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**Overview**

**Modular & Non-Modular VAV/Zone Controllers**

There are two variations of the VAV/Zone Controller Actuator Packages. One is referred to as the Modular VAV/Zone Controller Actuator Package and the other as the Non-Modular VAV/Zone Controller Actuator Package. This manual is written for the Non-Modular Actuator Package. If you have the Modular Actuator Package you will need to refer to the Modular VAV/Zone Controller Actuator Package Technical Guide, Form No: OR-MZCAP-TGD. Below is information regarding the differences between the Modular & Non-Modular products.

**Modular VAV/Zone Controller Act. Pkg.**

The Modular VAV/Zone Controller Actuator Packages utilize modular connectors on the VAV/Zone Controller board which connect to a Power/Comm Board via pre-fabricated cables that have mating modular connectors to provide power & communications to the VAV/Zone Controller Actuator Package. The following Orion products use this type of communications & power wiring architecture.

- OE742-31-VAVZ: VAV/Zone Controller Actuator Package - Pressure Dependent
- OE744-31-VAVZ: VAV/Zone Controller Actuator Package Pressure Independent
- OE520-XX: VAV/Zone Round Damper Assembly - Pressure Dependent
- OE521-XX: VAV/Zone Round Damper Assembly Pressure Independent
- OE736-01: VAV/Zone Rectangular Damper Kit

**Non-Modular VAV/Zone Controller**

The Non-Modular VAV/Zone Controller Actuator Packages all utilize wiring terminals instead of modular connectors on the VAV/Zone Controller board. The 24 VAC power is supplied from a transformer wired to the VAV/Zone Controller using standard stranded wire and 2 pole terminal blocks. The communications wiring is connected between the other VAV/Zone Controllers, CommLink, MiniLink, HVAC unit controller or other controllers on the local loop by using 2 conductor twisted pair with shield wire which is connected to the VAV/Zone controllers via a standard 3 pole terminal block. The following Orion products use this type of communications & power wiring architecture.

- OE742-32-VAVZ: N.M. VAV/Zone Controller Actuator Package - Pressure Dependent
- OE744-32-VAVZ: N.M. VAV/Zone Controller Actuator Package Pressure Independent
- OE520N-XX: N.M. VAV/Zone Round Damper Assembly - Pressure Dependent
- OE521N-XX: N.M. VAV/Zone Round Damper Assembly Pressure Independent
- OE736N-01: N.M VAV/Zone Rectangular Damper Kit

**Features**

**Non-Modular VAV/Zone Controller Act. Pkg.**

The Non-Modular VAV/Zone Controller Actuator Package is used for controlling airflow and operation of VAV or Zoning terminal units. The package contains the VAV/Zone Controller and Actuator mounted and housed in a plastic enclosure. The VAV/Zone Controller is a programmable digital controller which allows for program setpoints to be stored in non-volatile memory. The controller is connected to a room sensor via a modular cable assembly which monitors space temperature allowing the VAV/Zone Controller to modulate a damper in response to space temperature, duct temperature, and airflow requirements in the controlled space.

The Non-Modular VAV/Zone Controller Actuator Package has four integral modular jacks for connection to the actuator, the airflow sensor (for pressure independent applications), the room sensor, and the VAV/Zone Controller Expansion Module via modular cables. Wire terminal connections are provided for the 24 VDC power and system communications. A quick connect terminal connector is also supplied for connection of the Modular Service Tool to facilitate programming of the controller. The controller has an on-board dip switch provided for board addressing.

The VAV/Zone Controller is provided with two relays for tri-state control of the damper actuator. All outputs and the relay common are electrically isolated from all other circuitry on the board. All relay outputs are supplied with transient suppression devices across each set of contacts to reduce EMI and arcing. The relay output contacts are rated for pilot duty control of a maximum of 1 Amps @ 24 VAC or 24 VDC. The actuator connects via a modular cable to the board and provides the VAV/Zone Controller with feedback monitoring for precise positioning of the actuator.

**OE325-01 Zone Controller Expansion Module**

The OE325-01 Zone Controller Expansion Module is used in conjunction with the Non-Modular VAV/Zone Controller Actuator Package to allow for control of VAV and Zone terminal units, including series and parallel fan terminal units with 1, 2 or 3 stages of electric heat, modulating hot water heat, 2 position hot water heat, SCR electric heat, and/or auxiliary heat devices.

The OE325-01 Zone Controller Expansion Module connects to the VAV/Zone Controller board by means of a modular cable provided with the expansion module. Power is supplied to the board by means of this modular cable. Screw terminals are provided for connection of field wiring to the relay and analog outputs.

The relay outputs are N.O. contacts with one common terminal. All outputs and the relay common are electrically isolated from all other circuitry on the board. All relay outputs are supplied with transient suppression devices across each set of contacts to reduce EMI and arcing. The relay output contacts are rated for pilot duty control of a maximum of 1 Amps @ 24 VAC or 24 VDC. The analog output provides a 0-10 VDC modulating signal output into a 1K Ohm minimum load.
Figure 1: OE742-32-VAVZ Non-Modular VAV/Zone Controller Actuator Package Dimensions - P.D.
Figure 2: OE744-32-VAVZ Non-Modular VAV/Zone Controller Actuator Package Dimensions - P.I.
Non-Modular VAV/Zone Controller Actuator Package Components

Overview

Figure 3: OE742-32 Pressure Dependent Non-Modular VAV/Zone Controller Actuator Pkg. Components

Figure 4: OE744-32 Pressure Independent Non-Modular VAV/Zone Controller Actuator Pkg. Components

Non-Modular ZCAP Technical Guide
Zone Controller Expansion Module Dimensions and Components

Figure 5: OE325-01 Zone Controller Expansion Module Dimensions

Figure 6: OE325-01 Zone Controller Expansion Module Components
Overview

Inputs and Outputs

The following inputs and outputs are available on the VAV/Zone Controller and the OE325-01 Zone Controller Expansion Module. For component locations of the inputs on the VAV/Zone Controller and VAV Zone Controller Expansion Module see Figures 3, 4, and 6. For wiring of inputs and outputs, see Figures 7 through 13.

VAV/Zone Controller Analog Inputs

Space Temperature
The Modular Room Sensor that reads space temperature is attached to this input. The Modular Sensor connects via a modular cable to the Non-Modular VAV/Zone Controller Actuator Package.

Airflow Sensor
If the OE744-32-VAVZ Non-Modular VAV/Zone Controller Actuator Package is being used, the terminal unit’s pressure pick-up tube must be connected with FRP tubing to the barb fittings on the side of the enclosure. This pressure sensor input is used for CFM (airflow) calculations. If an Airflow Sensor is attached to this input, the VAV/Zone Controller will automatically detect this and switch to pressure independent operation. If the sensor is not attached or becomes defective, the controller automatically reverts to pressure dependent operation.

Supply Air Temperature Sensor
A Supply Air Temperature Sensor can be connected to these terminals. It should be mounted in the supply duct close to the terminal unit where the VAV/Zone Controller is installed. This sensor can be used for monitoring purposes or in place of the Supply Air Temperature Broadcast from the VCM-X Controller.

Other Controller Connections

Expansion Board Modular Connector
This modular connector is used to connect the optional OE325-01 Zone Controller Expansion Module to the Non-Modular VAV/Zone Controller Actuator Package. This module is only required when electric or hot water heating and/or fan terminal control is required. The Expansion Module is not required for cooling only terminal units.

Actuator Modular Connector
This modular connector is used to connect a modular cable from the VAV/Zone Controller to a tri-state actuator.

24 VAC Power Terminal Block
This two pole terminal block is used to wire the 24 Volt power to the Non-Modular VAV/Zone Controller Actuator Packages. If desired a single transformer can be used to power multiple VAV/Zone Controller Actuator 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.

Communications Terminal Block
This three pole terminal block is used for connecting the communications wiring between each Non-Modular VAV/Zone Controller Actuator Package and/or to the MiniLink Polling Device, CommLink, HVAC Unit Controller or other controller on the local communications loop. Communications wiring should be 18 gauge 2 conductor twisted pair with shield Belden #82760 or its equivalent.

Modular Service Tool DIN Connector
This connector is used to connect a cable between the Modular Service Tool or the USB-Link and the Non-Modular VAV/Zone Controller Actuator Package for programing and configuration of the VAV/Zone Controller.

OE325-01 Zone Controller Expansion Module
As previously stated, when control of a fan or if heating is required, the OE325-01 Zone Controller Expansion Module is required.

Relay Output #1 - Fan Enable
The first expansion relay on the Output Expansion terminal boards is used for energizing the fan on Series or Parallel Fan Terminal Units.

Relay Output #2 - Heating Stage 1
If you have at least one stage of heating, this is the relay used to energize the 1st stage of terminal unit heating. This heating stage can either be used with electric heat or On/Off hot water valve control.

Relay Output #3 - Heating Stage 2
If you have two stages of electric heating, this relay controls the 2nd stage of electric heat. For 3 stage heating, this relay output will be energized for both the 2nd and 3rd stage of heat. See the following paragraph for more information regarding 3 stage heating applications.

3 Stage Heating Applications
If three stages of electric heat are configured, relays #2 and #3 will stage in a staggered sequence. This allows you to achieve 3 stages of heating using only relays #2 and #3. Each of the 3 heating elements should be sized for one third of the total KW output required. Both the 2nd and 3rd stage heating contactors (C2 & C3) must be connected to Relay Output #3. See Table 1 below for relay sequencing information.

<table>
<thead>
<tr>
<th>Stage No.</th>
<th>Relay Output #2</th>
<th>Relay Output #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VAV/Zone Controller Package ON (C1)</td>
<td>OFF (C2 &amp; C3)</td>
</tr>
<tr>
<td>2</td>
<td>OFF (C1)</td>
<td>ON (C2 &amp; C3)</td>
</tr>
<tr>
<td>3</td>
<td>ON (C1)</td>
<td>ON (C2 &amp; C3)</td>
</tr>
</tbody>
</table>

Table 1: Relay Sequencing For 3 Stage Heating

Auxiliary Heat Relay
If you have an auxiliary heat source you would like to control in addition to or in lieu of the other heat options, you can connect it to relay R4 on the expansion module. This relay has a separate setpoint available for controlling an electric baseboard or duct heater or a two position hot water valve for a baseboard radiator or duct heater.

Analog Output
If you are using hot water or steam heating via a modulating steam or hot water valve, this output can supply a 0-10 Volts DC signal for proportional control of the valve.
General
Correct wiring of the VAV/Zone Controller is the most important factor in the overall success of the controller installation process. The VAV/Zone Controller wiring has been simplified by the use of modular connectors and prefabricated modular cables.

Controller Mounting
If you purchased the Round Zone Damper or Rectangular Zone Damper Kits from WattMaster, the controller and actuator are factory mounted and wired in the damper control enclosure. If your VAV/Zone Controllers 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 VAV/Zone Controller 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.

When the Non-Modular VAV/Zone Controller Actuator Package is to be field mounted, it is important to mount it in a location that is free from extreme high or low temperatures, moisture, dust, and dirt.

1. Leave the enclosure cover on the Non-Modular VAV/Zone Controller Actuator Package circuit board during installation to protect the circuit board from damage. The damper actuator is factory mounted for what we refer to as right-hand terminal unit mounting. This assumes you are standing downstream of the terminal unit with air hitting you in the face. The side of the unit towards your right arm would be the right side of the unit and where the standard configuration Zone Controller Actuator Package would be mounted over the damper shaft. If you have a left-hand terminal unit, the actuator will need to be rotated 180 degrees within the plastic enclosure and the enclosure assembly flipped over to mount over the damper shaft on the left side of the terminal unit. The enclosure base is designed with the appropriate holes and cutouts to allow for these two mounting options. A left-hand label is also included with the actuator and can be applied over the right-hand label for left-hand control locations when desired.

2. If you need to rotate the damper actuator from its factory supplied position, first unplug the actuator cable from the actuator, then remove the (3) screws on the back side of the enclosure base that secure the actuator to the enclosure’s base. Rotate the actuator 180 degrees and re-install the (3) screws you just removed into the mating holes on the enclosure base and tighten them to secure the actuator to the base.

3. Turn the enclosure base/actuator assembly back over to its original mounting position so the actuator is facing up. All installation instructions are based on the damper moving clockwise to open (see the note below if your damper requires counterclockwise-to-open rotation). Check the damper for proper rotation and mark the end of the damper shaft to indicate open and closed positions. Loosen the (2) shaft mounting bracket nuts on the ends of the universal mounting clamp enough to slide the entire actuator and plastic enclosure assembly over the terminal unit damper shaft. Rotate the enclosure base/actuator assembly until it is approximately level and perpendicular with the terminal unit mounting surface or enclosure side walls. Use the included self-tapping mounting screw to secure the enclosure base to the terminal unit sheet metal or terminal unit control enclosure surface. This is done by inserting the screw through the anti-rotation bushing, centering it and the bushing in the mounting slot, and using a battery powered drill to tighten it until the screw head is flush with the top surface of the anti-rotation bushing. Do not overtighten the screw!

4. Turn the damper blade to its fully closed position. With the manual override clutch button depressed, rotate the actuator clamp to within approximately 1/16 in. to 1/4 in. of the distance between the actuator stop and the clamp. This varies depending on the damper seal design and thickness. Finger-tighten the universal clamp mounting nuts. Then tighten the two nuts again with an 8 millimeter wrench to approximately 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. Re-attach the actuator cable removed in step #1 to the actuator.

Note: If the damper on the terminal unit cannot be installed for clockwise-to-open operation, the Non-Modular VAV/Zone Controller Actuator Package can be configured for counterclockwise-to-open operation via the operator interface or through the Prism software program. It must be changed prior to system start-up for the designated units for the zone damper to function properly. See page 19 of this manual for detailed, reverse acting configuration information. Installation for reverse acting configurations is the same as for clockwise-to-open units except all references to clockwise will now be in the counter-clockwise direction.

Important Wiring Considerations
Please carefully read and apply the following information when wiring the Non-Modular VAV/Zone Controller Actuator Package. See Figure 7 for Non-Modular VAV/Zone Controller Actuator Package wiring and connections. See Figure 14 for connecting and wiring multiple Non-Modular VAV/Zone Controller Actuator Packages in a system.

1. Size and wire the transformer to be used for powering the Non-Modular VAV/Zone Controller Actuator Package(s) per the instructions. Failure to size the transformer and/or wire the Non-Modular VAV/Zone Controller Actuator Package(s) correctly may cause the VAV/Zone Controller Actuator Package to operate erratically or not at all. See Figure 15 for wiring and transformer sizing information.

2. If a Supply Air Temperature Sensor is to be connected, the minimum wire size used should be 24 gauge.

3. 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.

4. Communications wiring should be 18 gauge 2 conductor twisted pair with shield Belden #82760 or its equivalent. This type of wire is available form WattMaster.
Wiring Considerations

The OE325-01 Zone Controller Expansion Module connects to the Non-Modular VAV/Zone Controller Actuator Package by means of a modular cable provided with the expansion module. Power is supplied to the Zone Controller Expansion Module by means of this modular cable. Screw terminals are provided for connection of field wiring to the relay and analog outputs. The Expansion Module is used to supply extra relays and/or analog outputs to control fan and heating functions for the Non-Modular VAV/Zone Controller Actuator Package.

The OE325-01 Zone Controller Expansion Module is always shipped loose for field mounting by others. Be careful not to damage the electronic components when mounting the controller. Remove the controller from its snap track mount. Mark the control enclosure base using the snap track as a template. Drill pilot holes in the enclosure base and secure the snap track to it using sheet metal screws. Do not allow metal shavings to fall onto the circuit board. Re-attach the controller to the snap track. Be sure the mounting location is close enough to the Non-Modular VAV/Zone Controller Actuator Package so that the supplied modular cable will reach from it to the Zone Controller Expansion Module.

**Warning:** The 3 relay outputs available on the OE325-01 Expansion Module are each rated for 1 Amp. @ 24 VAC. If your device load exceeds these limits, a pilot duty relay (by others) must be used in the circuit.

The wiring consideration information previously outlined for the Non-Modular VAV/Zone Controller Actuator Package should be followed when wiring the OE325-01 Zone Controller Expansion Module.
Figure 8: Zone Controller Expansion Module Wiring - Fan Terminals And/Or Staged Electric Heat
Installation & Wiring

Zone Controller Expansion Module Wiring

Figure 9: Zone Controller Expansion Module Wiring - Fan Terminals And/Or Modulating Hot Water Heat

Figure 10: Zone Controller Expansion Module Wiring - Fan Terminals And/Or 2 Position HW Heat
Figure 11: Zone Controller Expansion Module Wiring - Fan Terminals And/Or SCR Electric Heat

Figure 12: Zone Controller Expansion Module Wiring - Fan Terminals And/Or Auxiliary Electric Heat
**Expansion Board & Communications Wiring**

**Figure 13:** Zone Controller Expansion Module Wiring - Fan Terminals And/Or Auxiliary 2 Position HW Heat

- **Figure 14:** Communication & Power Wiring Diagram

*Warning:* Potentially must be observed on all 24 VAC wiring or damage to the controller will result.

- 24 VAC Transformer (by Others)
- See non-modular devices transformer sizing information for calculating VA requirements.

Use WallMaster 2 conductor twisted pair with 24 VAC or 625/0 or equivalent. To connect between each non-modular Wall|Zone controller actuator package and from the VAC controller/actuator PD or controller to the first non-modular Wall|Zone controller/actuator package as required by your application.

Local Loop RS-485 9600 Baud

Wire to the next non-modular Wall|Zone controller/actuator package on the Local Communications Loop.
Non-Modular Devices Transformer Sizing

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

Some installers like to use one large 24VAC 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. WattMaster Controls recommends using a separate transformer for each device in order to eliminate the potential for damaging controllers due to incorrect polarity. Using separate transformers 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 24VAC power to the devices.

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

Each Non-Modular VAV/Zone Controller Actuator Package requires 5 VA @ 24VAC power. In the examples below we have a total of 8 Controllers.

8 Non-modular VAV/Zone Controller Actuator Packages @ 6VA each............... 8 x 6 VA = 48 VA.

The above calculation determines that our transformer will need to be sized for a minimum of 48 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. WattMaster 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.

\[ 0.00054 \text{ (voltage drop per foot for 18 gauge wire)} \times 48 \text{ VA controller load} = 0.02592 \text{ Volts/Ft.} \]

WattMaster controllers will operate efficiently with a voltage drop no greater than 2 Volts. Divide the total allowable voltage drop of 2 Volts by the number you arrived at above and you have the maximum number of feet you can run the 18 gauge wire with an 48 VA transformer with no more than a 2 Volt drop at the farthest controller from the transformer.

\[ \frac{2 \text{ (Volts total allowable voltage drop)}}{0.02592 \text{ (voltage drop per 1 ft. @ 48 VA load)}} = 77.16 \text{ feet} \]

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 22 Volts.

![Diagram of Non-Modular VAV/Zone Controller Actuator Package Transformer Sizing](image_url)
**Slaved Zone Damper Wiring**

For large zones, it may be necessary to have more than one air damper controlled by a Non-Modular VAV/Zone Controller Actuator Package and its associated space sensor. The Orion system allows for connecting up to two additional slaved zone dampers to the master Non-Modular VAV/Zone Controller Actuator 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 and branch circuit calculations for the Power/Comm board. See the previous section regarding transformer sizing of the Power/Comm board for complete information.

Two Slave Wiring Adapters (OE267) consisting of a slave wiring interface card and modular cable are supplied with the OE523 Round Slaved Zone Damper, OE738 Slaved VAV/Zone Rectangular Damper Kit, and the OE282-03 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 Non-Modular VAV/Zone Controller Actuator Package. It is mounted by fastening the plastic snap-track to 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 16 for complete wiring details.

**Figure 16: Slaved Zone Damper Wiring & Connection Diagram**
General

In order to have a trouble free start-up, it is important to follow a few simple procedures. Before applying power for the first time, it is very important to correctly address the controller and run through a few simple checks.

Controller Addressing

All Non-Modular VAV/Zone Controller Actuator Packages are equipped with address switches. If the Non-Modular VAV/Zone Controller Actuator Package is to operate as a Stand Alone controller (not connected to any other HVAC unit or VAV/Zone Controller(s)), the controller address switch should be set for address 1. When the Non-Modular VAV/Zone Controller Actuator Package is to be connected to other Non-Modular VAV/Zone Controller Actuator Packages on a communication loop, each Non-Modular VAV/Zone Controller Actuator Package’s address switch must be set with a unique address between 1 and 58.

When programming the Non-Modular VAV/Zone Controller Actuator Package 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 Non-Modular VAV/Zone Controller Actuator Package 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 the Non-Modular VAV/Zone Controller Actuator Package is connected to and then enter the Non-Modular VAV/Zone Controller Actuator Package’s address. See Figure 17 for a diagram depicting address switch settings.

Power Wiring

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 for the Power/Comm board that is connected to it. Each Non-Modular VAV/Zone Controller Actuator Package requires 6 VA of power delivered to it at 24 VAC. See page 15 of this manual for complete wiring and transformer sizing information for the VAV/Zone Controller.

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 Non-Modular VAV/Zone Controller Actuator Package. Check the actuator cable and be sure it is plugged in and secured to the modular connector on the actuator and the Non-Modular VAV/Zone Controller Actuator Package circuit board modular connector. Check that the Modular Room Sensor modular connector is connected to one end of the modular sensor cable and the other end is connected to the modular sensor connector on the VAV/Zone Controller Actuator Package. Be sure any Expansion Modules connected to the Non-Modular VAV/Zone Controller Actuator Packages are also correctly wired per the Expansion Module wiring instructions on pages 10 through 14 of this manual.

After all the above wiring checks are complete, apply power to the transformer(s) that is connected to the Non-Modular VAV/Zone Controller Actuator Packages.

For detailed information regarding communication wiring and connection for Interconnected and Networked systems, please see the Orion System Installation & Troubleshooting Guide.

Figure 17: Address Switch Setting
Initialization

On system power-up, the “STAT” LED is extinguished for a few seconds and then the controller “flashes” its address switch setting. If the address switch were set to 7, you would see 7 flashes. After the address is finished, the LED will extinguish for another 5 seconds. At the conclusion of this 5-second delay, the LED will begin a continuous flashing while the Damper Feedback limits are calibrated. If the Damper is driving open, the LED will blink slowly. If the Damper is driving closed, the LED will blink fast. When the calibration is completed, the normal diagnostic flashes will begin. These diagnostic flashes are described in the Troubleshooting section of this guide. In addition, during the first few seconds of power-up, all default setpoints are initialized and all outputs are turned off. There is also a 30 second start-up delay to protect the fan and other components from short cycling during intermittent power conditions. If all inputs are operating correctly, the LED will blink once every ten seconds.

Programming the Controller

The next step is programming the controller for your specific requirements. In order to configure and program the Non-Modular VAV/Zone Controller Actuator Package, you must have a central operator interface or a personal computer with the Prism computer front end software installed. Different operator interfaces are available for programming of the VAV/Zone Controller. You may use the Modular Service Tool, Modular System Manager, Tactio SI Touch Screen, System Manager TS, or a personal computer with Prism software installed to access the status and setpoints of any Non-Modular VAV/Zone Controller Actuator Package or VCM-X controller on the system’s communications loop. See the Modular Service Tool and System Manager Operator Interface Technical Guide, the System Manager TS Technical Guide, or the Prism Computer Front-End Technical Guide for complete VAV/Zone Controller programming information. No matter which operator interface you use, it is recommended that you proceed with the programming and setup of the controller in the order that follows:

1. Configure The Controller For Your Application.
2. Program The Controller Setpoints.
3. Review Controller Status Screens To Verify System Operation And Correct Controller Configurations

Figure 18: Operator Interfaces
VAV/Zone Configuration & Setup

There are a few configuration selections available which can be used to tailor the software operation to match the mechanical equipment the controller is installed on. These are programmed using either the Modular System Manager, the Modular Service Tool, the System Manager TS, or a personal computer with Prism computer front end software installed on it. See the Modular Service Tool and System Manager Operator Interface Technical Guide, the System Manager TS Technical Guide, or the Prism Computer Front End Technical Guide for complete VAV/Zone Controller programming information.

General

Several options are available to configure the VAV/Zone Controller for the appropriate equipment it is installed on. All of these options can be set from the “Configuration” menu with the exception of “AHU Heat Call” which is set from the “Setpoints” menu. Again, please refer to the Operator’s Interface Technical Guide or the Prism Computer Front-End Technical Guide for detailed programming information.

Box Control Method

Set this configuration item for the type of box the VAV/Zone Controller is used on. The options available are:

0 = Cooling Only Box (With Reheat if Required)
1 = Heating/Cooling Changeover Box
2 = Series Fan Powered Box With Reheat
3 = Parallel Fan Powered Box With Reheat

Damper Operating Mode

This option sets the direction of rotation the damper moves when driving towards its full open position. The options available are:

0 = Direct Acting (Clockwise-to-Open Damper)
1 = Reverse Acting (Counterclockwise-to-Open Damper)

Voting Zone

If this particular VAV/Zone Controller is being used on a “Zoning” system as opposed to a true VAV system, this option must be set to allow the MiniLink Polling Device to determine if this controller should be included in the zoning system voting process. If this is set to “Yes”, this controller will be included in the voting process. If this is a zoning system and it is set to “No”, this controller will not vote in the zoning system voting process. If it is a true “VAV” system, the option should be set to “No”. The options available are:

0 = Yes
1 = No

Pressure Independent Boxes-Airflow @ 1” W.C.

If this is a pressure independent box, this option allows you to calibrate the box CFM correctly using the box manufacturer’s “K” factor. Enter the correct “K” (CFM) factor for the inlet diameter of the box you are configuring.

Expansion Relays - Steps of Reheat

If the box has reheat supplied by an electric coil, this option must be set for the number of electric heating stages on the box. If the box has hot water heat with a 2 position hot water valve, set the number of stages to “1”. For hot water heat with a proportional hot water valve, this must be set for “0”. Options available are:

0 = No Staging
1 = 1 Stage of Reheat
2 = 2 Stages of Reheat
3 = 3 Stages of Reheat

Proportional Heating Signal

If the box has hot water reheat using a proportional hot water valve, set this option to match the voltage signal required by the hot water valve you are using. Options available are:

0 = 0-10 VDC Voltage Signal
1 = 2-10 VDC Voltage Signal

Allow Box Heat With AHU Heat

If the box you are using has reheat or auxiliary heat, configuring this setting to 1=Yes will allow the box heat to operate at the same time as the HVAC unit heat. Options available are:

0 = No
1 = Yes

Main Fan Status

If the VAV/Zone Controller is installed on a non-fan powered box that has reheat, set this option to “Yes” in order to enable box reheat only when the HVAC unit fan is running. A full description of how this setting affects the various box types in the occupied and unoccupied modes is contained under the “Mode Sequence” heading that follows later in this manual. Options available are:

0 = No
1 = Yes

Push-Button Override Group ID#

During Unoccupied Mode, all VAV/Zone Controllers with a corresponding Group ID# will resume Occupied operation whenever any of the VAV/Zone Controllers with the same Group ID# has its push-button depressed to initiate an override condition. This allows you to group zones in various areas of the building. For example, individual tenants with several offices could restore occupied mode for just their zones and not affect other zones in the building. If you don’t want a specific zone to be a part of any group, enter a ‘0’ for its Group ID #.

Dump Zone

If this VAV/Zone Controller is to be used as a “Dump Zone”, set this configuration to 1=Yes. The dump zone is a controller without an actuator that is used to control a duct heater or auxiliary heat. Options available are:

0 = No
1 = Yes

AHU Heat Call

This setting is located under the “Setpoints” menu on screen #3. This is used only for the unoccupied mode. For non-fan powered terminal units, this temperature setpoint is used to allow auxiliary heat such as baseboard heaters to be energized in an attempt to satisfy the heating demand prior to initiating the HVAC unit Supply Air Heating mode. For fan powered terminal units, this setpoint can be used to operate the series or parallel box to satisfy the heating demand by using plenum air and reheat prior to initiating the HVAC Supply Air Heating mode.

During unoccupied mode, when the temperature in the space drops below the AHU Heat Call setpoint, the VAV/Zone Controller sends a signal to the VCM-X Controller to initiate the HVAC unit Supply Air Heating Mode. This setpoint temperature can be set higher or lower than the Space Heating Setpoint.
Sequence of Operations

Scheduling and Operation Modes

Scheduling

Occupied/Unoccupied Mode
The VAV/Zone Controller monitors the communications loop for its Occupied and Unoccupied mode of operation command. Either the VAV/Zone Controller Package or the GPC Plus can transmit the Occupied command to the VAV/Zone Controller. This requires the Non-Modular VAV/Zone Controller Actuator 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 VAV/Zone Controller and VCM-X Controller back to occupied operation by pressing the override button on the Modular Room Sensor or Digital Room Sensor. The operation for the push-button override sequence is different depending on which sensor you are using.

Modular Room Sensor
Pushing the override button for less than 3 seconds initiates the override which will continue for a 2 hour duration. If during the override period the button is pressed a second time for less than 3 seconds, an additional 2 hours will be added to the remaining override duration that is left at the time of pushing the button. If the button is then depressed for more than 3 seconds anytime during the override duration, it cancels the override and places the unit back into normal unoccupied operation.

Digital Room Sensor
Pushing the override button momentarily initiates the override which will continue for a 2 hour duration. If during the override period the button is pressed a second time, it will cancel the override. If it is pressed again, the override will be initiated again for a 2 hour duration. Every other time the button is pushed, it cancels 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 VAV/Zone Controller can cause several other controllers to follow along and return to occupied mode for the programmed duration. Other VAV/Zone 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.

Modes of Operation
There are 7 possible modes of operation for the HVAC Unit and the VAV/Zone Controller. These modes are determined by the supply air and/or space demand conditions. They are:

- Supply Air Vent Mode (Based on HVAC Unit SAT)
- Space Vent Mode (Based on VAV/Zone Controller Space Temp.)
- Supply Air Cooling Mode (Based on HVAC Unit SAT)
- Space Cooling Mode (Based on VAV/Zone Controller Space Temp.)
- Supply Air Heating Mode (Based on HVAC Unit SAT)
- Space Heating Mode (Based on VAV/Zone Controller Space Temp.)
- Off Mode (Not displayed. See “Definitions of Modes”)

The process of determining each mode is in the following paragraph, but the actual operation of each mode is explained in the sections that follows.

Definitions of Modes

VAV & Zone Control Schemes
On all fan-powered and non-fan-powered terminal units, ‘VAV’ or ‘Zoning’ supply air modes and space demands are calculated the same. If the supply air temperature rises the deadband amount above the space temperature, the supply air mode is heating. To cancel the supply air heating mode, the supply air temperature must fall to within 2 °F of the space temperature. If the supply air falls the deadband amount below the space temperature, the supply air mode is cooling. To cancel the supply air cooling mode, the supply air temperature must rise to within 2 °F of the space temperature. If the supply air is between the heating and cooling deadband amounts, it is considered vent mode.

Supply Air Vent Mode
This mode occurs when the Supply Air Temperature is within 2.0 °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
This mode occurs when the Space Temperature is between 0.5 °F below the Cooling Setpoint and 0.5 °F above the Heating Setpoint.

Supply Air Cooling Mode
This mode occurs when the Supply Air Temperature falls to less than the Space Temperature minus the Supply Air HVAC Deadband.

Space Cooling Mode
This mode occurs when the Space Temperature rises to 0.5 °F below the Space Cooling Setpoint.

Supply Air Heating Mode
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.

Space Heating Mode
This mode occurs when the Space Temperature falls to 0.5 °F above the Space Heating Setpoint.
Sequence of Operations

Damper Positions and Occupied Mode Sequences

**Off Mode**
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 setpoint screens 4 through 9 for the VAV/Zone 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.

**Reheat Minimum**
This is the position that the damper moves to when Reheat is initiated. If the VAV/Zone 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.

**Space Cooling Mode**
Occupied Space Cooling mode is initiated by the temperature in the space rising to within 0.5 ºF of the Occupied Cooling Setpoint.

If the HVAC unit is in the Supply Air Heating and another VAV/Zone Controller has a cooling demand, the damper/airflow for the VAV/Zone 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 Supply Air Cooling mode, the damper is normally held at the minimum cooling position until the space temperature begins to rise above the cooling setpoint. As the space temperature rises to within 0.5 ºF 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 ºF above the setpoint. This is a 2 ºF proportional window starting 0.5 ºF below the cooling setpoint to 1.5 ºF above the cooling setpoint.

The damper/airflow is never allowed to modulate outside the user-adjusted minimum and 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 VAV/Zone 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 fans 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 make-up air source. When the damper/airflow rises 15% above the low limit setpoint, the fan will be deactivated.
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 VAV/Zone Controller has a heating demand, the damper/airflow for the VAV/Zone 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 VAV/Zone Controller can activate auxiliary heating relays if the Expansion Module has been connected and the correct number of heating stages (1, 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 and heat relay staging points.

Modulating (Proportional) Heat

The Non-Modular VAV/Zone Controller Actuator Package also provides an analog output for control of a modulating hot water valve or SCR electric heater. It provides a 0-10 VDC signal to control the heating device. When the space temperature drops to 0.5 °F above the Heating Setpoint the output starts at 0 VDC and ramps up to 10 VDC at 1.5 below the Heating Setpoint.

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 VCM-X 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.

<table>
<thead>
<tr>
<th>Relays Stage On At</th>
<th>Series Fan</th>
<th>Parallel Fan</th>
<th>Heat Stage 1</th>
<th>Heat Stage 2</th>
<th>Heat Stage 3</th>
<th>Aux. Heat</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 °F Above Box Heat Setpoint</td>
<td>ON With HVAC Fan *See Note 1</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At Box Heat Setpoint</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0 °F Below Box Heat Setpoint</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0 °F Below Box Heat Setpoint</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>0.5 °F Below Box Heat Setpoint</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relays Stage Off At</th>
<th>Series Fan</th>
<th>Parallel Fan</th>
<th>Heat Stage 1</th>
<th>Heat Stage 2</th>
<th>Heat Stage 3</th>
<th>Aux. Heat</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 °F Above Box Heat Setpoint</td>
<td>OFF With HVAC Fan *See Note 1</td>
<td>X See Note 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At Box Heat Setpoint</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0 °F Above Box Heat Setpoint</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>0.5 °F Above Aux. Heat Setpoint</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Note:
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
**Sequence of Operations**

**Unoccupied Mode Sequences**

**Series Flow Fan Terminals**
If the VAV/Zone 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 make-up 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.

**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.

**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.

When one or more of the VAV/Zone Controllers has a heating demand and another VAV/Zone Controller has a cooling demand, the damper/airflow for the VAV/Zone 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 Heating 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 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 VAV/Zone 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 fan 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 fan status has been selected or not. If check for main fan 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 fan 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.

**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 below the heating setpoint to 1.5 °F below the heating setpoint.
Sequence of Operations

Unoccupied Mode Sequences

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 ºF above to 1.5 ºF below the heating setpoint. This allows the space to take advantage of the warm supply air in the duct.

If check for main fan 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 fan status is selected, the reheat will only operate when the HVAC unit fan is operating.

The VAV/Zone Controller can activate auxiliary heating relays if the Expansion Module has been connected and the correct number of heating stages (1, 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 ºF below the heating setpoint. The third stage will activate if the space temperature falls 2.0 ºF 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 ºF 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 ºF. See Table 2: Fan & Reheat Relay Staging for a complete layout of the various fan & heat relay staging points.

Modulating (Proportional) Heat

The Non-Modular VAV/Zone Controller Actuator Package also provides an analog output for control of a modulating hot water valve or SCR electric heater. It provides a 0-10 VDC signal to control the heating device. When the space temperature drops to 0.5 ºF above the Heating Setpoint, the output starts at 0 VDC and ramps up to 10 VDC at 1.5 below the Heating Setpoint.

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 ºF below the Auxiliary Heat Setpoint and de-energizes 0.5 ºF above the Auxiliary Heat Setpoint. The Auxiliary Heat will continue to function regardless of the HVAC Mode the VCM-X is in, or at any airflow condition. This is typically used to control baseboard heat or an external duct heater.
**Damper Control**

The damper position is calculated by the mode and demand from the space sensor. Included in this calculation is an 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 programmed 100% maximum

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, causing premature wear of the actuator gears and motor.

On pressure dependent terminal units, the damper position is maintained to within ± 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:

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

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 the 50% of the maximum damper position setpoint, and it will not change until the sensor is repaired or replaced.

**Tenant Override Logs**

If you require tenant billing for push-button override usage, a MiniLink Polling Device must be installed on each local loop. The MiniLink Polling Device 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 front-end software program. No other method exists for retrieving these logs. That means that all of your units will be connected together on the communications loop and the loop will be terminated at a CommLink device connected to an on-site computer.

**Warning:** This computer must be on 24 hours a day 7 days a week running the Prism software in order for tenant logging to be tracked.

The tenant logs are kept on the dedicated job site 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 VAV/Zone Controllers can read it and use it in their tenant and trend logs.
Zoning

Description
The Orion system can be configured to operate as a true zoning system with the addition of a MiniLink Polling Device. The MiniLink Polling Device acts as a loop manager receiving information from the Non-Modular VAV/Zone Controller Actuator Packages, interpreting this information, and then sending a heat, cool, or vent signal to the VCM-X Controller.

Zone Polling
The MiniLink Polling Device must be configured for zoning operation from the Modular System Manager, System Manager TS, Modular Service Tool, or Prism computer software. During the setup and programming, the user is required to enter the last VAV/Zone address on the loop. Once configured, the MiniLink Polling Device 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 Polling Device 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 call out to maintenance or a supervisor if the system has been properly setup. See the “Alarm Detection And Reporting section for more information.

Zone Voting
If a zone has been configured for the VOTING mode, the MiniLink Polling Device will perform the following tests based on the data received during the zone polling operation. These tests insure 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 has not failed driving Open or Closed and has passed Calibration
- 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 Polling Device
- 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 PD. 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 is 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 Polling Device 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 personal computer with the Prism Computer Software installed.

Alarm Detection and Reporting
The VAV/Zone 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, System Manager TS, or a Modular Service Tool is connected, the alarms will be reported on the Status Screens. If the Prism computer front end 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 except the Damper Feedback Failure condition can initiate a call out to a pager to alert someone to the alarm condition. See the Prism Technical Guide for further information on this topic.
Internal Trend Logging

The VAV/Zone Controller continuously maintains an Internal Trend Log, which records a fixed set of values at an interval programmed by the user. These values can be retrieved only with the graphical front-end program. In order to utilize these logs, a computer with Prism computer software installed must be connected to the Orion system.

There are 120 log positions available. Once the last (120th) position has been recorded, the log jumps back to the first position and begins overwriting the old data. 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.

<table>
<thead>
<tr>
<th>Interval</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Minute Interval</td>
<td>2 Hour Duration</td>
</tr>
<tr>
<td>15 Minute Interval</td>
<td>30 Hour Duration</td>
</tr>
<tr>
<td>30 Minute Interval</td>
<td>60 Hour Duration</td>
</tr>
<tr>
<td>60 Minute Interval</td>
<td>120 Hour Duration</td>
</tr>
</tbody>
</table>

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 (Fan)
- Box Heat Stages
- Auxiliary Heat Stages (Aux Ht)

Note: For proper time and date stamping of the tenant log, you must configure the VCM-X Controller to broadcast the time so that the VAV/Zone 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 because there is no battery-backed memory on the VAV/Zone Controllers.

Force Modes or Overrides

The VAV/Zone 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. That 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 VCM-X 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.
LED Troubleshooting

Using LEDs To Verify Operation

The VAV/Zone Controller is equipped with LEDs that can be used as very powerful troubleshooting tools. The VAV/Zone Controller board has three LEDs. Two of these LEDs are used in troubleshooting. See Figure 19 for the LED locations. The LEDs and their uses are as follows:

“REC”
This LED will light up to indicate system communications.

“PWR”
This LED will light up to indicate that 24 VAC power has been applied to the controller.

“STAT”
This is the diagnostic blink code LED. It will light up and blink out diagnostic codes.

“REC” LED Operations
When the controller is communicating, this LED will flicker. If it does not flicker, check the MiniLink PD and/or CommLink that is connected to the Power/Comm board which connects to your VAV/Zone Controller and make sure the MiniLink and/or CommLink is powered up and properly connected to the Power/Comm board.

“PWR” LED Operations
When the VAV/Zone Controller is powered up, the “PWR” LED should light up and stay on continuously. If it does not light up, check to be sure that the modular connector is connected to the board, that the connections are tight, and the tab is locked on the connector. Be sure power is connected and turned on to the Power/Comm board and that the modular cable connector is securely connected. If after making all these checks the “PWR” LED does not light up, the board is probably defective.

“STAT” LED Operations
As previously described, when the board is first powered up, the LED will do the following:
- Flashes Once
- Off for 5 seconds
- STAT LED blinks the board address (Address 14 = 14 blinks)
- 5 second pause
- 20 second time delay - LED blinks 20 times
- LED blinks slowly as damper moves towards the open position. The LED blinks fast as the damper moves towards the closed position.

After the above steps, the status code is repeatedly blinked every 10 seconds to indicate controller status. The status blink codes are listed in Table 3 below in order of priority with 7 being the highest priority.

<table>
<thead>
<tr>
<th>LED Blinks This Number of Times</th>
<th>Blink Code Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Normal Operation. No Alarm Conditions Exist</td>
</tr>
<tr>
<td>2</td>
<td>Push-button Override or Group Override is Active</td>
</tr>
<tr>
<td>3</td>
<td>Communications Failure</td>
</tr>
<tr>
<td>4</td>
<td>Bad Airflow Sensor</td>
</tr>
<tr>
<td>5</td>
<td>Bad Or Missing Space Sensor</td>
</tr>
<tr>
<td>6</td>
<td>Damper Open or Close Failure</td>
</tr>
<tr>
<td>7</td>
<td>Damper Feedback Failure</td>
</tr>
</tbody>
</table>

Table 3: “STAT” LED Blink Codes

Only the highest priority failure code will be shown. You must correct the highest priority alarm before other problems will be indicated.

If the “STAT” LED does not operate as indicated above, first check the address switch setting. See Figure 17 for correct address switch setting procedures. If the address switch setting is correct and the “STAT” LED still does not behave as indicated above, contact Orion Controls Technical support.

**Note:** Power to the controller being addressed must always be cycled after changing address switch settings in order for the changes to take effect.
Other Checks

**Space Temperature Sensor**
If the Space Temperature Sensor is not reading a valid temperature, first make sure that the modular cable connector is firmly plugged into the mating female modular connectors on the board and at the Space Temperature Sensor. Also make sure if a cable coupler is used, that it is firmly connected. If the problem persists, try swapping the sensor with a known good Space Temperature Sensor. If that sensor works when connected to the VAV/Zone Controller board, you can assume you have a defective or damaged 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 4. 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 4.

**Airflow Sensor**
If the Airflow Sensor seems to be reading incorrectly, first check the Airflow Sensor’s modular cable connector and be sure it is firmly connected to its mating connector on the VAV/Zone Controller board.

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 VAV/Zone 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 aforementioned procedures solves the problem, remove power from the VAV/Zone 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 VAV/Zone Controller to run through its calibration sequence. Restart the HVAC unit and check the VAV/Zone 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.

**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 VAV/Zone Controller board. 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 VAV/Zone 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.

**Expansion Module**
If the Expansion Module does not seem to operate correctly, first make sure the modular cable between the Expansion Module and the Non-Modular VAV/Zone Controller Actuator Package is firmly connected at both ends. Be sure that the Expansion Module has been configured correctly. The expansion board must be configured using the Modular Service Tool, Modular System Manager, System Manager TS, or Prism 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.
Temperature Sensor Testing

The following sensor voltage and resistance table 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 20 when checking sensors.

<table>
<thead>
<tr>
<th>Temp (°F)</th>
<th>Resistance (Ohms)</th>
<th>Voltage @ Input (VDC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10</td>
<td>93333</td>
<td>4.620</td>
</tr>
<tr>
<td>-5</td>
<td>80531</td>
<td>4.550</td>
</tr>
<tr>
<td>0</td>
<td>69822</td>
<td>4.474</td>
</tr>
<tr>
<td>5</td>
<td>60552</td>
<td>4.390</td>
</tr>
<tr>
<td>10</td>
<td>52500</td>
<td>4.297</td>
</tr>
<tr>
<td>15</td>
<td>45902</td>
<td>4.200</td>
</tr>
<tr>
<td>20</td>
<td>40147</td>
<td>4.095</td>
</tr>
<tr>
<td>25</td>
<td>35165</td>
<td>3.982</td>
</tr>
<tr>
<td>30</td>
<td>30805</td>
<td>3.862</td>
</tr>
<tr>
<td>35</td>
<td>27140</td>
<td>3.737</td>
</tr>
<tr>
<td>40</td>
<td>23874</td>
<td>3.605</td>
</tr>
<tr>
<td>45</td>
<td>21094</td>
<td>3.470</td>
</tr>
<tr>
<td>50</td>
<td>18655</td>
<td>3.330</td>
</tr>
<tr>
<td>52</td>
<td>17799</td>
<td>3.275</td>
</tr>
<tr>
<td>54</td>
<td>16956</td>
<td>3.217</td>
</tr>
<tr>
<td>56</td>
<td>16164</td>
<td>3.160</td>
</tr>
<tr>
<td>58</td>
<td>15385</td>
<td>3.100</td>
</tr>
<tr>
<td>60</td>
<td>14681</td>
<td>3.042</td>
</tr>
<tr>
<td>62</td>
<td>14014</td>
<td>2.985</td>
</tr>
<tr>
<td>64</td>
<td>13382</td>
<td>2.927</td>
</tr>
<tr>
<td>66</td>
<td>12758</td>
<td>2.867</td>
</tr>
<tr>
<td>68</td>
<td>12191</td>
<td>2.810</td>
</tr>
<tr>
<td>69</td>
<td>11906</td>
<td>2.780</td>
</tr>
<tr>
<td>70</td>
<td>11652</td>
<td>2.752</td>
</tr>
<tr>
<td>71</td>
<td>11379</td>
<td>2.722</td>
</tr>
<tr>
<td>72</td>
<td>11136</td>
<td>2.695</td>
</tr>
<tr>
<td>73</td>
<td>10878</td>
<td>2.665</td>
</tr>
</tbody>
</table>

Table 4: Temperature/Resistance for Type III 10K Ohm Thermistor Sensors
Modular and Digital Room Sensor Testing

Testing Resistance & Voltage On Modular & Digital Room Sensors

Note: For this test, the sensor must be disconnected from its FMRSC cable as shown. 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.

If the voltage is above 5.08 VDC, then the sensor or wiring is "open." If the voltage is less than 0.05 VDC, then the sensor or wiring is shorted.

Note: For this test, the sensor must be connected with its FMRSC cable from the VAV/Zone controller actuator package modular sensor port to the modular temperature sensor port as shown. The VAV/Zone controller board must also be powered for this test. Use the table on the facing page to determine if the sensor is reading the correct voltage value for the ambient temperature. This voltage value should match the temperature value listed next to the voltage 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.

Figure 20: Testing Resistance & Voltage On Modular & Digital Room Sensors
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