

Application 2358: Multi-Speed Fan Coil Unit, Cooling and Heating — Electronic Output

Overview

In Application 2358, the controller modulates separate valves in the fan coil unit for cooling and heating. The fan coil unit also has a multi-speed fan to circulate room air. In order for the fan coil unit to work properly, the central plant must provide chilled and hot water. Refer to Figures 2358-1 and 2358-2.

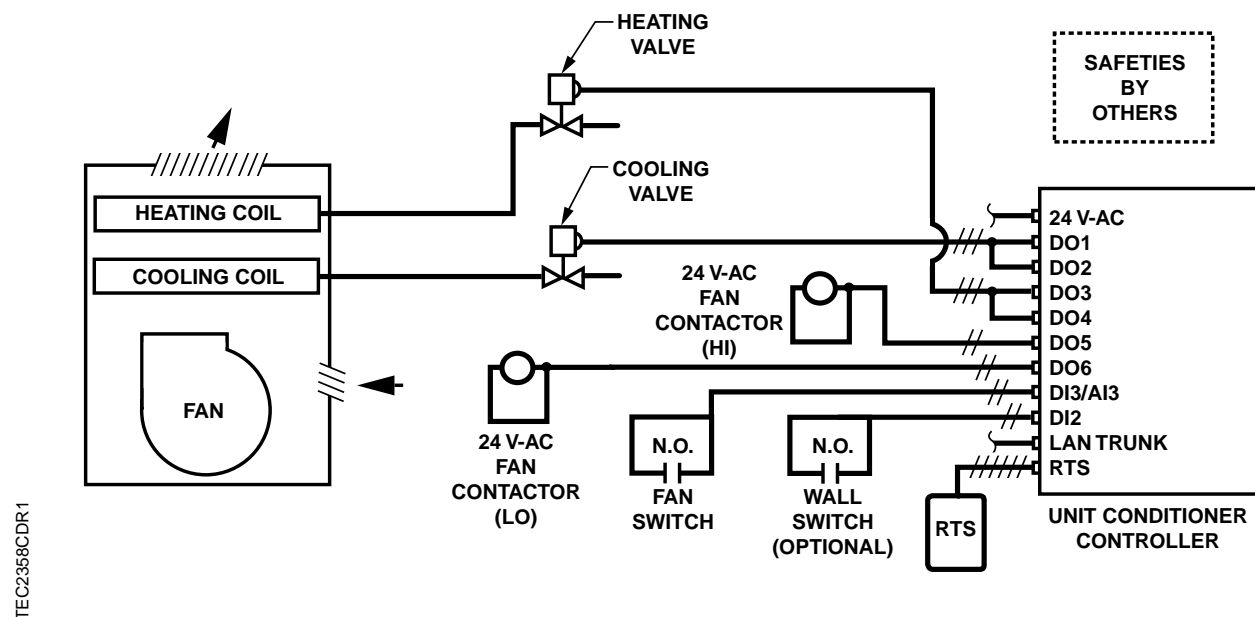
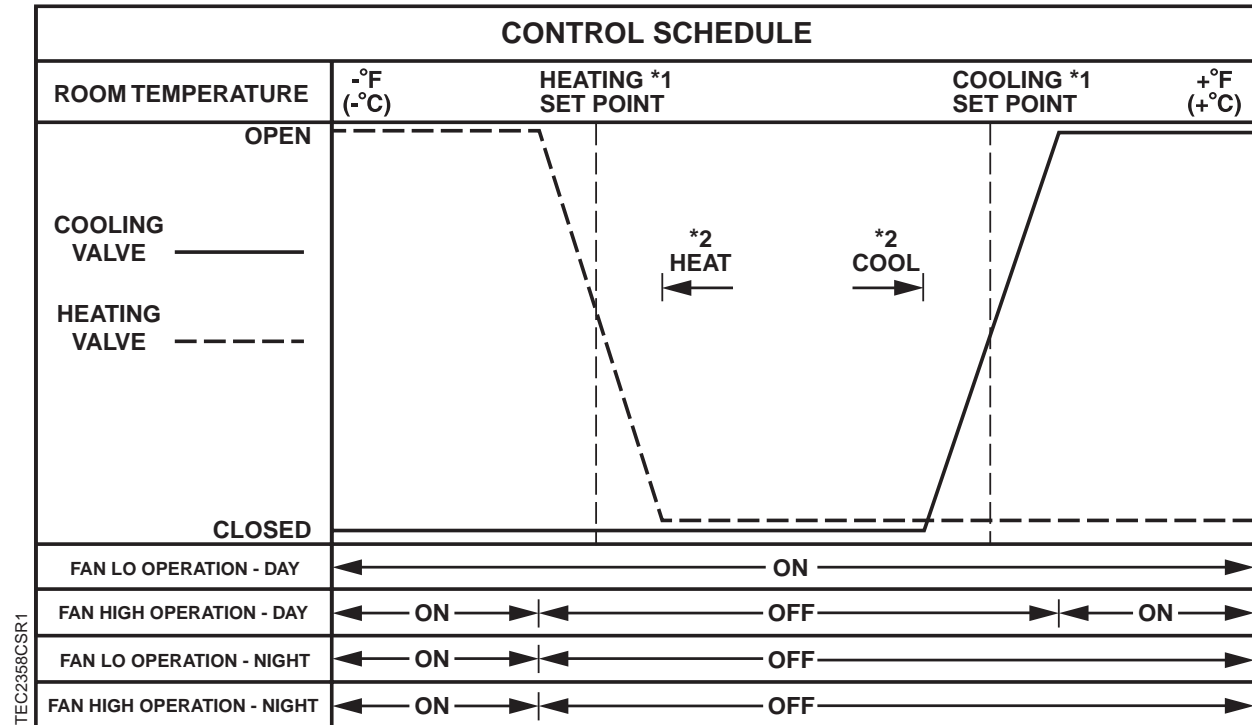


Figure 2358-1. Application 2358 Control Drawing.



1. Refer to the *Control Temperature Set Points* section.
2. Refer to the *Heating/Cooling Switchover* section.

Figure 2358-2. Application 2358 Control Schedule.

Hardware Inputs

Analog

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

Digital

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

Hardware Outputs

Analog

- None

Digital

- Cooling valve actuator
- Fan low speed (switched 24 vac, pilot duty)
- Fan high speed (switched 24 vac, pilot duty) heating valve actuator

Ordering Notes

Order custom solution number 241.

Point Database

Table 2358-1 presents the point database information for Application 2358.

Sequence of Operation

The following paragraphs present the sequence of operation for Application 2358, “Multi-Speed Fan Coil Unit, Cooling and Heating — Electronic Output.”

Control Temperature Set Points

If STPT DIAL (Point 14) is set to NO, CTL STPT (Point 92) holds the value of OCC CLG STPT (Point 6) or OCC HTG STPT (Point 7) depending on the value of HEAT.COOL (Point 5).

If the set point dial is used and the value of RM STPT DIAL is less than the value of RM STPT MIN (Point 11), then CTL STPT holds the value of RM STPT MIN. If the value of RM STPT DIAL is greater than the value of RM STPT MAX (Point 12), then CTL STPT holds the value of RM STPT MAX. If the setpoint dial is used and the value of RM STPT DIAL is between RM STPT MIN and RM STPT MAX, then CTL STPT will hold the value of RM STPT DIAL.

NOTE: The value of CTL TEMP (Point 78) is the same as the value of ROOM TEMP (Point 4), unless CTL TEMP is overridden.

Day and Night Modes

The occ/unocc status of the space is determined by the status of OCC.UNOCC (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 (Figures 2358-1 and 2358-3), and WALL SWITCH (Point 18) equals YES, the controller monitors the status of DI 2. When the status of DI 2 (Point 24) is ON (the switch is closed), OCC.UNOCC 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), OCC.UNOCC 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 OCC.UNOCC. 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 (Temperature)

This application goes into the Occupied Mode based on either one of the following events:

- The space temperature is too low.
- Somebody pushes the override button.

This section describes case low space temperature. The override button is described in the following section.

In order for this module to work correctly, UOC TEMP (Point 33) must be greater than OCC TEMP (Point 32). If UOC TEMP is less than or equal to OCC TEMP, then TEMP OVRD (Point 28) is set equal to UNOCC. This saves energy at night by keeping the fan OFF if UOC TEMP has been set incorrectly.

Once UOC TEMP is set greater than OCC TEMP, the module works as follows:

- If CTL TEMP is less than OCC TEMP, then TEMP OVRD is set equal to OCC.
- If CTL TEMP is greater than UOC TEMP, then TEMP OVRD is set equal to UNOCC.
- If CTL TEMP is between OCC TEMP and UOC TEMP, then TEMP OVRD will remain in its last commanded state.

NOTE: When OCC.UNOCC equals OCC, TEMP OVRD will be set to UNOCC.

Night Mode Override (Switch)

If an override switch is present on the room temperature sensor and a value (in hours) other than zero has been entered into OVRD TIME (Point 20), then by pressing the override switch a room occupant can reset the controller to occupied mode for the amount of time set in OVRD TIME. The status of UNOCC OVRD (Point 21) will change to OCC. After the override time elapses, the controller returns to night mode and the status of UNOCC OVRD changes back to UNOCC.

It is only when the controller is in unoccupied mode that the override switch on the room sensor will have any effect on the controller. Furthermore, when OCC.UNOCC equals OCC, UNOCC OVRD will be set to UNOCC.

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

- The point HTG LOOPOUT (Point 80) is less than SWITCH LIMIT (Point 85).
- The point CTL TEMP (Point 78) is above CTL STPT (Point 92) by at least the value set in SWITCH DBAND (Point 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 (Point 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 CTL STPT (Point 92). Refer to the *Control Temperature Set Points* section.

Cooling Operation

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

When in heating mode, the cooling valve is closed.

Heating Operation

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

When in cooling mode, the heating valve is closed.

NOTE: If both FAN LO DO 6 (Point 46) and FAN HI DO 5 (Point 45) are OFF, then both the heating valve and the cooling valve are fully closed.

Fan Operation

If HI DI 3 (Point 25) is HI, then both FAN LO DO 6 and FAN HI DO 5 will be ON. If HI DI 3 is LO, then both FAN LO DO 6 and FAN HI DO 5 are under control of the application.

Occupied Heating Mode – FAN LO DO 6 is ON. If VLV 2 COMD (Point 52) is greater than HI ON (Point 30), then FAN HI DO 5 will be ON. If VLV 2 COMD is less than HI OFF (Point 31), then FAN HI DO 5 will be OFF. If VLV 2 COMD is between HI ON and HI OFF, then FAN HI DO 5 will remain in its last commanded state.

Occupied Cooling Mode – FAN LO DO 6 is ON. If VLV 1 COMD (Point 48) is greater than HI ON, then FAN HI DO 6 will be ON. If VLV 1 COMD is less than HI OFF, then FAN HI DO 6 will be OFF. If VLV 1 COMD is between HI ON and HI OFF, then FAN HI DO 6 will remain in its last commanded state.

Night Mode – If both UNOCC OVRD (Point 21) and TEMP OVRD (Point 28) are UNOCC, then both FAN LO DO 6 and FAN HI DO 5 will be OFF. If either UNOCC OVRD or TEMP OVRD is OCC, then FAN LO DO 6 will be ON and FAN HI DO 5 will be controlled as it is during the day. For information on how UNOCC OVRD is controlled see the *Night Mode Override (Switch)* section of this document. For information on how TEMP OVRD is controlled, see the *Night Mode Override (Temperature)* section of this document.

Calibration

The controller will regularly calibrate the valves based on the value of CAL TIMER (Point 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 (Point 49) and VLV 2 POS (Point 53) to 0. The actuators are then released to normal control.

Temperature Alarm Indication

In order for this module to work correctly, NORMAL TEMP (Point 27) must be greater than ALARM TEMP (Point 26). If NORMAL TEMP is less than or equal to ALARM TEMP, then TEMP STATUS (Point 03) is set equal to ALARM.

Once NORMAL TEMP is set greater than ALARM TEMP, the module works as follows:

- If CTL TEMP is less than ALARM TEMP, then TEMP STATUS is set equal to ALARM.
- If CTL TEMP is greater than NORMAL TEMP, then TEMP STATUS is set to NORMAL.
- If CTL TEMP is between ALARM TEMP and NORMAL TEMP, then TEMP STATUS remains in its last commanded state.

Fail-safe Operation

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

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 Controller 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 VLV 1 COMD (Point 48) for DO 1 and DO 2, and VLV 2 COMD (Point 52) for DO 3 and DO 4. Refer to the *Apogee Automation Start-up Procedures Manual* (125-3014).

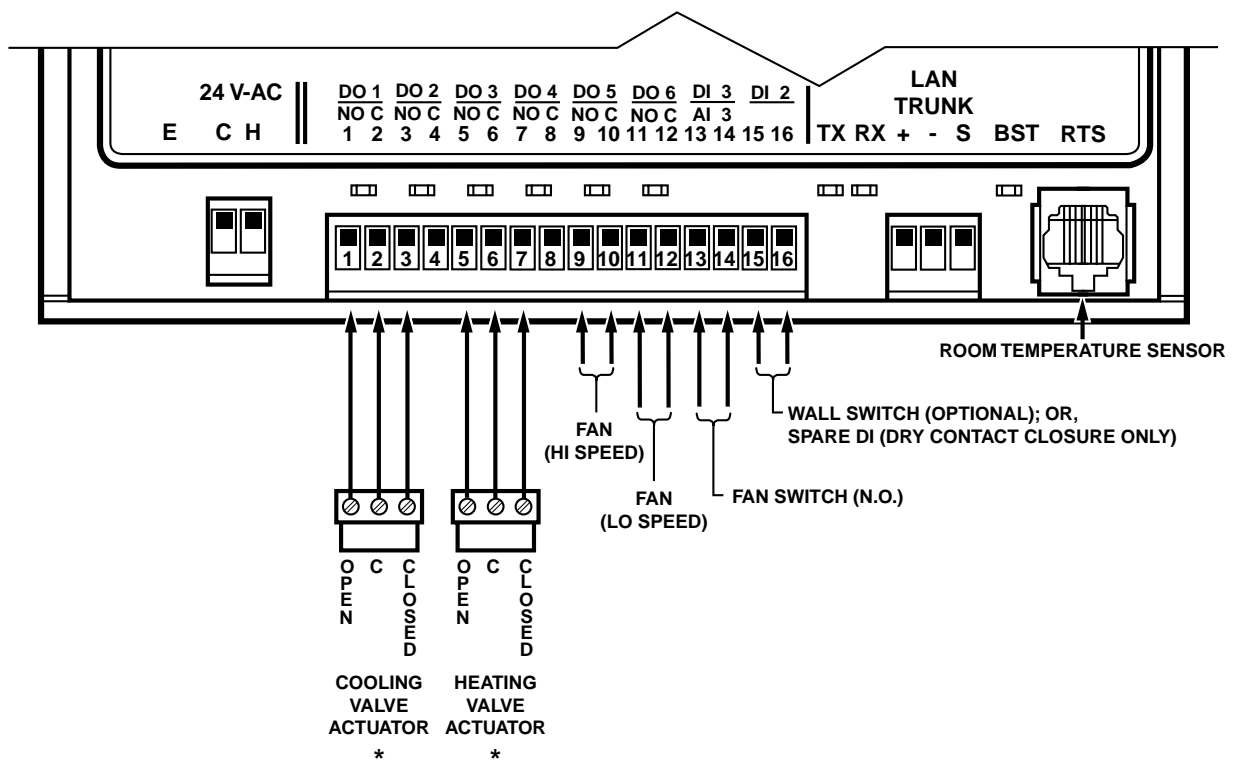
Wiring Diagram

The point wiring for Application 2358 is shown in Figure 2358-3.

**CAUTION:**

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

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



TEC2358WDR1

Figure 2358-3. Application 2358 Wiring Diagram.

Table 2358-1. Point Database for Application 2358.

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	--	--
{03}	TEMP STATUS	NORMAL	--	--	--	ALARM	NORMAL
{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	OCC CLG STPT	74.0 (23.44888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
07	OCC HTG STPT	70.0 (21.20888)	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
18	WALL SWITCH	NO	--	--	--	YES	NO
{19}	DI OVRD SW	OFF	--	--	--	ON	OFF
20	OVRD TIME	0	HRS	1	0	--	--
{21}	UNOCC OVRD	UNOCC	--	--	--	UNOCC	OCC
{24}	DI 2	OFF	--	--	--	ON	OFF
{25}	HI DI 3	LO	--	--	--	HI	LO
26	ALARM TEMP	55.0 (12.80888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
27	NORMAL TEMP	57.0 (13.92888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
{28}	TEMP OVRD	UNOCC	--	--	--	UNOCC	OCC
{29}	OCC.UNOCC	OCC	--	--	--	UNOCC	OCC
30	HI ON	98.0	PCT	0.4	0.0	--	--
31	HI OFF	90.0	PCT	0.4	0.0	--	--
32	OCC TEMP	56.0 (13.36888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
33	UOC TEMP	58.0 (14.48888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
{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 HI DO 5	OFF	--	--	--	ON	OFF
{46}	FAN LO DO 6	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	--	--

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 2358-1. Point Database for Application 2358.

Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
{53}	VLV 2 POS	0.0	PCT	0.4	0.0	--	--
55	MTR 2 TIMING	130	SEC	1	0	--	--
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	--	--
{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.