System 450 Series Modular Control Systems with Communications Control Modules Technical Bulletin



C450CRN, C450CEN, C450SBN, C450SCN, C450SPN, C450SQN, C450YNN

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Document Introduction

This document describes System 450™ features and functions, and provides guidelines and instructions for designing, selecting, installing, setting up, and troubleshooting System 450 control systems that use System 450 control modules with network communications (C450CRN-x and C450CEN-x models).

This document also provides System 450 *Technical Specifications* and references to System 450 *Related Documentation*.

In this document, **communications control module** refers to the System 450 control modules with network communications (C450CRN-x and C450CEN-x models).

Note:

- For information regarding System 450 standard control modules, System 450 control module with hybrid analog output, and control systems that use standard and hybrid analog control modules, refer to the *System 450 Series Modular Control Systems with Standard Control Modules Technical Bulletin (LIT-12011459)*.
- For information regarding System 450 reset control modules and control systems that use reset control modules, refer to the *System 450 Series Modular Control Systems with Reset Control Modules Technical Bulletin (LIT-12011842)*.

Related Documentation

Table 1 provides references to System 450 related documentation, including sensor installation instructions.

Table 1: Related Documentation

For Information On	See Document	LIT or Part Number
System 450 Series Features, Benefits, Models, and Technical Specifications	*System 450 Series Modular Controls Product Bulletin*	*LIT-12011458*
System 450 Series Features, Benefits, Models, and Technical Specifications	*System 450 Series Modular Controls Catalog Page*	*LIT-1900549*
Installing and Wiring System 450 Control Modules with Modbus® Communications	*System 450 Series Control Modules with RS485 Modbus Communications Installation Instructions*	*Part No. 24-7664-2926*
Installing and Wiring System 450 Control Modules with Ethernet Communications	*System 450 Series Control Modules with Ethernet Communications Installation Instructions*	*Part No. 24-7664-2934*
Installing and Wiring System 450 Expansion Modules with Relay Output	*System 450 Series Expansion Modules with Relay Outputs Installation Instructions*	*Part No. 24-7664-2861*
Installing and Wiring System 450 Expansion Modules with Analog Output	*System 450 Series Expansion Modules with Analog Outputs Installation Instructions*	*Part No. 24-7664-2799*
Installing and Wiring the System 450 Power Module	*System 450 Series Power Module Installation Instructions*	*Part No. 24-7664-2691*
Installing and Wiring the A99 Series Temperature Sensors	*A99B Series Temperature Sensors Product/Technical Bulletin*	*LIT-125186* *Part No. 24-7664-1636*

Table 1: Related Documentation

For Information On	See Document	LIT or Part Number
Installing and Wiring the TE-6000 Series Temperature Sensing Elements	*TE-6000 Series Temperature Sensing Elements Installation Instructions*	*Part No. 24-4034-26*
Installing and Wiring the TE-6300P Series Temperature Sensors	*TE-6300P Series Temperature Sensors Installation Instructions*	*Part No. 24-4034-107*
Installing and Wiring the TE-6300M Series Well Insertion Temperature Sensors	*TE-6300M Series Well Insertion Temperature Sensors Installation Instructions*	*Part No. 24-4034-182*
Installing and Wiring the TE-6300P Series Outdoor Air Temperature Sensors	*TE-6300P Series Outdoor Air Temperature Sensors Installation Instructions*	*Part No. 24-4034-190*
Installing and Wiring the TE-6300V Series Flange Mount Duct Averaging Temperature Sensors	*TE-6300V Series Flange Mount Duct Averaging Temperature Sensors Installation Instructions*	*Part No. 24-4034-220*
Installing and Wiring the TE-6300P Series Wall Mount Temperature Sensors	*TE-6300P Series Wall Mount Temperature Sensors Installation Instructions*	*Part No. 24-4034-204*
Installing and Wiring the TE-6300M Series Duct Averaging Temperature Sensors	*TE-6300M Series Duct Averaging Temperature Sensors Installation Instructions*	*Part No. 24-4034-174*
Installing and Wiring the TE-6300F Series Flush Mount Sensors	*TE-6300F Series Flush Mount Sensors Installation Instructions*	*Part No. 24-4034-255*
Installing and Wiring the TE-6300A Series Adjustable Length Duct Probe Temperature Sensors	*TE-6300A Series Adjustable Length Duct Probe Temperature Sensors Installation Instructions*	*Part No. 24-4034-247*
Installing and Wiring the TE-6300V Series Flange Mount Duct Probe Temperature Sensors	*TE-6300V Series Flange Mount Duct Probe Temperature Sensors Installation Instructions*	*Part No. 24-4034-212*
Installing and Wiring the TE-6300M Series Duct Probe Temperature Sensors	*TE-6300M Series Duct Probe Temperature Sensors Installation Instructions*	*Part No. 24-4034-166*
Installing and Wiring the TE-6800 Series Temperature Sensors	*TE-6800 Series Temperature Sensors Installation Instructions*	*Part No. 24-10409-1*
Installing and Wiring the P499 Series Electronic Pressure Transducers	*P499 Series Electronic Pressure Transducers Product/Technical Bulletin*	*LIT-12011190, Part No. 24-7664-2659*
Installing and Wiring the P599 Series Electronic Pressure Transducers	*P599 Series Electronic Pressure Transducers Product/Technical Bulletin*	*LIT-12012446 Part No. 24-7664-3264*

Table 1: Related Documentation

For Information On	See Document	LIT or Part Number
Installing and Wiring the HE-6800 Humidity Sensors and Humidity with Temperature Sensors	HE-6800 Series Humidity Transmitters with Temperature Sensor Installation Guide	Part No. 24-10409-28
Installing and Wiring the HE-6900 Humidity Sensors and Humidity with Temperature Sensors	HE-69xxONP Duct Probe Humidity Element with Temperature Sensor Installation Guide	Part No. 24-11025-00013
Installing and Wiring Setra Systems Model 265 Differential Pressure Transducers	*Setra Systems Model 265 Differential Pressure Transducer Installation Guide*	*Search QuickLIT Product Information Website for Setra System Model 265.*

System 450 Overview

The System 450 Series is a family of compact digital electronic control, expansion, and power modules that are easily assembled and set up to provide reliable on/off and proportional control of temperature, pressure, and humidity conditions in a wide variety of HVACR and commercial and industrial process applications.

The System 450 Series is designed to replace System 350 Series and System 27 Series control systems and provides more features and greater flexibility with far fewer model variations. Most System 350 and System 27 modules are designed for single-condition applications (either temperature, pressure, or humidity) and cannot be configured to control multiple conditions with a single control system. Depending on the control module model used, a single System 450 control system can monitor and control both temperature and humidity, or temperature, pressure, and humidity simultaneously.

ⓘ **Note:** System 450 modules are not compatible with System 350 or System 27 modules, but you can build all of the System 350 and System 27 control systems and many more with System 450 modules, usually with fewer modules.

The System 450 Series has several model variations; each module is designed to be multi-purpose, adaptable, and completely field configurable for temperature, pressure, and humidity applications. The System 450 Series allows you to build a wide range of inexpensive, compact, durable, and versatile custom control systems that allow you to monitor and control multiple control loops in your controlled system. A System 450 control system can monitor temperature, pressure, and humidity simultaneously and control up to ten outputs (analog outputs, relay outputs, or both) based on the monitored conditions.

ⓘ **Note:** System 450 **communications control modules**, System 450 **standard control modules**, and the System 450 **control module with hybrid analog output** can monitor and control temperature, pressure, and humidity applications simultaneously. System 450 **reset control modules** can monitor and control temperature and humidity applications simultaneously.

A System 450 Series control system includes:

- a single System 450 control module, which provides the control system UI for setting up, monitoring, and controlling your system and the sensor wiring interface for connecting the sensors to your control system.
- one to ten outputs provided by the control module and expansion modules. Each output provides either On/Off control or a proportional analog signal (0 to 10 VDC or 4 to 20 mA) to the equipment in your controlled system.

- one to three sensors or transducers, which are hardwired directly to the control module and provide input signals for monitoring and controlling your system equipment.
- an optional power module to provide power to the connected control module and expansion modules.

See Table 41 for a list of System 450 modules that can be used in control systems with network communications. Refer to the *System 450 Series Modular Controls Product Bulletin (LIT-12011458)* for a complete list and description of the System 450 modules, compatible sensors and transducers, and accessories.

Figure 1 shows an example System 450 control system with Modbus network communications that controls a cooling system and provides condenser fan speed control.

Figure 1: Example System 450 Control System with a Modbus Communications Module Controlling a Cooling System with Condenser Fan Speed Control

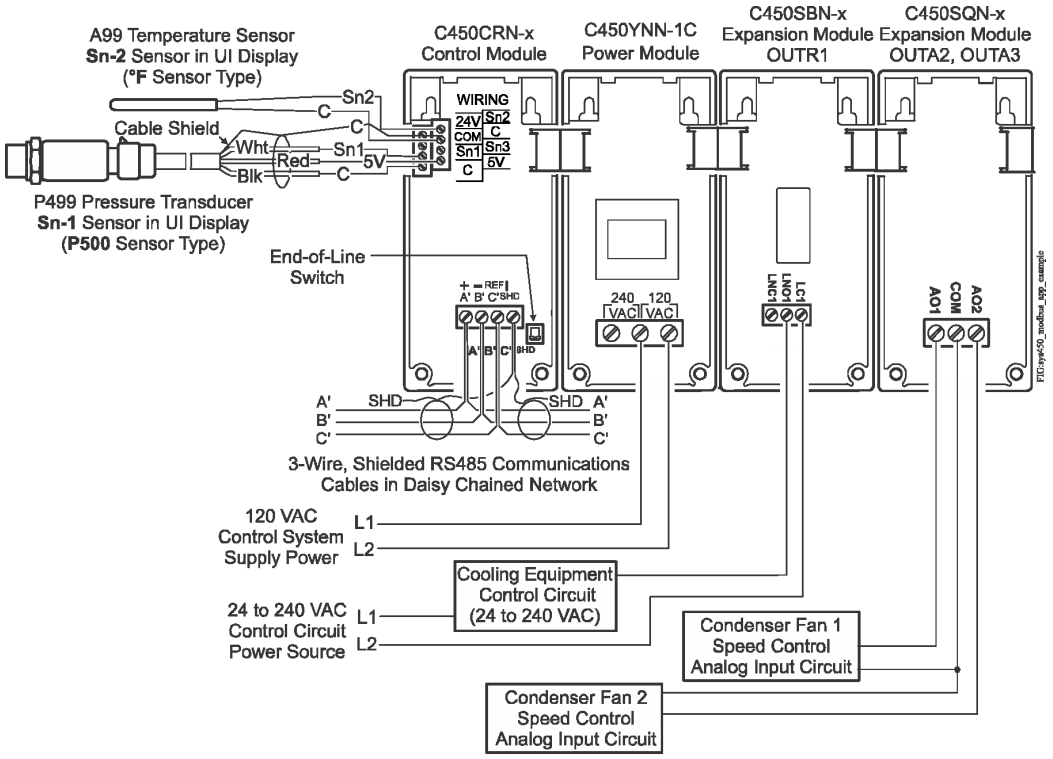


Figure 3 shows the System 450 UI Main Screens, System Status screens, and System Setup Screens for the cooling control system shown in Figure 1.

System 450 Control Systems with Communications Control Modules

A System 450 control system with a communications control module can provide the following types of control to your application equipment:

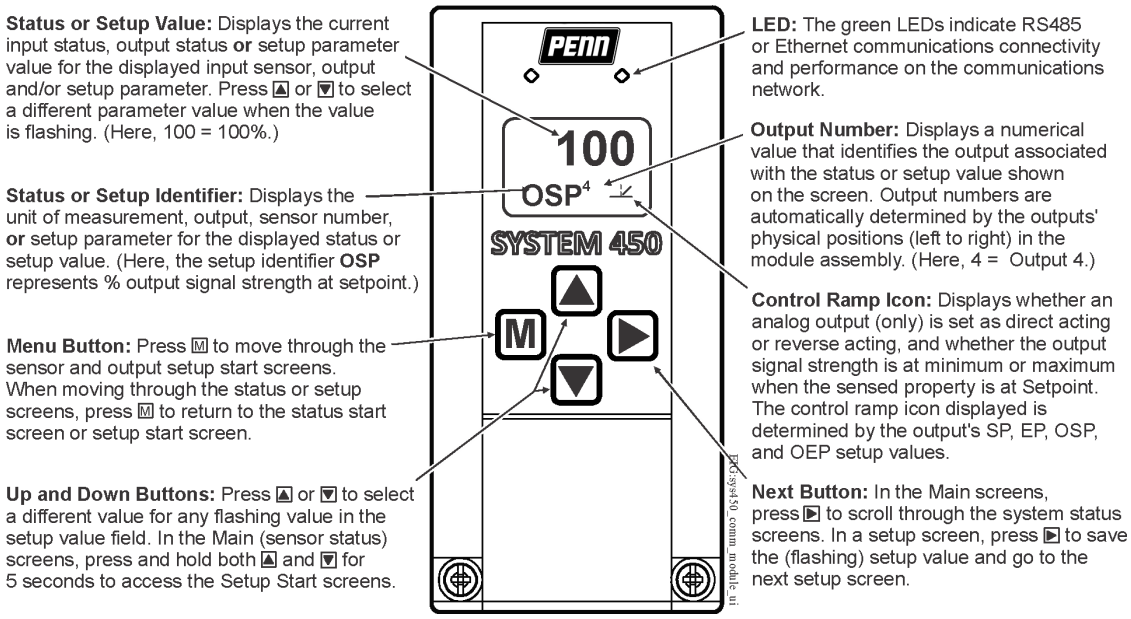
- Network Communications provide network connectivity and communications with other network devices. Depending on the control module, System 450 can connect and communicate on Modbus networks or Ethernet networks. See *System 450 Network Communications* for more information.

- On/Off Control, including multi-stage control for temperature, pressure, and humidity applications. See *Relay Outputs* for more information.
- Proportional Analog Control, including multi-stage control for temperature, pressure, and humidity applications. See *Analog Outputs* for more information.
- Combination of On/Off Relay and Analog Output Control, with up to 10 outputs per control system and any combination of relay and analog outputs.
- Multi-Purpose Control, including simultaneous monitoring and control of temperature, pressure, and humidity conditions.
- Binary Input Control allows to connect a set of binary contacts (dry contacts) to any System 450 input and control your system's relay outputs. See *Binary Input Control for Relay Outputs* for more information.
- Direct and Reverse Action Proportional Control. See *Direct and Reverse Control Actions for Analog Outputs* for more information.
- Proportional Plus Integral Control. See *Proportional Plus Integral Control and Integration Constants* for more information.
- High Input Signal Selection allows you to monitor a condition with two or three identical sensors at different locations in your controlled system and control system outputs according to the highest condition value sensed by the sensors. See *High Input Signal Selection* for more information.
- Differential Control allows you to monitor and control a condition differential in a controlled system; for example, the water pressure drop across an in-line water filter. See *Differential Control* for more information.
- Output Update Rate allows you to select the rate at which an analog output updates the output signal to the controlled equipment. See *Analog Output Update Rate* for more information.
- Output Signal Dead Band allows you to create a dead band for the analog output signal within which the output signal strength remains constant. See *Analog Output Dead Band* for more information.
- Four Time Control Parameters allow you to set up the relay outputs with On or Off time delays and minimum On or Off times. See *Relay On and Off Duration Control* for more information.

Control Modules and User Interface

Each System 450 control system requires a single control module. System 450 control modules have an LCD that enables you to set up and monitor your control system, along with a four-button touchpad for navigating the control system status and setup screens, and setting up the system parameters. Figure 2 shows a communications control module and describes the various features of the System 450 control system UI.

Figure 2: System 450 Communications Control Module Showing LCD and Four-Button Touchpad User Interface



System 450 communications control modules do not have onboard outputs, but provide all the features and functions of a standard control module. Communications control modules allow up to three input sensors and can control up to ten outputs on connected expansion modules. You set up all of the sensors and all of the outputs in your control system, in the communications control module UI.

Depending on the model, System 450 communications control modules enable either network communications or Ethernet communications for your System 450 control systems. See *System 450 Network Communications* for more information on System 450 network communications features.

All System 450 control modules can control both relay outputs and analog outputs, regardless of the type of outputs that the control has onboard. You set up all of the sensors and all of the outputs (relay and analog), including the expansion module outputs, in the control module UI.

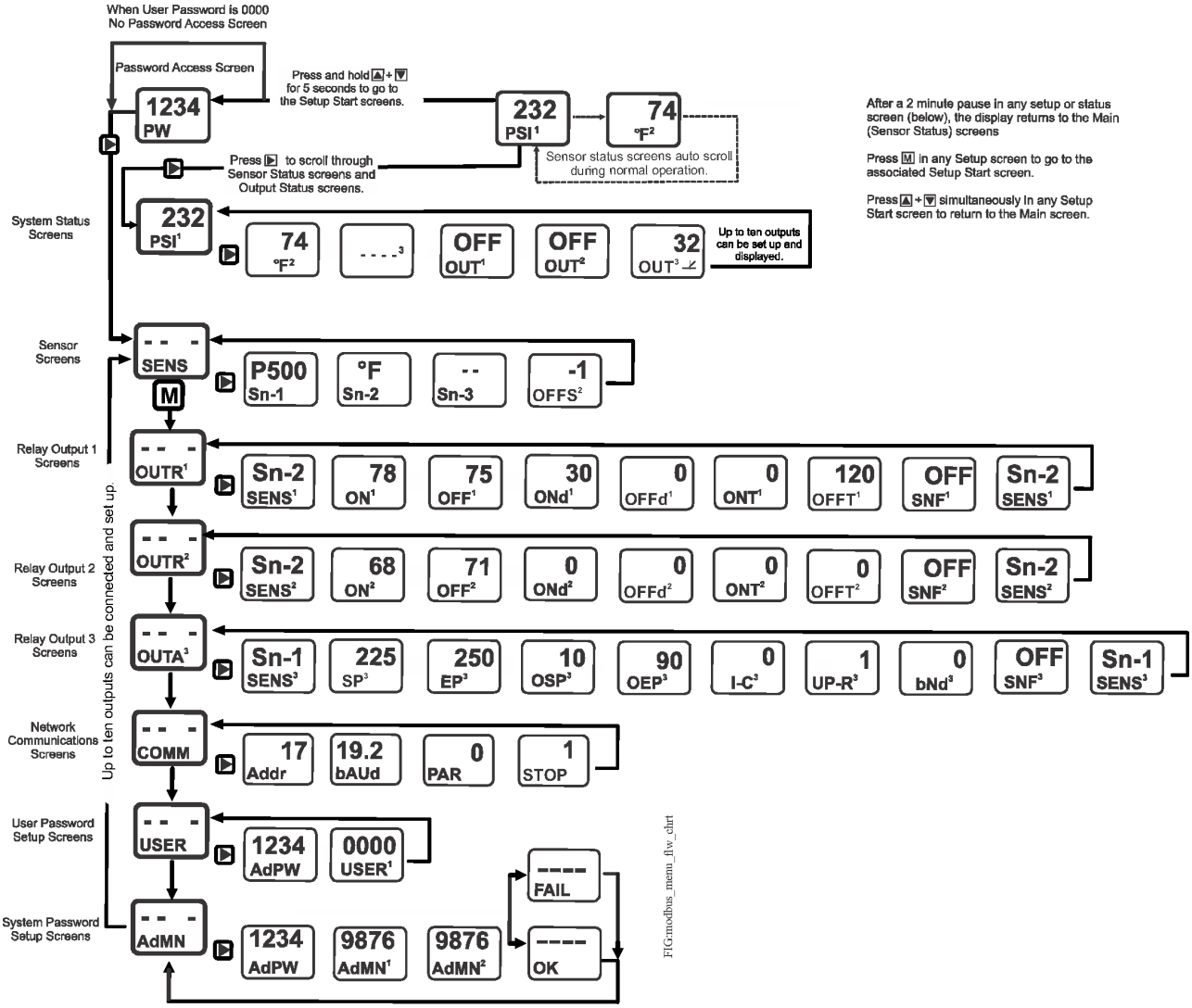
During normal operation, the LCD displays the Main System 450 screens (Sensor Status screens), which automatically scroll through and display the status of the hard-wire and functional sensors in your control system. You can also view the status of all the outputs in your control system and access the System Setup screens from the Main screens in the System 450 UI. See *Setting up a System 450 Control System* for more information.

The System 450 System Status screens display the status of each output in the control system (in addition to the sensor status screens). A relay output status is displayed as ON or OFF. An analog output status is displayed as a percentage of the total output signal strength, 0 to 100 (%). The analog output status screens also display an icon that indicates the control action of the analog output. See *Direct and Reverse Control Actions for Analog Outputs* for more information.

The System Setup screens in the System 450 UI enable you to easily set up the system sensors, all of the system outputs, and the network communications for your control system. See *Setting up a System 450 Control System* for more detailed procedure for setting up your control system.

Figure 3 illustrates the System 450 UI navigation paths, parameter designations, and values for the control system example (shown in Figure 1) using a System 450 control module with Modbus communications.

Figure 3: System 450 Communications Control Module UI Menu Flow Chart Example Showing Navigation Paths and Example Settings in the Main, System Status, Sensor Setup, and Output Setup Screens for a Control System with Modbus Communications

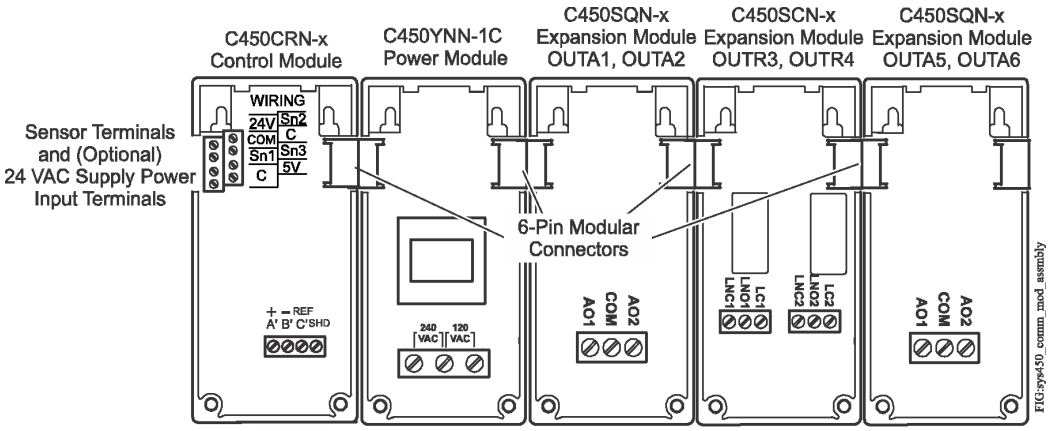


Expansion Modules, Module Assemblies, and Outputs

System 450 expansion modules provide additional outputs to expand your control systems and meet your specific application requirements.

A System 450 control system can provide up to ten outputs, which can be any combination of relay and analog outputs. Expansion modules are available with one or two relay outputs, or with one or two analog outputs. See Table 41 for information on the System 450 modules that can be used in a control system.

Figure 4: System 450 Module Assembly Example Showing Communications Control Module and Expansion Module Positions, Output Positions, and Output Numbers



Module Assemblies, Output Types, and Output Numbers

You can easily plug System 450 modules together using the 6-pin connectors located on the sides of the modules' housings and mount these module assemblies on standard 35 mm DIN rail (recommended) or directly to a hard, even surface. See *Mounting* for more information.

Figure 4 shows a System 450 module assembly example, the module positions, the output types, and the automatically assigned output numbers used in the System Setup screens in the control module UI.

The control module is always mounted on the left side of the module assembly. If a System 450 power module is used, the power module is always plugged into the right side of the control module. If expansion modules are used, they can be plugged into the assembly in any order on the right side of the power module (or the right side the control module, if a power module is not used in the assembly). See *Assembling System 450 Modules* for more information.

Each time a System 450 module assembly is powered on, the control module polls all of the modules to identify output type (relay or analog) and then assigns an output number (1 to 9 and 0 = 10) to each output, starting with the first output on the first expansion module connected to the right of the communications control module. Output numbers are displayed on the control module LCD to identify the output you are viewing as you navigate the system status and setup screens in the System 450 UI (Figure 2).

System 450 Compatible Sensors and Transducers

System 450 communications control modules are designed to operate with a variety of compatible sensors and transducers. The System 450 compatible sensors and transducers cover a wide range of temperature, pressure, and humidity conditions.

ⓘ **Note:** System 450 compatible sensors consist of temperature sensors, humidity sensors, and pressure transducers. The term sensor refers to all System 450 compatible input devices including transducers, unless noted otherwise.

System 450 compatible sensors also come in a variety of styles and configurations, allowing you to select the sensor or transducer that best fits your control system requirements. See Table 42 through Table 49 in *Repair and Ordering Information* for more information on System 450 compatible sensors for communications control modules.

You can connect up to three sensors to a System 450 control module at the low-voltage terminal block. See *Wiring System 450 Components* for more information on System 450 sensor wiring terminals on control modules. Refer to the System 450 module installation instructions and the

sensor installation instructions referenced in *Related Documentation* for information on installing, wiring, operating, troubleshooting, and replacing System 450 compatible sensors.

For each sensor in your control system, you must select the sensor's corresponding Sensor Type when you set up the sensors in the System 450 UI. A sensor's corresponding Sensor Type determines the controlled condition, unit of measurement, minimum differential, setup values, and ranges for each output that is set up to reference the sensor.

See Table 2 for information about Sensor Types, the corresponding output setup values and ranges, sensor models, and transducer models used in communications System 450 control systems.

System 450 automatically designates the sensor connected to the Sn1 terminal and a common (C) terminal as the Sn-1 sensor in the UI. The sensor connected to the Sn2 and a C terminal is designated Sn-2, and the sensor connected to Sn3 and a C terminal is designated Sn-3. You set up each sensor in the corresponding sensor setup screens in the UI.

ⓘ **Note:** For a System 450 control system to operate properly, you must wire the correct sensor or transducer model to the correct sensor input terminals on the control module and select the correct Sensor Type in the corresponding **Select Sensor Type** screen in the System 450 UI.

See *Setting up a System 450 Control System* and *Setting Up the Sensors and Transducers* for more information and procedures on setting up sensors and Sensor Types in the System 450 UI. See *Active and Passive Sensors* for more information.

System 450 Sensors and Transducers for Communications Control Modules

Table 2 shows the Sensor Types, output setup values, value ranges, and product types for the temperature sensors, humidity sensors, and pressure transducers that are compatible with System 450 communications control modules.

Table 2: System 450 Sensor Types, Setup Values, and Product Codes for Communications Control Modules

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-68Nx-0N00WS HE-69Sx0NP
P 0.25	**INWC** (Pressure/in. W.C.)	-0.250 to 0.250	-0.225 to 0.250	0.005	0.010	DPT2650-R25B-AB
P 0.5	**INWC** (Pressure/in. W.C.)	0 to 0.5	0.025 to 0.5	0.005	0.010	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

Table 2: System 450 Sensor Types, Setup Values, and Product Codes for Communications Control Modules

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]
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 P599RCXX401C
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 P599RCPS402C
P 30	**bAR** (Pressure/ bar)	0 to 30	0 to 30	0.1	0.4	P499Rxx-404C P599RCXX404C
P 50	**bAR** (Pressure/ bar)	0 to 50	0 to 50	0.2	0.4	P499Rxx-405C P599RCXX405C
P 100	**PSI** (Pressure/ psi)	0 to 100	0 to 100	0.5	1	P499Rxxx101C P599RAXX101C
[3]**P 110**[3]	**Hg/PSI** (Pressure/Hg-psi)	-10 to 100	-10 to 100	0.5	1	P499Rxxx100C P599RAXX100C
P 200	**PSI** (Pressure/ psi)	0 to 200	0 to 200	1	1	P499Rxxx102C P599RAXX102C
P 500	**PSI** (Pressure/ psi)	0 to 500	90 to 500	1	5	P499Rxx-105C P599RAXX105C
P 750	**PSI** (Pressure/ psi)	0 to 750	150 to 750	2	6	P499Rxx-107C P599RAXX107C
HI°F	**°F** (Temperature/ degrees)	-50 to 360	-40 to 350[4]	1	1	TE-631x TE-6000-x TE-68NT-0N00S
HI°C	**°C** (Temperature/ degrees)	-45.5 to 182	-40 to 176[4]	0.5	0.5	TE-631x TE-6000-x TE-68NT-0N00S
bin	Open or Closed[5]	N/A	N/A	N/A	N/A	Dry Contacts

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. See Table 5 for the Range of Usable Values when an output references Sn-d.

2 See Table 42 through Table 49 in *Repair and Ordering Information* for more information on System 450 compatible sensors.

3 See *Setting up Control System Outputs* for information on setting up System 450 outputs that reference the P110 Sensor Type.

4 Many of the 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. See Table 43, Table 44, and Table 45 or refer to the Technical Specifications to determine the sensor hardware configuration and temperature. The TE-6000-6 Nickel Sensor is the only sensor designed for use over the entire temperature range.

5 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* for more information.

Active and Passive Sensors

Each sensor or transducer hardwired to a System 450 control system is either an active or passive sensor. Passive System 450 sensors are two-wire temperature sensors that connect to one of the sensor input terminals and a common terminal (C) only. Active sensors are three-wire humidity sensors and pressure transducers that connect to one of the sensor input terminals, a common terminal, and a voltage supply terminal (24V for humidity transducers or 5V for pressure transducers).

When the Sensor Type is selected on the UI Sensor Setup Screens, the communications control module automatically sets the input to active or passive.

Binary Input Sensor

You can connect a binary input (dry contacts) to any of the three System 450 communications control module inputs (Sn1, Sn2, or Sn3) and control output relays in your control system based on the binary input state (open or closed).

A sensor (Sn-1, Sn-2, or Sn-3) set up as a binary input can be referenced by relay outputs only. Sensors set up as binary inputs are not available for selection when you set up an analog output. When you select a sensor (Sn-1, Sn-2, or Sn-3) in the UI that is set up as a binary input, the On value and the OFF value selection screens are not available in the Relay Output Setup screens. See *Binary Input Control for Relay Outputs* for more information.

System 450 Functional Sensors

System 450 control modules also enable several functional sensors based on the input from one or more of the hard-wired sensors in your control system. Selecting a functional sensor for an output on a System 450 control system enables the differential or high signal selection control features on the output.

System 450 communications control modules provide for three functional sensors:

- When Sn-1 and Sn-2 are set up as the same Sensor Type, the High Input Signal Selection functional sensor (HI-2) and Differential Control functional sensor (Sn-d) are enabled and available in the Sensor Selection screens for each output in the control system.
- When Sn-1, Sn-2, and Sn-3 are the same Sensor Type, the High Input Signal Selection functional sensor (HI-3) is also enabled and available.

See *High Input Signal Selection* and *Differential Control* for more information about these functional sensors and system control features.

Relay Outputs

Relay outputs provide low and line-voltage on/off control for devices and equipment in your controlled systems. Each relay output is a Single-Pole, Double-Throw (SPDT) set of dry contacts. See Figure 18.

ⓘ **Note:** System 450 output relays are SPDT dry contact relays only and they do not provide any power source for your controlled equipment.

Selecting an ON value that is less than the OFF value (ON < OFF) turns the relay on when the sensed condition value decreases, which is the typical heating mode in temperature applications and referred to as reverse acting on/off control.

Selecting an ON value that is greater than the OFF value (ON > OFF) turns the relay on when the sensed condition value increases, which is the typical cooling mode in temperature applications and referred to as direct acting on/off control.

You can set up multiple relay outputs to create a variety of equipment staging control systems. See *Wiring System 450 Components* for information on wiring output relays. See *Technical Specifications* for the relay output electrical ratings.

A green LED on the relay control and relay expansion module housings (Figure 2) indicates the relay output status.

When a relay output is On:

- the corresponding green LED on the module housing is lit
- the LNO (Line Normally Open) relay contact is closed
- the LNC (Line Normally Closed) relay contact is open
- the corresponding Output Status screen in the UI displays **ON**

When a relay output is Off:

- the corresponding green LED on the module housing is not lit
- the LNO relay contact is open
- the LNC relay contact is closed
- the corresponding Output Status screen in the UI displays **OFF**

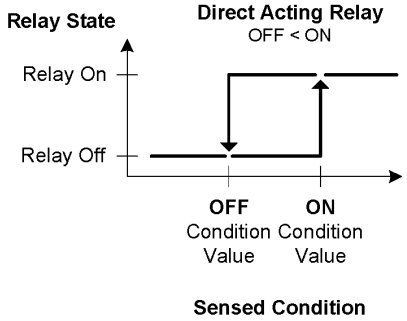
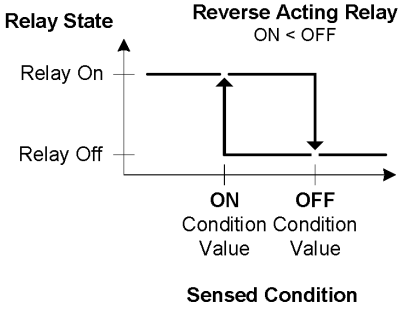
System 450 control and expansion modules are available with one or two relay outputs. See Table 41 and *Technical Specifications* for more information about the System 450 Series module models used to build control systems with network communications.

A relay output's control action is determined by the values that you select in the ON and OFF relay output setup screens:

- Relay ON values (ON) are the values at which the relay turns On.
- Relay Off values (OFF) are the values at which the relay turns Off.

Table 3 illustrates direct and reverse relay actions. When you select On/Off condition values where OFF is less than On, the output relay is a direct acting relay. When you select condition values where On is less than Off, the output relay is a reverse acting relay.

Table 3: System 450 Output Relay Control Actions and the Relationship Between ON and OFF Values

Control Action	Set the Relay Output ON/OFF Value Relationships for the Desired Control Action
	**OFF < ON**
	**ON < OFF**

In temperature applications, direct acting relays are often used to control cooling equipment, while reverse acting relays are often used to control heating equipment.

In pressure applications, directing acting relays are often used for condenser fan cycling control or pump-down control, while reverse acting relay may be used for high pressure cut-out.

In humidity applications, direct acting relays often control dehumidification equipment, and reverse acting relay often control humidification equipment.

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 (Sn1, Sn2, or Sn3 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. Figure 5 and Figure 6 show an example binary input state and the resulting output states with and without the timer parameters applied to the output.

See *Relay On and Off Duration Control* for more information on binary input control, relay output behavior, and the resulting On/Off behaviors when applying the On/Off Delay Time and the Minimum On/Off Time parameters.

Relay On and Off Duration Control

System 450 provides four time duration control parameters that can be applied to the relay output On or Off times generated by an input sensor or a binary input. Each of the four On or Off duration control parameters can be set up for 0 to 300 seconds (5 minutes) in 1-second intervals

The four time duration control parameters are:

- **On Delay:** (ONd) Delays the time that a relay output goes to the On state after reaching the On condition. See the third graph in Figure 5.
- **Off Delay:** (OFFd) Delays the time that a relay output goes to the Off state after reaching the Off condition. See the bottom graph in Figure 5.
- **Minimum On Time:** (ONT) Maintains the relay in the On state for the selected minimum time after reaching the On condition and overrides any sensor input that would normally switch the relay off during the Minimum On Time interval. See the third graph in Figure 6.
- **Minimum Off Time:** (OFFT) Maintains the relay in the Off state for the selected minimum time after reaching the Off condition and overrides any sensor input that would normally switch the relay on during the Minimum Off Time interval. See the bottom graph in Figure 6.

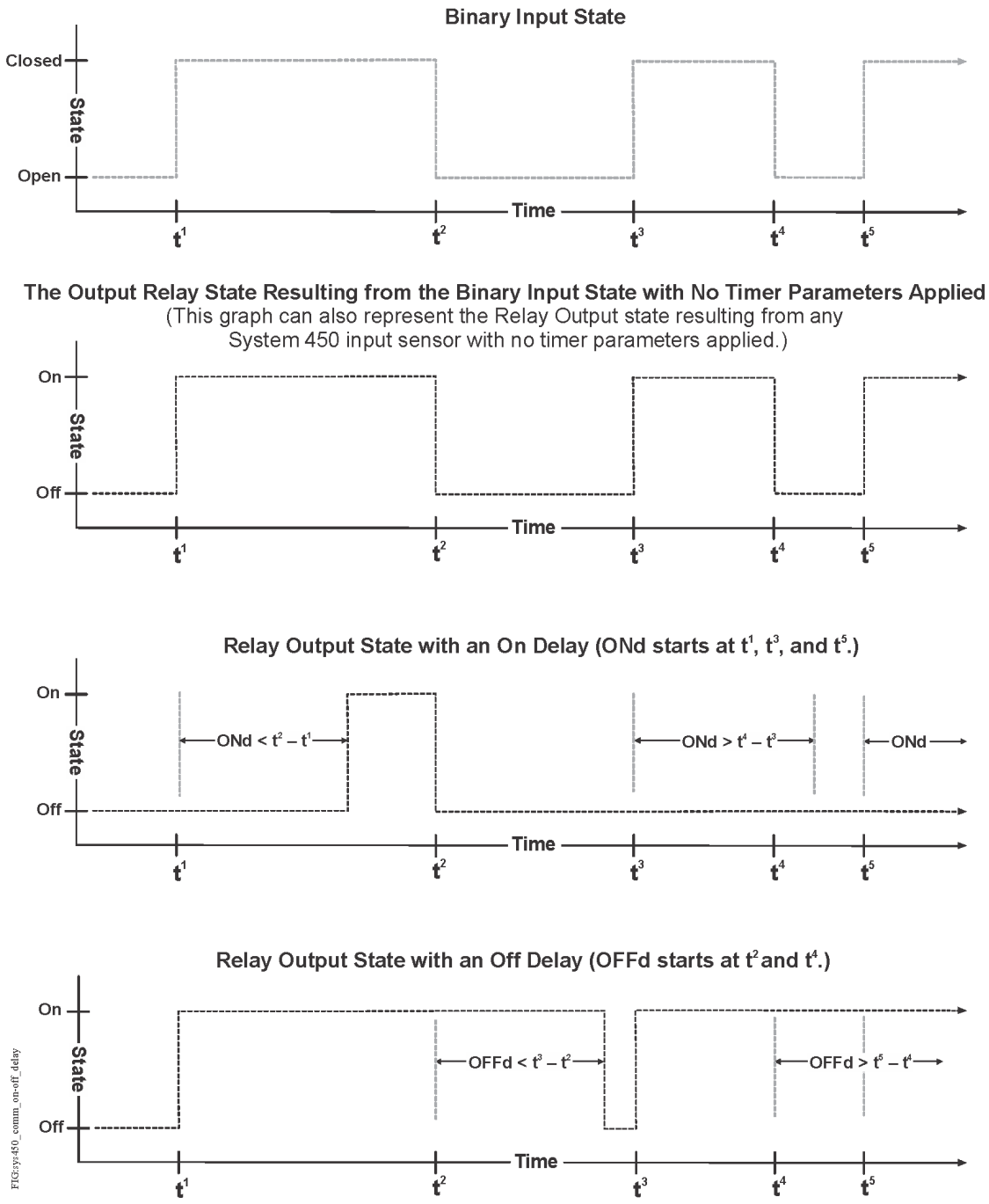
The top two graphs in Figure 5 and Figure 6 show an example of a binary input opening and closing (top graph in each figure) and the resulting behavior of the referenced relay output with no On/Off duration parameter applied to the relay output (second graph in each figure).

The second graph in each figure can also represent a typical example of a relay output responding to the On and Off values for any System 450 compatible sensor.

The third and the bottom graphs in Figure 5 and Figure 6 show the behavior of the output relay when the On and Off Delay parameters are applied (Figure 5) and when the Minimum On and Minimum Off parameters are applied (Figure 6) to the output.

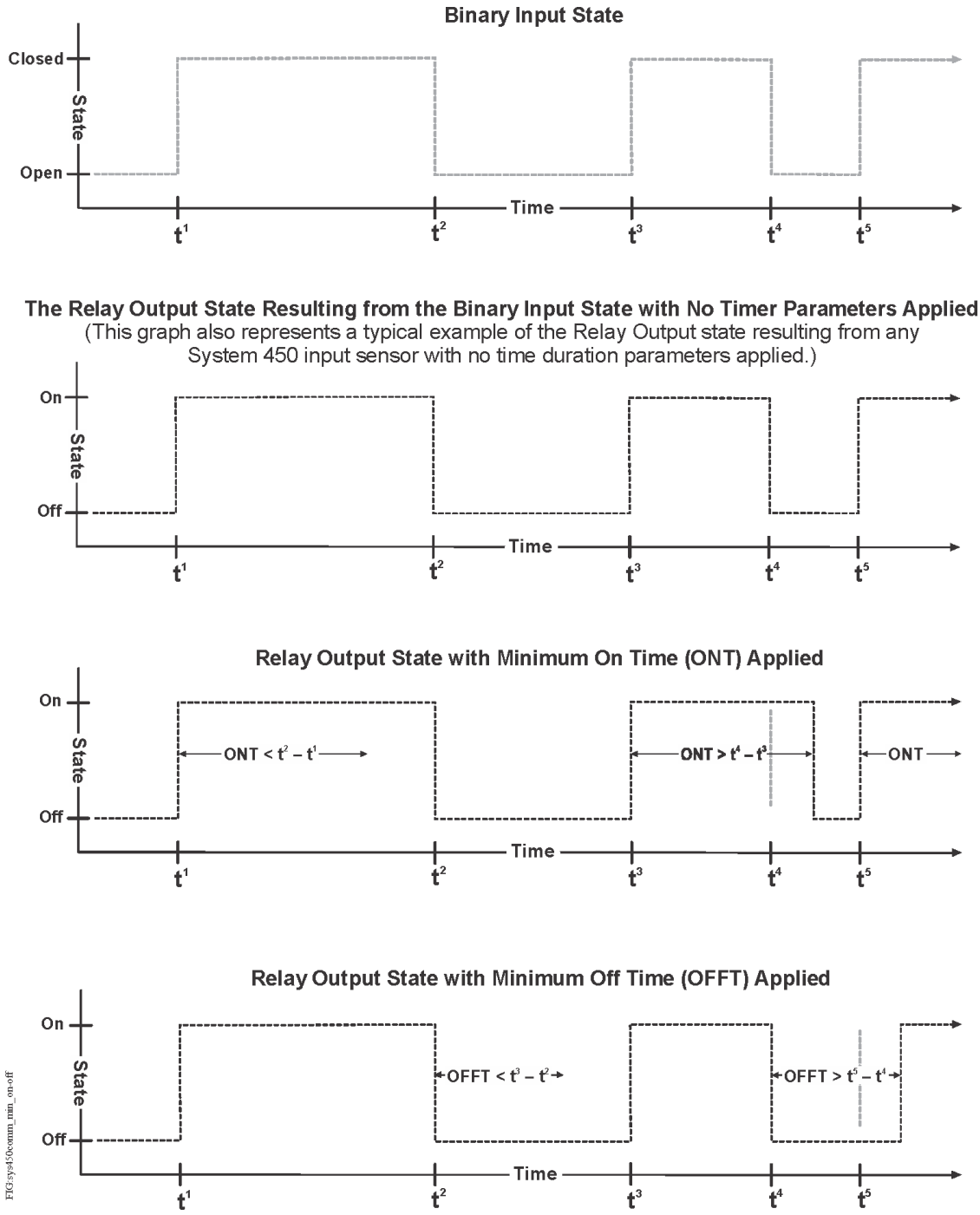
The bottom two graphs in Figure 5 show an example of the relay output behavior when the On or Off Delay parameter is applied to the relay output (regardless of whether the relay output references a binary input or another compatible sensor).

Figure 5: Behavior of a Relay Output Referencing a Binary Input or Other System 450 Compatible Sensor and the Resulting Output States with the On Delay and Off Delay Parameters Applied



The bottom two graphs in Figure 6 show an example of the relay output behavior when the Minimum On or Off Time parameter is applied to the relay output (regardless of whether the relay output references a binary input or another compatible sensor).

Figure 6: Behavior of a Relay Output Referencing a Binary Input or Other System 450 Sensor and the Resulting Output States with the Minimum On and Minimum Off Time Parameters Applied



Analog Outputs

Analog outputs provide proportional analog signals for devices and equipment in your controlled systems. Each analog output can generate either a 4 to 20 mA or 0 to 10 VDC signal. The output signal type is self-selecting; after you connect the analog output to the controlled equipment, the output detects the analog input on the controlled equipment and generates the appropriate analog signal for the connected input.

You can set up an analog output to generate a direct acting or reverse acting proportional output signal. You can also set up the output signal strength to increase or decrease in either the direct acting or reverse acting mode. See *Direct and Reverse Control Actions for Analog Outputs* for more information.

System 450 also provides six integration constants that allow you to set up a proportional plus integral control signal, which can provide more precise setpoint control. See *Proportional Plus Integral Control and Integration Constants* for information on determining the integration constant for an analog output.

For procedures on setting up analog outputs on communications control modules, see *Setting up an Analog Output*.

System 450 expansion modules are available with one or two analog outputs. System 450 control modules with communications do not have outputs. See Table 41 and *Technical Specifications* for more information about the System 450 Series module models that are used to build control systems with network communications.

Direct and Reverse Control Actions for Analog Outputs

An analog output can be set up to provide one of four different control actions, which allow you to match the output signal to the requirements of your control system and the controlled equipment. The proportional output signal can provide direct acting or reverse acting control. In addition, the output signal can be set up to generate either the minimum or the maximum output signal strength at Setpoint.

A control ramp icon is displayed on the status screens for all analog outputs in your control system. See Figure 2. The displayed control ramp icon represents the control action of the analog output signal. See Table 4 for more information on analog output control actions and control ramp icons.

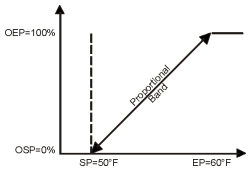
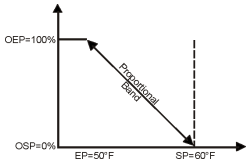
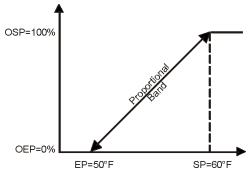
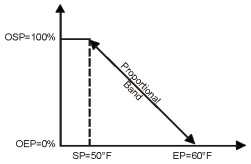
An analog output's control action and the corresponding control ramp are automatically determined by the values that you select in four analog output setup screens:

- **Setpoint** value (SP) is the target value that the control system drives toward, and along with the End Point, defines the analog output's proportional band.
- **End Point** value (EP) is the maximum deviation from the target value (Setpoint). The control system applies maximum output at the EP to drive the process back toward the SP. The SP and EP define the analog output's proportional band.
- **Output at Setpoint** value (OSP) is the signal strength level of the analog output when the input sensor is at Setpoint (SP). The OSP is expressed as a percentage (0 to 100%) of the full scale output.
- **Output at Endpoint** value (OEP) is the signal strength level of the analog output when the input sensor is at the End Point (EP). The OEP is expressed as a percentage (0 to 100%) of the full scale output.

ⓘ **Note:** System 450 analog outputs that reference the differential control sensor (Sn-d) use a Differential Setpoint (dSP) and Differential End Point (dEP) to define the output's proportional band. See *Differential Control* for more information.

Table 4 shows the four control ramp icons and describes their corresponding control actions and the setup value relationships required to configure the four control actions. See Figure 27 and Figure 28 for examples.

Table 4: System 450 Control Ramps, Analog Output Control Actions, and System Setup Value Relationships

Control Ramp Displayed	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**

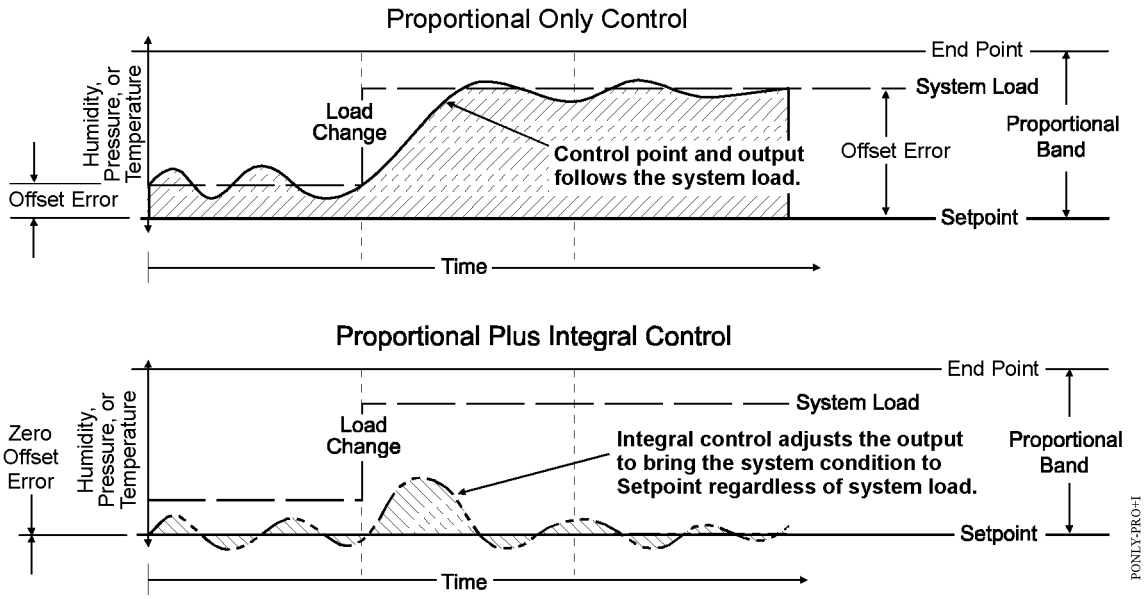
Proportional Plus Integral Control and Integration Constants

In addition to standard proportional control, System 450 provides Proportional plus Integral (PI) control capability. The addition of integral control enables a properly set up analog output to drive a controlled condition closer to Setpoint (Figure 7).

Standard proportional-only controls continuously adjust the output in proportion to the difference (offset error) between the Setpoint value and the sensor value. As the load on the system increases, the offset error increases. A proportional-only control responds to the increased offset error by changing the output signal, which drives the controlled equipment to compensate for the load change (Figure 7). Proportional-only control loops are relatively easy to set up and adjust.

Typically, under constant system load, proportional-only control loops do not drive a system to the selected Setpoint. Instead, the controlled system is maintained at a control point within the proportional band (throttling range) between setpoint and end point. The larger the load on the system, the further the control point drifts from setpoint. Still, for many applications, proportional-only control is the best choice for analog output control.

Figure 7: Proportional Only Control Versus Proportional Plus Integral Control



Proportional plus Integral (PI) control incorporates a time-integral control action with proportional control action and, if properly set up, a PI control loop can effectively eliminate offset error and enable a controlled system to drive to setpoint even under large constant loads (Figure 7). On a properly sized system with predictable loads, PI control can maintain the controlled system very close to setpoint.

A system's output capacity, the size of the load on the system, and the integration constant selected determine the speed (recovery rate) at which the PI control drives the system to setpoint.

The integration constant establishes the rate at which the control readjusts the analog output signal. The faster the integration constant, the faster the control readjusts the output signal and the faster the recovery rate of a properly sized and setup control loop.

ⓘ **Note:** PI control is not suitable for all controlled systems. Improperly applied PI control loops are unstable and can overshoot setpoint, resulting in control loop oscillation. Also, with PI control, the proportional band (throttling range) and the integration constant are interdependent and you must properly set up these values in relation to each other. You must also properly size the system equipment to handle the maximum load. Close observation over several cycles and under different load condition is required to properly set up a PI control loop. On a properly sized system, a PI control loop can drive the system condition much closer to setpoint than proportional-only control.

In addition to a proportional-only setting, System 450 provides six time-integral settings in the **Integration Constant Setup** screen for matching the analog signal's response rate to the controlled system's recovery rate. The seven integration constant settings are shown in Table 12.

See *Determining the Integration Constant for an Analog Output* for more information and the procedures for determining an integration constant and testing a PI control loop in your controlled system.

The Analog Output Update Rate and Output Dead Band contain two parameters that can be used to minimize the frequency of changes to the output signal from the control. When controlling a device such as an actuator, these features can lengthen the actuator life by reducing the actuator position update frequency. See *Analog Output Update Limiters* and *Analog Output Dead Band* for more information.

Analog Output Update Limiters

The Output Update Rate and Output Dead Band are used to minimize the frequency of changes to the output signal from the control. When controlling a device such as an actuator, these features can lengthen actuator life by reducing the actuator position update frequency.

Analog Output Update Rate

The Output Update Rate feature allows you to select the rate, in seconds, during which the control does not allow an update to the analog output's signal strength. The Output Update Rate value range is 1 to 240 (seconds) and the default value is 1 (second).

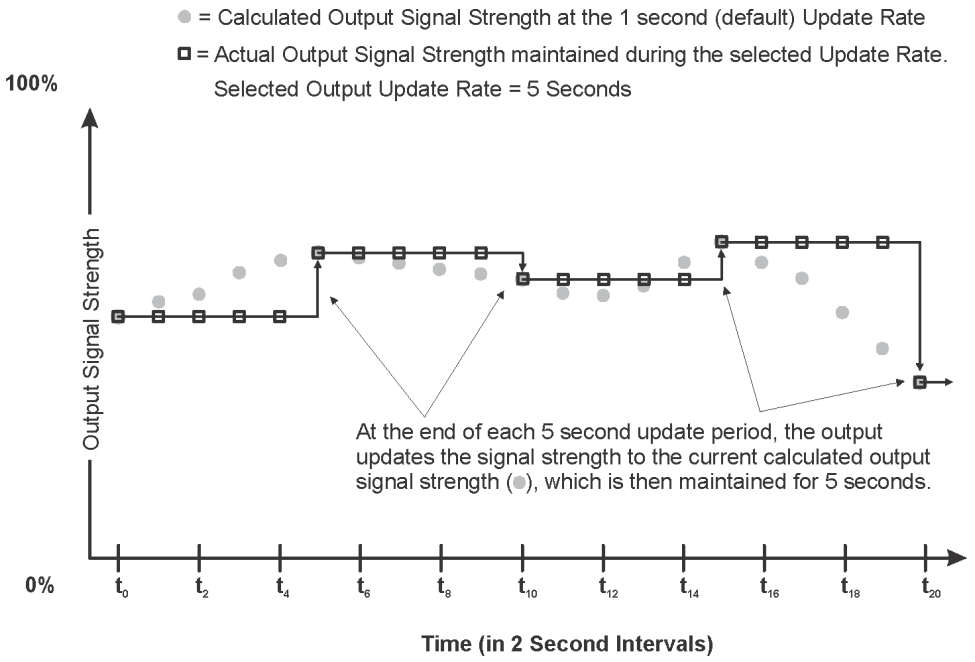
The Output Update Rate and Output Dead Band are used to minimize the frequency of changes to the output signal from the control. When controlling a device such as an actuator, these features can lengthen actuator life by reducing the actuator position update frequency.

The System 450 communications control module calculates the input-induced output signal strength once per second. The default Output Update Rate is one second. The actual output signal strength is updated to the calculated output signal strength once every second when the control is set to the default update value. In some control applications, a 1-second update rate may be too frequent and may result in premature wear on the controlled equipment, such as actuators.

When you select an Output Update Rate value greater than 1 second, the control module delays updating the output and maintains the output signal strength for the duration of the selected update rate. At the end of the selected update rate, the control updates the output signal strength to the current calculated output signal strength and maintains the new output signal strength value for the selected output update rate value.

For example, if you select an Output Update Rate value of 5 (seconds), the control module updates the output signal strength every 5 seconds, reducing changes at the controlled equipment to 20% of the default update rate. See Figure 8 .

Figure 8: Graph Showing Calculated Output Signal Strength and Output Signal Strength Maintained by a 5-Second Update Rate



Note: The Output Update Rate feature can be used in conjunction with the Output Dead Band feature, but care must be taken when selecting these values for your control system. In process loops where the condition (temperature, pressure, or humidity) value can change quickly over a large range, the delay in updating the actual output signal strength can cause the controlled equipment to oscillate out of range and drive the process away from the desired setpoint. After selecting new Output Update Rate and Output Dead Band values, observe your controlled system through several cycles to determine the affect of the new values. If the calculated output signal strength is 0 or 100%, the actual output signal strength changes immediately.

Analog Output Dead Band

The Output Dead Band feature allows you to establish a dead band value around the calculated output signal strength. The Output Dead Band value is expressed as a percent of the output signal strength range. The Output Dead Band value range is 0 to 50 (percent of the OSP to OEP range) and the default value is 0 (percent).

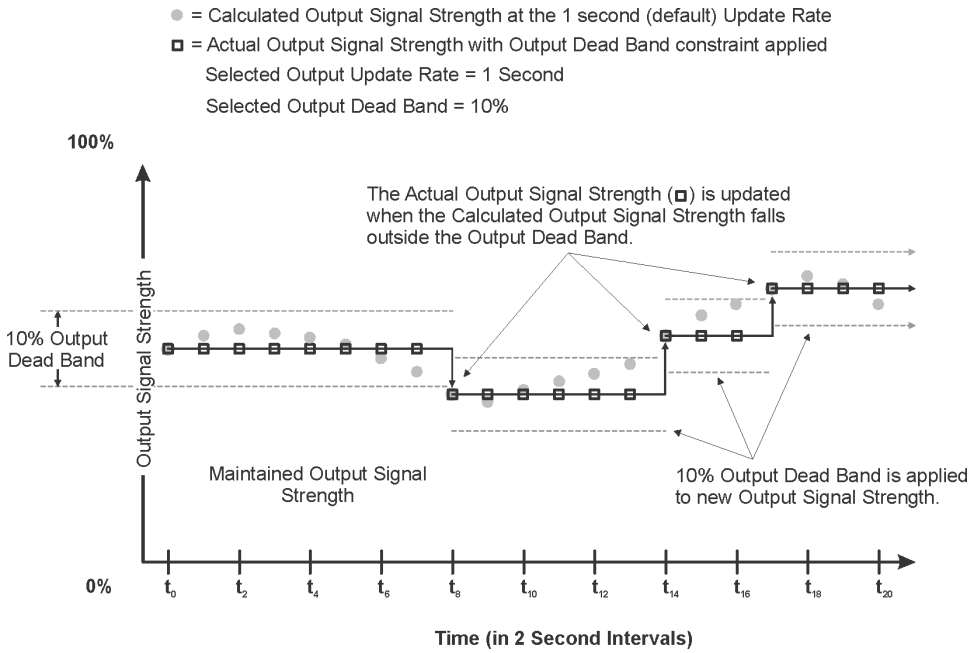
The Output Update Rate and Output Dead Band are used to minimize the frequency of changes to the output signal from the control. When controlling a device such as an actuator, these features can lengthen actuator life by reducing the actuator position update frequency.

The System 450 communications control module responds to a changing input signal and updates the analog output's calculated output signal strength at the rate selected in the Output Update Rate screen. At each update of the calculated output signal strength, the control determines if the new calculated output signal strength is within the selected Output Dead Band or not.

If the calculated output signal strength is within the selected Output Dead Band, the actual output signal strength is not updated and remains unchanged.

If the calculated output signal falls outside the Output Dead Band, the actual output signal strength is updated, and the selected Output Dead Band is applied to the new output signal strength value. See Figure 9.

Figure 9: Graph Showing Calculated Output Signal Strength and Output Signal Strength Constrained by Output Signal Dead Band



The Output Dead Band feature can be used in conjunction with the Output Update Rate feature, but care must be taken when selecting these values for your control system. In process loops where the condition (temperature, pressure, or humidity) value can change quickly over a large range, the delay in updating the actual output signal strength can cause the controlled equipment to oscillate out of range and drive the process away from the desired setpoint. After selecting new Output Update Rate and Output Dead Band values, observe your controlled system through several cycles to determine the affect of the new values. If the calculated output signal strength is 0 or 100%, the actual output signal strength changes immediately.

High Input Signal Selection

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 analog outputs based on the highest condition value sensed by the two or three referenced sensors.

When Sn-1 and Sn-2 are set up with the same Sensor Type, the functional High Input Signal Selection sensor (HI-2) is available for selection when you set up the outputs in the control system. When Sn-1, Sn-2, and Sn-3 are set up with the same Sensor Type, the functional sensor (HI-3) is also available for selection.

ⓘ **Note:** Setting up Sn-1 and Sn-2 as the same Sensor Types also enables the functional Differential Control sensor (Sn-d). See *Differential Control* for more information.

High Input Signal Selection control application examples include:

- fan-staging control on multi-circuit condensing units
- fan motor speed control on multi-circuit condensing units

Differential Control

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

Differential Control application examples include:

- solar heating systems
- pump pressure-drop monitoring and control
- fluid filter pressure-drop monitoring
- air filter pressure-drop monitoring

Setting up an output (relay or analog) for Differential Control requires connecting two identical sensors to input terminals Sn1 and Sn2 and selecting the same Sensor Type in the System 450 UI for Sensor 1 (Sn-1) and Sensor 2 (Sn-2). The System 450 control system recognizes the same Sensor Types and makes the functional Differential Control sensor (Sn-d) available for selection when you set up each of the control system outputs.

ⓘ **Note:** Setting up Sn-1 and Sn-2 as the same Sensor Types also enables the functional High Input Signal Selection sensor (HI-2). See *High Input Signal Selection* for more information.

When a Differential Control sensor (Sn-d) is set up, the differential sensor 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 sensed differential value (Sn-d) between Sn-1 and Sn-2 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 5 for Sensor Types and their units of measurement.

When a relay output is set up for Differential Control, System 450 compares the sensed differential value, Sn-d (Sn-d = Sn-1 minus Sn-2), to the user-selected differential values (dON and dOFF) to control the relay's On/Off state.

When an analog output is set up for Differential Control, System 450 compares the sensed differential value, Sn-d (Sn-d = Sn-1 minus Sn-2), to the user-selected differential values (dSP and dEP) to control the analog output signal strength.

ⓘ **Note:** Because of the way that the System 450 Differential Sensor (Sn-d) is set up and calculated using two sensors with identical Sensor Types, the Range of Usable Values for each Sensor Type is twice as large as a single sensor. (Each Sensor Type has an equal number of positive and negative values on outputs that reference Sn-d.) See Table 5 for a Sensor Type's Range of Usable Values when an output references Sn-d

Table 5: Range 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	**P 100**	-100.0 to 100.0
P 0.25	-0.500 to 0.500	**P 110**	-110.0 to 110.0
P 0.5	-0.500 to 0.500	**P 200**	-200 to 200
P 2.5	-2.50 to 2.50	**P 500**	-500 to 500
P 5	-5.00 to 5.00	**P 750**	-750 to 750
P 8	-9.00 to 9.00	**HI°F**	-380 to 380
P 10	-10.00 to 10.00	**HI°C**	-210.0 to 210.0
P 15	-16.0 to 16.0	**--**	--

Sensor Failure Mode

System 450 allows you to select the mode of operation for your control system outputs in the event of a sensor (or sensor wiring) failure of the sensor or sensors that the outputs reference. When you set up an output in the System 450 UI, you must select a sensor failure mode of operation in the Sensor Failure Mode (SNF) screen. Your selection determines how an output responds if a referenced sensor or sensor wiring fails.

System 450 outputs can be set up to directly reference a single compatible sensor hardwired to the control system (Sn-1, Sn-2, or Sn-3). Outputs in control systems with System 450 standard control modules can also be set up to reference several functional sensors (Sn-d, HI-2, or HI-3). The functional sensors reference input from one or more of the hard-wired sensors; thus one or more of the hard-wired sensors can influence the outputs that reference functional sensors.

When any one of the connected sensors (Sn-1, Sn-2, or Sn-3) or associated sensor wiring fails, all of the outputs that reference the failed sensor, either directly or through a functional sensor, go into the outputs' selected sensor failure modes and continue to operate in the sensor failure modes until the sensor or sensor wire failure is corrected.

You can select either ON or OFF for an output's Sensor Failure Mode. Depending on the type of output (relay or analog), the ON and OFF Sensor Failure Modes are defined as follows:

- Relay output SNF On = Relay On. (See *Relay Outputs* for more information regarding a relay output's On state.)
- Relay output SNF OFF = Relay OFF. (See *Relay Outputs* for more information regarding a relay output's Off state.)
- Analog output SNF On = Output Signal Strength at End Point (OEP). (See *Direct and Reverse Control Actions for Analog Outputs* for more information regarding Output Signal at End Point.)
- Analog output SNF OFF = Output Signal Strength at Setpoint (OSP). (See *Direct and Reverse Control Actions for Analog Outputs* for more information regarding Output Signal at Setpoint.)

System 450 Network Communications

The System 450 communications control modules enable System 450 control systems to connect to and communicate over Modbus networks and Ethernet networks, providing remote monitoring and control of your System 450 control systems and the equipment those systems control. The System 450 Control Module with Modbus Communications is an RS485, RTU compliant Modbus subordinate device.

System 450 communications control modules include:

- the System 450 control module with Modbus communications (C450CRN-x)
- the System 450 control module with Ethernet communications (C450CEN-x)

In addition to Modbus and Ethernet communications, System 450 communications control modules provide all of the features and functions of a standard System 450 control module.

ⓘ **Note:** System 450 communications control modules do not have onboard outputs, therefore System 450 control systems with communications must always include at least one expansion module to provide outputs for your control system with communications. System 450 communications control modules can be used as a standalone monitoring device and allow you to remotely monitor temperature, pressure, and humidity.

See *Setting Up Modbus Network Communications* and *Setting Up Ethernet Communications* for information on setting up network communications for System 450 control systems.

System 450 Local Password Protection

The System 450 communications control modules provide two levels of password-protected access to the control system setup UI—an Administrator (Admin) level password and User level password. The local password protection feature protects your control system from unauthorized access to the system setup UI and changes to your control system settings. The Main (sensor status) and the output status screens are not password protected.

After the local password protection feature is enabled, users encounter a password challenge screen when they attempt to access the System Setup screens. Figure 3 shows where you encounter the password challenge screen in the System 450 UI menu flow.

The local Password Setup screens exhibit slightly different behavior from the other System Setup screens. When you enter the four-digit password value, you enter each digit in the screen one digit at a time. For example, to enter the default Admin password in the Password Access or Password Setup screens, first (left) digit displays a flashing underscore. Press **Up** to select 1, then press **Next** to save the value and go to the second digit. Then, with the underscore flashing in the second digit position, press **Up** twice to select 2, and press **Next** to save the value and go to the third digit. Repeat for the third and fourth digits. When you press **Next** to save the fourth value, the four values are entered into the screen and the next screen appears.

See *Setting Up Password Protection* for more information and detailed procedures.

System 450 Control System Examples

With System 450 control and expansion modules, you can build a wide variety of cost-effective, custom control systems. Each of the following examples provide an illustration of the module assembly, including wiring diagrams for system sensors and outputs, and menu flow charts showing typical Main screens and System Status screens, along with System Setup screens and example setup values.

Note: The physical configurations, wiring, and setup values shown in the following examples are meant to illustrate typical control system applications, control features, and system setup values. Your control applications may require different modules, module configurations, sensors, wiring, and UI setup parameters and values.

See *Control Modules and User Interface* and *Expansion Modules, Module Assemblies, and Outputs* for general information and guidelines on System 450 modules and UI. See *Detailed Procedures* for information and procedures on designing your control system, selecting modules and sensors, mounting and wiring your control system, accessing and navigating the System 450 UI, and setting up your control system in the UI.

Example Communications Control System

Figure 1 shows an example System 450 communications control system module assembly and the (user-installed) field wiring for a cooling application with condenser fan speed control. Figure 3 shows the System 450 UI menu flow for monitoring and setting up the control application shown in Figure 1.

Figure 10 shows a typical heating and cooling System 450 communications control system example, and Figure 13 shows the corresponding Main, System, Status, and Setup Screens.

Figure 11 shows a temperature, humidity, and pressure System 450 communications control system example, the module positions, the output types, and the automatically assigned output numbers used in the System Setup screens in the control module UI. Figure 14 shows the corresponding Main, System Status, and Setup Screens.

Figure 12 shows a System 450 communications control system example for a solar water heating and storage application that uses the Differential Control feature to control two circulation pumps. Figure 15 shows the corresponding Main, System Status, and Setup Screens.

Figure 10: Example System 450 Control with Communications Showing a Room Heating and Cooling Application with Condenser Fan Speed Control

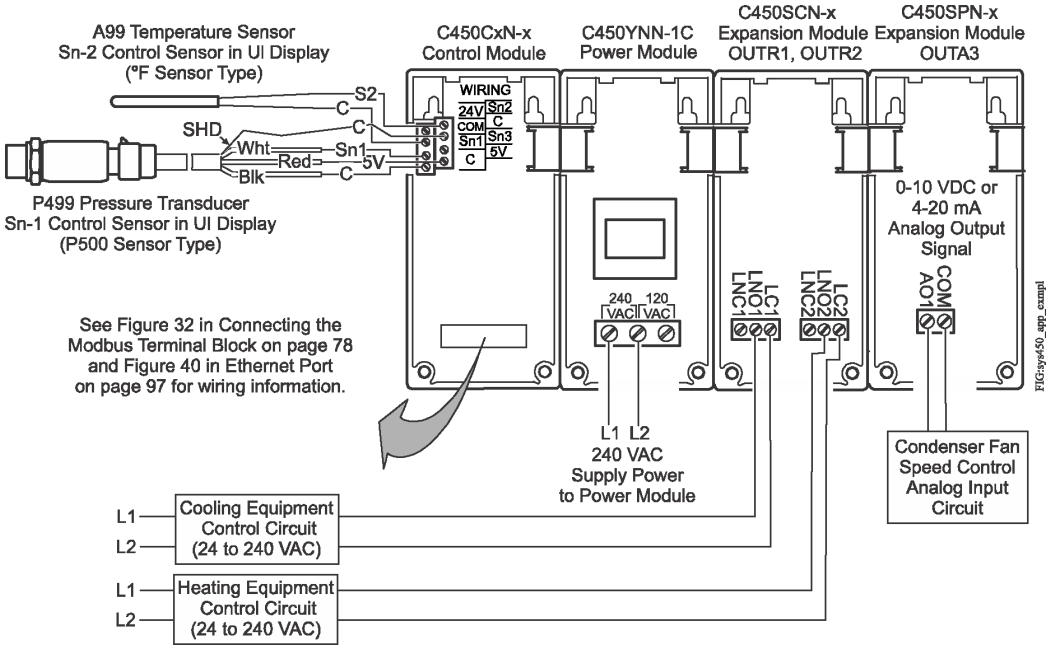
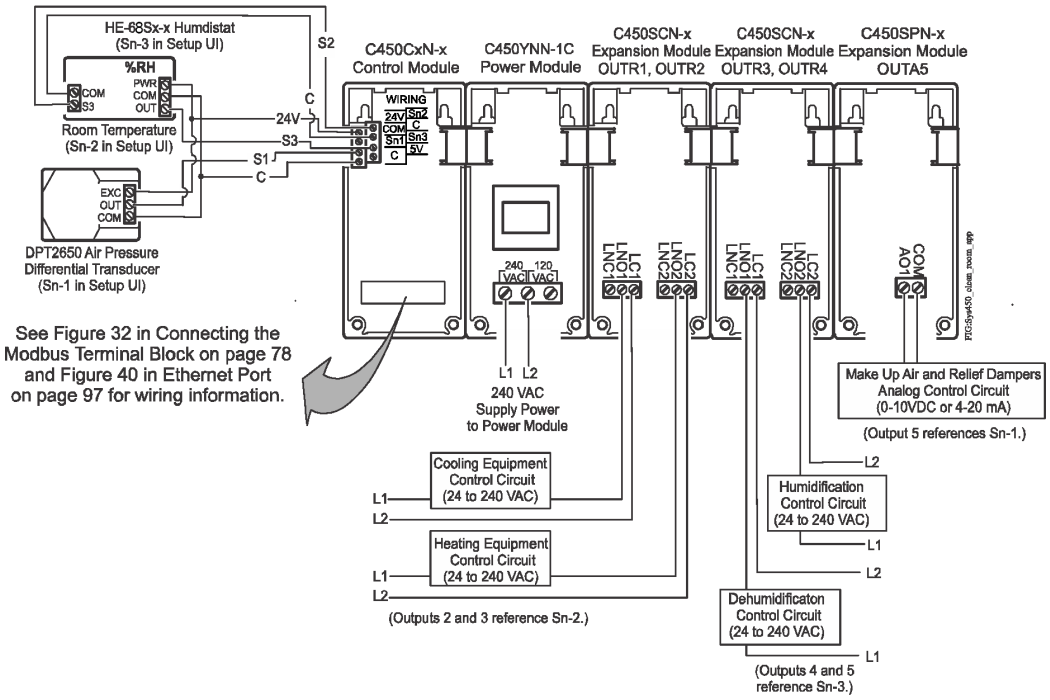


Figure 11: Example System 450 Control with Communications Showing a Clean Room Application that Controls Temperature, Pressure, and Humidity Simultaneously



Detailed Procedures

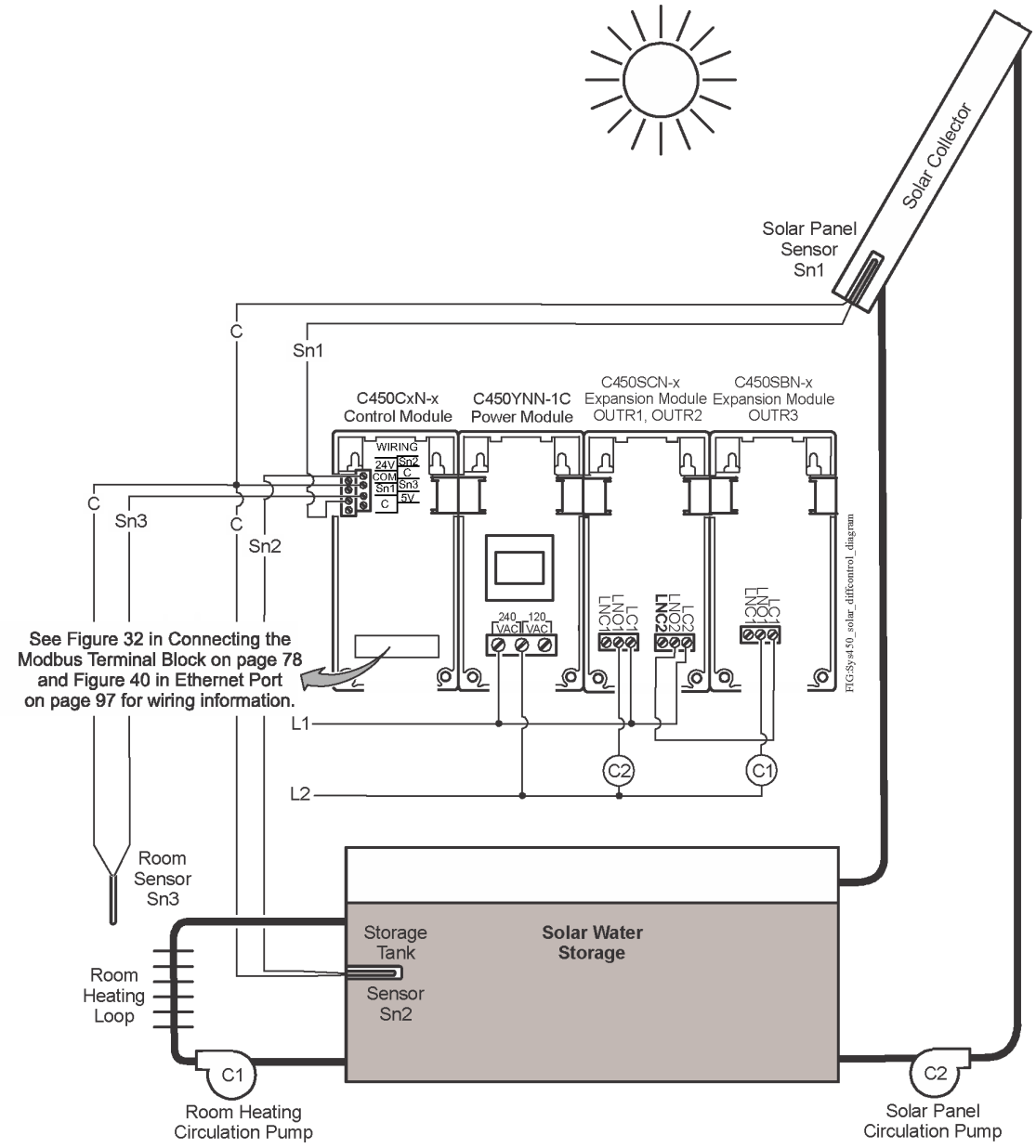
Designing and Building System 450 Control Systems

The variety and flexibility of System 450 modules and sensors allow you to build a wide variety of custom control systems.

Observe the following guidelines when designing a control system with network communications and selecting components for your control system:

- Determine your application's network communications requirements and which communications control module model satisfies those requirements. (See Table 41 for System 450 communications control module model information.)
- Determine the conditions and condition ranges that must be monitored and controlled in your application to determine the sensors you need. Up to three sensors can be connected and up to three conditions (temperature, pressure, and humidity) can be monitored simultaneously using communications control modules. (See Table 5 and *Selecting, Installing, and Setting Up Sensors* for more information.)
- Determine the type of control your application requires – standard control, relay control, analog proportional control, Differential Control, High Input Signal Selection, multi-purpose, or a combination of control types. (See *System 450 Control Systems with Communications Control Modules* for more information regarding System 450 control systems with network communications.)
- Determine the number and type (relay or analog) of outputs required to control the equipment in your application. Up to ten outputs can be configured and controlled by a single System 450 control module.

Figure 12: Example System 450 Control with Communications Showing a Solar Water Space Heating Application that Uses the Differential Control Feature



- Determine the types of control and expansion modules (relay or analog) needed to provide the required outputs for your application and the minimum number of modules required to provide those outputs.

  Note:

  - Many System 450 control systems can be configured using different combinations of module models to build the assembly, but typically there is one combination of modules that is more cost effective to build than other potential module assembly configurations.

- System 450 communications control modules do not have on-board outputs; all of the outputs on control systems with network communications are provided by expansion modules.

Figure 13: Main, System, Status, and Setup Screen for a Room Heating a Cooling Application with Condenser Fan Speed Control

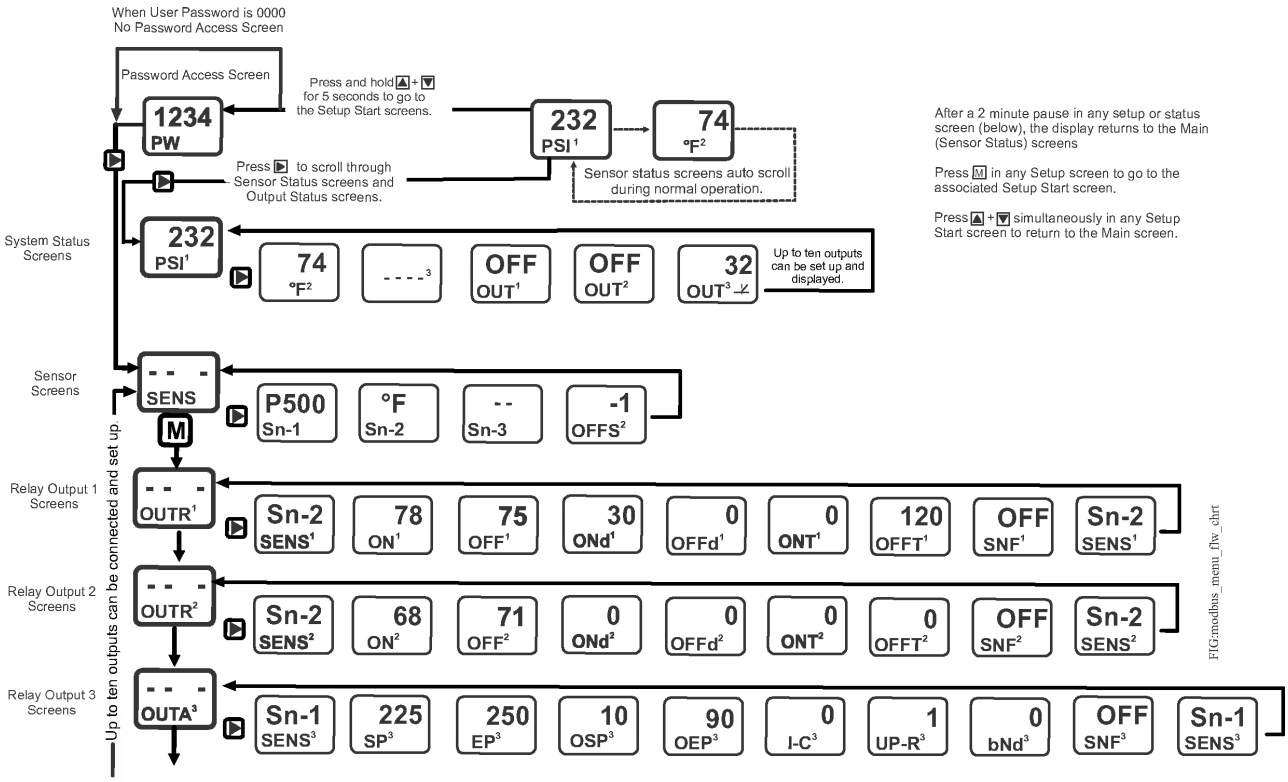


Figure 14: Main, System Status and Setup Screens for a Clean Room Application that Controls Temperature, Pressure, and Humidity Simultaneously

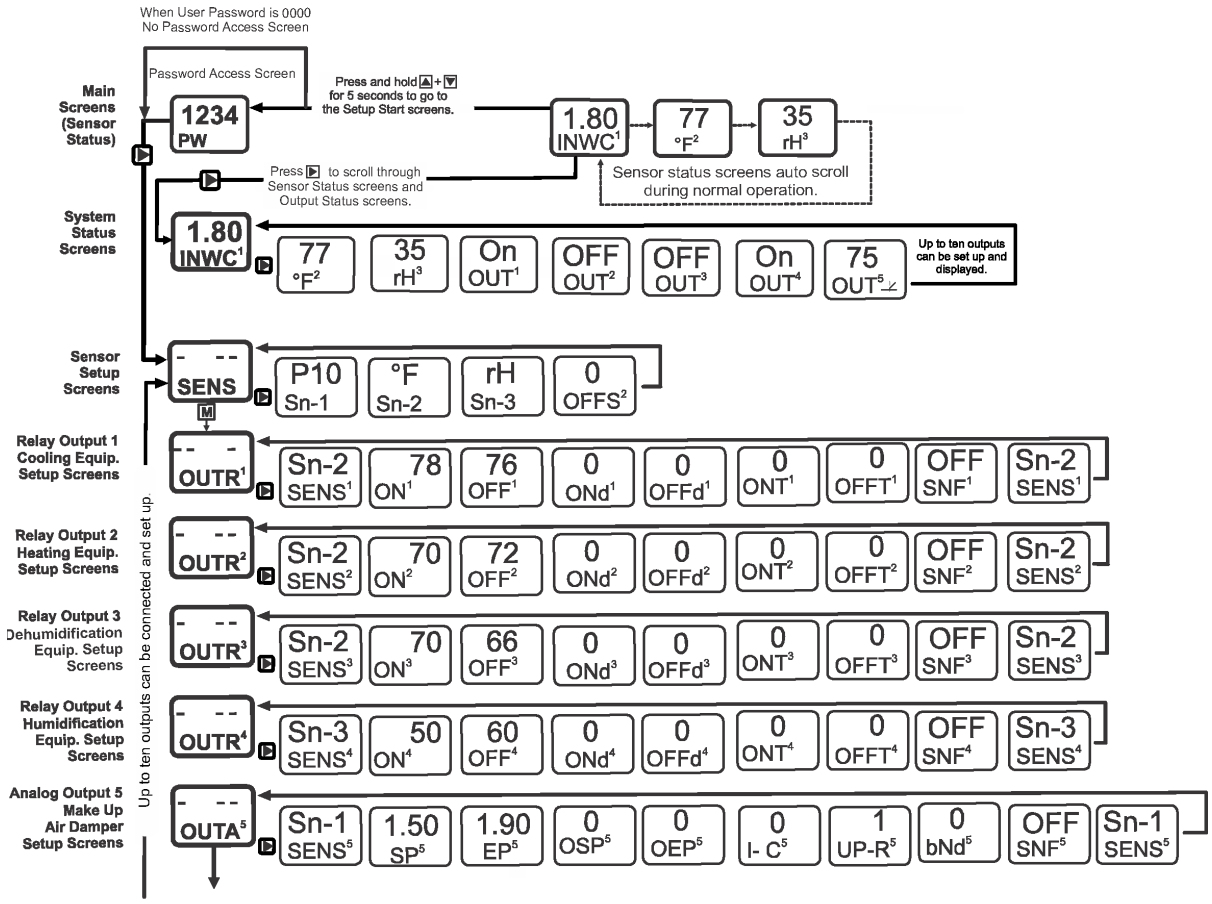
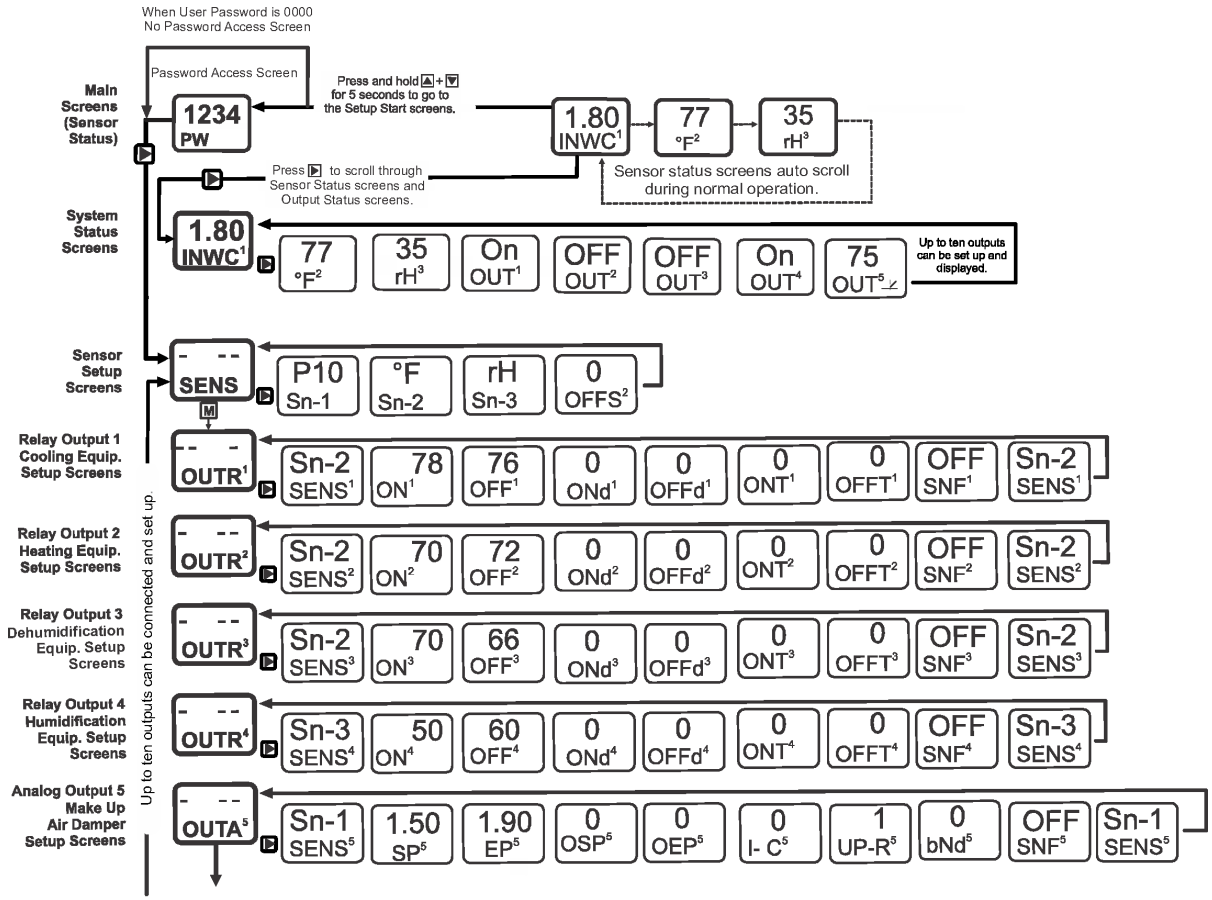


Figure 15: Main, System Status, and Setup Screens for a Solar Water Heating Control System Example that Uses the Differential Control Feature



See Figure 37 for Modbus communications setup screen information.

See Figure 41 for Ethernet communications setup screen information.

See Figure 31 for User and Admin Password setup screen information.

Selecting, Installing, and Setting Up Sensors

In a System 450 control system, all of the outputs reference one or more of the sensors that are wired to the control module and set up in the control module UI. Observe the following guidelines when selecting, installing, and setting up sensors for your control system:

- Select only System 450 compatible sensors. See Table 5 for a complete list of System 450 sensor types and models that are compatible with communications control modules. See Table 42 through Table 49 in *Repair and Ordering Information* for more information on System 450 compatible sensors.
- Select only the sensors that match the desired conditions and units of measurement, and are designed to operate in the ranges that your control system is intended to monitor and control.
- Ensure that the correct sensor is wired properly to the correct input terminals on the control module. See *Wiring System 450 Components*.
- Ensure that the wire length between the sensors and control module is as short as possible or practical, and ensure that the wiring is properly sized. Refer to the sensor installation instructions referenced in *Related Documentation* for more information on wiring sensors.

- Ensure that the correct sensor type is selected in the System 450 UI for each sensor wired to the control module. See *Setting Up the Sensors and Transducers*.
- Ensure that each output references the correct sensor in the System 450 UI. See *Setting up a System 450 Control System*.

Assembling System 450 Modules

After selecting the System 450 components for your control system, you must assemble the modules. Figure 4 shows an example of a System 450 module assembly.

Observe the following guidelines when assembling System 450 modules:

- Always locate the control module on the left side of the module assembly.
- Always plug the System 450 power module (when used) into the right side of the control module.
- Plug the expansion modules together, in any order, on the right side of the System 450 power module or on the right side of the control module when an external 24 V power supply is used instead of a System 450 power module. (See *Wiring System 450 Components* for information on wiring an optional external 24 VAC supply power to System 450 control systems that do not include a power module.)

Installing System 450 Components

Locating System 450 Modules

Observe these guidelines when locating and mounting System 450 modules:

- Ensure that the mounting surface can support the module assembly, DIN rail, mounting hardware, and any (user-supplied) panel or enclosure.
- Mount the modules in a horizontal, upright orientation wherever possible. DIN rail mounting is strongly recommended.
- In direct-mount applications, mount the modules on flat and even surfaces.
- Mount the modules in a location free of corrosive vapors and observe the ambient operating conditions in the *Technical Specifications*.
- Allow sufficient space for making connections, running wires, and viewing the LCD.
- Do not mount the modules on surfaces that are prone to vibration or in locations where high-voltage relays and motor-starters, electromagnetic emissions, or strong radio frequency 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 ambient temperature to exceed 66°C (150°F).

Mounting

About this task:
Mount System 450 modules on 35 mm DIN rail (recommended) or directly to a flat and even surface.
In this task you 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 in a suitable location using appropriate mounting hardware.

2. Clip the control module on the rail, position the module's upper DIN rail clips on the top rail, and gently snap the lower clips on to the bottom of the rail.

   ➤ **Important:** When mounting a module assembly on a DIN rail, clip the modules on to the DIN rail individually before gently sliding and plugging the mounted modules together on the DIN rail. Clipping a complete module assembly that is already plugged together on to the DIN rail can damage the 6-pin modular plugs and void any warranties.

3. Clip the remaining modules to the right of the control module on to the DIN rail and gently slide and plug the modules together. (If a System 450 power module is used, mount the power module on the right side of the control module so that the power module plugs directly into the control module.)

In this task you direct-mount modules to walls and other flat surfaces using the four keyhole slots.

1. Plug the modules together, remove the module covers, place the module assembly horizontally against the wall surface in a suitable location, and mark the mount hole locations on the mounting surface (Figure 2).

   ⓘ **Note:** The four keyhole slots on the communications module are not accessible from the front (even with the cover removed). Use another module to mark the communications module mounting hole locations on the mounting surface.

2. Install appropriate screws or fasteners, leaving the screw heads approximately one to two turns away from flush to the mounting surface.
3. Position the assembly mounting slots over the screw heads, and then carefully tighten the mounting screws to secure the assembly to the surface.

   ⓘ **Note:**

   - The mounting screws on a communications module cannot be accessed or tightened after the module is attached to the screws. The enclosure has a ramp molded into the keyhole slots, which allows you mount the module on the screw heads.
   - If you mount the modules on an uneven surface, use shims or washers to mount module assembly evenly on the surface.

Result

Refer to the sensor installation instructions referenced in *Related Documentation* for information on locating and mounting System 450 compatible sensors.

Wiring System 450 Components

When wiring your System 450 control system, observe the following guidelines. See Figure 16, Figure 18, Figure 19, Figure 20, Table 6, Table 8, Table 9, and Table 10 for wiring terminal locations and designations. See *Technical Specifications* for the electrical ratings for System 450 modules used to built System 450 control systems with communications.

⚠ WARNING

Risk of Electric Shock.

Disconnect or isolate all power supplies before making electrical connections. More than one disconnect 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.

➤ Important:

- Use copper conductors only. Make all wiring in accordance with local, national, and regional regulations.
- 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.
- 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.
- Electrostatic discharge can damage System 450 modules. Use proper Electrostatic Discharge (ESD) precautions during installation and servicing to avoid damaging System 450 modules.
- Do not connect supply power to the System 450 modules before checking all wiring connections. Short circuits or improperly connected wires can result in damage to the modules and void any warranty.
- 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.
- 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 16 shows the locations of and designations for the wiring terminals on a C450CRN-x control module with Modbus communications. Table 6 provides descriptions, ratings, requirements, and recommended cable types and wire sizes for a C450CRN-x control module with Modbus communications.

Figure 16: C450CRN-1 Control Module with Modbus Communications Showing Wiring Terminals

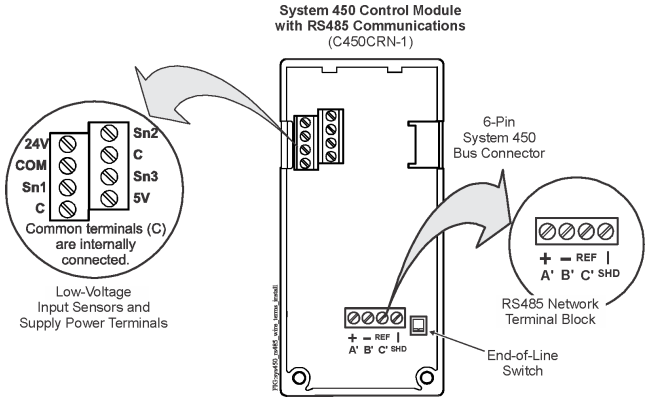


Table 6: System 450 Control Module with Modbus Communications Wiring Information

Terminal Block	Label	Function, Electrical Ratings and Requirements	Recommended Cable Type and Wire Sizes
Low Voltage and Input Sensors Terminal Block	24V	Provides internal 24 VAC rectified power at terminals for (humidity) sensors when a C450YNN-1C power module **is** connected in the control system module assembly. **or** Accepts external 24 V (20 to 30 VAC or 22 to 30 VDC) supply power for the control system, when a C450YNN-1C power module is **not** connected in the control system module assembly.	0.08 mm^2 to 1.5 mm^2 28 AWG to 16 AWG
	COM	Provides the internally or externally supplied 24 V power common connection.	
	S1, S2, S3	Accepts passive or active (0–5 VDC) input signals from control sensors[1].	0.08 mm^2 to 1.5 mm^2 28 AWG to 16 AWG
	C, C	Provide low-voltage common connections for the sensors connected to the 5V, Sn1, Sn2, or Sn3 terminals (only). ⓘ **Note:** The two **C** terminals are used for sensor common connections only. The two **C** terminals are connected internally.	
	5V	Provides 5 VDC power for active sensors.	

Table 6: System 450 Control Module with Modbus Communications Wiring Information

Terminal Block	Label	Function, Electrical Ratings and Requirements	Recommended Cable Type and Wire Sizes
Modbus Network Terminal Block	A’ +	Modbus Communications	0.34 mm^2 (22 AWG) stranded, 3-wire shielded cable recommended
	B’ -		
	C’ REF	Modbus signal Reference	
	SHD	Cable shield connection (splice) terminal ⓘ **Note:** SHD is an isolated terminal and is not connected to any internal System 450 circuit. The SHD terminal is used to splice the cable shield drains on the daisy-chained Modbus trunk.	

1 For sensor wire runs greater than 50 ft or where the sensor wiring is exposed to electromagnetic or radio frequency interference, use shielded cable and connect the shield to a C (common) terminal on the control module.

Figure 17 shows the locations of and designations for the wiring terminals on an Ethernet control module. Table 7 provides descriptions, ratings, requirements, and recommended cable types and wire sizes for an Ethernet control module.

Figure 17: C450CEN-1 Control Module with Ethernet Communications Showing Wiring Terminals

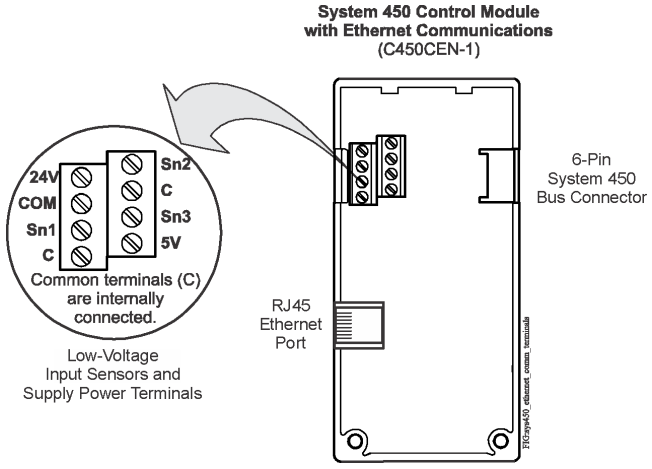


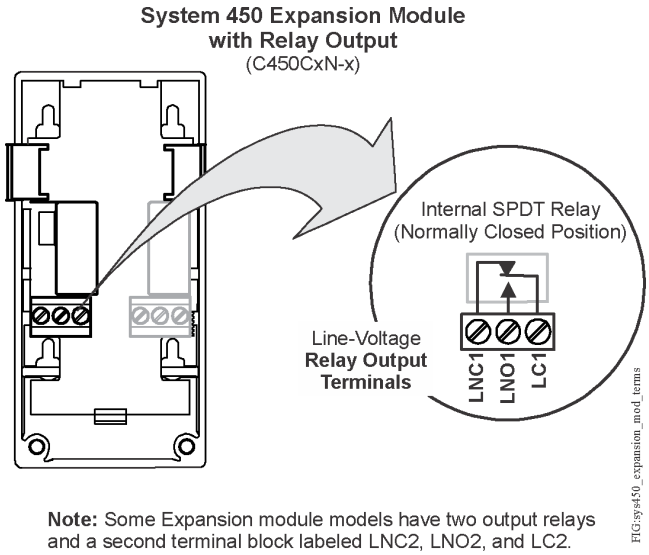
Table 7: System 450 Control Module with Ethernet Communications Wiring Information

Terminal Block	Label	Function, Electrical Ratings and Requirements	Recommended Cable Type and Wire Sizes
Low Voltage and Input Sensors Terminal Block	24V	Provides internal 24 VAC power at terminals for (humidity) sensors when a C450YNN power module **is** connected in the control system module assembly. **or** Accepts external 24 VAC (20–30 VAC) supply power for the control system, when a C450YNN-1C power module is **not** connected in the control system module assembly.	0.08 mm^2 to 1.5 mm^2 28 AWG to 16 AWG
	COM	Provides the common connection for 24 VAC power terminal for either internally or externally supplied 24 VAC power (only).	
	S1, S2, S3	Accepts passive or active (0–5 VDC) input signals from control sensors[1].	0.08 mm^2 to 1.5 mm^2 28 AWG to 16 AWG
	C, C	Provide low-voltage common connections for the sensors connected to the 5V, Sn1, Sn2, or Sn3 terminals (only). ⓘ **Note:** The two **C** terminals are use for sensor common connections only. The two **C** terminals are connected internally.	
	5V	Provides 5 VDC power for active sensors.	
Ethernet Port		8-Pin RJ45 modular jack for connecting to an Ethernet network. Yellow LED (Network Speed) OFF indicates 10Mb; ON indicates 100 Mb. Green LED (Activity) OFF indicates the link is inactive; ON indicates the link is active; blinking indicates activity.	CAT 5 Straight-Through or Crossover Cable.

1 For sensor wire runs greater than 50 ft or where the sensor wiring is exposed to electromagnetic or radio frequency interference, use shielded cable and connect the shield to a C (common) terminal on the control module.

Figure 18 shows the locations of and designations for the wiring terminals on C450SBN-x and C450SCN-x expansion modules with relay output. Table 8 provides descriptions, ratings, requirements, and recommended wire sizes for C450SBN-x and C450SCN-x expansion modules with relay output. See *Relay Outputs* for information regarding Relay Output control actions.

Figure 18: System 450 C450SxN-x Expansion Module with Relay Output Showing Wiring Terminals and Relay Contact Positions



Note: Some Expansion module models have two output relays and a second terminal block labeled LNC2, LNO2, and LC2.

Table 8: System 450 Relay Expansion Modules Wiring Terminals and Wire Size Information

Terminal Block Type	Terminal Label	Terminal Function	Required Wire Sizes
Line-Voltage Output Relay Terminal Blocks	**LNC1, LNC2**	Connects equipment control circuit to the Line-voltage Normally Closed (LNC) contact on the SPDT relay. ⓘ **Note:** The LNC2 terminal is only on expansion module models with two output relays.	28 AWG to 14 AWG 0.08 mm^2 to 2.5 mm^2
	LNO1, LNO2	Connects equipment control circuit to the Line-voltage Normally Open (LNO) contact on the SPDT relay. ⓘ **Note:** The LNO2 terminal is only on expansion module models with two output relays.	
	LC1 LC2	Connects line power to the Line-voltage Common (LC) on the SPDT relay. ⓘ **Note:** The LC2 terminal is only on expansion module models with two output relays.	

Table 8 shows the location of and designations for the wiring terminals on C450SPN-x and C450SQN-x expansion modules with analog output. Table 9 provides descriptions, ratings, requirements, and recommended wire sizes for C450SPN-x and C450SQN-x expansion modules with analog output. See *Analog Outputs* for information regarding Analog Output control actions.

Figure 19: System 450 C450SQN-x Expansion Module with Analog Output Showing Low-Voltage Analog Output Terminals and Signal Polarity

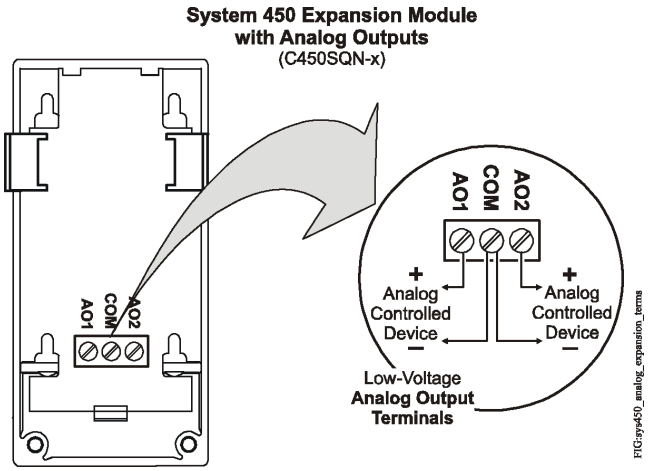


Table 9: System 450 Analog Expansion Module Wiring Terminal and Wire Size Information

Terminal Block Type	Terminal Label	Terminal Function	Required Wire Sizes
Low-Voltage Analog Output Terminal Block	**AO1** **AO2**	In conjunction with the COM terminal, provides a self-detecting analog output signal; either 0 to 10 VDC or 4 to 20 mA. ⓘ **Note:** The AO2 terminal is only on expansion module models with two analog outputs.	28 AWG to 16 AWG 0.08 mm^2 to 1.5 mm^2
	COM	In conjunction with the AO1 or AO2 terminal, provides a self-detecting analog output signal; either 0 to 10 VDC or 4 to 20 mA.	

Figure 20 shows the location of and designations for the wiring terminals on a C450YNN-1C power module. Table 10 provides descriptions, ratings, requirements, and recommended wire sizes for a C450YNN-1C power module.

Figure 20: System 450 C450YNN-1C Power Module Showing High-Voltage Supply Power Terminals

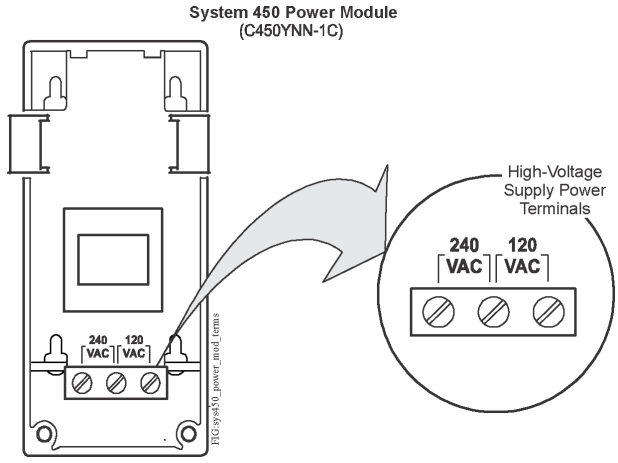


Table 10: System 450 Power Module Wiring Terminal and Wire Size Information

Terminal Block Type (on Module Type)	Terminal Label	Terminal Function	Required Wire Sizes
Line-Voltage Supply Power Terminal Block (on Power Modules)	**240 VAC**	Left terminal is for one 240 VAC supply power lead.	22 AWG to 14 AWG 0.34 mm^2 to 2.5 mm^2
	No Label on the Middle Terminal	Middle terminal is the Common connection for either the 120 VAC or 240 VAC supply power lead.	
	120 VAC	Right terminal is for one 120 VAC supply power lead.	

Wiring System 450 Sensors and Transducers

Refer to the sensor installation instructions referenced in *Related Documentation* for information on wiring System 450 compatible sensors.

Setting up a System 450 Control System

After assembling the modules, your System 450 control system is ready to connect to power and to be set up in the control module UI.

Note:

- You can power on and set up your System 450 control system in the control module UI before installing the module assembly or wiring the sensors and outputs.
- The sensors or transducers must be set up in the System 450 UI before you can set up any of the control system outputs. See *Setting Up the Sensors and Transducers* for more information and detailed procedures.

Determining Output Numbers and Output Types

After all of the modules in your control system are properly assembled and each time power is supplied to the module assembly, the control module automatically polls all of the modules in the assembly, assigns output numbers, and determines output types and their order in the assembly.

The control module assigns a sequential output number to each output in the module assembly, starting with the output farthest to the left in the module assembly (first expansion module), which is assigned output number 1. Each output to the right of output 1 is assigned an output number; the numbers are 2 to 9 in order of the output's physical position, left to right, in the module assembly. Zero (0) is assigned to output 10, if the control system has ten outputs. See Figure 4 for an example of output numbers in a module assembly.

The control module also determines if an output is a relay output or an analog output, and generates the appropriate status screens and setup screens in the System 450 UI for each output.

Important: Do not change the module positions after a System 450 control system is assembled, powered, and set up in the System 450 UI. System 450 control logic is set up in the UI according to the Sensor Type, Output Type, and Output Number. If you change the module positions in a module assembly that is already set up in the UI, the output numbers and default setup values for the outputs also change, which often requires you to set up the entire control system in the UI again.

System 450 UI Navigation Guidelines

See the example menu flowchart in Figure 3 and the following general guidelines for information on navigating the System 450 UI on communications control modules.

- During normal operation, the Main screens (sensor status screens) auto-scroll, displaying the control system's sensor statuses on the LCD.
- While the Main screens are auto scrolling on the LCD, press **Next** (repeatedly) to manually scroll through the sensor status and output status screens.
- While the Main screens are auto scrolling on the LCD, press and hold **Up** and **Down** simultaneously for 5 seconds to go to the Sensor Setup Start screen and access the rest of the System Setup screens.

  ⓘ **Note:** If the system is set up for local UI password protection, a password challenge screen appears. See *System 450 Local Password Protection* for more information.
- While in any System Setup Start screen, press **Menu** repeatedly to scroll through the System Setup Start screens for your control system. (You cannot type values in System Setup Start screens.)
- You **must** set up the sensors before you can set up the outputs. (See *Setting Up the Sensors and Transducers* for procedures for setting up the sensors.)
- An output's type (relay or analog) and output's ID number in the UI is determined by the output types on the connected expansion modules and the order in which the modules are connected in the module assembly. (See *Module Assemblies, Output Types, and Output Numbers* for more information.)

  ⓘ **Note:** System 450 communications control modules do not have onboard outputs. In communications control systems, outputs are provided by expansion modules only.
- An output's setup parameters are determined by the output's type (relay or analog) and the Sensor Type of the sensor you select for the output to reference. (See *Expansion Modules, Module Assemblies, and Outputs* and *System 450 Control System Examples* for more information.)
- In System Setup screens with flashing values, you can change the parameter value by pressing **Up** or **Down**. When the desired parameter value is flashing in the setup screen, press **Next** to save the selected value and go to the next setup screen.
- After 2 minutes of inactivity in a System Status or System Setup screen, the LCD reverts back to the Main screens.

Accessing and Navigating the User Interface

System 450 control modules feature a backlit LCD and a four-button touchpad UI for monitoring system status and setting up the sensors and outputs in your control system. Figure 2 describes the System 450 UI features and functions.

During normal operation, the System 450 control module LCD displays the Main screens. The Main screens are the sensor status screens, which scroll automatically and provide real-time status of the conditions sensed at the hard-wired and functional sensors.

Figure 21 shows an example of the System 450 Main screens and System Status screens.

Viewing the System Status Screens

From the Main screens, you can scroll through and view the System Status screens.

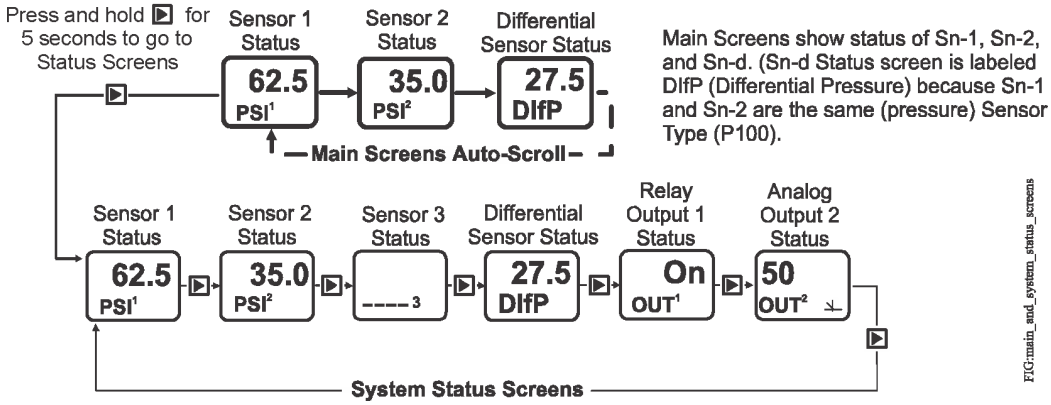
To view the system status screens, while the control module LCD is auto-scrolling through Main screens, press **Next** (repeatedly) to scroll through and display the Sensor Status screens and the Output Status screens for all sensors and outputs set up in your control system.

When you stop pressing **Next**, the Sensor or Output Status screen that is being viewed is displayed for 2 minutes before it times out and reverts to the Main screens. The 2-minute pause allows you to monitor a sensor that is changing quickly during system setup or normal system operation.

System 450 Main screens display the status at the hard-wired Sn-1, Sn-2, and Sn-3 sensors, and the statuses of the functional sensor Sn-d when used in the control system. The System Status screens also display hard-wired and functional sensor statuses along with output statuses.

Figure 21 shows the Main screens (sensor status) and the System Status screens (sensor and output status) for a standard System 450 control system that is set up for differential pressure control.

Figure 21: Main Screens and System Status Screens Example for a Standard System 450 Control System Set Up for Differential Control



Accessing the System Setup Screens

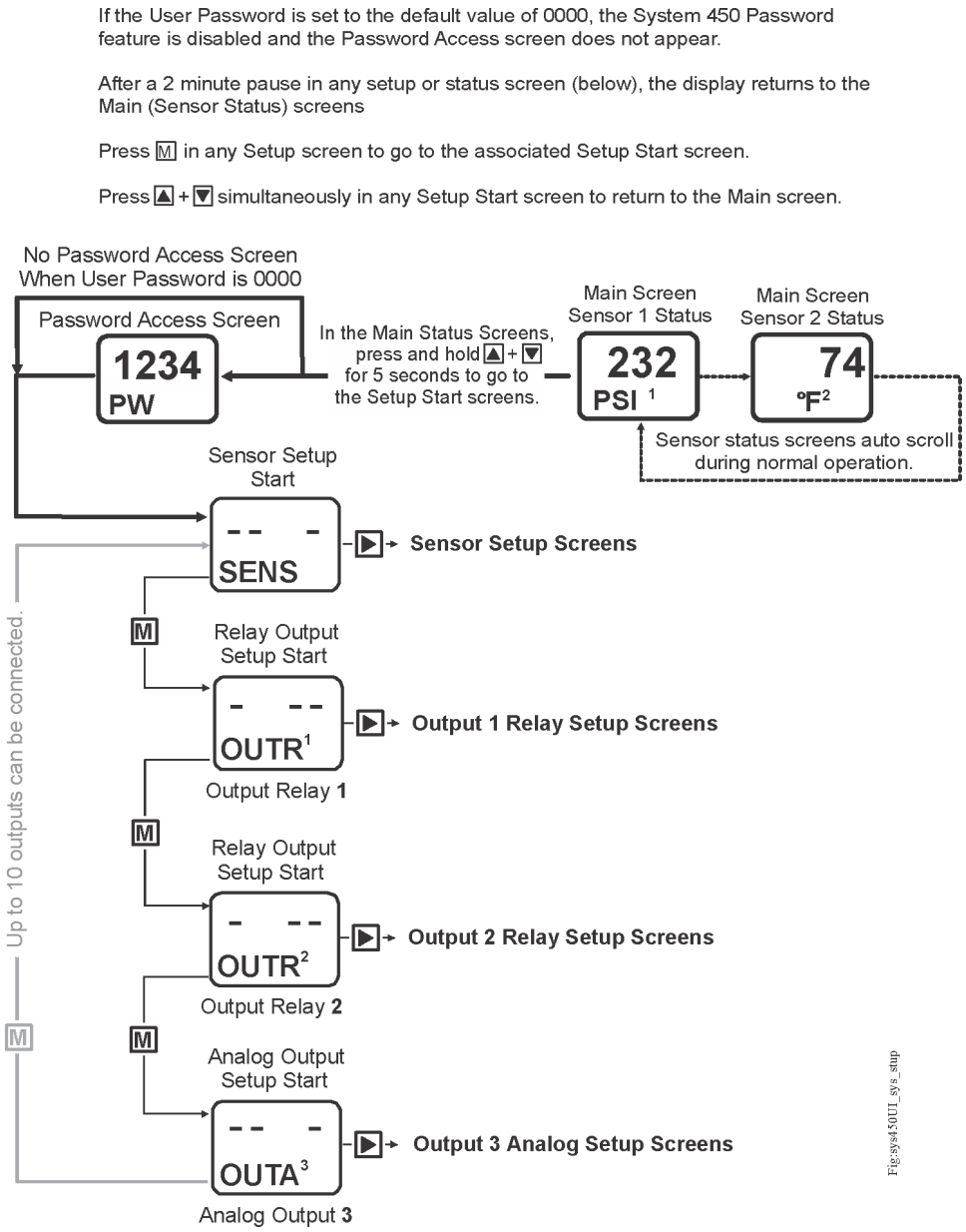
About this task:
From the Main screens, you can also access the Sensor Setup Start screen and the Output Setup Start screens.

- From the Sensor Setup Start screen, you can set up all of the hard-wired sensors for your control system. (See *Setting Up the Sensors and Transducers* for procedures on setting up the sensors and transducers.)
- From the Output Setup Start screens, you can set up each output in your control system. (See *Setting up a Relay Output* and *Setting up an Analog Output* for procedures on setting up outputs.)

In this task you access and navigate the System 450 Setup Start screens.

1. In the **Main** screens, press **Up** and **Down** simultaneously and hold for 5 seconds:
   a. If the User password is set to the default value of 0000, the password protection feature is disabled and the **Sensor Setup Start** (**SENS**) screen appears (Figure 22).
   b. If the User password is set to any value other than the default value of 0000, the password protection feature is enabled and the **Password Access** (**PW**) screen appears (Figure 22) and you must enter either the User password or the Admin password to go to the **Sensor Setup Start** (**SENS**) screen. See *System 450 Local Password Protection* for more information.

Figure 22: Accessing the Setup Start Screens in the System 450 UI



2. Press **Menu** (repeatedly) to scroll through and access the **Output Setup Start (OUTX^{x})** screens for all of the outputs in your control system.

   ⓘ **Note:** All Setup Start screens have four flashing dashes in the setup value fields. You cannot enter values for the fields in the Setup Start screens.

3. Depending on the Setup Start screen that you have navigated to, press **Next**:

   - in the **Sensor Setup Start (SENS)** screen to go the **Select Sensor 1 Type** (**Sn-1**) screen and set up the sensors in your control system. (See *Setting Up the Sensors and Transducers* for procedures on setting up the hard-wired sensors and transducers.)
   - in any **Output Setup Start (OUTX^{x})** screen to go to the first output setup screen for the output. (See *Setting up a Relay Output* or *Setting up an Analog Output* for the procedures for setting up outputs.)

ⓘ **Note:** You must set up the sensors and transducers in the System 450 UI before you can set up the outputs in the UI.

Result
In any of the system setup screens, press **Menu** to return to the setup start screen. In the setup start screen, press **Up** and **Down** simultaneously or wait two minutes to return to the Main screens.

Setting Up the Sensors and Transducers

About this task:
To set up the sensors and transducers in your control system, you must select the correct Sensor Type in the System 450 UI for each sensor and transducer used in your application. You can also select an optional temperature offset value for any temperature sensor that is set up in your control system.

ⓘ **Note:** System 450 compatible sensors consist of temperature sensors, humidity sensors, and pressure transducers. The term sensor refers to all System 450 compatible input devices including transducers, unless noted otherwise.

The Sensor Type you select for a sensor or transducer automatically determines the condition type, unit of measurement, minimum differential, setup value ranges, and default setup values for each output in your control system that references the sensor.

Communications control modules:

- support specified temperature sensors, pressure transducers, and humidity sensors.
- support binary inputs (a external set of dry contacts) connected to input sensor terminals (Sn1, Sn2, or Sn3 and C)
- support configuration of Sn-1, Sn-2, and Sn-3 as any supported Sensor Type.
- support the functional sensors HI-2 and HI-3 and the High Input Signal Selection feature.
- support the functional sensor Sn-d and the Differential Control feature.
- require Sn-1 and Sn-2 to be the same Sensor Type to set up the functional sensors HI-2 and Sn-d.
- require Sn-1, Sn-2, and Sn-3 to be the same Sensor Type to set up the functional sensor HI-3 (in addition to HI-2 and Sn-d).

ⓘ **Note:** For a System 450 control system to operate properly, you must wire the correct sensor or transducer model to the correct sensor input terminals on the control module, and select the correct Sensor Type in the associated Select Sensor Type screen in the System 450 UI. See Table 2 for System 450 Sensor Types and their associated values and settings.

See Table 42 through Table 49 in *Repair and Ordering Information* for more information on System 450 compatible sensors.

System 450 allows you to select an offset for each temperature sensor (only) in your control system. Whenever you select the **°F** or **°C** Sensor Type for a sensor, a Select Temperature Offset screen appears after the Select Sensor 3 Type screen for each temperature sensor in your control system.

The Select Temperature Offset screens are:

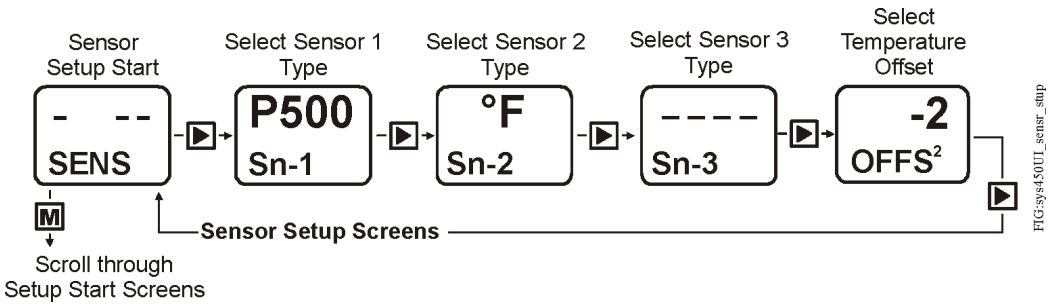
- Sensor Type **°F**, which enables an offset of up to +/- 5°F in 1-degree increments.
- Sensor Type **°C**, which enables an offset of up to +/- 2.5°C in 0.5-degree increments.

The temperature offset adjusts the displayed temperature value, sensed at the sensor, by the offset value. For example, if the measured value is 72(°F) without an offset, and a -2(°F) offset is selected, the measured value is offset -2(°F) and the displayed value is 70(°F).

To set up the sensor's Sensor Type and offsets for the temperature sensors:

1. Access the System 450 UI and navigate to the **Sensor Setup Start (SENS)** screen (Figure 23).
2. In the **Sensor Setup Start (SENS)** screen, press **Next** to go to the next screen.

Figure 23: Sensor Setup Start, Select Sensor Type,and Select Temperature Offset Screens



3. In the **Select Sensor 1 Type (Sn-1)** screen, press **Up** or **Down** to scroll through the Sensor Types. When the desired Sensor Type is displayed (blinking), press **Next** to save the Sensor Type selection and go to the Select Sensor 2 Type screen.
4. Repeat Step 3 in the **Select Sensor 2 Type (Sn-2)** screen and **Select Sensor 3 Type (Sn-3)** screen if your control system uses a second or third sensor.

   After you have selected the correct Sensor Type for each sensor in your control system, the sensors are set up in the UI and can be selected and referenced by the outputs that you set up in the system.

   ⓘ **Note:** System 450 communications control modules provide for three functional sensors. When Sn-1 and Sn-2 are set up as the same Sensor Type, the High Input Signal Selection functional sensor (HI-2) and Differential Control functional sensor (Sn-d) are enabled and available in the Sensor Selection screens for each output. When Sn-1, Sn-2, and Sn-3 are the same Sensor Type, the High Input Signal Selection functional sensor (HI-3) is also enabled and available. See *High Input Signal Selection* and *Differential Control* for more information on these functional sensors and the associated control features.

5. If a temperature Sensor Type (**°F** or **°C**) is selected for a sensor in your control system, a **Select Temperature Offset (OFFS^{x})** screen is displayed after the **Select Sensor 3 Type (Sn-3)** screen (for each temperature sensor in your control system). Select the desired temperature offset by pressing **Up** or **Down**. Press **Next** to save the offset value and go to the next screen.
6. After all of the sensors and temperature offsets are set up:

   - Press **Next** to return to the **Sensor Setup Start (SENS)** screen; then press **Menu** to scroll through the output setup start screens and set up the outputs in your control system. (See *Setting up Control System Outputs* for procedures on setting up outputs for your control module.)
   - Allow the UI to remain dormant for 2 minutes and the Main screen begins to autoscroll. You may also return to the Main screen by pressing **Up** and **Down** simultaneously while a Setup Start screen is displayed.

Setting up Control System Outputs

After setting up the sensors for your System 450 communications control system, you can reference the hard-wired sensors (and any functional sensors that resulted from the hard-wire sensor setup) as you set up the outputs.

Setting up a Relay Output

About this task:
Relay Outputs provide single and multiple stage on/off control to controlled equipment. A Relay Output can be set up to be a direct acting relay or reverse acting relay (Figure 24 and Figure 25). See *Relay Outputs* for more information about System 450 Relay Output operation and the relay ON and OFF states.

Figure 24: Direct Acting Relay (OFF < ON) Set Up to Control Cooling

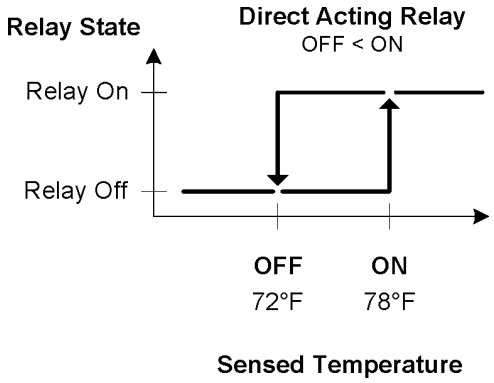
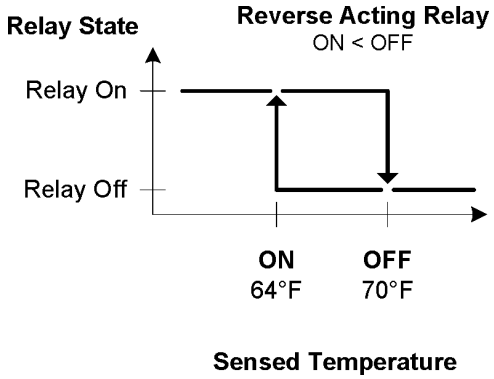


Figure 25: Reverse Acting Relay (ON < OFF) Set Up to Control Heating



When you supply power to a module assembly, the control module polls all of the connected modules, detects all of the outputs in the module assembly, then assigns an output number to each output, and enables a **Relay Output Setup Start (OUTR^{x})** screen for each relay output detected (Figure 26).
The first screen in the relay output setup menu flow is the **Sensor Selection (SENS^{x})** screen. The sensor you select (Sn-1, Sn-2, Sn-3, HI-2, HI-3, or Sn-d) in this screen determines the Sensor Type parameter ranges and values available in the remaining output setup screens.

Note: The condition (temperature, pressure, or humidity), unit of measurement, minimum differential value, default setup values, and condition value ranges available in the output setup screens are determined by the Sensor Type for the sensor that an output references. See Table 5 for more information on sensors that are compatible with System 450 communications control modules, their Sensor Types, and the values and ranges associated with each Sensor Type.

The Relay ON and Relay OFF parameters allow you to select the condition values at which the relay turns on and turns off. The first time you access the Relay ON (ON^{x}) and Relay OFF (OFF^{x}) screens, the default ON and OFF values for the referenced sensor appear.

Note: If you select a sensor (Sn-1, Sn-2, or Sn-3) that is set up as a binary input, the ON and OFF selections screens do not appear in the Relay Output Setup screens. The relay ON and OFF state is controlled by the binary input state. See *Binary Input Control for Relay Outputs* for more information.

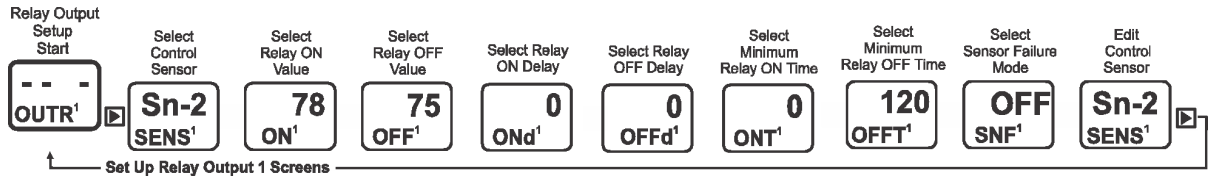
The **minimum differential value** for the condition is determined by the Sensor Type of the sensor that an output references. The minimum differential is fixed and is automatically enforced in the setup UI when you select ON and OFF values. After you select the ON value, the condition values within the minimum differential range are not available to select. See Table 5 for minimum differential ranges.

The ON Delay Time and OFF Delay Time parameters allow you to set a time (0 to 300 seconds) to delay the relay from going On or Off after the ON or OFF value is reached. See *Relay On and Off Duration Control* for more information.

The Minimum Relay ON Time and Minimum Relay OFF Time parameters allow you to set a minimum time (0 to 300 seconds) that the relay stays On or Off after the ON or OFF value is reached. See *Relay On and Off Duration Control* for more information.

The Sensor Failure Mode parameter allows you to select whether the output relay is on or off if the referenced sensor encounters a sensor or wiring failure. See *Sensor Failure Mode* for more information.

Figure 26: Relay Output Setup Start Screen and Setup Screen Flow



In this task you set up a relay output.

1. Access the System 450 UI and navigate to the desired **Relay Output Setup Start (OUTR[x])** screen (Figure 26). (See *Accessing and Navigating the User Interface*.)
2. In the **Relay Output Setup Start (OUTR[x])** screen, press **Next** to go to the **Select Sensor (SENS[x])** screen. (The Select Sensor screen does not appear here if a sensor is already selected for this output. In that case, go to the next step.) Press **Up** or **Down** to select the hard-wired or functional sensor (Sn-1, Sn-2, Sn-3, Sn-d, HI-2, or HI-3) that the output references. Press **Next** to save the sensor selection and go to the next screen.
3. In the **Select Relay ON Value (ON[x])** screen, press **Up** or **Down** to select the temperature, pressure, or humidity value at which the relay turns On. Press **Next** to save the ON value and go to the next screen.
   Note: If you selected the **Sn-d** sensor in Step 2, the **Select Relay Differential ON Value (dON[x])** screen is displayed. Press **Up** or **Down** to select the temperature, pressure, or humidity differential value at which the relay turns On. Press **Next** to save the dON value and go to next screen. (See *Differential Control* for more information.)
4. In the **Select Relay OFF Value (OFF[x])** screen, press **Up** or **Down** to select the temperature, pressure, or humidity value at which the relay turns Off. Press **Next** to save the OFF value and go to the next screen.
   Note: If you selected the **Sn-d** sensor in Step 2, the **Select Relay Differential OFF Value (dOFF[x])** screen is displayed. Press **Up** or **Down** to select the temperature, pressure, or humidity differential value at which the relay turns OFF. Press **Next** to save the dOFF value and go to the next screen. (See *Differential Control* for more information.)

5. In the **Select ON Time Delay (ONd*)** screen, press **Up** or **Down** to select the number of seconds that the relay output delays going to the On state after the Relay ON (or dON) value is reached. Press **Next** to save the ONd value and go to the next screen. (See *Relay On and Off Duration Control* for more information.)
6. In the **Select OFF Time Delay (OFFd*)** screen, press **Up** or **Down** to select the number of seconds that the relay output delays going to the OFF state after the Relay OFF (or dOFF) value is reached. Press **Next** to save the OFFd value and go to the next screen. (See *Relay On and Off Duration Control* for more information.)
7. In the **Select Minimum Relay ON Time (ONT*)** screen, press **Up** or **Down** to select the minimum number of seconds that the relay remains On after the Relay goes ON. Press **Next** to save the ONT value and go to the next screen. (See *Relay On and Off Duration Control* for more information.)
8. In the **Select Minimum Relay OFF Time (OFFT*)** screen, press **Up** or **Down** to select the minimum number of seconds that the relay remains Off after the Relay goes OFF. Press **Next** to save the OFFT value and go to the next screen. (See *Relay On and Off Duration Control* for more information.)
9. In the **Select Sensor Failure Mode (SNF*)** screen, press **Up** or **Down** to select whether the output relay stays on or off when a sensor failure is detected. Press **Next** to save the Sensor Failure Mode value and go to the next screen.
10. In the **Edit Sensor (SENS*)** screen:

    - If the displayed sensor (Sn-1, Sn-2, Sn-3, Sn-d, HI-2, or HI-3) is the correct sensor for the output relay, the output setup is complete. Press **Next** to return to the Relay Output Setup Start screen.
    - If the displayed sensor (Sn-1, Sn-2, Sn-3, Sn-d, HI-2, or HI-3) is **not** the correct sensor for the output relay, press **Up** or **Down** to select the correct sensor. Press **Next** to save the new sensor selection and go to the Relay Output Setup Start screen. Press **Next** again to go to the Relay ON Value screen and repeat Step 3 through Step 10 for the new sensor.

Result
The relay output is set up and saved in the control module. If you need to set up the next output, press **Menu** to navigate to the next Output Setup Start screen. If you have completed your control system setup, press **Up** and **Down** simultaneously or wait two minutes to return to the Main screens.

Setting up an Analog Output

About this task:
Analog Outputs provide proportional analog control signals to controlled equipment based on the sensed conditions. See *Analog Outputs* for more information.
When you supply power to a module assembly, the control module polls all of the connected modules, detects all of the outputs in the module assembly, then assigns an output number to each output, and enables an **Analog Output Setup Start (OUTA*)** screen for each analog output detected (Figure 29). See *Analog Outputs* for more information.

ⓘ **Note:** The condition (temperature, pressure, or humidity), unit of measurement, minimum differential value, default setup values, and condition value ranges available in the output setup screens are determined by the Sensor Type of the sensor that you select for the output. See Table 5 for more information on sensors that are compatible with System 450 communications control modules, their Sensor Types, and the values and ranges associated with each Sensor Type.

The Setpoint (SP) and End Point (EP) parameters allow you to set up a proportional band (or throttling range) for the control loops in your controlled system.

The Output at Setpoint (OSP) and Output at End Point (OEP) parameters allow you to select the output signal strength (as a percentage of the total signal strength range) that an analog output sends to the controlled equipment at Setpoint and End Point.

The relationship between these four setup values (SP, EP, OSP, and OEP) determines the analog output's proportional control action, which is indicated on the control module LCD by the control ramp indicator. See Figure 2 and *Direct and Reverse Control Actions for Analog Outputs* for more information on the control ramp indicator.

Figure 27: Relationship between Setpoint, End Point, Output at Setpoint, and Output at End Point for an Analog Output That Controls Room Heating

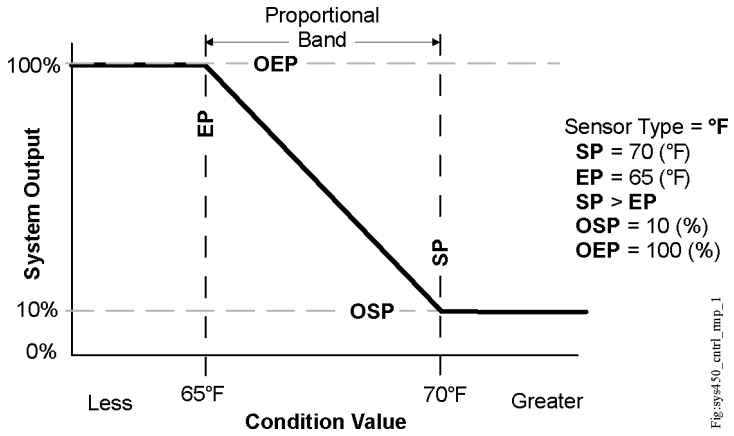
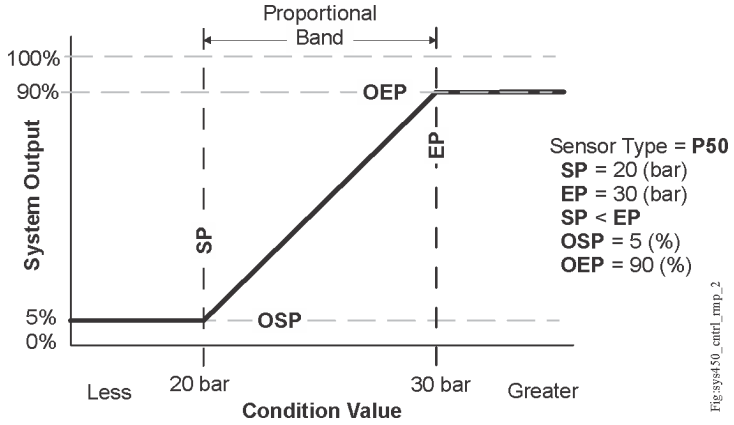


Figure 28: Relationship between Setpoint, End Point, Output at Setpoint, and Output at End Point for an Analog Output That Controls Condenser Fan Speed



Note: System 450 analog outputs that reference the differential control sensor (Sn-d) use a Differential Setpoint (dSP) and Differential End Point (dEP) to define the output's proportional band. See *Differential Control* for more information.

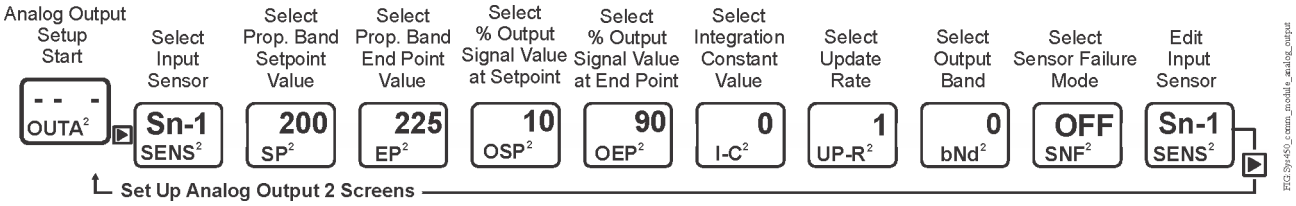
The Integration Constant (I-C) parameter allows you to select an integration constant for the analog signal. Selecting an integration constant other than 0 enables proportional plus integral control action, which in many applications can drive the condition closer to setpoint (than proportional-only control action). See *Proportional Plus Integral Control and Integration Constants* for more information. See *Determining the Integration Constant for an Analog*

Output for procedures on determining and testing the integration constants in your control application.

The Output Signal Update Rate screen and the Output Signal Dead Band screen allow you to reduce the rate at which an analog output updates the output signal strength, reducing wear on controlled equipment such as actuators. See *Analog Output Update Limiters* and *Analog Output Dead Band* for more information.

The Sensor Failure Mode (SNF) parameter allows you to select whether the analog output signal is off (corresponding to the lowest output capacity) or on (corresponding to the highest output capacity) when a sensor failure is detected. See *Sensor Failure Mode* for more information.

Figure 29: Analog Output Setup Start Screen and Setup Screens Flow



In this task you set up an analog output.

Note: In any of the system setup screens, press **Menu** to return to the setup start screen. In the setup start screen, press **Up** and **Down** simultaneously or wait two minutes to return to the Main screens.

1. Access the System 450 UI and navigate to the desired **Analog Output Setup Start (OUTA^{x})** screen (Figure 29). (See *Accessing and Navigating the User Interface* for information on accessing the System Setup screens.)
2. In the **Analog Output Setup Start (OUTA^{x})** screen, press **Next** to go to the **Select Sensor (SENs^{x})** screen. (The Select Sensor screen does not appear here if the sensor is already selected for this output. In that case, go to the next step.) Press **Up** or **Down** to select the hard-wired or functional sensor (Sn-1, Sn-2, Sn-3, Sn-d, HI-2, or HI-3) that the output references. Press **Up** to save the sensor selection and go to the Select Setpoint Value screen.
3. In the **Select Setpoint Value (SP^{x})** screen, press **Up** or **Down** to select the Setpoint value. (The controlled system drives towards Setpoint [SP] and away from End Point [EP], which together define the proportional band for the analog output.) Press **Next** to save the Setpoint value and go to the next screen.

   Note: If you selected the **Sn-d** sensor in Step 2, the **Select Differential Setpoint Value (dSP^{x})** screen is displayed. Press **Up** or **Down** to select the temperature, pressure, or humidity differential value towards which the controlled system is driving. Press **Next** to save the dSP value and go to the **Select Differential End Point Value (dEP^{x})** screen. (See *Differential Control* for more information.)
4. In the **Select End Point Value (EP^{x})** screen, press **Up** or **Down** to select the End Point value. (The controlled system operates between Setpoint and End Point, which together define the proportional band for the analog output.) Press **Next** to save the End Point value and go to the next screen.

ⓘ **Note:** If you selected the **Sn-d** sensor in Step 2, the **Select Differential End Point Value (dEP^{x})** screen is displayed, press **Up** or **Down** to select the differential End Point value. (The controlled system operates between differential Setpoint and differential End Point, which together define the proportional band for the analog output.) Press **Next** to save the dEP value and go to the next screen. (See *Differential Control* for more information.)

5. In the **Select Output Signal Strength at Setpoint (OSP^{x})** screen, press **Up** or **Down** to select the value in percent of the output signal strength (0 to 100%), corresponding to the lowest output capacity, when the sensor is at Setpoint (SP^{x}). Press **Next** to save the displayed OSP value and go to the next screen.
6. In the **Select Output Signal Strength at End Point (OEP^{x})** screen, press **Up** or **Down** to select the value in percent of the output signal strength (0 to 100%), corresponding to the highest output capacity, when the sensor is at the End Point (EP^{x}). Press **Next** to save the displayed OEP value and go to the next screen.
7. In the **Select Integration Constant (I-C^{x})** screen, press **Up** or **Down** to select the integration constant value for the analog output. (See *Determining the Integration Constant for an Analog Output* for more information.) Press **Next** to save the displayed I-C value and go to the next screen.
8. In the **Select Output Signal Update Rate** (**UP-R^{x}**) screen, press **Up** or **Down** to select the output update rate value. One (second) is the default value. You can select a value between 1 and 240 (seconds). (See *Analog Output Update Limiters* for more information.) Press **Next** to save the output update rate value and go to the next screen.
9. In the **Select Output Signal Dead Band** (**bNd^{x}**) screen, press **Up** or **Down** to select the output dead band value as a percentage of the total output signal range. Zero (percent) is the default value. You can select a value between 0 and 50 (percent). (See *Analog Output Dead Band* for more information.) Press **Next** to save the output dead band value and go to the next screen.
10. In the **Select Sensor Failure Mode (SNF^{x})** screen, press **Up** or **Down** to select whether the analog output signal is to be set to its ON or OFF value when a failure of the referenced sensor is detected. (When sensor that is referenced by analog output fails, the ON value sets the output to the OEP value and the OFF value sets the output to the OSP value.) Press **Next** to save the displayed SNF value and go to the next screen.
11. In the **Edit Sensor (SENS^{x})** screen, you can change the hard-wired or functional sensor that the output currently references:

    - If the displayed sensor (Sn-1, Sn-2, Sn-3, Sn-d, HI-2, or HI-3) is the correct sensor for the output relay, the output setup is complete. Press **Next** to go to the Analog Output Setup Start screen.
    - If the displayed sensor (Sn-1, Sn-2, Sn-3, Sn-d, HI-2, or HI-3) is not the correct sensor for the output relay, press **Up** or **Down** to select the correct sensor. Press **Next** to save the new sensor selection and go to the Analog Setpoint Value screen. Repeat Step 3 through Step 10 for the new sensor.

12. When you complete setting up the analog output, press **Menu** to return to the **Analog Output Setup Start (OUTA^{x})** screen.

Result
The analog output is set up and saved in the control module.

Setting Up Outputs That Reference a P 110 Sensor

The P 110 Sensor Type can monitor negative pressure down to 20 inHg (-10 psi). When referencing a P 110 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 P 110 sensor and the setup value is a negative pressure value, you must select the pressure value in negative psi (not inHg).

Use Table 11 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 11: inHg Target Values and Equivalent 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

When an output is set up for Differential Control and references the P 110 Sensor Type (Sn-1 and Sn-2 are both P 110 Sensor Type), the sensed negative pressure values displayed in the Main screen for differential pressure status (dIFP) are displayed as negative psi values, not inHg values.

Determining the Integration Constant for an Analog Output

The default Integration Constant (I-C) setting for analog outputs is 0 (zero) or no integration constant. An I-C setting of 0 provides a proportional-only analog signal. Many applications do not require you to change this default setting. See *Proportional Plus Integral Control and Integration Constants* for more information.

If you want to apply proportional plus integral to a control loop in your controlled system, here are two methods of determining the best I-C setting for the analog output that controls the loop.

ⓘ **Note:** Both of the following methods for determining an I-C setting require you to install, set up, and operate the control loop in your controlled system under a variety of typical load conditions and observe the response to load changes and different I-C settings.

Testing the Slowest to Fastest Time Integral to Determine I-C Setting

About this task:
One method of determining the best I-C setting for a control loop is to observe the controlled system's operation at the slowest time integral (I-C setting of 1) and then increase the I-C setting one step at a time to determine the best setting.
In this task you determine the best I-C setting for an analog output by testing slowest to fastest time integral.

1. Set up the System 450 control loop for proportional-only control (I-C setting of 0 [zero]), power the controlled system under typical or steady load conditions, and allow the system to stabilize at a control point somewhere in the proportional band between the Setpoint and End Point values.
2. After the controlled system has stabilized at a control point, set the integration constant to the slowest time integral (I-C setting of 1) and observe the control point to see if it stabilizes closer to the selected Setpoint.

    - If the control point overshoots Setpoint, go to Step 3.
    - If the control point stabilizes closer to Setpoint but does not overshoot Setpoint, set the integration constant to the next (faster) time integral and then observe the control point to see if it stabilizes closer to the selected Setpoint.
        - If the control point does not overshoot Setpoint at new I-C setting, continue to increase the setting and observe the system until the control point overshoots Setpoint, then go to Step 3.

3. When the control point overshoots Setpoint, continue to observe the control point:

    - If the control point drifts past Setpoint, reverses, and then drifts back towards Setpoint and stabilizes at or near Setpoint, go to Step 4.
    - If the control point drives significantly beyond Setpoints, then reverses quickly, drives back past Setpoint, and continues oscillating significantly above and below Setpoint, reset the I-C setting to the previous (slower) time integral and go to Step 4.

4. When the control point stabilizes near Setpoint or drifts slightly above and below Setpoint, operate the control loop under a variety of load conditions, including the maximum load condition:

    - If the control point drives past Setpoint and begins to oscillate significantly above and below Setpoint, reset the I-C setting to the previous (slower) time integral and repeat Step 3.
    - If the control point drifts to or past Setpoint and stabilizes near Setpoint, the current I-C setting for your control loop is correct.

Result
Continue to observe the controlled system until you are sure that the system control point stabilizes somewhere near Setpoint and does not oscillate under all load conditions.

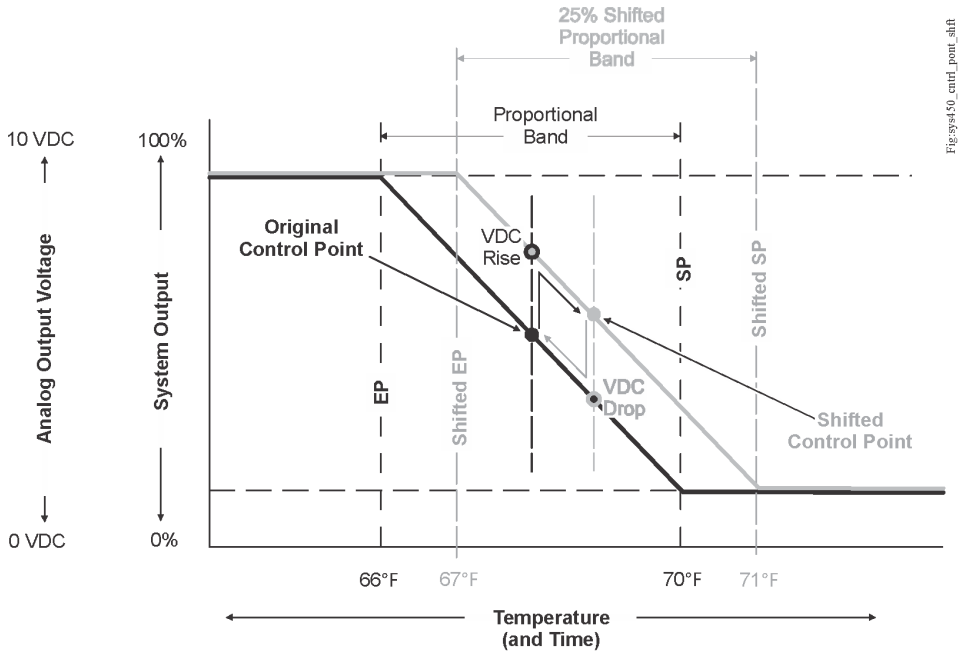
Using the Response Time to a Step Change to Determine the I-C Setting

About this task:
Another method for determining the best I-C setting for a System 450 control loop is to temporarily create a step change that shifts the proportional band in your controlled system away from the original or desired proportional band. To do so, measure the (first response) time it takes for your controlled system to drive to and stabilize at the shifted control point. Then shift (step change) the proportional band back to original and measure the (second response) time that it takes to return to the original control point.
You need a digital voltmeter set to VDC to perform this procedure.
In this task you determine the best I-C setting for a control loop using the response time to a step change.

1. Set up the System 450 analog output for proportional-only control (I-C setting of 0 [zero]), power your controlled system on, operate the system under steady load conditions, and allow the control loop to stabilize at a control point within the proportional band between the selected Setpoint and End Point values.
2. Connect a digital volt-meter across the analog output terminals to measure VDC signal strength changes. Measure and record the signal strength voltage at this (original) stable control point.
3. Change the Setpoint and End Point values to shift (step change) the proportional band 25% away from the original proportional band; the VDC signal rises (or drops) immediately and significantly in response to the proportional band shift. Begin timing the response (to the first step change) at this voltage rise (or drop).

   The direction of the voltage changes (rise or drop) depends on whether the analog output is set up as a direct acting or reverse acting output signal. These instructions refer to the room heating application example shown in Figure 30.

Figure 30: Graph Showing Temporary Proportional Band and Control Point Shifts Used to Measure Response Time in a Heating Application



Measure the (first response) time that it takes for the controlled system to drive from the original control point to the shifted control point and then measure the (second response) time for the system to drive from the shifted control point back to the original control point. Use the slower response to determine the proper I-C.

4. Observe the system response and record the time it takes for the measured voltage to drive to and stabilize at the shifted control point in the shifted proportional band. (Typically the shifted control point voltage is slightly higher [or lower] than the original control point voltage.)
5. With the controlled system stabilized at the shifted control point, return (second step change) the Setpoint and End Point values back to the original proportional band. The signal VDC drops (or rises) immediately and significantly in response to the proportional band shift back to original. Begin timing the response (to the second step change) at this voltage drop (or rise).
6. Observe the system response and record the time it takes for the measured voltage to drive back to and stabilize at original control point (voltage) in the original proportional band.

ⓘ **Note:** In many applications, the response time away from the original control point to the shifted control point is different from the response time of the shifted control point back to the original control point, depending on a variety of factors such as system load and system output. Choose the slower of the two measured response times to determine the I-C setting for your application.

7. Use the slower of the two measured response times and the following table to determine which integration constant (I-C setting) to set on the control and test first.

Table 12: Response Times, Reset Rates, and Integration Constants

Slowest Measured Response Time for Control Point Shift	Select This Integration Constant (I-C) Value for the Analog Output	Estimated Total Reset Rate for Integration Constant
N/A	0	No reset rate
10 to 15 minutes	1	1 hour (3,600 seconds)
6 to 10 minutes	2	30 minutes (1,800 seconds)
3 to 6 minutes	3	15 minutes (900 seconds)
1 to 3 minutes	4	5 minutes (300 seconds)
30 to 60 seconds	5	2 minutes (120 seconds)
10 to 30 seconds	6	1 minute (60 seconds)

8. Set the integration constant to the determined I-C setting. Operate and observe the controlled system at a variety of load conditions to determine if the system is stable at the determined I-C setting over the entire output range of the controlled system.

Setting Up Network Communications for System 450 Control Systems

System 450 communications control modules allow you to connect your System 450 controls to supported communications networks. The System 450 Series control systems, currently support network communications on Modbus networks and Ethernet networks. To connect to a communications network, the control module in your System 450 control system must be a C450CRN-1 model (for Modbus networks) or a C450CEN-1 model (for Ethernet networks).

See *Setting Up Modbus Network Communications* for information on connecting to a Modbus network, setting up the communications network parameters in the System 450 UI, and implementing the System 450 control system on the Modbus network.

See *Setting Up Ethernet Communications* for information on connecting to an Ethernet network and setting up the Ethernet communications network parameters in the System 450 UI.

Setting Up Password Protection

System 450 communications control modules provide password-protected access to your System 450 control systems. You can operate your control system with or without password protection.

There are two password types in the System 450 UI – a User level password and an Administrator (Admin) level password. Both password are four-digit values (0000 to 9999).

The User password allows you to access the System Setup screens from the System Status screens.

When the User password is set to the factory-default value of 0000, password-protected access is disabled and a password is not required to access the System Setup screens and change control system parameters and values. Changing the User password to a value other than 0000 enables password protected access.

The Admin password allows you access to the System Setup screens just like the User password. The Admin password also provides access to the User Password Setup screens and the Administrator Password Setup screens (Figure 31). The factory-default Admin password is 1234.

The User and Admin Password Setup screens behave differently than the other System Setup screens. In the System Setup screens, the entire parameter value blinks and you enter an entire new value, then press to save the entire value and go to the next screen.

In the User and Admin Password Setup screens you must enter each digit in the screen individually and press **Next** to save the single-digit value and go to the next digit in the four-digit password string.

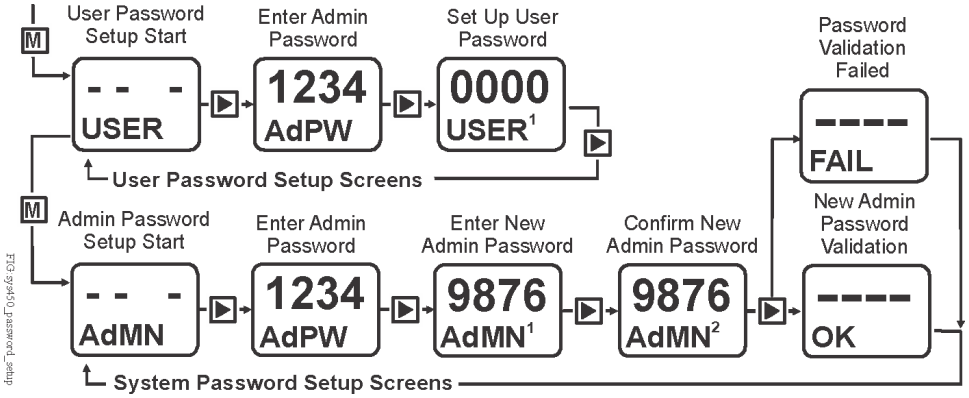
After you have selected and saved a digit, you can not go back and change the previous digit. You must navigate to the change password screen and re-enter the entire four-digit password with the correct digits.

When you press to save the last digit in a Password Setup screen, the four-digit password is saved and the UI displays the next screen. When you press to save the last digit in the Confirm Admin Password screen, the password is confirmed and the UI displays the Validate Admin Password Change screen with OK.

ⓘ **Note:** If you enter an incorrect value in either Enter Admin Password (AdPW) screen (in the Admin or User Password Setup screens), the Main screens appear. If the values you enter in the Enter New Admin Password (AdMN[1]) screen and the Confirm New Admin Password (AdMN[2]) screen are different, FAIL appears in the New Admin Password Validation screen (instead of OK) and the Admin password is unchanged. After the Validation (OK) or Failed Validation (FAIL) screen appears for approximately 5 seconds, the Administrator Password Setup Start (AdMN) appears.

➤ **Important:** The default Admin password is 1234. When you change the Admin password, you should record and safely store the new Admin password. If you do not recall your new Admin password, you cannot access the Admin or User Setup screens to change either the User level password or the Admin password. If you do not recall your new User level password and your new Admin password, you cannot access your control system UI.

Figure 31: User and Admin Password Setup Screens



Changing the User Password

About this task:
To change the System 450 User password:

ⓘ **Note:** In any of the system setup screens, press **Menu** to return to the setup start screen. In the setup start screen, press **Up** and **Down** simultaneously or wait two minutes to return to the Main screens.

1. Access the System 450 UI and navigate to the **User Password Setup Start (USER)** screen (Figure 31). (See *Accessing and Navigating the User Interface* for information on accessing the System Setup screens.)

2. In the **User Password Setup Start (USER)** screen, press **Next** to go to the **Enter Admin Password (AdPW)** screen. Enter your control system's valid Admin Password (one digit at a time) and press **Next** to go to the **Set Up User Password (USER[1])** screen.

   ⓘ **Note:** If you enter an invalid Admin password in the Admin Password (AdPW) screen, the display reverts to the Main screens.

3. In the **Set Up User Password (USER[1])** screen, enter the new User password for your system (one digit at a time) and press **Next** to save the new User password and return to the **User Password Setup Start (USER)** screen.

Result
Users are now required to use the new User password to access the System Setup screens. (Admin level users can use either the User password or the Admin password to access the System Setup screens.)

ⓘ **Note:** If you set the User password to 0000, password-protected access to the System Setup screens is disabled on your control system.

Changing the Admin Password

About this task:

ⓘ **Note:** In any of the system setup screens, press **Menu** to return to the setup start screen. In the setup start screen, press **Up** and **Down** simultaneously or wait two minutes to return to the Main screens.

To change the System 450 Admin password:

1. Access the System 450 UI and navigate to the **Admin Password Setup Start (AdMN)** screen (Figure 31). (See *Accessing and Navigating the User Interface* for information on accessing the System Setup screens.)
2. In the **Admin Password Setup Start (AdMN)** screen, press **Next** to go to the **Enter Admin Password (AdPW)** screen. Enter your control system's valid Admin Password (one digit at a time) and press **Next** to go to the **Set Up Admin Password (AdMN[1])** screen.

   ⓘ **Note:** If you enter an invalid Admin password in the Admin Password (AdPW) screen, the display reverts to the Main screens.

3. In the **Set Up Admin Password (AdMN[1])** screen, enter your new Admin password (one digit at a time) and press **Next** to save the new Admin password and go to the **Confirm Admin Password (AdMN[2])** screen.
4. In the **Confirm Admin Password (AdMN[2])** screen, re-enter your new Admin password (one digit at a time) and press **Next** to confirm the new Admin password and go to the **New Admin Password Validation** screen:

   - If the four-digit passwords you entered in the Set Up Admin Password (AdMN[1]) screen and the Confirm Admin Password (AdMN[2]) screen match, **OK** appears in the **New Admin Password Validation** screen and the new Admin password is saved.
   - If the four-digit passwords you entered in the Set Up Admin Password (AdMN[1]) screen and the Confirm Admin Password (AdMN[2]) screen do not match, **FAIL** appears in the **New Admin Password Validation** screen and the new Admin password is **not** saved.

Result

The **New Admin Password Validation** screen appears for approximately 5 seconds (**OK** or **FAIL**), then the display automatically reverts to the Admin Password Setup Start screen:

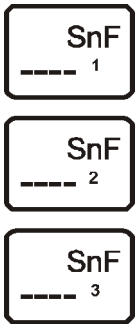
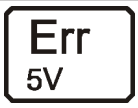
- If the **New Admin Password Validation** screen displayed **OK**, your new Admin password is saved and Admin level users must use the new password to access the User and Admin Password Setup screens.
- If the **New Admin Password Validation** screen displayed **FAIL**, your new Admin password is **not** saved and you must repeat the Admin password setup procedure successfully to save your new Admin password.

Troubleshooting System 450 Control Systems

System 450 control modules display error messages on the LCD when the module detects a sensor, sensor wiring, sensor power, or power supply failure.

Table 13 shows the System 450 error messages that may be displayed, and provides possible causes for the error messages and the solutions for remedying the errors.

Table 13: System 450 Control System LCD Error Messages

Error Screen	Problem/Symptom	Possible Cause	Solution
	Sensor failure is detected and < SNF > is displayed (instead of a value). Outputs that reference the failed sensor are operating in the Sensor Failure Modes selected for the Output at setup.	Sensor, sensor wiring, or sensor connections may have failed to open or close.	Check and the verify integrity of sensor wiring and connections. Measure the voltage between the sensor terminal (Sn1, Sn2, or Sn3) and the low-voltage common (C) terminal (with the sensor connected). See Table 14 for the sensor's expected voltage range. If the sensor wiring and sensor connections are good, replace the sensor and recheck the voltage.
	Sensor power drops below 4.75 VDC and < Err 5V > is displayed (instead of a value). All Outputs are Off.	The +5 VDC output is out of the specified range; the output may be shorted to ground at the wiring or an active humidity or pressure sensor may have failed.	Check the voltage between the +5 VDC (5V) terminal and any one of the common (C) terminals. The specified voltage range is +4.8 to +5.2 VDC. If the specified voltage is out of range, check the primary supply voltage. (See the solution that follows.) If the primary supply voltage is in range, remove all wiring connection to the 5V terminal and check the voltage between 5V and any C terminal. If the voltage is still out of range, replace the control module. If the voltage is in range (+4.8 to +5.2 VDC), reconnect each sensor one at a time to determine which sensor is causing the voltage drop. Replace the faulty sensor and recheck the output voltage.
	Supply power failure is detected and < Err PWR > is displayed (instead of a value). All Outputs are Off.	Supply power failure; supply voltage is too low or too high.	Check the supply voltage to the C450 power module. The measured voltage must be between 100 and 130 VAC at the 120 VAC terminals, or between 200 and 260 VAC at the 240 VAC terminals. If the System 450 control system is powered by an external 24 VAC power supply, the voltage must be between 20 and 30 VAC. Bring the supply into range.

Specified Voltage Ranges for Sensors

Table 14 provides the specified operating voltage range for System 450 sensors. To determine if a sensor is operating in the specified range, measure the voltage between the sensor's terminal connections at the System 450 control module (the Sn1, Sn2, or Sn3 terminal and one of the C terminals).

If the voltage is out of the specified range, check the sensor wiring for shorted or open circuits. Repair or replace wiring as needed. If the wiring appears to be in good condition, replace the sensor and retest the voltage and operation.

Table 14: Specified Voltage Ranges between Sensor Terminals

Connected Sensor	Specified Voltage Range Measured between a Sensor Terminal (Sn1, Sn2, or Sn3) and a Common Terminal (C)
A99B Series and TE-6xxx Series Nickel (1,000 ohm at 70°F) Temperature Sensors	0.49 to 1.43 VDC
HE-69xx Humidity Sensor	0 to 5.0 VDC
DPT2650 Low-Pressure Differential Sensor	0 to 5.0 VDC
P499 Series Electronic Pressure Transducer	0.5 to 4.5 VDC
P599 Series Electronic Pressure Transducer	0.5 to 4.5 VDC

LED Blink Definitions

The System 450 control module with Modbus communications (C450CRN-x) has two LEDs located above the LCD on the control UI. The LED success blink rate indicates the LED is on longer than it is off. The LED fail blink rate indicates the LED is off longer than it is on. See Table 15 for the C450CRN-x control module LED blink rate definitions.

Table 15: C450CRN-x Control Module LED Blink Rate Definitions

C450CRN-x Control Module LED	LED Blink Rate Definition
Green LED on Left Side	The success blink indicates the C450CRN module is transmitting properly.
Green LED on Right Side	The success blink indicates C450CRN is receiving valid messages. The fail blink indicates a problem with baud rate, parity, framing, or CRC. Off indicates no bus traffic.

The System 450 control module with Ethernet communications (models C450CEN and C450CEN-1C) has two LEDs located on the RJ-45 connector and two LEDs located above the LCD on the control UI. See Table 16 for the C450CEN control module LED blink rate definitions.

Table 16: C450CEN-x Control Module LED Blink Rate Definitions

C450CEN Control Module LED	LED Blink Rate Definition
Yellow LED on RJ-45	Indicates network speed: Off indicates 10 Mb, On indicates 100 Mb.
Green LED on RJ-45	Indicates network activity: Off indicates the link is inactive, On indicates the link is active, and blinking indicates network activity.
Green LED above LCD on Left	Off indicates no proper communication, blinking indicates that the C450CEN is properly transmitting web page information to a computer.
Green LED above LCD on Right	Off indicates no proper communication, blinking indicates the C450CEN is properly receiving a web page request from a computer.

Setting up Modbus Communications

The System 450 communications control module with Modbus communications (C450CRN-1 model) allows you to connect your System 450 control system to and communicate over Modbus networks. The System 450 Control Module with Modbus Communications is an RS485, RTU compliant Modbus subordinate device. You must use the C450CRN-1 model control module to connect your System 450 control system to a Modbus network.

The communications control module for Modbus communications allows your entire control system to be set up on a Modbus network as a Modbus subordinate device. Modbus subordinate devices respond to data requests and commands from a Modbus master device on the Modbus network.

System 450 Control Systems on Modbus: Overview

About this task:
There are different workflows for integrating a subordinate device on to a Modbus network. The following steps provide an overview of a recommended workflow for integrating your System 450 control system (subordinate device) on to a Modbus network. Your Modbus integration may be successful using other procedures.
In this task you prepare your System 450 control system for integration on to a Modbus network.

1. Assemble your System 450 control system modules and ensure that all of the modules in the module assembly are connected in the proper order. (See *Designing and Building System 450 Control Systems* for more information on building module assemblies.)

   ⓘ **Note:** To integrate the control system on to a Modbus network, you must assemble the System 450 modules in the desired control system configuration and provide power to the module assembly. But you do **not** have to wire the control system sensors or outputs to integrate the control system on to the Modbus network.

2. Power the module assembly on and set up your System 450 control system parameters and values in the communications control module UI. (See *Setting up a System 450 Control System* for more information.)

   ➤ **Important:** Do not change the module positions after a System 450 control system is assembled, powered, and set up in the System 450 UI. System 450 control logic is set up in the UI according to the Sensor Type, Output Type, and Output Number. If you change the module positions in a module assembly that is already set up in the UI, the Output Numbers and default setup values for the outputs also change, which often requires you to set up the entire control system in the UI again.

3. Set the device address, baud rate, parity, and stop bits for your System 450 control system on the Modbus network trunk in the Communications Setup screens in the communications control module UI. (See *Setting the Modbus Communications Values in the System 450 UI* for more information on setting the device address, baud rate, parity, and stop bits for your System 450 control system.)
4. Connect your System 450 control system module assembly to the Modbus master device. (See *Connecting the Modbus Terminal Block* for more information on connecting a System 450 control system to a Modbus network.)

   ⓘ **Note:** If your System 450 control system is connected to the Modbus trunk, you must set the EOL switch on the System 450 control module to the appropriate position, depending on the control system's position on the Modbus network trunk. (See *Setting the End of Line Switch* for detailed procedures on setting the control system EOL switch.)

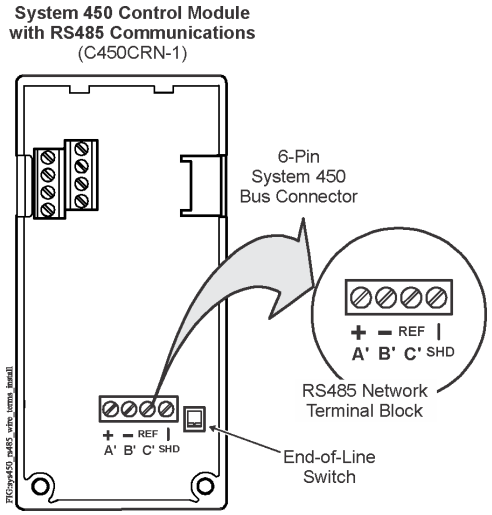
5. After your System 450 control system (module assembly) is set up and connected to the Modbus master device, you can begin mapping theSystem 450 network map registers to the master device.

   Note: Many Modbus master devices provide a WYSIWYG interface for mapping subordinate device registers to the master device. Refer to your master device's technical documentation for information on mapping subordinate devices to the master device.

Connecting the Modbus Terminal Block

The network terminal block, mounted on the PCB under the control module cover, connects your System 450 control system to the Modbus network (Figure 32).

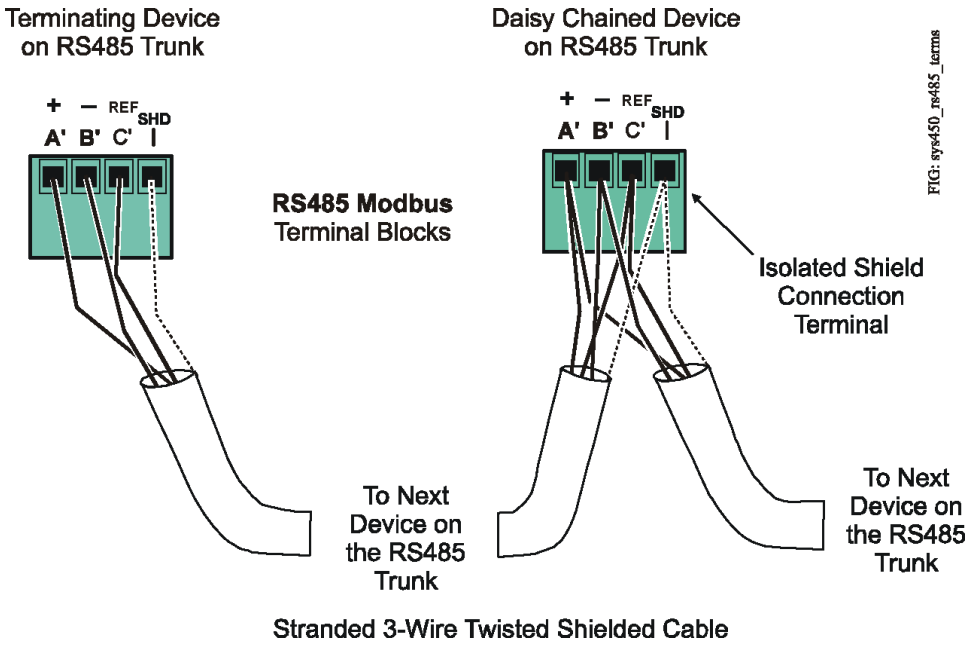
Figure 32: C450CRN-x Control Module with Modbus Communications Showing Wiring Terminals, Input Terminals, and Network End of Line Switch



Connect the network terminal block on the System 450 control module to the other Modbus devices in a daisy-chain configuration using 3-wire twisted, shielded cable as shown in Figure 33.

The cable shield drain terminal (SHD) on the network terminal block is isolated and is used to splice the cable shields along the daisy-chain bus.

Figure 33: Modbus Terminal Block Wiring Detail



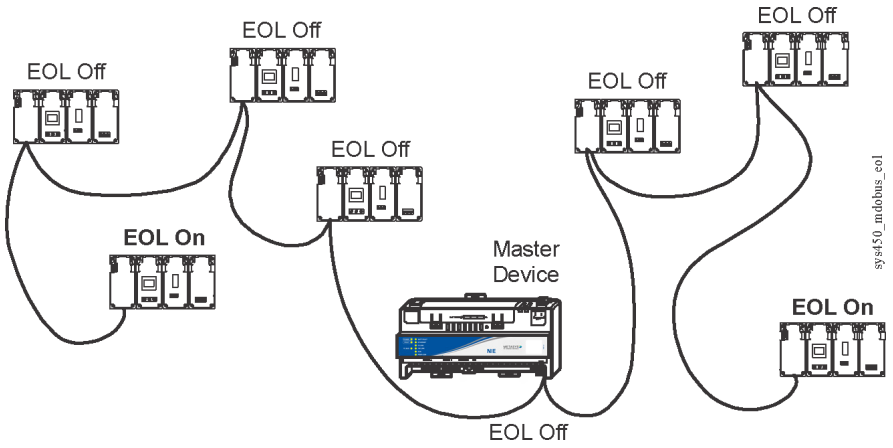
Note: The network cable shield drains should be spliced and isolated at all of the subordinate devices on the network trunk. The cable shield should be connected to ground at only one point along the daisy chain – at the Modbus master device on the trunk.

Setting the End of Line Switch

About this task:
Each network device (master or subordinate) that is connected to the end of a daisy-chain network trunk must be set as a network trunk terminating device.
The System 450 control module with communications (C450CRN-1) has an integral End of Line (EOL) switch, which, when set to On, sets the control module as a terminating device on the trunk. See Figure 16 for the EOL switch location on the communications control module. The default EOL switch position is factory set to Off.
In this task you set the EOL switch to the correct position on the communications control module.

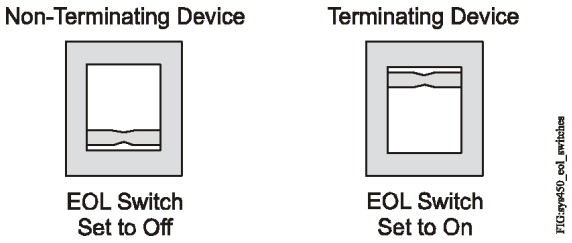
1. Determine the physical location of the System 450 control module connection on the network trunk. If the control module terminates the network trunk, it must be set as a terminating device on the trunk. (See Figure 34 and Figure 35.)

Figure 34: EOL Switch Settings on an Example Modbus Network Trunk



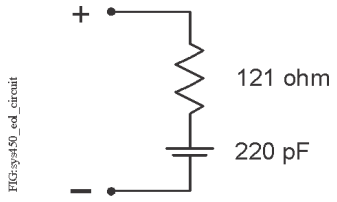
2. If the System 450 control module is a terminating device on the Modbus trunk, position the EOL switch to On (up). If the field controller is not a terminating device on the bus, position the EOL switch to Off (down) as shown in Figure 35.

Figure 35: EOL Switch Position for Terminating and Non-Terminating Devices



Result
Figure 36 shows the internal EOL circuit on the System 450 control module with Modbus communications that is connected to the end of the Modbus network trunk when the System 450 EOL switch is set to the On position.

Figure 36: System 450 Internal EOL Circuit That Is Applied to Network When EOL Switch is On



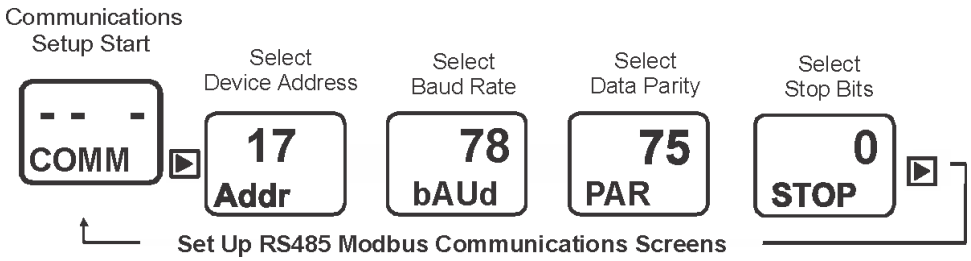
Setting Up Modbus Network Communications

You set up the network communications parameters for your System 450 control system with Modbus communications in the System 450 UI on the control module with communications (model C450CRN-1 control modules).

Setting the Modbus Communications Values in the System 450 UI

About this task:
You set up your System 450 control system's Modbus device address, the network baud rate, parity, and number of stop bits in the communications control module UI.

Figure 37: Communications Setup Start Screen and the Modbus Communications Setup Screens



In this task you set up your System 450 communications control module for a Modbus network.

ⓘ **Note:** In any of the system setup screens, press **Menu** to return to the setup start screen. In the setup start screen, press **Up** and **Down** simultaneously or wait two minutes to return to the Main screens.

1. Navigate to the **Communications Setup Start** screen to begin setting up the Modbus communications. (See *Accessing the System Setup Screens* for information on accessing the Communications Setup Start screen.)
2. In the **Communications Setup Start** screen (**COMM**), press **Next** to go to the **Select Device Address** screen.
3. In the **Select Device Address** screen (**Addr**), press **Up** or **Down** to select the unique device address value for your System 450 control system on the Modbus network. Device addresses are restricted to 1 through 247. Press **Next** to save your selection and go to the next setup screen.
4. In the **Select Baud Rate** screen (**bAUd**), press **Up** or **Down** to select the baud rate value that matches the baud rate of the Modbus network that your System 450 control module is connected to. Selections include 9,600 baud, 19.2 kbaud, and 38.4 kbaud. Press **Next** to save the baud rate selection and go to the next screen.
5. In the **Select Parity** screen (**PAR**), press **Up** or **Down** to select the parity setting value that matches the parity of the Modbus network that your System 450 control module is connected to. Selections include; 0 (no parity), 1 (odd parity), and 2 (even parity). Press **Next** to save the parity value selection and go to the next screen.
6. In the **Select Stop Bits** screen (**STOP**), press **Up** or **Down** to select the stop bit value that matches the stop bits of the Modbus network that your System 450 communications control module is connected to. Selections include 1 or 2. The option to select 2 stop bits is only available if the parity is set to 0 (no parity). Press **Next** to save the stop bits value selection and return to the Communications Setup Start screen.
7. Press **Up** and **Down** simultaneously to return to the Main screens.

Result
Your System 450 control system with network communications is set up to connect to your Modbus network.

ⓘ **Note:** You have to map your System 450 control system (subordinate device) to the Modbus master device. See *System 450 Network Image for Modbus Implementation* for more information on mapping your control system to the Modbus master device.

System 450 Network Image for Modbus Implementation

The System 450 Modbus network image resides in the communications control module (C450CRN-1) firmware. The network image provides a suite of data holding registers that you can map to a Modbus master device to enable the master device to read data from and write data to your System 450 control system over a Modbus network.

Because System 450 control systems are modular systems with up to three input sensors and 10 relay or analog outputs in any combination, the possible control systems you can build are numerous and highly variable; and each control system variation can require a different combination of sensors, output types, number of outputs, setup parameters, and setup values. A robust and comprehensive Modbus network image has been developed to accommodate the flexibility and variability of System 450 control systems.

Each communications control module has a complete System 450 Modbus network image, which consists of all of the holding registers and enumeration values needed to map the required data for any of the possible valid System 450 control systems to a Modbus master device. But most System 450 control systems do not use all 10 outputs or all three sensors, and many systems monitor and control only one or two conditions. For many of your Modbus implementations, you may need to map only a small subset of the complete network image to the Modbus master device.

System 450 Information

The complete set of setup parameters and values for your System 450 control system is determined by the number and type of outputs in your control system, the sensors that the outputs are set up to reference, and the Sensor Types you select for the sensors in your control system.

Each output's Output Number (1–10) and Output Type (relay or analog) are automatically determined by the expansion module models that you use to build your control system and the physical position of the expansion modules in the module assembly. See *Expansion Modules, Module Assemblies, and Outputs* for more information.

The Sensor Type that you select for each of the sensors (Sn1, Sn2, or Sn3) hardwired to the control module determines the units of measurement, ranges, and values for many of the setup parameters for the sensors. Therefore, the sensor (Sn-1, Sn-2, Sn-3, Sn-d, HI-2, or HI-3) you select in the UI for an output to reference determines the parameter units of measurement, values, and ranges for the output setup. See *System 450 Compatible Sensors and Transducers* for more information on Sensor Types.

When your control system is operating, it is generating system statuses that can be mapped to the Modbus master device. Depending on the Modbus master device and your Modbus network implementation, the master device may also write new system setup values to your System 450 control system.

You must determine the System 450 setup and status information that you want the Modbus master device to read from and write to your control system; then map the System 450 network image holding registers that hold the relevant system data to the Modbus master device.

The following sections define the data holding registers, enumeration values, and register addresses for mapping any System 450 control system (subordinate device) to a Modbus master device.

Modbus Holding Registers, Addresses, and Request Frames

Modbus data holding registers **hold** small chunks of data regarding your control system's configuration and operation. A Modbus register address identifies a specific holding register that resides in the System 450 (subordinate device) network image in the firmware. The register addresses that you map to the Modbus master device enable the master device to **read** the data held in the mapped holding registers in the System 450 firmware. Modbus master devices can also **write** data to certain System 450 data holding registers that enable both read and write capability.

Some of the data held in the System 450 holding registers is pre-defined, static, and does not change in your control system. Examples of holding registers with static, factory-determined data include System 450 model ID, Modbus network image version, and firmware version. These are read-only holding registers; the Modbus master device cannot write new data to these registers.

Your control system's configuration data such as, units of measurement, ranges, values, and setpoints is determined by your control application requirements, and is typically static once your control system is assembled, set up, and placed in operation. Much of this configuration data is automatically determined by the expansion modules and sensors that you select to build your control system and how you connect them together in your system. You also apply configuration data such as setpoint, end point, On and Off values to control the conditions and process loops in your control application.

When mapped, the Modbus master device can read all of this configuration data **and** also write to many of this control system configuration to the mapped registers. But typically, the only reason for writing new data to configuration related holding registers is to change set point or On/Off type values or change a component (module, sensor) in your control system configuration. Examples of holding registers with application specific configuration data include, the Number of Outputs, Output Number, Output Type values, Sensor values, Sensor Type values, Temperature Offset values, and Sensor units of measurement.

The remaining holding registers in the System 450 network image hold dynamic condition and process status data that changes as the conditions in your controlled system (process loops) change and your control system responds to the changes. Examples of holding registers with dynamic, process determined data include Sensor Status values, Sensor Failure State values, and Output Status values. As these values change in your system, the content of the holding registers is updated.

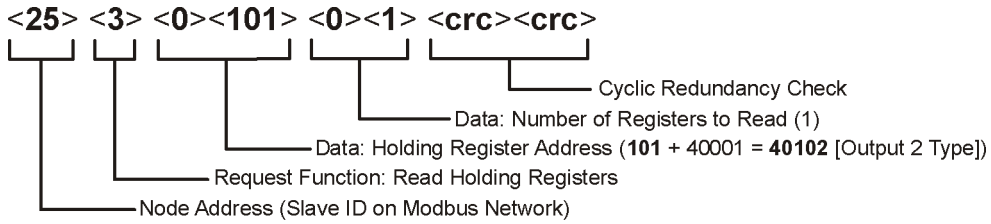
The enumeration tables and register map tables that follow define the values held by each holding register in the System 450 network image. Use these tables to convert your control system's identifiers and settings to Modbus register data and map your System 450 control system to the Modbus master device.

After your control system is mapped to the Modbus master device, the master device uses the Modbus register addresses to request data from the various holding registers.

Modbus register addresses are encoded when they are sent from the Master device to the subordinate device. The Modbus register address in a request frame is equal to the Modbus register address minus 40001.

A request frame has the device address for the target subordinate device, the request function (read, write), the holding register address, the number of registers to read or write to, and a cyclic redundancy check to terminate the request.

Figure 38: Modbus Register Address in a Holding Register Request Frame



System 450 supports the commands listed in Table 17 to read and write holding registers.

Table 17: Modbus Commands Supported by System 450

Function Code	Description
3	**Read Holding Registers** – command used to read one or more registers
6	**Write Single Register** – command used to allow a master device to write a single register
16	**Write Multiple Registers** – command used to allow a master device to write multiple registers within a single message (frame)

Data Types

Table 18 provides the data types used by the holding registers.

Table 18: Data Types Used by the Holding Registers

Value	Description
Float	4-byte IEEE-754 floating point value, spanning two adjacent registers
Int 16	2-byte signed integer
String	Series of contiguous registers, each register contains two ASCII characters

Byte Order

Float values are 32-bit values stored in two consecutive registers. The values are encoded with the most significant byte first, or big endian.

Note: The Niagara Modbus Driver refers to this byte order as Order3210.

Encoding Strings

Strings are encoded by placing two ASCII characters into a single 16-bit register value. The high byte contains the first character, and the low byte contains the second character. Subsequent registers contain additional characters.

For example, the Model Name string C450ABC is encoded as:

Register		Content
40013	=	0x4334 (‘C’, ‘4’)
40014	=	0x3430 (‘5’, ‘0’)
40015	=	0x4142 (‘A’, ‘B’)
40016	=	0x4300 (‘C’, ‘null’)

All strings are null terminated (char = 0x00). Any characters detected past the null terminator are ignored.

Control Module Information

Table 19 provides the enumeration for the current System 450 control module model with Modbus communications capability.

Table 19: Control Module Identification Encoding

Value	Description
24	C450CRN: Modbus Control Module

Table 20 provides the registers for mapping static control module and firmware information as well as the dynamic control module status; CPU temperature.

Table 20: Control Module Information Registers Map

Register Name	Address	Read/ Write	Register Type	Description	Additional Information, Requirements, Limits
Model ID	40001	R	Integer 16	Identifies the control module model number as an integer. See Table 19 for current Modbus communication control module enumerations.	Static; determined by the control module firmware.
Network Image Version	40002	R	Integer 16	Identifies the network image or register map version	Static; determined by the control module firmware.
Firmware Version	40003 – 40018	R	String	Identifies the control module's System 450 firmware version as string characters 1–31 + null	Static; determined by the control module firmware.
CPU Temp (°F)	40091 – 40092	R	Float	CPU Temperature in °F	Dynamic; determined by the control module conditions.

Sensor Type Setup Information

Table 21 provides the System 450 Sensor Type enumerations. The Sensor Type of a sensor (Sn-1, Sn-2, or Sn-3) referenced by an output determines the condition, units of measurement, setpoint range value, control band value, and other setup parameters for the output.

ⓘ **Note:** System 450 firmware enforces the setpoint range value and the minimum control band value.

Table 21: Sensor Type Enumeration Table

Value	Sensor Type and Condition Measured	Units	Setpoint Range Value[1]	Minimum Control Band Value[1]
0	No Sensor Type configured	--	N/A	N/A
1	**°F** (Standard Temperature)	deg F	-40 to 250	1
2	**°C** (Standard Temperature)	deg C	-40 to 121.0	0.5
3	**rH** (Humidity)	% rH	10 to 95	2
4	**P 0.5** (Pressure)	inwc	0.025 to 0.500	0.01
5	**P 8** (Pressure)	bar	-1.00 to 8.00	0.1
6	**P 10** (Pressure)	inwc	0.05 to 10.00	0.2
7	**P 15** (Pressure)	bar	-1.0 to 15.0	0.2
8	**P 30** (Pressure)	bar	0.0 to 30.0	0.4
9	**P 50** (Pressure)	bar	0.0 to 50.0	0.4
10	**P 100** (Pressure)	psi	0.0 to 100.0	1
11	**P 500** (Pressure)	psi	90 to 500	5
12	**P 750** (Pressure)	psi	150 to 750	6

Table 21: Sensor Type Enumeration Table

Value	Sensor Type and Condition Measured	Units	Setpoint Range Value[1]	Minimum Control Band Value[1]
13	**P 200** (Pressure)	psi	0 to 200	1
14	**P 2.5** (Pressure)	inwc	0.10 to 2.50	0.1
15	**P 5** (Pressure)	inwc	0.25 to 5.00	0.25
16	**HI°F** (High Temperature)	deg F	-40 to 350	1
17	**HI°C** (High Temperature)	deg C	-40 to 176.0	0.5
18	**P 110** (Pressure)	psi	-10 to 100	1
19	**bin** (binary input, dry contacts)	N/A	N/A	N/A
20	**P 0.25** (Pressure)	inwc	-0.225 to -0.250	0.010

1 The Setpoint Range values and the Minimum Control Band value are enforced in the System 450 UI and in the Modbus Register Map for the System 450 control system.

Sensor Setup Registers

Table 22 provides the sensor setup registers. The sensor setup registers are read and write registers that define the sensors' (Sn-1, Sn-2, and Sn-3) Sensor Types, and, for temperature sensors, define the temperature offset for the sensors. See Table 21 for the Sensor Type enumerations.

Table 22: Sensor Setup Register Map

Register Name	Address	Read/ Write	Register Type	Description	Additional Information, Requirements, and Limits
Sn-1 Sensor Type	40501	R/W	Integer 16	Sensor Type value for the sensor connected to Sn1	Determine the Sensor Type value from Table 21.
Sn-1 Temperature Offset	40502 – 40503	R/W	Float	User determined temperature offset if Sn-1 is a temperature sensor **°F** = -5° to 5° in 1° increments **°C** = -2.5° to 2.5° in 0.5° increments	Offset not available for pressure or humidity sensors.
Sn-2 Sensor Type	40504	R/W	Integer 16	Sensor Type value for the sensor connected to Sn2	Determine the Sensor Type value from Table 21.

Table 22: Sensor Setup Register Map

Register Name	Address	Read/ Write	Register Type	Description	Additional Information, Requirements, and Limits
Sn-2 Temperature Offset	40505 – 40506	R/W	Float	User determined temperature offset if Sn-2 is a temperature sensor **°F** = -5° to 5° in 1° increments **°C** = -2.5° to 2.5° in 0.5° increments	Offset not available for pressure or humidity sensors.
Sn-3 Sensor Type	40507	R/W	Integer 16	Sensor Type value for the sensor connected to Sn3	Determine the Sensor Type value from Table 21.
Sn-3 Temperature Offset	40508 – 40509	R/W	Float	User determined temperature offset if Sn-3 is a temperature sensor **°F** = -5° to 5° in 1° increments **°C** = -2.5° to 2.5° in 0.5° increments	Offset not available for pressure or humidity sensors.

Table 23 provides the sensor values used when the sensor is configured as a binary output.

Table 23: Sensor Value When Configured as a Binary Input

Value	Description
0.0	Open, the sensed contact closure is open
1.0	Closed, the sensed contact closure is closed

Sensor Status Registers

Table 24 provides the sensor status registers. The sensor status registers are read-only registers that define the sensors' (Sn-1, Sn-2, Sn3, Sn-d, HI-2, and HI-3) sensed value and sensor failure state.

Table 24: Sensor Statuses Register Map

Register Name	Address	Read/ Write	Type	Description	Additional Information, Requirements, and Limits
Sn-1 Value	40301 – 40302	R	Float	Sensed value at Sn1	Dynamic; determined by the control system.
Sn1 Failure State	40303	R	Integer 16	Sn1 sensor or sensor wiring state: 0 = Operational 1 = Failed	Dynamic; determined by the control system.
Sn-2 Value	40304 – 40305	R	Float	Sensed value at Sn2	Dynamic; determined by the control system.
Sn2 Failure State	40306	R	Integer 16	Sn2 sensor or sensor wiring state: 0 = Operational 1 = Failed	Dynamic; determined by the control system.
Sn-3 Value	40307 – 40308	R	Float	Sensed value at Sn3	Dynamic; determined by the control system.
Sn3 Failure State	40309	R	Integer 16	Sn3 sensor or sensor wiring state: 0 = Operational 1 = Failed	Dynamic; determined by the control system.
Sn-d Value	40310 – 40311	R	Float	Value equal to the value sensed at Sn1 minus the value sensed at Sn2	Dynamic; determined by the control system.
Sn-d Failure State	40312	R	Integer 16	Sn1 or Sn2 sensor or sensor wiring state: 0 = Operational 1 = Failed	Dynamic; determined by the control system.
HI-2 Value	40313 – 40314	R	Float	Highest sensed value at Sn1 or Sn2	Dynamic; determined by the control system.
HI-2 Failure State	40315	R	Integer 16	Sn1 or Sn2 sensor or sensor wiring state: 0 = Operational 1 = Failed	Dynamic; determined by the control system.
HI-3 Value	40316 – 40317	R	Float	Highest sensed value at Sn1, Sn2, or Sn3	Dynamic; determined by the control system.
HI-3 Failure State	40318	R	Integer 16	Sn1, Sn2, or Sn3 sensor or sensor wiring state: 0 = Operational 1 = Failed	Dynamic; determined by the control system.
Sn-1 Units	40401 – 40404	R	String	Sn-1 units of measurement string; Characters 1–7 + null	Static; determined by the Sensor Type selected for Sn1.
Sn-2 Units	40405 – 40408	R	String	Sn-2 units of measurement string; Characters 1–7 + null	Static; determined by the Sensor Type selected for Sn2.

Table 24: Sensor Statuses Register Map

Register Name	Address	Read/ Write	Type	Description	Additional Information, Requirements, and Limits
Sn-3 Units	40409 – 40412	R	String	Sn-3 units of measurement string; Characters 1–7 + null	Static; determined by the Sensor Type selected for Sn3.
Sn-d Units	40413 – 40416	R	String	Sn-d units of measurement string; Characters 1–7 + null	Static; determined by the Sensor Type selected for Sn1 and Sn2.
HI-2 Units	40417 – 40420	R	String	HI-2 units of measurement string; Characters 1–7 + null	Static; determined by the Sensor Type selected for Sn1 and Sn2.
HI-3 Units	40421 – 40424	R	String	HI-3 units of measurement string; Characters 1–7 + null	Static; determined by the Sensor Type selected for Sn1, Sn2, and Sn3.

Output Type Registers

Output Type registers are read-only and are used to define the Output Type for each output in your control system. The Modbus Master device uses the defined Output Type to determine how to display Output Status (On/Off or 0–100%) and define which parameters (relay or analog) to use to define the outputs operation.

Table 25 provides the Output Type enumerations for defining and mapping the Output Statuses and Output Setup parameters.

Table 25: Output Type Enumerations

Value	Description
0	No Output present
1	Relay Output
2	Analog Output

Use Table 26 to define and map the output numbers and output types in your System 450 control system.

Table 26: System Output Types Registers Map

Register Name	Address	Read/ Write	Register Type	Description	Additional Information, Requirements, and Limits
Number of System Outputs	40100	R	Integer 16	Total number of outputs in the control system; Range = 0 to 10	Static value determined by your control system configuration.
Output 1 Type	40101	R	Integer 16	Type of output: Table 25 0 = None, 1 = Relay, or 2 = Analog	Static value determined by your control system configuration.
Output 2 Type	40102	R	Integer 16	Type of output: Table 25 0 = None, 1 = Relay, or 2 = Analog	Static value determined by your control system configuration.
Output 3 Type	40103	R	Integer 16	Type of output: Table 25 0 = None, 1 = Relay, or 2 = Analog	Static value determined by your control system configuration.
Output 4 Type	40104	R	Integer 16	Type of output: Table 25 0 = None, 1 = Relay, or 2 = Analog	Static value determined by your control system configuration.
Output 5 Type	40105	R	Integer 16	Type of output: Table 25 0 = None, 1 = Relay, or 2 = Analog	Static value determined by your control system configuration.
Output 6 Type	40106	R	Integer 16	Type of output: Table 25 0 = None, 1 = Relay, or 2 = Analog	Static value determined by your control system configuration.
Output 7 Type	40107	R	Integer 16	Type of output: Table 25 0 = None, 1 = Relay, or 2 = Analog	Static value determined by your control system configuration.

Table 26: System Output Types Registers Map

Register Name	Address	Read/ Write	Register Type	Description	Additional Information, Requirements, and Limits
Output 8 Type	40108	R	Integer 16	Type of output: Table 25 0 = None, 1 = Relay, or 2 = Analog	Static value determined by your control system configuration.
Output 9 Type	40109	R	Integer 16	Type of output: Table 25 0 = None, 1 = Relay, or 2 = Analog	Static value determined by your control system configuration.
Output 10 Type	40110	R	Integer 16	Type of output: Table 25 0 = None, 1 = Relay, or 2 = Analog	Static value determined by your control system configuration.

Output Status Registers

Use Table 27 to define how the status of each output in your control system is displayed, including the output's status value and units of measurement.

Table 27: Output Statuses Register Map

Register Name	Address	Read/ Write	Type	Description	Additional Information
Output 1 Status	40201	R	Integer 16	**Relay Output**: On = 1, Off = 0 **Analog Output**: % Total Signal Strength (0–100)	Dynamic; determined by the controlled system.
Output 2 Status	40202	R	Integer 16	**Relay Output**: On = 1, Off = 0 **Analog Output**: % Total Signal Strength (0–100	Dynamic; determined by the controlled system.
Output 3 Status	40203	R	Integer 16	**Relay Output**: On = 1, Off = 0 **Analog Output**: % Total Signal Strength (0–100)	Dynamic; determined by the controlled system.
Output 4 Status	40204	R	Integer 16	**Relay Output**: On = 1, Off = 0 **Analog Output**: % Total Signal Strength (0–100)	Dynamic; determined by the controlled system.
Output 5 Status	40205	R	Integer 16	**Relay Output**: On = 1, Off = 0 **Analog Output**: % Total Signal Strength (0–100)	Dynamic; determined by the controlled system.

Table 27: Output Statuses Register Map

Register Name	Address	Read/ Write	Type	Description	Additional Information
Output 6 Status	40206	R	Integer 16	**Relay Output**: On = 1, Off = 0 **Analog Output**: % Total Signal Strength (0–100)	Dynamic; determined by the controlled system.
Output 7 Status	40207	R	Integer 16	**Relay Output**: On = 1, Off = 0 **Analog Output**: % Total Signal Strength (0–100)	Dynamic; determined by the controlled system.
Output 8 Status	40208	R	Integer 16	**Relay Output**: On = 1, Off = 0 **Analog Output**: % Total Signal Strength (0–100)	Dynamic; determined by the controlled system.
Output 9 Status	40209	R	Integer 16	**Relay Output**: On = 1, Off = 0 **Analog Output**: % Total Signal Strength (0–100)	Dynamic; determined by the controlled system.
Output 10 Status	40210	R	Integer 16	**Relay Output**: On = 1, Off = 0 **Analog Output**: % Total Signal Strength (0–100)	Dynamic; determined by the controlled system.

Output Setup Registers

Sensor ID Enumerations

Each output setup in your control system requires a SENS setup value. Table 28 provides the enumerations for the sensors that an output can be set up to reference. Use this table to determine the SENS register enumeration value for each output in your control system. See Table 31 for the Output Setup registers, including the SENS setup register.

Table 28: Sensor ID Enumerations for Sensor Setup Selection (SENS)

Value	Description
0	No Sensor selected for or referenced by this output.
1	**Sn-1** sensor selected for and referenced by this output.
2	**Sn-2** sensor selected for and referenced by this output.
3	**Sn-3** sensor selected for and referenced by this output.
4	**Sn-d** (Differential Sensor) selected for this output; Sn-1 and Sn-2 are referenced by this output.
5	**HI-2** (High Input Signal Selection Sensor) selected for this output; Sn-1 and Sn-2 are referenced by this output.
6	**HI-3** (High Input Signal Selection Sensor) selected for this output; Sn-1, Sn-2, andSn-3 are referenced by this output.

Table 29 provides the Sensor Failure Mode enumerations for defining the Sensor Failure Mode Output Setup parameter

Table 29: Sensor Failure Mode Enumeration (SNF)

Value	Description
0	Sensor Fail On (output is On if sensor fails)
1	Sensor Fail Off (output is Off if sensor fails)

Integration Constant Enumerations

You can apply an Integration Constant (I-C) to an Analog Output. Selecting the default I-C value of 0, enables proportional only control on an Analog Output. Selecting an I-C value of 1 to 6 enables proportional plus integral control on an Analog Output and defines the integration constant for the output.

Table 30: Integration Constant Enumerations

Value	Integration Time
0	No Integration Time; Proportional Only Control
1	1 hour
2	30 minutes
3	15 minutes
4	5 minutes
5	2 minutes
6	1 minute

Output Setup Register Maps

An Output Setup register map provides two paths for setting up an output. The path that you use and the data you provide as you set up an output depends on the output's type (relay or analog). See Table 25.

Note that the Output Type register is read only. This information is self-determined by the control and you cannot override it through the Modbus network. If the Output Type of an output is none, it indicates that the output is not physically present and the setup parameters for this output have no affect. For example, if your control system has four outputs, you can ignore the registers for outputs 5 through output 10.

If an output is a relay output, enter the values used to set up the output in the System 450 UI into the following registers: SENS, On, OFF, ONd, OFFd, ONT, OFFT, and SNF.

If the output is a analog output, enter the values used to set up the output in the System 450 UI into the following registers: SENS, SP, EP, OSP, OEP, I-C, UP-R, bNd, and SNF.

Table 31: Output Setup Register Map

Register Name	Register Address[1]	Read/ Write	Register Type	Description	Additional Information, Requirements, Limits
Output Type	41***n***01	R	Integer 16	No Output Present = 0 Relay Output Type = 1 Analog Output Type = 2	Output Type determines the type of setup parameters used in the output setup registers (relay or analog).

Table 31: Output Setup Register Map

Register Name	Register Address[1]	Read/ Write	Register Type	Description	Additional Information, Requirements, Limits
SENS Referenced Sensor	41***n***02	R/W	Integer 16	Defines the sensor (Sn-1, Sn-2,Sn-3, Sn-d, HI-2, or HI-3) that this output references. Sensor Setup determines the Sensor Type that an output references. See Table 28 for sensor enumerations.	Sensor selection determines Sensor Type, which determines Output setup parameters, values, and ranges.
ON[2] Relay Output On Value	41***n***03 – 41***n***04	R/W	Float	Relay Output On Value	Enter the Analog Output or Relay Output Setup Value depending on the Output Type and the Sensor Type.
SP Analog Output Setpoint				Analog Output Setpoint Value	
OFF[2] Relay Output Off Value	41***n***05 – 41***n***06	R/W	Float	Relay Output Off Value	Enter the Analog Output or Relay Output Setup Value depending on the Output Type and the Sensor Type.
EP Analog Output End Point				Analog Output End Point Value	
Validate Relay Output ON and OFF or Analog Output SP and EP Values[3]	41***n***07	R/W	Integer 16	Validates that Relay ON and OFF values or Analog SP and EP values are valid for the selected Output Type and Sensor Type of the SENS referenced by the output.	To be valid, the ON/OFF and SP/ EP values must conform to the defined ranges for the selected Sensor Type. See Table 21 for valid value ranges.
ONd Relay Output ON Delay	41***n***08	R/W	Integer 16	Defines the value in seconds (0–300) that the Relay Output delays going to On after the Relay On value is reached.	Enter the Relay Output or Analog Output Setup Value depending on the Output Type.
OSP % Analog Output Signal at Setpoint				Defines the % (value) of the total analog output signal strength at Setpoint.	

Table 31: Output Setup Register Map

Register Name	Register Address[1]	Read/ Write	Register Type	Description	Additional Information, Requirements, Limits
OFFd Relay Output OFF Delay	41***n***09	R/W	Integer 16	Defines the value in seconds (0–300) that the Relay Output delays going to OFF after the Relay OFF value is reached.	Enter the Relay Output or Analog Output Setup Value depending on the Output Type.
OEP % Analog Output Signal at End Point				Defines the % (value) of the total analog output signal strength at End Point.	
ONT Minimum Relay Output On Time	41***n***10	R/W	Integer 16	Defines the minimum value in seconds (0–300) that the Relay Output stays On after the Relay On value is reached.	Enter the Relay Output or Analog Output Setup Value depending on the Output Type.
I-C Analog Output Integration Constant				Defines the Integration Constant value (0–6) for the Analog Output.	
OFFT Minimum Relay Output Off Time	41***n***11	R/W	Integer 16	Defines the minimum value in seconds (0–300) that the Relay Output stays Off after the Relay Off value is reached.	Enter the Relay Output or Analog Output Setup Value depending on the Output Type.
UP-R Analog Output Update Rate				Defines the minimum Update Rate value in seconds (1–240), at which the Analog Output signal strength is updated to a new value.	

Table 31: Output Setup Register Map

Register Name	Register Address[1]	Read/ Write	Register Type	Description	Additional Information, Requirements, Limits
SNF Relay Output Sensor Failure Mode	41***n***12	R/W	Integer 16	Defines the Sensor Failure Mode and State of the Relay Output.	
bNd Analog Output Dead Band				Defines the dead band value as a % of the total range (0–50) within which the Analog Output Signal Strength remains constant after the output updates.	Enter the Analog Output Setup Value.
N/A	41***n***13	R/W	Integer 16	No parameter for Relay Output	
SNF Analog Output Sensor Failure Mode				Defines the Sensor Failure Mode and State of the Relay Output.	Enter the Analog Output Setup Value.

1 The variable ***n*** represent the output's Output Number in the control system. See Table 32 for the holding registers used by each output.

2 If a relay output references a SENS that is a Binary Input Sensor Type, the ON and OFF values for the output are ignored.

3 The ON and OFF values or SP and EP values you enter into the registers must comply with the enforced System 450 values. Each set of ON/OFF or SP/EP values must be within the defined Range of Usable Values and the Minimum Proportional and Control Band for the Sensor Type of the input sensor (SENS) that is referenced by the output. See Table 5 to determine the Range of Usable Values and the Minimum Proportional and Control Band for the output you are mapping.

Output Setup Register Addresses

Table 32 defines the register addresses used to set up the 10 potential outputs in a System 450 control system.

Table 32: Output Setup Register Addresses

Output Number	Registers Addresses Used to Set Up the Output
Output 1	41101 to 41113
Output 2	41201 to 41213
Output 3	41301 to 41313
Output 4	41401 to 41413
Output 5	41501 to 41513
Output 6	41601 to 41613
Output 7	41701 to 41713
Output 8	41801 to 41813
Output 9	41901 to 41913
Output 10	42001 to 42013

Mapping Setpoints

System 450 automatically determines correct setpoint values (including minimum control band) and rejects invalid values. The Modbus Communications Control Module validates correct setpoint values and reject invalid values for the range of usable values, resolution increment values, and minimum proportional or control band.

Consider the value of a single parameter and its relationship to other parameters when writing setpoints. For example, if an output references a P 750 sensor and has an ON value of 500, the OFF value must be less than or equal to 494 OR greater than or equal to 506. If the minimum control band is not maintained, the ON and OFF values are considered invalid and are rejected. See Table 2 for more information about sensor types and setup values.

The setpoint registers for a relay output include SENS, ON, and OFF. The ON and OFF values are both comprised of two registers and together form a floating point value. The setpoint registers for an analog output include SENS, SP, and EP. The SP and EP values are both comprised of two registers and together form a floating point value.

The Output Setup information includes the ON and OFF floating point values for relay outputs and the SP and EP values for analog outputs. The SENS value identifies the sensor referenced by the output. Acceptable values for these parameters are determined by rules, and each parameter must be evaluated with reference to one another.

For example, if a relay output references sensor 1 and that sensor has been configured as sensor type P 2.5, the acceptable range for the ON and OFF values is 0.00 to 2.50 inwc and the minimum differential is 0.02 inwc. A minimum differential must be maintained between the ON and OFF point.

The dependency between parameters creates a problem when a Modbus master device must make changes to one or more of the setpoint fields. The master device may not be able to write all of the registers with a single Modbus frame or message. The master device may only want to update a single parameter and leave the related parameters unchanged. The Modbus subordinate device must determine when the setpoints are written so it can validate the setpoint parameters and accept or reject them.

Setpoint Write Complete

Five registers are used to determine when a setpoint write is complete. These registers are loosely described as setpoint registers because they either hold setpoint information or the reference sensor ID.

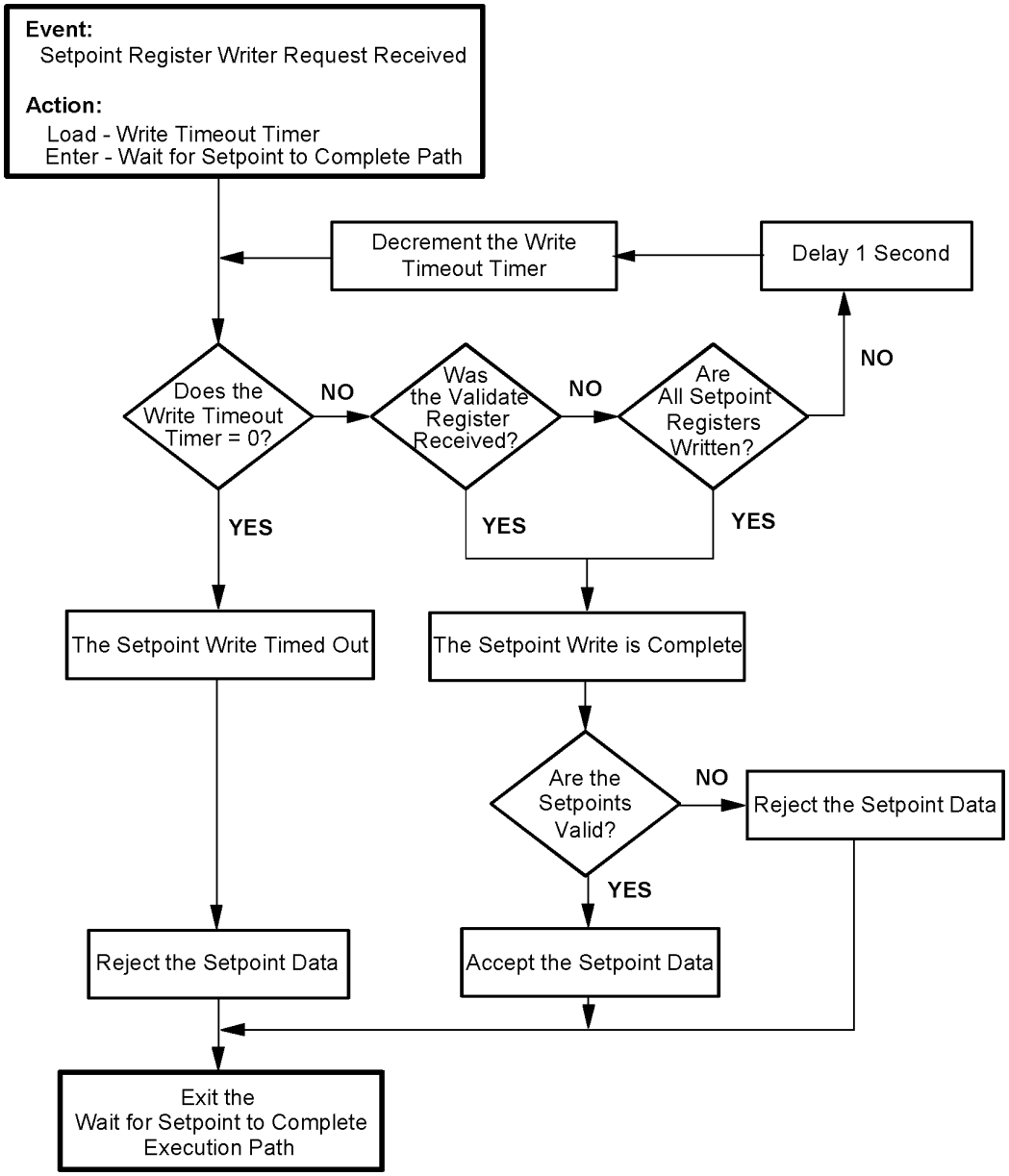
When a value is written to the validate register or a value is written to all five of the setpoint registers, the process of writing to the setpoint registers is considered complete.

The actual value written to the validate register is irrelevant. Any value written by a master device is considered to be a confirmation that all the setpoint data has been sent by the master device. At this point, the Modbus master device checks if the values are valid and either accepts or rejects them.

Figure 39 illustrates the logic that determines when a setpoint write is complete for a single output. Identical logic is executed for each output that is present in the system. Note the following information:

- Setpoint Register refers to any of the registers listed above.
- Setpoint Data refers to the content of these five registers.

Figure 39: Setpoint Wiring Flowchart



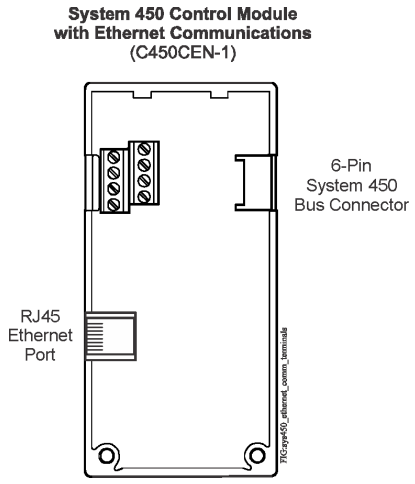
Setting Up Ethernet Communications

The System 450 communications control module with Ethernet communications (C450CEN-1C) enables you to connect your System 450 control system to an Ethernet network. You must use the C450CEN-1 control module with Ethernet communications to connect to and communicate over an Ethernet network.

Ethernet Port

The Ethernet port is an 8-pin RJ45 port on the left side of the control module (Figure 40).

Figure 40: C450CEN-1 Control Module with Ethernet Communications Showing Input Wiring Terminals and Ethernet Port



Connecting to an Ethernet Network

The System 450 Control Module with Ethernet Communications enables you to connect your control system to an Ethernet network.

Setting Up Ethernet Communications

You set up the Ethernet communications parameters for the System 450 control module with Ethernet communications in a web browser on a computer that is connected to the control module.

Table 33 provides procedures, screen examples, setup, and general information for setting up a System 450 control module with communications on an Ethernet network.

You can use an Ethernet patch cable to connect your computer directly to the System 450 control module with Ethernet communications.

The default (factory set) Ethernet IP address for a System 450 control module with Ethernet communications is 169.254.1.1.

Figure 41 shows the Communications Setup Start Screen and Ethernet Communications Setup Screens.

Figure 41: Communications Setup Start Screen and Ethernet Communications Setup Screens

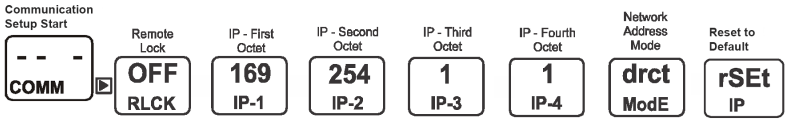


Table 33: System 450 Ethernet Network Setup Screen Information and Procedures

LCD Screen	Name, Description or Function, User Action, and Example
	**Communications View and Setup Start Screen:** From the Communications Setup Start screen, you can access the communications screens for the control module with Ethernet communications. 1. In the Communications Setup Start screen, press **Next** to go to the Remote Network Access Lock screen. The screen example shows the Communications Setup Start screen.
	**Remote Network Access Lock Screen:** You can lock or unlock remote access (via Ethernet) to the System, Sensor, and Network web pages in the control module's web UI. When On is selected, the login fields on the Home page are not available; remote users can access only the System 450 Home page and view the system status. Select OFF to enable the login fields, which allow users log in the UI and to access the setup screens. 2. Select ON or OFF and press **Next** to save the selection and go to the next screen. The screen example shows the Remote Network Access Lock is set to OFF. Remote Access refers to the ability to make configuration changes to the device through the Ethernet connection.
	**First IP-Address Octet Display Screen:** Displays the first octet (one to three numerals) of the control module IP address. This is a view-only screen. The control module's IP address is set up using a client computer connected to the control module. 3. Press **Next** to go to the next screen. The screen example shows the first IP address octet value **169** for the complete example IP address of **169**.254.1.1, which is the factory-default IP address.
	**Second IP-Address Octet Display Screen:** Displays the second octet (one to three numerals) of the control module IP address. This is a view-only screen. The control module's IP address is set up using a client computer connected to the control module. 4. Press **Next** to go to the next screen. The screen example shows the second IP address octet value **254** for the complete example IP address of 169.**254**.1.1, which is the factory-default IP address.
	**Third IP-Address Octet Display Screen:** Displays the third octet (one to three numerals) of the control module IP address. This is a view-only screen. The control module's IP address is set up using a client computer connected to the control module. 5. Press **Next** to go to the next screen. The screen example shows the third IP address octet value **1** for the complete example IP address of 169.254.**1**.1, which is the factory-default IP address.

Table 33: System 450 Ethernet Network Setup Screen Information and Procedures

LCD Screen	Name, Description or Function, User Action, and Example
	**Fourth IP-Address Octet Display Screen:** Displays the fourth octet (one to three numerals) of the control module IP address. This is a view-only screen. The control module's IP address is set up using a client computer connected to the control module. 6. Press **Next** to go to the next screen. The screen example shows the fourth IP address octet value **1** for the complete example IP address of 169.254.1.**1**, which is the factory-default IP address.

Table 33: System 450 Ethernet Network Setup Screen Information and Procedures

LCD Screen	Name, Description or Function, User Action, and Example
drct ModE	**Network Address Mode Status Screen:** Displays the Network Address mode that the control module is configured to operate in. This is a view-only screen. The three available modes are: • **drct ModE** (Direct Connection mode) • **StAt ModE** (Static IP Connection mode) • **Auto ModE** (Automatically Obtain IP Address mode) After you configure the network parameters for your control module in the web UI and reset the control to implement your network settings, this screen displays the network address mode. 7. Press **Next** to go to the next screen. This screen example shows that the communications control module is in the Direct Connection mode.
rSEt IP	**Reset Default Network Configuration Screen:** Allows you to restore all of the network configuration parameters to their default values, and places the communications control module in the Direct Connection mode. 8. Press and hold **Down** for 5 seconds to restore the control module's network configuration values to the original default values. This causes the control module to reset and use the default values. The following Ethernet fields and parameters are restored to their default setting when the Reset Default Network Configuration (rSEt) feature is implemented in the Web User Interface Network Configuration page: • **Static IP Address** is restored to 169.254.1.1 • **Subnet Mask** is restored to 255.255.0.0 • **Default Gateway** is restored to 169.254.1.2 • **Direct Connect** option is selected • **Web Server Site Name** field is blank • **Web User Name** is restored to System450User1 • **Web Password** is restored to Wx9jc3 • **HTTP Port** is restored to 80 • **Dynamic DNS Service Provider** field is blank In the Local User Interface Ethernet Network **COMM** Setup Screens, **RLCK** is set to OFF. This screen example shows the Reset Network Configuration screen.

Table 33: System 450 Ethernet Network Setup Screen Information and Procedures

LCD Screen	Name, Description or Function, User Action, and Example
	**Communications Setup Start Screen:** From the Communications Setup Start screen, you can access the communications screens for the control module with Ethernet communications. 9. Press **Next** to go to the Remote Network Access Lock screen, or press **Menu** to scroll through the System Setup Start screens, or press and hold **Down** and **Up** simultaneously to return to the Main screens. This screen example shows the Communications Setup Start screen.

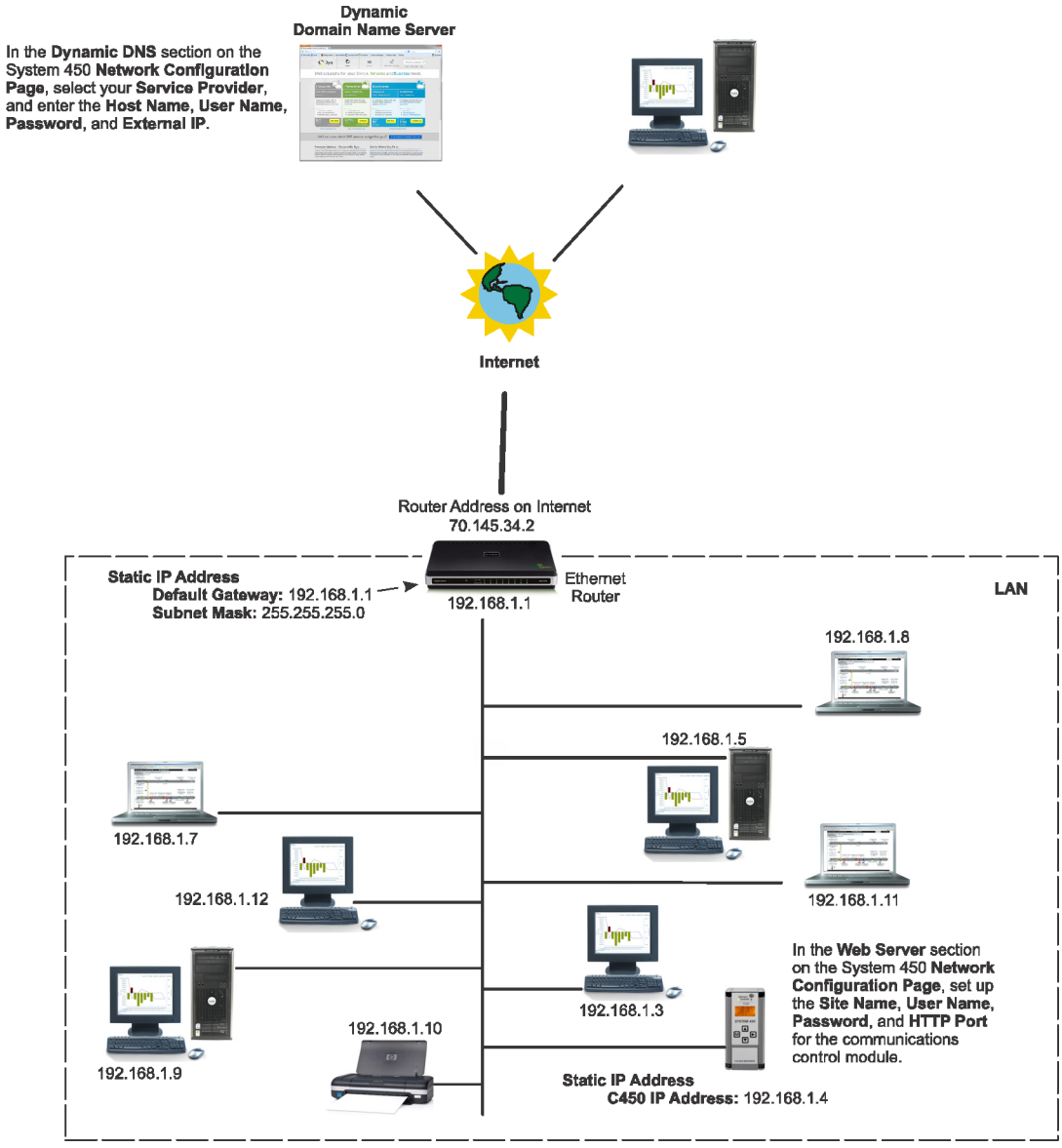
Determining Ethernet Communication Settings

Before configuring the network settings for the System 450 Control Module with Ethernet Communications (C450CEN-1C), consider the following questions. Some of these questions require a thorough understanding of your network infrastructure. Consult with your network administrator to determine infrastructure information, setup procedures, and rules for the network you are connecting your System 450 control system to.

1. Will you be connecting to the control system just on an occasional basis or will you be adding the control system to an existing network? If you are only connecting occasionally, just to configure or troubleshoot the control system, you probably want to use the Direct Connect mode and connect your laptop directly to the Ethernet control module on the control system (Figure 45).
2. If you are adding the control system to an existing Ethernet network, consider the following: What type of network management devices and services will it interact with? Does the network contain a router? Do you want the router to assign an IP address to the Ethernet control module or will you use a static IP address? If you use a static IP address, what address can you use that does not conflict with other devices on the network?
3. Will remote (Internet) access be made available? If the network supports Internet access, will it use a Dynamic DNS service? Will you need to remotely access more than one Ethernet control system on the network?

The answers to these questions help you determine the proper network configuration for the Ethernet control module. The following sections provide a description of the different addressing modes, Internet access, and Dynamic DNS. An understanding of these concepts and how they relate to your network is required to properly configure the Ethernet communication parameters of the control module.

Figure 42: Example Network Diagram with System 450 on a Local Network



IP Address Modes

System 450 Ethernet control modules use TCP/IP protocol to communicate with other devices over Ethernet networks. Each device on a network of devices, including the Ethernet control module, requires a unique IP address on the network. How a device acquires or is assigned its unique IP address depends on the local network's configuration and rules.

The control module can be set up in one of three addressing modes: Direct Connect, Static IP, or Automatic. You set up the control modules addressing mode according to the network configuration and rules on the network that you are connecting to.

Direct Connect Mode

Use the Direct Connect mode for the following scenarios:

- to connect a single computer directly to an Ethernet control module

- during the initial setup to commission a control module before integrating the module into an existing network
- to connect devices that use the network connection sporadically

Direct Connect is the default addressing mode for the control module. You can restore the control module to the default Direct Connect mode through the rSEt feature in the local user interface, which provides a recovery path in cases where the network configuration has changed or been corrupted and the current state of the device is unknown.

In Direct Connect mode, the control module functions as a DHCP server and assigns itself the IP address **169.254.1.1**. A DHCP server automatically identifies devices as the devices are added to an Ethernet network and then supplies the devices with a network configuration, including an IP address.

When the control module is in Direct Connect mode and acts as a DHCP server, it can assign an IP address to a connected computer that runs a browser in order to configure the control module.

Static IP Address Mode

When you select Static IP Address mode, the Ethernet control module uses a fixed or static IP address. It is the network administrator's responsibility to determine an IP address that is compatible with the rest of the network before assigning it to the control module. Assuming that the network contains a router that acts as a DHCP server, consider the following rules when determining the static IP address to use:

- The IP address must not fall within the range of the router's DHCP client address table. (Linksys® routers typically use 192.168.1.100 through 192.168.1.149 for DHCP clients. Other routers may vary.)
- The IP address must be a unique address on the network, including other devices that may use a static IP address.
- The IP address must reside within the address range defined by the subnet mask of the router. For example, if the router has an IP address of 192.168.1.1 and a subnet mask of 255.255.255.0, all IP addresses on this subnet should be in the range of 192.168.1.2 through 192.168.1.255.

Work with your network administrator to determine if Static IP Address mode is the best fit for your network configuration. The benefit to using Static IP Address mode is that the Ethernet control module has an IP address that never changes. A limitation to using this mode is that network management becomes more difficult when multiple devices have statically assigned IP addresses, especially in large networks. You must maintain a list of device IP addresses to avoid assigning duplicate addresses.

Automatic IP Address Mode

When you select Automatic IP Address mode, the Ethernet control module relies on a network DHCP server to assign it an IP address and subnet mask. This DHCP server is part of an existing network infrastructure.

Work with your network administrator to determine if Automatic IP Addressing mode is the best fit for your network configuration.

Benefits to selecting Automatic IP Address mode include:

- A single router/DHCP server manages the IP addresses that the Ethernet control modules use. Network administrators can access one device rather than managing multiple control modules.
- No static IP addresses are assigned to Ethernet control modules, eliminating the need to maintain a list of device IP addresses.

Limitations of the Automatic IP Address mode include:

- The router/DHCP server may assign a different IP address to the Ethernet control module following a reset, and users may not know the current IP address of the control module so they cannot browse to it. This problem can be resolved if the router/DHCP server uses a reserved IP address for the Ethernet control module.
- The IP address used by the Ethernet control module needs to remain constant if your network configuration requires Internet access and port forwarding is used.

In a typical small network, a router acts as a DHCP server and assigns IP addresses to devices that connect to the network. This can cause confusion if users do not know the IP address that is assigned to a control module, because that address is needed in order to browse to the module.

One way to avoid this confusion but still rely on the DHCP server in the router is to configure the DHCP server to reserve a specific IP address for the control module. The DHCP server associates the unique MAC ID of the control module with the reserved IP address. If you have multiple Ethernet control modules, you can reserve an IP address for each module's unique MAC ID. (Each control module has a label that identifies the module's unique MAC ID.) Users get the benefit of a static IP address that they can browse to. Network administrators may find this feature preferable because it moves management of the network addresses to a single device (the router). Consult the feature set of your router if you choose to pursue this option.

Internet Access

To make an Ethernet control module accessible via the Internet, the control module is often connected to the Internet through a router and a cable or digital subscriber line (DSL) modem. In this case, the router is usually connected to the Internet via an Internet Service Provider (ISP).

The router has an IP address that is visible on the Internet. This external IP address exists in addition to the internal IP address visible from the network that the router manages. The router external network is sometimes referred to as a WAN (wide area network, external network) and the router internal network is referred to as a LAN (local area network, internal or private network). The router routes traffic between devices on its internal network and devices on the Internet (Figure 42). It acts as a gateway between the LAN and WAN.

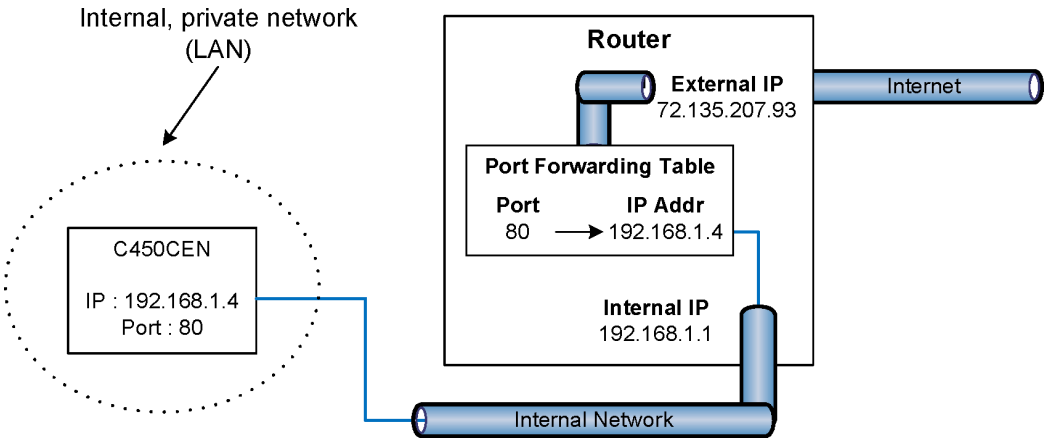
To make the Ethernet control module visible on the Internet, you must enable port forwarding on the router. Port forwarding enables requests by a client browser, on the Internet, to be forwarded to the control module located on the internal network. The control module then transmits the web page to the remote client browser.

Port numbers are used in conjunction with the router's external IP address to route messages to the correct device. Web servers typically use Port 80. When an Ethernet control module is set up to use Port 80, the user only needs to type a URL or IP address into the address bar of their web browser. The browser automatically identifies Port 80 as the target service since it is the default port number used by web servers and client browsers.

If a port number other than 80 is assigned, a user must type the IP address followed by a colon and the port number.

If the port forwarding configuration of the router asks for a specific protocol to forward, select All (if available), HTTP, or TCP/IP. The web server in the Ethernet control module uses the HTTP protocol, which is based on the TCP/IP protocol. See Figure 43 for an example port forwarding configuration.

Figure 43: Port Forwarding Configuration Example



When accessing the Ethernet control module from a web browser in this example, browse to http://72.135.207.93 to access the Ethernet control module at 192.168.1.4 (Figure 43).

ⓘ **Note:** If Port 80 is used and there is only one device on the LAN of the router, you do not need to include the port number after the router external IP address.

When the router receives a request for a web page (a Port 80 request), it forwards the request to the web server at the internal IP address of 192.168.1.4, based on its port forwarding table.

Multiple Ethernet Control Modules and Port Numbers

A problem occurs when more than one Ethernet control module exists on a network and remote Internet access is necessary. When a router receives a request for a web page, the router determines which Ethernet control module the request should be forwarded to using the Ethernet control module's port number contained in the request. Although web server requests typically use Port 80, servers are able to use different port numbers and requests from a client browser can specify a port other than 80.

In order to support Internet access to multiple Ethernet control modules located on a private network (behind a router), configure a unique port number for each control module. You must configure the port forwarding feature of the router to route these unique port numbers to the specific Ethernet control module that supports them.

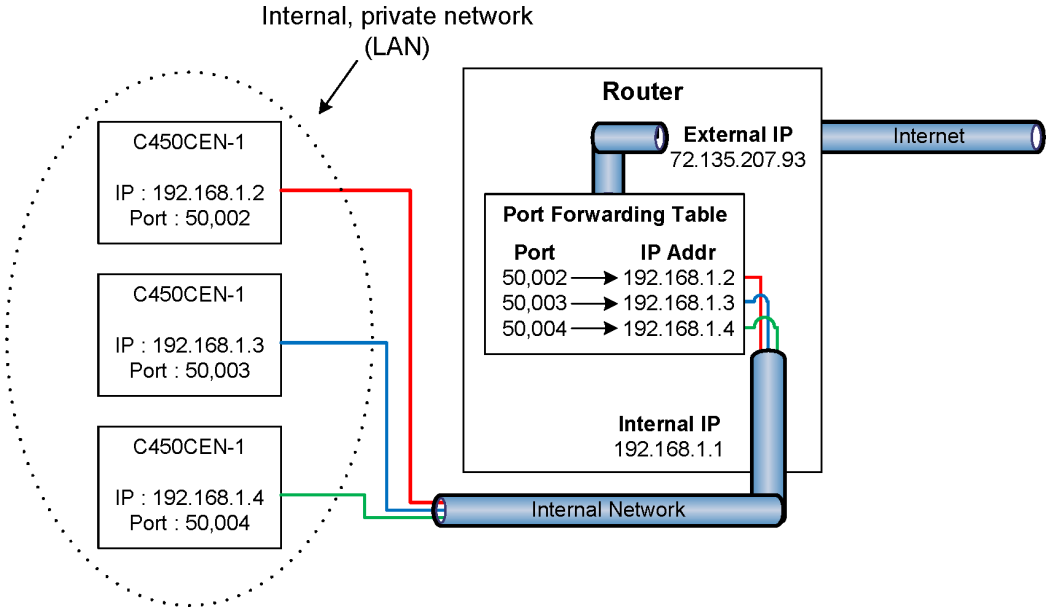
Users can browse to the Ethernet control modules by appending the port number to the IP address as part of the URL.

Multiple C450CEN-1 Control Modules and Port Numbers Example

In this example, the external IP address of the router is 72.135.207.93, which is the IP address of the router as viewed from the Internet.

Three Ethernet control modules are located on the private network with static or reserved IP addresses 192.168.1.2, 192.168.1.3, and 192.168.1.4. Each control module is configured to use a unique port number: 50,002, 50,003, or 50,004 (Figure 44).

Figure 44: Multiple Ethernet Control Modules and Port Numbers Example



To access the three Ethernet control modules from a web browser, use the following URLs to direct you to the controllers:

- http://72.135.207.93:50002 to access the Ethernet control module at 192.168.1.2
- http://72.135.207.93:50003 to access the Ethernet control module at 192.168.1.3
- http://72.135.207.93:50004 to access the Ethernet control module at 192.168.1.4

The router receives all requests to these devices and forwards those requests to a specific Ethernet control module based on the port number in the request.

Dynamic DNS

Dynamic DNS is an optional feature that the Ethernet control module supports. Dynamic DNS is only used on devices that are accessed through the Internet. You must create an account with DynDns (http://dyn.com/dns/) to use this feature and configure the Ethernet control module.

Using Dynamic DNS, you can easily identify an Ethernet control module with a text-based URL (host name) instead of numeric IP addresses and port numbers. For example, instead of browsing to http://72.135.207.94, you can create a text-based host name, such as abc_temp_control.dyndns.org.

In situations where the external IP address of the router is assigned by an ISP, the address that is assigned may change periodically. Within the Ethernet control module is an update client that causes the text-based URL to remain valid.

The update client in the Ethernet control module, working in conjunction with the service offered by DynDNS, detects changes to the external IP address of the router, contacts the DynDNS server, and updates the account with the new IP address. The static text-based URL hides the changing IP address, allowing users to remember only one URL to access the control module rather than having to remember and become aware of a new IP address each time the IP address of the router changes.

If your application includes multiple Ethernet control modules, an additional step is required to configure Dynamic DNS. Refer to the DynDNS knowledge base at http://dyn.com/support/ in the web hops and redirections topic. This scenario uses unique port numbers, described in *Multiple Ethernet Control Modules and Port Numbers*, as a means of distinguishing between multiple Ethernet control modules.

Refer to http://dyn.com/dns/ for information about purchasing and using Dynamic DNS.

Setting Up Ethernet Communications

About this task:
Obtain the information in this section and record the values in the fields provided. This information is required to set up the Ethernet control module to use a Static IP address. Your network administrator may be able to provide most, if not all, of this Ethernet setup information. Use the following steps to connect your computer to the router using a wired port or Wi-Fi:

ⓘ **Note:** Skip steps 2 through 6 if you are using the Automatic IP Addressing mode.

1. Consult the user manual for the router or see your Network Administrator to obtain the router IP address, user name, and password.

   - Record the router's Internal LAN IP address (___.___.___.___).
   - Record the user name (_____) and password (_____).

2. Log in to the router using the router's IP address and login credentials from Step 1. Access the configuration and setup pages within the router.
3. Locate the router's LAN setup screen to view the router's subnet mask.
   ⓘ **Note:** The subnet mask is usually 255.255.255.0.

   - Record the router's subnet mask (___.___.___.___).

4. Determine the DHCP client address range used by the router. You can use addresses outside this DHCP address range for static addressing.
   ⓘ **Note:** If the DHCP client address range does not provide space for the devices you need to add to the network, reduce the DHCP client address range.

   - Record the DHCP client address range (___.___.___.___ to ___.___.___.___).

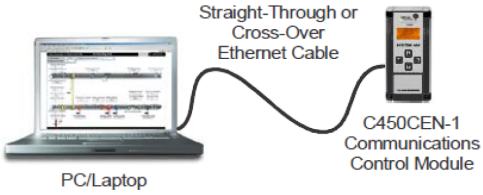
5. Determine if there are any existing devices on the network that use a static IP address. Examples might include printers, cameras, or other special equipment.
6. Determine the static address range. The static address range does not fall within the DHCP client address range and does not conflict with any existing devices that use a static IP address. For example, if the DHCP client address range is 192.168.1.2 to 192.168.1.100, the space available for static IP addressing would be 192.168.1.101 to 192.168.1.255.

   - Record the static address range (___.___.___.___ to ___.___.___.___).

Establishing a Direct Connection

About this task:
The Ethernet control module is shipped with the Direct Connect addressing mode enabled. When operating in Direct Connect mode, the control module uses an integral DHCP server to provide an IP address to your computer and enables communications between your computer and the control module.
After you have established a direct connection between your computer and the Ethernet control module (Figure 45), you can use a web browser on your computer to browse to the Ethernet control module and set up the Ethernet control module's network configuration before connecting it to an existing local network.

Figure 45: Direct Connection Between a Laptop and a System 450 Communications Control Module



You can also use the Direct Connection mode to connect and browse to System 450 communications control systems that are not permanently connected to a network.

ⓘ **Note:** The control module's network settings, with the exception of resetting the network configuration to its default state, cannot be set up or changed via the local user interface.

In this task you establish a direct connection between a computer and an Ethernet control module.

1. Start your computer and disable the wireless networking feature (Wi-Fi) on the computer.
2. Connect an Ethernet cable (straight-through or crossover) between your computer's RJ-45 Ethernet port and the Ethernet control module's RJ-45 Ethernet port.
3. Connect power to the Ethernet control module. Using the local UI, navigate to the Communications Setup screen and verify that the address mode is set to Direct (drct). If it is not, navigate to the Reset Default Network Configuration screen and restore the network configuration to its default state. See Table 33 for information on navigating to and through the Communications Setup screen.
4. Open the Windows® Internet Explorer® web browser on your computer. The Internet Explorer browser at version 9 or later is recommended and supported.
5. Type the IP address 169.254.1.1 into the browser's address bar and press Enter. The System 450 Overview and Login page should appear (Figure 46).

   ⓘ **Note:** If the Ethernet control module does not respond, close the browser, wait for 1 to 2 minutes, and try again. It may take some time for the control module to assign an IP address to your computer. If the control module still does not respond, you may need to turn the power off and on.
6. Enter the System 450 web server user name and password to log in.

   ➤ **Important:** When you log in for the first time, the default web server User Name is **System450User1** and the default Password is **Wx9jc3**. After the initial login, we strongly recommend assigning a different web password in the web server section of the Network Configuration page. You can also change the web user name at this time. Record and save these values. You must enter the web user name and web password each time that you log in to the System 450 web server. You can use the rSEt feature in the local UI to restore the entire network configuration to its default state, including the web server user name and password, if necessary.

   After you log in, you can set up your control system parameters and configure the Ethernet control module for connection to a local network and the Internet.
7. Follow the steps in *Setting Up a Static IP Address* or *Setting up an Automatic IP Address*, depending on your desired network configuration.

Setting Up a Static IP Address

About this task:

To configure your Ethernet control module for a local network using a static IP address, you must determine the default gateway (router) address and subnet mask on your local network and a static IP address for the control module. See Figure 42 for an example network diagram with a System 450 on a local network.

ⓘ **Note:** Your network administrator may be able to provide most or all of this network setup information.

Use the following steps to configure the Ethernet control module to use a static address:

1. See *Establishing a Direct Connection* for instructions about how to connect a computer directly to the Ethernet control. Log in to the System 450 web UI and go to the Network Configuration page (Figure 51).
2. In the IP Address section on the Network Configuration page, click the Static IP Address option in the IP Address section. Use a value from the static address range determined in Step 6 of *Setting Up Ethernet Communications*.
3. In the IP Address section on the Network Configuration page, enter the assigned subnet mask in the Subnet Mask field. Use the value recorded in Step 3 of *Setting Up Ethernet Communications*.
4. In the IP Address section on the Network Configuration page, enter the gateway address in the Default Gateway field. Use the value recorded in Step 1 of *Setting Up Ethernet Communications*.
5. In the Web Server section of the Network Configuration page, enter a Site Name and a new web password. This is **strongly** recommended for security reasons. The new password must have at least six digits with a minimum of one uppercase letter, one lowercase letter, and one number. See *Setting up the System 450 Web Server* for more information.
   ⓘ **Note:** The default web password can be restored through the **rSEt** (Reset to Default Settings) feature in the local UI. When the default password is restored using the rSEt feature, the entire network configuration reverts to the direct connect default state.
6. Click OK to save the new settings.
   ⓘ **Note:** Clicking OK on the Network Configuration page after changing network setup values initiates a reset of the Ethernet control module. After the reset, the new settings take effect and the direct connection is no longer functional.
7. Remove the Ethernet cable from the computer and connect the Ethernet control module to the router on the local network you specified.
8. Enable the wireless networking feature on your computer again so it can connect to the router local network. Type the static IP address assigned to the Ethernet control module in the address bar of the web browser to open the web UI and verify it connects to the network. You entered this IP address into the Ethernet control module's IP address field in Step 2.

Setting up an Automatic IP Address

About this task:
In this task you configure the Ethernet control module to use automatic IP addressing.

1. Follow the steps in *Establishing a Direct Connection* to establish a direct connection between your computer and the Ethernet control module.
2. Log in to the System 450 web UI and open the Network Configuration page.
3. In the IP Address section on the Network Configuration page, click Automatically Obtain an IP Address option.

4. In the Web Server section on the Network Configuration page, enter a Site Name and a new web password. This is **strongly** recommended for security reasons. The new password must have at least six digits with a minimum of one uppercase letter, one lowercase letter, and one number.

   ⓘ **Note:** The default web password can be restored through the **rSEt** (Reset to Default Settings) feature in the local UI. When the default password is restored using the rSEt feature, the entire network configuration reverts to the Direct Connect default state.

5. Click OK to save the new settings.

   ⓘ **Note:** Clicking OK on the Network Configuration page after changing network setup values initiates a reset of the Ethernet control module. After the reset, the new settings take effect and the direct connection is no longer functional.

6. Connect the Ethernet control module to the local network you specified so the router can assign the IP Address. Access the router web pages to verify that it is connected to the local network.

   ⓘ **Note:** You can perform the following actions on the Network Configuration web page any time that the web server UI is accessed.

Setting up the System 450 Web Server

About this task:
You can assign a site name, web user name, web password, and HTTP port for the web server on the Ethernet control module in the Web Server section of the Network Configuration page.
In this task you set up the control module web server.

1. Assign a 15-character (or less) site name for your Ethernet control system in the Web Server section on the Network Configuration page. The site name appears on all web pages that are provided by the Ethernet control module. It is useful to distinguish one Ethernet control module from the others in situations in which there are multiple controllers.
2. Optionally, assign a 15-character (or less) web user name for accessing your Ethernet control system in the Web Server section on the Network Configuration page. The web user name is used to log in to the System 450 web UI configuration pages to change system, sensor, or network parameters.
3. We strongly recommend that you assign a new web password for your Ethernet control system in the web server section on the Network Configuration page. The new password must have at least six digits with a minimum of one uppercase letter, one lowercase letter, and one number. The maximum length of the password is 15 characters. The web password is used to log in to the System 450 web UI configuration pages to change system, sensor, or network parameters. You can also change the web user name at this time.
4. Assign an HTTP Port for your Ethernet control system in the Web Server section on the Network Configuration page. Use the default value of 80 unless you have multiple Ethernet control modules on your network and intend to support remote Internet access.

Accessing C450CEN-1 Control Systems from the Internet

About this task:
The router to which the Ethernet control module is connected must have access to the Internet. Use the following steps to determine the router's external IP address and access Ethernet control systems from the Internet:

1. Connect an Ethernet cable to the computer and plug it into a numbered port on the router, or connect the computer wirelessly to the router.

2. Determine the router's external IP address as viewed from the Internet. You can determine this IP address using one of the following methods:

   - In the router configuration web pages, there may be a status page (such as Advanced, WAN Setup) that lists the external IP address.
   - Use a computer connected to the internal network to browse to an IP address lookup website to learn the external IP address of the router.

3. Enable port forwarding in the router. Consult the user manual for the router to determine the steps necessary to configure port forwarding.

   ⓘ **Note:** You must enable port forwarding on the network router to allow requests from the Internet to reach the Ethernet control module.

   - If you have a single Ethernet control module, you can forward Port 80 requests (HTTP) to the static IP address of the device. Web servers typically use Port 80 and if you have a single Ethernet control module, that value can be left unchanged.
   - If you have multiple Ethernet control modules on the network, you must assign a unique port number to each device. You can choose a value of 80, 8,080, or 50,000 through 65,535. The port that the Ethernet control module uses is set as part of the network configuration of the device. If you need to establish unique port numbers, browse to the device, login, select the network configuration page, and set the port number.

4. After you establish port numbers, browse to the router configuration pages, locate the port forwarding setup feature, and forward the ports you defined to the static IP address of the Ethernet control module that uses those ports.
5. Access the Ethernet control module from the Internet by browsing to http://<Router External IP Address>:<Port Number>.

   ⓘ **Note:** If you have a single Ethernet control module and it uses Port 80, you can omit the colon and port number from the browser address. If you have multiple Ethernet control modules, the router uses the port number to route the request to a specific Ethernet control module.

Setting Up Dynamic DNS

About this task:
To enable Dynamic DNS on your System 450 control system, you must first set up an account with DynDNS (http://dyn.com/dns/). You must enter your account information (host name, user name, and password) on the Network Configuration page. See *Dynamic DNS* for a complete description of this feature.
Use the following steps to set up your System 450 control system to use Dynamic DNS:

1. In the Dynamic DNS section on the Network Configuration page, select DynDNS as the service provider from the drop-down menu.
2. Enter the host name, user name, and password for the http://dyn.com/dns/ account.
3. Click OK to save the Dynamic DNS settings.
4. Supply the IP address of an available DNS server in the DNS Server field on the Network Configuration page. The default value for this field is 8.8.8.8, which points to a public DNS server maintained by Google. The chosen DNS server must be able to resolve the name of Internet-based web servers (as opposed to internal network servers).
5. In the network configuration page of the Ethernet control module, select DynDNS.com as the service provider and enter the account information in the Dynamic DNS section of the page.

6. In the DNS Server section of the Network Configuration page, enter the target DNS server IP address in the DNS Server IP field.

System 450 Web User Interface

System 450 control modules with Ethernet communications have an integral web server. The web server delivers web pages to client browsers on desktop and laptop computers. The System 450 web UI allows you to monitor your control system status and change the configuration in simple, user-friendly web pages delivered to your computer via a direct connection, connection through a LAN, or over the Internet.

You can monitor control system status and configure the control system parameters in both the local UI (LCD and four-button touch pad) and the web UI.

System Overview Page

Figure 46 shows an example System Overview page for a System 450 control system that is set up and operating. In the System Overview, you can view the system status, system setup parameters and values, and you can log in to the control system's web UI.

You cannot make any changes to the system configurations on the System Overview page. You must log in to the web UI with the assigned user name and password and then go to the sensor and output configuration pages to change your control system parameters and values.

This control system example uses the following input sensors and outputs:

- a pressure sensor (Sn-1) to control the motor speed of two condenser fans with Analog Outputs (OUTA1 and OUTA2)
- a temperature sensor (Sn-2) to control the cooling equipment (via Relay Output OUTR3) that maintains room temperature
- a humidity sensor (Sn-3) to control the humidification equipment (via Relay Output OUTR4) to maintain the room humidity

Table 34 provides descriptions, user actions, and references for the items called out in Figure 46.

Figure 46: System 450 System Overview Page Example

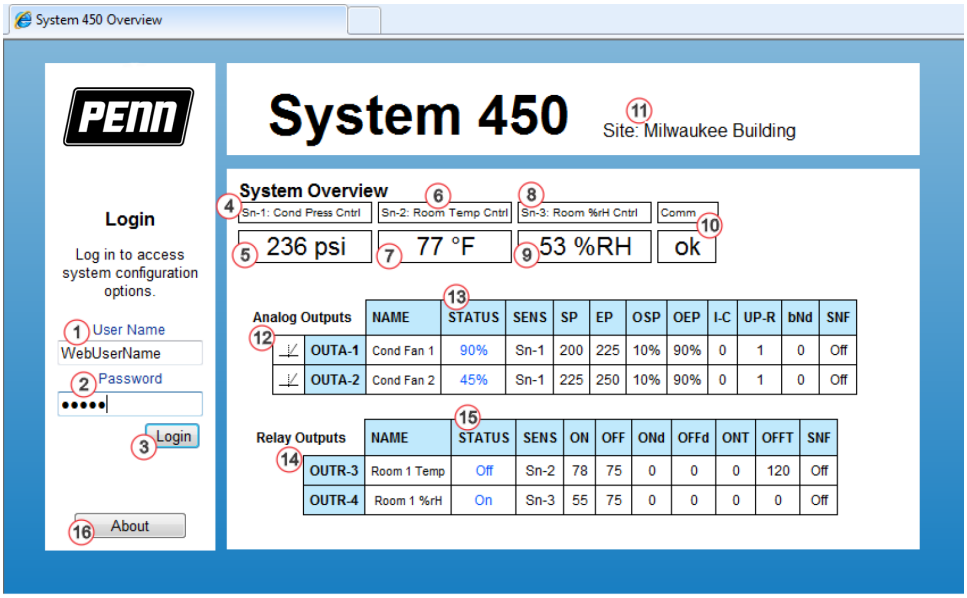


Table 34: System 450 Web UI Overview Page Descriptions, User Actions, and References

Callout Number	Identifier *Item Name*	User Actions, Descriptions, References
1	User Name *Login Field*	Enter the assigned System 450 web **user name** here. ⓘ **Note:** You can assign a web user name in the *Web User Name:* field in the W*eb Server* section on the *Network Configuration* page. See *Network Configuration Page* for more information about assigning a user name. In this example, *WebUserName* is entered as the assigned login name. The default web user **name** is a blank field.
2	Password *Login Field*	Enter the assigned System 450 web UI login web **password** here. ⓘ **Note:** You can assign a web password in the *Web Password:* field in the *Web Server* section on the *Network Configuration* page. See *Network Configuration Page*. In this example, a password is entered.
3	Login *Button*	After entering the assigned web user name and web password, click **Login** to log in to the System 450 web UI. The System Configuration page appears. See page 98 for more information.
4	**Sn-1:** ***Sensor 1 Name***	Identifies the Sn-1 (Sensor 1) and displays the assigned Sn-1 name. ⓘ **Note:** You have the option to assign a sensor name for Sn-1 in the *Name* field in the *Sn-1: Sensor 1* section on the *Sensor Configuration Page*. In this example, the assigned sensor name for Sn-1 is **Cond Press Cntrl**.
5	***Sn-1 Status***	Displays the current condition status sensed at Sn-1.
6	**Sn-2:** ***Sensor 2 Name***	Identifies the Sn-2 (Sensor 2) and displays the assigned Sn-2 name. ⓘ **Note:** You have the option to assign a sensor name for Sn-2 in the *Name* field in the *Sn-2: Sensor 2* section on the *Sensor Configuration Page*. In this example, the assigned sensor name for Sn-2 is **Room Temp Cntrl**.
7	***Sn-2 Status***	Displays the current condition status sensed at Sn-2.
8	***Sn-3*** ***Sensor 3 Name***	Identifies the Sn-3 (Sensor 3) and displays the assigned Sn-3 name. ⓘ **Note:** You have the option to assign a sensor name for Sn-3 in the *Name* field in the *Sn-3: Sensor 3* section on the *Sensor Configuration Page* In this example, the assigned sensor name for Sn-3 is **%rH Cntrl**.
9	**Sn-3: *Status***	Displays the current condition status sensed at Sn-3.
10	***Communications Status***	Displays the current status of communication between your System 450 communications control module and the connected LAN, WAN, or Internet. Communications status is defined as OK or FAIL.

Table 34: System 450 Web UI Overview Page Descriptions, User Actions, and References

Callout Number	Identifier *Item Name*	User Actions, Descriptions, References
11	**Site** ***Name Field***	Displays the assigned **site** name. ⓘ **Note:** You have the option to assign a site name for your System 450 control system in the *Site Name:* field in the *Web Server* section on the *Network Configuration* page. See *Network Configuration Page* for more information.
12	**Analog Outputs** ***Status Section***	Displays the setup values for each Analog Output in your control system, including the configured control ramp icon, analog output name (NAME), output signal status (STATUS), referenced sensor (SENS), setpoint (SP), end point (EP), output signal strength at setpoint (OSP), output signal strength at end point (OEP), integration constant (I-C), output signal update rate (UP-R), output signal dead band (bNd), and sensor failure mode (SNF). See *Setting up an Analog Output* for more information on setting up analog outputs in the System 450 web UI.
13	**STATUS** ***of Analog Output Signal***	Displays the current status of each Analog Output in your control system as a percentage of the total output signal strength range. In this example, OUTA-1 (Analog Output 1) is providing an output signal that is 90% of the full signal strength, OUTA-2 (Analog Output 2) is providing an output signal that is 45% of the full signal strength.
14	**Relay Outputs** ***Status Section***	Displays the setup values for each Relay Output in your control system, including relay name (NAME), relay output status (STATUS), referenced sensor (SENS), relay On value (ON), relay OFF value (OFF), ON-delay value (ONd), OFF-delay value (OFFd), minimum ON time (ONT), minimum OFF time (OFFT) and sensor failure mode (SNF). See *Setting up a Relay Output* for more information on setting up relay outputs in the System 450 web UI.
15	**STATUS** ***of Relay Output***	Displays the current status of each Relay Output in your control system as either **On** or **Off**. In this example, OUTR-3 (Relay Output 3) is Off, OUTR-4 (Relay Output 4) is On.
16	**About** ***Button***	Click **About** to display the System 450 Control Firmware version numbers and other information. This information is used to troubleshoot advanced control and firmware problems. See *About Page* for more information.

System Configuration Page

Figure 47 shows an example System Configuration page for a System 450 control system that is already configured and in operation. The System Configuration page is the first page that appears when you log in to the System 450 web UI.

You can block access to the System 450 UI configuration pages by enabling a remote access lock. When remote access is locked, you can access the System Overview page to view system status, but you cannot log in to the web UI and make system changes. You enable and disable the remote access lock in the control module's local UI (four-button touch pad and LCD display).

The System Configuration page provides system status information (just as the Overview page does) and access to the Sensor Configuration page, Analog Output Configuration pages, Relay Output Configuration pages, and Network Configuration page.

Table 35 provides descriptions, user actions, and references for the items called out in Figure 47.

Figure 47: System 450 System Configuration Page Example

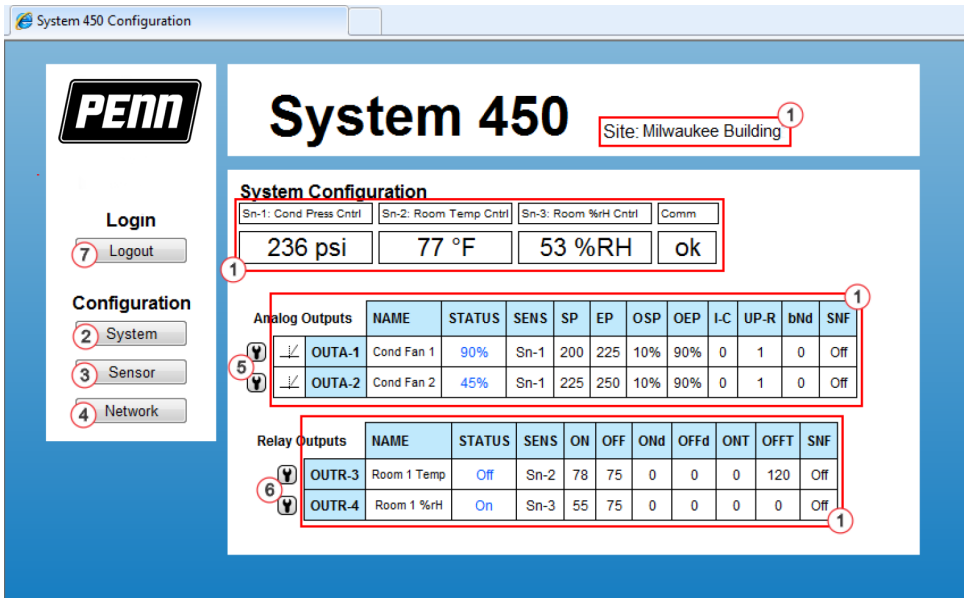


Table 35: System 450 Web UI System Configuration Page User Actions, Descriptions, and References

Callout Number	Identifier / *Item Name*	User Actions, Descriptions, References
1	***Site Name and System Status Information***	See *System Overview Page* for information regarding the system status information and site name. This information is the same on both the System Overview page and the System Configuration page.
2	**System *Button***	Click **System** to go to this System Configuration page. ⓘ **Note:** Clicking the System button on the System Configuration page simply refreshes the page. Click the System button on any other configuration page to go to the System Configuration page.
3	**Sensor *Button***	Click **Sensor** to go to the Sensor Configuration page. ⓘ **Note:** You set up your control system sensors on the Sensor Configuration page. You must set up the system sensors before you can set up the outputs. See *Sensor Configuration Page* for more information on setting up your control system sensors in the web UI.
4	**Network *Button***	Click **Network** to go to the Network Configuration page. ⓘ **Note:** You set up your control system Network communications setting on the Network Configuration page. See *Network Configuration Page* for more information on setting up network communications in the web UI.

Table 35: System 450 Web UI System Configuration Page User Actions, Descriptions, and References

Callout Number	Identifier / *Item Name*	User Actions, Descriptions, References
5	***Analog Output Setup Access Buttons***	Click the button (showing a small wrench head) to the left of an Analog Output(OUTA-*x*) status row to go to that Analog Output's configuration page. ⓘ **Note:** The control module automatically detects the type and position of the control system outputs in the module assembly and assigns an output type and unique output number for each output in your system. See *Setting up an Analog Output* for more information on setting up Analog Outputs in the web UI. In this example, Outputs 1 and 2 are Analog Outputs.
6	***Relay Output Setup Access Buttons***	Click the button (showing a small wrench head) to the left of a Relay Output (OUTR-*x*) status row to go to that Relay Output's configuration page. ⓘ **Note:** The control module automatically detects the type and position of the control system outputs in the module assembly and assigns an output type and unique output number for each output in your system. See *Setting up a Relay Output* for more information on setting up Relay Outputs in the web UI. In this example, Outputs 3 and 4 are Relay Outputs.
7	**Logout *Button***	Click **Logout** to log out of the System Configuration page and go to the System Overview page. ⓘ **Note:** After 15 minutes of inactivity in the System Configuration page, the System 450 UI automatically logs out of the web UI.

Sensor Configuration Page

Figure 48 shows an example Sensor Configuration page for a System 450 control system that is already configured and in operation. On the Sensor Configuration page, you set up the hard-wire sensors (Sn-1, Sn-2, and Sn-3) and the Differential Sensor (Sn-d), if your control system uses the Differential Control feature.

This example uses a pressure sensor (Sn-1), a temperature sensor (Sn-2), and a humidity sensor (Sn-3). This control system does not use the Differential Control feature.

Table 36 provides descriptions, user actions, and references for the items called out in Figure 48.

Figure 48: System 450 Sensor Configuration Page Example

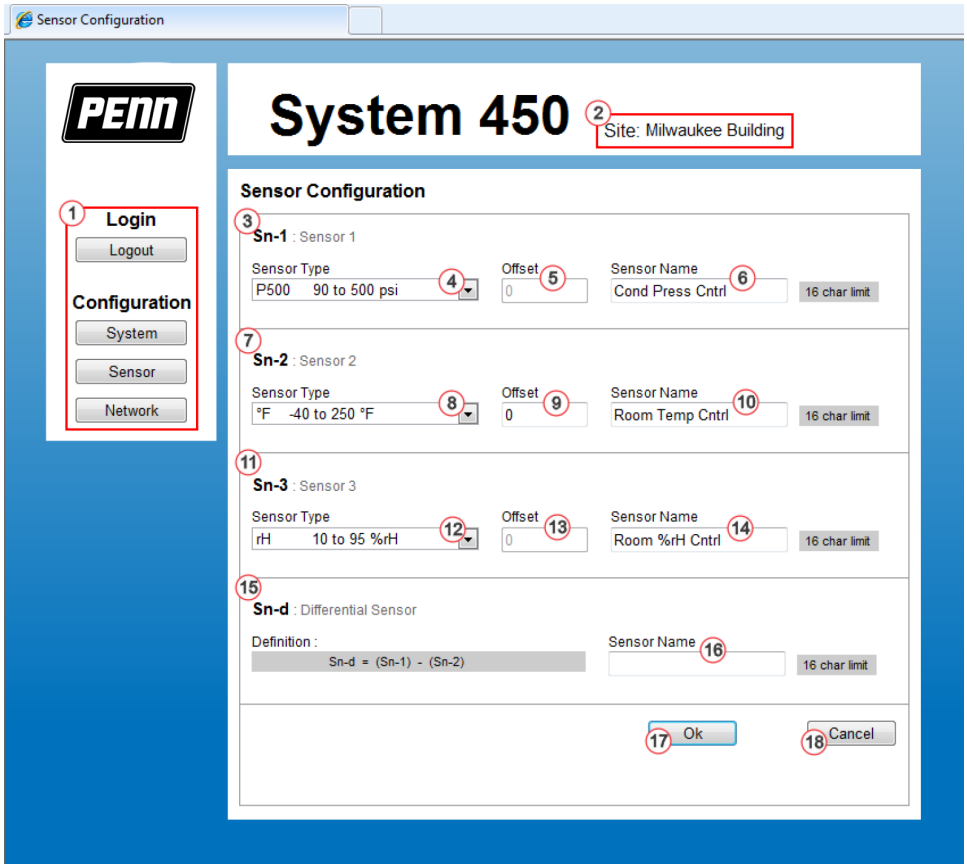


Table 36: System 450 Web UI Sensor Configuration Page User Actions, Descriptions, and References

Callout Number	Identifier / *Item Name*	User Actions, Descriptions, References
1	**Logout and Configuration Buttons**	See *System Configuration Page* for descriptions and user actions regarding the System, Sensor, and Network buttons.
2	**Site Name**	Displays the assigned site name. You can assign a website name on the Network Configuration page. See *Network Configuration Page* for more information about assigning a site name.
3	**Sn-1: Sensor 1**	Sensor 1 Configuration Section: Select the Sn-1 sensor type, select an offset value (only if Sn-1 is a temperature sensor), and assign a name for Sn-1.
4	**Sensor Type** (Sn-1)	Click the drop-down menu arrow to select the desired **sensor type** for Sn-1. The selected sensor type provides the condition, the units of measurement, range of usable values, resolution increments, and minimum proportional or control band for each output that references Sn-1. In this example, the **P 500** sensor type is selected for Sn-1.

Table 36: System 450 Web UI Sensor Configuration Page User Actions, Descriptions, and References

Callout Number	Identifier / *Item Name*	User Actions, Descriptions, References
5	(Temperature) **Offset** (Sn-1)	Enter an **offset** value for temperature sensors (only). ⓘ **Note:** You cannot select an offset value for pressure or humidity sensors. When the sensor type is a pressure or humidity sensor type, the 0 (zero) value in the Offset field is gray and cannot be changed. In this example, the Sn-1 Sensor Type is P 500 (pressure sensor). Therefore, a temperature offset value cannot be selected.
6	**Sensor Name** (Sn-1)	Assign a web UI **sensor name** for the Sn-1 sensor by entering a 16 character (maximum) name in this field. ⓘ **Note:** You are not required to assign a sensor name. When you assign a sensor name, the assigned Sn-1 sensor name is displayed on the Overview page, the System Configuration page, and the Output Configuration pages for outputs that reference Sn-1. In this example, the assigned sensor name is **Con Press Cntrl**.
7	**Sn-2: Sensor 2**	Sensor 2 Configuration Section: Select the Sn-2 sensor type, select an offset value (only if Sn-2 is a temperature sensor), and assign a name for Sn-2.
8	**Sensor Type** (Sn-2)	Click the drop-down menu arrow to select the desired **sensor type** for Sn-2. The selected sensor type provides the condition, the units of measurement, range of usable values, resolution increments, and minimum proportional or control band for each output that references Sn-2. In this example, the **°F** sensor type is selected for Sn-2.
9	(Temperature) **Offset** (Sn-2)	Enter an **Offset** value for temperature sensors (only). Enter the desired value to offset the displayed temperature from actual sensed temperature. Sensor Type °F allows an offset of up to +/- 5°F in 1 degree increments. Sensor Type °C allows an offset of up to +/- 2.5°C in 0.5 degree increments. ⓘ **Note:** You cannot select an offset value for pressure or humidity sensors. When the sensor type is a pressure or humidity sensor type, the 0 (zero) value in the Offset field is gray and cannot be changed. In this example, the Sn-2 sensor type is **°F** (temperature sensor), and 0 is selected for the Temperature Offset value.

Table 36: System 450 Web UI Sensor Configuration Page User Actions, Descriptions, and References

Callout Number	Identifier / *Item Name*	User Actions, Descriptions, References
10	**Sensor Name** (Sn-2)	Assign a web UI **sensor name** for the Sn-2 sensor by entering a 16 character (maximum) name in this field. ⓘ **Note:** You are not required to assign a sensor name. When you assign a sensor name, the assigned Sn-2 sensor name is displayed on the Overview page, the System Configuration page, and the Output Configuration pages for outputs that reference Sn-2. In this example, the assigned sensor name is **Room Temp Cntrl**.
11	**Sn-3: Sensor 3**	Sensor 3 Configuration Section: Select the Sn-3 sensor type, select an offset value (only if Sn-3 is a temperature sensor), and assign a Name for Sn-3.
12	**Sensor Type** (Sn-3)	Click the drop-down arrow to select the desired sensor type for Sn-3. The selected sensor type provides the condition, the units of measurement, range of usable values, resolution increments, and minimum proportional or control band for each output that references Sn-3. In this example, the **rH** sensor type is selected for Sn-3.
13	(Temperature) **Offset** (Sn-3)	Enter an **Offset** value for temperature sensors (only). ⓘ **Note:** You cannot select an offset value for pressure or humidity sensors. When the Sensor Type is a pressure or humidity sensor type, the 0 (zero) value in the Offset field is gray and cannot be changed. In this example, the Sn-3 sensor type is **rH** (humidity sensor). Therefore, a temperature offset value cannot be selected.
14	**Sensor Name** (Sn-3)	Assign a web UI **sensor name** for the Sn-3 sensor by entering a 16 character (maximum) name in this field. ⓘ **Note:** You are not required to assign a sensor name. When you assign a sensor name, the assigned Sn-3 sensor name is displayed on the Overview page, the System Configuration page, and the Output Configuration pages for outputs that reference Sn-3. In this example, the assigned sensor name is **Room %rH Cntrl**.
15	[1]**Sn-d: Differential**[1] **Sensor**	Sn-d: Differential Sensor Configuration Section: Assign a web UI sensor name for Sn-d.

Table 36: System 450 Web UI Sensor Configuration Page User Actions, Descriptions, and References

Callout Number	Identifier / *Item Name*	User Actions, Descriptions, References
16	**Sensor Name** (Sn-d)	Assign a web UI **sensor name** for the Sn-d sensor by entering a 16 character (maximum) name in this field. ⓘ **Note:** You are not required to assign a sensor name. When you assign a sensor name, the assigned Sn-d sensor name is displayed on the Overview page, the System Configuration page, and the Output Configuration pages for outputs that reference Sn-d. In this example, there is no Sn-d (Differential Sensor), therefore no sensor name is assigned.
17	**Ok** ***Button***	Click **Ok** to save any changes you made on this web page and go to the System Configuration page. ⓘ **Note:** If you leave a web page before clicking Ok, any changes made on the page are not saved, and the page reverts to the previous values.
18	**Cancel** ***Button***	Click **Cancel** to cancel any changes you made on this web page, revert to the previous values on the web page, and go to the System Configuration page.

1 Whenever Sn-1 and Sn-2 are set up with the same sensor type, the Sn-d (Differential Sensor) is automatically set up and made available in the SENS drop-down menus in the Output Configuration pages. You are not required to use Sn-d, but the Sn-d status is displayed in the System Overview page, Sensor Configuration page, System Configuration page, and the Output Configuration pages.

Analog Output Configuration Page

Figure 49 shows an example Analog Output Configuration Page for a System 450 control system that is set up and operating.

Table 37 provides descriptions, user actions, and references for the items called out in Figure 49.

Figure 49: System 450 Analog Output Configuration Page Example

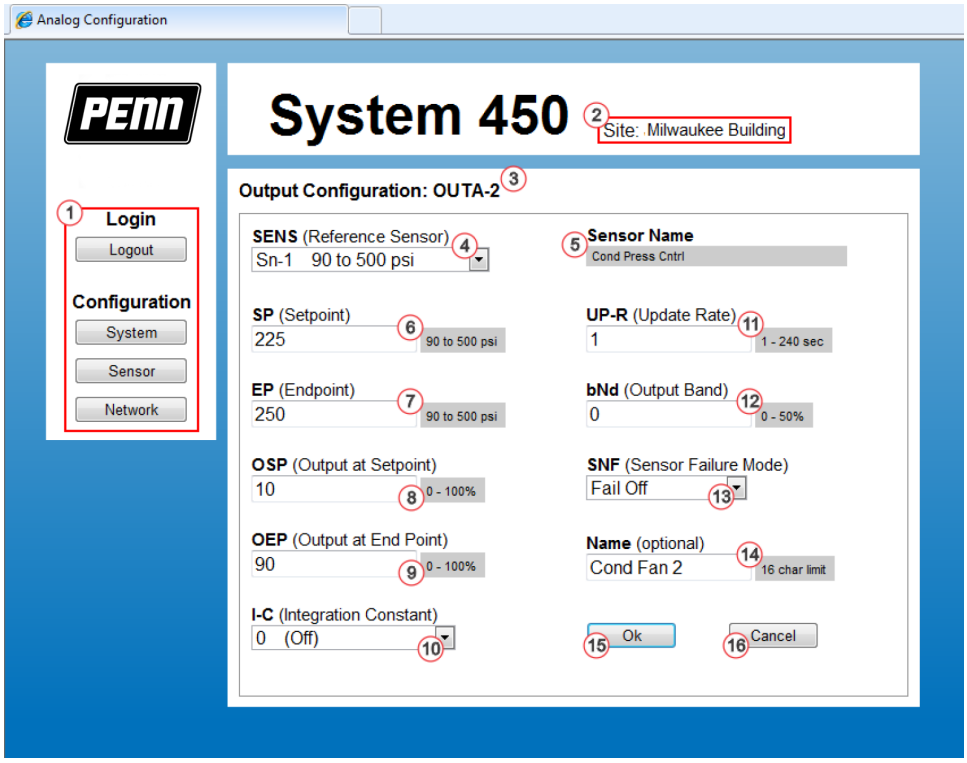


Table 37: System 450 Web UI Analog Output Configuration Page, User Actions, Descriptions, and References

Callout Number	Identifier / *Item Name*	User Actions, Descriptions, References
1	**Logout and Configuration Buttons**	See *System Configuration Page* for descriptions and user actions regarding the System, Sensor, and Network buttons.
2	**Site Name**	Displays the assigned site name. You can assign a website name on the Network Configuration page. See *Network Configuration Page* for more information about assigning a site name.
3	**Output Configuration: *OUTA-2***	Displays the output type (OUTA or OUTR) and output number (*-n*), which are assigned by the control module. ⓘ **Note:** When you first power on a System 450 module assembly, the control module automatically detects the connected outputs and assigns an output type and number for each connected output. In this example, an Analog Output is detected and identified in the number 2 position in the module assembly (OUTA-2).

Table 37: System 450 Web UI Analog Output Configuration Page, User Actions, Descriptions, and References

Callout Number	Identifier / *Item Name*	User Actions, Descriptions, References
4	**SENS (Reference Sensor)**	Click the drop-down menu to select the sensor that this output references. The reference sensor selected for this output is displayed in this field. ⓘ **Note:** If Sn-1 and Sn-2 have the same sensor type, the Sn-d and HI-2 sensors are available for selection. If Sn-1, Sn-2, and Sn-3 have the same sensor type, the Sn-d, HI-2 and HI-3 sensors are available for selection. After a sensor is selected for the output, the sensor number is displayed in the field, along with the sensor's sensor type and the usable range of values. In this example, Sn-1 is the selected reference sensor and Sn-1 is configured as a P 500 sensor type, which provides a 90 to 500 psi range.
5	**Sensor Name**	Displays the assigned sensor name. ⓘ **Note:** You can assign a 16-character (maximum) name for each sensor that you set up on the Sensor Configuration page. See *Sensor Configuration Page* for more information on assigning sensor names.
6	**SP (Setpoint)**	Enter the desired **SP** (Setpoint) value for the analog output. The range of usable values and the Setpoint units of measurement are displayed in the gray box to the right of the Setpoint field. ⓘ **Note:** The sensor type of the selected reference sensor determines the units of measurement, the range of usable values, and the minimum differential between the Setpoint and End Point values. In this example, the SP value is 225 (psi) and the usable range is 90 to 500 psi.
7	**EP (End Point)**	Enter the **EP** (End Point) value for the analog output. The range of usable values and the end point units of measurement are displayed in the gray box to the right of the End Point field. ⓘ **Note:** The sensor type of the selected reference sensor determines the units of measurement, the range of usable values, and the minimum differential between the End Point and Setpoint values. In this example, the EP value is 250 (psi) and the usable range is 90 to 500 psi.

Table 37: System 450 Web UI Analog Output Configuration Page, User Actions, Descriptions, and References

Callout Number	Identifier / *Item Name*	User Actions, Descriptions, References
8	**OSP (Output at Setpoint)**	Enter the **OSP** (Output at Setpoint) value that you want the analog output signal strength to be when the sensed condition is at SP (Setpoint). The Output at Setpoint value is a percentage of the total output signal strength range. The default OSP value is 0 and the range of usable values is 0 to 100. In this example, the OSP value is 10 (10%).
9	**OEP (Output at End Point)**	Enter the **OEP** (Output at End Point) value that you want the analog output signal strength to be when the sensed condition is at EP (End Point). The Output at End Point value is a percentage of the total output signal strength range. The default OEP value is 100 and the range of usable values is 0 to 100. In this example, the OEP value is 90 (90%).
10	**I-C (Integration Constant)**	Enter the **I-C** (Integration Constant) value for the output. There are six integration constant values (1 to 6). The default value (0) indicates that **no** integration constant is applied to the analog output. ⓘ **Note:** Johnson Controls recommends using the default value (0) when setting up your application for the first time. Refer to the *System 450™ Series Modular Control Systems with Communications Control Modules Technical Bulletin (LIT-12011826)* for information on setting up and testing an integration constant for your application. In this example, the I-C value is the default value 0 and the integration feature is Off.
11	**UP-R (Update Rate)**	Enter the **UP-R** (Update Rate) value at which the analog output signal strength is updated. You can select an Update Rate value (time-interval in seconds) between 1 and 300. In this example, the Update Rate value is the default value 1 (second).
12	**bNd (Output Deadband)**	Enter the desired **bNd** (Output Deadband), within which the output signal strength remains constant. The Output Deadband value is a percentage of the total usable sensor range. You can set the Output Deadband value to be 0 to 50 of the total range. In this example, Output Deadband is the default value 0.

Table 37: System 450 Web UI Analog Output Configuration Page, User Actions, Descriptions, and References

Callout Number	Identifier / *Item Name*	User Actions, Descriptions, References
13	**Sensor Failure Mode of Operation**	Select from the drop-down menu how you want the Relay Output to respond when the reference sensor or reference sensor wiring fails. • If you choose **Fail Off**, the Analog Output generates the selected OSP (Output Signal Strength at Setpoint) value to the controlled device. • If you choose **Fail On**, the Analog Output generates the selected OEP (Output Signal Strength at End Point) value to the controlled device. In this example, Fail Off is selected. Therefore, if the reference sensor (Sn-1) or sensor wiring fail, OUTA-2 provides the selected OSP (10%) to the controlled device until the sensor failure is resolved.
14	**(Output) Name**	Assign a 16-character or less web UI name for the Analog Output. ⓘ **Note:** You are not required to assign an output name. When you assign an output name, the assigned name is displayed on the Overview page, the System Configuration page, the Output Configuration pages and the Sensor Configuration page. In this example, the assigned name is **Cond Fan 2**.
15	**Ok** ***Button***	Click **Ok** to save any changes you made on this web page and go to the System Configuration page. ⓘ **Note:** If you leave a web page before clicking Ok, any changes made on the page are not saved, and the page reverts to the previous values.
16	**Cancel** ***Button***	Click **Cancel** to cancel any changes you made on this web page, revert to the previous values on the web page, and go to the System Configuration page.

Relay Output Configuration Page

Figure 50 shows an example Relay Output Configuration Page for a System 450 control system that is set up and operating.

Table 38 provides descriptions, user actions, and references for the items called out in Figure 50.

Figure 50: System 450 Relay Output Configuration Page Example

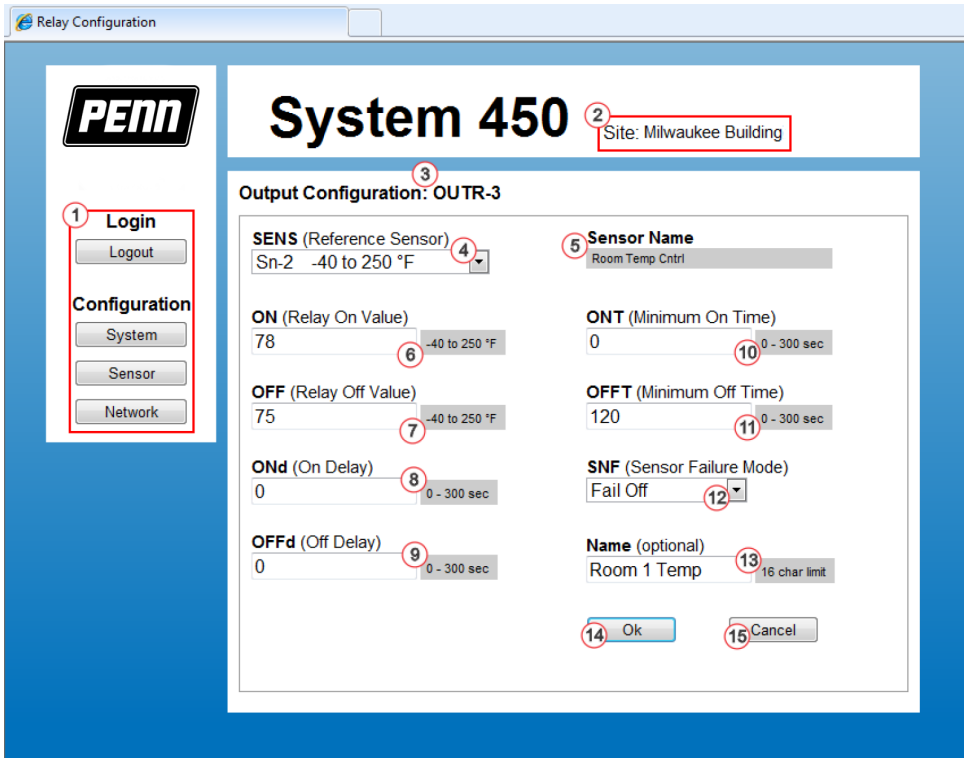


Table 38: System 450 Web UI Relay Output Configuration Page, User Actions, Descriptions, and References

Callout Number	Identifier / *Item Name*	User Actions, Descriptions, References
1	**Logout and Configuration Buttons**	See *System Configuration Page* for descriptions and user actions regarding the System, Sensor, and Network buttons.
2	**Site Name**	Displays the assigned site name. You can assign a website name on the Network Configuration page. See *Network Configuration Page* for more information about assigning a site name.
3	**Output Configuration: *OUTR-3***	Displays the output type (OUTA or OUTR) and output number (*-n*), which are assigned by the control module. ⓘ **Note:** When you first power on a System 450 module assembly, the control module automatically detects the connected outputs and assigns an output type and number for each connected output. In this example, a Relay Output is detected and identified in the number 3 position in the module assembly (**OUTR-3**).

Table 38: System 450 Web UI Relay Output Configuration Page, User Actions, Descriptions, and References

Callout Number	Identifier / *Item Name*	User Actions, Descriptions, References
4	**SENS (Reference Sensor)**	Click the drop-down menu to select the sensor that this output references. The reference sensor selected for this output is displayed in this field. ⓘ **Note:** If Sn-1 and Sn-2 have the same sensor type, the Sn-d and HI-2 sensors are available for selection. If Sn-1, Sn-2, and Sn-3 have the same sensor type, the Sn-d, HI-2 and HI-3 sensors are available for selection. After a sensor is selected for the output, the sensor number is displayed in the field, along with the sensor's sensor type and the usable range of values. In this example, Sn-2 is the selected reference sensor and Sn-2 is configured as a **°F** sensor type, which provides a -40 to 250°F temperature range.
5	**Sensor Name**	Displays the assigned **sensor name** for the selected reference sensor. ⓘ **Note:** You can assign a 16-character (maximum) name for each sensor that you set up on the Sensor Configuration page. See *Sensor Configuration Page* for more information on assigning sensor names. In this example, the sensor name is **Room Temp Cntrl**.
6	**ON (Relay On)**	Enter the desired **ON** (Relay On) value for the relay output. The range of usable values and units of measurement for ON are displayed in the gray box to the right of the ON value field. ⓘ **Note:** The sensor type of the selected reference sensor determines the units of measurement, the range of usable values, and the minimum differential between the ON and OFF values. In this example, the ON value is 78 (°F) and the usable range is -40 to 250°F.
7	**OFF (Relay Off)**	Enter the **OFF** (Relay Off) value for the relay output. The range of usable values and units of measurement for OFF are displayed in the gray box to the right of the OFF value field ⓘ **Note:** The sensor type of the selected reference sensor determines the units of measurement, the range of usable values, and the minimum differential between the OFF and ON values. In this example, the ON value is 75 (°F) and the usable range is -40 to 250°F.

Table 38: System 450 Web UI Relay Output Configuration Page, User Actions, Descriptions, and References

Callout Number	Identifier / *Item Name*	User Actions, Descriptions, References
8	**ONd (ON Time Delay)**	Enter the **ONd** (ON Time Delay) value in seconds that you want the Relay Output to delay turning on after the Relay ON value is reached and maintained.
9	**OFFd (OFF Time Delay)**	Enter the **OFFd** (OFF Time Delay) value in seconds that you want the Relay Output to delay turning off after the Relay OFF value is reached and maintained.
10	**ONT (Minimum On Time)**	Enter the **ONT** (Minimum On Time) value in seconds (0 to 300). The ONT determines the minimum time that the Relay Output remains on after reaching the ON point, regardless of changing conditions.
11	**OFFT (Minimum Off Time)**	Enter the **OFFT** (Minimum Off Time) value in seconds (0 to 300). The OFFT determines the minimum time that the Relay Output remains off after reaching the OFF point, regardless of changing conditions.
12	**SNF (Sensor Failure Mode)**	Select from the drop-down menu how you want the Relay Output to respond when the reference sensor or reference sensor wiring failure. • If you choose **Fail Off**, the Relay Output goes off when the reference sensor or sensor wiring fail. • If you choose **Fail On**, the Relay Output goes on when the reference sensor or sensor wiring fail. In this example, **Fail Off** is selected.
13	Name **(Optional)**	Assign a 16 character or less web UI name for the Relay Output. ⓘ **Note:** You are not required to assign an output name. When you assign a name, the assigned name is displayed on the Overview page, the System Configuration page, the Sensor Configuration page and the Output Configuration pages. In this example, the name is **Room 1 Temp**.
14	**Ok *Button***	Click **Ok** to save any changes you made on this web page and go to the System Configuration page. ⓘ **Note:** If you leave a web page before clicking Ok, any changes made on the page are not saved, and the page reverts to the previous values.
15	**Cancel *Button***	Click **Cancel** to cancel any changes you made on this web page, revert to the previous values on the web page, and go to the System Configuration page.

Network Configuration Page

Figure 51 shows an example Network Configuration Page for a System 450 control system that is set up and operating.

Table 39 provides descriptions, user actions, and references for the items called out in Figure 51.

Figure 51: System 450 Network Configuration Page Example

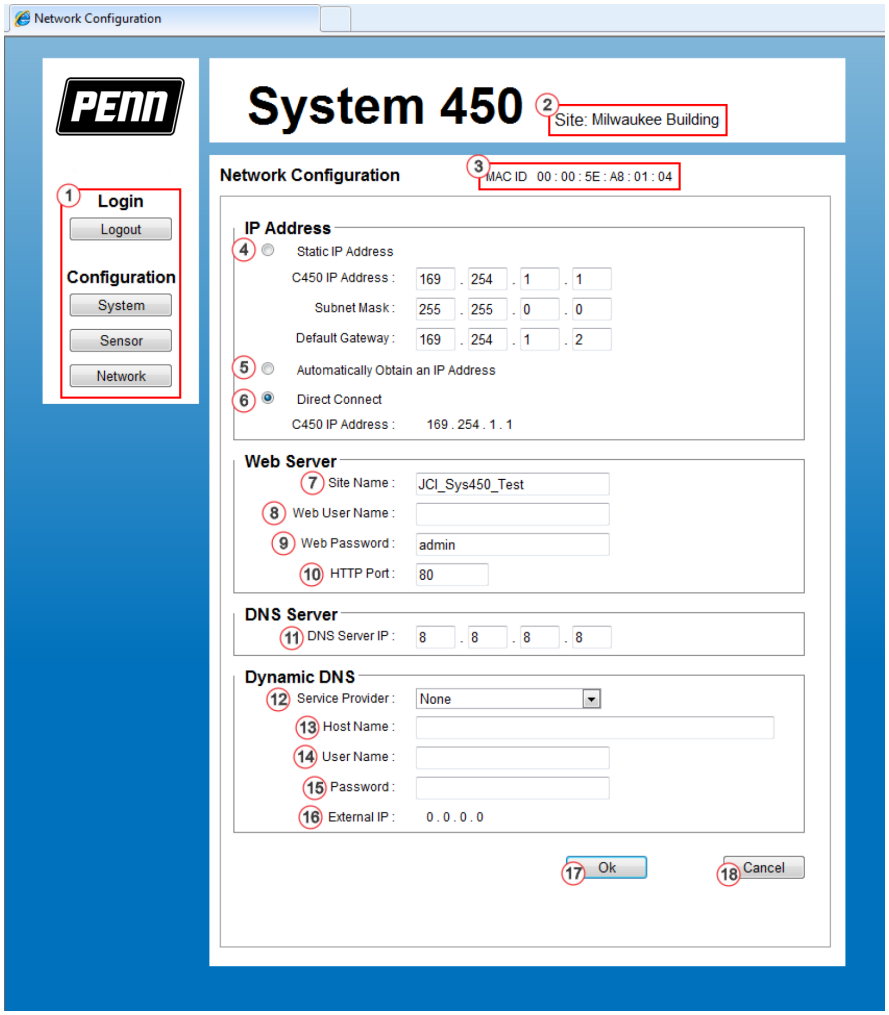


Table 39: System 450 Web UI Relay Output Configuration Page, User Actions, Descriptions, and References

Callout Number	Identifier / Item Name	User Actions, Descriptions, References
1	**Logout and Configuration Buttons**	See *System Configuration Page* for descriptions and user actions regarding the Logout, System, Sensor, and Network buttons.
2	**Site Name**	Displays the assigned site name. You can assign a website name on the Network Configuration page. See Site Name below for more information about assigning the site name.
3	**MAC ID**	Displays the unique physical address assigned to the communications control module when the module is manufactured. A module's MAC ID address cannot be changed.

Table 39: System 450 Web UI Relay Output Configuration Page, User Actions, Descriptions, and References

Callout Number	Identifier / Item Name	User Actions, Descriptions, References
4	**Static IP Address**	Select **Static IP Address** to enable and configure a static IP address for your System 450 control system with communications.
	C450 IP Address	If you click the **Static IP Address** option, you must assign a unique IP address for the C450 control module. Typically, the network administrator for the network the C450 is connected to provides an IP address for your C450 communications control module. The default C450 IP Address is **169.254.1.1**.
	Subnet Mask	If you click the **Static IP Address** option, you must assign a subnet mask for the C450 control module. Typically, the network administrator for the network that the C450 is connected to provides the subnet mask for your C450 communications control module. The default subnet mask is **255.255.0.0**.
	Default Gateway	If you click the **Static IP Address** option, you must assign a default gateway address for the modem, router, or switch that connects your C450 control module to the network. Typically, the network administrator for the network that the C450 is connected to provides the default gateway address for your C450 communications control module. The factory default gateway address is **169.254.1.2**.
5	**Automatically Obtain an IP Address**	Select **Automatically Obtain an IP Address** to obtain an IP address and the required network settings from the network DHCP server.
6	**Direct Connect**	Select **Direct Connect** when you are connecting the communications control module directly to a laptop or desktop computer with an Ethernet cable. ⓘ **Note:** The communications control module is shipped in the Direct Connect network mode. You must establish a direct connection between the control and your computer to set up the control module for connection to a local network and the Internet.
7	**Site Name:**	Assign a **site name** for your System 450 control system with communications. The assigned site name appears at the top of each web page to the right of **System 450**. The site name must be 15 characters or less. A site name is not required.

Table 39: System 450 Web UI Relay Output Configuration Page, User Actions, Descriptions, and References

Callout Number	Identifier / Item Name	User Actions, Descriptions, References
8	**Web User Name:**	Assign a **web user name** for your System 450 control system. The web user **name** is used to log in to the System 450 web UI configuration pages. The web user name must be 15 characters or less. A user name is not required. If you do not assign a web user name, users must leave the user name field blank when logging into the web UI. See *System Overview Page* for more information about user name, password, and logging in. The default web user name is System450User1.
9	**Web Password:**	Assign a **Web Password** for your System 450 control system. The web password is used to log in to the System 450 web UI. The password must be 15 characters or less. Passwords must be at least six characters long and contain at least one uppercase character, one lowercase character, and one digit. We strongly recommend that you change the default user name and password when commissioning your device. See *System Overview Page* for more information about user name, password, and logging in. The default web Password is **Wx9jc3**.
10	**HTTP Port:**	Assign the port number to be used by the HTTP Server. The default HTTP Port number is **80**.
11	**DNS Server IP:**	Enter the IP address of the DNS (Domain Name System) server that the C450 control module queries to resolve Internet addresses when Dynamic DNS is enabled.
12	**Service Provider:**	Select the dynamic DNS provider. Options include **None** (dynamic DNS not used) or **DynDNS.com**.
13	**Host Name:**	Enter the **host name** used by your dynamic DNS provider. Leave this field blank if your system does not use dynamic DNS.
14	**User Name:**	Enter the user name for the account that is set up with your dynamic DNS provider. Leave this field blank if your system does not use dynamic DNS.
15	**Password:**	Enter the password for the account that is set up with your dynamic DNS provider. Leave this field blank if your system does not use dynamic DNS.

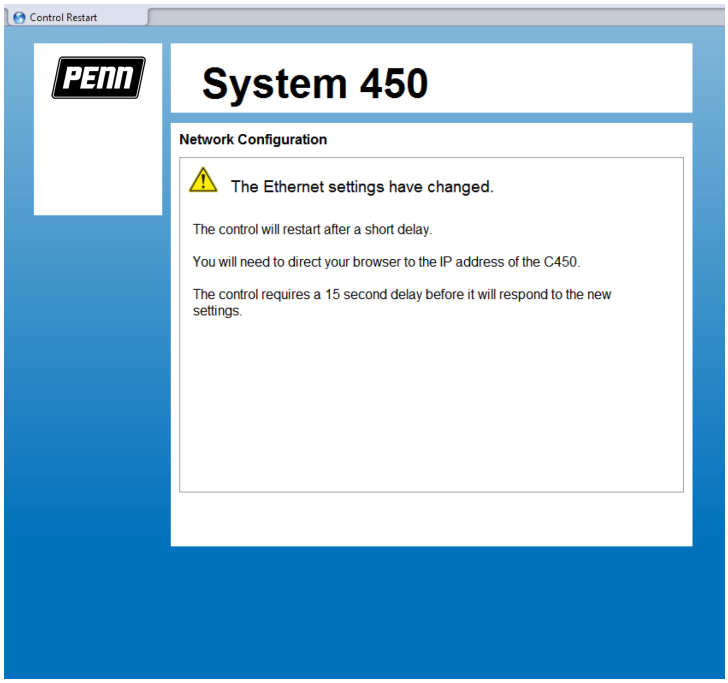
Table 39: System 450 Web UI Relay Output Configuration Page, User Actions, Descriptions, and References

Callout Number	Identifier / Item Name	User Actions, Descriptions, References
16	**External IP:**	This field automatically displays the C450 communications control module's IP address as seen from the Internet. This address can be used to troubleshoot Internet connectivity issues between the control module and the dynamic DNS provider.
17	**Ok** ***Button***	Click **Ok** to save any changes you made on this web page. ⓘ **Note:** • Changing the network configuration values initiates a reset of the System 450 communications module, before the new network configuration values take effect. You must use the new network settings to establish connection with the control module. If the new values do not allow a connection, you can reset the device to its default state using the Reset IP settings with the local UI. Once the device is in its default state, you can re-establish the direct connection values. • If you leave a web page before clicking Ok, any changes made on the page are not saved, and the page reverts to the previous values.
18	**Cancel** ***Button***	Click **Cancel** to cancel any changes you made on this web page, revert to the previous values on the web page, and go to the System Configuration page.

Network Settings Reset Page

When you change the IP Address mode, Static IP Address, Subnet Mask, Default Gateway, or HTTP Port value and click Ok, the communication controls module initiates a control reset and the Network Configuration Reset page (Figure 52) appears while the control resets the network settings for the new values.

Figure 52: Network Configuration Settings Reset Page



About Page

Figure 53 shows an example About Page for a System 450 control module.

Table 40 provides descriptions, user actions, and references for the items called out in Figure 53.

Figure 53: System 450 About Page Example

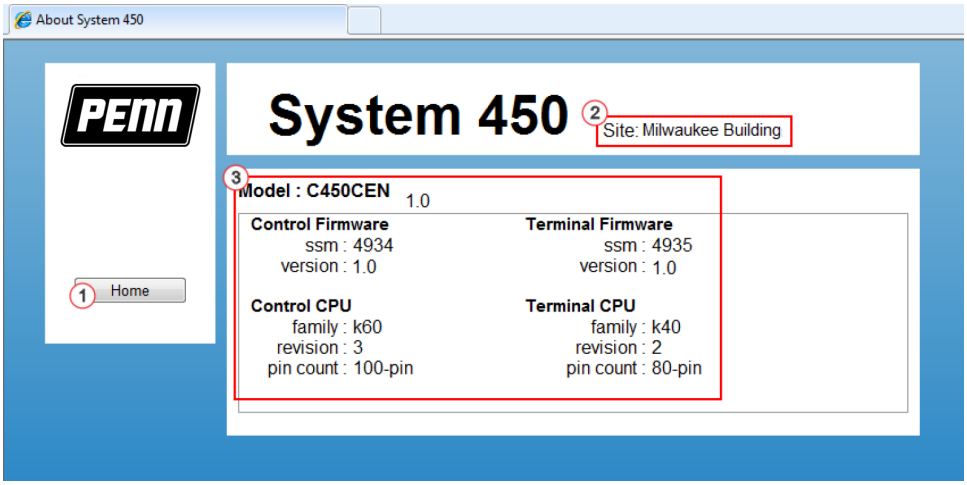


Table 40: System 450 Web UI Relay Output Configuration Page, User Actions, Descriptions, and References

Callout Number	Identifier / *Item Name*	User Actions, Descriptions, References
1	**Home** Button	Click **Home** to go to the **System Overview** page.
2	**Site Name**	Displays the assigned site name. You can assign a website name on the Network Configuration page. See *Network Configuration Page* for more information about assigning a site name.
3	**Model:** **Control Firmware** **Terminal Firmware** **Control CPU** **Terminal CPU**	Displays information about the control module model, firmware, and chip set. This information may be used for identification and advanced troubleshooting byJohnson Controls or PENN product technical support. This information cannot be changed in the field.

Repair and Ordering Information

Table 41 provides ordering information for the System 450 Series modules that can be used to build control systems with network communications. See *Technical Specifications* for detailed product specifications for the control modules listed in Table 41.

Table 42 through Table 49 provide ordering information for the System 450 compatible sensors and transducers. For more information on installing System 450 compatible sensors and transducers, see *Related Documentation*.

Table 41: System 450 Modules and Accessories Ordering Information

Product Code Number	Product Description
C450CEN-1C	Control Module with Ethernet Communications, LCD, and Four-Button Touchpad UI. (No onboard outputs available on control modules with network communications capabilities.)
C450CRN-1C	Control Module with RS485 Modbus Communications, LCD, and Four-Button Touchpad UI. (No onboard outputs available on control modules with network communications capabilities.)
C450SBN-4C	Relay Output Expansion Module; provides one SPDT line-voltage relay output.
C450SCN-4C	Relay Output Expansion Module; provides two SPDT line-voltage relay outputs.
C450SPN-4C	Analog Output Expansion Module; provides one analog output (0 to 10 VDC or 4 to 20 mAself-selecting signal) for proportional control.
C450SQN-4C	Analog Output Expansion Module; provides two analog outputs (0 to 10 VDC or 4 to 20 mAself-selecting signals) for proportional control.
C450YNN-1C	Power Module; provides 24 VAC to System 450 Module Assembly; 120 VAC or 240 VAC supply power input terminals.
BKT287-1R	DIN Rail; 12 in. (0.30 m) long
BKT287-2R	DIN Rail; 39-1/3 in. (1 m) long
BKT287-3R	DIN Rail; 24 in. (0.61 m) long

Table 41: System 450 Modules and Accessories Ordering Information

Product Code Number	Product Description
BKT287-4R	DIN Rail; 14 in. (0.36 m) long
PLT344-1R	DIN Rail End Clamps (2 clamps)
WHA-C450-100C	System 450 module connection extension cable, 100 cm (3.3 ft) long

Table 42: System 450 Compatible A99B Temperature Sensors and Accessories Ordering Information[1]

Product Code Number	Product Description
A99BA-200C	PTC Silicon Sensor with Shielded Cable; Cable length (2 m) 6-1/2 ft Sensor Temperature Range: -40 to 120°C (-40 to 250°F) Cable Jacket Temperature Range: -40 to 100°C (-40 to 212°F)
A99BB-25C	PTC Silicon Sensor with PVC Cable; Cable length (0.25 m) 9-3/4 in. Sensor Temperature Range: -40 to 120°C (-40 to 250°F) Cable Jacket Temperature Range: -40 to 100°C (-40 to 212°F)
A99BB-200C	PTC Silicon Sensor with PVC Cable; Cable length (2 m) 6-1/2 ft Sensor Temperature Range: -40 to 120°C (-40 to 250°F) Cable Jacket Temperature Range: -40 to 100°C (-40 to 212°F)
A99BB-300C	PTC Silicon Sensor with PVC Cable; Cable length (3 m) 9-3/4 ft Sensor Temperature Range: -40 to 120°C (-40 to 250°F) Cable Jacket Temperature Range: -40 to 100°C (-40 to 212°F)
A99BB-500C	PTC Silicon Sensor with PVC Cable; Cable length (5 m) 16-3/8 ft Sensor Temperature Range: -40 to 120°C (-40 to 250°F) Cable Jacket Temperature Range: -40 to 100°C (-40 to 212°F)
A99BB-600C	PTC Silicon Sensor with PVC Cable; Cable length (6 m) 19-1/2 ft Sensor Temperature Range: -40 to 120°C (-40 to 250°F) Cable Jacket Temperature Range: -40 to 100°C (-40 to 212°F)
A99BC-25C	PTC Silicon Sensor with High Temperature Silicon Cable; Cable length (0.25 m) 9-3/4 in. Sensor Temperature Range: -40 to 120°C (-40 to 250°F) Cable jacket rated for full sensor temperature range.
A99BC-300C	PTC Silicon Sensor with High Temperature Silicon Cable; Cable length (3 m) 9-3/4 ft Sensor Temperature Range: -40 to 120°C (-40 to 250°F) Cable jacket rated for full sensor temperature range.
A99BC-1500C	PTC Silicon Sensor with High Temperature Silicon Cable; Cable length (15 m) 49 ft Sensor Temperature Range: -40 to 120°C (-40 to 250°F) Cable jacket rated for full sensor temperature range.
BOX10A-600R	PVC enclosure for A99 sensor; includes wire nuts and conduit connector (for outdoor sensor)
WEL11A-601R	Immersion well for A99 sensor liquid sensing applications
A99-CLP-1	Mounting clip for A99 temperature sensor
ADP11A-600R	Conduit adaptor, 1/2 in. snap-fit EMT conduit adaptor (box of 10)

Table 42: System 450 Compatible A99B Temperature Sensors and Accessories Ordering Information[1]

Product Code Number	Product Description
TE-6001-1	Duct mounting hardware with handy box for A99 sensor
TE-6001-11	Duct mounting hardware without handy box for A99 sensor
SHL10A-603R	Sun Shield (for use with outside A99 sensors in sunny locations)

1 Refer to the *A99B Series Temperature Sensors Product/Technical Bulletin (LIT-125186)* for more information.

Table 43: System 450 Compatible TE-6000 Series 1,000 Ohm Nickel Temperature Sensors and Accessories Ordering Information

Product Code Number	Product Description
TE-6000-x	TE6000 Series 1,000 ohm at 70°F nickel temperature sensors (only). Only the TE-6000-6 sensor can be used for the entire HI°C and HI°F temperature range. Different sensing element packages are available for various applications. For a complete list of compatible 1,000 ohm nickel sensors, including sensor descriptions, technical specifications, and mounting accessories, refer to the *TE-6000 Series Temperature Sensing Elements Product Bulletin (LIT-216288)*. (System 450 Sensor Types **HI°C** and **HI°F**)

Table 44: System 450 Compatible TE-6300 Series 1,000 Ohm Nickel Temperature Sensors and Accessories Ordering Information

Product Code Number	Product Description
TE-631x-x	TE6300 Series 1,000 ohm at 70°F nickel averaging and 1,000 ohm thin-film nickel temperature sensors (only). For a complete list of compatible 1,000 ohm nickel averaging and thin-film nickel sensors, including sensor descriptions, technical specifications, and mounting accessories, refer to the *TE-6300 Series Temperature Sensors Product Bulletin (LIT-216320)*. (System 450 Sensor Types **HI °C** and **HI°F**)

Table 45: System 450 Compatible TE-68NT-0N00S 1,000 Ohm Nickel Temperature Sensor Ordering Information

Product Code Number	Product Description
TE-68NT-0N00S	TE6800 Series 1,000 ohm at 70°F nickel temperature sensor for wall-mount applications. For more information, including sensor description, technical specifications, and mounting accessories, refer to the *TE-6800 Series Temperature Sensors Product Bulletin (LIT-12011542)*. (System 450 Sensor Types **HI°C** and **HI°F**)

Table 46: System 450 Compatible HE69xx Type Humidity Sensors with Integral A99B Temperature Sensor Ordering Information[1]

Product Code Number	Product Description
HE-69S20NP	Duct Mount Humidity Sensor with A99B Type Temperature Sensor: 10 to 90% RH;-40 to 121°C (-40 to 250°F)

1 The HE69xx sensors require 24 VAC input and must use the 0–5 VDC output. Refer to the *Series HE-69Sx0NP Humidity Element with Temperature Sensors Product Bulletin (LIT-216245)* for more information (including technical specifications and mounting accessories).

Figure 54: HE-69 Sensor



Table 47: System 450 Compatible HE6800 Series Humidity Transmitters with Temperature Sensor Ordering Information[1]

Product Code Number	Product Description
HE-68N2-0N00WS	Wall Mount Humidity Transmitter with Nickel Temperature Sensor: 10 to 90 ±2% RH; 0 to 55°C (32 to 131°F)
HE-68N3-0N00WS	Wall Mount Humidity Transmitter with Nickel Temperature Sensor: 10 to 90 ±2% RH; 0 to 55°C (32 to 131°F)

1 The HE-6800 transmitters require 24 VAC input and must use the 0–5 VDC output. Refer to the *HE-6800 Series Humidity Transmitters with Temperature Sensor Product Bulletin (LIT-12011625)* for more information, including technical specifications and mounting accessories.

Table 48: System 450 Compatible Low Pressure Differential Transducer Ordering Information[1, 2]

Product Code Number	Product Description
DPT2650-R25B-AB[3]	Low Pressure Differential Transducer: -0.25 to 0.25 in. W.C. (System 450 Sensor Type: **P 0.25**)[3]
DPT2650-0R5D-AB	Low Pressure Differential Transducer: 0 to 0.5 in. W.C. (System 450 Sensor Type: **P 0.5**)
DPT2650-2R5D-AB	Low Pressure Differential Transducer: 0 to 2.5 in. W.C. (System 450 Sensor Type: **P 2.5**)
DPT2650-005D-AB	Low Pressure Differential Transducer: 0 to 5.0 in. W.C. (System 450 Sensor Type: **P 5**)
DPT2650-10D-AB	Low Pressure Differential Transducer: 0 to 10 in. W.C. (System 450 Sensor Type: **P 10**)

1 Refer to the *Setra Systems Model DPT265 Very Low Differential Pressure Transducer Catalog Page* for more information.
2 The DPT265 sensors require 24 VAC input and must use the 0–5 VDC output. Refer to the *Setra Systems Model DPT265 Very Low Differential Pressure Transducer Catalog Page* for more information.
3 Only used with Communications Control Modules.

Table 49: System 450 Compatible P499 and P599 Series Transducers with 1/4 in. SAE 45 Flare Internal Thread with Depressor (Style 47) Ordering Information[1]

Product Code Number	Product Description
P499RCP-401C; P599RCPS401C	-1 to 8 bar; Order WHA-PKD3 type wire harness separately.
P499RCP-402C; P599RCPS402C	-1 to 15 bar; Order WHA-PKD3 type wire harness separately.
P499RCP-404C; P599RCPS404C	0 to 30 bar; Order WHA-PKD3 type wire harness separately.
P499RCP-405C P599RCPS405C	0 to 50 bar; Order WHA-PKD3 type wire harness separately.
P499RCPS100C; P599RCPS100C	-10 to 100 psis (sealed for wet and freeze/thaw applications); Order WHA-PKD3 type wire harness separately.
P499RCPS100K; P599RCPS100K	-10 to 100 psis (sealed for wet and freeze/thaw applications); WHA-PKD3-200C wire harness included.
P499RCPS102C; P599RCPS102C	0 to 200 psis (sealed for wet and freeze/thaw applications); Order WHA-PKD3 type wire harness separately.
P499RCPS102K; P599RCPS102K	0 to 200 psis (sealed for wet and freeze/thaw applications); WHA-PKD3-200C wire harness included.
P499RCP-101C; P599RCPS101C	0 to 100 psig; Order WHA-PKD3 type wire harness separately.
P499RCP-101K; P599RCPS101K	0 to 100 psig; WHA-PKD3-200C wire harness included.
P499RCP-105C; P599RCPS105C	0 to 500 psig; Order WHA-PKD3 type wire harness separately.

Table 49: System 450 Compatible P499 and P599 Series Transducers with 1/4 in. SAE 45 Flare Internal Thread with Depressor (Style 47) Ordering Information[1]

Product Code Number	Product Description
P499RCP-105K; P599RCPS105K	0 to 500 psig; WHA-PKD3-200C wire harness included.
P499RCP-107C; P599RCP-107C	0 to 750 psig; Order WHA-PKD3 type wire harness separately.
P499RCP-107K; P599RCPS107K	0 to 750 psig; WHA-PKD3-200C wire harness included.

1 The P499 and P599 sensors must be powered with the +5 VDC and C terminals and the output is 0.5 to 4.5 VDC. Refer to the *P499 Series Electronic Pressure Transducers Product/Technical Bulletin (LIT-12011190)* and the *P599 Series Electronic Pressure Transducers Product/Technical Bulletin (LIT-12012446)*for more information.

Table 50: System 450 Compatible P499 and P599 Series Transducers with 1/8 in. 27 NPT External Thread (Style 49) Ordering Information[1]

Product Code Number	Product Description
P499RAPS100C; P599RAPS100C	-10 to 100 psis (sealed for wet and freeze/thaw applications); Order WHA-PKD3 type wire harness separately.
P499RAPS100K; P599RAPS100K	-10 to 100 psis (sealed for wet and freeze/thaw applications); WHA-PKD3-200C wire harness included.
P499RAP-101C; P599RAPS101C	0 to 100 psig; Order WHA-PKD3 type wire harness separately.
P499RAP-101K; P599RAPS101K	0 to 100 psig; WHA-PKD3-200C wire harness included.
P499RAP-102C; P599RAPS102C	0 to 200 psig; Order WHA-PKD3 type wire harness separately.
P499RAP-105C; P599RAPS105C	0 to 500 psig; Order WHA-PKD3 type wire harness separately.
P499RAP-105K; P599RAPS105K	0 to 500 psig; WHA-PKD3-200C wire harness included.
P499RAP-107C; P599RAPS107C	0 to 750 psig; Order WHA-PKD3 type wire harness separately.
P499RAP-107K; P599RAPS107K	0 to 750 psig; WHA-PKD3-200C wire harness included.

1 The P499 and P599 sensors must be powered with the +5 VDC and C terminals and the output is 0.5 to 4.5 VDC. Refer to the *P499 Series Electronic Pressure Transducers Product/Technical Bulletin (LIT-12011190)* and the *P599 Series Electronic Pressure Transducers Product/Technical Bulletin (LIT-12012446)* for more information.

System 450 Series Modular Control System with Communications Control Modules technical specifications

Table 51: C450CEN-1C Control Module with Ethernet Communications Technical Specifications

Specification	Description
Product	C450CEN: System 450 control modules are sensing controls and operating controls with LCD and four-button touchpad UI, Ethernet communications capability, and no outputs. C450CEN-1C: Control module with Ethernet communications capability
Supply Power	**Internal Supply Power:** C450YNN-1C Power Supply Module **External Supply Power:** 24 VAC (20–30 VAC) Safety Extra-Low Voltage (SELV) (Europe), Class 2 (North America), 50/60 Hz, 10 VA minimum ⓘ **Note:** A System 450 control module or module assembly can use an internal or an external supply power source, but must not be connected to both simultaneously.
Ambient Operating Conditions	**Temperature:** -40 to 66°C (-40 to 150°F) **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; 1,035 ohm at 25°C (77°F) for an A99 PTC Temperature Sensor
Analog Input Accuracy	**Resolution:** 16 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 63 x 63 mm (5 x 2-3/8 x 2-3/8 in.)
Weight	C450CEN-1C: 207 g (0.46 lb)
Compliance	**North America:** cULus Listed; UL 60730, File E27734; FCC Compliant to CFR47, Part 15, Subpart B, Class B Industry Canada (IC) Compliant to Canadian ICES-003, Class B limits
CE	**Europe:** CE Mark – Johnson Controls declares that this product is in compliance with the essential requirements and other relevant provisions of the EMC Directive; Low Voltage Directive; CISPR22, class B.
	Australia: Mark: C-Tick Compliant (N1813)

Table 52: C450CRN-1C Control Module with RS485 Modbus Communications Technical Specifications

Specification	Description
Product	C450CRN-1C: System 450 control modules are sensing controls and operating controls with LCD and four-button touchpad UI and no outputs. This control module is an RS485, RTU compliant Modbus subordinate device.
Supply Power	**Internal Supply Power:** C450YNN-1C Power Supply Module **External Supply Power:** 24 VAC (20–30 VAC) Safety Extra-Low Voltage (SELV) (Europe), Class 2 (North America), 50/60 Hz, 10 VA minimum ⓘ **Note:** A System 450 control module or module assembly can use an internal or an external supply power source, but must not be connected to both simultaneously.
Ambient Operating Conditions	**Temperature:** -40 to 66°C (-40 to 150°F) **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; 1,035 ohm at 25°C (77°F) for an A99 PTC Temperature Sensor
Analog Input Accuracy	**Resolution:** 16 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 63 x 63 mm (5 x 2-3/8 x 2-3/8 in.)
Weight	C450CRN-1C: 207 g (0.46 lb)
Compliance	**North America:** cULus Listed; UL 60730, File E27734: FCC Compliant to CFR47, Part 15, Subpart B, Class B Industry Canada (IC) Compliant to Canadian ICES-003, Class B limits
CE	**Europe:** CE Mark – Johnson Controls declares that this product is in compliance with the essential requirements and other relevant provisions of the EMC Directive; Low Voltage Directive; CISPR22, class B
	Australia: Mark: C-Tick Compliant (N1813)

Table 53: C450SPN-4C and C450SQN-4C Expansion Modules with Analog Output Technical Specifications

Specification	Description
Product	C450SPN-4C: System 450 Expansion Module with one Analog output C450SQN-4C: System 450 Expansion Module with two Analog outputs
Power Consumption	C450SPN-4C: 1.1 VA max using 0–10 V out; 1.3 VA maximum using 4–20 mA out C450SQN-4C: 1.8 VA max using 0–10 V out; 2.2 VA maximum using 4–20 mA out
Supply Power	**Internal Supply Power:** C450YNN-1C Power Supply Module **External Supply Power:** 24 VAC (20–30 VAC) Safety Extra-Low Voltage (SELV) (Europe), Class 2 (North America), 50/60 Hz, 10 VA minimum ⓘ **Note:** A System 450 control module or module assembly can use an internal or an external supply power source, but must not be connected to both simultaneously.
Ambient Operating Conditions	**Temperature:** -40 to 66°C (-40 to 150°F) when using 0 to 10 VDC outputs; -40 to 40°C (-40 to 104°F) when using 4 to 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)
Analog Output	**Voltage Mode (0 to 10 VDC):** 10 VDC maximum output voltage 10 mA maximum output current Requires an external load of 1,000 ohm or more ⓘ **Note:** The AO operates in Voltage Mode when connected to devices with impedance greater than 1,000 ohm. Devices that drop below 1,000 ohm may not operate as intended with Voltage Mode applications.
	Current Mode (4 to 20 mA): Requires an external load between 0 to 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 with Current Mode applications.
Control Construction	Independently mounted control, surface mounted with Lexan® 950 enclosure suitable for DIN rail mounting or direct mounting to a hard, even surface.

Table 53: C450SPN-4C and C450SQN-4C Expansion Modules with Analog Output Technical Specifications

Specification	Description
Dimensions (H x W x D)	127 x 61 x 61 mm (5 x 2-3/8 x 2-3/8 in.)
Weight	C450SPN-4C: 150 g (0.33 lb) C450SQN-4C: 150 g (0.33 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
CE	**Europe:** CE Mark - Johnson Controls declares that this product is in compliance with the essential requirements and other relevant provisions of the Low Voltage Directive and the EMC Directive.
	Australia: Mark: C-Tick Compliant (N1813)

Table 54: C450SBN-4C and C450SCN-4C Expansion Modules with Relay Output Technical Specifications

Specification	Description
Product	C450SBN-4C: System 450 Expansion Module with one SPDT output relay C450SCN-4C: System 450 Expansion Module with two SPDT output relays
Power Consumption	C450SBN-4C: 0.8 VA maximum C450SCN-4C: 1.2 VA maximum
Supply Power	**Internal Supply Power:** C450YNN-1C Power Supply Module **External Supply Power:** 24 VAC (20–30 VAC) Safety Extra-Low Voltage (SELV) (Europe), Class 2 (North America), 50/60 Hz, 10 VA minimum ⓘ **Note:** A System 450 control module or module assembly can use an internal or an external supply power source, but must not be connected to both simultaneously.
Ambient Operating Conditions	**Temperature:** -40 to 66°C (-40 to 150°F) **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)

Table 54: C450SBN-4C and C450SCN-4C Expansion Modules with Relay Output Technical Specifications

Specification	Description
Output Relay Contacts	**General:** 1/2 HP at 120/240 VAC, SPDT
	Specific: AC Motor Ratings 120 VAC • AC Full-Load Amperes: 9.8 A • AC Locked-Rotor Amperes: 58.8 A 208/240 VAC • AC Full-Load Amperes: 4.9 A • AC Locked-Rotor Amperes: 29.4 A 10 Amperes AC noninductive at 24/240 VAC Pilot Duty: 125 VA at 24/240 VAC
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	C450SBN-4C: 172 g (0.38 lb) C450SCN-4C: 186 g (0.41 lb)
Compliance	**North America:** cULus Listed; UL 60730, File E27734; FCC Compliant to CFR47, Part 15, Subpart B, Class B Industry Canada (IC) Compliant to Canadian ICES-003, Class B limits
CE	**Europe:** CE Mark – Johnson Controls declares that this product is in compliance with the essential requirements and other relevant provisions of the EMC Directive and the Low Voltage Directive.
	Australia: Mark: C-Tick Compliant (N1813)

Table 55: C450YNN-1C Power Supply Module) Technical Specifications

Specification	Description
Product	C450YNN-1C: System 450 Power Supply Module; 120 or 240 VAC stepdown to24 VAC Class 2 (North America) or SELV (Europe)
Supply Power	110/120 VAC or 220/240 VAC at 50/60 Hz (100 mA maximum)
Secondary Power	24 VAC, 10 VA
Ambient Operating Conditions	**Temperature:** -40 to 66°C (-40 to 150°F) **Humidity:** Up to 95% RH noncondensing; Maximum Dew Point 29°C (85°F)

Table 55: C450YNN-1C Power Supply Module) Technical Specifications

Specification	Description
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)
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	C450YNN-1C: 390 gm (0.86 lb)
Compliance CE	**North America:** cULus Listed; UL 60730, File E27734: 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 declares that this product is in compliance with the essential requirements and other relevant provisions of the EMC Directive and the Low Voltage Directive.
	Australia: Mark: C-Tick Compliant (N1813)

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.

System 450 Glossary of Terms

°C

Degrees Celsius (°C) appears in the Main (sensor status) screens, along with the current sensed temperature value, when a Celsius temperature sensor is set up in your control system. °C also designates a Sensor Type that is available when you set up the sensors in the Sensor Setup screens. See *Accessing and Navigating the User Interface* and *System 450 Compatible Sensors and Transducers* for more information.

°F

Degrees Fahrenheit (°F) appears in the Main (sensor status) screens, along with the current sensed temperature value, when a Fahrenheit temperature sensor is set up in your control system. °F also designates a Sensor Type that is available when you set up the sensors in the Sensor Setup screens. See *Accessing and Navigating the User Interface* and *System 450 Compatible Sensors and Transducers* for more information.

Active Sensors

Three-wire input sensors that require a low-voltage power source to generate their input signal. Active sensors are hardwired to one of the sensor input terminals (Sn1, Sn2, or Sn3), a Common terminal (C), and either the 24 V or 5 V power terminal on the low-voltage terminal block on the control module. All of the System 450 compatible pressure transducers and humidity sensors are active sensors. Communications control modules automatically detect the input sensors and determine if the detected sensors are active or passive. You do not have to set a sensor to active or passive on communications control modules.

Analog Output

System 450 provides self-selecting 0 to 10 VDC signal or 4 to 20 mA signal analog outputs. The analog outputs can be set up to provide a wide variety of direct and reverse acting proportional control applications, including multi-stage control and proportional plus integral control. Analog outputs are identified in the System 450 UI as OUTA in the Output Setup Start screens and with a percent signal strength and control ramp icon in the System Status screens. See *Analog Outputs*, *Setting up an Analog Output*, and *Viewing the System Status Screens* for more information.

bAR

bAR appears in the Main (sensor status) screens along with the current sensed pressure value, when your control system uses one or more pressure transducers with P 8, P 15, P 30, or P 50 Sensor Types. Bar is an SI (International System) unit of measurement for the pressure value displayed in the Main screens. One **bar** is equal to approximately one atmosphere of pressure, 14.5 psi, and 100 kPa. See *System 450 Sensors and Transducers for Communications Control Modules* for more information.

bin

The Binary Input (bin) sensor provides relay output control using an external (user-supplied) binary input or set of dry contacts to control the relay output state (On or Off) based on the binary input state (closed or open). A binary input can be connected to the Sn1, Sn2, or Sn3 terminals and a C terminal on the control module. Binary input is only available on communications control modules. See *Binary Input Control for Relay Outputs* for more information.

bNd

In the Output Signal Dead Band (bNd^{x}) screen in the Analog Output Setup screens, select the output dead band value (as a percentage of the total output signal range). You can select a value between 0 and 50 (percent).

Control Module

The primary module in a System 450 control system, and sometimes the only module in stand-alone control systems. Each System 450 control system has only one control module, which contains the control system processor, firmware, memory, and LCD. The control module receives the input signals from the system sensors, and it monitors and controls all of the system outputs, including the expansion module outputs. There are four types of System 450 control modules: standard control modules, reset control modules, hybrid analog output control modules, and communications control modules. See *Control Modules and User Interface* and *Repair and Ordering Information* for more information.

dEP^{x}

In the Differential End Point (dEP^{X}) screen in the Analog Output Setup screens, select the differential value that analog output number ***x*** is driving the controlled loop or process away from. The dEP value, along with Differential Setpoint (dSP) value, establishes the output's proportional control band. The dEP screen appears in the Analog Output Setup screens after you set up and select the Differential Sensor (Sn-d) for the output reference. See *Differential Control* for more information.

DHCP

DHCP stands for Dynamic Host Configuration Protocol. DHCP servers automatically identify devices as they are added to an ethernet network and supply them with a network configuration, including an IP address.

Default Gateway

A default gateway serves as an access point or IP router that a networked computer uses to send information to a computer in another network or the Internet.

Differential Control

The Differential Control feature is used to monitor and maintain a selected difference in a condition (temperature, pressure, or humidity) between two sensor points within a system, process, or space. See *Differential Control* for more information.

Direct Acting

With Direct Acting proportional control, an increase in the sensor signal results in a proportional increase of the output signal generated to the controlled equipment and vice versa. See *Direct and Reverse Control Actions for Analog Outputs* for more information.

dSP^{x}

In the Differential Setpoint (dSP^{x}) screen in the Analog Output Setup screens, select the target differential value that analog output number ***x*** is driving the controlled loop towards. The dSP value, along with Differential End Point (dEP) establishes the output's proportional control band. The dSP screen appears in the Analog Output Setup screens after you select the Differential Sensor (Sn-d) for the output reference. See *Differential Control* for more information.

EP^{x}

In the End Point Selection (EP^{x}) screen in the Analog Output Setup screens, select the condition value that analog output number ***x*** is driving the control loop away from and towards the Setpoint (SP) value. The EP and SP values define the proportional band that the analog output is intended to control the condition within. See *Direct and Reverse Control Actions for Analog Outputs* for more information.

Ethernet

A baseband network medium that communicates at 10 megabits per second and uses the CSMA/CD access method.

Expansion Modules

Provide additional relay or analog outputs to your control system. Expansion module models are available with one or two relay outputs, and one or two analog outputs. All of the outputs in a control system, including the Expansion module outputs are set up in the control module UI. System 450 control systems can control up to 10 outputs, which can be any combination of relay or analog outputs. See *Expansion Modules, Module Assemblies, and Outputs* and *Repair and Ordering Information* for more information.

Functional Sensor

In addition to the wide variety of System 450 compatible hard-wired temperature, pressure, and humidity sensors available, the System 450 firmware also enables several functional sensors based on the input from one or more of the hard-wired sensors in your control system. Functional sensors include: the Reset Setpoint sensor (rES), which enables reset control, setback control, and run-time balancing; the Differential Control sensor (Sn-d), which enables the Differential Control feature; and the High Input Signal Selection functional sensors (HI-2 and HI-3), which enable the High Input Signal Selection feature. When you select a functional sensor for an output, the output is controlled according to values sensed at multiple sensors and the control logic/calculation designed into the functional sensor. See *System 450 Functional Sensors* for more information.

Hg

Hg appears in the Main (sensor status) screens along with the current sensed pressure value, when your control system uses one or more pressure transducers with P 110 Sensor Types. Hg is an abbreviation of the unit of measurement inHg, which is used to measure negative pressure values (below 0 psi). P 110 Sensor Type is capable of monitoring and displaying negative pressure values. Outputs that reference P 110 sensors requires a unique setup calculation and the negative pressure values are displayed differently in the P 110 setup and status screens. See *System 450 Sensors and Transducers for Communications Control Modules* and *Setting Up Outputs That Reference a P 110 Sensor* for more information.

HI-2

A functional High Input Signal Selection Sensor that references two hard-wired sensors of the same Sensor Type. When you set up the hard-wired sensors Sn-1 and Sn-2 as the same Sensor Type, functional sensor HI-2 is available for selection when you set up the control system outputs. Outputs that are set up to reference HI-2 use the higher of the two condition values (sensed at Sn-1 and Sn-2) to control the output. High Input Signal selection is available on standard control modules with firmware Version 2.00 or later, hybrid analog output control modules, and communication control modules, but is not available on reset control modules. See *High Input Signal Selection* for more information.

HI-3

A functional High Input Signal Selection Sensor that references three hard-wired sensors of the same Sensor Type. When you set up the hard-wired sensors Sn-1, Sn-2, and Sn-3 as the same Sensor Type, functional sensor HI-3 is available for selection when you set up the control system outputs. Outputs that are set up to reference HI-3 use the highest of the three condition values (sensed at Sn-1, Sn-2, and Sn-3) to control the output. High Input Signal selection is available on standard control modules with firmware Version 2.00 or later, hybrid analog output control modules, and communication control modules, but is not available on reset control modules. See *High Input Signal Selection* for more information.

High Input Signal Selection

Functional High Input Signal Selection sensors (HI-2, HI-3) enable an output to reference two or three hard-wired sensors of the same Sensor Type and control the output by responding to

the input sensor that is sensing the highest value (temperature, pressure, or humidity) from the two or three sensed values. The High Input Signal Selection feature is on standard control modules with firmware Version 2.00 or later, on the hybrid analog control module, and also on the communication control modules. See *High Input Signal Selection* for more information.

I-C^{x}

In the Integration Constant Selection (I-C^{x}) screen in the Analog Output Setup screens, select the I-C value for analog output ***x*** in your control system. There are seven integration constants values to select from (0 through 6). In most applications, the default integration value 0 (no integration constant, proportional-only control) is the recommended selection. See *Proportional Plus Integral Control and Integration Constants* and *Determining the Integration Constant for an Analog Output* for more information.

Integration Constant

A time-integral variable, which is applied to the proportional control only analog output to provide Proportional plus Integral (P-I) control on the output. The integration constant determines the rate at which the control readjusts the output signal to drive the process to setpoint. In well-balanced control applications with predictable loads and properly sized equipment, P-I control provides tighter control to setpoint and a faster response to system load changes than proportional-only control. See *Proportional Plus Integral Control and Integration Constants* and *Determining the Integration Constant for an Analog Output* for more information.

inHg

Represents Inches of Mercury (see the Hg term and definition).

INWC

INWC and the sensed pressure value appears in the Main (sensor status) screens on control systems using a sensor with a Sensor Type of P 0.5, P 2.5, P 5, or P 10. INWC represents Inches Water Column (in.W.C.), which is a unit of measurement for measuring very low pressures such as building and duct static pressures and pressure differentials. See *System 450 Sensors and Transducers for Communications Control Modules* for more information.

IP Address

IP stands for Internet Protocol. An IP Address is the address that is typically used with ethernet-based devices. In C450CEN-x modules, the IP Address consists of four octets, each ranging in value from 0 to 255.

LAN

A LAN is a high-speed communications system designed to link computers and other devices (such as the C450CEN-1 control) together within a small geographic area such as a workgroup, department, or a single floor of a multi-story building. A router has a LAN network and an Internet network connection.

MAC Address

Media Access Control (MAC) address. Each network adapter has a unique six byte-address that is burned in to firmware on the card. The first three bytes denote the card manufacturer and the last three bytes are unique among all of the cards sold by that manufacturer. The MAC address is used to deliver MAC frames to stations attached to a shared medium LAN such as Ethernet.

Main Screens

The default screens that auto-scroll on the LCD during normal control system operation. The Main screens display the sensor status for each hard-wired and functional sensor on communications control systems. In reset control systems, the Main screens also display the Time screen, when the

Time parameters are set up. From the Main screens, press **Next** (repeatedly) to manually scroll through the sensor status and output status screens. From the Main screens, press and hold **Up** and **Down** simultaneously for 5 seconds to go to the System Setup screens. See *Accessing and Navigating the User Interface* and *Viewing the System Status Screens* for more information.

Normally Closed (N.C.)

Normally Closed (N.C.) relay contacts are closed when the relay is **not** energized/activated and open when the relay is energized. On System 450 Relay Outputs, the LC*y* and LNC*y* terminals connect to the Normally Closed contacts. See *Relay Outputs* for more information.

Normally Open (N.O.)

Normally Opened (N.O.) relay contacts are open when the relay is **not** energized/activated and closed when the relay is energized. On System 450 Relay Outputs, the LC*y* and LNO*y* terminals connect to the Normally Opened contacts. See *Relay Outputs* for more information.

OEP^{x}

In the Percent Output Signal Strength at End Point Selection (OEP^{x}) screen in the Analog Output Setup screens, select the value (0 to 100%) of the total signal strength, to be generated by analog output ***x*** when the controlled condition is at the selected End Point (EP) value. See *Direct and Reverse Control Actions for Analog Outputs* and *Setting up an Analog Output* for more information.

OFFd

In the Off Delay (OFFd^{x}) screen in the Relay Setup screens, select the number of seconds (0 to 300) that the output relay ***x*** delays going Off after the Off condition is reached. See *Relay On and Off Duration Control* for more information.

OFFS^{x}

In the Temperature Offset Selection (OFFS^{x}) screen in the Sensor Setup screens, select the value (in degrees) that you want the measured (and displayed) temperature value to differ from the actual sensed temperature value. System 450 allows you to select a offset for each temperature sensor in your System 450 control system. You cannot select an offset for pressure or humidity sensors. The ***x*** value is the ID number for the temperature sensor you are setting up (Sn-1, Sn-2, or Sn-3). See *Setting Up the Sensors and Transducers* for more information.

OFFT^{x}

In the Minimum Off-Time Selection (OFFT^{x}) screen in the Relay Setup screens, select the number of seconds (0 to 300) that output relay ***x*** remains Off after being driven Off by control loop conditions. The minimum off-time feature is typically used to prevent short-cycling of controlled equipment. See *Setting up a Relay Output* for more information.

ONd

In the On Time Delay (ONd^{x}) screen in the Relay Setup screens, select the number of seconds (0 to 300) that the output relay ***x*** delays going on after the On condition is reached. See *Relay On and Off Duration Control* for more information.

ONT^{x}

In the Minimum On-Time (ONT^{x}) screen in the Relay Setup screens, select the number of seconds (0 and 300 seconds) that relay output ***x*** remains On after being driven On by control loop conditions. The minimum on-time feature is typically used to prevent short-cycling of controlled equipment. See *Setting up a Relay Output* for more information.

OSP^{x}

In the Percent Output Signal Strength at Setpoint (OSP^{x}) screen in the Analog Output Setup screens, select the value (0 to 100%) of the total signal strength, to be generated by analog output when the controlled condition is at the selected Setpoint (SP) value. The ***x*** value is the ID number for the output you are setting up. See *Direct and Reverse Control Actions for Analog Outputs* and *Setting up an Analog Output* for more information.

OUTA^{x}

In the Analog Output Setup Start (OUTA^{x}) screen, press **Next** to set up or edit the Analog Output Setup screens, or press **Menu** to go to the next Output Setup Start screen or return to the Sensor Setup screens. The ***x*** value is the ID number for the output you are setting up. See *Accessing the System Setup Screens* and *Setting up an Analog Output* for more information.

OUTR^{x}

In the Relay Output Setup Start (OUTR^{x}) screen, press **Next** to set up or edit the Relay Output Setup screens, or press **Menu** to go to the next Output Setup Start screen or return to the Sensor Setup screens. The ***x*** value is the ID number for the output you are setting up. See *Accessing the System Setup Screens* and *Setting up a Relay Output* for more information.

Passive Sensor

Passive Sensors are two-wire sensors. All of the System 450 compatible temperature sensors are passive sensors. Communications control modules automatically select active or passive sensors. See *Active and Passive Sensors* for more information.

Proportional (Only) Control

Adjusts the control output signal in proportion to the difference between the sense value of the condition and the Setpoint (SP) value for the condition. Proportional (only) controls drive the condition to a control point within the proportional band between End Point (EP) and SP, but not all the way to SP. The larger the load on the system, the further the control point deviates from the target SP value. Proportional (only) control applications are relatively stable and easy to set up, and often the difference between Setpoint and control point (offset error) is predictable and can be compensated for by selecting a SP with offset error calculated into the selection. See *Proportional Plus Integral Control and Integration Constants* for more information.

Proportional Plus Integral (P-I) Control

Incorporates a time-integral control action with proportional control action and, if properly set up, a PI control loop can effectively eliminate offset error and enable a controlled system to drive to setpoint even under large constant loads. On a properly sized system with predictable loads, PI control can maintain the controlled system very close to setpoint. See *Proportional Plus Integral Control and Integration Constants* for more information.

PSI

When a pounds per square inch (psi) pressure sensor is set up in your control system, PSI appears in the Main (sensor status) screens, along with the current sensed pressure value. PSI sensors include Sensor Types P 100, P 110, P 200, P 500, and P 750. See *Accessing and Navigating the User Interface* and *System 450 Sensors and Transducers for Communications Control Modules* for more information.

Relay Output

System 450 provides Single-Pole, Double-Throw (SPDT) relay outputs rated to 240 VAC. The relay outputs can be set up to provide a wide variety of on/off control applications, including multi-stage control applications. Relay outputs are identified in the System 450 UI as OUTR in the Output Setup

Start screens and with ON or OFF in the System Status screens. See *Relay Outputs*, *Setting up a Relay Output*, and *Viewing the System Status Screens* for more information.

Reset Control Modules

Provide Reset Setpoint (RSP) control, real-time clock, Setback scheduling (SbK) control, and run-time balancing, in addition to providing many of the features and control types provided by standard control modules. Reset control modules include the C450RxN-x models. Reset control modules do not control pressure applications and do not provide Differential Control, High Input Signal Selection, or Hybrid Analog Output control. Communication modules do not provide Reset Setpoint control, real-time clock, Setback scheduling control, or run-time balancing. Refer to the *System 450™ Series Modular Control Systems with Reset Control Modules Technical Bulletin (LIT-12011842)* for more information.

Reverse Acting

With Reverse Acting proportional control, an increase in the sensor signal results in a proportional decrease of the output signal generated to the controlled equipment and vice versa. See *Direct and Reverse Control Actions for Analog Outputs* for more information.

Sensor Type

Each System 450 compatible sensor and transducer model is associated with a specific Sensor Type. Each Sensor Type provides the setup parameters that define the condition (temperature, pressure, or humidity), unit of measurement, usable range, resolution, and minimum proportional band for the associated sensor and the outputs that reference the sensor. You must select a Sensor Type for each sensor connected to your control system (Sn1, Sn2, and Sn3) when you set up the sensors for your control system. When you select a hard-wire sensor or a functional sensor as an output's reference sensor, the output uses the Sensor Type parameters to define the output's setup parameters. See *System 450 Compatible Sensors and Transducers* and *Setting Up the Sensors and Transducers* for more information.

SENS^{x}

SENS appears in several screens in the System 450 UI and is associated with either the initial sensor setup screens, or the sensor selection and sensor edit screens in the output setup screens.

In the Sensor Setup Start (SENS) screen, press **Next** to go to the Sensor Setup screens and set up the hard wire sensors for your control system. There is no output ID number (***x***) in the Sensor Setup Start screen. See *Setting Up the Sensors and Transducers* for more information.

In the Sensor Selection (SENS^{x}) screen at the **start** of the Output Setup screens, select the sensor that you want output ***x*** to reference. You can select a sensor or transducer that is hard-wired to the control module (Sn-1, Sn-2, or Sn-3) or you can select a functional sensor (Sn-d, HI-2, HI-3, or rES). After you select the referenced sensor, the firmware provides the output setup parameter values in the remaining Output Setup screens according to the Sensor Type associated with the selected sensor.

In the Edit Sensor (SENS^{x}) screen at the **end** of the Output Setup screens, you can select a different sensor for the output to reference. If you do not want to change the selected sensor for output ***x***, press **Next** to save the output setup values and return to the Output Setup Start screen. If you select a different sensor in the Edit Sensor (SENS^{x}) screen, you must set up the output again for the new sensor parameter values. See *Setting up a Relay Output* and *Setting up an Analog Output* for more information.

Sn-1

Input Sensor 1 (Sn-1) as identified in the System 450 UI. Outputs that reference Sn-1 reference the sensor or transducer that is hard-wired to the Sn1 terminal and a Common (C) terminal on the low-

voltage terminal block on the system's control module. On standard System 450 control systems, the Sn-1 sensor is also used to create the functional Differential Control sensor (Sn-d) and the High Input Signal Selection feature (HI-2, HI-3). See *System 450 Compatible Sensors and Transducers* and *Setting Up the Sensors and Transducers* for more information.

Sn-2

Input Sensor 2 (Sn-2) as identified in the System 450 UI. Outputs that reference Sn-2 reference the sensor or transducer that is hard wired to the Sn2 terminal and a Common (C) terminal on the low-voltage terminal block on the system's control module. On standard System 450 control systems, the Sn-2 sensor is also used to create the functional Differential Control sensor (Sn-d) and the High Input Signal Selection feature (HI-2, HI-3). See *System 450 Compatible Sensors and Transducers* and *Setting Up the Sensors and Transducers* for more information.

Sn-3

Input Sensor 3 (Sn-3) as identified in the System 450 UI. Outputs that reference Sn-3, reference the sensor or transducer that is hard wired to the Sn3 terminal and a Common (C) terminal on the low-voltage terminal block on the system's control module. On standard System 450 control systems, the Sn-3 sensor is also used to create the High Input Signal Selection feature (HI-3). See *System 450 Compatible Sensors and Transducers* and *Setting Up the Sensors and Transducers* for more information.

Sn-d

The functional Differential Control sensor (Sn-d) as identified in the System 450 UI. Sn-d is available on standard System 450 control systems (only), when Sn-1 and Sn-2 are the same Sensor Type. The differential control value (Sn-d) is defined as Sn-d = (Sn-1) - (Sn-2). Differential Control is available only on standard control modules and communication control modules. See *Differential Control*, *System 450 Compatible Sensors and Transducers*, and *Setting Up the Sensors and Transducers* for more information.

SNF^{x}

In the Sensor Failure Mode (SNF^{x}) screen in the Output Setup screens, select the mode of operation for output ***x*** in the event that a sensor (or associated sensor wiring) that the output references fails. SNF modes for relay outputs are ON and OFF. SNF modes for analog outputs are ON (=OEP) or OFF (=OSP). See *Sensor Failure Mode* for more information.

SP^{x}

In the Setpoint (SP) Selection screen in the Analog Output Setup screens, select the target value that analog output ***x*** is driving the control loop towards and away from the End Point (EP) value. The SP and EP values define the proportional band that the analog output is intended to control the condition within. See *Direct and Reverse Control Actions for Analog Outputs* for more information.

SSID

SSID stands for Service Set Identifier. SSIDs are an up to 32-character, unique identifier used to allow wireless devices to communicate with other devices on the wireless network that uses the same SSID.

Standard Control Modules

Provide on/off relay control, direct and reverse acting proportional analog control, multi-stage control, multi-purpose control, stand-alone control, and proportional plus integral control. Standard control modules include the C450CxN-x models. Standard control modules with Version 2.00 and later firmware also provide Differential Control and High Input Signal Selection. Standard control modules do not provide reset control, real-time scheduling, setback control, run-time balancing or hybrid analog output control.

Subnet Mask

A method of representing a portion of the IP network address that is devoted to subnet addresses. This mask is used in conjunction with the IP address to determine how packets traverse the network. An IP address can be divided into two parts: network address and host address. The subnet mask defines the dividing line between the two parts.

System Setup Screens

Enable you to select the values that determine how your control system operates and the condition ranges that your system controls. Depending on the control module type and firmware version, your System Setup screens can include Sensor Setup screens, Relay Output Setup screens, and/or Analog Output Setup screens. You access the System Setup screens by navigating to the various System Setup Start screens. See *Accessing the System Setup Screens* for more information.

System Status Screens

Provide the current status of each sensor and output in your control system. You access the System Status screens by pressing **Next** repeatedly, when the Main screens are auto-scrolling on the display. See *Viewing the System Status Screens* for more information.

UP-R

In the Select Output Signal Update Rate (UP-R^{x}) screen in the Analog Output Setup screens, select the minimum update rate value, in seconds (1–240), at which the control updates an analog output's signal strength. See *Analog Output Update Rate* for more information.

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.

Product warranty

This product is covered by a limited warranty, details of which can be found at www.johnsoncontrols.com/buildingswarranty.

Software terms

Use of the software that is in (or constitutes) this product, or access to the cloud, or hosted services applicable to this product, if any, is subject to applicable end-user license, open-source software information, and other terms set forth at www.johnsoncontrols.com/techterms. Your use of this product constitutes an agreement to such terms.

Contact information

Contact your local branch office: www.johnsoncontrols.com/locations

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