TEP/TEA Series Platinum Temperature Sensors and TQ-6000-1 Accessory Transmitter

Installation

IMPORTANT: Use this TEP/TEA Series Platinum Temperature Sensor and TQ-6000-1 Accessory Transmitter only to provide input to equipment under normal operating conditions. Where failure or malfunction of a temperature sensor or transmitter could lead to personal injury or property damage to the controlled equipment or other property, additional precautions must be designed into the control system. Incorporate and maintain other devices, such as supervisory or alarm systems or safety or limit controls intended to warn of, or protect against, failure or malfunction of the temperature sensor or transmitter.

Parts Included

TEP Probe Sensor

The TEP Series platinum probe sensor, 2 in. (51 mm) long, has 6 in. (150 mm) wire leads but no enclosure.

TEA Averaging Sensor

The TEA Series Platinum equivalent averaging-type sensor comes in either a 10 or 20 ft (305 or 610 cm) long model, encased in an aluminum sheath attached to a metal electrical box. Each sensor comes with two TE-6001-8 element holders and a gasket (requires minor assembly).

TQ-6000-1 Transmitter

Use the 4 to 20 mA TQ-6000-1 transmitter with 100 ohm platinum sensing elements. The TQ includes a 250 ohm, 1/4-W resistor. A sensor is not included.

Dimensions

See Figure 1, Figure 2, Figure 3, and Figure 4 for temperature sensor and accessory dimensions.

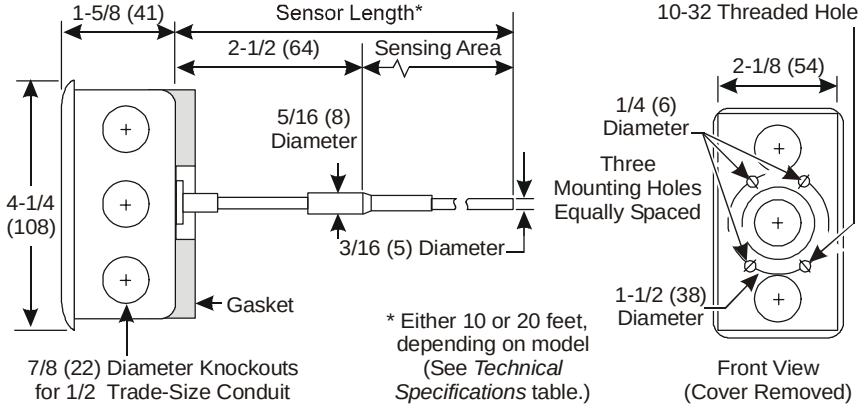


Figure 1: TEA Series Averaging Sensor Dimensions, in. (mm)

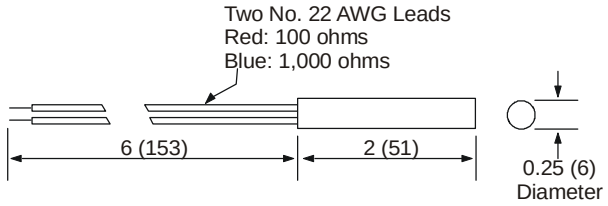


Figure 2: TEP Series Probe Sensor Dimensions, in. (mm)

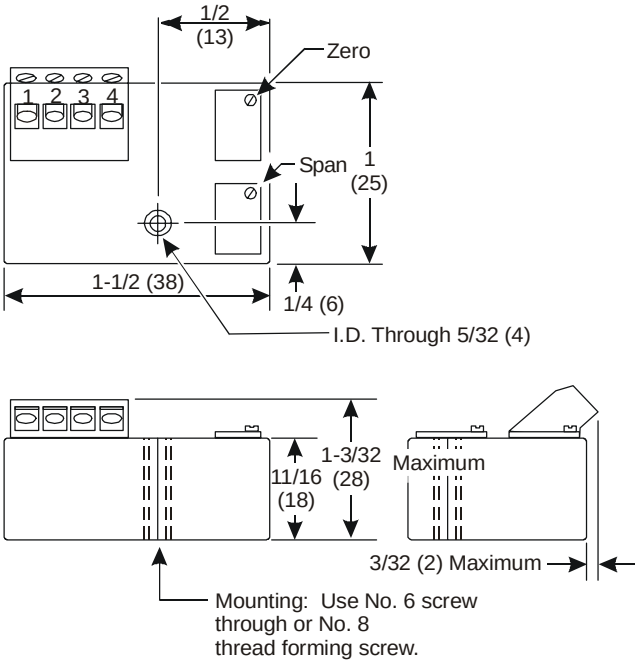


Figure 3: TQ-6000-1 Transmitter Dimensions, in. (mm)

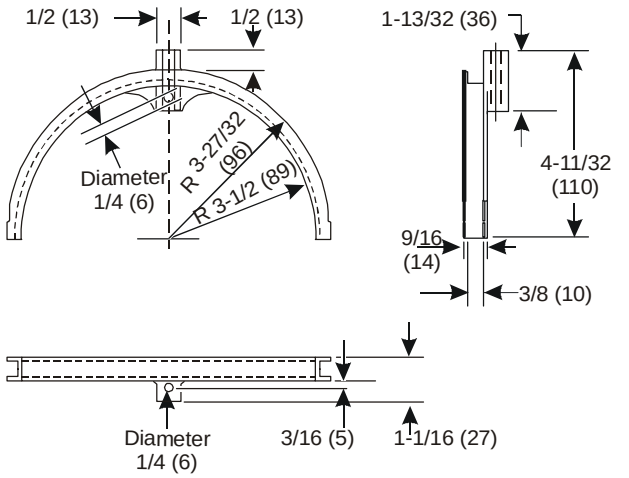


Figure 4: TE-6001-8 Temperature Element Holder Dimensions, in. (mm)

Mounting

IMPORTANT: Do not mount the temperature element and transmitter in the same enclosure. The transmitter functions as a variable resistor; therefore, some heat is dissipated. The heat generated by the transmitter can build up inside the enclosure and warm the element several degrees above the true ambient temperature, resulting in errors in the temperature of the controlled environment.

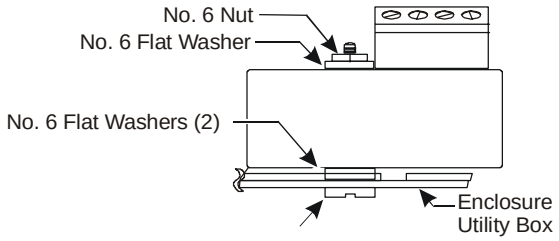
Mount the TEP probe sensors in the appropriate hardware assemblies as instructed in the *TE-6001 Hardware Assemblies for TE-6000 Temperature Elements Product/Technical Bulletin (LIT-216300)*.

To mount the TEA averaging sensor/hardware assemblies, see the following instructions and Figure 1.

1. Remove the electrical box cover and remove the foam gasket.
2. Thread the gasket over the element onto the electrical box, adhesive side to the box. (Alternately, slit the gasket to mount more easily.)
3. Remove the paper backing and press the gasket in place.
4. Mark and drill a 1-1/8 in. (29 mm) hole through the mounting surface for the sensing element.
5. Insert the averaging element into the drilled hole.
6. Use the box as a template to drill two 5/32 in. (4 mm) diameter holes into the mounting surface.
7. Mount the sensor into the holes just drilled using two No. 10 screws (not included).
8. Use the two (included) optional TE-6001-8 Mounting Brackets (or some other means of securing the sensor) with the averaging sensors, as required, to support the averaging element. (See Figure 4.)

Note: If not using the TE-6001-8 Mounting Bracket, the minimum bending radius is 3-1/2 in. (89 mm). Order additional TE-6001-8 Mounting Brackets as needed.

For 100-ohm sensors only, mount the TQ-6000-1 transmitter in a utility box with a No. 6-32 screw (not included). (See Figure 5.)



Use a No. 6 Screw (1 to 1-1/4 in. [26 to 32 mm] long) through either of the two smaller holes in the back of the utility box.

Figure 5: TQ-6000-1 Transmitter Mounted in an Enclosure Utility Box (Order separately.)

If mounting the transmitter and sensor together, limit error due to heat buildup in the transmitter. Thermally isolate the sensing element from the transmitter by mounting the transmitter inside a utility box placed behind the sensor.

Wiring

CAUTION: Risk of Property Damage. Do not apply power to the system before checking all wiring connections. Short circuited or improperly connected wires may result in permanent damage to the equipment.

IMPORTANT: Use copper conductors only. Make all wiring connections in accordance with local, national, and regional regulations. Do not exceed the sensor or transmitter electrical ratings.

Keep wires as short as possible to minimize sensor error. Each 150 ft (46 m) of 18 AWG wire, or 50 ft (15 m) of 24 AWG wire, creates 1 F° (0.56 C°) error for a 1,000 ohm platinum sensor due to wire resistance. To maintain less than 1F° (0.56 C°) error for 1,000 ohm platinum, hold the total resistance of all sensor wiring below 2 ohms. To minimize wiring error in applications using a 100-ohm platinum sensor, use the TQ-6000-1, 4 to 20 mA transmitter. Using a 4-wire (Kelvin) connection can also eliminate wiring error.

When wiring the sensor, do not run low-voltage wiring in the same conduit as line-voltage wiring or other conductors supplying highly inductive loads.

Consulting Figure 6, observe the following measures to avoid possible TQ-6000-1 wiring errors:

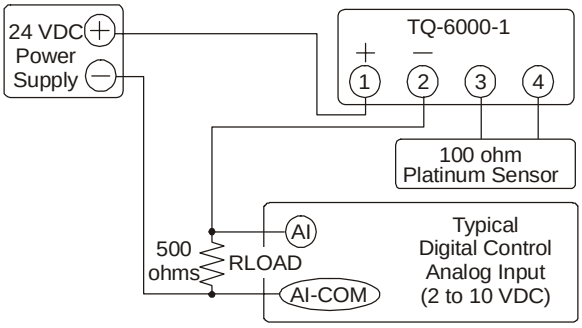


Figure 6: Wiring Diagram

1. **Do not** connect the transmitter sensor input to the power supply, as this may destroy the electronics.
2. **Do not** reverse the polarity of the power supply/signal loop.
3. **Do not** connect multiple transmitters in series. The transmitter reading the lowest temperature controls the current of the whole loop.
4. **Do not** put the TQ-6000-1 or the power supply in parallel with load resistor (R_{LOAD}). The signal loop must be in series with all load resistors.

Setup and Adjustments

Table 1: Temperature vs. Resistance

Temperature		Resistance
°F	°C	(ohms)
-50	**-46**	82.07
-40	**-40**	84.27
-30	**-34**	86.47
-20	**-29**	88.66
-10	**-23**	90.84
0	**-18**	93.03
10	**-12**	95.21
20	**-7**	97.39
30	**-1**	99.57
32	**0**	100.00
40	**4**	101.74
50	**10**	103.90
60	**16**	106.07
70	**21**	108.22
80	**27**	110.38
90	**32**	112.53
100	**38**	114.68
110	**43**	116.83
120	**49**	118.97
130	**54**	121.11
140	**60**	123.24
150	**66**	125.37
160	**71**	127.50
170	**77**	129.62
180	**82**	131.74
190	**88**	133.86
200	**93**	135.97
210	**99**	138.08
220	**104**	140.18
230	**110**	142.29
240	**116**	144.38
250	**121**	146.48
260	**127**	148.57
270	**132**	150.66
275	**135**	151.70

Note: Resistance values above are for the 100-ohm sensor. Multiply the values by 10 for the 1,000-ohm sensor.

Use the following formula to determine the nominal current output (I_T) at any temperature (T) using a 100-ohm sensor:

For Degrees Fahrenheit

I_T = 4 mA + [16 mA x (T°F/100°F)]

For Degrees Celsius

I_T = 4 mA + [16 mA x (T°C –17.8°C)/55.6°C]

Example: The output at 50°F (10°C) is:

I_T = 4 mA + [16 mA x (50°F/100°F)] = 12 mA

The transmitter derives operating power from the current signal.

The factory-calibrated TQ-6000-1 transmitter requires no field adjustment. **Do not** recalibrate unless a problem is evident. To check calibration or accuracy, use only instruments with at least five times the accuracy expected from the TQ-6000-1.

Technical Specifications

Product	TEP/TEA Temperature Sensing Elements
Elements	TEP Platinum (Equivalent) Resistance Type, Continuous Averaging TEA Platinum Resistance Type
Element Length	TEA Probe: 2 in. (51 mm) TEA – J/L Avg 10 ft (305 cm) TEA – K/M Avg 20 ft (610 cm)
Accuracy	±1F° at 70°F (±0.56C° at 21.1°C)
Reference Resistance at 32°F (0°C)	100 ohms: TEP-J000000, TEA-J000000, TEA-K000000 1,000 ohms: TEP-L000000, TEA-L000000, TEA-M000000
Temperature Coefficient of Resistance (TCR)	0.002139 ohm/ohm/°F (0.00385 ohms/ohms/°C)
Maximum Current	5 mA
Temperature Range	Sensing Element: -50 to 275°F (-46 to 135°C) TEA Gasket: 212°F (100°C)
Electrical Connections	22 AWG wire leads, 6 in. (150 mm) 100 ohm: Red Leads 1,000 ohm: Blue Leads
Materials	TEA Electrical Box: Galvanized Steel TEA Avg Element Sheath: Aluminum TEP Probe Copper Alloy
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Technical Specifications (Cont.)	
Product	TQ-6000-1 Temperature Transmitter
Output	4 to 20 mA DC Scaled over the 0 to 100°F (-18 to 38°C) Sensor Range
Sensing Element	Requires 100 ohms Platinum or Platinum Equivalent element with TCR = 0.002139 ohm/ohm/°F (0.00385 ohms/ohms/°C)
Factory Calibration	4 mA at 0°F (-17.8°C) 20 mA at 100°F (37.8°C)
Calibration Accuracy	±0.1% of Span at 75°F (23.9°C)
Adjustments	Zero: -5 to 5°F (-21 to -15°C) Span 95 to 105°F (35to -41°C)
Supply Voltage	8.5 to 35 VDC (Reverse Polarity Protected)
Warmup Drift	±0.1% of Span Maximum, with Vsupply = 24 VDC and Rloop = 250 ohms: Stable within 30 Minutes
Loop Resistance	The maximum allowable resistance of the signal carrying loop (with load resistor RLOAD and extension wires) is calculated with the following formula: Rloop maximum = (Vsupply - 8.5 V)/0.02 A
Linearity	±0.1% of Span. Referenced to Actual Sensor Temperature.
Ambient Temperature Effects	±0.007% of Span/°F (±0.13% of Span/°C) Change in Ambient Temperature over Usable Range
Supply Voltage Effects	±0.001% of Span/V
Electrical Connections	Screw Terminal Block for 22 to 18 AWG Wire
Ambient Operating Temperature	32 to 122°F (0 to 50°C)
Storage Temperature	-67 to 212°F (-55 to 100°C)
Shipping Weight	TEP-J/L000000 0.2 lb (0.09 kg) TEA-J/L000000 1.0 lb (0.45 kg) TEA-K/M000000 1.1 lb (0.5 kg) TQ-6000-1 0.24 lb (0.14 kg)

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.

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