

**From:** Dan Wilson [<mailto:DWilson@wilsonengineeringservices.com>]

**Sent:** Thursday, April 09, 2015 5:10 PM

**To:** Bernstein, Barbara

**Subject:** RE: checking...

Barbara,

Here is the list of items. I numbered the attachments to match with the numbers below.

- 1) please highlight the temperature operating range and parameters for the temperature sensors - (information provided was generic to many different temperature sensor models) – Attached pdfs
- 2) please highlight or provide (as needed) the manufacturer's literature/statement on calibration requirements for flow meter and temperature sensors
- 3) please confirm and make affirmative statement that recordings will be made hourly or more frequently (probably best in letter from TAE)
- 4) please provide direct statement that all metering equipment is properly installed to manufacturer requirements (here is exact language - probably best in the letter from TAE) "A statement by a professional engineer that is licensed in New Hampshire and in good standing that the project meets the metering requirements of Puc 2506 and that the meters were installed according to manufacturer's recommendation, and that the renewable energy source meets the requirements of this part."
- 5) Puc 2505.02(d)(8) requests name and contact information of the seller of the thermal equipment:

Johnson Controls

John B. Sanborn

Energy Solutions Engineer

Johnson Controls, Inc.

116 Railroad Ave.

Albany, NY 12205

518-894-8669

[john.b.sanborn@jci.com](mailto:john.b.sanborn@jci.com)

I'll give you a call to confirm.

Regards,

Dan

Daniel A. Wilson, PE

WES Wilson Engineering Services, PC

[www.wilsonengineeringservices.com](http://www.wilsonengineeringservices.com)

## TE-6300 Series Temperature Sensors

### Description

The TE-6300 Temperature Sensor line provides economical solutions for a wide variety of temperature sensing needs, including wall-mount, outdoor-air, duct, strap-mount, well-insertion, duct-averaging, and Variable Air Volume (VAV) flange-mount duct-probe applications. The TE-6300 line offers both a metal and a plastic enclosure for the most popular models.

Sensors are available in the following types:

- 1k ohm thin-film nickel
- 1k ohm nickel averaging
- 1k ohm thin-film platinum
- 100 ohm platinum equivalent averaging
- 1k ohm platinum equivalent averaging
- 2.2k (2,252) ohm thermistor
- 10k ohm thermistor, Johnson Controls® Type II

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

Refer to the *TE-6300 Temperature Sensors Product Bulletin (LIT-216320)* for important product application information.

### Features

- full line of versatile sensors — supports all your temperature sensing needs from a single supplier: wall mount, outdoor air, duct probe, duct averaging, strap-mount, well insertion, and flange mount duct probe
- single assembly ordering — simplifies ordering; provides a complete assembly in one box
- models featuring an integral NPT Adaptor — increase sensor connection strength, which eliminates the need for a special adaptor
- models with a stainless steel sensor probe — protect the sensor while increasing corrosion resistance
- metal enclosure (TE-63xxM Models only) — meets plenum requirements
- models featuring a retainer for the sensor holder — allow you to lock the sensor holder into the conduit box
- brushed stainless steel mounting plate — offers a durable, aesthetically-pleasing design
- low profile flush mount design — provides a tamper-proof installation ideally suited for schools, sporting complexes, retailers, prisons, and more

All TE-6300 series sensors are two-wire, passive, resistance output devices.

### TE-63xxA Models

The TE-63xxA (adjustable length) models:

- provide a thermoplastic mounting flange and gland nut to adjust the length of the probe

- include two hex-head self-drilling screws for mounting
- come equipped with a 10 ft (3 m) plenum-rated cable with 1/4 in. (6.35 mm) female insulated quick-connect terminations on leads

### TE-63xxF Models

The TE-63xxF (flush mount) models:

- provide a low profile when installed in an electrical box
- feature thermally isolated sensor from the wall with a foam pad
- offer a rugged stainless steel cover
- provide 22 AWG lead wires with low voltage installation

### TE-63xxM Models

The TE-63xxM (metal enclosure) models:

- come with a corrosion-protected steel enclosure with a 0.88 in. (22 mm) hole for a 1/2 in. (12.7 mm) conduit fitting
- include two hex-head self-drilling screws for mounting the duct and duct averaging models
- offer (well models only) either a direct mount or 1/2-14 NPT threaded well sensor holder for mounting in TE-6300W Series thermal wells (Order the thermal well separately.)
- provide optional well sensor holders (order separately) to mount duct models in thermal wells.
- meet UL 1995 plenum use requirements
- offer optional accessory kit (order separately) to replace plastic hole plug and wiring bushing to meet International Mechanical Code (IMC) requirements

### TE-63xxP Models

The TE-63xxP (plastic enclosure) models:

- provide a thermoplastic conduit box with 1/2-14 NPT female thread for connecting to conduit
- provide aluminum mounting plate and 1/2-14 NPT threaded hub mounting options for the duct and duct averaging models
- use the 1/2-14 NPT female thread to mount the Outdoor Air models directly to ridged conduit
- provide optional sensor holders (order separately) to mount duct models in thermal wells
- offer an optional accessory metal cover kit (order separately) to replace the plastic cover to meet UL 1995 plenum use requirements
- include a replaceable sensing probe on duct probe, outdoor air, and well insertion models



TE-6300 Series Temperature Sensors

### TE-63x4P Wall Mount Models

The TE-63x4P (plastic enclosure) models:

- come with a white thermoplastic ventilated cover with a brushed aluminum face plate and a steel mounting plate for surface mounting
- include faceplates for both horizontal and vertical mounting
- offer an accessory mounting kit for mounting to a standard electrical box
- offer optional covers

### TE-63xS Models

The TE-63xS (Strap-Mount) models:

- provide a 1/4 in. (6.35 mm) diameter stainless steel probe without an enclosure
- include three cable ties for mounting to pipe up to 2-5/8 in. (67 mm) diameter
- come equipped with a 10 ft (3 m) plenum rated cable
- meet UL 1995 plenum use requirements
- offer an accessory mounting kit for mounting to a pipe up to 11 in. (280 mm) diameter

### TE-63xxV Models

The TE-63xxV (VAV flange mount) models:

- provide a stainless steel mounting flange with two hex-head self-drilling mounting screws
- come equipped with a 10 ft (3 m) plenum rated cable with 1/4 in. (6.35 mm) female insulated quick-connect terminations on leads
- meet UL 1995 plenum use requirements

### Repair Information

If the TE-6300 Series Temperature Sensor fails to operate within its specifications, refer to the *TE-6300 Series Temperature Sensors Product Bulletin (LIT-216320)* for a list of repair parts available.

## TE-6300 Series Temperature Sensors (Continued)

### Selection Charts

| Sensor            | Mounting Style          | Probe Length in. (mm) | Product Code Number     |
|-------------------|-------------------------|-----------------------|-------------------------|
| Nickel (1k ohm)   | Adjustable <sup>1</sup> | 8 (203)               | TE-6311A-1              |
|                   | Averaging               | 8 ft (2.4 m)          | TE-6315M-1              |
|                   |                         |                       | TE-6315V-2 <sup>1</sup> |
|                   |                         | 17 ft (5.2 m)         | TE-6316M-1              |
|                   |                         |                       | TE-6316V-2 <sup>1</sup> |
|                   | Duct                    | 4 (102)               | TE-631GM-1              |
|                   |                         | 8 (203)               | TE-6311M-1              |
|                   |                         |                       | TE-6311P-1              |
|                   |                         | 18 (457)              | TE-631JM-1              |
|                   | Flange                  | 4 (102)               | TE-631GV-2              |
|                   |                         | 8 (203)               | TE-6311V-2              |
|                   | Flush                   | N/A                   | TE-6310F-0              |
|                   |                         |                       | TE-6310F-1              |
|                   | Outdoor Air             | 3 (76)                | TE-6313P-1              |
|                   | Strap-Mount             | 3 (76)                | TE-631S-1               |
|                   | Wall <sup>2</sup>       | N/A                   | TE-6314P-1              |
|                   | Well                    | 6 (152)               | TE-631AM-2              |
|                   |                         | 8 (203)               | TE-6312M-1              |
| Platinum (1k ohm) | Adjustable              | 8 (203)               | TE-6351-A               |
|                   | Duct                    | 4 (102)               | TE-635GM-1              |
|                   |                         | 8 (203)               | TE-6351M-1              |
|                   |                         |                       | TE-6351P-1              |
|                   |                         | 18 (457)              | TE-635JM-1              |
|                   | Flange                  | 4 (102)               | TE-635GV-2              |
|                   |                         | 8 (203)               | TE-6351V-2              |
|                   | Flush                   | N/A                   | TE-6350F-0              |
|                   |                         |                       | TE-6350F-1              |
|                   | Strap-Mount             | 3 (76)                | TE-635S-1               |
|                   | Outdoor Air             | 3 (76)                | TE-6353P-1              |
|                   | Wall <sup>2</sup>       | N/A                   | TE-6324P-1              |
|                   | Well                    | 6 (152)               | TE-635AM-2              |
|                   |                         | 8 (203)               | TE-6352M-1              |

| Sensor                       | Mounting Style                 | Probe Length in. (mm) | Product Code Number |
|------------------------------|--------------------------------|-----------------------|---------------------|
| Platinum Equivalent          | 1k ohm Averaging <sup>1</sup>  | 10 ft (3 m)           | TE-6327P-1          |
|                              |                                | 20 ft (6.1 m)         | TE-6328P-1          |
|                              | 100 ohm Averaging <sup>1</sup> | 10 ft (3 m)           | TE-6337P-1          |
|                              |                                | 20 ft (6.1 m)         | TE-6338P-1          |
| Thermistor (2.2k ohm)        | Adjustable                     | 8 (203)               | TE-6341A-1          |
|                              | Duct                           | 8 (203)               | TE-6341P-1          |
|                              | Flange                         | 4 (102)               | TE-634GV-2          |
|                              |                                | 8 (203)               | TE-6341V-2          |
|                              | Outdoor Air                    | 3 (76)                | TE-6343P-1          |
|                              | Wall <sup>2</sup>              | N/A                   | TE-6344P-1          |
|                              | Well                           | 8 (203)               | TE-6342M-1          |
|                              |                                | 6 (152)               | TE-634AM-2          |
| Thermistor (10k ohm) Type II | Adjustable                     | 8 (203)               | TE-6361A-1          |
|                              | Duct                           | 4 (102)               | TE-636GM-1          |
|                              |                                | 8 (203)               | TE-6361M-1          |
|                              |                                |                       | TE-6361P-1          |
|                              |                                | 18 (457)              | TE-636JM-1          |
|                              | Flange                         | 4 (102)               | TE-636GV-2          |
|                              |                                | 8 (203)               | TE-6361V-2          |
|                              | Flush                          | N/A                   | TE-6360F-0          |
|                              |                                |                       | TE-6360F-1          |
|                              | Outdoor Air                    | 3 (76)                | TE-6363P-1          |
|                              | Strap-Mount                    | 3 (76)                | TE-636S-1           |
|                              | Well                           | 6 (152)               | TE-636AM-2          |
|                              |                                | 8 (203)               | TE-6362M-1          |

- Two TE-6001-8 Element Holders come with the platinum equivalent averaging sensors. Order separately to use with a nickel averaging sensor.
- Order the TE-1800-9600 Mounting Hardware separately to mount the wall unit to a wallbox.

### Optional Accessories

| Product Code Number | Description  |
|---------------------|--|
| F-1000-182          | Thermal Conductive Grease for element wells (8 oz.)  |
| T-4000-xxxx         | Wall Mount Cover   |
| T-4000-119          | Allen Head Tool for Wall Mount Cover Screws (order in multiples of 30)                       |
| TE-1800-9600        | Mounting Hardware for mounting the wall mount unit to a wall box                             |
| TE-6001-8           | Element Holder for mounting an averaging sensor (order in multiples of 10)                   |
| TE-6001-13          | Metal Cover and Gasket Kit (5 per package)   |
| TE-6300-101         | 12 in. (305 mm) (1k ohm) Nickel Probe (cut to an appropriate length) <sup>1</sup>            |
| TE-6300-105         | 12 in. (305 mm) (1k ohm) Platinum Class A Probe (cut to an appropriate length) <sup>1</sup>  |
| TE-6300-103         | 1/2-14 NPT Plastic Sensor Holder without retainer (order in multiples of 10)                 |
| TE-6300-104         | 12 in. (305 mm) (2.2k ohm) Thermistor Probe (cut to an appropriate length) <sup>1</sup>      |
| TE-6300-613         | IMC Kit, Metal Knockout Plug, Metal Clamp Connector (order in multiples of 10)               |
| TE-6300-614         | Cable Tie Mounting Kit, 0.50 to 2.625 in. (12.7 to 66.7 mm) Bundle Diameter (10 per package) |
| TE-6300-615         | Cable Tie Mounting Kit, 11 in. (280 mm) Max Bundle Diameter                                  |
| TE-6300-616         | 8 in. (203 mm) 1k ohm Platinum Class A Probe   |
| TE-6300-617         | 3 in. (76 mm) 1k ohm Platinum Class A Probe  |
| TQ-6000-1           | 4 to 20 mA Output Transmitter for use with the 100 ohm platinum sensor                       |
| TE-6300W-102        | 6 in. (152 mm) Stainless Steel Well (direct mount)   |
| TE-6300W-101        | 6 in. (152 mm) Brass Well (direct mount with thermal grease included)                        |
| TE-6300W-110        | 8 in. (203 mm) Stainless Steel Well  |

- Cut 12 in. probes to a minimum of 3 in. (76 mm).

## TE-6300 Series Temperature Sensors (Continued)

T-4000 Covers Available for the Wall Mount TE-63x4P Series

| Product Code Number      | Horizontal Johnson Controls Logo | Vertical Johnson Controls Logo | Thermometer, with °F/°C Scale | Faceplate/Cover Color  |
|--------------------------|----------------------------------|--------------------------------|-------------------------------|------------------------|
| T-4000-2138 <sup>1</sup> |                                  |                                |                               | Brushed Aluminum/Beige |
| T-4000-2139              | ■                                |                                |                               |                        |
| T-4000-2140              | ■                                |                                | ■                             |                        |
| T-4000-2144              |                                  | ■                              |                               |                        |
| T-4000-2639              | ■                                |                                |                               | Brown and Gold/Beige   |
| T-4000-2640              | ■                                |                                | ■                             |                        |
| T-4000-2644              |                                  | ■                              |                               |                        |
| T-4000-3139              | ■                                |                                |                               |                        |
| T-4000-3140              | ■                                |                                | ■                             | Brushed Aluminum/White |
| T-4000-3144              |                                  | ■                              |                               |                        |

1. Without Johnson Controls logo

## Technical Specifications

| TE-6300 Series Temperature Sensors (Part 1 of 2) |                            |   |
|--|----------------------------|---|
| Sensor Reference Resistance                      | 1k ohm Nickel              | 1k ohms at 70°F (21°C)  |
|  | 1k ohm Nickel Averaging    |   |
|  | 1k ohm Platinum            | 1k ohms at 32°F (0°C)   |
|  | 100 ohm Platinum Averaging | 100 ohms at 32°F (0°C)  |
|  | 1k ohm Platinum Averaging  | 1k ohms at 32°F (0°C)   |
|  | 2.2k ohm Thermistor        | 2,252 ohms at 77°F (25°C)   |
|  | 10k ohm Thermistor         | 10.0k ohms at 77°F (25°C)   |
| Sensor Accuracy                                  | 1k ohm Nickel              | ±0.34F° at 70°F (±0.19C° at 21°C)   |
|  | 1k ohm Nickel Averaging    | ±3.4F° at 70°F (±1.9C° at 21°C)   |
|  | 1k ohm Platinum Class A    | ±0.35F° at 70°F (±0.19C° at 21°C), DIN Class A  |
|  | 1k ohm Platinum Class B    | ±0.73F° at 70°F (±0.41C° at 21°C), DIN Class B  |
|  | 100 ohm Platinum Averaging | ±1.0F° at 70°F (±0.58C° at 21°C)  |
|  | 1k ohm Platinum Averaging  |   |
|  | 2.2k ohm Thermistor        | ±0.36F° (±0.2C°) in the range: 32 to 158°F (0 to 70°C)  |
|  | 10k ohm Thermistor         | ±0.9F° (±0.5C°) in the range: 32 to 158°F (0 to 70°C)   |
| Sensor Temperature Coefficient                   | 1k ohm Nickel              | Approximately 3 ohms/F° (5.4 ohms/C°)   |
|  | 1k ohm Nickel Averaging    |   |
|  | 1k ohm Platinum            | Approximately 2 ohms/F° (3.9 ohms/C°) 3850 ppm/K  |
|  | 100 ohm Platinum Averaging | Approximately 0.2 ohms/F° (0.39 ohms/C°)  |
|  | 1k ohm Platinum Averaging  | Approximately 2 ohms/F° (3.9 ohms/C°)   |
|  | 2.2k ohm Thermistor        | Nonlinear, Negative Temperature Coefficient (NTC)   |
|  | 10k ohm Thermistor         | Nonlinear NTC, Johnson Controls Type II   |
| Electrical Connection                            | TE-63xxM                   | 22 AWG (0.6 mm diameter) x 6 in. (152 mm) long  |
|  | TE-63xxP                   |   |
|  | TE-63xxF                   | 22 AWG (0.6 mm diameter) x 12 ft (3 m) braided-copper wires, low voltage insulation, half-stripped ends               |
|  | TE-63xxP Nickel Averaging  | 18 AWG (1.0 mm diameter) x 6 in. (152 mm) long  |
|  | TE-63xS                    | 22 AWG (0.6 mm diameter) x 10 ft (3 m) long plenum-rated cable  |
|  | TE-63xxA, TE-63xxV         | 22 AWG (0.6 mm diameter) x 10 ft (3 m) long plenum-rated cable with 0.25 in. (6.35 mm) female quick-connect terminals |

## TE-6300 Series Temperature Sensors (Continued)

| TE-6300 Series Temperature Sensors (Part 2 of 2) |          |   |
|--|----------|---|
| Materials  | Probes   | Nickel Averaging: 0.094 in. (2.4 mm) Outside Diameter (O.D.) copper tubing<br>Nickel Averaging Adaptor: 0.25 in. (6.35 mm) O.D. Brass<br>Platinum Averaging Probe: 0.19 in. (4.8 mm) Aluminum tubing<br>All others (except Averaging): 0.25 in. (6.35 mm) O.D. Stainless Steel  |
|  | TE-63xxA | Mounting Adapter Plate and Gland: Thermoplastic   |
|  | TE-63xxF | Flush Mount: Stainless Steel  |
|  | TE-63xxM | Enclosure: Corrosion-Protected Steel<br>Well Sensor Holder: 0.875 in. (22.2 mm) Hex Brass   |
|  | TE-63xxP | Conduit box and Shield: Rigid Thermoplastic<br>Mounting Plate: Aluminum<br>Sensor Holder: Rigid Thermoplastic<br>Wall Mount Base Plate: Corrosion-Protected Steel<br>Wall Mount Cover: Rigid Thermoplastic (White)<br>Wall Mount Face Plate: Brushed Aluminum   |
|  | TE-63xxV | Mounting Flange: Stainless Steel  |
|  | TE-63xxA | -50 to 140°F (-46 to 60°C)  |
| Operating Conditions                             | TE-63xxF | <del>32 to 104°F (0 to 40°C)</del>  |
|  | TE-63xxM | -50 to 220°F (-46 to 104°C)   |
|  | TE-63xxP | <del>Enclosure: -50 to 122°F (-46 to 50°C)</del><br>Sensor Probe: -50 to 220°F (-46 to 104°C)   |
|  | TE-63xS  | Sensor Probe: -50 to 220°F (-46 to 104°C)   |
|  | TE-63xxV | Wire Harness: -50 to 122°F (-46 to 50°C)  |
|  | TE-63xxA | 0.2 lb (0.09 kg)  |
| Shipping Weight                                  | TE-63xxF | 0.25 lb (113.4 kg)  |
|  | TE-63xxM | Duct Averaging: 0.9 lb (0.41 kg)<br>Duct Mount: 0.4 lb (0.18 kg)<br>Well Insertion: 0.5 lb (0.23 kg)  |
|  | TE-63xxP | Duct Averaging: 0.5 lb (0.23 kg)<br>Duct Mount: 0.4 lb (0.18 kg)<br>Outdoor Air: 0.5 lb (0.23 kg)<br>Wall Mount: 0.2 lb (0.09 kg)<br>Well Insertion: 0.35 lb (0.16 kg)  |
|  | TE-63xS  | Strap-Mount: 0.2 lb (0.09 kg)   |
|  | TE-63xxV | Duct Averaging: 0.7 lb (0.32 kg)<br>Duct Mount: 0.2 lb (0.09 kg)  |
|  | TE-63xxA | 2.17 in. (55 mm) diameter plus 4 or 8 in. (102 or 203 m) element  |
|  | TE-63xxF | Flush Mount: 4-1/2 x 2-3/4 in. (114 x 70 mm)  |
| Dimensions (H x W x D)                           | TE-63xxM | Duct Averaging: 1.87 x 1.87 x 1.80 in. (47.5 x 47.5 x 45.8 mm) plus 8 or 17 ft (2.4 or 5.2 m) element<br>Duct Mount: 1.87 x 1.87 x 1.80 in. (47.5 x 47.5 x 45.8 mm) plus 4, 8, or 18 in. (102, 203, or 457 mm) element<br>Well Insertion: 1.87 x 1.87 x 1.80 in. (47.5 x 47.5 x 45.8 mm) plus 6 or 8 in. (152 or 203 mm) element  |
|  | TE-63xxP | Duct Averaging: 5.97 x 1.38 x 2.75 in. (152 x 35 x 70 mm) plus 8, 10, 17, or 20 ft (2.4, 3.0, 5.2, or 6.1 m) element<br>Duct Mount: 5.97 x 1.38 x 2.75 in. (152 x 35 x 70 mm) plus 6 or 8 in. (152 or 203 mm) probe<br>Outdoor Air: 5.97 x 3.47 x 4.46 in. (152 x 88 x 113 mm)<br>Wall Mount: 2.09 x 3.12 x 1.80 in. (53 x 79 x 46 mm)<br>Well Insertion: 5.97 x 1.38 x 2.75 in. (152 x 35 x 70 mm) plus 6 or 8 in. (152 or 203 mm) probe |
|  | TE-63xS  | Strap-Mount: 0.25 in. (6.35 mm) diameter x 3.00 in. (76 mm.) long   |
|  | TE-63xxV | Duct Averaging: 2.25 x 1.50 in. (57 x 38 mm) plus 8 or 17 ft (2.4 or 5.2 m) element<br>Duct Mount: 2.25 x 1.50 in. (57 x 38 mm) plus 4 or 8 in. (102 or 203 m) element  |
|  | TE-63xxA | 2.17 in. (55 mm) diameter plus 4 or 8 in. (102 or 203 m) element  |
|  | TE-63xxF | Flush Mount: 4-1/2 x 2-3/4 in. (114 x 70 mm)  |

# TE-6300 Series Temperature Sensors

## Product Bulletin

**Code No. LIT-216320**  
**Issued August 26, 2013**  
*Supersedes April 18, 2013*

Refer to the [QuickLIT website](#) for the most up-to-date version of this document.

The TE-6300 Temperature Sensor line provides economical solutions for a wide variety of temperature sensing needs, including wall-mount, outdoor-air, duct, strap-mount, well-insertion, duct-averaging, and VAV Modular Assembly (VMA) flange-mount duct-probe applications. The TE-6300 line offers both a metal and a plastic enclosure for the most popular models.

Sensors are available in the following types:

- 1k ohm thin-film nickel
- 1k ohm nickel averaging
- 1k ohm thin-film platinum
- 100 ohm platinum equivalent averaging
- 1k ohm platinum equivalent averaging
- 2.2k (2,252) ohm thermistor
- 10k ohm thermistor, Johnson Controls® Type II



**Figure 1: TE-6300 Series Temperature Sensors**

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

**Table 1: Features and Benefits**

| Features   | Benefits   |
|--|--|
| <b>Full Line of Versatile Sensors</b>                    | Supports all your temperature sensing needs from a single supplier: wall-mount, outdoor-air, duct, duct-averaging, strap-mount, well-insertion, and flange-mount duct-probe. |
| <b>Single Assembly Ordering</b>                          | Simplifies ordering; provides a complete assembly in one box.  |
| <b>Models Featuring an Integral NPT Adaptor</b>          | Increase sensor connection strength, which eliminates the need for a special adaptor.  |
| <b>Models with a Stainless Steel Sensor Probe</b>        | Protect the sensor while increasing corrosion resistance.  |
| <b>Metal Enclosure (TE-63xxM Models Only)</b>            | Meets plenum requirements.   |
| <b>Models Featuring a Retainer for the Sensor Holder</b> | Allow you to lock the sensor holder into the conduit box.  |
| <b>Brushed Stainless Steel Mounting Plate</b>            | Offers a durable, aesthetically pleasing design.   |
| <b>Low Profile Flush Mount Design</b>                    | Provides a tamper-proof installation ideally suited for schools, sporting complexes, retailers, prisons, and more.   |

## Product Overview

**IMPORTANT:** The TE-6300 Series Temperature Sensors are intended to provide an input to equipment under normal operating conditions. Where failure or malfunction of the sensor 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 sensor.

All TE-6300 Series sensors are two-wire, passive, resistance-output devices.

### ***TE-63xxA Models***

The TE-63xxA (adjustable length) models:

- provide a thermoplastic mounting flange and gland nut to adjust the length of the probe
- include two hex-head self-drilling screws for mounting
- come equipped with a 10 ft (3 m) plenum-rated cable with a 2-position plug terminal block for 1/4 in. (6.35 mm) male tab terminals on 0.197 in. (5 mm) centers, for direct connection to Johnson Controls VMA controller products

### ***TE-63xxF Models***

The TE-63xxF (flush mount) models:

- provide a low profile when installed in an electrical box
- feature thermally isolated sensor from the wall with a foam pad
- offer a rugged stainless steel cover
- provide 22 AWG lead wires with low voltage installation

### ***TE-63xxM Models***

The TE-63xxM (metal enclosure) models:

- come with a corrosion-protected steel enclosure with a 0.88 in. (22 mm) hole for a 1/2 in. (12.7 mm) conduit fitting
- include two hex-head self-drilling screws for mounting the duct and duct averaging models
- offer (for well models only) either a direct-mount or 1/2-14 NPT threaded well sensor holder for mounting in TE-6300W Series thermowells (order the thermowell separately)

- provide optional well sensor holders (order separately) to mount duct models in thermowells
- meet UL 1995 plenum use requirements
- offer an optional accessory kit (order separately) to replace plastic hole plug and wiring bushing to meet International Mechanical Code (IMC) requirements

### ***TE-63xxP Models***

The TE-63xxP (plastic enclosure) models:

- provide a thermoplastic conduit box with 1/2-14 NPT female thread for connecting to conduit
- provide aluminum mounting plate and 1/2-14 NPT threaded hub mounting options for the duct and duct-averaging models
- use the 1/2-14 NPT female thread to mount the Outdoor Air models directly to ridged conduit
- provide sensor holders included to mount duct models in thermowells (order thermowell separately)
- offer an optional accessory metal cover kit (order separately) to replace the plastic cover to meet UL 1995 plenum use requirements
- include a replaceable sensing probe on duct-probe, outdoor-air, and well-insertion models

### ***TE-63x4P Wall Mount Models***

The TE-63x4P (plastic enclosure) models:

- come with a white thermoplastic ventilated cover with a brushed aluminum face plate and a steel mounting plate for surface mounting
- include faceplates for both horizontal and vertical mounting
- offer an accessory mounting kit for mounting to a standard electrical box
- offer optional covers

### ***TE-63xS Models***

The TE-63xS (Strap-Mount) models:

- provide a 1/4 in. (6.35 mm) diameter stainless steel probe without an enclosure
- include three cable ties for mounting to pipe up to 2-5/8 in. (67 mm) diameter
- come equipped with a 10 ft (3 m) plenum-rated cable
- meet UL 1995 plenum use requirements

- offer an accessory mounting kit for mounting to a pipe up to 11 in. (280 mm) diameter

### TE-63xxV Models

The TE-63xxV (VAV flange mount) models:

- provide a stainless steel mounting flange with two hex-head self-drilling mounting screws
- come equipped with a 10 ft (3 m) plenum-rated cable with a 2-position plug terminal block for 1/4 in. (6.35 mm) male tab terminals on 0.197 in. (5 mm) centers, for direct connection to Johnson Controls VMA controller products

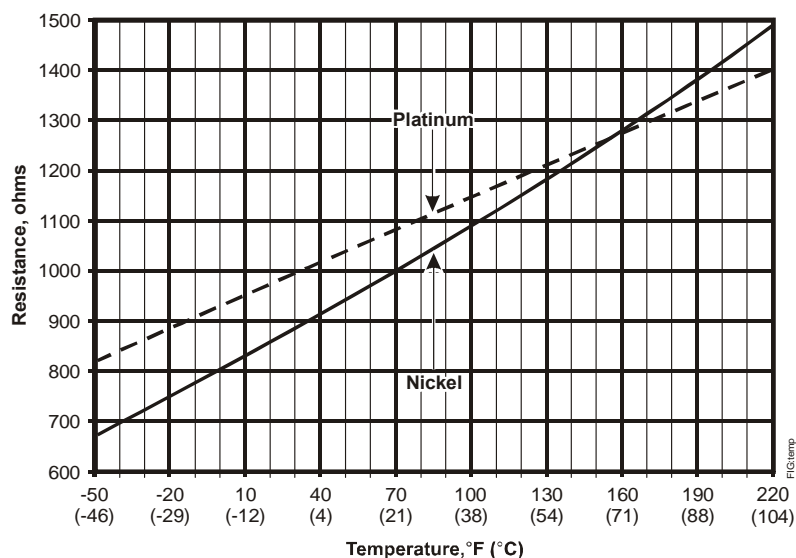
- meet UL 1995 plenum use requirements

### Additional Product Information

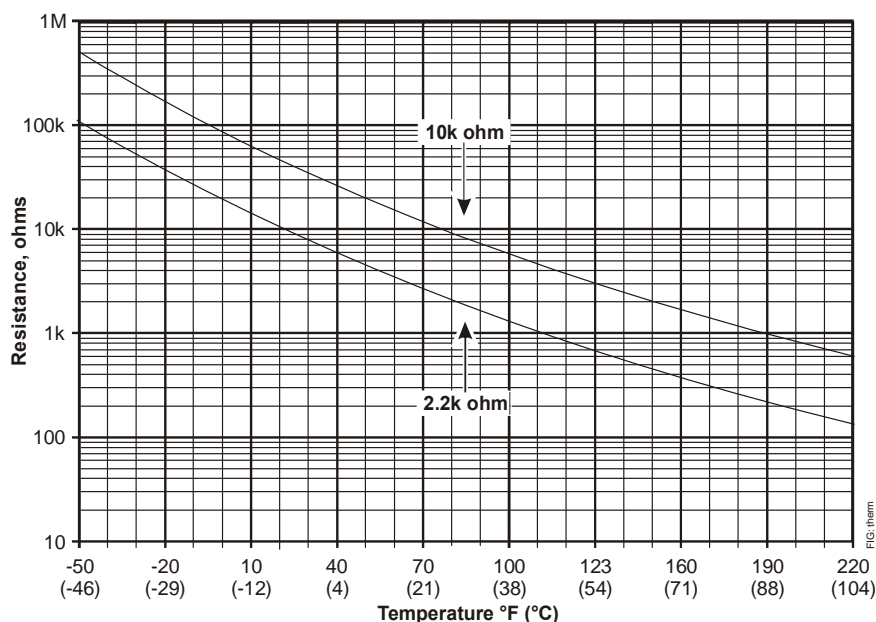
See Figure 2 for nickel and platinum sensor Resistance/Temperature (R/T) response characteristics. See Table 2 for all sensor Temperature/Resistance values.

**Note:** Figure 2 shows 1k ohm platinum sensor characteristic. For 100 ohm platinum sensor characteristic, divide the resistance value by 10.

See Figure 3 for 2.2k and 10k ohm thermistor sensor R/T response characteristics.



**Figure 2: Nickel and Platinum Temperature Response**



**Figure 3: Thermistor Temperature Response**

**Table 2: Nominal Values for: Nickel (Ni), Platinum (Pt)<sup>1</sup>, and Thermistor Sensors**

| Temperature |     | Resistance (ohms) |                    |            |         |
|-------------|-----|-------------------|--------------------|------------|---------|
| °F          | °C  | 1k Ni             | 1k Pt <sup>1</sup> | Thermistor |         |
|             |     |                   |                    | 2.2k       | 10k     |
| -50         | -46 | 674               | 821                | 109,905    | 489,981 |
| -40         | -40 | 699               | 843                | 75,487     | 366,185 |
| -30         | -34 | 725               | 865                | 52,584     | 233,990 |
| -20         | -29 | 751               | 887                | 37,123     | 165,085 |
| -10         | -23 | 777               | 908                | 26,544     | 117,978 |
| 0           | -18 | 803               | 930                | 19,210     | 85,349  |
| 10          | -12 | 830               | 952                | 14,063     | 62,464  |
| 20          | -7  | 858               | 974                | 10,408     | 46,221  |
| 30          | -1  | 885               | 996                | 7,783      | 34,562  |
| 40          | 4   | 914               | 1,017              | 5,879      | 26,103  |
| 50          | 10  | 942               | 1,039              | 4,482      | 19,903  |
| 60          | 16  | 971               | 1,061              | 3,449      | 15,313  |
| 70          | 21  | 1,000             | 1,082              | 2,676      | 11,883  |
| 80          | 27  | 1,030             | 1,104              | 2,094      | 9,298   |
| 90          | 32  | 1,060             | 1,125              | 1,651      | 7,333   |
| 100         | 38  | 1,090             | 1,147              | 1,312      | 5,827   |
| 110         | 43  | 1,121             | 1,168              | 1,050      | 4,663   |
| 120         | 49  | 1,152             | 1,190              | 846        | 3,757   |
| 130         | 54  | 1,184             | 1,211              | 686        | 3,048   |
| 140         | 60  | 1,216             | 1,232              | 560        | 2,488   |
| 150         | 66  | 1,248             | 1,254              | 460        | 2,043   |
| 160         | 71  | 1,281             | 1,275              | 380        | 1,687   |
| 170         | 77  | 1,314             | 1,296              | 315        | 1,401   |
| 180         | 82  | 1,348             | 1,317              | 263        | 1,170   |
| 190         | 88  | 1,382             | 1,339              | 221        | 982     |
| 200         | 93  | 1,417             | 1,360              | 186        | 828     |
| 210         | 99  | 1,452             | 1,381              | 158        | 701     |
| 220         | 104 | 1,487             | 1,402              | 134        | 597     |

1. For 100 ohm platinum sensors, divide resistance values by 10.

## Applications

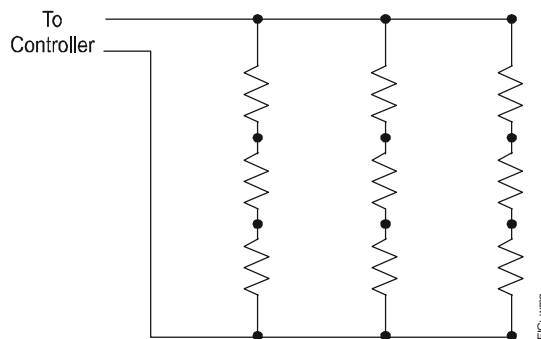
### Averaging Sensing

Series-parallel wiring arrangements of four (2 x 2), nine (3 x 3), sixteen (4 x 4), or more sensors provide an average temperature reading in an area or large duct when one sensor cannot provide a representative reading. (See Figure 4.)

A series-parallel arrangement requires the same number of parallel-connected sensors as there are series-connected sensors. For example:

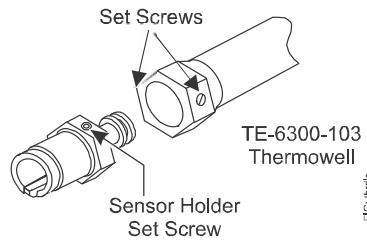
- with four sensors, connect two parallel legs with two sensors in series in each leg
- with nine sensors, connect three parallel legs with three sensors in series in each leg

**Note:** All sensors in a series-parallel network must be of the same sensor type and value. For example, use all 100 ohm platinum or all 1k ohm nickel sensors.



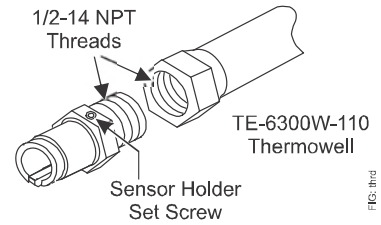
**Figure 4: Nine-Sensor Series-Parallel Wiring**

### Installing the TE-63xAP-1 Sensor Holder



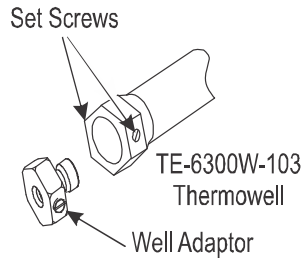
- Sensor model TE-63xAP-1
- Threadless Sensor Holder/Well Adaptor
- 6 in. (150 mm) probe
- includes well adaptor

### Installing the TE-63x2P-1 Sensor Holder



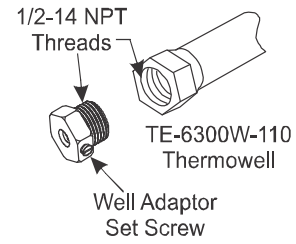
- Sensor model TE-63x2P-1
- 1/2-14 NPT Threaded Sensor Holder/Well Adaptor
- 8 in. (200 mm) probe
- includes well adaptor

### Installing the TE-63xAM-1 Well Adaptor



- Sensor model TE-63xAM-1
- Threadless Well Adaptor
- 6 in. (150 mm) probe
- includes well adaptor

### Installing the TE-63x2M-1 Well Adaptor



- Sensor model TE-63x2M-1
- 1/2-14 NPT Threaded Well Adaptor
- 8 in. (200 mm) probe
- includes well adaptor

For specific TE-6300 Series Temperature Sensor applications, see Table 3.

**Table 3: TE-6300 Series Temperature Sensor Applications (Part 1 of 2)**

| Application                   | Nominal Probe Length, in. (mm)                                | Sensor Type  | Application Notes  |
|-------------------------------|---|--|--|
| <b>Duct Probe</b>             | 4 (102)<br>8 (203)<br>18 (457)                                | 1k ohm Thin-Film Nickel<br>1k ohm Thin-Film Platinum<br>2.2k ohm Thermistor<br>10k ohm Thermistor Type II  | <ul style="list-style-type: none"> <li>• Ideal in freezer lockers or for mounting outside of the sensed area.</li> <li>• Available with plastic enclosure, metal enclosure, flange mount, or with mounting bracket for adjustable length.</li> <li>• Use TE-63xxM or TE-63xxV models for plenum applications.</li> <li>• Use TE-6300-613 accessory kit with TE-63xxM models to meet IMC requirements.</li> <li>• Use TE-6001-13 metal cover kit with TE-63xxP models to meet UL 1995 plenum requirements.</li> <li>• Order an optional TE-63xxP model accessory: 12 in. (300 mm) probe.</li> </ul>   |
| <b>Duct Averaging Element</b> | 8 ft (2.4 m)<br>10 ft (3 m)<br>17 ft (5.2 m)<br>20 ft (6.1 m) | 1k ohm Nickel Wire<br>100 ohm Platinum Equivalent Wire<br>1k ohm Platinum Equivalent Wire                  | <ul style="list-style-type: none"> <li>• Use to sense duct temperature where stratification can occur, such as mixed air ducts.</li> <li>• Duct averaging models come in three styles: plastic enclosure, metal enclosure, or flange mount.</li> <li>• Use about 1 ft (0.3 m) of sensor per sq ft (0.09 m<sup>2</sup>) of duct cross section.</li> <li>• Use a series-parallel sensor network to cover larger ducts.</li> <li>• Use a TE-6001-8 element holder (recommended) when installing an averaging sensor in a duct.</li> <li>• Use TE-63xxM or TE-63xxV models for plenum applications.</li> <li>• Use TE-6300-613 kit with TE-63xxM models to meet IMC requirements.</li> <li>• Use the TE-6001-13 metal cover kit with TE-63xxP models to meet UL 1995 plenum requirements.</li> </ul> |
| <b>Outdoor Air</b>            | 3 (76)  | 1k ohm Thin-Film Nickel<br>1k ohm Thin-Film Platinum<br>2.2k ohm Thermistor<br>10k ohm Thermistor, Type II | <ul style="list-style-type: none"> <li>• Use to sense outside ambient temperature to determine efficient heating and cooling strategies.</li> <li>• Mount the sensor out of direct sunlight and away from exhaust vents or equipment that can cause inaccurate temperature sensing.</li> </ul>   |
| <b>Strap-Mount</b>            | 3 (76)  | 1k ohm Thin-Film Nickel<br>1k ohm Thin-Film Platinum<br>10k ohm Thermistor, Type II                        | <ul style="list-style-type: none"> <li>• Clamp the probe directly to a pipe or the device to be sensed.</li> <li>• Mount the probe away from fans or radiant heat that can affect measurement of the sensed device.</li> <li>• Use for plenum applications.</li> <li>• Order an accessory mounting kit or use readily available hardware for pipe up to 11 in. (280 mm) diameter.</li> </ul>   |
| <b>Wall Mount</b>             | N/A   | 1k ohm Thin-Film Nickel<br>1k ohm Thin-Film Platinum<br>2.2k ohm Thermistor                                | <ul style="list-style-type: none"> <li>• Use to sense room or space temperature.</li> <li>• Order an accessory cover with a thermometer or to match the style of existing installations.</li> <li>• Mount the sensor on an inside wall, out of direct sunlight and away from radiant heat.</li> </ul>  |
| <b>Wall Plate Flush Mount</b> | N/A   | Flush Mount 1k ohm Nickel Sensor<br>Flush Mount 1k ohm Platinum Sensor<br>Flush Mount 10k ohm NTC Sensor   | <ul style="list-style-type: none"> <li>• Flush mount 10k ohm NTC sensor: do not install the flush mount sensor in temperatures beyond 0–40°C</li> <li>• Use copper conductors only. Refer to installation diagrams for recommended wiring lengths.</li> </ul>  |

**Table 3: TE-6300 Series Temperature Sensor Applications (Part 2 of 2)**

| Application                 | Nominal Probe Length, in. (mm) | Sensor Type  | Application Notes  |
|-----------------------------|--------------------------------|--|--|
| <b>Well Insertion Probe</b> | 6 (152)<br>8 (203)             | <b>TE-63xxM</b><br>1k ohm Thin-Film Nickel<br>1k ohm Thin-Film Platinum<br>2.2k ohm Thermistor<br>10k ohm Thermistor Type II | <ul style="list-style-type: none"> <li>• Metal enclosure.</li> <li>• Mount the thermal well at an angle so condensation runs out of the well. If not possible, seal the well adaptor and wiring end of the sensor probe with RTV silicone sealant.</li> <li>• Use TE-63xxM models to meet UL 1995 plenum use applications.</li> <li>• No separate well adaptor to order when using recommended thermowell and sensor model combinations.</li> <li>• Threaded sensor holder has 1/2-14 NPT threads; threadless holder accommodates setscrew-type wells.</li> <li>• Order TE-63x2M-1, which includes 1/2-14 NPT adaptor, for TE-6300W-110 or retrofit applications of WZ-1000-2 and WZ-1000-4 thermowells.</li> <li>• Order TE-63xAM-2 for use with direct-mount thermowells, TE-6300W-101 and TE-6300W-102.</li> <li>• Order TE-63xAM-1, which includes threadless adaptor, for retrofit applications of TE-6300W-103 and WZ-1000-5 thermowells.</li> <li>• Order compatible thermowells using Table 5 and Table 6.</li> </ul>                              |
|                             |                                | <b>TE-63xxP</b><br>1k ohm Thin-Film Nickel<br>1k ohm Thin-Film Platinum<br>2.2k ohm Thermistor                               | <ul style="list-style-type: none"> <li>• Plastic enclosure.</li> <li>• Mount the thermal well at an angle so condensation runs out of the well. If not possible, seal the sensor holder and the wiring end of the sensor probe with RTV silicone sealant.</li> <li>• Use TE-6001-13 metal cover kit with TE-63xxP models to meet UL 1995 plenum requirements.</li> <li>• Use the accessory 12 in. (305 mm) probe with the TE-63xxP sensor in longer wells.</li> <li>• No separate well adaptor to order when using recommended thermowell and sensor model combinations.</li> <li>• Threaded sensor holder has 1/2-14 NPT threads; threadless holder accommodates setscrew-type wells.</li> <li>• Order TE-63x2P-1, which includes 1/2-14 NPT adaptor, for TE-6300W-110 or retrofit applications of WZ-1000-2 and WZ-1000-4 thermowells.</li> <li>• Order TE-63xAP-1, which includes threadless adaptor, for TE-6300W-103 or retrofit applications of WZ-1000-5 thermowells.</li> <li>• Order compatible thermowells using Table 5 and Table 7.</li> </ul> |

Ordering Information

To order a TE-6300 Series temperature sensor, contact the nearest Johnson Controls representative. Specify the desired sensor product code number from Table 4 and accessories from Table 5, depending on the model.

**Note:** Use the TE-63xxM or TE-63xxV model to meet plenum requirements where UL1995 rating is accepted, or replace the existing plastic cover on the TE-63xxP models with the TE-6001-13 Metal Cover Kit.

Use the TE-63xxM model and a TE-6300-613 Accessory Kit to replace the plastic bushing to meet International Mechanical Code (IMC) requirements.

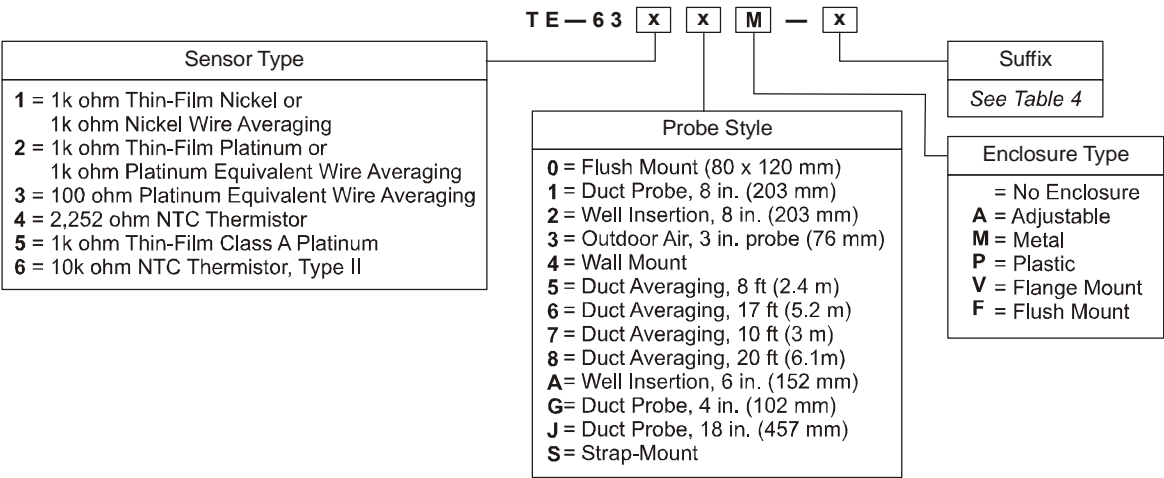


Figure 5: Ordering Template

**Note:** Not all possible combinations are available. See Table 4 for available models.

Table 4: Product Ordering (Part 1 of 2)

| Sensor                   | Mounting Style         | Probe Length in. (mm) | Product Code Number     |
|--------------------------|------------------------|-----------------------|-------------------------|
| <b>Nickel (1k ohm)</b>   | Adjustable             | 8 (203)               | TE-6311A-1              |
|                          | Averaging <sup>1</sup> | 8 ft (2.4 m)          | TE-6315M-1              |
|                          |                        |                       | TE-6315P-1              |
|                          |                        |                       | TE-6315V-2              |
|                          |                        |                       | TE-6316M-1              |
|                          |                        |                       | TE-6316P-1              |
|                          |                        | 17 ft (5.2 m)         | TE-6316V-2              |
|                          |                        |                       | TE-6316V-2              |
|                          | Duct                   | 4 (102)               | TE-631GM-1              |
|                          |                        | 8 (203)               | TE-6311M-1              |
|                          |                        |                       | TE-6311P-1              |
|                          |                        | 18 (457)              | TE-631JM-1              |
|                          | Flange                 | 4 (102)               | TE-631GV-2              |
|                          |                        | 8 (203)               | TE-6311V-2              |
|                          | Flush                  | N/A                   | TE-6310F-0              |
|                          |                        |                       | TE-6310F-1              |
|                          | Outdoor Air            | 3 (76)                | TE-6313P-1              |
|                          | Strap-Mount            | 3 (76)                | TE-631S-1               |
|                          | Wall <sup>2</sup>      | N/A                   | TE-6314P-1              |
|                          | Well                   | 6 (152)               | TE-631AM-1 <sup>3</sup> |
|                          |                        |                       | TE-631AM-2              |
|                          |                        |                       | TE-631AP-1              |
|                          |                        | 8 (203)               | TE-6312M-1              |
|                          |                        |                       | TE-6312P-1              |
| <b>Platinum (1k ohm)</b> | Adjustable             | 8 (203)               | TE-6351A-1              |
|                          | Duct                   | 4 (102)               | TE-635GM-1              |
|                          |                        | 8 (203)               | TE-6351M-1              |
|                          |                        |                       | TE-6351P-1              |
|                          |                        | 18 (457)              | TE-635JM-1              |
|                          | Flange                 | 4 (102)               | TE-635GV-2              |
|                          |                        | 8 (203)               | TE-6351V-2              |
|                          | Flush                  | N/A                   | TE-6350F-0              |
|                          |                        |                       | TE-6350F-1              |
|                          | Outdoor Air            | 3 (76)                | TE-6353P-1              |
|                          | Strap-Mount            | 3 (76)                | TE-635S-1               |
|                          | Wall <sup>2</sup>      | N/A                   | TE-6324P-1              |
|                          | Well                   | 6 (152)               | TE-635AM-2              |
|                          |                        |                       | TE-635AP-1              |
|                          |                        | 8 (203)               | TE-6352M-1              |
|                          |                        |                       | TE-6352P-1              |

Table 4: Product Ordering (Part 2 of 2)

| Sensor                              | Mounting Style                 | Probe Length in. (mm) | Product Code Number |
|-------------------------------------|--------------------------------|-----------------------|---------------------|
| <b>Platinum Equivalent</b>          | 1k ohm Averaging <sup>1</sup>  | 10 ft (3 m)           | TE-6327P-1          |
|                                     |                                | 20 ft (6.1 m)         | TE-6328P-1          |
|                                     | 100 ohm Averaging <sup>1</sup> | 10 ft (3 m)           | TE-6337P-1          |
|                                     |                                | 20 ft (6.1 m)         | TE-6338P-1          |
| <b>Thermistor (2.2k ohm)</b>        | Adjustable                     | 8 (203)               | TE-6341A-1          |
|                                     | Duct                           | 8 (203)               | TE-6341P-1          |
|                                     | Flange                         | 4 (102)               | TE-634GV-2          |
|                                     |                                | 8 (203)               | TE-6341V-2          |
|                                     | Outdoor Air                    | 3 (76)                | TE-6343P-1          |
|                                     | Wall <sup>2</sup>              | N/A                   | TE-6344P-1          |
|                                     |                                |                       |                     |
|                                     | Well                           | 6 (152)               | TE-634AM-2          |
|                                     |                                | 8 (203)               | TE-6342M-1          |
|                                     |                                |                       |                     |
| <b>Thermistor (10k ohm) Type II</b> | Adjustable                     | 8 (203)               | TE-6361A-1          |
|                                     | Duct                           | 4 (102)               | TE-636GM-1          |
|                                     |                                | 8 (203)               | TE-6361M-1          |
|                                     |                                |                       | TE-6361P-1          |
|                                     |                                | 18 (457)              | TE-636JM-1          |
|                                     | Flange                         | 4 (102)               | TE-636GV-2          |
|                                     |                                | 8 (203)               | TE-6361V-2          |
|                                     | Flush                          | N/A                   | TE-6360F-0          |
|                                     |                                |                       | TE-6360F-1          |
|                                     | Outdoor Air                    | 3 (76)                | TE-6363P-1          |
|                                     | Strap-Mount                    | 3 (76)                | TE-636S-1           |
|                                     | Well                           | 6 (152)               | TE-636AM-2          |
|                                     |                                | 8 (203)               | TE-6362M-1          |
|                                     |                                |                       |                     |

- Two TE-6001-8 Element Holders come with the platinum equivalent averaging sensors. Order separately to use with a nickel averaging sensor.
- Order the TE-1800-9600 Mounting Hardware separately to mount the wall unit to a wallbox.
- TE-631AM-1 includes TE-6300-612 brass threadless well adaptor for retrofit to TE-6300W-103 or WZ-1000-5 thermowells.

**Table 5: Optional Accessories<sup>1</sup>**

| <b>Product Code Number</b> | <b>Description</b>   |
|----------------------------|--|
| <b>F-1000-182</b>          | Thermal Conductive Grease for Element Wells (8 oz. [.23 kg])   |
| <b>T-4000-xxxx</b>         | Wall Mount Cover (see Table 9)   |
| <b>T-4000-119</b>          | Allen Head Tool for Wall Mount Cover Screws (order in multiples of 30)   |
| <b>TE-1800-9600</b>        | Mounting Hardware for Mounting the Wall Mount Unit to a Wall Box   |
| <b>TE-6001-8</b>           | Element Holder for Mounting an Averaging Sensor (order in multiples of 10)   |
| <b>TE-6001-13</b>          | Metal Cover and Gasket Kit (5 per package)   |
| <b>TE-6300-101</b>         | 12 in. (305 mm) (1k ohm) Nickel Probe (cut to an appropriate length) <sup>2</sup>  |
| <b>TE-6300-105</b>         | 12 in. (305 mm) (1k ohm) Platinum Class A Probe (cut to an appropriate length) <sup>2</sup>  |
| <b>TE-6300-103</b>         | 1/2-14 NPT Plastic Sensor Holder without retainer (order in multiples of 10)   |
| <b>TE-6300-104</b>         | 12 in. (305 mm) (2.2k ohm) Thermistor Probe (cut to an appropriate length) <sup>2</sup>  |
| <b>TE-6300-613</b>         | IMC Kit, Metal Knockout Plug, Metal Clamp Connector (order in multiples of 10)   |
| <b>TE-6300-614</b>         | Cable Tie Mounting Kit, 0.50 to 2.625 in. (12.7 to 66.7 mm) Bundle Diameter (10 per package)   |
| <b>TE-6300-615</b>         | Cable Tie Mounting Kit, 11 in. (280 mm) Maximum Bundle Diameter  |
| <b>TQ-6000-1</b>           | 4 to 20 mA Output Transmitter for Use With the 100 ohm Platinum Sensor   |
| <b>TE-6300W-101</b>        | Thermowell, brass with copper bulb, 2.38 in. (60.5 mm) immersion depth, with thermal grease, direct mount, no adaptor required, for use with 6 in. (150 mm) probe model TE-63xAM-2   |
| <b>TE-6300W-102</b>        | Thermowell, stainless steel, 2.38 in. (60.5 mm) immersion depth, without thermal grease, direct mount, no adaptor required, for use with 6 in. (150 mm) probe model TE-63xAM-2   |
| <b>TE-6300W-103</b>        | Thermowell, brass with copper bulb, 2.38 in. (60.5 mm) immersion depth, with thermal grease, threadless adaptor required, for use with 6 in. (150 mm) probe models TE-63xAM-1 (adaptor included) and TE-63xAP-1 (adaptor included) |
| <b>TE-6300W-110</b>        | Thermowell, stainless steel, 4.50 in. (114.3 mm) immersion depth, without thermal grease, 1/2-14 NPT adaptor required, for use with 8 in. (200 mm) probe models TE-63x2M-1 (adaptor included) and TE-63x2P-1 (adaptor included)    |

1. For accessory usage, see Table 6, Table 7, and Table 8.
2. Cut 12 in. (305 mm) probes to a minimum of 3 in. (76 mm).

**Table 6: Typical Accessory and Replacement Part Usage for TE-6300M Models**

| Product Code Number | Description   | TE-6311M-1 | TE-6312M-1 | TE-6315M-1 | TE-6316M-1 | TE-631AM-1 | TE-631AM-2 | TE-631GM-1 | TE-631JM-1 | TE-6351M-1 | TE-6352M-1 | TE-635AM-2 | TE-635GM-1 | TE-635JM-1 | TE-6361M-1 | TE-6362M-1 | TE-636AM-2 | TE-636GM-1 | TE-636JM-1 | TE-634AM-2 |
|---------------------|---|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| TE-6001-8           | Averaging Bracket   |            |            | X          | X          |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |
| TE-6300-611         | Well Adaptor, Brass, 1/2-14 NPT, for use with TE-6300W-110 (replacement part, included with TE-63x2M-1)   |            | X          |            |            |            |            |            |            |            | X          |            |            |            |            | X          |            |            |            |            |
| TE-6300-612         | Well Adaptor, Brass, Threadless, for use with TE-6300W-103 (included with TE-631AM-1)   |            |            |            |            | X          | X          |            |            |            |            | X          |            |            |            |            | X          |            |            | X          |
| TE-6300-613         | IMC Kit with Metal Plugs  | X          | X          | X          | X          | X          | X          | X          | X          | X          | X          | X          | X          | X          | X          | X          | X          | X          | X          | X          |
| TE-6300W-101        | Thermowell, Brass with Copper Bulb, 2.38 in. (60.5 mm) immersion depth, with thermal grease included, direct mount, no adaptor required, for use with 6 in. (150 mm) probe                    |            |            |            |            |            | X          |            |            |            |            | X          |            |            |            |            | X          |            |            | X          |
| TE-6300W-102        | Thermowell, Stainless Steel, 2.38 in. (60.5 mm) immersion depth, without thermal grease, direct mount, no adaptor required, for use with 6 in. (150 mm) probe                                 |            |            |            |            |            | X          |            |            |            |            | X          |            |            |            |            | X          |            |            | X          |
| TE-6300W-103        | Thermowell, Brass with Copper Bulb, 2.38 in. (60.5 mm) immersion depth, thermal grease included, threadless adaptor required, for use with 6 in. (150 mm) probe (TE-631AM-1 includes adaptor) |            |            |            |            | X          |            |            |            |            |            |            |            |            |            |            |            |            |            |            |
| TE-6300W-110        | Thermowell, Stainless Steel, 4.50 in. (114.3 mm) immersion depth, without thermal grease, 1/2-14 NPT adaptor required, for use with 8 in. (200 mm) probe (TE-63x2M-1 includes adaptor)        |            | X          |            |            |            |            |            |            |            | X          |            |            |            |            | X          |            |            |            |            |

**Note:** Direct-mount thermal wells TE-6300W-101 and TE-6300W-102 can be used only with the TE-6300M sensors.

Table 7: Typical Accessory and Replacement Part Usage for TE-6300P Models

| Product Code Number | Description   | TE-6311P-1 | TE-6312P-1 | TE-6313P-1 | TE-6314P-1 | TE-6315P-1 | TE-6316P-1 | TE-631AP-1 | TE-6324P-1 | TE-6327P-1 | TE-6328P-1 | TE-6337P-1 | TE-6338P-1 | TE-6341P-1 | TE-6343P-1 | TE-6344P-1 | TE-6351P-1 | TE-6352P-1 | TE-6353P-1 | TE-635AP-1 | TE-6361P-1 | TE-6363P-1 |
|---------------------|---|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| T-4000-119          | Allen Head Tool   |            |            |            | X          |            |            |            | X          |            |            |            |            |            | X          |            |            |            |            |            |            |            |
| TE-1800-9600        | Mounting Hardware   |            |            |            | X          |            |            |            | X          |            |            |            |            |            | X          |            |            |            |            |            |            |            |
| TE-6001-8           | Averaging Bracket   |            |            |            |            | X          | X          |            |            | X          | X          | X          | X          |            |            |            |            |            |            |            |            |            |
| TE-6001-13          | Metal Cover Kit   | X          | X          | X          |            | X          | X          | X          |            | X          | X          | X          | X          | X          | X          |            | X          | X          | X          | X          | X          | X          |
| TE-6300-101         | 12 in. (305 mm), 1k ohm Nickel Probe  | X          |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |
| TE-6300-104         | 12 in. (305 mm), 2.2k ohm Thermistor Probe  |            |            |            |            |            |            |            |            |            |            |            |            | X          |            |            |            |            |            |            |            |            |
| TE-6300-105         | 12 in. (305 mm), 1k ohm Platinum Class A Probe  |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            | X          |            |            |            |            |            |
| TE-6300-601         | 8 in. (203 mm), 1k ohm Nickel Probe   | X          |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |
| TE-6300-603         | 3 in. (76 mm), 1k ohm Nickel Probe  |            |            | X          |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |
| TE-6300-605         | Sensor Holder/Well Adaptor, Plastic, 1/2-14 NPT, for use with TE-6300W-110 (replacement part, included with TE-63xxP-1)   | X          | X          |            |            | X          | X          |            |            | X          | X          | X          | X          | X          |            |            | X          | X          |            |            | X          |            |
| TE-6300-606         | 8 in. (203 mm), 2.2k ohm Thermistor Probe   |            |            |            |            |            |            |            |            |            |            |            |            | X          |            |            |            |            |            |            |            |            |
| TE-6300-607         | 3 in. (76 mm), 2.2k ohm Thermistor Probe  |            |            |            |            |            |            |            |            |            |            |            |            | X          |            |            |            |            |            |            |            |            |
| TE-6300-609         | Sensor Holder/Well Adaptor, Plastic, Threadless, for use with TE-6300W-103 (replacement part, included with TE-63xAP-1)   |            |            |            |            |            |            | X          |            |            |            |            |            |            |            |            |            |            |            | X          |            |            |
| TE-6300-616         | 8 in. (203 mm), 1k ohm Platinum Class A Probe   |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            | X          |            |            |            |            |            |
| TE-6300-617         | 3 in. (76 mm), 1k ohm Platinum Class A Probe  |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            | X          |            |            |            |
| TQ-6000-1           | 4 to 20 mA Output Transmitter   |            |            |            |            |            |            |            |            |            |            | X          | X          |            |            |            |            |            |            |            |            |            |
| Thermowells         |   |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |
| F-1000-182          | Thermal Conductive Compound, 8 oz. Container  |            | X          |            |            |            |            | X          |            |            |            |            |            |            |            |            |            |            | X          | X          |            |            |
| TE-6300W-103        | Thermowell, Brass with Copper Bulb, 2.38 in. (60.5 mm) immersion depth, thermal grease included, threadless adaptor required, for use with 6 in. (150 mm) probe (TE-63xAP-1 includes adaptor) |            |            |            |            |            |            | X          |            |            |            |            |            |            |            |            |            |            |            | X          |            |            |
| TE-6300W-110        | Thermowell, Stainless Steel, 4.50 in. (114.3 mm) immersion depth, without thermal grease, 1/2-14 NPT adaptor required, for use with 8 in. (200 mm) probe (TE-63x2P-1 includes adaptor)        |            | X          |            |            |            |            |            |            |            |            |            |            |            |            |            |            | X          |            |            |            |            |

**Note:** Direct-mount thermal wells TE-6300W-101 and TE-6300W-102 can be used only with the TE-6300M sensors.

**Table 8: Typical Accessory and Replacement Part Usage for TE-63xS Models**

| Product Code Number | Description  |
|---------------------|--|
| F-1000-182          | Thermal Conductive Grease for element wells (8 oz.)  |
| TE-6300-614         | Cable Tie Mounting Kit, 0.50 to 2.625 in. (12.7 to 66.7 mm) Bundle Diameter (10 per package) |
| TE-6300-615         | Cable Tie Mounting Kit, 11 in. (280 mm) Maximum Bundle Diameter                              |

**Table 9: T-4000 Covers Available for the Wall-Mount TE-63x4P Series**

| Product Code Number      | Horizontal Johnson Controls Logo | Vertical Johnson Controls Logo | Thermometer, with °F/°C Scale | Faceplate/Cover Color  |
|--------------------------|----------------------------------|--------------------------------|-------------------------------|------------------------|
| T-4000-2138 <sup>1</sup> |                                  |                                |                               | Brushed Aluminum/Beige |
| T-4000-2139              | X                                |                                |                               |                        |
| T-4000-2140              | X                                |                                | X                             |                        |
| T-4000-2144              |                                  | X                              |                               |                        |
| T-4000-2639              | X                                |                                |                               | Brown and Gold/Beige   |
| T-4000-2640              | X                                |                                | X                             |                        |
| T-4000-2644              |                                  | X                              |                               |                        |
| T-4000-3139              | X                                |                                |                               | Brushed Aluminum/White |
| T-4000-3140              | X                                |                                | X                             |                        |
| T-4000-3144              |                                  | X                              |                               |                        |

1. Without Johnson Controls logo

## Repair Information

If the TE-63xxA, TE-63xxM, TE-63xS, or TE-63xxV Series temperature sensor fails to operate within its specifications, replace the unit. For a replacement temperature sensor, see Table 4 and contact the nearest Johnson Controls representative. For a replacement sensor probe for TE-63xxP duct, well, and outdoor-air models, see Table 10.

**Table 10: Replacement Parts**

| <b>Product Code Number)</b> | <b>Description</b>   |
|-----------------------------|--|
| <b>TE-6300-601</b>          | 8 in. (203 mm), 1k ohm Nickel Probe                                      |
| <b>TE-6300-616</b>          | 8 in. (203 mm), 1k ohm Platinum Class A Probe                            |
| <b>TE-6300-603</b>          | 3 in. (76 mm), 1k ohm Nickel Probe                                       |
| <b>TE-6300-617</b>          | 3 in. (76 mm), 1k ohm Platinum Class A Probe                             |
| <b>TE-6300-605</b>          | 1/2-14 NPT Threaded Plastic Sensor Holder with Retainer (10 per package) |
| <b>TE-6300-606</b>          | 8 in. (203 mm), 2.2k ohm Thermistor Probe                                |
| <b>TE-6300-607</b>          | 3 in. (76 mm), 2.2k ohm Thermistor Probe                                 |
| <b>TE-6300-609</b>          | Threadless Plastic Sensor Holder with Retainer (10 per package)          |
| <b>TE-6300-611</b>          | 1/2-14 NPT Threaded Brass Sensor Holder (Order in multiples of 10)       |
| <b>TE-6300-612</b>          | Threadless Brass Sensor Holder (Order in multiples of 10)                |

## Technical Specifications

### TE-6300 Series Temperature Sensors (Part 1 of 3)

|   |                            |  |
|---|----------------------------|--|
| <b>Sensor Reference Resistance</b>                  | 1k ohm Nickel              | k ohms at 70°F (21°C)  |
|   | 1k ohm Nickel Averaging    |  |
|   | 1k ohm Platinum            | 1k ohms at 32°F (0°C)  |
|   | 100 ohm Platinum Averaging | 100 ohms at 32°F (0°C)   |
|   | 1k ohm Platinum Averaging  | 1k ohms at 32°F (0°C)  |
|   | 2.2k ohm Thermistor        | 2,252 ohms at 77°F (25°C)  |
|   | 10k ohm Thermistor         | 10.0k ohms at 77°F (25°C)  |
| <b>Sensor Accuracy</b>                              | 1k ohm Nickel              | ±0.34F° at 70°F (±0.19C° at 21°C)  |
|   | 1k ohm Nickel Averaging    | ±3.4F° at 70°F (±1.9C° at 21°C)  |
|   | 1k ohm Platinum Class A    | ±0.35F° at 70°F (±0.19C° at 21°C), DIN Class A   |
|   | 1k ohm Platinum Class B    | ±0.73F° at 70°F (±0.41C° at 21°C), DIN Class B   |
|   | 100 ohm Platinum Averaging | ±1.0F° at 70°F (±0.58C° at 21°C)   |
|   | 1k ohm Platinum Averaging  |  |
|   | 2.2k ohm Thermistor        | ±0.36F° (±0.2C°) in the range: 32 to 158°F (0 to 70°C)   |
|   | 10k ohm Thermistor         | ±0.9F° (±0.5C°) in the range: 32 to 158°F (0 to 70°C)  |
| <b>Sensor Temperature Coefficient (see Table 2)</b> | 1k ohm Nickel              | Approximately 3 ohms/F° (5.4 ohms/C°)  |
|   | 1k ohm Nickel Averaging    |  |
|   | 1k ohm Platinum            | Approximately 2 ohms/F° (3.9 ohms/C°) 3,850 ppm/K  |
|   | 100 ohm Platinum Averaging | Approximately 0.2 ohms/F° (0.39 ohms/C°)   |
|   | 1k ohm Platinum Averaging  | Approximately 2 ohms/F° (3.9 ohms/C°)  |
|   | 2.2k ohm Thermistor        | Nonlinear, Negative Temperature Coefficient (NTC)  |
|   | 10k ohm Thermistor         | Nonlinear NTC, Johnson Controls Type II  |
| <b>Electrical Connection</b>                        | TE-63xxM                   | 22 AWG (0.6 mm diameter) x 6 in. (152 mm) long   |
|   | TE-63xxP                   |  |
|   | TE-63xxF                   | 22 AWG (0.6 mm diameter) x 12 ft (3 m) braided copper wires, low voltage insulation, half-stripped ends  |
|   | TE-63xxP Nickel Averaging  | 18 AWG (1.0 mm diameter) x 6 in. (152 mm) long   |
|   | TE-63xS                    | 22 AWG (0.6 mm diameter) x 10 ft (3 m) long plenum-rated cable   |
|   | TE-63xxA, TE-63xxV         | 22 AWG x 10 ft (3 m) long plenum-rated cable, with 2-position plug terminal block for 1/4 in. (6.35 mm) male tab terminals on 0.197 in. (5 mm) centers |

### TE-6300 Series Temperature Sensors (Part 2 of 3)

|                             |                 |  |
|-----------------------------|-----------------|--|
| <b>Materials</b>            | <b>Probes</b>   | Nickel Averaging: 0.094 in. (2.4 mm) Outside Diameter (O.D.) copper tubing<br>Nickel Averaging Adaptor: 0.25 in. (6.35 mm) O.D. Brass<br>Platinum Averaging Probe: 0.19 in. (4.8 mm) Aluminum tubing<br>All Others (except Averaging): 0.25 in. (6.35 mm) O.D. Stainless Steel |
|                             | <b>TE-63xxA</b> | Mounting Adaptor Plate and Gland: Thermoplastic  |
|                             | <b>TE-63xxF</b> | Flush Mount: Stainless Steel   |
|                             | <b>TE-63xxM</b> | Enclosure: Corrosion-Protected Steel<br>Well Sensor Holder: 0.875 in. (22.2 mm) Hex Brass  |
|                             | <b>TE-63xxP</b> | Conduit box and Shield: Rigid Thermoplastic<br>Mounting Plate: Aluminum<br>Sensor Holder: Rigid Thermoplastic<br>Wall Mount Base Plate: Corrosion-Protected Steel<br>Wall Mount Cover: Rigid Thermoplastic (White)<br>Wall Mount Face Plate: Brushed Aluminum                  |
|                             | <b>TE-63xxV</b> | Mounting Flange: Stainless Steel   |
|                             | <b>TE-63xxA</b> | -50 to 140°F (-46 to 60°C)   |
| <b>Operating Conditions</b> | <b>TE-63xxF</b> | Temperature Limits: 32 to 104°F (0 to 40°C)  |
|                             | <b>TE-63xxM</b> | -50 to 220°F (-46 to 104°C)  |
|                             | <b>TE-63xxP</b> | Enclosure: -50 to 122°F (-46 to 50°C)<br>Sensor Probe: -50 to 220°F (-46 to 104°C)   |
|                             | <b>TE-63xS</b>  | Sensor Probe: -50 to 220°F (-46 to 104°C)  |
|                             | <b>TE-63xxV</b> | Wire Harness: -50 to 122°F (-46 to 50°C)   |
|                             | <b>TE-63xxA</b> | 0.2 lb (0.09 kg)   |
| <b>Shipping Weight</b>      | <b>TE-63xxF</b> | 0.25 lb (113.4 kg)   |
|                             | <b>TE-63xxM</b> | Duct Averaging: 0.9 lb (0.41 kg)<br>Duct Mount: 0.4 lb (0.18 kg)<br>Well Insertion: 0.5 lb (0.23 kg)   |
|                             | <b>TE-63xxP</b> | Duct Averaging: 0.5 lb (0.23 kg)<br>Duct Mount: 0.4 lb (0.18 kg)<br>Outdoor Air: 0.5 lb (0.23 kg)<br>Wall Mount: 0.2 lb (0.09 kg)<br>Well Insertion: 0.35 lb (0.16 kg)   |
|                             | <b>TE-63xS</b>  | Strap-Mount: 0.2 lb (0.09 kg)  |
|                             | <b>TE-63xxV</b> | Duct Averaging: 0.7 lb (0.32 kg)<br>Duct Mount: 0.2 lb (0.09 kg)   |
|                             | <b>TE-63xxA</b> | 0.2 lb (0.09 kg)   |
|                             | <b>TE-63xxF</b> | 0.25 lb (113.4 kg)   |

## TE-6300 Series Temperature Sensors (Part 3 of 3)

|                           |          |                 |  |
|---------------------------|----------|-----------------|--|
| Dimensions<br>(H x W x D) | TE-63xxA |                 | 2.17 in. (55 mm) diameter plus 4 or 8 in. (102 or 203 mm) element                                    |
|                           | TE-63xxF | Flush Mount:    | 4-1/2 x 2-3/4 in. (114 x 70 mm)  |
|                           | TE-63xxM | Duct Averaging: | 1.87 x 1.87 x 1.80 in. (47.5 x 47.5 x 45.8 mm) plus 8 or 17 ft (2.4 or 5.2 m) element                |
|                           |          | Duct Mount:     | 1.87 x 1.87 x 1.80 in. (47.5 x 47.5 x 45.8 mm) plus 4, 8, or 18 in. (102, 203, or 457 mm) element    |
|                           |          | Well Insertion: | 1.87 x 1.87 x 1.80 in. (47.5 x 47.5 x 45.8 mm) plus 6 or 8 in. (152 or 203 mm) element               |
|                           | TE-63xxP | Duct Averaging: | 5.97 x 1.38 x 2.75 in. (152 x 35 x 70 mm) plus 8, 10, 17, or 20 ft (2.4, 3.0, 5.2, or 6.1 m) element |
|                           |          | Duct Mount:     | 5.97 x 1.38 x 2.75 in. (152 x 35 x 70 mm) plus 6 or 8 in. (152 or 203 mm) probe                      |
|                           |          | Outdoor Air:    | 5.97 x 3.47 x 4.46 in. (152 x 88 x 113 mm)   |
|                           |          | Wall Mount:     | 2.09 x 3.12 x 1.80 in. (53 x 79 x 46 mm)   |
|                           |          | Well Insertion: | 5.97 x 1.38 x 2.75 in. (152 x 35 x 70 mm) plus 6 or 8 in. (152 or 203 mm) probe                      |
|                           | TE-63xS  | Strap-Mount:    | 0.25 in. (6.4 mm) diameter x 3.00 in. (76 mm) long   |
|                           | TE-63xxV | Duct Averaging: | 2.25 x 1.50 in. (57 x 38 mm) plus 8 or 17 ft (2.4 or 5.2 m) element                                  |
|                           |          | Duct Mount:     | 2.25 x 1.50 in. (57 x 38 mm) plus 4 or 8 in. (102 or 203 mm) 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.



### Building Efficiency

507 E. Michigan Street, Milwaukee, WI 53202

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# FLOW METER



## CERTIFICATE OF CALIBRATION

CALIBRATION, INSTALLATION & CONFIGURATION DATA for NON-ISOLATED ANALOG OUTPUT  
FLOW METERS Model F-1210 Serial No 268435

### INSTALLATION DATA

Flow Meter Length: 18.000"  
Gage Length: 14.875"  
Overall Length: 20.250"

### CONFIGURATION DATA

Wetted Metal Components: Brass  
Temperature: Hi-Temp  
Type of Enclosure: Weather Tight  
Peripheral Equipment: None

Meter Tag Information:

### CALIBRATION DATA

Model: F-1210 Serial No: 268435  
Pipe Size: 5" Pipe Type: Schedule 40 Carbon Steel  
MCU Code: 12.170

Frequency Output Meter Factor: 11.99 Pulses Per Gallon

Analog Output Range: 0 - 800 GPM

Voltage: 0-10VDC  
Current: 4-20 mA

Typical Flow Rate: Not Provided

Calibrated By:

Tim Rice

Date: 11/11/2014

ONICON Incorporated certifies that this flow meter was calibrated against  
a primary standard accurate to within 0.1% and traceable to the  
U.S. National Institute Of Standards And Technology (NIST).

11451 Belcher Road South, Largo, Florida 33773 Tel (727) 447-6140 Fax (727) 442-5699



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Tel: (802) 316-8888  
Fax: (802) 583-1054

April 9, 2015

John Sanborn  
Johnson Controls, Inc.  
116 Railroad Ave.  
Albany, NY 12205

RE: Mascoma Schools  
BTU Meters installations Certification

John,

This is provide the requested confirmations to outstanding items that came up during the TREC review.

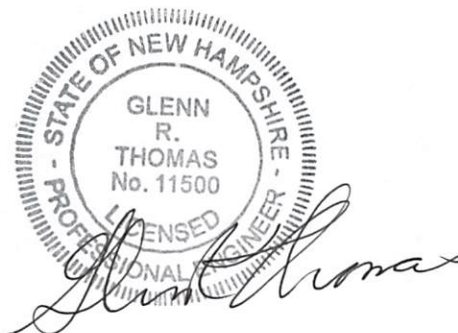
Item 3. As seen in the attached trend example, the readings are recorded in at least 1 hour intervals. They are recorded in 10 minute intervals for this project's buildings.

Item 4. As a professional engineer licensed and in good standing in the State of New Hampshire, I hereby state that the project meets the metering requirements of PUC 2506, that the meters were installed according to the manufacturer's recommendations, and that the renewable energy source meets the requirements of this part.

Please let me know if there are anything further required.

Yours truly,  
Glenn R Thomas, PE

Thomas Engineering Associates, PC



|                          | Pellet Boiler Return Temp                    | Pellet Boiler Supply Temp                    | Hot Water Flow                                 |  |                   |                  |
|--------------------------|--|--|--|--|-------------------|------------------|
| Time                     | EE-HWS.PBR-T.Trend -<br>Present Value (degF) | EE-HWS.PBS-T.Trend -<br>Present Value (degF) | EE-HWS.HW-<br>F.Trend - Present<br>Value (gpm) |  | Delta T<br>Pellet | BTU/hr<br>Pellet |
| 12/30/14 9:50:00 AM EST  | 154  | 158  | 204  |  | 4.04              | 68,774           |
| 12/30/14 10:00:00 AM EST | 152  | 156  | 204  |  | 4.02              | 68,298           |
| 12/30/14 10:10:00 AM EST | 151  | 155  | 204  |  | 4.30              | 73,239           |
| 12/30/14 10:20:00 AM EST | 150  | 154  | 205  |  | 4.30              | 73,620           |
| 12/30/14 10:30:00 AM EST | 149  | 153  | 204  |  | 4.59              | 78,130           |
| 12/30/14 10:40:00 AM EST | 148  | 153  | 203  |  | 4.58              | 77,670           |
| 12/30/14 10:50:00 AM EST | 146  | 150  | 204  |  | 3.61              | 61,380           |
| 12/30/14 11:00:00 AM EST | 145  | 149  | 204  |  | 3.91              | 66,431           |
| 12/30/14 11:10:00 AM EST | 144  | 149  | 203  |  | 4.20              | 70,979           |
| 12/30/14 11:20:00 AM EST | 144  | 148  | 203  |  | 4.50              | 76,340           |
| 12/30/14 11:30:00 AM EST | 144  | 148  | 204  |  | 4.50              | 76,458           |
| 12/30/14 11:40:00 AM EST | 149  | 152  | 203  |  | 2.67              | 45,170           |
| 12/30/14 11:50:00 AM EST | 167  | 167  | 203  |  | -                 | -                |
| 12/30/14 12:00:00 PM EST | 165  | 167  | 202  |  | 2.77              | 46,671           |
| 12/30/14 12:10:00 PM EST | 161  | 165  | 204  |  | 3.68              | 62,536           |
| 12/30/14 12:20:00 PM EST | 159  | 163  | 203  |  | 3.69              | 62,573           |
| 12/30/14 12:30:00 PM EST | 157  | 160  | 203  |  | 3.69              | 62,409           |
| 12/30/14 12:40:00 PM EST | 155  | 159  | 204  |  | 3.98              | 67,630           |
| 12/30/14 12:50:00 PM EST | 153  | 157  | 204  |  | 3.98              | 67,593           |