

Application 2347: Fan Coil Unit, Cooling and Heating with 3-Speed Fan

Overview

In Application 2347, the controller modulates separate valves in the fan coil unit for cooling and heating, and a 3-Speed fan circulates room air. The central plant must provide chilled and hot water for the fan coil unit to work properly. Refer to Figures 2347-1 and 2347-2.

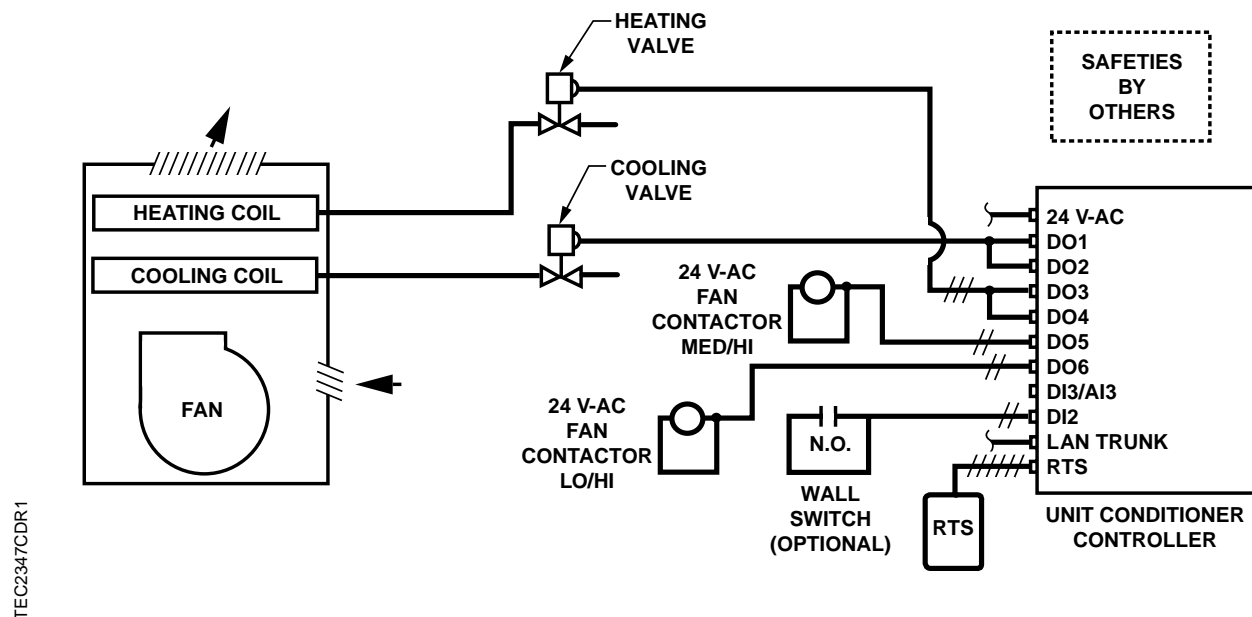
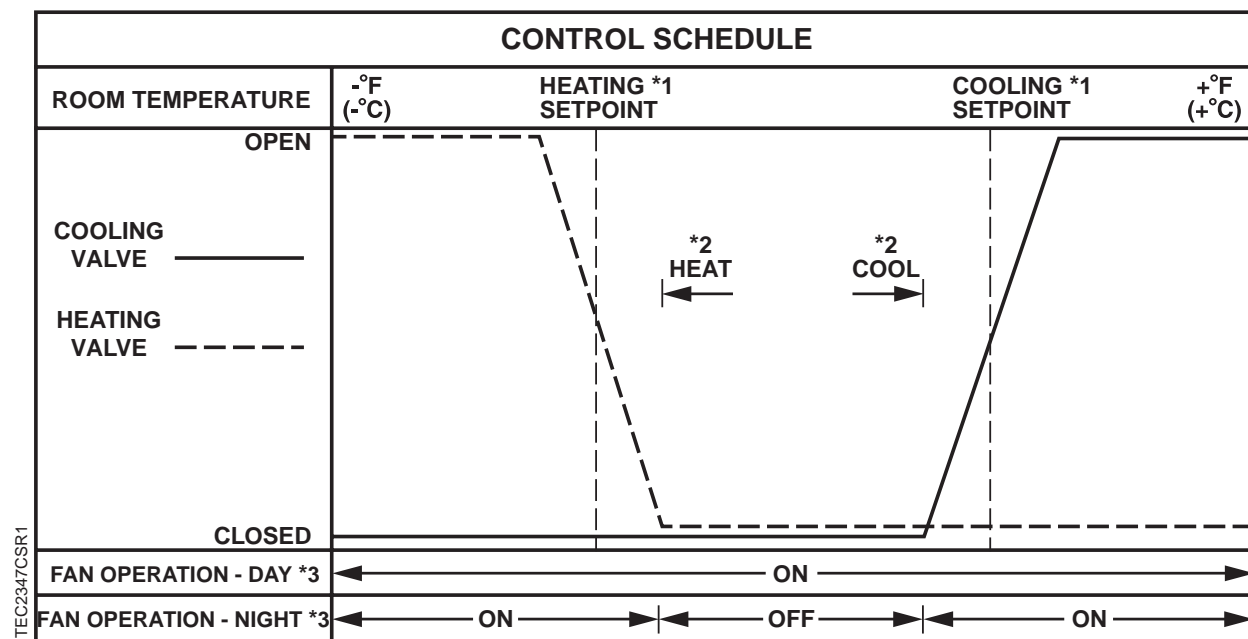


Figure 2347-1. Application 2347 Control Drawing.



1. Refer to the *Control temperature set points* section.
2. Refer to the *Heating/cooling switchover* section.
3. Refer to the *Fan operation* section.

Figure 2347-1. Application 2347 Control Schedule.

Hardware inputs

Analog

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

Digital

- Night mode override (optional)
- Wall switch (optional)

Hardware outputs

Analog

- None

Digital

- Cooling valve actuator
- Fan (switched 24 Vac, pilot duty)
- Heating valve actuator

Point database

Table 2347-2 presents the point database information for Application 2347.

Sequence of Operation

The following paragraphs present the sequence of operation for Application 2347, "Fan Coil Unit, Cooling and Heating with 3-Speed Fan."

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 2347-1 and 2347-3), 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, 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 set in OVRD TIME. The status of the point NGT OVRD (number 21) changes to DAY. After the override time elapses, 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.

Heating/cooling switchover

The heating/cooling switchover determines whether the controller is in heating or cooling mode by monitoring the room temperature and the demand for heating or cooling (as determined by the temperature control loops).

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 less than the point SWITCH LIMIT (number 85).
- The point CTL TEMP (number 78) is above the point CTL STPT (number 92) by at least the value set in the point SWITCH DBAND (number 90).
- The point 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 less than SWITCH LIMIT.
- CTL TEMP is below CTL STPT by at least the value set in SWITCH DBAND.
- CTL TEMP is less than the appropriate heating set point plus SWITCH DBAND.

Control loops

The fan coil unit is controlled by two Proportional, Integral, and Derivative (PID) temperature loops.

Temperature Loops – The two temperature loops are a cooling loop and a heating loop. The active temperature loop maintains room temperature at the value in the point CTL STPT (number 92). Refer to the *Control temperature set points* section for more information.

Cooling operation

In cooling mode, the controller uses the points CTL STPT (number 92) and CTL TEMP (number 78) as the inputs to the cooling loop. The output of the cooling loop is the point CLG LOOPOUT (number 79) which modulates the cooling valve point, VLV 1 COMD (number 48). The point HTG LOOPOUT (number 80) is set to 0%.

In heating mode the cooling valve is closed.

Heating operation

In heating mode, the controller uses the points CTL STPT (number 92) and CTL TEMP (number 78) as the inputs to the heating loop. The output of the heating loop is the point HTG LOOPOUT (number 80) which modulates the hot water valve point, VLV 2 COMD (number 52) in order to warm up the space. The point CLG LOOPOUT (number 79) is set to 0%.

In cooling mode the heating valve is closed.

Fan operation

When the fan is said to be ON, it may be operating at low, medium, or high speed. To determine fan speed when the fan is ON, look at the point FAN SPEED (number 32). Table 2347-1 shows the actual fan speed and the values of DOs 5 and 6 for a given value of FAN SPEED.

Table 2347-1. FAN SPEED Values and Meanings.

| FAN SPEED | Actual Fan Speed | DO 5 | DO 6 |
|-----------|------------------|------|------|
| 0 | OFF | OFF | OFF |
| 1 | LOW | OFF | ON |
| 2 | MEDIUM | ON | OFF |
| 3 | HIGH | ON | ON |

When the fan is said to be OFF, DOs 5 and 6 will be OFF regardless of the value of the point FAN SPEED.

NOTE: This application does not vary the fan speed automatically except when a communications failure occurs — see the *Fail-safe operation* section of this document for more details. For the fan speed to vary during normal operation, FAN SPEED must be unbundled and controlled by PPCL.

Day Mode – During the day mode, the fan is ON.

Night Mode – During the night mode, the fan is ON.

Calibration

The controller will regularly calibrate the valves based on the value of the point CAL TIMER (number 96). A value of 12 indicates that the controller will calibrate the valves once every 12 hours.

The calibration consists of driving the valves closed and then resetting the values of the points VLV 1 POS (number 49) and VLV 2 POS (number 53) to 0. The actuators are then released to normal control.

Fail-safe operation

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

If STAND ALONE (number 91) is OFF and there is no communication between the TEC and Field Panel for at least the amount of time stored in COM FAILTIME (number 31), then a communications failure has occurred and COM FAILED (number 30) will be set to YES. When this happens, the application will set FAN SPEED (number 32) to 2 (medium speed).

When communication is restored between the TEC and Field Panel, COM FAILED is set back to NO and FAN SPEED is released to normal control.

Application notes

1. 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 the *Apogee Automation Service Procedures Manual* (125-3013) for more information.
2. The Unit Conditioner Controller – Electronic Output, as shipped from the factory, keeps all associated equipment OFF. Refer to the Equipment Controllers tab in the *Apogee Automation Start-up Procedures Manual* (125-3014) for information on how to release the controller and its equipment to application control.
3. Spare DOs can be used as auxiliary points that are controlled by the field panel after being defined in the field panel's database. If a cooling valve is not being controlled by the application, then DO 1 and DO 2 may be used as auxiliary motor points. If a heating valve is not being controlled by the application, then DO 3 and DO 4 may be used as auxiliary motor points. If using a pair of spare DOs to control a motor, you must make sure that the motor setup, motor timing, and motor rotation angle are enabled correctly before you unbundle the point VLV 1 COMD (number 48) for DO 1 and DO 2 and point VLV 2 COMD (number 52) for DO 3 and DO 4. Refer to the *Apogee Automation Start-up Procedures Manual* (125-3014) for more information.

Wiring diagram

The point wiring for Application 2347 is shown in Figure 2347-3.



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, or DC power requirements, use an interposing 220 V 4-relay module.

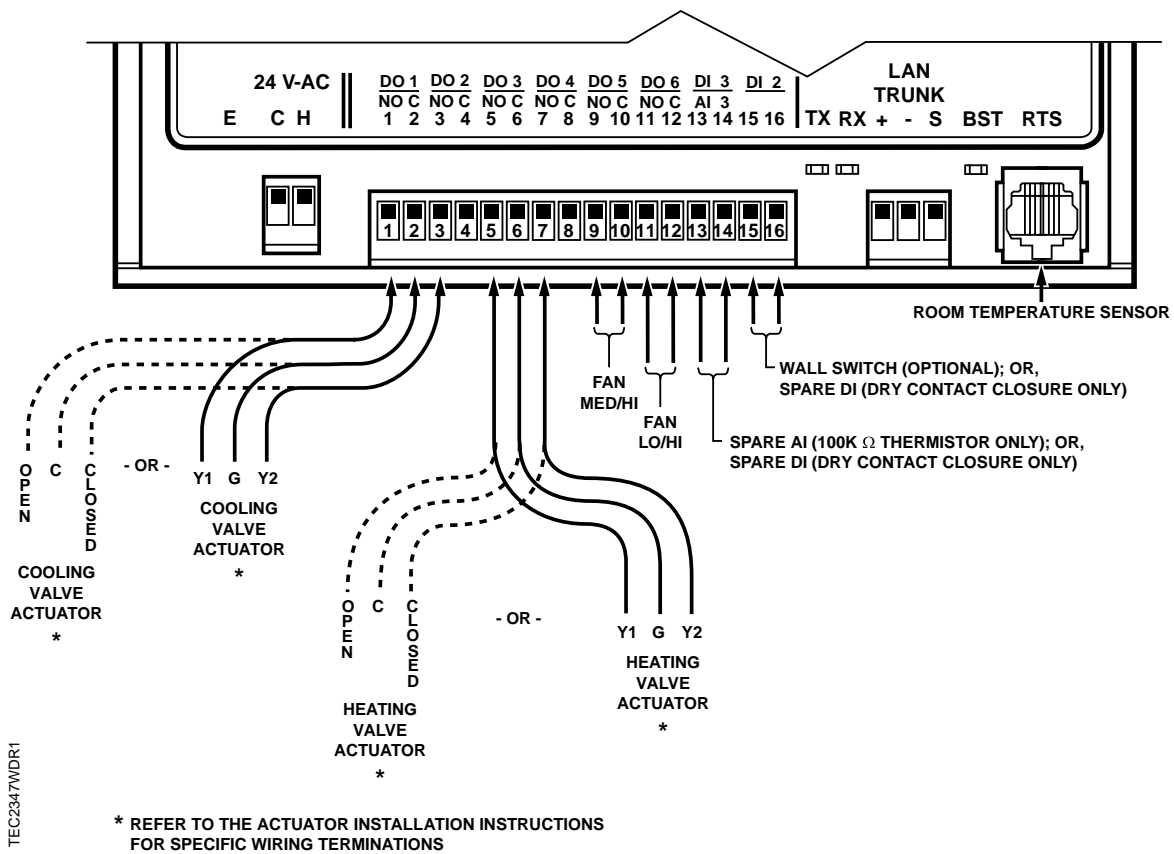


Figure 2347-3. Application 2347 Wiring Diagram.

Table 2347-2. Point Database for Application 2347.

| 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 | 2090 | -- | 1 | 0 | -- | -- |
| {04} | ROOM TEMP | 74.0 (23.44888) | DEG F (DEG C) | 0.25 (0.14) | 48.0(8.88888) | -- | -- |
| {05} | HEAT.COOL | COOL | -- | -- | -- | HEAT | COOL |
| 06 | DAY CLG STPT | 74.0 (23.44888) | DEG F (DEG C) | 0.25 (0.14) | 48.0(8.88888) | -- | -- |
| 07 | DAY HTG STPT | 70.0 (21.20888) | DEG F (DEG C) | 0.25 (0.14) | 48.0(8.88888) | -- | -- |
| 08 | NGT CLG STPT | 82.0 (27.92888) | DEG F (DEG C) | 0.25 (0.14) | 48.0(8.88888) | -- | -- |
| 09 | NGT HTG STPT | 65.0 (18.40888) | DEG F (DEG C) | 0.25 (0.14) | 48.0(8.88888) | -- | -- |
| 11 | RM STPT MIN | 55.0 (12.80888) | DEG F (DEG C) | 0.25 (0.14) | 48.0(8.88888) | -- | -- |
| 12 | RM STPT MAX | 90.0 (32.40888) | DEG F (DEG C) | 0.25 (0.14) | 48.0(8.88888) | -- | -- |
| {13} | RM STPT DIAL | 74.0 (23.44888) | DEG F (DEG C) | 0.25 (0.14) | 48.0(8.88888) | -- | -- |
| 14 | STPT DIAL | NO | -- | -- | -- | YES | NO |
| {15} | AUX TEMP | 74.0 (23.495556) | DEG F (DEG C) | 0.5 (0.28) | 37.5(3.055556) | -- | -- |
| 18 | WALL SWITCH | NO | -- | -- | -- | YES | NO |
| {19} | DI OVRD SW | OFF | -- | -- | -- | ON | OFF |
| 20 | OVRD TIME | 0 | HRS | 1 | 0 | -- | -- |
| {21} | NGT OVRD | NIGHT | -- | -- | -- | NIGHT | DAY |
| {24} | DI 2 | OFF | -- | -- | -- | ON | OFF |
| {25} | DI 3 | OFF | -- | -- | -- | ON | OFF |
| {29} | DAY.NGT | DAY | -- | -- | -- | NIGHT | DAY |
| {30} | COM FAILED | NO | -- | -- | -- | YES | NO |
| 31 | COM FAILTIME | 30 | SEC | 1 | 0 | -- | -- |
| {32} | FAN SPEED | 0 | -- | 1 | 0 | -- | -- |
| {41} | DO 1 | OFF | -- | -- | -- | ON | OFF |
| {42} | DO 2 | OFF | -- | -- | -- | ON | OFF |
| {43} | DO 3 | OFF | -- | -- | -- | ON | OFF |
| {44} | DO 4 | OFF | -- | -- | -- | ON | OFF |
| {45} | FAN MED.HI | OFF | -- | -- | -- | ON | OFF |
| {46} | FAN LOW.HI | OFF | -- | -- | -- | ON | OFF |
| {48} | VLV 1 COMD | 0.0 | PCT | 0.4 | 0.0 | -- | -- |
| {49} | VLV 1 POS | 0.0 | PCT | 0.4 | 0.0 | -- | -- |
| 51 | MTR 1 TIMING | 130 | SEC | 1 | 0 | -- | -- |
| {52} | VLV 2 COMD | 0.0 | PCT | 0.4 | 0.0 | -- | -- |
| {53} | VLV 2 POS | 0.0 | PCT | 0.4 | 0.0 | -- | -- |
| 55 | MTR 2 TIMING | 130 | SEC | 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.

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Table 2347-2. Point Database for Application 2347.

| Point Number | Descriptor | Factory Default (SI Units) | Engr Units (SI Units) | Slope (SI Units) | Intercept (SI Units) | On Text | Off Text |
|--------------|--------------|----------------------------|-----------------------|------------------|----------------------|---------|----------|
| 56 | MTR1 ROT ANG | 90 | -- | 1 | 0 | -- | -- |
| 57 | MTR2 ROT ANG | 90 | -- | 1 | 0 | -- | -- |
| 58 | MTR SETUP | 0 | -- | 1 | 0 | -- | -- |
| 59 | DO DIR. REV | 0 | -- | 1 | 0 | -- | -- |
| 63 | CLG P GAIN | 20.0 (36.0) | -- | 0.25 (0.45) | 0.0 | -- | -- |
| 64 | CLG I GAIN | 0.01 (0.018) | -- | 0.001 (0.0018) | 0.0 | -- | -- |
| 65 | CLG D GAIN | 0 (0.0) | -- | 2 (3.6) | 0 | -- | -- |
| 66 | CLG BIAS | 0.0 | PCT | 0.4 | 0.0 | -- | -- |
| 67 | HTG P GAIN | 10.0 (18.0) | -- | 0.25 (0.45) | 0.0 | -- | -- |
| 68 | HTG I GAIN | 0.01 (0.018) | -- | 0.001 (0.0018) | 0.0 | -- | -- |
| 69 | HTG D GAIN | 0 (0.0) | -- | 2 (3.6) | 0 | -- | -- |
| 70 | HTG BIAS | 0.0 | PCT | 0.4 | 0.0 | -- | -- |
| {78} | CTL TEMP | 74.0 (23.44888) | DEG F (DEG C) | 0.25 (0.14) | 48.0(8.88888) | -- | -- |
| {79} | CLG LOOPOUT | 0.0 | PCT | 0.4 | 0.0 | -- | -- |
| {80} | HTG LOOPOUT | 0.0 | PCT | 0.4 | 0.0 | -- | -- |
| 85 | SWITCH LIMIT | 5.2 | PCT | 0.4 | 0.0 | -- | -- |
| 86 | SWITCH TIME | 10 | MIN | 1 | 0 | -- | -- |
| 90 | SWITCH DBAND | 1.0 (0.56) | DEG F (DEG C) | 0.25 (0.14) | 0.0 | -- | -- |
| 91 | STAND ALONE | OFF | -- | -- | -- | ON | OFF |
| {92} | CTL STPT | 74.0 (23.44888) | DEG F (DEG C) | 0.25 (0.14) | 48.0(8.88888) | -- | -- |
| 96 | CAL TIMER | 12 | HRS | 1 | 0 | -- | -- |
| 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.