Rosemount 648 Wireless Temperature Transmitter

- *An installation-ready solution that provides a variety of mounting options, transmitter configurations, and sensors/thermowells*
- *4 user configurable alerts*
- *Flexibility to meet your most demanding applications*
- *Wireless output with >99% data reliability delivers rich HART data, protected by industry leading security*
- *The Transmitter-Sensor Matching feature improves temperature measurement accuracy when compared to unmatched assemblies*
- *The integral LCD conveniently displays the primary sensor input and diagnostics of the transmitter*
- *Same simple and easy installation practices already used today for robust installations*

Contents

High Accuracy and Reliability for Monitoring Applications

The Rosemount 648 temperature transmitter is ideal for monitoring applications, especially in hard-to-reach or cost-prohibitive locations. It provides reliability with advanced accuracy for all installations. The Rosemount 648 can be configured for a variety of sensor inputs: RTD, thermocouple, millivolt, or ohm.

SELF-ORGANIZING NETWORKS

Self-forming, intelligent devices that provide exceptional data reliability and network stability. The Rosemount 648 works the same as wired devices, allowing you to leverage existing practices, training and maintenance procedures, but without the added wiring costs.

LAYERED SECURITY KEEPS YOUR NETWORK SAFE

Emerson Process Management's layered approach to wireless network security ensures that your network stays protected. The network devices implement Encryption, Authentication, Verification, Anti-Jamming and Key Management methods to ensure that data transmissions are received only by the Wireless Gateway.

SMARTPOWER™

Rosemount devices incorporate SmartPower™. SmartPower™ refers to the benefits that users enjoy due to the engineering efforts made to reduce power consumption. Emerson has power-optimized our instrumentation, both hardware and software, to extend power module life while still delivering highly reliable measurements with rich HART data and diagnostic information.

TRANSMITTER-SENSOR MATCHING

Entering the temperature-resistance profile specific to the RTD sensor into the 648 transmitter results in transmitter-sensor matching. This eliminates the sensor interchangeability error, which can improve accuracy.

INTEGRAL LCD DISPLAY

Local indication of temperature measurement and diagnostics provides real time and accurate verification of process conditions.

RELIABLE TRANSMITTER PERFORMANCE

The 648 ensures top transmitter performance in harsh and/or noisy EMI/RFI environments.

DIGITAL FIELD DEVICES THAT POWER PLANTWEB

The Rosemount 648 powers *PlantWeb*® by communicating important temperature diagnostics and *PlantWeb* alerts to ensure process health and enable economical single-sensor architecture.

MOUNTING FLEXIBILITY

PlantWeb head mount transmitters to be direct mounted via a sensor or thermocouple, or remote mounted, allowing the flexibility needed to reach any measurement point. The PlantWeb head also offers an LCD for local display that is easily visible, even in remote mount installations.

SMART WIRELESS SOLUTIONS

1420 Wireless Gateway

The 1420 enables the most robust security available, easy host integration with no additional software and continuously is optimizing network performance to maximize data reliability and power module life of the wireless devices.

Rosemount 3051S Wireless Series

The scalable 3051S enables fully integrated pressure, flow and level self-organizing network solutions to optimize plant performance and reduce risk.

Wireless Overview

Devices

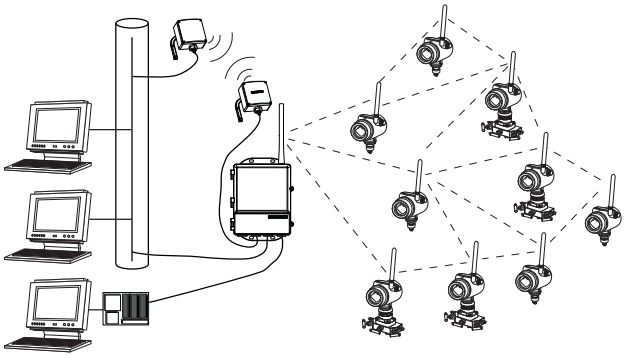
The Rosemount 648 is a Smart Wireless temperature device. Along with the other devices in the Self-Organizing Network, it is easy to install, and provides reliable measurement and diagnostics data to the Information System via the 1420 Wireless Gateway.

Gateway

The 1420 Wireless Gateway enables the most robust security available, easy host integration with no additional software and continuously is optimizing network performance to maximize data reliability and power module life of the wireless devices.

Seamless Integration

Smart Wireless devices from Emerson Process Management provide measurement data and diagnostics data back to any type of information system including Serial Modbus, Modbus TCP, OPC, legacy systems and data historians.



Specifications

Functional Specifications

Input

Supports Thermocouple, RTD, millivolt and ohm input types. See “Accuracy” on page 5 for sensor options.

Output

Wireless enabled *HART*, linear with temperature or input.

Local Display

The optional five-digit integral LCD Display can display engineering units (°F, °C, °R, K, Ω, and millivolts). Display updates at transmit rate up to once per minute.

Humidity Limits

0–100% relative humidity

Transmit Rate

User selectable, 15 sec. to 60 min.

Accuracy (PT 100 @ reference conditions: 20 °C)
±0.45 °C (±0.81 °F)

Physical Specifications

Electrical Connections

Wireless Power Module

Replaceable, Intrinsically Safe Lithium-Thionyl Chloride power module with PBT enclosure. Eight year life at one minute transmit rate; ten year life at 10 minute transmit rate.(1)

Sensor Terminals

Screw terminals permanently fixed to terminal block

HART Communicator Connections

Communication Terminals

Clips permanently fixed to terminal block

Materials of Construction

Enclosure

Housing - Low-copper aluminum

Paint - Polyurethane

Cover O-ring - Buna-N

Terminal Block and Power Module

PBT

Antenna

PBT/PC integrated omnidirectional antenna

Mounting

Transmitters may be attached directly to the sensor. Mounting brackets also permit remote mounting. See “Dimensional Drawings” on page 9.

Weight

648 without LCD - 4.6 lbs. (2 kg)

648 with M5 LCD - 4.7 lbs (2.1 kg)

Enclosure Ratings (648)

Housing option code D is NEMA 4X, and IP66.

(1) Reference conditions are 70° F (21° C), and routing data for three additional network devices.
NOTE: Continuous exposure to ambient temperature limits (-40 °F or 185 °F) (-40 °C or 85 °C) may reduce specified life by less than 20 percent.

Performance Specifications

ElectroMagnetic Compatibility (EMC)

All Models:

Meets all relevant requirements of EN 61326.

Transmitter Stability

The 648 has a stability of ±0.3% of output reading or 0.3 °C (whichever is greater) for 24 months

Self Calibration

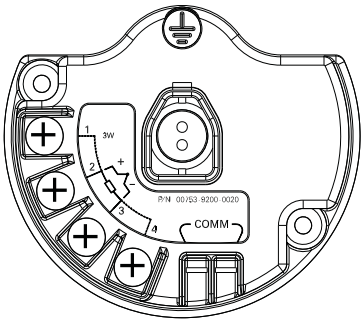
The analog-to-digital measurement circuitry automatically self-calibrates for each temperature update by comparing the dynamic measurement to extremely stable and accurate internal reference elements.

Vibration Effect

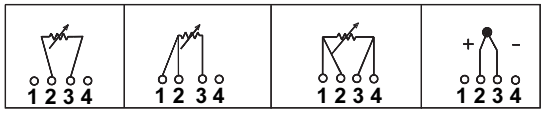
Less than ±0.1% of URL when tested per the requirements of IEC60770-1 field or pipeline with high vibration level (10-60 Hz 0.21mm displacement peak amplitude / 60-2000 Hz 3g).

Housing Style codes 1J, 1K, 1L, 2J
Less than ±0.1% of URL when tested per the requirements of IEC60770-1 field with general application or pipeline with low vibration level (10-60 Hz 0.15mm displacement peak amplitude / 60-500 Hz 2g).

Sensor Connections



648 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.*

Temperature Limits

Description	Operating Limit	Storage Limit
Without LCD Display	–40 to 185 °F –40 to 85 °C	–40 to 185 °F –40 to 85 °C
With LCD Display	–4 to 175 °F –20 to 80 °C	–40 to 185 °F –40 to 85 °C

Accuracy

TABLE 1. Rosemount 648 Input Options and Accuracy.

Sensor Options	Sensor Reference	Input Ranges		Digital Accuracy(1)	
2-, 3-, 4-wire RTDs		°C	°F	°C	°F
Pt 50 (α = 0.003910)	GOST 6651-94	-200 to 550	-328 to 990	± 0.9	± 1.62
Pt 100 (α = 0.00385)	IEC 751, 1995 (α = 0.00385)	–200 to 850	–328 to 1562	± 0.45	± 0.81
Pt 100 (α = 0.003910)	GOST 6651-94	-200 to 550	-328 to 990	± 0.45	± 0.81
Pt 100 (α = 0.003916)	JIS 1604, 1981 (α = 0.003916)	–200 to 645	–328 to 1193	± 0.45	± 0.81
Pt 200	IEC 751, 1995 (α = 0.00385)	–200 to 850	–328 to 1562	± 0.81	± 1.458
Pt 200 (α = 0.003916)	JIS 1604, 1981 (α = 0.003916)	–200 to 645	–328 to 1193	± 0.81	± 1.458
Pt 500	IEC 751, 1995 (α = 0.00385)	–200 to 850	–328 to 1562	± 0.57	± 1.026
Pt 1000	IEC 751, 1995 (α = 0.00385)	–200 to 300	–328 to 572	± 0.57	± 1.026
Ni 120	Edison Curve No. 7	–70 to 300	–94 to 572	± 0.45	± 0.81
Cu 10	Edison Copper Winding No. 15	–50 to 250	–58 to 482	± 4.16	± 7.488
Cu 50 (α = 426)	GOST 6651-94	-50 to 200	-122 to 392	±1.44	± 2.592
Cu 50 (α = 428)	GOST 6651-94	-185 to 200	-365 to 392	±1.44	± 2.592
Cu 100 (α = 426)	GOST 6651-94	-50 to 200	-122 to 392	±0.72	± 1.296
Cu 100 (α = 428)	GOST 6651-94	-185 to 200	-365 to 392	±0.72	± 1.296
Thermocouples(2)					
Type B(3)	NIST Monograph 175, IEC 584	100 to 1820	212 to 3308	± 2.25	± 4.05
Type E	NIST Monograph 175, IEC 584	–50 to 1000	–58 to 1832	± 0.60	± 1.08
Type J	NIST Monograph 175, IEC 584	–180 to 760	–292 to 1400	± 1.05	± 1.89
Type K(4)	NIST Monograph 175, IEC 584	–180 to 1372	–292 to 2502	± 1.46	± 2.628
Type N	NIST Monograph 175, IEC 584	–200 to 1300	–328 to 2372	± 1.46	± 2.628
Type R	NIST Monograph 175, IEC 584	0 to 1768	32 to 3214	± 2.25	± 4.05
Type S	NIST Monograph 175, IEC 584	0 to 1768	32 to 3214	± 2.1	± 3.78
Type T	NIST Monograph 175, IEC 584	–200 to 400	–328 to 752	± 1.05	± 1.89
GOST L	GOST R 8.585-2001	-200 to 800	-392 to 1472	± 1.80	± 3.24
DIN Type L	DIN 43710	–200 to 900	–328 to 1652	± 1.05	± 1.89
DIN Type U	DIN 43710	–200 to 600	–328 to 1112	± 1.05	± 1.89
Type W5Re/W26Re	ASTM E 988-96	0 to 2000	32 to 3632	± 2.1	± 3.78
Millivolt Input		–10 to 100 mV		± 0.045 mV	
2-, 3-, 4-wire Ohm Input		0 to 2000 ohms		± 1.35 ohm	

(1) The published digital accuracy applies over the entire sensor input range. Digital output can be accessed by HART Communications or wireless protocol.

(2) Total digital accuracy for thermocouple measurement: sum of digital accuracy +0.8 °C. (cold junction accuracy)

(3) Digital accuracy for NIST Type B T/C is ±9.0 °C (±16.2 °F) from 100 to 300 °C (212 to 572 °F).

(4) Digital accuracy for NIST Type K T/C is ±2.1 °C (±3.79 °F) from –180 to –90 °C (–292 to –130 °F).

Ambient Temperature Effect

TABLE 2. Ambient Temperature Effect

Sensor Options	Temperature Effects per 1.0 °C (1.8 °F) Change in Ambient Temperature(1)	Range
2-, 3-, 4-wire RTDs		
Pt 50 (α = 0.003910)	0.018 °C (0.0324 °F)	Entire Sensor Input Range
Pt 100 (α = 0.00385)	0.009 °C (0.0162 °F)	Entire Sensor Input Range
Pt 100 (α = 0.003910)	0.009 °C (0.0162 °F)	Entire Sensor Input Range
Pt 100 (α = 0.003916)	0.009 °C (0.0162 °F)	Entire Sensor Input Range
Pt 200	0.012 °C (0.0216 °F)	Entire Sensor Input Range
Pt 200 (α = 0.003916)	0.012 °C (0.0216 °F)	Entire Sensor Input Range
Pt 500	0.009 °C (0.0162 °F)	Entire Sensor Input Range
Pt 1000	0.009 °C (0.0162 °F)	Entire Sensor Input Range
Ni 120	0.009 °C (0.0162 °F)	Entire Sensor Input Range
Cu 10	0.06 °C (0.162 °F)	Entire Sensor Input Range
Cu 50 (α = 426)	0.012 °C (0.0216 °F)	Entire Sensor Input Range
Cu 50 (α = 428)	0.012 °C (0.0216 °F)	Entire Sensor Input Range
Cu 100 (α = 426)	0.009 °C (0.0162 °F)	Entire Sensor Input Range
Cu 100 (α = 428)	0.009 °C (0.0162 °F)	Entire Sensor Input Range
Thermocouples		
Type B	0.0435 °C	R ≥ 1000°C
	0.096 °C – (0.0075% of (R – 300))	300 °C ≤ R < 1000 °C
	0.162 °C – (0.033% of (R – 100))	100 °C ≤ R< 300 °C
Type E	0.015 °C +(0.00129% of R)	All
Type J	0.0162 °C +(0.00087%of R)	R ≥ 0 °C
	0.0162 °C + (0.0075% of absolute value R)	R < 0 °C
Type K	0.0183 °C +(0.0027% of R)	R ≥ 0 °C
	0.0183 °C + (0.0075% of absolute value R)	R < 0 °C
Type N	0.0204 °C +(0.00108% of R)	All
Type R, S, W5Re/W26Re	0.048 °C	R ≥ 200°C
	0.069 °C – (0.0108% of R)	R < 200 °C
Type T	0.0192 °C	R ≥ 0 °C
	0.0192 °C +(0.0129% of absolute value R)	R < 0 °C
GOST L	0.021 °C	R ≥ 0 °C
	0.0105 °C + (0.0045% of absolute value R)	R < 0 °C
DIN Type L	0.0162 °C + (0.00087% of R)	R ≥ 0 °C
	0.0162 °C +(0.0075% of absolute value R)	R < 0 °C
DIN Type U	0.0192 °C	R ≥ 0 °C
	0.0192 °C +(0.0129% of absolute value R)	R < 0 °C
Millivolt Input	0.0015 mV	Entire Sensor Input Range
2-, 3-, 4-wire Ohm	0.0252 Ω	Entire Sensor Input Range

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

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 at 30 °C ambient temperature:

- Digital Temperature Effects: 0.009 °C x (30 - 20) = 0.09 °C
- Worst Case Error: Digital + Digital Temperature Effects = 0.45 °C + 0.09 °C = 0.54 °C
- Total Probable Error: $\sqrt{0.45^2 + 0.09^2} = 0.46$

Product Certifications

Approved Manufacturing Locations

Rosemount Inc. – Chanhassen, Minnesota, USA
Emerson Process Management GmbH & Co. - Karlstein, Germany
Emerson Process Management Asia Pacific Private Limited - Singapore

European Union Directive Information

The EC declaration of conformity for all applicable European directives for this product can be found at www.rosemount.com. A hard copy may be obtained by contacting an Emerson Process Management representative.

ATEX Directive (94/9/EC)

Emerson Process Management complies with the ATEX Directive.

Electro Magnetic Compatibility (EMC) (89/336/EEC)

EN 50081-1: 1992; EN 50082-2: 1995; EN 61326-1: 1997 — Industrial

Radio and Telecommunications Terminal Equipment Directive (R&TTE) (1999/5/EC)

Emerson Process Management complies with the R&TTE Directive.

Telecommunication Compliance

All wireless devices require certification to ensure that they adhere to regulations regarding the use of the RF spectrum. Nearly every country requires this type of product certification. Emerson is working with governmental agencies around the world to supply fully compliant products and remove the risk of violating country directives or laws governing wireless device usage. To see which countries our devices have received certification for use in, see www.rosemount.com/smartwireless.

FCC and IC

This device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions: This device may not cause harmful interference, this device must accept any interference received, including interference that may cause undesired operation.

This device must be installed to ensure a minimum antenna separation distance of 20 cm from all persons.

Ordinary Location Certification for FM

As standard, the transmitter has been examined and tested to determine that the design meets basic electrical, mechanical, and fire protection requirements by FM, a nationally recognized testing laboratory (NRTL) as accredited by the Federal Occupational Safety and Health Administration (OSHA).

Hazardous Locations Certificates

North American Certifications

Factory Mutual (FM) Approvals

I5 FM Intrinsic Safety and Non-incendive
Intrinsically Safe for Class I/II/III, Division 1, Groups A, B, C, D, E, F, and G.
Zone Marking: Class I, Zone 0, AEx ia IIC
Temperature Codes T4 (T_{amb} = -50 to 70° C)
Non-incendive for Class I, Division 2, Groups A, B, C, and D.
Intrinsically Safe and non-incendive when installed in accordance with Rosemount drawing 00648-1000.
For use with Rosemount SmartPower options 753-9220-XXXX only.
Enclosure Type 4X / IP66

CSA - Canadian Standards Association

I6 CSA Intrinsic Safety
Intrinsically Safe for Class I, Division 1, Groups A, B, C, and D.
Temp Code T3C
Enclosure Type 4X / IP66
For use with Rosemount SmartPower options 753-9220-XXXX only.
Intrinsically Safe when installed per Rosemount drawing 00648-1020

European Certifications

I1 ATEX Intrinsic Safety
Certificate No.: Baseefa07ATEX0011 ⟨Ex⟩ II 1G
Ex ia IIC T4 (T_a = -60 °C to 70 °C)
IP66
For use with Rosemount SmartPower options 753-9220-XXXX only.

CE 1180

TABLE 3. Sensor Parameters

Sensor
U_o = 6.6 V
I_o = 3.6 mA
P_o = 23.3 mW
C_o = 11 uF
L_o = 500 mH

IECEx Certifications

I7 IECEx Intrinsic Safety
Certificate No.: IECEx BAS 07.0007
Ex ia IIC T4 (T_{amb} = -60 °C to 70 °C)
IP66
For use with Rosemount SmartPower options 753-9220-XXXX only.

TABLE 4. Sensor Parameters

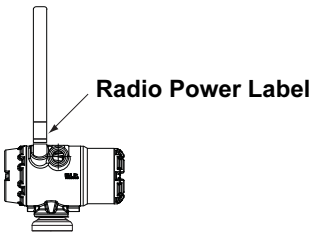
Sensor
U_o = 6.6 V
I_o = 3.6 mA
P_o = 23.3 mW
C_o = 11 uF
L_o = 500 mH

CE ⓘ

Country	Restriction
Bulgaria	General authorization required for outdoor use and public service
France	Outdoor use limited to 10mW e.i.r.p.
Italy	If used outside of own premises, general authorization is required.
Norway	May be restricted in the geographical area within a radius of 20 km from the center of Ny-Alesund.
Romania	Use on a secondary basis. Individual license required.

Radio Power Label - see Figure 1- indicates output power configuration of the radio. Devices with this label are configured for output power less than 10 mW e.i.r.p. At time of purchase the customer must specify ultimate country of installation and operation.

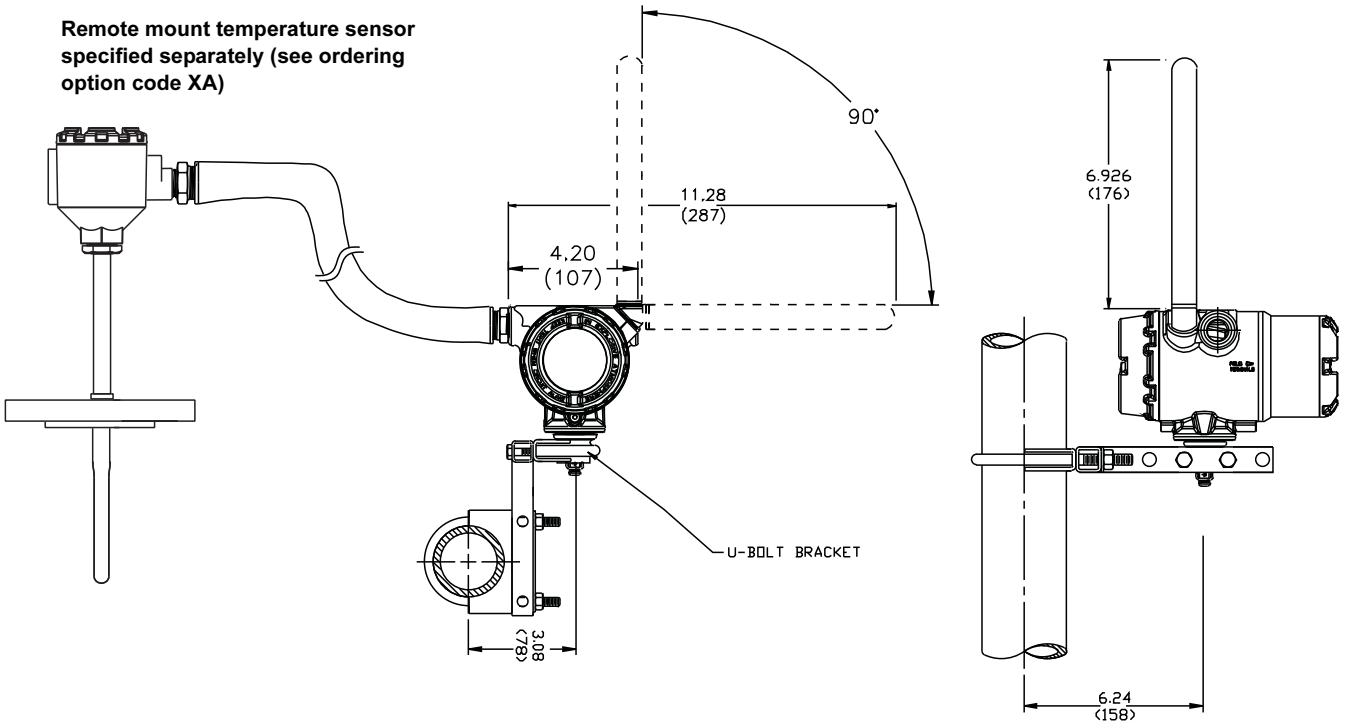
FIGURE 1.



Dimensional Drawings

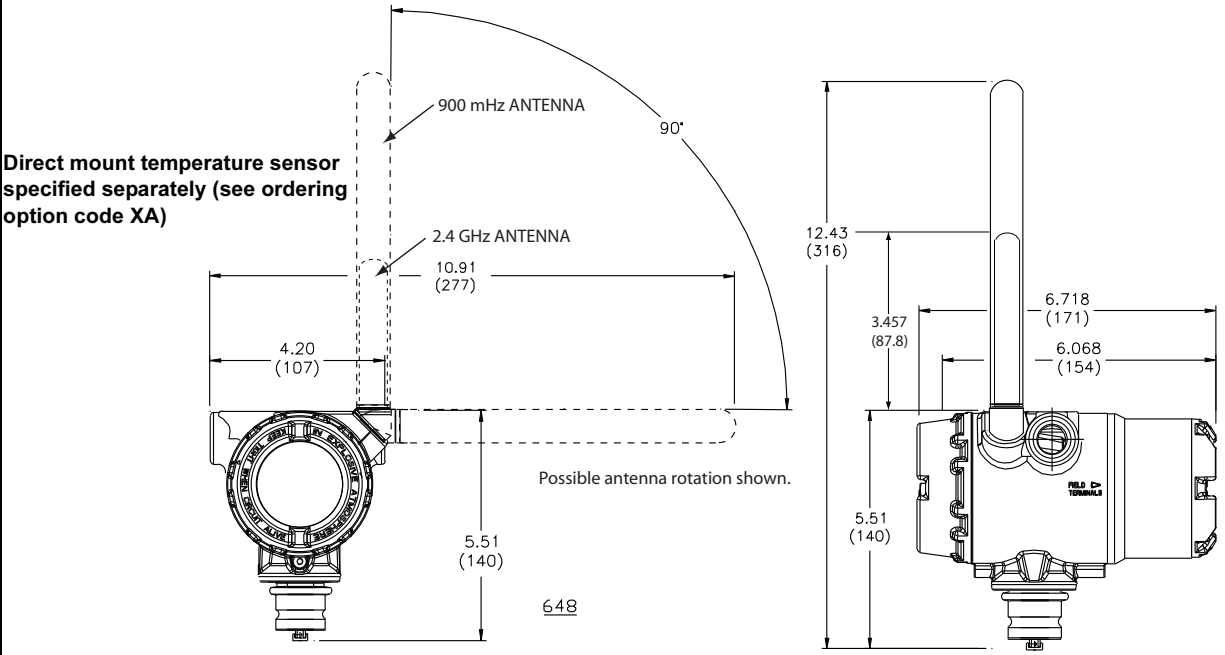
648 Remote Mount

Remote mount temperature sensor specified separately (see ordering option code XA)



648 Direct Mount

Direct mount temperature sensor specified separately (see ordering option code XA)



Dimensions are in inches (millimeters)

Ordering Information

Model	Product Description	
648	Temperature Transmitter	
Code	**Transmitter Type**	
D	Wireless Field Mount	
Code	**Output**	
X	Wireless	
Code	**Measurement**	
1	Single Sensor	
Code	**Housing**	**Metal**
D	Dual Compartment Housing - Aluminum	AL
Code	**Conduit Threads**	
1	1/2-14 NPT	
Code	**Certifications**	
I5	FM Intrinsically Safe, Non-incendive	
I6	CSA Intrinsically Safe	
I1	ATEX Intrinsically Safe	
I7	IECEx Intrinsically Safe	
NA	No Approval	
Code	**Wireless Options**	
Wireless Transmit Rate		
WA	User Configurable Transmit Rate	
Operating Frequency and Protocol		
1	2.4 GHz DSSS, HART	
2	900 MHz FHSS, HART	
Antenna		
WK	Omnidirectional, Integral Antenna	
SmartPower™		
1	Long-life Power Module Adapter, Intrinsically Safe	
	NOTE: Long Life Power Module must be shipped separately, order Part #00753-9220-0001.	
Meter		
M5	LCD Meter	
Configuration		
C1	Factory Configure Date, Descriptor, Message Fields, and Wireless Parameters	
Filter		
F6	60 Hz Line Voltage Filter	
F5	50 Hz Line Voltage Filter	
Trim		
C2	Transmitter-Sensor Matching - Trim to specific Rosemount RTD Calibration Schedule (CVD Constants)	
5-Point Calibration		
C4	5-Point Calibration (requires Q4 option code to generate a calibration certificate)	
Calibration Certificate		
Q4	Calibration Certificate (3-Point Calibration with Certificate)	
Cable Gland		
G2	Cable Gland (7.5 mm - 11.9 mm)	
G4	Thin Wire Cable Gland (3 mm - 8 mm)	
Sensor Options		
XA	Assemble to Transmitter, Sensor Specified Separately	
Typical Model Number: 648 D X 1 D 1 NA WA 2 WK 1 M5 C1 F6		

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