AMERICAN
AUTO-MATRIX®
A Cylon Energy Inc. Company

CBT12iVAV
User Guide

CBT12iVAV (MAN0113US rev 13)

TRADEMARKS

www.aamatrix.com

Contents

SECTION 1 :   GETTING STARTED

How to use this manual

The **CBT12iVAV** manual provides users with the information needed to install and configure the controller for all the various application specific requirements.

CBT12iVAV

The **CBT12iVAV** is a configurable BACnet MS/TP device designed to be used within a BACnet system to include existing eBuilding systems. The **CBT12iVAV** is designed to control a wide variety of VAV box types used in commercial HVAC installations. The controller comes preloaded with a strategy that will control most VAV applications; however, it is possible to load a custom strategy or to modify the preloaded strategy to meet any application-specific needs.

CBT12iVAV Strategy Version Information

This revision of the **CBT12iVAV** manual applies to **CBT12iVAV Strategy** version 2.4. The box label the **CBT12iVAV** controller is shipped in will have the strategy version printed on the label.

Physical specifications

Size (excluding terminal plugs)	8.3 x 5.12 x 2.36" (210 x 130 x 60 mm)
Enclosure	Injection molded ABS
Mounting	DIN rail
Airflow Sensor Connection	Use rubber hose suitable for a 0.2" (5.1 mm) O.D. nozzle

Certifications

UL

(CDN & US) UL916 Energy Management Equipment - File No. E176435

BTL Listed

Supporting Software

The following software is required to configure the **CBT12iVAV**.

Cylon Engineering Center 6.75 Build 68 or later versions

The **Cylon Engineering Center** is used to configure the controller for installation. Users will be able to set MS/TP addresses, baud rate, and configuration values using this software. Users will also be able to change the strategy and download their changes to the controller.

For commissioning the controller, it is recommended to use **CBT-STAT**.

NetLink version 1.2 or later

NetLink is commissioning software for hand-held computers, available for Cylon Technical Support. **NetLink** software can be used to configure the controller for installation. Like the **Cylon Engineering Center**, users can set the MS/TP address, baud rate and configuration values with this software. Users will need the predefined **NetLink** screens that were developed for use with the preloaded strategy that comes shipped for the **CBT12iVAV**.

Edifice 5.x

Edifice is the configuration software used in an **eBuilding** site. It is used for adding and configuring controllers to a site.

Envoy 5.x

Envoy is the **eBuilding** site supervisor software used for graphical interface to the **eBuilding** site.

Supporting files

The following files are needed for configuring the **CBT12iVAV**. Also available are the **Edifice** template and profile for **eSC**.

CBT12iVAVver2.4Decoder.xlsx

This spreadsheet is used to determine what configuration codes are needed to configure the **CBT12iVAV**. See *Configuring the CBT12iVAV controller* on page 22 for instructions.

Netlink screens

NetLink screens are also used for configuration of the **CBT12iVAV**, and for test and balancing. See *Configuring the CBT12iVAV controller* on page 22 for instructions.

Edifice Template

The Edifice template "`CBT12iVAV_Ver2_0.xml`" is also available which includes a description of all the points. The most commonly used points have been grouped for ease of use.

Profile for eSC

The **CBT12iVAV** v2.4 controllers have added priority array support and functionality. There are now a few points within the v2.4 sequence that support the priority array. As a result of these changes, the profile for these controllers will need to be added to any **eSC** that will be communicating MS/TP to the **CBT12iVAV** v2.4 controllers, and **CEC** 6.75 b68 or later must be used for engineering.

SECTION 2 :   INSTALLATION OVERVIEW

Preparing to install the CBT12iVAV

This section describes how to unpack the unit and how to prepare the site for installation of the **CBT12iVAV**. In order to ensure reliable operation of the controller, the installation site should meet the requirements listed in this section.

Environmental and Electrical Requirements

The controller's immediate environment must meet the following specifications.

Supply Voltage: 24 Vac, 50/60Hz

> **Note:** One side of the 24 volts transformer must be grounded; refer to *Connecting Power to the CBT12iVAV* on page 13 for more information.

Temperature: Operating temperature is 32°... 122°F (0°... 50°C) ambient

Unpacking the CBT12iVAV

The **CBT12iVAV** is shipped in its own box. Multiple **CBT12iVAV** boxes may be packaged together in a larger box. Upon receiving the **CBT12iVAV** controller shipment, immediately open and inspect the contents. Check outside of the box for any physical damage. Contact the shipper immediately to report any shipping-related damage to the product. Cylon is not responsible for damage to the product caused by shipping, either by a Cylon-selected shipper or by a customer-specified shipping company.

Installation of CBT12iVAV

Physical Installation of controller

When installing the **CBT12iVAV** controller you should consider the following:

- Selecting a location with the appropriate clearance.
- Determining the damper shaft diameter.

Note: Shaft diameter must be no larger than 5/8" (15.8 mm).

- Determining the direction of rotation for the damper.
- Accommodating dampers with less than a 90° actuator stroke.
- Mounting controller.

Controller Dimensions and Clearances

The image below shows the mounting dimensions of the controller. Be sure to choose a location for the controller that allows the documented clearance for installation and servicing.
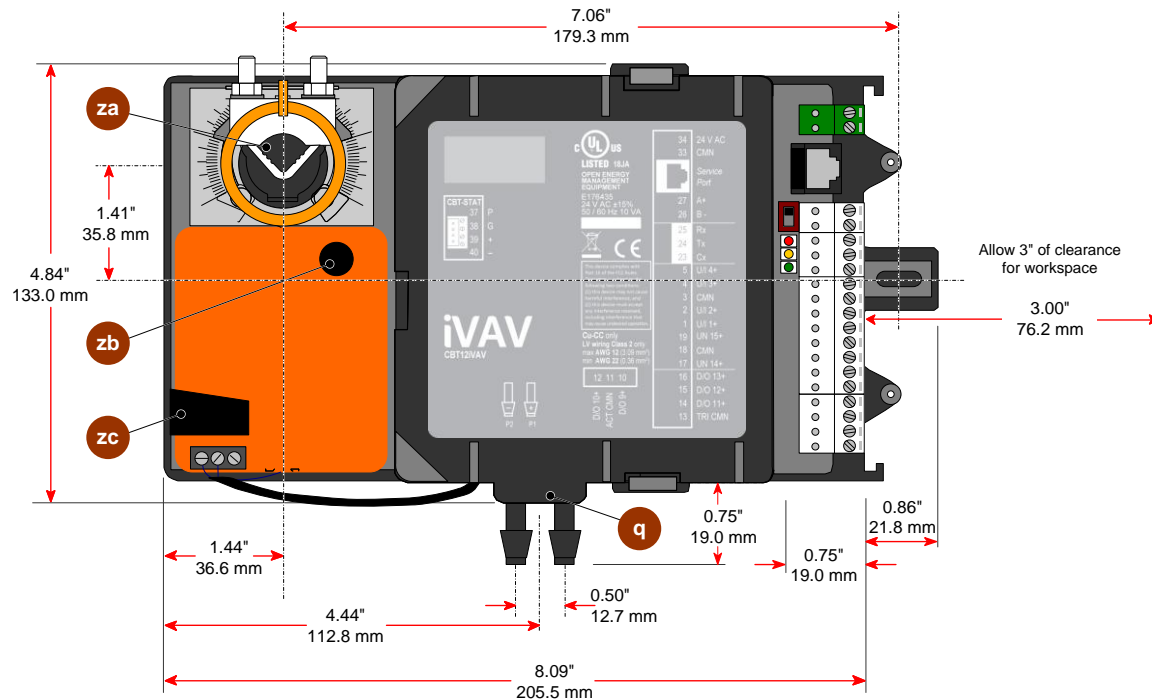
Figure 2.1

Determining Damper Shaft Direction of Rotation

Before mounting the actuator onto the shaft, users will need to determine the direction the shaft rotates in order to open the damper (clockwise/cw or counter-clockwise/ccw). By default the **CBT12iVAV** controller is configured to open the damper in a clockwise/cw rotation. To change the rotation, digital set point DampReverse (D230) R/W will need to be set to on (default off). **Do not use the switch on the Belimo actuator to adjust rotation.**

Mounting controller to VAV box

Use the following steps for mounting the **CBT12iVAV** on the VAV box.

1. The controller is designed for two-point mounting, with one point being the damper shaft. Attach the **CBT12iVAV** to the shaft of the VAV damper by slipping the damper shaft through the round hole containing the "U" mounting bracket.

Note: Do NOT tighten it to the shaft at this time.

2. The controller has a mounting tab to the right side of controller. Ensure that the controller is positioned correctly and is in its final position. When positioned correctly, finish fastening the controller to the VAV box by screwing in the supplied screw through the mounting tab into the VAV box.

3. Before tightening the controller to the damper shaft, rotate the VAV damper blade to the closed position.

4. While pushing in the Damper Manual Override button (located on the front of actuator), rotate the hub to the full closed position.

5. Tighten the "U" mounting bracket to the damper shaft.

6. Using Polyethylene plenum-rated pneumatic tubing (not supplied), connect the airflow sensor on the **CBT12iVAV** to the velocity pickup station on the VAV box. Be sure to connect the "high pressure/P1" side of the **CBT12iVAV** to the "High" or "Total Pressure" connection of the VAV box. The "low pressure/P2" side of the **CBT12iVAV** needs to be connected to the "Low" or "Static Pressure" connection of the VAV box.

Note: An inline filter should be installed between the "high pressure/P1" input and the high pressure of the airflow device.

Accommodating Dampers with Less than a 90° Actuator Stroke

Use the following procedure to set the actuator to accommodate dampers with less than a 90° stroke.

1. If the angle of the damper opening is either 45° or 60°, close the actuator by pushing in the Damper Manual Override button on the front of the actuator.

2. While holding the Damper Manual Override button in, rotate the hub until the damper is fully open.

3. Loosen the range stop screw and set range stop to appropriate position.

4. Tighten range stop screw so that the actuator will no longer be able to rotate beyond the point where range stop was set.

Wiring the CBT12iVAV

Once the box type has been determined, users can then wire the **CBT12iVAV** for the network, the room sensors, and the elements of the VAV box (fan, heating coils, valve, and so forth). This section will go over the various wiring considerations for the **CBT12iVAV**.

Connecting Power to the CBT12iVAV

The **CBT12iVAV** requires 24 Vac +/- 15% at 55 VA (up to 12 VA internal power plus up to 43 VA supplied to Triac loads) maximum supplied from an externally mounted power transformer. One conductor of the 24 volt side of transformer must be grounded to avoid damage to the controller. This conductor will be wired to the CMN (common) of the controller. The wiring diagram is shown below:
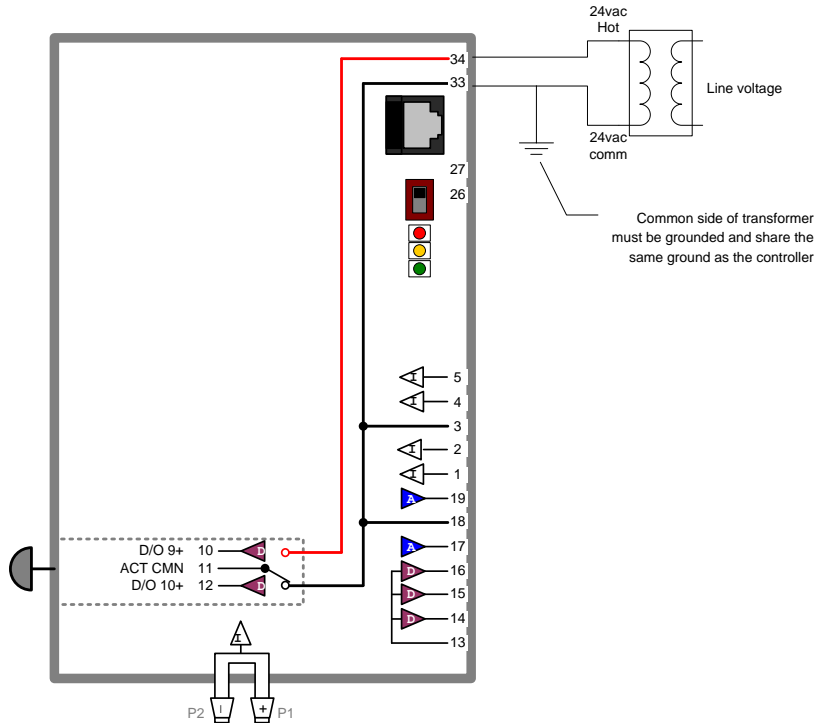
Figure 2.2

Wiring the RS-485 Network

Wiring the RS-485 network involves connecting the A+ and B− terminals in a daisy-chained configuration. One end of the network will be connected to the subnet of the **eSC** or fieldbus of CBR. At the other end of the network, the last device must be "terminated" by either installing a 100 ohm to 120 ohm resistor or, if the last device is a **CBT12iVAV**, users can switch the "Fieldbus Terminator" to on. This will effectively terminate the network. The shield, or drain wire, must be carried through the entire network. If the RS-485 network is wired to an **eSC**, then the shield will be grounded at the **eSC**. If it is wired to a CBR, the shield must be grounded at one point on the network as shown below:
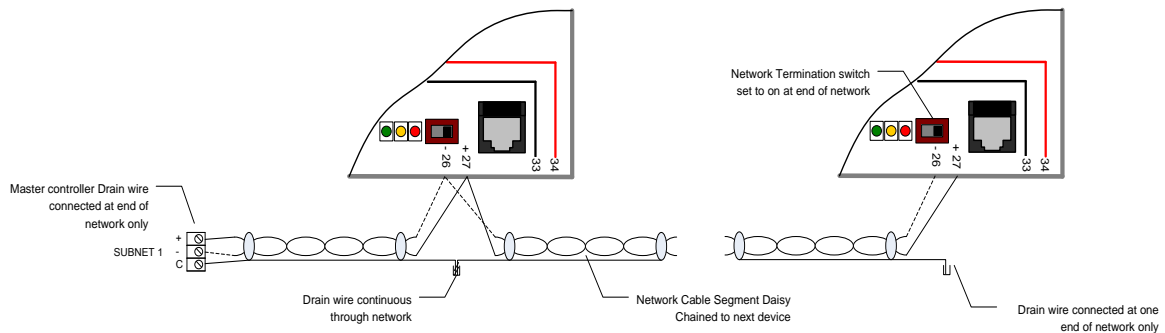
Figure 2.3

Wiring the Universal Inputs

The **CBT12iVAV** comes with 5 universal inputs. U/I-8 is dedicated to the internal air flow sensor. U/I-1 through U/I-4 are used for wiring in room sensors, set point adjust, discharge air sensors, CO_2 sensors, relative humidity sensors, and motion sensors, depending on the application. The sequences for this wide range of applications are available within the preloaded strategy. See *Configuring the CBT12iVAV controller* on page 22 of this manual for selecting the sequence for specific applications.

- **U/I - 1** will typically be where the room temperature sensor is wired. This input is pre-configured to support a 10K Type III thermistor. All room sensors purchased from Cylon Energy are 10K Type III.

Note: Room sensors that short the thermistor for push button occupancy are supported with this controller.

- **U/I – 2** will typically be where the room set point adjust is wired. This input is pre-configured to support a 5K POT. All room sensors purchased from AAM are of this sensor type.

Note: It is possible to fine tune the set point adjust or to change it to support a 10K POT by changing analog setpoints *SliderValAt_xx* (A385 … A389 e.g. SliderValAt_0) R/W to change the resistance table. See *Appendix : List of CBT12iVAV points* on page **Error! Bookmark not defined.** for details on changing these values.

- **U/I – 3** is a dedicated input that has been configured to read a thermistor. In the pre-loaded strategy this input is used for a supply air temperature sensor for auto changeover. See *Primary Air State and Damper Control* on page 43 for more information on this feature.

- **U/I – 4** is configured as a voltage input. This input can be used for wiring in a CO_2 sensor, relative humidity sensor, or a motion sensor (must be a dry contact closure).

Note: For CO_2 or relative humidity sensors it must be a 0…10 Vdc sensor type. To change the span for the CO_2 sensor that is installed, adjust the following:

- UI04CO2SensorBase (A253) Low range of sensor.
- UI04CO2SensorSpan (A254) Total range of senor.

To adjust the span for the relative humidity sensor that is installed, adjust the following:

- UI04SensorBase (A256)   Low range of sensor.
- UI04SensorSpan (A257)   Total range of senor.

IO POINTS	DESCRIPTION
UI-01	Zone Temperature (with optional override button)
UI-02	Setpoint Adjustment (optional 5K slider)
UI-03	Discharge Temperature (optional)
UI-04	CO_2, Humidity, or occupancy signal (all optional)
UI-08	Flowrate Sensor

Note: The **Sensiron** airflow sensor used in the **CBT12iVAV** v2.4 behaves differently from the airflow sensor used in **CBT12iVAV** v1.0. As a result the strategy in the v2.4 controller must be different from the one used in older versions. Please ensure that the correct strategy version is used.

On the **CBT12iVAV** v2.4 this sensor is connected to Point 8, where in v1 it was connected to Point 5 in the controller Strategy. You can determine the version of a specific controller using the product code:

- Code 1M710100 (v1.0): Point 5
- Code 1M710105 (v2.4): Point 8

The product code can be found on the shipping box.

The product serial code will also indicate the point number:

If the second character of the serial number is

- "I" : Point 5 (v1.0)
- "S": Point 8 (v2.4)

The product serial code can be found on the user access area of the board.

Wiring the Room Sensor

The diagram below illustrates the typical room sensor that can be ordered from Cylon Energy. This is a standard room sensor with a space temperature type III thermistor, including a 5K setpoint slide adjust.
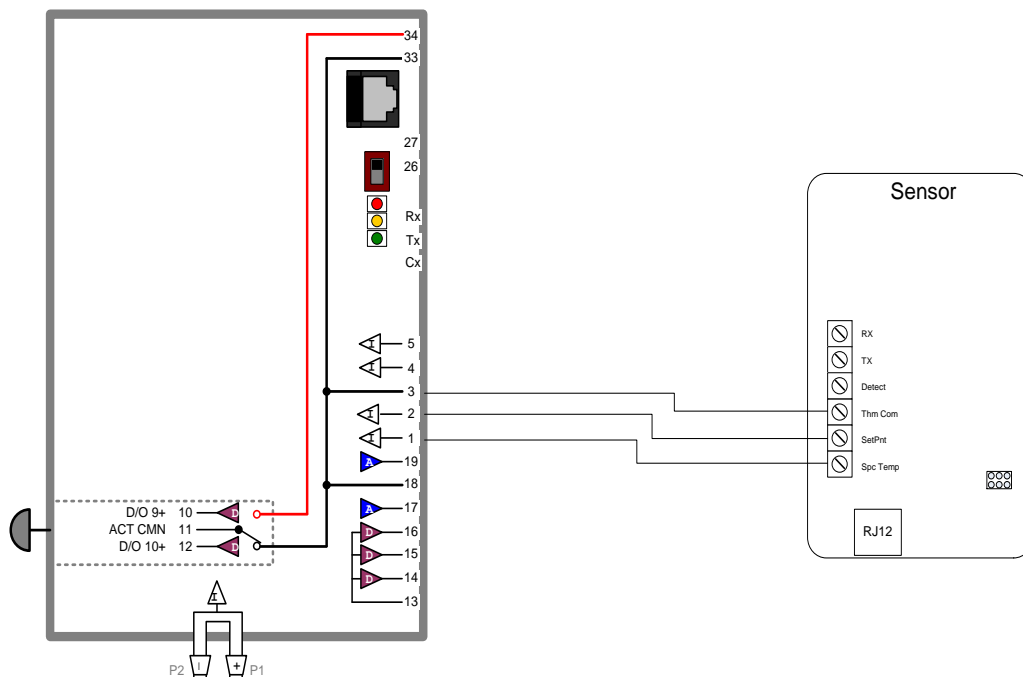
Wiring for Serial Communications through Room Sensor

In addition to the sensor connection illustrated above, the sensor can pass through serial communications connected to its RJ12 port. To pass these comms to the **CBT12iVAV**, the Rx, Tx and Detect ports must be connected in addition to the sensor connections, as illustrated below:
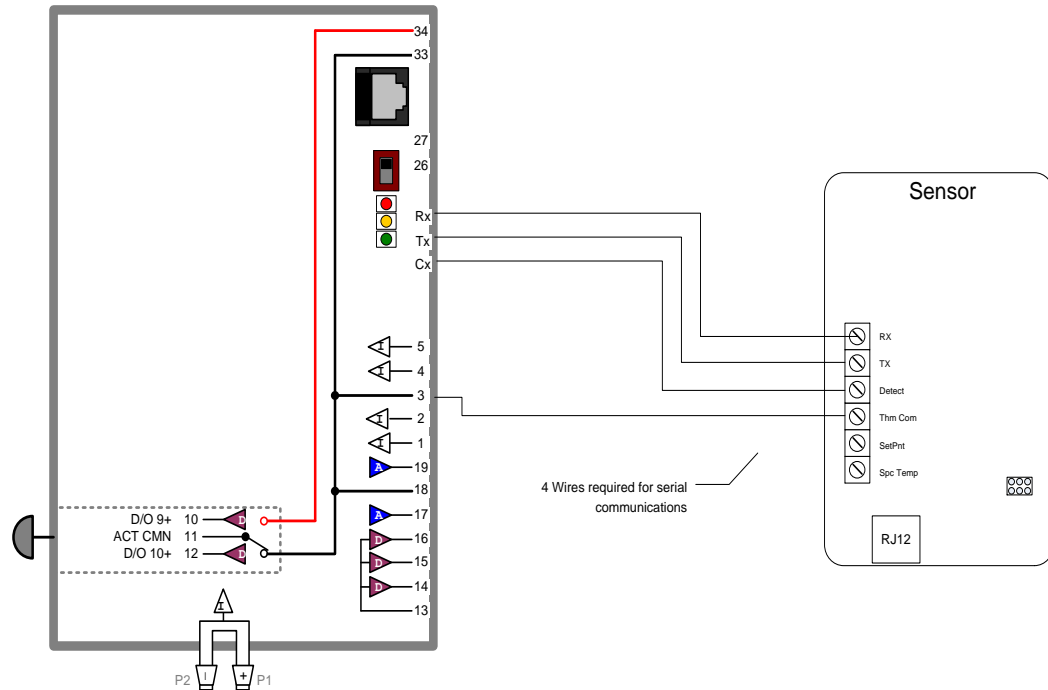
Wiring the Digital and Analog Outputs

The **CBT12iVAV** comes with 2 digital outputs for damper control and 3 digital outputs and 2 analog outputs for controlling a wide variety of possible elements of the VAV box. It is possible to control single speed and variable speed fans (both parallel and series), electric heat (optional pulse width modulation), proportional heating valves, and tri-state heating valves depending on the application.

- **DO-11** can be configured for controlling first stage electric heat (on-off or pulse width modulation optional), or to open a tri-state heating valve.

- **DO-12** can be configured for controlling second stage electric heat (on-off or pulse width modulation optional), or to close a tri-state heating valve.

- **DO-13** can be configured for controlling third stage (on-off or pulse width modulation optional), or to control a single speed fan (series or parallel).

    Note: It is also possible to define DO-13 as a start command for a variable speed fan (series or parallel). Both AO-15 and DO-13 must be configured as either series or parallel for this feature.

- **AO-14** can be configured for controlling any first stage modulating heating valves, SCR (Silicone Controlled Rectifier), or EMC (Electronic Modulating Control) type controls depending on the heating elements of the VAV box.

- **AO-15** can be configured for controlling any second stage modulating heating valves, SCR (Silicone Controlled Rectifier), or EMC (Electronic Modulating Control) type controls depending on the heating elements of the VAV box. This output can also be configured for variable speed fan control (series or parallel).

Note: `AO-14` and `AO-15` are preconfigured as a 0⋯10 Vdc direct acting output. During configuration it is possible to configure either output or both outputs for reverse acting or 10⋯0 Vdc. Either or both of these outputs can also be configured for 2⋯10 Vdc or 10⋯2 Vdc. In **CBT12iVAV** v2.4 controllers the DOs can now be configured for reverse acting.

IO POINTS	DESCRIPTION
DO-09	Damper Open/Close
DO-10	Damper Close/Open
DO-11	1st Stage Electric Heat (optional PWM) or Tri-State Heat Valve Open
DO-12	2nd Stage Electric Heat (optional PWM) or Tri-State Heat Valve Closed
DO-13	3rd Stage Electric Heat (optional PWM) or Fan Command (Series or Parallel)
AO-14	1st Stage Modulating Heat Control
AO-15	2nd Stage Modulating Heat Control or Variable Fan Speed Control (Series or Parallel)

Wiring Digital Outputs

The **CBT12iVAV** can be wired to switch either hot 24 Vac or common. In most applications users will be wiring the digital outputs to switch 24 Vac. **To switch 24 Vac, users must wire an externally sourced 24 Vac hot to TRI CMN (triac common) on the CBT12iVAV, the 24 Vac can be sourced from the same power supply as the VAV, or an external 24 Vac source**. Figure 2.6 below is a typical wiring diagram for controlling a relay by switching 24 Vac.
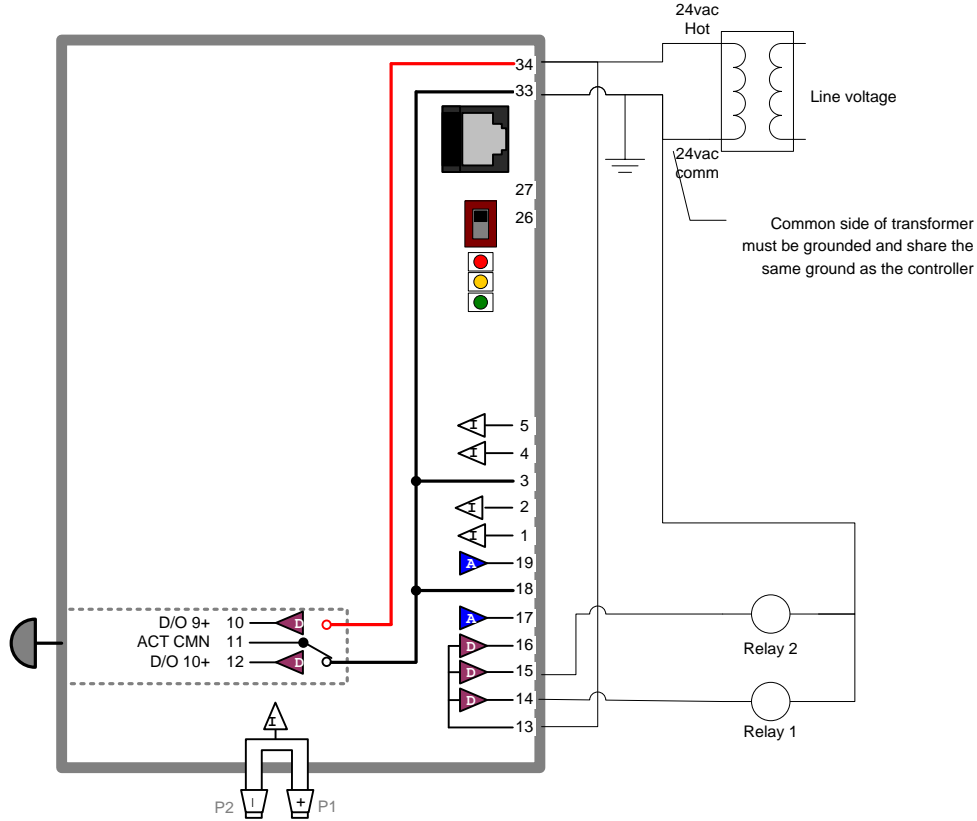

Figure 2.6

Configuring the CBT12iVAV for BACnet communications

The **CBT12iVAV** is shipped with the following default settings:

MS/TP Address:	01
BACnet Instance Number	17101
MS/TP Baud Rate	38,400 bps
Serial to PC Baud Rate	9600 bps

To communicate to other MS/TP devices on a BACnet MS/TP network, the MS/TP address must be set to a unique address within the MS/TP subnet. Where possible, there should be no gaps between MS/TP addresses. The BACnet Instance Number must also be unique for the BACnet site. The MS/TP baud rate must match on all devices on the MS/TP subnet. The PC Baud Rate should be left at the default value of 9600 bps.

For the initial configuration of the device, the controller must first be powered on.

> **Note**: Service Port (serial connection) must not be connected until after the device is powered on.

> **Note:** Ensure the 24 V AC and Common wires are correctly connected to the controller. If the wires are swapped, it may cause damage to anything connected to the controller.

If connecting directly to the **CBT12iVAV**, use a **UC32-PC commissioning cable** by inserting the 9 pin D-Type serial cable into a serial port of the PC on which **NetLink** is installed. Next, insert the RJ-45 connector into the RJ-45 socket on the front of the **CBT12iVAV** controller.

If connecting to the **CBT12iVAV** through a room sensor that has been wired for serial communications, insert the 9 pin D-Type serial cable into a serial port on the PC on which **NetLink** is installed, then insert the RJ-12 connector into the RJ-12 socket on the room sensor.

See *Wiring for Serial Communications through Room Sensor* on page 16 for more detail.

Once connected to the controller, it is possible to change the settings on the controller using the **Cylon Engineering Center** or, preferably, **NetLink**. For details on how to use the **Cylon Engineering Center**, please refer to the *Cylon BACnet Manual (MAN0106)* available from the `support.cylonenergy.com` website. For details on how to use **NetLink**, continue to the section below.

NetLink is available from Cylon Technical Support. Once downloaded, **NetLink** must be installed. Follow the step by step installer and use the default settings where possible.

1. Start **NetLink** from the Start menu or shortcut on your desktop that was created during install.

2. Select Preferences and in the drop-down menu select the COM port that is assigned to serial cable.
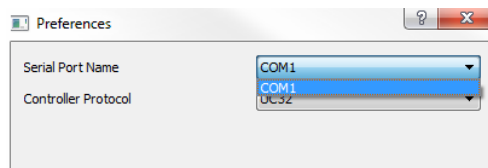
Controller Protocol must be set to "UC32".

3. Click open .
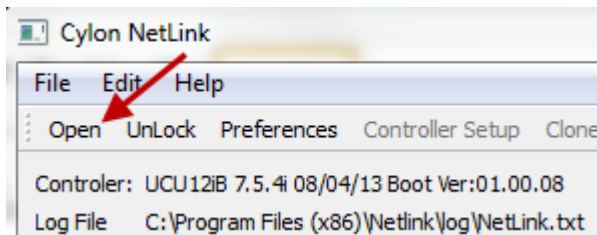
4. Navigate to where the **NetLink** screens are saved and select the "`IO_config.nls`" screen.

5. Click on UnLock and type in the password.
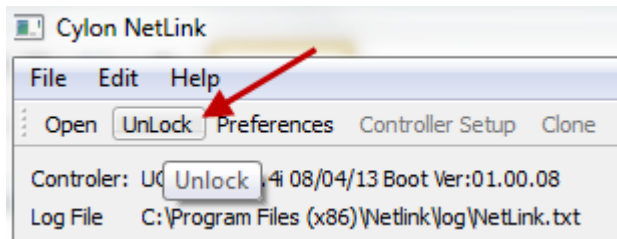
Note: The **NetLink** screens have been configured with a password of "*password*".

5. After unlocking the screens users can now select Controller Setup .
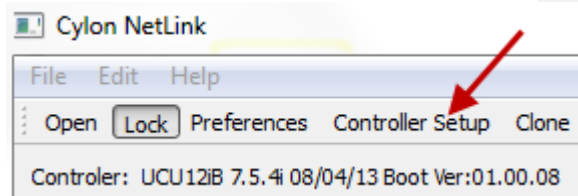
6. After selecting Controller Setup the following BACnet Controller Setup dialog will open:
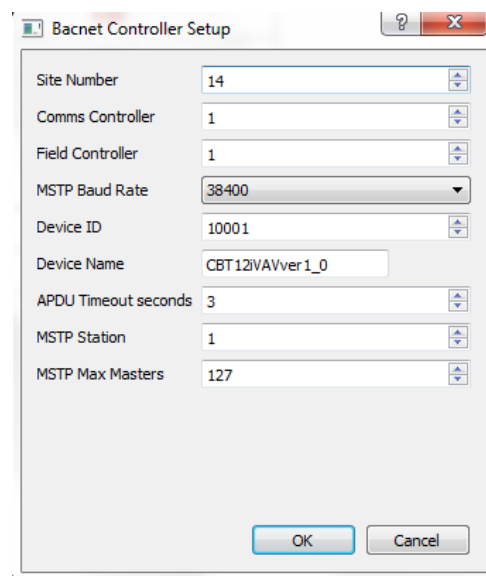
7. From this window the BACnet MS/TP configuration settings can now be configured.

Note: It is not required to change the Site Number or Comms Controller preset values. It is however recommended to match the Field Controller address with the MSTP Station address (see below).

MSTP Baud Rate is the Baud rate at which all the other devices on the subnet (fieldbus) are communicating. All devices **must** be configured for the same baud rate for communications on the subnet.

Device ID is the BACnet device instance number. Every BACnet controller within the site must receive a unique BACnet instance number to ensure proper communications. This BACnet instance number should be unique even across subnets. See the *Cylon BACnet Manual (MAN0106)* for further information.

Device Name is the user assigned name for the controller. This is not necessary for BACnet communications, however, it is useful to name each controller for organizational purposes.

APDU Timeout seconds Leave this at the default setting of 3 seconds.

MSTP Station is the MS/TP device address. This is the unique address users must give each controller on the subnet (fieldbus).

MSTP Max Masters is the maximum address that this controller will poll when in the "poll for masters" state. Because this is a BACnet master device it will go into this state to search for the next BACnet master device to pass the token to. To optimize the speed of the network, it is recommended that the last master device on the subnet be set at the maximum MS/TP address on the network. For example, if the last device on the subnet (fieldbus) is the **CBT12iVAV** at address 63, then users would set the **MSTP Max Masters** to 63. This will speed up communications as it will not go into the "poll for masters" state and immediately pass the token back to the **eSC** or **CBM** at MS/TP address 0.

See the *Cylon BACnet Manual (MAN0106)* for more details regarding this functionality and for other tips on optimizing the BACnet network.

Configuring the CBT12iVAV controller

The **CBT12iVAV** has a pre-loaded strategy that is designed to be highly configurable for a wide variety of VAV sequences. The sequences can be selected by writing a value to the 6 various input and output codes that are within the strategy. There are multiple ways to configure the **CBT12iVAV** for a specific sequence. Users are able to set these configuration values through a serial connection using **NetLink** or the **Cylon Engineering Center**. If the BACnet configuration settings have been configured then users can also set these configuration variables using either Edifice or Envoy. It is recommended that users use **NetLink** for setting these configuration variables.

Setting CBT12iVAV Configuration Codes using Netlink

To start, the "`CBT12iVAVver2.4Decoder.xlsx`" will need to be downloaded from our web site. This spreadsheet will be used to determine the sequence for the **CBT12iVAV** controller. On this spread sheet will be all of the configuration options for the inputs and outputs for the **CBT12iVAV**. There are also other options available for configuration on this spread sheet.

Input codes

By clicking into the field associated with each input users will notice that there are multiple options which can be selected:

- **UI-1** This input is typically going to be either local zone temperature or local zone temperature with push button override. The push button override option is the override button for occupying the VAV while in an unoccupied state. On any room sensors purchased from Cylon Energy this simply "shorts" the thermistor while the button is pushed.

- **UI-2** This input is typically going to be configured for set point slide adjust. This input will support a 5K POT to support room sensors ordered from Cylon Energy. If the room sensor does not have a slide adjust then select none.

- **UI-3** There are no configurable options for this input. If there is a supply air sensor that will be used for determining "Primary Air State" (hot or cold air being supplied to VAV) wire the sensor to this input.

  Note: Under "options" select "Switch Heat/Cool Primary Air State by SAT" to enable this feature. By default this feature is off and Primary Air State is set to cooling or heating from a master controller. See *Primary Air Setpoint Management* on page 50 for further information.

- **UI-4** This input can be configured for a variety of different options.

  - " Local CO2 " is the option to select if there is a CO_2 sensor wired to this input. By selecting this option the sequence will open the damper when CO_2 level gets above LocalCO2Stpt (A255). See *Primary Air Flow Reset CO2* on page 51 for further information.
    - " Remote CO2 " is an option that can be selected to write a CO_2 command from a master controller.

  - Select " Local Dehumid " if there is a relative humidity sensor wired to this input. By selecting this option the sequence will open the damper when the relative humidity level gets above LocalDehumidStpt (A258). See *Primary Air Flow Reset Dehumidification* on page 52 for further information.
    - " Remote Dehumid " is an option that can be selected to write a dehumidification command from a master controller.

  - Select " Local Occ Sensor " if there is a dry contact switch that will close for putting the VAV box in an occupied state. This is typically going to be used for a motion sensor. See *Occupancy State Command* on page 44 for further information.

Output codes

By clicking into the field associated with each output, multiple options can be selected:

- ▪ **DO-11** can be configured for first stage heat on/off control, PWM, or to open a tristate actuator.

- ▪ **DO-12** can be configured for second stage heat on/off control, PWM, or to close a tristate actuator.

- ▪ **DO-13** can be configured for third stage heat on/off control, PWM, parallel constant volume fan, or series single speed fan.

- ▪ **AO-14** can be configured for modulating heat control. By default this will be first stage heat unless otherwise specified under options.

- ▪ **AO-15** can be configured for modulating heat control. By default this will be second stage heat unless otherwise specified under options. This output can also be configured for parallel variable speed fan, or series variable speed fan.

Options

Defining baseboard heat

A variety of different options are available depending on the application. From the drop down box select the appropriate heating output as being baseboard heat. By designating one output as baseboard heat it is then possible to select it as being first stage heat during unoccupied call for heat.

An example of this configuration is `DO-11` could be first stage electric heat in VAV box, `DO-12` can be second stage electric, and `DO-13` could be a thermal valve controlling baseboard heat. During normal occupied operation `DO-13` will be the last stage of heat to come on as the heating demand rises. However, by designating `DO-13` as baseboard heat it is possible to select only baseboard heat during unoccupied mode. This will effectively make this output stage 1 heat during an unoccupied call for heat. This will prevent needing to run the AHU associated with this VAV during an unoccupied call for heat.

Defining AOs and DOs heat stage sequence

With this option it is possible to assign AOs defined as heat to stage before DOs defined as heat. Conversely the DOs can be configured to stage before the AOs. By default this sequence is disabled and both AOs and DOs will stage concurrently.

Defining AOs

By default the AOs are configured as direct acting 0···10 Vdc. However, it is possible to define either/or `AO-14` and `AO-15` as being reverse acting 10···0 Vdc. Depending on the actuator being controlled it's also possible to change the voltage range for 2···10 Vdc or 10···2 Vdc for either AO output.

Now that the input and output codes have been determined, it is possible to use **NetLink** to change the configuration codes within the **CBT12iVAV** controller.

Setting DOs for reverse acting

In the " IO_Config " **NetLink** screen you will find the following points:

- • DO11RevAct (D313)

- • DO13RevAct (D312)
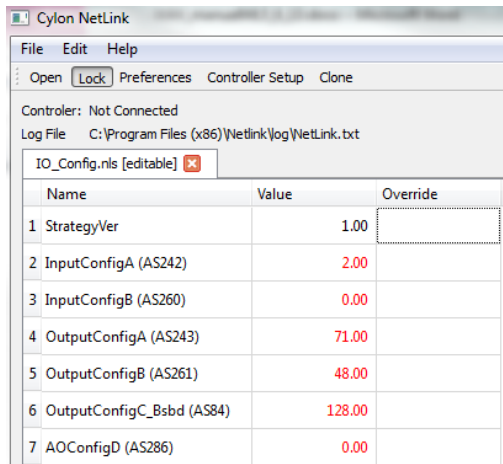
Setting the correct corresponding point(s) to `On` will reverse the action of that DO(s).

Writing the configuration codes to the CBT12iVAV

Connect to the controller using **NetLink**. If not already connected to controller refer to

on page 18. Open the "`IO_config.nls`" screen to be able to write to the various input/output codes.
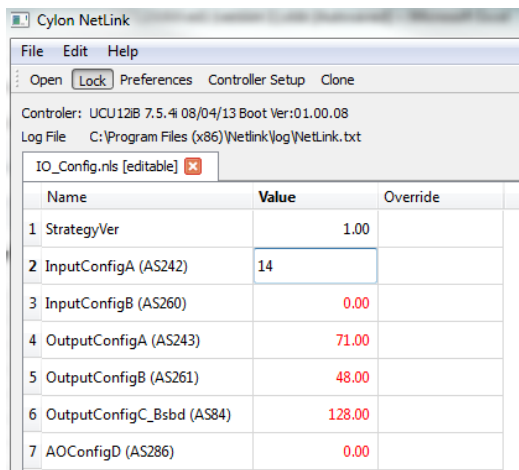
Note: By default, the controller is configured as VAV one stage of heat with parallel fan (`DO-13` single speed and `AO-15` variable speed are both configured as parallel fan). `UI-1` is configured with a room sensor with push button override. When first connecting to the controller using **NetLink**, the following is the configuration values that have been preconfigured at the factory.

The values that are shown in red are values that can be changed and written to. All values that are shown in black are read only.

Having determined what the input and output configuration codes are for the desired specific application using the "`CBT12iVAVver2.4Decoder.xlsx`", those configuration codes will need to be written to the controller. To change the input and output configuration codes simply double click in the appropriate value box and type in the correct code as shown below.

Press enter on the keyboard for the changes to take effect.

After having changed the value it should now be displayed in red.
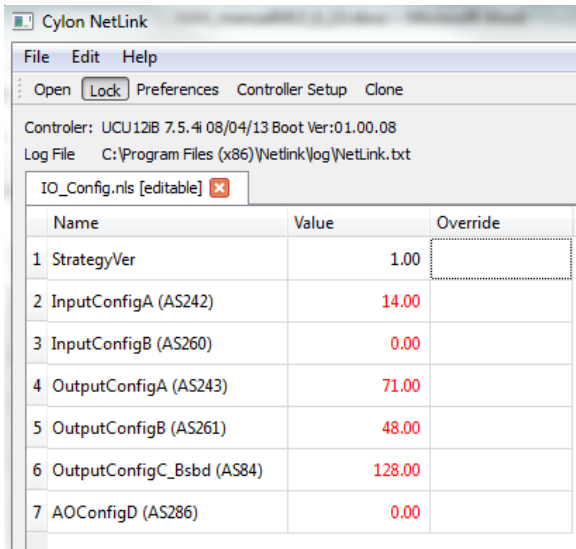
Change the rest of the input and output configuration codes.

Note: The **CBT12iVAV** must be powered for these values to be written to flash. If changing these values through a serial connection using **NetLink** or **Cylon Engineering Center**, it may take up to 10 minutes before the new values are written to flash. If the device is power cycled before this time it could potentially revert back to the default input and output configuration values.

If changing these values utilizing **Edifice**, **Envoy**, or another master controller via BACnet MS/TP, the controller must be powered for 24 hours before the change in value is written to flash.

These conditions apply to any writable analog or binary values within this controller.

SECTION 3 :   CBT12IVAV CONTROL SEQUENCES

CBT12iVAV Control sequences

This section provides details of the typical control sequences used for most VAV applications. The sequences covered in this manual include the following:

- VAV Cooling only No Fan
- VAV Cooling only Single Speed Fan
- VAV Cooling only Variable Speed Fan
- VAV One to Three Stage Electric Reheat No Fan
- VAV One to Two Stage Electric Reheat Single Speed Fan
- VAV One to Three Stage Electric Reheat Variable Speed Fan
- VAV Modulating Hot Water Reheat No Fan
- VAV Modulating Hot Water Reheat Single Speed Fan
- VAV Modulating Hot Water Reheat Variable Speed Fan

Temperature Control

When the zone temperature is greater than, or equal to, the cooling temperature setpoint, the controller will enter the cooling mode. The primary air flow rate will be varied between its TABPriAirDbandStpt (A210), or deadband setpoint, and its maximum Flowrate setpoint TABPriAirMaxStpt (A211) as required to maintain the zone at the cooling temperature setpoint.

When the zone temperature falls to the heating setpoint, the controller will enter the heating mode and the primary air flow rate will be varied between its TabPriAirMinHtgStpt (A153) and its TabPriAirMaxHgtStpt (A212), or maximum heating Flowrate setpoint. Normally on a cooling-only VAV box both the TABPriAirDbandStpt (A210) and the TabPriAirMaxHgtStpt (A212) will be the same to maintain a minimum rate of flow into the space while in the heating mode.

Input / Output Points

VAV Cooling Only, no fan

IO POINTS	DESCRIPTION
UI-01	Zone Temperature (with optional override button)
UI-02	Setpoint Adjustment (optional 5K slider)
UI-03	Discharge Temperature (optional)
UI-04	CO_2, Humidity, or occupancy signal (all optional)
UI-08	Flowrate Sensor
DO-09	Damper Control
DO-10	Damper Control
DO-11	
DO-12	
DO-13	
AO-14	
AO-15	

VAV Cooling only Single Speed Fan

Temperature Control

When the zone temperature is greater than, or equal to, the cooling temperature setpoint, the controller will enter the cooling mode. The primary air flow rate will be varied between its TABPriAirDbandStpt (A210), or deadband setpoint, and its maximum Flowrate setpoint TABPriAirMaxStpt (A211) as required to maintain the zone at the cooling temperature setpoint.

When the zone temperature falls to the heating setpoint, the controller will enter the heating mode and the primary air flow rate will be varied between its TabPriAirMinHtgStpt (A153) and its TabPriAirMaxHgtStpt (A212), or maximum heating Flowrate setpoint. Normally on a cooling only VAV-box both the TabPriAirMinHtgStpt (A153) and the TabPriAirMaxHgtStpt (A212) will be the same to maintain a minimum rate of flow into the space while in the heating mode.

Series Single Speed Fan

The fan (DO 13) will operate continuously whenever the unit is in the occupied state, or in another state and in the cooling or heating mode. The fan control matrix is as follows:

MODE	COOLING	DEADBAND	HEATING
Occupied	*On*	On	*On*
Unoccupied	*On*	Off	*On*
Warm-up	*N/A*	Off	*On*
Standby	*On*	Off	*On*

Input / Output Points

VAV Cooling Only 1 speed fan

IO POINTS	DESCRIPTION
UI-01	Zone Temperature (with optional override button)
UI-02	Setpoint Adjustment (optional 5K slider)
UI-03	Discharge Temperature (optional)
UI-04	CO_2, Humidity, or occupancy signal (all optional)
UI-08	Flowrate Sensor
DO-09	Damper Control
DO-10	Damper Control
DO-11	
DO-12	
DO-13	Series Fan
AO-14	
AO-15	

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VAV Cooling only Variable Speed Fan

Temperature Control

When the zone temperature is greater than, or equal to, the cooling temperature setpoint, the controller will enter the cooling mode. The primary air flow rate will be varied between its TABPriAirDbandStpt (A210), or deadband setpoint, and its maximum Flowrate setpoint TABPriAirMaxStpt (A211) as required to maintain the zone at the cooling temperature setpoint.

When the zone temperature falls to the heating setpoint, the controller will enter the heating mode and the primary air flow rate will be varied between its TabPriAirMinHtgStpt (A153) and its TabPriAirMaxHgtStpt (A212), or maximum heating Flowrate setpoint. Normally on a cooling only VAV box both the TabPriAirMinHtgStpt (A153) and the TabPriAirMaxHgtStpt (A212) will be the same to maintain a minimum rate of flow into the space while in the heating mode.

Series Variable Speed Fan

The variable fan speed will be controlled by modulating AO 15 (default 0 ⋯ 10 Vdc). As more cooling is required, the fan speed will increase. See *Fan Control* on page 59 for more detail.

Input / Output Points

VAV Cooling Only with variable speed fan

IO POINTS	DESCRIPTION
UI-01	Zone Temperature (with optional override button)
UI-02	Setpoint Adjustment (optional 5K slider)
UI-03	Discharge Temperature (optional)
UI-04	CO_2, Humidity, or occupancy signal (all optional)
UI-08	Flowrate Sensor
DO-09	Damper Control
DO-10	Damper Control
DO-11	
DO-12	
DO-13	
AO-14	
AO-15	Variable Speed Series Fan Speed Control (0⋯10 Vdc)

VAV One to Three Stage Electric Reheat No Fan

Temperature Control

When the zone temperature is greater than, or equal to, the cooling temperature setpoint, the controller will enter the cooling mode. The primary air flow rate will be varied between its TABPriAirDbandStpt (A210), or deadband setpoint, and its maximum Flowrate setpoint TABPriAirMaxStpt (A211) as required to maintain the zone at the cooling temperature setpoint.

When the zone temperature falls to the heating setpoint, the controller will enter the heating mode and the primary air flow rate will be varied between its TabPriAirMinHtgStpt (A153) and its TabPriAirMaxHgtStpt (A212), or maximum heating Flowrate setpoint. The stages of electric heat are then staged and optionally duty-cycled (PWM) as required to maintain the zone at the heating temperature setpoint.

Input / Output Points

VAV Electric Reheat, no fan

IO POINTS	DESCRIPTION
UI-01	Zone Temperature (with optional override button)
UI-02	Setpoint Adjustment (optional 5K slider)
UI-03	Discharge Temperature (optional)
UI-04	CO_2, Humidity, or occupancy signal (all optional)
UI-08	Flowrate Sensor
DO-09	Damper Control
DO-10	Damper Control
DO-11	Electric Heat1
DO-12	Electric Heat2 (optional)
DO-13	Electric Heat3 (optional)
AO-14	
AO-15	

VAV One to Two Stage Electric Reheat Single Speed Fan

Temperature Control

When the zone temperature is greater than, or equal to, the cooling temperature setpoint, the controller will enter the cooling mode. The primary air flow rate will be varied between its TABPriAirDbandStpt (A210), or deadband setpoint, and its maximum Flowrate setpoint TABPriAirMaxStpt (A211) as required to maintain the zone at the cooling temperature setpoint.

When the zone temperature falls to the heating setpoint, the controller will enter the heating mode and the primary air flow rate will be varied between its TabPriAirMinHtgStpt (A153) and its TabPriAirMaxHgtStpt (A212), or maximum heating Flowrate setpoint. The stages of electric heat are then staged and optionally duty-cycled (PWM) as required to maintain the zone at the heating temperature setpoint.

Fan Control

Parallel Single Speed Fan Option

During the occupied mode, the intermittent single speed fan will typically be energized in the heating mode. The typical fan control matrix is as follows, although other options are possible:

MODE	COOLING	DEADBAND	HEATING
Occupied	Off	Off	On
Unoccupied	Off	Off	On
Warm-up	Off	Off	Off
Standby	Off	Off	On

Series Single Speed Fan Option

The fan will operate continuously whenever the unit is in the occupied state, or in another state and in the cooling or heating mode. The fan control matrix is as follows:

MODE	COOLING	DEADBAND	HEATING
Occupied	On	On	On
Unoccupied	On	Off	On
Warm-up	N/A	Off	On
Standby	On	Off	On

Input / Output Points

VAV Electric Reheat with 1 speed fan

IO POINTS	DESCRIPTION
UI-01	Zone Temperature (with optional override button)
UI-02	Setpoint Adjustment (optional 5K slider)
UI-03	Discharge Temperature (optional)
UI-04	CO_2, Humidity, or occupancy signal (all optional)
UI-08	Flowrate Sensor
DO-09	Damper Control
DO-10	Damper Control
DO-11	Electric Heat1
DO-12	Electric Heat2 (optional)
DO-13	Parallel or Series Fan
AO-14	
AO-15	

VAV One to Three Stage Electric Reheat Variable Speed Fan

Temperature Control

When the zone temperature is greater than, or equal to, the cooling temperature setpoint, the controller will enter the cooling mode. The primary air flow rate will be varied between its TABPriAirDbandStpt (A210), or deadband setpoint, and its maximum Flowrate setpoint TABPriAirMaxStpt (A211) as required to maintain the zone at the cooling temperature setpoint.

When the zone temperature falls to the heating setpoint, the controller will enter the heating mode and the primary air flow rate will be varied between its TabPriAirMinHtgStpt (A153) and its TabPriAirMaxHgtStpt (A212), or maximum heating Flowrate setpoint. The stages of electric heat are then staged and optionally duty-cycled (PWM), as required to maintain the zone at the heating temperature setpoint.

Fan Control

Parallel Variable Fan Speed Option

The variable fan speed will be controlled by modulating `AO 15` (default 0 ⋯ 10 Vdc). The fan will run in heating mode only. As more heating is required, the fan speed will increase. See *Fan Control* on page 59 for more detail.

Series Variable Fan Speed Option

The variable fan speed will be controlled by modulating `AO-15` (default 0 ⋯ 10 Vdc). In deadband mode, the fan will run at a slower speed. As more heating or cooling is required, the fan speed will increase. See *Fan Control* on page 59 for more detail.

Input / Output Points

VAV Electric Reheat with variable speed fan

IO POINTS	DESCRIPTION
UI-01	Zone Temperature (with optional override button)
UI-02	Setpoint Adjustment (optional 5K slider)
UI-03	Discharge Temperature (optional)
UI-04	CO_2, Humidity, or occupancy signal (all optional)
UI-08	Flowrate Sensor
DO-09	Damper Control
DO-10	Damper Control
DO-11	Electric Heat1
DO-12	Electric Heat2 (optional)
DO-13	Electric Heat3 (optional)
AO-14	
AO-15	Variable Speed Parallel or Series Fan Speed Command (0 ⋯ 10 Vdc)

VAV Modulating Hot Water Reheat No Fan

Temperature Control

When the zone temperature is greater than, or equal to, the cooling temperature setpoint, the controller will enter the cooling mode. The primary air flow rate will be varied between its TABPriAirDbandStpt (A210), or deadband setpoint, and its maximum Flowrate setpoint TABPriAirMaxStpt (A211) as required to maintain the zone at the cooling temperature setpoint.

When the zone temperature falls to the heating setpoint, the controller will enter the heating mode and the primary air flow rate will be varied between its TabPriAirMinHtgStpt (A153) and its TabPriAirMaxHgtStpt (A212), or maximum heating Flowrate setpoint. The modulating hot water reheat valve will then drive open to maintain the desired heating setpoint.

Typically, the modulating heating valve may be controlled by either `AO-14` or `DO-11` and `D0-12` in a tri-state control mode where `DO-11` drives the hot water valve open, and `DO-12` drives it closed. There are additional options available such as having `AO-14` as first stage modulating heat and `AO-15` as second stage modulating heat.

Input / Output Points

VAV Modulating HW Reheat, no fan AO (0 ⋯ 10 Vdc)

IO POINTS	DESCRIPTION
UI-01	Zone Temperature (with optional override button)
UI-02	Setpoint Adjustment (optional 5K slider)
UI-03	Discharge Temperature (optional)
UI-04	CO_2, Humidity, or occupancy signal (all optional)
UI-08	Flowrate Sensor
DO-09	Damper Control
DO-10	Damper Control
DO-11	Tri-State Heat Valve Open
DO-12	Tri-State Heat Valve Closed
DO-13	
AO-14	Modulating Heat Control (0 ⋯ 10 Vdc)
AO-15	

VAV Modulating HW Reheat, no fan Tri-state

IO POINTS	DESCRIPTION
UI-01	Zone Temperature (with optional override button)
UI-02	Setpoint Adjustment (optional 5K slider)
UI-03	Discharge Temperature (optional)
UI-04	CO_2, Humidity, or occupancy signal (all optional)
UI-08	Flowrate Sensor
DO-09	Damper Control
DO-10	Damper Control
DO-11	Heat Valve Open
DO-12	Heat Valve Close
DO-13	
AO-14	
AO-15	

VAV Modulating Hot Water Reheat Single Speed Fan

Temperature Control

When the zone temperature is greater than, or equal to, the cooling temperature setpoint, the controller will enter the cooling mode. The primary air flow rate will be varied between its TABPriAirDbandStpt (A210), or deadband setpoint, and its maximum Flowrate setpoint TABPriAirMaxStpt (A211) as required to maintain the zone at the cooling temperature setpoint.

When the zone temperature falls to the heating setpoint, the controller will enter the heating mode and the primary air flow rate will be varied between its TabPriAirMinHtgStpt (A153) and its TabPriAirMaxHgtStpt (A212), or maximum heating Flowrate setpoint. The modulating hot water reheat valve will then drive open to maintain the desired heating setpoint.

Typically, the modulating heating valve may be controlled by either `AO-14` or `DO-11` and `DO-12` in a tri-state control mode where `DO-11` drives the hot water valve open, and DO 12 drives it closed. There are additional options available such as having `AO-14` as first stage modulating heat and AO 15 as second stage modulating heat.

Fan Control

Parallel Single Speed Fan Option

During the occupied mode, the intermittent single speed fan will be energized in the heating mode. The fan control matrix is as follows:

MODE	COOLING	DEADBAND	HEATING
Occupied	Off	Off	On
Unoccupied	Off	Off	On
Warm-up	Off	Off	Off
Standby	Off	Off	On

Series Single Speed Fan Option

The fan will operate continuously whenever the unit is in the occupied state, or in another state and in the cooling or heating mode. The fan control matrix is as follows:

MODE	COOLING	DEADBAND	HEATING
Occupied	On	On	On
Unoccupied	On	Off	On
Warm-up	N/A	Off	On
Standby	On	Off	On

Input / Output Points

VAV Modulating HW Reheat with 1 speed fan `AO-14` (0 ⋯ 10 Vdc)

IO POINTS	DESCRIPTION
UI-01	Zone Temperature (with optional override button)
UI-02	Setpoint Adjustment (optional 5K slider)
UI-03	Discharge Temperature (optional)
UI-04	CO_2, Humidity, or occupancy signal (all optional)
UI-08	Flowrate Sensor
DO-09	Damper Control
DO-10	Damper Control
DO-11	
DO-12	
DO-13	Parallel or Series Fan
AO-14	Modulating Heat Control (0 ⋯ 10 Vdc)
AO-15	

VAV Modulating HW Reheat with 1 speed fan Tri-state

IO POINTS	DESCRIPTION
UI-01	Zone Temperature (with optional override button)
UI-02	Setpoint Adjustment (optional 5K slider)
UI-03	Discharge Temperature (optional)
UI-04	CO_2, Humidity, or occupancy signal (all optional)
UI-08	Flowrate Sensor
DO-09	Damper Control
DO-10	Damper Control
DO-11	Heat Valve Open
DO-12	Heat Valve Close
DO-13	Parallel or Series Fan
AO-14	
AO-15	

VAV Modulating Hot Water Reheat Variable Speed Fan

Temperature Control

When the zone temperature is greater than, or equal to, the cooling temperature setpoint, the controller will enter the cooling mode. The primary air flow rate will be varied between its TABPriAirDbandStpt (A210), or deadband setpoint, and its maximum Flowrate setpoint TABPriAirMaxStpt (A211) as required to maintain the zone at the cooling temperature setpoint.

When the zone temperature falls to the heating setpoint, the controller will enter the heating mode and the primary air flow rate will be varied between its TabPriAirMinHtgStpt (A153) and its TabPriAirMaxHgtStpt (A212), or maximum heating Flowrate setpoint. The modulating hot water reheat valve will then drive open to maintain the desired heating setpoint.

Typically, the modulating heating valve may be controlled by either `AO-14` or `DO-11` and `DO-12` in a tri-state control mode where `DO-11` drives the hot water valve open, and `DO-12` drives it closed. There are additional options available such as having `AO-14` as first stage modulating heat and AO 15 as second stage modulating heat.

Fan Control

Parallel Variable Fan Speed Option

The variable fan speed will be controlled by modulating `AO-15` (default 0 ⋯ 10 Vdc). The fan will run in heating mode only. As more heating is required, the fan speed will increase. See *Fan Control* on page 59 for more detail.

Series Variable Fan Speed Option

The variable fan speed will be controlled by modulating AO 15 (default 0 ⋯ 10 Vdc). In deadband mode, the fan will run at a slower speed. As more heating or cooling is required, the fan speed will increase See *Fan Control* on page 59 for more detail.

Input / Output Points

VAV Modulating HW Reheat with variable speed fan AO 15 (0 ⋯ 10 Vdc)

IO POINTS	DESCRIPTION
UI-01	Zone Temperature (with optional override button)
UI-02	Setpoint Adjustment (optional 5K slider)
UI-03	Discharge Temperature (optional)
UI-04	CO_2, Humidity, or occupancy signal (all optional)
UI-08	Flowrate Sensor
DO-09	Damper control
DO-10	Damper control
DO-11	
DO-12	
DO-13	
AO-14	Modulating Heat Control (0 .. 10 Vdc)
AO-15	Variable Speed Parallel or Series Fan Speed Command (0 ⋯ 10 Vdc)

VAV Modulating HW Reheat with variable speed fan Tri-state

IO POINTS	DESCRIPTION
UI-01	Zone Temperature (with optional override button)
UI-02	Setpoint Adjustment (optional 5K slider)
UI-03	Discharge Temperature (optional)
UI-04	CO_2, Humidity, or occupancy signal (all optional)
UI-08	Flowrate Sensor
DO-09	Damper Control
DO-10	Damper Control
DO-11	Heat Valve Open
DO-12	Heat Valve Close
DO-13	
AO-14	
AO-15	Variable Speed Parallel or Series Fan Speed Command (0 … 10 Vdc)

SECTION 4 : CONTROL SEQUENCE OVERVIEW

This section provides an overview of the control features applicable to many of the **CBT12iVAV** control sequences. The sections that follow go into more depth on each subject.

Occupancy States and Mode Commands

Occupied State

The default state of the controller is occupied. If set in this mode, the **CBT12iVAV** will control to the occupied temperature setpoints.

Unoccupied State

When indexed to the unoccupied state, the **CBT12iVAV** controllers will operate in a night setback mode and control to the unoccupied setpoints.

Warm-up/Heating State

When the units are commanded into the warm-up mode (primary air state is hot), each **CBT12iVAV** controller will operate its associated box heat and any perimeter heat as required to return the zone to the occupied heating temperature setpoint.

Standby State of Operation

After the warm-up state is complete, the master controller may (optionally) set each terminal unit to the standby state. This state may be utilized to maintain a zone ready for occupancy with minimum energy utilization.

Primary Air State Command

The primary air state command tells the **CBT12iVAV** to expect hot or cold air. While in the off condition primary air state is cold.

Primary Air Mode

Primary Air Mode is either ON or OFF indicating the AHU fan status or command state.

Temperature Control

Control Modes

The **CBT12iVAV** continuously compares the zone temperature with the active setpoints. Heating demand and cooling demand calculations are constantly updated. These calculations are expressed as 0–100% heating needed and 0–100% cooling needed.

- *Heating Mode*

In the heating mode, stages of heat are energized, and/or valve positions are increased, as the heating demand increases. Primary supply air Flowrate is set to the current primary air heating flow setpoint. If the terminal unit includes a variable speed fan, its speed will increase with heating demand.

- *Cooling Mode*

In the cooling mode, the primary air Flowrate setpoint is modulated toward maximum as the cooling demand increases. If the terminal unit includes a series variable speed fan, its speed will increase with cooling demand.

- *Deadband Mode*

In the deadband mode, the primary air Flowrate setpoint is reduced to minimum. All heating is off, parallel fans are off, and series variable speed fans are set to minimum.

Primary Air State and Damper Control

Cooling Control

In normal operation, terminal units are provided with primary air, which is cooler than the zone temperature setpoint, therefore, the **CBT12iVAV** controller operates with a cold primary air state. In this mode, the primary air damper opens in direct proportion to the cooling load percentage calculated by the **CBT12iVAV** controller.

Heating Control

The hot primary air state is used when the Air Handler goes into a heating mode. Hot primary air state is used to put the box into Morning Warmup Mode. In this mode, the primary air damper opens in direct proportion to the heating load percentage calculated by the **CBT12iVAV** controller.

Primary Air Flow Reset CO_2

The primary air flow setpoint will increase as CO_2 increases above the local CO_2 setpoint.

Primary Air Flow Reset Dehumidification

The primary air flow setpoint will increase as relative humidity increases above the local dehumidification setpoint.

Heating Control

Terminal Unit Heat

The **CBT12iVAV** controller has both analog and digital outputs available to control modulating heating coils and discrete on/off stages of heat.

Baseboard Heat

The **CBT12iVAV** control outputs not being used for terminal unit heat may be used for baseboard heat. Like terminal unit heat, these may be either analog or digital outputs, depending on what type of point is available.

Fan Control

The controller has routines for both parallel and series fans. Either type of fan may be controlled as a single speed on/fan or a variable speed fan. See the fan operation matrix specific to each **CBT12iVAV** sequence for details on its operation.

Occupancy States and Mode Commands

Occupancy State Command

The Occupancy State Command is written by the master controller to the **CBT12iVAV**. It is one of several commands in the GroupXOccCode (e.g. Group1OccCode) command. See *Writing the Command Mode to the CBT12iVAV* on page 46.

- Included in the GroupXOccCode command R/W

Occupied State

The default state of the controller is occupied. If commanded to this mode, the **CBT12iVAV** will control to the occupied temperature setpoints. Parallel fan powered terminal unit fans will be energized only as required to maintain the space temperature above the occupied heating setpoint. Series fan powered terminal unit fans will be energized in the occupied mode.

- OccModeSts (D186) RO point is on (occ), this indicates the **CBT12iVAV** is in the occupied state.

Unoccupied State

When commanded to the unoccupied state, the **CBT12iVAV** controllers will operate in a night setback mode and control to the unoccupied temperature setpoints. Parallel fan powered terminal unit fans will be energized only as required to maintain the space temperature above the unoccupied heating setpoint. Series fan powered terminal unit fans will energize whenever the space temperature falls below unoccupied heating or rises above unoccupied cooling setpoints (if unoccupied cooling is used).

- OccModeSts (D186) RO point is off (Non occ), this indicates the **CBT12iVAV** is in the unoccupied state.

Primary Air State Command

The primary air state command tells the **CBT12iVAV** to expect hot or cold air. This command will typically be used in morning warm-up mode with the associated AHU providing hot air to the VAV boxes. If the **CBT12iVAV** is configured to use the local supply air temperature sensor to determine Primary Air State, this command will be ignored in favor of the local command.

- Included in the GroupXOccCode command R/W
- PriAirStateEffCmd (D123) RO (Off = Cool, On= Heat)

Normal Operation: Cool Air

Under normal circumstances the air handling unit is providing cooling air. This is the default value of the Primary Air State Command

Warm-up/Heating Operation: Hot Air

When the Primary Air State Command is set to Hot Air for morning warm-up or other air handler heating state, each **CBT12iVAV** controller will open its primary air damper as required to return its zone to the occupied heating temperature setpoint.

Note: While Primary Air State is commanded to hot air, accessory heat will not be commanded on.

The primary air damper will control within its minimum and maximum setpoints as described under *Primary Air State: Hot* on page 51.

Standby State of Operation

After the warm-up state is complete, the master controller may (optionally) set the terminal unit to the standby state. This state may be utilized to maintain a zone ready for occupancy with minimum energy utilization.

When in the standby state, the occupied temperature setpoints will be used. When the unit is in a deadband mode, the primary air damper will be closed, or controlled to a reduced Flowrate setpoint.

Variable speed series and parallel fan powered terminal units will be controlled to the TABFanStandbyStpt (A227) setpoint when there is no heating or cooling demand.

- Included in the GroupXOccCode command R/W
- StandbyModeSts (D187) RO

Primary Air Mode

Primary Air Mode is either ON or OFF. Typically, the master controller writes this command to the **CBT12iVAV** box based on AHU fan status or similar start/stop logic. By default, the Primary Air Mode is on. If it is off, the **CBT12iVAV** will not open the primary air damper or attempt any cooling.

- Included in the GroupXOccCode command R/W
- PriAirModeEffCmd (D122) RO

Load Shed Enable

If the master controller commands load shed on to this **CBT12iVAV** or the group it is a member of, the effective cooling setpoint will be shifted up, and the effective heating setpoint shifted down, by *LoadShedOccStptOffset* (A198).

- Included in the GroupXOccCode command R/W
- LoadShedOccStptOffset (A198) R/W
- EffLoadShedOccStptOffset (A66) RO

Fire Stop Command

The fire stop command will close the primary air damper and de-energize all fans and stages of heat.

- Included in the GroupXOccCode command R/W
- FireStopEffCmd (D125) RO

Purge Command

The purge command will put primary airflow setpoint to max Flowrate setpoint and de-energizes all stages of heat.

- Included in the GroupXOccCode command R/W
- PurgeEffCmd (D226) RO

Writing the Command Mode to the CBT12iVAV

The master controller must write an occupancy state to each **CBT12iVAV** or they will be left in the default occupied state at all times.

These writes are to one of the four GroupXOccCode points on each controller.

GroupAddress (A93) may be set to one of 4 groups: 0, 1, 2, or 3. With the default setting of group 0, this box will respond to writes to Group0OccCode (A90). If this box is set to a different group, it will respond to writes to the corresponding GroupOccCode – Group1OccCode (A91), Group2OccCode (A92), or Group3OccCode (A100).

These GroupXOccCodes now support the priority array in the **CBT12iVAV** v2.4 controllers. This allows for multiple different values to be written to the specified GroupXOccCode point at various priorities. This is most commonly used for fire stop commands being written at priority 1 or purge command at priority 2.

Writing a 1 or 0 to the correct corresponding GroupXOccCode will enable or disable the occupancy mode, and in addition, may also contain several other commands as follows:

Group0OccCode (A90) - typical for each of the 4 groups

BIT	FUNCTION	OFF VALUE/ON VALUE	OFF STATE/ ON STATE
0	Occupancy Command	0,1	Unoccupied / Occupied
1	Primary Air Mode Command	0,2	Primary Air On / Off
2	Primary Air State Command	0,4	Primary Air State is Cold / Hot
3	Standby Command	0,8	Unoccupied / Standby
4	Load Shed Enable	0,16	Load Shedding is Disabled / Enabled
5	Fire Stop Command	0,32	Fire Alarm is OK /Fire Stop is Active
6	Purge Command	0,64	Normal Operation/ Purge Mode

Note: By default the controllers are set to Occupied with a GroupxOccCode of 1 in all groups.

Sending an Occupied or Unoccupied command

The easiest command to the **CBT12iVAV** box is simply to write either (1) for Occupied or (0) for Unoccupied. This will control occupancy but leave all other functions in their respective default modes.

Encoding multiple commands into one group occupancy code write

To pack more than one command into the group occupancy code, add the on values of all desired on commands.

To write Occupied and a Primary Air State of Hot Air, send the value 5 (1 for occupied + 4 for Primary Air State=hot).

To write Standby and a Primary Air State of Hot Air, send the value 12 (8 for Standby + 4 for Primary Air State=hot).

If the desired mode is the default mode ("off value"), users do not need to write anything as the value is always 0. Only add that value to all other on values when "on value" is desired.

On a day to day basis, users might write occupied/unoccupied (by schedule), primary air mode command on/off (by AHU fan status) and, if there is morning warm up or other AHU heat, Primary air state command Cold/Hot (by AHU discharge air temp).

Note: There are other points that can be used to put the **CBT12iVAV** controller into these modes. To utilize these points the GroupXOccCode must be set for the default setting of 1. Conversely, to use the GroupXOccCode the following points must be set to default settings. **If the appropriate points are not set to default then CBT12iVAV may not go into the mode that it is being commanded to.** The following is a list of those points and their default settings.

POINT NAME	DEFAULT VALUE
OccCmd (D184)	1 / Occ
CmdPriAirMode (D160)	0 / Enable
CmdPriAirState (D161)	0 / Cooling
StandbyCmd (D185)	0 / Off
LoadShedEnable (D211)	0 / Disable
FireStopCmd (D199)	0 / Disable
Purge (D213)	0 / Disable

BACnet communications status and Stand-Alone operation

The **CBT12iVAV** has the ability to monitor its communication status with the master controller. If this feature is enabled, the box will be put into a failsafe mode if communications are lost.

To use this feature, set point OfflineTimerEnaBACnet (D257) to 1 (default is set to 0 or off). The master controller must write a value of 1 to point OfflineTimerCommTestValueBACnet (A2) more frequently than the time delay setting in point CommunicationsOfflineTimer (A259) (do not use less than 5 minutes, default is 15 minutes).

After the time delay expires, if no writes are seen, CommunicationsStatus (D10) will be set to a value of 1 indicating a communications loss.

During a communications loss state, the **CBT12iVAV** will be set to the following:

- Occupied
- Primary Air Mode: On
- Primary Air State: Cool
- Load Shed: Disabled
- CommunicationsStatus (D10) RO   (0 = Communications OK, 1 = Communications loss)

Note: If the last command sent to the **CBT12iVAV** was firestop enabled before losing BACnet communications, it will stay in this state until firestop command has been disabled.

Temperature Control

Control Modes

The **CBT12iVAV** continuously compares the zone temperature with the active setpoints. Heating demand and cooling demand calculations are constantly updated. These calculations are expressed as 0···100% heating demand and 0···100% cooling demand.

Heating Mode

In the heating mode, stages of heat are energized, and/or valve positions are increased, as the heating demand increases. Primary supply air Flowrate is set to the current primary air heating flow setpoint; point TabPriAirMaxHgtStpt (A212). If the terminal unit includes a variable speed fan, its speed will increase with heating demand.

- ZoneTempCV (A193)   *(Current Zone Temperature)*
- ZoneHeatEffCalc (A184)   *(Calculated Heating Demand)*
- EffHeatStpt (A182)   *(Current Active Heating Setpoint)*
- HeatModeSts (D180) RO   *(Heating Mode Status)*

Cooling Mode

In the cooling mode, the primary air Flowrate setpoint is modulated toward maximum Flowrate setpoint TABPriAirMaxStpt (A211) as the cooling demand increases. If the terminal unit includes a series variable speed fan, its speed will increase with cooling demand.

- ZoneTempCV (A193)   *(Current Zone Temperature)*
- ZoneCoolEffCalc (A185)   *(Calculated Cooling Demand)*
- EffCoolStpt (A183)   *(Current Active Cooling Setpoint)*
- CoolModeSts (D181) RO   *(Cooling Mode Status)*
- EnaUnoccCool (D231) R/W   *(Enable Unocc Cooling)*

Deadband Mode

In the deadband mode, the primary air Flowrate setpoint is reduced to minimum. All heating is off, parallel fans are off, and series variable speed series fans are set to minimum.

Cooling and Heating Offsets

These points will offset the EffCoolStpt (A183) and the EffHeatStpt (A182) at the zone temperature cooling and heating PIDs. When value is entered into the CoolingOffsetPID (A39) point the zone temperature cooling control PID will enable when zone temperature rises above the EffCoolStpt (A183). The cooling zone temperature control PID will then control to the EffCoolStpt (A183) minus the value entered into CoolingOffsetPID (A39). PID will then disable putting controller into deadband mode once this modified setpoint is achieved. HeatingOffsetPID (32) will work in much the same way however it will add the value entered to the EffHeatStpt (A182). PID will enable when zone temperature drops below EffHeatStpt (A182) and disable when zone temperature rises above this modified value. This is typically used when there is a supply air temperature setpoint reset at AHU that is monitoring the number of VAVs in deadband mode to determine the setpoint for the supply air temperature. Utilitzing this feature will drive more VAVs in deadband mode resulting in increased energy cost savings.

- CoolingOffsetPID (A39)   Default 0   *(Offset of Active Cooling Setpoint)*
- EffCoolStpt (A183)   RO   *(Current Active Cooling Setpoint)*
- HeatingOffsetPID (32)   Default 0   *(Offset of Active Heating Setpoint)*
- EffHeatStpt (A182)   RO   *(Current Active Heating Setpoint)*

Zone Temperature Setpoints

Zone temperature is controlled to these setpoints, as modified by other factors shown below.

- ZoneOccHeatStpt (A201)   (Occupied heating temperature setpoint)
- ZoneOccCoolStpt (A200)   (Occupied cooling temperature setpoint)
- ZoneUnoccHeatStpt (A203)   (Unoccupied heating temperature setpoint)
- ZoneUnoccCoolStpt (A202)   (Unoccupied cooling temperature setpoint)

Default temperature setpoints are 71°F/75°F for the occupied mode heating/cooling and 65°F/85°F for the unoccupied mode heating/cooling.

Setpoint Modifiers

The Occupied setpoints may be modified by the position of the setpoint adjustment lever, load shed offset, standby offset, etc. The effective setpoints the **CBT12iVAV** will be controlling to are displayed by:

- EffCoolStpt (A183)   *(Current Active Cooling Setpoint)*
- EffHeatStpt (A182)   *(Current Active Heating Setpoint)*

ZATContrlModeEnumeration (A190) RO

The current control mode may be viewed or displayed using this point.

ZATContrlModeEnumeration (A190)

VALUE	FUNCTION
0	Deadband
1	Occupied Heating
2	Unoccupied Heating
4	Occupied Cooling
8	Unoccupied Cooling
16	Standby

Zone Temperature Alarms

If the zone temperature goes above the EffCoolStpt (A183) or below the EffHeatStpt (A182) by the DegreesAbvBlwSPAlarm (A371) setpoint, default 2 degrees, then a delay timer will be started TempAlarmOnDelay (A373), default 60 minutes. If the zone temperature has not corrected before the time delay, an alarm will be generated. The points that will be set to on during an alarm condition are:

- HighTempAlarm (D310)   on is high temp alarm, off is no alarm
- LowTempAlarm (D311)   on is low temp alarm, off is no alarm

Additionally, during a low temp alarm condition point AlarmEncode (A41) will be set to 1. While in a high temp alarm condition AlarmEncode (A41) will be set to 2.

If the zone temperature sensor malfunctions and input 1 is reading above 100 or below 0, the controller will go into local temp fault alarm. **CBT12iVAV** will operate as it would in the deadband mode and no heating will be enabled. The point set to on during this alarm condition is:

- LocalTempSensorFault (D169)   on is zone temperature sensor fault, off is no fault

When in this condition AlarmEncode (A41) will be set to 16.

Primary Air Damper Control

Primary Airflow

The **CBT12iVAV** controller calculates air flow rate setpoints based on the space temperature deviation from zone setpoint and the duration of deviation. The primary inlet airflow rate is measured and compared to this control point. Any error greater than the deadband setting will cause the primary air damper to be driven open or closed as required to reduce the error to within an adjustable Flowrate deadband.

The primary airflow setpoint is read from point EffPriAirFlowStpt (A197) RO.

Primary Air Setpoint Management

The PrimaryAirState is set by the GroupXOccupiedCode or by the on-board Supply Air temp sensor if enabled (see `CBT12iVAVver2.4Decoder.xlsx` spreadsheet to enable this option). The normal and default primary air state is cold air.

Primary Air State: Cold

In normal operation, terminal units are provided with primary air, which is cooler than the zone temperature setpoint, therefore, the **CBT12iVAV** controller operates with a cold primary air state. In this mode, the primary air damper opens in direct proportion to the cooling load percentage calculated by the **CBT12iVAV** controller.

When the primary air state is cold, the primary air volume control is approximated below:
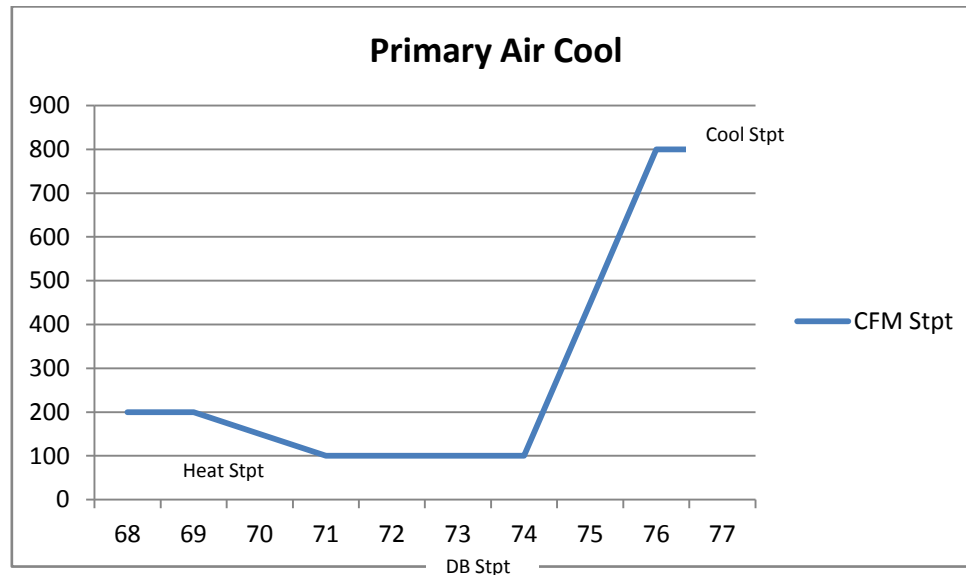
- Maximum Heat Flowrate Setpoint is TabPriAirMaxHgtStpt (A212).
  - The Max Heat Flowrate setpoint may be set the same as the Deadband Flowrate Stpt for fan powered heating boxes, or higher for heating applications without a fan.
- Minimum Heat Flowrate Setpoint is TabPriAirMinHtgStpt (A153).
  - The Min Heat Flowrate setpoint may be set the same as the Deadband Flowrate Stpt for fan powered heating boxes, or higher or lower for heating applications without a fan.
- Deadband Flowrate Setpoint is TABPriAirDbandStpt (A210).
- Cooling Flowrate Setpoint is TABPriAirMaxStpt (A211).

Primary Air State: Hot

The hot primary air state is used when the Air Handler goes into a heating mode. The hot primary air state is used to put the box into Morning Warmup Mode. In this mode the primary air damper opens in direct proportion to the heating load percentage calculated by the **CBT12iVAV** controller.

The PrimaryAirState may be set by the GroupXOccupiedCode or by the on-board Supply Air temp sensor (see `CBT12iVAVver2.4Decoder.xlsx` spreadsheet to enable this option) to hot air.

When the primary air state is hot, the primary air volume control is approximated below:
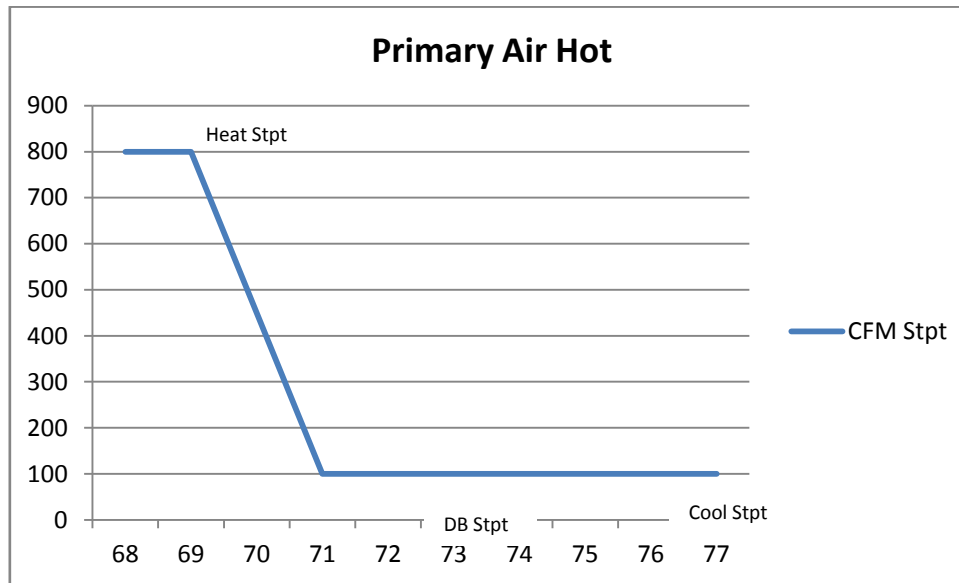
- Heat Flowrate Setpoint is TABPriAirMaxStpt (A211).
- Deadband Flowrate Setpoint is TABPriAirDbandStpt (A210).
- Cooling Flowrate Setpoint is also TABPriAirDbandStpt (A210).

Primary Air Flow Reset CO_2

Local CO_2 Sensor

If the local ZoneCO2ValueCV (A67) goes above the LocalCO2Stpt (A255), the primary air flow setpoint will modulate up to the TABPriAirMaxStpt (A211), or maximum Flowrate setpoint. CO_2 demand calculation can be determined from point LocalRemoteSlaveC02Calc (A76). If the **CBT12iVAV** is in heat mode, the heat will stage on accordingly. If heating demand is greater than 95%, however, the calculated LocalRemoteSlaveC02Calc (A76) will be limited to 70%.

Remote CO_2 Sensor

If the **CBT12iVAV** is a slave VAV box, and another controller is master and has a CO_2 sensor, users can write the CO_2 calculated demand to the RemoteSlaveCO2Cmd (A75). When configured for remote CO_2, this will calculate the Flowrate setpoint in the same manner as if it had a local CO_2 sensor.

Primary Air Flow Reset Dehumidification

- *Local Dehumidification Sensor*

If the local ZoneRHValueCV (A13) goes above the LocalDehumidStpt (A258), the primary air flow setpoint will modulate up to the TABPriAirMaxStpt (A211), or maximum Flowrate setpoint. Dehumidification demand calculation can be determined from point LocalRemoteSlaveDehumidCalc (A79). If the **CBT12iVAV** is in heat mode, the heat will stage on accordingly. If heating demand is greater than 95%, however, the calculated LocalRemoteSlaveDehumidCalc (A76) will be limited to 70%.

- *Remote Dehumidification Sensor*

If the **CBT12iVAV** is a slave VAV box and another controller is master and has a relative humidity sensor, users can write the dehumidification calculated demand to the RemoteSlaveDehumidCmd (A1). When configured for remote dehumidification, this will calculate the Flowrate setpoint in the same manner as if it had a local relative humidity sensor.

Calculated Flowrate Alarms

If the calculated Flowrate goes above or below the EffPriAirFlowStpt (197) by the CFMAbvBlwSPAlarm (A7) setpoint, default 75 Flowrate, then a delay timer will be started CFMAlarmOnDelay (A373), default 30 minutes. If the calculated Flowrate has not corrected before the time delay, an alarm will be generated. The following are the points that will be set to on during an alarm condition.

- CFMHighAlarm (D201)   on is high Flowrate alarm, off is no alarm

- CFMLowAlarm (D202)   on is low Flowrate alarm, off is no alarm

Additionally, if there is a low Flowrate alarm condition AlarmEncode (A41) will be set to 4. In a high Flowrate alarm condition AlarmEncode (A41) will be set to 8.

Test and Balance

A point has been setup to allow test and balance commands to be sent to individual boxes, or groups of boxes, to set the primary air damper to max Flowrate, deadband Flowrate, full open, full closed, etc. These commands may be used to calibrate the air flow sensor and balance the boxes.

GroupXTABCode R/W

With the default GroupXOccCode of group 0, the box will respond to writes to Group0TABCode (A77). If the box is set to another GroupXOccCode group, the corresponding point will be used: *Group1TABCode* (A80), *Group2TABCode* (A85) or, *Group3TABCode* (A87).

The TAB code default value of 0 allows normal operation. Setting the point to any of the values below will override the Flowrate setpoint for the primary air damper to the indicated value.

- *Group0TABCode (A77) -typical for all 4 groups*

BIT	FUNCTION	OFF VALUE/ON VALUE	OFF STATE/ ON STATE
0	DampMaxManEff (D131)	0,1	normal, control damper to max Flowrate stpt
1	DampMinManEff (D132)	0,2	normal, control damper to deadband Flowrate stpt
2	DampAuxManEff (D133)	0,4	normal, control damper to aux (heat) Flowrate stpt
3	DampOpenManEff (D136)	0,8	normal, drive damper full open
4	DampCloseManEff (D137)	0,16	normal, drive damper full closed

Note: default value for each item is "Off Value"

PriAirModeEnumeration (A208) RO

This point displays the current On/Off Air State as commanded by the GroupXOccCode.

- *PriAirModeEnumeration (A208)*

VALUE	FUNCTION
0	On
1	Off: Normal
3	Off: Fire Stop

PriDamperCmdEnumeration (A219) RO

This point displays the primary air damper's current control state as commanded by GroupXTABCode.

- *PriDamperCmdEnumeration (A219)*

VALUE	FUNCTION
0	Off
1	Open
2	Close
8	Open Manual
16	Close Manual
32	Close Fire Stop

Zeroing Airflow sensor

The **CBT12iVAV** comes from the factory with the airflow sensor zeroed. To compensate for possible air leakage around the damper, users are able to zero the airflow sensor in the field. To zero the airflow sensor, users will need to do the following:

1. Drive damper to the closed position by enabling DampCloseMan (D192).

2. After damper has fully shut, set TABPriAirZero (D150) to on.

After 10 seconds the TABPriAirZero (D150) will be automatically set back to off and the airflow sensor will now be zeroed. Be sure to disable DampCloseMan (D192) when finished with this step.

Airflow Calibration Procedure

This section provides information on the calibration procedure of the **CBT12iVAV** airflow sensor.

The K factors

- The AFS_AltitudeKfactor (A24) is the K factor for gas density/altitude compensation. The following values should be used depending on the altitude at which the **CBT12iVAV** will be installed. Sea Level/1013 mbars =0.95

- 250 m / 984 mbars / 820 ft = 0.98

- 425 m / 966 mbars / 1395 ft = 1

- 500 m / 958 mbars / 1640 ft = 1.01

- 750 m / 925 mbars / 2060 ft = 1.04

The TABPriPickupK (A215) is the K factor for the amplification ring. Sometimes this is referred to as the amplification factor or magnification factor. This value can be found in the flow ring manufacturer's literature. It is typically found in a table that lists the flow at a specific pressure (e.g. 1"wc) pressure for given inlet diameters. Amplification factor can be calculated using the following formula.

$$(\text{imperial strategy})\ \text{TABPriPickupK}\ (A215) = \frac{\text{Duct area in "SqFt" x 4005}}{\text{Flow in CFM @ 1"wc}}$$

$$(\text{metric strategy})\quad \text{TABPriPickupK}\ (A215) = \frac{\text{Duct area in } m^2 \text{ x 20345}}{\text{Flow in liters/second @ 2.54 cm wc}}$$

The airflow sensor K factor TABPriKFactor (A214) is used to compensate for any pressure drops, tolerance buildup encountered during installation of the **CBT12iVAV**, or amplification of the velocity signal. The airflow sensor K factor TABPriKFactor (A214) value is used internally to convert the velocity pressure to a Flowrate value based on predefined input values. There are two different methods that can be used to set the K factor TABPriKFactor (A214) value.

Method 1

To set the K factor users will need to drive the damper to the Maximum Flowrate setpoint TABPriAirMaxStpt (A211). To drive the damper to the maximum Flowrate setpoint, simply put point DampMaxMan (D193) to on. Once uncalibrated, current Flowrate value PriAirFlowCV (A194) is at the TABPriAirMaxStpt (A211). The next step is to calculate the airflow sensor K factor TABPriKFactor (A214) using the following formula:

$$new\ \text{TABPriKFactor}\ (A214) = \frac{\text{Flowrate reading at hood}}{\text{Flowrate value at CBT12iVAV PriAirFlowCV (A194)}} \times current\ \text{TABPriKFactor}\ (A214)$$

Method 2

This method can be used to auto calculate and set the K factor TABPriKFactor (A214). The following steps are needed to utilize this feature.

1. After determining what the maximum Flowrate setpoint is going to be for the VAV box, set TABPriAirManMode (D204) to `on`. Once in this mode users are able to manually set the EffPriAirFlowStpt (A197) that the **CBT12iVAV** uses for its calculated Flowrate setpoint.

2. Wait for the value of PriAirFlowCV (A194) to stabilize, then:

   • If the value of PriAirFlowCV (A194) reaches the value in TABPriManStpt (A218), get a hood reading at the diffusers to get the actual Flowrate of the VAV box.

   • If the value of PriAirFlowCV (A194) doesn't reach the value in TABPriManStpt (A218), set TABPriManStpt (A218) to a value below the value reached by PriAirFlowCV (A194) as a reference point.

3. After the PriAirFlowCV (A194) has reached the TABPriManStpt (A218) value that was set in step 2, get a hood reading at the diffusers to get the actual Flowrate of the VAV box.

4. Set the TABPriHoodAtMax (A245) to the actual Flowrate reading that was recorded utilizing the hood.

5. Set the TABAutoCalKfactor (D151) to on. This will automatically set the TABPriKFactor (A214) internally through the program calculating the K factor as shown in method 1. After setting TABAutoCalKfactor (D151) to on, the value will stay on for 4 seconds then automatically be set back to off. It will also set the TABPriAirManMode (D204) to off and the calculated EffPriAirFlowStpt (A197) will go back to normal operation.

Note: When setting the TABPriAirManMode (D204) to on, it will stay on until time entered on point TABPriAirManModeTimer (A217) has expired unless TABAutoCalKfactor (D151) is set to on. The default for TABPriAirManModeTimer (A217) is 600 seconds or 10 minutes. To disable TABPriAirManMode (D204) before the time has expired set TABPriAirManModeReset (D206) to on.

Heating Control

Terminal Unit Heat

The **CBT12iVAV** has (3) Digital Outputs (DO) to control both fan or heat stages and (2) Analog Outputs (AO) to control modulating heat or fans. A tri-state heating valve may be configured using `DO-11` and `DO-12`.

On/Off Control

The **CBT12iVAV** may control on/off stages of electric terminal heat. On a fall in zone temperature below the controller heating setpoint, the **CBT12iVAV** controller will energize the heat stages in sequence from lowest output number to highest.

When using stages of Electric Heat without a fan, parameters are available to disable electric heat until airflow reaches a Flowrate setpoint ElecHeatCFMTestStpt (A3). Flowrate must stay above ElecHeatCFMTestStpt (A3) for the amount of time set in ElecHeatCFMTestTime (A112) before heat will be enabled.

- ElecHeatCFMTestStpt (A3) R/W
- ElecHeatCFMTestTime (A112)
- AirflowOKforElecHeat (D20) RO

Modulating Control

The **CBT12iVAV** may control modulating terminal heat. On a fall in zone temperature below the controller heating setpoint, the **CBT12iVAV** controller will modulate the hot water valve open. Various voltage ranges and direct or reverse action are available.

See "`CBT12iVAVver2.4Decoder.xlsx`" spreadsheet for more detail on setting up these points.

Note: If the **CBT12iVAV** has been configured for a series or parallel fan, heat will not be energized until the fan has been commanded on.

Baseboard Heat

The **CBT12iVAV** control outputs not being used for terminal unit heat may be used for baseboard heat. Like terminal unit heat, these may be either analog or digital outputs, depending on what type of point is available.

In the occupied mode, the baseboard heat will be controlled in sequence with any terminal unit heat.

In the unoccupied mode, the baseboard heat may be configured to operate either in sequence with terminal unit heat or as the only source of heat.

On/Off Control

If DO point(s) are available, the **CBT12iVAV** may control on/off baseboard heat. On a fall in zone temperature below the controller heating setpoint, the **CBT12iVAV** controller will energize the associated baseboard heat.

Modulating Control

If AO or tri-state point(s) are available, the **CBT12iVAV** may control modulating baseboard heat. On a fall in zone temperature below the controller heating setpoint, the **CBT12iVAV** controller will modulate the associated baseboard section hot water valve.

Run Only Baseboard heat during unoccupied

This option is available from the drop down menus on the "`CBT12iVAVver2.4Decoder.xlsx`" spreadsheet. In order to use this feature, first identify the output controlling baseboard heat, then select Run Only Baseboard heat during unoccupied . Any other heat stages will be skipped during unoccupied.

Heat Order

Using the configuration spreadsheet, it is possible to choose how to stage baseboard heat in conjunction with any box heat. This is done by first determining which type of heat is used in the box (On/Off, modulating, or tri-state) and at the baseboard, then by making use of the following rules. A heating strategy may be configured to cover most cases:

1. Within digital and analog heat outputs, the lower output number is staged on first, and
2. The box may be configured to run AO or DO heat (including Tri-state outputs) first, last, or concurrently. See the drop down menu options on the "`CBT12iVAVver2.4Decoder.xlsx`" spreadsheet.

Digital Output Direct/Reverse Action

In the **CBT12iVAV** the digital outputs could also be set for reverse acting. This would be typically used for controlling normally-closed heating valves.

- DO11RevAct (DS313)
- DO12RevAct (DS314)
- DO13RevAct (DS312)

Digital Output Display Position

These points will display the heat command for the various digital outputs regardless if digital output(s) are set for reverse or direct acting.

- DO11CmdDisplay (D284)
- DO12CmdDisplay (D305)
- DO13CmdDisplay (D306)

Analog Output Range Options

"`CBT12iVAVver2.4Decoder.xlsx`" spreadsheet configuration options for the range of the AOs include 0 ⋯ 10 Vdc, 2 ⋯ 10 Vdc, and custom ranges. If using custom ranges, enter them in the points listed below. For example, to give AO14 a closed position of 6.0 Vdc and an open position of 9.0 Vdc, 60 would be entered in A247 and 90 would be entered in A248.

- CustomClosedVX10_AO14 (A247)
- CustomOpenVX10_AO14 (A248)
- CustomClosedVX10_AO15 (A157)
- CustomOpenVX10_AO15 (A240)

Analog Output Direct/Reverse Action

Direct or reverse action may be chosen from the spreadsheet for each AO.

Analog Output Display Position

These points will display the full range 0 ... 100% logical control signal to the output point no matter what the physical configuration is; direct/reverse, 2 ... 10 Vdc, etc.

- AO14DisplayPos (A155)
- AO15DisplayPos (A241)

Parallel Single Speed Fan

The intermittent single speed fan will be energized when the **CBT12iVAV** is in the heat mode. It will be off when not in the heat mode.

MODE	COOLING	DEADBAND	HEATING
Occupied	Off	Off	On
Unoccupied	Off	Off	On
Warm-up	Off	Off	Off
Standby	Off	Off	On

Note: If Flowrate is above the TABParallelDisableFanSP (A380) + TABParallelFanDB (A381) then parallel fan will be disabled. Once Flowrate drops below TABParallelDisableFanSP (A380) parallel fan will then be enabled. This is used to prevent high Flowrates at the diffusers.

Series Single Speed Fan

The terminal unit fan will operate continuously whenever the **CBT12iVAV** is in the occupied state. It will also run whenever the **CBT12iVAV** is in the unoccupied heating or unoccupied cooling mode.

OCCUPIED	ON	ON	ON
Unoccupied	On	Off	On
Warm-up	N/A	Off	On
Standby	On	Off	On

Note: If Flowrate is above the SeriesFanStartLckOutSP (A383) the damper will drive shut until Flowrate is below the setpoint before starting the fan. This prevents the fan from reverse rotation when starting.

Variable Speed Fan

The terminal unit fan speed will be controlled through `AO-15` (0 ... 10 Vdc, 2 ... 10 Vdc, or a custom range).

When initially powered up, or upon restoration of power after a power outage, the **CBT12iVAV** controller executes a fan startup sequence to prevent reverse rotation. The fan startup sequence drives the primary air damper closed, waits 30 seconds, and then sets the fan speed output to 100% for 2 seconds. The controller will then set the fan speed output to the current fan setpoint, EffFanSpeedCmd (A176.)

Fan Speed Calculation

For variable speed fans, EffFanSpeedCmd (A176) is determined by translating the current Cool or Heat demand percent to the range from min to max fan speed. For instance, with a Cooling demand of 50% and a series fan with a min (deadband) fan speed setpoint of 20% and a maximum (cool stpt) fan speed setpoint of 70%, EffFanSpeedCmd (A176) is calculated as follows:

> Fan Speed Setpoint Range: 70% max - 20% min = 50%
>
> Cool Demand = 50%
>
> 50% demand X 50% range = 25% signal
>
> EffFanSpeedCmd (A176) = signal + min
>
> EffFanSpeedCmd (A176) = 25% + 20% = 45%

Parallel Variable Speed Fan

The Parallel Variable Speed fan will be energized when the **CBT12iVAV** is in the heat mode and off when not in the heat mode. Speed will modulate between the Minimum and Maximum Setpoints as shown below.
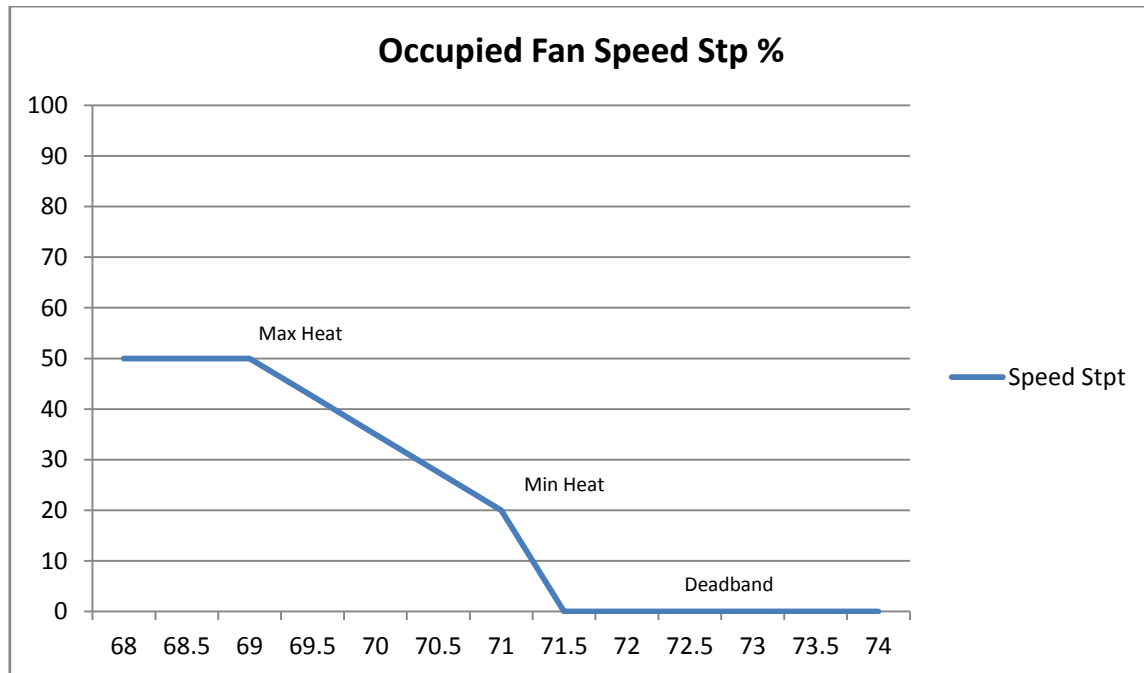
- Max Heat Fan Speed Setpoint is TABFanHtgMaxStpt (A226)
- Min Heat Fan Speed Setpoint is TabFanHtgMinStpt (A154)
- Min Fan Speed Setpoint is TABFanDbandStpt (A224)

Series Variable Speed Fan

The Series Variable Speed fan will operate continuously whenever the **CBT12iVAV** is in the occupied state. It will also run whenever the **CBT12iVAV** is in the unoccupied heating or unoccupied cooling modes.
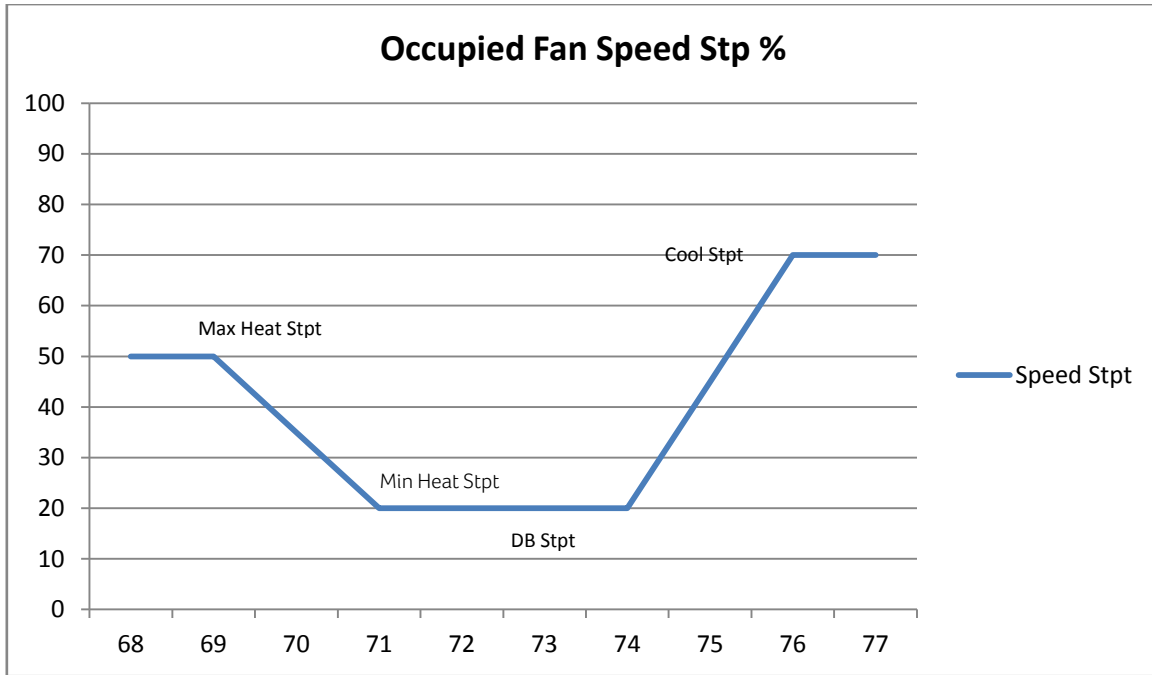
- Max Heat Fan Speed Setpoint is TABFanHtgMaxStpt (A226)
- Min Heat Fan Speed Setpoint is TabFanHtgMinStpt (A154)
- Deadband Fan Speed Setpoint is TABFanDbandStpt (A224)
- Cooling Fan Speed Setpoint is TABFanMaxStpt (A225).

SECTION 5 :   APPENDIX : LIST OF CBT12IVAV POINTS

The **CBT12iVAV** strategy is available in both Imperial and Metric units.

The tables in this Appendix list and describe the points in the Strategy, and gives the units in each Strategy type along with the default value in that Strategy type.

Analog Points

Hardware (I/O)

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION
1	Analog Input	UI01	Input UI01 Value
2	Analog Input	UI02	Input UI02 Value
3	Analog Input	UI03	Input UI03 Value
4	Analog Input	UI04	Input UI04 Value
8	Analog Input	UI08	Input UI08 Value
14	Analog Output	AO14	Output AO14 Value
15	Analog Output	AO15	Output AO14 Value

Values

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION
10	Analog	UI04ScaledValueCO2 (A10)	Scaled value from local CO_2 sensor
12	Analog	UI04ScaledValue (A12)	Scaled value from local relative humidity sensor
13	Analog	ZoneRHValueCV (A13)	Local relative humidity reading from sensor
41	Analog	AlarmEncode (A41)	Encodes various alarms as follows: 0=No Alarm 1=Low Temp Alarm 2=High Temp Alarm 4=Low Air Flow 8=High Air Flow 16=Local Temp Fault 32= No MSTP comms to master
66	Analog	EffLoadShedOccStptOffset (A66)	Effective load shed occupied setpoint offset
67	Analog	ZoneCO2ValueCV (A67)	Local CO_2 reading from sensor
71	Analog	HiSelectCO2DehumidEffAFlowCmd (A71)	Maximum of CO_2 or dehumidification effective airflow setpoint
76	Analog	LocalRemoteSlaveC02Calc (A76)	Current CO_2 command 0···100%
79	Analog	LocalRemoteSlaveDehumidCalc (A79)	Current dehumidification command 0···100%
86	Analog	StptSliderEffOccOffset (A86)	Current slider setpoint offset
88	Analog	EffGroupAddress (A88)	Current group address
122	Analog	UI03_10KSensorHost (A122)	Current UI03 sensor reading with calibration offset
140	Analog	TABPriAirEffMaxStpt (A140)	Current effective maximum Flowrate setpoint
155	Analog	AO14DisplayPos (A155)	AO14 display value 0···100%
172	Analog	TotalHeatingStagesDefined (A172)	Amount of stages of heat defined
174	Analog	HeatMasterCalc (A174)	Heat Master Calculated Percent
176	Analog	EffFanSpeedCmd (A176)	Current variable speed fan command 0···100%
177	Analog	FanSpeedCmdAuto (A177)	Calculated variable fan speed command
180	Analog	UI01_10KSensorHost (A180)	UI01 control value
182	Analog	EffHeatStpt (A182)	Active heating setpoint
183	Analog	EffCoolStpt (A183)	Active cooling setpoint
184	Analog	ZoneHeatEffCalc (A184)	Current zone heating command. Calculation. This point supports priority array.
185	Analog	ZoneCoolEffCalc (A185)	Current zone heating command calculation. This point supports priority array
190	Analog	ZATContrlModeEnumeration (A190)	Point can be used to determine zone control mode 0 = Deadband mode 1 = Occupied heating mode 2 = Unoccupied heating mode 4 = Occupied cooling mode 8 = Unoccupied cooling mode 16 = Standby mode
191	Analog	EffZoneUnoccCoolStpt (A191)	Active unoccupied cooling setpoint
192	Analog	EffZoneUnoccHeatStpt (A192)	Active unoccupied heating setpoint
193	Analog	ZoneTempCV (A193)	Current zone control temperature
194	Analog	PriAirFlowCV (A194)	Current primary airflow

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION
197	Analog	*EffPriAirFlowStpt (A197)*	Current primary airflow active setpoint
199	Analog	*StrategyVer (A199)*	Strategy version loaded into CBT12iVAV
208	Analog	*PriAirModeEnumeration (A208)*	Numerated value of primary air mode state. 0 = On 1 = Off 3 = Fire stop
219	Analog	*PriDamperCmdEnumeration (A219)*	Enumerated value for damper command state 0 = Off 1 = Open 2 = Close 4 = Close Flowrate high for series fan 8 = Open manual 16 = Close manual 32 = Closed fire stop
241	Analog	*AO15DisplayPos (A241)*	AO15 display value 0···100%
263	Analog	*EffZoneOccHeatStpt (A263)*	Zone Effective Occupied Heat Setpoint
264	Analog	*EffZoneOccCoolStpt (A264)*	Zone Effective Occupied Cool Setpoint
271	Analog	*ZATError (A271)*	Zone Temp Error from Heating and Cooling Setpoints
281	Analog	*TriStateHtVlvPos (A281)*	Current valve position if tristate heat valve is used 0···100%
313	Analog	*DamperPosition (A313)*	Current damper position

Setpoints

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	UNITS AND DEFAULT VALUES			
				IMPERIAL STG.		METRIC STG.	
1	Analog Setpoint	*RemoteSlaveDehumidCmd (A1)*	Remote dehumidification command setpoint 0···100%	0	%	0	%
2	Analog Setpoint	*OfflineTimerCommTestValueBACnet (A2)*	Required to write a 1 to this point every 5···10 minutes when offline timer for BACnet communications point OfflineTimerEnaBACnet (D257) is enabled.	1	none	1	none
3	Analog Setpoint	*ElecHeatCFMTestStpt (A3)*	Minimum Flowrate setpoint to enable electric heat. Applicable only for VAV boxes configured for no fan or series fan.	150	cfm	150	l/sec
7	Analog Setpoint	*CFMAbvBlwSPAlarm (A7)*	Flowrate error from current calculated Flowrate setpoint alarm	75	cfm	75	l/sec
24	Analog Setpoint	*AFS_AltitudeKfactor (A24)*	Altitude K Factor Sea Level/1013 mbars = 0.95 250 meters/984 mbars/820 ft = 0.98 425 meters/966 mbars/1395 ft = 1 500 meters/958 mbars/1640 ft = 1.01 750 meters/925 mbars/2060 ft = 1.04	0.95	none	0.95	none
32	Analog Setpoint	*HeatingOffsetPID (A32)*	Offsets effective heating setpoint at PID	0	°F	0	°c
39	Analog Setpoint	*CoolingOffsetPID (A39)*	Offsets effective cooling setpoint at PID	0	°F	0	°c
47	Analog Setpoint	*AO15RemoteCmd (A47)*	Remote command for AO15	0	%	0	%
75	Analog Setpoint	*RemoteSlaveCO2Cmd (A75)*	Remote CO_2 command setpoint 0···100%	0	%	0	%
77	Analog Setpoint	*Group0TABCode (A77)*	Group 0 TAB code	0	none	0	none
80	Analog Setpoint	*Group1TABCode (A80)*	Group 1 TAB code	0	none	0	none
84	Analog Setpoint	*OutputConfigC_Bsbd (A84)*	VAV box configuration setpoint	128	none	128	none
85	Analog Setpoint	*Group2TABCode (A85)*	Group 2 TAB code	0	none	0	none
87	Analog Setpoint	*Group3TABCode (A87)*	Group 3 TAB code	0	none	0	none
90	Analog Setpoint	*Group0OccCode (A90)*	Group 0 command used to put VAV box in multiple modes of operation. This point supports priority array.	1	none	1	none
91	Analog Setpoint	*Group1OccCode (A91)*	Group 1 command used to put VAV box in multiple modes of operation. This point supports priority array.	1	none	1	none
92	Analog Setpoint	*Group2OccCode (A92)*	Group 2 command used to put VAV box in multiple modes of operation. This point supports priority array.	1	none	1	none
93	Analog Setpoint	*GroupAddress (A93)*	Point used to set the group address	0	none	0	none
100	Analog Setpoint	*Group3OccCode (A100)*	Group 3 command used to put VAV box in multiple modes of operation. This point supports priority array.	1	none	1	none
112	Analog Setpoint	*ElecHeatCFMTestTime (A112)*	Amount of seconds current Flowrate needs to be above calculated Flowrate setpoint before enabling electric heat. Only applicable for VAV boxes configured for no fan or series fan	60	Sec	60	sec
113	Analog Setpoint	*NominalHeatCapacity (A113)*	Not used. Has been assigned for future use	0	KW	0	kw

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	UNITS AND DEFAULT VALUES			
				IMPERIAL STG.		METRIC STG.	
120	Analog Setpoint	`UI03_10KSensorCal (A120)`	UI03 sensor calibration offset	0	°F	0	°c
141	Analog Setpoint	`heatStateOnStpt (A141)`	Temperature setpoint for setting Primary Air State to hot when VAV box has been configured for local auto change over.	80	°F	80	°c
143	Analog Setpoint	`AO14RemoteCmd (A143)`	AO14 remote command	0	%	0	%
153	Analog Setpoint	`TabPriAirMinHtgStpt (A153)`	Primary air max heating Flowrate setpoint. This point supports priority array.	50	CFM	25	l/sec
154	Analog Setpoint	`TabFanHtgMinStpt (A154)`	Minimum heating variable speed fan command setpoint	0	%	60	%
157	Analog Setpoint	`CustomClosedVX10_AO15 (A157)`	AO15 Close Value Custom = Volts X 10	0	%	0	%
168	Analog Setpoint	`Remote_SlaveTemp (A168)`	Remote control temperature written to from master controller	55	°F	21	°c
175	Analog Setpoint	`HeatCapacityLimit (A175)`	Point used to limit heat capacity 0···100%	100	%	100	%
186	Analog Setpoint	`ManualSlaveHeatCmd (A186)`	When point EnableManualHeatCmd (D178) is enabled this slave heating command point can be written to from master controller 0···100%.	0	%	0	%
187	Analog Setpoint	`ManualSlaveCoolCmd (A187)`	When point EnableManualCoolCmd (D179) is enabled this slave cooling command point can be written to from master controller 0···100%.	0	%	0	%
198	Analog Setpoint	`LoadShedOccStptOffset (A198)`	Amount of degrees that occupied setpoints are offset when load shed mode is enabled.	0	°F	0	°c
200	Analog Setpoint	`ZoneOccCoolStpt (A200)`	Occupied cooling setpoint. This point supports priority array	75	°F	23	°c
201	Analog Setpoint	`ZoneOccHeatStpt (A201)`	Occupied heating setpoint. This point supports priority array	71	°F	21	°c
202	Analog Setpoint	`ZoneUnoccCoolStpt (A202)`	Unoccupied cooling setpoint	85	°F	26	°c
203	Analog Setpoint	`ZoneUnoccHeatStpt (A203)`	Unoccupied heating setpoint	65	°F	18	°c
204	Analog Setpoint	`ZoneUnoccDiff (A204)`	Degrees above unoccupied heating setpoint when heat is disabled	3	°F	3	°c
205	Analog Setpoint	`StandbyOffset (A205)`	Amount of degrees that occupied setpoints are offset when standby mode is enabled.	0	°F	0	°c
206	Analog Setpoint	`OnBoardOccSensorOverrideTime (A206)`	Amount of minutes that VAV box will be occupied when local push button override or motion sensor has been activated.	60	min	60	min
210	Analog Setpoint	`TABPriAirDbandStpt (A210)`	Primary air control dead band Flowrate setpoint. This point supports priority array.	50	CFM	25	l/sec
211	Analog Setpoint	`TABPriAirMaxStpt (A211)`	Primary air maximum Flowrate setpoint. This point supports priority array.	800	CFM	400	l/sec
212	Analog Setpoint	`TabPriAirMaxHgtStpt (A212)`	Primary air max heating Flowrate setpoint. This point supports priority array.	50	CFM	25	l/sec
213	Analog Setpoint	`TABPriDuctDia (A213)`	Calculated round duct diameter	10	in	25	cm
214	Analog Setpoint	`TABPriKFactor (A214)`	Primary K factor	1	none	1	none
215	Analog Setpoint	`TABPriPickupK (A215)`	Flow ring K factor. Supplied from box manufacturer	1.25	none	1.5	none
216	Analog Setpoint	`AFSZeroCalOffset (A216)`	Zero Offset of AFS in Pascals	0	none	0	none
217	Analog Setpoint	`TABPriAirManModeTimer (A217)`	Amount of time in seconds primary air manual mode will be active after point TABPriAirManMode (D204) has been enabled	600	sec	600	sec
218	Analog Setpoint	`TABPriManStpt (A218)`	Airflow setpoint when primary air manual mode has been enabled.	800	CFM	400	l/sec
221	Analog Setpoint	`CBT_STAT_CFG (A221)`		3	none	3	°
224	Analog Setpoint	`TABFanDbandStpt (A224)`	Minimum variable fan speed command setpoint	0	%	0	%
225	Analog Setpoint	`TABFanMaxStpt (A225)`	Maximum cooling variable speed fan command setpoint	60	%	0	%
226	Analog Setpoint	`TABFanHtgMaxStpt (A226)`	Maximum heating variable speed fan command setpoint	60	%	0	%
227	Analog Setpoint	`TABFanStandbyStpt (A227)`	Variable fan speed command setpoint when in standby mode	0	%	0	%
230	Analog Setpoint	`UI01_10KSensorCal (A230)`	UI01 calibration offset	0	°F	0	°c
231	Analog Setpoint	`SetptSliderSpan (A231)`	Setpoint slider span	4	°F	4	°c
232	Analog Setpoint	`ZonePIDGain (A232)`	Zone temperature PID gain	10	none	10	none
233	Analog Setpoint	`DBper1SqFt (A233)`	Box CFM DB setpoint, box area sq Ft X value	25	none	25	none
235	Analog Setpoint	`HeatStateOffStpt (A235)`	Temperature setpoint for setting Primary Air State to cold when VAV box has been configured for local auto change over.	72	°F	72	°c

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	UNITS AND DEFAULT VALUES			
				IMPERIAL STG.		METRIC STG.	
236	Analog Setpoint	PriAirPIDGain (A236)	Primary air PID gain	0.1	none	0.1	none
237	Analog Setpoint	PriAirPIDInteg (A237)	Primary air PID integral	180	none	180	none
240	Analog Setpoint	CustomOpenVX10_AO15 (A240)	AO15 Open Value Custom = Volts X 10]	50	%	50	%
242	Analog Setpoint	InputConfigA (A242)	VAV box configuration setpoint	0	none	0	none
243	Analog Setpoint	OutputConfigA (A243)	VAV box configuration setpoint	-71	none	-71	none
244	Analog Setpoint	PriAirMaxMult (A244)	Max Flowrate Air Multiplier	1	none	1	none
245	Analog Setpoint	TABPriHoodAtMax (A245)	TAB Air Reading at Max Flowrate	800	cfm	400	l/sec
246	Analog Setpoint	PriAirPIDDeriv (A246)	Primary Air PID derivative	0	none	0	none
247	Analog Setpoint	CustomClosedVX10_AO14 (A247)	AO14 Open Value Custom = Volts X 10	0	%	0	%
248	Analog Setpoint	CustomOpenVX10_AO14 (A248)	AO14 Open Value Custom = Volts X 10	50	%	78	%
250	Analog Setpoint	FPM_ZeroFactor (A250)	Zero Offset of AFS in FPM	0	none	0	none
253	Analog Setpoint	UI04CO2SensorBase (A253)	CO_2 Sensor Reading at 0 V DC	0	ppm	62	ppm
254	Analog Setpoint	UI04CO2SensorSpan (A254)	CO_2 Sensor Reading at 10 V DC	2000	ppm	80	ppm
255	Analog Setpoint	LocalCO2Stpt (A255)	Net Zone CO_2 Setpoint	500	ppm	68.5	ppm
256	Analog Setpoint	UI04SensorBase (A256)	Relative Humidity Sensor Reading at 0 V DC	0	%RH	0	%RH
257	Analog Setpoint	UI04SensorSpan (A257)	Relative Humidity Sensor Reading at 10 V DC	100	%RH	100	%RH
258	Analog Setpoint	LocalDehumidStpt (A258)	Zone Dehumidification Setpoint	65	%RH	65	%RH
259	Analog Setpoint	CommunicationsOfflineTimer (A259)	Amount of minutes before communication status has been considered off when BACnet communications point OfflineTimerEnaBACnet (D257) is enabled.	15	min	0	min
260	Analog Setpoint	InputConfigB (A260)	VAV box configuration setpoint	0	none	0	none
261	Analog Setpoint	OutputConfigB (A261)	VAV box configuration setpoint	0	none	0	none
286	Analog Setpoint	AOConfigD (A286)	VAV box configuration setpoint	0	none	1	none
296	Analog Setpoint	DamperDegrees (A296)	Damper AngleTravel Range - degrees	90	none	90	none
297	Analog Setpoint	DampActDriveTime (A297)	Damper actuator travel time	95	none	95	sec
320	Analog Setpoint	TriStateHtVlvDriveTime (A320)	Tristate valve travel time in seconds	95	sec	95	sec
334	Analog Setpoint	netOCC (A334)		2	none	Can't find in strat	none
335	Analog Setpoint	CommFailMode (A335)		0	none	in strat	
369	Analog Setpoint	TriStateHtVlvMinOnTime (A369)	Tristate valve minimum on time in seconds	2	sec	2	sec
371	Analog Setpoint	DegreesAbvBlwSPAlarm (A371)	Zone temperature error from current temperature setpoints alarm	2	°F	2	°c
373	Analog Setpoint	TempAlarmOnDelay (A373)	Amount of minutes before zone temperature alarms are triggered	60	min	60	min
379	Analog Setpoint	CFMAlarmOnDelay (A379)	Amount of minutes before Flowrate alarms are triggered	30	min	30	min
380	Analog Setpoint	TABParallelDisableFanSP (A380)	Parallel fan is enabled when Flowrate is below this setpoint	3000	cfm	3000	l/sec
381	Analog Setpoint	TABParallelFanDB (A381)	Parallel fan will be disabled when Flowrate is above this point + TABParallelDisableFanSP (A380)	50	cfm	25	l/sec
383	Analog Setpoint	SeriesFanStartLckOutSP (A383)	Series fan is disabled if Flowrate is above this setpoint when first energized. If this occurs, damper will drive shut and when Flowrate drops below this setpoint series fan will start	200	cfm	100	l/sec
385	Analog Setpoint	SliderValAt_N2 (A385)	Resistance at UI02 when slider is all the way to the left	15	ohms	15	ohms
386	Analog Setpoint	SliderValAt_N1 (A386)	Resistance at UI02 when slider is between all the way to left and middle	1315	ohms	1315	ohms
387	Analog Setpoint	SliderValAt_0 (A387)	Resistance at UI02 when slider is in middle	2800	ohms	2800	ohms
388	Analog Setpoint	SliderValAt_P1 (A388)	Resistance at UI02 when slider is between all the way to right and middle	4460	ohms	4460	ohms
389	Analog Setpoint	SliderValAt_P2 (A389)	Resistance at UI02 when slider is all the way to the right	4989	ohms	4989	ohms
401	Analog Setpoint	GraphicA (A401)		0	none	0	none
402	Analog Setpoint	GraphicB (A402)		0	none	0	none
403	Analog Setpoint	SpareAV403 (A403)		0	°F	Can't find in strat	
404	Analog Setpoint	SpareAV404 (A404)		0	°F	in strat	
405	Analog Setpoint	SpareAV405 (A405)		0	°F	Can't find	

Digital Points

Hardware (I/O)

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	UNITS
9	Digital Output	DO09	DO09 Command	
10	Digital Output	DO10	DO10 Command	
11	Digital Output	DO11	DO11 Command	
12	Digital Output	DO12	DO12 Command	
13	Digital Output	DO13	DO13 Command	

Values

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	UNITS
10	Digital	CommunicationsStatus (D10)	Communications with master controller failure if OfflineTimerEnaBACnet (D257) is enabled	
12	Digital	LocalDehumidControl (D12)	Enabled if local dehumidification control has been configured	
20	Digital	AirflowOKforElecHeat (D20)	Enabled when airflow has proved for electric heat. Applies to VAVs with no fan or series fan	
57	Digital	TerminalFanDefined (D57)	Enabled when controller has been configured for a series or parallel fan	
58	Digital	LocalCO2Control (D58)	Enabled if local CO_2 control has been configured	
65	Digital	LocalStptSlider (D65)	Enabled if local slide adjust has been configured and is not disabled by point DisableLocalSetptSliderViaEMS (D23)	
78	Digital	FanCmdAnimation (D78)	Current fan command	
97	Digital	CO2ControlRemote_Slave (D97)	CO_2 control source	1=Remote, 0=Local
122	Digital	PriAirModeEffCmd (D122)	Current Primary Air Mode Command	0=Enable 1=Disable
123	Digital	PriAirStateEffCmd (D123)	Current Primary Air State Command	0=Cool Air 1=Hot Air
125	Digital	FireStopEffCmd (D125)	Primary Air Mode Fire Stop Command	0=Off, Normal 1=On, Fire Stop
127	Digital	DehumidControlRemote_Slave (D127)	Dehumidification Control Source ON=Remote, OFF=Local	
131	Digital	DampMaxManEff (D131)	Damper set to Max Flowrate Manual Mode	
132	Digital	DampMinManEff (D132)	Damper set to Min Flowrate Manual Mode	
133	Digital	DampAuxManEff (D133)	Damper set to Heat Flowrate Manual Mode	
136	Digital	DampOpenManEff (D136)	Damper set Full Open Manual Mode	
137	Digital	DampCloseManEff (D137)	Damper set Full Close Manual Mode	
166	Digital	UI01DigitalStatusHost (D166)	UI01 Digital Control value	
169	Digital	LocalTempSensorFault (D169)	If zone temperature has short or open circuit, this point will be triggered	0=Normal 1=Alarm
180	Digital	HeatModeSts (D180)	Heat mode status	
181	Digital	CoolModeSts (D181)	Cool mode status	
186	Digital	OccModeSts (D186)	Occupancy mode status	1=Occupied 0=Unoccupied
187	Digital	StandbyModeSts (D187)	Standby mode status	0=Off 1=On
188	Digital	OccSensorEffCmdOnBoardSwitch (D188)	Occupancy effective command from push button override or motion sensor	
201	Digital	CFMHighAlarm (D210)	High Flowrate alarm	
202	Digital	CFMLowAlarm (D202)	Low Flowrate alarm	
208	Digital	LoadShedEffCmd (D208)	Load Shed Enable Effective Command	0=Disabled 1=Enabled
222	Digital	OverrideStatus_Outputs (D222)	If any outputs have been overridden this point will be on	0 = No Active Overrides 1 = Overrides Active
223	Digital	ManualStatus_Application (D223)	If any TAB manual mode override points have been set to on this point will be on	
224	Digital	OverrideStatus_Inputs (D224)	If any inputs have been overridden this point will be on	
226	Digital	PurgeEffCmd (D226)	If commanded to Purge mode this point will be on	

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	UNITS
232	Digital	`IO_Application_Status (D232)`	If any input, outputs, or manual status application mode is on, this point is on	
235	Digital	`UI04DigitalStatusHost (D235)`	UI04 digital status host	
241	Digital	`UnoccHeatRequest (D241)`	Unoccupied heat request	
242	Digital	`UnoccCoolRequest (D242)`	Unoccupied cool request	
253	Digital	`PriDamperOpenCmd (D253)`	Primary Damper Open Command	
254	Digital	`PriDamperCloseCmd (D254)`	Primary Damper Close Command	
284	Digital	`DO11CmdDisplay (D284)`	If DO11 is used in strategy this point will display on when DO 11 is commanded on	
305	Digital	`DO12CmdDisplay (D305)`	If DO12 is used in strategy this point will display on when DO 12 is commanded on	
305	Digital	`DO13CmdDisplay (D305)`	If DO13 is used in strategy this point will display on when DO 13 is commanded on	
310	Digital	`HighTempAlarm (D310)`	High temperature alarm	0=Normal 1=Alarm
311	Digital	`LowTempAlarm (D311)`	Low temperature alarm	0=Normal 1=Alarm

Setpoints

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	UNITS	DEFAULT VALUES	
					IMP STG.	MET STG.
23	Digital Setpoint	`DisableLocalSetptSliderViaEMS (D23)`	Disables the local setpoint slider	1 = On (Slider disabled), 0 = Off (Slider enabled)	0	0
150	Digital Setpoint	`TABPriAirZero (D150)`	TAB Calibrate Zero Airflow	1=On, 0=Off	0	0
151	Digital Setpoint	`TABAutoCalKfactor (D151)`	TAB Auto Calibrate K Factor	1=On, 0=Off	0	0
160	Digital Setpoint	`CmdPriAirMode (D160)`	Primary Air Mode Command	1=Disable, 0=Enable	0	0
161	Digital Setpoint	`CmdPriAirState (D161)`	Primary Air State Command	1=Heating, 0=Cooling	0	0
163	Digital Setpoint	`DampAuxMan (D163)`	Damper Command to Heat Flowrate Manual Mode	1=On, 0=Off	0	0
170	Digital Setpoint	`DO11RemoteCmd (D170)`	DO11 override on command	1=On, 0=Off	0	0
171	Digital Setpoint	`DO12RemoteCmd (D171)`	DO12 override on command	1=On, 0=Off	0	0
172	Digital Setpoint	`FanCoolMaxMan (D172)`	Fan Commanded to Max Cool Speed Manual Mode	1=On, 0=Off	0	0
173	Digital Setpoint	`FanDeadbandMan (D173)`	Fan Commanded to Min Speed Manual Mode	1=On, 0=Off	0	0
174	Digital Setpoint	`FanHeatMaxMan (D174)`	Fan Commanded to Max Heat Speed Manual Mode	1=On, 0=Off	0	0
175	Digital Setpoint	`FanStandbyMan (D175)`	Fan Commanded to Standby Speed Manual Mode	1=On, 0=Off	0	0
177	Digital Setpoint	`DO13RemoteCmd (D177)`	DO13 override on command	1=On, 0=Off	0	0
178	Digital Setpoint	`EnableManualHeatCmd (D178)`	Manual Heat Enable Command	1=On, 0=Off	0	0
179	Digital Setpoint	`EnableManualCoolCmd (D179)`	Manual Cool Enable Command	1=On, 0=Off	0	0
184	Digital Setpoint	`OccCmd (D184)`	Occupancy command	1=Occupied 0=Unoccupied	1	1
185	Digital Setpoint	`StandbyCmd (D185)`	Standby command	1=On, 0=Off	0	0
191	Digital Setpoint	`DampOpenMan (D191)`	Set Damper Full Open Manual Mode	1=On, 0=Off	0	
192	Digital Setpoint	`DampCloseMan (D192)`	Set Damper Full Close Manual Mode	1=On, 0=Off	0	
193	Digital Setpoint	`DampMaxMan (D193)`	Damper set to Max Flowrate Manual Mode	1=On, 0=Off	0	
194	Digital Setpoint	`DampMinMan (D194)`	Damper set to Min Flowrate Manual Mode	1=On, 0=Off	0	
199	Digital Setpoint	`FireStopCmd (D199)`	Damper set to Fire Stop Cmd	1=Enable, 0=Disable	0	0
204	Digital Setpoint	`TABPriAirManMode (D204)`	Primary air manual mode command	1=On, 0=Off	0	0
206	Digital Setpoint	`TABPriAirManModeReset (D206)`	Disables primary air manual mode	1=On, 0=Off	0	0
210	Digital Setpoint	`FanHeatMinMan (D210)`	Fan Commanded to Min Heat Speed Manual Mode	1=On, 0=Off	0	0
211	Digital Setpoint	`LoadShedEnable (D211)`	Load Shed Enable Command	1=Enable, 0=Disable	0	0
213	Digital Setpoint	`Purge (D213)`		1=Enable, 0=Disable	0	0
230	Digital Setpoint	`DampReverse (D230)`	Reverses damper action 0 = CW open, CCW close 1 = CW close, CCW open	1=On, 0=Off	0	0

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	UNITS	DEFAULT VALUES	
					IMP STG.	MET STG.
231	Digital Setpoint	*EnaUnoccCool (D231)*	This point enables unoccupied cooling	1=Enable, 0=Disable	1	1
257	Digital Setpoint	*OfflineTimerEnaBACnet (D257)*	Enables offline timer test. When set to on controller will be set to occupied when loss of BACnet MS/TP communication occurs	1=Enable, 0=Disable	0	0
285	Digital Setpoint	*ParallelFanEnabPriAirHot (D285)*	When this point is enabled, parallel fan will be allowed to run when primary air state is hot and there is a call for heat	1=Enable, 0=Disable	0	0
296	Digital Setpoint	*EnabDamperPosReset (D296)*	By default, when VAV is in unoccupied mode and there is less than 10 CFM the damper will drive shut for 100 seconds to zero out damper position calculation	1=Enable, 0=Disable	1	1
312	Digital Setpoint	*DO13RevAct (D312)*	When this point is enabled, DO13 will be set for reverse acting	1=Enable, 0=Disable	0	0
313	Digital Setpoint	*DO11RevAct (D313)*	When this point is enabled, DO11 will be set for reverse acting	1=Enable, 0=Disable	0	0
314	Digital Setpoint	*DO12RevAct (D314)*	When this point is enabled, DO12 will be set for reverse acting	1=Enable, 0=Disable	0	0

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