Reference Manual
00809-0100-4728, Rev LA
April 2011

Rosemount 644 Temperature Transmitter with HART® Protocol

HART COMMUNICATION PROTOCOL

ROSEMOUNT®

www.rosemount.com

EMERSON™
Process Management

Rosemount 644 Temperature Transmitter

Rosemount 644 Hardware Revision	**30**
Device Revision	**7**
HART® Revision	**5.9**

NOTICE

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

The United States has two toll-free assistance numbers and one international number.

Customer Central
1-800-999-9307 (7:00 a.m. to 7:00 p.m. CST)

National Response Center
1-800-654-7768 (24 hours a day)
Equipment service needs

International
1-(952)-906-8888

⚠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 a Emerson Process Management Sales Representative.

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SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises 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

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 HART in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-intrinsic 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.

OVERVIEW

Manual

This manual is designed to assist in the installation, operation, and maintenance of Rosemount 644 head mount and 644 rail mount.

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- Considerations
- Return of Materials

Section 2: Installation

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Transmitter

Features of the Rosemount 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

Refer to the following literature for a full range of compatible connection heads, sensors, and thermowells provided by Emerson Process Management.

- Temperature Sensors and Assemblies Product Data Sheet, Volume 1 (document number 00813-0100-2654)
- Temperature Sensors and Assemblies Product Data Sheet, Volume 2 (document number 00813-0200-2654)

CONSIDERATIONS

General

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

Commissioning

The transmitter can be commissioned before or after installation. It may be useful to commission it on the bench, before installation, to ensure proper operation and to become familiar with its functionality. Make sure the instruments in the loop are installed in accordance with intrinsically safe, or non-incendive field wiring practices.

Mechanical

Location

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

Special Mounting

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

Electrical

Proper electrical installation is necessary to prevent errors due to sensor lead resistance and electrical noise. For best results, shielded cable should be used in electrically noisy environments.

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

Environmental

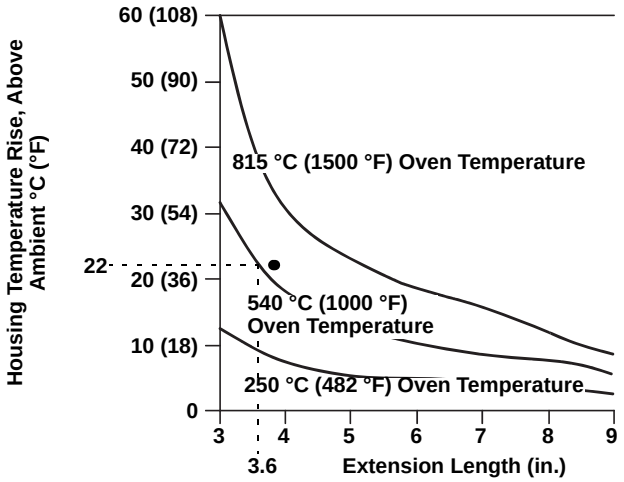
The transmitter electronics module is permanently sealed within the housing, resisting moisture and corrosive damage. Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

Temperature Effects

The transmitter will operate within specifications for ambient temperatures between –40 and 185 °F (–40 and 85 °C). Heat from the process is transferred from the thermowell to the transmitter housing. If the expected process temperature is near or beyond specification limits, consider the use of additional thermowell lagging, extension nipple, or a remote mounting configuration to isolate the transmitter from the process.

Figure 1-1 provides an example of the relationship between transmitter housing temperature rise and extension length.

Figure 1-1. 644 head mount Transmitter Connection Head Temperature Rise vs. Extension Length



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 (moves 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.

RETURN OF MATERIALS

To expedite the return process in North America, call the Emerson Process Management National Response Center toll-free at 800-654-7768. This center, available 24 hours a day, will assist you with any needed information or materials.

⚠ The center will ask for the following information:

- Product model
- Serial numbers
- The last process material to which the product was exposed

The center will provide

- A Return Material Authorization (RMA) number
- Instructions and procedures that are necessary to return goods that were exposed to hazardous substances

For other locations, please contact an Emerson Process Management sales representative.

NOTE
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.

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 potentially raises 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

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 Field 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.
- 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.

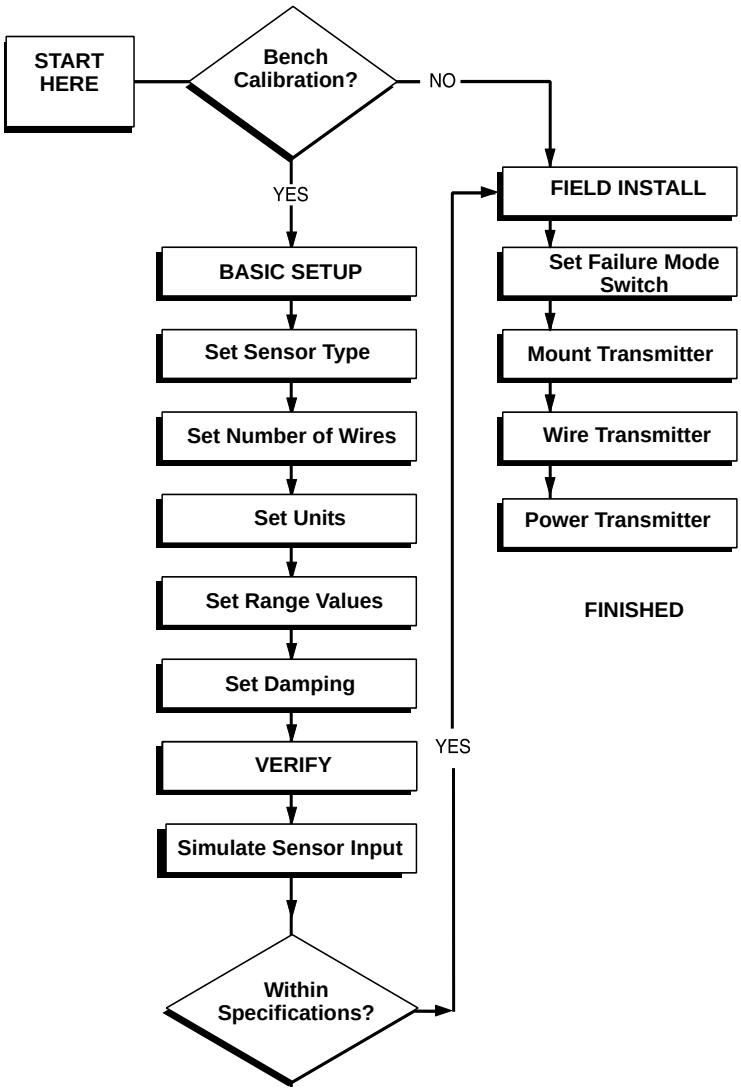
Process leaks could result in death or serious injury.

- 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.

Figure 2-1. Installation Flowchart



MOUNTING

Mount the transmitter at a high point in the conduit run to prevent moisture from draining into the transmitter housing.

The 644 head mount installs

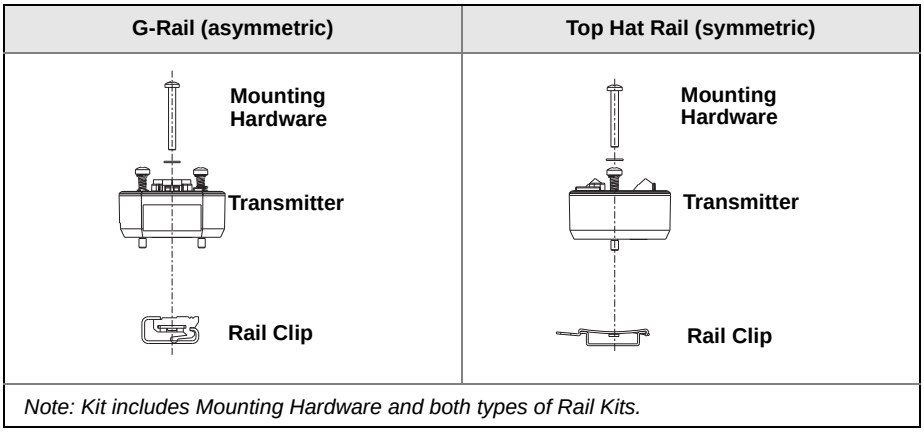
- In a connection head or universal head mounted directly on a sensor assembly
- Apart from a sensor assembly using a universal head
- To a DIN rail using an optional mounting clip.

The 644 rail mount attaches directly to a wall or to a DIN rail.

Mounting a 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 2-2. Follow the procedure under “Rail Mount Transmitter and Sensor”.

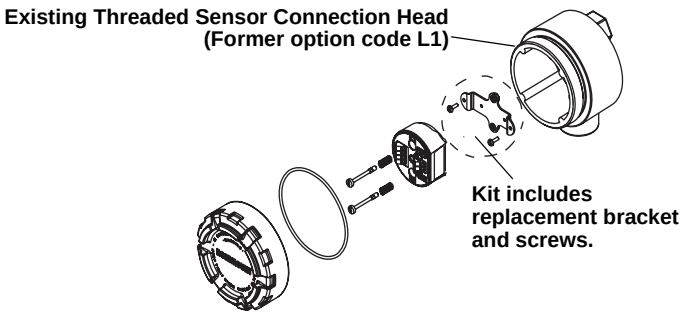
Figure 2-2. Assembling Rail Clip Hardware to a 644H



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

To mount a 644H in an existing threaded sensor connection head (former option code L1), order the 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 644H in the existing head. See Figure 2-3.

Figure 2-3. Assembling 644H for Use in an Existing L1 Connection Head

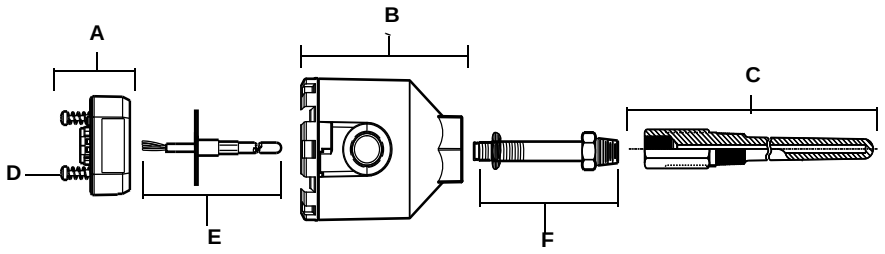


INSTALLATION

Typical European Installation

Head Mount Transmitter with DIN Plate Style Sensor

1. Attach the thermowell to the pipe or process container wall. Install and tighten the thermowell before applying process pressure.
2. Verify the transmitter failure mode switch.
3. Assemble the transmitter to the sensor. Push the transmitter mounting screws through the sensor mounting plate and insert the snap rings (optional) into the transmitter mounting screw groove.
4. Wire the sensor to the transmitter (see Figure 2-8 on page 2-10).
5. Insert the transmitter-sensor assembly into the connection head. Thread the transmitter mounting screw into the connection head mounting holes. 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 power cable leads to the transmitter power terminals. Avoid contact with sensor leads and sensor connections.
9. Install and tighten the connection head cover. Enclosure covers must be fully engaged to meet explosion-proof requirements.

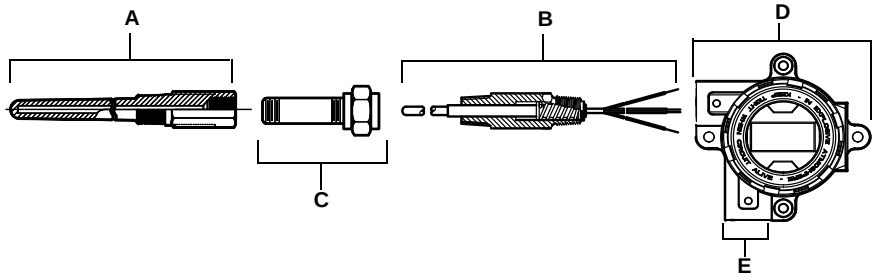


A = 644H Transmitter	D = Transmitter Mounting Screws
B = Connection Head	E = Integral Mount Sensor with Flying Leads
C = Thermowell	F = Extension

Typical North American Installation

Head Mount Transmitter with Threaded Sensor

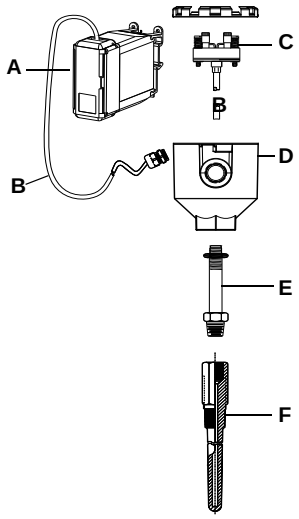
1. Attach the thermowell to the pipe or process container wall. Install and tighten thermowells before applying process pressure.
2. Attach necessary extension nipples and adapters to the thermowell. Seal the nipple and adapter threads with silicone tape.
3. Screw the sensor into the thermowell. Install drain seals if required for severe environments or to satisfy code requirements.
4. Verify the transmitter failure mode switch.
5. Pull the sensor wiring leads through the universal head and transmitter. Mount the transmitter in the universal head by threading the transmitter mounting screws into the universal head mounting holes.
6. Mount the transmitter-sensor 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 other terminals.
9. Install and tighten the universal head cover. Enclosure covers must be fully engaged to meet explosion-proof requirements.



A = Threaded Thermowell	D = Universal Head
B = Threaded Style Sensor	E = Conduit Entry
C = Standard Extension	

Rail Mount Transmitter and Sensor

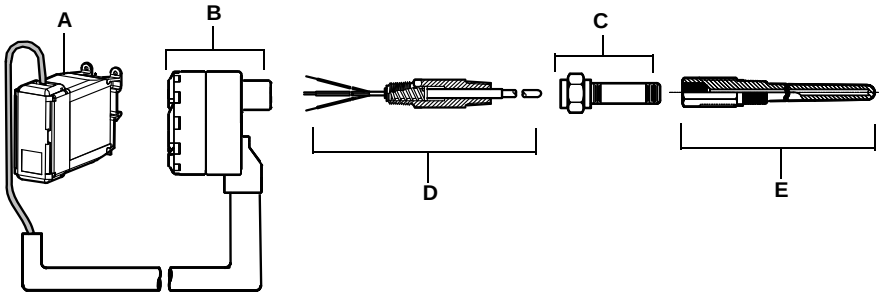
1. Attach the transmitter to a suitable rail or panel.
2. Attach the thermowell to the pipe or process container wall. Install and tighten the thermowell, according to plant standards, before applying pressure.
3. Attach the sensor to the connection head and mount the entire assembly to the thermowell.
4. Attach and connect sufficient lengths of sensor lead wire from the connection head to the sensor terminal block.
5. 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. Verify the transmitter failure mode switch.
8. Attach the sensor wires to the transmitter (see Figure 2-8 on page 2-10).



A = Rail Mount Transmitter
B = Sensor Leads with Cable Glands
C = Integral Mount Sensor with Terminal Block
D = Connection Head
E = Standard Extension
F = Threaded Thermowell

Rail Mount Transmitter with Threaded Sensor

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.
10. Attach the sensor wires to the transmitter (see Figure 2-8 on page 2-10).



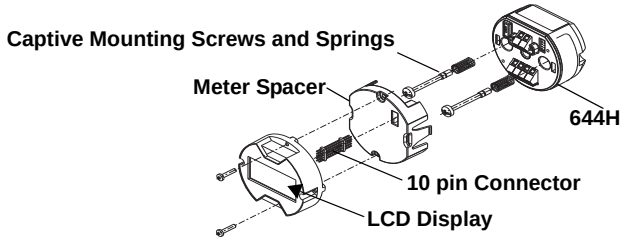
A = Rail Mount Transmitter	C = Standard Extension
B = Threaded Sensor Connection Head	D = Threaded Style Sensor
	E = Threaded Thermowell

LCD Display Installation

The LCD display provides local indication of the transmitter output and abbreviated diagnostic messages governing transmitter operation. Transmitters ordered with the LCD display 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 display assembly (includes LCD display, meter spacer, and 2 screws)
- Meter cover with O-ring in place

Figure 2-4. Installing the LCD Display



Use the following procedure to install the meter.

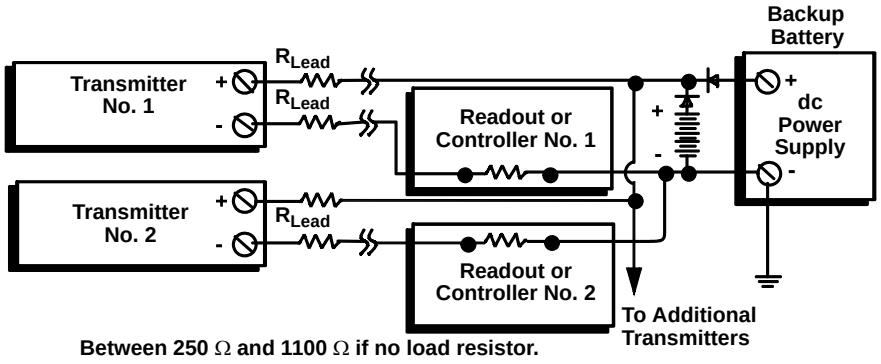
1. If the transmitter is installed in a loop, secure the loop and disconnect the power. If the transmitter is installed in an enclosure, remove the cover from the enclosure.
2. Decide meter orientation (the meter can be rotated in 90° increments). To change meter orientation, remove the screws located 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 Field Communicator, AMS software tool to configure the meter to the desired display. Refer to “LCD Meter Options (644H Only)” for information on configuring the LCD display.

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

Multichannel Installations

In a HART installation, several transmitters can be connected to a single master power supply, as shown in Figure 2-5. 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 2-5 prevent unwanted charging or discharging of the back-up battery.

Figure 2-5. Multichannel Installations



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 Vdc.

⚠ 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 Vdc. A constant 42.4 volts across the sensor terminals may damage the unit.)

For multichannel HART installations, see above. The transmitters will accept inputs from a variety of RTD and thermocouple types. Refer to Figure 2-6 on page 2-10 when making sensor connections.

Use the following steps to wire the power and sensor to the transmitter:

1. Remove the terminal block cover (if applicable).
2. Connect the positive power lead to the "**+**" terminal. Connect the negative power lead to the "**–**" terminal (see Figure 2-7).
3. Tighten the terminal screws. When tightening the sensor and power wires, the max torque is 6-in.-lbs (0.7 N-m).
4. Reattach and tighten the cover (if applicable).
5. Apply power (see "Power Supply").

Figure 2-6. Transmitter Power, Communication, and Sensor Terminals

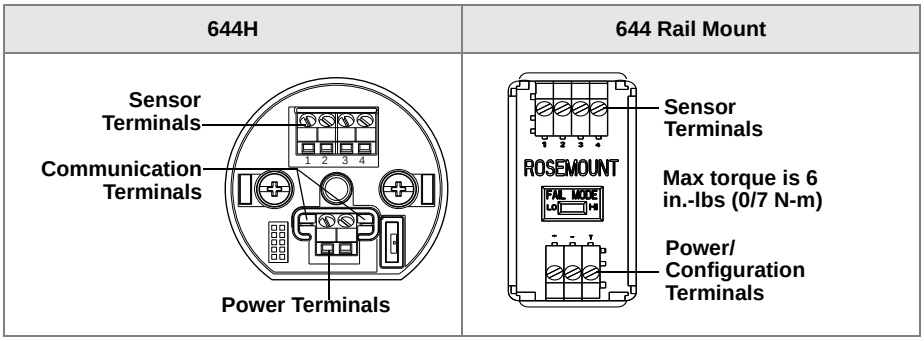
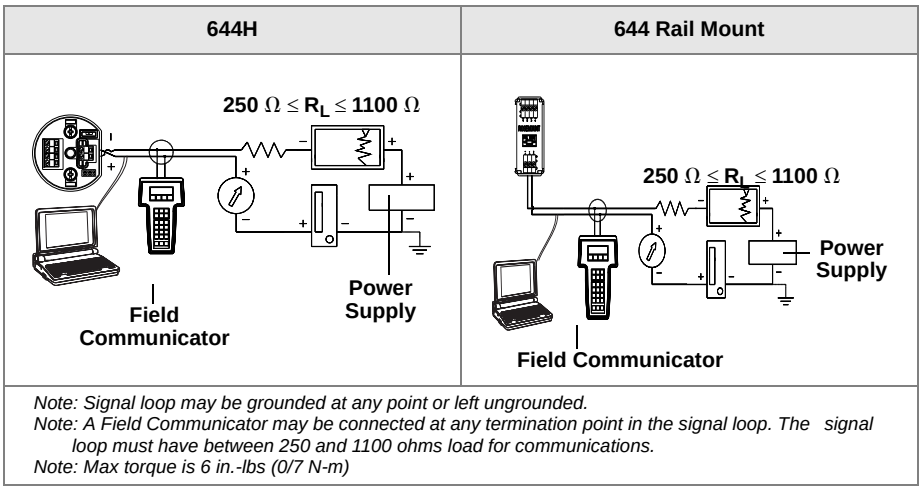


Figure 2-7. Connecting a HART Communication Tool to a Transmitter Loop

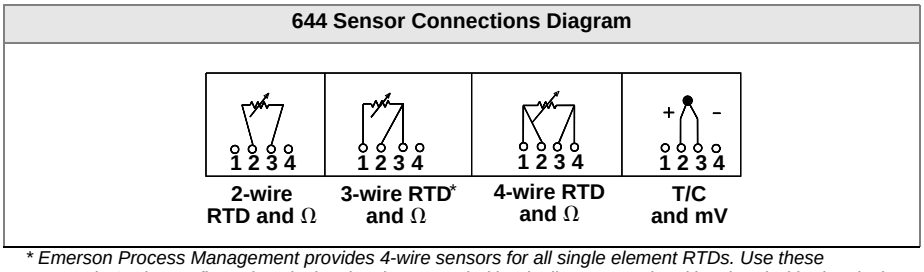


Note: Signal loop may be grounded at any point or left ungrounded.
Note: A Field Communicator may be connected at any termination point in the signal loop. The signal loop must have between 250 and 1100 ohms load for communications.
Note: Max torque is 6 in.-lbs (0/7 N-m)

Sensor Connections

⚠ The 644 is compatible with a number of RTD and thermocouple sensor types. Figure 2-8 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.

Figure 2-8. Sensor Wiring Diagrams



** Emerson Process Management provides 4-wire sensors for all single element RTDs. Use these RTDs in 3-wire configurations by leaving the unneeded leads disconnected and insulated with electrical tape.*

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.

RTD or Ohm Inputs

The transmitters will accept a variety of RTD configurations, including 2-wire, 3-wire or 4-wire. 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 60 ohms per lead (equivalent to 6,000 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/m °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

$$= \frac{(0.0039\ \Omega / \Omega\ °C) \times (25\ °C) \times (0.5\ \Omega)}{(0.00385\ \Omega / \Omega\ °C) \times (100\Omega)} = \pm 0.1266 °C$$

- 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

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

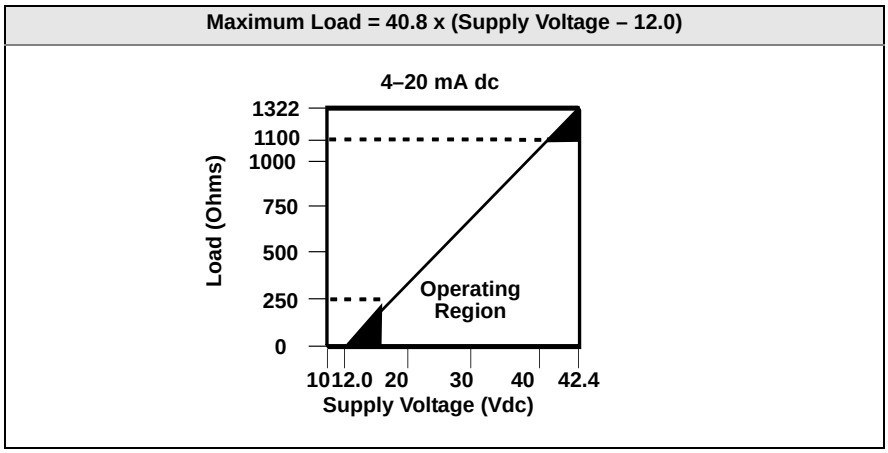
POWER SUPPLY

Installation

To communicate with a transmitter, a 18.1 Vdc minimum power supply is required. The power supplied to the transmitter should not drop below the transmitter lift-off voltage (see Figure 2-9). 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 2 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 2-9. Load Limits



Ground the Transmitter

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 Vdc/ac rms (707 Vdc), so the input circuit may also be grounded at any single point. When using a grounded thermocouple, the grounded junction serves as this point.

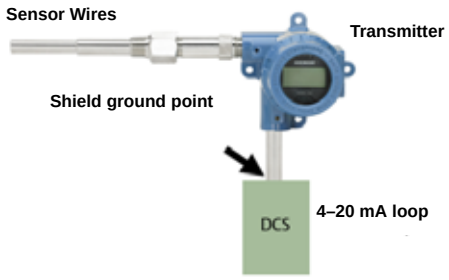
NOTE
Do not ground the signal wire at both ends.

Ungrounded Thermocouple, mV, and RTD/Ohm Inputs

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

Option 1:

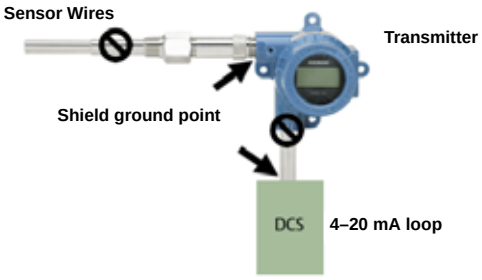
1. Connect signal wiring shield to the sensor wiring shield.
2. Ensure the two shields are tied together and electrically isolated from the transmitter housing.
3. Ground shield at the power supply end only.
4. Ensure that the sensor shield is electrically isolated from the surrounding grounded fixtures.



Connect shields together, electrically isolated from the transmitter

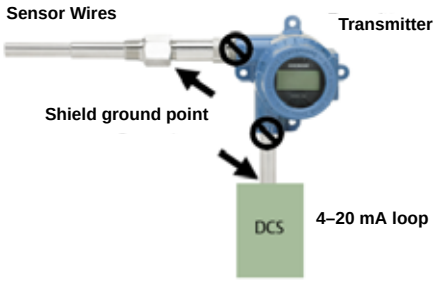
Option 2:

1. Connect sensor wiring shield to the transmitter housing (only if the housing is grounded).
2. Ensure the sensor shield is electrically isolated from surrounding fixtures that may be grounded.
3. Ground signal wiring shield at the power supply end.



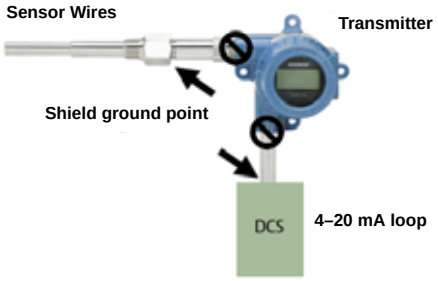
Option 3:

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



Grounded Thermocouple Inputs

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



Section 3 Configuration

OVERVIEW

This section contains information on commissioning and tasks that should be performed on the bench prior to installation. The Field Communicator and instructions are given to perform configuration functions.

For convenience, Field Communicator fast key sequences are labeled “Fast Keys” for each software function below the appropriate headings.

Traditional Interface Fast Keys	1, 2, 3, etc.
Device Dashboard Fast Keys	1, 2, 3, etc.

For additional information, refer to the HART Communication Reference Manual (Document Number 00809-0100-4276). AMS help can be found in the AMS on-line guides within the AMS system.

SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises 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

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 Field 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.
- 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.

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 470 Transient Protector. Refer to the 470 Transient Protector Product Data Sheet (document number 00813-0100-4191) for more information.

COMMISSIONING

The 644 must be configured for certain basic variables to operate. 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.

Commissioning consists of testing the transmitter and verifying transmitter configuration data. 644 transmitters can be commissioned either before or after installation. Commissioning the transmitter on the bench before installation using a Field Communicator or AMS ensures that all transmitter components are in working order.

⚠ To commission on the bench, connect the transmitter and the Field Communicator or AMS as shown in Figure 2-7 on page 2-10. Make sure the instruments in the loop are installed according to intrinsically-safe or non-incendive field wiring practices before connecting a communication in an explosive atmosphere. Connect HART Communication leads at any termination point in the signal loop. For convenience, connect them to the terminals labeled “COMM” on the terminal block. Connecting across the “TEST” terminals will prevent successful communication. Avoid exposing the transmitter electronics to the plant environment after installation by setting all transmitter jumpers during the commissioning stage on the bench.

When using a Field Communicator, any configuration changes made must be sent to the transmitter by using the “Send” key (F2). AMS configuration changes are implemented when the “Apply” button is clicked.

For more information on using the Field Communicator with the 644 transmitter, see Section 3: Configuration.

Setting the Loop to Manual

When sending or requesting data that would disrupt the loop or change the output of the transmitter, set the process application loop to manual. The Field Communicator or AMS will prompt you to set the loop to manual when necessary. Acknowledging this prompt does not set the loop to manual. The prompt is only a reminder; set the loop to manual as a separate operation.

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 by the factory or using the Field 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 “Hardware and Software Failure Mode” on page A-7 for standard and NAMUR-compliant operation parameters.

Changing Switch Positions

To change the failure mode on the 644 transmitter, follow the steps below.

⚠ 1. If applicable, remove the enclosure cover.
2. Locate the orange failure mode switch. On the 644H, the switch is located near the power terminals and located in the center of the front panel on the 644 rail mount (see Figure 2-6).
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.

FIELD COMMUNICATOR

The Field 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 Field Communicator in parallel with the transmitter (see Figure 2-11). Use the loop connection ports on the rear panel of the Field Communicator. The connections are non-polarized. Do not make connections to the serial port or the NiCad recharger jack in explosive atmospheres. Before connecting the Field 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.

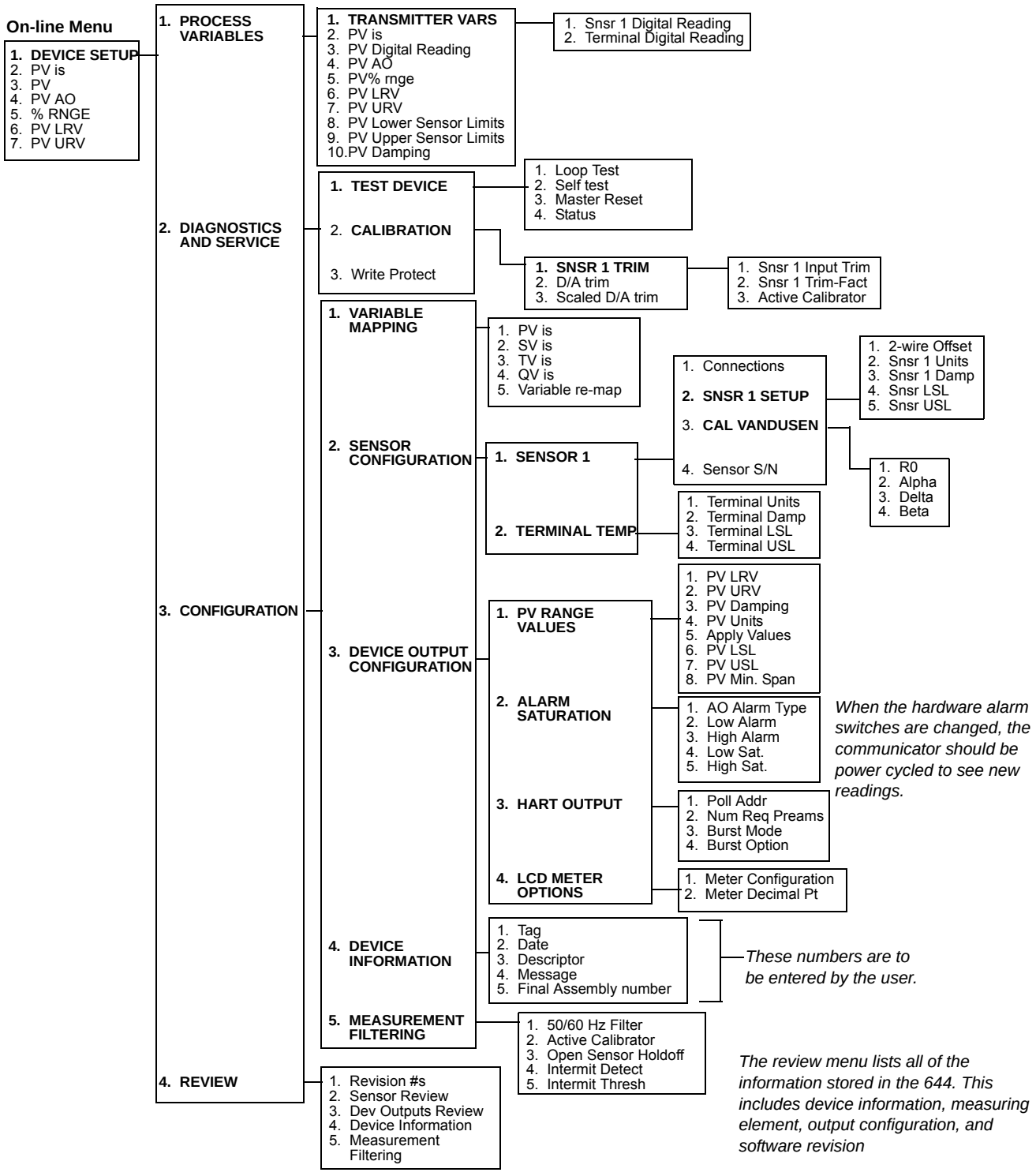
For more information regarding the Field Communicator, please see the Field Communicator Reference Manual.

CONFIGURATION

The 644 transmitter can be configured either on-line or off-line using a Field Communicator or AMS. During on-line configuration, the transmitter is connected to a Field 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 Field 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.

Traditional Interface Menu Tree

Options listed in bold type indicate that a selection provides other options.



Traditional Fast Key Sequence

Table 3-1 lists the fast key sequences for common transmitter functions.

NOTE:
The fast key sequences assume that DD Dev v6, DD v1 is being used. Some features apply only to the 644H, as noted in the following pages. Table 3-1 provides alphabetical function lists for all Field Communicator tasks as well as their corresponding fast key sequences.

Table 3-1. Traditional Fast Key Sequence

Function	Fast Keys		Function	Fast Key
Active Calibrator	1, 2, 2, 1, 3		Num Req Preams	1, 3, 3, 3, 2
Alarm/Saturation	1, 3, 3, 2		Open Sensor Holdoff	1, 3, 5, 3
AO Alarm Type	1, 3, 3, 2, 1		Percent Range	1, 1, 5
Burst Mode	1, 3, 3, 3, 3		Poll Address	1, 3, 3, 3, 1
Burst Option	1, 3, 3, 3, 4		Process Temperature	1, 1
Calibration	1, 2, 2		Process Variables	1, 1
Callendar-Van Dusen	1, 3, 2, 1		PV Damping	1, 3, 3, 1, 3
Configuration	1, 3		PV Unit	1, 3, 3, 1, 4
D/A Trim	1, 2, 2, 2		Range Values	1, 3, 3, 1
Damping Values	1, 1, 10		Review	1, 4
Date	1, 3, 4, 2		Scaled D/A Trim	1, 2, 2, 3
Descriptor	1, 3, 4, 3		Sensor Connection	1, 3, 2, 1, 1
Device Info	1, 3, 4		Sensor 1 Setup	1, 3, 2, 1, 2
Device Output Configuration	1, 3, 3		Sensor Serial Number	1, 3, 2, 1, 4
Diagnostics and Service	1, 2		Sensor 1 Trim	1, 2, 2, 1
Filter 50/60 Hz	1, 3, 5, 1		Sensor 1 Trim-Factory	1, 2, 2, 1, 2
Hardware Rev	1, 4, 1		Sensor Type	1, 3, 2, 1, 1
Hart Output	1, 3, 3, 3		Software Revision	1, 4, 1
Intermittent Detect	1, 3, 5, 4		Status	1, 2, 1, 4
LCD Display Options	1, 3, 3, 4		Tag	1, 3, 4, 1
Loop Test	1, 2, 1, 1		Terminal Temperature	1, 3, 2, 2,
LRV (Lower Range Value)	1, 1, 6		Test Device	1, 2, 1
LSL (Lower Sensor Limit)	1, 1, 8		URV (Upper Range Value)	1, 1, 7
Measurement Filtering	1, 3, 5		USL (Upper Sensor Limit)	1, 1, 9
Message	1, 3, 4, 4		Variable Mapping	1, 3, 1
Meter Configuring	1, 3, 3, 4, 1		Variable Re-Map	1, 3, 1, 5
Meter Decimal Point	1, 3, 3, 4, 2		Write Protect	1, 2, 3
			2-Wire Offset	1, 3, 2, 1, 2, 1

DEVICE DASHBOARD MENU TREE

Figure 3-1. 644 Device Dashboard - Overview

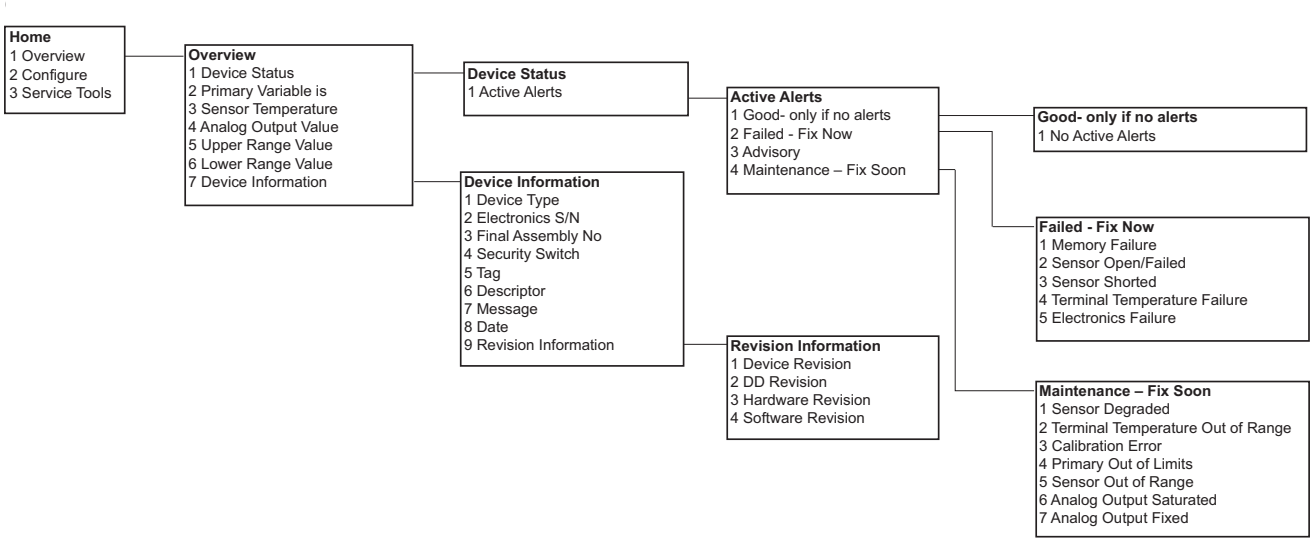


Table 3-2. 644 Device Dashboard - Configure

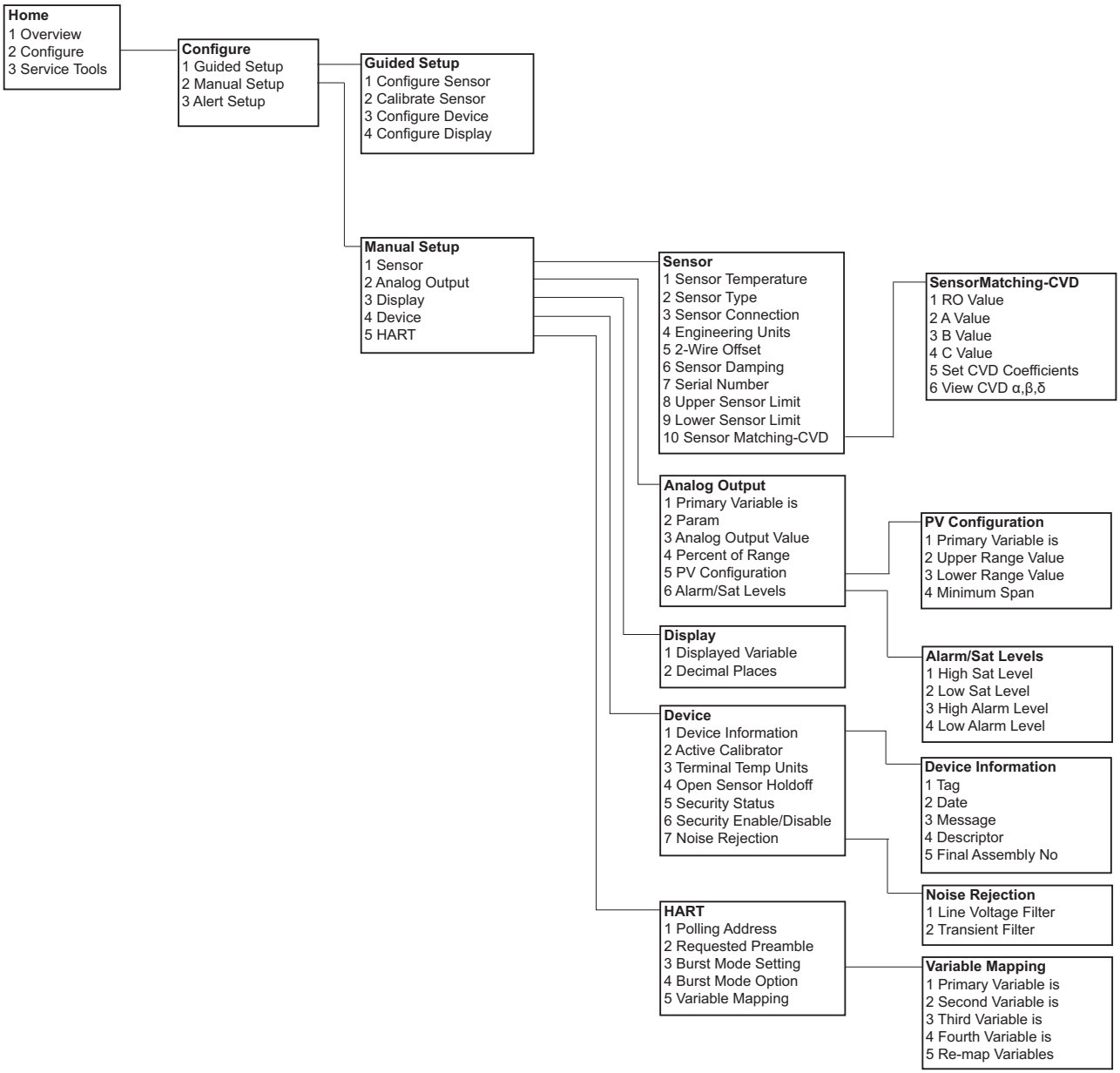
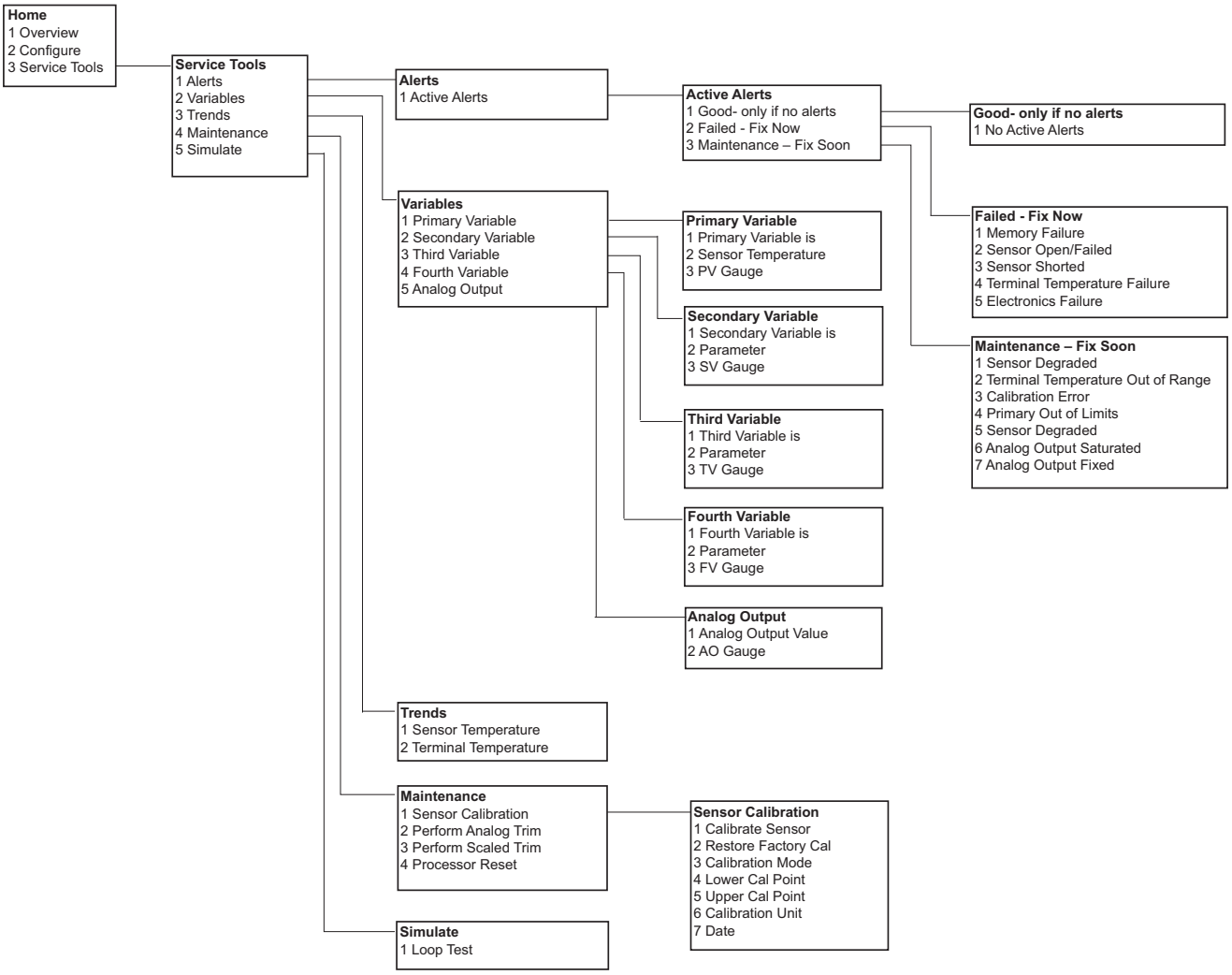


Table 3-3. 644 Device Dashboard - Service Tools



Device Dashboard Fast Key Sequences

Table 3-4 lists the fast key sequences for common transmitter functions.

NOTE:
The fast key sequences assume that DD Dev v6, DD v1 is being used. Some features apply only to the 644H, as noted in the following pages. Table 3-4 provides alphabetical function lists for all Field Communicator tasks as well as their corresponding fast key sequences.

Table 3-4. Device Dashboard Fast Key Sequence

Function	Fast Keys		Function	Fast Key
Active Calibrator	2, 2, 4, 2		Open Sensor Holdoff	2, 2, 4, 4
Alarm/Saturation	2, 2, 2, 6		Percent Range	2, 2, 2, 3
Burst Mode	2, 2, 5, 3		Poll Address	2, 2, 5, 1
Burst Option	2, 2, 5, 4		PV Damping	2, 2, 1, 6
Calibration	2, 1, 2		PV Unit	2, 2, 1, 4
Callendar-Van Dusen	2, 2, 1, 10		Range Values	2, 2, 2, 5
Configuration	2, 1, 1		Review	2, 2
D/A Trim	3, 4, 2		Scaled D/A Trim	3, 4, 3
Damping Values	2, 2, 1, 6		Sensor Connection	2, 2, 1, 3
Date	1, 7, 8		Sensor 1 Setup	2, 2, 1
Descriptor	1, 7, 6		Sensor Serial Number	2, 2, 1, 7
Device Info	1, 7		Sensor 1 Trim	3, 4, 1
Device Output Configuration	1, 1, 3		Sensor 1 Trim-Factory	3, 4, 1, 2
Filter 50/60 Hz	2, 2, 4, 7, 1		Sensor Type	2, 2, 1, 2
Hardware Rev	1, 7, 9, 3		Software Revision	1, 7, 9, 4
Hart Output	2, 2, 5		Tag	2, 2, 4, 1, 1
LCD Display Options	2, 2, 3		Terminal Temperature	3, 3, 2
Loop Test	3, 5, 1		URV (Upper Range Value)	2, 2, 2, 5, 2
LRV (Lower Range Value)	2, 2, 2, 5, 3		USL (Upper Sensor Limit)	2, 2, 1, 8
LSL (Lower Sensor Limit)	2, 2, 1, 9		Variable Mapping	2, 2, 5, 5
Message	1, 7, 7		Variable Re-Map	2, 2, 5, 5, 5
Meter Configuring	2, 2, 3, 1		Write Protect	2, 2, 4, 6
Meter Decimal Point	2, 2, 3, 2		2-Wire Offset	2, 2, 1, 5
Num Req Preams	2, 2, 5, 2			

REVIEW CONFIGURATION DATA

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

Review

Traditional Fast Keys	1, 4
Device Dashboard Fast Keys	2, 2

When activating the *Review* function, scroll through the configuration data list to check each process 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 644 digital output parameters to ensure that the transmitter is operating properly.

Process Variables

Traditional Fast Keys	1, 1
Device Dashboard Fast Keys	2, 2, 2

The *Process Variables* menu displays process variables, including sensor temperature, percent of range, analog output, and terminal temperature. These process variables are continuously updated. The primary variable is the 4 –20 mA analog signal. The secondary variable is the transmitter terminal temperature.

CONFIGURATION

The 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

Traditional Fast Keys	1, 3, 1
Device Dashboard Fast Keys	2, 2, 5, 5

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

Traditional Fast Keys	1, 3, 2, 1, 1
Device Dashboard Fast Keys	2, 2, 1, 2

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

- 2-, 3-, or 4-wire Pt 100, Pt 200, Pt 500, Pt 1000 RTDs: α = 0.00385 Ω/Ω/°C
- 2-, 3- or 4-wire Pt 100, PT 200: α = 0.003916 Ω/Ω/°C
- 2-, 3- or 4-wire Cu 50, Cu 100: α =0.00428 Ω/Ω/°C
- 2-, 3-, or 4-wire Ni 120 nickel RTDs
- 2-, 3-, or 4-wire Cu 10 RTDs
- 2-, 3- or 4-wire Cu 50, Cu 100: α =0.00426 Ω/ Ω/°C
- IEC/NIST/Type B, E, J, K, R, N, S, T thermocouples
- DIN type L, U thermocouples
- ASTM Type W5Re/W26Re thermocouple
- GOST Type L thermocouple
- –10 to 100 millivolts
- 2-, 3-, or 4-wire 0 to 2000 ohms

Contact a Emerson Process Management representative for information on the temperature sensors, thermowells, and accessory mounting hardware that is available through Emerson Process Management.

Sensor Serial Number

Traditional Fast Keys	1, 3, 2, 1, 4
Device Dashboard Fast Keys	2, 2, 1, 7

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.

Set Output Units

Traditional Fast Keys	1, 3, 2, 1, 2, 2
Device Dashboard Fast Keys	2, 2, 1, 4

The *Set Output 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

50/60 Hz Filter

Traditional Fast Keys	1, 3, 5, 1
Device Dashboard Fast Keys	2, 2, 4, 7, 1

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

Terminal Temperature

Traditional Fast Keys	1, 3, 2, 2, 2
Device Dashboard Fast Keys	3, 3, 2

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

LCD Meter Options (644H Only)

Traditional Fast Keys	1, 3, 3, 4
Device Dashboard Fast Keys	2, 2, 3

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 with the Traditional Fast key sequence 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 Of Range, Analog Output. As many outputs as desired can be turned ON at once.
3. Press F4, ENTER, and then F2, SEND, to send the information to the transmitter. The LCD display will scroll through the outputs selected in step 2.

To change the decimal point configuration, perform the following steps with the Traditional Fast key sequence:

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.

Process Variable (PV) Damping

Traditional Fast Keys	1, 3, 3, 1, 3
Device Dashboard Fast Keys	2, 2, 1, 6

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 the 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 off and the transmitter output reacts to changes in input as quickly as the intermittent sensor algorithm allows (refer to “Intermittent Threshold” on page 3-18 for a description of the intermittent sensor algorithm). Increasing the damping value increases the transmitter response time.

With damping enabled, if the temperature change is within 0.2% of the sensor limits, 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

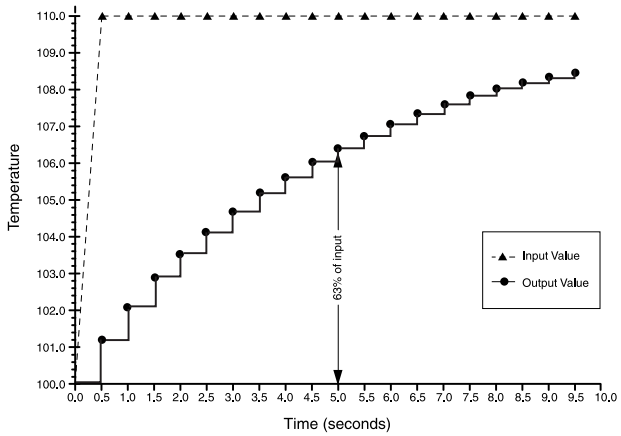
T = damping time constant

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

For example, as illustrated in Figure 3-2, if the temperature undergoes a step change—within 0.2% of the sensor limits—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% 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 0.2% of the sensor limits, refer to “Intermittent Threshold” on page 3-18.

Figure 3-2. Change in Input vs. Change in Output with Damping Set to Five Seconds



2-Wire RTD Offset

Traditional Fast Keys	1, 3, 2, 1, 2, 1
Device Dashboard Fast Keys	2, 2, 1, 5

The *2-Wire RTD 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– RTD Input” on page 2-11 for more information.

To utilize this feature perform the following steps with Traditional Fast key sequence:

1. Measure the lead wire resistance of both RTD leads after installing the 2-wire RTD and the 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 Field 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

Traditional Fast Keys	1, 3, 4, 1
Device Dashboard Fast Keys	2, 2, 4, 1, 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 the application. The tag defined is automatically displayed when a Field 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

Traditional Fast Keys	1, 3, 4, 2
Device Dashboard Fast Keys	2, 2, 4, 1, 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 Field Communicator.

Descriptor

Traditional Fast Keys	1, 3, 4, 3
Device Dashboard Fast Keys	2, 2, 4, 1, 4

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 Field Communicator.

Message

Traditional Fast Keys	1, 3, 4, 4
Device Dashboard Fast Keys	2, 2, 4, 1, 3

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 Field Communicator.

DIAGNOSTICS AND SERVICE

Loop Test

Traditional Fast Keys	1, 2, 1, 1
Device Dashboard Fast Keys	3, 5, 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 with Traditional Fast Key sequence:

1. Connect a reference meter to the transmitter. To do so, shunt the transmitter power through the meter at some point in the loop.
2. 644H: From the **HOME** screen, select *1 Device Setup*, *2 Diag/Serv*, *1 Test Device*, *1 Loop Test* before performing a loop test.
   644 rail mount, select *1 Device Setup*, *2 Diagnostics and Service, 2 Loop Test*. Select **OK** after setting 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 mA.
4. Check the current meter installed in the test loop to verify that it reads the value that was commanded 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 another output value can be chosen.

Master Reset

Traditional Fast Keys	1, 2, 1, 3
Device Dashboard Fast Keys	3, 5, 4

Master Reset resets the electronics without actually powering down the unit. It does not return the transmitter to the original factory configuration.

Active Calibrator

Traditional Fast Keys	1, 2, 2, 1, 3
Device Dashboard Fast Keys	2, 2, 4, 2

The *Active Calibrator Mode* command enables or disables the pulsating current feature. The transmitter ordinarily operates with pulsating current so that sensor diagnostic functions, such as open sensor detection and EMF compensation, can be performed correctly. Some calibration equipment requires steady current to function properly. By enabling the Active Calibrator Mode, the transmitter stops sending pulsating current to the sensor and supples a steady current. Disabling the Active Calibrator returns the transmitter to its normal operating state of sending a pulsating current to the sensor, thus enabling the sensor diagnostic functions.

The Active Calibrator Mode is volatile and will be automatically disabled when power is cycled or when a Master Reset is performed using the Field Communicator.

NOTE
The Active Calibrator Mode must be disabled before returning the transmitter to the process. This will ensure that the full diagnostic capabilities of the 644 are available.

Disabling or enabling the Active Calibrator Mode will not change any of the sensor trim values stored in the transmitter.

Sensor Review

Traditional Fast Keys	1, 4, 2
Device Dashboard Fast Keys	2, 2, 2

The *Signal Condition* command allows viewing or changing the primary variable lower and upper range values, sensor percent of range, and alarm and saturation.

Write Protect

Traditional Fast Keys	1, 2, 3
Device Dashboard Fast Keys	2, 2, 4, 6

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 with Traditional Fast Key sequence:

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 644, repeat the procedure, replacing *Enable WP* with *Disable WP*.

HART Output

Traditional Fast Keys	1, 3, 3, 3
Device Dashboard Fast Keys	2, 2, 5

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

Alarm and Saturation

Traditional Fast Keys	1, 3, 3, 2
Device Dashboard Fast Keys	2, 2, 2, 6

The *Alarm/Saturation* command allows the alarm settings (Hi or Low) and saturation values to be viewed and changed. To change the alarm values and saturation values, select the value to be changed, either *2 Low Alarm*, *3 High Alarm*, *4 Low Sat.*, or *5 High Sat*. Enter the desired new value, which 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 $3.8 \leq S \leq 3.9$ 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 $20.5 \leq S \leq 20.7$ mA.

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.

PV Range Values

Traditional Fast Keys	1, 3, 3, 1
Device Dashboard Fast Keys	2, 2, 2, 5

The *PV URV* and *PV LRV* commands, found in the *PV Range Values* menu screen, allow the user to set the transmitter's lower and upper range values using limits of expected readings. The range of expected readings is defined by the Lower Range Value (LRV) and Upper Range Value (URV). The transmitter range values can be reset 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.

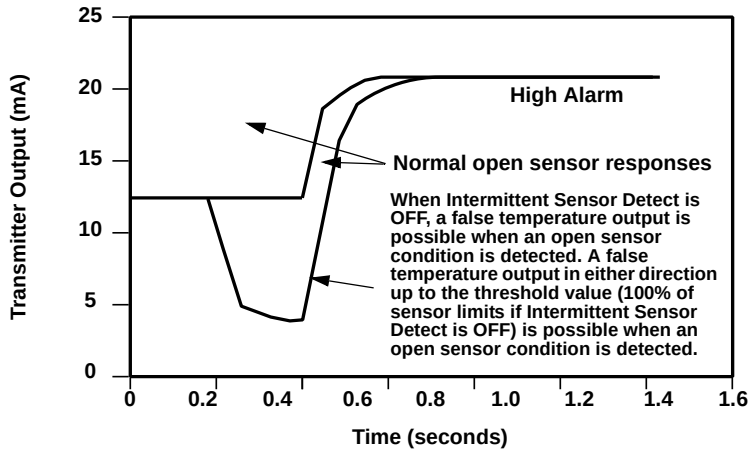
NOTE:
The rerange functions should not be confused with the trim functions. Although the rerange command matches a sensor input to a 4–20 mA output, as in conventional calibration, it does not affect the transmitter's interpretation of the input.

Intermittent Threshold

Traditional Fast Keys	1, 3, 5, 4
Device Dashboard Fast Keys	2, 2, 4, 7

The threshold value can be changed from the default value of 2%. 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 up to one update in either direction (see Figure 3-4 on page 3-20) up to the threshold value (100% of sensor limits if Intermittent Sensor Detect is **OFF)**. Unless rapid response rate is necessary, the suggested setting of the Intermittent Sensor Detect mechanism is **ON** with 2% threshold.

Figure 3-3. Open Sensor Response



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 one update). By default, the transmitter is shipped with the Intermittent Sensor Detect feature switched ON and the threshold value set at 2% of sensor limits. 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 sensor limits with a Field 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.

The threshold value of the 644 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 sensor limits.

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.

Open Sensor Holdoff

Traditional Fast Keys	1, 3, 5, 3
Device Dashboard Fast Keys	2, 2, 4, 4

The *Open Sensor Holdoff* option, at the normal setting, enables the 644 to be more robust under heavy EMI conditions. This is accomplished through the software by having the transmitter perform additional verification of the open sensor status prior to activating the transmitter alarm. If the additional verification shows that the open sensor condition is not valid, the transmitter will not go into alarm.

For users of the 644 that desire a more vigorous open sensor detection, the Open Sensor Holdoff option can be changed to a fast setting. With this setting, the transmitter will report an open sensor condition without additional verification of the open condition.

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 Rosemount 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.

A Field Communicator can test, configure, and format a multidropped 644 transmitter in the same way as in a standard point-to-point installation.

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 3-4. Typical Multidropped Network

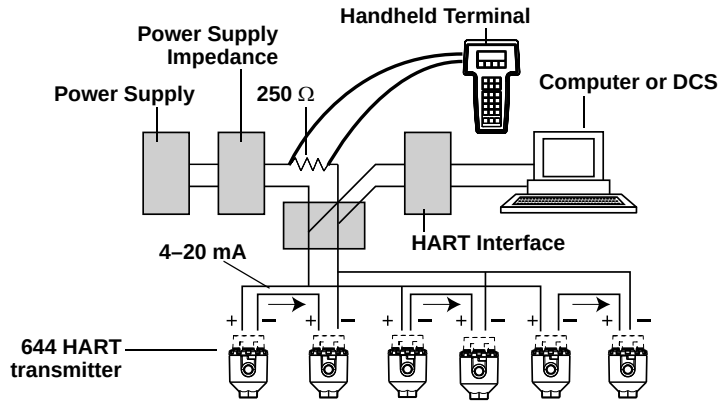


Figure 3-4 shows a typical multidrop network. Do not use this figure as an installation diagram. Contact Emerson Process Management product support with specific requirements for multidrop applications.

NOTE
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.

OPERATION AND MAINTENANCE

Calibration

Calibrating the transmitter increases the measurement precision by allowing corrections to be made to the factory-stored characterization curve by digitally altering the transmitter's interpretation of the sensor input.

To understand calibration, it is necessary to understand that smart transmitters operate differently from analog transmitters. An important difference is that smart transmitters are factory-characterized, meaning that 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.

Calibration of the 644 may include the following procedures:

- Sensor Input Trim: digitally alter the transmitter's interpretation of the input signal
- Transmitter Sensor Matching: generates a special custom curve to match that specific sensor curve, as derived from the Callendar-Van Dusen constants
- Output Trim: calibrates the transmitter to a 4–20 mA reference scale
- Scaled Output Trim: calibrates the transmitter to a user-selectable reference scale.

Trim the Transmitter

One or more of the trim functions may be used when calibrating. The trim functions are as follows

- Sensor Input Trim
- Transmitter Sensor Matching
- Output Trim
- Output Scaled Trim

Sensor Input Trim

Traditional Fast Keys	1, 2, 2, 1, 1
Device Dashboard Fast Keys	3, 4, 1, 1

Perform a sensor trim if the transmitters digital value for the primary variable does not match the plant's 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 the system.

The *Sensor Input Trim* command allows the transmitter's interpretation of the input signal to be digitally altered (see Figure 3-5). 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.

Use the following procedure to perform a sensor trim with a 644H with Traditional Fast Key sequence.

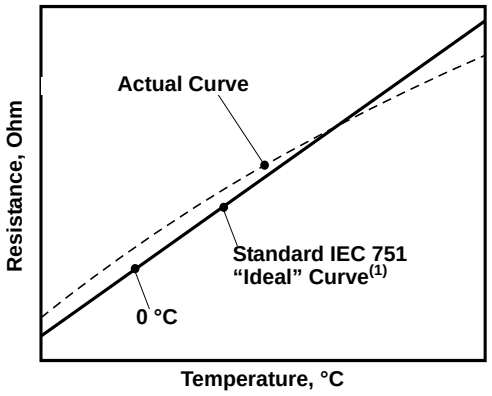
1. Connect the calibration device or sensor to the transmitter. Refer to Figure 2-9 on page 2-11 or inside of the transmitter terminal side cover for sensor wiring diagrams. (If using an active calibrator, please see “Active Calibrator” on page 3-16)
2. Connect the communicator to the transmitter loop.
3. From the Home screen, select *1 Device Setup*, *2 Diag/Service*, *2 Calibration*, *1 Sensor 1 Trim*, *1 Sensor 1 Input Trim* to prepare to trim the sensor.
4. Set the control loop to manual and select **OK**.
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 a combined sensor and transmitter system are being trimmed, 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 the selection in Step 6.

Transmitter-Sensor Matching

Traditional Fast Keys	1, 3, 2, 1
Device Dashboard Fast Keys	2, 2, 1, 10

Perform the *Transmitter Sensor Matching* procedure to enhance the temperature measurement accuracy of the system (see the comparison below) and if you have a sensor with Callendar-Van Dusen constants. When ordered from Emerson Process Management, sensors with Callendar-Van Dusen constants are NIST-traceable.

The 644 accepts Callendar-Van Dusen constants from a calibrated RTD schedule and generates the actual curve to match that specific sensor curve.



(1) The Actual Curve is identified from the Callendar-Van Dusen equation.

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	
644H	±0.15 °C	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

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

Callendar-Van Dusen equation:

$$R_t = R_o + R_o\alpha\,[t - \delta(0.01t-1)(0.01t) - \beta(0.01t - 1)(0.01t)^3]$$

The following input variables, 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 *2 Configure, 2 Manual Setup, 1 Sensor.* Set the control loop to manual and select OK.
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. Return the control loop to automatic control and select OK.

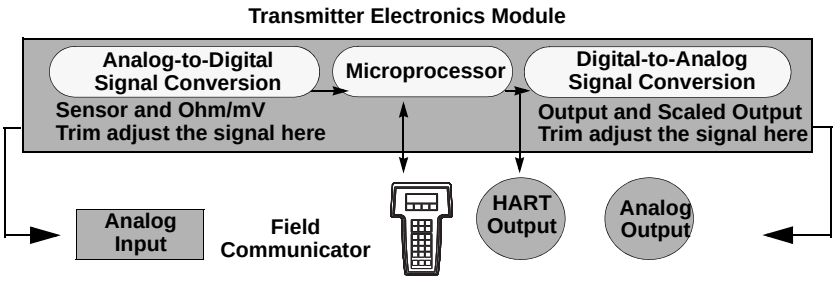
To disable the transmitter-sensor matching feature from the **HOME** screen select *2 Configure, 2 Manual Setup, 1 Sensor, 10 SensorMatching-CVD*. Choose the appropriate sensor type from the **ENTER SENSOR TYPE** prompt.

NOTE
When the transmitter-sensor matching is disabled, 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.

Output Trim or Scaled Output Trim

Perform an output trim or a scaled output trim if the digital value for the primary variable matches the plant's standards but the transmitter's analog output does not match the reading on the 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 3-15).

Figure 3-5. Dynamics of Smart Temperature Measurement



Output Trim

Traditional Fast Keys	1, 2, 2, 2
Device Dashboard Fast Keys	3, 4, 2

The *D/A Trim* command allows the transmitter's conversion of the input signal to a 4–20 mA output to be altered (see Figure 3-5 on page 3-24). Adjust the analog output signal at regular intervals to maintain measurement precision. To perform a digital-to-analog trim, perform the following procedure with Traditional Fast Key sequence:

1. From the **HOME** screen, select *1 Device setup*, *2 Diag/Service*, *2 Calibration*, *2 D/A trim*. Set the control loop to manual and select **OK**.
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 the user 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. Return the control loop to automatic control and select **OK**.

Scaled Output Trim

Traditional Fast Keys	1, 2, 2, 3
Device Dashboard Fast Keys	3, 4, 3

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.

Hardware

Maintenance

The 644H has no moving parts and requires minimal scheduled maintenance.

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 644, or consult the factory for a replacement special sensor and transmitter combination.

Diagnostic Messages

Hardware

⚠ If a malfunction is suspected despite the absence of diagnostics messages on the Field Communicator or AMS display, follow the procedures described in Table 3-5 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 3-5. 644H Troubleshooting Chart

Symptom	Potential Source	Corrective Action
Transmitter Does Not Communicate with Field Communicator	Loop Wiring	• Check the revision level of the transmitter device descriptors (DDs) stored in the communicator. The communicator should report Dev v6, DD v1. • Check for a minimum of 250 ohms resistance between the power supply and Field Communicator connection. • Check for adequate voltage to the transmitter. If a Field 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 Field 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 Vdc (over entire 3.75 to 23 mA operating range).
	Electronics Module	• Connect a Field Communicator and enter the transmitter status mode to isolate module failure. • Connect a Field 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 Vdc at the transmitter terminals (over entire 3.75 to 23 mA operating range). • Check for intermittent shorts, open circuits, and multiple grounds. • Connect a Field Communicator and enter the Loop test mode to generate signals of 4 mA, 20 mA, and user-selected values.
	Electronics Module	• Connect a Field Communicator and enter the transmitter test mode to isolate module failure.

Symptom	Potential Source	Corrective Action
Low Output or No Output	Sensor Element	• Connect a Field 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 Vdc (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 Field Communicator and enter the Loop test mode. • Check wire insulation to detect possible shorts to ground.
	Electronics Module	• Connect a Field Communicator and check the sensor limits to ensure calibration adjustments are within the sensor range. • Connect a Field Communicator and enter the Transmitter test mode to isolate an electronics module failure.

Field Communicator

Table 3-6 provides a guide to diagnostic messages used by the Field Communicator.

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 3-6. 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 Field Communicator 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 Field Communicator 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 Field Communicator 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.

Message	Description
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.
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 Field Communicator off. Press NO to turn the Field Communicator 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 Field Communicator 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 Display

The LCD displays abbreviated diagnostic messages for troubleshooting the transmitter. To determine the cause of a message, use a Field Communicator to further interrogate the transmitter. A description of each diagnostic message is identified in Table 3-7. The device sometimes requires additional interrogation to determine the source of the warning. Contact Emerson Process Management Customer Central at (800) 999-9307 for further information.

Table 3-7. LCD Display 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 Emerson Process Management 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 Specifications and Reference Data

SPECIFICATIONS

Functional

Inputs
User-selectable; sensor terminals rated to 42.4 Vdc. See “Accuracy” on page A-7 for sensor options.

Output
Single 2-wired device with either 4–20 mA/HART, linear with temperature or input.

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

Local Display
The optional five-digit integral LCD Display includes a floating or fixed decimal point. It can also display engineering units (°F, °C, °R, K, Ω, and millivolts), milliampere, 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 HART communication protocol.

Humidity Limits
0–99% relative humidity

Update Time
≤ 0.5 seconds

Accuracy (default configuration) PT 100
HART (0-100 °C): ±0.18 °C

Physical

Electrical Connections

Model	Power and Sensor Terminals
644H	Compression screws permanently fixed to terminal block
644R	Compression screw permanently fixed to front panel
WAGO® Spring clamp terminals are optional (option code G5)	

Field Communicator Connections

Communication Terminals	
644H	Clips permanently fixed to terminal block
644R	Clips permanently fixed to front panel

Materials of Construction

Electronics Housing and Terminal Block	
644H	*Noryl*® glass reinforced
644R	*Lexan*® polycarbonate
Enclosure (Option code J5 or J6)	
Housing	Low-copper aluminum
Paint	Polyurethane
Cover O-ring	Buna-N

Materials of Constructions (Stainless Steel Housing for Biotechnology, Pharmaceutical Industries, and Sanitary Applications)

Housing and Standard Meter Cover

- 316 SST

Cover O-Ring

- Buna-N

Mounting

The 644R attaches directly to a wall or a DIN rail. The 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.

Weight

Code	Options	Weight
644H	HART, Head Mount Transmitter	96 g (3.39 oz)
644R	HART, Rail Mount Transmitter	174 g (6.14 oz)
M5	LCD Display	38 g (1.34 oz)
J5, J6	Universal Head, Standard Cover	577 g (20.35 oz)
J5, J6	Universal Head, Meter Cover	667 g (23.53 oz)

Weight (Stainless Steel Housing for Biotechnology, Pharmaceutical Industries, and Sanitary Applications)

Option Code	Standard Cover	Meter Cover
S1	840 g (27 oz)	995 g (32 oz)
S2	840 g (27 oz)	995 g (32 oz)
S3	840 g (27 oz)	995 g (32 oz)
S4	840 g (27 oz)	995 g (32 oz)

Enclosure Ratings (644H)

All option codes (S1, S2, S3, S4, J5, J6, J7, and J8) are NEMA 4X, IP66, and IP68. Option code J6 is CSA Enclosure Type 4X.

Sanitary Housing Surface

Surface finish is polished to 32 RMA. Laser etched product marking on housing and standard covers.

Performance

EMC (ElectroMagnetic Compatibility)

NAMUR NE 21 Standard

The Rosemount 644 meets the requirements for the NAMUR NE 21 rating.

CE Electromagnetic Compatibility Compliance Testing

The 644 is compliant with Directive 2004/108/EC. Meets the criteria under IEC 61326:2006.

Power Supply Effect

Less than ±0.005% of span per volt

Stability

RTDs and thermocouples have a stability of ±0.15% of output reading or 0.15 °C (whichever is greater) for 24 months

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.

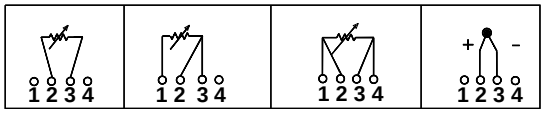
Vibration Effect

The 644 is tested to the following specifications with no effect on performance per IEC 60770-1, 1999:

Frequency	Vibration
10 to 60 Hz	0.21 mm displacement
60 to 2000 Hz	3 g peak acceleration

Sensor Connections

644244EH Sensor Connections Diagram



2-wire RTD and Ω | **3-wire RTD and Ω*** | **4-wire RTD and Ω** | **T/C and mV**

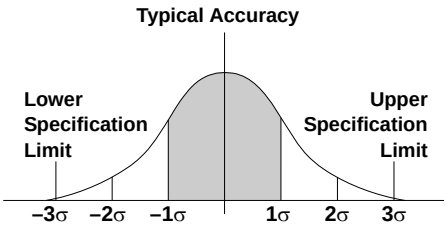
** Rosemount Inc. provides 4-wire sensors for all single element RTDs. You can use these RTDs in 3-wire configurations by leaving the unneeded leads disconnected and insulated with electrical tape.*

Rosemount Conformance to Specifications

A Rosemount product not only meets its published specifications, but most likely exceeds them. Advanced manufacturing techniques and the use of Statistical Process Control provide specification conformance to at least ± 3σ[(1)]. Our commitment to continual improvement ensures that product design, reliability, and performance will improve annually.

For example, the Reference Accuracy distribution for the 644 is shown to the right. Our Specification Limits are ± 0.15 °C, but, as the shaded area shows, approximately 68% of the units perform three times better than the limits. Therefore, it is very likely that you will receive a device that performs much better than our published specifications.

Conversely, a vendor who "grades" product without using Process Control, or who is not committed to ± 3σ performance, will ship a higher percentage of units that are barely within advertised specification limits.



Accuracy distribution shown is for the 644, Pt 100 RTD sensor, Range 0 to 100 °C

(1) Sigma (σ) is a statistical symbol to designate the standard deviation from the mean value of a normal distribution.

4–20 mA / HART SPECIFICATIONS

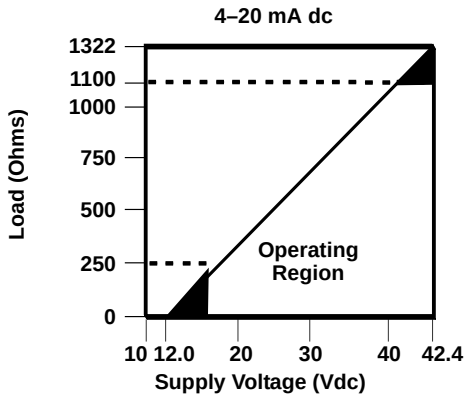
Communication Requirements

Transmitter power terminals are rated to 42.4 Vdc. A Field Communicator requires a loop resistance between 250 – 1100 ohms. The 644 HART device does not communicate when power is below 12 Vdc at the transmitter terminals.

Power Supply

An external power supply is required for HART devices. The transmitter operates on 12.0 to 42.4 Vdc transmitter terminal voltage with load resistance between 250 and 660 ohms. A minimum of 17.75 Vdc power supply is required with a load of 250 ohms. Transmitter power terminals are rated to 42.4 Vdc.

Maximum Load = 40.8 x (Supply Voltage – 12.0)



Temperature Limits

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

Hardware and Software Failure Mode

The 644 features software driven alarm diagnostics. The independent circuit is designed to provide backup alarm output if the microprocessor software fails. The alarm directions (HIGH/LO) are user-selectable using the failure mode switch. If failure occurs, the position of the switch determines the direction in which the output is driven (HI or LO). The 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, custom, or NAMUR-compliant (NAMUR recommendation NE 43, June 1997) operation. Table 1 shows the alarm ranges available for the device to be configured to.

TABLE 1. Available Alarm Range(1)

	Standard	NAMUR- NE 43 Compliant
Linear Output:	$3.9 \leq I^{(2)} \leq 20.5$	$3.8 \leq I \leq 20.5$
Fail High:	$21 \leq I \leq 23$	$21 \leq I \leq 23$
Fail Low:	$3.5 \leq I \leq 3.75$	$3.5 \leq I \leq 3.6$

(1) Measured in milliamperes.
(2) I = Process Variable (current output).

Custom Alarm and Saturation Level

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

Turn-on Time

Performance within specifications in less than 5.0 seconds after power is applied, when damping value is set to 0 seconds.

Transient Protection

The Rosemount 470 prevents damage from transients induced by lightning, welding, or heavy electrical equipment. For more information, refer to the 470 Product Data Sheet (document number 00813-0100-4191).

Accuracy

Table A-1. Rosemount 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 (α = 0.00385)	IEC 751	–200 to 850	–328 to 1562	10	18	± 0.15	± 0.27	±0.03% of span
Pt 200 (α = 0.00385)	IEC 751	–200 to 850	–328 to 1562	10	18	± 0.15	± 0.27	±0.03% of span
Pt 500 (α = 0.00385)	IEC 751	–200 to 850	–328 to 1562	10	18	± 0.19	± 0.34	±0.03% of span
Pt 1000 (α = 0.00385)	IEC 751	–200 to 300	–328 to 572	10	18	± 0.19	± 0.34	±0.03% of span
Pt 100 (α = 0.003916)	JIS 1604	–200 to 645	–328 to 1193	10	18	± 0.15	± 0.27	±0.03% of span
Pt 200 (α = 0.003916)	JIS 1604	–200 to 645	–328 to 1193	10	18	± 0.27	± 0.49	±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
Pt 50 (α = 0.00391)	GOST 6651-94	–200 to 550	–328 to 1022	10	18	± 0.30	± 0.54	±0.03% of span
Pt 100 (α = 0.00391)	GOST 6651-94	–200 to 550	–328 to 1022	10	18	± 0.15	± 0.27	±0.03% of span
Cu 50 (α = 0.00426)	GOST 6651-94	–50 to 200	–58 to 392	10	18	±1.34	± 2.41	±0.03% of span
Cu 50 (α = 0.00428)	GOST 6651-94	–185 to 200	–301 to 392	10	18	±1.34	± 2.41	±0.03% of span
Cu 100 (α = 0.00426)	GOST 6651-94	–50 to 200	–58 to 392	10	18	±0.67	± 1.20	±0.03% of span
Cu 100 (α = 0.00428)	GOST 6651-94	–185 to 200	–301 to 392	10	18	±0.67	± 1.20	±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 2501	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 900	–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
GOST Type L	GOST R 8.585-2001	–200 to 800	–328 to 1472	25	45	± 1.00	± 1.26	±0.03% of span
Other Input Types								
Millivolt Input		–10 to 100 mV				±0.015 mV		±0.03% of span
2-, 3-, 4-wire Ohm Input		0 to 2000 ohms				±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) The published digital accuracy applies over the entire sensor input range. Digital output can be accessed by HART or FOUNDATION fieldbus Communications or Rosemount control system.
(3) Total Analog accuracy is the sum of digital and D/A accuracies. This is not applicable for FOUNDATION fieldbus.
(4) Total digital accuracy for thermocouple measurement: sum of digital accuracy +0.5 °C. (cold junction accuracy).
(5) Digital accuracy for NIST Type B T/C is ±3.0 °C (±5.4 °F) from 100 to 300 °C (212 to 572 °F).
(6) Digital accuracy for NIST Type K T/C is ±0.70 °C (±1.26 °F) from –180 to –90 °C (–292 to –130 °F).

Accuracy Example

When using a Pt 100 (α = 0.00385) sensor input with a 0 to 100 °C span:

- Digital accuracy = ±0.15 °C
- D/A accuracy = ±0.03% of 100 °C or ±0.03 °C
- Total accuracy = ±0.18 °C.

Ambient Temperature Effect

Table A-2. Ambient Temperature Effect

Sensor Options	Sensor Reference	Input Range (°C)	Temperature Effects per 1.0 °C (1.8 °F) Change in Ambient Temperature[1]	Range	D/A Effect[2]
2-, 3-, 4-wire RTDs					
Pt 100 (α = 0.00385)	IEC 751	-200 to 850	0.003 °C (0.0054 °F)	Entire Sensor Input Range	0.001% of span
Pt 200 (α = 0.00385)	IEC 751	-200 to 850	0.004 °C (0.0072 °F)	Entire Sensor Input Range	0.001% of span
Pt 500 (α = 0.00385)	IEC 751	-200 to 850	0.003 °C (0.0054 °F)	Entire Sensor Input Range	0.001% of span
Pt 1000 (α = 0.00385)	IEC 751	-200 to 300	0.003 °C (0.0054 °F)	Entire Sensor Input Range	0.001% of span
Pt 100 (α = 0.003916)	JIS 1604	-200 to 645	0.003 °C (0.0054 °F)	Entire Sensor Input Range	0.001% of span
Pt 200 (α = 0.003916)	JIS 1604	-200 to 645	0.004 °C (0.0072 °F)	Entire Sensor Input Range	0.001% of span
Ni 120	Edison Curve No. 7	-70 to 300	0.003 °C (0.0054 °F)	Entire Sensor Input Range	0.001% of span
Cu 10	Edison Copper Winding No. 15	-50 to 250	0.03 °C (0.054 °F)	Entire Sensor Input Range	0.001% of span
Pt 50 (α = 0.00391)	GOST 6651-94	-200 to 550	0.004 °C (0.0072 °F)	Entire Sensor Input Range	0.001% of span
Pt 100 (α = 0.00391)	GOST 6651-94	-200 to 550	0.003 °C (0.0054 °F)	Entire Sensor Input Range	0.001% of span
Cu 50 (α = 0.00426)	GOST 6651-94	-50 to 200	0.008 °C (0.0144 °F)	Entire Sensor Input Range	0.001% of span
Cu 50 (α = 0.00428)	GOST 6651-94	-185 to 200	0.008 °C (0.0144 °F)	Entire Sensor Input Range	0.001% of span
Cu 100 (α = 0.00426)	GOST 6651-94	-50 to 200	0.004 °C (0.0072 °F)	Entire Sensor Input Range	0.001% of span
Cu 100 (α = 0.00428)	GOST 6651-94	-185 to 200	0.004 °C (0.0072 °F)	Entire Sensor Input Range	0.001% of span
Thermocouples					
Type B	NIST Monograph 175, IEC 584	100 to 1820	0.014 °C	T ≥ 1000 °C	0.001% of span
			0.032 °C – (0.0025% of (T – 300))	300 °C ≤ T < 1000 °C	0.001% of span
			0.054 °C – (0.011% of (T – 100))	100 °C ≤ T < 300 °C	0.001% of span
Type E	NIST Monograph 175, IEC 584	-50 to 1000	0.005 °C + (0.0043% of T)	All	0.001% of span
Type J	NIST Monograph 175, IEC 584	-180 to 760	0.0054 °C + (0.00029%of T)	T ≥ 0 °C	0.001% of span
			0.0054 °C + (0.0025% of absolute value T)	T < 0 °C	0.001% of span
Type K	NIST Monograph 175, IEC 584	-180 to 1372	0.0061 °C + (0.0054% of T)	T ≥ 0 °C	0.001% of span
			0.0061 °C + (0.0025% of absolute value T)	T < 0 °C	0.001% of span
Type N	NIST Monograph 175, IEC 584	-200 to 1300	0.0068 °C + (0.00036% of T)	All	0.001% of span
Type R	NIST Monograph 175, IEC 584	0 to 1768	0.016 °C	T ≥ 200 °C	0.001% of span
			0.023 °C – (0.0036% of T)	T < 200 °C	0.001% of span
Type S	NIST Monograph 175, IEC 584	0 to 1768	0.016 °C	T ≥ 200 °C	0.001% of span
			0.023 °C – (0.0036% of T)	T < 200 °C	0.001% of span
Type T	NIST Monograph 175, IEC 584	-200 to 400	0.0064 °C	T ≥ 0 °C	0.001% of span
			0.0064 °C +(0.0043% of absolute value T)	T < 0 °C	0.001% of span
DIN Type L	DIN 43710	-200 to 900	0.0054 °C + (0.00029% of T)	T ≥ 0 °C	0.001% of span
			0.0054 °C + (0.0025% of absolute value T)	T < 0 °C	0.001% of span
DIN Type U	DIN 43710	-200 to 900	0.0064 °C	T ≥ 0 °C	0.001% of span
			0.0064 °C + (0.0043% of absolute value T)	T < 0 °C	0.001% of span
Type W5Re/W26Re	ASTM E 988-96	0 to 2000	0.016 °C	T ≥ 200 °C	0.001% of span
			0.023 °C – (0.0036% of T)	T < 200 °C	0.001% of span
GOST Type L	GOST R 8.585-2001	-200 to 800	0.007 °C	T ≥ 0 °C	0.001% of span
			0.007 °C – (0.003% of absolute value T)	T < 0 °C	0.001% of span

Table A-2. Ambient Temperature Effect

Sensor Options	Sensor Reference	Input Range (°C)	Temperature Effects per 1.0 °C (1.8 °F) Change in Ambient Temperature[1]	Range	D/A Effect[2]
Other Input Types					
Millivolt Input		-10 to 100 mV	0.0005 mV	Entire Sensor Input Range	0.001% of span
2-, 3-, 4-wire Ohm		0 to 2000 Ω	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.
(2) Does not apply to FOUNDATION fieldbus.

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, each transmitter is individually characterized over this ambient temperature range at the factory.

Temperature Effects Example

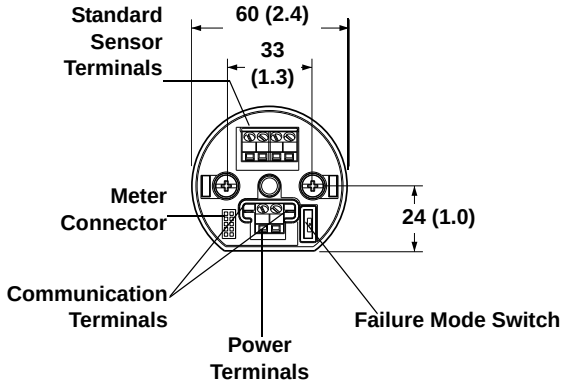
When using a Pt 100 (α = 0.00385) sensor input with a 0–100 °C span at 30 °C ambient temperature:

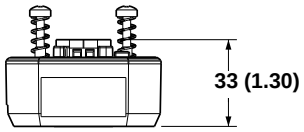
- Digital Temperature Effects: 0.003 °C x (30 - 20) = 0.03 °C
- D/A Effects: [0.001% of 100] x (30 - 20) = 0.01 °C
- Worst Case Error: Digital + D/A + Digital Temperature Effects + D/A Effects = 0.15 °C + 0.03 °C + 0.03 °C + 0.01 °C = 0.22 °C
- Total Probable Error: $\sqrt{0.15^2 + 0.03^2 + 0.03^2 +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

DIMENSIONAL DRAWINGS

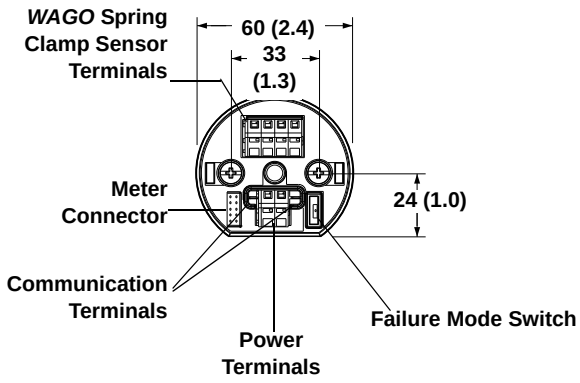
644H (DIN A Head Mount)

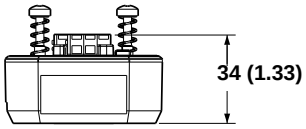
Shown with Standard Compression Screw Terminals



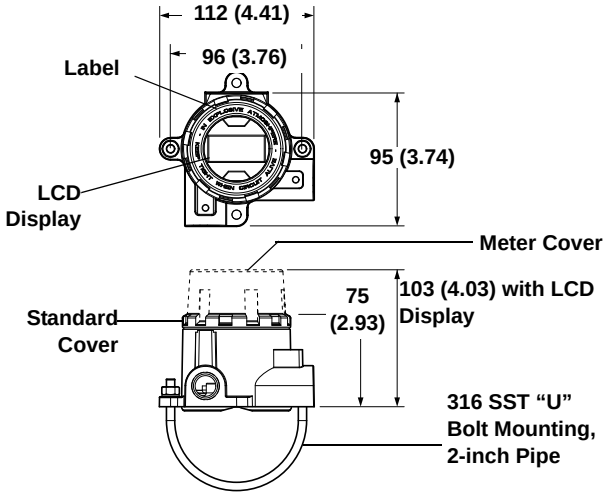


Shown with WAGO® Spring Clamp Terminals



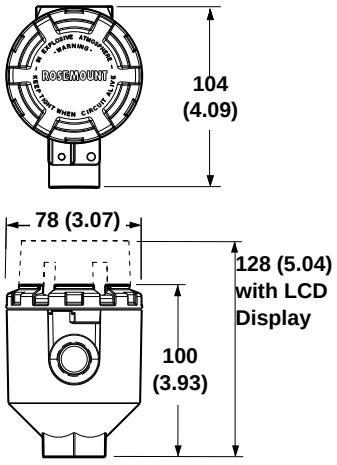


Threaded-Sensor Universal Head (Option code J5 or J6)



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

Integral DIN Style Sensor Connection Head

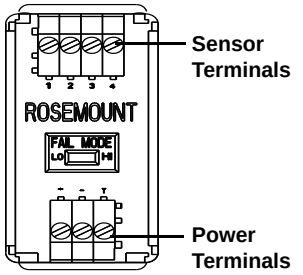


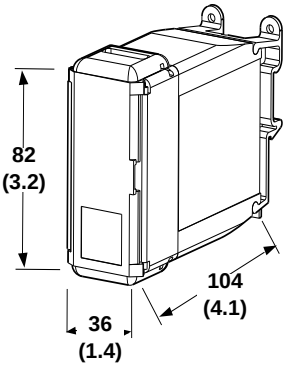
Note: The DIN Style Integral sensor connection head is only available through Volume 2 of the Rosemount Temperature Sensors and Accessories Product Data Sheet (document number 00810-0101-2654).

Dimensions are in millimeters (inches)

644 Rail Mount

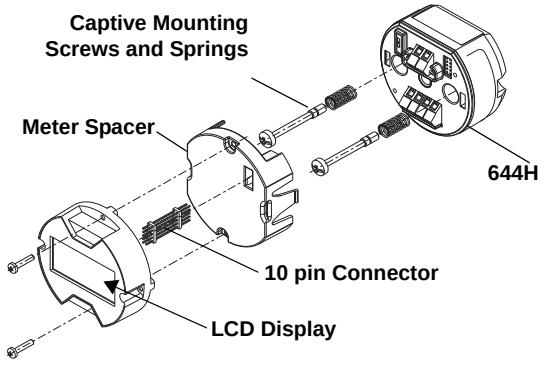
HART Protocol Only





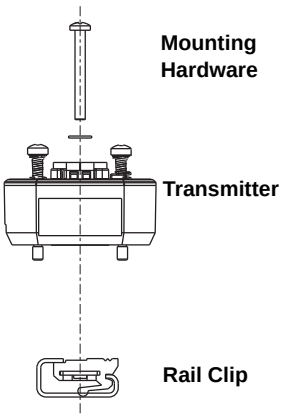
LCD Display

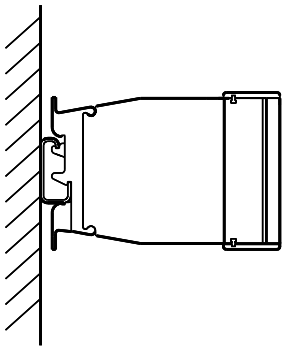
Head Mount Transmitter



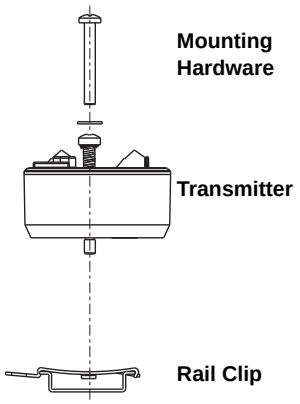
Mounting

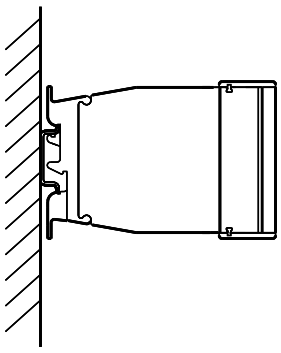
G-Rail (asymmetric)





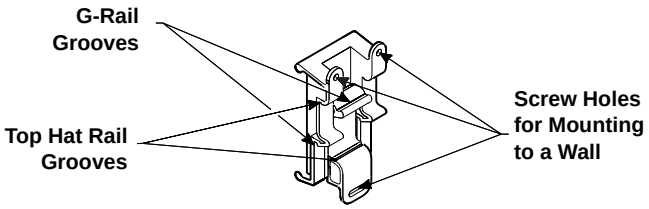
Top Hat Rail (symmetric)



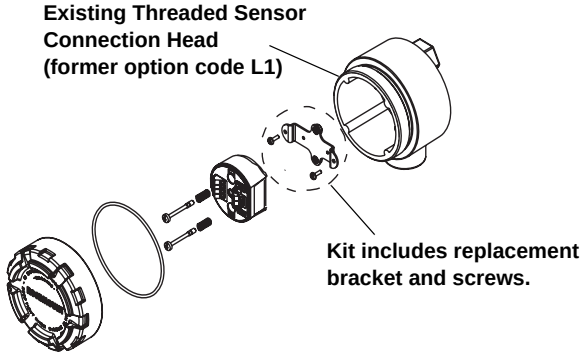


Note: Kit (part number 00644-5301-0010) includes mounting hardware and both types of rail kits.

Universal Clip for Mounting to a Wall or a Rail (part number 03044-4103-0001)



644H Retrofit Kit



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

ORDERING INFORMATION

Table A-3. Rosemount 644 Smart Temperature Transmitter Ordering Information

★ The Standard offering represents the most common models and options. These options should be selected for best delivery.
The Expanded offering is manufactured after receipt of order and is subject to additional delivery lead time.

● = Available
– = Not Available

Model	Product Description					
644	Temperature Transmitter					
Transmitter Type						
Standard						**Standard**
H	DIN A Head Mount (suitable for mounting in the field with enclosure options below)					★
R	Rail Mount					★
Output		**Head**			**Rail**	
Standard						**Standard**
A	4–20 mA with digital signal based on HART protocol	●			●	★
F	FOUNDATION fieldbus digital signal (includes 2 AI function blocks and Backup Link Active Scheduler)	●			–	★
W	Profibus PA digital signal	●			–	★
Product Certifications						
Hazardous Locations Certificates (consult factory for availability)		**A**	**F**	**W**	**A**	
Standard						**Standard**
NA	No approval	●	●	●	●	★
E5(1)	FM Explosion–Proof	●	●	●	–	★
I5(2)	FM Intrinsically Safe	●	●	●	●	★
K5(2)(1)	FM Intrinsically Safe, Explosion-Proof Combination	●	●	●	–	★
KC	FM/CSA Intrinsically Safe and Non-incendive Approval	●	●	●	–	★
I6(2)	CSA Intrinsically Safe	●	●	●	–	★
K6(1)(3)	CSA Intrinsically Safe, Explosion-Proof Combination	●	●	●	–	★
E1(1)	ATEX Flameproof	●	●	●	–	★
I1(2)	ATEX Intrinsically Safe	●	●	●	●	★
N1(1)	ATEX Type n	●	●	●	–	★
NC	ATEX Type n Component	●	●	●	●	★
ND(1)	ATEX Dust Ignition–Proof	●	●	●	–	★
E7(1)	IECEx Flameproof and Dust	●	●	●	–	★
I7(2)	IECEx Intrinsically Safe	●	●	●	●	★
N7(1)	IECEx Type n	●	●	●	–	★
NG	IECEx Type n Component	●	●	●	●	★
E2(1)	INMETRO Flameproof	●	●	●	–	★
E4(1)(3)	TIIS Explosion–Proof	●	●	●	●	★
E3(1)	China Flameproof	●	●	●	–	★
I3	China Intrinsic Safety	●	●	●	–	★

Options

		A	**F**	**W**	**A**	
PlantWeb Control Functionality						
Standard						**Standard**
A01	FOUNDATION fieldbus Advanced Control Function Block Suite	–	●	–	–	★
Assemble To Options						
Standard						**Standard**
XA	Sensor Specified Separately and Assembled To Transmitter	●	●	●	–	★
		Head			**Rail**	
		A	**F**	**W**	**A**	

Table A-3. Rosemount 644 Smart Temperature Transmitter Ordering Information

★ The Standard offering represents the most common models and options. These options should be selected for best delivery.
The Expanded offering is manufactured after receipt of order and is subject to additional delivery lead time.

● = Available
– = Not Available

Enclosure Options						
Standard						**Standard**
J5[4][5]	Universal Head (junction box), aluminum alloy with 50.8 mm (2-in.) SST pipe bracket (M20 entries)	●	●	●	–	★
J6[4]	Universal Head (junction box), aluminum alloy with 50.8 mm (2-in.) SST pipe bracket ($^1/_2$–14 NPT entries)	●	●	●	–	★
J7[4][5]	Universal Head (junction box), cast SST with 50.8 mm (2-in.) SST pipe bracket (M20 entries)	●	●	●	–	★
J8[4]	Universal Head (junction box), cast SST with 50.8 mm (2-in.) SST pipe bracket ($^1/_2$–14 NPT entries)	●	●	●	–	★
Expanded						
S1	Connection Head, Polished Stainless Steel ($^1/_2$–14 NPT entries)	●	●	●	–	
S2	Connection Head, Polished Stainless Steel ($^1/_2$–14 NPSM entries)	●	●	●	–	
S3	Connection Head, Polished Stainless Steel (M20 x 1.5 conduit and entries)	●	●	●	–	
S4	Connection Head, Polished Stainless Steel (M20 x 1.5 conduit entries, M24 x 1.5 head entry)	●	●	●	–	
Display						
Standard						**Standard**
M5	LCD Display	●	●	●	–	★
Expanded						
M6	LCD Display with Polycarbonate Meter Face	●	●	●	–	
Software Configuration						
Standard						**Standard**
C1	Custom Configuration of Date, Descriptor and Message (Requires CDS with order)	●	●	●	●	★
Alarm Level Configuration						
Standard						**Standard**
A1	NAMUR alarm and saturation levels, high alarm	●	–	–	●	★
CN	NAMUR alarm and saturation levels, low alarm	●	–	–	●	★
C8	Low Alarm (Standard Rosemount Alarm and Saturation Values)	●	–	–	●	★
Line Filter						
Standard						**Standard**
F6	60 Hz Line Voltage Filter	●	●	●	●	★
Sensor Trim						
Standard						**Standard**
C2	Transmitter-Sensor Matching - Trim to Specific Rosemount RTD Calibration Schedule (CVD constants)	●	●	●	●	★
5-Point Calibration Option						
Standard						**Standard**
C4	5-point calibration. *Use option code Q4 to generate a calibration certificate*	●	●	●	●	★
Calibration Certificate						
Standard						**Standard**
Q4	Calibration certificate. *3-Point calibration with certificate*	●	●	●	●	★
External Ground						
Standard						**Standard**
G1	External ground lug assembly (see “External Ground Screw Assembly” on page A-14)	●	●	●	–	★
Cable Gland Option						
Standard						**Standard**
G2	Cable gland[6] (7.5 mm - 11.99 mm)	●	●	●	–	★
G7	Cable gland, M20x1.5, Ex e, Blue Polyamide (5 mm - 9 mm)	●	●	●	–	★

Table A-3. Rosemount 644 Smart Temperature Transmitter Ordering Information

★ The Standard offering represents the most common models and options. These options should be selected for best delivery.
The Expanded offering is manufactured after receipt of order and is subject to additional delivery lead time.

		● = Available – = Not Available				
Cover Chain Option						
Standard						**Standard**
G3	Cover chain	●	●	●	–	★
Terminal						
Standard						**Standard**
G5	WAGO spring clamp terminals	●	●		–	★
Conduit Electrical Connector						
Standard						**Standard**
GE(7)	M12, 4-pin, Male Connector (eurofast®)	●	●	●	–	★
GM(7)	A size Mini, 4-pin, Male Connector (minifast®)	●	●	●	–	★
External Label						
Standard						**Standard**
EL	External label for ATEX Intrinsic Safety	●	●	●	–	★
Typical Rail Mount Model Number: 644 R A I5 **Typical Head Mount Model Number: 644 H F I5 M5 J5 C1**						

(1) Requires enclosure option J5, J6, J7, or J8.
(2) When IS approval is ordered on a FOUNDATION fieldbus, both standard IS and FISCO IS approvals apply. The device label is marked appropriately.
(3) Consult factory for availability.
(4) Suitable for remote mount configuration.
(5) When ordered with XA, 1/2-in. NPT enclosure will come equipped with an M20 adapter with the sensor installed as process ready.
(6) Only available with Enclosure option code J5.
(7) Available with Intrinsically Safe approvals only. For FM Intrinsically Safe or non-incendive approval (option code I5), install in accordance with Rosemount drawing 03151-1009 to maintain NEMA 4X rating.

NOTE
For additional options (e.g. “K” codes), please contact your local Emerson Process Management representative.

Tagging

Hardware

- 13 characters total
- Tags are adhesive labels
- Permanently attached to transmitter
- Character height is 1/16-in (1.6 mm)

Software

- The transmitter can store up to 8 for HART protocol. If no characters are specified, the first 8 characters of the hardware tag are the default.

Considerations

Special Mounting Considerations

See “Mounting” on page A-11 for the special hardware that is available to:

- Mount a 644H to a DIN rail. (see Table 2 on page A-15)
- Retrofit a new 644H to replace an existing 644H transmitter in an existing threaded sensor connection head. (see Table 2 on page A-15)

External Ground Screw Assembly

The external ground screw assembly can be ordered by specifying code G1 when an enclosure is specified. However, some approvals include the ground screw assembly in the transmitter shipment, hence it is not necessary to order code G1. The table below identifies which approval options include the external ground screw assembly and which do not.

Approval Type	External Ground Screw Assembly Included?
E5, I1, I2, I5, I6, I7, K5, K6, NA, I4	No–Order option code G1
E1, E2, E3, E4, E7, K7, N1, N7, ND	Yes

TABLE 2. Transmitter Accessories

Part Description	Part Number
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 Display (includes meter and meter spacer assembly)	00644-4430-0002
LCD Display kit (includes meter and meter spacer assembly, and meter cover)	00644-4430-0001
Ground screw assembly kit	00644-4431-0001
Kit, Hardware for mounting a 644H to a DIN rail (includes clips for symmetrical and asymmetrical rails)	00644-5301-0010
Kit, Hardware for retrofitting a 644H in an existing threaded sensor connection head (former option code L1)	00644-5321-0010
Kit, 316 U-Bolt for Universal Housing	00644-4423-0001
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 – quantity 12)	00644-4432-0001
SST Universal Head, standard cover—M20 entries	00644-4433-0002
SST Universal Head, meter cover—M20 entries	00644-4433-0102
SST Universal Head, standard cover—1/2-14 NPT entries	00644-4433-0001
SST Universal Head, meter cover—1/2-14 NPT entries	00644-4433-0101
Polished SST Connection Head, standard cover—1/2-14 NPT entries	00079-0312-0011
Polished SST Connection Head, meter cover—1 1/2-14 NPT entries	00079-0312-0111
Polished SST Connection Head, standard cover—1/2-14 NPSM entries	00079-0312-0022
Polished SST Connection Head, meter cover—1/2-14 NPSM entries	00079-0312-0122
Polished SST Connection Head, standard cover—M20 x 1.5 entries	00079-0312-0033
Polished SST Connection Head, meter cover—M20 x 1.5 entries	00079-0312-0133
Polished SST Connection Head, standard cover—M20 x 1.5 / M24 x 1.5 entries	00079-0312-0034
Polished SST Connection Head, meter cover—M20 x 1.5 / M24 x 1.5 entries	00079-0312-0134

Configuration

Transmitter Configuration

The transmitter is available with standard configuration setting for HART (see "Standard HART Configuration"). The configuration settings may be changed in the field with DeltaV®, with AM, or with any field communicator.

Standard HART Configuration

Unless specified, the transmitter will be shipped as follows:

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/Saturation Modes	High (21.75 mA) / Upscale (20.5 mA)
Line Voltage Filter	50 Hz
Tag	Configuration Data Sheet requires

Custom Configuration

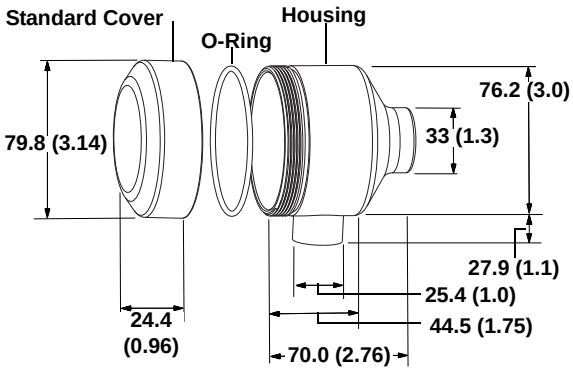
Custom configurations are to be specified when ordering. This configuration must be the same for all sensors. The following table lists the necessary requirements to specify a custom configuration.

Option Code	Requirements/ Specification
C1: Factory Configuration Data (CDS required)	Date: day/month/year Descriptor: 16 alphanumeric characters Message: 32 alphanumeric character Analog Output: Alarm and saturation levels
C2:Transmitter – Sensor Matching	The transmitters are designed to accept Callendar-Van Dusen constants from a calibrated RTD. Using these constants, the transmitter generates a custom curve to match the sensor-specific curve. Specify a Series 65, 65, or 78 RTD sensor on the order with a special characterization curve (V or X8Q4 option). These constants will be programmed into the transmitter with this option
A1: NAMUR-Compliant, High Alarm	High Alarm = 21.5 mA Upscale Saturation = 20.5 mA
CN: NAMUR-Compliant, Low Alarm	Low Alarm = 3.6 mA Downscale Saturation = 3.8 mA
C4: Five Point Calibration	Will include 5-point calibration at 0, 25, 50, 75, and 100% analog and digital output points. Use with Calibration Certificate Q4.
F6: 60 Hz Line Filter	Calibrated to a 60 Hz line voltage filter instead of 50 Hz filter

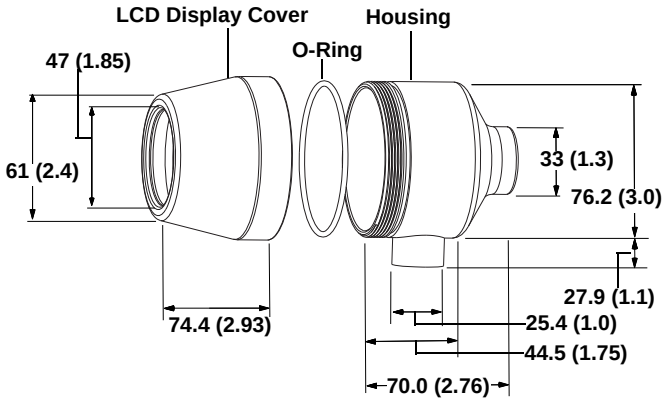
Dimensional Drawings

Sanitary Housing Covers

Standard Cover



LCD Display Cover



Dimensions are in millimeters (inches)

Appendix B Product Certifications

APPROVED MANUFACTURING LOCATIONS

Emerson Process Management Rosemount Division. – Chanhassen, Minnesota, USA

Rosemount Temperature GmbH – Germany

Emerson Process Management Asia Pacific – Singapore

EUROPEAN UNION DIRECTIVE INFORMATION

The EC declaration of conformity for all applicable European directives for this product can be found on the Rosemount website at www.rosemount.com. A hard copy may be obtained by contacting our local sales representative.

ATEX Directive (94/9/EC)

Rosemount Inc. complies with the ATEX Directive.

CE Electromagnetic Compatibility Compliance Testing

The 644 meets the criteria under IEC 61326:2006

HAZARDOUS LOCATIONS CERTIFICATES

North American Certifications

Factory Mutual (FM) Approvals

I5 FM Intrinsically Safe and Non-incendive
Intrinsically Safe for Class I/II/III, Division 1, Groups A, B, C, D, E, F, and G.
Non-incendive for Class I, Division 2, Groups A, B, C, and D.

Temperature Code: T5 (T_a = – 50 °C to 85 °C)

When installed in accordance with Rosemount drawing 00644-0009.

Table B-1. Temperature Code

Pi	Temperature Code
0.67 W	T5 (T_{amb} = – 50 °C to 50 °C)
0.67 W	T6 (T_{amb} = – 50 °C to 40 °C)
1.0 W	T4 (T_{amb} = – 50 °C to 80 °C)
1.0 W	T5 (T_{amb} = – 50 °C to 40°C)

E5 FM Explosion Proof
Explosion Proof for Class I, Division 1, Groups B, C, and D.

Nonincendive for use in Class 1, Division 2, Groups A, B, C, and D.

Temperature Code: T5 (T_{amb} = – 50 °C to 85 °C)
When installed per Rosemount control drawing 00644-1049

Dust Ignition Proof for Class II/III, Division 1, Groups E, F, G.
Temperature Code: T5 (T_a = – 50 °C to 85 °C)

When installed per Rosemount drawing 00644-1049.
(J5, J6 and J8 options only.)

K5 Combination of I5 and E5.

NOTE
K5 is only available with 644H option code J6.

Canadian Standards Association (CSA) Approvals

I6 CSA Intrinsically Safe
Intrinsically Safe for Class I, Division 1, Groups A, B, C, and D when installed in accordance with Rosemount drawing 00644–1064.

Table B-2. Temperature Code

Pi	Temperature Code
0.67 W	T6 (T_{amb} = – 50 °C to 40 °C)
0.67 W	T5 (T_{amb} = – 50 °C to 60 °C)
1.0 W	T4 (T_{amb} = – 50 °C to 80 °C)

K6 CSA Intrinsically Safe, Explosion–Proof, and Non-incendive
Combination of I6 and 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; Class III, Division 1 hazardous locations, when installed in accordance with Rosemount drawing 00644–1059.
Suitable for Class I, Division 2, Groups B, C, and D when installed in a suitable enclosure.
Temperature Code: Ambient Limits –50 °C to 85 °C.

NOTE
K6 is only available with 644H option code J6.

European Certifications

I1 ATEX Intrinsic Safety
Certificate Number: BAS00ATEX1033X
ATEX Marking: ⟨Ex⟩ II 1 G Ex ia IIC T4/T5/T6
CE 1180

Table B-3. Temperature Code

Pi	Temperature Code
0.67 W	T6 (– 60 °C ≤ T_{amb} ≤ 40 °C)
0.67 W	T5 (– 60 °C ≤ T_{amb} ≤ 50 °C)
1.0 W	T5 (– 60 °C ≤ T_{amb} ≤ 40 °C)
1.0 W	T4 (– 60 °C ≤ T_{amb} ≤ 80 °C)

Table B-4. Entity Parameters

Loop/Power	Sensor
U_i = 30 V	U_o = 13.6 V
I_i = 200 mA	I_o = 80 mA
P_i = 0.67 W or 1.0 W	P_o = 80 mW
C_i = 10 nF	C_i = 75 nF
L_i = 0	L_i = 0

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.

Non-metallic enclosures must have a surface resistance of less than 1GΩ. Light alloy or zirconium enclosures must be protected from impact and friction when installed.

E1 ATEX Flame-Proof
Certificate Number: KEMA99ATEX8715X
ATEX Marking: ⟨Ex⟩ II 2 G Ex d IIC T6
CE 1180
Temperature Code: T6 (–50 °C ≤ T_{amb} ≤ 65 °C)
Max Input Voltage: U_i = 42.4 Vdc

Special Conditions for Safe Use (X):

For information on the dimensions of the flameproof joints the manufacturer shall be contacted.

N1 ATEX Type n
Certificate Number: BAS00ATEX3145
ATEX Marking: ⟨Ex⟩ II 3 G Ex nL IIC T5
Temperature Code: T5 (–40 °C ≤ T_{amb} ≤ 70 °C)
Max Input Voltage: U_i= 42.4 Vdc

NC ATEX Type n Component
Certificate Number: BAS99ATEX3084U
ATEX Marking: ⟨Ex⟩ II 3 G Ex nL IIC T5
Temperature Code: T5 (–40 °C ≤ T_{amb} ≤ 70 °C)
Max Input Voltage: U_i= 42.4 Vdc

NOTE
The equipment must be installed in an enclosure meeting the requirements of IP54 and the requirements of the impact tests described in EN50021.

ND ATEX Dust Ignition-Proof

Certificate Number: KEMA99ATEX8715X
ATEX Marking: ⟨Ex⟩ II 1 D
tD A20 T95 C (-50 °C = T_{amb} = +85 °C)
IP 66

Special Conditions for Safe Use (X):

For information on the dimensions of the flameproof joints the manufacturer shall be contacted.

IECEx Certifications

E7 IECEx Flameproof and Dust
Certificate Number: IECEx KEM 09.0015X
Ex d IIC T6 (Flameproof)
Ex tD A20 IP 66 T 95 °C (Dust)
Vmax = 42.4 V

Special Conditions for Safe Use (X):

For information on the dimensions of the flameproof joints the manufacturer shall be contacted.

Table B-5. Electrical Data

Transmitter	Sensor
U_{max} = 42.4 Vdc	U_{max} = 5 Vdc
I_{max} = 24.0 mA	I_{max} = 2.0 mA

I7 IECEx Intrinsic Safety
Certificate Number: IECEx BAS 07.0053X
Ex ia IIC T4/T5/T6

Table B-6. Temperature Classification

$P_{i\ (W)}$	Temperature Class	T_{amb}
0.67	T6	-60 °C to 40 °C
0.67	T5	-60 °C to 50 °C
1.0	T5	-60 °C to 40 °C
1.0	T4	-50 °C to 80 °C

Special Conditions for Safe Use (X):

1. The apparatus must be installed in an enclosure which affords it a degree of protection of at least IP20.
2. 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.

Table B-7. Entity Parameters

Transmitter	Sensor
U_i = 30 Vdc	U_o = 13.6 Vdc
I_i = 200 mA	I_o = 80 mA
P_i = 0.67 W or 1.0 W	P_o = 80 mW
C_i = 10 nF	C_i = 75 nF
L_i = 0 mH	L_i = 0 mH

N7 IECEx Type n
Certificate Number: IECEx BAS 07.0055
Ex nA nL IIC T5 (-40 °C ≤ T_{amb} ≤ 70 °C)

Table B-8. Electrical Data

Transmitter	Sensor	
	RTD	Thermocouple
U_i = 42.4 V	U_i = 5 V	U_i = 0

NG IECEx Type n Component
Certificate Number: IECEx BAS 07.0054U
Ex nA nL IIC T5 (-40 °C ≤ T_{amb} ≤ 75 °C)
Input Parameter: Ui = 32 Vdc

Schedule of Limitations:

The component must be housed in a suitably certified enclosure that provides a degree of protection of at least IP54.

Brazilian Certifications

Centro de Pesquisas de Energia Eletrica (CEPEL) Approval

I2 CEPEL Intrinsic Safety. Not available, consult factory

Russian Certifications

Gostandart

Tested and approved by the Russian Metrological Institute GOSTANDART.

Japanese Certifications

Japanese Industrial Standard (JIS) Approvals

E4 JIS Explosion-Proof

Table B-9. Certificate and Description

Certificate	Description	Approval Group	Temp Code
C15744	644H with meter and no sensor	Ex d II C	T6
C15745	644H without meter and no sensor	Ex d II C	T6
C15749	644H without meter and with RTD	Ex d II B	T4
C15750	644H without meter and with thermocouple	Ex d II B	T4
C15751	644H with meter and thermocouple	Ex d II B	T4
C15752	644H with meter and RTD	Ex d II B	T4
C15910	644H without meter and with thermocouple	Ex d II B + H2	T4
C15911	644H with meter and thermocouple	Ex d II B + H2	T4
C15912	644H without meter and with RTD	Ex d II B + H2	T4
C15913	644H with meter and RTD	Ex d II B + H2	T4

NOTE
Explosion Proof certification is only available as a complete assembly with Rosemount universal head – option codes J5, J6, J7, and J8.

Slovak Republic Certification

Ex ia IIC T4 & T5
See Intrinsic Safety Certificate

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, 2 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. CSA Intrinsic Safety Installation Drawing 00644-1064, Rev. AB

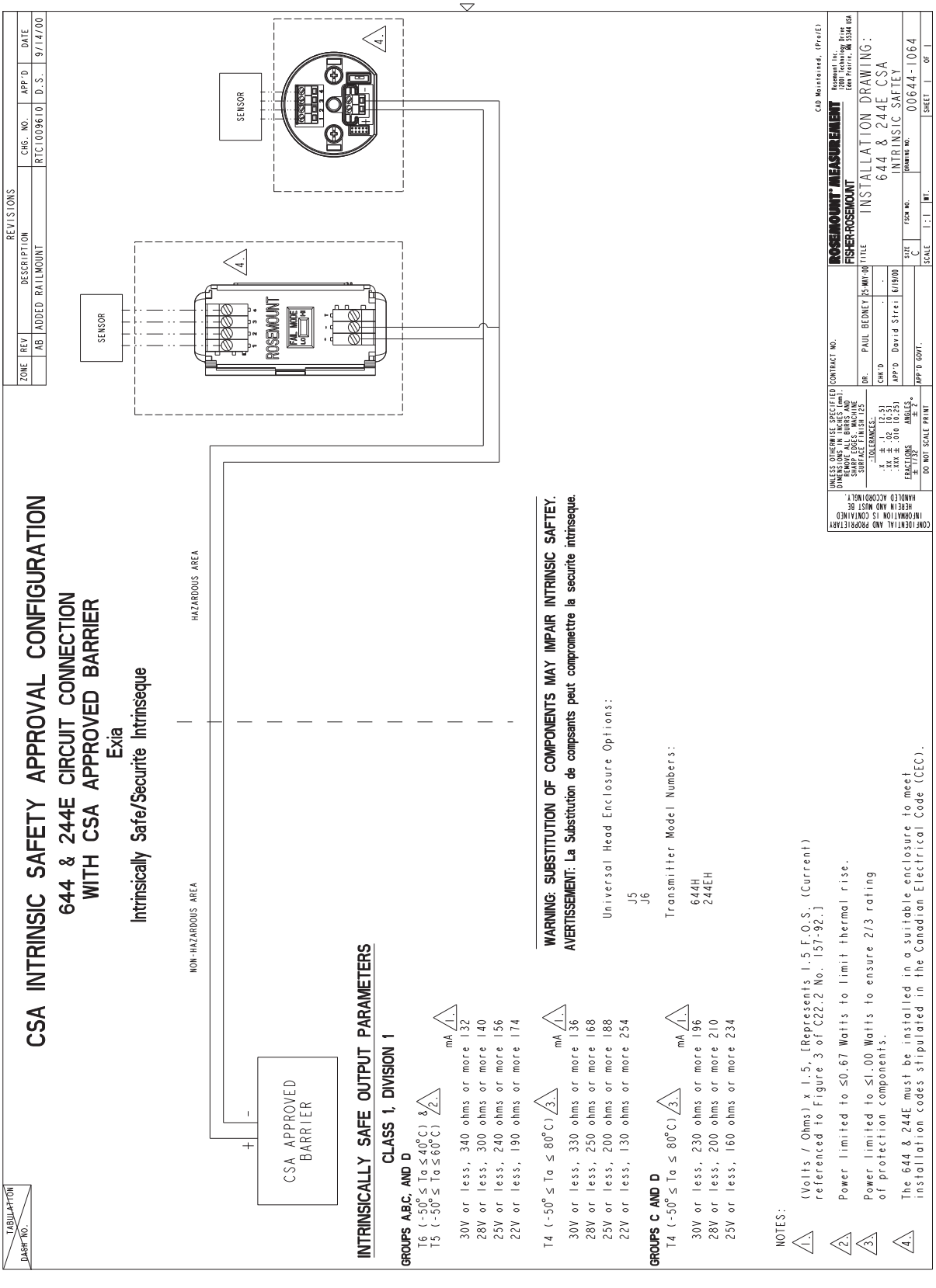


Figure B-2. CSA Explosion-Proof Installation Drawing 00644-1059, Rev. AH

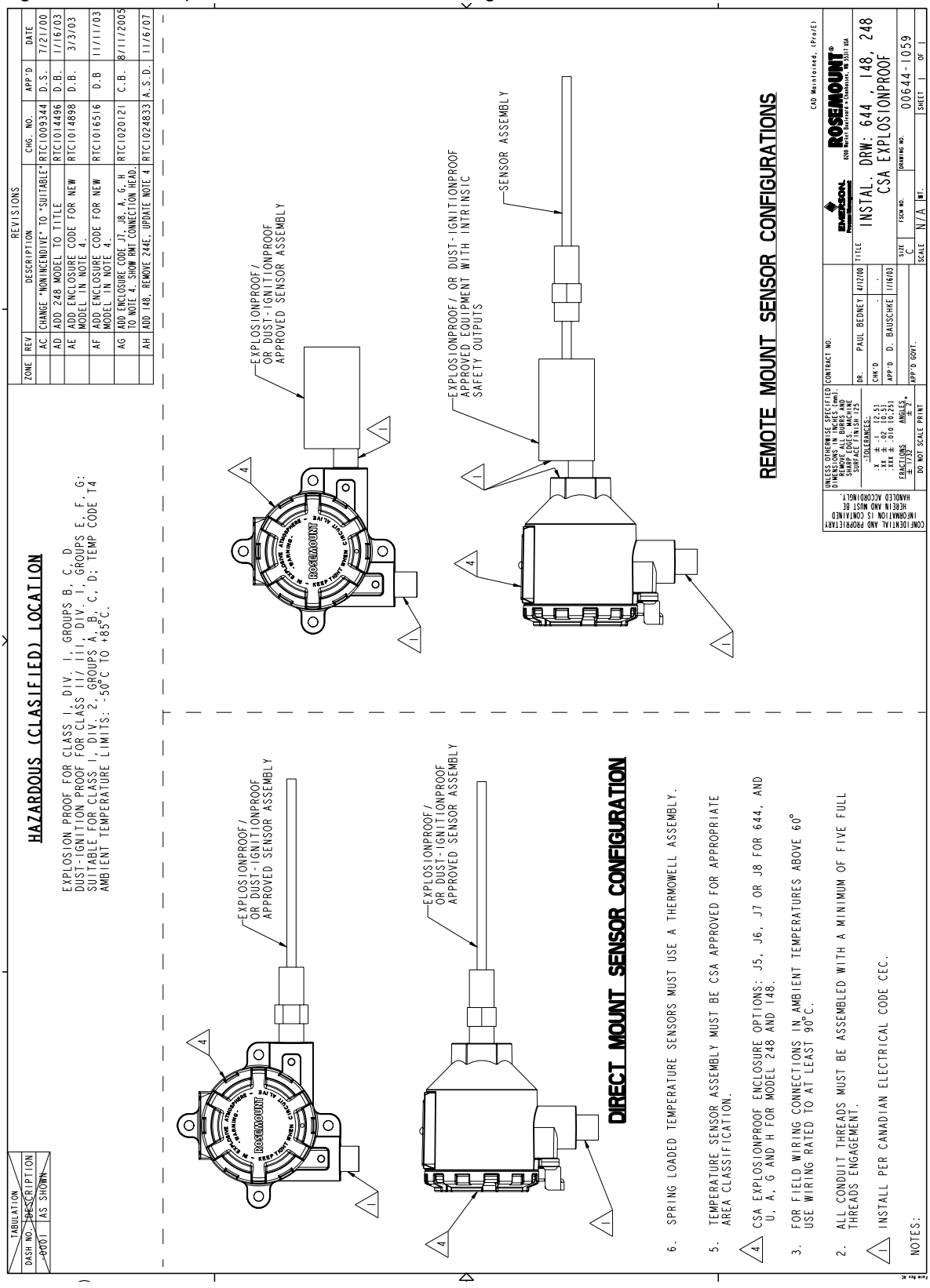
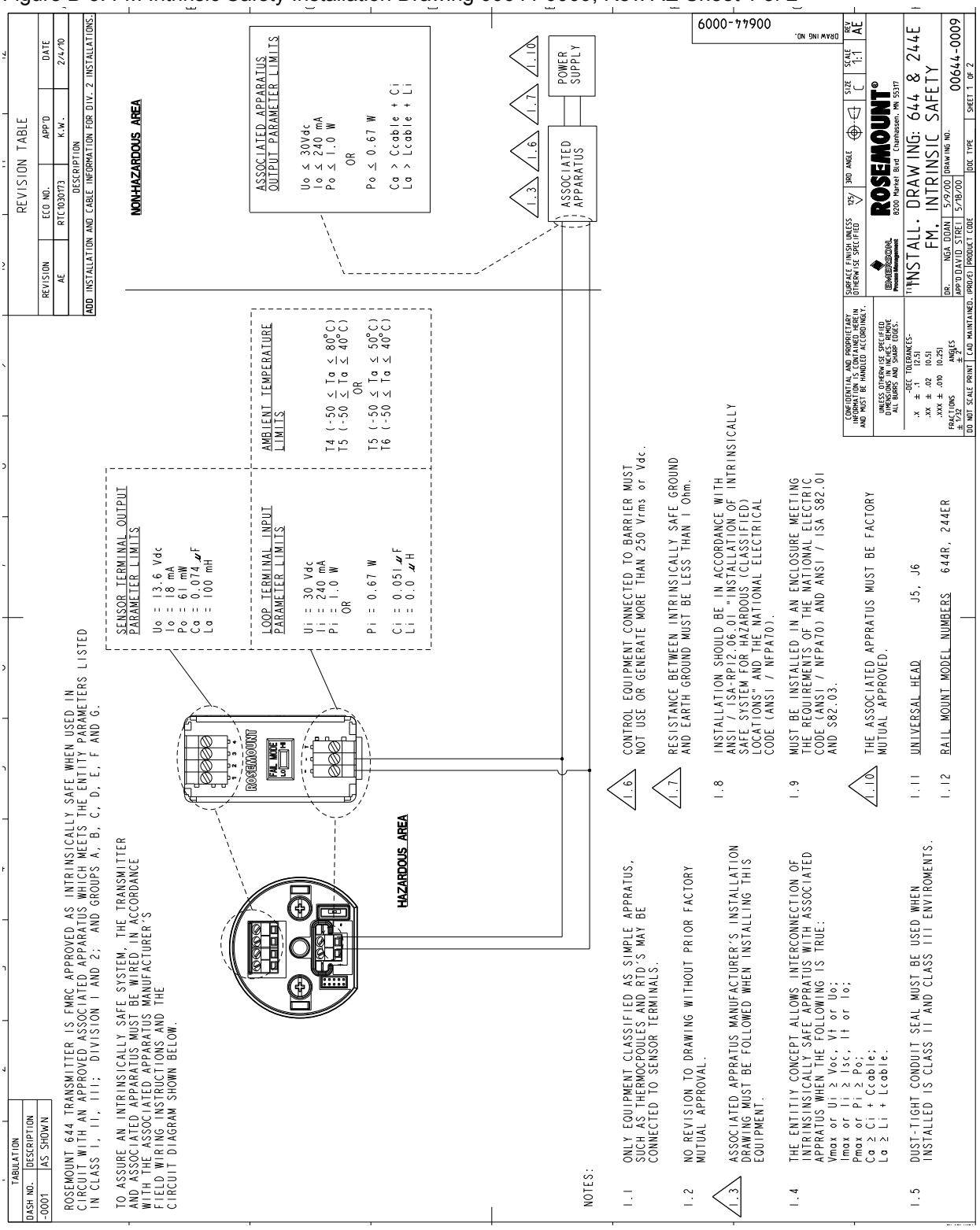
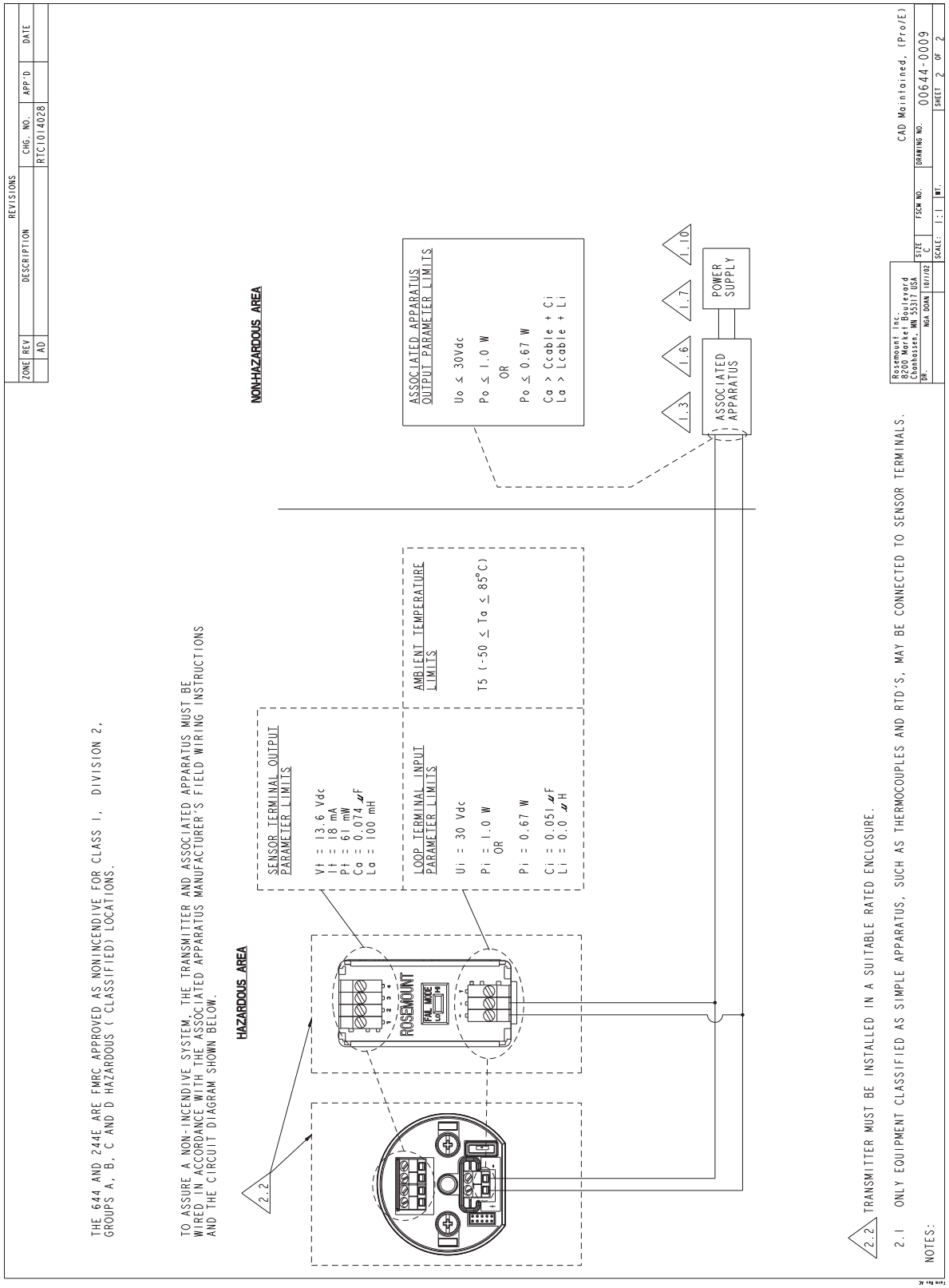


Figure B-3. FM Intrinsic Safety Installation Drawing 00644-0009, Rev. AE Sheet 1 of 2

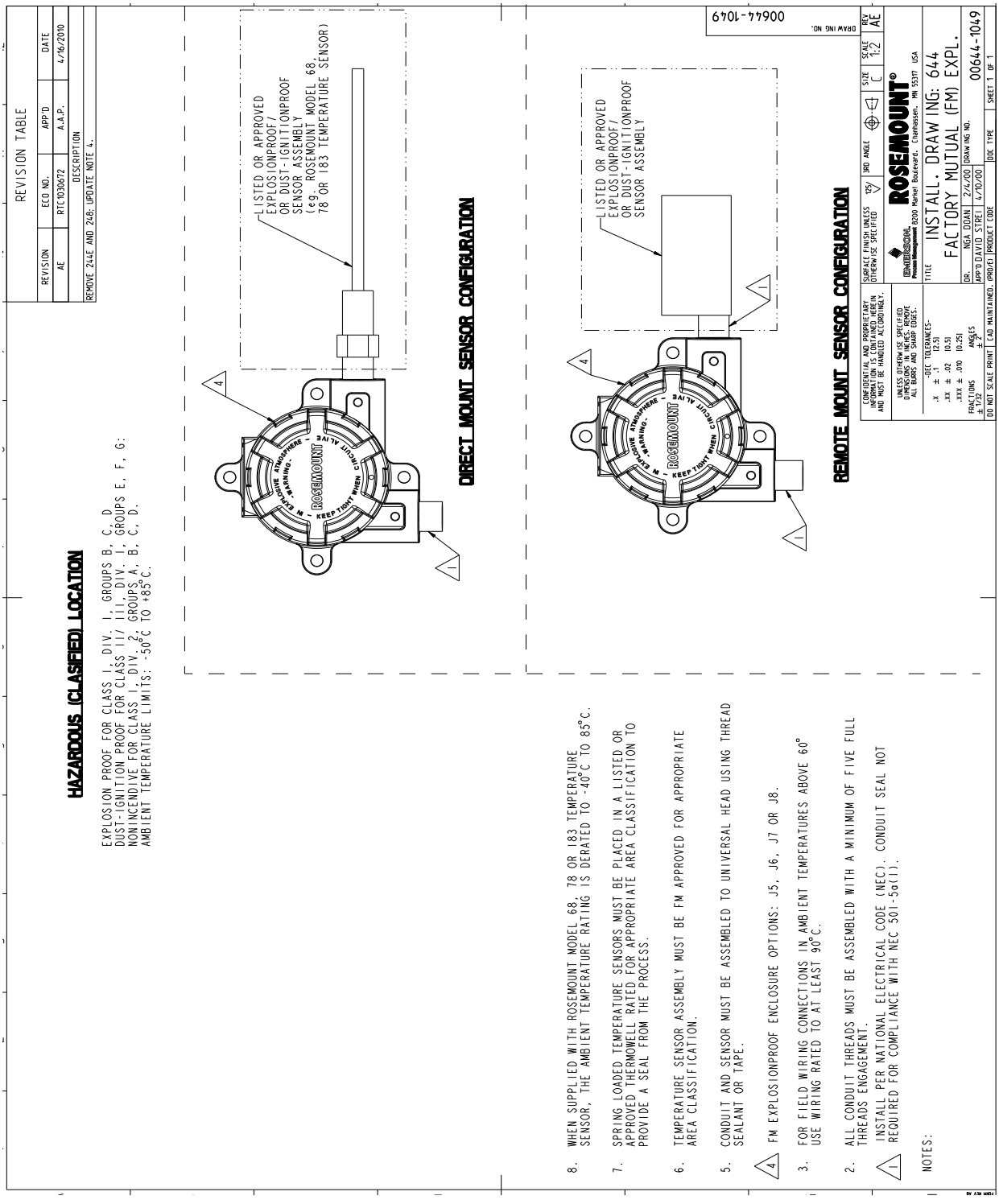


Sheet 2 of 2



644-0009A01A

Figure B-4. FM Explosion-Proof Installation Drawing 00644-1049, Rev. AE



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