System 450™ Series Control Module with Hybrid Analog Output
Installation Instructions
C450CPW-400

Part No. 24-7664-2802, Rev. E
Issued October 2018

Refer to the QuickLIT website for the most up-to-date version of this document.

Application

**IMPORTANT:** Use this System 450 Series Control Module with Hybrid Analog Output and High Input Signal Selection only as an operating control. Where failure or malfunction of the System 450 Series Control Module 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 System 450 Series Control Module.

**IMPORTANT:** Utiliser ce System 450 Series Control Module with Analog Output uniquement en tant que dispositif de régulation. Lorsqu’une défaillance ou un dysfonctionnement du System 450 Series Control Module 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 System 450 Series Control Module.

System 450™ is a family of modular, digital electronic controls that is easily assembled and set up to provide reliable temperature, pressure, and humidity control for a wide variety of Heating, Ventilating, Air Conditioning, and Refrigeration (HVACR), and commercial/industrial process applications.

The System 450 Series allows you to configure custom application-specific control systems with up to three input sensors and ten (relay and/or analog) outputs, including control systems that can monitor and control temperature, pressure, and humidity applications simultaneously.

You can easily install and quickly configure a stand-alone System 450 control module and sensor in the field as a replacement control for almost any temperature, pressure, and humidity control.

The C450CPW-400 model is a hybrid analog output control module with Liquid Crystal Display (LCD) and four-button touchpad User Interface (UI) that allows you to set up a System 450 control system. This model uses the same hardware and setup screens as the C450CPN-4, but with an additional function:

- the ability to configure a hybrid Analog Output (AO) to transition between a pulse output and a standard VDC output, depending on the sensor value relative to the proportional band. At low output levels, the pulse output signal provides an average motor speed that is less than the EC motor’s fixed minimum speed.

**Note:** This model was designed for (but is not limited to) controlling an EC motor. By using temperature, humidity, or pressure sensor inputs, this control can be used for a wide range of applications.

Refer to the System 450™ Series Modular Control Systems with Standard Control Modules Technical Bulletin (LIT-12011459) for detailed information on designing, installing, setting up, and troubleshooting System 450 Series control applications.

The System 450 technical bulletin can be accessed and downloaded on the Johnson Controls® QuickLIT Product Literature website.
Installation

Location Considerations

Observe the following System 450 location guidelines:

- Ensure that the mounting surface can support the module assembly, mounting hardware, and any (user-supplied) panel or enclosure.
- Mount the modules upright and plugged together in a horizontal row where possible. DIN rail mounting is highly recommended.
- Mount modules on flat even surfaces.
- Allow sufficient space for wires and connections.
- Mount the modules in locations free of corrosive vapors and observe the ambient operating conditions in Technical Specifications.
- Do not mount the modules on surfaces that are prone to vibration or in locations where radio frequency or electromagnetic emissions may cause interference.
- Do not install the modules in airtight enclosures.

Do not install heat-generating devices in an enclosure with the modules that may cause the temperature to exceed the ambient operating limit.

Mounting

Mount System 450 modules on a 35 mm DIN rail (recommended) or directly to an even wall surface. To mount the modules on a DIN rail:

1. Provide a section of 35 mm DIN rail that is longer than the module assembly width, and mount the DIN rail horizontally in a suitable location using appropriate mounting hardware/fasteners.
2. Clip the control module on the rail, position the upper DIN rail clips on the top rail, and gently snap the lower clips onto the rail.
3. Clip the remaining modules to the right of the control module onto the DIN rail and plug together.

To direct mount modules to wall surfaces:

1. Plug the modules together, remove the module covers, place the assembly against wall surface horizontally in a suitable location, and mark the mount hole locations on the surface.

2. Install appropriate screw fasteners, leaving screw heads approximately one to two turns away from flush to the surface.

3. Place the assembly over screw heads and on the mounting slots, and carefully tighten mount screws.

   **Note:** If you mount the module assembly on an uneven surface, do not damage the module housing when tightening the mounting screws. Use shims/washers to mount the module assembly evenly on the surface.

Refer to the control sensor installation instructions for information on locating and mounting control sensors.

**Wiring**

See Figure 2 and Table 1 for electrical termination locations and wiring information. See *Technical Specifications* for electrical ratings.

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**WARNING**

**Risk of Electric Shock.**

Disconnect or isolate all power supplies before making electrical connections. More than one disconnection or isolation may be required to completely de-energize equipment. Contact with components carrying hazardous voltage can cause electric shock and may result in severe personal injury or death.

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**AVERTISSEMENT**

**Risque de décharge électrique.**

Débrancher ou isoler toute alimentation avant de réaliser un branchement électrique. Plusieurs isolations et débranchements sont peut-être nécessaires pour -couper entièrement l'alimentation de l'équipement. Tout contact avec des composants conducteurs de tensions dangereuses risque d'entrainer une décharge électrique et de provoquer des blessures graves, voire mortelles.

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**IMPORTANT:** Use copper conductors only. Make all wiring in accordance with local, national, and regional regulations.

**IMPORTANT:** Do not exceed the System 450 module electrical ratings. Exceeding module electrical ratings can result in permanent damage to the modules and void any warranty.

**IMPORTANT:** Run all low-voltage wiring and cables separate from all high-voltage wiring. Shielded cable is strongly recommended for input (sensor) and analog output cables that are exposed to high electromagnetic or radio frequency noise.

**IMPORTANT:** Electrostatic discharge can damage System 450 modules. Use proper Electrostatic Discharge (ESD) precautions during installation and servicing to avoid damaging System 450 modules.

**IMPORTANT:** Do not connect 24 VAC supply power to the System 450 modules before finishing wiring and checking all wiring connections. Short circuits or improperly connected wires can result in damage to the modules and void any warranty.
**IMPORTANT:** A System 450 control module and module assembly can be connected to an internal power source (a System 450 power module) or an external power source (24 V power connected to the 24V and COM terminals on the control module), but must not be connected to both power sources simultaneously. Connecting a control module to both internal and external power sources can damage the modules and void any warranty.

**IMPORTANT:** When connecting System 450 compatible sensors with shielded cable to a System 450 control module, connect the cable shield drain lead to one of the C (common) terminals on the input sensor terminal block. Do not connect the shield at any other point along the cable. Isolate and insulate the shield drain at the sensor end of the cable. Connecting a cable shield at more than one point can enable transient currents to flow through the sensor cable shield, which can cause erratic control operation.

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### Table 1: System 450 Analog Output Control Module Terminal Wiring Information

<table>
<thead>
<tr>
<th>Label</th>
<th>Terminal Function</th>
<th>Wire Sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td>24V</td>
<td>Accepts 24 VAC supply power, when a C450YNN power module is not connected, and provides power terminal for 24 VAC (humidity) sensors.</td>
<td>0.8 mm² to 1.5 mm² (28 AWG to 16 AWG)</td>
</tr>
<tr>
<td>5V</td>
<td>Provides 5 VDC power for active sensors.</td>
<td></td>
</tr>
<tr>
<td>S1, S2, S3</td>
<td>Accepts passive or active (0–5 VDC) input signals from control sensors.</td>
<td></td>
</tr>
<tr>
<td>C (Three Terminals)</td>
<td>Provide low-voltage Common connections for 24 VAC power and passive or active sensors connected to the 5V, Sn1, Sn2, and Sn3 terminals. <strong>Note:</strong> The three C terminals are connected internally and can be connected to ground in the field.</td>
<td></td>
</tr>
<tr>
<td>AO1</td>
<td>Provides a self-detecting analog output signal in conjunction with the COM terminal; either 0–10 VDC or 4–20 mA; Provides option to transition standard output to pulse output for controlling EC motors at speeds below the motor’s minimum speed</td>
<td>0.08 mm² to 1.5 mm² (28 AWG to 16 AWG)</td>
</tr>
<tr>
<td>COM</td>
<td>Provides a common connection for AO1.</td>
<td></td>
</tr>
</tbody>
</table>
Setup and Adjustments

System 450 Components
A System 450 control system consists of one control module, one to three control sensors, and one to ten outputs that provide analog control and/or On/Off control. Figure 3 shows an example System 450 module assembly with two sensors and three outputs (two analog outputs and one relay output).

Setting up a Module Assembly
To set up a System 450 module assembly:

1. Determine the controlled conditions, sensor types, and value ranges required for your application, and select the appropriate System 450 sensor types.
2. Determine the number and type (relay or analog) of outputs required to control your application, and select the appropriate System 450 control module and expansion modules.
3. Assemble the control and expansion modules, starting with the control module on the left.
   
   **Note:** If you use a C450YN-1 power module, it must be plugged into the control module. Plug remaining expansion modules to the right of the power module.
4. Apply power to the module assembly.

You can now set up the module assembly in the control module UI.

Setting up a Control System in User Interface
System 450 control modules have a back-lit LCD and a four-button touchpad User Interface (UI) that enable you to set up all of the inputs (sensors) and outputs in the module assembly (Figure 4).

Figure 7 provides an example System 450 setup overview that corresponds to the control system example shown in Figure 3 and the following setup examples and procedures.

**Figure 3:** Example System 450 EC Motor Fan Speed Control
To set up a control system in the System 450 UI:

1. Build your control system module assembly and connect it to power. See Setting up a Module Assembly.

   IMPORTANT: Each time a module assembly is powered ON, the control module polls all of the modules to identify output type (relay or analog) and assigns a sequential output number (1 to 9 [0 = 10]) to each output starting with the control module output on the left. The output numbers identify each output's setup screens in the UI (see Figure 4).

2. Access the System 450 setup screens in the UI. See Accessing the System 450 Setup Screens.

3. Set up the control system inputs in the UI. See Setting up System 450 Sensors.

4. Set up the control system outputs in the UI. See Setting up System 450 Outputs.

   IMPORTANT: Do not change the module positions after a System 450 control system is set up in the System 450 UI. System 450 control logic is set up in the UI according to the input Sensor Types, the output types, and the output numbers. Changing modules or module positions in a module assembly that is already set up in the UI, can change the output numbers, output types, and/or the setup values of the assembly outputs, which requires setting up the outputs again.

Use the worksheet provided to plan and record the settings for your System 450 control system.

Viewing the Main and System Status Screens

After your control system is installed, wired, and set up, the Main (Input Status) screen appears when you connect power to your system. During normal operation, the Main screen displays the current status of each input (sensor) in your control system. See Table 2 for more information on the Main screens.

The System Status screens can display an output status screen for each output in your control system along with the Input Status screens; in the Main (Input Status) screen, press \[\text{up} \] repeatedly to scroll through and view all of the Output Status screens in your control system. See Table 2 for more information on the System Status screens.
Accessing the System 450 Setup Screens

You can access the setup screens from the Main screen. To access the System 450 setup screens:

1. Apply power to your module assembly. After a startup check, the Main screen appears on the LCD.

2. In the Main screen, press and hold Up and Down simultaneously for 5 seconds to access the setup screens and to go to the Sensor Setup Start screen.

   Note: The Sensor Setup Start screen is the first screen displayed when you access the System 450 setup screens. From the Sensor Setup Start screen, you can navigate to all of the remaining setup screens for your control system.

3. Press repeatedly to scroll through the setup start screens. See Figure 7.

   Note: The setup start screens are view-only; selections cannot be made in setup start screens. Press Next in a Setup Start screen to go to the sensor or output setup screens.

Setting up System 450 Sensors

You must set up the input sensors for your control system before you can set up any of outputs. To set up the input sensors you must access the setup screens. See Accessing the System 450 Setup Screens.

The Sensor Setup Start screen is the first screen displayed when you access the system setup screens in the System 450 UI.

Table 3 provides information about System 450 sensors, Sensor Types, parameter values, and specified sensor/transducer product code numbers.

Table 4 provides information, procedures, and examples regarding Sensor Setup screens and setting up sensors. Figure 7 provides a System 450 UI and setup overview example.

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Table 2: System 450 Main Screens and Status Screens Information and Procedures

<table>
<thead>
<tr>
<th>LCD Screen</th>
<th>Name, Description/Function, User Action, and Example</th>
</tr>
</thead>
</table>
| ![](176 PSI.png) | **Main (Input Status) Screen:** During normal operation, the Main screen automatically scrolls through the current status at each input sensor in your control system and displays the sensor number, the unit of measurement, and the sensed condition value. See Figure 7.  
**Note:** Main screens are view-only, selections are not made in Main screens. Press Next repeatedly to scroll through and view the System Status screens for all inputs and outputs in your control system.  
Press and hold both Up and Down for 5 seconds to access your control system's setup screens.  
**Note:** In any system setup screen, you can return to the Main Screens by pressing both Up and Down simultaneously. Also, the UI returns to the Main screen after 2 minutes of inactivity in any screen.  
Screen examples show Sensor 1 sensing 232 psi, Sensor 2 sensing 181 psi, and Sensor 3 sensing 74°F. |
| ![](181 PSI.png) |
| ![](74 °F.png) | **System Status Screens:** The System Status screens display current status of all inputs and outputs in your control system. Relay output status screens display output number and relay status (On/Off). Analog output status screens display output number, signal strength, and control ramp icon. See Figure 7.  
**Note:** System Status screens are view-only; selections are not made in Status screens. Press Next repeatedly to scroll and view the System Status screens for the inputs and outputs in your control system.  
Screen examples show Output 1 signal strength is 61% of the total signal strength and Output 2 relay is OFF. The control ramp icon in the top screen example indicates that the Analog Output is set up with SP<EP and OSP<OEP. (See Setting up an Analog Output (OUTAx) for information about control ramp icons.) |
| ![](61 OUT.png) |  |
| ![](OFF OUT.png) |  |
Table 3: System 450 Sensor Types, Setup Values, and Sensor/Transducer Product Codes (Part 1 of 2)

<table>
<thead>
<tr>
<th>Sensor Type</th>
<th>Unit of Measurement Value (Condition/Units)</th>
<th>Effective Sensing Range</th>
<th>Range of Usable Values</th>
<th>Resolution Increment Value</th>
<th>Minimum Differential or Proportional Band</th>
<th>Sensor / Transducer Product Type Number¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>°F</td>
<td>°F (Temperature/degrees)</td>
<td>-46 to 255</td>
<td>-40 to 250</td>
<td>1</td>
<td>1</td>
<td>A99x-xxx</td>
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<tr>
<td>°C</td>
<td>°C (Temperature/degrees)</td>
<td>-43 to 124</td>
<td>-40 to 121</td>
<td>0.5</td>
<td>0.5</td>
<td>A99x-xxx</td>
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<tr>
<td>rH</td>
<td>% (Humidity/%RH)</td>
<td>1 to 100</td>
<td>10 to 95</td>
<td>1</td>
<td>2</td>
<td>HE-67Sx-xxxxxx</td>
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<td>HE-67Nx-xxxxxx</td>
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<td>HE-68Nx-0N00WS</td>
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<td>P 0.25</td>
<td>INWC (Pressure/in. W.C.)</td>
<td>-0.250 to 0.250</td>
<td>-0.225 to 0.250</td>
<td>0.005</td>
<td>0.010</td>
<td>DPT2650-R25B-AB</td>
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<tr>
<td>P 0.5</td>
<td>INWC (Pressure/in. W.C.)</td>
<td>0 to 0.5</td>
<td>0.025 to 0.5</td>
<td>0.005</td>
<td>0.010</td>
<td>DPT2650-0R5D-AB</td>
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<td>P 2.5</td>
<td>INWC (Pressure/in. W.C.)</td>
<td>0 to 2.5</td>
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<td>P 5</td>
<td>INWC (Pressure/in. W.C.)</td>
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<td>0.25 to 5.0</td>
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<td>P598RCPSN401C</td>
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<td>P 10</td>
<td>INWC (Pressure/in. W.C.)</td>
<td>0 to 10</td>
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<td>-1 to 15</td>
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<td>0.4</td>
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<td>P 100</td>
<td>PSI (Pressure/psi)</td>
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<td>P 110</td>
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<td>-10 to 100</td>
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<td>P 200</td>
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Table 3: System 450 Sensor Types, Setup Values, and Sensor/Transducer Product Codes (Part 2 of 2)

<table>
<thead>
<tr>
<th>Sensor Type</th>
<th>Unit of Measurement Value (Condition/Units)</th>
<th>Effective Sensing Range</th>
<th>Range of Usable Values</th>
<th>Resolution Increment Value</th>
<th>Minimum Differential or Proportional Band</th>
<th>Sensor / Transducer Product Type Number¹</th>
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<tbody>
<tr>
<td>P 500</td>
<td>PSI (Pressure/psi)</td>
<td>0 to 500</td>
<td>90 to 500</td>
<td>1</td>
<td>5</td>
<td>P499RAP-105C, P499RAP-105K, P499RCP-105C, P499RCP-105K, P598RAPSN105C, P598RAPSN105K, P598RCPSN105C, P598RCPSN105K</td>
</tr>
<tr>
<td>HI°F</td>
<td>°F (Temperature/degrees)</td>
<td>-50 to 360</td>
<td>-40 to 350</td>
<td>1</td>
<td>1</td>
<td>TE-631x, TE-6000-x, TE-68NT-0N00S</td>
</tr>
<tr>
<td>HI°C</td>
<td>°C (Temperature/degrees)</td>
<td>-45.5 to 182</td>
<td>-40 to 176</td>
<td>0.5</td>
<td>0.5</td>
<td>TE-631x-x, TE-6000-x, TE-68NT-0N00S</td>
</tr>
<tr>
<td>bin</td>
<td>Open or Closed²</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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</tr>
</tbody>
</table>

1. Refer to the System 450 Series Modular Controls Product Bulletin (LIT-12011458), Catalog Page (LIT-1900549), or Technical Bulletin (LIT-12011459) for complete ordering information for System 450 compatible sensors and transducers.

2. Selecting the bin Sensor Type for a sensor (Sn-1, Sn-2, or Sn-3) sets up the input to control relay outputs (only) based on the state of the binary input contacts (open or closed) connected to the sensor input (Sn1, Sn2, or Sn3). See Binary Input Control for Relay Outputs on page 18 for more information.

Table 4: System 450 Sensor Setup Information and Procedures (Part 1 of 2)

<table>
<thead>
<tr>
<th>LCD Screen</th>
<th>Name, Description/Function, User Action, and Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>SENS</td>
<td>Sensor Setup Start Screen: The Sensor Setup Start screen is the first screen displayed when you access the System 450 setup screens. From the Sensor Setup Start screen you can navigate to the Output Setup Start screens or the Sensor Setup screens. See Figure 7. Note: You must set up the input sensors before you can set up the control system outputs. The Sensor Setup Start screen is view-only, selections are not made in setup start screens. Press Menu (repeatedly) to scroll through the Output Setup Start screens. (See Setting up a Relay Output (OUTRx) and Setting up an Analog Output (OUTAx) for information and procedures on setting up outputs.) 1. Press Next to go to the first Sensor Type Selection screen (Sn-1) and begin setting up the sensors in your control system. Screen example shows the Sensors Setup Start screen with four flashing dashes.</td>
</tr>
</tbody>
</table>
Sensor Type Selection Screens: The Sensor Type you select for an input sensor automatically determines the setup parameters and values for each output that is set up to reference that sensor. See Table 3 for information about System 450 sensors/transducers, Sensor Types, condition type, units of measurement, minimum differential or proportional band, setup values, value ranges, and product code numbers.

Note: For an output to operate properly, the selected Sensor Type must match the sensor/transducer model wired to the control module, and the sensor/transducer must be wired to the proper control module input terminals.

2. In the Sn-1 Sensor Type Selection screen, press Up or Down to select the desired Sensor Type. Press Next to save your selection and go to the Sn-2 Sensor Type Selection screen.

3. In the Sn-2 Sensor Type Selection screen, press Up or Down to select the desired Sensor Type. Press Next to save your selection and go to the Sn-3 Sensor Type Selection screen.

Note: If your control system does not use three input sensors, simply press Next while the two dashes are flashing in a Sensor Type Selection screen to save no Sensor Type and go to the next setup screen.

4. In the Sn-3 Sensor Type Selection screen, press Up or Down to select the desired Sensor Type. Press Next to save your selection and either:
   • go to the Temperature Offset Setup screen for the first temperature sensor in your system.
   • return to the Sensor Setup-Start Screen, if your control system has no temperature sensors.

Screen examples show Sensor 1 and Sensor 2 with the P500 Sensor Type selected and Sensor 3 with the °F Sensor Type selected.

Temperature Offset Selection Screens: Select a temperature offset for the temperature inputs (only) in your control system.

Sensor Type °F enables an offset of +/- 5°F in 1 degree increments.
Sensor Type °C enables an offset of +/- 2.5°C in 0.5 degree increments.

Note: The temperature offset changes the displayed temperature value by the selected offset value.

5. Press Up or Down to select the desired temperature offset value. Press Next:
   • to go to the next Temperature Offset Selection screen and repeat this step (if required).
   • to return to the Sensors Setup-Start Screen, if your control system has no temperature sensors.

Screen example shows -1 (flashing) is the selected temperature offset value for Sensor 3, thus a sensed temperature of 75°F at Sensor 3 is displayed as 74°F.


After the sensors are set up for your control system, you can:
• Press Menu to scroll through the Output Setup Start screens and begin setting up your system outputs. See Setting up a Relay Output (OUTRx) and Setting up an Analog Output (OUTAx) for more information and procedures.
• Press Up and Down simultaneously and hold for 5 seconds to return to the Main screens.

Screen example shows Input Sensors Setup-Start screen with four flashing dashes.
Setting up System 450 Outputs

After you build and connect power to your control system module assembly, the output numbers and output types for your control system are automatically assigned in the UI.

**Note:** You must set up the input sensors for your control system before you can set up the outputs.

To set up System 450 outputs in the UI:

1. Access the System 450 setup screens, the **Sensor Setup Start** screen (SENS) appears. (See **Accessing the System 450 Setup Screens**.)

2. In the **Sensor Setup Start** screen (SENS), press **Menu** repeatedly to scroll through and select the desired **Output Setup Start** screen. The Output Setup Start screen indicates the output number and the output type for the selected output.

For Analog Outputs, see **Setting up an Analog Output (OUTAx)** and Table 6 for setup information and procedures.

The C450CPW-400 model has a special hybrid Analog Output mode. See **Setting up the Pulse Region of the Hybrid Analog Output** and Table 7 for setup information and procedures.

For Relay Outputs, see **Setting up a Relay Output (OUTRx)** and Table 8 for setup information and procedures.

**Setting up an Analog Output (OUTAx)**

Analog outputs provide an auto-selecting analog signal that is proportional to the sensed input condition. The analog output circuit senses the impedance and automatically selects voltage or current mode operation.

The control action between the input signal and the output signal can be set up four different ways, depending on the values selected for the Setpoint (SP), End Point (EP), %Output Signal Strength at Setpoint (OSP), and %Output Signal Strength at End Point (OEP). The LCD displays different Control Ramp icons for the four control actions.

Figure 5 shows an example of the analog output setup values and the resulting output signal in a typical space heating application (SP > EP and OSP < OEP).

![Figure 5: Control Ramp Example for a Typical Heating Application (SP > EP and OSP < OEP)](image-url)
Table 5 shows the four Control Ramp icons and the associated analog output setup value relationships.

**Table 5: Analog Output Control Ramp Icons**

<table>
<thead>
<tr>
<th>Control Ramp Displayed on LCD</th>
<th>Control Action</th>
<th>Set the Analog Output Value Relationships for the Desired Control Action and Corresponding Control Ramp</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Output Minimum at SP" /></td>
<td>SP &lt; EP, OSP &lt; OEP</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Output Minimum at SP" /></td>
<td>SP &gt; EP, OSP &lt; OEP</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Output Maximum at SP" /></td>
<td>SP &gt; EP, OSP &gt; OEP</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Output Maximum at SP" /></td>
<td>SP &lt; EP, OSP &gt; OEP</td>
<td></td>
</tr>
</tbody>
</table>
See Table 6 for analog output setup information and procedures.

**Table 6: System 450 Analog Output Setup Screens Information (Part 1 of 2)**

<table>
<thead>
<tr>
<th>LCD Screen</th>
<th>Name, Description/Function, User Action, Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTA&lt;sup&gt;1&lt;/sup&gt;</td>
<td><strong>Analog Output Setup Start Screen:</strong> Output number and the output type (relay or analog) are automatically assigned when you connect power to your control system's module assembly. <strong>Note:</strong> You must set up the system's sensors before you can set up the outputs. 1. Press Up or Down to go to this output's Sensor Selection screen. Screen example shows the Analog Output Setup-Start screen for Output 1.</td>
</tr>
<tr>
<td>HI–2 SENS&lt;sup&gt;1&lt;/sup&gt;</td>
<td><strong>Sensor Selection Screen:</strong> The Sensor you select here determines this output's setup parameters and values, including condition type, unit of measurement, minimum proportional band, default setup values, and setup value ranges for several of the remaining output setup screens. If a sensor is not selected here, this output's remaining setup screens do not appear. If a sensor is already selected for this output, the Sensor Selection screen does not appear here; instead, the Setpoint Selection screen appears. <strong>Note:</strong> You must select a sensor in this Sensor Selection screen and the selected sensor must be already set up in the System 450 UI. (See Setting up System 450 Sensors.) 2. Press Up or Down to select the Sensor (Sn-1, Sn-2, Sn-3, HI-2 or HI-3) that this output references. Press Next to save your sensor selection and go to the Setpoint Selection screen. Screen example shows High Input (HI-2) automatic signal selection (between Sn-1 and Sn-2).</td>
</tr>
<tr>
<td>175 SP&lt;sup&gt;1&lt;/sup&gt;</td>
<td><strong>Setpoint Selection Screen:</strong> Setpoint is the target value that the controlled system drives towards and along with End Point, defines this output’s proportional band. <strong>Note:</strong> An output’s minimum proportional band (between Setpoint and End Point) is automatically enforced in the output’s Setpoint and End Point Selection screens. 3. Press Up or Down to select this output's Setpoint value. Press Next to save your Setpoint value selection and go to the End Point Selection screen. Screen example shows a Setpoint of 175 (psi) selected for Output 1.</td>
</tr>
<tr>
<td>185 EP&lt;sup&gt;1&lt;/sup&gt;</td>
<td><strong>End Point Selection Screen:</strong> End Point is the (condition) value that the controlled system drives away from (towards Setpoint) and, along with Setpoint, defines this output’s proportional band. <strong>Note:</strong> An output’s proportional band (between Setpoint and End Point) is automatically enforced in the output’s Setpoint and End Point Selection screens. 4. Press Up or Down to select this output's End Point value. Press Next to save your End Point value selection and go to the %Output Signal Strength at Setpoint Selection screen. Screen example shows a End Point of 185 (psi) selected for Output 1.</td>
</tr>
<tr>
<td>0 OSP&lt;sup&gt;1&lt;/sup&gt;</td>
<td><strong>Output Signal Strength at Setpoint Selection Screen:</strong> Select the strength of the signal that this output generates when the sensed condition is at the Setpoint value. The signal strength range is 0 to 100 (%). 5. Press Up or Down to select this output's %Output Signal Strength at Setpoint value. Press to save your selection and go to the %Output Signal Strength at End Point Selection screen. Screen example shows Analog Output 1 is set up to generate 0% of the total signal strength when the input is at the Setpoint value (= 0 V or 4 mA).</td>
</tr>
<tr>
<td>100 OEP&lt;sup&gt;1&lt;/sup&gt;</td>
<td><strong>Output Signal Strength at End Point Selection Screen:</strong> Select the strength of the signal that this output generates when the sensed condition is at the End Point value. The signal strength range is 0 to 100 (%). 6. Press Up or Down to select this output's %Output Signal Strength at End Point value. Press to save your selection and go to the Integration Constant Selection screen. Screen example shows Output 1 is set up to generate 100% of the total signal strength when the input is at the End Point value (= 10 V or 20 mA).</td>
</tr>
<tr>
<td>5 I–C&lt;sup&gt;1&lt;/sup&gt;</td>
<td><strong>Integration Constant Selection Screen:</strong> An integration constant allows you to set up proportional plus integral control for this analog output. Proportional plus integral control can drive the load closer to Setpoint than proportional only control. <strong>Note:</strong> Initially, you should select the I-C value of 0 (zero) for no integration constant. Refer to the System 450 Series Technical Bulletin (LIT-12011459) for more information on proportional plus integral control and setting an integration constant in the System 450 UI. 7. Press Up or Down to select this output's Integration Constant for proportional plus integral control. Press Next to save your selection and go to the Sensor Failure Mode Selection screen. Screen example shows an Integration Constant of 5 (zero) selected for Output 1.</td>
</tr>
</tbody>
</table>
### Output Signal Update Rate Selection Screen
Select the time interval (in seconds) at which the output updates the output signal strength. The selected Output Signal Update Rate is the minimum time that the output maintains a constant signal strength (regardless of the input signal) before updating the output signal in response to the referenced input signal. The Output Signal Update Rate value range is 1 to 240 (seconds).

**Note:** The Output Update Rate is used to reduce excessive cycling or repositioning of controlled equipment, such as valve and damper actuators. The Output Signal Update Rate feature can be used in conjunction with the Output Signal Deadband feature.

8. Press **A** or **V** to select this output’s Output Signal Update Rate. Press **B** to save your selection and go to the Output Signal Deadband Selection screen.

The screen example shows an Output Update Rate value of 1 (second), which is the default and lowest update rate you can select.

### Output Signal Deadband Selection Screen
Select the Output Signal Deadband value (as a percent of the output signal strength range) to establish a deadband around the analog output signal strength. The analog output responds to a changing input signal and updates the output signal strength whenever the input signal moves outside of the selected Output Signal Deadband.

At each update of the output signal, the control determines if the calculated (input-induced) output signal strength is within the selected Output Signal Deadband or not. If the input-induced change of the output signal strength is within the selected Output Signal Deadband, the output signal strength is not updated and remains unchanged. If the input-induced change of the output signal falls outside the Output Signal Deadband, the output signal strength is updated to the new signal strength value and the selected Output Signal Deadband is applied to the new signal strength value. The Output Signal Deadband range is 0 to 50% of the OSP to OEP range.

**Note:** The Output Signal Deadband is used to reduce excessive cycling or repositioning of controlled equipment, such as valve and damper actuators. The Output Signal Deadband feature can be used in conjunction with the Output Signal Update Rate feature.

9. Press **Up** or **Down** to select this output’s Output Signal Deadband. Press **Next** to save your selection and go to the Sensor Failure Mode Selection screen.

The screen example shows an Output Deadband value of 0 (%), which is the default value and disables the Output Deadband feature.

### Sensor Failure Mode Selection Screen
10. Press **Up** or **Down** to select this output’s mode of operation if the sensor or sensor wiring fails. Press **Next** to save your selection and go to the Edit Sensor Selection screen.

You can select this output’s mode of operation in the event of a sensor or sensor wiring failure. The output operates in the selected mode until the failure is fixed. Sensor Failure Mode selections for Analog Outputs include:

- **ON** - output generates maximum signal strength during sensor failure.
- **OFF** - output generates minimum signal strength during sensor failure.

Screen example shows the OFF Sensor Failure Mode selected for Output 1.

### Edit Sensor Selection Screen
11. Press **Up** or **Down** to change the sensor that this output references (only if required), then press **Next** to go to this output’s setup start screen.

**Note:** Changing the sensor that an output references to a sensor with a different sensor type changes the default setup values for the output, and requires setting up the output again.

Screen example shows the High Input (HI-2) signal selection (between Sn-1 and Sn-2).
High Input Signal Selection
The C450CPW-400 model has the ability to control an output using the High Input signal value of two (HI-2) or three (HI-3) sensors.

When you configure Sn-1 and Sn-2 as the same sensor type (temperature, humidity, or pressure), the SENSX screen includes the option of selecting Sn-1, Sn-2, Sn-3, or HI-2. Selecting **HI-2** results in the highest input signal of Sn-1 or Sn-2 (controlling the analog output).

When you configure Sn-1, Sn-2, and Sn-3 as the same sensor type (temperature, humidity, or pressure), the SENSX screen includes the option of selecting Sn-1, Sn-2, Sn-3, HI-2, or HI-3. Selecting **HI-3** results in the highest input signal of Sn-1, Sn-2, or Sn-3 controlling the analog output.

**Figure 6: Pulse Signal with Pulse Level = 25% and Logical Output = 12.5%**
**Setting up the Pulse Region of the Hybrid Analog Output**

The C450CPW-400 control’s single hybrid Analog Output (AO) (OUTA) transitions between a pulse output and a standard VDC output, depending on the sensor value relative to the proportional band. At low output levels, the pulse output signal provides an average motor speed that is less than the EC motor’s fixed minimum speed.

**Note:** This control function is not limited to EC Motor applications.

The **Pulse Region Hybrid AO Setup Screens** allow the user to select a Period (in seconds) and Level (expressed in %) for the Hybrid AO (see Table 7).

**Table 7: Pulse Region Hybrid Analog Output Setup Screens Information**

<table>
<thead>
<tr>
<th>LCD Screen</th>
<th>Name, Description/Function, User Action, Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>![PULS]</td>
<td>Pulse Region Hybrid AO Setup Start Screen: Only OUTA1 is capable of using the hybrid AO. 1. Press Next to go to this output’s Pulse Output Level selection screen. Screen example shows Pulse Region Hybrid AO Setup Start Screen for Analog Output 1. Note: Additional AO expansion modules provide a standard 0–10 VDC output signal.</td>
</tr>
<tr>
<td>![25 LEV]</td>
<td>Pulse Output Level: Set the Pulse Output Level to a value higher than required for the EC Motor to run. If the motor requires a minimum speed reference of 2 VDC before it runs, set the Pulse Level higher than 2 VDC. 2. Press Up or Down to select this Output’s Pulse Output Level value. Press Next to save your Pulse Output Level value selection and go to the Pulse Period Selection screen. Range is 0 to 100%. Set the Pulse Output Level to 0% to disable the pulse output. Set the Pulse Output Level to 100% to use the pulse output over the entire 0–10 V output range. Screen example shows the Pulse Period set to 25%.</td>
</tr>
<tr>
<td>![2 PER]</td>
<td>Pulse Period: 3. Press Up or Down to select this output’s Pulse Period value. Press Next to save your Pulse Period value selection and go to the Pulse Region Hybrid AO Setup Start Screen. Screen example shows the Pulse Period set for 2 seconds. Range is 1 to 30 seconds.</td>
</tr>
</tbody>
</table>

**Setting up a Relay Output (OUTRx)**

Relay outputs provide On/Off control for the equipment in your application based on input from the sensor the output is set up to reference. See Table 8 for relay output setup information and procedures.

**Table 8: System 450 Relay Output Setup Screen Information, and User Actions (Part 1 of 3)**

<table>
<thead>
<tr>
<th>LCD Screen</th>
<th>Name, Description/Function, User Action, and Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>![OUTR]</td>
<td>Relay Output Setup Start Screen: Output number and the output type (relay or analog) are automatically assigned when you connect power to your control system’s module assembly. <strong>Note:</strong> You must set up the system’s sensors before you can set up the outputs. 1. Press Next to go to this output’s Sensor Selection screen. Screen example shows the Relay Output Setup Start screen for Output 2.</td>
</tr>
<tr>
<td>![SENS]</td>
<td>Sensor Selection Screen: The sensor you select in this screen determines this output’s setup parameters and values, including condition type, unit of measurement, minimum differential, default setup values, and setup value ranges for several of the remaining output setup screens. If a sensor is not selected in this screen, this output’s remaining setup screens do not appear. If a sensor is already selected for this output, the Sensor Selection screen does not appear; instead, the Relay ON Selection screen appears. <strong>Note:</strong> You must select a sensor in this Sensor Selection screen and the selected sensor must be already set up in the System 450 UI. (See <strong>Setting up System 450 Sensors</strong>.) 2. Press Up or Down to select the Sensor (Sn-1, Sn-2, or Sn-3) that this output references. Press Next to save your sensor selection and go to the Relay ON Selection Screen. Screen example shows input Sensor 3 selected for Output 2.</td>
</tr>
</tbody>
</table>
### Table 8: System 450 Relay Output Setup Screen Information, and User Actions (Part 2 of 3)

<table>
<thead>
<tr>
<th>LCD Screen</th>
<th>Name, Description/Function, User Action, and Example</th>
</tr>
</thead>
</table>
| 78 ON²     | **Relay ON Selection Screen:** Select the value at which the relay turns On. Relay ON is defined as relay LED On/Lit, relay contacts NO to C are closed, and NC to C contacts are open.  
**Note:** The value ranges and minimum differential are determined by the Sensor Type selected for the sensor that this output references and are enforced in the Relay ON and Relay OFF Selection screens.  
3. Press Up or Down to select the value at which the output relay turns On. Press Next to save your selection and go to Relay OFF Selection Screen.  
Screen example shows an ON value of 78 (°F) selected for Relay Output 2. |
| 75 OFF²    | **Relay OFF Selection Screen:** Select the value at which the relay turns Off. Relay OFF is defined as relay LED Off, relay contacts NC to C are closed, and NO to C contacts are open.  
**Note:** The value ranges and minimum differential are determined by the Sensor Type selected for the sensor that this output references and are enforced in the Relay ON and Relay OFF Selection screens.  
4. Press Up or Down to select the value at which output relay turns Off. Press Next to save your selection and go to Minimum Relay ON Time Selection Screen.  
Screen example shows an OFF value of 75 (°F) selected for Relay Output 2. |
| 30 Ond²    | **Relay-On Delay Time Selection Screen:** Select the value (in seconds) that you want output relay to delay turning ON after the condition reaches and maintains the Relay-On value. The Relay-On Delay time range is 0 to 300 seconds.  
**Note:** The condition change must reach or exceed the output's Relay-On value for the entire duration of the Relay-On Delay, before the output relay goes On. This feature can be used to prevent controlled equipment such as actuators from being exercised every time the condition momentarily spikes to the Relay-On value, reducing wear on the controlled equipment.  
5. Press Up or Down to select the time value (in seconds) that the output relay delays turning on after the process condition reaches the Relay-On value, then press Next to save your selection and go to the Relay-On Delay Time Selection Screen.  
The screen example shows an ONd value of 30 (seconds) selected for Output 1. |
| 0 OFFd²    | **Relay-Off Delay Time Selection Screen:** Select the value (in seconds) that you want output relay to delay turning Off after the condition reaches and maintains the Relay Off value. The Relay-Off Delay time range is 0 to 300 seconds.  
**Note:** The Relay-Off Delay feature can be used to delay the output relay from going to the Off state after the Off value is reached at the referenced input sensor. The condition change must reach or exceed the output's Relay-Off value for the entire duration of the Relay-Off Delay, before the output relay goes Off. This feature is used to prevent controlled equipment such as actuators from being exercised every time the condition momentarily spikes to the Relay-Off value, reducing wear on the controlled equipment.  
6. Press Up or Down to select the time value (in seconds) that the output relay delays turning off after the process condition reaches the Relay Off value, then press Next to save your selection and go to the Relay-Off Delay Time Selection Screen.  
The screen example shows an OFFd value of 0 (seconds) selected for Output 1. |
| 0 ONT²     | **Minimum Relay ON Time Selection Screen:** Minimum ON Time range is 0 to 300 seconds.  
7. Press Up or Down to select the minimum time that the output relay remains On after reaching the Relay ON value. Press Next to save your selection and go to the Minimum Relay OFF Time Selection Screen.  
Screen example shows 0 (zero) seconds selected for the minimum ON-Time for Output 2. |
| 120 OFFT²  | **Minimum Relay OFF Time Selection Screen:** Minimum OFF Time range is 0 to 300 seconds.  
8. Press Up or Down to select the minimum time that this output relay remains Off after reaching the Relay OFF value. Press Next to save your selection and go to the Sensor Failure Mode Selection screen.  
Screen example shows 120 seconds selected for the minimum OFF-Time for Output 2. |
Binary Input Control for Relay Outputs

You can connect a binary input or a set of dry contacts to any of the three control module inputs (Sn-1, Sn-2, or Sn-3 and C) and control the output relays in your control system based on the binary input’s state (open or closed).

A sensor (Sn-1, Sn-2, or Sn-3) set up as a binary input can only be referenced by a relay output. Sensors set up as binary inputs are not available for selection when you set up an analog output.

When a relay output references a sensor (Sn-1, Sn-2, or Sn-3) that is set up as a binary input, the ON and OFF parameter screens are not available as you set up the output. The relay output’s On/Off state is controlled by the binary input’s state and any of the timer parameters (ONT, OFFT, ONd, or OFFd) that you set up for the relay output. When the binary input is closed, the relay is On. When the binary input is open, the relay is Off. If no timer parameters are used, the relay output state directly follows the binary input state.

Setting Up the LCD Backlight Brightness

The LCD backlight brightness can be adjusted in the UI. Table 9 provides information, procedures, guidelines, and screen examples for setting up the backlight brightness on System 450 control modules. See Figure 7 on page 20 for example menu flow of the backlight setup in Table 9.

### Table 8: System 450 Relay Output Setup Screen Information, and User Actions (Part 3 of 3)

<table>
<thead>
<tr>
<th>LCD Screen</th>
<th>Name, Description/Function, User Action, and Example</th>
</tr>
</thead>
</table>
| OFF SNF²   | **Sensor Failure Mode Selection Screen:** Select this output’s mode of operation if the referenced sensor or sensor wiring fails. The output operates in the selected mode until the failure is remedied. Sensor Failure mode selections for Relay Outputs include:  
  • ON - output relay remains On during sensor failure.  
  • OFF - output relay remains Off during sensor failure.  
  **9. Press Up or Down to select this output mode of operation if the sensor or sensor wiring fails. Press Next to save your sensor failure mode selection and go to the Edit Sensor Screen.**  
  Screen example shows OFF sensor failure mode selected for Output 2. This output relay is Off if the referenced sensor or sensor wiring fails. |
| Sn–3 SENS² | **Edit Sensor Screen:** This screen displays the sensor that this output currently references. Typically, no action is taken in this screen. But if you need to change the sensor that this output references, you can select a different sensor for this output in this screen.  
  **Note:** Changing the sensor that an output references to a sensor with a different Sensor Type changes the default setup values for the output, and requires setting up the output again.  
  **10. To change this output’s sensor, press Up or Down to select the sensor that this output references. After you select a different sensor for this output, press Next to return to the Relay ON Selection screen (Step 3 above) and repeat the output relay setup procedure for this output and the new Sensor Type values associated with the new sensor selection.**  
  If you do not need to change this output’s sensor, simply press Next to save the current sensor selection and return to the Relay Output Setup Start screen.  
  This Relay Output is now set up in the System 450 UI.  
  Screen example shows input Sensor 3 selected for Output 2 (Output 3 references Sensor 3). |
| OUTR²      | **Relay Output Setup Start Screen:** After you have set up this Relay Output, you can go to another Output Setup Start screen, the Sensor Setup Start screen, or return to the Main screens.  
  **11. Press Menu to scroll through the remaining Output Setup Start screens and return to the Sensor Setup Start screen, or press Up and Down simultaneously and hold for 5 seconds to return to the System 450 Main screens.**  
  Screen example shows the Relay Output Setup-Start screen for Output 2. |

### Binary Input Control for Relay Outputs

You can connect a binary input or a set of dry contacts to any of the three control module inputs (Sn-1, Sn-2, or Sn-3 and C) and control the output relays in your control system based on the binary input’s state (open or closed).

A sensor (Sn-1, Sn-2, or Sn-3) set up as a binary input can only be referenced by a relay output. Sensors set up as binary inputs are not available for selection when you set up an analog output.

When a relay output references a sensor (Sn-1, Sn-2, or Sn-3) that is set up as a binary input, the ON and OFF parameter screens are not available as you set up the output. The relay output’s On/Off state is controlled by the binary input’s state and any of the timer parameters (ONT, OFFT, ONd, or OFFd) that you set up for the relay output. When the binary input is closed, the relay is On. When the binary input is open, the relay is Off. If no timer parameters are used, the relay output state directly follows the binary input state.

### Setting Up the LCD Backlight Brightness

The LCD backlight brightness can be adjusted in the UI. Table 9 provides information, procedures, guidelines, and screen examples for setting up the backlight brightness on System 450 control modules. See Figure 7 on page 20 for example menu flow of the backlight setup in Table 9.

### Table 9: System 450 Setup Screen Information and Procedures for Backlight Brightness (Part 1 of 2)

<table>
<thead>
<tr>
<th>LCD Screen</th>
<th>Name, Description/Function, User Action, and Example</th>
</tr>
</thead>
</table>
| bKLT       | **Backlight Setup Start Screen:** The Backlight Brightness level feature allows you to adjust the backlight intensity. The selected backlight low level value is applied when the control is in idle mode. When you enter the programming menus to set up the control or press any key, the LCD automatically goes to the selected backlight high level value.  
  **1. Press Next to go to the Edit Backlight Low Level screen.**  
  The screen example shows the Backlight Setup Start screen. |
2. Press Up or Down to select the backlight brightness low level value. Press Next to save your selection and go to the Edit Backlight High Level screen. The screen example shows the Backlight low level set to OFF.

3. Press Up or Down to select the backlight brightness high level value. Press Next to save your selection and return to the Backlight Setup Start screen. The screen example shows the Backlight high level set to 10.

4. Press Menu to return to the Sensor Setup Start screen, or press Up and Down simultaneously to return to the System 450 Main screens. The screen example shows the Backlight Setup Start screen.

### Table 9: System 450 Setup Screen Information and Procedures for Backlight Brightness (Part 2 of 2)

<table>
<thead>
<tr>
<th>LCD Screen</th>
<th>Name, Description/Function, User Action, and Example</th>
</tr>
</thead>
</table>
| **OFF**    | **Backlight Low Level:** The backlight low level defines the brightness of the backlight during regular or idle mode, when you are not making adjustments to the control.  
2. Press Up or Down to select the backlight brightness low level value. Press Next to save your selection and go to the Edit Backlight High Level screen. The screen example shows the Backlight low level set to OFF. |
| **10**     | **Backlight High Level:** The high level defines the brightness when you are making configuration changes to the control and interacting with the UI. The backlight high level can be set to values 1–10; it cannot be turned completely off.  
3. Press Up or Down to select the backlight brightness high level value. Press Next to save your selection and return to the Backlight Setup Start screen. The screen example shows the Backlight high level set to 10. |
| **Backlight Setup Start Screen** | After you have set up the backlight brightness level, you can go to the Sensor Setup Start screen, or return to the Main screens.  
4. Press Menu to return to the Sensor Setup Start screen, or press Up and Down simultaneously to return to the System 450 Main screens. The screen example shows the Backlight Setup Start screen. |
System 450™ Series Control Module with Hybrid Analog Output Installation Instructions

Figure 7: System 450 Status Screens, Setup Screens, and Menu Flow Example

During normal operation, the display automatically scrolls through the Sensor Status screens for all sensors set up in the UI. After a 2 minute pause in any setup or status screen (below), the display returns to the Main (Sensor Status) screen. Press M in any Setup screen to go to the associated Setup Start screen. Press A | V simultaneously in any Setup Start screen to return to the Main screen.

In this System 450 setup example:
1) Sensor Type P500 is selected for Sn-1 and Sn-2. Sensor Type °F is selected for Sn-3 in the Sensor Type Setup screens.
2) The Select Temperature Offset screen for Sn-3 appears after the third Sensor Type Setup screen, and a temperature (only) offset of -1°F is selected. (For Celsius the sensor offset is set in 0.5 degree increments.)
3) Higher sensor input between Sn-1 and Sn-2 (pressure sensors) is selected for Output 1, so the default setup values for the output setup screens are determined by Sensor Type PBI.
4) Control sensor Sn-3 is selected for Output 2, so the default setup values for output setup screens are determined by Sensor Type °F.
### Technical Specifications

#### C450CPW-400 Control Module with Hybrid Analog Input and High Input Signal Selection

<table>
<thead>
<tr>
<th>Product</th>
<th>C450Cxx: System 450 Control Module models are sensing controls and operating controls with LCD, four-button touchpad, and analog output. C450CPW-400: Control Module with Hybrid Analog Output and High Input Signal Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Power</td>
<td>C450YNN-1 Power Supply Module or 24 (20–30) VAC Safety Extra-Low Voltage (SELV) (Europe) Class 2 (North America) 50/60 Hz, 10 VA minimum</td>
</tr>
<tr>
<td>Ambient Operating Conditions</td>
<td><strong>Temperature:</strong> -40 to 66°C (-40 to 150°F) when Voltage Mode is selected; -40 to 40°C (-40 to 104°F) when Current Mode is selected  <strong>Humidity:</strong> Up to 95% RH Noncondensing; maximum dew point 29°C (85°F)</td>
</tr>
<tr>
<td>Ambient Shipping and Storage Conditions</td>
<td><strong>Temperature:</strong> -40 to 80°C (-40 to 176°F)  <strong>Humidity:</strong> Up to 95% RH noncondensing; maximum dew point 29°C (85°F)</td>
</tr>
<tr>
<td>Input Signal</td>
<td>0–5 VDC; 1,035 ohm at 25°C (77°F) for an A99 PTC Temperature Sensor</td>
</tr>
<tr>
<td>Analog Output</td>
<td><strong>Voltage Mode (0–10 VDC):</strong> 10 VDC maximum output voltage 10 mA maximum output current Requires an external load of 1,000 ohm or more <strong>Note:</strong> The hybrid AO operates in Voltage Mode when connected to devices with impedances greater than 1,000 ohm. Devices that drop below 1,000 ohm may not operate as intended for Voltage Mode applications.  <strong>Current Mode (4–20 mA):</strong> Requires an external load between 0–300 ohm <strong>Note:</strong> The hybrid AO operates in Current Mode when connected to devices with impedances less than 300 ohm. Devices that exceed 300 ohm may not operate as intended for Current Mode applications.</td>
</tr>
<tr>
<td>Analog Input Accuracy</td>
<td>Resolution: 14 bit</td>
</tr>
<tr>
<td>Control Construction</td>
<td>Independently-mounted control, surface mounted with Lexan® 950 enclosure suitable for DIN rail mounting or direct mounting to a hard, even surface.</td>
</tr>
<tr>
<td>Dimensions (H x W x D)</td>
<td>127 x 61 x 61 mm (5 x 2-3/8 x 2-3/8 in.)</td>
</tr>
<tr>
<td>Weight</td>
<td>195 g (0.43 lb)</td>
</tr>
<tr>
<td>Compliance</td>
<td><strong>United States:</strong> cULus Listed; UL 60730-1, File E27734; FCC Compliant to CFR47, Part 15, Subpart B, Class B  <strong>Canada:</strong> cULus Listed; CAN/CSA-E60730-1, File E27734; Industry Canada (IC) Compliant to Canadian ICES-003, Class B limits  <strong>Europe:</strong> CE Mark – Johnson Controls declares that this product is in compliance with the essential requirements and other relevant provisions of the EMC Directive.  <strong>Australia and New Zealand:</strong> RCM Mark, Australia/NZ Emissions Compliant</td>
</tr>
</tbody>
</table>

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult Johnson Controls Application Engineering at (414) 524-5535. Johnson Controls shall not be liable for damages resulting from misapplication or misuse of its products.
North American Emissions Compliance

United States

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Canada

This Class (B) digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulations.
Cet appareil numérique de la Classe (B) respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.