

TEC Custom Solutions Application 2330 Constant Volume — Pneumatic Output with 1-10V Flow Signal

TEC 0204.08

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Overview

In Application 2330, the controller provides a constant volume of air to the space while it is occupied, and a different constant volume of air when it is unoccupied. A 1 to 10V AO is used to send a signal out to other controllers indicating current airflow. Refer to Figures 2330-1 and 2330-2.

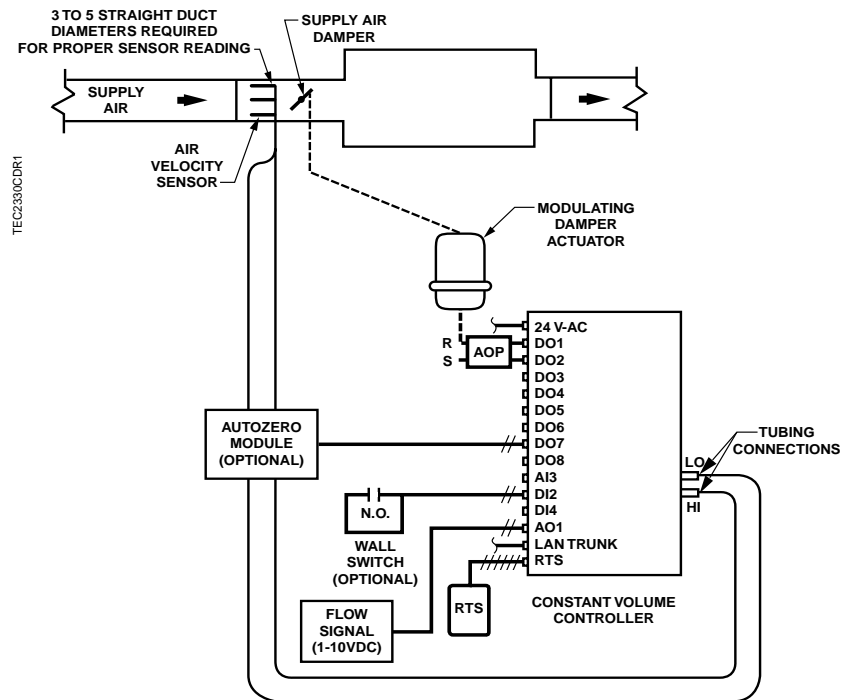


Figure 2330-1. Application 2330 Control Drawing.

CONTROL SCHEDULE		
ROOM TEMPERATURE	°F (°C)	°F (°C)
MAXIMUM AIR OCCUPIED		
SUPPLY AIR		
UNOCCUPIED MINIMUM AIR		

Figure 2330-2. Application 2330 Control Schedule.

Hardware Inputs

Analog

- Air Velocity Sensor
- Room Temperature Sensor
- Room Temperature Set Point Dial (optional)

Digital

- Night Mode Override (optional)
- Wall Switch (optional)

Hardware Outputs

Analog

- 1 to 10V flow signal

Digital

- Pneumatic Damper Actuator

Ordering Notes

Constant Volume Controller – Pneumatic Output with 1 to 10V Flow Signal:

- Controller only: 540-839
- Assembly: 540-560

Custom Solution number 220.

Sequence of Operation

The following paragraphs present the sequence of operation for Application 2330, “Constant Volume — Pneumatic Output with 1 to 10V Flow Signal.”

Occupied and Unoccupied Modes

The occupied/unoccupied status of the space is determined by the status of OCC.UNOCC (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 DI2 (Figures 2330-1 and 2330-3), and WALL SWITCH (Point 18) equals YES, the controller monitors the status of DI2. When the status of DI2 (Point 24) is ON (the switch is closed), then OCC.UNOCC is set to OCC, indicating that the controller is in occupied mode. When the status of DI2 is OFF (the switch is open), then OCC.UNOCC is set to UNOCC, indicating that the controller is in unoccupied mode.

When WALL SWITCH equals NO, the controller does not monitor the status of the 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 occupied 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 the point OCC.UNOCC. Refer to *Powers Process Control Language (PPCL) User's Manual* (125-1896) and *Field Panel User's Manual* (125-1895) for more information.

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 occupied operational mode for the amount of time that is set in OVRD TIME. The status of UNOCC OVRD (Point 21) changes to OCC. After the override time elapses, the controller returns to unoccupied mode and the status of UNOCC OVRD changes back to UNOCC.

It is only when the controller is in unoccupied mode that the override switch on the room temperature sensor has any effect on the controller.

Control Loops

The flow loop maintains FLOW STPT (Point 93) by modulating the supply air damper point, FLOW LOOPOUT (Point 81). The flow loop maintains the airflow at either OCC FLOW (Point 32) or UNOCC FLOW (Point 31), depending on the value of OCC.UNOCC (Point 29).

FLOW (Point 75) is the input value for the flow loop. It is calculated as a percentage based on where AIR VOLUME (Point 35) is between 0 CFM (LPS) and OCC FLOW. In the following text, this percentage is referred to as % flow.

- If AIR VOLUME equals 0 CFM (LPS), then FLOW is 0% flow.
- If AIR VOLUME equals OCC FLOW, then FLOW is 100% flow.

The FLOW STPT percentage that corresponds to UNOCC FLOW is calculated as:

$$(\text{UNOCC FLOW} \div \text{OCC FLOW}) \times 100\% \text{ flow.}$$

For example, if UNOCC FLOW equals 250 CFM, and if OCC FLOW equals 1000 CFM, then, in unoccupied mode, $\text{FLOW STPT} = (250 \text{ CFM} \div 1000 \text{ CFM}) \times 100\% \text{ flow} = 0.25 \times 100\% \text{ flow} = 25\% \text{ flow}$.

Since 25% of 1000 CFM equals 250 CFM, the flow is controlled to 250 CFM in unoccupied mode.

UNOCC FLOW can be set less than or equal to, but not greater than OCC FLOW.

Flow Signal

The AO provides a 1 to 10V signal indicating the flow.

- When the flow is at the value of FLOW RANGE (Point 16), the output is 10V.
- When the flow is at 0 CFM, the output is 1V.
- When the flow is failed, the output is 0V.

Pneumatic Output Module

The controller uses a Pneumatic Output Module to modulate the control air pressure. The module does this by adding air to the control line using a supply solenoid, or removing air from the control line using a bleed solenoid. This is accomplished by commanding the appropriate loop output.

When a flow loopout is a positive number, the supply solenoid opens. When it is a negative number, the bleed solenoid opens. The amount of time that the solenoid is open is determined by the value of the flow loopout. The greater the value, the longer the time the solenoid is open. Consider these examples:

- A value of 100 means that the supply solenoid is open for the full period of the loop time.
- A value of -100 means that the bleed solenoid is open for the full period of the loop time.
- A value of 50 means that the supply solenoid is open for one-half of the period of the loop time.
- A value of zero means that both solenoids are closed.

Calibration

Calibration of the controller's internal air velocity transducer is periodically required to maintain accurate air velocity readings. CAL SETUP (Point 95) is set with the desired calibration option during controller start-up. Depending upon the value of CAL SETUP, calibration may be set to take place automatically or manually. If the status of CAL AIR (Point 94) is YES, then calibration is in progress.

- For a controller used without an Autozero Module (CAL MODULE (Point 87) = NO), the damper is commanded closed to get a zero airflow reading during calibration.
- For a controller used with an Autozero Module (CAL MODULE = YES), calibration occurs without closing the damper.

NOTE: The first time after start-up or initialization, the controller calibrates the dampers as if not using an Autozero Module, although the Autozero Module will be activated. All subsequent calibrations use the Autozero Module only.

At the end of a calibration sequence, CAL AIR returns to NO automatically. A status of NO indicates that the controller is not in a calibration sequence.

The Autozero Module is enabled when it is wired to DO 7 and CAL MODULE (Point 87) is set to YES.

Fail-Safe Operation

If the air velocity sensor fails, then the controller determines the status of FAIL MODE (Point 40) and positions the damper accordingly. If FAIL MODE equals OPEN and the air velocity sensor fails, then the damper opens. If FAIL MODE equals CLOSED (the default) and the air velocity sensor fails, then the damper closes.

If the room temperature sensor fails, then the controller holds the last known temperature value. In this application, the room temperature is not controlled, it is for monitoring purposes only.

Application Notes

1. If FLOW (Point 75) is oscillating while FLOW STPT (Point 93) is constant, then the flow loop requires tuning. Refer to *APOGEE Automation Service Procedures* on InfoLink for troubleshooting information.
2. The Constant Volume Controller – Pneumatic Output with 1 to 10V Flow Signal, 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.

Wiring Diagram



CAUTION:

The 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 220V 4-relay module.

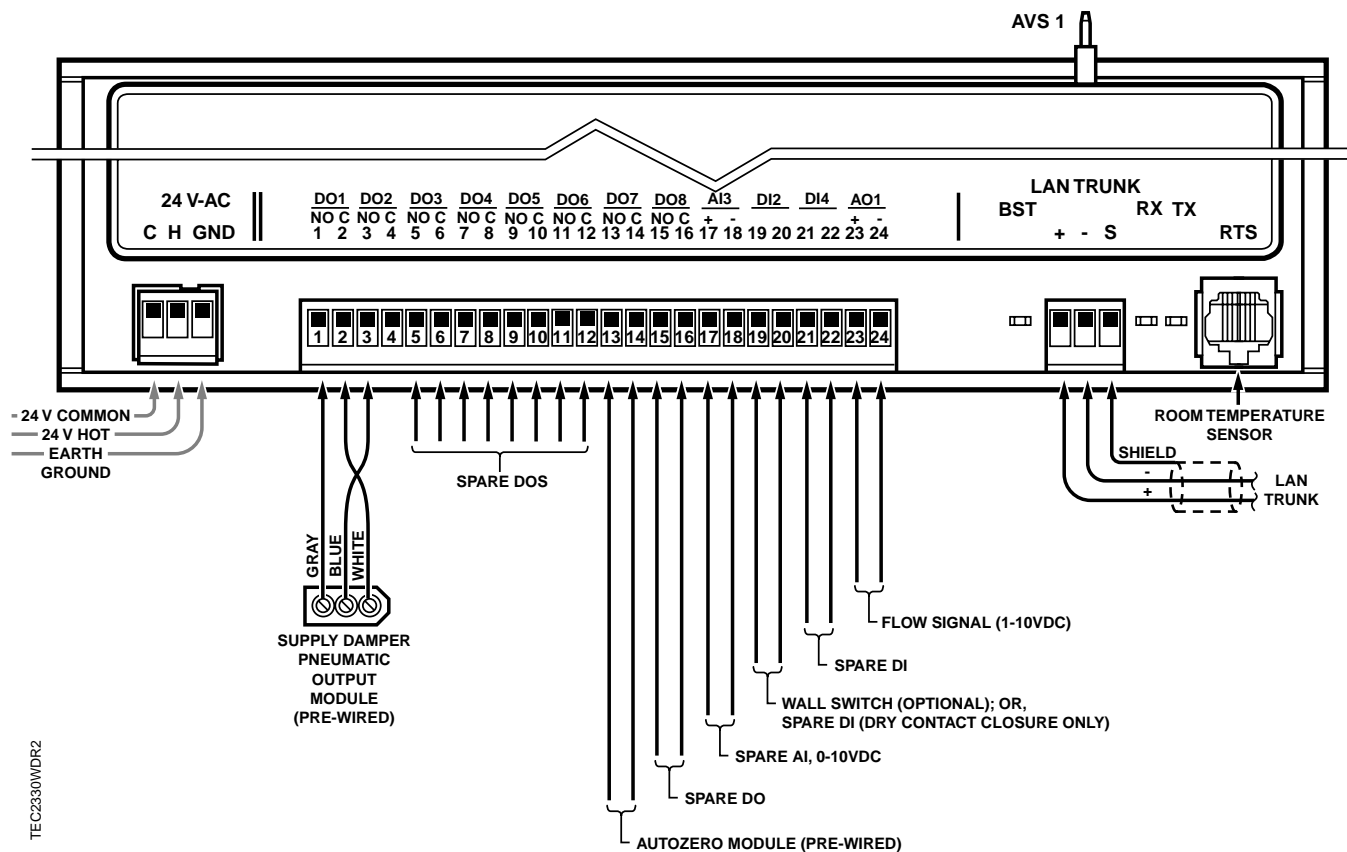


Figure 2330-3. Application 2330 Wiring Diagram.

Point Database

Table 2330-1. Point Database for Application 2330.

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	2295	--	1	0	--	--
{04}	ROOM TEMP	74.00 (23.44888)	DEG F (DEG C)	0.25 (0.14)	48 (8.88888)	--	--
{15}	AI3 0.10V	0.00	VOLTS	0.04	0	--	--
16	FLOW RANGE	2200 (1038.1800)	CFM (LPS)	4 (1.8876)	0	--	--
18	WALL SWITCH	NO	--	--	--	YES	NO
{19}	DI OVRD SW	OFF	--	--	--	ON	OFF
20	OVRD TIME	1	HRS	1	0	--	--
{21}	UNOCC OVRD	UNOCC	--	--	--	UNOCC	OCC
{24}	DI2	OFF	--	--	--	ON	OFF
{26}	DI4	OFF	--	--	--	ON	OFF
{29}	OCC.UNOCC	OCC	--	--	--	UNOCC	OCC
31	UNOCC FLOW	220 (103.8180)	CFM (LPS)	4 (1.8876)	0	--	--
32	OCC FLOW	2200 (1038.1800)	CFM (LPS)	4 (1.8876)	0	--	--
{35}	AIR VOLUME	0 (0.0000)	CFM (LPS)	4 (1.8876)	0	--	--
36	FLOW COEFF	1.00	--	0.01	0	--	--
37	AO DIR.REV	0	--	1	0	--	--
{38}	AOV1	0.00	VOLTS	0.01	0	--	--
40	FAIL MODE	OPEN	--	--	--	CLOSED	OPEN
{41}	VOL SUP DO1	CLOSED	--	--	--	OPEN	CLOSED
{42}	VOL BLD DO2	OPEN	--	--	--	CLOSED	OPEN
{43}	DO3	OFF	--	--	--	ON	OFF
{44}	DO4	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 2330-1. Point Database for Application 2330.

Point Number	Descriptor	Factory Default (SI Units)	Engr. Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
{45}	DO5	OFF	--	--	--	ON	OFF
{46}	DO6	OFF	--	--	--	ON	OFF
{47}	AUTOZERO DO7	OFF	--	--	--	ON	OFF
{50}	DO8	OFF	--	--	--	ON	OFF
52	AOV1 SPAN	10.00	VOLTS	0.01	0	--	--
53	AOV1 START	0.00	VOLTS	0.01	0	--	--
62	DMPR SETUP	NCLOSE	--	--	--	NCLOSE	NOPEN
71	FLOW P GAIN	1.00	--	0.02	0	--	--
72	FLOW I GAIN	0.0000	--	0.0005	0	--	--
73	FLOW D GAIN	0	--	1	0	--	--
{75}	FLOW	0.00	PCT	0.25	0	--	--
{78}	CTL TEMP	74.00 (23.44888)	DEG F (DEG C)	0.25 (0.14)	48 (8.88888)	--	--
{81}	FLOW LOOPOUT	-100	--	1	-100	--	--
87	CAL MODULE	NO	--	--	--	YES	NO
{89}	PT FAIL COND	NORMAL	--	--	--	ALARM	NORMAL
{93}	FLOW STPT	0.00	PCT	0.25	0	--	--
{94}	CAL AIR	NO	--	--	--	YES	NO
95	CAL SETUP	4	--	1	0	--	--
96	CAL TIMER	12	HRS	1	0	--	--
97	DUCT AREA	1.000 (0.092920)	SQ. FT (SQ M)	0.025 (0.002323)	0	--	--
98	LOOP TIME	1.00	SEC	0.25	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.