TE-6300 Series Temperature Sensors

The TE-6300 Temperature Sensor line offers an economical solution for a wide variety of temperature sensing needs, including wall mount, outdoor air, duct, well, or duct averaging applications.

Sensors are available in the following types: 1k ohm thin-film nickel, 1k ohm nickel averaging, 1k ohm thin-film platinum, 1k and 100 ohm platinum equivalent averaging, and 2.2k ohm thermistor.

Each sensor is packaged with the necessary mounting accessories, which maximize ordering and installation ease and reduce both commissioning time and cost.

Figure 1: TE-6300 Series Temperature Sensors

Features and Benefits

❑ **Full Line of Sensors**	Supports all your temperature sensing needs from a single supplier: wall mount, outdoor air, duct, duct averaging, and well insertion
❑ **Inexpensively Priced**	Provides more sensor value for your dollar; enhances your competitive position in the marketplace
❑ **Single Assembly Ordering**	Simplifies ordering; provides a complete assembly in one box
❑ **Integral NPT Adaptor**	Increases the connection strength of the sensor; eliminates the need for a special adaptor
❑ **Noncorrosive PVC Enclosure**	Resists the effects of the environment with a durable, easy-to-use, standard conduit enclosure
❑ **Stainless Steel Sensor Probe**	Protects the sensor while increasing corrosion resistance
❑ **Retainer for the Sensor Holder**	Locks the sensor holder into the conduit box

Part No. 24-4034-107, Rev. C
Code No. LIT-216320

Product Overview

Duct probe sensor includes:

- 8 in. nickel, platinum, or thermistor sensor
- quick mount sensor holder with retainer
- metal mounting plate with screws (4) and locknut
- conduit enclosure with cover
- integral 1/2 in. NPT adaptor
- wire nuts (2)

Duct averaging sensor includes:

- 8 or 17 ft nickel, or 10 or 20 ft platinum sensor
- quick mount sensor holder with retainer
- metal mounting plate with screws (4) and locknut
- conduit enclosure with cover
- integral 1/2 in. NPT adaptor
- wire nuts (2)

Well insertion sensor includes:

- 6 or 8 in. nickel or platinum, or 8 in. thermistor sensor
- quick mount sensor holder with retainer
- conduit enclosure with cover
- 1/2 in. integral NPT adaptor
- wire nuts (2)

Outdoor air sensor includes:

- 3 in. nickel, platinum, or thermistor sensor
- outdoor air shield
- conduit enclosure with cover
- integral 1/2 in. NPT adaptor
- wire nuts (2)

Wall mount sensor includes:

- nickel, platinum, or thermistor sensor
- white T-4000 style cover and base with silver faceplate and horizontal logo
- Drywall mounts and spacers (2 each)
- mounting screws (2)
- wire nuts (2)

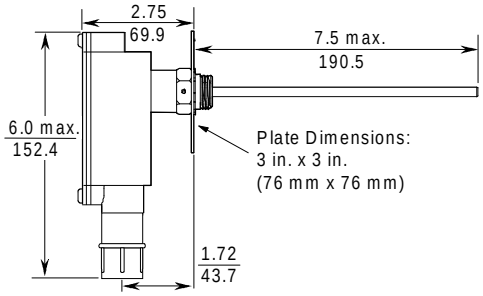

Figure 2: Duct Probe Sensor (in./mm)

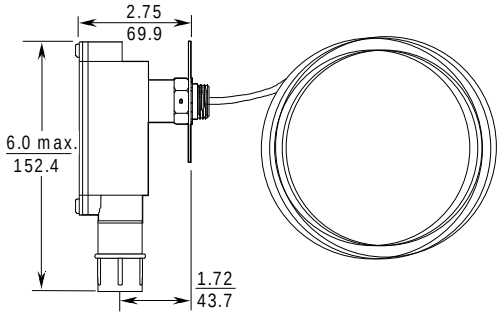

Figure 3: Duct Averaging Sensor (in./mm)

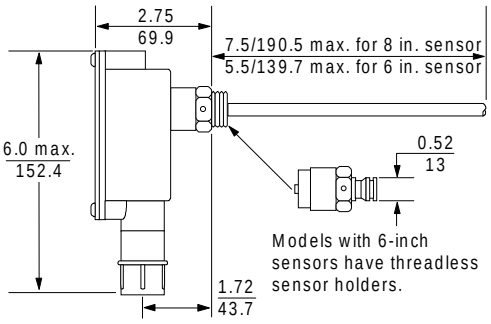

Figure 4: Well Insertion Sensor (in./mm)

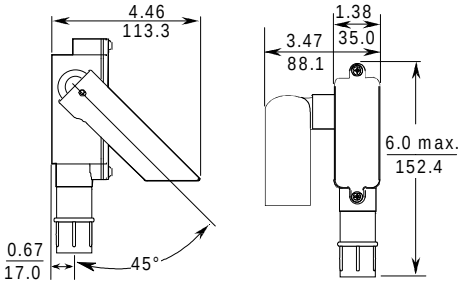

Figure 5: Outdoor Air Sensor (in./mm)

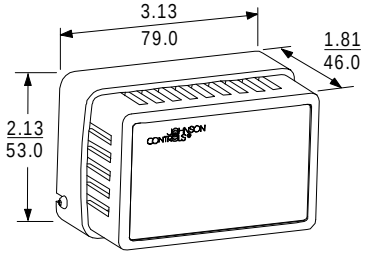

Figure 6: Wall Mount Sensor (in./mm)

Applications

Table 1: Sensor Application Matrix

Application	Suggested Sensor	Description	Application Notes
Wall Mount	TE-6314P-1 TE-6324P-1 TE-6344P-1	Nickel sensor Platinum sensor 2.2k ohm thermistor	• 2-screw wall plate provided for surface mounting. • White cover provided. (See Table 7 for additional covers available.)
Outdoor Air	TE-6313P-1 TE-6323P-1 TE-6343P-1	Nickel, 3 in. probe Platinum, 3 in. probe 2.2k ohm thermistor, 3 in. probe	• Used to sense outside ambient temperature to determine efficient heating and cooling strategies.
Duct Probe	TE-6311P-1 TE-6321P-1 TE-6341P-1	Nickel, 8 in. probe Platinum, 8 in. probe 2.2k ohm thermistor, 8 in. probe	• 4-screw mounting plate provided for duct mounting. • Can also be used for plenums. • Ideal in freezer lockers or where sensor mounting should be located outside of the sensed area. • 12 in. probe is available for use in larger ducts.
Duct Averaging	TE-6315P-1 TE-6316P-1 TE-6327P-1 TE-6328P-1 TE-6337P-1 TE-6338P-1	Nickel, 8 ft averaging element Nickel, 17 ft averaging element Platinum, 1k ohm, 10 ft avg. element Platinum, 1k ohm, 20 ft avg. element Platinum, 100 ohm, 10 ft avg. element Platinum, 100 ohm, 20 ft avg. element	• 4-screw mounting plate provided for duct mounting. • Used in duct where average temperature is needed. • Approximately 1 ft of sensor is recommended for each sq ft of duct cross section. • TE-6001-8 element holder is recommended when installing an averaging sensor in a duct.
Well Insertion	TE-6312P-1 TE-6322P-1 TE-6342P-1 TE-631AP-1 TE-632AP-1	Nickel, 8 in. probe, threaded holder Platinum, 8 in. probe, threaded holder 2.2k ohm thermistor, 8 in. probe, threaded holder Note: The 8 in. probes are to be used **only** with the WZ-1000-2 and WZ-1000-4. Nickel, 6 in. probe, threadless holder Platinum, 6 in. probe, threadless holder Note: The 6 in. probes are to be used only with the WZ-1000-5.	• Threaded sensor holder has 1/2 in. NPT threads; threadless holder accommodates set screws. • Thermal well should be mounted at an angle so condensation will run out of the well. If not possible, seal the sensor holder and the wiring end of the sensor probe with RTV silicone rubber. • 12 in. probe is available for use in longer wells. • Compatible Johnson Controls thermal wells are listed in *Table 4: Optional Accessories* of the *Repair and Replacement* section.

Note: Well sensor probe lengths are longer than accessory well lengths because part of the probe is in the conduit box and sensor holder.

Averaging Sensing

Four, nine, sixteen, or more sensors may be wired in a series parallel arrangement to provide an average temperature reading in an area. (See Figure 14.)

In a series parallel arrangement, there must always be the same number of parallel connected legs as there are series connected sensors per leg.

For example: With four sensors, there must be two parallel legs and two sensors connected in series in each leg. With nine sensors, as shown in Figure 7, there must be three parallel legs and three sensors connected in series in each leg.

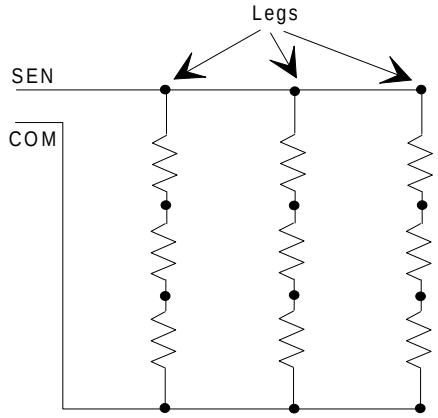

Figure 7: Series Parallel Wiring Arrangement

Theory of Operation

IMPORTANT: All TE-6300 Series Temperature Sensors are designed for use **only** in conjunction with operating controls. Where an operating control failure would result in personal injury and/or loss of property, it is the responsibility of the installer to add safety devices or alarm systems that protect against, and/or warn of, control failure.

The thin-film nickel sensors have a reference resistance of 1k ohms at 70°F (21°C) and a change in resistance of approximately 3 ohms/F° (5 ohms/C°). They have white leads.

The platinum and platinum equivalent averaging sensors have a reference resistance of either 100 or 1k ohms at 32°F (0°C) and meet the DIN 43760 standard. The 1k ohm platinum sensors are identified by white leads with a blue stripe. The 1k ohm platinum equivalent averaging sensors have blue leads, and the 100 ohm platinum equivalent averaging sensors have red leads.

See Table 2 or Figure 8 for resistance values at selected temperatures for nickel, platinum, and platinum equivalent sensors.

The thermistor sensors have a negative temperature coefficient, and can be identified by white leads with a green stripe. They have a reference resistance of 2.2k ohms at 77°F (25°C), and match Fenwal unicurve characteristics. (See Table 2 or Figure 9 for resistance values at selected temperatures.)

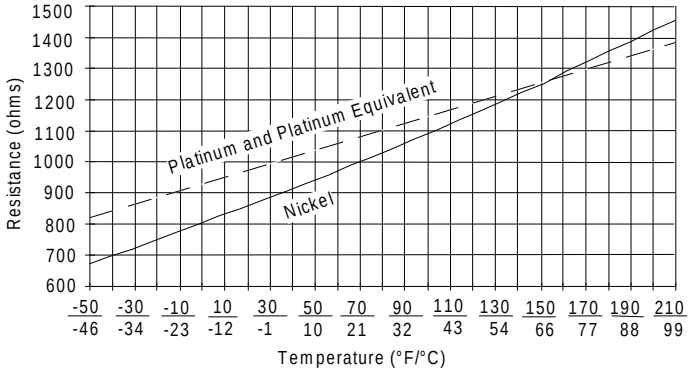

Figure 8: Temperature vs. Resistance for the Nickel, Platinum, and Platinum Equivalent Sensors

Table 2: Nominal Temperature vs. Resistance for Nickel, Platinum, Platinum Equivalent*, and Thermistor Sensors

Temperature		Resistance (ohms)		
°F	°C	Nickel	Platinum	Thermistor (2.2k)
-50	-46	674	821	109872
-40	-40	699	843	75466
-30	-34	725	865	52571
-20	-29	751	887	37116
-10	-23	777	908	26539
0	-18	803	930	19208
10	-12	830	952	14062
20	-7	858	974	10408
30	-1	885	996	7784
40	4	914	1017	5880
50	10	942	1039	4484
60	16	971	1061	3450
70	21	1000	1082	2678
80	27	1030	1104	2095
90	32	1060	1125	1652
100	38	1090	1147	1313
110	43	1121	1168	1051
120	49	1152	1190	847
130	54	1184	1211	687
140	60	1216	1232	561
150	66	1248	1254	461
160	71	1281	1257	380
170	77	1314	1296	316
180	82	1348	1317	264
190	88	1382	1339	221
200	93	1417	1360	187
210	99	1452	1381	158
220	104	1487	1402	135

*Note: For 100 ohm platinum equivalent sensors, divide the resistance values for the 1k ohm platinum sensors by 10.

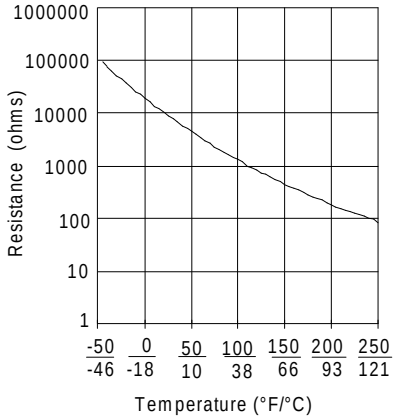

Figure 9: Temperature vs. Resistance for the 2.2k ohm Thermistor Sensors

Location Considerations

- Avoid areas subject to excessive vibration or electrical noise.
- **Keep conductors as short as possible** to minimize temperature error. For 1k ohm nickel sensors, wire resistance can cause approximately 1F° error for each 250 ft run of 18 AWG wire (or 100 ft of 22 AWG wire). With a 1k ohm platinum sensor, a 1F° error can occur with a 150 ft run of 18 AWG wire (50 ft of 22 AWG wire).

  To minimize error caused by field wiring, the total resistance of all **nickel** sensor wiring should be less than 3 ohms, and the total resistance of all **1k ohm platinum** sensor wiring should be less than 2 ohms.

  To minimize wiring error in applications using **100 ohm platinum equivalent** sensors, the TQ-6000, 4 to 20 mA transmitter may be used. A 4-wire (Kelvin) connection can also be used to eliminate wiring error.

  In **2.2k thermistor** applications, wiring can be quite long before wire resistance becomes a significant contribution to total resistance at the monitor or controller, except in very high temperature applications. As a general rule, a 150 ft, 2-wire run of 18 AWG wire will contribute a 2 ohm error or 0.1° error at 100°F.

  Note: As long as the errors, due to the wiring, are small (when compared to the change in resistance of the sensor due to a 1F° or 1C° temperature change), the wire run will not significantly affect the temperature reading.
- Install sensors in areas where sufficient mixing of the sensed medium occurs or use an averaging sensor.

> ⚠ CAUTION: **Equipment Damage Hazard**. Do not exceed the temperature range given in the *Specifications* section or the sensing element may be permanently damaged.

Tools Needed

- hole saw with a 1-3/8 in. (35 mm) blade
- drill with 1/8 in. (3 mm) drill bit
- 1/16 in. (1.5 mm) Allen wrench
- flat-blade screwdriver
- wire cutter/stripper

Installation

Cutting the Sensor Probe

If necessary, sensor probes can be cut at the wiring end using the following procedure:

1. Mark the desired length, measuring from the end of the tube without leads. (The sensor probe **must** be left at least 3 in. long.)
2. Cut probe using a tubing cutter with a sharp blade. (Cut slowly, using minimum pressure to decrease burr size and help avoid damage to the leads.)
3. Slide the loose tubing carefully over the leads to remove.
4. Insert leads into shrink wrap or use other material to protect the leads from potential sharp edges where the probe was cut. (Heat the shrink wrap using a moderate heat source.)

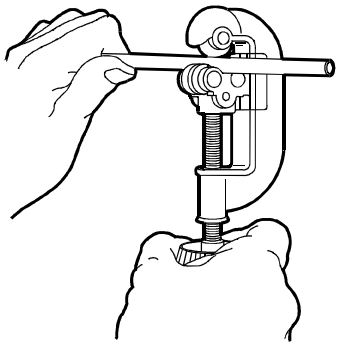

Figure 10: Cutting the Sensor Probe

Securing or Removing the Sensor Holder

The enclosed sensor holder includes a retainer (gray plastic tube approximately 1 1/4 in. long x 1/2 in. in diameter). The retainer must be used to lock the sensor holder into the conduit box. Using the retainer will prevent the snap finger from deflecting, locking the sensor holder into the conduit box. To install the retainer: Slide the retainer over the sensor wires and sensor probe, and into the sensor holder. (See Figure 13.)

To remove the sensor holder from the box, slide the retainer off of the sensor probe. While pushing the snap finger toward the center of the sensor holder, pull the holder out of the conduit box.

Note: It may be necessary to loosen the set screw and remove the sensor probe to obtain adequate clearance to slide the sensor holder out of the conduit box.

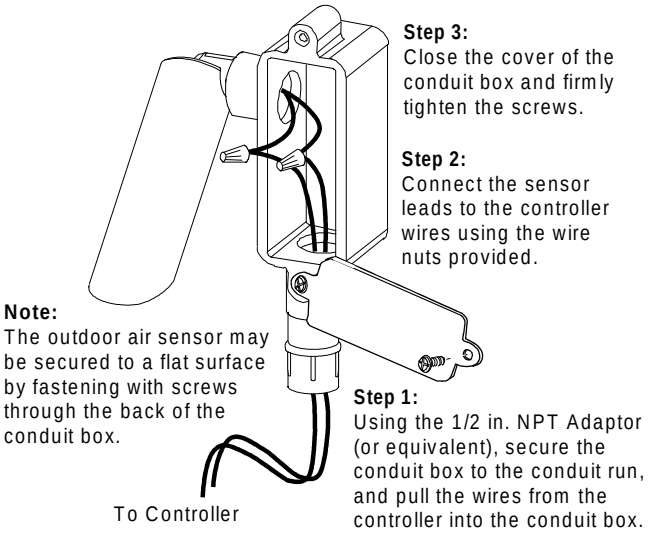

Figure 11: Installing the Outdoor Air Sensor

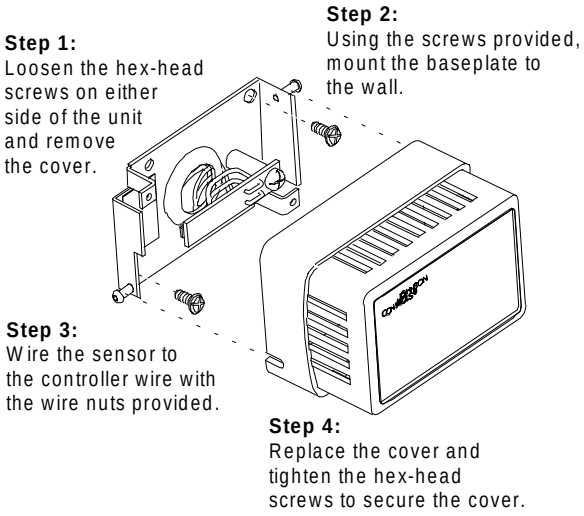

Figure 12: Installing the Wall Mount Temperature Sensor

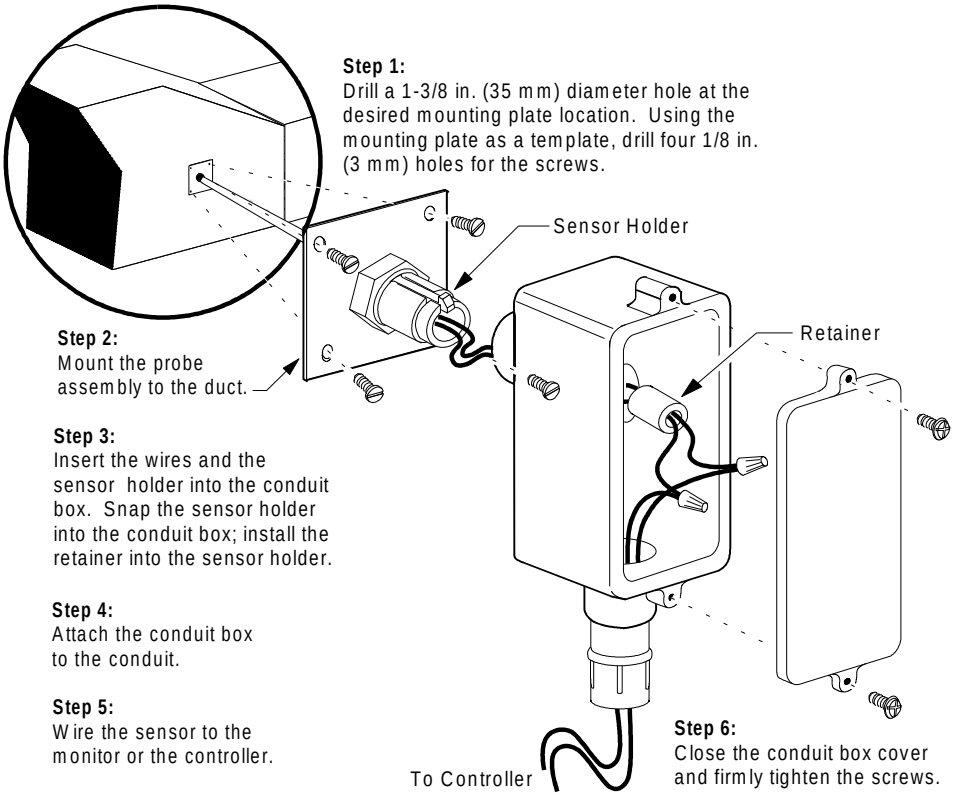

Figure 13: Installing the Duct Sensor Using the Sensor Holder and Retainer

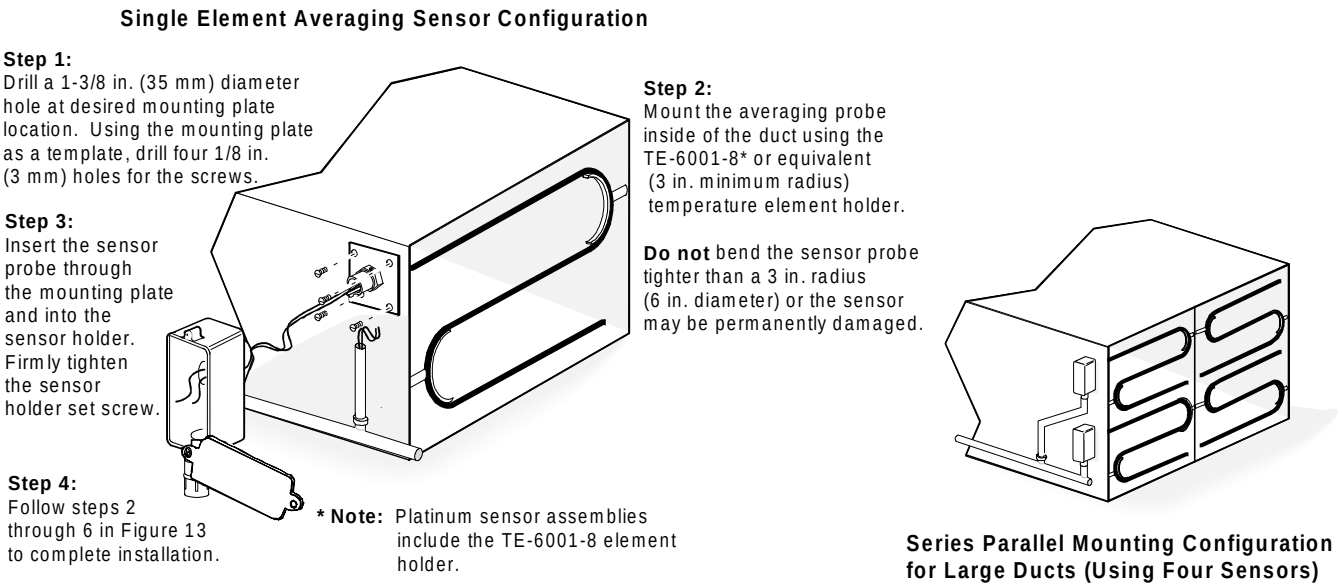

Figure 14: Installing the Duct Averaging Sensor

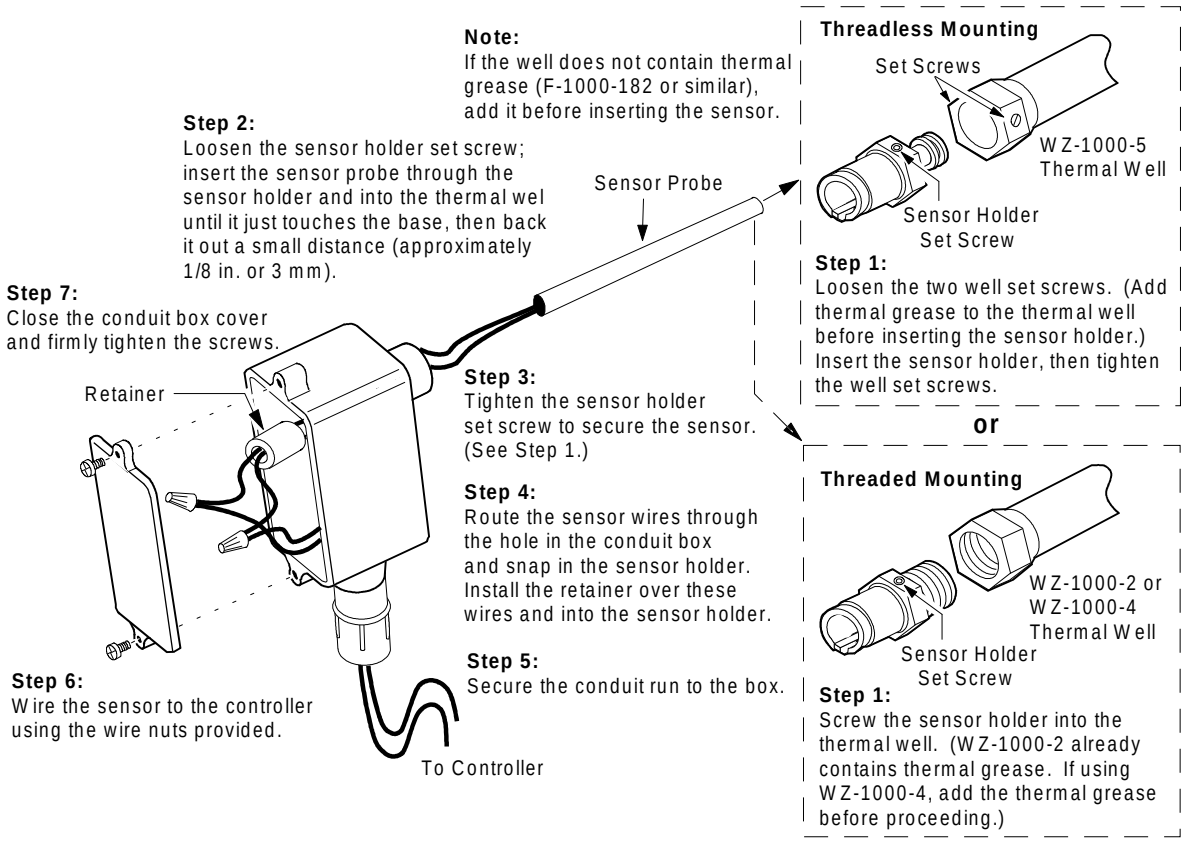

Figure 15: Installing the Well Sensor using the Sensor Holder and Retainer

Wiring

See the appropriate controller documentation for recommended sensor wiring.

> ⚠ CAUTION: **Equipment Damage Hazard**. Disconnect the power supply before wiring connections are made to avoid electrical shock or possible damage to the equipment.

> IMPORTANT: Make all wiring connections in accordance with the National Electrical Code and all local regulations.

Ordering Information

Table 3: Product Ordering

Sensor	Mounting Style	Probe Length	Product Code Number
Nickel	Duct	8 in.	TE-6311P-1
	Well	6 in.	TE-631AP-1
		8 in.	TE-6312P-1
	Outdoor Air	3 in.	TE-6313P-1
	Averaging*	8 ft	TE-6315P-1
		17 ft	TE-6316P-1
	Wall**	NA	TE-6314P-1
Platinum	Duct	8 in.	TE-6321P-1
	Well	6 in.	TE-632AP-1
		8 in.	TE-6322P-1
	Outdoor Air	3 in.	TE-6323P-1
	Wall**	NA	TE-6324P-1
Platinum Equivalent	1k ohm Averaging*	10 ft	TE-6327P-1
		20 ft	TE-6328P-1
	100 ohm Averaging*	10 ft	TE-6337P-1
		20 ft	TE-6338P-1
Thermistor (2.2k ohm)	Duct	8 in.	TE-6341P-1
	Well	8 in.	TE-6342P-1
	Outdoor Air	3 in	TE-6343P-1
	Wall**	NA	TE-6344P-1

***** The TE-6001-8 Element Holder is included with the platinum equivalent averaging sensors, but must be ordered separately for use with nickel averaging sensors.

****** TE-1800-9600 Mounting Hardware must be ordered separately when mounting the wall unit to a handy box.

Repair and Replacement

The TE-6300 series of products allows for easy replacement of the temperature element. For a replacement sensor, refer to Table 3, and contact the nearest Johnson Controls representative.

Table 4: Optional Accessories

Product Code Number	Description
TE-6001-8	Element holder for mounting an averaging sensor (10/pkg.)
TE-1800-9600	Mounting hardware for mounting the wall mount unit to a handy box
TE-6300-101	12 in. nickel probe that can be cut to an appropriate length
TE-6300-102	12 in. (1k ohm) platinum probe that can be cut to an appropriate length
TE-6300-104	12 in. (2.2k) thermistor probe that can be cut to an appropriate length
TQ-6000-1	4-20 mA output transmitter for use with the 100 ohm platinum sensor
WZ-1000-2	6-1/2 in. length, stainless steel well, thermal compound included
WZ-1000-4	6-1/2 in. length, stainless steel well
WZ-1000-5*	4-11/16 in. length, brass well
Note: To order a different cover for the wall mount sensor, see your Johnson Controls catalog and pricing sheet under T-4000-XXXX.	

*Use the TE-631AP-1 or TE-632AP-1 with this well.

Table 5: Repair Parts

Product Code Number	Description
TE-6300-601	8 in. nickel probe
TE-6300-602	8 in. (1k ohm) platinum probe
TE-6300-606	8 in. thermistor probe (2.2k)
TE-6300-603	3 in. nickel probe
TE-6300-604	3 in. (1k ohm) platinum probe
TE-6300-607	3 in. thermistor probe (2.2k)
TE-6300-605	Threaded sensor holder with retainer (10/pkg.)
TE-6300-609	Threadless sensor holder with retainer (10/pkg.)

Table 6: Typical Accessory Usage

Product/ Accessory	TE-6001-8 Averaging Sensor Bracket	TE-1800-9600 Mounting Hardware for use with 2 in. x 4 in. Electrical Box	TE-6300-101 12 in. Nickel Probe	TE-6300-102 12 in. Platinum Probe	TE-6300-104 12 in. Thermistor Probe	TQ-6000-1 4-20 mA Output Transmitter	WZ-1000-2 6-1/2 in. Stainless Steel Well with Thermal Compound	WZ-1000-4 6-1/2 in. Stainless Steel Well	WZ-1000-5 4-11/16 in. Brass Well
TE631AP-1									X
TE6311P-1			X						
TE6312P-1							X	X	
TE6313P-1									
TE6314P-1		X							
TE6315P-1	X								
TE6316P-1	X								
TE632AP-1									X
TE6321P-1				X					
TE6322P-1							X	X	
TE6323P-1									
TE6324P-1		X							
TE6327P-1	X								
TE6328P-1	X								
TE6337P-1	X					X			
TE6338P-1	X					X			
TE6341P-1					X				
TE6342P-1							X	X	
TE6343P-1									
TE6344P-1		X							

Table 7: T-4000 Covers Available for the TE-6300 Series

Product Code Number	Horizontal Johnson Controls Logo	Vertical Johnson Controls Logo	Thermometer	Material (Plastic Cover/ Faceplate)
T-4000-2138				Beige/Brushed Aluminum
T-4000-2139	X			
T-4000-2140	X		X	
T-4000-2144		X		
T-4000-2639	X			Beige/Brown and Gold
T-4000-2640	X		X	
T-4000-2644		X		
T-4000-3139	X			White/Brushed Aluminum
T-4000-3140	X		X	
T-4000-3144		X		

Notes

Specifications

Product	TE-6300 Series Temperature Sensors
Thin-film Nickel Sensor	
Temperature Coefficient	Approximately 3 ohms/F° (5.4 ohms/C°)
Reference Resistance	1k ohms at 70°F (21°C)
Accuracy	±0.34F° at 70°F (±0.18C° at 21°C)
Nickel Averaging Sensor	
Temperature Coefficient	Approximately 3 ohms/F° (5.4 ohms/C°)
Reference Resistance	1k ohms at 70°F (21°C)
Accuracy	±3.0F° at 70°F (±1.67C° at 21°C)
Platinum Sensor	
Temperature Coefficient	Approximately 2 ohms/F° (3.9 ohms/C°), meets DIN 43760
Reference Resistance	1k ohms at 32°F (0°C)
Accuracy	±0.65F° at 70°F (± 0.36C° at 21°C), DIN Class B
Platinum Equivalent Sensor	Meets DIN 43760
Temperature Coefficient and	Approximately 2 ohms/F° (3.9 ohms/C°) for 1k ohms at 32°F (0°C)
Reference Resistance	Approximately 0.2 ohms/F° (0.39 ohms/C°) for 100 ohms at 32°F (0°C)
Accuracy	Approximately ±1.08F°at 70°F (± 0.56C° at 21°C)
2.2k ohm Thermistor Sensors	
Temperature Coefficient	Nonlinear, negative temperature coefficient
Reference Resistance	2.25k ohms at 77°F (25°C)
Accuracy	2.25k: ±0.36F° (±0.2C°) in the range of 32 to 158°F (0 to 70°C)
Temperature Range	Probe Assembly: -50 to 220°F (-46 to 82°C) Conduit Box: -50 to 122°F (-46 to 50°C)
Sensor Construction	Sensor: 1/4 in. O.D. stainless steel probe (except for averaging and wall sensors) Conduit Access Box: Rigid PVC plastic
Lead Wiring	22 AWG wire, 6 in. (152 mm) leads. (See controller for connection requirements.)

Sensor Type	Lead Color	Sensor Type	Lead Color
Nickel	White	1k ohm Platinum	White w/blue stripe
1k ohm Platinum Averaging*	Blue	Thermistor	White w/green stripe
100 ohm Platinum Averaging*	Red	Nickel Averaging*	White

* 18 AWG wire

Mounting Choices	Duct, Well, Outdoor Air, Wall Mount
Shipping Weight	Wall Mount: 0.2 lb (0.9 kg) Duct Mount: 0.4 lb (0.18 kg) Well Insertion: 0.35 lb (0.16 kg) Outdoor Air: 0.5 lb (0.23 kg) Duct Averaging: 0.5 lb (0.23 kg)
Dimensions (H x W x D)	Wall Mount: 2.13 in. x 3.13 in. x 1.81 in. (53 mm x 79 mm x 46 mm) Duct Mount: 4.47 in. x 1.38 in. x 2.75 in. (114 mm x 35 mm x 70 mm) + adjustable probe depth Well Insertion: 4.47 in. x 1.38 in. x 2.75 in. (114 mm x 35 mm x 70 mm) + adjustable probe depth Outdoor Air: 4.47 in. x 3.47 in. x 4.46 in. (114 mm x 88 mm x 113 mm) Duct Averaging: 4.47 in. x 1.38 in. x 2.75 in. (114 mm x 35 mm x 70 mm) + 8,10,17, or 20 ft element

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.

JOHNSON CONTROLS

Controls Group
507 E. Michigan Street
P.O. Box 423
Milwaukee, WI 53201

Printed in U.S.A.