

Application 2540: BACnet MS/TP Unit Conditioner – Variable Air Volume Pressure Dependent Cooling or Heating

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Overview

In Application 2540, the controller modulates the supply air damper of the terminal box for cooling and heating. In order for it to work properly, the central air-handling unit must provide cool supply air in the cooling mode and warm supply air in the heating mode. See Figure 2540-1 and Figure 2540-2.

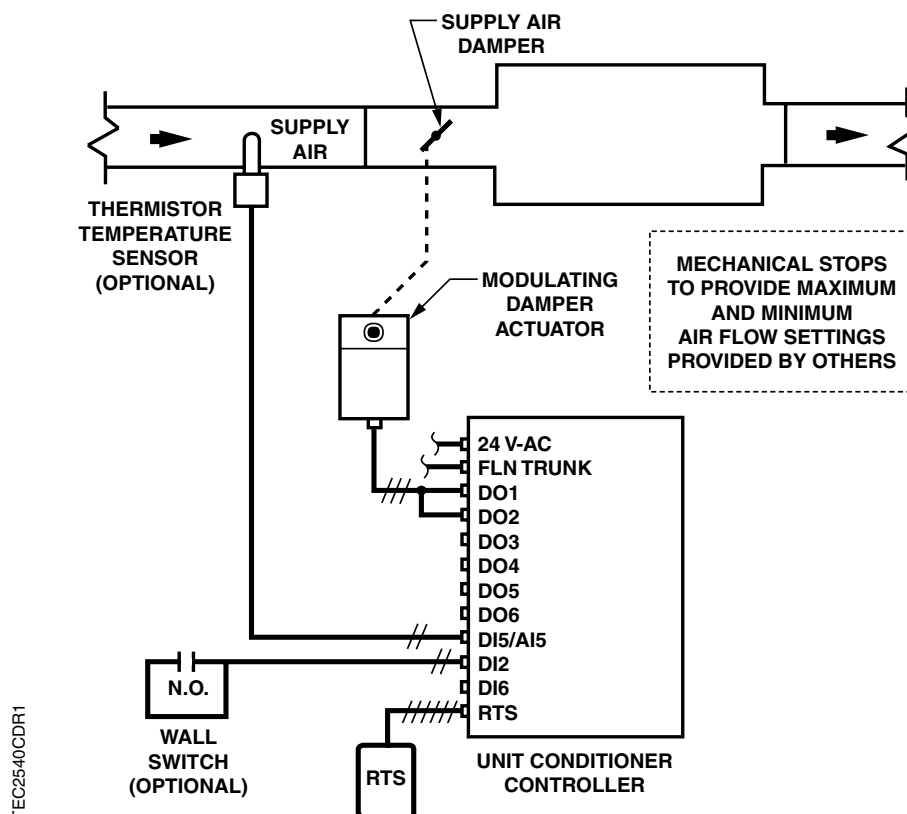


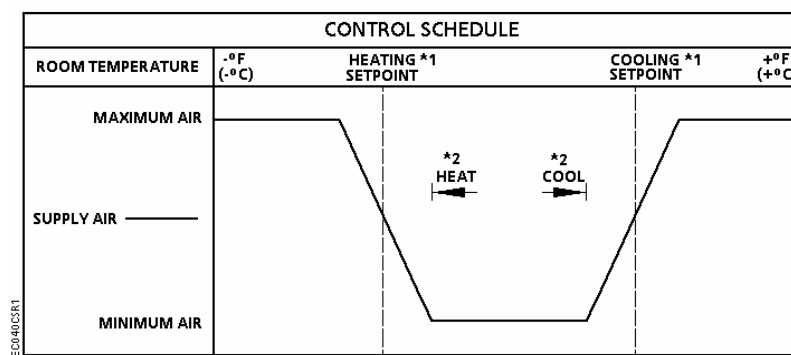
Figure 2540-1. Application 2540 Control Drawing.

BACnet

The BACnet MS/TP Unit Conditioner Controller communicates using BACnet MS/TP protocol for open communications on BACnet MS/TP networks.

Table 2540-1. Supported BIBBs

Product	Supported BIBBs	BIBB Name
BTEC	DS-RP-B	Data Sharing-Read Property-B
	DS-RPM-B	Data Sharing-Read Property Multiple-B
	DS-WP-B	Data Sharing-Write Property-B
	DM-DDB-B	Device Management-Dynamic Device Binding-B
	DM-DOB-B	Device Management-Dynamic Object Binding-B
	DM-DDC-B	Device Management-Device Communication Control-B



1. See *Sequence of Operation, Control Temperature Setpoints*.
2. See *Sequence of Operation, Heating/Cooling Switchover*.

Figure 2540-2. Application 2540 Control Schedule.

Hardware Inputs

Analog

- Duct temperature sensor (optional)
- Room temperature sensor
- Room temperature setpoint dial (optional)

Digital

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

Hardware Outputs

Analog

- None

Digital

- Damper actuator

Ordering Notes

BACnet MS/TP Unit Conditioner Controller

550-789A

See *APOGEE Automation Configuration and Sizing Guidelines* on InfoLink for product numbers.

Damper actuator

Duct temperature sensor (optional)

Terminal Equipment Controller room temperature sensor

Point Database

Table 2540-2 presents the point database information for Application 2540.

Sequence of Operation

The following paragraphs present the sequence of operation for Application 2540, "Variable Air Volume Pressure Dependent Cooling or Heating".

Control Temperature Setpoints

Depending on the controller's current operational mode (day or night), CTL STPT (Point 92) holds the value of one of the following setpoints:

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 setpoint dial and STPT DIAL (Point 14) = YES, CTL STPT holds the value of RM STPT DIAL (Point 13).

If the setpoint dial is used and RM STPT DIAL < RM STPT MIN (Point 11), CTL STPT holds the value of RM STPT MIN. If RM STPT DIAL > RM STPT MAX (Point 12), CTL STPT holds the value of RM STPT MAX.

Night Mode – CTL STPT holds the value of NGT CLG STPT (Point 8) or NGT HTG STPT (Point 9).

Room Temperature Offset

NOTE: The Room Temperature Offset feature is optional.

RMTMP OFFSET (Point 3) is a user-adjustable offset that will compensate for deviations between the value of ROOM TEMP (Point 4) and the actual room temperature. This corrected value is displayed in CTL TEMP (Point 78).

CTL TEMP (Point 78) = ROOM TEMP (Point 4) + RMTMP OFFSET (Point 3)

EXAMPLE: If the actual room temperature is 72.0°F, and the value of ROOM TEMP is 73.0°F, then the value entered into RMTMP OFFSET is -1.0. In this case, the value of ROOM TEMP would read 73.0°F, but the value of CTL TEMP would read 72.0°F.

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 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 DI 2 (Figure 2540-1 and Figure 2540-3), and WALL SWITCH (Point 18) = YES, the controller monitors the status of DI 2. When DI 2 (Point 24) = ON (the switch is closed), DAY.NGT will be set to DAY indicating that the controller is in day mode. When DI 2 = OFF (the switch is open), DAY.NGT will be set to NIGHT indicating that the controller is in night mode.

When WALL SWITCH = NO, the controller does not monitor the status of the wall switch, even if one is connected to it. In this case, the controller is operating stand-alone and stays in day mode all the time. If the controller is operating with centralized control, connected to a field panel, the field panel can send an operator command to override the status of DAY.NGT.

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), pressing the override switch will reset the controller to day mode for the amount of time set in OVRD TIME. The status of NGT OVRD (Point 21) changes to DAY. After the override time elapses, the controller returns to night mode and the status of NGT OVRD changes back to NIGHT.

The override switch on the room temperature sensor will only affect the controller when in night mode.

Heating/Cooling Switchover

There are three options for the heating/cooling switchover for this application. In order for the controller to function properly, one of the following three options must be used:

1. A temperature sensor is installed in the supply air ductwork. The controller uses the measured temperature point, SUPPLY TEMP (Point 15), to determine whether it is in heating or cooling mode.

When $\text{SUPPLY TEMP} < \text{COOL TEMP}$ (Point 61), the controller sets HEAT.COOL (Point 5) to COOL, switching the controller to cooling mode.

When $\text{SUPPLY TEMP} > \text{HEAT TEMP}$ (Point 62), the controller sets HEAT.COOL to HEAT, switching the controller to heating mode.

2. If the controller is connected to a field panel, the field panel can command SUPPLY TEMP.

When SUPPLY TEMP is commanded below the value of COOL TEMP, the controller sets HEAT.COOL to COOL, switching the controller to cooling mode.

When SUPPLY TEMP is commanded above the value of HEAT TEMP, the controller sets HEAT.COOL to HEAT, switching the controller to heating mode.

3. If the controller is connected to a field panel, the field panel can switch the controller between heating and cooling modes by commanding HEAT.COOL to HEAT or COOL.

Control Loops

The BACnet MS/TP Unit Conditioner Controller 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). See *Sequence of Operation, Control Temperature Setpoints*.

Cooling Operation

In cooling mode, the controller uses CTL STPT (Point 92) and CTL TEMP (Point 78) as inputs for the cooling loop. The central air-handling unit must provide cool supply air. The output of the cooling loop is CLG LOOPOUT (Point 79), which modulates the supply air damper, DMPR COMD (Point 48). HTG LOOPOUT (Point 80) is set to 0%.

Heating Operation

In heating mode, the controller uses CTL STPT (Point 92) and CTL TEMP (Point 78) as inputs for the heating loop. The central air-handling unit must provide warm supply air. The output of the heating loop is HTG LOOPOUT (Point 80), which modulates the supply air damper, DMPR COMD (Point 48). CLG LOOPOUT (Point 79) is set to 0%.

Calibration

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

The calibration consists of driving the damper closed, and then resetting the value of DMPR POS (Point 49) to 0. The damper is then released to normal control.

NOTE: If mechanical stops are installed to provide minimum airflow, the damper cannot be correctly calibrated.

Fail-safe Operation

If the room temperature sensor fails or the supply air temperature sensor fails, the controller operates using the last known temperature value.

Application Notes

1. If temperature swings in the room are excessive or there is trouble maintaining the setpoint, the cooling loop, the heating loop, or both need to be tuned. See *iKnow Troubleshooting Tool* for more information.
2. The controller as shipped from the factory keeps all associated equipment OFF. See the Start-up documentation 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. DO 3 and DO 4 or DO 5 and DO 6 may 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 MTR 2 COMD (Point 52) for DO 3 and DO 4 and point MTR 3 COMD (Point 37) for DO 5 and DO 6.

Wiring Diagram

The point wiring for Application 2540 is shown in Figure 2540-3.



CAUTION:

The controller's 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 requirements
- DC power requirements
- Separate transformers used to power the load

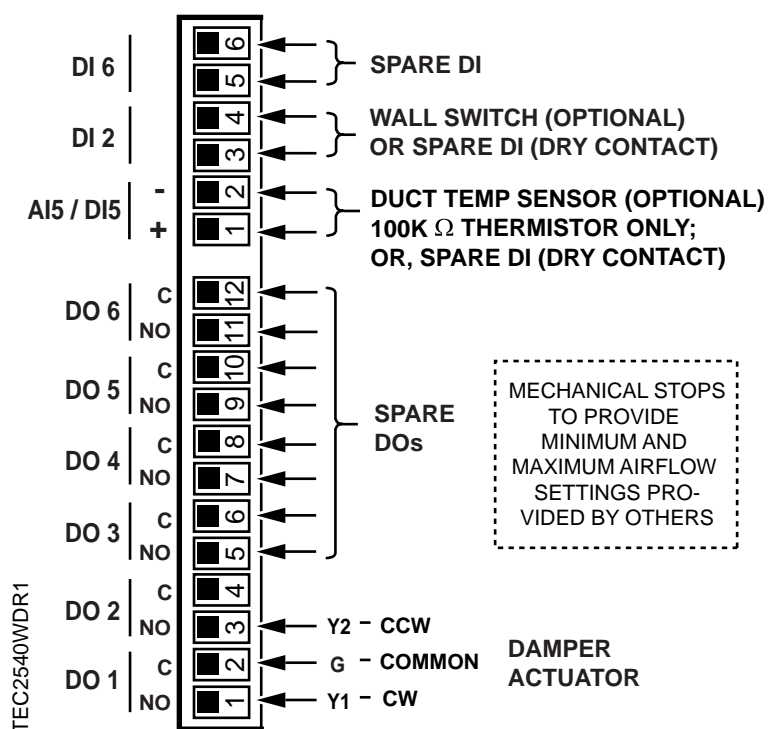


Figure 2540-3. Application 2540 Wiring Diagram.

Point Database

Table 2540-2. Point Database for Application 2540

Object Type ^a	Object Instance (Point Number) ^b	Object Name (Descriptor)	Factory Default (SI Units) ^c	Engr Units (SI Units) ^c	Range	Active Text	Inactive Text
AO	01	CTLR ADDRESS	99	--	0 to 255	--	--
AO	02	APPLICATION	2591	--	0 to 32767	--	--
AO	03	RMTMP OFFSET	0.0 (0.0)	DEG F (DEG C)	-31.75 to 32.0	--	--
AI	{04}	ROOM TEMP	74.0 (23.44888)	DEG F (DEG C)	48.0 to 111.75	--	--
BO	{05}	HEAT.COOL	COOL	--	Binary	HEAT	COOL
AO	06	DAY CLG STPT	74.0 (23.44888)	DEG F (DEG C)	48.0 to 111.75	--	--
AO	07	DAY HTG STPT	70.0 (21.20888)	DEG F (DEG C)	48.0 to 111.75	--	--
AO	08	NGT CLG STPT	82.0 (27.92888)	DEG F (DEG C)	48.0 to 111.75	--	--
AO	09	NGT HTG STPT	65.0 (18.40888)	DEG F (DEG C)	48.0 to 111.75	--	--
BI	{10}	DI 6	OFF	--	Binary	ON	OFF
AO	11	RM STPT MIN	55.0 (12.80888)	DEG F (DEG C)	48.0 to 111.75	--	--
AO	12	RM STPT MAX	90.0 (32.40888)	DEG F (DEG C)	48.0 to 111.75	--	--
AI	{13}	RM STPT DIAL	74.0 (23.44888)	DEG F (DEG C)	48.0 to 111.75	--	--
BO	14	STPT DIAL	NO	--	Binary	YES	NO
AI	{15}	SUPPLY TEMP	74.0 (23.495556)	DEG F (DEG C)	37.5 to 165.0	--	--
BO	18	WALL SWITCH	NO	--	Binary	YES	NO
BI	{19}	DI OVRD SW	OFF	--	Binary	ON	OFF
AO	20	OVRD TIME	0	HRS	0 to 255	--	--
BO	{21}	NGT OVRD	NIGHT	--	Binary	NIGHT	DAY

^a Object Types are; Analog Input (AI), Analog Output (AO), Binary Input (BI) and Binary Output (BO).

^b Points not listed are not used in this application.

^c A single value in a column means that the value is the same in English units and in SI units.

^d Point numbers that appear in brackets { } may be unbundled at the field panel.

Table 2540-2. Point Database for Application 2540

Object Type ^a	Object Instance (Point Number) ^b	Object Name (Descriptor)	Factory Default (SI Units) ^c	Engr Units (SI Units) ^c	Range	Active Text	Inactive Text
BI	{24}	DI 2	OFF	--	Binary	ON	OFF
BO	{29}	DAY.NGT	DAY	--	Binary	NIGHT	DAY
AO	{37}	MTR 3 COMD	0.0	PCT	0.0 to 102.0	--	--
AO	{38}	MTR 3 POS	0.0	PCT	0.0 to 102.0	--	--
AO	39	MTR 3 TIMING	130	SEC	0 to 511	--	--
BO	{41}	DO 1	OFF	--	Binary	ON	OFF
BO	{42}	DO 2	OFF	--	Binary	ON	OFF
BO	{43}	DO 3	OFF	--	Binary	ON	OFF
BO	{44}	DO 4	OFF	--	Binary	ON	OFF
BO	{45}	DO 5	OFF	--	Binary	ON	OFF
BO	{46}	DO 6	OFF	--	Binary	ON	OFF
AO	{48}	DMPR COMD	0.0	PCT	0.0 to 102.0	--	--
AO	{49}	DMPR POS	0.0	PCT	0.0 to 102.0	--	--
AO	51	MTR 1 TIMING	130	SEC	0 to 511	--	--
AO	{52}	MTR 2 COMD	0.0	PCT	0.0 to 102.0	--	--
AO	{53}	MTR 2 POS	0.0	PCT	0.0 to 102.0	--	--
AO	55	MTR 2 TIMING	130	SEC	0 to 511	--	--
AO	56	MTR1 ROT ANG	90	--	0 to 255	--	--
AO	57	MTR2 ROT ANG	90	--	0 to 255	--	--
AO	58	MTR SETUP	0	--	0 to 255	--	--
AO	59	DO DIR. REV	0	--	0 to 255	--	--
AO	61	COOL TEMP	65.0 (18.455556)	DEG F (DEG C)	37.5 to 165.0	--	--
AO	62	HEAT TEMP	80.0 (26.855556)	DEG F (DEG C)	37.5 to 165.0	--	--
AO	63	CLG P GAIN	20.0 (36.0)	--	0.0 to 63.75	--	--
AO	64	CLG I GAIN	0.01 (0.018)	--	0.0 to 1.023	--	--

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Object Type ^a	Object Instance (Point Number) ^b	Object Name (Descriptor)	Factory Default (SI Units) ^c	Engr Units (SI Units) ^c	Range	Active Text	Inactive Text
AO	65	CLG D GAIN	0 (0.0)	--	0 to 510	--	--
AO	66	CLG BIAS	0.0	PCT	0.0 to 102.0	--	--
AO	67	HTG P GAIN	10.0 (18.0)	--	0.0 to 63.75	--	--
AO	68	HTG I GAIN	0.01 (0.018)	--	0.0 to 1.023	--	--
AO	69	HTG D GAIN	0 (0.0)	--	0 to 510	--	--
AO	70	HTG BIAS	0.0	PCT	0.0 to 102.0	--	--
AO	{78}	CTL TEMP	74.0 (23.44888)	DEG F (DEG C)	48.0 to 111.75	--	--
AO	{79}	CLG LOOPOUT	0.0	PCT	0.0 to 102.0	--	--
AO	{80}	HTG LOOPOUT	0.0	PCT	0.0 to 102.0	--	--
AO	{92}	CTL STPT	74.0 (23.44888)	DEG F (DEG C)	48.0 to 111.75	--	--
AO	96	CAL TIMER	12	HRS	0 to 255	--	--
AO	98	LOOP TIME	5	SEC	0 to 255	--	--
AO	{99}	ERROR STATUS	0	--	0 to 255	--	--

a Object Types are; Analog Input (AI), Analog Output (AO), Binary Input (BI) and Binary Output (BO).

b Points not listed are not used in this application.

c A single value in a column means that the value is the same in English units and in SI units.

d Point numbers that appear in brackets { } may be unbundled at the field panel.