory.
Sending data to device.	Data is being transferred from configuration memory to a device.
There are write only variables which have not been edited. Please edit them.	There are write-only variables which have not been set by the user. These variables should be set or invalid values may be sent to the device.
There is unsent data. Send it before shutting off?	Press YES to send unsent data and turn the HC off. Press NO to turn the HC off and lose the unsent data.
Too few data bytes received	Command returns fewer data bytes than expected as determined by the device description.
Transmitter Fault	Device returns a command response indicating a fault with the connected device.
Units for <variable label> has changed. Unit must be sent before editing, or invalid data will be sent.	The engineering units for this variable have been edited. Send engineering units to the device before editing this variable.
Unsent data to online device. SEND or LOSE data	There is unsent data for a previously connected device which must be sent or thrown away before connecting to another device.
Use up/down arrows to change contrast. Press DONE when done.	Gives direction to change the contrast of the HC display.
Value out of range	The user-entered value is either not within the range for the given type and size of variable or not within the min/max specified by the device.
<message> occurred reading/writing <variable label>	Either a read/write command indicates too few data bytes received, transmitter fault, invalid response code, invalid response command, invalid reply data field, or failed pre- or post-read method; or a response code of any class other than SUCCESS is returned reading a particular variable.
<variable label> has an unknown value. Unit must be sent before editing, or invalid data will be sent.	A variable related to this variable has been edited. Send related variable to the device before editing this variable.

LCD Meter

In addition to the output, the LCD meter displays abbreviated diagnostic messages for troubleshooting the transmitter. To determine the cause of a message, use a Model 275 HART Communicator to further interrogate the transmitter. A description of each diagnostic message is identified in Table 4-3. The device sometimes requires additional interrogation to determine the source of the warning. Contact Rosemount Customer Central at (800) 999-9307 or your local Rosemount support center for further information.

TABLE 4-3. LCD Meter Diagnostics

ALARM	Description
DEV FAIL	The top line of the display scrolls through the following three messages: • "BAD" • "DEV" • "FAIL" This message indicates one of several conditions. For example, the transmitter may have experienced an electronics failure while attempting to store information. If diagnostics indicate an electronics failure, replace the transmitter with a new one. Contact the nearest Rosemount Field service Center if necessary.
SNSR FAIL	The top line of the display scrolls through the following three messages: • "BAD" • "SNSR" • "FAIL" The bottom line display s the name of the sensor that has failed. This message indicates that the transmitter has detected an open or shorted sensor condition. The sensor may be disconnected, connected improperly, or malfunctioning. Check the sensor connections and sensor continuity.
UNCRN	The top line of the display alternates between "UNCRN" and the sensor value. The bottom line will display the name of the sensor for which this message applies. The uncertain message is displayed when the sensor reading is outside of the acceptable temperature range for the particular sensor type.
FIXED	During a loop test or a a 4–20 mA output trim, the analog output defaults to a fixed value. The top line of the display alternates between "FIXED" and the amount of current selected in milliamperes. The bottom line will hold on "AO mA."
OFLOW	The location of the decimal point, as configured in the meter setup, is not compatible wit the value to be displayed by the meter. For example, if the meter is measuring a process temperature greater than 9.9999 degrees and the meter decimal point is set to 4-digit precision, the meter will display an "OFLOW" message because it is only capable of displaying a maximum of 9.9999 when set to 4-digit precision.
ALARM	When a failure occurs and the meter is configured to display Primary Variable Percent of Range and/or Analog Output, the top line o the meter will display "ALARM." This indicates that the transmitter is in failure mode.
SAT	When the transmitter output saturates and the meter is configured to display Primary Variable Percent of Range and/or Analog Output, the top line of the meter will display "SAT." This indicates that the transmitter output has reached saturation level.

Appendix A Reference Data

SPECIFICATIONS

Functional

Inputs
User-selectable; sensor terminals rated to 42.4 V dc. See Table A-2 on page A-3

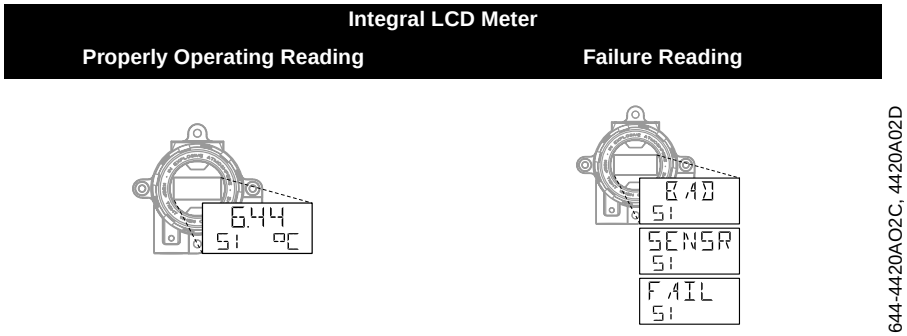
Output
2-wire 4–20 mA, linear with temperature or input; digital output signal superimposed on 4–20 mA signal, available for a HART communicator or control system interface

Isolation
Input/output isolation tested to 500 V ac rms (707 V dc) at 50/60 Hz

Humidity Limits
0–99% relative humidity, non-condensing

Local Display
The optional five-digit integral LCD meter includes a floating or fixed decimal point. It also displays options for engineering units (°F, °C, °R, K, Ω, and millivolts), milliamperes, and percent of span. The display can be configured to alternate between selected display options. Display settings are preconfigured at the factory according to the standard transmitter configuration. They can be reconfigured in the field using a HART Communicator. Figure A-1 illustrates the temperature display when the transmitter and sensor are working properly and when a sensor failure occurs.

Figure A-1. Local Display



Turn-on Time

Performance within specifications is less than 5.0 seconds after power is applied to transmitter when damping value is set to zero seconds

Update Time

Approximately 0.5 seconds

Power Supply

An external power supply is required. The transmitter operates on 12.0 to 42.4 V dc transmitter terminal voltage with load resistance between 250 and 1100 ohms. A minimum of 17.75 V dc power supply is required with a load of 250 ohms. Transmitter power terminals are rated to 42.4 V dc.

NOTE

A HART Communicator requires a loop resistance between 250 and 1100 ohms. Do not communicate with the transmitter when power is below 12 V dc at the transmitter terminals.

Temperature Limits

Status	Operating Limit		Storage Limit	
	°F	°C	°F	°C
With LCD Meter	–4 to 185	–20 to 85	–50 to 185	–45 to 85
Without LCD Meter	–40 to 185	–40 to 85	–58 to 248	–50 to 120

Transient Protection

Install the Model 644H transmitter into a suitable connection head with the Rosemount Model 470 Transient Protector. The Model 470 prevents damage from transients induced by lightning, welding, heavy electrical equipment, or switch gears. Refer to the Model 470 Product Data Sheet (document number 00813-0100-4191) for more information.

Failure Mode

The Model 644 transmitters feature software driven alarm diagnostics. The independent circuit is designed to provide backup alarm output in case of microprocessor hardware or software failure. The alarm levels are user selectable by the failure mode jumper. In case of alarm, the position of the jumper determines the direction in which the output is driven (HI or LO). The jumper switch feeds into the digital-to-analog (D/A) converter, which drives the proper alarm output even if the microprocessor fails. The values at which the transmitter drives its output in failure mode depends on whether it is configured to standard, NAMUR-compliant (NAMUR recommendation NE 43, June 1997), or custom operation. The values for standard and NAMUR-compliant operation are as follows:

TABLE A-1. Standard and NAMUR-Compliant Operation Parameters

	Standard	NAMUR-Compliant
Linear Output:	3.9 ≤ I ≤ 20.5 mA	3.8 ≤ I ≤ 20.5 mA
Fail high:	21.0 ≤ I ≤ 23.0 mA (Default)	21.0 ≤ I ≤ 23.0 mA
Fail low:	I ≤ 3.75 mA	I ≤ 3.6 mA

Custom Alarm and Saturation Levels

Custom factory configuration of alarm and saturation level is available with option code C1. These values can also be configured in the field using a HART Communicator.

Performance

The Model 644 transmitters maintain a specification conformance of at least 3σ.

Accuracy

TABLE A-2. Model 644 Input Options and Accuracy.

Sensor Options	Sensor Reference	Input Ranges		Recommended Min. Span [1]		Digital Accuracy[2]		D/A Accuracy[3]
2-, 3-, 4-Wire RTDs		°C	°F	°C	°F	°C	°F	
Pt 100	IEC 751, 1995 (α = 0.00385)	–200 to 850	–328 to 1562	10	18	± 0.15	± 0.27	±0.03% of span
PT 100	JIS 1604, 1981 (α = 0.003916)	–200 to 645	–328 to 1193	10	18	± 0.15	± 0.27	±0.03% of span
Pt 200	IEC 751, 1995 (α = 0.00385)	–200 to 850	–328 to 1562	10	18	± 0.27	± 0.49	±0.03% of span
Pt 500	IEC 751, 1995 (α = 0.00385)	–200 to 850	–328 to 1562	10	18	± 0.19	± 0.34	±0.03% of span
Pt 1000	IEC 751, 1995 (α = 0.00385)	–200 to 300	–328 to 572	10	18	± 0.19	± 0.34	±0.03% of span
Ni 120	Edison Curve No. 7	–70 to 300	–94 to 572	10	18	± 0.15	± 0.27	±0.03% of span
Cu 10	Edison Copper Winding No. 15	–50 to 250	–58 to 482	10	18	±1.40	± 2.52	±0.03% of span
Thermocouples[4]								
Type B[5]	NIST Monograph 175, IEC 584	100 to 1820	212 to 3308	25	45	± 0.77	± 1.39	±0.03% of span
Type E	NIST Monograph 175, IEC 584	–50 to 1000	–58 to 1832	25	45	± 0.20	± 0.36	±0.03% of span
Type J	NIST Monograph 175, IEC 584	–180 to 760	–292 to 1400	25	45	± 0.35	± 0.63	±0.03% of span
Type K[6]	NIST Monograph 175, IEC 584	–180 to 1372	–292 to 2502	25	45	± 0.50	± 0.90	±0.03% of span
Type N	NIST Monograph 175, IEC 584	–200 to 1300	–328 to 2372	25	45	± 0.50	± 0.90	±0.03% of span
Type R	NIST Monograph 175, IEC 584	0 to 1768	32 to 3214	25	45	± 0.75	± 1.35	±0.03% of span
Type S	NIST Monograph 175, IEC 584	0 to 1768	32 to 3214	25	45	± 0.70	± 1.26	±0.03% of span
Type T	NIST Monograph 175, IEC 584	–200 to 400	–328 to 752	25	45	± 0.35	± 0.63	±0.03% of span
DIN Type L	DIN 43710	–200 to 900	–328 to 1652	25	45	± 0.35	± 0.63	±0.03% of span
DIN Type U	DIN 43710	–200 to 600	–328 to 1112	25	45	± 0.35	± 0.63	±0.03% of span
Type W5Re/W26Re	ASTM E 988–96	0 to 2000	32 to 3632	25	45	± 0.70	± 1.26	±0.03% of span
Millivolt Input		–10 to 100 mV		3 mV		±0.015 mV		±0.03% of span
2-, 3-, 4-Wire Ohm Input		0 to 2000 ohms		20 ohm		±0.45 ohm		±0.03% of span

(1) No minimum or maximum span restrictions within the input ranges. Recommended minimum span will hold noise within accuracy specification with damping at zero seconds.
(2) Digital accuracy: Digital output can be accessed by HART Communicator or Rosemount control system.
(3) Total Analog accuracy is the sum of digital and D/A accuracies.
(4) Total digital accuracy for thermocouple measurement: sum of digital accuracy +0.5 °C
(5) Digital accuracy for NIST Type B T/C is ±3.0 °C from 100 to 300 °C.
(6) Digital accuracy for NIST Type K T/C is ±0.70 °C from –292 to –130 °F (–180 to –90 °C).

Accuracy Example

When using a Pt 100 (α = 0.00385) sensor input with a 0 to 100 °C span: Digital accuracy would be ±0.15 °C, D/A accuracy would be ±0.03% of 100 °C or ±0.03 °C, Total = ±0.18 °C.

Ambient Temperature Effect

Transmitters can be installed in locations where the ambient temperature is between –40 and 85 °C (–40 and 185 °F). In order to maintain excellent accuracy performance in dynamic industrial environments, each transmitter is individually characterized over this ambient temperature range at the factory.

This special manufacturing technique is accomplished through hot and cold temperature profiling with individual adjustment factors programmed into each transmitter. The transmitters automatically adjust for component temperature drift caused by changing environmental conditions.

Sensor Options	Temperature Effects per 1.0 °C (1.8 °F) Change in Ambient Temperature[1]	Ranges	D/A Effect
2-, 3-, 4-Wire RTDs			
Pt 100 (α = 0.00385)	• 0.003 °C (0.0054 °F)	Entire sensor input range	0.001% of span
PT 100 (α = 0.003916)	• 0.003 °C (0.0054 °F)	Entire sensor input range	0.001% of span
Pt 200	• 0.004 °C (0.0072 °F)	Entire sensor input range	0.001% of span
Pt 500	• 0.003 °C (0.0054 °F)	Entire sensor input range	0.001% of span
Pt 1000	• 0.003 °C (0.0054 °F)	Entire sensor input range	0.001% of span
Ni 120	• 0.003 °C (0.0054 °F)	Entire sensor input range	0.001% of span
Cu 10	• 0.03 °C (0.054 °F)	Entire sensor input range	0.001% of span
Thermocouples			
Type B	• 0.014 °C • 0.032 °C – (0.0025% of (R – 300)) • 0.054 °C – (0.011% of (R – 100))	• R ≥ 1000°C • 300 °C ≤ R < 1000 °C • 100 °C ≤ R< 300 °C	0.001% of span
Type E	• 0.005 °C +(0.00043% of R)	• All	0.001% of span
Type J	• 0.0054 °C +(0.0029%of R) • 0.0054 °C + (0.0025% of absolute value R)	• R ≥ 0 °C • R < 0 °C	0.001% of span
Type K	• 0.0061 °C +(0.00054% of R) • 0.0061 °C + (0.0025% of absolute value R)	• R ≥ 0 °C • R < 0 °C	0.001% of span
Type N	• 0.0068 °C +(0.00036% of R)	• All	0.001% of span
Type R, S, W5Re/W26Re	• 0.016 °C • 0.023 °C – (0.0036% of R)	• R ≥ 200°C • R < 200 °C	0.001% of span
Type T	• 0.0064 °C • 0.0064 °C +(0.0043% of absolute value R)	• R ≥ 0 °C • R < 0 °C	0.001% of span
DIN Type L	• 0.0054 °C + (0.00029% of R) • 0.0054 °C +(0.0025% of absolute value R)	• R ≥ 0 °C • R < 0 °C	0.001% of span
DIN Type U	• 0.0064 °C • 0.0064 °C +(0.0043% of absolute value R)	• R ≥ 0 °C • R < 0 °C	0.001% of span
Millivolt Input	• 0.0005 mV	Entire sensor input range	0.001% of span
2-, 3-, 4-Wire Ohm Input	0.0084 Ω	Entire sensor input range	0.001% of span

(1) Change in ambient is with reference to the calibration temperature of the transmitter 68 °F (20 °C) from factory.

Temperature Effects Example

When using a Pt 100 ($\alpha = 0.00385$) sensor input with a 0–100 °C span at 30 °C ambient temperature:

Digital Temperature Effects:	0.003 °C x (30 – 20) = 0.03 °C
D/A Effect:	[0.001% of 100] x (30 – 20) = 0.01 °C
Worst Case Error:	Digital + D/A + Digital Temperature Effects + D/A Effects = 0.15 °C + 0.03 °C + 0.03 °C + 0.01 °C = 0.22 °C
Total Probable Error:	$\sqrt{0.15^2 + 0.03^2 + 0.03^2 + 0.01^2} = 0.16°C$

Stability

RTDs and thermocouples have a stability of ±0.1% of reading or 0.1 °C (whichever is greater) for twelve months.

Power Supply Effect

Less than ±0.005% of span per volt

Vibration Effect

The Model 644H and Model 644R are tested to the following specifications with no effect on performance:

Frequency	Vibration
10–60 Hz	0.21 mm peak displacement
60–500 Hz	3 g peak acceleration

CE Electromagnetic Compatibility Compliance Testing

The Models 644H and 644R meet all requirements listed under IEC 61326: Amendment 1, 1998.

Self Calibration

The analog-to-digital measurement circuitry automatically self-calibrates for each temperature update by comparing the dynamic measurement to extremely stable and accurate internal reference elements.

PHYSICAL SPECIFICATIONS

Electrical Connections

Power and Sensor Terminals		
Model 644H	Compression screws permanently fixed to terminal block	Clips permanently fixed to terminal block
Model 644R:	Compression screw permanently fixed to front panel	Clips permanently fixed to front panel

WAGO® spring clamp terminals are optional (option code G5)

Materials of Construction

Construction Material for the Electronics Housing and Terminal Block	
Model 644H	*Noryl*® glass reinforced
Model 644R:	*Lexan*® polycarbonate

Mounting

The Model 644H installs in a connection head or universal head mounted directly on a sensor assembly, apart from a sensor assembly using a universal head, or to a DIN rail using an optional mounting clip. The Model 644R mounts directly to a wall or to a DIN rail.

Weight

Code	Options	Add(1)
Model 644H	Head Mount	78 (2.75)
M5	LCD Meter	34 (1.20)
J5, J6	Universal Head, Standard Cover	520 (18.43)
J5, J6	Universal Head, Meter Cover	604 (21.27)
Model 644R	Rail Mount	173 (6.10)

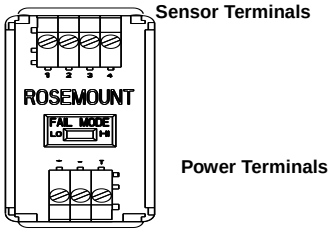
(1) All weights are in grams (ounces).

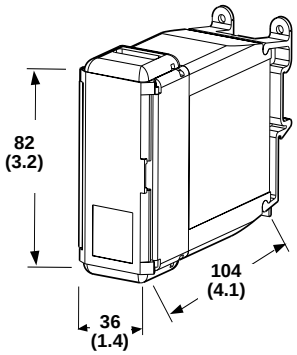
Enclosure Ratings (Model 644H)

Option codes J5 and J6 are NEMA 4X, IP66, and IP68.
Option code J6 is CSA Enclosure Type 4X

DIMENSIONAL DRAWINGS

Model 644R

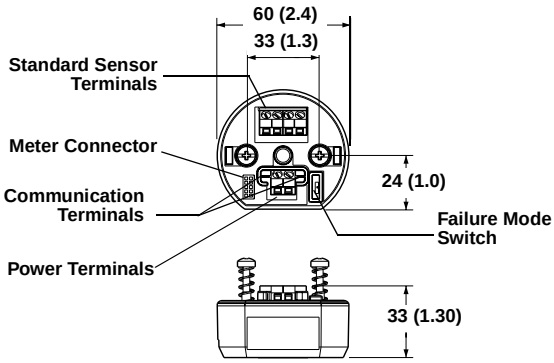




644-1105E01A. 1101A01A

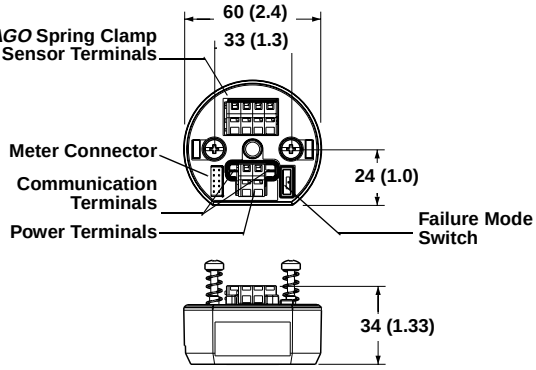
Model 644H

Shown with Standard Compression Screw Terminals



644-1360A02A

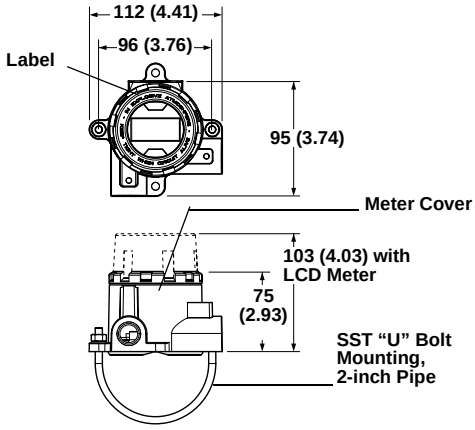
Shown with WAGO Spring Clamp Terminals



644-1360B02A

Threaded-Sensor Universal Head (Option code J5 or J6)

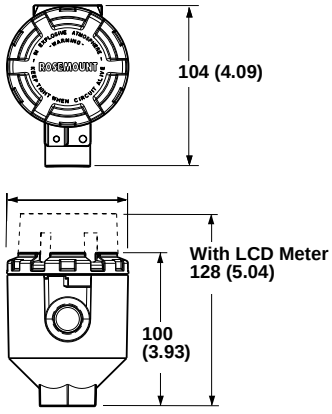
Shown with LCD Meter



Note: A "U" Bolt is shipped with each universal head unless assembly option X1, X2, or X3 is ordered. However, since the head can be integrally mounted to the sensor, it may not need to be used.

Integral DIN Style Sensor Connection Head

(see note below)

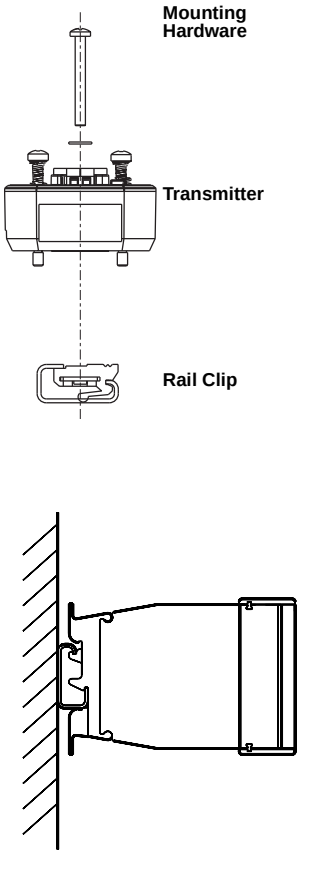


Note: The DIN Style Integral sensor connection head is only available through Volume 2 of the Rosemount Temperature Sensors and Accessories Product Data Sheet (document number 00810-0101-2654).

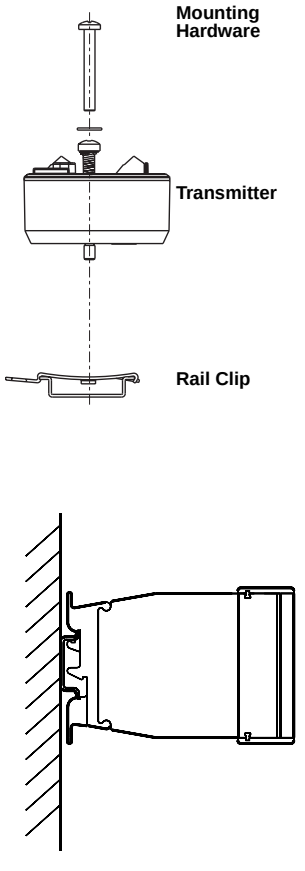
Dimensions are in millimeters (inches)

Mounting

G-Rail (asymmetric)

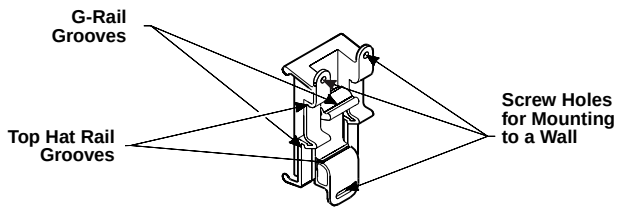


Top Hat Rail (symmetric)



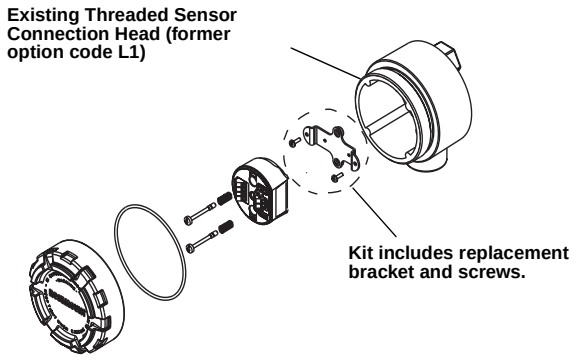
Note: Kit (part number 00644-5301-0010 includes mounting hardware and both types of rail kits.

Universal Clip for Mounting to a Wall or a Rail (part number 03044-4301-0001)



3044-4001A01B, 644-5302B01A, D02A

Model 644H Retrofit Kit



3044-0000C01B, D01B, 644-1041B02B,G02

Note: Kit (part number 00644-5321-0010) includes a new mounting bracket and the hardware necessary to facilitate the installation.

ORDERING INFORMATION

Flameproof and Explosion-Proof Approvals for Temperature Assemblies

Both flameproof and explosion-proof protection depend on the enclosure type. Compliance with flameproof and explosion-proof approvals requires an appropriately approved assembly, including the sensor. The Model 644H requires an appropriate enclosure for approved use in locations requiring flameproof or explosion-proof installations.

Orders that include enclosure options J5 or J6 must be ordered from the Model 644H ordering information table (see Table 5-3).

When ordering a complete DIN style assembly, select the appropriate connection head from Volume 2 of the Rosemount Temperature Sensors and Accessories Product Data Sheet (document number 00813-0101-2654).

TABLE 1. Model 644H and Model 644R Ordering Table

• = Available
— = Not available

Model	Product Description	Head Mount	Rail Mount
644H	Smart Head Mount Temperature Transmitter	•	—
644R	Smart Rail Mount Temperature Transmitter	—	•

Code	Hazardous Area Certifications	Enclosure Purchase Required?	Head Mount	Rail Mount
E5	FM Explosion-Proof Approval	Yes	•	—
I5	FM Intrinsic Safety and Non-Incendive Approval	No*	•	•
K5	FM Intrinsic Safety, Non-Incendive, and Explosion-Proof Approval Combination	Yes	•	—
I6	CSA Intrinsic Safety and Non-Incendive Approval	No*	•	•
C6	CSA Intrinsic Safety, Non-Incendive, and Explosion-Proof Approval Combination	Yes	•	—
N1	CENELEC/BASEEFA Type n Approval	Yes	•	—
ED	CENELEC/KEMA Flameproof Approval	Yes	•	—
I1	CENELEC/BASEEFA Intrinsic Safety Approval	No*	•	•
E7	SAA Flameproof Approval. *Consult factory for availability.*	Yes	•	—
N7	SAA Type N Approval. *Consult factory for availability*	Yes	•	—
I7	SAA Intrinsic Safety Approval. *Consult factory for availability.*	No*	•	•
NA	No Approval	No*	•	•

** Transmitters with intrinsic safety approvals can be ordered without enclosures. However, to meet intrinsic safety requirements, the transmitter must be installed in an enclosure with IP20 or higher rating. Model 644H transmitters ordered with enclosure options J5 or J6 meet this requirement.*

Code	Options		
	Assembly Options (Model 644H Only)		
X1	Assemble Transmitter to a Sensor Assembly (hand tight, *Teflon*® (PTFE) tape where appropriate, fully wired)	•	—
X2	Assemble Transmitter to a Sensor Assembly (hand tight, no *Teflon* (PTFE) tape, unwired)	•	—
X3	Assemble Transmitter to a Sensor Assembly (wrench tight, *Teflon* (PTFE) where appropriate, fully wired)	•	—
	Note: If ordering X1, X2, X3, specify the same code on the sensor model number. *Option codes X1 and X3 are not available with CSA Approvals (Hazardous Area Certifications C6 or I6)*		
	Enclosure Options **Threaded Style Temperature Sensor Users (Americas and Asia Pacific)** *Remote/Integral Mount*		
J6	Universal Head (Junction Box), Aluminum Alloy with 2-in. SST Pipe Bracket (M20 Entries)	•	—
	DIN Plate Style Temperature Sensor Users (EMEA-Europe, Middle East, and Africa) *Remote Mount*		
J5	Universal Head (Junction Box), Aluminum Alloy with 2-in. SST Pipe Bracket (M20 Entries)	•	—
J6	Universal Head (Junction Box), Aluminum Alloy with 2-in. SST Pipe Bracket ($^1/_2$–14 NPT Entries)	•	—
	Integral Mount		
	******Order connection head through Volume 2 of the Rosemount Temperature Sensor and Accessories Product Data Sheet (document number 00810-0101-2654) sensor model number******		
	Configuration Options		
C1	Factory Custom Configuration of Alarm and Saturation Levels, Date, Descriptor, and Message Fields.	•	•
A1	Analog Output Levels Compliant with NAMUR-Recommendations NE 43:June 1997	•	•
CN	Analog Output Levels Compliant with NAMUR-Recommendations NE 43: June 1997: Alarm Configuration Low	•	•
F6	60 Hz Line Voltage Filter	•	•
	Calibration Options		
C2	Transmitter-Sensor Matching Trim to specific Rosemount RTTD Calibration Schedule.	•	•
C4	5-Point Calibration. *Use Q4 option to generate a calibration certificate*	•	•
Q4	Calibration Certificate. *3-Point standard; use C4 with Q4 option for a 5-point calibration certificate.*	•	•
	Accessory Options (Model 644H only)		
M5	LCD Meter Option. *Enclosure Option J5 or J6 is required when ordering flame-proof or explosion-proof approvals.*	•	—
G1	External Ground Screw. *Only available with options J5 or J6.*	•	—
G2	Cable Gland. *Only available with option code J5.*	•	—
G3	Cover Chain. *Only available with enclosure options J5 or J6. Not available with LCD meter option code M5.*	•	—
G5	*WAGO* Spring Clamp Terminals	•	—

Typical Model Number – Americas and Asia Pacific: 644H E5 X1 J6 M5 F6
Typical Model Number – Europe, Middle East, Africa: 644H ED X1 M5

TABLE 2. Transmitter Accessories

Part Description	Part Number	Availability
Aluminum Alloy Universal Head, Standard Cover—M20 Entries	00644-4420-0002	•
Aluminum Alloy Universal Head, Meter Cover—M20 Entries	00644-4420-0102	•
Aluminum Alloy Universal Head, Standard Cover—1/2-14 NPT Entries	00644-4420-0001	•
Aluminum Alloy Universal Head, Meter Cover—1/2-14 NPT Entries	00644-4420-0101	•
LCD Meter (includes meter and meter space assembly)	00644-4430-0002	•
LCD Meter Kit (includes meter and meter space assembly, and meter cover)	00644-4430-0001	•
Ground Screw Assembly Kit	00644-4431-0001	•
Kit, Hardware for Mounting a Model 644H to a DIN rail (includes clips for symmetrical and asymmetrical rails)	00644-5301-0010	•
Kit, Hardware for Retrofitting a Model 644H in an existing Threaded Sensor Connection Head (former option code L1)	00644-5321-0010	•
Blank Transmitter Configuration Labels (sheet of 48)	00644-5154-0001	•
Universal Clip for Rail or Wall Mount	03044-4103-0001	•
24 Inches of Symmetric (Top Hat) Rail	03044-4200-0001	•
24 Inches of Asymmetric (G) Rail	03044-4201-0001	•
Ground Clamp for symmetric or asymmetric rail	03044-4202-0001	•
End Clamp for symmetric or asymmetric rail	03044-4203-0001	•
Snap Rings Kit (used for assembly to a DIN sensor)	00644-4432-0001	•

CONFIGURATION

Standard

Unless specified, the transmitter will be shipped as follows:

TABLE A-3. Standard Configuration Parameters

Sensor Type:	RTD, PT 100 (α = 0.00385, 4-wire)
4 mA Value:	0 °C
20 mA Value:	100 °C
Damping:	5 seconds
Output:	Linear with temperature
Failure Mode:	High/Upscale
LIne Voltage Filter:	50 Hz
Tag:	See “Ordering Information”

Custom

The transmitter can be ordered with custom configuration. Use Table A-4 to determine the requirements when specifying the custom configuration.

TABLE A-4. Custom Configuration Requirements/Specification

Option Code	Requirements/Specification
C1: Factory Configuration Data	Date: day/month/year Descriptor: 16 alphanumeric characters Message: 32 alphanumeric character Analog Output: Alarm and saturation levels
C2: Transmitter Sensor Matching	Specify a Rosemount 65, 68, or 78 RTD order with a special characterization curve
A1: NAMUR-compliant	See Table A-1 on page 2
CN: NAMUR-Compliant, Low Alarm	See Table A-1 on page 2
C4:” Five Point Calibration	Will include five-point calibration at 0, 25, 50, 75, and 100% analog and digital output points. Use with Rosemount Calibration Certificate Q4.
F6: 60 Hz Line Filter	Calibrated to a 60 Hz line voltage filter instead of the standard 50 Hz filter

Tagging

Hardware Tag	Software Tag
• No charge • Tagged in accordance with customer requirements • Tags are adhesive labels • Permanently attached to transmitter • Character height is $^{1}/_{16}$-in (1.6 mm)	• No charge • The transmitter can store up to 8 characters. If no characters are specified, the first 8 characters of the hardware tag are the default.

Appendix B Approvals

SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

⚠WARNING

Once a device labeled with multiple approval types is installed, it should not be reinstalled using any of the other labeled approval types. To ensure this, the approval label should be permanently marked to distinguish the used from the unused approval type(s).

HAZARDOUS LOCATIONS INSTALLATIONS

⚠ The Model 644 is available with circuitry that is suitable for intrinsically safe operation. The Model 644H is available with optional explosion-proof enclosures and can be specified for non-incendive operation. Individual transmitters are clearly marked with a tag indicating the approvals they carry.

To maintain certified ratings for installed transmitters, they must be installed in accordance with all applicable installation codes and approval drawings. Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certification.

IMPORTANT

Once a device labeled with multiple approval types is installed, it should not be reinstalled using any of the other labeled approval types. To ensure this, the approval label should be permanently marked to distinguish the used from the unused approval type(s).

LOCATIONS CERTIFICATIONS

Factory Mutual (FM) Approvals

E5 Explosion-Proof for Class I, Division 1, Groups B, C, and D. Dust-Ignition Proof for Class II, Division 1, Groups E, F, and G. Dust-Ignition Proof for Class III, Division 1 hazardous locations when installed in accordance with Rosemount Drawing 00644-1049. Non-Incendive for Class I, Division 2, Groups A, B, C, and D. Ambient temperature limits: –50 to 85 °C. Conduit seal not required for compliance with NEC 501-5a(1). Temperature Code T5 (T_{amb} = 85 °C)

NOTE:
Approval E5 is only available with 644H option codes J5 and J6.

I5 Intrinsically Safe for Class I, II, III, Division 1, Groups A, B, C, D, E, F, G; Non-incendive for Class I, Division 2, Groups A, B, C, D. Ambient temperature limits: –50 to 60 °C when installed in accordance with Rosemount Drawing 00644-0009.

FM Entity Parameters: See installation drawing identified on the transmitter approval label and Appendix : Models 644 and 244E Temperature Transmitters Manual Supplement for entity parameters.

K5 Combination of E5 and I5

NOTE:
Approval K5 is only available with Model 644H option codes J5 and J6.

Canadian Standards Association (CSA) Approvals

I6 Intrinsically safe for Class I, Division 1, Groups A, B, C, and D when connected in accordance with Rosemount drawing 00644-1064 (see Appendix : Models 644 and 244E Temperature Transmitters Manual Supplement for connection parameters).

C6 Combination of I6 and the following: Explosion-Proof for Class I, Division 1, Groups C and D. Dust-ignition proof for Class II, Division 1, Groups E, F, and G.
Dust-ignition proof for Class III, Division 1 hazardous locations when installed in accordance with Rosemount Drawing 00644-1059. Suitable for Class I, Division 2, Groups A, B, C, and D (must be installed in a suitable enclosure).

NOTE:
Approval C6 is only available with Model 644H option code J6.

KEMA Approvals

ED ATEX II 2 G

Flameproof (Zone 1) (Model 644H only)

EEx d IIC T6 (T_{amb} = –40 to 65 °C).

British Approvals Service for Electrical Equipment in Flammable Atmospheres (BASEEFA) Approvals

I1 ATEX II 1 G

Intrinsically Safe Operation (Zones 0)
EExia IIC T6 (T_{amb} = –60 to 40 °C)
EExia IIC T4 (T_{amb} = –60 to 80 °C)

Entity Parameters: See appropriate approval certificate and Appendix : Models 644 and 244E Temperature Transmitters Manual Supplement for entity parameters.

Special Conditions for Safe Use (X):

The transmitter must be installed so that its external terminals and communication pins are protected to at least IP20.

N1 ATEX II 3 G

Type 'nL' Operation Non-Incendive Approval (Zone 2 only)

Ex nL IIC T5 (T_{amb} = 70 °C)

(Type 'nL' certification is only available as a complete assembly with the Rosemount universal head, thermometer, and thermowell.)

Standard Australia Quality Assurance Service (SAA)

NOTE
Consult factory for SAA availability.

I7 Intrinsic Safety,
Ex ia IIC T6 (T_{amb} = –40 to 40 °C)
Ex ia IIC T4 (T_{amb} = –40 to 70 °C)

Entity Parameters: See appropriate approval certificate

Special Conditions for Safe Use (X):

The transmitter must be installed so that its external terminals and communication pins are protected to at least IP20.

N7 Type N Approval,
Ex n IIC T5 (T_{amb} = 70 °C)

Special Conditions for Safe Use (X):

The assembly must be installed such that its external terminals and communication pins are protected to at least the requirements of IP54.

E7 Flameproof Approval (Model 644H only)

Ex d IIC T6

NOTE:
Flameproof certification is only available as a complete assembly with Rosemount universal head – option codes J5 or J6.

Gostandart

Tested and approved by the Russian Metrological Institute GOSTANDART.

The Model 244EC Configuration Interface is approved for Factory Mutual (FM) and Canadian Standards Association (CSA) Ordinary Locations

INSTALLATION DRAWINGS

The installation guidelines presented by the drawings must be followed in order to maintain certified ratings for installed transmitters.

Rosemount Drawing 00644-1064, 1 Sheet,
Canadian Standards Association Intrinsic Safety Installation Drawing

Rosemount Drawing 00644-1059, 1 Sheet;
Canadian Standards Association Explosion-Proof Installation Drawing

Rosemount Drawing 00644-0009, 1 Sheet
Factory Mutual Intrinsic Safety Installation Drawing

Rosemount Drawing 00644-1049, 1 Sheet;
Factory Mutual Explosion-proof Installation Drawing

IMPORTANT
Once a device labeled with multiple approval types is installed, it should not be reinstalled using any of the other labeled approval types. To ensure this, the approval label should be permanently marked to distinguish the used from the unused approval type(s).

Figure B-1. Canadian Standards Association (CSA) Intrinsic Safety Installation Drawing 00644-1064, Rev. AB

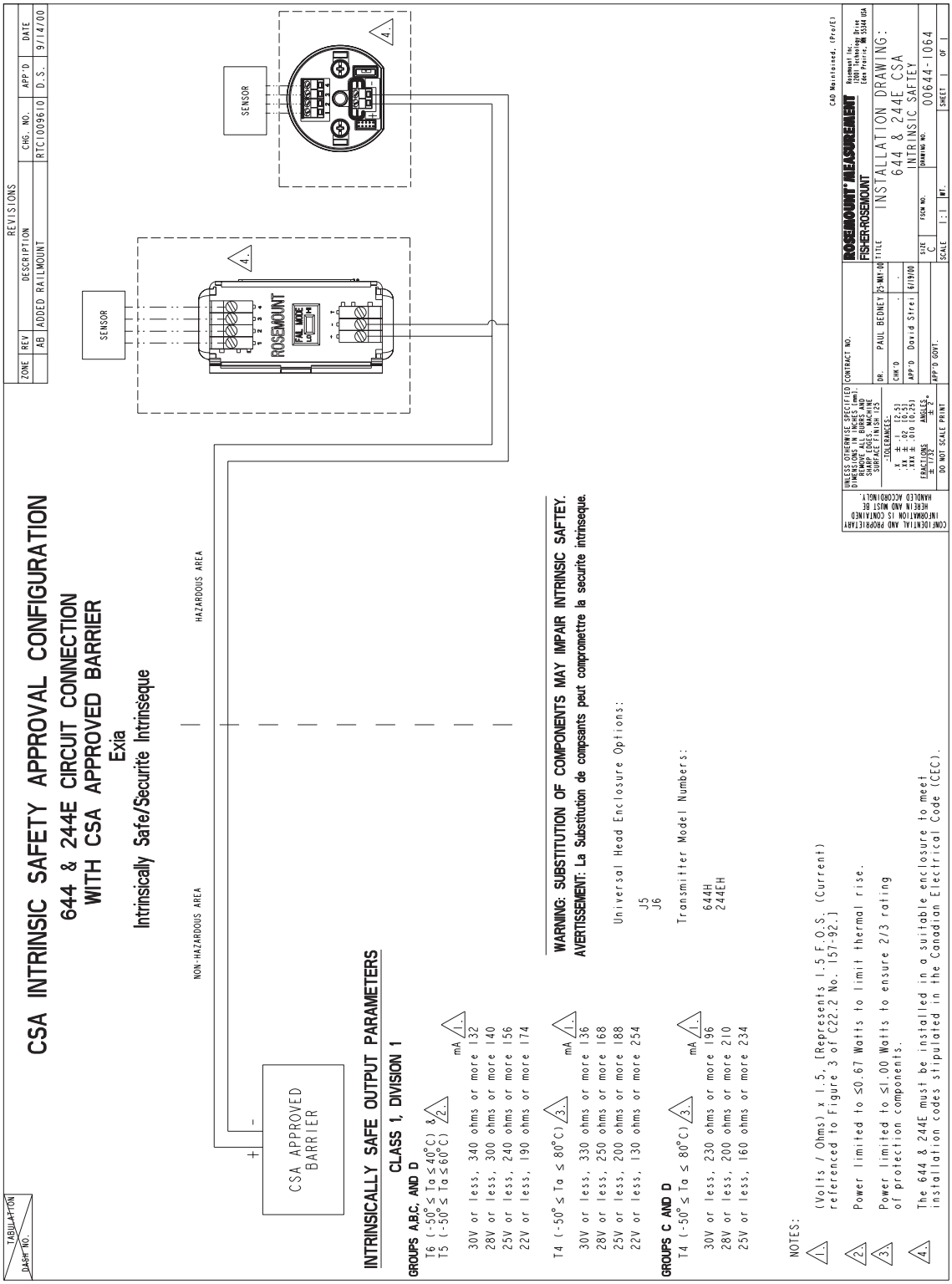
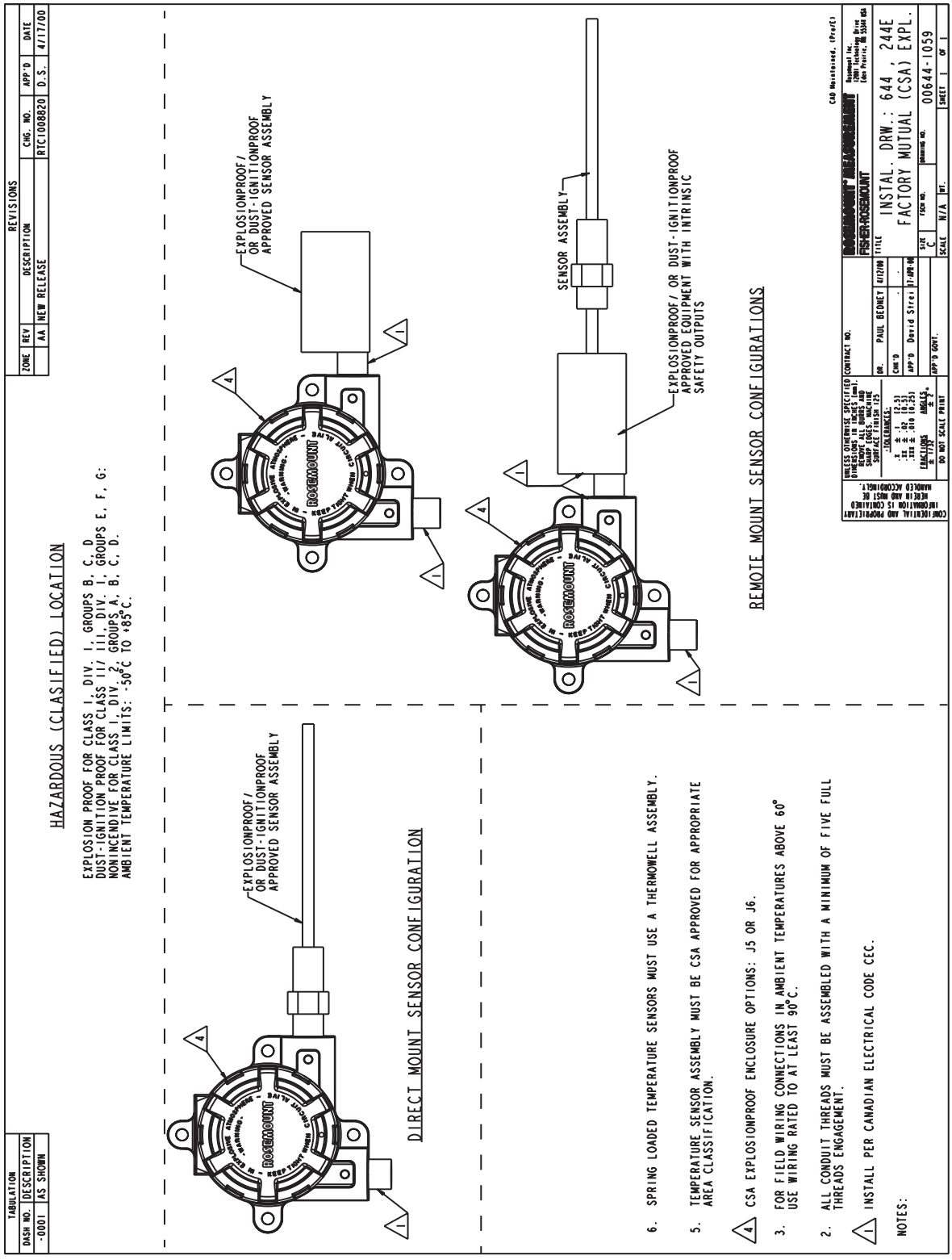
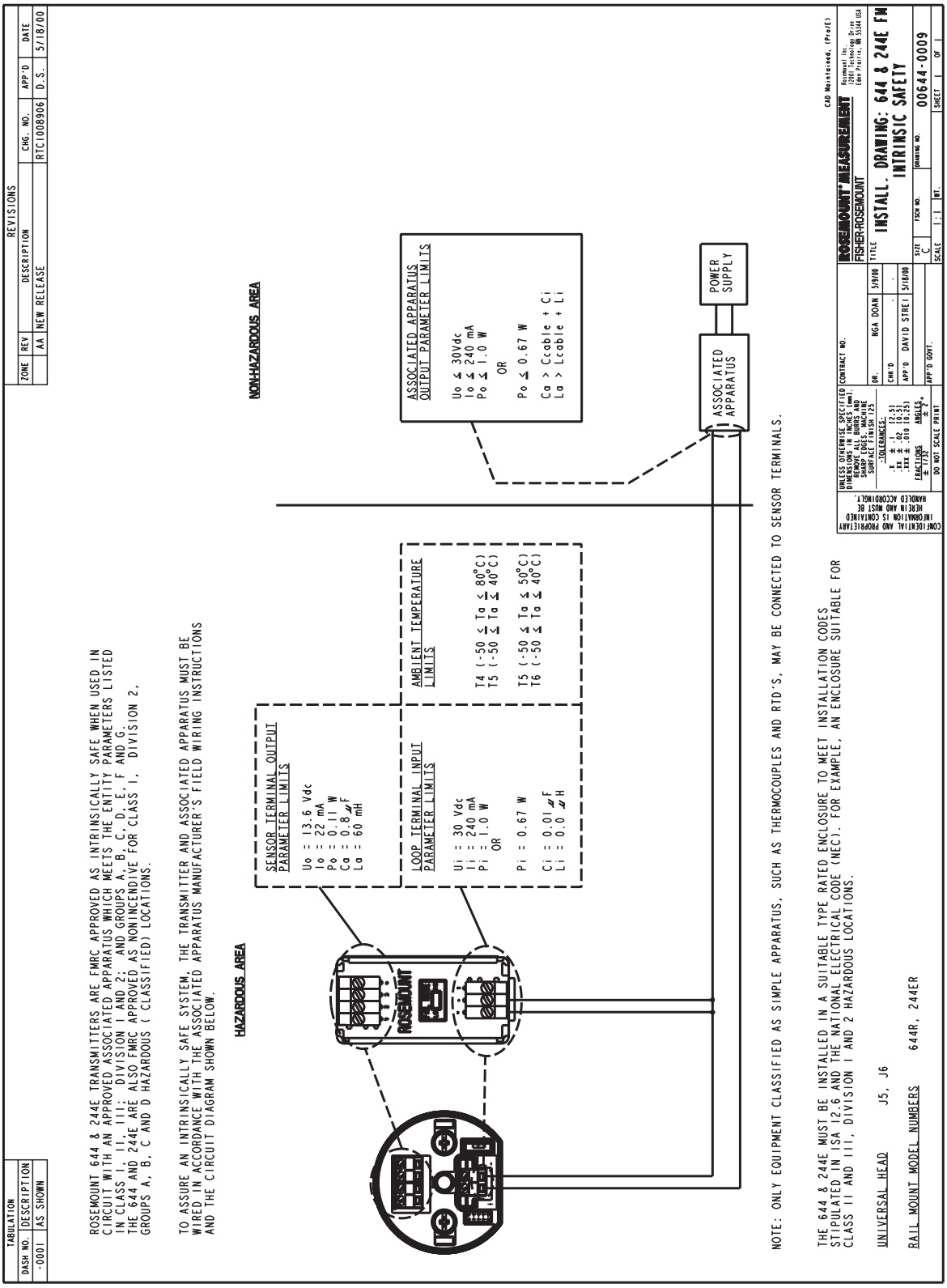


Figure B-2. Canadian Standards Association (CSA) Explosion-Proof Installation Drawing 00644-1059, Rev. AA



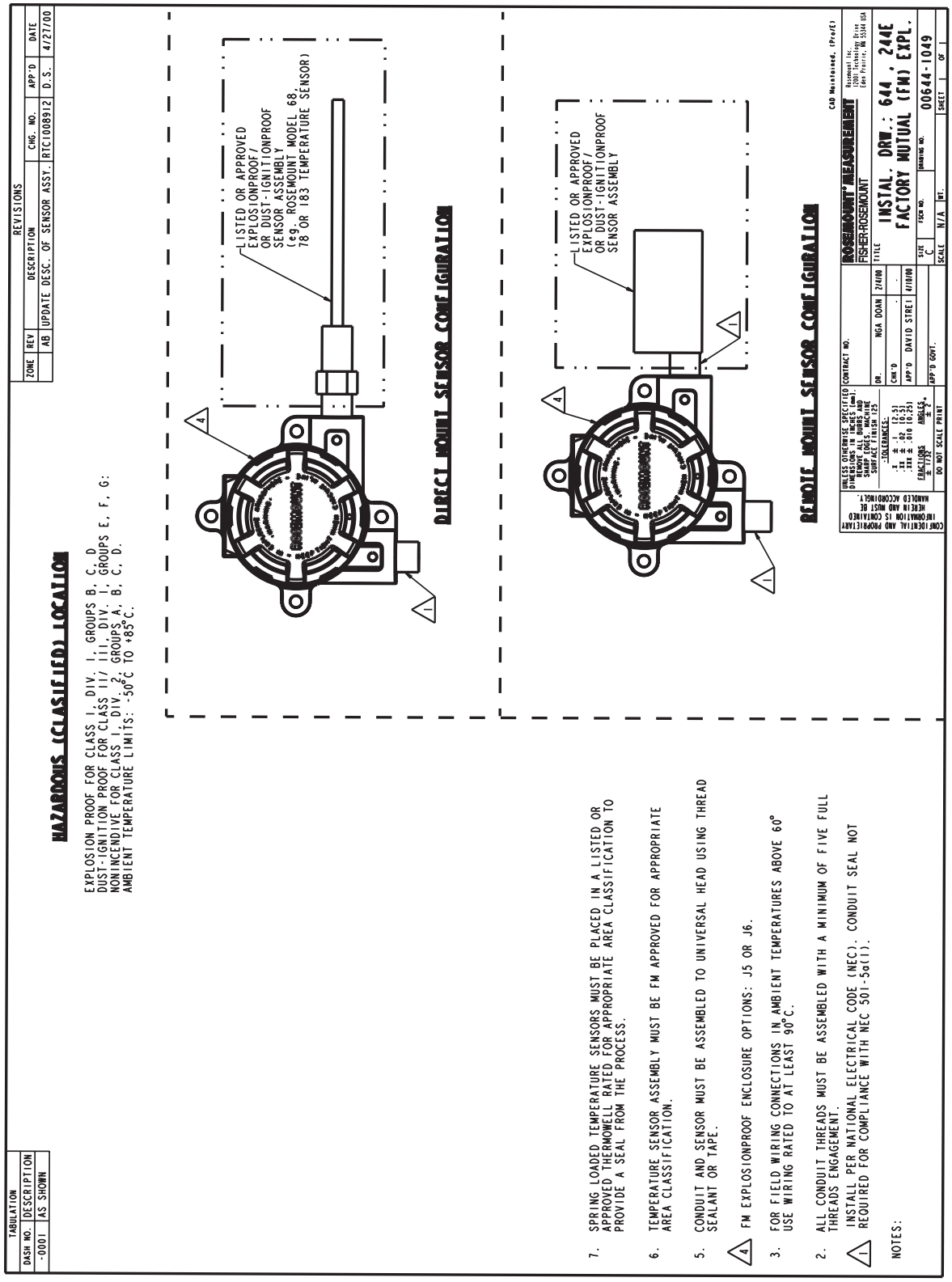
644-1059A01A

Figure B-3. Factory Mutual (FM)
Intrinsic Safety Installation Drawing
00644-0009, Rev. AA



644-0009A01A

Figure B-4. Factory Mutual (FM)
Explosion-Proof Installation Drawing
00644-1049, Rev. AB



644-1049A01A

Appendix C

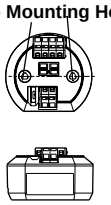
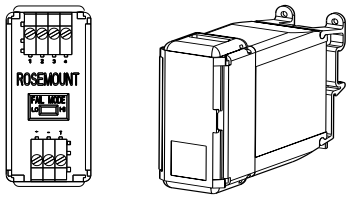
Models 644 and 244E Temperature Transmitters Manual Supplement

This manual supplement is intended to indicate the primary differences between the old and new Models 644 and 244E. These differences are as follows:

- Transmitter design
- Sensor Wiring Diagrams
- Special Mounting Considerations
- Specifications

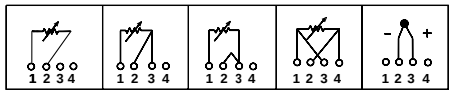
OLD

Transmitter Design

Models 644H and 244EH	Models 644R and 244ER
Two Mounting Holes 	

Sensor Wiring Diagrams

Models 644 and 244E



2-wire RTD and Ω | 3-wire * RTD and Ω | RTD with Comp. Loop | ** 4-wire RTD and Ω | T/C and mV

644-0000B01B

* *Rosemount Inc. provides 4-wire sensors for all single element RTDs. You can use these RTDs in 3-wire configurations by leaving the unneeded leads disconnected and insulated with electrical tape.*

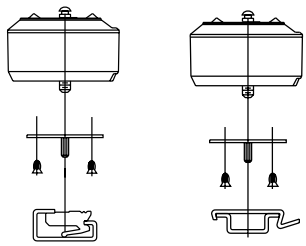
** *The transmitters must be configured for a 3-wire RTD in order to recognize an RTD with a compensation loop.*

Special Mounting Considerations

Mounting a Model 644H to a DIN Rail

1. Assemble the appropriate rail clip (part number 00644-5301-0001).
2. Attach the transmitter to a rail or panel.
3. Attach the thermowell to the pipe or process container wall and attach sufficient lengths of sensor lead wire. Tighten the connection head cover.
4. Run the sensor lead wires from to the sensor and set the transmitter failure mode switch.
5. Attach the sensor and power leads to the transmitter.

G-Rail | **Top Hat Rail**



644-5301B01B,D01B

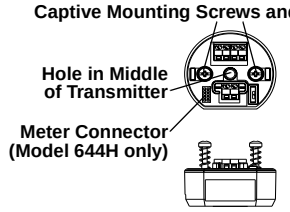
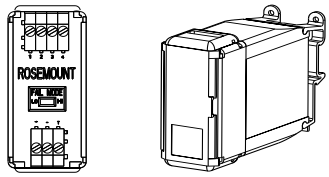
Use with an Existing Threaded Sensor Connection Head

To mount the Models 644H and 244EH in an existing L1 connection head, assemble the Model 644H retrofit kit (part number 00644-5321-0001) to the transmitter as shown. Then mount the assembly in the connection head.

644-644-5051A01A

NEW

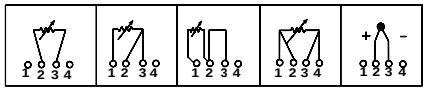
Transmitter Design

Models 644H and 244EH	Models 644R and 244ER
	

644, 244-1360A02B

Sensor Wiring Diagrams

Models 644 and 244E



2-wire RTD and Ω | 3-wire * RTD and Ω | RTD with** Comp. Loop | 4-wire RTD and Ω | T/C and mV

644-0000B01C

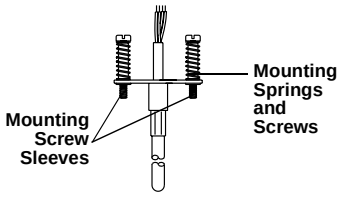
* *Rosemount Inc. provides 4-wire sensors for all single element RTDs. You can use these RTDs in 3-wire configurations by leaving the unneeded leads disconnected and insulated with electrical tape.*

** *The transmitters must be configured for a 3-wire RTD in order to recognize an RTD with a compensation loop.*

Special Mounting Considerations

Use with an Existing DIN Plate Style Sensor

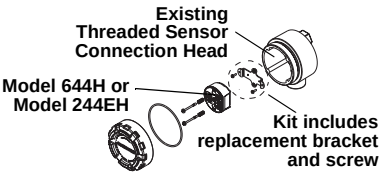
1. Secure the bottom of the mounting screw sleeve with pliers. Remove the mounting screws and springs.
2. Once the springs are removed, use the new transmitter mounting screws to assembly the transmitter to the DIN plate and connection head. (Optional snap rings (part number 00644-4432-0001) are available to ease installation to the existing DIN plate style sensor.)



SENSORS-0000A02B

Use with an Existing Threaded Sensor Connection Head

To mount the new Models 644H or 244EH to the existing threaded sensor connection head (former option code L1), order the models 644H and 244EH retrofit kit (part number 00644-5321-0010). The fit includes a new mounting bracket and all associated hardware necessary to facilitate the installation of the Models 644H and 244EH into the existing head.



644-644-5321A01A,

HART Communicator (Model 644H only)

To guarantee proper transmitter functionality and communication, your Model 275 HART Communicator should contain device revision Dev v5 DD v2 or higher. To check software device revision,

1. Turn on the communicator.
2. Select *1 Off-line*, *1 New Configuration*, *Rosemount*, *644 Temp*

If you do not have this device revision, contact your local Rosemount representative for information on receiving an upgrade.

SPECIFICATIONS

Old					New			
BASEFFA[1] Intrinsically Safe Installation Entity Parameters:								
Power Loop	$U_{max:in}$	30 V dc			30 V dc			
	$I_{max:in}$	200 mA			200 mA			
Group II C Zones 0 and 1	$W_{max:in}$	1.0 W • T5 (– 40 ≤ T_a ≤ 40 °C) • T4 (– 40 ≤ T_a ≤ 80 °C)			1.0 W • T5 (– 60 ≤ T_a ≤ 40 °C) • T4 (– 60 ≤ T_a ≤ 80 °C)		0.67 W • T6 (– 60 ≤ T_a ≤ 40 °C) • T5 (– 60 ≤ T_a ≤ 50 °C)	
	C_{eq}	13.4 nF			10 nF			
	L_i	0 µH			0 µH			
Sensor	U_o	24.2 V dc			13.6 V dc			
	I_o	33 mA			80 mA			
	P_o	0.2 W			0.08 W			
Cable Load		IIC	IIB	IIA	IIC	IIB	IIA	
	C_o (µF)	0.2	0.6	1.6	0.7	5.1	18.5	
	L_o (mH)	31	93	248	5	23	48	
Special Conditions for Safe Use: The apparatus must be installed such that its external terminals and the communication pins are protected to at least IP20.					*Special Conditions for Safe Use: The apparatus must be installed in an enclosure which affords it a degree of protection of at least IP20. Non-metallic enclosures must have a surface resistance of less than 1 GΩ, light alloy or zirconium enclosures must be protected from impact and friction when installed.*			
CSA[2] Intrinsically Safe Installation Connection Parameters:								
Class I Div. 1 Groups A, B, C, and D	T5 (– 50 ≤ T_a ≤ 60 °C)	• 30 V or less, 330 ohms or more • 28 V or less, 300 ohms or more • 25 V or less, 200 ohms or more • 22 V or less, 180 ohms or more			T6 (– 50 ≤ T_a ≤ 40 °C) T5 (– 50 ≤ T_a ≤ 60 °C)		• 30 V or less, 340 ohms or more • 28 V or less, 300 ohms or more • 25 V or less, 240 ohms or more • 22 V or less, 190 ohms or more	
					T4 (– 50 ≤ T_a ≤ 80 °C)		• 30 V or less, 330 ohms or more • 28 V or less, 250 ohms or more • 25 V or less, 240 ohms or more • 22 V or less, 190 ohms or more	
Class I Div. 1 Groups C and D		• 30 V or less, 150 ohms or more			T4 (– 50 ≤ T_a ≤ 80 °C)		• 30 V or less, 230 ohms or more • 28 V or less, 200 ohms or more • 25 V or less, 160 ohms or more	
Factory Mutual[3] Intrinsically Safe Installation Entity Parameters:								
Power Loop	V_i	30 V dc			30 V dc			
	I_i	250 mA			240 mA			
Class I, II, and III Div. 1 Groups A, B, C, D, E, F, and G	P_i	1.0 W • T5 (– 50 ≤ T_a ≤ 60 °C)			1.0 W • T5 (– 50 ≤ T_a ≤ 40 °C) • T4 (– 50 ≤ T_a ≤ 80 °C)		0.67 W • T6 (– 50 ≤ T_a ≤ 40 °C) • T5 (– 50 ≤ T_a ≤ 50 °C)	
	C_i	0.008 µF			0.010 µF			
	L_i	0 µH			0 µH			
Sensor	V_t	10.7 V dc			13.6 V dc			
	I_t	15.3 mA			22 mA			
	P_o	0.04 W			0.11 W			
	C_a	2.23 µF			0.8 µF			
	L_a	140 mH			60.0 mH			

(1) For more information see approval certificate, Old: Model 644H: 95C2010X, Model 244E: 95C2019X; New: Model 644H: BAS00ATEX1033X, Model 244E: BAS00ATEX1034X

(2) For more information see Rosemount drawing 00644-1040, Rev. B (old) and 00644-1064, Rev AB (new).

(3) For more information see Rosemount drawing 00644-1056, Rev. B (old) and 00644-0009, Rev AA (new)

Index

Rosmeount Inc.
8200 Market Boulevard
Chanhassen, MN 55317
USA
Tel 1-800-999-9307
Fax (952) 949-7001

Fisher Rosemount Limited
Heath Place
Bodnor Regis
West Sussex PO 22 9SH
England
Tel 44 (1243) 863 121
Fax 44 (1243) 867 5541

Fisher Rosemount
Singapre Pte Ltd.
1 Pandan Crescent
Singapore128461
Tel (65) 777 8211
Fax (65) 777-0947
AP.RMT-Specialist@frco.com

Product documentation available at...
www.rosemount.com

00809-0100-4728 Rev FA 10/00

ROSEMOUNT®

FISHER-ROSEMOUNT™