

Application 2337 VAV with Chilled Water, 2-Position Outside Air Damper and Static Pressure Control.

Overview

This application controls a variable air volume air handling unit. The speed of the fan in this AHU is controlled by a static pressure loop. Other features of this application include:

- Chilled water control via a cooling loop that maintains the proper discharge air temperature.
- Two position control of an outdoor air damper.
- Night override (unoccupied override).
- Optional DI control of the OCC.UNOCC mode.
- Optional DI safety.
- Warm-up mode in addition to occupied and unoccupied modes.

In addition to the above features, this application will monitor (but not control) the return air temperature. Refer to Figures 1 through 4.

With this application, it is important to understand the operational modes available, what happens in them, and how the application can get into them.

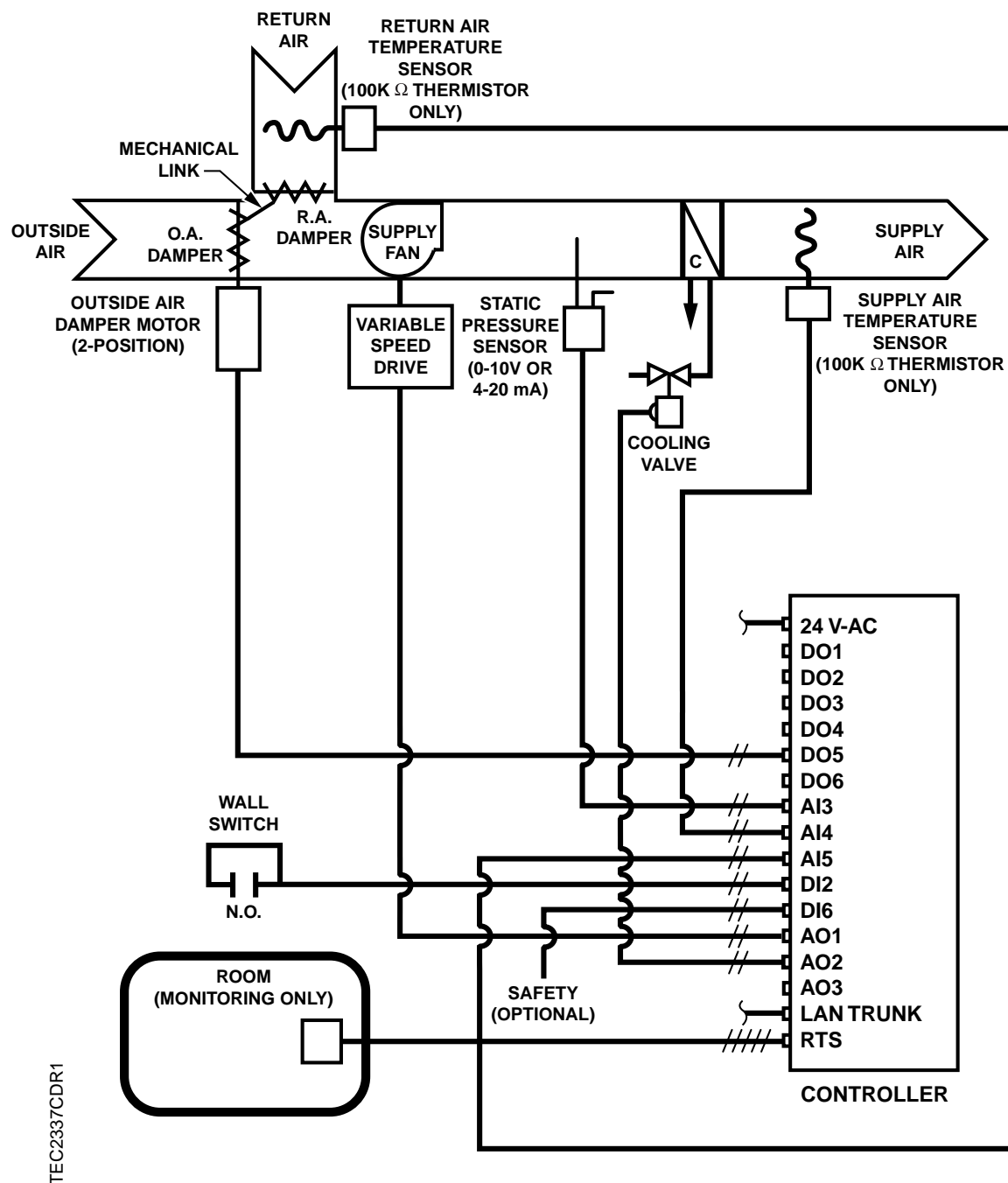
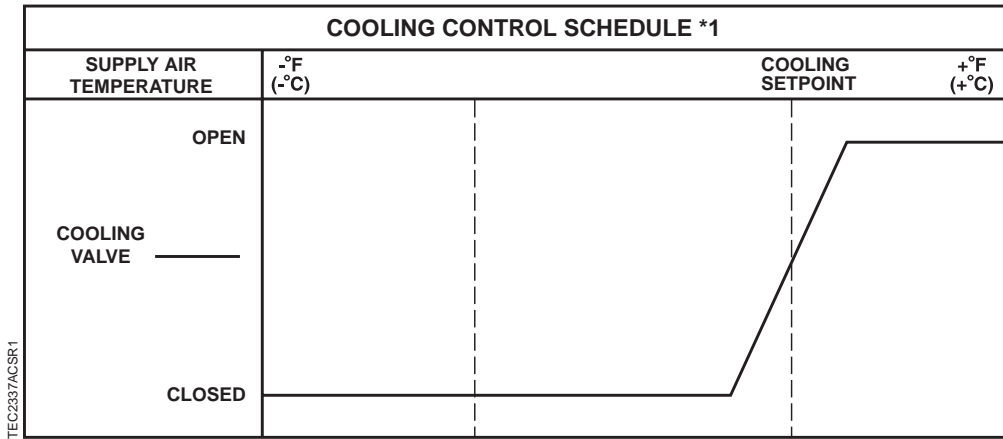
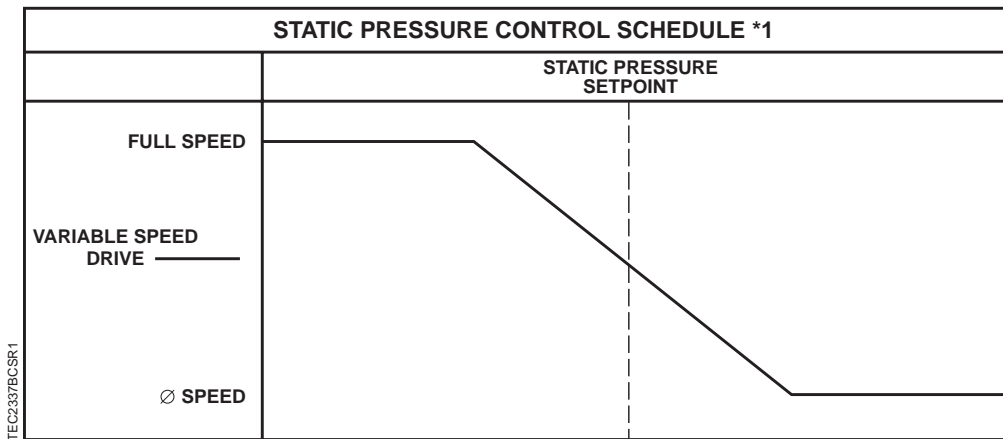


Figure 1. Application 2337 Control Drawing.



1. This is how the cooling valve is controlled in the occupied mode. During the unoccupied mode and the warm-up mode, the cooling valve is shut.

Figure 2. Cooling Control Schedule.



1. This is how the variable speed drive is controlled in the occupied mode and warm-up mode. During the unoccupied mode, the variable speed drive is OFF (Ø speed).

Figure 3. Static Pressure Control Schedule.

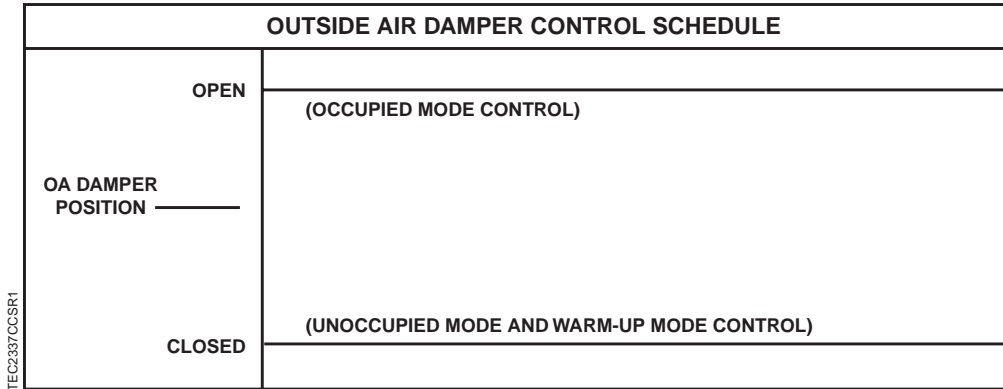


Figure 4. Outside Air Damper Control Schedule.

Hardware inputs

Analog

- Static pressure sensor
- Supply air temperature sensor
- Return air temperature sensor
- Room temperature sensor
- Room temperature set point dial (optional)

Digital

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

Hardware outputs

The following devices can be used by this application depending on your hardware configuration.

Analog

- Variable speed drive
- Cooling valve

Digital

- 2-position damper actuator

Sequence of Operation

The following paragraphs present the sequence of operation for Application 2337, "VAV with Chilled Water, 2-Position Outside Air Damper and Static Pressure Control."

Control modes

This application can be in one of three modes:

1. An unoccupied mode.
2. A warm-up mode.
3. An occupied mode.

These modes are controlled by three points: UNOCC OVRD (number 21), WARM UP (number 87) and OCC.UNOCC (number 29). The value of these points will determine what mode the application is in according to the following rules.

1. If the value of the point UNOCC OVRD is equal to OCC, then the application will be in the occupied mode regardless of the value of the points WARM UP and OCC.UNOCC. This will remain in effect until the night override period is over. Normally, the point UNOCC OVRD is controlled by a push-button on top of the thermostat attached to the TEC. However, in this application the thermostat will be in the supply air duct. Therefore the point UNOCC OVRD should be controlled by PPCL (if it is controlled at all). If this point is not controlled it will remain at the UNOCC value. When UNOCC OVRD has a value of UNOCC, the value of the points WARM UP (number 87) and OCC.UNOCC (number 29) will determine which mode the application is in.
2. If the point UNOCC OVRD is at UNOCC and the point WARM UP is ON, then the application will be in the warm-up mode regardless of the value of the point OCC.UNOCC. (The WARM UP point is controlled by PPCL.)
3. If the point UNOCC OVRD is at UNOCC and the point WARM UP is OFF, then the mode will be determined by the value of the point OCC.UNOCC; that is, the application will be in the unoccupied mode when OCC.UNOCC equals UNOCC, and it will be in the occupied mode when the point OCC.UNOCC equals OCC. If the point WALL SWITCH (number 18) equals YES, then OCC.UNOCC is controlled by the value of DI 2. If WALL SWITCH equals NO, then OCC.UNOCC is controlled by the Time of Day program in a field panel.

Unoccupied mode

When the application is in the unoccupied mode, the following events will occur:

- The static pressure loop is disabled and its output is sent to zero. The variable speed drive is then sent to zero.
- The discharge temperature loop is disabled and its output is sent to zero.
- The cooling valve is shut.
- The outdoor air damper is closed.

Warm-up mode

When the application is in the warm-up mode, the following events will occur:

- The static pressure PID loop is enabled and its output is controlled normally. The variable speed drive is now being controlled by this loop.
- The discharge temperature loop is disabled and its output is sent to zero.
- The cooling valve is shut.
- The outdoor air damper is closed.

Occupied mode

When the application is in the occupied mode, the following events will occur:

- The static pressure PID loop is enabled and its output is controlled normally. The variable speed drive is now being controlled by this loop.
- The discharge temperature loop is enabled and its output is controlled normally.
- The cooling valve is controlled by the discharge temperature PID loop.
- The outdoor air damper is opened.

Cooling PID loop operation

The discharge temperature loop acts as a cooling loop. In the occupied mode, the discharge temperature loop uses the points CLG SAT STPT (number 03) and SUPPLY TEMP (number 16) as inputs. The output of the discharge temperature loop is the point SA CLO (number 79) which is used to modulate the cooling valve, CLG VALVE (number 84) in order to maintain the proper supply air temperature.

Static pressure PID loop operation

The static pressure loop is operational during the warm-up and occupied modes. When operational, the static pressure loop uses the points STATIC PRES (number 15) and SP STP (number 05) as inputs. The output of the static pressure loop is the point SP LOOPOUT (number 80). This point (SP LOOPOUT) is used to control the variable speed drive point (VSD, number 85) in order to maintain proper static pressure.

Fail-safe operation

This application's reaction to a safety will depend upon what is failing.

When the supply air temperature sensor fails, the outdoor air damper and the cooling valve will remain at their last commanded position. Static pressure control will be unaffected by a failure of the supply air temperature point.

When the static pressure sensor fails, the application will be sent into the unoccupied mode.

This application has the option of using DI 6 as a general purpose safety (such as, smoke, low temperature, dirty filter, etc.). When DI 6 is being used as a safety, and is closed, the application will be sent into Shutdown mode. When not used as a safety, DI 6 is a spare point available for other uses.

Application Notes

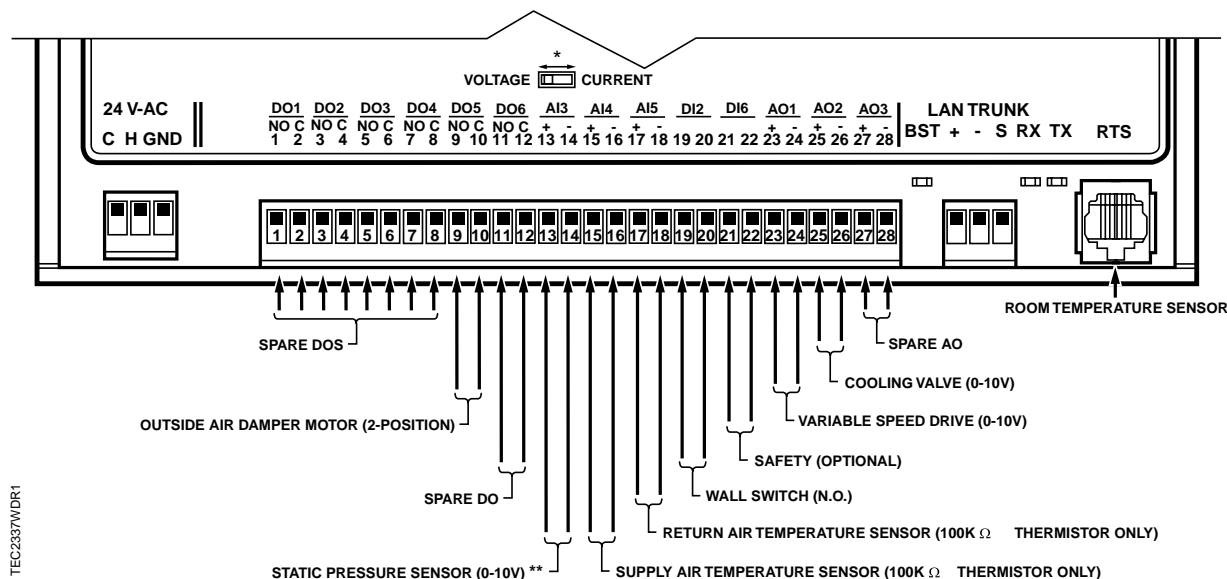
1. If the temperature swings in the supply duct are excessive or if there is trouble maintaining the CLG SAT STPT (number 03), then the discharge temperature loop needs to be tuned. If the point STATIC PRES (number 15) is oscillating while the point SP STP (number 05) is held constant, then the static pressure loop requires tuning. 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 *Start-up* document for this controller 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.

Wiring diagrams

The point wiring for Application 2337 is shown in Figure 5.

**CAUTION:**

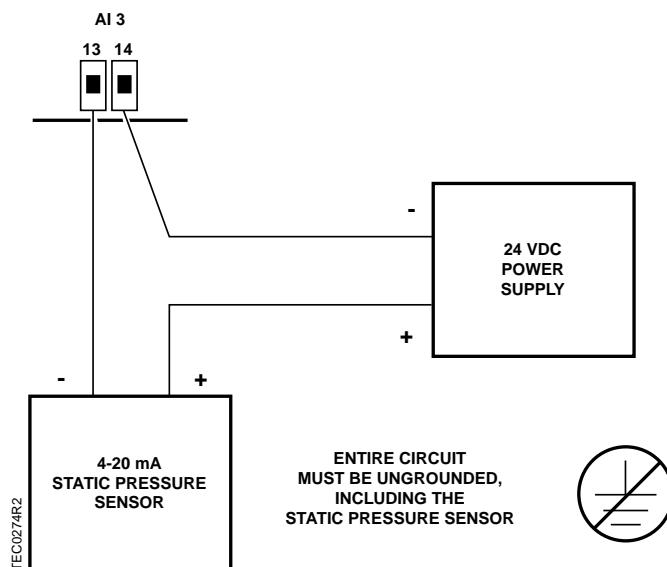
The VAV with Static Pressure Controller's Digital Outputs (DOs) control 24 Vac loads only. The maximum rating is 12 VA for each DO. For higher VA requirements, 110 or 220 Vac requirements, or DC power requirements, use an interposing 220 V 4-relay module.



* If AI 3 monitors a 0-10 volt sensor, then dip-switch located behind AI 3 on controller's circuit board (under controller assembly's cover) must be set to the left (voltage position). If AI 3 monitors a 4-20 mA sensor, this dip-switch must be set to right (current position).

** A 4-20 mA static pressure sensor, if used, requires special wiring requirements. Refer to Figure 6.

Figure 5. Wiring diagram for application 2337.



NOTE: Each 4-20 mA sensor requires a dedicated 24V DC power supply.

Figure 6. Point Wiring for AI 3 if 4-20 mA sensor is used.

Table 2337-1. Point Database for Application 2337.

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	2299	--	1	0	--	--
{03}	CLG SAT STP	74.0 (23.496)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
{04}	ROOM TEMP	74.0 (23.45)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
{05}	SP STP	1.0	INCHES	0.001	0.0	--	--
{13}	RM STPT DIAL	74.0 (23.45)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
14	STPT DIAL	NO	--	--	--	YES	NO
{15}	STATIC PRES	0.0	INCHES	0.001	0.0	--	--
{16}	SUPPLY TEMP	74.0 (23.496)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
{17}	RETURN TEMP	74.0 (23.496)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
18	WALL SWITCH	NO	--	--	--	YES	NO
{19}	DI OVRD SW	OFF	--	--	--	ON	OFF
20	OVRD TIME	1	HRS	1	0	--	--
{21}	UNOCC OVRD	OCC	--	--	--	UNOCC	OCC
{24}	DI 2	OFF	--	--	--	ON	OFF
{26}	DI 6	OFF	--	--	--	ON	OFF
{29}	OCC.UNOCC	OCC	--	--	--	UNOCC	OCC
31	AOV1 SPAN	10.0	VOLTS	0.01	0.0	--	--
32	AOV1 START	0.0	VOLTS	0.01	0.0	--	--
33	AOV2 SPAN	10.0	VOLTS	0.01	0.0	--	--
34	AOV2 START	0.0	VOLTS	0.01	0.0	--	--
35	AOV3 SPAN	10.0	VOLTS	0.01	0.0	--	--
36	AOV3 START	0.0	VOLTS	0.01	0.0	--	--
37	AO DIR.REV	0	--	1	0	--	--
{38}	AOV1	0.0	VOLTS	0.01	0.0	--	--
{39}	AOV2	0.0	VOLTS	0.01	0.0	--	--
{40}	AOV3	0.0	VOLTS	0.01	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}	OA DMPR DO5	OFF	--	--	--	ON	OFF
{46}	DO 6	OFF	--	--	--	ON	OFF
59	DO DIR.REV	0	--	1	0	--	--
60	CLG P GAIN	5.0	--	0.25	0.0	--	--
61	CLG I GAIN	0.01	--	0.001	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.

Table 2337-1. Point Database for Application 2337.

Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
62	CLG D GAIN	0	--	2	0	--	--
63	CLG BIAS	0.0	PCT	0.1	0.0	--	--
64	SP P GAIN	0.0	--	0.25	0.0	--	--
65	SP I GAIN	0.01	--	0.001	0.0	--	--
66	SP D GAIN	0	--	2	0	--	--
67	SP BIAS	0.0	PCT	0.1	0.0	--	--
{78}	CTL TEMP	74.0 (23.45)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
{79}	SA CLO	0.0	--	0.1	0.0	--	--
{80}	SP LOOPOUT	0.0	--	0.1	0.0	--	--
{84}	CLG VALVE	0.0	--	0.1	0.0	--	--
{85}	VSD	0.0	--	0.1	0.0	--	--
{86}	MODE	0	--	1	0	--	--
{87}	WARM UP	OFF	--	--	--	ON	OFF
88	DI6 SAFETY	NO	--	--	--	YES	NO
89	OVERRIDE	NO	--	--	--	YES	NO
90	SWITCH DBAND	2.0 (1.12)	DEG F (DEG C)	0.25 (0.14)	0.0	--	--
{92}	CTL STPT	74.0 (23.45)	DEG F (DEG C)	0.25 (0.14)	48.0(8.89)	--	--
97	SP RANGE	2.5	INCHES	0.02	0.0	--	--
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.