

Application 2356 Heating and DX Cooling, ASHRAE Cycles I and II

Overview

In Application 2356, the Unit Vent Small Point Controller – 0-10V Output (hereafter referred to as Unit Vent SPC) controls a unit ventilator equipped with a DX coil for cooling, and/or a heating coil which may be hot water, steam, or electric, for ASHRAE Cycles I and II. A face-bypass damper can be controlled, in place of the modulating (0-10V) heating actuator, but it (the face-bypass damper) will modulate only in heating mode. If a face-bypass damper is used, 2-position valves on the coils may be controlled. Cooling only units can also be controlled with this application by overriding the point HEAT.COOL (number 5) to COOL.

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.

While in heating, this application controls room temperature by resetting the discharge air temperature. While in cooling, this application controls room temperature by cycling the DX unit. This application also controls an outdoor air damper according to the schedules as defined by ASHRAE Cycles I and II. The free-cooling/economizer function is turned ON and OFF by the field panel 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 open in sequence with the heating actuator or the DX. The unit ventilator fan is also controlled in this application.

NOTE: This application is very similar to application 2284, but with 2 main differences:

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

Refer to Figures 2356-1 through 2356-4.

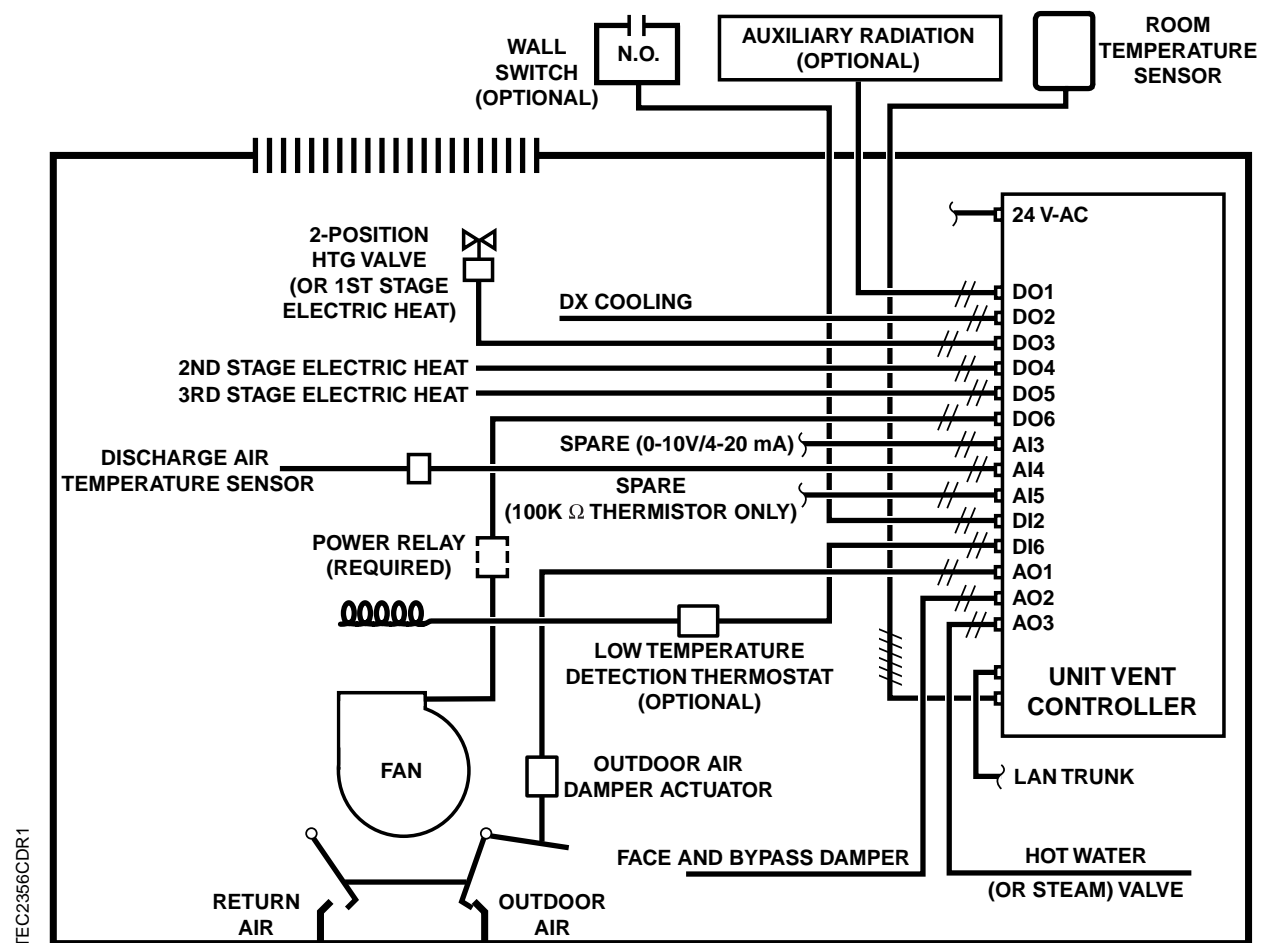
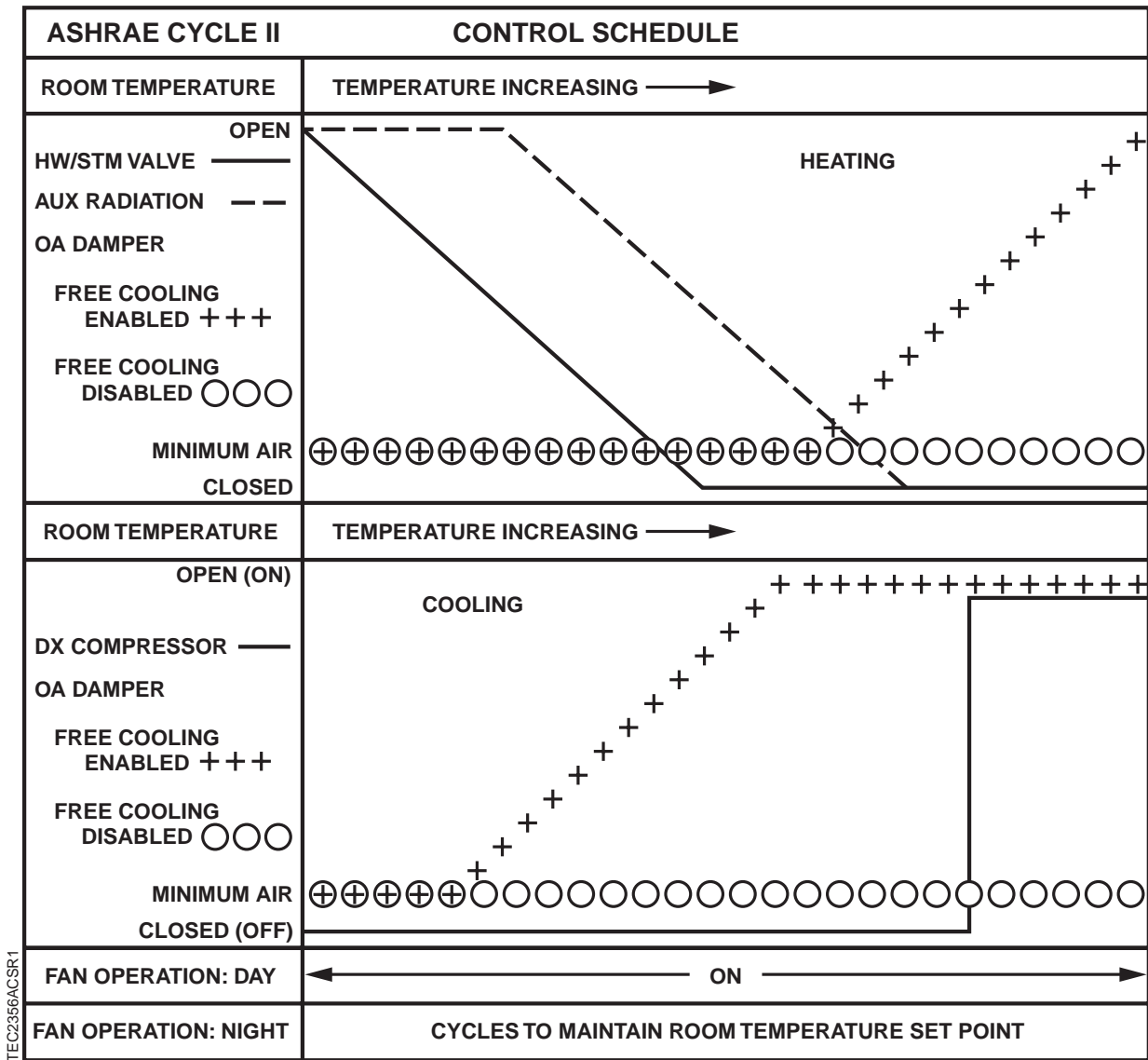
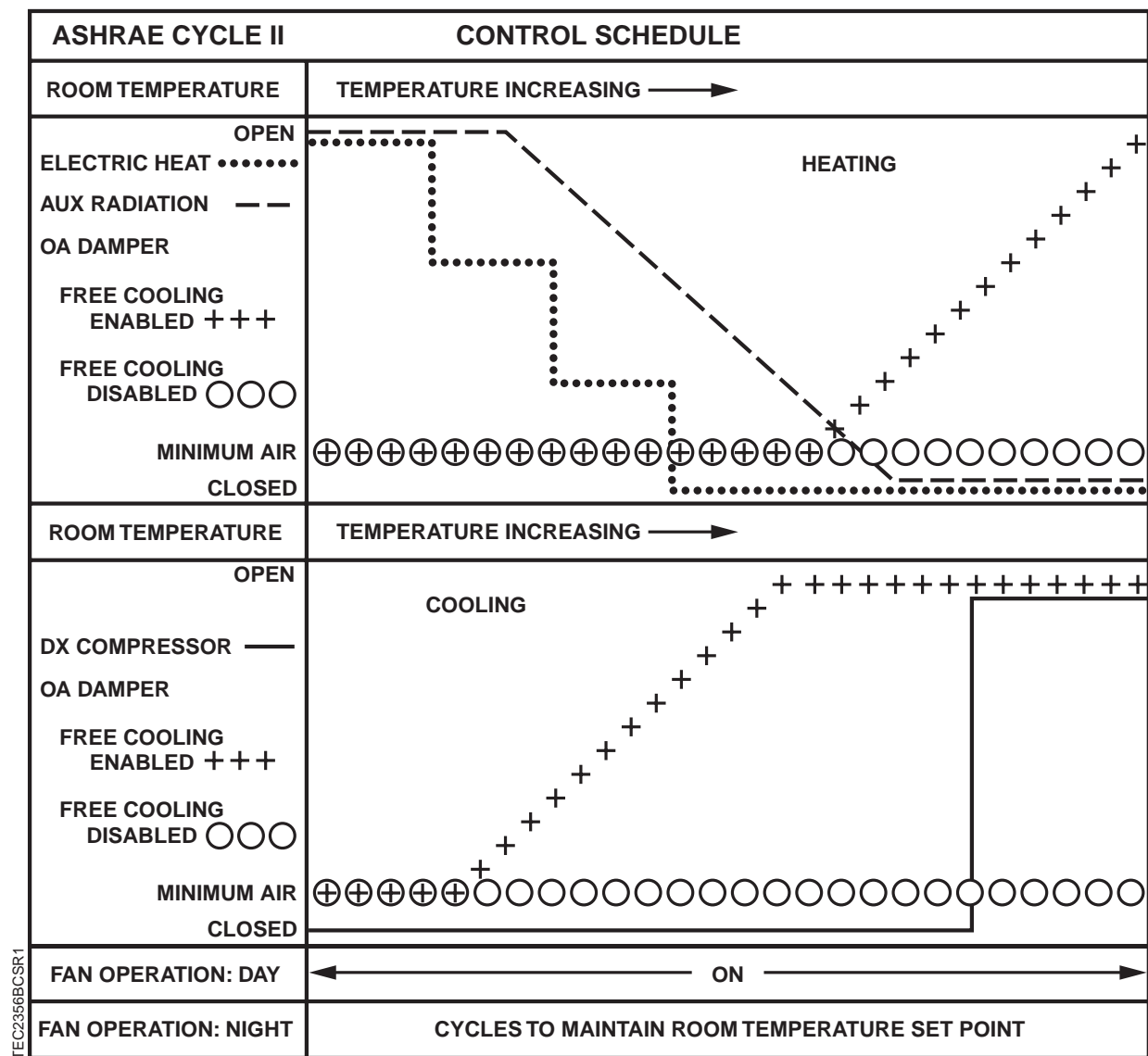


Figure 2356-1. Application 2356 Control Drawing.



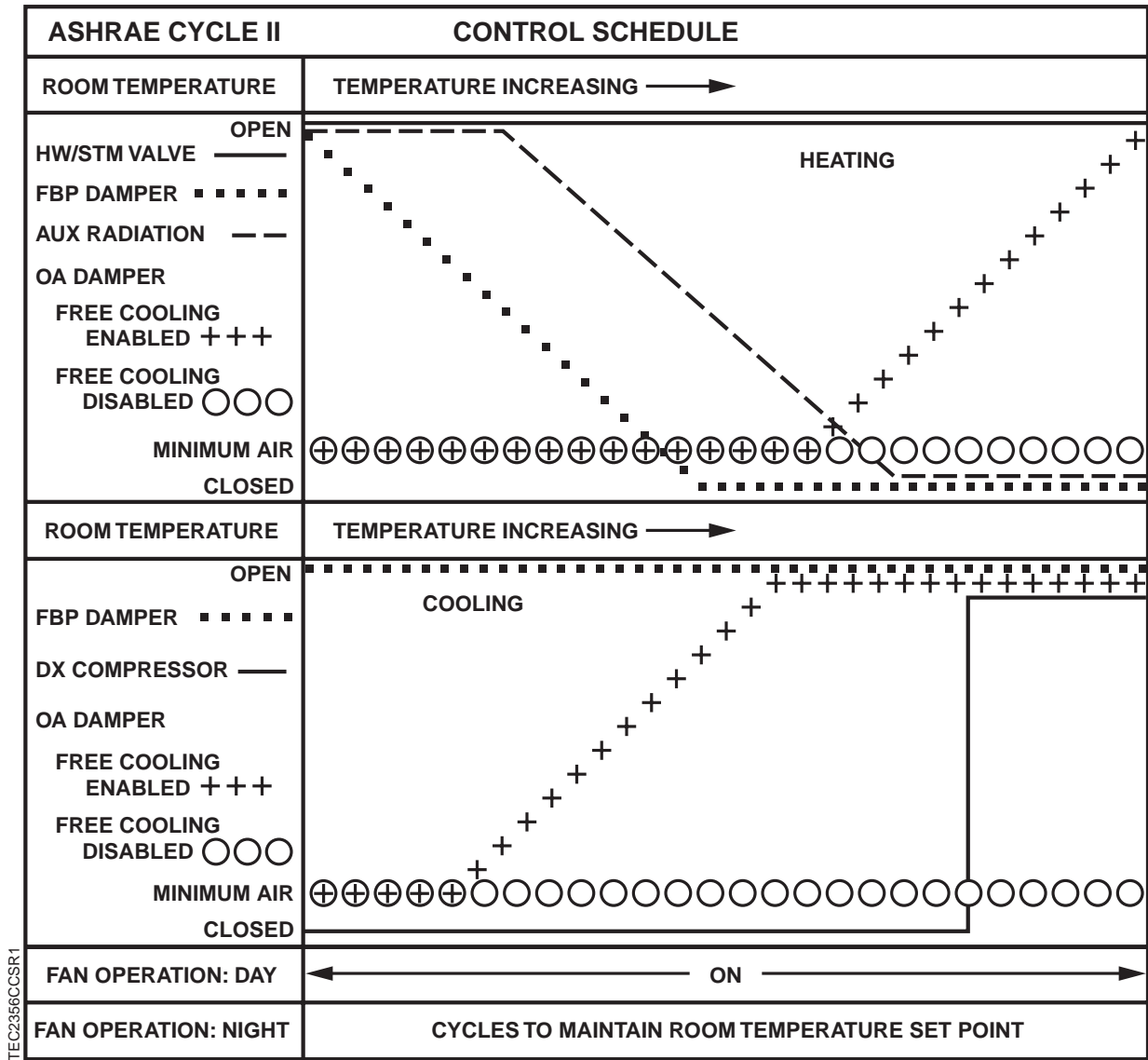
NOTE: The auxiliary radiation is an independent loop and is not sequenced with the other control loops.

Figure 2356-2. Application 2356 Control Schedules.



NOTE: The auxiliary radiation is an independent loop and is not sequenced with the other control loops.

Figure 2356-3. Application 2356 Control Schedules (continued).



NOTE: The auxiliary radiation is an independent loop and is not sequenced with the other control loops.

Figure 2356-4. Application 2356 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)

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

Digital

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

Sequence of Operation

The following paragraphs present the sequence of operation for Application 2356, "Heating and DX Cooling, ASHRAE Cycles I and II."

Control temperature set points

Depending on the controller's current operational mode (day or night), the control temperature set point, CTL STPT (number 92) holds the value of one of the following set points:

Day Mode – In day mode, CTL 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 CTL 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 CTL 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 CTL STPT holds the value of RM STPT MAX.

Night Mode – In night mode, CTL 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 CTL TEMP (number 78) is the same as the value of the point ROOM TEMP (number 4), unless CTL 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 2356-1 and 2356-5) 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), 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 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.

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:

- Resetting the unit ventilator's discharge temperature set point, DISCH STPT (number 93), based on the difference between the points CTL TEMP (number 78) and CTL STPT. If CTL TEMP goes below CTL STPT, then the discharge temperature set point increases. If the reverse occurs, then the set point decreases. DISCH STPT may not drop below the value of the point DSH MIN TEMP (number 94), nor may it rise above the point DSH MAX TEMP (number 95).
- Modulating the available coil control device based on the difference between the discharge temperature point, DISCH TEMP (number 15), and DISCH STPT. If DISCH TEMP goes below DISCH STPT, then the available coil control device either opens (if heating valve actuator or face-bypass damper), or energizes (if electric heat). If DISCH TEMP goes above DISCH STPT, then the reverse occurs.
- Controlling auxiliary radiation (if provided) using a pulse-width modulation algorithm. The auxiliary radiation will be ON for a percentage of the time held in the point AUX HTG TIME (number 57). The on-time is based on the difference between DISCH STPT and the point AUX DSH STPT (number 91). If DISCH STPT goes below AUX DSH STPT, then the on-time of the auxiliary radiation valve decreases. If DISCH STPT goes above AUX DSH STPT, then the on-time increases.
- Positioning the outdoor air damper as follows:
 1. For ASHRAE Cycle I, the point OADPR MINPOS (number 10) is set to 100%.
 2. For ASHRAE Cycle II, OADPR MINPOS is set to a value less than 100% to satisfy the minimum outdoor air requirements.
 3. When the coil is providing heat, the damper is positioned at its minimum setting. When the coil is not providing heat and the point FREE CLG (number 23) is set to ENABLE, the damper is positioned from minimum to maximum open to provide ventilation cooling. If FREE CLG is set to DISABL, then the damper is kept at minimum at all times.

Day cooling operation

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

- The face-bypass damper (if present) is at full face all the time.
- Cycling the DX coil based on the difference between the control temperature point, CTL TEMP (number 78) and CTL STPT.
- Positioning the outdoor air damper as follows:
 4. For ASHRAE Cycle I, the point OADPR MINPOS (number 10) is set to 100%.
 5. For ASHRAE Cycle II, OADPR MINPOS is set to a value less than 100% to satisfy the minimum outdoor air requirements.
 6. When the coil is providing cooling and the point FREE CLG (number 23) is set to ENABLE, the damper is kept open. When the coil is not providing cooling and FREE CLG is set to ENABLE, the damper is modulated between minimum and maximum. If FREE CLG is set to DISABL, then the damper is kept at minimum at all times.

Night heating operation

The controller maintains the room temperature at the value stored in the point CTL STPT (number 92) by doing the following:

- If the point CTL TEMP (number 78) drops below the value of the point NGT HTG STPT (number 9) minus the value of the point NGT DBAND (number 88), then:
 7. The fan turns ON.
 8. Heating turns ON.
- If CTL TEMP rises above NGT HTG STPT, then:
 9. The fan turns OFF.
 10. 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 CTL STPT (number 92) by doing the following:

- If the point CTL TEMP (number 78) rises above the sum of the points NGT CLG STPT (number 8) and NGT DBAND (number 88), then:
 11. The fan turns ON.
 12. DX cooling turns ON.
- If CTL TEMP drops below NGT CLG STPT, then:
 13. DX cooling turns OFF.
 14. The fan turns OFF 30 seconds after the DX cooling turns OFF.

Other things to keep in mind with night cooling operation:

- When the point NGT CLG MODE (number 54) is set to NO, the unit will operate in night heating mode only.
- 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 all the time.

Heating/cooling switchover

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 free cooling is disabled, or below SWITCH LIMIT if free cooling is enabled.
- 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 50% if free cooling is disabled, or below SWITCH LIMIT if free cooling is enabled.
- CTL TEMP is less than CTL STPT minus SWITCH DBAND.
- CTL TEMP is less than the appropriate heating 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 four Proportional, Integral, and Derivative (PID) control loops: a room loop, a heating loop, a DX loop, and an auxiliary loop.

Room Loop – The room loop uses the values of the points CTL STPT (number 92) and CTL TEMP (number 78) to set the discharge set point, DISCH STPT (number 93) between the values of the points DSH MIN TEMP (number 94) and DSH MAX TEMP (number 95).

Heating Loop – The heating loop uses the value of DISCH STPT and the point DISCH TEMP (number 47) to modulate the value of the point HTG LOOPOUT (number 80).

DX Loop – The DX loop uses the value of CTL STPT and CTL TEMP to modulate the value of the point CLG LOOPOUT (number 79).

Auxiliary Loop – The auxiliary loop uses the points AUX DSH STPT (number 91) and DISCH STPT (number 93) to modulate the value of the point AUX 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 temperature of the space reaches the value of the point CTL 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 CTL STPT minus MORN DBAND. For example, if CTL 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 CTL STPT plus MORN DBAND.

ON/OFF coil valve control

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

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

NOTE: For both conditions above, if NGT HW HTG is set to YES during night heating or cooling, then the heating coil is kept open.

DX cooling operation

DX cooling is controlled as follows:

- If the point CLG OUTPUT (number 61) is greater than 75%, then the DX turns ON.
- If CLG OUTPUT is less than 75%, then the DX turns OFF.
- The DX may not turn ON or OFF until the number of minutes held in the point CMP MIN ON (number 76) or the point CMP MIN OFF (number 75) have expired.

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 temperature drops below the value of the points CTL STPT (number 92) minus NGT DBAND (number 88). When the temperature rises above CTL 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 temperature rises above the value of CTL STPT plus NGT DBAND. When the temperature drops below CTL STPT, the fan turns OFF. If the DX coil is ON, then the fan will be ON. The fan will remain ON for 30 seconds after the DX coil is turned 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).
- DX cooling is full OFF.
- Face-bypass damper is open to face.
- Fan is OFF.
- Auxiliary radiation is OFF.
- 2-position heating valve actuator is open.

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 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.
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.

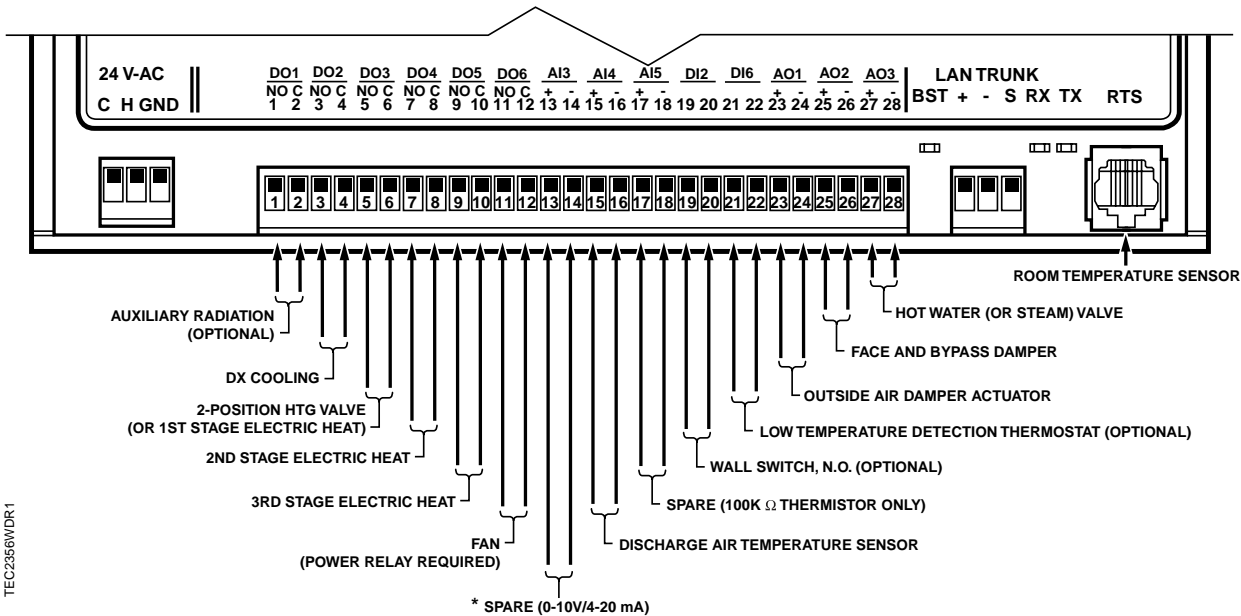
Wiring diagrams

The point wiring for Application 2356 is shown in Figure 2356-5.



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 2356-5. Application 2356 Wiring Diagram.

Table 2356-1. Point Database for Application 2356.

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	--	--
{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	--	--
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	--	--
37	AO DIR.REV	0	--	1	0	--	--
{38}	AOV1	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 2356-1. Point Database for Application 2356.

Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
{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}	DX	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}	DISCH TEMP	74.0 (23.496)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
{48}	AI 5	74.0 (23.496)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
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	--	--
71	ROOM P GAIN	2.3 (4.14)	--	0.05 (0.09)	0.0	--	--
72	ROOM I GAIN	0.00504 (0.009072)	--	0.00009 (0.000162)	0.0	--	--
73	ROOM D GAIN	76 (136.8)	--	2 (3.6)	0	--	--
74	ROOM BIAS	72.0 (22.376)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
75	CMP MIN OFF	5	MIN	1	0	--	--
76	CMP MIN ON	5	MIN	1	0	--	--

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

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{77}	AUX LOOPOUT	0.0	PCT	0.2	0.0	--	--
{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}	AUX P GAIN	0.2 (0.36)	--	0.02 (0.036)	0.0	--	--
{82}	AUX I GAIN	0.00054 (0.000972)	--	0.00009 (0.000162)	0.0	--	--
{83}	AUX D GAIN	24 (43.2)	--	1 (1.8)	0	--	--
{84}	AUX 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	--	--
{91}	AUX DSH STPT	80.0 (26.856)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
{92}	CTL STPT	63.5 (17.616)	DEG F (DEG C)	0.25 (0.14)	37.5(3.056)	--	--
{93}	DISCH STPT	74.0 (23.496)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
94	DSH MIN TEMP	60.0 (15.656)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
95	DSH MAX TEMP	110.0 (43.656)	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.