

A319 Electronic Temperature Control

The A319 Series is a line voltage, single-stage electronic temperature control with Single-Pole, Double-Throw (SPDT) relay output and LED indication. The A319 features heating or cooling modes of operation, adjustable cut-in, adjustable differential, and an interchangeable temperature sensor. The A319 couples electronic accuracy with remote sensing capability in a NEMA 1 high-impact plastic enclosure suitable for surface or DIN rail mounting.



Figure 1: A319 Electronic Temperature Control

| Features and Benefits | |
|--|---|
| <input type="checkbox"/> Operates on 120 or 208/240 volts | Eliminates need for 24 VAC power, saving installation time and cost |
| <input type="checkbox"/> Electronic Circuitry | Improved accuracy and higher reliability than equivalent electromechanical controls |
| <input type="checkbox"/> Solid-state Sensor | Handles remote sensing applications up to 800 feet without the need for ambient compensation or other limitations of electromechanical temperature controls; eliminates potential capillary breakage problems |
| <input type="checkbox"/> Interchangeable Temperature Sensors and Mounting Accessories | Allows flexibility in application; increases versatility and serviceability |
| <input type="checkbox"/> Three Models Cover Temperature Ranges from -25 to 220°F (-32 to 105°C) | Reduces inventory by encompassing the temperature ranges required to support the majority of refrigeration and HVAC applications |
| <input type="checkbox"/> Model Designed Specifically for Refrigeration Applications | Provides easy and accurate adjustments to satisfy refrigeration applications (model number A319ABC-07-01) |
| <input type="checkbox"/> Wide Adjustable Differential of 1 to 30°F (0.6 to 17°C) | Enables the user to match equipment cycle rate for a given application; maintains a tighter differential than typical electromechanical controls |
| <input type="checkbox"/> Field-selectable Mode Jumpers | Works to control either heating or cooling equipment with LED indication of relay energization status |

Application Overview

The A319 can be used to control a wide variety of single-stage refrigeration or HVAC equipment.

Typical applications include:

- frozen/refrigerated food cases
- compressor lockout (disables compressor when temperature exceeds limits)
- beverage/milk coolers
- condenser fan cycling
- boiler control
- pump control (cooling towers)
- space and return air temperature control
- immersion sensing for actuation of hot water and steam valves in heating applications (well required)

Refer to Figures 5 and 6 for typical wiring diagrams.

Operation

IMPORTANT: Use this A319 Electronic Temperature Control only as an operating control. Where failure or malfunction of the temperature control could lead to personal injury or property damage to the controlled equipment or other property, additional precautions must be designed into the control system. Incorporate and maintain other devices, such as supervisory or alarm systems or safety or limit controls, intended to warn of or protect against failure or malfunction of the temperature control.

IMPORTANT : Utiliser ce A319 Electronic Temperature Control uniquement en tant que dispositif de contrôle de fonctionnement. Lorsqu'une défaillance ou un dysfonctionnement du temperature control risque de provoquer des blessures ou d'endommager l'équipement contrôlé ou un autre équipement, la conception du système de contrôle doit intégrer des dispositifs de protection supplémentaires. Veiller dans ce cas à intégrer de façon permanente d'autres dispositifs, tels que des systèmes de supervision ou d'alarme, ou des dispositifs de sécurité ou de limitation, ayant une fonction d'avertissement ou de protection en cas de défaillance ou de dysfonctionnement du temperature control.

The A319 Temperature Control operates on 120 or 208/240 VAC; 50/60 Hz and supplies a SPDT relay output. A front panel LED indicates "ON" when the relay is energized (which closes the N.O. contacts). Adjustable features include:

- cut-in
- differential
- heating/cooling mode

Definitions

Cut-in: The point at which the N.O. (Normally Open) contact closes. Equal to the dial setting of the A319.

Cut-out: The point at which the N.O. contact opens.

Cut-in Adjustment

With the jumper block in either the heating or cooling position, the relay is energized and the N.O. contacts will close when the sensed temperature reaches the cut-in temperature.

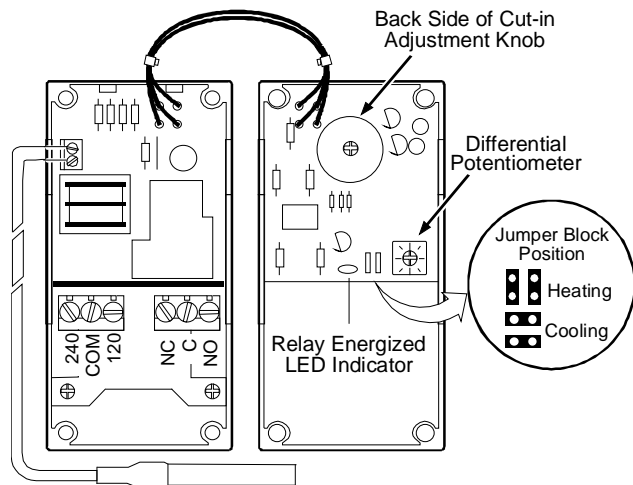


Figure 2: A319 Electronic Temperature Control Board Layout and Terminal Locations

Differential Adjustment

Differential is defined as the change in sensor temperature between relay energize (cut-in) and relay de-energize (cut-out). The differential can be adjusted between 1 and 30°F (0.6 to 17°C) for the A319ABC-12 and -24 models, and between 1 and 15°F (0.5 to 8°C) for the A319ABC-07 model. Adjust the potentiometer (marked DIFF.) to set the differential. Refer to Figure 2 for potentiometer location.

Heating/Cooling Mode

When the **heating mode** is selected, the differential is above the cut-in temperature. The relay will energize and the LED indicator will illuminate when the temperature drops to the cut-in temperature. When the temperature rises to the cut-in *plus* the differential setting, the relay and LED indicator will de-energize (refer to Figure 3).

When the **cooling mode** is selected, the differential is below the cut-in temperature. The relay will energize and the LED indicator will illuminate when the temperature rises to the cut-in. When the temperature drops to the cut-in *minus* differential setting, the relay and LED indicator will de-energize (refer to Figure 3).

IMPORTANT: Note the relationship of the differential to the dial setting. If the storage temperature must stay above freezing:

In heating applications the cut-in temperature must be above 32°F.

In cooling applications the cut-in minus the differential must be above 32°F if the temperature must stay above freezing.

Models A319ABC-24 and A319ABC-07 are shipped with the heating/cooling jumper blocks installed in the horizontal cooling position. Model A319ABC-12 is shipped with the jumper blocks installed in the vertical heating position (refer to Figure 2).

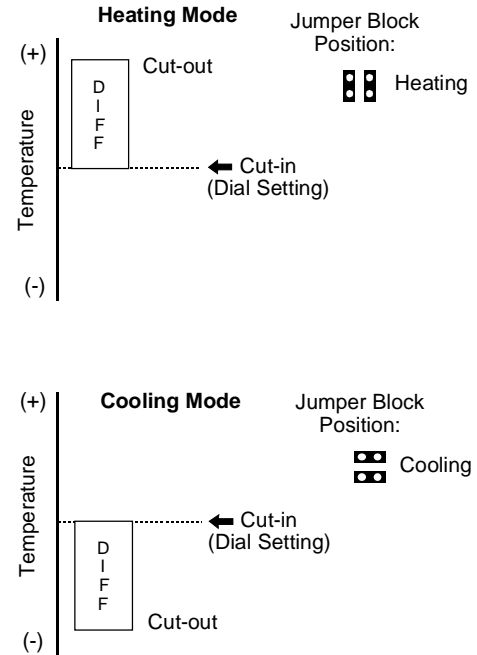


Figure 3: A319 Cut-in Control with Differential (Heating and cooling are both shown; action depends on jumper position.)

Using the A319 for Low Temperatures

The A319ABC-07 can be configured to continue cooling to -40°F. This is achieved by combining the cut-in and the differential. [The minimum cut-in (-25° F) minus the differential (15°) equals -40° F.]

Dimensions

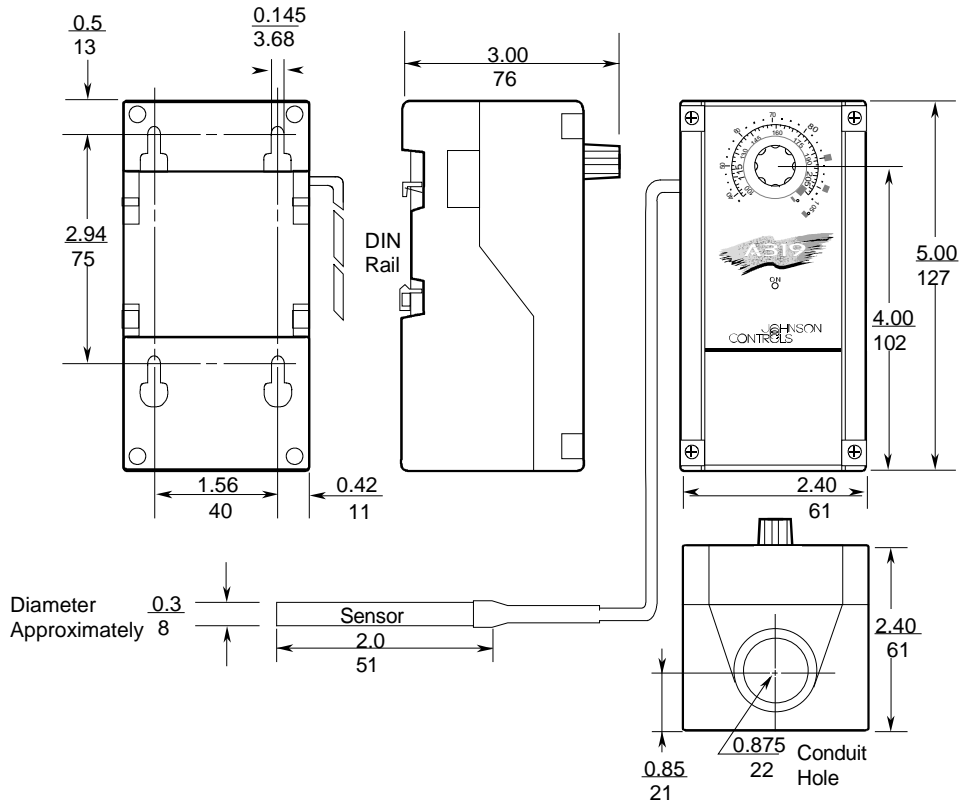


Figure 4: A319 Control Dimensions, in./mm

Installation and Wiring

The A319 Series Temperature Control is housed in a compact NEMA 1 plastic enclosure with four key-slot mounting holes on the back for surface mounting. The mounting hole pattern of the A319 is identical to that of the A19. Provision for standard 35 mm DIN rail mounting is also provided (refer to Figure 4).

The A319 is not position sensitive but should be mounted for convenient wiring and adjustment.

Note: When mounting the A319 to rigid conduit, attach the hub to the conduit before securing the hub to the control enclosure.

⚠ WARNING: Risk of Electric Shock.
 Disconnect the power supply before making electrical connections. Contact with components carrying hazardous voltage can cause electric shock and may result in severe personal injury or death.

AVERTISSEMENT : Risque de décharge électrique. Débrancher l'alimentation avant de réaliser tout branchement électrique. Tout contact avec des composants conducteurs de tensions dangereuses risque d'entraîner une décharge électrique et de provoquer des blessures graves, voire mortelles.

- Install all wiring to conform to the National Electrical Code and local regulations. For maximum electrical rating of control, refer to the *Specifications* table or the label inside the control cover. Use copper conductors only.

- Consult the typical wiring diagrams (Figures 5 and 6) for proper wiring and terminal designations.

Note: Wire the load to the N.O. contacts to obtain A319 operation functions (as described in this bulletin).

Sensor Connection and Mounting

- Connect the sensor to the terminal strip located at the top left of the printed circuit board (Figure 2). The sensor leads are interchangeable.
- Mount the sensor where it can accurately sense the temperature of the controlled medium.
- Keep conductors as short as possible to minimize temperature error. Wire resistance will cause a shift in the nominal value by lowering the displayed sensor temperature.
- Shielded cable is not generally required for sensor wiring on runs of 50 feet or less, but is recommended for lengths greater than 50 feet. Refer to Table 1 for the appropriate wire gauge.
- When shielded cable is used, connect shield to the "-" terminal of sensor terminal block (as shown in Figures 5 and 6).

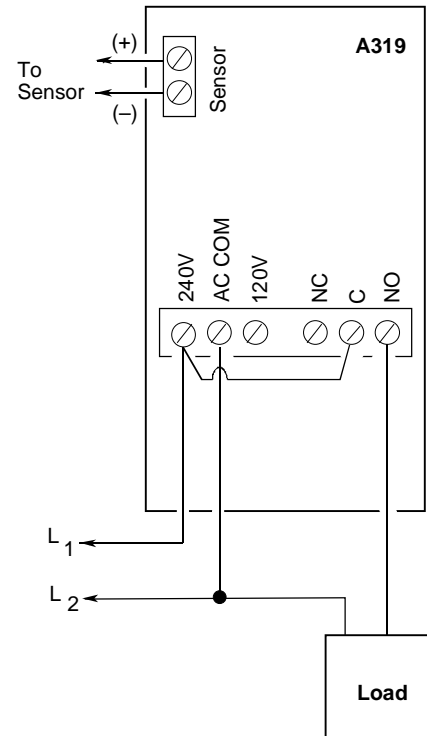


Figure 6: Typical 240 VAC Wiring for the A319 Control

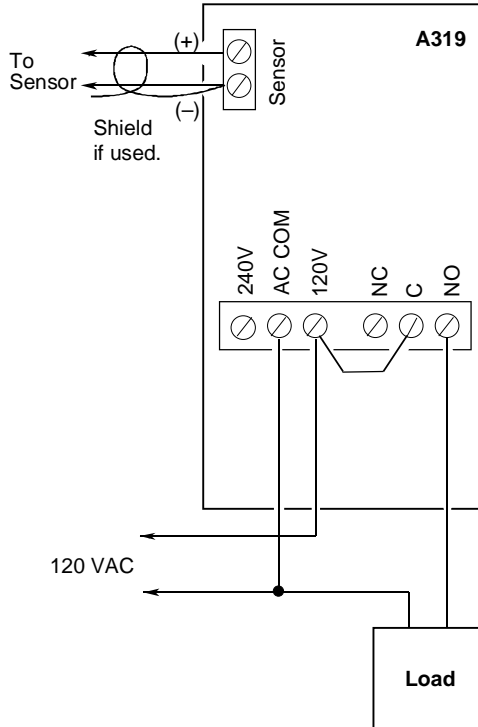


Figure 5: Typical Line Voltage (120 VAC) Wiring for the A319 Control

Table 1: Maximum Recommended Sensor Cable Lengths

| Wire Gauge | Maximum Sensor Cable Length | | | |
|------------|-----------------------------|--------|--------------------------|--------|
| | A319ABC-12 | | A319ABC-24 A319ABC-07 | |
| | Feet | Meters | Feet | Meters |
| 14 AWG | 500 | 152 | 800 | 244 |
| 16 AWG | 300 | 91 | 800 | 244 |
| 18 AWG | 185 | 56 | 800 | 244 |
| 20 AWG | 120 | 37 | 800 | 244 |
| 22 AWG | 75 | 23 | 800 | 244 |

Note: At the maximum cable lengths listed for all models in Table 1, no more than 1°F (0.5°C) error in the sensed temperature will result due to the wire resistance. For models A319ABC-07 and A319ABC-24, a maximum of cable length of 800 feet is recommended to reduce problems associated with high frequency noise.

Adjustments

IMPORTANT: Verify that the heating/cooling jumper blocks are in the proper position before powering the A319 Electronic Temperature Control. If the jumper blocks are in the wrong position, the device will activate the relay in response to the opposite signal. The heating or cooling equipment will remain energized until the error is corrected.

1. Remove the A319 cover by loosening the four captive cover screws.
2. Set the heating/cooling jumper blocks to the desired mode of operation. Position the jumper blocks vertically for heating or horizontally for cooling (refer to Figure 2).
3. Adjust the differential potentiometer “DIFF” as desired (the number of degrees between relay energized and de-energized). Rotate clockwise to increase the differential.
4. Replace the cover, fasten in place with the four screws, and move the cut-in dial to the desired setting.

Note: The A319 is factory calibrated at midscale to a tolerance of $\pm 1\text{F}^\circ$ (0.5C°). The cut-in tolerance at the extreme ends of the cut-in potentiometer rotation in relation to the printed scale plate is $\pm 3\text{F}^\circ$ (1.7C°).

Checkout Procedure

Before applying power, make sure installation and wiring connections are according to job specifications. After necessary adjustments and electrical connections have been made, put the system in operation and observe at least three complete operating cycles before leaving the installation.

Troubleshooting

If the control system does not function properly, verify that the proper heating/cooling mode is selected and the load is wired to the SPDT relay. Use the following procedures to determine the cause of the problem:

1. **Check for proper voltage applied to the A319 Control.**
 - a) Select AC volts on a voltmeter and connect it between the “AC COM” and “120V” (or “240V”) terminals located on the terminal block below the relay (Figure 2).
 - b) Verify that the voltage is between 85 and 135 VAC (or 170 and 270 VAC).

If the voltmeter reading is within the required voltage range, proceed to Step 2.

If the voltmeter reading is **not** within the required voltage range, check wiring.
2. **Check temperature sensor for proper operation.**
 - a) Let the thermometer stabilize and take an independent temperature reading at the sensor location (T_s).
 - b) Disconnect the sensor from the control. Using an ohmmeter, measure the resistance across the two sensor leads. Consult *Table 2: Nominal Temperature vs. Sensor Resistance* to verify sensor conformance.
 - c) If the sensor’s actual performance deviates substantially from that measured, replace the sensor.

3. **Check the A319 for proper operation.**

Note: Perform Steps 1 and 2 before performing this step.

- a) Reconnect the sensor to the A319.
- b) Change the cut-in temperature by slowly adjusting the dial until the control relay and LED turn ON and OFF as shown in Table 3.
- c) If the relay does **not** perform as indicated in Table 3, replace the A319.

Table 2: Nominal Temperature vs. Sensor Resistance

| Temperature | | Resistance |
|-------------|-----|------------|
| °F | °C | ohms |
| -30 | -34 | 52571 |
| -20 | -29 | 37116 |
| -10 | -23 | 26539 |
| 0 | -18 | 19208 |
| 10 | -12 | 14062 |
| 20 | -7 | 10408 |
| 30 | -1 | 7784 |
| 40 | 4 | 5880 |
| 50 | 10 | 4484 |
| 60 | 16 | 3450 |
| 70 | 21 | 2678 |
| 80 | 27 | 2095 |
| 90 | 32 | 1652 |
| 100 | 38 | 1313 |
| 110 | 43 | 1051 |
| 120 | 49 | 847 |
| 130 | 54 | 687 |
| 140 | 60 | 561 |
| 150 | 66 | 461 |
| 160 | 71 | 380 |
| 170 | 77 | 316 |
| 180 | 82 | 264 |
| 190 | 88 | 221 |
| 200 | 93 | 187 |
| 210 | 99 | 158 |
| 220 | 104 | 135 |

Table 3: Relay Troubleshooting

| Action | LED | N.O. Relay Status | N.C. Relay Status | Cut-in Dial Setting |
|---------|-----|-------------------|-------------------|----------------------------------|
| Heating | ON | Closed | Open | (T _S) |
| Heating | OFF | Open | Closed | (T _S) + differential |
| Cooling | ON | Closed | Open | (T _S) |
| Cooling | OFF | Open | Closed | (T _S) - differential |

Repairs and Replacement

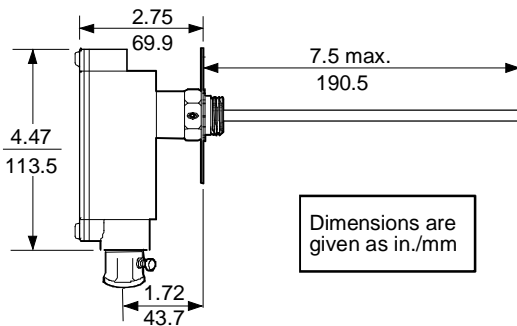
Do not make field repairs or calibration. Replacement A319 Controls and TE-6300 Series Sensors are available through the nearest Johnson Controls representative. Refer to Table 4 for ordering information.

Accessory Sensors

The TE-6300-608 Temperature Sensor is available as a replacement sensor. Accessory sensors with mounting hardware are also available and some accessory mounting hardware can be ordered without the sensor. (Refer to *Table 4: Ordering Information and Accessories.*) Refer to the *TE-6300 Series Temperature Sensors Product/Technical Bulletin* for details regarding sensor installation.

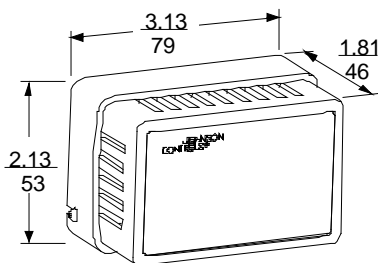
Duct Probe Sensor (TE-6341P-1) includes:

- 8 in. thermistor sensor
- quick mount sensor holder
- metal mounting plate with four screws and locknut
- conduit enclosure with cover
- 1/2 in. EMT conduit adapter
- two wire nuts



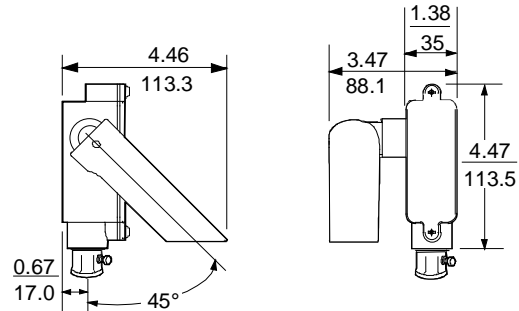
Wall Mount Sensor (TE-6344P-1) includes:

- thermistor sensor
- white T-4000 style cover and base with silver faceplate and horizontal logo
- two mounting screws
- two wall anchors
- two wire nuts



Outdoor Air Sensor (TE-6343P-1) includes:

- 3 in. thermistor sensor
- outdoor air shield
- conduit enclosure with cover
- 1/2 in. EMT conduit connector
- two wire nuts



Accessory Mounting Hardware

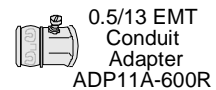
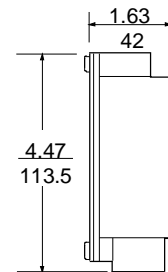
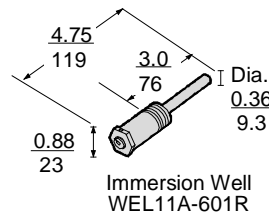
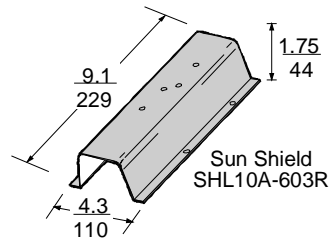


Table 4: Ordering Information and Accessories

| Item | Product Code Number | Description |
|--|---------------------|---|
| A319 Temperature Control with sensor | A319ABC-12-01 | Cut-in Range: 100 to 220°F (38 to 105°C) Differential: 1 to 30°F (0.5 to 17°C) Sensor Lead Length: 8 ft (2.4 m) |
| A319 Temperature Control with sensor | A319ABC-24-01 | Cut-in Range: -20 to 100°F (-30 to 38°C) Differential: 1 to 30°F (0.5 to 17°C) Sensor Lead Length: 8 ft (2.4 m) |
| A319 Temperature Control with sensor | A319ABC-07-01 | Cut-in Range: -25 to 50°F (-32.5 to 10°C) Differential: 1 to 15°F (0.5 to 8°C) Sensor Lead Length: 8 ft (2.4 m) |
| A319 Temperature Control without sensor | A319ABC-12-02 | Cut-in Range: 100 to 220°F (38 to 105°C); Differential: 1 to 30°F (0.5 to 17°C) |
| A319 Temperature Control without sensor | A319ABC-24-02 | Cut-in Range: -20 to 100°F (-30 to 38°C); Differential: 1 to 30°F (0.5 to 17°C) |
| A319 Temperature Control without sensor | A319ABC-07-02 | Cut-in Range: -25 to 50°F (-32.5 to 10°C) Differential: 1 to 15°F (0.5 to 8°C) |
| Replacement Temperature Sensors | TE-6300-608 | NTC Thermistor Sensor with 8 ft (2.4 m) Leads |
| | TE-6300-610 | NTC Thermistor Sensor with 12 ft (3.7 m) Leads |
| | TE-6300-606 | 8 in. NTC Thermistor Sensor with 6 in. (152.4 mm) Leads |
| | TE-6300-607 | 3 in. NTC Thermistor Sensor with 6 in. (152.4 mm) Leads |
| Accessory Temperature Sensors* | TE-6341P-1 | Thermistor Sensor <i>with</i> Duct Insertion Mounting Hardware |
| | TE-6343P-1 | Thermistor Sensor <i>with</i> Outdoor Air Mounting Hardware |
| | TE-6344P-1 | Thermistor Sensor <i>with</i> Wall Mounting Hardware |
| Accessory Mounting Hardware | WEL11A-601R | Immersion Well for use with TE-6300-608 |
| | BOX10A-600R | PVC Enclosure for Outdoor Mounting of TE-6300-608 |
| | SHL10A-603R | Sun Shield for use with TE-6300-608 and BOX10A-600R |
| | ADP11A-600R | 1/2 in. dia. EMT Conduit Adapter (box of 10) for use with BOX10A-600R |
| | BKT287-1R | 35 x 7.5 mm, 0.305 m (12 in.) long DIN Rail for use with A319 |
| | BKT287-2R | 35 x 7.5 mm, 0.914 m (36 in.) long DIN Rail for use with A319 |
| | PLT344-1R | Two End Clamps, for DIN Rail Mounting of A319 Controls |

* For additional information on accessory sensors, refer to the *TE-6300 Series Temperature Sensors Product/Technical Bulletin*.

Specifications

| | | | | |
|------------------------------------|--|--------------------------------|-------------|-------------|
| Product | A319 Electronic Temperature Control | | | |
| Cut-in Range | Refer to <i>Table 4: Ordering Information and Accessories</i> | | | |
| Differential Range | Refer to <i>Table 4: Ordering Information and Accessories</i> | | | |
| Supply Voltage | 120 or 208/240 VAC, 50/60 Hz | | | |
| Power Consumption | 1.8 VA Max. | | | |
| Relay Electrical Ratings | SPDT | 120V | 208V | 240V |
| | Horsepower [N.O. (N.C.)]: | 1 (0.25) hp | 1 (0.33) hp | 1 (0.5) hp |
| | Full Load Amperes [N.O. (N.C.)]: | 16 (5.8) A | 9.2 (4.0) A | 8.0 (4.9) A |
| | Locked Rotor Amperes [N.O. (N.C.)]: | 96 (34.8) A | 55 (24) A | 48 (29) A |
| | Non-inductive Amperes [N.O. (N.C.)]: | 15 (10) A | 10 (10) A | 10 (10) A |
| | Pilot Duty: | 125 VA (N.O.) @ 24 to 240 VAC | | |
| | | 125 VA (N.C.) @ 120 to 240 VAC | | |
| | | 50 VA (N.C.) @ 24 VAC | | |
| Sensor Type | Replaceable Thermistor with Reference Resistance of 2.25K ohms at 77°F (25°C) | | | |
| Control Ambient Temperature | Operating: -30 to 140°F (-34 to 60°C) Shipping: -40 to 185°F (-40 to 85°C) | | | |
| Ambient Humidity | 0 to 95% RH Non-condensing; Maximum Dew Point: 85°F (29°C) | | | |
| Control Material | Case and Cover: NEMA 1 High-Impact Thermoplastic | | | |
| Agency Listings | UL Listed: File E27734, Guide XAPX CSA Certified: File LR948, Class 4813 02 | | | |

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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