System 450™ Series Modular Control Systems with Reset Control Modules

Technical Bulletin

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Technical Bulletin

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 reset control modules (C450RxN-x models).

This document also provides System 450 *Technical Specifications* on page 78 and references to System 450 *Related Documentation*.

In this document, **reset control module** refers to the System 450 reset control modules (C450RxN-x models).

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

Note: For information regarding System 450 **control modules with network communications**, refer to the *System 450 Series Modular Control Systems with Communications Control Modules Technical Bulletin (LIT-12011826).*

Related Documentation

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

Table 1: Related Documentation (Part 1 of 2)

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, Wiring, and Setting up System 450 Reset Control Modules with Real-Time Clock and Relay Output	*System 450 Series Reset Control Modules with Real-Time Clock and Relay Output Installation Instructions*	*Part No. 24-7664-2888*
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 (Part 2 of 2)

For Information On	See Document	LIT or Part Number
Installing and Wiring the HE-67xx Humidity Sensors and Humidity with Temperature Sensors	*TrueRH Series HE-67xx Humidity Element with Temperature Sensor Installation Instructions*	*Part No. 24-9527-7*

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/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 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 **reset control modules** can monitor and control temperature and humidity applications simultaneously. 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.

A System 450 reset control system includes:

- a single System 450 reset control module, which provides the control system UI for setting up, monitoring, and controlling your system and the sensor wiring terminals 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, which are hard-wired 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 9 on page 76 for a list of System 450 modules that can be used in reset control systems. 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 accessories.

Figure 1 shows an example System 450 reset control system that controls a three-stage boiler with or without Load Balancing.

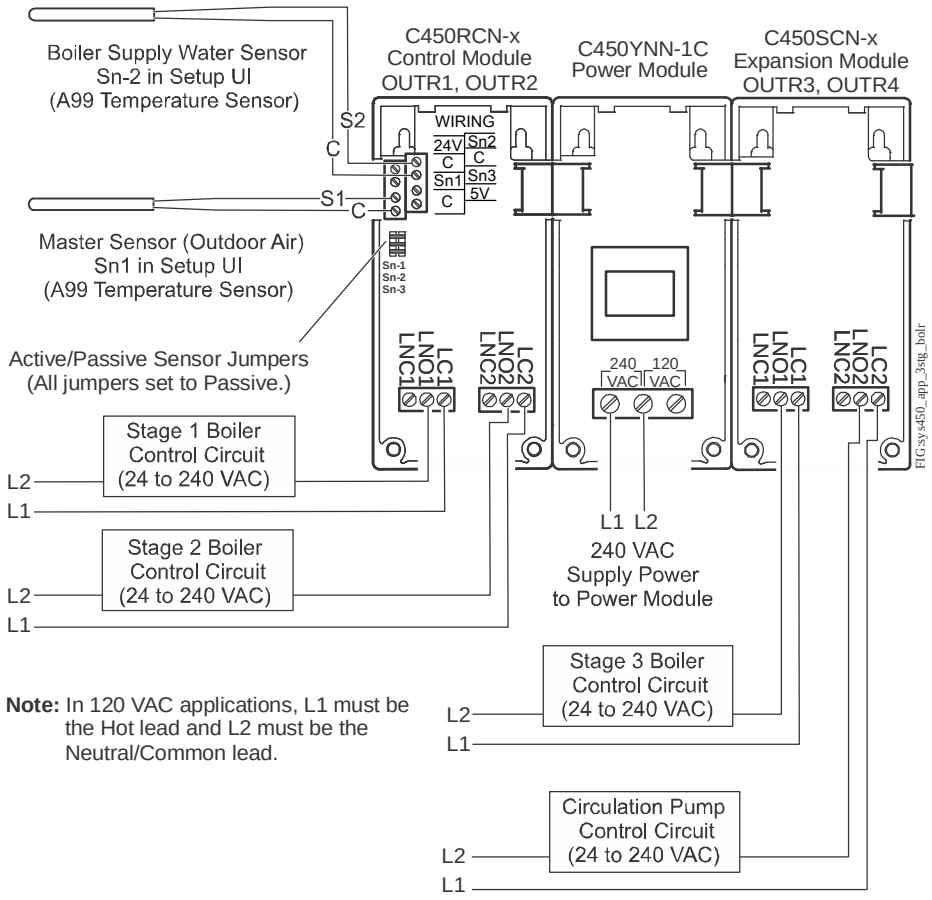


Figure 1: System 450 Reset Control System Example

Figure 3 on page 12 shows the System 450 UI Main Screens, System Status screens, and System Setup Screens for the example system shown in Figure 1.

System 450 Reset Control Modules

A System 450 reset control system can provide the following types of control to your application equipment:

- **On/Off Control**, including multi-stage control for temperature and humidity applications. See *Relay Outputs* on page 16 for more information.
- **Proportional Analog Control**, including multi-stage control for temperature and humidity applications. See *Analog Outputs* on page 18 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-Stage Control (Relay and Analog)** for temperature and humidity applications.
- **Multi-Purpose Control**, including simultaneous control of temperature and humidity conditions.
- **Stand-Alone Control**. A single standard control module can be quickly and easily configured to replace a wide variety of specialized controls in the field.
- **Direct and Reverse Action Proportional Control**. See *Direct and Reverse Control Actions for Analog Outputs* on page 19 for more information.
- **Proportional Plus Integral Control**. See *Proportional Plus Integral Control and Integration Constants* on page 21 for more information.
- **Temperature and Humidity Reset Setpoint Control** in humidity and temperature applications. See *Temperature or Humidity Reset Setpoint* on page 22 for more information.
- **Real-Time Clock** for configuring temperature or humidity setback based on an occupancy schedule. See *Real-Time Clock* on page 27 for more information.
- **Scheduling and Temperature Setback Control**, including Time of Day and Day of Week scheduling. See *Setback Control Schedule* on page 27 for more information.
- **Load Balancing** of staged equipment using relay outputs. See *Load Balancing* on page 27 for more information.

Note: System 450 reset control modules do not provide pressure control, Differential Control, or High Input Signal Selection.

Control Modules and User Interface

Each System 450 reset 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 reset control module and describes the various features of the System 450 control system UI for reset control modules.

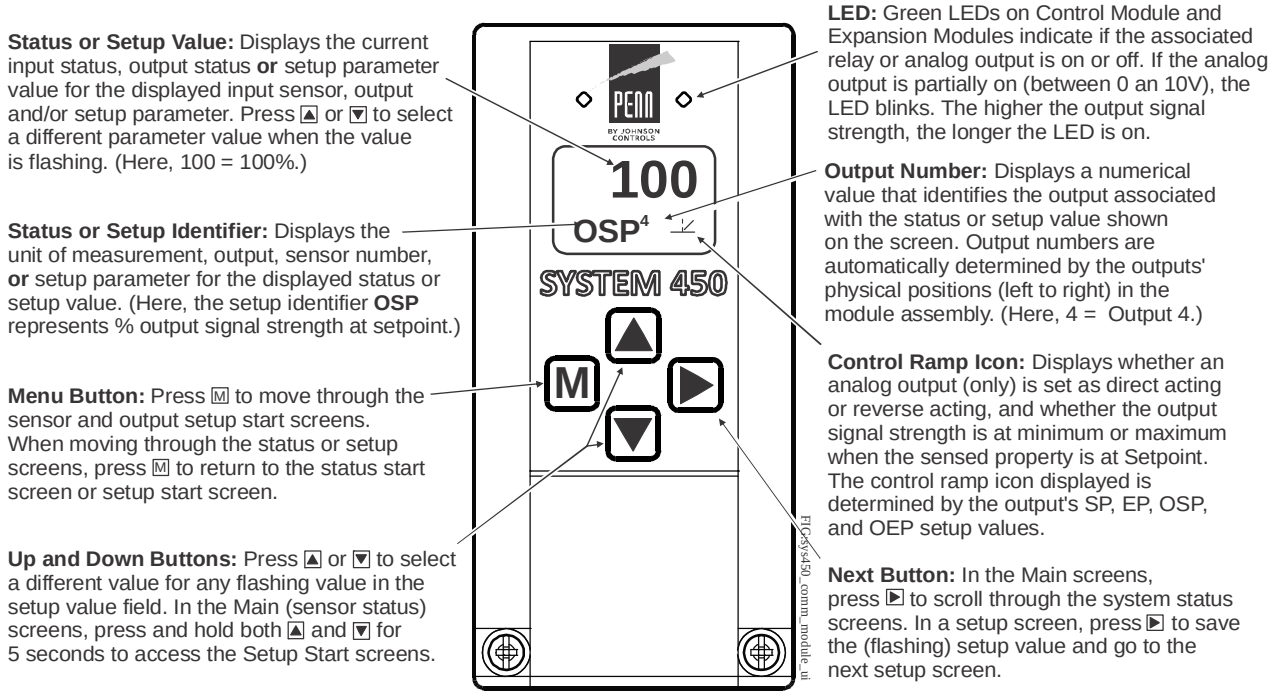


Figure 2: System 450 Control Module with Relay Outputs Showing LCD and Four-Button Touchpad User Interface

System 450 reset control modules are available with one or two relay outputs and the System 450 reset control firmware. See Table 9 on page 76 for model descriptions and *Repair and Ordering Information* on page 76 for more information.

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. A reset control module can also be configured as a simple stand-alone control system when your application requires only one or two relay outputs.

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-wired sensors and reset sensor 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 Reset Control System* on page 41 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. See *Relay Outputs* on page 16 for more information. 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 output. See *Direct and Reverse Control Actions for Analog Outputs* on page 19 for more information.

The System Setup screens in the System 450 UI enable you to easily set up the system sensors and all of the system outputs for your control system. See *Setting up a System 450 Reset Control System* on page 41 for more detailed procedures 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 reset control module. Figure 3 shows the Main screens (sensor status screens), the System Status screens, the System Setup screens, and the Output Setup screens for an example System 450 reset control application.

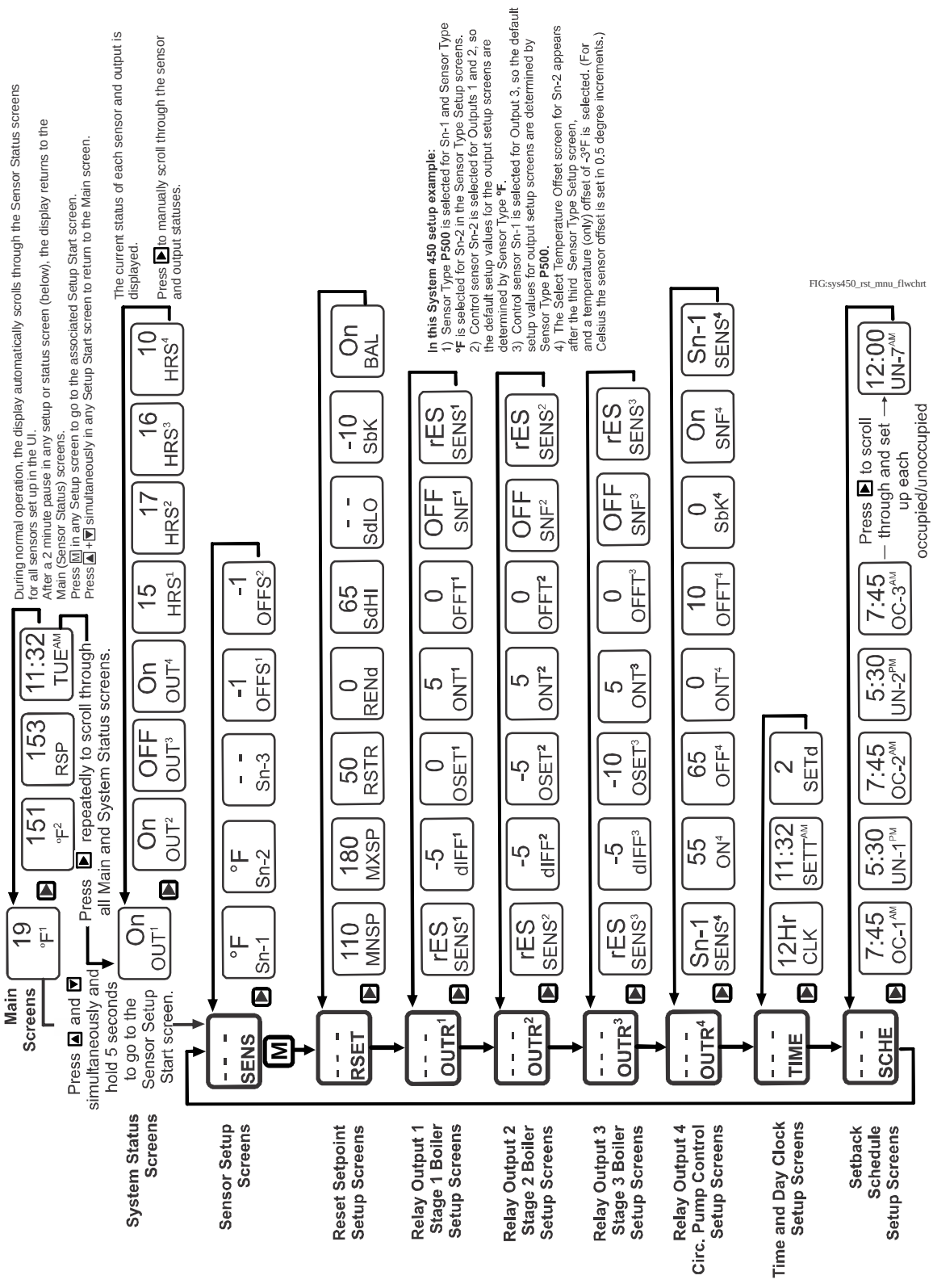


Figure 3: System 450 UI Menu Flow Chart Example Showing Navigation Paths and Example Settings in the Main, System Status, Sensor Setup, and Output Setup Screens for the Example in Figure 1

Expansion Modules, Module Assemblies, and Outputs

System 450 expansion modules provide additional outputs to expand your control systems and meet 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 9 on page 76 for information on the System 450 modules that can be used in a reset control system.

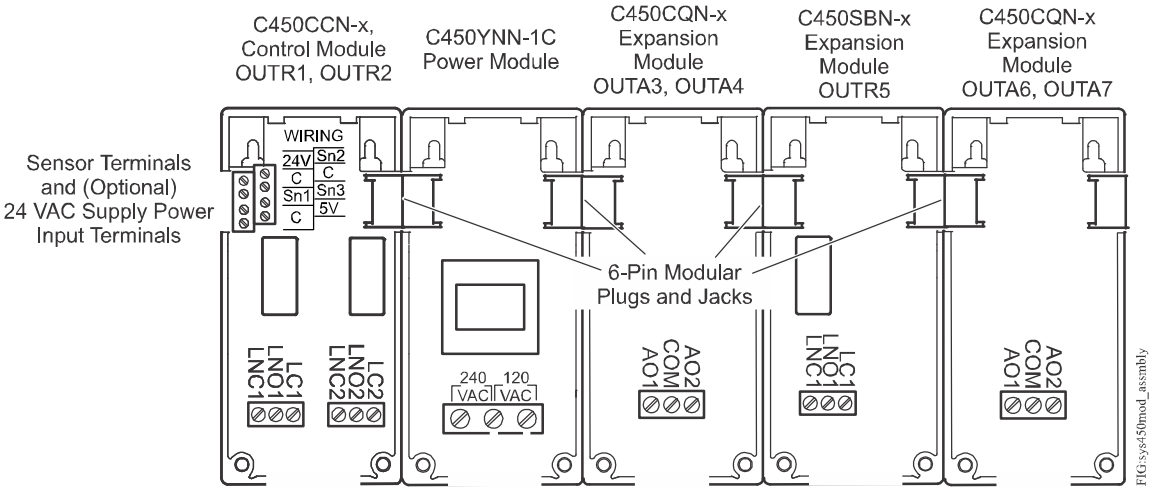


Figure 4: System 450 Module Assembly Example Showing Reset Control Module Positions, Output Positions, and Output Numbers

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* on page 36 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 of the control module, if a power module is not used in the assembly). See *Assembling System 450 Modules* on page 35 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 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

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

Note: System 450 compatible sensors for reset control modules consist of temperature and humidity sensors. The term **sensor** refers to all System 450 compatible input devices for reset control modules, unless noted otherwise.

System 450 compatible sensors also come in a variety of styles and configurations, allowing you to select the sensor that best fits your control system requirements. See Table 9, Table 10, and Table 11 in *Repair and Ordering Information* on page 76 for more information on System 450 compatible sensors.

You can connect up to three sensors to a System 450 control module at the low-voltage terminal block. See *Wiring System 450 Components* on page 37 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* on page 5 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 on page 15 for information about Sensor Types, the corresponding output setup values and ranges and sensor models used in System 450 reset 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 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. You must also set the active/passive sensor jumpers or switches on the control module correctly for each sensor connected to your control system.

See *Setting up a System 450 Reset Control System* on page 41 and *Setting Up the Sensors* on page 45 for more information and procedures on setting up sensors and Sensor Types in the System 450 UI. See *Active and Passive Sensors* on page 15 for information on setting the active/passive switches and jumpers.

System 450 Sensors for Reset Control Modules

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

Note: The reset control modules do not control pressure applications and do not have compatible pressure transducers.

Table 2: Sensor Types, Setup Values, and Product Codes for Reset Control Modules

Sensor Type	Unit	Range of Usable Values	Resolution Increments Value	Minimum Differential or Proportional Band	Effective Sensing Range	Range of Usable Pb/dIFF and SbK Values for RSP	Range of Usable OSET Values for RSP	Sensor Product Type Number[1]
°**F**	°F	-40 to 250	1	1	-46 to 255	-30 to 30	-30 to 30	A99B-xxx
°**C**	°C	-40 to 121	0.5	0.5	-43 to 124	-17 to 17	-17 to 17	A99B-xxx
rH	**%** Humidity	10 to 95	1	2	1 to 100	-20 to 20	-30 to 30	HE-67Sx-xxxxx

1. See *Troubleshooting System 450 Control Systems* on page 75 (Table 7 and Table 8) for additional ordering information for System 450 compatible sensors.

Active and Passive Sensors

Each sensor 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. For reset control modules, active sensors are three-wire humidity sensors that connect to one of the sensor input terminals, a common terminal, and a voltage supply terminal (24V).

The sensors have the following requirements:

- Temperature sensors do not require a power source.
- Humidity sensors require 24 VAC supply power and must be connected to the 24V terminal on the input terminal block.

On reset control modules with relay outputs, position the active/passive jumpers across both pin terminals for passive temperature sensors and on one terminal for active humidity sensors.

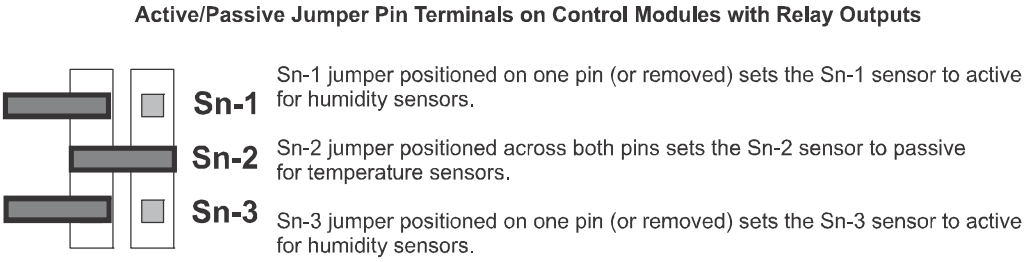


Figure 5: Example Showing the Active/Passive Jumper Positions on a Control Module with Relay Outputs

See *System 450 Reset Control System Examples* on page 29 for System 450 control system examples showing active/passive sensor jumper or switch settings.

System 450 Reset Sensor (rES)

System 450 reset control modules also enable a reset sensor based on the input from two hard-wired sensors (Sn-1 and Sn-2) in your control system. Selecting a reset sensor for an output on a System 450 control system enables the reset control feature on the output.

On System 450 reset control modules, the Reset Setpoint (RSP) that is used to control temperature and humidity reset control applications is derived from the functional Reset Sensor (rES), which is based on the outdoor air temperature sensed at Sn-1 and the process or space temperature sensed at Sn-2. See *Temperature or Humidity Reset Setpoint* on page 22 for information and procedures on setting up the Reset Sensor and Reset Setpoint.

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 11 on page 39.

Note: System 450 output relays are SPDT dry contact relays only and 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 is 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 is 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* on page 37 for information on wiring output relays. See *Technical Specifications* on page 78 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 9 on page 76 and *Technical Specifications* on page 78 for more information about the System 450 Series module models used to build reset control systems.

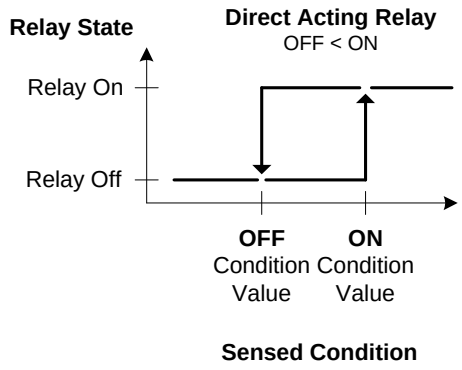
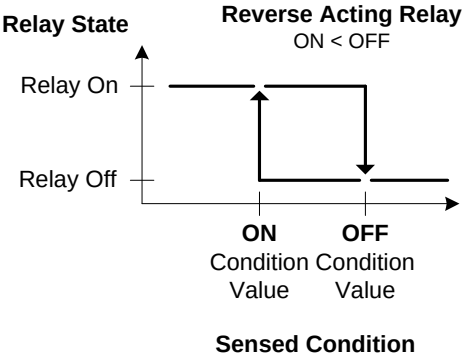
For procedures on setting up relay outputs on reset control modules, see *Setting up a Relay Output with Unoccupied Setback* on page 56 or *Setting up a Relay Output with Reset Control and Unoccupied Setback* on page 63.

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

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* on page 19 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* on page 21 for information on determining the integration constant for an analog output.

For procedures on setting up analog outputs on reset control modules, see *Setting up an Analog Output with Unoccupied Setback* on page 60 or *Setting up an Analog Output with Reset Control and Unoccupied Setback* on page 64.

System 450 control and expansion modules are available with one or two analog outputs; however, the System 450 Reset Control modules are not available with analog outputs. See Table 9 on page 76 and *Technical Specifications* for more information about the System 450 Series module models that are used to build reset control systems.

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.

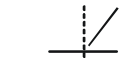
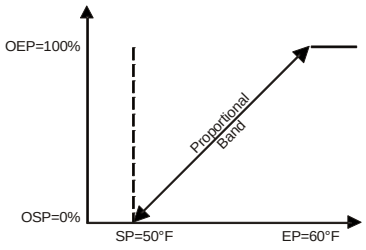
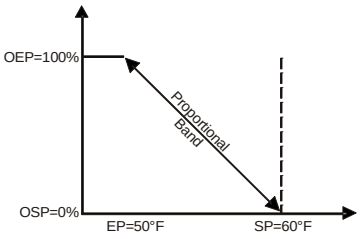
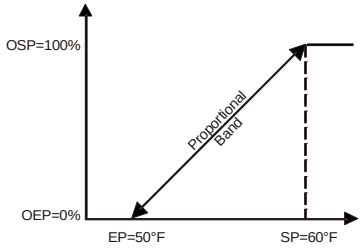
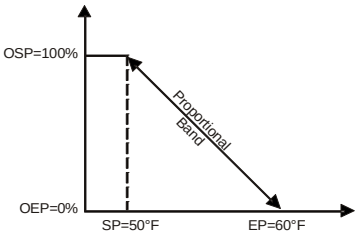
A control ramp icon is displayed on the status screens for all analog outputs in your control system (Figure 2 on page 10). The displayed control ramp icon represents the control action of the analog output signal. See Table 4 on page 20 for more information on analog output control actions and control 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 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.

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.

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 6).

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 6). 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.

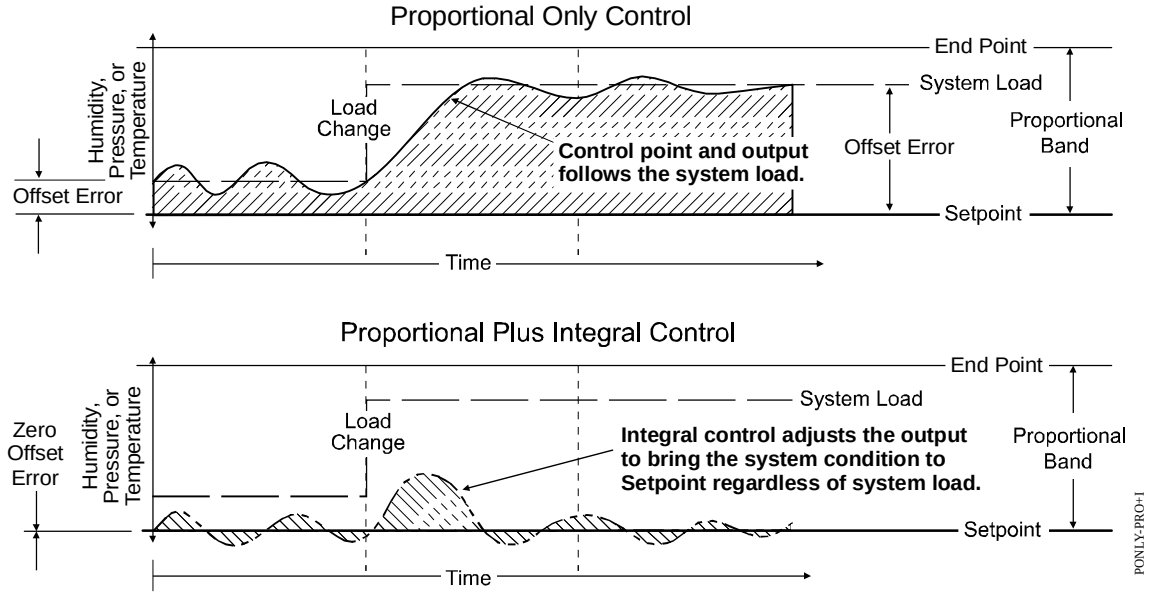


Figure 6: Proportional Only Control Versus Proportional Plus Integral Control

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 6). 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 6 on page 74.

See *Determining the Integration Constant for an Analog Output* on page 71 for more information and the procedures for determining an integration constant and testing a PI control loop in your controlled system.

Reset Control

System 450 reset control modules allow you to reset the controlled loop setpoint based on a master sensor (typically outdoor air temperature) and control outputs based on changing conditions at the master sensor. Typical reset control applications include boiler water reset, chilled water reset, and VAV zone control applications. See *Temperature or Humidity Reset Setpoint* on page 22 for more information on Reset Setpoint RSP.

The reset control module's real-time clock allows you to schedule outputs by day of week and time of day. You can also set up setback temperatures (and humidity) to create an occupied/unoccupied schedule for the outputs in your control system. The reset control module's load balancing feature enables your control system to even out the runtimes of staged equipment by automatically selecting the stage with the least runtime when responding to increases in the system load.

Temperature or Humidity Reset Setpoint

System 450 reset control modules allow you to set up outputs in your control system with temperature or humidity reset control capability.

The temperature or humidity reset control uses an algorithm to calculate and adjust (reset) the setpoint for a temperature or humidity control loop based on changes in ambient outdoor temperature or other uncontrolled condition temperature.

Figure 7 on page 23 shows an example of a simple temperature reset control application used to control either boiler or chiller supply-water temperature. See *System 450 Reset Control System Examples* on page 29 for example reset control applications.

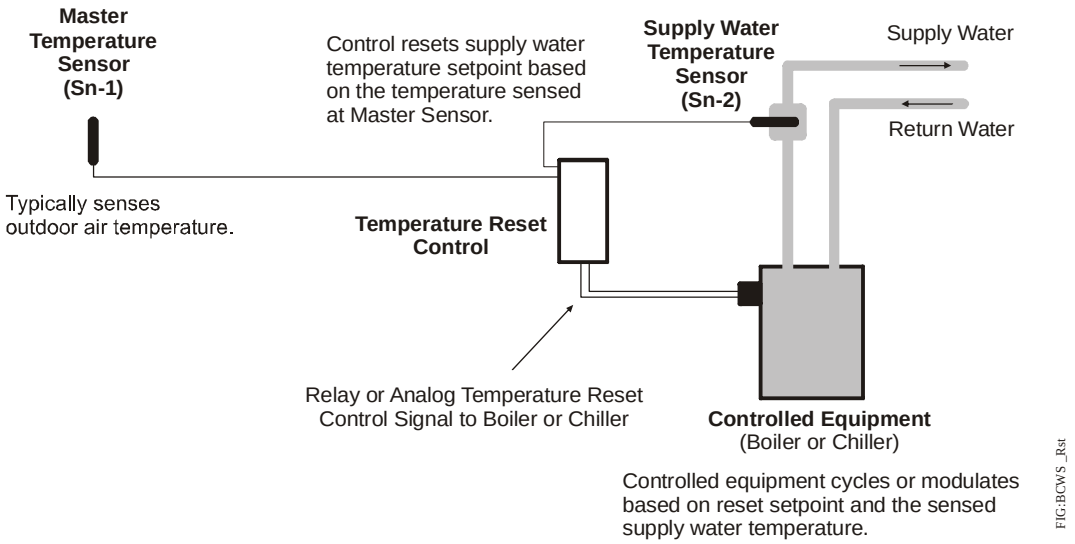


Figure 7: Example Boiler or Chilled Water Temperature Reset Application

When the ambient or uncontrolled temperature (sensed at the master sensor [Sn-1]), rises or lowers, the reset control module calculates a proportional adjustment that lowers or raises the supply-water temperature control setpoint (Reset Setpoint [RSP]). A second sensor (Sn-2) senses the supply loop/output temperature. The reset control calculates and generates the output signal response that is required to drive the supply/output temperature to the RSP.

Reset control logic regulates a supply (control loop) temperature or humidity based on outdoor air temperature to allow proper capacity of the supply to heat, cool, dehumidify, or humidify the desired space or environment. Common temperature reset applications are boiler-water temperature reset based on ambient outdoor air temperature, and chilled-water temperature reset based on outdoor air temperature. You can also apply temperature reset to Variable Air Volume (VAV) zone temperature control systems and a variety of other temperature and humidity control applications.

System 450 reset control modules allow you to set up a wide variety of temperature reset control systems. To set up a System 450 temperature reset control system:

1. Set up the master temperature sensor (Sn-1 in the System 450 UI). See *Setting up a System 450 Reset Control System* on page 41 for information and procedures.
2. Set up the output/supply temperature sensor (Sn-2 in the System 450 UI). See *Setting up a System 450 Reset Control System* on page 41 for information and procedures.

3. Set up the RSP in the System 450 reset control module UI. See the following information and procedures.

Reset Control Modes of Operation

System 450 reset control modules and relay output expansion modules can control multi-stage temperature and humidity applications. Reset control applications automatically adjust the control loop setpoint to save energy based on input from the master (outdoor/ambient) sensor and the user-selected reset setpoint settings.

Figure 8 shows an example of direct acting control for a cooling application. In a cooling application, you select the direct acting mode of operation by using a positive differential (dIFF) and positive offset (OSET). When the Reset Setpoint (RSP) is reached on a drop in temperature, the normally open relay contacts open, ending the on cycle of Stage 1. Figure 8 also shows the System Setup screens for this four-stage cooling application.

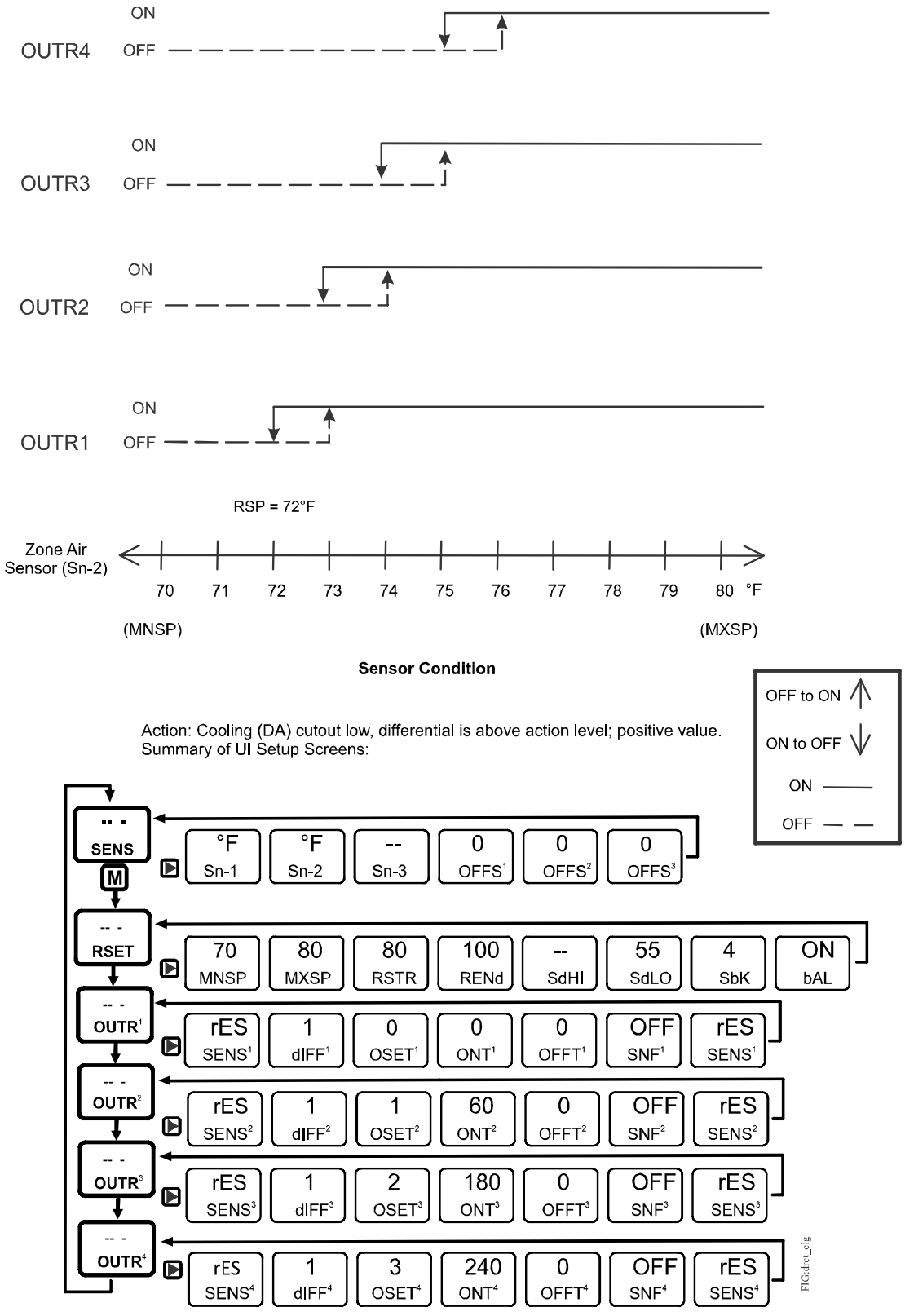


Figure 8: System 450 Direct Acting Mode of Operation Example

Figure 9 shows an example of reverse acting control for a heating application. In a heating application, you select the reverse acting mode of operation by using a negative differential (dIFF) and negative offset (OSET). When the RSP is reached on a rise of temperature, the normally open relay contacts open, ending the on cycle for Stage 1. Figure 9 also shows the System Setup screens for this four-stage heating application

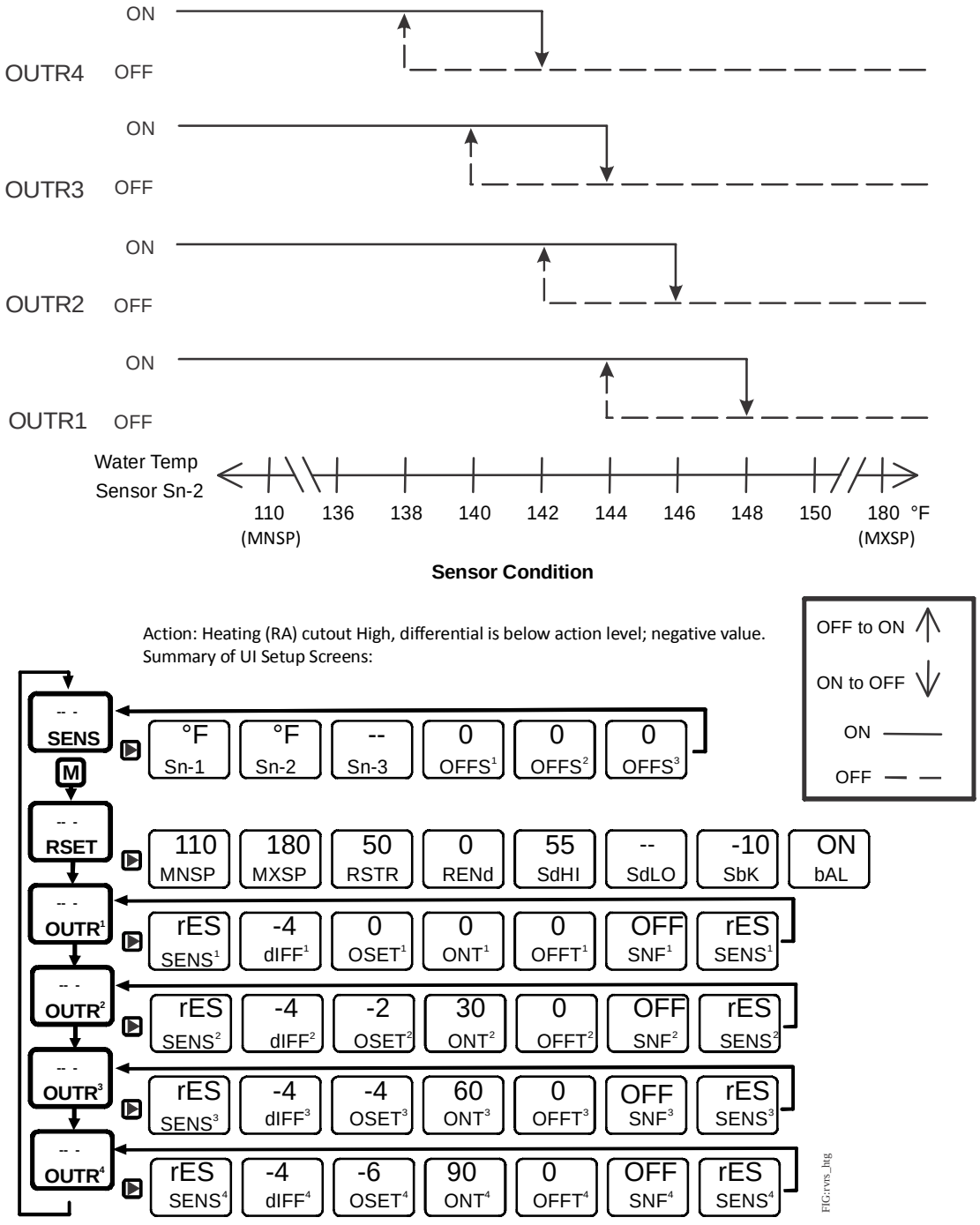


Figure 9: System 450 Reverse Acting Mode of Operation Example

Note: The System Setup screens in Figure 8 and Figure 9 show the selections you make to configure the illustrated control system examples. You must select values that are appropriate for your control system application.

Real-Time Clock

System 450 reset control modules include a real-time clock that allows you to control outputs based on time of day and day of week. The real-time clock allows you to configure temperature or humidity setback based on an occupancy schedule. See *Setting Time and Day* on page 66 for more information about configuring the real-time clock.

Setback Control Schedule

Setback Control allows you to change the setpoint based on the time of day and day of the week. See *Setting up an Occupied/Unoccupied Schedule* on page 67 for a complete description.

The setback selection screen determines a (floating) unoccupied setback value (RSP + SbK) for all of the relay and analog outputs that reference the rES sensor. The setback value may be negative for heating or humidification, or positive for cooling or dehumidification control.

Load Balancing

The examples in Figure 8 and Figure 9 also use the Load Balancing feature. When Load Balancing Mode (bAL) is set to ON, the reset control module turns on the output with the least amount of ON time first and this output becomes Stage 1. The output with the most amount of ON time turns on last and becomes Stage 4. The reset control module automatically moves $dIFF^1$ and $OSET^1$ from the previous Stage 1 output to the new Stage 1 output, and moves $dIFF^4$ and $OSET^4$ from the previous Stage 4 output to the new Stage 4 output. This pattern works the same way for the Stages 2 and 3 outputs.

Note: The output numbers in the module assembly and UI remain the same in a control system using the Load Balancing feature. The System 450 control system selects the output with the lowest runtime as the first stage (or next stage) as additional stages are needed to move the system load towards setpoint.

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 the reset sensor (rES). The reset sensor references 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 the reset sensor.

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 reset 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* on page 16 for more information regarding a relay output's on state.)
- Relay output SNF OFF = Relay Off. (See *Relay Outputs* on page 16 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* on page 19 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* on page 19 for more information regarding Output Signal at Setpoint.)

On System 450 reset control systems, if the Sn-1 sensor or sensor wiring fails, the Reset Setpoint (RSP) cannot be calculated. In this case, the failure default RSP is either the selected Minimum Reset Setpoint (MNSP) or the selected Maximum Reset Setpoint (MXSP). The failure default RSP value (MNSP or MXSP) depends on the reset action you have configured for the output. For outputs (relay and analog) that reference RSP, the failure modes when Sn-1 fails are defined as follows:

- If the calculated RSP is set up to **decrease** when the temperature increases at the master sensor, then RSP = MXSP. This condition is identified as RSTR > REND (Reset Start > Reset End). (See Figure 24.)
- If the calculated RSP is set up to **increase** when the temperature increases at the master sensor, then RSP = MNSP. This condition is identified as REND > RSTR (Reset End > Reset Start). (See Figure 25.)

System 450 Reset Control System Examples

With System 450 reset 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* on page 10 and *Expansion Modules, Module Assemblies, and Outputs* on page 13 for general information and guidelines on System 450 modules and UI. See *Detailed Procedures* on page 34 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.

System 450 reset control systems use the C450RxN-x reset control modules along with System 450 expansion modules to provide on/off relay control or proportional analog control (or both) based on a floating Reset Setpoint (RSP).

Boiler Stage Control System Example with Temperature Reset, Setback, and Load Balancing

Figure 10 shows a System 450 reset control system example for controlling three boiler stages and a boiler water circulation pump. This reset control system controls the boiler supply water temperature based on outdoor air temperature, stages the boilers to meet changing load conditions, provides scheduled setback, and balances the boiler stages to provide even runtime on all the boilers.

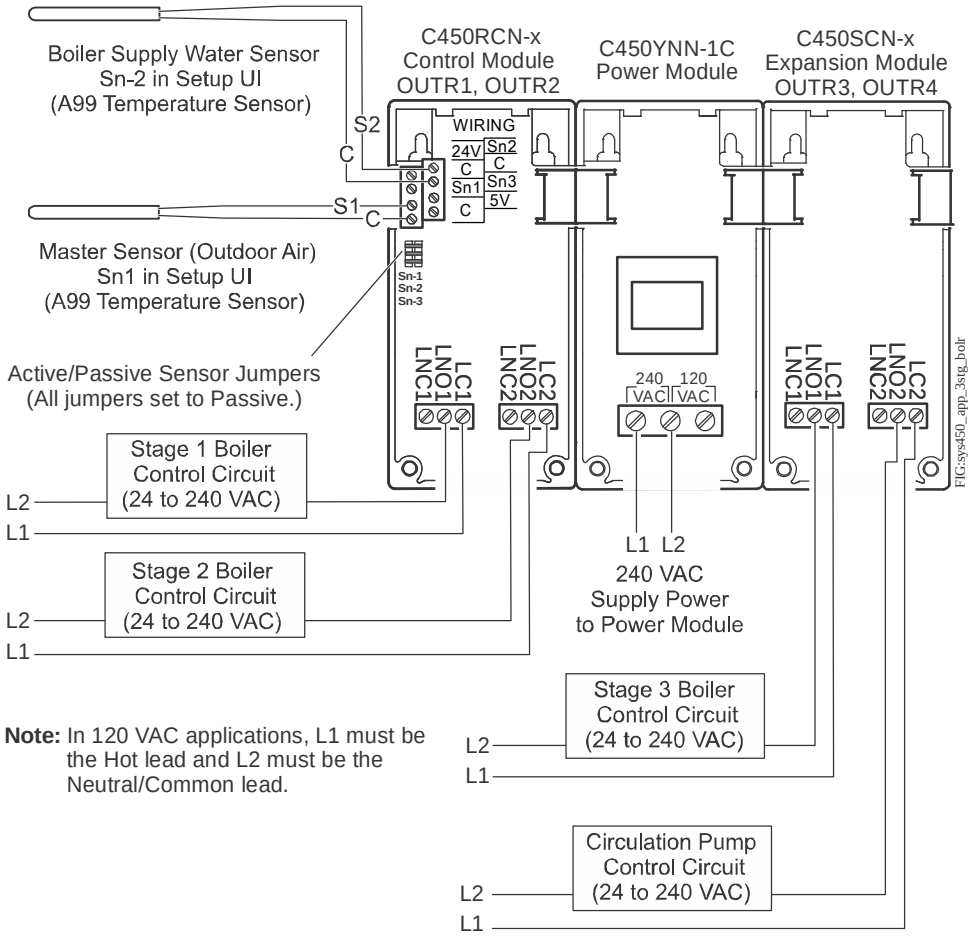


Figure 10: System 450 Reset Control System Example for Three Boiler Stages with Load Balancing

Figure 11 shows the System 450 UI Main screens, System Status screens, and System Setup screens for the example shown in Figure 10.

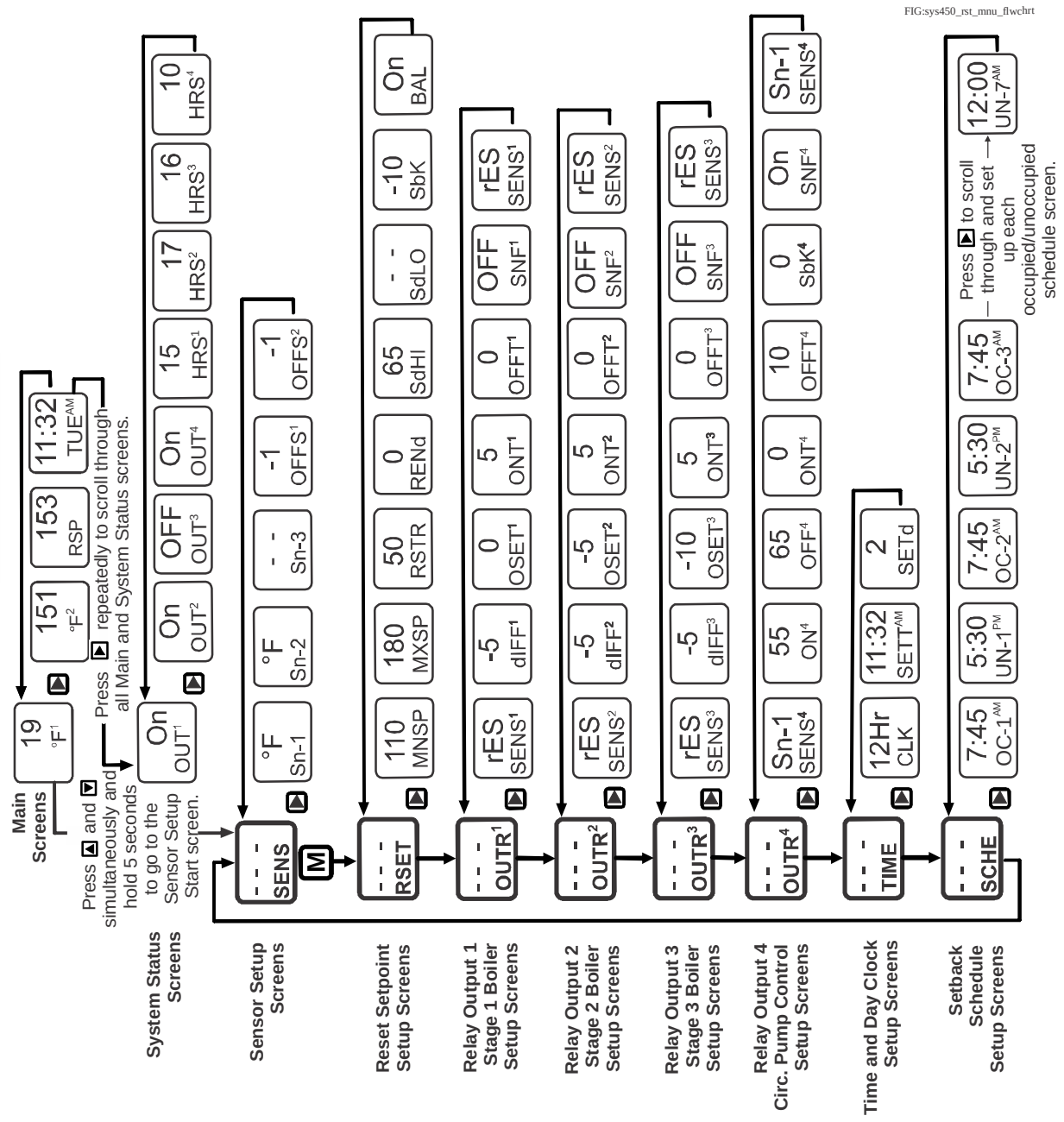


Figure 11: Main, System Status, and Setup Screens For Three Boiler Stages with Load Balancing Control System Example

Chilled Water Reset Control System Example With Free Cooling

Figure 12 shows a System 450 reset control system example for modulating chilled water temperature or flow based on outdoor air temperature. The control system also provides free cooling when the outdoor air temperature is low enough.

This example uses an external 24 VAC Class 2 transformer for supply power instead of a System 450 power module.

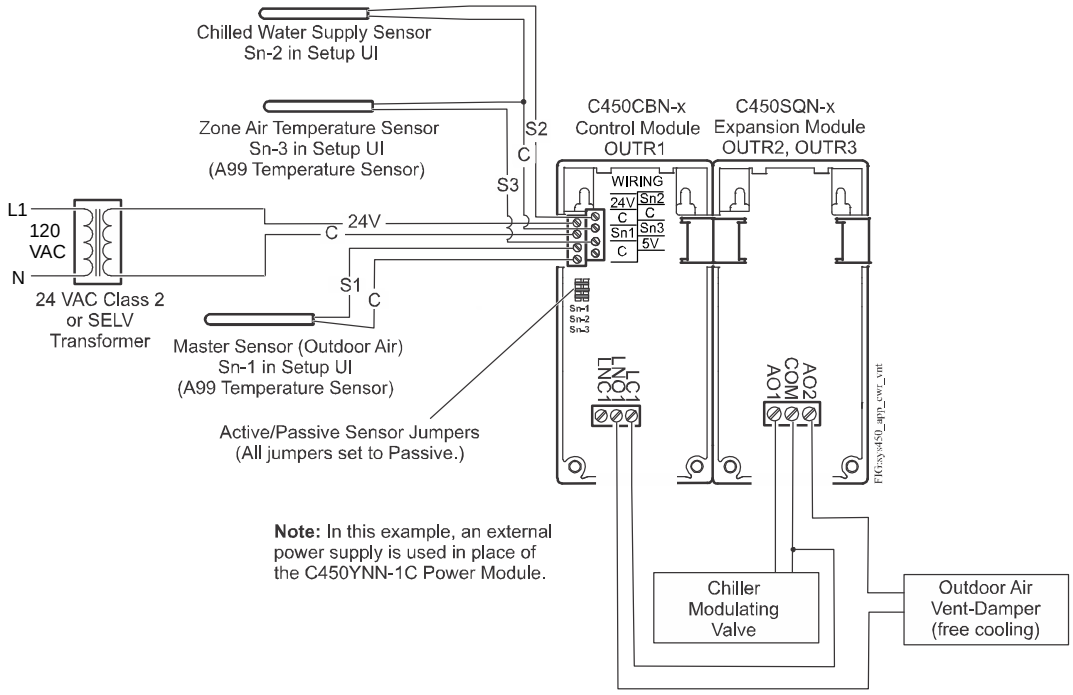


Figure 12: System 450 Reset Control System Example for a Chilled Water System with Free Outdoor Air Cooling

Figure 13 shows the System 450 UI Main screens, System Status screens, and System Setup screens for the control system example in Figure 12.

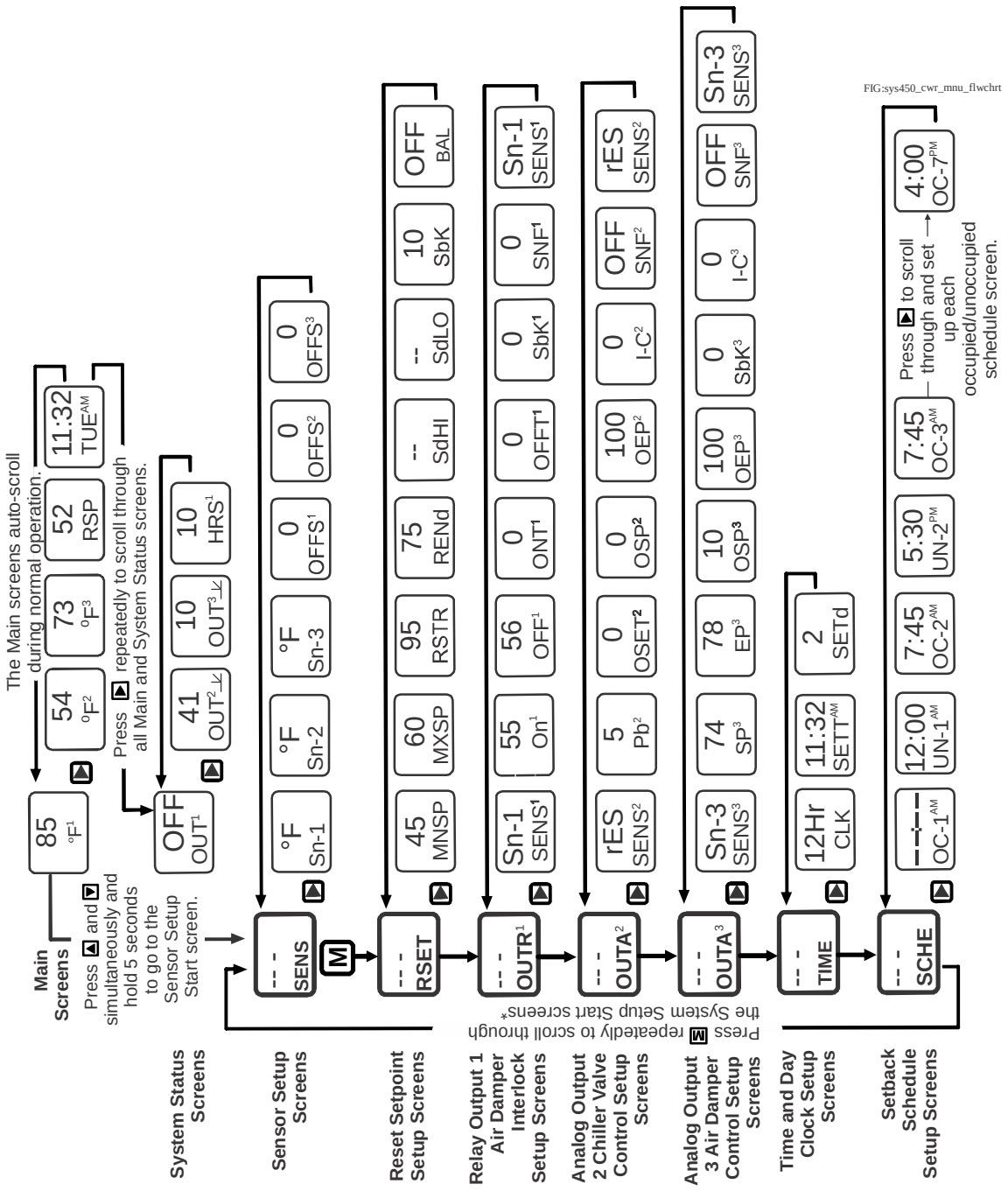


Figure 13: Main, System Status, and Setup Screens For Chilled Water Reset with Vent Cooling Control System Example

Detailed Procedures

Designing and Building System 450 Control Systems

The variety and flexibility of System 450 modules and sensors allow you to build an almost limitless variety of custom control systems. In fact, for many control systems, different System 450 components can be configured to achieve the same results.

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

- 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 two conditions (temperature and humidity) can be monitored simultaneously using reset control modules. See Table 2 on page 15 and *Selecting, Installing, and Setting Up Sensors* for more information.
- Determine the type of control your application requires – reset, setback, load balancing, real-time scheduling, or a combination of control types. See *System 450 Reset Control Modules* on page 9 for more information regarding System 450 control types provided by reset control modules.
- Select a reset control module if your application requires a reset function, occupied and unoccupied scheduling, energy savings with setback, and/or load balancing. (See Table 9 on page 76 for System 450 control module model information.) If your application requires functions that are not available from the reset control module, consider the standard control module, hybrid analog output control module, or the communications control modules.
- 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.
- 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.

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 with reset control modules:

- Select only System 450 compatible sensors. See Table 2 on page 15 for a complete list of System 450 compatible sensor types and models that are compatible with reset control modules. See Table 10 and Table 11 and *Repair and Ordering Information* on page 76 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* on page 37.
- Ensure that the wire length between the sensors and control module is as short as possible/practical, and ensure that the wiring is properly sized. Refer to the sensor installation instructions referenced in *Related Documentation* on page 5 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* on page 45.
- Ensure that the active/passive switches on the reset control module are set correctly for each sensor in your control system. See *Active and Passive Sensors* on page 15 for more information.
- Ensure that each output references the correct sensor in the System 450 UI. See *Setting up a System 450 Reset Control System* on page 41.

Assembling System 450 Modules

After selecting the System 450 components for your control system, you must assemble the modules. Figure 4 on page 13 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 VAC power supply is used instead of a System 450 power module. (See *Wiring System 450 Components* on page 37 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 mount is 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* on page 78.
- 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

Mount System 450 modules on 35 mm DIN rail (recommended) or directly to a flat/even surface.

To mount the modules on DIN rail:

1. Provide a section of 35 mm DIN rail that is longer than the module assembly width, and mount the DIN rail 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.)

To 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 1).
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: If you mount the modules on an uneven surface, use shims or washers to mount module assembly evenly on the surface.

Refer to the sensor installation instructions referenced in *Related Documentation* on page 5 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 14, Figure 15, and Table 5 for wiring terminal locations and designations. See *Technical Specifications* on page 78 for the electrical ratings for System 450 modules used to build System 450 reset control systems.

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.

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

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

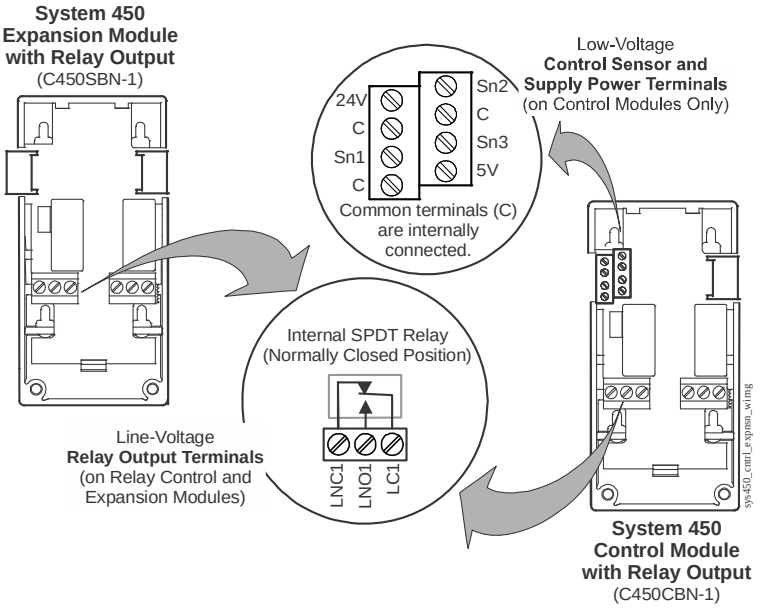
IMPORTANT: Electrostatic discharge can damage System 450 modules. Use proper Electrostatic Discharge (ESD) precautions during installation and servicing to avoid damaging System 450 modules.

IMPORTANT: Do not connect 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.

IMPORTANT: A System 450 control module and module assembly can be connected to an internal power source (a System 450 power module) or an external power source (24 V power connected to the 24V and COM terminals on the control module), **but must not be connected to both power sources simultaneously**. Connecting a control module to both internal and external power sources can damage the modules and void any warranty.

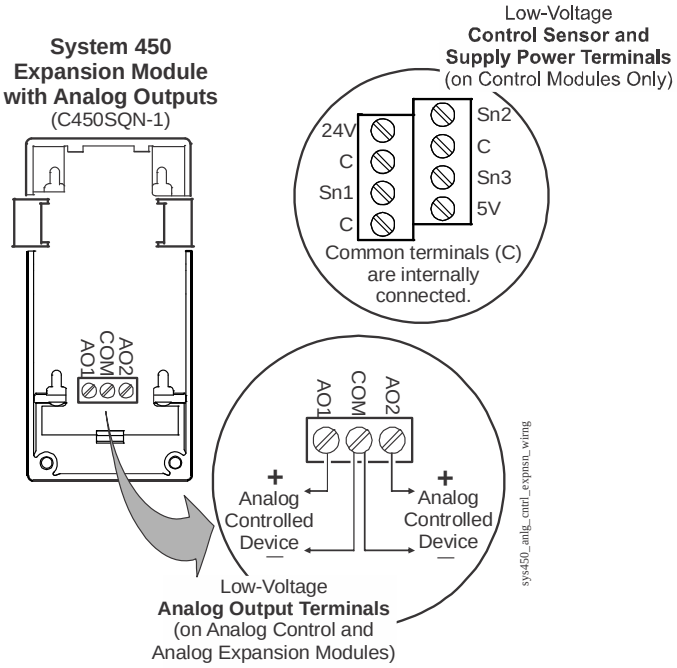
IMPORTANT: When connecting System 450 compatible sensors with shielded cable to a System 450 control module, connect the cable shield drain lead to one of the C (common) terminals on the input sensor terminal block. Do not connect the shield at any other point along the cable. Isolate and insulate the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

Figure 14 and Figure 15 show the locations of and designations for the wiring terminals for System 450 reset control modules and expansion modules.



Note: The C450xCN-1 Control and Expansion module models have two output relays and a second terminal block labeled LNC2, LNO2, and LC2.

Figure 14: Wiring Terminal Details for System 450 Control and Expansion Modules with Relay Output



Note: C450xPN-1 control and expansion modules only have two terminals with AO1 and COM connections.

Figure 15: Wiring Terminal Details for System 450 Control and Expansion Modules with Analog Outputs

Table 5 provides descriptions, ratings, requirements, and recommended cable types and recommended wire sizes for System 450 reset control, expansion, and power modules.

Table 5: System 450 Wiring Terminal and Wire Size Information

Terminal Block Type (on Module Type)	Terminal Label	Terminal Function	Required Wire Sizes
Sensor and Low-Voltage Supply Power Terminal Block (on all Control Modules)	**24V**	Accepts 24 VAC supply power, when a C450YNN-1C power module is **not** connected, and provides power terminal for active 24 VAC (humidity) sensors.	28 AWG to 16 AWG 0.08 mm^2 to 1.5 mm^2
	5V	Provides 5 VDC power for active sensors.	
	Sn1, Sn2, Sn3	Accepts passive or active input signals from sensors.	
	C (3 Terminals)	Provides low-voltage common connections for 24 VAC power and passive or active sensors connected to the 5V, Sn1, Sn2, and Sn3 terminals. **Note:** The three **C** terminals are connected internally.	

Table 5: System 450 Wiring Terminal and Wire Size Information

Terminal Block Type (on Module Type)	Terminal Label	Terminal Function	Required Wire Sizes
Line-Voltage Output Relay Terminal Blocks (on Control and Expansion Modules with Relay Output)	**LNC1, LNC2**	Connects equipment control circuit to the line-voltage Normally Closed (LNC) contact on the SPDT relay. LNC2 terminals are only on control and expansion modules 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. LNO2 terminals are only on control and expansion modules with two output relays.	
	LC1 LC2	Connects line power to the line-voltage Common (LC) on the SPDT relay. LC2 terminals are only on control and expansion modules with two output relays.	
Low-Voltage Analog Output Terminal Block (on Control and Expansion Modules with Analog Outputs)	**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.	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.	
Line-Voltage Supply Power Terminal Block (on Power Modules only)	**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

Refer to the sensor installation instructions referenced in *Related Documentation* on page 5 for information on wiring System 450 compatible sensors.

Setting up a System 450 Reset 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.

Note: The sensors 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* on page 45 for more information and detailed procedures.

IMPORTANT: The setup information in the control module is retained if the control system experiences a power failure. If power is lost for an extended period of time (8 hours or more), the time clock setup parameter resets (on reset control modules only), which is indicated by dashes shown on the time screen. When this occurs, the occupied and unoccupied function defaults to occupied mode until you re-enter the time.

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 on page 13 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 on page 12 and the following general guidelines for information on navigating the System 450 UI on reset 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 ▶ (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 ▲ and ▼ simultaneously for 5 seconds to go to the Sensor Setup Start screen and access the rest of the System Setup screens.
- While in any System Setup Start screen, press M repeatedly to scroll through the System Setup Start screens for your control system. (You cannot enter values in System Setup Start screens.)
- You **must** set up the sensors before you can set up the outputs. (See *Setting Up the Sensors* on page 45 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 control module and any connected expansion modules and the order in which the modules are connected in the module assembly. (See *Module Assemblies, Output Types, and Output Numbers* on page 13 for more information.)
- 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* on page 13 and *System 450 Compatible Sensors* on page 14 for more information.)
- In System Setup screens with flashing values, you can change the setup value by pressing ▲ or ▼. When the desired parameter value is flashing in the setup screen, press ▶ to save the 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.
- In the Time Setup (SETT) screen, the Occupied Start Time (OC-y) screens, and the Unoccupied Start Time (UN-y) screens, press and hold ▲ or ▼ to scroll through the minute values in 15-minute intervals.

  Note: Occupied and Unoccupied Start Times can be set at 15-minute intervals (:00, :15, :30, or :45) only.
- In any Setup screen, press M to go to the associated Setup Start screen.
- In Setup Start screen, press ▲ or ▼ simultaneously to resume autoscrolling through 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 on page 10 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 hardwired and reset sensors.

Figure 16 shows an example of the System 450 Main screens and the 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 ▶ (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 ▶, the Sensor or Output Status screen that is being viewed is displayed for 2 minutes before it times out and reverts to autoscrolling through the Main screens. The 2-minute pause allows you to monitor a sensor that is changing quickly during system setup or 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 reset sensors rES (the RSP) when used in the control system. The System Status screens also display hard-wired and reset sensor statuses along with output statuses. The Status screens also display total runtime for outputs that are set up with the Load Balancing feature.

Figure 16 shows the Main screens (sensor status) and the System Status screens (sensor and output status) for a System 450 reset control system.

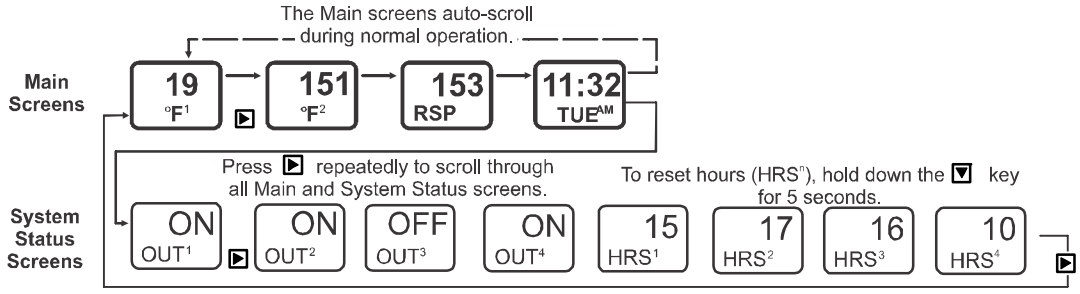


Figure 16: Main Screens and System Status Screens Example for a System 450 Reset Control System

Accessing the System Setup Screens

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* on page 45 for procedures on setting up the sensors.)

- From the Output Setup Start screens, you can set up each output in your control system. (See *Setting up a Relay Output* on page 47 and *Setting up Reset Setpoint, Day, Time, and Scheduled Setback Control* on page 53 for procedures on setting up outputs.)

To access and navigate the System 450 Setup Start screens:

1. In the **Main (Sensor Status)** screen, press ▲ and ▼ simultaneously and hold for 5 seconds. The **Sensor Setup Start** (**SENS**) screen appears (Figure 17).

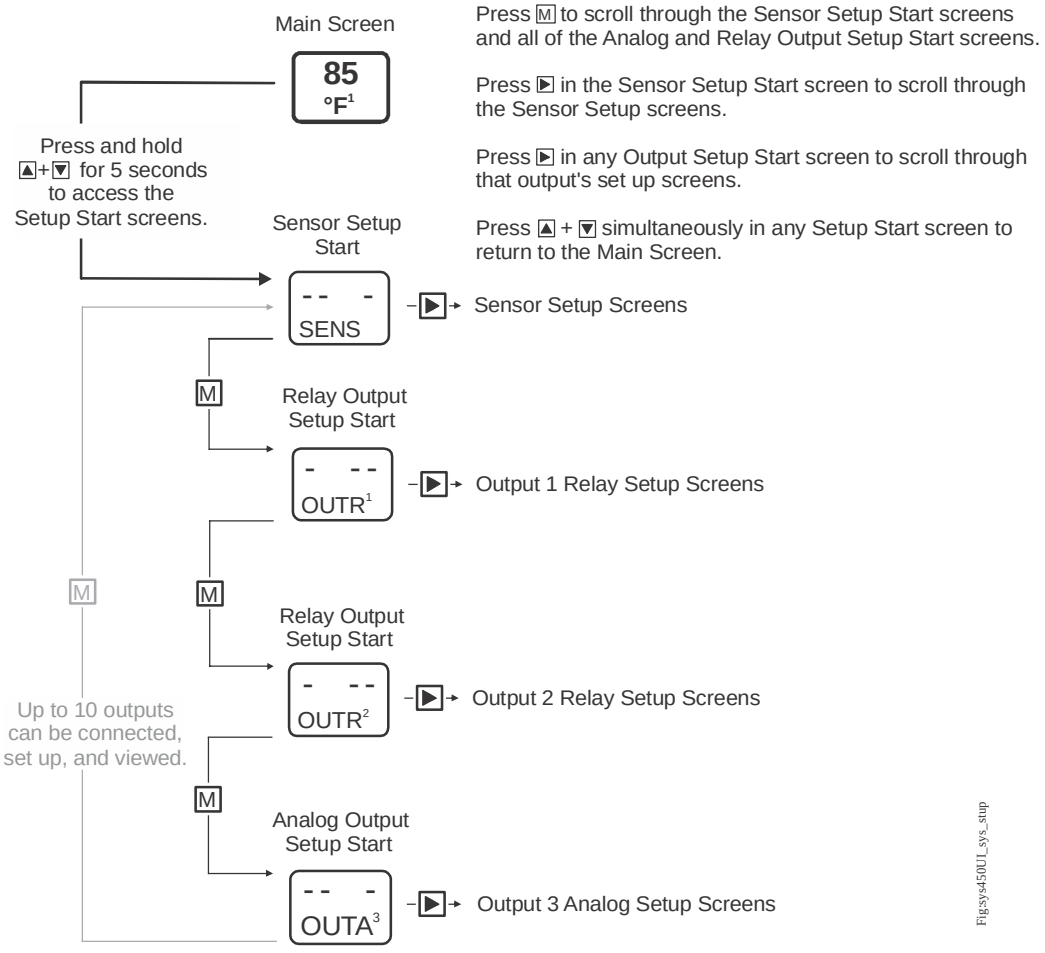


Figure 17: Accessing the Setup Start Screens in the System 450 UI

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

   Note: All Setup Start screens have four blinking dashes in the setup value fields. You cannot select values for the fields in the Setup Start screens.

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

- 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* for procedures on setting up the hard-wired sensors.)
- in any **Output Setup Start (OUT*X*^{X})** screen to go to the first output setup screen for the output. (See *Setting up Reset Setpoint, Day, Time, and Scheduled Setback Control* for the procedures for setting up outputs.)

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

Setting Up the Sensors

To set up the sensors in your control system, you must select the correct Sensor Type in the System 450 UI for each sensor 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 for reset control modules consist of temperature and humidity sensors. The term **sensor** refers to all System 450 compatible input devices, unless noted otherwise.

The Sensor Type you select for a sensor 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.

Note: For a System 450 control system to operate properly, you must wire the correct sensor 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 on page 15 for System 450 Sensor Types and their associated values and settings.

See Table 9 through Table 11 in *Repair and Ordering Information* on page 76 and *System 450 Sensors for Reset Control Modules* on page 15 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 18).
2. In the **Sensor Setup Start (SENS)** screen, press ▶ to go to the next screen.

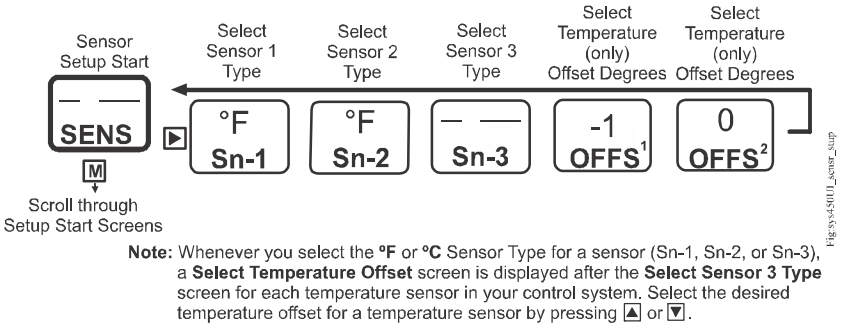


Figure 18: Sensor Setup Start, Select Sensor Type, and Select Temperature Offset Screens

3. In the **Select Sensor 1 Type (Sn-1)** screen, press ▲ or ▼ to scroll through the Sensor Types. When the desired Sensor Type is displayed (blinking), press ▶ 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.
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 ▲ or ▼. Press ▶ to save the offset value and go to the next screen.
6. After all of the sensors and temperature offsets are set up:
   - Press ▶ to return to the **Sensor Setup Start (SENS)** screen; then press M to scroll through the output setup start screens and set up the outputs in your control system. (See *Setting up Outputs* on page 47 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 ▲ and ▼ simultaneously while a Setup Start screen is displayed.

Setting up Outputs

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

Setting up a Relay Output

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 19 and Figure 20). See *Relay Outputs* on page 16 for more information about System 450 Relay Output operation and the relay ON and OFF states.

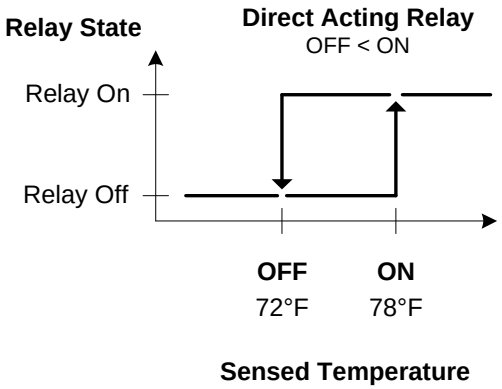


Figure 19: Direct Acting Relay (OFF < ON) Set Up to Control Cooling

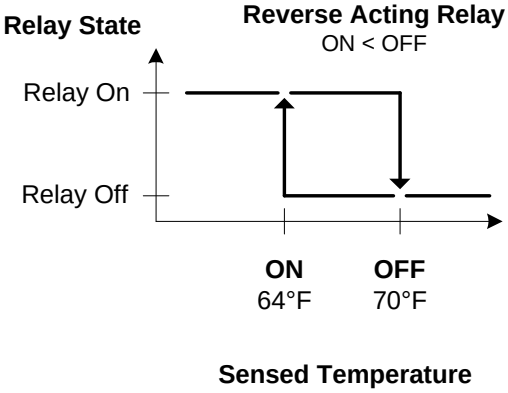


Figure 20: Reverse Acting Relay (ON < OFF) Set Up to Control Heating

When you supply power to a module assembly, the control module polls all of the connected modules, detects all of the outputs in the modular 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 21 on page 49).

The first screen in the relay output setup menu flow is the **Sensor Selection (SENS^{x})** screen. The sensor you select in this screen (Sn-1, Sn-2, Sn-3, or rES) determines the Sensor Type parameter ranges and values available in the remaining output setup screens.

Note: The condition (temperature 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 2 on page 15 for more information on sensors that are compatible with System 450 reset control modules, their Sensor Types, and the values and ranges associated with each Sensor Type.

The **Relay ON (ON^{x})** screen and **Relay OFF (OFF^{x})** screen 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 appear.

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.

The **Minimum Relay ON Time (ONT^{x})** and **Minimum Relay OFF Time (OFFT^{x})** screens provide anti-short-cycling control for system equipment by allowing you to delay the shutdown or startup for up to 300 seconds (5 minutes) after the ON or OFF value is reached.

The **Sensor Failure Mode (SNF^{x})** screen 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* on page 27 for more information.

To set up a relay output:

1. Access the System 450 UI and navigate to the desired **Relay Output Setup Start (OUTR^{x})** screen (Figure 21). (See *Accessing and Navigating the User Interface* on page 42.)
2. In the **Select Relay Output Setup Start (OUTR^{x})** screen, press ▶ 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 ▲ or ▼ to select the hard-wired or reset sensor (Sn-1, Sn-2, Sn-3, or rES) that the output references. Press ▶ to save the sensor selection and go to the next screen.

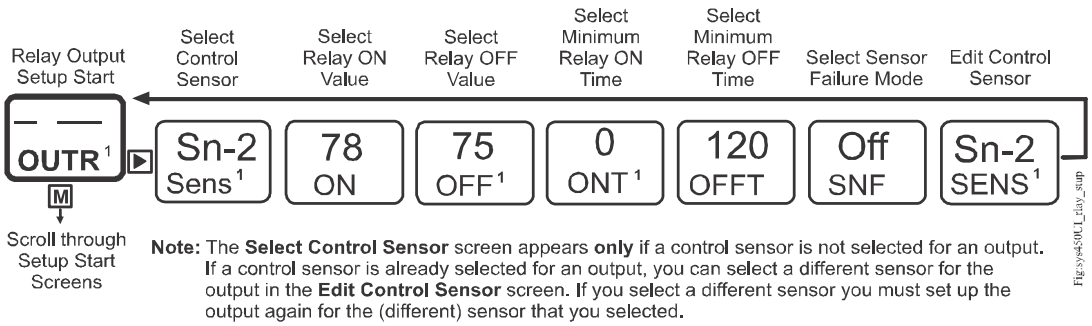


Figure 21: Relay Output Setup Start Screen and Setup Screen Flow

3. In the **Select Relay ON Value (ON^{x})** screen, press ▲ or ▼ to select the temperature or humidity value at which the relay turns On. Press ▶ to save the ON value and go to the next screen
4. In the **Select Relay OFF Value (OFF^{x})** screen, press ▲ or ▼ to select the temperature or humidity value at which the relay turns Off. Press ▶ to save the OFF value and go to the next screen.
5. In the **Select Minimum Relay ON Time (ONT^{x})** screen, press ▲ or ▼ to select the minimum number of seconds that the relay stays on after the Relay ON (or dON) value is reached. Press ▶ to save the ONT value and go to the next screen.
6. In the **Select Minimum Relay OFF Time (OFFT^{x}**) screen, press ▲ or ▼ to select the minimum number of seconds that the relay stays off after the Relay OFF (or dOFF) value is reached. Press ▶ to save the OFFT value and go to the next screen.
7. In the **Select Sensor Failure Mode (SNF^{x})** screen, press ▲ or ▼ to select whether the output relay stays on or off when a sensor failure is detected. Press ▶ to save the Sensor Failure Mode value and go to the next screen.
8. In the **Edit Sensor (SENS^{x})** screen:
   - If the displayed sensor (Sn-1, Sn-2, Sn-3, or rES) is the correct sensor for the output relay, the output setup is complete. Press ▶ to go to the Relay Output Setup Start screen.
   - If the displayed sensor (Sn-1, Sn-2, Sn-3, or rES) is not the correct sensor for the output relay, press ▲ or ▼ to select the correct sensor. Press ▶ to save the new sensor selection and go to the Relay Output Setup Start screen. Press ▶ again to go to the Relay ON Value screen and repeat Step 3 through Step 8 for the new sensor.

The relay output is set up and saved in the control module. If you need to set up the next output, press M to navigate to the next Output Setup Start screen. If you have completed your control system setup, press ▲ and ▼ simultaneously to return to the Main screens.

Setting up an Analog Output

Analog Outputs provide proportional analog control signals to controlled equipment based on the sensed conditions. See *Analog Outputs* on page 18 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^{x})** screen for each analog output detected (Figure 23 on page 51). See *Analog Outputs* on page 18 for more information.

Note: The condition (temperature 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 2 on page 15 for more information on sensors that are compatible with System 450 reset control modules, their Sensor Types, and the values and ranges associated with each Sensor Type.

The **Setpoint (SP)** and **End Point (EP)** screens 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)** screens 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.

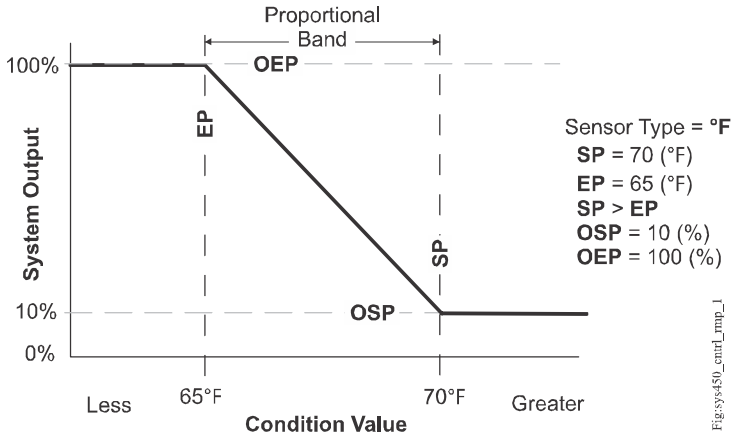


Figure 22: Relationship between Setpoint, End Point, Output at Setpoint, and Output at End Point for an Analog Output That Controls Room Heating

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 on page 10 and *Direct and Reverse Control Actions for Analog Outputs* on page 19 for more information on the control ramp indicator.

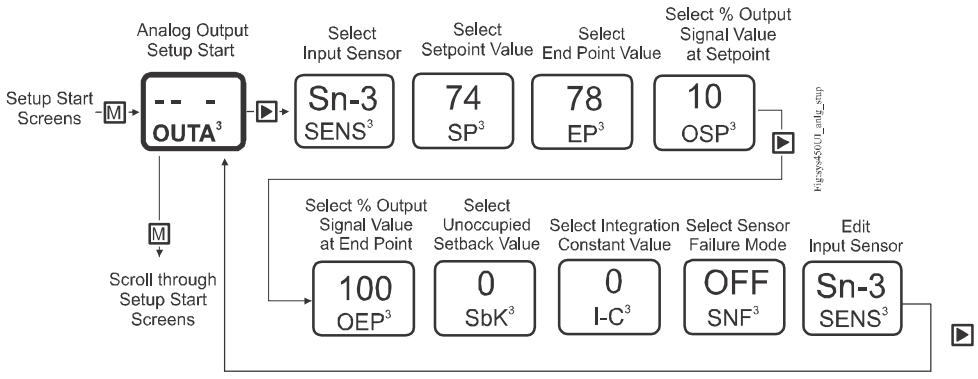
The **Integration Constant (I-C)** screen allows you to select an integration constant for the analog signal. Selecting an integration constant other than 0 enables proportional plus integral control action, which in many applications can drive the condition closer to setpoint (than proportional-only control action). See *Proportional Plus Integral Control and Integration Constants* on page 21 for more information. See *Determining the Integration Constant for an Analog Output* on page 71 for procedures on determining and testing the integration constants in your control application.

The **Sensor Failure Mode (SNF^{x})** screen 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* on page 27 for more information.

To set up an analog output:

Note: In any of the system setup screens, press M to return to the setup start screen. In the setup start screen, press ▲ and ▼ 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 23). (See *Accessing and Navigating the User Interface* on page 42 for information on accessing the System Setup screens.)



Note: The **Select Input Sensor** screen appears (with two dashes on the top line) **only** if an input sensor is not selected for an output. If an input sensor is already selected for an output, you can select a different sensor for the output in the **Edit Input Sensor** screen. If you select a different sensor you must set up the output again for the (different) sensor that you selected.

Figure 23: Analog Output Setup Start Screen and Setup Screen Flow

2. In the **Analog Output Setup Start (OUTA^{x})** screen, press ▶ 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 ▲ or ▼ to select the hard-wired or reset sensor (Sn-1, Sn-2, Sn-3, or rES) that the output references. Press ▶ to save the sensor selection and go to the Select Setpoint Value screen.

3. In the **Select Setpoint Value (SP^{x})** screen, press ▲ or ▼ 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 ▶ to save the Setpoint value and go to the next screen.

4. In the **Select End Point Value (EP^{x})** screen, press ▲ or ▼ 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 ▶ to save the End Point value and go to the next screen.

5. In the **Select Output Signal Strength at Setpoint (OSP^{x})** screen, press ▲ or ▼ to select the value in percent of the output signal strength (0-100%), corresponding to the lowest output capacity, when the sensor is at Setpoint (SP^{x}). Press ▶ 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 ▲ or ▼ 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 ▶ to save the displayed OEP value and go to the next screen.

7. In the **Select Unoccupied Setback (SbK)** screen, press ▲ or ▼ repeatedly to scroll through and select the setback value for the output. Then press ▶ to save the selected value and go to the next screen.

   Note: A negative setback value is used for heating or humidify reset applications and a positive setback value is used for cooling or de-humidify reset applications. If you select a setback value, all of the outputs that reference the **rES** use the selected value according the occupied/unoccupied setback schedule you set up for the control system. During unoccupied time periods, the setback is added to RSP, with the restriction that the RSP value can never exceed the MXSP value, nor be less than the MNSP value. See *Setting up an Occupied/ Unoccupied Schedule* on page 67 for more information.

8. In the **Select Integration Constant (I-C^{x})** screen, press ▲ or ▼ to select the integration constant value for the analog output. (See *Determining the Integration Constant for an Analog Output* on page 71 for more information.) Press ▶ to save the displayed I-C value and go to the next screen.

9. In the **Select Sensor Failure Mode (SNF^{x})** screen, press ▲ or ▼ 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 ▶ to save the displayed SNF value and go to the next screen.

10. In the **Edit Sensor (SENS^{x})** screen, you can change the hard-wired or reset sensor that the output currently references:

- If the displayed sensor (Sn-1, Sn-2, Sn-3, or rES) is the correct sensor for the output relay, the output setup is complete. Press ▶ to go to the Analog Output Setup Start screen.
- If the displayed sensor (Sn-1, Sn-2, Sn-3, or rES) is not the correct sensor for the output relay, press ▲ or ▼ to select the correct sensor. Press ▶ to save the new sensor selection and go to the Analog Setpoint Value screen. Repeat Step 3 through Step 9 for the new sensor.

11. Press M to return to the **Analog Output Setup Start (OUTA^{x})** screen.

The analog output is set up and saved in the control module. If you have completed the control system setup, press ▲ and ▼ simultaneously to return to the Main screens.

Setting up Reset Setpoint, Day, Time, and Scheduled Setback Control

After setting up the sensors for your System 450 reset control system, you can reference them as you set up the Reset Setpoint and/or outputs. This section also explains how to set the time, day, and schedule.

Setting up the Reset Setpoint

In the System 450 reset control module UI, RSP is defined by the:

- Minimum Reset Setpoint (MNSP) value and the Maximum Reset Setpoint (MXSP) value
- Reset Setpoint Start Temperature (RSTR) value and the Reset Setpoint End Temperature (RENd) value

Figure 24 and Figure 25 illustrate the relationship between the temperature sensed at the master sensor and the RSP.

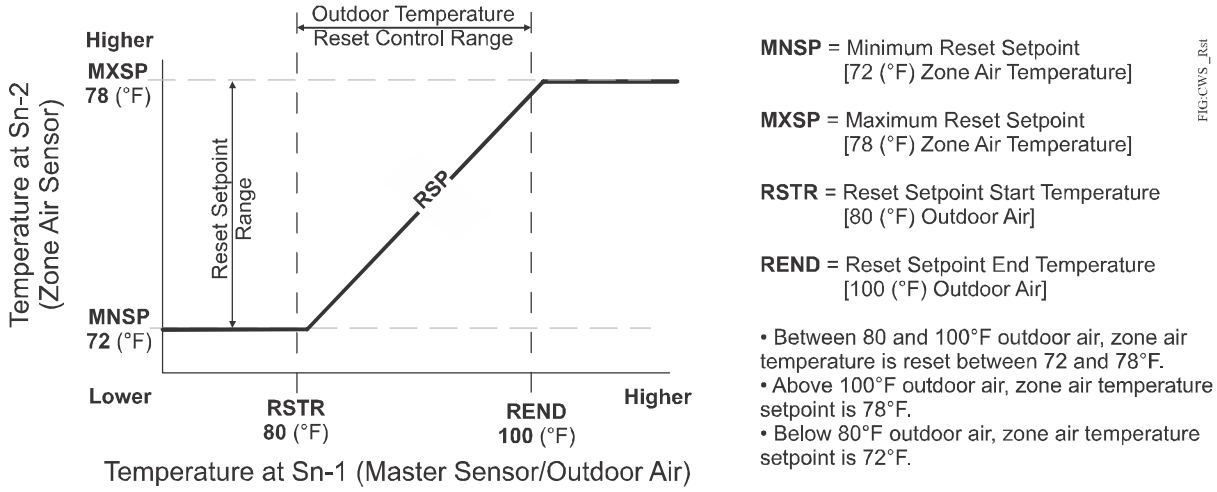


Figure 25: Graph Showing an Example of Zone Air Temperature Reset Based on Sn-1 Outdoor Air Temperature

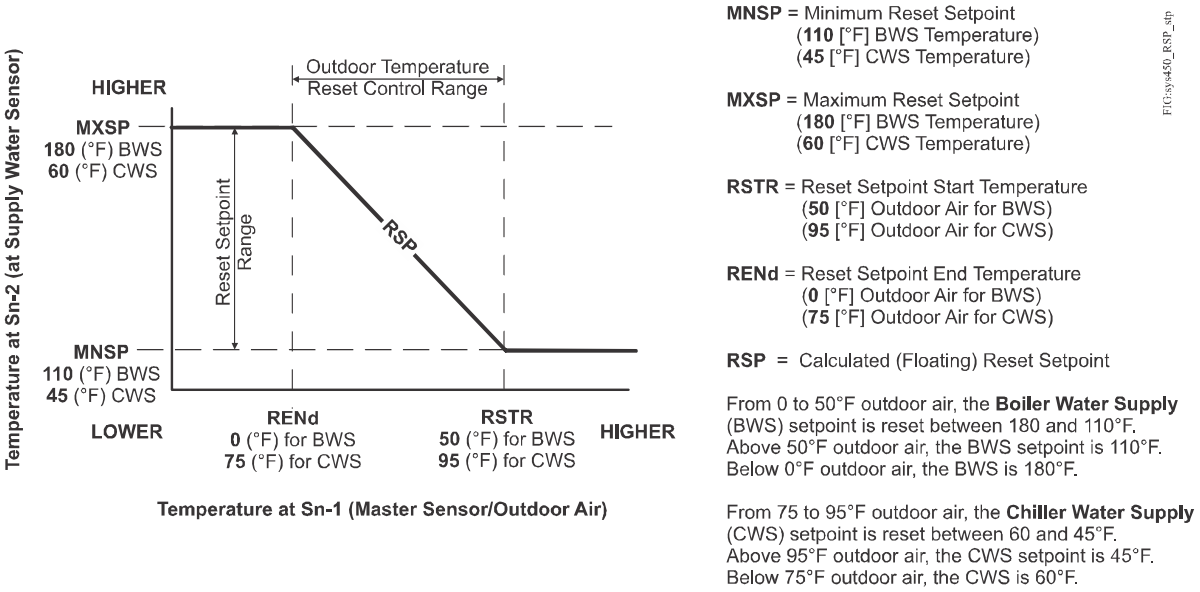


Figure 24: Example Reset Setpoint Applications for Boiler Water Supply and Chiller Water Supply Showing the Relationships between the Reset Setpoint Setup Parameters

The temperature RSP is adjusted (proportionally) over the defined setpoint range by entering the ambient/uncontrolled temperature values that you want to correspond with the MNSP and MXSP values. Two values are available:

- Reset setpoint Start temperature (RSTR): ambient/uncontrolled temperature value (sensed at the master sensor) that corresponds with the Minimum Setpoint value (MNSP).
- Reset setpoint End temperature (RENd): ambient/uncontrolled temperature value (sensed at the master sensor) that corresponds with the Maximum Setpoint (MXSP).

You can also set up temperature limits to turn outputs off at specified high and/or low temperatures. Two values are available:

- Shutdown High temperature value (SdHI): turns the referenced outputs off when the temperature sensed at the master sensor increases to the Shutdown High temperature value; as a result, MNSP is not maintained. As Figure 24 indicates, you can set a SdHI temperature greater than RSTR.
- Shutdown Low temperature value (SdLO): turns the referenced outputs off when the temperature sensed at the master sensor decreases to the Shutdown Low temperature value; as a result, MNSP is not maintained. As Figure 25 indicates, a VAV zone air temperature reset application can use a SdLO valve.

You can also set up an unoccupied setback value and/or select load balancing.

- Setback (SbK): positive or negative value that is added to the setpoint value during the unoccupied period to provide for energy savings. The unoccupied Setback value ([RSP] + [SbK]) is referenced during all scheduled unoccupied times. To use the Setback feature in your control system, you must also set up the time and day of week. See *Setting Time and Day* on page 66. For a weekly occupied/unoccupied schedule, see *Setting up an Occupied/Unoccupied Schedule* on page 67.
- Load Balancing (bAL): Select either ON (enabled) or OFF (disabled). If you select ON, load balancing is used to even out the runtimes between pieces of equipment. The output that has the lowest runtime hours is the next one to be turned on, whereas the output with the highest runtime hours is the next one to be turned off. Load Balancing is not available for analog outputs.

To set up the RSP:

1. Power the reset control module assembly On.
2. Press and hold ▲ and ▼ simultaneously for 5 seconds. The **Sensor Setup Start (SENS)** screen appears.
3. Press M once to go to the **Reset Setpoint Setup Start (RSET)** screen.
4. Press ▶ to go to the **Select Minimum Reset Setpoint (MNSP)** screen (Figure 26).

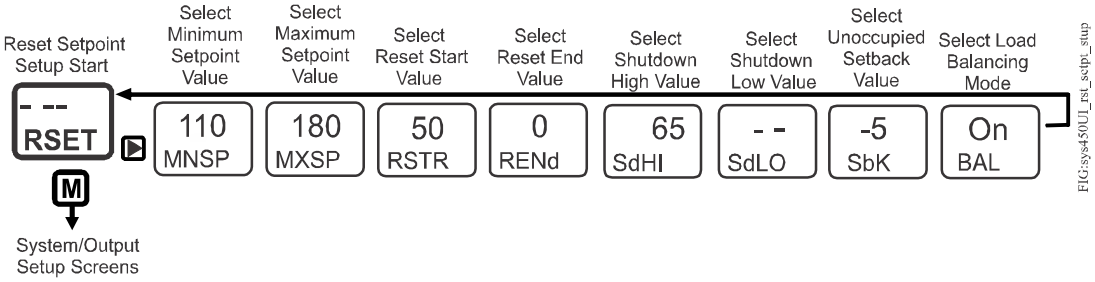


Figure 26: Reset Setpoint Setup Screens

5. In the **Select Minimum Reset Setpoint (MNSP)** screen, press ▲ or ▼ repeatedly to scroll through and select the minimum reset setpoint value. Then press ▶ to save the MNSP value and go to the next screen (Figure 26).
6. In the **Select Maximum Reset Setpoint (MXSP)** screen, press ▲ or ▼ repeatedly to scroll through and select the maximum reset setpoint value. Then press ▶ to save the MXSP value and go to the next screen (Figure 26).
7. In the **Select Reset Setpoint Start Temperature (RSTR)** screen, press ▲ or ▼ repeatedly to scroll through and select the desired start value for the reset temperature range sensed at the master sensor. Then press ▶ to save the selected reset start temperature value and go to the next screen (Figure 26).

8. In the **Select Reset Setpoint End Temperature (RENd)** screen, press ▲ or ▼ repeatedly to scroll through and select the desired end value for the reset temperature range sensed at the master sensor. Then press ▶ to save the selected reset end temperature value and go to the next screen (Figure 26).

9. In the **Select Shutdown High Temperature (SdHI)** screen, press ▲ or ▼ repeatedly to scroll through and select the Shutdown High temperature value. (For many applications, you can enter no value and keep this value set to --.) Then press ▶ to save the selected shutdown high temperature value and go to the next screen (Figure 26).

   Note: When the uncontrolled temperature, sensed at the master sensor, rises above the Shutdown High temperature, **all** of the outputs in the control system that reference the Reset Setpoint sensor (rES) turn off and MNSP is not maintained.

10. In the **Select Shutdown Low Temperature (SdLO)** screen, press ▲ or ▼ repeatedly to scroll through and select the shutdown low temperature value. (For many applications, you can enter no value and keep this value set to --.) Then press ▶ to save the selected shutdown low temperature value and go to the next screen (Figure 26).

    Note: When the uncontrolled temperature, sensed at the master sensor, drops below the Shutdown Low temperature, **all** of the outputs in the control system that reference the Reset Setpoint sensor (rES) turn Off; as a result, MNSP is not maintained.

11. In the **Select Unoccupied Setback (SbK)** screen, press ▲ or ▼ repeatedly to scroll through and select the Setback value for the output. Then press ▶ to save the selected setback value and go to the next screen.

    Note: If you select a Setback value, all of the outputs that reference the **rES** use the selected setback value according the occupied/unoccupied setback schedule you set up for the control system. During unoccupied time periods, the setback is added to RSP, with the restriction that the RSP value can never exceed the MXSP value, nor be less than the MNSP value. See *Setting up an Occupied/Unoccupied Schedule* on page 67 for more information.

12. In the **Select Load Balancing Mode (bAL)** screen, press ▲ or ▼ to select either ON or OFF. Then press ▶ to save the load balancing mode selection and return to the Reset Setpoint Setup Start (RSET) screen (Figure 26).

Reset Setpoint sensor (rES) is now set up and available for selection in the Sensor Selection screens as you set up the outputs in your System 450 reset control system.

Setting up a Relay Output with Unoccupied Setback

System 450 reset control modules allow you to set up Relay Outputs with a setback temperature or humidity value that is applied during the unoccupied times of the weekly occupied/unoccupied schedule.

Note: System 450 outputs apply setback values only during the unoccupied times of the control system's occupied/unoccupied schedule. You must also set up a weekly occupied/unoccupied schedule for the control system to apply an unoccupied setback value to an output. See *Setting up an Occupied/ Unoccupied Schedule* on page 67 for more information on setting up a weekly occupied/unoccupied schedule.

Relay Outputs provide single and multiple stage on/off control to controlled equipment. When you supply power to a module assembly, the control module polls all of the connected modules, detects any relay outputs, and then assigns an output number and enables a **Relay Output Setup Start (OUTR^{x})** screen for each relay output detected. See *Relay Outputs* on page 16 for more information.

Note: The condition (temperature 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 2 on page 15 for more information on Sensor Types and their associated values and ranges.

The **Relay ON (ON^{x})** screen and **Relay OFF (OFF^{x})** screen 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 appear.

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

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; the condition values within the minimum differential range are not available to select.

The **Minimum Relay ON Time (ONT^{x})** and **Minimum Relay OFF Time (OFFT^{x})** screens provide anti-short-cycling control for system equipment by allowing you to delay the shutdown or startup for up to 300 seconds (5 minutes) after the ON or OFF value is reached.

To set up a standard Relay Output with Unoccupied Setback:

1. Power the reset control module assembly On.
2. Press and hold ▲ and ▼ simultaneously for 5 seconds. The **Sensor Setup Start (SENS)** screen appears.

3. Press M repeatedly to go to a **Relay Output Setup Start** screen (Figure 27).

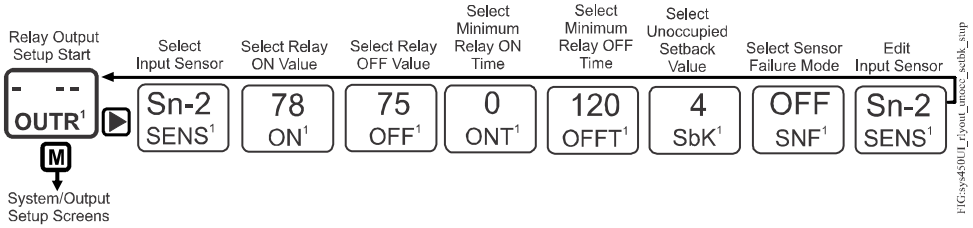
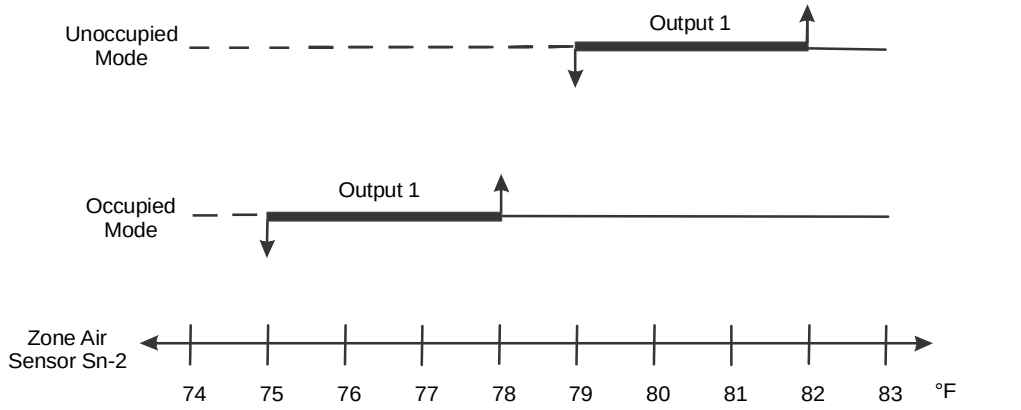


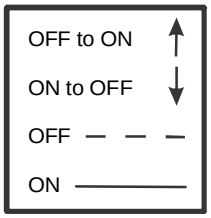
Figure 27: Relay Output with Unoccupied Setback Setup Screens

4. In the **Relay Output Setup Start (OUTR^{x})** screen, press ▶. The **Select Sensor (SENS^{x})** screen does not appear if an sensor is already selected for the output. Then go to Step 6.
5. In the **Select Sensor (SENS^{x})** screen, press ▲ or ▼ to select the sensor (Sn-1, Sn-2, Sn-3, or rES) that the output references. If sensor rES is selected, see *Setting up a Relay Output with Reset Control and Unoccupied Setback* on page 63. Press ▶ to save the sensor selection (Sn-1, Sn-2, or Sn-3) and go to the next screen.
6. In the **Select Relay ON Value (ON^{x})** screen, press ▲ or ▼ to select the temperature value at which the relay turns On. Press ▶ to save the ON value and go to the next screen.
7. In the **Relay OFF Value (OFF^{x})** screen, press ▲ or ▼ to select the temperature value at which the relay turns Off. Press ▶ to save the OFF value and go to the next screen.
8. In the **Minimum Relay ON Time (ONT^{x})** screen, press ▲ or ▼ to select the minimum number of seconds that the relay stays on after the Relay ON value is reached. Press ▶ to save the Minimum ON value and go to the next screen.
9. In the **Minimum Relay OFF Time (OFFT^{x})** screen, press ▲ or ▼ to select the minimum number of seconds that the relay stays off after the Relay OFF value is reached. Press ▶ to save the Minimum OFF value and go to the next screen.

10. In the unoccupied **Setback (SbK^{x})** screen, press ▲ or ▼ to select the temperature or humidity setback value that is added to the Relay ON value and Relay OFF values during unoccupied times (Figure 28). The setback may be a positive or negative value. The occupied and unoccupied times are set up in the system's weekly occupied/unoccupied schedule. To use the Setback feature in your control system, you must also set up the time and day of week. See *Setting Time and Day* on page 66. For a weekly occupied/unoccupied schedule, see *Setting up an Occupied/Unoccupied Schedule* on page 67. Press ▶ to save the Unoccupied Setback value and go to the next screen.



Description:
In this example, occupied mode is controlled by the parameters entered on the OUTR1 Relay Output Setup screen (see Figure 28). When Sn-2 climbs to 78°F, OUTR1 turns ON and remains ON until the temperature falls to 75°F.
The parameters entered in the schedule, along with the current time, determine the occupied/unoccupied mode. As shown, Day 1 OC-1 (Occupied) is set to 8:00 AM and UN-1 (Unoccupied) is set to 8:00 PM. These same parameters are entered for each day of the 7 day schedule. The SbK1 parameter is set to 4°F as indicated in Figure 28. During occupied time from 8:00 AM to 8:00 PM, zone temperature ON and OFF points are 78°F and 75°F (respectively). During unoccupied time, zone temperature ON and OFF points are 82°F and 79°F (respectively).



Summary of UI Setup Screens:

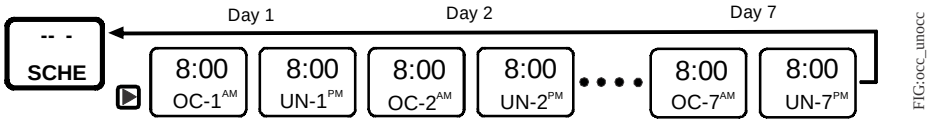


Figure 28: Occupied and Unoccupied Modes Example

11. In the **Sensor Failure Mode (SNF^{x})** screen, press ▲ or ▼ to select whether the output relay stays on or off when a sensor failure is detected. Press ▶ to save the Sensor Failure Mode value and go to the next screen.
12. In the **Edit Sensor (SENS^{x})** screen:
    - If the displayed sensor (Sn-1, Sn-2, or Sn-3) is the correct sensor for the output relay, the output setup is complete. Press ▶ to go to the Relay Output Setup Start screen.

- If the displayed sensor (Sn-1, Sn-2, or Sn-3) is not the correct sensor for the output relay, press ▲ or ▼ to select the correct sensor. Press ▶ to save the new sensor selection and go to the Relay Output Setup Start screen. Press ▶ again to go to the Relay ON Value screen and repeat Step 5 through Step 12 for the new sensor.

The relay output with setback is set up and saved in the reset control module. To navigate to the next Output Setup Start screen, press M. If you have completed the control system setup, press ▲ and ▼ simultaneously to return to the Main screens.

Setting up an Analog Output with Unoccupied Setback

System 450 reset control modules allow you to set up a standard analog output to provide proportional analog control signals to controlled equipment based on the sensed conditions and enable an unoccupied Setback (SbK) value, unoccupied time of days and days of week.

When you supply power to a module assembly, the control module polls all of the connected modules, detects any analog outputs, and then assigns an output number and enables an **Analog Output Setup Start** screen for each analog output detected. See *Analog Outputs* on page 18 for more information.

Note: The condition (temperature 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 2 on page 15 for more information on sensors for reset control modules, Sensor Types, and their associated values and ranges.

The **Setpoint (SP^{x})** and **End Point (EP^{x})** screens allow you to set up a proportional band (or throttling range) for the control loops in your controlled system. The **Output at Setpoint (OSP^{x})** and **Output at End Point (OEP^{x})** screens 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 *Direct and Reverse Control Actions for Analog Outputs* on page 19 for more information.

The unoccupied **Setback (SbK^{x})** screen allows you to specify a positive or negative value that is added to the Setpoint value during the unoccupied period to provide for energy savings. The unoccupied Setback value (SP + SbK and EP + SbK) is referenced during all scheduled unoccupied times.

To use the Setback feature in your control system, you must also set up the time and day of week. See *Setting Time and Day* on page 66. For a weekly occupied/unoccupied schedule, see *Setting up an Occupied/Unoccupied Schedule* on page 67.

The **Integration Constant (I-C^{x})** screen 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 on page 21* for more information.

The **Sensor Failure Mode (SNF^{x})** screen allows you to select whether the analog output signal goes to the ON or OFF value when a failure of the referenced sensor is detected. An analog output's SNF ON value = the selected OEP value. The SNF OFF value = the selected OSP value.

To set up a standard analog output with unoccupied setback:

1. Power the reset control module assembly On.
2. Press and hold ▲ and ▼ simultaneously for 5 seconds. The **Sensor Setup Start (SENS^{x})** screen appears.
3. Press M repeatedly to go to the **Analog Output Setup Start (OUTA^{x})** screen (Figure 29).

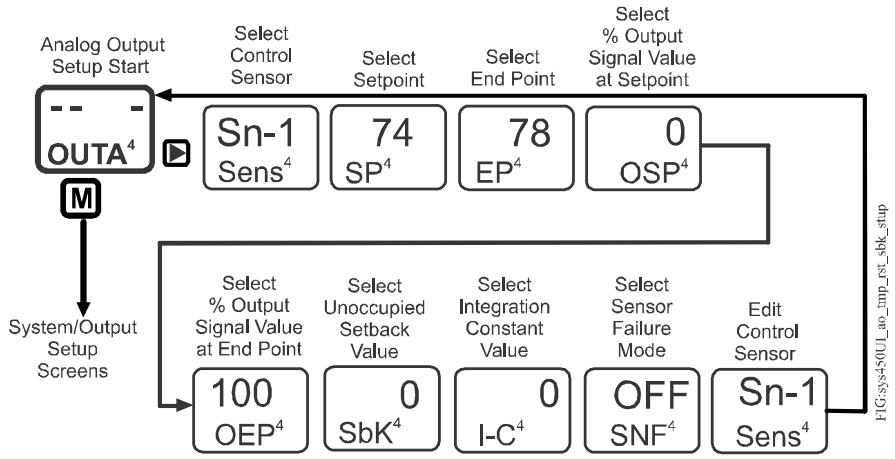


Figure 29: Analog Output with Unoccupied Setback Setup Screens

4. In the **Analog Output Setup Start (OUTA^{x})** screen, press ▶. The Select Sensor (SENS) screen does not appear if an sensor is already selected. If already selected, go to Step 6.
5. In the **Select Sensor (SENS^{x})** screen, press ▲ or ▼ to select Sn-x. Press ▶ to save the sensor selection and go to the next screen.
6. In the **Select Setpoint (SP^{x})** screen, press ▲ or ▼ to select the control setpoint for OUTA-x. Press ▶ to save the setpoint value and go to the next screen.
7. In the **Select End Point (EP^{x})** screen, press ▲ or ▼ to select the desired End Point value. Press ▶ to save the End Point value and go to the next screen.

8. In the Select **Output Signal Strength at Setpoint (OSP^{x})** screen, press ▲ or ▼ 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 ▶ to save the OSP value and go to the next screen.

9. In the **Select Output Signal Strength at End Point (OEP^{x})** screen, press ▲ or ▼ 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 ▶ to save the OEP value and go to the next screen.

10. In the unoccupied **Setback Temperature (SbK^{x})** screen, press ▲ or ▼ to select the temperature or humidity setback value that is added to the SP value (SP+SbK) and EP value (EP+SbK) to calculate a setback proportional band that this output references during the unoccupied times. The occupied and unoccupied times are set up in the system's weekly occupied/unoccupied schedule. Press ▶ to save the Unoccupied Setback value and go to the next screen.

11. In the **Integration Constant (I-C^{x})** screen, press ▲ or ▼ to select an integration constant to provide proportional plus integral control for the analog output. Initially, select the I-C value of 0 (zero) for no integration constant. Press ▶ to save the integration constant and go to the next screen.

12. In the **Sensor Failure Mode (SNF^{x})** screen, press ▲ or ▼ to select whether the analog output signal is set to its ON or OFF value when a sensor failure is detected. The ON value is the OEP value. The OFF value is the OSP value. Press ▶ to save the sensor failure mode value and go to the next screen. See *Sensor Failure Mode* on page 27 for more information.

13. In the **Edit Sensor Selection (SENS^{x})** screen, press ▲ or ▼ to change the sensor that this output references (only if required). Then press ▶ to go to the output's setup start screen.

    Note: If you change the sensor that an output references to a sensor that has a different Sensor Type, the setup values for the output also change, which requires you to set up the output again with the new values.

The analog output with reset control is set up and saved in the reset control module. To navigate to the next Output Setup Start screen, press M. If you have completed the control system setup, press ▲ and ▼ simultaneously to return to the Main screens.

Note: If the TIME and SCHE Setup screens are set up for an unoccupied schedule, the setback value (SbK value selected in the Reset Setpoint Setup screens) and the unoccupied schedule is enforced on all relay and analog outputs that reference the Reset Setpoint (rES) sensor.

Setting up a Relay Output with Reset Control and Unoccupied Setback

System 450 reset control modules allow you to set up outputs controlled by a temperature or humidity reset setpoint. See *Temperature or Humidity Reset Setpoint* on page 22 for information on setting up the Reset Setpoint on System 450 reset control modules.

Relay outputs with reset control reference the Reset Setpoint to control the on/off output signal. In cases where the offset (OSET) is 0 at the Reset Setpoint value, the output relay is On. The output relay turns off at the Reset Setpoint plus the Differential from Reset Setpoint value.

To set up a relay output with temperature reset control and unoccupied setback:

1. Power the reset control module assembly On.
2. Press and hold ▲ and ▼ simultaneously for 5 seconds. The **Sensor Setup Start** screen appears.
3. Press M repeatedly to go to an **Relay Output Setup Start (OUTR^{x})** screen (Figure 30).

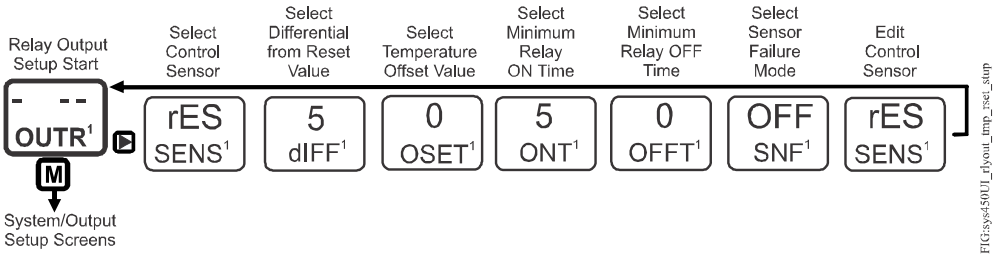


Figure 30: Relay Output with Temperature Reset Control Setup Screens

4. In the **Relay Output Setup Start (OUTR^{x})** screen, press ▶. The Select Sensor (SENS) screen does not appear if a sensor is already selected. If already selected, go to Step 6.
5. In the **Select Sensor (SENS^{x})** screen, press ▲ or ▼ to select **rES** to enable reset control. Press ▶ to save the **rES** selection and go to the next screen.
6. In the **Select Differential from Reset Setpoint (dIFF^{x})** screen, press ▲ or ▼ to scroll to and select the desired differential from the reset setpoint. Press ▶ to save the differential value and go to the next screen.

   Note: The Differential from Reset Setpoint value defines the range between relay on and relay off. The differential from RSP can be a positive or negative value. A positive differential provides direct acting control, whereas a negative differential provides reverse acting control. See *Reset Control Modes of Operation* on page 24 for examples.
7. In the **Select Temperature Offset (OSET^{x})** screen, press ▲ or ▼ to scroll to and select the desired temperature (only) offset value. Press ▶ to save the temperature offset value and go to the next screen.

Note: The temperature offset value is applied to the entire RSP range (RSP through differential from RSP value).

8. In the **Select Minimum Relay ON Time (ONT^{x})** screen, press ▲ or ▼ to select the minimum number of seconds that the relay stays on after the Relay ON value is reached. Press ▶ to save the minimum On-time value and go to the next screen.
9. In the **Select Minimum Relay OFF Time (OFFT^{x})** screen, press ▲ or ▼ to select the minimum number of seconds that the relay stays off after the Relay OFF value is reached. Press ▶ to save the minimum OFF-Time value and go to the next screen.
10. In the **Select Sensor Failure Mode (SNF^{x})** screen, press ▲ or ▼ to select whether the output relay stays on or off when a sensor failure is detected. Press ▶ to save the Sensor Failure Mode value and go to the next screen.
11. In the **Edit Sensor (SENS^{x})** screen:
    - If the displayed sensor is **rES**, the output setup is complete. Press ▶ to go to the Relay Output Setup Start screen.
    - If the displayed sensor is not **rES**, press ▲ or ▼ to select **rES**. Press ▶ to save the new rES sensor selection and go to the Relay Output Setup Start screen. Press ▶ again to go to the Select Sensor screen and repeat Step 5 through Step 11 for the new rES sensor.

The relay output with reset is set up and saved in the reset control module. To navigate to the next Output Setup Start screen, press M. If you have completed the control system setup, press ▲ and ▼ simultaneously to return to the Main screens.

Note: If the TIME and SCHE Setup screens are set up for an unoccupied schedule, the setback value (SbK value selected in the Reset Setpoint Setup screens) and the unoccupied schedule is enforced on all relay and analog outputs that reference the Reset Setpoint (rES) sensor.

Setting up an Analog Output with Reset Control and Unoccupied Setback

System 450 reset control modules allow you to set up analog outputs controlled by a reset setpoint. See *Temperature or Humidity Reset Setpoint* on page 22 for information on setting up the RSP and rES on System 450 reset control modules.

Analog outputs with reset control reference the rES and RSP to control the output signal strength.

To set up an analog output with temperature reset control and unoccupied setback:

1. Power the reset control module assembly On.
2. Press and hold ▲ and ▼ simultaneously for 5 seconds. The **Sensor Setup Start (SENS^{x})** screen appears.

3. Press M repeatedly to go to the **Analog Output Setup Start (OUTA^{x})** screen (Figure 31).

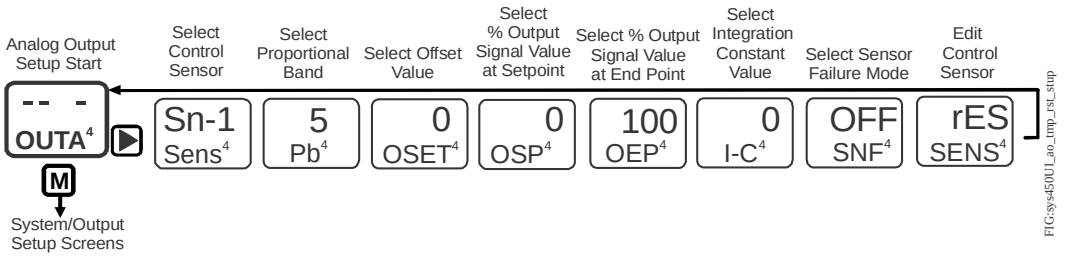


Figure 31: Analog Output with Temperature Reset Control Setup Screens

4. In the **Analog Output Setup Start (OUTA^{x})** screen, press ▶. The Select Sensor (SENS) screen does not appear if an sensor is already selected. If already selected, go to Step 6.
5. In the **Select Sensor (SENS^{x})** screen, press ▲ several times to select rES to enable reset control. Press ▶ to save the sensor selection and go to the next screen.
6. In the **Select Proportional Band (Pb^{x})** screen, press ▲ or ▼ to select the proportional band for the sensor. Press ▶ to save the value and go to the next screen.
7. In the **Select Temperature Offset (OSET^{x})** screen, press ▲ or ▼ to select the desired temperature (only) offset value. Press ▶ to save the temperature offset value and go to the next screen.
8. In the **Select Output Signal Strength at Setpoint (OSP^{x})** screen, press ▲ or ▼ to select the strength of the signal that the output generates when the sensed condition is at its setpoint (RSP + OSET^{x}). The signal strength range is 0 to 100 (%). Press ▶ to save the percentage value and go to the next screen.
9. In the **Select Output Signal Strength at End Point (OEP^{x})** screen, press ▲ or ▼ to select the strength of the signal that the output generates when the sensed condition is at its End Point value (RSP + Pb^{x} + OSET^{x}). The signal strength range is 0 to 100 (%). Press ▶ to save the percentage value and go to the next screen.
10. In the **Select Integration Constant (I-C^{x})** screen, press ▲ or ▼ to select an integration constant to provide proportional plus integral control for the analog output. Initially, select the I-C value of 0 (zero) for no integration constant. Press ▶ to save the integration constant and go to the next screen.
11. In the **Select Sensor Failure Mode (SNF^{x})** screen, press ▲ or ▼ to select whether the analog output signal is to be set to its ON or OFF value when a sensor failure is detected. The ON value is the OEP value. The OFF value is the OSP value. Press ▶ to save the sensor failure mode value and go to the next screen.

12. In the **Select Edit Sensor Selection (SENS^{x})** screen, press ▲ or ▼ to change the sensor that this output references (only if required). Then press ▶ to go to the output's setup start screen.

    Note: If you change the sensor that an output references to a sensor that has a different Sensor Type, the setup values for the output also change, which requires you to set up the output again with the new values.

The analog output with reset control is set up and saved in the reset control module. To navigate to the next Output Setup Start screen, press M. If you have completed the control system setup, press ▲ and ▼ simultaneously to return to the Main screens.

Note: If the TIME and SCHE Setup screens are set up for an unoccupied schedule, the setback value (SbK value selected in the Reset Setpoint Setup screens) and the unoccupied schedule is enforced on all relay and analog outputs that reference the Reset Setpoint (rES) sensor.

Setting Time and Day

System 450 reset control modules include a real-time clock that allows you to control outputs based on time of day and day of week. A typical control scenario enables a setback temperature (or humidity) based on the time or day when the controlled space is occupied and unoccupied. Before you can set up an occupied/unoccupied schedule, you must set the real time clock to the proper time and day of week.

To set the current time and day on a System 450 reset control module:

1. Power the reset control module assembly On.
2. Press and hold ▲ and ▼ simultaneously for 5 seconds. The **Sensor Setup Start (SENS^{x})** screen appears.
3. Press M repeatedly until the **Time and Day Setup Start (TIME)** screen appears (Figure 32).

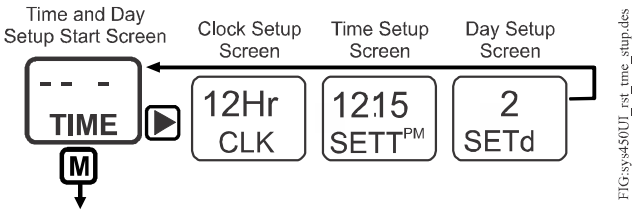


Figure 32: Reset Control's Time and Day Setup Screens

4. In the **Time and Day Setup Start (TIME)** screen, press ▶ to go to the next screen.
5. In the **Clock Setup (CLK)** screen, press:
   - ▲ to select the 24-hour clock display
   - ▼ to select the 12-hour (AM/PM) clock display

6. Press ▶ to save your Clock Setup selection and go to the next screen.
7. In the **Set Time (SETT^{XM})** screen, press ▲ or ▼ repeatedly to scroll (in 1-minute increments) to the desired time of day setting.

   Note: Pressing and holding ▲ or ▼ allows you to scroll through the time values in 15-minute increments.
8. Press ▶ to save your time of day selection and go to the next screen.
9. In the **Set Day (SETd)** screen, press ▲ or ▼ repeatedly to scroll to the desired day value.

   Note: A **Set Day** value of 1 is Monday, 2 is Tuesday, 3 is Wednesday, and so on to 7, which is the **Set Day** value for Sunday.
10. Press ▶ to save your **Set Day** selection and return to the **Time and Day Setup Start (TIME)** screen.

Setting up an Occupied/Unoccupied Schedule

System 450 reset control modules allow you to enable a temperature or humidity setback value according to an occupied/unoccupied schedule on some or all of the outputs in your reset control system. To specify setback for a heating system, enter a **negative** number for SbK. To specify setup for a cooling system, enter a **positive** number for SbK.

You can set up a weekly occupied/unoccupied schedule by setting up an occupied and unoccupied time for each day of the week. (1 = Monday, 2 = Tuesday, and so on to 7 = Sunday.) Occupied/unoccupied times are set in 15-minute increments.

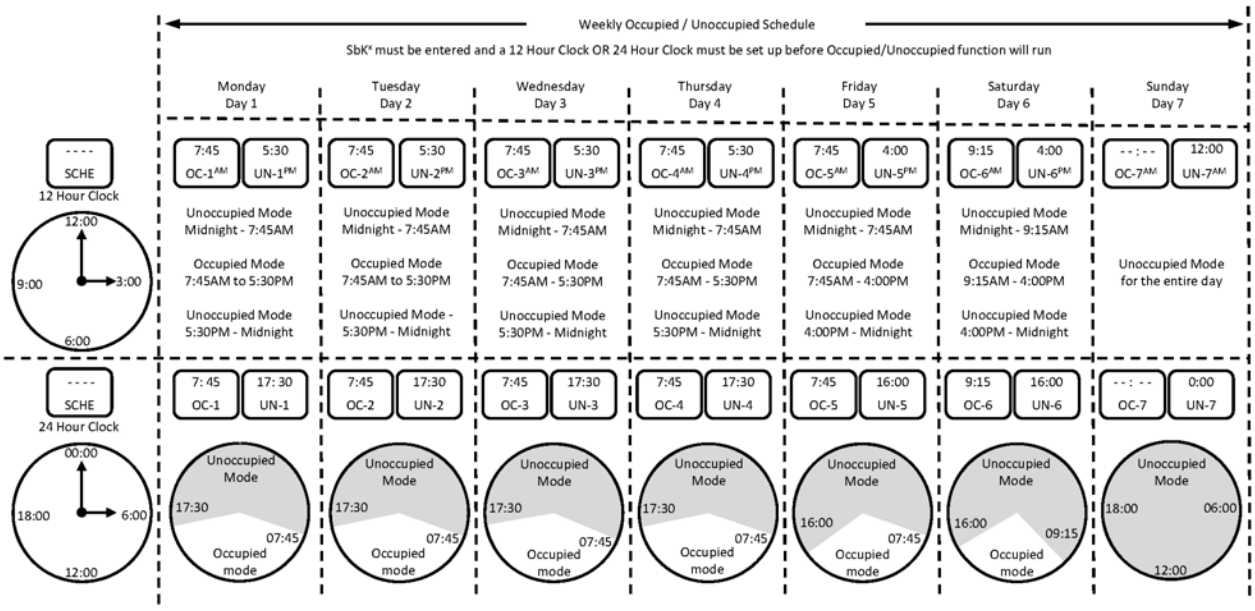


Figure 33: Example System 450 Weekly Occupied/Unoccupied Schedule Showing Occupied and Unoccupied Setup Values (12 Hr or 24 Hr)

Occupied/Unoccupied Setback Modes

Relay Output That References a Sensor

See Figure 27 on page 58. During the occupied time, ON = 78°F (25.5°C) and OFF = 75°F (24°C). During the unoccupied times with SbK = 4F° (2C°), ON changes from 78°F (25.5°C) to 82°F (27.5°C), and OFF changes from 75°F (24°C) to 79°F (26°C).

Analog Output That References a Sensor

See Figure 29 on page 61. During the occupied time, SP = 74°F (23.5°C) and EP = 78°F (25.5°C). During the unoccupied times with SbK = 5F° (2.5C°), the SP changes from 74°F (23.5°C) to 79°F (26°C), and EP changes from 78°F (25.5°C) to 83°F (28°C).

Relay Output and Analog Output That References RSP

See Figure 24 on page 54 and Figure 25 on page 53. During the occupied time, the RSP is calculated as shown. See Figure 34; during the unoccupied time with the SbK = -15F° (-8.5C°), the water supply RSP temperature decreases by 15F° (8.5C°).

Multi-stage Cooling That References RSP and Load Balancing Is Set to One

See Figure 8 on page 25. During the occupied time, the RSP = 72°F (22.5°C). During the unoccupied times with SbK = 4F° (2C°), the RSP changes from 72°F (22.5°C) to 76°F (24.5°C). The load balancing feature is not affected in its function as a result of Occupied/Unoccupied modes.

Multi-stage Cooling That References RSP and Load Balancing Is Set to One

See Figure 9 on page 26. During the occupied times, the RSP = 148°F (64.5°C). During the unoccupied times with SbK = -10F° (-5.5C°), the RSP is setback from 148°F (64.5°C) to 138°F (59°C). The load balancing feature is not affected as a result of Occupied/Unoccupied modes.

When you set up an Occupied/Unoccupied schedule on System 450 reset control system, the outputs respond as follows:

- During an **Occupied** time mode of operation, the outputs are controlled according to the setup values entered for the output (for example, ON, OFF, RSP, dIFF, OSET).
- During an **Unoccupied** time mode of operation:
  - On a standard controller with relay and analog outputs, the setback value (SbK^x) entered for each output is added to the relay output ON and OFF values, or added to the analog output Setpoint (SP) and End Point (EP) values. The UI does not show these new calculated unoccupied values.
  - On a reset control system with relay and analog outputs, the setback value (SbK^x) entered in the RSET Setup Start screen is added to the calculated RSP to create the new calculated RSP, which includes the setback value.

Note: The RSP with added setback cannot go below MNSP or above MXSP. See Figure 34.

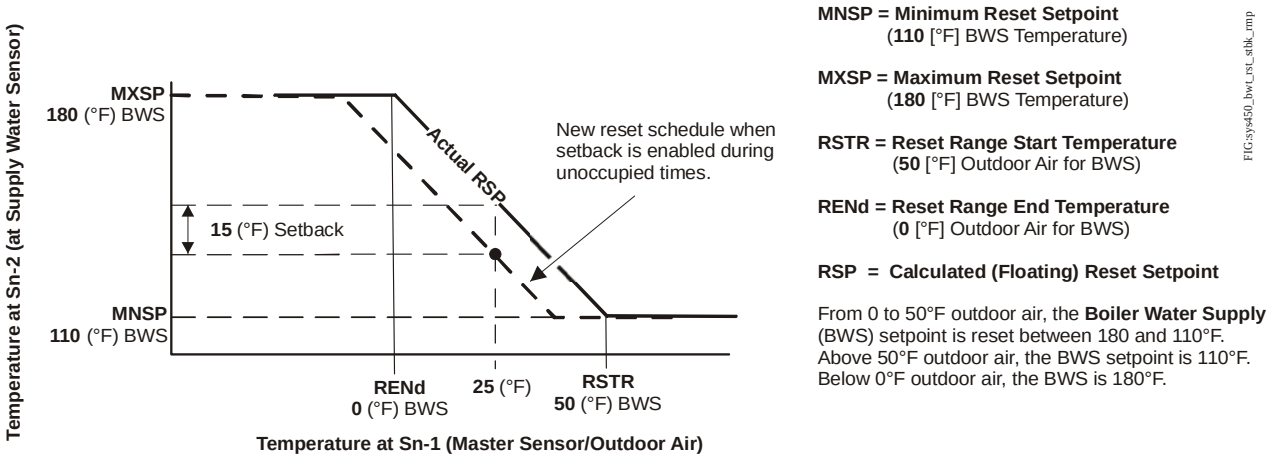


Figure 34: Boiler Water Supply Reset Setpoint with a 15°F Setback

Note: A negative Setback Temperature (SbK) value subtracts from the ON and OFF values and functions as an unoccupied setback condition in heating mode. A positive Setback Temperature (SbK) value adds to the ON and OFF values and functions as an unoccupied setup condition in the cooling mode. In addition, the unoccupied setback value is subtracted from or is added to the calculated RSP value to create an Unoccupied RSP, which is displayed as the RSP value in the UI during scheduled unoccupied times.

Note: To enable the occupied/unoccupied control function for an output, you need to set up an occupied/unoccupied schedule and enter a Setback value (other than 0) for the output. If you do not enter a positive or negative Setback (SbK) value for an output (default is 0), the output controls its signal according to the occupied setting values during both the occupied and unoccupied time periods.

When you set up an Occupied/Unoccupied schedule, consider the following:

- Typically, Day-1 represents Monday, Day-2 represents Tuesday, Day-3 is Wednesday, and so on to Day-7, which represents Sunday (in a typical weekly schedule).
- Occupied/unoccupied time intervals are 15 minutes apart. Press ▲ or ▼ repeatedly to scroll through the time of day in 15-minute intervals. You can also press and hold ▲ or ▼ to quickly scroll through the time of day intervals.
- If an entire day needs to be unoccupied, set OC-x to -- and set UN-x to **12:00 AM** or **0:00** (where x is the day number). If the entire day needs to be occupied, set OC-x to **12:00 AM** or **0:00** and set UN-x to --.

  Note: If OC-x time = UN-x time, then the entire day is set as occupied.

To set up an occupied/unoccupied schedule:

1. Power the reset control module assembly On.

2. Press and hold ▲ and ▼ simultaneously for 5 seconds. The **Sensor Setup Start (SENS)** screen appears.
3. Press M repeatedly until the **Schedule Setup Start (SCHE)** screen appears.

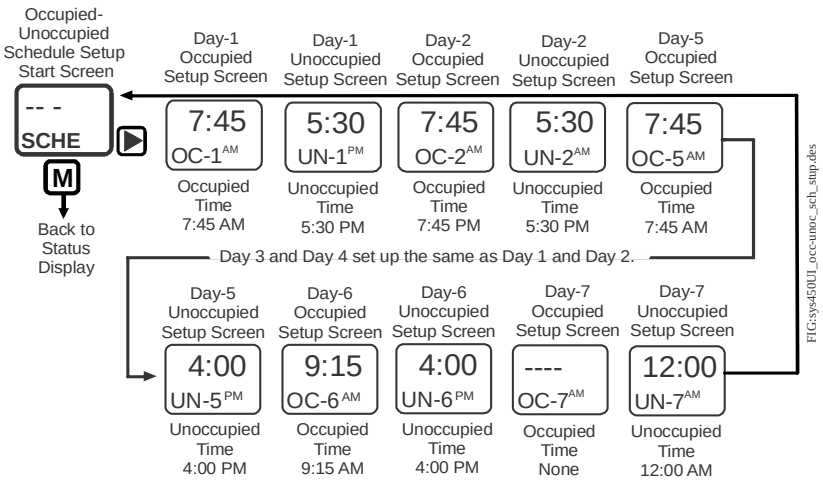


Figure 35: Example of Weekly Occupied/Unoccupied Schedule Setup Screens

4. In the **Schedule Setup Start (SCHE)** screen, press ▶ to go to the next screen.
5. In the **Day-1 Occupied Time (OC-1^{xM})** screen, press ▲ or ▼ to scroll to and select the occupied start time for the Day-1 of the week. Then press ▶ to save the occupied time and go to the next screen.
6. In the **Day-1 Unoccupied Time (UN-1^{xM})** screen, press ▲ or ▼ to scroll to and select the unoccupied start time for the Day-1 of the week. Then press ▶ to save the unoccupied time and go to the next screen.
7. In the **Day-2 Occupied Time (OC-2^{xM})** screen, press ▲ or ▼ to scroll to and select the occupied start time for the Day-1 of the week. Then press ▶ to save the occupied time and go to the next screen.
8. In the **Day-2 Unoccupied Time (UN-2^{xM})** screen, press ▲ or ▼ to scroll to and select the unoccupied start time for the Day-1 of the week. Then press ▶ to save the unoccupied time and go to the Day-2 Occupied Time screen.
9. Repeat Step 7 and Step 8 for the remaining 5 days of the week, until you return to the Schedule Setup Start screen.
10. Press M to return to the Status Display screen.

The weekly occupied/unoccupied schedule for your System 450 control system is entered and saved.

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* on page 21 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

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.

To 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 on under typical/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.

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

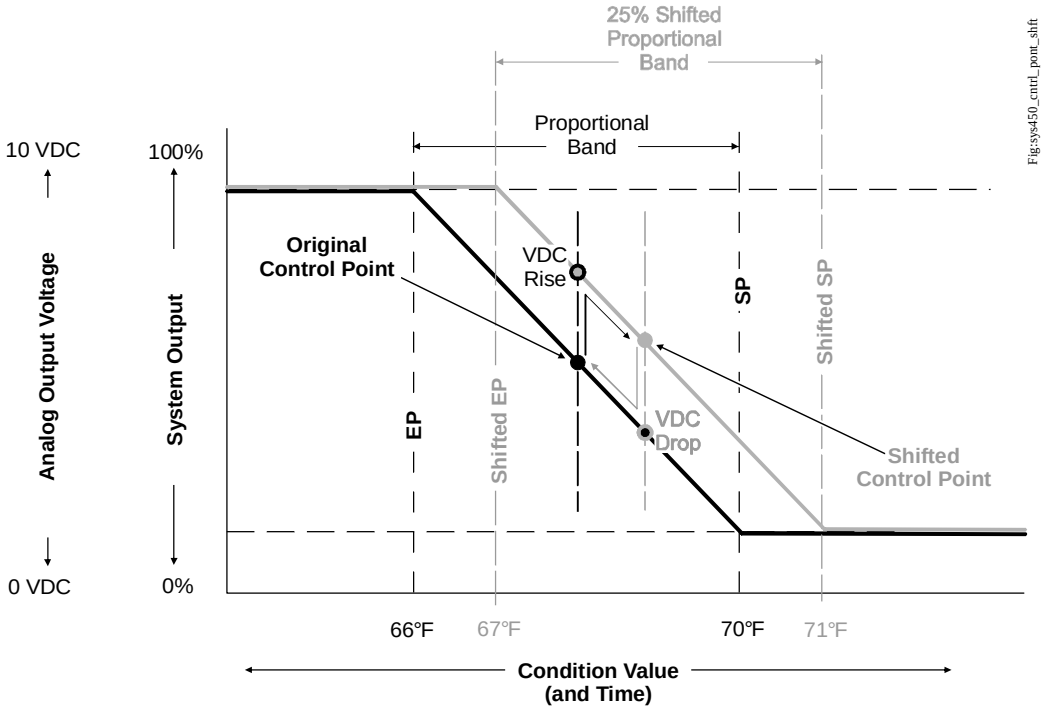
Another method for determining the best I-C setting for a System 450 control loop is to temporarily create a step change that shifts the proportional band in your controlled system away from the original/desired proportional band. To do so, measure the (first response) time it takes for your controlled 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.

To 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).

Note: 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 36.



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.

Figure 36: Graph Showing Temporary Proportional Band and Control Point Shifts Used to Measure Response Time in a Heating Application

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 6: 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)

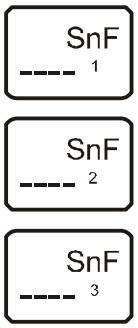
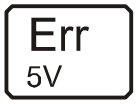
8. Set the integration constant to the determined I-C setting. Operate and observe the controlled system at a variety of load conditions to determine if the system is stable at the determined I-C setting over the entire output range of the controlled system.

Troubleshooting System 450 Control Systems

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

Table 7 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 7: System 450 Control System 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 8 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 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 8 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 8: 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 (1,000 ohm at 70°F) Temperature Sensors	0.24 to 0.67 VDC (-40°F to 250°F)
HE-67xx Humidity Sensor	0.25 to 4.75 VDC (from 5% to 95% RH)

Repair and Ordering Information

Table 9 provides ordering information for the System 450 Series modules that can be used to build reset control systems. See *Technical Specifications* on page 78 for detailed product specifications for the control modules listed in Table 9.

Table 10 and Table 11 provides ordering information for the System 450 compatible sensors. For more information on installing System 450 compatible sensors, see *Related Documentation* on page 5.

Table 9: System 450 Modules and Accessories Ordering Information

Product Code Number	Product Description
C450RBN-3C	Reset Control Module with LCD, Four-Button Touchpad UI, and SPDT relay output; provides one SPDT output relay.
C450RCN-3C	Reset Control Module with LCD, Four-Button Touchpad UI, and SPDT relay output; provides two SPDT output relays.
C450SBN-3C	Relay Output Expansion Module; provides one SPDT line-voltage relay output.
C450SCN-3C	Relay Output Expansion Module; provides two SPDT line-voltage relay outputs.
C450SPN-1C	Analog Output Expansion Module; provides one analog output (0–10 VDC or 4–20 mA self-selecting signal) for proportional control.
C450SQN-1C	Analog Output Expansion Module; provides two analog outputs (0–10 VDC or 4–20 mA self-selecting signals) for proportional control.
C450YNN-1C	Power Module; provides 24 V to System 450 Module Assembly; 120 VAC or 240 VAC supply power input terminals.
BKT287-1R	DIN Rail; 0.30 m (12 in.) long
BKT287-2R	DIN Rail; 1 m (39-1/3 in.) long
BKT287-3R	DIN Rail; 0.61 m (24 in.) long
BKT287-4R	DIN Rail; 0.36 m (14 in.) 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 10: 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)
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)* on the Johnson Controls® Product Literature web site for more information.

Table 11: System 450 Compatible HE67S3 Type Humidity Sensors with Integral A99B Temperature Sensor Ordering Information[1]

Product Code Number	Product Description
HE-67S3-0N0BT	Wall Mount Humidity Sensor with A99B Type Temperature Sensor: 10 to 90% RH; 0 to 60°C (32 to 140°F)
HE-67S3-0N00P	Duct Mount Humidity Sensor with A99B Type Temperature Sensor: 10 to 90% RH; 0 to 60°C (32 to 140°F)

1. The HE-67S3 sensors require 24 VAC input and must use the 0–5 VDC output. Refer to the *TrueRH Series HE-67xx Humidity Element with Temperature Sensors Product Bulletin (LIT-216245)* on the Johnson Controls Product Literature website for more information, including technical specifications and mounting accessories.

Technical Specifications

C450RBN-3C and C450RCN-3C Reset Control Modules with Real-Time Clock and Relay Output

Product	C450RBN-3C and C450RCN-3C: System 450 Reset Control Module models are sensing controls and operating controls with LCD, four-button touchpad, and SPDT relay output C450RBN-3C: Control Module with one SPDT output relay C450RCN-3C: Control Module with two SPDT output relays
Power Consumption	C450RBN-3C: 0.9 VA maximum C450RCN-3C: 1.3 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)
Input Signal	0–5 VDC for humidity sensors 1,035 ohm at 25°C (77°F) for A99 PTC temperature sensors
Output Relay Contacts	**General:** 1/2 HP at 120/240 VAC, SPDT **Specific:** AC Motor Ratings — 120 VAC — 208/240 VAC AC Full-load Amperes: 9.8 A 4.9 A AC Locked-Rotor Amperes: 58.8 A 29.4 A 10 Amperes AC Non-inductive at 24/240 VAC Pilot Duty: 125 VA at 24/240 VAC
Clock Accuracy	±4 minutes per year
Clock Backup Power	12 hours (capacitor reserve)
Setback Events	One occupied and one unoccupied event per day; 7 day schedule
Analog Input Accuracy	**Resolution:** 14 bit
Control Construction	Independently mounted control, surface mounted with Lexan® 950 enclosure suitable for DIN rail mounting or direct mounting to a hard, even surface.

C450RBN-3C and C450RCN-3C Reset Control Modules with Real-Time Clock and Relay Output (Continued)

Dimensions (H x W x D)	127 x 61 x 61 mm (5 x 2-3/8 x 2-3/8 in.)
Weight	C450RBN-3C: 209 g (0.46 lb) C450RCN-3C: 222 g (0.49 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, Inc. 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)

C450SPN-1C and C450SQN-1C Expansion Modules with Analog Output

Product	C450SPN-1C: System 450 Expansion Module with one Analog output C450SQN-1C: System 450 Expansion Module with two Analog outputs
Power Consumption	C450SPN-1C: 1.1 VA maximum using 0–10 V out; 1.3 VA maximum using 4–20 mA out C450SQN-1C: 1.8 VA maximum 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.

C450SPN-1C and C450SQN-1C Expansion Modules with Analog Output

Dimensions (H x W x D)	127 x 61 x 61 mm (5 x 2-3/8 x 2-3/8 in.)
Weight	C450SPN-1C: 150 g (0.33 lb) C450SQN-1C: 150 g (0.33 lb)
Compliance CE	**North America:** cULus Listed; UL 60730, File E27734, Vol. 1; FCC Compliant to CFR47, Part 15, Subpart B, Class B Industry Canada (IC) Compliant to Canadian ICES-003, Class B limits
	Europe: CE Mark - Johnson Controls, Inc., declares that this product is in compliance with the essential requirements and other relevant provisions of the Low Voltage Directive and the EMC Directive.
	Australia: Mark: C-Tick Compliant (N1813)

C450SBN-3C and C450SCN-3C Expansion Modules with Relay Output

Product	C450SBN-3C: System 450 Expansion Module with one SPDT output relay C450SCN-3C: System 450 Expansion Module with two SPDT output relays
Power Consumption	C450SBN-3C: 0.8 VA maximum C450SCN-3C: 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)
Output Relay Contacts	**General:** 1/2 HP at 120/240 VAC, SPDT
	Specific: AC Motor Ratings — 120 VAC — 208/240 VAC AC Full-Load Amperes: 9.8 A 4.9 A AC Locked-Rotor Amperes: 58.8 A 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-3C: 172 g (0.38 lb) C450SCN-3C: 186 g (0.41 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, Inc. 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)

C450YNN-1C Power Supply Module

Product	C450YNN-1C: System 450 Power Supply Module; 120 or 240 VAC stepdown to 24 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)
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, Inc. 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, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.

United States Emissions Compliance

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

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

Canadian Emissions Compliance

This Class (B) digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la Classe (B) respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

System 450 Glossary of Terms

Term	Definition
°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* on page 42 and *System 450 Compatible Sensors* on page 14 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* on page 42 and *System 450 Compatible Sensors* on page 14 for more information.
Active Sensors	Three-wire input sensors that require a low-voltage power source to generate their input signal. Active sensors are hard-wired 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. You must set the associated active/passive jumper or DIP switch to the active position for each active sensor that is hard wired to the sensor terminals. See *Active and Passive Sensors* on page 15 for more information.
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* on page 18, *Setting up an Analog Output* on page 50, and *Viewing the System Status Screens* on page 43 for more information.
bAL	In the Load Balancing Setup (bAL) screen in the Reset Setpoint Sensor Setup screens, select ON to activate the Load Balancing feature. See the Term *Load Balancing* for more information. The Load Balancing feature is available only on Reset Control systems and only for outputs that reference the Reset Setpoint (RSP). Load Balancing equalizes the run time between the outputs that control equipment and staged control applications. See *Load Balancing* on page 27 and *Setting up the Reset Setpoint* on page 53 for more information.

Term	Definition
CLK	In the Clock Setup (CLK) screen in the Time and Day Setup screens, select whether to display time of day in a 12-hour (12HR) or 24-hour (24HR) format. A real-time clock and the Time and Day features are only available on reset control modules. See *Setting Time and Day* on page 66 for more information.
Communications Control Module	Provide network connectivity and communications with other network devices. Depending on the control module, System 450 can connect and communicate on RS485 Modbus networks or Ethernet networks. Communications control modules include the C450CRN-x and C450CEN-x models. Refer to the *System 450 Series Modular Control Systems with Communications Control Modules Technical Bulletin (LIT-12011826)* for more information.
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* on page 10 and *Repair and Ordering Information* on page 76 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* on page 19 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* on page 19 for more information.
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* on page 13 and *Repair and Ordering Information* on page 76 for more information.

Term	Definition
Functional Sensor	In addition to the wide variety of System 450 compatible hard-wired temperature and humidity sensors available, the System 450 reset control firmware also enables an rES functional sensor based on the input from Sn1 in your control system. Functional sensors include the Reset Setpoint sensor (rES), which enables reset control, setback control, and load balancing. 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 Reset Sensor (rES)* on page 16 for more information.
Hybrid Analog Output Control Module	A control module with hybrid analog output provides an analog output on which you can set up a pulse region to control very low speeds on variable speed EC motors. The hybrid analog output control module provides many of the same control types and features as standard control modules. Differential control is not available on hybrid analog output control modules. Refer to the *System 450 Series Modular Control Systems with Standard Control Modules Technical Bulletin (LIT-12011459)* 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 7 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* on page 21 and *Determining the Integration Constant for an Analog Output* on page 71 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* on page 21 and *Determining the Integration Constant for an Analog Output* on page 71 for more information.
Load Balancing	Equalizes the runtimes of staged equipment in multi-staged temperature (or humidity) Reset Control applications. You can activate the Load Balancing feature when you set up the Reset Setpoint Sensor (rES) in the UI. When activated, the Load Balancing feature automatically selects the output with the least amount of runtime for the first (or next) stage to turn on in response to a load increase. See *Load Balancing* on page 27 and *Setting up the Reset Setpoint* on page 53 for more information.

Term	Definition
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 reset sensor and the Time screen, when the Time parameters are set up. From the Main screens, press ▶ (repeatedly) to manually scroll through the sensor status and output status screens. From the Main screens, press and hold ▲ and ▼ simultaneously for 5 seconds to go to the System Setup screens. See *Accessing and Navigating the User Interface* on page 42 and *Viewing the System Status Screens* on page 43 for more information.
Master Sensor	A temperature sensor (typically, an outdoor/ambient air sensor) connected to the Sn1 and a Common (C) terminals on the low-voltage input sensor terminal blocks and identified as the Sn-1 sensor in the System 450 UI. When a reset control application is set up, the temperature sensed at the master sensor determines the calculated Reset Setpoint (RSP). See *System 450 Reset Control Modules* on page 9 and *Temperature or Humidity Reset Setpoint* on page 22 for more information.
MNSP	In the Minimum Setpoint Selection (MNSP) screen in the Reset Setpoint Setup screens, select the minimum temperature (or % humidity) value that the medium in the controlled loop or process must stay above. MNSP is the minimum RSP value available for the reset control loop. The Reset Setpoint (RSP) value floats between the MNSP value and the Maximum Setpoint (MXSP) value, dependent on the master sensor input and the RSTR and RENd values. See *Setting up the Reset Setpoint* on page 53 for more information.
MXSP	In the Maximum Setpoint Selection (MXSP) screen in the Reset Setpoint Setup screens, select the maximum temperature (or % humidity) value that the medium in the controlled loop or process must stay below. MXSP is the maximum RSP value available for the reset control loop. The Reset Setpoint (RSP) value floats between the MXSP value and the Minimum Setpoint (MNSP) value, dependent on the master sensor input and the RENd and RSTR values. See *Setting up the Reset Setpoint* on page 53 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* on page 16 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* on page 16 for more information.

Term	Definition
OC-*y*	In the Occupied Start-Time Selection (OC-y) screen in the Occupied/ Unoccupied Schedule Setup screens, select the time of day that you want all of the outputs in your control system with a Setback (Sbk) value other than 0 to switch from the unoccupied mode to the occupied mode. The ***y*** indicates the numerical day-of-week ID. There is one OC-y screen for each day of the week (OC-1, OC-2, OC-3, and so on to OC-7) and there are corresponding Unoccupied Start-Time Selection (UN-y) screens for each day of the week. You must set up the Time and Day parameters before setting up the occupied/unoccupied schedule. You can set up only one occupied/unoccupied schedule on your control system for all outputs with SbK values other than 0. See *Setting up an Occupied/Unoccupied Schedule* on page 67 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* on page 19 and *Setting up an Analog Output* on page 50 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* on page 45 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* on page 47 for more information.
ONT^{x}	In the Minimum On-Time Selection (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* on page 47 for more information.

Term	Definition
OSET*x*	In the Temperature Offset Selection (OSET*x*) screen in the Output Setup screens for outputs that reference Reset Setpoint Sensor (rES), select the value (in degrees) to be added to the calculated Reset Setpoint (RSP). The OSET*x* screen appears in the Output Setup screens for all outputs that reference the rES in Reset Control applications, and you can set up a different Temperature Offset value for each output. OSET is typically used to set up multi-stage applications. The ***x*** value is the ID number for the output you are setting up. See *Reset Control Modes of Operation* on page 24, *Setting up a Relay Output with Reset Control and Unoccupied Setback* on page 63, and *Setting up an Analog Output with Reset Control and Unoccupied Setback* on page 64 for more information.
OSP*x*	In the Percent Output Signal Strength at Setpoint Selection (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* on page 19 and *Setting up an Analog Output* on page 50 for more information.
OUTA*x*	In the Analog Output Setup Start (OUTA*x*) screen, press ▶ to set up or edit the Analog Output Setup screens, or press Ⓜ 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* on page 43 and *Setting up an Analog Output* on page 50 for more information.
OUTR*x*	In the Relay Output Setup Start (OUTR*x*) screen, press ▶ to set up or edit the Relay Output Setup screens, or press Ⓜ 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* on page 43 and *Setting up a Relay Output* on page 47 for more information.
Passive Sensor	Passive Sensors are two-wire sensors. All of the System 450 compatible temperature sensors are passive sensors. You must set the associated active/passive jumper or DIP switch to passive for each passive sensor that is hard-wired to the sensor terminals. See *Active and Passive Sensors* on page 15 for more information.

Term	Definition
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* on page 21 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 (Figure 4). 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* on page 21 for more information.
Real-Time Clock	Reset control modules include a real-time clock that enables you to set up time-of-day and day-of week scheduling, and create unoccupied setback periods for the HVAC/R applications in your reset control systems. See *Reset Control* on page 22 and *Setting Time and Day* on page 66 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* on page 16, *Setting up a Relay Output* on page 47, and *Viewing the System Status Screens* on page 43 for more information.
RENd	In the Reset Setpoint End Temperature (RENd) Selection screen in the Reset Setpoint Setup screens, select the temperature value (sensed at the Sn-1 master [outdoor air] sensor) that you want to associate with the Maximum Reset Setpoint (MXSP) value. For example, select an RENd value of 0 (zero degrees outdoor temperature) to be associated with a MXSP value of 180 (degrees boiler supply water). RENd and MXSP define one end of the Reset Setpoint (RSP) ramp; RSTR and MNSP define the other end of the RSP ramp. See *Setting up the Reset Setpoint* on page 53 for more information.

Term	Definition
rES	Reset Setpoint Sensor. A functional sensor that enables the variable/ calculated Reset Setpoint (RSP) in System 450 reset control applications. The rES is set up by selecting appropriate MNSP and MXSP values for the controlled loop, and the associated RSTR and RENd values sensed at the master (outdoor/ambient) sensor. When you select rES in the Select Sensor screen for an output, the output references the rES and controls the connected equipment according to the calculated RSP. See *Setting up the Reset Setpoint* on page 53 for more information.
Reset Control Modules	Provide Reset Setpoint (RSP) control, real-time clock, Setback (SbK) control, and load balancing, in addition to providing many of the features and control types provided by standard control modules. 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 load balancing. See *Reset Control* on page 22 for more information.
Reset Setpoint	System 450 reset control modules enable you to set up a calculated Reset Setpoint (RSP), which is based on a master sensor (Sn-1, typically measuring outdoor air temperature) and control outputs based on changing conditions at the master sensor. The RSP is calculated by the functional Reset Setpoint Sensor (rES) and is based on the temperature sensed at the master sensor and the temperature or humidity range selected for the control loop or process. When the rES is set up in your Reset Control application, the current calculated RSP is displayed in the Main screens. Typical reset control applications include boiler water reset, chilled water reset, and Variable Air Volume (VAV) zone control applications. See *Setting up the Reset Setpoint* on page 53 for more information.
RSET	In the Reset Setpoint Setup Start screen, press ▶ to set up or edit the Reset Setpoint Setup screens, or press M to go to the next Output Setup Start screen or return to the Sensor Setup screens. See *Setting up the Reset Setpoint* on page 53 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* on page 19 for more information.
RSP	The current calculated Reset Setpoint temperature or humidity value displayed in the Main (sensor status) screens, when the Reset Setpoint Sensor (rES) is set up on your reset control application. The Reset Setpoint (RSP) is calculated by the functional rES and is based on the temperature sensed at the master sensor (Sn-1) and the temperature or humidity range selected for the control loop or process sensed at the control loop sensor, Sn-2. See *Setting up the Reset Setpoint* on page 53 for more information.

Term	Definition
RSTR	In the Reset Setpoint Start Temperature (RSTR) screen, select the temperature value, sensed at the master sensor, that you want associated with the Minimum Reset Setpoint (MNSP) for the controlled loop or process. When the ambient outdoor air temperature reaches the RSTR value, the controlled loop or process is driven to or maintained at the MNSP value. See *Setting up the Reset Setpoint* on page 53 for more information.
SbK	The Setback (SbK) parameter appears in several setup screens in the System 450 UI on reset control modules only. In the Setback Setup (SbK^{x}) screen in the Output Setup screens for outputs that do not reference the Reset Setpoint (RSP), select the temperature (or humidity) value that you want the unoccupied mode setpoints to be offset from the occupied mode. Select a positive SbK value for cooling applications and a negative Sbk value for heating applications. The ***x*** value is the ID number for the output you are setting up. See *Setting up a Relay Output with Reset Control and Unoccupied Setback* on page 63 and *Setting up an Analog Output with Unoccupied Setback* on page 60 for more information. In the Setback Setup (SbK) screen in the Reset Setpoint Setup screens, select the positive or negative temperature or humidity value that you want the RSP in the unoccupied mode to be setback from the RSP in the occupied mode. See *Setting up the Reset Setpoint* on page 53 for more information.
SCHE	In the Occupied/Unoccupied Schedule Setup Start (SCHE) screen, press ▶ to go to the Occupied Start-Time screen for Sundays, or press Ⓜ to return to the Sensor Setup Start (SENS) screen. **Note:** You cannot enter a value into the SCHE screen or any other setup start screen. See *Setting up an Occupied/Unoccupied Schedule* on page 67 for more information.
SdHI	In the Shutdown High Selection (SdHI) screen in the Reset Setpoint Setup screens, select the high temperature value, sensed at the master (outdoor/ ambient) sensor, at which the outputs referencing the Reset Setpoint Sensor (rES) go to OFF for relay outputs or to OSP for analog outputs. Typically, you select an SdHI value for heating applications only, an SdHI value is not required for heating applications. If you select an SdHI value for your reset heating application, you should select a value greater than the Reset Setpoint Start Temperature (RSTR) value. See *Setting up the Reset Setpoint* on page 53 for more information.

Term	Definition
SdLO	In the Shutdown Low Selection (SdLO) screen in the Reset Setpoint Setup screens, select the low temperature value, sensed at the master (outdoor/ ambient) sensor, at which the outputs referencing the Reset Setpoint Sensor (rES) go to OFF for relay outputs or to OSP for analog outputs. Typically, you select an SdLO value for cooling applications only, but an SdLO value is not required for cooling applications. If you select an SdLO value for your reset cooling application, you should select a value less than the Reset Setpoint Start Temperature (RSTR) value. See *Setting up the Reset Setpoint* on page 53 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 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* on page 14 and *Setting Up the Sensors* on page 45 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 ▶ 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* on page 45 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 ▶ 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* on page 47 and *Setting up an Analog Output* on page 50 for more information.

Term	Definition
Setback	A fixed temperature or humidity value that an output's setpoint values (for the occupied mode) are offset by when the output goes to the unoccupied mode. The Setback feature is only available on System 450 reset control modules. All of the outputs that reference the Reset Setpoint Sensor (rES) use the same SbK value selected in the Reset Setpoint Setup (RSET) screens. For outputs that do not reference the rES, you can select a unique SbK value for each output. You must also set up the Time and Day and the Occupied/Unoccupied setup screens, to apply the Setback feature to your control application.
SETT^{xM}	In the Set Time screen, set the time of day (for the 12-hour or 24-hour clock) and set either AM or PM (for the 12 hour clock). See *Setting Time and Day* on page 66 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 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 reset control systems, Sn-1 is the master sensor used to create the functional Reset Setpoint Sensor (rES). See *System 450 Compatible Sensors* on page 14 and *Setting Up the Sensors* on page 45 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 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 reset control systems, Sn-2 is the control loop sensor used to create the functional Reset Setpoint Sensor (rES). See *System 450 Compatible Sensors* on page 14 and *Setting Up the Sensors* on page 45 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 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. See *System 450 Compatible Sensors* on page 14 and *Setting Up the Sensors* on page 45 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). SNF modes for outputs that reference the Reset Setpoint (RSP) are MXSP for reverse acting RSP or MNSP for direct acting RSP. See *Sensor Failure Mode* on page 27 for more information.

Term	Definition
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* on page 19 for more information.
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, load balancing, or hybrid analog output control. Refer to the *System 450 Series Modular Control Systems with Standard Control Modules Technical Bulletin (LIT-12011459)* for more information.
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, Analog Output Setup screens, Reset Setpoint Setup screens, Time and Day Clock Setup screens, Schedule setup screens, and/or Pulse Setups screens. You access the System Setup screens by navigating to the various System Setup Start screens. See *Accessing the System Setup Screens* on page 43 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 ▶ repeatedly, when the Main screens are auto-scrolling on the display. See *Viewing the System Status Screens* on page 43 for more information.
TIME	Time Setup Start screen, where you begin setting up the time of day and day of week parameters for your System 450 control system. Reset control modules (C450RxN-x models) are the only control modules with an integral real-time clock, and therefore the TIME setup parameters are available only on control systems that use a reset control module. The TIME parameters allow you to schedule outputs actions and create setback/occupancy schedules. See *Setting Time and Day* on page 66 for more information.

Term	Definition
UN-*y*	In the Unoccupied Start-Time Selection (UN-*y*) screen in the Occupied/ Unoccupied Schedule Setup screens, select the time of day when you want all of the outputs in your control system that have a Setback (SbK) value other than 0 (zero) to switch from the occupied mode to the unoccupied mode. The ***y*** indicates the numerical day-of-week ID. There is one UN-*y* screen for each day of the week (UN-1, UN-2, UN-3, and so on to UN-7) and there are corresponding Occupied Start-Time Selection (OC-*y*) screens for each day of the week. You must set up the Time and Day parameters before setting up the occupied/unoccupied schedule. You can set up only one occupied/unoccupied schedule on your control system for all outputs with SbK values other than 0. See *Setting up an Occupied/Unoccupied Schedule* on page 67 for more information.

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