SIEMENS

BACnet PTEC Controller

Unit Conditioner Heating and Cooling Controller with Multi-Speed Fan, ON/OFF Switch, and Occupancy Sensor, Application 6611

Application Note

140-1178
2014-07-17

Restricted

Building Technologies

Table of Contents

Overview 5
BACnet 10
Hardware Inputs 10
Room Unit Identification 11
Hardware Outputs 11
Ordering Notes 11
Sequence of Operation 12
Point Limitations 12
Control Temperature Setpoints 12
CTL STPT Using Standard/Absolute Mode (Digital Room Unit, Revision 26 and later) 13
CTL STPT Using Warmer/Cooler Mode (Digital Room Unit, Revision 26 and later) 14
CTL STPT Using Standard/Absolute Mode (Analog or Digital Room Unit) 14
CTL STPT Using Warmer/Cooler Mode (Analog Room Unit Only) 15
Heating/Cooling Switchover 15
Heating/Cooling Switchover using Standard/Absolute Mode (Digital Room Unit, Revision 26 and later) 16
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
Room Temperature Configuration, Room Temperature Offset and CTL TEMP 19
ON and OFF Modes 20
OFF Override Mode 20
Occupied and Unoccupied Modes 20
Unoccupied Override Mode 21
Control Loops 22
Cooling Operation 22
Heating Operation 23
Floating Valve Control 23
Spring-Return Analog Valve Control 24
Fan Control 25
Heating and Cooling Stages 28
Alarms 31
Room Unit Operation 33
Sensor Select 33
Room CO2 33
Room RH 34

Room DEW POINT....34
Auto Discovery....34
Auto Addressing....34
PPCL STATUS....34
Fail Mode Operation....35
Application Notes....35
Wiring Diagram....36
Application 6611 Point Database....38

Overview

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

The controller can be configured in a variety of ways to provide temperature control, with the following features supported:

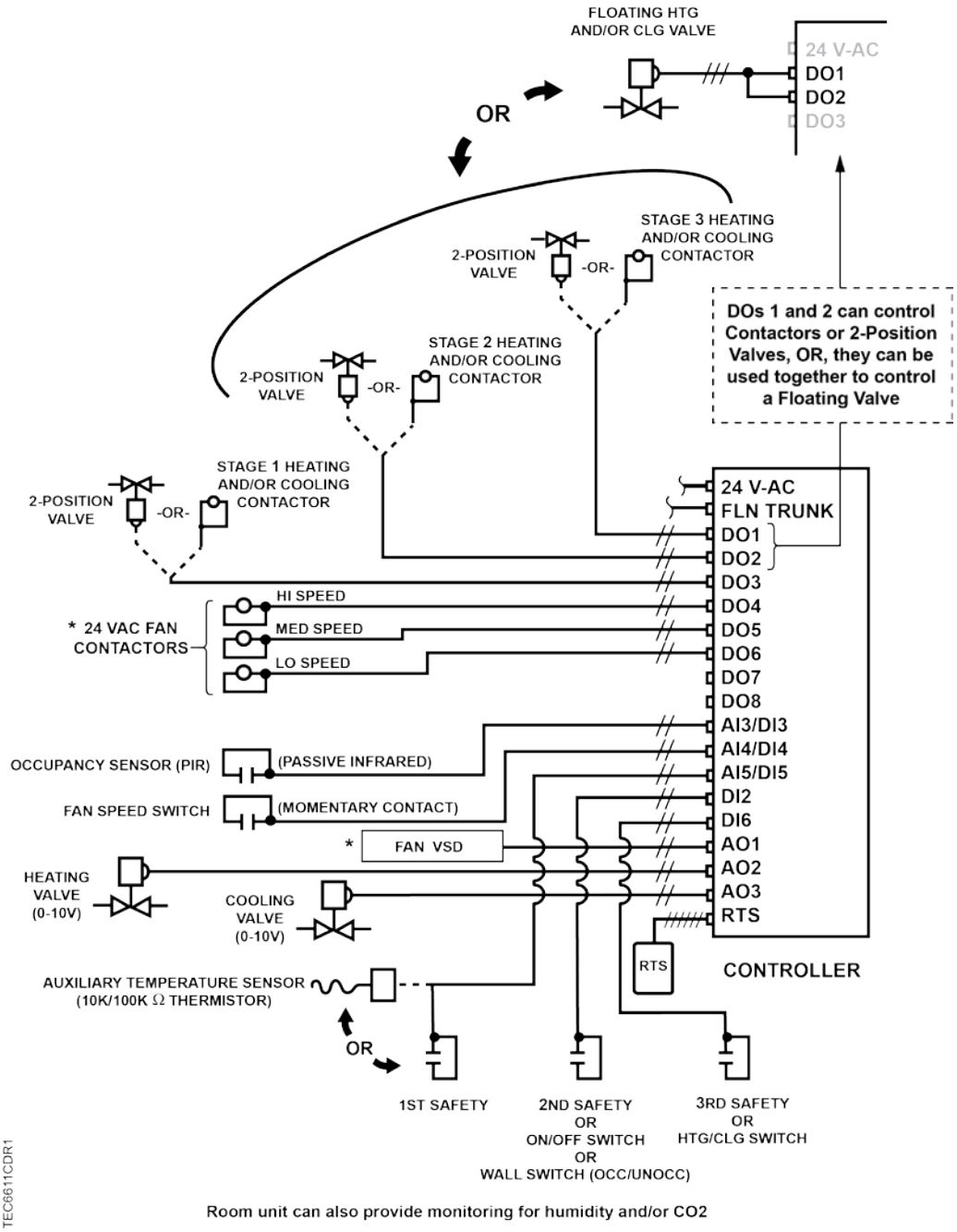
- Separate modulating, spring return heating and cooling valves (each one using a 0–10 Volt AOV).
- Up to 3 ON/OFF stages using DOs 1 through 3 that can either be heating stages, cooling stages, or combination heating and cooling stages used to control electric heat, DX cooling or 2-position valves; OR, a floating control valve (using DOs 1 and 2) which can be a heating valve, a cooling valve, or a combination heating/cooling valve.

The central plant must provide chilled water for any cooling valve being controlled and hot water for any heating valve being controlled. Also, if combination heating/cooling valves are used, the central plant must ensure that only hot water is provided in the heating season and chilled water in the cooling season.

Application 6611 controls a multi-speed fan to circulate room air. Fan speed is varied by using 3 DOs for low, medium, and high speed, or by using a 0–10V AOV to operate a variable speed drive.

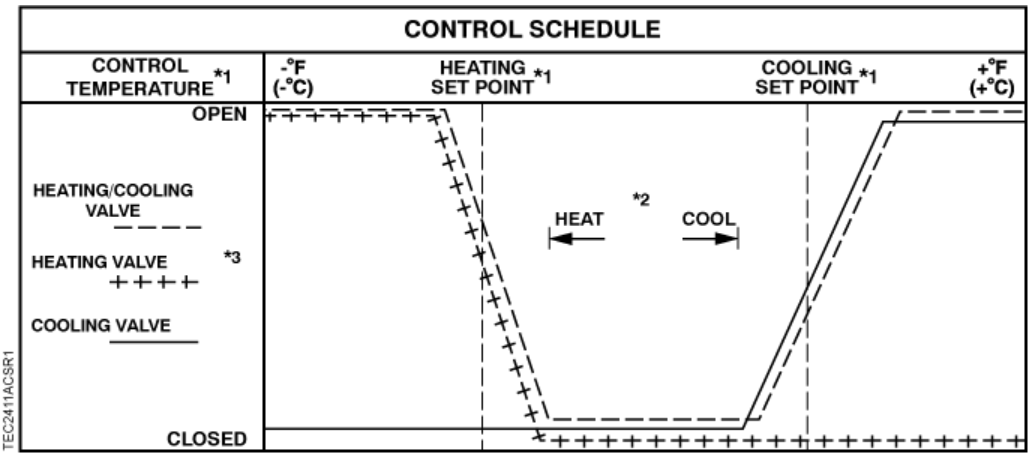
This application can also:

- Set controller to ON and OFF modes with an ON/OFF switch.
- Set occupancy mode by using an occupancy sensor, a night override button, or a wall switch. (Different set points are used in the occupied and unoccupied modes.)
- Determine the heating/cooling mode by sensing the room load or by using the status of a DI contact.
- Use up to 3 DIs for three different alarms. Also, three different alarm levels are supported.
- Control the room temperature or an auxiliary temperature such as return air or supply air.
- Operate either as part of a network or stand-alone.



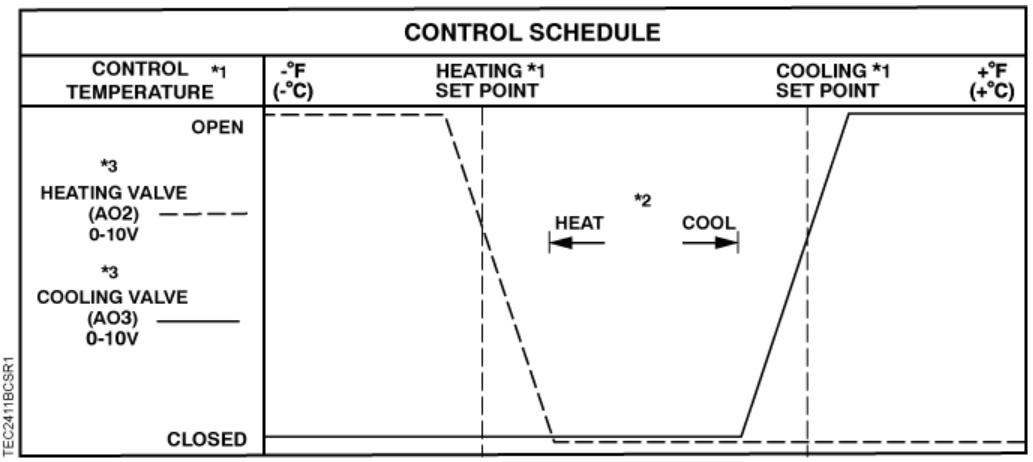
Application 6611 Control Diagram.

*Although the firmware for this application allows DOs 4, 5, and 6 as well as AO 1 to be used for fan speed control, box manufacturers do not readily support both types of fan control (digital and analog) on the same terminal box.



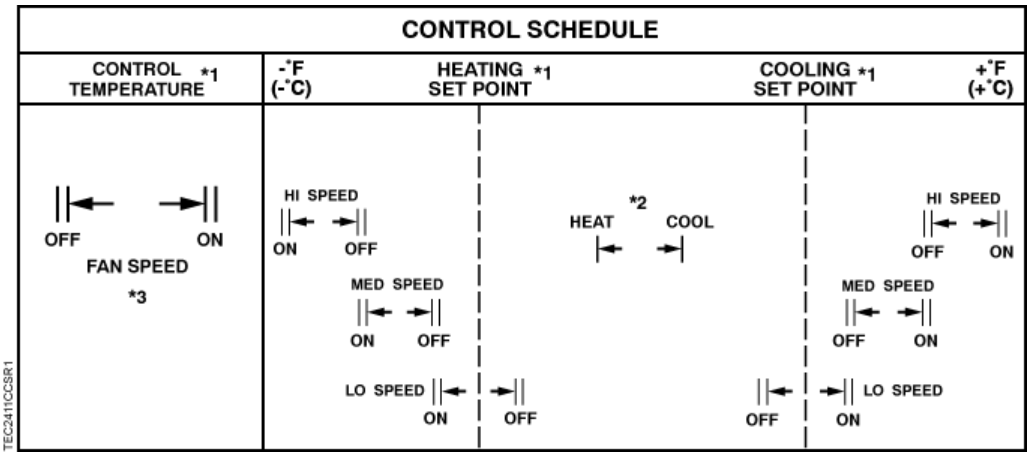
Control Schedule for Floating Valve Controlled by DO 1 and DO 2.

1. See *Control Temperature Setpoints*.
2. See *Heating/Cooling Switchover*.
3. See *Floating Valve Control*.



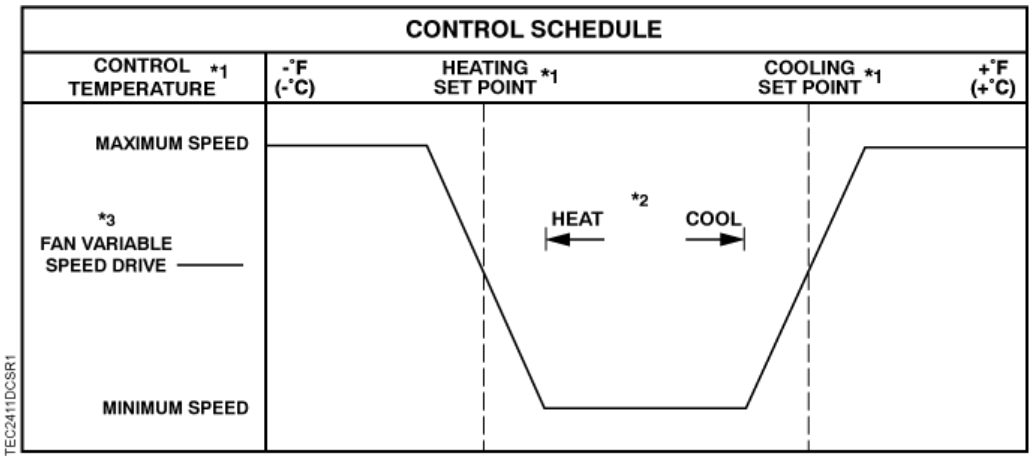
Control Schedule for 0–10V Heating and Cooling Valves.

1. See *Control Temperature Setpoints*.
2. See *Heating/Cooling Switchover*.
3. See *Spring Return Valve Control*.



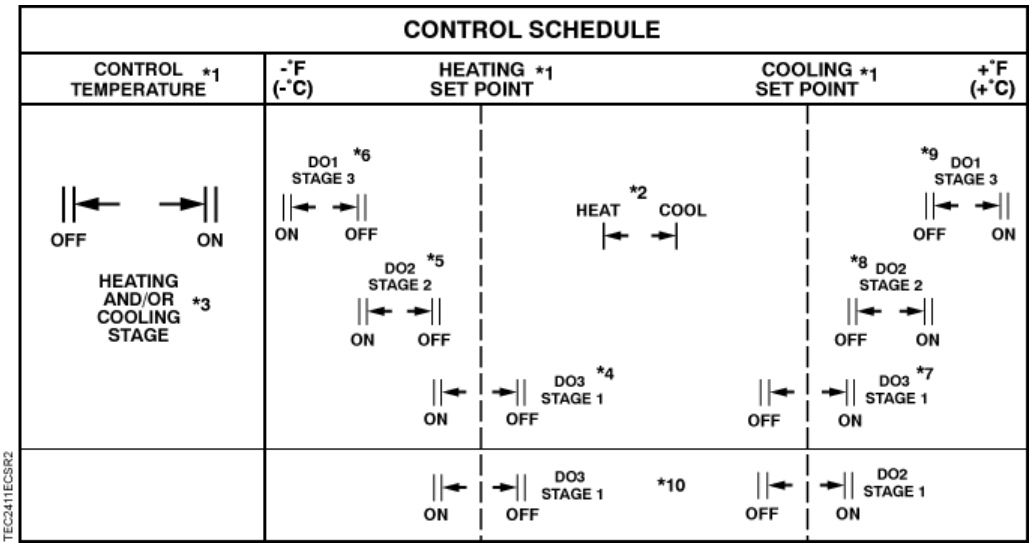
Multi-Speed Fan Control Schedule.

1. See *Control Temperature Setpoints*.
2. See *Heating/Cooling Switchover*.
3. See *Fan Control by DOs*.



Fan Variable Speed Drive Control Schedule.

1. See *Control Temperature Setpoints*.
2. See *Heating/Cooling Switchover*.
3. See *Fan Control by Variable Speed Drive*.



Control Schedule for Heating and/or Cooling Stages.

1. See *Control Temperature Setpoints*.
2. See *Heating/Cooling Switchover*.
3. See *Heating and Cooling Stages*.
4. DO 3 configured as a heating stage or as a combination heating/cooling stage.
5. DO 2 configured as a heating stage or as a combination heating/cooling stage.
6. DO 1 configured as a heating stage or as a combination heating/cooling stage.
7. DO 3 configured as a cooling stage or as a combination heating/cooling stage.
8. DO 2 configured as a cooling stage or as a combination heating/cooling stage.
9. DO 1 configured as a cooling stage or as a combination heating/cooling stage.
10. Controller is configured to have only 1 stage of heating and only 1 stage of cooling using DOs 3 and 2, respectively. See the *Heating and Cooling Stages* section for more information.

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

- Auxiliary temperature sensor (10K or 100K) (optional, when not used for DI)
- Room temperature sensor
- Room temperature setpoint dial (optional)
- Spare temperature sensor (10K or 100K) (when not used for DI)
- Spare analog sensor (0-10Vdc or 4-20 mA) (when not used for DI)

Digital

- Night mode override and maximum of five DIs
- ON/OFF switch (optional)
- Heat/Cool switch (optional)
- Occupancy sensor
- Alarms (up to three) (optional)
- 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

Analog

- Fan variable speed drive (optional)
- Heating valve actuator
- Cooling valve actuator

Digital

- Valve actuator (uses 2 DOs) (optional)
- Fan (switched 24 Vac, pilot duty); up to three speeds; each speed uses 1 DO
- Staged heating, cooling, or heating/cooling; up to 3 stages; each stage uses 1 DO
- Spare DOs

Ordering Notes

You can order the Siemens BACnet PTEC Unit Conditioner Heating and Cooling Controller with Multi-Speed Fan, ON/OFF Switch, and Occupancy Sensor as 540-863LN. If push-button fan speed control is desired, you will need the Series 2000 or 2200 Room Temperature Sensor with Fan-Speed Control.

(If push-button fan speed control is not desired, a regular Series 2200/2300 Digital Room Temperature Sensor can be used.)

550-480PA	Siemens BACnet PTEC Unit Conditioner Heating and Cooling Controller with Multi-Speed Fan, ON/OFF Switch, and Occupancy Sensor
QPA228x.xWNC	Series 2200 Room Temperature Sensor (**with** Fan Speed Control)
QPA228x.xWSC	Series 2200 Room Temperature Sensor (**without** Fan Speed Control)

Sequence of Operation

The following paragraphs present the sequence of operation for the Siemens BACnet PTEC Unit Conditioner Heating and Cooling Controller with Multi-Speed Fan, ON/OFF Switch, and Occupancy Sensor.

Point Limitations

Application 6611 supports a large number of features with a standard number of points. To do this, some inputs and outputs must support multiple features which cannot be in use at the same time, see Table *Limitation of Points*.

Limitation of Points			
I/O Termination	Can be used for		
	Either	Or	Or
DI 2	2nd Alarm	ON/OFF Switch	Occ/Unocc Button
AI 4/DI 4 (Same physical point)	DI 4 As fan speed control	AI 4 As Temp Sensor (spare)	AI 4 As room temperature source (per TEMP CONFIG)
AI 5/DI 5 (Same physical point)	DI 5 1st Alarm	AUX TMP AI 5 Auxiliary Temp Sensor	AUX AI 5 As room temperature source (per TEMP CONFIG)
DI 6	3rd Alarm	Heating/Cooling Switch	--
DO 1 DO 2	Floating Control	Staged Heating and/or Cooling	--

It is assumed that the hardware needed to support the feature being described has been properly configured. See the *Start-up* document for complete information on configuration.

Control Temperature Setpoints

This application has a number of different room temperature setpoints (DAY HTG STPT, NGT CLG STPT, RM STPT DIAL, etc.). The application actually controls using the CTL STPT. CTL STPT is set to different values depending on its override status, the time of day, whether or not a temperature deadband (zero energy band) has been configured, and the type of RTS used.

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

The heating/cooling switchover determines whether the controller is in heating or cooling mode. The application makes this determination in one of three ways:

- By a command from the field panel or PPCL in the PTEC.
- By using DI 6 to control the status of HEAT.COOL.
- By monitoring room load.

Field Panel Command or PPCL in the PTEC – HEAT.COOL can, if desired, be commanded at any time by using the field panel. But, if either VALVE TYPE or STAGE

TYPE = 3, indicating that a control element might either heat or cool the space, then HEAT.COOL must be set by the field panel (based on availability of the correct heating/cooling medium).

DI 6 – If DI 6 CONFIG = 3, the application commands HEAT.COOL based on the status of DI 6. This method of heating/cooling switchover is useful when controlling heating/cooling stages or a combination heating/cooling valve. DI 6 can be connected to a two-position temperature sensor monitoring water temp in the valve. HEAT.COOL is set to HEAT when hot water is detected, and to COOL when cold water is detected.

Room Load – When neither DI 6 CONFIG, VALVE TYPE nor STAGE TYPE = 3, the heating/cooling switchover will determine whether the controller is in heating or cooling mode by monitoring the room temperature and the demand for heating and cooling (as determined by the temperature control loops). The way this happens is as follows:

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 < SWITCH LIMIT
- CTL TEMP > CTL STPT by at least the value set in SWITCH DBAND
- CTL TEMP > 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 < SWITCH LIMIT
- CTL TEMP < CTL STPT by at least the value set in SWITCH DBAND
- CTL TEMP < the appropriate heating setpoint minus SWITCH DBAND

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) [→ 16]
- 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) [→ 17]
- 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 Configuration, Room Temperature Offset and CTL TEMP

Configuration TEMP CONFIG specifies the source for ROOM TEMP which can be from the room temperature sensor (RTS) room unit, analog input AI4 or analog input AI5. Default TEMP CONFIG value is 1 (RTS room unit) in the following table.

TEMP CONFIG Value	Function	Note
1 (default)	room temperature input from external source	Room unit or network command
4	Use thermistor input from AI4	range limited to 48 to 95°F for control
5	Use thermistor input from AUX TEMP AI5	range limited to 48 to 95°F for control (also see AI5/DI5 CONFIG to set as temp input)
Other values	Invalid	Firmware will revert to default value (1)

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

CTL TEMP is the 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 (via room unit or AI4 or AI5) are related by the following equation:

CTL TEMP = ROOM TEMP + RMTMP OFFSET
or
CTL TEMP = AUX TEMP AI5 + RMTMP OFFSET
or
CTL TEMP = AI4 + RMTMP OFFSET

If CTL TEMP is not overridden, then:

- The current value of ROOM TEMP (normal or overridden) will be used to determine the value of CTL TEMP.
- Based on which sensor is selected, if the temperature sensor has a status of Failed the last known good value of the selected sensor will be used to determine the value of CTL TEMP.

If CTL TEMP is overridden then:

- CTL TEMP equals its overridden value and the points ROOM TEMP, AI4, AUX TEMP AI5, and RMTMP OFFSET have no effect on the value of CTL TEMP.

ON and OFF Modes

In **ON mode**, the controller is engaged in normal space control. In **OFF mode** the controller provides no control at all, conserving energy.

Application 6611 allows ON.OFF to be commanded by an ON/OFF Switch.

If DI2 CONFIG is set to 3 and an ON/OFF switch is physically connected to the controller at DI2, the controller monitors DI 2 to determine its ON/OFF status.

- When DI 2 is **ON** (the switch is closed), ON.OFF is set to ON, indicating that the controller is ON and all equipment is being controlled according to the occupied or unoccupied sequences of operation.
- When DI 2 is **OFF** (the switch is open), ON.OFF is set to OFF, indicating that the controller is OFF.

If DI2 CONFIG is not set to 3, DI2 cannot be used for an ON/OFF switch.

- If the controller is operating stand-alone, the controller remains OFF until the user commands the ON.OFF point to ON. Once this is done, the controller will remain ON until the user commands the ON.OFF point to OFF.
- If the controller is operating with centralized control (connected to a field panel), the field panel can send an operator or PPCL command to override the status of ON.OFF. See the APOGEE Powers Process Control Language (PPCL) User's Manual (125-1896) and APOGEE BACnet ALN Field Panel User's Manual (125-3020) for more information.

When the controller is commanded to OFF mode (both ON.OFF and OFF OVRD equal OFF), controlled equipment is staged OFF in a manner appropriate to protect the equipment.

OFF Override Mode

When ON.OFF = OFF, an occupancy sensor (passive infrared (PIR) or other) connected to DI3 (PIR DI 3) can turn the controller back ON for a certain period of time if the following conditions are true:

- PIR ENABLE set to either **2** or **3**.
- Value (in minutes) other than 0 has been entered into PIR TIME.

If these conditions are met, when PIR DI 3 is ON (the contact is closed), the controller is turned ON for the amount of time set in PIR TIME. The status of OFF OVRD changes to ON and remains there until PIR TIME elapses, at which point the controller returns to OFF mode and the status of OFF OVRD changes back to OFF.

Only when ON.OFF = OFF will an occupancy sensor connected to PIR DI 3 have any effect on the controller’s ON /OFF status.

Occupied and Unoccupied Modes

Application 6611 allows OCC.UNOCC to be commanded by a wall switch. If DI 2 CONFIG = 0 and WALL SWITCH = YES, and a wall switch is physically connected to the controller’s termination strip at DI 2, then the controller monitors the status of DI 2 in order to determine the occupied/unoccupied status of the space.

- When the status of DI 2 is ON (the switch is closed), OCC.UNOCC is set to OCC indicating that the controller is in occupied mode.

- When the status of DI 2 is OFF (the switch is open), OCC.UNOCC is set to UNOCC indicating that the controller is in unoccupied mode.

When WALL SWITCH equals NO, the controller does not monitor the status of a wall switch, even if one is connected to it.

- If the controller is operating stand-alone, the controller stays in occupied mode all the time.
- If the controller is operating with centralized control (connected to a field panel), the field panel can send an operator or PPCL command to override the status of OCC.UNOCC.

If DI 2 CONFIG does not equal 0, the controller will not use DI 2 as a wall switch, even if WALL SWITCH is set to YES.

When the controller is in OFF mode (both ON.OFF and OFF OVRD = OFF), neither a wall switch nor OCC.UNOCC has any effect.

Unoccupied Override Mode

If OCC.UNOCC = UNOCC, the controller can, for a period of time, be sent back into occupied mode either by an override switch on the temperature sensor or by the occupancy sensor.

Override Switch

The room occupant can reset the controller to occupied mode by pressing the override switch, provided the following conditions are true:

- Override switch present on the room temperature sensor.
- Value (in hours) other than 0 has been entered into OVRD TIME.
- Either ON.OFF or OFF OVRD (or both) is/are ON.

The status of UNOCC OVRD changes to OCC and remains there until the amount of time set in OVRD TIME elapses, at which point the controller returns to unoccupied mode and the status of UNOCC OVRD changes back to UNOCC.

While the controller is in occupied mode, the override switch on the room temperature sensor has no effect on the controller's occ/unocc status.

Occupancy Sensor

An occupancy sensor can send the controller back into occupied mode in either of two ways, depending on the value of PIR ENABLE. PIR ENABLE must equal 1 or 3. If PIR ENABLE = 1, the controller must be ON before PIR DI 3 can send it to occupied mode. PIR ENABLE = 3, the controller does not need to be ON before PIR DI 3 can send it to occupied mode.

PIR ENABLE = 1: When PIR ENABLE equals 1, PIR DI 3 resets the controller to occupied mode provided the following conditions are true:

- PIR DI 3 detects people in the room (PIR DI 3 = ON (closed).
- Value (in hours) other than zero has been entered into OVRD TIME.
- Either ON.OFF or OFF OVRD (or both) is ON.

When these conditions are met, the controller is reset to occupied mode for the amount of time set in OVRD TIME. The status of UNOCC OVRD changes to OCC and remains there until the override time elapses, at which point the controller returns to unoccupied mode and the status of UNOCC OVRD changes back to UNOCC.

PIR ENABLE = 3: If PIR ENABLE equals 3 and ON.OFF = ON, the occupancy sensor behaves identically as when PIR ENABLE equals 1 and ON.OFF = ON (see above). But if PIR ENABLE = 3 and ON.OFF = OFF (the controller is OFF) when PIR DI 3 detects people, the application must first turn the controller ON by setting OFF OVRD to ON (this ON period lasts for the amount of time stored in PIR TIME). Once OFF OVRD is set to ON and the controller is ON, the application then resets the controller to occupied mode for the amount of time set in OVRD TIME. The status of UNOCC OVRD changes to OCC and remains there until the override time elapses, at which point the controller returns to unoccupied mode as UNOCC OVRD changes back to UNOCC.

NOTE:
If PIR TIME is less than OVRD TIME, the controller will shut OFF before UNOCC OVRD changes back to UNOCC, ending occupied mode prematurely. If the customer finds this undesirable, PIR TIME can be set > OVRD TIME.

If the override switch is pressed after the occupancy sensor has sent the controller into occupied mode, the amount of time that the controller remains in occupied mode is reset to the full amount of time set in OVRD TIME. The same is true if the occupancy sensor detects people in the room after the override switch has been pressed—the amount of time is reset to the full OVRD TIME.

Control Loops

The Siemens BACnet PTEC Unit Conditioner Heating and Cooling Controller with Multi-Speed Fan, ON/OFF Switch, and Occupancy Sensor is controlled by two Proportional, Integral, and Derivative (PID) temperature loops.

The two temperature loops are a cooling loop and a heating loop. The active temperature loop maintains room temperature at the value in CTL STPT. See Control Temperature Setpoints.

Cooling Operation

In cooling mode, the controller uses CTL STPT and CTL TEMP as inputs for the cooling loop.

NOTE:
Cooling loops will be disabled and their outputs will equal 0 under the following circumstances:
- Both ON.OFF OFF OVRD = OFF.
- ALARM > 1 (A medium or high-level alarm has occurred.)
- FAN SPEED is manually set to OFF.

The output of the cooling loop is CLG LOOPOUT, which varies from 0 to 100% as the cooling load changes.
When in heating mode (HEAT.COOL = HEAT), the cooling loop is disabled and CLG LOOPOUT = 0%.

Heating Operation

In heating mode, the controller uses CTL STPT and CTL TEMP as inputs for the heating loop.

NOTE:
Heating loops will be disabled and their outputs will equal 0 under the following circumstances:
- Both ON.OFF OFF OVRD = OFF.
- ALARM > 1 (A medium or high-level alarm has occurred.)
- FAN SPEED is manually set to OFF.

The output of the heating loop is HTG LOOPOUT, which varies from 0 to 100% as the heating load changes.
When in cooling mode the heating loop is disabled and HTG LOOPOUT = 0%.

Floating Valve Control

Application 6611 can be set up to use DOs 1 and 2 together to operate a floating valve. If the valve loses power, when a non-spring return actuator is used, it stays in its last position rather than going fully opened or fully closed. This valve can be a heating only valve, a cooling only valve, or a heating/cooling valve. The operation of the valve depends on the value of VALVE TYPE shown in the *Floating Valve Configuration* table.

Floating Valve Configuration	
Value of VALVE TYPE	**Modulating (Floating) Valve Configuration**
0	No valve is used (DOs 1, 2 are available for stages)
1	Heating Valve only
2	Cooling Valve only
3	Heating and Cooling Valve

NOTE:
If the valve is enabled, MTR SETUP must be set to enable the floating motor driver. Also, MTR TIMING must be set to the proper value for the specific valve model used. See the appropriate *Start-up Procedures* for instructions to set MTR SETUP and MTR TIMING.

When the valve is used, it modulates to the position that is stored in VALVE COMD. VALVE COMD ranges from 0% Open to 100% Open. (For example, if VALVE COMD equals 58, the valve will go to a position of 58% open. If VALVE COMD equals 0, the valve will completely shut and if VALVE COMD equals 100 the valve will fully open.)

The valve will be completely shut (VALVE COMD will equal zero) under either of the following circumstances:

- ON.OFF and OFF OVRD both equal OFF.
- ALARM is greater than 1 (a medium or high-level alarm has occurred).

If neither of the above two conditions are true, the valve will be controlled as follows:

- If the valve is a heating valve (VALVE TYPE = 1), VALVE COMD equals HTG LOOPOUT when HEAT.COOL = HEAT and 0 when HEAT.COOL = COOL.
- If the valve is a cooling valve (VALVE TYPE = 2), VALVE COMD equals CLG LOOPOUT when HEAT.COOL = COOL and. VALVE COMD equals 0 when HEAT.COOL = HEAT
- If the valve is a heating/cooling valve (VALVE TYPE = 3), VALVE COMD equals HTG LOOPOUT when HEAT.COOL =HEAT and VALVE COMD equals CLG LOOPOUT when HEAT.COOL = COOL.

Spring-Return Analog Valve Control

In Application 6611, AOs 2 and 3 can be used as 0-10 V AOVs to control a spring return heating valve and a spring return cooling valve.

The application will:

- Close the heating valve by sending HTG AOV 2 to the voltage value that is stored in AOV 2 CLOSE.
- Open the heating valve by sending HTG AOV 2 to the voltage value that is stored in AOV 2 OPEN.
- Close the cooling valve by sending CLG AOV 3 to the voltage value that is stored in AOV 3 CLOSE.
- Open the cooling valve by sending CLG AOV 3 to the voltage value that is stored in AOV 3 OPEN.

Both the heating and cooling valves will be completely shut (HTG AOV 2 = AOV 2 CLOSE and CLG AOV 3 = AOV 3 CLOSE) under either of the following circumstances:

- Both ON.OFF and OFF OVRD = OFF.
- ALARM = 2 or 3 (a medium or high-level alarm, respectively, has occurred).

If neither of the above two conditions are true, the spring-return heating and cooling valves are controlled as follows:

When HEAT.COOL = HEAT, the voltage for the heating valve connected to HTG AOV 2 is scaled between AOV 2 CLOSE and AOV 2 OPEN as HTG LOOPOUT goes from 0% to 100%. The equation for this scaling is:

HTG AOV 2 = [(HTG LOOPOUT/100) × (AOV 2 OPEN – AOV 2 CLOSE)] + AOV 2 CLOSE.

Example

Assume AOV 2 CLOSE equals 8 Volts and AOV 2 OPEN equals 2 Volts. Then:

- If HTG LOOPOUT equals 0%, HTG AOV 2 will equal 8 Volts.
- If HTG LOOPOUT equals 30%, HTG AOV 2 will equal 6.2 Volts.
- If HTG LOOPOUT equals 80%, HTG AOV 2 will equal 3.2 Volts.
- If HTG LOOPUT equals 100%, HTG AOV 2 will equal 2 Volts.

When HEAT.COOL = COOL, the heating valve will be shut (HTG AOV 2 will equal AOV 2 CLOSE).

When HEAT.COOL = COOL the voltage for the cooling valve connected to CLG AOV 3 is scaled between AOV 3 CLOSE and AOV 3 OPEN as CLG LOOPOUT goes from 0% to 100%. The equation for this scaling is:

CLG AOV 3 = [(CLG LOOPOUT/100) × (AOV 3 OPEN – AOV 3 CLOSE)] + AOV 3 CLOSE.

Example

Assume AOV 3 CLOSE equals 5 Volts and AOV 3 OPEN equals 10 Volts. Then:

- If CLG LOOPOUT equals 0%, CLG AOV 3 will equal 5 Volts.
- If CLG LOOPOUT equals 30%, CLG AOV 3 will equal 6.5 Volts.
- If CLG LOOPOUT equals 70%, CLG AOV 3 will equal 8.5 Volts.
- If CLG LOOPUT equals 100%, CLG AOV 3 will equal 10 Volts.

When HEAT.COOL = HEAT, the cooling valve will be shut (CLG AOV 3 will equal AOV 3 CLOSE).

Fan Control

NOTE:
Although the firmware for this application allows DOs 4, 5, and 6 as well as AO 1 to be used for fan speed control, box manufacturers do not readily support both types of fan control (digital and analog) on the same terminal box.

Determining Fan Speed

Fan control priority goes in the following order, from highest to lowest:

1. User Override (local or from field panel)
2. ALARM
3. Manual control
4. OFF mode
5. Automatic control, occupancy sensor
6. Automatic control, heating/cooling loopout

User Override – The user can directly control the fan speed either locally or via PPCL in the PTEC or at the field panel by setting FAN SPEED to 0, 1, 2 or 3 (OFF, low, medium, or high respectively).

Alarms – If ALARM equals 3, the fan speed is set to OFF. ALARM has no effect on the fan when it equals 0, 1 or 2.

Manual Control – (FAN MODE = MANUAL) When the fan operates under manual control, DI 4 monitors a momentary contact that cycles the fan speed when pressed. The pattern of this cycle depends on the value of FAN SPD CNT.

- If FAN SPD CNT = 3, fan speed toggles from OFF to Low to Medium to High and back to OFF.
- If FAN SPD CNT = 2, fan speed toggles from OFF to Low to Medium and back to OFF.
- If FAN SPD CNT = 1, fan speed toggles between OFF and Low. The fan remains OFF if FAN SPD CNT = 0.

OFF Mode - If the unit is turned OFF (both ON.OFF and OFF OVRD are OFF), FAN SPEED is set to 0 (OFF). (If any heating stages were ON, then the fan must stay ON until the safeties have finished the shutdown sequence of the stages.) If desired, the fan can be commanded back on manually while the unit is OFF. When the unit returns

to ON mode after being OFF, the fan will remain in whatever state it was just in. That is, if it was ON it stays ON, but if the fan had not been commanded manually back ON while the controller was OFF, the fan does not automatically turn back ON when the controller returns to ON mode. (ON mode means that ON.OFF and/or OFF OVRD = ON.)

Automatic Control, Occupancy Sensor – (FAN MODE = AUTO) When the fan operates under automatic control, the application first checks whether the occupancy sensor has sent the application into OFF override or unoccupied override mode. If it has (OFF OVRD = ON or UNOCC OVRD = OCC), the fan runs at the highest available speed as determined by FAN SPD CNT until the room temperature (CTL TEMP) comes within SWITCH DBAND value of the desired room temperature setpoint (CTL STPT), or until the amount of time set in FAN OVRD TIME elapses, whichever comes first. Fan speed is then released to normal automatic control, which varies depending on whether HEAT.COOL equals HEAT OR COOL.

NOTE:
If unoccupied override is initiated by the override button (DI OVRD SW), the application does not control the fan at its maximum speed for a period of time as described. Instead, the fan is released to normal automatic control immediately.

Automatic Control, HTG LOOPOUT – (HEAT.COOL = HEAT) If HTG MOD FAN = NO, FAN SPEED is set to HTG FAN SPD. If HTG MOD FAN = YES, HTG LOOPOUT controls FAN SPEED as follows. If:

- HTG LOOPOUT reaches FAN LO ON, fan speed is set to low.
  (HTG LOOPOUT must drop at least 5% below FAN LO ON before the fan will turn OFF; if FAN LO ON is set to 5% or less, the fan will not turn OFF.)
- HTG LOOPOUT reaches FAN MED ON, fan speed is set to medium.
  (HTG LOOPOUT must drop at least 5% below FAN MED ON (or to 0, whichever is larger) to return the fan to low speed.)
- If HTG LOOPOUT reaches FAN HI ON, fan speed is set to high.
  (HTG LOOPOUT must drop at least 5% below FAN HI ON (or to 0, whichever is larger) to return the fan to medium speed.)

Automatic Control, CLG LOOPOUT – (HEAT.COOL = COOL) When HEAT.COOL = COOL, CLG LOOPOUT controls the fan speed as follows. If:

- CLG LOOPOUT reaches FAN LO ON, fan speed is set to low.
  (CLG LOOPOUT must drop at least 5% below FAN LO ON before the fan will turn OFF; if FAN LO ON is set to 5% or less, the fan will not turn back OFF.)
- CLG LOOPOUT reaches FAN MED ON, fan speed is set to medium.
  (CLG LOOPOUT must drop at least 5% below FAN MED ON (or to 0, whichever is larger) to return the fan to low speed.)
- CLG LOOPOUT reaches FAN HI ON, fan speed is set to high.
  (CLG LOOPOUT must drop at least 5% below FAN HI ON (or to 0, whichever is larger) to return the fan to medium speed.)

NOTE:
If FAN SPEED is set to OFF while any configured heating and/or cooling stage(s) are ON, the fan does not stop running, but instead is kept ON until all stages are OFF. An exception exists if ALARM = 3, in which case the fan turns OFF immediately.

Fan Control by DOs

Application 6611 can control up to 3 fan speeds using DOs 4, 5, and 6. The value of FAN SPEED indicates which of these DOs are ON and which are OFF, with the different configurations determining fan speed as shown in the *Fan Speed Controlled by DOs* table.

Fan Speed Controlled by DOs			
FAN SPEED	**FAN HI DO 4**	**FAN MED DO 5**	**FAN LO DO 6**
0 (OFF)	OFF	OFF	OFF
1 (Low)	OFF	OFF	**ON**
2 (Med)	OFF	**ON**	OFF
3 (High)	**ON**	OFF	OFF

NOTE:
FAN SPD CNT defines the number of fan speeds used. Normal values are from 1 to 3. (Setting FAN SPD CNT to 0 disables the fan.) If one speed is defined, DOs 4 and 5 are spare. If 2 speeds are defined, only DO 4 is spare. (Note: The firmware for this application prohibits using DO 6 as a spare.)

Fan Control by AOV

Application 6611 can control fan speed by modulating a variable speed drive connected to FAN AOV 1.

If ALARM = equals 3, FAN AOV 1 is set to the voltage value held by AOV 1 FN ALM.

Manual Fan Control – When FAN MODE = MANUAL, FAN AOV 1 is set to different values depending on the value of FAN SPEED as shown in the *Fan Speed and AOV* 1 table.

Fan Speed and AOV 1	
FAN SPEED	**FAN AOV 1**
0 (Off)	AOV 1 FN OFF
1 (Low)	AOV 1 FN LOW
2 (Med)	AOV 1 FN MED
3 (Hi)	AOV 1 FN HI

Auto Fan Control – When FAN MODE = AUTO, FAN AOV 1 is controlled as follows:

HEAT.COOL = HEAT

- If HTG MOD FAN = NO, FAN SPEED is set equal to HTG FAN SPD and FAN AOV 1 is set according to values in the *Fan Speed and AOV* table.
- If HTG MOD FAN = YES, the voltage for FAN AOV 1 is scaled between AOV 1 FN OFF and AOV 1 FN HI as HTG LOOPOUT goes from 0% to 100%. The equation for this scaling is:

FAN AOV 1 = [(HTG LOOPOUT/100) × (AOV 1 FAN HI – AOV 1 FAN OFF)] + AOV 1 FAN OFF.

Example

If AOV 1 FAN OFF equals 3 Volts and AOV 1 FAN HI equals 8 Volts, then:

- If HTG LOOPOUT equals 0%, FAN AOV 1 will equal 3 Volts.
- If HTG LOOPOUT equals 40%, FAN AOV 1 will equal 5 Volts.
- If HTG LOOPOUT equals 70%, FAN AOV 1 will equal 6.5 Volts.
- If HTG LOOPUT equals 100%, FAN AOV 1 will equal 8 Volts.

HEAT.COOL = COOL

The voltage for FAN AOV 1 is scaled between AOV 1 FN OFF and AOV 1 FN HI as CLG LOOPOUT goes from 0% to 100%. The equation for this scaling is:

FAN AOV 1 = [(CLG LOOPOUT/100) × (AOV 1 FAN HI – AOV 1 FAN OFF)] + AOV 1 FAN OFF.

Example

If AOV 1 FAN OFF equals 9 Volts and AOV 1 FAN HI equals 2 Volts, then:

- If CLG LOOPOUT equals 0%, FAN AOV 1 will equal 9 Volts.
- If CLG LOOPOUT equals 20%, FAN AOV 1 will equal 7.6 Volts.
- If CLG LOOPOUT equals 80%, FAN AOV 1 will equal 3.4 Volts.
- If CLG LOOPUT equals 100%, FAN AOV 1 will equal 2 Volts.

Heating and Cooling Stages

Application 6611 can control a variety of configurations of heating and/or cooling stages. These stages can be heating only, cooling only, both heating and cooling, or 1 stage of heating and 1 stage of cooling. The exact configuration of the heating and cooling stages depends on the values of STAGE COUNT and STAGE TYPE.

Since so many variations of heating and cooling stages are possible, it would be cumbersome to explain which DOs turn ON and OFF for each stage control circumstance. Therefore, heating and cooling stages will be referred to in general terms (heating stage 1, cooling stage 3, etc.). To find out specifically which DOs are being controlled, see the *Heating and Cooling Stages Configuration* table. (The *Heating and Cooling Stages Configuration* table uses abbreviations for heating and cooling stages. Cooling stage 1 is abbreviated Clg 1, cooling stage 2 is Clg 2 and so on. Heating stages are treated the same.)

The table does not have any examples of STAGE COUNT or STAGE TYPE equaling 0. When STAGE COUNT or STAGE TYPE = 0, no heating or cooling stages are controlled. DO3 would be a spare while DOs 1 and 2 would be, depending on the value of MTR SETUP, either spare or working together to control a valve.

When STAGE TYPE = 4, DO 2 is the cooling stage and DO 3 is the heating stage regardless of the value of STAGE COUNT, as long as STAGE COUNT does not equal 0. (If STAGE COUNT = 0, the application will not control any heating or cooling stages.)

Each DO in the *Heating and Cooling Stages Configuration* table has 2 columns associated with it (one column for HEAT and another for COOL). These descriptors refer to the value of HEAT.COOL and show how each DO is controlled in heating mode and cooling mode.

Heating and Cooling Stages Configuration							
STAGE TYPE	STAGE COUNT	DO 1		DO 2		DO 3	
		HEAT	COOL	HEAT	COOL	HEAT	COOL
1	1					Htg 1	OFF
	2			Htg 2	OFF	Htg 1	OFF
	3	Htg 3	OFF	Htg 2	OFF	Htg 1	OFF
2	1					OFF	Clg 1
	2			OFF	Clg 2	OFF	Clg 1
	3	OFF	Clg 3	OFF	Clg 2	OFF	Clg 1
3	1					Htg 1	Clg 1
	2			Htg 2	Clg 2	Htg 1	Clg 1
	3	Htg 3	Clg 3	Htg 2	Clg 2	Htg 1	Clg 1
4	NOT 0			OFF	Clg 1	Htg 1	OFF

Heating and Cooling Stage Control Priority goes in the following order, highest too lowest:

1. User Override (local or from field panel)
2. ALARM
3. OFF mode or fan turning OFF
4. Automatic control, htg/clg loopout

User Override – The user can directly control the heating and cooling stages either locally or via PPCL at the field panel by overriding HTG LOOPOUT or CLG LOOPOUT.

Alarms – If ALARM equals 3 or 2, all stages of heating and cooling are immediately turned OFF. The ALARM point has no effect on the heating and cooling stages when ALARM equals 0 or 1.

OFF Mode or Fan turning OFF – When FAN SPEED changes to 0 (OFF), or when the controller changes from ON to OFF mode (both ON.OFF and OFF OVRD = OFF), the fan remains ON until any configured heating or cooling stages turn OFF. These stage(s) may or may not turn OFF immediately depending on whether the time set in STG OFF DLAY has elapsed—the time must elapse before the stage(s) turn OFF.

The amount of time stored in STG OFF DLAY is reset every time a heating or cooling stage changes status (turns ON or OFF). If the amount of time since a change in the status of a heating or cooling stage is less than the amount of time set in STG OFF DLAY (at a time when FAN SPEED is set to 0 or the controller is set to OFF mode), the time remaining in STG OFF DLAY must elapse before the heating or cooling stage(s) and fan are turned OFF.

Automatic Control, HTG LOOPOUT – When HEAT.COOL equals HEAT and all cooling stages have been shut OFF, the heating stages are controlled as follows: (Note: This description describes what happens as the heating load changes from low to high and back to low. It is assumed that STAGE COUNT = 3.)

- If heating stage 1 has been OFF for at least the amount of time set in H STG TIME, it turns ON as soon as HTG LOOPOUT reaches HTG 1 ON.
- If heating stage 1 has been ON for at least the amount of time set in H STG TIME, stage 2 turns ON as soon as HTG LOOPOUT reaches HTG 2 ON.

If heating stage 2 has been ON for at least the amount of time set in H STG TIME, stage 3 turns ON as soon as HTG LOOPOUT reaches HTG 3 ON.

If heating stage 3 has been ON for at least the amount of time set in H STG TIME, it turns OFF as soon as HTG LOOPOUT drops below HTG 3 ON.

- If heating stage 3 has been OFF for at least the amount of time set in H STG TIME, stage 2 turns OFF as soon as HTG LOOPOUT drops below HTG 2 ON.
- If heating stage 2 has been OFF for at least the amount of time set in H STG TIME, stage 1 turns OFF as soon as HTG LOOPOUT drops below HTG 1 ON.

CLG LOOPOUT – When HEAT.COOL = COOL and all heating stages have been shut OFF, the cooling stages are controlled as follows: (Note: This description describes what happens as the cooling load changes from low to high and back to low. It is assumed that STAGE COUNT = 3.)

- If cooling stage 1 has been OFF for at least the amount of time set in C STG TIME, it turns ON as soon as CLG LOOPOUT reaches CLG 1 ON.
- If cooling stage 1 has been ON for at least the amount of time set in C STG TIME, stage 2 turns ON as soon as CLG LOOPOUT reaches CLG 2 ON.
- If cooling stage 2 has been ON for at least the amount of time set in C STG TIME, stage 3 turns ON as soon as CLG LOOPOUT reaches CLG 3 ON.
- If cooling stage 3 has been ON for at least the amount of time set in C STG TIME, it turns OFF as soon as CLG LOOPOUT drops below CLG 3 ON.

If cooling stage 3 has been OFF for at least the amount of time set in C STG TIME, stage 2 turns OFF as soon as CLG LOOPOUT drops below CLG 2 ON.

- If cooling stage 2 has been OFF for at least the amount of time set in C STG TIME, stage 1 turns OFF as soon as CLG LOOPOUT drops below CLG 1 ON.

Operation of Heating and Cooling Stages during Heating/Cooling Switchover

If any heating stages are ON when HEAT.COOL changes from HEAT to COOL, they are shut OFF in a timed, orderly fashion as follows: The highest stage of heat that is ON (stage 3, 2, or 1) is immediately shut OFF if it has been ON for at least the full amount of time set in H STG TIME. If it has not been ON for the full amount of time, it stays ON until H STG TIME elapses and then it is shut OFF. The timer associated with H STG TIME gets reset and the next highest remaining stage of heat stays ON until the amount time set in H STG TIME elapses, after which it too is shut OFF. This process continues until all heating stages are OFF. Regardless of how high the value of CLG LOOPOUT is, no cooling stages will turn ON until all heating stages are OFF.

If any cooling stages are ON when HEAT.COOL changes from COOL to HEAT, they are shut OFF in a timed, orderly fashion in the same manner as the heating stages described above. The highest stage of cooling that is ON (stage 3, 2, or 1) will be shut OFF immediately if it has been ON for at least the full amount of time set in C STG TIME. If it has not been ON for the full amount of time, then it stays ON until C STG TIME elapses and then is shut OFF. The application resets the timer associated with C STG TIME and the next highest remaining stage of cooling stays ON until the time set in C STG TIME elapses, after which it too is shut OFF. This process continues until all

cooling stages are OFF. Regardless of how high the value of HTG LOOPOUT is, no heating stages will turn ON until all cooling stages are OFF.

Alarms

DI 2, DI 5, and DI 6 can be configured as safety inputs. Each safety input is also configured to have an associated alarm level.

ALARM is set to the highest level of alarm detected. DIs may also be monitored individually for specific alarms. See the *Start-up Procedures* for how to configure these safety points and their alarm levels.

The alarm levels determine the application's alarm sequence.

Alarm Levels	
Value of ALARM	**Result**
0	Alarm level 0 – No Alarm
1	Alarm level 1 (low level alarm) – No response, monitoring only
2	Alarm level 2 (medium level alarm) – All controls set to OFF except fan
3	Alarm level 3 (high level alarm) – All controls set to OFF including fan

Alarms are configured by setting the input parameters.

Alarm Levels for Application 6611		
Setup Point	**Value**	**Result**
SAFETY SET 1	0 1 2 3	DI 5 is not used for alarming DI 5 will trigger a low level alarm DI 5 will trigger a medium level alarm DI 5 will trigger a high level alarm
SAFETY SET 2	0 1 2 3	DI 2 is not used for alarming DI 2 will trigger a low level alarm DI 2 will trigger a medium level alarm DI 2 will trigger a high level alarm
SAFETY SET 3	0 1 2 3	DI 6 is not used for alarming DI 6 will trigger a low level alarm DI 6 will trigger a medium level alarm DI 6 will trigger a high level alarm
AIDI5 CONFIG	0 1 2 3	DI 5 is a spare input DI 5 is a N.O. Safety (DI 5 alarms when closed) DI 5 is a N.C. Safety (DI 5 alarms when opened) AI/DI 5 is an Aux temperature sensor
DI2 CONFIG	0 1 2 3	DI 2 is a spare input or available for use as a wall switch DI 2 is a N.O. Safety (DI 2 alarms when closed) DI 2 is a N.C. Safety (DI 2 alarms when opened) DI 2 is an ON/OFF Switch
DI6 CONFIG	0	DI 6 is a spare input

Alarm Levels for Application 6611		
Setup Point	**Value**	**Result**
	1	DI 6 is a N.O. Safety (DI 6 alarms when closed)
	2	DI 6 is a N.C. Safety (DI 6 alarms when opened)
	3	DI 6 is a HEAT/COOL switch (typically used when a coil or stage can be either heating or cooling, and the unit is operating standalone)

ALARM Point Values

ALARM has several different values it can assume (0, 1, 2 and 3) each of which has a different meaning.

When ALARM has a value of zero, it can mean any one of the following:

- None of the DIs are being used as safeties.
  AIDI5 CONFIG = 0 or 3, DI 2 CONFIG = 0 or 3, and DI 6 CONFIG = 0 or 3.
- None of the safeties have been enabled.
  SAFETY SET 1 = 0, SAFETY SET 2 = 0, and SAFETY SET 3 = 0.
- No alarms have been detected.

When ALARM has a value of 1 it means that all of the following are true:

- At least 1 low level alarm has been detected.
- No medium level alarms have been detected.
- No high level alarms have been detected.

When ALARM has a value of 2, all of the following are true:

- At least 1 medium level alarm has been detected.
- No high level alarms have been detected.
- Any low level alarms (if they have occurred) are being ignored.

When ALARM has a value of 3, all of the following are true:

- At least 1 high level alarm has been detected.
- Any medium level alarms (if they have occurred) are being ignored.
- Any low level alarms (if they have occurred) are being ignored.

ALARM Point Reset

Whenever ALARM has a non-zero value, an alarm has occurred somewhere in the system. If the DI that caused the alarm goes back to its non-alarm state, the application automatically resets ALARM to zero provided no other DIs are in alarm.

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 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.

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.

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.

Fail Mode Operation

If the room temperature sensor fails, the controller operates using the last known temperature value.

Application Notes

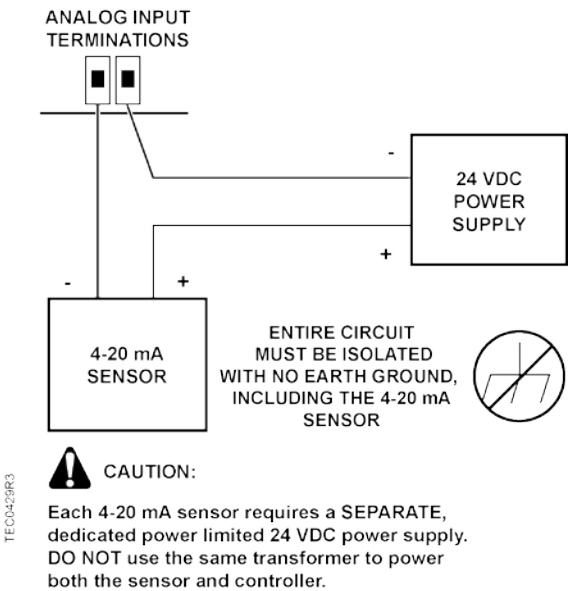
- The controller keeps all associated equipment OFF. See the appropriate *Start-up Procedures* for information on how to release the controller and its equipment to application control.
- If the temperature swings in the room are excessive, or if there is trouble in maintaining the set point, then either the cooling loop, the heating loop or both need to be tuned.
- Spare DOs can be used as auxiliary points that are controlled by the field panel after being defined in the field panel's database. If a modulating, floating control valve is not being controlled by the application and DO 1 and DO 2 are not being used to control staged heating and/or cooling, then DO 1 and DO 2 may be used as auxiliary motor points. If using a pair of spare DOs to control a motor, you must make sure that the motor setup and motor timing are enabled correctly before you unbundle VLV COMD for DO 1 and DO 2.

See the *Start-up Procedures* on Asset Portal or InfoLink for more information.

Wiring Diagram

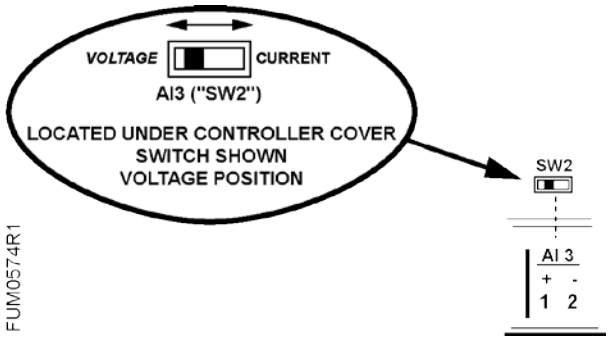
	⚠ CAUTION
	The controller's DOs control 24 Vac loads only. The maximum rating is 12 VA for each DO. An external interposing relay is required for any of the following: • VA requirements higher than the maximum • 110 or 220 Vac requirements • DC power requirements • Separate transformers used to power the load (for example part number 540-147, Terminal Equipment Controller Relay Module)

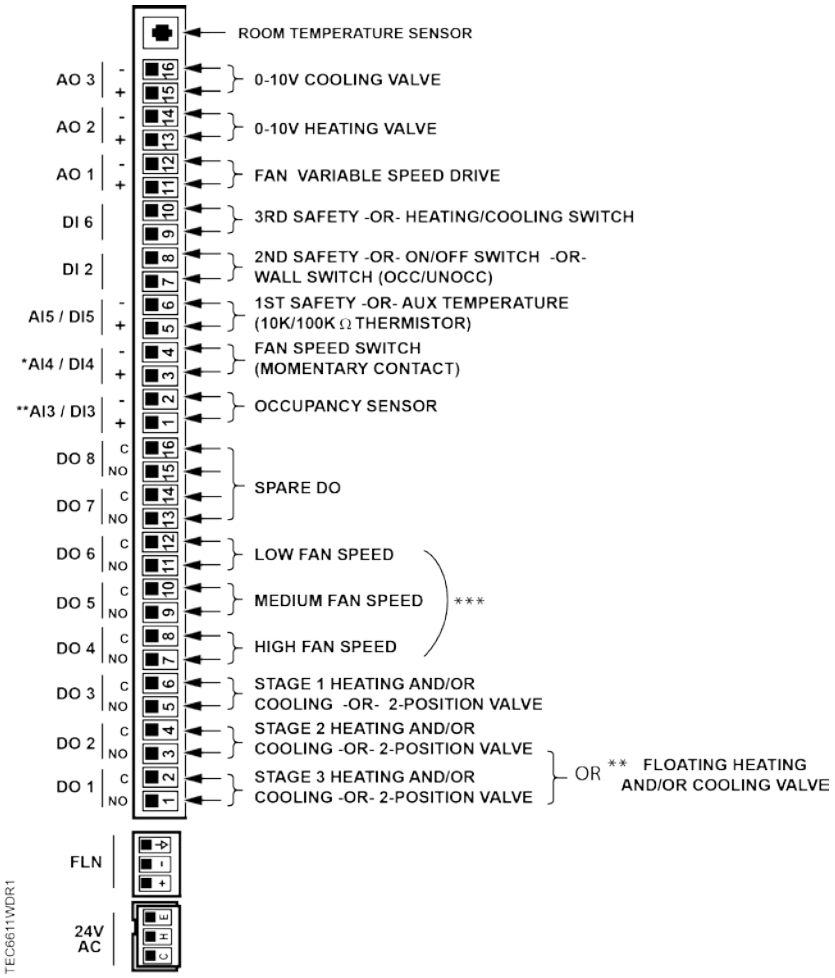
NOTE:
Thermistor inputs are 10K (default) or 100K software selectable (AUX TEMP AI X).



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.





* Dipswitch for AI 3 (under controller cover on circuit board) must be in voltage (V) position.

Note: AI 3 can be a spare input (4-20 mA or 0-10V). The voltage/current dipswitch must be set accordingly and PIR ENABLE must = 0. (IMPORTANT: If AI 3 is used as 4-20 mA sensor input, special wiring instructions must be followed).

Note: Certain other I/O points can be spare as well. See the Application and/or the Start-up document. (AI 4/DI 4 and AI 5/DI 5, if used for spare analog input, are 10K/100K Ω thermistor.)

** DOs 1 and 2 can control contactors or 2-position valves, OR, they can be used together to control a floating valve.

*** Although the firmware for this application allows DOs 4, 5, and 6 as well as AO1 to be used for fan speed control, box manufacturers do not readily support both types of control (digital and analog) on the same terminal box.

Application 6611 Point Database

Object Type[1]	Object Number	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	6697	--	0-32767	--	--
AO	3	AOV 1 FN LOW	2	VOLTS	0-10.23	--	--
AI	{04}	ROOM TEMP	74.0 (23.44888)	DEG F (DEG C)	48-111.75	--	--
BO	{05}	HEAT.COOL	COOL	--	Binary	HEAT	COOL
AO	6	OCC CLG STPT	74.0 (23.44888)	DEG F (DEG C)	48-111.75	--	--
AO	7	OCC HTG STPT	70.0 (21.20888)	DEG F (DEG C)	48-111.75	--	--
AO	8	UOC CLG STPT	82.0 (27.92888)	DEG F (DEG C)	48-111.75	--	--
AO	9	UOC HTG STPT	65.0 (18.40888)	DEG F (DEG C)	48-111.75	--	--
AO	10	AOV 1 FN MED	6	VOLTS	0-10.23	--	--
AO	11	RM STPT MIN	55.0 (12.80888)	DEG F (DEG C)	48-111.75	--	--
AO	12	RM STPT MAX	90.0 (32.40888)	DEG F (DEG C)	48-111.75	--	--
AI	{13}	RM STPT DIAL	74.0 (23.44888)	DEG F (DEG C)	48-111.75	--	--
BO	14	STPT DIAL	NO	--	Binary	YES	NO
AO	15	HTG 1 ON	4.8	PCT	0-102	--	--
AO	16	HTG 2 ON	34.8	PCT	0-102	--	--
AO	17	HTG 3 ON	70	PCT	0-102	--	--
BO	18	WALL SWITCH	NO	--	Binary	YES	NO
BI	{19}	DI OVRD SW	OFF	--	Binary	ON	OFF
AO	20	OVRD TIME	0	HRS	0-255	--	--
BO	{21}	UNOCC OVRD	UNOCC	--	Binary	UNOCC	OCC
AO	22	CLG 1 ON	4.8	PCT	0-102	--	--
AO	23	CLG 2 ON	34.8	PCT	0-102	--	--
AO	24	CLG 3 ON	70	PCT	0-102	--	--
BO	{25}	OFF OVRD	OFF	--	Binary	ON	OFF
AO	{26}	FAN SPEED	0	--	0-255	--	--
AO	{27}	ALARM	0	--	0-255	--	--
BO	{28}	ON.OFF	OFF	--	Binary	ON	OFF

Object Type[1]	Object Number	Object Name Descriptor	Factory Default (SI Units)[2]	Eng Units (SI Units)	Range	Active Text	Inactive Text
BO	{29}	OCC.UNOCC	UNOCC	--	Binary	UNOCC	OCC
AO	30	AOV 2 CLOSE	0	VOLTS	0-10.23	--	--
AO	31	AOV 2 OPEN	10	VOLTS	0-10.23	--	--
AO	32	AOV 3 CLOSE	0	VOLTS	0-10.23	--	--
AO	33	AOV 3 OPEN	10	VOLTS	0-10.23	--	--
AO	34	SWITCH DBAND	2.0 (1.12)	DEG F (DEG C)	0-63.75	--	--
AO	35	VALVE TYPE	2	--	0-255	--	--
AO	36	MTR SETUP	0	--	0-255	--	--
AO	37	MTR TIMING	130	SEC	0-511	--	--
AO	{38}	VALVE COMD	0	PCT	0-102	--	--
AO	{39}	VALVE POS	0	PCT	0-102	--	--
AO	40	DO DIR. REV	0	--	0-255	--	--
BO	{41}	DO 1	OFF	--	Binary	ON	OFF
BO	{42}	DO 2	OFF	--	Binary	ON	OFF
BO	{43}	DO 3	OFF	--	Binary	ON	OFF
BO	{44}	FAN HI DO 4	OFF	--	Binary	ON	OFF
BO	{45}	FAN MED DO 5	OFF	--	Binary	ON	OFF
BO	{46}	FAN LO DO 6	OFF	--	Binary	ON	OFF
BI	{47}	DI 2	OFF	--	Binary	ON	OFF
BI	{48}	PIR DI 3	OFF	--	Binary	ON	OFF
BI	{49}	DI 4	OFF	--	Binary	ON	OFF
BI	{50}	DI 5	OFF	--	Binary	ON	OFF
BI	{51}	DI 6	OFF	--	Binary	ON	OFF
AI	{52}	AI 3	0	PCT	0-102	--	--
AI	{53}	AI 4	74.0 (23.495556)	DEG F (DEG C)	37.5-165	--	--
AI	{54}	AUX TMP AI5	74.0 (23.495556)	DEG F (DEG C)	37.5-165	--	--
AO	{55}	FAN AOV 1	0	VOLTS	0-10.23	--	--
AO	56	STG OFF DLAY	0	MIN	0-255	--	--
AO	{57}	HTG AOV 2	0	VOLTS	0-10.23	--	--
AO	{58}	CLG AOV 3	0	VOLTS	0-10.23	--	--
AO	59	TEMP CONFIG	1	--	0-255	--	--
AO	60	AOV 1 FN ALM	0	VOLTS	0-10.23	--	--
AO	61	AOV 1 FN OFF	2	VOLTS	0-10.23	--	--
AO	62	AOV 1 FN HI	10	VOLTS	0-10.23	--	--

Object Type[1]	Object Number	Object Name Descriptor	Factory Default (SI Units)[2]	Eng Units (SI Units)	Range	Active Text	Inactive Text
AO	63	CLG P GAIN	20.0 (36.0)	--	0-63.75	--	--
AO	64	CLG I GAIN	0.01 (0.018)	--	0-1.023	--	--
AO	65	CLG D GAIN	0 (0.0)	--	0-510	--	--
AO	66	CLG BIAS	0	PCT	0-102	--	--
AO	67	HTG P GAIN	10.0 (18.0)	--	0-63.75	--	--
AO	68	HTG I GAIN	0.01 (0.018)	--	0-1.023	--	--
AO	69	HTG D GAIN	0 (0.0)	--	0-510	--	--
AO	70	HTG BIAS	0	PCT	0-102	--	--
AO	71	PIR ENABLE	0	--	0-255	--	--
AO	72	PIR TIME	0	MIN	0-255	--	--
AO	73	DI2 CONFIG	0	--	0-255	--	--
AO	74	DI6 CONFIG	0	--	0-255	--	--
AO	75	AIDI5 CONFIG	0	--	0-255	--	--
AO	76	C STG TIME	1	MIN	0-255	--	--
AO	77	H STG TIME	1	MIN	0-255	--	--
AO	{78}	CTL TEMP	74.0 (23.44888)	DEG F (DEG C)	48-111.75	--	--
AO	{79}	CLG LOOPOUT	0	PCT	0-102	--	--
AO	{80}	HTG LOOPOUT	0	PCT	0-102	--	--
AO	81	SAFETY SET 1	0	--	0-255	--	--
AO	82	SAFETY SET 2	0	--	0-255	--	--
AO	83	SAFETY SET 3	0	--	0-255	--	--
AO	84	FAN SPD CNT	3	--	0-255	--	--
AO	85	SWITCH LIMIT	5.2	PCT	0-102	--	--
AO	86	SWITCH TIME	10	MIN	0-255	--	--
AO	87	FAN OVRD TIM	0	MIN	0-255	--	--
AO	88	STAGE COUNT	0	--	0-255	--	--
AO	89	STAGE TYPE	0	--	0-255	--	--
BO	90	HTG MOD FAN	NO	--	Binary	YES	NO
AO	91	HTG FAN SPD	1	--	0-255	--	--
AO	{92}	CTL STPT	74.0 (23.44888)	DEG F (DEG C)	48-111.75	--	--
AO	93	FAN LO ON	0	PCT	0-102	--	--
AO	94	FAN MED ON	33.2	PCT	0-102	--	--
AO	95	FAN HI ON	67.2	PCT	0-102	--	--
AO	96	CAL TIMER	12	HRS	0-255	--	--
BO	97	FAN MODE	AUTO	--	Binary	AUTO	MANUAL

Object Type[1]	Object Number	Object Name Descriptor	Factory Default (SI Units)[2]	Eng Units (SI Units)	Range	Active Text	Inactive Text
AO	98	LOOP TIME	5	SEC	0-255	--	--
AO	{99}	ERROR STATUS	0	--	0-255	--	--
BO	{102}	DO 7	OFF	--	Binary	ON	OFF
BO	{103}	DO 8	OFF	--	Binary	ON	OFF
AO	107	RMTMP OFFSET	0.0 (0.0)	DEG F (DEG C)	-31.75-32	--	--
AO	{120}	DEW POINT	-40.0 (-40.0)	DEG F (DEG C)	-40-1598.35	--	--
AO	121	STPT SPAN	0.0 (0.0)	DEG F (DEG C)	0-63.75	--	--
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	140-1178	140-1178(AA)
Edition	2014-07-17	Restricted