

Application 2409: Fan Coil Cooling and Heating with Condensate Alarm

TEC-0349.08

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Overview

In Application 2409, the controller modulates separate valves for cooling and heating, and controls a fan to circulate room air. In order for the fan coil unit to work properly, the central plant must provide chilled and hot water. Application 2409 also includes a condensate alarm, a fan proof alarm, and high and low discharge temperature alarms. Refer to Figures 2409-1 and 2409-2.

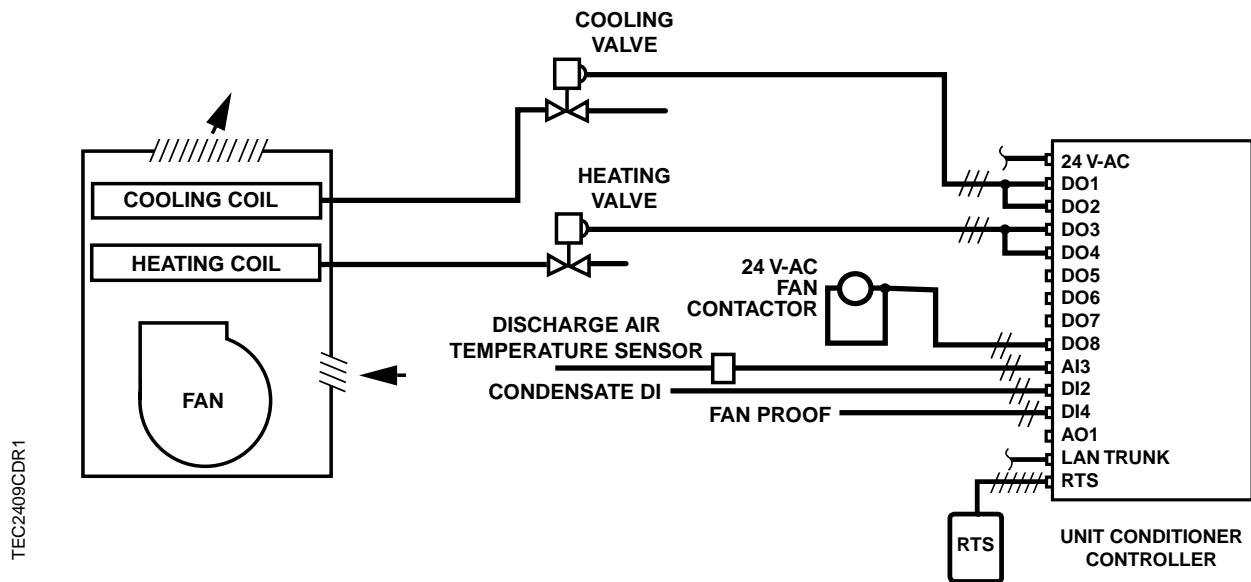
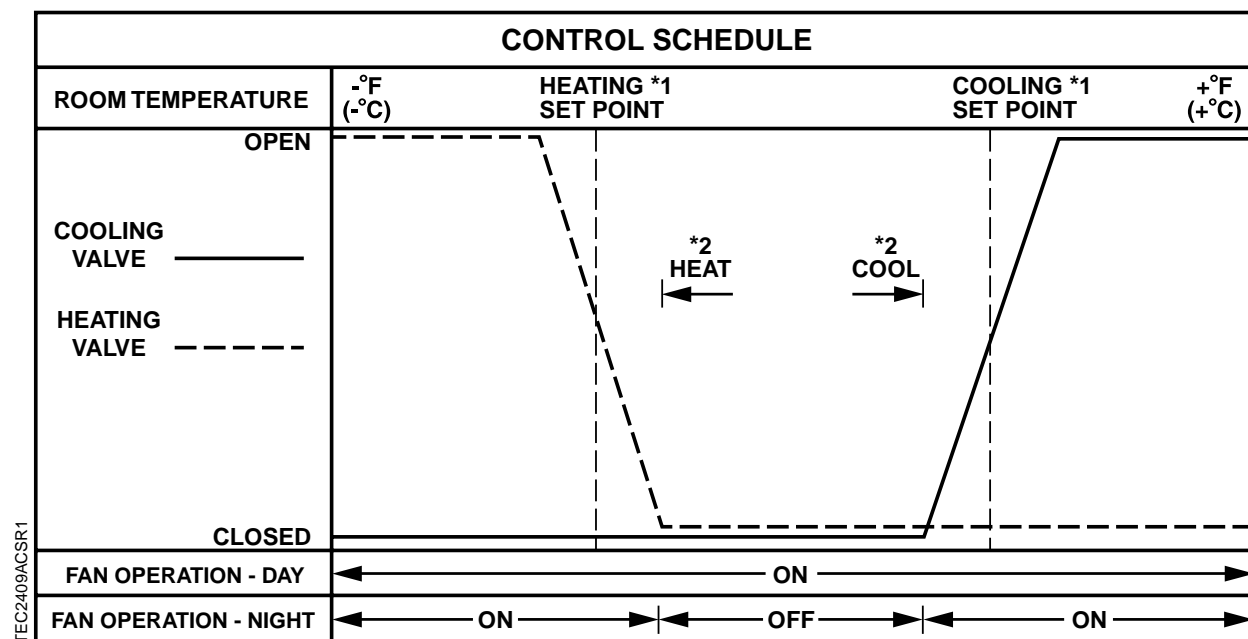


Figure 2409-1. Application 2409 Control Drawing.



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

Figure 2409-2. Application 2409 Control Schedule (Normal Condensate Condition).

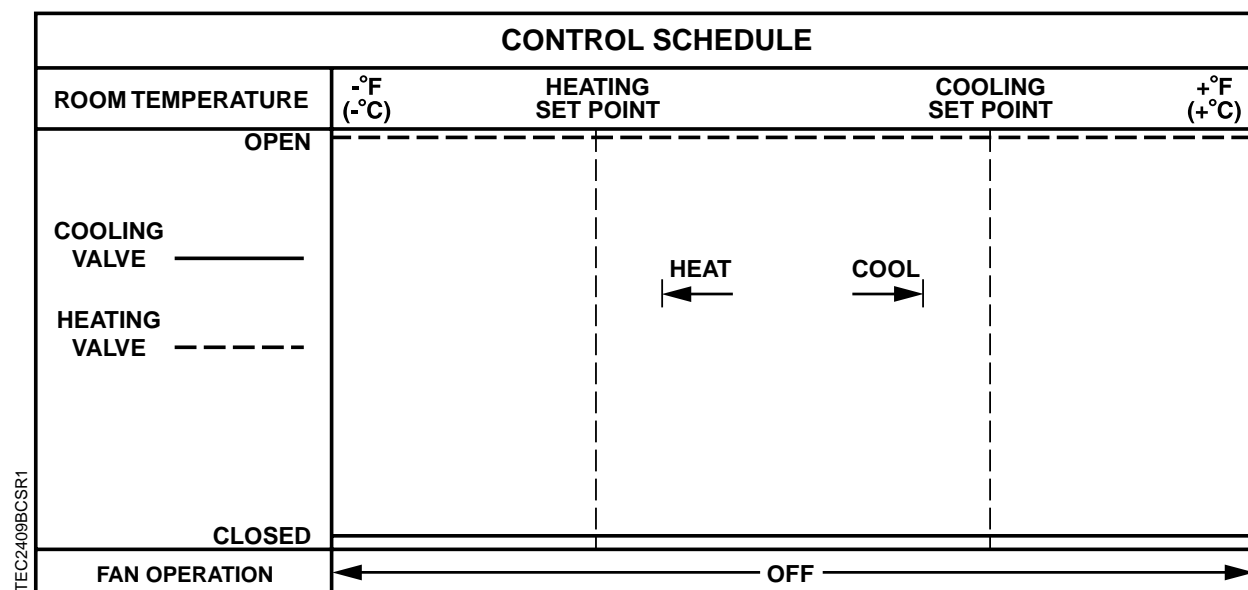


Figure 2409-3. Application 2409 Control Schedule (Alarm Condition for Condensate).

Hardware Inputs

Analog

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

Digital

- Night mode override (optional)
- Condensate alarm DI
- Fan proof DI (optional)

Hardware Outputs

Analog

- None

Digital

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

Ordering Notes

Fan Coil Cooling and Heating Controller with Condensate Alarm: Part Number 550-188.

Sequence of Operation

The following paragraphs present the sequence of operation for Application 2409, *Fan Coil Cooling and Heating with Condensate Alarm*.

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 following set points:

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 or not the controller is connected to a field panel.

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, it 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 mode for the amount of time that is set in OVRD TIME. The status of NGT OVRD (Point 21) will change to DAY and remain there until after the override time elapses, at which point NGT OVRD will change back to NIGHT, returning the controller to night mode.

Only during night mode does the override switch on the room sensor 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 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:

- HTG LOOPOUT (Point 80) is less than SWITCH LIMIT (Point 85).
- 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:

- 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.

Condensate Alarm

CONDENSATE (Point 30) is set to NORMAL (that is, there is no alarm) when:

- DI 2 CONTACT (Point 10) is NOPEN and COND DI 2 (Point 24) is OPENED.
- DI 2 CONTACT is NCLOSE and COND DI 2 is CLOSED.

CONDENSATE is set to ALARM when:

- DI 2 CONTACT is NOPEN and COND DI 2 stays CLOSED longer than COND TIME (Point 35).
- DI 2 CONTACT is NCLOSE and COND DI 2 stays OPENED longer than COND TIME.

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

If CONDENSATE (Point 30) is equal to ALARM, then the cooling valve, VALVE 1 COMD (Point 48), is 0% Open. If CONDENSATE is equal to NORMAL, then the cooling valve is controlled as follows:

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 modulates the cooling valve point, VLV 1 COMD. (HTG LOOPOUT (Point 80) is set to 0% during the cooling mode.)

When in heating mode, the cooling valve is closed.

Heating Operation

If CONDENSATE (Point 23) is equal to ALARM, then the hot water valve, VALVE 2 COMD (Point 52), is 100% Open. If CONDENSATE is equal to NORMAL, then the hot water valve is controlled as follows:

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 modulates the hot water valve point, VLV 2 COMD. (CLG LOOPOUT (Point 79) is set to 0% during the heating mode.)

When in cooling mode, the heating valve is closed.

Fan Operation

If CONDENSATE (Point 30) is equal to ALARM, then the fan is OFF. If CONDENSATE is equal to NORMAL, then the fan is controlled as follows:

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

1. If either of the valve points, VLV 1 COMD (Point 48) or VLV 2 COMD (Point 52), is open more than the value of STAGE FAN (Point 84), then the fan turns ON.
2. If both valves are closed below the value of SWITCH LIMIT (Point 85), then the fan turns OFF.
3. If neither of the above two conditions is met, then the condition of the fan remains unchanged.

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

Fan Proofing

The fan proofs when:

- FAN (Point 50) is ON and FAN DI 4 (Point 26) is ON.
- FAN is OFF and FAN DI 4 is OFF.

(FAN STATUS (Point 31) equals NORMAL when either of these two cases occurs.)

The fan fails to proof when:

- FAN is ON and FAN DI 4 stays OFF longer than PROOF TIME (Point 36).
- FAN is OFF and FAN DI 4 stays ON longer than PROOF TIME.

(FAN STATUS is set to ALARM when either of these two cases occurs.)

Discharge Temperature Alarms

Application 2409 has two discharge temperature alarms: a high discharge temperature alarm and a low discharge temperature alarm. In order for these alarms to work properly, LO TEMP (Point 28) must be less than HI TEMP (Point 27). If not, then HI DIS TEMP (Point 32) and LO DIS TEMP (Point 33) are both set to ALARM.

When LO TEMP and HI TEMP are set up properly, the discharge temperature alarms operate as follows:

When DIS TMP AI3 (Point 15) is greater than HI TEMP for a longer amount of time than is stored in TEMP ALM DEL (Point 34), HI DIS TEMP is set to ALARM. When DIS TMP AI3 is less than or equal to HI TEMP for a longer amount of time than is stored in TEMP ALM DEL, HI DIS TEMP is set to NORMAL. When neither of these conditions is true, HI DIS TEMP remains in its last commanded state.

When DIS TMP AI3 is less than LO TEMP for a longer amount of time than is stored in TEMP ALM DEL, LO DIS TEMP is set to ALARM. When DIS TMP AI3 is greater than or equal to LO TEMP for a longer amount of time than is stored in TEMP ALM DEL, LO DIS TEMP is set to NORMAL. When neither of these conditions is true, LO DIS TEMP remains in its last commanded state.

Calibration

The controller will regularly calibrate the valves based on the value of CAL TIMER (Point 96). The default value is 12, indicating 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 VLV 1 POS (Point 49) and VLV 2 POS (Point 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.

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* on InfoLink for more information.
2. The controller, as shipped from the factory, keeps all associated equipment OFF. Refer to *Equipment Controllers* 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. If a cooling valve is not being controlled by the application, then DO 1 and DO 2 can be used as auxiliary motor points. If a heating valve is not being controlled by the application, then DO 3 and DO 4 can 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* on InfoLink for more information.

Wiring Diagram



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.

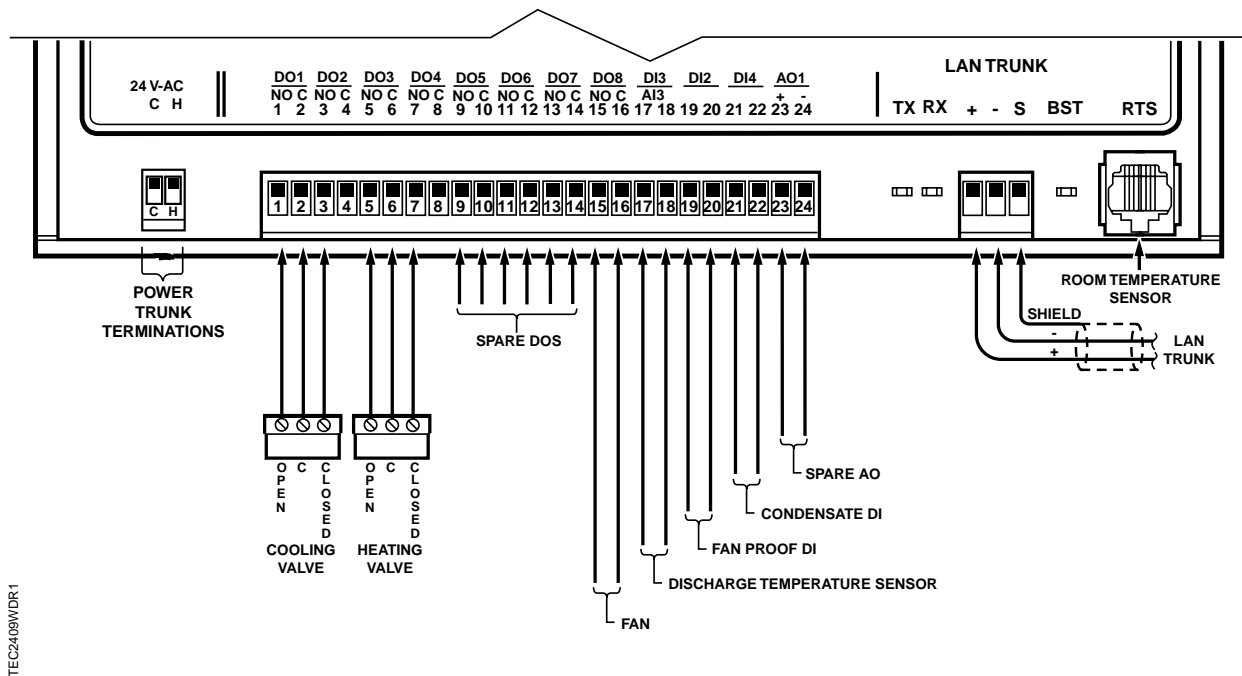


Figure 2409-4. Application 2409 Wiring Diagram.

Point Database

Table 2409-1. Point Database for Application 2409.

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	2492	--	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)	--	--
10	DI 2 CONTACT	NOPEN	--	--	--	NCLOSE	NOPEN
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}	DIS TMP AI3	74.0 (23.495556)	DEG F (DEG C)	0.5 (0.28)	37.5(3.055556)	--	--
{19}	DI OVRD SW	OFF	--	--	--	ON	OFF
20	OVRD TIME	0	HRS	1	0	--	--
{21}	NGT OVRD	NIGHT	--	--	--	NIGHT	DAY
{24}	COND DI 2	OPENED	--	--	--	CLOSED	OPENED
{25}	DI 3	OFF	--	--	--	ON	OFF
{26}	FAN DI 4	OFF	--	--	--	ON	OFF
27	HI TEMP	100.0 (38.055556)	DEG F (DEG C)	0.5 (0.28)	37.5(3.055556)	--	--
28	LO TEMP	50.0 (10.055556)	DEG F (DEG C)	0.5 (0.28)	37.5(3.055556)	--	--
{29}	DAY.NGT	DAY	--	--	--	NIGHT	DAY
{30}	CONDENSATE	NORMAL	--	--	--	ALARM	NORMAL
{31}	FAN STATUS	NORMAL	--	--	--	ALARM	NORMAL
{32}	HI DIS TEMP	NORMAL	--	--	--	ALARM	NORMAL
{33}	LO DIS TEMP	NORMAL	--	--	--	ALARM	NORMAL
34	TEMP ALM DEL	30	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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Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
35	COND TIME	30	SEC	1	0	--	--
36	PROOF TIME	30	SEC	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}	DO 5	OFF	--	--	--	ON	OFF
{46}	DO 6	OFF	--	--	--	ON	OFF
{47}	DO 7	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	--	--
{50}	FAN	OFF	--	--	--	ON	OFF
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	--	--
54	AO DIR. REV	0	--	1	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	--	--
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	--	--
{72}	AOV 1	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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Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
{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	--	--
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	--	--
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.