

Application 2400

Unit Conditioner, Cooling with Pulse Accumulator

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Overview

In Application 2400, the controller modulates a valve in the fan coil unit for cooling. The fan coil unit also has 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. Refer to Figures 2400-1 and 2400-2. Application 2400 also has the ability to count and totalize DI 2 pulses. This is useful for energy metering.

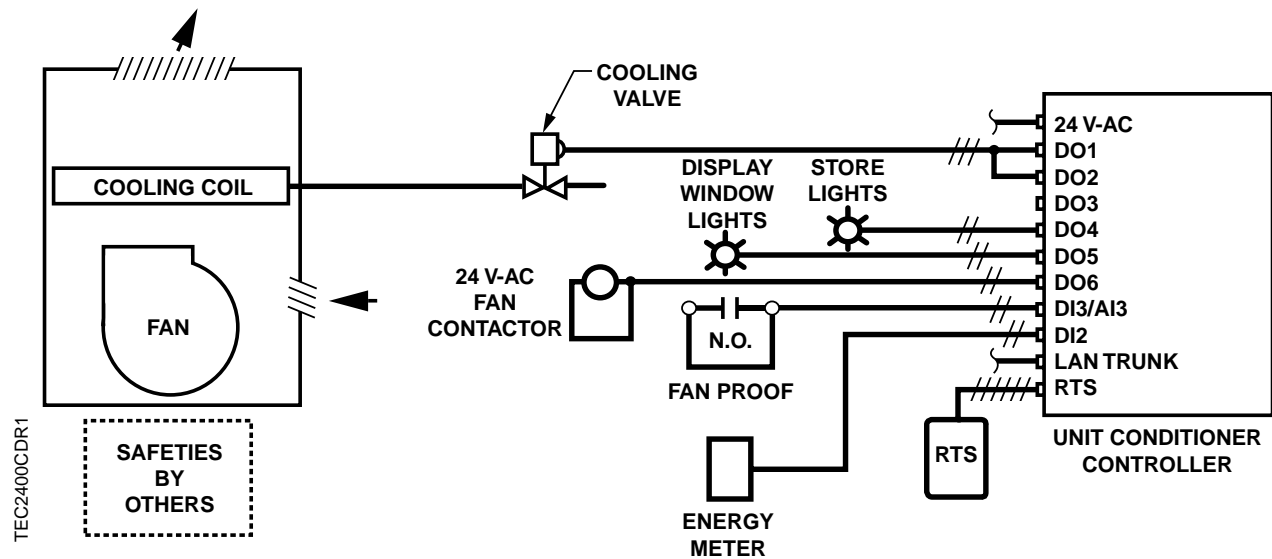
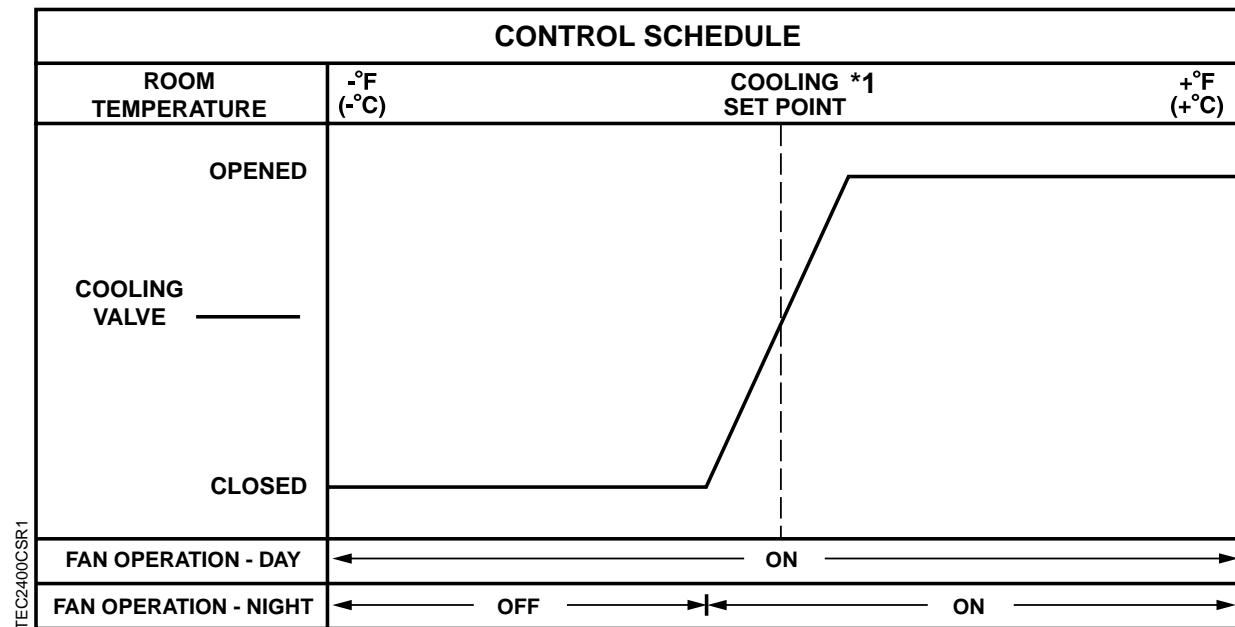


Figure 2400-1. Application 2400 Control Drawing.



¹Refer to the *Control Temperature Set Points* section.

Figure 2400-1. Application 2400 Control Schedule.

Hardware Inputs

Analog

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

Digital

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

Hardware Outputs

Analog

- None

Digital

- Cooling valve actuator
- Fan (switched 24 Vac, pilot duty)
- Display window lights
- Store lights

Ordering Notes

Custom Solutions Application 2400.

Controller Part Number: 540-816.

Sequence of Operation

The following paragraphs present the sequence of operation for Application 2400, “Unit Conditioner, Cooling with Pulse Accumulator — Electronic Output.”

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 06) if STPT DIAL (Point 14) is set to NO. If the room temperature sensor has a set point dial and STPT DIAL is set to YES, then the value of CTL STPT will be as follows:

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 value of RM STPT DIAL is between RM STPT MIN and RM STPT MAX, then CTL STPT holds the value of RM STPT DIAL.

Night Mode – In night mode, CTL STPT holds the value of NGT CLG STPT (Point 08).

NOTE: The value of CTL TEMP (Point 78) is the same as the value of ROOM TEMP (Point 04), 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). 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 operational mode for the amount of time that is set in OVRD TIME. The status of NGT OVRD (Point 21) changes to DAY and remains there until the override time elapses, at which time 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.

Control Loops

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

Temperature Loops – The one temperature loop is a cooling loop. This temperature loop maintains room temperature at the value in CTL STPT (Point 92). Refer to the *Control Temperature Set Points* section.

Cooling Operation

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).

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) 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:

- If the valve point, VLV 1 COMD (Point 48) is open more than the value of FAN ON (Point 35), then the fan will turn ON.
- If the cooling valve is closed below the value of FAN OFF (Point 36), then the fan will turn OFF.

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 above, 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 controller uses fan proofing logic to determine whether the fan has proofed. The fan proofs in either of the following two conditions:

- FAN (Point 46) is OFF and FAN DI3 (Point 25) is OFF.
- FAN is ON and FAN DI3 is ON.

When either of these 2 cases occurs, FAN STATUS (Point 26) is set to NORMAL.

The fan fails to proof when either of the following occurs:

- FAN is OFF and FAN DI3 stays ON longer than the PROOF TIME (Point 87).
- FAN is ON and FAN DI3 stays OFF longer than the PROOF TIME.

When either of these 2 cases occurs, FAN STATUS is set to ALARM.

NOTE: When DI 3 is being used for Fan Proofing, AI 3 cannot be used to measure AUX TEMP. Conversely, when AI 3 is being used to measure AUX TEMP, DI 3 cannot be used for Fan Proofing.

Pulse Counting

The controller can count and totalize DI 2 (Point 24) pulses, if desired. Pulse counting is done as follows:

- If PULSE EDGE (Point 30) equals 1.0, then the number of rising DI 2 pulses is totalized and stored in PULSE COUNT (Point 31).
- If PULSE EDGE equals 2.0, then the number of falling DI 2 pulses is totalized and stored in PULSE COUNT.
- If PULSE EDGE equals 3.0, then the number of rising and falling DI 2 pulses is totalized and stored in PULSE COUNT.
- If PULSE EDGE does not equal 1.0, 2.0, or 3.0, then DI 2 pulses are not totalized and PULSE COUNT is frozen at its current value. .

- NOTES:**
1. DI 2 may have several pulses per LOOP TIME (Point 98). The TEC will keep track of DI 2 pulses at a maximum rate of 25 HZ.
 2. 32,767 is the maximum value PULSE COUNT can have. When the number of pulses is greater than 32,767, PULSE COUNT is reset to 0.

Lighting Control

Even though DO 4 is called STORE LIGHT (Point 44) and DO 5 is called WINDOW LIGHT (Point 45), the application does not control lighting. If lighting control is desired using these DOs, then they must be unbundled into a field panel's point database and controlled through PPCL at the field panel.

Calibration

The controller will regularly calibrate the cooling valve based on the value of CAL TIMER (Point 96). A value of 12 indicates that the controller will calibrate the cooling valve once every 12 hours.

The calibration consists of driving the cooling valve closed and then resetting the value of VLV 1 POS (Point 49) to 0. The actuator is 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 maintaining the set point, then the cooling loop needs to be tuned. Refer to the *APOGEE Automation Service Procedures Manual* (125-3013) for more information.

2. The Unit Conditioner 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 pair of spare DOs is used to control a motor, make sure that the motor setup, motor timing, and motor rotation angle are enabled correctly before unbundling 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) for more information.

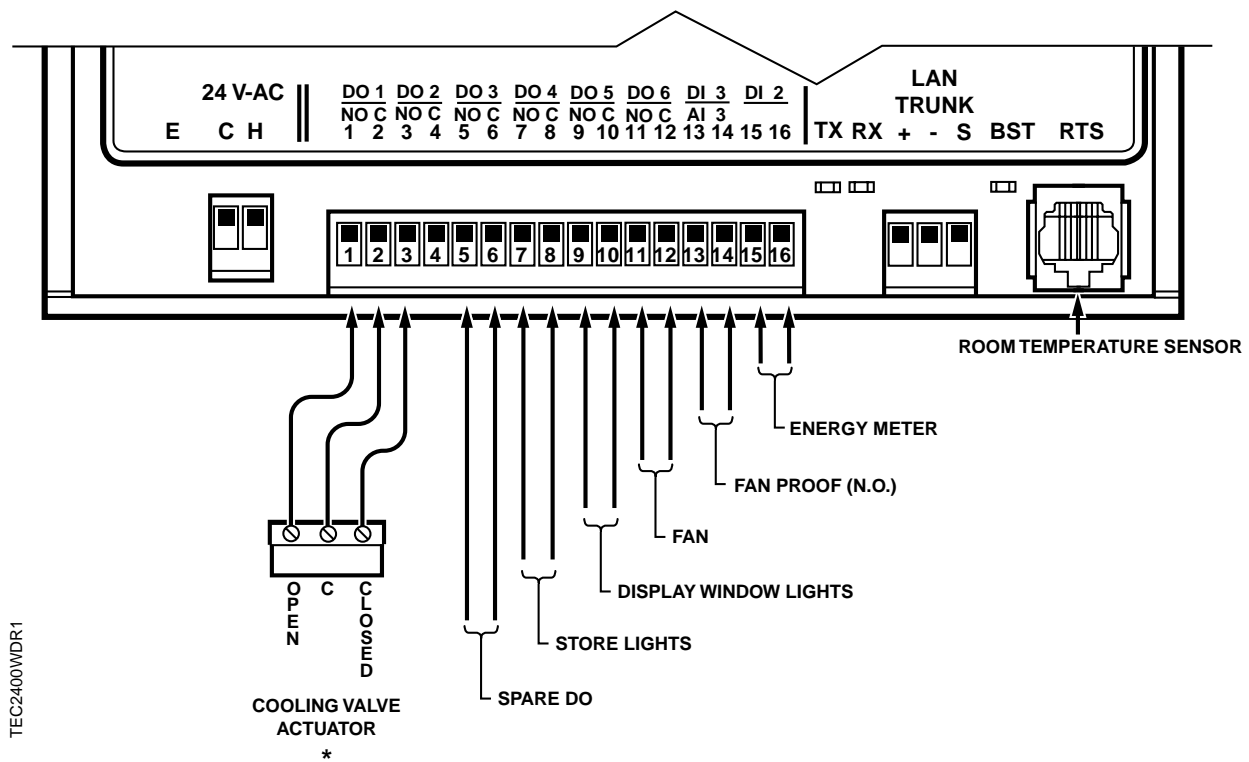
Wiring Diagram

The point wiring for Application 2400 is shown in Figure 2400-3.

**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



* REFER TO THE ACTUATOR INSTALLATION INSTRUCTIONS
FOR SPECIFIC WIRING TERMINATIONS

Figure 2400-3. Application 2400 Wiring Diagram.

Table 2400-1. Point Database for Application 2400.

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	2490	--	1	0	--	--
{04}	ROOM TEMP	74.0 (23.44888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
06	DAY CLG STPT	74.0 (23.44888)	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)	--	--
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)	--	--
{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}	FAN DI3	OFF	--	--	--	ON	OFF
{26}	FAN STATUS	NORMAL	--	--	--	ALARM	NORMAL
{29}	DAY.NGT	DAY	--	--	--	NIGHT	DAY
30	PULSE EDGE	0	--	1	0	--	--
{31}	PULSE COUNT	0	--	1	0	--	--
35	FAN ON	10.0	PCT	0.4	0.0	--	--
36	FAN OFF	5.2	PCT	0.4	0.0	--	--
{41}	DO 1	OFF	--	--	--	ON	OFF
{42}	DO 2	OFF	--	--	--	ON	OFF
{43}	DO 3	OFF	--	--	--	ON	OFF
{44}	STORE LIGHT	OFF	--	--	--	ON	OFF
{45}	WINDOW LIGHT	OFF	--	--	--	ON	OFF
{46}	FAN	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	--	--
56	MTR1 ROT ANG	90	--	1	0	--	--
58	MTR SETUP	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.

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Table 2400-1. Point Database for Application 2400.

Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
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	--	--
{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	--	--
87	PROOF TIME	30	SEC	1	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.