

Application 2152: Fan Coil Unit Cooling and Electric Heat with Secure Mode

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Overview

In Application 2152, the controller energizes a maximum of two stages of cooling and a maximum of three stages of electric heat in the fan coil unit. The fan coil unit also has a fan to circulate room air. See Figure 2152-1 and Figure 2152-2.

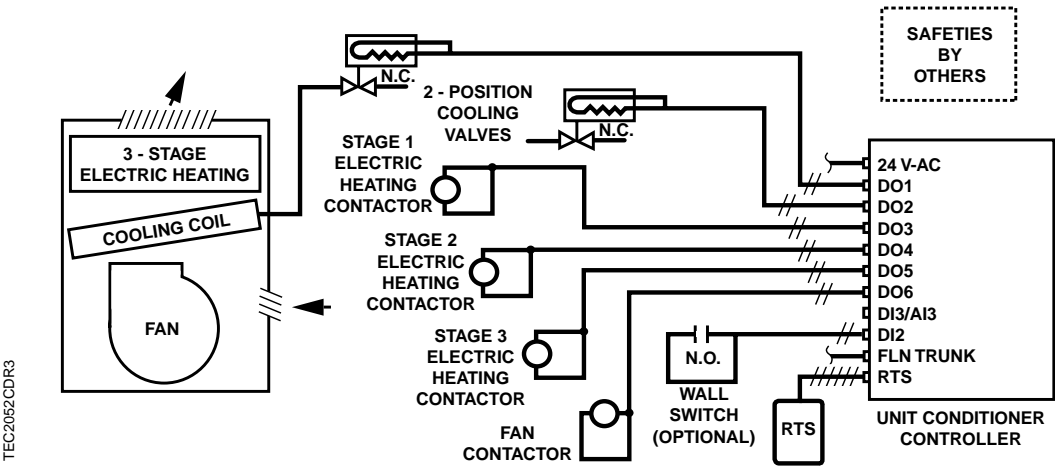
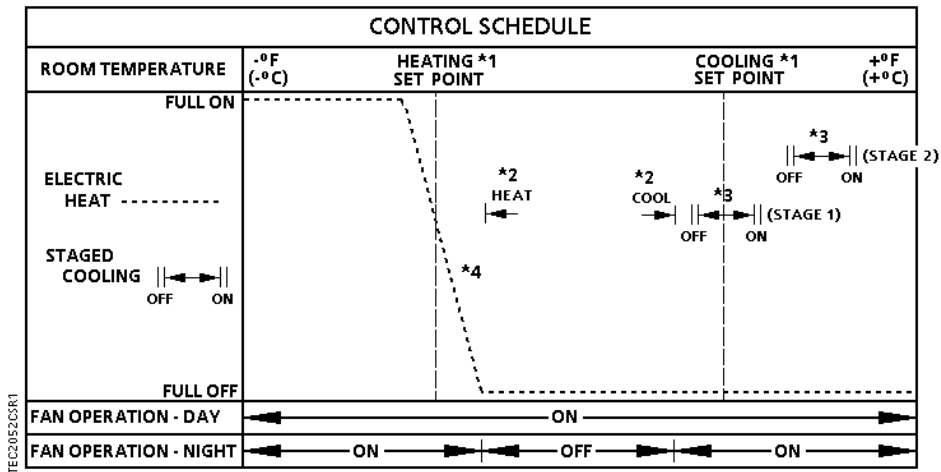


Figure 2152-1. Application 2152 Control Drawing.



1. See Sequence of Operation, Control Temperature Setpoints.
2. See Sequence of Operation, Heating/Cooling Switchover.
3. See Sequence of Operation, Cooling Operation.
4. The electric heat is time-modulated. This allows it to be controlled proportionally rather than with deadbands.

Figure 2152-2. Application 2152 Control Schedule.

Hardware Inputs

Analog

- Room temperature sensor
- Room temperature setpoint dial (optional)

Digital

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

Hardware Outputs

Analog

- None

Digital

- Fan (switched 24 Vac, pilot duty)
- Stage 1 cooling (2-position valve actuator, or cooling compressor)
- Stage 2 cooling (2-position valve actuator, or cooling compressor)
- Stage 1 electric heat
- Stage 2 electric heat
- Stage 3 electric heat

Ordering Notes

Unit Conditioner Controller – Electronic Output with Secure Mode 540-110C

See *APOGEE Automation Configuration and Sizing Guidelines* on InfoLink for product numbers.

Terminal Equipment Controller room temperature sensor

Point Database

Table 2152-1 presents the point database information for Application 2152.

Secure Mode Operation

Secure Mode prevents unauthorized users from making changes to the TEC through the MMI port or room sensor. This mode can only be enabled/disabled through an Insight command. When Secure Mode is enabled, any attempts to make point changes in the TEC will be rejected and result in an error message indicating that the priority is too low.

Sequence of Operation

The following paragraphs present the sequence of operation for Application 2152, “Fan Coil Unit Cooling and Electric Heat with Secure Mode”.

Control Temperature Setpoints

Depending on the controller’s current operational mode (day or night), CTL STPT (Point 92) holds the value of one of the following setpoints:

Day Mode – CTL STPT holds the value of DAY CLG STPT (Point 6) or DAY HTG STPT (Point 7). If the room temperature sensor has a setpoint dial and STPT DIAL (Point 14) = YES, CTL STPT holds the value of RM STPT DIAL (Point 13).

If the setpoint dial is used and RM STPT DIAL < RM STPT MIN (Point 11), CTL STPT holds the value of RM STPT MIN. If RM STPT DIAL > RM STPT MAX (Point 12), CTL STPT holds the value of RM STPT MAX.

Night Mode – CTL STPT holds the value of NGT CLG STPT (Point 8) or NGT HTG STPT (Point 9).

Room Temperature Offset

Room Temperature Offset, RMTMP OFFSET (Point 3), is a user-adjustable offset that will compensate for deviations between the value of ROOM TEMP (Point 4) and the actual room temperature. This corrected value is displayed in CTL TEMP (Point 78).

$\text{CTL TEMP (Point 78)} = \text{ROOM TEMP (Point 4)} + \text{RMTMP OFFSET (Point 3)}$.

Day and Night Modes

The day/night status of the space is determined by the status of DAY.NGT (Point 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 (Figure 2152-1 and Figure 2152-3), and WALL SWITCH (Point 18) = YES, the controller monitors the status of DI 2. When the status of DI 2 (Point 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 = NO, the controller does not monitor the status of the wall switch, even if one is connected to it. In this case, the controller is operating stand-alone and stays in day mode all the time. If the controller is operating with centralized control, connected to a field panel, the field panel can send an operator or PPCL command to override the status of DAY.NGT. See *APOGEE Powers Process Control Language (PPCL) User’s Manual* (125-1896) and [APOGEE Field Panel User’s Manual](#) (125-3000) 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 is entered into OVRD TIME (Point 20), pressing the override switch resets the controller to day mode for the amount of time that is set in OVRD TIME. The status of NGT OVRD (Point 21) changes to DAY. After the override time elapses, the controller returns to night mode and NGT OVRD changes back to NIGHT.

The override switch on the room sensor will only affect the controller when in night mode.

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 and cooling (as determined by the temperature control loops).

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

- HTG LOOPOUT (Point 80) < SWITCH LIMIT (Point 85).
- CTL TEMP (Point 78) > CTL STPT (Point 92) by at least the value set in SWITCH DBAND (Point 90).
- CTL TEMP > the appropriate cooling setpoint minus SWITCH DBAND.

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

- CLG LOOPOUT (Point 79) < SWITCH LIMIT.
- CTL TEMP < CTL STPT by at least the value set in SWITCH DBAND.
- CTL TEMP < the appropriate heating setpoint 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 CTL STPT (Point 92). See *Control Temperature Setpoints*.

Cooling Operation

In cooling mode, the controller uses CTL STPT (Point 92) and CTL TEMP (Point 78) as inputs for the cooling loop. The cooling loop controls up to two stages of cooling as defined by the value of CLG STG CNT (Point 75).

The staged cooling operates as follows:

CLG STG 1 (Point 41) will turn ON when CLG LOOPOUT (Point 79) > CLG 1 ON (Point 71), provided that CLG STG 1 has been OFF for at least the time set in CLG MIN OFF (Point 77).

CLG STG 2 (Point 42) will turn ON when CLG LOOPOUT > CLG 2 ON (Point 73), provided that CLG STG 2 has been OFF for at least the time set in CLG MIN OFF.

CLG STG 2 will turn OFF, when CLG LOOPOUT < CLG 2 OFF (Point 74), provided that CLG STG 2 has been ON for at least the time set in CLG MIN ON (Point 76).

CLG STG 1 will turn OFF, when CLG LOOPOUT < CLG 1 OFF (Point 72), provided that CLG STG 1 has been ON for at least the time set in CLG MIN ON.

HTG LOOPOUT (Point 80) = 0%.

When in heating mode, both stages of cooling are OFF.

Heating Operation

In heating mode, the controller uses CTL STPT (Point 92) and CTL TEMP (Point 78) as inputs for the heating loop. The output of the heating loop, HTG LOOPOUT (Point 80), modulates the electric reheat in order to warm up the space. CLG LOOPOUT (Point 79) is set to 0%.

Electric Reheat



CAUTION:

Verify that the equipment is supplied with safeties by others to ensure that there is airflow across the heating coils when they are to be energized.

The heating loop controls up to three stages of electric reheat to warm up the room. The electric reheat is time modulated using a duty cycle as shown in the following example. When the controller is in cooling mode, the electric heat is OFF at all times.

Example

If the duty cycle is 10 minutes (HTG STG TIME (Point 89) = 10 minutes) and the heating loop is calling for 60% of heating (HTG LOOPOUT (Point 80) = 60%) for every 10-minute period, the stages of electric auxiliary heat cycle are as follows:

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

Fan Operation

Day Mode – The fan may be set to stay ON at all times or to cycle to save energy. If CYCLE FAN (Point 60) = NO, the fan will be ON during the day. If CYCLE FAN = YES, the fan will cycle according to the following conditions:

1. If the first heating stage, the first cooling stage, or the second cooling stage is ON, the fan will turn ON.
2. If the first heating stage is OFF and has been OFF for a complete duty cycle, HTG STG TIME (Point 89), and the first and second cooling stages are OFF and have been OFF for the minimum off time, the fan will turn OFF.
3. If neither of the above two conditions is met, the condition of the fan remains unchanged.

Night Mode – The fan cycles using the same three conditions described in the day mode section above, regardless of the setting of CYCLE FAN. If NGT OVRD (Point 21) = DAY (indicating that the night mode override button has been pressed), the fan is controlled as in day mode.

Fail-safe Operation

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

Application Notes

1. If temperature swings in the room are excessive or there is trouble maintaining the setpoint, the cooling loop, the heating loop, or both need to be tuned. See *iKnow Troubleshooting Tool* for more information.
2. The Unit Conditioner Controller – Electronic Output, as shipped from the factory, keeps all associated equipment OFF. See the *Equipment Controllers* section in the *APOGEE Automation Start-up Procedures* on InfoLink 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. DO 3, DO 4, and DO 5 control the stages of electric heat. If less than three stages are being controlled by the application, the DOs that are not used will be spare. See *APOGEE Automation Start-up Procedures* on InfoLink for more information.

Wiring Diagram

The point wiring for Application 2152 is shown in Figure 2152-3.



CAUTION:

The controller's DOs control 24 Vac loads only. The maximum rating is 12 VA for each DO. Use an interposing 220V 4-relay module for any of the following:

- VA requirements higher than the maximum
- 110 or 220 Vac requirements
- DC power requirements
- Separate transformers used to power the load

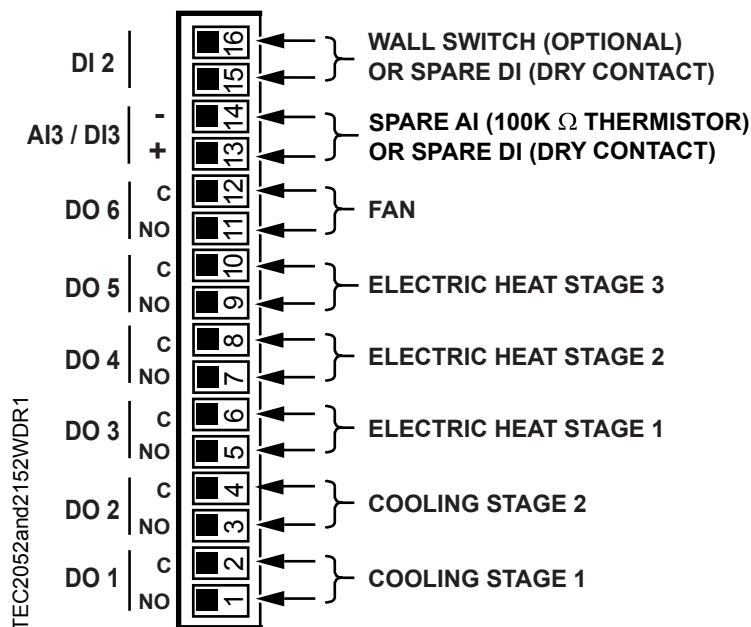


Figure 2152-3. Application 2152 Wiring Diagram.

Table 2152-1. Point Database for Application 2152.

Point Number	Descriptor	Factory Default (SI Units)	Eng Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
01	CTLR ADDRESS	99	–	1	0	–	–
02	APPLICATION	2188	–	1	0	–	–
03	RMTMP OFFSET	0.0 (0.0)	DEG F (DEG C)	0.25 (0.14)	-31.75 (-17.78)	–	–
{04}	ROOM TEMP	74.0 (23.449)	DEG F (DEG C)	0.25 (0.14)	48.0 (8.889)	–	–
{05}	HEAT.COOL	COOL	–	–	–	HEAT	COOL
06	DAY CLG STPT	74.0 (23.449)	DEG F (DEG C)	0.25 (0.14)	48.0 (8.889)	–	–
07	DAY HTG STPT	70.0 (21.209)	DEG F (DEG C)	0.25 (0.14)	48.0 (8.889)	–	–
08	NGT CLG STPT	82.0 (27.929)	DEG F (DEG C)	0.25 (0.14)	48.0 (8.889)	–	–
09	NGT HTG STPT	65.0 (18.409)	DEG F (DEG C)	0.25 (0.14)	48.0 (8.889)	–	–
11	RM STPT MIN	55.0 (12.809)	DEG F (DEG C)	0.25 (0.14)	48.0 (8.889)	–	–
12	RM STPT MAX	90.0 (32.409)	DEG F (DEG C)	0.25 (0.14)	48.0 (8.889)	–	–
{13}	RM STPT DIAL	74.0 (23.449)	DEG F (DEG C)	0.25 (0.14)	48.0 (8.889)	–	–
14	STPT DIAL	NO	–	–	–	YES	NO
{15}	AUX TEMP	74.0 (23.496)	DEG F (DEG C)	0.5 (0.28)	37.5 (3.056)	–	–
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
{41}	CLG STG 1	OFF	–	–	–	ON	OFF

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 2152-1. Point Database for Application 2152.

Point Number	Descriptor	Factory Default (SI Units)	Eng Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
{42}	CLG STG 2	OFF	–	–	–	ON	OFF
{43}	HTG STG 1	OFF	–	–	–	ON	OFF
{44}	HTG STG 2	OFF	–	–	–	ON	OFF
{45}	HTG STG 3	OFF	–	–	–	ON	OFF
{46}	FAN	OFF	–	–	–	ON	OFF
58	MTR SETUP	0	–	1	0	–	–
59	DO DIR. REV	0	–	1	0	–	–
60	CYCLE FAN	NO	–	–	–	YES	NO
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	–	–
71	CLG 1 ON	40.0	PCT	0.4	0.0	–	–
72	CLG 1 OFF	20.0	PCT	0.4	0.0	–	–
73	CLG 2 ON	80.0	PCT	0.4	0.0	–	–
74	CLG 2 OFF	60.0	PCT	0.4	0.0	–	–
75	CLG STG CNT	2	–	1	0	–	–
76	CLG MIN ON	120	SEC	1	0	–	–
77	CLG MIN OFF	120	SEC	1	0	–	–
{78}	CTL TEMP	74.0 (23.449)	DEG F (DEG C)	0.25 (0.14)	48.0 (8.889)	–	–
{79}	CLG LOOPOUT	0.0	PCT	0.4	0.0	–	–

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Table 2152-1. Point Database for Application 2152.

Point Number	Descriptor	Factory Default (SI Units)	Eng Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
{80}	HTG LOOPOUT	0.0	PCT	0.4	0.0	–	–
{81}	AVG HEAT OUT	0.0	PCT	0.4	0.0	–	–
82	HTG STG MAX	90.0	PCT	0.4	0.0	–	–
83	HTG STG MIN	10.0	PCT	0.4	0.0	–	–
84	STAGE FAN	10.0	PCT	0.4	0.0	–	–
85	SWITCH LIMIT	5.2	PCT	0.4	0.0	–	–
86	SWITCH TIME	10	MIN	1	0	–	–
88	HTG STG CNT	1	–	1	0	–	–
89	HTG STG TIME	10	MIN	1	0	–	–
90	SWITCH DBAND	1.0 (0.56)	DEG F (DEG C)	0.25 (0.14)	0.0	–	–
{92}	CTL STPT	74.0 (23.449)	DEG F (DEG C)	0.25 (0.14)	48.0 (8.889)	–	–
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.