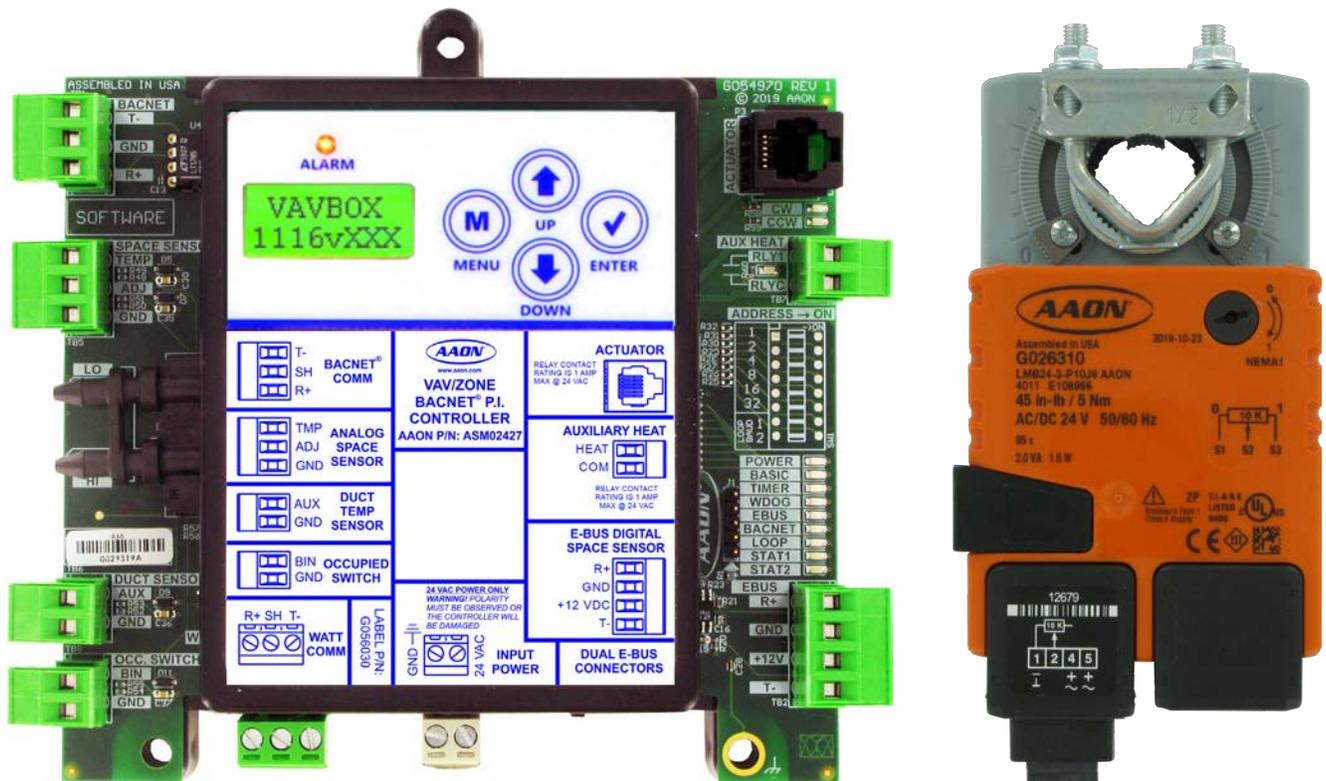




VAV/Zone BACnet® Controller Package Technical Guide

Pressure Independent Controller Code: DT005335-001/SS1116
Pressure Dependent Controller Code: DT006304-001/SS1146



VAVZB CONTROLLER TECHNICAL GUIDE

REVISION & DATE	CHANGE
Rev. 01B, October 19, 2020	VAVZB P.I. and P.D. Round Damper part numbers updated, page 7
Rev. 01B, October 19, 2020	Updated voltage and environment requirements, Table 1, page 14 - updated voltage requirements in Figures 8, 9 & 10 on pages 16. 17 & 20 and Figures 21-23 on pages 50-52
Rev. 01B, February 2, 2021	Updated Thermistor Sensor testing tables. pages 39-40. Updated environment requirements, Table 1.
Rev. C December 21, 2022	Updated Modulating (Proportional) Heat, pages 28 and 30



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OVERVIEW.....	4
Features and Applications.....	4
Parts and Descriptions.....	5
VAV/Zone BACnet® Controller, Actuator, and Expansion Module Dimensions.....	10
Slaved Zone Damper Kit Dimensions.....	11
Rectangular Damper Kit Dimensions.....	11
Round Damper Kit Dimensions.....	12
INSTALLATION AND WIRING.....	13
Mounting and Installation.....	13
Important Wiring Considerations.....	14
Wiring Checks.....	15
Controller Addressing.....	15
Powering Up.....	15
Device Transformer Sizing.....	16
VAV/Zone BACnet® Controller Communications Wiring.....	17
VAV/Zone BACnet® Controller Inputs and Outputs.....	18
Expansion Module Outputs.....	19
VAV/Zone BACnet® Controller Package Wiring.....	20
Expansion Module Wiring.....	21
Slaved Zone Wiring.....	24
START-UP AND COMMISSIONING.....	25
Initialization.....	25
Operator Interfaces.....	25
Configuring the VAV/Zone Controller.....	25
SEQUENCE OF OPERATION.....	26
Scheduling, Operation Modes, and Damper Positions.....	26
Occupied Mode.....	27
Unoccupied Mode.....	29
Damper Control.....	31
Zoning.....	32
Alarms.....	33
Tenant Override Logs.....	33
Trend Logs.....	34
Force Modes or Overrides.....	34
TROUBLESHOOTING.....	35
LED Troubleshooting.....	35
Other Checks.....	36
Temperature Sensor Testing.....	38
APPENDIX A - VAV/ZONE BACnet® CONTROLLER LCD DISPLAY SCREENS.....	41
APPENDIX B - BACnet® MS/TP CONNECTION TO NETWORK & BACnet® PARAMETERS.....	45
APPENDIX C - VAV/ZONE BACnet® CONTROLLER SYSTEM ARCHITECTURE.....	50
Single Loop VAV/Zoning.....	50
Multiple Loop VAV/Zoning.....	50
Networked Single Loop System with MLPD5.....	51
Networked Single Loop System with MLPD5 and CommLink 5.....	52
Networked Multiple Loop System.....	53
INDEX.....	54

OVERVIEW

VAV/Zone BACnet® Controller Package Features

VAV/Zone BACnet® Controller Overview

The ASM02427 VAV/Zone BACnet® Controller (VAVZB) is designed for Pressure Independent VAV Box and Zone Damper applications. It is supplied with an integral Airflow Sensor and is mounted in a plastic enclosure.

The ASM02426 VAV/Zone BACnet® Controller (VAVZB) is designed for Pressure Dependent VAV Box and Zone Damper applications and is mounted in a plastic enclosure.

The VAVZB utilizes terminal block connections for wiring. The 24 VAC power is supplied from a transformer (by others) wired to the VAVZB using standard stranded wire and 2 position terminal blocks. The communications wiring is connected between the other VAVZBs, Comm-Link 5, MiniLink PD5, HVAC unit controller or other controllers on the local loop by using 2 conductor 18 gauge twisted pair with shield wire which is connected to the VAVZB via a standard 3 position terminal block.

The VAVZB has an on-board BACnet® port for connection to an MS/TP network. The Controller contains a 2 x 8 LCD character display and 4 buttons that allow for status and alarm display, unit address setting, and BACnet® configuration.

The VAVZB is designed for use with a Zone Damper Actuator. The VAVZB connects to the actuator via the modular cable that is included with the actuator.

The VAVZB can use a Standard Room Temperature Sensor wired to the provided 3 position terminal block or an E-BUS Digital Room Sensor connected via the integral E-BUS cable connector or to the provided 4 position terminal block. The VAVZB also has a 2 position terminal block for wiring a Discharge Temperature Sensor, if desired.

A relay output on the VAVZB provides for one stage of electric heat or an On/Off Hot Water Valve if the controlled terminal unit is not a fan terminal unit.

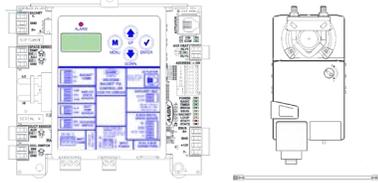
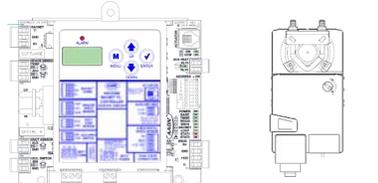
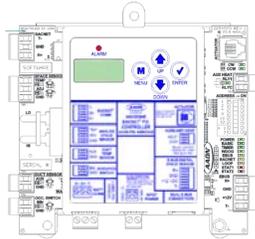
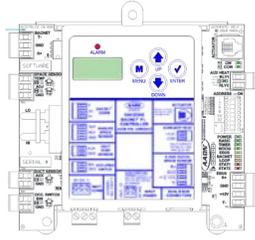
An optional Expansion Module is available for applications using fan terminals and/or more than 1 stage of electric heat, SCR electric heat, or modulating HW heat. The Expansion Module connects to the VAV/Zone Controller by means of a prefabricated E-BUS cable.

VAV/Zone BACnet® Controller Packages

The Pressure Independent VAVZB Package includes the VAVZB, the Zone Damper Actuator with cable, and an Airflow Sensor.

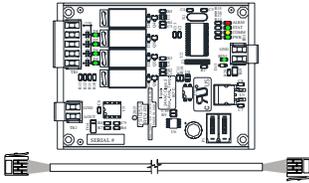
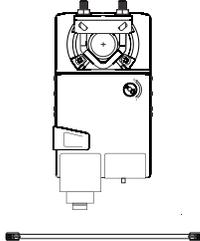
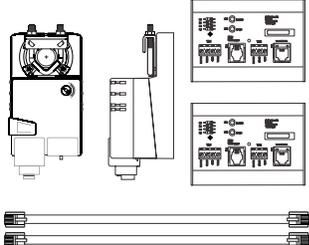
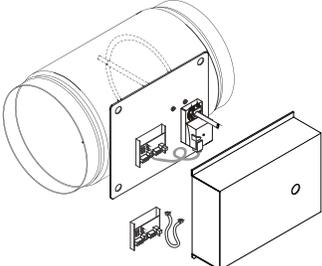
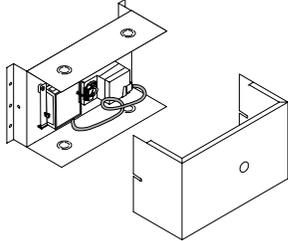
The Pressure Dependent VAVZB Package includes the VAVZB and the Zone Damper Actuator with cable.

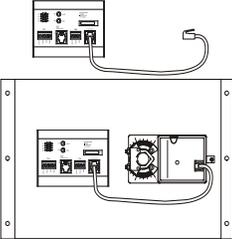
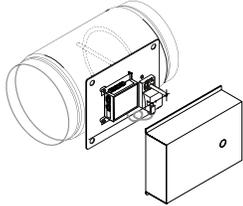
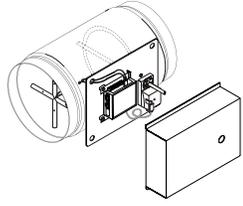
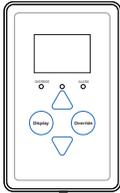
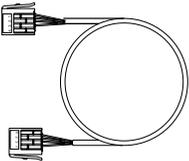
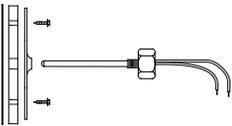
The VAVZB packages are factory-mounted on AAON Controls Zone Dampers. Detailed mounting and installation instructions are provided with each VAVZB package.

PART NO.	PART DESCRIPTION	ILLUSTRATION	PAGE NO.
ASM02661	<p>Pressure Dependent VAV/Zone BACnet® Controller Package with Terminal Blocks</p> <p>Includes: Pressure Dependent VAV/Zone BACnet® Controller with terminal blocks and Zone Damper Actuator with an 18-inch modular cable.</p> <p>The Pressure Dependent VAV/Zone BACnet® Controller with terminal blocks is designed for pressure dependent VAV Box and Zone Damper applications and is mounted in a plastic enclosure. One stage of Auxiliary Heat is provided on the controller.</p> <p>The VAV/Zone Controller Expansion Module (sold separately) is also available for applications using fan terminals and/or more than 1 stage of electric heat, SCR electric heat, or modulating HW heat.</p>		<p>Pages 10, 17, 20</p>
ASM02662	<p>Pressure Independent VAV/Zone BACnet® Controller Package with Terminal Blocks</p> <p>Includes: Pressure Independent VAV/Zone BACnet® Controller with terminal blocks and airflow sensor and Zone Damper Actuator with an 18-inch modular cable.</p> <p>The Pressure Independent VAV/Zone BACnet® Controller with terminal blocks is designed for pressure independent VAV Box and Zone Damper applications. It is supplied with an integral Airflow Sensor and is mounted in a plastic enclosure. One stage of Auxiliary Heat is provided on the controller.</p> <p>The VAV/Zone Controller Expansion Module (sold separately) is also available for applications using fan terminals and/or more than 1 stage of electric heat, SCR electric heat, or modulating HW heat.</p>		<p>Pages 10, 17, 20</p>
ASM02426	<p>Pressure Dependent VAV/Zone BACnet® Controller with Terminal Blocks</p> <p>Includes: Pressure Dependent VAV/Zone BACnet® Controller with terminal blocks mounted in a plastic enclosure.</p>		<p>Pages 10, 17, 20</p>
ASM02427	<p>Pressure Independent VAV/Zone BACnet® Controller with Terminal Blocks</p> <p>Includes: Pressure Independent VAV/Zone BACnet® Controller with terminal blocks and airflow sensor mounted in a plastic enclosure.</p>		<p>Pages 10, 17, 20</p>

OVERVIEW

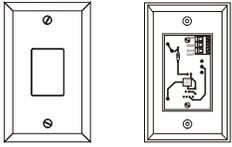
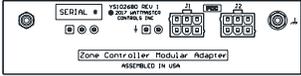
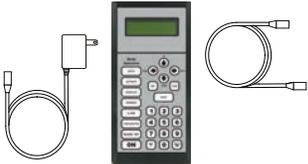
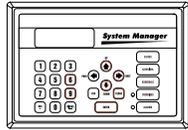
Parts and Descriptions

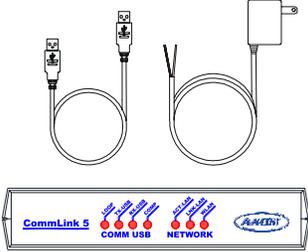
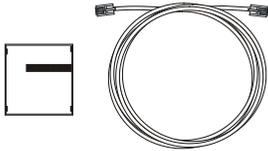
PART NO.	PART DESCRIPTION	ILLUSTRATION	PAGE NO.
ASM01629	<p>VAV/Zone Controller Expansion Module</p> <p>Includes: Expansion Module and 3 foot E-BUS modular cable. The Expansion Module is used in conjunction with the VAV/Zone BACnet® Controller and the VAV/Zone BACnet® Controller Packages and allows Fan & Heat control of terminal units, including series and parallel fan terminal units with up to 3 stages of electric heat, SCR electric heat, or modulating hot water heat. Provides 4 relay outputs for pilot duty switching control (1 fan, 2 heat, and 1 auxiliary heat), and 1 Analog output for control of a 0-10V modulating hot water valve or SCR controlled electric heating coil.</p>		<p>Pages 10, 20-23</p>
ASM01846	<p>Zone Damper Actuator</p> <p>Includes: Zone Damper Actuator & 18-inch modular cable only. The Zone Damper Actuator is used to provide control of air volume dampers in a VAV or Zoning system. The Actuator is a shaft mounted, floating point control actuator with an included phone jack cable. Actuators are 24VAC/24VDC with a 10K Ohm feedback signal for position monitoring. Wiring connection to the actuator is by means of a modular phone cable connector located on the actuator cover.</p>		<p>Pages 10, 20</p>
ASM01851	<p>Slaved Zone Damper Kit</p> <p>Includes: Zone Damper Actuator, (2) Slave Wiring Interface Boards & modular cables for controller to actuator connection. Used when a terminal unit is to be slaved with another VAV/Zone Damper.</p>		<p>Pages 11, 24</p>
<p>ASM01932 (6") ASM01933 (8") ASM01934 (10") ASM01935 (12") ASM01936 (14") ASM01937 (16")</p>	<p>Pressure Dependent Round Slaved Zone Damper Assembly</p> <p>Includes: Damper Actuator, Slave Interface Card, modular cables for controller to interface card connection, and Interface card to actuator connection, mounted in a sheet metal control enclosure on a Round Damper Assembly. Also includes a second Slave Interface Card and modular cables shipped loose for field connection to master zone controller.</p>		<p>«</p>
ASM01944	<p>Pressure Dependent Rectangular Damper Kit with Terminal Blocks</p> <p>The Rectangular Damper Kit comes packaged with the Pressure Dependent VAV/Zone BACnet® Controller Package already mounted in a metal enclosure.</p> <p>The Rectangular Damper Kit is used in conjunction with rectangular dampers for applications where rectangular dampers are specified or required because of space limitations or job requirements. The rectangular dampers may be purchased from AAON or you may get them from the supplier of your choice. For proper control, AAON recommends the use of low leakage opposed blade dampers.</p>		<p>Page 11</p>

PART NO.	PART DESCRIPTION	ILLUSTRATION	PAGE NO.
ASM02252	<p>Slaved VAV/Zone Rectangular Damper Kit</p> <p>Includes: Damper Actuator and (1) Bypass Wiring Interface Board mounted in a sheet metal enclosure. Also includes (1) Slave Wiring Interface Board shipped loose for connection to VAV/Zone Rectangular Damper Kit. Also includes (2) modular cables for controller to actuator connection. Used when a Rectangular Damper is to be used as a Slaved VAV/Zone Damper. Enclosure cover not shown.</p>		N/A
ASM02605 (6") ASM02606 (8") ASM02607 (10") ASM02608 (12") ASM02609 (14") ASM02610 (16")	<p>Pressure Dependent BACnet® Round Damper with Terminal Blocks</p> <p>The Round Pressure Dependent Zone Damper Assembly with terminal block connectors consists of a round air damper and the Pressure Dependent VAV/Zone BACnet® Controller Package with terminal block wiring connectors. An optional Expansion Module is available for control of reheat, auxiliary heat and/or control of series or parallel flow fan terminal units.</p>		Page 12
ASM02611 (6") ASM02612 (8") ASM02613 (10") ASM02614 (12") ASM02615 (14") ASM02616 (16")	<p>Pressure Independent BACnet® Round Damper with Terminal Blocks</p> <p>The Round Pressure Independent Zone Damper Assembly with terminal block connectors consists of a round air damper with airflow pickup cross and the Pressure Independent VAV/Zone BACnet® Controller Package (including air flow sensor) with terminal block connectors. An optional Expansion Module is available for control of reheat, auxiliary heat and/or control of series or parallel flow fan terminal units.</p>		Page 12
ASM01819	<p>E-BUS Digital Room Sensor</p> <p>The E-BUS Digital Room Sensor's LCD display and keypad allow for setpoint adjustment, override, and display of certain status and setpoints. The Sensor is used with the VAV/Zone BACnet® Controller for room air temperature sensing applications. Typically hard wired to the VAV/Zone BACnet® Controller or can use the optional EBC E-BUS cables.</p>		Page 20
G029440 (1.5 Ft) G012870 (3 Ft) G029460 (10 Ft) G045270 (25 Ft) G029510 (50 Ft) G029530 (75 Ft) G029450 (100 Ft) G029470 (150 Ft) V36590 (250 Ft)	<p>EBC E-BUS Cable Assembly (Optional)</p> <p>Includes: EBC E-BUS Cable Assembly. The EBC E-BUS Cables can be used to connect the E-BUS Digital Room Sensor to the VAV/Zone BACnet® Controller if desired. Otherwise, the sensor can be hard-wired to the VAV/Zone BACnet® Controller. Different lengths can be joined together using an E-BUS adapter hub. The EBC E-BUS Cables are available in 1.5, 3, 10, 25, 50, 75, 100, 150 & 250 foot lengths.</p>		Page 20
G051240 (6") G051250 (12")	<p>Duct Temperature Sensor - 6" Probe Duct Temperature Sensor - 12" Probe</p> <p>Used for return or supply air temperature sensing applications. Includes: 10k Ohm Duct Temperature Sensor, 2 wire only.</p>		Page 20

OVERVIEW

Parts and Descriptions

PART NO.	PART DESCRIPTION	ILLUSTRATION	PAGE NO.
ASM02227 ASM01638 ASM01642 ASM01643	<p>Standard Room Sensor - Plain, w/Override, w/Slide Adjust, w/Override & Slide Adjust</p> <p>For wall mounting. Connects to the VAV/Zone BACnet® Controller using wiring terminals.</p> <ul style="list-style-type: none"> ASM02227 - Plain ASM01638 - with Override Button ASM01642 - with Slide Adjust ASM01643 - with Override Button & Slide Adjust 		<p>Page 20</p>
ASM02188	<p>VAV/Zone Controller Power/Comm Cable (PCC) Modular Adapter</p> <p>Includes: Modular Adapter. The PCC modular cabling is not included. The VAV/Zone Controller Modular Adapter is used to provide two Modular PCC connections to the VAV/Zone BACnet® Controllers and the VAV/Zone BACnet® Controller Packages so that these controllers can be used with PCC cables.</p> <p>The VAV/Zone Controller Modular Adapter is only available as a field-installable kit. It plugs into the 3 pin Comm connector, and the 2 pin 24VAC power connector that is on the VAV/Zone BACnet® Controller.</p>		<p>N/A</p>
ASM01900	<p>System Manager Touch Screen - Limited Access</p> <p>The System Manager Touch Screen - Limited Access (SMTS-L) provides a direct, graphic-enhanced, menu-driven link. The SMTS-L is an end-user interface only and allows the end user to view status points, change Space Setpoints, and view certain alarms of most controllers on the Orion Controls System. The SMTS-L is equipped with a 4.3" 480 x 272 WQVGA RGB TFT LCD Touch Screen Display. The System Manager TS-L is furnished with hardware for flush mounting into hollow drywall or surface mounting on concrete brick or plaster surfaces. Includes: SMTS-L with 12 ft. long pigtail cable assembly.</p>		<p>See the SMTS-L Technical Guide</p>
ASM01895	<p>Modular Service Tool SD</p> <p>Includes: Modular Service Tool, power supply, communication cables, 4 Gigabyte SD card, and (4) AA batteries. Used to program and monitor all Orion controllers.</p>		<p>See the Unit Controller Operator Interfaces SD Technical Guide</p>
ASM01901	<p>Modular System Manager SD</p> <p>Includes: Modular System Manager SD with 4 Gigabyte SD card and 12 ft. long pigtail cable assembly. Used to program and monitor all Orion controllers. Designed for hollow core wall mounting.</p>		<p>See the Unit Controller Operator Interfaces SD Technical Guide</p>

PART NO.	PART DESCRIPTION	ILLUSTRATION	PAGE NO.
<p>ASM01874</p>	<p>CommLink 5 Communications Interface</p> <p>The CommLink 5 connects to your control system using a USB computer connection to provide direct on-site communications with the control system from a computer with the Prism 2 software installed. For remote communications, see the IP Module Kit.</p> <p>Includes: CommLink 5, 6 ft. long USB cable, and 120/24 VAC power supply. Required on all networked systems or if direct computer or remote computer connection is required. Connects to your computer's USB 1.1 or 2.1 port. Prism 2 computer software must be installed on the direct connected or remote connected computer in order to communicate with your system.</p>		<p>See the <i>CommLink 5 Technical Guide</i></p>
<p>ASM01902</p>	<p>IP Module Kit - Internet/LAN Connection</p> <p>Used for Internet or Local Area Network communications with the control system. Field installs by plugging into the CommLink 5 circuit board and provides an addressable Ethernet connection to the controls system from any computer connected to your building's LAN. It can also be configured to allow access to the control system from the Internet through your LAN if your Ethernet firewall is configured for this option.</p> <p>Includes: IP Link module, 10 ft. long Ethernet cable, and installation instructions. Prism 2 computer software must be installed on the remote computer in order to dial-up and communicate with the controls system.</p>		<p>See the <i>IP Module Technical Guide</i></p>
<p>ASM01626</p>	<p>MiniLink PD 5</p> <p>Used with all Orion controllers to provide network communications, zone voting, alarming, and tenant logging capabilities. A MiniLink Polling Device is required on each loop of a Networked system. Includes: MiniLink Polling Device.</p>		<p>See the <i>Orion MiniLink PD 5 Technical Guide</i></p>
<p>ASM02244</p>	<p>USB-Link 2 Kit</p> <p>The USB-Link 2 is a pocket-sized communications interface used to connect a laptop computer to your controls system for programming and monitoring purposes, utilizing a modular cable to allow connection to the service port connector on the controllers and a USB cable to connect to a laptop computer.</p> <p>Includes: USB-Link 2 for multiple or single loop systems, USB cable, modular connection cable, two mini-DIN to terminal adapters, and Prism 2 software.</p>		<p>See the <i>USB-Link 2 Technical Guide</i></p>
<p>ASM02533</p>	<p>Prism 2 Graphical Computer Software</p> <p>Prism 2 provides standard, easy to understand status screens for each type of Orion controllers installed. Prism 2 software has provisions for custom screens which allow floor plans, equipment photos, or user-defined summary screens to be implemented to meet their own individual needs. All controlling setpoints, trend logs, and alarm conditions are accessed in the Prism environment. Prism 2 can be configured for direct on-site installation, remote modem connection, or TCP/IP Internet connection to several installations.</p>		<p>Page 25</p>

OVERVIEW

VAVZB, Actuator & Expansion Module Dimensions

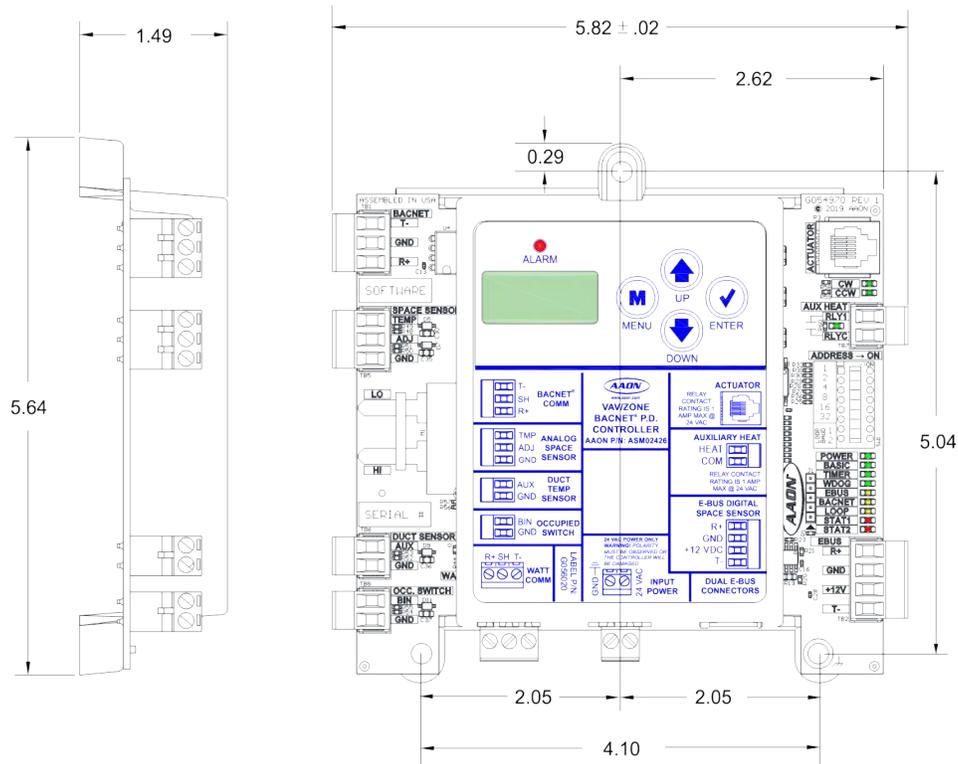


Figure 1: VAVZB Dimensions

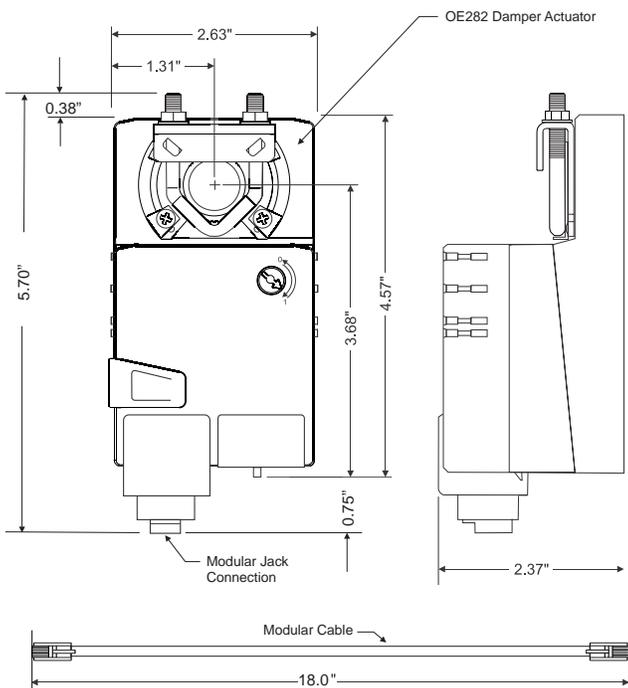


Figure 2: Zone Damper Actuator Dimensions

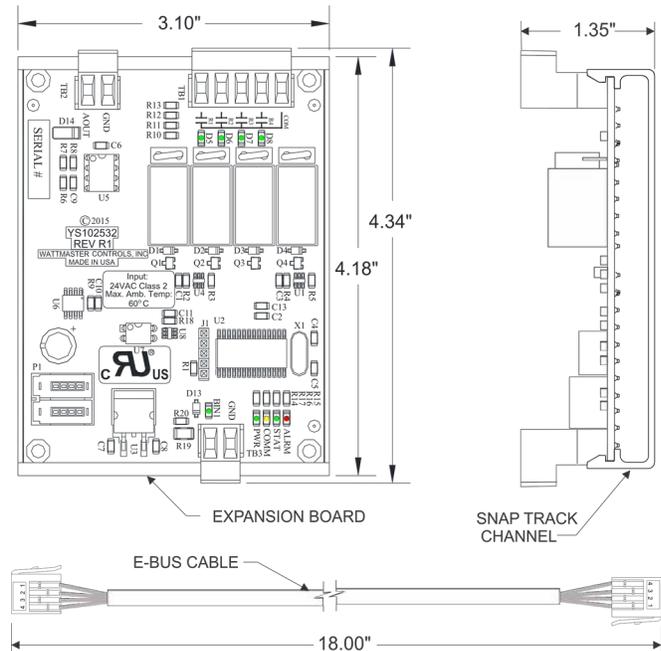


Figure 3: VAV/Zone Controller Expansion Module Dimensions

Slaved Zone Damper Kit & Rectangular Damper Kit Dimensions

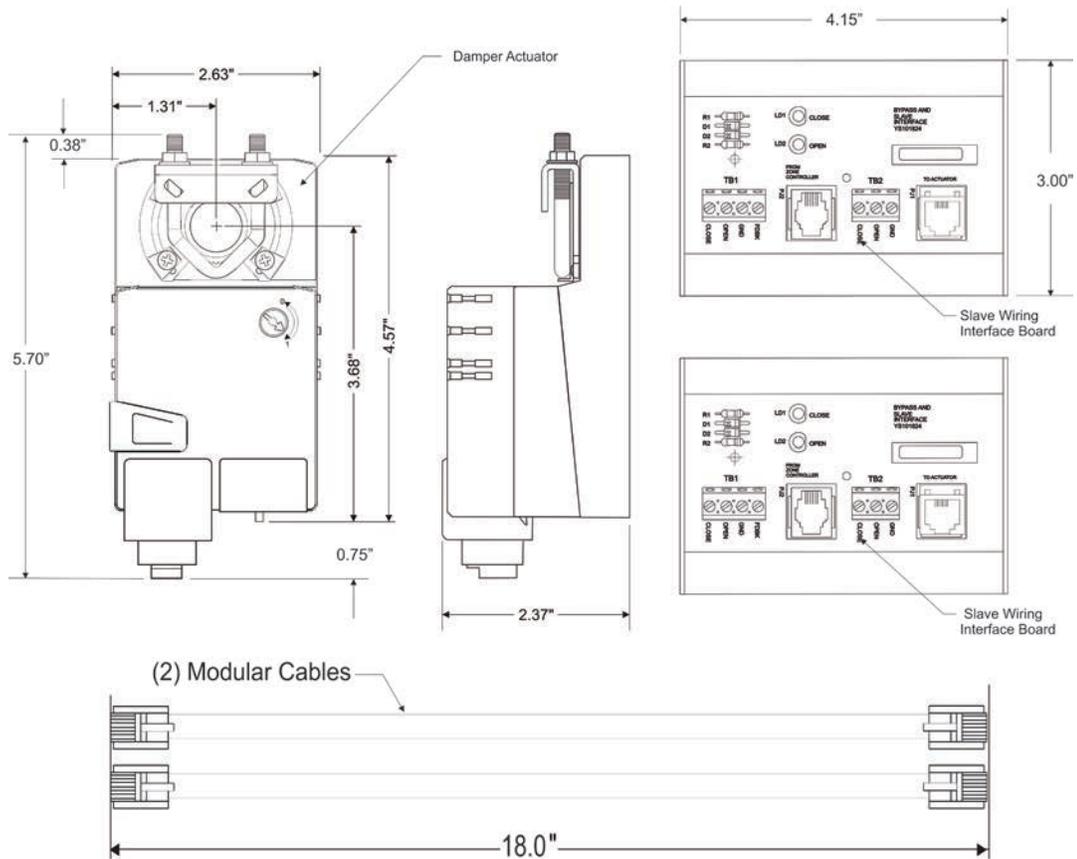


Figure 4: Slaved Zone Damper Kit

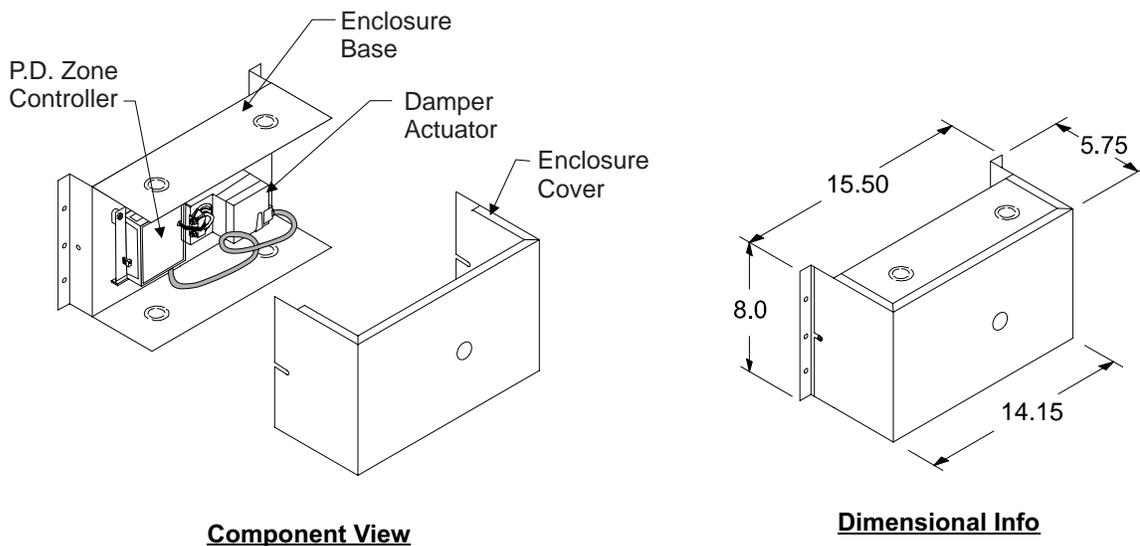


Figure 5: P.D. Rectangular Damper Kit with Terminal Blocks

OVERVIEW

Round Damper Kit Dimensions

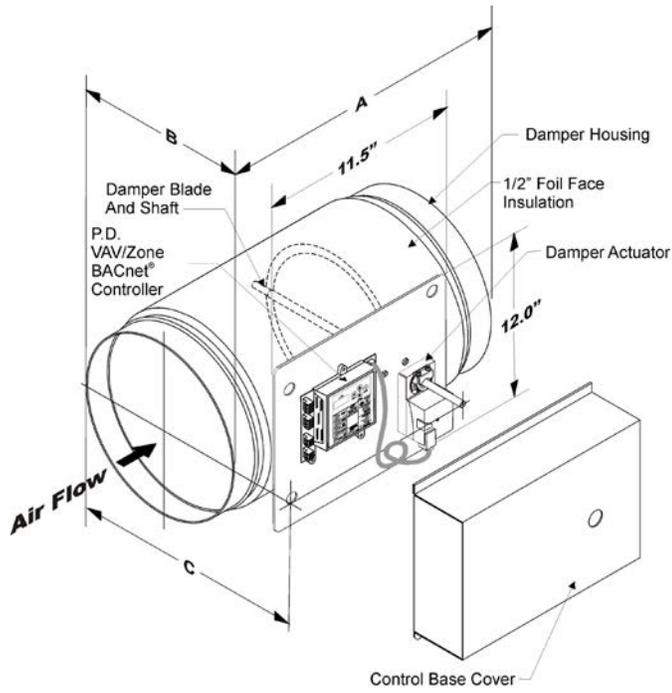


Figure 6: P.D. Round Damper Kit with Terminal Blocks

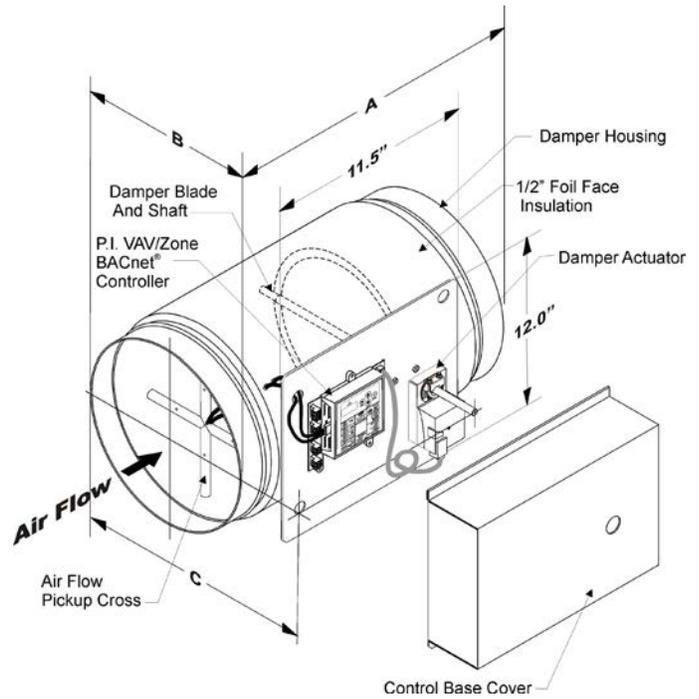


Figure 7: P.I. Round Damper Kit with Terminal Blocks

Mounting & Installation

If you purchased the Round Zone Damper or Rectangular Zone Damper Kits from AAON, the controller and actuator are factory mounted and wired in the damper control enclosure. If your VAVZBs are pressure independent, an airflow probe and pressure sensor will also be factory mounted and wired.

Most terminal unit manufacturers will offer the option of factory mounting the Orion controls in their terminal units for an additional charge. An installation worksheet and instructions are available for the Orion VAVZB package which can be shipped with the VAV/Zone control(s) to the terminal unit manufacturer to simplify factory mounting and wiring of the controller.

VAVZB Package

NOTE: The VAVZB defaults to Direct Acting, which means that when looking at the damper shaft, the damper rotates clockwise to open. If the damper on the terminal unit is not installed for clockwise to open operation, the VAVZB can be configured for counterclockwise-to-open operation via the Modular Service Tool, Modular System Manager, or through the Prism 2 software. It must be changed prior to system start-up for the designated units for the zone damper to function properly. See the *VCCX2 Controller Operator Interfaces SD Technical Guide* or *Prism 2 Technical Guide* for further information on reconfiguring for reverse acting operation. Installation is the same as for clockwise-to-open units except all references to clockwise will now be counter-clockwise direction.

1. The terminal unit damper (by others) should be installed so the damper shaft turns in a clockwise direction to open the damper. This is the software default for the VAVZB Package. If this is not possible, the VAVZB can be re-configured for counter-clockwise-to-open operation using one of the operator interfaces. See the note above for details. All installation instructions are based on the clockwise-to-open default. Check the damper for proper rotation and mark the end of the damper shaft to indicate open and closed positions.

2. Loosen the (2) shaft mounting bracket nuts on the ends of the damper actuator's shaft mounting U-bolt and slide damper actuator assembly over the terminal unit damper shaft. The actuator may have to be rotated from position shown depending on the terminal unit's available mounting area and damper shaft location and whether this is a left or right hand installation. Hand tighten the U-bolt nuts until the damper shaft is loosely secured to the shaft.

3. After positioning the damper actuator over the damper shaft, secure the damper actuator to the controller enclosure base using the supplied L-bracket and 2 screws.

4. Turn the damper blade to its fully closed position. With the manual override clutch button depressed, rotate the actuator clamp to within approximately $\frac{1}{16}$ inch to $\frac{1}{8}$ inch distance between the actuator stop and the clamp, depending on the damper seal design. Tighten the (2) shaft mounting bracket nuts on the ends of the damper actuator's shaft mounting U-bolt with an 8 mm wrench to 3-5 ft-lb of torque. On dampers with edge seals, the actuator will compress the damper blade seal when reaching the end position. Adjust the end stops, if required. Attach the actuator cable between the actuator and controller.

Space Temperature Sensors

The Space Temperature Sensors should be mounted in the space served by the equipment the sensor is connected or hard wired to. All Space Sensors should be mounted approximately 5 feet above the floor and in an area that does not experience direct sunlight or drafts in order to get accurate readings. Cabling or wiring should be routed so the wire or cable is protected from being pinched or punctured by building fasteners or materials.

Discharge Temperature Sensors

These sensors should be mounted in the supply air duct of the equipment. The Discharge Temperature Sensor should be mounted at least 10 feet away from any Heating or Cooling source and be mounted 3 duct diameters from any elbow.

Cabling or wiring should be routed so the wire or cable is protected from being pinched or punctured by building fasteners or materials.

NOTE: If this is a stand-alone damper, this sensor would be mounted upstream of the damper to act as a Supply Air Sensor.

INSTALLATION & WIRING

Important Wiring Considerations

General

Correct wiring of the VAVZB is the most important factor in the overall success of the controller installation process.

Voltage and Environment Requirements

The VAVZB and expansion modules must be connected to a 24 VAC power source of the proper size for the calculated VA load requirements. All transformer sizing should be based on the VA rating listed in **Table 1**.

Control Device	Voltage	Load	Temperature	Humidity (Non-Condensing)
VAV/Zone BACnet® Controller Actuator Package (VAVZB)	18-30 VAC	10 VA Includes Expansion Module & Actuator VA Load	*-22°F to 158°F (-30°C to 70°C)	0-95% RH
Zone Damper Actuator	18-30 VAC	Included in VAVZB Actuator Package VA Load	-22°F to 122°F (-30°C to 50°C)	0-95% RH
VAV/Zone Controller Expansion Module	18-30 VAC	Included in VAVZB Actuator Package VA Load	-22°F to 158°F (-30°C to 70°C)	0-95% RH
Slaved Zone Module	18-30 VAC	Add 3 VA To VAVZB Load For Each Slaved Zone	-22°F to 158°F (-30°C to 70°C)	0-95% RH
VAV/Zone BACnet® Controller Only, No Actuator or Expansion Module	18-30 VAC	7 VA	*-22°F to 158°F (-30°C to 70°C)	0-95% RH

* NOTE: If the temperature at the controller is below -4°F (20°C), the display refresh rate could be less responsive.

Table 1: Voltage and Environment Requirements

WARNING: When using a single transformer to power more than one controller or expansion module, the correct polarity must always be maintained between the boards. Failure to observe correct polarity will result in damage to the VAVZB, actuator, and expansion module.

Important Wiring Considerations

Please carefully read and apply the following information when wiring the VAVZB. See **Figure 10, page 20** for VAVZB wiring and connections. See **Figure 9, page 17** for connecting and wiring multiple VAVZBs in a system.

1. Size and wire the transformer to be used for powering the VAVZB(s) per the instructions. Failure to size the transformer and/or wire the VAVZB(s) correctly may cause the VAVZB to operate erratically or not at all. See **Figure 8, page 16** for wiring and transformer sizing information.
2. All wiring is to be in accordance with local and national electrical codes and specifications.
3. All 24 VAC wiring must be connected so that all ground wires remain common. Failure to follow this procedure can result in damage to the controller and connected devices.
4. Minimum wire size for 24 VAC wiring should be 18-gauge.
5. Minimum wire size for all sensors should be 24-gauge. Some sensors require 2-conductor wire and some require 3-or 4-conductor wire.
6. Minimum wire size for 24 VAC thermostat wiring should be 22 gauge.
7. Be sure that all wiring connections are properly inserted and tightened into the terminal blocks. Do not allow wire strands to stick out and touch adjoining terminals which could potentially cause a short circuit.
8. Do not pry on the connectors when connecting or disconnecting the modular cables. Be sure to push in on the connector release clip and then pull straight up.
9. When communication wiring is to be used to interconnect VAVZBs together or to connect to other communication devices, all wiring must be plenum-rated, minimum 18-gauge, 2-conductor, twisted pair with shield. AAON can supply communication wire that meets this specification and is color coded for the network or local loop. Please consult your AAON distributor for information. If desired, Belden #82760 or equivalent wire may also be used.
10. Before applying power to the VAVZB, be sure to recheck all wiring connections and terminations thoroughly.

Wiring Checks

One of the most important checks to make before powering up the system for the first time is to confirm proper voltage and transformer sizing. Each VAVZB requires 10 VA Max draw of power delivered to it at 18-30 VAC. You may use separate transformers for each device (preferred) or power several devices from a common transformer. If several devices are to be powered from a single transformer, correct polarity must be followed. See **pages 16-24** of this manual for complete wiring and transformer sizing information for the VAVZB.

WARNING: Observe Polarity! All boards must be wired with GND-to-GND and 24 VAC-to-24 VAC. Failure to observe polarity will result in damage to one or more of the boards.

Check all modular connectors to be sure they are completely pushed and locked into their mating connectors. Confirm that all sensors required for your system are mounted in the appropriate location and that the modular cables are plugged into the correct connectors on the VAVZB. Check the actuator cable and be sure it is plugged in and secured to the modular connector on the actuator and the VAVZB circuit board modular connector.

If using a Standard Room Sensor or terminal connection for an E-BUS Digital Room Sensor, check to make sure the wiring is correct. See **Figure 10, page 20** in this manual for wiring details. If attaching an E-BUS Sensor with an E-BUS cable, make sure the E-BUS connector is connected to one end of the E-BUS sensor cable and the other end is connected to the E-BUS sensor connector on the VAVZB. Be sure any VAV/Zone Controller Expansion Modules connected to the VAVZB are also correctly wired per the VAV/Zone Controller Expansion Module wiring instructions on **pages 20-23** of this manual.

Check all wiring leads at the terminal block for tightness. Be sure that wire strands do not stick out and touch adjacent terminals.

After all the above wiring checks are complete, apply power to the transformer(s) that is connected to the VAVZB.

Controller Addressing

Before applying power for the first time, it is very important to correctly address the controller and run through a few simple checks.

If the VAVZB is to operate as a Stand Alone controller (not connected to any other HVAC unit or VAVZB(s)), the controller address switch should be set for address 1. When the VAVZB is to be connected to other VAVZB on a communication loop, each VAVZB's address switch must be set with a unique address between 1 and 58.

When programming the VAVZB on a Stand Alone or Interconnected System and you are asked to enter the unit ID, you would enter the address for the controller you wish to program. When programming the VAVZB on a Networked System and you are asked to enter the Unit ID, you would first enter the MiniLink PD loop address for the loop that the VAVZB Package is connected to and then enter the VAVZB's address.

Powering Up

When the Controller and Modules are first powered up, the POWER LED should light up and stay on continuously. If it does not light up, check to be sure that you have 18-30 VAC connected to the controller, that the wiring connections are tight, and that they are wired for the correct polarity. The 18-30 VAC power must be connected so that all ground wires remain common. If after making all these checks, the POWER LED does not light up, please contact AAON Controls Technical Support for assistance.

INSTALLATION & WIRING

Device Transformer Sizing

24 VAC Power - Transformer & Wire Sizing Considerations for Devices without Modular Connectors

Some installers like to use one large 24 VAC transformer to power several devices. This is allowable as long as polarity is maintained to each device on the transformer circuit. **Warning: If polarity is not maintained, severe damage to the devices may result. AAOB recommends using a separate transformer for each device in order to eliminate the potential for damaging controllers due to incorrect polarity.** Using separate transformers also allows redundancy in case of a transformer failure. Instead of having 8 controllers inoperative because of a malfunctioning transformer you have only 1 controller off line. If the installer does decide to use a large transformer to supply power to several devices, the following transformer and wire sizing information is presented to help the installer correctly supply 24 VAC power to the devices.

Following is a typical example to help the installer to correctly evaluate transformer and wiring designs.

Each VAV/Zone BACnet Controller requires 10 VA @ 24VAC power. In the examples below we have a total of 8 VAV/Zone BACnet Controllers.

$$8 \text{ VAV/Zone BACnet Controllers @ } 10 \text{ VA each} \dots\dots\dots 8 \times 10 \text{ VA} = 80 \text{ VA.}$$

The above calculation determines that our transformer will need to be sized for a minimum of 80 VA if we are to use one transformer to power all the controllers.

Next we must determine the maximum length of run allowable for the wire gauge we wish to use in the installation. Each wire gauge below has a voltage drop per foot value we use to calculate total voltage drop.

18ga wire.....	0.00054 = voltage drop per 1' length of wire
16ga wire.....	0.00034 = voltage drop per 1' length of wire
14ga wire.....	0.00021 = voltage drop per 1' length of wire

For our example we will use 18 gauge wire. AAOB recommends 18 gauge as a minimum wire size for all power wiring.

Next use the voltage drop per foot value for 18 gauge wire from the list above and multiply by the total VA load of the 8 controllers to be installed.

$$0.00054 \text{ (Voltage drop per foot for 18 gauge wire)} \times 80 \text{ VA controller load} = \mathbf{0.0432 \text{ Volts/Ft.}}$$

AAOB controllers will operate efficiently with a voltage drop no greater than 5 Volts. Divide the total allowable voltage drop of 5 Volts by the number you arrived at above and you have the maximum number of feet you can run the 18 gauge wire with a 75 - 100 VA transformer with no more than a 5 Volt drop at the farthest controller from the transformer.

$$\frac{5 \text{ (Volts total allowable voltage drop)}}{0.0432 \text{ (Voltage drop per 1 ft. @ 80 VA load)}} = 115.7 \text{ feet}$$

Parallel circuiting of the wiring instead of wiring all 8 controllers in series allows for longer wire runs to be used with the same size wire (as shown in our examples below). It is often necessary for the installer to calculate and weigh the cost and installation advantages and disadvantages of wire size, transformer size, multiple transformers, circuiting, etc., when laying out an installation. No matter what layout scheme is decided upon, it is mandatory that the farthest controller on the circuit is supplied with a minimum of 19 Volts.

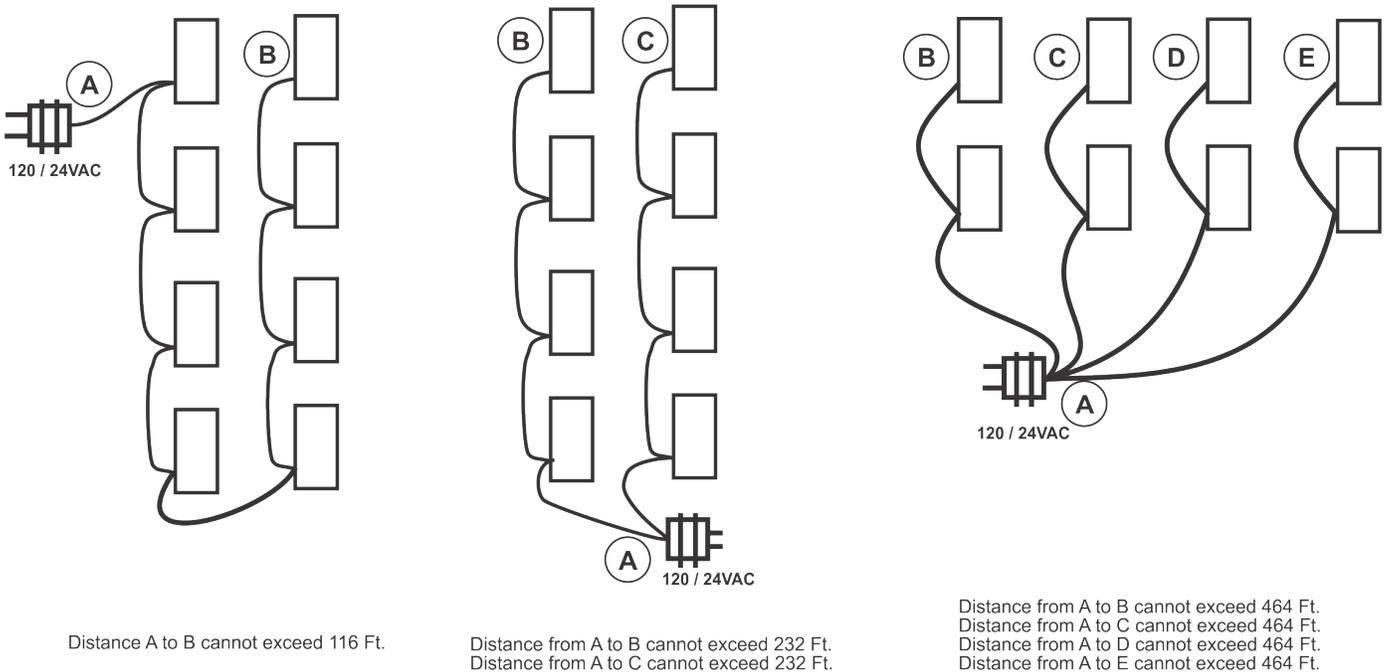


Figure 8: VAVZB Package With Terminal Blocks Transformer Sizing

VAVZB Communications Wiring

NOTE: A Single Transformer Supplying Each VAVZB Controller Individually Can Be Used Or A Transformer Supplying Several VAVZB Controllers Can Be Used. Each Controller Requires 10 VA Maximum Power. Our recommendation is 16 Controllers Attached To Two Transformers @ 100 VA each. Also See Warning Note Regarding Polarity.

WARNING: If Multiple Controllers Are Wired To A Single Transformer As Shown, Polarity Must Be Observed On All 24 VAC Wiring Or Damage To The Controllers Will Result.

CAUTION: Size Power Wiring Per Wire Sizing Information In This Manual. Be Sure Wiring Is Sized For Minimum Voltage Drop For Your Length Of Wiring Run.

Use AAO2 2 Conductor Twisted Pair With Shield Cable Or Belden #82760 Or Equivalent To Connect Between Each VAVZB And From The Unit Controller, MiniLink PD Or CommLink To The First VAV/Zone Controller As Required By Your Application.

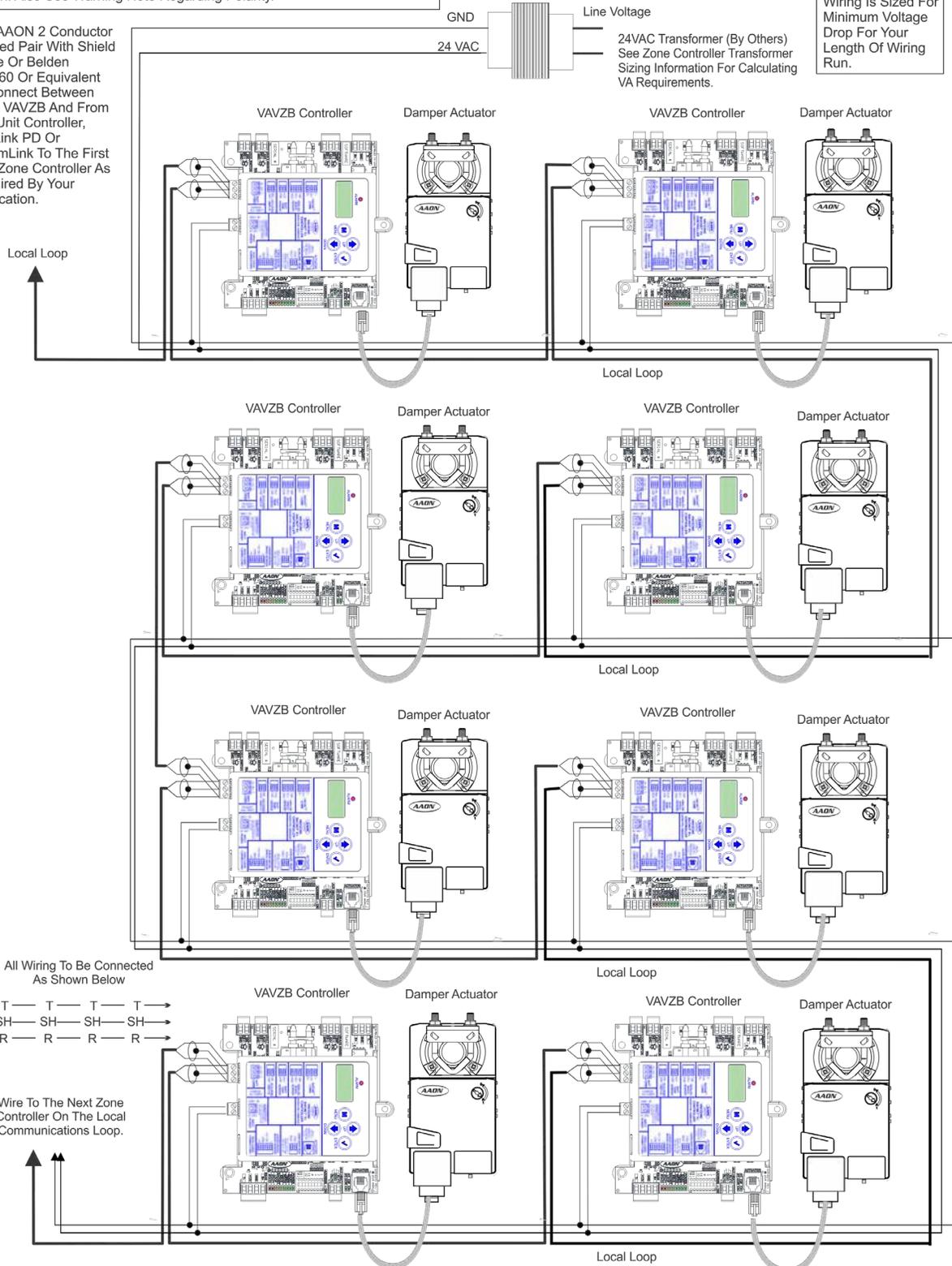


Figure 9: VAVZB Controllers Communication & Power Wiring Diagram

INSTALLATION & WIRING

VAVZB Inputs and Outputs

VAVZB Inputs

Analog Space Sensor

An analog space sensor—Standard Room Temperature Sensor—can hard wire to the Analog Space Sensor wiring terminals on the VAVZB. Alternatively, an E-BUS Digital Room Sensor can be used.

E-BUS Digital Room Sensor

An E-BUS Digital Room Temperature Sensor can hard wire to the E-BUS Digital Space Sensor wire terminals on the VAVZB or it can be connected to the EBC E-BUS connector on the VAVZB using an EBC E-BUS pre-fabricated cable of the desired length. Alternatively, a Standard Room Temperature Sensor can be used.

Discharge Temperature Sensor

A Discharge Temperature Sensor can monitor the discharge air temperature of the terminal unit, round damper, or rectangular damper used with the VAVZB. The Sensor is typically used when the terminal unit has reheat installed so that the true temperature of the air being supplied to the space can be monitored. The Sensor should be mounted in the discharge duct downstream of the terminal unit where the VAVZB is installed.

NOTE: If this is a stand-alone damper, this sensor would be mounted upstream of the damper to act as a Supply Air Temperature Sensor.

Occupied Switch

This input is used when you have a motion switch or window switch to determine room occupancy and allows for setback of the heating or cooling during occupied periods.

Window Open Detection Mode

If the “Window Open Detection” button is checked, and the “Occupied Switch” contacts (located on the VAVZB) are open, the VAVZB will control to the Unoccupied Cooling and Heating Setpoints and the Damper will completely close. When the contacts are shorted, the unit will control to the Occupied Cooling and Heating Setpoints. If the “Reverse Contact Polarity” button is checked, then the unit controls to the Unoccupied Cooling and Heating setpoints when the Occupied Switch contacts are shorted, and control to the Occupied Cooling and Heating Setpoints when the contacts are open.

Motion Sensor Occupancy Detection

This operation only occurs in the scheduled Occupied Mode. If the Motion Sensor Occupancy Detection button is checked, the Occupancy Detection Time and Occupancy Duration Timeout setpoints are used to determine the cooling and heating setpoints of the VAVZB. A motion sensor is connected to the Occupied Switch contacts (located on the VAVZB) and when motion is detected (contacts shorted together) for the Occupancy Detec-

tion Time period, the controller will display “Occupied Mode” and control to the Occupied Cooling and Heating setpoints. If no motion is detected for a period longer than the Occupancy Duration Timeout setpoint, (the contacts will open) the controller will display “Occupied Room Empty” and the controller will go to the Occupancy Cooling and Heating Setback temperatures, until motion is detected again. If the “Reverse Contact Polarity” button is checked, then the unit controls the opposite. When no motion is detected (contacts shorted) the controller will display “Occupied Room Empty” and unit will control to the Occupancy Cooling and Heating Setback temperatures, until motion is detected. When motion is detected (contacts open) for the Occupancy Detection Time period, the controller will display “Occupied Mode” and control to the Occupied Cooling and Heating setpoints.

Airflow Sensor

If using the Pressure Independent VAVZB, the terminal unit’s pressure pick-up tube must be connected with FRP tubing to the barb fittings on the side of the VAVZB. No wiring connections are required as the pressure sensor is integral to the VAVZB. This pressure sensor input is used for CFM (airflow) calculations.

VAVZB Outputs

Auxiliary Reheat Relay

This relay has a dry contact on the VAVZB and can be configured for Auxiliary Heat or Box Reheat. Box Reheat is used when you only need 1 stage of electric heat or On/Off Hot Water Valve. Auxiliary Heat is selected when you are using Baseboard or some other Heating Source. Use this relay if the controlled terminal unit is not a fan terminal unit. When you are using a fan terminal unit or have more than 1 stage of electric heat, SCR electric heat, or modulating HW heat, the VAV/Zone Controller Expansion Module must be used.

Configure the relay for Auxiliary Heat if the heat being controlled by the controller is baseboard type heat or any other type heat that does not require airflow through box. The relay will be energized whenever the Space Temperature drops 0.5° below the Auxiliary Heat Setpoint and the damper will remain in the position determined by the mode of operation.

If the relay is configured for Box Reheat, then the relay will be energized whenever the Space Temperature drops below the Occupied Heating Setpoint and the damper will go to the Minimum Damper During Box Heating Mode Setpoint. The stages of box reheat will need to be set to 1.

VAVZB and Expansion Module Outputs**VAVZB Communication Connections****BACnet® Comm Terminal Block**

This three position terminal block is used for connecting the communications wiring between the VAVZB and BACnet® Communications device.

Watt Comm Terminal Block

This three position terminal block is used for connecting the communications wiring between each VAVZB or to the Mini-Link, HVAC Unit Controller, or other installed controller on the local communications loop. Communications wiring should be plenum-rated 18 gauge minimum 2 conductor twisted pair with shield Belden #82760 or its equivalent.

VAVZB Power Connection**24 VAC Power Terminal Block**

This two position terminal block is used to wire the 24 Volt power to the VAVZB Packages. If desired, a single transformer can be used to power multiple VAVZB Packages together, or a separate transformer can be used for each controller.

WARNING: If multiple controllers are to be wired to the same transformer, polarity must be observed or damage to the controller will result.

VAVZB Other Connections**Dual E-BUS Connectors**

There are two EBC E-BUS connectors that are used to connect an expansion module or E-BUS Digital Room Temperature Sensor.

The expansion module is only required when staged electric heat (more than 1 stage), SCR electric heat, modulating HW heat, and/or fan terminal control is required.

Actuator Modular Connector

This modular connector is used to connect a modular cable from the VAVZB to a damper actuator.

VAV/Zone Controller Expansion Module Outputs

As previously stated, when you are using a fan terminal unit or have more than 1 stage of electric heat, have SCR electric heat, or have modulating HW heat, the VAV/Zone Controller Expansion Module is required.

Binary Input - Proof of Flow

This input is for an airflow Proving Switch. It is only an option with Stand-Alone damper applications using electric reheat.

Relay #1 - Fan Enable

This relay is used for energizing the Fan on Series or Parallel Fan Terminal units.

Relay #2 - Heating Stage 1

If you have at least 1 stage of Heat, this relay is used to energize the 1st stage of terminal unit Heat. This Heating Stage can either be used with Electric Heat or On/Off Hot Water Valve control.

Relay #3 - Heating Stage 2

If you have 2 stages of Electric Heat, this relay controls the 2nd stage of Electric Heat.

Relay #4 - Heating Stage 3

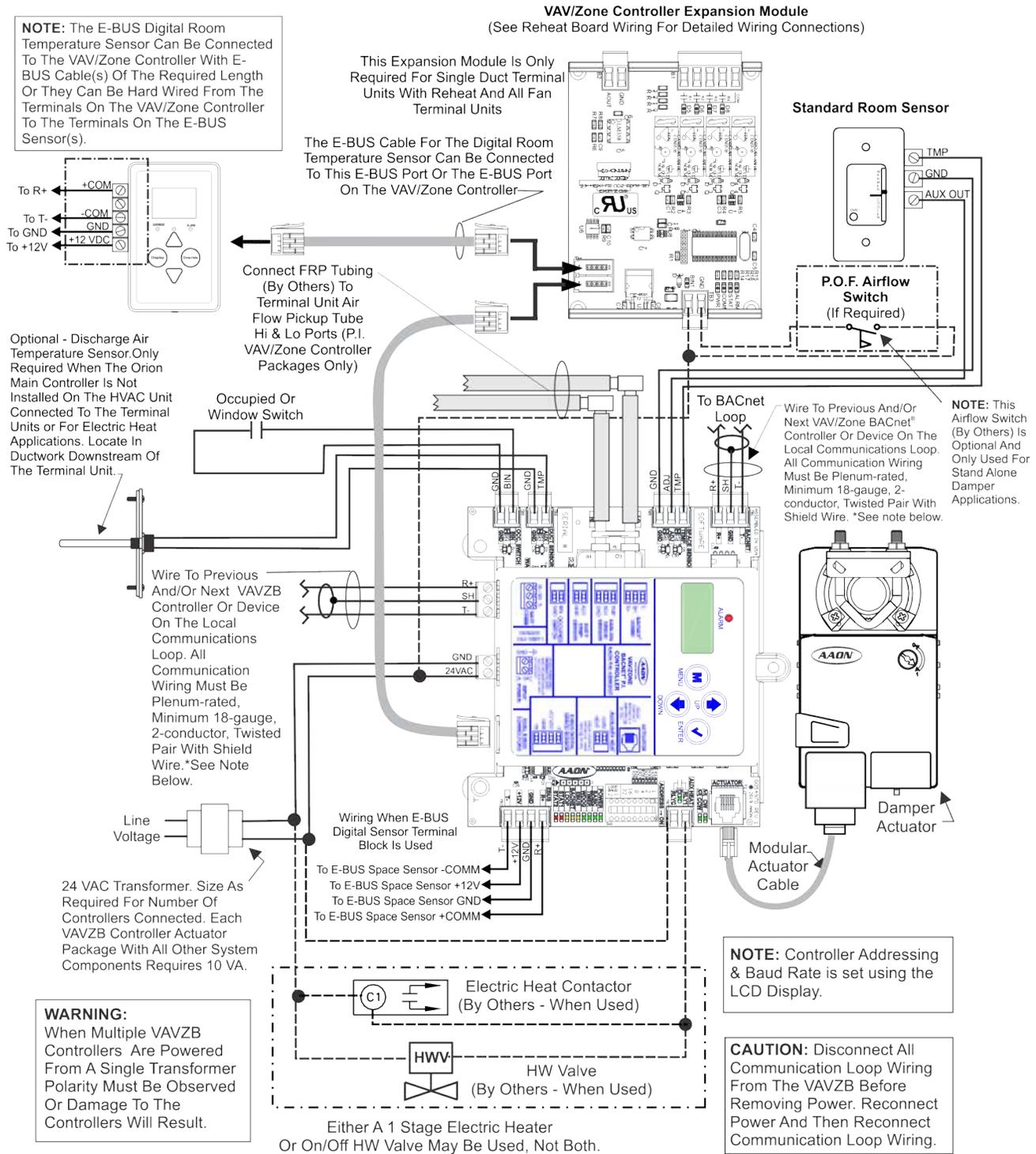
If you have 3 stages of Electric Heat, this relay controls the 3rd stage of Electric Heat.

Analog Output

If you are using SCR Electric Heat or a modulating Hot Water Valve or modulating Steam Valve for Heating, this output can supply a 0-10 VDC signal for proportional control of the Valve or SCR Electric Heater.

INSTALLATION & WIRING

VAVZB Controller Package Wiring



* **NOTE:** AAO can supply communication wire that meets this specification and is color coded for local loop. The local loop wire part number is G038140, is color coded with green candy striping and comes on a 1000 ft. spool. If desired, 18 gauge minimum Belden #82760 or equivalent communications wire may also be used for the local loop wiring.

Figure 10: VAVZB Controller Package Wiring (Pressure Independent version shown)

VAV/Zone Controller Expansion Module Wiring

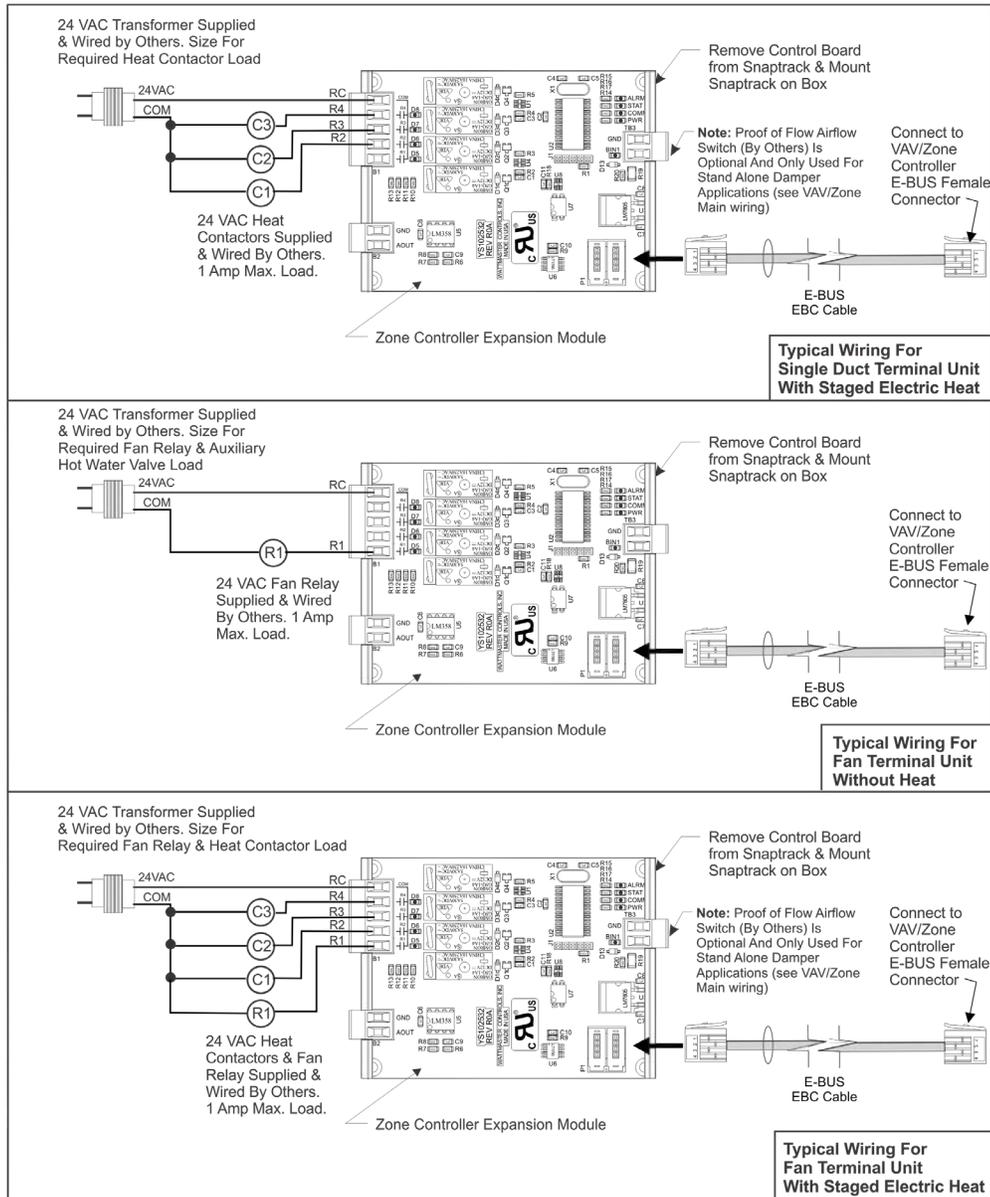


Figure 11: VAV/Zone Controller Expansion Module Wiring - Fan Terminals and/or Electric Staged Heat

INSTALLATION & WIRING

VAV/Zone Controller Expansion Module Wiring

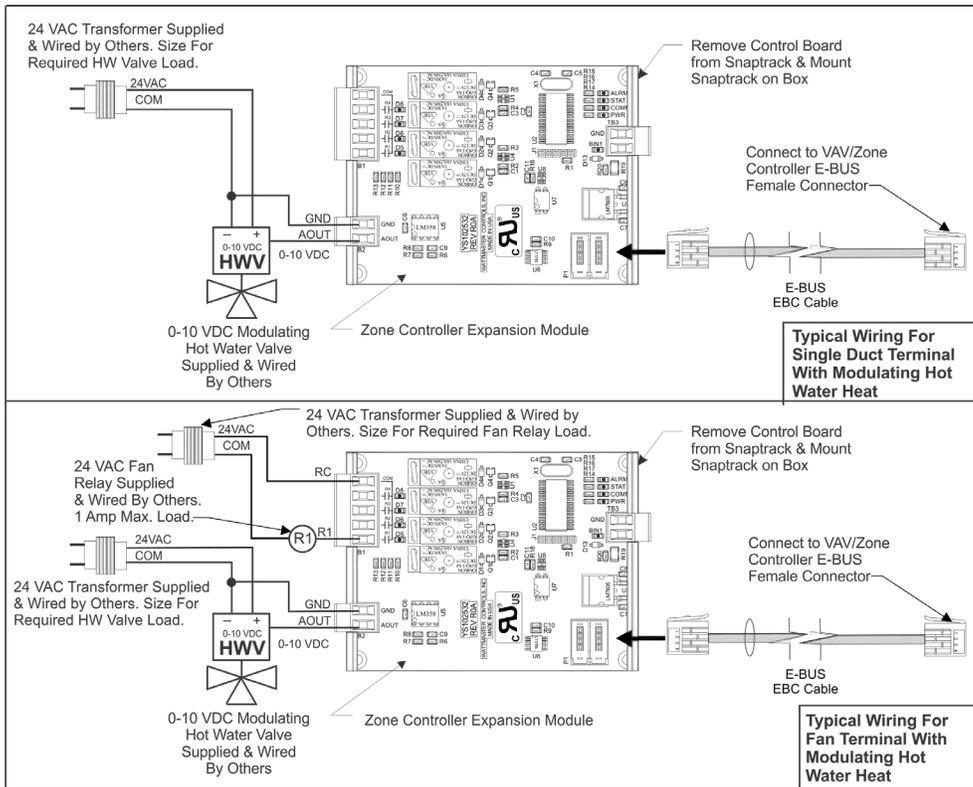


Figure 12: VAV/Zone Controller Expansion Module Wiring - Fan Terminals and/or Modulating HW Heat

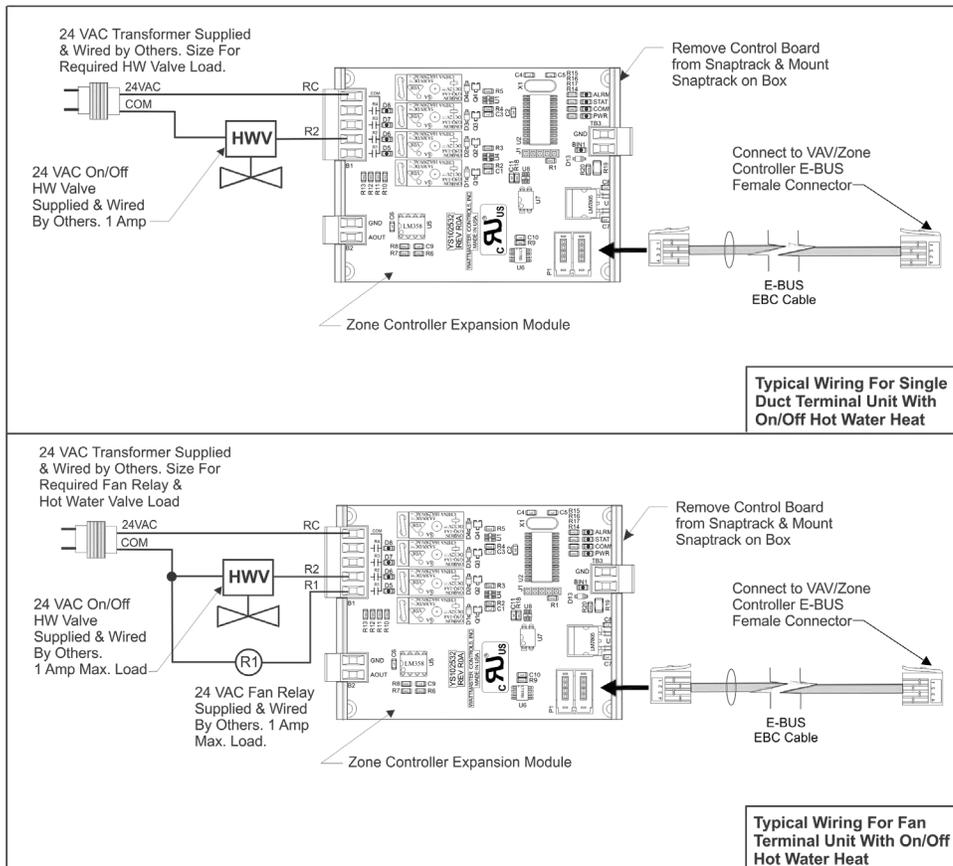


Figure 13: VAV/Zone Controller Expansion Module Wiring - Fan Terminals and/or On/Off HW Heat

VAV/Zone Controller Expansion Module Wiring

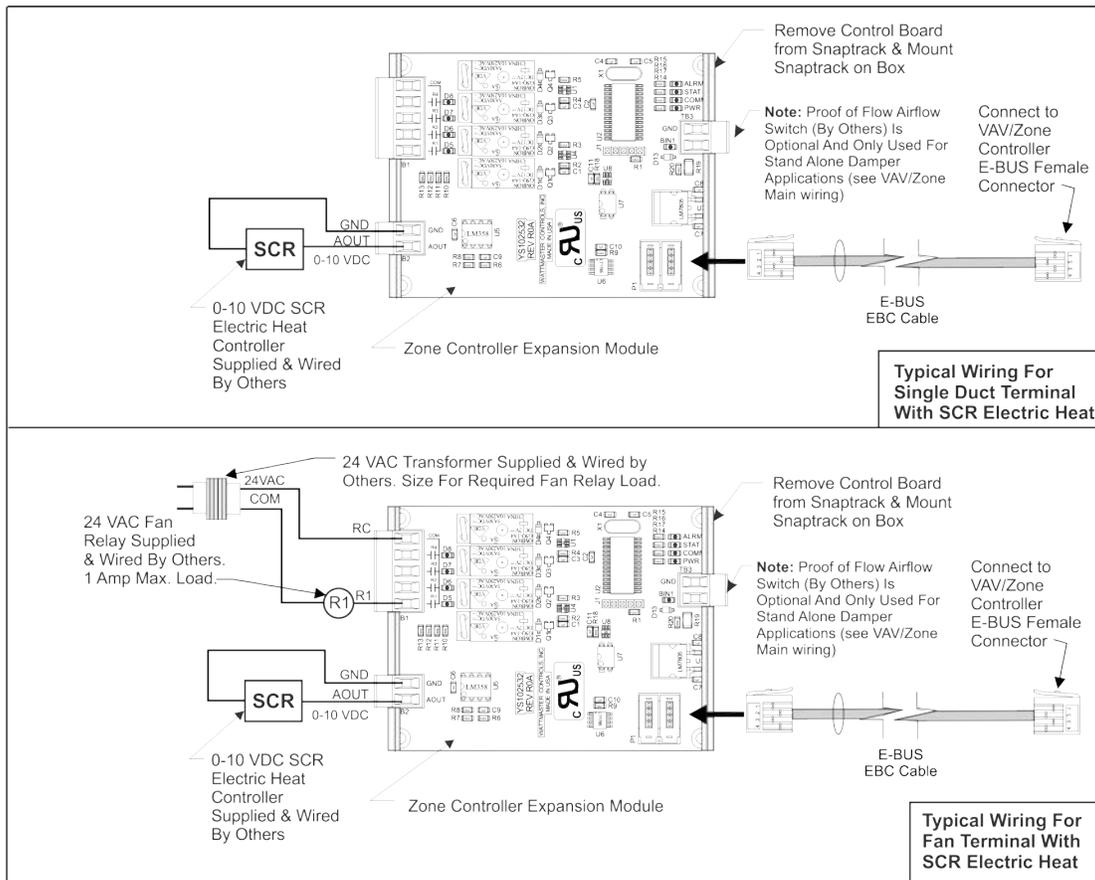


Figure 14: VAV/Zone Controller Expansion Module Wiring - Fan Terminals and/or SCR Electric Heat

INSTALLATION & WIRING

Slaved Zone Damper Wiring

Slaved Zone Damper Wiring

For large zones, it may be necessary to have more than one air damper controlled by a VAVZB Package and its associated space sensor. The Orion system allows for connecting up to two additional Slaved Zone Dampers to the master VAVZB Package. *Slaving is not available for pressure independent damper applications.*

NOTE: Each slaved actuator is considered a modular device rated at 6 VA each. This 6 VA load must be included in the transformer sizing. See the previous section regarding transformer sizing for complete information.

Two Slave Wiring Adapters consisting of a slave wiring interface card and modular cable are supplied with the Round Slaved Zone Damper, Slaved VAV/Zone Rectangular Damper Kit, and the Slaved VAV/Zone Damper Kit. These are required when attaching slave actuator(s) to the master zone damper. One slave wiring interface card should be mounted near the control enclosure of the master VAVZB Package. It is mounted by fastening the plastic snap-track to a suitable sheet metal mounting surface with the sheet metal screws provided. The other card is mounted in the control enclosure of the slaved zone damper. Run 24 AWG minimum wire between the slave wiring interface cards. Connect modular cables to the slave wiring interface cards and to the zone actuators as shown. See **Figure 15**, below for complete wiring details.

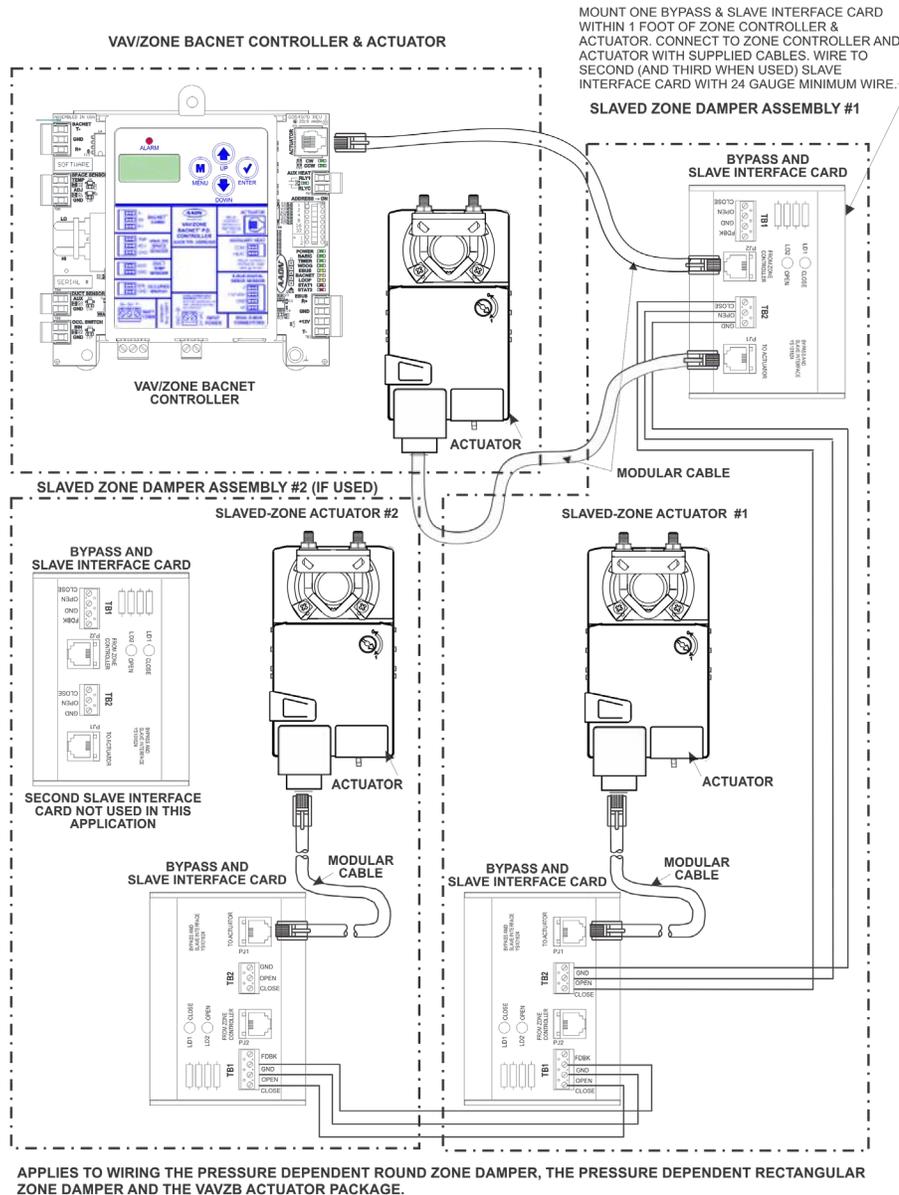


Figure 15: Slaved Zone Damper Wiring & Connection Diagram

Initialization

On system power-up, the “STAT 1” & “STAT 2” LEDs on the VAVZB Controller are extinguished for a few seconds, and then STAT1 flashes a set of 3 flashes five times. The controller will go into damper calibration and the ACTUATOR LEDs will come on. The LCD Display will display, FEEDBACK CALIBRAT. The CW LED will be on while the actuator is driving clockwise, and the CCW LED will light when the damper is driving counter-clockwise. When the calibration is completed, the normal diagnostic flashes of STAT2 will begin. If everything is operating correctly, STAT2 LED will blink once every 10 seconds.

Operator Interfaces

The next step is configuring the controller for your specific requirements. In order to configure the VAVZB, you must use an operator interface. Four different operator interfaces are available for programming and monitoring of the VAVZB. See **Figure 16**. They are as follows:

- Modular Service Tool SD
- Modular System Manager SD
- PC or laptop with Prism 2 software installed
- System Manager TS-L (Touch Screen - Limited Access)

Any of these devices or a combination of them can be used to access the status, configuration, and setpoints of any controller on your communications loop.

Additional Information

In order to configure your VAVZB, you will want to refer to one or more of the following technical guides, all downloadable from our website, www.aon.com/controlsmanuals.

- *Prism 2 Technical Guide*
- *VCCX2 Controller Operator Interfaces SD Technical Guide (VAV/Zone screens in back)*
- *System Manager TS-L Technical Guide.*
- *CommLink 5 Technical Guide*
- *IP Module Technical Guide*
- *USB-Link 2 Technical Guide*
- *MiniLink PD 5 Technical Guide*

If using the Modular Service Tool SD or the Modular System Manager SD for programming, refer to the *VCCX2 Controller Operator Interfaces SD Technical Guide* for the VAV/Zone Controller configuration setpoints. If using a computer and the Prism 2 software for programming, refer to the *Prism 2 Technical Guide*. If using the System Manager TS-L for monitoring, please see the *System Manager TS-L Technical Guide*.

Configuration

No matter which operator interface you use, we recommend that you proceed with the programming and setup of the VAVZB in the order that follows:

1. Set the Controller address using the LCD display.
2. Configure the Controller for your application.
3. Program the Controller setpoints.
4. Program the Controller operation schedules.
5. Set the Controller current time and date.
6. Review Controller status screens to verify system operation and correct Controller configuration.

NOTE: For BACnet® Configuration, see **Appendix B, page 44**.



Figure 16: Operator Interfaces

SEQUENCE OF OPERATIONS

Scheduling & HVAC Operation Modes

Scheduling

Occupied Mode/Unoccupied Mode

The VAVZB Controller monitors the communications loop for its Occupied and Unoccupied mode of operation command. Either the Unit Controller or a GPC-XP Controller can transmit the Occupied command to the VAVZB Controller. This requires the VAVZB Controller Packages to all be connected to the system communication loop through their RS-485 connector and to be properly addressed for the command to be received.

Push-button Override Operation

During unoccupied hours, you can force the VAVZB Controller and Unit Controller back to occupied operation by pressing the override button on the Analog Room Sensor or Digital Room Sensor. The operation for the push-button override sequence is different depending on which sensor you are using.

Standard Room Sensor

Pushing the override button for less than 3 seconds initiates the override which will continue for a configurable duration of time (0-8 hours). If during the override period the button is pressed a second time for less than 3 seconds, an additional configurable duration of time (0-8 hours) will be added to the remaining override duration that is left at the time of pushing the button. Depressing the button between 3 and 10 seconds will cancel the override.

E-BUS Digital Room Sensor

Pushing the override button momentarily initiates the override which will continue for a configurable duration of time (0-8 hours). If during the override period the button is pressed a second time, it will cancel the override and places the unit back into normal unoccupied operation.

Grouping Controllers For Overrides

On larger installations with several terminal units, the VAV/Zone Controllers can be configured into groups so that an override generated by one VAVZB Controller can cause several other controllers to follow along and return to occupied mode for the programmed duration. Other VAVZB Controllers not in the same group will simply maintain an unoccupied damper or airflow setting as set by the user. Push-button overrides are broadcast continuously by the initiating VAV/Zone Controller until the controller itself times out or the override is cancelled by the user. This broadcast forces the air handler to start its main fan and provide cooling or heating, if so configured. It will remain on until the override broadcast has not been detected for at least 2 consecutive minutes.

HVAC Modes of Operation

There are 7 possible modes of operation for the HVAC Unit and the VAVZB Controller. These modes are determined by the Supply Air Temperature (SAT) and/or space demand conditions. They are as follows:

- **Supply Air Vent Mode**
(Based on HVAC Unit SAT)
This mode occurs when the Supply Air Temperature is within 2°F of the Space Temperature and stays in this mode until the Supply Air Temperature is above or below the Space Temperature plus or minus the Supply Air HVAC Mode Deadband.
- **Space Vent Mode**
(Based on VAVZB Controller Space Temp)
This mode occurs when the Space Temperature is below the Cooling Setpoint and 1.0°F above the Heating Setpoint.
- **Supply Air Cooling Mode**
(Based on HVAC Unit SAT)
This mode occurs when the Supply Air Temperature falls to less than the Space Temperature minus the Supply Air HVAC Deadband. To cancel the Supply Air Cooling Mode, the Supply Air Temperature must rise to within 2°F of the Space Temperature.
- **Space Cooling Mode**
(Based on VAVZB Controller Space Temp)
This mode occurs when the Space Temperature rises above the Space Cooling Setpoint.
- **Supply Air Heating Mode**
(Based on HVAC Unit SAT)
This mode occurs when the Supply Air Temperature rises to a temperature that is greater than the Space Temperature plus the Supply Air HVAC Deadband. To cancel the Supply Air Heating Mode, the Supply Air Temperature must fall to within 2°F of the Space Temperature.
- **Space Heating Mode**
(Based on VAVZB Controller Space Temp)
This mode occurs when the Space Temperature falls below the Space Heating Setpoint.
- **Off Mode - (Not displayed)**
During Unoccupied Mode, the mode is considered OFF if the Space Temperature does not generate a Heating Mode or Cooling Mode based on the Unoccupied Heating & Cooling Setpoints.

Damper Positions

The actual values for the minimum damper positions that are described in the following paragraphs can be configured by changing the values in the setpoint screens for the VAVZB Controller. These minimums are expressed in damper open percentages for pressure dependent terminal units or in CFM for pressure independent terminal units.

Cooling Minimum

When the HVAC unit is in the Supply Air Cooling Mode but the space does not require cooling, the VAV/Zone damper will move to the Cooling Minimum position.

Heating Minimum

When the HVAC unit is in the Supply Air Heating Mode but the space does not require Heating, the VAV/Zone damper will move to the Heating Minimum position.

Vent Minimum

This is the position the VAV/Zone damper will move to when the HVAC unit is in the Supply Air Vent Mode.

Night Minimum

This is the position that the damper moves to during the Unoccupied mode. When using non-fan powered terminal units, the VAV/Zone damper will position itself in the Night Minimum position. In order for fan powered terminal units to position the damper to the Night Minimum position, the check for main fan status must be selected, and the HVAC unit fan must be operating.

Box Heating Minimum

This is the position that the damper moves to when Reheat is initiated. If the VAVZB Controller is used on a terminal unit that has reheat, the VAV/Zone damper will move to the Reheat position whenever a Space Heating demand occurs and the HVAC unit is in Supply Air Cooling or Vent Mode. When the HVAC unit is in Supply Air Heating Mode, the VAV/Zone damper will modulate as required to maintain the Space Heating Setpoint.

Occupied Mode Sequences

Space Vent Mode

This mode only applies to the Occupied Mode of operation. If the equipment is in the Unoccupied Mode, then a lack of heating or cooling demand would generate the Off Mode.

If the HVAC unit is in Supply Air Vent Mode, you can adjust the damper position on pressure dependent terminal units and the airflow on pressure independent terminal units to provide a fixed amount of ventilation air into the space when there are no heating or cooling demands. During this time, the damper does not modulate on pressure dependent terminal units. On pressure independent terminal units, it only modulates to the extent required to maintain the Vent Minimum Airflow setting.

If the VAVZB Controller detects that the HVAC unit is in Supply Air Heating Mode, indicating that the air handler has activated its heat, the Heating Airflow Minimum will be substituted for the Vent Minimum.

If the VAVZB Controller detects that the HVAC unit is in Supply Air Cooling Mode, indicating that the air handler has activated its cooling, the Cooling Airflow Minimum will be substituted for the Vent Minimum.

Space Cooling Mode

Occupied Space Cooling mode is initiated by the temperature in the space rising to within 0.5°F of the Occupied Cooling Setpoint.

If the HVAC unit is in the Supply Air Heating Mode and another VAVZB Controller has a cooling demand, the Damper Position/Airflow for the VAVZB Controller requiring cooling will position itself to provide the Heating Minimum Damper Position/Airflow Setpoint amount of air into the space. No modulation open will occur because the space does not want the warm air currently being supplied by the air handler.

When the HVAC unit is in the Supply Air Cooling Mode, the damper is normally held at the Minimum Cooling Position until the Space Temperature begins to rise above the Occupied Cooling Setpoint. As the Space Temperature rises to within 0.5°F of the Occupied Cooling Setpoint, the Damper/Airflow calculation causes the air valve to open proportionally until the Maximum Setpoint is achieved at 1.5°F above the setpoint. This is a 2°F Proportional Window starting 0.5°F below the Occupied Cooling Setpoint to 1.5°F above the Occupied Cooling Setpoint.

The Damper Position/Airflow is never allowed to modulate outside the user-adjustable Minimum and Maximum setpoints. The Maximum Damper Position/Airflow Setpoint applies to Heating and Cooling modes of operation only. All of the modes have their own individual minimum setting.

Series Flow Fan Terminals

If the VAVZB Controller has been configured as a Series Fan Powered terminal unit, the series fan relay will activate and run the series box fan continuously anytime the HVAC unit fan is running.

In all cases, before the series box fan can be activated, the air damper is driven fully closed and held that way for 30 seconds to make sure the series box fan hasn't inadvertently started to spin backwards. Once the series box fan starts, it waits an additional 10 seconds to allow the fan to spin up before it starts to open the damper and introduce airflow from the HVAC unit fan.

Parallel Flow Fan Terminals

During normal cooling or vent mode and adequate air supply, the parallel fan will be off. During the Occupied Cooling Mode, the fan will only activate if the damper/airflow is below a user-defined low limit setting. This causes it to be used as a supplemental air source. When the damper/airflow rises 15% above the low limit setpoint, the fan will be deactivated.

NOTE: A VAV/Zone Controller Expansion Module is required for each VAV/Zone Controller used when you are using a Fan Terminal even if you do not have any heat requirements. All Single Duct Terminal Units with multiple heat stages or modulating heat also require a VAV/Zone Controller Expansion Module.

SEQUENCE OF OPERATIONS

VAVZB Occupied Mode Sequences

Space Heating Mode

Occupied Space Heating mode is initiated by the temperature in the space falling to within 0.5°F of the Occupied Heating Setpoint.

If the HVAC unit is in the Supply Air Cooling Mode and another VAVZB Controller has a heating demand, the damper/airflow for the VAVZB Controller requiring heating will position itself to provide the Cooling Minimum amount of air into the space. No modulation open will occur because the space does not want the cold air currently being supplied by the air handler.

When the HVAC unit is in the Occupied Supply Air Heating Mode, the damper will be held at the Heating Minimum position until the space temperature falls to within 0.5°F of the Occupied Heating Setpoint. As the Space Temperature falls below the Heating Setpoint, the damper/airflow calculation causes the air valve to open proportionally until the maximum setpoint is achieved at 1.5°F below the setpoint. This is a 2°F proportional window starting 0.5°F above the Heating Setpoint to 1.5°F below the Heating Setpoint.

Two different configurations are available for the Occupied Space Heating Mode. If the box is configured to allow reheat during Supply Air Heating Mode, the reheat relays can be activated even when the HVAC unit is in the Supply Air Heating Mode. If the box is configured not to allow reheat when the HVAC unit is in Supply Air Heating Mode, the box heat relays will be de-energized when the HVAC unit is in Supply Air Heating mode. In either configuration, when the HVAC unit is in the Supply Air Heating Mode, the damper will modulate open proportionally to the space demand. The proportional window for the space temperature is to 1.5°F below the Heating Setpoint. This allows the space to take advantage of the warm supply air in the duct.

The VAVZB Controller can activate auxiliary heating relays. Multiple heat stages or modulating heat can activate if the Expansion Module has been connected and the correct number of additional heating stages (2 or 3) has been configured. During demands for Heat, the first stage will activate whenever the space temperature drops below the Heating Setpoint. The second stage will activate if the Space Temperature falls 1.0°F below the Heating Setpoint. The third stage will activate if the Space Temperature falls 2.0°F below the Heating Setpoint. There is a two-minute delay between staging. This prevents stages from activating at the same time. Once a Heating Stage has been activated, it must remain on for at least one minute. Once it has been deactivated, it must remain off for at least two minutes. The third stage relay will deactivate when the Space Temperature rises to within 1.0°F of the Heating Setpoint. The second stage relay will deactivate when the Space Temperature rises to the Heating Setpoint. The first stage relay will deactivate when the Space Temperature rises above the Heating Setpoint by 1.0°F. See **Table 2** for a complete layout of the various Fan & Heat relay staging points.

Auxiliary Heat

The Auxiliary Heat option allows for a separate setpoint that is different from the other heating setpoints. The Auxiliary Heat Relay energizes at 0.5°F below the Auxiliary Heat Setpoint and de-energizes 0.5°F above the Auxiliary Heat Setpoint. The Auxiliary Heat will continue to function regardless of the HVAC Mode the Unit controller is in or at any airflow condition. This is typically used to control baseboard heat or an external duct heater. See **Table 2** for a complete layout of the various fan and heat relay staging points.

Fan & Reheat Relay Staging						
Relays Stage On At	Series Fan	Parallel Fan	Heat Stage 1	Heat Stage 2	Heat Stage 3	Aux. Heat
0.5°F Above Box Heat Setpoint	ON with HVAC fan*	X				
Box Heat Setpoint			X			
1.0°F Below Box Heat Setpoint				X		
2.0°F Below Box Heat Setpoint					X	
0.5°F Below Aux. Heat Setpoint						X
Relays Stage Off At	Series Fan	Parallel Fan	Heat Stage 1	Heat Stage 2	Heat Stage 3	Aux. Heat
1.0°F Above Box Heat Setpoint	OFF with HVAC fan*	X**				
1.0°F Above Box Heat Setpoint			X			
Box Heat Setpoint				X		
1.0°F Below Box Heat Setpoint					X	
0.5°F Above Aux. Heat Setpoint						X

NOTES: *1.) If check for main fan status is selected when configuring the controller, the series fan will energize anytime the HVAC unit's fan is operating, even in the unoccupied mode. **2.) The parallel fan will continue to run for 2 minutes following the relay staging off.

Table 2: Fan & Reheat Relay Staging

Modulating (Proportional) Heat

The VAVZB Controller Package with the Zone Controller Expansion Module provides an analog 0-10 VDC output for control of a Modulating Hot Water Valve, Steam Valve, or SCR Electric Heater. The default settings use a 0-100% direct acting control logic. As the temperature goes down, the output modulates from 0% (closed) which outputs 0 VDC, up to 100% (open) which outputs 10 VDC. The voltage output can be changed through the configuration to output 2-10 VDC instead of 0-10 VDC if the actuator requires this. When the space temperature drops to 0.5°F above the Heating Setpoint, the output starts at 0% and ramps

up to 100% at 1.5 below the Heating Setpoint. If the valve is a failsafe, 0 VDC or 2 VDC (if configured for 2-10 VDC control) equals full open and 10 VDC equals full closed. The configuration can be changed in the controller to reverse the VDC output. When configured for reverse acting for proportional heat, 0% (closed) would output 10 VDC and 100% (open) will output 0 VDC or 2 VDC (if configured for 2-10VDC control).

Series Flow Fan Terminals

If the VAVZB Controller has been configured as a Series Fan Powered terminal unit, the series fan relay will activate and run the series box fan continuously anytime the HVAC unit fan is running.

In all cases, before the series box fan can be activated, the air damper is driven fully closed and held that way for 30 seconds to make sure the series box fan hasn't inadvertently started to spin backwards. Once the series box fan starts, it waits an additional 10 seconds to allow the fan to spin up before it starts to open the damper and introduce airflow from the HVAC unit fan.

Parallel Flow Fan Terminals

On parallel fan powered terminal units, the fan will run whenever Space Heating Mode is active. At all other times, the fan will only activate if the damper/airflow is below a user defined low limit setting. This causes it to be used as a supplemental air source. When the damper/airflow rises 15% above the low limit setpoint, the fan will be deactivated if there are no heating stages active, and no space demand exists.

The check for main fan status setting has no effect on the Parallel Fan box when in the occupied mode. The Parallel Fan will only be energized when in the Space Heating Mode.

Unoccupied Mode Sequences

Space Vent Mode

This mode only applies to the Occupied Mode of operation. If the equipment is in the Unoccupied Mode, then a lack of Heating or Cooling demand would generate "No Space Demand" on the Unit Controller display.

Off Mode

This mode only applies to the Unoccupied Mode of operation. If the equipment is in the Unoccupied Mode, then a lack of heating or cooling demand would generate this mode. The VAV/Zone Controller will put the damper into the Night Minimum Position if "check main fan status" has been selected. If "check main fan status" has not been selected, the damper will be in the fully closed position.

Space Cooling Mode

During Unoccupied Mode, the HVAC unit is normally off. Unoccupied Space Cooling Mode is initiated by the temperature in the space rising to within 0.5°F of the Unoccupied Cooling Setpoint.

If the HVAC unit is in the Unoccupied Supply Air Heating Mode because one or more of the VAVZB Controllers has a Heating demand and another VAVZB Controller has a Cooling demand, the damper/airflow for the VAVZB Controller requiring Cooling will position itself to provide the Heating Minimum Setpoint amount of air into the space. No modulation open will occur because the space does not want the warm air currently being supplied by the air handler.

When the HVAC unit is in the Unoccupied Supply Air Cooling Mode, the damper will be held at the Night Minimum Position until the Space Temperature begins to rise above the Cooling Setpoint. As the Space Temperature rises to within 0.5°F of the Unoccupied Cooling Setpoint, the damper/airflow calculation causes the air valve to open proportionally until the maximum setpoint is achieved at 1.5°F above the setpoint. This is a 2°F proportional window starting 0.5°F below the Cooling Setpoint to 1.5°F above the Cooling Setpoint.

The damper/airflow is never allowed to modulate outside the user-adjusted minimum and the maximum setpoints. The Maximum Damper/Airflow Setpoint applies to Heating and Cooling Modes of operation only. All of the modes have their own individual minimum setting.

Series Flow Fan Terminals

If the VAVZB Controller has been configured as a Series Fan Powered terminal unit and "Check for Main Status" has been selected, the series fan relay will activate and run the series box fan continuously anytime the HVAC unit fan is running. The damper will be held at the Night Minimum Position until the Space Temperature begins to rise above the Cooling Setpoint. If "Check for Main Status" has not been selected, the series fan relay will activate and run the series box fan when in the Space Cooling Mode. The damper will be in the fully closed position until the Space Temperature begins to rise above the Cooling Setpoint.

In all cases, before the series box fan can be activated, the air damper is driven fully closed and held that way for 30 seconds to make sure the series box fan hasn't inadvertently started to spin backwards. Once the series box fan starts, it waits an additional 10 seconds to allow the fan to spin up before it starts to open the damper and introduce airflow from the HVAC unit fan.

Parallel Flow Fan Terminals

In the Unoccupied Cooling Mode, the parallel fan will be off whether "Check for Main Status" has been selected or not. If "Check for Main Status" has been selected, the damper will be held at the Night Minimum Position until the Space Temperature begins to rise above the Cooling Setpoint. If "Check for Main Status" has not been selected, the damper will be held in the fully closed position until the Space Temperature begins to rise above the Cooling Setpoint.

SEQUENCE OF OPERATIONS

VAVZB Unoccupied Mode Sequences

Space Heating Mode

During Unoccupied Mode, the HVAC unit is normally off. Unoccupied Space Heating Mode is initiated by the temperature in the space falling to within 0.5°F of the Unoccupied Space Heating Setpoint.

If the HVAC unit is in the Unoccupied Supply Air Cooling Mode because one or more of the VAV/Zone Controllers has a cooling demand and another VAV/Zone Controller has a heating demand, the damper/airflow for the VAV/Zone Controller requiring heating will position itself to provide the Night Minimum Position Setpoint amount of air into the space. No modulation open will occur because the space does not want the cold air currently being supplied by the air handler.

When the HVAC unit is in the Unoccupied Supply Air Heating Mode, the damper will be held at the Night Minimum Position until the Space Temperature begins to fall below the Unoccupied Heating Setpoint. As the Space Temperature falls to 0.5°F below the Unoccupied Heating Setpoint, the damper/airflow calculation causes the air valve to open proportionally until the maximum setpoint is achieved at 1.5°F below the setpoint. This is a 2°F proportional window starting 0.5°F above the Heating Setpoint to 1.5°F below the Heating Setpoint.

As with the Occupied Mode of operation, two different configurations are available for the Unoccupied Space Heating Mode. If the box is configured to allow reheat during Supply Air Heating Mode, the reheat relays can be activated even when the HVAC unit is in the Supply Air Heating Mode. If the box is configured not to allow reheat when the HVAC unit is in Supply Air Heating Mode, the box heat relays will be de-energized when the HVAC unit is in Supply Air Heating Mode. In either configuration, when the HVAC unit is in the Supply Air Heating Mode, the damper will modulate open proportionally to the space demand. The proportional window for the space temperature is 0.5°F above to 1.5°F below the Heating Setpoint. This allows the space to take advantage of the warm supply air in the duct.

If “Check for Main Status” is not selected and the VAV/Zone terminal unit has auxiliary heat (baseboard heat etc.) that does not require the HVAC unit fan to operate, reheat can be used without the HVAC unit fan operating. If “Check for Main Status” is selected, the reheat will only operate when the HVAC unit fan is operating.

The VAV/Zone Controller can activate auxiliary heating relays. Multiple heat stages or modulating heat can activate if the Expansion Module has been connected and the correct number of additional heating stages (2 or 3) has been configured. During demands for Heat, the first stage will activate whenever the Space Temperature drops below the Heating Setpoint. The second stage will activate if the Space Temperature falls 1.0°F below the Heating Setpoint. The third stage will activate if the Space Temperature falls 2.0°F below the Heating Setpoint. There is a two-minute

delay between staging. This prevents stages from activating at the same time. Once a heating stage has been activated, it must remain on for at least one minute. Once it has been deactivated, it must remain off for at least two minutes. The third stage relay will deactivate when the Space Temperature rises to within 1.0°F of the Heating Setpoint. The second stage relay will deactivate when the Space Temperature rises to the Heating Setpoint. The first stage relay will deactivate when the Space Temperature rises above the Heating Setpoint by 1.0°F. See **Table 2, page 28** for a complete layout of the various fan & heat relay staging points.

Auxiliary Heat

The Auxiliary Heat option allows for a separate setpoint that is different from the other heating setpoints. The Auxiliary Heat Relay energizes at 0.5°F below the Auxiliary Heat Setpoint and de-energizes 0.5°F above the Auxiliary Heat Setpoint. The night offsets would apply to these values. The Auxiliary Heat will continue to function regardless of the HVAC Mode the Unit Controller is in, or at any airflow condition. This is typically used to control baseboard heat or an external duct heater.

Modulating (Proportional) Heat

The VAVZB Controller Package provides an analog 0-10 VDC output for control of a Modulating Hot Water Valve, Steam Valve, or SCR Electric Heater. The default settings use a 0-100% direct acting control logic. As the temperature goes down, the output modulates from 0% (closed) which outputs 0 VDC, up to 100% (open) which outputs 10 VDC. The voltage output can be changed through the configuration to output 2-10 VDC instead of 0-10 VDC if the actuator requires this. When the space temperature drops to 0.5°F above the Unoccupied Heating Setpoint, the output starts at 0% and ramps up to 100% at 1.5 below the Heating Setpoint. If the valve is a failsafe, 0 VDC or 2 VDC (if configured for 2-10 VDC control) equals full open and 10 VDC equals full closed. The configuration can be changed in the controller to reverse the VDC output. When configured for reverse acting for proportional heat, 0% (closed) would output 10 VDC and 100% (open) will output 0 VDC or 2 VDC (if configured for 2-10VDC control).

Series Flow Fan Terminals

If the VAVZB Controller has been configured as a Series Fan Powered terminal unit, the series fan will run continuously when the VAVZB Controller is in the Space Heating Mode, no matter whether check for main fan status has been selected or not. If the HVAC unit is in Supply Air Heating Mode, the damper will modulate to maintain the Space Heating Setpoint.

Any series fan terminal unit that has “Check for Main Status” selected will also operate its series box fan anytime the HVAC unit controller is broadcasting that the HVAC unit fan is operating, regardless of whether it is calling for heat or not. The damper will be held at the closed position until the main fan status broadcast is received. Once the broadcast is received, the damper will then

move to its Reheat Minimum position. If “Check for Main Status” has not been selected, the series box fan will only activate and run when it is in Space Heating Mode. When in Space Heating Mode, the damper will move to its Reheat Minimum position. When in Supply Air Heating Mode, the damper will modulate to maintain the Unoccupied Heating Setpoint.

In all cases, before the series box fan can be activated, the air damper is driven fully closed and held that way for 30 seconds to make sure the series box fan hasn't inadvertently started to spin backwards. Once the series box fan starts, it waits an additional 10 seconds to allow the fan to spin up before it starts to open the damper and introduce airflow from the HVAC unit fan.

Parallel Flow Fan Terminals

If the VAVZB Controller has been configured as a Parallel Fan Powered terminal unit, the Parallel fan will run continuously when the VAVZB Controller is in the Space Heating Mode no matter whether “Check for Main Status” has been selected or not. At all other times, the fan will be off.

If “Check for Main Status” is selected, the damper will remain in the closed position until the HVAC unit controller is broadcasting that the HVAC unit fan is operating, regardless of whether it is calling for heat or not. The damper will be held at the closed position until the main fan status broadcast is received. Once the broadcast is received, the damper will then move to its Night Minimum position. If “Check for Main Status” has not been selected, the damper will stay in the closed position until Space Heating Mode is initiated. When in Space Heating Mode the damper will move to its Reheat Minimum position. When in Supply Air Heating Mode the damper will modulate to maintain the Unoccupied Heating Setpoint.

Damper Control

The damper position is calculated by the demand from the space. This calculation can also include an optional Integral function. This prevents the damper/airflow from stagnating at a position somewhere above the setpoint because the Supply Air Temperature or Duct Pressure isn't quite enough to satisfy the space at the currently calculated proportional position. The Integral causes the calculation to keep adding a small amount of the proportional error back into the damper/airflow position each time a new position is calculated. The amount the Integral adds back in is user-adjustable. This value is presented as a number between 0.0 and 10.0. That means that if the Integral is less than 1.0, you are adding a percentage from 0 to 100% of the error back into the calculation. If you increase the Integral above 1.0, you are adding more than 100% back in.

With just proportional control, a 1°F error would cause a 50% increase in damper/airflow if the Integral is not included. (1°F is half of the 2°F Proportional Window).

If you had set the Integral to 1.0, the calculation would add 2% to the current damper/airflow calculation each time. The calculation occurs once every 10 seconds, so it would take a little over 4 minutes to reach the programmed 100% maximum.

Example:

1. 50% Remaining / 2% Integral = 25 moves to get to a 100% Maximum
2. 25 Moves times 10 seconds = 250 seconds or a little over 4 minutes to reach the 100% maximum damper/airflow position.

Of course, different Space Temperature errors and different Integral values cause this calculation to operate slower or faster. It is up to the user to determine the optimum setting that provides the tightest temperature control without causing the damper to continue to hunt or modulate which causes premature wear of the actuator gears and motor.

On pressure dependent terminal units, the damper position is maintained to within $\pm 3\%$ of the calculated position. No attempt is made to position the damper exactly on the calculated position. This reduces wear and tear on the actuator gears and motors and the amount of airflow involved is not affected by that small amount of damper error.

On pressure independent terminal units, the airflow is maintained to within roughly 3% of the terminal unit size constant but no tighter than 16 CFM on the smallest terminal units. The actual control window is based on the formula:

$$\text{Window} = \text{Terminal unit size} \times \text{Square Root} (1 / 750)$$

where Terminal unit size refers to the total rated CFM of the terminal unit

This sliding window allows the control to be much tighter on the smaller terminal units than can be achieved on the larger terminal units as far as CFM readings. On a large terminal unit, 25 CFM may not be noticeable, but on a small terminal unit, 25 CFM may be more than the minimum airflow setting for the space.

If the pressure sensor is disconnected or fails on a pressure independent terminal unit, the controller automatically reverts to pressure dependent operation and generates an alarm to alert the user that a failure has occurred.

On either type of terminal unit, a space sensor failure will force the damper to position itself to 50% of the maximum damper position setpoint, and it will not change until the sensor is repaired or replaced.

Zoning

Zoning

The Orion Control System can be configured to operate as a true zoning system with the addition of a MiniLink PD 5. The MiniLink PD 5 acts as a loop manager receiving information from the VAVZB Controller Packages, interpreting this information, and then sending a heat, cool, or vent signal to the Unit Controller. Only 16 zones can be configured as voting zones per loop. Additional zones will be non-voting.

Zone Polling

The MiniLink PD 5 must be configured for zoning operation using the Modular Service Tool SD, System Manager SD, or Prism 2 computer software. During the setup and configuring, the user is required to enter the last Zone address on the loop. Once configured, the MiniLink PD 5 begins polling each VAV/Zone Controller for its temperature and setpoint information. A zone poll cycles through all configured zones in one pass without interruption.

The following is a list of status information required by the MiniLink PD 5 to correctly perform its HVAC mode calculations.

- Zone Temperature
- Current Cooling Setpoint
- Current Heating Setpoint
- Current Zone Operating Mode Status & Alarm Conditions

A zone is considered Missing if it fails to respond to 5 consecutive polling requests. A Missing Zone alarm can be generated in less than 2 minutes. This alarm can generate an alarm callout to maintenance or a supervisor if the system has been properly setup. See the “Alarm Detection and Reporting” section on **page 33** for more information.

Zone Voting

If a zone has been configured for the Voting mode, the MiniLink will perform the following tests based on the data received during the zone polling operation. These tests ensure that only properly operating zones can have an effect on the HVAC Mode calculation.

- The zone has not been reported as Missing
- The zone is not currently undergoing Damper Calibration
- The zone damper does not have an alarm condition
- The zone temperature readings are between 40°F and 105°F
- The Zone Cooling Setpoint is between 55°F and 105°F
- The Zone Heating Setpoint is between 48°F and 99°F
- The zone has not been declared Maverick by the MiniLink
- The zone has been configured as a Voting zone

If *all* the above tests are passed, the zone temperature and setpoints are then included in the HVAC mode decision; otherwise, this zone is ignored.

Testing for Maverick Zones

During the HVAC mode decision process, a zone cannot be included in the Voting if it has been declared as Maverick. A zone is determined to be a Maverick if it stays 4°F below the Space Heating Setpoint for 1 hour or 4°F above the Space Cooling Setpoint for 1 hour. During this 1 hour time period, the zone is still included in the voting, but it generates a Priority call for Heating or Cooling to the MiniLink. During this 1 hour time period, if the Space Temperature moves to within 2°F of its Space Heating or Space Cooling Setpoint, the Priority and Maverick are both canceled. If the zone stays in Priority for greater than 1 hour, it then becomes a Maverick zone. At that point, its Priority is canceled and the zone is ignored in the voting process until the Space Temperature changes to within 2°F of its Space Heating or Space Cooling Setpoint. If at least 75% of the zones go Maverick simultaneously, the MiniLink assumes an abnormal condition has occurred in the building and resets all the zones back to normal. It then restarts the 1 hour Maverick test over again for all zones. Maverick testing can be disabled if your system is connected to a computer with Prism 2, the Modular System Manager SD, or the Modular Service Tool SD.

Alarm Detection and Reporting

The VAVZB Controller continuously performs self diagnostics during normal operations to determine if any operating failures have occurred. These failures can be reported to the user in several ways, depending on the type of system and options installed by the user. If a System Manager TS-L is connected, the alarms will be reported on the Status Screens. If the Prism 2 computer software is installed, the alarms will be reported on the main screen of the program and be logged to disk. If the remote communications option is installed, all alarms can initiate an e-mail to alert someone to the alarm condition. See the *Prism 2 Technical Guide* for further information on this topic.

VAVZB Controller Alarms

Space Sensor Failure Alarm

If the controller detects an open or short on the Space Sensor input, this alarm will be generated.

CFM Sensor Failure Alarm

If the Airflow Constant (K Factor) is set to any value other than zero, and the controller does not detect the Airflow Sensor, this alarm will be generated.

Damper Opening Alarm

After initial calibration, if the damper is called to be fully open and cannot reach that position within approximately 2 minutes, this alarm will be generated.

Damper Closing Alarm

After initial calibration, if the damper is called to be fully closed and cannot reach that position within approximately 2 minutes, this alarm will be generated.

High Space Temp Alarm

If the zone temperature is above the Cooling Setpoint by the High Zone Alarm Offset (user adjusted) for the Zone Alarm Delay Period (user adjusted), this alarm will be generated.

Low Space Temp Alarm

If the zone temperature is below the Heating Setpoint by the Low Zone Alarm Offset (user adjusted) for the Zone Alarm Delay Period (user adjusted), this alarm will be generated.

Damper Feedback Failure Alarm

If the controller fails to detect the actuator feedback signal, this alarm will be generated.

Tenant Override Logs

If you require tenant billing for push-button override usage, a MiniLink PD 5 must be installed on each local loop. The MiniLink PD 5 has the ability to track the amount of override time generated by each space sensor equipped with push-button override.

Storing and retrieving these logs requires a dedicated computer running the Prism 2 front-end software program. No other method exists for retrieving these logs. This means that all of your units must be connected together on the communications loop and the loop must be terminated at a CommLink device connected to the on-site computer.

WARNING: The computer must be powered on 24 hours a day, 7 days a week running the Prism 2 software in order for tenant logging to be tracked.

The tenant logs are kept on the dedicated jobsite computer's hard drive. The only limitation to the number of logs stored is the capacity of the hard drive on the computer to which it is being logged.

NOTE: For proper time and date stamping of the tenant log, you must configure the air handler to broadcast the time so that the VAVZB Controllers can read it and use it in their tenant and trend logs.

SEQUENCE OF OPERATIONS

Internal Trend Logs & Force Modes or Overrides

Internal Trend Logging

In order to retrieve and utilize these logs, a computer with Prism 2 computer software installed must be connected to the Orion Controls System. The VAVZB Controller continuously maintains an Internal Trend Log, which records a fixed set of values at an interval configured by the user.

There are 120 log values available. Once all 120 log values have been recorded, the oldest value is replaced by each subsequent new value. This means the user is required to retrieve the logs at an interval that is shorter than the duration of the last 120 logs. Shown below are some log intervals and the duration of 120 logs.

1 minute interval	2 hour duration
15 minute interval	30 hour duration
30 minute interval	60 hour duration
60 minute interval	120 hour duration

The fixed items in the log are listed below with the column header in parentheses:

- Date (Date)
- Time (Time)
- Space Temperature (Space)
- Active Cooling Setpoint (CoolSP)
- Active Heating Setpoint (HeatSP)
- Supply Air Temperature (SAT)
- Discharge Air Temperature (DAT)
- Airflow (Airflow) [P.I. Units Only]
- Damper Position (Damper)
- Proportional Heat (Heat)
- Current Operating Mode (Mode)
- Space Temperature Mode (SPCMode)
- SAT Mode (SATMode)
- Fan Status (Box)
- Box Heat Stages (BoxHt)
- Auxiliary Heat Stages (AuxHt)

NOTE: For proper time and date stamping of the tenant log, you must configure the Unit Controller to broadcast the time so that the VAVZB Controllers can read it and use it in their tenant and trend logs.

CAUTION: These logs are subject to loss if a power outage occurs.

Force Modes or Overrides

The VAVZB Controller damper can be forced to one of several positions. These force modes aid the user during troubleshooting or air balancing, etc.

- Force Damper Full Open (ignores Airflow reading)
- Force Damper Full Closed (ignores Airflow reading)
- Force to Maximum Airflow/Damper Setpoint
- Force to Minimum Airflow/Damper Setpoint
- Force to Fixed Airflow/Damper Setpoint
- Force Damper to Re-Calibrate

The Force to Fixed Airflow/Damper Mode also has a setpoint associated with it. This allows the user to provide a non-changing fixed amount of air into the space that doesn't affect the minimum or maximum setpoints. This means the user doesn't have to disturb the real minimum and maximum setpoints to achieve a nonstandard setting during their troubleshooting or air balancing modes.

The Force to Minimum Mode uses the currently active minimum setting based on the Vent, Cooling, or Heating Modes. Whatever mode the VAV/Zone Controller is in determines the minimum used by the force mode.

The damper force modes will remain in effect until cancelled by the user or until the power is removed. Unlike the Unit Controllers which require the initiating device to be present at all times during a force mode, the damper force modes are more permanent since they are less likely to damage any equipment. There are no force commands available for the auxiliary relays.

Using LEDs To Verify Operation

The VAV/Zone Controller is equipped with LEDs that can be used to verify operation and perform troubleshooting. See **Figure 17** for the LED locations. The LEDs and their uses are as follows:

Operation LEDs - Factory Troubleshooting

POWER - This green LED will light up to indicate that 24 VAC power has been applied to the controller.

BASIC - This green LED will light up and blink continuously to indicate the operating system is working properly.

TIMER - This green LED will light up and stay lit to indicate the operating system is working properly.

WDOG - This green LED will light up and stay lit to indicate the operating system is working properly.

Communication LEDs

EBUS - This yellow LED will blink to signal E-BUS communications.

LOOP COMM - This yellow LED will light up and blink continuously to indicate the VAVZB is communicating.

BACNET - This yellow LED will light up and blink continuously to indicate BACnet® communications.

Diagnostic LEDs

ALARM - This green/red LED located directly above the LCD display is a diagnostic blink code LED. It will light up red and stay lit when there is an alarm present. The type of alarm will display on the LCD display.

STAT 1 - This red LED is a diagnostic blink code LED. It blinks continuously while in TEST MODE at address 63. Under normal operation, it should not be blinking.

STAT 2 - This red LED is a diagnostic blink code LED. It blinks continuously while in TEST MODE at address 63. This LED should blink every 10 seconds to indicate normal operation.

AUX HEAT RELAY LED - This yellow LED will blink to signal the Aux Heat Relay is enabled.

CCW LED & CW LED - These yellow LEDs blink or are on steady depending on the direction the damper is currently being driven.

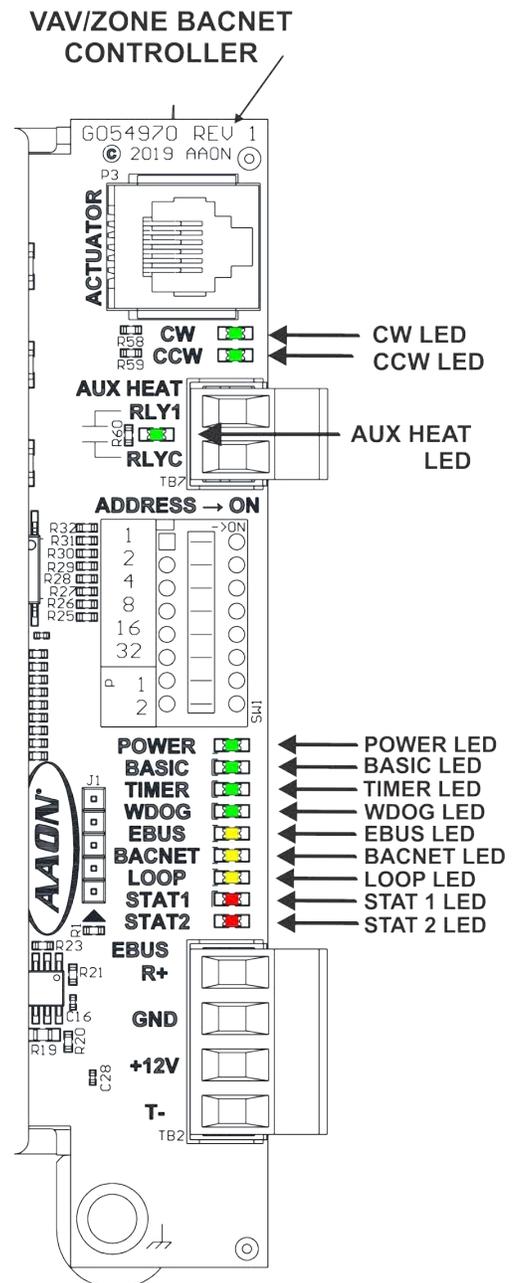


Figure 17: VAV/Zone BACnet® Controller LED Locations

Other Checks

Analog Space Temperature Sensor

If the Space Temperature Sensor is not reading a valid temperature, make sure the wiring terminal connections are tight and that any wiring splices are properly connected. You can check the operation of the Space Temperature Sensor by measuring the resistance or voltage using a digital multimeter. Set the meter to DC Volts. Place the positive probe on the AIN terminal and the negative probe on the GND terminal. Read the DC Volts and find that voltage in **Table 3, page 39**. Read the temperature corresponding with that voltage and determine if this is close to the actual temperature the sensor is exposed to. If the temperature from the chart is different by more than a few degrees, you probably have a defective or damaged sensor. You can also check the sensor resistance to determine correct operation. To read the resistance, set the meter to Ohms. Unplug the sensor connector from the board and measure the resistance across the disconnected wires. This resistance should match the corresponding temperature from **Table 3, page 39**.

E-BUS Digital Room Temperature Sensor

If the E-BUS Digital Room Temperature Sensor is not displaying a valid temperature, first make sure that the E-BUS modular cable connector is firmly plugged into the E-BUS modular connector on the board and at the Temperature Sensor. If the problem persists, try swapping the sensor with a known good Room Temperature Sensor. If that sensor works when connected to the VAV/Zone Controller, you can assume you have a defective or damaged sensor. If you are using a terminal connector to connect the sensor, follow the instructions for the Analog Space Temperature Sensor.

Supply Air Temperature Sensor

If you suspect the Supply Air Temperature Sensor is not reading correctly, make sure the wiring terminal connections are tight and that any wiring splices are properly connected. You can check the operation of the Supply Air Temperature Sensor by measuring the resistance or voltage using a digital multimeter. Set the meter to DC Volts. Place the positive probe on the AIN terminal and the negative probe on the GND terminal. Read the DC Volts and find that voltage in **Table 3, page 39**. Read the temperature corresponding with that voltage and determine if this is close to the actual temperature the sensor is exposed to. If the temperature from the chart is different by more than a few degrees, you probably have a defective or damaged sensor. You can also check the sensor resistance to determine correct operation. To read the resistance, set the meter to Ohms. Unplug the sensor connector from the board and measure the resistance across the disconnected wires. This resistance should match the corresponding temperature from **Table 3, page 39**.

Airflow Sensor

If the Airflow Sensor seems to be reading incorrectly, check the Airflow Sensor tubing connections at the airflow pickup tubes. The high pressure port of the sensor needs to be connected to the upstream pickup tube. The low pressure port of the sensor needs to be connected to the downstream pickup tube.

The “Air Valve Sizing Constant” setting under the configuration settings for the VAVZB Controller must be set to a number other than 0. This number is normally referred to as the “K” factor and is supplied by the terminal unit manufacturer. It represents the airflow through the box inlet at 1” W.G. constant static pressure. This factor must be entered in the configuration screen or the airflow through the box will be incorrect.

If none of the procedures above solves the problem, remove power from the VAVZB Controller. Shut down the HVAC unit supplying the duct that the VAV/Zone damper is located on. Be sure that no airflow is present in the duct. Reapply power to the board and wait for the VAVZB Controller to run through its calibration sequence. Restart the HVAC unit and check the VAVZB Controller CFM readings. If the CFM reading still seems to be in error, you probably have a defective Airflow Sensor and will need to replace it.

Zone Damper Actuator

Check the Modular cable between the controller and the actuator. Be sure both ends of the cable are firmly connected to the mating connectors on the actuator and the VAVZB Controller. Be sure the damper moves freely and is not bound. Do this by pressing the actuator clutch button and rotating the damper shaft in both directions to verify smooth operation. If binding is present, fix the problem as required. Remove power from the VAVZB Controller. Reapply power and observe the damper rotation. If the actuator does not drive the damper in both directions, the actuator is probably defective or damaged. Another test that can be performed is to swap cables with another known operating actuator to determine if the cable could be bad. If the problem goes away, you have a defective cable that must be replaced. You can also try swapping a functioning actuator with the suspected defective actuator. If this solves the problem, the defective actuator will need to be replaced.

VAV/Zone Controller Expansion Module

If the VAV/Zone Controller Expansion Module does not seem to operate correctly, first make sure the E-BUS cable between the Expansion Module and the VAVZB Controller is firmly connected at both ends. Be sure that the Expansion Module has been configured correctly. The Expansion Module must be configured using the Modular Service Tool SD, Modular System Manager SD, or Prism 2 computer software for your application before it will operate. You must configure the number of heat stages, and if it is a fan terminal you must configure whether it is a Series Flow or Parallel Flow Fan Terminal unit. On a single duct non-fan terminal unit when a call for heat is initiated, the LED labeled RLY2 should light up. If the Expansion Module is configured as a fan terminal, on a call for the fan, the LED labeled RLY1 should light up. If the LEDs do not light up, the Expansion Module is probably defective and must be replaced.

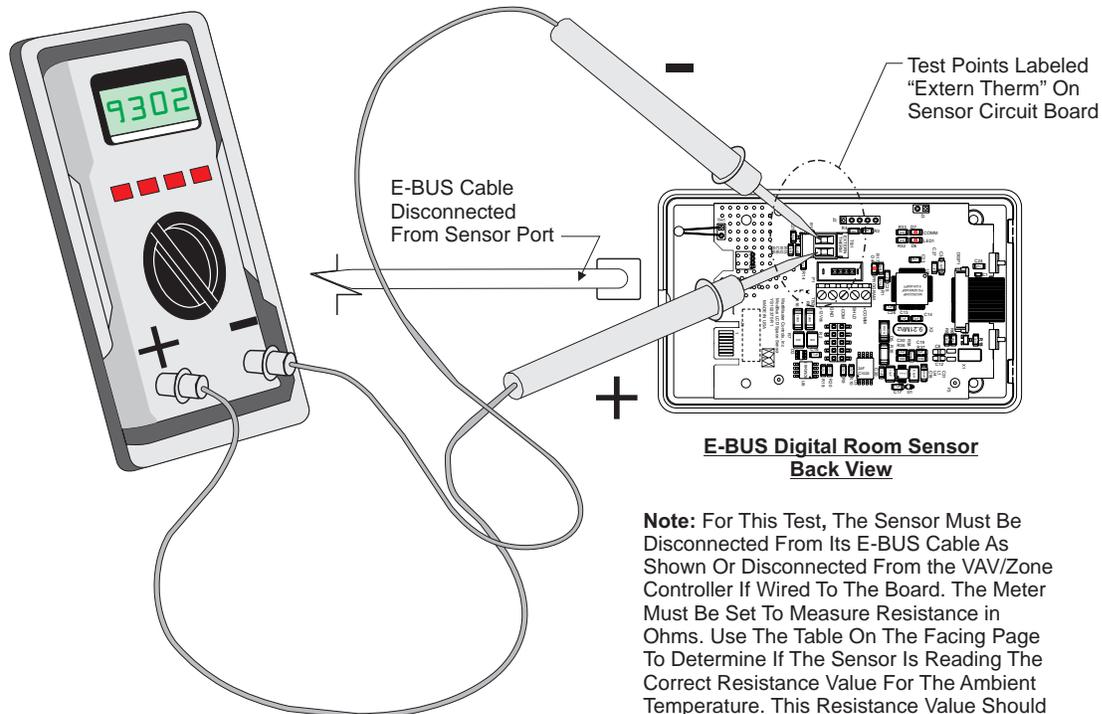
TROUBLESHOOTING

Temperature Sensor Testing

Temperature Sensor Testing

The sensor voltage and resistance tables (Tables 3 & 4, pages 39 & 40) is provided to aid in checking sensors that appear to be operating incorrectly. Many system operating problems can be traced to incorrect sensor wiring. Be sure all sensors are wired per the wiring diagrams in this manual.

If the sensors still do not appear to be operating or reading correctly, check voltage and/or resistance to confirm that the sensor is operating correctly per the table. Please follow the notes and instructions in **Figure 18, below** when checking sensors.



Note: For This Test, The Sensor Must Be Disconnected From Its E-BUS Cable As Shown Or Disconnected From the VAV/Zone Controller If Wired To The Board. The Meter Must Be Set To Measure Resistance in Ohms. Use The Table On The Facing Page To Determine If The Sensor Is Reading The Correct Resistance Value For The Ambient Temperature. This Resistance Value Should Match The Temperature Value Listed Next To The Resistance Value In The Table. The Temperature Should Be Measured With A Separate Accurate Temperature Measuring Device Located In The Area Where The Sensor Is Currently Located.

Measuring Digital Sensor Resistance

Figure 18: Testing Resistance on E-BUS Digital Room Sensors

0-3V Temperature/Resistance/Voltage Table

TEMPERATURE TO RESISTANCE/VOLTAGE CHART							
Temp (°F)	Temp (°C)	Resistance (Ohms)	Voltage @ Input (VDC)	Temp (°F)	Temp (°C)	Resistance (Ohms)	Voltage @ Input (VDC)
-10	-23.3	93333	2.98	72	22.2	11136	1.74
-5	-20.6	80531	2.94	73	22.7	10878	1.72
0	-17.8	69822	2.89	74	23.3	10625	1.70
5	-15.0	60552	2.83	75	23.9	10398	1.68
10	-12.2	52500	2.77	76	24.4	10158	1.66
15	-9.4	45902	2.71	78	25.6	9711	1.63
20	-6.7	40147	2.64	80	27.8	9302	1.59
25	-3.9	35165	2.57	82	27.8	8893	1.55
30	-1.1	30805	2.49	84	28.9	8514	1.52
35	1.6	27140	2.41	86	30.0	8153	1.48
40	4.4	23874	2.33	88	31.1	7805	1.45
45	7.2	21094	2.24	90	32.2	7472	1.41
50	10.0	18655	2.15	95	35.0	6716	1.33
52	11.1	17799	2.11	100	37.8	6047	1.24
54	12.2	16956	2.08	105	40.6	5453	1.16
56	13.3	16164	2.04	110	43.3	4923	1.09
58	14.4	15385	2.00	115	46.1	4449	1.02
60	15.6	14681	1.96	120	48.9	4030	.95
62	16.7	14014	1.93	125	51.7	3656	.88
64	17.8	13382	1.89	130	54.4	3317	.82
66	18.9	12758	1.85	135	57.2	3015	.76
68	20.0	12191	1.81	140	60.0	2743	.71
69	20.6	11906	1.79	145	62.8	2502	.66
70	21.1	11652	1.78	150	65.6	2288	.61
71	21.7	11379	1.76				

Table 3: 0-3V Temperature/Resistance/Voltage

TROUBLESHOOTING

0-5V Temperature/Resistance/Voltage Table

TEMPERATURE - RESISTANCE - VOLTAGE FOR TYPE III 10 K OHM THERMISTOR SENSORS							
Temp (°F)	Temp (°C)	Resistance (Ohms)	Voltage @ Input (VDC)	Temp (°F)	Temp (°C)	Resistance (Ohms)	Voltage @ Input (VDC)
-10	-23.33	93333	4.51	72	22.22	11136	2.635
-5	-20.55	80531	4.45	73	22.77	10878	2.605
0	-17.77	69822	4.37	74	23.33	10625	2.576
5	-15	60552	4.29	75	23.88	10398	2.549
10	-12.22	52500	4.2	76	24.44	10158	2.52
15	-9.44	45902	4.1	77	25	10000	2.5
20	-6.66	40147	4.002	78	25.55	9711	2.464
25	-3.88	35165	3.891	80	26.66	9302	2.41
30	-1.11	30805	3.773	82	27.77	8893	2.354
35	1.66	27140	3.651	84	28.88	8514	2.3
40	4.44	23874	3.522	86	30	8153	2.246
45	7.22	21094	3.39	88	31.11	7805	2.192
50	10	18655	3.252	90	32.22	7472	2.139
52	11.11	17799	3.199	95	35	6716	2.009
54	12.22	16956	3.143	100	37.77	6047	1.884
56	13.33	16164	3.087	105	40.55	5453	1.765
58	14.44	15385	3.029	110	43.33	4923	1.65
60	15.55	14681	2.972	115	46.11	4449	1.54
62	16.66	14014	2.916	120	48.88	4030	1.436
64	17.77	13382	2.861	125	51.66	3656	1.339
66	18.88	12758	2.802	130	54.44	3317	1.246
68	20	12191	2.746	135	57.22	3015	1.159
69	20.55	11906	2.717	140	60	2743	1.077
70	21.11	11652	2.691	145	62.77	2502	1.001
71	21.66	11379	2.661	150	65.55	2288	0.931

Table 4: 0-5V Temperature/Resistance/Voltage for Type III 10K Ohm Thermistor Sensors

Navigation Keys & Editing Keys

LCD Display Screen & Navigation Keys

The LCD display screens and buttons allow you to view status and alarms, enable force modes, and make BACnet® configuration changes. See **Figure 19, below** and refer to **Table 5** for Navigation Key functions. The keys also have editing functions. Refer to **Table 6** for Editing functions.

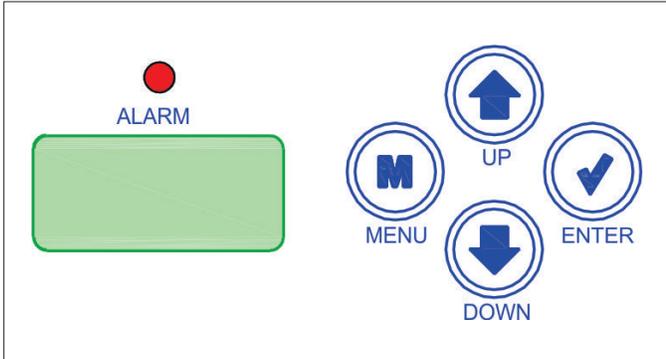


Figure 19: LCD Display and Navigation/Editing Keys

EDITING KEY	FUNCTION
<p>UP or DOWN</p>	<p>Use the UP or DOWN key to enter editing mode on a user-adjustable screen. Edit Mode is indicated by the underscore appearing on the screen.</p> <p>NOTE: Entering Edit Mode will also adjust the value up one (UP key) or down one (DOWN key), so you may have to readjust the value.</p>
<p>ENTER</p>	<p>Use the ENTER key to move through the digits in the screen when editing a numeric value. An extended press of the ENTER key saves your edits no matter the location of the editing cursor within the digits.</p> <p>Press the ENTER key to save a non-numeric value - such as Hi Speed Network.</p>
<p>MENU</p>	<p>The MENU key cancels editing when in Edit Mode. The screen you were editing will return to its original value and the underscore will disappear.</p> <p>A second press of the MENU key will return you to the Main Menu.</p>

NAVIGATION KEY	KEY FUNCTION
<p>MENU</p>	Use the MENU key to move through screens within Main Menu categories and return to the Main Menu while at other screens.
<p>UP</p>	Use this key to adjust setpoints and change configurations.
<p>DOWN</p>	Use this key to adjust setpoints and change configurations.
<p>ENTER</p>	Use the ENTER key to navigate through the Main Menu Screen categories.

Table 5: Navigation Key Functions

Table 6: Editing Key Functions

VAVZB Main Screen Map & Settings Screens

VAVBOX Main Screens Map

Refer to the following map when navigating through the *VAVBOX Main Screens*. The first screen is an initialization screen. When power is first applied, the calibration screen below will appear. Calibration could take up to 1 minute. To scroll through the rest of the screens, press the <MENU> button. NOTE: The calibration screen does not apply to dump zones.

VAVBOX
1116VXXX

FEEDBACK
CALIBRAT

Press  to go to the *Settings Screen*.

Settings

Press  to scroll through the *Settings Screens*.

Press  to go to the *Status Screen*.

Status

Press  to scroll through the *Status Screens*.

Press  to go to the *Alarms Screen*.

Alarms or
No Alarms

Press  to scroll through the Alarms.

Press  to go to the *Factory Testing Screen*.

Factory
Testing

NOTE: This screen is for Factory Use Only.

Press  to return to the *VAVBOX Screen*.

Settings Screens

Refer to the following map when navigating through the Settings Screens. From the *Settings Screen*, press <ENTER> to scroll through the screens.

Settings



Unit ID#
Addr #1-58

UNIT ADDRESS

Unit address. Valid range is 1-58. Default is 0.



485 - Baud
Hi Speed or
Lo Speed

BAUD RATE SPEED

485 baud rate speed. Valid range Hi Speed or Lo Speed. Default is Hi Speed.



MAC Addr
0 TO 127

BACnet® - CURRENT MAC ADDRESS

Valid range is 0 to 127. Default is 1.

The <ENTER> key moves the cursor between the digit fields starting with the ones field. Once the cursor is under a field, use the <UP> & <DOWN> arrow keys to select a number between 0 and 9.



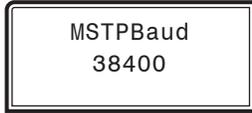
DEVICEID
15000

BACnet® - CURRENT DEVICE ID

A Device ID of up to 7 digits can be entered.

The <ENTER> key moves the cursor between the digit fields starting with the ones field. Once the cursor is under a field, use the <UP> & <DOWN> arrow keys to select a number between 0 and 9.

Settings Screens & Status Screens



BACnet® - CURRENT BAUD RATE

9600, 19200, 38400, 57600, 76800. Default is 38400.



CURRENT SPACE TEMPERATURE



COOLING SETPOINT



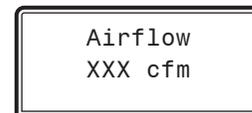
HEATING SETPOINT



DUCT TEMPERATURE READING FROM INPUT



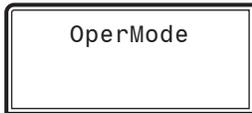
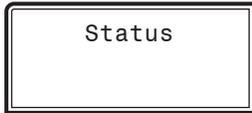
DISCHARGE TEMPERATURE READING FROM INPUT



AIRFLOW READING FROM INPUT

Status Screens

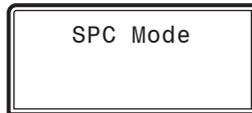
Refer to the following map when navigating through the Status Screens. From the *Status Screen*, press <ENTER> to scroll through the screens.



OPERATION MODE

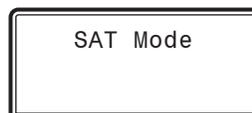
This screen displays the current mode of operation. Options are:

Unoccupy, Occupied, Override, Calibrate Override, WindOpen, Protect, Empty Rm



SPACE MODE

No Demand, Cool, Heat, Fail



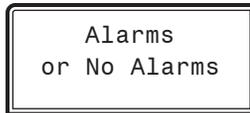
SAT MODE

Vent Mode, Heat Mode, Cool Mode

Alarm Screens

Alarm Screens

If there are no Alarms, the *Alarm Screen* will display “No Alarms.” If there are alarms present, the screen will display, “Alarms.” You can press <ENTER> to scroll through the alarms or you can let the alarms automatically scroll on the screen. For detailed alarm descriptions, see **page 33**.



No Alarms

This will be shown if there are no current alarms.

Active Alarms!

This will display if there are active alarms.

SPACE SENSOR	Space Temperature Sensor Failure Alarm
AIRFLOW SENSOR	Airflow Sensor Alarm
DMPOPEN FAILURE	Damper Open Alarm
DMPCLOSE FAILURE	Damper Closed Alarm
HI SPACE ALARM	High Space Temperature Alarm
LO SPACE ALARM	Low Space Temperature Alarm
FEEDBACK FAILURE	Feedback Failure Alarm

BACnet® Connection To MS/TP Network

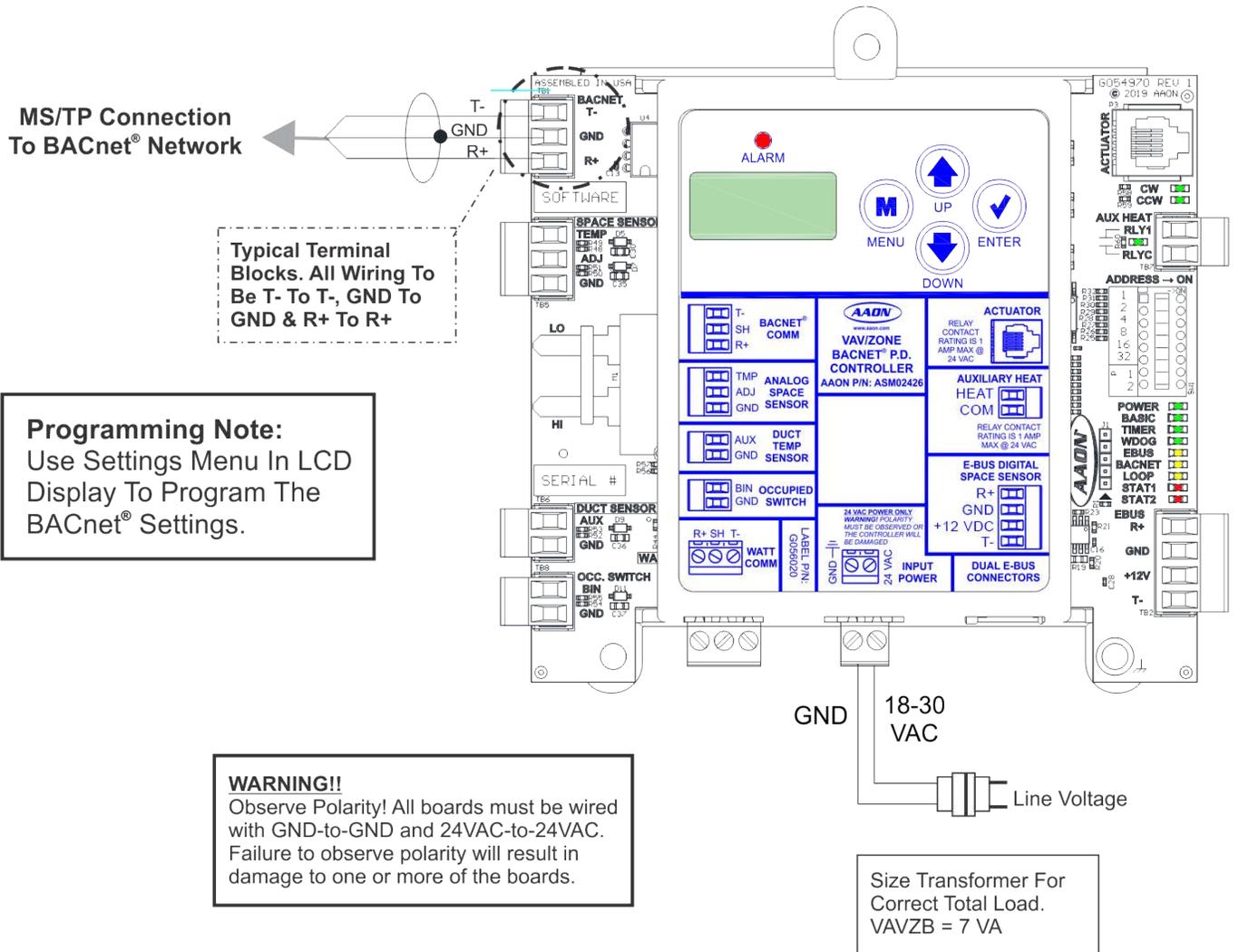


Figure 20: BACnet® Connection to MS/TP Network

BACnet® Analog Inputs

BACNET® ANALOG INPUTS		
BACnet® Point Type	Number	BACnet® Point Name
AI	1	Application Software Version
AI	2	Space Temperature
AI	3	Active Cooling Setpoint
AI	4	Active Heating Setpoint
AI	5	Slide Offset Effect
AI	6	Duct Temperature
AI	7	Discharge Temperature
AI	8	Damper Position
AI	9	Pressure Independent Airflow
AI	10	Active Heat Stages
AI	11	Modulating Heat Signal

Table 7: BACnet® MS/TP Parameter Analog Inputs

BACnet® Analog Values

BACNET® ANALOG VALUES				
BACnet® Point Type	Number	Limit Range		BACnet® Point Name
AV	1	50°	90°	Occupied Cooling Setpoint
AV	2	50°	90°	Occupied Heating Setpoint
AV	3	0°	30°	Unoccupied Cooling Setpoint Offset
AV	4	-30°	0°	Unoccupied Heating Setpoint Offset
AV	5	1°	50°	Cooling Alarm Limit Offset
AV	6	-50°	-1°	Heating Alarm Limit Offset
AV	7	0°	5°	Maximum Slide Offset Effect
AV	8	0.0 Hr	8.0 Hr	Push-Button Override Duration
AV	9	50°	90°	Heating Setpoints to Call on Main Heat
AV	10	50°	90°	Auxiliary Heat Setpoint
AV	11	0	30000	Maximum Damper/Airflow Setting
AV	12	0	30000	Vent Mode Damper/Airflow Setting
AV	13	0	30000	Cooling Mode Damper/Airflow Setting
AV	14	0	30000	Heating Mode Damper/Airflow Setting
AV	15	0	30000	Unoccupied Damper/Airflow Setting
AV	16	0	30000	Parallel Fan On Damper/Airflow Setting
AV	17	0	30000	Damper Force Mode Fixed Position
AV	18	0	30000	Box Heating Min Damper/Airflow Setting
AV	19	0	1	Requires Main Fan Status for Heating
AV	20	0	1	Force Damper to Fixed Position
AV	21	-100°	100°	Space Sensor Calibration Offset
AV	22	-100°	100°	Discharge Sensor Calibration Offset
AV	23	0°	30°	Vacant Room Cooling Mode Offset
AV	24	-30°	0°	Vacant Room Heating Mode Offset

Table 8: BACnet® MS/TP Parameter Analog Values

BACnet® Binary Inputs

BACNET® BINARY INPUTS			
BACnet® Point Type	Number	BACnet® Name	Value
BI	1	Box Fan Status	Status
BI	2	Heating Relay #1	Status
BI	3	Heating Relay #2	Status
BI	4	Main Fan Required	Status
BI	5	Main Fan Status	Status
BI	6	Airflow Too Low for Heating	Status
BI	7	Box Allowed to Vote	Status
BI	8	Box Fan Starting Delay Active	Status
BI	9	Auxiliary Heat Relay Status	Status
BI	10	Occupancy Status	Status
BI	11	Bad or Missing Space Sensor	Alarm
BI	12	Bad or Missing Airflow Sensor	Alarm
BI	13	Damper Failed to Move Clockwise	Alarm
BI	14	Damper Failed to Move Counter-Clockwise	Alarm
BI	15	High Space Temperature Alarm	Alarm
BI	16	Low Space Temperature Alarm	Alarm
BI	17	Damper Feedback Failure	Alarm

Table 9: BACnet® MS/TP Parameter Binary Inputs

BACnet® Multi-State Inputs

MULTI-STATE INPUTS		
BACnet® Point #	BACnet® Description	Limits
MSI: 1	Scheduled Mode of Operation	1 = Unoccupied Mode 2 = Occupied Mode 3 = Override Mode 4 = Calibrating Damper Feedback 5 = Group Override 6 = Open Window Forced Off 7 = Lost Communication with RTU 8 = Occupied Room is Empty
MSI: 2	Space Temperature HVAC Mode	1 = No Space Demand 2 = Space Cooling Mode 3 = Space Heating Mode 4 = Sensor Failure Mode
MSI: 3	Type of VAV Box	1 = Cooling Only Box 2 = Heat/Cool Changeover Box 3 = Series Fan Powered Box 4 = Parallel Fan Powered Box

Table 10: BACnet® MS/TP Parameter Multi-State Inputs

VAV/Zone Controller System Architecture

Single Loop VAV/Zoning

If you have a single HVAC unit that will be using VAV terminal units or are using a zoning system and don't have any CV units you should select the Single Loop Zoning System. On a Variable Volume Variable Temperature Zoning System up to 16 VAV/Zone Controllers can be configured as voting zones, and additional zone controllers can be non-voting zones. For VAV systems you can have up to 58 total VAV/Zone Controllers in addition to the HVAC unit controller for the VAV boxes.

The Unit Controller(s) are connected to a MiniLink communications interface which provides communications between all controllers on the local communications loop and the System Manager TS-L end-user interface, Modular System Manager SD operator interface, Prism 2 operator interface, or CommLink communication interface. The MiniLink provides for alarm polling of all VAV/Zone Controllers.

Each of the controllers are connected together and to the MiniLink by means of local loop communications cable. All communication wiring must be plenum-rated, minimum 18 gauge, 2-conductor, twisted pair with shield cable. AAON can supply communication wire that meets this specification and is color coded for the network or local loop or if desired, Belden #82760 or its equivalent wire may also be used.

The System Manager TS-L is an operator interface that can be used for monitoring of the system. It has a color touch screen display and intuitive graphical user interface.

In addition or as an alternative a CommLink communication interface can be provided that allows for connection to any computer which has the free Prism 2 software installed to provide for configuring and monitoring of the system. Prism 2 is a Windows®-based color graphical computer front end software package designed by AAON. An optional IP Module is also available to provide Internet connectivity to the control system.

Multiple Loop VAV/Zoning

If you have multiple HVAC units that will be using VAV Terminal Units or will be using a Zoning System and don't have any CV units you should select the Multiple Loop Zoning System. On a Zoning System each local loop allows up to 16 VAV/Zone Controllers that can be configured as voting zones, and additional controllers to be non-voting zones. For VAV systems you can have up to 58 total VAV/Zone Controllers in addition to the HVAC unit controller for the VAV boxes.

Each local loop is connected to its own MiniLink communications interface which provides communications between all controllers on the local communications loop and the System Manager TS-L end-user interface, Modular System Manager SD operator interface, Prism 2 operator interface, and/or the CommLink communication interface. The MiniLink provides for alarm polling of all the zone controllers.

On this type of system the CommLink communications interface is required and acts as the main hub for all the local loops on the system and passes communications between and across all the local loops. The wiring between the CommLink and all the MiniLink devices is called the network loop

Each of the controllers on the local loops are connected together and to the MiniLink by means of local loop communications cable. Each of the MiniLink devices are connected together and to the CommLink on the network loop using network communications cable. All communication wiring must be plenum-rated, minimum 18 gauge, 2 conductor, twisted pair with shield cable. AAON can supply communication wire that meets this specification and is color coded for the network loop or local loop, or if desired, Belden #82760 or its equivalent wire may also be used.

The System Manager TS-L is an operator interface that can be used for monitoring of the entire control system. It has a color touch screen display and intuitive graphical user interface. It can be located on any local loop on the system. Multiple System Manager TS-L operator interfaces can also be used if desired.

The CommLink communication interface is standard on the Multiple Loop type of system and allows for connection to any personal computer which has Prism 2 software installed to provide for configuring and monitoring of the system. Prism 2 is a Windows®-based color graphical computer front end software package designed by AAON. An optional IP Module is also available to provide Internet connectivity to the control system.

APPENDIX C - SYSTEM ARCHITECTURE

VAV/Zone Controller System Architecture

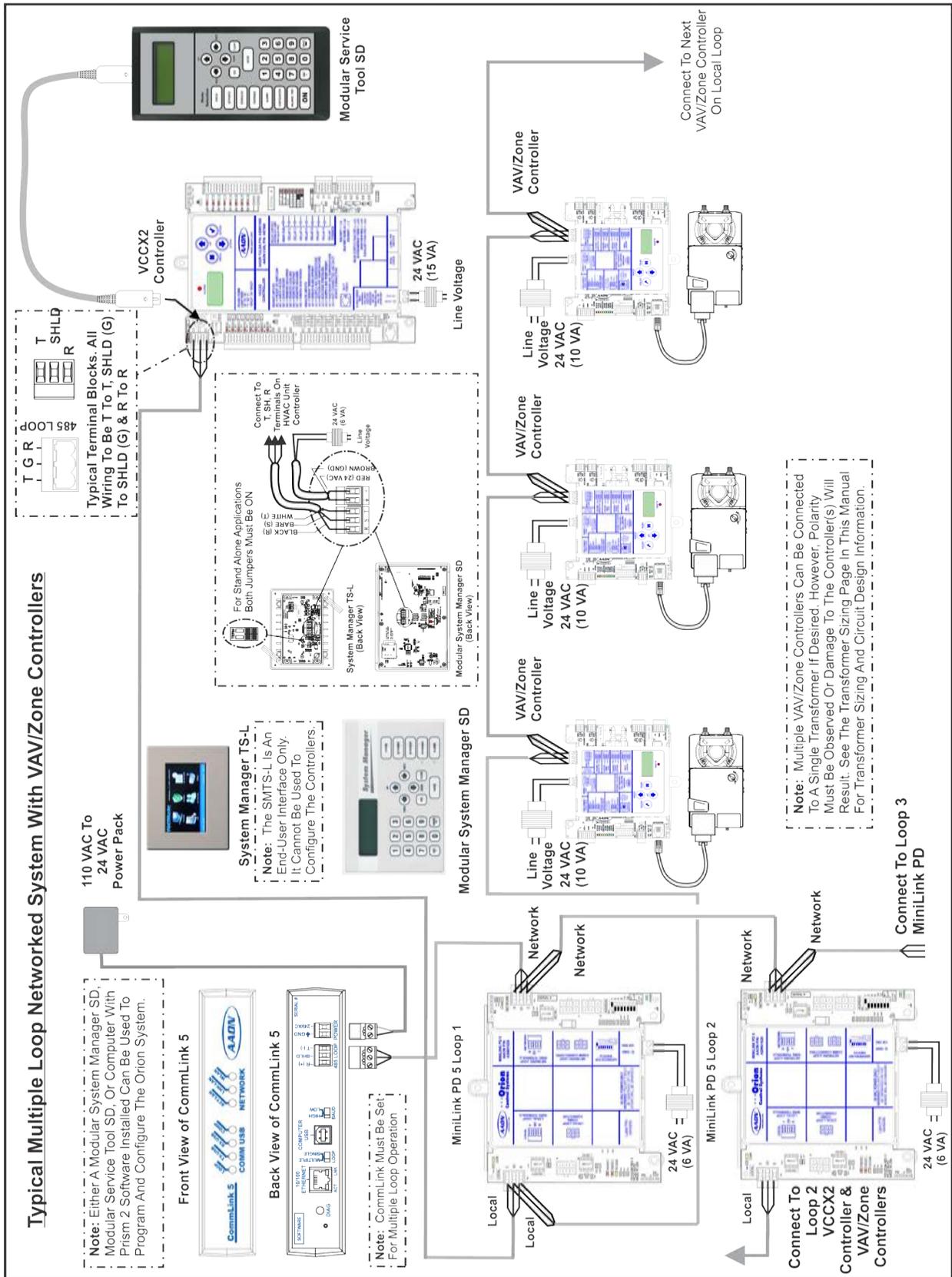


Figure 23: Networked Multiple Loop System Wiring With VAV/Zone Controllers

1 Stage Electric or On/Off HW Heat.....18
2-Conductor Wire.....14
24-Gauge.....14
24 VAC Power Terminal Block.....19
24 VAC-to-24 VAC.....15

A

Actuator Diagnostics.....37
Actuator Modular Connector.....19
Addressing.....15
 Interconnected System.....15
 MiniLink PD.....15
 Networked System.....15
 Setting.....41
 Stand Alone System.....15
Address Airflow Sensor.....18
 Diagnostics.....36
 Troubleshooting.....36
Alarm
Alarm Detection.....33
Alarm Reporting.....33
Alarms
 CFM Sensor Failure.....33
 Damper Closing Alarm.....33
 Damper Feedback Failure Alarm.....33
 Damper Opening Alarm.....33
 High Space Temp Alarm.....33
 Low Space Temp Alarm.....33
 Space Sensor Failure.....33
Alarm Screens.....43
Analog Inputs.....45
Analog Output.....19
Analog Space Sensor.....18
Analog Space Temperature Sensor.....36
 Troubleshooting.....36
Analog Values.....46
Auxiliary Heat.....28, 30
Auxiliary Reheat Relay.....18

B

BACnet®.....4
BACnet® Comm Terminal Block.....19
BACnet® Connection.....44
BACnet® - Current Device ID.....41
BACnet® Baud Rate.....42
Baud Rate Setting.....41
Belden #82760 Wire.....14, 49
Binary Input - Proof of Flow.....19
Binary Inputs.....47
Box Heating Minimum.....27

C

CFM Sensor Failure Alarm.....33
CommLink 5.....9
CommLink 5 Technical Guide.....25
Communication & Power Wiring Diagram.....17
Communication Wiring.....17
Computer
 Pentium 2 GHz Processor.....25
Configuration.....25
Configuring
 VAVZB.....25
Connection Diagram
 Slaved Zone.....24
Controller
 Voltage and Environment Requirements.....14
Controller Addressing.....15
Cooling Minimum.....27

D

Damper
 Control.....31
 Positions.....26
Damper Closing Alarm.....33
Damper Feedback Failure Alarm.....33
Damper Opening Alarm.....33
Damper Positions.....26
Data Entry Keys, Described.....40
Diagnostics.....36, 37
Digital Room Sensor.....26
 Override Button.....26
Digital Room Temperature Sensor
 Troubleshooting.....36
Dimensions
 Zone Controller Expansion Module.....10
Discharge Temperature Sensor.....13, 18
Dual E-BUS Connectors.....19
Duct Temperature Sensor.....18
 Described.....7
Duct Temperature Sensor - 6" Probe.....7
Duct Temperature Sensor - 12" Probe.....7

E

EBC E-BUS Cables.....7
E-BUS Connectors.....19
E-BUS Digital Room Sensor.....7, 8, 18, 26
 Troubleshooting.....36, 38
EBUS LED.....35
Editing Keys.....40
Electric Staged Heat.....21
Electric Staged Heat Wiring.....21

Enter Key.....40
 ESC Key.....40
 Expansion Board Modular Connector.....19
 Expansion Module
 Diagnostics.....37
 Dimensions.....10
 Outputs.....19
 Troubleshooting.....37
 Wiring.....21, 22, 23
 Expansion Module Outputs.....19

F

Factory Mounted.....13
 Factory Testing Screen.....41
 Fan Enable.....19
 Fan Enable Relay.....19
 Fan & Reheat Relay Staging.....28
 Fan Relay Staging.....28
 Fan Terminals.....21, 23
 Fan Terminals Wiring.....21, 22
 Force Modes.....34

H

Heating
 Minimum.....27
 Stage 1.....19
 Stage 2.....19
 Stage 3.....19
 Heating Minimum.....27
 High Space Temp Alarm.....33
 Hot Water Valve.....19
 HVAC Modes of Operation.....26

I

Important Wiring Considerations.....14
 Initialization.....25
 Installation.....13
 Interconnected System, Addressing.....15
 Internal Trend Logging.....34
 Internet/LAN Connection.....9
 IP Module Kit.....9
 IP Module Technical Guide.....25

K

Keys, Function.....40

L

LCD Display Screen.....40
 LED Blink Codes.....35
 LED Locations.....35
 LED Troubleshooting.....35
 LOOP COMM LED.....35
 Low Space Temp Alarm.....33

M

MAC Address.....41
 Main Screen Map.....41
 Maverick Zones.....32
 MiniLink.....33
 MiniLink PD, Addressing.....15
 MiniLink PD 5.....9
 MiniLink PD 5 Technical Guide.....25
 Minus Key Defined.....40
 Modes of Operation.....26
 Modular Connectors
 Actuator.....19
 Modular Service Tool SD.....8, 25
 Modular System Manager SD.....8, 25
 Modulating Heat.....28, 30
 Modulating Hot Water Heat
 Wiring.....21, 22
 Modulating HW Heat.....22
 Modulating HW Heat Wiring.....22
 Modulating (Proportional) Heat.....28, 30
 Motion Sensor Occupancy Detection.....18
 Mounting.....13
 Multiple Loop VAV/Zoning.....49
 Multiple Loop Zoning/VAV.....49
 Multi-State Inputs.....48

N

Navigation Keys.....40
 Networked Multiple Loop System.....52
 Networked Multiple Loop System Wiring.....52
 Networked Single Loop System.....50, 51
 Networked Single Loop System With CommLink.....51
 Networked System, Addressing.....15
 Night Minimum.....27

- O**
- Occupied Mode.....26, 27, 28
 - Sequences.....27
 - Occupied Switch.....18
 - Occupied/Unoccupied Mode.....26
 - Off Mode.....26, 29
 - On/Off HW Heat.....22
 - Wiring.....22
 - Operation Modes.....26
 - Operation Mode Screens.....42
 - Operator Interfaces.....25
 - Override Button.....26
 - Override Operation.....26
 - Overrides.....34
- P**
- Parallel Flow Fan Terminals.....27, 29, 31
 - Polarity
 - Correct.....14, 15
 - Observing.....15
 - Warning.....15
 - Powering Up.....15
 - Power Wiring Diagram.....17
 - Pressure Dependent Rectangular Damper Kit.....6
 - Pressure Dependent Round Slaved Zone Damper
 - Assembly.....6
 - Pressure Dependent VAV/Zone Controller.....5
 - Pressure Independent VAV/Zone Controller.....5
 - Prism 2.....9, 25
 - Prism 2 Technical Guide.....25
 - Proof of Flow.....19
 - Proportional Heat.....28, 30
 - Push-button Override Operation.....26
- R**
- Rectangular Damper Kit.....6
 - Dimensions.....11
 - Rectangular Zone Damper Kit
 - Mounting.....13
 - Reheat Relay Staging.....28
 - Relay Output #2 - Heating Stage 1.....19
 - Relay Output #3 - Heating Stage 2.....19
 - Relay Output #4 - Heating Stage 3.....19
 - Relay Outputs.....19
 - Relays
 - Analog Output.....19
 - Fan Enable.....19
 - Heating Stage 1.....19
 - Heating Stage 2.....19
 - Relay Staging.....28
 - Resistance Testing
 - Digital Room Sensor.....38
 - Modular Room Sensor.....38
 - Round Damper.....7
 - Round Damper Kit.....12
 - Dimensions.....12
 - Round Zone Damper Kit
 - Mounting.....13
- S**
- Scheduling.....26
 - Screens
 - LCD Screens.....41-43
 - SCR Electric Heat.....23
 - Wiring.....23
 - SCR Electric Heat Wiring.....23
 - Sensors
 - Mounting.....13
 - Temperature Sensor Testing.....38
 - Sequences.....27
 - Series Flow Fan Terminals.....27, 29, 30
 - Service Tool.....25
 - Settings Screens.....41
 - Single Loop VAV/Zoning.....49
 - Slaved VAV/Zone Rectangular Damper Kit.....7
 - Slaved Zone Damper Connection Wiring.....24
 - Slaved Zone Damper Kit.....6
 - SMTS-L.....8
 - Space Cooling Mode.....26, 27, 29
 - Space Heating Mode.....26, 28, 29, 30
 - Space Sensor Failure Alarm.....33
 - Space Temperature Sensor
 - Diagnostics.....36
 - Troubleshooting.....36
 - Space Temperature Sensors.....13
 - Mounting.....13
 - Space Vent Mode.....26, 27, 29
 - Stand Alone System
 - Addressing.....15
 - Standard Room Sensor.....8, 26
 - STAT 1 LED.....35
 - STAT 2 LED.....35
 - STATUS 2 LED Blink Codes.....35
 - Status Screens.....42
 - Supply Air Cooling Mode.....26
 - Supply Air Duct Temperature Sensors
 - Mounting.....13
 - Supply Air Heating Mode.....26
 - Supply Air Sensor.....13, 18
 - Supply Air Temperature Sensor.....18
 - Diagnostics.....36
 - Troubleshooting.....36

Supply Air Temperature Sensor Failure Alarm.....33
 Supply Air Vent Mode.....26
 System Architecture.....49
 System Manager Touch Screen.....8
 System Manager TS-L.....8, 25
 System Manager TS-L Technical Guide.....25
 System Manager TS-L Wiring.....50-52

T

Temperature/Resistance Chart.....39
 Temperature/Resistance/Voltage Table.....39
 Temperature Sensor Testing.....38
 Tenant Override Logs.....31, 33
 Terminal Block.....19
 Testing for Maverick Zones.....32
 Thermistor Sensors
 Resistance.....39
 Temperature.....39
 Testing.....39
 Touch Screen System Manager.....25
 Transformer Sizing.....14, 16
 Trend Logging.....34
 Troubleshooting
 Airflow Sensor.....36
 E-BUS Digital Room Sensors.....38
 E-BUS Digital Room Temperature Sensor.....36
 Expansion Module.....37
 LEDs.....35
 Space Temperature Sensor.....36
 Supply Air Temperature Sensor.....36
 VAV/Zone Controller Expansion Module.....37
 Zone Damper Actuator.....37

U

Unit Address Setting.....41
 Unit Selection Screen.....41, 42
 Unoccupied Mode.....26, 29
 Unoccupied Mode Sequence.....29
 USB-Link 2 Kit.....9
 USB-Link 2 Technical Guide.....25

V

VA Load.....14
 VA Rating.....14
 VAVZB Communication Connections.....19
 VAVZB Inputs.....18
 VAVZB Outputs.....18
 VAVZB Power Connection.....19
 VAVZB Controller
 Alarms.....33
 Dimensions.....10
 Inputs.....18
 LED Locations.....35
 System Architecture.....49
 Wiring.....14, 17, 51-53
 VAV/Zone Controller Expansion Module.....6
 Dimensions.....10
 Outputs.....19
 Troubleshooting.....37
 Wiring.....21, 22, 23
 VAV/Zone Controller Package.....3, 4, 13, 16, 20
 Mounting.....13
 Wiring.....20
 VAV/Zone Controller System Architecture.....49
 VAV/Zone Damper Control.....31
 VAV/Zone Force Modes.....34
 VAV/Zone Controller
 Alarm Screens.....43
 Settings Screens.....41
 Status Screens.....42
 VCCX2 Controller Operator Interfaces SD
 Technical Guide.....25
 Vent Minimum.....27
 Voltage and Environment Requirements.....14

W

Watt Comm Terminal Block.....	19
WDOG LED.....	35
Window Open Detection Mode.....	18
Wire, Belden #82760.....	14, 49
Wire Size, Minimum for 24 VAC.....	14
Wiring.....	14
24-gauge.....	14
24 VAC-to-24 VAC.....	15
Expansion Module.....	21, 23
GND-to-GND.....	15
Modulating Hot Water Heat.....	21, 22
SCR Electric Heat.....	23
Slaved Zone.....	24
Slaved Zone Damper.....	24
VAV/Zone.....	14, 20, 22
VAV/Zone Controller Expansion Module.....	21, 22, 23
VAV/Zone Controller Package.....	20
Zone Controller Actuator Package.....	20
Wiring Checks.....	15
Wiring Considerations.....	14

Z

Zone Controller Actuator Package Wiring.....	20
Zone Damper Actuator.....	6
Troubleshooting.....	37
Zone Polling.....	32
Zone Voting.....	32
Zoning.....	32

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