

Application 2355 Heating and/or Chilled Water Cooling, ASHRAE Cycle III (SENSOR TYPE = DISCH)

Overview

Application 2355 behaves differently depending on the value of the point SENSOR TYPE (number 51). This bulletin is written assuming SENSOR TYPE = DISCH (discharge). Another bulletin covers application 2355 when SENSOR TYPE = ROOM.

When SENSOR TYPE = DISCH in application 2355, the Unit Vent Small Point Controller – 0-10V Output (hereafter referred to as Unit Vent SPC) controls a unit ventilator equipped with a chilled water coil for cooling, and/or a heating coil which may be hot water, steam, or electric, for ASHRAE Cycle III. A face-bypass damper can be controlled, replacing both the modulating (0-10V) heating and cooling actuators. If a face-bypass damper is used, 2-position valves on the coils may be controlled. Heating only and cooling only units can also be controlled with this application by overriding the point HEAT.COOL (number 5).

Other features available in this application include:

- Morning warm-up/cool-down
- Night mode override
- Free cooling
- Auxiliary radiation in heating mode

NOTE: For hot water and steam systems, the use of a low temperature detection thermostat (LTDT) is strongly recommended.

This application controls discharge temperature by directly modulating the coil control devices. This application also controls an outdoor air damper as defined by ASHRAE Cycle III to maintain a given mixed air temperature set point. The free cooling/economizer function is turned ON and OFF by the field panel using the point FREE CLG (number 23). If free cooling is not available, then the outdoor air damper will be kept at minimum position; otherwise, the outdoor air damper will modulate to maintain the mixed air temperature set point. The unit ventilator fan is also controlled in this application.

NOTE: This application is very similar to application 2283, but with 3 main differences:

1. This application uses a different hardware board.
2. This application uses more advanced LTDT software.
3. This application's heating and cooling loops control discharge temperature instead of room temperature.

Refer to Figures 2355D-1 through 2355D-4.

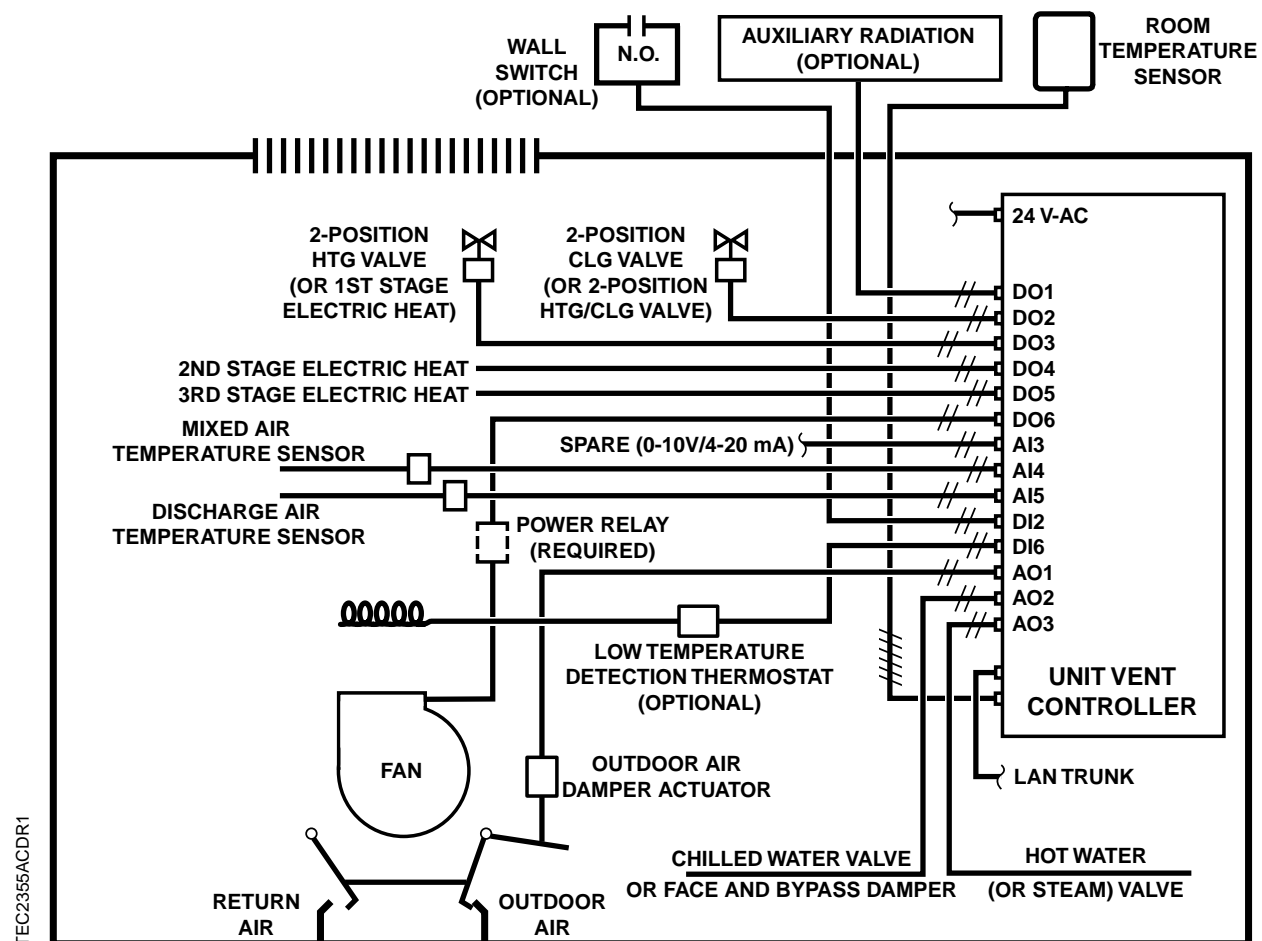


Figure 2355D-1. Application 2355 (SENSOR TYPE = DISCH) Control Drawing.

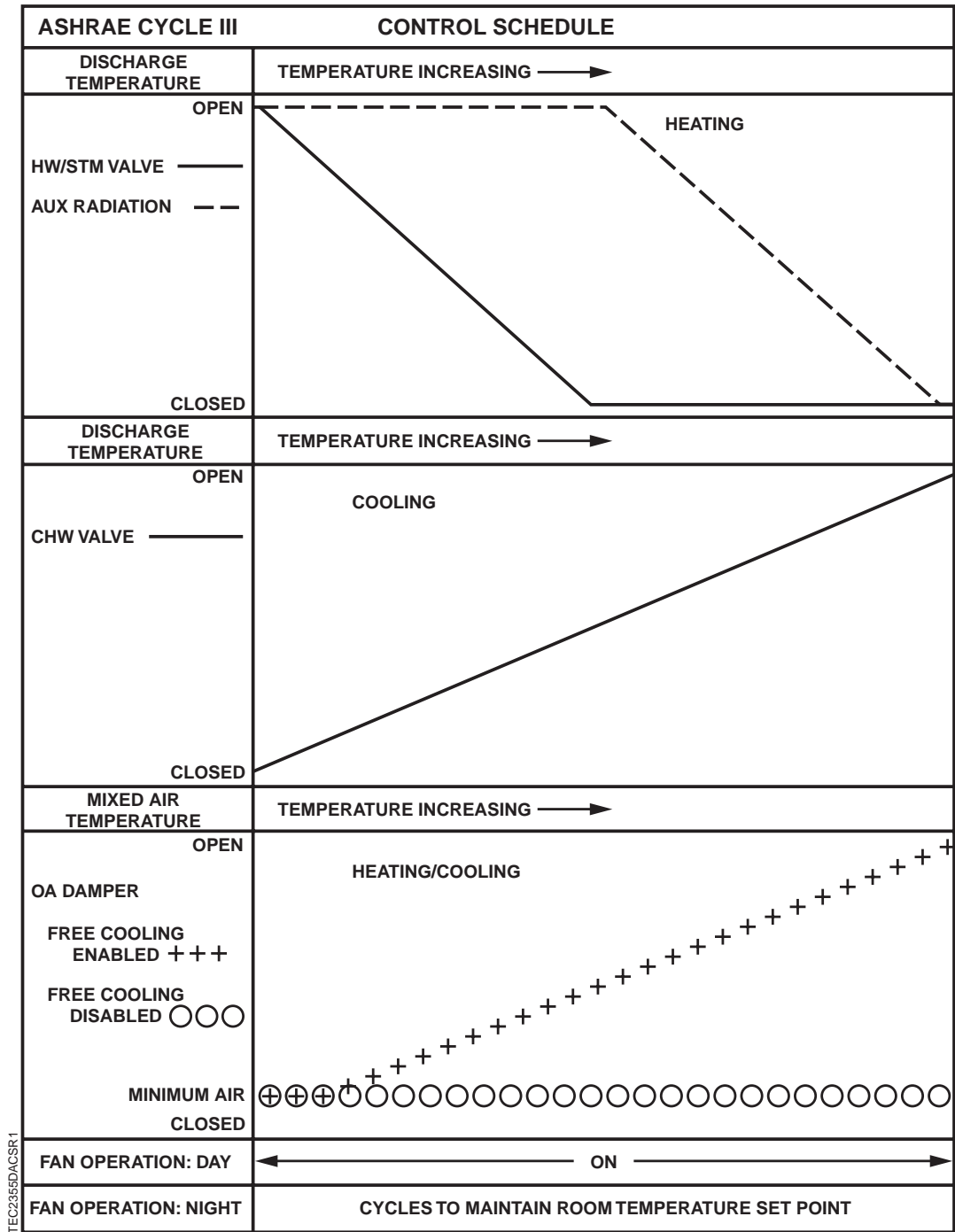


Figure 2355D-2. Application 2355 (SENSOR TYPE = DISCH) Control Schedules.

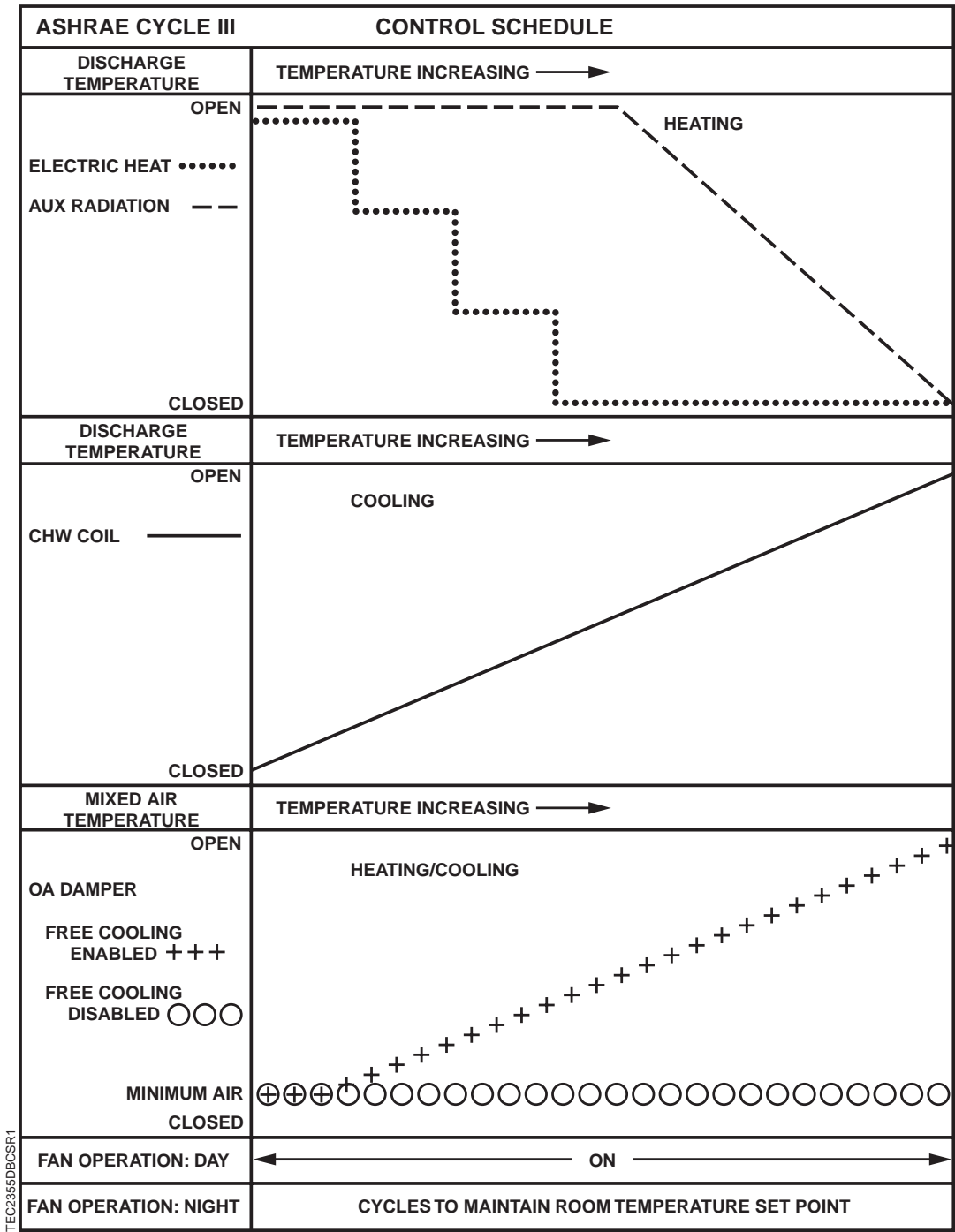


Figure 2355D-3. Application 2355 (SENSOR TYPE = DISCH) Control Schedules (continued).

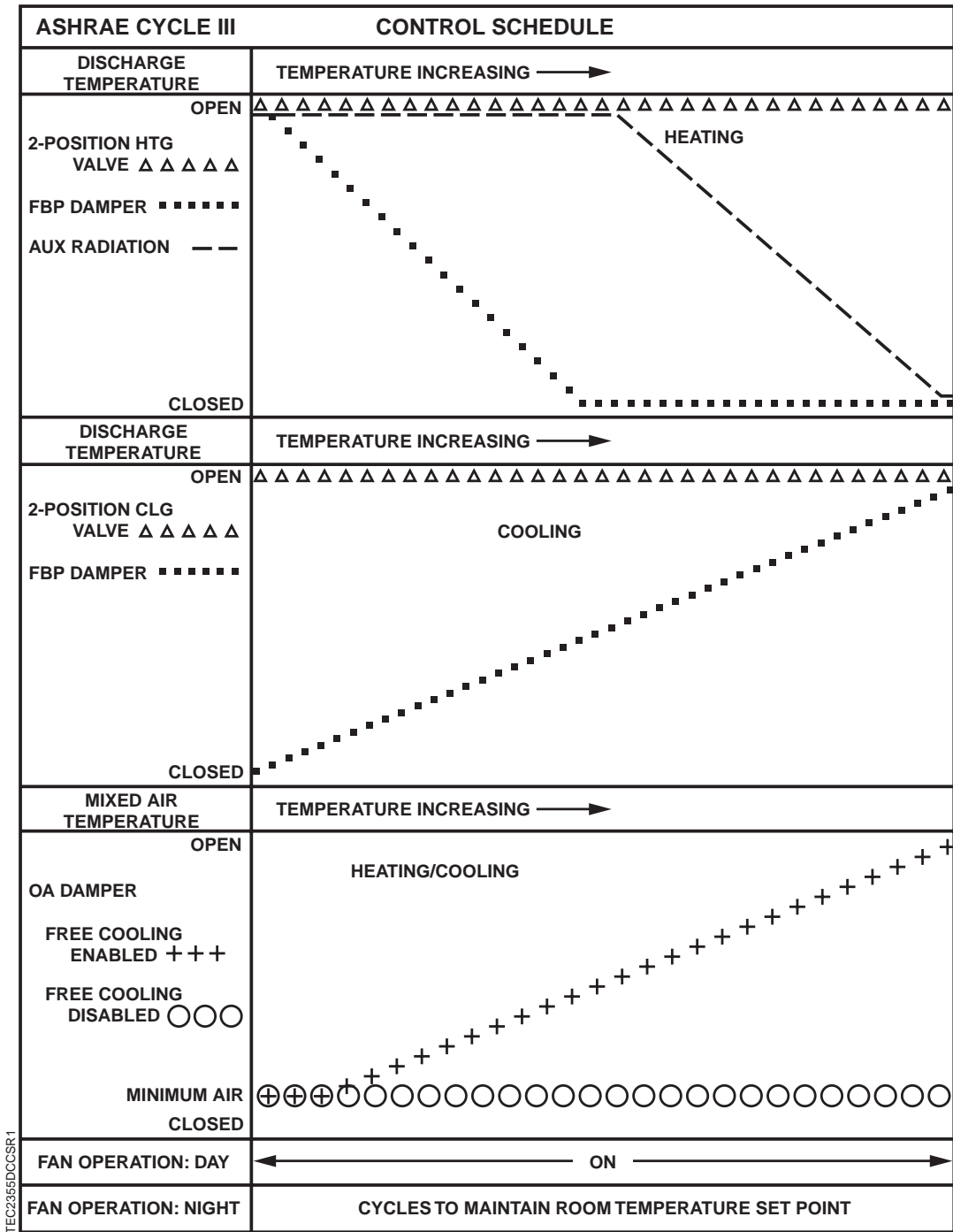


Figure 2355D-4. Application 2355 (SENSOR TYPE = DISCH) Control Schedules (continued).

Hardware inputs

Analog

- Averaging air temperature sensor (for mixed air)
- Averaging air temperature sensor (for discharge air)
- Room temperature sensor
- Room temperature set point dial (optional)

Digital

- Low temperature detection thermostat (LTDT)
- Night mode override (optional)
- Wall switch (optional)

Hardware outputs

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

Analog (0-10V)

- Cooling valve actuator, **or**, face-bypass damper actuator
- Heating valve actuator
- Outdoor air damper actuator

Digital

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

Sequence of Operation

The following paragraphs present the sequence of operation for Application 2355, "Heating and/or Chilled Water Cooling, ASHRAE Cycle III." (**SENSOR TYPE = DISCH**)

Control temperature set points

Depending on the controller's current operational mode (day or night), the room control temperature set point, CTRLRM STPT (number 49) holds the value of one of the following set points:

Day Mode – In day mode, CTRLRM STPT holds the value of the point DAY CLG STPT (number 6) or the point DAY HTG STPT (number 7). If the room temperature sensor has a set point dial and the point STPT DIAL (number 14) is set to YES, then CTRLRM STPT holds the value of the point RM STPT DIAL (number 13).

If the set point dial is used and the value of RM STPT DIAL is less than the value of the point RM STPT MIN (number 11), then CTRLRM STPT holds the value of RM STPT MIN. If the value of RM STPT DIAL is greater than the value of the point RM STPT MAX (number 12), then CTRLRM STPT holds the value of RM STPT MAX.

Night Mode – In night mode, CTRLRM STPT holds the value of the point NGT CLG STPT (number 8) or the point NGT HTG STPT (number 9).

- NOTES:**
1. This feature determines the desired room set point, **not** the discharge set point.
 2. The value of the point CTRLRM TEMP (number 50) is the same as the value of the point ROOM TEMP (number 4), unless CTRLRM TEMP is overridden.

Day and night modes

The day/night status of the space is determined by the status of the point DAY.NGT (number 29). 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 (Figures 2355A-1 and 2355A-5), and the point WALL SWITCH (number 18) equals YES, the controller monitors the status of DI 2. When the status of the point DI 2 (number 24) is ON (the switch is closed), then DAY.NGT will be set to DAY, indicating that the controller is in day mode. When the status of DI 2 is OFF (the switch is open), then DAY.NGT will be set to NIGHT, indicating that the controller is in night mode.

When WALL SWITCH equals NO, the controller does not monitor the status of the wall switch, even if one is connected to it. In this case, and if the controller is operating stand-alone (that is, not connected to a field panel), then the controller stays in day mode all the time. If the controller is operating with centralized control (connected to a field panel), then the field panel can send an operator or PPCL command to override the status of the point DAY.NGT. Refer to *Powers Process Control Language (PPCL) User's Manual* (125-1896) and *Field Panel User's Manual* (125-1895) for more information.

Night mode override switch

If an override switch is present on the room temperature sensor and a value (in hours) other than zero has been entered into the point OVRD TIME (number 20), then by pressing the override switch a room occupant can reset the controller to day operational mode for the amount of time that is set in OVRD TIME. The status of the point NGT OVRD (number 21) changes to DAY and remains there until after the override time elapses, at which time the controller returns to night mode and the status of NGT OVRD changes back to NIGHT.

It is only when the controller is in night mode that the override switch on the room sensor will have any effect on the controller.

Valve configuration

Definition of "2-pipe heat/cool."

- If the unit has one valve which controls a coil that has either hot or chilled water depending on the season, then the point 1 VLV HTGCLG (number 16) is set to YES. This configuration is often referred to as "2-pipe heat/cool."
- If the unit has any other setup, then 1 VLV HTGCLG is set to NO. This includes units which are heating or cooling only, units with a heating and a cooling coil (often referred to as "4-pipe"), units with electric heating, etc.

Set point and temperature selection

In this application bulletin, SENSOR TYPE (number 51) = DISCH. Therefore:

- CTL STPT (number 92) = DISCH STPT (number 03).
- CTL TEMP (number 78) = DISCH STPT (number 03).

In some of the following sections CTL STPT and CTL TEMP are used; in other sections, CTLRM STPT and CTLRM TEMP are used. When CTL STPT and CTL TEMP are used the feature being explained uses the discharge temperature and set point. When CTLRM STPT and CTLRM TEMP are used, the feature being explained uses the desired room set point and the control room temperature (regardless of the value of SENSOR TYPE).

Day heating operation

In day heating operation, the controller maintains the discharge temperature at the value stored in the point CTL STPT (number 92) by doing the following:

- Modulating the available coil control device based on the difference between the control temperature point, CTL TEMP (number 78) and CTL STPT. If CTL TEMP goes below CTL STPT, then the available coil control device either opens (if heating valve actuator or face-bypass damper), or energizes (if electric heat). If CTL TEMP goes above CTL STPT, then the reverse occurs.
- Controlling auxiliary radiation (if provided) using a pulse-width modulation algorithm. The auxiliary radiation will be ON for a percentage of the time held in the point AUX HTG TIME (number 57). The on-time is modulated in sequence with the coil control device. Auxiliary radiation is first ON and last OFF.
- Positioning the outdoor air damper as follows:
 1. (ASHRAE Cycle III) When the point FREE CLG (number 23) is enabled, the position of the outdoor air damper is based on the difference between the mixed air temperature point, MA TEMP (number 47), and the mixed air temperature set point, MA STPT (number 93). If the value of MA TEMP is below the value of MA STPT, then the damper closes. The damper cannot close beyond the value of the point OADPR MINPOS (number 10). When FREE CLG is disabled, the damper is held at the value of OADPR MINPOS.

Day cooling operation

In day cooling operation, the controller maintains the discharge temperature at the value stored in the point CTL STPT (number 92) by:

- Modulating the available coil control device based on the difference between the control temperature point, CTL TEMP (number 78) and CTL STPT. If CTL TEMP goes above CTL STPT, then the available coil control device (cooling valve actuator or face-bypass damper) opens. If CTL TEMP goes below CTL STPT the reverse occurs.
- Positioning the outdoor air damper as follows:
 2. (ASHRAE Cycle III) When the point FREE CLG (number 23) is enabled, the position of the outdoor air damper is based on the difference between the mixed air temperature point, MA TEMP (number 47), and the mixed air temperature set point, MA STPT (number 93). If the value of MA TEMP is below the value of MA STPT, then the damper closes. The damper cannot close beyond the value of the point OADPR MINPOS (number 10). When FREE CLG is disabled, the damper is held at the value of OADPR MINPOS.

Night heating operation

In night heating operation, the controller maintains the room temperature at the value stored in the point CTRLM STPT (number 49) by doing the following:

- If the point CTRLM TEMP (number 50) drops below the value of the point NGT HTG STPT (number 9) minus the value of the point NGT DBAND (number 88), then:
 3. The fan turns ON.
 4. Heating turns ON.
- If CTRLM TEMP rises above NGT HTG STPT, then:
 5. The fan turns OFF.
 6. Heating turns OFF.

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

Other things to keep in mind with night heating operation:

- For units with hot water coils, the point NGT HW HTG (number 53) must be set to YES so that the valve will be positioned to full open.
- For units with steam or electric coils, NGT HW HTG must be set to NO so that the coils can be cycled.
- The face-bypass damper is at full face when the fan is ON and full bypass when the fan is OFF and the 2-position heating valve actuator is open.
- The controller may switch to cooling mode when appropriate if the point NGT CLG MODE (number 54) is set to YES.
- Heating only is provided when NGT CLG MODE is set to NO.

NOTE: Even though SENSOR TYPE (number 51) equals DISCH, night heating control is based on room temperature, not discharge temperature. If it were based on discharge temperature, the fan would cycle too much.

Night cooling operation

In night cooling operation, the controller maintains the room temperature at the value stored in the point CTRLM STPT (number 49) by doing the following:

- If the point CTRLM TEMP (number 50) rises above the sum of the points NGT CLG STPT (number 8) and NGT DBAND (number 88), then:
 7. The fan turns ON.
 8. Cooling turns ON.

- If CTLRM TEMP drops below NGT CLG STPT, then:
 9. The fan turns OFF.
 10. Cooling turns OFF.

Other things to keep in mind with night cooling operation:

- For units with hot water coils, the point NGT HW HTG (number 53) must be set to YES so that the valve will be positioned to full open.
- For units with steam or electric coils, NGT HW HTG must be set to NO so that the heating coils can be kept OFF.
- The face-bypass damper is at full face when the fan is ON and at full bypass when the fan is OFF and the 2-position cooling valve actuator is open.
- When the point NGT CLG MODE (number 54) is set to NO, the unit will operate in night heating mode only.

NOTE: Even though SENSOR TYPE (number 51) equals DISCH, night cooling control is based on room temperature, not discharge temperature. If it were based on discharge temperature, the fan would cycle too much.

Heating/cooling switchover

For 2-pipe heating/cooling units (the point 1 VLV HTGCLG (number 16) is set to YES), the switchover between heating and cooling must be controlled by the field panel which commands the point HEAT.COOL (number 5). For all other units (the point 1 VLV HTGCLG is set to NO), the heating/cooling switchover is determined as follows:

If **all** of the following conditions are met for the length of time set in the point SWITCH TIME (number 86), then the controller switches from heating to cooling mode by setting the point HEAT.COOL (number 5) to COOL:

- The point HTG LOOPOUT (number 80) is below 50% if auxiliary radiation is not available (the point AUX.NOAUX (number 22) is set to NOAUX), or below SWITCH LIMIT if auxiliary radiation is available.
- The point CTL TEMP (number 78) is greater than the sum of the points CTL STPT (number 92) plus SWITCH DBAND (number 90).
- CTL TEMP is greater than the appropriate cooling set point minus SWITCH DBAND.

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

- The point CLG LOOPOUT (number 79) is below SWITCH LIMIT.
- CTL TEMP is less than CTL STPT minus SWITCH DBAND.
- CTL TEMP is less than the appropriate heating set point plus SWITCH DBAND.

If night cooling is not available, as indicated by the point NGT CLG MODE (number 54), then the controller remains in heating mode during the night.

Control loops

The unit ventilator is controlled by three Proportional, Integral, and Derivative (PID) control loops: a heating loop, a cooling loop, and a mixed air loop.

Heating Loop – The heating loop uses the values of the point CTL STPT (number 92) and the point CTL TEMP (number 78) to modulate the value of the point HTG LOOPOUT (number 80). This is a discharge temperature controller because SENSOR TYPE (number 51) = DISCH (therefore CTL TEMP = DISCH TEMP and CTL STPT = DISCH STPT).

Cooling Loop – The cooling loop uses the values of CTL STPT and CTL TEMP to modulate the value of the point CLG LOOPOUT (number 79). This is a discharge temperature controller because SENSOR TYPE (number 51) = DISCH (therefore CTL TEMP = DISCH TEMP and CTL STPT = DISCH STPT).

Mixed Air Loop – The mixed air loop uses the values of the points MA STPT (number 93) and MA TEMP (number 47) to modulate the value of the point MA LOOPOUT (number 77).

Morning warm-up/cool-down

Morning warm-up or cool-down occurs after the controller switches from night mode to day mode, upon power-up, or if the controller is reset. During morning warm-up or cool-down the controller provides maximum heating or cooling with the outdoor air damper closed until the room temperature, CTLRM TEMP (number 50) reaches the value of the room set point, CTLRM STPT (number 92) plus or minus the value of the point MORN DBAND (number 89). In morning cool-down, if the point FREE CLG (number 23) is set to ENABLE, then the outdoor air damper is opened.

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

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

NOTE: Even though SENSOR TYPE (number 51) equals DISCH, this feature is controlled using the room temperature, CTLRM TEMP, and the room set point, CTLRM STPT. This is because this application is trying to warm-up or cool-down the room, not the duct.

ON/OFF coil valve control

When a face-bypass configuration is used, the coils may be turned ON and OFF with 2-position valves using DOs. There are two conditions when this might occur:

1. In the case where a 4-pipe configuration is used with a face-bypass damper, the cooling valve actuator will be shut while in heating, and the heating valve actuator will be shut while in cooling. In this configuration, 2-position valves must be used to prevent both coils from being ON at the same time.
2. When in heating or cooling, if the face-bypass damper is all the way closed (bypass) for more than two minutes, then the active coil can be closed to conserve energy. This is an option that is performed when the point FBP.2PSVCTL (number 28) is set to ENABLE. Otherwise, the valve is kept open when the damper is closed.

- NOTES:**
1. For both conditions above, if NGT HW HTG is set to YES in night cooling, then the heating coil is kept open.
 2. When a 2-pipe heat/cool configuration is used, with or without a face-bypass damper (the point 1 VLV HTGCLG (number 16) is set to YES in either case), the point NGT HW HTG should be set to YES. The 2-pipe heat/cool coil will then stay open during both night heating and night cooling.

Electric heat

Electric heat (if used) is controlled as follows:

HTG OUTPUT (number 60)	Stage 1	Stage 2	Stage 3
0% - 33%	ON	OFF	OFF
34% - 66%	ON	ON	OFF
67% - 100%	ON	ON	ON

In addition, no stage may turn ON or OFF until the number of seconds held in the point EHT STG DELY (number 58) have elapsed since the last time any stage turned ON or OFF. Stage one will always be the first stage to turn ON and the last stage to turn OFF.

Fan operation

In day mode, the point FAN (number 46) is ON all of the time.

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

In night heating, the fan turns ON when the room temperature CTLRM TEMP (number 50) drops below the value of the points room set point, CTLRM STPT (number 49) minus NGT DBAND (number 88). When the room temperature rises above CTLRM STPT, the fan turns OFF. If any stage of electric heat is ON, then the fan will be ON. The fan will remain ON for 30 seconds after the last stage of electric heat is turned OFF.

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

NOTE: Even though SENSOR TYPE (number 51) equals DISCH, night fan control is based on room temperature, not discharge temperature. If it were based on discharge temperature, the fan would cycle too much.

Fail-safe operation

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

A low temperature detection thermostat LOW TEMP DET (number 87) connected to DI 6 (number 26) can be used to signal the controller when the temperature, sensed by the LTDT, is below the low temperature limit. This LTDT can be either normally opened or normally closed depending on the value of LTDT CONTACT (number 52).

NOTE: If an LTDT is not wired to DI 6, then LTDT USED (number 56) should be set to NO.

If the room temperature sensor input to the Unit Vent SPC fails, or the LTDT equals ON when LTDT USED equals YES, then the controller goes through the following Shutdown sequence:

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

If the discharge air temperature sensor fails, then the following occurs:

- If the last valid value is less than 150 degrees, then the controller shuts down as described in the above Shutdown sequence.
- If the last valid value is greater than 150 degrees, then the heat is turned OFF, the outdoor air damper is closed, and the fan is turned ON. If the sensor does not come back within 10 minutes, then the controller shuts down as described in the Shutdown sequence above.

If the mixed air temperature sensor fails, then the outdoor air damper is closed and the heating and cooling loops continue to control room temperature.

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

Analog and digital outputs cannot be commanded when the controller is in fail-safe mode; however, failed points may be overridden, allowing the controller to return from fail-safe mode. In this instance, room temperature control is not possible.

Application notes

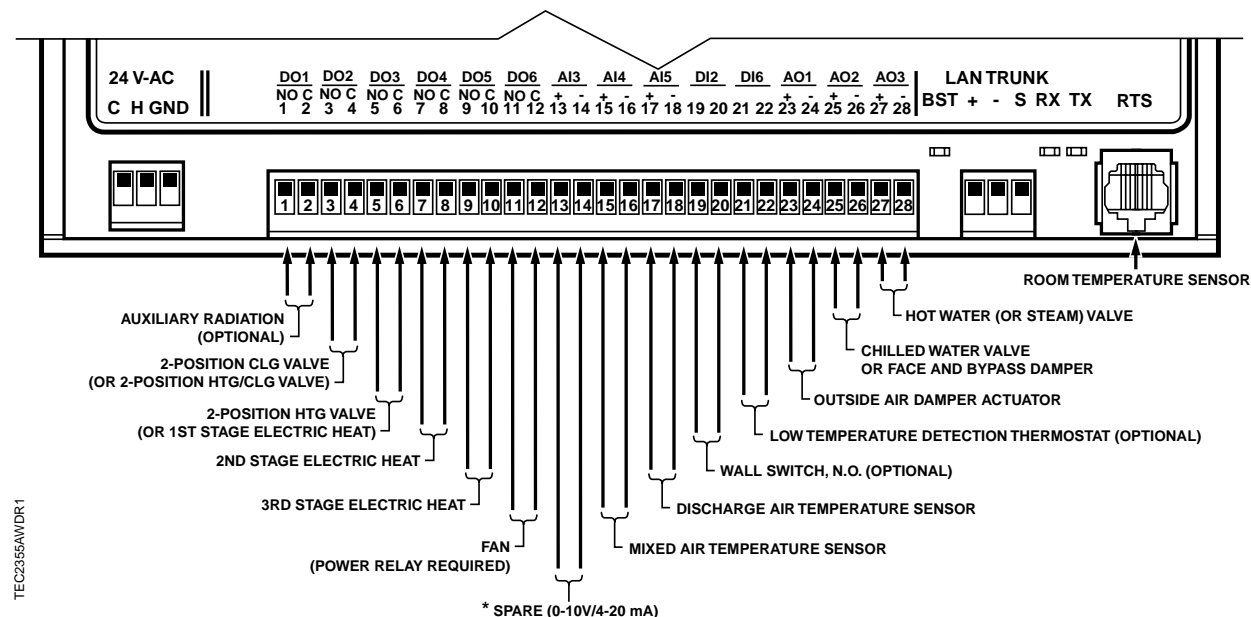
1. If the unit ventilator cycles excessively, or if the temperature swings in the room are excessive, or if there is trouble maintaining the set point, then either the cooling loop, the heating loop or both need to be tuned. Refer to *APOGEE Automation Service Procedures Manual* (125-3013) for more information.
2. The Unit Vent Small Point Controller – 0-10V Output, as shipped from the factory, keeps all associated equipment OFF. Refer to the Equipment Controllers tab in *APOGEE Automation Start-up Procedures Manual* (125-3014) for information on how to release the controller and its equipment to application control.
3. When the fan is manually switched OFF at the unit fan speed switch, the actuators should be wired so they return to their normal state.
4. When SENSOR TYPE (number 51) equals DISCH, the heating/cooling switchover feature is controlled by discharge temperature, not room temperature. If the HEAT.COOL point switches back and forth too often, then the value(s) of SWITCH TIME (number 86) and/or SWITCH DBAND (number 90) should be increased.

Wiring diagrams

The point wiring for Application 2355 is shown in Figure 2355D-5.

**CAUTION:**

The Controller's Digital Outputs (DOs) control 24 Vac loads only. The maximum rating is 12 VA for each DO. For higher VA requirements, 110 or 220 Vac requirements, separate requirements used to power the load, or DC power requirements, use an interposing 220V 4-relay module.



* A dip-switch behind AI 3 on the controller's circuit board (under the controller assembly's cover) must be set to the left (voltage position) or to the right (current position) if AI 3 is used to monitor a 0-10 V or a 4-20 mA sensor.

Figure 2355D-5. Application 2355 Wiring Diagram.

Table 2355D-1. Point Database for Application 2355 (SENSOR TYPE = DISCH).

Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
01	CTLR ADDRESS	99	--	1	0	--	--
02	APPLICATION	2384	--	1	0	--	--
03	DISCH STPT	60.0 (15.656)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
{04}	ROOM TEMP	74.0 (23.45)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
{05}	HEAT.COOL	COOL	--	--	--	HEAT	COOL
06	DAY CLG STPT	74.0 (23.45)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
07	DAY HTG STPT	70.0 (21.21)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
08	NGT CLG STPT	82.0 (27.93)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
09	NGT HTG STPT	65.0 (18.41)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
10	OADPR MINPOS	14.8	PCT	0.4	0.0	--	--
11	RM STPT MIN	55.0 (12.81)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
12	RM STPT MAX	90.0 (32.41)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
{13}	RM STPT DIAL	74.0 (23.45)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
14	STPT DIAL	NO	--	--	--	YES	NO
{15}	AI3	29.2	PCT	0.4	0.0	--	--
16	1 VLV HTGCLG	NO	--	--	--	YES	NO
17	FBP.MODVALVE	VALVE	--	--	--	FBP	VALVE
18	WALL SWITCH	NO	--	--	--	YES	NO
{19}	DI OVRD SW	OFF	--	--	--	ON	OFF
20	OVRD TIME	1	HRS	1	0	--	--
{21}	NGT OVRD	DAY	--	--	--	NIGHT	DAY
22	AUX.NOAUX	NOAUX	--	--	--	AUX	NOAUX
{23}	FREE CLG	DISABL	--	--	--	ENABLE	DISABL
{24}	DI 2	OFF	--	--	--	ON	OFF
{26}	DI 6	OFF	--	--	--	ON	OFF
27	ELEC.NOELEC	NOELEC	--	--	--	ELEC	NOELEC
28	FBP.2PSVCTL	DISABL	--	--	--	ENABLE	DISABL
{29}	DAY.NGT	DAY	--	--	--	NIGHT	DAY
{30}	WRMUP.COOLDN	ON	--	--	--	ON	OFF
31	AOV1 SPAN	10.0	VOLTS	0.01	0.0	--	--
32	AOV1 START	0.0	VOLTS	0.01	0.0	--	--
33	AOV2 SPAN	10.0	VOLTS	0.01	0.0	--	--
34	AOV2 START	0.0	VOLTS	0.01	0.0	--	--
35	AOV3 SPAN	10.0	VOLTS	0.01	0.0	--	--
36	AOV3 START	0.0	VOLTS	0.01	0.0	--	--

1. Points not listed are not used in this application.
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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Table 2355D-1. Point Database for Application 2355 (SENSOR TYPE = DISCH).

Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
37	AO DIR.REV	0	--	1	0	--	--
{38}	AOV1	0.0	VOLTS	0.01	0.0	--	--
{39}	AOV2	0.0	VOLTS	0.01	0.0	--	--
{40}	AOV3	0.0	VOLTS	0.01	0.0	--	--
{41}	AUX RAD	OFF	--	--	--	ON	OFF
{42}	CLG 2POS VLV	OFF	--	--	--	ON	OFF
{43}	EHEAT1.HVALV	OFF	--	--	--	ON	OFF
{44}	EHEAT 2	OFF	--	--	--	ON	OFF
{45}	EHEAT 3	OFF	--	--	--	ON	OFF
{46}	FAN	OFF	--	--	--	ON	OFF
{47}	MA TEMP	74.0 (23.496)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
{48}	DISCH TEMP	74.0 (23.496)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
{49}	CTLRM STPT	74.0 (23.45)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
{50}	CTLRM TEMP	74.0 (23.45)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
51	SENSOR TYPE	ROOM	--	--	--	DISCH	ROOM
52	LTDT CONTACT	NCLOSE	--	--	--	NCLOSE	NOPEN
53	NGT HW HTG	YES	--	--	--	YES	NO
54	NGT CLG MODE	NO	--	--	--	YES	NO
{55}	AUX OUTPUT	0.0	PCT	0.4	0.0	--	--
56	LTDT USED	YES	--	--	--	YES	NO
57	AUX HTG TIME	10	MIN	1	0	--	--
58	EHT STG DELY	30	SEC	1	0	--	--
59	DO DIR.REV	0	--	1	0	--	--
{60}	HTG OUTPUT	0.0	PCT	0.4	0.0	--	--
{61}	CLG OUTPUT	0.0	PCT	0.4	0.0	--	--
{62}	OA DMPR POS	0.0	PCT	0.4	0.0	--	--
63	CLG P GAIN	1.6 (2.88)	--	0.2 (0.36)	0.0	--	--
64	CLG I GAIN	0.05 (0.09)	--	0.0005 (0.0009)	0.0	--	--
65	CLG D GAIN	10 (18.0)	--	2 (3.6)	0	--	--
66	CLG BIAS	50.0	PCT	0.2	0.0	--	--
67	HTG P GAIN	0.4 (0.72)	--	0.05 (0.09)	0.0	--	--
68	HTG I GAIN	0.015 (0.027)	--	0.0002 (0.00036)	0.0	--	--
69	HTG D GAIN	5 (9.0)	--	1 (1.8)	0	--	--
70	HTG BIAS	50.0	PCT	0.2	0.0	--	--
{77}	MA LOOPOUT	0.0	PCT	0.2	0.0	--	--

1. Points not listed are not used in this application.
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.

continued on the next page...

Table 2355D-1. Point Database for Application 2355 (SENSOR TYPE = DISCH).

Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
{78}	CTL TEMP	63.5 (17.616)	DEG F (DEG C)	0.25 (0.14)	37.5(3.056)	--	--
{79}	CLG LOOPOUT	0.0	PCT	0.2	0.0	--	--
{80}	HTG LOOPOUT	0.0	PCT	0.2	0.0	--	--
{81}	MA P GAIN	0.2 (0.36)	--	0.02 (0.036)	0.0	--	--
{82}	MA I GAIN	0.00054 (0.000972)	--	0.00009 (0.000162)	0.0	--	--
{83}	MA D GAIN	24 (43.2)	--	1 (1.8)	0	--	--
{84}	MA BIAS	0.0	PCT	0.2	0.0	--	--
85	SWITCH LIMIT	4.8	PCT	0.4	0.0	--	--
86	SWITCH TIME	10	MIN	1	0	--	--
{87}	LOW TEMP DET	OFF	--	--	--	ON	OFF
88	NGT DBAND	3.0 (1.68)	DEG F (DEG C)	0.25 (0.14)	0.0	--	--
89	MORN DBAND	2.0 (1.12)	DEG F (DEG C)	0.25 (0.14)	0.0	--	--
90	SWITCH DBAND	2.0 (1.12)	DEG F (DEG C)	0.25 (0.14)	0.0	--	--
{92}	CTL STPT	63.5 (17.616)	DEG F (DEG C)	0.25 (0.14)	37.5(3.056)	--	--
{93}	MA STPT	74.0 (23.496)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
98	LOOP TIME	5	SEC	1	0	--	--
{99}	ERROR STATUS	0	--	1	0	--	--

1. Points not listed are not used in this application.
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.

Application 2355 Heating and/or Chilled Water Cooling, ASHRAE Cycle III (SENSOR TYPE = ROOM)

Overview

Application 2355 behaves differently depending on the value of the point SENSOR TYPE (number 51). This bulletin is written assuming SENSOR TYPE = ROOM. Another bulletin covers application 2355 when SENSOR TYPE = DISCH (discharge).

In application 2355 the Unit Vent Small Point Controller – 0-10V Output (hereafter referred to as Unit Vent SPC) controls a unit ventilator equipped with a chilled water coil for cooling, and/or a heating coil which may be hot water, steam, or electric, for ASHRAE Cycle III. A face-bypass damper can be controlled, replacing both the modulating (0-10V) heating and cooling actuators. If a face-bypass damper is used, 2-position valves on the coils may be controlled. Heating only and cooling only units can also be controlled with this application by overriding the point HEAT.COOL (number 5).

Other features available in this application include:

- Morning warm-up/cool-down
- Night mode override
- Free cooling
- Auxiliary radiation in heating mode.

NOTE: For hot water and steam systems, the use of a low temperature detection thermostat (LTDT) is strongly recommended.

This application controls room temperature by directly modulating the coil control devices. An outdoor air damper is controlled according to the schedule as defined by ASHRAE Cycle III to maintain a given mixed air temperature set point. The free cooling/economizer function is turned ON and OFF by the field panel using the point FREE CLG (number 23). If free cooling is not available, then the outdoor air damper will be kept at minimum position; otherwise, the outdoor air damper will modulate to maintain the mixed air temperature set point. The unit ventilator fan is also controlled in this application.

NOTE: This application is very similar to application 2283, but with 2 main differences:

1. This application uses a different hardware board.
2. This application has more advanced LTDT software.

Refer to Figures 2355R-1 through 2355R-4.

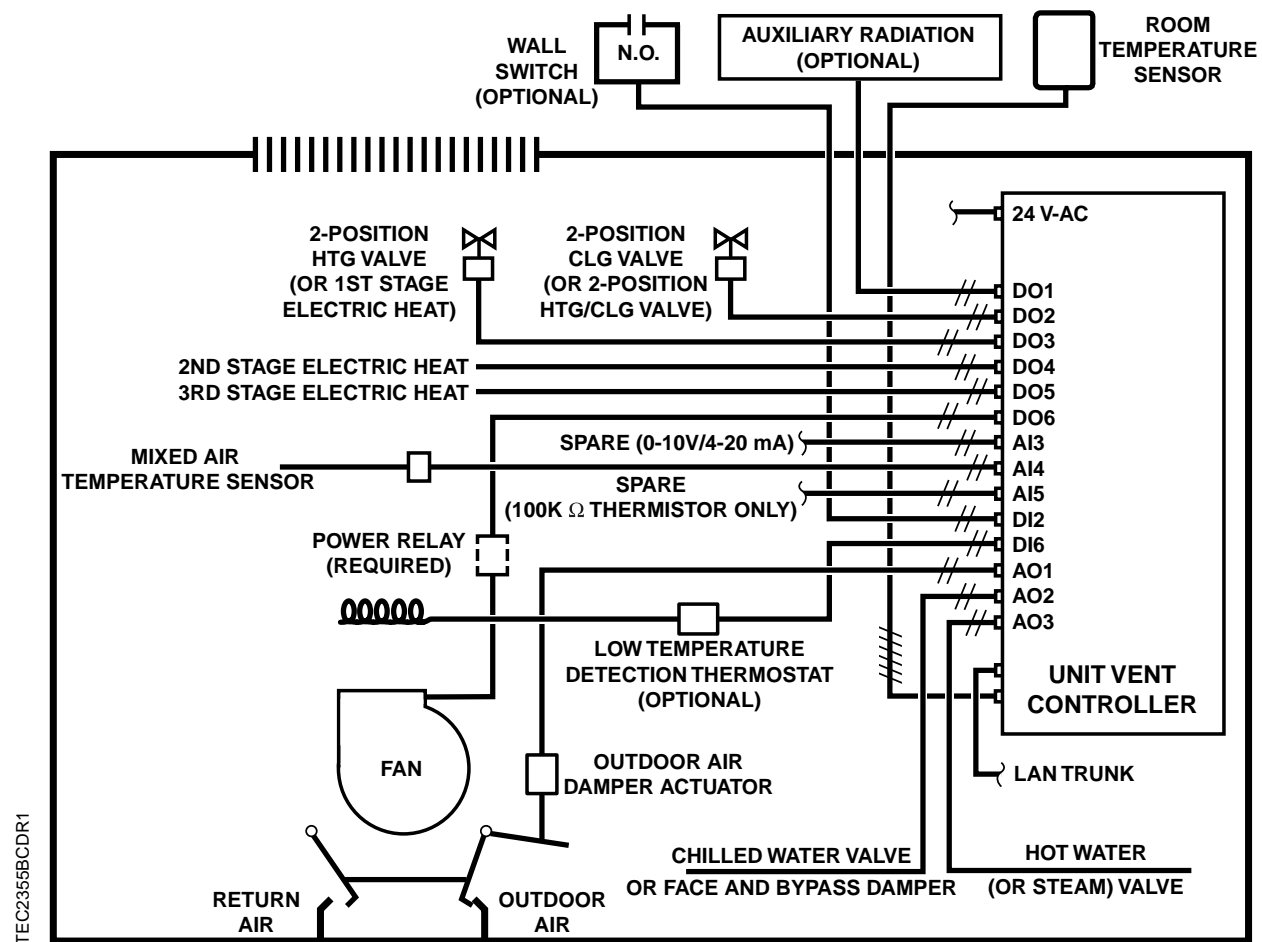


Figure 2355R-1. Application 2355 (SENSOR TYPE = ROOM) Control Drawing.

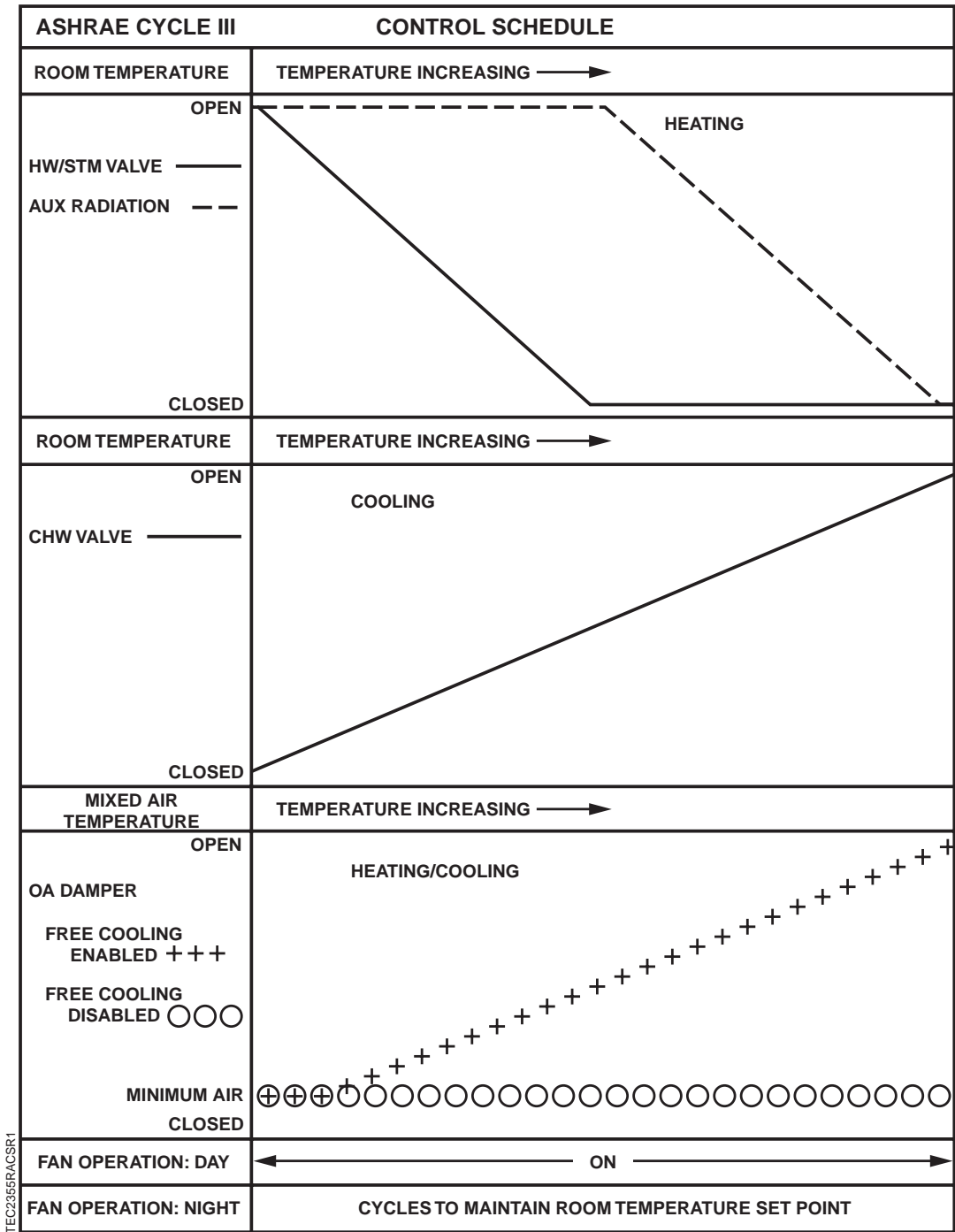


Figure 2355R-2. Application 2355 (SENSOR TYPE = ROOM) Control Schedules.

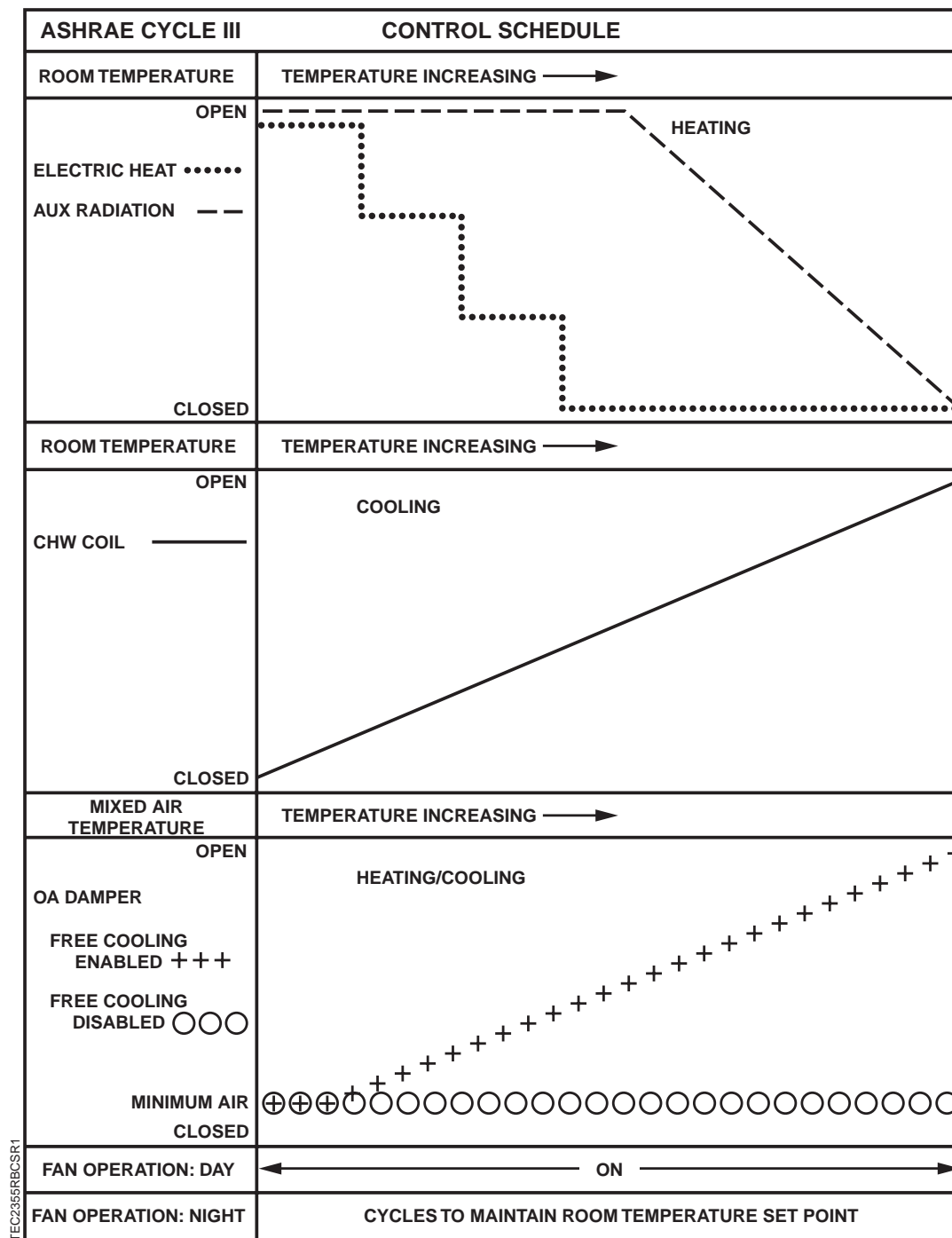


Figure 2355R-3. Application 2355 (SENSOR TYPE = ROOM) Control Schedules (continued).

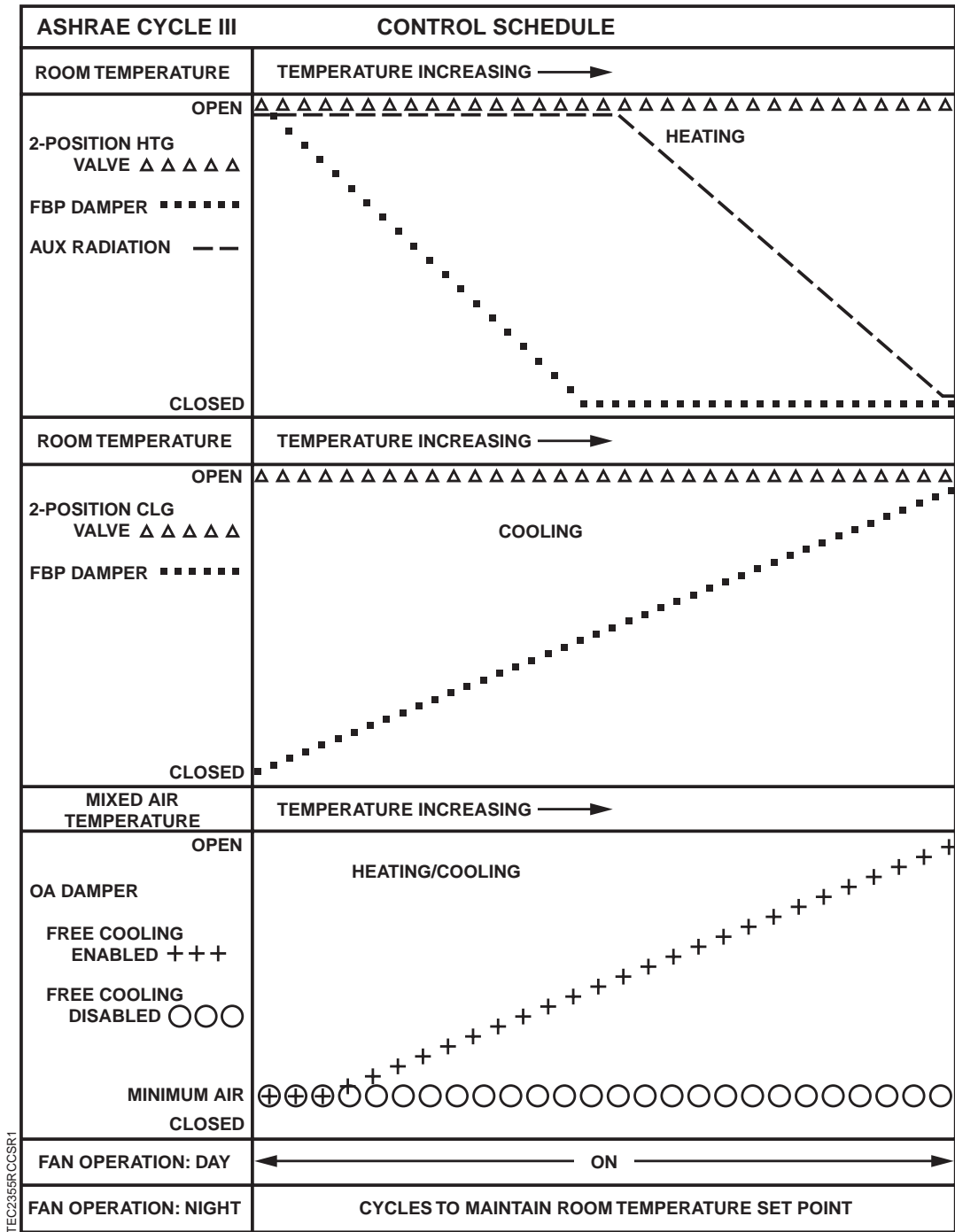


Figure 2355R-4. Application 2355 (SENSOR TYPE = ROOM) Control Schedules (continued).

Hardware inputs

Analog

- Averaging air temperature sensor
- Room temperature sensor
- Room temperature set point dial (optional)

Digital

- Low temperature detection thermostat (LTDT)
- Night mode override (optional)
- Wall switch (optional)

Hardware outputs

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

Analog (0-10V)

- Cooling valve actuator, **or**, face-bypass damper actuator
- Heating valve actuator
- Outdoor air damper actuator

Digital

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

Sequence of Operation

The following paragraphs present the sequence of operation for Application 2355, "Heating and/or Chilled Water Cooling, ASHRAE Cycle III." (**SENSOR TYPE = ROOM**)

Control temperature set points

Depending on the controller's current operational mode (day or night), the control temperature set point, CTRLRM STPT (number 49) holds the value of one of the following set points:

Day Mode – In day mode, CTRLRM STPT holds the value of the point DAY CLG STPT (number 6) or the point DAY HTG STPT (number 7). If the room temperature sensor has a set point dial and the point STPT DIAL (number 14) is set to YES, then CTRLRM STPT holds the value of the point RM STPT DIAL (number 13).

If the set point dial is used and the value of RM STPT DIAL is less than the value of the point RM STPT MIN (number 11), then CTRLRM STPT holds the value of RM STPT MIN. If the value of RM STPT DIAL is greater than the value of the point RM STPT MAX (number 12), then CTRLRM STPT holds the value of RM STPT MAX.

Night Mode – In night mode, CTRLRM STPT holds the value of the point NGT CLG STPT (number 8) or the point NGT HTG STPT (number 9).

NOTE: The value of the point CTRLRM TEMP (number 50) is the same as the value of the point ROOM TEMP (number 4), unless CTRLRM TEMP is overridden.

Day and night modes

The day/night status of the space is determined by the status of the point DAY.NGT (number 29). 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 (Figures 2355B-1 and 2355B-5) and the point WALL SWITCH (number 18) equals YES, the controller monitors the status of DI 2. When the status of the point DI 2 (number 24) is ON (the switch is closed), DAY.NGT will be set to DAY, indicating that the controller is in day mode. When the status of DI 2 is OFF (the switch is open), DAY.NGT will be set to NIGHT, indicating that the controller is in night mode.

When WALL SWITCH equals NO, the controller does not monitor the status of the wall switch, even if one is connected to it. In this case, and if the controller is operating stand-alone (that is, not connected to a field panel), the controller stays in day mode all the time. If the controller is operating with centralized control (connected to a field panel), then the field panel can send an operator or PPCL command to override the status of the point DAY.NGT. Refer to *Powers Process Control Language (PPCL) User's Manual* (125-1896) and *Field Panel User's Manual* (125-1895) for more information.

Night mode override switch

If an override switch is present on the room temperature sensor and a value (in hours) other than zero has been entered into the point OVRD TIME (number 20), then by pressing the override switch a room occupant can reset the controller to day operational mode for the amount of time that is set in OVRD TIME. The status of the point NGT OVRD (number 21) changes to DAY and remains there until override time elapses, at which time the controller returns to night mode and the status of NGT OVRD changes back to NIGHT.

It is only when the controller is in night mode that the override switch on the room sensor will have any effect on the controller.

Valve configuration

Definition of “2-pipe heat/cool”:

- If the unit has one valve which controls a coil that has either hot or chilled water depending on the season, then the point 1 VLV HTGCLG (number 16) is set to YES. This configuration is often referred to as “2-pipe heat/cool.”
- If the unit has any other setup, then 1 VLV HTGCLG is set to NO. This includes units which are heating or cooling only, units with a heating and a cooling coil (often referred to as “4-pipe”), units with electric heating, etc.

Setpoint and temperature selection

In this application bulletin, SENSOR TYPE (number 51) = ROOM. Therefore:

- CTL STPT (number 92) = CTRLM STPT (number 49).
- CTL TEMP (number 78) = CTRLM STPT = ROOM TEMP (number 4).

In some of the following sections CTL STPT and CTL TEMP are used; in other sections, CTRLM STPT and CTRLM TEMP are used. When CTL STPT and CTL TEMP are used, the feature being explained will control differently based on the value of the point SENSOR TYPE. When CTRLM STPT and CTRLM TEMP are used, the feature being explained will use the desired room setpoint and the control room temperature (regardless of the value of SENSOR TYPE).

Day heating operation

In day heating operation, the controller maintains the room temperature at the value stored in the point CTL STPT (number 92) by doing the following:

- Modulating the available coil control device based on the difference between the control temperature point, CTL TEMP (number 78), and CTL STPT. If CTL TEMP goes below CTL STPT, then the available coil control device either opens (if heating valve actuator or face-bypass damper), or energizes (if electric heat). If CTL TEMP goes above CTL STPT, then the reverse occurs.

- Controlling auxiliary radiation (if provided) using a pulse-width modulation algorithm. The auxiliary radiation will be ON for a percentage of the time held in the point AUX HTG TIME (number 57). The on-time is modulated in sequence with the coil control device. Auxiliary radiation is first ON and last OFF.
- Positioning the outdoor air damper as follows:
 1. (ASHRAE Cycle III) When the point FREE CLG (number 23) is enabled, the position of the outdoor air damper is based on the difference between the mixed air temperature point, MA TEMP (number 47) and the mixed air temperature set point, MA STPT (number 93). If the value of MA TEMP is below the value of MA STPT, then the damper closes. The damper cannot close beyond the value of the point OADPR MINPOS (number 10). When FREE CLG is disabled, the damper is held at the value of OADPR MINPOS.

Day cooling operation

In day cooling operation, the controller maintains the room temperature at the value stored in the point CTL STPT (number 92) by doing the following:

- Modulating the available coil control device based on the difference between the control temperature point, CTL TEMP (number 78) and CTL STPT. If CTL TEMP goes above CTL STPT, then the available coil control device (cooling valve actuator or face-bypass damper) opens. If CTL TEMP goes below CTL STPT the reverse occurs.
- Positioning the outdoor air damper as follows:
 2. (ASHRAE Cycle III) When the point FREE CLG (number 23) is enabled, the position of the outdoor air damper is based on the difference between the mixed air temperature point, MA TEMP (number 47) and the mixed air temperature set point, MA STPT (number 93). If the value of MA TEMP is below the value of MA STPT, then the damper closes. The damper cannot close beyond the value of the point OADPR MINPOS (number 10). When FREE CLG is disabled, the damper is held at the value of OADPR MINPOS.

Night heating operation

The controller maintains the room temperature at the value stored in the point CTRLRM STPT (number 49) by doing the following:

- If the point CTRLRM TEMP (number 50) drops below the value of the point NGT HTG STPT (number 9) minus the value of the point NGT DBAND (number 88), then:
 3. The fan turns ON.
 4. Heating turns ON.
- If CTRLRM TEMP rises above NGT HTG STPT, then:
 5. The fan turns OFF.
 6. Heating turns OFF.

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

Other things to keep in mind with night heating operation:

- For units with hot water coils, the point NGT HW HTG (number 53) must be set to YES so that the valve will be positioned to full open.
- For units with steam or electric coils, NGT HW HTG must be set to NO so that the coils can be cycled.
- The face-bypass damper is at full face when the fan is ON and full bypass when the fan is OFF and the 2-position heating valve actuator is open.
- The controller may switch to cooling mode when appropriate if the point NGT CLG MODE (number 54) is set to YES.
- Heating only is provided when NGT CLG MODE is set to NO.

Night cooling operation

In night cooling operation, the controller maintains the room temperature at the value stored in the point CTLRM STPT (number 49) by doing the following:

- If the point CTLRM TEMP (number 50) rises above the sum of the points NGT CLG STPT (number 8) and NGT DBAND (number 88), then:
 7. The fan turns ON.
 8. Cooling turns ON.
- If CTLRM TEMP drops below NGT CLG STPT, then:
 9. The fan turns OFF.
 10. Cooling turns OFF.

Other things to keep in mind with night cooling operation:

- For units with hot water coils, the point NGT HW HTG (number 53) must be set to YES, so that the valve will be positioned to full open.
- For units with steam or electric coils, NGT HW HTG must be set to NO, so that the heating coils can be kept OFF.
- The face-bypass damper is at full face when the fan is ON and at full bypass when the fan is OFF and the 2-position cooling valve actuator is open.
- When the point NGT CLG MODE (number 54) is set to NO, the unit will operate in night heating mode only.

Heating/cooling switchover

For 2-pipe heating/cooling units (the point 1 VLV HTGCLG (number 16) is set to YES), the switchover between heating and cooling must be controlled by the field panel which commands the point HEAT.COOL (number 5). For all other units (the point 1 VLV HTGCLG is set to NO), the heating/cooling switchover is determined as follows:

If **all** of the following conditions are met for the length of time set in the point SWITCH TIME (number 86), then the controller switches from heating to cooling mode by setting the point HEAT.COOL (number 5) to COOL:

- The point HTG LOOPOUT (number 80) is below 50% if auxiliary radiation is not available (the point AUX.NOAUX (number 22) is set to NOAUX), or below SWITCH LIMIT if auxiliary radiation is available.
- The point CTL TEMP (number 78) is greater than the sum of the points CTL STPT (number 92) plus SWITCH DBAND (number 90).
- CTL TEMP is greater than the appropriate cooling set point minus SWITCH DBAND.

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

- The point CLG LOOPOUT (number 79) is below SWITCH LIMIT.
- CTL TEMP is less than CTL STPT minus SWITCH DBAND.
- CTL TEMP is less than the appropriate heating set point plus SWITCH DBAND.

If night cooling is not available, as indicated by the point NGT CLG MODE (number 54), then the controller remains in heating mode during the night.

Control loops

The unit ventilator is controlled by three Proportional, Integral, and Derivative (PID) control loops: a heating loop, a cooling loop, and a mixed air loop.

Heating Loop – The heating loop uses the value of the point CTL STPT (number 92) and the point CTL TEMP (number 78) to modulate the value of the point HTG LOOPOUT (number 80). This is a room temperature controller because SENSOR TYPE (number 51) = ROOM (therefore CTL TEMP = CTLRM TEMP and CTL STPT = CTLRM STPT).

Cooling Loop – The cooling loop uses the value of CTL STPT and CTL TEMP to modulate the value of the point CLG LOOPOUT (number 79). This is a room temperature controller because SENSOR TYPE (number 51) = ROOM (therefore CTL TEMP = CTLRM TEMP and CTL STPT = CTLRM STPT).

Mixed Air Loop – The mixed air loop uses the values of the points MA STPT (number 93) and MA TEMP (number 47) to modulate the value of the point MA LOOPOUT (number 77).

Morning warm-up/cool-down

Morning warm-up or cool-down occurs after the controller switches from night mode to day mode, upon power-up, or if the controller is reset. During morning warm-up or cool-down, the controller provides maximum heating or cooling with the outdoor air damper closed until the room temperature, CTLRM TEMP (number 50) reaches the value of the room setpoint, CTLRM STPT (number 92) plus or minus the value of the point MORN DBAND (number 89). In morning cool-down, if the point FREE CLG (number 23) is set to ENABLE, then the outdoor air damper is opened.

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

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

ON/OFF coil valve control

When a face-bypass configuration is used, the coils may be turned ON and OFF with 2-position valves using DOs. There are two conditions when this might occur:

1. In the case where a 4-pipe configuration is used with a face-bypass damper, the cooling valve actuator will be shut while in heating, and the heating valve actuator will be shut while in cooling. In this configuration, 2-position valves must be used to prevent both coils from being ON at the same time.
2. When in heating or cooling, if the face-bypass damper is all the way closed (bypass) for more than two minutes, then the active coil can be closed to conserve energy. This is an option that is performed when the point FBP.2PSVCTL (number 28) is set to ENABLE. Otherwise, the valve is kept open when the damper is closed.

- NOTES:**
1. For both conditions above, if NGT HW HTG is set to YES in night cooling, then the heating coil is kept open.
 2. When a 2-pipe heat/cool configuration is used, with or without a face-bypass damper (the point 1 VLV HTGCLG (number 16) is set to YES in either case), the point NGT HW HTG should be set to YES. The 2-pipe heat/cool coil will then stay open during both night heating and night cooling.

Electric heat

If electric heat is used it is controlled as follows:

HTG OUTPUT (number 60)	Stage 1	Stage 2	Stage 3
0% - 33%	ON	OFF	OFF
34% - 66%	ON	ON	OFF
67% - 100%	ON	ON	ON

In addition, no stage may turn ON or OFF until the number of seconds held in the point EHT STG DELY (number 58) have elapsed since the last time any stage turned ON or OFF. Stage one will always be the first stage to turn ON and the last stage to turn OFF.

Fan operation

In day mode, the point FAN (number 46) is ON all of the time.

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

In night heating, the fan turns ON when the room temperature CTRLRM TEMP (number 50) drops below the value of the points room setpoint, CTRLRM STPT (number 49) minus NGT DBAND (number 88). When the room temperature rises above CTRLRM STPT, the fan turns OFF. If any stage of electric heat is ON, then the fan will be ON. The fan will remain ON for 30 seconds after the last stage of electric heat is turned OFF.

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

Fail-safe operation

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

A low temperature detection thermostat LOW TEMP DET (number 87) connected to DI 6 (number 26) can be used to signal the controller when the temperature, sensed by the LTDT, is below the low temperature limit. This LTDT can be either normally opened or normally closed depending on the value of LTDT CONTACT (number 52).

NOTE: If an LTDT is not wired to DI 6, then LTDT USED (number 56) should be set to NO.

If the room temperature sensor input to the Unit Vent SPC fails or the LTDT equals ON when LTDT USED equals YES, then the controller goes through the following Shutdown sequence:

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

When SENSOR TYPE equals ROOM (as it does in this application bulletin) the discharge temperature sensor is not used. Therefore, no safety condition will occur if the discharge sensor fails.

If the mixed air temperature sensor fails, then the outdoor air damper is closed and the heating and cooling loops continue to control room temperature.

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

Analog and digital outputs cannot be commanded when the controller is in fail-safe mode; however, failed points may be overridden, allowing the controller to return from fail-safe mode. In this instance, room temperature control is not possible.

Application notes

1. If the unit ventilator cycles excessively, or 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. Refer to *APOGEE Automation Service Procedures Manual* (125-3013) for more information.

NOTE: When SENSOR TYPE (number 51) = ROOM, set CLG P GAIN (number 63) = 20, CLG I GAIN (number 64) = 0.015 and HTG P GAIN (number 67) = 10. You may need to fine-tune these on a per room basis, however, these are reasonable starting values.

2. The Unit Vent Small Point Controller – 0-10V Output, as shipped from the factory, keeps all associated equipment OFF. Refer to the Equipment Controllers tab in *APOGEE Automation Start-up Procedures Manual* (125-3014) for information on how to release the controller and its equipment to application control.
3. When the fan is manually switched OFF at the unit fan speed switch, the actuators should be wired so they return to their normal state.

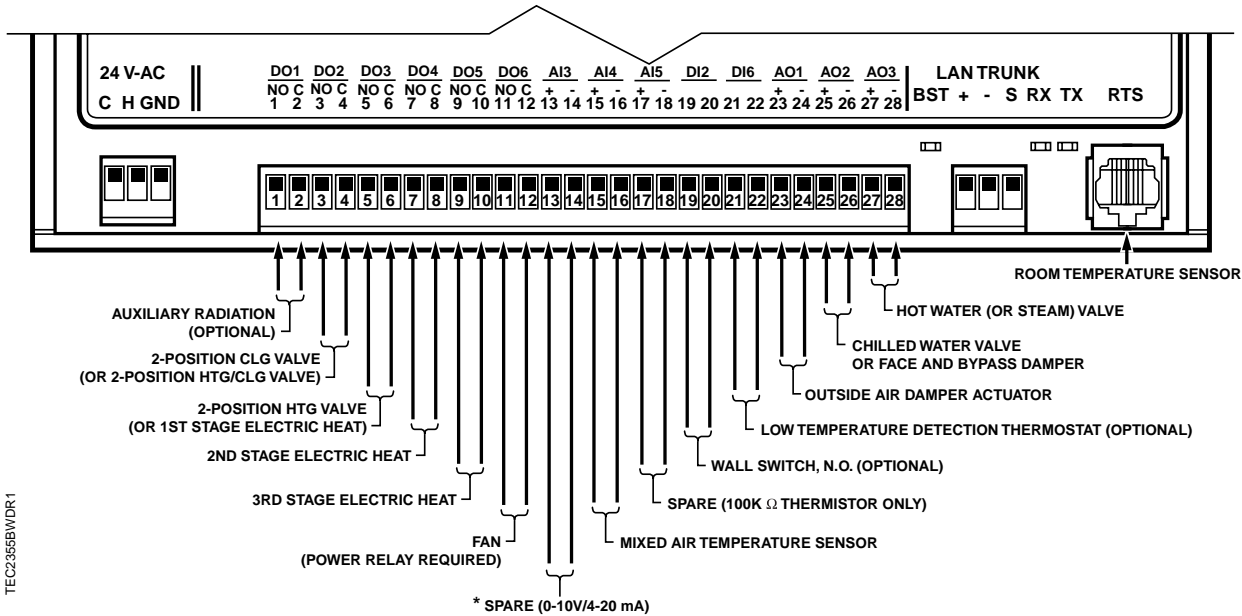
Wiring diagrams

The point wiring for Application 2355 is shown in Figure 2355R-5.



CAUTION:

The Controller's Digital Outputs (DOs) control 24 Vac loads only. The maximum rating is 12 VA for each DO. For higher VA requirements, 110 or 220 Vac requirements, separate requirements used to power the load, or DC power requirements, use an interposing 220V 4-relay module.



* A dip-switch behind AI 3 on the controller's circuit board (under the controller assembly's cover) must be set to the left (voltage position) or to the right (current position) if AI 3 is used to monitor a 0-10 V or a 4-20 mA sensor.

Figure 2355R-5. Application 2355 Wiring Diagram.

Table 2355R-1. Point Database for Application 2355 (SENSOR TYPE = ROOM).

Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
01	CTLR ADDRESS	99	--	1	0	--	--
02	APPLICATION	2384	--	1	0	--	--
03	DISCH STPT	60.0 (15.656)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
{04}	ROOM TEMP	74.0 (23.45)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
{05}	HEAT.COOL	COOL	--	--	--	HEAT	COOL
06	DAY CLG STPT	74.0 (23.45)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
07	DAY HTG STPT	70.0 (21.21)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
08	NGT CLG STPT	82.0 (27.93)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
09	NGT HTG STPT	65.0 (18.41)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
10	OADPR MINPOS	14.8	PCT	0.4	0.0	--	--
11	RM STPT MIN	55.0 (12.81)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
12	RM STPT MAX	90.0 (32.41)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
{13}	RM STPT DIAL	74.0 (23.45)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
14	STPT DIAL	NO	--	--	--	YES	NO
{15}	AI3	29.2	PCT	0.4	0.0	--	--
16	1 VLV HTGCLG	NO	--	--	--	YES	NO
17	FBP.MODVALVE	VALVE	--	--	--	FBP	VALVE
18	WALL SWITCH	NO	--	--	--	YES	NO
{19}	DI OVRD SW	OFF	--	--	--	ON	OFF
20	OVRD TIME	1	HRS	1	0	--	--
{21}	NGT OVRD	DAY	--	--	--	NIGHT	DAY
22	AUX.NOAUX	NOAUX	--	--	--	AUX	NOAUX
{23}	FREE CLG	DISABL	--	--	--	ENABLE	DISABL
{24}	DI 2	OFF	--	--	--	ON	OFF
{26}	DI 6	OFF	--	--	--	ON	OFF
27	ELEC.NOELEC	NOELEC	--	--	--	ELEC	NOELEC
28	FBP.2PSVCTL	DISABL	--	--	--	ENABLE	DISABL
{29}	DAY.NGT	DAY	--	--	--	NIGHT	DAY
{30}	WRMUP.COOLDN	ON	--	--	--	ON	OFF
31	AOV1 SPAN	10.0	VOLTS	0.01	0.0	--	--
32	AOV1 START	0.0	VOLTS	0.01	0.0	--	--
33	AOV2 SPAN	10.0	VOLTS	0.01	0.0	--	--
34	AOV2 START	0.0	VOLTS	0.01	0.0	--	--
35	AOV3 SPAN	10.0	VOLTS	0.01	0.0	--	--
36	AOV3 START	0.0	VOLTS	0.01	0.0	--	--

1. Points not listed are not used in this application.
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3. Point numbers that appear in brackets {} may be unbundled at the field panel.

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Table 2355R-1. Point Database for Application 2355 (SENSOR TYPE = ROOM).

Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
37	AO DIR.REV	0	--	1	0	--	--
{38}	AOV1	0.0	VOLTS	0.01	0.0	--	--
{39}	AOV2	0.0	VOLTS	0.01	0.0	--	--
{40}	AOV3	0.0	VOLTS	0.01	0.0	--	--
{41}	AUX RAD	OFF	--	--	--	ON	OFF
{42}	CLG 2POS VLV	OFF	--	--	--	ON	OFF
{43}	EHEAT1.HVALV	OFF	--	--	--	ON	OFF
{44}	EHEAT 2	OFF	--	--	--	ON	OFF
{45}	EHEAT 3	OFF	--	--	--	ON	OFF
{46}	FAN	OFF	--	--	--	ON	OFF
{47}	MA TEMP	74.0 (23.496)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
{48}	DISCH TEMP	74.0 (23.496)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
{49}	CTLRM STPT	74.0 (23.45)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
{50}	CTLRM TEMP	74.0 (23.45)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
51	SENSOR TYPE	ROOM	--	--	--	DISCH	ROOM
52	LTDT CONTACT	NCLOSE	--	--	--	NCLOSE	NOPEN
53	NGT HW HTG	YES	--	--	--	YES	NO
54	NGT CLG MODE	NO	--	--	--	YES	NO
{55}	AUX OUTPUT	0.0	PCT	0.4	0.0	--	--
56	LTDT USED	YES	--	--	--	YES	NO
57	AUX HTG TIME	10	MIN	1	0	--	--
58	EHT STG DELY	30	SEC	1	0	--	--
59	DO DIR.REV	0	--	1	0	--	--
{60}	HTG OUTPUT	0.0	PCT	0.4	0.0	--	--
{61}	CLG OUTPUT	0.0	PCT	0.4	0.0	--	--
{62}	OA DMPR POS	0.0	PCT	0.4	0.0	--	--
63	CLG P GAIN	1.6 (2.88)	--	0.2 (0.36)	0.0	--	--
64	CLG I GAIN	0.05 (0.09)	--	0.0005 (0.0009)	0.0	--	--
65	CLG D GAIN	10 (18.0)	--	2 (3.6)	0	--	--
66	CLG BIAS	50.0	PCT	0.2	0.0	--	--
67	HTG P GAIN	0.4 (0.72)	--	0.05 (0.09)	0.0	--	--
68	HTG I GAIN	0.015 (0.027)	--	0.0002 (0.00036)	0.0	--	--
69	HTG D GAIN	5 (9.0)	--	1 (1.8)	0	--	--
70	HTG BIAS	50.0	PCT	0.2	0.0	--	--
{77}	MA LOOPOUT	0.0	PCT	0.2	0.0	--	--

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Table 2355R-1. Point Database for Application 2355 (SENSOR TYPE = ROOM).

Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
{78}	CTL TEMP	63.5 (17.616)	DEG F (DEG C)	0.25 (0.14)	37.5(3.056)	--	--
{79}	CLG LOOPOUT	0.0	PCT	0.2	0.0	--	--
{80}	HTG LOOPOUT	0.0	PCT	0.2	0.0	--	--
{81}	MA P GAIN	0.2 (0.36)	--	0.02 (0.036)	0.0	--	--
{82}	MA I GAIN	0.00054 (0.000972)	--	0.00009 (0.000162)	0.0	--	--
{83}	MA D GAIN	24 (43.2)	--	1 (1.8)	0	--	--
{84}	MA BIAS	0.0	PCT	0.2	0.0	--	--
85	SWITCH LIMIT	4.8	PCT	0.4	0.0	--	--
86	SWITCH TIME	10	MIN	1	0	--	--
{87}	LOW TEMP DET	OFF	--	--	--	ON	OFF
88	NGT DBAND	3.0 (1.68)	DEG F (DEG C)	0.25 (0.14)	0.0	--	--
89	MORN DBAND	2.0 (1.12)	DEG F (DEG C)	0.25 (0.14)	0.0	--	--
90	SWITCH DBAND	2.0 (1.12)	DEG F (DEG C)	0.25 (0.14)	0.0	--	--
{92}	CTL STPT	63.5 (17.616)	DEG F (DEG C)	0.25 (0.14)	37.5(3.056)	--	--
{93}	MA STPT	74.0 (23.496)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
98	LOOP TIME	5	SEC	1	0	--	--
{99}	ERROR STATUS	0	--	1	0	--	--

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