

SBC-VAVr/t/a/f USER MANUAL

SBC-VAV(r/t/a/f) User Manual

Part Number 1E-04-00-0107

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4/12/2012

(Corresponds to firmware revision 4.08)

- . Added information regarding new Unoccupied Flow Override feature
- . Added information regarding Relative Humidity information
- . General document corrections and updates.

Version 2.2

(Corresponds to firmware revision 4.00)

- . Implementation of Indoor Air Quality variant
- . Universal Input 3 added for IAQ variant
- . Corrected various spelling errors found during manual review
- . Refined configuration steps for Dual Duct Configuration
- . Removed VAVr model references from manual, as device is no longer manufactured or sold.
- . Addition of Calculated Setpoint Display Functionality

Version 2.1

(Corresponds to firmware revision 3.10)

- . Changed number of triacs on SBC-VAVta and SBC-VAVtf models from three (3) to five (5) in §1, §1.2.2.1, §1.4.4, §1.4.5, and §2.4.3.5.
- . Added section 2.2 Changing the Actuator Orientation.
- . Added FF00;**MS** to §3.8.1 and Appendix A.
- . Corrected entries in Appendix A for FA05;**AE** and FA05;**AS**.
- . Corrected transformer specification in §1.5.5 to be class 2.
- . Sorted table entries in Appendix A alphabetically.

This manual includes an overview of, and instructions for wiring, installing, and configuring the SBC-VAV(r/t/a/f) controllers. Also included are definitions of the SBC-VAV(r/t/a/f) channels and attributes, and features of the SBC-STAT when used with SBC-VAV(r/t/a/f) controllers.

This manual is divided into the following sections:

- **Section 1: Overview**, provides an introduction to and descriptions of the four (4) SBC-VAV(r/t/a/f) type controllers and their features and components.
- **Section 2: Wiring and Installation**, details wiring and installation procedures including mounting, supplying power, connecting to the communications network, and connecting inputs and outputs.
- **Section 3: SBC-VAV Channels and Attributes**, defines the channels and attributes of the SBC-VAV(r/t/a/f) controllers.
- **Section 4: Configuration**, provides instructions for configuring the SBC-VAV(r/t/a/f) controllers for use in various applications.
- **Section 5: SBC-STAT Features**, describes the SBC-STAT setpoint adjustment and LED, and the SBC-STAT3 menus when connected to an SBC-VAV(r/t/a/f).
- **Appendix A: PUP Channels and Attributes**, lists the PUP channel numbers for each channel, the PUP data type, read/write access, type of storage, SoloPro for Windows location, and a description of each attribute.
- **Appendix B: PUP Data Type Codes**, lists the hexadecimal numbers, digit format, and a meaning of PUP data types.

This document contains certain style and formatting conventions for conveying information in a clear and concise manner:

- Attribute names are shown in **bold**. For example: **;CV**.
- Menu commands appear with a ">" symbol between levels. For example: File>Open.
- *Italics* indicate a section of this manual or another publication.
- The following formats are used to highlight important information:

NOTE

Notes indicate important 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 information that may prevent personal injury or equipment damage and appear in boxes with this format separated from the running text.

1.1 What Is the SBC-VAV(r/t/a/f)?	1-3
1.1.1 Features of the SBC-VAV(r/t/a/f) Controllers	1-3
1.2 Inputs/Outputs	1-5
1.2.1 Universal Inputs (UI)	1-5
1.2.2 Outputs	1-6
1.3 Components and Features	1-9
1.3.1 Motor Management Technology (MMT).....	1-9
1.3.2 Integration With SBC-STATs	1-9
1.3.3 Networking	1-10
1.3.4 Flow Sensor	1-11
1.4 SBC-VAV(r/t/a/f) Controllers	1-12
1.4.1 The SBC-VAVra.....	1-12
1.4.2 The SBC-VAVrf.....	1-12
1.4.3 The SBC-VAVta (-IAQ)	1-13
1.4.4 The SBC-VAVtf (-IAQ)	1-13
1.5 Specifications.....	1-15
1.5.1 Networking	1-15
1.5.2 Integrated Components	1-15
1.5.3 Actuator Motor	1-15
1.5.4 Terminations	1-15
1.5.5 Input Supply	1-15
1.5.6 Operating Environment.....	1-15
1.5.7 Dimensions	1-15
1.5.8 Agency Approvals.....	1-15
2.1 Installation.....	2-3
2.2 Changing the Actuator Orientation	2-4
2.3 Mounting.....	2-8
2.4 Connecting the Airflow Sensor	2-10
2.5 Wiring Requirements	2-13
2.5.1 Power Wiring.....	2-13
2.5.2 EIA-485 Communications Wiring.....	2-15
2.5.3 Input & Output Wiring.....	2-16
2.5.4 Optional Actuator Wiring.....	2-23
3.1 Introduction	3-2
3.2 System.....	3-3
3.2.1 About.....	3-3
3.2.2 Diagnostics	3-4
3.2.3 Power Up	3-5
3.3 Schedules	3-9
3.3.1 Clock/Calendar	3-10
3.3.2 Summary.....	3-11
3.3.3 Schedules 1 Through 6.....	3-13
3.4 Temperature (Analog Inputs).....	3-17
3.4.1 Thermostat.....	3-17
3.4.2 Setpoint Adjust.....	3-18

3.4.3 Override	3-18
3.4.4 Cooling Setpoints	3-19
3.4.5 Heating Setpoints	3-20
3.4.6 Alarms	3-22
3.4.7 Supply	3-25
3.4.8 Sensor Bus	3-26
3.5 Flow	3-32
3.5.1 Control	3-32
3.5.2 Cooling	3-33
3.5.3 Heating	3-36
3.5.4 Unoccupied	3-36
3.5.5 Warm-Up	3-36
3.5.6 Indoor Air Quality	3-37
3.5.7 Damper	3-37
3.5.8 Alarms	3-38
3.5.9 Proof of Flow	3-39
3.6 Auxiliary	3-45
3.6.1 Fan	3-45
3.6.2 Electric Reheat	3-46
3.6.3 Valve Control	3-47
3.6.4 PID Control	3-50
3.6.5 Occupancy Detector	3-60
3.6.6 Relative Humidity	3-60
3.7 I/O Setup	3-66
3.7.1 Universal Inputs (UI1, UI2 and UI3)	3-66
3.7.2 Analog Output (AO1)	3-72
3.7.3 Relay Outputs	3-75
3.8 Networking	3-80
3.8.1 Configuration	3-80
3.8.2 Schedule Broadcast	3-81
4.1 Scheduling	4-2
4.1.1 Inactive Schedule State	4-4
4.1.2 All-day Override	4-4
4.1.3 Schedule Broadcast	4-5
4.1.4 Power-up State	4-5
4.1.5 Host Override	4-7
4.1.6 Zone Scheduling	4-7
4.1.7 Occupancy Detection	4-7
4.1.8 User Override	4-9
4.2 Setting the Temperature and Flow Setpoints	4-11
4.3 SBC-VAV Control Modes	4-16
4.3.1 Constant Air Volume (CAV)	4-16
4.3.2 Supply Dependant (VST)	4-16
4.3.3 Heating Only	4-18
4.3.4 Cooling Only	4-21

4.3.5 Cooling with Reheat.....	4-23
4.4 Auxiliary Functions.....	4-25
4.4.1 Series Fan.....	4-25
4.4.2 Parallel Fan.....	4-25
4.4.3 Induction Damper.....	4-25
4.4.4 Valve Control	4-26
4.5 Digital Outputs	4-29
4.6 Dual Duct Applications.....	4-30
4.7 Tracking	4-31
4.8 Indoor Air Quality	4-32
5.1 Temperature Display	5-3
5.2 Setpoint Adjustment Display.....	5-4
5.2.1 SBC-STAT2	5-4
5.2.2 SBC-STAT2-D	5-4
5.2.3 SBC-STAT3	5-4
5.3 Calculated Setpoint Display.....	5-5
5.4 LED.....	5-6
5.5 Override Mode	5-7
5.6 Menu Actions	5-8
5.6.1 Enable/Disable Values.....	5-8
5.6.2 Setting Values.....	5-8
5.7 SBC-STAT3 Menus	5-9
5.7.1 User Menu	5-9
5.7.2 Install Menu.....	5-10
5.7.3 Balance Menu	5-13
5.7.4 Service Menu	5-17
System Channel, FF00	A-3
DAT Channel, FE08.....	A-5
UI3 Channel, FE03	A-6
UI2 Channel, FE02	A-8
UI1 Channel, FE01	A-10
Temperature Channel, FE00	A-12
AO Channel, FD01	A-17
Proof of Flow Channel, FC02	A-18
Occupancy Detection Channel, FC01	A-19
Digital Output Channel, FB01-FB05	A-20
Fan Channel, FB01.....	A-21
PID Channel, FA11	A-22
Valve Control 2 Channel, FA09	A-24
Valve Control 1 Channel, FA08	A-26
Flow Alarm Channel, FA05.....	A-28
Electric Reheat Channel, FA03	A-29
Flow Setpoints Channel, FA01	A-30
Indoor Air Quality, FA01	A-31
Flow Channel, FA00	A-32

Schedules Channels, F901-F906	A-34
Schedules Channel, F900.....	A-35
Network Channel, F005	A-37
Appendix B: Pup Data Types.....	B-1

SECTION 1: OVERVIEW

This document provides general information regarding the SBC-VAV(r/t/a/f) model unitary controllers. General configuration and application information is provided in this document; however, the various SBC-VAV(r/t/a/f) controllers can be used in a wide variety of applications.

IN THIS SECTION

What Is the SBC-VAV(r/t/a/f)?	1-3
Features of the SBC-VAV(r/t/a/f) Controllers.....	1-3
Inputs/Outputs	1-5
Universal Inputs (UI)	1-5
Outputs.....	1-6
Components and Features.....	1-9
Motor Management Technology (MMT)	1-9
Integration With SBC-STATs	1-9
Networking	1-10
Flow Sensor	1-11
SBC-VAV(r/t/a/f) Controllers.....	1-12
The SBC-VAVra.....	1-12
The SBC-VAVrf.....	1-12
The SBC-VAVta (-IAQ).....	1-13
The SBC-VAVtf (-IAQ).....	1-13
Specifications	1-15

1.1 WHAT IS THE SBC-VAV(R/T/A/F)?

The SBC-VAV(r/t/a/f) model controllers are variable air volume (VAV) and constant air volume (CAV) terminal box digital controllers. The SBC-VAV(r/t/a/f) controllers (refer to Table 1-1, "SBC-VAV(r/t/a/f) Models," on page 3) can be employed in different applications. The SBC-VAV(r/t/a/f) controllers work on existing Public Unitary Protocol (PUP) networks. Through an SBC-STAT Sensor Bus (SSB), the SBC-VAV(r/t/a/f) controllers communicate with SBC-STAT sensors without the use of an I/O point on the controller. Sections 1.4.1 through 1.4.4 further describe the four SBC-VAV(r/t/a/f) type controllers.

NOTE

The term SBC-VAV(r/t/a/f), does not apply to the SBC-VAV1-5T (FBK), SBC-VAV2, or SBC-VAV3.

Table 1-1 SBC-VAV(r/t/a/f) Models

SBC-VAV Controller	Triacs	Relays	Analog Outputs	Universal Inputs	STAT-BUS	Real-time Clock	Airflow Sensor	Actuator
SBC-VAVra	None	5	1	2	1	External Option	Yes	Yes
SBC-VAVrf	None	5	1	2	1	External Option	Yes	Feedback
SBC-VAVta	5	None	1	2	1	External Option	Yes	Yes
SBC-VAVta-IAQ	5	None	1	3	1	External Option	Yes	Yes
SBC-VAVtf	5	None	1	2	1	External Option	Yes	Feedback
SBC-VAVtf-IAQ	5	None	1	3	1	External Option	Yes	Feedback

1.1.1 FEATURES OF THE SBC-VAV(R/T/A/F) CONTROLLERS

- . Optically isolated triac solid-state relay outputs with metal oxide varistors (MOV) (SBC-VAVta and -VAVtf)
- . Mechanical relays equipped with a tranzorb protection device to suppress transients and contact arcing (SBC-VAVra, and SBC-VAVrf)
- . Analog outputs with 0-10VDC range, 8-bit resolution
- . 15-bit resolution universal inputs (UI)
- . Easy configuration through tools such as *SoloPro for Windows™*
- . Automatic settings for VAV or CAV control mode
- . Separate heating and cooling options for supply mode
- . Up to 115.2K baud communication rate
- . Motor Management Technology™ (MMT™) for monitoring, identifying, and correcting motor shorts
- . An integrated Belimo® LM24-10P-M feedback actuator that allows you to monitor the position of the damper at all times or an integrated Belimo LM24-M actuator
- . An on board, solid-state airflow sensor that measures the airflow and enables the calibration of airflow measurement for a wide range of VAV and CAV terminal box sizes and types

- . SBC-STAT features, including: digital thermostat capability; non-polar SSB wiring; light emitting diode (LED) display; password protection; easy-to-follow menu selections; a two-wire multiplexed power and data bus; a common terminal (SSB) for a single SBC-STAT or SBC-RHT; and the capability of having four digital SBC-STATs on a single controller
- . Flash updates through *SoloPro for Windows* for easy incorporation of the latest firmware
- . Real-time clock module (optional) for more accurate, stand alone time keeping

1.2 INPUTS/OUTPUTS

1.2.1 UNIVERSAL INPUTS (UI)

The Universal (analog) Inputs at Terminal Block 1 are high resolution (15-bit) UIs that can accept 0-20mA (DC) when in *current mode*, 0-1M Ω inputs when in *resistance mode*, or 0-10VDC when in *voltage mode*. A capacitor in the circuit provides a 10Hz low-pass filter. Overrange protection is provided to clamp normal overrange conditions and to protect against damage from electrostatic discharge (ESD). Input modes are selected by positioning a jumper on the current, voltage, and resistance (IVR) pin-terminal block located adjacent to TB1 (refer to Figure 1-1). When the I and V pins are jumpered together, the UI is in current mode. When the R and V pins are jumpered together, the UI is in resistance mode. Use resistance mode for dry contact digital inputs. If there is no jumper, the UI is in voltage mode. The UIs can be configured for alarming, setup/setback, filtering, and input polarity. UIs can be used as a universal input, as the proof of flow input, as a motion detection input, or as the duct temperature input.

- When a UI is in current mode, a jumper connects a 249 Ω , $\pm 1\%$ resistor between the UI terminal and ground (COM). A 20mA current into the input will develop 4.98VDC at the UI terminal. The sensed voltage is then converted to 4-20mA. Configuration tool settings should not be confused with the 0-20mA physical input range.
- When a UI is in resistance mode, a jumper connects a 10K Ω , $\pm 1\%$ pull-up resistor between the UI terminal and +5VREF. When in Resistance Mode, the attribute FE0x;ST for the UI should be set to *Thermistor*. Multi-point calibration curve capability is available using *SoloPro for Windows*.
- In voltage mode, the UI has a DC input impedance of 200K Ω , $\pm 1\%$. When in voltage mode, the UI normal physical input range is 0-10VDC. Through *SoloPro for Windows*, you can customize the input range by selecting minimum and maximum values between 0 and 10 at attributes FE01;MN and MX. It is also possible to set the zero and span points for 0-100% range results. These settings should not be confused with the 0-10VDC physical input range.

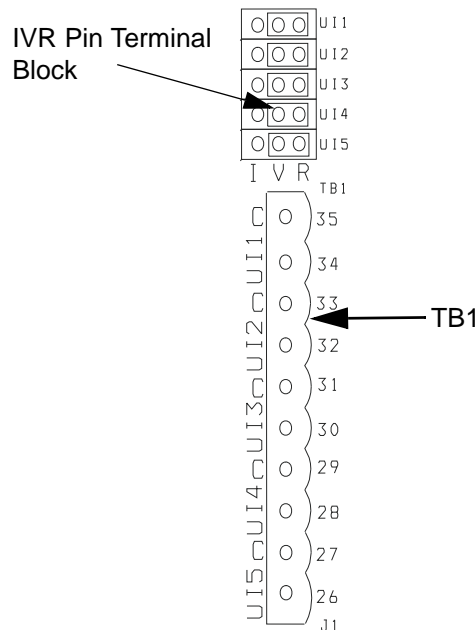


Figure 1-1: The IVR Pin Terminal Block Located Above TB1

1.2.2 OUTPUTS

1.2.2.1 DIGITAL OUTPUTS

Digital Outputs (DOs) provide ON/OFF control of output devices such as fans, valves, or cooling or reheat stages. There are two types of DOs: optically-isolated triac solid-state (triacs) and mechanical relay (relays). Relays and triacs have identical logical operation. However, they have different physical operating conditions. All DOs enforce minimum cycle time operation, determine the polarity (ON/OFF), and provide a runtime alarm limit for the output. Through *SoloPro for Windows*, you can define normal, inverted, always on, or always off operating modes for the DOs.

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. At the rated load, the relays have an operating lifetime of greater than one (1) million operations. Pulse width modulation (PWM) operation of floating valves, etc., 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
<i>Triacs will switch a 1A, 24VDC load, but they will not turn off until the load power is removed.</i>

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

The SBC-VAVta and SBC-VAVtf controllers have five (5) triac outputs at TB3 terminals 11 through 20. The triac outputs are suitable for driving pilot duty relays, PWM valve actuators, and floating setpoint valve actuators. Each triac output is capable of tracking the amount of time that the output is considered to be engaged (runtime hours).

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

The second DO (marked K2 on the PCB) can: control one stage of reheat; function as the *decrease position* signal when driving a valve; or function as the PWM output when PWM is used for chill/hot water valve positioning.

The third DO (marked K3 on the PCB) can control one stage of reheat or can serve as the *increase position* signal when driving a valve.

The fourth DO (marked K4 on the PCB) can control one stage of reheat or function as the *decrease position* signal for motor control.

The fifth DO (marked K5 on the PCB) can control one stage of reheat or function as the *increase position* signal for motor control. (SBC-VAVra and SBC-VAVrf only.)

1.2.2.2 ANALOG OUTPUTS

You can control analog outputs (AO) automatically, manually, or by a program over the EIA-485 communications network. When set to automatic control, the output is dedicated to the analog control proportional+integral+derivative (PID) loop. Modulation of reheat valves, radiation valves, or lighting ballasts is a suitable application for the AO, which has 0–10VDC and 8-bit resolution.

Table 1-2 SBC-VAV(r/t/a/f) Input and Output Assignments

Terminal	I/O	Description
1 (TB5)	SSB	SSB Signal
2 (TB5)	COM	SSB Common
3 (TB5)	AO1	Analog Output Channel 1
4 (TB5)	COM	Analog Output Common
11 (TB3)	K1	Relay 1 Common - (SBC-VAVra, and SBC-VAVrf controller types only) or, Triac Output 1 - (SBC-VAVta and -VAVtf controller types only)
12 (TB3)	K1	Relay 1 Normally Open - (SBC-VAVra, and SBC-VAVrf controller types only) or, Triac Output 1 - (SBC-VAVta and -VAVtf controller types only)
13 (TB3)	K2	Relay 2 Common - (SBC-VAVra, and SBC-VAVrf controller types only) or, Triac Output 2 - (SBC-VAVta and -VAVtf controller types only)
14 (TB3)	K2	Relay 2 Normally Open - (SBC-VAVra, and SBC-VAVrf controller types only) or, Triac Output 2 - (SBC-VAVta and -VAVtf controller types only)
15 (TB3)	K3	Relay 3 Common - (SBC-VAVra, and SBC-VAVrf controller types only) or, Triac Output 3 - (SBC-VAVta and -VAVtf controller types only)
16 (TB3)	K3	Relay 3 Normally Open - (SBC-VAVra, and SBC-VAVrf controller types only) or, Triac Output 3 - (SBC-VAVta and -VAVtf controller types only)

Table 1-2 SBC-VAV(r/t/a/f) Input and Output Assignments

Terminal	I/O	Description
17 (TB3)	K4	Relay 4 Common - (SBC-VAVra, and SBC-VAVrf controller types only) or, Triac Output 4 - (SBC-VAVta and -VAVtf controller types only)
18 (TB3)	K4	Relay 4 Normally Open - (SBC-VAVra, and SBC-VAVrf controller types only) or, Triac Output4 - (SBC-VAVta and -VAVtf controller types only)
19 (TB3)	K5	Relay 5 Common - (SBC-VAVra, and SBC-VAVrf controller types only) or, Triac Output 5 - (SBC-VAVta and -VAVtf controller types only)
20 (TB3)	K5	Relay 5 Normally Open - (SBC-VAVra, and SBC-VAVrf controller types only) or, Triac Output5 - (SBC-VAVta and -VAVtf controller types only)
21 (TB4)	AC Line	24 Volt AC Control Power Input
22 (TB4)	AC AUX	24 Volt AC Auxiliary Output for DC Loads (5A Fuse)
23 (TB4)	AC RET	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

1.3 COMPONENTS AND FEATURES

1.3.1 MOTOR MANAGEMENT TECHNOLOGY (MMT)

MMT extends the functions of the Belimo LM24-M (supplied with the SBC-VAVra and -VAVta) and the LM24-10P-M (supplied with the SBC-VAVrf and SBC -VAVtf controllers only) actuators via:

- . Alarm generation upon actuator disconnect, reconnect, or failure;
- . Motor short detection and correction;
- . End of travel detection; and
- . Motor usage monitoring for energy conservation.

The MMT circuit measures both the motor current and voltage to detect normal, overload, stall, and shorted conditions. In case of commutator or brush shorts, the MMT circuit provides a clearing pulse to remove small amounts of debris. Through the MMT circuit, you can monitor the position of a potentiometer on feedback actuators.

NOTE

MMT functions only on SBC-VAV(r/t/a/f) controllers connected to Belimo LM24-M and LM24-10P-M model actuators.

NOTE

The Siemens GDE131.1U and the Neptonic BBT 24 have been tested and approved by AAM; however, most industry actuators are compatible with the SBC-VAV(r/t/a/f) family of controllers.

1.3.2 INTEGRATION WITH SBC-STATS

Terminal Block 5/SSB (**TB5:SSB**) is a non-polar, two wire, bidirectional sensor bus that can be used in either digital or analog mode. In analog mode, it supports the SBC-STAT1™ and SBC-STAT2™. In digital mode, it can communicate with multiple SSB digital devices such as the SBC-STAT3™, SBC-STAT1D™, and SBC-STAT2d™. Mode switching is automatic and any SSB digital device will override any analog device.



Figure 1-2: SBC-STAT3 (left), SBC-STAT1 and SBC-STAT1-D (center), SBC-STAT2 and SBC-STAT2-D (right)

Through the SBC-STAT Bus (SSB), the SBC-VAV(r/t/a/f) controllers can communicate with SBC-STAT thermostats without the use of an I/O point on the controller. The SBC-VAV(r/t/a/f) controllers can support one (1) SBC-STAT1, one (1) SBC-STAT2, or up to four (4) digital SBC-STATs through the SSB.

The SSB can be used to link two or more SBC-VAV(r/t/a/f) controllers for certain applications. When using the SSB to link SBC-VAV(r/t/a/f) controllers, one controller must be configured as a master, and all other controllers must be configured as a slave. In addition, proper polarity must be maintained. **Connect SSB to SSB and COM to COM** (connect terminal 1 of TB5 on controller A to terminal 1 of TB5 on controller B; and connect terminal 2 of TB5 on controller A to terminal 2 of TB5 on controller B). Refer to *Section 2, Wiring and Installation*, for additional information.

CAUTION

When using the SSB to link two SBC-VAV(r/t/a/f) controllers (as needed for certain applications), polarity must be maintained. Connect SSB of controller A to SSB of controller B and COM of controller A to COM of Controller B.

1.3.3 NETWORKING

Through *SoloPro for Windows*, you can program the SBC-VAV(r/t/a/f) controllers and monitor/modify their setpoints. This configuration tool also allows you to use the SBC-VAV(r/t/a/f) flash memory capabilities for uploading and downloading software updates tracked by Software Release Codes. (For more information, refer to the *SoloPro for Windows User Manual*.)

Networking is also possible using the Auto-Pilot™ software through the SAGE^{MAX}™ or SF1™ area controllers. Auto-Pilot enables you to detect alarms, generate trends, and view color graphical displays of your system with live data.

Integration of the SBC-VAV(r/t/a/f) controllers into an AAM system occurs through direct connection to the SAGE^{MAX} or SF1, or to other unitary controllers. Networking of up to 128 SBC-VAV(r/t/a/f) controllers is possible through a single SAGE^{MAX} port.

1.3.4 FLOW SENSOR

The SBC-VAV(r/t/a/f) on board, solid-state airflow sensor measures the airflow through the terminal box. Airflow measurement and calibration for maximum energy efficiency is possible for a wide range of VAV and CAV terminal box sizes and types.

1.4 SBC-VAV(r/t/a/f) CONTROLLERS

Sections 1.4.1 through 1.4.4 provide a brief description of each of the SBC-VAV(r/t/a/f) controllers.

1.4.1 THE SBC-VAVra

The SBC-VAVra has five (5) digital relay outputs, one (1) AO, and two (2) UIs. The SBC-VAVra also includes an integrated Belimo LM24-M actuator that employs MMT to monitor, identify, and correct motor shorts. The position of the controller's integrated damper motor is controlled by the SBC-VAVra's proportional+integral (PI) control loop.



Figure 1-3: The SBC-VAVra and SBC-VAVrf (feedback actuator)

1.4.2 THE SBC-VAVrf

The SBC-VAVrf is equipped with five (5) digital relay outputs, one (1) AO, and two (2) UIs. The SBC-VAVrf is also equipped with a Belimo LM24-10P-M feedback actuator, which enables you to monitor the damper position at all times. The position of the controller's integrated damper motor is controlled by the SBC-VAVrf's PI control loop.

1.4.3 THE SBC-VAVta (-IAQ)

The SBC-VAVta is equipped with five (5) triac solid-state relay outputs, one (1) AO, and two (2) UIs. The SBC-VAVta also includes an integrated Belimo actuator that employs MMT to monitor, identify, and correct motor shorts. The position of the controller's integrated damper motor is controlled by the SBC-VAVta's PI control loop.

SBC-VAVta-IAQ based controllers will include an additional Universal Input (total of three (3) UIs), which is used exclusively for CO² readings for the Indoor Air Quality application.



Figure 1-4: The SBC-VAVta (actuator) and SBC-VAVtf (feedback actuator)

1.4.4 THE SBC-VAVtf (-IAQ)

The SBC-VAVtf is equipped with five (5) triac solid-state relay outputs, one (1) AO, and two (2) UIs. The SBC-VAVtf also includes an integrated Belimo LM24-10P-M feedback actuator that employs MMT to monitor, identify, and correct motor shorts. The position of the controller's integrated damper motor is controlled by the SBC-VAVtf's PI control loop. The feedback actuator allows you to monitor the position of the damper at all times.

SBC-VAVtf-IAQ based controllers will include an additional Universal Input (total of three (3) UIs), which is used exclusively for CO² readings for the Indoor Air Quality application.

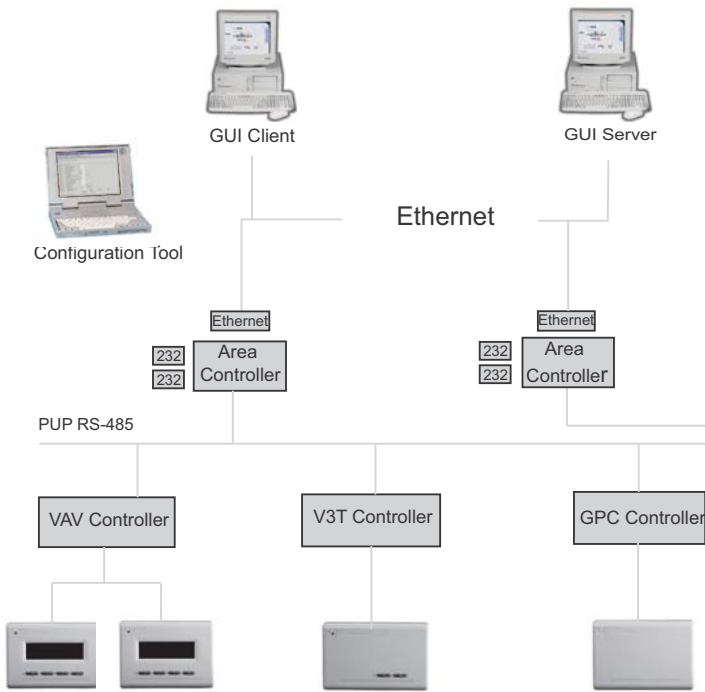


Figure 1-5: System Architecture of SBC-VAV Products

1.5 SPECIFICATIONS

1.5.1 NETWORKING

The following specifications are necessary for networking of the SBC-VAV(r/t/a/f) controllers:

- . **line signaling:** EIA-485
- . **wiring:** shielded, twisted pair 18-22 AWG
- . **network protection:** dual tranzorbs, Hi ESD driver
- . **communications speed:** 1,200bps–115.2Kbps baud rate, programmable
- . **network configuration:** multidrop to 5,000ft. (1.5km) total
- . **protocol:** PUP.

1.5.2 INTEGRATED COMPONENTS

- . LM24-M Belimo actuator (SBC-VAVra and SBC-VAVta) with floating mount, eliminating damper shaft stress and binding.
- . LM24-10P-M Belimo feedback actuator (SBC-VAVrf and SBC-VAVtf) with floating mount, eliminating damper shaft stress and binding.
- . Flow sensor.

1.5.3 ACTUATOR MOTOR

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

1.5.4 TERMINATIONS

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

1.5.5 INPUT SUPPLY

- . NEC class 2 transformer (customer-supplied).
- . 24VAC, 50/60Hz, 10VA maximum, 5VA typical.
- . 5A fuse load protection.
- . PTC control electronics protection.

1.5.6 OPERATING ENVIRONMENT

- . **Temperature range:** 0–50°C.
- . **Humidity range:** 5–95% RH noncondensing.

1.5.7 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)

1.5.8 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.

SECTION 2: WIRING AND INSTALLATION

This section covers mounting, connecting the airflow sensor, and wiring the SBC-VAV controllers. Wiring instructions for power, communications, and inputs/outputs appear along with safety requirements.

IN THIS SECTION

Installation	2-3
Changing the Actuator Orientation	2-4
Mounting	2-8
Connecting the Airflow Sensor	2-10
Wiring Requirements	2-13
Power Wiring	2-13
EIA-485 Communications Wiring	2-15
Input & Output Wiring	2-16
Optional Actuator Wiring	2-23

2.1 INSTALLATION

The installation of the SBC-VAV model controllers involves mounting, supplying power, connecting to the communications network, and connecting input and output devices. All wiring connections to the SBC-VAV are made with the use of terminal blocks (TB). The TBs are plug (female) & socket (male) style. 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.

WARNING

SBC-VAV controllers should only be used in a manner specified by the manufacturer.

WARNING

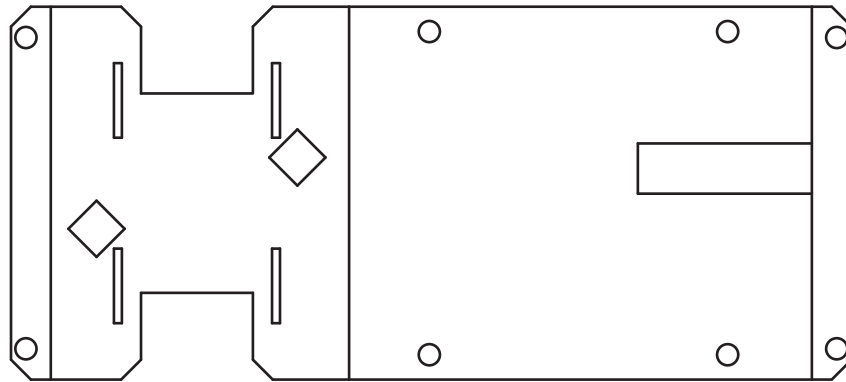
Only trained personnel should service SBC-VAV type controllers. No operator replaceable parts exist in SBC-VAV type controllers.

WARNING

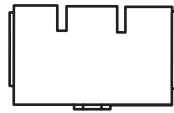
Remove power before servicing.

2.2 CHANGING THE ACTUATOR ORIENTATION

Depending on the specifics of a particular job, it may be advantageous to have the actuator mounted to the left or right of the controller. This may be due to the mounting site, the direction of wiring, etc. The SBC-VAV(r/t/a/f) allows you to reverse the orientation of the actuator by changing the mounting clip. 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.



Baseplate



Mounting Clip

Figure 2-1 NB-VAV Metalwork

Before reversing the orientation of the actuator mounting clip, you must remove the actuator by unplugging the signal 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, you must 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.

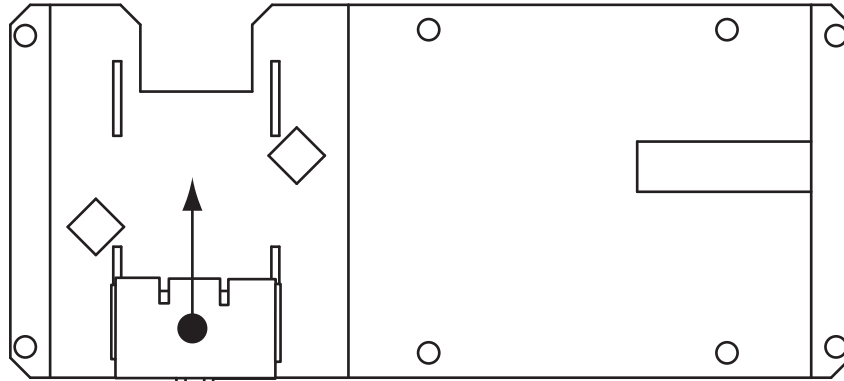


Figure 2-2 Unlock Actuator Mounting Clip

2. Remove the mounting clip from the baseplate.

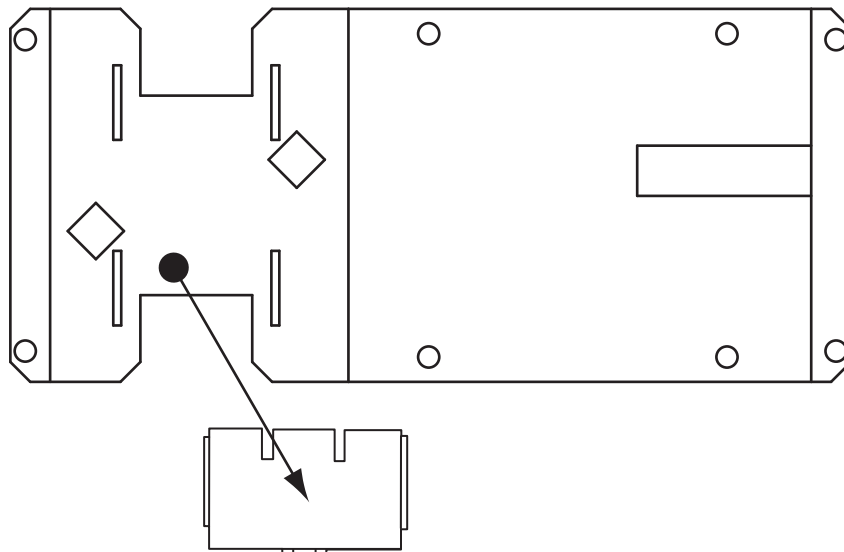


Figure 2-3 Remove Actuator Mounting Clip

3. Rotate the mounting clip.

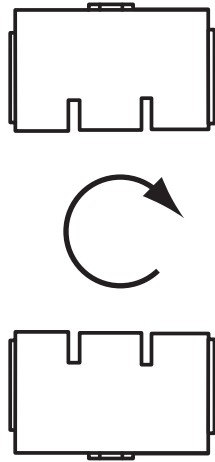


Figure 2-4 Rotate Mounting Clip

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

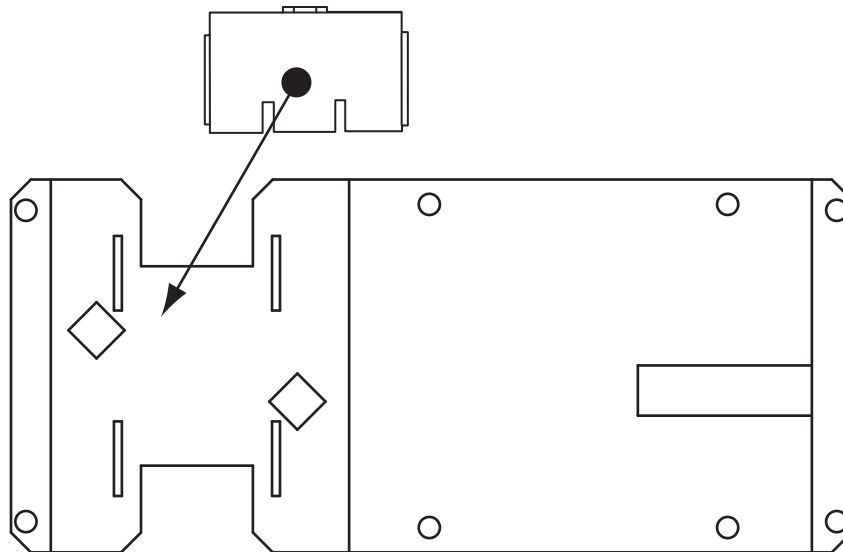


Figure 2-5 Insert Mounting Clip in Slots

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

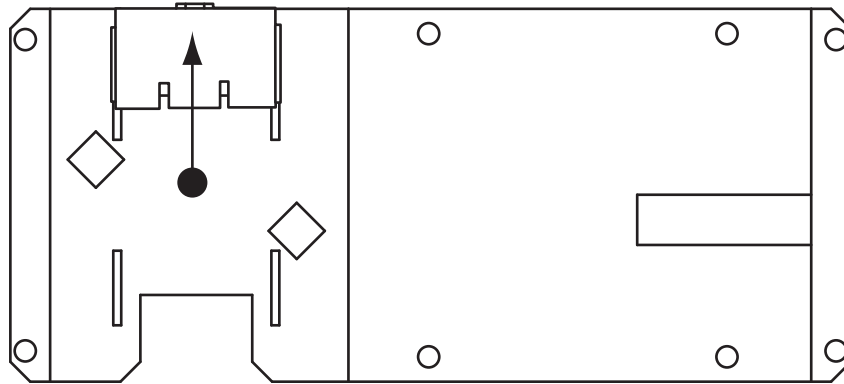


Figure 2-6 Slide Clip Into Place

2.3 MOUNTING

Perform the following procedure to mount the SBC-VAV controller.

CAUTION

The mounting area should be free from moisture and leakage.

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 SBC-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 metal of the SBC-VAV mounting bracket must make contact with the metal of the terminal box and the terminal box must be grounded to a true earth ground. Otherwise, electrical and communications problems are likely to occur.

4. Hand tighten the 10mm hex nuts to temporarily secure the damper clamp to the damper shaft.

NOTE

AAM recommends the use of self-drilling mounting screws for securing the controller to the terminal box. Mounting screws used to secure the controller to the terminal box are not supplied with the SBC-VAV controllers.

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 SBC-VAV controller to the terminal box.
6. Align the mounting holes of the SBC-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 SBC-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.

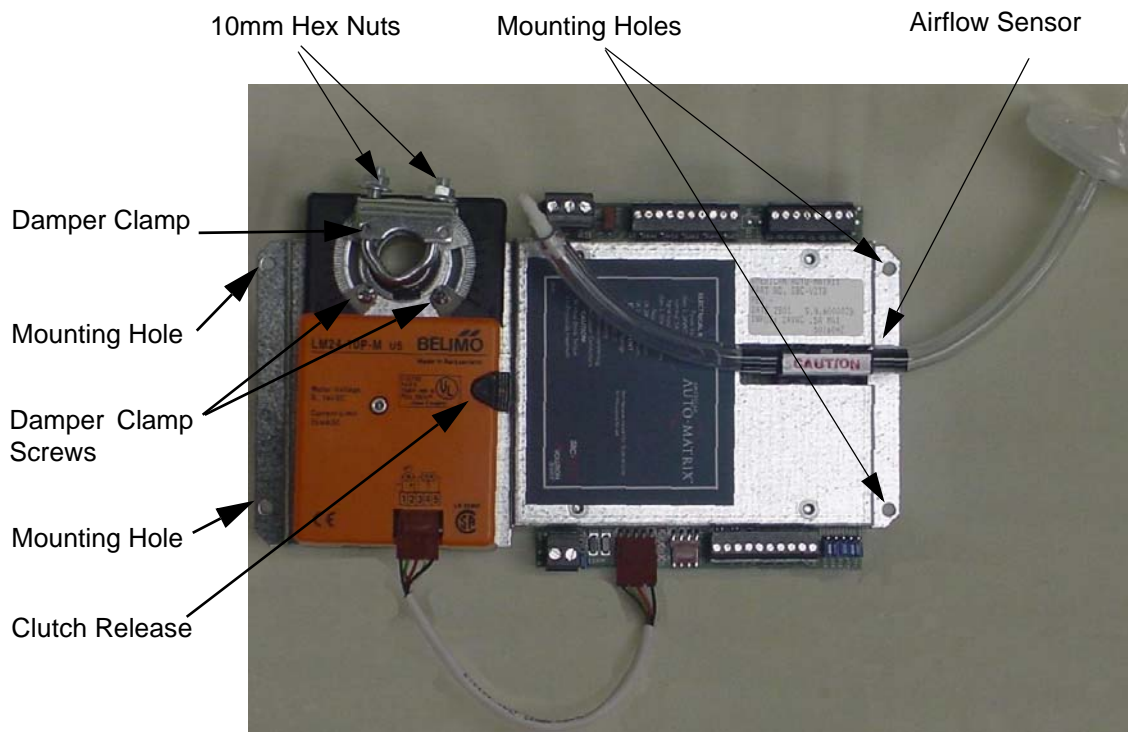


Figure 2-7: SBC-VAV Controller

2.4 CONNECTING THE AIRFLOW SENSOR

The SBC-VAV's integral airflow sensor is a precision instrument. To prevent dust particles from entering the SBC-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 SBC-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. Do not twist the sensor at any time.

CAUTION

Twisting or applying torque to the airflow sensor will damage the internal components of the device. Once damaged, the device will either not work at all or will produce inaccurate measurements. If it is determined that application caused the damage, the warranty will become void.

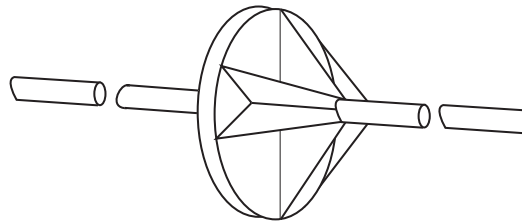


Figure 2-8: Airflow Sensor Filter

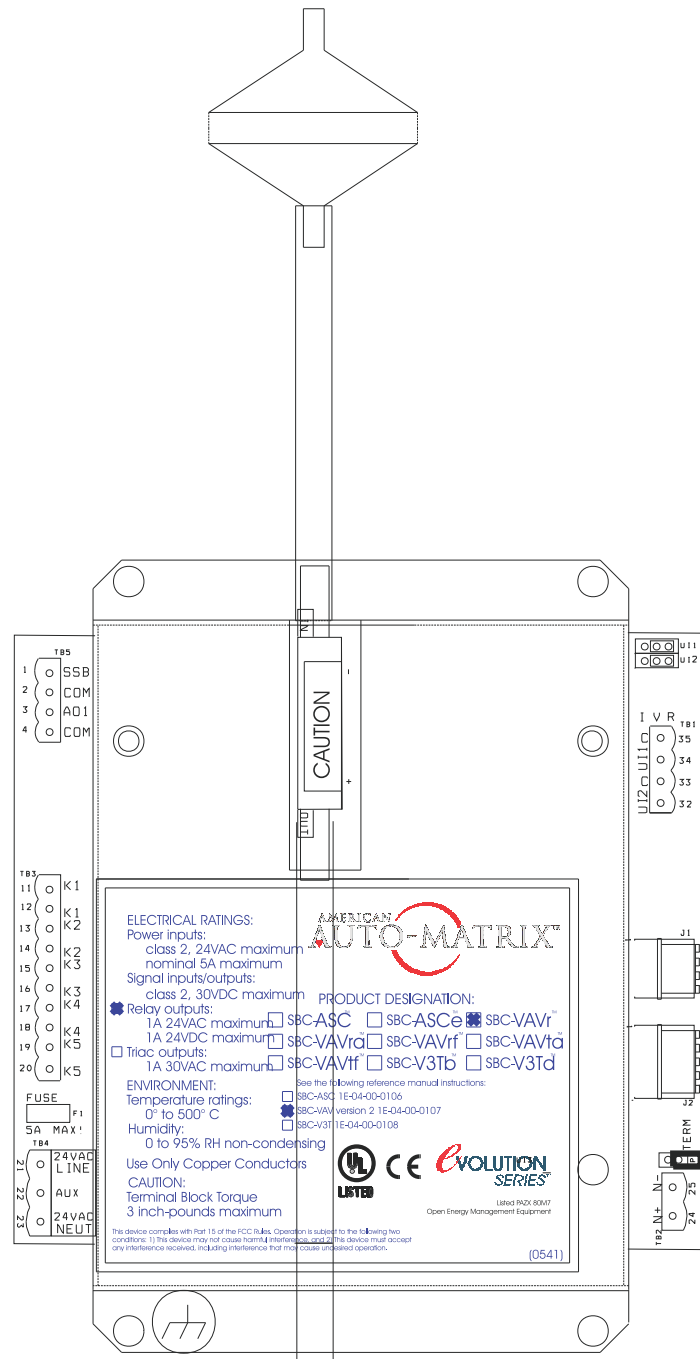


Figure 2-9: The SBC-VAVra, SBC-VAVrf (actuator not shown)

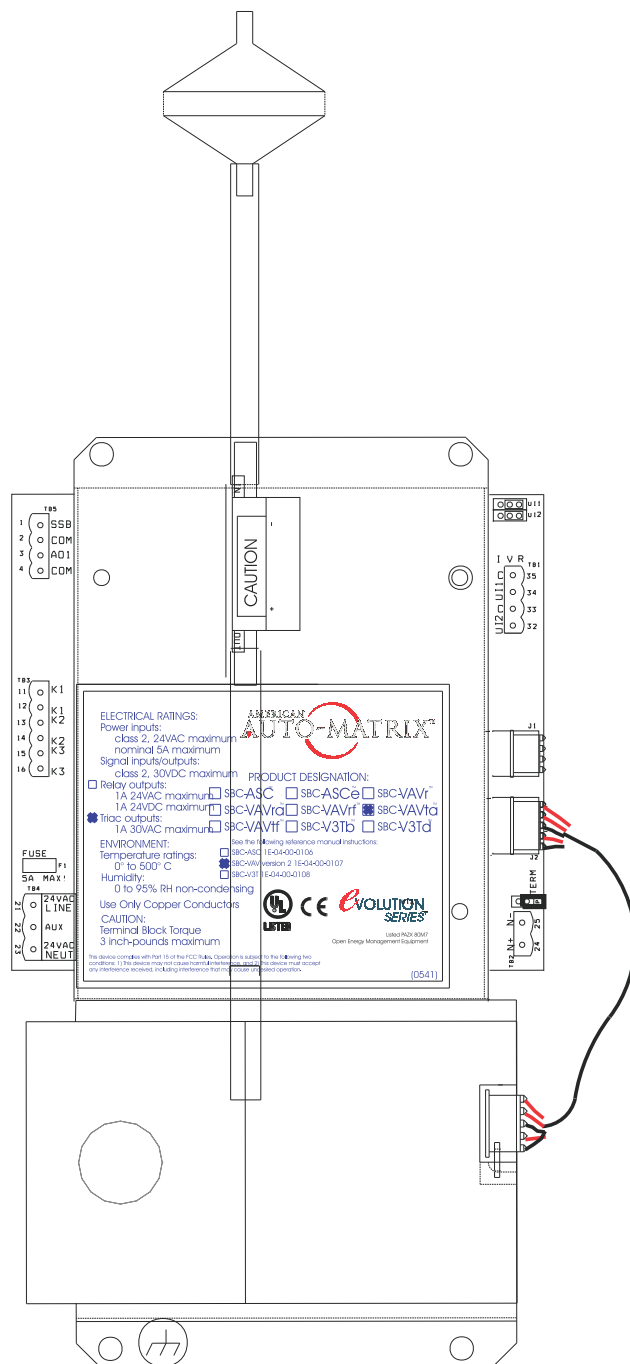


Figure 2-10: SBC-VAVta and -VAVtf

2.5 WIRING REQUIREMENTS

CAUTION

Wiring for the SBC-VAVra, SBC-VAVrf, SBC-VAVta, and SBC-VAVtf, differs greatly from the previous versions of the SBC-VAV controllers (the SBC-VAV1 and SBC-VAV2). Do not use wiring instructions provided in this manual when wiring SBC-VAV1 or SBC-VAV2 type controllers.

WARNING

Remove power when performing the following wiring procedures for the SBC-VAV.

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 POWER WIRING

You must use a 24VAC 50/60Hz NEC class II transformer rated at 10VA maximum (5VA typical) for power supply to the SBC-VAV type controllers. Figure 2-5 shows how to wire the SBC-VAV for power. AAM recommends that 18AWG wiring be used, but the terminals can accommodate 14–22AWG.

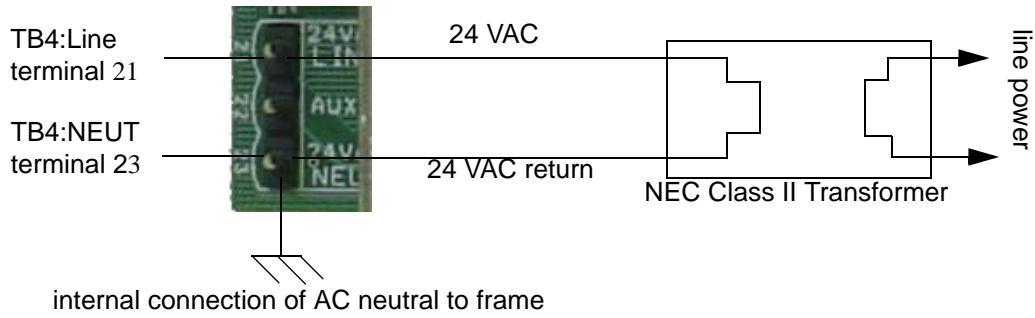


Figure 2-11: Wiring 24VAC Power

NOTE

AAM recommends that each SBC-VAV on a network has an individual power transformer.

CAUTION

AAM does not recommend that you share power transformers among unitary controllers. If this technique is used against the recommendations of AAM, AC polarity must be maintained throughout the power network. Damage will result if two or more network devices sharing the same AC supply do not have their power correctly polarized. Such damage voids the product warranty.

CAUTION

All power transformers used must be rated to power all devices connected to them.

2.5.2 EIA-485 COMMUNICATIONS WIRING

Figure 2-6 illustrates the EIA-485 communications network wiring for the SBC-VAV. For cases in which 14–22AWG, individually shielded, twisted pair wiring is recommended for optimal operations, EIA-485 (RS-485) wiring standards apply.

JP6 is an RS-485 termination resistor of 250 ohms. Set the jumper on JP6 of the last device on the network for termination of all EIA-485 networks.

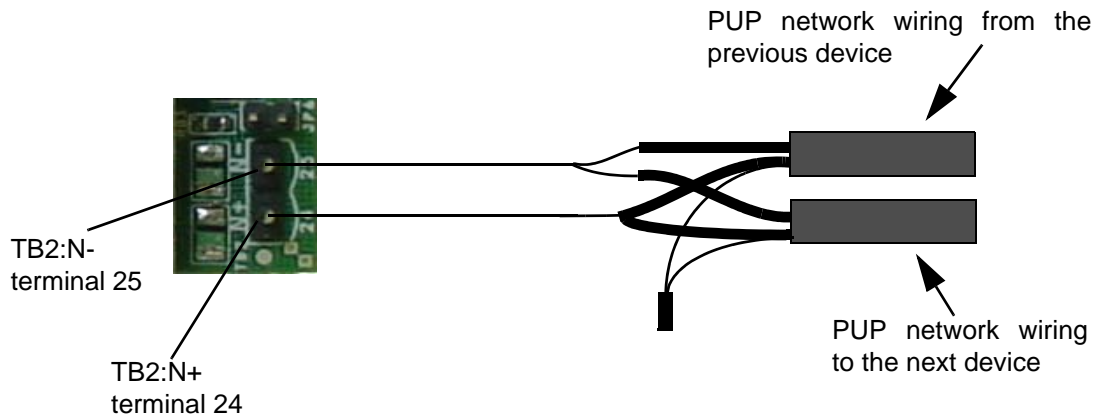


Figure 2-12: Multidrop EIA-485 Wiring

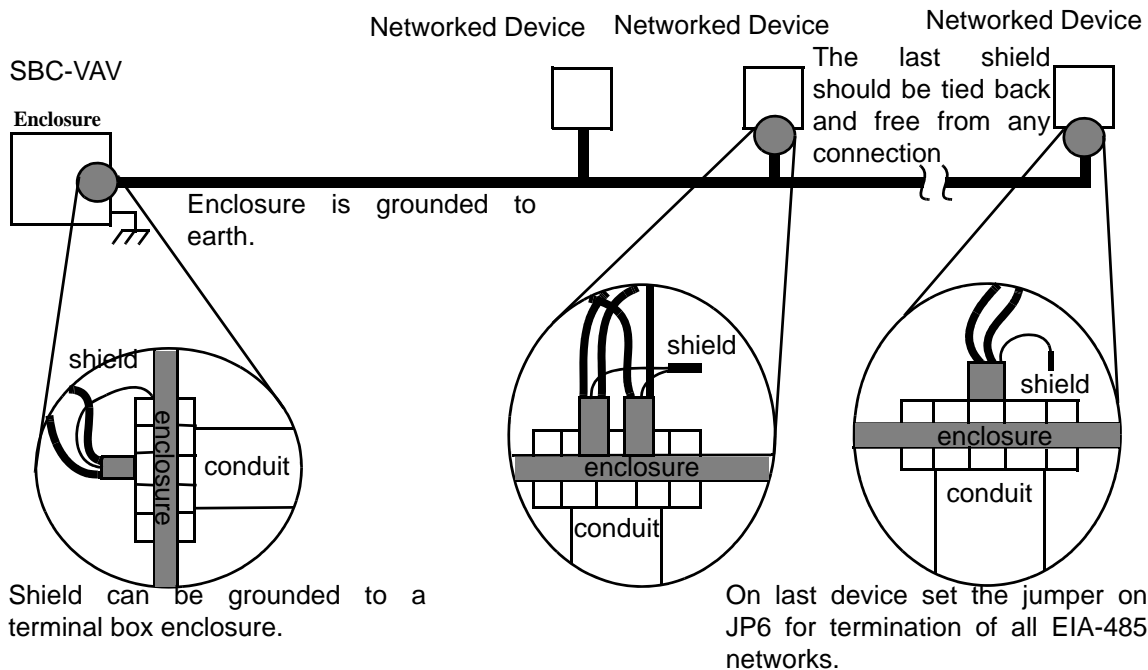


Figure 2-13: Proper Shield Wiring of Networked Devices

2.5.3 INPUT & OUTPUT WIRING

The most common wiring applications for the SBC-VAV type controllers appear in subsections 2.5.3.1 through 2.5.3.6. You should discuss deviations from the following examples with AAM Technical Support before making modifications to controllers. Any modifications other than those supported by AAM may void the product warranty.

The Universal Inputs (UI) can be used as voltage, current, and resistance inputs. Input modes are selected by positioning a jumper on the current, voltage, and resistance (IVR) pin-terminal block located adjacent to **TB1**. Overrange protection is provided to clamp normal overrange conditions and to protect against damage from electrostatic discharge (ESD). When the **I** and **V** pins are jumpered together, the **UI** is in current mode. When the **R** and **V** pins are jumpered together, the **UI** is in resistance mode. If there is no jumper, the **UI** is in voltage mode. The **UIs** can be configured for alarming, setup/setback, filtering, and input polarity. **UIs** can be used as a universal input, as the SBC-VAV proof of flow input, as a motion detection input, or as the duct temperature input. Refer to *Section 1, Overview*, for additional information.

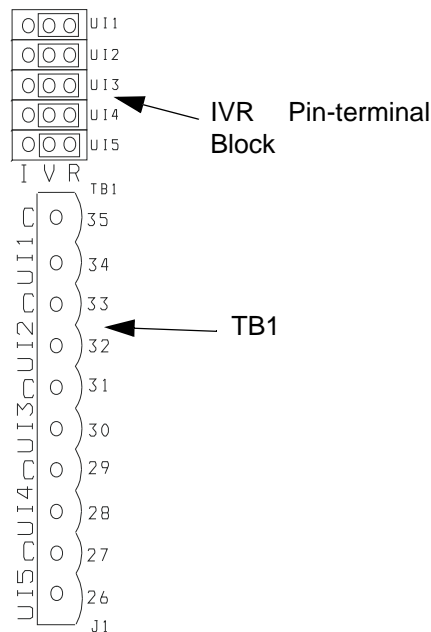


Figure 2-14 IVR Pin-Terminal Block

2.5.3.1 UNIVERSAL INPUT AS VOLTAGE INPUT

When the **UI** is used as a 0–10VDC analog input, do not jumper the pins on the IVR pin-terminal block. For example, if **UI1** is to be used as a 0–10VDC analog input, then **UI1** is in voltage mode and therefore, the jumper on the **UI1** row of the IVR pin-terminal block should be removed.

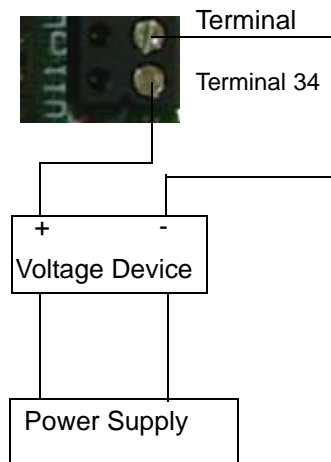


Figure 2-15: 0–5VDC Device Used on UI

2.5.3.2 UNIVERSAL INPUT AS 4–20mA INPUT

When using the **UI** as a 4–20mA input, the **I** and **V** pins on the IVR pin-terminal block must be jumpered together. For example, if **UI1** is to be used as a 4–20mA input, then the **UI** is in current mode and therefore, the **I** and **V** pins on the **UI1** row on the pin-terminal block should be jumpered together.

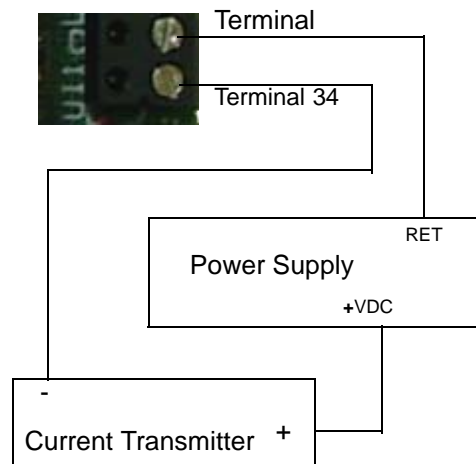


Figure 2-16: 4–20mA Device Used on UI

2.5.3.3 UNIVERSAL INPUT AS DIGITAL INPUT OR THERMISTOR

The **UI** can also be configured as a thermistor or digital input device using a dry contact. In this configuration, the **V** and **R** pins on the IVR pin-terminal block must be jumpered together.

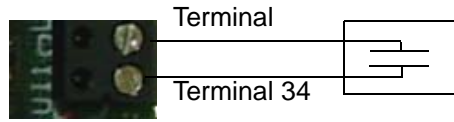


Figure 2-17: Dry Contact as Digital Input Using UI

2.5.3.4 SBC-STAT/THERMISTOR WIRING

Figure 2-12 illustrates wiring of the SBC-STAT Communications Bus (STAT Bus) on the SBC-STAT3 to the SBC-VAV through the SSB and COM terminals on TB1. This terminal correlates to the SSB/COM terminals of the SBC-STAT3 as shown.

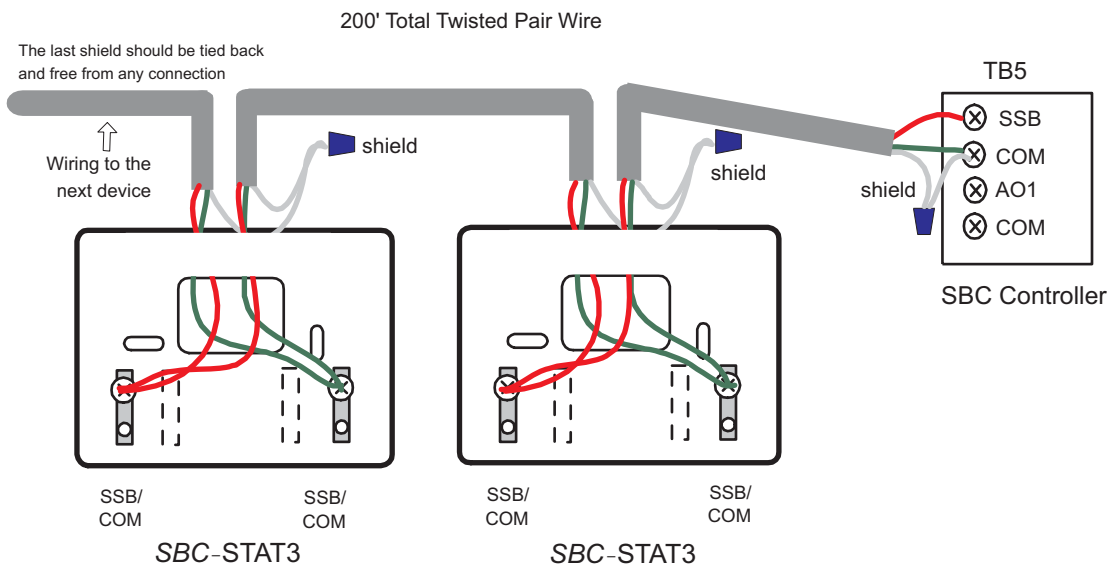


Figure 2-18: SBC-STAT Bus Wiring of SBC-STAT3 to SBC-VAV

Figure 2-13 illustrates wiring of the SBC-STAT Communications Bus (STAT Bus) on the SBC-STAT2 or SBC-STAT1 to the SBC-VAV through the SSB and COM terminals on TB1. This terminal correlates to the SSB/COM terminals of the SBC-STAT2 and SBC-STAT1 as shown.

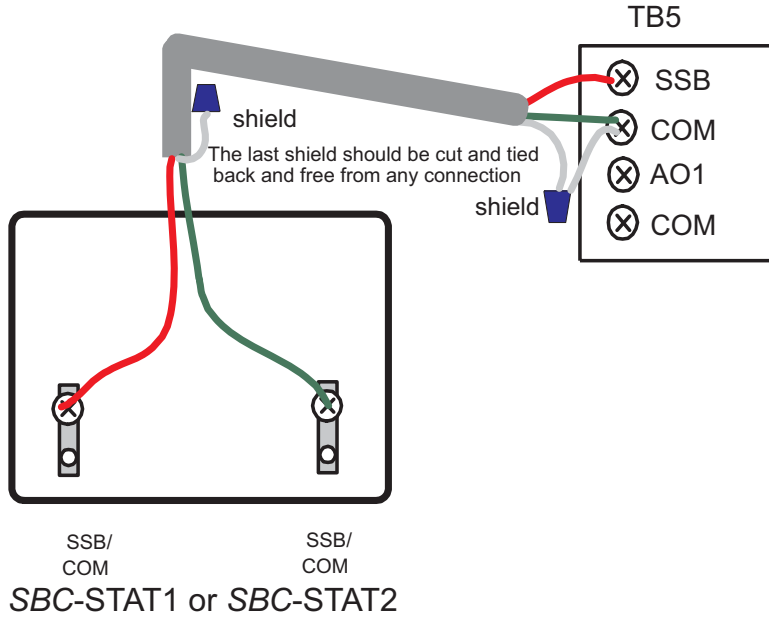


Figure 2-19: SBC-STAT Bus Wiring of SBC-STAT2 or SBC-STAT1 to SBC-VAV

Figure 2-14 illustrates the optional network wiring of the SBC-STAT to the SBC-VAV through the N+ and N- terminals on TB2.

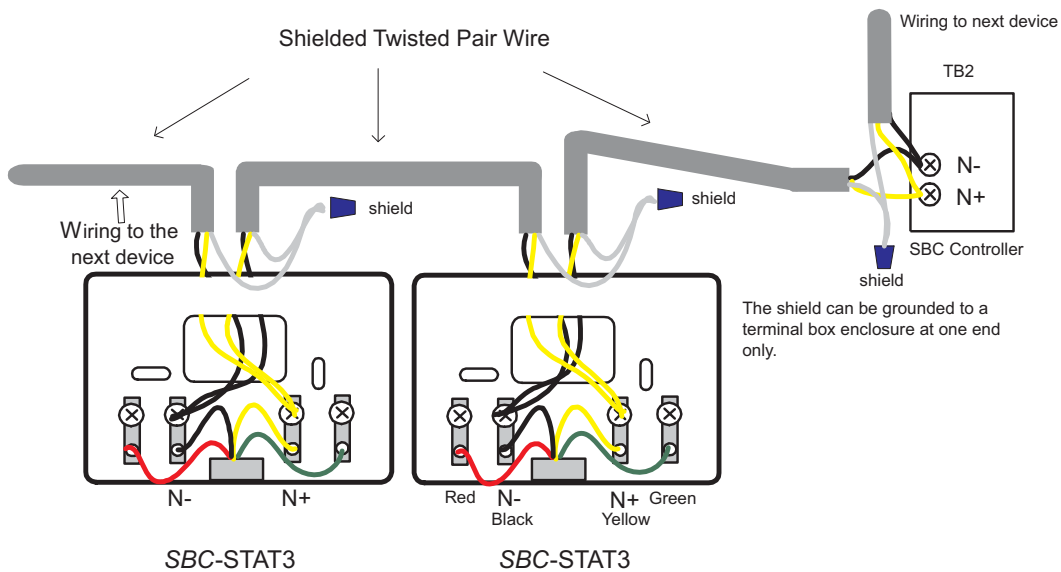


Figure 2-20: SBC-STAT Network Wiring to SBC-VAV

Using digital thermostats—SBC-STAT1-D, SBC-STAT2-D and SBC-STAT3—two or more SBC-VAVs can be wired onto the same Sensor Bus. For this wiring structure to work properly, one SBC-VAV must be set up as a Master (**BM=0**), and all other SBC-VAVs must be set up as Slaves (**BM=1**). Remember, the maximum number of digital SBC-STATs allowed on a Sensor Bus is four.

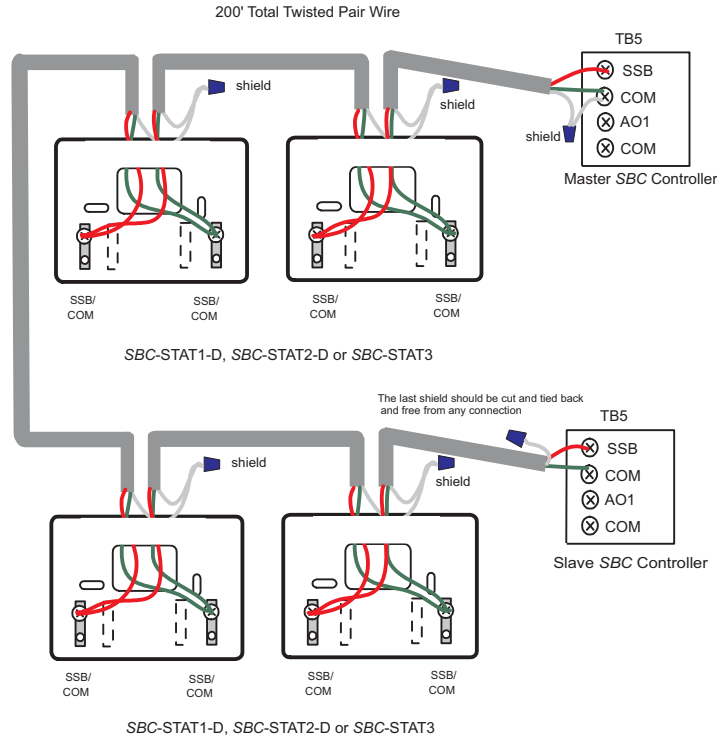


Figure 2-21: Multiple SBC-VAVs on a Sensor Bus.

NOTE

When connecting two or more SBC-VAVs to the same STATbus, polarity must be maintained at all connections. Make sure to connect COM to COM and SSB to SSB at each device

2.5.3.5 DIGITAL OUTPUTS

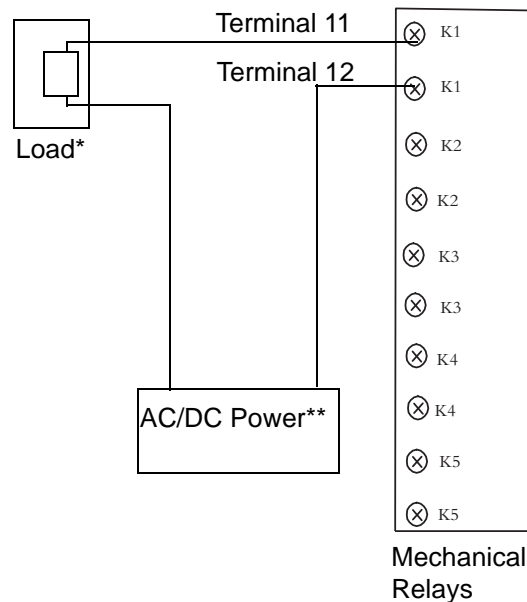
CAUTION

Wiring for the SBC-VAVra, SBC-VAVrf, SBC-VAVta, and SBC-VAVtf, differs greatly from the previous versions of the SBC-VAV controllers (the SBC-VAV1 and SBC-VAV2). Do not use wiring instructions provided in this manual when wiring the SBC-VAV1 and SBC-VAV2.

NOTE

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

The SBC-VAVra, and SBC-VAVrf controllers have five (5) relay outputs at **TB3** terminals 11 and 12 (both marked K1 on the PCB), 13 and 14 (both marked K2 on the PCB), 15 and 16 (both marked K3 on the PCB), 17 and 18 (both marked K4 on the PCB), and 19 and 20 (both marked K5 on the PCB). When wiring, connect one of the output load wires to either K2 terminal (if using relay number 2), connect the remaining output load wire to a power source wire, then connect the other power source wire to the other K2 terminal on **TB3**. For additional information about relays, refer to *Section 1, Overview*.



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

Figure 2-22: Wiring Relays Using 24VAC/DC Pilot Relays for Typical Setup

The SBC-VAVta and -VAVtf controllers have five (5) triac outputs at **TB3** terminals 11 and 12 (both marked K1 on the PCB), 13 and 14 (both marked K2 on the PCB), and 15 and 16 (both marked K3 on the PCB). Each triac output is capable of tracking the amount of time that the output is considered to be engaged (runtime hours). Refer to Figure 2-17 for wiring information. For additional information about triacs, refer to *Section 1, Overview*.

CAUTION

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

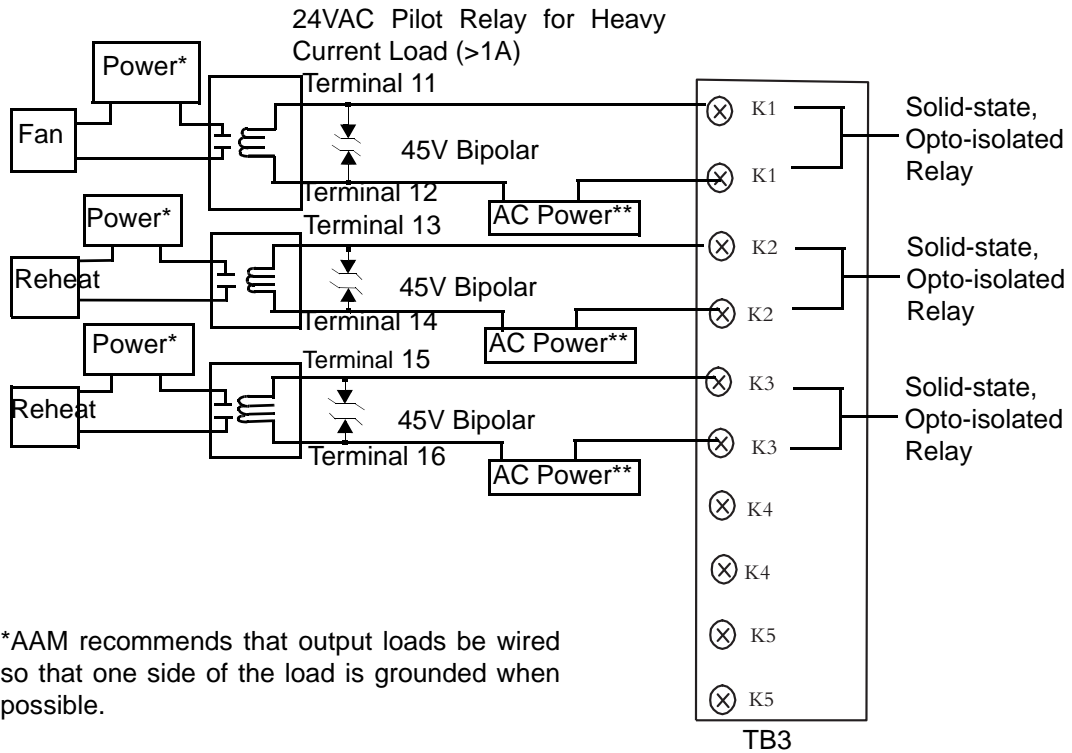
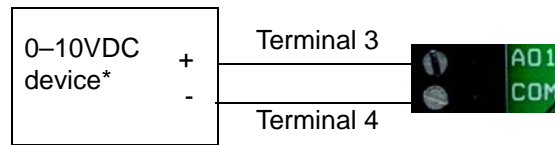


Figure 2-23: Wiring Triacs Using 24VAC Pilot Relays for Typical Setup

2.5.3.6 WIRING THE ANALOG OUTPUT

You can control analog outputs (AO) manually or by a program over the EIA-485 communications network. When set to automatic control, the output is dedicated to the analog control proportional+integral+derivative (PID) loop. Modulation of reheat valves, chiller valves, or lighting ballasts is a suitable application for AOs, which have 0–10VDC and 8-bit resolution.

Pin 3 on TB5 is the AO. Pin 4 is AO common.



*MAXIMUM LOAD: 500Ω @
10VDC

Figure 2-24: SBC-VAV Analog Output Wired for a 0–10VDC Output Device

2.5.4 OPTIONAL ACTUATOR WIRING

Optional actuators can be either AC- or DC-powered. See Figure 2-19 for wiring an AC actuator.

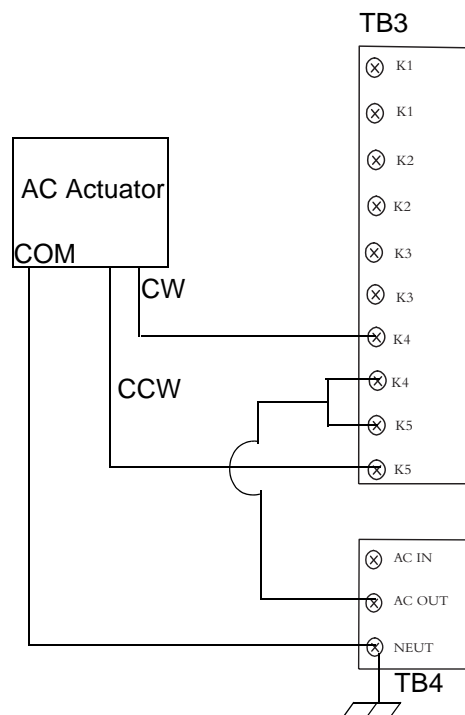


Figure 2-25: AC Actuator Wiring

When connecting a DC-powered actuator, connect the actuators wires to pins 4 (Actuator -) and 5 (Actuator +) on the SBC-VAV(r/t/a/f) J2 connector. See Figure 2-20 for more information.

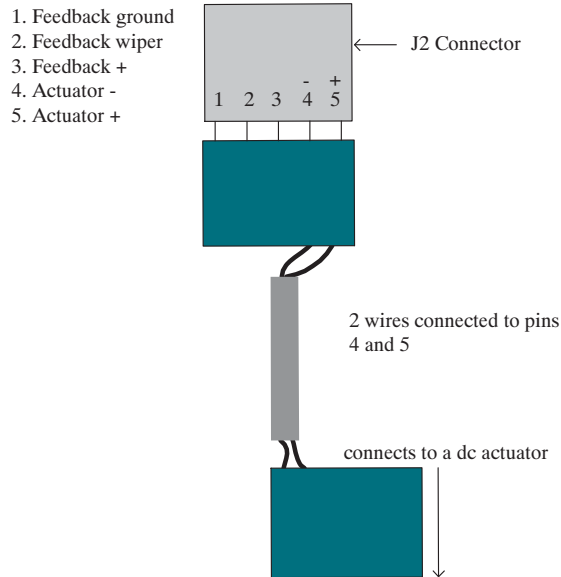


Figure 2-26: DC Actuator Wiring

If connecting a feedback POT to an optional actuator, connect the POT wires to pins 1, 2 and 3 on the SBC-VAV(r/t/a/f) J2 connector. For wiring information, see Figure 2-21.

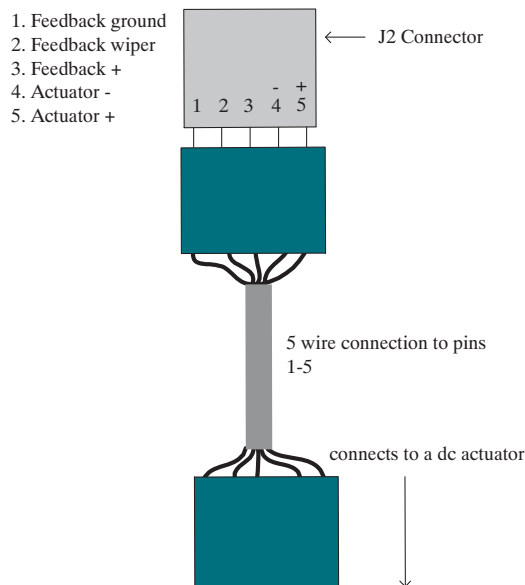


Figure 2-27: DC Actuator Potentiometer Wiring

SECTION 3: SBC-VAV ATTRIBUTES

This section introduces you to the groupings of attributes used to control the parameters of the SBC-VAV model controllers over the PUP network. Detailed descriptions of all points for the controller appear here. Information on common usage of the attributes is also included.

IN THIS SECTION

Introduction	3-2
System	3-3
About.....	3-3
Diagnostics	3-4
Power Up	3-5
Schedules	3-9
Clock/Calendar	3-10
Summary.....	3-11
Schedules 1 Through 6.....	3-13
Temperature (Analog Inputs).....	3-17
Thermostat	3-17
Setpoint Adjust.....	3-18
Override	3-18
Cooling Setpoints.....	3-19
Heating Setpoints.....	3-20
Alarms	3-22
Supply	3-25
Sensor Bus	3-26
Flow	3-32
Control	3-32
Cooling	3-33
Unoccupied.....	3-36
Warm-Up.....	3-36
Indoor Air Quality	3-37
Damper	3-37
Alarms	3-38
Proof of Flow.....	3-39
Auxiliary	3-45
Fan	3-45
Electric Reheat.....	3-46
Valve Control.....	3-47
PID Control	3-50
Occupancy Detector.....	3-60
Relative Humidity	3-60
I/O Setup	3-66
Universal Inputs (UI1, UI2 and UI3)	3-66
Analog Output (AO1)	3-72
Relay Outputs	3-75
Networking	3-80
Configuration.....	3-80
Schedule Broadcast.....	3-81

3.1 INTRODUCTION

Attributes have two-character names that are generally mnemonic, such as “CV” for current value. In addition, each point has a default attribute. Generally the most important or useful attribute is the default attribute. For example, analog input has zone temperature—read from the SBC-STAT—as its default attribute (**ZT**).

All attributes appear in boldface to facilitate locating descriptions of a particular attribute in the document text.

For a listing of each attribute along with the associated channel, see **Appendix A: PUP Channels and Attributes**.

3.2 SYSTEM

The following are System attributes:

FF00;**EM**, **SN**, **CT**, **VE**, **FT**, **SR**, **CM**, **UP**, **IC**, **RC**, **WC**, **CC**, **OC**, **ZP**, **PD**, **PS**, **BU**, **DE**, and **RS**.
FE00;**OA**, **TF**, **TE**, **RT**, and **ET**.

3.2.1 ABOUT

Attribute FF00;**EM** is Engineering Units. It specifies the type of engineering units (U.S./English or Metric) to be used for temperatures. If **EM** is set to zero, degrees are specified in Fahrenheit. If **EM** is set to 1, degrees are specified in Celsius. A change in this attribute automatically converts setpoints to the appropriate units. The display mode for digital thermostats also changes but can be set separately. English (**EM** = 0) is the default setting.

NOTE

If the value of **EM** changes, make sure any attributes set prior to the change are recalculated and reprogrammed to reflect the **EM** type chosen. Then reset the SBC-VAV. Failure to correct these entries will result in display and calculating errors.

Attribute FF00;**SN** is Serial Number. It displays the Serial Number of the SBC-VAV controller. This attribute is read-only.

Attribute FF00;**CT** is the Controller Type. This point identifies the type of device. An SBC-VAV is type 102. This attribute is read-only, and its value is established at the American Auto-Matrix factory. Flash updates for the SBC-VAV are rejected if **CT** is not 102.

Attribute FF00;**VE** is the Firmware Version. It indicates the version number of the active firmware. This attribute is read-only.

Attribute FF00;**FT** is Firmware Type. It defines the class of firmware operating system used in this controller. Only flash updates of matching firmware type will be accepted. Upgrades and conversions to other classes of firmware will require special handling. Contact American Auto-Matrix for more information. This attribute is read-only.

Attribute FF00;**SR** is the Flash Release Code. This point uniquely defines each flash firmware image. You can access updated firmware images through *SoloPro for Windows™*. The numerically higher the firmware image, the more recent it is. We recommend that all controllers be updated periodically to use the latest available firmware. For instructions see the *SoloPro for Windows User Manual*. This attribute is read-only.

Attribute FF00;**CM** is the Manufacturer of the device. For American Auto-Matrix products, the number is 255. This attribute is read-only. It is useful when host systems are connected to networks with unitary controllers from different manufacturers. Flash updates are rejected if **CM** is not 255.

3.2.1.1 STATISTICS

Attribute FE00;**OA** is Accumulated Extended Occupancy Time. This read/write point shows the total amount of time that the SBC-VAV has spent in extended occupancy (override during scheduled

unoccupied periods). You can clear this value by setting **OA** to 0.

NOTE

For successful use of the Extended Occupancy Override feature, **SE** must > 0.

Attribute FE00;**TF** is Total Accumulated Flow (cooling duct). It 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 FE08;**CV** MUST be a reliable duct temperature value. This attribute is read only. However you can set it to 0 by making **RT** = 1.

Attribute FE00;**TE** is Total Accumulated Energy. It shows the total amount of accumulated energy in BTUs or kilojoules used by the terminal box. The SBC-VAV multiplies the flow (FA00;**CA**) by the absolute value of the difference between the duct temperature and zone temperature (**ZT** - FE08;**CV**) and a constant to produce a value that reflects the amount of energy used by the zone. For correct calculation of accumulated energy, **ET** MUST be enabled and FE08;**CV** MUST be a reliable duct temperature value. The SBC-VAV calculates the value of this attribute once every minute. You can set **TE** to 0 by making **RT** = 1.

NOTE

Both **TE** and **TF** are useful for keeping track of supply air and supply air temperature, which are important in submetering applications. These attributes are backed up into EEPROM once per day (at midnight) or every time that the system backup RAM value (**BU**) is manually changed to 1.

Attribute FE00;**RT** is Reset Totals. When set to 1, this point will establish zero values in the total accumulated flow (**TF**) and total accumulated energy (**TE**) attributes. This attribute returns to 0 when reset is complete.

Attribute FE00;**ET** is Enable Totalization. This attribute, when set to 1, calculates totalized flow and totalized energy. If you enable this point, you MUST make sure that FE08;**CV** is a duct temperature value. Energy totalization is invalid in any other circumstance. Therefore unless FE08;**CV** is a reliable duct temperature sensor, **ET** should remain disabled (**ET** = 0).

3.2.2 DIAGNOSTICS

Attribute FF00;**UP** is Flash Update Count. This counter increments each time a new flash firmware image is accepted by the controller.

Attribute FF00;**IC** is EEPROM Default Count. This counter increments whenever the EEPROM is restored to factory default settings (see System attribute **DE** Default Enable).

Attribute FF00;**RC** is Power-up Count. This counter increments each time power is applied to the controller. This counts power outages and noise related resets as well as resets initiated through System attribute RS.

Attribute FF00;**WC** is Watchdog Count. This counter increments upon firmware failure but can also be advanced during the removal of power.

Attribute FF00;**CC** is Clock Fail Count. This counter increments upon hardware failure but can also be advanced during the removal of power.

Attribute FF00;**OC** is Illegal Opcode Count. This counter increments upon firmware failure but can also be advanced during the removal of power.

Attribute FF00;**ZP** is MMT Pulse Count. This counter advances when Motor Management Technology (MMT) takes action to maintain the operation of the actuator. When several counts are tallied over a period of a few days, the actuator is reaching its end of life. Low level count activity is normal.

3.2.3 POWER UP

Attribute FF00;**PD** is Power-Up Delay. It determines how long, in seconds (0–255), a SBC-VAV waits before energizing its outputs after a power loss or soft reset. During this time, all output control and alarm functions stop after cycling of power or SBC-VAV reset. This attribute defaults to a value of 5. Any setting < 2 seconds will receive a value of 2 seconds.

Attribute FF00;**PS** is Power-Up State. It determines which schedule state the SBC-VAV uses after a power loss and before its time is synchronized. The selections are as follows: unoccupied = 0, warm-up = 1, occupied = 2 and night setback = 3. The default for this attribute is 2.

NOTE

You can also set the time through the optional Real-time Clock module. Manual time setting is also possible.

Attribute FF00;**BU** is Backup RAM Values. It forces the backup of the attributes **TF** and **TE**, and the digital input attribute **OA** and digital outputs 1-5 **RH** to EEPROM. The SBC-VAV copies these values to EEPROM at midnight each day. However you may force a copy at any time by setting **BU** to 1. The attribute returns to 0 when the backup is complete. We recommend that you perform a backup any time that a maintenance power down is planned or any time that the Electric Reheat attribute **RO** changed. Attributes affected by **BU** or the automatic RAM backup feature of the SBC-VAV are as follows:

- . the run time values of Digital Output 1 **RH** through Digital Output 5 **RH**
- . the accumulated extended time attribute value Digital Input **OA**
- . the analog input total accumulated flow value of the analog input **TF** and the accumulated energy value of the Analog Input attribute **TE**
- . the staged values (which are invisible to the user) set when **RO** is modified.

Attribute FF00;**DE** is Default Enable. This attribute restores configuration settings to factory defaults. To set the defaults, enter a value of 197 (a value that is unlikely to occur randomly). It may take several

seconds to complete the reset. Note that this will not alter the unit **ID** or selected communications baud rate.

The attribute FF00;**RS** is Reset of the SBC-VAV. This point allows a host or operator to reset the controller. You can reset by giving **RS** a value of 1, after which **RS** returns to 0 (the default).

Table 3-1 System Attributes

	attr	description
System: About FF00		
	EM	Engineering Units —specifies which units of measurement to use in returning temperature values. 0 = English Units 1 = Metric Units
	SN	Serial Number —displays the serial number of the SBC-VAV controller.
	CT	Controller Type —(read-only) factory-set controller type identifies the type of unitary controller. CT for the SBC-VAV is 102.
	VE	Firmware Version —(read-only) contains the version number of the active firmware.
	FT	Firmware Type —defines the class of firmware operating system used in this controller.
	SR	Flash Release Code —(read-only) uniquely defines each flash firmware image. The numerically higher the firmware image, the more recent it is.
	CM	Manufacturer —(read-only) is the manufacturer of the device. AAM devices are 255.
System: Statistics FE00		
	OA	Accumulated Extended Occupancy —displays the amount of time the SBC-VAV has spent in extended occupancy.
	TF	Total Accumulated Flow —(read-only) is a measurement of how much air has passed through the duct since the last time TF was set to zero. TF is shown in cubic feet or liters.
	TE	Total Accumulated Energy —is the total amount of accumulated energy used by the terminal box. TE is shown in BTUs or kilojoules.
	RT	Reset Totals —when = 1, sets TF and TE to zero.

Table 3-1 System Attributes

	attr	description
	ET	Enable Flow/Energy Totalization —calculates totalized flow and totalized energy when: ET = 1 and FE08;CV = a reliable duct temperature.
System: Diagnostics FF00		
	UP	Flash Update Count —increments each time a new flash firmware image is accepted by the controller.
	IC	EEPROM Default Count —increments whenever the EEPROM is restored to factory default settings.
	RC	Power-up Count —increments each time power is applied to the controller.
	WC	Watchdog Count —increments upon firmware failure but can also be advanced during the removal of power.
	CC	Clock Fail Count —increments upon hardware failure but can also be advanced during the removal of power.
	OC	Illegal Opcode Count —increments upon firmware failure but can also be advanced during the removal of power.
	ZP	MMT Pulse Count —advances when MMT takes action to maintain the operation of the actuator. The activity on this count should be low. If it is high, the actuator is reaching the end of its life.
System: Power-up FF00		
	PD	Power-up Delay —determines how long (0-255 seconds) a SBC-VAV waits before energizing its outputs after power loss or soft reset. PD defaults to 5 seconds.
	PS	Power-up State —determines which schedule state to use after a power loss and before time sync. 0 = unoccupied 1 = warm-up 2 = occupied (default) 3 = night setback
	BU	Backup RAM Values —backs up TF , TE , the digital input attribute OA and digital outputs 1-5 RH to EEPROM each day at midnight. To copy them at any other time, set BU = 1.
	DE	Default Enable —restores configuration settings to factory defaults. Enter 197 to set the defaults.

Table 3-1 System Attributes

	attr	description
	RS	Reset the Controller? —allows a host or operator to reset the controller by setting RS = 1.

3.3 SCHEDULES

The following are Schedule attributes:

F900; **TM, DT, H0-H9, DA, DH, CV, C1-C6, AS, HE, HO, ZE, and IS.**

F90x; **CV, WO, OC, UN, NS, AD, and AO.**

The SBC-VAV has one Main Schedule that reflects the values of and has an effect on how the other six schedules operate. The Main Schedule does not directly act as a schedule, but its current value is the present scheduled operating mode. This schedule provides attributes used to set the warm up options, the method of control employed when the SBC-VAV is in an inactive schedule state, zone reception of schedule information over the RS-485 PUP network and host schedule control options. There are four active schedule states available on the SBC-VAV:

- . warm-up mode (main schedule **CV** = 1)
- . occupied mode (main schedule **CV** = 2)
- . unoccupied mode (main schedule **CV** = 0)
- . night setback mode (main schedule **CV** = 3).

Warm-up is the period of time before occupancy. During this period, the central air handler unit supplies warm air to the VAV boxes. Warm-up provides special control action to bring the zone temperature to its desired setpoint for the occupied mode, based on the heating setpoint. The attributes used to define the warm-up temperature and flow appear in the analog inputs and damper control. Individual schedules (Schedule 1 through Schedule 6) dictate time controlled warm-up. In time based warm-up, the warm-up period ends when occupied mode begins.

Occupied mode is the period of time when the zone is occupied by people and the SBC-VAV must maintain appropriate comfort levels in the zone. The heating and cooling setpoints define a desired zone temperature range. Occupied mode ends when unoccupied mode time begins.

Unoccupied mode is the period of time when people are not expected to be in the zone and temperature control is not as strict. During unoccupied mode, the SBC-VAV maintains cooling comfort levels at setup values and heating comfort levels at setback values. These setup and setback values are used to broaden the control range between the heating and cooling setpoints in order to provide less stringent control. The attributes used to define the offsets are located in the analog inputs, but the time of implementation is set in the individual schedules (Schedule 1 through Schedule 6). Unoccupied mode usually ends when night setback begins.

Night setback is the period of time during unoccupied mode when the entire building is usually unoccupied and the air handler may be shut down. The controller provides the option to set up and set back the night setback control temperature (as does the standard unoccupied mode) and to determine when these offsets are reached or have exceeded damper control of air flow resumes. As with unoccupied mode, the attributes used to define the night setback offsets are located in the analog inputs. However the time of implementation is set in the individual schedules (Schedule 1 through Schedule 6). Figure 3-1 illustrates a standard time based flow of the SBC-VAV schedule control modes.

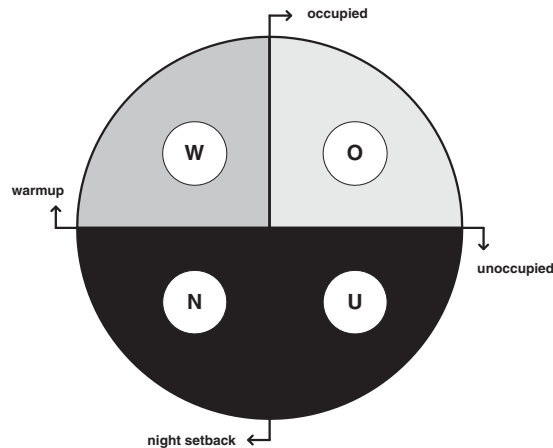


Figure 3-1: Standard Schedule Modes Rotation Example

In a situation in which schedules may overlap, the SBC-VAV will set priorities. The controller checks from Schedule 1 through Schedule 6 for the schedule with the highest priority mode. Modes take precedence in the following order:

- . occupied (highest priority)
- . warm-up
- . unoccupied
- . night setback (lowest priority).

3.3.1 CLOCK/CALENDAR

The schedules within the SBC-VAV are local. These schedules operate when the time (schedule attribute **TM** in HH:MM format) and day of the week (schedule attribute **DA**) have been synchronized by a PUP device communicating over the RS-485 network with synchronization capability.

NOTE

You can also set the time through the optional Real-time Clock module. Manual time setting is also possible.

Attribute F900;**TM** is the System Time attribute. It is a read-write attribute that displays the current system time in HH:MM format. This attribute defaults to an invalid time and must be set for the current system time.

Attribute F900;**DT** is the Current Date. This attribute specifies the current date in MM/DD/YY format.

Attribute F900;**DA** is the day-of-the-week attribute. It displays a read-write, numeric code (0–6) that corresponds to the current day of the week. The attribute defaults to an invalid code number. Codes for **DA** appear in Table 3-2.

Table 3-2: Day of the Week Codes

Value of DA	Day of the Week
0	Monday
1	Tuesday
2	Wednesda y
3	Thursday
4	Friday
5	Saturday
6	Sunday
7	Holiday

Attribute F900;**DH** is Holiday. It toggles the holiday status for the current day. This point is overridden by time synchronization.

Attribute F900;**H0-H9** is Programmed Holiday. This is a specified date to be considered a holiday. Set the date to 0/0/YY to ignore.

3.3.2 SUMMARY

Attribute F900;**CV** is Schedule Status. It displays the current schedule state of the SBC-VAV. The controller follows a series of prioritized steps to determine the state that **CV** is in at any given time. This attribute may be affected by Schedule 1 **CV**–Schedule 6 **CV**, the host override (schedule attribute **HE**, schedule attribute **HO**), the thermostat extended occupancy and the occupancy detector. The SBC-VAV repeatedly checks to establish which is valid. Figure 3-2 shows the order of priority that the SBC-VAV checks to determine **CV**. This attribute is a read-only value. The options for this attribute are as follows: unoccupied (third priority) = 0, warm-up (second priority) = 1, occupied (first priority) = 2, and night setback (lowest priority) = 3.

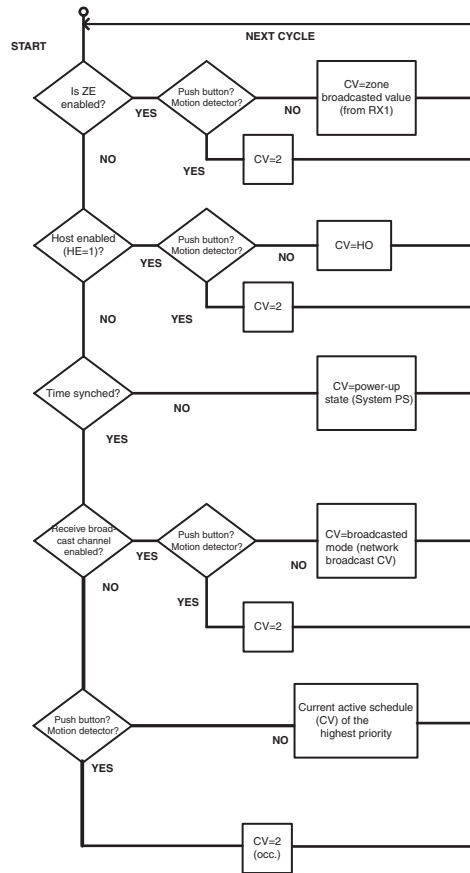


Figure 3-2: SBC-VAV Priority to Determine the State of CV

Attributes F900;C1 through F900;C6 are the current value schedule attributes. These six points are read-only attributes that reflect the actual schedule's current mode of operation in which 0 = unoccupied, 1 = warm-up, 2 = occupied, and 3 = night setback.

Attribute F900;AS is the active schedule bitmap. It is a read-only attribute that displays the currently active schedules in bitmap form. When the bit corresponding to a particular schedule is set to 1, that schedule is active for the day; if the bit is set to 0, the schedule is not active. Table 3-3 shows the correlation of each bit in the bitmap to the individual schedules.

Table 3-3: Active Schedule Map

Bit Number	Schedule
0	Schedule 1
1	Schedule 2
2	Schedule 3

Table 3-3: Active Schedule Map

Bit Number	Schedule
3	Schedule 4
4	Schedule 5
5	Schedule 6

Attribute F900;**HE** is the host override enable. If **HE** = 1, then **HO** is used as the host override state. When **HE** = 0, the scheduled state is controlled by **WO**, **OC**, **UN** and **NS** or schedule broadcast. The SBC-VAV and its schedules are ignored provided **ZE** = 0 (disabled).

Attribute F900;**HO** is the host override. It specifies the desired schedule override state when schedule attribute **HE** = 1. If **HE** = 0, then **HO** is not used. Setting **HO** to 0 represents unoccupied mode, **HO** = 1 represents warm-up, **HO** = 2 represents occupied mode and **HO** = 3 represents night setback.

Attribute F900;**ZE** is the zone schedule enable. It sets the current schedule mode for the entire zone from an area controller that is broadcasting zone schedule information to multiple SBC-VAVs in the zone. When enabled (**ZE** = 1), this attribute gives priority to schedule information received from the PUP network over **HO** and the local schedules; **CV** will reflect the value broadcast over the network. Setting **ZE** = 0 (the default) disables this feature.

Attribute F900;**IS** is the Inactive Schedule State. It determines which schedule state the SBC-VAV should follow when **AD** is 0 (no active days). Valid schedule choices are unoccupied (**IS** = 0), warm-up (**IS** = 1), occupied (**IS** = 2), and night setback (**IS** = 3). This attribute defines the **CV** value to use when local scheduling is being used (the time is properly synchronized) but is inactive.

3.3.3 SCHEDULES 1 THROUGH 6

Attribute F90x;**CV** is the Current Schedule Value. It shows the current schedule state.

Attribute F90x;**WO** is Warm-Up On Time. It specifies the time (in HH:MM format) to begin the warm-up period.

Attribute F90x;**OC** is Occupied Time. It specifies the time (in HH:MM format) to begin the occupied period and end the warm-up period.

Attribute F90x;**UN** is Unoccupied Time. It specifies the time (in HH:MM format) to begin the unoccupied period and end the occupied period.

Attribute F90x;**NS** is Night Setback Time. It specifies the time (in HH:MM format) to begin the night setback period and end the unoccupied period.

Attribute F90x;**AD** is Active Days. It shows the active days of the week during which the schedule is to follow the times in **WO**, **OC**, **UN** and **NS**. Valid day bit numbers are 0=Monday, 1=Tuesday, 2=Wednesday, 3=Thursday, 4=Friday, 5=Saturday, 6=Sunday and 7=Holiday. You can select active days by setting the corresponding bits to 1.

Attribute F90x;**AO** is All-Day Override. It overrides the schedule in **WO**, **OC**, **UN** and **NS** for active days. Settings are as follows: 0 = No Override, 1 = Unoccupied, 2 = Warm-Up, 3 = Occupied and 4 = Night Setback.

Control loops of the SBC-VAV may be configured to use the current schedule state of selected schedules to adjust setpoints or control parameters. In occupied mode, for example, a setpoint value is used to determine when a certain control action occurs. In unoccupied mode, a setup (or setback) amount is added to (or subtracted from, depending on its sign) the control loop setpoint—altering the point at which the control action occurs. In unoccupied mode, the control action is less stringent because fewer (if any) people are in the building.

Schedules in the SBC-VAV can be activated based on the values assigned to the Schedule attributes. When the current day of the week matches the setting of the Schedule attribute active days (**AD**), that schedule is active for the day.

The schedule mode attributes define four windows for a schedule that is active for a set of days in the week. When the current day of the week matches one of the active schedule days (specified in **AD**), the time of day determines which of the four available modes will dictate control strategy.

The active days for the schedule are designated by the **AD** attribute. It specifies a set of the eight possible days in the week (seven days plus holiday) during which the schedule will run in one of the four available modes at any given time of the active day. See Figure 3-3 for examples of how **AD**, **WO**, **OC**, **UN** and **NS** work. Holiday schedules refer to the host system that defines the holidays in each month of the year. If the SBC-VAV has bit 7 set for a currently active schedule, then the controller will follow that schedule when the holiday bit is sent from the host. If the host broadcasts a holiday and the SBC-VAV does not have a holiday schedule, then no schedules will be active until the host clears the holiday. All schedules are independent of each other. One or more schedules may be active when the rest are inactive.

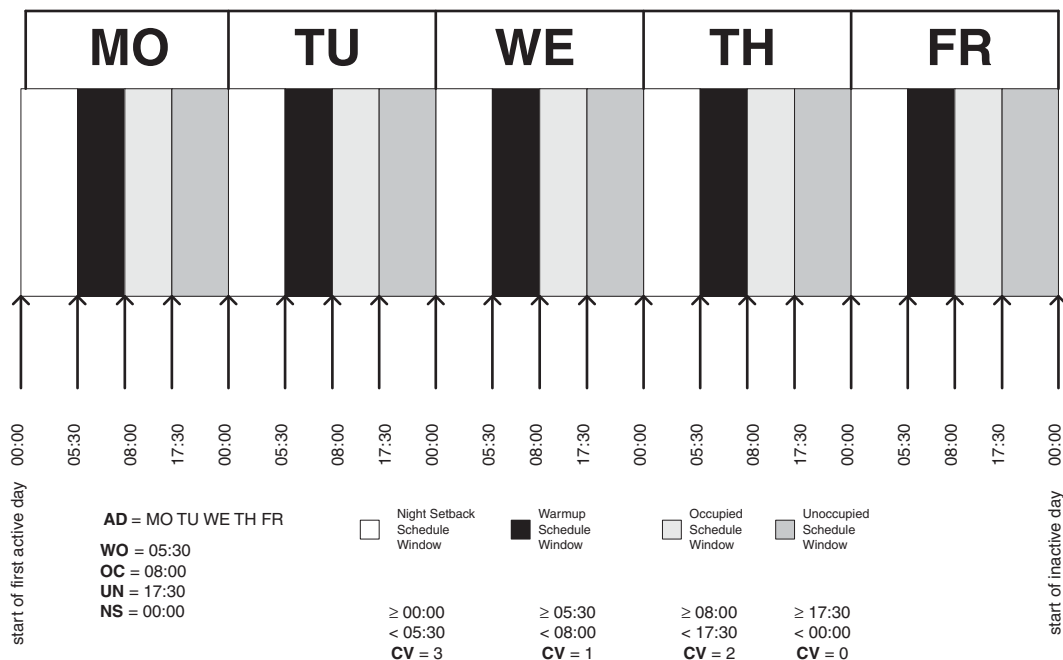


Figure 3-3: Sample Schedule 1

Table 3-4 Schedule Attributes

	attr	description
Schedules : Summary F900		
	CV	Schedule Status —displays the schedule state of the SBC-VAV. The order of priority is: Occupied = 2 Warm-up = 1 Unoccupied = 0 Night Setback = 3
	C1 - C6	Schedules 1-6 —(read-only) reflect the active schedule's current mode of operation.
	AS	Active Schedule —(read-only) displays, in bitmap form, which schedule is active. 0 = Schedule 1 1 = Schedule 2 2 = Schedule 3 3 = Schedule 4 4 = Schedule 5 5 = Schedule 6
	HE	Host Override Enable —when enabled (HE = 1), HE allows the host to set CV through HO . When disabled (HE = 0), the schedule state is controlled by the local schedule or schedule broadcast.
	HO	Host Override —specifies the desired schedule override state when HE = 1.
	ZE	Zone Schedule enable —sets the current schedule mode for the entire zone from an area controller to multiple SBC-VAVs in the zone. When ZE = 1, priority is given to schedule information received from the PUP network over HO and the local schedules. When ZE = 0, this feature is disabled.
	IS	Inactive Schedule State —determines which schedule state the SBC-VAV should follow when AD (active days) is 0.
Schedules : Clock/ Calendar F900		
	TM	System Time —displays the system time in HH:MM format.
	DT	Current Date —specifies the current date in MM/DD/YY format.

Table 3-4 Schedule Attributes

	attr	description
	DA	Day —displays a code corresponding to the current day of the week. 0 = Monday 1 = Tuesday 2 = Wednesday 3 = Thursday 4 = Friday 5 = Saturday 6 = Sunday 7 = Holiday
	DH	Holiday —toggles the holiday status for the current day. Time Synchronization overrides this point.
	H0 - H9	Programmed Holiday —a specified date to be considered a holiday. Set the date to 0/0/YY to ignore.
Schedules : (1-6) F90x		
	CV	Current Value —shows the current schedule state.
	W O	Warm-up Time —specifies the time to begin warm-up period.
	OC	Occupied Time —specifies the time to begin occupied period and end warm-up period.
	UN	Unoccupied Time —specifies the time to begin unoccupied period and end occupied period.
	NS	Night Setback Time —specifies the time to begin night setback period and end unoccupied period.
	AD	Active Days —shows the days of the week during which the schedule is to follow WO , OC , UN , and NS .
	AO	All-day Override —overrides the schedules in WO , OC , UN , and NS . 0 = No Override 1 = Unoccupied 2 = Warm-up 3 = Occupied 4 = Night Setback

3.4 TEMPERATURE (ANALOG INPUTS)

The following are Temperature attributes:

FE00;**ZT, OF, DM, DL, BT, OI, ZS, TS, TM, TP, TT, TR, SD, SE, ED, ER, CC, SC, UC, NC, CH, SH, UH, NH, SW, CV, LL, HL, HS, AS, AE, SU, BM, PU, PB, PS, PI, DS, DV, DF, T0-T3, G0-G3, RM, and PG.**
FE08;**CV, OF, RE, DD, SM, and OI.**

3.4.1 THERMOSTAT

Attribute FE00;**ZT** is Zone Temperature. It shows the current temperature value measured by the thermostat as adjusted by **OF**. This point is a read/write attribute stored in RAM. The data type of **ZT** (how the value is displayed) is always FDh (signed 9.1 digits). By setting **OI** to 1, you can override **ZT**. After overriding the attribute, you can write to **ZT** manually or through a program from a host controller on the EIA-485 communications network.

CAUTION

Care must be taken to ensure that terminal box operations are not adversely affected during use of the SBC-VAV's powerful receive broadcast features. Selection of the correct input is a must. Unitary controller programmers should be absolutely sure that the actions chosen in the system are exactly what is needed for optimal operation of the SBC-VAV.

Attribute FE00;**OF** is Temperature Correction. It defines an optional correction that may be required as an adjustment for the thermostat location and the possible measurement errors.

Attribute FE00;**DM** is Zone Demand. It indicates the demand for the zone. A satisfied zone will indicate "vent." If the SBC-VAV is in cooling mode and the zone temperature exceeds the cooling setpoint, "cool" is indicated. If the controller is in heating mode and the zone temperature falls below the heating setpoint, "heat" is indicated.

Attribute FE00;**DL** is Demand Load. It indicates the heating/cooling demand for the zone in terms of temperature separation from setpoints. A cooling demand will be indicated by a negative value and a heating demand by a positive value. If the zone is satisfied, then the Demand Load will be 0. A cooling box is satisfied whenever the zone temperature is lower than the setpoint. If the setpoint is 72 and zone temperature is 74, then the demand load will be -2. A heating box is satisfied whenever the zone temperature is greater than the setpoint. If the setpoint is 68 and the zone temperature is 72, then the demand load will be 0. If the setpoint is 68 and the zone temperature is 66, then the demand load will be 2.

Attribute FE00;**BT** is VAV Control Mode. Control Modes are none (**BT** = 0), cooling only (**BT** = 1), heating only (**BT** = 2), supply dependant (**BT** = 3) and cooling with reheat (**BT** = 4). The "disabled" setting supplies a constant air volume. The supply dependant setting requires source/duct air temperature and automatically selects cooling and heating modes as required.

Attribute FE00;**OI** is Override Temperature Value. When set to 1, it allows you to write to the Zone Temperature (**ZT**) directly. This would allow the Zone Temperature to be defined remotely when you are using alternate temperature sensors or diagnostics.

3.4.2 SETPOINT ADJUST

Attribute FE00;**ZS** is Zone Midpoint. It displays the midpoint between the current cooling and heating setpoints. This attribute 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.

Attribute FE00;**TS** is User Setpoint Offset. It 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.

NOTE

You cannot set attribute **TS** with the SBC-STAT1.

Attribute FE00;**TM** is User Adjust Increment. It 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.

Attribute FE00;**TP** is User Adjust Position. The User Setpoint Offset (**TS**) can be raised or lowered in integral steps. This attribute 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.

Attribute FE00;**TT** is User Adjust Duration. The User Setpoint Offset (**TS**) is a temporary setting. The **TT** attribute 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.

Attribute FE00;**TR** is User Adjust Remaining. It displays the time remaining before the User Setpoint Offset (**TS**) setting is reset.

Attribute FE00;**SD** is Calculated Setpoint Display. It specifies what method is used to display setpoint adjustments on an SBC-STAT3 LCD screen. A value of 0 will display +/-2.5 adjustment. A value of 1 will display the zone midpoint shown in FE00;**ZS**. A value of 2 will display the heating setpoint shown in FE00;**CH**. A value of 3 will display the cooling setpoint shown in FE00;**CC**.

3.4.3 OVERRIDE

During scheduled unoccupied periods, control loop setpoints and analog input alarm limits may be set up or set back to create a wider control range or deadband in the interest of conserving energy. The occupancy override feature of the SBC-VAV allows the control loop setpoints and analog input alarm limits to use their normal, nonsetup, nonsetback, occupied mode values through the SBC-STAT override feature. For more information, see the *SBC-STAT User Manual*.

During a scheduled unoccupied mode, you can manually override the scheduled state to occupied mode through the SBC-STAT; the setpoints are no longer set up or set back. The Override feature puts the selected schedules into a temporary occupied mode.

Attribute FE00;**SE** is User Override. This attribute enables or disables the user's ability to enter extended occupancy override.

Attribute FE00;**ED** is Extended Occupancy Duration. It specifies the amount of time in minutes to extend occupancy.

Attribute FE00;**ER** is Extended Occupancy Remaining. It 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. The point **ER** is a read-only attribute that cannot be changed directly.

NOTE

Attributes **ED** and **ER** will override the power-up default schedule mode.

3.4.4 COOLING SETPOINTS

Attribute FE00;**CC** is Current Setpoint. It shows the current cooling temperature control setpoint. This will depend on setbacks and user adjustments. The attribute is read-only and is derived from **SC**. It incorporates **TS** and any unoccupied mode setback (**UC**) or any night setback (**NC**) that may be in effect.

Attribute FE00;**SC** is Occupied Setpoint. It shows the desired zone temperature setpoint to be used for cooling control in occupied mode. This value is used in **CC** and defaults to 72.0°F.

Attribute **UC** is Unoccupied Setback. It specifies, in +/- degrees, the amount to be added to the cooling setpoint (**SC**) when the SBC-VAV schedule is in unoccupied mode. When the SBC-VAV is in an unoccupied state, the **UC** offset is added to **SC**, resulting in **CC**. This is the value used to control the cooling loop. When the SBC-STAT is enabled (**SE** > 0), the values of **TM** (thermostatic multiplier) and **TP** result in **TS**. This is added with **UC** and **SC** during unoccupied periods, resulting in **CC**. See Figure 3-4. User-definable **UC** defaults to 5.0.

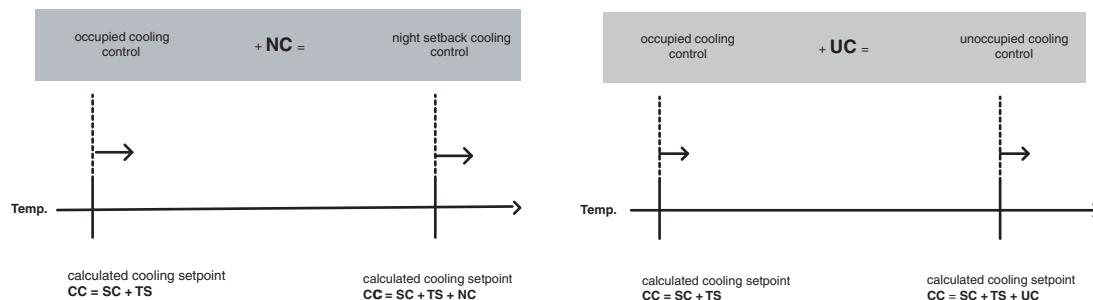


Figure 3-4: Effect of **NC** and **UC** on Cooling Control Using an SBC-STAT

Attribute FE00;**NC** is Night SetBack. It specifies, in +/- degrees, the amount to be added to the cooling setpoint (**SC**) when the SBC-VAV is in night setback mode. User definable **NC** defaults to 5.0. See Figure 3-4.

3.4.5 HEATING SETPOINTS

Attribute FE00;CH is Current Setpoint. It shows the current heating temperature control setpoint. This will depend on setbacks and user adjustments. The point is read-only and is derived from SH. It incorporates TS and any Unoccupied Setback (UH) or any night setback (NH) that may be in effect.

Attribute SH is Heating Setpoint. It shows the desired zone temperature setpoint to be used for heating control.

Attribute FE00;UH is Unoccupied Setback. It specifies, in +/- degrees, the amount to be added to the heating setpoint (SH) when the SBC-VAV schedule is in unoccupied mode. This attribute defaults to 10.0.

Attribute FE00;NH is Night SetBack. It specifies, in +/- degrees, the amount to be added to the heating setpoint (SH) when the SBC-VAV is in night setback mode. This attribute defaults to 10.0. Figure 3-6 shows the effect of UH and NH on SBC-VAV control operations in a scheduled night setback mode.

Attributes FE00;SC and FE00;SH are the cooling and heating setpoint attributes. They create a temperature range within which no cooling or heating is required (though minimum flow position is enforced). This range is called the deadband. By pressing the up and down push buttons on the SBC-STAT3 and SBC-STAT2, you can shift the deadband to a range higher or lower than the range set by SH and SC. The result is a new range defined by CH and CC. When TS = 0, the deadband is defined by the setpoint attributes SH and SC—for example, between 68°F and 72°F (4 degrees). However if you press the up push button on the SBC-STAT3 or SBC-STAT2 to raise the temperature 4 degrees (TS = 4), then the deadband still has the range—4 degrees. The control setpoints will then change to 72°F and 76°F. See Figure 3-5.

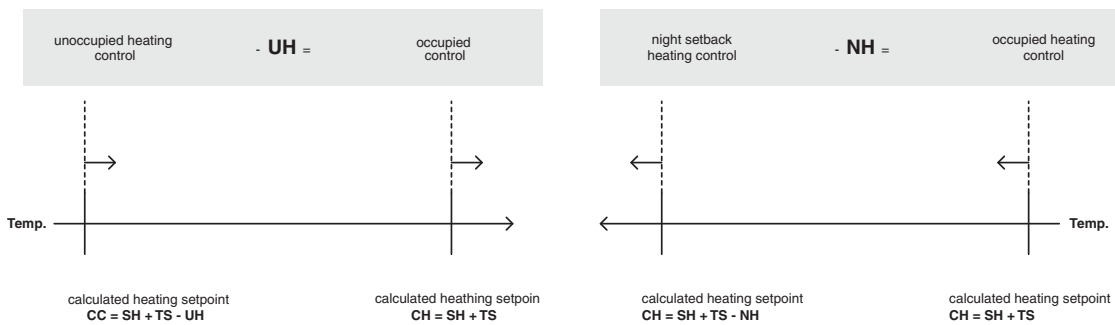


Figure 3-5: The Effect of UH and NH on Cooling and Heating Setpoints

Table 3-5: CC and HC Formulas for Use With the SBC-STAT2 or STAT3

Schedule Mode	Formula
OCCUPIED	CC = SC + (TS)
	CH = SH + (TS)
UNOCCUPIED	CC = SC + (TS) + UC
	CH = SH + (TS) - UH

Table 3-5: CC and HC Formulas for Use With the SBC-STAT2 or STAT3

Schedule Mode	Formula
NIGHT SETBACK	$CC = SC + (TS) + NC$ $CH = SH + (TS) - NH$

When an SBC-STAT1 is used with the SBC-VAV, **CC** and **CH** are calculated as in Table 3-6.

Table 3-6: **CC** and **HC** Formulas for Use With an SBC-STAT1

Schedule Mode	Formula
OCCUPIED	$CC = SC$ $CH = SH$
UNOCCUPIED	$CC = SC + UC$ $CH = SH - UH$
NIGHT SETBACK	$CC = SC + NC$ $CH = SH - NH$

Attributes FE00;**CC** and FE00;**CH** equal the temperature setpoints **SC** and **SH**, respectively. The **CC** and **CH** points include a plus or minus offset in the calculation to account for setup and setback when the SBC-VAV is in a scheduled unoccupied or night setback mode of operation. You can use the formulas in Table 3-5 to calculate **CC** and **CH** when **SE** > 0. The value of **TS** will be a positive or a negative integer based on the value of **TP**.

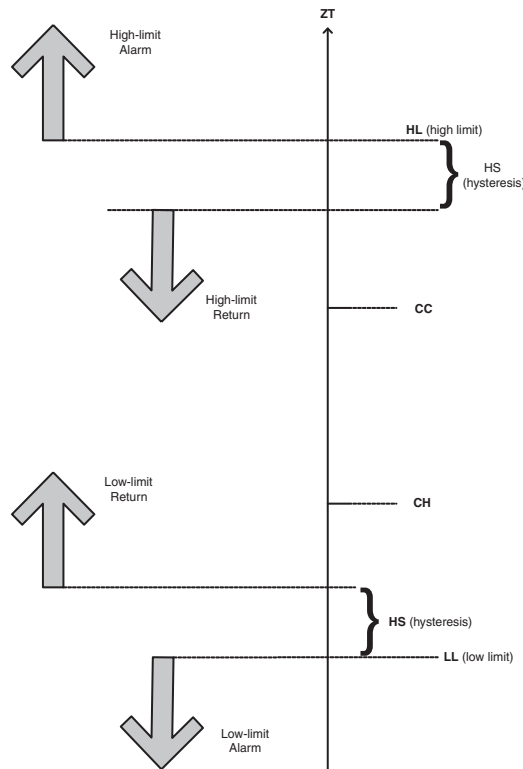


Figure 3-6: Effect of **UH** and **NH** on Control With an SBC-STAT

Attribute FE00;**SW** is Warm-Up Setpoint. It shows the zone temperature setpoint to be used for heating control.

3.4.6 ALARMS

Attribute FE00;**CV** is Current Value. It shows the current value of the input. As a dedicated zone temperature input, the data type is locked in as FDh (a signed 9.1 digit read out) PUP data type.

Attribute FE00;**LL** is Low Alarm Limit. It specifies the low alarm limit. If alarms are enabled and the current value drops below this value, a low limit alarm will be generated.

Attribute FE00;**HL** is High Alarm Limit. It specifies the high alarm limit. If alarms are enabled and the current value rises above this value, a high limit alarm will be generated.

Analog input alarming limits are defined using **HL** and **LL**. These limits create the upper and lower temperature limits acceptable as zone temperature values to tenths of a degree. The attributes **HL** and **LL** are only used when the input is configured for alarming. (See **AE**.) The setup/setback offset attribute **SU** affects **HL** and **LL**. When **SU** is set for some value, **HL** and **LL** will effectively slide by the amount of **SU** toward the positive side for **HL** and toward the negative side for **LL** when the SBC-VAV goes into unoccupied or night setback schedule modes. Refer to Figure 3-7 and Figure 3-8.

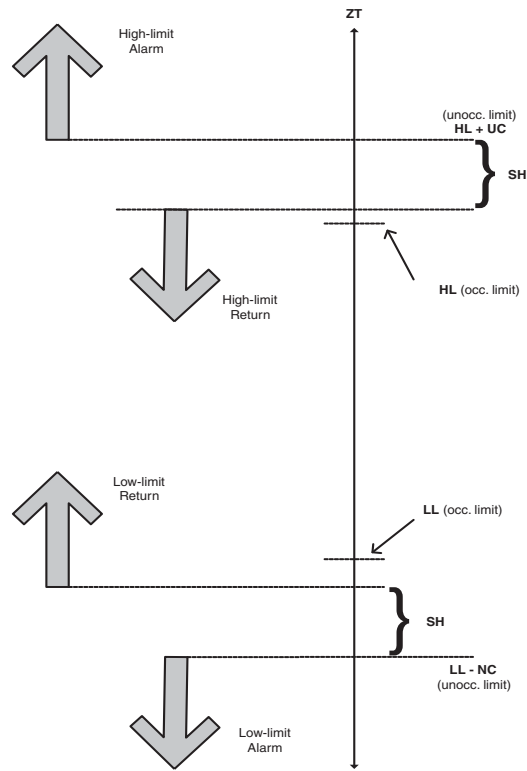


Figure 3-7: Input Alarming for ZT

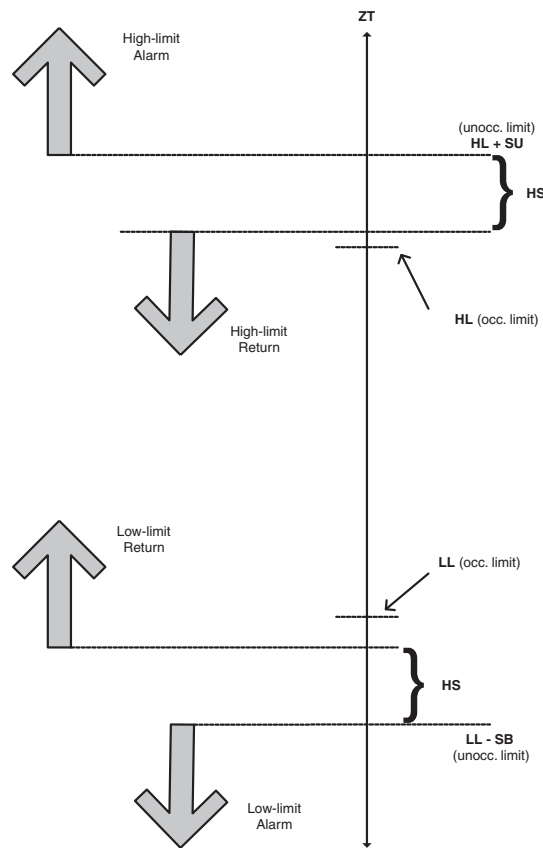


Figure 3-8: Unoccupied Shifting of Alarm Points Due to Setup/Setback

Attribute FE00;**HS** is Alarm Limit Hysteresis. It determines when the SBC-VAV returns from a high or low limit alarm. In the case of a high limit alarm, the **CV** value must drop below **HL – HS** to cause a high limit return. For a low limit alarm, the **CV** value must rise above **LL + HS** to cause a low limit return.

Attribute FE00;**AS** is Alarm Status. It shows the current alarm condition. A value of 0 indicates a normal condition; a nonzero number indicates alarm generation. Table 3-7 explains the status for each value.

Table 3-7: AS Values for Alarm Status

Value of AS	Alarm Condition
AS = 0	normal (no alarm)
AS = 5	low limit alarm
AS = 6	high limit alarm

Attribute FE00;**AE** is Enable Alarming. It specifies the type of alarm checking to be done on the **CV** value. A value of 0 indicates that alarming is disabled; a nonzero number indicates one of several alarm functions. Table 3-8 defines alarm options for **AE**.

To demonstrate how limit alarming operates, let **HL** = 80.5° while alarming is enabled for high limit alarming (**AE** = 5). Then let's say that the zone temperature changes from 72.0° to 83.0° because someone opened an outside door in summertime. A high limit alarm is generated over the EIA-485 network because 83.0° > **HL**. This also causes the alarm status attribute **AS** to equal 6 (high limit alarm). The SBC-VAV modulates the damper, providing more cool air to the zone. This action eventually begins to lower the zone temperature. Once the zone temperature drops below **HL** and the offset defined by **HS**, the alarm state returns to normal (**AS** = 0).

Table 3-8: **AE** Alarm Enable Options

Value of AE	Alarm Type Enabled
AE = 0	disabled
AE = 4	low limit alarm
AE = 5	high limit alarm
AE = 6	low and high limit

Attribute FE00;**SU** is Amount to Setup/Setback Alarm Limit. It specifies the amount added to **HL** or subtracted from **LL** during unoccupied periods. This attribute effectively shifts the points at which alarms and alarm returns are generated. Figure 3-8 illustrates the effects of setup/setback during unoccupied and night setback modes. (Note that **HS** shifts with the new limits.)

3.4.7 SUPPLY

Attribute FE08;**CV** is Supply Temperature. It shows the current value of source/duct temperature. This is used to select heating or cooling modes when **BT** is set to supply dependant provided that U11 is equipped with a thermistor. This value includes the **OF** offset adjustment.

Attribute FE08;**OF** is Supply Temperature Adjustment. It defines an offset used to adjust **CV**.

Attribute FE08;**RE** is Channel Reliability. This indicates whether or not the Supply/Duct Temperature value can be trusted.

Attribute FE08;**DD** is Auto Mode Deadband. This defines the temperature difference by which the supply air must either exceed the **CH** heating setpoint for a switch to heating mode or must fall below the **CC** cooling setpoint to engage cooling mode.

NOTE

Attribute **DD** is for use when **BT** is in supply dependant mode.

Attribute FE08;**SM** is Supply Mode. It indicates the current supply mode. This would be either Cooling or Heating as specified 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. The mode is cooling only if $ST < ZT - DD$ and $ST < CC - DD$. The mode is heating only if $ST > ZT + DD$ and $ST > CH + DD$.

Attribute FE08;**OI** is Override Supply Temperature. When set to 1, this allows the Supply Temperature (**CV**) to be altered manually.

3.4.8 SENSOR BUS

Attribute FE00;**BM** is 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**). Masters control and communicate with digital thermostats. Slaves receive their information from the Master. Slaves receive information from the following master Zone Temperature attributes: Zone Temperature (**ZT**), User Setpoint Offset (**TS**), User Adjust Remaining (**TR**) and Extended Occupancy Remaining (**ER**).

Attribute FE00;**PU** is User P.I.N. 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 a short time after their use.

Attribute FE00;**PB** is Balancer P.I.N. 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 a short time after their use.

Attribute FE00;**PS** is Service P.I.N. 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 a short time after their use.

Attribute FE00;**PI** is Installer P.I.N. This Personal Identification Number controls access to all menus. A value of 0 makes all of the menus 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.

Attribute FE00;**DS** is Display Mode. It 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 attribute is set but may be modified later if required to display the alternate units.

Attribute FE00;**DV** is 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).

Attribute FE00;**DF** is Display Format. This attribute 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.

Attribute FE00;**T0** is Reading Device 0. Up to 4 digital thermostats may be used on a single Sensor Bus. This attribute reflects the raw (without offset) reading for Device 0.

Attribute FE00;**T1** is Reading Device 1. Up to 4 digital thermostats may be used on a single Sensor Bus. This attribute reflects the raw (without offset) reading for Device 1.

Attribute FE00;**T2** is Reading Device 2. Up to 4 digital thermostats may be used on a single Sensor Bus. This attribute reflects the raw (without offset) reading for Device 2.

Attribute FE00;**T3** is Reading Device 3. Up to 4 digital thermostats may be used on a single Sensor Bus. This attribute reflects the raw (without offset) reading for Device 3.

Attribute FE00;**G0** is GID Device 0. The Global Identification for the Sensor Bus device.

Attribute FE00;**G1** is GID Device 1 The Global Identification for the Sensor Bus device.

Attribute FE00;**G2** is GID Device 2. The Global Identification for the Sensor Bus device.

Attribute FE00;**G3** is GID Device 3. The Global Identification for the Sensor Bus device.

Attribute FE00;**RM** is Reading Mode. It specifies the technique used to determine Zone Temperature when multiple thermostats are present. The default is Average mode (**RM** = 0). Highest (**RM** = 1) and Lowest (**RM** = 2) modes set **ZT** appropriately. The Hi/Lo VST mode (**RM** = 3) selects either the highest or lowest temperature depending on the supply mode. The highest temperature is used in cooling mode. The lowest temperature in heating mode.

A specific thermostat may be selected by device position 0-3 (**RM** = 4-7). Note that while thermostats appear in device positions consistently, the order may change when thermostats are added, removed or replaced. To specify a unique thermostat by its GID, select the Primary GID mode (**RM** = 8) and define the GID with the **PG** attribute.

When a single thermostat is present, its temperature is used regardless of the setting of **RM**. If a specified thermostat is absent, the Average mode (**RM** = 0) is used.

Attribute FE00;**PG** is Primary GID. It 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.

Table 3-9 Temperature Attributes

	attr	description
Temperature: Thermostat FE00		
	ZT	Zone Temperature —is the current temperature value measured by the thermostat as adjusted by OF . You can override ZT by setting OI = 1.
	OF	Temperature Correction —defines an optional correction that may be required as an adjustment for the thermostat location and the possible measurement errors.
	DM	Zone Demand —indicates the demand for the zone. The options are vent, cool or heat.

Table 3-9 Temperature Attributes

	attr	description
	DL	Demand Load —indicates the heating/cooling demand for the zone in terms of temperature separation from setpoints. Cooling = negative value Heating = positive value
	BT	VAV Control Mode —specifies the type of VAV terminal box being used.
	OI	Override Temperature Value —when set to 1, it allows you to write to FE00;ZT directly.
Temperature: Setpoint Adjust FE00		
	ZS	Zone Midpoint—displays the midpoint between the current cooling and heating setpoints.
	TS	User Setpoint Offset—defines an offset to be applied to PID setpoints.
	TM	User Adjust Increment—specifies the magnitude of incremental changes to the User Setpoint Offset (FE00;TS).
	TP	User Adjust Position—the User Setpoint Offset (TS) can be raised or lowered in integral steps; the FE00;TP attribute tracks the current step.
	TT	User Adjust Duration—the User Setpoint Offset (TS) is a temporary setting; the FE00;TT attribute defines in minutes the duration for which the setting applies.
	TR	User Adjust Remaining—displays the time remaining before the User Setpoint Offset (TS) setting is reset.
	SD	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 (FE00;ZS) 2 = Heating Setpoint (FE00;CH) 3 = Cooling Setpoint (FE00;CC)
Temperature: Override FE00		
	SE	User Override—enables or disables your ability to enter extended occupancy override.
	ED	Extended Occupancy Duration—specifies the amount of time in minutes to extend occupancy.
	ER	Extended Occupancy Remaining—shows the amount of time remaining in extended occupancy.

Table 3-9 Temperature Attributes

	attr	description
Temperature: Cooling Setpoints FE00		
	CC	Current Setpoint—shows the current cooling flow control setpoint.
	SC	Occupied Setpoint—shows the zone temperature setpoint desired to begin cooling control.
	UC	Unoccupied Setback—specifies, +/- degrees, the amount to be added to the cooling setpoint (SC) when the SBC-VAV schedule is in unoccupied mode.
	NC	Night Setback—specifies, in +/- degrees, the amount to be added to the cooling setpoint (SC) when the SBC-VAV is in night setback mode.
Temperature: Cooling Setpoints FE00		
	CH	Current Setpoint—shows the current heating flow control setpoint.
	SH	Occupied Setpoint—shows the zone temperature setpoint desired to begin heating control.
	UH	Unoccupied Setback—specifies, in +/- degrees, the amount to be added to the heating setpoint (SH) when the SBC-VAV is in night setback mode.
	NH	Night Setback—specifies, in +/- degrees, the amount to be added to the heating setpoint (HS) when the SBC-VAV is in night setback mode.
	SW	Warm-up Setpoint—shows the zone temperature setpoint desired for beginning warm-up heating control.
Temperature: Alarms FE00		
	CV	Current Value—shows the current value of the input.
	LL	Low Alarm Limit—if alarms are enabled and the current value drops below this value, a low limit alarm will be generated.
	HL	High Alarm Limit—if alarms are enabled and the current value rises above this value, a high limit alarm will be generated.
	HS	Alarm Limit Hysteresis—determines when the SBC-VAV returns from a high or low limit alarm.

Table 3-9 Temperature Attributes

	attr	description
	AS	Alarm Status—shows the current alarm condition. 0=normal 5=low limit 6=high limit
	AE	Alarm Enable—specifies the type of alarm checking to be done on the CV value. 0=disabled 4=low limit alarm 5=high limit alarm 6=low and high limit
	SU	Alarm Limit Setup/Setback—specifies the amount added to HL or subtracted from LL during unoccupied periods.
Temperature: Supply FE08		
	CV	Supply Temperature—shows the current value of source/duct temperature
	OF	Supply Temperature Adjustment—defines an offset used to adjust ST.
	AE	Channel Reliability—indicates whether or not the Supply/Duct Temperature value can be trusted.
	DD	Auto Mode Deadband—defines the temperature difference by which the supply air must either exceed the FE00;HC heating setpoint to switch to heating mode or fall below the FE00;CC cooling setpoint to engage cooling mode.
	SM	Supply Mode—indicates that supply air is usable for heating or cooling.
	OI	Override Supply Temperature—when set to 1, this attribute allows the Supply Temperature (ST) to be altered manually.
Temperature: Cooling Setpoints FE00		
	BM	Bus Mode—should be set to Master (BM = 0) unless multiple controllers are wired onto a SSB. Any additional controllers on the SSB must be configured as Slaves (BM = 1).
	PU	User P.I.N.—this personal identification number controls access to the User Menu.
	PB	Balancer P.I.N.—this personal identification number controls access to the Balance Menu.
	PS	Service P.I.N.—this personal identification number controls access to the Service Menu.

Table 3-9 Temperature Attributes

	attr	description
	PI	Installer P.I.N.—This personal identification number controls access to all menus.
	DS	Display Mode—specifies whether English or Metric units are to be used for the digital thermostat display.
	DV	Display Value—when DV = 0 each digital thermostat displays the identical temperature value (average) (FE00;ZT). When DV = 1 each thermostat displays its own temperature.
	DF	Display Format —defines the format used to display the current temperature on the digital thermostat.
	T0	Reading Device 0—is the raw reading for Device 1 on a SSB.
	T1	Reading Device 1—is the raw reading for Device 2 on a SSB.
	T2	Reading Device 2— is the raw reading for Device 3 on a SSB.
	T3	Reading Device 3—is the raw reading for Device 4 on a SSB.
	G0	GID Device 0—is the global identification for the SSB device.
	G1	GID Device 1— is the global identification for the SSB device.
	G2	GID Device 2—is the global identification for the SSB device.
	G3	GID Device 3—is the global identification for the SSB device.
	RM	Reading Mode —is the technique used to determine Zone Temperature when multiple thermostats are present. 0 = Average Mode 1 = Highest 2 = Lowest 3 = Hi/Lo VST mode 4 = Device position 0 5 = Device position 1 6 = Device position 2 7 = Device position 3 8 = Primary GID mode
	PG	Primary GID—is the GID of the Primary thermostat in Primary GID mode (RM = 8)

3.5 FLOW

The following are Flow attributes:

FA00;**CV**, **CD**, **CA**, **OF**, **AC**, **FH**, **CK**, **KC**, **K2**, **FC**, **DM**, **CB**, **OI**, **DP**, **EP**, **EF**, **DM**, **DC**, **DD**, **AT**, **AS**, and **RZ**.

FA01;**CM**, **CX**, **CP**, **CI**, **HM**, **HX**, **HP**, **HI**, **WM**, **WX**, **WP**, **WI**, **AS**, **AM**, **RP**, **DB**.

FA05;**CV**, **LL**, **HL**, **HS**, **AS**, **AE**, and **SU**.

FC02;**PF**, **DR**, **IC**, **MF**, and **PD**.

3.5.1 CONTROL

Attribute FA00;**CV** is Current Value. It shows the current real time measured amount of airflow in CFM. This attribute is read-only, but you can overwrite it when **OI** = 1.

Attribute FA00;**CD** is Target Flow. It shows the desired flow (cfm) setpoint calculated by the cooling or heating PI loops. You can write to this point only in Manual mode or with CAV Box Type. When set manually, this point is preserved in EEPROM configuration memory. Manual Target Flow settings are no longer lost when power is removed. This feature is required for CAV applications.

Attribute FA00;**CA** is Average Flow. It shows the measured average flow in cfm. This read only point displays an average of **CV**, the actual air flow measured by the SBC-VAV flow sensor (whether the terminal box is cooling or heating). This point will track and follow **CD** as the SBC-VAV controls the air flow by modulating the duct damper.

Attribute FA00;**OF** is Flow Offset. It defines an offset or adjustment applied to the target flow. When operated in Auto (FA00;**AC**=1) or Tracking (FA00;**AC**=2) mode, the Flow Offset is added to the derived target. The Target Flow (FA00;**CD**) includes this offset.

Attribute FA00;**AC** is Control Mode. When set to Auto, the Target Flow (**CD**) is determined by the control algorithms and setpoints. Select Manual to override the Target Flow. A VAV controller functioning as a slave device to a master VAV on the SSB can be set to “track” the current average flow of the master. With the flow channel of the slave set for *Tracking* (FA00;**AC**=2), the Target Flow (FA00;**CD**) is derived from the Average Flow (FA00;**CA**) of the master VAV offset by the Flow Offset (FA00;**OF**) established for the slave.

Attribute FA00;**FH** is Flow Hysteresis. It specifies the maximum amount of flow sensor variation to be tolerated by the SBC-VAV before showing a valid change of flow. This point allows you to set a hysteresis, or deadband, centered around the calculated air flow value. This hysteresis prevents bouncing of the air flow value. Such bouncing is usually prevalent at the lower and higher ends of the air flow range, potentially creating situations in which the damper may be toggled because of controller response. Air flow values (**CV**) must be greater than or less than the upper and lower limits defined around **CV** by **FH**. Figure 3-9 illustrates the boundaries set around **CV** when **FH** > 0. This attribute defaults to 20.

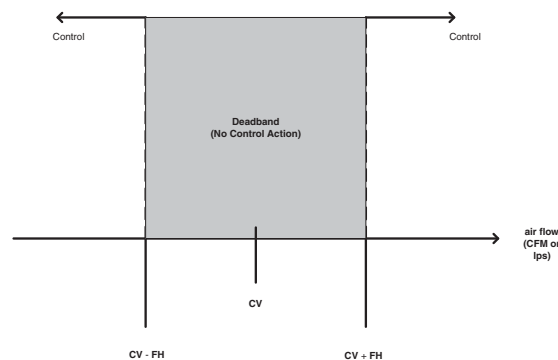


Figure 3-9: Flow Hysteresis Around FA00;**CV** When **FH** > 0

Attribute FA00;**CK** is Duct Scaling Factor. It shows the scaling factor for the particular VAV box being used. An initial scaling factor may be calculated as 4,005 times the effective area of the duct in square feet. The default is 786 (for a 6" round duct). This scaling factor may be automatically calculated using 1-Point Calibration (**KC**).

Attribute FA00;**KC** is 1-Point Calibration. Enter the CFM value measured externally, and this will automatically adjust the Duct Scaling Factor **CK** based on the present flow reading to properly scale the duct. Note that this does not perform the function if 0 is entered or if **CV** is overridden.

Attribute FA00;**K2** is 2-Point Calibration. It 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.

Attribute FA00;**FC** is Fan. It controls the current status of the fan output.

Attribute FA00;**DM** is Damper Mode. Through this point, you can command the damper to open fully (**DM=1**). The attribute includes settings that force the damper to control cooling minimum flow (**DM=2**), cooling maximum flow (**DM=3**), Heating minimum flow (**DM=4**), heating maximum flow (**DM=5**), warm-up minimum flow (**DM=6**) and warm-up maximum flow (**DM=7**). Enabling either **CM**, **CX**, **HM**, **HX**, **WM**, or **WX** forces the target flow (**CD**) to the appropriate flow setting. Manual/Auto Target Flow values are restored when the damper is returned to Automatic (**DM=0**).

Attribute FA00;**CB** is Calibrate Flow Sensor. It allows a host or operator to manually calibrate the flow sensor (Zero Offset) based on the complete absence of airflow once the unit is installed in the field. Calibration occurs when you completely shut down the air supply and set **CB** = 1. Once the SBC-VAV runs through its calculations and adjusts for zero air flow, **CB** automatically resets itself to 0.

Attribute FA00;**OI** is Override Flow Measurement. It allows a host or operator to manually set the value of the Current Flow. If **OI** is set to 0, overriding is disabled. If **OI** is set to 1, the current flow can manually be changed or can be written to by an area controller.

3.5.2 COOLING

Attribute FA01;**CM** is Cooling Minimum Flow. It shows the allowable minimum (cooling) duct flow, in CFM, required while the controller is at the calculated cooling setpoint (Analog Output **CC**). See Figure 3-10.

The point FA01;**CM** has a range of 0 to 65,535 with a default of 100.

Attribute FA01;**CX** is Cooling Maximum Flow. It shows the allowable maximum (cooling) duct flow. This point has a range of 0–65,535 and defaults to 500.

Attribute FA01;**CP** is Cooling Proportional Band. It 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** (cooling minimum flow) to **CX** (cooling maximum flow) when cooling is called for by the controller. This point defaults to 5.0°. See Figure 3-10. 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 **CC** defaults to 5.0°.

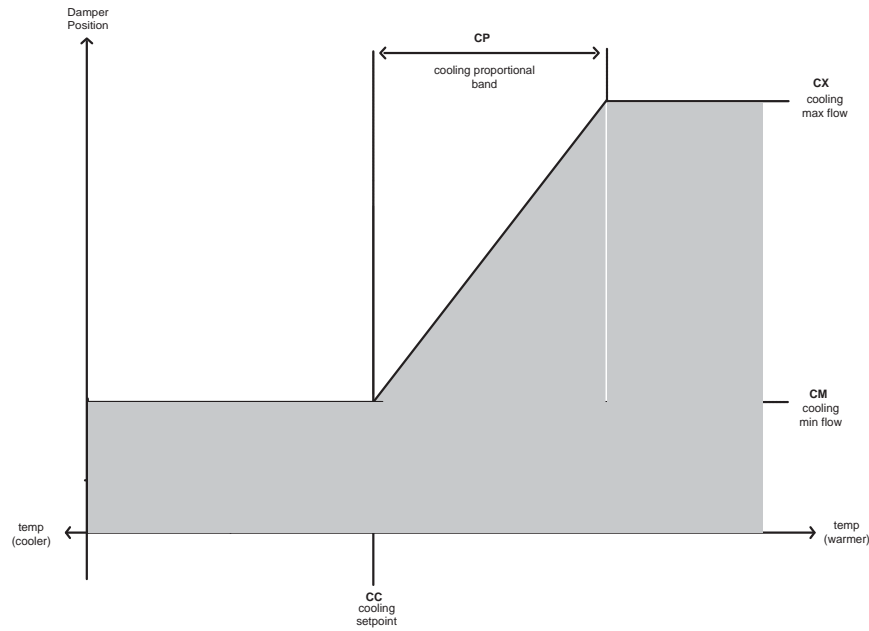


Figure 3-10: Cooling Only Mode

NOTE

The attribute **CC** reflects the thermostat setpoint value of the SBC-STAT and any setback, whereas **CS** does not. The SBC-VAV uses **CC** in its control algorithm.

Attribute FA01;**CI** is Cooling Integration Constant. It shows the amount of proportional error history (0 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. Figure 3-11 illustrates the concepts of control using proportional only and proportional + integral action. This point defaults to 0.0.

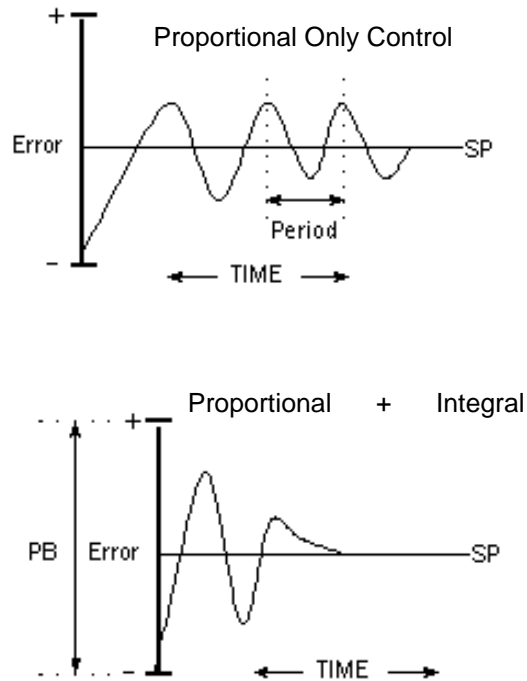


Figure 3-11: Examples of Proportional and Proportional + Integral Control

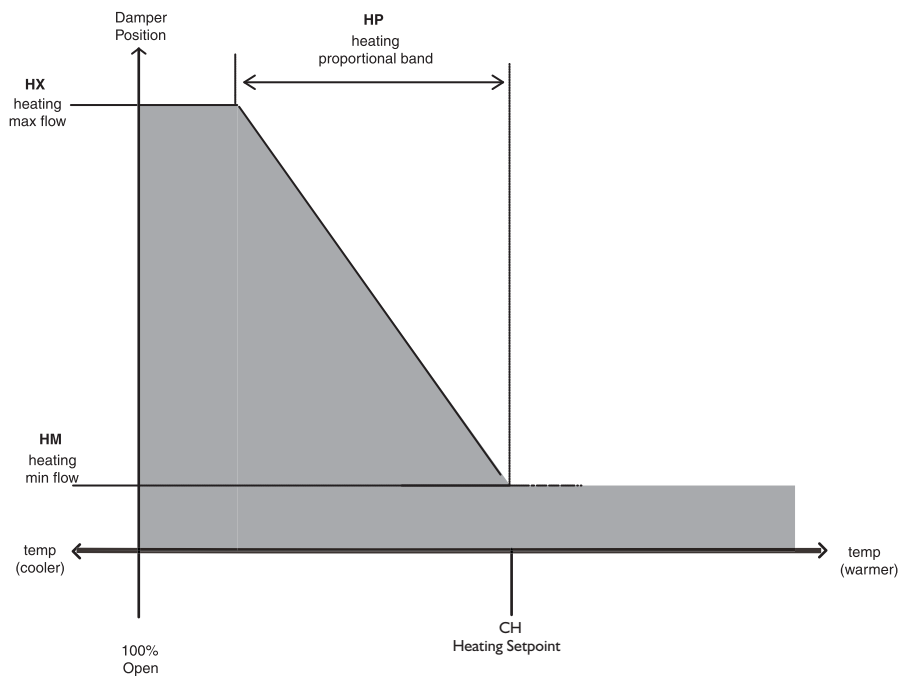


Figure 3-12: Heating Only Mode

The P+I control loop controls the amount of integral (integral sum) that is accumulated during use of the antireset windup strategy. When the control loop reaches its maximum (maximum air flow) or its minimum (minimum air flow), the integral sum is dumped. Integral will begin to calculate again when the control is once more within the proportional band.

3.5.3 HEATING

Attribute FA01;**HM** is Heating Minimum Flow. It shows the allowable minimum heating duct flow during heating. The point **HM** has a range of 0–65,535 and defaults to 100.

Attribute FA01;**HX** is Heating Maximum Flow. It shows the allowable maximum heating duct flow during heating. This attribute defaults to 500 and can be set from 0 to 65,535.

Attribute FA01;**HP** is Heating Proportional Band. It specifies, in degrees (0.0 to 100), 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 **HC** (calculated heating setpoint) creating an operational band in which the damper controls air flow based on area temperature from **HM** (heating minimum flow) to **HX** (heating maximum flow) when heating is called for by the controller. Attribute HP defaults to 5.0°. Refer to Figure 3-12.

Attribute FA01;**HI** is Heating Integration Constant. It 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 separating within the confines of the proportional band. Attribute **HI** defaults to 0.0.

The P+I control loop controls the amount of integral (integral sum) that is accumulated by using an antireset windup strategy. When the control loop reaches its maximum (maximum air flow) or its minimum (minimum air flow), the integral sum is dumped. Integral will begin to be calculated again when the control is once more within the proportional band.

3.5.4 UNOCCUPIED

Attribute FA01;**MD** is Min Flow Overrides. It specifies the method of overriding the target flow during unoccupied schedule periods. By default, this is configured as None. When set as “Use UM”, the target flow that the VAV will control by will be the value defined in FA01;**UM** in the event where there is a mismatch between the Supply Demand (FE08;**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 FA01;**UM**. When set for “Both”, both conditions will apply.

Attribute FA01;**UM** is Unoccupied Minimum Flow. This defines the flow setpoint that the VAV will follow during Unoccupied periods.

3.5.5 WARM-UP

Attribute FA01;**WM** is Warm-Up Minimum Flow. It shows the allowable minimum heating duct flow during warm-up.

The SBC-VAV provides for user tailored warm-up operation through attribute settings. (See the Schedules subsection of this section.) Attribute **WX** is Warm-up Maximum Flow. It shows the allowable maximum (heating) duct flow during warm-up which can be called for by schedule. This attribute defaults to 400 and has a setting range of 0 to 65,535.

Attribute FA01;**WP** is Warm-Up Proportional Band. It 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.

Attribute FA01;**WI** is Warm-Up Integration Constant. It shows the amount of proportional error history (0 to 25.5%) used to calculate the desired position for the heating duct damper.

3.5.6 INDOOR AIR QUALITY

Attribute FA01;**AS** is the Air Quality Setpoint. This value should be set to the acceptable CO² level in the zone. A value of zero (0) will disable the Indoor Air Quality application.

Attribute FA01;**DB** is a deadband which specifies the CO² variable range over which the damper is controlled.

Attribute FA01;**RP** is the Air Quality Damper Ramp Rate. It is the percentage rate per minute that the damper moves to compensate for the change in CO² levels.

Attribute FA01;**AM** is the Air Quality Control Max Air Flow. It specifies the allowable maximum air flow.

3.5.7 DAMPER

Attribute FA00;**DP** is Damper Position. It shows the damper position when using an actuator with built-in feedback potentiometer (SBC-VAVrf, -VAVtf).

Attribute FA00;**EP** is Estimated Target Position. It shows the estimated target position with which the loop should control the damper to bring the flow closer to the setpoint. A change in **EP** causes the actuator to drive in the proper control direction.

Attribute FA00;**EF** is Estimated Flow at Full Open. It shows the estimated flow at full open in cfm. This attribute is used when the damper control attribute is set to Pressure Dependant (FA00;**DC**=0).

Attribute FA00;**DM** is Damper Mode. Through this point, you can command the damper to open fully (**DM**=1). The attribute includes settings that force the damper to control cooling minimum flow (**DM**=2), cooling maximum flow (**DM**=3), Heating minimum flow (**DM**=4), heating maximum flow (**DM**=5,) warm-up minimum flow (**DM**=6) and warm-up maximum flow (**DM**=7). Enabling either **CM**, **CX**, **HM**, **HX**, **WM**, or **WX** forces the target flow (**CD**) to the appropriate flow setting. Manual/Auto Target Flow values are restored when the damper is returned to Automatic (**DM**=0).

Attribute FA00;**DC** is Damper Control. It defines the method used to control the damper. For Pressure Dependant mode (FA00;**DC**=0), the damper position is estimated based on the target flow (FA00;**CD**) and the estimated maximum flow (FA00;**EF**). In Measured Flow mode (FA00;**DC**=1), the damper is modulated to maintain the target flow (FA00;**CD**). Dual Mixed (CAV) mode (FA00;**CD**=2) enables both the internal DC actuator control and the remote AC actuator (K4-K5). The DC actuator performs the pressure dependant function while the AC actuator maintains constant flow. In Dual Mixed mode, FA00;**CD** is set to the desired CAV setting, however, the PID loop continues to calculate the desired **DC** damper position.

Attribute FA00;**DD** is Damper Direction. It is used to set the direction of the damper motor. When the attribute is set to 0, the motor turns in the normal direction. With the attribute set to 1, the motor turns in the opposite direction.

Attribute FA00;**AT** is Actuator Type. It defines the type and connection for the damper actuator. Actuators with ac power will use the optional triac outputs **K4** and **K5**. Those with DC power use the standard

actuator connector. Motor Management Technology supports the Belimo LM24-M and LM24-10P-M. You can also choose *None* if you are not using an actuator with your SBC-VAV.

Attribute FA00;**AS** is Actuator Status. It reports the status of the actuator as determined by MMT. Possible values are Ready, Disconnected/Open and Jammed/Shorted. Diagnostic alarms and returns are issued when this status changes.

Attribute FA00;**RZ** is Rejuvenate Count. When MMT detects the possibility of an actuator short, electrical pulses are used to rejuvenate the motor. Each pulse is tallied by this attribute. The Actuator Status is changed to indicate the short if it is not rectified after 10 consecutive pulses. The Rejuvenate Count can be used to determine the general well-being of the actuator

3.5.8 ALARMS

Attribute FA05;**CV** is Current Value. It shows the current measured amount of airflow in cfm.

Attribute FA05;**LL** is Low Alarm Limit. It specifies the low alarm limit. If alarms are enabled and the current value (**CV**) drops below this value, a low limit alarm will be generated.

Attribute FA05;**HL** is High Alarm Limit. It specifies the high alarm limit. If alarms are enabled and the current value (**CV**) rises above this value, a high limit alarm will be generated.

Attribute FA05;**HS** is Alarm Limit Hysteresis. It determines when the SBC-VAV returns from a high or low limit alarm. In the case of a high limit alarm, the **CV** value must drop below **HL – HS** to cause a high limit return. For a low limit alarm, the **CV** value must rise above **LL + HS** to cause a low limit return.

Attribute FA05;**AS** is Alarm Status. It shows the current alarm condition. A value of 0 indicates a normal condition; a nonzero number indicates alarm generation. This attribute is read-only. Table 3-10 explains the condition for each value.

Table 3-10: Values for Alarm Status Attribute AS

Value of AS	Alarm Condition
AS = 0	normal
AS = 5	low limit
AS = 6	high limit

Attribute FA05;**AE** is Alarm Enable. It specifies the type of alarm checking to be done on the **CV** value. A 0 indicates that alarming is disabled; a nonzero value indicates one of several alarm functions. Table 3-11 lists the options for **AE**.

Table 3-11: AE Alarm Enable Options

Value of AE	Alarm Type Enabled
AE = 0	disabled
AE = 4	low limit alarm
AE = 5	high limit alarm
AE = 6	low and high limit

Attribute FA05;**SU** is Amount to Setup/Setback Alarm Limit. It specifies the amount added to **HL** or subtracted from **LL** during unoccupied periods. Figure 3-13 illustrates the effect of **SU** during unoccupied mode.

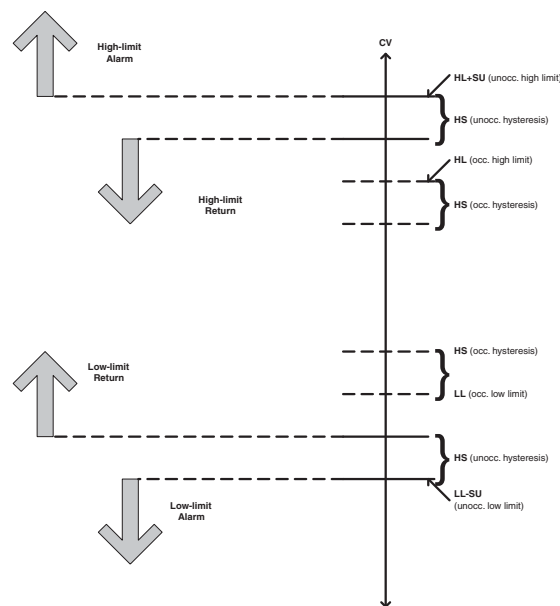


Figure 3-13: Unoccupied Setup/Setback Alarm Shifting

3.5.9 PROOF OF FLOW

Attribute FC02;**PF** is Proof of Flow. It shows the status of the Proof of Flow, the flow control **CV** (when **CV** is used as a proof of flow switch) and is only valid when **DR** = 2 or 3.

Attribute FC02;**DR** is Method. This defines the requirements for Proof of Flow. Indication of Positive Flow always appears if None is selected (**DR** = 0). If Minimum Flow is selected (**DR** = 1), then the Measured Flow must exceed **MF** for a Positive Flow indication to occur. If Paddle Switch (**DR** = 2) is selected, then the UI1 input must be nonzero for a Positive Flow indication. You may select Both (**DR** = 3) for cases in which both the minimum flow reading AND a nonzero UI1 is required.

Attribute FC02;**IC** is Digital Input. Selects the digital input where a non-zero value indicates flow.

Attribute FC02;**MF** is Minimum Required Flow. It is the minimum flow reading required to indicate Positive Flow. The flow reading from the flow control **CA** is used. This is a long term average and provides sufficient filtering to prevent false Proof of Flow indications. This point works in conjunction with **DR** indicating a user definable flow that allows reheats to be engaged. The attribute is used only when **DR** = 1 or 3.

Attribute FC02;**PD** is Proof of Flow Delay. It shows the amount of time, from 0 to 255 seconds, imposed before the enabling of a positive flow indication.

Table 3-12 Flow Attributes

	attr	description
Flow: Control FA00		
	CV	Current Value—shows the current measured amount of airflow in cfm.
	CD	Target Flow—shows the desired flow (cfm) setpoint calculated by the cooling or heating PI loops.
	CA	Average Flow—shows the measured average flow in cfm.
	OF	Flow Offset—defines an offset or adjustment applied to the target flow. When operated in Auto (FA00;AC=1) or Tracking (FA00;AC=2) mode, the Flow Offset is added to the derived target. The Target Flow (FA00;CD) includes this offset.
	AC	Control—when set for Auto, the Target Flow (CD) is determined by the control algorithms and setpoints. A VAV controller functioning as a slave device to a master VAV on the SSB can be set to “track” the current average flow of the master. With the flow channel of the slave set for <i>Tracking</i> (FA00;AC=2), the Target Flow (FA00;CD) is derived from the Average Flow (FA00;CA) of the master VAV offset by the Flow Offset (FA00;OF) established for the slave.
	FH	Flow Hysteresis—specifies the maximum amount of flow sensor variation to be tolerated by the SBC-VAV before it shows a valid change of flow.
	CK	Duct Scaling Factor (K)—shows the scaling factor for the particular VAV box being used.
	KC	1-Point Calibration—when you enter the cfm value measured externally, this will automatically adjust the Duct Scaling Factor (CK) based on the present flow reading to properly scale the duct.
	K2	2-Point Calibration—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.

Table 3-12 Flow Attributes

	attr	description
	FC	Fan—shows the current status of the fan output.
	DM	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.
	CB	Calibrate Flow Sensor—allows a host or operator to manually calibrate the flow sensor.
	OI	Override Current Value—allows a host or operator to manually set the value of the current flow.
Flow: Cooling FA01		
	CM	Cooling Minimum Flow—shows the allowable minimum (cooling) duct flow.
	CX	Cooling Maximum Flow—shows the allowable maximum (cooling) duct flow.
	CP	Cooling Proportional Band—specifies, in degrees (0.0 to 25.5), the offset from the calculated cooling control setpoint CC that determines the proportional band for damper control.
	CI	Cooling Integration Constant—shows the amount of proportional error history (0 to 100%) used to calculate the desired position for the cooling duct damper.
Flow: Heating FA01		
	HM	Heating Minimum Flow—shows the allowable minimum heating duct flow during heating.
	HX	Heating Maximum Flow—shows the allowable maximum heating duct flow during heating.
	HP	Heating Proportional Band—specifies, in degrees (0.0 to 25.5), the offset from the calculated heating control setpoint that determines the proportional band for the heating duct damper control.
	HI	Heating Integration Constant—shows the amount of proportional error history (0 to 100%) used to calculate the desired position for the heating duct damper.
Flow: Unoccupi ed FA01		

Table 3-12 Flow Attributes

	attr	description
	MD	Min Flow Overrides - It specifies the method of overriding the target flow during unoccupied schedule periods. By default, this is configured as None. When set as "Use UM", the target flow that the VAV will control by will be the value defined in FA01; UM in the event where there is a mis-match between the Supply Demand (FE08; 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 FA01; UM . When set for "Both", both conditions will apply.
	UM	Unoccupied Minimum Flow - This defines the flow setpoint that the VAV will follow during Unoccupied periods.
Flow: Warm-up FA01		
	WM	Warm-up Minimum Flow—shows the allowable minimum heating duct flow during warm-up heating.
	WX	Warm-up Maximum Flow—shows the allowable maximum heating duct flow during warm-up heating.
	WP	Warm-up Proportional Band—specifies in degrees (0.0 to 25.5) the offset from the calculated heating control setpoint that determines the proportional band for the warm-up heating duct damper control.
	WI	Warm-up Integration Constant—shows the amount of proportional error history (0 to 100%) used to calculate the desired position for the heating duct damper.
Flow: Indoor Air Quality FA01		
	AS	Air Quality Setpoint—specifies value should be set to the acceptable CO ² level in the zone. A value of zero (0) will disable the Indoor Air Quality application.
	DB	Air Quality Deadband—specifies the CO ² variable range over which the control of the damper is stroked.
	RP	Air Quality Damper Ramp Rate—specifies the percentage rate per minute that the damper moves to compensate for the change in CO ² levels.
	AM	Air Quality Control Max Air Flow—specifies the allowable maximum air flow.
Flow: Damper FA00		

Table 3-12 Flow Attributes

	attr	description
	DP	Position—shows the damper position with an optional actuator having a built in feedback potentiometer.
	DM	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.
	EP	Estimated Target Position—shows the estimated target position with which the loop should control the valve to bring the measured input variable closer to the setpoint.
	EF	Estimated Flow at Full Open—shows the estimated flow at full open in cfm. (Used when Damper Control is pressure dependant.)
	DC	Damper Control—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). In Dual Mixed CAV (DC = 2) mode, both the internal DC actuator and the remote AC actuator (K4-K5) are enabled. The DC actuator performs the 'Pressure Dependant' function while the AC actuator maintains constant flow. Note that in this mode, CD is set to the desired CAV setting, however, the PID loop continues to calculate the desired DC damper position.
	DD	Direction—used to set the direction of the damper motor.
	AT	Actuator Type—defines the type and connection for the damper actuator.
	AS	Actuator Status—reports the status of the actuator as determined by the MMT.
	RZ	Rejuvenate Count— when MMT detects the possibility of an actuator short, electrical pulses are used in an attempt to rejuvenate the motor.
Flow: Alarms FA05		
	CV	Current Value—shows the current measured amount of airflow in cfm.
	LL	Low Alarm Limit—if alarms are enabled and the current value drops below this value, a low limit alarm will be generated.
	HL	High Alarm Limit—if alarms are enabled and the current value rises above this value, a high limit alarm will be generated.
	HS	Alarm Limit Hysteresis—determines when the SBC-VAV returns from a high or low limit alarm.
	AS	Alarm Status—shows the current alarm condition.

Table 3-12 Flow Attributes

	attr	description
	AE	Alarm Enable—specifies the type of alarm checking to be done on the CV value.
	SU	Alarm Limit Setup/Setback—specifies the amount added to HL or subtracted from LL during unoccupied periods.
Flow: Proof of Flow FC02		
	PF	Proof of Flow—shows the status of the proof of flow.
	DR	Method—defines the requirements for proof of flow.
	IC	Digital Input—selects the digital input where a non-zero value indicates flow.
	MF	Minimum Required Flow—the minimum flow reading required in order to indicate positive flow.
	PD	Flow Proof Delay—shows the amount of time, in seconds, imposed before enabling a positive flow indication.

3.6 AUXILIARY

The following are Auxiliary attributes:

FB01;**FO, FS, SF, FC**, and **CV**.

FA03;**RO, FR, AV, EN, AF, MX, BA, OF**, and **ID**.

FA08 and FA09;**ST, VU, VM, VA, VD, UT, RI, VO, VP, VI, VT, PP, TL, TH, CD**, and **AM**.

FA11;**SP, CS, PO, AO, IN, IC, MR, RC, RV, RS, RL, DB, PB, RP, RT, SG, SU**, and **CE**.

FC01;**MS, IC, MD, MT**, and **MR**.

3.6.1 FAN

Attribute FB01;**FO** is Fan/Damper Mode. It is used to configure the fan or damper. The options are No Fan/ Induction Damper (**FO** = 0), Series Fan (**FO** = 1), Parallel Fan (**FO** = 2) and Induction Damper (**FO** = 3).

Attribute FB01;**FS** is Fan Setpoint. It allows you to define the setpoint, in cubic feet per minute or liters of air flow as measured by the flow control **CA**, at which the fan or induction damper is enabled so that it can assist the terminal box in maintaining the minimum air flow requirements.

Table 3-13 describes the conditions that must be met for the output to be enabled/disabled (on or off).

Attribute FB01;**SF** is Unoccupied Series Fan. When a series fan box type is selected (**FO** = 1), **SF** defines how the series fan is controlled during unoccupied periods. If **SF** = 0 (default value), the series fan is always on during unoccupied periods.

When **SF** = 1, the series fan control is based on the zone temperature (**ZT**). If **ZT** is within the deadband created by the calculated heating and cooling control setpoints (Flow **CC** and Flow **CH**), then the series fan is shut off during unoccupied periods. If **ZT** extends above or beyond the deadband, the series fan is turned on during unoccupied periods. Refer to Figure 3-14.

Attribute FB01;**FC** is Fan Minimum Cycle Time. It shows the minimum amount of time, in minutes (0.0 to 25.5), that the fan output will stay energized or de-energized. This prevents short cycling of the fan output.

Attribute FB01;**CV** is Fan. It defines the status of the fan output.

Table 3-13: Fan Setpoint

Current State	If FS = 0 and		If FS > 0 and	
	ZT < CH	ZT > CH	ZT < CH	ZT > CH
Occupied	On	Off	Flow Controlled	Flow Controlled
Unoccupied	On	Off	On	Off
Warm-up	On	Off	On	Off
Night Setback	On	Off	On	Off

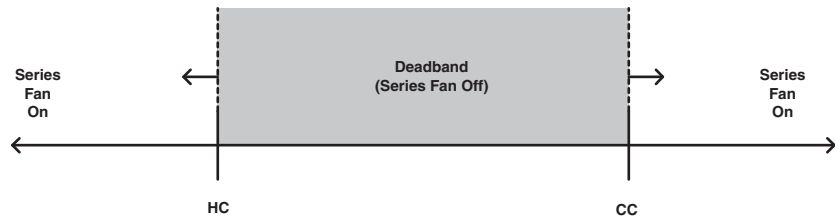


Figure 3-14: Unoccupied Series Fan Operation With **BT** = 1 and **SF** = 1

3.6.2 ELECTRIC REHEAT

The SBC-VAV provides electric reheat capabilities with four stage electric reheat available.

Attribute FA03;**RO** is Reheat Options. It is used to configure the SBC-VAV's outputs for electric reheat. The options are Disabled (default), 2-Stage (**K2–3**), 2-Stage (**K4–5**), and 4-Stage (**K2–5**). Table 3-14 lists the options offered by **RO**.

Table 3-14: Options of **RO**

Value of RO	Option
0	disabled (no reheat)
1	two stages of electric reheat (K2 & 3)
2	two stages of electric reheat (K4 & 5)
3	four stages of electric reheat (K2,3,4 & 5)

Attribute FA03;**FR** is Stages Requiring Flow. It defines by the appropriate bit setting which of the available reheat stages requires a Positive Flow indication (see Proof of Flow). Not all sources of auxiliary heat (perimeter heating for instance) will require verification of air flow. By default all stages require a Positive Flow indication.

Attribute FA03;**AV** is Available Stages. It displays the stages that are currently available for use. This depends on the current options (**RO**) and the presence of a positive flow indication. Other uses of the digital outputs (ac actuator, for instance) may remove those stages from reheat availability. This attribute is read-only.

Attribute FA03;**EN** is Energized Stages. It displays those reheat stages that are currently energized. This attribute is read-only.

Attribute FA03;**AF** is 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 (Damper Control attribute **HI**) should be used. This permits the PID loop to reach a maximum target airflow when the supply air is unable to satisfy the zone.

Attribute FA03;**MX** is Maximum Supply Temperature. It establishes a maximum supply duct temperature above which the reheats will deenergize. If no supply temperature is available set **MX** to 999.0 to disable this lockout.

Attribute FA03;**BA** is Balance Stage Usage. If set to Yes (**BA** = 1), it considers the Run Hour Totals (Digital Output **RH**) for the individual digital 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 does not perform balancing.

Attribute FA03;**OF** is Reheat Offset. It specifies, in degrees, the offset from the calculated heating control setpoint (**HC**) 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 temperatures below the heating setpoint but within the Reheat Offset of it, reheat stages are de-energized at 30 second intervals.

Attribute FA03;**ID** is Stage Delay. It 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. This point defaults to 1.0 minute.

3.6.3 VALVE CONTROL

There are two types of PI valve control provided by the SBC-VAV: pulse width modulated control and time based ramp control. Pulse width modulation allows you to utilize a pulse width driven motor valve. The SBC-VAV uses a PI control loop to calculate the percent of control needed. The controller then provides the equivalent power pulse.

Valve control operates on a reverse acting ramp for hot water reheat operations. When the temperature falls (negative to the controlling setpoint, the valve will move to a more open position. When the temperature begins to rise, the valve will move to a more closed position.

In chilled water applications, the valve operates in a normal acting ramp. When the temperature rises (positive to the controlling setpoint), the valve is driven in a positive direction (more open). When the temperature begins to drop, the valve is driven to a more closed position.

This control loop operates on the basis of the travel time for the valve in use. Full travel time will result in the valve being driven to its maximum open or closed position, depending on the direction of travel requested. Figure 3-15 illustrates both valve ramps.

The Valve Control attributes control the optional hot water reheat or chilled water cooling support in terminal boxes. This attribute provides closed loop proportional plus integral (PI) control.

Attribute FA0x;**ST** is Valve Status. The options are off, open, close, and calibrate

Attribute FA0x;**VU** is Valve Use. The options are disabled, cooling and heating.

Attribute FA0x;**VM** is Valve Mode. The options are Pulse Width Modulation and Floating Point Motor Control.

Attribute FA0x;**VA** is Actual Valve Position. It shows the actual valve position (in percent) based on travel time. This point is read only.

Attribute FA0x;**VD** is Desired Valve Position. It 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.

Attribute FA0x;**UT** is 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 value for insignificant changes.

Attribute FA0x;**RI** is Recalibrate Interval. It shows the amount of time, from 1 to 255 hours, between valve recalibrations. 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

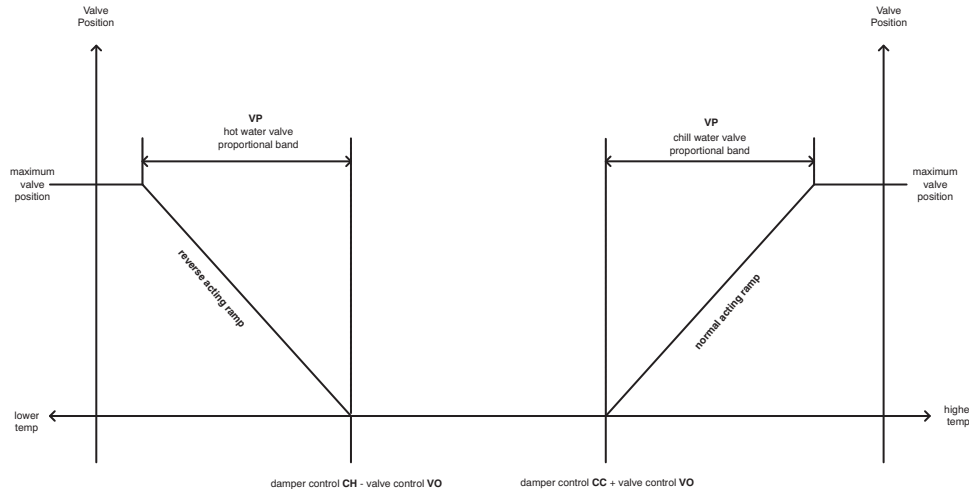


Figure 3-15: Reverse and Normal Valve Ramps

value greater than 0 for **RI** to be considered valid by the controller. When calibration occurs, the SBC-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.

NOTE

If **RI** = 0 and a power failure occurs, the valve will **not** be recalibrated upon power-up. **RI** must be set > 0 for a recalibration to occur.

Attribute FA0x;**VO** is Valve Offset. It is added to **CC** or subtracted from **HC** for calculation of the loop setpoint. If the SBC-VAV is configured for hot water control, then **VO** is subtracted from **HC**. If the SBC-VAV is configured for chilled water control, then **VO** is added to **CC**.

Attribute FA0x;**VP** is Valve Proportional Band. It 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.

Attribute FA0x;**VI** is Valve Integration Constant. It 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 0.0.

The P+I control loop controls the amount of integral (integral sum) that is accumulated through the use of an antireset windup strategy. When the control loop reaches its maximum (maximum valve position) or its minimum (minimum valve position), the integral sum is dumped. Integral will begin to calculate again when the control is once more within the proportional band.

Attribute FA0x;**VT** is Valve Motor Travel Time. It 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%). The SBC-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.

Attribute FA0x;**PP** is Pulse Duration Period. It shows the amount of time, in seconds, during which the valve is to be pulsed ON or pulse width modulation is enabled. For example if **PP** = 100 seconds and the SBC-VAV is calling for 40% heat, then the valve is pulsed on for 40 seconds and then remains off for 60 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 attribute defaults to 0 seconds.

Attribute FA0x;**TL** is DAT Low Temp Lockout. It 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.

Attribute FA0x;**TH** is DAT High Temp Lockout. It 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.

NOTE

If a supply temperature sensor does not exist, set both **TL** and **TH** to 999.0. When **TL** and **TH** are set to 999.0, the valve control will not look for a supply temperature.

Attribute FA0x;**CD** is Change Valve Direction. It is 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 FB02 and a decrease signal on FB03. With the attribute set to 1, the outputs are reversed.

Attribute FA0x;**AM** is Auto/Manual Mode. It 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 a PUP network program. If **AM** = 1 (Automatic), then the valve position is set by the control loop.

3.6.4 PID CONTROL

The Analog control of the SBC-VAV is a general purpose PID loop used to control the analog output.

Proportional+Integral+Derivative (PID) represents a method of control that controls equipment according to a setpoint in proportion to the value of a measured variable. It accounts for the amount of error (difference between the measured variable and the setpoint) and the continued presence of error. You can use PID control in the analog output loop by enabling the Control Enable attribute (**CE** = 1). Setting **CE** = 0 disables PID control.

Attribute FA11;**SP** is Loop Setpoint. It specifies the desired loop setpoint. In PID control, the setpoint is defined in **SP**. The measured input variable is the analog sensor referenced by the universal input specified in **IC**. The setpoint is expressed in the same kind of measurement units (engineering units) that the measured variable uses (e.g., degrees, cfm, inches of WC, etc.). For example, when using the analog control attributes to adjust cooling dampers to control a temperature value that the input sensor measures (in degrees), you must express the setpoint for the analog control in degrees. The data type of **SP** is the same as the data type of the selected measured variable. This value is used with the unoccupied setup/setback and the reset to calculate **CS**.

Attribute FA11;**CS** is Calculated Control Setpoint. It 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. This point is expressed in the same kind of measurement units (engineering units) that the measured variable uses (e.g., degrees, cfm, inches of WC, etc.). The data type of **CS** is the same as the data type of the selected measured variable.

Attribute FA11;**PO** is Percent Output Value. This attribute shows the output value in hundredths of a percent (e.g., 75.00%). The value is calculated based on the error, change in error and past error for the control loop. The point is then scaled to the selected engineering units of the analog output and is stuffed into the **AO** attribute as well as into **CV** of the analog output. This point can be set manually if the control loop is disabled (**CE** = 0).

Attribute FA11;**AO** is Analog Output Value. It shows the scaled output value used by the analog output and is a reflection of the Analog Output attribute **CV**. This point is the **PO** value scaled to UI1 **MN** and UI1 **MX** of the corresponding analog output **AO**. You can write to attribute **AO** when the Analog Output attribute **AM** = 0.

Attribute FA11;**IN** is Measured Variable's Value. It is read only and displays the value of the input selected in **IC**.

Attribute FA11;**IC** is Loop Measured Variable. It specifies the input to be used for the control loop's measured variable. A value of 0 in **IC** disables the control loop. A nonzero value selects one of the inputs. A list of the available measured variable inputs appears in Table 3-15.

Table 3-15: Control Loop Measured Variables Using **IC**

Value of IC	Measured Variable
0	disabled (default)
1	Zone Temp
2	Supply Temp
3	Flow
4	UI1
5	UI2
9	Zone Heating
10	Zone Cooling
11	Outside Air Temperature (OAT)

Attribute FA11;**MR** is Maximum Amount to Reset Setpoint. It specifies the maximum amount needed to reset the loop setpoint (**SP**) based on when reset is being used. Attribute **CS** takes into account the use of the maximum reset specified in **MR**.

NOTE

The data type of **MR** is the same as the data type of the referenced input variable specified by **IC**.

Attribute FA11;**RC** is Reset Variable's Value. It displays the value of the input selected in **RV**.

Attribute FA11;**RV** is Reset Variable. It specifies the input to be used for calculating the reset used by the control loop. A value of 0 disables reset. A nonzero value selects one of the inputs. The reset variable can be any one of the values specified in Table 3-16. This point provides the ability to control a loop using one input while resetting the loop using a different input.

Table 3-16: Available Inputs for Control Loop Reset Variable **RV**

Value of RV	Reset Variable
0	disabled (default)
1	Zone Temp
2	Supply Temp
3	Flow
4	UI1
5	UI2
11	Outside Air Temperature (OAT)

Attribute FA11;**RS** is the Setpoint at Which Reset Action Begins. This attribute 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. Just as **SP** is the proportional control setpoint for MV, **RS** is the reset control setpoint for the value of the reset variable selected by **RV**. The data type of **RS** is the same as the data type of the reset variable specified by **RV**.

Attribute FA11;**RL** is Limit for Maximum Reset. It specifies the value at which maximum reset is used. When the value of the reset variable is equal to **RL**, the maximum reset (**MR**) is used in determining the calculated setpoint.

The relationship between **RL** and **RS**, as well as the sign (+ or -) of **MR**, determines how changes in the reset variable **RV** affect the setpoint of the loop **SP**. Refer to Figure 3-16.

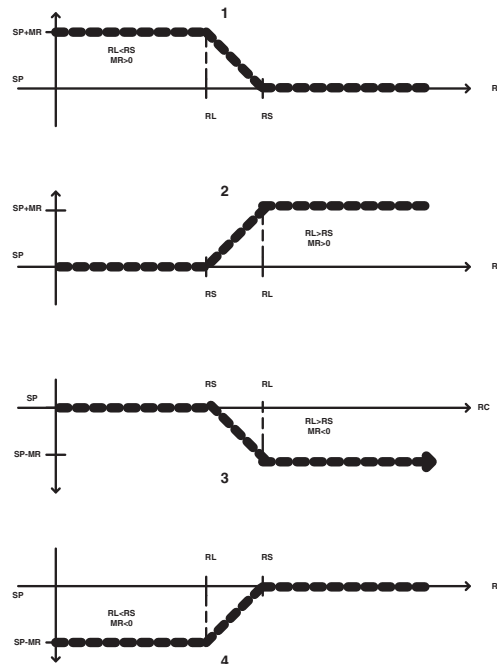


Figure 3-16: Four Forms of Reset Action

NOTE

The data types returned for attributes **RS** and **RL** are determined by the data type of the referenced reset variable specified by **RV**.

NOTE

It may not be possible to use a negative value for **MR** if the data type of the control loop's input **IC** uses an unsigned data type.

Attribute FA11;**DB** is Deadband. It specifies the deadband within the proportional control band in which the output remains constant at a point midway between maximum output and minimum output. By specifying a **DB** that is greater than or equal to the resolution of the sensor specified in **IC**, you eliminate the possibility of cycling around the setpoint. The value of **DB** should never exceed the proportional band **PB**. If **DB** is greater than **PB**, then the control loop will not have proportional control.

The attribute FA11;**DB** relates to the resolution of the input variable of the control loop. Recall that the range of a 16-bit, analog input is scaled into 65,535 equal divisions. The SBC-VAV can recognize input changes that are greater than or equal to the resolution of each of the divisions. For linear analog input

devices having a large operational range, the size of each division is also relatively large. For a linear analog input device having a relatively small operational range, the size of each division is relatively small.

In the case of nonlinear sensors such as thermistors, the resolution of each division becomes more irregular as the temperature range extends to the outer limits of the operational range. At these outer limits of the sensor's operation range, one small division may represent a very large or very small temperature range because of the nonlinear nature of the sensor's response curve. The incidence of this phenomenon is even more pronounced with the use of an 8-bit analog input sensor.

Whether or not the divisions of a particular sensor represent a relatively large or relatively small number, it is important to realize that if the setpoint (**SP**) chosen does not exactly fall on one of these divisions, the SBC-VAV will never attain the setpoint. The resulting control action will be an oscillation of the output around the setpoint. In order to eliminate the effects of this hunting action, a deadband can be programmed that is centered on the selected setpoint.

Attribute FA11;**DB** is used to specify an input variable range within the proportional band **PB**. The size of **DB** should be based on the type of sensor input selected for the input specified in **IC**. When the value of the measured variable is within this deadband, the output signal remains constant at the midpoint of the minimum/maximum range.

The point **DB** is centered on the setpoint **SP** to create the actual control deadband. When the value of the control variable (specified by **IC**) is within $\pm\text{DB}/2$ of the setpoint **SP**, the SBC-VAV assumes that it has reached the setpoint.

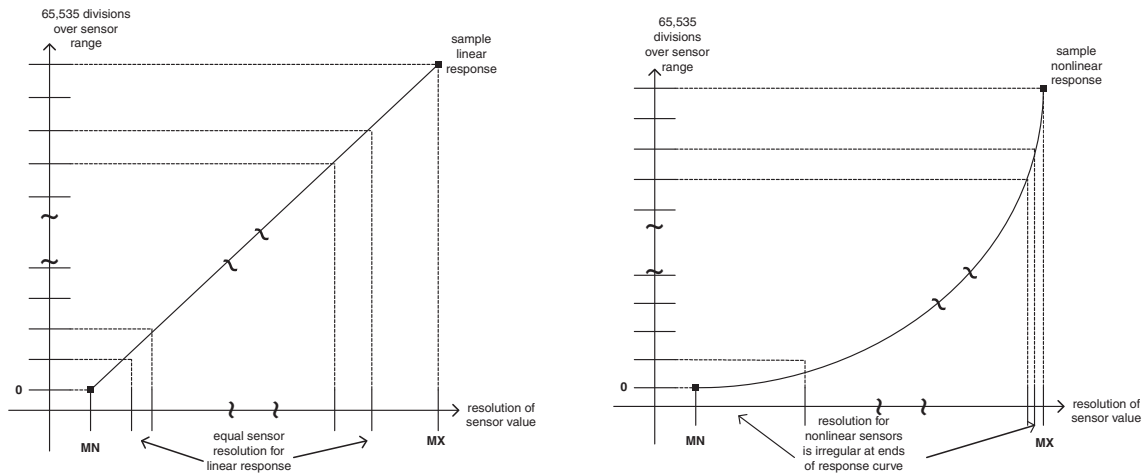


Figure 3-17: Sensor Resolution for Linear and Nonlinear Devices

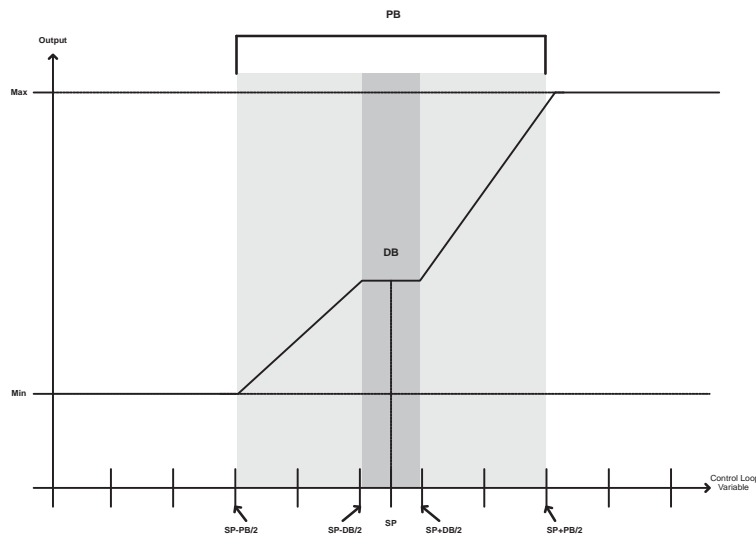


Figure 3-18: Normal Acting, Proportional Control Output Response Showing a Deadband Centered Around the Setpoint (**SP**)

By entering a value in FA11;**DB** that is greater than the resolution of the measured variable sensor, you create a deadband that allows the SBC-VAV to effectively reach setpoint.

Be sure that the **DB** selected does not exceed the size of the proportional band (**PB**). The attribute **DB** is expressed in the same kind of measurement units (engineering units) that the measured variable uses (e.g., degrees, cfm, inches W.C., etc.). The data type of **DB** is the same as the data type of the selected measured variable. The point **DB** defaults to 0.

NOTE

The data types returned for attributes **DB** and **PB** are determined by the data type of the referenced measured variable specified by **IC**.

CAUTION

Never change **DB** to a value greater than half of the proportional band **PB**. Doing so will eliminate the effects of PID control, resulting in on/off control.

At this point, the SBC-VAV will provide simple closed loop feedback proportional control. This means that the actual measured performance of the control (from the measured variable input) is fed back to the

controller and is compared with the effective setpoint for the loop. Any difference between the actual value of the measured variable (let's call this MV) and effective setpoint values is called error ($MV - CS$).

An analogy is helpful in explaining the effects of error. Figure 3-19 shows a simple lever and fulcrum. A change in the lever position on the error side produces a proportional change in the lever on the output side. Depending on the position of the fulcrum, a change on the error side will have a greater or lesser effect on the output side. The fulcrum position changes the ratio of error to output.

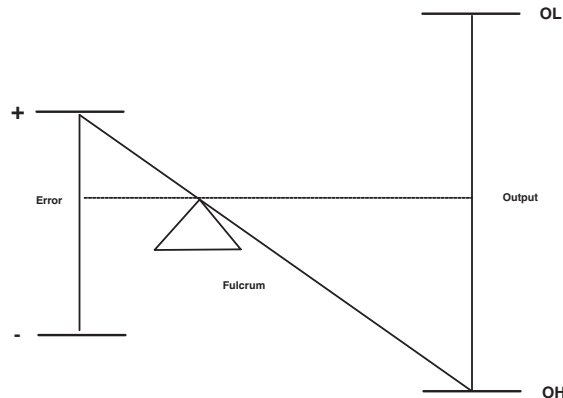


Figure 3-19: Input/Output Ratio

One problem with proportional only control is the changes in loop performance that occur when the condition being measured by the input sensor changes (e.g., the measured temperature changes when a door is opened and the room or space is flooded with cold air). As the loop environment changes, the proportional only control loop begins to cycle around an offset from the setpoint. Figure 3-20 illustrates the performance of a typical loop under proportional only control.

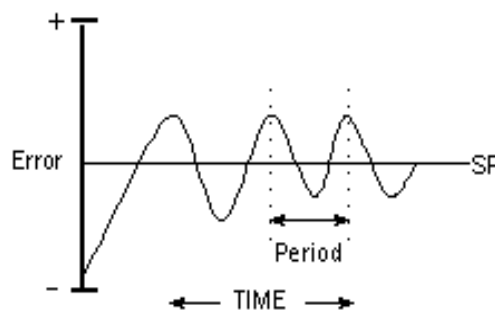


Figure 3-20: Proportional Only Control

Attribute FA11;**PB** is Proportional Band. It 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). The proportional band is centered around setpoint for the loop. This point is expressed in the same kind of measurement units (engineering units) that the measured variable uses—for example: degrees, cfm, inches W.C. The data type of **PB** is the same as the data type of the selected measured variable

NOTE

The data type of **PB** is the same as the data type of the referenced input variable specified by **IC**.

To determine **PB**, first decide how closely the SBC-VAV must control the output to the setpoint. For instance, if the setpoint is 72°F, then an acceptable control range might be within two degrees of the setpoint. This control range can be expressed as a band centered on the setpoint: from 70° to 74°, or 4 degrees—the *proportional band (PB)*. Refer to Figure 3-21 and Figure 3-22.

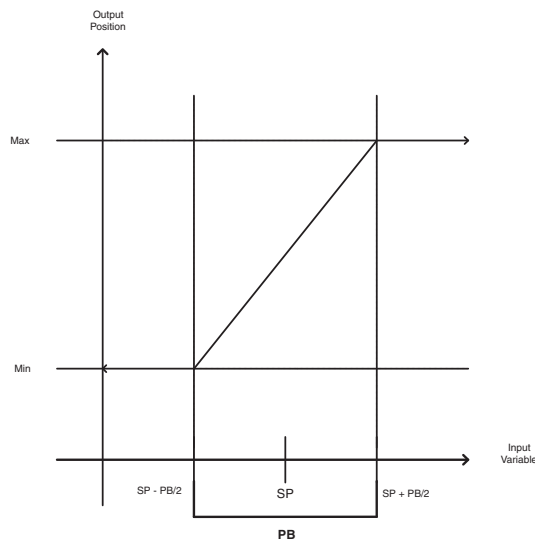


Figure 3-21: Proportional Band for Normal Acting Control ($SG = 0$)

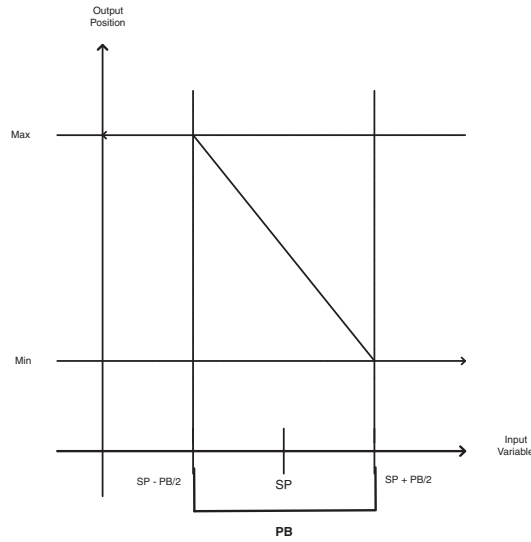


Figure 3-22: Proportional Band for Reverse Acting Control ($SG = 1$)

For normal acting control loops, **PO** is set to maximum output when the input variable equals the setpoint plus half of the proportional band ($SP + PB/2$). The point **PO** is set to minimum output when the input variable equals the setpoint minus half of the proportional band ($SP - PB/2$). These associations are reversed for reverse acting control loops.

Attribute FA11;**RP** is Reset Period. This attribute specifies the reset period (in seconds) over which the error history is accumulated. If **RP** = 10 seconds with a constant error of 2.0, then the error history would increase by 0.2 every second. In five seconds, the error history would be 1.0. At the end of ten seconds, the error history would be 2.0. Setting **RP** to 0 disables integral action. The longer **RP** is, the less effect it has on the control response. Figure 3-23 shows the response of a typical control loop when integral action is used in addition to proportional action (PI control). A value of 0 disables the reset period.

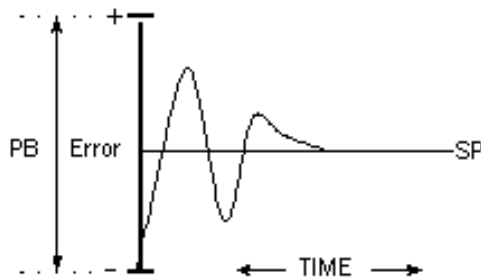


Figure 3-23: Proportional + Integral (PI) Control

At the start-up of the loop or following a change in setpoint (see Figure 3-24), the error is fairly large. Proportional action causes the loop output to accelerate toward the setpoint. However by the time the loop response reaches the setpoint value, it has gained inertia from the preceding proportional action. This causes the loop to overshoot the setpoint. As the loop exceeds the setpoint moving toward its first peak, the error sum is accumulating. This slows down the acceleration, eventually causing the downturn in response.

As the error falls and then drops below the setpoint, the error sum will be reduced because now the error is in the opposite direction. The cycle continues in diminishing peaks until it finally converges at the setpoint.

The proportional control action of the loop has a major effect on integral action. Increasing **PB** results in a smaller integral effect for a given value of **RP**. In general, decreasing the proportional band **PB** will increase the amount of overshoot. On the other hand, the larger **PB** is, the slower the loop response.

Several important factors may not be obvious to inexperienced users of these DDC techniques.

First, whenever the error falls outside of the proportional band—that is, $\pm \text{PB}/2$ from the setpoint, two important things happen: the controller's output is fully pegged in the appropriate direction, and the error sum stops accumulating. The control produces its maximum output because it must bring the error within the proportional band again. The error sum is accumulating so that it does not “wind up” a massive error sum that would take many control cycles to dissipate. This feature is called antireset windup.

Antireset windup also makes the loop recover quickly when it reenters the proportional band. Another feature of antireset windup is that the error history is limited to **PB**/2 because that is all that required to produce maximum output. Additional error accumulation would only slow down loop recovery.

To quicken loop response while eliminating overshoot, derivative action must be taken. Derivative action takes into account the rate of change in error and allows the SBC-VAV to counter the effects of the error's rate of change on the control output. To find the change in error, subtract the current error (read every second by the PID loop) from the previous second's error. A percentage of this change (specified by **RT**) becomes the derivative contribution to the PID output.

Attribute FA11;**RT** is Derivative Rate. It specifies a percentage of change in error that is to be used in calculating **PO**. The value is specified in percent per second. The point **RT** can have any value from 0.0 to 25.5%/second. The effect of adding derivative action to the output response appears in Figure 3-24.

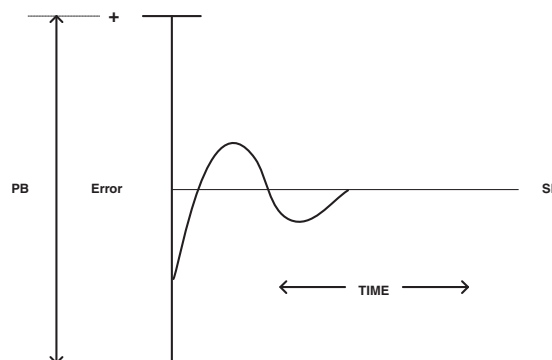


Figure 3-24: Proportional + Integral + Derivative (PID) Control

Attribute FA04;**SG** is Control Action. It 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. This point determines the response of the loop output to the kind of error. If the output action is to be increased (toward max) when the error is positive (**MV** > **SP**), set **SG** to normal (0). If the output action is to be decreased (toward min) for positive error, set **SG** to reverse (1). (Attribute **SG** is also used during schedule control to determine whether **SU** is added to **SP** [**SG** = 0] or subtracted from **SP** [**SG** = 1] during unoccupied periods.) For more information, refer to attribute **SU**.

Proportional only control produces cycling, and its performance changes when the measured environment changes. The way to eliminate cycling and to compensate for load changes is to use *integral* action, the *I* part for PID control.

Rather than responding exclusively to the loop error from moment to moment as is the case with proportional action, integral action is based on a summation of the error that has occurred over some period. This error sum is used to reset, or modify, the response of the control loop (output) based on a running average of the error. The amount of time over which the error averaging is accumulated is called the *reset period*.

Attribute FA11;**SU** is Unoccupied Setup/Setback. This point specifies the amount to add (if **SG** = 0) or subtract (if **SG** = 1) from the setpoint during an unoccupied period. The adjusted setpoint will be displayed in **CS**. The attribute **CS** (the effective setpoint incorporates any setup/setback that may exist as well as any reset or setpoint adjustment from the SBC-STAT. The data type of the value specified in **SU** is the same as the data type of the referenced measured variable specified by **IC**.

Attribute FA11;**CE** is Enable Control Loop. It enables the PID loop. When **CE** = 0, **PO** is not updated but may be set manually. When **CE** = 1, **PO** is updated by the PID control loop and if the analog output is set to automatic control, the **AO** value will be set accordingly.

3.6.5 OCCUPANCY DETECTOR

The Occupancy Detector attributes allow you to define the circumstances under which the SBC-VAV will automatically switch to an extended occupied mode during unoccupied periods when occupancy detector is used with the controller.

Attribute FC01;**MS** is Occupancy Status. This read-only point shows the status of the occupancy detector digital input. To enable occupancy detection, **MT** must be > 0 and UI1 MUST be configured as digital (UI1 **ST** = 0). If either of these two conditions are not met, **MS** will display 0. When this point is enabled (**MS** = 1) and when occupancy in the zone is detected during unoccupied periods, the occupancy input extends occupancy time by the amount specified in **MT**.

Attribute FC01;**IC** is Status Input. It enables occupancy detection (**IC** = 1) and specifies the binary input channel to be used for detection. This point uses a nonzero value from **UI1** to indicate occupancy.

Attribute FC01;**MD** is Extended Occupancy Delay. It 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.

Attribute FC01;**MT** is Extended Occupancy Duration. It defines, in minutes, the length of time needed to override the zone whenever occupancy is detected.

Attribute FC01;**MR** is Extended Occupancy Remaining. This read-only point displays the time remaining for occupancy detector override.

3.6.6 RELATIVE HUMIDITY

Beginning with v4.08 firmware, this family of devices can accept a single SBC-RHT sensor to monitor both temperature and humidity from a single thermostat. This application is valid only for single STAT sensor applications, and does not support multi-networking.

Attribute FE00;**RH** is Relative Humidity. This read-only point reflects the current sensed relative humidity from the space/zone from a connected SBC-RHT thermostat.

Attribute FE00;**HD** is Display Relative Humidity Mode. It defines whether or not relative humidity should be displayed on the LCD of a connected SBC-RHT thermostat.

Attribute FE00;**HC** is Relative Humidity Correction. It defines a correction offset to the measured relative humidity in the space/zone; providing a means to calibrate and adjust the sensed reading if necessary.

Attribute FE00;**HO** is Override Relative Humidity. It defines the ability to override the current sensed relative humidity for testing purposes when necessary.

Table 3-17 Auxiliary Attributes

	attr	description
Auxiliary: Fan FB01		
	FO	Fan/Damper Mode—used to configure the fan or damper.
	FS	Fan Setpoint—used to set the parallel fan, induction damper or constant volume setpoint (cfm).
	SF	Series Fan Unoccupied Mode—shows the status of the series fan during the unoccupied schedule state.
	FC	Minimum Cycle Time—shows the minimum amount of time, in minutes, during which the fan output will stay energized or de-energized.
	CV	Fan—defines the status of the fan output.
Auxiliary: Electric Reheat FA03		
	RO	Reheat Mode— used to configure the SBC-VAV's outputs for electric reheat. 0 = Disabled 1 = 2 stage electric reheat (K2 and 3) 2 = 2 stage electric reheat (K4 and 5) 3 = 4 stage electric reheat (K2,3,4, and 5)
	FR	Stage Requiring Flow—defines by the appropriate bit setting which of the available reheat stages requires a positive flow indication.
	AV	Available Stages—displays the stages that are currently for use.
	EN	Energized Stages—displays those reheat stages that are currently energized.
	AF	Require Max Airflow—if set to “Yes” (AF = 1), this holds off the addition of reheat stages until the PID loop is calling for maximum airflow.

Table 3-17 Auxiliary Attributes

	attr	description
	MX	Max Supply Temp—establishes a maximum supply duct temperature above which the reheats will deenergize.
	BA	Balance Stage usage—if set to “Yes” (BA = 1), this attribute considers the Run Hour Totals (FB0x;RH) for the individual triac outputs in energizing reheat stages.
	OF	Reheat Offset— specifies, in degrees, the offset from the calculated heating control setpoint (FE00;HC) that determines the temperature below which additional reheat stages can be energized.
	ID	Stage Delay—shows the minimum amount of time, in minutes, before the next reheat stage will be energized.
Auxiliary: Valve Control FA08 and FA09		
	ST	Valve Status—indicates the status of the valve channel.
	VU	Valve Use—options are disabled, cooling and heating.
	VM	Valve Mode—options are Pulse Width Modulation and Floating Point Motor Control.
	VA	Actual Valve Position—shows the actual valve position based on travel time.
	VD	Desired Valve Position—shows the desired valve position at which the loop should control the valve in order to bring the measured input variable closer to the setpoint.
	UT	Update Threshold—used to minimize the actuation of the valve for insignificant changes.
	RI	Valve Recalibrate Interval—shows the amount of time between valve recalibrations.
	VO	Valve Offset —used to configure the valve mode.
	VP	Valve Proportional Band—specifies the input variable range, in degrees (0.0 to 25.5), over which the output is proportional to the error value.
	VI	Valve Integration Constant—shows the amount of proportional error history (0 to 100%) used to calculate the desired position for the valve.
	VT	Valve Travel Time—shows the amount of time, in seconds, that it takes the valve motor to travel from a fully closed position to a fully opened one.
	PP	Pulse Duration Period—shows the amount of time, in seconds, that the valve is to be pulsed ON when PE = 1 or pulse width modulation is enabled.

Table 3-17 Auxiliary Attributes

	attr	description
	TL	Low Temp Lockout—offers protection against freeze-up. If a supply temperature sensor is not present, set this attribute to 999.0.
	TH	High Temp Lockout—heating stages will energize if only if there is a reliable source/duct temperature below this setting. If a supply temperature sensor is not present, set this attribute to 999.0.
	CD	Change Valve Direction—used to set the direction of the valve outputs.
	AM	Auto/Manual—selects the control mode for the valve output(s).
Auxiliary: PID Control FA11		
	SP	Loop Setpoint—specifies the desired loop setpoint.
	CS	Control Setpoint—shows the actual loop control setpoint.
	PO	Percent Output—shows the output value in hundredths of a percent.
	AO	Analog Output Current Value—shows the scaled output value used by the analog output.
	IN	Input Channel Value—displays the value of the input selected in IC.
	IC	Input Channel—specifies the input to be used for the measured variable for the control loop. 0 = disabled 1 = Zone Temp 2 = Supply Temp 3 = Flow 4 = UI1 5 = UI2 9 = Zone Heating 10 = Zone Cooling
	MR	Maximum Reset—specifies the maximum amount by which to reset the loop setpoint (SP) when reset is being used.
	RC	Reset Variable Value—displays the value of the input selected in RV.
	RV	Reset Variable—specifies the input to be used for calculating the reset. 0=disabled 1 = Zone Temp 2 = Supply Temp 3 = Flow 4 = UI1 5 = UI2
	RS	Reset Setpoint—specifies the value at which the reset action begins.

Table 3-17 Auxiliary Attributes

	attr	description
	RL	Reset Limit—specifies the value at which maximum reset is used.
	DB	Deadband—specifies the input variable range over which the output value is proportional to the error value.
	PB	Proportional Band—specifies the input variable range over which the output value is proportional to the error value.
	RP	Reset Period— specifies the reset period (in seconds) over which the error history is accumulated.
	RT	Rate—specifies a percentage of change in error that is to be used in calculating PO.
	SG	Control Sign—specifies the control action for the control loop.
	SU	SetUp/Setback—specifies the amount to add (if SG = 0) or subtract (if SG = 1) from the setpoint during an unoccupied period.
	CE	Control Enabled—enables the PID loop.
Auxiliary: Occupancy Detector FC01		
	MS	Occupancy Detector Input Status—shows the status of the occupancy detector digital input.
	IC	Occupancy Detector Enable—uses a nonzero value from UI1 to indicate occupancy.
	MD	Extended Occupancy Delay—sets the amount of time, in seconds, during which the occupancy detector must remain on before it will override the zone.
	MT	Extended Occupancy Duration—defines, in minutes, the length of time to override the zone whenever occupancy is detected.
	MR	Extended Occupancy Remainingc
Auxiliary: Relative Humidity FE00		
	RH	Relative Humidity—reflects the current sensed humidity from the zone/ space.
	HD	Display Relative Humidity—defines whether or not relative humidity should be displayed on the connected SBC-RHT's LCD display.

Table 3-17 Auxiliary Attributes

	attr	description
	HC	Relative Humidity Correction—defines a correction offset to apply against the measured humidity from the space/zone.
	HO	Override Relative Humidity—defines a means to override the sensed humidity for testing.

3.7 I/O SETUP

The following are Input/Output Setup attributes:

FE0x;**CV, RE, ST, DT, MN, MX, LL, HL, HS, AS, AE, SU, IP, IF, and OI.**

FD01;**CV, DT, MN, MX, LS, HS, and AM.**

FB0x;**CV, OP, RH, RL, and OI.**

3.7.1 UNIVERSAL INPUTS (UI1, UI2 and UI3)

I/O Setup offers specific operational options. It provides you with options to use either UI1 or UI2 for one of several SBC-VAV features. It can be used for the duct temperature input, as a proof of flow input, as an analog control PID input or as an occupancy detection input of the SBC-VAV. When FE0x is used as a duct temperature sensor input, energy totalization can be internally calculated and updated by the SBC-VAV. As a digital input, UI1 can be used as a proof of flow input safeguarding electric reheats when air flow is not present. When used as an occupancy detection sensor input, UI1 can be dedicated to the SBC-VAV occupancy detection feature—allowing for automatic unoccupied override. This sends the SBC-VAV into an occupied mode of operation when occupancy is detected in the control area. Each use precludes the use of the input for other functions. For instance if the input is used for occupancy detection, energy totalization/autowarm-up mode and proof of flow are disabled.

UI3 on the SBC-VAV controller is exclusively used for the controller's Indoor Air Quality feature, where a CO2 sensor must be connected to the input. If you are not using the SBC-VAV's Indoor Air Quality feature, you may still use UI3 as an extra Universal Input for other general purposes.

Attribute FE0x;**CV** is Current Value. It shows the current value of UI1. This attribute is read-only unless overridden (**OI** = 1).

Attribute FE0x;**RE** is Data Reliability and can be either a 0 or 1. It is set to 1 if the universal input is questionable. The digital input is considered unreliable during the input filtering delay time. Any time the digital input changes state (from 0 to 1 or from 1 to 0), it is considered questionable. If the digital input remains stable (does not change state) for **IF** seconds, the corresponding bit in **RE** is set back to 0—indicating a reliable/stable value. If the digital input does change state before **IF** seconds expire, the reliability bit remains set to 1—indicating that the change of state may be a digital input bounce.

Attribute FE0x;**ST** is Sensor Type. Through this point, you can select one of the following input types: digital, linear (scaled **MN** to **MX**), 4–20mA linear (scaled **MN** to **MX**), or thermistor (-22.0 to 122.0°F). The associated settings appear in Table 3-18.

Table 3-18: Sensor Types for FE0x

Value of ST	Sensor Type
ST = 0	digital
ST = 2	full scale, linear input scaled from MN to MX (0–10VDC)
ST = 3	4–20mA input scaled from MN to MX

Table 3-18: Sensor Types for FE0x

Value of ST	Sensor Type
ST = 7	-22.0 to 122.0°F (-30.0 to 50.0°C) thermistor (default)

When **ST** = 0, the universal input will be configured to operate as a digital input and will allow **CV** to display a 1 or a 0—the meaning of which is dependent on **IP** (input polarity). If **IP** = 0, a low voltage input (< 2.5VDC) to the universal input will result in **CV** = 0; a high voltage (> 2.5VDC) applied to the universal input will result in **CV** = 1. If **IP** = 1, a low voltage applied to the universal input will read as **CV** = 1; a high voltage will result in **CV** = 0.

Setting **ST** to 2 and having the SBC-VAV set up to use the appropriate hardware input provides the ability to use a 0–10VAC device as the input. The minimum and maximum values of the range are set in attributes **MN** and **MX**. For example if the input value is to be displayed as a percentage, then set **ST** = 2, **MN** = 0 and **MX** = 0 (0–100%). The SBC-VAV will determine the voltage input converted internally to raw counts, will scaled the raw counts (0–255) across the range 0–100 and will display the value of the input as a range of 0–100. For linear voltage devices, be sure that there is no jumper on the U11 row of pins on the IVR pin terminal block. *Section 2: Wiring and Installation.*

The following sample calculation shows how the SBC-VAV scales raw counts on the 10-bit U11 using a current value of 115. (The result is rounded.)

$$\mathbf{CV} = \mathbf{MN} + \left[\frac{\text{Current Counts} \times \mathbf{MX}}{\text{Max Counts}} \right]$$

$$\mathbf{CV} = 0.00 + \left[\frac{115 \times 100}{65,535} \right]$$

$$\mathbf{CV} = 0.00 + \left[\frac{11500}{65,535} \right]$$

$$\mathbf{CV} = 0.18$$

The following sample calculation shows how the SBC-VAV scales raw counts on the 10-bit input using a current value of 185 counts.

$$CV = MN \left[\frac{\text{Current Counts} \times (MX)}{\text{Max Counts}} \right]$$

$$CV = 0.0 \left[\frac{185 \times 100}{65,535} \right]$$

$$CV = 0.0 + \left[\frac{18500}{65,535} \right]$$

$$CV = 0.28$$

If the input's value was 185 in raw counts according to the percentage scaling of **MN** and **MX**, then the value of 0.25 (rounded) would be displayed in **CV**.

If you make the value of **MN** greater than the value of **MX**, the input is configured for reverse scaling. This is useful for 5–0VDC sensors (as opposed to 0–5VDC sensors).

The SBC-VAV also provides linear input scaling for 4–20mA current transmitters (**ST** = 3). For sensors that provide a 4–20mA signal, set **ST** = 3. Attributes **MN** and **MX** are used in the same way as they are for **ST** = 2.

Set **ST** = 7 if using a thermistor. For information on hardware settings, refer to *Section 2: Wiring and Installation*.

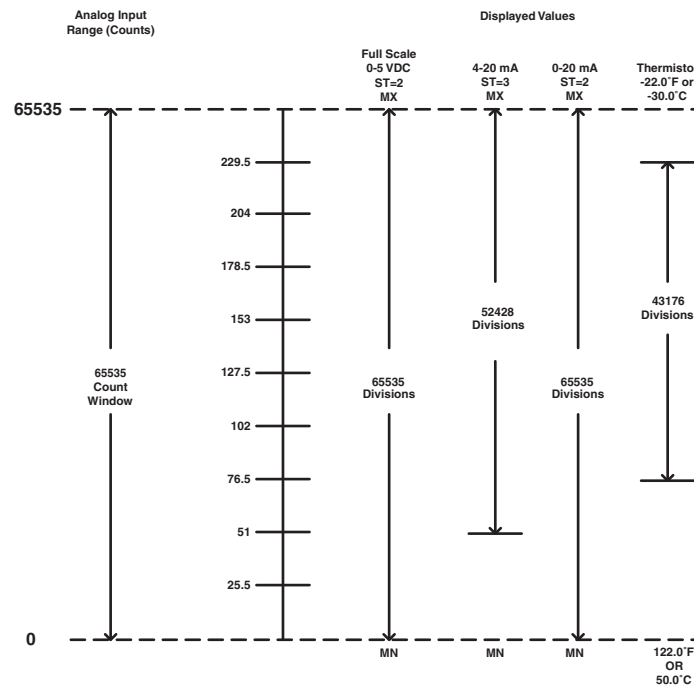


Figure 3-25: Analog Sensor Types

Attribute **DT** is PUP Data type for Input. It specifies the PUP data type for the input. The data type determines how certain universal input attributes are displayed. This point affects the display of **CV**, **MN**, **MX**, **SU**, **LL**, **HL** and **HS**. Data type codes determine the number of decimal places in the value and whether or not the value is signed (positive or negative) or unsigned. This attribute defaults to 253 (signed 9.1 digit).

Attribute FE0x;**MN** is Minimum Scaled Value. It specifies the minimum engineering unit for the input corresponding to the lowest value measured at the input connection. This point is used to scale the measured value to meaningful engineering units for display.

Attribute FE0x;**MX** is Maximum Scaled Value. It specifies the maximum engineering unit for the input corresponding to the highest value measured at the input connection. This point is used to scale the measured value to meaningful engineering units for display.

Attributes **MN** and **MX** program the minimum and maximum scaled values for linear, analog inputs (**ST** = 2 and **ST** = 3). For example if the input value is to be displayed as a percentage, you would set **ST** = 2, **MN** = 0 and **MX** = 100 (0–100%). The SBC-VAV will scale the raw counts 0–255 for 8-bit inputs across the range 0–100 and will display the value of the input for a range of 0–100. For linear input devices, be sure that the appropriate hardware is set on the SBC-VAV. For information on hardware settings, refer to *Section 2: Wiring and Installation*.

Attributes **LL**, **HL**, **HS**, **AS** and **SU** provide parameters for analog PUP alarming. The **AE** attribute determines whether or not input alarming is used.

Attribute FE0x;**LL** is Low Alarm Limit. It specifies the low alarm limit. If alarms are enabled and the current value drops below this value, a low limit alarm will be generated.

Attribute FE0x;**HL** is High Alarm Limit. It specifies the high alarm limit. If alarms are enabled and the current value rises above this value, a high limit alarm will be generated.

The data types of **LL** and **HL** are specified by the data type attribute **DT** of the universal inputs.

Attribute FE0x;**HS** is Alarm Limit Hysteresis. It determines when the SBC-VAV returns from a high or low limit alarm. In the case of a high limit alarm, the **CV** value must drop below **HL - HS** to cause a high limit return. For a low limit alarm, the **CV** value must rise above **LL + HS** to cause a low limit return. Figure 3-26 illustrates this concept.

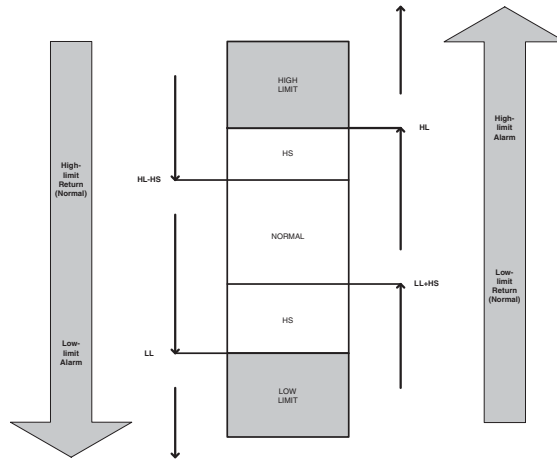


Figure 3-26: Alarm States and Thresholds for Limit Alarming

Attribute FE0x;**AS** is Alarm Status. It shows the current alarm condition. A value of 0 indicates a normal condition. A nonzero number indicates alarm generation. Table 3-19 explains each status.

Table 3-19: Values for Alarm Status Attribute

Value of AS	Alarm Condition
AS = 0	normal (no alarm)
AS = 1	contact (0 → 1)
AS = 2	contact (1 → 0)
AS = 3	change of state
AS = 5	low limit alarm
AS = 6	high limit alarm

Attribute FE0x;**AE** is Alarm Enable. It specifies the type of alarm checking to be done on the **CV** value. A value of 0 indicates that alarming is disabled; a nonzero value selects one of several alarm functions. Table 3-20 lists the options for **AE**.

Table 3-20: Alarm Enable Options

Value of AE	Alarm Type Enabled
AE = 0	disabled
AE = 1	contact, 0 → 1
AE = 2	contact, 1 → 0
AE = 3	change of state, 1 ↔ 0
AE = 4	low limit alarm
AE = 5	high limit alarm
AE = 6	low and high limit

Attribute FE0x;SU is the Amount to Setup/Setback Alarm Limit. It specifies the amount added to **HL** or subtracted from **LL** during unoccupied periods. The attribute is added to **HL** defining the unoccupied high-limit alarm threshold; **SU** is subtracted from **LL** defining the unoccupied low-limit alarm threshold.

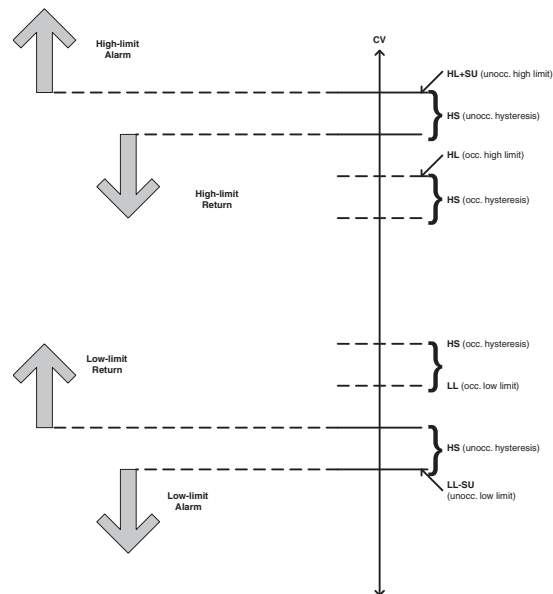


Figure 3-27: Unoccupied Setup/Setback Alarm Shifting

Attribute FE0x;**IP** is Input Polarity. It specifies the input polarity when configured as digital. A value of 0 in **IP** indicates that a low voltage displays as **CV** = 0 and a high voltage displays as **CV** = 1. A value of 1 in **IP** indicates that a low voltage displays as **CV** = 1, and a high voltage displays as **CV** = 0.

Attribute FE0x;**IF** is Input Filter Delay. It specifies the amount of time in tenths of seconds during which an input configured as digital must remain stable in order for the value to be considered reliable if fluctuations are not uncommon. This is also the weighted gain if the input is configured as analog. This attribute is used in the following equation to calculate the average value:

$$\text{Average Value} = \frac{(\text{Old Value} \times \text{IF}) + \text{New Value}}{\text{IF} + 1}$$

Attribute FE0x;**IF** for digital inputs is determined by the amount of time that the input is in the most recent change of state. The attribute's resolution for digital inputs is user adjustable in tenths of seconds. The default for digital and analog input filtering is 0.0.

Attribute FE0x;**OI** is Override Input. It allows a host or operator to directly set the value of the source/duct temperature. This attribute defaults to 0. When it is enabled (**OI** = 1), you can manually write to **CV**.

CAUTION

*If the Zone Temperature Alarms attribute **OI** is enabled and the power to the unit is removed or lost, you must immediately rewrite to the Zone Temperature Alarms attribute **CV**. The attribute **CV** will have 00.0 as a reading when power is restored to the unit. If not corrected, this situation will have a detrimental effect on the operation of the unit.*

3.7.2 ANALOG OUTPUT (AO1)

Analog Output provides an 8-bit, 0–10VDC output signal. You can control the analog outputs by writing a value to **CV**, by having a host controller on the EIA-485 communications network write a value to **CV** (still in manual mode) or by automatically controlling the SBC-VAV's analog control.

Attribute FD01;**CV** is Current Output Value. It shows the current value for the analog output, any portion of the 0–10VDC signal. This value may be set manually or automatically. In manual mode (**AM** = 0), the analog output is set by an operator or host by changing **CV**. In automatic mode (**AM** = 1), the analog controls are used to set the value. See the PID control subsection in this section for more information.

Attribute FD01;**DT** is PUP Data type for Output. It specifies the PUP data type for the analog output. The data type determines how certain analog output attributes are displayed. This point affects the display of **CV**, **MN** and **MX**. The attribute defaults to 252 (unsigned, 9.1 digit).

Attribute FD01;**MN** is Minimum Scaled Value. It specifies the minimum scaled value for the analog output corresponding to the lowest value output. This point is used to scale the measured value to meaningful engineering units for display.

Attribute FD01;**MX** is Maximum Scaled Value. It specifies the maximum scaled value for the analog output corresponding to the highest value output. This point is used to scale the measured value to meaningful engineering units for display.

NOTE

Reverse scaling can be accomplished by setting **MN** > **MX**. The attributes **MN** and **MX** default to 0.00 and 100.0, respectively.

Attribute FD01;**LS** is Minimum Scaled Voltage. It specifies the actual analog output value for a **CV** value of **MN**.

Attribute FD01;**HS** is Maximum Scaled Voltage. It specifies the actual analog output value for a **CV** value of **MX**.

Attributes **LS** and **HS** specify a range of the total output signal that is then scaled across **MN** and **MX**. The low and high voltages can range from 0.0VDC to 10.0VDC. Reverse scaling can be accomplished by setting **LS** > **HS**. Attributes **LS** and **HS** default to 0.0% and 100.0%, respectively. For example if the analog output value **CV** is to be displayed as a percentage (0–100) of a 10VDC output range, then set **MN** to 0 and **MX** to 100 (a 0.0%–100.0% display range). Set **LS** = 0.0% and **HS** = 100.0% (the full range of the output signal) because **CV** = 0 represents 0.0% of the output range **CV** = 100 represents 100.0% of the output range. Refer to Figure 3-28.

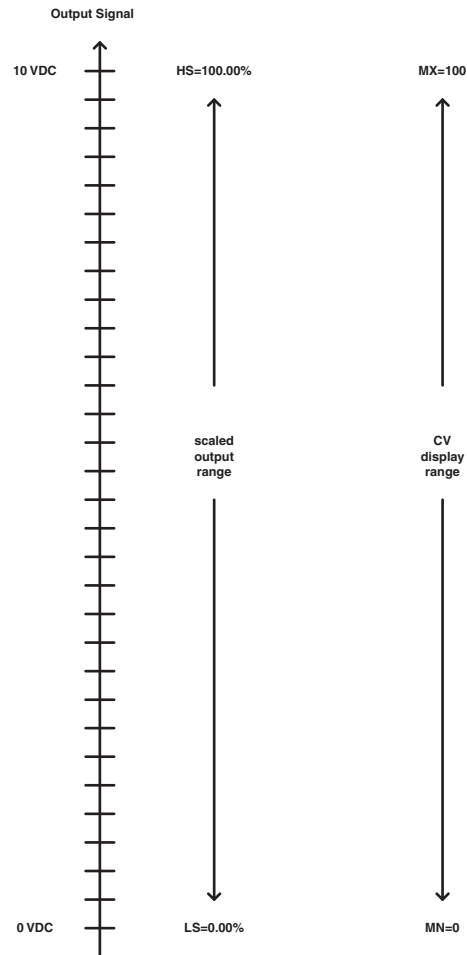


Figure 3-28: Analog Output Example 1

Attributes **MN** and **MX** can be adjusted to display the output signal between a particular range other than a typical 0–100%. Similarly **LS** and **HS** may be adjusted if the desired output signal is something other than the standard 0–10VDC. For example, assume that an actuator requires a 2–10VDC signal to go full stroke. Further assume that the application requires **CV** to be displayed as the current voltage (rather than 0%–100%). In this example, **MN** = 2.0 and **MX** = 10.0 to represent the display range of the output signal in engineering units (2–10VDC). Attribute **LS** would be set to 20% (20% × 10VDC range = 2VDC minimum signal) and **HS** would be set to 100% (100% × 10VDC range = 10VDC maximum signal). Refer to Figure 3-29.

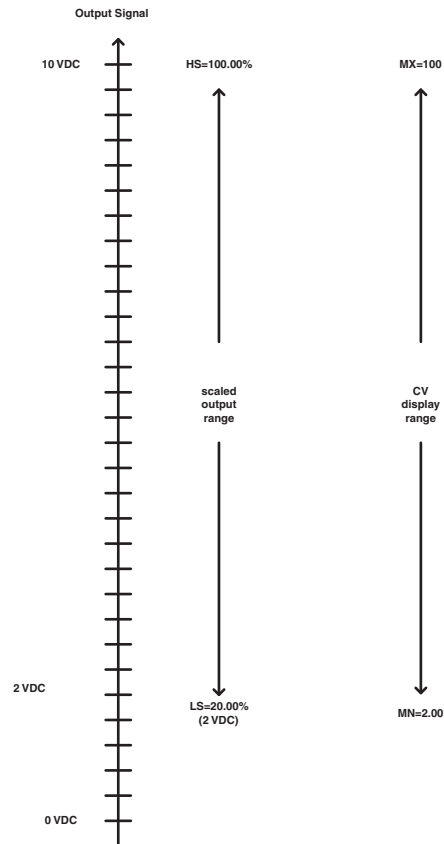


Figure 3-29: Analog Output Example 2

Attribute FD01;**AM** is Automatic/Manual Control. It selects the control mode for the analog output. If **AM** = 0 (Manual), then **CV** must be set manually to the desired value by changing **CV**. If **AM** = 1 (Automatic), then **CV** is set by the corresponding analog control loop. (Control loop FA04 controls FD01.)

3.7.3 RELAY OUTPUTS

Attribute FB0x;**CV** is Current Value. This point reflects the current requested state of the output as determined by the output control.

Attribute FB0x;**OP** is Output Polarity. It is used to define whether the output is normal acting (**OP** = 0) or reverse acting (**OP** = 1). As a *normal* acting output, the output is off when output control is not calling for the output to be on. As a *reverse* acting output, the output is off when the control loop is calling for the output to be on.

Attribute FB0x;**RH** is Runtime Hours. It is a time tracking attribute that displays hours and tenths of hours. The point reflects the amount of time that the output is actually allowing the fan to run as determined by the Relay Output attribute **OP** and the control loop demand. Run hours are stored in EEPROM automatically at midnight and when the System attribute **BU** is enabled. Attribute **RH** is restored with the latest backed up information upon restoration of power after shut down or power loss. This attribute defaults to 0.

NOTE

You should perform an attribute back up (System attribute **BU** = 1) after clearing the Relay Output attribute **RH**. Otherwise the most recent “stored” value will be restored in **RH** after a power loss.

Attribute FB0x;**RL** is Runtime Limit. It specifies a runtime limit in hours for the output. Once the run hours for the fan output exceed the runtime limit (**RH** > **RL**), the SBC-VAV will generate a runtime limit alarm. To clear the run limit alarm or to receive another run limit alarm, you **MUST** set **RH** to 0.

Attribute FB0x;**OI** is Override. This attribute overrides the digital output. You can choose from four options: On (**OI** = 1) constantly energizes the output; Off (**OI** = 0) disables the output; Auto (**OI** = 2) allows for automatic control; Manual (**OI** = 3) allows the CV to be directly written to.

Table 3-21 Input/Output Attributes

	attr	description
I/O: Universal Inputs (UI1- UI2) FE0x		
	CV	Current Value —(read-only unless OI = 1) shows the current value of UI1.
	RE	Channel Reliability —can be either a 0 or 1. It is set to 1 if the universal input is questionable. Any time the digital input changes state (from 0 to 1 or from 1 to 0), it is considered questionable. If the digital input remains stable (does not change state) for IF seconds, the corresponding bit in RE is set back to 0—indicating a reliable/stable value. If the digital input does change state before IF seconds expire, the reliability bit remains set to 1—indicating that the change of state may be a digital input bounce.
	ST	Sensor Type —allows you to select an input type. 0 = digital 2 = full scale, linear input scaled from MN to MX 3 = 4-20mA input scaled from MN to MX 7 = -22.0 to 122.0°F thermistor
	DT	Datatype for Input —specifies the PUP data type for the input. The default is 253 (signed 9.1 digit).
	MN	Minimum Scaled Value —program the minimum scaled values for linear, analog inputs.

Table 3-21 Input/Output Attributes

	attr	description
	MX	Maximum Scaled Value —program the maximum scaled values for linear, analog inputs.
	LL	Low Alarm Limit —specifies the low alarm limit. If alarms are enabled and the current value drops below this value, a low limit alarm will be generated.
	HL	High Alarm Limit —specifies the high alarm limit. If alarms are enabled and the current value rises above this value, a high limit alarm will be generated.
	HS	Alarm Limit Hysteresis —a value that determines when the SBC-VAV returns from a high- or low-limit alarm. For a high-limit alarm, the CV must drop below HL - HS to cause a high limit return. For a low-limit alarm, the CV value must rise above LL + HS to cause a low limit return.
	AS	Alarm Status —shows the current alarm condition. 0 = no alarm 1 = contact (0 to 1) 2 = contact (1 to 0) 3 = change of state 5 = low limit alarm 6 = high limit alarm
	AE	Alarm Enable —specifies the type of alarm checking to be done on the CV value. 0 = disabled 1 = contact (0 to 1) 2 = contact (1 to 0) 3 = changed of state 4 = low limit alarm 5 = high limit alarm 6 = low and high limit
	SU	Alarm Limit Setup/Setback —specifies a value that is added to HL and subtracted from LL during unoccupied periods.
	IP	Input Polarity —specifies the input polarity when configured as digital. 0 = low voltage displays as CV = 0, high voltage displays as CV = 1 1 = low voltage displays as CV = 1, high voltage displays as CV = 0
	IF	Input Filtering/Averaging —specifies the amount of time in tenths of seconds during which an input configured as digital must remain stable in order for the value to be considered reliable if fluctuations are not uncommon.

Table 3-21 Input/Output Attributes

	attr	description
	OI	Override Input —enables/disables overriding CV . If OI = 0, override is disabled and CV displays the value of the input. If OI = 1, the override is enabled and the value of CV can be manually changed. 0 = disabled 1 = enabled
I/O: Analog Output (AO1) FD01		
	CV	Current Value —shows the current value for the corresponding analog output.
	DT	Datatype for Input —specifies the PUP data type for the analog output. DT affects the display of CV , MN , and MX . DT defaults to 252 (unsigned, 9.1 digit).
	MN	Minimum Value —specifies the minimum scaled value for the analog output corresponding to the highest value output.
	MX	Maximum Value —specifies the maximum scaled value for the analog output corresponding to the highest value output.
	LS	Low Scaled Voltage —specifies the actual analog output value for a CV value of MN .
	HS	High Scaled Voltage —specifies the actual analog output value for a CV value of MX .
	AM	Control Mode —specifies how the analog output is controlled: 0 = manual 1 = automatic
I/O: Relay Outputs (K1-K5) FB0x		
	CV	Current Value—shows the current value for the analog output.
	OP	Output Polarity—allows you to change the polarity of the output.
	RH	Runtime Hours—shows the total amount of time, in hours, during which the output has been energized.
	RL	Runtime Limit—specifies a run time limit in hours for the output.

Table 3-21 Input/Output Attributes

	attr	description
	OI	Override —overrides the digital output. 0 = Off (default) 1 = On 2 = Auto 3 = Manual

3.8 NETWORKING

The following are Networking attributes:

FF00;**ID**, **ZN**, **CP**, **TP**, **ER**, and **U1-U4**.

F005;**CV** and **RB**.

3.8.1 CONFIGURATION

Attribute FF00;**ID** is the Unit Number. This value is used to set a unique network address for each controller connected on a multidrop. Each **ID** is factory set to the last four digits of the board serial number. Valid values are 0 to 9999. For example, if the serial number is 100072, the Unit ID is 72. If the serial number is 498765, the Unit ID is 8765.

Attribute FF00;**ZN** is Zone Number. The Zone Number (from 0 to 65,535) is used to group controllers together so that they can be controlled simultaneously. For example you can set a group of controllers to enter Warm-Up Mode all at the same time. The Zone Number programs a Zone Address. The SBC-VAV uses this code to decide whether or not a PUP Write Zone Attribute command should be honored by this unit. This attribute defaults to 0.

Attribute FF00;**CP** is Communication Speed. It specifies the communication speed (baud rate) at which devices on the network will communicate. American Auto-Matrix unitary controllers communicate over EIA-485 networks using PUP. All devices on the same multidrop must have **CP** set to the same value. Valid baud rates are as follows: 0=9600, 1=4800, 2=2400, 3=1200, 6=38.4K, 7=19.2K, 8=115.2K and 9=57.6K. This attribute defaults to 0.

Table 3-22: Communication Speed Options

Value of CP	Baud Rate
0	9600
1	4800
2	2400
3	1200
6	38.4K
7	19.2K
8	115.2K
9	57.6K

NOTE

In order for a change of **CP** to take effect, you must reset the SBC-VAV.

Attribute FF00;**TP** is Token Passing Type. This attribute defines the mode for token passing. When a controller is an Irresponsible Peer it will always return a token to the device that passed it, after performing any pending transactions. In Full Administrator mode, the token is passed to each unit listed in the Peer List (FF00;**U1** through FF00;**U4**).

Attribute FF00;**ER** is Token Recovery. This attribute enables Token Recovery. In a token passing environment there should always be network activity, but if a token is lost the network will fall silent. If Token Recovery is enabled, and a token is lost, Full Administrator will detect the condition and initiate a new token.

Attribute FF00;**U1-U4** is Peer Unit Number. This attribute defines the Unit ID of a peer. In Full Administrator mode, the token is passed to each unit in the Peer List.

Attribute FF00;**MS** is Trend Master unit number. **MS** is used in configuring the display of trends from a SAGE on the lcd display of a STAT3 connected to the This is the unit number of the SAGE area controller that stores the trend information which will be displayed.

3.8.2 SCHEDULE BROADCAST

The Schedule Broadcast attributes allow the SBC-VAV to receive network schedule information.

Attribute F005;**CV** is Current Value. It shows the current value of the network broadcast schedule values received by the SBC-VAV. When **RB** is enabled, **CV** is forced into the Main Schedule attribute **CV** and is used as the functioning schedule value of the SBC-VAV.

Attribute F005;**RB** is Receive Broadcast. It enables the SBC-VAV to receive network broadcasts and sets F900;**CV** value based on the received value. If **RB** = 0, then receive broadcast is disabled. If **RB** = 1, then the SBC-VAV receives the network value and places it in **CV** and Main Schedule attribute **CV**. (This overrides the schedules of the SBC-VAV, which become ineffective.

Table 3-23 Network Attributes

	attr	description
Network: Configuratio n FF00		
	ID	Unit ID —is a unique network address for each controller connected on a multidrop.
	ZN	Zone Number —(from 0 to 65,535) is used to group controllers together so that they can be controlled simultaneously.

Table 3-23 Network Attributes

	attr	description
	CP	Communication Speed —specifies the communication speed (baud rate) at which devices on the network will communicate. 0=9600 1=4800 2=2400 3=1200 6=38.4K 7=19.2K 8=115.2K 9=57.6K
	TP	Token Passing Type —defines the mode for token passing. When a controller is an Irresponsible Peer it will always return a token to the device that passed it, after performing any pending transactions. In Full Administrator mode, the token is passed to each unit listed in the Peer List (FF00;U1 through FF00;U4).
	ER	Token Recovery —in a token passing environment there should always be network activity, but if a token is lost the network will fall silent. If Token Recovery is enabled, and a token is lost, Full Administrator will detect the condition and initiate a new token.
	U1 - U4	Peer Unit Number —defines the Unit ID of a peer. In Full Administrator mode, the token is passed to each unit in the Peer List.
	MS	Trend Master unit number —specifies the unit ID of the SAGE area controller containing the trend information to be displayed on a connected STAT3.
Network: Schedule Broadcast F005		
	CV	Current Value —shows the current value of the network broadcast schedule values received by the SBC-VAV.
	RB	Receive Broadcast —enables the SBC-VAV to receive network broadcasts and sets F900;CV based on the received value.

SECTION 4: CONFIGURATION

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

IN THIS SECTION

Scheduling	4-2
Inactive Schedule State.....	4-4
All-day Override	4-4
Schedule Broadcast.....	4-5
Power-up State.....	4-5
Host Override.....	4-7
Zone Scheduling.....	4-7
Occupancy Detection.....	4-7
User Override.....	4-9
Setting the Temperature and Flow Setpoints	4-11
SBC-VAV Control Modes	4-16
Constant Air Volume (CAV).....	4-16
Supply Dependant (VST)	4-16
Heating Only	4-18
Cooling Only	4-21
Cooling with Reheat.....	4-23
Auxiliary Functions.....	4-25
Series Fan.....	4-25
Parallel Fan.....	4-25
Induction Damper.....	4-25
Valve Control.....	4-26
Digital Outputs.....	4-29
Dual Duct Applications.....	4-30
Tracking	4-31
Indoor Air Quality	4-32

4.1 SCHEDULING

Scheduling controls the current zone temperature setpoint of the SBC-VAV. Internal schedules can be defined by the user in the Schedules:Clock/Calendar and Summary [F900] channel attributes, and the Schedules:(1-6) [F90(1-6)] attributes. Using these channels, the user can determine when and in which schedule mode (or state) the SBC-VAV will operate—occupied, warm-up, unoccupied, or night setback. See Section 3: SBC-VAV Attributes for a description of each schedule mode.

The SBC-VAV is equipped with:

- . a Schedules:Clock/Calendar channel with user-definable attributes that reflect the current time, date, and day, and whether or not the current day is a holiday
- . a Schedules:Summary channel
- . six internal schedule channels in which the user can define the SBC-VAV schedule modes.

The Schedules:Summary channel:

- . reflects the values of and has an effect on how the six internal schedule channels operate
- . allows the user to enter the dates of ten holidays
- . allows the user to select the method of control employed when the SBC-VAV is in an inactive schedule state
- . indicates the zone reception of schedule information over the EIA-485 PUP network
- . includes host schedule control options.

In addition, the user can enter the dates of ten (10) holidays in the Schedules:Clock/Calendar channel.

To configure the internal schedules by which you want the SBC-VAV to operate, refer to Table 4-1.

NOTE
<p>Before configuring the internal schedules, set the Schedules:Clock/Calendar:Date [F900;DT] and Current Time [F900;TM]. If you manually set the time and date, also click on the radio button next to the current day in the Day [F900;DA] attribute. Even if the current day is already selected (this attribute defaults to <i>Monday</i>), you must click on the radio button next to the current day to set it.</p>

Table 4-1 : Configuring the SBC-VAV for Internal Scheduling

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Schedules: Clock/Calendar: Current Time	In the field provided, enter the current time or verify that the clock has been synchronized.	Set F900; TM = the current time or verify that the clock has been synchronized.

Table 4-1 : Configuring the SBC-VAV for Internal Scheduling

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Schedules: Clock/Calendar: Current Date	In the field provided, enter the current date. (E.g., 9/15/01)	Set F900; DT to the current date.
Schedules: Clock/Calendar: Day	Click on the radio button next to the current day.	Set F900; DA to the current day.
Schedules: (1-6): Warm-up Time	In the field provided, enter the time at which you want warm-up mode to begin.	Set F90(1-6); WO = the time at which you want warm-up mode to begin.
Schedules: (1-6): Occupied Time	In the field provided, enter the time at which you want occupied mode to begin. (Warm-up mode ends at this time.)	Set F90(1-6); OC = the time at which you want occupied mode to begin. (Warm-up mode ends at this time.)
Schedules: (1-6): Unoccupied Time	In the field provided, enter the time at which you want unoccupied mode to begin. (Occupied mode ends at this time.)	Set F90(1-6); UN = the time at which you want unoccupied mode to begin. (Occupied mode ends at this time.)
Schedules: (1-6): Night Setback Time	In the field provided, enter the time at which you want night setback mode to begin. (Unoccupied Mode ends at this time.)	Set F90(1-6); NS = the time at which you want night setback mode to begin.
Schedules: (1-6): Active Days	Click on (place a check in) the check boxes next to the day(s) by which you want the schedule to run.	Use the F90(1-6); AD bitmap to select the days by which you want the schedule to run. Set the days you want to be active = 1.

In a situation in which schedules may overlap, the SBC-VAV will prioritize the schedule modes. The controller checks Schedule 1 through Schedule 6 for the highest priority schedule mode, and operates in that mode. Schedule modes take precedence in the following order:

1. Occupied (highest priority)
2. Warm-up
3. Unoccupied
4. Night Setback (lowest priority)

Eight factors can cause the current internal schedule to be overridden. The following list is the order of precedence in which the overrides can occur.

1. User Override from SBC-STAT (highest priority)
2. Occupancy Detection
3. Broadcast Zone Value
4. Host Override

5. Power-up State
6. Schedule Broadcast
7. All-day Override
8. Inactive Schedule State (lowest priority)

The following subsections provide an explanation of the eight factors that can cause the current internal schedule to be overridden.

4.1.1 INACTIVE SCHEDULE STATE

The current internal schedule will be overridden if the Schedules:Summary:**Inactive Schedule State** [F900;**IS**] attribute is set to a higher priority schedule mode than the current internal schedule's active mode. For example, if the current internal schedule's active mode is unoccupied, and **IS** is warm-up, the current internal schedule will be overridden and the SBC-VAV will operate in warm-up mode (warm-up mode is a higher priority schedule mode than unoccupied mode). To change **IS**, refer to Table 4-2.

Table 4-2 : Changing the Inactive Schedule State

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Schedules: Summary: Inactive Schedule State	Select the desired schedule mode from the drop-down box.	Set F900; IS = to the desired schedule mode. Unoccupied = 0 Warm-up = 1 Occupied = 2 Night Setback = 3

The schedule mode set **IS** will be the active schedule mode unless:

- . the active schedule mode is a higher priority mode
- . all-day override occurs
- . a scheduled broadcast is received
- . a soft reset of the SBC-VAV occurs or power is restored after an unscheduled power loss and the current time is **not** set or has **not** been synchronized
- . the host overrides the schedule
- . a zone broadcast is received
- . an occupancy sensor is properly configured and occupancy is detected
- . user override occurs.

4.1.2 ALL-DAY OVERRIDE

The current internal schedule can be overridden using the Schedules:(1-6):**All-day Override** [F90(1-6);**AO**] attribute. For example, if the internal schedule in the Schedules:2 [F902] channel is the active schedule, and unoccupied is the active schedule mode, the user can override the unoccupied mode by setting **AO** to another desired schedule mode. The SBC-VAV will remain in **AO** mode until Schedules:2 is no longer the active schedule. To employ all-day override, refer to Table 4-3.

The schedule mode set in **AO** will be the active mode until:

- . the internal schedule that is being effected by the all-day override is no longer the active schedule
- . the active internal schedule's **AO** attribute is set to *none* [F90(1-6);**AO** = 0]
- . a scheduled broadcast is received

- . a soft reset of the SBC-VAV occurs or power is restored after an unscheduled power loss and the current time is **not** set or has **not** been synchronized
- . the host overrides the schedule
- . a zone broadcast is received
- . an occupancy sensor is properly configured and occupancy is detected
- . user override occurs.

Table 4-3 : Overriding the Current Internal Schedule Using All-day Override

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Schedules: (1-6) [whichever schedule is the active schedule]: All-day Override	Select the desired schedule mode from the drop-down box in the active internal schedule.	Set F90(1-6); AO = the desired schedule mode. None = 0 Unoccupied = 1 Warm-up = 2 Occupied = 3 Night setback = 4

4.1.3 SCHEDULE BROADCAST

Broadcast Schedules are schedules sent out by networked controllers. The active internal schedule will be overridden if the SBC-VAV is configured to receive network broadcast schedules. If the Network:Schedule Broadcast:**Receive Broadcast?** [F005;**RB**] attribute is enabled, the current schedule will reflect the Network:Schedule Broadcast:**Current Value** [F005;**CV**] attribute. To configure the SBC-VAV to receive network broadcast schedules, refer to Table 4-4.

The schedule mode set by the schedule broadcast is the active mode until:

- . a soft reset of the SBC-VAV occurs or power is restored after an unscheduled power loss and the current time is **not** set or has **not** been synchronized
- . the host overrides the schedule
- . a zone broadcast is received
- . an occupancy sensor is properly configured and occupancy is detected
- . user override occurs.

4.1.4 POWER-UP STATE

If an unscheduled power loss occurs and power is restored, or if a soft reset of the SBC-VAV occurs (System:Power-up:**Reset the SBC-VAV?** enabled [FF00;**RS** = 1]), the SBC-VAV will operate in the schedule mode defined by the user in the **Power-up State** [FF00;**PS**] attribute until the Schedules:Clock/Calendar:**Current Time** [F900;**TM**] is set or synchronized by a host. To set the schedule mode in which

you want the SBC-VAV to operate upon power restoration or after a soft reset has occurred, refer to Table 4-5.

Table 4-4 : Configuring the SBC-VAV to Receive Broadcast Schedules

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Network: Schedule Broadcast: Receive Broadcast	Click on the radio button next to Yes.	Set F005; RB = 1.
Schedules: Summary: Host Overrides Local Schedules?	Click on the radio button next to No.	Set F900; HE = 0.
Schedules: Summary: Received Schedule	Click on the radio button next to No.	Set F900; ZE = 0.
Schedules: Clock/Calendar: Current Time	In the field provided, enter the current time of day or verify that the clock has been synchronized.	Set F900; TM = the current time, or verify that the clock has been synchronized.
Schedules: Clock/Calendar: Day	Click on the radio button next to the current day. Note that even if the correct day is already selected, you must click on it again to activate the setting.	Set F900; DA = the current day.

Table 4-5 : Setting the SBC-VAV's Power-up State

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
System: Power-up: Power-up State	Click on the radio button next to the schedule mode in which you want the SBC-VAV to operate upon power restoration or after a soft reset has occurred.	Set FF00; PS = the schedule mode in which you want the SBC-VAV to operate upon power restoration or after a soft reset has occurred. . Unoccupied = 0 . Warm-up = 1 . Occupied = 2 . Night setback = 3

NOTE

The SBC-VAV will remain in the schedule mode set in **PS** until **TM** is set or synchronized by a host. Once the **TM** is set or synchronized, the SBC-VAV will return to its internal schedule mode. Also note that one of the other overriding factors may be preventing the SBC-VAV from returning to the expected schedule mode once the **TM** is set or synchronized.

4.1.5 HOST OVERRIDE

When the Schedules:Summary:**Host Overrides Local Schedules?** [F900;**HE**] attribute is enabled, the host can set the value of the **Schedule Status** [F900;**CV**] attribute through the **Host Schedule Setting** [F900;**HO**] attribute. To enable host override, set **HE** to yes [F900;**HE** = 1].

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

- . a soft reset of the SBC-VAV occurs or power is restored after an unscheduled power loss and the current time is **not** set or has **not** been synchronized
- . a zone broadcast is received
- . an occupancy sensor is properly configured and occupancy is detected
- . user override occurs.

4.1.6 ZONE SCHEDULING

Zone scheduling allows controllers with the same zone number to be scheduled identically by a master unit. If the Schedules:Summary:**Received Schedule** [F900;**ZE**] attribute is enabled, zone scheduling is in effect and the SBC-VAV's schedule follows the last value successfully written to the **Current Value** [F900;**CV**] attribute by a PUP network 'Zone Attribute Write' command specifically for the defined zone. The defined zone is determined by the user in the Network:Configuration:**Zone Number** [FF00;**ZN**] attribute. All controllers on the network with the same **ZN** will receive the broadcast. To configure the SBC-VAV to receive zone scheduling broadcasts, refer to Table 4-6.

The broadcast Zone Schedule will be the active schedule mode unless:

- . an occupancy sensor is properly configured and occupancy is detected
- . user override occurs.

4.1.7 OCCUPANCY DETECTION

The occupancy detection feature enables the SBC-VAV to automatically go to occupied mode, (also called extended occupancy,) provided that an occupancy sensor is properly installed and the SBC-VAV is properly configured. The length of time that the SBC-VAV will operate in extended occupancy is defined by

the user in the Aux:Occupancy Detector:**Extended Occupancy Duration** [FC01;MT] attribute. To configure the SBC-VAV for occupancy detection capability, refer to Table 4-7.

Table 4-6 : Configuring the SBC-VAV to Receive Zone Scheduling Broadcasts

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Schedules: Summary: Received Schedule	Click on the radio button next to Yes.	Set F900; ZE = 1.
Network: Configuration: Zone Number	The value entered in the field next to this attribute must be the same as the master unit that broadcasts the zone scheduling, otherwise, the SBC-VAV will not receive the zone scheduling broadcast.	FF00; ZN must be = the master unit that broadcasts the zone scheduling, otherwise, the SBC-VAV will not receive the zone scheduling broadcast.

Table 4-7 : Configuring the SBC-VAV for Occupancy Detection Capability

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
I/O Setup: Input (UI1): Sensor Type	Click on the radio button next to Digital.	Set FE01; ST = 0.
Aux: Occupancy Detector: Mode	Click on the radio button next to Enabled (UI1).	Set FC01; IC = 1.
Aux: Occupancy Detector: Extended Occupancy Delay	In the field provided, enter the desired number of seconds the occupancy detector is to detect occupancy before overriding the zone. This prevents false triggering of occupancy detection in the event that someone or something quickly passes through the zone.	Set FC01; MD = the desired number of seconds the occupancy detector is to detect occupancy before overriding the zone. This prevents false triggering of occupancy detection in the event that someone or something quickly passes through the zone.

Table 4-7 : Configuring the SBC-VAV for Occupancy Detection Capability

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Aux: Occupancy Detector: Extended Occupancy Duration	In the field provided, enter the desired number of minutes the SBC-VAV is to remain in extended occupancy once it is detected that the zone is occupied. This value must be greater than zero, otherwise the SBC-VAV will not go into extended occupancy.	Set FC01; MT = the desired number of minutes the SBC-VAV is to remain in extended occupancy once it is detected that the zone is occupied. This value must be > 0, otherwise the SBC-VAV will not go into extended occupancy.

NOTE

If the **Extended Occupancy Duration** is not set to a value greater than zero [FC00;**MT** > 0], the SBC-VAV will not go into extended occupancy when it is detected that the zone is occupied.

4.1.8 USER OVERRIDE

If the active schedule by which the SBC-VAV is in unoccupied mode, user override is possible. If the user presses the up or down arrow push-button on the SBC-Stat2 or SBC-Stat3 and the Temperature:Override:**User Override** attribute is enabled [FE00;**SE** = 1], the SBC-VAV will go to occupied mode. The duration of this mode, which is also called extended occupancy, can be set by using the Temperature:Override:**Extended Occupancy Duration** [FE00;**ED**] attribute. To configure the SBC-VAV for user override ability via an SBC-STAT, refer to Table 4-8.

Table 4-8 : Configuring the SBC-VAV for User Override Ability

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Temperature: Override: User Override	Click on the radio button next to Enabled.	Set FE00; SE = 1.

Table 4-8 : Configuring the SBC-VAV for User Override Ability

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Temperature: Override: Extended Occupancy Duration	In the field provided, enter the number of minutes you want the SBC-VAV to remain in occupied mode (extended occupancy) once the up or down arrow push-button on the SBC-STAT2 or STAT3 is pressed. This value must be greater than zero, otherwise, user override will not take effect.	Set FE00;ED = the number of minutes you want the SBC-VAV to remain in occupied mode (extended occupancy) once the up or down arrow push-button on the SBC-STAT2 or STAT3 is pressed. This value must be > 0, otherwise, user override will not take effect.

4.2 SETTING THE TEMPERATURE AND FLOW SETPOINTS

This section provides guidelines for configuring the temperature and flow setpoints of the SBC-VAV. The SBC-VAV maintains the zone according to the Temperature:Heating/Cooling Setpoints:**Current Setpoints** [FE00;**CH** and FE00;**CC**].

NOTE

Before setting the temperature setpoints, set the System>About:**Engineering Units** to the desired unit of measurement—*English* or *Metric*. Set FF00;**EM** = the desired engineering units.

- . English = 0
- . Metric = 1

Changing **EM** will automatically convert all setpoint and offset attributes to the same units.

Flow settings and readings are always in CFM.

Table 4-9 : Setting the Heating Control Temperature Setpoints

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Temperature: Heating Setpoints: Occupied Setpoint	In the field provided, enter the temperature that you want the zone to maintain when the active schedule mode is occupied. During occupied mode, the Temperature:Heating Setpoints: Current Setpoint is equal to the Occupied Setpoint .	Set FE00; SH = the temperature that you want the zone to maintain when the active schedule mode is occupied. During occupied mode: FE00; CH = FE00; SH
Temperature: Heating Setpoints: Unoccupied Setback	In the field provided, enter the value you want subtracted from the Occupied Setpoint when the active schedule mode is unoccupied. For example, if the Occupied Setpoint is 70° and the Unoccupied Setback is 4°, the value in the Temperature:Heating Setpoints: Current Setpoint attribute will be 66° when the active schedule mode is unoccupied.	Set FE00; UH = the value to be subtracted from FE00; SH when the active schedule mode is unoccupied. During unoccupied mode: FE00; CH = SH - UH

Table 4-9 : Setting the Heating Control Temperature Setpoints

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Temperature: Heating Setpoints: Night Setback	In the field provided, enter the value you want subtracted from the Occupied Setpoint when the active schedule mode is night setback. For example, if the Occupied Setpoint is 70° and the Night Setback is 8°, the value in the Temperature:Heating Setpoints: Current Setpoint attribute will be 62° when the active schedule mode is night setback.	Set FE00; NH = the value to be subtracted from FE00; SH when the active schedule mode is night setback. During night setback mode: FE00; CH = SH - NH
Temperature: Heating Setpoints: Warm-up Setpoint	In the field provided, enter the temperature that you want the zone to maintain when warm-up is the active schedule mode. During warm-up mode, the Temperature:Heating Setpoints: Current Setpoint is equal to the Warm-up Setpoint .	Set FE00; SW = the temperature that you want the zone to maintain when Warm-up is the active schedule mode. During warm-up mode: FE00; CH = SW

Table 4-10 : Setting the Cooling Control Temperature Setpoints

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Temperature: Cooling Setpoints: Occupied Setpoint	In the field provided, enter the temperature that you want the zone to maintain when the active schedule mode is occupied. During occupied mode, the Temperature:Cooling Setpoints: Current Setpoint is equal to the Occupied Setpoint .	Set FE00; SC = the temperature that you want the zone to maintain when the active schedule mode is occupied. During occupied mode: FE00; CC = FE00; SC
Temperature: Cooling Setpoints: Unoccupied Setback	In the field provided, enter the value you want added to the Occupied Setpoint when the active schedule mode is unoccupied. For example, if the Occupied Setpoint is 70° and the Unoccupied Setback is 4°, the value in the Temperature:Cooling Setpoints: Current Setpoint attribute will be 74° when the active schedule mode is unoccupied.	Set FE00; UC = the value to be added to FE00; SC when the active schedule mode is unoccupied. During unoccupied mode: FE00; CC = SC + UC

Table 4-10 : Setting the Cooling Control Temperature Setpoints

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Temperature: Cooling Setpoints: Night Setback	In the field provided, enter the value you want added to the Occupied Setpoint when the active schedule mode is night setback. For example, if the Occupied Setpoint is 70° and the Night Setback is 8°, the value in the Temperature:Cooling Setpoints: Current Setpoint attribute will be 78° when the active schedule mode is night setback.	Set FE00; NC = the value to be added to FE00; SC when the active schedule mode is night setback. During night setback mode: FE00; CC = SC + NC

Table 4-11 : Setting the Heating Control Flow Attributes

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Flow: Heating: Heating Minimum Flow	In the field provided, enter the value of the minimum rate at which you want air to flow through the duct. This value is measured in CFM.	Set FA01; HM = the value of the minimum rate at which you want air to flow through the duct. This value is measured in CFM.
Flow: Heating: Heating Maximum Flow	In the field provided, enter the value of the maximum rate at which you want air to flow through the duct. This value is measured in CFM.	Set FA01; HX = the value of the maximum rate at which you want air to flow through the duct. This value is measured in CFM.
Flow: Heating: Heating Proportional Band	In the field provided, enter the number of degrees from the Occupied Setpoint over which proportional heating will take place.	Set FA01; HP = the number of degrees from FE00; HS over which proportional heating will take place.
Flow: Heating: Heating Integration Constant	In the field provided, enter the percentage of accumulated error used to calculate the required supply airflow. American Auto-Matrix (AAM) recommends setting this attribute to 5%.	Set FA01; HI = the percentage of accumulated error used to calculate the required supply airflow. AAM recommends setting this attribute to 5%.

Table 4-12 : Setting the Cooling Control Flow Attributes

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Flow: Cooling: Cooling Minimum Flow	In the field provided, enter the value of the minimum rate at which you want air to flow through the duct. This value is measured in CFM.	Set FA01; CM = the value of the minimum rate at which you want air to flow through the duct. This value is measured in CFM.
Flow: Cooling: Cooling Maximum Flow	In the field provided, enter the value of the maximum rate at which you want air to flow through the duct. This value is measured in CFM.	Set FA01; CX = the value of the maximum rate at which you want air to flow through the duct. This value is measured in CFM.
Flow: Cooling: Cooling Proportional Band	In the field provided, enter the number of degrees from the Occupied Setpoint over which proportional cooling will take place.	Set FA01; CP = the number of degrees from FE00; CS over which proportional heating will take place.
Flow: Cooling: Cooling Integration Constant	In the field provided, enter the percentage of accumulated error used to calculate the required supply airflow. AAM recommends setting this attribute to 5%.	Set FA01; CI = the percentage of accumulated error used to calculate the required supply airflow. AAM recommends setting this attribute equal to 5%.

Table 4-13 : Setting the Warm-up Flow Attributes

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Flow: Warm-up: Warm-up Minimum Flow	In the field provided, enter the value of the minimum rate at which you want air to flow through the duct when the active schedule mode is warm-up.	Set FA01; WM = the value of the minimum rate at which you want air to flow through the duct when the active schedule mode is warm-up.
Flow: Warm-up: Warm-up Maximum Flow	In the field provided, enter the value of the maximum rate at which you want air to flow through the duct when the active schedule mode is warm-up.	Set FA01; WX = the value of the maximum rate at which you want air to flow through the duct when the active schedule mode is warm-up.

Table 4-13 : Setting the Warm-up Flow Attributes

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Flow: Warm-up: Warm-up Proportional Band	In the field provided, enter the number of degrees from the Warm-up Setpoint over which proportional heating will take place.	Set FA01; WP = the number of degrees from FE00; WS over which proportional heating will take place.
Flow: Warm-up: Warm-up Integration Constant	In the field provided, enter the percentage of accumulated error used to calculate the required supply airflow. AAM recommends setting this attribute to 10%.	Set FA01; WI = the percentage of accumulated error used to calculate the required supply airflow. AAM recommends setting this attribute equal to 10%.

NOTE

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

4.3 SBC-VAV CONTROL MODES

The SBC-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 SBC-VAV.

4.3.1 CONSTANT AIR VOLUME (CAV)

The SBC-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:**Target Flow** [FA00;CD] attribute becomes the constant volume setpoint. The SBC-VAV will modulate the damper appropriately to maintain the **CD** while airflow is present. Reheat capabilities are identical to VAV operation. The reheat measured variable is the zone temperature. To configure the SBC-VAV for CAV control, refer to Table 4-14.

4.3.2 SUPPLY DEPENDANT (VST)

When operating in supply dependant mode, the SBC-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. For example, if the Temperature:Supply:**Supply Temperature** [FE08;CV] is greater than *both* the Temperature:Thermostat:**Zone Temperature** [FE00;ZT] and the Temperature:Heating Setpoints:**Current Setpoint** [FE00;CH], the SBC-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 FE08;CV is less than *both* ZT and the Temperature:Cooling Setpoints:**Current Setpoint** [FE00;CC], the SBC-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 **Auto Mode Deadband** [FE00;DD] attribute, the user can define the point at which the terminal box will go into cooling or heating mode. For example, if **DD** is set to 3° and the **Current** (temperature) **Setpoint** is 70°:

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

Table 4-14 : Configuring the SBC-VAV for CAV Control

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Temperature: Thermostat: VAV Control Mode	Click on the radio button next to <i>None (CAV)</i> .	Set FE00;BT = 0

Table 4-14 : Configuring the SBC-VAV for CAV Control

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Flow: Control: Target Flow	In the field provided, enter the desired constant volume setpoint (in cfm).	Set FA00; CD = desired constant volume setpoint
Set the temperature and flow setpoints as desired. Refer to Table 4-9 and Table 4-11 for instructions on configuring these setpoints.		

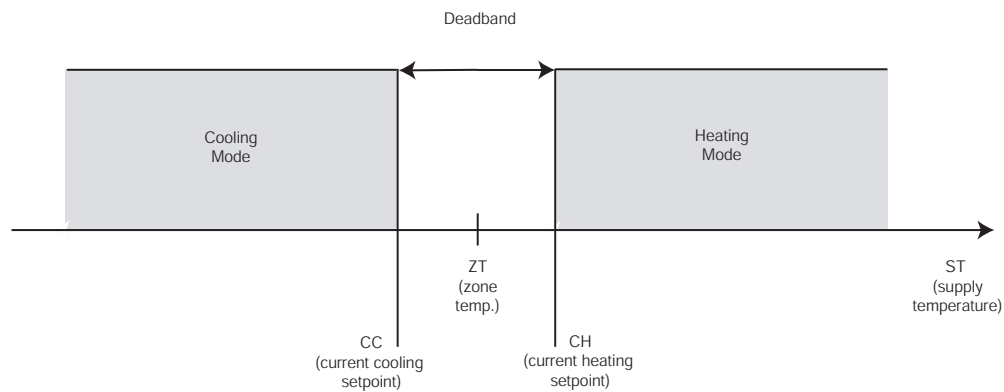


Figure 4-1: Supply Dependant (VST) Control

Table 4-15 : Configuring the SBC-VAV for Supply Dependant Control

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Temperature: Thermostat: VAV Control Mode	Click on the radio button next to <i>Supply Dependant (VST)</i> .	Set FE00; BT = 3.
Temperature: Supply: Auto Mode Deadband	Enter the desired value in the field provided. This value will be subtracted from the heating Current Setpoint and added to the cooling Current Setpoint .	Set FE00; DD = the value you want subtracted from CH and added to CC .
Set the temperature and flow setpoints as desired. Refer to Table 4-9 and Table 4-11 for instructions on configuring these setpoints.		

The mode in which the SBC-VAV is operating will be indicated in the Temperature:Supply:**Supply Mode** attribute (FE00;**SM** will = 0 if in cooling mode and 1 if in heating mode).

When in VST mode, the SBC-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.

In the event that the **CC** is greater than the **CH** [FE00;**CC** > FE00;**CH**], the **DD** attribute must be set to half the difference between the setpoints to create a deadband with a wide enough range to provide sufficient heating/cooling. For example, if you set **CC** to 74° and **CH** is 70°, set **DD** to 2° to create a sufficient deadband.

4.3.3 HEATING ONLY

When configured for heating only control, the SBC-VAV uses Proportional+Integral (PI) control to modulate the damper and control airflow to the zone based on two factors; the Temperature:Thermostat:**Zone Temperature** [FE00;**ZT**] and the **Current** (heating) **Setpoint** [FE00;**CH**]. If the **ZT** is less than the **Current Setpoint**, the SBC-VAV will open the damper and provide warm air to the zone to maintain a **ZT** as close as possible to the **Current Setpoint**.

NOTE

Scheduling controls the **Current** (temperature) **Setpoint**.

Heating only VAV works on a reverse acting ramp that slopes from the values defined by the user in the Flow:Heating:**Heating Minimum Flow** [FA01;**HM**] to the **Heating Maximum Flow** [FA01;**HX**] attributes. When **ZT** strays from **CH**, the SBC-VAV opens the damper—increasing the supply airflow to the zone. As **ZT** reaches the **CH**, the SBC-VAV closes the damper to minimize airflow. No fan or reheat stage control exists when the SBC-VAV is configured for heating only control. See Figure 4-2.

To configure the SBC-VAV for heating only control, refer to Table 4-16.

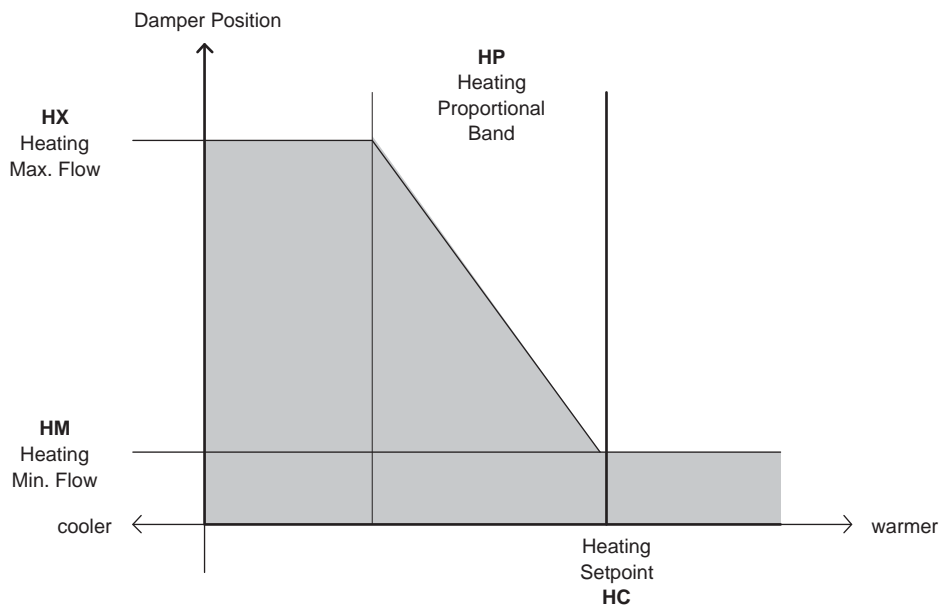


Figure 4-2: Heating Only

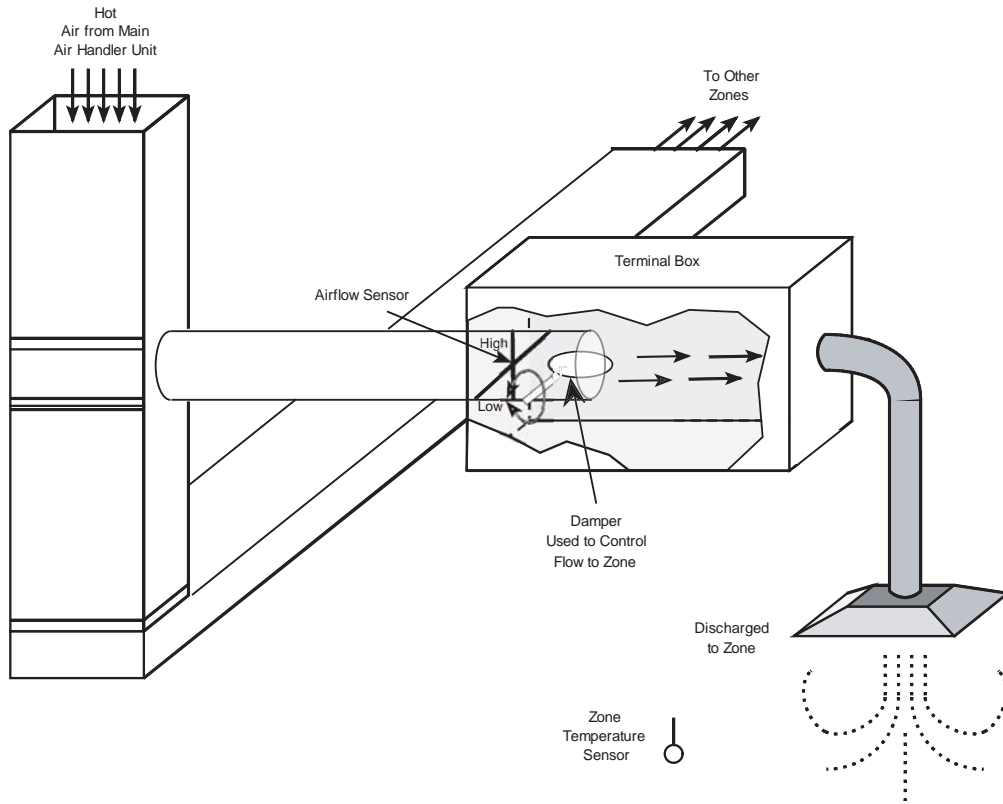


Figure 4-3: Example of a Heating Only Application

Table 4-16 : Configuring the SBC-VAV for Heating Only Control

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Temperature: Thermostat: VAV Control Mode	Click on the Radio Button next to <i>Heating Only</i> .	Set FE00; BT = 2.
Flow: Control: Duct Scaling Factor (K)	In the field provided, enter the scaling factor specified by the manufacturer of the VAV box.	Set FA00; CK = the scaling factor specified by the manufacturer of the VAV box.
Set the temperature and flow setpoints as desired. Refer to Table 4-9 and Table 4-11 for instructions on configuring these setpoints.		

4.3.4 COOLING ONLY

When configured for cooling only control, the SBC-VAV uses PI control to modulate the damper and control airflow to the zone based on two factors; the Temperature:Thermostat:Zone **Temperature** [FE00;ZT] and the Temperature:Cooling Setpoints:**Current Setpoint** [FE00;CC]. If ZT is greater than CC, the SBC-VAV will open the damper and provide cool air to the zone to maintain ZT as close as possible to the CC.

NOTE

Scheduling controls the current temperature setpoint.

Cooling only VAV works on a forward acting ramp that slopes from the values defined by the user in the Flow:Cooling:**Cooling Minimum Flow** [FA01;CM] and **Cooling Maximum Flow** [FA01;CX] attributes. When the ZT strays from the CC, the SBC-VAV opens the damper—increasing the supply airflow to the zone. As the ZT reaches the CC, the SBC-VAV closes the damper to minimize airflow (See Figure 4-4). Refer to Table 4-17 to configure the SBC-VAV for cooling only control.

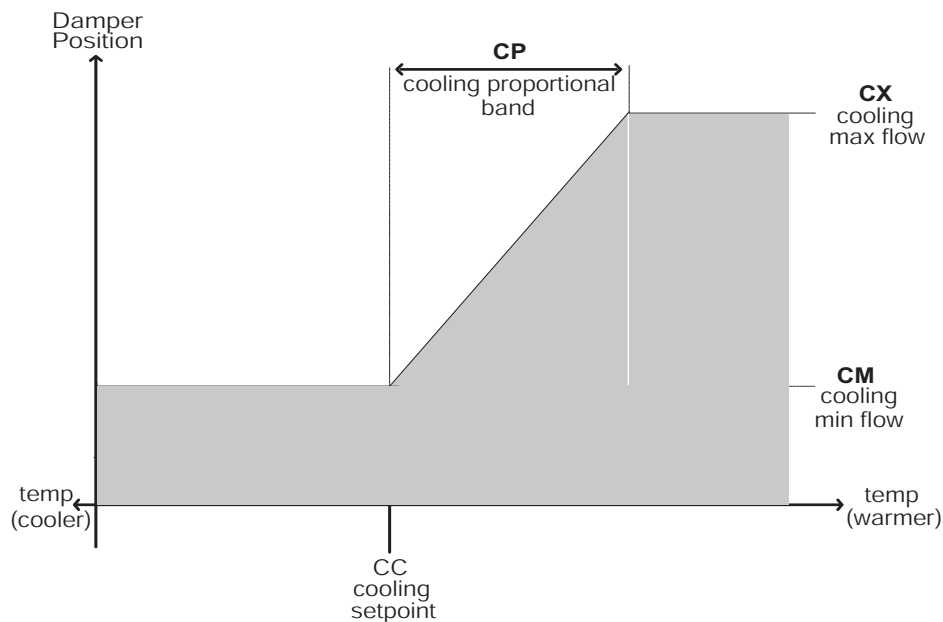


Figure 4-4: Cooling Only

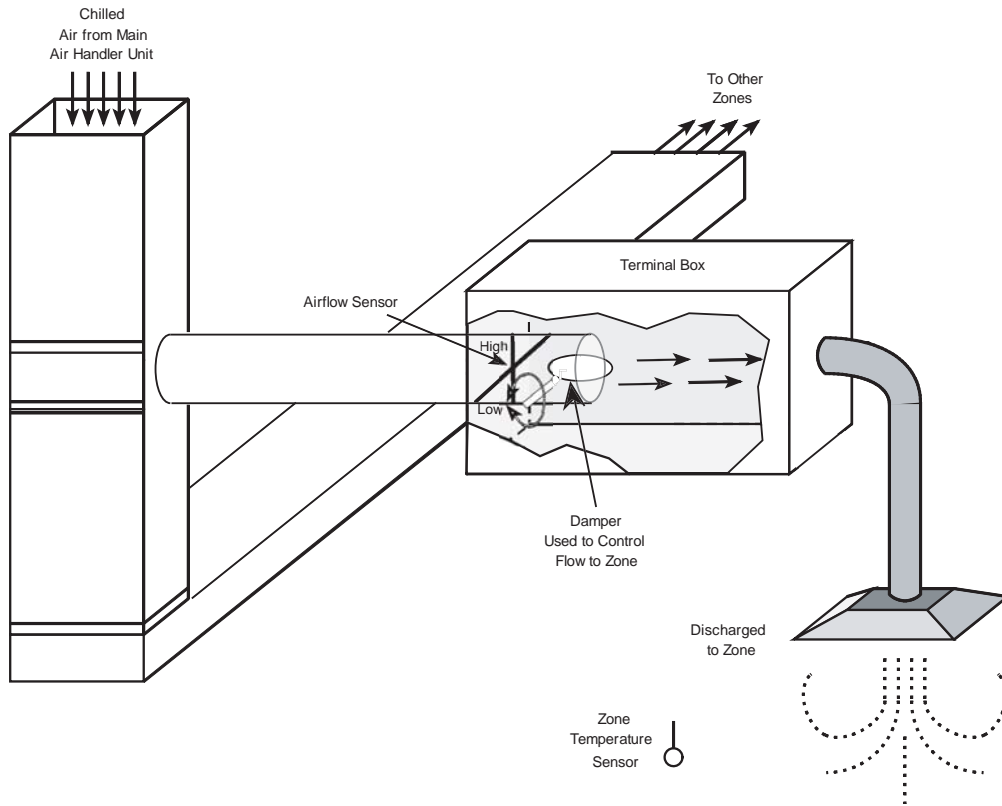


Figure 4-5: Example of a Cooling Only Application

Table 4-17 : Configuring the SBC-VAV for Cooling Only Control

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Temperature: Thermostat: VAV Control Mode	Click on the radio button next to <i>Cooling Only</i> .	Set FE00; BT = 1.
Flow: Control: Duct Scaling Factor (K)	In the field provided, enter the scaling factor specified by the manufacturer of the VAV box.	Set FA00; CK = the scaling factor specified by the manufacturer of the VAV box.
Set the temperature and flow setpoints as desired. Refer to Table 4-10 and Table 4-12 for instructions on configuring these setpoints.		

4.3.5 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 SBC-VAV will maintain the Temperature:Cooling Setpoints:**Current Setpoint** [FE00;**CC**] by providing supply air through proportional damper positioning. With its PI algorithm, the SBC-VAV will modulate the damper to maintain the Temperature:Thermostat:**Zone Temperature** [FE00;**ZT**] between **CC** and the Temperature:Heating Setpoints:**Current Setpoint** [FE00;**CH**]. The reheat stages will energize at the time interval defined by the user in the Aux:Electric Reheat:**Stage Delay** [FA03;**ID**] attribute until **ZT** reaches **CH**. Reheat stages de-energize at thirty-second intervals.

The SBC-VAV prolongs the life of reheats through its Aux:Electric Reheat:**Balance Stage Usage** [FA03;**BA**] attribute. With this attribute enabled, reheat stages with less run time will energize first. To configure the SBC-VAV for cooling with reheat control, refer to Table 4-18.

Table 4-18 : Configuring the SBC-VAV for Cooling with Reheat Control

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Temperature: Thermostat: VAV Control Mode	Click on the radio button next to the <i>Cooling w/Reheat</i> option.	Set FE00; BT = 4
Flow: Control: Duct Scaling Factor (K)	In the field provided, enter the scaling factor specified by the manufacturer of the VAV box.	Set FA00; CK = the scaling factor specified by the manufacturer of the VAV box.
Aux: Electric Reheat: Reheat Mode	Select the desired mode from the drop-down box: <ul style="list-style-type: none"> . Disabled . 2-Stage (K2-K3) . 2-Stage (K4-K5) . 4-Stage (K2-K5) 	Set FA03; RO = the desired mode: <ul style="list-style-type: none"> . Disabled = 0 . 2-Stage (K2-K3) = 1 . 2-Stage (K4-K5) = 2 . 4-Stage (K2-K5) = 3
Aux: Electric Reheat: Stage Delay	In the field provided, enter the number of minutes you want to expire before the second and each additional stage energizes.	Set FA03; OF = the number of minutes you want to expire before the second and each additional stage energizes.
Set the temperature and flow setpoints as desired. Refer to Table 4-10 and Table 4-12 for instructions on configuring these setpoints.		

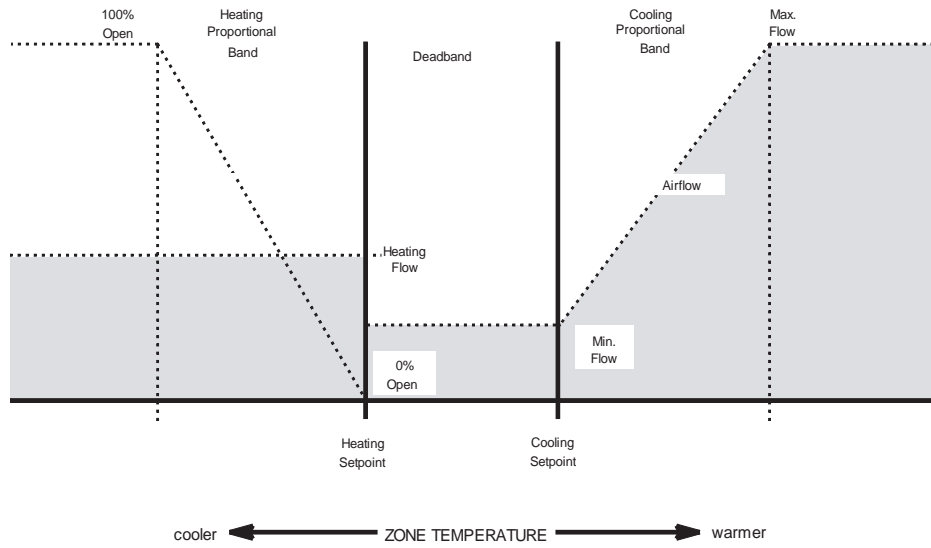


Figure 4-6: Cooling with Reheat

4.4 AUXILIARY FUNCTIONS

4.4.1 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 Aux:Fan:**Series Fan Unoccupied Mode** attribute is set to *Always On* [FB01;SF = 0]. When night setback is the active mode, the series fan remains off unless the Temperature:Thermostat:**Zone Temperature** [FE00;ZT] varies beyond the limits of the control deadband.

Table 4-19 : Configuring the SBC-VAV for Series Fan Operation

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Aux: Fan: Fan/Damper Mode	Select <i>Series Fan</i> from the drop-down box.	Set FB01;FO = 1.
Aux: Fan: Series Fan Unoccupied Mode	Click on the radio button next to the desired operation mode when the active schedule mode is unoccupied: <i>Always on</i> , or <i>Off in Deadband</i>	Set FB01;SF as desired. 0 = Always on 1 = Off in deadband
Aux: Fan: Minimum Cycle Time	In the field provided, enter the number of minutes you want the fan output to stay energized/de-energized. This prevents short cycling of the fan output.	Set FB01;FC = the number of minutes you want the fan output to stay energized/de-energized. This prevents short cycling of the fan output.

4.4.2 PARALLEL FAN

When Aux:Fan:**Fan Damper Mode** is set to *Parallel Fan* [FB01;FO = 2], the parallel fan is energized when the active schedule mode is occupied and Flow:Control:**Current Value** [FA00;CV] is less than Aux:Fan:**Fan Setpoint** [FB01;FS]. If **FS** is equal to zero, the fan is energized when Temperature:Thermostat:**Zone Temperature** [FE00;ZT] is less than **Current** (heating) **Setpoint** [FE00;CH].

4.4.3 INDUCTION DAMPER

The SBC-VAV can control an induction damper. The induction damper opens when the current airflow falls below the values set in the Flow:Cooling/Heating/Warm-up:**Minimum Flow** [FA01;CM, HM, and WM] attributes. The induction damper closes when the current airflow rises above the values set in the Flow:Cooling/Heating/Warm-up:**Maximum Flow** [FA01;CX, HX, and WX] attributes. To configure the SBC-VAV for operation of an induction damper, select *Induction Damper* from the drop-down box next to the Aux:Fan:**Fan/Damper Mode** attribute [set FB01;FO = 3].

4.4.4 VALVE CONTROL

NOTE

Using FA08 and FA09 for Valve control prohibits the use of reheats. FA08 uses triacs 2 and 3, and FA09 uses triacs 4 and 5.

There are two types of valve control provided by the SBC-VAV: pulse width modulated control and floating setpoint control. The SBC-VAV uses its PI algorithm to calculate the percent of control needed for pulse width driven motor valves. There are two (2) valve control channels, FA08 and FA09.

The user-defined value in the Aux:Valve Control:Valve Offset [FA08/FA09;VO] attribute is added to the Temperature:Cooling Setpoints:Current Setpoint [FE00;CC] or subtracted from Temperature:Heating Setpoints:Current Setpoint [FE00;CH] for calculation of the loop setpoint.

For hot water reheat operations, the valve operates in a reverse acting ramp. As the Temperature:Thermostat:Zone Temperature [FE00;ZT] falls below the CH, the valve begins to open. As the ZT rises, the valve will begin to close.

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

The user-defined value in the Aux:Valve Control:Valve Proportional Band [FA08/FA09;VP] attribute 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.

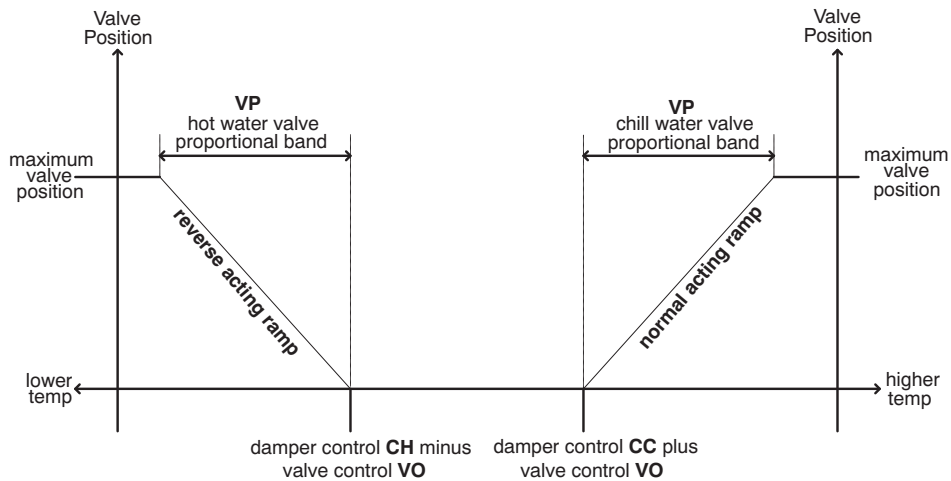


Figure 4-7 Valve Ramps

The Aux:Valve Control:Valve Integration Constant [FA08/FA09;VI] attribute 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.

4.4.4.1 BASIC CONFIGURATION FOR PWM VALVE CONTROL

Refer to Table 4-20 to configure the SBC-VAV for pulse width modulated valve control.

NOTE

The SBC-VAVra, and SBC-VAVrf should not be used for PWM control. AAM recommend only the SBC-VAVta and -VAVtf be used for PWM control.

Table 4-20 : Configuring the SBC-VAV for Pulse Width Modulated Valve Control

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Aux: Valve Control:1,2 Valve Mode	Click on the radio button next to <i>Pulse Width Modulation</i> .	Set FA08/FA09; VM = 0.
Flow: Proof of Flow: Proof of Flow Method	Select <i>None</i> from the drop-down box.	Set FC02; DR = 0.
Aux: Valve Control:1, 2 Valve Use	Click on the radio button next to the desired control mode: <i>Disabled, Cooling, or Heating</i> .	Set FA08/FA09; VU to the desired control mode <ul style="list-style-type: none"> . 0 = Disabled . 1 = Cooling . 2 = Heating
Aux: Valve Control:1, 2 Pulse Duration Period	In the field provided, enter the number of seconds the valve is to be pulsed on. Refer to the valve manufacturer's specifications.	Set FA08/FA09; VT = the number of seconds the valve is to be pulsed on.

4.4.4.2 BASIC CONFIGURATION FOR FLOATING SETPOINT VALVE CONTROL

Refer to Table 4-21 to configure the SBC-VAV for floating setpoint valve control.

Table 4-21 : Configuring the SBC-VAV for Floating Setpoint Valve Control

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Aux: Valve Control:1, 2 Valve Mode	Click on the radio button next to <i>Floating Point Motor Control</i> .	Set FA08/FA09; VM = 1.
Flow: Proof of Flow: Proof of Flow	Select <i>None</i> from the drop-down box	Set FC02; DR = 0.
Aux: Valve Control:1, 2 Valve Use	Click on the radio button next to the desired control mode: <i>Disabled, Cooling, or Heating</i> .	Set FA08/FA09; VU to the desired control mode: . 0 = Disabled . 1 = Cooling . 2 = Heating
Aux: Valve Control:1, 2 Valve Travel Time	In the field provided, enter the number of seconds it takes the valve to go from fully closed to fully open. Refer to the valve manufacturer's specifications.	Set FA08/FA09; VT = the number of seconds it takes the valve to go from fully closed to fully open. Refer to the valve manufacturer's specifications.

4.5 DIGITAL OUTPUTS

The digital (relay) outputs are used to determine the state of the SBC-VAV outputs. The configuration of the digital outputs includes the Current Value, Output Polarity, Runtime Hours, Runtime Limit, and Override.

Refer to Table 4-22 to configure the digital outputs.

Table 4-22 : Configuring the Digital Outputs

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Input/Output Setup: Relay Outputs: Output Polarity	Click the radio button next to the desired output polarity: Normal or Reverse. When CV =1, setting OP to normal (0) energizes the output. When CV =0, setting OP to reverse (1) energizes the output.	Set FB0x; OP to the desired Output Polarity: <ul style="list-style-type: none"> . 0 = Normal . 1 = Reverse
Input/Output Setup: Relay Outputs: Runtime Limit	In the field provided, enter a run time limit in hours for the output. When the run hours for the output exceed the runtime limit (RH > RL), the SBC-VAV will generate a runtime limit alarm	Set FB0x; RL = a run time limit in hours. When the run hours for the output exceed the runtime limit (FB0x; RH >FB0x; RL), the SBC-VAV will generate a runtime limit alarm.
Input/Output Setup: Relay Outputs: Override	After setting up and verifying all other configuration options, click the radio button next to the appropriate Override option: <i>Off, On, Auto, Manual</i> .	Set FB0x; OI = appropriate option: <ul style="list-style-type: none"> . 0 = Off (default) . 1 = On . 2 = Auto . 3 = Manual

NOTE

To allow full configuration before controller operation, Input/Output Setup:Relay Outputs:**Override** is factory set to Off (**OI** = 0). After all other configurations are complete, each digital output must be manually enabled as appropriate to the installation.

4.6 DUAL DUCT APPLICATIONS

NOTE

Only the SBC-VAVrf can be used in dual duct applications.

Only the SBC-VAVrf can be used in dual duct applications. 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.

To configure the SBC-VAVrf for dual duct applications, refer to Table 4-23.

Table 4-23 : Configuring the SBC-VAVrf for Dual Duct Application

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Temperature: Thermostat: VAV Control Mode	Click on the radio button next to <i>Supply Dependant (VST)</i> .	Set FE00; BT = 3
Flow: Damper Damper Control	Click the radio button next to <i>Dual Mixed (CAV)</i>	Set FA00; DC = 2
Flow: Damper Estimated Flow at Full Open	In the field provided, enter the maximum hot duct airflow value (in CFM).	Set FA00; EF =the maximum hot duct airflow value (in CFM).
Flow: Control: Target Flow	In the field provided, enter the desired CAV airflow value (in CFM).	Set FA00; CD =the desired CAV airflow value (in CFM).
Flow: Damper: Actuator Type	Click on the radio button next to <i>LM-24M (MMT)</i> .	Set FA00; AT =0

4.7 TRACKING

An SBC-VAV configured as a slave can “track” the Average Flow of an SBC-VAV configured as a master. The Target Flow of the slave SBC-VAV will then be derived from the Average Flow (FA00;**CA**) of the master and the user-defined Flow Offset (FA00;**OF**) of the slave. Refer to Table 4-24 to configure the slave controller for tracking.

Table 4-24 : Configuring a Slave SBC-VAV for Tracking

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Temperature: Sensor Bus: Bus Mode	Click on the radio button next to <i>Slave</i> .	Set FE00; BM =1
Flow: Control: Offset	In the field provided, enter the value (in CFM) you want added to/subtracted from the master controller's Average Flow (FA00; CA) when determining its Target Flow.	Set FA00; OF = the value (in CFM) you want the slave SBC-VAV to consider when determining its Target Flow.
Flow: Control: Control Mode	Click on the radio button next to <i>Tracking</i> .	Set FA00; AC =2

4.8 INDOOR AIR QUALITY

The SBC-VAVta-IAQ and SBC-VAVtf-IAQ are capable of providing Indoor Air Quality (IAQ) control based upon space Carbon Dioxide (CO₂) levels. The IAQ VAV monitors space CO₂ levels and upon the detection of high CO₂ 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 CO₂ levels. In this application, it is assumed that the Air Handling Unit providing supply air to the VAV unit monitors CO₂ levels in the building and adjust its air mixture accordingly.

On the controller, the CO₂ sensor must be connected to the dedicated input, Universal Input 3 (**UI3**). UI3 is only intended for a CO₂ sensor and is capable of accepting sensor types: current (0-20 mA), resistance (0-1MW), or voltage (0-10VDC). For help in configuring Universal Input 3 for the correct sensor type, refer to Section 3.7.1.

NOTE
Indoor Air Quality control will not operate in Dual Duct applications.

Table 4-25: Configuring Indoor Air Quality

Attribute Path for Graphical User Interface (GUI) Utility: Attribute Name	GUI Configuration Utility Setting	Channel Setting
Flow: Damper: Damper Mode	Select Automatic from the drop window	Set FA00; DM = 0
Flow: Indoor Air Quality: Air Quality Setpoint	In the field provided, enter the desired CO ₂ level for the zone (in PPM)	Set FA01; AS to desired CO ₂ level (in PPM)
Flow: Indoor Air Quality: Air Quality Deadband	In the field provided, enter the deadband of CO ₂ reading allowed before the damper control occurs	Set FA01; DB to desired control deadband
Flow: Indoor Air Quality: Air Quality Damper Ramp Rate	In the field provided, enter the ramp rate (in percent-per-minute) at which the damper will move to compensate for changes in CO ₂ levels in the zone	Set FA01; RP to desired ramp rate for damper control (in percent-per-minute)
Flow: Indoor Air Quality: Air Quality Control Max Air Flow	In the field provided, enter the maximum air flow (in CFM) allowed during CO ₂ control	Set FA01; AM to desired maximum air flow (In CFM) allowed during CO ₂ control.

Using the Air Quality (IAQ) Setpoint [FA01;**AS**] and the Air Quality (IAQ) Deadband [FA01;**DB**] attributes, the user defines when IAQ control overrides the normal temperature control. This occurs when the CO₂ level, as sensed by Universal Input 3 [FE03;**CV**], 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 Air Quality Damper Ramp Rate [FA01;**RP**] until the airflow reaches the maximum setpoint. The normal temperature control resumes when the CO₂ level again equals **AS** minus **DB**.

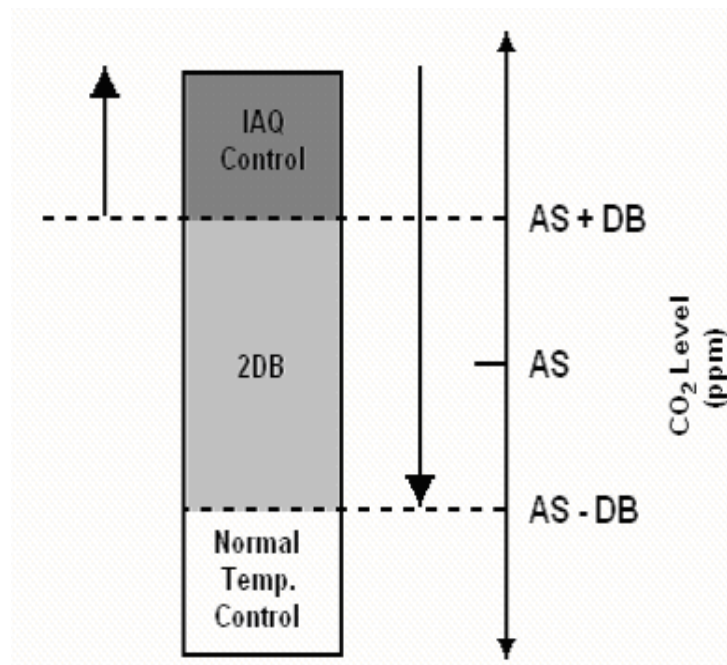


Figure 4-8 Indoor Air Quality Diagram

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 4-26: Air Flow Control with IAQ Control Enabled

Current Mode	Maximum Air Flow Setpoint
Venting	IAQ Max Air Flow [FA01; AM]
Heating	IAQ Max Air Flow [FA01; AM] or Heating Max Flow [FA01; HX]*
Cooling	IAQ Max Air Flow [FA01; AM] or Cooling Max Flow [FA01; CX]*
Warmup	IAQ Max Air Flow [FA01; AM] or Warmup Max Flow [FA01; WX]*

* Maximum Air Flow Setpoint is determined by the lower setpoint.

SECTION 5: SBC-STAT FEATURES

SBC-STATs use information from a connected SBC controller. The SBC-STAT3 displays this information on its graphical display and gives the user the ability to navigate through the menus using its four buttons. The following section describes the SBC-STAT setpoint adjustment and LED, and the SBC-STAT3 menus when connected to an SBC-VAV.

IN THIS SECTION

Temperature Display	5-3
Setpoint Adjustment Display	5-4
SBC-STAT2	5-4
SBC-STAT2-D	5-4
SBC-STAT3	5-4
Calculated Setpoint Display	5-5
LED	5-6
Override Mode	5-7
Menu Actions	5-8
Enable/Disable Values	5-8
Setting Values	5-8
SBC-STAT3 Menus	5-9
User Menu	5-9
Install Menu	5-10
Balance Menu	5-13
Service Menu	5-17

5.1 TEMPERATURE DISPLAY

When connected to an SBC-VAV, an SBC-STAT3 displays the room temperature (in degrees Celsius or Fahrenheit) with **Warm-up**, **Setback**, **Occupied**, or **Unoccupied** on the bottom left of the display. Also **Heat**, **Cool**, or **Vent** is displayed on the bottom right of the display.

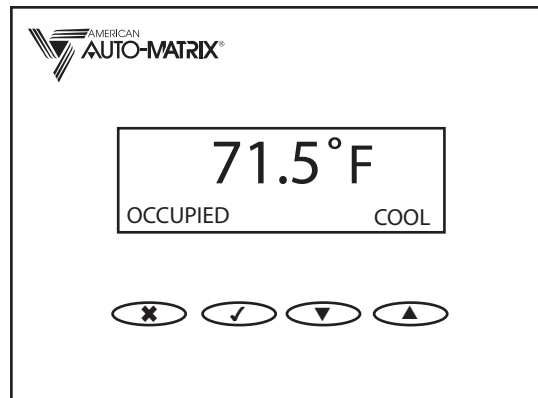


Figure 5-1: Room Temperature Display

5.2 SETPOINT ADJUSTMENT DISPLAY

When you press the up or down arrow button on the SBC-STAT3, a setpoint adjustment display appears and the LED blinks.

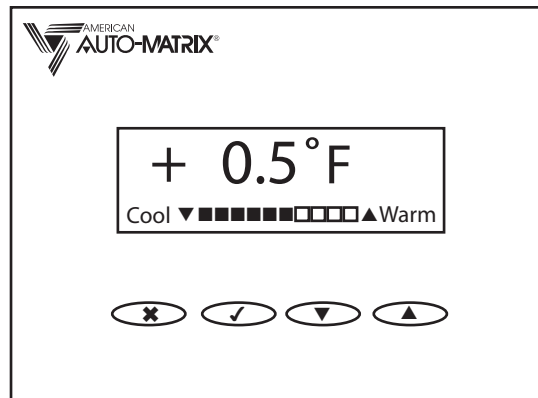


Figure 5-2: Setpoint Adjustment Display

5.2.1 SBC-STAT2

When the up or down arrow button is first pressed, the LED will flash to indicate the current setpoint. If the up or down arrow is pressed again within 15 seconds the setpoint will change one position and the red LED will flash for that setpoint. The setpoint range is one (1) through five (5) flashes. Each additional flash indicates a warmer setting. See Table 5-2 LED for more information on the blinking pattern for setpoint adjustment.

5.2.2 SBC-STAT2-D

When the up or down arrow button is first pressed, the LED will flash to indicate the current setpoint. If the up or down arrow is pressed again within 15 seconds the setpoint will change one position and the red LED will flash for that setpoint. The setpoint can be adjusted five increments on either side of zero with zero being six (6) red flashes. See Table 5-2 LED for more information on the blinking pattern for setpoint adjustment.

5.2.3 SBC-STAT3

When the up or down arrow button is first pressed, the current setpoint offset will be displayed on the graphical display. If the button is pressed again within 15 seconds, the setpoint will move one increment in the direction of the button pressed. The setpoint can be adjusted five increments on either side of zero with zero being six (6) red flashes. The magnitude of the increment is programmed at installation.

5.3 CALCULATED SETPOINT DISPLAY

In version 4.00 firmware or greater, the SBC-VAV(r/t/a/f) allows users to choose a method of setpoint display on an SBC-STAT3 when a user adjusts the zone setpoint. Four options are available for setpoint displayed and are outlined in Table 5-1

Table 5-1: Calculated Setpoint Display Options

Channel and Attribute	Value	Setpoint Display
FE00; SD	0	Standard Offset (+/-2.5)
	1	Zone Midpoint (FE00; ZS)
	2	Heating Setpoint (FE00; CH)
	3	Cooling Setpoint (FE00; CC)

5.4 LED

The following table lists the blinking patterns that occur during specific events in the SBC-STAT.

Table 5-2 LED

Event	SBC-STAT2 flash	SBC-STAT2-D flash	SBC-STAT3 flash
Setpoint adjustment	coldest = 1 red flash colder = 2 red flashes normal = 3 red flashes warmer = 4 red flashes warmest = 5 red flashes	coldest = 1 red flash = 2 red flashes = 3 red flashes = 4 red flashes = 5 red flashes normal = 6 red flashes = 7 red flashes = 8 red flashes = 9 red flashes = 10 red flashes warmest = 11 red flashes	coldest = 1 red flash = 2 red flashes = 3 red flashes = 4 red flashes = 5 red flashes normal = 6 red flashes = 7 red flashes = 8 red flashes = 9 red flashes = 10 red flashes warmest = 11 red flashes
Override mode	red flash every 6 seconds	red flash every 6 seconds	no flash
Occupied mode	no flash	solid green	solid green
Warm-up	no flash	flashing green	flashing green
Night Setback	no flash	periodic yellow flash	periodic yellow flash
Unoccupied mode	no flash	periodic yellow flash	periodic yellow flash
Menus	no flash	no flash	solid yellow

5.5 OVERRIDE MODE

NOTE

Users can not enter override mode through an SBC-STAT unless the following criteria are met:

- . The SBC-VAV's Temperature:Override: **User Override** attribute is enabled [FE00;**SE** = 1];
- . The **Extended Occupancy Duration** attribute is greater than or equal to 1 [FE00;**ED** ≥ 1]; and
- . The active schedule mode is warm-up, unoccupied, or night setback.

The SBC-STAT2 and SBC-STAT2-D can enter override mode through any keypress. Once in override mode, the LED will flash red every six seconds. To cancel override mode hold down the up or down arrow button for five seconds or until the LED starts flashing. The LED will flash a minimum of ten times to confirm the cancellation.

Through the SBC-STAT3, override mode will begin when:

- . the up or down arrow button on the SBC-STAT3 is pressed; or
- . the user enters override mode through the User Menu. Refer to Section 5.7.1.

5.6 MENU ACTIONS

When you enter a menu you can enable/disable or set/edit a value. Sections 5.6.1 and 5.6.2 describe how to perform these actions.

5.6.1 ENABLE/DISABLE VALUES

After entering a menu, use the up and down arrows to highlight a selection, then press the 4 button to initiate an action or enable/disable a function. Press the 6 button to exit and return to the previous menu. Refer to Section 5.7 for more information about the SBC-STAT3 menus.

NOTE

Only one action per menu can be enabled at any time. To disable an action highlight the action and press 4.

5.6.2 SETTING VALUES

Options in the Install, Balance, and Service menus allow values to be set. Selecting one of these options opens an Edit screen allowing you to use the 4 button to move places to the right and the s and t buttons to change values. Once you have entered a desired value, press 4 to highlight **set** and press 4 once more to store the value and return to the previous menu. To exit the Edit screen without saving any changes, press 6.

5.7 SBC-STAT3 MENUS

The SBC-STAT3 displays a menu system through which the user navigates using the SBC-STAT3 buttons.

There are four (4) menus, each of which provide different levels of monitoring and control. Along with their default 4-digit passwords, they are as follows:

- . User
- . Install
- . Balance
- . Service

Sections 5.7.1 through 5.7.4 further describe the SBC-STAT3 menus.

5.7.1 USER MENU

The main menu is the User Menu. The User Menu can be reached by pressing the Select button (4) while viewing the room temperature display.

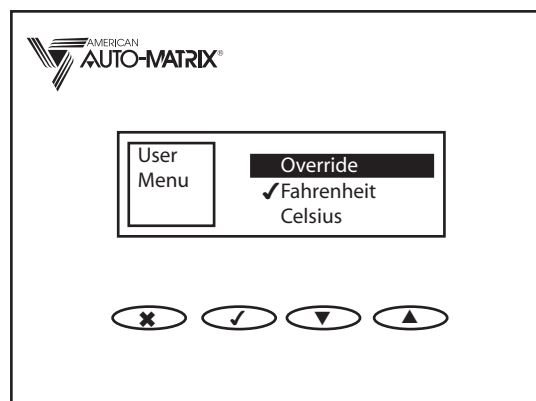


Figure 5-3: User Menu

From the User Menu, the user can press the up and down arrow buttons to highlight an entry. The entries are **Override**, degrees **Fahrenheit**, and degrees **Celsius**. Highlight then press the Select button (4) to initiate an action or enable/disable a function. Press the Escape button (6) to exit and return to the previous menu.

NOTE

If the user selects **Override** while the + icon is displayed, extended occupancy will be canceled.

5.7.2 INSTALL MENU

To enter the Install Menu, press the Escape (6) and Up (s) buttons simultaneously. A password prompt will appear. Enter your four digit password using the up and down arrow buttons. The default passwords are as follows:

- . **User:** No password required
- . **Install:** 3300
- . **Balance:** 2200
- . **Service:** 1100

Press Select (4) to move each place to the right. Once you have selected the correct password press 4 one more time to enter the Install Menu.

Through the Install Menu, users can:

- . View **Ctrl Mon** functions (further described in Section 5.7.2.1);
- . Perform an **LED Test** (further described in Section 5.7.2.2);
- . Monitor and edit the **Properties** of the SBC controller (further described in Section 5.7.2.3), and
- . **Reset** the SBC-STAT3 and the SBC-VAV (further described in Section 5.7.2.4)

The menu display remains on for four minutes. The LED flashes yellow 15 seconds before the display clears. Pressing any button while viewing the menu extends the time the menu is displayed. To exit out of a menu press the 6 button until the room temperature screen is displayed.

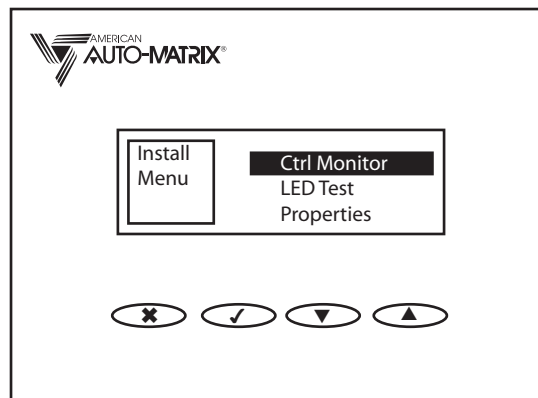


Figure 5-4: Install Menu

5.7.2.1 CONTROL MONITOR

The first menu option listed in the Install Menu is **Ctrl Monitor**. This option allows the monitoring of temperature and flow control operation.

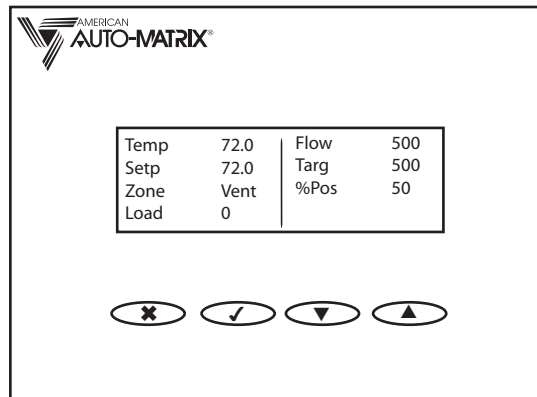


Figure 5-5: Control Monitor Screen 1

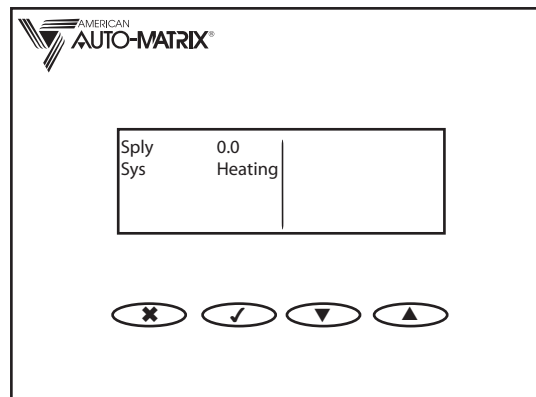


Figure 5-6: Control Monitor Screen 2

5.7.2.2 LED TEST

A temporary option under the Install menu is LED test. This allows the installer to toggle the LED modes. The modes are:

- . Green
- . Red
- . Bright Red Flash
- . Green Flash
- . Slow Yellow Flash
- . Yellow Flash
- . Yellow.

5.7.2.3 PROPERTIES

This option gives the installer access to the Channels and Attributes of the connected controller. Press the s and t arrow buttons to scroll through the attributes and to monitor the value of each attribute. Press the 4 to select the attribute, then you can scroll through all of the attributes for the selected channel. Also, new

values can be set for all read/write attributes. If an invalid value is entered, "ERROR" will appear. Figure 5-7 shows a read only Properties screen and Figure 5-8 shows read/write Properties screen.

At the bottom of each Properties screen, the functions of each button are listed. These functions will change as you navigate through each screen. For example, by pressing the 4 while viewing a read/write attribute, the 4 button will have the following functions: attr, edit, next, and set.

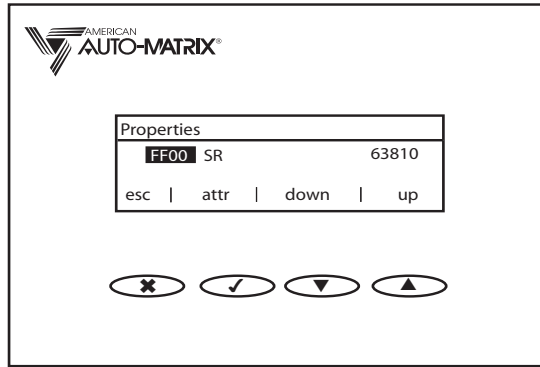


Figure 5-7 Read only Properties Screen

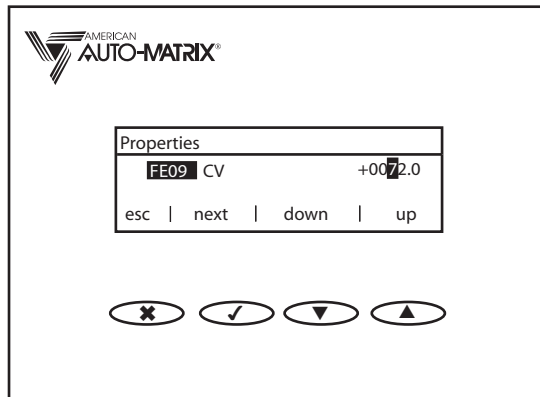


Figure 5-8: Read/Write Properties Screen

5.7.2.4 RESET

This option restarts the SBC Controller and the SBC-STAT3.

5.7.3 BALANCE MENU

Through the Balance Menu, users can:

- . View **Ctrl Monitor** functions (refer to Section 5.7.2.1);
- . Perform **Calibrate** functions (further described in Section 5.7.3.1);
- . Perform **Damper Mode** functions (further described in Section 5.7.3.7);
- . Perform Flow **Setpoint** adjustments (further described in Section 5.7.3.8); and
- . **Reset** the SBC-STAT3 and the SBC-VAV (refer to Section 5.7.2.4)

To access the Balance Menu, press the 6 and the 4 buttons simultaneously. Enter your four digit password using the up and down arrow buttons to scroll through the numbers and Select (4) to move each place to the right. Once you have selected the correct password press 4 one more time to enter the Balance Menu screen (as shown in Figure 5-9).

5.7.3.1 CALIBRATE

Sections 5.5.0.0.2 through 5.5.0.0.6 describe the functions that can be performed from the Calibration menu.

5.5.0.0.2 1ST MEASURED CFM

Single-point calibration uses 1st Measured CFM only. Here the measured airflow in CFM is entered during the calibration process. Multi-point calibration uses two (2) CFM readings. The 1st Measured CFM calculates the K Factor while the 2nd Measured CFM uses both readings to calculate the K Factor and the Zero Offset.

5.5.0.0.3 2ND MEASURED CFM

When you enter the Calibrate Menu for the first time, there will be an X next to 2nd Measured CFM. This marks the 2nd Measured CFM unavailable until a single-point calibration is performed. Once the single-point calibration is performed a 4 appears next to the menu option. A 4 will also appear next to 2nd Measured CFM after the multi-point calibration is performed. See **Setting Values** earlier in this section for information on entering a value.

5.5.0.0.4 K FACTOR

For the initial SBC Controller setup, the K Factor can be estimated. Performing a field flow calibration is required for precise flow measurement. After the calibration procedure is complete you can view the precise K Factor by Selecting this option. For information on entering a value, see **Setting Values** earlier in this section.

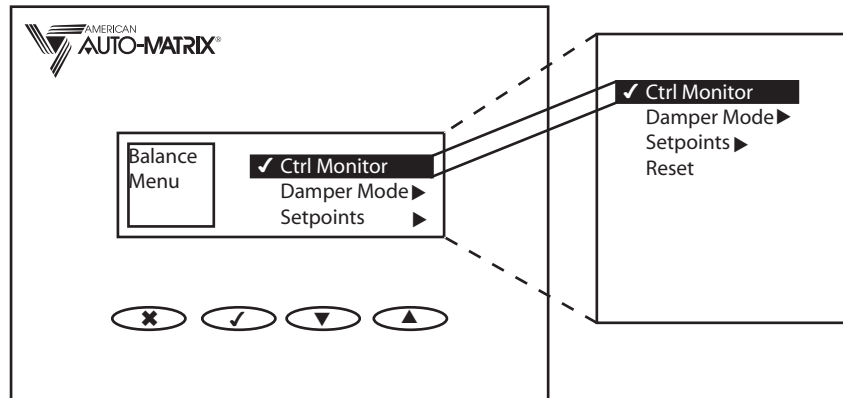


Figure 5-9: Balance Menu

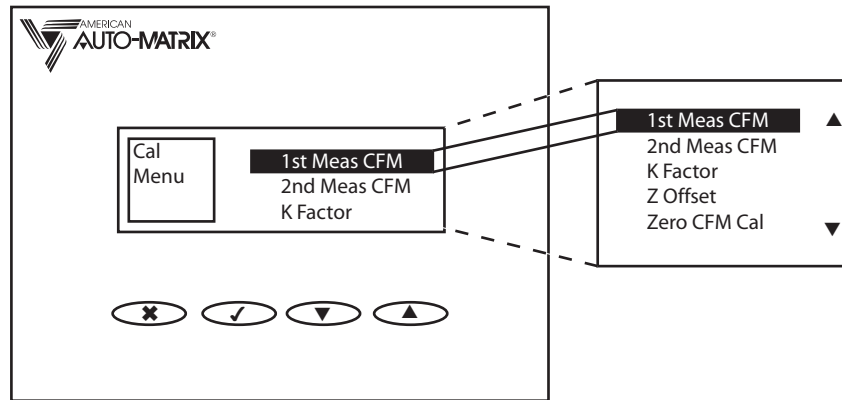


Figure 5-10: Calibration Menu

5.5.0.0.5 Z OFFSET

Here you can view or set the **Zero Offset** value determined by the single- or multi-point calibration process.

5.5.0.0.6 ZERO CFM CAL

Selecting this option opens a screen allowing you to press 4 to initiate the Zero Offset calibration. This option is only used in single-point calibration.

5.7.3.7 DAMPER MODE

From this menu, users can change the Flow:Damper:**Damper Mode** [FA00;DM] attribute setting. The Damper Modes are as follows:

- . Controlled (Automatic)
- . Full Open
- . Min Cool
- . Max Cool
- . Min Heat
- . Max Heat
- . Min Warm-up
- . Max Warm-up

NOTE

Only one mode can be selected at a time.

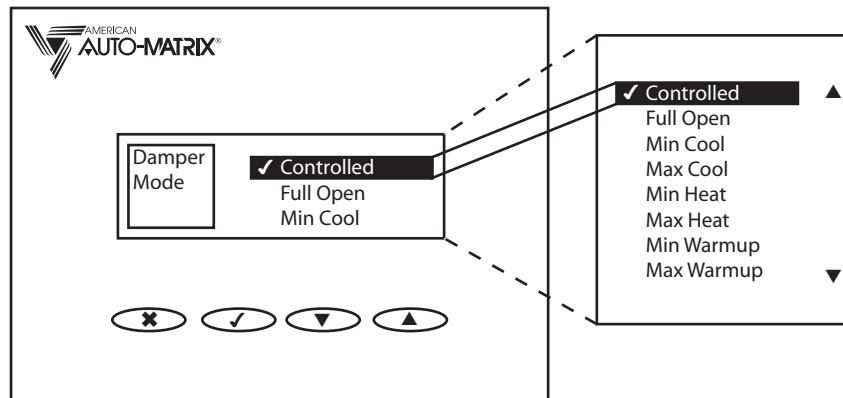


Figure 5-11: Damper Mode Menu

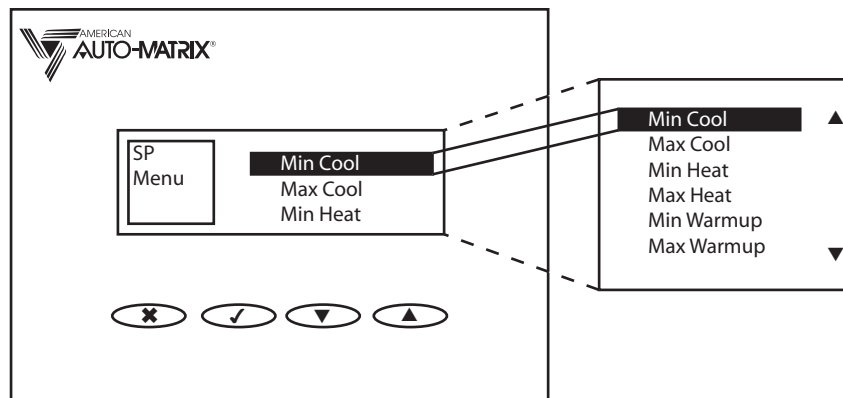


Figure 5-12: Setpoints Menu

5.7.3.8 FLOW SETPOINTS

Through this menu, you can view and edit the following setpoints:

- . Min Cool [Flow:Cooling:**Cooling Minimum Flow (FA01;CM)**]
- . Max Cool [Flow:Cooling:**Cooling Maximum Flow (FA01;CX)**]
- . Min Heat [Flow:Cooling:**Heating Minimum Flow (FA01;HM)**]
- . Max Heat [Flow:Cooling:**Heating Maximum Flow (FA01;HX)**]
- . Min Warm-up [Flow:Cooling:**Warm-up Minimum Flow (FA01;WM)**]
- . Max Warm-up [Flow:Cooling:**Warm-up Maximum Flow (FA01;WX)**]

5.7.4 SERVICE MENU

To enter the Service Menu press the Escape and Down (6t) buttons simultaneously. Enter your four digit password using the up and down arrow buttons. Press the Select (4) to move each place to the right. Once

you have selected the correct password, press Select one more time to enter the Service Menu. The default password for this menu is 1100.

Through the Service Menu, users can:

- . View **Ctrl Monitor** functions (refer to Section 5.7.2.1);
- . Adjust the temperature offset
- . Select local or global temperature (further described in Section 5.7.4.1);
- . Perform Temperature **Setpoint** adjustments (refer to Section 5.7.4.2);
- . View Version information; (further described in 5.7.4.3); and
- . **Reset** the SBC-STAT3 and the SBC-VAV.

5.7.4.1 LOCAL TEMP

This option toggles the multiple thermostat display between zone and individual modes.

5.7.4.2 TEMP OFFSET, COOLING SP, HEATING SP, OR WARM-UP SP

These options open an Edit screen allowing you to change a value. Use the up arrow button to toggle between a negative (-) and positive (+) sign. Use the 4 button to move places to the right and the up and down arrows to change a value. Once you have entered a desired value, press 4 to highlight set and press 4 once more to store the value and return to the Service Menu. To exit the Edit screen without saving any changes, press 6.

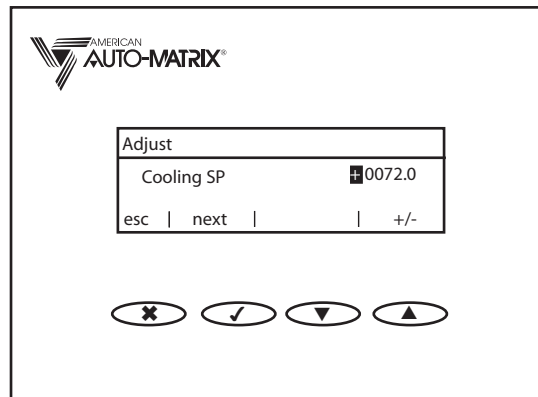


Figure 5-13 Cooling SP Screen

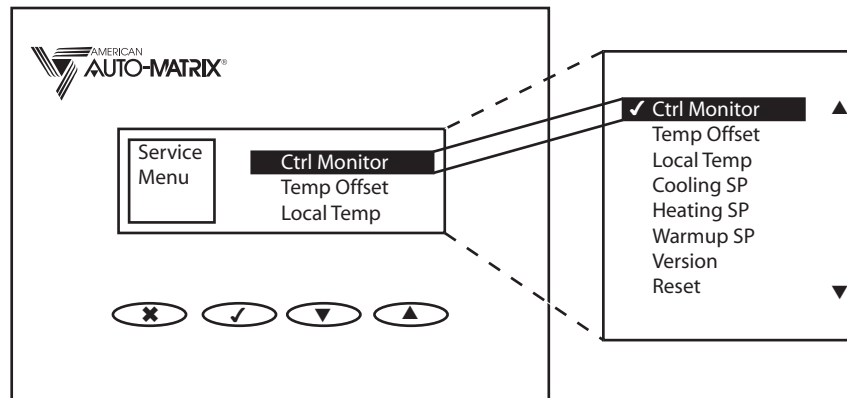


Figure 5-14 Service Menu

5.7.4.3 VERSION

This option displays:

- . SBC controller's **Serial Number**,
- . The **Version Number** of the software,
- . The **Release Code**,
- . The **Firmware Type**,
- . The **Controller Type**,
- . The SBC controller's **Unit ID**,
- . The **Thermostat Version**, and
- . The **Global ID**.

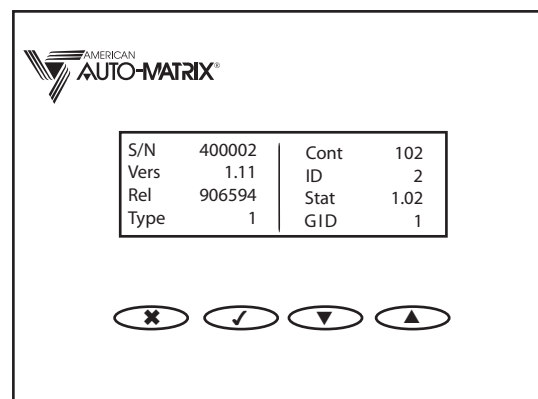


Figure 5-15 Version Screen

APPENDIX A: PUP CHANNELS AND ATTRIBUTES

The following tables contain a list of Public Unitary Protocol (PUP) attribute and channel assignments for the SBC-VAVra, SBC-VAVrf, SBC-VAVta, and SBC-VAVtf.

Each attribute is given with its PUP channel assignment, PUP data type, access code, where it is stored, its SoloPro for Windows location, and a brief description.

IN THIS SECTION

System Channel, FF00	A-3
DAT Channel, FE08	A-5
UI3 Channel, FE03	A-6
UI2 Channel, FE02	A-8
UI1 Channel, FE01	A-10
Temperature Channel, FE00	A-12
AO Channel, FD01	A-17
Occupancy Detection Channel, FC01	A-19
Digital Output Channel, FB01-FB05	A-20
Fan Channel, FB01	A-21
PID Channel, FA11	A-22
Valve Control 2 Channel, FA09	A-24
Valve Control 1 Channel, FA08	A-26
Flow Setpoints Channel, FA01	A-30
Indoor Air Quality, FA01	A-31
Electric Reheat Channel, FA03	A-29
Flow Setpoints Channel, FA01	A-30
Indoor Air Quality, FA01	A-31
Schedules Channels, F901-F906	A-34
Schedules Channel, F900	A-35
Network Channel, F005	A-37

SYSTEM CHANNEL, FF00

FF00 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
BU	FE	RW	RAM 0	System/Power-up	Back Up RAM Values copies specific attribute values from RAM to EEPROM when set to 1: 0 = normal operation, 1 = back up RAM to EEPROM
CC	FE	RW	EE 0	System/ Diagnostics	Clock Fail Count increments upon hardware failure but can also be advanced during the removal of power
CM	FE	R	RAM Flash 255	System/About	Controller Manufacturer contains the factory-set manufacturer number for the unitary controller
CP	FE	RW	EE 0	Network/ Configuration	Communication Speed specifies the communication speed (baud rate) at which devices on this network will communicate 0=9600 1=4800 2=2400 3=1200 4=reserved 5=reserved 6=38.4K 7=19.2K 8=115.2K 9=57.6K
CT	FE	R	RAM Flash 102	System/About	Controller Type factory-set controller type identifies the type of unitary controller
DE	FE	RW	RAM 0	System/Power-up	Default Enable this attribute is used to restore configuration settings to factory defaults
EM	FE	RW	EE 0	System/About	English/Metric specifies which units of measurement to use in returning temperature and airflow values: 0 = English Units; 1 = Metric Units
ER	FE	RW	EE 0 Disabled	Network/ Configuration	Token Recovery enables Token Recovery. In a token passing environment there should always be network activity, but if a token is lost the network will fall silent. If Token Recovery is enabled, and a token is lost, Full Administrator will detect the condition and initiate a new token.
FT	FE	R	RAM Flash 1	System/About	Firmware Type defines the class of firmware operating system used in this controller
IC	FE	R	EE 0	System/ Diagnostics	EEPROM Default Count increments whenever the EEPROM is restored to factory default settings (see FF00;DE Default Enable)
ID	FE	RW	EE Factory Set	Network/ Configuration	Unit Number used to set a unique network address for each controller connected to a multidrop
MS				Network/ Configuration	Trend Master unit number specifies the unit ID of the SAGE area controller containing the trend information to be displayed on a connected STAT3.

FF00 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
OC	FE	RW	EE 0	System/ Diagnostics	Illegal Opcode Count increments upon firmware failure but can also be advanced during the removal of power
PD	FE	RW	EE 5	System/Power-up	Power On Delay time delay in seconds (0–255) that must elapse after the SBC-VAV is reset before output control or alarm functions can begin: 0 = no delay, 1–255 = delay specified in seconds
PS	FE	RW	EE 2	System/Power-up	Power Up State schedule state the SBC-VAV will operate in when it is initially powered or the state that it will operate in when power is restored after a power failure. 0=unoccupied 1=warm-up 2=occupied 3=night setback
RC	FE	RW	EE 0	System/ Diagnostics	Power-up Count increments each time power is applied to the controller. This counts power outages and noise related resets as well as resets initiated through FF00;RS.
RS	FE	RW	RAM 0	System/Power-up	Reset the Controller? used to reset the SBC-VAV: 0 = disabled (default), 1 = reset the SBC-VAV
SN	FE	R	RAM factory set	System/About	Serial Number displays the serial number of the SBC-VAV controller
SR	FE	R	RAM Flash	System/About	Flash Release Code uniquely defines each flash firmware image
TP	FE	RW	EE 0 Irresponsib le Peer	Network/ Configuration	Token Passing Type defines the mode for token passing. When a controller is an Irresponsible Peer it will always return a token to the device that passed it, after performing any pending transactions. In Full Administrator mode, the token is passed to each unit listed in the Peer List (FF00;U1 through FF00;U4).
U1-U4	FE	RW	EE 65535	Network/ Configuration	Peer Unit Number defines the Unit ID of a peer. In Full Administrator mode the token is passed to each unit in the Peer List.
UP	FE	R	EE 0	System/ Diagnostics	Flash Update Count increments each time a new flash firmware image is accepted by the controller.
VE	FA	R	RAM Flash	System/About	Version Number contains the factory-set firmware version
WC	FE	RW	EE 0	System/ Diagnostics	Watchdog Count increments upon firmware failure but can also be advanced during the removal of power
ZN	FE	RW	EE 0	Network/ Configuration	Zone Number from 0 to 65,535 used to group controllers so that they can be controlled simultaneously
ZP	FE	R	RAM 0	System/ Diagnostics	MMT Pulse Count advances when MMT takes action to maintain the operation of the actuator

DAT CHANNEL, FE08

FE08 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
CV	FD	R (RW if OI = 1)	RAM NA	Temperature/ Thermostat	Supply Temperature (UI1) shows the current value of source/duct temperature. This attribute is used to select heating or cooling mode when FF00; BT is set to 'Auto'. The offset adjustment FE08; OF is included in this value.
DD	FC	RW	EE 2.5°F	Temperature/ Thermostat	Auto Mode Dead Band defines the temperature difference by which the supply air must either exceed the FE00; HC heating setpoint to switch to heating mode or fall below the FE00; CC cooling setpoint to engage cooling mode
OF	FD	RW	EE 0	Temperature/ Thermostat	Supply Temperature Adjustment defines an offset used to adjust FE08; CV
OI	FE	RW	EE 0	Temperature/ Thermostat	Override Supply Temperature? allows the Supply Temperature (FE08; CV) to be altered manually 0=No 1=Yes
RE	FE	R	RAM NA	Temperature/ Thermostat	Channel Reliability indicates whether or not the Supply/Duct (DAT) values can be trusted 0=Reliable 1=Unreliable
SM	FE	R	RAM NA	Temperature/ Thermostat	Supply Mode indicates that supply air is suitable for heating or cooling 0=Cooling

UI3 CHANNEL, FE03

FE03 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
AE	FE	RW	EE 0	I/O Setup/Input (UI3)	Alarm Enable specifies the type of alarm checking to be done on the FE03;CV value 0=Disabled 1=Contact (0→1) 2=Contact (1→0) 3=Contact (1↔0) 4=Low limit 5=High limit 6=Low/high limit
AS	FE	R	RAM 0	I/O Setup/Input (UI3)	Alarm Status shows the current alarm condition 0=No alarm 1=Contact (0→1) 2=Contact (1→0) 3=Change of state 4=Unused 5=Low limit 6=High limit
CV	FD	RW	RAM NA	I/O Setup/Input (UI3)	Source Temperature shows the current value of source/duct temperature
DT	FE	RW	EE 253	I/O Setup/Input (UI3)	Data Type for Input specifies the PUP data type for the input
HL	FD	RW	EE 0.0	I/O Setup/Input (UI3)	High Alarm Limit if alarms are enabled and the current value rises above this value, a high limit alarm will be generated
HS	FD	RW	EE 0.0	I/O Setup/Input (UI3)	Alarm Limit Hysteresis determines when the SBC-VAV returns from a high or low limit alarm
IF	FE	RW	EE 0.0	I/O Setup/Input (UI3)	Input Filter Delay specifies the amount of time in tenths of seconds during which an input configured as digital input must remain stable for the value to be considered reliable
IP	FE	RW	EE 0	I/O Setup/Input (UI2)	Input Polarity specifies the input polarity when the input is configured as a digital input 0=Normal 1=Reverse
LL	FD	RW	EE 0.0	I/O Setup/Input (UI3)	Low Alarm Limit specifies the maximum engineering unit for the input corresponding to the highest value measured at the input connection
MN	FD	RW	EE 0.0	I/O Setup/Input (UI3)	Minimum Scaled Value specifies the minimum engineering unit for the input corresponding to the lowest value measured at the input connection
MX	FD	RW	EE 0.0	I/O Setup/Input (UI3)	Maximum Scaled Value specifies the minimum engineering unit for the input corresponding to the lowest value measured at the input connection
OI	FE	RW	EE 0	I/O Setup/Input (UI3)	Override Input allows a host or operator to directly set the value of the source/duct temperature 0=No 1=Yes

FE03 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
RE	FE	R	RAM NA	I/O Setup/Input (UI3)	<p>Data Reliability an analog input value is considered unreliable if it is out of range for the selected sensor type</p> <p>0=Reliable 1=Unreliable</p>
ST	FE	RW	EE 7	I/O Setup/Input (UI3)	<p>Sensor Type selects one of the following input types:</p> <p>0= digital 2= full scale, linear -5V dc or 0-20mA scaled from MN to MX 3= 4-20mA liner scaled from MN to MX 7= -22.0 to 122.0xF thermistor</p>
SU	FD	RW	EE 0.0	I/O Setup/Input (UI3)	<p>Amount of Setup/Setback Alarm Limit specifies the amount added to FE04;HL or subtracted from FE04;LL during unoccupied periods</p>

UI2 CHANNEL, FE02

FE02 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
AE	FE	RW	EE 0	I/O Setup/Input (UI2)	Alarm Enable specifies the type of alarm checking to be done on the FE02;CV value 0=Disabled 1=Contact (0→1) 2=Contact (1→0) 3=Contact (1↔0) 4=Low limit 5=High limit 6=Low/high limit
AS	FE	R	RAM 0	I/O Setup/Input (UI2)	Alarm Status shows the current alarm condition 0=No alarm 1=Contact (0→1) 2=Contact (1→0) 3=Change of state 4=Unused 5=Low limit 6=High limit
CV	FD	RW	RAM NA	I/O Setup/Input (UI2)	Source Temperature shows the current value of source/duct temperature
DT	FE	RW	EE 253	I/O Setup/Input (UI2)	Data Type for Input specifies the PUP data type for the input
HL	FD	RW	EE 0.0	I/O Setup/Input (UI2)	High Alarm Limit if alarms are enabled and the current value rises above this value, a high limit alarm will be generated
HS	FD	RW	EE 0.0	I/O Setup/Input (UI2)	Alarm Limit Hysteresis determines when the SBC-VAV returns from a high or low limit alarm
IF	FE	RW	EE 0.0	I/O Setup/Input (UI2)	Input Filter Delay specifies the amount of time in tenths of seconds during which an input configured as digital input must remain stable for the value to be considered reliable
IP	FE	RW	EE 0	I/O Setup/Input (UI2)	Input Polarity specifies the input polarity when the input is configured as a digital input 0=Normal 1=Reverse
LL	FD	RW	EE 0.0	I/O Setup/Input (UI2)	Low Alarm Limit specifies the maximum engineering unit for the input corresponding to the highest value measured at the input connection
MN	FD	RW	EE 0.0	I/O Setup/Input (UI2)	Minimum Scaled Value specifies the minimum engineering unit for the input corresponding to the lowest value measured at the input connection
MX	FD	RW	EE 0.0	I/O Setup/Input (UI2)	Maximum Scaled Value specifies the minimum engineering unit for the input corresponding to the lowest value measured at the input connection
OI	FE	RW	EE 0	I/O Setup/Input (UI2)	Override Input allows a host or operator to directly set the value of the source/duct temperature 0=No 1=Yes

FE02 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
RE	FE	R	RAM NA	I/O Setup/Input (UI2)	<p>Data Reliability an analog input value is considered unreliable if it is out of range for the selected sensor type</p> <p>0=Reliable 1=Unreliable</p>
ST	FE	RW	EE 7	I/O Setup/Input (UI2)	<p>Sensor Type selects one of the following input types:</p> <p>0= digital 2= full scale, linear -5V dc or 0-20mA scaled from MN to MX 3= 4-20mA liner scaled from MN to MX 7= -22.0 to 122.0xF thermistor</p>
SU	FD	RW	EE 0.0	I/O Setup/Input (UI2)	<p>Amount of Setup/Setback Alarm Limit specifies the amount added to FE04;HL or subtracted from FE04;LL during unoccupied periods</p>

UI1 CHANNEL, FE01

FE01 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
AE	FE	RW	EE 0	I/O Setup/Input (UI1)	Alarm Enable specifies the type of alarm checking to be done on the FE01;CV value 0=Disabled 1=Contact (0→1) 2=Contact (1→0) 3=Contact (1↔0) 4=Low limit 5=High limit 6=Low/high limit
AS	FE	R	RAM 0	I/O Setup/Input (UI1)	Alarm Status shows the current alarm condition 0=No alarm 1=Contact (0→1) 2=Contact (1→0) 3=Change of state 4=Unused 5=Low limit 6=High limit
CV	FD	RW	RAM NA	I/O Setup/Input (UI1)	Source Temperature shows the current value of source/duct temperature
DT	FE	RW	EE 253	I/O Setup/Input (UI1)	Data Type for Input specifies the PUP data type for the input
HL	FD	RW	EE 0.0	I/O Setup/Input (UI1)	High Alarm Limit if alarms are enabled and the current value rises above this value, a high limit alarm will be generated
HS	FD	RW	EE 0.0	I/O Setup/Input (UI1)	Alarm Limit Hysteresis determines when the SBC-VAV returns from a high or low limit alarm
IF	FE	RW	EE 0.0	I/O Setup/Input (UI1)	Input Filter Delay specifies the amount of time in tenths of seconds during which an input configured as digital input must remain stable for the value to be considered reliable
IP	FE	RW	EE 0	I/O Setup/Input (UI1)	Input Polarity specifies the input polarity when the input is configured as a digital input 0=Normal 1=Reverse
LL	FD	RW	EE 0.0	I/O Setup/Input (UI1)	Low Alarm Limit specifies the maximum engineering unit for the input corresponding to the highest value measured at the input connection
MN	FD	RW	EE 0.0	I/O Setup/Input (UI1)	Minimum Scaled Value specifies the minimum engineering unit for the input corresponding to the lowest value measured at the input connection
MX	FD	RW	EE 0.0	I/O Setup/Input (UI1)	Maximum Scaled Value specifies the minimum engineering unit for the input corresponding to the lowest value measured at the input connection
OI	FE	RW	EE 0	I/O Setup/Input (UI1)	Override Input allows a host or operator to directly set the value of the source/duct temperature 0=No 1=Yes

FE01 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
RE	FE	R	RAM NA	I/O Setup/Input (U1)	Data Reliability an analog input value is considered unreliable if it is out of range for the selected sensor type 0=Reliable 1=Unreliable
ST	FE	RW	EE 7	I/O Setup/Input (U1)	Sensor Type selects one of the following input types: 0= digital 2= full scale, linear -5V dc or 0-20mA scaled from MN to MX 3= 4-20mA liner scaled from MN to MX 7= -22.0 to 122.0xF thermistor
SU	FD	RW	EE 0.0	I/O Setup/Input (U1)	Amount of Setup/Setback Alarm Limit specifies the amount added to FE04;HL or subtracted from FE04;LL during unoccupied periods

TEMPERATURE CHANNEL, FE00

FE00 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
AE	FE	RW	EE 0	Temperature/ Alarms	Enable Alarming specifies the type of alarm checking to be done on the CV value 0=disabled 4=low limit 5=high limit 6=Low/High Limit
AS	FE	R	RAM 0	Temperature/ Alarms	Alarm Status shows the current alarm condition 0=No Alarm 5=low limit 6=high limit
BM	FE	RW	EE 0	Temperature/ Sensor Bus	Bus Mode should be set to Master (FE00;BM=0) unless multiple controllers are wired onto a SSB. Any additional controllers on the SSB must be configured as Slaves (FE00;BM=1).
BT	FE	RW	EE 1 cooling only	Temperature/ Thermostat	VAV Control Mode this attribute specifies the type of VAV terminal box being used 0=None (CAV) 1=Cooling Only 2=Heating Only 3=Supply Dependant (VST) 4=Cooling w/reheat
CC	FD	R	RAM NA	Temperature/ Cooling Setpoints	Current Setpoint this attribute shows the current cooling control setpoint
CH	FD	R	RAM	Temperature/ Heating Setpoints	Current Setpoint this attribute shows the current heating control setpoint
CV	FD	RW	RAM NA	Temperature/ Alarms	Current Value shows the current value of the input
DF	FE	RW	EE 3 ##.#	Temperature/ Sensor Bus	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=##d 1=##.#d 2=##df 3=##.#df 4=None
DL	FD	R	RAM NA	Temperature/ Thermostat	Demand Load indicates the heating/cooling demand of the zone in terms of the temperature separation from setpoints
DM	FE	R	RAM NA	Temperature/ Thermostat	Zone Demand indicates the demand for the zone
DS	FE	RW	EE 0 degrees F	Temperature/ Sensor Bus	Display Mode specifies whether English or Metric units are to be used for the digital thermostat display 0=Fahrenheit 1=Celsius

FE00 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
DV	FE	RW	EE 0	Temperature/ Sensor Bus	Display Value , when FE00;DV=0 each digital thermostat displays the identical temperature value (average) (FE00;ZT). When FE00;DV=1 each thermostat displays its own temperature
ED	FE	RW	EE 60 minutes	Temperature/ Override	Extended Occupancy Duration this attribute specifies the amount of time in minutes to extend occupancy
ER	FE	R	RAM NA	Temperature/ Override	Extended Occupancy Remaining this attribute shows the amount of time remaining in extended occupancy
ET	FE	RW	EE 0	System/Statistics	Enable Flow/Energy Totalization when enabled (ET = 1), SBC-VAV will calculate expended flow and energy provided that universal input FE04 is used as a duct temperature sensor; energy totalization is invalid in any other circumstance 0=No 1=Yes
G0	FE	R	RAM NA	Temperature/ Sensor Bus	GID Device 0 the global identification for the SSB device
G1	FE	R	RAM NA	Temperature/ Sensor Bus	GID Device 1 the global identification for the SSB device
G2	FE	R	RAM NA	Temperature/ Sensor Bus	GID Device 2 the global identification for the SSB device
G3	FE	R	RAM NA	Temperature/ Sensor Bus	GID Device 3 the global identification for the SSB device
HL	FD	RW	EE 0.0	Temperature/ Alarms	High Alarm Limit if alarms are enabled and the current value rises above this value, a high limit alarm will be generated
HS	FD	RW	EE 0.0	Temperature/ Alarms	Alarm Limit Hysteresis determines when the SBC-VAV returns from a high or low limit alarm
LL	FD	RW	EE 0.0	Temperature/ Alarms	Low Alarm Limit if alarms are enabled and the current value drops below this value, a low limit alarm will be generated
NC	FD	RW	EE 5.0	Temperature/ Cooling Setpoints	Night Setback this attribute specifies, in +/- degrees, the amount to be added to the cooling setpoint (FE00;SC) when the SBC-VAV is in night setback mode
NH	FD	RW	EE 10.0°F	Temperature/ Heating Setpoints	Night Setback specifies, in +/- degrees, the amount to be added to the heating setpoint (FE00;SH) when the SBC-VAV is in night setback mode
OA	FE	RW	RAM 0	System/Statistics	Accumulated Extended Occupancy Time shows the total amount of time that the SBC-VAV has spent in extended occupancy
OF	FD	RW	EE 0	Temperature/ Thermostat	Temperature Correction this defines the correction that is being applied to temperature readings
OI	FE	RW	EE 0	Temperature/ Thermostat	Override Temperature Value? allows you to write to FE00;ZT directly 0=No 1=Yes

FE00 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
PB	FE	RW	EE 2200	Temperature/ Sensor Bus	Balancer P.I.N. this personal identification number controls access to the Balance Menu
PG	FE	RW	EE NA	Temperature/ Sensor Bus	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	FE	RW	EE 3300	Temperature/ Sensor Bus	Installer P.I.N. this Personal Identification Number controls access to all menus.
PS	FE	RW	EE 1100	Temperature/ Sensor Bus	Service P.I.N. this personal identification number controls access to the Service Menu
PU	FE	RW	EE 0000	Temperature/ Sensor Bus	User P.I.N. this personal identification number controls access to the User Menu
RM	FE	RW	EE 0	Temperature Sensor Bus	Reading Mode specifies the technique used to determine Zone Temperature when multiple thermostats are present. 0=Average mode (default) 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	FE	RW	RAM 0	System/Statistics	Reset Totals? used to reset TF and TE to 0, restarting the totalization process 0=No 1=Yes
SC	FD	RW	EE 72.0	Temperature/ Cooling Setpoints	Cooling Setpoint shows the zone temperature setpoint desired to begin cooling control
SD	FE	RW	EE 0	Temperature/ Setpoint Adjust	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 (FE00;ZS) 2 = Heating Setpoint (FE00;CH) 3 = Cooling Setpoint (FE00;CC)t
SE	FE	RW	EE 1 enables	Temperature/ Override	User Override this attribute enables or disables your ability to enter extended occupancy 0=Disabled 1=Enabled
SH	FD	RW	EE 68.0°F	Temperature/ Heating Setpoints	Heating Setpoint this attribute shows the zone temperature setpoint desired to begin heating control
SU	FC	RW	EE 0.0	Temperature/ Alarms	Amount to Setup/Setback Alarm Limit specifies the amount added to HL or subtracted from LL during unoccupied periods
SW	FD	RW	EE 72.0°F	Temperature/ Heating Setpoints	Warm-up Setpoint shows the zone temperature setpoint desired for beginning warm-up heating control

FE00 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
T0	FD	R	RAM NA	Temperature/ Sensor Bus	Reading Device 0 the raw reading for Device 1 on a SSB
T1	FD	R	RAM NA	Temperature/ Sensor Bus	Reading Device 1 the raw reading for Device 2 on a SSB
T2	FD	R	RAM NA	Temperature/ Sensor Bus	Reading Device 2 the raw reading for Device 3 on a SSB
T3	FD	R	RAM NA	Temperature/ Sensor Bus	Reading Device 3 the raw reading for Device 4 on a SSB
TE	FE	RW	RAM *1 NA	System/Statistics	Total Accumulated Energy specifies the total amount of energy in BTUs (or kilojoules) that have been used by the terminal box (from 0 to 4,294,967,295) since the last time TE was reset
TF	FE	RW	RAM *1 NA	System/Statistics	Total Accumulated Flow specifies the total number of cubic feet (or liters) of airflow (from 0 to 4,294,967,29) that have passed through the primary (cooling) duct since the last time TF was reset
TM	FD	RW	EE 0.5°F	Temperature/ Setpoint Adjust	User Adjust Increment this attribute specifies the magnitude of incremental changes to the User Setpoint Offset (FE00; TS)
TP	FF	RW	RAM 0	Temperature/ Setpoint Adjust	User Adjust Position the User Setpoint Offset (FE00; TS) can be raised or lowered in integral steps; the FE00; TP attribute tracks the current step
TR	FE	RW	RAM 0	Temperature/ Setpoint Adjust	User Adjust Remaining displays the time remaining before the User Setpoint Offset (FE00; TS) setting is reset
TS	FD	RW	RAM 0	Temperature/ Setpoint Adjust	User Setpoint Offset this attribute defines an offset to be applied to PID setpoints
TT	FE	RW	EE 120 minutes	Temperature/ Setpoint Adjust	User Setpoint Offset the User Setpoint Offset (FE00; TS) is a temporary setting; the FE00; TT attribute defines in minutes the duration for which the setting applies
UC	FD	RW	EE 5.0	Temperature/ Cooling Setpoints	Unoccupied Setback this attribute specifies, +/- degrees, the amount to be added to the cooling setpoint (FE00; SC) when the SBC-VAV schedule is in unoccupied mode
UH	FD	RW	EE 10.0°F	Temperature/ Heating Setpoints	Unoccupied Setback specifies, in +/- degrees, the amount to be added to the heating setpoint (FE00; SH) when the SBC-VAV is in unoccupied mode
ZS	FD	RW	RAM 70.0	Temperature/ Setpoint Adjust	Zone Midpoint displays the midpoint between the current cooling and heating setpoints.
ZT	FD	R (RW if FE00; OI = 1)	RAM NA	Temperature/ Thermostat	Zone Temperature shows the current temperature value measured by the thermostat as adjusted by FE00; OF
RH	FE	R	RAM NA	Aux/Relative Humidity	Relative Humidity shows the current sensed relative humidity from a connected SBC-RHT.
HD	FE	RW	EE 0	Aux/Relative Humidity	Display Relative Humidity indicates if relative humidity should be displayed on the LCD of the SBC-RHT.

FE00 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
HC	FD	RW	EE 0.0	Aux/Relative Humidity	Relative Humidity Correction defines a correction offset for the sensed relative humidity.
HO	FE	RW	EE 0	Aux/Relative Humidity	Override Relative Humidity? permits overrides to the relative humidity.

AO CHANNEL, FD01

FD01 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
AM	FE	RW	EE 0	I/O Setup/Output (AO1)	Automatic/Manual Control selects the control mode for the analog output 0=Manual 1=Automatic
CV	FD	RW	RAM 0.0	I/O Setup/Output (AO1)	Current Output Value shows the current value of the analog output
DT	FE	RW	EE 252	I/O Setup/Output (AO1)	Data Type for Output specifies the PUP data type for the analog output
HS	FA	RW	EE 100.0	I/O Setup/Output (AO1)	Maximum Scaled Voltage specifies the actual analog output value for a FD01; CV value of FD01; MX
LS	FA	RW	EE 0.00	I/O Setup/Output (AO1)	Minimum Scaled Voltage specifies the actual analog output value for a FD01; CV value of FDO1; MX
MN	FD	RW	EE 0.0	I/O Setup/Output (AO1)	Minimum Scaled Value specifies the minimum scaled value for the analog output corresponding to the lowest value output
MX	FD	RW	EE 100.0	I/O Setup/Output (AO1)	Maximum Scaled Value specifies the maximum scaled value for the analog output corresponding to the highest value output

PROOF OF FLOW CHANNEL, FC02

FC02 Attr.	Data Type	Access	Store & Value	SP for Windows Location	Description
DR	FE	RW	EE 1	Flow/Proof of Flow	Method defines the requirements for proof of flow 0=None 1=Minimum Flow 2=Digital Input 3=Both
IC	FE	RW	EE	Flow/Proof of Flow	Status Input Selects the input where a non-zero value indicates flow 0=None 1=UI1 2=UI2
MF	FE	RW	EE 75	Flow/Proof of Flow	Minimum Required Flow the minimum flow reading required in order to indicate positive flow
PD	FE	RW	EE 60	Flow/Proof of Flow	Flow Proof Delay Shows the amount of time, in seconds, imposed before enabling a positive flow indication
PF	FE	R	RAM 0	Flow/Proof of Flow	Proof of Flow shows the status of the proof of flow 0=No Flow 1=Flow

OCCUPANCY DETECTION CHANNEL, FC01

FC01 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
IC	FE	RW	EE 0	Aux/Occupancy Detector	Status Input enables occupancy detection and specifies the binary input channel to be used for detection 0=None 1=U11 2=U12
MD	FE	RW	EE 30	Aux/Occupancy Detector	Extended Occupancy Delay sets the amount of time, in seconds, during which the occupancy detector must remain on before it will override the zone
MR	FE	R	RAM NA	Aux/Occupancy Detector	Extended Occupancy Remaining displays the time remaining for occupancy detector override
MS	FE	R	RAM NA	Aux/Occupancy Detector	Occupancy Status shows the status of the occupancy detector digital input 0=No Detection 1=Detection
MT	FE	RW	EE 0	Aux/Occupancy Detector	Extended Occupancy Duration defines, in minutes, the length of time to override the zone whenever motion is detected

DIGITAL OUTPUT CHANNEL, FB01-FB05

FB01-FB05 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
CV	FE	RW	RAM NA	I/O Setup/Triac Outputs	Current Value shows the current value for the analog output
OI	FE	RW	EE 0 Off	I/O Setup/Triac Outputs	Override overrides the digital output. On (;OI=1) constantly energizes the output; Off (;OI=0) disables the output; Auto (;OI=2) allows for automatic control; Manual (;OI=3) allows the CV to be directly written.
OP	FE	RW	EE 0	I/O Setup/Triac Outputs	Output Polarity allows you to change the polarity of the output 0=Normal 1=Reverse
RH	FC	RW	RAM *	I/O Setup/Triac Outputs	Runtime Hours shows the total amount of time, in hours, during which the output has been energized
RL	FC	RW	EE 0.0	I/O Setup/Triac Outputs	Runtime Limit specifies a run time limit in hours for the output

FAN CHANNEL, FB01

FB01 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
CV	FE	RW	RAM NA	Aux/Fan	Fan defines the status of the fan output 0=Off 1=On
FC	FC	RW	EE 0	Aux/Fan	Minimum Cycle Time shows the minimum amount of time, in minutes, during which the fan output will stay energized or de-energized
FO	FE	RW	EE 0	Aux/Fan	Fan/Damper Mode used to configure the fan or damper 0=No Fan/Ind Damp 1=Series Fan 2=Parallel Fan 3=Induction Damper
FS	FE	RW	EE 0	Aux/Fan	Fan Setpoint used to set the parallel fan, induction damper or constant volume setpoint (cfm)
SF	FE	RW	EE 0	Aux/Fan	Series Fan Unoccupied Mode shows the status of the series fan during the unoccupied schedule state 0=Always On 1=Off in Deadband

PID CHANNEL, FA11

FA11 Attr.	Data Type	Access	Store & Value	SP for Windows Location	Description
AO	FD	RW	RAM NA	Aux/PID Control	Analog Output Value shows the scaled output value used by the analog output
CE	FE	RW	EE 0	Aux/PID Control	Control Enabled? enables the PID loop 0=No 1=Yes
CS	FD	R	RAM NA	Aux/PID Control	Control Setpoint shows the actual loop control setpoint
DB	FC	RW	EE 0	Aux/PID Control	Dead band specifies the input variable range over which the output value is proportional to the error value
IC	FE	RW	EE 0	Aux/PID Control	Input channel specifies the input to be used for the measured variable for the control loop 0=Disabled 1=Zone Temp 2=Supply Temp 3=Flow 4=UI1 5=UI2 9=Zone Heating 10=Zone Cooling
IN	FC	R	RAM 0	Aux/PID Control	Input Channel Value displays the value of the input selected in FA04;IC
MR	FD	RW	EE 0	Aux/PID Control	Maximum Reset specifies the maximum amount by which to reset the loop setpoint (SP) when reset is being used
PB	FC	RW	EE 0	Aux/PID Control	Proportional Band specifies the input variable range over which the output value is proportional to the error value
PO	FC	RW	RAM NA	Aux/PID Control	Percent Output Value shows the output value in hundredths of a percent
RC	FC	R	RAM NA	Aux/PID Control	Reset Variable Value displays the value of the input selected in RV
RL	FC	RW	EE 0	Aux/PID Control	Limit for Maximum Reset specifies the value at which maximum reset is used
RP	FE	RW	EE 0	Aux/PID Control	Reset Period specifies the reset period (in seconds) over which the error history is accumulated
RS	FC	RW	EE 0	Aux/PID Control	Reset Setpoint specifies the value at which the reset action begins
RT	FC	RW	EE 0	Aux/PID Control	Rate specifies a percentage of change in error that is to be used in calculating FA04;PO

FA11 Attr.	Data Type	Access	Store & Value	SP for Windows Location	Description
RV	FE	RW	EE 0	Aux/PID Control	Reset Variable specifies the input to be used for calculating the reset 0=disabled 1=Zone Temp 2=Supply Temp 3=Flow 4=UI1 5=UI2
SG	FE	RW	EE 0	Aux/PID Control	Control Sign specifies the control action for the control loop 0=Normal 1=Reverse
SP	FD	RW	EE 0	Aux/PID Control	Loop Setpoint specifies the desired loop setpoint
SU	FC	RW	EE 0	Aux/PID Control	Setup/Setback specifies the amount to add (if SG = 0) or subtract (if SG = 1) from the setpoint during an unoccupied period

VALVE CONTROL 2 CHANNEL, FA09

FA09 Attr.	Data Type	Access	Store & Value	SP for Windows Location	Description
AM	FE	RW	EE 0	Aux/Valve Control/ 2	Auto/Manual Mode selects the control mode for the valve output(s) 0=Manual 1=Automatic
CD	FE	RW	EE 0	Aux/Valve Control/ 2	Change Valve Direction used to set the direction of the valve outputs 0=Normal 1=Reverse
PP	FE	RW	EE 0	Aux/Valve Control	Pulse Duration Period shows the amount of time, in seconds, that the valve is to be pulsed ON when PE = 1 or pulse width modulation is enabled
RI	FE	RW	EE 0	Aux/Valve Control/ 2	Recalibrate Interval shows the amount of time, in hours, between valve recalibrations. Calibration is disabled when RI = 0. This point defaults to 0. Note that if RI = 0 and a power failure occurs, the valve will not be recalibrated upon power-up.
ST	FE	R	RAM NA	Aux/Valve Control/ 2	Valve Status indicates the status of the valve channel 0=Off 1=Open 2=Close 3=Calibrate
TH	FD	RW	EE 105.0	Aux/Valve Control/ 2	DAT High Temp Lockout Heating stages will be engaged only if there is a Reliable Source/Duct Temperature DAT below this setting. If a supply temperature sensor is not present, set this attribute to 999.0.
TL	FD	RW	EE 45.0	Aux/Valve Control/ 2	DAT Low Temp Lockout Defines the minimum Source/Duct Temperature (DAT - Discharge Air Temperature) below which cooling will be disengaged. This offers protection against freeze up. If a supply temperature sensor is not present, set this attribute to 999.0.
UT	FE	RW	EE 5	Aux/Valve Control/ 2	Update Threshold used to minimize the actuation of the value for the insignificant changes
VA	FE	R	RAM NA	Aux/Valve Control/ 2	Actual Valve Position shows the actual valve position based on travel time.
VD	FE	RW	RAM NA	Aux/Valve Control/ 2	Desired Valve Position shows the desired valve position at which the loop should control the valve in order to bring the measured input variable closer to the setpoint
VI	FC	RW	EE 0.0	Aux/Valve Control/ 2	Valve Integration Constant shows the amount of proportional error history (0 to 100%) used to calculate the desired position for the valve
VM	FE	RW	EE 0	Aux/Valve Control/ 2	Valve Mode 0=PWM 1=Floating Point Motor Control
VO	FC	RW	EE 0.0	Aux/Valve Control/ 2	Valve Offset used to configure the valve mode
VP	FC	RW	EE 5.0	Aux/Valve Control/ 2	Valve Proportional Band specifies the input variable range, in degrees (0.0 to 25.5), over which the output is proportional to the error value

FA09 Attr.	Data Type	Access	Store & Value	SP for Windows Location	Description
VT	FE	RW	EE 180	Aux/Valve Control/ 2	Valve Travel Time shows the amount of time, in seconds, that it takes the valve motor to travel from a fully closed position to a fully opened one
VU	FE	RW	EE 0	Aux/Valve Control/ 2	Valve Use options are disabled, cooling and heating 0=Disabled 1=Cooling 2=Heating

VALVE CONTROL 1 CHANNEL, FA08

FA08 Attr.	Data Type	Access	Store & Value	SP for Windows Location	Description
AM	FE	RW	EE 0	Aux/Valve Control/ 1	Auto/Manual Mode selects the control mode for the valve output(s) 0=Manual 1=Automatic
CD	FE	RW	EE 0	Aux/Valve Control/ 1	Change Valve Direction used to set the direction of the valve outputs 0=Normal 1=Reverse
PP	FE	RW	EE 0	Aux/Valve Control/ 1	Pulse Duration Period shows the amount of time, in seconds, that the valve is to be pulsed ON when PE = 1 or pulse width modulation is enabled
RI	FE	RW	EE 0	Aux/Valve Control/ 1	Recalibrate Interval shows the amount of time, in hours, between valve recalibrations. Calibration is disabled when RI = 0. This point defaults to 0. Note that if RI = 0 and a power failure occurs, the valve will not be recalibrated upon power-up.
ST	FE	R	RAM NA	Aux/Valve Control/ 1	Valve Status indicates the status of the valve channel 0=Off 1=Open 2=Close 3=Calibrate
TH	FD	RW	EE 105.0	Aux/Valve Control/ 1	DAT High Temp Lockout heating stages will be energized only if there is a reliable source/duct temperature. If a supply temperature sensor is not present, set this attribute to 999.0.
TL	FD	RW	EE 45.0	Aux/Valve Control/ 1	DAT Low Temp Lockout the minimum source/duct temperature below which cooling will be disengaged. This offers protection against freeze-up. If a supply temperature sensor is not present, set this attribute to 999.0.
UT	FE	RW	EE 5	Aux/Valve Control/ 1	Update Threshold used to minimize the actuation of the value for the insignificant changes
VA	FE	R	RAM NA	Aux/Valve Control/ 1	Actual Valve Position shows the actual valve position based on travel time.
VD	FE	RW	RAM NA	Aux/Valve Control/ 1	Desired Valve Position shows the desired valve position at which the loop should control the valve in order to bring the measured input variable closer to the setpoint
VI	FC	RW	EE 0.0	Aux/Valve Control/ 1	Valve Integration Constant shows the amount of proportional error history (0 to 100%) used to calculate the desired position for the valve
VM	FE	RW	EE 0	Aux/Valve Control/ 1	Valve Mode 0=PWM 1=Floating Point Motor Control
VO	FC	RW	EE 0.0	Aux/Valve Control/ 1	Valve Offset used to configure the valve mode
VP	FC	RW	EE 5.0	Aux/Valve Control/ 1	Valve Proportional Band specifies the input variable range, in degrees (0.0 to 25.5), over which the output is proportional to the error value

FA08 Attr.	Data Type	Access	Store & Value	SP for Windows Location	Description
VT	FE	RW	EE 180	Aux/Valve Control/ 1	Valve Travel Time shows the amount of time, in seconds, that it takes the valve motor to travel from a fully closed position to a fully opened one
VU	FE	RW	EE 0	Aux/Valve Control/ 1	Valve Use options are disabled, cooling and heating 0=Disabled 1=Cooling 2=Heating

FLOW ALARM CHANNEL, FA05

FA05 Attr.	Data Type	Access	Store & Value	SP for Windows Location	Description
AE	FE	RW	EE 0	Flow/Alarms	Alarm Enable specifies the type of alarm checking to be done on the CV value 0=Disable 4=Low Limit 5=High Limit 6=Low/High Limit
AS	FE	R	RAM 0	Flow/Alarms	Alarm Status shows the current alarm condition 0=No Alarm 5=Low Limit 6=High Limit
CV	FE	R (RW if OI = 1)	RAM NA	Flow/Alarms	Current Value shows the current measured amount of airflow in cfm
HL	FE	RW	EE 0	Flow/Alarms	High Alarm Limit if alarms are enabled and the current value rises above this value, a high limit alarm will be generated
HS	FE	RW	EE 0	Flow/Alarms	Alarm Limit Hysteresis determines when the SBC-VAV returns from a high or low limit alarm
LL	FE	RW	EE 0	Flow/Alarms	Low Alarm Limit if alarms are enabled and the current value drops below this value, a low limit alarm will be generated
SU	FE	RW	EE 0	Flow/Alarms	Alarm Limit Setup/Setback specifies the amount added to HL or subtracted from LL during unoccupied periods

ELECTRIC REHEAT CHANNEL, FA03

FA03 Attr.	Data Type	Access	Store & Value	SP for Windows Location	Description
AF	FE	RW	EE 1	Aux/Electric Reheat	Require Max Airflow if set to "Yes" (FA03;AF = 1), this holds off the addition of reheat stages until the PID loop is calling for maximum airflow
AV	FE	R	RAM NA	Aux/Electric Reheat	Available Stages displays the stages that are currently available for use
BA	FE	RW	EE 0	Aux/Electric Reheat	Balance Stage Usage if set to "Yes" (FA03;BA = 1), this attribute considers the Run Hour Totals (FB0x;RH) for the individual relay outputs in energizing reheat stages
EN	FE	R	RAM NA	Aux/Electric Reheat	Energized Stages displays the reheat stages that are currently energized
FR	FE	RW	EE 15	Aux/Electric Reheat	Stages Requiring Flow defines by the appropriate bit setting which of the available reheat stages requires a positive flow indication
ID	FC	RW	EE 4.0	Aux/Electric Reheat	Stage Delay shows the minimum amount of time, in minutes, before the next reheat stage will be energized
MX	FC	RW	EE 105.0	Aux/Electric Reheat	Maximum Supply Temperature establishes a maximum supply duct temperature above which the reheats will de-energize
OF	FC	RW	EE 1.5°F	Aux/Electric Reheat	Reheat Offset specifies, in degrees, the offset from the calculated heating control setpoint (FE00;HC) that determines the temperature below which additional reheat stages can be energized
RO	FE	RW	EE 0	Aux/Electric Reheat	Reheat Mode used to configure the SBC-VAV's outputs for electric reheat 0=Disabled 1=2 stage electric reheat (K2 and 3) 2=2 stage electric reheat (K4 and 5) 3=4 stage electric reheat (K2,3,4 and 5)

FLOW SETPOINTS CHANNEL, FA01

FA01 Attr.	Data Type	Access	Store & Value	SP for Windows Location	Description
CI	FC	RW	EE 5.0%	Flow/Cooling	Cooling Integration Constant shows the amount of proportional error history (0 to 100%) used to calculate the desired position for the cooling duct damper
CM	FE	RW	EE 100	Flow/Cooling	Cooling Minimum Flow shows the allowable minimum (cooling) duct flow
CP	FC	RW	EE 5.0°F	Flow/Cooling	Cooling Proportional Band specifies, in degrees (0.0 to 25.5), the offset from the calculated cooling control setpoint ; CC that determines the proportional band for damper control
CX	FE	RW	EE 500	Flow/Cooling	Cooling Maximum Flow shows the allowable maximum (cooling) duct flow
HI	FC	RW	EE 5.0%	Flow/Heating	Heating Integration Constant shows the amount of proportional error history (0 to 100%) used to calculate the desired position for the heating duct damper
HM	FE	RW	EE 100	Flow/Heating	Heating Minimum Flow shows the allowable minimum heating duct flow during heating
HP	FC	RW	EE 5.0	Flow/Heating	Heating Proportional Band specifies, in degrees (0.0 to 25.5), the offset from the calculated heating control setpoint that determines the proportional band for the heating duct damper control
HX	FE	RW	EE 500	Flow/Heating	Heating Maximum Flow shows the allowable maximum heating duct flow during heating
WI	FC	RW	EE 10.0%	Flow/Warm-up	Warm-up Integration Constant shows the amount of proportional error history (0 to 100%) used to calculate the desired position for the heating duct damper
WM	FE	RW	EE 300	Flow/Warm-up	Warm-up Minimum Flow shows the allowable minimum heating duct flow during warm-up heating
WP	FC	RW	EE 5.0°F	Flow/Warm-up	Warm-up Proportional Band specifies in degrees (0.0 to 25.5) the offset from the calculated heating control setpoint that determines the proportional band for the warm-up heating duct damper control
WX	FE	RW	EE 700	Flow/Warm-up	Warm-up Maximum Flow shows the allowable maximum heating duct flow during warm-up heating.
MD	FE	RW	EE 0	Flow/Unoccupied	Min Flow Overrides defines the application for flow override during unoccupied periods.
UM	FE	RW	EE 0	Flow/Unoccupied	Unoccupied Minimum Flow defines the minimum flow that the VAV should follow for schedule periods other than occupied.

INDOOR AIR QUALITY, FA01

FA01	Data Type	Access	Store & Default	SP for Windows Location	Description
AS	FE	RW	EE	Flow/Indoor Air Quality	Air Quality Setpoint specifies the acceptable CO ² level in the zone
DB	FE	RW	EE	Flow/Indoor Air Quality	Air Quality Deadband specifies the CO ² variable range over which the control of the damper is stroked
RP	FE	RW	EE	Flow/Indoor Air Quality	Air Quality Damper Ramp Rate specifies the percentage rate per minute that the damper moves to compensate for the change in CO ² levels
AM	FE	RW	EE	Flow/Indoor Air Quality	Air Quality Control Max Air Flow specifies the allowable maximum air flow

FLOW CHANNEL, FA00

FA00 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
AC	FE	RW	EE 1	Flow/Control	Control Mode when set for Auto, the Target Flow (FA00;CD) is determined by the control algorithms and setpoints 0=Manual 1=Auto 2=Tracking
AS	FE	R	RAM NA	Flow/Damper	Actuator Status reports the status of the actuator as determined by the MMT
AT	FE	RW	EE 0	Flow/Damper	Actuator Type defines the type and connection for the damper actuator
CA	FE	R	RAM NA	Flow/Control	Average Flow shows the measured average flow in cfm
CB	FE	RW	RAM 0	Flow/Control	Calibrate Flow Sensor? allows a host or operator to manually calibrate the flow sensor 0=No 1=Yes
CD	FE	RW with manual CAV	RAM NA	Flow/Control	Target Flow shows the desired flow (cfm) setpoint calculated by the cooling or heating PI loops
CK	FE	RW	EE 768	Flow/Control	Duct Scaling Factor shows the scaling factor for the particular VAV box being used
CV	FE	R (RW if OI=1)	RAM NA	Flow/Control	Current Value shows the current measured amount of airflow in cfm
DC	FE	RW	EE 0	Flow/Damper	Damper Control defines the method used to control the damper. For 'Pressure Dependant' mode (FA00;DC=0) the damper position is estimated based on the target flow (FA00;CD) and the estimated maximum flow (FA00;EF). In 'Measured Flow' mode (FA00;DC=1 default) the damper is modulated to maintain the target flow (FA00;CD).
DD	FE	RW	EE 0	Flow/Damper	Direction used to set the direction of the damper motor
DM	FE	RW	EE 0	Flow/Control and Flow/Damper	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 1=open fully 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
DP	FE	R	RAM NA	Flow/Damper	Damper Position shows the damper position with an optional actuator having a built in feedback potentiometer
EF	FE	RW	EE 700	Flow/Damper	Estimated Flow at Full Open shows the estimated flow at full open in cfm

FA00 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
EP	FE	R	RAM NA	Flow/Damper	Estimated Target Position shows the estimated target position with which the loop should control the valve to bring the measured input variable closer to the setpoint. A change in EP causes the valve to drive in the proper control direction.
FC	FE	RW	RAM 0	Flow/Control	Fan controls the current status of the fan output 0=Off 1=On
FH	FE	RW	EE 20	Flow/Control	Flow Hysteresis specifies the maximum amount of flow sensor variation to be tolerated by the SBC-VAV before it shows a valid change of flow
K2	FE	RW	RAM NA	Flow/Control	2-Point Calibration accepts a measured CFM value that is at least 100 CFM different than that last entered in FA00; KC . Both this measured CFM value and that entered in FA00; KC are then used to calibrate. This provides for an improved flow calibration.
KC	FE	RW	RAM NA	Flow/Control	1-Point Calibration when you enter the cfm value measured externally, this will automatically adjust the Duct Scaling Factor (FA00; CK) based on the present flow reading to properly scale the duct
OF	FF	RW	EE 0	Flow/Control	Flow Offset Defines an offset or adjustment applied to the target flow. When operated in Auto (FA00; AC =1) or Tracking (FA00; AC =2) mode the Flow Offset is added to the derived target. The Target Flow (FA00; CD) includes this offset.
OI	FE	RW	EE 0	Flow/Control	Override Current Value? allows a host or operator to manually set the value of the current flow 0=No 1=Yes
RZ	FE	R	RAM NA	Flow/Damper	Rejuvenate Count when MMT detects the possibility of an actuator short, electrical pulses are used in an attempt to rejuvenate the motor

SCHEDULES CHANNELS, F901-F906

F901-F906 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
AD	E9	RW	EE M,T,W,T,F	Schedules/1-6	Active Days Day-of-week map specifying which of eight possible days of the week (seven days plus holiday) that the schedule is active
AO	FE	RW	EE 0	Schedules/1-6	All-Day Override this attribute is used to override the schedule in WO , OC , UN and NS for active days
CV	FE	R	RAM NA	Schedules/1-6	Current Mode indicates the current state of the schedule: 0 = unoccupied mode 1 = warm-up 2 = occupied mode 3 = night setback
NS	E6	RW	EE 19:00	Schedules/1-6	Night Setback start time in short military format when night setback should begin
OC	E6	RW	EE 08:00	Schedules/1-6	Occupied Time start time in short military format when occupied mode should begin
UN	E6	RW	EE 17:00	Schedules/1-6	Unoccupied Time start time in short military format when unoccupied mode should begin
WO	E6	RW	EE 07:00	Schedules/1-6	Warm-up Time start time in short military format when warm-up mode should begin

SCHEDULES CHANNEL, F900

F900 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
AS	E9	R	RAM NA	Schedules/ Summary	Active Schedule Bitmap displays the currently active schedules in bitmap form bit #0=F901 bit #1=F902 bit #2=F903 bit #3=F904 bit #4=F905 bit #5=F906
C1	FE	R	RAM NA	Schedules/ Summary	Current Value of Schedule 1 reflects the current value of F901; CV
C2	FE	R	RAM NA	Schedules/ Summary	Current Value of Schedule 2 reflects the current value of F902; CV
C3	FE	R	RAM NA	Schedules/ Summary	Current Value of Schedule 3 reflects the current value of F903; CV
C4	FE	R	RAM NA	Schedules/ Summary	Current Value of Schedule 4 reflects the current value of F904; CV
C5	FE	R	RAM NA	Schedules/ Summary	Current Value of Schedule 5 reflects the current value of F905; CV
C6	FE	R	RAM NA	Schedules/ Summary	Current Value of Schedule 6 reflects the current value of F906; CV
CV	FE	R	RAM NA	Schedules/ Summary	Current Value for Schedule read only attribute that displays the present schedule operating state of the SBC-VAV as determined by priority checking
DA	FE	RW	RAM NA	Schedules/Clock/ Calendar	Day of the Week specifies the current day of the week as a number from 0–7; must be set by a host controller for proper operation (default invalid): bit #0 = Monday bit #1 = Tuesday bit #2 = Wednesday bit #3 = Thursday bit #4 = Friday bit #5 = Saturday bit #6 = Sunday bit #7 = Holiday
DH	FE	RW	RAM	Schedules/Clock/ Calendar	Holiday toggles the holiday status for the current day
DT	E4	RW	RAM NA	Schedules/Clock/ Calendar	Current Date specifies the current date in MM/DD/YY format.
H0-H9	E4	RW	EE 0/0/00	Schedules/Clock/ Calendar	Programmed Holiday is a specified date to be considered a holiday. Set the date to 0/0/YY to ignore.
HE	FE	RW	EE 0	Schedules/ Summary	Host Overrides Local Schedule? specifies whether the SBC-VAV will operate from its local schedules or from a host on the network: 0 = CV is set by schedules F901–F906, 1 = CV is set by HO (ZE must = 0)

F900 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
HO	FE	RW	RAM 0	Schedules/ Summary	Host Schedule Setting specifies the desired schedule override state of the SBC-VAV when HE = 1: 0 = unoccupied 1 = warm-up 2= occupied 3 = night setback
IS	FE	RW	EE 3	Schedules/ Summary	Inactive Schedule specifies which of the four possible schedule modes is used by the SBC-VAV schedules during inactive schedule periods (when current day of the week is not an active day)
TM	E6	RW	RAM NA	Schedules/Clock/ Calendar	Time specifies the current system time (HH:MM) in military format from 00:00 to 23:59 (default invalid)
ZE	FE	RW	EE 0	Schedules/ Summary	Receive Schedule used to set the current schedule mode for the entire zone from the network broadcast of a controller capable of broadcasting zone schedule information to multiple SBC-VAVs in the zone

NETWORK CHANNEL, F005

F005	Data Type	Access	Store & Default	SP for Windows Location	Description
CV	FE	R	RAM 0	Network/Schedule Broadcast	Current Value shows the current value of the network broadcast schedule values received by the SBC-VAV
RB	FE	RW	EE 0	Network/Schedule Broadcast	Receive Broadcast? enables the SBC-VAV to receive network broadcasts and sets the F900; CV value based on the received value 0=No 1=Yes

APPENDIX B: PUP DATA TYPES

This Appendix lists the hexadecimal and decimal PUP numeric data type codes. The hexadecimal codes are followed by h and the decimal codes are provided in parentheses.

Code	Digit Format	Meaning
FFh (255)	±XXXXXXXXXX.	signed 10 digit
FEh (254)	XXXXXXXXXX.	unsigned 10 digit
FDh (253)	±XXXXXXXXX.X	signed 9.1 digit
FCh (252)	XXXXXXXXX.X	unsigned 9.1 digit
FBh (251)	±XXXXXXXXXX	signed 8.2 digit
FAh (250)	XXXXXXXXXX	unsigned 8.2 digit
F9h (249)	±XXXXXXX.XXX	signed 7.3 digit
F8h (248)	XXXXXXX.XXX	unsigned 7.3 digit
F7h (247)	±XXXXXX.XXXX	signed 6.4 digit
F6h (246)	XXXXXX.XXXX	unsigned 6.4 digit
F5h (245)	±XXXXX.XXXXX	signed 5.5 digit
F4h (244)	XXXXX.XXXXX	unsigned 5.5 digit
F3h (243)	±XXXX.XXXXXX	signed 4.6 digit
F2h (242)	XXXX.XXXXXX	unsigned 4.6 digit
F1h (241)	±XXX.XXXXXXX	signed 3.7 digit
F0h (240)	XXX.XXXXXXX	unsigned 3.7 digit
EFh (239)	±XX.XXXXXXXX	signed 2.8 digit
EEh (238)	XX.XXXXXXXX	unsigned 2.8 digit
EDh (237)	±X.XXXXXXXX	signed 1.9 digit
ECh (236)	X.XXXXXXXX	unsigned 1.9 digit
EBh (235)	±XXXXXXXXXX	signed .10 digit
EAh (234)	.XXXXXXXXXX	unsigned .10 digit
E9h (233)	channel map	one bit per channel
E8h (232)	bitmap of text	one bit per text field

APPENDIX B: PUP DATA TYPES

Code	Digit Format	Meaning
E7h (231)	BCD (H/S/M)	hours is LSB
E6h (230)	BCD (H/M)	hours is LSB
E5h (229)	packed BCD	8 BCD digits as 4 bytes
E4h (228)	BCD date (Y/M/D)	MSW is year LSW/MSB is month LSW/LSB is day
E3h (227)	Binary date	MSW is year LSW/MSB is month LSW/LSB is day
E2h (226)	reserved	
E1h (225)	reserved	
E0h (224)	IEEE 784 32-bit floating point	
DFh-00h (223-0)	reserved	