SIEMENS

BACnet PTEC Controller

Dual Duct 2 AVS - VAV One Inlet and One Outlet Sensor with Optional Reheat, Application 6668

Application Note

140-1116
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Building Technologies

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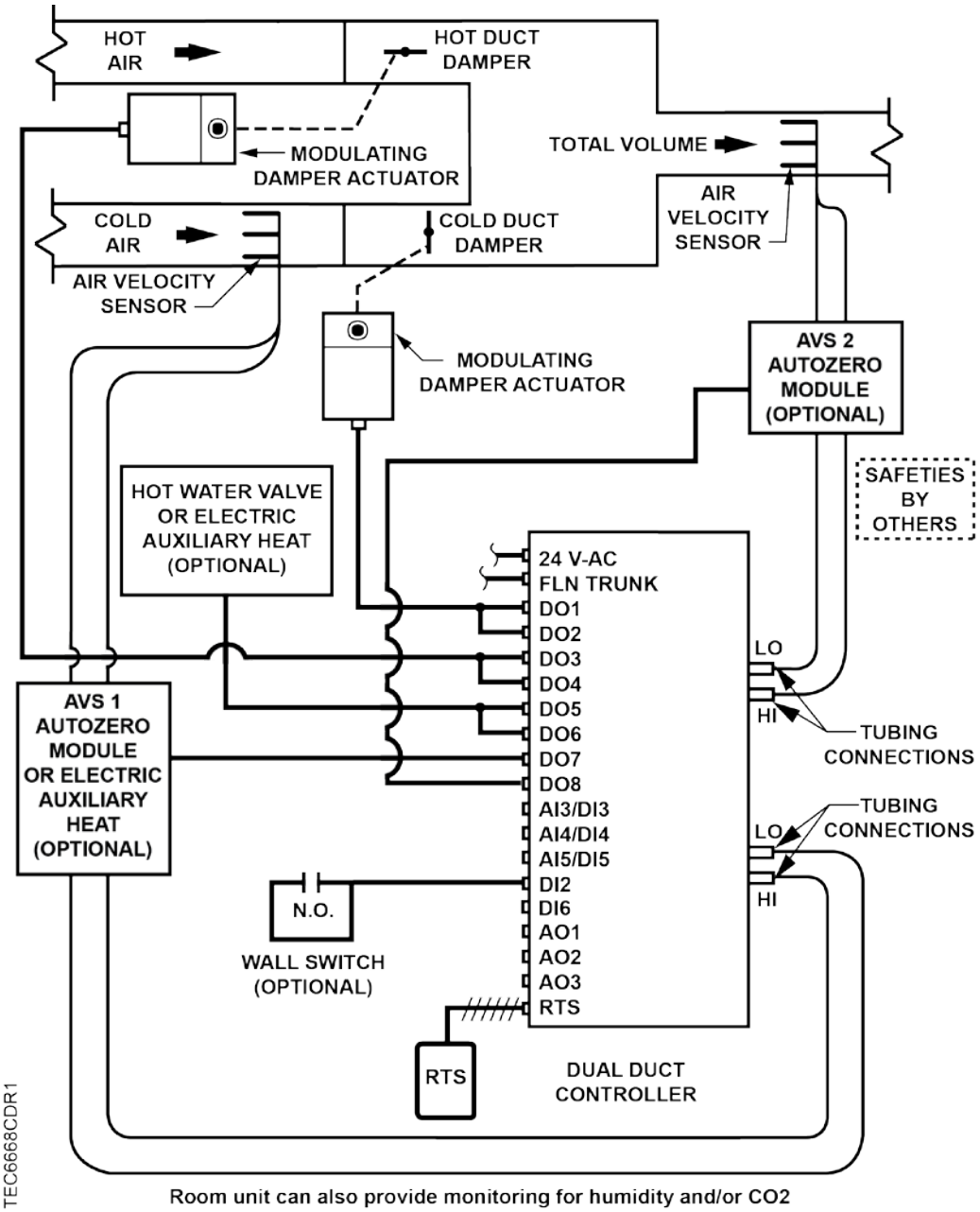
Overview

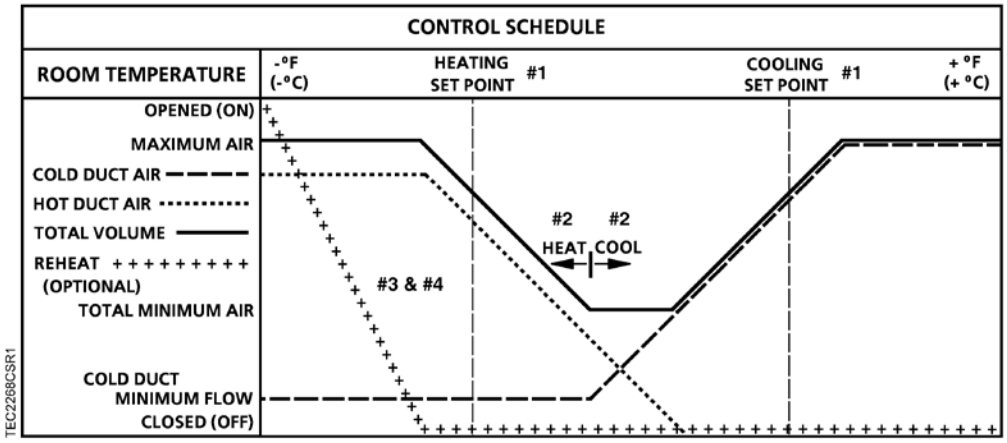
NOTE:
For information on applications with Firmware Revision B*x*40 or earlier, see InfoLink and/or Asset Portal for documentation.

In Application 6668, the controller provides independent control of the hot duct and the cold duct inlet dampers to provide variable air volume control to modulate the cold and hot duct dampers via two flow sensors-one in the cold duct and one in the common discharge duct.

In cooling mode, the controller modulates the cold duct damper to maintain the room temperature setpoint and modulates the hot duct damper to ensure minimum airflow. In heating mode, the controller modulates the hot duct damper in order to maintain the room temperature setpoint and modulates the cold duct damper to ensure minimum airflow. If auxiliary heat is used, the controller modulates an optional hot water valve or up to three stages of electric reheat to maintain the room temperature setpoint.



Application 6668 Control Diagram.



Application 6668 Control Schedule.

NOTES:

1. See *Control Temperature Setpoints*.
2. See *Heating/Cooling Switchover*.
3. The reheat can be either a modulating valve or time modulated electric reheat. See *Optional Auxiliary Heat*.
4. The reheat can be sequenced to operate either in series or in parallel with the hot duct damper. It is shown in series. See *Sequencing Logic*.
5. In the day/occupied cooling mode, the cold duct maintains room temperature by controlling from CLG FLOW MIN to CLG FLOW MAX based on cooling loopout. The hot duct flow will insure that the larger of TOT FLOW MIN or VENT DMD MIN is provided that the cooling flow does not supply.
6. In day/occupied heating mode, the hot duct maintains room temperature at the portion of the heating loop configured and will insure that the dual duct flow is not less than TOT FLOW MIN. The cold duct will provide larger of CLG FLOW MIN and VENT DMD MIN.
7. In the night/unoccupied cooling mode, the cold duct will maintain the unoccupied cooling setpoint. The hot duct flow will insure up to NGT FLOW MIN is provided that the cooling flow does not supply.
8. In the night/unoccupied heating mode, the hot duct will maintain the unoccupied heating setpoint and insure that a minimum flow of NGT FLOW MIN is maintained. The cold duct damper is closed.

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

- Night 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 6668 -- VAV One Inlet and One Outlet Sensor with Optional Reheat.

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

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) [➞ 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.

Night Flow Minimum

An additional flow setpoint, NGT FLOW MIN, in place of TOT FLOW MIN, addresses conditions during unoccupied times. As the flow at night/unoccupied times does not require the ventilation needs for personnel, it can be set below other minimums or at zero. The configured maximum heating and cooling flow setpoints will still be used when the zone temperature exceeds the night cooling or heating setpoints.

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.

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

The cooling flow loop maintains CLG FLO STPT by modulating the cold duct damper point, CLG DMP CMD. During day/occupied cooling mode, the cooling flow loop maintains the cold duct airflow between the value of CLG FLOW MIN and the value of CLG FLOW MAX. During day/occupied heating mode the CLG FLO STPT is set to the larger of CLG FLOW MIN and VENT DMD MIN.

During night/unoccupied in cooling mode, the cooling flow loop maintains the cold duct airflow between 0 cfm and the value of CLG FLOW MAX. In the night/unoccupied heating mode the CLG FLO STPT is set to zero.

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%.

The heating flow loop uses TOT FLO STPT to modulate HTG DMP CMD. During day/occupied heating mode, the heating flow loop maintains the hot duct airflow between TOT FLOW MIN and the TOT FLOW MAX that is not provided by the cooling flow. During day/occupied cooling mode, the heating flow will insure that the TOT FLO STPT from the dual duct box is the larger of TOT FLOW MIN or VENT FLOW MIN that is not provided by the cold duct flow.

During night/unoccupied heating mode, the heating flow loop maintains the hot duct airflow between NGT FLOW MIN and TOT FLOW MAX. The CLG FLOW STPT = 0.

During night/unoccupied cooling mode, the heating flow insures that the total flow from the dual duct unit is not less than NGT FLOW MIN.

The heating flow loop maintains TOT FLO STPT by modulating HTG DMP CMD.

The heating flow loop maintains TOT FLO STPT by modulating HTG DMP CMD. During occupancy, the heating flow loop maintains the hot duct airflow between 0 cfm and the value of TOT FLOW MAX. During unoccupied periods, the heating flow loop maintains the hot duct airflow between 0 cfm and TOT FLOW MAX.

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

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

The output of the cooling loop, CLG LOOPOUT, is used to calculate the setpoint for the cooling flow loop, CLG FLO STPT. This flow loop maintains the space temperature. The cooling flow loop limits the airflow supplied by the cold duct to the value of CLG FLOW MAX. In day mode, the minimum airflow from the cold duct will be CLG FLOW MIN. In night mode, the minimum airflow from the cold duct will be 0 cfm. The heating flow loop provides any make up air that is necessary to ensure that the airflow from the dual duct box is at least the larger of TOT FLOW MIN or VENT DMD MIN. When the cooling loop provides an airflow equal to or greater than the value of TOT FLOW MIN of VENT DMD MIN from the cold duct, the HTG FLO STPT = 0, causing the hot duct damper to close.

In day cooling mode (HEAT.COOL = COOL), the cooling flow loop controls the space temperature using the following calculation (scaling CLG LOOPOUT between CLG FLOW MIN and CLG FLOW MAX):

$$CLG\ FLO\ STPT = \frac{\left[(CLG\ FLO\ MAX - CLG\ FLO\ MIN) \times CLG\ LOOPOUT\right] + 100 \times CLG\ FLOW\ MIN}{CLG\ FLOW\ MAX}$$

In night cooling mode, the CLG FLO STPT = CLG LOOPOUT.

Heating Operation

In both day and night heating modes, the value of the TOT FLO STPT depends on the value of HTG LOOPOUT. Room temperature control is then done by the heating flow loop and the auxiliary heat working in sequence, simultaneously, or overlapping. See *Sequencing Logic* for more information.

In heating mode, the heating flow loop is used to provide any additional air needed in order to ensure that the airflow out of the dual duct box is at least the same as the value stored in TOT FLOW MIN. If the cold duct is unable to provide enough flow so

that the total flow is equal to, or greater than, the TOT FLOW MIN (or VENT DMD MIN), the heating flow damper will open to make up the difference.

In day heating mode, the hot duct damper modulates the total flow to be between CLG FLOW MAX and TOT FLOW MIN or CLG FLOW MIN, whichever is greater. The cold duct damper is set to provide the cooling flow minimum.

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.

⚠ 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.

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 the air velocity sensor point, TOT VOLUME is failed, or if both air velocity sensor points (TOT VOLUME and CLG VOLUME) are failed, damper control depends on the status of HEAT.COOL.

- 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 HEAT.COOL reads HEAT, the following occurs:
  - HTG DMP CMD is set equal to the total flow setpoint, TOT FLO STPT,
  - CLG DMP CMD is set equal to 100% minus TOT FLO STPT.

- or -

- If HEAT.COOL reads COOL, the following occurs:
  - CLG DMP CMD is set equal to the output of the cooling loop, CLG LOOPOUT,
  - HTG DMP CMD is set equal to 100% minus CLG LOOPOUT.

This causes the hot duct and the cold duct dampers to be controlled as pressure dependent dampers by the cooling temperature loop.

If only the air velocity sensor point CLG VOLUME is failed, the heating damper is controlled normally. Control of the cold duct damper depends on the status of HEAT.COOL as follows:

- If HEAT.COOL reads HEAT, CLG DMP CMD is set to 0% open closing the cold duct damper.
- If HEAT.COOL reads COOL, CLG DMP CMD is set equal to the output of the cooling loop, CLG LOOPOUT.

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.

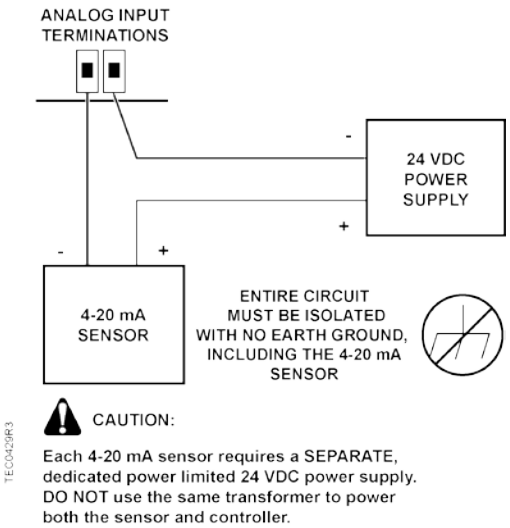
Wiring Diagrams

⚠ 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:

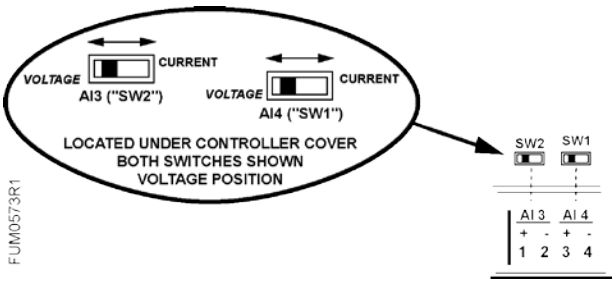
- VA requirements higher than the maximum
- 110 or 220 Vac requirements
- DC power requirements
- Separate transformers used to power the load
(for example part number 540-147, Terminal Equipment Controller Relay Module)

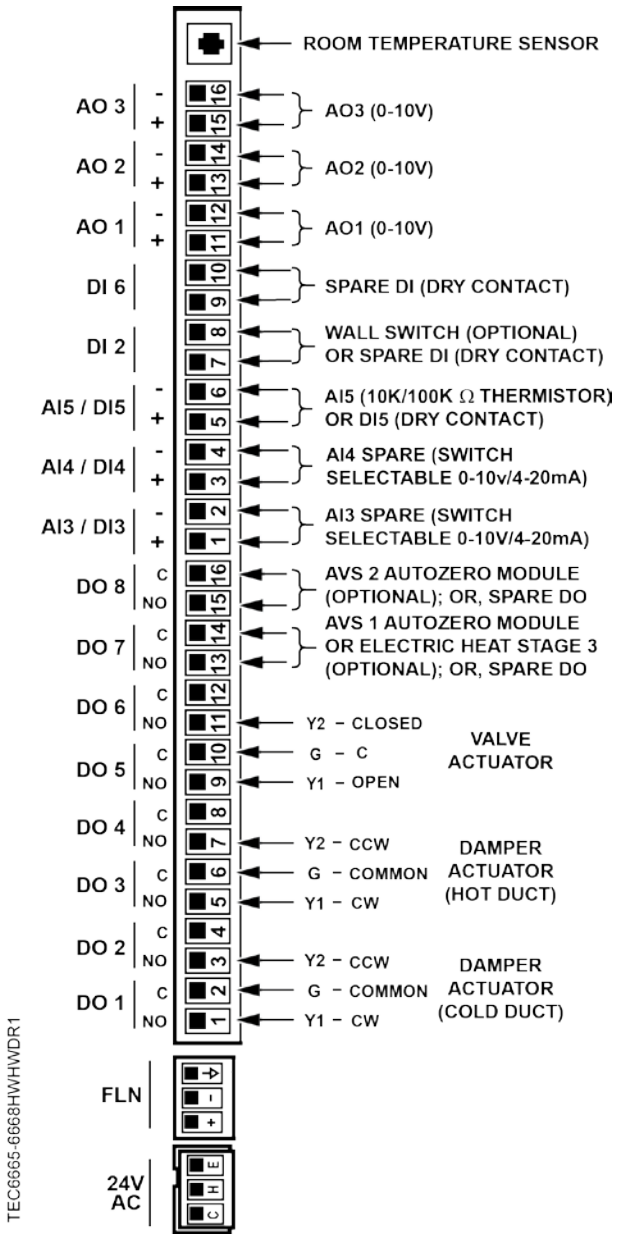
NOTE:
Thermistor inputs are 10K (default) or 100K software selectable (AUX TEMP AI X).



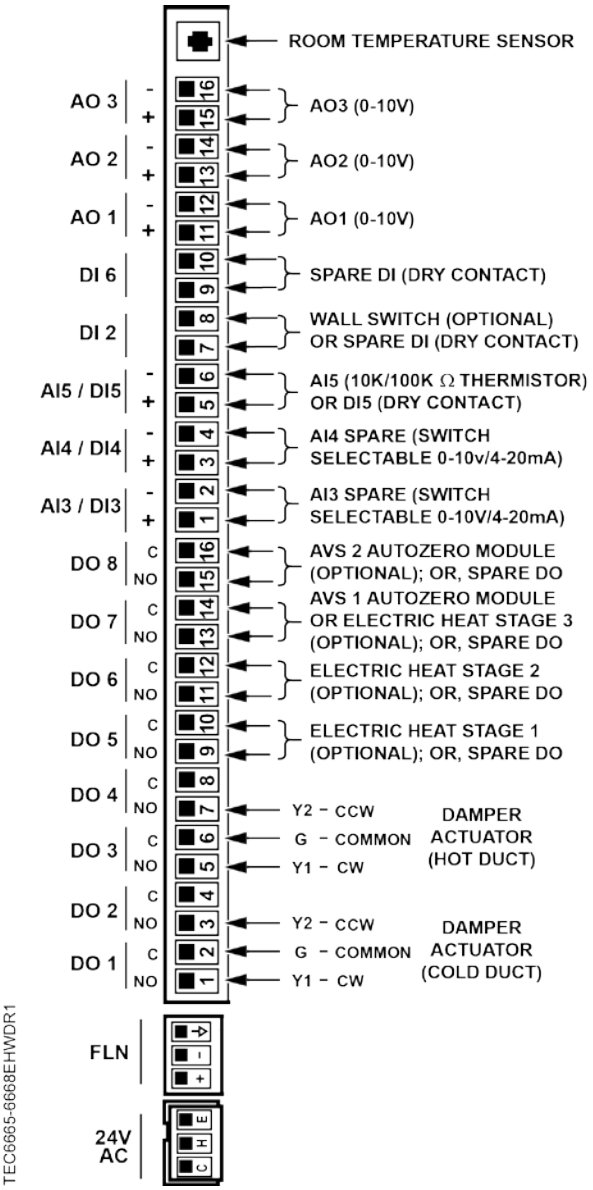
Wiring for AI with a 4 to 20 mA Sensor.

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 6668 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	DAY CLG STPT	74.0 (23.44888)	DEG F (DEG C)	48-111.75	--	--
AO	7	DAY HTG STPT	70.0 (21.20888)	DEG F (DEG C)	48-111.75	--	--
AO	8	NGT CLG STPT	82.0 (27.92888)	DEG F (DEG C)	48-111.75	--	--
AO	9	NGT 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	--	--
AO	16	FLOW START	0	PCT	0-102	--	--
AO	17	FLOW END	100	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}	NGT OVRD	NIGHT	--	Binary	NIGHT	DAY
AO	22	REHEAT START	50	PCT	0-102	--	--
AO	23	REHEAT END	100	PCT	0-102	--	--
BI	{24}	DI 2	OFF	--	Binary	ON	OFF
BI	{25}	DI 3	OFF	--	Binary	ON	OFF
AO	26	TOTFLO PGAIN	0	--	0-51.15	--	--
AO	27	TOTFLO IGAIN	0.018	--	0-1.023	--	--
AO	28	TOTFLO DGAIN	0	--	0-510	--	--
BO	{29}	DAY.NGT	DAY	--	Binary	NIGHT	DAY

Object Type a)	Object Instance (Point Number)	Object Name (Descriptor)	Factory Default (SI Units) b)	Eng Units (SI Units)	Range	Active Text	Inactive Text
AI	{30}	TOT VOLUME	0 (0.0)	CFM (LPS)	0-131068	--	--
AO	{32}	CLG FLOW MAX	2200 (1038.18)	CFM (LPS)	0-131068	--	--
AO	{33}	TOT FLOW MIN	220 (103.818)	CFM (LPS)	0-131068	--	--
AO	{34}	TOT FLOW MAX	2200 (1038.18)	CFM (LPS)	0-131068	--	--
AI	{35}	CLG VOLUME	0 (0.0)	CFM (LPS)	0-131068	--	--
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	{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	--	--

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	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	--	--
AO	72	CLGFLO IGAIN	0.018	--	0-1.023	--	--
AO	73	CLGFLO DGAIN	0	--	0-510	--	--
AO	{74}	TOT FLOW	0	PCT	0-1023.75	--	--
AO	{75}	CLG FLOW	0	PCT	0-1023.75	--	--
AO	76	NGT FLOW MIN	0 (0.0)	CFM (LPS)	0-131068	--	--
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}	TOT 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	--	--

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	{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
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.

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