SIEMENS

BACnet PTEC Controller

Unit Vent - Heating and DX Cooling, ASHRAE Cycles I and II, Application 6677

Application Note

140-1182
2014-08-06

Building Technologies

Table of Contents

Overview

NOTE:
For information on applications with Firmware Revision B*x*40 or earlier, see InfoLink and/or Asset Portal for documentation.

In Application 6677, the controller controls a unit ventilator equipped with a DX coil for cooling, and/or a heating coil, which may be hot water, steam, or electric, for ASHRAE Cycles I and II. A face-bypass damper can be controlled, replacing the modulating (0 to 10V) heating actuator, but will modulate only in heating mode. If a face-bypass damper is used, 2-position valves on the coils may be controlled. Cooling only units can also be controlled with this application by overriding HEAT.COOL to COOL.

Other features available in this application include morning warm-up/cool-down, night mode override, and free-cooling.

NOTE:
Using a low temperature detection thermostat (LTDT) is strongly recommended for hot water and steam systems.

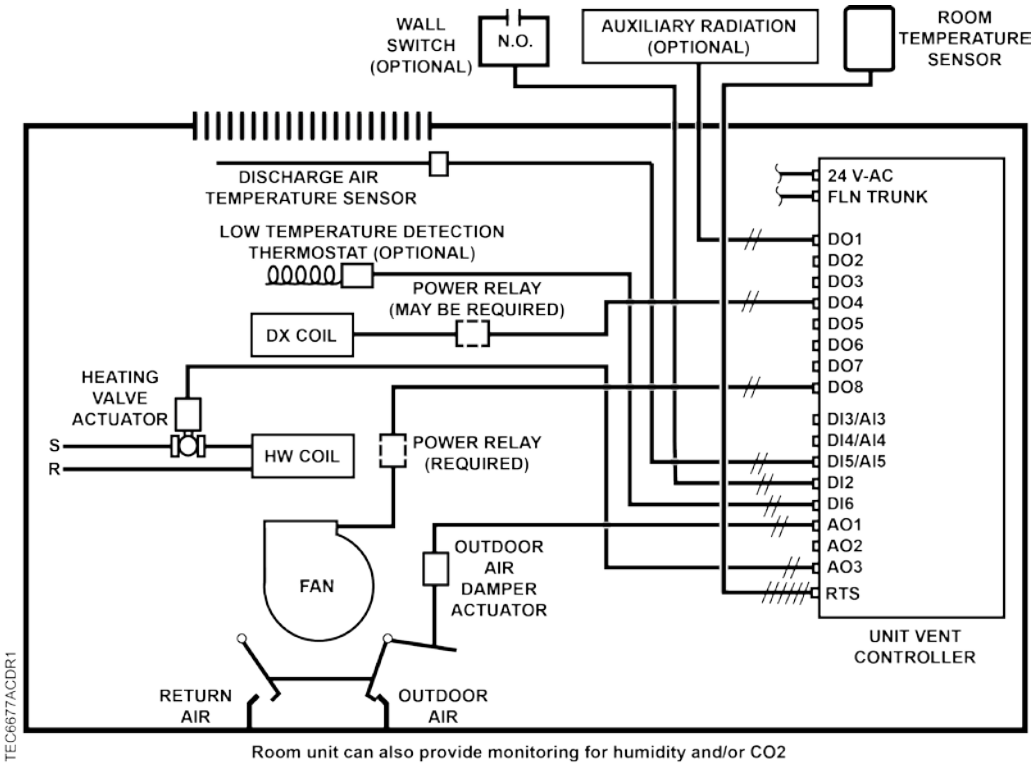
While in heating, this application controls room temperature by resetting the discharge air temperature. While in cooling, this application controls room temperature by cycling the DX unit. This application also controls an outdoor air damper according to the schedules as defined by ASHRAE Cycles I and II. The free-cooling/economizer function is turned on and off by the field panel, or using PPCL within the controller, by setting FREE CLG. If free cooling is not available, the outdoor air damper will be kept at minimum position; otherwise, the outdoor air damper will modulate open in sequence with the heating actuator or the DX. The unit ventilator fan is also controlled in this application.

Cross Reference Diagram

Application 6677			
Hardware Configuration	**Control Drawing**	**Control Schedule**	**Wiring Diagrams**
DX coil, single step control	Control Diagram 1 [→ 6], except: 1. No heating coil, heating valve actuator, or auxiliary radiation. 2. No LTDT.	Control Schedule 1 [→ 8], except: 1. No heating mode.	Wiring Diagram 1 [→ 27], except: 1. No heating valve actuator, or auxiliary radiation. 2. No LTDT.
Hot water and DX coils, valve and single step control	Control Diagram 1 [→ 6], except: 1. LTDT recommended.	Control Schedule 1 [→ 8]	Wiring Diagram 1 [→ 27], except: 1. LTDT recommended.
Hot water and DX coils, face-bypass damper controls and single step control	Control Diagram 3 [→ 7], except: 1. LTDT recommended.	Control Schedule 3 [→ 9]	Wiring Diagram 3 [→ 29], except: 1. LTDT recommended.

Application 6677			
Hardware Configuration	**Control Drawing**	**Control Schedule**	**Wiring Diagrams**
Steam and DX coils, valve and single step control	Control Diagram 1 [→ 6], except: 1. Read steam coil instead of heating coil. 2. LTDT recommended.	Control Schedule 1 [→ 8]	Wiring Diagram 1 [→ 27], except: 1. LTDT recommended.
Steam and DX coils, face-bypass damper control and single step control	Control Diagram 3 [→ 7], except: 1. Read steam coil instead of heating coil. 2. LTDT recommended.	Control Schedule 3 [→ 9]	Wiring Diagram 3 [→ 29], except: 1. LTDT recommended.
Electric and DX step control	Control Diagram 2 [→ 6], except: 1. No LTDT.	Control Schedule 2 [→ 8]	Wiring Diagram 2 [→ 28], except: 1. No LTDT.

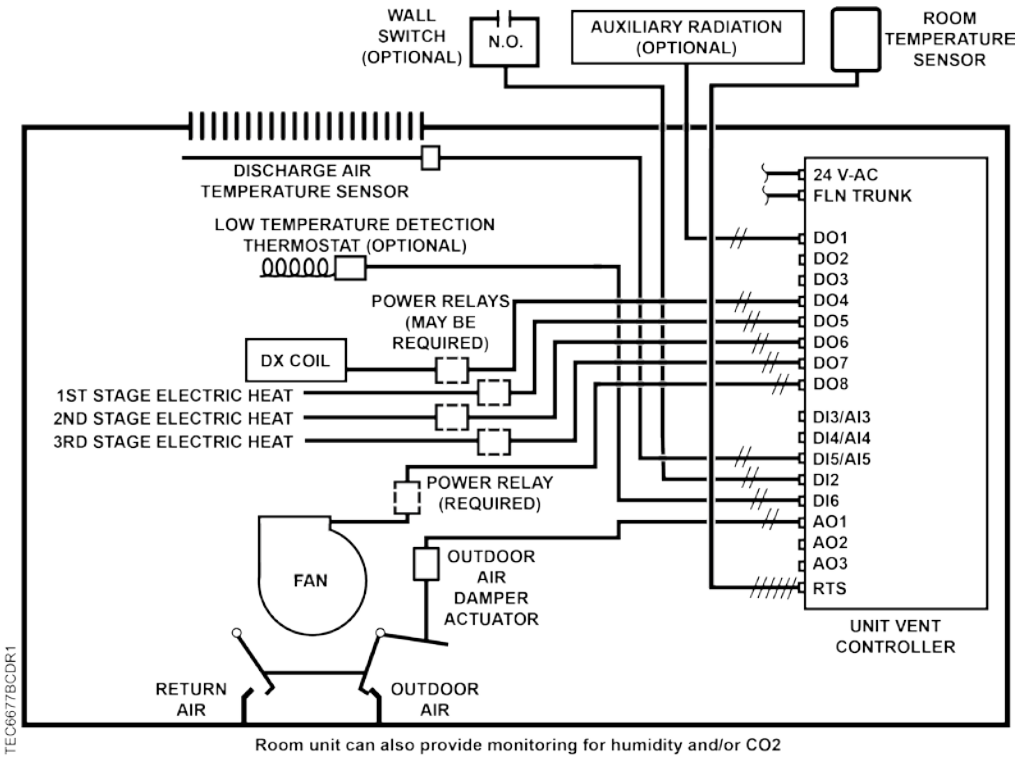
Control Diagram 1



Room unit can also provide monitoring for humidity and/or CO2

See the Cross Reference Diagram [→ 5] for Application Configuration(s).

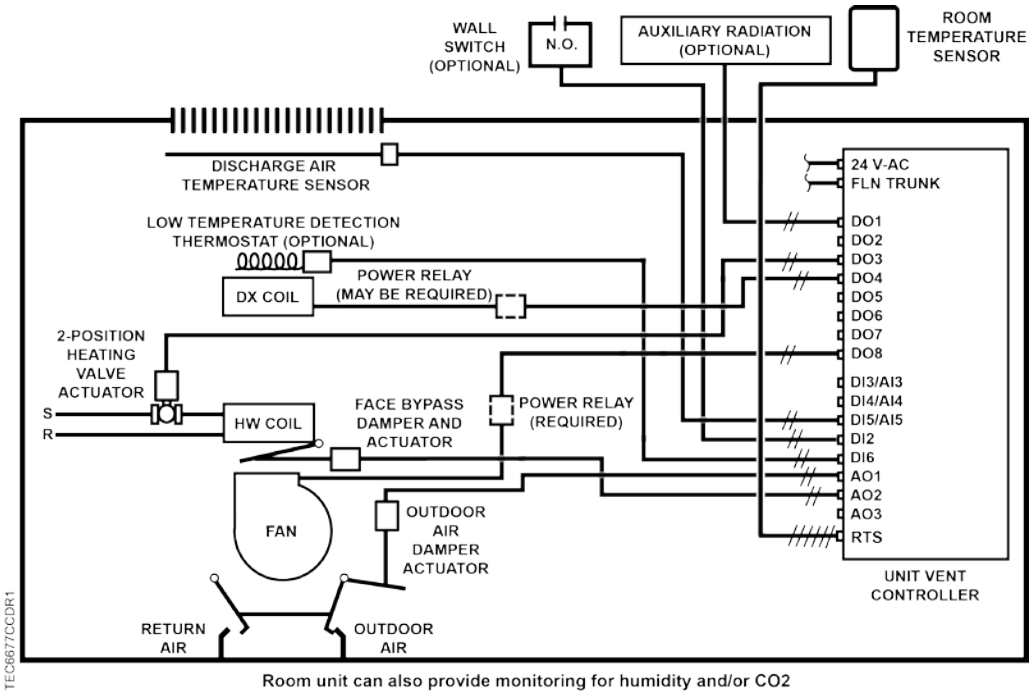
Control Diagram 2



Room unit can also provide monitoring for humidity and/or CO2

See the Cross Reference Diagram [→ 5] for Application Configuration(s).

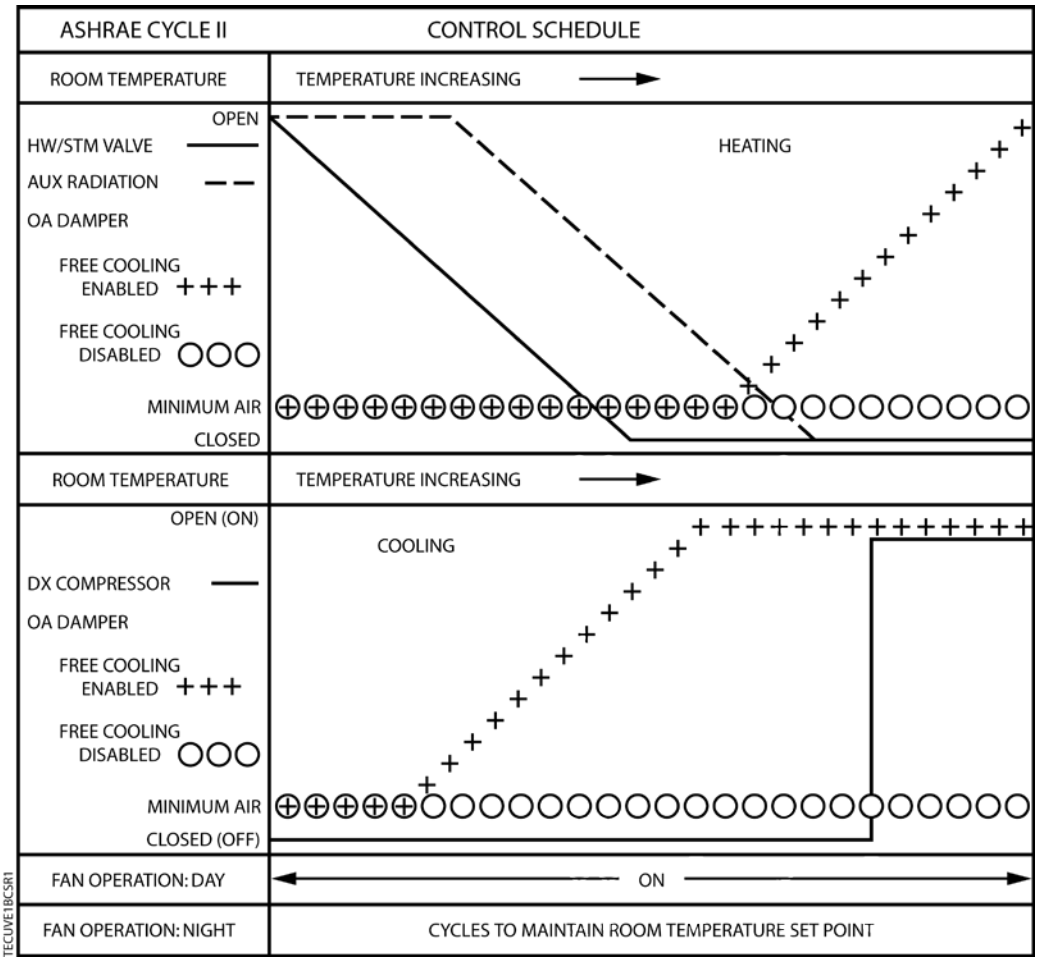
Control Diagram 3



Room unit can also provide monitoring for humidity and/or CO2

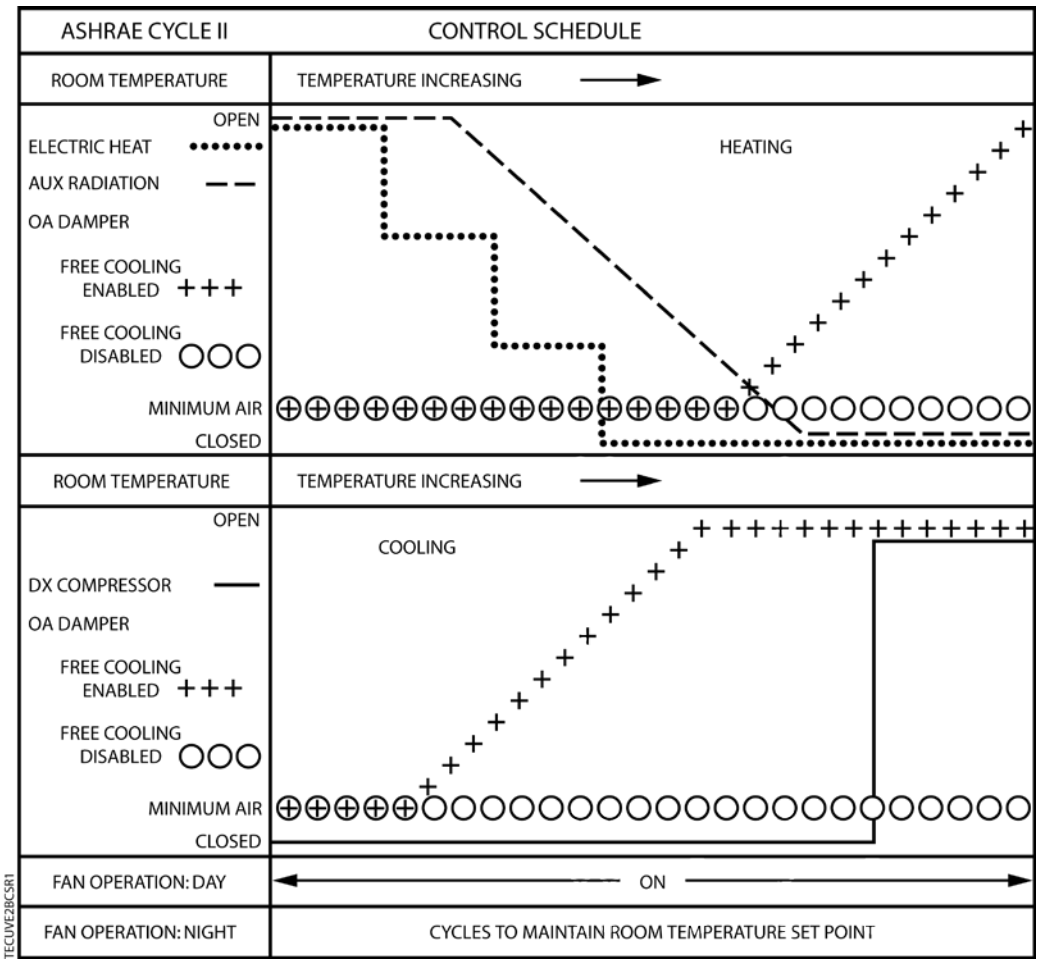
See the Cross Reference Diagram [→ 5] for Application Configuration(s).

Control Schedule 1



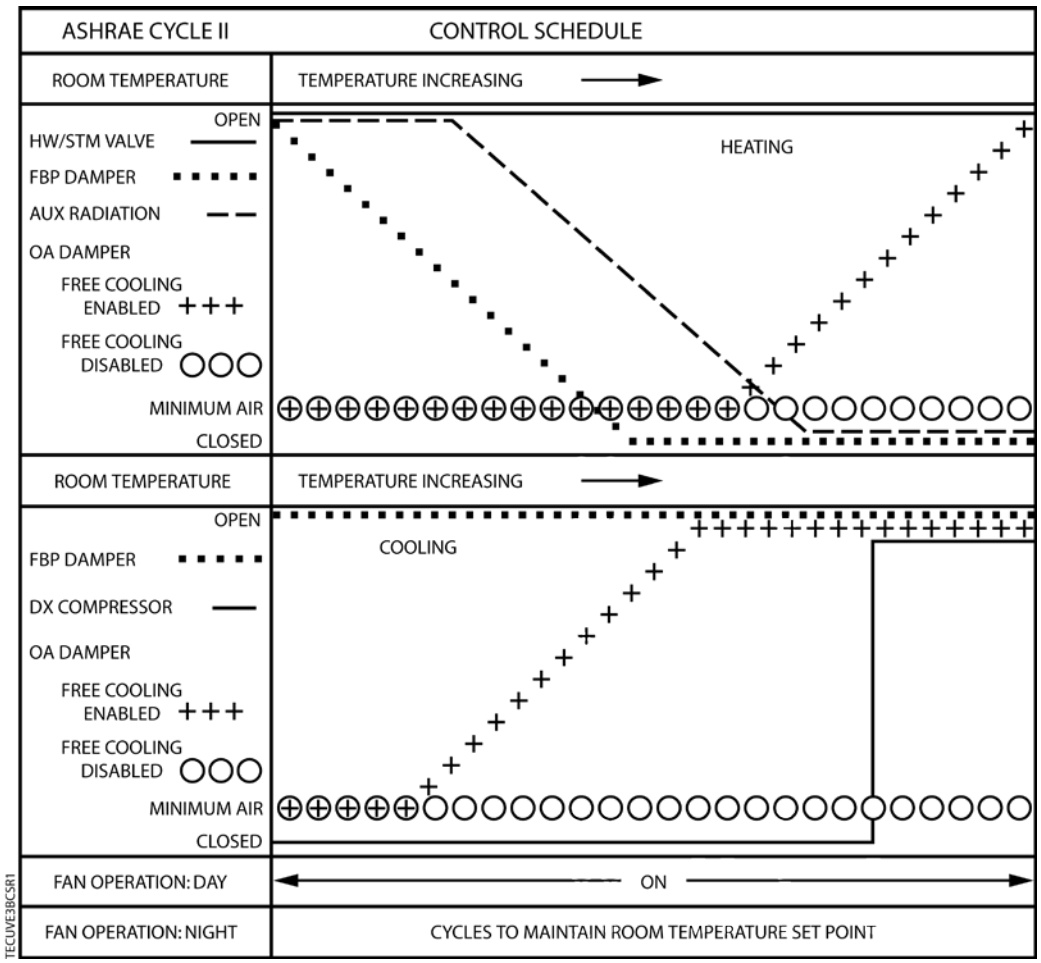
See the Cross Reference Diagram [→ 5] for Application Configuration(s).

Control Schedule 2



See the Cross Reference Diagram [→ 5] for Application Configuration(s).

Control Schedule 3



See the Cross Reference Diagram [➞ 5] for Application Configuration(s).

BACnet

The controller communicates using BACnet MS/TP protocol for open communications on BACnet MS/TP networks.

Product	Supported BIBBs	BIBB Name
BTEC/PTEC	DS-RP-B B	Data Sharing-Read Property-B
	DS-RPM-B	Data Sharing-Read Property Multiple-B
	DS-WP-B	Data Sharing-Write Property-B
	DM-DDB-B	Device Management-Dynamic Device Binding-B
	DM-DOB-B	Device Management-Dynamic Object Binding-B
	DM-DCC-B	Device Management-Device Communication Control-B
	DM-RD-B	Device Management-Reinitialize Device-B
	DM-BR-B	Device Management-Backup and Restore-B
	DM-OCD-B	Device Management-Object Creation and Deletion-B

Hardware Inputs

Analog

- Averaging air temperature sensor (10K or 100K thermistor)
- Spare temperature sensor 10K or 100K thermistor
- Spare analog sensor switch selectable 0-10V or 4-20 mA
- Room temperature sensor
- Room temperature setpoint dial (optional)

Digital

- Low Temperature Detection Thermostat (LTDT)
- Night mode override (optional)
- Wall switch (optional)

NOTE:
Digital Room Units (Firmware Revision 26 and later) will update their controlled inputs without putting them Out Of Service. However, a command from an external source through the digital room unit will put the associated BACnet Input point Out Of Service.

Room Unit Identification

- For Analog Room Units – The revision number is visually identified by its case.
- For Digital Room Units (Firmware Revision 25 or earlier) – The revision number displays for 5 seconds when the room unit is first powered up. These room units will display `laptop` when a laptop is connected and will no longer update room temperature sensor values.
- For Digital Room Units (Firmware Revision 26 and later) – The revision number displays for 5 seconds when the room unit is first powered up or when a laptop is disconnected. These room units will continue to display and update the room temperature sensor values when a laptop is connected.

Hardware Outputs

The following is a list of devices that can be used by this application depending on your hardware configuration.

Analog (0 to 10V)

- Heating valve actuator
- Face-bypass damper actuator
- Outdoor air damper actuator

Digital

- Unit fan
- DX coil
- Auxiliary radiation electric coil contact; or, auxiliary radiation 2-position valve actuator
- 1st stage electric heat
- 2nd stage electric heat
- 3rd stage electric heat
- 2-position heating valve actuator

Ordering Notes

550-493PA	Siemens BACnet PTEC Unit Vent Controller

Sequence of Operation

The following paragraphs present the sequence of operation for Siemens BACnet PTEC Unit Vent Controller Application 6677, Heating and DX Cooling, ASHRAE Cycles I and II.

Control Temperature Setpoints

CTL STPT is Overridden:

If CTL STPT is overridden, that value is used regardless of any other settings. This disables the setpoint deadband feature.

CTL STPT in Night Mode:

The controller is in Night Mode if DAY.NGT = NGT and NGT OVRD = NGT.

When the controller is in night mode, CTL STPT holds the value of NGT CLG STPT or NGT HTG STPT depending on the value of HEAT.COOL. When the controller is in night mode, the value of RM STPT DIAL is ignored.

CTL STPT in Day Mode:

The controller is in Day Mode if DAY.NGT = DAY or NGT OVRD = DAY.

Without setpoint dial:

When the controller is in day mode and STPT DIAL = NO, CTL STPT holds the value of DAY CLG STPT or DAY HTG STPT depending on the value of HEAT.COOL.

With setpoint dial:

When the controller is in day mode and STPT DIAL = YES, CTL STPT holds a value based on RM STPT DIAL depending on your room unit model/revision.

The following sections describe the value of CTL STPT based on room unit type and configuration:

- CTL STPT using Standard/Absolute Mode (Digital Room Unit, Revision 26 and later)
- CTL STPT using Warmer/Cooler Mode (Digital Room Unit, Revision 26 and later)
- CTL STPT using Standard/Absolute Mode (Analog or Digital Room Unit)
- CTL STPT using Warmer/Cooler Mode (Analog Room Unit Only)

NOTE:
If RM STPT DIAL is failed, it maintains the last known value.

CTL STPT Using Standard/Absolute Mode (Digital Room Unit, Revision 26 and later)

Digital Room Unit (2200/2300 Series Firmware Revision 26 and later)

For all new digital room units, the value displayed and reported by the room unit is linked to the current heat/cool mode. When the mode changes, the value is automatically updated based on the new heat/cool mode.

When STPT SPAN is set to 0, the room setpoint adjustment on the digital room unit will function in a standard mode. The range of the adjustment will be based on RM STPT MIN and RM STPT MAX.

CTL STPT is set equal to RM STPT DIAL. The values for RM STPT MIN and RM STPT MAX will be applied to limit RM STPT DIAL before it is copied into CTL STPT.

CTL STPT Using Warmer/Cooler Mode (Digital Room Unit, Revision 26 and later)

Digital Room Unit (2200/2300 Series Firmware Revision 26 and later)

NOTE:
The warmer-cooler function is only available with BACnet PTEC controllers (standard 66xx apps).

When STPT SPAN is set to a value > 0, the room setpoint adjustment on the digital room unit will function in a warmer/cooler mode. The range of the adjustment will be calculated based on the current DAY CLG STPT or DAY HGT STPT and the STPT SPAN value. This will allow the Room Setpoint Dial to be incremented up or down from these setpoints by STPT SPAN.

CTL STPT is set equal to RM STPT DIAL. The values for RM STPT MIN and RM STPT MAX will be applied to limit RM STPT DIAL before it is copied into CTL STPT.

When SPTP SPAN > 0, the minimum and maximum values for RM STPT DIAL are calculated as follows:

- Minimum lowest adjusted setpoint value is equal to DAY CLG STPT or DAY HTG STPT - STPT SPAN
- Maximum highest adjusted setpoint value is equal to DAY CLG STPT or DAY HTG STPT + STPT SPAN

Example in Cooling Mode

If the STPT SPAN is set to 2.0 degrees, and the DAY CLG STPT is 76°F, you can step up or down the room unit to adjust the RM STPT DIAL from 74°F to 78°F.

CTL STPT Using Standard/Absolute Mode (Analog or Digital Room Unit)

Analog (Series 1000) or Digital Room Units (Firmware Revision 25 or earlier)

NOTE:
2200/2300 digital room units with Firmware Revision 25 or earlier are only compatible with standard room unit functionality (no warmer/cooler).

When STPT SPAN is set to 0, CLT STPT is set based on the value of the setpoint dial and the setpoint deadband.

The setpoint deadband exists to allow the controller to provide a separation of the heating and cooling temperature setpoints when a setpoint dial is enabled.

The setpoint deadband is the difference between the cooling and heating day setpoints (DAY CLG STPT DAY – HTG STPT). The setpoint deadband can be disabled by setting DAY HTG STPT equal to DAY CLG STPT. When DAY HTG STPT does not equal DAY CLG STPT, a setpoint deadband (or zero energy band) is used.

The following values are used in the calculation of CTL STPT:

- *Deadband* is the value of the difference between DAY CLG STPT and DAY HTG STPT and is used to establish the current heating and cooling setpoints.
- *Deadband* = (DAY CLG STPT – DAY HTG STPT)

CTL STPT is calculated as follows:

With Deadband disabled:

CTL STPT = RM STPT DIAL

With Deadband enabled in Heat Mode:

CTL STPT = RM STPT DIAL – 0.5 * *Deadband*

With Deadband enabled in Cool Mode:

CTL STPT = RM STPT DIAL + 0.5 * *Deadband*

CTL STPT is limited between the value of RM STPT MIN and RM STPT MAX

CTL STPT Using Warmer/Cooler Mode (Analog Room Unit Only)

Analog Room Unit (Series 1000)

NOTE:
The warmer-cooler function for analog room units (Series 1000) use the warmer/cooler scale of units with a warmer/cooler housing.

When SPTP SPAN > 0, the minimum and maximum values for RM STPT DIAL are calculated as follows:

- Minimum lowest adjusted setpoint value is equal to DAY CLG STPT or DAY HTG STPT - STPT SPAN
- Maximum highest adjusted setpoint value is equal to DAY CLG STPT or DAY HTG STPT + STPT SPAN

The full range of the analog room unit slider will be mapped to a range of minimum setpoint value to maximum setpoint value.

CTL STPT is set equal to RM STPT DIAL. The values for RM STPT MIN and RM STPT MAX will be applied to limit RM STPT DIAL before it is copied into CTL STPT.

Example in Cooling Mode

If the STPT SPAN is set to 2.0 degrees, and the DAY CLG STPT is 76°F, the room unit slider will adjust the cooling setpoint from 74°F to 78°F.

Heating/Cooling Switchover

If the following conditions are met for the length of time set in SWITCH TIME, the controller switches from heating to cooling mode by setting HEAT.COOL to COOL:

- HTG LOOPOUT is below 50% if free cooling is disabled or below SWITCH LIMIT if free cooling is enabled.
- CTL TEMP is greater than the sum of CTL STPT plus SWITCH DBAND.
- CTL TEMP is greater than the appropriate cooling setpoint minus SWITCH DBAND.

If the following conditions are met for the length of time set in SWITCH TIME, the controller switches from cooling to heating mode by setting HEAT.COOL to HEAT:

- CLG LOOPOUT is below 50% if free cooling is disabled or below SWITCH LIMIT if free cooling is enabled.
- CTL TEMP is less than CTL STPT minus SWITCH DBAND.
- CTL TEMP is less than the appropriate heating setpoint plus SWITCH DBAND.

If night cooling is not available, as indicated by NGT CLG MODE, then the controller remains in heating mode during the night.

When the STPT DIAL = NO, the heating/cooling switchover values are determined by DAY HTG STPT and DAY CLG STPT.

When the STPT DIAL = YES, the following sections describe the values used for the heating/cooling switchover points based on room unit type and configuration.

See the appropriate sections:

- Heating/Cooling Switchover Using Standard/Absolute Mode (Digital Room Unit, Revision 26 and later) [→ 17]
- Heating/Cooling Switchover Using Warmer/Cooler Mode (Digital Room Unit, Revision 26 and later) [→ 17]
- Heating/Cooling Switchover Using Standard/Absolute Mode (Analog Room Unit) [→ 18]
- Heating/Cooling Switchover Using Warmer/Cooler Mode (Analog Room Unit) [→ 18]

Heating/Cooling Switchover using Standard/Absolute Mode (Digital Room Unit, Revision 26 and later)

Recommended Configuration: Digital Room Units (2200/2300 Series Firmware Revision 26 and later)

For new digital room units, the graphic or actual value displayed and reported by the room unit is linked to the current heat/cool mode. When the mode changes, the value is automatically updated based on the new heat/cool mode.

- When the controller is in cooling mode, the heating switchover setpoint is as follows:
  Heating switchover point is equal to RM STPT DIAL – DAY CLG STPT + DAY HTG STPT
- When the controller is in heating mode, the cooling switchover setpoint is as follows:
  Cooling switchover point is equal to RM STPT DIAL – DAY HTG STPT + DAY CLG STPT

Example

DAY CLG STPT = 74 and DAY HTG STPT = 70

In cooling mode, when the user adjusts the setpoint value on the room unit to 76, the heating switchover point will equal 72 - SWITCH DBAND.

Heating switchover point: 76 – 74 + 70 = 72 - SWITCH DBAND

When the room temperature drops below heating switchover point and the switchover conditions are met, the controller switches to heating mode, the new value for the setpoint displays and RM STPT DIAL is 72 degrees.

Heating/Cooling Switchover Using Warmer/Cooler Mode (Digital Room Unit, Revision 26 and later)

Digital Room Unit (2200/2300 Series Firmware Revision 26 and later)

For new digital room units, the graphic or actual value displayed and reported by the room unit is linked to the current heat/cool mode. When the mode changes, the value is automatically updated based on the new heat/cool mode.

The RM STPT DIAL will display the current temperature setpoint based on a plus or minus position or increment entered by the user at the room unit.

When SPTP SPAN > 0, the minimum and maximum values for RM STPT DIAL are calculated as follows:

- Minimum lowest adjusted setpoint value is equal to DAY CLG STPT or DAY HTG STPT - STPT SPAN
- Maximum highest adjusted setpoint value is equal to DAY CLG STPT or DAY HTG STPT + STPT SPAN

The heat/cool switchover mechanism is the same as in standard/absolute mode.

- When the controller is cooling mode, the heating switchover setpoint is as follows:
  Heating switchover point is equal to RM STPT DIAL – DAY CLG STPT + DAY HTG STPT

- When the controller is heating mode, the cooling switchover setpoint is as follows:
  Cooling switchover point is equal to RM STPT DIAL – DAY HTG STPT + DAY CLG STPT

Heating/Cooling Switchover Using Standard/Absolute Mode (Analog Room Unit)

Analog (Series 1000) or Digital Room Units (Firmware Revision 25 or earlier)

The difference between day heating and day cooling setpoint establishes the separation for heat/cool switchover points (deadband = DAY CLG STPT – DAY HTG STPT).

- When the controller is in cooling mode, the heating switchover setpoint is as follows:
  Heating switchover point is equal to RM STPT DIAL – 0.5 * the deadband
- When the controller is in heating mode, the cooling switchover setpoint is as follows:
  Cooling switchover point is equal to RM STPT DIAL + 0.5 * the deadband

Heating/Cooling Switchover Using Warmer/Cooler Mode (Analog Room Unit)

Analog Room Unit (Series 1000)

The RM STPT DIAL will display the current temperature setpoint based on a plus or minus position or increment entered by the user at the room unit.

The amount of offset that can be entered with the analog room unit is limited to a value of minus STPT SPAN to plus STPT SPAN.

- When the controller is in cooling mode, the heating switchover setpoint is as follows:
  Heating switchover point is equal to DAY CLG STPT, plus the amount of offset entered
- When the controller is in heating mode, the cooling switchover setpoint is as follows:
  Cooling switchover point is equal to DAY HTG STPT, plus the amount of offset entered

Room Temperature, Room Temperature Offset and CTL TEMP

ROOM TEMP is the temperature that is being sensed by the room temperature sensor (RTS).

RMTMP OFFSET (or TEMP OFFSET) is a user-adjustable offset that will compensate for deviations between the value of ROOM TEMP and the actual room temperature.

CTL TEMP is the room temperature that is used for control purposes. In other words, what the application is trying to do is to maintain CTL TEMP at the control setpoint.

When CTL TEMP is not overridden, CTL TEMP and ROOM TEMP are related by the following equation:

CTL TEMP = ROOM TEMP + RMTMP OFFSET (or TEMP OFFSET)

If CTL TEMP is not overridden, then:

- The current value of ROOM TEMP (normal or overridden) is used to determine the value of CTL TEMP.
- If ROOM TEMP has a status of Failed, then last known good value of ROOM TEMP is used to determine the value of CTL TEMP.

Day and Night Modes

The day/night status of the space is determined by the status of DAY.NGT. The control of this point differs depending on whether the controller is monitoring the status of a wall switch or if the controller is connected to a field panel.

When a wall switch is physically connected to the termination strip on the controller DI 2 (see the *Control Diagram* in the *Overview* section), and WALL SWITCH = YES, the controller monitors the status of DI 2.) When the status of DI 2 is ON (the switch is closed), then DAY.NGT is set to DAY indicating that the controller is in day mode. When the status of DI 2 is OFF (the switch is open), then DAY.NGT is set to NIGHT indicating that the controller is in night mode.

When WALL SWITCH = NO, the controller does not monitor the status of the wall switch, even if one is connected to it. In this case, if the controller is operating stand-alone, then the controller stays in day mode all the time. If the controller is operating with centralized control (that is, it is connected to a field panel), then the field panel can send an operator or PPCL command to override the status of DAY.NGT. See *Powers Process Control Language (PPCL) User's Manual* (125-1896) and *Field Panel User's Manual* (125-3019) or *BACnet Field Panel User's Manual* (125-3020) for more information.

Night Mode Override Switch

If an override switch is present on the room temperature sensor and a value (in hours) other than zero has been entered into OVRD TIME, pressing the override switch will reset the controller to DAY operational mode for the time period that is set in OVRD TIME. The status of NGT OVRD changes to DAY. After the override time elapses, the controller returns to night mode and the status of NGT OVRD changes back to NIGHT.

The override switch on the room sensor will only affect the controller when it is in night mode.

Day Heating Operation

In day heating operation, the controller maintains the room temperature at the value stored in CTL STPT by doing the following:

- Resetting the unit ventilator's discharge temperature setpoint, DISCH STPT, based on the difference between CTL TEMP and CTL STPT. If CTL TEMP goes below CTL STPT, then the discharge temperature setpoint increases. If the reverse occurs, then the setpoint decreases. DISCH STPT may not drop below the value of DSH MIN TEMP, nor may it rise above DSH MAX TEMP.

- Modulating the available coil control device based on the difference between the discharge temperature point, DISCH TEMP, and DISCH STPT. If DISCH TEMP goes below DISCH STPT, then the heating valve actuator opens, the face-bypass damper opens, or the stages of electric heat energize. If DISCH TEMP goes above DISCH STPT, then the reverse occurs.
- Controlling auxiliary radiation (if provided) using a pulse-width modulation algorithm. The auxiliary radiation will be on for a percentage of the time held in AUX HTG TIME. The on-time is based on the difference between DISCH STPT and AUX DSH STPT. If DISCH STPT goes below AUX DSH STPT, then the on-time of the auxiliary radiation valve decreases. If the reverse occurs, then the on-time increases.
- Positioning the outdoor air damper as follows:
  - For ASHRAE Cycle I, OADPR MINPOS is set to 100%.
  - For ASHRAE Cycle II, OADPR MINPOS is set to a value less than 100% to satisfy the minimum outdoor air requirements.
  - When the coil is providing heat, the damper is positioned at its minimum setting. When the coil is not providing heat and FREE CLG is set to ENABLE, the damper is positioned from minimum to maximum open to provide ventilation cooling. If FREE CLG is set to DISABL, then the damper is kept at minimum at all times.

Day Cooling Operation

In day cooling operation, the controller maintains the room temperature at the value stored in CTL STPT by doing the following:

- Verifying that the face-bypass damper (if present) is at full face all the time.
- Cycling the DX coil based on the difference between the control temperature point, CTL TEMP, and CTL STPT.
- Positioning the outdoor air damper as follows:
  - For ASHRAE Cycle I, OADPR MINPOS is set to 100%.
  - For ASHRAE Cycle II, OADPR MINPOS is set to a value less than 100% to satisfy the minimum outdoor air requirements.
  - When the coil is providing cooling and FREE CLG is set to ENABLE, the damper is kept open. When the coil is not providing cooling and FREE CLG is set to ENABLE, the damper is modulated between minimum and maximum. If FREE CLG is set to DISABL, then the damper is kept at minimum at all times.

Night Heating Operation

The controller maintains the room temperature at the value stored in CTL STPT by doing the following:

If CTL TEMP drops below the value of NGT HTG STPT minus the value of NGT DBAND:

- The fan turns ON
- Heating turns ON

If CTL TEMP rises above NGT HTG STPT:

- The fan turns OFF

- Heating turns OFF

When the fan turns ON, the heating actuators and auxiliary radiation are opened. When the fan turns OFF, all heating and auxiliary radiation is closed. If electric heat is being controlled, then the fan will remain ON for 30 seconds after the last stage of electric heat is turned OFF. If NGT HW HTG is set to YES, (for hot water coils), then the heating actuator is kept open at all times during the night.

In night heating operation, the controller operates as follows:

- For units with hot water coils, NGT HW HTG must be set to YES, so that the valve will be positioned to full open.
- For units with steam or electric coils, NGT HW HTG must be set to NO, so that the coils can be cycled.
- The face-bypass damper is at full face when the fan is ON and full bypass when the fan is OFF and the 2-position heating valve actuator is open.
- The controller may switch to cooling mode when appropriate if NGT CLG MODE is set to YES.
- Heating only is provided when NGT CLG MODE is set to NO.

Night Cooling Operation

In night cooling operation, the controller maintains the room temperature at the value stored in CTL STPT by doing the following:

- When NGT CLG MODE is set to NO, the unit will operate in night heating mode only.

In night cooling operation, the controller operates as follows:

- For units with hot water coils, NGT HW HTG must be set to YES, so that the valve will be positioned to full open.
- For units with steam or electric coils, NGT HW HTG must be set to NO, so that the heating coils can be kept OFF.
- The face-bypass damper is at full face when the fan is ON and at full bypass when the fan is OFF and the 2-position cooling valve actuator is open.

Control Loops

The unit ventilator is controlled by four Proportional, Integral, and Derivative (PID) control loops; a room loop, a heating loop, a DX loop, and an auxiliary loop.

Room Loop – The room loop uses the values of CTL STPT and CTL TEMP to set the discharge setpoint, DISCH STPT, between the values of DSH MIN TEMP and DSH MAX TEMP.

Heating Loop – The heating loop uses the value of DISCH STPT and DISCH TEMP to modulate the value of HTG LOOPOUT.

Cooling Loop – The cooling loop uses the value of DISCH STPT and DISCH TEMP to modulate the value of CLG LOOPOUT.

Auxiliary Loop – The auxiliary loop uses AUX DSH STPT and DISCH STPT to modulate the value of AUX LOOPOUT.

DX Loop – The DX loop uses the values of CTL STPT and CTL TEMP to modulate the value of CLG LOOPOUT.

Morning Warm-up/Cool-down

Morning warm-up or cool-down occurs after the controller switches from night mode to day mode, upon power-up, or if the controller is reset. During morning warm-up or cool-down, the controller provides maximum heating or cooling with the outdoor air damper closed until the temperature of the space reaches the value of CTL STPT plus or minus the value of MORN DBAND. In morning cool-down, if FREE CLG is set to ENABLE, the outdoor air damper is opened.

In heating mode, normal day heating operation begins when the temperature of the room reaches the value of CTL STPT minus MORN DBAND.

In cooling mode, normal day cooling operation begins when the temperature of the room reaches the value of CTL STPT plus MORN DBAND.

For example, in day heating mode, if CTL STPT is 72°F (22.2°C) and MORN DBAND is 3°F (1.6°C), normal day heating operation begins when the temperature of the room reaches 69°F (20.6°C).

DX Cooling Operation

DX cooling is controlled as follows:

- If CLG OUTPUT is greater than 75%, the DX turns ON.
- If CLG OUTPUT is less than 75%, the DX turns OFF.
- The DX may not turn ON or OFF until the number of minutes held in CMP MIN ON or CMP MIN OFF have expired.

Staged Electric Heat

If electric heat is used, then it is controlled as follows:

HTG OUTPUT	Stage 1	Stage 2	Stage 3
0% - 33%	ON	OFF	OFF
34% - 66%	ON	ON	OFF
67% - 100%	ON	ON	ON

In addition, no stage may turn ON or OFF until the number of seconds held in EHT STG DELY have elapsed since the last time any stage turned ON or OFF. Stage one will always be the first stage to turn ON and the last stage to turn OFF.

Room Unit Operation

Sensor Select

SENSOR SEL is a configurable, enumerated point (values are additive). This point tells the controller what type of room unit is being used and how to handle loss of data. It also provides the ability to enable the optional RH and CO2 sensors and which thermistor type is connected.

Room Temperature, Setpoint, RH and CO2

- When the digital room unit (Series 2200/2300) is used, SENSOR SEL selects the source for temperature and setpoint and enables a loss of communications indication:
  - Temperature/Setpoint enable and supervision for fail communications (temperature) with a value of 1.
  - Relative humidity enable and supervision for fail communications with a value of 2.
  - CO2 enable and supervision for fail communications with a value of 4.
- When the analog room unit (Series 1000/2000) is used, default temperature sensing (0) from an analog room unit is enabled (relative humidity and CO2 sensing are not available and should not be selected).

Thermistor Inputs

- Default for either input is 10K.
- To enable 100K thermistor on input, see the following table for additive values of 8 or 16.

Other Inputs (only available on Digital Room Unit)

- Use the following table to select and enable communications supervision of room temperature/setpoint dial, relative humidity or CO2 for additive values of 1, 2 and 4.

SENSOR SEL Value * (additive)	Description (include values to enable feature)
1	Select Digital Room Unit (for temperature sensing and setpoint dial)
2	Relative Humidity (RH) sensing
4	CO_2 sensing
8	If short board: 100K Ω thermistor on AI 3 (else input is 10K Ω) If long board: 100K Ω thermistor on AI 5 (else input is 10K Ω)
16	Long board only: 100K Ω thermistor on AI 4 (else input is 10K Ω)

Room CO2

RM CO2 displays the CO_2 value in units of parts-per-million (PPM). RM CO2 (from the digital 2200/2300 room units) can be used with PPCL in the PTEC controller or unbundled for control or monitoring purposes.

Room RH

RM RH displays the relative humidity value in percent. RM RH can be used for PPCL in the PTEC or unbundled for control or monitoring purposes.

Room DEW POINT

The controller provides a calculation for DEW POINT temperature in Fahrenheit degrees (or Celsius degrees) using room temperature (using CLT TEMP) and room

humidity (using RM RH). This calculation is valid for ranges of 55°F (12.8°C) to 95°F (35°C) and 20 to 100% relative humidity.

Room ENTHALPY

The controller provides a calculation for room Enthalpy using room temperature (using CLT TEMP) and room humidity (using RM RH). This calculation is valid for ranges of 55 F to 95 F and 20% to 100% relative humidity.

Auto Discovery

Auto Discovery allows you to automatically discover and identify PTEC controller devices on the BACnet MS/TP Network. There are two basic configurations:

- Devices not configured with an address. (Devices are discovered by their unique serial number.)
- Devices configured with an address and available for modification.

Auto Addressing

Auto Addressing allows you to automatically assign device addresses to a PTEC controller on the BACnet MS/TP Network. If a controller is not configured with a MAC address, you have the option to auto-address or manually address the controller. During this time the baud rate is automatically detected by the controller.

Controller(s) must be connected on the BACnet/IP network in order for automatic addressing to occur.

Fan Operation

In day mode, FAN is ON all of the time.

In night mode, the fan only operates when required for heating or cooling.

In night heating, the fan turns ON when the temperature drops below the value of CTL STPT minus NGT DBAND. When the temperature rises above CTL STPT, the fan turns OFF.

If any stage of electric heat is ON, the fan will be ON. The fan will remain ON for 30 seconds after the last stage of electric heat is turned OFF.

In night cooling, the fan turns ON when the temperature rises above the value of CTL STPT plus NGT DBAND. When the temperature drops below CTL STPT, the fan turns OFF.

If the DX coil is ON, the fan is ON. The fan remains ON for 30 seconds after the DX coil is turned OFF.

PPCL STATUS

PPCL STATUS displays LOADED or EMPTY.

- LOADED = PPCL programming is present in the controller. A new application number must be assigned (12000 through 12999).
- EMPTY = NO PPCL programming is present.

The maximum number of PPCL dynamic points is 15.

Fail Mode Operation

The Unit Vent Controller has a fail-safe operation that can be triggered by several occurrences.

A low temperature detection thermostat (LTDT) can be used to signal the controller when the temperature sensed by the LTDT is below the low temperature limit.

If the room temperature sensor input to the controller fails or the LTDT equals ON, the controller goes through the following shutdown sequence:

- Outdoor air damper is closed.
- Heating is full ON (except electric which is OFF).
- DX cooling is full OFF.
- Face-bypass damper is open to face.
- Fan is OFF.
- Auxiliary radiation is OFF.
- 2-position heating valve actuator is open.

* Firmware Revision BE50 or later has been updated to improve working with the Wireless Mesh Thermostats. These devices put ROOM TEMP into OVRD mode (and report the point as FAIL) but will not activate the Fail Mode Operation. OVRD mode will be cleared if the Wireless Mesh Thermostats battery fails or is removed, and the Fail Mode Operation will be activated.

NOTE:
DO 2 will not be commanded by the fail mode; all other DOs can be affected.

If the discharge air temperature sensor fails, the following conditions occur:

- If the last valid value is greater than 150°, then the heat is turned OFF, the outdoor air damper is closed, and the fan is turned ON.
- If the sensor does not come back within 10 minutes or if the last valid value is less than 150°, then the controller shuts down as described above.
- In the failed state, temperature control is not possible.

If a failed sensor returns or if the LTDT turns OFF, then normal control resumes.

Application Notes

- If the unit ventilator cycles excessively, if the temperature swings in the room are excessive or if there is trouble in maintaining the setpoint, then either the cooling loop, the heating loop, or both need to be tuned.
- The Unit Vent Controller as shipped from the factory keeps all associated equipment OFF. See the *Start-up Procedures* document for how to release the controller and its equipment to application control.
- When the fan is manually switched OFF at the unit fan speed switch, the actuators should be wired so they return to their normal state.

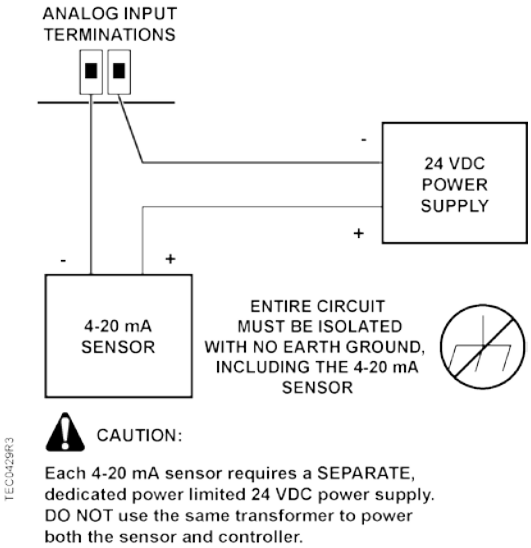
Wiring Diagram

CAUTION

The controller's DOs control 24 Vac loads only. The maximum rating is 12 VA for each DO. An external interposing relay is required for any of the following:

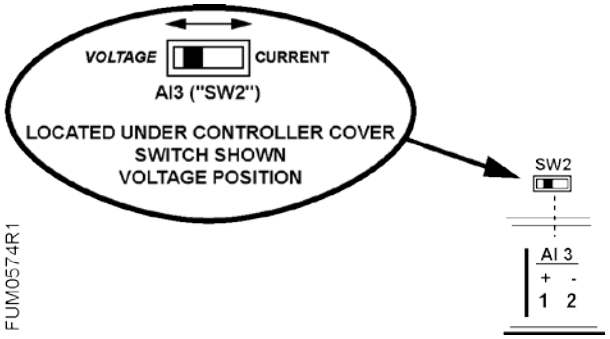
- VA requirements higher than the maximum
- 110 or 220 Vac requirements
- DC power requirements
- Separate transformers used to power the load
(for example part number 540-147, Terminal Equipment Controller Relay Module)

NOTE:
Thermistor inputs are 10K (default) or 100K software selectable (AUX TEMP AI X).

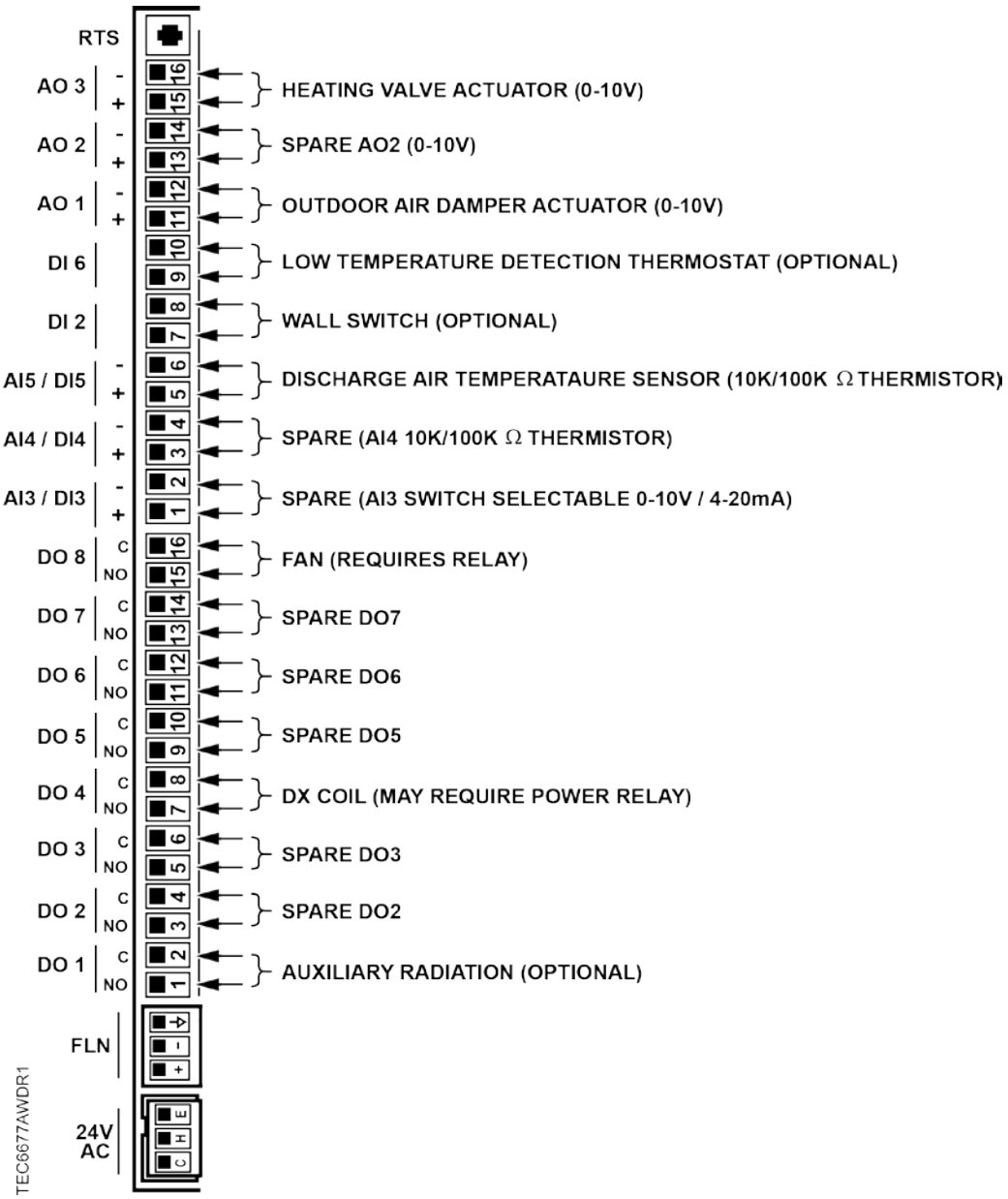


Wiring for AI with a 4 to 20 mA Sensor.

NOTE:
If the voltage/current switch is set to current and a 4 to 20 mA sensor is connected to an AI, then special wiring requirements must be followed.

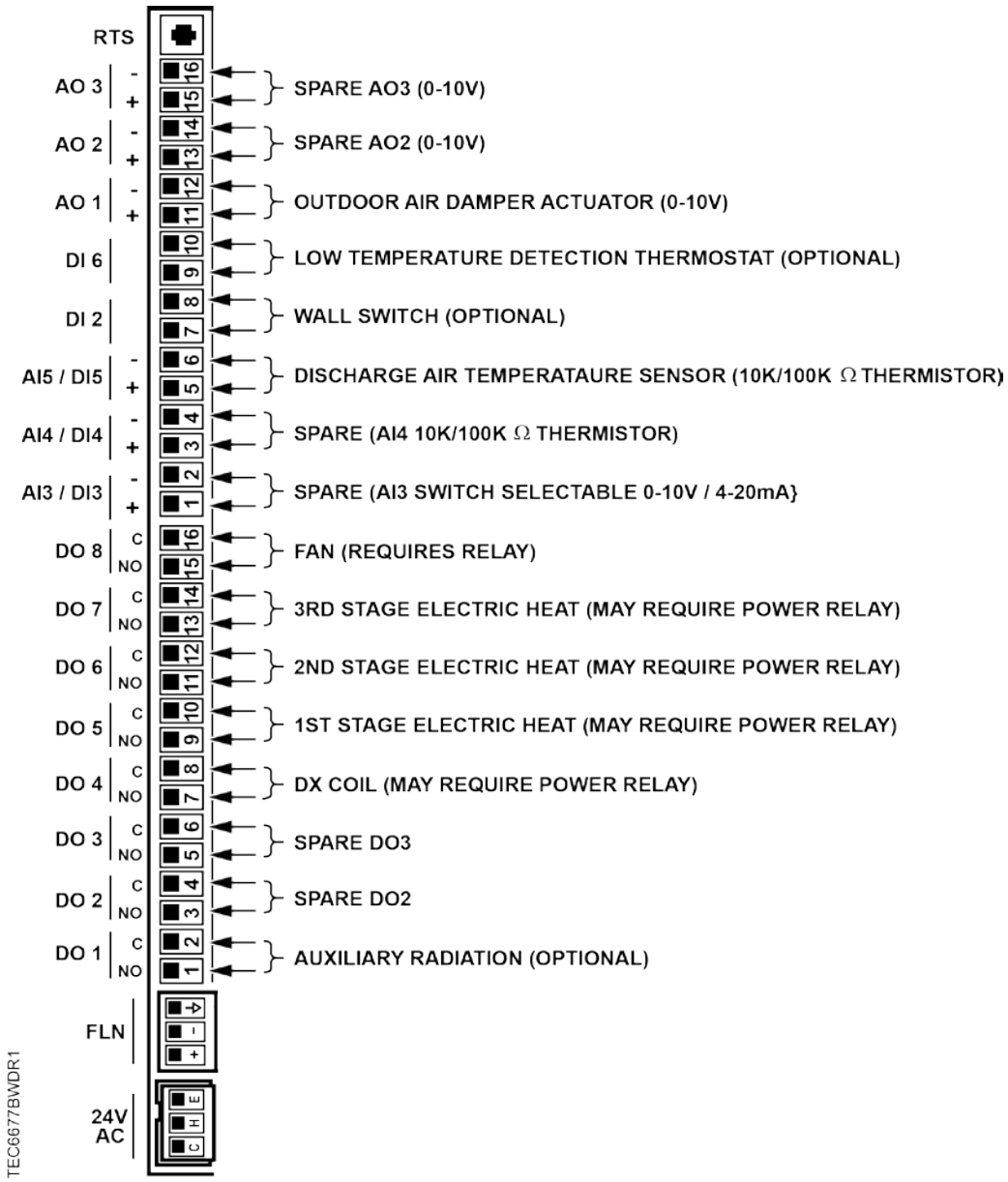


Wiring Diagram 1



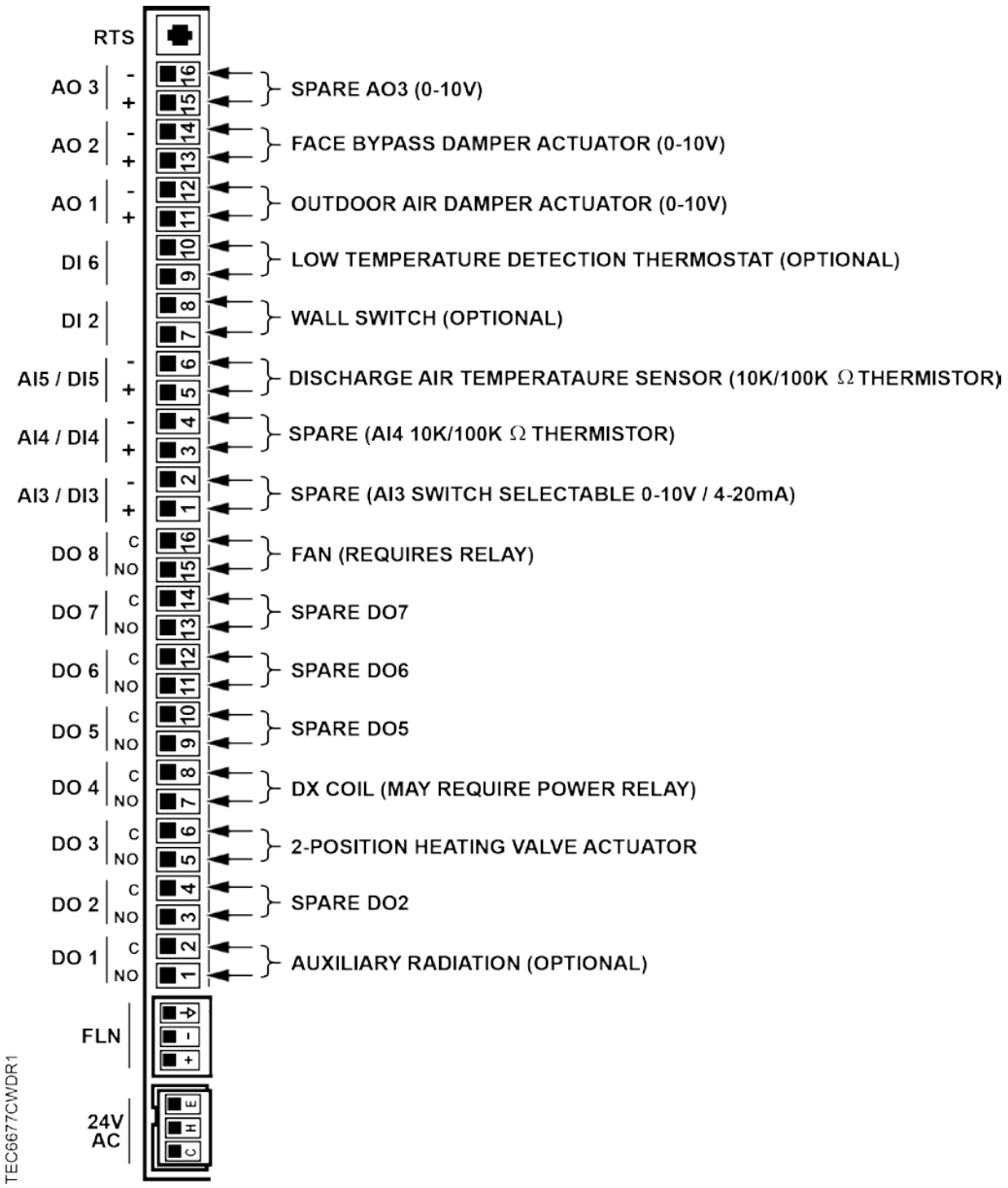
Application 6677 Wiring Diagram 1.

Wiring Diagram 2



Application 6677 Wiring Diagram 2.

Wiring Diagram 3



Application 6677 Wiring Diagram 3.

Application 6677 Point Database

Object Type[1]	Object Instance	Object Name (Descriptor)	Factory Default (SI Units)[2]	Eng Units (SI Units)	Range	Active Text	Inactive Text
AO	1	CTLR ADDRESS	255	--	0-255	--	--
AO	2	APPLICATION	6695	--	0-32767	--	--
AO	3	TEMP OFFSET	0.0 (0.0)	DEG F (DEG C)	-31.75-32	--	--
AI	{04}	ROOM TEMP	74.0 (23.45)	DEG F (DEG C)	48-111.75	--	--
BO	{05}	HEAT.COOL	COOL	--	Binary	HEAT	COOL
AO	6	DAY CLG STPT	74.0 (23.45)	DEG F (DEG C)	48-111.75	--	--
AO	7	DAY HTG STPT	70.0 (21.21)	DEG F (DEG C)	48-111.75	--	--
AO	8	NGT CLG STPT	82.0 (27.93)	DEG F (DEG C)	48-111.75	--	--
AO	9	NGT HTG STPT	65.0 (18.41)	DEG F (DEG C)	48-111.75	--	--
AO	10	OADPR MINPOS	14.8	PCT	0-102	--	--
AO	11	RM STPT MIN	55.0 (12.81)	DEG F (DEG C)	48-111.75	--	--
AO	12	RM STPT MAX	90.0 (32.41)	DEG F (DEG C)	48-111.75	--	--
AI	{13}	RM STPT DIAL	74.0 (23.45)	DEG F (DEG C)	48-111.75	--	--
BO	14	STPT DIAL	NO	--	Binary	YES	NO
AI	{15}	DISCH TEMP	74.0 (23.496)	DEG F (DEG C)	37.5-165	--	--
BO	17	FBP.MODVALVE	VALVE	--	Binary	FBP	VALVE
BO	18	WALL SWITCH	NO	--	Binary	YES	NO
BI	{19}	DI OVRD SW	OFF	--	Binary	ON	OFF
AO	20	OVRD TIME	1	HRS	0-255	--	--
BO	{21}	NGT OVRD	NIGHT	--	Binary	NIGHT	DAY
BO	22	AUX.NOAUX	NOAUX	--	Binary	AUX	NOAUX
BO	{23}	FREE CLG	DISABL	--	Binary	ENABLE	DISABL
BI	{24}	DI 2	OFF	--	Binary	ON	OFF
BI	{25}	DI 5	OFF	--	Binary	ON	OFF
BI	{26}	LOW TEMP DET	ON	--	Binary	OFF	ON
BO	27	ELEC.NOELEC	NOELEC	--	Binary	ELEC	NOELEC
BO	28	FBP.2PSVCTL	DISABL	--	Binary	ENABLE	DISABL

Object Type[1]	Object Instance	Object Name (Descriptor)	Factory Default (SI Units)[2]	Eng Units (SI Units)	Range	Active Text	Inactive Text
BO	{29}	DAY.NGT	DAY	--	Binary	NIGHT	DAY
BO	{30}	WRMUP.COOLDN	ON	--	Binary	ON	OFF
AO	31	AOV1 SPAN	10	VOLTS	0-10.23	--	--
AO	32	AOV1 START	0	VOLTS	0-10.23	--	--
AO	33	AOV2 SPAN	10	VOLTS	0-10.23	--	--
AO	34	AOV2 START	0	VOLTS	0-10.23	--	--
AO	35	AOV3 SPAN	10	VOLTS	0-10.23	--	--
AO	36	AOV3 START	0	VOLTS	0-10.23	--	--
AO	37	AO DIR.REV	0	--	0-255	--	--
AO	{38}	AOV1	0	VOLTS	0-10.23	--	--
AO	{39}	AOV2	0	VOLTS	0-10.23	--	--
AO	{40}	AOV3	0	VOLTS	0-10.23	--	--
BO	{41}	AUX RAD	OFF	--	Binary	ON	OFF
BO	{42}	DO 2	OFF	--	Binary	ON	OFF
BO	{43}	HTG 2POS VLV	OFF	--	Binary	ON	OFF
BO	{44}	DX	OFF	--	Binary	ON	OFF
BO	{45}	EHEAT 1	OFF	--	Binary	ON	OFF
BO	{46}	EHEAT 2	OFF	--	Binary	ON	OFF
BO	{47}	EHEAT 3	OFF	--	Binary	ON	OFF
AI	{48}	AI 3	0	PCT	0-102	--	--
AI	{49}	AUX TEMP AI4	74.0 (23.496)	DEG F (DEG C)	37.5-165	--	--
BO	{50}	FAN	OFF	--	Binary	ON	OFF
BI	{51}	DI 3	OFF	--	Binary	ON	OFF
BI	{52}	DI 4	OFF	--	Binary	ON	OFF
BO	53	NGT HW HTG	YES	--	Binary	YES	NO
BO	54	NGT CLG MODE	NO	--	Binary	YES	NO
AO	{55}	AUX OUTPUT	0	PCT	0-102	--	--
AO	57	AUX HTG TIME	10	MIN	0-255	--	--
AO	58	EHT STG DELY	30	SEC	0-255	--	--
AO	59	DO DIR.REV	0	--	0-255	--	--
AO	{60}	HTG OUTPUT	0	PCT	0-102	--	--
AO	{61}	CLG OUTPUT	0	PCT	0-102	--	--
AO	{62}	OA DMPR POS	0	PCT	0-102	--	--
AO	63	CLG P GAIN	1.6 (2.88)	--	0-51	--	--
AO	64	CLG I GAIN	0.05 (0.09)	--	0-2.0475	--	--
AO	65	CLG D GAIN	10 (18.0)	--	0-2046	--	--

Object Type[1]	Object Instance	Object Name (Descriptor)	Factory Default (SI Units)[2]	Eng Units (SI Units)	Range	Active Text	Inactive Text
AO	66	CLG BIAS	50	PCT	0-102.2	--	--
AO	67	HTG P GAIN	0.4 (0.72)	--	0-12.75	--	--
AO	68	HTG I GAIN	0.015 (0.027)	--	0-0.819	--	--
AO	69	HTG D GAIN	5 (9.0)	--	0-1023	--	--
AO	70	HTG BIAS	50	PCT	0-102.2	--	--
AO	71	ROOM P GAIN	2.3 (4.14)	--	0-12.75	--	--
AO	72	ROOM I GAIN	0.00504 (0.009072)	--	0-0.36855	--	--
AO	73	ROOM D GAIN	76 (136.8)	--	0-510	--	--
AO	74	ROOM BIAS	72.0 (22.376)	DEG F (DEG C)	37.5-165	--	--
AO	75	CMP MIN OFF	5	MIN	0-255	--	--
AO	76	CMP MIN ON	5	MIN	0-255	--	--
AO	{77}	AUX LOOPOUT	0	PCT	0-102.2	--	--
AO	{78}	CTL TEMP	74.0 (23.45)	DEG F (DEG C)	48-111.75	--	--
AO	{79}	CLG LOOPOUT	0	PCT	0-102.2	--	--
AO	{80}	HTG LOOPOUT	0	PCT	0-102.2	--	--
AO	{81}	AUX P GAIN	0.2 (0.36)	--	0-5.1	--	--
AO	{82}	AUX I GAIN	0.00054 (0.000972)	--	0-0.36855	--	--
AO	{83}	AUX D GAIN	24 (43.2)	--	0-255	--	--
AO	{84}	AUX BIAS	0	PCT	0-102.2	--	--
AO	85	SWITCH LIMIT	4.8	PCT	0-102	--	--
AO	86	SWITCH TIME	10	MIN	0-255	--	--
AO	88	NGT DBAND	3.0 (1.68)	DEG F (DEG C)	0-63.75	--	--
AO	89	MORN DBAND	2.0 (1.12)	DEG F (DEG C)	0-63.75	--	--
AO	90	SWITCH DBAND	2.0 (1.12)	DEG F (DEG C)	0-63.75	--	--
AO	{91}	AUX DSH STPT	80.0 (26.856)	DEG F (DEG C)	37.5-165	--	--
AO	{92}	CTL STPT	74.0 (23.45)	DEG F (DEG C)	48-111.75	--	--
AO	{93}	DISCH STPT	74.0 (23.496)	DEG F (DEG C)	37.5-165	--	--
AO	94	DSH MIN TEMP	60.0 (15.656)	DEG F (DEG C)	37.5-165	--	--
AO	95	DSH MAX TEMP	110.0	DEG F	37.5-165	--	--

Object Type[1]	Object Instance	Object Name (Descriptor)	Factory Default (SI Units)[2]	Eng Units (SI Units)	Range	Active Text	Inactive Text
			(43.656)	(DEG C)			
AO	98	LOOP TIME	5	SEC	0-255	--	--
AO	{99}	ERROR STATUS	0	--	0-255	--	--
AO	106	STPT SPAN	0.0 (0.0)	DEG F (DEG C)	0-63.75	--	--
AO	{121}	DEW POINT	-40.0 (-40.0)	DEG F (DEG C)	-40-1598.35	--	--
AO	{122}	ENTHALPY	0	BTU.LB	0-8191.75	--	--
AO	124	SENSOR SEL	0	--	0-255	--	--
AI	{125}	RM CO2	1000	PPM	0-8191	--	--
AI	{126}	RM RH	50	PCT	0-102	--	--
BO	{127}	PPCL STATE	EMPTY	--	Binary	LOADED	EMPTY

1) Object Types are; Analog Input (AI), Analog Output (AO), Binary Input (BI) and Binary Output (BO).

2) A single value in a column means that the value is the same in English units and in SI units.

3) Point numbers that appear in brackets { } may be unbundled at the field panel.

Issued by
Siemens Industry, Inc.
Building Technologies Division
1000 Deerfield Pkwy
Buffalo Grove IL 60089
Tel. +1 847-215-1000

Document ID	140-1182	140-1182(AA)
Edition	2014-08-06	Restricted