



System 450™ Series Control Modules with Analog Outputs Installation Instructions

C450CPN-3
C450CQN-3

Part No. 24-7664-2853, Rev. E
Issued March 2016

Application

IMPORTANT: Use this System 450™ Series Control Module with Analog Output 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 control modules allow 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.

C450CxN-3 models are analog output control modules with Liquid Crystal Display (LCD) and four-button touchpad User Interface (UI) that allows you to set up a System 450 control system. C450CPN-3 models provide one self-selecting analog output, C450CQN-3 models provide two self-selecting analog outputs.

Refer to the *System 450™ Series Modular Control Systems with Standard Control Modules Technical Bulletin (LIT-12011459)* for more detailed information on designing, installing, setting up, and troubleshooting System 450 Series control systems. The System 450 technical bulletin can be accessed and downloaded on the Johnson Controls® Online Product Literature Web site at the following Web address:

<http://cgproducts.johnsoncontrols.com/default.aspx>.

Installation

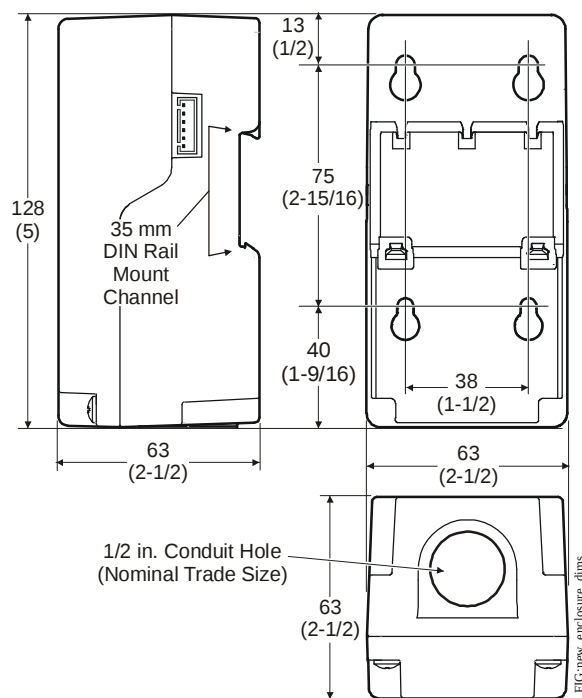


Figure 1: System 450 Module Dimensions, mm (in.)

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 (Figure 3). 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 listed in the *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 35 mm DIN rail (recommended) or directly to an even wall surface. To mount modules on 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 power and/or expansion modules to the right of the control module on to the DIN rail and plug the 6-pin module connectors together (Figure 3).

Note: If your System 450 control system uses a power module, the power module **must** be plugged into the right-hand side of the control module.

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 (Figure 1).
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 on the mounting slots, and carefully tighten the mounting screws.

Note: If you mount the modules on an uneven surface, do not damage the housings when tightening mounting screws. Use shims/washers to mount 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* on page 23 for electrical ratings.



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.

AVERTISSEMENT : Risque de décharge électrique.

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

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.

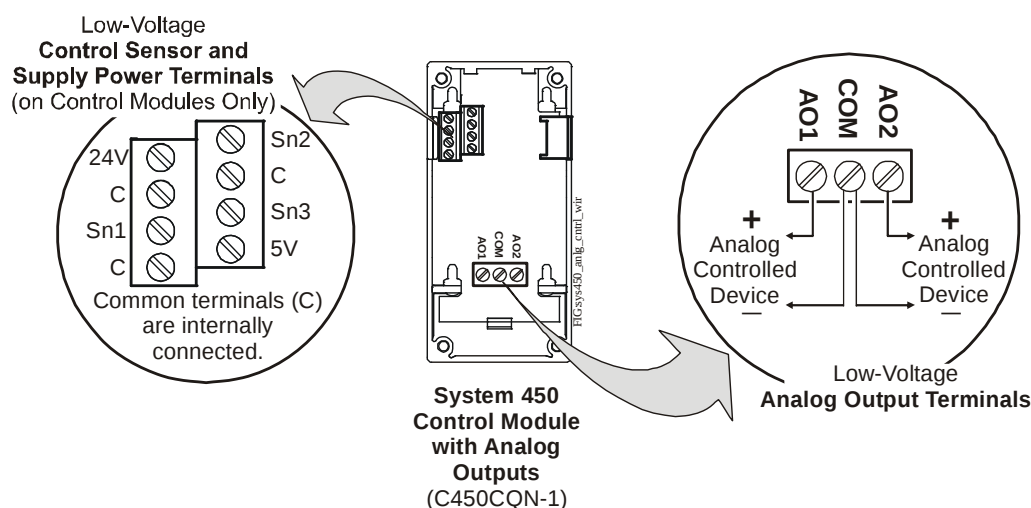


Figure 2: C450CxN-3 Wiring Terminals

Table 1: System 450 Analog Output Control Module Terminal Wiring Information (Part 1 of 2)

Label	Terminal Function	Wire Sizes
24V	Accepts 24 VAC supply power, when a C450YNN power module is not connected, and provides power terminal for 24 VAC (humidity) sensors.	0.8 mm ² to 1.5 mm ² 28 AWG to 16 AWG
5V	Provides 5 VDC power for active sensors.	
S1, S2, S3	Accepts passive or active (0-5 VDC) input signals from control sensors.	
C (Three Terminals)	Provide low-voltage Common connections for 24 VAC power and passive or active sensors connected to the 5V, Sn1, Sn2, and Sn3 terminals. Note: The three C terminals are connected internally and can be connected to ground in the field.	

Table 1: System 450 Analog Output Control Module Terminal Wiring Information (Part 2 of 2)

Label	Terminal Function	Wire Sizes
AO1, AO2	Provides a self-detecting analog output signal in conjunction with the COM terminal; either 0–10 VDC or 4–20 mA.	0.08 mm ² to 1.5 mm ² 28 AWG to 16 AWG
COM	Provides a self-detecting analog output signal in conjunction with the AO1 or AO2 terminal; either 0–10 VDC or 4–20 mA.	

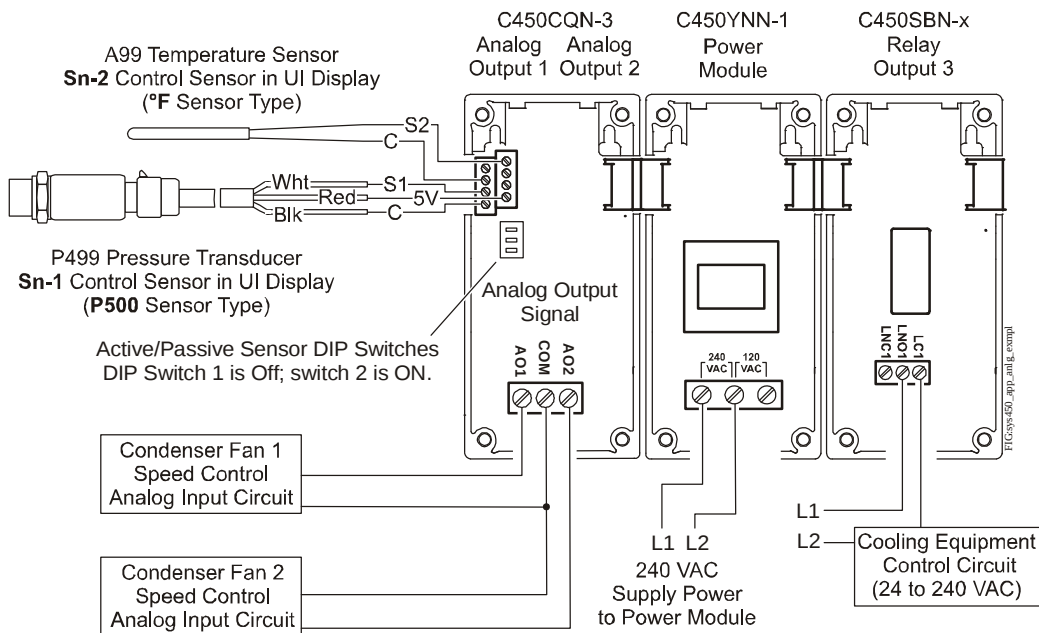


Figure 3: Example System 450 Heat/Cool System with Condenser Fan Speed Control

Setup and Adjustments

System 450 Component Requirements

A System 450 control system consists of one control module, one to three control sensor inputs, and one to ten outputs that provide On/Off control and/or analog 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 System 450 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 to provide the outputs.
3. Assemble the control and expansion modules in the proper order, starting with the control module on the left.

Note: If you use a C450YNN-1 power module, it must be plugged into the control module. Plug in any expansion modules (for your control system) to the right of the power module.

4. Apply supply power to the module assembly.

You can now set up your control system in the System 450 reset control module UI.

Note: After you power on your module assembly, you can set up your control system in the control module UI before wiring the sensors or outputs to your assembly.

Setting Active/Passive Sensor DIP Switches

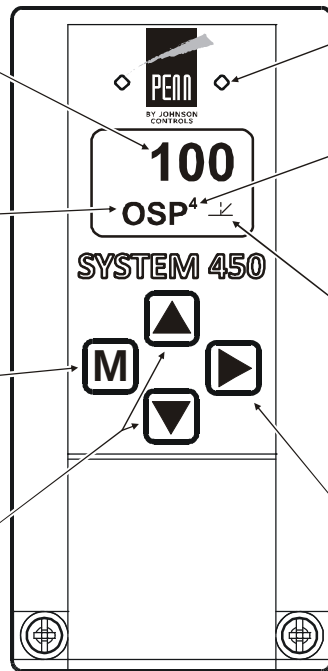
Before putting your control system into operation, you must set up each sensor in the system as either passive or active by positioning the associated switch (On or Off) on the DIP switch block located below the sensor terminal block. See Figure 3.

Status or Setup Value: Displays the current input status, output status or setup parameter value for the displayed input sensor, output and/or setup parameter. Press or to select a different parameter value when the value is flashing. (Here, 100 = 100%.)

Status or Setup Identifier: Displays the unit of measurement, output, sensor number, or setup parameter for the displayed status or setup value. (Here, the setup identifier **OSP** represents % output signal strength at setpoint.)

Menu Button: Press to move through the sensor and output setup start screens. When moving through the status or setup screens, press to return to the status start screen or set up start screen.

Up and Down Buttons: Press or to select a different value for any flashing value in the setup value field. In the Main (sensor status) screens, press and hold both and for 5 seconds to access the Setup Start screens.



Light-Emitting Diode (LED): Green LEDs on Relay Control Module and Relay Expansion Modules (only) indicates if the associated relay output is on or off.

Output Number: Displays a numerical value that identifies the output associated with the status or setup value shown on the screen. Output numbers are automatically determined by the outputs' physical positions (left to right) in the module assembly. (Here, 4 = Output 4.)

Control Ramp Icon: Displays whether an analog output (only) is set as direct-acting or reverse acting, and whether the output signal strength is at minimum or maximum when the sensed property is at Setpoint. The control ramp icon displayed is determined by the output's SP, EP, OSP, and OEP setup values.

Next Button: In the Main screens, press to scroll through the system status screens. In a setup screen, press to save the (flashing) setup value and go to the next setup screen.

Figure 4: System 450 Control Module Output Relay LEDs, LCD, Four-Button Touchpad User Interface

Temperature sensors are passive (2-wire) sensors and corresponding switches must be set to ON. Humidity and pressure transducers are active (3-wire) sensors and corresponding switches must be set to Off. See Figure 5 for the switch settings for the System 450 example shown in Figure 3.

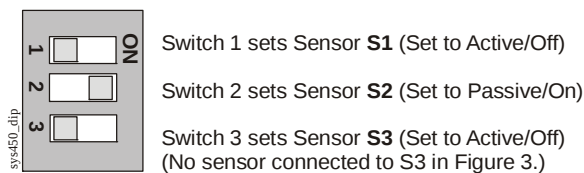


Figure 5: Active/Passive Sensor DIP Switch Block (Set up for Example in Figure 3)

Setting Up a Control System in the User Interface

System 450 control modules have a backlit LCD and a four-button touchpad UI (Figure 4) that enable you to set up your control system. 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 System 450 Module Assembly](#) on page 4.

Note: Every 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 Start Screens](#) on page 7.
3. Set up the control system inputs in the UI. See [Setting Up System 450 Sensors](#) on page 7.
4. Set up the control system outputs in the UI. See [Setting Up System 450 Outputs](#) on page 10.

IMPORTANT: Do not change the module positions after a System 450 control system is set up in the UI. System 450 control logic is set up in the UI according to the 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 the setup values of the assembly outputs, which requires setting up the outputs again.

Use the worksheet provided on page 24 to plan and record the settings for your System 450 control system.

Viewing the Startup, Main, and System Status Screens

Every time you connect power to a System 450 control module, the Startup screen appears for several seconds before the Main screens appear. The Startup screen displays the current firmware version for the module. See Table 2 and [System 450 Firmware Versions](#) for more information.

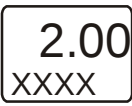
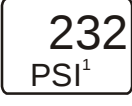
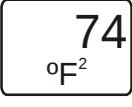
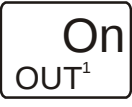
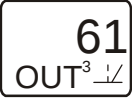
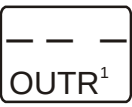
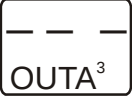
After you install, wire, power on, and set up your control system in the UI, the Main screens appear on the LCD, immediately after the Startup screen. During normal operation, the Main screens automatically scroll through the current status of each sensor in your control system. See Table 2 for more information.

The System Status screens display the current status of each input and output in your control system. With the Main screen displayed, press  repeatedly to scroll through and view all of the status screens in your control system. See Table 2 for more information about the System Status screens.

System 450 Firmware Versions

System 450 firmware versions identify the features available on System 450 modules. Standard System 450 control modules with Version 2.00 firmware and later include the High Input-Signal Selection and Differential Control features. See [High Input-Signal Selection](#) on page 9 and [Differential Control](#) on page 16 for more information.

Table 2: System 450 Startup Screen, Main Screens, Status Screens, and Setup Start Screens Information and Procedures

LCD Screen	Name, Description/Function, User Action, and Example
	Startup Screen: When you power a System 450 control module, the LCD displays the control module's current firmware version for approximately five seconds before it displays the Main (Input Status) screen. Screen example shows System 450 firmware version number 2.00 on the top of the screen. The number on the bottom of the screen (indicated in this example with xxxx) identifies the Johnson Controls firmware.
 	Main (Input Status) Screens: During normal operation, the Main screens automatically scroll through the current status of each input sensor in your control system and display the sensor number, the unit of measurement, and the sensed condition value. See Figure 7 and Figure 8 for example Main screens. Note: Main screens are view-only; selections are not made in Main screens. The Main screens are the System 450 default screens. After 2 minutes of inactivity in any screen, the UI reverts to the Main screens. While the Main screens are scrolling, you can press  repeatedly to scroll through and view the System Status screens for all inputs and outputs in your control system. While the Main Screens are scrolling, you can press and hold  and  for 5 seconds to access your control system's Setup Start screens. The screen examples show Sensor 1 sensing 232 psi and Sensor 2 sensing 74°F.
 	System Status Screens: The System Status screens display current status of all inputs and outputs in your control system. System Status screens are view-only; selections are not made in Status screens. 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. Press  repeatedly to scroll and view the System Status screens for the inputs and outputs in your control system. When you stop pressing , the displayed Status screen refreshes its value and remains displayed for 2 minutes before returning to the Main Screens. The screen examples show Output 1 relay is On and Output 3 signal strength is 61% of the total signal strength. The control ramp icon in the bottom screen example indicates that the Analog Output is set up with SP<EP and OSP<OEP. See Setting Up an Analog Output for Standard Control or High Input-Signal Selection Control for information about ramp icons.
  	Setup Start Screens: Setup Start screens are view-only screens, from which you can access the setup screens for the sensors or the displayed output; selections are not made in Setup Start screens. The Sensor Setup Start screen is the first screen displayed when you access the System 450 setup screens. Note: The numerical order and type of Output Setup Start screens are determined by the modules selected for your System 450 control system and their physical order in the control system module assembly. See Setting Up a Control System in the User Interface on page 5 for more information. From the Sensor Setup Start screen, press  repeatedly to scroll through the Output Setup Start screens for all of the outputs in your control system. When a Setup Start screen is displayed, press  to go to the setup screens for the sensors or the output displayed in the screen. Note: In any Setup Start screen, you can return to the Main screens by pressing both  and  simultaneously. Also, the UI returns to the Main screen after 2 minutes of inactivity in any screen. The screen examples show the Sensor, Relay Output 1, and Analog Output 3 Setup Start screens.

Accessing the System 450 Setup Start Screens

Access the System 450 Setup Start screens from the Main screen. See Table 2 for more information about the Setup Start screens.

To access the System 450 setup screens:

1. Apply power to your module assembly. After the **Startup** screen appears briefly (displaying the control module firmware version), the **Main** screen appears on the LCD.
2. In the **Main** screen, press and hold  and  simultaneously for 5 seconds to access the setup screens and to go to the **Sensor Setup Start** screen.

3. Press  repeatedly to scroll through the **Output Setup Start** screens. See Figure 7.

Note: The UI returns to the Main screens after 2 minutes of inactivity in any screen in the UI.

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 Start Screens](#).

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

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

Table 3: System 450 Sensor Types, Setup Values, and Sensor/Transducer Product Codes

Sensor Type	Unit of Measurement Value (Condition/Units)	Effective Sensing Range	Range of Usable Values ¹	Resolution Increment Value	Minimum Proportional or Control Band	Sensor Product Type Number ²
°F	°F (Temperature/degrees)	-46 to 255	-40 to 250	1	1	A99B-xxx
°C	°C (Temperature/degrees)	-43 to 124	-40 to 121	0.5	0.5	A99B-xxx
rH	% (Humidity/%RH)	1 to 100	10 to 95	1	2	HE-67Sx-xxxxx HE-67Nx-xxxxx HE-68Nx-0N00WS
P 0.5	INWC (Pressure/in. W.C.)	0 to 0.5	0.025 to 0.5	0.005	0.025	DPT2650-0R5D-AB
P 2.5	INWC (Pressure/in. W.C.)	0 to 2.5	0.1 to 2.5	0.02	0.1	DPT2650-2R5D-AB
P 5	INWC (Pressure/in. W.C.)	0 to 5.0	0.25 to 5.0	0.05	0.25	DPT2650-005D-AB
P 8	bAR (Pressure/bar)	-1 to 8	-1 to 8	0.05	0.1	P499Rxx-401C
P 10	INWC (Pressure/in. W.C.)	0 to 10	0.5 to 10	0.05	0.2	DPT2650-10D-AB
P 15	bAR (Pressure/bar)	-1 to 15	-1 to 15	0.1	0.2	P499Rxx-402C
P 30	bAR (Pressure/bar)	0 to 30	0 to 30	0.1	0.4	P499Rxx-404C
P 50	bAR (Pressure/bar)	0 to 50	0 to 50	0.2	0.4	P499Rxx-405C
P100	PSI (Pressure/psi)	0 to 100	0 to 100	0.5	1	P499Rxx-101C
P110 ³	Hg/PSI (Pressure/Hg-psi)	-10 to 100	-10 to 100	0.5	1	P499Rxx-100C
P200	PSI (Pressure/psi)	0 to 200	0 to 200	1	1	P499Rxx-102C
P500	PSI (Pressure/psi)	0 to 500	90 to 500	1	5	P499Rxx-105C
P750	PSI (Pressure/psi)	0 to 750	150 to 750	2	6	P499Rxx-107C
HI°F	°F (Temperature/degrees)	-50 to 340	-40 to 340 ⁴	1	1	TE-631x, TE-6000-x TE-68NT-0N00S
HI°C	°C (Temperature/degrees)	-45.5 to 170	-40 to 170 ⁴	0.5	0.5	TE-631x, TE-6000-x TE-68NT-0N00S

1. Because of the way that the System 450 Differential Sensor (Sn-d) is set up and calculated with two identical sensors (Sn-1 and Sn-2), the Range of Usable Values is twice as large as a single sensor. Each Sensor Type has an equal number of positive and negative values. See Table 9 for the Range of Usable Values when an output references Sn-d.
2. Refer to the *System 450 Series Modular Controls Product Bulletin (LIT-12011458)*, *Catalog Page (LIT-1900549)*, or *Technical Bulletin (LIT-12011459)* for additional ordering information for System 450 compatible sensors and transducers.
3. See [Setting Up Outputs That Reference a P110 Sensor](#) on page 9 for information on setting up System 450 outputs that reference the P110 Sensor Type.

4. Many of the 1,000 ohm Nickel temperature sensors that can be set up as HI°F or HI°C Sensor Types are not designed for use across the entire Range of Usable Values for HI°F and HI°C Sensor Types. Refer to the *Technical Specifications* sections in the *TE-6000 Series Temperature Sensing Elements Product Bulletin (LIT-216288)*, the *TE-6300 Series Temperature Sensors Product Bulletin (LIT-216320)*, and the *TE-6800 Series Temperature Sensor Product Bulletin (LIT-12011542)* to determine the temperature range that the various 1,000 ohm Nickel temperature sensors are specified to operate in.

Table 4 provides sensor setup information, procedures, and example screens. Figure 7 on page 21 provides a System 450 UI setup example.

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

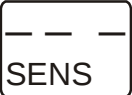
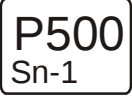
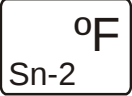
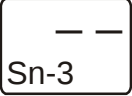
LCD Screen	Name, Description/Function, User Action, and Example
	Sensor Setup Start Screen: The Sensor Setup Start screen is the first screen displayed when you access the System 450 setup screens. From the Sensor Setup Start screen you can navigate to the Output Setup Start screens or the Sensor Setup 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. 1. In the Sensor Setup Start screen, press  to go to the first Sensor Type Selection screen (Sn-1) and begin setting up the sensors in your control system. The screen example shows the Sensors Setup Start screen with flashing dashes.
  	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 control band or proportional band, setup values, value ranges, and product code numbers. Note: For outputs 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  or  to select the desired Sensor Type. Press  to save your selection and go to the Sn-2 Sensor Type Selection screen. 3. In the Sn-2 Sensor Type Selection screen, press  or  to select the desired Sensor Type. Press  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  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  or  to select the desired Sensor Type. Press  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. Note: Beginning with firmware Version 2.00, if you select the same Sensor Type for Sn-1 and Sn-2, two additional functional sensors (Sn-d and HI-2) are available for selection when you set up the control system outputs. If you select the same Sensor Type for Sn-1, Sn-2 and Sn-3, then functional sensor HI-3 is also available for selection when you set up outputs. See High Input-Signal Selection on page 9 and Differential Control on page 16 for more information. The screen examples show Sn-1 with the P500 Sensor Type selected; Sn-2 with the °F Sensor Type selected; and Sn-3 with the no 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  or  to select the desired temperature offset value. Press : - to go to the next Temperature Offset Selection screen (if there are additional temperature sensors in your control system) and repeat this step for each temperature sensor. - to return to the Sensor Setup Start screen. The screen example shows an OFFS value of -3 (°F) for Sensor 2. Therefore a sensed temperature value of 75 (°F) at Sensor 2 is displayed as 72 (°F).

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

LCD Screen	Name, Description/Function, User Action, and Example
	Sensor Setup Start Screen: When you have finished setting up all of the sensors for your control system, the display returns to the Sensor Setup Start screen. Note: You can edit the sensor set up values at any time, if required. However, changing the Sensor Type for a sensor that is referenced by an output requires setting up the output again to the new Sensor Type values. After the sensors are set up for your control system, you can: - Press  to scroll through the Output Setup Start screens and begin setting up your system outputs. - Press  and  simultaneously to return to the Main screens. The screen example shows Sensors Setup Start screen with flashing dashes.

Setting Up Outputs That Reference a P110 Sensor

The P110 Sensor Type can monitor negative pressure down to 20 InHg (-10 psi). When referencing a P110 sensor, System 450 displays negative pressure values in InHg on the Main and System Status screens.

But when you set up an output that references a P110 sensor and the setup value is a negative pressure value, you must select a pressure value in negative psi.

Use Table 5 to determine the negative PSI setup value that corresponds to your InHg target value. For example, if you want a relay output to go off when the sensed pressure reaches 7 InHg, you select the value -3.5 (psi) in the output's Relay OFF Selection screen.

Table 5: InHg Target Values/PSI Setup Values

InHg Value	psi Setup Value	InHg Value	psi Setup Value
1	-0.5	11	-5.5
2	-1.0	12	-6.0
3	-1.5	13	-6.5
4	-2.0	14	-7.0
5	-2.5	15	-7.5
6	-3.0	16	-8.0
7	-3.5	17	-8.5
8	-4.0	18	-9.0
9	-4.5	19	-9.5
10	-5.0	20	-10.0

Note: When an output references the P110 Sensor Type and the output is set up for Differential Control (Sn-1 and Sn-2 are P110 Sensor Type), the negative pressure values displayed in the differential pressure System Status screen (dIFP) are displayed as negative psi values, not InHg values. See *Differential Control* on page 16 for more information.

High Input-Signal Selection

Beginning with firmware Version 2.00, standard System 450 control modules include the High Input-Signal Selection control capability.

The High Input-Signal Selection feature enables a System 450 control system to monitor a condition (temperature, pressure, or humidity) with two or three sensors (of the same type) and control relay and/or analog outputs based on the highest condition value sensed by the two or three referenced sensors.

In two sensor applications (HI-2), Sn-1 and Sn-2 must be the same Sensor Type. In three sensor applications (HI-3), Sn-1, Sn-2, and Sn-3 must be the same Sensor Type.

A System 450 control system, using High Input-Signal Selection, can monitor the outlet pressures of two condenser coils in a multi-circuit condensing unit using two pressure sensors of the same type; one connected to each coil outlet.

If the multi-circuit condensing unit has single speed fan motors, multiple relay outputs can be set up to reference the high input-signal and System 450 can stage the fans on and off based on the pressure sensed at the coil with the highest pressure.

If the multi-circuit condensing unit has variable speed fan motors, one or more analog outputs can be set up to reference the high input-signal and control the fan motor speeds based on the pressure sensed at the coil with the highest pressure.

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. See [Setting Up System 450 Sensors](#) on page 7 for more information.

To set up System 450 outputs in the UI:

1. Apply power to your module assembly. After the **Startup** screen appears briefly (displaying the control module firmware version), the **Main** screen appears on the LCD.
2. In the **Main** screen, press and hold  and  simultaneously for 5 seconds to access the setup screens and to go to the **Sensor Setup Start** screen.
3. At the **Sensor Setup Start** screen, press  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.

4. To set up standard Relay Outputs and Relay Outputs with High Input-Signal Selection, see [Setting Up a Relay Output for Standard Control or High Input-Signal Selection Control](#) and Table 6 for setup information and procedures.
5. For standard Analog Outputs and Analog Outputs with High Input-Signal Selection, see [Setting Up an Analog Output for Standard Control or High Input-Signal Selection Control](#) and Table 8 for setup information and procedures.
6. For Relay Outputs with Differential Control, see [Setting Up an Output for Differential Control](#) on page 16 and Table 10.
7. For Analog Outputs with Differential Control, see [Setting Up an Output for Differential Control](#) on page 16 and Table 11.

Setting Up a Relay Output for Standard Control or High Input-Signal Selection Control

Table 6 provides information, procedures, guidelines, and screen examples for setting up relay outputs for standard or High Input-Signal Selection control. See Figure 7 on page 21 for example menu flow of the Relay Output 1 set up in Table 6.

Table 6: System 450 Setup Screen Information and Procedures for Relay Outputs with Standard Control and High Input-Signal Selection Control (Part 1 of 3)

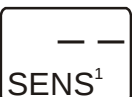
LCD Screen	Name, Description/Function, User Action, and Example
	Relay Output Setup Start Screen: The output numbers and the output type (relay or analog) are determined by the module types and configuration of your control system's module assembly and are automatically assigned when you connect power to the module assembly. (See Setting Up a Control System in the User Interface on page 5.) Note: You must set up the control system input sensors before you can set up the outputs. 1. In the Relay Output Setup Start screen, press  to go to the output's Sensor Selection screen. The screen example shows a Relay Output Setup Start screen for Output 1.
   	Sensor Selection Screen: The sensor you select here determines the output's setup parameters and values, including condition type, unit of measurement, minimum control band, default setup values, and setup value ranges for several of the remaining output setup screens. If a sensor is not selected, the remaining output setup screens do not appear. If a sensor is already selected for this output, the Sensor Selection screen does not appear here and the Relay ON Selection (ON or dON) screen appears instead. Note: 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.) Note: Beginning with firmware Version 2.00, the functional sensors Sn-d and HI-2 are available, if Sn-1 and Sn-2 are the same Sensor Type. If Sn-1, Sn-2, and Sn-3 are the same Sensor Type, the functional sensor HI-3 is also available. 2. Press  or  to select the sensor that this output references: • For standard control action, select Sn-1, Sn-2, or Sn-3. • For standard control action with High Input-Signal Selection, select HI-2 or HI-3. Then press  to save your sensor selection and go to the Relay ON Selection screen. Note: For Differential Control, select Sn-d and go to Table 10 on page 17 for information, procedures, guidelines, and screen examples for setting up outputs for Differential Control. The top screen example shows the initial Sensor Selection screen for Relay Output 1 before a sensor is selected. The remaining screen examples show some of the sensors that may be available for selection. For the Output Relay example, Sn-2 is selected as the Sensor for Output 1 as shown in the second screen.

Table 6: System 450 Setup Screen Information and Procedures for Relay Outputs with Standard Control and High Input-Signal Selection Control (Part 2 of 3)

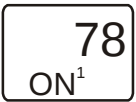
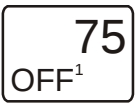
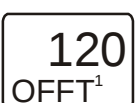
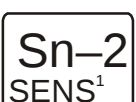
LCD Screen	Name, Description/Function, User Action, and Example
	Relay ON Selection Screen: Select the value at which the relay turns On. Relay ON is defined as relay LED On/Lit, relay contacts N.O. to C are closed, and N.C. to C contacts are open. Note: The value ranges and minimum control band are determined by the Sensor Type selected for the sensor that the output references and are enforced in the Relay ON and Relay OFF Selection screens. 3. Press  or  to select the value at which the output relay turns On, then press  to save your selection and go to Relay OFF Selection screen. The screen example shows an ON value of 78 (°F) selected for Relay Output 1.
	Relay OFF Selection Screen: Select the value at which the relay turns Off. Relay OFF is defined as relay LED Off, relay contacts N.C. to C are closed, and N.O. to C contacts are open. Note: The value ranges and minimum control band are determined by the Sensor Type selected for the sensor that the output references and are enforced in the Relay ON and Relay OFF Selection screens. 4. Press  or  to select the value at which output relay turns Off, then press  to save your selection and go to Minimum Relay ON Time Selection screen. The screen example shows an OFF value of 75 (°F) selected for Relay Output 1.
	Minimum Relay ON Time Selection Screen: Minimum ON Time range is 0 to 300 seconds. 5. Press  or  to select the minimum time that the output relay remains On after reaching the Relay ON value, then press  to save your selection and go to the Minimum Relay OFF Time Selection screen. Screen example shows an ONT value of 0 (seconds) selected for Output 1.
	Minimum Relay OFF Time Selection Screen: Minimum OFF Time range is 0 to 300 seconds. 6. Press  or  to select the minimum time that this output relay remains Off after reaching the Relay OFF value. Press  to save your selection and go to the Sensor Failure Mode Selection screen. The screen example shows an OFFT value of 120 (seconds) selected for Output 1.
	Sensor Failure Mode Selection Screen: Select the output's mode of operation if a referenced sensor or sensor wiring fails. If the output references functional sensors HI-2 or HI-3, the output enters the Sensor Failure mode whenever a referenced sensor or sensor wiring fails. The output operates in the selected Sensor Failure 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. 7. Press  or  to select this output's mode of operation if the sensor or sensor wiring fails. Press  to save your sensor failure mode selection and go to the Edit Sensor screen. The screen example shows OFF selected as the Sensor Failure mode for Output 1.
	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: If you change the sensor that an output references to a sensor with a different Sensor Type, the default setup values for the output change, and you must set the output up again. 8. If you do not need to change this output's sensor, simply press  to save the current sensor selection and return to the Relay Output Setup Start screen. To change the sensor this output references, press  or  to select the new sensor that this output references. Then press  to save the new sensor selection and return to the Relay ON Selection screen (ON or dON). If the new sensor has a different Sensor Type from the previously referenced sensor, repeat the output setup procedure for this output. This Relay Output is now set up in the System 450 UI. The screen example shows Sn-2 is selected Sensor for Output 1.

Table 6: System 450 Setup Screen Information and Procedures for Relay Outputs with Standard Control and High Input-Signal Selection Control (Part 3 of 3)

LCD Screen	Name, Description/Function, User Action, and Example
	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. 9. Press ⏮ to scroll through the remaining Output Setup Start screens and return to the Sensor Setup Start screen, or press ⏮ and ⏭ simultaneously to return to the System 450 Main screens. The screen example shows a Relay Output Setup Start screen for Output 1.

Setting Up an Analog Output for Standard Control or High Input-Signal Selection Control

Analog outputs provide an analog signal to control equipment in you application based on the input from a standard fixed setpoint sensor (Sn-1, Sn-2, or Sn-3) or a High Input Signal Selection sensor (HI-2 or HI-3).

Note: The differential sensor, Sn-d, is used to set up analog and relay outputs for Differential Control. See [Setting Up an Output for Differential Control](#) on page 16 for more information.

Analog outputs provide an auto-selecting analog signal that is proportional to the sensed input condition. The System 450 analog output senses the impedance of the controlled equipment’s analog input circuit and automatically delivers either a 0–10 VDC or 4–20 mA signal to the controlled equipment.

Figure 6 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).

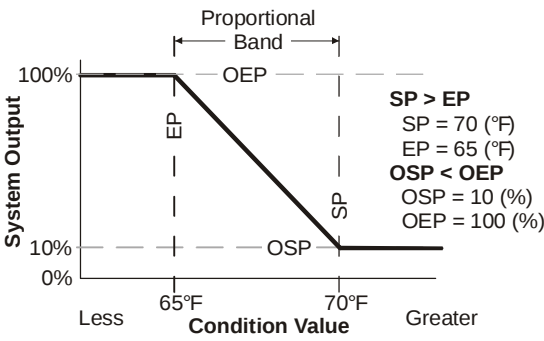


Figure 6: Control Ramp Example for a Typical Heating Application (SP > EP and OSP < OEP)

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

Table 7 shows the four Control Ramp icons and the associated analog output setup value relationships.

Table 7: Analog Output Control Ramp Icons

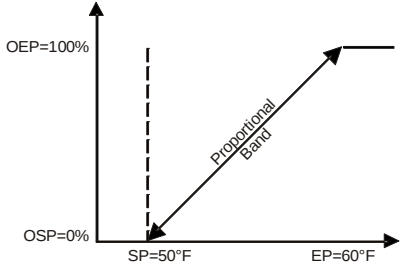
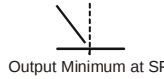
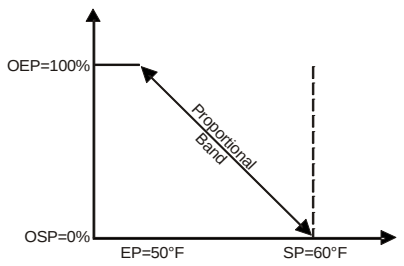
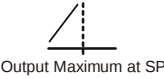
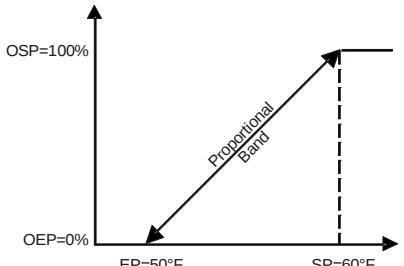
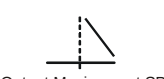
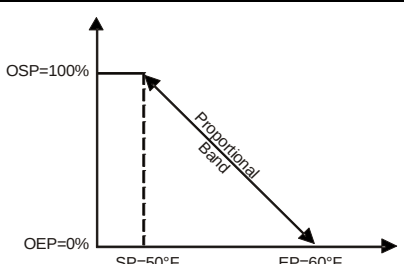
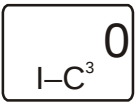
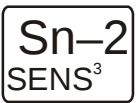
Control Ramp Displayed on LCD	Control Action	Set the Analog Output Value Relationships for the Desired Control Action and Corresponding Control Ramp
 Output Minimum at SP		$SP < EP$ $OSP < OEP$
 Output Minimum at SP		$SP > EP$ $OSP < OEP$
 Output Maximum at SP		$SP > EP$ $OSP > OEP$
 Output Maximum at SP		$SP < EP$ $OSP > OEP$

Table 8 provides information, procedures, guidelines, and screen examples for setting up analog outputs that reference standard or High Input-Signal Selection sensors. See Figure 7 on page 21 for example menu flow of the Analog Output 3 set up in Table 8.

Table 8: System 450 Setup Screen Information and Procedures for Analog Output with Standard and High Input-Signal Selection Control (Part 1 of 2)

LCD Screen	Name, Description/Function, User Action, Example
	Analog Output Setup Start Screen: The output numbers and the output type (relay or analog) are determined by the module types and configuration of your control system's module assembly and are automatically assigned when you connect power to the module assembly. (See Setting Up a Control System in the User Interface on page 5.) Note: You must set up the system's sensors before you can set up the outputs. 1. Press  to go to this output's Sensor Selection screen. The screen example shows the Analog Output Setup Start screen for Output 3.
   	Sensor Selection Screen: 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, and the Setpoint Selection (SP or dSP) screen appears instead. Note: 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.) Note: Beginning with firmware Version 2.00, the functional sensors Sn-d and HI-2 are available if Sn-1 and Sn-2 are the same Sensor Type. If Sn-1, Sn-2, and Sn-3 are the same Sensor Type, the functional sensor HI-3 is also available. 2. Press  or  to select the sensor that this output references: • For standard control action, select Sn-1, Sn-2, or Sn-3. • For standard control action with High Input-Signal Selection, select HI-2 or HI-3. Then press  to save your sensor selection and go to the Setpoint Selection screen. Note: For Differential Control, select Sn-d and go to Table 11 on page 18 for information, procedures, guidelines, and screen examples for setting up an Analog Output for Differential Control. The top screen example shows the initial Sensor Selection screen for Analog Output 3 before a sensor is selected. The remaining screen examples show some of the sensors that may be available for selection. For the Analog Output example, Sn-1 is the selected Sensor for Output 3 as shown in the second screen.
	Setpoint Selection Screen: Setpoint is the target value that the controlled system drives towards and along with End Point, defines this output's proportional band. Note: 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  or  to select this output's Setpoint value. Press  to save your Setpoint value selection and go to the End Point Selection screen. The screen example shows a Setpoint value of 200 (psi) selected for Output 3.
	End Point Selection Screen: 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. Note: 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  or  to select this output's End Point value. Press  to save your End Point value selection and go to the %Output Signal Strength at Setpoint Selection screen. The screen example shows an End Point value of 250 (psi) selected for Output 3.
	Output Signal Strength at Setpoint Selection Screen: 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  or  to select this output's %Output Signal Strength at Setpoint (OSP) value. Press  to save your selection and go to the %Output Signal Strength at End Point Selection screen. The screen example shows an OSP value of 10 (%) selected for Output 3. Therefore Output 3 generates 10% of the total signal strength (1 V or 5.6 mA) when the input is at the Setpoint value of 200 (psi).
	Output Signal Strength at End Point Selection Screen: 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  or  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. The screen example shows an OEP value of 90 (%) selected for Output 3. Therefore Output 3 generates 90% of the total signal strength (9 V or 18.4 mA) when the input is at the End Point value of 250 (psi).

Table 8: System 450 Setup Screen Information and Procedures for Analog Output with Standard and High Input-Signal Selection Control (Part 2 of 2)

LCD Screen	Name, Description/Function, User Action, Example
	Integration Constant Selection Screen: 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. Note: Initially, you should select the I-C value of 0 (zero) for no integration constant. Refer to the <i>System 450 Series Technical Bulletin (LIT-12011459)</i> for more information on proportional plus integral control and setting an integration constant in the System 450 UI. 7. Press  or  to select this output's Integration Constant for proportional plus integral control. Press  to save your selection and go to the Sensor Failure Mode Selection screen. The screen example shows an I-C value of 0 (zero) selected for Output 3.
	Sensor Failure Mode Selection Screen: Select the output's mode of operation if a referenced sensor or sensor wiring fails. If the output references functional sensors HI-2 or HI-3, the output enters the Sensor Failure mode whenever one of the referenced sensors or sensor wiring fails. The output operates in the selected Sensor Failure mode until the failure is remedied. Sensor Failure mode selections for Analog Outputs include: • ON = Output generates the selected OEP signal strength during sensor failure. • OFF = Output generates the selected OSP signal strength during sensor failure. 8. Press  or  to select this output's mode of operation if the sensor or sensor wiring fails. Press  to save your selection and go to the Edit Sensor Selection screen. The screen example shows OFF selected as the Sensor Failure mode for Output 3.
	Edit Sensor Selection 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: If you change the sensor that an output references to a sensor with a different Sensor Type, the default setup values for the output change, and you must set the output up again. 9. If you are not changing this output's sensor, simply press  to save the current sensor selection and return to the Analog Output Setup Start screen. To change the sensor this output references, press  or  to select the new sensor that this output references. Then press  to save the new sensor selection and return to the Setpoint Selection screen (SP or dSP). If the new sensor has a different Sensor Type from the previously referenced sensor, repeat the output setup procedure for this output. The screen example shows Sn-2 as the selected Sensor for Output 3.
	Analog Output Setup Start Screen After you have set up this Analog Output, you can go to another Output Setup Start screen, the Sensor Setup Start screen, or return to the Main screens. 10. Press  to scroll through the remaining Output Setup Start screens and return to the Sensor Setup Start screen, or press  and  simultaneously to return to the System 450 Main screens. The screen example shows the Analog Output Setup Start screen for Output 3.

Differential Control

Beginning with Version 2.00 firmware, standard System 450 control modules include Differential Control capability. Differential control is used to monitor and/or maintain a given difference in a condition (temperature, pressure, or humidity) between two sensor points within a system, process, or space.

The Differential Control feature enables a System 450 control system to monitor the temperature, pressure, or humidity differential between two sensors of the same type (Sn-1 and Sn-2) and control relay and/or analog outputs based on the sensed differential value relative to user-selected differential values (dON, dOFF, dSP, and dEP).

When a Differential Control sensor (Sn-d) is set up, the displayed differential sensor value is a calculated variable value; $(\text{Sn-d}) = (\text{Sn-1}) - (\text{Sn-2})$.

Note: The System 450 Differential Control sensor (Sn-d) value is always equal to Sn-1 minus Sn-2. Therefore, depending on the intended control action of the output, the differential value may be either a positive or negative value.

The Sn-d value is displayed in the System Status screens as either a temperature differential value (dIFT), pressure differential value (dIFP), or humidity differential value (dIFH). The unit of measurement associated with the displayed differential value is determined by the Sn-1 and Sn-2 Sensor Type. See Table 3 on page 7 for Sensor Types and their units of measurement.

The relay output setup values dON and dOFF are also condition differential values.

- When a relay output is set up for differential control, System 450 controls the relay state (On or Off) based on the difference between Sn-1 and Sn-2 (Sn-d) relative to the user-selected differential On (dON) and differential Off (dOFF) values.
- When an analog output is set up for differential control, System 450 controls the analog signal strength (0 to 100%) based on the difference between Sn-1 and Sn-2 (Sn-d) relative to the user-selected differential setpoint (dSP) and differential endpoint (dEP) values.

Differential Sensor Failure Mode

Any output set up to reference the Differential Sensor (Sn-d) enters the selected Sensor Failure mode when either Sn-1 sensor, Sn-2 sensor, or the sensor wiring fails.

Differential Sensor Range of Usable Values

Because of the way that the System 450 Differential Sensor (Sn-d) is set up and calculated with two identical sensors (Sn-1 and Sn-2), the Range of Usable Values is twice as large as a single sensor. Each Sensor Type has an equal number of positive and negative values. See Table 9 for the Range of Usable Values when an output references Sn-d.

Table 9: Ranges of Usable Values for Sensor Types in Differential Control Applications

Sensor Type	Sn-d Range of Usable Values	Sensor Type	Sn-d Range of Usable Values
°F	-290 to 290	P 30	-30.0 to 30.0
°C	-161.0 to 161.0	P 50	-50.0 to 50.0
rH	-95 to 95	P100	-100.0 to 100.0
P 0.5	-0.500 to 0.500	P110	-110.0 to 110.0
P 2.5	-2.50 to 2.50	P200	-200 to 200
P 5	-5.00 to 5.00	P500	-500 to 500
P 8	-9.00 to 9.00	P750	-750 to 750
P 10	-10.00 to 10.00	HI°F	-380 to 380
P 15	-16.0 to 16.0	HI°C	-210.0 to 210.0

Setting Up an Output for Differential Control

Table 10 provides information, procedures, guidelines, and screen examples for setting up relay outputs that reference the Differential Control sensor.

Table 11 provides information, procedures, guidelines, and screen examples for setting up analog outputs that reference the Differential Control sensor.

Figure 8 on page 22 shows the menu flow used to set up the output examples in Table 10 and Table 11.

Table 10: System 450 Setup Screen Information and Procedures for Relay Outputs with Differential Control
(Part 1 of 2)

LCD Screen	Name, Description/Function, Procedures, and Example
	Relay Output Setup Start Screen: The output numbers and the output type (relay or analog) are determined by the module types and configuration of your control system's module assembly and are automatically assigned when you connect power to the module assembly. (See Setting Up a Control System in the User Interface on page 5.) Note: You must set up the system's sensors before you can set up the system outputs, and you must set up the Differential Control sensor (Sn-d) before you can set up an output with Differential Control. (See Setting Up System 450 Sensors for information on setting up the Differential Control sensor.) 1. Press  to go to this output's Sensor Selection screen. The screen example shows the Relay Output Setup Start screen for Output 1.
 	Sensor Selection Screen: Selecting the Differential Control sensor (Sn-d) here establishes this output as a Differential Control output. Differential Control outputs have several different setup parameters and value ranges from standard and High Input-Signal Selection outputs. Note: To set up an output for Differential Control, the Differential Control sensor (Sn-d) must be already set up in the System 450 UI (See Setting Up System 450 Sensors for more information.), and you must select Sn-d in the Sensor Selection screen. If Sn-d is not selected here, the Differential Control setup screens do not appear. If a sensor is already selected for this output, the Sensor Selection screen does not appear here, instead the Relay ON Selection screen (ON or dON) appears. 2. Press  or  to select the Differential Control sensor (Sn-d) as the sensor this output references. Press  to save your sensor selection and go to the Relay dON Selection Screen. The screen example shows Sn-d is the selected Sensor for Output 1.
	Relay dON Selection Screen: Select the dON value at which the relay turns on. The dON value is a differential value that represents the intended difference in the condition (temperature, pressure, or humidity) between Sn-1 and Sn-2 (Sn-1 minus Sn-2) at which the relay is turned on. Depending on the intended control action and the physical location of Sn-1 and Sn-2 sensors in the condition process, dON may be a positive or negative value. Relay dON is defined as relay LED On/Lit, relay contacts N.O. to C are closed, and N.C. to C contacts are open. Note: The unit of measurement, resolution increment, minimum control band, and range of usable values for dON and dOFF are determined by the Sensor Type selected for Sn-1 and Sn-2. (See Table 3 and Table 9 for more information.) 3. Press  or  to select the differential value at which the output relay turns On. Press  to save your selection and go to Relay dOFF Selection Screen. The screen example shows a dON value of 30 (psi) selected for Relay Output 1.
	Relay dOFF Selection Screen: Select the dOFF value at which the relay turns off. The dOFF value is a differential value that represents the intended difference in the condition (temperature, pressure, or humidity) between Sn-1 and Sn-2 (Sn-1 minus Sn-2) at which the relay is turned off. Depending on the intended control action and the physical location of Sn-1 and Sn-2 sensors in the condition process, dOFF may be a positive or negative value. dOFF is defined as relay LED Off, relay contacts N.C. to C are closed, and N.O. to C contacts are open. Note: The unit of measurement, resolution increment, minimum control band, and range of usable values for dON and dOFF are determined by the Sensor Type selected for Sn-1 and Sn-2. (See Table 3 and Table 9 for more information.) 4. Press  or  to select the differential value at which output relay turns Off. Press  to save your selection and go to Minimum Relay ON Time Selection Screen. The screen example shows a dOFF value of 32 (psi) selected for Relay Output 1.
	Minimum Relay ON Time Selection Screen: Minimum ON Time range is 0 to 300 seconds. 5. Press  or  to select the minimum time that the output relay remains On after reaching the Relay dON value. Press  to save your selection and go to the Minimum Relay OFF Time Selection Screen. The screen example shows an ONT value of 0 (seconds) selected for Output 1.
	Minimum Relay OFF Time Selection Screen: Minimum OFF Time range is 0 to 300 seconds. 6. Press  or  to select the minimum time that this output relay remains Off after reaching the Relay dOFF value. Press  to save your selection and go to the Sensor Failure Mode Selection screen. The screen example shows an OFFT value of 30 (seconds) selected for Output 1.

Table 10: System 450 Setup Screen Information and Procedures for Relay Outputs with Differential Control (Part 2 of 2)

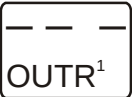
LCD Screen	Name, Description/Function, Procedures, and Example
	Sensor Failure Mode Selection Screen: Select the differential output's mode of operation if either of the referenced sensors (Sn-1 or Sn-2) or the sensor wiring fails. The output operates in the selected mode until the failure is remedied. Sensor Failure mode selections for Relay Outputs include: • ON = Output relay remains On during sensor failure. • OFF = Output relay remains Off during sensor failure. 7. Press  or  to select this output's mode of operation if a referenced sensor or sensor wiring fail. Press  to save your sensor failure mode selection and go to the Edit Sensor Screen. The screen example shows OFF selected as the Sensor Failure mode for Output 1.
	Edit Sensor Screen: This screen displays the Differential Sensor (Sn-d) 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: If you change the Sn-d sensor to a different sensor, the output is no longer a Differential Control output and you must set the output up again for the new sensor selection. 8. If you do not need to change this output's sensor, simply press  to save the current sensor selection and return to the Relay Output Setup Start screen. To change the sensor this output references, press  or  to select the new sensor that this output references. Then press  to save the new sensor selection and return to the Relay ON Selection screen (ON or dON). If the new sensor has a different Sensor Type from the previously referenced sensor, repeat the output setup procedure for this output. This Relay Output is now set up in the System 450 UI. The screen example shows Sn-d as the selected Sensor for Output 1.
	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. 9. Press  to scroll through the remaining Output Setup Start screens and return to the Sensor Setup Start screen, or press  and  simultaneously to return to the System 450 Main screens. The screen example shows the Relay Output Setup Start screen for Output 1.

Table 11: System 450 Setup Screen Information and Procedures for Analog Outputs with Differential Control (Part 1 of 3)

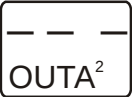
LCD Screen	Name, Description/Function, User Action, Example
	Analog Output Setup Start Screen: The output numbers and the output type (relay or analog) are determined by the module types and configuration of your control system's module assembly and are automatically assigned when you connect power to the module assembly. (See Setting Up a Control System in the User Interface on page 5.) Note: You must set up the system's sensors before you can set up the system outputs, and you must set up the Differential Control sensor (Sn-d) before you can set up an output with Differential Control. (See Setting Up System 450 Sensors for information on setting up the Differential Control sensor.) 1. Press  to go to this output's Sensor Selection screen. The screen example shows the Analog Output Setup Start screen for Output 2.
	Sensor Selection Screen: Selecting the Differential Control sensor (Sn-d) here establishes this output as a Differential Control output. Differential Control outputs have several different setup parameters and value ranges from standard and High Input-Signal Selection outputs. Note: To set up an output for Differential Control, the Differential Control sensor (Sn-d) must be already set up in the System 450 UI (See Setting Up System 450 Sensors for more information.), and you must select Sn-d in the Sensor Selection screen. If Sn-d is not selected here, the Differential Control 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 (SP or dSP) appears instead. 2. Press  or  to select the Differential Control sensor (Sn-d) as the sensor this output references. Press  to save your sensor selection and go to the Setpoint Selection screen. The screen example shows Sn-d as the selected Sensor for Output 2.

Table 11: System 450 Setup Screen Information and Procedures for Analog Outputs with Differential Control (Part 2 of 3)

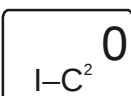
LCD Screen	Name, Description/Function, User Action, Example
	Differential Setpoint Selection Screen: Differential Setpoint (dSP) is the target value that the controlled system drives towards and along with Differential End Point (dEP), defines this output's proportional band. The dSP value is a differential value that represents a (selected) difference in the condition (temperature, pressure, or humidity) between Sn-1 and Sn-2 (Sn-1 minus Sn-2). Depending on the intended proportional control action and the physical location of Sn-1 and Sn-2 sensors in the condition process, dSP may be a positive or negative value. Note: The unit of measurement, resolution increment, minimum proportional band, and range of usable values for dSP and dEP are determined by the Sensor Type selected for Sn-1 and Sn-2. (See Table 3 and Table 9 for more information.) The output's minimum proportional band (between dSP and dEP) is automatically enforced in the output's Setpoint and End Point Selection screens. 3. Press  or  to select this output's Differential Setpoint value. Press  to save your Differential Setpoint value selection and go to the End Point Selection screen. The screen example shows a dSP value of 30 (psi) selected for Output 2.
	Differential End Point Selection Screen: Differential End Point (dEP) is the target value that the controlled system drives towards and along with Differential Setpoint (dSP), defines this output's proportional band. The dEP value is a differential value that represents a (selected) difference in the condition (temperature, pressure, or humidity) between Sn-1 and Sn-2 (Sn-1 minus Sn-2). Depending on the intended proportional control action and the physical location of Sn-1 and Sn-2 sensors in the condition process, dEP may be a positive or negative value. Note: The unit of measurement, resolution increment, minimum proportional band, and range of usable values for dSP and dEP are determined by the Sensor Type selected for Sn-1 and Sn-2. (See Table 3 and Table 9 for more information.) The output's minimum proportional band (between dSP and dEP) is automatically enforced in the output's Setpoint and End Point Selection screens. 4. Press  or  to select this output's Differential End Point value. Press  to save your Differential End Point value selection and go to the %Output Signal Strength at Setpoint Selection screen. The screen example shows a dEP value of 25 (psi) selected for Output 2.
	Output Signal Strength at Setpoint Selection Screen: Select the strength of the signal that this output generates when the sensed condition is at the Differential Setpoint (dSP) value. The signal strength range is 0 to 100 (%). 5. Press  or  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. The screen example shows an OSP value of 0 (%) selected for Output 2. Therefore Output 2 generates 0% of the total signal strength (0 V or 4.0 mA) when the input is at the Setpoint value of 30.0 (psi).
	Output Signal Strength at End Point Selection Screen: Select the strength of the signal that this output generates when the sensed condition is at the Differential End Point (dEP) value. The signal strength range is 0 to 100 (%). 6. Press  or  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. The screen example shows an OEP value of 100 (%) selected for Output 2. Therefore Output 3 generates 100% of the total signal strength (10 V or 20 mA) when the input is at the Differential End Point value of 25 (psi).
	Integration Constant Selection Screen: 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. Note: Initially, you should select the I-C value of 0 (zero) for no integration constant. Refer to the <i>System 450 Series Technical Bulletin (LIT-12011459)</i> for more information on proportional plus integral control and setting an integration constant in the System 450 UI. 7. Press  or  to select this output's Integration Constant for proportional plus integral control. Press  to save your selection and go to the Sensor Failure Mode Selection screen. The screen example shows an I-C value of 0 (zero) selected for Output 2.

Table 11: System 450 Setup Screen Information and Procedures for Analog Outputs with Differential Control (Part 3 of 3)

LCD Screen	Name, Description/Function, User Action, Example
	Sensor Failure Mode Selection Screen: Select the differential output's mode of operation if either of the referenced sensors (Sn-1 or Sn-2) or the sensor wiring fails. The output operates in the selected mode until the failure is fixed. Sensor Failure Mode selections for Analog Outputs include: • ON = Output generates the selected OEP signal strength during sensor failure. • OFF = Output generates the selected OSP signal strength during sensor failure. 8. Press  or  to select this output's mode of operation if a referenced sensor or sensor wiring fail. Press  to save your selection and go to the Edit Sensor Selection screen. The screen example shows OFF selected as the Sensor Failure mode for Output 2.
	Edit Sensor Screen: This screen displays the Differential Sensor (Sn-d) 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: If you change the Sn-d sensor to a different sensor, the output is no longer a Differential Control output and you must set the output up again for the new sensor selection. 9. If you are not changing this output's sensor, simply press  to save the current sensor selection and return to the Analog Output Setup Start screen. To change the sensor this output references, press  or  to select the new sensor that this output references. Then press  to save the new sensor selection and return to the Setpoint Selection screen (SP or dSP). If the new sensor has a different Sensor Type from the previously referenced sensor, repeat the output setup procedure for this output. The screen example shows Sn-d as the selected Sensor for Output 2.
	Analog Output Setup Start Screen After you have set up this Analog Output, you can go to another Output Setup Start screen, the Sensor Setup Start screen, or return to the Main screens. 10. Press  to scroll through the remaining Output Setup Start screens and return to the Sensor Setup Start screen, or press  and  simultaneously to return to the System 450 Main screens. The screen example shows the Analog Output Setup Start screen for Output 2.

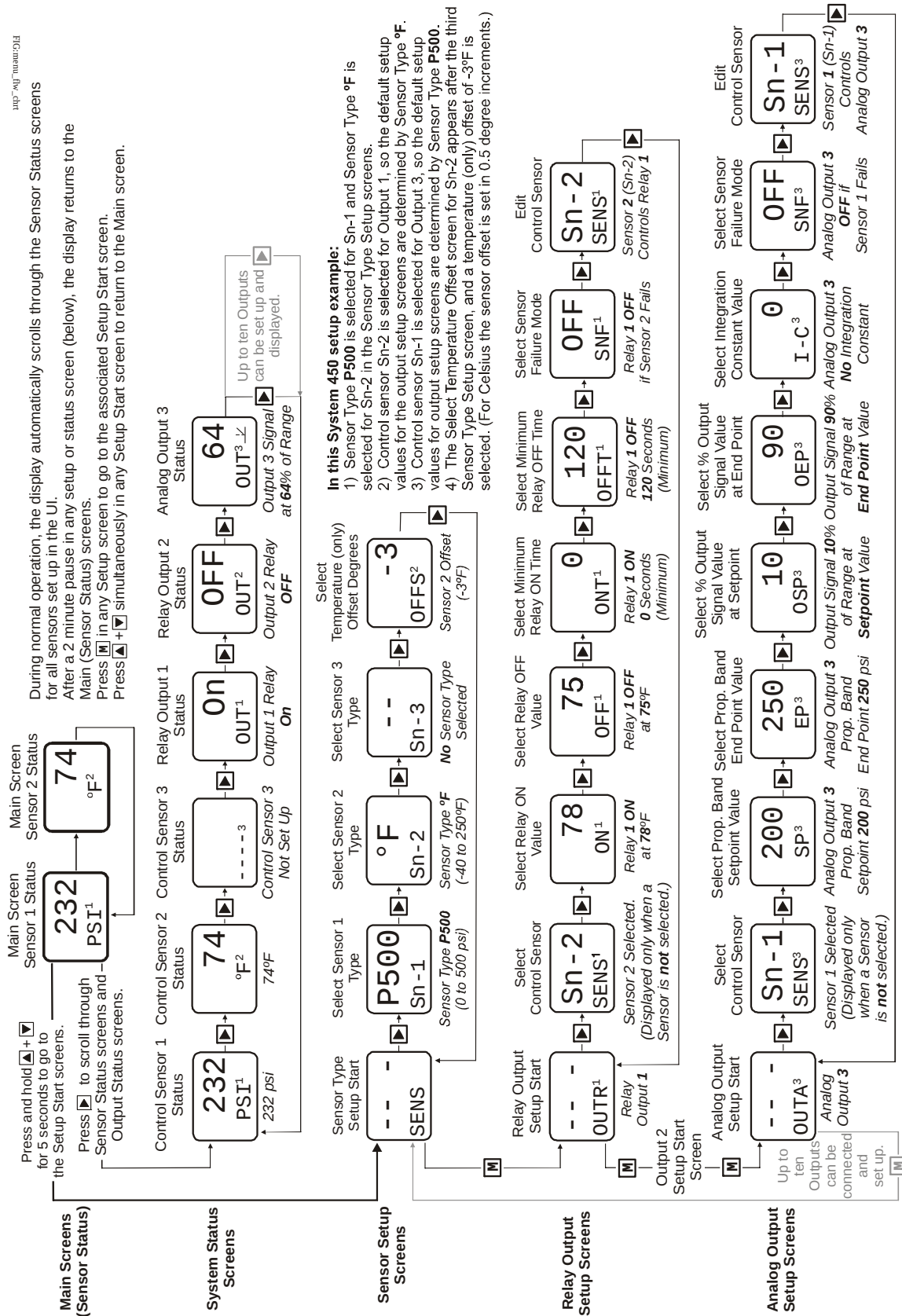


Figure 7: System 450 Status Screens, Setup Screens, and Menu Flow Example

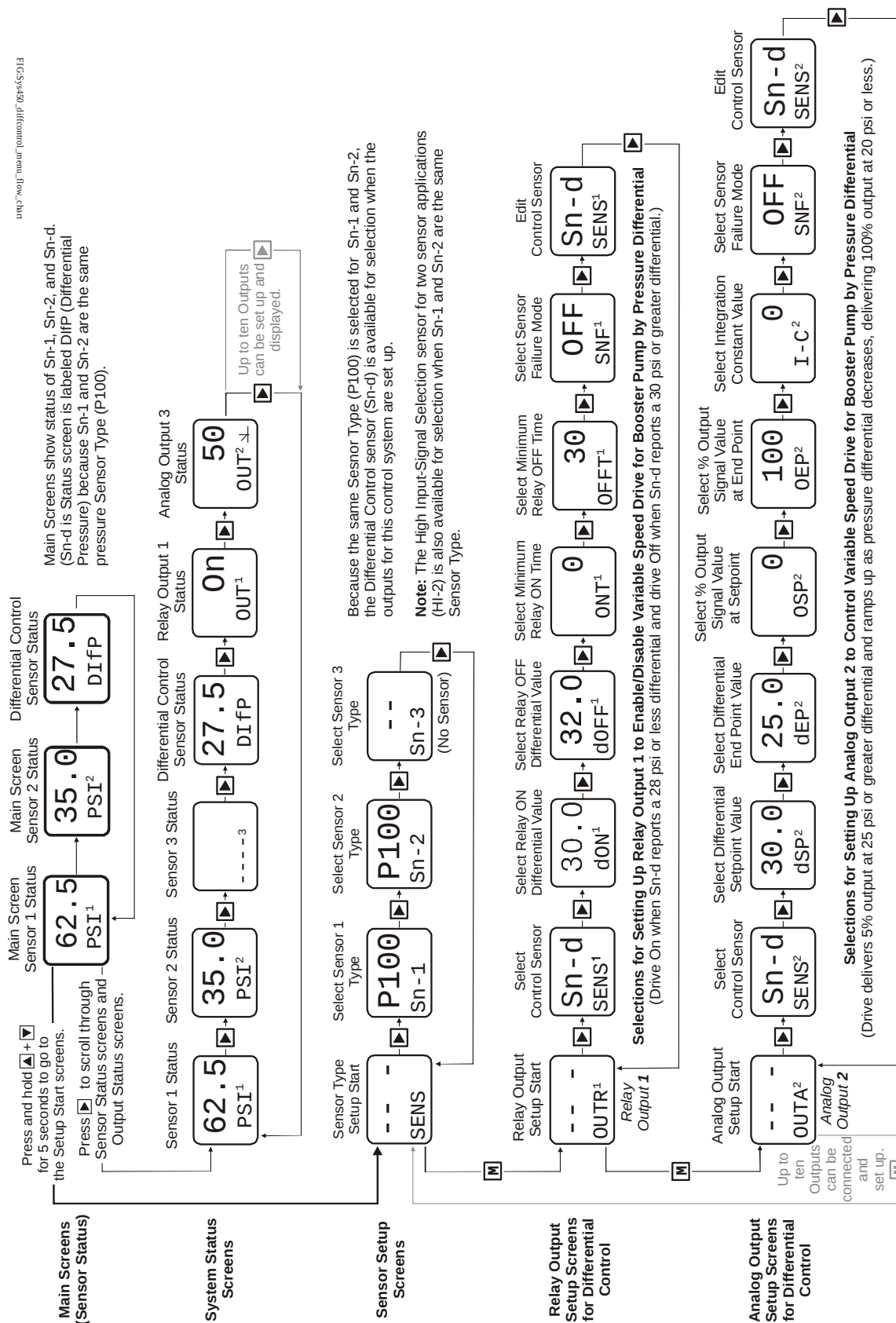


Figure 8: System 450 Status Screens, Setup Screens, and Menu Flow Example for Differential Control

Technical Specifications

C450CxN-3

Product	C450CxN-3: System 450 Control Module models are sensing controls and operating controls with LCD, four-button touchpad, and analog output. C450CPN-3: Control Module with One Analog Output C450CQN-3: Control Module with Two Analog Outputs
Supply Power	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
Ambient Operating Conditions	Temperature: -40 to 66°C (-40 to 150°F) when using 0-10 VDC outputs; -40 to 40°C (-40 to 104°F) when using 4-20 mA outputs Humidity: Up to 95% RH noncondensing; Maximum Dew Point 29°C (85°F)
Ambient Shipping and Storage Conditions	Temperature: -40 to 80°C (-40 to 176°F) Humidity: Up to 95% RH noncondensing; Maximum Dew Point 29°C (85°F)
Input Signal	0-5 VDC; 1035 ohms at 25°C (77°F) for an A99 PTC Temperature Sensor
Analog Output	Voltage Mode (0–10 VDC): Requires an external load of 1,000 ohm or more 10 VDC maximum output voltage; 10 mA maximum output current Note: The 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.
	Current Mode (4–20 mA): Requires an external load between 0–300 ohm Note: The 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.
Analog Input Accuracy	Resolution: 14 bit
Control Construction	Independently-mounted control, surface mounted with Lexan® 950 enclosure suitable for DIN rail mounting or direct mounting to a hard, even surface.
Dimensions (H x W x D)	127 x 61 x 61 mm (5 x 2-3/8 x 2-3/8 in.)
Weight	C450CPN-3: 195 g (0.43 lb) C450CQN-3: 195 g (0.43 lb)
Compliance 	North America: cULus Listed; UL 60730, File E27734, Vol. 1; FCC Compliant to CFR47, Part 15, Subpart B, Class B Industry Canada (IC) Compliant to Canadian ICES-003, Class B limits
	Europe: CE Mark – Johnson Controls, Inc. declares that this product is in compliance with the essential requirements and other relevant provisions of the EMC Directive; Low Voltage Directive.
	Australia and New Zealand: RCM, Australia/NZ Emissions Compliant

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, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.

United States Emissions Compliance

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.

Canadian Emissions Compliance

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.

European Single Point of Contact:

JOHNSON CONTROLS
WESTENDHOF 3
45143 ESSEN
GERMANY

NA/SA Single Point of Contact:

JOHNSON CONTROLS
507 E MICHIGAN ST
MILWAUKEE WI 53202
USA

APAC Single Point of Contact:

JOHNSON CONTROLS
C/O CONTROLS PRODUCT
MANAGEMENT
NO. 22 BLOCK D NEW DISTRICT
WUXI JIANGSU PROVINCE 214142
CHINA

**Building Efficiency**

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