NB-VAV

User Manual

American Auto-Matrix®
Smart Building Solutions®

NB-VAV User Manual

Part Number 1E-04-00-0115

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4/10/2013

- Corresponds to v6.09 Firmware Release
- Updated Section 1.6 - Corrected Relative Humidity operating range.
- Updated Section 2.6 - Changed name to SBC-STAT Support. All references for wiring and installation are now referred to the STAT User Manual (1E-04-00-0103)
- Updated Appendix A to document new heat recovery factor property for totalized energy routines.

4/12/2012

- Correspond to v6.08.00 firmware release

12/29/2011

- Updated Appendix A with correct property identifiers in Zone Temperature Object
- Added Relative Humidity Object

10/20/2009

- Manual Relaunch - Coincides with BTL listing of the product. All previous revisions of documentation are discontinued.

This manual describes the installation and operation of the NB-VAV. This document is divided into the following sections, each beginning with a table of contents for the section:

- One: Product Overview, describing the features of the NB-VAV and presenting the specifications for the controller.
- Two: Wiring & Installation, detailing the wiring and installation procedures.
- Three: Fundamental Concepts, listing rudimentary concepts of American Auto-Matrix technology.
- Four: Product Configuration for Rooftop Mode.
- Appendix A - Rooftop Object and Property Reference.

NOTE
Notes indicate noteworthy information and appear in boxes with this format separated from the running text.

CAUTION
Cautions indicate information that may prevent serious system or user problems and appear in boxes with this format separated from the running text.

WARNING
Warnings indicate inforamtion that prevent personal injury or equipment damage and appear in boxes with this format separated from the running text.

SECTION 1: OVERVIEW

This section provides a complete overview of the NB-VAV family of Native BACnet terminal box controllers manufactured by American Auto-Matrix. Detailed functionality descriptions of each key feature of the NB-VAV (inputs, outputs, etc.) is provided within this section.

IN THIS SECTION:

1.1 DESCRIPTION

The Native BACnet Series (NB) unitary control modules are fundamental control devices in the American Auto-Matrix (AAM) BACnet System Architecture.

The *NB*-VAV is a unitary controller designed for variable air volume (VAV) and constant air volume (CAV) terminal box applications. The NB-VAV provides built-in control functions such as closed loop, direction control for applications requiring floating setpoint actuation, fully modulating analog outputs using PID control, thermostatic control of digital outputs, occupancy detection, runtime totalization and scheduling to name a few.

Network communications occurs over BACnet MS/TP (Master Slave Token Passing). The *NB*-VAV is designed to operate in a stand-alone environment, or interact with other BACnet MS/TP devices. Using NB-Pro, AAM's Native BACnet Commissioning Environment, the NB-VAV can be programmed over the network or in a direct connect application.

The hardware layout of the NB-VAV consists of a main module with removable terminal blocks to connect universal inputs, analog outputs, digital outputs, and even a dedicated input for connecting a single or networked set of *SBC*-STAT family devices using AAM's revolutionary sensor network known as STATbus. The *NB*-VAV also includes an on-board airflow sensor and integrated Belimo Actuator. Other key components include diagnostic LEDs for network indication and digital output status, and configurable jumpers for configuring universal inputs for a wide-array of applications. Using the IAQ variant of *NB*-VAV, users can implement CO_2-based Indoor Air Quality applications by connecting a CO_2 sensor to the additional Universal Input offered.

The NB-VAV is available in many product variants dependent on your application scenario, including relay only board, triac only boards, and actuator types.

Table 1-1: NB-VAV Models

Product Designation	Triac	Relay	AO	UI	Real-time Clock	Airflow Sensor	Actuator
NB-VAVta	5	None	1	2	Optional	Yes	Standard Actuator
NB-VAVta-IAQ	5	None	1	3	Optional	Yes	Standard Actuator
NB-VAVtf	5	None	1	2	Optional	Yes	Feedback Actuator
NB-VAVtf-IAQ	5	None	1	3	Optional	Yes	Feedback Actuator
NB-VAVra	None	5	1	2	Optional	Yes	Standard Actuator
NB-VAVrf	None	5	1	2	Optional	Yes	Feedback Actuator

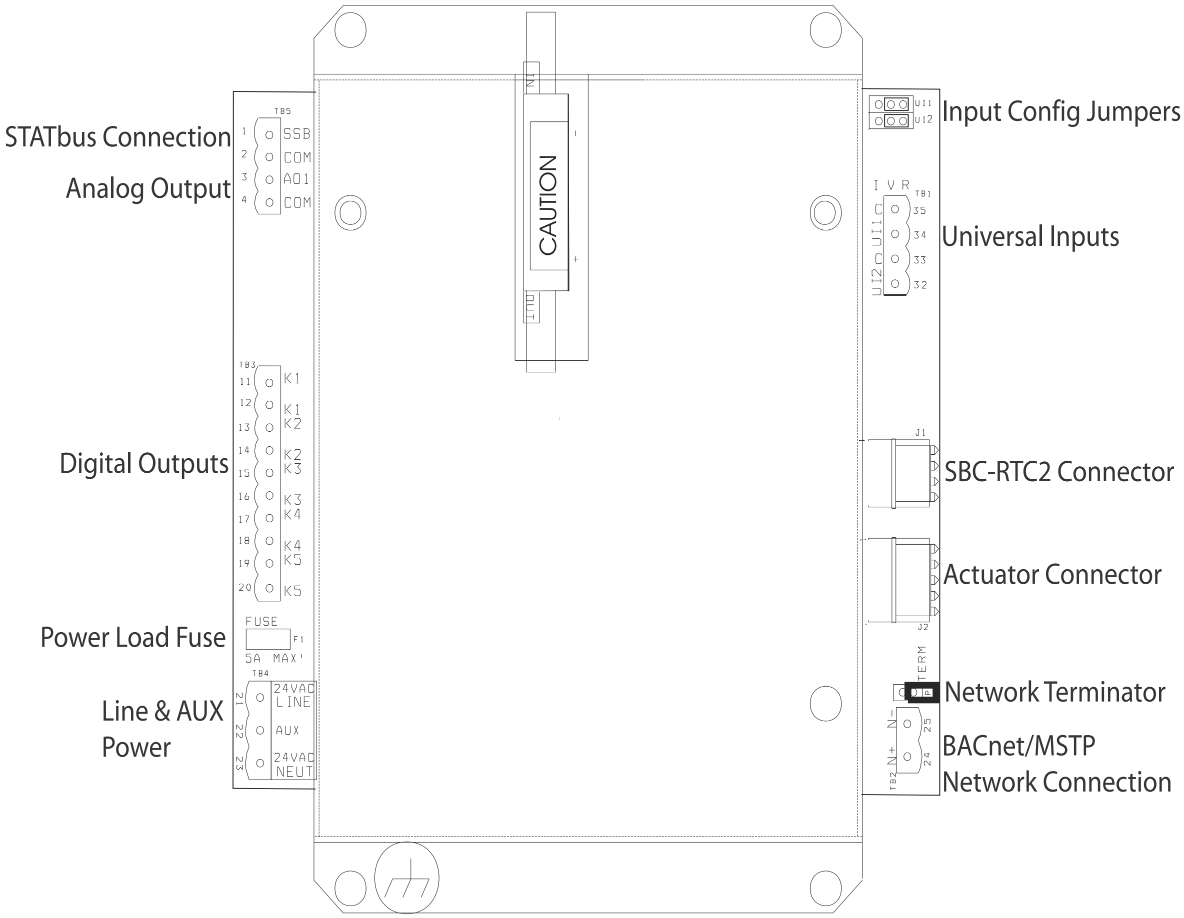

Figure 1-1 NB-VAV Hardware Layout

Table 1-2: NB-VAV Input/Output Board Assignments

Terminal	I/O	Description
1 (TB5)	SSB	STATbus Network Port Lead
2 (TB5)	COM	STATbus Network Port Common
3 (TB5)	AO1	Analog Output Channel 1
4 (TB5)	COM	Analog Output Common
11 (TB3)	K1	Relay 1 Common or Triac Output 1
12 (TB3)	K1	Relay 1 Normally Open or Triac Output 1
13 (TB3)	K2	Relay 2 Common or Triac Output 2
14 (TB3)	K2	Relay 2 Normally Open or Triac Output 2
15 (TB3)	K3	Relay 3 Common or Triac Output 3
16 (TB3)	K3	Relay 3 Normally Open or Triac Output 3
17 (TB3)	K4	Relay 4 Common or Triac Output 4
18 (TB3)	K4	Relay 4 Normally Open or Triac Output 4
19 (TB3)	K5	Relay 5 Common or Triac Output 5
20 (TB3)	K5	Relay 5 Normally Open or Triac Output 5
21 (TB4)	24 VAC Line	24 Volt AC Control Power Input
22 (TB4)	AUX	24 Volt AC Auxiliary Output for DC Loads (5A Fuse)
23 (TB4)	24 VAC NEUT	24 Volt AC Neutral
24 (TB2)	N+	Positive 485 Network Communication Line
25 (TB2)	N-	Negative 485 Network Communication Line
30 (TB1)	UI3	Universal Input 3 (IAQ Models Only)
31 (TB1)	COM	Common (IAQ Models Only)
32 (TB1)	UI2	Universal Input 2
33 (TB1)	COM	Common
34 (TB1)	UI1	Universal Input 1
35 (TB1)	COM	Common

1.2 INPUTS

The NB-VAV Universal Inputs are high resolution (15-bit) UIs that can accept 0-20mA when in current mode, 0-1MΩ inputs when in resistance mode, or 0-10VDC when in voltage mode. A capacitor in the circuit provides a 10Hz low-pass filter. Over-range protection is provided to clamp normal overrange conditions and to protect against damage from electrostatic discharge (ESD). The UIs can be configured for alarming, setup/setback, filtering, and input polarity.

All of the UIs have associated selection jumpers for selecting current, resistance and voltage modes. The procedure for configuring these jumpers in explained in further detail in Section 2: Wiring and Installation.

1.2.1 UIS CONFIGURED AS DIGITAL INPUTS

Each Universal Input may be programmed to behave as a digital (on/off) input. UIs configured as digital can be defined for contact closures or any two-state inputs that are needed in a particular application. Typical digital input applications that are supported by the NB-VAV are fan status, proof of flow, and occupancy detection (dependent on sensor type).

Digital configured UIs support two different types of contact alarming (changes from 0 to1 or 1 to 0). Filtering options are also provided to program the amount of time required for input stability prior to alarming. The polarity of the digital input signal is also programmable within the input object.

1.2.2 UIS CONFIGURED FOR LINEAR SENSORS

Each Universal Input may be programmed as a linear scaled input for 0-10VDC input devices or 4-20mA input devices. Each of these types of devices may be programmed within minimum and maximum Engineering Units which define the end points of the analog values after they are read and converted to scaled Engineering Units.

For example, if you are using a linear, 4-20mA input device to measure carbon dioxide content (CO2) in the air, you must configure the minimum and maximum scaled values for that input as 0 ppm (parts-per-million) and 5,000 ppm.

Linearly scaled analog inputs have associated high and low alarm limit properties that may be setup and setback during unoccupied periods (programmable times when zone control can be less stringent), the result is a wider operating range during unoccupied periods. In addition, a hysteresis can be applied to each alarm definition to control nuisance alarms that may occur between transitions.

High and low limit alarms may be disabled for a programmable length of time after the controller has been reset or after power has been cycled.

1.2.3 UIS CONFIGURED FOR THERMISTOR SENSORS

Each Universal Input may be programmed to accept a Precon, type-3, 10k ohm thermistor. A built-in table is provide for approximate linearization. Inputs using Precon, type 3 thermistors will use temperature ranges of -30.0° to 230.0° F (-35.0° to 110.0° C). The temperature units (Fahrenheit or Celsius) can be configured in the Device object of the NB-VAV controller using property **EM**.

Thermistor inputs of the NB-VAV have associated high and low alarm properties that may be setup and setback during unoccupied periods (programmable times when zone control can be less stringent), The result of a wider operating range during unoccupied periods. In addition, a hysteresis can be applied to each alarm definition to control nuisance alarms that may occur between transitions.

High and low limit alarms may be disabled for a programmable length of time after the controller has been reset of after power has been cycled.

1.3 OUTPUTS

The NB-VAV provides five (5) triacs or relays (dependent on the variant of NB-VAV purchased) and one (1) Analog Outputs.

1.3.1 DIGITAL OUTPUTS

Digital Outputs provide On/Off control of output devices such as fans, valves, or cooling/heating stages. There are two types of Digital Outputs that can be obtained at time of purchase: optically isolated, solid state triacs or mechanical relays. Relay and triacs have identical logical operation. However, they have different physical operating conditions. All DOs enforce minimum cycle time operation, determine the polarity, and provide a runtime alarm limit for the output.

Relays have a 1A, 24VAC/DC rated load, normally open, non-polar contact. A tranzorb protection device is provided to suppress transients and contact arcing. Pulse width modulation (PWM) operation of floating valves or other devices is not recommended with relays.

Triacs have a 1A, 24VAC rated load, normally open, non-polar contact. An MOV protection device is provided to suppress transients. Triacs are recommended for PWM operation of floating valves, damper motors, etc. Triacs will switch a 1A, 24VDC load, but they will not turn off until the load power is removed.

CAUTION

Triacs are capable of switching a 1A, 24VDC load, but they will not turn off until the power load is removed.

NOTE

AAM recommends that output loads be wired so that one side of the load is grounded when possible.

DO 1 (marked K1 on the PCB Board) is the Fan Digital Output. It is dedicated for the use of series fan, parallel fan, or induction damper binary control.

DO 2(marked K2 on the PCB) can control a stage of reheat; function as the *close* signal for Valve Control 1, or function as the PWM output when PWM is used.

DO3 (marked K3 on the PCB) can control a stage of reheat or can serve as the *open* signal for Valve Control 1.

DO4 (marked K4 on the PCB) can control a stage of reheat or function as the *close* signal for Valve Control 2, or function as the PWM output when PWM is used.

DO5 (marked K5 on the PCB) can control a stage of reheat or function as the *open* signal for Valve Control 2.

1.3.1.1 VALVE CONTROL LOOPS

The NB-VAV has two Valve Control loops, capable of providing floating point motor control or pulse width modulation (PWM) control based off Zone Temperature. The Valve Control loops feature discharge air temperature lockout options, user-defined loop variables (proportional control band, integration constant, valve travel times, etc.), heating/cooling changeover, and control sign (normal or reverse operation) capabilities.

Table 1-3: Valve Control Output Assignments

Output	Valve Control Loop	Floating Point Control Signal	Pulse Width Modulation
K2	Valve Control 1	Close	Control
K3	Valve Control 1	Open	
K4	Valve Control 2	Close	Control
k5	Valve Control 2	Open	

1.3.2 ANALOG OUTPUT

The NB-VAV includes one Analog Output, capable of outputting a 0-10VDC signal at an 8-bit resolution. The Analog Output may be programmed to operate in either manual mode or automatic mode.

In automatic mode, the Analog Output is typically associated to PID Loop 1, which can be used to control an end device that requires an analog signal (damper, transducer, etc.). In manual mode, the Analog Output may be directly controlled by a host or other BACnet MS/TP peer using Priority Array.

1.3.2.1 PID CONTROL LOOP

The NB-VAV has one Proportional + Integral + Derivative (PID) control loop which can perform closed-loop PID control using the available Analog Output. These PID loops provide analog output control (for use with electronic actuators, for example) and feature a selectable measured variable input, a selectable reset input, control sign (normal or reverse operations) and setup/setback schedule control.

When the value of the selected measured variable is within the control loop’s programmable deadband, no control action is taken by the PID loop. For example, control loop deadband is programmed to be 1 degree for a thermistor input, then the loop output may hunt (open and close) if the VAV cannot achieve setpoint to within 0.5 degrees around the setpoint.

When the value of the measured variable is outside the deadband, but within a programmable proportional band, the output is modulated using PID control according to the setpoint of the control loop. When the value of the measured variable is outside the deadband and beyond (either above or below) the proportional band, the output is set to its minimum or maximum value, as appropriate.

The PID loop can reset its setpoint when the value of a selectable reset variable is above a range of the reset limit

1.4 STATBUS

The NB-VAV includes one STATbus (SSB) port for connecting a single or a network of up to 4 digital *SBC*-STAT room sensors. STATbus is a polarity insensitive, two wire sensor bus that can be used in either analog or digital mode. In analog mode, NB-VAV supports *SBC*-STAT1 and *SBC*-STAT2.

In digital mode, NB-VAV supports digital *SBC*-STAT1D, *SBC*-STAT2D, *SBC*-STAT3, and SBC-RHT as well as the ability to network up to four digital *SBC*-STAT sensors together on the same physical sensor bus. In networked *SBC*-STAT applications, the NB-VAV has the option to control based on a collective average, highest reading, lowest reading, or one specific *SBC*-STAT. Additionally, STATbus can be used to link NB-VAV controllers together for tracking applications.

Unique to the industry, the *SBC*-STAT3 can be used to fully balance a VAV box through the use of a standard menu driven interface, protected with PIN number access.

For information on *SBC*-STAT products, reference the STAT User Manual for complete details.

NOTE

Analog *SBC*-STAT sensors cannot be networked together on the same sensor bus. If your application requires multiple zone sensors, you must use digital *SBC*-STAT senosrs.

Table 1-4: SBC-STAT Sensors Supported by NB-VAV

Analog *SBC*-STAT	Digital *SBC*-STAT
SBC-STAT1	SBC-STAT1D
SBC-STAT2	SBC-STAT2D
	SBC-STAT3D
	SBC-RHT

NOTE

The use of an SBC-RHT is only supported on firmware versions 6.07 and greater. In order to utilize this functionality please update the NB-VAV to the latest supported revision.

1.5 VAV OPERATIONS

The NB-VAV maintains the zone temperature to a user defined setpoint by modulating the VAV box damper controlling the air flow through the box to the area. The NB-VAV can control using the integrated Belimo actuator with: series fan, parallel fan, two-state induction damper; floating position or pulse with-modulation of hot water/chill water valve; electric reheats; and analog or, with the use of an I/P transducer, pneumatic damper or valve actuator.

Each NB-VAV may be connected to a single *SBC*-STAT, or network of digital *SBC*-STAT modules, incorporating zone temperature sensing with push button access to adjust setpoints and extend occupancy override.

> **NOTE**
>
> SBC-STAT functionality is dependent on the model of SBC-STAT connected to the NB-VAV. Reference the STAT User Manual for more information.

The NB-VAV primarily uses a local warmup application. In this application, electric reheats stage on as required, and the damper modulates to the preset warm-up flow setpoint.

During occupied and unoccupied periods, the damper, reheat, and fan functions are enabled for control. A minimum cycle time for the fan prevents short cycling. An internal proportional plus integral (P+I) control of the terminal box airflow ensures optimal control. An additional PID control loop is provided for the NB-VAV's analog output.

In electric reheat applications, two (2) or four (4) digital outputs can perform staged on/off control. Each stage is energized independently based on the zone temperature setpoints with a user-defined offset, and an optional proof-of-flow indication, indicated by either a digital input or minimum flow setting. Stages can also be configured to switch primary and secondary staging based on the on-time of the currently leading output. If both Valve Control objects are configured, electric reheat will be unavailable.

In select applications using digital *SBC*-STAT room thermostats, the *NB*-VAV can be configured to track the average flow of another *NB*-VAV controller. The target flow of one NB-VAV will then be derived from the other's average flow.

In Valve Control applications, users may configure the NB-VAV to pulse-width modulation (PWM) or floating point motor control applications based on heating or cooling needs. In PWM application, the output is energized for a percentage of the total drive/pulse period of a definable travel time. The output is pulsed/driven to an 'on' state for the amount of time called for by the control loop each time the full travel time of the valve elapses. In this configuration, any remaining digital output pairs (K2-K3 or K4-K5) can be used for electric reheat if desired.

The NB-VAV can utilize series fan, parallel fan, or induction damper modes. In series fan applications, the fan output is energized during all occupied and warm-up periods. In unoccupied mode, the fan is temperature controlled, but this can be overridden to an "always on" state. In night setback mode, the series fan remains off until the zone temperature varies beyond the limits of the control deadband. In parallel fan applications, the fan output is energized when schedule mode is occupied and the flow is less than the defined fan setpoint property. If the fan setpoint is equal to zero, the fan is energized in heating mode based on zone temperature control. For induction damper modes, The damper opens when the current airflow falls below preset minimum values for the heating cooling and warmup flow set in the Flow Setpoints object. The induction damper closes when the current airflow rises above the maximum values also specified in the Flow Setpoints object.

The NB-VAV can keep track of the volume of air and the total energy supplied through the terminal unit by monitoring the flow rate and the difference between the duct and zone temperatures, Extended occupancy time is accumulated as well, making complete sub-metering and tenant billing possible from a host or energy application.

The NB-VAV keeps track of the time of day once it has been initialized by a host device over the BACnet MS/TP network. If power to the NB-VAV is interrupted, the time-based functions are disabled and the occupancy state is determined by a user-defined software mode until the time of day is synchronized by the host controller. If the NB-VAV is equipped with the optional SBC-RTC module, NB-VAV will have the ability to keep track of its own time and day. The NB-VAV operates in four modes: occupied, unoccupied, warmup, and night setback. The active (or current) mode is determined by one of four sources: the host system, Schedule;weekly-schedule, schedule broadcasts from another NB device, broadcasts from a networked area controller, or local thermostat override.

The difference between occupied and unoccupied operations in the NB-VAV is in the temperature setpoints used for control. During occupied operation, heating and cooling setpoints define a desired temperature range. During unoccupied operations, these setpoints can be automatically modified for energy conservation through the use of setback values. Night setback is a special case of unoccupied mode. During night setback, the heating and cooling setpoints are set back by a user-definable value. If the zone temperature is within the deadband during night setback, the terminal box damper is set to minimum position.

1.6 SPECIFICATIONS

1.6.1 NETWORKING

The following specifications are necessary for networking of the *NB*-VAV controllers:

- **line signaling:** EIA-485
- **wiring:** shielded, twisted pair 18-22 AWG
- **network protection:** dual tranzorbs, Hi ESD driver
- **network configuration:** multidrop to 4,000ft. (1.5km) total
- **protocol:** BACnet MS/TP over EIA-485

1.6.2 INTEGRATED COMPONENTS

- LM24-M Belimo actuator (*NB*-VAVra-(IAQ) and *NB*-VAVta-(IAQ)) with floating mount, eliminating damper shaft stress and binding.
- LM24-10P-M Belimo feedback actuator (*NB*-VAVrf and *NB*-VAVtf-(IAQ)) with floating mount, eliminating damper shaft stress and binding.
- Flow sensor (0 - 3” wc).

1.6.3 ACTUATOR MOTOR

- **Torque rating:** 35in. lbs. (8Nm minimum).
- **Travel time:** approximately 85 seconds.

1.6.4 TERMINATIONS

- Pluggable terminal blocks for inputs, outputs, power, and network connection.

1.6.5 INPUT SUPPLY

- NEC class 2 transformer (customer-supplied).
- 22-26VAC, 50/60Hz, 10VA maximum, 5VA typical.
- 5A fuse load protection.
- PTC control electronics protection.

1.6.6 OPERATING ENVIRONMENT

- **Temperature range:** 0–50°C.
- **Humidity range:** 0–95% RH non-condensing.

1.6.7 DIMENSIONS

- **Size:** 8.5 in. (21.6 cm) × 4.75 in. (14.6 cm) × 2.63 in. (6.7 cm) and 5.5 in (16.51 cm) × 4.75 in (14.6 cm) × 1.5 in. (3.81 cm)
- **Shipping weight:** 2.04 lbs (.93 kg) and 1.86 lbs (.84 kg)

1.6.8 AGENCY APPROVALS

- UL listed 916, Management Equipment, Energy (PAZX).
- UL 873 Component-Temperature-Indicating and Regulating Equipment (XAPX2).
- Complies with FCC rules Part 15, Class B Computing Device.
- Complies with CE directives and standards.
- BTL Listed - BACnet-Application Specific Controller (B-ASC), conforming to 135-2004 standard.

SECTION 2: WIRING & INSTALLATION

This section reviews general wiring and installation practices for NB-VAV controllers. Detailed information is given to many areas including wiring for power, communications, inputs/outputs, and important safety requirements.

IN THIS SECTION:

2.1 INSTALLATION

The installation of the *NB*-VAV controllers involves determining actuator orientation, mounting the controller, supplying power, connecting to the communications network, and connecting input and output devices. All wiring connections to the *NB*-VAV are made with the use of plug (female) & socket (male) terminal blocks (TB). The plug consists of terminal ports and adjustment screws. Input/output device, network, and power wires enter the terminal ports and are secured to the assembly with the adjustment screws. The socket consists of a row of pins and is permanently mounted to the printed circuit board (PCB).

When connecting/disconnecting the two parts of the TB, align the holes on the plug with the pins on the socket and avoid twisting, thus damaging the assembly. Such damage will void the product warranty.

WARNING
The sockets to which the terminal block plugs connect are permanently attached to the PCB. Twisting or applying torque when connecting/ disconnecting will result in damage that will void the product warranty.

2.2 THE ACTUATOR ORIENTATION

The physical layout of the NB-VAV provides a method to allow the actuator orientation to be reversed from standard factory settings. This feature is available for retrofit applications in the event of an unpredictable mounting site, the direction of wiring, etc. The metal work consists of two pieces, the baseplate and the mounting clip, shown in Figure 2-1. The mounting clip is removable and can be reversed to provide mounting options with the actuator on the left or right side.

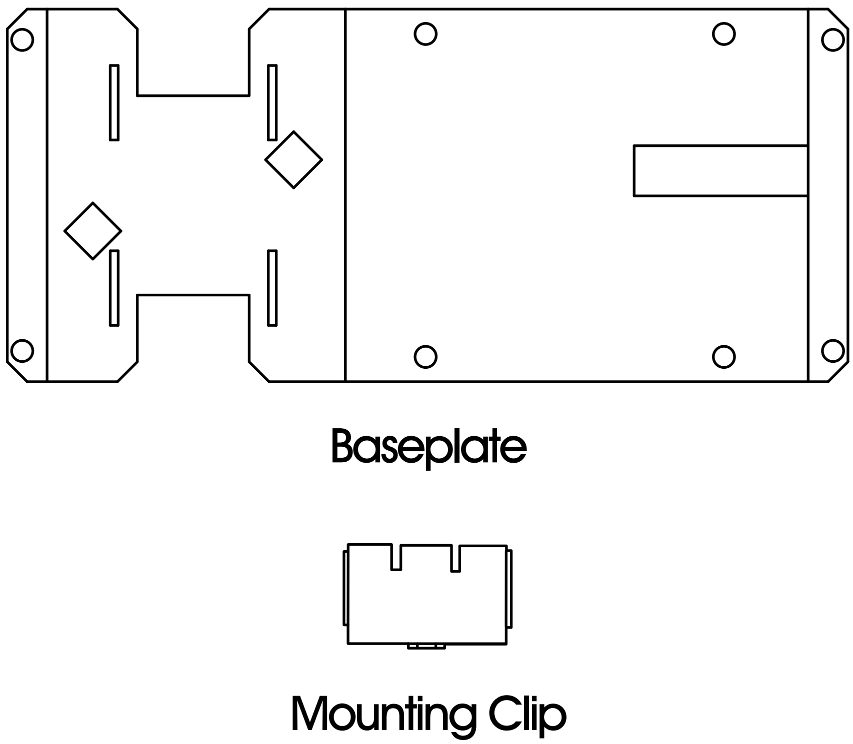

Figure 2-1 NB-VAV Metalwork

Before reversing the orientation of the actuator mounting clip you must first remove the actuator by unplugging the cable connecting the actuator to the controller and removing the screws from the reverse side of the controller which hold the actuator.

To reverse the orientation of the actuator mounting clip, perform the following steps:

1. Press on the locking tab to release the mounting clip. While maintaining pressure on the tab, slide the mounting clip to the end of the slots.

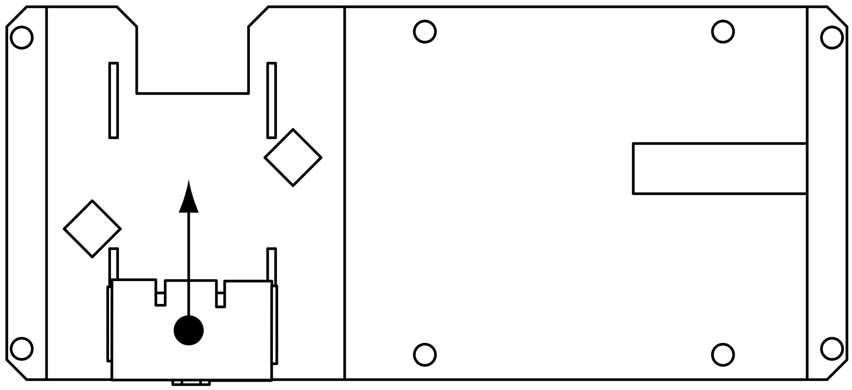

Figure 2-2 Unlock Actuator Mounting Clip

2. Remove the mounting clip from the baseplate.

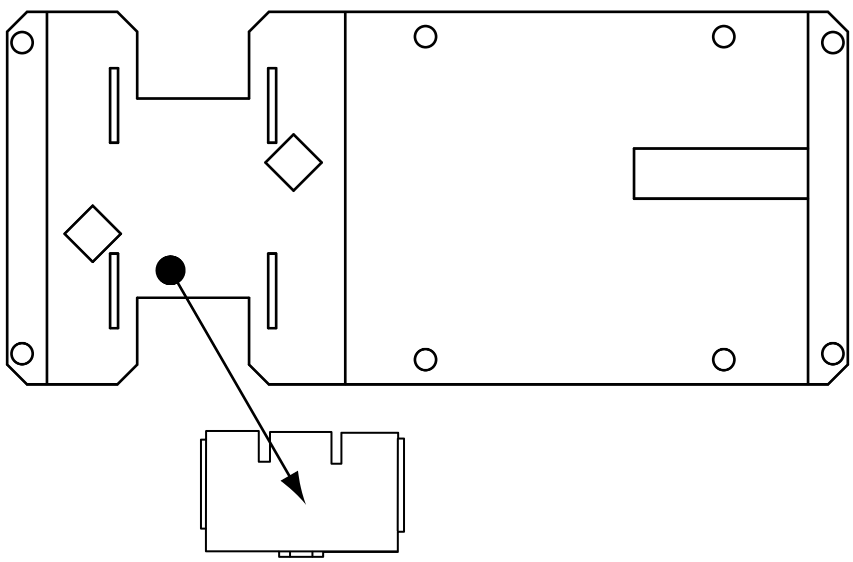

Figure 2-3 Remove Actuator Mounting Clip

3. Rotate the mounting clip.

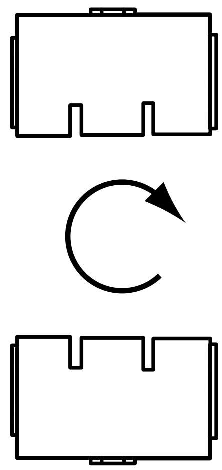

Figure 2-4 Rotate Mounting Clip

4. Insert the mounting clip into the other set of slots.

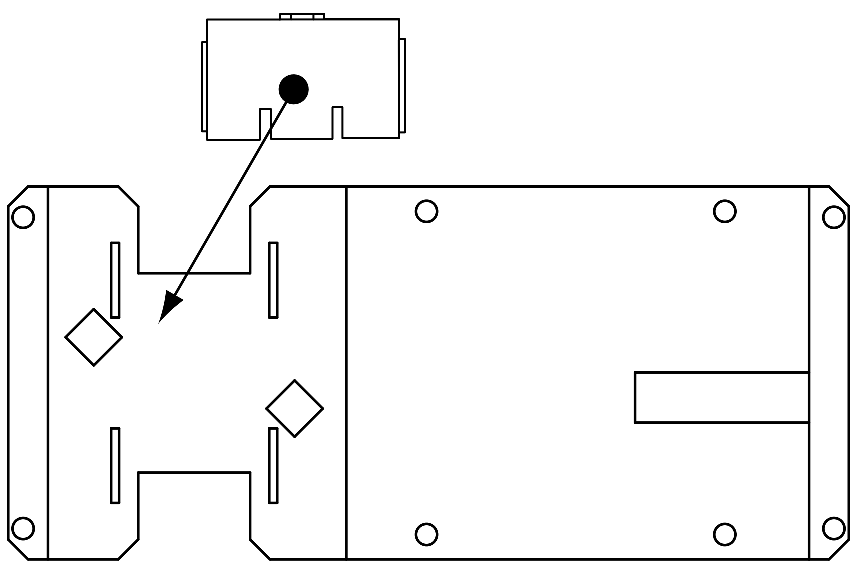

Figure 2-5 Insert Mounting Clip in Slots

5. Slide the mounting clip towards the edge of the baseplate until the locking tab clicks into place.

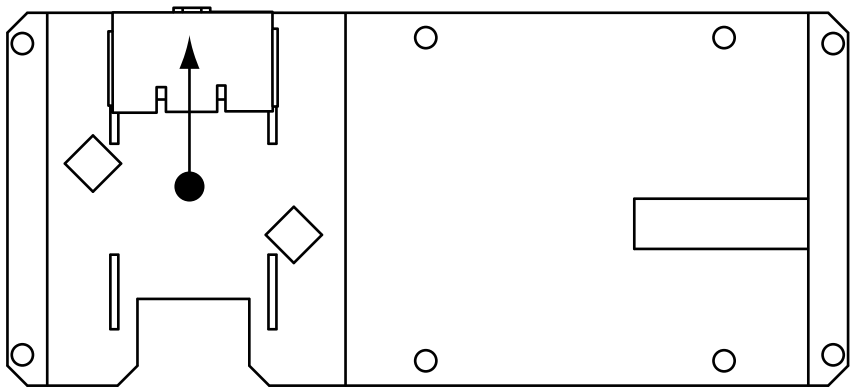

Figure 2-6 Slide Clip Into Place

2.3 MOUNTING THE NB-VAV CONTROLLER

To mount the NB-VAV controller, perform the following steps

CAUTION
The area in which the NB-VAV is being mounted should be free from moisture, to prevent against short-circuiting of on-board components.

1. Loosen the 10mm hex nuts of the U-bolt attached to the damper clamp.
2. Adjust the alignment of the actuator to the mounting bracket so that the screw attaching the two parts fits snugly into the bottom portion of the diamond shaped hole on the bracket.
3. Place the damper clamp around the damper shaft and position the *NB*-VAV controller on the terminal box so that at least two (2) of the controller backing's mounting holes are on the terminal box. Make sure that the bottom of the actuator is flush with the bottom of the sheet metal plate behind it.

CAUTION
The mounting bracket of the NB-VAV must make contact with the metal of the terminal box and the terminal box must be grounded to true earth ground to prevent electrical and communication problems.

4. Hand tighten the 10mm hex nuts to temporarily secure the damper clamp to the damper shaft.
5. If you are not using self-drilling mounting screws, use the controller backing as a template and mark the mounting hole locations on the terminal box. Remove the controller, then drill pilot holes in the terminal box. AAM recommends that at least two (2) screws be used to secure the *NB*-VAV controller to the terminal box.
6. Align the mounting holes of the *NB*-VAV controller with the pilot holes drilled in Step 5 and secure the controller to the terminal box using mounting screws. Mounting screws used to secure the controller to the terminal box are not supplied with the *NB*-VAV controllers.
7. Set the damper and actuator to 50 percent and fully tighten the damper clamp's 10mm hex nuts.
8. Adjust the hard stops of the damper clamp by loosening the screws that appear on top of the stops. Move the stops to the desired positions, and tighten the associated screws.

2.4 CONNECTING THE AIRFLOW SENSOR

The *NB*-VAV's integral airflow sensor is a precision instrument. To prevent dust particles from entering the *NB*-VAV's flow sensor, a sealed in-line filter is provided. Place the filter between the input (high) pressure side of the sensor and the high pressure side of the airflow pickup. When installing an *NB*-VAV type controller, connect the low pressure side of the duct airflow pitot to the low pressure side of the airflow sensor and the high pressure side of the duct airflow pitot to the high pressure side of the airflow sensor.

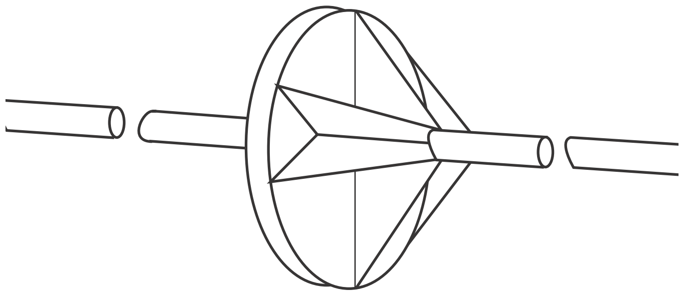

Figure 2-7 Airflow Sensor Filter

WARNING
Do not twist or apply torque to the airflow sensor. Doing so may damage the internal components of the NB-VAV. If damaged, the device wiill either not work at all or produce inaccurate measurements. Causing damage in this manner will void product warranty.

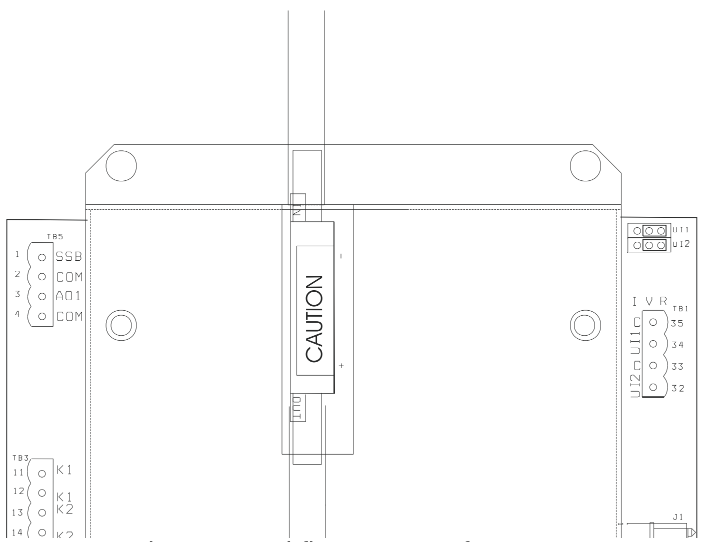

Figure 2-8 Airflow Sensor of NB-VAV

2.5 WIRING REQUIREMENTS

WARNING
For your safety, power should be removed when performing any type of wiring to the NB-VAV controller.

Follow the recommended wiring guidelines to reduce the chance of operation and communication errors. If you do not use proper wiring techniques, your site may not meet Federal Communications Commission (FCC) Class A regulations for radio frequency interference (RFI) emissions. All EIA-485 communications networks should employ shielded, twisted pair wiring. Each twisted pair must be individually shielded. Unshielded cables must be placed in solid metal conduit alone. Communications wiring (as well as *SBC*-STAT and other input wiring) **should not** be routed together with—or close to—other wiring carrying DC switching, AC lines, fluorescent lighting or any other RFI/electromagnetic interference (EMI)-emitting source. Failure to use these types of conductors may result in various system communications problems such as excessive network retries, noise susceptibility, and loss of communication.

2.5.1 CONNECTING POWER

You must use a 24VAC 50/60Hz NEC class II transformer rated at 10VA maximum (5VA typical) for power supply to the *NB*-VAV. AAM recommends that at least 18AWG wiring be used, but the terminals can accommodate 14–22AWG. Connect power to the 24VAC LINE (TB4: Terminal 21) and 24VAC NEUT (TB4: Terminal 23) of the NB-VAV.

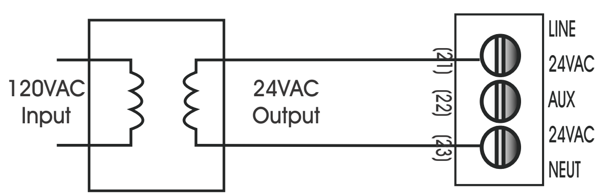

Figure 2-9 Connecting Power to the NB-VAV

CAUTION
AAM does not recommend sharing power transformers between devices. If this technique is used, AC polarity must be maintained throughout the power network. Product damage due to mis-application of power will void any warranty in place.

2.5.2 UNIVERSAL INPUT WIRING

The following section discusses common wiring applications for use with the NB-VAV controller. Deviations from the following examples should be discussed with AAM Technical Services prior to making modifications to a controller. Any modification other than those supported by AAM may void product warranty.

2.5.2.1 CONNECTING VOLTAGE INPUTS TO UIS

To connect a voltage input (0 - 10VDC analog input device) to a UI, perform the following:

1. Remove the IVR jumper for the corresponding Universal Input.
2. Wire voltage input device to UI and COM terminals accordingly.

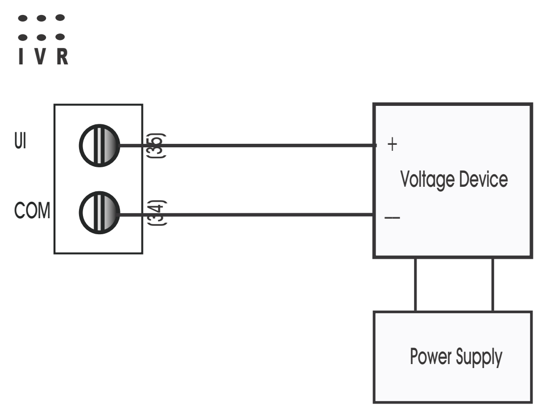

Figure 2-10 Wiring a Voltage Input to a Universal Input

2.5.2.2 CONNECTING 4-20MA INPUTS TO UIS

To connect a 4-20mA input to a UI, perform the following:

1. Jumper the I and V pins for the corresponding Universal Input on the IVR jumper block.
2. Wire 4-20mA device to UI and COM terminals accordingly.

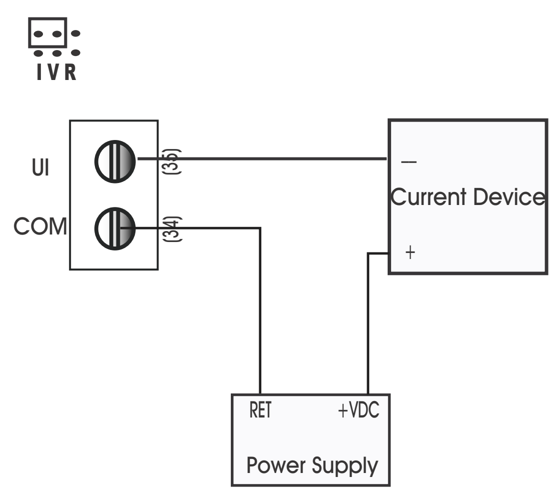

Figure 2-11 Wiring a 4-20mA Input to a Universal Input

2.5.2.3 CONNECTING STATUS INPUTS TO UIS

To connect a status input (digital input) to a UI, perform the following:

1. Jumper the V and R pins for the corresponding Universal Input on the IVR jumper block.
2. Wire digital input to UI and COM terminals accordingly.

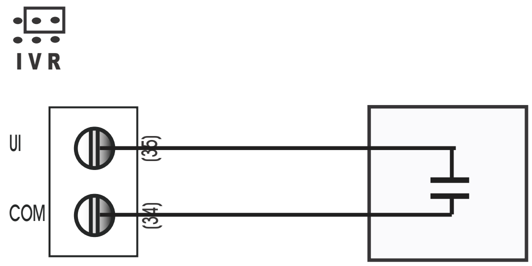

Figure 2-12 Wiring a Digital Input to a Universal Input

2.5.3 OUTPUT WIRING

The following section discusses common digital output wiring applications for use with the NB-VAV. Depending on which NB-VAV model ordered, your device will either have triac outputs or relay outputs. For example, *NB*-VAVrf has relay outputs, whereas *NB*-VAVtf has triac outputs.

2.5.3.1 RELAY DIGITAL OUTPUTS

NB-VAVra and NB-VAVrf relay outputs are mechanical relays with the following features:

- 24VAC/VDC, 1A rated load
- Isolated, normally open (Form 1A) contact
- Non-Polar

When wiring, connect one of the output load wires to either one of the relay output terminals, connect the remaining output load wire to a power source wire, then connect the other power source wire to the other remaining relay output terminal.

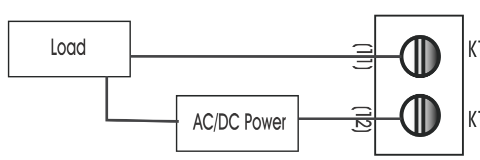

Figure 2-13 Wiring Relay Outputs

2.5.3.2 TRIAC DIGITAL OUTPUTS

NB-VAVta(IAQ) and NB-VAVtf(IAQ) triac outputs are solid state triac relays with the following features:

- 24VAC, 1A rated load
- Optically isolated, normally open (Form 1A) contact
- Non-Polar

In the example below, the AUX terminal located on the Power Input provides 24V for your triac. The AUX is fused at 5A max.

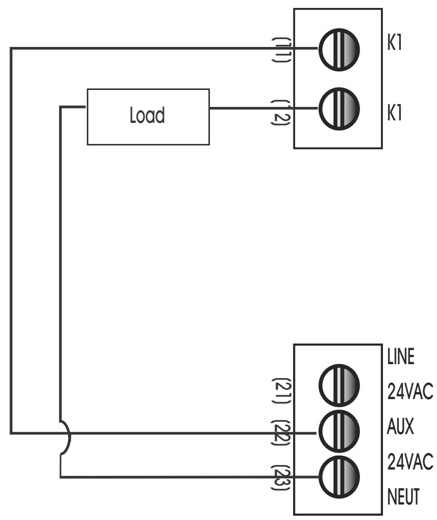

Figure 2-14 Wiring Triac Outputs using the 24VAC Auxiliary Power

If more power is needed, a properly rated external power source must be used. When wiring triacs, loads can be resistive or inductive. If your load requires more than 24V or more than 1A, a properly sized intermediate relay must be used.

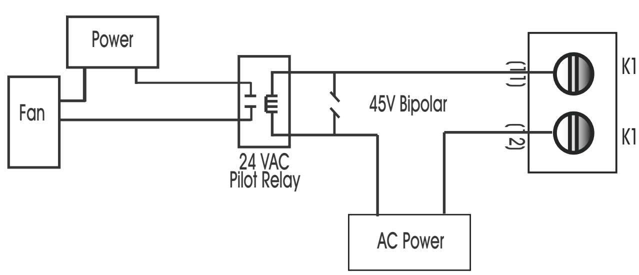

Figure 2-15 Wiring Triac Outputs with 24VAC Pilot Relays

CAUTION

Triacs will switch a 1A, 24VDC load. However, the triac will not turn off until the load power applied is removed.

2.5.3.3 ANALOG OUTPUT WIRING

The analog output is a 0-10VDC output (8-bit resolution) which is typically used for PID Loop applications. Wiring the analog output to a device is straight-forward, by wiring the AO terminal to the positive side of the end device, followed by the COM terminal to the negative side of the end device.

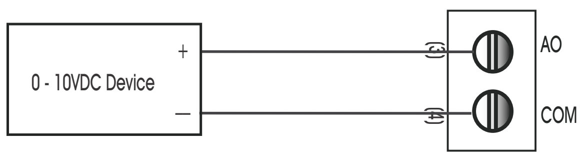

Figure 2-16 Analog Output Wired for a 0-10VDC Output

2.5.4 OPTIONAL ACTUATOR WIRING

The NB-VAV can accommodate an optional actuator, either AC or DC powered. Figure Figure 2-17 below provides an example of wiring an AC actuator to the NB-VAV.

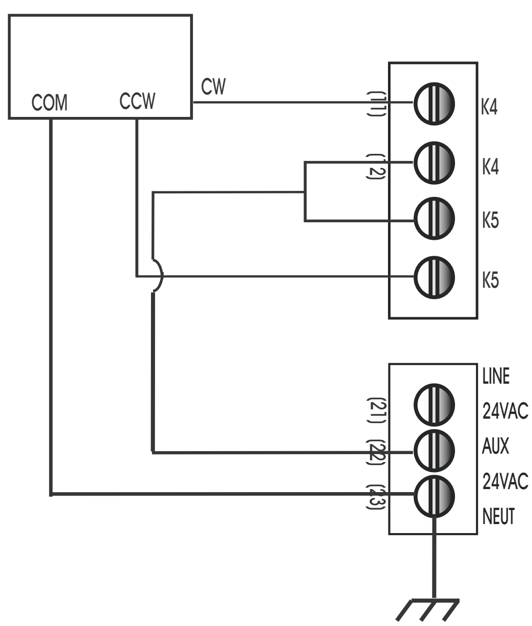

Figure 2-17 AC Actuator Wiring

When connecting a DC powered actuator, connect the actuator wires to pin 4 (Actuator -) and 5 (Actuator +) on the SBC-VAV(r/t/a/f) J2 connector.

2.6 SBC-STAT SUPPORT

The Product Name supports the following SBC-STAT models:

- SBC-STAT1
- SBC-STAT1d
- SBC-STAT2
- SBC-STAT2d
- SBC-STAT3
- SBC-RHT

For information on wiring and installation of SBC-STAT products, please refer to the STAT User Manual (Part # 1E-04-00-0103).

NOTE

The designation of ‘d’ in the SBC-STAT model indicates that the unit uses a digital sensor, and can support networking of multiple SBC-STAT devices.

SBC-STAT models with no ‘d’ designation cannot be networked and are intended for a one-to-one application between in and the controller.

NOTE

Use of the SBC-RHT with this product is valid for single thermostat applications only. The NB-VAV(rtaf) does not support the ability to network multiple SBC-RHT sensors, or a mixture of digital SBC-STAT sensors and SBC-RHT sensors.

NOTE

This product supports the ability to network SBC-STAT1D, SBC-STAT2d, and SBC-STAT3. SBC-RHT sensors cannot be used in networked applications.

SECTION 3: FUNDAMENTAL CONCEPTS

This section provides information on general concepts and theory that must be understood prior to setup and configuration of AAM Native Series products.

IN THIS SECTION:

3.1 FUNDAMENTAL CONCEPTS

This section of the user manual reviews standard fundamental concepts and provides an explanation of the prerequisite information necessary to know prior to installing American Auto-Matrix NB-Series products.

3.1.1 BACNET MS/TP PROTOCOL INFORMATION

BACnet MS/TP (**M**aster **S**lave **T**oken **P**assing) is an EIA-485 network layer intended for use with lower-level devices such as Unitary Controllers. In comparison to BACnet/IP and BACnet/Ethernet, MS/TP is more cost-effective to implement due to lower cost of wiring. Given the MS/TP network is a serial-based network, devices may be configured to communicate at different baud rates specified by BACnet. Therefore it is essential to know information regarding the BACnet network you are connecting to prior to installing and implementing the NB-VAV.

3.1.2 MS/TP TOKEN PASSING

BACnet MS/TP uses token passing to allow devices to communicate on the network. Token passing is controlled by each device, which contains an internal memory list of other MS/TP peers connected to the network. The token is passed in order of the MAC Address (Unit ID) from lowest to highest. In most MS/TP networks, each device is configured to be a master. Given all devices may be a master, MS/TP may appear and react slower than traditional building automation protocols. However, configuring your network for faster baud rates will help provide better bandwidth and transport speed of network messaging.

Token passing is a communications scheme that allows connected devices connected to inter-communicate with one another. A network "token" is passed from unit to unit on the network in a round-robin fashion by order of the MAC Address (lowest to highest) to provide a transport to access the network. When a unit possesses the token, it may perform any network activity for which it is responsible. When finished, the token is then passed onto the next device. At any time, the unit that possesses the token is the only device permitted to initiate communications with another device on the network or to request information from it. A device that receives the token may or may not need to perform network functions (e.g. read values from a remote device, broadcast information, etc.). If not, it will simply pass the token along the network.

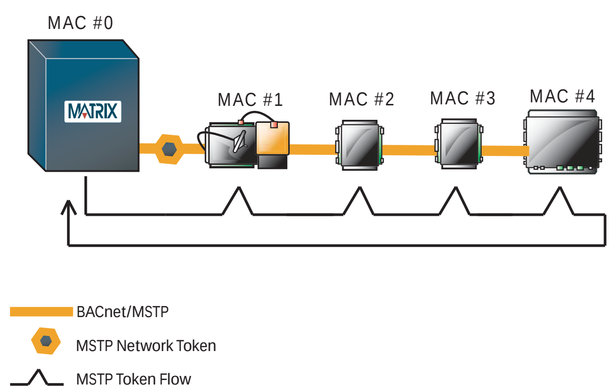

Figure 3-1 MS/TP Token Passing Example

Because each device can be an MS/TP master, it is important to realize that each MS/TP network should be optimized. Later sub-sections of this manual explain this process.

3.1.3 MS/TP LAN WIRING

Similar to EIA-485 standards, BACnet MS/TP networks support a maximum network distance of 4000 feet maximum with 18-AWG, 2-wire, shielded-twisted-pair cabling. American Auto-Matrix devices are designed with half-watt serial drivers, allowing up to a maximum of 64 devices to be connected to a single MS/TP network bus.

If you are connecting the NB-VAV to an existing MS/TP network consisting of third-party devices, consult third-party vendor documentation regarding MS/TP network considerations.

3.1.4 DEVICE ADDRESSING

BACnet MS/TP devices contain two device addresses. One device address is known as a Device Instance, and the other is a MAC Address.

The Device Instance is an address assignment that is used to identify the BACnet device on a global BACnet network. When a device is connected to a global BACnet network consisting of multiple data layers joined together using routers, the Device Instance is used to uniquely identify the device on a global basis. The valid range for the device instance in a BACnet device is 0 to 4,194,302. The NB-VAV must be configured for a unique, non-conflicting Device Instance. In the event that multiple devices are assigned the same Device Instance, both devices will simply not communicate on the BACnet network, or could be subject to mis-directed messaging (a message intended for Device-A may be routed to Device-B)

The MAC Address is an address assignment used within the BACnet MS/TP segment to permit a device to actively communicate on the BACnet MS/TP network. Valid MAC Address assignments range from 0 to 127 and are typically assigned in a logical and incremental order to permit faster token passing between devices. The MAC Address of a BACnet MS/TP device must be a unique, non-conflicting value that exists on the local MS/TP network. In the event that multiple devices are assigned with the same MAC Address, the effects can be far detrimental than that of a conflicting Device Instance; potentially resulting in a failure of the entire local MS/TP network. In the event that the NB-VAV encounters its MAC Address may be a duplicate, the NB-VAV will inform the user that a duplicate MAC Address has been detected and will not perform client communications until resolved.

3.1.5 COMMUNICATION RATES

As a serial based protocol, BACnet MS/TP supports the following four baud rates: 9.6kbps, 19.2kbps, 38.4kbps, and 76.8kbps. The NB-VAV can be configured for any of the these baud rates, as well as native PC baud rates 57.6kbps and 115.2kbps which are currently not supported by the BACnet standard.

Each device communicating on an MS/TP network must be configured for the same baud rate at all times. In the event that the NB-VAV's communication baud rate is incorrect for the network it is connected to, the NB-VAV will inform the user that a different baud rate has been detected and will not perform client communications until resolved.

3.1.6 NETWORK OPTIMIZATION

In BACnet MS/TP devices, specific device properties are available to permit optimization. network communications. By adjusting Device properties max-master and max-info-frames, users can adjust the token passing abilities of devices. The functionality of these two properties is described as follows:

- ***Max-Master*** - defines the highest unit ID of a MSTP master that is connected to the network. This value specifies to what address extent a token may pass. For example if you have 64 devices addressed in logical order, this value would be assigned to 64. This value should be set to the same value across all devices connected to an MSTP network.
- ***Max-Info-Frames*** - defines the amount of data frames that a MSTP master can use the token before passing onto the next device. This value is typically set by the factory, but can be modified if necessary. In the event a device does not need to keep the token for the amount of frames specified, AAM devices will automatically pass the token onto the next device.

3.2 COMMAND PRIORITIZATION

BACnet uses a command prioritization scheme for objects that control equipment or software parameters that affect the operation of equipment connected to devices. Through the use of this command prioritization scheme (commonly referred to as Priority Array), a method is provided that allows a device to determine the order in which an object is controlled. Command Prioritization assigns unique levels of priority to the different types of devices that could write values to a device. There are 16 prioritization levels with Level 1 being highest and Level 16 the lowest. A complete list of BACnet Priority Array Levels and their uses is given in Table 3-3.

Table 3-1 : Command Prioritization Levels

Priority Level	Application	Priority Level	Application
1	Manual-Life Safety	9	Available
2	Automatic-Life Safety	10	Available
3	Available	11	Available
4	Available	12	Available
5	Critical Equip. Control	13	Available
6	Minimum On/Off	14	Available
7	Available	15	Available
8	Manual Operator	16	Available

BACnet defines the types of objects that are either required or may optionally support the command prioritization scheme. While many factors depend on whether an object may support the feature, Table 3-2 provides a list of objects that are subject to Command Prioritization.

Table 3-2: Objects Subject to Command Prioritization Support

Object Type	Support Required?	Notes
Analog Output	Yes	n/a
Analog Value	No	An Analog Value which is “writable” is not required to support Command Prioritization, rather the out-of-service property must be set to TRUE in order for the object to accept write commands. The ability to set an Analog Value into an out-of-service mode may be limited by the manufacturer of the device, as the functionality of the object may be intended to be read-only.
Binary Output	Yes	n/a

Table 3-2: Objects Subject to Command Prioritization Support

Object Type	Support Required?	Notes
Binary Value	No	A Binary Value which is “writable” is not required to support Command Prioritization, rather the out-of-service property must be set to TRUE in order for the object to accept write commands. The ability to set an Binary Value into an out-of-service mode may be limited by the manufacturer of the device, as the functionality of the object may be intended to be read-only.
Multi-State Output	Yes	n/a
Multi-State Value	No	A Multi-State Value which is “writable” is not required to support Command Prioritization, rather the out-of-service property must be set to TRUE in order for the object to accept write commands. The ability to set an Multi-State into an out-of-service mode may be limited by the manufacturer of the device, as the functionality of the object may be intended to be read-only.

3.2.1 COMMAND PRIORITIZATION

BAcnet uses a command prioritization scheme for objects that control equipment such as Analog Outputs and Binary Outputs. Through the use of priority arrays, command prioritization provides devices with a way to determine the order in which an object is controlled.

A priority array assigns unique levels of priority to the different types of devices that could write values to a device. There are 16 prioritization levels with Level 1 being highest and Level 16 the lowest. A complete list of BACnet Priority Array Levels and their uses is given in Table 3-3.

Table 3-3 : Priority Array Levels

Priority Level	Application	Priority Level	Application
1	Manual-Life Safety	9	Available
2	Automatic-Life Safety	10	Available
3	Available	11	Available
4	Available	12	Available
5	Critical Equip. Control	13	Available
6	Minimum On/Off	14	Available
7	Available	15	Available
8	Manual Operator	16	Available

The internal control sequence and algorithm used by NB-VAV to control Analog and Binary Outputs is Priority Array Level 11. If, at any time, the internal control sequence is disabled by manual intervention, NB-VAV will relinquish control over Priority Array Level 11. If you have a custom application where

SECTION 4: CONFIGURATION

The NB-VAV model controllers can provide control for a wide range of VAV terminal box applications as well as CAV control. This section covers the quick-start configurations for input and output setup, scheduling, airflow, auxiliary functions such as fan operation and electric reheat, and the controller's alarming capabilities.

IN THIS SECTION

4.1 UNIVERSAL INPUT CONFIGURATION

Universal Inputs permit the configuration of multiple sensor types, dependent on your application. The NB-VAV also supports alarm capabilities within its Universal Inputs. The following section provides a quick-start reference for initial configuration of inputs, as well as alarming. Complete information regarding each property available within Universal Inputs can be located in Section 5.

4.1.1 SENSOR CONFIGURATION

The following section discusses how to configure a Universal Input for a specific sensor type. Universal Input configuration includes modifying control logic programming inside the NB-VAV using *NB*-Pro and IVR hardware jumper configuration. The IVR jumpers are located above the Universal Input terminal blocks on the top right-hand side of the unitary controller, as illustrated in Figure 4-1.

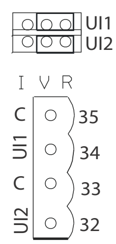

Figure 4-1 Universal Input IVR Jumper Location

4.1.1.1 DIGITAL INPUTS

To setup an input as a digital sensor, you must first configure the IVR jumper to VR, which places the input into a resistance setting.

Access object UI01, UI02, or UI03 (dependent on the UI), and set UI0x:**(ST) sensor type** = 0 (Digital). Verify that UI0x:**out-of-service** = False to assure that the value displayed in UI0x;present-value is the actual reading from the sensor. If UI0x:**reliability** displays a value other than No Fault Detected, verify input wiring.

Table 4-1: Summary of Digital Input Configuration

Object	Property	Value	Description
UI0x	(ST) sensor type	0	Digital sensor configuration
	out-of-service	0 (False)	Input set to automatic mode

4.1.1.2 LINEAR SENSORS (0-10VDC)

To setup an input for a 0-10VDC sensor, completely remove the IVR jumper to configure the UI for voltage mode.

Access object UI01, UI02, or UI03 (dependent on the UI). Set UI0x:**(ST) sensor type** = 2 (Linear). Configure UI0x:**min-pres-value** and UI0x:**max-pres-value** to the minimum and maximum scaled values for the input you are reading. Verify that UI0x:**out-of-service** is set to false to assure that the value displayed in UI0x:present-value is the actual reading from the sensor. If UI0x:**reliability** displays a value other than No Fault Detected, verify input wiring and value scaling.

Table 4-2: Summary of an Example Linear Input Configuration

Object	Property	Value	Description
UI0x	(ST) sensor type	2	Linear sensor configuration
	min-pres-value	0	Lowest present-value scale reading for the target sensor
	max-pres-value	100	Highest present-value scale reading for the target sensor
	out-of-service	0 (False)	Input set to automatic mode

4.1.1.3 4-20mA SENSORS

To setup an input as a 4-20mA sensor, you must first configure the IVR jumper to IV, which places the input into a voltage setting.

Access object UI01, UI02, or UI03 (dependent on the UI) and set UI0x:**(ST) sensor type** = 3 (4-20mA). Configure UI0x:**min-pres-value** and UI0x:**max-pres-value** to the minimum and maximum scaled values for the input you are reading. Verify that UI0x:**out-of-service** is set to false to assure that the value displayed in UI0x:**present-value** is the actual reading from the sensor. If UI0x:**reliability** displays a value other than No Fault Detected, verify input wiring and value scaling.

Table 4-3: Summary of an Example 4-20mA Input Configuration

Object	Property	Value	Description
UI0x	(ST) sensor type	3	4-20mA sensor configuration
	min-pres-value	0	Lowest present-value scale reading for the target sensor
	max-pres-value	100	Highest present-value scale reading for the target sensor
	out-of-service	0 (False)	Input set to automatic mode

4.1.1.4 THERMISTOR INPUT

To setup an input for thermistor readings, you must first configure the IVR jumper to VR, which places the input into a resistance setting.

Access object UI01, UI02, or UI03 (dependent on the UI), and set UI0x:**(ST) sensor type** = 7 (Thermistor). Verify that UI0x:**out-of-service** = false to assure that the value displayed in UI0x;present-value is the actual reading from the sensor. If UI0x:**reliability** displays a value other than No Fault Detected, verify input wiring.

Table 4-4: Summary of Thermistor Input Configuration

Object	Property	Value	Description
UI0x	(ST) sensor type	7	Thermistor sensor configuration
	out-of-service	0 (False)	Input set to automatic mode

4.1.1.5 ANALOG SBC-STAT1

To setup an input for temperature readings from an Analog SBC-STAT1, you must first configure the IVR jumper to VR, which places the input into a resistance setting.

Access object UI01, UI02, or UI03 (dependent on the UI), and set UI0x:**(ST) sensor type** = 8 (Analog STAT1). Verify that UI0x:**out-of-service** = false to assure that the value displayed in UI0x;present-value is the actual reading from the sensor. If UI0x:**reliability** displays a value other than No Fault Detected, verify input wiring.

Table 4-5: Summary of Analog STAT1 Configuration

Object	Property	Value	Description
UI0x	(ST) sensor type	8	Analog STAT1 sensor configuration
	out-of-service	0 (False)	Input set to automatic mode

4.2 SCHEDULING

Scheduling controls the current temperature setpoint of the NB-VAV. There are multiple ways scheduling can be performed in the controller. Internal schedules can be defined by the user. The user can determine when and in which schedule mode (or state) the *NB*-ASC will operate; including occupied, warm-up, unoccupied, or night setback. The NB-ASC(e) accommodates four-mode schedules or two-mode schedules (utilizing Occupied and Unoccupied modes only). All schedule configuration is performed through the *Schedule* object.

4.2.1 WEEKLY SCHEDULING

The NB-VAV contains a BACnet Schedule object, which is capable of performing 4-mode scheduling (Occupied, Unoccupied, Warm up, and Night Setback) for all days of the week.

To configure a Schedule Object, perform the following steps:

1. Using NB-Pro, access *Schedules.*
2. Determine if you wish to use two-mode scheduling or four-mode scheduling. To use two-mode scheduling, you must write an ENUM data type value to schedule-default. A value of zero (0) indicates Unoccupied, where as a value of one (1) indicates Occupied mode. Otherwise, write an unsigned value (0 = Unoccupied, 1 = Warm up, 2 = Occupied, 3 = Night Setback).
3. Configure time,value entries for each day of the week in **weekly-schedule**. A maximum of 6 time,value entries can be associated to one day of the week. If no values are entered for a specific day, the schedule will operate using the last time,value entry made in the previous day. No entries in any day of the week will result in the Schedule operating off the **schedule-default** value.

4.2.2 BROADCAST SCHEDULE

The Broadcast Schedule is a schedule sent out over the network by another controller such as an NB-GPC. The active internal schedule will be overridden if the NB-VAV is configured to receive network broadcast schedules. If the **(RB) Receive Broadcast** property is enabled, the current schedule will reflect the **(CV) Current Value** property. To configure the NB-VAV to receive network broadcast schedules:

1. Using NB-Pro, access *Broadcast Schedule*
2. Set **(RB) Receive Broadcast** = 1 (Yes)

4.2.3 POWER-UP STATE

If an unscheduled power loss occurs and power is restored, or if a soft reset of the controller is performed (Device;**(RS) Reset Controller** = 1), the controller will operate in the schedule mode defined by the user in the **Power-up State** (Device; **(PS) Power Up State**) property until a time synchronization received by the device from a time master. To set the schedule mode in which you want the device to operate upon power restoration or after a soft reset has occurred, select the value that corresponds to the desired power-up state. The possible states are listed in Table 4-6.

Table 4-6 : Power-up States

Value	Power-Up State
0	Unoccupied
1	Warm-up
2	Occupied
3	Night Setback

4.2.4 HOST OVERRIDE

In multi-device or zone situations, it may be advantageous to have a host or other peer device directly control the schedule state of the controller without broadcasts. In this case, the controller has a Host Override function in the Schedule object that can be utilized.

To configure the device to have its schedule controlled by an external source, set Schedule; **(HE) Host Override Local Schedules** = 1 (Yes). Once set, the schedule of the device is then controlled through writes to the Schedule;**(HO) Host Schedule Setting** property.

The schedule mode set in **HO** will be the active mode unless:

- a broadcast is received
- an occupancy sensor is properly configured and occupancy is detected
- user override occurs

When host override is used, the true state of the schedule can be monitored through Zone Temperature; **(PO) Present Occupancy Status**. In previous iterations of NB-ASC(e) firmware, the present-value of the schedule could be monitored, but cannot in v6.03 or later due to BTL requirements.

4.3 SETTING THE TEMPERATURE AND FLOW SETPOINTS

This section provides guidelines for configuring the temperature and flow setpoints of the *NB-VAV*. The *NB-VAV* maintains the zone according to the **present-value** of the Cool Setpoint and Heat Setpoint objects. These values can also be found in the Zone Temperature:**(CC) current cooling setpoint** and Zone Temperature:**(CH) current cooling setpoint** properties.

To set the heating and cooling setpoints, you must enter the temperature that you want the zone to maintain when the active schedule mode is the mode corresponding to the object. This value can be entered into the **present-value** property of the appropriate Setpoint object.

You also have the option to specify an unoccupied setup/setback value for both the heating and cooling setpoints. This is the value you want subtracted from the heating setpoint and added to the cooling setpoint when the active schedule mode is unoccupied. For example, if the setpoint is 70° and the setback is 4°, the setpoint will be adjusted to 66° when the active schedule mode is unoccupied. To set the heating or cooling setbacks, enter the desired setback amount in the **present-value** of the Heat Unoccupied Setback or Cool Unoccupied Setback object, respectively.

You may also specify the night setup/setback value you want subtracted from the heating setpoint or added to the cooling setpoint when the active schedule mode is Night Setback. You may specify the setback to be applied to the heating or cooling setpoint by entered the appropriate amount in the **present-value** property of the Heat Night Setback or Cool Night Setback object respectively.

A warm-up setpoint may be specified for the NB-VAV. This is the temperature that you want the zone to maintain when warm-up is the active schedule mode. To set the warm-up setpoint, enter the desired value in the **present-value** property of the Warmup Setpoint object.

The NB-VAV has capabilities to control the flow during the different schedule states. The parameters which control this behavior are found in the Flow Setpoint object.

For cooling applications, you may specify the value of the minimum and maximum rate, measured in cfm, at which you want air to flow through the duct. by entering values into **(CM) cooling minimum flow** and **(CX) cooling maximum flow**. These set the minimum and maximum values for the Flow Control:**(CD) target flow** property.

The NB-VAV sets the target flow via a PID loop controlling off the temperature setpoint. There is an integration constant, specified by the Flow Setpoints:**(CI) cooling integration constant** object, which defines the percentage of accumulated error used to calculate the required supply airflow, and a proportional band, specified by the Flow Setpoints:**(CP) cooling proportional band** object, which specifies the number of degrees over which proportional cooling will take place.

The **(HM) heating minimum flow** and **(HX) heating maximum flow** objects and the **(WM) warmup minimum flow** and (**WX) warmup maximum flow** properties in the Flow Setpoints object perform the same functions as their cooling counterparts, setting the minimums and maximums for the heating and warmup flows respectively.

The **(HP) heating proportional band** and **(HI) heating integration constant** properties and the (**WP) warmup proportional band** and **(WI) warmup integration constant** properties are used to define the proportional bands and integration constants to be used for heating and warmup.

NOTE
The Minimum and Maximum Flow properties should not exceed the minimum and maximum allowable rates of flow specified by the manufacturer of the VAV terminal box.

4.3.1 UNOCCUPIED FLOW SETPOINT CONFIGURATION

Beginning with v6.08.00 firmware, NB-VAV can now specify a flow setpoint to follow for unoccupied schedule periods. This feature can be used to close the damper in the event of mis-match between the supply and zone temperature, or used to simply close the damper past minimum position.

Property (**MD) Minimum Flow Override Modes** specifies the method of overriding the target flow during unoccupied schedule periods. By default, this is configured as None. When set as “Supply/Demand Mismatch Override”, the target flow that the VAV will control by will be the value defined in **(UM) Unoccupied/Night Setback Minimum Flow Setpoint** in the event where there is a mismatch between the Supply Demand (Supply Temp;**SM**) and the Zone Temperature demand.

When set for “Incorrect Supply” and the schedule mode is other than Occupied, the VAV’s target flow will equal (**MD) Minimum Flow Override Modes**. When set for “Both”, both conditions will apply.

4.4 NB-VAV CONTROL MODES

The *NB-VAV* can operate in one of five control modes:

- Constant Air Volume (CAV)
- Cooling Only
- Heating Only
- Supply Dependant [Variable Supply Temperature (VST)]
- Cooling with Reheat

The following subsections provide explanations of and configuration instructions for the different control modes of the *NB-VAV*.

4.4.1 CONSTANT AIR VOLUME (CAV)

The *NB-VAV* is capable of controlling (CAV) terminal boxes. With a CAV unit, zone temperature is not a control factor. Instead, the value defined by the user in the Flow:Control:**(CD) target flow** property becomes the constant volume setpoint. The *NB-VAV* will modulate the damper appropriately to maintain the target flow while airflow is present. Reheat capabilities are identical to VAV operation and use zone temperature as the measured variable for control.

To configure the *NB-VAV* for CAV control, you must first set the Zone Temperature:**(BT) application (box type)** property to “0=CAV”. The Flow Control:**(CK) duct scaling factor** property is specific to the duct you are using and should be set to a value of 4005 multiplied by the area of the duct measured in square feet.

The flow should be calibrated to zero flow by setting Flow Control:**(CB) calibrate flow** property to 1. After the **present-value** and **(CA) average flow** properties both equal zero, then you will check the controller's CFM reading with what the balancer is reading. If they do not match, enter the balancer's reading in Flow Control:**(KC) measured cfm for CK adjust**. If the values still do not agree, you should adjust the damper so the CFM has changed by more than 100 CFM. You should then enter the second balancer's reading in Flow Control:**(K2) measured cfm for 2pt cal**. Finally, the Flow Control:**(AC) auto/manual/track mode select** property should be set to “1=Auto”.

During scheduled unoccupied and night setback periods, the damper will go to the minimum position.

The properties that need to be configured for CAV operation and examples of the values that should be entered for them are given in Table 4-7.

Table 4-7 Summary of Control Settings for Constant Air Volume (CAV) Operation

Object Name	Property	Value	Description
Zone Temperature	**(BT) application (box type)**	0	Constant Air volume
Flow Control	**(CK) duct scaling factor**	786	4005 x duct square feet (default 6” round)
	(CB) calibrate flow	1	1 = calibrate flow sensor reading with no flow (will automatically return to zero)
	(CD) target flow	100	Desired constant volume setpoint in CFM

Table 4-7 Summary of Control Settings for Constant Air Volume (CAV) Operation

Object Name	Property	Value	Description
	(KC) measured cfm for CK adjust	0	For CFM calibration purpose enter actual measured CFM value.
	(K2) measured cfm for 2pt cal	0	For finer CFM calibration enter actual measured CFM value but must be at least 100CFM different than KC reading
	(AC) auto/manual/track mode select	1	0 = manual 1 = auto 2 = tracking

4.4.2 SUPPLY DEPENDENT (VST)

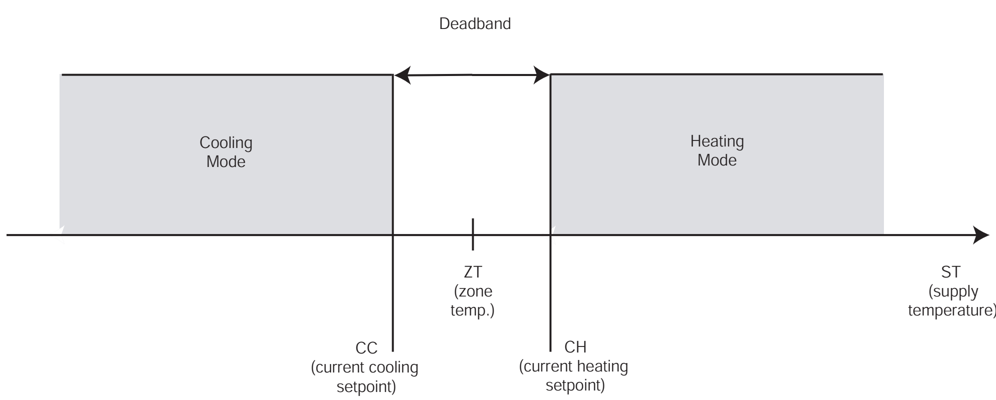

Figure 4-2: Supply Dependant (VST) Control

When operating in supply dependant mode, the *NB-VAV* monitors the temperature of the source/duct air, determines whether or not the air is hot or cold enough to heat or cool the zone, then automatically functions in heating or cooling mode accordingly. This requires that the box has a supply temperature sensor or a broadcast value from a central point. For example, if the Supply Temperature:**present-value** is greater than *both* the Zone Temperature:**present-value** and the Heat Setpoint:**present-value** (also displayed, but not editable, in the Zone Temperature:**(CH) current heating setpoint** object), the *NB*-VAV will operate in heating mode and open the damper to provide the warm supply air to the zone (the source, or supply air is warm enough to heat the space). Conversely, if Supply Temperature:**present-value** is less than *both* Zone Temperature:**present-value** and the Cool Setpoint:**present-value** (also displayed, but not editable, in the Zone Temperature:**(CC) current cooling setpoint** object), the *NB*-VAV will operate in cooling mode and open the damper to provide the cool supply air to the zone (the source, or supply air is cold enough to cool the space).

Using the Supply Temperature**:(DD) auto duct delta temperature** property, the user can define the point at which the terminal box will go into cooling or heating mode. For example, if (**DD) auto duct delta temperature** is set to 3° and the current (temperature) setpoint is 70°:

. the *NB*-VAV will switch to heating only mode and supply the warm source air to the zone when the supply temperature exceeds 73°
. the *NB*-VAV will switch to cooling only mode and supply the cool source air to the zone when the supply temperature drops below 67°
. the *NB*-VAV will remain in the last active mode when the temperature is in the deadband (67 to 73°)

To configure the *NB-VAV* for VST control, you must first set the Zone Temperature:**(BT) application (box type)** property to “3=Supply Dependent”. The mode in which the *NB*-VAV is operating will be indicated in the Supply Temperature:**(SM) cooling / heating supply mode** property.

When in VST mode, the *NB*-VAV will override the minimum airflow settings to prevent undesired cooling and heating. Dampers will fully close when the supply air is not suitable for what the zone is calling when the **(MD) minimum flow override mode** is set equal to a 1 (Supply/Demand mis-match override) otherwise it will control to the respective minimum flow setpoint.

The Flow Control:**(CK) duct scaling factor** property is specific to the duct you are using and should be set to a value of 4005 multiplied by the area of the duct measured in square feet.

The flow should be calibrated to zero flow by setting Flow Control:**(CB) calibrate flow** property to 1 when the fan is completely shutdown. After the **present-value** and **(CA) average flow** properties both equal zero, then you will check the controller's CFM reading with what the balancer is reading. If they do not match, enter the balancer's reading in Flow Control:**(KC) measured cfm for CK adjust**. If the values still do not agree, you should adjust the damper so the CFM has changed by more than 100 CFM. You should then enter the second balancer's reading in Flow Control:**(K2) measured cfm for 2pt cal**. Finally, the Flow Control:**(AC) auto/manual/track mode select** property should be set to “1=Auto”.

Next, the heating and cooling setpoints for the various schedule states should be entered into the **present-value** property of the appropriate setpoint object. The *NB-VAV* maintains the zone according to the **present-value** of the Cool Setpoint and Heat Setpoint objects. These values can also be found in the Zone Temperature:**(CC) current cooling setpoint** and Zone Temperature:**(CH) current cooling setpoint** properties.

To set the heating and cooling setpoints, you must enter the temperature that you want the zone to maintain when the active schedule mode is the mode corresponding to the object. This value can be entered into the **present-value** property of the appropriate Setpoint object.

You also have the option to specify an unoccupied setup/setback value for both the heating and cooling setpoints. This is the value you want subtracted from the heating setpoint and added to the cooling setpoint when the active schedule mode is unoccupied. For example, if the setpoint is 70° and the setback is 4°, the setpoint will be adjusted to 66° when the active schedule mode is unoccupied. To set the heating or cooling setbacks, enter the desired setback amount in the **present-value** of the Heat Unoccupied Setback or Cool Unoccupied Setback object, respectively.

You may also specify the night setup/setback value you want subtracted from the heating setpoint or added to the cooling setpoint when the active schedule mode is Night Setback. You may specify the setback to be applied to the heating or cooling setpoint by entered the appropriate amount in the **present-value** property of the Heat Night Setback or Cool Night Setback object respectively.

A warm-up setpoint may be specified for the *NB*-VAV. This is the temperature that you want the zone to maintain when warm-up is the active schedule mode. To set the warm-up setpoint, enter the desired value in the **present-value** property of the Warmup Setpoint object.

The *NB*-VAV has capabilities to control the flow during the different schedule states. The parameters which control this behavior are found in the Flow Setpoint object.

For cooling applications, you may specify the value of the minimum and maximum rate, measured in cfm, at which you want air to flow through the duct. by entering values into **(CM) cooling minimum flow** and **(CX) cooling maximum flow**. These set the minimum and maximum values for the Flow Control:**(CD) target flow** property.

The *NB*-VAV sets the target flow via a PID loop controlling off the temperature setpoint. There is an integration constant, specified by the Flow Setpoints:**(CI) cooling integration constant** property, which defines the percentage of accumulated error used to calculate the required supply airflow, and a proportional band, specified by the Flow Setpoints:**(CP) cooling proportional band** property, which specifies the number of degrees over which proportional cooling will take place.

The **(HM) heating minimum flow** and **(HX) heating maximum flow** properties and the **(WM) warmup minimum flow** and (**WX) warmup maximum flow** properties in the Flow Setpoints object perform the same functions as their cooling counterparts, setting the minimums and maximums for the heating and warmup flows respectively.

The **(HP) heating proportional band** and **(HI) heating integration constant** properties and the (**WP) warmup proportional band** and **(WI) warmup integration constant** properties are used to define the proportional bands and integration constants to be used for heating and warmup.

NOTE
The Minimum and Maximum Flow properties should not exceed the minimum and maximum allowable rates of flow specified by the manufacturer of the VAV terminal box.

The Supply Temperature:**(IC) input channel** property should be set to the universal input used to read the supply temperature. The corresponding universal input should then be configured to read a thermistor input by setting the by setting the **(ST) sensor type** property to a value of 7 in the corresponding UI0x object corresponding to the input chosen.

The Supply Temperature:**(DD) auto duct delta temperature** specifies the number of degrees above the heating setpoint or below the cooling setpoint that the supply air temperature must be before target flow will be changed from the minimum flow setting.

During scheduled unoccupied and night setback periods, the damper will go to the minimum position.

The properties that need to be configured for supply dependent (VST) operation and examples of the values that should be entered for them are given in Table 4-8.

Table 4-8 Summary of Control Settings for Supply Dependent (VST) Operation

Object Name	Property	Value	Description
Zone Temperature	**(BT) application (box type)**	3	Supply Dependant

Table 4-8 Summary of Control Settings for Supply Dependent (VST) Operation

Object Name	Property	Value	Description
Flow Control	**(CK) duct scaling factor**	786	4005 x duct square feet (default 6” round)
	(CB) calibrate flow	1	1 = calibrate flow sensor reading with no flow (will automatically return to zero)
	(KC) measured cfm for CK adjust	0	For CFM calibration purpose enter actual measured CFM value.
	(K2) measured cfm for 2pt cal	0	For finer CFM calibration enter actual measured CFM value but must be at least 100CFM different than KC reading
	(AC) auto/manual/track mode select	1	0 = manual 1 = auto 2 = tracking
Cool Setpoint	**present-value**	72.0	Zone temp VAV damper will increase CFM
Cool Unoccupied Setback	**present-value**	5.0	Number of degrees added to cool setpoint when controller is unoccupied
Cool Night Setback	**present-value**	5.0	Number of degrees added to cool setpoint when controller is in night setback
Heat Setpoint	**present-value**	68.0	Zone temp must drop below for heating to occur
Heat Unoccupied Setback	**present-value**	10.0	Number of degrees subtracted from heat setpoint when controller is unoccupied
Heat Night Setback	**present-value**	10.0	Number of degrees subtracted from heat setpoint when controller is in night setback
Warmup Setpoint	**present-value**	72	Setpoint during Warmup periods
Flow Setpoint	**(CM) cooling minimum flow**	100	Cooling minimum CFM
	(CX) cooling maximum flow	500	Cooling maximum CFM
	(CP) cooling proportional band	5	Proportional band in degrees
	(CI) cooling integration constant	5	Amount of proportional error in% (0.0–25.5)

Table 4-8 Summary of Control Settings for Supply Dependent (VST) Operation

Object Name	Property	Value	Description
	(HM) heating minimum flow	100	Heating minimum CFM
	(HX) heating maximum flow	500	Heating maximum CFM
	(HP) heating proportional band	5	Proportional band in degrees
	(HI) heating integration constant	5	Amount of proportional error in% (0.0–25.5)
	(WM) warmup minimum flow	100	Warmup minimum CFM
	(WX) warmup maximum flow	500	Warmup maximum CFM
	(WP) warmup proportional band	5	Proportional band in degrees
	(WI) warmup integration constant	5	Amount of proportional error in% (0.0–25.5)
Supply Temperature	**(DD) auto duct delta temperature**	2.5	Number of degrees above heating setpoint or below cooling setpoint supply air temp must be before target flow will changed from minimum CFM
	(IC) input channel	1	
UO0x	**(ST) sensor type**	7	Thermistor

4.4.3 HEATING ONLY

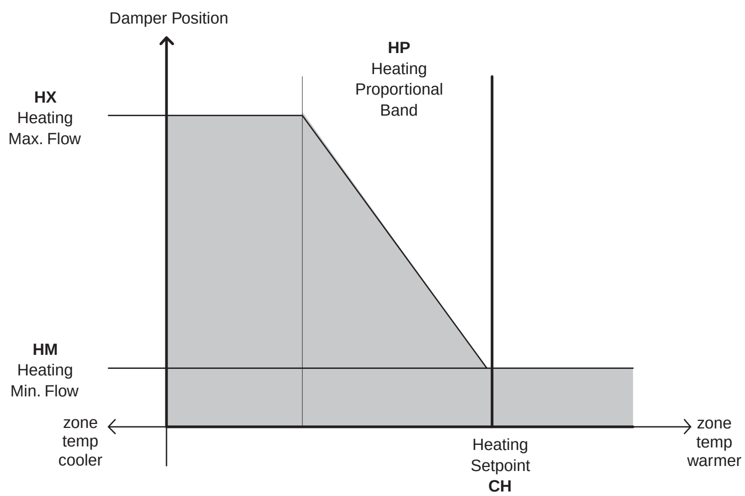

Figure 4-3: Heating Only

When configured for heating only control, the *NB-VAV* uses Proportional+Integral (PI) control to modulate the damper and control airflow to the zone based on two properties; the Zone Temperature:**present-value** and the Zone Temperature:**(CH) current heating setpoint**. If the **present-value** is less than the **(CH) current heating setpoint**, the *NB-VAV* will open the damper and provide warm air to the zone to maintain a zone temperature as close as possible to the setpoint.

Heating only VAV works on a reverse acting ramp that slopes from the values defined by the user in the Flow Setpoints:**(HM) heating minimum flow** to the Flow Setpoints:**(HX) heating maximum flow** properties. When the zone temperature strays below the current heating setpoint, the *NB-VAV* opens the damper—increasing the supply airflow to the zone. As the zone temperature nears the setpoint, the *NB-VAV* closes the damper to minimize airflow. See Figure 4-3.

To configure the *NB-VAV* for heating only control, you must first set the Zone Temperature:**(BT) application (box type)** property to “2=Heating Only”. You must then specify the duct scaling factor by multiplying 4005 by the effective duct area, measured in square feet, and entering the result into the Flow Control:**(CK) duct scaling factor (k)** property.

The flow should be calibrated to zero flow by setting Flow Control:**(CB) calibrate flow** property to 1 when the fan is completely shutdown. After the **present-value** and **(CA) average flow** properties both equal zero, then you will check the controller's CFM reading with what the balancer is reading. If they do not match, enter the balancer's reading in Flow Control:**(KC) measured cfm for CK adjust**. If the values still do not agree, you should adjust the damper so the CFM has changed by more than 100 CFM. You should then enter the second balancer's reading in Flow Control:**(K2) measured cfm for 2pt cal**. Finally, the Flow Control:**(AC) auto/manual/track mode select** property should be set to “1=Auto”.

Next, the heating and cooling setpoints for the various schedule states should be entered into the **present-value** property of the appropriate setpoint object. The *NB-VAV* maintains the zone according to the **present-value** Heat Setpoint objects. These values can also be found in the Zone Temperature:**(CH) current cooling setpoint** properties.

To set the heating setpoints, you must enter the temperature that you want the zone to maintain when the active schedule mode is the mode corresponding to the object. This value can be entered into the **present-value** property of the appropriate Setpoint object.

You also have the option to specify an unoccupied setup/setback value for the heating setpoints. This is the value you want subtracted from the heating setpoint when the active schedule mode is unoccupied. For example, if the setpoint is 70° and the setback is 4°, the setpoint will be adjusted to 66° when the active schedule mode is unoccupied. To set the heating setback, enter the desired setback amount in the **present-value** of the Heat Unoccupied Setback object.

You may specify a night setup/setback value you want subtracted from the heating setpoint when the active schedule mode is Night Setback. You may specify the setback to be applied to the heating setpoint by entered the appropriate amount in the **present-value** property of the Heat Night Setback object.

A warm-up setpoint may be specified for the *NB*-VAV. This is the temperature that you want the zone to maintain when warm-up is the active schedule mode. To set the warm-up setpoint, enter the desired value in the **present-value** property of the Warmup Setpoint object.

The *NB*-VAV has capabilities to control the flow during the different schedule states. The parameters which control this behavior are found in the Flow Setpoint object.

You may specify the value of the minimum and maximum desired rate, measured in cfm, at which you want air to flow through the duct. by entering values into **(HM) heating minimum flow** and **(HX) heating maximum flow**. These set the minimum and maximum values for the Flow Control:**(CD) target flow** property.

The *NB*-VAV sets the target flow via a PID loop controlling off the temperature setpoint. There is an integration constant, specified by the Flow Setpoints:**(HI) heating integration constant** property, which defines the percentage of accumulated error used to calculate the required supply airflow, and a proportional band, specified by the Flow Setpoints:**(HP) heating proportional band** property, which specifies the number of degrees over which proportional cooling will take place.

The **(WM) warmup minimum flow** and (**WX) warmup maximum flow** properties in the Flow Setpoints object perform the same functions as their heating counterparts, setting the minimums and maximums for the flow during scheduled warmup periods. Similarly, the (**WP) warmup proportional band** and **(WI) warmup integration constant** properties are used to define the proportional bands and integration constants to be used during this period.

NOTE

The Minimum and Maximum Flow properties should not exceed the minimum and maximum allowable rates of flow specified by the manufacturer of the VAV terminal box.

The properties that need to be configured for heating only operation and examples of the values that should be entered for them are given in Table 4-9.

Table 4-9 Summary of Control Settings for Heating Only Operation

Object Name	Property	Value	Description
Zone Temperature	**(BT) application (box type)**	2	Heating Only
Flow Control	**(CK) duct scaling factor**	786	4005 x duct square feet (default 6” round)
	(CB) calibrate flow	0	1 = calibrate flow sensor reading with no flow (will automatically return to zero)
	(KC) measured cfm for CK adjust	0	For CFM calibration purpose enter actual measured CFM value.
	(K2) measured cfm for 2pt cal	0	For finer CFM calibration enter actual measured CFM value but must be at least 100CFM different than KC reading

Table 4-9 Summary of Control Settings for Heating Only Operation

Object Name	Property	Value	Description
	(AC) auto/manual/track mode select	1	0 = manual 1 = auto 2 = tracking
Heat Setpoint	**present-value**	68.0	Zone temp must drop below for heating to occur
Heat unoccupied Setback	**present-value**	10.0	Number of degrees subtracted from heat setpoint when controller is unoccupied
Heat night setback	**present-value**	10.0	Number of degrees subtracted from heat setpoint when controller is in night setback
Warmup Setpoint	**present-value**	72	Setpoint during Warmup periods
Flow Setpoint	**(HM) heating minimum flow**	100	Heating minimum CFM
	(HX) heating maximum flow	500	Heating maximum CFM
	(HP) heating proportional band	5	Proportional band in degrees
	(HI) heating integration constant	5	Amount of proportional error in% (0.0–25.5)
	(WM) warmup minimum flow	100	Warmup minimum CFM
	(WX) warmup maximum flow	500	Warmup maximum CFM
	(WP) warmup proportional band	5	Proportional band in degrees
	(WI) warmup integration constant	5	Amount of proportional error in% (0.0–25.5)

4.4.4 COOLING ONLY

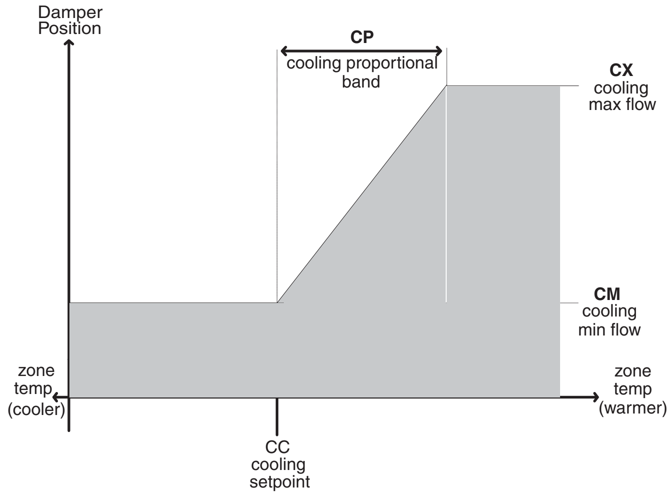

Figure 4-4: Cooling Only

When configured for cooling only control, the *NB-VAV* uses PI control to modulate the damper and control airflow to the zone based on two factors; the Zone Temperature:**present-value** and the Zone Temperature:**(CC) current cooling setpoint**. If the zone temperature is greater than the setpoint, the *NB-VAV* will open the damper and provide cool air to the zone to maintain the zone temperature as close to the setpoint as possible.

Cooling only VAV works on a normal acting ramp that slopes from the values defined by the user in the Flow Setpoints:**(CM) cooling minimum flow** to the Flow Setpoints:**(CX) cooling maximum flow** properties. When the zone temperature strays above the current cooling setpoint, the *NB-VAV* opens the damper—increasing the supply airflow to the zone. As the zone temperature nears the setpoint, the *NB-VAV* closes the damper to minimize airflow.

To configure the *NB-VAV* for cooling only control, you must first set the Zone Temperature:**(BT) application (box type)** property to “1=Cooling Only”. You must then specify the duct scaling factor by multiplying 4005 by the effective duct area, measured in square feet, and entering the result into the Flow Control:**(CK) duct scaling factor (k)** property. Cooling and flow setpoints would then be set as described in Section 4.3.

The Flow Control:**(CK) duct scaling factor** property is specific to the duct you are using and should be set to a value of 4005 multiplied by the area of the duct measured in square feet.

The flow should be calibrated to zero flow by setting Flow Control:**(CB) calibrate flow** property to 1 when the fan is completely shutdown. After the **present-value** and **(CA) average flow** properties both equal zero, then you will check the controller's CFM reading with what the balancer is reading. If they do not match, enter the balancer's reading in Flow Control:**(KC) measured cfm for CK adjust**. If the values still do not agree, you should adjust the damper so the CFM has changed by more than 100 CFM. You should then enter the second balancer's reading in Flow Control:**(K2) measured cfm for 2pt cal**. Finally, the Flow Control:**(AC) auto/manual/track mode select** property should be set to “1=Auto”.

Next, the heating and cooling setpoints for the various schedule states should be entered into the **present-value** property of the appropriate setpoint object. The *NB-VAV* maintains the zone according to the

present-value of the Cool Setpoint objects. The current setpoint can also be found in the Zone Temperature:**(CC) current cooling setpoint** property.

To set the cooling setpoints, you must enter the temperature that you want the zone to maintain when the active schedule mode is the mode corresponding to the object. This value can be entered into the **present-value** property of the appropriate Setpoint object.

You also have the option to specify an unoccupied setup/setback value for the cooling setpoint. This is the value you want added to the cooling setpoint when the active schedule mode is unoccupied. For example, if the setpoint is 70° and the setback is 4°, the setpoint will be adjusted to 74° when the active schedule mode is unoccupied. To set the cooling setback, enter the desired setback amount in the **present-value** of the Cool Unoccupied Setback object.

You may also specify the night setup/setback value you want added to the cooling setpoint when the active schedule mode is Night Setback. You specify the setback to be applied to the cooling setpoint by entering the appropriate amount in the **present-value** property of the Cool Night Setback object.

You may specify the value of the minimum and maximum rate, measured in cfm, at which you want air to flow through the duct. by entering values into **(CM) cooling minimum flow** and **(CX) cooling maximum flow**. These set the minimum and maximum values for the Flow Control:**(CD) target flow** property.

The *NB*-VAV sets the target flow via a PID loop controlling off the temperature setpoint. There is an integration constant, specified by the Flow Setpoints:**(CI) cooling integration constant** property, which defines the percentage of accumulated error used to calculate the required supply airflow, and a proportional band, specified by the Flow Setpoints:**(CP) cooling proportional band** property, which specifies the number of degrees over which proportional cooling will take place.

NOTE

The **Minimum** and **Maximum Flow** properties should not exceed the minimum and maximum allowable rates of flow specified by the manufacturer of the VAV terminal box.

The properties that need to be configured for heating only operation and examples of the values that should be entered for them are given in Table 4-10.

Table 4-10 Summary of Control Settings for Cooling Only Operation

Object Name	Property	Value	Description
Zone Temperature	**(BT) application (box type)**	1	Cooling Only
Flow Control	**(CK) duct scaling factor**	786	4005 x duct square feet (default 6” round)
	(CB) calibrate flow	0	1 = calibrate flow sensor reading with no flow (will automatically return to zero)

Table 4-10 Summary of Control Settings for Cooling Only Operation

Object Name	Property	Value	Description
	(KC) measured cfm for CK adjust	0	For CFM calibration purpose enter actual measured CFM value.
	(K2) measured cfm for 2pt cal	0	For finer CFM calibration enter actual measured CFM value but must be at least 100CFM different than KC reading
	(AC) auto/manual/track mode select	1	0 = manual 1 = auto 2 = tracking
Cool Setpoint	**present-value**	72.0	Zone temp VAV damper will increase CFM
Cool unoccupied Setback	**present-value**	5.0	Number of degrees added to cool setpoint when controller is unoccupied
Cool night setback	**present-value**	5.0	Number of degrees added to cool setpoint when controller is in night setback
Flow Setpoint	**(CM) cooling minimum flow**	100	Cooling minimum CFM
	(CX) cooling maximum flow	500	Cooling maximum CFM
	(CP) cooling proportional band	5	Proportional band in degrees
	(CI) cooling integration constant	5	Amount of proportional error in% (0.0–25.5)

4.4.5 COOLING WITH REHEAT

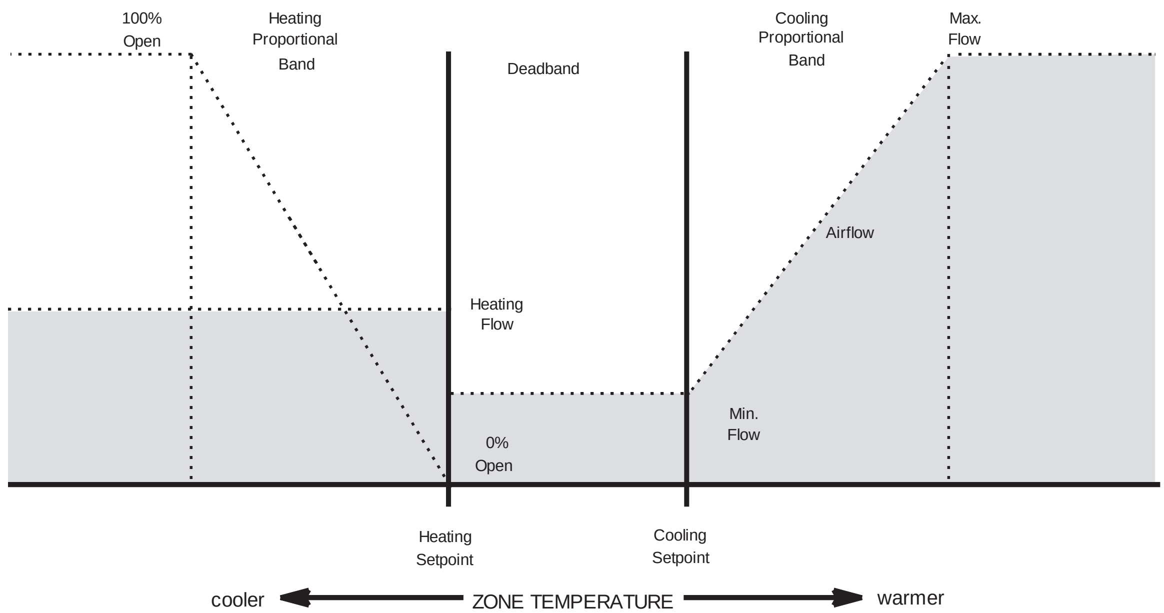

Figure 4-5: Cooling with Reheat

Cooling with reheat control uses the VAV box damper to let in cool supply air while providing any needed heating through up to four stages of electric reheat.

The *NB-VAV* will maintain the cooling setpoint specified in the Zone Temperature:**(CC) current cooling setpoint** property by providing supply air through proportional damper positioning. With its PI algorithm, the *NB-VAV* will modulate the damper to maintain the Zone Temperature:**present-value** between the current cooling setpoint and the current heating setpoint specified in the Zone Temperature:**(CH) current heating setpoint** property. The reheat stages will energize at the time interval defined by the user in the Electric Reheat:**(ID) interstage delay time** property until the zone temperature reaches the cooling setpoint. Reheat stages de-energize at thirty-second intervals.

To configure the *NB-VAV* for cooling with reheat control, you must first set the Zone Temperature:**(BT) application (box type)** property to “4=Cooling w/Reheat”. You must then specify the duct scaling factor by multiplying 4005 by the effective duct area, measured in square feet, and entering the result into the Flow Control:**(CK) duct scaling factor (k)** property.

The flow should be calibrated to zero flow by setting Flow Control:**(CB) calibrate flow** property to 1 when the fan is completely shutdown. After the **present-value** and **(CA) average flow** properties both equal zero, then you will check the controller's CFM reading with what the balancer is reading. If they do not match, enter the balancer's reading in Flow Control:**(KC) measured cfm for CK adjust**. If the values still do not agree, you should adjust the damper so the CFM has changed by more than 100 CFM. You should then enter the second balancer's reading in Flow Control:**(K2) measured cfm for 2pt cal**. Finally, the Flow Control:**(AC) auto/manual/track mode select** property should be set to “1=Auto”.

Next, the heating and cooling setpoints for the various schedule states should be entered into the **present-value** property of the appropriate setpoint object. The *NB-VAV* maintains the zone according to the **present-value** of the Cool Setpoint and Heat Setpoint objects. These values can also be found in the

Zone Temperature:**(CC) current cooling setpoint** and Zone Temperature:**(CH) current cooling setpoint** properties.

To set the heating and cooling setpoints, you must enter the temperature that you want the zone to maintain when the active schedule mode is the mode corresponding to the object. This value can be entered into the **present-value** property of the appropriate Setpoint object.

You also have the option to specify an unoccupied setup/setback value for both the heating and cooling setpoints. This is the value you want subtracted from the heating setpoint and added to the cooling setpoint when the active schedule mode is unoccupied. For example, if the heating setpoint is 70° and the setback is 4°, the setpoint will be adjusted to 66° when the active schedule mode is unoccupied. To set the heating or cooling setbacks, enter the desired setback amount in the **present-value** of the Heat Unoccupied Setback or Cool Unoccupied Setback object, respectively.

You may also specify the night setup/setback value you want subtracted from the heating setpoint or added to the cooling setpoint when the active schedule mode is Night Setback. You may specify the setback to be applied to the heating or cooling setpoint by entered the appropriate amount in the **present-value** property of the Heat Night Setback or Cool Night Setback object respectively.

A warm-up setpoint may be specified for the *NB*-VAV. This is the temperature that you want the zone to maintain when warm-up is the active schedule mode. To set the warm-up setpoint, enter the desired value in the **present-value** property of the Warmup Setpoint object.

The *NB*-VAV has capabilities to control the flow during the different schedule states. The parameters which control this behavior are found in the Flow Setpoint object.

For cooling applications, you may specify the value of the minimum and maximum rate, measured in cfm, at which you want air to flow through the duct. by entering values into **(CM) cooling minimum flow** and **(CX) cooling maximum flow**. These set the minimum and maximum values for the Flow Control:**(CD) target flow** property.

The *NB*-VAV sets the target flow via a PID loop controlling off the temperature setpoint. There is an integration constant, specified by the Flow Setpoints:**(CI) cooling integration constant** property, which defines the percentage of accumulated error used to calculate the required supply airflow, and a proportional band, specified by the Flow Setpoints:**(CP) cooling proportional band** property, which specifies the number of degrees over which proportional cooling will take place.

The **(HM) heating minimum flow** and **(HX) heating maximum flow** properties and the **(WM) warmup minimum flow** and (**WX) warmup maximum flow** properties in the Flow Setpoints object perform the same functions as their cooling counterparts, setting the minimums and maximums for the heating and warmup flows respectively.

The **(HP) heating proportional band** and **(HI) heating integration constant** properties and the (**WP) warmup proportional band** and **(WI) warmup integration constant** properties are used to define the proportional bands and integration constants to be used for heating and warmup.

NOTE

The **Minimum** and **Maximum Flow** properties should not exceed the minimum and maximum allowable rates of flow specified by the manufacturer of the VAV terminal box.

WIth the temperature and flow setpoints configured, you must then configure the properties in the Electric Reheat object.

You indicate which outputs you wish to use as heating stages by specifying the desired reheat mode. This is chosen by selecting one of the options listed in Table 4-11 in the Electric Reheat:**(RO) reheat application** property

Table 4-11 : Reheat Options

Value	Reheat Option
0	Disabled
1	2-Stage (K2-K3)
2	2-Stage (K4-K5)
3	4-Stage (K2-K5)

The *NB-VAV* can prolong the life of reheats through its **(BA) reheat balance mode** property. With this property enabled, reheat stages with less run time will energize first. If you wish to balance stage usage, you should set **BA** to 1.

You may specify which stages to require a positive flow indication by using the **(FR) stages requiring flow** property. **FR** is a bit map with each bit corresponding to a digital output. To require positive flow indication for an output, you must set the appropriate bit in **FR** to 1.

The **(AF) require max airflow** property determines whether the specified maximum airflow must be achieved before stages are energized. By default **AF** is set to 0 and maximum flow is not required for stages to energize.

The NB-VAV allows you to specify the number of minutes you want to expire before the additional stages are energized. To set the delay, enter the desired number of minutes in the Electric Reheat:**(ID) interstage delay** time property.

The **(MX) max supply temp** property specifies the maximum operating temperature for the stages. If the temperature reading exceeds this value the stages will be de-energized. **MX** must be set to a value of 999.0 is no reliable supply air temperature reading is available.

The temperature at which the first reheat stage will be energized is specified as an offset from the heating setpoint. The **(OF) reheat offset** property specifies the number of degrees the temperature must drop below the heating setpoint before the first stage is energized.

During scheduled unoccupied and night setback periods, the damper will go to the minimum position.

The properties that need to be configured for cooling with reheat operation and examples of the values that should be entered for them are given in Table 4-12.

Table 4-12 Summary of Control Settings for Cooling with Reheat Operation

Object Name	Property	Value	Description
Zone Temperature	**(BT) application (box type)**	4	Cooling w/reheat
Flow Control	**(CK) duct scaling factor**	786	4005 x duct square feet (default 6" round)
	(CB) calibrate flow	0	1 = calibrate flow sensor reading with no flow (will automatically return to zero)
	(KC) measured cfm for CK adjust	0	For CFM calibration purpose enter actual measured CFM value.
	(K2) measured cfm for 2pt cal	0	For finer CFM calibration enter actual measured CFM value but must be at least 100CFM different than KC reading
	(AC) auto/manual/track mode select	1	0 = manual 1 = auto 2 = tracking
Cool Setpoint	**present-value**	72.0	Zone temp VAV damper will increase CFM
Cool unoccupied Setback	**present-value**	5.0	Number of degrees added to cool setpoint when controller is unoccupied
Cool night setback	**present-value**	5.0	Number of degrees added to cool setpoint when controller is in night setback
Heat Setpoint	**present-value**	68.0	Zone temp must drop below for heating to occur
Heat unoccupied Setback	**present-value**	10.0	Number of degrees subtracted from heat setpoint when controller is unoccupied
Heat night setback	**present-value**	10.0	Number of degrees subtracted from heat setpoint when controller is in night setback
Warmup Setpoint	**present-value**	72	Setpoint during Warmup periods
Flow Setpoint	**(CM) cooling minimum flow**	100	Cooling minimum CFM

Table 4-12 Summary of Control Settings for Cooling with Reheat Operation

Object Name	Property	Value	Description
	(CX) cooling maximum flow	500	Cooling maximum CFM
	(CP) cooling proportional band	5	Proportional band in degrees
	(CI) cooling integration constant	5	Amount of proportional error in% (0.0–25.5)
	(HM) heating minimum flow	100	Heating minimum CFM
	(HX) heating maximum flow	100	Heating maximum CFM
Electric Reheat	**(AF) require max air flow**	0	0 = Max CFM is not required for stages to energize 1 = Max CFM is required before stages energize
	(BA) reheat balance mode	0	0 = No balancing of stage 1 = Stages with lowest usage energized first
	(FR) stages requiring flow	3	15 = K2, K3, K4 & K5 require flow 12 = K4 & K5 require flow 3 = K2 & K3 require flow 0 = Stages do not required flow
	(ID) interstage delay time	4.0	Time delay in minutes before the next stage will energize
	(MX) max supply temp	105.0	If supply temperature is equal to or greater than stages are de-energized. (Must be 999.0 if no supply temp and unreliable)
	(OF) reheat offset	1.5	Number of degrees below heating setpoint 1st stage of reheat will energize
	(RO) reheat application	1	0 = Disabled 1 = Two-stage (K2-K3) 2 = Two-stage (K4-K5) 3 = Four-stage (K2, K3, K4, & K5)

4.5 AUXILIARY FUNCTIONS

4.5.1 SERIES FAN

In series fan applications, the fan output is energized when the active schedule mode is either occupied or warm-up. When the active schedule mode is unoccupied, the fan is temperature-controlled, unless the BO01:**(FO) fan/damper application** property is set to “0=Always On”. When the active schedule mode is unoccupied or night setback, the series fan remains off unless the Zone Temperature:**present-value** varies beyond the limits of the control deadband.

To configure the NB-VAV for series fan operation, you should first set the BO01:**(FO) fan/damper application** property to “1=Series Fan”. Then you must specify the desired operation mode when the active schedule mode is unoccupied or night setback. This is done by setting the BO01:**(SF) fan mode** property to “0=Always On” or “1=Off in Deadband”.

The NB-VAV can be set to prevents short cycling of the fan output. To enable this option, enter the number of minutes you want the fan output to stay energized/de-energized in the BO01:**(FC) min cycle time** property.

Table 4-13 Summary of Control Settings for Series Fan Operation

Object Name	Property	Value	Description
BO0x	**(FO) fan/damper application**	1	Series fan
	(SF) fan mode	1	0 = Always on 1 = Off in deadband
	(FC) min cycle time	2.0	Minimum time fan will be ON and OFF

4.5.2 PARALLEL FAN

When the BO01:**(FO) fan/damper application** property is set to “2=Parallel Fan”, the parallel fan is energized when the active schedule mode is occupied and Flow:Control:**present-value** is less than the BO01:**(FS) fan setpoint** property. If the fan setpoint is equal to zero, the fan is energized when Zone Temperature:**present-value** is less than Zone Temperature:**(CH) current heating setpoint**.

To protect the output, a minimum cycle time may be entered into the **(FC) min cycle time** property.

Table 4-14 Summary of Control Settings for Parallel Fan Operation

Object Name	Property	Value	Description
BO0x	**(FO) fan/damper application**	2	Parallel fan
	(FS) fan setpoint	0	Parallel fan energizes when average CFM is below this value
	(FC) min cycle time	2.0	Minimum time fan will be ON and OFF

4.5.3 INDUCTION DAMPER

The *NB-VAV* can be configured to control an induction damper. The induction damper opens when the current airflow falls below preset minimum values for the heating cooling and warmup flow set in the Flow Setpoints object. The induction damper closes when the current airflow rises above the maximum values also specified in the Flow Setpoints object. To configure the *NB-VAV* for operation of an induction damper, set the BO01:**(FO) fan/damper application mode** property to "3=Induction Damper".

The **(FS) fan setpoint** property specifies the flow value below which the induction damper will open.

To protect the output, a minimum cycle time may be entered into the **(FC) min cycle time** property.

Table 4-15 Summary of Control Settings for Parallel Fan Operation

Object Name	Property	Value	Description
BO0x	**(FO) fan/damper application**	3	Induction Damper
	(FS) fan setpoint	0	Induction damper opens when average CFM is below this value
	(FC) min cycle time	2.0	Minimum time fan will be ON and OFF

4.5.4 VALVE CONTROL

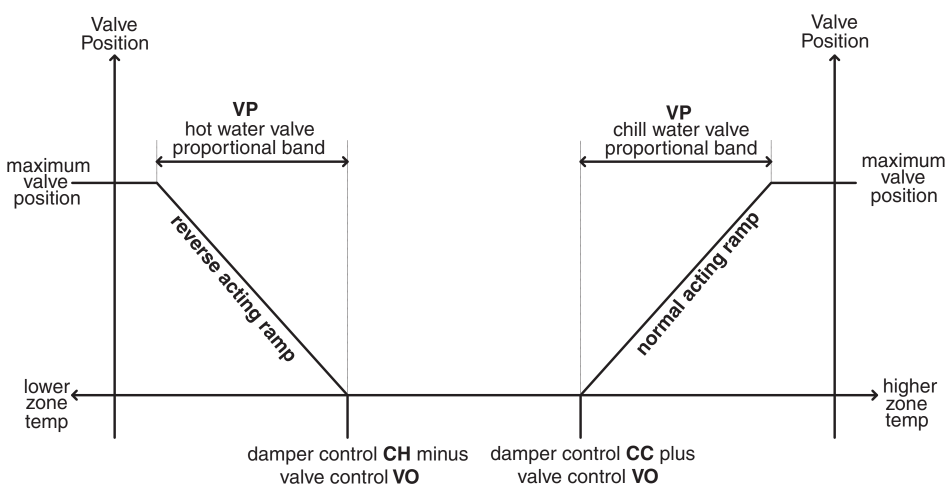

Figure 4-6 Valve Ramps

NOTE

Using the Valve Ctrl1 and Valve Ctrl 2 objects precludes the use of reheats. Valve Ctrl 1 uses BO02 and BO03 and Valve Ctrl 2 uses BO04 and BO05.

There are two types of valve control provided by the *NB-VAV*: pulse width modulated control and floating setpoint control. The *NB-VAV* uses its PI algorithm to calculate the percent of control needed for pulse width driven motor valves.

4.5.4.1 CONFIGURATION FOR PWM VALVE CONTROL

NOTE

The *NB*-VAVra, and *NB*-VAVrf should not be used for PWM control. AAM recommends only *NB*-VAV controllers with triac outputs (*NB*-VAVta and *NB*-VAVtf) be used for PWM control.

To configure the NB-VAV for pulse width modulation the **(VM) valve mode** property must be set to “0=Pulse Width Modulation”.

The **(AM) auto/manual flag** property should be set to “1=auto” to indicate that the controller should automatically control the valve.

The **(VU) valve use** property determines the control mode for the valve. To select a use, enter one of the values found in Table 4-16 for this property.

Table 4-16 : Valve Use Options

Value	Valve Use Option
0	Disabled
1	Cooling
2	Heating

The user-defined value in the **(VO) valve temp offset** property is added to the current cooling setpoint or subtracted from the current heating setpoint for calculation of the loop setpoint.

For hot water reheat operations, the valve operates in a reverse acting ramp. As the zone temperature falls below the current heating setpoint, the valve begins to open. As the zone temperature rises, the valve will begin to close.

In chilled water applications, the valve operates in a normal acting ramp. As the zone temperature rises above current cooling setpoint, the valve begins to open. As the temperature falls below the current cooling setpoint, the valve begins to close.

The **(VP) valve proportional band** property specifies the input variable range, in degrees (0.0 to 25.5), over which the output value is proportional to the error value. The proportional band is offset from the setpoint for the loop.

The **(VI) valve integration constant** property shows the amount of proportional error history (0 to 25.5%) used to calculate the desired position for the valve and to create an accumulated *integral sum*. This integral sum, applied once per minute, is used to control overshoot while the loop is operating within the confines of the proportional band.

The **(PP) pwm period** property specifies the number of seconds from the time the relay is energized before it can be energized again.

HIgh and low temperature lockouts are specified using the **(TH) high temp lockout** and **(TL) low temp lockout** properties. If the controller is in heating mode and the supply temperature exceeds **TH**, then the valve will be closed. Similarly, the valve will be closed if he controller is in cooling mode and the supply temperature drops below **TH**. If no reliable supply temperature is available, these properties should be set to a value of 999.0 to disable their functioning.

The **(VP) valve proportional band** and **(VI) valve integration constant** specify the proportional band and integration constant used in the PID algorithm which controls the valve.

Next, the heating setpoints for the various schedule states should be entered into the **present-value** property of the appropriate setpoint object.

To set the heating setpoints, you must enter the temperature that you want the zone to maintain when the active schedule mode is the mode corresponding to the object. This value can be entered into the **present-value** property of the appropriate Setpoint object.

You also have the option to specify an unoccupied setup/setback value for the heating setpoints. This is the value you want subtracted from the heating setpoint when the active schedule mode is unoccupied. For example, if the setpoint is 70° and the setback is 4°, the setpoint will be adjusted to 66° when the active schedule mode is unoccupied. To set the heating setback, enter the desired setback amount in the **present-value** of the Heat Unoccupied Setback object.

You may also specify the night setup/setback value you want subtracted from the heating setpoint when the active schedule mode is Night Setback. You may specify the setback to be applied to the heating setpoint by entered the appropriate amount in the **present-value** property of the Heat Night Setback object.

A warm-up setpoint may be specified for the *NB*-VAV. This is the temperature that you want the zone to maintain when warm-up is the active schedule mode. To set the warm-up setpoint, enter the desired value in the **present-value** property of the Warmup Setpoint object.

The Proof of Flow:**(DR) method to determine flow** property should be set to “0=None”.

The Supply Temperature:**(IC) input channel** property should be set to the appropriate input for the supply air temperature sensor. You should also confirm that the **(ST) sensor type** property for that input has been correctly configured.

Table 4-17 Summary of Control Settings for PWM Valve Control Operation

Object Name	Property	Value	Description
Valve Ctrl 1 or 2	**(AM) auto/manual flag**	1	0 = manual 1 = auto
	(PP) pwm period	20	Total time in seconds from time relay is energized until it is energized again
	(TH) high temp lockout	105.0	If supply temperature is equal to or greater than valve is closed in heat mode. (Must be 999.0 if no supply temp and unreliable)
	(TL) low temp lockout	45.0	If supply temperature is equal to or less than valve is closed in cool mode. (Must be 999.0 if no supply temp and unreliable)
	(VI) valve integration constant	20	Amount of proportional error in% (0.0–25.5)
	(VM) valve mode	0	Pulse with modulation
	(VP) valve proportional band	45	Proportional band in degrees
	(VU) valve mode	2	0 = disable 1 = cooling 2 = heating
Heat Setpoint	**present-value**	68.0	Zone temp must drop below for heating to occur
Heat Unoccupied Setup/Setback	**present-value**	10.0	Number of degrees subtracted from heat setpoint when controller is unoccupied
Heat Night Setup/ Setback	**present-value**	10.0	Number of degrees subtracted from heat setpoint when controller is in night setback
Warmup Setpoint	**present-value**	72	Setpoint during Warmup periods
Supply Temperature	**(IC) input channel**	1	1 = UI1 2 = UI2
UI0x	**(ST) sensor type**	7	0 = digital 2 = linear 3 = 4-20ma 7 = thermistor

Table 4-17 Summary of Control Settings for PWM Valve Control Operation

Object Name	Property	Value	Description
Proof of Flow	**(DR) method to determine flow**	0	0 = none (PF=1) 1 = minimum flow 2 = digital input 3 = both

4.5.4.2 BASIC CONFIGURATION FOR FLOATING SETPOINT VALVE CONTROL

To configure the *NB*-VAV for floating setpoint valve control, you must set the **(VM) valve mode** property in the associated Valve Ctrl object to “1=Floating Point Motor Control”. Then, you must disable the proof of flow sensors by setting the Proof of Flow:**(DR) method to determine flow** property to “0=None”.

The **(AM) auto/manual flag** property should be set to “1=auto” to indicate that the controller should automatically control the valve.

The **(VU) valve use** property determines the control mode for the valve. To select a use, enter one of the values found in Table 4-18 for this property.

Table 4-18 : Valve Use Options

Value	Valve Use Option
0	Disabled
1	Cooling
2	Heating

The user-defined value in the **(VO) valve temp offset** property is added to the current cooling setpoint or subtracted from the current heating setpoint for calculation of the loop setpoint.

For hot water reheat operations, the valve operates in a reverse acting ramp. As the zone temperature falls below the current heating setpoint, the valve begins to open. As the zone temperature rises, the valve will begin to close.

In chilled water applications, the valve operates in a normal acting ramp. As the zone temperature rises above current cooling setpoint, the valve begins to open. As the temperature falls below the current cooling setpoint, the valve begins to close.

The **(VP) valve proportional band** property specifies the input variable range, in degrees (0.0 to 25.5), over which the output value is proportional to the error value. The proportional band is offset from the setpoint for the loop.

The **(VI) valve integration constant** property shows the amount of proportional error history (0 to 25.5%) used to calculate the desired position for the valve and to create an accumulated *integral sum*. This integral sum, applied once per minute, is used to control overshoot while the loop is operating within the confines of the proportional band.

HIgh and low temperature lockouts are specified using the **(TH) high temp lockout** and **(TL) low temp lockout** properties. If the controller is in heating mode and the supply temperature exceeds **TH**, then the valve will be closed. Similarly, the valve will be closed if he controller is in cooling mode and the supply temperature drops below **TH**. If no reliable supply temperature is available, these properties should be set to a value of 999.0 to disable their functioning.

The **(VP) valve proportional band** and **(VI) valve integration constant** specify the proportional band and integration constant used in the PID algorithm which controls the valve.

The **(VT) recalb with new value** property is used to set the number of seconds it takes for the valve to go from fully open to fully closed. This value should be found in the valve manufacturer's literature.

To set the heating and cooling setpoints, you must enter the temperature that you want the zone to maintain when the active schedule mode is the mode corresponding to the object. This value can be entered into the **present-value** property of the appropriate Setpoint object.

You also have the option to specify an unoccupied setup/setback value for the heating and cooling setpoints. These are the values you want subtracted from the heating setpoint or added to the cooling setpoint when the active schedule mode is unoccupied. For example, if the heating setpoint is 70° and the setback is 4°, the setpoint will be adjusted to 66° when the active schedule mode is unoccupied. To set the setup/setback, enter the desired setback amounts in the **present-value** of the Heat Unoccupied Setup/ Setback and Cool Unoccupied Setup/Setback object.

You may also specify the night setup/setback value you want subtracted from the heating setpoint or added to the cooling setpoint when the active schedule mode is Night Setback. You may specify the setback to be applied to the heating setpoint by entered the appropriate amount in the **present-value** property of the Heat Night Setup/Setback object.

A warm-up setpoint may be specified for the *NB*-VAV. This is the temperature that you want the zone to maintain when warm-up is the active schedule mode. To set the warm-up setpoint, enter the desired value in the **present-value** property of the Warmup Setpoint object.

The Supply Temperature:**(IC) input channel** property should be set to the appropriate input for the supply air temperature sensor. You should also confirm that the **(ST) sensor type** property for that input has been correctly configured.

Table 4-19 Summary of Control Settings for Floating Point Valve Control Operation

Object Name	Property	Value	Description
Valve Ctrl 1 or 2	**(AM) auto/manual flag**	1	0 = manual 1 = auto
	(TH) high temp lockout	105.0	If supply temperature is equal to or greater than valve is closed in heat mode. (Must be 999.0 if no supply temp and unreliable)
	(TL) low temp lockout	45.0	If supply temperature is equal to or less than valve is closed in cool mode. (Must be 999.0 if no supply temp and unreliable)
	(VI) valve integration constant	20	Amount of proportional error in% (0.0–25.5)

Table 4-19 Summary of Control Settings for Floating Point Valve Control Operation

Object Name	Property	Value	Description
	(VM) valve mode	1	Floating Point Motor Control
	(VP) valve proportional band	45	Proportional band in degrees
	(VT) recalb with new value	180	The time in seconds it takes the valve to go from fully closed to fully open or fully open to fully close which ever is longer.
	(VU) valve mode	2	0 = disable 1 = cooling 2 = heating
Cool Setpoint	**present-value**	72.0	Zone temp VAV damper will increase CFM
Cool Unoccupied Setup/Setback	**present-value**	5.0	Number of degrees added to cool setpoint when controller is unoccupied
Cool Night Setup/ Setback	**present-value**	5.0	Number of degrees added to cool setpoint when controller is in night setback
Heat Setpoint	**present-value**	68.0	Zone temp must drop below for heating to occur
Heat Unoccupied Setup/Setback	**present-value**	10.0	Number of degrees subtracted from heat setpoint when controller is unoccupied
Heat Night Setup/ Setback	**present-value**	10.0	Number of degrees subtracted from heat setpoint when controller is in night setback
Warmup Setpoint	**present-value**	72	Setpoint during Warmup periods
Supply Temperature	**(IC) input channel**	2	1 = UI1 2 = UI2
UI0x	**(ST) sensor type**	7	0 = digital 2 = linear 3 = 4-20ma 7 = thermistor
Proof of Flow	**(DR) method to determine flow**	0	0 = none (PF=1) 1 = minimum flow 2 = digital input 3 = both

4.6 DUAL DUCT APPLICATION

CAUTION
Only the NB-VAVrf can be used for dual duct applications.

The *NB*-VAVrf can be configured to provide control for dual duct applications. Unlike past Dual Duct offerings, the NB-VAV only has one flow sensor. For this type of application you must connect the internal feedback actuator to the hot duct, and the external actuator to the cold duct. The external actuator must be connected to an external power supply and Relays 4 and 5 (K4 and K5) on the controller. Refer to *Section 2, Wiring and Installation* for additional information on wiring an external actuator.

The flow sensor must be connected to pitot tubes located after the hot and cold duct junction, where the NB-VAV can measure the combined airflow from both the hot deck and cold deck.

To configure the *NB*-VAVrf for dual duct applications, you must set the Zone Temperature:**(BT) application (box type)** property to “3=Supply Dependent”. You must also specify the actuator type by setting the Flow Control:**(AT) actuator type** property to “0=LM-24M (MMT)”. For dual duct operation, the **(DC) damper control mode** property should be set to “2=Dual Mixed (CAV”.

The maximum airflow through the hot duct is specified in the Flow Control:**(EF) estimated flow at full open** property and the target flow is specified in the Flow Control:**(CD) target flow** property These values specify the parameters used to control the dual duct system.

The flow should be calibrated to zero flow by setting Flow Control:**(CB) calibrate flow** property to 1 when the fan is completely shutdown. After the **present-value** and **(CA) average flow** properties both equal zero, then you will check the controller's CFM reading with what the balancer is reading. If they do not match, enter the balancer's reading in Flow Control:**(KC) measured cfm for CK adjust**. If the values still do not agree, you should adjust the damper so the CFM has changed by more than 100 CFM. You should then enter the second balancer's reading in Flow Control:**(K2) measured cfm for 2pt cal**. Finally, the Flow Control:**(AC) auto/manual/track mode select** property should be set to “1=Auto”.

To set the heating setpoints, you must enter the temperature that you want the zone to maintain when the active schedule mode is the mode corresponding to the object. This value can be entered into the **present-value** property of the appropriate Setpoint object.

You also have the option to specify an unoccupied setup/setback value for the heating and cooling setpoints. This is the value you want subtracted from the heating setpoint or added to the cooling setpoint when the active schedule mode is unoccupied. For example, if the heating setpoint is 70° and the setback is 4°, the setpoint will be adjusted to 66° when the active schedule mode is unoccupied. To set the setback, enter the desired setback amount in the **present-value** of the Heat Unoccupied Setup/Setback or the Cool Unoccupied Setup/Setback object.

You may specify a night setup/setback value you want subtracted from the heating setpoint or added to the cooling setpoint when the active schedule mode is Night Setback. You may specify the setback to be applied to the setpoints by entering the appropriate amount in the **present-value** property of the Heat Night Setup/Setback and the Cool Nigh Setup/Setback the object.

The *NB*-VAV has capabilities to control the flow during the different schedule states. The parameters which control this behavior are found in the Flow Setpoint object.

For cooling applications, you may specify the value of the minimum and maximum rate, measured in cfm, at which you want air to flow through the duct. by entering values into **(CM) cooling minimum flow** and **(CX) cooling maximum flow**. These set the minimum and maximum values for the Flow Control:**(CD) target flow** property.

The *NB*-VAV sets the target flow via a PID loop controlling off the temperature setpoint. There is an integration constant, specified by the Flow Setpoints:**(CI) cooling integration constant** property, which defines the percentage of accumulated error used to calculate the required supply airflow, and a proportional band, specified by the Flow Setpoints:**(CP) cooling proportional band** property, which specifies the number of degrees over which proportional cooling will take place.

The **(HM) heating minimum flow** and **(HX) heating maximum flow** properties and the **(WM) warmup minimum flow** and (**WX) warmup maximum flow** properties in the Flow Setpoints object perform the same functions as their cooling counterparts, setting the minimums and maximums for the heating and warmup flows respectively.

The **(HP) heating proportional band** and **(HI) heating integration constant** properties and the (**WP) warmup proportional band** and **(WI) warmup integration constant** properties are used to define the proportional bands and integration constants to be used for heating and warmup.

NOTE

The **Minimum** and **Maximum Flow** properties should not exceed the minimum and maximum allowable rates of flow specified by the manufacturer of the VAV terminal box.

The Supply Temperature:**(IC) input channel** property should be set to the appropriate input for the supply air temperature sensor. You should also confirm that the **(ST) sensor type** property for that input has been correctly configured.

Table 4-20 Summary of Control Settings for Dual Duct Operation

Object Name	Property	Value	Description
Zone Temperature	**(BT) application (box type)**	3	Supply Dependant (VST)
Flow Control	**(CK) duct scaling factor**	786	4005 x duct square feet (common duct) (default 6” round)
	(CB) calibrate flow	0	1 = calibrate flow sensor reading with no flow (will automatically return to zero)
	(KC) measured cfm for CK adjust	0	For CFM calibration purpose enter actual measured CFM value.

Table 4-20 Summary of Control Settings for Dual Duct Operation

Object Name	Property	Value	Description
	(K2) measured cfm for 2pt cal	0	For finer CFM calibration enter actual measured CFM value but must be at least 100CFM different than KC reading
	(AC) auto/manual/track mode select	1	0 = manual 1 = auto 2 = tracking
	(AT) actuator type	0	0 = LM-24M (MMT) 1 = Generic DC 2 = Generic AC (K4-5) 3 = None
	(CD) target flow	500	CAV in CFM from both Hot/Cold decks
	(DC) damper control mode	2	0 = Pressure Dependant 1 = Measured Flow 2 = Dual Mixed (CAV)
	(EF) estimated flow at full open	700	Hot deck box only
Cool Setpoint	**present-value**	72.0	Zone temp VAV damper will increase CFM
Cool Unoccupied Setup/Setback	**present-value**	5.0	Number of degrees added to cool setpoint when controller is unoccupied
Cool Night Setup/ Setback	**present-value**	5.0	Number of degrees added to cool setpoint when controller is in night setback
Heat Setpoint	**present-value**	71.0	Zone temp must drop below for hot deck damper to modulate toward HX
Heat Unoccupied Setup/Setback	**present-value**	10.0	Number of degrees subtracted from heat setpoint when controller is unoccupied
Heat Night Setup/ Setback	**present-value**	10.0	Number of degrees subtracted from heat setpoint when controller is in night setback
Warmup Setpoint	**present-value**	72	Setpoint during Warmup periods
Flow Setpoint	**(CP) cooling proportional band**	5	Proportional band in degrees
	(CI) cooling integration constant	5	Amount of proportional error in% (0.0–25.5)

Table 4-20 Summary of Control Settings for Dual Duct Operation

Object Name	Property	Value	Description
	(HM) heating minimum flow	100	Heating minimum CFM
	(HX) heating maximum flow	700	Heating maximum CFM
	(HP) heating proportional band	5	Proportional band in degrees
	(HI) heating integration constant	5	Amount of proportional error in% (0.0–25.5)
	(WM) warmup minimum flow	100	Warmup minimum CFM
	(WX) warmup maximum flow	500	Warmup maximum CFM
	(WP) warmup proportional band	5	Proportional band in degrees
	(WI) warmup integration constant	5	Amount of proportional error in% (0.0–25.5)
Supply Temperature	**(IC) input channel**	2	1 = UI1 (Supply Air Temp to Hot Deck Box) 2 = UI2
UI2	**(ST) sensor type**	7	0 = digital 2 = linear 3 = 4-20ma 7 = thermistor

4.7 TRACKING

The *NB*-VAV can be configured as a slave and used to “track” the Average Flow of another *NB*-VAV which is configured as a master. The Target Flow of the slave *NB*-VAV will then be derived from the Average Flow (Flow Control:**(CA) average flow**) of the master and the user-defined Flow Offset (Flow Control:**(OF flow offset**) of the slave.

To configure the NB-VAV to operate as a slave, set the Zone Temperature**:(BM) ssb bus mode** to “1=Slave Bus Mode”.

The flow should be calibrated to zero flow by setting Flow Control:**(CB) calibrate flow** property to 1 when the fan is completely shutdown. After the **present-value** and **(CA) average flow** properties both equal zero, then you will check the controller's CFM reading with what the balancer is reading. If they do not match, enter the balancer's reading in Flow Control:**(KC) measured cfm for CK adjust**. If the values still do not agree, you should adjust the damper so the CFM has changed by more than 100 CFM. You should then enter the second balancer's reading in Flow Control:**(K2) measured cfm for 2pt cal**. Finally, the Flow Control:**(AC) auto/manual/track mode select** property should be set to “1=Auto”.

Then, you must specify the flow (in CFM) that you want added to/subtracted from the master controller’s average flow when determining the slave unit’s Target Flow (Flow Control:**(CD) target flow**). This value is entered into the Flow Control:**(OF) offset** property. You must also set the Flow Control:**(AC) auto/manual/ tack mode select** property to “2=Tracking”.

Table 4-21 Summary of Control Settings for Tracking Operation

Object Name	Property	Value	Description
Zone Temperature	**(BM) ssb bus mode**	1	Slave Bus Mode
Flow Control	**(CK) duct scaling factor**	786	4005 x duct square feet (common duct) (default 6” round)
	(CB) calibrate flow	0	1 = calibrate flow sensor reading with no flow (will automatically return to zero)
	(KC) measured cfm for CK adjust	0	For CFM calibration purpose enter actual measured CFM value.
	(K2) measured cfm for 2pt cal	0	For finer CFM calibration enter actual measured CFM value but must be at least 100CFM different than KC reading
	(AC) auto/manual/track mode select	2	0 = manual 1 = auto 2 = tracking
	(OF) flow offset	0	Enter the value (in CFM) you want added to/subtracted from the master controller’s Average Flow (CA) to determine the Slave’s Target Flow (CD)

4.8 INDOOR AIR QUALITY

The NB-VAVta-IAQ and NB-VAVtf-IAQ are capable of providing Indoor Air Quality (IAQ) control based upon space Carbon Dioxide (CO^2) levels. The IAQ VAV monitors space carbon dioxide levels and upon the detection of high levels, initiates the IAQ control and overrides the normal temperature control sequence. The IAQ control gradually opens the damper to a predefined airflow setpoint in order to dilute the high space carbon dioxide levels. In this application, it is assumed that the Air Handling Unit providing supply air to the VAV unit monitors carbon dioxide levels in the building and adjust its air mixture accordingly.

At the NB-VAV, the carbon dioxide sensor must be connected to the dedicated input, Universal Input 3 (UI3). UI3 is only intended for a carbon dioxide sensors and is capable of accepting sensor types: current (0-20 mA), resistance (0-1MW), or voltage (0-10VDC).

Table 4-22: Indoor Air Quality Settings Example

Object Name	Property	Value	Description
Flow Control	**(DP) damper position**	0	0 = automatic damper mode. The Indoor Air Quality application will operate only when the damper mod is automatic
Flow Setpoints	**(AS) air quality setpoint**	700	For your applications, enter the desired CO_2 level for the zone in PPM
	(DB) air quality deadband	50	For your application, enter the desired CO_2 control deadband in PPM)
	(AM) air quality max air flow	400	For your application, enter the maximum allowed air flow in CFM.
	(RP) air quality control damper ramp rate	10	For your application, enter the desired ramp rate for damper control in percent-per-minute.

Using the **(AS) air quality setpoint** and the **(DB) air quality deadband** properties, the user defines when IAQ control overrides the normal temperature control. This occurs when the CO_2 level, as sensed by **UI03's present-value**, rises above the combined level of AS and DB. While in IAQ control, the damper continues to open at a rate as determined by the **(RP) air quality control damper ramp rate** until the airflow reaches the maximum setpoint. The normal temperature control resumes when the CO_2 level again equals AS minus DB.

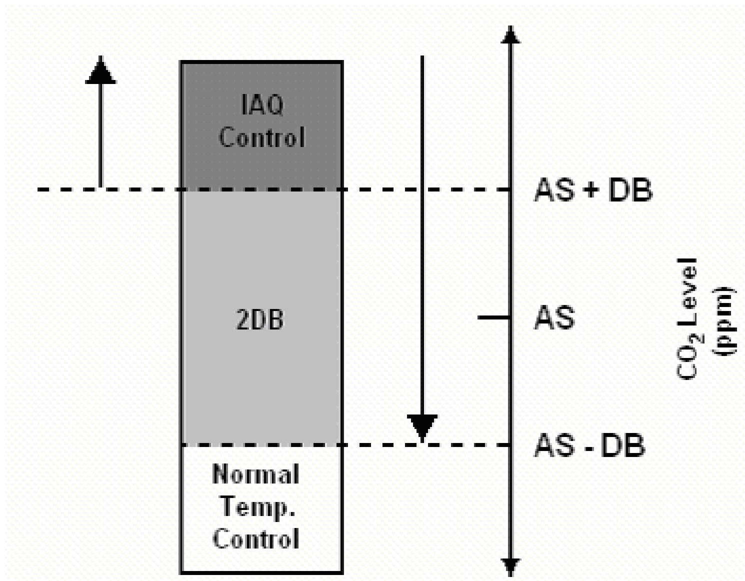

Figure 4-7 Indoor Air Quality Diagram

The Maximum Airflow allowed when in IAQ control is dependant upon the current mode of the VAV controller. The following table indicates what the maximum airflow setpoint is if IAQ override occurs in each mode:

Table 4-23: Air Flow Control with IAQ Control Enabled

Current Mode	Maximum Air Flow Setpoint
Venting	IAQ Max Air Flow
Heating	IAQ Max Air Flow or Heating Max Air Flow (whichever the less of the two)
Cooling	IAQ Max AirFlow or Cooling Max Air Flow (whichever the less of the two)
Warmup	IAQ Max Air Flow or Warmup Max Air Flow (whichever the less of the two)

4.9 SBC-STAT CONFIGURATION

The NB-VAV supports SBC-STAT model devices, as referenced in Section 2. There are a few configuration options available for a connected SBC-STAT, which this section reviews

4.9.1 SETPOINT ADJUSTMENT CONFIGURATION

Setpoint adjustment configuration can be achieved by accessing *Zone Temperature* using NB-Pro. Options found in this section include the following in the table below:

Table 4-24: Setpoint Adjustment Properties

Property	Value and Interpretation
(ZS) Zone Midpoint	Specifies the comfort level for the zone.
(TS) User Setpoint Offset	Specifies an offset to apply to Zone Heating and Zone Cooling for PID Control.
(TM) User Adjust Increment	Specifies the magnitude of increment/decrement changes made to the setpoint.
(TT) User Adjust Duration	Specifies how much time, in minutes, a setpoint change is applied to the controller.
(SD) Calculated Setpoint Display	Specifies whether the offset, zone midpoint, heating setpoint, or cooling setpoint is displayed when a user performs setpoint adjustment.

4.9.2 USER OVERRIDE

If the active schedule controlling the NB-VAV is in unoccupied or night setback mode, user override is possible. If the user presses the up or down arrow push-button on the SBC-STAT2, SBC-STAT2D, or SBC-STAT3 and the **(SE) Override Enable/Disable** property is Enabled (value of 1), the unit will go into occupied mode.

The duration of this mode, which is also called extended occupancy, can be set by using the **(ED) Extended Occupancy Duration** property.

To configure the NB-VAV for user override ability via an *SBC*-STAT, perform the following steps:

1. Using NB-Pro, access *Zone Temperature*
2. Set **(SE) User Override** = 1 (Enabled)
3. Set **(ED) Extended Occupancy Duration** to however many minutes you wish for user override mode to occur.

When the unit's schedule is in unoccupied mode and the user enables override from a connected STAT, occupancy will occur for the amount of minutes specified in **(ED) Extended Occupancy Duration**. Once the time has elapsed, the unit will revert back to its configured schedule mode.

4.10 OCCUPANCY DETECTION

The occupancy detection feature enables the NB-VAV to automatically go to occupied mode, (also called extended occupancy) when a dedicated occupancy sensor indicates the monitored zone is occupied. The length of time that the controller will operate in extended occupancy is defined by the user in the Occupancy Detection; **(MT) Extended Occupancy Duration** property. To configure the controller for occupancy detection capability, perform the following steps:

1. Using NB-Pro, access *Occupancy Detection*
2. Set **(IC) Status Input** to the input that the occupancy detector is connected to.
3. Set **(MD) Extended Occupancy Delay** to the desired number of seconds the detector must indicate that occupancy is detected before overriding the zone. This prevents false triggering of the occupancy detection in the event someone or something quickly passes through the zone.
4. Set **(MT) Extended Occupancy Duration** to the desired number of minutes the controller is to remain in occupied mode once the zone has been occupied.

NOTE

If **(MT) Extended Occupancy Duration** is not set to a value greater than zero, the controller will not enter extended occupancy when it is detected that the zone is occupied.

NOTE

The input selected for the Occupancy Detection application must be configured as a digital input.

APPENDIX A: VAV OBJECTS & PROPERTIES

The following tables contain listings of the BACnet objects and property assignments. Each property is listed with its identifier number, data type, access code, storage, default value (if any) and a brief description of its functionality.

IN THIS SECTION

A.1 DEVICE

NOTE

The Device object is represented in *NB*-Pro as follows:
AAM VAV xxxxxxxxxx
(where xxxxxxxxxx is the Unitary Controller serial number)

The instance must be a unique number from 0 to 4194302. By default, AAM sets the value in such a way that it is unique to AAM products based off the unit's serial number, however the user must ensure the device instance is unique on the job site's network.

Property	Identifier #	Data Type	Access	Storage & Default	Description
object_ identifier	75	BACnet ObjID	RO	EEPROM Device (8), Instance *serial number*	a numeric code that is used to identify the object.
object_name	77	CharStr	RO	NRAM AAM XXX *serial number*	represents a name for the object that is unique internetwork-wide.
object_type	79	BACnet ObjType	RO	- Device (8)	indicates membership in a particular object type class.
system_status	112	BACnet ObjID	RO	- 0	indicates the current physical and logical status of the BACnet Device.
vendor_name	121	CharStr	RO	NRAM American Auto-Matrix	identifies the manufacturer of the BACnet Device.
vendor_ identifier	120	Unsigned	RO	- 6	a unique vendor identification code, assigned by ASHRAE, which is used to distinguish proprietary extensions to the protocol.
model_name	70	CharStr	RO	NRAM NB-XXX	indicates the vendor’s name used to represent the model of the device.
firmware_ revision	44	CharStr	RO	NRAM *revision number*	indicates the level of firmware installed in the device.
application_ software_ version	12	CharStr	RO	NRAM *version number*	identifies the version of application software installed in the device.
protocol_ version	98	Unsigned	RO	- 1	indicates the version of the BACnet protocol supported by this BACnet Device.
protocol_ revision	139	Unsigned	RO	- 4	indicates the minor revision level of the BACnet standard.
protocol_ services_ supported	97	BACnet Services Supported	RO	-	indicates which standardized protocol services are supported by this device's protocol implementation.
protocol_ object_ types_ supported	96	BACnet Object Types Supported	RO	-	indicates which standardized object types are supported by this device's protocol implementation.

Property	Identifier #	Data Type	Access	Storage & Default	Description
object_list	76	BACnet Array	RO	-	a list of each object within the device that is accessible through BACnet services.
max_apdu_ length_ accepted	62	Unsigned	RO	NRAM 78	specifies the maximum number of information frames the node may send before it must pass the token.
segmentation_ supported	107	BACnet Segment ation	RO	- 3	indicates whether the device supports segmentation of messages and, if so, whether it supports segmented transmission, reception, or both.
local_time	57	Time	RW	-	indicates the time of day to the best of the device's knowledge.
local_date	56	Date	RW	-	indicates the date to the best of the device's knowledge.
apdu_timeout	11	Unsigned	RW	NRAM 3000	indicates the amount of time, in milliseconds, between retransmissions of an APDU requiring acknowledgment for which no acknowledgment has been received.
number_of_ apdu_retries	73	Unsigned	RW	NRAM 3	indicates the maximum number of times that an APDU shall be retransmitted.
time_ synchronization _recipients	116	List of BACnet recipients	RW	NRAM {}	a list of one device to which the device may automatically send a Time Synchronization request.
max_master	64	Unsigned	RW	EEPROM 127	specifies the highest possible address for master nodes and shall be less than or equal to 127.
max_info_ frames	63	Unsigned	RW	NRAM 4	specifies the maximum number of information frames the node may send before it must pass the token.
device_ address_ binding	30	List	RW	-	a list of the device addresses that will be used when the remote device must be accessed via a BACnet service request.
BU	16758	Bool	RW	RAM 0	**Backup Control** backs up TF, TE, the digital input property AE and digital outputs 1-5 RH to EEPROM each day at midnight. To copy them at any other time, set BU=1.
CC	16770	UInt	RW	EE 0	**Count of Clock Fails** increments upon hardware failure but can also be advanced during the removal of power.
CM	16779	UInt	R	RAM 255	**Controller Manufacturer Code** (read-only) is the manufacturer of the device. AAM devices are 255.
CP	16781	UInt	RW	EE 0	**Network Baud Rate** specifies the communication speed (baud rate) at which devices on the network will communicate. All devices on the network must have the same communication speed. Valid baud rates are as follows: 0=9600, 6=38.4K, 7=19.2K, 10=76.8K. This attribute defaults to 6.
CT	16784	UInt	R	RAM Flash 201	**Controller Type** factory-set controller type identifies the type of unitary controller. CT for the NB-VAV is 202.
DE	16795	UInt	RW	RAM 0	**Default Enable Command** restores configuration settings to factory defaults. Enter 197 to set the defaults.
EM	16813	Bool	RW	EE 0	**English/Metric** specifies which units of measurement to use in returning temperature values. 0=English Units 1=Metric Units

Property	Identifier #	Data Type	Access	Storage & Default	Description
FT	16834	UInt	R	RAM Flash	**Firmware Type** indicates the firmware application type loaded into the controller. This is a read-only value.
IC	16876	UInt	R	EE 0	**EEPROM Default Count**
ID	16877	UInt	RW	EE Factory Set Default	**Unit ID** MS/TP MAC Address for the unit. Assignable values include 0 to 127.
MS	16902	Bool	RW	EE 0	**Master/Slave Mode** used to configure the controller as a master node (passes token) or a slave node. Selections are as follows: 0=slave, 1=master.
OC	16917	UInt	RW	EE 0	**Count of Illegal Opcodes** increments upon firmware failure but can also be advanced during the removal of power.
OS	16925	Real	R	N/A	**Kernel Version** this read-only property defines the class of firmware operating system used in the controller.
PD	16942	UInt	RW	EE 5	**Power-on Delay** determines how long (0-255 seconds) an NB-VAV waits before energizing its outputs after power loss or soft reset. PD defaults to 5 seconds.
PS	16951	UInt	RW	EE 2	**Power-up State** 0=unoccupied 1=warmup 2=occupied 3=night setback
RC	16963	UInt	RW	EE 0	**Count of Resets** the number of times the controller has reset by power-cycle or through software reset (RS property).
RE	16964	UInt	RO	RAM 0	**STATbus Reset Count** This property reflects the number of instances that a STATbus reset occured. This property is used for diagnostic and troubleshooting purposes only.
RS	16972	Bool	RW	RAM 0	**Reset** 0 = disabled (default), 1 = reset controller
SN	16991	UInt	R	EE factory set	**Serial Number**
SR	16994	UInt	R	RAM Flash	**Software Time Stamp**
UP	17030	UInt	R	EE 0	**Flash Update Count** indicates the amount of times that the unit has been flash updated.
VE	17043	Real	R	RAM Flash	**Software Version** mirrors firmware-revision property.
WC	17050	UInt	RW	EE 0	**Count of Watchdog COP**
ZN	17084	UInt	RW	EE 0	**Zone Number** assignable zone number for receiving zone-based broadcasts.
PS	16951	UInt	RW	EE 2	**Power-up State** 0=unoccupied 1=warmup 2=occupied 3=night setback

Property	Identifier #	Data Type	Access	Storage & Default	Description
RC	16963	UInt	RW	EE 0	**Count of Resets** number of times the unit has rebooted.

A.2 ZONE TEMPERATURE

Property	Identifier #	Data Type	Access	Storage & Default	Description
object_identifier	75	BACnet ObjID	RO	- Analog Input (3), Instance *N*	a numeric code that is used to identify the object.
object_name	77	CharStr	RW	NRAM Universal Input *N*	represents a name for the object that is unique internetwork-wide.
object_type	79	BACnet ObjType	RO	- Analog Input (3)	indicates membership in a particular object type class.
present_value	85	Real	RW	RAM 0	indicates the current value, in engineering units, of the object.
status_flags	111	BACnet Status Flags	RO	RAM 0	four flags that indicate the general "health" of the program.
event_state	36	BACnet Event State	RO	RAM 0	provides a way to determine if this object has an active event state associated with it.
reliability	103	BACnet Reliability	RO	RAM 0	indicates whether the **present_value** is "reliable" as far as the device or operator can determine.
out_of_service	81	Boolean	RW	NRAM 0	indicates whether or not the process this object represents is not in service.
units	117	BACnet Eng. Units	RW	NRAM 95	indicates the measurement units of this object.
min_pres_value	69	Real	RW	NRAM	indicates the lowest number that can be reliably used for the **present_value** property of this object.
max_pres_value	65	Real	RW	NRAM	indicates the highest number that can be reliably used for the **present_value** property of this object.
BM	16754	UInt	RW	EE 0	**SSB Bus Mode** by default this should be set to Master (**BM**=0) unless multiple controllers are wired onto a single Sensor Bus (SSB). All additional controllers on the SSB must be configured as Slaves (**BM**=1).
BT	16757	UInt	RW	EE 0	**Application (Box Type)** none (**BT**=0), cooling only (**BT**=1), heating only (**BT**=2), supply dependant (**BT**=3), and cooling w/reheat (**BT**=4). **BT** defaults to cooling only (**BT**=1).
CC	16770	Real	R	RAM	**Current Cooling Setpoint** shows the current cooling temperature control setpoint. This will depend on setbacks and user adjustments. The attribute is read-only.
CH	16775	Real	R	RAM	**Current Heating Setpoint** shows the current heating temperature control setpoint. this will depend on setbacks and user adjustments. The point is read-only.
DF	16796	UInt	RW	EE 0	**Thermostat Display Format** defines the format used to display the current temperature on the digital thermostat. The display of the tenths digit and the Fahrenheit/Celsius character are options. Also, the display may be eliminated. 0=##° (Default) 1=##.#° 2=##°F (or C) 3=##.#°F (or C) 4=No Temp Display

Property	Identifier #	Data Type	Access	Storage & Default	Description
DL	16798	Real	R	RAM	**Total Zone Demand Load** indicates the heating/cooling demand for the zone in terms of temperature separation from setpoints.
DM	16799	UInt	R	RAM	**Demand Mode** indicates the demand for the zone. A satisfied zone will indicate “vent” (**DM**=0). If the *NB*-VAV is in cooling mode and the zone temperature exceeds the cooling setpoint, “cool” is indicated (**DM**=1). If the controller is in heating mode and the zone temperature falls below the heating setpoint, “heat” is indicated (**DM**=2).
DS	16803	UInt	RW	EE 0	**Thermostat Display Mode** specifies whether English or Metric units are to be used for digital thermostat display on the *SBC*-STAT3. This mode is automatically altered as appropriate when the system Engineering Units property is set but may be modified later if required to display the alternate units. 0=Fahrenheit (Default) 1=Celsius
DV	16805	UInt	RW	EE 0	**Thermostat Display Value** by default (**DV**=0) each digital thermostat will display the identical temperature value (**ZT**) which is the average of each. With **DV**=1, each thermostat will display its own temperature (including offset).
ED	16808	UInt	RW	EE 60	**Extended Occupancy Time Duration** specifies the amount of time in minutes to extend occupancy. **ED** has a default value of 60.
ER	16816	UInt	R	RAM	**Extended Occupancy Time Remaining** shows the amount of time remaining in extended occupancy. This value is set to the Extended Occupancy Duration (**ET**) when either push button on an analog thermostat is pressed. The *SBC*-STAT3 digital thermostat employs its User Menu for this function. **ER** is a read-only property that cannot be changed directly.
ET	16818	Boolean	RW	EE 0	**Enable Totalization** when set to 1, this calculates totalized flow, totalized energy, and heat recovery. If you enable this point, you must make sure that **ST** is a duct temperature value. Energy totalization is invalid in any other circumstance. Therefore unless **ST** is used as a duct temperature sensor, **ET** should remain disabled (**ET**=0).
G0	16837	UInt	R	RAM	**Global ID for Device** the Global Identification for the Sensor Bus device.
G1	16838	UInt	R	RAM	**Global ID for Device** the Global Identification for the Sensor Bus device.
G2	16839	UInt	R	RAM	**Global ID for Device** the Global Identification for the Sensor Bus device.
G3	16840	UInt	R	RAM	**Global ID for Device** the Global Identification for the Sensor Bus device.
OA	16916	UInt	RW	RAM 0	**Extended Occupancy Accumulation** shows the total amount of time that the *NB*-VAV has spent in extended occupancy (override during scheduled unoccupied periods). You can clear this value by setting **OA** to 0.
OF	16919	Real	RW	EE 0	**Temperature Adjustment** defines an optional correction that may be required as an adjustment for the thermostat location and the possible measurement errors.
PB	16940	UInt	RW	EE 2200	**Balance PIN** this Personal Identification Number controls access to the Balance Menu. A value of 0 makes the menu always accessible. Values inclusively from 1 to 9,999 are used to control access to the menu. A matching number must be entered by the Balancer. Values of 10,000 or greater will hide the menu. Entered P.I.N. numbers remain valid for only four (4) minutes after their use. **PB** has a default value of 2200.

Property	Identifier #	Data Type	Access	Storage & Default	Description
PG	16945	UInt	RW	EE 0	**Primary GID** specifies the GID of the Primary thermostat in Primary GID mode (**RM**=8). If this thermostat is not available, then the Average temperature mode (**RM**=0) is used.
PI	16947	UInt	RW	EE 3300	**Installer PIN** this Personal Identification Number controls access to all menus. A value of 0 makes the menu always accessible. Values inclusively from 1 to 9,999 are used to control access. A matching number must be entered by the Installer. Values of 10,000 or greater will hide the Install Menu. An authenticated Installer can access all menus. Entered P.I.N.s remain valid for only four minutes after the last button press. **PI** has a default value of 3300.
PS	16951	UInt	RW	EE 1100	**Service PIN** this Personal Identification Number controls access to the Service Menu. A value of 0 makes the menu always accessible. Values inclusively from 1 to 9,999 are used to control access to the menu. A matching number must be entered by the Servicer. Values of 10,000 or greater will hide the menu. Entered P.I.N.s remain valid for only four (4) minutes after their use. **PS** has a default value of 1100.
PU	16952	UInt	RW	EE 0000	**User PIN** this Personal Identification Number controls access to the User Menu. A value of 0 makes the menu always accessible. Values from 0001 to 9999 inclusive are used to control access to the menu. A matching number must be entered by the User. Values of 10,000 or greater will hide the menu. Entered P.I.N.s remain valid for only four (4) minutes after their use. **PU** has a default value of 0.
RM	16969	UInt	RW	EE 0	**Reading Mode** indicates the current reading mode. This would be either Cooling or Heating as specifies by the system box type (**BT**). If **BT** is set to supply dependant, the point will indicate the current mode as determined by the source/duct temperature. 0=Average 1=Highest 2=Lowest 3=Hi/Lo VST mode 4=Device 0 5=Device 1 6=Device 2 7=Device 3 8=Primary GID
RT	16973	Boolean	RW	RAM 0	**Reset Accumulations** when set to 1, this point will establish zero values in the total accumulated flow and total accumulated energy properties. This property returns to 0 when reset is complete.
SD	16983	UInt	RW	EE 0	**Calculated Setpoint Display** specifies what method is used to display setpoint adjustments on an SBC-STAT3 LCD screen. 0 = Disable (+/-2.5) 1 = Zone Midpoint (Zone Temperature: (ZS) Zone Midpoint) 2 = Heating Setpoint (Zone Temperature: (CH) Heating Setpoint) 3 - Cooling Setpoint (Zone Temperature: (CC) Cooling Setpoint)
SE	16984	Boolean	RW	EE 1	**Override Disabled/Enabled** enables or disables the user's ability to enter extended occupancy override. 0=Disabled 1=Enabled (Default)
T0	17002	Real	R	RAM	**Thermostat Reading for G0** indicates the current temperature sensed by G0.
T1	17003	Real	R	RAM	**Thermostat Reading for G1** indicates the current temperature sensed by G1.
T2	17004	Real	R	RAM	**Thermostat Reading for G2** indicates the current temperature sensed by G2.

Property	Identifier #	Data Type	Access	Storage & Default	Description
T3	17005	Real	R	RAM	**Thermostat Reading for G3** indicates the current temperature sensed by G3.
TE	17007	UInt	RW	RAM	**Total Energy** shows the total amount of accumulated energy (in BTUs or kilojoules) used by the terminal box. ET must be enabled for total energy to be calculated.
TF	17008	UInt	RW	RAM	**Total Flow** shows the total amount of accumulated cooling duct flow in cubic feet or liters. this is a measurement of how much air has passed through the duct since the last time TF was set to zero. For correct calculation of accumulated flow, ET must be enabled and ST must be a duct temperature value. This attribute is read only, however, you can set it to 0 by making RT=1.
EE	16809	UInt	RW	RAM	**Heat Recovery Factor** shows the total amount of recovered heat from the terminal box. ET must be enabled for heat recovery to be calculated.
TM	17011	Real	RW	EE 0.5	**Offset Increment** specifies the magnitude of incremental changes to the User Setpoint Offset (TS). The User Adjust Position (TP) is multiplied by TM to determine the User Setpoint Offset (TS) value. If the User Adjust Increment is 0, you will not be able to alter the setpoint.
TP	17013	UInt	RW	RAM 0	**User Adjust Position** the User Setpoint Offset (TS) can be raised or lowered in integral steps. This property tracks the current step. It can be set to any signed integer but will be constrained to +/-2 when adjusted by an analog thermostat or to +/-5 when set through a digital thermostat. The point is used in combination with the User Adjust Increment (TM) to calculate the User Setpoint Offset.
TR	17014	UInt		RAM 0	**User Adjust Remaining** displays the time remaining before the User Setpoint Offset (TS) setting is reset.
TS	17015	Real	RW	RAM 0	**Setpoint Offset** defines an offset for application to PID setpoints. This point shows the current value calculated when you multiply the User Adjust Position (TM) by the User Adjust Increment (TP). This setting is temporary and is valid only for TT minutes unless TT=0.
TT	17016	UInt	RW	EE 120	**User Adjust Duration** the User Setpoint Offset (TS) is a temporary setting. The TT property defines in minutes the duration for which the setting applies. After that time, the User Adjust Position and User Adjust Offset are reset to 0 degrees. If the User Adjust Duration is 0, then setpoint changes remain in effect until modified. The default value for TT is 120.
ZS	17087	Real	RW	RAM 70	**Heating/Cooling Setpoint** displays the midpoint between the current cooling and heating setpoints. This property reflects changes in both setpoints. A change in ZS results in the appropriate shift of both the cooling and heating setpoint maintaining the effective deadband.

A.3 UNIVERSAL INPUTS

Property	Identifier #	Data Type	Access	Storage & Default	Description
object_identifier	75	BACnet ObjID	RO	- Analog Input (0), Instance *N*	a numeric code that is used to identify the object.
object_name	77	CharStr	RW	NRAM Universal Input *N*	represents a name for the object that is unique internetwork-wide.
object_type	79	BACnet ObjType	RO	- Analog Input (0)	indicates membership in a particular object type class.
present_value	85	Real	RW	RAM 0	indicates the current value, in engineering units, of the object.
status_flags	111	BACnet Status Flags	RO	RAM 0	four flags that indicate the general "health" of the program.
event_state	36	BACnet Event State	RO	RAM 0	provides a way to determine if this object has an active event state associated with it.
reliability	103	BACnet Reliability	RO	RAM 0	indicates whether the **present_value** is "reliable" as far as the device or operator can determine.
out_of_service	81	Boolean	RW	NRAM 0	indicates whether or not the process this object represents is not in service.
units	117	BACnet Eng. Units	RW	NRAM 95	indicates the measurement units of this object.
min_pres_value	69	Real	RW	NRAM	indicates the lowest number that can be reliably used for the **present_value** property of this object.
max_pres_value	65	Real	RW	NRAM	indicates the highest number that can be reliably used for the **present_value** property of this object.
DT	16804	UInt	RW	EE 253	**Data Type**
IF	16878	UInt	RW	EE 0.0	**Input Filtering**
IP	16881	Bool	RW	EE 0	**Input Polarity** 0=normal 1=reverse
OF	16919	Real	RW	EE 0	**UI Offset**
ST	16996	UInt	RW	EE 7	**Sensor Type** 0= digital 2= full scale, linear from min_pres_value to max_pres_value 3= 4–20mA linear scaled from min_pres_value to max_pres_value 7= −22.0 to 122.0°F thermistor 1,4,5, and 6 are unused

A.4 FLOW CONTROL

Property	Identifier #	Data Type	Access	Storage & Default	Description
object_identifier	75	BACnet ObjID	RO	- Analog Input (3), Instance *6*	a numeric code that is used to identify the object.
object_name	77	CharStr	RW	NRAM Flow Control	represents a name for the object that is unique internetwork-wide.
object_type	79	BACnet ObjType	RO	- Analog Input (3)	indicates membership in a particular object type class.
present_value	85	Real	RW	RAM 0	indicates the current value, in engineering units, of the object.
status_flags	111	BACnet Status Flags	RO	RAM 0	four flags that indicate the general "health" of the program.
event_state	36	BACnet Event State	RO	RAM 0	provides a way to determine if this object has an active event state associated with it.
reliability	103	BACnet Reliability	RO	RAM 0	indicates whether the **present_value** is "reliable" as far as the device or operator can determine.
out_of_service	81	Boolean	RW	NRAM 0	indicates whether or not the process this object represents is not in service.
units	117	BACnet Eng. Units	RW	NRAM 95	indicates the measurement units of this object.
AC	16741	UInt	RW	EE 1	**Auto/Manual/Track Mode Select** when this property is set for Auto, the Target Flow (CD) is determined by the control algorithms and setpoints. 0=Manual 1=Auto (Default) 2=Tracking
AT	16748	UInt	RW	EE 0	**Actuator Type** defines the type and connection for the damper actuator. A/C Actuators will use the option relay outputs of K4 and K5. D/C actuators will use the standard actuator connection. Motor Management Technology (MMT) supports the Belimo LM-24M actuator. Choices: 0 = LM-24M (MMT) (Default) 1 = Generic D/C 2 = Generic A/C 3 = None
CA	16768	UInt	R	RAM	**Average Flow** shows the measured average flow in cfm.
CB	16769	Boolean	RW	RAM 0	**Calibrate Flow** allows a host or operator to manually calibrate the flow sensor.
CD	16771	UInt	RW with manual CAV	RAM	**Target Flow** shows the desired flow (cfm) setpoint calculated by the cooling or heating PI loops.
CK	16777	UInt	RW	EE 768	**Duct Scaling Factor** shows the scaling factor for the particular VAV box being used.

Property	Identifier #	Data Type	Access	Storage & Default	Description
DC	16793	UInt	RW	EE 1	**Damper Control Mode** defines the method used to control the damper. For Pressure Dependant mode (DC=0) the damper position is estimated based on the target flow (CD) and the estimated maximum flow (EF). In Measured Flow mode (DC=1 default) the damper is modulated to maintain the target flow (CD). DC=2 sets the controller to operate in a Dual Mixed CAV mode.
DD	16794	Boolean	RW	EE 0	**Damper Direction** use this property to set the direction of the damper motor. 0=normal (Default) 1=reverse
DM	16799	UInt	RW	EE 0	**Damper Mode** can be used to command the damper to fully open or to operate at minimum or maximum cooling, heating, and warm-up setpoints. 0=automatic (Default) 1=Full Open 2=Cooling Minimum Flow 3=Cooling Maximum Flow 4=Heating Minimum Flow 5=Heating Maximum Flow 6=Warm-up Minimum Flow 7=Warm-up Maximum Flow 8=Full Close
DP	16801	UInt	R	RAM	**Damper Position** shows the damper position with an optional actuator having a built in feedback potentiometer.
DS	16803	UInt	R	RAM	**Damper Status** This attribute reports the status of the actuator as determined by the MMT. 0=Ready 1=Disconnected/Open 2=Jammed/Shorted. Diagnostic alarms and returns are issued when this status changes.
EF	16810	UInt	RW	EE 700	**Estimated Flow at Full Open** shows the estimated flow at full open in cfm.
EP	16815	UInt	R	RAM	**Estimated Target Damper Position** shows the estimated target position, measured from 0-100%, with which the loop should control the valve to bring the measured input variable closer to the setpoint.
FC	16824	Boolean	RW	RAM 0	**Fan Status/Control** controls the current status of the fan output. 0=Off 1=On
FH	16827	UInt	RW	EE 20	**Flow Hysteresis** specifies the maximum amount of flow, measured in CFM, sensor variation to be tolerated by the *NB*-VAV before changing damper position.
K2	16883	UInt	RW	RAM	**Measured CFM for 2pt Cal** accepts a measured cfm value that is at least 100 cfm different than that last entered in KC. Both this measured cfm value and that entered in KC are then used to calibrate. This provides for an improved flow calibration.
KC	16884	UInt	RW	RAM	**Measured CFM for CK adjust** when you enter the cfm value measured externally, this will automatically adjust the Duct Scaling Factor (CK) based the present flow reading to properly scale the duct.

Property	Identifier #	Data Type	Access	Storage & Default	Description
OF	16919	Int	RW	EE 0	**Flow Offset** defines an offset or adjustment applied to the target flow. When operated in Auto (AC=1) or Tracking (AC=2) mode, the Flow Offset is added to the derived target. The Target Flow (CD) includes this offset.
RZ	16975	UInt	R	RAM	**Rejuvenate Count** when MMT detects the possibility of an actuator short, electrical pulses are used in an attempt to rejuvenate the motor.

A.5 SUPPLY TEMPERATURE

Property	Identifier #	Data Type	Access	Storage & Default	Description
object_identifier	75	BACnet ObjID	RO	- Analog Input (3), Instance *8*	a numeric code that is used to identify the object.
object_name	77	CharStr	RO	NRAM Supply Temperature	represents a name for the object that is unique internetwork-wide.
object_type	79	BACnet ObjType	RO	- Analog Input (3)	indicates membership in a particular object type class.
present_value	85	Real	RW	RAM 0	indicates the current value, in engineering units, of the object.
status_flags	111	BACnet Status Flags	RO	RAM 0	four flags that indicate the general "health" of the program.
event_state	36	BACnet Event State	RO	RAM 0	provides a way to determine if this object has an active event state associated with it.
reliability	103	BACnet Reliability	RO	RAM 0	indicates whether the **present_value** is "reliable" as far as the device or operator can determine.
out_of_service	81	Boolean	RW	NRAM 0	indicates whether or not the process this object represents is not in service.
units	117	BACnet Eng. Units	RW	NRAM 95	indicates the measurement units of this object.
DD	16794	Real	RW	EE 2.5°F	**Auto Duct Delta Temperature**
IC	16876	UInt	RW	EE 0	**Input Channel Select** 1=UI01 2=UI02 3=UI03 4=UI04 5=UI05
OF	16919	Real	RW	EE 0	**Supply/Duct Temperature Adjustment**
SM	16990	UInt	R	RAM NA	**Cooling/Heating Supply Mode** 0=Cooling 1=Heating

A.6 ANALOG OUTPUT

Property	Identifier #	Data Type	Access	Storage & Default	Description
object_identifier	75	BACnet ObjID	RO	- Analog Output (1), Instance 1	a numeric code that is used to identify the object.
object_name	77	CharStr	RW	NRAM Analog Output *1*	represents a name for the object that is unique internetwork-wide.
object_type	79	BACnet ObjType	RO	- Analog Output (1)	indicates membership in a particular object type class.
present_value	85	Real	RW	RAM 0.0	indicates the current value, in engineering units, of the object.
status_flags	111	BACnet Status Flags	RO	NRAM 0	four flags that indicate the general "health" of the program.
event_state	36	BACnet Event State	RO	RAM 0	provides a way to determine if this object has an active event state associated with it.
reliability	103	BACnet Reliability	RO	RAM 0	indicates whether the **present_value** is "reliable" as far as the device or operator can determine.
out_of_service	81	Boolean	RW	NRAM 0	indicates whether or not the process this object represents is not in service.
units	117	BACnet Eng. Units	RW	NRAM 95	indicates the measurement units of this object.
min_pres_value	69	Real	RW	NRAM 0.0	indicates the lowest number that can be reliably used for the **present_value** property of this object.
max_pres_value	65	Real	RW	NRAM 100.0	indicates the highest number that can be reliably used for the **present_value** property of this object.
priority_array	87	BACnet Array	RO	RAM NULL	contains prioritized commands that are in effect for this object.
relinquish_ default	104	Real	RW	NRAM 0.0	the default value to be used for the **present_value** property when all command priority values in the **priority_array** property have a NULL value.
DT	16804	UInt	RW	EE 252	**Data type**
HS	16863	Real	RW	EE 100.0	**Maximum Scaled Voltage** specifies the percentage of the total output
LS	16894	Real	RW	EE 0.00	**Minimum Scaled Voltage** specifies the percentage of the total output

A.7 ANALOG VALUES (SETPOINTS) 1-7

Property	Identifier #	Data Type	Access	Storage & Default	Description
object_identifier	75	BACnet ObjID	RO	- Analog Value (2), Instance 1-7	a numeric code that is used to identify the object.
object_name	77	CharStr	RO	NRAM *N*	represents a name for the object that is unique internetwork-wide.
object_type	79	BACnet ObjType	RO	- Analog Value (2)	indicates membership in a particular object type class.
present_value	85	Real	RW	RAM 0.0	indicates the current value, in engineering units, of the object.
status_flags	111	BACnet Status Flags	RO	NRAM 0	four flags that indicate the general "health" of the object.
event_state	36	BACnet Event State	RO	RAM 0	provides a way to determine if this object has an active event state associated with it.
out_of_service	81	Boolean	RW	NRAM False (0)	indicates whether or not the process this object represents is not in service. Setting this value to True will allow for the present-value to become writable.
units	117	BACnet Eng. Units	RW	NRAM 95	indicates the measurement units of this object.

A.8 BO01

Property	Identifier #	Data Type	Access	Storage & Default	Description
object_identifier	75	BACnet ObjID	RO	- Binary Output (4), Instance 1	a numeric code that is used to identify the object.
object_name	77	CharStr	RO	NRAM BO01	represents a name for the object that is unique internetwork-wide.
object_type	79	Enum	RO	- Binary Output (4)	indicates membership in a particular object type class.
present_value	85	Enum	RW	RAM 0	indicates the current value, in engineering units, of the object.
status_flags	111	Bit Str	RO	NRAM 0	four flags that indicate the general "health" of the program.
event_state	36	Enum	RO	RAM 0	provides a way to determine if this object has an active event state associated with it.
out_of_service	81	Boolean	RW	NRAM 0	indicates whether or not the process this object represents is not in service.
polarity	84	Enum	RW	NRAM 0	indicates the relationship between the physical state of the output and the logical state represented by the **present_value**e property. If the **polarity** property is NORMAL, then the ACTIVE state of the **present_value** property is also the ACTIVE or ON state of the physical output as long as **out_of_service** is FALSE. If the Polarity property is REVERSE, then the ACTIVE state of the **present_value** property is the INACTIVE or OFF state of the physical output as long as **out_of_service** is FALSE.
relinquish_ default	104	Real	RW	NRAM 7	the default value to be used for the **present_value** property when all command priority values in the **priority_array** property have a NULL value.
priority_array	87	BACnet Array	RO	RAM NULL	contains prioritized commands that are in effect for this object.
FC	16824	Real	RW	EE 30	**Minimum Cycle Time** Defines the minimum cycle time for the fan for on/off.
FO	16830	UInt	RW	EE 0	**Fan/Damper Application** 0=No Fan/Ind Damper 1=Series Fan 2=Parallel Fan 3=Induction Damper
FS	16833	UInt	RW	EE 1.0	**Fan Setpoint** Setpoint used at which fan or ind damper is enabled
RH	16966	Real	RW	RAM	**Run Hours** This property shows the total amount of time, in hours, the output has been energized.
RL	16968	Real	RW	EE 0.0	**Run Limit** This property specifies a run time limit in hours for the output.
SF	16985	Bool	RW	EE 0	**Fan Mode** 0=Always On 1=Off in deadband

A.9 BO02 - BO05

Property	Identifier #	Data Type	Access	Storage & Default	Description
object_identifier	75	BACnet ObjID	RO	- Binary Output (4), Instance 2,3,4 or 5	a numeric code that is used to identify the object.
object_name	77	CharStr	RO	NRAM BO0x	represents a name for the object that is unique internetwork-wide.
object_type	79	Enum	RO	- Binary Output (4)	indicates membership in a particular object type class.
present_value	85	Enum	RW	RAM 0	indicates the current value, in engineering units, of the object.
status_flags	111	Bit Str	RO	NRAM 0	four flags that indicate the general "health" of the program.
event_state	36	Enum	RO	RAM 0	provides a way to determine if this object has an active event state associated with it.
out_of_service	81	Boolean	RW	NRAM 0	indicates whether or not the process this object represents is not in service.
polarity	84	Enum	RW	NRAM 0	indicates the relationship between the physical state of the output and the logical state represented by the **present_value**e property. If the **polarity** property is NORMAL, then the ACTIVE state of the **present_value** property is also the ACTIVE or ON state of the physical output as long as **out_of_service** is FALSE. If the Polarity property is REVERSE, then the ACTIVE state of the **present_value** property is the INACTIVE or OFF state of the physical output as long as **out_of_service** is FALSE.
relinquish_ default	104	Real	RW	NRAM 7	the default value to be used for the **present_value** property when all command priority values in the **priority_array** property have a NULL value.
priority_array	87	BACnet Array	RO	RAM NULL	contains prioritized commands that are in effect for this object.
RH	16966	Real	RW	RAM	**Run Hours** This property shows the total amount of time, in hours, the output has been energized.
RL	16968	Real	RW	EE 0.0	**Run Limit** This property specifies a run time limit in hours for the output.

A.10 SCHEDULE

Property	Identifier #	Data Type	Access	Storage & Default	Description
object_identifier	75	BACnet ObjID	RO	- Schedule (17), Instance *1*	a numeric code that is used to identify the object.
object_name	77	CharStr	RW	NRAM Schedule	represents a name for the object that is unique internetwork-wide.
object_type	79	BACnet ObjType	RO	Schedule (17)	indicates membership in a particular object type class.
present-value	85	Unsigned or Enum	RO	RAM 0	indicates the current schedule value
effective-period	32	Date Range	RO	RAM 0	specifies the date rage in which the schedule is active.
schedule-default	174	Unsigned or Enum	RW	RAM 0	specifies the datatype and value used for partial time-of-day scheduling.
weekly-schedule	123	Array List	RW	RAM	contains time,value pair operations for each day of the week.
list-of-object-property-references	54	List	RO	NRAM 0	contains the list of object properties that the schedule writes to.
status-flags	111	Bitstring	RO	NRAM 0	indicates the general health of the object.
reliability	103	Enum	RO	NRAM 0	indicates the reliability of the object.
out-of-service	81	Boolean	RO	NRAM 0	indicates the service status of the object.
priority-for-writing	88	Unsigned	RW	NRAM 0	indicates the priority which the Schedule will write with.
HE	16853	Bool	RW	EE 0	H**ost Overrides** 0=disabled 1=enabled
HO	16860	UInt	RW	RAM 0	**Host Schedule** 0 = unoccupied 1 = warm-up 2 = occupied 3 = night setback
ZE	17081	Bool	RW	EE 0	**Receive Schedule** 0=No 1=Yes

A.11 FLOW SETPOINTS

Property	Identifier #	Data Type	Access	Storage & Default	Description
object_identifier	75	BACnet ObjID	RO	- Proprietary (133), Instance *1*	a numeric code that is used to identify the object.
object_name	77	CharStr	RW	NRAM Economizer	represents a name for the object that is unique internetwork-wide.
object_type	79	BACnet ObjType	RO	Proprietary (133)	indicates membership in a particular object type class.
CI	16776	Real	RW	EE 5.0	**Cooling Integration Constant** shows the amount of proportional error history (o to 25.5%) used to calculate the desired position for the cooling duct damper. this point is also used to calculate the error for the heating proportional band in Heating Only mode. The attribute is calculated each time the loop runs (once per second) creating an accumulated integral sum. This integral sum, applied once per minute, is used to control overshoot while the loop is operating within the confines of the proportional band. This property defaults to 5.0.
CM	16779	UInt	RW	EE 100	**Cooling Minimum Flow** shows the allowable minimum (cooling) duct flow, in CFM or lps, required while the controller is at the calculated cooling setpoint. Default value is 100 CFM.
CP	16781	Real	RW	EE 5.0	**Cooling Proportional Band** specifies, in degrees (0.0 to 100), the offset from the calculated cooling control setpoint that determines the proportional band for damper control. The damper controls air flow based on area temperature from CM to CX when cooling is called for by the controller. This point defaults to 5.0. The cooling proportional band is an offset that begins at the calculated cooling control setpoint (CC). The cooling proportional band ends at CC + CP. The attribute CP defaults to 5.0.
CX	16786	UInt	RW	EE 500	**Cooling Maximum Flow** shows the allowable maximum duct flow. This point has a range of 0-65,535 and defaults to 500 CFM.
HI	16857	Real	RW	EE 5.0	**Heating Integration Constant** shows the amount of proportional error history (0 to 25.5%) used to calculate the desired position for the heating duct damper. The value for this point is calculated each time that the loop runs (once per second) creating an accumulated integral sum. This integral sum, applied once per minute, is used to control overshoot while the loop is operating within the confines of the proportional band. Default value is 5.0.
HM	16859	UInt	RW	EE 100	**Heating Minimum Flow** shows the allowable minimum heating duct flow during heating. The point HM has a range of 0-65,535 and defaults to 100 CFM.
HP	16861	Real	RW	EE 5.0	**Heating Proportional Band** specifies, in degrees, the offset from the calculated heating control setpoint that determines the proportional band for the heating duct damper control. This point is an offset from the heating setpoint (Zone Temperature:CH) creating an operational band in which the damper control air flow based on area temperature from HM to HX when heating is called for by the controller. Attribute HP defaults to 5.0.
HX	16866	UInt	RW	EE 500	**Heating Maximum Flow** shows the allowable maximum heating duct flow during heating. This attribute defaults to 500 CFM and can be set from 0 to 65,535.
MD	16896	UInt	RW	EE 0	**Minimum Flow Override Modes** Specifies how the damper should be commanded 0=No Override 1=Supply/Demand Mismatch Override 2=Schedule Override 3=Both

Property	Identifier #	Data Type	Access	Storage & Default	Description
UM	17028	UInt	RW	EE 0	**Unoccupied/Night Setback Minimum Flow** specifies the minimum flow setpoint for unoccupied modes
WI	17052	Real	RW	EE 10.0	**Warm-up Integration Constant** shows the amount of proportional history (0 to 25.5%) used to calculate the desired position for the heating duct damper. Default value is 10.
WM	17053	UInt	RW	EE 300	**Warm-up Minimum Flow** shows the allowable minimum heating duct flow during warm-up. Default value is 300 CFM.
WP	17055	Real	RW	EE 5.0	**Warm-up Proportional Band** specifies, in degrees (0.0 to 100), the offset from the calculated heating control setpoint that determines the proportional band for the warm-up heating duct damper control. Default value is 5.0.
WX	17057	UInt	RW	EE 700	**Warm-up Maximum Flow** shows the allowable maximum duct flow during warm-up which can be called for by schedule. This attribute defaults to 700 CFM and has a setting range of 0 to 65,535.
AS	16747	UInt	RW	EE 700	**Air Quality Setpoint** This property specifies the acceptable CO2 level for the zone. This attribute defaults to 700 PPM and can be set from 0 to 65,535. A value of zero (0) will disable the NB-VAV's Indoor Air Quality application.
AM	16745	UInt	RW	EE 400	**Air Quality Control Max Airflow** This property specifies the maximum flow of air allowed during Indoor Air Quality calculations. This attribute defaults to 400 CFM and can be set from 0 to 65,535.
RP	16971	UInt	RW	EE 10	**Air Quality Damper Ramp Rate** This property specifies the rate (measured in percent-per-minute) that the NB-VAV's damper moves to compensate for changes in CO2 levels. This attribute defaults to 10%/min and has a setting range of 0 to 100.
DB	16792	UInt	RW	EE 50	**Air Quality Deadband** This property specifies the CO2 variable range over which the damper controls airflow. This attribute defaults to 50PPM and has a setting range of 0 to 65,535.

A.12 ELECTRIC REHEAT

Property	Identifier #	Data Type	Access	Storage & Default	Description
object_identifier	75	BACnet ObjID	RO	- Proprietary (133) Instance 3	a numeric code that is used to identify the object.
object_name	77	CharStr	RO	NRAM *Electric Reheat*	represents a name for the object that is unique internetwork-wide.
object_type	79	BACnet ObjType	RO	- Proprietary (133)	indicates membership in a particular object type class.
AF	16744	UInt	RW	EE 0	**Require Max Airflow** if set to Yes (AF=1), it holds off the addition of reheat stages until the PID loop calls for maximum airflow. This gives the damper priority in satisfying the heating demand. For proper operation, a Heating Integration Constant should be used. This permits the PID loop to reach a maximum target airflow when the supply air is unable to satisfy the zone. The default value is AF=0.
AV	16750	BitStr	R	RAM	**Stages Available for Use** displays the stages that are currently available for use. This depends on the current options and the presence of a positive flow indication. Other uses of the triac outputs (AC actuator, for instance) may remove those stages from reheat availability. This property is read-only.
BA	16751	UInt	RW	EE 0	**Reheat Balance Mode** if set to Yes (BA=1), it considers the run hour totals for the individual triac outputs in energizing reheat stages. Stages with lower usage will be energized first. The result is the balanced use of these stages. For best operation, all stages should be nearly equivalent. The default setting, BA=0, does not perform balancing.
EN	16814	BitStr	R	RAM	**Stages Energized** displays those reheat stages that are currently energized. This property is read-only.
FR	16832	BitStr	RW	EE 15	**Stages Requiring Flow** defines which of the available reheat stages requires a positive flow indication by the appropriate bit setting.
ID	16877	Real	RW	EE 4.0	**Interstage Delay Time** shows the minimum amount of time, in minutes, before the next reheat stage will be energized. Stages are energized at this interval until the zone temperature rises to within the reheat offset of the heating setpoint. This prevents power surges that might occur if both reheats were to be energized at the same time. ID defaults to 4 minutes.
MX	16905	Real	RW	EE 105.0	**Maximum Supply Temperature** establishes a maximum supply duct temperature above which the reheats will de-energize. Default value is 105.
OF	16919	Real	RW	EE 1.5	**Reheat Offset** specifies, in degrees, the offset from the calculated heating control setpoint that determines the temperature below which additional reheat stages can be energized. In addition to this, the AF attribute may be set to hold off the addition of stages. For temperature below the heating setpoint but within the reheat offset of it, reheat stages are de-energized at 30 second intervals. Default value is 1.5.
RO	16970	UInt	RW	EE 0	**Reheat Application** this property is used to configure the NB-VAV's outputs for electric reheat. The settings are 0=Disabled (default), 1=Two-stage (K2-3), 2=Two-stage (K4-5), and 3=Four-stage (K2-5).

A.13 VALVE CTRL 1 AND 2

Property	Identifier #	Data Type	Access	Storage & Default	Description
object_identifier	75	BACnet ObjID	RO	- Proprietary (133), Instance 8 or 9	a numeric code that is used to identify the object.
object_name	77	CharStr	RO	NRAM *N*	represents a name for the object that is unique internetwork-wide.
object_type	79	BACnet ObjType	RO	- Proprietary (133)	indicates membership in a particular object type class.
AM	16745	Boolean	RW	EE 0	**Auto/Manual Mode** selects the control mode for the valve output(s). If AM=0 (manual), then the valve position can be set by manually changing VD to the desired position. You can do this through the use of the MS/TP network program. If AM=1 (automatic), then the valve position is set by the control loop. Default value is 0.
CD	16771	Boolean	RW	EE 0	**Change Valve Direction** used to set the direction of the Valve outputs. When the attribute is set to 0, the direction is normal with an increase signal on BO02/BO04 and a decrease signal on BO03/BO05. With the attribute set 1, the outputs are reversed. Default value is 0.
PP	16950	UInt	RW	EE 0	**PWM Period** shows the amount of time, in seconds, during which the valve is to be pulsed ON when pulse width modulation is enabled. For example, if PP=100 seconds and the NB-VAV is calling for 40% heat, then the valve is pulsed on for 40 seconds (a total of PP seconds). The output will continue to be pulsed on for 40 seconds every full travel period of 100 seconds. This will last as long as 40% output control is called for by the control loop. This property defaults to 0 seconds.
RI	16967	UInt	RW	EE 0	**Recalibration Interval Check** shows the amount of time, from 1 to 255 hours, between valve recalibration periods. You can recalibrate the valve position by setting the valve in the closed direction for the full travel time then restoring it to the desired position. Valve Motor Travel Time (VT) must equal some value greater than 0 for RI to be considered valid by the controller. When calibration occurs. the NB-VAV drives the valve closed for VT + 10 seconds of time. Once calibrated the controller drives the valve to VD (desired valve position). Calibration is disabled when you set RI to 0. This point defaults to 0.
ST	16996	UInt	R	RAM	**Valve Status** the options are off (ST=0), open (ST=1), close (ST=2), and calibrate (ST=3).
TH	17009	Real	RW	EE 105.0	**DAT High Temp Lockout** defines the maximum source/duct temperature above which heating will be disengaged. This offers protection against overheating. Heating stages will be energized only if there is a reliable source/duct temperature below this setting.
TL	17010	Real	RW	EE 45.0	**DAT Low Temp Lockout** defines the minimum source/duct temperature below which cooling will be disengaged. This offers protection against freeze-up. Cooling stages will be energized only if there is a reliable source/duct temperature above this setting.
UT	17032	UInt	RW	EE 5	**Update Threshold** the desired valve position is not updated until it differs from the actual valve position by at least the amount specified by Update Threshold. The desired positions of 0% and 100% are not subject to the threshold requirement. This attribute is used to minimize the actuation of the valve for insignificant changes. Default value is 5.

Property	Identifier #	Data Type	Access	Storage & Default	Description
VA	17041	UInt	R	RAM	**Actual Valve Position** shows the actual valve position (in percent) based on travel time. This property is read only.
VD	17042	UInt	RW	RAM	**Valve Desired Position** shows the desired valve position with which the loop should control the valve to bring the measured input variable closer to the setpoint. A change in VD causes the valve to drive in the proper control direction. If AM=0, then VD can be set manually by a host.
VI	17044	Real	RW	EE 5.0	**Valve Integration Constant** shows the amount of proportional error history (0 to 25.5%) used to calculate the desired position for the valve and to create an accumulated integral sum. This integral sum, applied once per minute, is used to control overshoot while the loop is operating within the confines of the proportional band. This point defaults to 5.0.
VM	17045	UInt	RW	EE 0	**Valve Mode** the options are Pulse Width Modulation (VM=0) and Floating Point Motor Control (VM=1). Default value is 0.
VO	17046	Real	RW	EE 0.0	**Valve Temperature Offset** this property is added to CC or subtracted from CH for calculation of the loop setpoint. If the NB-VAV is configured for hot water control, then VO is subtracted from CH. If the NB-VAV is configured for chilled water control, then VO is added to CC. Default value is 0.0.
VP	17047	Real	RW	EE 5.0	**Valve Proportional Band** specifies the input variable range, in degrees (0.0 to 25.5), over which the output value is proportional to the error value. The proportional band is offset from the setpoint for the loop. This point defaults to 5.0.
VT	17048	UInt	RW	EE 180	**Valve Travel Time** shows the amount of time, in seconds, that it takes the valve motor to travel when moving from a fully closed position to a full open position (0-100%) when in Floating Point Motor Control. The NB-VAV uses this time to determine the motor position when called for by the valve control PI. The maximum setting for this point is 3,000 seconds. Default value is 180.
VU	17049	UInt	RW	EE 0	**Valve Use** the options are disabled (VU=0), cooling (VU=1), and heating (VU=2). Default value is 0.
CC	16770	UInt	RW	EE 0	**Changeover Control Input** specifies the input used to perform heating/cooling changeover 0 = Disabled 1 = UI2 2 = UI2 3 = UI3
CS	16783	Real	RW	EE 0.0	**Changeover Cooling Setpoint** specifies the cooling changeover setpoint.
HS	16863	Real	RW	EE 0.0	**Changeover Heating Setpoint** specifies the heating changeover setpoint.

A.14 ANALOG CONTROL

Property	Identifier #	Data Type	Access	Storage & Default	Description
object_identifier	75	BACnet ObjID	RO	- Proprietary (133), Instance 11-14	a numeric code that is used to identify the object.
object_name	77	CharStr	RW	NRAM Analog Control	represents a name for the object that is unique internetwork-wide.
object_type	79	BACnet ObjType	RO	- Proprietary (133)	indicates membership in a particular object type class.
AO	16746	UInt	RW	RAM NA	**Analog Output** shows the scaled output value used by the analog output and is a reflection of the Analog Output property present-value.
CE	16772	Bool	RW	EE 0	**Control Enable** enables the PID loop. When CE=0, PO is not updated. To enable, set CE=1. Default value is 0.
CS	16783	Real	R	RAM NA	**Control Setpoint** shows the actual loop control setpoint. This read-only point reflects the unoccupied setup/setback as well as any reset and/or SBC-STAT setpoint adjustment.
DB	16792	Real	RW	EE 0	**Deadband** specifies the deadband within the proportional control band in which the output remains constant at a point midway between maximum output and minimum output.
IC	16876	UInt	RW	EE 0	**Input Select** specifies the input to be used for the control loop's measured variable. 0=Disabled 1=Zone Temp 2=Supply Temp 3=Flow 4=UI1 5=UI2 9=Zone Heat 10=Zone Cool 13=Relative Humidity
IN	16880	Real	R	RAM 0	**Input Value** displays the value of the input selected in IC.
MR	16901	Real	RW	EE 0	**Maximum Reset** specifies the maximum amount needed to reset the loop setpoint (SP) based on when reset is being used. Default value is 0.0.
PB	16940	Real	RW	EE 0	**Proportional Band** specifies the input variable range over which the output value is proportional to the error value (i.e., changes in the measured variable result in proportional changes in the output signal). Default value is 0.0.
PO	16949	Real	RW	RAM NA	**Percent Output** shows the output value in hundredths of a percent (e.g., 75.00%).
RC	16963	Real	R	RAM NA	**Reset Value** displays the value of the input selected in RV.
RL	16968	Real	RW	EE 0	**Reset Limit** specifies the value at which maximum reset is used. Default value is 0.0.
RP	16971	UInt	RW	EE 0	**Reset Period** specifies the reset period, in seconds, over which the error history is accumulated. 0 disables the reset period. Default value is 0.

Property	Identifier #	Data Type	Access	Storage & Default	Description
RS	16972	Real	RW	EE 0	**Reset Setpoint** specifies the value at which the reset action begins. When the value of the reset variable exceeds RS, reset action will be used in determining the calculated setpoint.
RT	16973	Real	RW	EE 0	**Rate** specifies a percentage of change in error that is to be used in calculating PO. RT can have any value from 0.0 to 25.5% per second. Default value is 0.0.
RV	16974	UInt	RW	EE 0	**Reset Variable** specifies the input to be used for calculating the reset used by the control loop. 0=disables reset (Default) 1=zone temp 2=supply temp 3=flow 4=UI1 5=UI2 13=Relative Humidity
SG	16986	UInt	RW	EE 0	**Action** specifies the control action for the control loop. When SG=0 (normal), a positive error causes an increase in output. When SG=1 (reverse), a positive error causes a decrease in output. Default value is 0.
SP	16993	Real	RW	EE 0	**Loop Setpoint** specifies the desired loop setpoint.
SU	16997	Real	RW	EE 0	**Setup/Setback** specifies the amount to add (if SG=0) or subtract (if SG=1) from the setpoint during an unoccupied period. Default value is 0.0.

A.15 OCCUPANCY DETECTION

Property	Identifier #	Data Type	Access	Storage & Default	Description
object_identifier	75	BACnet ObjID	RO	- Proprietary (131), Instance 1	a numeric code that is used to identify the object.
object_name	77	CharStr	RO	NRAM Occupancy Detection	represents a name for the object that is unique internetwork-wide.
object_type	79	BACnet ObjType	RO	- Proprietary (254)	indicates membership in a particular object type class.
IC	16876	UInt	RW	EE 0	**Input Select** selects the input to be used for occupancy detection. 0=disabled 1=UI1 2=UI2
MD	16896	UInt	RW	EE 30	**Extended Occupancy Delay** sets the amount of time, in seconds, during which the occupancy detector must remain on before the occupancy detector will override the zone. This prevents false triggers that might occur as others pass quickly through the zone.
MR	16901	UInt	R	RAM NA	**Extended Occupancy Remaining** read-only point that displays the time remaining for occupancy detector override.
MS	16902	UInt	R	RAM NA	**Occupancy Status** a read-only point that shows the status of the occupancy detector digital input. To enable occupancy detection, MT must be greater than 0 and UI1 or UI2 (to whichever the occupancy detector is connected) MUST be configured as digital (UI1 or UI2 ST=0). If either of these two conditions are not met, MS will display 0.
MT	16903	UInt	RW	EE 0	**Extended Occupancy Duration** defines, in minutes, the length of time needed to override the zone whenever occupancy is detected.

A.16 PROOF OF FLOW

Property	Identifier #	Data Type	Access	Storage & Default	Description
object_identifier	75	BACnet ObjID	RO	- Proprietary (131), Instance 2	a numeric code that is used to identify the object.
object_name	77	CharStr	RW	NRAM Proof of Flow	represents a name for the object that is unique internetwork-wide.
object_type	79	BACnet ObjType	RO	- Proprietary (131)	indicates membership in a particular object type class.
DR	16802	UInt	RW	EE 0	**Method To Determine Flow** 0=None 1=Minimum Flow 2=Digital Input 3=Both
MF	16897	UInt	RW	EE 75	**Minimum Flow Required** Specifies the setpoint before proof of flow is established when method=1 or 3
IC	16876	UInt	RW	EE	**Input Select** specifies the input to be used for the control loop’s measured variable. 0=Disabled (default) 1=UI1 2=UI2
PD	16942	UInt	RW	EE 60	**Proof of Flow Delay (seconds)** shows the amount of time, from 0 to 255 seconds, imposed before the enabling of a positive flow indication.
PF	16944	UInt	R	RAM 0	**Proof of Flow Indication** shows the status of the Proof of Flow, the flow control present-value. PF=0 corresponds to no flow, while PF=1 indicates that flow is present.

A.17 BROADCAST SCHEDULE

Property	Identifier #	Data Type	Access	Storage & Default	Description
object_identifier	75	BACnet ObjID	RO	- Proprietary (143), Instance 5	a numeric code that is used to identify the object.
object_name	77	CharStr	RW	NRAM Broadcast Schedule	represents a name for the object that is unique internetwork-wide.
object_type	79	BACnet ObjType	RO	- Proprietary (143)	indicates membership in a particular object type class.
profile-name	168	CharStr	RO	RAM 6-NB-Rooftop-R1	indicates the current schedule value
CV	16785	UInt	R	RAM 0	**Current Value** shows the current value of the network broadcast schedule
RB	16962	Bool	RW	EE 0	**Receive Broadcasts?** 0=No 1=Yes

A.18 RELATIVE HUMIDITY

Property	Identifier #	Data Type	Access	Storage & Default	Description
object_identifier	75	BACnet ObjID	RO	- Analog Input (0), Instance 10	a numeric code that is used to identify the object.
object_name	77	CharStr	RO	NRAM *N*	represents a name for the object that is unique internetwork-wide.
object_type	79	BACnet ObjType	RO	- Analog Input (0)	indicates membership in a particular object type class.
present_value	85	Real	RW	RAM 0.0	indicates the current value, in engineering units, of the object.
status_flags	111	BACnet Status Flags	RO	NRAM 0	four flags that indicate the general "health" of the object.
event_state	36	BACnet Event State	RO	RAM 0	provides a way to determine if this object has an active event state associated with it.
reliability	103	Enum	RO	NRAM 0	indicates the reliability of the object.
out_of_service	81	Boolean	RW	NRAM False (0)	indicates whether or not the process this object represents is not in service. Setting this value to True will allow for the present-value to become writable.
units	117	BACnet Eng. Units	RW	NRAM 95	indicates the measurement units of this object.
DS	16803	UInt	RW	EE 0	**Stat Display Mode** 0=RH Not Displayed 1=Display RH.
OF	16919	Real	RW	EE 0	**Relative Humidity Adjustment** defines an adjustment to the current sensed relative humidity.