

## TEC Custom Solutions

### Application 2406

### Unit Conditioner Cooling with Motion Sensor

TEC-0348.08

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#### Table of Contents

- Overview
- Hardware Inputs
  - Analog
  - Digital
- Hardware Outputs
  - Analog
  - Digital
- Ordering Notes
- Sequence of Operation
  - Control Temperature Set Points
  - Door Status and Motion Sensor
  - Occupied and Unoccupied Modes
  - Unoccupied Mode Override Switch
  - Control Loops
  - Cooling Operation
  - Fan Operation
  - Lighting Control
  - Calibration
  - Fail-safe Operation
- Application Notes
- Wiring Diagram
- Point Database

## Overview

**NOTE:** For the latest on Custom Solution Applications and Controllers, visit the [Custom Solutions website](#).

In Application 2406, 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 water. Refer to Figures 2406-1 and 2406-2.

Application 2406 also has the ability to determine the occupied/unoccupied status of the room by reading the door position and the state of a motion sensor. This is useful for energy conservation when the room is unoccupied.

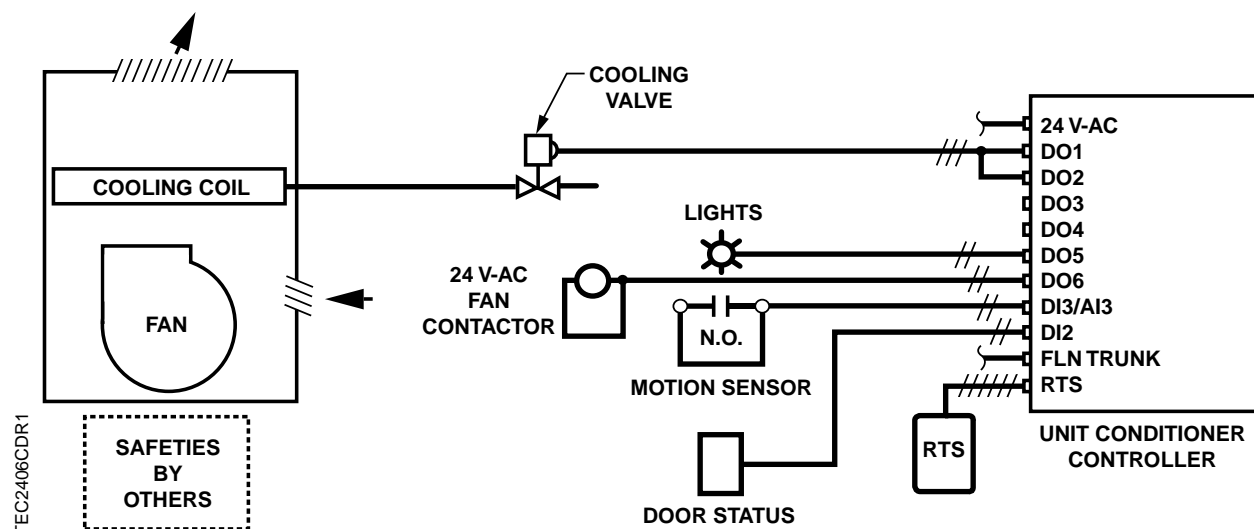
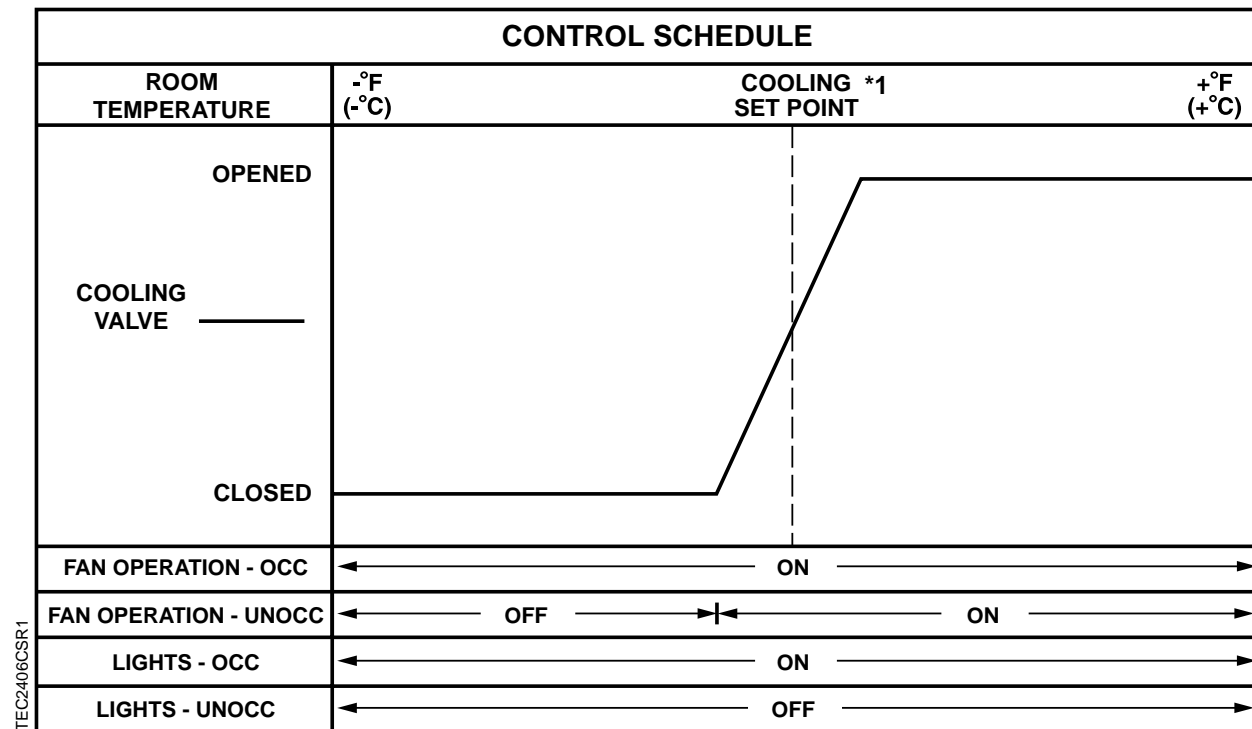


Figure 2406-1. Application 2406 Control Drawing.



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

**Figure 2406-2. Application 2406 Control Schedule.**

## Hardware Inputs

### Analog

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

### Digital

- Night mode override (optional)
- Wall switch (optional)
- Motion Sensor
- Door Status

## Hardware Outputs

### Analog

- None

### Digital

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

## Ordering Notes

You can either order the Unit Conditioner Controller with Motion Sensor as Part Number 550-069, or, you can order it as Custom Solution 253.

## Sequence of Operation

The following paragraphs present the sequence of operation for Application 2406, "Unit Conditioner Cooling with Motion Sensor."

### 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 the occupied mode, CTL STPT holds the value of OCC 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 (Point 13) 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 the unoccupied mode, CTL STPT holds the value of UOC 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.

### Door Status and Motion Sensor

When DI2 CONTACT (Point 26) is set at NOPEN, DOOR (Point 30) = OPEN when DI 2 (Point 24) is open. (This means that the door is open when DI 2 is opened.) When DI2 CONTACT is set at NCLOSE, DOOR = OPEN when DI 2 is closed. (This means that the door is open when DI 2 is closed.)

When DI3 CONTACT (Point 27) is set at NOPEN, MOTION (Point 31) = NO when DI 3 (Point 25) is open. (This means that no motion is detected when DI 3 is opened. In this case, motion is detected when DI 3 is closed.) When DI3 CONTACT is set at NCLOSE, MOTION = NO when DI 3 is closed. (This means that no motion is detected when DI 3 is closed. In this case, motion is detected when DI 3 is open.)

### Occupied and Unoccupied Modes

The occupied/unoccupied status of the space is determined by the status of OCC.UNOCC (Point 29). This application controls OCC.UNOCC by monitoring the door position and the status of a motion sensor. When the DOOR (Point 30) is OPEN, OCC.UNOCC is set to OCC. If the door is closed for a longer amount of time than is stored in MOTION DELAY (Point 91), the motion sensor will be used to determine the status of OCC.UNOCC. In this case, OCC.UNOCC will be set to UNOCC if there is no motion in the room for the amount of time stored in the point OCC TIME (Point 87). (That is, MOTION (Point 31) equals NO for longer than OCC TIME.)

## Unoccupied 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 UNOCC OVRD (Point 21) changes to OCC and remains there until the override time elapses, at which time the controller returns to night mode and the status of UNOCC OVRD changes back to UNOCC.

It is only during unoccupied mode that the override switch has any effect on the controller.

## Control Loops

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

**Occupied 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.

**Unoccupied Mode** – The fan cycles using the same three conditions described in the *Occupied Mode* section, regardless of the setting of CYCLE FAN. If UNOCC OVRD (Point 21) is set to OCC (indicating that the unoccupied mode override button has been pressed), then the fan is controlled as in occupied mode.

## Lighting Control

If either OCC.UNOCC (Point 29) or UNOCC OVRD (Point 21) (or both) equal OCC, LIGHTS DO5 (Point 45) is ON. When both OCC.UNOCC and UNOCC OVRD equal UNOCC, LIGHTS DO5 is OFF.

## 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* on InfoLink for more information.
2. The Unit Conditioner Controller, as shipped from the factory, keeps all associated equipment OFF. Refer to 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 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 MTR 2 COMD (Point 52) for DO 3 and DO 4. Refer to the *APOGEE Automation Start-up Procedures* on InfoLink for more information.

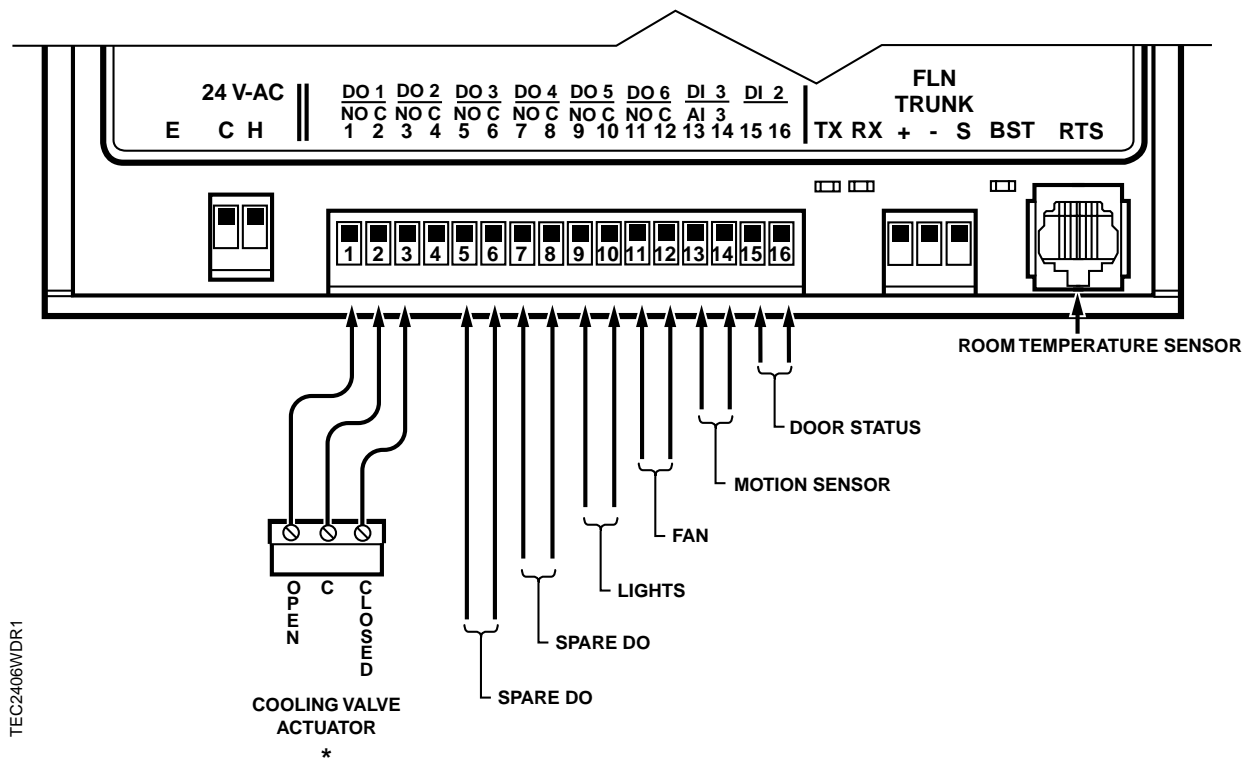
## Wiring Diagram



### 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



\* REFER TO THE ACTUATOR INSTALLATION INSTRUCTIONS FOR SPECIFIC WIRING TERMINATIONS

Figure 2406-3. Wiring Diagram for Application 2406.



## Point Database

**Table 2406-1. Point Database for Application 2406.**

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)	--	--
06	OCC CLG STPT	74.0 (23.44888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
{08}	UOC 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
{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}	DI 3	OFF	--	--	--	ON	OFF
26	DI2 CONTACT	NOPEN	--	--	--	NCLOSE	NOPEN
27	DI3 CONTACT	NOPEN	--	--	--	NCLOSE	NOPEN
{28}	ROOM STATUS	OCC	--	--	--	UNOCC	OCC
{29}	OCC.UNOCC	OCC	--	--	--	UNOCC	OCC
{30}	DOOR	OPEN	--	--	--	CLOSED	OPEN
{31}	MOTION	NO	--	--	--	YES	NO
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}	DO 4	OFF	--	--	--	ON	OFF
{45}	LIGHTS DO5	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 2406-1. Point Database for Application 2406.

Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
{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	--	--
{52}	MTR 2 COMD	0.0	PCT	0.4	0.0	--	--
{53}	MTR 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	--	--
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	OCC TIME	30	MIN	1	0	--	--
91	MOTION DELAY	0	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.