A419 Series Electronic Temperature Controls with NEMA 1 or NEMA 4X Watertight Enclosures

Application

IMPORTANT: The A419 Series Electronic Temperature Controls are intended to control equipment under normal operating conditions. Where failure or malfunction of an A419 control could lead to an abnormal operating condition that could cause personal injury or damage to the equipment or other property, other devices (limit or safety controls) or systems (alarm or supervisory) intended to warn of or protect against failure or malfunction of the A419 control must be incorporated into and maintained as part of the control system.

The A419 Electronic Temperature Control is a single-stage, electronic temperature control with a Single-Pole, Double-Throw (SPDT) output relay. The control features a lockable, three-button touchpad for setup and adjustment and a Liquid Crystal Display (LCD) which displays the sensed temperature and other control functions. A front panel Light-Emitting Diode (LED) indicates the output relay status. The control has a setpoint range of -30 to 212°F (-34 to 100°C) and is available in 24 VAC or 120/240 VAC models. See the Technical Specifications section.

The A419 control has heating and cooling modes with adjustable setpoint and differential, an adjustable anti-short cycle delay, and a temperature offset (setback) function. The control provides remote sensing capability, and electronic accuracy in a Type NEMA 1 high-impact plastic enclosure suitable for surface or DIN rail mounting or a surface mount Type NEMA 4X watertight and corrosion resistant enclosure. The temperature sensor supplied with the control is interchangable with compatible Johnson Controls/PENN® A99 temperature sensors.

Canadian Compliance Statement

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

FCC Compliance

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference that may cause undesired operation.

Installation

Refer to the following guidelines, procedures and illustrations when installing an A419 control.

Parts Included

Each A419 control includes a Johnson Controls/PENN A99 temperature sensor. The sensor may be removed and replaced with any compatible Johnson Controls A99 temperature sensor, or the wire leads on the sensor may be extended. See the Mounting and Wiring sections for additional guidelines and restrictions when mounting and wiring the control.

Dimensions

Figure 1: Dimensions for A419 Temperature Controls with NEMA 1 Enclosures, in./(mm)
Mounting

An A419 control has either a standard high-impact plastic NEMA 1 or a NEMA 4X watertight enclosure. The A419 control is not position sensitive but should be mounted for convenient wiring and adjustment. The NEMA 4X models may be mounted to flat vertical surfaces using the four screw holes at the enclosure corners. See Figure 2.

Note: When mounting the control to rigid conduit, attach the hub to the conduit before securing the hub to the control enclosure. For a NEMA 4X model, use a watertight fitting rated for the ambient environment.

On NEMA 4X models select the knockout to be removed. Place a screwdriver blade on the knockout near the edge. Apply a sharp blow to the screwdriver handle to loosen the knockout. Be careful not to damage the control’s interior components.

An additional low-voltage, two-wire cable is required to operate the A419 control’s temperature offset function. On NEMA 4X enclosures you must install a suitable water-tight fitting in an available knockout to pass the two-wire cable through the enclosure wall.

IMPORTANT: The short-lead A99 sensor, included with A419 NEMA 4X controls, must be mounted on the bottom of the control in the bracket on the NEMA 4X housing. Mounting the sensor on top of the control may reduce the accuracy of the displayed temperature. See Figure 2.

Wiring

WARNING: Risk of Electrical Shock.
To avoid the risk of electrical shock, disconnect all power sources to the control before wiring any connections. More than one disconnect may be required to completely de-energized the control and equipment.

IMPORTANT: All wiring must conform to local, national, and regional regulations. Use copper conductors only for all wire connections. Do not exceed the electrical ratings for the A419 control or the equipment it is wired to.

Observe the following guidelines and refer to Figure 3 and Table 1 when wiring the A419 control to your equipment:

- Use wire no larger than 12 AWG when connecting to the two lower terminal blocks (TB1 and TB2).
- Use wire no larger than 16 AWG when connecting to the upper sensor terminal block (TB3).
- Wire insulation rating must be 90°C, minimum.
- A99 temperature sensors are not polarity sensitive. Wire the leads to (+) SEN and (-) COM on the sensor terminal block (TB3). See Figure 3.
- Keep the leads between the control and sensor as short as possible/practical in your application. The additional resistance in long sensor leads creates error between the actual temperature and the displayed temperature. Refer to Table 1 when extending sensor leads.
- Temperature sensor signals may be affected by electrical interference. When extending sensor cable beyond 50 ft (15.2 m) use a twisted-pair, shielded cable to reduce electrical interference.

<table>
<thead>
<tr>
<th>Wire Gauge</th>
<th>Maximum Sensor Cable Length* feet (meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 AWG</td>
<td>500 (150)</td>
</tr>
<tr>
<td>18 AWG</td>
<td>300 (100)</td>
</tr>
<tr>
<td>20 AWG</td>
<td>200 (60)</td>
</tr>
<tr>
<td>22 AWG</td>
<td>125 (40)</td>
</tr>
</tbody>
</table>

* At the listed maximum cable lengths there is less than 1°F (0.6°C) error in the actual temperature vs. displayed temperature.
**Setup and Adjustments**

**WARNING: Risk of Electrical Shock.**
To avoid the risk of electrical shock disconnect all power sources to the control before opening control cover and repositioning jumpers. More than one disconnect may be required to completely de-energized the control and equipment.

**IMPORTANT:** To ensure that the output relay operates as intended, verify that all three of the jumpers are positioned properly for the application before powering the A419 control.

**IMPORTANT:** The touchpad cannot be unlocked without a jumper installed across the P5 jumper pins. Do not discard jumpers in case they are required in the future. See Figure 4 and Figure 5.

**Positioning the Jumpers**
The P5 jumper position determines if the touchpad is locked or unlocked.

The P4 jumper pin block has two pairs of jumper pins. The top pair of pins (JUMP1), determines if the control is set for Heating or Cooling mode. The bottom pair of pins, (JUMP2) establishes whether Setpoint is at cut-in or at cutout. See Figure 4 and Figure 5.

To position a jumper in the **Installed** position, place the jumper on both pins, which closes the circuit between the pins. To position a jumper in the **Removed** position, place the jumper on one pin only. See Figure 4.

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**Figure 3: Typical Wiring for the A419 Series Temperature Controls: 24, 120 and 240 VAC Applications**

**Figure 4: Positioning the Jumpers**

**Figure 5: Jumper Positions and Control Settings**
Table 2: Jumper Designations, Jumper Positions and Control Settings

<table>
<thead>
<tr>
<th>Function</th>
<th>Jumper Pins Designation on Control</th>
<th>Setting</th>
<th>Jumper Position</th>
<th>Factory Default Setting (and Jumper Position)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling/Heating Operating Mode</td>
<td>JUMP1 (Top Pair of Pins on Block P4)</td>
<td>Cooling Mode Removed</td>
<td>Heating Mode Installed</td>
<td>Heating Mode (Jumper Removed)</td>
</tr>
<tr>
<td>Setpoint at Cut-in or Cutout</td>
<td>JUMP2 (Bottom Pair of Pins on Block P4)</td>
<td>Setpoint at Cut-in Removed</td>
<td>Setpoint at Cutout Installed</td>
<td>Cut-in (Jumper Removed)</td>
</tr>
<tr>
<td>Touchpad Lock</td>
<td>P5</td>
<td>Locked Removed</td>
<td>Unlocked Installed</td>
<td>Unlocked (Jumper Installed)</td>
</tr>
</tbody>
</table>

The A419 Control Functions

Setpoint (SP) establishes the temperature value at which the equipment is switched on or off, depending on the user selected mode of operation. Setpoint range is -30 to 212°F or -34 to 100°C (in 1-degree increments).

If Setpoint mode is set to cut-in, setpoint is the temperature value at which the control closes the Normally Open (N.O.) contacts. If Setpoint mode is set to cutout, setpoint is the temperature at which the N.O. contacts open.

Differential (dIF) establishes the difference in temperature between the cut-in value and cutout value. The differential is set relative to Setpoint and may be set from 1 to 30°F or °C (in 1-degree increments).

Anti-Short Cycle Delay (ASd) establishes the minimum time that the output relay remains de-energized before the next on-cycle. The ASd does not allow the output relay to re-energize until the programmed time delay has elapsed. The delay is activated when the control is first turned on and every time an on-cycle ends. When the delay is activated, the LCD alternately flashes the sensor temperature and ASd. The Anti-short Cycle Delay range is 0 to 12 minutes (in 1-minute increments).

Sensor Failure Operation (SF) establishes how the A419 control’s output-relay operates the equipment in the event of a sensor or sensor wiring failure. The user may select to run the equipment continuously or to shut it down. When the control detects a sensor circuit failure, the LCD flashes SF alternately with OP (if the sensor circuit is open), or SH (if the sensor circuit is shorted). Before indicating a failure, the control implements a 1-minute delay, which allows verification of failure condition and avoids nuisance failure indications.

Temperature Offset (OFS) establishes a set secondary Setpoint and Differential values that may be invoked to control an application when a circuit is closed between the binary input (BIN) and common (COM) terminals (and BIN appears on the display). See Figure 3. Offset range is 0 to 50°F or °C (in 1-degree increments). A typical application might use a switching time clock to invoke night-setback temperature settings.

**IMPORTANT:** Make sure the Touchpad Lock jumper is installed (unlocked) before attempting to adjust the A419 control functions. See Figure 5.

Changing the A419 Control Temperature Units

The A419 control is factory set to display Fahrenheit temperature. To change to Celsius, press Up and Down (arrows) simultaneously. Press them again to display Fahrenheit units. Verify that the control is displaying the desired temperature units before setting the Setpoint.

Setting the A419 Control Setpoint Value

To view and adjust Setpoint, follow these steps:

1. Press and hold MENU (about 2 seconds) until the display flashes SP.
2. Press MENU again to display the existing setpoint value.
3. Press Up or Down (arrows) to change the setpoint value.
4. Press MENU again to save the new value. The display returns to the sensed temperature.

**Note:** If no setup entry is made for 30 seconds, the control reverts to the (normal) temperature display.
**Setting the Other A419 Control Functions**

To set the Differential, Anti-short Cycle Delay, Temperature Offset, or Sensor Failure operation, use the following method.

1. Press and hold MENU until the display changes to flashing SP. (This takes about 2 seconds.)
2. Press Up or Down (arrows) repeatedly until the desired function is displayed. (See Table 3.)

3. Press MENU to display the function’s current value.
4. Press Up or Down (arrows) until the desired value is displayed.
5. Press MENU to save the new value. The display returns to the sensor temperature.

**Note:** If no setup entry is made for 30 seconds, the control reverts to the (normal) temperature display.

**Note:** Any saved A419 control settings are non-volatile and remain in the control’s memory during power interruptions.

**Important:** Do not set Setpoint and Differential values which (when totaled) fall out of A419 control’s Setpoint range (-30 to 212°F [-34 to 100°C]). The control will not function properly if Cut-in or Cutout values are outside of the control’s Setpoint range.

**Checkout**

Before applying power, make sure installation and wire connections are correct for your application. Then power, operate and observe the system and A419 control for at least three complete operating cycles before leaving the installation.

**Table 3: Display Symbols, Control Function, Ranges, Units, Values, and Factory Settings**

<table>
<thead>
<tr>
<th>Display Symbol</th>
<th>Control Function</th>
<th>Range – Units/Value</th>
<th>Factory Set Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SP</strong></td>
<td>Setpoint*</td>
<td>-30 to 212 – °F (-34 to 100 – °C)</td>
<td>30</td>
</tr>
<tr>
<td><strong>dIF</strong></td>
<td>Differential*</td>
<td>1 to 30 – (°F or °C in 1-degree increments)</td>
<td>5</td>
</tr>
<tr>
<td><strong>ASd</strong></td>
<td>Anti-short Cycle Delay</td>
<td>0 to 12 – (in 1-minute increments)</td>
<td>1</td>
</tr>
<tr>
<td><strong>OFS</strong></td>
<td>Temperature Offset</td>
<td>0 to 50 (°F or °C in 1-degree increments)</td>
<td>0</td>
</tr>
<tr>
<td><strong>SF</strong></td>
<td>Sensor Failure Operation</td>
<td>(No range)— 0 = output relay de-energized</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = output relay energized</td>
<td></td>
</tr>
<tr>
<td><strong>F or C</strong></td>
<td>Temperature Units</td>
<td>(No range) – F° or C°</td>
<td><strong>F°</strong></td>
</tr>
<tr>
<td><strong>BIN</strong></td>
<td>Temperature Offset Indicator</td>
<td>(No range) – BIN is displayed and the A419 control operates on the secondary setpoints when the circuit between the BIN and COM terminals is closed.</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>❄ or ⚔</strong></td>
<td>Cooling or Heating Mode of Operation</td>
<td>(No range) – ❄ (Cooling Mode) is displayed when the Jump1 jumper is removed. ⚔ (Heating Mode) is displayed when the Jump1 jumper is installed.</td>
<td>⚔ Cooling Mode</td>
</tr>
</tbody>
</table>

* The sum of the Setpoint and Differential values must be within the Setpoint range, or the control may not function properly.
### Troubleshooting

**WARNING:** Risk of Electrical Shock. Hazardous voltages may be present at electrical terminals and other exposed internal metal surfaces. Do not touch any metal parts within the control when cover is removed. Any contact with metal parts, including with metal or conductive tools, may result in serious injury or death.

If the control system does not function properly, verify that the control is wired, and set up properly. If the problem persists, use the following procedures to determine the cause of the problem:

**IMPORTANT:** Follow these troubleshooting procedures in the order presented. Do not skip any of the steps in the procedures.

1. **Check for proper voltage to the A419 control.**
   - a. Remove the cover by loosening the four captive cover screws.
   - b. Use a reliable AC voltmeter to check the voltage between the **COM** and **120V** or **240V** terminals on-line voltage models and the two **24V** terminals on low-voltage models. Refer to Figure 3.
   - c. The voltage must be between 20 and 30 VAC for 24 VAC applications, 102 and 132 VAC for 120 VAC applications, 177 and 264 VAC for 208/240 VAC applications.
   - d. If the voltage reading is not within the required range, check the power source and input power wires for problems.

2. **Check for proper sensor operation.**
   - a. Disconnect all power sources to control.
   - b. Using an accurate thermometer, take a temperature reading at the sensor location.
   - c. Disconnect the sensor from the control.
   - d. Using an ohmmeter, measure the resistance across the two sensor leads while the sensor is at the temperature taken in Step 2b.
   - e. Consult Figure 7 to verify that the measured temperature and resistance conform to established temperature and resistance values.
   - f. If the measured values conform to the values in Figure 7, proceed to Step 3.

3. **Check the A419 for proper operation.**
   - a. Disconnect the load from the output relay terminals.
   - b. Ensure that the Touchpad Lock jumper is installed, so that the touchpad is unlocked.
   - c. Reconnect the sensor leads and supply power to the control.
   - d. Replace the cover.
   - e. Check the control settings for proper values.
   - f. Press and hold MENU until Setpoint appears (This takes about 2 seconds).
   - g. Press the Up and Down (arrows) to change the Setpoint temperature above and below the sensor temperature until the relay energizes and de-energizes as shown in Table 5.

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

   - a. Disconnect the load from the output relay terminals.
   - b. Ensure that the Touchpad Lock jumper is installed, so that the touchpad is unlocked.
   - c. Reconnect the sensor leads and supply power to the control.
   - d. Replace the cover.
   - e. Check the control settings for proper values.
   - f. Press and hold MENU until Setpoint appears (This takes about 2 seconds).

   **Note:** If the anti-short cycle delay has a set delay-time value greater than 0 minutes when the control is powered On, the relay does not energize until the time delay has elapsed.

   - h. If the output relay does not perform as indicated in Table 5, replace the A419 control.
   - i. If proper operation of the A419 control is verified, reconnect the load and consult the equipment manufacturer’s instructions for troubleshooting the controlled equipment.
Table 4: A419 Output Relay Operation in Different Operating modes

<table>
<thead>
<tr>
<th>Setpoint Mode</th>
<th>Operating Mode</th>
<th>Output Relay is Energized (closing the NO and COM contacts) at…</th>
<th>Output Relay is De-energized (opening the NO and COM contacts) at…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutout</td>
<td>Cooling</td>
<td>Setpoint plus differential</td>
<td>Setpoint</td>
</tr>
<tr>
<td></td>
<td>Heating</td>
<td>Setpoint minus differential</td>
<td>Setpoint</td>
</tr>
<tr>
<td>Cut-in</td>
<td>Cooling</td>
<td>Setpoint</td>
<td>Setpoint minus differential</td>
</tr>
<tr>
<td></td>
<td>Heating</td>
<td>Setpoint</td>
<td>Setpoint plus differential</td>
</tr>
</tbody>
</table>

Fault Codes
If the LCD displays an alarm or fault code (SF or EE), consult Table 5 for explanation.

Table 5: Fault Codes Defined

<table>
<thead>
<tr>
<th>Fault Code</th>
<th>Definition</th>
<th>System Status</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF</td>
<td>Open temperature sensor or sensor wiring</td>
<td>Output functions according to the selected sensor failure mode (SF setting)</td>
<td>See Troubleshooting section. Cycle power to reset the control.</td>
</tr>
<tr>
<td>SF</td>
<td>Shorted temperature sensor or sensor wiring</td>
<td>Output functions according to the selected sensor failure mode (SF setting)</td>
<td>See Troubleshooting section. Cycle power to reset the control.</td>
</tr>
<tr>
<td>EE</td>
<td>Program failure</td>
<td>Output is off</td>
<td>Reset the control by pressing MENU. If problems persist, replace the control.</td>
</tr>
</tbody>
</table>

Repairs and Replacement
Do not attempt to repair or recalibrate the A419 temperature control. In case of a defective or improperly functioning control, contact your nearest Authorized Johnson Controls/PENN Distributor or Sales Representative.

When contacting your Johnson Controls/PENN Distributor, have the model number of the control available. This number can be found on the label inside the cover of the control.

Ordering Information
Refer to Table 6 to order sensors, mounting hardware and other accessories used to install A419 controls. Contact your nearest Johnson Controls/PENN Distributor or Sales Representative to order these products.

Table 6: A419 Controls Accessories

<table>
<thead>
<tr>
<th>Product Code Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A99BB-200</td>
<td>Temperature Sensor: PTC Sensor with 6-1/2 ft (2 m) Non-shielded 2-Wire Lead</td>
</tr>
<tr>
<td>A99BA-200</td>
<td>Temperature Sensor: PTC Sensor with 6-1/2 ft (2 m) Shielded 2-Wire Lead</td>
</tr>
<tr>
<td>BKT287-1R</td>
<td>DIN Rail: 12 in. (305 mm) long</td>
</tr>
<tr>
<td>BKT287-2R</td>
<td>DIN Rail: 36 in. (914 mm) long</td>
</tr>
<tr>
<td>PLT344-1R</td>
<td>End Clamps for DIN Rail Mounting</td>
</tr>
<tr>
<td>CLK350-2C</td>
<td>7-Day Programmable Digital Clock for activating Binary Offset</td>
</tr>
<tr>
<td>WEL11A-601C</td>
<td>Immersion Well for Mounting Sensor in Liquid Applications</td>
</tr>
</tbody>
</table>
## Technical Specifications

### Product
A419 Series Electronic Temperature Controls with NEMA 1 General Purpose Enclosures and NEMA 4X Watertight Enclosures

### Setpoint Range
-30 to 212°F (-34 to 100°C)

### Differential Range
1 to 30°F (1 to 30°C)

### Supply Voltage
- 24 VAC, 60 Hz, Class 2:
  - A419GBF-1 (NEMA 1 Enclosure Model)
  - A419GEF-1 (NEMA 4X Watertight Enclosure Model)
- 120 or 240 VAC, 60 Hz:
  - A419ABC-1 (NEMA 1 Enclosure Model)
  - A419AEC-1 (NEMA 4X Watertight Enclosure Model)

### Power Consumption
1.8 VA Maximum

### Output Relay Contacts

#### Electrical Ratings

**120/240 VAC models:**
- A419ABC-1 (NEMA 1 Enclosure)
- A419AEC-1 (NEMA 4X Watertight Enclosure)

- **Applied Voltage:**
  - 120 VAC: 1 (0.25) hp, 16 (5.8) A
  - 208 VAC: 1 (0.33) hp, 9.2 (4.0) A
  - 240 VAC: 1 (0.5) hp, 8.0 (4.9) A

- **Horsepower N.O. (N.C.):**
  - 120 VAC: 16 (5.8) A
  - 208 VAC: 9.2 (4.0) A
  - 240 VAC: 8.0 (4.9) A

- **Locked Rotor Amperes N.O. (N.C.):**
  - 120 VAC: 55.2 (24) A
  - 208 VAC: 48 (29.4) A

- **Non-inductive Amperes N.O. (N.C.):**
  - 120 VAC: 15 (10) A
  - 208 VAC: 10 (10) A

- **Pilot Duty:**
  - 125 VA (N.O. contacts) @ 24 to 240 VAC
  - 125 VA (N.C. contacts) @ 120 to 240 VAC
  - 50 VA (N.C. contacts) @ 24 VAC

### Sensor Type
A99 Series Temperature Sensors (Various Models and Wire Lead Lengths Available)

### Control Ambient Temperature
- **Operating:**
  - -26 to 140°F (-32 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 Enclosure Material
Case and Cover:
- NEMA 1 - High-Impact Thermoplastic
- NEMA 4X - Watertight, High-Impact Noryl® Thermoplastic with Polycarbonate Faceplate

### Agency Listings
- UL: File E27734; CCN’s XAPX (US), XAPX7 (Canada)
- FCC: CFR 47, Part 15, Class A, DOC, Class A

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, contact Application Engineering at 1-800-275-5676. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.