*e*VOLUTION
SERIES ™

SBC-VAV-5T (FBK),
-VAV2, AND -VAV3
USER MANUAL

JULY 2002

AMERICAN
AUTO-MATRIX™
SMART BUILDING SOLUTIONS

SBC-VAV1-5T (FBK), -VAV2, and -VAV3 User Manual

Part Number 1E-04-00-0112

Section 4: Configuration 1

ABOUT THIS MANUAL

This manual includes an overview of, and instructions for wiring, installing, and configuring the *SBC*-VAV controllers. Also included are definitions of the *SBC*-VAV channels and attributes, and features of the *SBC*-STAT when used with *SBC*-VAV controllers.

This manual is divided into the following sections:

▼ **Section 1: Overview**, provides an introduction to and descriptions of the *SBC*-VAV1-5T, *SBC*-VAV1-5T-FBK, *SBC*-VAV2, and *SBC*-VAV3 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: Channels and Attributes**, defines the channels and attributes of the *SBC*-VAV controllers.

▼ **Section 4: Configuration**, provides instructions for configuring the *SBC*-VAV 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.

▼ **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.

Document Conventions

The following formats 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.

SECTION 1: OVERVIEW

This document provides general information about the SBC-VAV1-5T, SBC-VAV1-5T-FBK, SBC-VAV2, and SBC-VAV3 unitary controllers. General configuration and application information is provided in this document; however, the SBC-VAV controllers can be used in a wide variety of applications.

Table 1-1: SBC-VAV1-5T, SBC-VAV1-5T-FBK, SBC-VAV2, and SBC-VAV3 Characteristics

SBC-VAV Controller	Triacs	Analog Outputs	Universal Inputs	STAT-BUS	Real-time Clock	Sensor Type	Actuator
SBC-VAV1-5T	5	1	1	1	External Option	Airflow	Yes
SBC-VAV1-5T-FBK	5	1	1	1	External Option	Airflow	Feedback
SBC-VAV2	5	1	1	1	External Option	Airflow	None
SBC-VAV3	5	1	1	1	External Option	None	Feedback

NOTE

The term *SBC*-VAV, used throughout this manual, refers to the *SBC*-VAV1-5T, *SBC*-VAV1-5T-FBK, *SBC*-VAV2, and *SBC*-VAV3.

1.1 WHAT IS THE *SBC*-VAV?

SBC-VAV1-5T, *SBC*-VAV1-5T-FBK, *SBC*-VAV2, and *SBC*-VAV3 controllers are digital variable air volume (VAV) and constant air volume (CAV) terminal box controllers. The *SBC*-VAV1-5T, *SBC*-VAV1-5T-FBK, and *SBC*-VAV3 include an integrated Belimo actuator that employs Motor Management Technology™ (MMT™) to monitor, identify, and correct motor shorts. The *SBC*-VAV2 has an integrated control circuit that connects to most industry actuators.

NOTE

The *SBC*-VAV1-5T, *SBC*-VAV1-5T-FBK, *SBC*-VAV2, and *SBC*-VAV3 can only be flashed with firmware versions 2.x and later; however, previous versions of the *SBC*-VAV controllers can be flashed with the latest firmware.

NOTE

The *SBC*-VAV1-5T and *SBC*-VAV1-5T-FBK are identical with the exception of a feedback actuator that exists on the *SBC*-VAV1-5T-FBK. The *SBC*-VAV3 is a new controller designed for pressure dependant applications.

NOTE

MMT will function only on an *SBC*-VAV2 connected to a Belimo LM24. However, the following actuators are compatible with the *SBC*-VAV2 using AC power: the Belimo LM24, the Belimo NM24, the Siemens GDE131.1U and the Neptronic BBT 24.

The *SBC*-VAV unitary controllers are equipped with five (5) solid-state triac outputs. A Belimo LM24-10P-M feedback actuator is mounted to the *SBC*-VAV1-5T-FBK and the *SBC*-VAV3. A Belimo LM24-M actuator (without feedback) is mounted to the *SBC*-VAV1-5T. The *SBC*-VAV2 is not equipped with an actuator.

The *SBC*-VAV unitary controllers work on existing Public Unitary Protocol (PUP) networks and

connect to the *SBC*-STAT Sensor bus (SSB)
for sensor communications.
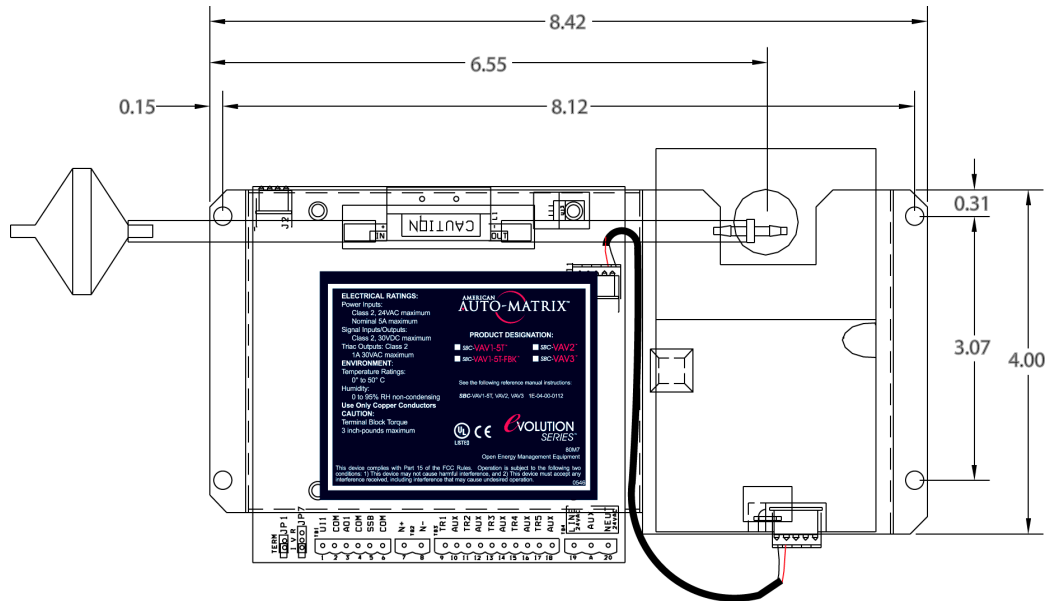
Figure 1-1: SBC-*VAV1-5T and* SBC-*VAV1-5T-FBK*
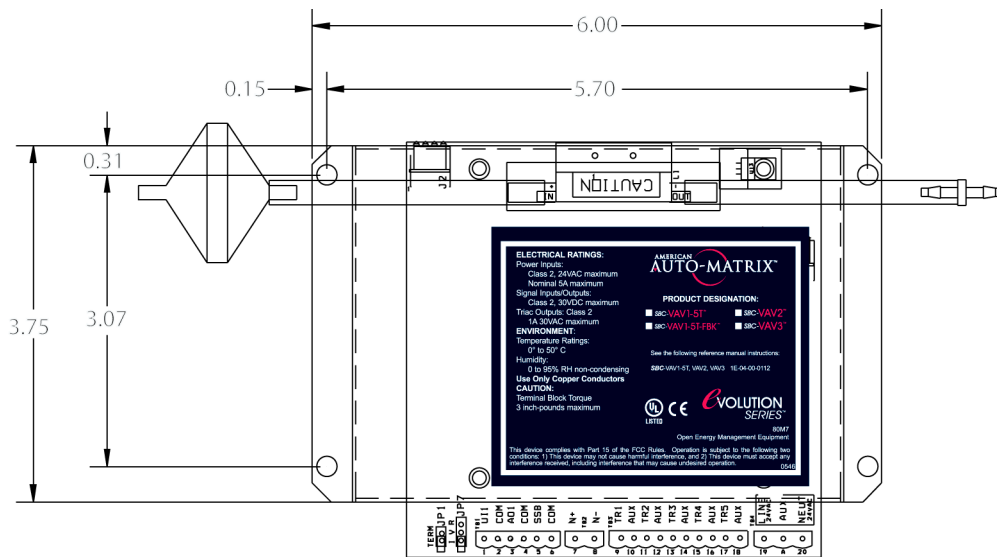
Figure 1-2: SBC-*VAV2*
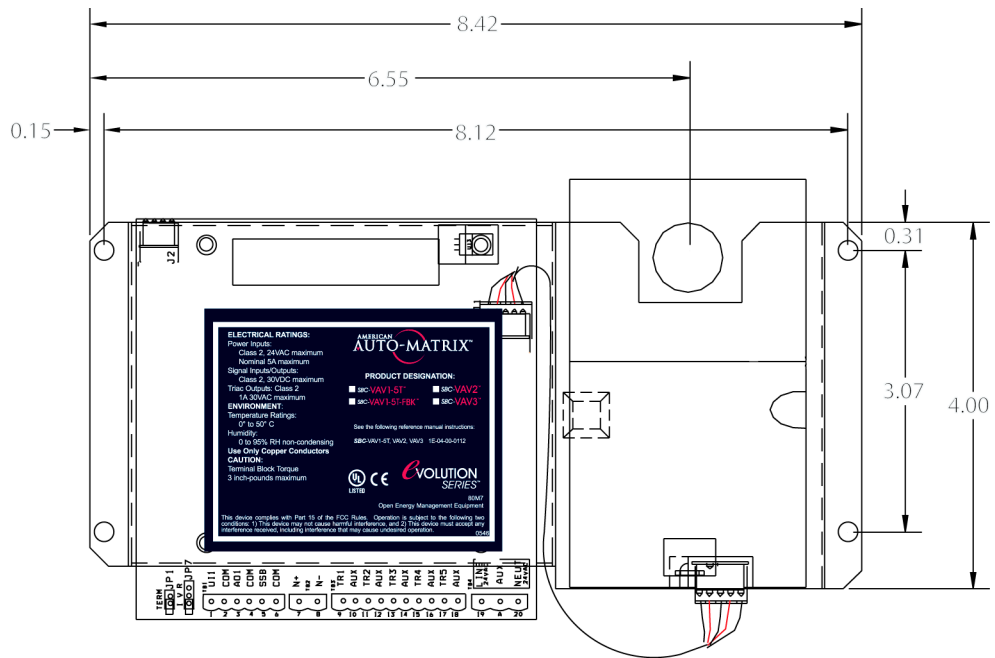
Figure 1-3: SBC-*VAV3*
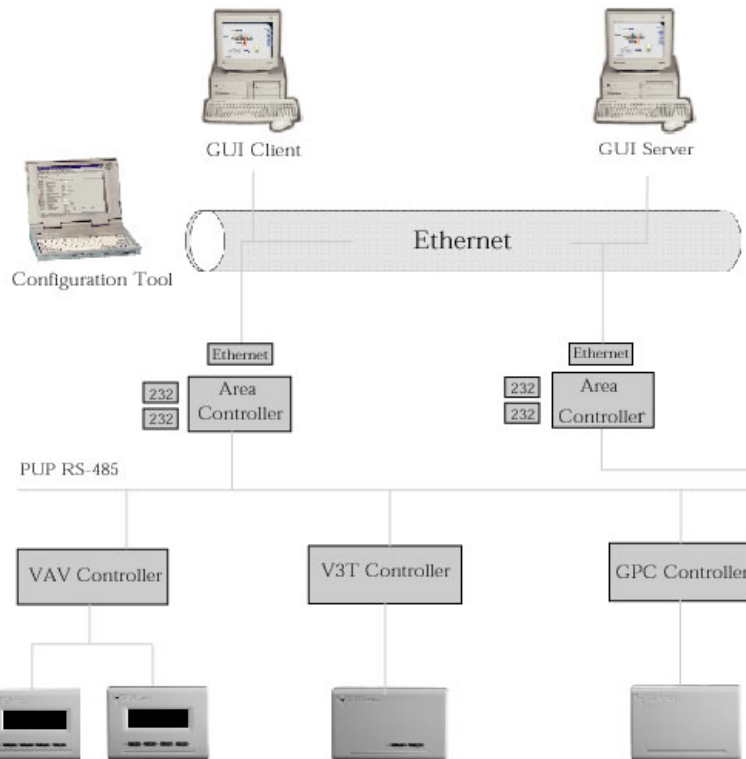
Figure 1-4: System Architecture of SBC-*VAV Products*

Figure 1-5: SBC-*STAT3 (left),* SBC-*STAT2 and* SBC-*STAT2-D (center),* SBC-*STAT1 and* SBC-*STAT1-D (right)*

1.1.1 CHARACTERISTICS OF THE *SBC*-VAV

▼ MMT for monitoring, identifying and correcting motor shorts.

▼ Real time clock module (optional) for more accurate, stand alone time keeping.

▼ New configuration features through *SoloPro for Windows*™ including the following: an automatic setting for VAV control mode, separate heating and cooling options for supply mode and up to 115.2K baud rate option.

▼ *SBC*-STAT features: digital thermostat capability, nonpolar SSB wiring, LED communication, passwords, menus, a two-wire multiplexed power and data bus, graphics capability, a common terminal (SSB) for the thermistor or *SBC*-STAT, the capability of having four *SBC*-STAT3s, *SBC*-STAT1-Ds or *SBC*-STAT2-Ds on a single controller.

▼ Triacs with metal oxide varistor (MOV) and positive temperature coefficient (PTC) protection built in.

▼ Flash updates through *SoloPro for Windows* for easy incorporation of the latest firmware.

1.2 COMPONENTS AND FEATURES

1.2.1 MOTOR MANAGEMENT TECHNOLOGY

MMT extends the functions of the Belimo LM24-M (supplied with the *SBC*-VAV1-5T) and the LM24-10P-M (supplied with the *SBC*-VAV5T-FBK and -VAV3 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.

MMT operates automatically on the *SBC*-VAV1-5T, *SBC*-VAV1-5T-FBK, and *SBC*-VAV3.

1.2.2 INTEGRATION WITH *SBC*-STATs

The *SBC*-STAT Bus connects to the *SBC*-VAV unitary controllers for communication with the *SBC*-STAT thermostats. Through this connection, information can pass between the *SBC*-VAV and the thermostat without the use of an I/O point on the controller. The *SBC*-VAV controllers can support one *SBC*-STAT1 or one *SBC*-STAT2, or up to four digital STATs through the SSB.

1.2.3 FLOW SENSOR (*SBC*-VAV1-5T, *SBC*-VAV1-5T-FBK, AND *SBC*-VAV2)

The *SBC*-VAV's on board, solid state flow sensor measures airflow through the terminal box. Through the sensor, calibration of flow measurement is possible for a wide range of box sizes and types.

NOTE

The *SBC*-VAV3 is not equipped with an airflow sensor.

1.2.4 INPUTS

Three (3) inputs appear on the *SBC*-VAV controller:

▼ One onboard analog input exists for the flow sensor. The flow sensor is a dedicated air flow input that correlates to Flow Control. The air flow sensor cannot physically be accessed other than for attaching supply hoses to it. The Air Flow sensor attributes are used to configure alarming and setup/setback capabilities for the flow sensor. The Flow Control attributes are used for calibration capabilities for the flow sensor.

▼ Terminal Block 1/Universal Input 1 (**T1:UI1**) is a high resolution (15 bit) universal input: 0–10VDC, 0–40mA, 0–1MΩ resistive loads. You can configure **UI1** as digital or linear, or as a nonlinear thermistor input. Universal Input 1 provides you with configuration options for alarming, setup/setback, filtering and input polarity. You can use **UI1** as a universal input, as the *SBC*-VAV proof of flow input, as a motion detection input or as the *SBC*-VAV duct temperature input.

▼ Terminal Block 1/*SBC*-STAT Bus (**TB1:SSB**) is a nonpolar two wire, bidirectional sensor bus. In analog mode, it supports the *SBC*-STATs, the SOLOStat and passive thermistor sensors such as Precon type 3. The SSB also connects to the *SBC*-STAT3 for digital sensor operation. Zone Temperature attributes correlate to *SBC*-STAT options such as

zone temperature thermistor, push button setpoint adjustment and unoccupied push button override.

1.2.5 OUTPUTS

The *SBC*-VAV unitary controllers have five (5) triac outputs and one analog output. The current sinking triac outputs provide a 24VAC output that can be used to control devices such as pilot duty relays, small 24VAC (1A up to 50°C) motors, and floating setpoint valve actuators. These points have MOV and PTC protection and are used to control electric reheat, for instance, or to control position based on the travel time of the device being driven (hot water/chill water valves). Each triac output is capable of tracking the amount of time that the output is considered to be engaged (runtime hours).

You can define the function of these outputs by adjusting correlating attributes. On the *SBC*-VAV1-5T, *SBC*-VAV1-5T-FBK, and *SBC*-VAV3, two digital outputs work to position the controller's integrated damper motor controlled by the *SBC*-VAV's proportional+integral (PI) control loop. These triacs are open on the *SBC*-VAV2 for use as digital outputs. **TB1:AO1** terminal 3, correlates to Analog Output attributes. You can control this output 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 the analog output, which has 0–10VDC and 8-bit resolution.

The first triac (**TB3:TR1** terminal 9) is the Fan Digital Output. It is dedicated to use for controlling series fan, parallel fan or induction damper binary control. The Fan Digital Output provides the capability to enforce minimum cycle time, to determine the polarity (ON and OFF) and to provide a runtime alarm limit for the output.

The second triac (**TR2**) serves as a control for one stage of reheat, as the *increase position* signal when driving a valve or as the pulse width modulated output when pulse width

modulation is used for chill/hot water valve positioning. This Digital Output provides the capability to enforce minimum cycle time, to determine the polarity (ON and OFF) and to provide a runtime alarm limit for output.

The third triac (**TR3**) can control one stage of reheat or can serve as the *decrease position* signal when driving a valve. This Digital Output provides the capability to enforce minimum cycle time, to determine the polarity (ON and OFF) and to provide a runtime alarm limit for the output.

The fourth triac (**TR4**) can control one stage of reheat or can serve as the *increase position* signal when driving a valve. This Digital Output provides the capability to enforce minimum cycle time, to determine the polarity (ON and

OFF) and to provide a runtime alarm limit for the output.

The fifth triac (**TR5**) can control one stage of reheat or can serve as the *decrease position* signal when driving a valve. This Digital Output provides the capability to enforce minimum cycle time, to determine the polarity (ON and OFF) and to provide a runtime alarm limit for the output.

1.2.6 NETWORKING

In addition to the SSB connection just described, networking to other American Auto-Matrix components is possible using the *SBC-VAV.*

Table 1-2: SBC-*VAV Input and Output Assignments*

Terminal	I/O	Description
1 (TB1)	UI1	Universal Input Channel 1
2 (TB1)	COM	Universal Input Common
3 (TB1)	AO1	Analog Output Channel 1
4 (TB1)	COM	Analog Output Common
5 (TB1)	SSB	Smart Stat Bus
6 (TB1)	COM	Smart Stat Bus Common
7 (TB2)	N+	Positive 485 Network Communication Line
8 (TB2)	N-	Negative 485 Network Communication Line
9 (TB3)	TR1	Triac Output 1
10 (TB3)	AUX	AC Out Triac 1
11 (TB3)	TR2	Triac Output 2
12 (TB3)	AUX	AC Out Triac 2
13 (TB3)	TR3	Triac Output 3
14 (TB3)	AUX	AC Out Triac 3
15 (TB3)	TR4	Triac Output 4
16 (TB3)	AUX	AC Out Triac 4
17 (TB3)	TR5	Triac Output 5
18 (TB3)	AUX	AC Out Triac 5
19 (TB4)	AC Line	24 Volt AC Control Power Input

Table 1-2: SBC-VAV Input and Output Assignments

Terminal	I/O	Description
A (TB4)	AC AUX	24 Volt AC Auxiliary Output for AC Loads
20 (TB4)	AC RET	24 Volt AC Return

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

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

Integration of the *SBC*-VAV into the American Auto-Matrix system occurs through direct connection to the SAGE^MAX or SF1 or to other unitary controllers. Networking of up to 128 *SBC*-VAVs is possible through a single SAGE^MAX port.

1.3 TYPICAL APPLICATIONS

Through use of the SSB, you can configure the *SBC*-VAV for setpoint establishment and override. Setup and broadcasting of schedules are possible through the Clock Module component. You can also use the *SBC*-VAV for standard flow control applications.

1.4 SPECIFICATIONS

1.4.1 NETWORKING

The following specifications are necessary for networking of the *SBC*-VAV controllers:
- **line signaling:** EIA-485
- **wiring:** shielded, twisted pair
- **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.

1.4.2 INTEGRATED COMPONENTS
- LM24 Belimo actuator (*SBC*-VAV1-5T, *SBC*-VAV1-5T-FBK, and *SBC*-VAV3) with movement, eliminating damper shaft stress and binding.
- Flow sensor (*SBC*-VAV1-5T, *SBC*-VAV1-5T-FBK, and *SBC*-VAV2).

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

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

1.4.5 INPUT SUPPLY
- NEC class 11 transformer.
- 24VAC, 50/60Hz, 10VA maximum, 5VA typical.
- PTC load protection.

1.4.6 SUPPLY FREQUENCY
- 50/60 Hz.

1.4.7 OUTPUT FREQUENCY
- 50/60 Hz.

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

1.4.9 DIMENSIONS

▼ **Size:** 8.3 × 4.5 × 2.75in. (*SBC*-VAV1-5T, *SBC*-VAV-5T-FBK, and *SBC*-VAV3), 5.75 × 4.5 × 1.75in. (*SBC*-VAV2).

▼ **Shipping weight:** 3lb. (*SBC*-VAV1-5T, *SBC*-VAV-5T-FBK, and *SBC*-VAV3), 1.5lb. (*SBC*-VAV2).

1.4.10 AGENCY APPROVALS

▼ UL listed PAZX, Management Equipment, Energy.

▼ UL recognized XAPX2 Temperature-Indicating and Regulating Equipment-Component.

▼ Complies with FCC rules Part 15, Class B Computing Device (approval pending).

▼ Complies with CE directives and standards.

1.4.11 MOUNTING

▼ Easy in-field alignment with simple tools.

SECTION 2: WIRING AND INSTALLATION

This section covers mounting, connecting the airflow sensor, and wiring the SBC-*VAV1-5T,* SBC-*VAV1-5T-FBK,* SBC-*VAV2, and* SBC-*VAV3 controllers. Wiring instructions for power, communications, and inputs/outputs appear along with safety requirements.*

2.1 INSTALLATION

The installation of the *SBC*-VAV unitary 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 *SBC*-VAV unitary controllers should only be used in a manner specified by the manufacturer. No operator replaceable parts exist in the product. Only trained personnel should service the equipment. Remove power before servicing.

NOTE
*The user must Time Sync the SBC-VAV or it **WILL NOT** operate correctly.*

2.2 MOUNTING

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

CAUTION
The mounting area should be free from moisture and leakage.

NOTE
If you are installing an *SBC*-VAV2, begin the mounting procedure with Step 5. Because the *SBC*-VAV2 is not supplied with an actuator, you need only to perform Steps 5 and 6 in this section to mount the *SBC*-VAV2.

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.

NOTE

When executing steps 4 and 5, do not tighten the screws that attach the *SBC*-VAV backing to the terminal box until both screws have been inserted.

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 location 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.

NOTE

Use the top screws on the mounting bracket for installation on round duct terminal boxes. Otherwise you can use either the top or the bottom holes on each side of the bracket.
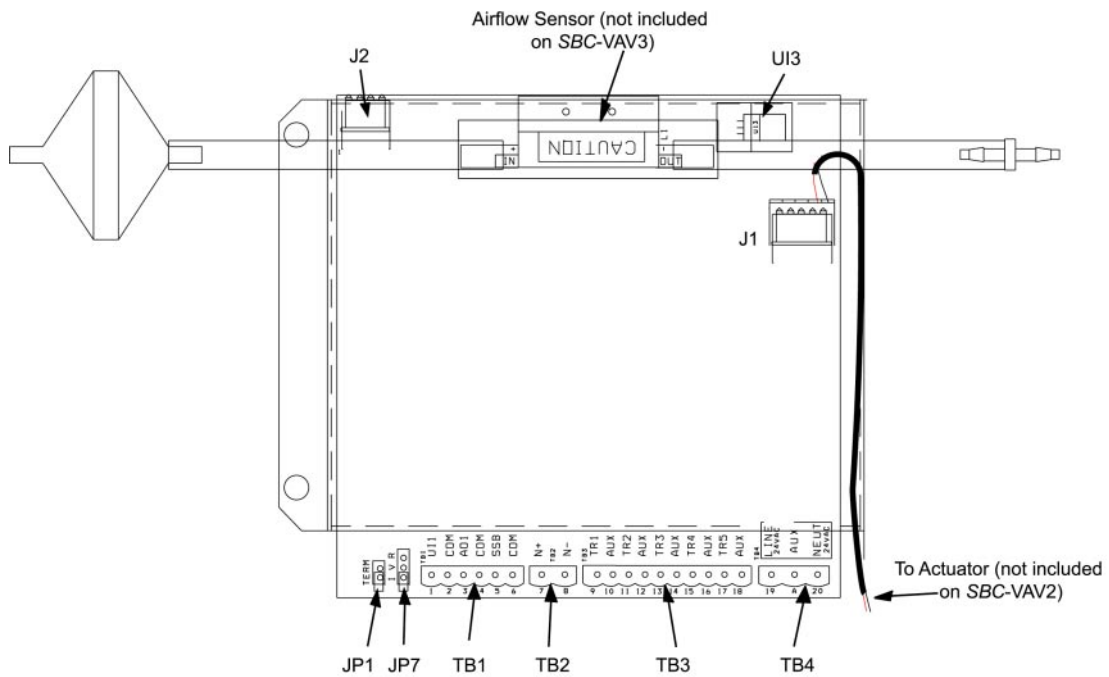
Figure 2-1: SBC-*VAV*1-5T, SBC-VAV1-5T-FBK, SBC-VAV2, and SBC-VAV3 PCB Layout

2.3 CONNECTING THE AIRFLOW SENSOR (NOT INCLUDED ON THE *SBC*-VAV3)

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 unitary 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 air flow 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.
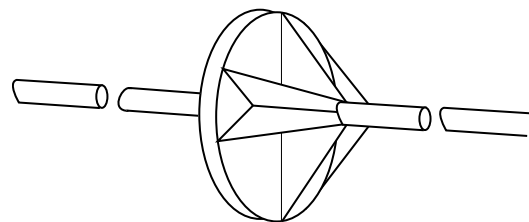
Figure 2-2: Airflow Sensor Filter
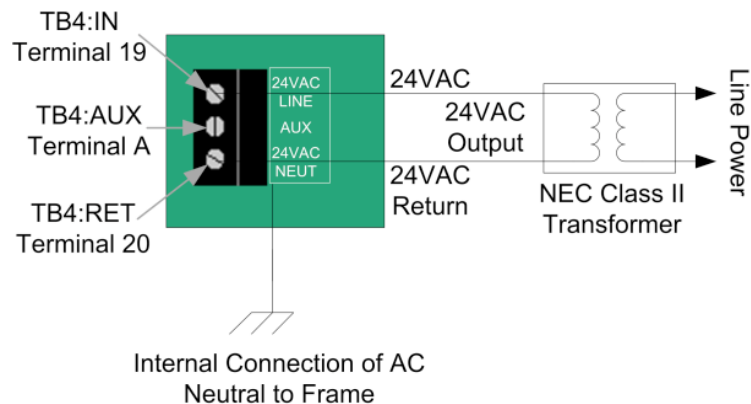
Figure 2-3: Wiring 24VAC Power

2.4 WIRING REQUIREMENTS

WARNING
Remove power when performing the following wiring procedures.

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 FCC Class A regulations for 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/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.

2.4.1 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 unitary controllers. Figure 2-3 shows how to wire the SBC-VAV for power. American Auto-Matrix recommends that at least 18AWG wiring be used, but the terminals can accommodate 14–22AWG.

NOTE
American Auto-Matrix recommends that each SBC-VAV on a network have an individual power transformer. This transformer is **not to be used with peripheral devices**.

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.

.
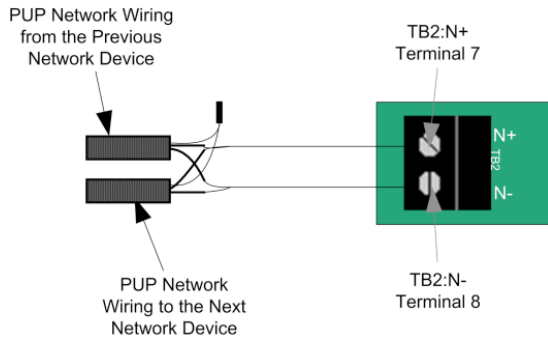
Figure 2-4: Multidrop EIA-485 Wiring

2.4.2 EIA-485 COMMUNICATIONS WIRING

Figure 2-4 illustrates the EIA-485 communications network wiring for the *SBC*-VAV unitary controllers. For cases in which 14–22AWG, individually shielded, twisted pair wiring is recommended for optimal operations, EIA-485 (RS-485) wiring standards apply.

2.4.2.1 JUMPERS

JP1 is an EIA-485 termination resistor of 250Ω. Set the jumper on JP1 of the last device on the network for termination of all EIA-485 networks.

2.4.3 INPUT & OUTPUT WIRING TERMINATION

The most common wiring applications for the *SBC*-VAV as a dedicated controller appear in subsections 2.4.3.1 through 2.4.3.7. You should discuss deviations from the following examples with American Auto-Matrix Technical Support before making modifications to controllers. Any modifications other than those supported by American Auto-Matrix may void the product warranty.

2.4.3.1 JUMPERS

Leave the jumper for **JP7** open for a 0–10V connection. To make a 4–20mA connection, place the jumper over **I** and **V**. Set the jumper at **V** and **R** for a dry contact/thermistor connection.

2.4.3.2 *SBC*-STAT/THERMISTOR WIRING

Figure 2-6 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.
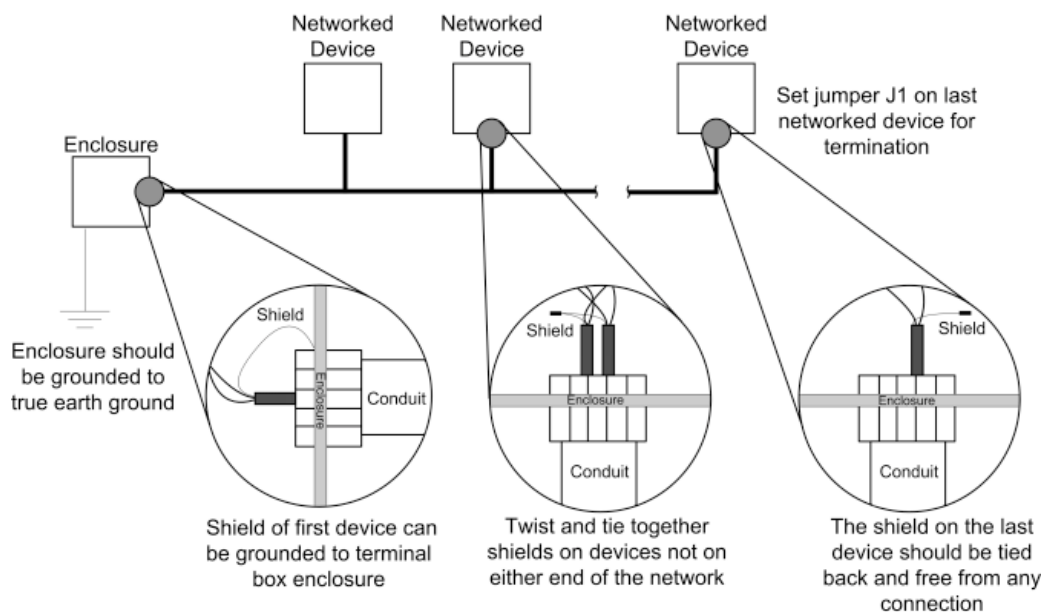
Figure 2-5: Proper Shield Wiring of Networked Devices
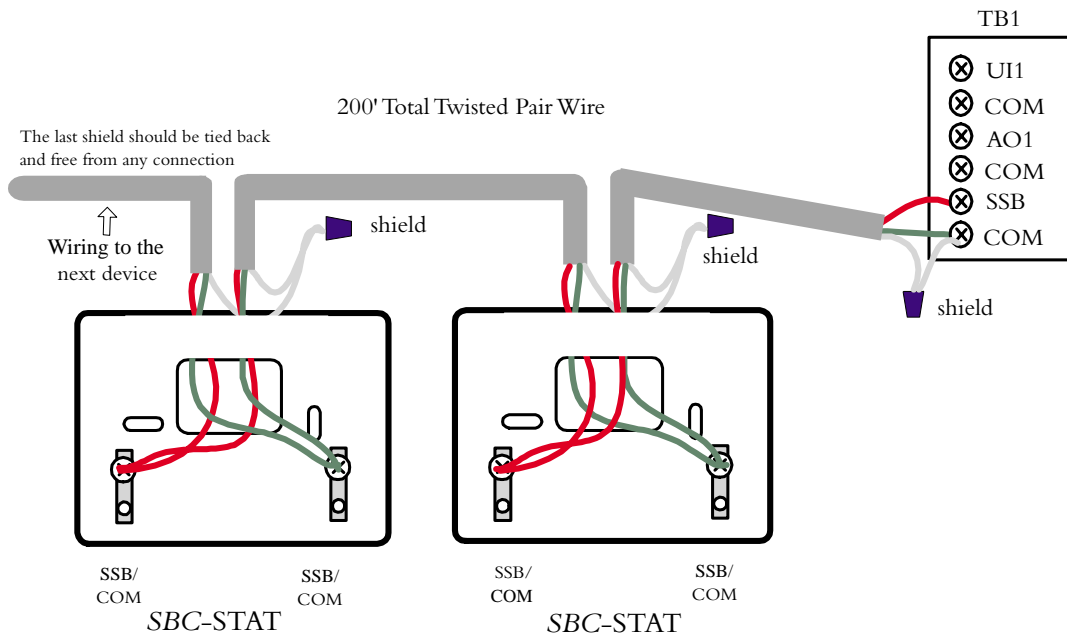
Figure 2-6: SBC-*STAT Bus Wiring of* SBC-*STAT3 to* SBC-*VAV*

Figure 2-7 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.
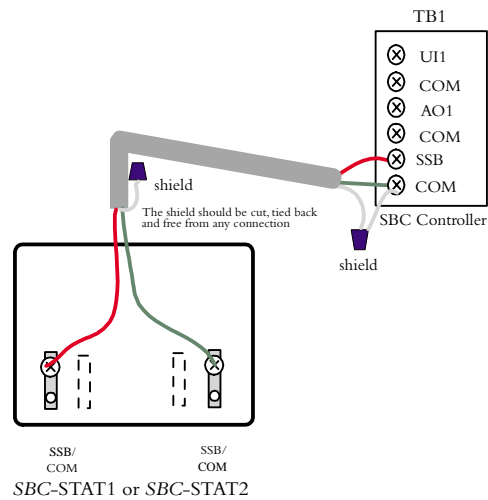
Figure 2-7: SBC-*STAT Bus Wiring of* SBC-*STAT2 or* SBC-*STAT*1 *to* SBC-*VAV*

Shielded Twisted Pair Wire

TB2

N+
N–

Wiring to the
next device

shield

shield

SBC Controller

shield

Shield can be grounded to a terminal
box enclosure at one end only

N+   N–

Red   N+   N–   Green
       Black   Yellow
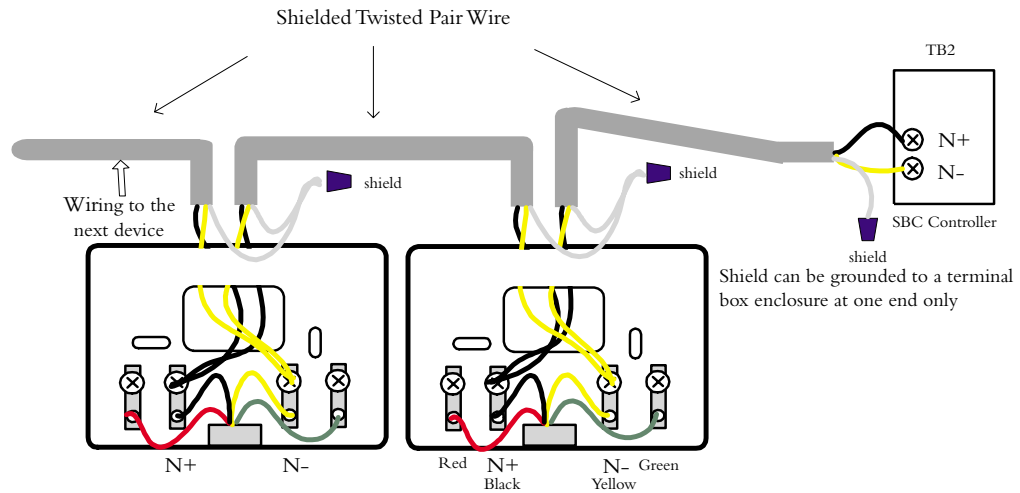
Figure 2-8: SBC-*STAT Network Wiring to* SBC-*VAV*

Figure 2-8 illustrates the optional network wiring of the *SBC*-STAT to the *SBC*-VAV through the N+ and N- terminals on TB2.

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.

200' Total Twisted Pair Wire

shield

shield

Master SBC-VAV

shield

TB1

UI1
COM
AO1
COM
SSB
COM

SSB/
COM

SSB/
COM

SSB/
COM

SSB/
COM

SBC-STAT1-D, SBC-STAT2-D or SBC-STAT3

The last shield should be cut and tied back
and free from any connection

shield

shield

Slave SBC-VAV

TB1

UI1
COM
AO1
COM
SSB
COM

SSB/
COM

SSB/
COM

SSB/
COM

SSB/
COM

SBC-STAT1-D, SBC-STAT2-D or SBC-STAT3
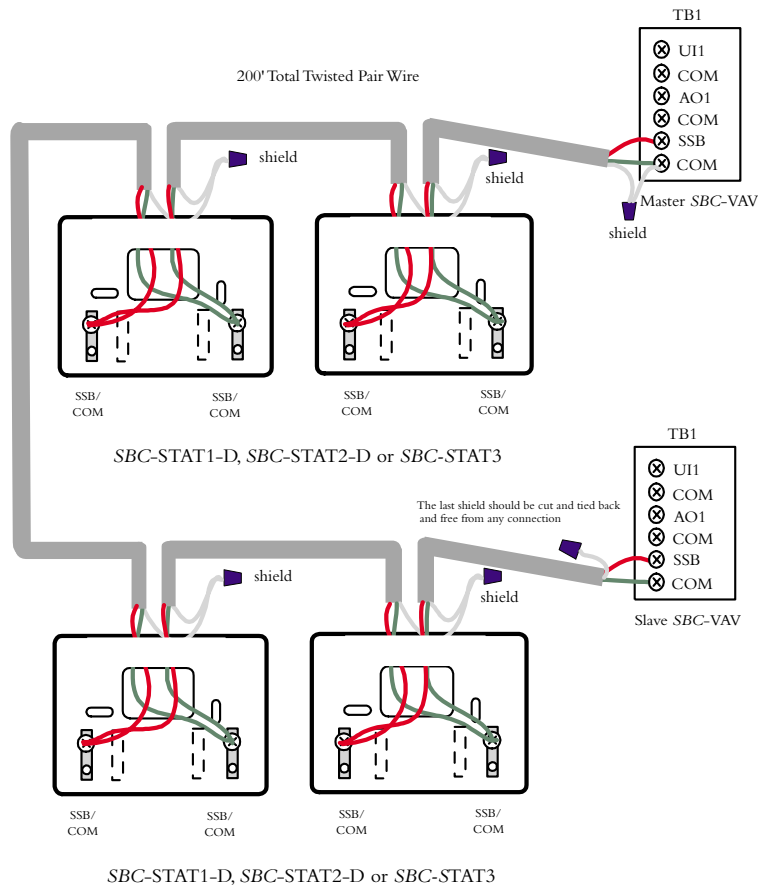
Figure 2-9: Multiple SBC-*VAVs on a Sensor Bus*

Figure 2-10 shows connection of a Precon Type 3 thermistor to the SSB and COM terminals of TB1 on the SBC-VAV. No jumpers are required for connection. This input measures resistance.

2.4.3.3 UNIVERSAL INPUT AS VOLTAGE INPUT

Special consideration must be taken when configuring **UI** for a 0–5VDC analog input device. When **UI** is used as a 0–5VDC analog input, it is necessary to remove the jumper from **JP7**.

TB1

UI1
COM
AO1
COM
SSB
COM

Precon Type 3 Thermistor

SBC Controller
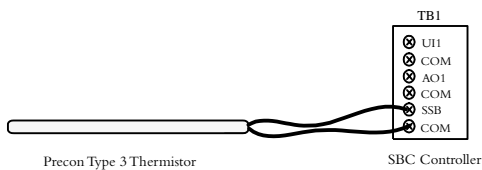
Figure 2-10: Connection of Thermistor to SBC-VAV

TB1:UI1
Terminal 1

Voltage Device

+

−

UI1

COM

TB1:COM
Terminal 2

Power Suppply
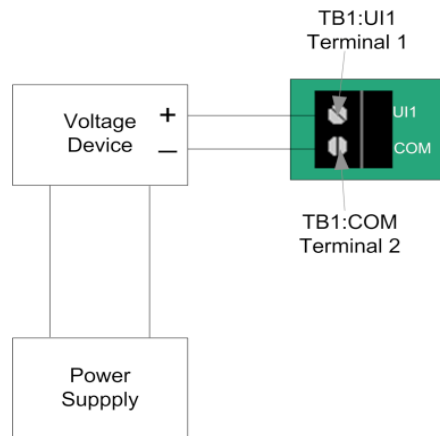
Figure 2-11: 0–5VDC Device Used on UI

2.4.3.4 UNIVERSAL INPUT AS 4–20MA INPUT

Special consideration must be observed when configuring **UI** for a 4–20mA analog input device. When setting **UI** as a 4–20mA input, you must place the jumper for **JP7** on the **I** and **V** pins.
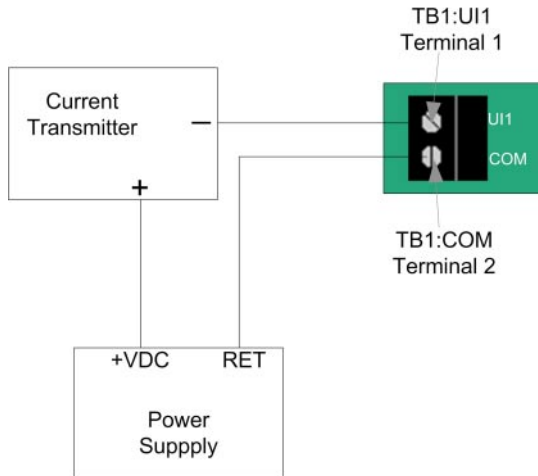
Figure 2-12: 4–20mA Device Used on UI

2.4.3.5 UNIVERSAL INPUT AS DIGITAL INPUT OR THERMISTOR

Universal Input (**UI**) can also be configured as a thermistor or digital input device using a dry contact. In this configuration, the jumper for **JP7** should be placed on pins **V** and **R**.
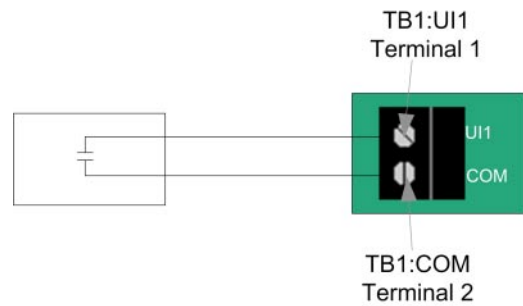
Figure 2-13: Dry Contact as Digital Input Using UI

2.4.3.6 TRIAC OUTPUTS

The *SBC*-VAV1-5T, *SBC*-VAV1-5T-FBK, *SBC*-VAV2, and *SBC*-VAV3 have five (5) Triacs. They are all wired the same. In all cases, a 24VAC pilot relay is recommended for use with heavy loads such as the fan motor, valve motor, and electric reheats. **TR1** is dedicated to the fan. **TR2** and **TR3** can be used to power a hot or cold water auxiliary valve. If no auxiliary valve exists, then **TR2** and **TR3** are available for electric reheat. The additional triacs can be used for additional stages of reheat or an optional actuator connection.

In summary, the options for use of the reheats are as follows: no electric reheat, two stage electric reheat, or four-stage electric reheat. Two stage electric reheat can be set to use either **TR2** and **TR3** or **TR4** and **TR5**, whichever set is available. For more information, see Outputs in Section 1: Overview.
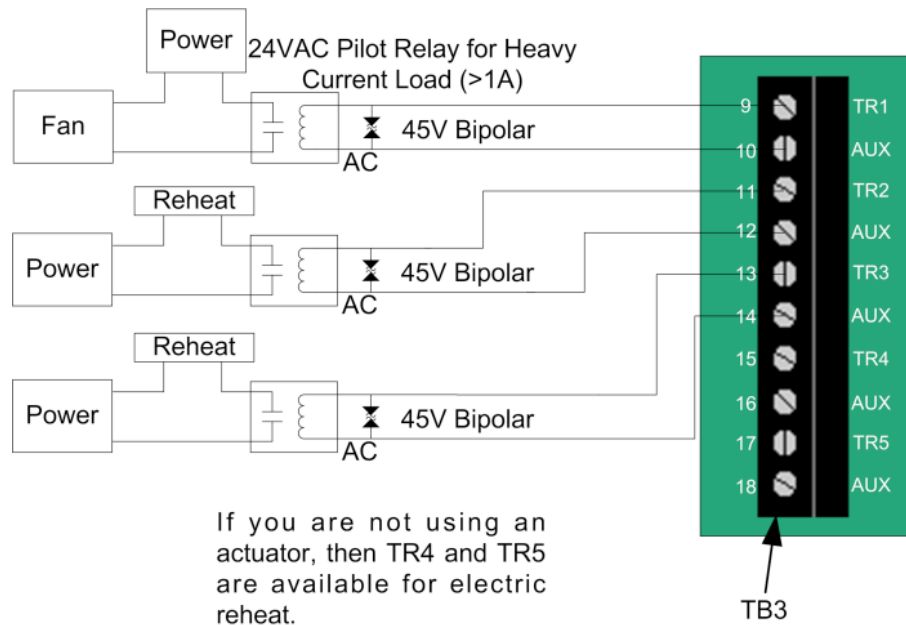
Figure 2-14: Wiring VAV Triacs Using 24VAC Pilot Relays for Typical Setup

2.4.3.7 WIRING THE ANALOG OUTPUT

The *SBC*-VAV has one built-in analog output that provides a 0–10VDC output signal. **AO** is normally controlled by the analog control PID loop. However it can also be manually controlled. **TB1** terminal 3 (**AO1**) and **TB1** terminal 4 (**COM**) are used to create the circuit with the output device.
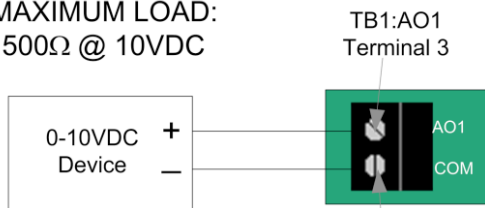
Figure 2-15: SBC-VAV Analog Output Wired for a 0–10VDC Output Device

2.4.4 OPTIONAL ACTUATOR WIRING

An *SBC*-VAV2 has an optional actuator connection. This optional actuator can be AC or DC. An AC actuator connection requires three wires. Two wires connect to Triacs 4 and 5 and one wire connects to AUX. Triac 4 turns the actuator clockwise and Triac 5 turns the actuator counterclockwise. See Figure 2-16 for more information.
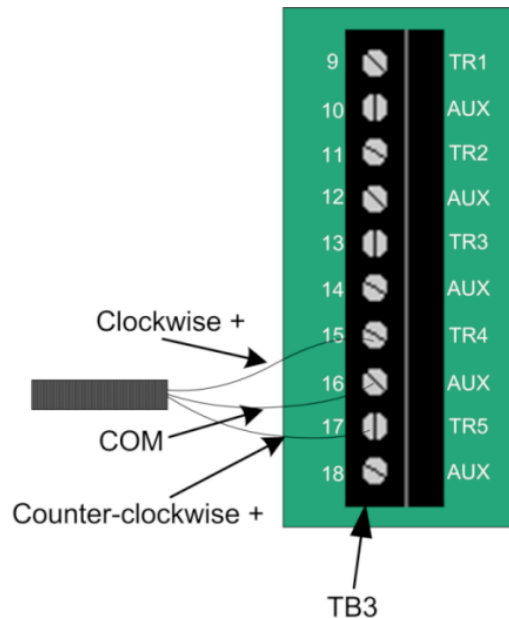
Figure 2-16: AC Actuator Wiring

A DC actuator connection requires two wires. These two wires connect to pins 4 (Actuator -) and 5 (Actuator +) on the *SBC*-VAV2 J1 connector. See Figure 2-16 for more information.

1. Feedback ground
2. Feedback wiper
3. Feedback +
4. Actuator -
5. Actuator +

← J1 Connector

1 2 3 4 5
         - +

2 wires connected to pins 4 and 5

connects to a dc actuator
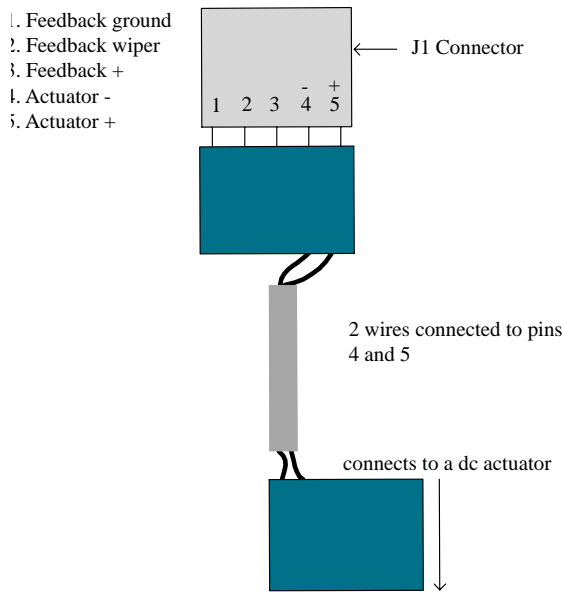
Figure 2-17: DC Actuator Wiring

An optional connection is a *SBC*-VAV1-5T-FBK with feedback potentiometer (POT). This gives the actuator position feedback features.

If you connect a POT to an optional actuator on a *SBC*-VAV2, in addition to the standard DC two wire connection to pins 4 and 5, the POT

uses pins 1, 2, and 3 on the *SBC*-VAV2 J1 connector. For wiring information, see Figure 2-18.

1. Feedback ground
2. Feedback wiper
3. Feedback +
4. Actuator -
5. Actuator +

← J1 Connector

1 2 3 4 5
         - +

5 wire connection to pins 1-5

connects to a dc actuator
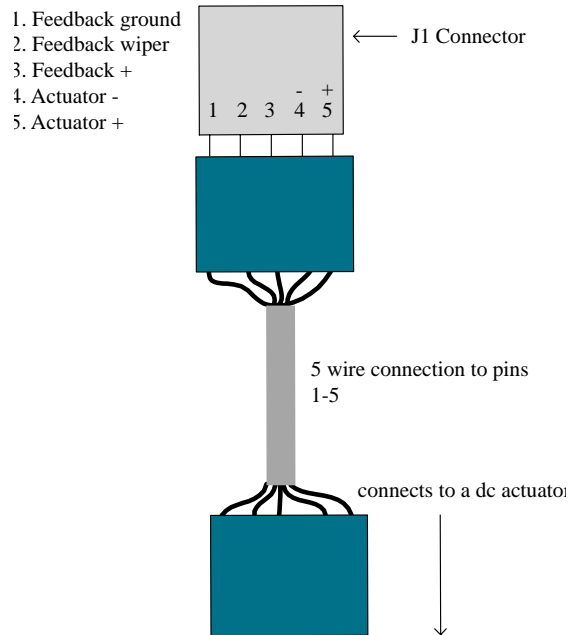
Figure 2-18: DC Actuator Potentiometer Wiring

SECTION 3: *SBC*-VAV ATTRIBUTES

This section introduces you to the groupings of attributes used to control the parameters of the SBC-*VAV1-5T,* SBC-*VAV1-5T-FBK,* SBC-*VAV2, and* SBC-*VAV3 over the PUP network. Detailed descriptions of all points for the controller appear here. Information on common usage of the attributes is also included.*

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   ATTRIBUTES

3.2.1   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;**AE**, **TF**, **TE**, **RT**, and **ET**.

3.2.1.1 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 100. 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 100.

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.

3.2.1.2 STATISTICS

NOTE

The *SBC*-VAV3 does not have the following attributes:
FE00;**TF**, **TE**, **RT**, and **ET**.

Attribute FE00;**AE** 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 **AE** 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 **CV** MUST be a 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 (**CA**) by the absolute value of the difference between the duct temperature and zone temperature (**ZT** − **ST**) 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 **ST** MUST be a 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 **ST** is a duct temperature value. Energy totalization is invalid in any other circumstance. Therefore unless **ST** is used as a duct temperature sensor, **ET** should remain disabled (**ET** = 0).

3.2.1.3 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 FF00;**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.

3.2.1.4 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 **AE** 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 **AE**
▼ 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
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 100.
	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.
FE00	AE	**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. **FE00;TF is not available on the *SBC*-VAV3.**
	TE	**Total Accumulated Energy**—is the total amount of accumulated energy used by the terminal box. **TE** is shown in BTUs or kilojoules. **FE00;TE is not available on the *SBC*-VAV3.**
	RT	**Reset Totals**—when = 1, sets **TF** and **TE** to zero. **FE00;RT is not available on the *SBC*-VAV3.**
	ET	**Enable Flow/Energy Totalization**—calculates totalized flow and totalized energy when: **ET** = 1 and **ST** = a duct temperature. **ET is not available on the *SBC*-VAV3.**
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 advance during the removal of power.

TABLE 3-1: SYSTEM ATTRIBUTES

	attr	description
	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.
	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 **AE** 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.
	RS	**Reset the *SBC*-VAV**—allows a host or operator to reset the controller by setting **RS** = 1.

3.2.2 SCHEDULES

The following are Schedule attributes:
F900;**TM**, **DT**, **H0-H-9**, **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.
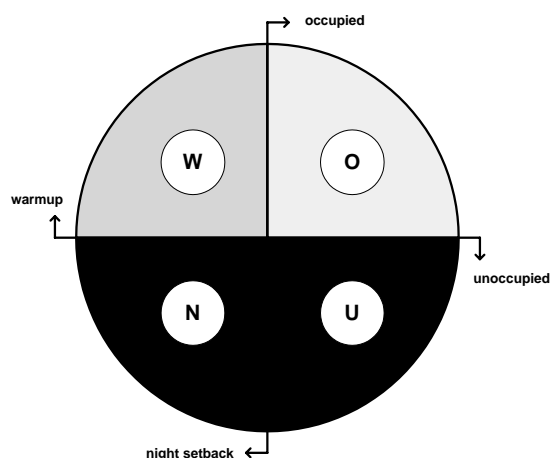
Figure 3-1: Standard Schedule Modes Rotation Example

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).

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

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	Wednesday
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.

3.2.2.2 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 motion 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.
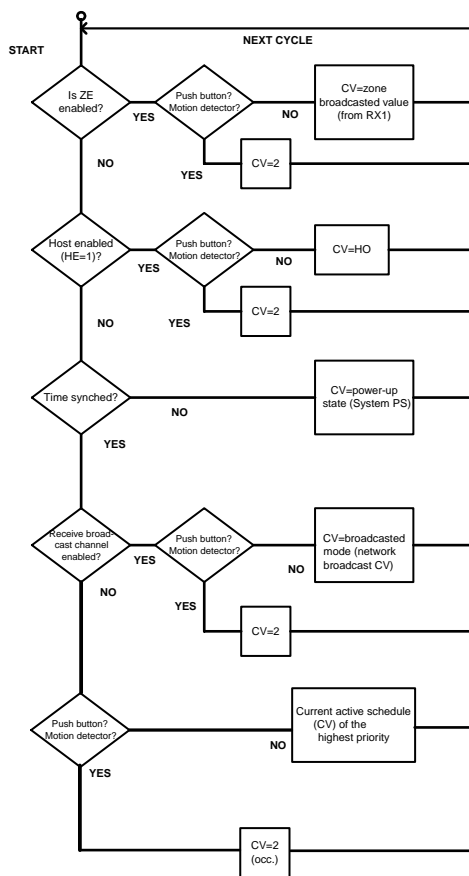
Figure 3-2: SBC-*VAV Priority to Determine the State of* **CV**

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
3	Schedule 4
4	Schedule 5
5	Schedule 6
6	unused
7	unused

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.

3.2.2.3 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.
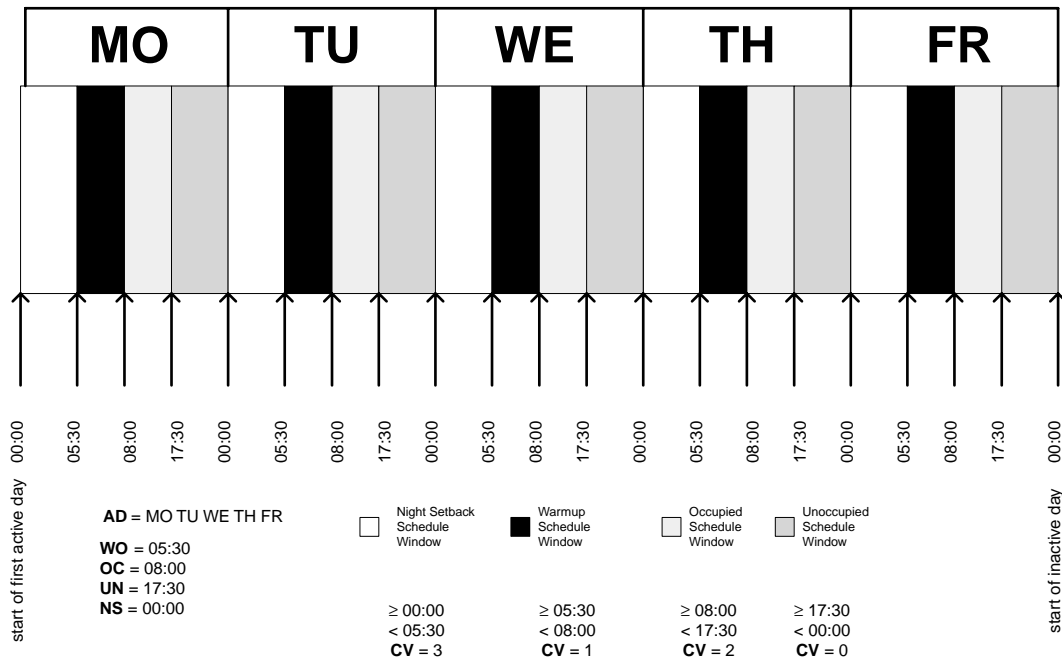
Figure 3-3: Sample Schedule 1

TABLE 3-4: SCHEDULE ATTRIBUTES

	attr	description
F900		
	TM	**System Time**—displays the system time in HH:MM format.
	DT	**Current Date**—specifies the current date in MM/DD/YY format.
	H0-H9	**Programmed Holiday**—a specified date to be considered a holiday. Set the date to 0/0/YY to ignore.
	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.
	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.

TABLE 3-4: SCHEDULE ATTRIBUTES

	attr	description
	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 6 and 7 = unused
	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.
F90x	CV	**Current Value**—shows the current schedule state.
	WO	**Warmup 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

3.2.3 TEMPERATURE (ANALOG INPUTS)

The following are Temperature attributes:
FE00;**ZT**, **OF**, **DM**, **DL**, **BT**, **OI**, **ZS**, **TS**, **TM**, **TP**, **TT**, **TR**, **SE**, **ED**, **ER**, **CC**, **CS**, **SU**, **SB**, **HC**, **HS**, **NU**, **NB**, **WS**, **ST**, **SO**, **DD**, **SM**, **OS**, **BM**, **PU**, **PB**, **PS**, **PI**, **DS**, **DV**, **DF**, **T0**, **T1**, **T2**, **T3**, **G0**, **G1**, **G2**, and **G3**.
FE01;**CV**, **LL**, **HL**, **HS**, **AS**, **AE**, and **SU**.

3.2.3.1 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°F and zone temperature is 74°F, then the demand load will be -2°F. A heating box is satisfied whenever the zone temperature is greater than the setpoint. If the setpoint is 68°F and the zone temperature is 72°F, then the demand load will be 0. If the setpoint is 68°F and the zone temperature is 66°F, then the demand load will be 2.

Attribute FE00;**BT** is VAV Control Mode. It indicates the type of VAV terminal box being used. The types of control 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.

3.2.3.2 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.

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.

3.2.3.4 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 **CS**. It incorporates **TS** and any unoccupied mode setback (**SU**) or any night setback (**SB**) that may be in effect.

Attribute FE00;**CS** is Cooling 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 $72.0°F$.

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.

3.2.3.3 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 dead band 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

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

Attribute **SU** is Unoccupied Setback. It specifies, in +/- degrees, the amount to be added to the cooling setpoint (**CS**) when the SBC-VAV schedule is in unoccupied mode. When the SBC-VAV is in an unoccupied state, the **SU** offset is added to **CS** (cooling setpoint) resulting in **CC** (the calculated cooling setpoint). 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 **SU** and **CS** during unoccupied periods, resulting in **CC**. See Figure 3-4. User definable **SU** defaults to 5.0.

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

3.2.3.5 HEATING SETPOINTS

Attribute FE00;**HC** 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 **CS**. It incorporates **TS** and any Unoccupied Setback (**NU**) or any night setback (**NB**) that may be in effect.

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

Attributes FE00;**CS** and FE00;**HS** 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 dead band to a range higher or lower than the range set by **HS** and **CS**. The result is a new range defined by **HC** and **CC**. When **TS** = 0, the dead band is defined by the setpoint attributes **HS** and **CS**—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 dead band still has the range—4 degrees. The control setpoints will then change to 72°F and 76°F. See Figure 3-5.
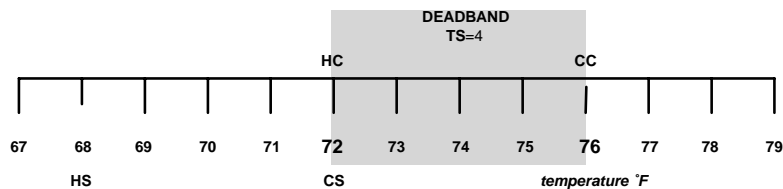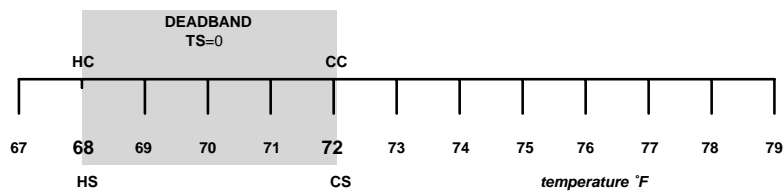
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*Figure 3-5: The Effect of **TS** on Cooling and Heating Setpoints*

Attributes FE00;**CC** and FE00;**HC** equal the temperature setpoints **CS** and **HS**, respectively. The **CC** and **HC** 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 **HC** when **SE** > 0. The value of **TS** will be a positive or a negative integer based on the value of **TP**.

*Table 3-5: **CC** and **HC** Formulas for Use With the* SBC-*STAT*

Schedule Mode	Formula
OCCUPIED	**CC** = **CS** + (**TS**)
	HC = **HS** + (**TS**)
UNOCCUPIED	**CC** = **CS** + (**TS**) + **SU**
UNOCCUPIED	**HC** = **HS** + (**TS**) — **NU**
NIGHT SETBACK	**CC** = **CS** + (**TS**) + **SB**
NIGHT SETBACK	**HC** = **HS** + (**TS**) — **NB**

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

*Table 3-6: **CC** and **HC** Formulas for non-*SBC-*STAT Use*

Schedule Mode	Formula
OCCUPIED	**CC** = **CS**
	HC = **HS**
UNOCCUPIED	**CC** = **CS** + **SU**
UNOCCUPIED	**HC** = **HS** — **NU**
NIGHT SETBACK	**CC** = **CS** + **SB**
NIGHT SETBACK	**HC** = **HS** — **NB**

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

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

*Figure 3-6: Effect of **NU** and **NB** on Control with an* SBC-*STAT*

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

3.2.3.6 ALARMS

Attribute FE01;**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 FE01;**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 FE01**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.
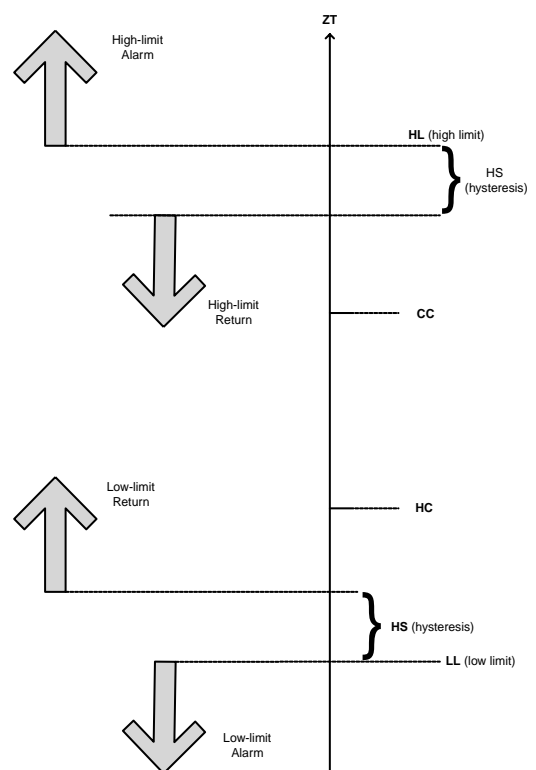
*Figure 3-7: Input Alarming for **ZT***

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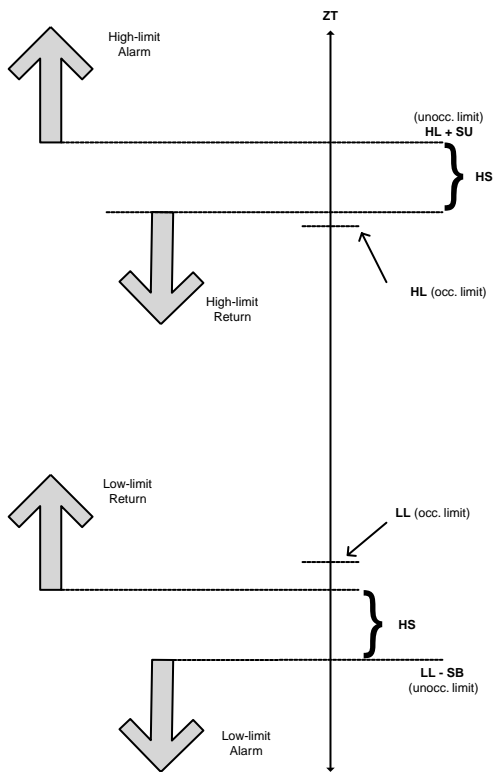
Figure 3-8: Unoccupied Shifting of Alarm Points Due to Setup/Setback

Attribute FE01;**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. Refer to Figure 3-8.

Attribute FE01;**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 = 1–4	unused
AS = 5	low limit alarm

*Table 3-7: **AS** Values for Alarm Status*

Value of AS	Alarm Condition
AS = 6	high limit alarm
AS = 7–12	**unused**

Attribute FE01;**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 = 1–3	unused
AE = 4	low limit alarm
AE = 5	high limit alarm
AE = 6	low and high limit
AE = 7–12	unused

Attribute FE01;**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 3-6 illustrates the effects of setup/setback during unoccupied and night

setback modes. (Note that **HS** shifts with the new limits.)

3.2.3.7 SUPPLY

Attribute FE00;**ST** 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 UI1 is equipped with a thermistor. This value includes the **SO** offset adjustment.

Attribute FE00;**SO** is Supply Temperature Adjustment. It defines an offset used to adjust **ST**.

Attribute FE00;**DD** is Auto Mode Dead Band. This defines the temperature difference by which the supply air must either exceed the **HC** 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 **ST** is in supply dependant mode.

Attribute FE00;**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** > **HC** + **DD**.

Attribute FE00;**OS** is Override Supply Temperature. When set to 1, this allows the Supply Temperature (**ST**) to be altered manually.

3.2.3.8 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-*

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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.

TABLE 3-9: TEMPERATURE ATTRIBUTES

	attr	description
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.
	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.
	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**).

TABLE 3-9: TEMPERATURE ATTRIBUTES

	attr	description
	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 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.
	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.
	CC	**Current Setpoint**—shows the current cooling flow control setpoint.
	CS	**Occupied Setpoint**—shows the zone temperature setpoint desired to begin cooling control.
	SU	**Unoccupied Setback**—specifies, +/– degrees, the amount to be added to the cooling setpoint (**CS**) when the *SBC*-VAV schedule is in unoccupied mode.
	SB	**Night Setback**—specifies, in +/– degrees, the amount to be added to the cooling setpoint (**CS**) when the *SBC*-VAV is in night setback mode.
	HC	**Current Setpoint**—shows the current heating flow control setpoint.
	HS	**Occupied Setpoint**—shows the zone temperature setpoint desired to begin heating control.
	NU	**Unoccupied Setback**—specifies, in +/– degrees, the amount to be added to the heating setpoint (**HS**) when the *SBC*-VAV is in night setback mode.
	NB	**Night Setback**—specifies, in +/– degrees, the amount to be added to the heating setpoint (**HS**) when the *SBC*-VAV is in night setback mode.
	WS	**Warmup Setpoint**—shows the zone temperature setpoint desired for beginning warm-up heating control.
FE01	**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.
	AS	**Alarm Status**—shows the current alarm condition. 0=normal 5=low limit 6=high limit 1-4 and 7-12 are unused

TEMPERATURE

TABLE 3-9: TEMPERATURE ATTRIBUTES

	attr	description
	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 1-3 and 7-12 are unused
	SU	**Alarm Limit Setup/Setback**—specifies the amount added to **HL** or subtracted from **LL** during unoccupied periods.
FE00	ST	**Supply Temperature**—shows the current value of source/duct temperature
	SO	**Supply Temperature Adjustment**—defines an offset used to adjust **ST**.
	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.
	OS	**Override Supply Temperature**—when set to 1, this attribute allows the Supply Temperature (**ST**) to be altered manually.
	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.
	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.

3.2.4 FLOW

The following are Flow attributes:
FA00;**CV**, **CD**, **CA**, **AC**, **FH**, **CK**, **KC**, **K2**, **FC**, **DM**, **CB**, **OI**, **DP**, **EP**, **EF**, **DM**, **DC**, **DD**, **AT**, **AS**, and **RS**.
FA01;**CM**, **CX**, **CP**, **CI**, **HM**, **HX**, **HP**, **HI**, **WM**, **WX**, **WP**, and **WI**.
FA05;**CV**, **LL**, **HL**, **HS**, **AS**, **AE**, and **SU**.
FA06;**PF**, **DR**, **MF**, and **PD**.

NOTE

The *SBC*-VAV3 does not have the following attributes:
FA00;**CV**, **CA**, **FH**, **CK**, **KC**, **K2**, **CB**, **OI**, **DC**, and **AT**.
FA05;**CV**, **LL**, **HL**, **HS**, **AS**, **AE**, and **SU**.
FA06;**MF**

NOTE

Options for FA06;**DR** in the *SBC*-VAV3 are *None* and *Paddle Switch* only. Refer to Section 3.2.4.7 for more information.

3.2.4.1 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. FA00;**CV** is not available on the *SBC*-VAV3.

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. FA00;**CA** is not available on the *SBC*-VAV3.

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.

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 dead band, 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 3-10 illustrates the boundaries set around **CV** when **FH** > 0. This attribute defaults to 20. FA00;**FH** is not available on the *SBC*-VAV3.

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**). FA00;**CK** is not available on the *SBC*-VAV3.

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. FA00;**KC** is not available on the *SBC*-VAV3.

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. FA00;**K2** is not available on the *SBC*-VAV3.

TEMPERATURE

Attribute FA00;**FC** is Fan. It controls the current status of the fan output.
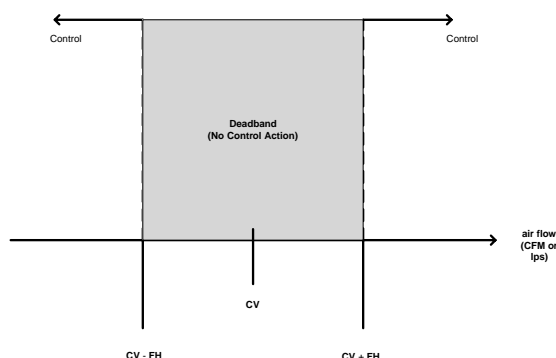
*Figure 3-9: Flow Hysteresis Around FA05;**CV** When **FH** > 0*

Attribute FA00;**DM** is Damper Mode. Through this point, you can command the damper to open fully. The attribute includes settings that force the damper to control cooling minimum flow (**CM**), cooling maximum flow (**CX)**, Heating minimum flow (**HM)**, heating maximum flow (**HX**,) warm-up minimum flow (**WM**) and warm-up maximum flow (**WX**). Enabling any one of the four attributes just mentioned forces the target flow (**CD)** to the appropriate flow setting. Manual/Auto Target Flow values are restored when the damper is returned to Automatic.

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. FA00;**CB** is not available on the *SBC*-VAV3.

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. FA00;**OI** is not available on the *SBC*-VAV3.

3.2.4.2 COOLING

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

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 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°. 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°. The range for **CP** is 0 to 6553.5.

NOTE

The attribute **CC** reflects the thermostat setpoint. value of the *SBC*-STAT and any setup, 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.
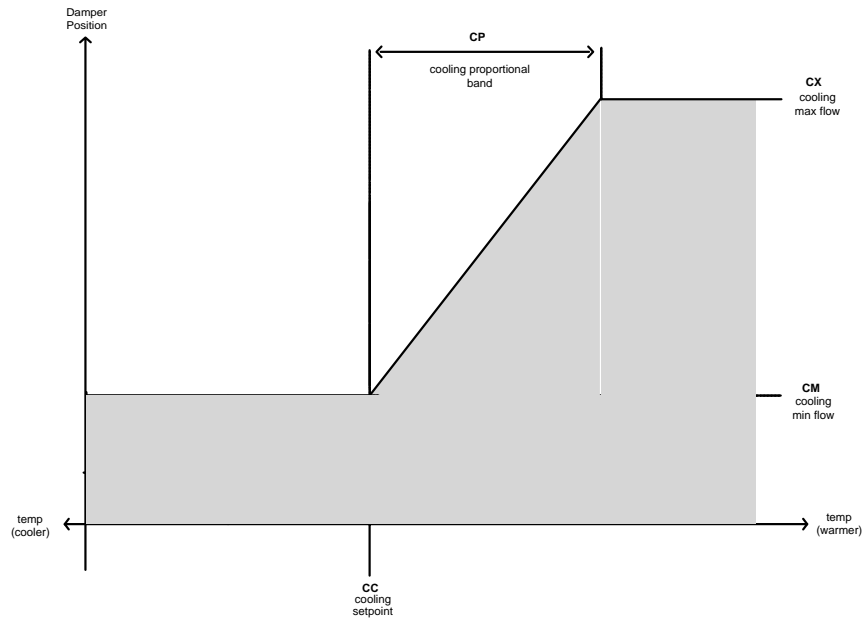
Figure 3-10: Cooling Only Mode
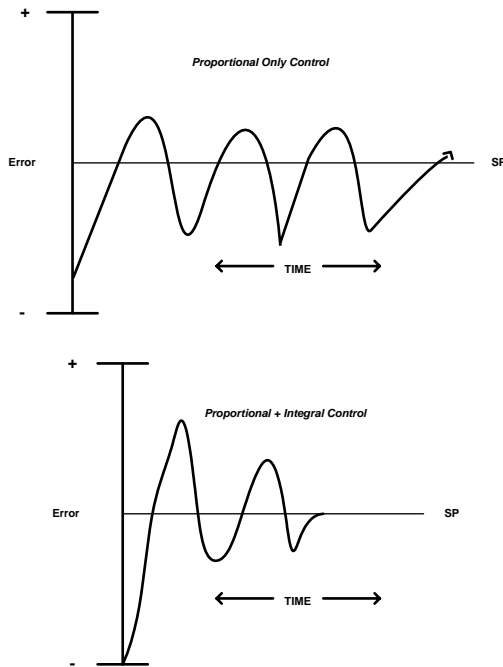
Figure 3-11: Examples of Proportional and Proportional + Integral Control

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.

3.2.4.3 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. See Figure 3-12.
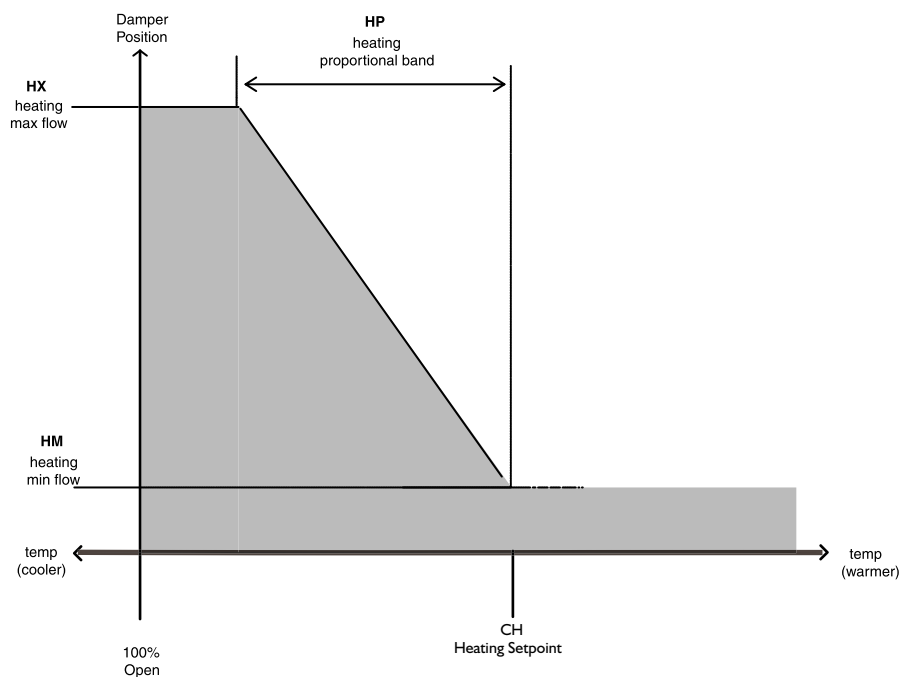
Figure 3-12: Heating Only Mode

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°.

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. Figure 3-12 illustrates the concepts of control

using proportional only and proportional + integral action. 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.

3.2.4.4 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.

3.2.4.5 DAMPER
Attribute FA00;**DP** is Damper Position. It shows the damper position when using an **optional** actuator with built-in feedback potentiometer. Contact AAM if function required.

Attribute FA00;**EP** is Estimated Target Position. It 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.

Attribute FA00;**EF** is Estimated Flow at Full Open. It shows the estimated flow at full open in cfm.

Attribute FA00;**DM** is Damper Mode. It can be used to command the damper to fully open. The options are minimum cooling flow, maximum cooling flow, minimum heating flow, maximum heating flow, warm up minimum and warm up maximum.

Attribute FA00;**DC** is Damper Control. **DC** 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), the damper is modulated to maintain the target flow (**CD**). The default value of **DC** is "1". FA00;**DC** is not available on the *SBC*-VAV3.

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 **TR4** and **TR5**. Those with

DC power use the standard actuator connector. Motor Management Technology supports the Belimo LM-24M. You can also choose None if you are not using an actuator with your *SBC*-VAV. FA00;**AT** is not available on the *SBC*-VAV3.

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.

3.2.4.6 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.

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Table 3-10: Values for Alarm Status Attribute AS

Value of **AS**	Alarm Condition
AS = 0	normal
AS = 1, 2, 3 & 4	unused
AS = 5	low limit
AS = 6	high limit
AS = 7–12	unused

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 = 1–3	unused
AE = 4	low limit alarm
AE = 5	high limit alarm
AE = 6	low and high limit
AE = 7–12	unused

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.
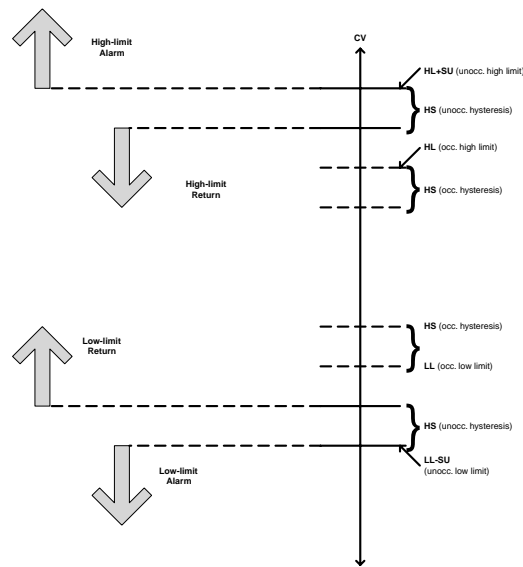
Figure 3-13: Unoccupied Setup/Setback Alarm Shifting

3.2.4.7 PROOF OF FLOW

Attribute FA06;**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 FA06;**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.

NOTE

Options for FA06;**DR** in the *SBC*-VAV3 are *None* and *Paddle Switch* only.

Attribute FA06;**MF** is Minimum 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 FA06;**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
FA00		
	CV	**Current Value**—shows the current measured amount of airflow in cfm. **FA00;CV is not available on the *SBC*-VAV3.**
	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. **FA00;CA is not available on the *SBC*-VAV3.**
	AC	**Control**—when set for Auto, the Target Flow (**CD**) is determined by the control algorithms and setpoints.
	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. **FA00;FH is not available on the *SBC*-VAV3.**
	CK	**Duct Scaling Factor (K)**—shows the scaling factor for the particular VAV box being used. **FA00;CK is not available on the *SBC*-VAV3.**
	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. **FA00;KC is not available on the *SBC*-VAV3.**
	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. **FA00;K2 is not available on the *SBC*-VAV3.**
	FC	**Fan**—controls 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. **FA00;CB is not available on the *SBC*-VAV3.**
	OI	**Override Current Value**—allows a host or operator to manually set the value of the current flow. **FA00;OI is not available on the *SBC*-VAV3.**
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 the offset from the calculated cooling control setpoint **CC** that determines the proportional band for damper control. The range for **CP** is 0 to 6553.5.
	CI	**Cooling Integration Constant**—shows the amount of proportional error history used to calculate the desired position for the cooling duct damper. The range for **CI** is 0 to 25.5%.
	HM	**Heating Minimum Flow**—shows the allowable minimum heating duct flow during heating.

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TABLE 3-12: FLOW ATTRIBUTES

	attr	description
	HX	**Heating Maximum Flow**—shows the allowable maximum heating duct flow during heating.
	HP	**Heating Proportional Band**—specifies the offset from the calculated heating control setpoint that determines the proportional band for the heating duct damper control. The range for **HP** is 0 to 6553.5.
	HI	**Heating Integration Constant**—shows the amount of proportional error history used to calculate the desired position for the heating duct damper. The range for **HI** is 0 to 25.5%.
	WM	**Warmup Minimum Flow**—shows the allowable minimum heating duct flow during warm-up heating.
	WX	**Warmup Maximum Flow**—shows the allowable maximum heating duct flow during warm-up heating.
	WP	**Warmup Proportional Band**—specifies the offset from the calculated heating control setpoint that determines the proportional band for the warm-up heating duct damper control. The range for **WP** is 0 to 6553.5.
	WI	**Warmup Integration Constant**—shows the amount of proportional error history used to calculate the desired position for the heating duct damper. The range for **WI** is 0 to 25.5%.
FA00	**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.
	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**). **FA00;DC is not available on the** SBC-**VAV3.**
	DD	**Direction**—used to set the direction of the damper motor.
	AT	**Actuator Type**—defines the type and connection for the damper actuator. **FA00;AT is not available on the** SBC-**VAV3.**
	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.
FA05	**CV**	**Current Value**—shows the current measured amount of airflow in cfm. **FA05;CV is not available on the** SBC-**VAV3.**
	LL	**Low Alarm Limit**—if alarms are enabled and the current value drops below this value, a low limit alarm will be generated. **FA05;LL is not available on the** SBC-**VAV3.**
	HL	**High Alarm Limit**—if alarms are enabled and the current value rises above this value, a high limit alarm will be generated. **FA05;HL is not available on the** SBC-**VAV3.**

TABLE 3-12: FLOW ATTRIBUTES

	attr	description
	HS	**Alarm Limit Hysteresis**—determines when the *SBC*-VAV returns from a high or low limit alarm. **FA05;HS is not available on the *SBC*-VAV3.**
	AS	**Alarm Status**—shows the current alarm condition. **FA05;AS is not available on the *SBC*-VAV3.**
	AE	**Alarm Enable**—specifies the type of alarm checking to be done on the **CV** value. **FA05;AE is not available on the *SBC*-VAV3.**
	SU	**Alarm Limit Setup/Setback**—specifies the amount added to **HL** or subtracted from **LL** during unoccupied periods. **FA05;SU is not available on the *SBC*-VAV3.**
FA06	**PF**	**Proof of Flow**—shows the status of the proof of flow.
	DR	**Method**—defines the requirements for proof of flow. Options for **DR** in the *SBC*-VAV3 are *None* and *Paddle Switch* only.
	MF	**Minimum Required Flow**—the minimum flow reading required in order to indicate positive flow. **FA06;MF is not available on the *SBC*-VAV3.**
	PD	**Flow Proof Delay**—shows the amount of time, in seconds, imposed before enabling a positive flow indication.

FLOW

3.2.5 AUXILIARY

The following are Auxiliary attributes:
FB01;**FO**, **FS**, **SF**, **FC**, and **CV**.
FA03;**RO**, **FR**, **AV**, **EN**, **AF**, **MX**, **BA**, **OF**, and **ID**.
FA02;**VU**, **VM**, **VA**, **VD**, **CR**, **RI**, **VO**, **VP**, **VI**, **VT**, **PP**, **CD**, and **AM**.
FA04;**SP**, **CS**, **PO**, **AO**, **IN**, **IC**, **MR**, **RC**, **RV**, **RS**, **RL**, **DB**, **PB**, **RP**, **RT**, **SG**, **SU**, and **CE**.
FC00;**IC**, **MS**, **MD**, **MT**, and **MR**.

3.2.5.1 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 decribes 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 dead band created by the calculated heating and cooling control setpoints (Flow **CC** and Flow **HC**), then the series fan is shut off during unoccupied periods. If **ZT** extends above or beyond the dead band, 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.
.
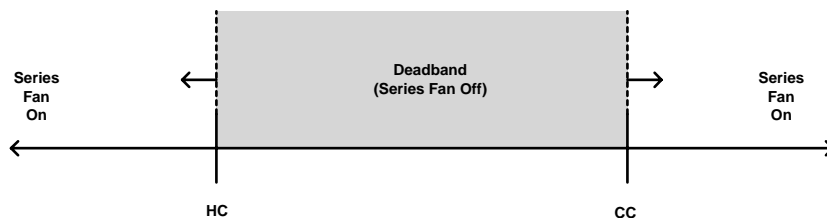
*Figure 3-14: Unoccupied Series Fan Operation With **BT** = 1 and **SF** = 1*

Table 3-13: Fan Setpoint

Current State	If **FS** = 0 and		If **FS** > 0 and	
	ZT < **HC**	**ZT** > **HC**	**ZT** < **HC**	**ZT** > **HC**
Occupied	On	Off	Flow Controlled	Flow Controlled
Unoccupied	On	Off	On	Off
Warm-up	On	Off	On	Off

Table 3-13: Fan Setpoint

Current State	If **FS** = 0 and		If **FS** > 0 and	
	ZT < **HC**	**ZT** > **HC**	**ZT** < **HC**	**ZT** > **HC**
Night Setback	On	Off	On	Off

3.2.5.2 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 (**TR2–3**), 2-Stage (**TR4–5**), and 4-Stage (**TR2–5**). Table 3-14 lists the options offered by **RO**.

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

RO	Option
0	disabled (no reheat)
1	two stages of electric reheat (TR 2 & 3)
2	two stages of electric reheat (TR 4 &5)
3	four stages of electric reheat (TR 2,3,4 & 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 triac outputs (ac actuator, for instance) may remove those stages from reheat availability. This attribute is read-only.

Attribute FA03;**MX** is Maximum Supply Temperature. It establishes a maximum supply

duct temperature above which the reheats will deenergize.

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;**BA** is Balance Stage Usage. If set to Yes (**BA** = 1), it considers the Run Hour Totals (Digital Output **RH**) for the individual triac outputs in energizing reheat stages. Stages with lower usage will be energized first. The result is the balanced use of these stages. For best operation, all stages should be nearly equivalent. The default setting 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

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surges that might occur if both reheats were to be energized at the same time. This point defaults to 1.0 minute.

3.2.5.3 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 that the *SBC*-VAV uses to PI 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 3-16 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.

Valve Control attribute **VU** is Valve Use. The options are disabled, cooling and heating.

Valve Control attribute FA02;**VM** is Valve Mode. The options are Pulse Width Modulation and Floating Point Motor Control.

Valve Control attribute FA02;**VA** is Actual Valve Position. It shows the actual valve position (in percent) based on travel time. This point is read only.

Valve Control attribute FA02;**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.

Valve Control attribute FA02;**CR** is Valve Auto-Creep Enabled. It enables or disables the auto-creep function. When **CR** = 1, the valve will creep at a rate of 1% per minute in the closed or open position when the output is at 0% or 100%, respectively. This is an alternative to constant driving of the output. If **CR** = 0, then the output will stay ON when the output reaches 100%. This point defaults to 0.

Valve Control attribute FA02;**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 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** that if **RI** =0 and a power failure occurs, the valve will **not** be recalibrated upon power-up.
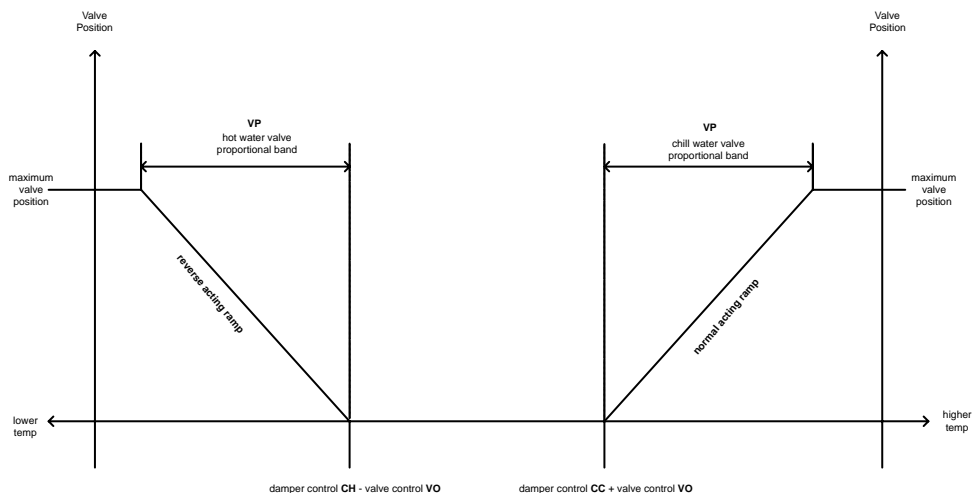
Figure 3-15: Reverse and Normal Valve Ramps

Valve Control attribute FA02; **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**.

Valve Control attribute FA02;**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.

Valve Control attribute FA02;**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. Figure 3-11 illustrates the concepts control using proportional only and proportional + integral sum. 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.

Valve Control attribute FA02;**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.

Valve Control attribute FA02;**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.

Valve Control attribute FA02;**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

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FB03. With the attribute set to 1, the outputs are reversed.

Valve Control attribute FA02;**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.

3.2.5.4 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 FA04;**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 FA04;**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 FA04;**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 FA04;**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 FA04;**IN** is Measured Variable's Value. It is read only and displays the value of the input selected in **IC**.

Attribute FA04;**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 3-14.

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

Value of **IC**	Measured Variable
0	disabled (default)
1	Zone Temp
2	Supply Temp
3	UI1
4	Flow

Attribute FA04;**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 FA04;**RC** is Reset Variable's Value. It displays the value of the input selected in **RV**.

Attribute FA04;**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	UI1
4	Flow

Attribute FA04;**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 FA04;**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.
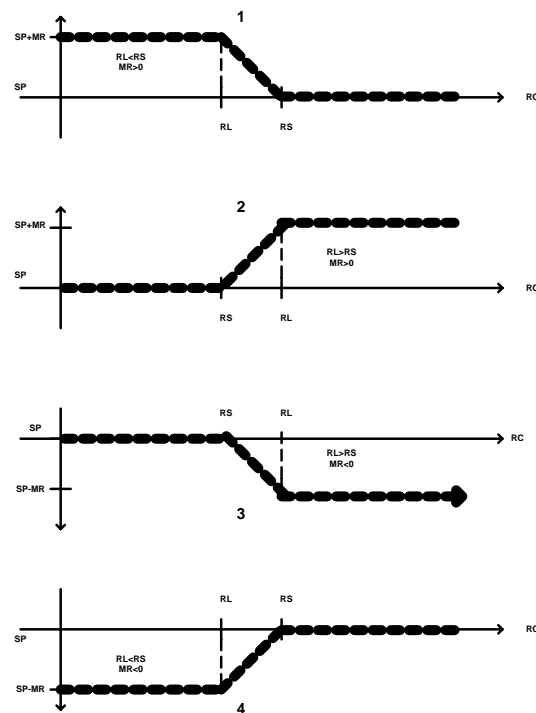
Figure 3-16: Four Forms of Reset Action

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

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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 FA04;**DB** is Dead Band. It specifies the dead band 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 FA04;**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. See Figure 3-17.

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 dead band can be programmed that is centered on the selected setpoint.

Attribute FA04;**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 dead band, 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 dead band. When the value of the control variable (specified by **IC**) is within ±**DB**/2 of the setpoint **SP**, the *SBC*-VAV assumes that it has reached the setpoint.

By entering a value in FA04;**DB** that is greater than the resolution of the measured variable sensor, you create a dead band 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 of WC, etc.). The data type of **DB** is the same as the data type of the selected measured variable. The point **DB** defaults to 0.
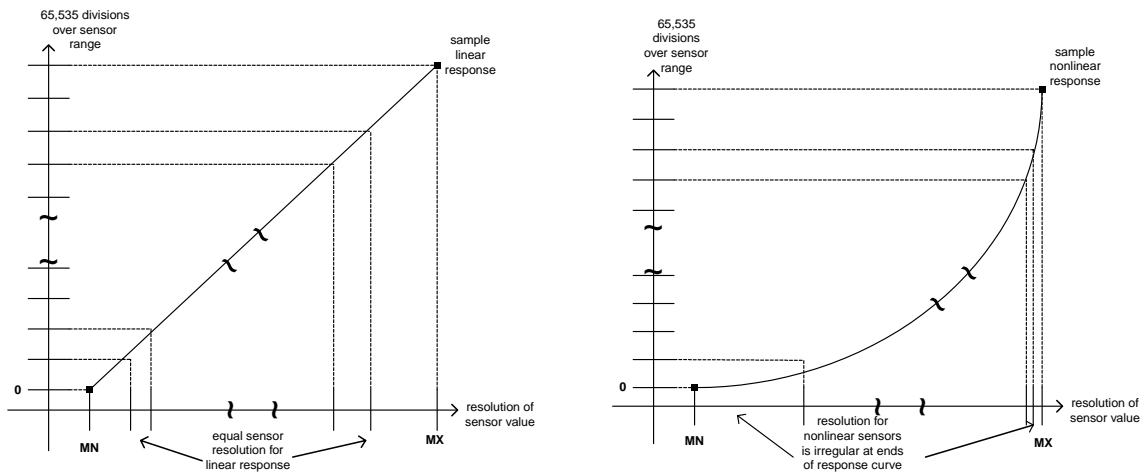
Figure 3-17: Sensor Resolution for Linear and Non-linear Devices
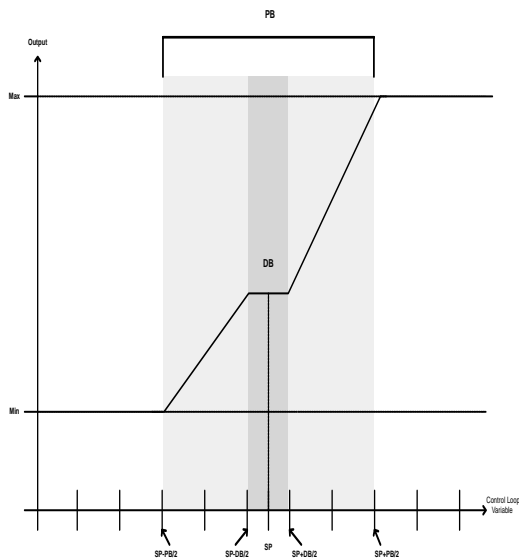
*Figure 3-18: Normal Acting, Proportional Control Output Response Showing a Dead Band Centered Around the Setpoint (**SP**)*

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.

NOTE

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

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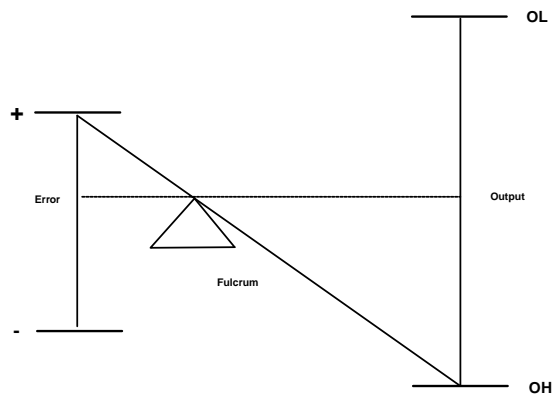
Figure 3-19: Input/Output Ratio

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.
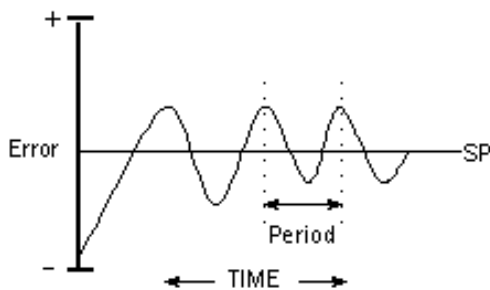
Figure 3-20: Proportional Only Control

Attribute FA04;**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 of WC. 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.
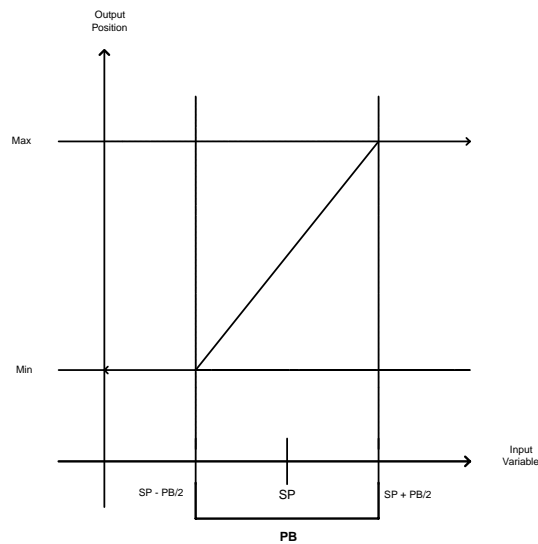
*Figure 3-21: Proportional Band for Normal Acting Control (**SG** = 0)*
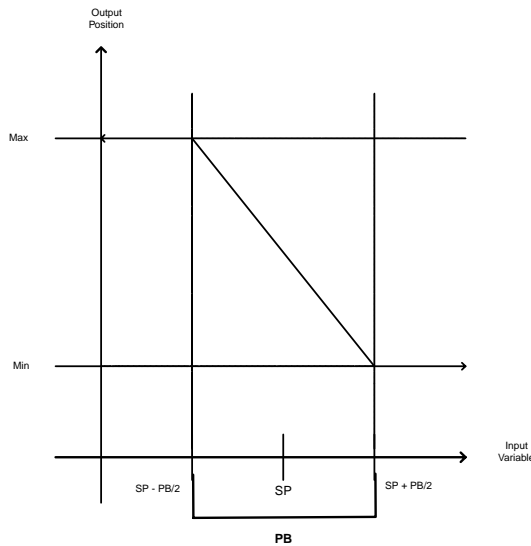
*Figure 3-22: Proportional Band for Reverse Acting Control (**SG** = 1)*

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

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. See Figure 3-22.

Attribute FA04;**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.

At the start-up of the loop or following a change in setpoint, 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 as shown in Figure 3-24.

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, ±**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 FA04;**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.
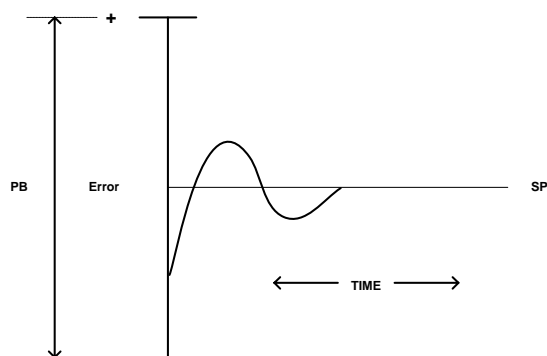
Figure 3-24: Proportional + Integral + Derivative (PID) Control

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 FA04;**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 FA04;**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.

3.2.5.5 MOTION DETECTOR
The Motion 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 motion detector is used with the controller.

Attribute FC00;**IC** is Motion Detector Enable. It enables motion detection (**IC** = 1). This point uses a nonzero value from **UI1** to indicate motion.

Attribute FC00;**MS** is Motion Detector Input Status. This read-only point shows the status of the motion detector digital input. To enable motion 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 motion in the zone is detected during unoccupied periods, the motion input extends occupancy time by the amount specified in **MT**.

Attribute FC00;**MD** is Extended Occupancy Delay. It sets the amount of time, in seconds, during which the motion detector must remain on before the motion detector will override the zone. This prevents false triggers that might occur as others pass quickly through the zone.

Attribute FC00;**MT** is Extended Occupancy Duration. It defines, in minutes, the length of time needed to override the zone whenever motion is detected.

Attribute FC00;**MR** is Extended Occupancy Remaining. This read-only point displays the time remaining for motion detector override.

TABLE 3-17: AUXILIARY ATTRIBUTES

	attr	description
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.
FA03	**RO**	**Reheat Mode**— used to configure the *SBC*-VAV's outputs for electric reheat. 0 = 2 stage electric reheat (TR2 and 3) 2 = 2 stage electric reheat (TR4 and 5) 3 = 4 stage electric reheat (TR2,3,4, 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.
	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.

AUXILIARY

TABLE 3-17: AUXILIARY ATTRIBUTES

	attr	description
	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.
	VU	**Valve Use**—options are disabled, cooling and heating.
FA02	**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.
	CR	**Valve Auto-Creep**— enables or disables the auto creep function.
	RI	**Valve Recalibrate Interval**—shows the amount of time, in hours, between valve recalibrations.
	VO	**Valve Offset**—used to configure the valve mode.
	VP	**Valve Proportional Band**—specifies the input variable range over which the output is proportional to the error value. The range for this attribute is 0 to 6553.5.
	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.
	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).
FA04	**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=UI1 4=Flow
	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**.

TABLE 3-17: AUXILIARY ATTRIBUTES

	attr	description
	RV	**Reset Variable**—specifies the input to be used for calculating the reset. 0=disabled 1=Zone Temp 2=Supply Temp 3=UI1 4=Flow
	RS	**Reset Setpoint**—specifies the value at which the reset action begins.
	RL	**Reset Limit**—specifies the value at which maximum reset is used.
	DB	**Dead Band**—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**. The range of **RT** is 0 to 25.5.
	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.
FC00	**IC**	**Motion Detector Enable**—uses a nonzero value from UI1 to indicate motion.
	MS	**Motion Detector Input Status**—shows the status of the motion detector digital input.
	MD	**Extended Occupancy Delay**—sets the amount of time, in seconds, during which the motion 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 motion is detected.
	MR	**Extended Occupancy Remaining**—displays the time remaining for motion detector override.

AUXILIARY

3.2.6   I/O SETUP

The following are Input/Output Setup attributes:
FE04;**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**.

3.2.6.1 INPUT (UI1)

I/O Setup (UI1) offers specific operational options. As a universal input it can be used as the referenced input for PID analog control. It provides you with the option to use any 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 a motion detection input of the *SBC*-VAV. When FE04 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 the motion detection sensor input, UI1 is dedicated to the *SBC*-VAV motion detection feature—allowing for automatic unoccupied override. This sends the *SBC*-VAV into an occupied mode of operation when motion 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 motion detection, energy totalization/autowarm-up mode and proof of flow are disabled.

Attribute FE04;**CV** is Current Value. It shows the current value of UI1. This attribute is read-only unless overridden (**OI** = 1).

Attribute FE04;**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 FE04;**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 table 1 (−22.0 to 122.0°F). The associated settings appear in Table 3-18.

Table 3-18: Sensor Types for FE02 and FE04

Value of **ST**	Sensor Type
ST = 0	digital
ST = 1	unused
ST = 2	full scale, linear input scaled from **MN** to **MX** (0–5VDC or 0–20mA)
ST = 3	4–20mA input scaled from **MN** to **MX**
ST = 4, 5, or 6	unused
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 the appropriate jumper and resistor on the PC board are properly set. For more information, see Section 2: Wiring and Installation.

The following sample calculation shows how the *SBC*-VAV scales raw counts on the 10-bit UI1 using a current value of 115. (The result is rounded.)

$$CV = MN + \boxed{\dfrac{\text{Current Counts} \times \textbf{MX}}{\text{Max Counts}}}$$

$$CV = 0.00 + \boxed{\dfrac{115 \times 100}{65,535}}$$

$$CV = 0.00 + \boxed{\dfrac{11500}{65,535}}$$

$$CV = 0.18$$

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

$$CV = MN + + \boxed{\dfrac{\text{Current Counts} \times (\textbf{MX})}{\text{Max Counts}}}$$

$$CV = \boxed{\dfrac{185 \times 100}{65,535}}$$

$$CV = 0.0 + \boxed{\dfrac{18500}{65,535}}$$

$$CV = 0.28$$

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. For information on hardware settings, refer to Section 2: Wiring and Installation. Figure 3-25 illustrates the counts used by a 4–20mA device.
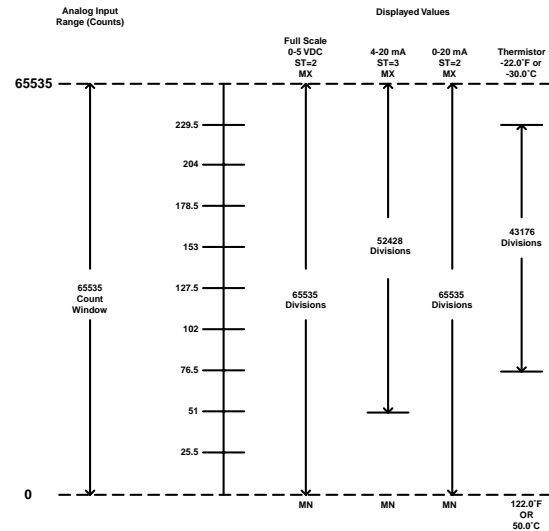
Figure 3-25: Analog Sensor Types

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 FE04;**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 FE04;**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

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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 FE04;**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 FE04;**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 FE04;**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.
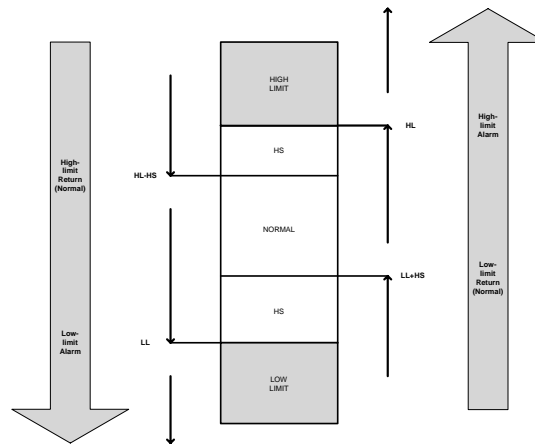
Figure 3-26: Alarm States and Thresholds for Limit Alarming

Attribute FE04;**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 $\rightarrow$ 1)
AS = 2	contact (1 $\rightarrow$ 0)
AS = 3	change of state
AS = 4	unused
AS = 5	low limit alarm
AS = 6	high limit alarm

Attribute FE04;**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, $0 \rightarrow 1$
AE = 2	contact, $1 \rightarrow 0$
AE = 3	change of state, $1 \leftrightarrow 0$
AE = 4	low limit alarm
AE = 5	high limit alarm
AE = 6	low and high limit
AE = 7–12	unused

Attribute FE04;**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. (See Figure 3-27.)

Attribute FE04;**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 FE04;**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:

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

Attribute FE04;**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 FE04;**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.*

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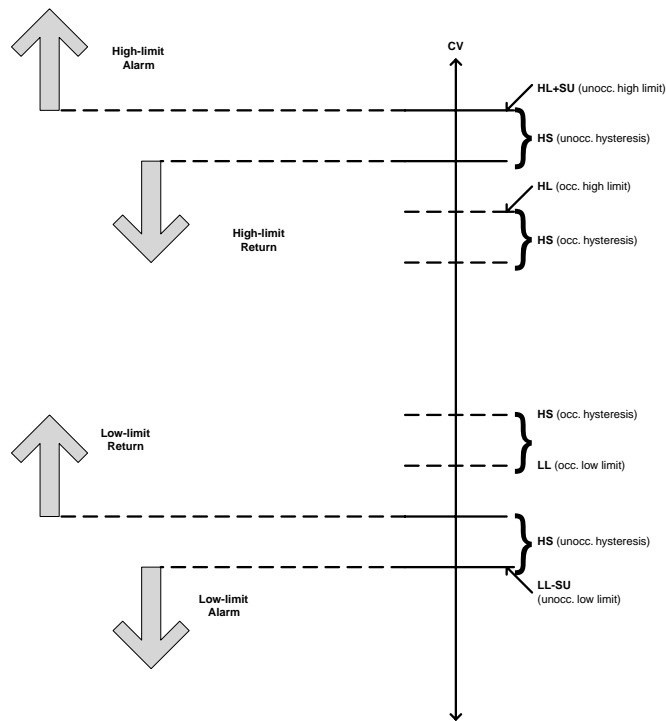
Figure 3-27: Unoccupied Setup/Setback Alarm Shifting

3.2.6.2 ANALOG OUTPUT (AO**1**)

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.

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.
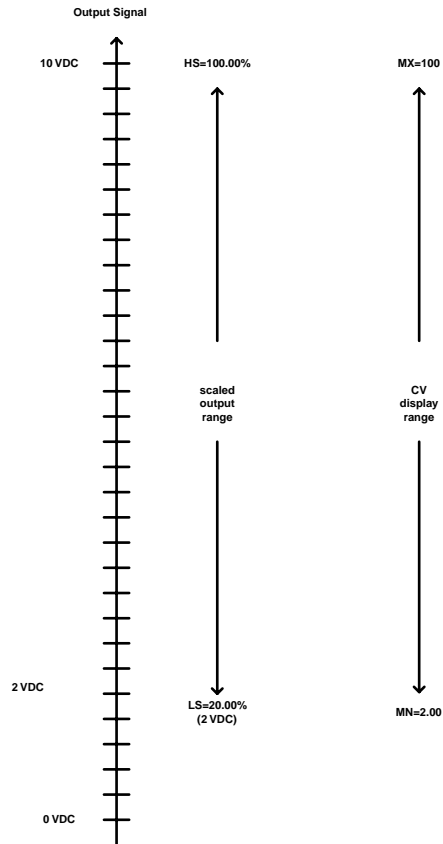
Figure 3-29: Analog Output Example 2

Figure 3-28: Analog Output Example 1

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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.)

3.2.6.3 I/O SETUP TRIAC OUTPUTS (TR1–TR5)

The Triac (digital) Outputs are used to determine the state of the *SBC*-VAV outputs at a glance.

TRIAC 1

Triac 1 is the fan digital outputs. It is associated with triac **TB3:TR**1 terminal 9 and is driven by fan control associated attributes. (See the Fan subsection earlier in this section.)

Attribute FB0x;**CV** is Current Value. This point is read only when automatic fan control is enabled (Fan Digital Output attribute **FO** > 0). The point reflects the current requested state of the fan output as determined by the fan 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 triac is off when fan control is not calling for the fan to be on, and the triac provides a complete current sinking path for 24VAC when there is a call for the fan to be on. As a *reverse* acting current sinking output, the triac provides a 24VAC path when fan control is not calling for the fan to be on, and the output is off when the control loop is calling for the fan 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 Fan Digital 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 Fan Digital 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 run time 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.

TRIACS 2 AND 3

Triacs 2 and 3 serve either as the first stage and second stage of reheat in a VAV terminal box or they are used as the increase "open value" signal (Triac 2) and as the decrease "close value" signal (Triac 3) in a hot water reheat or chill water situation. The output determination is made in Triac 3 **RO** (Reheat Options). Triacs 2 and 3 contain identical attributes.

Attribute FB0x;**CV** is Current Value. It is read only when the reheats are enabled (Triac 3 **RO** > 0) and reflects the current requested state of the output as determined by the reheat control. You can manually write to the attribute if Triac 3 **RO** = 0 (manual mode).

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 triac is off when reheat control is not calling for the reheat to be on. The triac provides a complete current sinking path for 24VAC when there is a call for

the reheat to be on. As a reverse acting current sinking output, the triac provides a 24VAC path when reheat control is not calling for the reheat to be on. The output is off when reheat control is calling for the reheat to be on.

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

Attribute FB0x;**RL** is Runtime Limit. It is used to define when the output should alarm. The point is generally used for preventative maintenance purposes. Setting **RL** > 0 determines the amount of time that must be exceeded before Triac 2 or 3 will generate a run time alarm. Run time limit alarming is disabled when **RL** = 0.

NOTE
Triacs 4 and 5 on the *SBC*-VAV2 can be used for reheats or generic AC actuator control.

TABLE 3-21: INPUT/OUTPUT ATTRIBUTES

	attr	description
FE04		
	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 1 = unused 2 = full scale, linear input scaled from MN to MX 3 = 4-20mA input scaled from MN to MX 4, 5 or 6 = unused 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 AND **MX**	**Minimum and Maximum Scaled Value**—program the minimum and 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.

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TABLE 3-21: INPUT/OUTPUT ATTRIBUTES

	attr	description
	AS	**Alarm Status**—shows the current alarm condition. 0 = normal 1 = contact (0 to 1) 2 = contact (1 to 0) 3 = change of state 4 = unused 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 7-12 = unused
	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.
	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
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
FB0x	CV	**Current Value**—shows the current value for the analog output.
	OP	**Output Polarity**—allows you to change the polarity of the output.

TABLE 3-21: INPUT/OUTPUT ATTRIBUTES

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

I/O SETUP

3.2.7 NETWORKING

There following are Networking attributes:
FF00;**ID**, **ZN**, **CP**, **TP**, **ER**, and **U1-U4.**
F005;**CV** and **RB**.

3.2.7.1 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.

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

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.

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.

3.2.7.2 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
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.
	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.
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.

NETWORKING

SECTION 4: CONFIGURATION

The SBC-VAV 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.

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.

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

NOTE
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 *Monday*), you must click on the radio button next to the current day to set it.

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.
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.

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: (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. Motion 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)

Sections 4.1.1 through 4.1.8 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
▼ a motion sensor is properly configured and motion 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
▼ a motion sensor is properly configured and motion 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

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.

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
- ▼ a motion sensor is properly configured and motion 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.

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
- ▼ a motion sensor is properly configured and motion 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.

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

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.

The broadcast Zone Schedule will be the active schedule mode unless:
▼ a motion sensor is properly configured and motion is detected
▼ user override occurs.

4.1.7 OCCUPANCY DETECTION

The motion detection feature enables the *SBC*-VAV to automatically go to occupied mode, (also called extended occupancy,) provided that a motion 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:Motion Detector:**Extended Occupancy Duration** [FC00;**MT**] attribute. To configure the *SBC*-VAV for occupancy detection capability, refer to Table 4-7.

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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 FE04;**ST** = 0.
Aux: Motion Detector: **Mode**	Click on the radio button next to Enabled (UI1).	Set FC00;**IC** = 1.
Aux: Motion Detector: **Extended Occupancy Delay**	In the field provided, enter the desired number of seconds the motion detector is to detect motion before overriding the zone. This prevents false triggering of motion detection in the event that someone or something quickly passes through the zone.	Set FC00;**MD** = the desired number of seconds the motion detector is to detect motion before overriding the zone. This prevents false triggering of motion detection in the event that someone or something quickly passes through the zone.
Aux: Motion Detector: **Extended Occupancy Duration**	In the field provided, enter the desired number of minutes the *SBC*-VAV is to remain in extended occupancy once motion is detected. This value must be greater than zero, otherwise the *SBC*-VAV will not go into extended occupancy.	Set FC00;**MT** = the desired number of minutes the *SBC*-VAV is to remain in extended occupancy once motion is detected. 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 motion is detected.

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 pushbutton 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 the user 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.

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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.
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;**HC** 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;**HS** = the temperature that you want the zone to maintain when the active schedule mode is occupied. During occupied mode: FE00;**HC** = FE00;**HS**
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;**NU** = the value to be subtracted from FE00;**HS** when the active schedule mode is unoccupied. During unoccupied mode: FE00;**HC** = **HS** - **NU**
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;**NB** = the value to be subtracted from FE00;**HS** when the active schedule mode is night setback. During night setback mode: FE00;**HC** = **HS** - **NB**
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;**WS** = the temperature that you want the zone to maintain when Warm-up is the active schedule mode. During warm-up mode: FE00;**HC** = **WS**

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;**CS** = the temperature that you want the zone to maintain when the active schedule mode is occupied. During occupied mode: FE00;**CC** = FE00;**CS**
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;**SU** = the value to be added to FE00;**CS** when the active schedule mode is unoccupied. During unoccupied mode: FE00;**CC** = **CS** + **SU**
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;**SB** = the value to be added to FE00;**CS** when the active schedule mode is night setback. During night setback mode: FE00;**CC** = **CS** + **SB**

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.

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 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. 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.
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.

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 *None (CAV)*.	Set FE00;**BT** = 0
Flow: Control: **Target Flow**	In the field provided, enter the desired constant volume setpoint (in cfm).	Set FA00;**CD** = desired constant volume setpoint

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 or a broadcast value from a central point. For example, if the Temperature:Supply:**Supply Temperature** [FE00;**ST**] is greater than *both* the Temperature:Thermostat:**Zone Temperature** [FE00;**ZT**] and the Temperature:Heating Setpoints:**Current Setpoint** [FE00;**HC**], 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 **ST** 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).
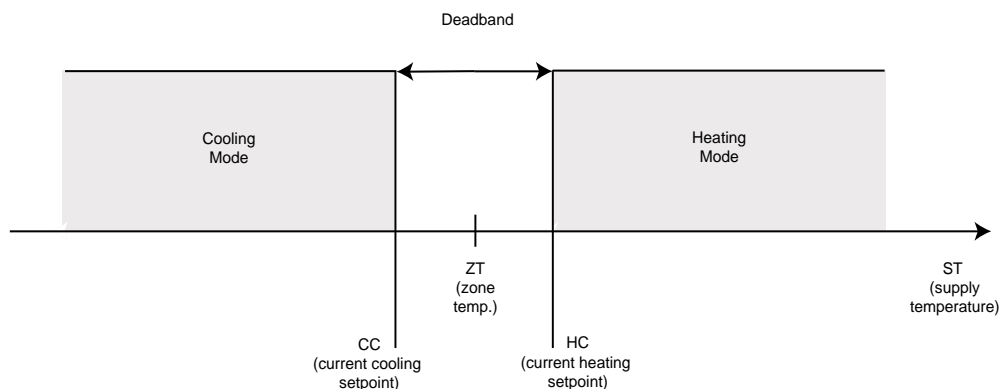
Figure 4-1: Supply Dependant (VST) Control

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°).

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).

In the event that the **CC** is greater than the **HC** [FE00;**CC** > FE00;**HC**], 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 **HC** is 70°, set **DD** to 2° to create a sufficient deadband.

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 *Supply Dependant (VST)*.	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 the heating **Current Set-point** and added to the cooling **Current Setpoint**.

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;**HC**]. 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 **HC**, the *SBC*-VAV opens the damper—increasing the supply airflow to the zone. As **ZT** reaches the **HC**, 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 .

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

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 *Heating Only*.	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 and for instructions on configuring these setpoints.		

Damper Position

HX
Heating
ax. Flow

HP
Heating
Proportional
Band

HM
Heating
Min. Flow

cooler

warmer

Heating
Setpoint
HC

Figure 4-2: Heating Only

Hot
Air from Main
Air Handler Unit

To Other
Zones

Terminal Box

Airflow Sensor

igh

ow

Damper
Used to Control
Flow to Zone

Discharged
to Zone

Zone
Temperature
Sensor

Figure 4-3: Example of a Heating Only Application

NOTE

Refer to Table 4-9 and Table 4-11 for instructions to set the temperature and flow setpoints.

NOTE

Scheduling controls the current temperature setpoint.

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**.

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). Refer to Table 4-17 to configure the *SBC*-VAV for cooling only control.
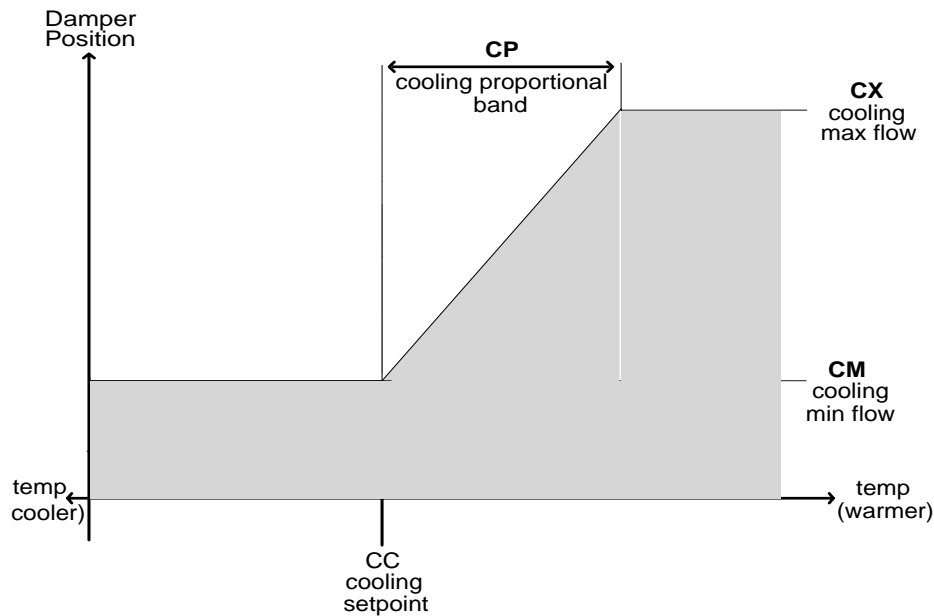
Figure 4-4: Cooling Only
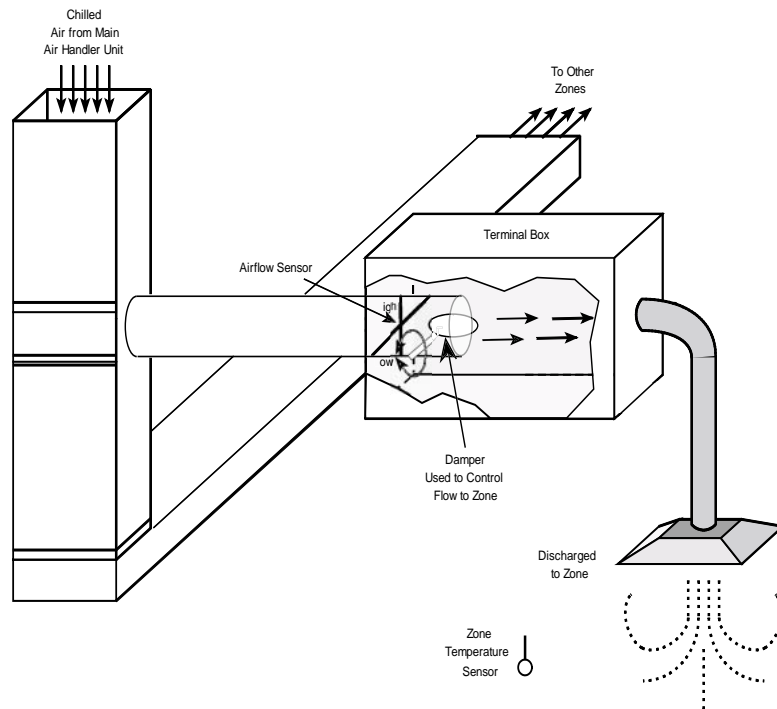
Figure 4-5:Example of a Cooling Only Application

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 *Cooling Only.*	Set FE00;**BT** = 1.
Set the temperature and flow setpoints as desired. Refer to and for instructions on configuring these setpoints.		
Flow: Heating: **Heating Minimum Flow**	Set **Heating Minimum Flow** equal to **Cooling Minimum Flow**.	Set FA01;**HM** = FA01;**CM**.
Flow: Heating: **Heating Maximum Flow**	Set **Heating Maximum Flow** equal to **Cooling Maximum Flow** attribute.	Set FA01;**HX** = FA01;**CX**.
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 manufacurer of the VAV box.
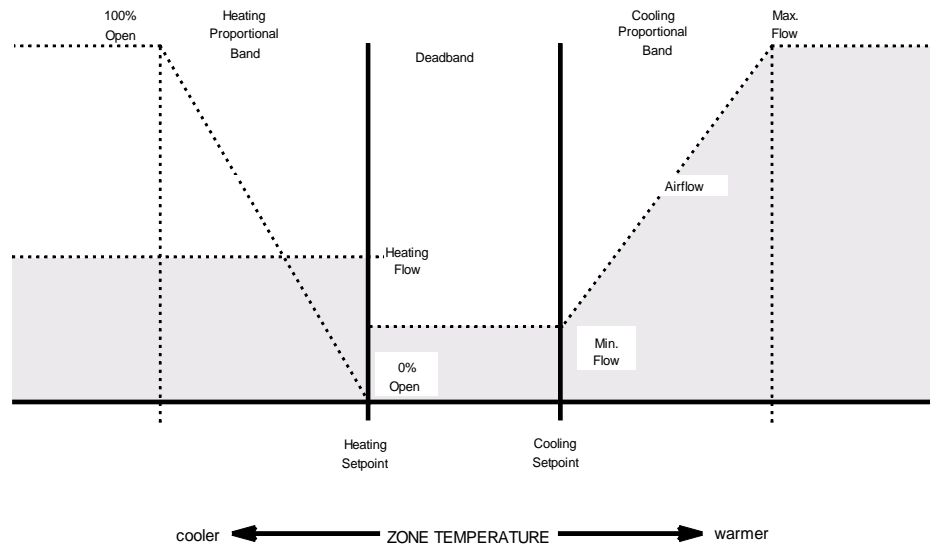
Figure 4-6: Cooling with Reheat

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;**HC**]. 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 **HC**. 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 *Cooling w/Reheat* option.	Set FE00;**BT** = 4
Set the temperature and flow setpoints as desired. Refer to and for instructions on configuring these setpoints.		

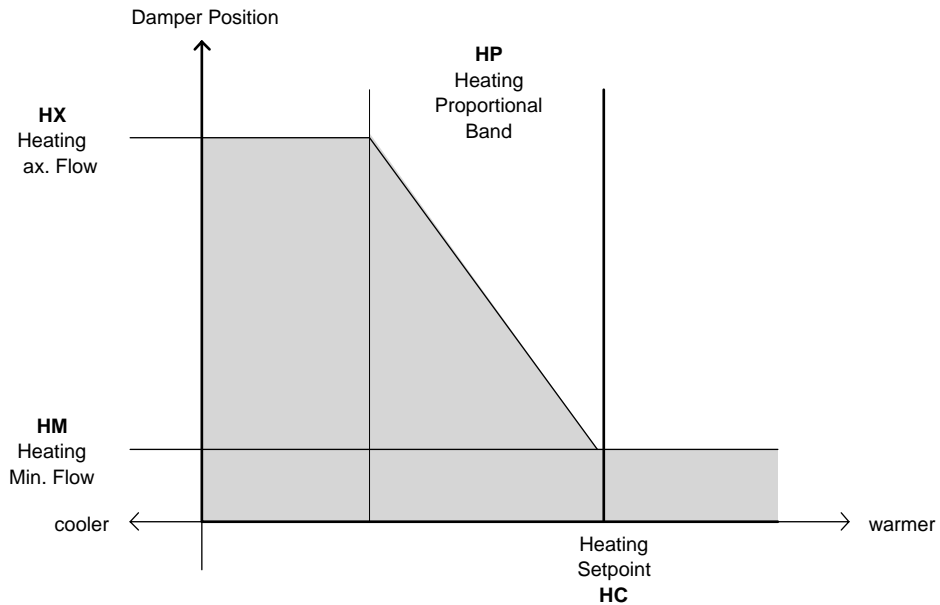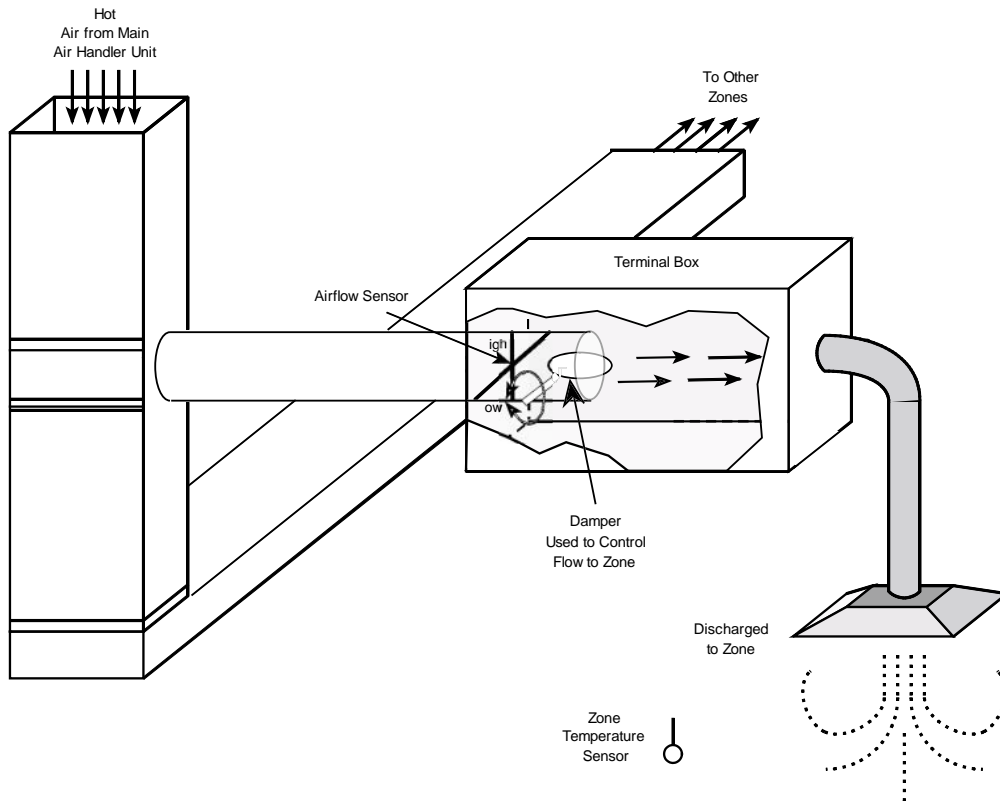*Table 4-18: Configuring the* SBC-*VAV for Cooling with Reheat Control*

Attribute Path for Graphical User Interface (GUI) Utility:**Attribute Name**	GUI Configuration Utility Setting	Channel Setting
Aux: Electric Reheat: **Reheat Mode**	Select the desired mode from the drop-down box: ▼ Disabled ▼ 2-Stage (TR2-TR3) ▼ 2-Stage (TR4-TR5) ▼ 4-Stage (TR2-TR5)	Set FA03;RO = the desired mode: ▼ Disabled = 0 ▼ 2-Stage (TR2-TR3) = 1 ▼ 2-Stage (TR4-TR5) = 2 ▼ 4-Stage (TR2-TR5) = 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.

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.

To configure the *SBC*-VAV for series fan applications, refer to Table 4-19.

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 *Series Fan* 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: *Always on*, or *Off in Deadband*	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;**HC**].

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

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.

The user-defined value in the Aux:Valve Control:**Valve Offset** [FA02; **VO**] attribute is added to the Temperature:Cooling Setpoints:**Current Setpoint** [FE00;**CC**] or subtracted from Temperature:Heating Setpoints:**Current Setpoint** [FE00;**HC**] 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 **HC**, 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** [FA02;**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.
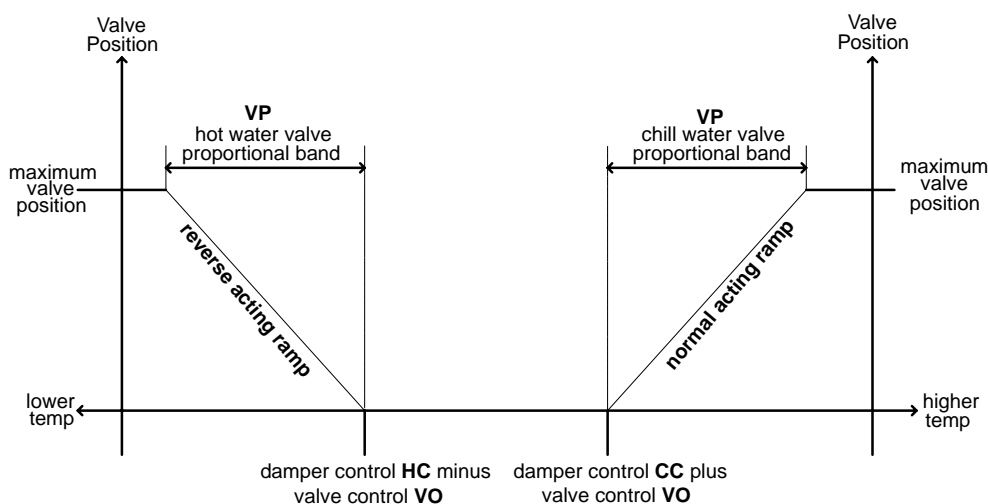
Figure 4-7: Valve Ramps

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: **Valve Mode**	Click on the radio button next to *Pulse Width Modulation*.	Set FA02;**VM** = 0.
Flow: Proof of Flow: **Proof of Flow**	Click on the radio button next to *No Flow*.	Set FA06;**PF** = 0.
Aux: Valve Control: **Valve Use**	Click on the radio button next to the desired control mode: *Disabled*, *Cooling*, or *Heating*.	Set FA02;**VU** to the desired control mode: ▼ 0 = Disabled ▼ 1 = Cooling ▼ 2 = Heating
Aux: Valve Control: **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 FA02;**PP** = the number of seconds the valve is to be pulsed on.

The Aux:Valve Control:**Valve Integration Constant** [FA02;**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 PULSE WIDTH MODULATED VALVE CONTROL
Follow the guidelines in Table 4-20 to configure the *SBC*-VAV for pulse width modulated valve control.

4.4.4.2 BASIC CONFIGURATION FOR FLOATING SETPOINT VALVE CONTROL
Follow the guidelines in 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: **Valve Mode**	Click on the radio button next to *Floating Point Motor Control*.	Set FA02;**VM** = 1.
Flow: Proof of Flow: **Proof of Flow**	Click on the radio button next to *No Flow*.	Set FA06;**PF** = 0.

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: **Valve Use**	Click on the radio button next to the desired control mode: *Disabled*, *Cooling*, or *Heating*.	Set FA02;**VU** to the desired control mode: ▼ 0 = Disabled ▼ 1 = Cooling ▼ 2 = Heating
Aux: Valve Control: **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 FA02;**PP** = 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 ALTERNATE CONTROL CONFIGURATION

This section is to be used as a guideline. For additional configuration information, contact American Auto-Matrix Technical Support.

SECTION 5: *SBC*-STAT MENUS

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 push-buttons. The following section describes the* SBC-*STAT setpoint adjustment and LED, and the* SBC-*STAT3 menus when connected to an* SBC-*VAV.*

5.1 TEMPERATURE DISPLAY

When connected to an *SBC*-VAV, an *SBC*-STAT3 has a room temperature display. This display shows 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.
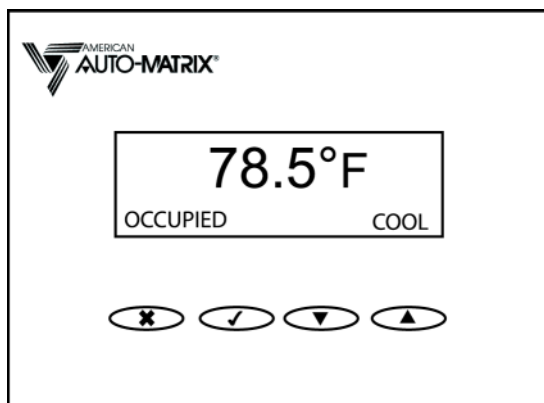
Figure 5-1: Room Temperature Display

5.2 SETPOINT ADJUSTMENT DISPLAY

When you press the up or down arrow push-button on the *SBC*-STAT3 a setpoint adjustment display appears and the LED blinks.
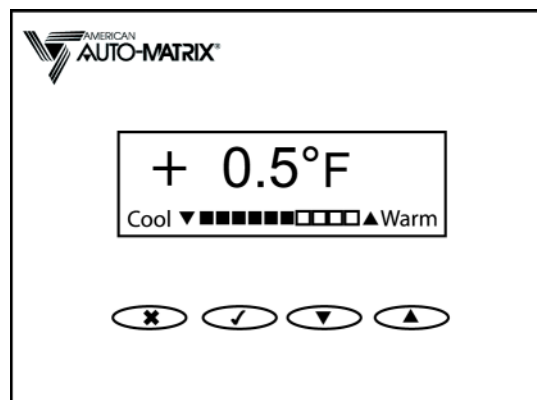
Figure 5-2: Setpoint Adjustment Display

5.2.1 *SBC*-STAT2

When the up or down arrow push-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 1 through 5 flashes. Each additional flash indicates a warmer setting. See Table 5-1: LED for more information on the blinking pattern for setpoint adjustment.

5.2.2 *SBC*-STAT2-D

When the up or down arrow push-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 five increments either side of zero. Refer to Table 5-1 for more information on the blinking pattern for setpoint adjustment.

Table 5-1: 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		
Occupied mode		solid green	solid green
Warm up		flashing green	flashing green
Night Setback		periodic yellow flash	periodic yellow flash
Unoccupied mode		periodic yellow flash	periodic yellow flash
Menus			solid yellow

5.2.3 *SBC*-STAT3

When the up or down arrow push-button is pressed, the current setpoint offset will be displayed on the graphical display. If the push-button is pressed again within 15 seconds, the setpoint will move one increment in the direction of the button pressed. The setpoint range is five increments either side of zero. The magnitude of the increment is programmed at installation.

5.3 LED

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

5.4 OVERRIDE MODE

The *SBC*-STAT2 and *SBC*-STAT2-D enter override through any keypress while in any mode. The LED will flash red once every six seconds. To cancel override mode hold down the up or down arrow push-button for five seconds or until the LED starts flashing. The LED will flash a minimum of ten times to confirm the cancellation. The *SBC*-STAT3 enters override mode through the User Menu (Select push-button). The user should highlight **Override** and press the Select push-button. A + icon appears indicating occupancy is fully extended. A ✔ indicates that occupancy is extended and that some time remains. In this case the user may choose to select **Override** to fully extend occupancy again. This mode must be enabled at installation using the Zone Temperature attribute **SE** and a timeout period (Zone Temperature attribute ED) through the PUP network.

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

5.5 MENU ACTIONS

When you enter a menu you can enable/ disable or set/edit a value. The following describes how to perform these actions.

5.5.1 ENABLE/DISABLE VALUE

The Damper Mode menu has options that allow you to enable/disable a value. After entering the menu, press the ✔ push-button to initiate an action or enable/disable a function. After you have selected the desired function press the ✘ push-button to exit and return to the previous menu.

Figure 5-3: User Menu

NOTE

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

5.5.2 SETTING VALUES

Options in the Calibrate and Setpoints menus allow values to be set. Selecting one of these options opens an Edit screen allowing you to use the ✔ push-button to move places to the right and the ▲ and ▼ push-buttons to change a value. Once you have entered a desired value, press ✔ to highlight **SET** and press ✔ once more to store the value and return to the previous menu. To exit the Edit screen without saving any changes, press ✘.

5.6 USER MENU

The *SBC*-STAT3 displays a menu system for the user to navigate through using the four push-buttons. The main menu is the User Menu. The User Menu can be reached by pressing the Select push-button (✔) while viewing the room temperature display.
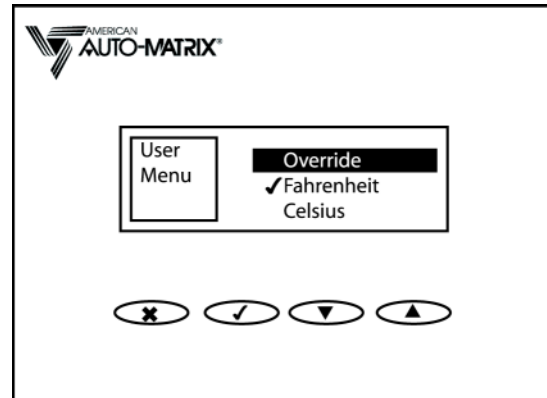
Once the user is in the menu they can press the up and down arrow push-buttons to highlight an entry. The entries are **Override**, degrees **Fahrenheit** and degrees **Celsius**. Press the Select push-button (✔) to initiate an action or enable/disable a function. Press the Escape push-button (✘) to exit and return to the previous menu.

5.7 INSTALL MENU

There are currently three options in the Install Menu. You may select **Ctrl Mon**, **LED Test** or **Reset**. To enter the Install Menu press the Escape and Up push-buttons (✘▲) simultaneously. A password prompt will appear. Enter your four digit password using the up and down arrow push-buttons to scroll through the numbers and Select (✔) to move each place to the right. Once you have selected the correct password press ✔ one more time to enter the Install Menu.

The Install Menu password opens access to all menus. The installer should control the access to other menus. The default passwords for each menu are as follows:

Install: 3300
Service: 1100
Balance: 2200

These passwords can be changed in **SoloPro for Windows** through the PUP network.
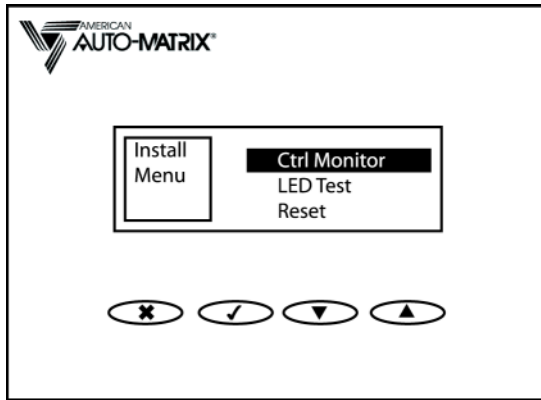
Figure 5-4: Install Menu

5.7.1 CONTROL MONITOR

The first menu option listed in the Install Menu is **Ctrl Monitor**. This option allows the monitoring of flow and temperature control operation.
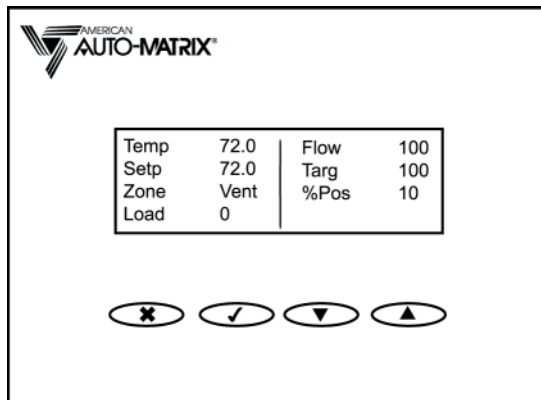
Figure 5-5: Control Monitor Screen
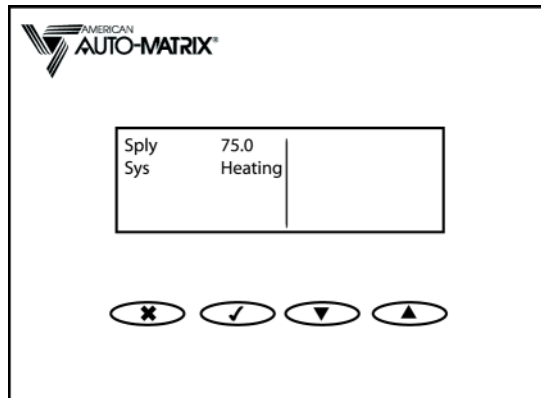
Figure 5-6: Control Monitor Screen

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

5.7.2 LED TEST

A temporary option under this menu is LED test. This allows you to toggle the LED modes. The modes are:
▼ Green
▼ Red
▼ Bright Red Flash
▼ Green Flash
▼ Slow Yellow Flash
▼ Yellow Flash
▼ Yellow

5.7.3 RESET

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

5.8 SERVICE MENU

To enter the Service Menu press the Escape and Down (✖▼) push-buttons simultaneously. A prompt for a password will appear. Enter your four digit password using the up and down arrow push-buttons to scroll through the numbers and Select (✔) 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. Once in the Service Menu you can scroll through, highlight and Select any option. See Figure 5-7 for a list of Service Menu options.
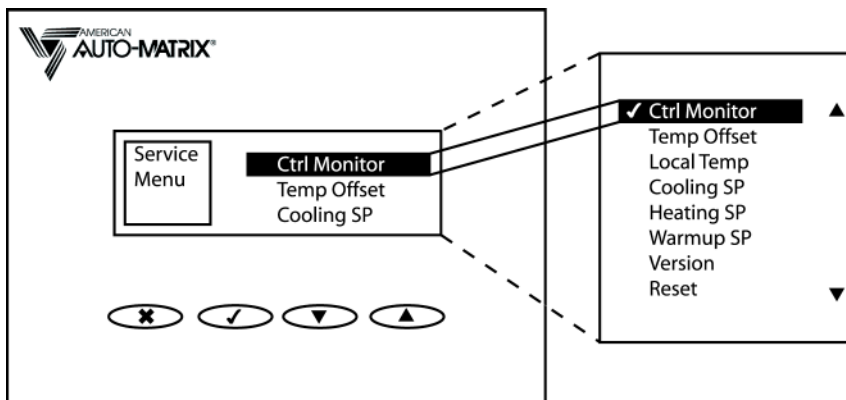
Figure 5-7: Service Menu

5.8.1 CONTROL MONITOR

This option allows the monitoring of flow and temperature control operation.

5.8.2 LOCAL TEMP

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

5.8.3 TEMP OFFSET, COOLING SP, HEATING SP, OR WARMUP SP

These options open an Edit screen allowing you to use the up and down arrow buttons to toggle between a negative (-) and positive (+) sign. Use the Select button to move places to the right and the up and down arrows to change a value. When you have entered a desired value, press ✔ to highlight SET and press ✔ once more to store the value and return to the Service Menu. To exit the Edit screen without saving any changes, press ✘.
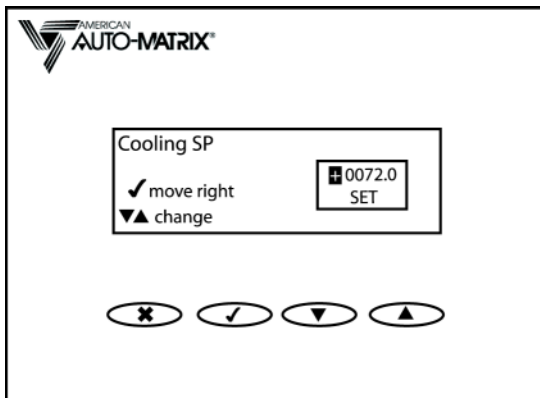
Figure 5-8: Cooling SP Screen

5.8.4 VERSION

This option displays the **Serial Number**, **Version Number**, **Release Code**, **Type**, **Controller Type**, **Unit ID**, **Thermostat Version**, and **Global ID** of your *SBC*-STAT.
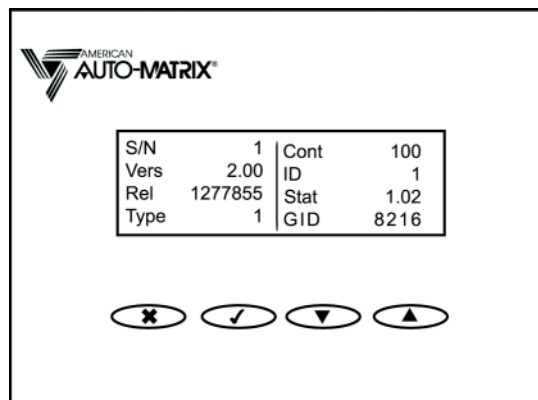
Figure 5-9: Version Screen

5.8.5 RESET

Selecting this item restarts the *SBC*-STAT and SBC Controller.

5.9 BALANCE MENU

The Balance Menu contains five main menus that allow you to monitor control operations, enable/disable an action or SET a new value.
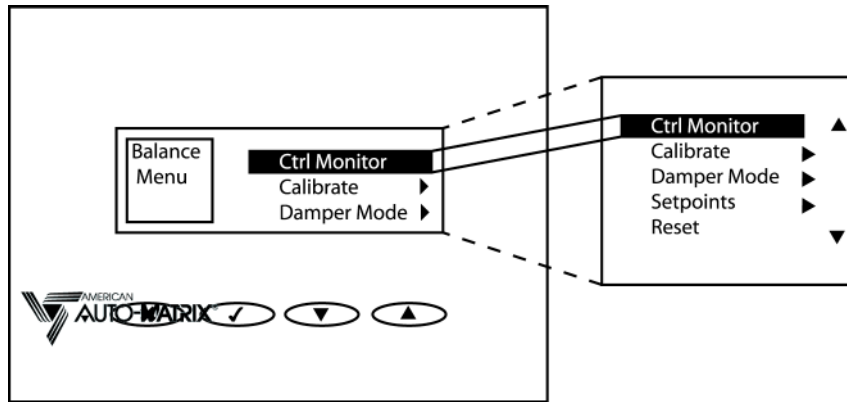
Figure 5-10: Balance Menu

To enter the Balance Menu, press the Escape and Select (✗✔) push-buttons simultaneously. A prompt for a password appears. Enter your four digit password using the up and down arrow buttons to scroll through the numbers and Select (✔) to move each place to the right. Once you have selected the correct password press ✔ one more time to enter the Balance Menu. The default password for this menu is 2200. Once in the Balance Menu you can scroll through, highlight and ✔ any option. See Figure 5-10 for a list of Balance Menu options.

5.9.1 CONTROL MONITOR

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

Figure 5-11: Control Montitor Menu

Figure 5-12: Control Monitor Menu

5.9.2 CALIBRATE

NOTE
Calibrate menu options are not available with the *SBC*-VAV3.

The following describes each of the Calibrate Menu options. All options are listed in Figure 5-13.
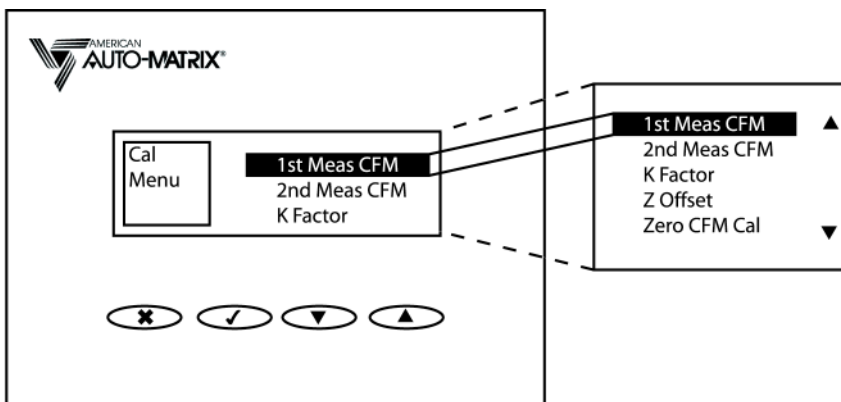
Figure 5-13: Calibration Menu

5.9.2.1 1ST AND 2ND MEASURED CFM

Here the measured airflow in CFM is entered during the calibration process. Single-point calibration uses 1st Measured CFM only. Multi-point calibration uses two 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.

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 ✔ appears next to the menu option. A ✔ 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.

5.9.2.2 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.

5.9.2.3 Z OFFSET

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

5.9.2.4 ZERO CFM CAL

Selecting this option opens a screen allowing you to press ✔ to initiate the Zero Offset calibration. This option is only used in single-point calibration. See steps 3 and 4 under the Single-Point Calibration procedure later in this section.

5.9.3 DAMPER MODE

This menu opens a submenu allowing you to enable or disable a Damper Mode. See **Enable/Disable** earlier in this section for more information on enabling/disabling a function.

NOTE
Only one mode can be selected at a time.
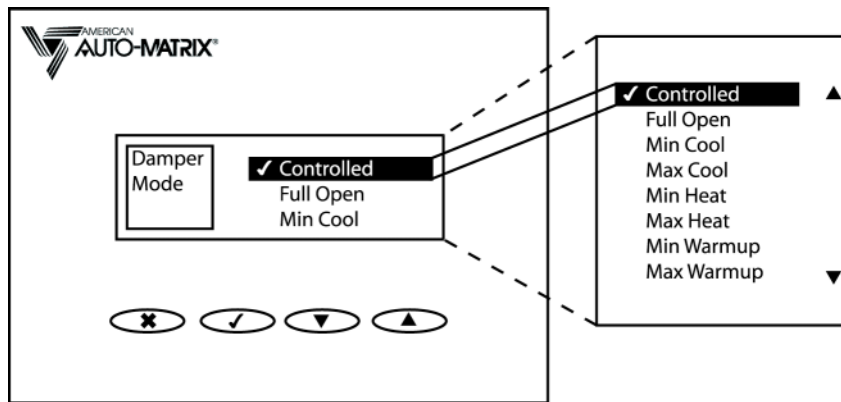
Figure 5-14: Damper Mode Menu
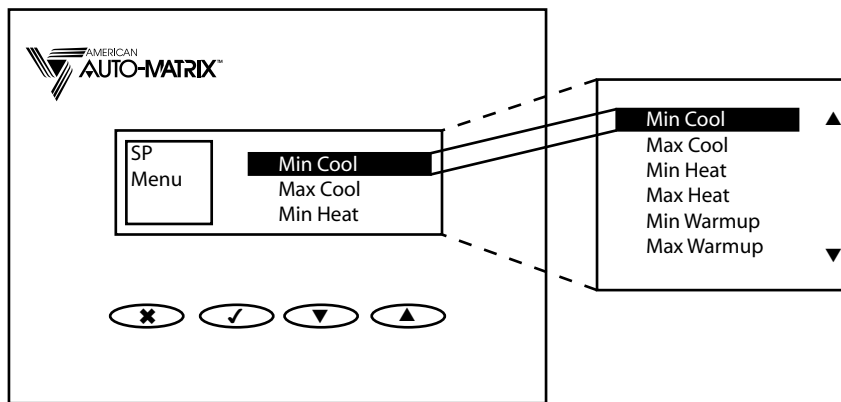
*Figure 5-15: **SP** Menu*

5.9.4 SETPOINTS

This menu opens a submenu that allows you to select an option and SET the setpoint for that option. See **Setting Values** earlier in this section to learn how to enter or edit a setpoint.

5.9.5 RESET

This Balance Menu option restarts the SBC Controller and the *SBC*-STAT3.

5.9.6 BALANCING PROCEDURES

There are two procedures that can be used to perform a field flow calibration. The single-point calibration procedure is consistent with previous VAV products and requires a zero-offset calibration step. The multi-point calibration procedure is new to the *SBC*-VAV and automatically determines the K Factor and the zero-offset without shutting down the air flow.

An alternate to using the *SBC*-STAT3 Balance Menu is **SoloPro for Windows** or another PUP network utility.

5.9.6.1 ZERO-OFFSET

1. Turn off fans and eliminate all air circulation through the duct. You may need to physically close the damper if there are static drafts. Alternatively, you may remove both hoses from the integral air flow sensor.

2. Initiate the sensor calibration.
3. Reconnect the hoses if they were removed.
4. Select **Z Offset** and record for future reference.

5.9.6.2 SINGLE-POINT CALIBRATION

1. Turn off fans and eliminate all air circulation through the duct.
2. Select **Ctrl Monitor** to check the current flow reading through the *SBC*-STAT3 Balance menu. The average/filtered flow is displayed next to **Flow**. With fans off, this should be a low number. Wait until the value stablilizes.
3. Press the **✖** push-button and Select **Zero CFM Cal** from the Calibration menu.
4. Press the **✔** push-button (Yes) to initiate the zero-offset calibration. Return to the **Ctrl Monitor** view to verify that flow is 0.
5. Select **Z Offset** and record for future reference.

Figure 5-17: Zero CFM Cal

1. Restart the air flow.
2. Select **Max Cool** from the Damper Mode menu. The VAV will attempt to establish the flow rate defined by **Max Cool SP**.
3. Return to the **Ctrl Monitor** view to verify that Target indicates cooling maximum flow setpoint. Wait until the Flow value stabilizes.

4. Measure the actual air flow in CFM using an external means.
5. Select **1st Measured CFM** from the Calibrate Menu. The numeric entry view appears. Enter the actual CFM reading you just measured.

Figure 5-16: Ctrl Monitor

NOTE

This should be done as soon as possible to insure the air flow has not changed.
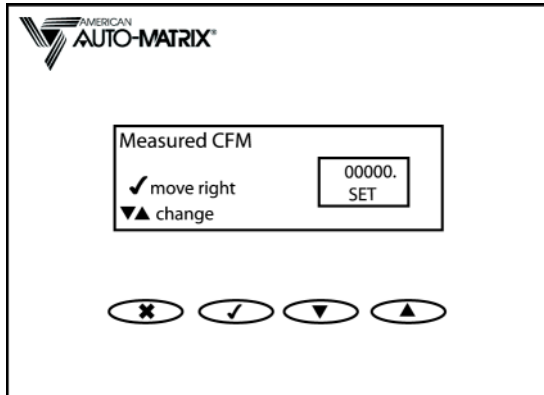
Figure 5-18: Measured CFM

1. Return to the **Ctrl Monitor** view and verify that the present Flow matches the Target flow to within acceptable tolerances.
2. Return to the Balance Menu and Select **Max Cool** or **Controlled** from the Damper Mode menu to disable the damper mode and to resume control.
3. Record the K factor for future reference. Select **K Factor** from the Balance Menu and note the value. Press the **✗** button to exit the K Factor view without altering the setting.
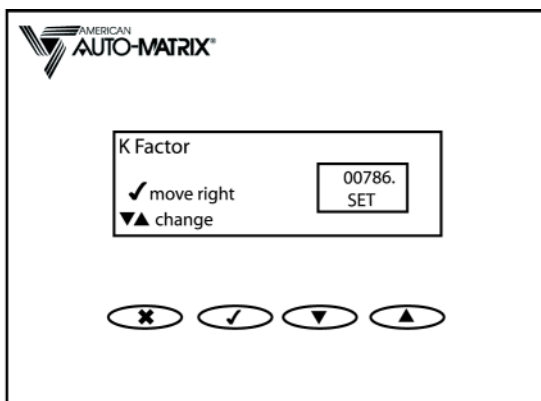
Figure 5-19: K Factor Menu

The calibration is complete and air flow readings should be accurate across the entire range.

NOTE

The zero-offset steps must be performed. This prepares the SBC Controller to receive the single CFM value and to calculate the K Factor as a result. If the zero-offset steps are not practical, perform the multi-point field flow calibration described next.

5.9.6.3 MULTI-POINT CALIBRATION

1. Select **Max Cool** in the Damper Mode menu. The VAV will attempt to establish the flow rate defined by Max Cool SP.
2. Select **Ctrl Monitor** from the Balance Menu and verify that Target indicates the Cooling maximum Flow setpoint. Wait until the Flow value stabilizes.

NOTE

This may not match the Target value at this point.

3. Measure the actual air flow in CFM using an external means.
    Select **1st Meas CFM** from the Calibrate Menu. The numeric entry view appears. Enter the actual CFM reading you just measured. Select **SET** to record this point.

NOTE

This should be done as soon as possible to insure the air flow has not changed.

NOTE

Min Cool and Max Cool setpoints must be at least 100 CFM apart.

4. Select **Min Cool** from the Damper Mode menu. The SBC Controller will attempt to establish the flow rate defined by Min Cool SP.
5. Measure the actual air flow in CFM using external means.
    Return to the Calibrate Menu and Select **2nd Meas CFM**. The numeric entry view appears. Enter the actual CFM reading you just measured. Select **SET** to record this point.

NOTE
This should be done as soon as possible to insure the air flow has not changed.

6. Return to the Damper Mode menu and Select **Min Cool** or **Controlled** to disable the forced damper mode and to resume control.
7. Record the K Factor for future reference. Select **K Factor** from the Balance Menu and note the value. Use the **X** push-button to exit the value display without altering the K Factor setting.
8. Select **Z Offset** and record Zero Offset for future reference.

The calibration is complete and air flow readings will be accurate across the entire range.

APPENDIX A: PUP CHANNELS AND ATTRIBUTES

The following tables contain a list of Public Unitary Protocol (PUP) attribute and channel assignments for the *SBC*-VAV.

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.

SYSTEM CHANNEL, FF00

FF00 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
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
SN	FE	R	EE factory set	System/ About	**Serial Number** displays the serial number of the *SBC*-VAV controller
CT	FE	R	Flash 100	System/ About	**Controller Type** factory-set controller type identifies the type of unitary controller
VE	FA	R	Flash 1.00	System/ About	**Version Number** contains the factory-set firmware version
FT	FE	R	Flash 1	System/ About	**Firmware Type** defines the class of firmware operating system used in this controller
SR	FE	R	Flash	System/ About	**Flash Release Code** uniquely defines each flash firmware image
CM	FE	R	Flash 255	System/ About	**Controller Manufacturer** contains the factory-set manufacturer number for the unitary controller
UP	FE	R	0	System/ Diagnostics	**Flash Update Count** increments each time a new flash firmware image is accepted by the controller.
IC	FE	R	0	System/ Diagnostics	**EEPROM Default Count** increments whenever the EEPROM is restored to factory default settings (see FF00;DE Default Enable)

FF00 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
RC	FE	R	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**.
WC	FE	R	0	System/ Diagnostics	**Watchdog Count** increments upon firmware failure but can also be advanced during the removal of power
CC	FE	RW	0	System/ Diagnostics	**Clock Fail Count** increments upon hardware failure but can also be advanced during the removal of power
OC	FE	RW	0	System/ Diagnostics	**Illegal Opcode Count** increments upon firmware failure but can also be advanced during the removal of power
ZP	FE	RW	0	System/ Diagnostics	**MMT Pulse Count** advances when MMT takes action to maintain the operation of the actuator
PD	FE	RW	EE 5	System/ Power-up	**Power On Delay** time delay in seconds (0ñ255) that must elapse after the *SBC*-VAV is reset before output control or alarm functions can begin: 0 = no delay, 1ñ255 = 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=warmup 2=occupied 3=night setback

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
DE	FE	RW	RAM	System/ Power-up	**Default Enable** this attribute is used to restore configuration settings to factory defaults
RS	FE	RW	RAM 0	System/ Power-up	**Reset** the *SBC*-VAV used to reset the *SBC*-VAV: 0 = disabled (default), 1 = reset the *SBC*-VAV
ID	FE	RW	EE SN	Network/ Configuration	**Unit Number** used to set a unique network address for each controller connected to a multidrop
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
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
TP	FE	RW	EE 0 Irresponsible Peers	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**).

FF00 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
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.
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.

ZONE TEMPERATURE CHANNEL, FE00

NOTE

The *SBC*-VAV3 does not have the following Zone Temperature Channel attributes: FE00;**TF**, **TE**, **RT**, and **ET**.

FE00 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
ZT	FD	RW (W if FE00; **OI** = 1)	RAM NA	Temperature/ Thermostat	**Zone Temperature** shows the current temperature value measured by the thermostat as adjusted by FE00;**OF**
OF	FD	RW	EE 0	Temperature/ Thermostat	**Temperature Correction** this defines the correction that is being applied to temperature readings
DM	FE	R	NA	Temperature/ Thermostat	**Zone Demand** indicates the demand for the zone
DL	FD	R	NA	Temperature/ Thermostat	**Demand Load** indicates the heating/ cooling demand of the zone in terms of the temperature separation from setpoints
BT	FE	RW	EE 1 cooling only	Temperature/ Thermostat	**Control Mode** this attribute specifies the type of VAV terminal box being used
OI	FE	RW	EE 0	Temperature/ Thermostat	**Override Temperature Value** when set to 1, it allows you to write to FE00;**ZT** directly
ZS	FD	RW	RAM 70.0	Temperature/ Setpoint Adjust	**Zone Midpoint** displays the midpoint between the current cooling and heating setpoints.
TS	FD	R	RAM 0	Temperature/ Setpoint Adjust	**User Setpoint Offset** this attribute defines an offset to be applied to PID setpoints

FE00 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
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
TT	FE	RW	EE 120 minutes	Temperature/ Setpoint Adjust	**User Setpoint Offset** the User Setpoint Offset (FE00;**TS**) is a a temporary setting; the FE00;**TT** attribute defines in minutes the duration for which the setting applies
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
SE	FE	RW	EE 1 enables	Temperature/ Override	**User Override** this attribute enables or disables your ability to enter extended occupancy override
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
AE	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
CC	FD	R	RAM NA	Temperature/ Cooling Setpoints	**Current Setpoint** this attribute shows the current cooling flow control setpoint

FE00 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
CS	FD	RW	EE 72.0	Temperature/ Cooling Setpoints	**Cooling Setpoint** shows the zone temperature setpoint desired to begin cooling control
SU	FD	RW	EE 5.0	Temperature/ Cooling Setpoints	**Unoccupied Setback** this attribute specifies, +/- degrees, the amount to be added to the cooling setpoint (FE00;**CS**) when the SBC-VAV schedule is in unoccupied mode
SB	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;**CS**) when the SBC-VAV is in night setback mode
HC	FD	R	RAM	Temperature/ Heating Setpoints	**Current Setpoint** this attribute shows the current heating flow control setpoint
HS	FD	RW	EE 68.0∘F	Temperature/ Heating Setpoints	**Heating Setpoint** this attribute shows the zone temperature setpoint desired to begin heating control
NU	FD	RW	EE 10.0∘F	Temperature/ Heating Setpoints	**Unoccupied Setback** specifies, in +/- degrees, the amount to be added to the heating setpoint (FE00;**HS**) when the SBC-VAV is in night setback mode
NB	FD	RW	EE 10.0∘F	Temperature/ Heating Setpoints	**Night Setback** this attribute specifies, in +/- degrees, the amount to be added to the heating setpoint (FE00;**HS**) when the *SBC*-VAV is in night setback mode
WS	FD	RW	EE 72.0∘F	Temperature/ Heating Setpoints	**Warm-up Setpoint** shows the zone temperature setpoint desired for beginning warm-up heating control
ST	FD	RW when FE00; **OS** = 1)	RAM NA	Temperature/ Supply	**Supply Temperature** shows the current value of source/duct temperature
SO	FD	RW	EE 0	Temperature/ Supply	**Supply Temperature Adjustment** defines an offset used to adjust FE00;**ST**

FE00 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
DD	FC	RW	EE 2.5∘F	Temperature/ Supply	**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
SM	FE	R	RAM NA	Temperature/ Supply	**Supply Mode** indicates that supply air is usable for heating or cooling
OS	FE	RW	EE 0	Temperature/ Supply	**Override Supply Temperature** when set to 1, this attribute allows the Supply Temperature (FE00;**ST**) to be altered manually
BM	FE	RW	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).
PU	FE	RW	EE 00000	Temperature/ Sensor Bus	**User P.I.N.** this personal identification number controls access to the User Menu
PB	FE	RW	EE 2200	Temperature/ Sensor Bus	**Balancer P.I.N.** this personal identification number controls access to the Balance Menu
PS	FE	RW	EE 1100	Temperature/ Sensor Bus	**Service P.I.N.** this personal identification number controls access to the Service Menu
PI	FE	RW	EE 3300	Temperature/ Sensor Bus	**Installer P.I.N.** this Personal Identification Number controls access to all menus.
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

FE00 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
DV	FE	RW	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
DF	RE	RW	EE 0 ##d	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.
T0	FD	R	NA	Temperature/ Sensor Bus	**Reading Device 0** is the raw reading for Device 1 on a SSB
T1	FD	R	NA	Temperature/ Sensor Bus	**Reading Device 1** is the raw reading for Device 2 on a SSB
T2	FD	R	NA	Temperature/ Sensor Bus	**Reading Device 2** is the raw reading for Device 3 on a SSB
T3	FD	R	NA	Temperature/ Sensor Bus	**Reading Device 3** is the raw reading for Device 4 on a SSB
G0	FE	R	NA	Temperature/ Sensor Bus	**GID Device 0** is the global identification for the SSB device
G1	FE	R	NA	Temperature/ Sensor Bus	**GID Device 1** is the global identification for the SSB device
G2	FE	R	NA	Temperature/ Sensor Bus	**GID Device 2** is the global identification for the SSB device
G3	FE	R	NA	Temperature/ Sensor Bus	**GID Device 3** is the global identification for the SSB device
TF	FE	R	*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. **FE00;TF is not available on the *SBC*-VAV3.**

FE00 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
TE	FE	R	*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. **FE00;TE is not available on the *SBC*-VAV3.**
RT	FE	RW	RAM 0	System/ Statistics	**Reset Totalization** used to reset **TF** and **TE** to 0, restarting the totalization process. **FE00;RT is not available on the *SBC*-VAV3.**
ET	FE	RW	EE 0	System/ Statistics	**Enable 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. **FE00;ET is not available on the *SBC*-VAV3.**

*1 Backed up daily at midnight to EEPROM or when FF00;BU is set to 1. The backed up values are restored when a reset or power up situation occurs.

ZONE TEMPERATURE ALARMS
CHANNEL, FE01

FE01 Attr.	Data Type	Access	Store & Value	SP for Windows Location	Description
CV	FD	RW	RAM NA	Temperature/ Alarms	**Current Value** shows the current value of the input
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
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
AS	FE	R	RAM 0	Temperature/ Alarms	**Alarm Status** shows the current alarm condition 0=normal 5=low limit 6=high limit 1-4 and 7-12 are unused
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 alarm 5=high limit alarm 6=low and high limit 1-3 and 7-12 are unused
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

UNIVERSAL INPUT 1 CHANNEL, FE04

FE04 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
CV	FD	RW	RAM NA	I/O Setup/ Input (UI1)	**Source Temperature** shows the current value of source/duct temperature
RE	FE	R	RAM NA	I/O Setup/ Input (UI1)	**Data Reliability** an analog input value is considered unreliable if it is out of range for the selected sensor type
ST	FE	RW	EE 7	I/O Setup/ Input (UI1)	**Sensor Type** selects one of the following input types: 0= digital 2= full scale, linear - 5VDC or 0-20mA scaled from MN to MX 3= 4ñ20mA liner scaled from MN to MX 7= -22.0 to 122.0°F thermistor 1,4,5 and 6 unused
DT	FE	RW	EE 253	I/O Setup/ Input (UI1)	**Data Type for Input** specifies the PUP data type for the input
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
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
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

FE04 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
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
AS	FE	R	RAM 0	I/O Setup/ Input (UI1)	**Alarm Status** shows the current alarm condition 0=normal 1=contact (0→1) 2=contact (1→0) 3=change of state 4=unused 5=low limit alarm 6=high limit alarm
AE	FE	RW	EE 0	I/O Setup/ Input (UI1)	**Alarm Enable** specifies the type of alarm checking to be done on the FE04;CV value 0=disabled 1= contact (0→1) 2=contact (1→0) 3=contact (1↔0) 4=low limit alarm 5=high limit alarm 6=low and high limit
SU	FD	RW	EE 0.0	I/O Setup/ Input (UI1)	**Amount of Setup/ Setback Alarm Limit** specifies the amount added to FE04;**HL** or subtracted from FE04;**LL** during unoccupied periods
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
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
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

ANALOG OUTPUT CHANNEL, FD01

FD01 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
CV	FC	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
MN	FC	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	FC	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
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**
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**
AM	FE	RW	EE 0	I/O Setup/ Output (AO1)	**Automatic/Manual Control** selects the control mode for the analog output

MOTION DETECTOR CHANNEL, FC00

FC00 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
IC	FE	RW	EE 0	Aux/ Motion Detector	**Motion Detector Enable** uses a nonzero value from UI1 to indicate motion
MS	FE	R	RAM NA	Aux/ Motion Detector	**Motion Detector Input Status** shows the status of the motion detector digital input
MD	FE	RW	EE 30	Aux/ Motion Detector	**Extended Occupancy Delay** sets the amount of time, in seconds, during which the motion detector must remain on before it will override the zone
MT	FE	RW	EE 10	Aux/ Motion Detector	**Extended Occupancy Duration** defines, in minutes, the length of time to override the zone whenever motion is detected
MR	FE	R	RAM NA	Aux/ Motion Detector	**Extended Occupancy Remaining** displays the time remaining for motion detector override

FAN DIGITAL OUTPUT CHANNEL (TR1), FB01

FB01 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
FO	FE	RW	EE 0	Aux/Fan	**Fan/Damper Options** used to configure the fan or 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 on During Unoccupied Mode** shows the status of the series fan during the unoccupied schedule state
FC	FC	RW	EE 2.0	Aux/Fan	**Fan Minimum Cycle Time** shows the minimum amount of time, in minutes, during which the fan output will stay energized or de-energized
CV	FE	RW	RAM NA	Aux/Fan	**Fan** defines the status of the fan output
OP	FE	RW	EE 0	I/O Setup/ Triac Outputs	**Output Polarity** allows you to change the polarity of the output
RH	FC	RW	*	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 s**pecifies a run time limit in hours for the 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.

DIGITAL OUTPUT CHANNEL (TR2-TR5), FB02-FB05

FB02 - FB05 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
CV	FE	RW	RAM NA	I/O Setup/ Triac Outputs	**Current Output Value** shows the current value for the analog output
OP	FE	RW	EE 0	I/O Setup/ Triac Outputs	**Output Polarity** allows you to change the polarity of the output
RH	FC	RW	*	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
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.

*Run hours are automatically backed up at midnight; restoration occurs when the unit is powered up after loss of power or after a reset.

FLOW CONTROL CHANNEL, FA00

FA00 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
KC	FE	RW		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. **FA00;KC is not available on the *SBC*-VAV3.**
K2	FE	RW		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. **FA00;K2 is not available on the *SBC*-VAV3.**
FC	FE	RW	RAM 0	Flow/Control	**Fan** controls the current status of the fan output
DM	FE	RW	EE 0	Flow/Control	**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	FE	RW	RAM 0	Flow/Control	**Calibrate Flow Sensor** allows a host or operator to manually calibrate the flow sensor. **FA00;CB is not available on the *SBC*-VAV3.**
OI	FE	RW	EE 0	Flow/Control	**Override Flow Measurement** allows a host or operator to manually set the value of the current flow. **FA00;OI is not available on the *SBC*-VAV3.**
DP	FE	R	RAM NA	Flow/Damper	**Damper Position** shows the damper position with an **optional** actuator having a built in feedback potentiometer
DD	FE	RW	EE 0	Flow/Damper	**Direction** used to set the direction of the damper motor

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NOTE

The *SBC*-VAV3 does not have the following Flow Control Channel attributes:
FA00;**CV**, **CA**, **FH**, **CK**, **KC**, **K2**, **CB**, **OI**, **DC**, and **AT**.

FA00 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
CV	FE	RW with OI=1	RAM NA	Flow/Control	**Current Value** shows the current measured amount of airflow in cfm. **FA00;CV is not available on the *SBC*-VAV3.**
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
CA	FE	R	RAM NA	Flow/Control	**Average Flow** shows the measured average flow in cfm. **FA00;CA is not available on the *SBC*-VAV3.**
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
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. **FA00;FH is not available on the *SBC*-VAV.**
CK	FE	RW	EE 786	Flow/Control	**Duct Scaling Factor** shows the scaling factor for the particular VAV box being used. **FA00;CK is not available on the *SBC*-VAV.**

FA00 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
EP	FE	R	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.
EF	FE	RW	700	Flow/ Damper	**Estimated Flow at Full Open** shows the estimated flow at full open in cfm.
DC	FE	RW	1	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**). **FA00;DC is not available on the *SBC-VAV3*.**
AT	FE	RW	EE 0	Flow/ Damper	**Actuator Type** defines the type and connection for the damper actuator. **FA00;AT is not available on the *SBC-VAV3*.**
AS	FE	R	RAM NA	Flow/ Damper	**Actuator Status** reports the status of the actuator as determined by the MMT
RZ	FE	R	EE 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

DAMPER CONTROL CHANNEL, FA01

FA01 Attr.	Data Type	Access	Store & Value	SP for Windows Location	Description
CM	FE	RW	EE 100	Flow/ Cooling	**Cooling Minimum Flow** shows the allowable minimum (cooling) duct flow
CX	FE	RW	EE 500	Flow/ Cooling	**Cooling Maximum Flow** shows the allowable maximum (cooling) duct flow
CP	FC	RW	EE 5.0∘F	Flow/ Cooling	**Cooling Proportional Band** specifies the offset from the calculated cooling control setpoint ;**CC** that determines the proportional band for damper control. The range for **CP** is 0 to 6553.5.
CI	FC	RW	EE 5.0%	Flow/ Cooling	**Cooling Integration Constant** shows the amount of proportional error history used to calculate the desired position for the cooling duct damper. The range for **CI** is 0 to 25.5.
HM	FE	RW	EE 100	Flow/ Heating	**Heating Minimum Flow** shows the allowable minimum heating duct flow during heating
HX	FE	RW	EE 500	Flow/ Heating	**Heating Maximum Flow** shows the allowable maximum heating duct flow during heating
HP	FC	RW	EE 5.0	Flow/ Heating	**Heating Proportional Band** specifies the offset from the calculated heating control setpoint that determines the proportional band for the heating duct damper control. The range for **HP** is 0 to 6553.5.
HI	FC	RW	EE 5.0%	Flow/ Heating	**Heating Integration Constant** shows the amount of proportional error history used to calculate the desired position for the heating duct damper. The range for **HI** is 0 to 25.5.
WM	FE	RW	EE 300	Flow/ Warmup	**Warm-up Minimum Flow** shows the allowable minimum heating duct flow during warm-up heating

FA01 Attr.	Data Type	Access	Store & Value	SP for Windows Location	Description
WX	FE	RW	EE 700	Flow/ Warmup	**Warm-up Maximum Flow** shows the allowable maximum heating duct flow during warm-up heating.
WP	FC	RW	EE 5.0∘F	Flow/ Warmup	**Warm-up Proportional Band** specifies the offset from the calculated heating control setpoint that determines the proportional band for the warm-up heating duct damper control. The range for **WP** is 0 to 6553.5.
WI	FC	RW	EE 10.0 %	Flow/ Warmup	**Warm-up Integration Constant** shows the amount of proportional error history used to calculate the desired position for the heating duct damper. The range for **WI** is 0 to 25.5.

VALVE CONTROL CHANNEL, FA02

FA02 Attr.	Data Type	Access	Store & Value	SP for Windows Location	Description
VU	FE	RW	EE 0	Aux/ Valve Control	**Valve Use** options are disabled, cooling and heating
VM	FE	RW	EE 0	Aux/ Valve Control	**Valve Mode** options are Pulse Width Modulation and Floating Point Motor Control
VA	FE	RW	RAM NA	Aux/ Valve Control	**Actual Valve Position** shows the actual valve position based on travel time.
VD	FE	RW	RAM NA	Aux/ Valve Control	**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
CR	FE	RW	EE 0	Aux/ Valve Control	**Water Valve Auto Creep Enabled** enables or disables the auto creep function
RI	FE	RW	EE 0	Aux/ Valve Control	**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.
VO	FC	RW	EE 0.0	Aux/ Valve Control	**Valve Options** used to configure the valve mode
VP	FC	RW	EE 5.0	Aux/ Valve Control	**Valve Proportional Band** specifies the input variable range over which the output is proportional to the error value
VI	FC	RW	EE 5.0	Aux/ Valve Control	**Valve Integration Constant** shows the amount of proportional error history used to calculate the desired position for the valve.
VT	FE	RW	EE 180	Aux/ Valve Control	**Valve Motor 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

FA02 Attr.	Data Type	Access	Store & Value	SP for Windows Location	Description
PP	FE	RW	EE 0	Aux/ Valve Control	**Pulse Width** shows the amount of time, in seconds, that the valve is to be pulsed ON when **PE** = 1 or pulse width modulation is enabled
CD	FE	RW	EE 0	Aux/ Valve Control	**Change Valve Direction** used to set the direction of the valve outputs
AM	FE	RW	EE 0	Aux/ Valve Control	**Auto/Manual Mode** selects the control mode for the valve output(s)

ELECTRIC REHEAT CHANNEL, FA03

FA03 Attr.	Data Type	Access	Store & Value	SP for Windows Location	Description
RO	FE	RW	EE 0	Aux/ Electric Reheat	**Reheat Options** used to configure the *SBC-VAVís* outputs for electric reheat 0 = 2 stage electric reheat (TR2 and 3) 2 = 2 stage electric reheat (TR4 and 5) 3 = 4 stage electric reheat (TR2,3,4 and 5)
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
AV	FE	R	RAM NA	Aux/ Electric Reheat	**Available Stages** displays the stages that are currently for use
MX	FC	RW	EE 105.0	Aux/ Electric Reheat	**Maximum Supply Temperature** establishes a maximum supply duct temperature above which the reheats will deenergize
EN	FE	R	RAM NA	Aux/ Electric Reheat	**Energized Stages** displays those reheat stages that are currently energized
AF	FE	RW	EE 1	Aux/ Electric Reheat	**Require Max Airflow** if set to ìYesî (FA03;AF = 1), this holds off the addition of reheat stages until the PID loop is calling for maximum airflow
BA	FE	RW	EE 0	Aux/ Electric Reheat	**Balance Stage Usage** if set to ìYesî (FA03;**BA** = 1), this attribute considers the Run Hour Totals (FB0x;**RH**) for the individual triac outputs in energizing reheat stages
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
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

ANALOG CONTROL CHANNEL, FA04

FA04 Attr.	Data Type	Access	Store & Value	SP for Windows Location	Description
SP	FD	RW	EE 0	Aux/PID Control	**Loop Setpoint** specifies the desired loop setpoint
CS	FD	R	RAM NA	Aux/PID Control	**Calculated Control Setpoint** shows the actual loop control setpoint
PO	FC	R	RAM NA	Aux/PID Control	**Percent Output Value** shows the output value in hundredths of a percent
AO	FC	RW	RAM NA	Aux/PID Control	**Analog Output Value** shows the scaled output value used by the analog output
IN	FD	R	RAM 0	Aux/PID Control	**Measured Variableís Value** displays the value of the input selected in FA04;**IC**
IC	FE	RW	EE 0	Aux/PID Control	**Loop Measured Variable** specifies the input to be used for the measured variable for the control loop 0= disabled 1=Zone Temp 2=Supply Temp 3=UI1 4=Flow 5=Zone Heating 6=Zone Cooling
MR	FD	RW	EE 0	Aux/PID Control	**Maximum Amount to Reset Setpoint** specifies the maximum amount by which to reset the loop setpoint (**SP**) when reset is being used
RC	FD	R	RAM NA	Aux/PID Control	**Reset Variableís Value** displays the value of the input selected in **RV**
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=UI1 4=Flow
RS	FD	RW	EE 0	Aux/PID Control	**Setpoint at Which Reset Action Begins** specifies the value at which the reset action begins

FA04 Attr.	Data Type	Access	Store & Value	SP for Windows Location	Description
RL	FD	RW	EE 0	Aux/PID Control	**Limit for Maximum Reset** specifies the value at which maximum reset is used
DB	FD	RW	EE 0	Aux/PID Control	**Dead band** specifies the input variable range over which the output value is proportional to the error value
PB	FD	RW	EE 0	Aux/PID Control	**Proportional Band** specifies the input variable range over which the output value is proportional to the error value
RP	FE	RW	EE 0	Aux/PID Control	**Reset Period** specifies the reset period (in seconds) over which the error history is accumulated
RT	FC	RW	EE 0	Aux/PID Control	**Derivative Rate** specifies a percentage of change in error that is to be used in calculating FA04;**PO**
SG	FE	RW	EE 0	Aux/PID Control	**Control Action** specifies the control action for the control loop
SU	FC	RW	EE 0	Aux/PID Control	**Unoccupied Setup/ Setback** specifies the amount to add (if **SG** = 0) or subtract (if **SG** = 1) from the setpoint during an unoccupied period
CE	FE	RW	EE 0	Aux/PID Control	**Enable Control Loop** enables the PID loop

FLOW ALARM CHANNEL, FA05

FA05 Attr.	Data Type	Access	Store & Value	SP for Windows Location	Description
SU	FE	RW	EE 0	Flow/ Alarms	**Amount to Setup/ Setback Alarm Limit** specifies the amount added to **HL** or subtracted from **LL** during unoccupied periods. **FA05;SU is not available on the** *SBC*-**VAV3.**

NOTE

The *SBC*-VAV3 does not have the following attributes:
FA05;**CV**, **LL**, **HL**, **HS**, **AS**, **AE**, and **SU**.

FA05 Attr.	Data Type	Access	Store & Value	SP for Windows Location	Description
CV	FE	R	RAM NA	Flow/ Alarms	**Current Value** shows the current measured amount of airflow in cfm. **FA05;CV is not available on the** *SBC*-**VAV3.**
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. **FA05;LL is not available on the** *SBC*-**VAV3.**
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. **FA05;HL is not available on the** *SBC*-**VAV3.**
HS	FE	RW	EE 0	Flow/ Alarms	**Alarm Limit Hysteresis** determines when the *SBC*-VAV returns from a high or low limit alarm. **FA05;HS is not available on the** *SBC*-**VAV3.**
AS	FE	R	RAM 0	Flow/ Alarms	**Alarm Status** shows the current alarm condition. **FA05;AS is not available on the** *SBC*-**VAV3.**
AE	FE	RW	EE 0	Flow/ Alarms	**Alarm Enable** specifies the type of alarm checking to be done on the **CV** value. **FA05;AE is not available on the** *SBC*-**VAV3.**

PROOF OF FLOW CHANNEL, FA06

NOTE

The *SBC*-VAV3 does not have the following Proof of Flow Channel attributes:
FA06;**MF**.

NOTE

Options for FA06;**DR** in the *SBC*-VAV3 are *None* and *Paddle Switch* only.

FA06 Attr.	Data Type	Access	Store & Value	SP for Windows Location	Description
PF	FE	R	RAM 0	Flow/ Proof of Flow	**Proof of Flow** shows the status of the proof of flow
DR	FE	RW	EE 1	Flow/ Proof of Flow	**Method** defines the requirements for proof of flow
MF	FE	RW	EE 75	Flow/ Proof of Flow	**Minimum Flow** the minimum flow reading required in order to indicate positive flow. FA06;**MF** is not available on the *SBC*-VAV3
PD	FE	RW	EE 60	Flow/ Proof of Flow	**Proof of Flow Delay** shows the amount of time, in seconds, imposed before enabling a positive flow indication

MAIN SCHEDULE CHANNEL, F900

F900 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
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)
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.
DA	FE	RW	RAM NA	Schedules /Clock/ Calendar	**Day of the Week** specifies the current day of the week as a number from 0ñ7; 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
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
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**

F900 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
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**
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 Bits #6 and #7 are unused
HE	FE	RW	EE 0	Schedules /Summary	**Host Schedule Override Enable** specifies whether the *SBC*-VAV will operate from its local schedules or from a host on the network: 0 = **CV** is set by schedules F901ñ F906, 1 = **CV** is set by **HO** (**ZE** must = 0)
HO	FE	RW	RAM 0	Schedules /Summary	**Host Schedule Override** specifies the desired schedule override state of the SBC-VAV when **HE** = 1: 0 = unoccupied 1 = warm-up 2= occupied 3 = night setback
ZE	FE	RW	EE 0	Schedules /Summary	**Zone Schedule Enable** 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
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)

SCHEDULE 1 THROUGH SCHEDULE 6
CHANNEL, F901-F906

F901 - F906 Attr.	Data Type	Access	Store & Default	SP for Windows Location	Description
CV	FE	R	RAM NA	Schedules/1-6	**Current Schedule Value** indicates the current state of the schedule: 0 = unoccupied mode, 1 = warm-up, 2 = occupied mode, 3 = night setback
WO	E6	RW	EE 08:00	Schedules/1-6	**Warm-up Time** start time in short military format when warm-up mode 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
NS	E6	RW	EE 08:00	Schedules/1-6	**Night Setback** start time in short military format when night setback should begin
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

NETWORK BROADCAST 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

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)	±XXXXXXXXX.	signed 10 digit
FEh (254)	XXXXXXXXX.	unsigned 10 digit
FDh (253)	±XXXXXXXX.X	signed 9.1 digit
FCh (252)	XXXXXXXX.X	unsigned 9.1 digit
FBh (251)	±XXXXXXX.XX	signed 8.2 digit
FAh (250)	XXXXXXX.XX	unsigned 8.2 digit
F9h (249)	±XXXXXX.XXX	signed 7.3 digit
F8h (248)	XXXXXX.XXX	unsigned 7.3 digit
F7h (247)	±XXXXX.XXXX	signed 6.4 digit
F6h (246)	XXXXX.XXXX	unsigned 6.4 digit
F5h (245)	±XXXX.XXXXX	signed 5.5 digit
F4h (244)	XXXX.XXXXX	unsigned 5.5 digit
F3h (243)	±XXX.XXXXXX	signed 4.6 digit
F2h (242)	XXX.XXXXXX	unsigned 4.6 digit
F1h (241)	±XX.XXXXXXX	signed 3.7 digit
F0h (240)	XX.XXXXXXX	unsigned 3.7 digit
EFh (239)	±X.XXXXXXXX	signed 2.8 digit
EEh (238)	X.XXXXXXXX	unsigned 2.8 digit
EDh (237)	±X.XXXXXXXXX	signed 1.9 digit
ECh (236)	X.XXXXXXXXX	unsigned 1.9 digit
EBh (235)	±.XXXXXXXXX	signed .10 digit
EAh (234)	.XXXXXXXXX	unsigned .10 digit
E9h (233)	channel map	one bit per channel
E8h (232)	bitmap of text	one bit per text field
E7h (231)	BCD (H/S/M)	hours is LSB

Code	Digit Format	Meaning
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	