

Application 2404

Unit Conditioner with 2-Position Damper and 3-Speed Fan

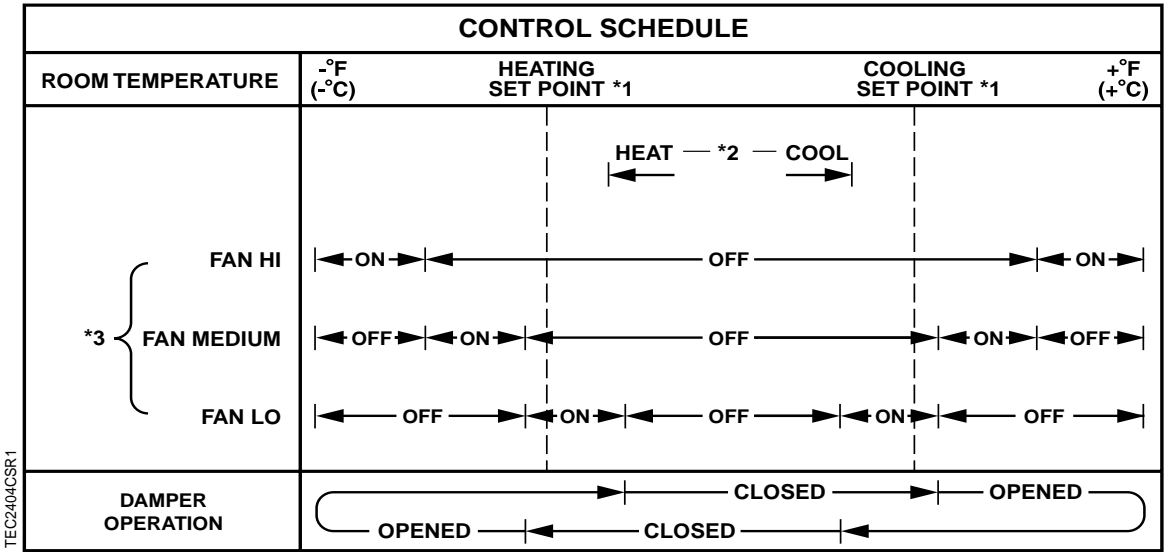
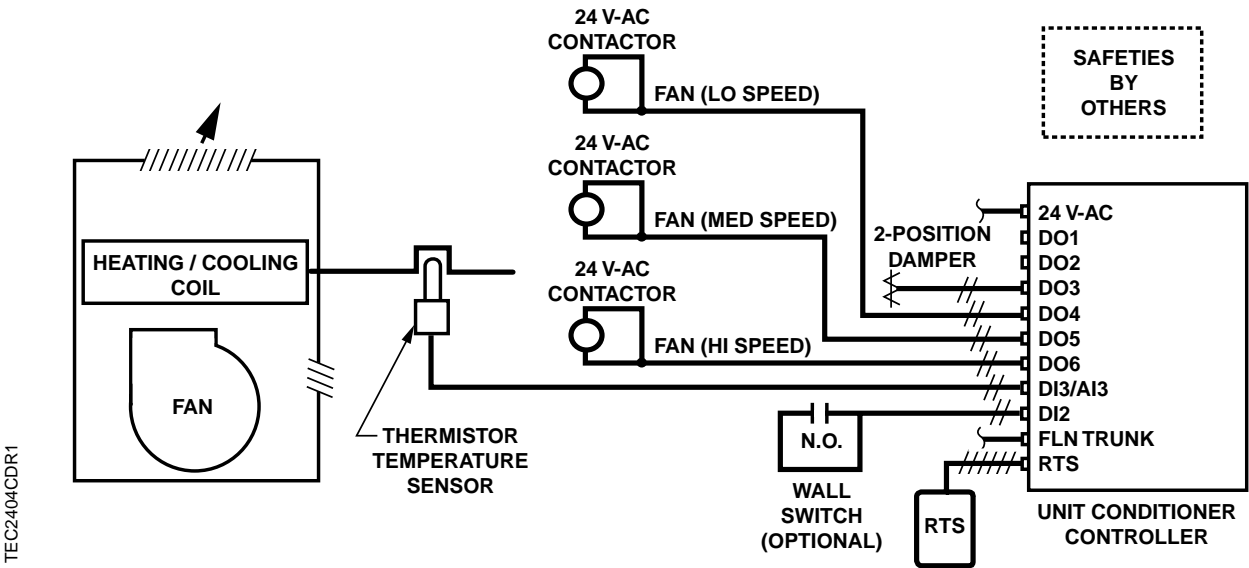
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Overview

In Application 2404, the controller modulates the speed of a fan for both heating and cooling. If the fan is ON, the damper is opened. If the fan is OFF, the damper is closed. Refer to *Figures 2404-1* and *2404-2*.



1.

Refer to *Control Temperature Set Points*.
2.

Refer to *Heating/Cooling Switchover*.
3.

Only one fan speed is on at a time. Refer to *Fan Operation*.

Figure 2404-2. Application 2404 Control Schedule.

Hardware Inputs

Analog

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

Digital

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

Hardware Outputs

Analog

- None

Digital

- 3 speed fan (switched 24 Vac, pilot duty)
- Valve actuator (optional)
- 2-position damper

Ordering Notes

Unit Conditioner Controller: Part Number 550-019.

Sequence of Operation

The following paragraphs present the sequence of operation for Application 2404, “Unit Conditioner with Two-Position Damper and Three-Speed Fan.”

Control Temperature Set Points

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

Day Mode – In 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 set point dial and STPT DIAL (Point 14) is set to YES, then CTL STPT holds the value of RM STPT DIAL (Point 13).

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.

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

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 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 (*Figures 2404-1 and 2404-4*), 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), 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 a 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 (that is, connected to a field panel), then the field panel can send an operator or PPCL command to override the status of 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 OVRD TIME (Point 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. This changes the status of NGT OVRD (Point 21) to DAY. After the override time elapses, the controller returns to night mode and the status of NGT OVRD changes back to NIGHT.

The override switch on the room sensor affects the controller only when the controller is in night mode.

Heating/Cooling Switchover

There are three options for the heating/cooling switchover for this application. For the switchover to function properly, one of the following three options must be used:

- **Temperature sensor attached to the supply water pipe:**
In this case, the controller uses the measured temperature point, SUPPLY TEMP (Point 15), to determine whether it is in heating or cooling mode.
 - When SUPPLY TEMP is below the value of COOL TEMP (Point 61), the controller sets HEAT.COOL (Point 5) to COOL, thereby switching the controller to cooling mode.
 - When SUPPLY TEMP is above the value of HEAT TEMP (Point 62), the controller sets HEAT.COOL (Point 5) to HEAT, switching the controller to heating mode.
- **(1) Controller connected to a field panel:**
In this case, the field panel commands the supply temperature point, SUPPLY TEMP (Point 15).
 - When SUPPLY TEMP is commanded below the value of COOL TEMP (Point 61), the controller sets HEAT.COOL (Point 5) to COOL, switching the controller to cooling mode.
 - When SUPPLY TEMP is commanded above the value of HEAT TEMP (Point 62), the controller sets HEAT.COOL (Point 5) to HEAT, switching the controller to heating mode.
- **(2) Controller connected to a field panel:**
In this case, the field panel switches the controller between heating and cooling modes by commanding HEAT.COOL (Point 5) to HEAT or COOL.

Control Loops

The fan coil unit is controlled by two Proportional, Integral, and Derivative (PID) temperature loops. One loop is for heating and the other is for cooling. The active temperature loop maintains room temperature at the value in CTL STPT (Point 92). Refer to *Control Temperature Set Points* for more information.

Cooling Operation

In cooling mode, the controller uses 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 controls the three-speed fan in the cooling mode. During cooling mode, HTG LOOPOUT (Point 80) is set to 0%.

Heating Operation

In heating mode, the controller uses 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 controls the three-speed fan in the heating mode. During heating mode, CLG LOOPOUT (Point 79) is set to 0%.

Fan Operation

The fan is controlled by CTL LOOPOUT (Point 81).

- When HEAT.COOL (Point 5) = COOL, CTL LOOPOUT equals CLG LOOPOUT (Point 79).
- When HEAT.COOL = HEAT, CTL LOOPOUT equals HTG LOOPOUT (Point 80).

NOTE: In order for this module to work properly, the following points must be set up in the following order as shown (this is extremely important):

HI ON (Point 74) > MD ON.HI OFF (Point 73) > LO ON.MD OFF (Point 72) > LO OFF (Point 71).
The fan remains completely OFF until these points are set up in the proper order. Once these points are set up properly, the fan is controlled as explained in the decision table that follows.

If...	Is...	Then,	(Dependencies)
CTL LOOPOUT	\geq HI ON	the fan is at high speed.	—
	< HI ON but > MD ON.HI OFF	fan control depends on the current state of the fan:	<ul style="list-style-type: none"> high speed remains at high speed all other cases go to medium speed
	\leq MD ON.HI OFF and > LO ON.MD OFF	fan control depends on the current state of the fan:	<ul style="list-style-type: none"> high speed is sent to medium speed medium speed remains at medium speed all other cases go to low speed
	\leq LO ON.MD OFF and > LO OFF	fan control depends on the current state of the fan:	<ul style="list-style-type: none"> OFF remains OFF all other cases go to low speed
	\leq LO OFF	the fan will be completely OFF.	—

For a graphical description of this fan sequence, refer to *Figure 2404-3*. (The following table helps to clarify the diagram in *Figure 2404-3*.)

Fan Speed	FAN LO DO4 (Point 44)		FAN MD DO5 (Point 45)		FAN HI DO6 (Point 46)	
	OFF	ON	OFF	ON	OFF	ON
High	√		√			√
Medium	√			√	√	
Low		√	√		√	
OFF	√		√		√	

NOTE: Do not command FAN CONTROL (Point 40) under normal operation. It is used only as a debugging tool and a functional verification tool.

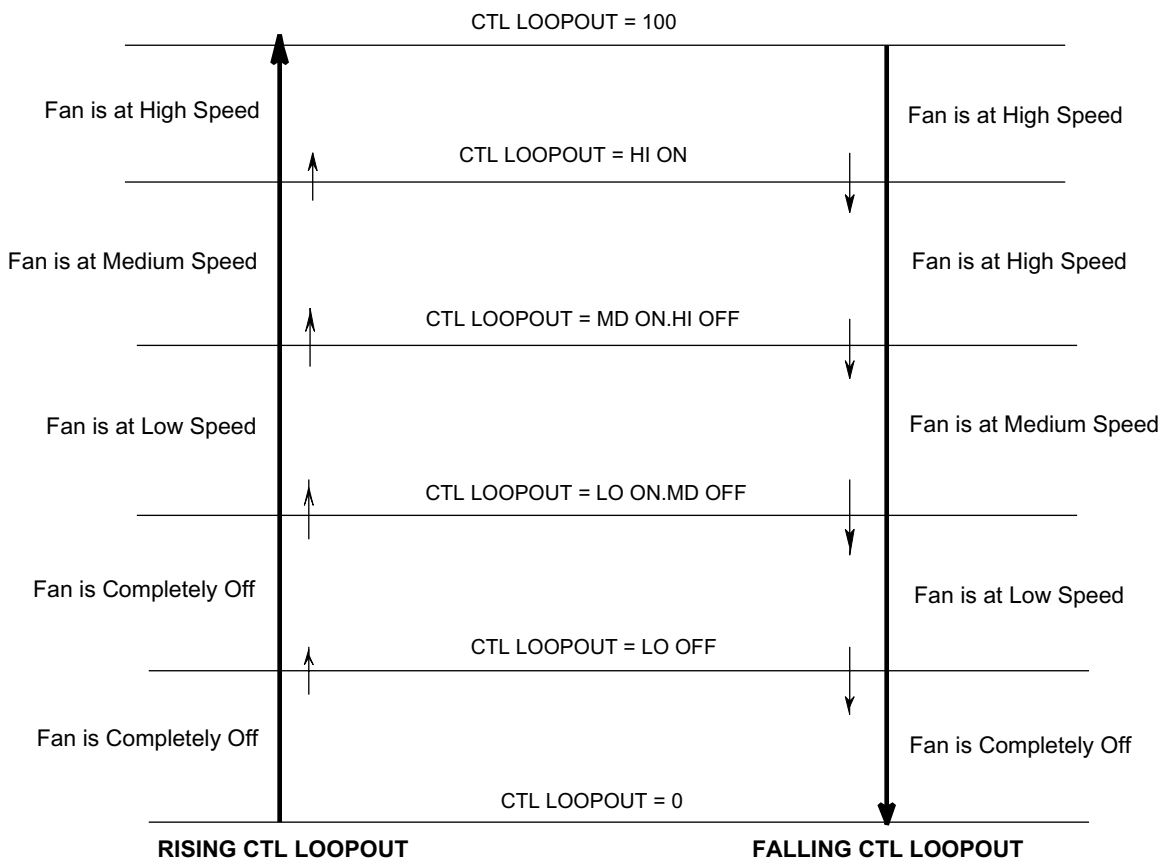


Figure 2404-3. Graphical Explanation of the Fan Control Sequence of Application 2404.

Damper Operation

When FAN LO DO4 (Point 44), or FAN MD DO5 (Point 45), or FAN HI DO6 (Point 46) is ON, DAMPER DO3 (Point 43) = OPENED. When FAN LO DO4, FAN MD DO5, and FAN HI DO6 are all OFF, DAMPER DO3 = CLOSED.

Calibration

There is nothing in application 2404 that needs calibrating. However, if motor 1 is used as a spare valve, this application will calibrate it. The controller will regularly calibrate the valve based on the value of CAL TIMER (Point 96). A value of 12 indicates that the controller will calibrate the valve(s) once every 12 hours.

The calibration consists of driving the valve closed, and then resetting the value of MTR 1 POS (Point 49) to 0. The actuator is then released to normal control.

Fail-safe Operation

If the room temperature sensor fails or the pipe temperature sensor fails, then 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 or the heating loop, or both need to be tuned. Refer to the *APOGEE Automation Service Procedures* on InfoLink for more information.
2. The Unit Conditioner Controller, as shipped from the factory, keeps all associated equipment OFF. Refer to the Equipment Controllers section in *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 1 and DO 2 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 MTR 1 COMD (Point 48). Refer to the *APOGEE Automation Start-up Procedures Manual* on InfoLink for more information.

Wiring Diagram

The point wiring for Application 2404 is shown in Figure 2404-4.



CAUTION:

The Controller's Digital Outputs (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
- DC power
- Separate transformers used to power the load

NOTE: Refer to the unit wiring diagrams or consult with the local representative if terminations are missing or are different.

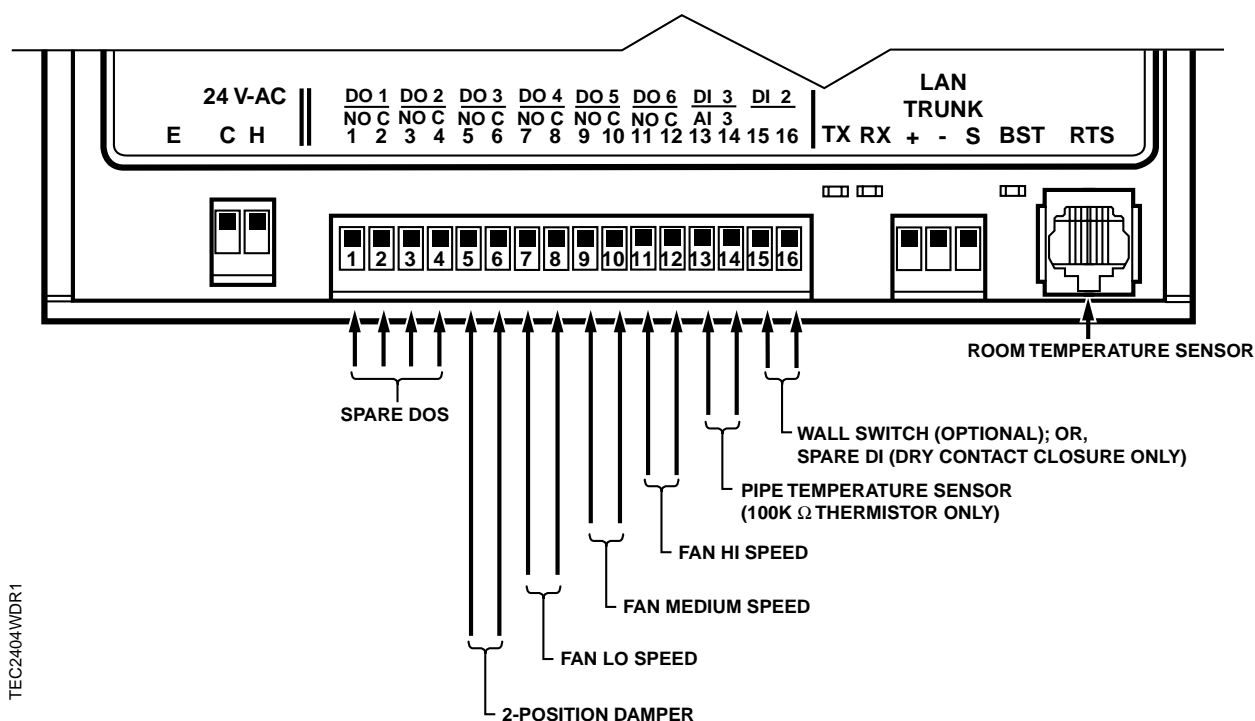


Figure 2404-4. Application 2404 Wiring Diagram.

Point Database

Table 2404-1. Point Database for Application 2404.

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}	SUPPLY 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
{29}	DAY.NGT	DAY	--	--	--	NIGHT	DAY
{40}	FAN CONTROL	0	--	1	0	--	--
{41}	DO 1	OFF	--	--	--	ON	OFF
{42}	DO 2	OFF	--	--	--	ON	OFF
{43}	DAMPER DO3	CLOSED	--	--	--	OPENED	CLOSED
{44}	FAN LO DO4	OFF	--	--	--	ON	OFF
{45}	FAN MD DO5	OFF	--	--	--	ON	OFF
{46}	FAN HI DO6	OFF	--	--	--	ON	OFF
{48}	MTR 1 COMD	0.0	PCT	0.4	0.0	--	--
{49}	MTR 1 POS	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.

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Table 2404-1. Point Database for Application 2404.

Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
51	MTR 1 TIMING	130	SEC	1	0	--	--
56	MTR1 ROT ANG	90	--	1	0	--	--
58	MTR SETUP	0	--	1	0	--	--
59	DO DIR. REV	0	--	1	0	--	--
61	COOL TEMP	65.0 (18.455556)	DEG F (DEG C)	0.5 (0.28)	37.5(3.055556)	--	--
62	HEAT TEMP	80.0 (26.855556)	DEG F (DEG C)	0.5 (0.28)	37.5(3.055556)	--	--
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	LO OFF	20.0	PCT	0.4	0.0	--	--
72	LO ON.MD OFF	40.0	PCT	0.4	0.0	--	--
73	MD ON.HI OFF	60.0	PCT	0.4	0.0	--	--
74	HI ON	80.0	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	--	--
{81}	CTL LOOPOUT	0.0	PCT	0.4	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.