SIEMENS

BACnet PTEC Controller

Dual Duct 2 AVS - Constant Volume One Inlet and One Outlet Sensor with Optional Reheat, Application 6666

Application Note

140-1114
2014-09-03

Building Technologies

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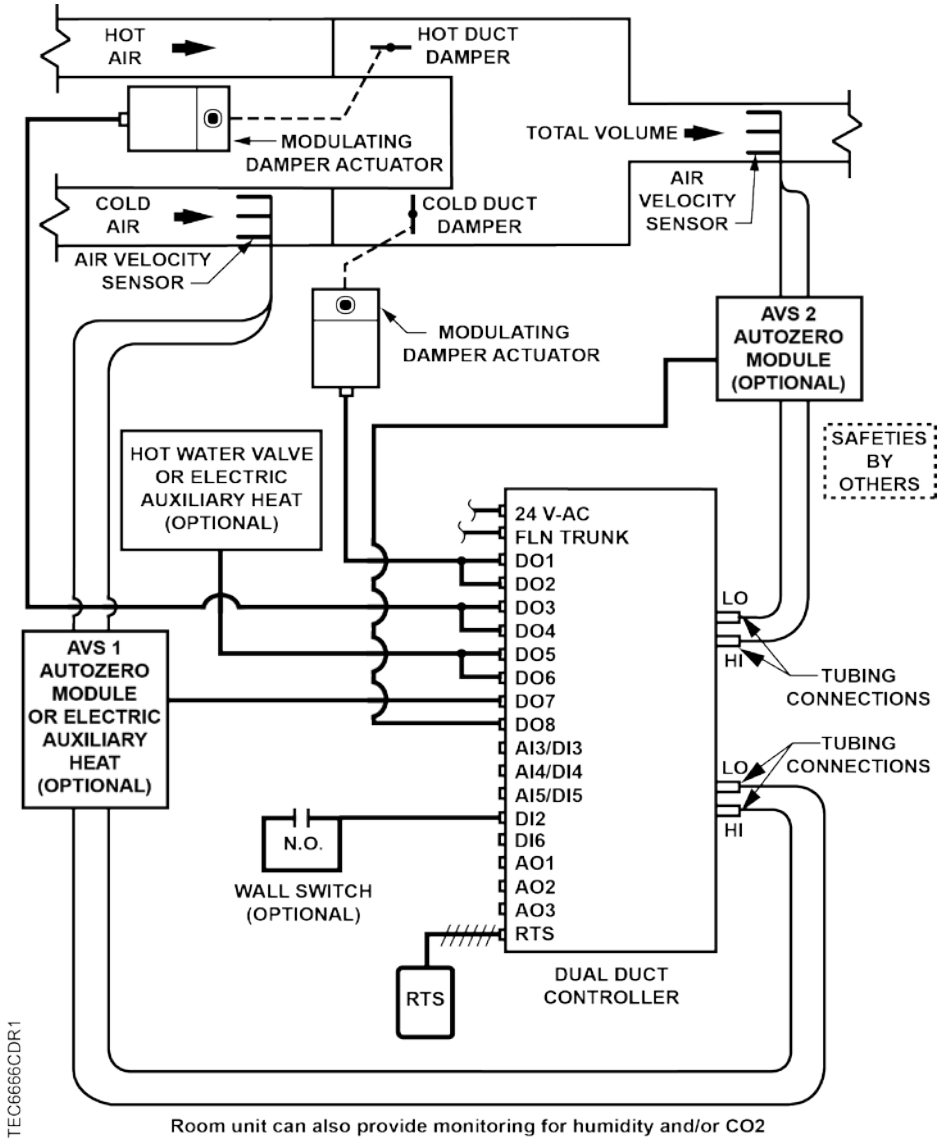
Overview

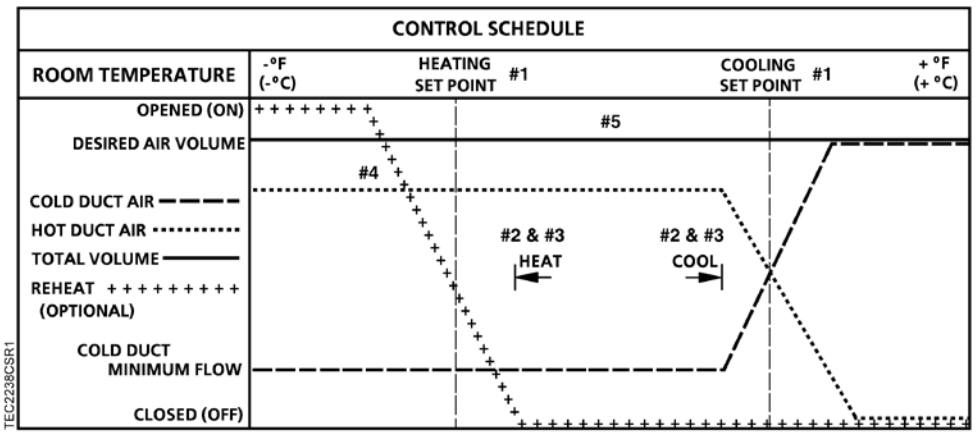
NOTE:
For information on applications with Firmware Revision B*x*40 or earlier, see InfoLink and/or Asset Portal for documentation.

In Application 6666, the controller provides independent control of the hot duct and the cold duct inlet dampers to provide a constant volume of air to the space during occupied periods and a lower constant volume of air during unoccupied periods.

In cooling mode, the cold duct damper is modulated to maintain the room temperature setpoint and the hot duct damper is modulated to maintain the volume setpoint. In heating mode, the hot duct damper is modulated to maintain the volume setpoint. The controller modulates an optional hot water valve or up to three stages of electric reheat to maintain the room temperature setpoint.



Application 6666 Control Diagram.



Application 6666 Control Schedule.

NOTES:
1. See *Control Temperature Setpoints*.
2. See *Heating/Cooling Switchover*.
3. If reheat is not used, this application operates only in cooling mode.
4. The reheat can either be a 2-position valve, hot water valve or time modulated electric reheat. See *Optional Auxiliary Heat*.
5. This application supports two total volume setpoints; one for occupied periods and on for unoccupied periods. See *Control Volume Setpoints*.
6. In Day/Occupied mode, minimum flow is from Cold Duct and is larger of VENT DMD MIN and CLG FLOW MIN. VENT DMD MIN can be reset by PPCL added in the controller or from the field panel.
7. In Night/Unoccupied mode, flow is limited to UNOCC FLOW.

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

- Air velocity sensor (two required)
- Room temperature sensor
- Room temperature setpoint dial (optional)
- Auxiliary temperature sensor (optional)
- Analog sensor (0-10Vdc/4-20 mA) (two) (optional)

Digital

- Unoccupied mode override (optional)
- Wall switch (optional)
- Spare digital sensor (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

- Spare AO 1, AO 2, and AO 3 (0-10V)

Digital

- Damper actuator (two required)
- Stage 1 electric heat (optional)
- Stage 2 electric heat (optional)
- Stage 3 electric heat (optional) or Autozero modules (optional)
- Valve actuator (optional)

Ordering Notes

550-497PA	Siemens BACnet PTEC Dual Duct 2 AVS Controller

Sequence of Operation

The following paragraphs present the sequence of operation for Application 6666 -- One Inlet and One Outlet Sensor with Optional Reheat.

NOTE:
The controller first meets the volume setpoint requirement of the space and then it controls to the room temperature setpoint requirement. The controller satisfies the airflow requirement of the dual duct even if doing so causes the temperature of the space to drift from its temperature setpoint.

Control Volume Setpoints

NOTE:
The following guidelines apply to the control volume setpoints, OCC FLOW and UNOCC FLOW:

- Do not set OCC FLOW to 0 cfm (0 lps).
- The value of OCC FLOW must be greater than or equal to the value of UNOCC FLOW.
- If desired, the values of OCC FLOW and UNOCC FLOW may be set equal to each other.

Depending on the controller's current operational mode (occupied or unoccupied), the control volume setpoints are as follows:

Occupied Cooling Mode – In occupied cooling mode, the controller resets CLG FLO STPT to ensure that the room temperature setpoint is satisfied, provided that the airflow from cold duct does not exceed the value of OCC FLOW. The minimum flow setpoint for the cold duct is the larger of CLG FLOW MIN and VENT DMD MIN. The controller resets HTG FLO STPT to ensure that the total flow provided by the dual duct is equal to the value of OCC FLOW.

The additional flow setpoint, VENT DMD MIN, can be used in place of CLG FLOW MIN and is provided to adjust the minimum flow based on air quality conditions, for example, CO2 concentration. Field panel or PPCL in the controller can be used to dynamically adjust this setpoint, as needed.

Occupied Heating Mode – The cold duct flow setpoint will be the larger of CLG FLOW MIN and VENT DMD MIN. The controller will then try to provide enough air from the hot duct to ensure that the total air flowing out of the dual duct terminal box equals OCC FLOW. If the hot duct is unable to provide enough airflow to satisfy this requirement, the controller modulates the cold duct damper to make up the difference.

Unoccupied Cooling Mode – In unoccupied cooling mode, the controller resets the value of CLG FLO STPT to ensure that the room temperature setpoint is satisfied, provided that the airflow from the cold duct does not exceed the value of UNOCC FLOW. The controller then resets the value of HTG FLO STPT to ensure that the total flow provided by dual duct is equal to the value of UNOCC FLOW.

Unoccupied Heating Mode – In unoccupied heating mode, the controller provides as much airflow as possible from the hot duct to satisfy the flow requirements of UNOCC FLOW. If the hot duct is unable to provide enough airflow to satisfy this requirement, then the controller modulates the cold duct damper to make up the difference.

Control Temperature Setpoints

NOTE:
Constant Volume Dual Duct applications use OCC.UNOCC and UNOCC OVRD in place of DAY.NGT and NGT OVRD. In addition, these applications use setpoints OCC CLG STPT, OCC HTG STPT, UOC CLG STPT and UOC HTG STPT for the 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

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

Switching to heating mode will only occur if AUX HTG USED = YES, otherwise, the controller will remain in cooling mode.

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) [➞ 13]
- Heating/Cooling Switchover Using Warmer/Cooler Mode (Digital Room Unit, Revision 26 and later) [➞ 14]
- Heating/Cooling Switchover Using Standard/Absolute Mode (Analog Room Unit) [➞ 14]
- Heating/Cooling Switchover Using Warmer/Cooler Mode (Analog Room Unit) [➞ 15]

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.

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.

Ventilation Demand Minimum

This VAV application has the ability to adjust the minimum flow setpoint for varying ventilation needs during occupied times. This may be done internally on controllers with PPCL, or externally via IAQ or DCV programs in a field panel. As the requirement may also exist to keep the cooling and heating flow minimum setpoints as originally specified, a new setpoint, ventilation demand minimum (VENT DMD MIN), is provided (and can be changed or written to as necessary).

The additional flow setpoint (VENT DMD MIN) is provided to allow setting and adjustment of the ventilation air required during occupied modes. VENT DMD MIN flow setpoint is used in conjunction with the existing cooling and heating flow minimum setpoints but only during the occupied modes.

VENT DMD MIN can be set above, equal to, or below CLG FLOW MIN or HTG FLOW MIN setpoints and the controlling minimum would be the larger of the two. This allows the cooling flow min to be set to zero and use the vent demand to control cooling and heating ventilation requirements.

VENT DMD MIN can be controlled (reset) externally, or by PPCL in the controller, for ventilation demands as based on CO2 or other indoor air quality requirements. Minimum air flow will be the larger of cooling flow min or heating flow min setpoints and the current ventilation demand flow setpoint. The control maximum flow setpoints are not affected by VENT DMD MIN.

Occupied and Unoccupied Modes

The occupied/unoccupied status of the space is determined by the status of OCC.UNOCC. 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 at DI 2 and WALL SWITCH = YES, the controller monitors the status of DI 2. When the status of DI 2 is ON (the switch is closed), OCC.UNOCC will be 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 will be set to UNOCC indicating that the controller is in unoccupied 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, 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.

Unoccupied 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, then by pressing the override switch, a room occupant can reset the controller to occupied mode for the length of time set in OVRD TIME. The status of UNOCC OVRD changes to OCC and remains there until OVRD TIME elapses, at which point UNOCC OVRD changes back to UNOCC and the controller returns to unoccupied mode.

NOTE:
Only during unoccupied mode (MODE = Unoccupied) can a room sensor’s override switch set the controller to occupied mode; if MODE equals anything other than Unoccupied, UNOCC OVRD will equal UNOCC.

Control Loops

The dual duct is controlled by four Proportional, Integral, and Derivative (PID) control loops: two temperature loops and two flow loops.

Temperature Loops – The two temperature loops are a cooling loop and a heating loop. The active temperature loop maintains CTL STPT. See Control Temperature Setpoints.

In cooling mode, the output of the cooling loop, CLG LOOPOUT, resets CLG FLO STPT to satisfy the space temperature setpoint, provided that the airflow out of the cold duct does not exceed the value of OCC FLOW in occupied mode or UNOCC FLOW in unoccupied mode. The controller then resets HTG FLO STPT in order to make sure that the airflow out of the box is equal to OCC FLOW in occupied mode or UNOCC FLOW in unoccupied mode.

In heating mode, HTG LOOPOUT, controls the auxiliary heat (if used). If auxiliary heat is not used, this application only operates in cooling mode (that is, the application sets HEAT.COOL to COOL) and the heating loop is disabled.

During occupancy for heating and cooling modes, the minimum amount of air allowed from the cold duct is the larger of CLG FLOW MIN and VENT DMD MIN. During unoccupied periods for these modes, the airflow from the cold duct will be allowed to reach 0 cfm.

Flow Loops – The two flow loops are a cooling flow loop and a heating flow loop.

CLG FLOW is the input value for the cooling flow loop. It is calculated as a percentage based on where CLG VOLUME is between 0 cfm and the value of CLG FLOW MAX.

- If CLG VOLUME = 0 cfm, CLG FLOW is 0%.
- If CLG VOLUME = CLG FLOW MAX, CLG FLOW is 100%.

HTG FLOW; (TOT FLOW – CLG FLOW) is the input value for the heating flow loop. It is calculated as a percentage based on where HTG VOLUME is between 0 cfm and the value of OCC FLOW.

- If HTG VOLUME = 0 cfm, HTG FLOW is 0%.
- If HTG VOLUME = OCC FLOW, HTG FLOW is 100%.

To enhance stable flow control, an advanced algorithm is used to calculate a controllable setpoint as the value approaches zero cfm (lps).

Cooling Operation

In occupied cooling mode CLG LOOPOUT, is used to calculate the setpoint for the cooling flow loop, CLG FLO STPT. This flow loop maintains the space temperature. In this mode, the cooling flow loop limits the airflow supplied by the cold duct to the value of OCC FLOW. The minimum airflow from the cold duct will be the larger of CLG FLOW MIN and VENT DMD MIN in the occupied cooling mode. The heating flow loop provides any make up air that is necessary to ensure that the airflow from the dual duct box is equal to OCC FLOW. When the cooling loop provides an airflow equal to OCC FLOW from the cold duct, the heating flow loop sets HTG DMP CMD to 0% open, causing the hot duct damper to close.

In unoccupied cooling mode, CLG LOOPOUT, multiplied by a scaling factor, becomes the set point for CLG FLO STPT. This flow loop maintains the space temperature. In this mode, the scaling factor, UNOCC FLOW ÷ OCC FLOW, limits the airflow supplied by the cold duct to the value of UNOCC FLOW. This limit is in effect even if it means that the space gets too warm. The heating flow loop provides any make up air that is necessary to ensure that the airflow from the dual duct box is equal to UNOCC FLOW. When the cooling loop provides an airflow equal to UNOCC FLOW from the cold duct, the heating flow loop modulates HTG DMP CMD to 0% open, causing the hot duct damper to close.

The following two situations could occur in cooling mode. However, they are most likely to occur in occupied periods.

1. When the cooling load is light, the cooling loop calls for the cold duct to provide very little air. To maintain a constant volume from the dual duct box, the majority of the air volume from the dual duct box must come from the hot duct. If the hot duct is unable to provide this air, the cold duct makes up the difference, even though the cooling loop calls for the cold duct to be closed or nearly closed.
2. When the cooling load is heavy, the hot duct must be closed or nearly closed to allow the space to be cooled. The majority of the air volume from the dual duct box must be supplied by the cold duct. If the cold duct is unable to provide this air, the hot duct makes up the difference, even though the temperature requirements of the space call for the hot duct to close.

Heating Operation

In occupied heating mode, the heating flow loop modulates HTG DMP CMD to ensure that the airflow from the dual duct box is equal to the value of OCC FLOW. The cold duct damper is set to provide the ventilation or cooling minimum flow. If the hot duct is unable to provide enough flow so that the total flow is equal to occupied flow, the cooling flow damper will open to make up the difference.

In unoccupied heating mode, the heating flow loop modulates the HTG DMP CMD to ensure that the airflow from the dual duct box is equal to the value of UNOCC FLOW. If the hot duct is unable to provide this airflow, the cold duct damper is modulated in order to make up the difference. If the hot duct is able to provide this airflow on its own, CLG DMP CMD = 0% open, causing the cold duct damper to close.

In heating mode, the output of the heating loop, HTG LOOPOUT, controls the auxiliary heat (if used). If auxiliary heat is not used, the application sets HEAT.COOL to COOL. The application then operates in cooling mode and the heating loop is disabled.

See Optional Auxiliary Heat [→ 18] for more information.

Optional Auxiliary Heat

If AUX HTG USED = YES, this application also controls auxiliary heat. The value of AUX HTG TYPE indicates the type of auxiliary heat control. If AUX HTG USED = NO, no auxiliary heat is used and HEAT.COOL is automatically set to COOL.

⚠ CAUTION

If using electric heat, verify that the equipment is supplied with safeties by others to ensure that there is airflow across the heating coils when they are to be energized or equipment damage may result.

Do not set TOT FLOW MIN or UNOCC FLOW to zero if air flow across the heating element is to be provided by the dual duct terminal unit.

Hot Water Auxiliary Heat – If AUX HTG TYPE = HW, the application controls auxiliary hot water heat. The heating loop modulates the heating valve point, VALVE COMD in order to warm the space. When the controller is in cooling mode, the heating valve is closed.

Electric Auxiliary Heat – If AUX HTG TYPE = ELEC, the heating loop controls up to three stages of electric reheat to warm up the room. The electric reheat is time modulated using a duty cycle as shown in the following example. When the controller

is in cooling mode, the electric heat is OFF at all times. STAGE COUNT must be set equal to the number of stages of electric reheat being used.

Example

If the duty cycle is 10 minutes (STAGE TIME = 10 minutes) and the heating loop is calling for 60% of heating (HTG LOOPOUT = 60%), for every 10-minute period, the stages of electric auxiliary heat cycle as follows:

	Stage 1: minutes		Stage 2: minutes		Stage 3: minutes	
	ON	OFF	ON	OFF	ON	OFF
With 1 stage of electric heat:	6	4	--	--	--	--
With 2 stages of electric heat:	10	0	2	8	--	--
With 3 stages of electric heat:	10	0	8	2	0	10

NOTE:
If three stages of electric heat are used, Autozero Modules cannot be used. If two stages or less are used, Autozero Modules can be used.

Calibration

Calibration of the controller's internal air velocity sensor(s) is periodically required to maintain accurate air velocity readings. CAL SETUP is set with the desired calibration option during controller startup.

Depending on the value of CAL SETUP, calibration may be set to take place automatically or manually. If CAL AIR = YES, calibration is in progress.

- For a controller used without an Autozero Module (CAL MODULE, = NO), the damper is commanded closed to get a zero airflow reading during calibration.
- For a controller used with an Autozero Module (CAL MODULE = YES), calibration occurs without closing the damper.

NOTE:
The first time after startup or initialization, the controller will calibrate the dampers as if not using Autozero Modules, although the Autozero Modules will be activated. All subsequent calibrations will use the Autozero Modules only.

Hot Water Valve - Calibration of a hot water valve (if used) is performed simultaneously with calibration of the air velocity sensor and is done by commanding the valve closed. Calibration of the valve is not affected by the presence of Autozero Modules.

At the end of a calibration sequence, CAL AIR automatically returns to NO. A status of NO indicates that the controller is not in a calibration sequence.

The Autozero Modules are used during calibration when they are wired to DO 7 and DO 8 and CAL MODULE = YES.

Floating Control Actuation Auto-correct

In addition to the existing options for floating control actuator full stroke actions, all floating control actuators are provided with additional logic to fully drive open or closed when commanded to 100% or 0%.

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 (from the room unit) for fail communications with a value of 2.
  - CO2 enable and supervision (from the room unit) 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 input is 10K.
- To enable 100K thermistor on input, see the following table for additive values of 8.

Other Inputs (only available on Digital Room Unit)

- Use the following able to select and enable communications supervision of room temperature/setpoint dial, relative humidity and 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.

Auto Discovery

Auto Discovery allows you to automatically discover and identify PTEC controllers 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.

The maximum number of PPCL dynamic points is 15.

Fail Mode Operation

If the air velocity sensor points, HTG VOLUME and/or CLG VOLUME are failed, the dampers are controlled in one of two ways:

- If FAIL MODE = OPEN, the controller sets CLG DMP CMD and HTG DMP CMD to 100% open.
- If FAIL MODE = CLOSED, the controller sets CLG DMP CMD and HTG DMP CMD to 0% open.

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

Application Notes

- If the temperature swings in the room are excessive or there is trouble maintaining the setpoint, then either the cooling loop, the heating loop, or both need to be tuned. If CLG FLOW is oscillating while CLG FLOW STPT is constant, then the flow loop requires tuning. If HTG FLOW is oscillating while HTG FLO STPT is constant, the heating flow loop requires tuning.
- The controller as shipped from the factory keeps all associated equipment OFF. See the *Start-up* document for how to release the controller and its equipment to application control.
- Spare DOs can be used as auxiliary points that are controlled by the field panel after being defined in the field panel's database. DO 5 and DO 6 may be used as auxiliary motor points. If using a pair of spare DOs to control a motor, you must unbundle the corresponding motor command point.

For more information, contact your nearest Siemens Industry, Inc. representative.

Wiring Diagrams

⚠ 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:

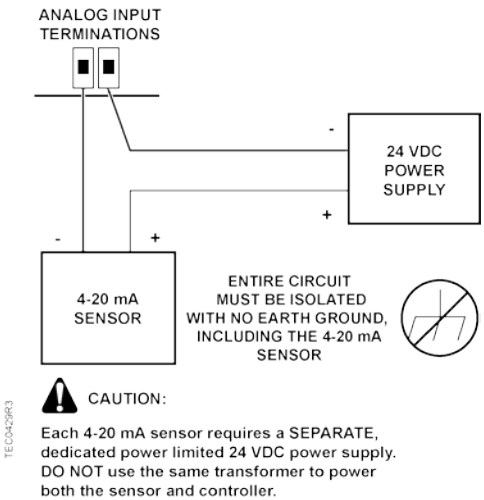
• VA requirements higher than the maximum

• 110 or 220 Vac requirements

• DC power requirements

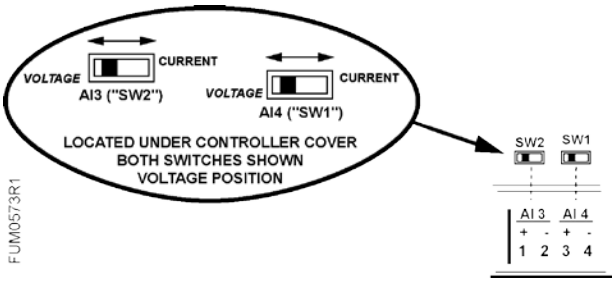
• Separate transformers used to power the load
(for example part number 540-147, Terminal Equipment Controller Relay Module)

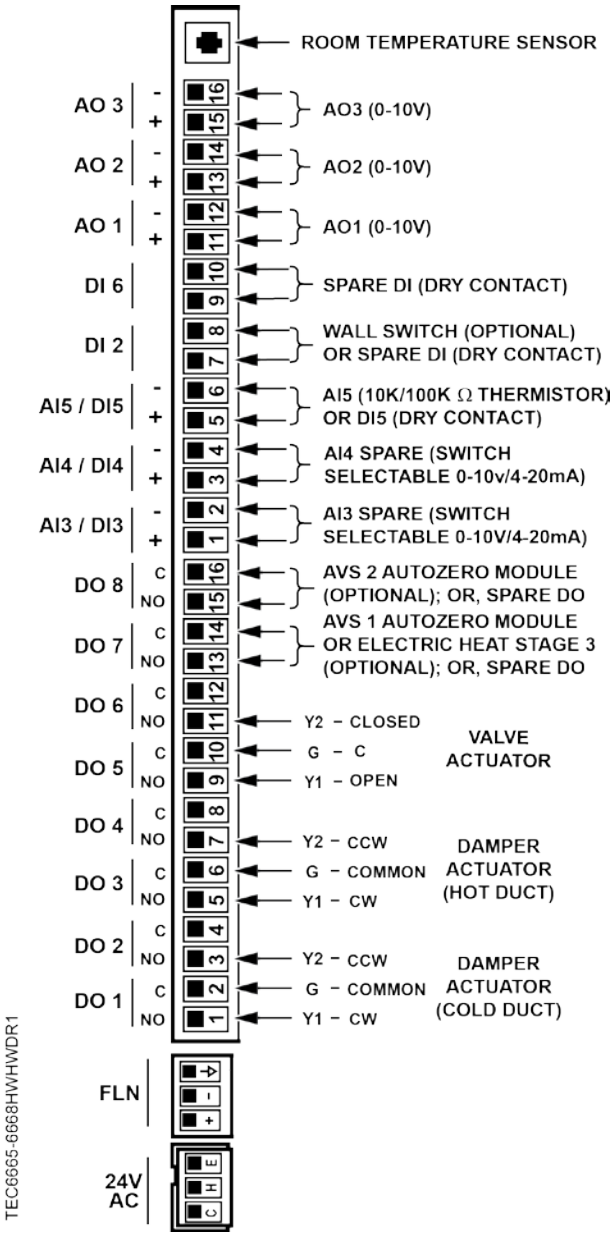
NOTE:
Thermistor inputs are 10K (default) or 100K software selectable (AUX TEMP AI X).



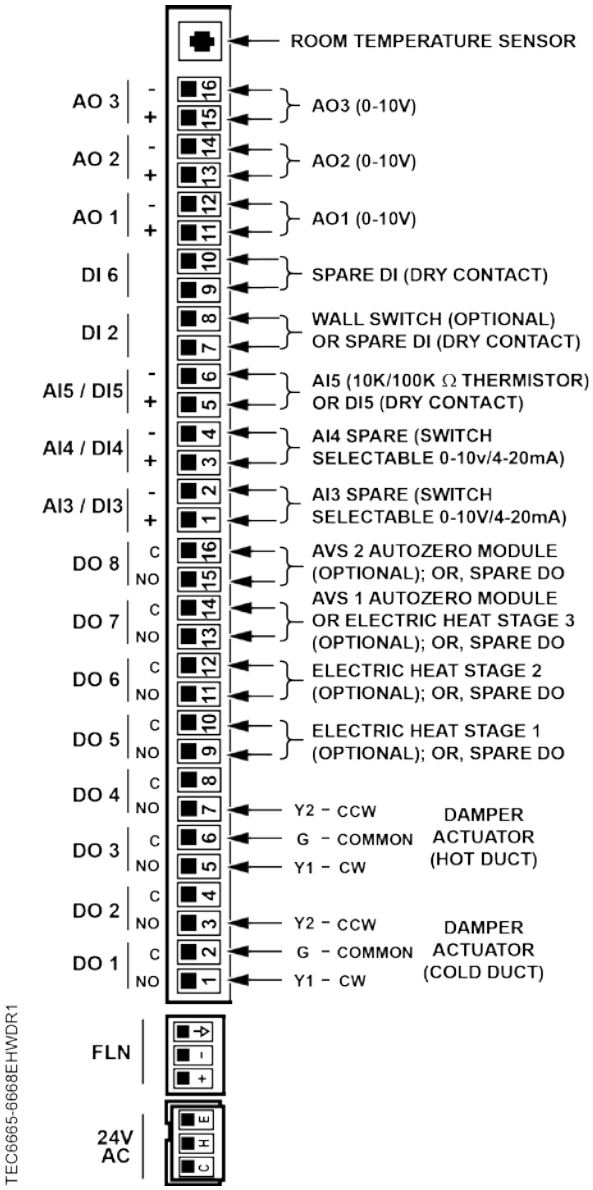
Wiring for AI with a 4 to 20 mA Sensor.

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.





Applications 6665, 6666, 6667, and 6668 with Hot Water Reheat.



Applications 6665, 6666, 6667, and 6668 with Electric Auxiliary Reheat.

Application 6666 Point Database

Object Type a)	Object Instance (Point Number)	Object Name (Descriptor)	Factory Default (SI Units) b)	Eng Units (SI Units)	Range	Active Text	Inactive Text
AO	1	CTLR ADDRESS	255	--	0-255	--	--
AO	2	APPLICATION	6693	--	0-32767	--	--
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	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
AI	{15}	AUX TEMP AI5	74.0 (23.495556)	DEG F (DEG C)	37.5-165	--	--
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
BI	{24}	DI 2	OFF	--	Binary	ON	OFF
BI	{25}	DI 3	OFF	--	Binary	ON	OFF
AO	26	HTGFLO PGAIN	0	--	0-51.15	--	--
AO	27	HTGFLO IGAIN	0.018	--	0-1.023	--	--
AO	28	HTGFLO DGAIN	0	--	0-510	--	--
BO	{29}	OCC.UNOCC	OCC	--	Binary	UNOCC	OCC
AI	{30}	TOT VOLUME	0 (0.0)	CFM (LPS)	0-131068	--	--
AO	{31}	UNOCC FLOW	220 (103.818)	CFM (LPS)	0-131068	--	--
AO	{32}	OCC FLOW	2200 (1038.18)	CFM (LPS)	0-131068	--	--
AI	{35}	CLG VOLUME	0 (0.0)	CFM (LPS)	0-131068	--	--

Object Type a)	Object Instance (Point Number)	Object Name (Descriptor)	Factory Default (SI Units) b)	Eng Units (SI Units)	Range	Active Text	Inactive Text
AO	36	CLG FLO COEF	1	--	0-2.55	--	--
AO	{37}	VALVE COMD	0	PCT	0-102	--	--
AO	{38}	VALVE POS	0	PCT	0-102	--	--
AO	39	MTR3 TIMING	130	SEC	0-511	--	--
BO	40	FAIL MODE	OPEN	--	Binary	CLOSE	OPEN
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}	DO 4	OFF	--	Binary	ON	OFF
BO	{45}	DO 5	OFF	--	Binary	ON	OFF
BO	{46}	DO 6	OFF	--	Binary	ON	OFF
BO	{47}	DO 7	OFF	--	Binary	ON	OFF
AO	{48}	CLG DMP CMD	0	PCT	0-102	--	--
AO	{49}	CLG DMP POS	0	PCT	0-102	--	--
BO	{50}	DO 8	OFF	--	Binary	ON	OFF
AO	51	MTR1 TIMING	95	SEC	0-511	--	--
AO	{52}	HTG DMP CMD	0	PCT	0-102	--	--
AO	{53}	HTG DMP POS	0	PCT	0-102	--	--
AO	54	TOT FLO COEF	1	--	0-2.55	--	--
AO	55	MTR2 TIMING	95	SEC	0-511	--	--
AO	56	DPR1 ROT ANG	90	--	0-255	--	--
AO	57	DPR2 ROT ANG	90	--	0-255	--	--
AO	58	MTR SETUP	0	--	0-255	--	--
AO	59	DO DIR. REV	0	--	0-255	--	--
AO	60	TOTDUCT AREA	1.0 (0.09292)	SQ. FT (SQ M)	0-6.375	--	--
AO	63	CLG P GAIN	20.0 (36.0)	--	0-63.75	--	--
AO	64	CLG I GAIN	0.012 (0.0216)	--	0-1.023	--	--
AO	65	CLG D GAIN	0 (0.0)	--	0-510	--	--
AO	66	CLG BIAS	50	PCT	0-102	--	--
AO	67	HTG P GAIN	10.0 (18.0)	--	0-63.75	--	--
AO	68	HTG I GAIN	0.012 (0.0216)	--	0-1.023	--	--
AO	69	HTG D GAIN	0 (0.0)	--	0-510	--	--
AO	70	HTG BIAS	50	PCT	0-102	--	--
AO	71	CLGFLO PGAIN	0	--	0-51.15	--	--

Object Type a)	Object Instance (Point Number)	Object Name (Descriptor)	Factory Default (SI Units) b)	Eng Units (SI Units)	Range	Active Text	Inactive Text
AO	72	CLGFLO IGAIN	0.018	--	0-1.023	--	--
AO	73	CLGFLO DGAIN	0	--	0-510	--	--
AO	{74}	HTG FLOW	0	PCT	0-1023.75	--	--
AO	{75}	CLG FLOW	0	PCT	0-1023.75	--	--
AO	{77}	VENT DMD MIN	0 (0.0)	CFM (LPS)	0-131068	--	--
AO	{78}	CTL TEMP	74.0 (23.44888)	DEG F (DEG C)	48-111.75	--	--
AO	{79}	CLG LOOPOUT	50	PCT	0-102	--	--
AO	{80}	HTG LOOPOUT	0	PCT	0-102	--	--
AO	{81}	AVG HEAT OUT	0	PCT	0-409.2	--	--
BO	82	AUX HTG USED	NO	--	Binary	YES	NO
BO	83	AUX HTG TYPE	ELEC	--	Binary	ELEC	HW
AO	{85}	HTG FLO STPT	0	PCT	0-255.75	--	--
AO	86	SWITCH TIME	10	MIN	0-255	--	--
BO	87	CAL MODULE	NO	--	Binary	YES	NO
AO	88	STAGE COUNT	1	--	0-255	--	--
AO	89	STAGE TIME	10	MIN	0-255	--	--
AO	90	SWITCH DBAND	1.0 (0.56)	DEG F (DEG C)	0-63.75	--	--
AO	{91}	CLG FLOW MIN	220 (103.818)	CFM (LPS)	0-131068	--	--
AO	{92}	CTL STPT	74.0 (23.44888)	DEG F (DEG C)	48-111.75	--	--
AO	{93}	CLG FLO STPT	0	PCT	0-255.75	--	--
BO	{94}	CAL AIR	NO	--	Binary	YES	NO
AO	95	CAL SETUP	4	--	0-255	--	--
AO	96	CAL TIMER	12	HRS	0-255	--	--
AO	97	CLGDUCT AREA	1.0 (0.09292)	SQ. FT (SQ M)	0-6.375	--	--
AO	98	LOOP TIME	5	SEC	0-255	--	--
AO	{99}	ERROR STATUS	0	--	0-255	--	--
AO	{102}	AOV 1	0	VOLTS	0-10.23	--	--
AO	{103}	AOV 2	0	VOLTS	0-10.23	--	--
AO	{104}	AOV 3	0	VOLTS	0-10.23	--	--
AI	{105}	AI 3	0	PCT	0-102	--	--
AI	{106}	AI 4	0	PCT	0-102	--	--
AO	{107}	RMTMP OFFSET	0.0 (0.0)	DEG F (DEG C)	-31.75-32	--	--
BI	{108}	DI 4	OFF	--	Binary	ON	OFF

Object Type a)	Object Instance (Point Number)	Object Name (Descriptor)	Factory Default (SI Units) b)	Eng Units (SI Units)	Range	Active Text	Inactive Text
BI	{109}	DI 5	OFF	--	Binary	ON	OFF
BI	{110}	DI 6	OFF	--	Binary	ON	OFF
AO	111	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