VAV/Zone Controller
Package Technical Guide
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VAV/Zone Controller Overview

The OE326-23I-OR VAV/Zone Controller 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 OE326-23D-OR VAV/Zone Controller is designed for pressure dependent VAV Box and Zone Damper applications and is mounted in a plastic enclosure.

The OE326-23I-OR and OE326-23D-OR VAV/Zone Controllers utilize terminal block connections for wiring. The 24 VAC power is supplied from a transformer (by others) wired to the VAV/Zone Controller using standard stranded wire and 2 position terminal blocks. The communications wiring is connected between the other VAV/Zone Controllers, CommLink 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 VAV/Zone Controllers via a standard 3 position terminal block.

Both VAV/Zone Controllers are designed for use with an OE282-01 Zone Damper Actuator. The VAV/Zone Controller connects to the actuator via the modular cable that is included with the actuator.

The VAV/Zone Controller 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 VAV/Zone Controller also has a 2 position terminal block for wiring a Discharge Temperature Sensor, if desired.

A relay output on the VAV/Zone Controller 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 Controller Packages

The OE744-03-OR Pressure Independent VAV/Zone Controller Package includes the OE326-23I-OR VAV/Zone Controller, the OE282-01 Zone Damper Actuator with cable, and an Airflow Sensor.

The OE742-03-OR Pressure Dependent VAV/Zone Controller Package includes the OE326-23D-OR VAV/Zone Controller and the OE282-01 Zone Damper Actuator with cable.

The VAV/Zone Controller packages are factory mounted on WattMaster Controls Zone Dampers. Detailed mounting and installation instructions are provided with each VAV/Zone Controller package.
### VAV/Zone Controller Package

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<thead>
<tr>
<th>PART NO.</th>
<th>PART DESCRIPTION</th>
<th>ILLUSTRATION</th>
<th>PAGE NO.</th>
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<tbody>
<tr>
<td>OE742-03-OR</td>
<td><strong>Pressure Dependent VAV/Zone Controller Package with Terminal Blocks</strong></td>
<td></td>
<td>Pages 10, 17, 20</td>
</tr>
<tr>
<td></td>
<td>Includes: OE326-23D-OR Pressure Dependent VAV/Zone Controller with terminal blocks and OE282-01 Zone Damper Actuator with 3 foot phone jack cable.</td>
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<tr>
<td></td>
<td>The Pressure Dependent VAV/Zone Controller with terminal blocks is designed for pressure independent VAV Box and Zone Damper applications and is mounted in a plastic enclosure. One stage of Auxiliary Heat is provided on the controller.</td>
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</tr>
<tr>
<td></td>
<td>The OE325-03 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.</td>
<td></td>
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</tr>
<tr>
<td>OE744-03-OR</td>
<td><strong>Pressure Independent VAV/Zone Controller Package with Terminal Blocks</strong></td>
<td></td>
<td>Pages 10, 17, 20</td>
</tr>
<tr>
<td></td>
<td>Includes: OE326-23I-OR Pressure Independent VAV/Zone Controller with terminal blocks and airflow sensor and OE282-01 Zone Damper Actuator with 3 foot phone jack cable.</td>
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</tr>
<tr>
<td></td>
<td>The Pressure Independent VAV/Zone 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.</td>
<td></td>
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<tr>
<td></td>
<td>The OE325-03 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.</td>
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</tr>
<tr>
<td>OE326-23D-OR</td>
<td><strong>Pressure Dependent VAV/Zone Controller with Terminal Blocks</strong></td>
<td></td>
<td>Pages 10, 17, 20</td>
</tr>
<tr>
<td></td>
<td>Includes: OE326-23D-OR Pressure Dependent VAV/Zone Controller with terminal blocks mounted in a plastic enclosure.</td>
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<tr>
<td>OE326-23I-OR</td>
<td><strong>Pressure Independent VAV/Zone Controller with Terminal Blocks</strong></td>
<td></td>
<td>Pages 10, 17, 20</td>
</tr>
<tr>
<td></td>
<td>Includes: OE326-23I-OR Pressure Independent VAV/Zone Controller with terminal blocks and airflow sensor mounted in a plastic enclosure.</td>
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</table>
### Parts and Descriptions

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<thead>
<tr>
<th>PART NO.</th>
<th>PART DESCRIPTION</th>
<th>ILLUSTRATION</th>
<th>PAGE NO.</th>
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<tbody>
<tr>
<td>OE325-03</td>
<td>VAV/Zone Controller Expansion Module</td>
<td><img src="attachment.png" alt="Diagram" /></td>
<td>Pages 10, 20-23</td>
</tr>
<tr>
<td></td>
<td>Includes: Expansion Module and 3 foot E-BUS modular cable. The Expansion Module is used in conjunction with the OE326-23I-OR and OE326-23D-OR VAV/Zone Controller and the OE742-03-OR and OE744-03-OR VAV/Zone Controller Packages and allows Fan &amp; 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.</td>
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<tr>
<td>OE282-01</td>
<td>Zone Damper Actuator</td>
<td><img src="attachment.png" alt="Diagram" /></td>
<td>Pages 10, 20</td>
</tr>
<tr>
<td></td>
<td>Includes: OE282 Zone Damper Actuator &amp; 3 foot phone jack cable only. The OE282-01 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.</td>
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</tr>
<tr>
<td>OE282-03</td>
<td>Slaved Zone Damper Kit</td>
<td><img src="attachment.png" alt="Diagram" /></td>
<td>Pages 11, 24</td>
</tr>
<tr>
<td></td>
<td>Includes: OE282 Zone Damper Actuator, (2) PL101824 Slave Wiring Interface Boards &amp; modular cables for controller to actuator connection. Used when a terminal unit is to be slaved with another VAV/Zone Damper.</td>
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<tr>
<td>OE736-03-PT</td>
<td>Pressure Dependent Rectangular Damper Kit with Terminal Blocks</td>
<td><img src="attachment.png" alt="Diagram" /></td>
<td>Page 11</td>
</tr>
<tr>
<td></td>
<td>The Rectangular Damper Kit comes packaged with the OE742-03-OR Pressure Dependent VAV/Zone Controller Package already mounted in a metal enclosure. 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 WattMaster or you may get them from the supplier of your choice. For proper control, WattMaster recommends the use of low leakage opposed blade dampers.</td>
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<td>PART NO.</td>
<td>PART DESCRIPTION</td>
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<tr>
<td>OE520-06-PT</td>
<td>Pressure Dependent Round Damper with Terminal Blocks</td>
<td>Page 12</td>
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<td>OE520-08-PT</td>
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<td>OE520-10-PT</td>
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<td>OE520-12-PT</td>
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<td>OE520-14-PT</td>
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<td>OE520-16-PT</td>
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</table>

The OE520-XX-PT Round Pressure Dependent Zone Damper Assembly with terminal block connectors consists of a round air damper and the OE742-03-OR VAV/Zone Controller Package with terminal block wiring connectors. An optional Expansion Module (OE325-03) is available for control of reheat, auxiliary heat and/or control of series or parallel flow fan terminal units.

<table>
<thead>
<tr>
<th>OE521-06-PT</th>
<th>Pressure Independent Round Damper with Terminal Blocks</th>
<th>Page 12</th>
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<tbody>
<tr>
<td>OE521-08-PT</td>
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<td>OE521-10-PT</td>
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<td>OE521-12-PT</td>
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<td>OE521-14-PT</td>
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<td>OE521-16-PT</td>
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</tbody>
</table>

The OE521-XX-PT Round Pressure Independent Zone Damper Assembly with terminal block connectors consists of a round air damper with air flow pickup cross and the OE744-03-OR VAV/Zone Controller Package (including air flow sensor) with terminal block connectors. An optional Expansion Module (OE325-03) is available for control of reheat, auxiliary heat and/or control of series or parallel flow fan terminal units.

<table>
<thead>
<tr>
<th>OE217-02</th>
<th>E-BUS Digital Room Sensor</th>
<th>Page 20</th>
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</thead>
</table>

LCD Display and keypad allow for setpoint adjustment, override, and display of certain status and setpoints. The OE217-02 is used with the VAV/Zone Controller for room air temperature sensing applications. Typically hard wired to the VAV/Zone Controller or can use the optional EBC E-BUS cables.

<table>
<thead>
<tr>
<th>EBC-1.5-F</th>
<th>EBC E-BUS Cable Assembly (Optional)</th>
<th>Page 20</th>
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<tbody>
<tr>
<td>EBC-3-F</td>
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<td>EBC-10-F</td>
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<td>EBC-25-F</td>
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<td>EBC-37-F</td>
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<td>EBC-50-F</td>
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<td>EBC-75-F</td>
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<td>EBC-100-F</td>
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<td>EBC-150-F</td>
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<td>EBC-250-F</td>
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</table>

Includes: EBC E-BUS Cable Assembly. The EBC E-BUS Cables can be used to connect the OE217-02 E-BUS Digital Room Sensor to the VAV/Zone Controller if desired. Otherwise, the sensor can be hard-wired to the VAV/Zone 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, 15, 25, 50, 75, 100, 150 & 250 foot lengths.

<table>
<thead>
<tr>
<th>OE230</th>
<th>Duct Temperature Sensor - 6&quot; Probe</th>
<th>Page 20</th>
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</thead>
<tbody>
<tr>
<td>OE231</td>
<td>Duct Temperature Sensor - 12&quot; Probe</td>
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</tbody>
</table>

OE230 = 6" probe length. OE231 = 12" probe length. Used for return or supply air temperature sensing applications. Includes: 10k Ohm Duct Temperature Sensor, 2 wire only.

<table>
<thead>
<tr>
<th>OE210</th>
<th>Standard Room Sensor - Plain, w/Override,</th>
<th>Page 20</th>
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<tbody>
<tr>
<td>OE211</td>
<td>w/Slide Adjust, w/Override &amp; Slide Adjust</td>
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<td>OE212</td>
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<td>OE213</td>
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For wall mounting. Connects to the VAV/Zone Controller using wiring terminals.

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**Parts and Descriptions**

**OVERVIEW**

**VAV/Zone Controller Package**

7
<table>
<thead>
<tr>
<th>PART NO.</th>
<th>PART DESCRIPTION</th>
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<tbody>
<tr>
<td>PL102681</td>
<td>VAV/Zone Controller Power/Comm Cable (PCC) Modular Adapter</td>
<td><img src="image" alt="Diagram" /></td>
<td>N/A</td>
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<tr>
<td></td>
<td>Includes: Modular Adapter. The PCC modular cabling is not included. The PL102681 VAV/Zone Controller Modular Adapter is used to provide two Modular PCC connections to the OE326-23I-OR and OE326-23D-OR VAV/Zone Controllers and the OE742-03-OR and OE744-03-OR VAV/Zone Controller Packages so that these controllers can be used with PCC cables. 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 Controller.</td>
<td><img src="image" alt="Diagram" /></td>
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</tr>
<tr>
<td>OE392-11</td>
<td>System Manager Touch Screen - Limited Access</td>
<td><img src="image" alt="Diagram" /></td>
<td>See the SMTS-L Technical Guide</td>
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<tr>
<td></td>
<td>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&quot; 480 x 272 WVQVA 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.</td>
<td><img src="image" alt="Diagram" /></td>
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<tr>
<td>OE391-12</td>
<td>Modular Service Tool SD</td>
<td><img src="image" alt="Diagram" /></td>
<td>See the Unit Controller Operator Interfaces SD Technical Guide</td>
</tr>
<tr>
<td></td>
<td>Includes: Modular Service Tool, power supply, communication cables, 4 Gigabyte SD card, and (4) AA batteries. Used to program and monitor all Orion controllers.</td>
<td><img src="image" alt="Diagram" /></td>
<td></td>
</tr>
<tr>
<td>OE392-12</td>
<td>Modular System Manager SD</td>
<td><img src="image" alt="Diagram" /></td>
<td>See the Unit Controller Operator Interfaces SD Technical Guide</td>
</tr>
<tr>
<td></td>
<td>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. When System Manager is to be mounted on a solid wall (concrete), you will also need to order the solid wall mounting bracket below.</td>
<td><img src="image" alt="Diagram" /></td>
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<tr>
<td>EB101505</td>
<td>Solid Wall Mounting Bracket for Modular System Manager SD</td>
<td><img src="image" alt="Diagram" /></td>
<td>N/A</td>
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<tr>
<td></td>
<td>Includes: 22 gauge galvanized sheet metal mounting bracket with mounting holes and wire routing opening. Dimensions are 9.25&quot;W x 8.00&quot;H x 0.50&quot;DP. The Wall Mounting Bracket provides wiring clearance between the System Manager and the wall mounting surface when the System Manager is to be mounted on a concrete or other solid wall surface. Not for use with the System Manager TS-L.</td>
<td><img src="image" alt="Diagram" /></td>
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<tr>
<td>PART NO.</td>
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<tr>
<td>OE361-13</td>
<td>CommLink 5 Communications Interface</td>
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<td>Page 26</td>
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<tr>
<td></td>
<td>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 OE415-02 IP Module Kit. 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.</td>
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<tr>
<td>OE415-02</td>
<td>IP Module Kit - Internet/LAN Connection</td>
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<td></td>
<td>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. 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.</td>
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<tr>
<td>OE364-23-OR</td>
<td>MiniLink PD 5</td>
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<td></td>
<td>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.</td>
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<tr>
<td>OE366</td>
<td>USB-Link 2 Kit</td>
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<tr>
<td></td>
<td>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. 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.</td>
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<tr>
<td>OE508</td>
<td>Prism 2 Graphical Computer Software</td>
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<td></td>
<td>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.</td>
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</table>
Figure 4: OE282-03 Slaved Zone Damper Kit

Figure 5: OE736-03-PT P.D. Rectangular Damper Kit with Terminal Blocks
Round Damper Kit Dimensions

Figure 6: OE520-XX-PT P.D. Round Damper Kit with Terminal Blocks

Figure 7: OE521-XX-PT P.I. Round Damper Kit with Terminal Blocks
Mounting & Installation

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.

VAV/Zone Controller Package

NOTE: The VAV/Zone Controller 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 WattMaster Zone Controller can be configured for counterclockwise to open operation via the operator interface or through the Prism software. It must be changed prior to system start-up for the designated units for the zone damper to function properly. See your operator interface or Prism manual 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 VAV/Zone Controller Package. If this is not possible, the Controller can be re-configured for counter-clockwise-to-open operation using the Prism software. 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 1/16 inch to 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.
Important Wiring Considerations

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.

Voltage and Environment Requirements
The VAV/Zone Controller and expansion modules must be connected to a 24 V AC 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.

<table>
<thead>
<tr>
<th>Control Device</th>
<th>Voltage</th>
<th>VA Load</th>
<th>Temperature Range</th>
<th>Humidity (Non-Condensing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OE336-23I-OR &amp; OE336-23D-OR</td>
<td>24VAC</td>
<td>6</td>
<td>-30°F to 150°F</td>
<td>0-90% RH</td>
</tr>
<tr>
<td>VAV/Zone Controller</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OE282-01 Zone Damper Actuator</td>
<td>24VAC</td>
<td>3</td>
<td>-22°F to 122°F</td>
<td>5-95% RH</td>
</tr>
<tr>
<td>OE325-03 VAV/Zone Controller</td>
<td>24VAC</td>
<td>5</td>
<td>10°F to 149°F</td>
<td>0-90% RH</td>
</tr>
<tr>
<td>Expansion Module</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OE282-03 Slaved Zone Damper Kit</td>
<td>24VAC</td>
<td>3</td>
<td>-22°F to 122°F</td>
<td>5-95% RH</td>
</tr>
</tbody>
</table>

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 VAV/Zone Controller, actuator, and expansion module.

Important Wiring Considerations
Please carefully read and apply the following information when wiring the VAV/Zone Controller Package. See Figure 10, page 20 for VAV/Zone Controller Package wiring and connections. See Figure 9, page 17 for connecting and wiring multiple VAV/Zone Controller Packages in a system.

1. Size and wire the transformer to be used for powering the Non-Modular VAV/Zone Controller Package(s) per the instructions. Failure to size the transformer and/or wire the Non-Modular VAV/Zone Controller Package(s) correctly may cause the VAV/Zone Controller Package 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 V AC 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 V AC 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 V AC 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 VAV/Zone Controllers together or to connect to other communication devices, all wiring must be plenum-rated, minimum 18-gauge, 2-conductor, twisted pair with shield. WattMaster can supply communication wire that meets this specification and is color coded for the network or local loop. Please consult your WattMaster distributor for information. If desired, Belden #82760 or equivalent wire may also be used.

10. Before applying power to the VAV/Zone Controller, 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 VAV/Zone Controller Package requires 6 VA of power delivered to it at 24 VAC. See pages 20-21 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 VAV/Zone Controller. Check the actuator cable and be sure it is plugged in and secured to the modular connector on the actuator and the VAV/Zone Controller 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 VAV/Zone Controller. Be sure any VAV/Zone Controller Expansion Modules connected to the VAV/Zone Controller are also correctly wired per the VAV/Zone Controller Expansion Module wiring instructions on pages 20 through 23 of this manual.

After all the above wiring checks are complete, apply power to the VAV/Zone Controller.

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 each controller. Each VAV/Zone Controller requires 6 VA of power delivered to it at 24 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.

**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 wiring leads at the terminal block for tightness. Be sure that wire strands do not stick out and touch adjacent terminals. Confirm that all sensors required for your system are mounted in the appropriate location and wired into the correct terminals on the VAV/Zone Controller.

After all the above wiring checks are complete, apply power to the VAV/Zone Controller.

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 24 VAC connected to the controller, that the wiring connections are tight, and that they are wired for the correct polarity. The 24 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 WattMaster Controls Technical Support for assistance.
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. 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 also allows redundancy in case of a transformer failure. Instead of having 8 controllers inoperable 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 GPC-XP Controller requires 8 VA @ 24VAC power. In the examples below we have a total of 8 GPC-XP Controllers.

8 GPC-XP Controllers @ 8 VA each.............. 8 x 8 VA = 64 VA.

The above calculation determines that our transformer will need to be sized for a minimum of 64 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.

<table>
<thead>
<tr>
<th>Wire Gauge</th>
<th>Voltage Drop per Foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>18ga</td>
<td>0.00054</td>
</tr>
<tr>
<td>16ga</td>
<td>0.00034</td>
</tr>
<tr>
<td>14ga</td>
<td>0.00021</td>
</tr>
</tbody>
</table>

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.

\[
\text{Volts/Ft.} = 0.00054 \times 64 \text{VA} = 0.0346 \text{ Volts/Ft.}
\]

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 75 VA transformer with no more than a 2 Volt drop at the farthest controller from the transformer.

\[
\text{Maximum Feet} = \frac{2 \text{ Volts}}{0.0346 \text{ Volts/Ft.}} = 57.8 \text{ feet}
\]

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.
NOTE: A Single Transformer Supplying Each VAV/Zone Controller Individually Can Be Used Or A Transformer Supplying Several VAV/Zone Controllers Can Be Used. Each Controller Requires 6 VA Minimum Power. Do Not Exceed 16 Controllers Attached To One Transformer (96 VA). 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.


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

Figure 9: VAV/Zone Controllers Communication & Power Wiring Diagram
**VAV/Zone Controller Inputs**

**Analog Space Sensor or Digital Space Sensor**
A Standard Room Temperature Sensor that hard wires to the Space Sensor wiring terminals on the VAV/Zone Controller is used when an analog sensor is desired. When an E-BUS Digital Room Temperature Sensor is desired, it can connect to the Digital Space Sensor wire terminals on the VAV/Zone Controller or it can be connected to the E-BUS connector on the VAV/Zone Controller using an E-BUS pre-fabricated cable of the desired length.

**Discharge Temperature Sensor**
This sensor can be used for monitoring the discharge air temperature of the terminal unit, round damper or rectangular damper used with the VAV/Zone Controller. The sensor is typically used when the terminal unit has reheat installed so the true temperature of the air being supplied to the space can be monitored. It should be mounted in the discharge duct downstream of the terminal unit where the VAV/Zone Controller 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 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 VAV/Zone Controller) are open, the VAV/Zone controller 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, then the Occupancy Detection Time and Occupancy Duration Timeout setpoints are used to determine the cooling and heating setpoints of the VAV/Zone controller. A motion sensor is connected to the Occupied Switch contacts (located on the VAV/Zone Controller) and when motion is detected (contacts shorted together) for the Occupancy Detection 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 the OE326-23I-OR Pressure Independent VAV/Zone Controller 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 VAV/Zone Controller. No wiring connections are required as the pressure sensor is integral to the VAV/Zone Controller. This pressure sensor input is used for CFM (airflow) calculations.

**VAV/Zone Controller Outputs**

**Auxiliary Reheat Relay**
This relay has a dry contact on the VAV/Zone Controller and can be configured for Auxiliary Heat or Box Re-heat. Box Re-heat 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 OE325-03 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.
**Other Connections**

**E-BUS Connectors**
The EBC E-BUS modular connectors are used to connect the optional OE325-03 VAV/Zone Controller Expansion Module to the VAV/Zone Controller. 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.

The E-BUS connector can also be used to connect an E-BUS Digital Room Temperature Sensor to the VAV/Zone Controller if desired.

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

**Communications Terminal Block**
This three position terminal block is used for connecting the communications wiring between each VAV/Zone Controller and/or to the MiniLink, HVAC Unit Controller, or other installed controller on the local communications loop. Communications wiring should be 18 gauge minimum 2 conductor twisted pair with shield Belden #82760 or its equivalent.

**24 VAC Power Terminal Block**
This two position terminal block is used to wire the 24 Volt power to the VAV/Zone Controller Packages. If desired, a single transformer can be used to power multiple VAV/Zone Controller 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.

**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 OE325-03 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.
Belden #82760 Or Equivalent Communications Wire

Local Loop Wire Part Number Is WR-LL-WG-18, Is Specification And Is Color Coded For Local Loop. The conductor, Twisted Pair With Shield Wire. Wattmaster Communications Loop. All Communication Wiring Stand-Alone Damper.

If Using Upstream Ductwork Downstream Of The Terminal Units. Locate In HVAC Unit Connected To The Required When The Main Temperature Sensor. Only Optional - Discharge Air

A Single Transformer, Polarity Must Be Actuator Packages Are Powered From WARNING:

VAV/Zone Controller Actuator Controllers Connected. Each Required For Number Of 24 VAC Transformer. Size As

Communication Loop Wiring. Power And Then Reconnect Communication Loop Wiring.

NOTE: The Optional E-BUS Digital Room Temperature Sensor Can Be Connected To The VAV/Zone Controller With E-BUS Cables(s) Of The Required Length Or They Can Be Hard Wired From The Terminals On The VAV/Zone Controller To The Terminals On The E-BUS Sensor.

NOTE: Mount Both Sensor At Least 5 Feet Above Floor.

Wire To Previous And/Or Next VAV/Zone Controller Actuator Package Or Device On The Local Communications Loop. All Communication Wiring Must Be Plenum-rated, Minimum 18-gauge, 2-conductor, Twisted Pair With Shield Wire. Wattmaster Can Supply Communication Wire That Meets This Specification And Is Color Coded For Local Loop. The Local Loop Wire Part Number Is WR-LL-WG-18. Is Color Coded With Green Candy Striping And Comes On A 1000 Ft. Spool. If Desired, 18 Gauge Minimum Belden #62760 Or Equivalent Communications Wire May Also Be Used For The Local Loop Wiring.

24 VAC Transformer. Size As Required For Number Of Controllers Connected. Each VAV/Zone Controller Actuator Package Requires 6 VA Minimum.

WARNING: When Multiple VAV/Zone Controller Actuator Packages Are Powered From A Single Transformer, Polarity Must Be Observed Or Damage To The Controllers Will Result.

CAUTION: Disconnect All Communication Loop Wiring From The VAV/Zone Controller Before Removing Power. Reconnect Power And Then Reconnect Communication Loop Wiring.

NOTE: The Power To The VAV/Zone Controller Must Be Removed And Reconnected After Changing The Address Switch Settings In Order For Any Changes To Take Effect.

The Address For Each VAV/Zone Controller Must Be Unique To The Other Zone Controllers On The Local Loop And Be Between 1 and 58.

Figure 10: VAV/Zone Controller Package with Terminal Blocks Wiring
Figure 11: VAV/Zone Controller Expansion Module Wiring - Fan Terminals And/Or Electric Staged Heat
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
Figure 14: VAV/Zone Controller Expansion Module Wiring - Fan Terminals And/Or SCR Electric Heat
Slaved Zone Damper Wiring

For large zones, it may be necessary to have more than one air damper controlled by a VAV/Zone Controller Package and its associated space sensor. The Orion system allows for connecting up to two additional Slaved Zone Dampers to the master VAV/Zone Controller 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 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 VAV/Zone Controller 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 15, below for complete wiring details.

Figure 15: Slaved Zone Damper Wiring & Connection Diagram
Controller Addressing & Baud Rate Setting

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 VAV/Zone Controller 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 VAV/Zone Controller is to be connected to other VAV/Zone Controllers on a communication loop, each VAV/Zone Controller’s address switch must be set with a unique address between 1 and 58.

When programming the VAV/Zone Controller 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 VAV/Zone Controller 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 VAV/Zone Controller Package is connected to and then enter the VAV/Zone Controller’s address. See Figure 16, below for a diagram depicting address switch settings.

Baud Rate Address switches 1 and 2 are used for the baud rate selection. See Figure 16, below for baud rate setting information.

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**NOTE:**
The Power To The Controller Must Be Removed And Reconnected After Changing The Address Switch Settings In Order For Any Changes To Take Effect.

**CAUTION:**
Disconnect All Communication Loop Wiring From The Controller Before Removing Power From The Controller. Reconnect Power And Then Reconnect Communication Loop Wiring.

---

**Figure 16: Address and Baud Rate Switch Setting**

### BAUD RATE SELECTION

<table>
<thead>
<tr>
<th>Baud</th>
<th>Switch 1</th>
<th>Switch 2</th>
<th>Communication Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>9600</td>
<td>OFF</td>
<td>OFF</td>
<td>CommLink IV</td>
</tr>
<tr>
<td>9600</td>
<td>OFF</td>
<td>OFF</td>
<td>CommLink 5 Set at Low Speed*</td>
</tr>
<tr>
<td>57600</td>
<td>OFF</td>
<td>ON</td>
<td>CommLink 5 Set at High Speed*</td>
</tr>
</tbody>
</table>

* The CommLink 5 must be set to Low Speed if it is being used on a system that includes the VCM-X Controller or older generation of Orion Controllers.

** The CommLink 5 can be set to High Speed if it is being used on a system that only includes VCC-X, VCB-X, or GPC-XP Controllers.
**Initialization and Operator Interfaces**

**Initialization**

On system power-up, the “STAT 1” & “STAT 2” LEDs are extinguished for a few seconds, and then STAT1 flashes a set of 3 flashes five times. After that, STAT2 flashes the number of the address switch setting, so if the address switch is set to 7, STAT2 will flash 7 times. If the address is higher than 9, both STAT 1 and 2 will flash with STAT1 flashing the 10s and STAT2 flashing the 1s. For example, if the address is 34, STAT1 will flash 3 times and STAT2 will flash 4 times. After the address is flashed, there is a short delay and then the controller will go into damper calibration and the ACTUATOR LEDs will come on. 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. If there is a problem with the controller, STAT2 LED will blink more than once. These diagnostic flashes are described in the Troubleshooting section of this manual.

**Operator Interfaces**

The next step is configuring the controller for your specific requirements. In order to configure the VAV/Zone Controller, you must use an operator interface. Four different operator interfaces are available for programming and monitoring of the VAV/Zone Controller. See Figure 17. They are as follows:

- Modular Service Tool SD
- Modular System Manager SD
- Computer with Prism 2 Software & CommLink 5 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.

If using the Modular Service Tool SD or the Modular System Manager SD for programming, refer to your HVAC Unit Controller’s Operator Interface SD Technical Guide. 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.

No matter which operator interface you use, we recommend that you proceed with the programming and setup of the VAV/Zone 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 17: Operator Interfaces
VAV/Zone Controller Configuration & Setup

Configuration can be accomplished by using either the Modular Service Tool SD, Modular System Manager SD, or a computer with Prism 2 software installed. 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 or Configuration Screens with the exception of “AHU Heating Call Setpoint” which is set from the Setpoints Menu or Setpoints Screens.

Box Control Method
Set this configuration item for the type of box the VAV/Zone Controller is used on. All options below are available with and without reheat. The options are:
- Cooling Only Box (VAV)
- Heating/Cooling Changeover Box (Zoning)
- Series Fan Powered Box (VAV & Zoning)
- Parallel Fan Powered Box (VAV & Zoning)

Damper Operating Mode
This option sets the direction of rotation the damper moves when driving towards its full open position. The options available are:
- Direct Acting (Clockwise-to-Open Damper)
- Reverse Acting (Counterclockwise-to-Open Damper)

NOTE: The Default is Direct Acting, which means that when looking at the damper shaft, the damper rotates clockwise to open. When the operating mode is changed, the damper will re-calibrate.

Voting Zone
When the 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 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 this is a true VAV system, the option should be set to No. A maximum of 16 voting zones can be configured. The options available are:
- Yes
- 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. See the “K” factor table that follows if you are using the Round VAV/Zone Dampers.

### Table 2: Airflow K-Factor (CFM) Requirements

<table>
<thead>
<tr>
<th>Damper Size</th>
<th>K-Factor (CFM)</th>
<th>Velocity (FPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6” Nominal Dia.</td>
<td>448</td>
<td>2282</td>
</tr>
<tr>
<td>8” Nominal Dia.</td>
<td>904</td>
<td>2590</td>
</tr>
<tr>
<td>10” Nominal Dia.</td>
<td>1436</td>
<td>2633</td>
</tr>
<tr>
<td>12” Nominal Dia.</td>
<td>1891</td>
<td>2408</td>
</tr>
<tr>
<td>14” Nominal Dia.</td>
<td>3015</td>
<td>2820</td>
</tr>
<tr>
<td>16” Nominal Dia.</td>
<td>3889</td>
<td>2749</td>
</tr>
</tbody>
</table>

NOTES: K-Factor in the table is corrected to 70 °F @ 1000 ft. elevation. For other elevations add 2% for each additional 1000 ft. of elevation.
Add 1% for each additional 10 degrees of temperature increase.

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:
- No Staging
- 1 Stage of Reheat
- 2 Stages of Reheat
- 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:
- 0-10 VDC Voltage Signal
- 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:
- No
- Yes

Multiple Daily Setpoints/Schedules
By clicking on the “Use Schedule Space Setpoints” box, in the Prism Setpoints/Configuration screen, you can set up to 5 Temperature Setpoint periods in a 24 hour period. You can select a Cooling and Heating Setpoint for the period from Midnight to the first event, then different setpoints from the first event to second event, then the second event to third event, then the third event to fourth event, and finally from the fourth event to midnight. Each of the event times and temperatures are configurable.
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 in the Occupied Mode Sequences and Unoccupied Mode Sequences that follow later in this manual. Options available are No - Heat can operate without fan or Yes - Heat cannot operate without fan.

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.

The default group ID number for all VAV/Zone Controllers is set at the factory as 1. If you don’t want a specific zone(s) to be part of that group, you must give each one a distinct group number between 2 and 16.

NOTE: WattMaster recommends that your groups consist of at least 3 zones to ensure minimum airflow across the HVAC unit coil.

Dump Zone
The dump zone is a controller without an actuator that is used to control a duct heater or Auxiliary Heat. If this VAV/Zone Controller is to be used as a Dump Zone, set this configuration to 1=Yes. Options available are Yes or No.

AHU Heating Call
This setting is located under the Setpoints Menu or Setpoints Screens and is used only for the Unoccupied mode. For Non-Fan Powered Terminal units, this temperature setpoint is used to allow a heating device such as baseboard heaters to be energized in an attempt to satisfy the heating demand prior to initiating the HVAC unit’s 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 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 Unit Controller to initiate the HVAC unit Supply Air Heating Mode. This setpoint temperature can be set higher or lower than the Space Heating Setpoint.

NOTE: This setpoint follows the Unoccupied Heating Setpoint Setback.

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 or other perimeter heat sources. See Table 3, page 31 for a complete layout of the various fan and heat relay staging points.

Expansion Relays – Steps of Reheat
If only 1 stage of box heat is required and this is not a Fan Terminal Unit, use the Auxiliary Heat relay on the VAV/Zone Controller and select “Used for BOX Re-heating” in the Configuration. Also in “Stages of Box Re-Heat” configure for 1 stage.

If the box requires more than 1 stage of reheat, the OE325-03 VAV/Zone Controller Expansion Module must be used and 2 or 3 stages of heat must be selected. If a Fan Terminal Unit is used, use the OE325-03 VAV/Zone Controller Expansion Module for all stages of heat.

Box Reheat
The box heat 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.

Window Open Detection
When this feature is selected, if the contacts on terminals BIN and GND are open, the controller will control to the Unoccupied Cooling and Heating Setpoints, and when the contacts are closed, it will go control to the Occupied Cooling and Heating Setpoints. Normally closed operation can be selected by configuring reverse contact polarity. See the VAV/Zone Controller Inputs and Outputs section for more details.

Motion Sensor Occupancy Detection
When this feature is selected, if the contacts on terminals BIN and GND are open, the controller will control to the Occupancy Cooling and Heating Setback Setpoints. When the contacts are closed, it will go back to the Occupied Cooling and Heating Setpoints. Normally closed operation can be selected by configuring reverse contact polarity. See the VAV/Zone Controller Inputs and Outputs section for more details.

Type of Space Sensor
Choose the type of Space Sensor that you are using - Analog or Digital.

Stand Alone Box Running Continuous Occupied Mode
Choose if unit is a Stand-Alone Box that operates independently without requiring communication with the HVAC unit controller.
Scheduling & 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 Unit Controller or a GPC-XP Controller can transmit the Occupied command to the VAV/Zone Controller. This requires the VAV/Zone 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 VAV/Zone Controller and Unit 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.

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.

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.

HVAC 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 Temperature (SAT) and/or space demand conditions. They are:

- **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.

- **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 VAV/Zone 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 VAV/Zone 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 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.
**SEQUENCE OF OPERATIONS**

**VAV/Zone Occupied Mode Sequences**

**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 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.

If the VAV/Zone 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 VAV/Zone 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 VAV/Zone Controller has a cooling demand, the Damper Position/Airflow for the VAV/Zone 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 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**
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.
**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. 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 3 for a complete layout of the various Fan & Heat relay staging points.

**Modulating (Proportional) Heat**

The VAV/Zone Controller Package with the Zone Controller Expansion Module 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 Unit controller is in or at any airflow condition. This is typically used to control baseboard heat or an external duct heater. See Table 3 for a complete layout of the various Fan and heat relay staging points.

### Table 3: Fan & Reheat Relay Staging

<table>
<thead>
<tr>
<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><strong>0.5°F Above Box Heat Setpoint</strong></td>
<td><strong>ON With HVAC Fan</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>At Box Heat Setpoint</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>1.0°F Below Box Heat Setpoint</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2.0°F Below Box Heat Setpoint</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>0.5°F Below Aux. Heat Setpoint</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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.

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**VAV/Zone Controller Package**

31
SEQUENCE OF OPERATIONS

VAV/Zone 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 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.

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 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 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 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 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

VAV/Zone 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 3, page 31 for a complete layout of the various fan & heat relay staging points.

Modulating (Proportional) Heat
The VAV/Zone Controller 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 Unoccupied 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 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.

Series Flow Fan Terminals
If the VAV/Zone Controller has been configured as a Series Fan Powered terminal unit, the series fan will run continuously when the VAV/Zone Controller is in the Space Heating Mode, no matter whether check for main 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 HV AC 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 Supply 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.
**SEQUENCE OF OPERATIONS**

**VAV/Zone Damper Control**

**Parallel Flow Fan Terminals**
If the VAV/Zone Controller has been configured as a Parallel Fan Powered terminal unit, the Parallel fan will run continuously when the VAV/Zone 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 HVAC unit controller is broadcasting that the HVAC unit fan is operating, regardless of whether it is calling for heat or not. 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 ±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:

\[
\text{Window} = \text{Terminal unit size} \times \sqrt{\frac{1}{750}}
\]

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.
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 VAV/Zone 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 an alarm callout 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 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.
SEQUENCE OF OPERATIONS

Alarms & Tenant Override Logs

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 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.

VAV/Zone 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 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 VAV/Zone Controllers can read it and use it in their tenant and trend logs.
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 VAV/Zone 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 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.

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. 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 18 for the LED locations. The LEDs and their uses are as follows:

Operation LEDs - Factory Troubleshooting

COMM - This orange LED will light up and blink continuously to indicate communications are working properly.

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

APP HB - This green LED will light up and blink continuously to indicate the application software is working properly.

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

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

Diagnostic LEDs

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. The status code is repeatedly blinked every 10 seconds to indicate controller status. See Table 4, below for STAT 2 LED Blink Codes. The Blink Codes are listed in order of priority with 7 being the highest priority.

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

<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 4: STATUS 2 LED Blink Codes

If the STAT 2 LED does not operate as indicated, first check the address switch setting. See Figure 16, page 25 for correct address switch setting procedures. If the address switch setting is correct and the STAT 2 LED still does not behave as indicated above, contact WattMaster Controls Technical support.
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 5, page 42. 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 5, page 42.

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 5, page 42. 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 5, page 42.

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 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 procedures above 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.
**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 VAV/Zone 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 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.

**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 VAV/Zone 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.
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 19, below when checking sensors.

**Figure 19: Testing Resistance On E-BUS Digital Room 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.
Table 5: Temperature/Resistance for Type III 10K Ohm Thermistor Sensors

| Temperature – Resistance – Voltage for Type III 10 K Ohm Thermistor Sensors |
|-----------------------------|------------------|-----------------|
| Temp (°F) | Resistance (Ohms) | Voltage @ Input (VDC) |
| -10      | 93333            | 4.620            |
| -5       | 80531            | 4.550            |
| 0        | 69822            | 4.474            |
| 5        | 60552            | 4.390            |
| 10       | 52500            | 4.297            |
| 15       | 45902            | 4.200            |
| 20       | 40147            | 4.095            |
| 25       | 35165            | 3.982            |
| 30       | 30805            | 3.862            |
| 35       | 27140            | 3.737            |
| 40       | 23874            | 3.605            |
| 45       | 21094            | 3.470            |
| 50       | 18655            | 3.330            |
| 52       | 17799            | 3.275            |
| 54       | 16956            | 3.217            |
| 56       | 16164            | 3.160            |
| 58       | 15385            | 3.100            |
| 60       | 14681            | 3.042            |
| 62       | 14014            | 2.985            |
| 64       | 13382            | 2.927            |
| 66       | 12758            | 2.867            |
| 68       | 12191            | 2.810            |
| 69       | 11906            | 2.780            |
| 70       | 11652            | 2.752            |

| Temperature – Resistance – Voltage for Type III 10 K Ohm Thermistor Sensors |
|-----------------------------|------------------|-----------------|
| Temp (°F) | Resistance (Ohms) | Voltage @ Input (VDC) |
| 71       | 11379            | 2.722            |
| 72       | 11136            | 2.695            |
| 73       | 10878            | 2.665            |
| 74       | 10625            | 2.635            |
| 75       | 10398            | 2.607            |
| 76       | 10158            | 2.577            |
| 78       | 9711             | 2.520            |
| 80       | 9302             | 2.465            |
| 82       | 8893             | 2.407            |
| 84       | 8514             | 2.352            |
| 86       | 8153             | 2.297            |
| 88       | 7805             | 2.242            |
| 90       | 7472             | 2.187            |
| 95       | 6716             | 2.055            |
| 100      | 6047             | 1.927            |
| 105      | 5453             | 1.805            |
| 110      | 4923             | 1.687            |
| 115      | 4449             | 1.575            |
| 120      | 4030             | 1.469            |
| 125      | 3656             | 1.369            |
| 130      | 3317             | 1.274            |
| 135      | 3015             | 1.185            |
| 140      | 2743             | 1.011            |
| 145      | 2502             | 1.024            |
| 150      | 2288             | 0.952            |

Table 5: Temperature/Resistance for Type III 10K Ohm Thermistor Sensors
### 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. WattMaster 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 WattMaster. An optional IP Module is also available to provide Internet connectivity to the control system.

### Multiple Loop VAV/Zoning

If you have a 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 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 that loops 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. WattMaster 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 this type of system and allows for connection to any personal 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 WattMaster. An optional IP Module is also available to provide Internet connectivity to the control system.
APPENDIX

VAV/Zone Controller System Architecture

Figure 20: Networked Single Loop System With MiniLink PD VAV/Zone Controllers Wiring
Figure 21: Networked Single Loop System With CommLink & MLPD VAV/Zone Controller Wiring
APPENDIX

VAV/Zone Controller System Architecture

Figure 22: Networked Multiple Loop System Wiring With VAV/Zone Controllers
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