SIEMENS

TEC Controller

VAV 0-10V Fan Control with Hot Water Heat

Start-up Procedures

140-1227
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Building Technologies

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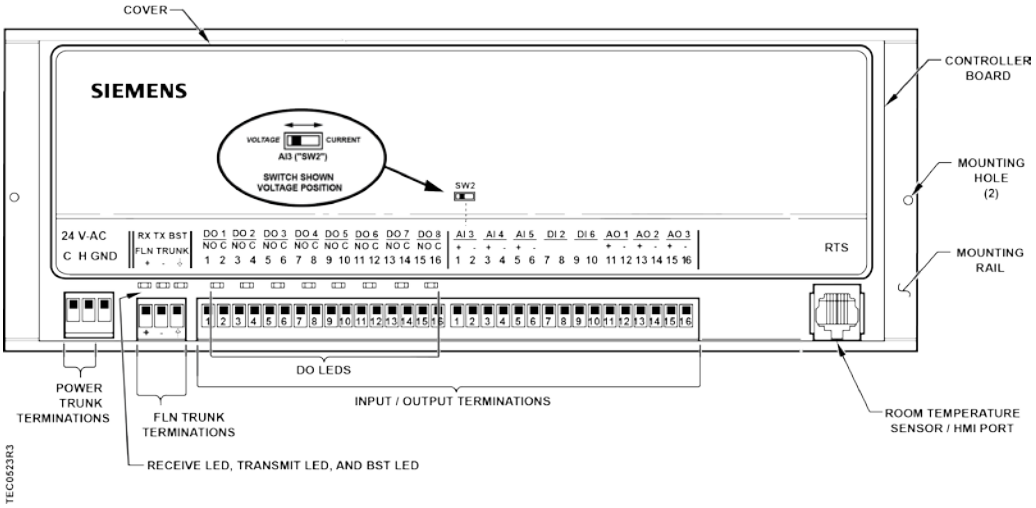
Before You Begin



Generic Controller I/O Layout. See *Wiring Diagram* for application specific details.

Communication and DO Indicators

The TEC VAV 0-10V Fan Control with Hot Water Heat has LEDs to indicate communication (yellow), digital output (DO) status (green) and BST (green).

Controller LEDs.			
LED Type	**Label (if present)***	**LED Number**	**Indication**
DO	DO1 - DO8	1 – 8	Indicates the ON/OFF status of the DO associated with it. A glowing LED indicates that the DO is energized.
Receive	RX	13	Indicates, when flashing, that the controller is receiving information from the field panel.
Transmit	TX	12	Indicates, when flashing, that the controller is transmitting information to the field panel.
BST ”Basic Sanity Test”	BST	7	Indicates, when flashing ON and OFF once per second, that the controller is functioning properly.

* Some LED labels and numerals may be hidden by the controller cover.

Verifying Power to the Controller

Verify that the controller is powered up. Check that the BST LED on the controller is flashing. If the BST LED does not flash ON/OFF once per second, see the *iKnow Troubleshooting Tool* or contact Technical Support for troubleshooting information.

Enabling Actuators

⚠ CAUTION

The controller's DOs control only 24 Vac loads.
The maximum rating is 12 VA for each DO.

The point that determines actuator run times are:

- MTR 1 TIMING
- MTR 2 TIMING
- MTR 3 TIMING

Your application may not have or use all three points.

1. Use the manufacturing datasheet to set run time(s) for the actuator used by your application.
2. For damper rotation angles other than 90°, set ROT ANG to the appropriate value.

Specifying Motor Setup

MTR SETUP determines which actuators are controlled by the application and whether they are direct or reverse acting. Set MTR SETUP according to Table *MTR SETUP Values*.

NOTE:
When MTR SETUP is changed, all enabled actuators calibrate. Wait until each actuator has completed its calibration before continuing.

MTR SETUP Values									
	Motor 1 Enabled			Motor 1 Enabled and Reversed			Motor 1 Not Used		
	Motor 2 Not Used	Motor 2 Enabled	Motor 2 Enabled and Reversed	Motor 2 Not Used	Motor 2 Enabled	Motor 2 Enabled and Reversed	Motor 2 Not Used	Motor 2 Enabled	Motor 2 Enabled and Reversed
Motor 3 Not Used	1	5	13	3	7	15	0	4	12
Motor 3 Enabled	17	21	29	19	23	31	16	20	28
Motor 3 Enabled and Reversed	49	53	61	51	55	63	48	52	60

Setting the Hot Water Valve for Analog Outputs

The application supports configuring one (or both) hot water valve actuator(s) for floating or analog (0-10V) control actuators. The first hot water valve is enable when VALVE COUNT = 1 (or 2) and can be controlled by DO 3 and DO 4 as floating control per above table. The second hot water valve is similarly enabled when VALVE COUNT = 2 and can be controlled by DO 5 and DO 6 as floating control, also per above table.

To configure the hot water valves for analog control use the following steps are required.

First Hot Water Valve for AOV 2

1. Set VALVE COUNT = 1 (or 2).
2. Do not enable Motor 2 in MTR SETUP. (Do not set bits values 4 or 8.)
3. Set MTR2 TIMING to analog valve actuator stroke time.
4. Set AOV 2 CLOSE to the voltage for valve 1 fully closed (command = 0 pct).
5. Set AOV 2 OPEN to the voltage for valve 1 fully open (command = 100 pct). (For example, for a normally open hot water valve AOV 2 CLOSE = 10 volts, and AOV 2 OPEN = 0 volts.)

Second Hot Water Valve

1. Set VALVE COUNT = 2. **Note:** Valve 1 and valve 2 can be independently configured.
2. Do not enable Motor 3 in MTR SETUP. (Do not set bits values 16 or 32.)
3. Set MTR3 TIMING to analog valve actuator stroke time.
4. Set AOV 3 CLOSE to the voltage for valve 2 fully closed (command = 0 pct).
5. Set AOV 3 OPEN to the voltage for valve 2 fully open (command = 100 pct). (For example, for a normally open (8 volt to 2 volt) hot water valve AOV 3 CLOSE = 8 volts, and AOV 2 OPEN = 2 volts.)

The timing configuration allows the HTG VLV1 POS and HTG VLV2 POS to be calculated for either floating or analog control configuration. Furthermore, the position will be updated if AOV 2 or AOV 3 is overridden and will take into account the CLOSE/OPEN configurations.

Verifying Actuator Setup

1. Command all actuators closed. Verify that they close and remain closed. If not, adjust the setting for MTR SETUP according to Table *MTR SETUP Values* for floating control actuators or the CLOSE/OPEN voltage configurations for analog actuators.
2. If any of the actuators still do not close completely, then the actuators have been installed or set up incorrectly. See the TEC VAV 0-10V Fan Control with Hot Water Heat Installation Instructions (540-1037), the iKnow Troubleshooting Tool, or contact Technical Support.

Setting the Application

Add the TEC to your job database and select Application 2236.

AVS Calibration

At the start of the air velocity sensor calibration cycle, the controller sets CAL AIR to YES. The damper is then commanded closed to get a zero airflow reading during calibration.

NOTE:
The calibration cycle takes from 2 to 5 minutes. You must wait until the calibration cycle is complete (CAL AIR is set to NO) before continuing with the rest of the start-up procedures.

Selecting Automatic Calibration Option

1. Using the following table, set CAL SETUP to the value that best meets your job requirements.
2. If appropriate, change CAL TIMER from the default of 12 hours. This setting applies only if your choice for CAL SETUP includes Option 4.

NOTE:
The air velocity sensor should be calibrated at least once every 24 hours. Make sure that the sensor has been calibrated before balancing takes place, as this will affect the balancer's results.

CAL SETUP Options.

CAL SETUP (value)	Description
0	Calibration occurs ONLY when the point CAL AIR is set to **YES**.
1	Calibration occurs when the field panel commands a Day/Night mode changeover. Actual calibration is subject to a time delay of 0, 1, 2, or 3 minutes. This delay is determined by the point CTLR ADDRESS divided by 4. The remainder is the time delay in minutes. **Example:** If CTLR ADDRESS = 11, then the controller will wait 3 minutes (11 ÷ 4 = 2 R3) after it receives the Day/Night mode changeover command before beginning the calibration routine.
2	Calibration occurs immediately after the override switch is pressed.
4 (factory default value)	Calibration occurs on the time interval set in the point CAL TIMER. **Example:** If CAL TIMER = 12, then the calibration period is 12 hours. Actual calibration is subject to a time delay based on the value of CTLR ADDRESS. See the example in Option 1 in this table.

NOTE:
Since these are additive values, options can be combined by summing their numbers. For example, to calibrate in Options 1 and 2, set CAL SETUP to **3**.

Setting Room Temperature Setpoints

NOTE:
For this application, the point names for cooling and heating temperature setpoints are: OCC CLG STPT, OCC HTG STPT, UOC CLG STPT and UOC HTG STPT.

- Day (or OCC) cooling setpoint: DAY CLG STPT or OCC CLG STPT
- Day (or OCC) heating setpoint: DAY HTG STPT or OCC HTG STPT
- Night (or UOC) cooling setpoint: NGT CLG STPT or UOC CLG STPT
- Night (or UOC) heating setpoint: NGT HTG STPT or UOC HTG STPT

1. If the room temperature sensor has a setpoint dial that will be used, set STPT DIAL to **YES**. Otherwise, leave STPT DIAL to **NO**.
   - Set RM STPT MIN and RM STPT MAX for the minimum and maximum allowable room temperature setpoint values, respectively. Valid values range from 55° to 95°F (13° to 35°C). Default values are 55°F (13°C) for RM STPT MIN and 90°F (32°C) for RM STPT MAX.
2. Setpoint dial configured with a heating/cooling deadband (default).
   - To allow the controller to operate with a heating/cooling deadband (functioning the same as provided when the setpoint dial is not present), use the following configuration:
   - Set the DAY HTG STPT less than the DAY CLG STPT by the deadband (or zero energy band) that is desired. (For example, DAY HTG STPT = 70°F; DAY CLG STPT = 74°F, providing a deadband of 4 degrees). Only the difference between these values is used to determine What setpoint will be used.
   - As described below, the setpoint(s) for heating/cooling will be 1/2 of the deadband above or below the setpoint dial value.
   - ⇨ When HEAT.COOL equals HEAT, then:
   - ⇨ CTL STPT will equal RM STPT DIAL – 0.5 * (DAY CLG STPT – DAY HTG STPT) and will be limited by RM STPT MIN and RM STPT MAX.
   - ⇨ When HEAT.COOL equals COOL, then:
   - ⇨ CTL STPT will equal RM STPT DIAL + 0.5 * (DAY CLG STPT – DAY HTG STPT) and will be limited by RM STPT MIN and RM STPT MAX.
     NOTE: A space where the deadband is used can be more energy efficient than a space where the deadband is not being used.

3. Setpoint dial configured for zero heating/cooling deadband.
   - When the job specification requires a common heating and cooling temperature setpoint, use the following configuration:
   - Set DAY HTG STPT equal to DAY CLG STPT. This configures the setpoint deadband equal to zero.
   - If a setpoint deadband equals zero, then:
     CTL STPT equals RM STPT DIAL, and is limited by RM STPT MIN and RM STPT MAX.
     NOTE: A space where the heating/cooling deadband is zero may be more comfortable than a space where the deadband is being used; however, may use more energy.
4. Set the room temperature setpoints to the desired values. Heating setpoints are not present in cooling only applications.

Setting Override Time

If using night/unoccupied override, set OVRD TIME to the number of whole hours that an override should last. If OVRD TIME equals 0 (default), this feature is disabled.

Setting Hot Water Reheat

Check the hardware to verify the number of heating valves used. Set VALVE COUNT to this value. See the *Specify Motor Setpoint* section for more information.

Setting FAN MODE

Set FAN MODE to the desired value, CONST or VARI. (VARI = variable volume; CONST = constant volume.)

Setting Fan Flow Points

1. Set FAN FLO CMAX to the maximum desired value that FAN FLOW should be during the occupied cooling mode. FAN FLO CMAX is also the value of FAN FLOW if FAN MODE equals CONST and the fan is ON.
   If FAN MODE equals VARI, proceed with Step 2 of this section. If FAN MODE equals CONST, and VAVLE COUNT equals 2, skip to step 4. If FAN MODE equals CONST but VAVLE COUNT is less than 2, skip Steps 2 through 4 but read the NOTE at the end of this section, then proceed with the *Setting FAN TIME* section.
2. Enter into FAN FLOW MIN the minimum value that you want FAN FLOW to be during the occupied heating and cooling modes.
3. Enter into FAN FLO HMAX the maximum value that you want FAN FLOW to be during the occupied heating mode.
4. Enter into FAN FLOW MID the CFM value that FAN FLOW must be before the first heating valve may start modulating. (If you do not want either heating valve to modulate until the airflow out of the fan is equal to FAN FLO HMAX, then set FAN FLOW MID equal to or greater than FAN FLO HMAX.)

NOTE:
If FAN MODE = CONST, it is STRONGLY recommended that FAN FLO MID be set equal to or greater than FAN FLO HMAX.

Setting FAN TIME

FAN TIME is used as a speed limit. It means different things under different circumstances.

- When VALVE COUNT equals 1 or when VALVE COUNT equals 2 and FAN FLOW MID is equal to or greater than FAN FLO HMAX, FAN FLOW is not allowed to change from FAN FLOW MIN to FAN FLO HMAX (or vice versa) faster than the length of time set in FAN TIME.
- When VALVE COUNT equals 2 and FAN FLOW MID is less than FAN FLO HMAX, FAN FLOW is not allowed to change from FAN FLOW MIN to FAN FLOW MID (or vice versa) faster than the length of time set in FAN TIME. Also, under these conditions, the same length of time is required for FAN FLOW to change from FAN FLOW MID to FAN FLO HMAX (or vice versa).

Enter the desired value for FAN TIME.

Setting Valve Times

1. Enter into VLV 1 TIME the amount of time the first heating valve must be fully opened before second heating valve may begin to open.
2. Enter into VLV 2 TIME the amount of time the second heating valve must be completely closed before the first heating valve may begin to close.

Setting CLOSE TIME

NOTE:
If FAN MODE equals CONST, then skip this section. If FAN MODE equals VARI, then proceed with this section.

CLOSE TIME affects how the fan is controlled when HEAT.COOL equals HEAT. (It does not effect fan operation during the Cooling mode.)

CLOSE TIME means different things under different circumstances:

- When VALVE COUNT equals 1, the heating valve must be closed longer than CLOSE TIME before FAN FLOW can be set below FAN FLO HMAX
- When VALVE COUNT equals 2 and FAN FLOW MID is equal to or greater than FAN FLO HMAX, both heating valves must be closed longer than CLOSE TIME before FAN FLOW can be set below FAN FLO HMAX
- When VALVE COUNT equals 2 and FAN FLOW MID is less than FAN FLO HMAX:
  - –The second heating valve must be closed longer than CLOSE TIME before FAN FLOW can be set below FAN FLO HMAX.
  - –The first heating valve must be closed longer than CLOSE TIME before FAN FLOW can be set below FAN FLO MID.

Set CLOSE TIME to the desired value (in minutes).

Setting HTG DBAND

Set HTG DBAND to the number of degrees below CTL STPT (UOC HTG STPT) and above TEMP LLIMIT to active the baseboard radiation.

Baseboard radiation (DO 7) will only be active in unoccupied heating modes when CTL TEMP is between TEMP HLIMIT and TEMP LLIMIT.

DO 7 will turn ON when CTL TEMP is less than CTL STPT by HTG DBAND and will turn OFF when CTL TEMP is greater than CTL STPT.

Setting MORN DBAND

Set MORN DBAND to the number of degrees below CTL STPT (OCC HTG STPT) to activate morning warmup (WARMUP).

Morning warmup can only be activated on the transition from unoccupied mode to occupied mode and when the control temperature is less than setpoint by MORN DBAND.

Setting TEMP HLIMIT and TEMP LLIMIT

TEMP HLIMIT

The supply air damper cannot modulate (for cooling) in the unoccupied mode until CTL TEMP rises above TEMP HLIMIT and VAV AHU is set to ON (by the field panel).

- Enter the desired value for TEMP HLIMIT.

TEMP LLIMIT

The hot water heat will not modulate in the unoccupied mode until CTL TEMP drops below TEMP LLIMIT.

- Enter the desired value for TEMP LLIMIT.

Setting the Heat Sequencing Points

When FAN MODE equals CONST, the airflow out of the fan is constant at FAN FLO CMAX.

- If FAN MODE equals CONST, enter the desired value for FLOW END and skip the rest of this section. If FAN MODE equals VARI, continue with the rest of this section.

If this application is configured with only one heating valve (VALVE COUNT equals 1), FAN FLOW will be set equal to FAN FLO HMAX and the heating valve will modulate whenever HTG LOOPOUT is equal to or greater than FLOW END.

NOTE:
While HTG LOOPOUT can be overridden, it will only have an effect if all safety conditions are met. (For example, it must be in heat mode.)

- Enter the desired value for FLOW END and skip the rest of this section. (If you are not sure where to set FLOW END, it is recommended that you set it to 33.)

If the application is configured with two heating valves (VALVE COUNT equals 2), and FAN FLOW MID is set equal to or greater than FAN FLO HMAX, FAN FLOW will be set equal to FAN FLO HMAX (and both reheat valves will modulate) whenever HTG LOOPOUT is equal to or greater than FLOW END.

- Enter the desired value for FLOW END and skip the rest of this section. (If you are not sure where to set FLOW END, it is recommended that you set it to 33.)

If the application is configured with two hot water coils, and FAN FLOW MID is set less than FAN FLO HMAX, then the following four conditions apply:

- When HTG LOOPOUT is equal to FLOW 1 END, FAN FLOW will be set equal to FAN FLOW MID.
- When HTG LOOPOUT is between FLOW 1 END and FLOW 2 START, the first heating valve will modulate.
- When HTG LOOPOUT goes from FLOW 2 START to FLOW END, FAN FLOW will go from FAN FLOW MID to FAN FLO HMAX.
- When HTG LOOPOUT is greater than FLOW END, the second heating valve will modulate.

Set FLOW 1 END, FLOW 2 START, and FLOW END to the desired values. (Leave at default values if you are not sure what value to set them to.)

Setting Box Size

One of the functions of Application 2236 is to determine the proper airflow value for the terminal box's VAV fan.

This value is stored in FAN FLOW. Once a value for FAN FLOW has been determined, a Table Statement embedded in the application's firmware uses it to determine the proper value for FAN AOV1. The application actually contains four such Table Statements, but only one will be used. Selecting the correct Table Statement depends on the value of BOX SIZE.

- BOX SIZE should be set to 3, 5, or 7 when a Nailor box is using a size of 3, 5, or 7. When this is done, the application will use 1 of 3 pre-coded Table Statements with pre-determined FAN AOV1 voltage levels that correspond to airflow values of FAN

FLOW. The voltage and flow values in these pre-coded Table Statements are fixed and cannot be changed by the user.

- BOX SIZE should be set to 0 when a box other than a Nailor box is being used, or when a Nailor Box is using a size other than 3, 5 or 7. When this is done, the application uses an embedded, general purpose Table Statement to adjust the value of FAN AOV1 based on the value of FAN FLOW. The flow and voltage values of this table statement are not pre-coded and must be entered into the controller.

Enter the desired value for BOX SIZE.

If BOX SIZE is set to a value other than 0, READ THE NOTE at the end of this section, then proceed with *Setting Controller Address*.

If BOX SIZE is set to 0, the controller needs to have the following fan AOV Table Statement parameters entered into it:

- FLO LO – This is the lowest flow the fan can produce. (FLO LO must be equal to or less than FAN FLOW MIN.)

⚠ CAUTION

Make sure that FLO LO is high enough that the fan can actually maintain it.

If FLO LO is set too low, the fan could shut off without the application being aware of it. If this happens, there is a possibility that the heat could turn on while the fan is off. Consult with the fan manufacturer to find out what the lowest airflow is that the fan can maintain.

- FLO LO VOLTS – This is the voltage value that FAN AOV1 must have in order to get the fan to produce the amount of airflow that is stored in FLO LO.
- FLO HI – This is the highest flow that the fan can produce. FLO HI must be set greater than or equal to both FAN FLO HMAX and FAN FLO CMAX.
- FLO HI VOLTS – This is the voltage value that FAN AOV1 must have in order to get the fan to produce the amount of airflow that is stored in FLO HI.

Enter the desired values for FLO LO, FLO HI, FLO LO VOLTS and FLO HI VOLTS.

When properly set up, the Table Statement works as follows:

- When FAN FLOW is equal to or less than FLO LO, FAN AOV1 will be set to FAN LO VOLTS.
- When FAN FLOW is equal to or greater than FAN HI, FAN AOV1 will be set to FAN HI VOLTS.
- When FAN FLOW is in between FLO LO and FLO HI, the Table Statement will use linear interpolation to set the value of FAN AOV1 to a value that is between FAN LO VOLTS and FAN HI VOLTS.

NOTE:
Once FAN AOV1 is set to a particular voltage, this signal is sent to an intelligent motor controller that controls the fan and which is provided by others. This controller must be configured to know what airflow corresponds to a given voltage of FAN AOV1. Consult the operating instructions provided by the manufacturer of the intelligent motor controller for proper set-up information.

Setting Controller Address

NOTE:
If you are going to enter a point at the field panel, record the controller address and override time you enter using WCIS. You will be required to enter these values again when adding the controller definition at the field panel.

Set the controller address by setting CTLR ADDRESS to the appropriate number. (Addresses 00 through 98 are valid; 00 through 31 are typically used.)

Update each controller at the field panel immediately after you complete the controller start-up procedures and have made all other changes to the controller's point database (including balancing, tuning, and so on.).

Setting Duct Area

If you do not know the duct area, use the following table:

Area =	Round Duct	Rectangular Duct
Area in Sq. Ft.	(π x R^2)/144 (*Where:* π = 3.14 and R = radius of duct in inches)	Width x Height/144 (in inches)
Area in Sq. M	(π x R^2)/10,000 (*Where:* π = 3.14 and R = radius of duct in centimeters)	Width x Height/10,000 (in centimeters)

Setting Flow Coefficient

1. Set FLOW COEFF to the appropriate value found in the following table. This value is a starting point for the air balancer.
2. To fine tune the flow coefficient use the following formula:
   ⇨ **New Flow Coefficient = (Actual Volume ÷ Controller Volume) × Old Flow Coefficient**
   The actual volume is the actual value obtained from the balancer's measurements. The controller volume is the value obtained from AIR VOLUME.
3. If the controller volume is not within 5% of the actual volume, repeat Steps 1 and 2 until it is within 5%.

Box Manufacturer Flow Coefficients		
Manufacturer	**Sensor Type**	**Value**
Anemostat	2-pipe without orifice 2-pipe with orifice Spider without orifice Spider with orifice	0.79 0.59 0.73 0.39
Carnes	2-pipe Flow cross	0.66 0.59
Carrier		0.59
E.H. Price/Siemens Industry Terminal Boxes		0.78
Environmental Technologies		0.79
Krueger		0.68
Metal Aire		0.72
Nailor Industries		0.69
Titus		0.60
Trane		0.66

Setting MIN and MAX Airflow Setpoints

NOTE:
The maximum flow must be greater than or equal to the minimum flow.

Follow these steps to set the minimum and maximum airflow set points:

1. Set CTL FLOW MIN to the desired minimum airflow setpoint. (This will be used as both the heating and cooling minimum airflow.)
2. Set CLG FLOW MAX to the desired maximum cooling airflow setpoint.
3. Set HTG FLOW MAX to the desired maximum heating airflow setpoint.

Enabling Wall Switch

If a wall switch is used for day/night (occupied/unoccupied) control, enable it by setting WALL SWITCH to **YES**.

Otherwise, leave WALL SWITCH at its default value of **NO**.

Setting FLOW TEMP Alarm Configurations

The alarm point FLOW TEMP provides information that the controller cannot maintain cooling and there is insufficient flow in the occupied mode.

The following conditions and settings are used for this alarm point:

1. Controller is in occupied mode and in COOL mode
2. The supply air flow (FLOW) is less than FLOW STPT by LOW FLOW
   - Set LOW FLOW to the percentage below CLG FLOW MAX
3. The control temperature (CTL TEMP) is greater than CTL STPT
4. These conditions are present for the ALRAM TIME.
   - Set ALRRM TIME to the number of minutes to delay alarm activation.

Start-up Notes

NOTES:
1. Under certain circumstances, how this application controls, depends on whether VAV AHU is ON or OFF. When VAV AHU is ON, the application interprets this to mean that the central air handling unit that this terminal box is connected to is ON. Likewise, when VAV AHU is OFF, the application interprets this to mean that the central air handling unit is OFF.
2. This application only reacts to VAV AHU; it does not command it. In order to command VAV AHU, this point needs to be unbundled at a field panel and PPCL written to control it. (See *Control Loops* in the Application Note for more information on how the application uses VAV AHU.)

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