

VCB-X Controller Field Technical Guide

VCB-X Controller Code: SS1051 Version 2.0 and up
Requires Service Tool SD Code: SS1063 Version 1.0 and up
Requires System Manager SD Code: SS1068 Version 1.0 and up
Requires System Manager TS II Code: SS7002 Version 2.0 and up

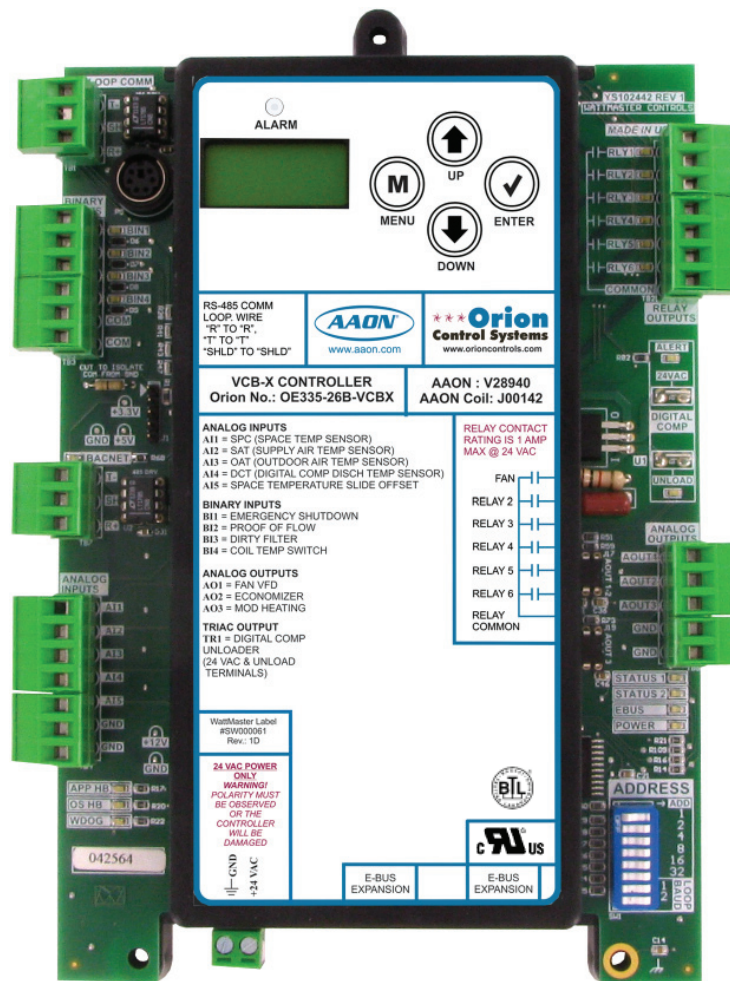


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Features

The VCB-X Controller (OE335-26B-VCBX-A) is designed with 5 analog inputs, 3 analog outputs, 1 triac output, 4 binary inputs, and 6 relay outputs. It also has an on-board BACnet® port for connection to an MS/TP network. The Controller contains a 2 x 8 LCD character display and 4 buttons that allow for status and alarm display and force modes as well as BACnet configuration.

The VCB-X EM1 Expansion Module (OE336-23-EM1-A) provides an additional 6 analog inputs, 4 analog outputs, 3 binary inputs, and 5 configurable relay outputs. The VCB-X EM2 Expansion Module (OE336-23-EM2-A) provides an additional 1 analog input, 2 analog outputs, and 3 binary inputs. The VCB-X 12 Relay Expansion Module (OE358-23E-12R-A) provides up to 12 additional configurable relay outputs.

There are also 2 E-BUS Expansion Ports which allow for the connection of the three expansion modules listed above, communicating sensors, an EBTRON® or GreenTrol™ Airflow Monitoring system, and future E-BUS Modules via modular cable assemblies. There are presently 5 communicating sensors available. Two of these sensors have LCD displays: E-BUS Digital Space Temperature Only Sensor or E-BUS Digital Space Temperature and Humidity Sensor. There is a communicating E-BUS Space Temperature and Humidity Sensor with no LCD display as well as an E-BUS Space CO₂ Sensor, and E-BUS Duct CO₂ Sensor with no LCD display.

The VCB-X Controller provides for Constant Volume, VAV, Single Zone VAV, MUA, and Air to Air Heat Pump applications.

Most common HVAC unit control applications can be configured using only the VCB-X Controller. If the application requires more inputs and/or outputs, the optional expansion modules are available to provide for additional analog, binary, or digital inputs and outputs as required.

Other features of the VCB-X include:

- Direct Digital Control of (1) Copeland Digital Scroll™ Compressor
- Modulating Cooling Output for Chilled Water Valve Control
- Modulating Heating Output (Hot Water Valve, Steam Valve, SCR Electric Heat Control)
- Full Integration with the AAON® MODGAS-X Modulating Natural Gas Controller
- Full Integration with the AAON® MHGRV-X Modulating Hot Gas Reheat Controller
- Configurable for Heat Pump Applications
- Heat Pump Defrost Operation
- Advanced Dehumidification Capabilities

- Auxiliary and Emergency Heat Options for Heat Pumps
- Air Flow Monitoring of Outdoor Air, Supply Air, Return Air, and Exhaust Air Streams
- Air Flow Control of Outdoor Air Damper
- Single Zone VAV Control w/Optional CAV Heating
- Primary/Secondary Heating Control
- Remote Forced Cooling, Heating, and Dehumidification Control
- Remote SAT Reset Signal
- Return Air Bypass Control
- Adaptive Supply Air Reset
- Selectable Mode Enable Sensor
- Fan Proving Interlock
- Dirty Filter Alarm
- Emergency Shutdown Input (Smoke Detector/Firestat or other Shutdown Conditions)
- Drybulb/Wetbulb/Dewpoint Control of Economizer Operation
- Building Pressure Control (Direct or Reverse Acting)
- Remote Forced Occupied Capability
- Configurable for AAON® PAC and DPAC Applications
- IAQ Economizer Reset
- Title 24 Economizer Certified
- 7-Day, 2-Event-per-Day Scheduling
- 14 Holiday Event Scheduling
- Daylight Savings Time Adjustment
- Trend Logging Capability
- Static Pressure Control for Filter Loading Applications
- Heat Wheel - On/Off Control
- Head Pressure Control
- Water Source Heat Pump Monitoring
- On-board BACnet® port for connection to an MS/TP network (See Appendices B & C)



Applications

Applications

Variable Air Volume Unit

The VCB-X can control VAV units that are typically designed for occupied Cooling Mode only, where VAV boxes equipped with reheat satisfy heating demands in individual spaces. In this application, unit heat is typically used for Morning Warm-Up. Morning Cool-Down is also available. The controller can be configured to control the supply fan VFD to maintain a duct static pressure setpoint.

The VCB-X can also control VAV units that may require occupied Heating operation to “temper” the outdoor air if it is too cold outside for the mixed air to maintain the Cooling Supply Air Setpoint.

Constant Air Volume Unit

The VCB-X can be configured for Constant Volume applications, that are typically Space Temperature or Return Air Temperature controlled.

The VCB-X can also be used for restaurant kitchen or lab applications that are 100% Outdoor Air part of the time and recirculating air part of the time. A Hood On binary contact closure input forces the VCB-X to switch to 100% Outdoor Air control based on an exhaust hood switch activation. The VCB-X requires Outdoor and Indoor Air Temperature (and Humidity) Sensors to accomplish this application.

Single Zone VAV

This is a hybrid CAV/VAV application for a unit serving a single space and using Space Temperature Setpoints to enable Heating and Cooling Modes. Heating and Cooling are controlled to their respective Supply Air Setpoints while the supply fan modulates to maintain the Space Temperature Setpoints. Single Zone VAV applications can be configured for VAV Cooling and either VAV or CAV Heating. Single Zone VAV operation requires the use of modulating Heating or Cooling sources.

Space Temperature Control of High Percentage Outdoor Air Units

This application allows the unit to be configured to use the space temperature to initiate Cooling and Heating Modes on units that are high percentage outdoor air or 100% outdoor air units. Before entering the space Vent Mode, the controller will first determine if the outdoor air temperature is above or below special outdoor air Cooling and Heating setpoints. If so, the unit will leave stages of Cooling or Heating on as necessary to achieve a neutral supply air temperature – thus avoiding dumping very hot or cold air into the space.

Make-Up Air Unit

The VCB-X can be configured for 100% Outdoor Air control for Make-Up Air units. All HVAC Modes are determined from the Outdoor Temperature and Humidity Sensors. The Outdoor Air Volume should be at least 50% or higher to be configured for Outdoor Air control.

AAON® Return Air Bypass Control

This control scheme can only be used on Constant Volume HVAC units that are equipped with a Return Air Bypass Damper and that use Space Temperature and Humidity Sensors as the Controlling Sensors.

AAON® Return Air Bypass Control provides improved moisture removal capabilities while utilizing internal space loads for reheat by redirecting Return Air from the upstream side of the DX Evaporator Coil to the downstream side of the coil during Dehumidification.

Zone Voting

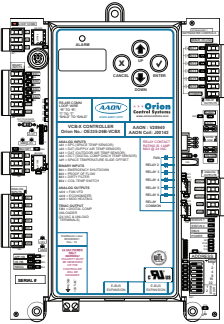
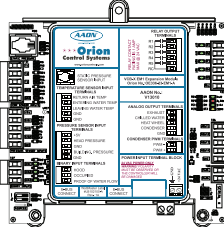
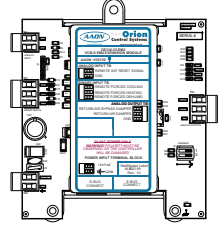
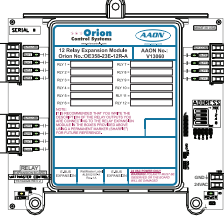
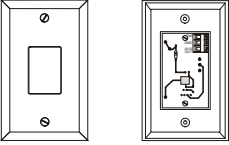

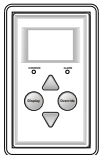
The VCB-X can be configured to be the unit controller in a zone voting system where the individual zones vote to put the unit into occupied Cooling or Heating Mode. To be used in this application, Orion zone controllers must also be used in order to allow communication between the zones and the VCB-X Controller. Duct static pressure control can be accomplished with a supply fan VFD or a bypass damper.

Part Number Cross Reference

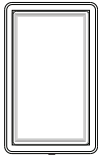

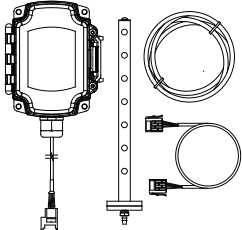
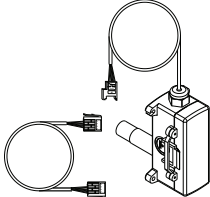
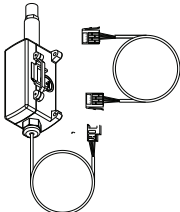
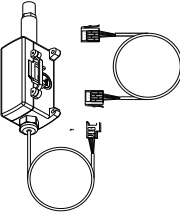
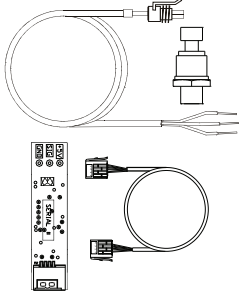
PART DESCRIPTION	ORION PART NUMBER
VCB-X Controller	OE335-26B-VCBX-A / OE335-26B-VCBX-C
VCB-X 12 Relay Expansion Module	OE358-23E-12R-A
VCB-X EM1 Expansion Module	OE336-23-EM1-A / OE336-23-EM1-C
VCB-X EM2 Expansion Module	OE336-23-EM2-A
Building Static Pressure Sensor	OE258-01
CommLink 5 Communications Interface	OE361-13
Duct Static Pressure Sensor	OE271
EBC E-BUS Cable Assembly E-BUS Power & Comm 1.5 Ft, 3 Ft, 10 Ft, 25 Ft, 50 Ft, 75 Ft, 100 Ft, 150 Ft, 250 Ft, and 1000 Foot Spool	EBC-1.5-F-A, EBC-3-F-A, EBC-10-F-A, EBC-25-F-A, EBC-50-F-A, EBC-75-F-A, EBC-100-F-A, EBC-150-F-A, EBC-250-F-A, EBC-SPOOL-A
E-BUS Adapter Hub	MS000248
E-BUS Adapter Hub with 1.5 Ft. EBC Cable	HZ-EBC-248
E-BUS Adapter Board	OE365-15-EBA-A
E-BUS CO ₂ Sensor with Remote Pickup - Duct Mounted	OE256-07-A
E-BUS CO ₂ Sensor - Space	OE256-05-A
E-BUS Digital Room Sensor - LCD Display - Temp. Only	OE217-02-A
E-BUS Digital Room Sensor - LCD Display - Temp & RH	OE217-03-A
E-BUS Digital Room Sensor - No LCD Display - Temp & RH	OE217-04-A
E-BUS Horizontal Outside Air Temperature & RH Sensor	OE265-15-A / OE265-15-C
E-BUS Vertical Outside Air Temperature & RH Sensor	OE265-16-A
E-BUS Return Air Temperature & RH Sensor	OE265-17-A
GPC-X Controller	OE332-23-GPCX
GPC-XP Controller	OE338-23-GPCXP
Immersion Well for OE230 Water Temperature Sensor	OE291
IP Module Kit	OE415-02
MHGRV-X Controller	OE377-26-00059
MiniLink Polling Device 5	OE364-23-OR
MODGAS-X Controller	OE377-26-00058
Modular Service Tool SD - Operator Interface	OE391-12
Modular System Manager SD - Operator Interface	OE392-12
Outdoor Air Temperature Sensor	OE250
PREHEAT-X Controller	OE377-26-00061
Return Air Temperature Sensor	OE231
Standard Room Sensor - Plain	OE210
Standard Room Sensor - W/ Override	OE211
Standard Room Sensor - W/ Slide Adjust	OE212
Standard Room Sensor - W/ Override & Slide Adjust	OE213
Static Pressure Pickup Tube	OE290
Strap-On Temperature Sensor Kit	OE233
Suction Pressure Sensor Kit with E-BUS Adapter	OE275-03-A
Supply Air Temperature Sensor	OE231
System Manager TS II - Operator Interface	OE392-10
System Manager TS-L (Touch Screen - Limited Access)	OE392-11
USB-Link 2 Kit	OE366
Water/Air Temperature Sensor	OE230

OVERVIEW

Parts and Descriptions

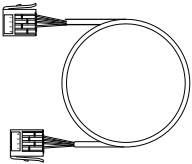
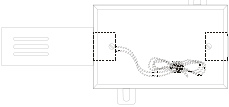
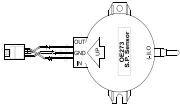
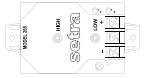
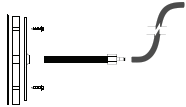
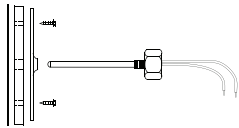
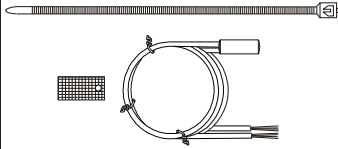
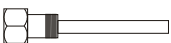

PART NO.	PART DESCRIPTION	ILLUSTRATION	PAGE NO.
OE335-26B-VCBX-A	<p>VCB-X Controller The VCB-X Controller provides 5 analog inputs, 3 analog outputs, 1 triac input, 4 binary inputs, and 6 user-configurable relays. It also has an on-board BACnet port for connection to an MS/TP network. The Controller contains a 2 x 8 LCD character display and 4 buttons that allow for status and alarm display as well as BACnet configuration. It presently allows for the addition of the EM1 Expansion Module and the 12 Relay Expansion Module described below.</p> <p>NOTE: Set-up, configuration, and monitoring of the VCB-X Controller requires one of the following communication interfaces—Prism 2 Front-End Software used with a personal computer, System Manager Touch Screen, or Modular Service Tool SD.</p>		Page 20
OE336-23-EM1-A	<p>VCB-X EM1 Expansion Module The EM1 Expansion Module adds VAV applications, building pressure control, head pressure control, water source heat pump monitoring, and other functions. It provides 6 additional analog inputs, 3 binary inputs, 5 additional relays, and 4 analog outputs. It connects with an EBC E-BUS cable to the VCB-X Controller.</p>		Page 36
OE336-23-EM2-A	<p>VCB-X EM2 Expansion Module The EM2 Expansion Module adds remote forced heating, cooling, and dehumidification using 3 additional binary inputs. It provides 2 analog outputs for controlling a Return Air Bypass Damper and a Return Damper in Return Air Bypass applications. It also has an analog input that can be used as a remote voltage input to reset the Supply Air Setpoint or as a Title 24 Economizer feedback signal. It connects with an EBC E-BUS cable to the VCB-X Controller.</p>		Page 47
OE358-23E-12R-A	<p>VCB-X E-BUS 12 Relay Expansion Module The VCB-X 12 Relay Expansion Module adds 12 configurable relays to the VCB-X Control System. It connects to the VCB-X Controller with an EBC E-BUS cable.</p>		Page 50
OE210 OE211 OE212 OE213	<p>Standard Room Sensor—Plain, w/Override, w/Override & Slide Adjust & w/Slide Adjust Only Includes: Standard Room Sensor - Plain, with Override, with Override and Slide Adjust & with Slide Adjust only. For wall mounting. Use with VCB-X Controller only. Connects to controller via field fabricated wiring.</p>		Page 25
OE217-02	<p>E-BUS Digital Room Sensor - Temp. Only LCD Display and keypad allow for setpoint adjustment, override, and display of certain status and setpoints. The OE217-02 is used with the VCB-X Controller for room air temperature sensing applications. Uses EBC E-BUS cable.</p>		Page 22
OE217-03	<p>E-BUS Digital Room Sensor - Temp and Humidity LCD Display and keypad allow for setpoint adjustment, override, and display of certain status and setpoints. The OE217-03 is used with the VCB-X Controller for room air temperature and humidity sensing applications. Uses EBC E-BUS cable.</p>		Page 22

Parts and Descriptions

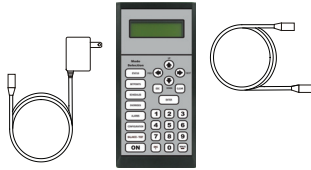
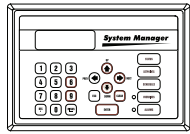
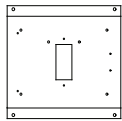
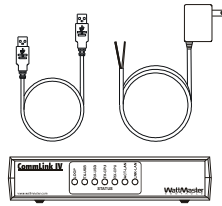
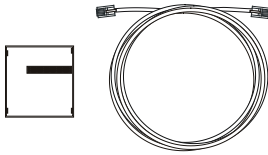
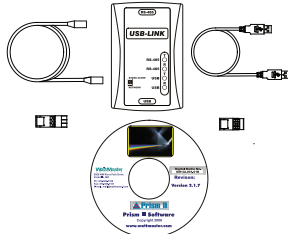
PART NO.	PART DESCRIPTION	ILLUSTRATION	PAGE NO.
OE217-04	<p>E-BUS Digital Room Sensor - Temp and Humidity</p> <p>The OE217-04 is used with the VCB-X Controller for room air temperature and humidity sensing applications. Contains no LCD Display or keypad. Uses EBC E-BUS cable.</p>		Page 22
OE256-05	<p>E-BUS CO₂ Wall-Mounted Sensor</p> <p>Used with the VCB-X for CO₂ sensing applications where wall mounting in the space is desired. Connects to the VCB-X Controller with an EBC E-BUS cable of required length. Cable sold separately.</p>		Page 23
OE256-07	<p>E-BUS CO₂ Duct Sensor with Remote Pickup Tube</p> <p>Used with the VCB-X Controller for duct mounted CO₂ sensing applications. Connects to the VCB-X Controller with an EBC E-BUS cable of required length. Includes: Duct Mounted CO₂ Sensor, Integral Aspiration Box, Airflow Pickup Tube and 10 ft. EBC Cable.</p>		Page 24
OE265-15-A	<p>E-BUS Horizontal Outdoor Air Temperature & Humidity Sensor</p> <p>Used for outdoor temperature and humidity sensing applications. Connects to VCB-X Controller or E-BUS Adapter Hub using EBC E-BUS cable. Includes: 10k Ohm E-BUS Horizontal Outside Air Temperature & Humidity Sensor, mounted in a weatherproof handy box with attached 3 foot EBC E-BUS Cable with jack.</p>		Page 28
OE265-16-A	<p>E-BUS Vertical Outdoor Air Temperature & Humidity Sensor</p> <p>Used for outdoor temperature and humidity sensing applications. Connects to VCB-X Controller or E-BUS Adapter Hub using EBC E-BUS cable. Includes: 10k Ohm E-BUS Vertical Outside Air Temperature & Humidity Sensor, mounted in a weatherproof handy box with attached 3 foot EBC E-BUS Cable with jack. A 10 foot EBC cable is included to connect to the VCB-X Controller. If a longer EBC cable is required, it must be ordered separately.</p>		Page 28
OE265-17-A	<p>E-BUS Return Air Temperature & Humidity Sensor</p> <p>Used for return air temperature and humidity sensing applications. Connects to VCB-X Controller or E-BUS Adapter Hub using EBC E-BUS cable. Includes: 10k Ohm E-BUS Return Air Temperature & Humidity Sensor, mounted in a weatherproof handy box attached 3 foot EBC E-BUS Cable with jack. A 50 foot EBC cable is included to connect to the VCB-X Controller. If a longer EBC cable is required, it must be ordered separately.</p>		Page 29
OE275-03-A	<p>Suction Pressure Transducer Kit with E-BUS Adapter</p> <p>Used for suction pressure sensing applications. Connects to VCB-X Controller using E-BUS Adapter Board and EBC E-BUS cable. Includes: OE275-01 Suction Pressure Transducer, modular cable with a modular connector on one end and bare stripped wires on the other end, E-BUS Adapter, and 3 Foot EBC E-BUS cable.</p>		Page 30

OVERVIEW

Parts and Descriptions



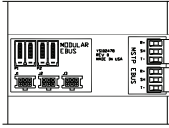
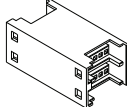
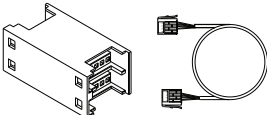
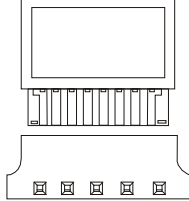
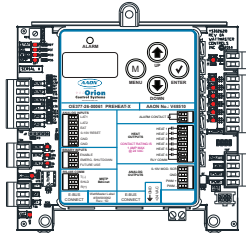
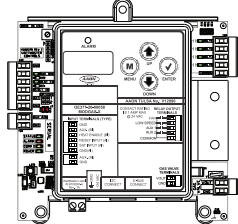
PART NO.	PART DESCRIPTION	ILLUSTRATION	PAGE NO.
EBC-1.5-F EBC-3-F EBC-10-F EBC-25-F EBC-50-F EBC-75-F EBC-100-F EBC-150-F EBC-250-F EBC-SPOOL	EBC E-BUS Cables The EBC E-BUS Expansion Cables attach to the VCB-X Controller, VCB-X Expansion Modules, and E-BUS Sensors. The EBC E-BUS cables can be crimped and clamped to the E-BUS connector. Different lengths can be joined together using an E-BUS extension adapter. The EBC E-BUS Cables are available in 1.5, 3, 10, 15, 25, 50, 75, 100, 150, 250 & 1000 feet lengths. Includes: EBC E-BUS Cable Assembly.		N/A
OE250	Outdoor Air Temperature Sensor Used for temperature sensing applications. Includes: 10k Ohm Outside Air Temperature Sensor, 2 wire, mounted in a weatherproof handy box only.		Page 27
OE271	Duct Static Pressure Sensor Used for duct static pressure sensing applications. Includes: 0-5" W.C., 0-5 VDC, Static Pressure Sensor only.		Page 38
OE258-01	Building Static Pressure Sensor Used for Building Pressure Sensing. Includes: -0.25 to +0.25" W.C., 0-5 VDC, 24 VAC/VDC supply power Building Pressure Sensor only.		Page 41
OE290	Static Pressure Pick-up Tube Used with OE271 Static Pressure Sensor for static pressure sensing applications. Includes: Static Pressure Pick-up Tube with 1 ft. length of FRP tubing, gasketed mounting bracket, and screws.		Page 38
OE230 OE231	Duct Temperature Sensor - 6" Probe Duct Temperature Sensor - 12" Probe 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.		Pages 39 & 40
OE233	Strap-on Temperature Sensor Kit Includes: 10k Ohm, Type 3, Strap-on Temperature Sensor, 2 wire. Used for water temperature sensing applications. Includes sensor, thermal mastic, and plastic mounting strap.		Pages 40 & 41
OE291	Immersion Well for OE230 Water Temperature Sensor Includes: Stainless steel thermowell to be used with the OE230 Temperature Sensor listed above. The thermowell is designed to thread into a 1/2" FPT elbow or tee in the water piping system.		Page 40
OE392-10	System Manager TS II Operator Interface The System Manager TS II provides a direct, graphic-enhanced, menu-driven link to enable the system operator to view the status and adjust the setpoints of any controller on the VCB-X control system. The System Manager TS is equipped with a 4.3" 480 x 272 WQVGA RGB TFT LCD Touch Screen Display. The System Manager TS is furnished with hardware for flush mounting into hollow drywall or surface mounting on concrete brick or plaster surfaces. Includes: System Manager TS with 12 ft. long pigtail cable assembly.		See System Manager Touch Screen II Technical Guide

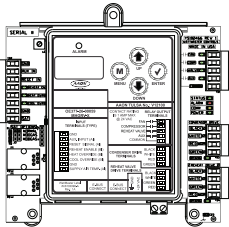
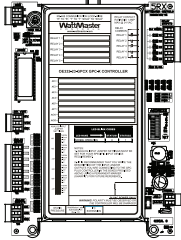
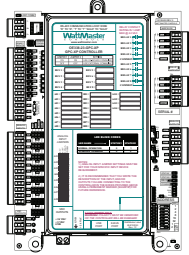
Parts and Descriptions

PART NO.	PART DESCRIPTION	ILLUSTRATION	PAGE NO.
<p>OE391-12</p>	<p>Modular Service Tool SD Includes: Modular Service Tool, power supply, communication cables, 4 Gigabyte SD card, and (4) AA batteries. Used to program and monitor all Orion controllers.</p>		<p>See VCB-X Controller Operator Interfaces SD Technical Guide</p>
<p>OE392-12</p>	<p>Modular System Manager SD 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.</p>		<p>See VCB-X Controller Operator Interfaces SD Technical Guide</p>
<p>EB101505</p>	<p>Solid Wall Mounting Bracket for Modular System Manager SD Includes: 22 gauge galvanized sheet metal mounting bracket with mounting holes and wire routing opening. Dimensions are 9.25"W x 8.00"H x 0.50"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 System Manager TS.</p>		<p>N/A</p>
<p>OE361-13</p>	<p>CommLink 5 Communications Interface 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 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 front-end software must be installed on the direct connected or remote connected computer in order to communicate with your system.</p>		<p>See CommLink 5 Technical Guide</p>
<p>OE415-02</p>	<p>IP Module Kit - Internet/LAN Connection 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 front-end software must be installed on the remote computer in order to dial-up and communicate with the controls system.</p>		<p>See IP Module Technical Guide</p>
<p>OE366</p>	<p>USB-Link 2 Kit 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.</p>		<p>See USB-Link 2 Technical Guide</p>

OVERVIEW

Parts and Descriptions

PART NO.	PART DESCRIPTION	ILLUSTRATION	PAGE NO.
OE364-23-OR	<p>MiniLink Polling Device 5</p> <p>Includes: MiniLink PD 5. Used with all Orion controllers to provide network communications, zone voting, alarming, and tenant logging capabilities. A MiniLink PD 5 is required on each loop of a Networked system.</p>		N/A
OE508	<p>Prism 2 Front-End Computer Software</p> <p>Prism 2 provides standard, easy to understand status screens for each type of VCB-X equipment installed. Prism 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 can be configured for direct on-site installation, remote modem connection, or TCP/IP Internet connection to several installations.</p>		Page 55
OE365-15-EBA-A	<p>E-BUS Adapter Board</p> <p>The E-BUS Adapter Board is used for connecting the EBTRON®, Green-Trol™, or Paragon Airflow Measurement Digital Transmitter to the VCB-X Control System. The E-BUS Adapter Board connects to the VCB-X Controller with an EBC E-BUS cable. Cable supplied separately.</p>		Pages 28, 29 & 51
MS000248	<p>E-BUS Adapter Hub</p> <p>The E-BUS Adapter Hub is used for connecting E-BUS devices and Controllers together with EBC E-BUS cables of varying lengths. Includes: E-BUS Adapter Hub.</p>		Pages 28 & 29
HZ-EBC-248	<p>E-BUS Adapter Hub with 1.5 Foot EBC E-BUS Cable</p> <p>The E-BUS Adapter Hub is used for connecting E-BUS devices and Controllers together with EBC E-BUS cables of varying lengths. Includes: E-BUS Adapter Hub and 1.5 foot EBC E-BUS cable.</p>		Pages 28 & 29
OE437-03	<p>Communication Surge Protector Kit</p> <p>Used to isolate power surges to the communications wiring caused by lightning strikes for communications wiring loops that are routed outdoors or between buildings. One kit is required at each point where the communications wiring leaves or enters a building.</p> <p>Includes: Communication Bus Surge Protector, Base Module, and Mounting/Wiring Instructions.</p>		N/A
OE377-26-00061	<p>PREHEAT-X Controller</p> <p>The PREHEAT-X Controller is designed to control fixed stages of Preheat or optional modulating Preheat to maintain a desired Preheat Leaving Air Temperature Setpoint. The PREHEAT-X Controller directly connects to the VCB-X Controller or indirectly using an E-BUS Expansion Board via an EBC E-BUS cable.</p>		See the PREHEAT-X Controller Technical Guide
OE377-26-00058	<p>MODGAS-X Controller</p> <p>The MODGAS-X Controller modulates up to (2) gas valves to maintain a desired Discharge Air Temperature. It also controls the speed of the induced draft fan to maintain proper combustion in the heat exchanger. The MODGAS-X Controller connects to the VCB-X Controller via an EBC E-BUS cable. Available only from AAON.</p>		Page 53

PART NO.	PART DESCRIPTION	ILLUSTRATION	PAGE NO.
<p>OE377-26-00059</p>	<p>MHGRV-X Controller The MHGRV-X Controller controls a Modulating Hot Gas Reheat Valve to maintain a desired Supply Air Temperature and Dehumidification setpoint. The MHGRV-X Controller connects to the VCB-X Controller via an EBC E-BUS cable. Available only from AAON.</p>		<p>Page 52</p>
<p>OE332-23-GPCX</p>	<p>GPC-X Controller The GPC-X Controller provides the flexibility to control, schedule, and/or monitor equipment such as unit heaters, exhaust fans, motorized louvers, etc. The GPC-X has (6) configurable inputs which will accept signals from thermistor temperature sensors, 4-20mA or 0-5 VDC transmitters, or dry contact closures. An additional modular input is provided for connection of an OE271 Static Pressure Sensor. The GPC-X has (5) relay outputs for on/off control and (2) analog outputs. The GPC-X also has (5) separate 2-events-per-day schedules, each with its own optimal start functions built in. In addition, the GPC-X provides Lead/Lag start capabilities. Use the GPC-X to provide additional schedules for your controllers. Includes: OE332-23-GPCX Controller.</p>		<p>See the <i>GPC-X Controller Technical Guide</i></p>
<p>OE338-23-GPCXP</p>	<p>GPC-XP Controller The GPC-XP Controller is used for controlling equipment or processes that cannot be controlled using a standard HVAC controller. Prism 2 computer front end software is used to interface with the GPC-XP Controller functions. The GPC-XP Controller provides the flexibility to control, schedule, and/or monitor equipment such as unit heaters, exhaust fans, motorized louvers, and other mechanical equipment. In addition, the GPC-XP provides Lead/Lag start capabilities.</p> <p>The GPC-XP has 8 configurable analog inputs which will accept signals from thermistor temperature sensors, 4-20mA or 0-5VDC or 0-10VDC transmitters. Custom formulas created by available math functions and operators can be used in conjunction with the analog inputs to create a calculated value to be used and displayed for a specific analog input. The inputs are set for the desired scaling by means of a jumper bar. An additional input is available for communicating sensors available from WattMaster Controls. The GPC-XP also supports 8 wet contact binary inputs which can be configured for either normally open or normally closed operation. The GPC-XP has 8 relay outputs for on/off control and 4 analog outputs for proportional control signals. Highest/lowest/average of the analog input values can be used in the GPC-XP logic or broadcast to other controllers on the control system loop. The GPC-XP also has 8 separate 2 events per day schedules which can be assigned to any input or output for operational control or alarm recognition based on time of day. These schedules can also be configured to broadcast to other WattMaster HVAC equipment installed on the control system loop. Includes: OE338-23-GPCXP Controller.</p>		<p>See the <i>GPC-XP Controller Technical Guide</i></p>

OVERVIEW

VCB-X Controller Dimensions

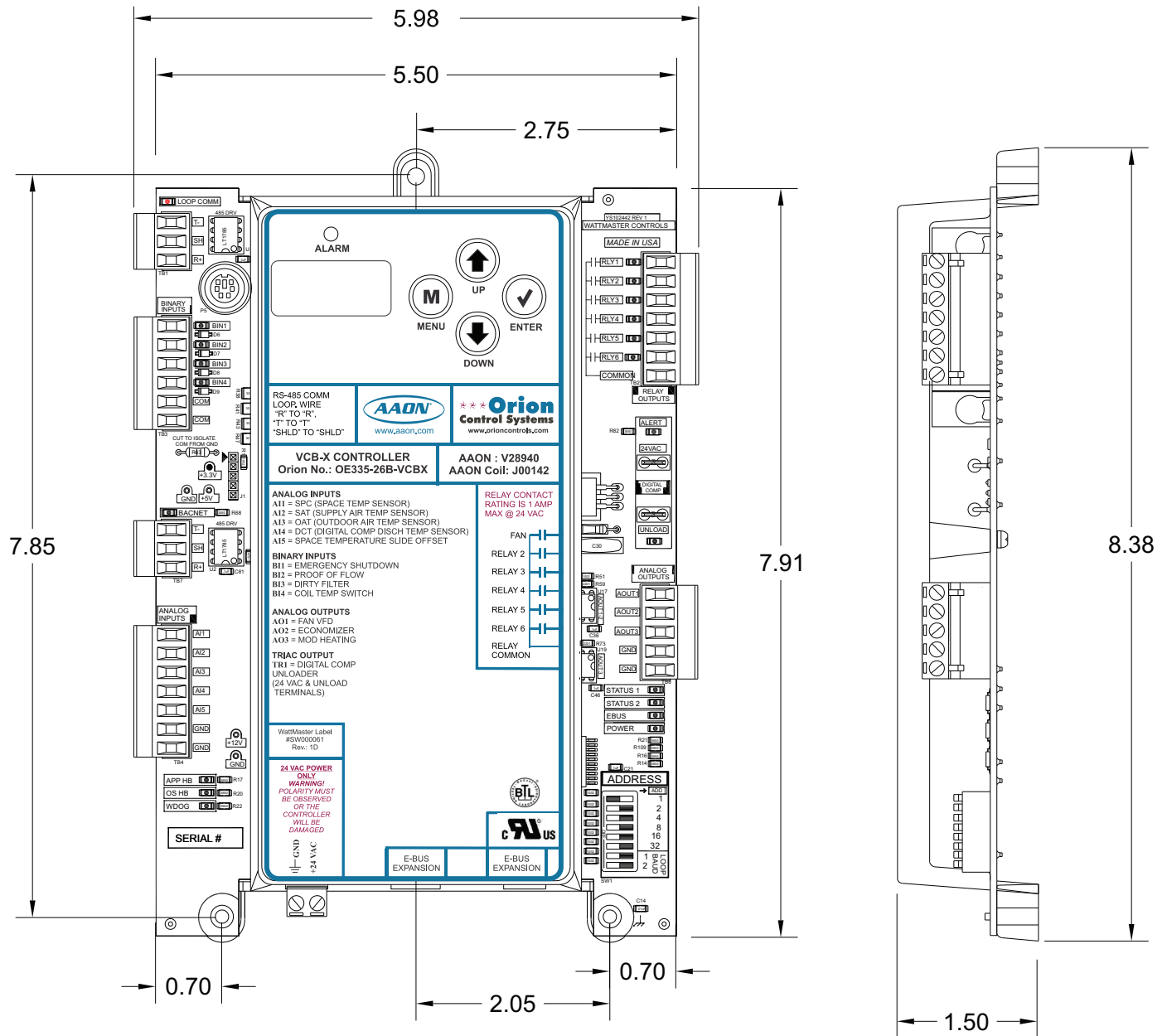


Figure 1: VCB-X Controller Dimensions

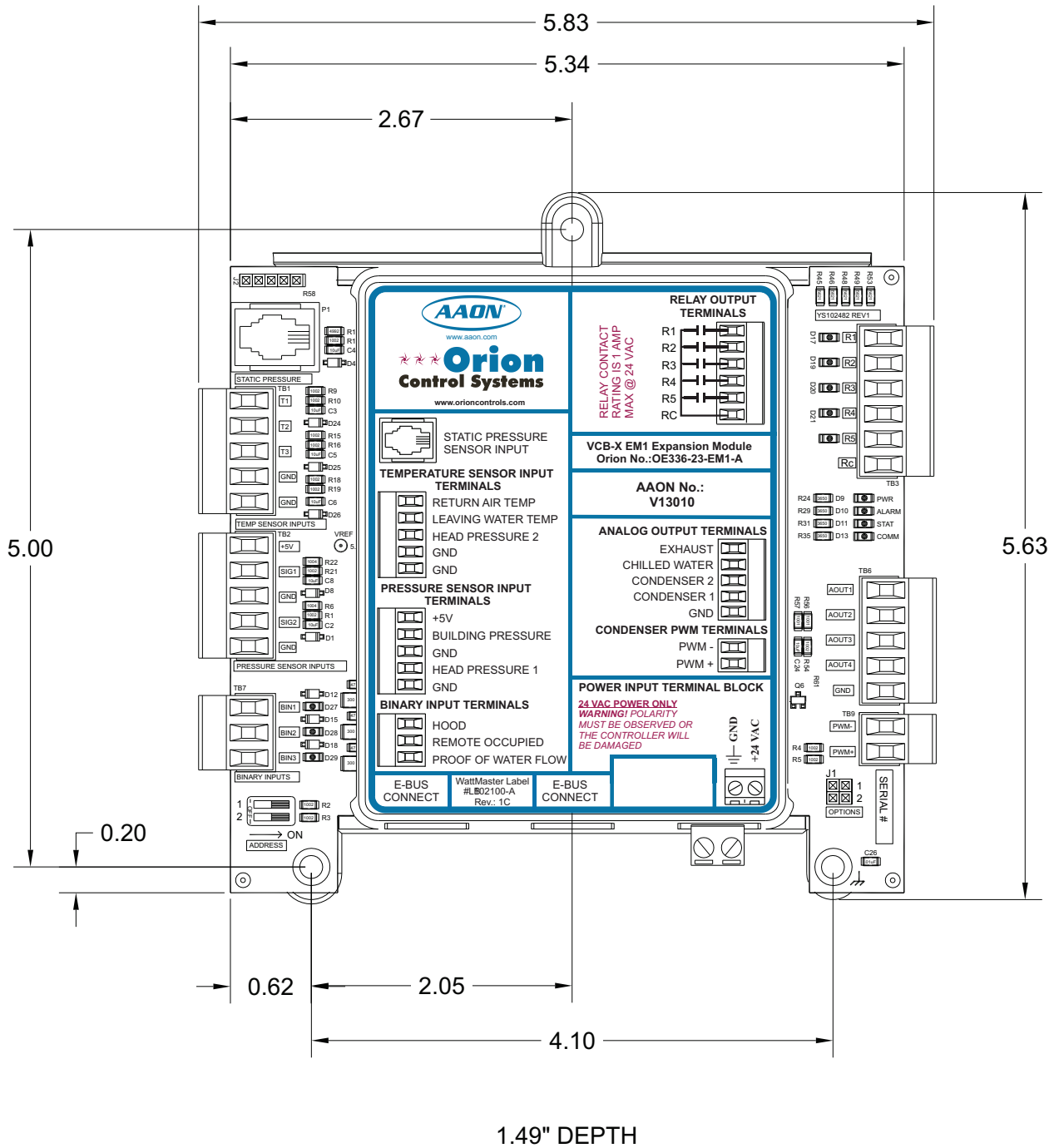


Figure 2: VCB-X EM1 Expansion Module Dimensions

INSTALLATION & WIRING

VCB-X EM2 Dimensions

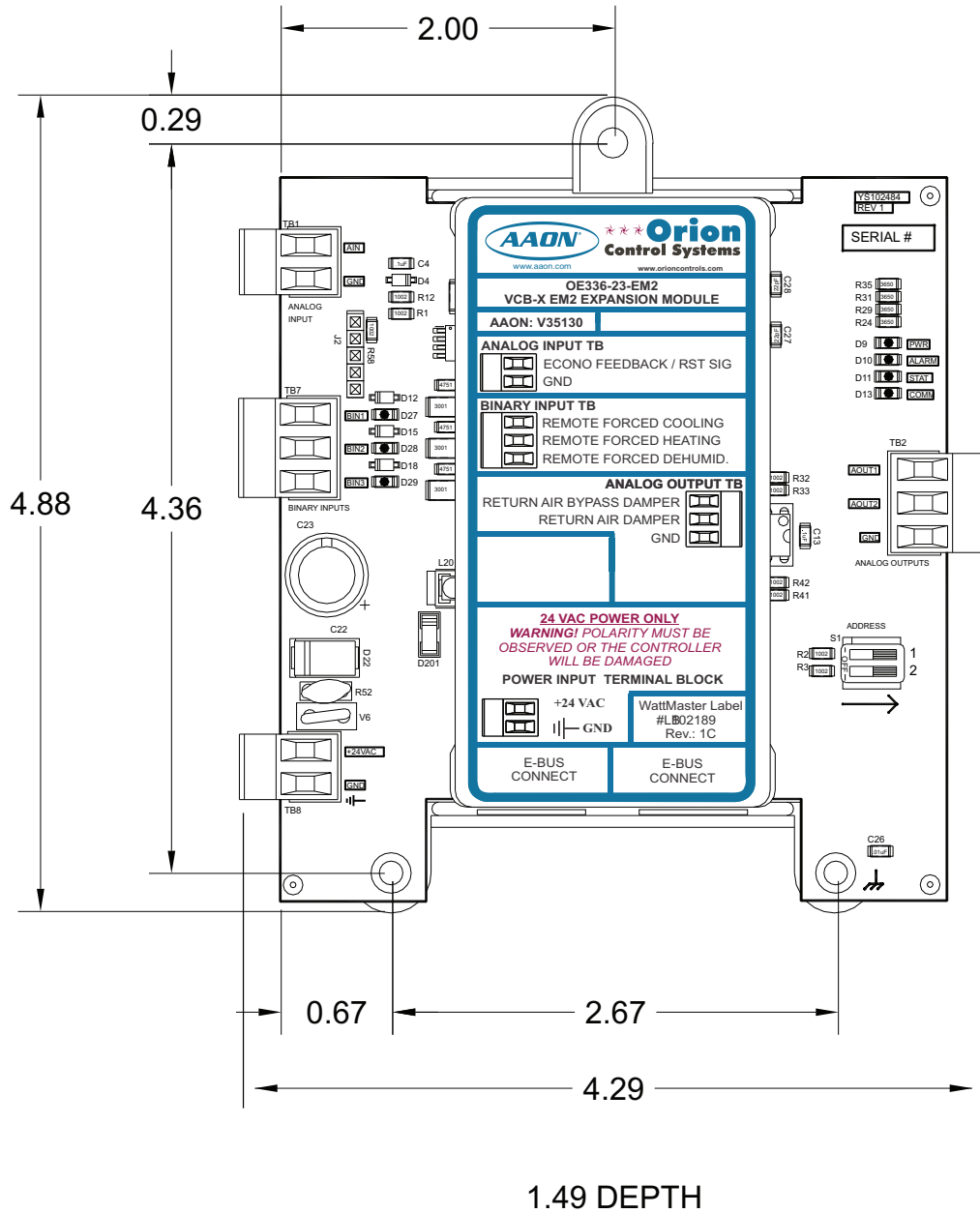


Figure 3: VCB-X EM2 Expansion Module Dimensions

VCB-X 12 Relay Module Dimensions

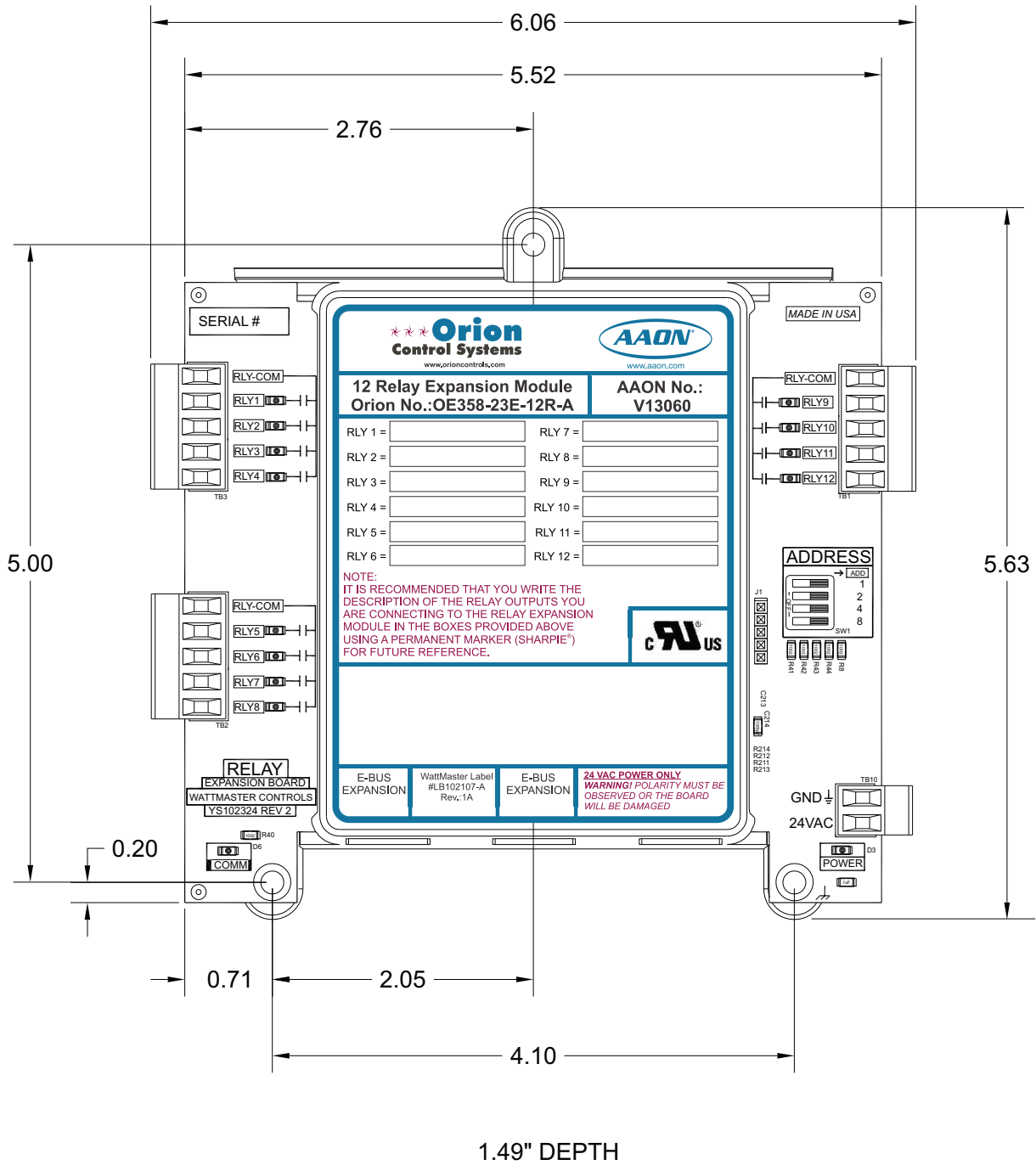


Figure 4: VCB-X 12 Relay Module Dimensions

OVERVIEW

Controller with Enclosure Components

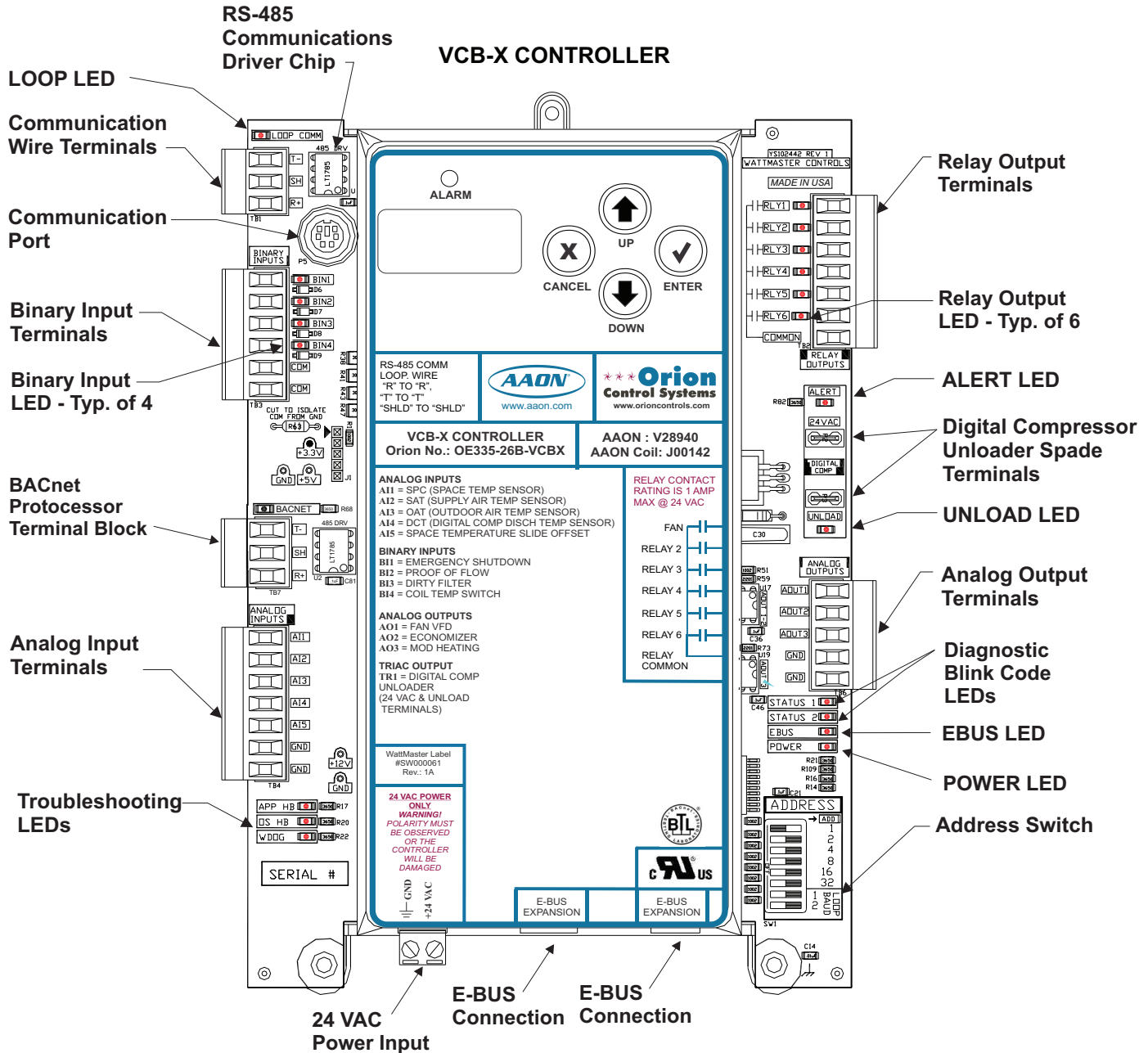


Figure 5: VCB-X Controller w/Enclosure Components

Important Wiring Considerations

General

Correct wiring of the VCB-X Controller is the most important factor in the overall success of the controller installation process. In general, most VCB-X Controllers are factory installed and wired at the AAON® factory. It is also possible to purchase these controllers through your local AAON®/Orion representative for installation in the field. Some of the following information pertains to field wiring and may not apply to your installation if it was pre-wired at the factory. However, if troubleshooting of the controller is required, it is a good idea to be familiar with the system wiring, no matter if it was factory or field wired.

Controller Mounting

When the controller is to be field mounted, it is important to mount the controller in a location that is free from extreme high or low temperatures, moisture, dust, and dirt. See **Table 1** for a list of the required operating conditions for the VCB-X Controller and associated expansion modules.

The VCB-X Controller is housed in a plastic enclosure. It is designed to be mounted by using the 3 mounting holes in the enclosure base. The VCB-X Controller needs to be installed in an environment which can maintain a temperature range between -30°F and 150°F not to exceed 90% RH levels (non-condensing). Be careful not to damage the electronic components when mounting the controller.

Considerations

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

Control Device	Voltage	VA Load	Temperature	Humidity (Non-Condensing)
OE335-26B-VCB-X-A VCB-X Controller	24VAC	8	-30°F to 150°F	90% RH
OE336-23-EM1-A	24VAC	5	-30°F to 150°F	90% RH
OE336-23-EM2-A	24VAC	5	-30°F to 150°F	90% RH
OE358-23E-12R-A	24VAC	15	-30°F to 150°F	90% RH

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 VCB-X Controller and expansion modules.

Please carefully read and apply the following information when wiring the VCB-X Controller or the Expansion Modules. See **Figures 6 & 7** for VCB-X input and output wiring. See **Figures 22 & 23** for the VCB-X EM1 Expansion Module wiring, **Figures 34 & 35** for VCB-X EM2 Expansion wiring, and **Figure 36** for the VCB-X 12 Relay Expansion Module wiring.

- All wiring is to be in accordance with local and national electrical codes and specifications.
- All 24 VAC wiring must be connected so that all ground wires remain common. Failure to follow this procedure can result in damage to the controller and connected devices.
- Minimum wire size for 24 VAC wiring should be 18-gauge.
- Minimum wire size for all sensors should be 24-gauge. Some sensors require 2-conductor wire and some require 3-or 4-conductor wire.
- Minimum wire size for 24 VAC thermostat wiring should be 22 gauge.
- 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.
- When communication wiring is to be used to interconnect VCB-X 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.
- Before applying power to the VCB-X Controller, be sure to recheck all wiring connections and terminations thoroughly.

INSTALLATION & WIRING

VCB-X Controller Input Wiring

VCB-X Controller Inputs

The VCB-X Controller is designed with 5 analog inputs, 3 analog outputs, 1 triac output, 4 binary inputs and 6 relay outputs.

There are also 2 E-BUS Expansion Ports which allow the use of communicating sensors and the E-BUS Modules.

See Figures 6 & 7 for wiring details. Detailed wiring for all inputs and outputs are found on the pages that follow.

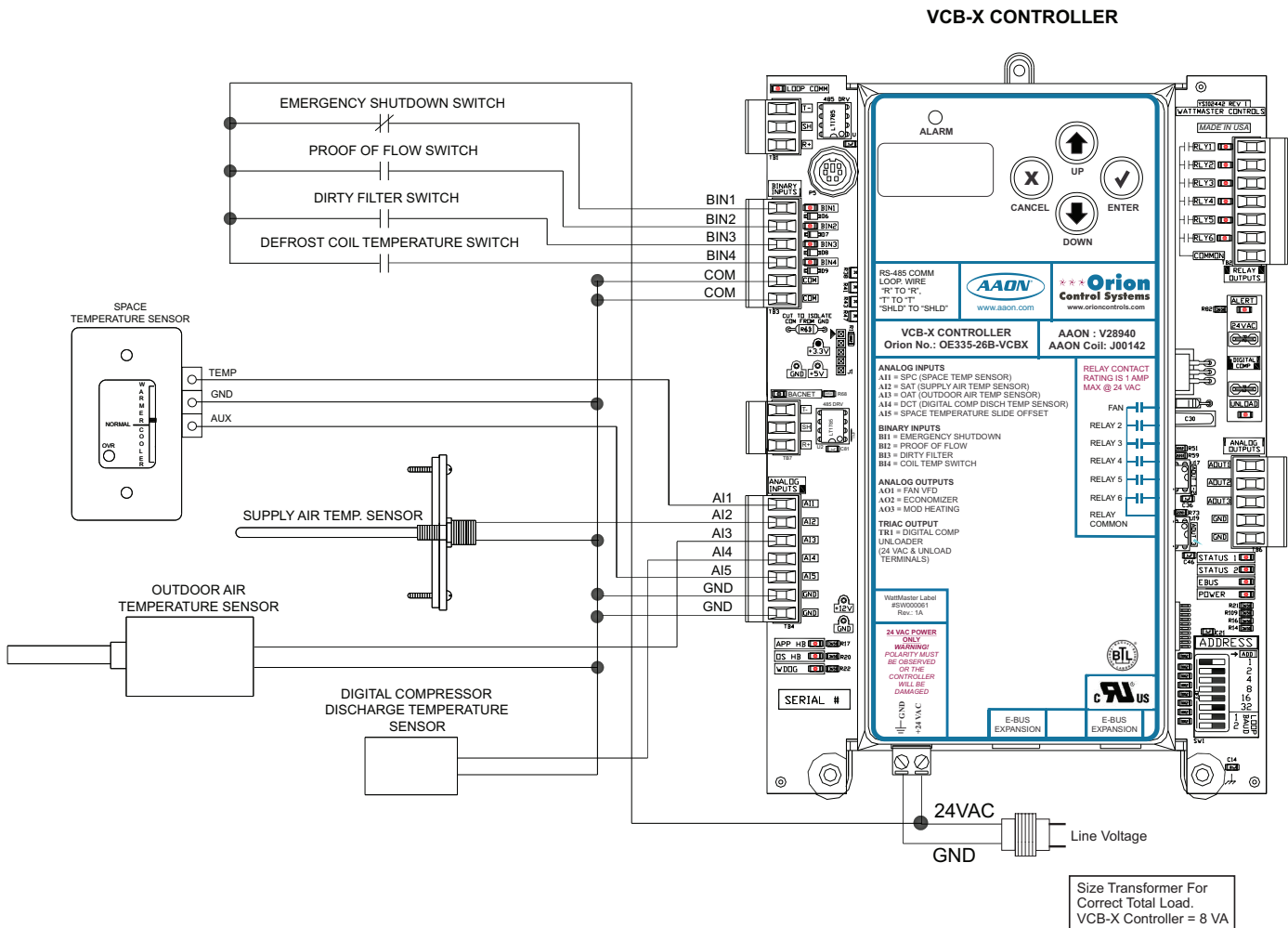


Figure 6: VCB-X Controller Input Wiring

VCB-X Controller Output Wiring

VCB-X Controller Outputs

The VCB-X Controller must be connected to 24 VAC as shown in the wiring diagram below. Please see **Table 1** for correct VA requirements to use when sizing the transformer(s) used for powering the Controller.

Also please note that when wiring the VCB-X Controller, its contacts must be wired as wet contacts (connected to 24 VAC).

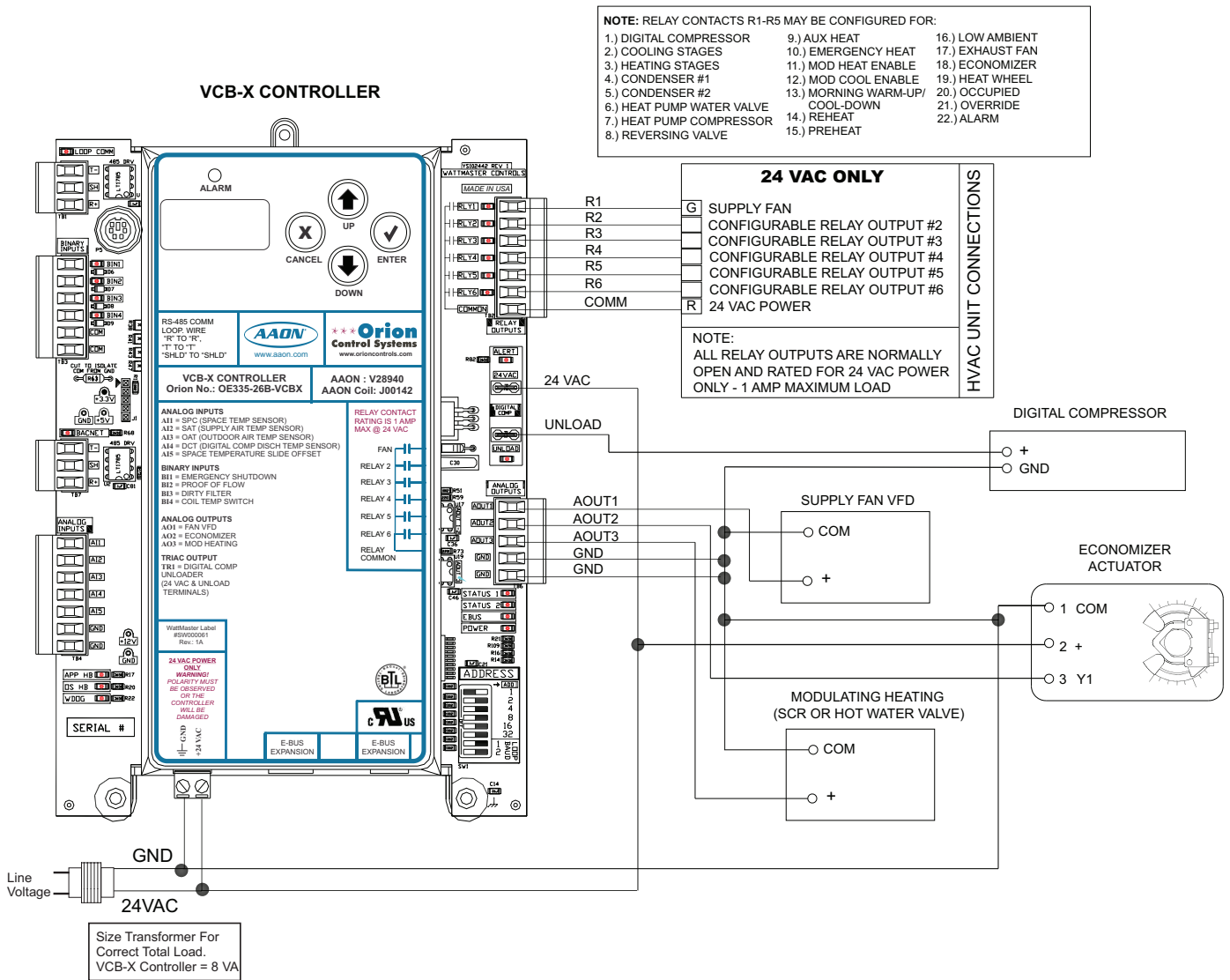


Figure 7: VCB-X Controller Output Wiring

INSTALLATION & WIRING

E-BUS Digital Room Sensor Wiring

E-BUS Digital Room Sensor

The OE217-02 E-BUS Digital Room Temperature Sensor can be used to sense Space Temperature. The OE217-03 or OE217-04 E-BUS Digital Room Temperature Sensor can be used to sense Space Temperature and Humidity. The OE217-04 has no LCD display or keypad. The Sensor connects to the VCB-X Controller with the EBC E-BUS expansion cable. It can also be daisy-chained with a CO₂ Sensor for applications requiring both a wall mounted CO₂ sensor and space temperature sensor.

The E-BUS Digital Room Sensor should be mounted at approximately 5 Ft. above the floor on the wall in an area that does not have drafts or is exposed to direct sunlight. See **Figure 8** for wiring details.

NOTE: If using multiple E-BUS Sensors or Modules, the E-BUS Hub or Adapter Board may be required.

NOTE: Only one indoor combination Temperature/Humidity Sensor should be used - either Space or Return Air. If both a Space and Return Air Sensor are used, the unit will only use the Return Air Humidity value and will display that value for both the Space and Return Air Humidity Status.

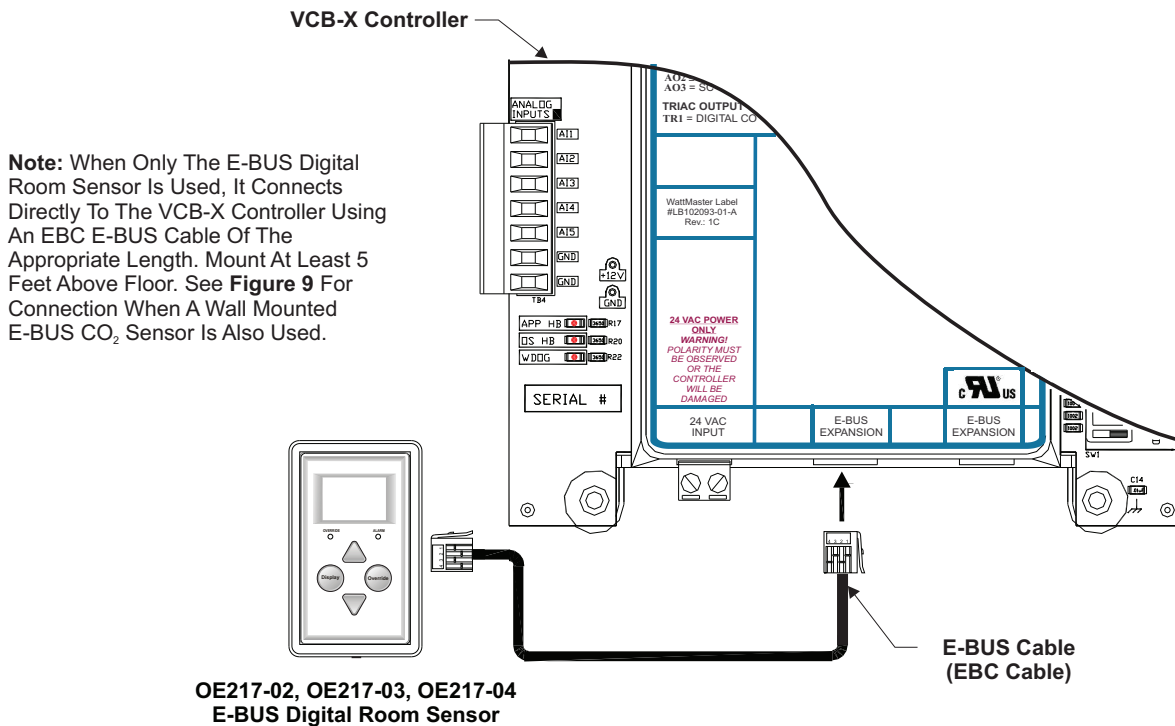


Figure 8: OE217-02, OE217-03, OE217-04 – E-BUS Digital Room Sensor Wiring

Wall-Mounted E-BUS CO₂ Sensor Wiring

E-BUS CO₂ Wall-Mounted Sensor

The OE256-05 Wall Mounted E-BUS CO₂ Sensor is used to monitor CO₂ levels in the space served by the HVAC unit. The E-BUS CO₂ Sensor connects to the VCB-X Controller with an EBC E-BUS cable. It can be daisy-chained with the E-BUS Digital Room Sensor (OE217-02, OE217-03, OE217-04) for applications requiring both a room CO₂ sensor and room temperature sensor.

It should be mounted at approximately 5 Ft. above the floor on the wall in an area that does not have drafts or is exposed to direct sunlight. See **Figure 9** for wiring details and installation notes. A Duct Mounted E-BUS CO₂ Sensor can be used if desired instead of the Wall Mounted E-BUS CO₂ Sensor. See **Figure 10** for Duct Mounted E-BUS CO₂ Sensor wiring details.

NOTE: If using multiple E-BUS Sensors or Modules, the E-BUS Hub or Adapter Board may be required.

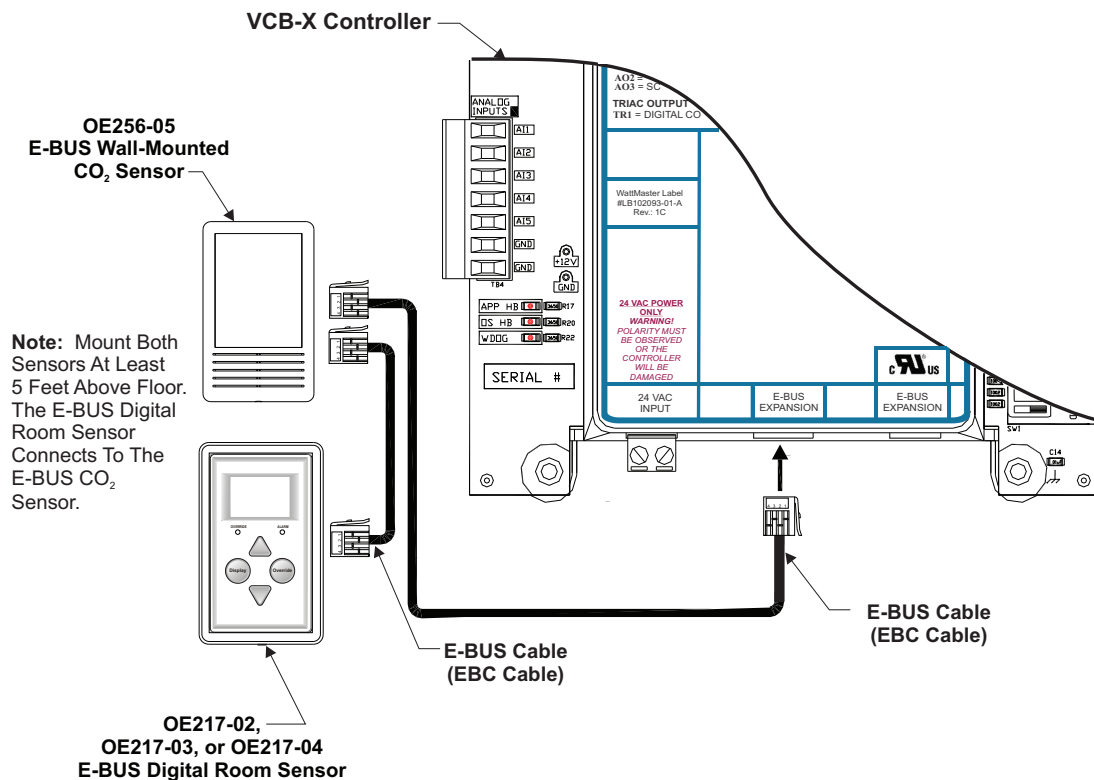


Figure 9: OE256-05 – Wall Mounted E-BUS CO₂ Sensor Wiring

INSTALLATION & WIRING

Duct Mounted E-BUS CO₂ Sensor

Duct Mounted E-BUS CO₂ Sensor

The OE256-07 Duct Mounted E-BUS CO₂ Sensor with Remote Pickup Tube is used for sensing the current CO₂ level in the HVAC unit's return air stream. This is useful when you want an average CO₂ reading in the area served by the HVAC unit or when you don't want a wall mounted E-BUS CO₂ Sensor due to sensor tampering concerns in the space.

The OE256-07 Duct Mounted Return Air CO₂ Sensor is comprised of the CO₂ Sensor, the WattMaster Aspiration Box Assembly, and a Remote Pickup Tube.

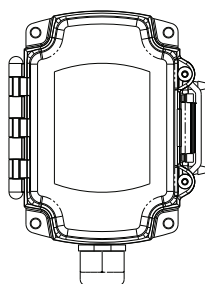
The Duct Mounted Return Air E-BUS CO₂ Sensor with Remote Pickup Tube is designed to be mounted in the return air duct of the HVAC unit and uses its integral aspiration box to sample the CO₂ level in the duct. See **Figure 10** below for wiring and installation details.

NOTE: If using multiple E-BUS Sensors or Modules, the E-BUS Hub or Adapter Board may be required.

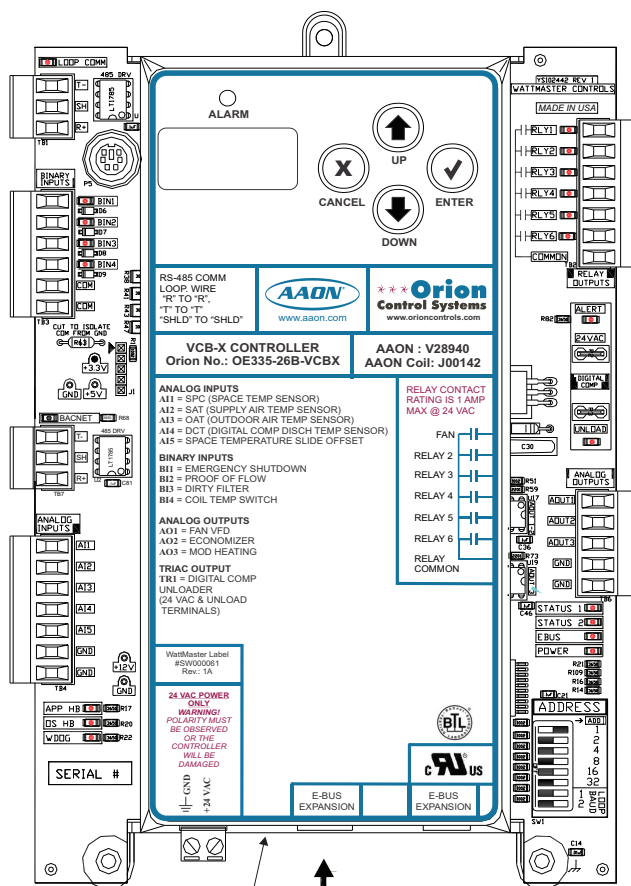
Note:

1.) The Duct Mounted E-BUS CO₂ Sensor Connects To The VCB-X Controller Using An EBC E-BUS Cable Of The Required Length Or The Provided 10 Foot EBC Cable.

OE256-07 Duct Mounted E-BUS CO₂ Sensor



EBC E-BUS Cable with Jack Connection



VCB-X Controller

10 Foot EBC E-BUS Cable (Provided)

Figure 10: OE256-07 - Duct Mounted E-BUS CO₂ Sensor Wiring

Space Temperature Sensor Wiring

Space Temperature Sensor

The OE210, OE211, OE212, OE213 Space Temperature Sensor is typically used for constant volume HVAC unit applications controlling one zone. The Space Temperature Sensor is a 10K Type III thermistor sensor and should be mounted approximately 5 feet above the floor in the space that is to be controlled.

The Space Temperature Sensor is available as a sensor only, sensor with override button, sensor with slide adjust, and sensor with slide adjust and override configurations.

See **Figure 11** below for complete Space Temperature Sensor wiring details.

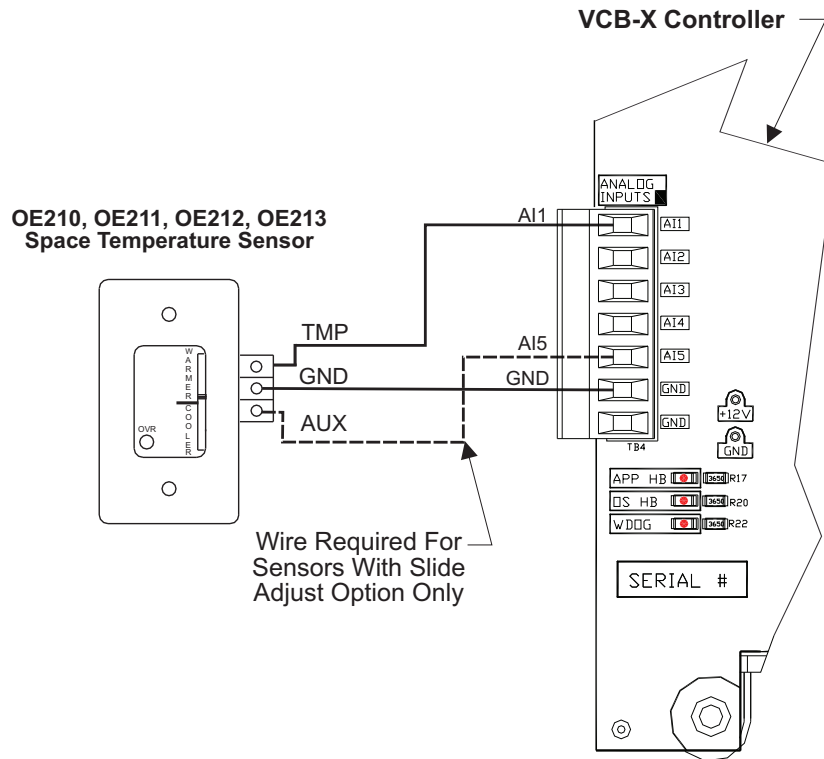


Figure 11: OE210, OE211, OE212, OE213 – Space Temperature Sensor Wiring and Slide Adjust

INSTALLATION & WIRING

Supply Air Temperature Sensor Wiring

Supply Air Temperature Sensor

The OE231 Supply Air Temperature Sensor must be wired as shown for proper operation. The Supply Air Temperature Sensor is a 10K Type III thermistor sensor. The Supply Air Temperature Sensor should be mounted in the unit discharge plenum or in the supply air duct. See **Figure 12** below for details.

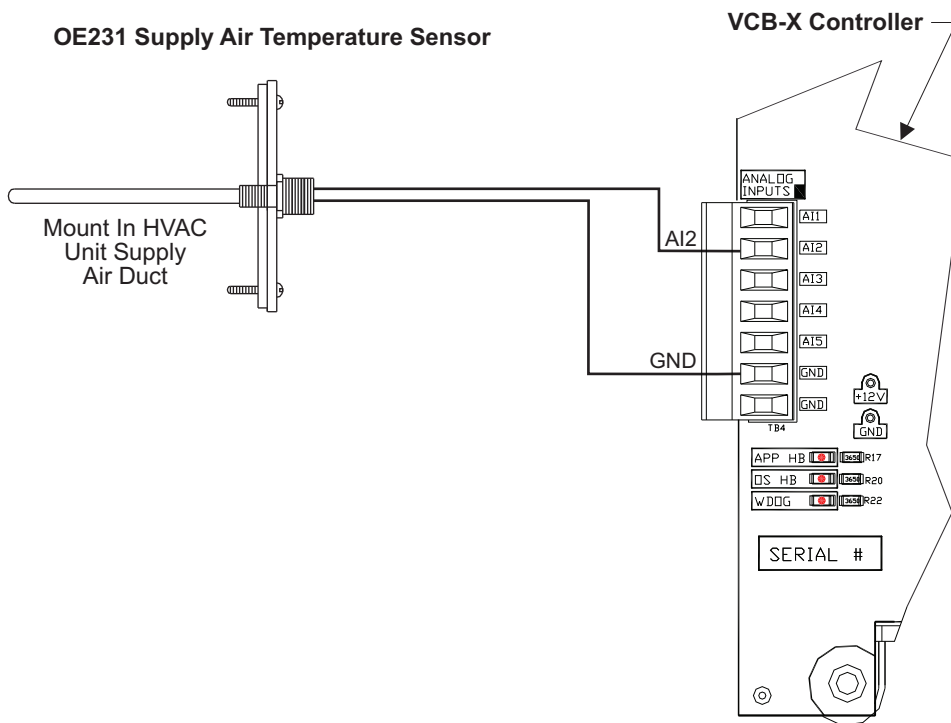


Figure 12: OE231 – Supply Air Temperature Sensor Wiring

Outdoor Air Temperature Sensor Wiring

Outdoor Air Temperature Sensor

The OE250 Outdoor Air Temperature Sensor must be wired as shown for proper operation of the VCB-X Controller. The Outdoor Air Temperature Sensor is a 10K Type III thermistor sensor. The sensor should be mounted in the upright position as shown in an area that is protected from the elements and direct sunlight. Be sure to make the wiring splices inside of the Outdoor Air Temperature Sensor weather-tight enclosure. See **Figure 13** below for details.

For applications involving Outdoor Air Humidity, the OE265-15-A E-BUS Outside Air & Humidity Sensor must be used instead. See **Figure 14** for details.

CAUTION: Be sure to mount the Outdoor Air Temperature Sensor in an area that is not exposed to direct sunlight. The shaded area under the HVAC unit rain hood is normally a good location. Unused conduit opening(s) must have closure plugs installed and must be coated with sealing compound to provide a rain-tight seal. Water can damage the sensor.

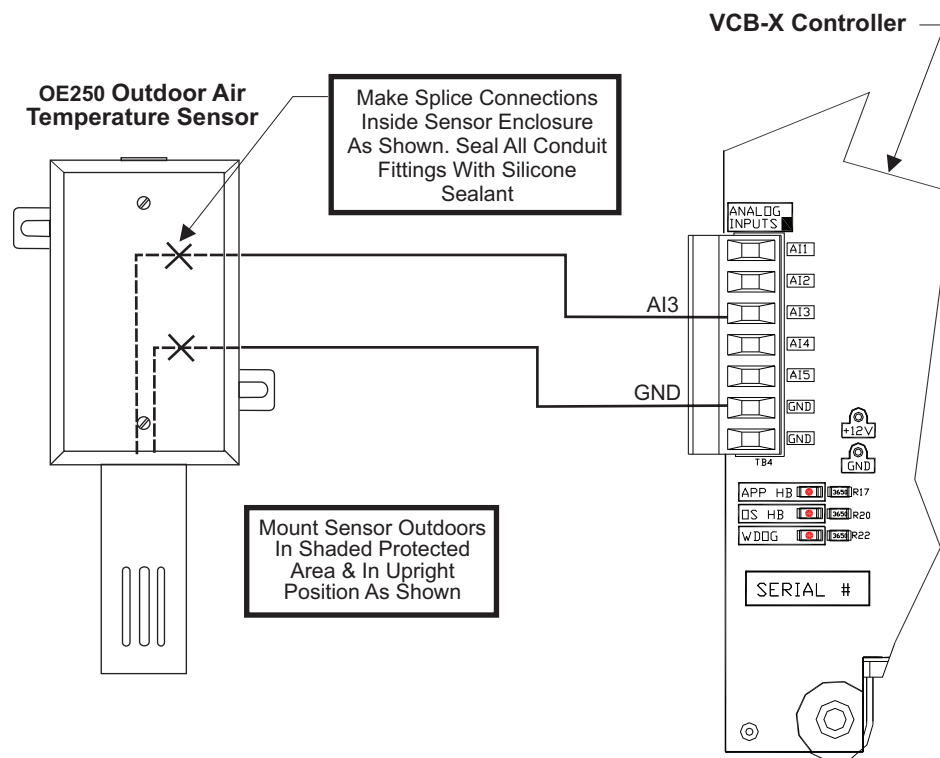


Figure 13: OE250 – Outdoor Air Temperature Sensor Wiring

INSTALLATION & WIRING

E-BUS Outdoor Air Temperature & Humidity Sensor Wiring

E-BUS Horizontal or Vertical Outdoor Air Temperature & Humidity Sensor

The OE265-15-A (Horizontal) or OE265-16-A (Vertical) E-BUS Outdoor Air Temperature & Humidity Sensor connects to the VCB-X Controller. An EBC E-BUS cable plugs into the Sensor's attached 3 foot cable and then plugs into the E-BUS port of the VCB-X Controller or other E-BUS Expansion Board. The sensor should be mounted in the upright position as shown in an area that is protected from the elements and direct sunlight. See **Figure 14** below for details.

CAUTION: Be sure to mount the Outdoor Air Temperature & Humidity Sensor in an area that is not exposed to direct sunlight. The shaded area under the HVAC unit rain hood is normally a good location. Unused conduit opening(s) must have closure plugs installed and must be coated with sealing compound to provide a rain-tight seal. Water can damage the sensor.

NOTE: If using multiple E-BUS Sensors or Modules, the E-BUS Hub (HZ-EBC-248 or MS000248) or E-BUS Adapter Board (OE365-15-EBA) may be required.

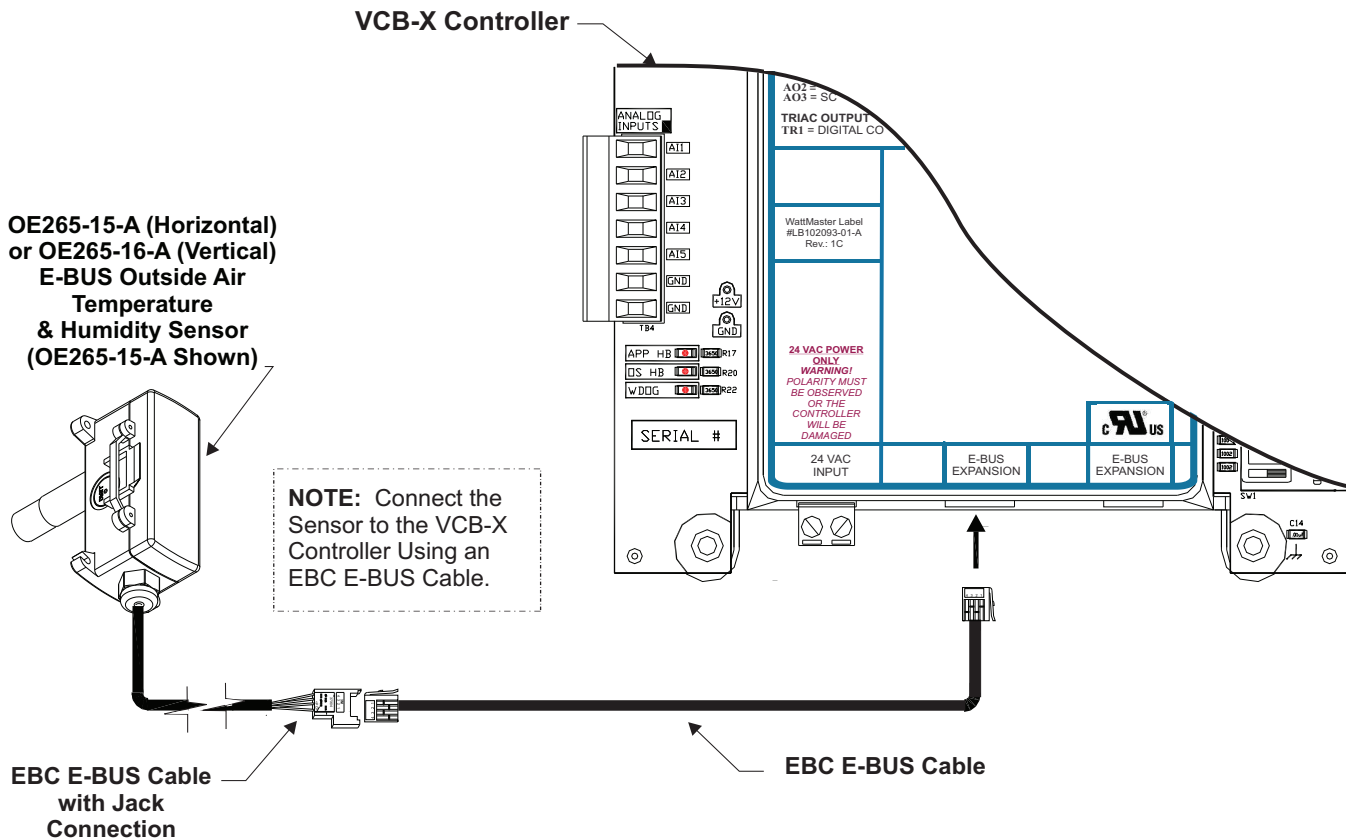


Figure 14: OE265-15-A & OE265-16-A – E-BUS Outdoor Air Temperature & Humidity Sensor Wiring

E-BUS Return Air Temperature & Humidity Sensor Wiring

E-BUS Return Air Temperature & Humidity Sensor

The OE265-17-A E-BUS Return Air Temperature & Humidity Sensor connects to the VCB-X Controller. A 50 foot EBC E-BUS cable (provided) plugs into the Sensor's attached 3 foot cable and then plugs into the E-BUS port of the VCB-X Controller or other E-BUS Expansion Board. The sensor should be mounted in the upright position as shown in an area that is protected from the elements and direct sunlight. See **Figure 15** below for details.

NOTE: Only one indoor combination Temperature/ Humidity Sensor should be used - either Space or Return Air. If both a Space and Return Air Sensor are used, the unit will only use the Return Air Humidity value and will display that value for both the Space and Return Air Humidity Status.

NOTE: If using multiple E-BUS Sensors or Modules, the E-BUS Hub (HZ-EBC-248 or MS000248) or E-BUS Adapter Board (OE365-15-EBA) may be required.

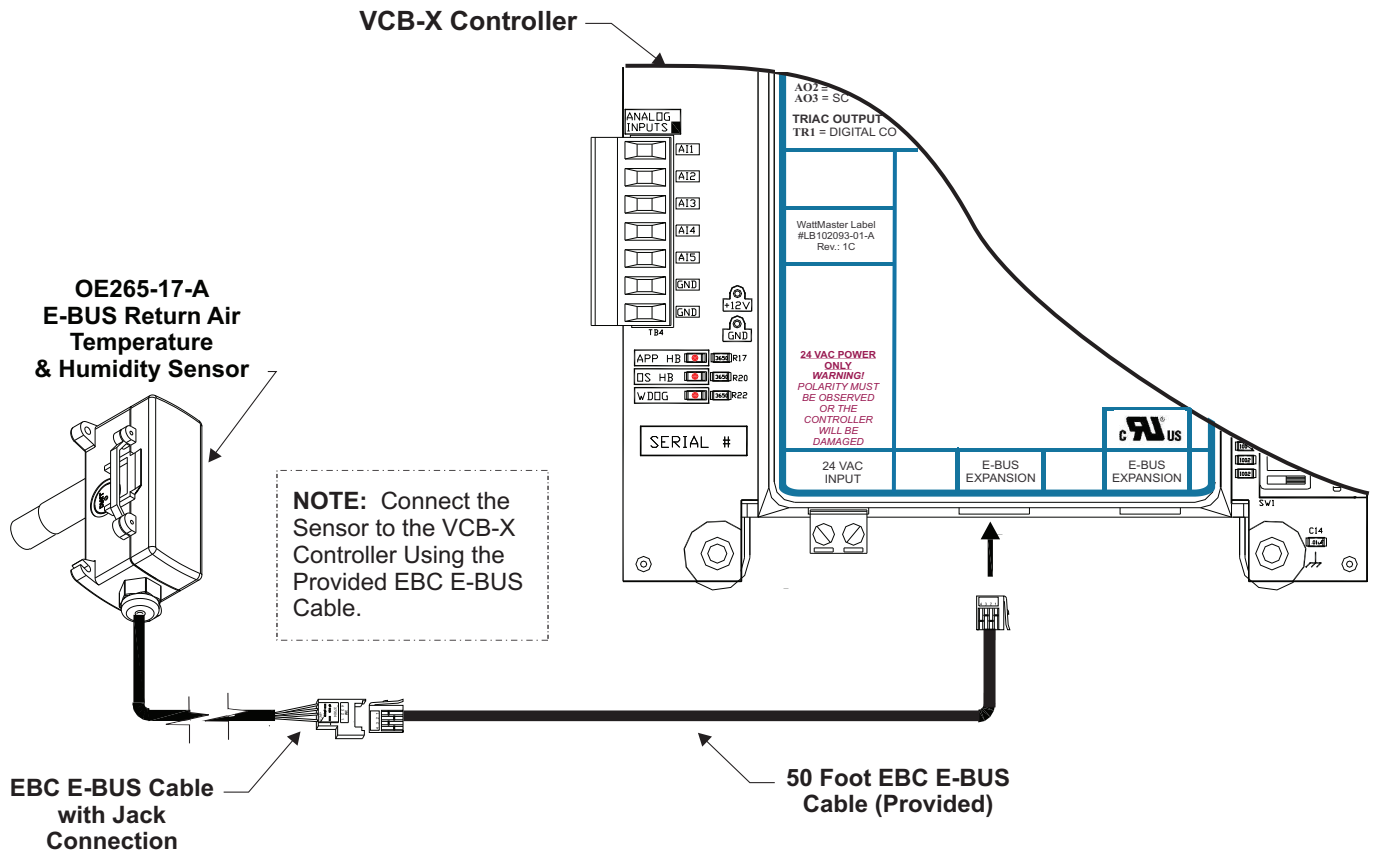


Figure 15: OE265-17-A – E-BUS Return Air Temperature & Humidity Sensor Wiring

INSTALLATION & WIRING

Suction Pressure Transducer Wiring

Suction Pressure Transducer Kit

The OE275-03-A Suction Pressure Transducer Kit is comprised of the OE275-01 Suction Pressure Transducer, modular cable with a modular connector on one end and bare stripped wires on the other end, an E-BUS Adapter Board, and a 3 foot EBC E-BUS Cable. It is required for any VCB-X application with DX Cooling that requires Dehumidification and for Water Source Heat Pump applications.

The Suction Pressure Transducer is used to measure suction pressure at the HVAC unit's DX evaporator coil suction line. This suction line pressure is converted to saturated refrigerant temperature by the VCB-X Controller. This temperature is used by the VCB-X Controller to accurately control the compressors to a suction temperature setpoint to provide optimum performance from the system during Dehumidification operation and to provide compressor protection on Water Source Heat Pump units.

The Suction Pressure Transducer wires to the VCB-X Controller as shown in **Figure 16** below. In this application, the Suction Pressure Transducer connects to the E-BUS Adapter Board's V, SIG, and GND terminals through a cable. The cable is supplied with a 3-pin Packard mating connector for attachment to the sensor on one end and has 3 color-coded stripped wires on the other end. The stripped wire ends can be spliced to other wires to extend the wiring length when required. The EBC E-BUS Cable connects to the E-BUS Adapter Board. This cable must then connect to the VCB-X Controller directly or to a VCB-X Expansion Board connected to the VCB-X Controller.

NOTE: If using multiple E-BUS Sensors or Modules, the E-BUS Hub (HZ-EBC-248 or MS000248) or E-BUS Adapter Board (OE365-15-EBA) may be required.

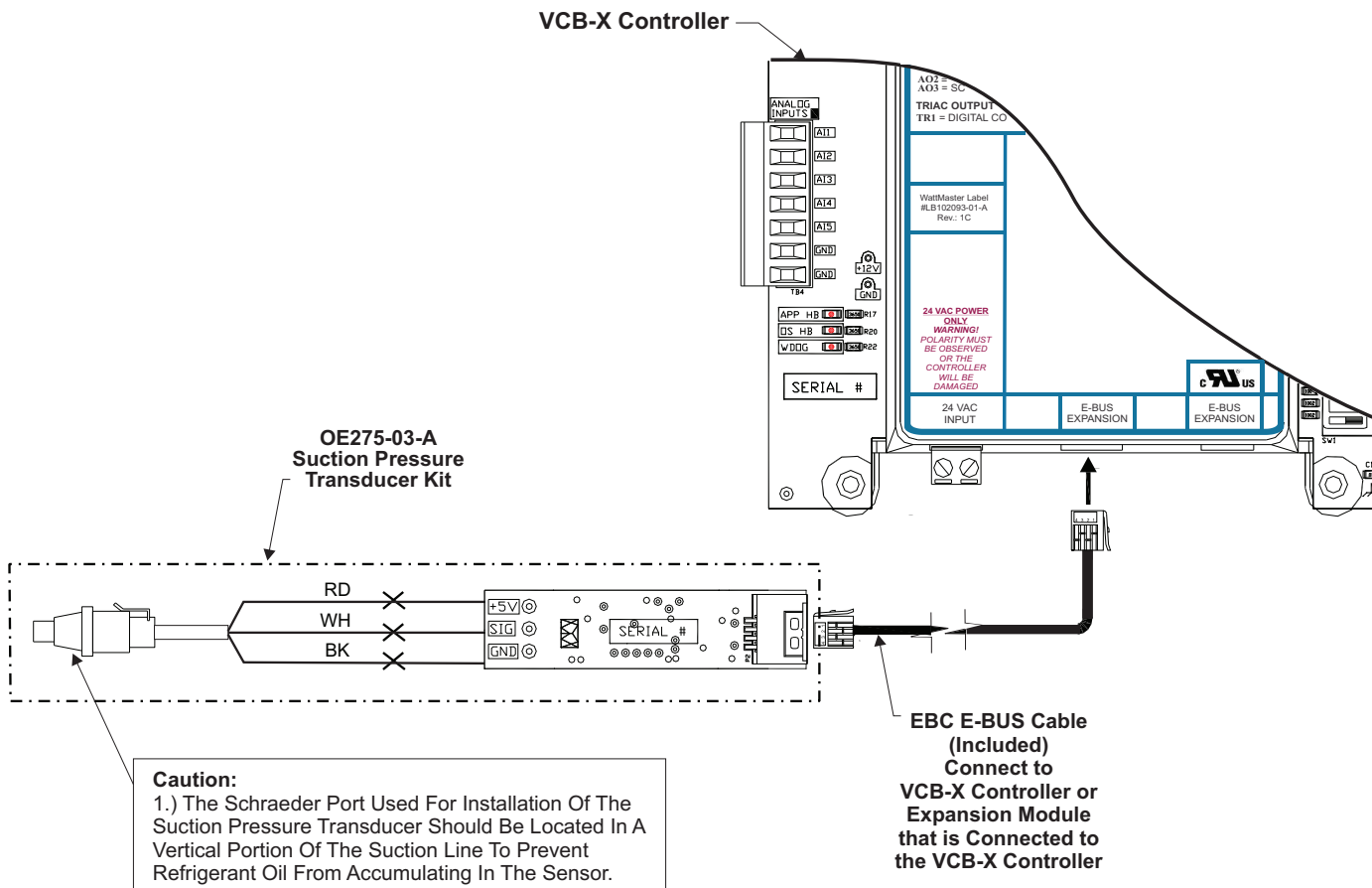


Figure 16: OE275-03-A – Suction Pressure Transducer Kit Wiring

Digital Compressor Discharge Temperature Sensor Wiring

Digital Compressor Discharge Temperature Sensor

A Digital Compressor Discharge Temperature Sensor (by others) must be wired as shown in **Figure 17** below for proper operation of the VCB-X Controller's Digital Scroll Compressor.

The Discharge Temperature Input is a thermistor input. There is no polarity requirement for the thermistor.

NOTE: For thermistor signal wiring, short wire runs are recommended.

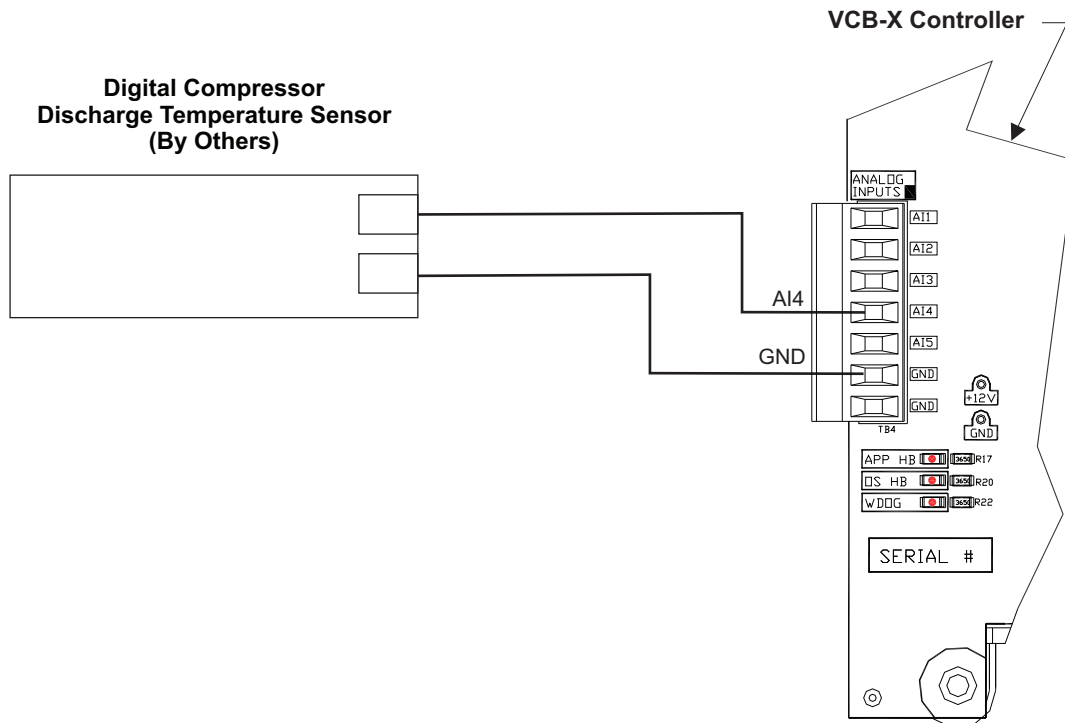


Figure 17: Digital Compressor Discharge Temperature Sensor Wiring

INSTALLATION & WIRING

Digital Compressor Unloader Wiring

Digital Compressor Unloader

The Digital Compressor Unloader uses a solenoid unloader as the capacity control method. The unloader solenoid is energized in an on/off pattern to deliver the capacity needed by the digital compressor to achieve setpoint.

The Unloader Solenoid output is a triac output. The maximum continuous solenoid load is 0.5A and the peak inrush current is 6A.

Only (1) Digital Compressor can be controlled with the VCB-X Controller.

See **Figure 18** below for wiring details.

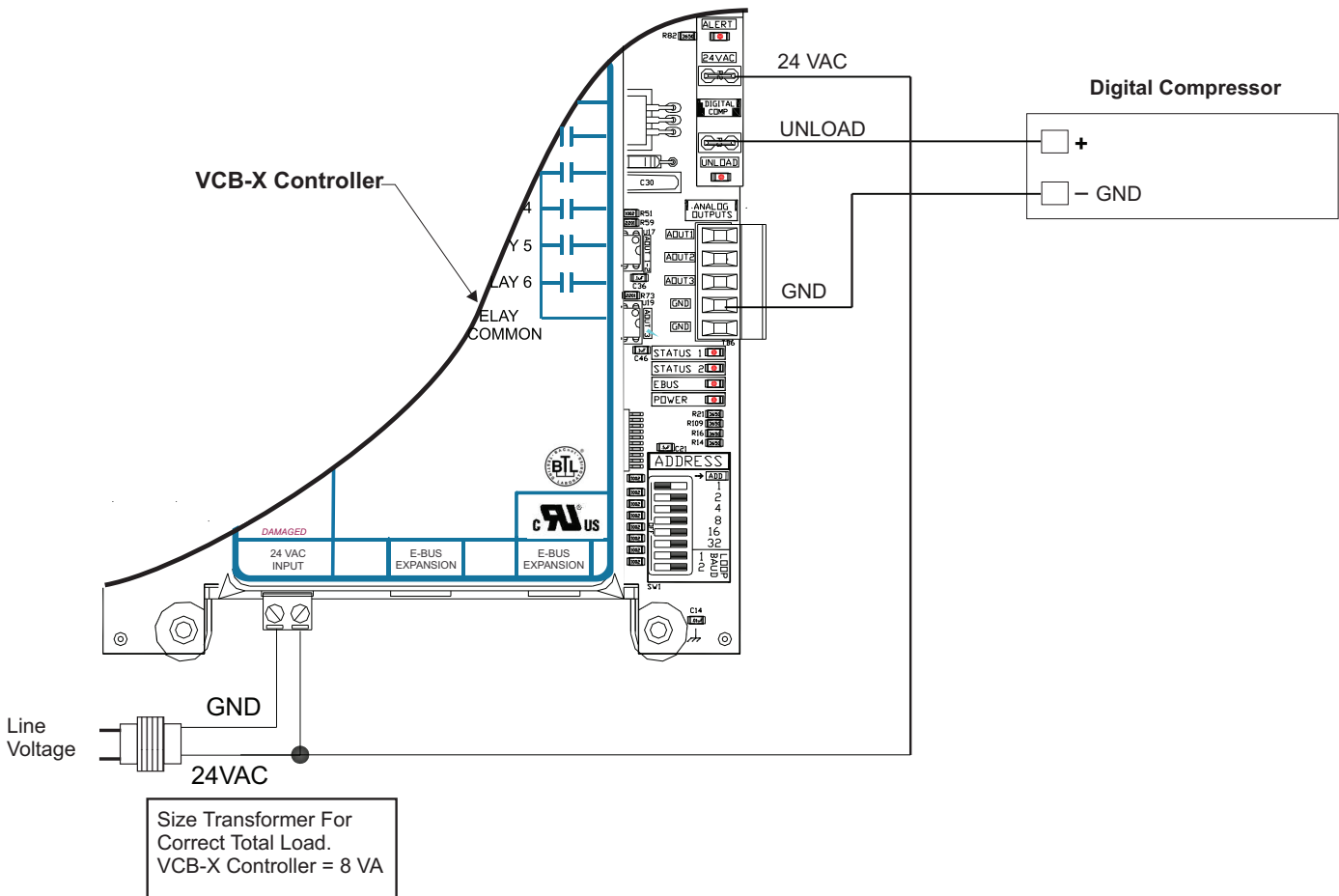


Figure 18: Digital Compressor Unloader Wiring

Supply Fan VFD Signal

The Supply Fan VFD Signal is a user-adjustable signal with a range of 0-10 VDC from AOUT1 on the VCB-X Controller. This signal output can be connected to the Supply Fan Variable Frequency Drive to modulate the Supply Fan speed.

See **Figure 19** below for detailed wiring.

CAUTION: Variable Frequency Drive units can cause large transient noise spikes which can cause interference to be propagated on other electronic equipment. Use shielded wire wherever possible and route all sensor and controller wiring away from the Variable Frequency Drive and the HVAC Unit electrical wiring.

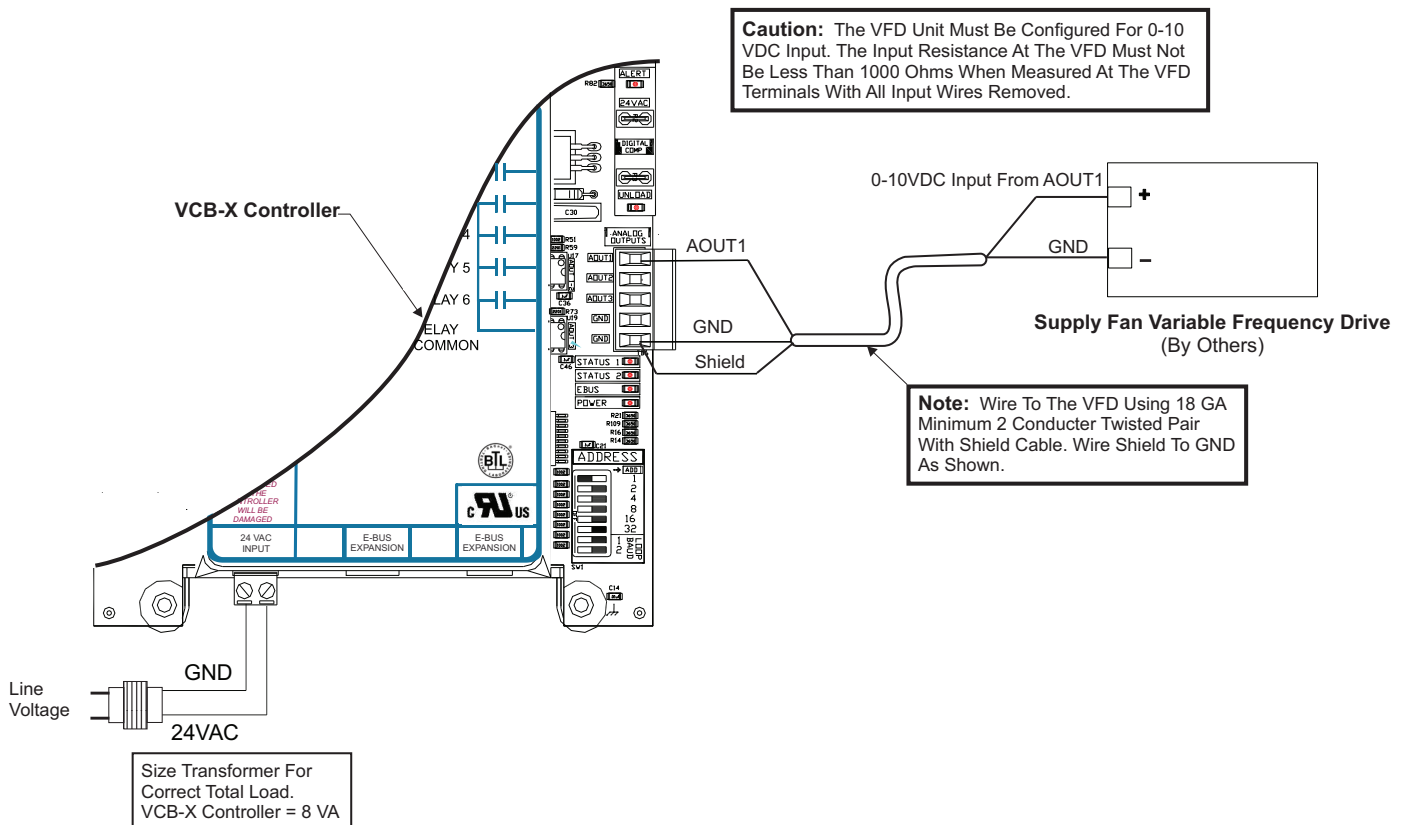


Figure 19: Supply Fan VFD Wiring

INSTALLATION & WIRING

Economizer Actuator Wiring

Economizer Damper Actuator

The Economizer Damper Actuator signal voltage output (using AOUT2) is user-adjustable, but must be set to 2-10 VDC for this application. This signal output is used by the VCB-X Controller to modulate the Economizer Damper Actuator in order to control the amount of Outdoor Air delivered to the HVAC unit for Free Cooling and/or Indoor Air Quality requirements. See **Figure 20** for detailed wiring.

WARNING: It is very important to be certain that all wiring is correct as shown in the wiring diagram below. Failure to observe the correct polarity will result in damage to the actuator or VCB-X Controller.

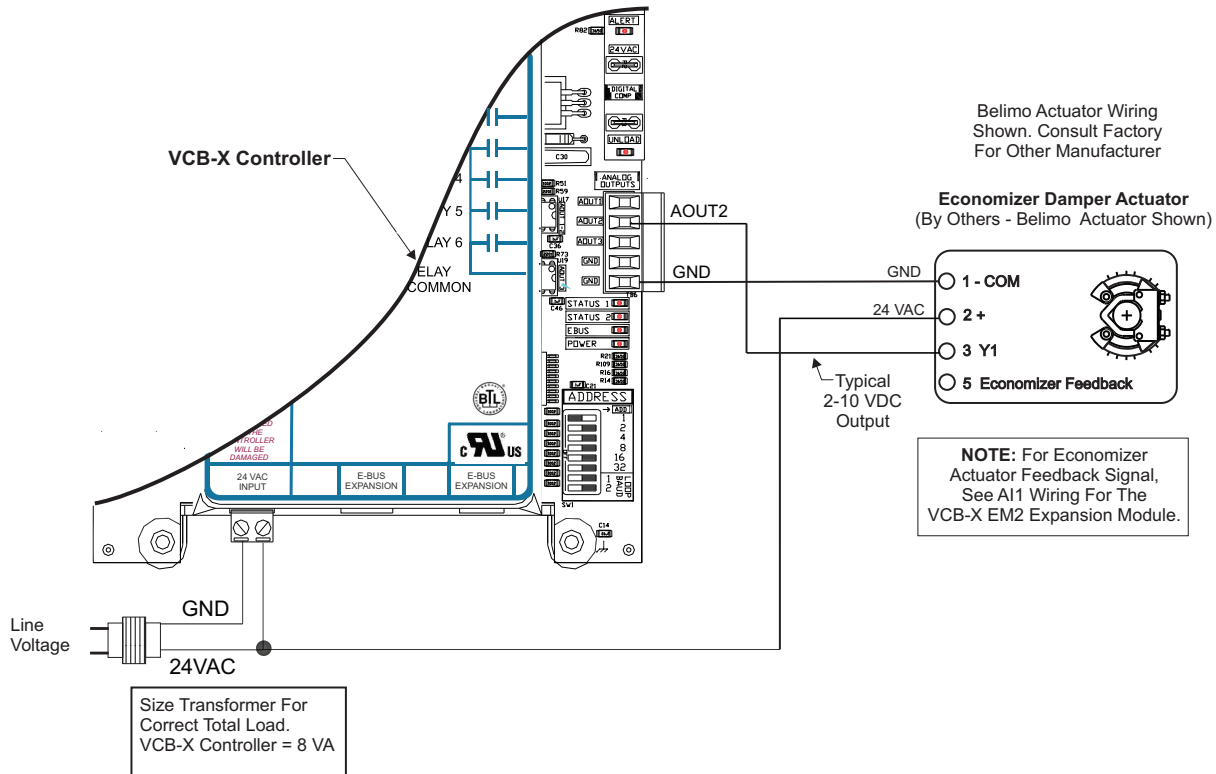


Figure 20: Economizer Damper Actuator Wiring

Modulating Heating Device Wiring

Modulating Heating Device

The Modulating Heating Device signal voltage output is a user-adjustable signal with a range of 0-10 VDC from AOUT3 when programming the controller. The output signal can be configured for either Direct Acting or Reverse Acting operation as required.

The Output signal is normally used to control a Modulating Hot Water Valve or Modulating Steam Valve or is used for SCR Control of an Electric Heating Coil.

See Figure 21 below for detailed wiring of the Modulating Heating Device.

WARNING: It is very important to be certain that all wiring is correct as shown in the wiring diagram below. Failure to observe the correct polarity could result in damage to the Modulating Heating Device or the VCB-X Controller.

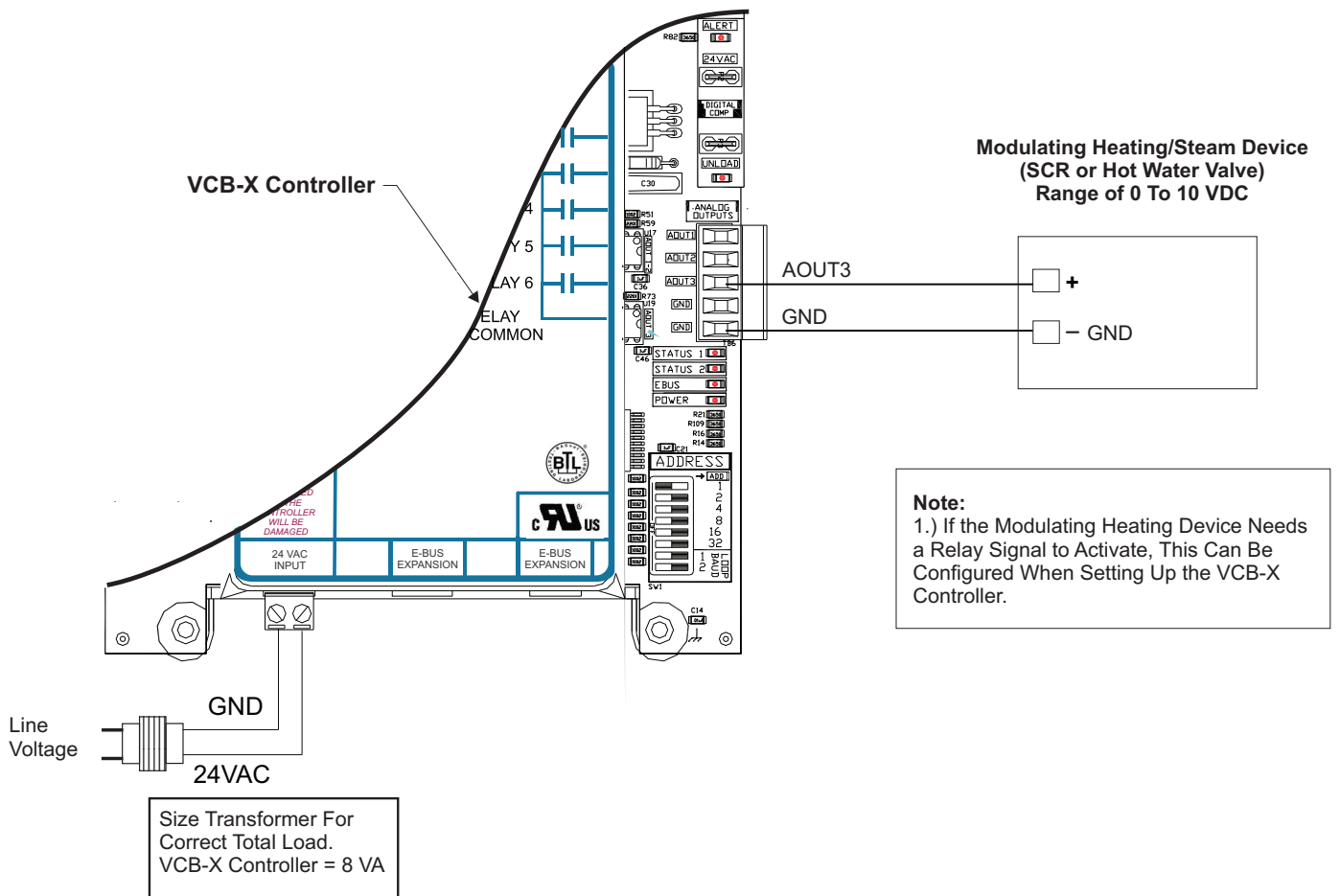


Figure 21: Modulating Heating Device Wiring

INSTALLATION & WIRING

VCB-X EM1 Expansion Module Input Wiring

VCB-X EM1 Expansion Module Inputs

The VCB-X EM1 Expansion Module (OE336-23-EM1-A) provides an additional 6 analog inputs, 4 analog outputs, 3 binary inputs, and 5 configurable relay outputs. See Figures 22 & 23 for complete wiring details.

The VCB-X EM1 Expansion Module can be used in conjunction with the VCB-X EM2 Expansion Module (OE336-23-EM2-A) and the E-BUS 12-Relay Expansion Module (OE358-23E-12R-A). The expansion modules can be used individually or together to provide the required inputs and outputs for your specific applications.

WARNING!!
Observe Polarity! All boards must be wired with GND-to-GND and 24VAC-to-24VAC. Failure to observe polarity will result in damage to one or more of the boards. Expansion Modules must be wired in such a way that the expansion modules and the controller are always powered together. Loss of power to the expansion module will cause the controller to become inoperative until power is restored to the expansion module.

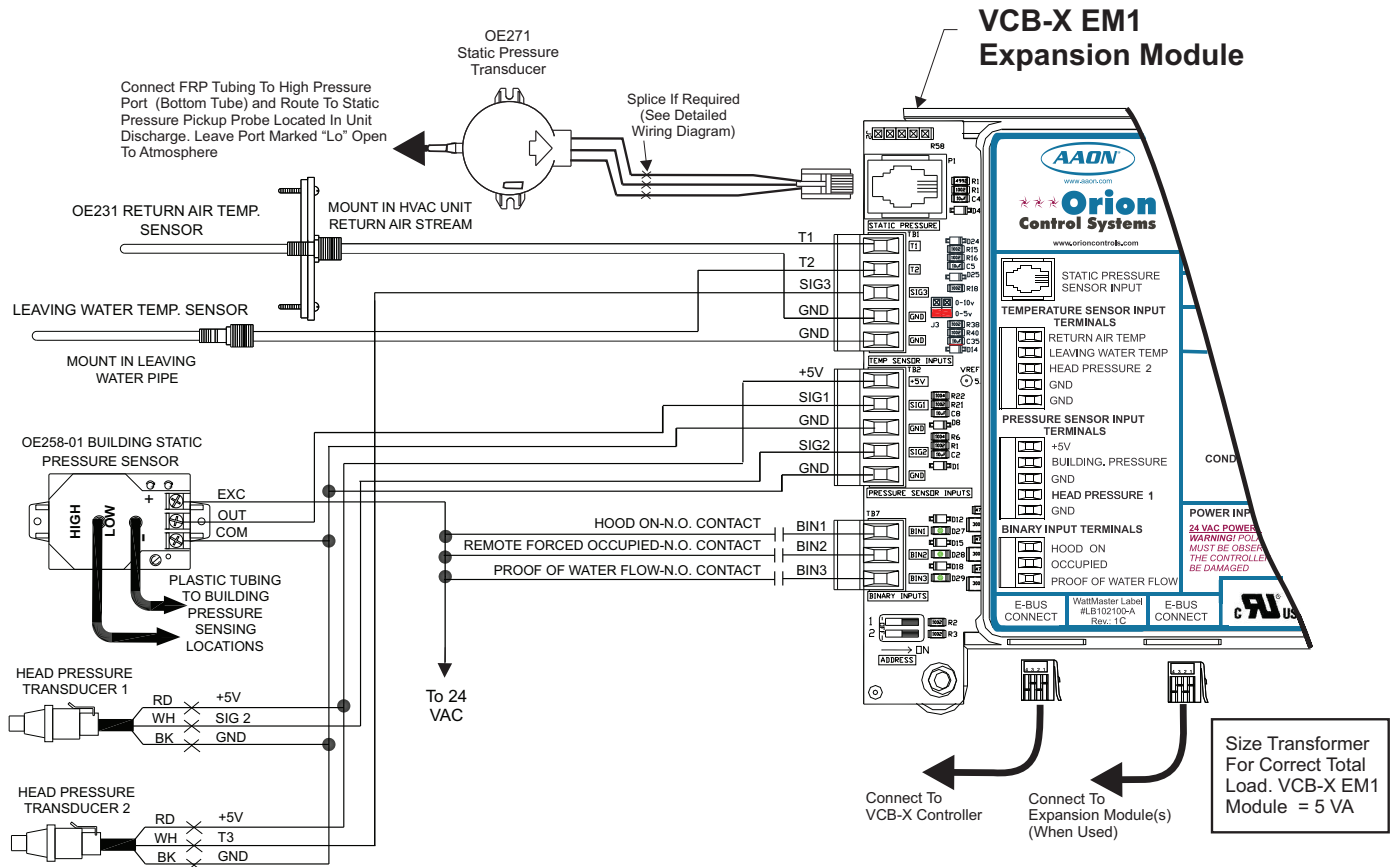


Figure 22: VCB-X EM1 Expansion Module Input Wiring Diagram

VCB-X EM1 Expansion Module Output Wiring

VCB-X EM1 Expansion Module Outputs

The VCB-X EM1 Expansion Module must be connected to 24 VAC as shown in the wiring diagram below. Please see **Table 1** for correct VA requirements to use when sizing the transformer(s) used for powering the expansion module.

Also, please note that when wiring the VCB-X EM1 Expansion Module, its contacts must be wired as wet contacts (connected to 24 VAC).

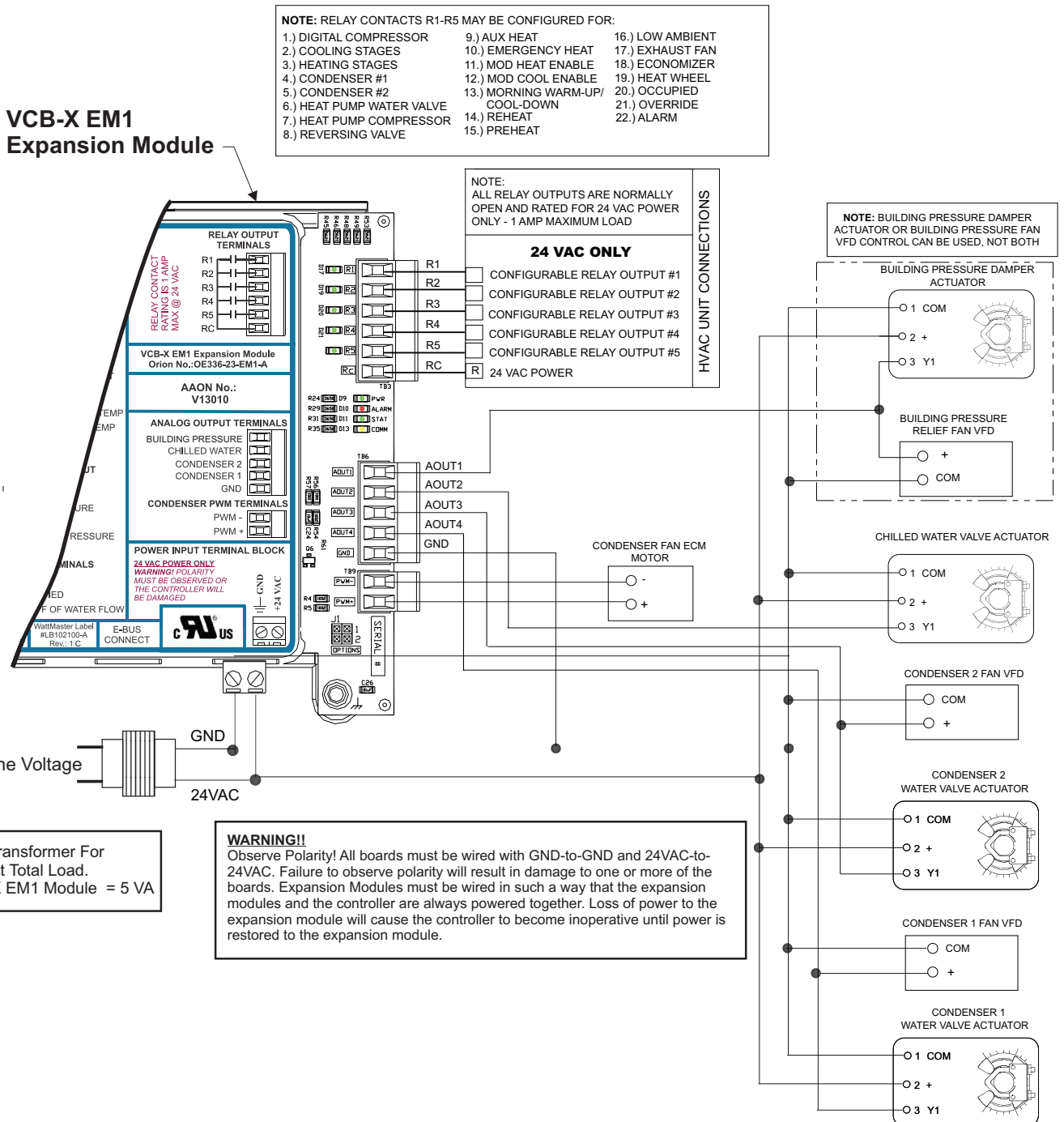


Figure 23: VCB-X EM1 Expansion Module Output Wiring Diagram

INSTALLATION & WIRING

Static Pressure Transducer Wiring

Static Pressure Transducer

The OE271 Static Pressure Transducer plugs directly into the VCB-X EM1 Expansion Module's Static Pressure port. The Duct Static Pressure Sensor reading is used to determine current Duct Static Pressure. This Static Pressure reading is used to control the output signal supplied to the Supply Fan VFD or Zoning Bypass Damper Actuator. If you have configured the HVAC unit for Constant Volume operation, this Sensor is optional. If it is installed on a Constant Volume unit, it will not affect operation, but rather will be used as a status-only reading. See **Figure 24** below for detailed wiring.

CAUTION: It is strongly recommended that you use pneumatic tubing instead of relocating the sensor. Extending the wires could cause voltage drop problems.

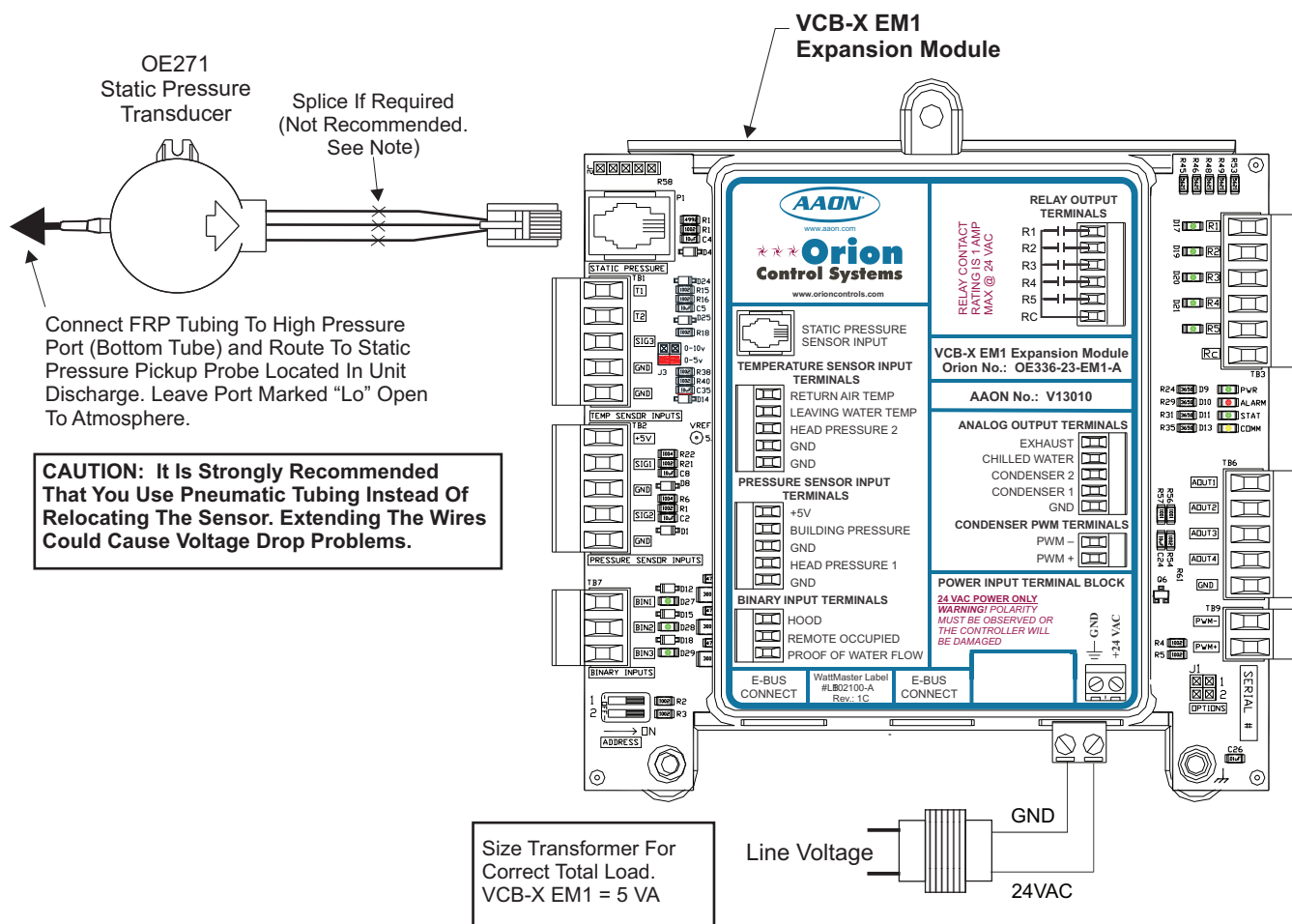


Figure 24: OE271 Static Pressure Transducer Wiring Diagram

Return Air Temperature Sensor Wiring

Return Air Temperature Sensor

The OE231 Return Air Temperature Sensor must be wired as shown in **Figure 25** below. The Return Air Temperature Sensor is a 10K Type III thermistor sensor. The Return Air Temperature Sensor should be mounted in the return air duct. If the system has a Zoning Bypass Damper installed, be sure the return air sensor is located upstream of the bypass duct connection.

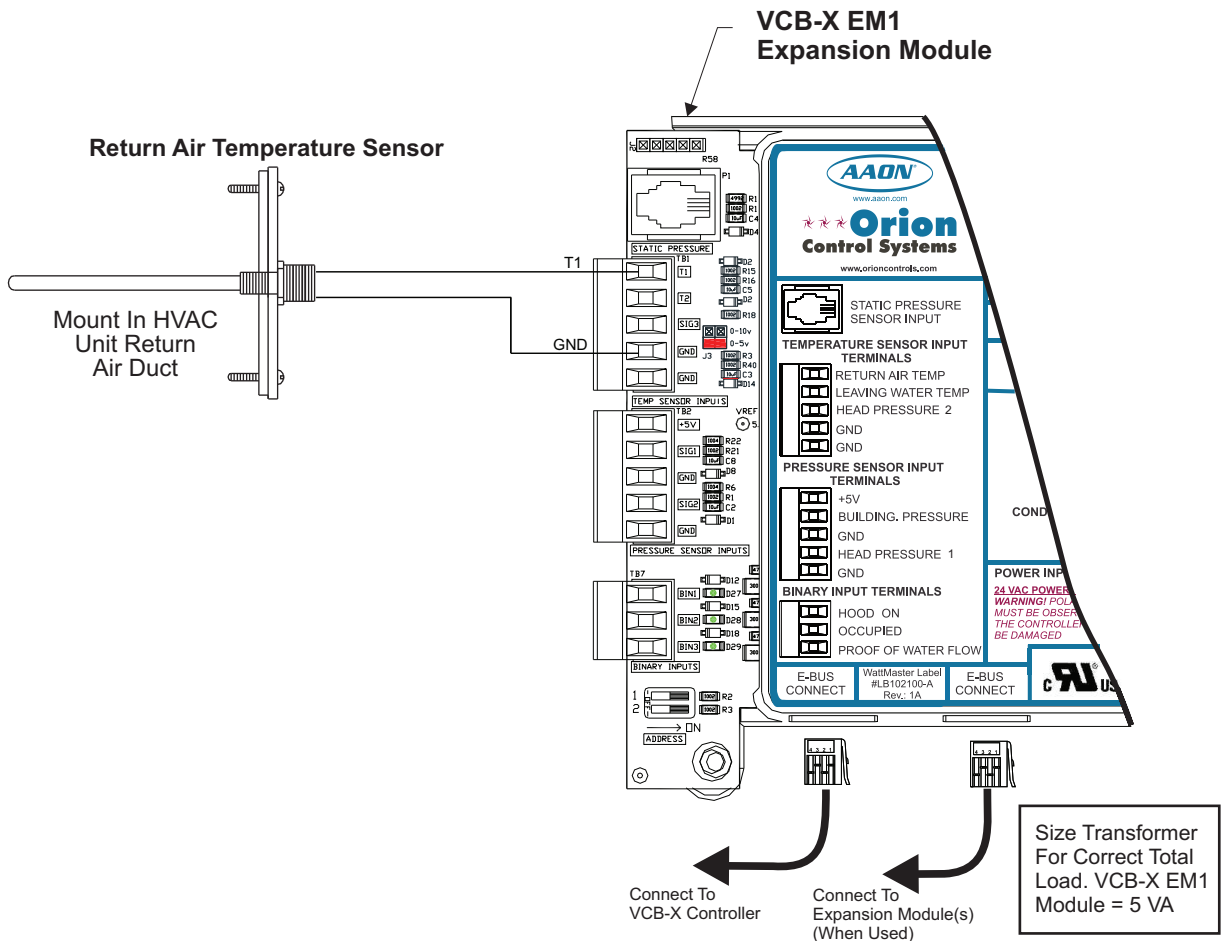


Figure 25: OE231 Return Air Temperature Sensor Wiring Diagram

Strap-On Leaving Water Temperature Sensor Wiring

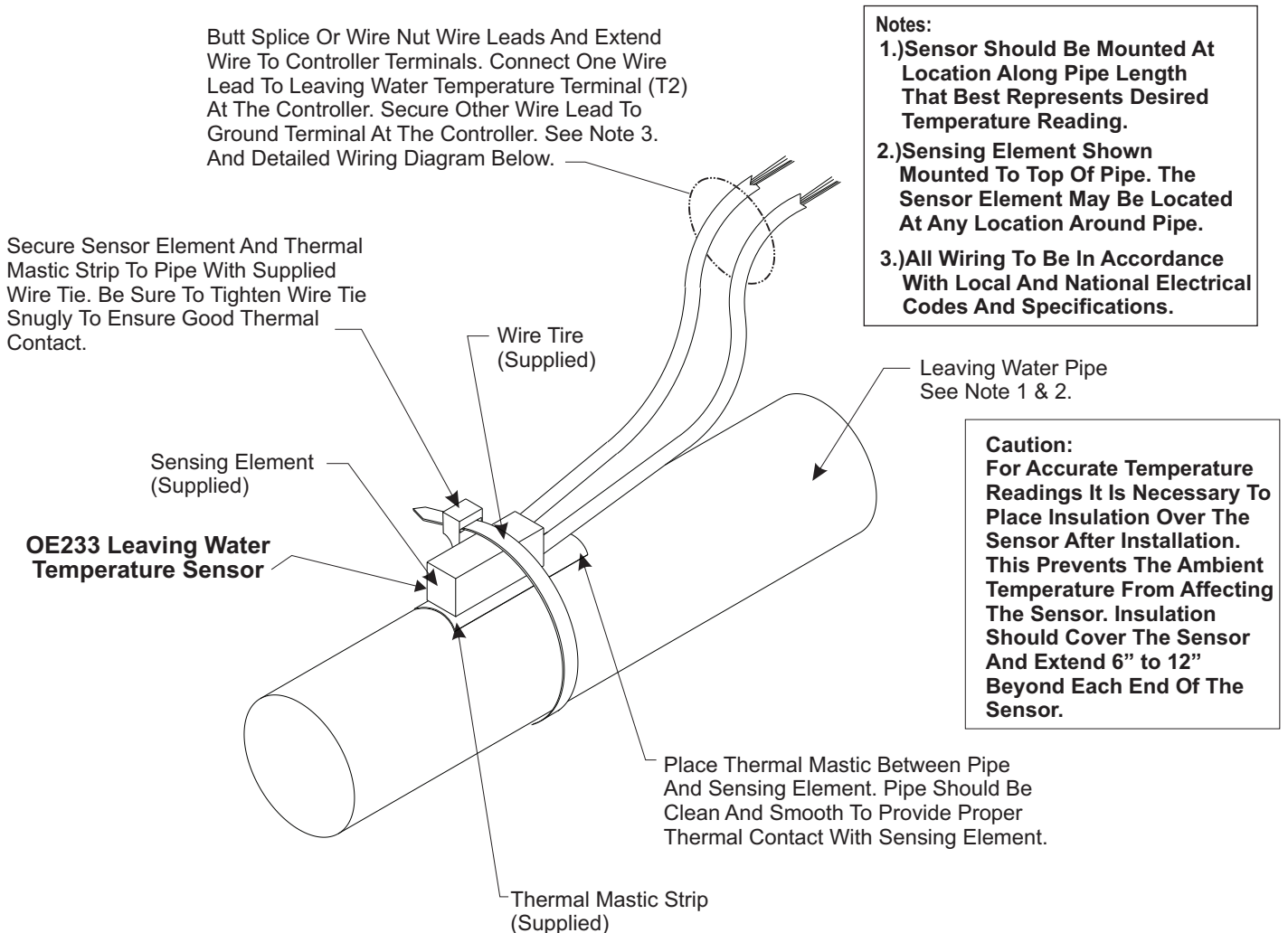


Figure 27: OE233 Strap-On Leaving Water Temperature Sensor Installation

INSTALLATION & WIRING

Building Static Pressure Sensor Wiring

Building Static Pressure Sensor

The OE258-01 Building Static Pressure Sensor must be wired as shown in **Figure 28** below. There are 3 terminal connections on the Building Static Pressure Sensor. Connect the power side of the 24 VAC power source to the terminal labeled “+ EXC.” Connect the GND side of the 24 VAC power source to the terminal labeled “- COM.” Connect the remaining terminal labeled “OUT” to SIG1 on the VCB-X EM1 terminal block.

WARNING: It is very important to be certain that all wiring is correct as shown in the wiring diagram below. Failure to observe the correct polarity will result in damage to the HVAC Unit Controller, Building Static Pressure Sensor, and the VCB-X Expansion Module.

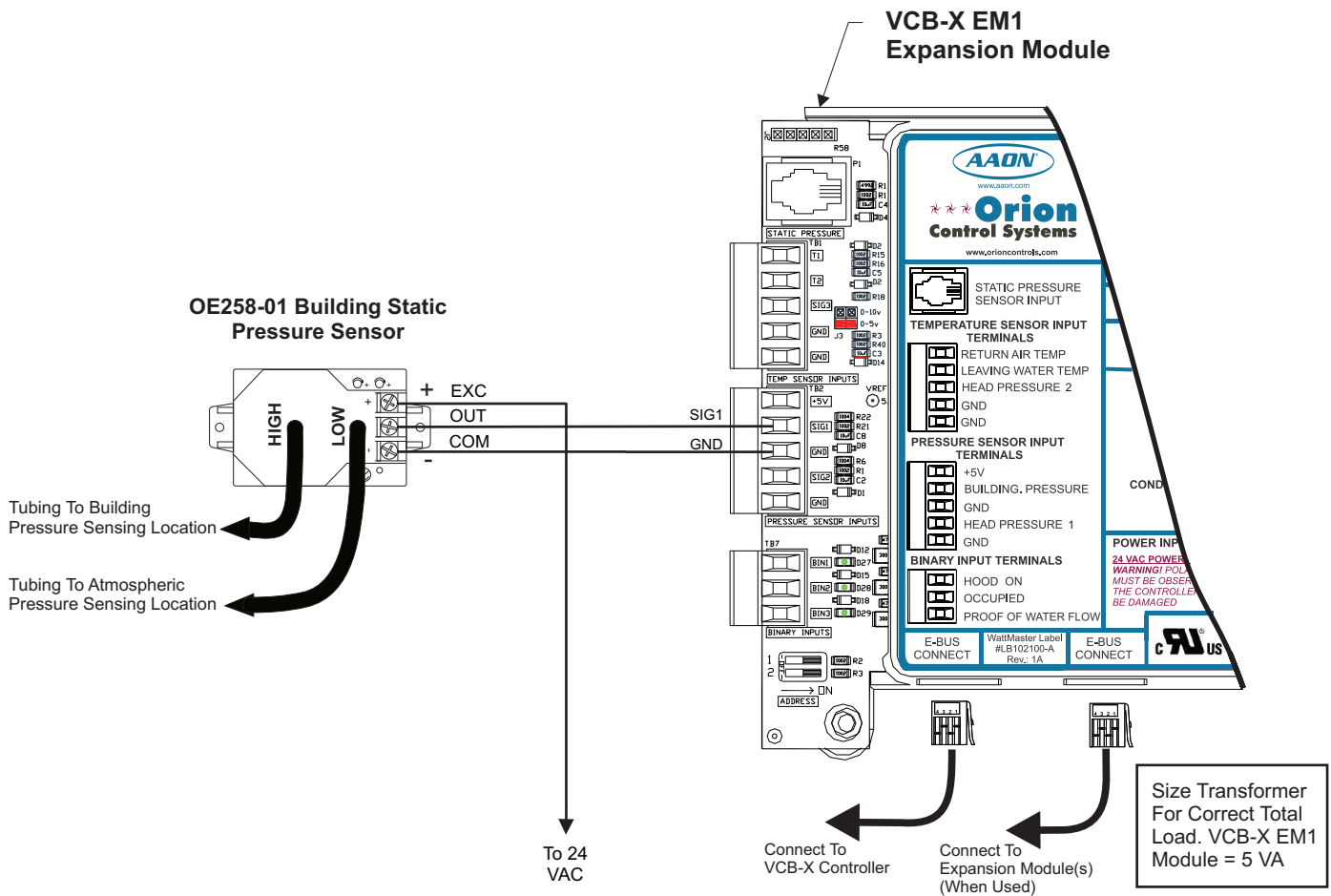


Figure 28: OE258-01 Building Static Pressure Sensor Wiring Diagram

Head Pressure Transducers Wiring

Head Pressure Transducers

The Head Pressure Transducer(s) (by others) must be wired as shown in **Figure 29** below. Make sure the jumper for SIG 1 is set to 0-5V.

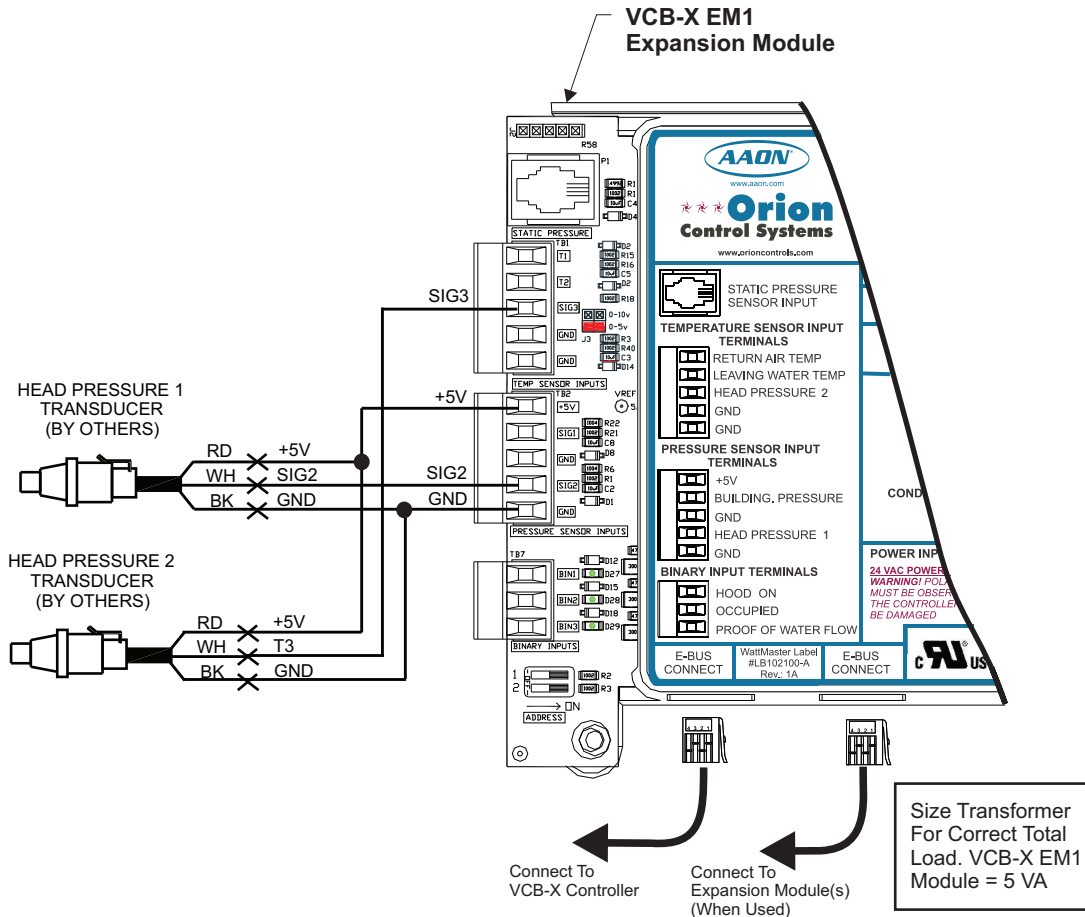


Figure 29: Head Pressure Transducers Wiring Diagram

INSTALLATION & WIRING

Building Pressure Control Output Wiring

Building Pressure Control Output

The Building Pressure Control Output is a 0-10 VDC or 2-10 VDC signal sent from the VCB-X EM1 Expansion Module. When using the output for Direct Building Pressure Control (output signal rises on a rise in building pressure), the output signal can be connected to either a Variable Frequency Drive controlling an exhaust fan or to a damper actuator controlling an exhaust damper (both by others). When used in this manner, the output signal must be configured for Direct Acting operation. See Figure 30 below for detailed wiring of the Building Pressure Control Output Signal.

When using this output for Reverse Building Pressure Control (output signal rises on a fall in building pressure), a damper actuator controlling an OA Damper or Supply Fan VFD would be used. When

using the OA damper for Reverse Building Pressure Control, the output signal must be configured for Reverse Acting operation. A Building Pressure Sensor connected to SIG1 on the VCB-X EM1 Expansion Module is used to sense and control the signal to the Building Pressure Output. The OE258-01 Building Static Pressure Sensor must be connected in order for the Building Pressure Output to operate correctly.

CAUTION: Variable Frequency Drive units can cause large transient noise spikes that can cause interference to be propagated on other electronic equipment. Use shielded wire wherever possible and route all sensor and controller wiring away from the Variable Frequency Drive and the HVAC unit electrical wiring.

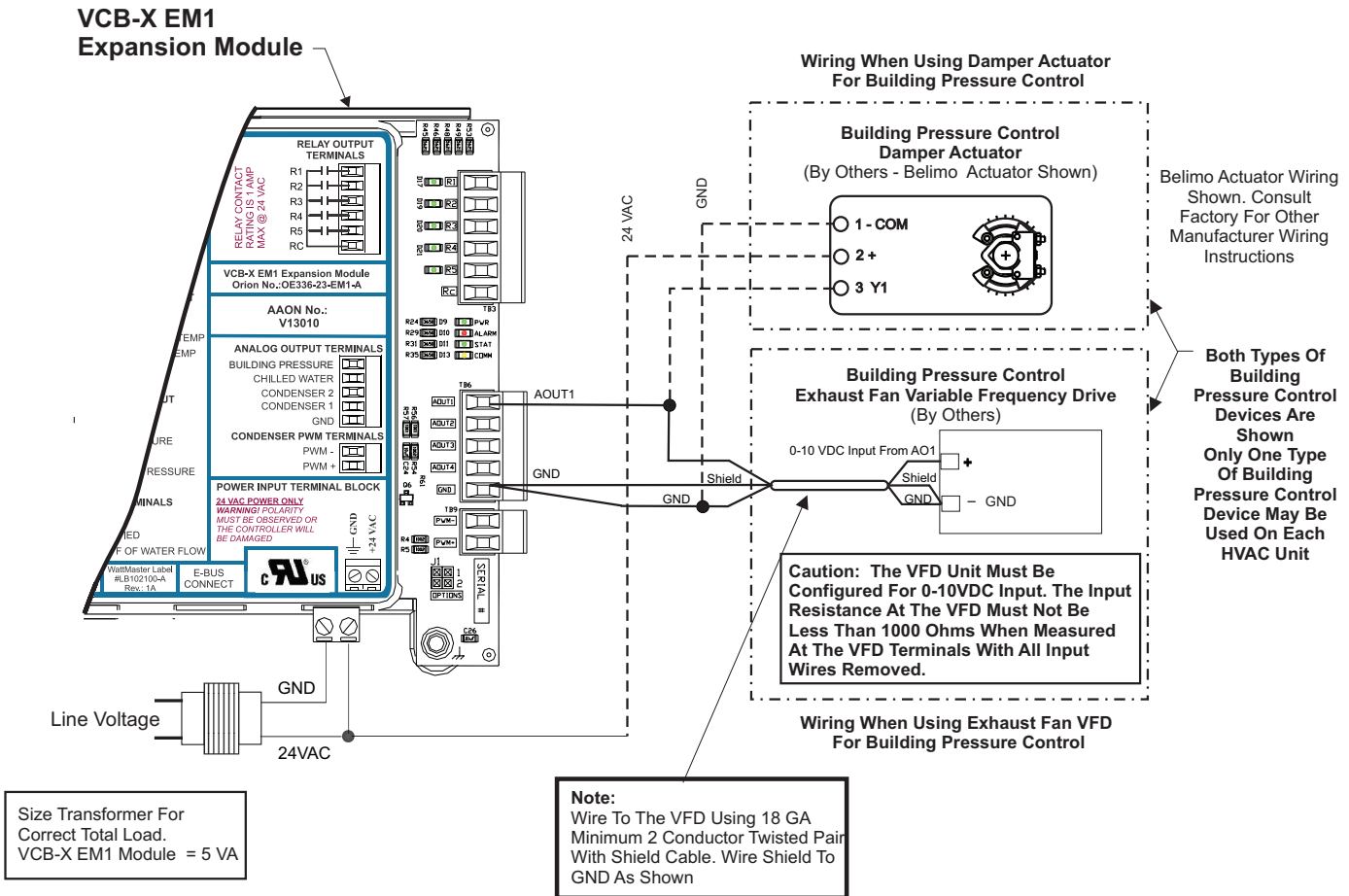


Figure 30: Building Pressure Control Output Wiring Diagram

Chilled Water Valve Actuator Wiring

Modulating Cooling Output

This output is used to control a Modulating Chilled Water Valve to maintain the Cooling Supply Air Temperature Setpoint. The output is configured for either 0-10 VDC or 2-10 VDC operation and can be configured for direct acting or reverse acting operation. See **Figure 31** for wiring details.

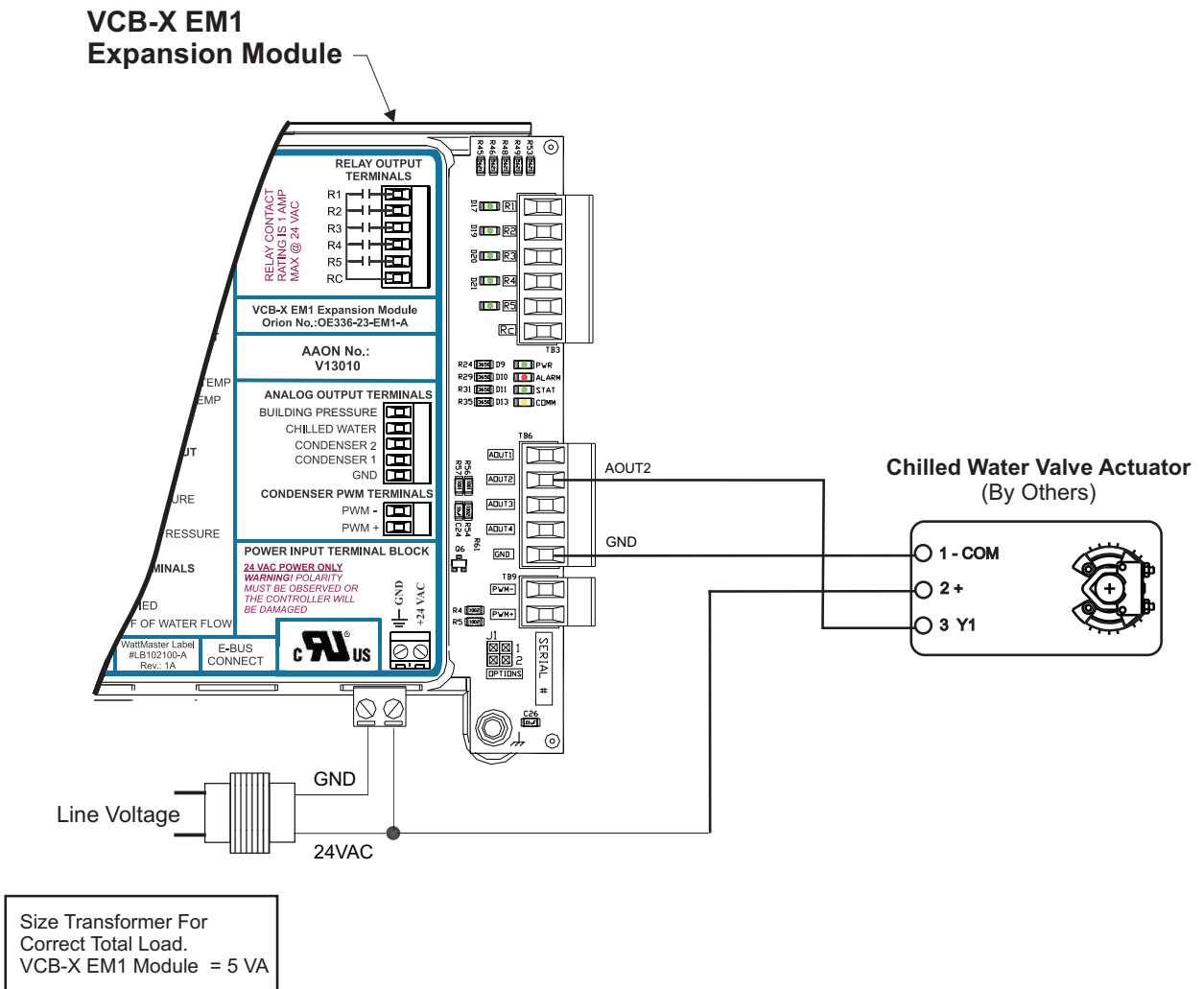


Figure 31: Chilled Water Valve Actuator Wiring Diagram

INSTALLATION & WIRING

Condenser Fan ECM Motor and VFD or Water Valve Actuator Wiring

Head Pressure Control Output

The VCB-X EM1 Expansion Module can monitor up to (2) Head Pressure Transducers and control up to (2) Condenser Fans or Condenser Water Valves to maintain a Head Pressure Setpoint. The VCB-X Controller can be configured for an Air Cooled Condenser (default) or for a Water Cooled Condenser. See **Figure 32** for wiring

On an Air Cooled Unit, the Condenser Fan will be controlled with 0-10 VDC output signal or a PWM output signal. Both outputs operate simultaneously. On a Water Cooled Unit, the Condenser Water Valve will be controlled with a 2-10 VDC output signal.

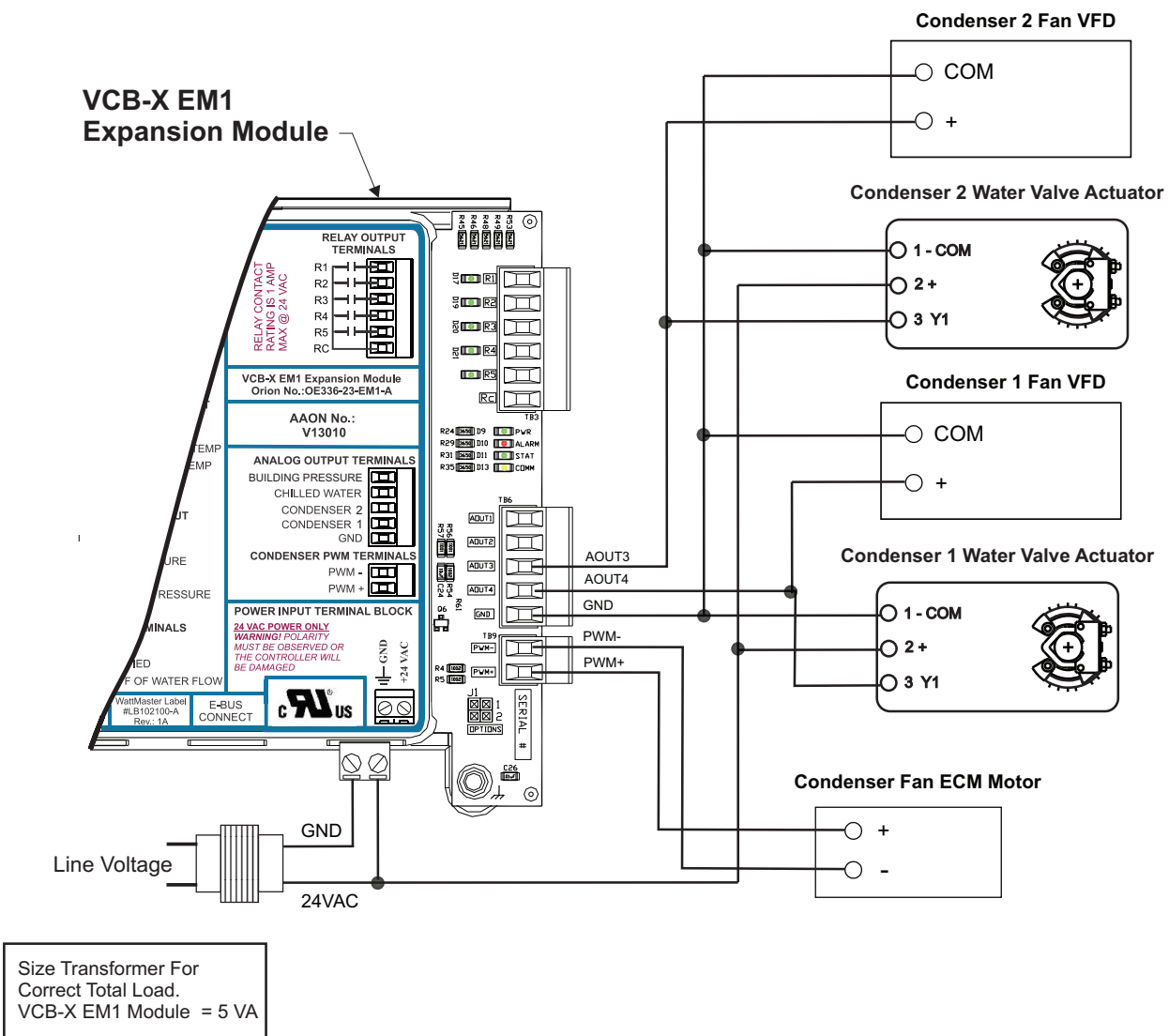


Figure 32: Condenser Fan ECM Motor and (2) Condenser Fans VFD or (2) Condenser Water Valves Actuator Wiring Diagram

VCB-X EM2 Expansion Module

VCB-X EM2 Expansion Module

The VCB-X EM2 Expansion Module (OE336-23-EM2-A) provides 1 additional analog input, 2 analog outputs, and 3 binary inputs. See **Figures 34 & 35** for complete wiring details.

The VCB-X EM2 Expansion can be used in conjunction with the VCB-X EM1 Expansion Module (OE336-23-EM1-A) and the E-BUS 12-Relay Expansion Module (OE358-23E-12R-A). The expansion modules can be used individually or together to provide the required inputs and outputs for your specific applications.

The VCB-X EM2 Expansion Module must be connected to 24 VAC as shown in the wiring diagram below. Please see **Table 1** for correct VA requirements to use when sizing the transformer(s) used for powering the expansion module.

Also please note that when wiring the VCB-X EM2 Expansion Module, its contacts must be wired as wet contacts (connected to 24 VAC).

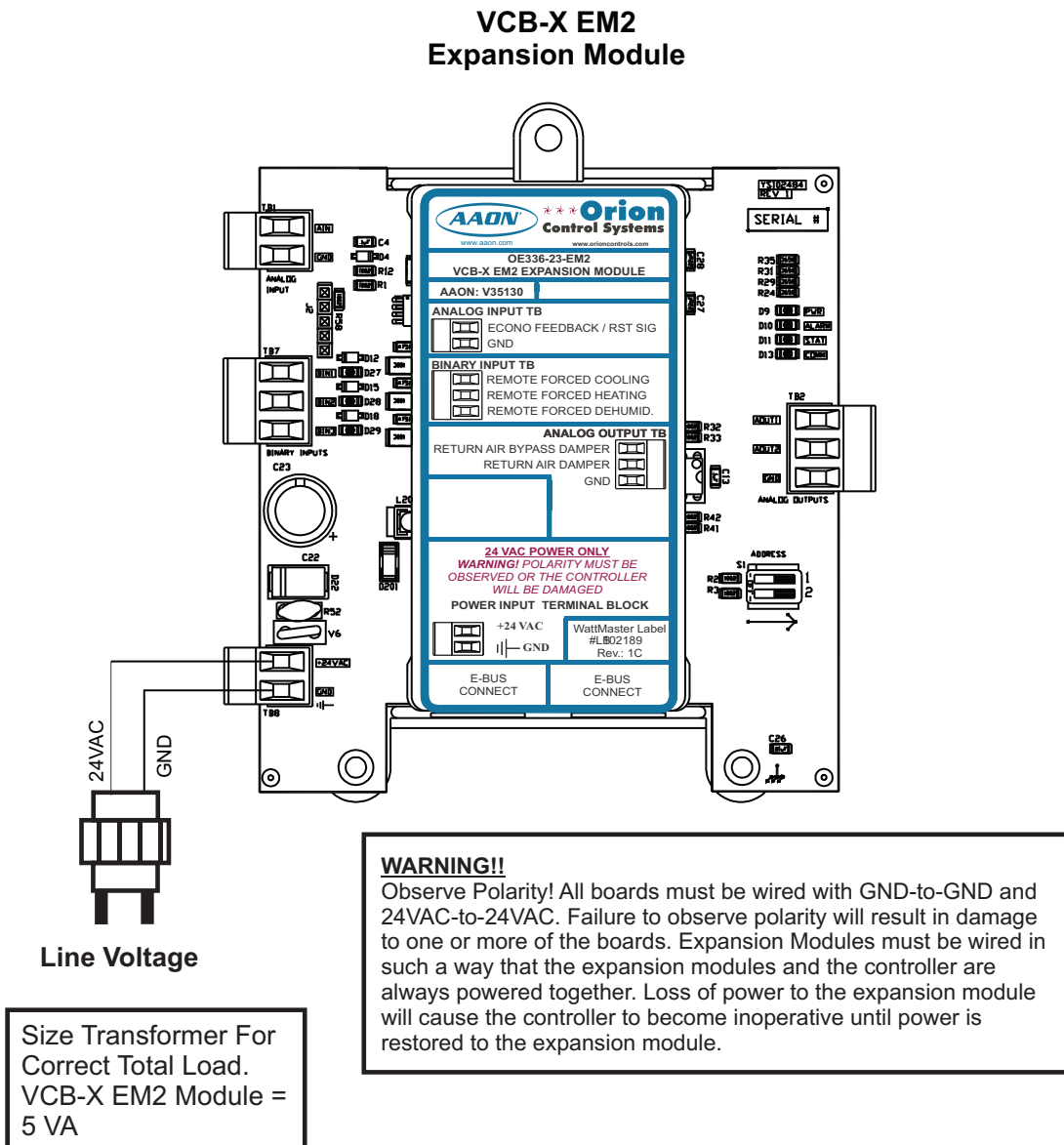


Figure 33: VCB-X EM2 Expansion Module

INSTALLATION & WIRING

VCB-X EM2 Input Wiring

AIN1

Analog Input #1 can be used for one of the following options:

Title 24 Economizer Feedback

If the controller has been configured for Title 24 Economizer operation, the Economizer Actuator Feedback signal will be wired to this input.

Remote SAT Reset Signal

If Title 24 Economizer operation has not been configured, a Remote Supply Air Temperature Reset Signal can be connected to AIN1 for applications requiring Remote Reset of the Supply Air Temperature Setpoint.

When the Slide Offset option on the Room Sensor is used, the Remote Supply Air Temperature Reset Signal cannot be used. Only one of these options may be used for VCB-X Controller applications.

This input on the VCB-X EM2 Expansion Module can accept a configurable voltage signal from 0-10 VDC (Direct or Reverse Acting). See **Figure 34** below for complete wiring details.

BIN1-BIN3 - Remote Forced Cooling, Heating, and Dehumidification

The VCB-X Controller can be configured to accept 24 VAC wet contact closures to force the unit into Cooling, Heating, and Dehumidification. If the Forced Contact configuration option is selection, it applies to all three modes. See **Figure 34** below for wiring details.

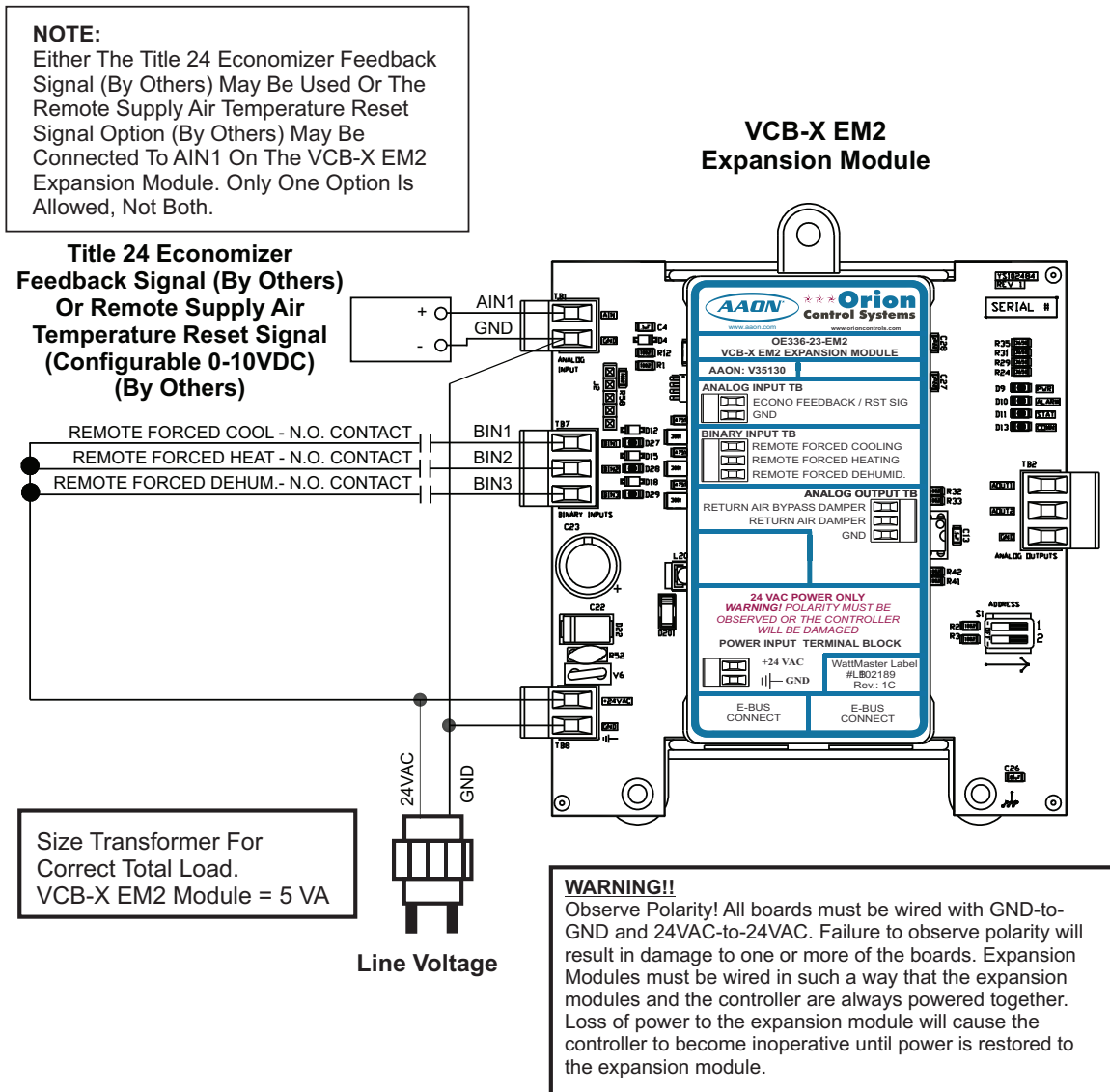


Figure 34: VCB-X EM2 Inputs Wiring

VCB-X EM2 Output Wiring

Return Air Bypass

The VCB-X Controller can be configured for AAON® PAC or DPAC applications. Both AAON® PAC and DPAC control schemes provide improved moisture removal capabilities while utilizing internal space loads for reheat by redirecting Return Air around the Evaporator Coil instead of through the coil. See the AAON® PAC and DPAC applications section of this manual on **page 6** for complete operation details.

The AAON® PAC and DPAC control applications utilize a Return Air Bypass Damper Actuator and a Return Air Damper Actuator to modulate the Return Air and Return Air Bypass Dampers to control the amount of air that is redirected around the Evaporator Coil.

The AAON® DPAC control scheme provides improved moisture removal capabilities and tighter temperature control than the AAON® PAC controls scheme by combining Copeland Digital Scroll™ Compressor control in addition to Return Air Bypass control. See the Return Air Bypass Sequence for more details.

See **Figure 35** below for detailed wiring of the Return Air Bypass and Return Air Damper Actuators.

WARNING: It is very important to be certain that all wiring is correct as shown in the wiring diagram below. Failure to observe the correct polarity could result in damage to the Damper Actuator or the VCB-X Expansion Module.

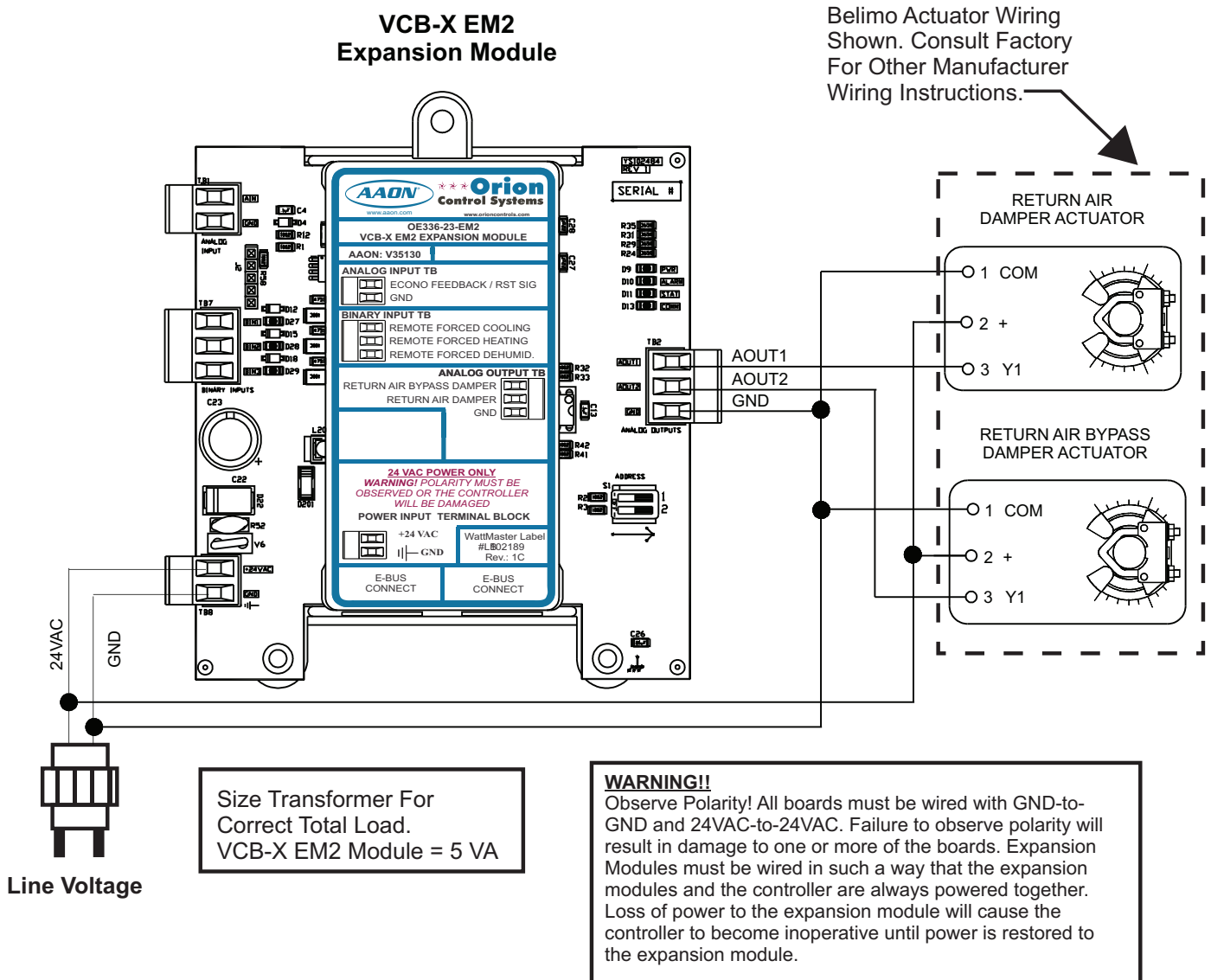


Figure 35: Return Air Bypass Wiring

INSTALLATION & WIRING

12-Relay E-BUS Expansion Module Wiring

E-BUS 12-Relay Expansion Module

The E-BUS 12-Relay Expansion Module (OE358-23E-12R-A) provides for 12 Dry Contact Configurable Relay Outputs. See **Figure 36** below for complete wiring details.

The E-BUS 12-Relay Expansion Module can be used in conjunction with the VCB-X EM1 Expansion Module (OE336-23-EM1-A) and the VCB-X EM2 Expansion Module (OE336-23-EM2-A). The expansion modules can be used individually or together to provide the required inputs and outputs for your specific applications.

The expansion modules can be used individually or together to provide the required inputs and outputs for your specific applications.

WARNING!!

Observe Polarity! All boards must be wired with GND-to-GND and 24VAC-to-24VAC. Failure to observe polarity will result in damage to one or more of the boards. Expansion Modules must be wired in such a way that the expansion modules and the controller are always powered together. Loss of power to the expansion module will cause the controller to become inoperative until power is restored to the expansion module.

Note:

A Total Of 17 Relays Are Available By Adding The Relay Expansion Modules. All Expansion Module Relay Outputs Are User-Configurable.

Note:

All Relay Outputs Are Normally Open And Rated For 24 VAC Power Only. 1 Amp Maximum Load.

NOTE: RELAY CONTACTS R1-R5 MAY BE CONFIGURED FOR:

- | | | |
|---------------------------|------------------------------------|------------------|
| 1.) DIGITAL COMPRESSOR | 9.) AUX HEAT | 16.) LOW AMBIENT |
| 2.) COOLING STAGES | 10.) EMERGENCY HEAT | 17.) EXHAUST FAN |
| 3.) HEATING STAGES | 11.) MOD HEAT ENABLE | 18.) ECONOMIZER |
| 4.) CONDENSER #1 | 12.) MOD COOL ENABLE | 19.) HEAT WHEEL |
| 5.) CONDENSER #2 | 13.) MORNING WARM-UP/
COOL-DOWN | 20.) OCCUPIED |
| 6.) HEAT PUMP WATER VALVE | 14.) REHEAT | 21.) OVERRIDE |
| 7.) HEAT PUMP COMPRESSOR | 15.) PREHEAT | 22.) ALARM |
| 8.) REVERSING VALVE | | |

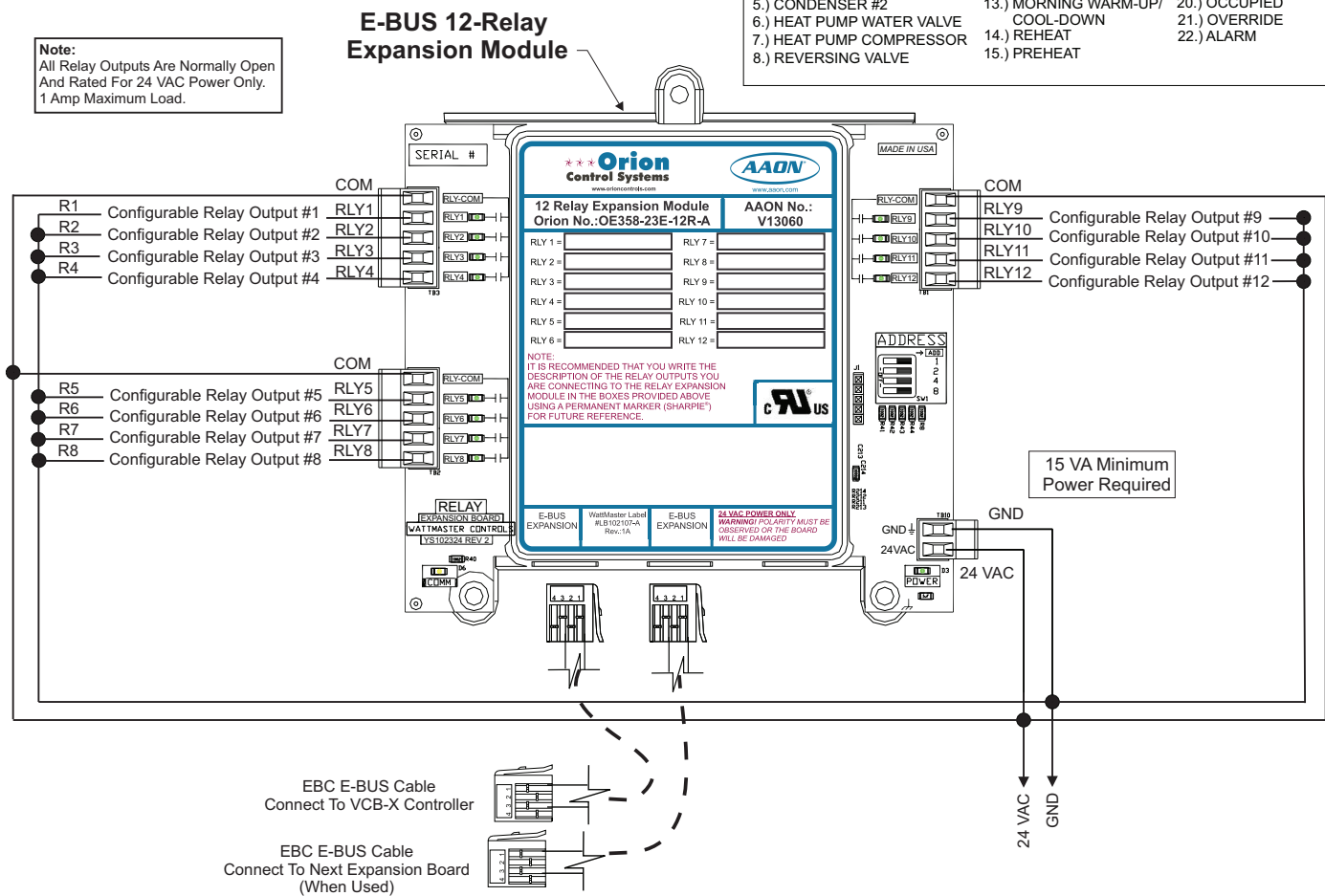


Figure 36: OE358-23E-12R-A – E-BUS 12-Relay Expansion Module Wiring

EBTRON®, GreenTrol™, and Paragon Wiring

EBTRON®, GreenTrol™, and Paragon Air Flow Measurement Digital Transmitters

NOTE: Only the EBTRON® GTC116 series, GreenTrol™ GA-200-N Module (with GF series Airflow Station), or Paragon MicroTrans^{EQ} series of MODBUS RTU transmitters are compatible with the VCB-X Controller. No other series of transmitters will work for this application. Contact WattMaster Controls for information on other airflow station options.

The OE365-15-EBA E-BUS Adapter Board attaches to the VCB-X Controller with an EBC E-BUS cable. The Adapter Board is used for connecting the EBTRON®, GreenTrol™, or Paragon Airflow Measurement Digital Transmitter to the VCB-X Control System. You must wire the Airflow Measurement Digital Transmitter to the Adapter Board as shown in **Figure 37**.

NOTE: The Airflow Station's baud rate needs to be set to 19,200 in order to communicate with the VCB-X Controller.

NOTE: Up to 4 EBTRON®, GreenTrol™, or Paragon Airflow Measurement Digital Transmitters can be attached to each Adapter Board.

NOTE: If using multiple E-BUS Sensors or Modules, the E-BUS Hub (HZ-EBC-248 or MS000248) may be required.

***NOTE:** When configuring the GTC116 Series, be sure to set the Parity to "NO PARITY, 1 STOP BIT."

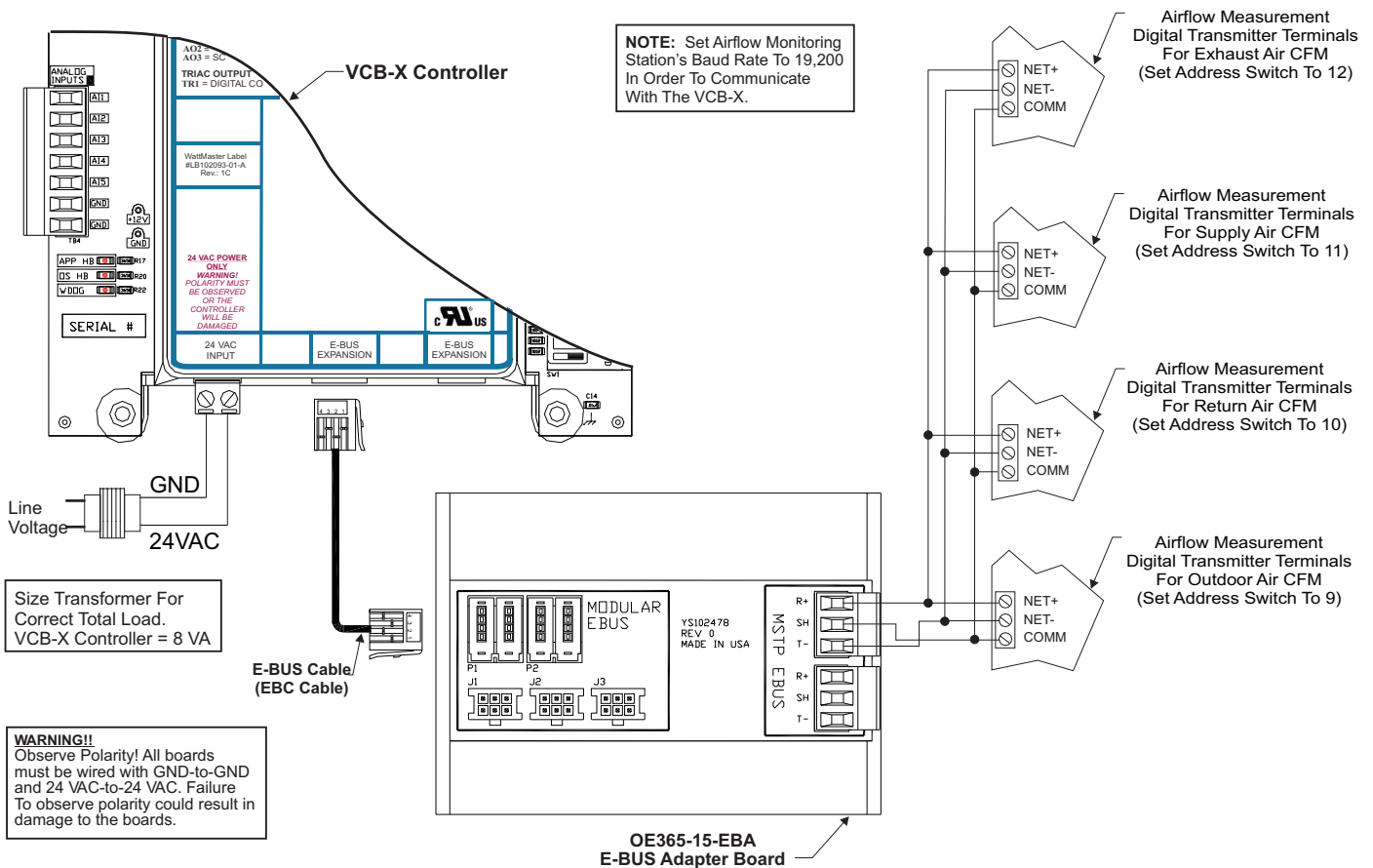


Figure 37: EBTRON® GTC116 Series, GreenTrol™ GA-200-N Series, and Paragon MicroTrans^{EQ} Series Air Flow Measurement Digital Transmitter Wiring

INSTALLATION & WIRING

MHGRV-X Controller Wiring

MHGRV-X Controller Wiring

The OE377-26-00059 MHGRV-X Controller (AAON part number V12100) is designed to control a Modulating Hot Gas Reheat Valve to maintain a desired Supply Air Temperature and Dehumidification setpoint. The MHGRV-X Controller directly connects to the VCB-X Controller or indirectly using an E-BUS Expansion Board via an EBC E-BUS cable. See **Figure 38**.

The following information will be passed between the MHGRV-X controller and the VCB-X Controller:

- Reheat Enable command
- Supply Air Temperature Setpoint
- The Reset Supply Air Temperature Setpoint

- The Supply Air Temperature Reset Signal
- If the communication is interrupted between the MHGRV-X Controller and the VCB-X Controller, the MHGRV-X controller will revert to stand-alone operation.

For more information, refer to the *MHGRV-X Controller Technical Guide*.

NOTE: If using multiple E-BUS Sensors or Modules, the E-BUS Hub or Adapter Board may be required.

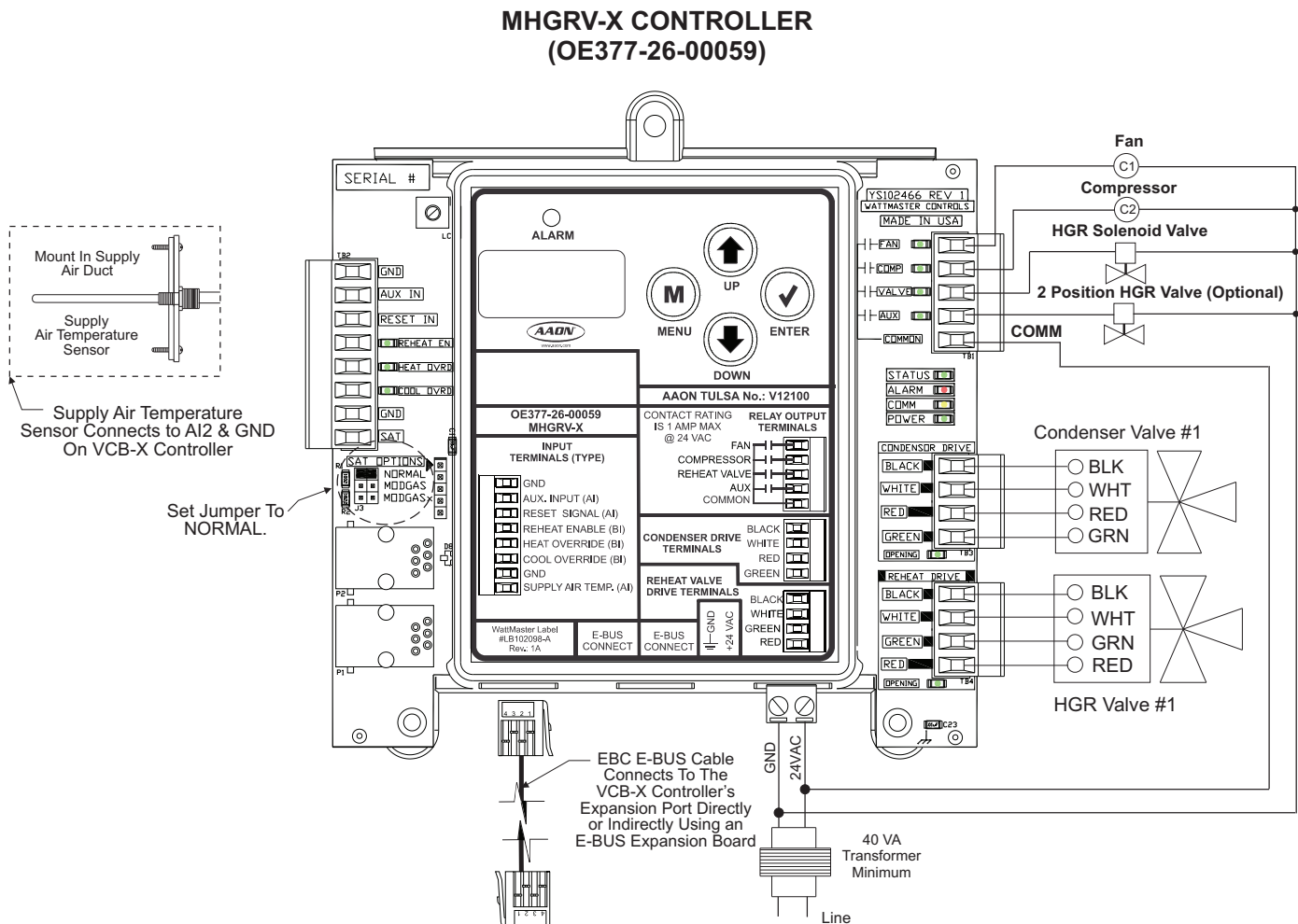


Figure 38: MHGRV-X Controller to VCB-X Controller Wiring

MODGAS-X Controller Wiring

MODGAS-X Controller Wiring

The OE377-26-00058 MODGAS-X Controller (AAON Part No. V12090) is designed to modulate up to (2) gas valves to maintain a desired Discharge Air Temperature. It also controls the speed of the induced draft fan to maintain proper combustion in the heat exchanger. The MODGAS-X Controller directly connects to the VCB-X Controller or indirectly using an E-BUS Expansion Board via an EBC E-BUS cable. See **Figure 39**.

The following information will be passed between the MODGAS-X controller and the VCB-X Controller:

- Heat activation command
- Heating Discharge Setpoint

- The offset for the Supply Air Temperature Sensor
- High Limit Temperature Setpoint
- If the communication is interrupted between the MODGAS-X Controller and the VCB-X Controller, the MODGAS-X controller will revert to stand-alone operation.

For more information, refer to the *MODGAS-X Controller Technical Guide*.

NOTE: If using multiple E-BUS Sensors or Modules, the E-BUS Hub or Adapter Board may be required.

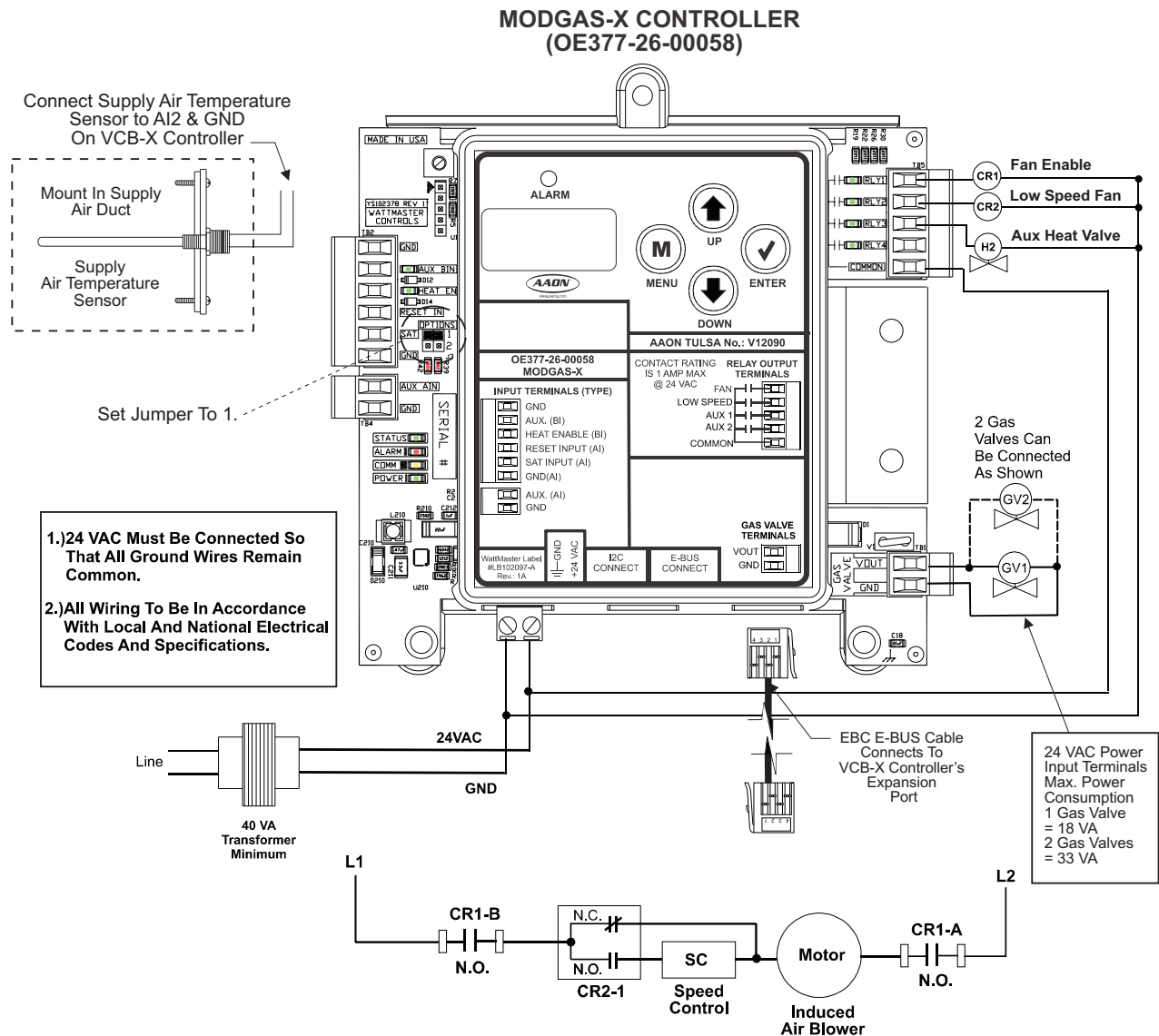


Figure 39: MODGAS-X Controller to VCB-X Controller Wiring Diagram

START-UP & COMMISSIONING

Addressing, Baud Rate & Powering Up

Before Applying Power

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

Controller Addressing and Baud Rate

All VCB-X Controllers are equipped with address switches. If the VCB-X Controller is to operate as a stand-alone system (not connected to any other HVAC unit or VAV/Zone Controllers), the controller address switch should be set for address 1. When using the Modular Service Tool or System Manager to program and configure the VCB-X Controller, you would enter this address to communicate with the controller. When the system is to be connected to other HVAC unit controllers on a communication loop, each controller's address switch must be set with a unique address between 1 and 59.

Address switches 7 and 8 are used for the baud rate selection. See **Figure 40** below for address switch and baud rate setting information.

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 VCB-X Controller requires 8 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.

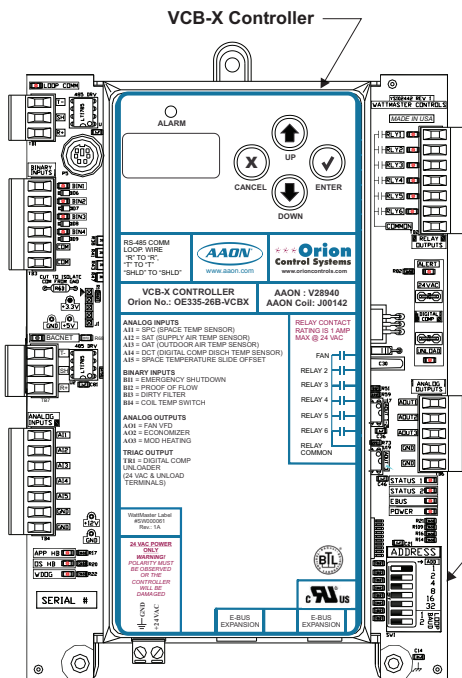
WARNING: Observe Polarity! All boards must be wired with GND-to-GND and 24 VAC-to-24 VAC. Failure to observe polarity will result in damage to one or more of the boards.

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 VCB-X Controller.

After all the above wiring checks are complete, apply power to the VCB-X Controller.

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.



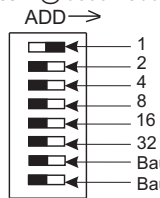
BAUD RATE SELECTION

Baud	Switch 7	Switch 8	Communication Setting
9600	OFF	OFF	CommLink IV
9600	OFF	OFF	CommLink 5 Set at Low Speed*
57600	OFF	ON	CommLink 5 Set at High Speed* or VCB-X is Stand Alone

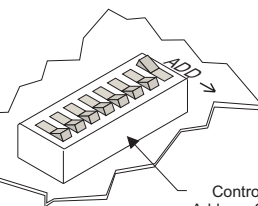
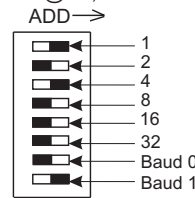
* The CommLink 5 must be set to Low Speed if it is being used on a system that includes the VCM-X Controller or older generation of Orion Controllers.

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

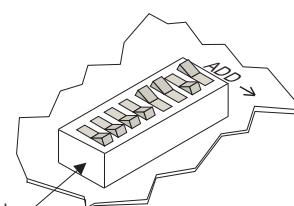
Address 1 @ 9600 Baud



Address 5 @ 57,600 Baud



Address Switch Shown Is Set For Address 1



Address Switch Shown Is Set For Address 13

The Address For Each Controller Must Be Unique To The Other Controllers On The Local Loop And Be Between 1 and 59

Figure 40: VCB-X Controller Address Switch and Baud Rate Setting

Initialization

When power is first applied, STATUS 1 LED and STATUS 2 LED will flash out the controller address. STATUS 1 LED will flash to represent the tens position. STATUS 2 LED will flash to represent the ones position. After the controller address has flashed, STATUS 1 LED and STATUS 2 LED will flash the diagnostic blink codes.

Example of a controller address of 59:

STATUS 1 LED will flash 5 times. STATUS 2 LED will flash 9 times.

See **Table 5** in the Troubleshooting Section of this manual for detailed diagnostic blink code information.

Programming the Controller

The next step is programming the controller for your specific requirements. In order to configure and program the VCB-X Controller, you must use an operator interface. Three different operator interfaces are available for programming and monitoring of the VCB-X Controller. See **Figure 41**. They are as follows:

- Modular Service Tool SD
- System Manager Touch Screen II
- Computer with Prism 2 Software and CommLink 5 Installed

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 or System Manager TS with your system, refer to the *VCB-X Operator Interface SD Technical Guide* and the *System Manager Touch Screen II Technical Guide* for complete VCB-X Controller programming instructions.

If using a Notebook or Desktop computer and the Prism Computer Front End Software, refer to the *Prism 2 Technical Guide*.

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

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

NOTE: For BACnet® Configuration, see Appendices B & C.



Figure 41: Modular Service Tool SD, System Manager TS II, and Prism 2 Graphical Software Operator Interfaces

INPUTS & OUTPUTS

VCB-X Controller and Expansion Module Input/Output Maps

Input/Output Map

See **Table 2** for the VCB-X Controller's Input/Outputs, **Table 3** for the VCB-X EM1 Expansion Module's Inputs/Outputs, and **Table 4** for the VCB-X EM2 Expansion Module's Inputs/Outputs.

VCB-X CONTROLLER	
Analog Inputs	
1	Space Temperature (AI1)
2	Supply Air Temperature (AI2)
3	Outside Air Temperature (AI3)
4	Discharge Temperature (For Digital Compressor) (AI4)
5	Space Slide Offset (AI5)
Binary Inputs	
1	Emergency Shutdown (BI1)
2	Proof of Flow (BI2)
3	Dirty Filter (BI3)
4	Defrost Coil Temperature Switch (BI4)
Analog Outputs (0-10 VDC)	
1	Fan VFD (AOUT1)
2	Economizer (Outdoor Air Damper) (AOUT2)
3	Modulating Heating (Hot Water, Steam, or SCR) (AOUT3)
Binary Outputs (24 VAC)	
1	Fan Relay (R1)
2	Configurable Relay (R2)
3	Configurable Relay (R3)
4	Configurable Relay (R4)
5	Configurable Relay (R5)
6	Configurable Relay (R6)
7	Digital Compressor Unloader Triac (TR1)

The following E-BUS sensors and modules are available to connect to the VCB-X Controller via E-BUS ports or E-BUS Expansion Modules:

1. E-BUS Digital Room Sensor - LCD Display - Temp Only or Temp & Humidity
2. E-BUS Digital Room Sensor - No LCD Display - Temp & Humidity
3. E-BUS Space and Return Air CO₂ Sensors
4. E-BUS connection to EBTRON, GreenTrol and Paragon Air Flow Stations
5. E-BUS Outside Air Temperature & Humidity Sensor
6. Suction Pressure Transducer with E-BUS Adapter Board

Table 2: VCB-X Controller Inputs & Outputs

VCB-X EM1 EXPANSION MODULE	
Analog Inputs	
1	Static Pressure (AI1)
2	Return Air Temperature (T1)
3	Leaving Water Temperature (T2)
4	Head Pressure 2 (SIG3)
5	Building Pressure (SIG1)
6	Head Pressure 1 (SIG2)
Binary Inputs	
1	Hood On/Off (BIN1)
2	Remote Forced Occupied (BIN2)
3	Proof of Water Flow (BIN3)
Analog Outputs (0-10 VDC)	
1	Exhaust Fan VFD (AOUT1)
2	Chilled Water (AOUT2)
3	Condenser 2 (AOUT3)
4	Condenser 1 (AOUT4)
PWM+/- Output	
1	Condenser Fan
Binary Outputs (24 VAC)	
1	Configurable Relay (R1)
2	Configurable Relay (R2)
3	Configurable Relay (R3)
4	Configurable Relay (R4)
5	Configurable Relay (R5)

Table 3: VCB-X EM1 Inputs & Outputs

VCB-X EM2 EXPANSION MODULE	
Analog Input (Configurable 0-10 VDC)	
1	Economizer Feedback/Remote SAT Reset (AIN1)
Binary Inputs	
1	Remote Forced Cooling (BIN1)
2	Remote Forced Heating (BIN2)
3	Remote Forced Dehumidification (BIN3)
Analog Outputs (0-10 VDC)	
1	Return Air Damper (AOUT1)
2	Return Air Bypass Damper (AOUT2)

Table 4: VCB-X EM2 Inputs & Outputs

VCB-X Controller Inputs

AI1 - Space Temperature Sensor Input

The Space Temperature Sensor will initiate Occupied Heating and Cooling modes if the unit is configured for Space Temperature control. It is always the sensor used to initiate Unoccupied Heating and Cooling modes. If the Space Temperature Sensor used is equipped with the optional Push-Button Override feature, this input will detect user overrides and switch the unit from the Unoccupied Mode back to the Occupied Mode operation for a user-adjustable amount of time. The Space Temperature can also be configured to reset the Supply Air Temperature Setpoint.

AI2 - Supply Air Temperature Sensor Input

Once the unit is in the Heating or Cooling Mode (based on the temperature at the mode enable sensor), the unit will control the staging or modulation of the heating or cooling sources to maintain a Heating or Cooling Supply Air Setpoint. The HVAC unit must always have a Supply Air Temperature Sensor installed.

AI3 - Outdoor Air Temperature Sensor Input

The Outdoor Air Temperature is used to lock out Heating or Cooling to conserve energy at whatever temperature you deem appropriate for each Mode of Operation. This sensor is also used to initiate Heating and Cooling modes on a Make Up Air unit. The Outdoor Air Temperature Sensor can also be used for Pre-Heater operation and for Low Ambient Protection operation.

NOTE: For AI1 through AI3, all Temperature Sensors must be Thermistor Type III which provide 77.0°F @ 10K Ohms Resistance.

AI4 - Digital Compressor Discharge Temperature Sensor Input

The Digital Compressor Discharge Temperature Sensor monitors the discharge temperature from the Digital Compressor to protect against overheating.

AI5 - Space Temperature Sensor Slide Adjust

If the Space Temperature Sensor being used has the optional Slide Adjust feature, its AUX output is connected to this input. The Slide Adjust control is used to vary the HVAC Mode Heating and Cooling Setpoints by a user-configured maximum amount.

If the Space Temperature is configured as the SAT Reset Source, the Slide Adjustment adjusts both the HVAC Mode Enable Heating and Cooling setpoints and the SAT Reset Source Heating and Cooling setpoints simultaneously by a user-configurable maximum amount.

B11 - Emergency Shutdown Input

This wet contact input is used to initiate shutdown of the HVAC unit when a N.C. Smoke Detector (by others), Firestat (by others), or other shutdown condition (by others) contact is opened. The controller remains active and can initiate alarm relays.

B12 - Proof of Flow Input

A Proof of Flow Switch (by others) that provides a wet contact closure whenever the HVAC unit Supply Fan is operating can be connected to this input. If the Proof of Flow Switch contact opens while the Supply Fan is operating, all Heating and Cooling is suspended or disabled.

B13 - Dirty Filter Contact Closure Input

This wet contact input is required for Filter Status Indication and requires a Differential Pressure Switch to initiate a Dirty Filter alarm.

B14 - Defrost Coil Temperature Switch Input

This wet contact input monitors a Defrost Coil Temperature Switch on air to air heat pump units. If the compressors are operating in the Heating Mode and this switch closes, it will initiate a Defrost Mode.

NOTE: The Binary Inputs require wet contacts (24 VAC only) to recognize an active input. If you provide dry contacts, the contact closure will not be recognized. All Binary Inputs are optional. This means that you must configure the VCB-X Controller to recognize these input signals.

VCB-X Controller Outputs

VCB-X Controller Outputs

AOUT1 - Supply Fan VFD Control Signal

This user-adjustable voltage signal is used to modulate the Supply Fan VFD in VAV, Single Zone VAV, or Filter Loading applications.

AOUT2 - Economizer (Outdoor Air Damper) Control Signal

This user-adjustable voltage signal is used to control the Outdoor Air Damper during Economizer operation. It is also used to maintain the Outdoor Air Damper at its Minimum Position during the Occupied Mode when the Outdoor Air Temperature is not suitable for Economizer Cooling purposes. This minimum position can be reset based on CO₂ override conditions.

This output is also used to control the Outdoor Air Damper based on an Outdoor Air Flow Setpoint if using an Outdoor Airflow Monitoring station. This position can be overridden during Economizer Control.

Finally, this output can be used to control the Outdoor Air Damper during Reverse Acting Building Pressure Control to maintain a Building Pressure Setpoint.

AOUT3 - Modulating Heat Control Signal

This output can be configured with a user-adjustable voltage range of operation which can be set up to provide either a direct or reverse acting operation. This output is used to operate a modulating heating device to maintain the Heating Supply Air Setpoint during the Heat Mode of operation.

TR1 - Digital Compressor Unloader

The unloader solenoid is energized in an on/off pattern to deliver the capacity needed by (1) digital compressor to achieve setpoint.

R1 - Supply Fan (Enable)

This is a non-configurable output.

R2-R6 - User-Configurable Relays

These relays are configurable by the user. For all the available configuration options, see **Table 5**.

No.	Relay Description	Details
1	Digital Compressor	Configured for a Digital Compressor.
2	Cooling Stage	Configured for each fixed stage of cooling (except heat pump compressor).
3	Heating Stage	Configured for each fixed stage of heating.
4-5	Condenser #1 Condenser #2	Configured for Condenser Fan/Valve operation. This relay(s) will be active anytime the respective compressors are active, except if the unit is in Heat Pump Defrost Mode.
6	Heat Pump Water Valve	On a Water Source Heat Pump, this relay will be active anytime compressors are active.
7	Heat Pump Compressor	Configured for a Fixed Heat Pump Compressor stage.
8	Reversing Valve	Configured for the Reversing Valve of a heat pump unit.
9	Aux Heat	Configured for a fixed stage of Aux Heat in a heat pump unit.
10	Emergency Heat	Configured for a fixed stage Emergency Heat in a heat pump unit.
11	Mod Heat Enable	Configure if a 0-10 VDC Modulating Heat source needs a relay to enable it.
12	Mod Cool Enable	Configure if a 0-10 VDC Modulating Cool source needs a relay to enable it.
13	Morning Warm-Up/ Cool-Down (VAV Boxes)	Configure (1) Relay for Morning Warm-Up/Cool-Down when Non-Orion VAV/Zone Controllers are used.
14	Reheat	Configure (1) Relay for On/Off Reheat when used.
15	Pre-Heat	Configure for Pre-Heat operation.
16	Low Ambient	Configure for Low Ambient operation.
17	Exhaust Fan	Configure (1) Relay for enabling exhaust fan when Building Pressure Control is used.
18	Economizer Active	If configured, this relay will energize if unit is in Economizer mode and the damper has moved 5% above its Economizer Minimum Setpoint position.
19	Heat Wheel	Configure (1) Relay that turns heat wheel on when in Occupied operation and turns heat wheel off when in Economizer Mode.
20	Occupied Active	If configured, this relay will energize whenever the unit is in the Occupied Mode.
21	Override Active	If configured, this relay will energize anytime the space sensor Push-button override is active.
22	Alarm Active	If configured, this relay will energize anytime a VCB-X alarm is active.

Table 5: User-Configurable Relay Outputs

VCB-X EM1 Expansion Module Inputs & Outputs**VCB-X EM1 Expansion Module****AI1 - Duct Static Pressure Sensor Input**

This phone jack-style input connection accepts a Duct Static Pressure Sensor modular cable input. The Duct Static Pressure Sensor reading is used to determine current Duct Static Pressure. This Static Pressure reading is used to control the output signal supplied to the Supply Fan VFD or Zoning Bypass Damper Actuator. If you have configured the HVAC unit for Constant Volume operation, this Sensor is optional. If it is installed on a Constant Volume unit, it will not affect operation, but rather will be used as a status-only reading.

T1 - Return Air Temperature Sensor Input

If you want to generate occupied Heating and Cooling demands based on Return Air Temperature, select this Sensor as the HVAC Mode Enable Sensor. The Return Air Temperature Sensor is also used to initiate or cancel the Morning Warm-up Period on VAV-configured units. If the Return Air Temperature Sensor is connected, the Outdoor Air Temperature must be at least 5°F below the Return Air Temperature to allow Economizer Cooling operation.

T2 - Leaving Water Temperature Sensor Input

This input monitors the Condenser Leaving Water Temperature and determines if the water source condenser is operating in a safe water temperature range.

SIG3 - Head Pressure 2 Transducer Input

The Head Pressure 2 Transducer is connected to this input when Head Pressure Control is required.

+5V VDC Power

This output is a 5 VDC output that supplies power to the Head Pressure Transducer.

SIG1 - Building Static Pressure Sensor Input

This Sensor is only required if you wish to configure the VCB-X Controller for Building Pressure Control. Building Pressure Control can be accomplished by using one of two main control methods. One control method uses the 0-10 VDC signal to control an Exhaust Fan VFD or an Exhaust Damper Actuator for Direct Acting Pressure Control applications. In addition, for Reverse Acting Pressure Control applications, it can control an Outdoor Air Damper Actuator. The other available control method is to configure one of the Output Relays as an Exhaust Fan output that will activate the Exhaust Fan any time the Building Pressure is above the Building Pressure Setpoint.

SIG2 - Head Pressure 1 Transducer Input

The Head Pressure 1 Transducer is connected to this input when Head Pressure Control is required.

BIN1 - Hood On Input

When this wet contact input closes (Hood On), the VCB-X Controller switches from Indoor Air Control to Outdoor Air Control. This is typically used on CAV applications requiring CAV/MUA Dual Damper (Hood On/Off) Modes.

BIN2 - Remote Forced Occupied Mode Input

When this wet contact input closes, it will force the VCB-X Controller into the Occupied Mode. When the Remote Forced Occupied Signal is removed, the controller will revert to the Unoccupied Mode of operation if no internal or external schedule has been configured or is in effect when this occurs.

BIN3 - Water Proof of Flow Input

This wet contact input is for the Water Proof of Flow Switch. If the Water Proof of Flow Switch contact opens while the Condenser Valve is operating, the controller will react to protect the system depending on the current mode of operation.

NOTE: The Binary Inputs require wet contacts (24 VAC only) to recognize an active input. If you provide dry contacts, the contact closure will not be recognized. All Binary Inputs are optional. This means that you must configure the VCB-X Controller to recognize these input signals.

VCB-X EM1 & EM2 Expansion Module Inputs & Outputs

AOUT1 - Building Pressure Control Signal

This user-adjustable voltage signal is used to provide Direct Acting Building Pressure Control using an Exhaust Fan VFD or a modulating Exhaust Damper.

NOTE: For Reverse Acting Building Pressure Control using the Outdoor Air Damper or Supply Fan VFD, the VCB-X Controller will use the outputs specific to those devices. On the main VCB-X Controller, AOUT2 would control the Outdoor Air Damper and AOUT1 would control the Supply Fan VFD to maintain the Building Pressure Setpoint.

AOUT2 - Modulating Chilled Water Signal

This output is used to control a Modulating Chilled Water Valve to maintain the Cooling Supply Air Temperature Setpoint. This output can be configured with a user-adjustable voltage range of operation which can be set up to provide either direct or reverse acting operation.

AOUT3 - Condenser 2 Fan VFD or Condenser Water Valve Signal

This is a direct acting output signal that is used to modulate the Condenser Fan VFD (0-10 VDC signal) on an Air Cooled unit. It will control a Condenser Water Valve Actuator (2-10 VDC Signal) on a unit configured as a Water Source Heat Pump.

AOUT4 - Condenser 1 Fan VFD or Condenser Water Valve Signal

This is a direct acting output signal that is used to modulate the Condenser Fan VFD (0-10 VDC signal) on an Air Cooled unit. It will control a Condenser Water Valve Actuator (2-10 VDC Signal) on a unit configured as a Water Source Heat Pump.

PWM+

This output connects to the plus (+) input on an ECM motor for Condenser Fan control.

PWM-

This output connects to the minus (-) input on an ECM motor for Condenser Fan control.

R1-R5 - User-Configurable Relays

These relays are configurable by the user. For all the available configuration options, see [Table 5](#).

VCB-X EM2 Expansion Module

AIN1 - Economizer Feedback/Remote SAT Reset Signal

If Title 24 Economizer operation has been configured, this input will be used for the 0-10 VDC Feedback Signal from the Economizer actuator. Otherwise, if a Remote SAT Reset Signal is configured as the Reset Source, this input can be used to accept a configurable voltage input between 0-10 VDC (Direct or Reverse Acting) to reset the Supply Air Temperature Setpoint. See the Supply Air Temperature Reset section in the Sequence of Operations for more details.

BIN1 - Remote Forced Cooling Mode Input

A wet contact closure on this input is used to provide a means for another BAS or control device (by others) to force the unit into Cooling Mode.

BIN2 - Remote Forced Heating Mode Input

A wet contact closure on this input is used to provide a means for another BAS or control device (by others) to force the unit into Heating Mode.

BIN3 - Remote Forced Dehumidification Input

A wet contact closure on this input is used to provide a means for another BAS or control device (by others) to force the VCB-X Controller into Dehumidification Mode.

AOUT1 - Return Air Damper Actuator Signal

This output signal is a Direct Acting 0-10 VDC output signal that is used to modulate a Return Air Damper Actuator in concert with a Return Air Bypass Damper Actuator for AAON® PAC or DPAC control schemes.

AOUT2 - Return Air Bypass Damper Actuator Signal

This output signal is a Direct Acting 0-10 VDC output signal that is used to modulate a Return Air Bypass Damper Actuator in concert with a Return Air Damper Actuator for AAON® PAC or DPAC control schemes.

E-BUS 12-Relay Expansion Module

Please refer to the user-configurable relays in [Table 5](#) for relay definitions.

Supply Fan & Occupied/Unoccupied Operation

Supply Fan Operation

Anytime the Supply Fan is requested to start, a 1 minute minimum off timer must be satisfied. If the timer is satisfied, the Supply Fan relay is activated while all other outputs are held off until their minimum off timers have been met.

Upon going into the Occupied Mode or upon power-up, the controller will initiate a user-adjustable Fan Starting Delay to provide a staggered start for systems with several HVAC units.

In Fan Cycle Mode or when going unoccupied, the Supply Fan is held on for 2 minutes after the last stage of Heating or Cooling stages off.

Purge Mode

When going into Occupied Mode, an optional “Purge Mode” is initiated. The fan runs with the Economizer closed, and all Cooling and Heating is de-energized. The length of the Purge Mode is user-adjustable.

Occupied Mode

The Supply Fan can be configured to run continuously (default) or to cycle with Heating, Cooling, or Dehumidification.

Unoccupied Mode

The Supply Fan will cycle on a call for Heating, Cooling, or Dehumidification.

HVAC Source Configuration Options

The VCB-X Controller can be configured to have various HVAC Source options that will determine the mode of operation (Heating, Cooling, or Vent Mode) of the unit. The following are descriptions of those options.

Space Temperature—Typical selection for CAV recirculating units.

Return Air Temperature—Optional selection for CAV recirculating units.

Single Zone VAV—Selected for a Space Temperature controlled Single Zone VAV application.

Outdoor Air Temperature—Typical selection for 100% Outdoor Air (MUA) or High Percentage Outdoor Air units.

Supply Air Temperature—Selected for Cooling Only VAV units with optional Morning Warm-Up.

Supply Air Tempering—Selected for Cooling Only VAV units with optional Morning Warm-Up.

Space Temperature with High Outdoor Air %— Provides Space Temperature (instead of Outdoor Air Temperature) control of 100% or high percentage Outdoor Air units by tempering the air during the Space Vent Mode of operation to prevent dumping of hot or cold air into the space.

HVAC Mode Set by Remote Contact Input— Provides for wet contact closures to force the unit into Heating, Cooling, and Dehumidification modes. If this option is selected, it applies to all three modes, and all three modes will only be initiated by these contact closures.

Occupied/Unoccupied Mode of Operation

The VCB-X Controller can utilize several methods for determining the Occupied Mode of Operation. These are as follows:

- Forced Schedule
- Remote Forced Occupied Signal
- Internal Week Schedule
- Push-Button Override Signal

Forced Schedule

The VCB-X Controller can be forced into the Occupied Mode by inputting a Forced Schedule from any operator interface.

Remote Forced Occupied Signal

This Forced Occupied input can be used in place of, or in conjunction with, the internal VCB-X Schedule. When this wet contact input closes, it will force the VCB-X Controller into the Occupied Mode. When the Remote Forced Occupied Signal is removed, the controller will revert to the Unoccupied Mode of operation, or if an internal VCB-X schedule is also being used, it will revert back to the current scheduled mode.

Setting the Internal Week Schedule to ‘0’ will cause the controller to only look for the Remote Forced Occupied Signal for Occupied/Unoccupied commands.

Internal Week Schedule

An Internal Week Schedule, which supports up to two start/stop events per day and allows scheduling of up to 14 holiday periods per year is available for determining Occupied and Unoccupied Schedules. It also allows for daylight savings configuration.

Unoccupied Operation

Uses Unoccupied Setback Offset Setpoints for heating and cooling calls. If Unoccupied Setback Setpoints are left at the default 30°F, no Unoccupied Setback operation will occur and the unit will be off.

The Outdoor Air Damper will be closed except if the unit is in unoccupied Economizer Free Cooling mode.

If there is no call for Heating or Cooling, the unit will be off.

SEQUENCE OF OPERATIONS

Cooling Mode & Economizer

HVAC Modes of Operation

There are 7 possible HVAC Modes of Operation. They are as follows:

- Cooling Mode
- Heating Mode
- Vent Mode
- Dehumidification Mode
- Heat Pump
- Warm-Up Mode / Cool-Down Mode
- Off Mode

Cooling Mode

Occupied Cooling is enabled when the temperature at the Mode Enable Sensor rises one deadband above the Cooling Setpoint. Cooling is disabled when the Mode Enable temperature falls one deadband below the Cooling Setpoint. The setpoint and deadband are user-adjustable.

Unoccupied Cooling operation is enabled when the Space Temperature rises above the Cooling Mode Enable Setpoint plus the Unoccupied Cooling Offset.

Mechanical cooling is disabled if the Outdoor Air Temperature (OAT) falls 1° below the Cooling Lockout Setpoint and will remain disabled until the OAT rises 1° above the Cooling Lockout Setpoint. If the OAT disables mechanical cooling while it is currently operating, mechanical cooling will stage off as minimum run times and stage down delays are satisfied.

If the economizer is enabled, it will function as the first stage of cooling (see Economizer section).

Cooling without Digital Scroll Compressor

Available cooling options are staged DX, Modulating Chilled Water, and On/Off Chilled Water.

In the Cooling Mode, as the Supply Air Temperature (SAT) rises above the Active Supply Air Cooling Setpoint (see Supply Air Temperature Setpoint Reset section for explanation), cooling will begin to stage on or to modulate. Each stage must meet its Minimum Off Time (adj.) before it is allowed to energize, and successive stages are subject to a Cooling Stage Up Delay (adj.).

Cooling stages will continue to run until the SAT falls below the Active Supply Air Temperature Setpoint minus the Cooling Stage Control Window at which point the cooling will begin to stage off. Each stage must meet its Minimum Run Time (adj.) before it is allowed to stage off and successive stages are subject to a Cooling Stage Down Delay (adj.).

Cooling with Digital Scroll Compressor

In the Cooling Mode, as the Supply Air Temperature (SAT) rises above the Active Supply Air Cooling Setpoint (see Supply Air Temperature Setpoint Reset section for explanation), the Digital Compressor will stage on and modulate to control to the Active Supply Air Cooling Setpoint. One Digital Compressor can be controlled with the VCB-X Controller.

If additional cooling is required, fixed compressor stages can be staged on while the Digital Compressor continues to modulate.

To stage up the extra compressor(s), the SAT needs to be above the Active Supply Air Cooling Setpoint and the Digital Compressor needs to be at 100% for a period of time equal to the Stage Up Delay. Once a fixed compressor is enabled, the digital compressor signal will go to 50% and modulate up as needed. This will repeat as additional fixed compressors are staged up. For compressors to stage on, Minimum Off Times (adj.) must be satisfied as well as Stage Up Delays (adj.).

To stage down the extra compressor(s), the SAT needs to be below the Active Supply Air Cooling Setpoint minus the Cooling Stage Control Window, the Digital Compressor needs to be below 30%, and the Stage Down Delay requirement met. Once a fixed compressor stages off, the digital compressor will go to 50% and modulate down as needed. This will repeat as additional fixed compressors stage off.

For compressors to stage down, Minimum Run Times (adj.) must be satisfied as well as Stage Down Delays (adj.). The digital compressor is always the last compressor to be deactivated.

Modulating Cooling Signal Control

If Modulating Chilled Water or a Digital Scroll Compressor is being used, the Modulating Cooling Proportional Window is used to determine the signal to the Modulating Cooling Source and is user-adjustable. The Modulating Cooling signal is calculated based on the differential between the Supply Air Temperature and the Active Supply Air Temperature Setpoint based on the Modulating Cooling Proportional Window.

The Maximum Signal Adjustment per Time Period is 10% and is not user-adjustable. The Minimum Signal Adjustment per Time Period is based on the Modulating Cooling Proportional Window. The larger the Modulating Cooling Proportional Window, the smaller the signal adjustment will be per Time Period. The Time Period is the delay between another increase or decrease in the Modulating Cooling Source Signal and is user-adjustable. For example, if the Modulating Cooling Proportional Window is 5°F, the signal would adjust 2% per °F each Time Period above or below the Active Supply Air Temperature Setpoint. When the Supply Air Temperature is above or below the Active Supply Air Temperature Setpoint by 5°F or more, the signal would adjust 10% each Time Period.

Economizer Operation

Economizer operation is enabled when the Outdoor Air (OA) drybulb, wetbulb, or dewpoint temperature falls below the Economizer Enable Setpoint by 1°F and if the Outdoor Temperature is at least 5°F below the Return Air Temperature (if that value is available). Economizer operation is disabled when the OA temperature rises 1°F above the Economizer Enable Setpoint.

The Economizer acts as the 1st stage of cooling and controls to the Active Supply Air Cooling Setpoint. An Economizer Minimum Position can be programmed into the controller. During Economizer Operation, the economizer will modulate between this minimum position and 100%. If the economizer reaches 100% and the Supply Air Temperature is still above setpoint, mechanical cooling is then allowed to stage up while the economizer is held at the full open position. Any time cooling stages are currently running, and the economizer becomes enabled, it will immediately open to 100%.

During Heat and Vent Modes, the Economizer will remain at its minimum position. The only exception to this can occur during “VAV Operation with Outdoor Air Temperature Control (VAV Tempering)”. See that section for more details. During Unoccupied Mode, the Economizer can be used for night setback free cooling; otherwise it will remain closed.

IAQ (CO₂) Override of the Economizer simply resets the Economizer Minimum Position higher. See IAQ (CO₂) Control Operation section for more details.

If utilizing the Title 24 Economizer option, an Economizer feedback signal (0-10 VDC) can be wired into the VCB-X EM2 Expansion Module for status monitoring. Several Title 24 alarm conditions can also be annunciated and are listed in the Alarms section of this manual.

Dehumidification Mode

On VAV, CAV, Single Zone VAV, and High Percentage Outdoor Units with Space Temperature Control, the Dehumidification Mode is initiated when the Indoor Humidity rises above the Low Indoor Humidity Setpoint by 4%. The unit will leave the Dehumidification Mode when the humidity falls 4% below this setpoint.

On 100% Outdoor Air (MUA) units with Outdoor Air Temperature Control, Dehumidification is initiated when the Outdoor Air Dewpoint rises above the Outdoor Air Dewpoint Setpoint by 2°F. The unit will leave the Dehumidification Mode when the humidity falls 2°F below this setpoint. The Outdoor Air Dewpoint is calculated using the Outdoor Air Temperature and the Outdoor Air Humidity.

There are four configuration options for Dehumidification operation.

In Occupied Vent Mode Only—Dehumidification can only be initiated in the Occupied Mode when there is no call for Heating or Cooling. This creates a Vent Dehumidification Mode.

In Both Occupied and Unoccupied Vent Mode—Dehumidification can be initiated in the Occupied and Unoccupied Modes when there is no call for Heating or Cooling. This creates a Vent Dehumidification Mode.

NOTE: Do not use this option on a MUA unit that does not have return air and which is not configured for space controlled Night Setback operation. Damage to the unit could occur since the OA damper remains closed in the Unoccupied Mode.

In All Modes while Occupied—Dehumidification can be initiated anytime in the Occupied Mode during Cooling, Heating, or Vent Mode. This can create a Cooling Dehumidification Mode, a Heating Dehumidification Mode, or a Vent Dehumidification Mode.

In All Modes while Occupied and Unoccupied—Dehumidification can be initiated anytime in the Occupied or Unoccupied Mode during Cooling, Heating, Vent, or Off Mode. This can create a Cooling Dehumidification Mode, a Heating Dehumidification Mode, or a Vent Dehumidification Mode. This configuration should not be used for an MUA unit with no return air, since it could start the unit in the Unoccupied Mode when the Outdoor Air damper is closed. Any calls for Unoccupied Dehumidification use the same Dehumidification Setpoint as during the Occupied Mode since you never want humidity to get out of control.

NOTE: Do not use this option on a MUA unit that does not have return air and which is not configured for space controlled Night Setback operation. Damage to the unit could occur since the OA damper remains closed in the Unoccupied Mode.

There is no Dehumidification allowed during Heat Mode on a Heat Pump unit.

Dehumidification Operation

For DX Cooling Stages, the VCB-X activates the Cooling Stages based on the actual Evaporator Coil Temperature compared to the Evaporator Coil Suction (Saturation) Temperature Setpoint. The Evaporator Coil Suction (Saturation) Temperature is calculated by using the Suction Pressure Sensor and converting the pressure to temperature.

For Copeland Digital Scroll™ Compressor units, the VCB-X will modulate the Copeland Digital Scroll™ Compressor to maintain the Evaporator Coil Suction (Saturation) Temperature Setpoint and activate Fixed Capacity Compressors as necessary.

If the Fixed Capacity Compressor is activated, the Copeland Digital Scroll™ Compressor will only be allowed to modulate within the range of 70% - 100% in order to prevent the loss of reheat capacity during low load conditions. If, with both compressors on, the digital compressor has modulated down to its 70% minimum and the Coil Suction Temperature falls below the Coil Temperature Setpoint minus the Cooling Stage Control Window, then the second compressor will stage off once its Compressor Minimum Run Time and the Stage Down Delay Timers have been met. At that point, the Copeland Digital Scroll™ Compressor can modulate down as needed to maintain the Coil Temperature Setpoint.

SEQUENCE OF OPERATIONS

Dehumidification and Economizer Operation

SAFETY: If the Coil Suction (Saturation) Temperature drops below 32°F, any cooling remaining on will be forced to stage off.

For Modulating Chilled Water units, the VCB-X will modulate the Chilled Water Valve to a fixed 100% position during Dehumidification to provide full moisture removal capabilities. With On/Off Chilled Water units, the Cooling Relay will energize to open the valve.

During Dehumidification, the Economizer will be held to its minimum position. If the unit will be using the CAV/MUA Dual Mode (Hood On/Off) Operation, Dehumidification will require the use of an Outdoor and Indoor Humidity Sensor.

Reheat

During the Dehumidification Mode, the VCB-X activates Cooling to extract moisture from the Supply Air and utilizes either Modulating Hot Gas Reheat, On/Off Hot Gas Reheat, or Heating to reheat the Supply Air. Hot Gas Reheat is the standard form of Reheat.

Reheat is always controlled to the Active Supply Air Setpoint (see the Supply Air Temperature Setpoint Reset section for further explanation) which will be different depending on whether the unit is in Cooling Mode Dehumidification, Heating Mode Dehumidification, or Vent Mode Dehumidification.

During Cooling Dehumidification, Reheat is controlled to the Active Cooling Supply Air Setpoint. During Heating Dehumidification, Reheat is controlled to the Active Heating Supply Air Setpoint. During Vent Dehumidification, Reheat is controlled to a calculated setpoint that is halfway between the Heating and Cooling Mode Enable Setpoints.

If the unit is equipped with a Modulating Hot Gas Reheat Controller (MHGRV-X), then during Dehumidification, it will modulate the reheat valve to maintain the Supply Air Temperature at the Active Supply Air Temperature Setpoint.

If the unit is equipped with an On/Off Hot Gas Valve, then one of the relays will be configured for Reheat. The Reheat Relay will be activated if the SAT is less than the SAT Setpoint. The Hot Gas Reheat Relay will remain on during the Dehumidification Mode regardless of the Supply Air Temperature. This is to ensure a steady Supply Air Temperature.

The HVAC unit's Heat Source or a Heat Source located in the Supply Air Duct can be used for Reheat if the unit is not equipped with Hot Gas Reheat or to supplement Hot Gas Reheat. Please read the warning that follows regarding applications that operate Heating and Cooling simultaneously.

WARNING: Simultaneous Heating and Cooling cannot be approved unless the HVAC unit has been specifically designed for this purpose. A Special Price Authorization (SPA) must be obtained from the AAON® factory for these applications to avoid warranty and/or rating problems. WattMaster Controls Inc. assumes no liability for any Simultaneous Heating and Cooling application if a SPA is not obtained from the AAON® Factory at the time the HVAC unit is ordered.

When Heating is used for Reheat instead of Hot Gas Reheat, the VCB-X can activate the Heat Source(s) discussed in the Heating Mode section. When Heating is used to supplement Hot Gas Reheat, the VCB-X restricts the Heating to one form of Modulating Heat or one stage of Gas or Electric Heat.

Coil Suction (Saturation) Temperature Reset

The Indoor Humidity can be used to reset the Coil Suction (Saturation) Temperature Setpoint. A user adjustable range of Indoor Humidity values can be used to reset the Coil Temperature Setpoint between a user adjustable range of values. As the Indoor Humidity rises within its range the Coil Suction (Saturation) Temperature Setpoint will be lowered within its range.

Return Air Bypass Damper Control

The Return Air Bypass (RAB) Damper is only used on constant air volume units with space temperature configured as the HVAC Mode Enable sensor. The RAB Damper is only active during the Dehumidification Mode and is used as the first form of Reheat. If the HVAC unit is equipped with modulating Hot Gas Reheat, the RAB Damper needs to be at 100% before the modulating Hot Gas Reheat can be used. The RAB Damper modulates from 0-100% as the Space Temperature falls below the Cooling Setpoint. When the Space Temperature is equal to the Cooling Setpoint, the RAB Damper will be at 0%. When the Space Temperature falls to halfway between the Cooling and Heating Setpoints, the RAB Damper will be at 100%.

If the HVAC unit is equipped with separate actuators for the Outdoor Air and Return Air Dampers, the Return Air Damper will proportionally close more as the RAB Damper opens. The rate at which the Return Air Damper closes is user-adjustable. The purpose of closing the Return Air Damper more as the RAB Damper opens is to allow more air to bypass the evaporator coil through the RAB Damper. If you want more air to pass through the RAB Damper, enter a larger number in the Return Air Damper Factor setpoint. If you want less air to pass through the RAB Damper, enter a smaller number in the Return Air Damper Factor setpoint.

NOTE: See page 6 for specific AAON® DPAC and PAC operation.

Heating Mode

Available heating options are Staged Gas, Modulating Gas, Staged Electric, On/Off Hot Water, Modulating Hot Water, and Modulating SCR Electric.

Heating is enabled when the temperature at the Mode Enable Sensor falls one deadband below the Heating Setpoint. Heating is disabled when the Mode Enable temperature raises one deadband above the Heating Setpoint.

In the Heating Mode, as the Supply Air Temperature falls below the Active Supply Air Heating Setpoint (see Supply Air Temperature Setpoint Reset section for explanation), the heating will begin to

Heating Mode, Ventilation Mode & Off Mode

stage on or to modulate. Each stage must meet its Minimum Off Time (adj.) before it is allowed to energize, and successive stages are subject to a Heating Stage Up Delay (adj.).

Heating stages will continue to run until the Supply Air Temperature rises above the Active Supply Air Temperature Setpoint plus the Heating Stage Control Window at which point the heating will begin to stage off. Each stage must meet its Minimum Run Time (adj.) before it is allowed to stage off, and successive stages are subject to a Heating Stage Down Delay (adj.).

Mechanical heating is disabled if the Outdoor Air Temperature (OAT) rises 1° above the Heating Lockout Setpoint and will remain disabled until the OAT falls 1° below the Heating Lockout Setpoint. If the OAT disables mechanical heating while it is currently operating, mechanical heating will stage off as minimum run times and stage down delays are satisfied.

Modulating Heating

The VCB-X supports various forms of Modulating Heat such as SCR Electric Heat, Modulating Hot Water Heat, and Modulating Steam Heat. This references Modulating Heat that is controlled from AOUT3 on the VCB-X Controller with a user-adjustable voltage range between 0-10 VDC. Modulating Gas, which is controlled by the ModGas-X Controller, is not included in this section. Whichever form of Modulating Heating is used, the VCB-X will modulate the Heat Source to achieve the Active Supply Air Temperature Setpoint.

The Modulating Heating Proportional Window is used to determine the signal to the Modulating Heating Source and is user-adjustable. The Modulating Heating Signal is calculated by the differential between the Supply Air Temperature and the Active Supply Air Temperature Setpoint based on the Modulating Heating Proportional Window. The maximum signal adjustment per Time Period is 10% and is not user-adjustable. The minimum signal adjustment per Time Period is based on the Modulating Heating Proportional Window. The larger the Modulating Heating Proportional Window, the smaller the signal adjustment will be per Time Period. The Time Period is the delay between another increase or decrease in the Modulating Heating source signal and is user-adjustable.

For example, if the Modulating Heating Proportional Window is 5°F, the signal will be adjusted 2% per °F each Time Period above or below the Active Supply Air Temperature Setpoint. When the Supply Air Temperature is above or below the Active Supply Air Temperature Setpoint by 5°F or more, the signal will adjust 10% each Time Period.

Hot Water Coil Protection**Fan On Mode**

If anytime the fan is on, the Supply Air Temperature falls below the user-adjustable Low Supply Air Temperature Cutoff Setpoint for at least one minute, the Hot Water Valve will move to a user-adjustable position configured with the Hot Water Valve Protection Position Setpoint. If the Supply Air Temperature rises back above the Low Supply Air Cutoff by 5°F, the valve will return to its normal position.

If the Supply Air Temperature remains below the Low Supply Air Temperature Cutoff Setpoint for ten minutes, the unit will then shut

down and the Low Supply Air Temperature Cutoff Alarm will be generated. If the Supply Air Temperature rises above the Low Supply Air Cutoff by 5°F, the alarm (if generated) will clear and the unit will attempt to restart and resume normal operation.

Fan Off Mode

If anytime the fan is off, the Outdoor Air Temperature falls below the user-adjustable Low Ambient Setpoint, the Hot Water Valve will move to the user-adjustable Hot Water Valve Protection Position Setpoint. If the Outdoor Temperature rises above the Low Ambient Setpoint, the valve will return to its normal position.

If the Hot Water Valve Protection Position setpoint is left at the default of 0%, the controller will not initiate this protection sequence.

Primary and Secondary Heating

The VCB-X can activate two forms of Heating, which are classified as Primary and Secondary Heat Sources. The following section describes that operation.

Primary Modulating Heat with Secondary Staged Heat

The Modulating Heat source can be ModGas, Modulating Hot Water, Modulating Steam, or SCR Electric Heat. In this case the modulating heat will be the first form of heat used and will operate as described above to attempt to achieve the Active Supply Air Heating Setpoint. If the modulating heat reaches 100%, the Heating Stage Up Delay begins. If the Primary Heat Source is still at 100% after the Heating Stage Up Delay expires, the Secondary Heat Source will activate. The Primary Heat Source can then modulate as necessary to achieve the Active Supply Air Heating Setpoint. If there are additional stages of heat, they will stage up as described, with the Primary Heat Source modulating as necessary.

If the Secondary Heat Source is activated and the Primary Heat Source has modulated to 0%, the Heating Stage Down Delay will begin. If the Primary Heat Source is still at 0% after the Heating Stage Down Delay expires, the Secondary Heat Source will deactivate. If there are multiple stages of Secondary Heat, they will stage off in the same manner. Then, if the Supply Air Temperature rises above the Active Supply Air Heating Setpoint plus the Heating Stage Control Window, the Primary Heat Source will modulate to 0% to allow the Supply Air Temperature to cool off.

Ventilation Mode

This mode is only available in the Occupied Mode of operation on units configured for continuous Supply Fan operation and is generated anytime there is no demand for heating or cooling. The fan will operate at the configured Minimum Vent speed.

Off Mode

Off Mode occurs in the Unoccupied Mode when there is no heating or cooling demand. The Supply Fan is off and the outside air damper is closed.

Off Mode can only occur in the Occupied Mode if the fan is configured to cycle with heating and cooling and there is no call for heating or cooling. Space Sensor Operation

SEQUENCE OF OPERATIONS

Remote Contact Control, Space Sensor Operation, IAQ

VCB-X Remote Contact Control

A Remote Contact Control option can be configured on the VCB-X Controller to initiate the HVAC Modes of operation. If this option is configured, all Heating, Cooling, and Dehumidification modes will only be initiated based on 24 VAC wet contact closures on the Forced Heating, Forced Cooling, and Forced Dehumidification inputs on the EM2 Expansion Module. This is a single configuration option that applies to all three modes. When using this Remote Contact Control, configure the Outdoor Air Sensor as the controlling sensor.

If both the Forced Heating and Forced Cooling inputs are inactive or if both are simultaneously active, then the unit is in a Vent mode (neutral) state. In this condition in the Occupied Mode, only the fan would be on for ventilation. In this condition in the Unoccupied Mode, the unit would just be Off.

If Forced Dehumidification is also being used, it will operate in conjunction with the Forced Heating and Forced Cooling inputs according to which Dehumidification option you have configured. The four configuration options are described in the Dehumidification Mode section on [page 63](#).

Space Sensor Operation

Space Sensors are available as a Plain Sensor, Sensor with Override, Sensor with Setpoint Slide Adjust, and Sensor with Override and Setpoint Slide Adjust (this is the version that is factory supplied).

An E-BUS Digital Space Sensor is also available with override and setpoint adjustment capability.

Sensors with Setpoint Slide Adjust can be programmed to allow Space Setpoint adjustment of up to $\pm 10^\circ$ F.

If the Space Temperature is the SAT/Reset Source, then the Slide Adjust will adjust the HVAC Mode Enable Setpoints and the SAT/Reset Source Setpoints simultaneously.

During Unoccupied hours, the Override Button can be used to force the unit back into the Occupied Mode (by pressing the button for less than 3 seconds) for a user-defined override duration of up to 8.0 hours. Pressing the button between 3 to 10 seconds cancels the override.

IAQ (CO₂) Control Operation

If you have configured the VCB-X Controller to monitor and control CO₂ levels, the Economizer operation will be modified as follows:

1. If the CO₂ levels remain below the Low CO₂ Level Setpoint, the Economizer Minimum Position will remain at its configured value.
2. As the level of CO₂ increases above the Minimum CO₂ Level Setpoint, the Economizer Minimum Position will begin to be reset higher. The Economizer Minimum Position will be proportionally reset higher as the CO₂ rises within the range set by the Minimum CO₂ Level Setpoint and the

Maximum CO₂ Level Setpoint. If the CO₂ level reaches the High CO₂ Level Setpoint, the Economizer Minimum Position will be reset to the Maximum Reset Position.

3. The Maximum Reset Position Setpoint is the highest the Economizer Minimum Position can be reset to during CO₂ Control Operation. This setpoint is user-adjustable and does not keep the Economizer from opening further during Economizer operation.

Morning Warm-Up Mode Operation

NOTE: Morning Warm-Up can now be configured for any application but should not be used on 100% Outdoor Air Units, since the Outdoor Air Damper remains closed during Warm Up.

When the VCB-X Controller is configured for Morning Warm Up and switches to the Occupied Mode of Operation (not Override or Force Mode), the unit compares the Return Air Temperature to a Morning Warm-Up Target Temperature. If the Return Air Temperature is below this Setpoint, the Warm-Up Mode is initiated. Heating will then be controlled to the Warm-Up Supply Air Temperature Setpoint.

This Mode remains in effect until the Return Air Temperature rises above the Target Temperature or a user-adjustable Time Period expires. Warm-Up Mode is not initiated by Push-Button Overrides or Unoccupied Heating demands. The Outdoor Air Damper remains closed during Warm-Up Mode.

Once the Warm-Up Mode has been terminated, it cannot resume until the unit has been through a subsequent Unoccupied Mode. Only one Warm-Up Mode is allowed per Occupied cycle.

If you have stand-alone VAV boxes that need to be forced wide open during the Warm-Up Mode, you can configure one of the relay outputs to be used during this Mode. If the Warm-Up Mode is active, the relay is activated. This relay then becomes the Force Open Command for all VAV boxes to which it is wired.

Morning Cool-Down Mode Operation

When the VCB-X Controller is configured for Morning Cool-Down and switches to the Occupied Mode of Operation (not Override Mode), the unit compares the Return Air Temperature to a Cool-Down Target Temperature. If the Return Air Temperature is above this Setpoint, the Cool-Down Mode is initiated. Cooling will then be controlled to the Cool-Down Supply Air Temperature Setpoint.

This Mode remains in effect until the Return Air Temperature drops below the Target Temperature or a user-adjustable Time Period expires. Cool-Down is not initiated by Push-Button Overrides or Unoccupied Cooling demands. The Outdoor Air Damper remains closed during Cool-Down Mode.

Morning Warm Up and Single Zone VAV

Once the Cool-Down Mode has been terminated, it cannot resume until the unit has been through a subsequent Unoccupied Mode. Only one Cool-Down Mode is allowed per Occupied cycle.

If you have stand-alone VAV boxes that need to be forced wide open during the Cool-Down Mode, you can configure one of the relay outputs to be used during this Mode. If the Cool-Down Mode is active, the relay is activated. This relay then becomes the Force Open Command for all VAV boxes to which it is wired.

Single Zone VAV

Single Zone VAV Operation is a hybrid CAV/VAV application where the Supply Fan VFD is modulated to maintain the Space Temperature Setpoint while heating or cooling is modulated to maintain the Supply Air Setpoint. This application can be configured to use VAV Cooling and either VAV Heating or CAV Heating. There is no Supply Air Setpoint reset function on a Single Zone VAV unit.

VAV Cooling and VAV Heating require modulating cooling and heating sources in order to maintain a constant Supply Air Temperature no matter what the fan speed is. CAV Heating must be configured if using a staged form of heat.

The Space Temperature Sensor determines the heating or cooling mode of operation. Heating and cooling are enabled and disabled as described previously in the Heating and Cooling sections.

In the Cooling Mode, the modulating cooling source will modulate to maintain the Cooling Supply Air Setpoint. The Supply Fan VFD will begin operation at the Minimum VFD Cooling Speed (30% default) and modulate between this setpoint and 100% as needed to maintain the Space Temperature within the Space Cooling Reset Window created by configuring a Space Cooling High and a Space Cooling Low Reset Source Setpoint.

If the unit is configured for VAV Heating, then in the Heating Mode the modulating heating source will modulate to maintain the Heating Supply Air Setpoint. The Supply Fan VFD will begin operation at the Minimum VFD Heating Speed (50% default) and modulate between this setpoint and the Maximum VFD Heating Speed (100% default) as needed to maintain the space temperature within the Space Heating Reset Window created by configuring a Space Heating High and a Space Heating Low Reset Source Setpoint.

If the unit needs to be configured for CAV Heating, set the Minimum VFD Heating Speed to be the same as the Maximum VFD Heating Speed desired during heating. Once the unit enters the Heating Mode, the Supply Fan will run at the set Maximum VFD Heating Speed (100% default) and Heating will occur as described in the Heating Section of this sequence.

In the Vent Mode of operation, the Supply Fan will operate at the VFD Vent Speed (user-adjustable).

During Dehumidification, the fan will operate as described above, depending on if the Space Temperature is calling for Cooling, Heating, or Vent Mode of operation.

Whenever the unit is in CO₂ override operation of the Outdoor Air Damper, the minimum VFD Fan Speed is forced to 75% and can modulate up from there.

If the Hood On/Off operation is used on a SZ VAV unit, then during Hood On, the mode enable will switch to the Outdoor Air Temperature Sensor using Hood On Mode Enable Setpoints and the Outdoor Air Damper will modulate to 100%. The Supply Fan VFD will still control to maintain the Space Temperature Setpoints.

Supply Air Temperature Setpoint Reset

Various sources can be configured to reset the Supply Air Temperature (SAT) Setpoint. Since the Supply Air Temperature Setpoints are not fixed during reset, we refer to them as “Active Supply Air Temperature Setpoints.” The following Reset Source options are available in this release:

1. Space Temperature
2. Outdoor Air Temperature
3. Return Air Temperature
4. Fan VFD Signal
5. Remote SAT Reset Signal

For whatever option is selected, a High and a Low Reset Source Setpoint must be configured that will correspond to configured Low and High SAT Setpoints. This must be done separately for the Cooling Mode Setpoints and for the Heating Mode Setpoints.

When the Reset Source is at its highest configured setpoint, the SAT Setpoint will be reset to its lowest configured setpoint. When the Reset Source is at its lowest configured setpoint, the SAT Setpoint will be reset to its highest configured setpoint.

In all cases, as the Reset Source value moves within its range established by the configured High and Low Reset Setpoints, the Supply Air Setpoint will be proportionally reset within its range established by the configured Low and High SAT Setpoints.

If a Remote SAT Reset Signal is configured as the Reset Source, a configurable voltage signal (between 0 and 10 VDC, direct or reverse acting) can be used to reset the Supply Air Temperature Setpoint. You can configure what voltage will correspond to the Low SAT Setpoint and what voltage will correspond to the High SAT Setpoint in both the Heating and the Cooling Modes. The EM2 Expansion Module is required for this option.

SEQUENCE OF OPERATIONS

Airflow Monitoring and Duct Static Pressure Control

Airflow Monitoring

Outdoor, Supply, Return and Exhaust Airflow can be monitored using the EBTRON® GTC116 series, Paragon MicroTrans^{EQ} series, or GreenTrol GA-200-N Module in conjunction with a GreenTrol GF series of airflow station. Contact WattMaster Controls for information on other airflow station options. The VCB-X will control the Outdoor Air Damper to maintain an Outdoor Air CFM Setpoint. This operation can be overridden higher by normal Economizer control.

Pre-Heater Operation

A Pre-Heat relay can be configured to energize anytime the Supply Fan is operating and the Outdoor Air Temperature is below the Pre-Heat Setpoint. This option allows pre-heating of cold outside air before it reaches the evaporator coils and is useful in Hot Water/Chilled Water applications or during CO₂ control of the economizer in low temperature conditions. This operation only occurs in the Occupied Mode of Operation.

If using the Preheat-X Controller, an SCR preheater and/or stages of preheat can be controlled. If the Entering Air Temperature (sensor connected to the Preheat-X) falls below the Pre-Heat Setpoint, then preheat will be controlled to either a Cooling, Heating or Vent Mode Preheater Leaving Air Setpoint - depending on if the VCB-X is currently in the Cooling, Heating, or Vent mode of operation. These setpoints are all set in the VCB-X Controller. See the *PREHEAT-X Controller Technical Guide* for more details.

Low Ambient Operation

A Low Ambient Relay can be configured. Whenever the Outdoor Air Temperature falls below the Low Ambient Setpoint, this Low Ambient Relay will energize. This operation occurs in both the Occupied and Unoccupied Modes of Operation.

Heat Wheel

One of the relay outputs can be configured as a Heat Wheel Relay. This relay will enable the Heat Wheel when the unit goes into the Occupied Mode. If the unit is configured for Economizer Operation, this relay will disable the Heat Wheel when the unit goes into Economizer Mode. If the Heat Wheel Relay is active, a Heat Wheel Defrost Cycle will occur that will disable the Heat Wheel Relay for 2 minutes if the Outdoor Air Temperature is below the Heat Wheel Defrost Setpoint and 30 minutes have elapsed since the last Heat Wheel Defrost Cycle.

Duct Static Pressure Control

If the VCB-X Controller has been configured for Duct Static Pressure Control, then anytime the Supply Fan is operating, the unit will be controlling to a Duct Static Pressure Setpoint. The Static Pressure Control Output Signal can be used to control a Supply Fan VFD (Direct Acting Operation) or a Zoning Bypass Damper Actuator (Reverse Acting Operation).

The Duct Static Pressure Setpoint, the Setpoint Deadband, the Static Pressure Control Signal, and the Static Control Rate are all user-adjustable. The Static Control Rate is the amount of time that elapses between each adjustment to the Duct Static Pressure Control Output Signal. The default period is 10 seconds and should not be changed unless close observation reveals that the Supply Fan or Bypass Damper is hunting and not maintaining a stable pressure reading.

For Supply Fan VFD operation, the Output Signal increases (increases the VFD speed) if the Duct Static Pressure is below the Duct Static Pressure Setpoint by the Deadband amount, and the Output Signal decreases (decreases VFD Speed) if the Static Pressure is above the Setpoint by the Deadband amount.

For Bypass Damper operation, the VCB-X will reverse the logic of the Output Signal. The Output Signal decreases (closes the Zoning Bypass Damper) if the Duct Static Pressure is below the Duct Static Pressure Setpoint by the Deadband amount, and the Output Signal increases (opens the Zoning Bypass Damper) if the Duct Static Pressure is above the Duct Static Pressure Setpoint by the Deadband amount.

If the Static Pressure ever rises 0.5" above the Duct Static Pressure Setpoint, the Duct Static Pressure Control Output Signal will be cut in half every control period until the Static Pressure is brought under control. This is to prevent damage to the ductwork if all the VAV boxes are closed or some other blockage occurs in the ductwork.

WARNING: The manufacturer does not assume responsibility for protecting the equipment from over-pressurization! You should always install mechanical high static protection cutoffs to protect your system!

Any time the Supply Fan is off, the Duct Static Pressure Control Output Signal will remain at zero volts. If Duct Static Pressure Control is not configured, the Static Pressure can still be monitored if a Static Sensor is installed, however, no control will occur.

Duct Static Pressure Control for Filter Loading

In order to maintain a constant CFM through the supply air ducts on a mixed air CAV unit, the VCB-X can utilize a Duct Static Pressure Sensor (used to monitor the discharge pressure) in conjunction with a Supply Fan VFD. If the filters are getting dirty, the VCB-X will ramp up the VFD to compensate for the decrease in airflow. To utilize this feature, the unit must be configured to use VFD Fan Control. This feature cannot be used if this is a VAV or Zoning application with typical Duct Static Pressure Control, or if this unit has been configured for Single Zone VAV operation.

Building Pressure Control

The VCB-X can maintain Building Static Pressure anytime the Supply Fan is operating. A Building Pressure Transducer must be connected to the VCB-X EM1 Expansion Module. The following are the available control options.

Direct Acting Building Pressure Control

- **On/Off Exhaust Fan**—If an On/Off Exhaust Fan is being used, a relay output must be configured for “Exhaust Fan”. This relay will energize whenever the Building Pressure rises above the Building Pressure Setpoint by the Deadband amount. The relay will de-energize when the Building Pressure falls below the Building Pressure Setpoint by the Deadband amount.
- **Exhaust Fan VFD or Modulating Exhaust Damper**—If configured for Modulating Exhaust, a user-adjustable voltage output (AOUT1 – Building Pressure Output on the VCB-X EM1 Expansion Module) will be used to control this fan or damper. An Exhaust Relay can be configured if necessary to enable the fan or damper. Whenever the Building Pressure rises above the Building Pressure Setpoint by the Deadband amount, the Exhaust Fan Relay will energize and the Modulating Signal will activate to control to the Building Pressure Setpoint. If the Building Pressure falls below the Building Pressure Setpoint by the Deadband amount, the Modulating Signal will modulate towards 0% as it attempts to maintain the Building Pressure Setpoint. The Exhaust Fan Relay is energized whenever the Modulating Signal is above 0%.

Reverse Acting Building Pressure Control

- **Outdoor Air Damper**—If this option is configured, the VCB-X will use the user-adjustable Economizer/ Outdoor Air Damper output signal (AOUT2 – Economizer Control Signal) to maintain the Building Pressure Setpoint. Whenever the Building Pressure falls below the Building Pressure Setpoint by the Deadband amount, the modulating Economizer Output Signal will modulate the damper open to control to the Building Pressure Setpoint. If the Building Pressure rises above the Building Pressure Setpoint by the Deadband amount, the damper will modulate towards closed as it attempts to maintain the Building Pressure Setpoint. When this option is selected, no Economizer free cooling or CO₂ IAQ operation will be available.
- **Supply Fan VFD**—Careful consideration should be made regarding the effects of potential reduced airflow when using this option. Contact WattMaster if you have questions. If this option is selected, the user-adjustable Supply Fan VFD Output (AOUT1 on the VCB-X) will be used to control the Supply Fan VFD to maintain the Building Pressure Setpoint in similar fashion to the Outdoor Air Damper control described above.

MUA Operation

- **Occupied Mode**—The VCB-X will use the normal Cooling and Heating Mode Enable Setpoints (not the Hood On Setpoints) in conjunction with the Outdoor Air (OA) temperature sensor to determine the mode of operation. The Outdoor Air Dewpoint Setpoint will initiate the Dehumidification Mode. See the Cooling, Heating and Dehumidification Modes of Operation sections for those details. The Outdoor Air Damper will be modulated to the Economizer Minimum Damper Position (normally set at 100% for a MUA unit).
- **Unoccupied Mode**—Normally, an MUA unit is off during the Unoccupied Mode. However, if the unit has Return Air, it can be configured to operate as a recirculating Night Setback Controlled unit during Unoccupied Hours. This is accomplished by simply configuring Night Setback Temperature Setpoints (anything other than the default 30°F) on a unit that is also configured for Outdoor Temperature Control (MUA). With this configuration, when the unit goes Unoccupied, it will close the Outdoor Air Damper and begin to use a Space Temperature Sensor in conjunction with the existing Heating and Cooling Setpoints, offset by the Night Setbacks, to make Night Setback calls. If a Space Humidity Sensor is installed, and the unit is configured for Night Humidity control, the VCB-X Controller will use the Space Humidity Setpoint for unoccupied Dehumidification calls.

SEQUENCE OF OPERATIONS

CAV/MUA and Condenser Fan/Water Valve Operation

CAV/MUA Dual Mode (Hood On/Off Operation)

The VCB-X Controller can be configured as a CAV controller but switch to MUA operation when an exhaust hood is energized. This MUA force mode occurs when a 24 VAC wet contact closure is received on the Hood On binary input on the VCB-X EM1 Expansion Module. Under normal operation (CAV), the unit will operate as a recirculating Space Temperature (and Space Humidity) controlled unit.

When the Hood On contact is made, the unit will open the Outdoor Air Damper to its full open position. The Heating and Cooling Modes will then be determined by the Outdoor Air Temperature Sensor using the Hood On Outdoor Air Heating and Cooling Setpoints which are used only in Hood On operation. Dehumidification would then be initiated by an Outdoor Dewpoint Setpoint.

When the Hood On Force Mode is removed, the unit will revert to CAV operation with the Outdoor Damper returning to its minimum position (unless economizer operation is enabled) and with mode control initiated by the Space Temperature and Humidity Sensors.

Space Temperature Control of High Percentage Outside Air Units

This option allows for Space Temperature control of 100% Outside Air MUA Units or units with a high percentage of Outdoor Air (normally 50% or greater). For this application you would configure "Space Temperature w/High OA %" for the Controlling Sensor option. The intent of this sequence is to allow Space Temperature control of the unit while preventing the dumping of hot or cold outside air into the space during the Space Vent Mode of operation.

Once the Space Temperature is satisfied, before switching to Vent Mode, the controller compares the Outside Air Temperature to the Hood On HVAC Setpoints (Hood On MUA Setpoints) to determine if a continued demand for heating or cooling is required to prevent dumping. If there is no demand, the VCB-X Controller switches to Vent Mode. If the Outside Air Temperature is greater than the Hood On HVAC Cooling Setpoint or less than the Hood On HVAC Heating Setpoint, plus the Occupied Deadband, the VCB-X Controller will continue mechanical cooling or heating operation and stage it as necessary to maintain the Vent Mode Supply Air Setpoint (Calculated to halfway between the Mode Enable Setpoints).

During this Vent Mode Tempering operation, indoor humidity (space or return air) will continue to control the dehumidification operation. So, if dehumidification is configured and the humidity is above setpoint, the unit will be in Vent Mode Dehumidification (see the Dehumidification Mode section for more details). Reheat will be controlled to the calculated Vent Mode Supply Air Setpoint described earlier.

A call for Heating or Cooling from the Space Sensor will cancel the Outdoor Air Tempering operation.

NOTE: All Minimum Run times must be satisfied before mechanical cooling or heating is de-energized.

Supply Air Tempering (VAV Operation with Outdoor Air Temperature Control)

NOTE: This operation is handled differently than what was used in the VCM-X Controller.

On a VAV unit that may need daytime heating in order to maintain the Cooling Supply Air Setpoint, previous controllers used a Supply Air Tempering sequence with the Supply Air Temperature Sensor configured as the Controlling Sensor. The VCB-X Controller accomplishes the same result using the Hood-On Outdoor Air (OA) Setpoints to initiate Cooling and Heating.

To utilize this sequence, the HVAC Mode Enable Source must be configured as Supply Air Tempering. Then, configure the Hood On HVAC Setpoints for the OA temperature values that will enable Cooling and Heating. The Hood On Heating Setpoint should be set at or above the OA Temperature, that when mixed with the Return Air (with the economizer at its minimum position), will require Heating in order to achieve the Heating Supply Air Setpoint. The Hood On Cooling Setpoint would be set above that, which will allow a Vent Mode in between.

Then, configure the Cooling and Heating Supply Air Setpoints. While not set at the same value (see below), those would normally both be set at or near 55°F to allow the box heat to keep spaces comfortable.

With this configuration, as the OA Temperature rises above the Hood On Cooling Setpoint, the unit will be in Cooling Mode, controlling to the Cooling Supply Air Setpoint. The economizer can operate as normal for free cooling to maintain the Cooling Supply Air Setpoint.

During the Vent Mode, when the OA Temperature is between the Hood On Cooling and Heating Setpoints, the economizer can modulate if necessary to maintain the Cooling Supply Air Setpoint.

Whenever the OA Temperature falls below the Hood On Heating Setpoint, the unit will be in Heating Mode controlling to the Heating Supply Air Setpoint. The Heating Supply Air Setpoint should be set at least 2°F below the Cooling Supply Air Setpoint. The economizer can still modulate if necessary to maintain the Cooling Supply Air Setpoint. Configured this way, even if the OA Temperature is below the Hood On Heating Setpoint, if the Supply Air Temperature is too warm (above the Cooling Supply Air Setpoint), the economizer can modulate open to maintain the Cooling Supply Air Setpoint. If the Supply Air Temperature drops below the Cooling Supply Air Setpoint, the economizer will have time to close off before heating is energized below the Heating Supply Air Setpoint.

During Morning Warm-Up, heating will be controlled to the Morning Warm-Up Supply Air Setpoint (see the Morning Warm-Up Mode Operation section for complete details).

In this operation, if Night Setback operation will be initiated by a space sensor connected to the VCB-X Controller, then the Night Setback Cooling and Heating Offsets will be applied to the normal Occupied HVAC Mode Enable Setpoints (not the Hood On Setpoints). During Night Setback operation, Heating will be controlled to the Morning Warm-Up supply Air Setpoint.

Finally, configure the VCB-X for Duct Static Pressure Control (see the Duct Static Pressure Control section for complete details).

Air to Air Heat Pump Operation

Cooling Mode will operate in the same manner as described in the Cooling section.

A reversing valve relay output can be configured to activate with the first compressor stage in the Heating Mode or the Cooling Mode of operation.

In the Heating Mode, Compressor Heat, Auxiliary Heat, and Emergency Heat can be used to achieve the Active Supply Air Heating Setpoint. Auxiliary Heat can be either a modulating or staged form of heat, or it can be a modulating form of heat followed by staged heat.

When Auxiliary Heat comes on in conjunction with a digital compressor heat stage, the digital compressor will be locked at 100% until the Supply Air Temperature (SAT) rises above the SAT Heating Setpoint plus the Heat Staging Window. At that point, the Auxiliary Heat will stage off (after a stage down delay) and the digital compressor heat will be allowed to modulate.

When the Outdoor Air Temperature (OAT) is below the Heating Lockout but above the OAT Compressor Heating Lockout, Compressor Heat will be used and can be supplemented by Auxiliary Heat.

When the OAT is below the OAT Compressor Heating Lockout, Compressor Heat is locked out. Auxiliary Heat will then be the primary heat and can be supplemented with stage(s) of Emergency Heat (if available). Emergency heat is only available when the OAT is below the OAT Compressor Lockout.

For Dehumidification during Heat Mode of an Air to Air Heat Pump Unit, Auxiliary Heat can be used as the Reheat Source or to supplement Modulating Hot Gas Reheat.

Valve. Any fixed Heat Pump compressor stage must be configured as a “Heat Pump Compressor” rather than a “Cooling Stage.”

Heat Pump Standard Defrost Operation

If using the VCB-X Controller with an installed Defrost Coil Temperature Switch, a Defrost Cycle is available.

If the compressor(s) are operating in the Heating Mode and the Defrost Coil Temperature Switch closes, the unit will enter the Defrost Mode, provided the user-adjustable Defrost Interval Timer has elapsed since the last Defrost Cycle.

In the Defrost Cycle, the reversing valve signal is switched to the opposite operation, and the compressors are brought to maximum capacity. Auxiliary Heat will be used to attempt to maintain the Heating SAT Setpoint.

The unit will leave the Defrost Mode after 10 minutes have elapsed or the Defrost Coil Temperature Switch opens.

If the unit leaves the compressor heating mode, the Defrost Interval will restart once the unit re-enters the compressor heating mode.

Heat Pump Adaptive Defrost Operation

The Adaptive Defrost operation adjusts the time interval (Adaptive Defrost Timer) in between Defrost Mode cycles.

As stated above, the unit will leave the Defrost Mode after 10 minutes have elapsed or the Defrost Coil Temperature Switch opens. If the Defrost Cycle is terminated because the 10 minute timer runs out, this could be an indicator that the unit may need more defrost time. To address this issue, the Adaptive Defrost Timer value will be subtracted from the original Defrost Interval.

If the Defrost Cycle is terminated between the 8th and 9th minute, the Defrost Interval will not be changed.

If the Defrost Cycle is terminated before the 8th minute, this could be an indicator that the unit may need less defrost time. To address this issue, the Adaptive Defrost Timer value will be inversely proportionally added to the original Defrost Interval as the termination time moves from 8 minutes to 0 minutes.

Adaptive Defrost can be disabled by setting the Adaptive Defrost Timer Setpoint to 0.

NOTE: Any digital compressor stage in a Heat Pump unit must be configured as a “Digital Compressor”. The VCB-X will know it will operate as a heat pump compressor by the unit being configured as having a Reversing

SEQUENCE OF OPERATIONS

Water Source Heat Pump Operation

Water Source Heat Pump Operation

Cooling Mode will operate in the same manner as described in the Cooling section.

A reversing valve relay output can be configured to activate with the first compressor stage in the Heating Mode or the Cooling Mode of operation.

In the Heating Mode, Auxiliary Heat can be used with Compressor Heat to achieve the Active Supply Air Heating Setpoint. Auxiliary Heat can be either modulating or staged forms of heat, or it can be a modulating form of heat followed by staged heat.

When Auxiliary Heat comes on in conjunction with a digital compressor heat stage, the digital compressor will be locked at 100% until the Supply Air Temperature (SAT) rises above the SAT Heating Setpoint plus the Heat Staging Window. At that point, the Auxiliary Heat will stage off (after a stage down delay) and the digital compressor heat will be allowed to modulate.

There is no Dehumidification during Heat Mode of a Water Source Heat Pump Unit. There is no Defrost Mode on a Water Source Heat Pump Unit.

NOTE: Any digital compressor stage in a Heat Pump unit must be configured as a “Digital Compressor”. The VCB-X will know it will operate as a heat pump compressor by the unit being configured as having a Reversing Valve. Any fixed Heat Pump compressor stage must be configured as a “Heat Pump Compressor” rather than a “Cooling Stage.”

The unit can be configured for the percentage of glycol it has. The options are 0%-40% in 5% increments.

Safety Monitoring

Proof of Flow

1. If there is a call for a compressor and there is no Proof of Flow (POF) Input enable:
 - Compressors will not be enabled.
 - The VCB-X will wait up to 3 minutes to activate the POF Alarm and the POF LEDs which will blink the code-indicating failure. If POF failure still exists, compressors will remain disabled.
2. If compressors(s) are running and the POF contact opens for 2 seconds during Heat Pump Heating:
 - Compressors will be disabled.
 - POF Alarm will activate and POF LEDs will blink the code-indicating failure.
 - If after a 2 minute delay POF is established, compressors will be enabled.
3. If compressors(s) are running and the POF contact opens for 2 seconds during Cooling:
 - POF input will be ignored.
 - No alarm will be generated.

Low Suction Pressure Detection

1. If the Suction Pressure falls below the Low Suction Temperature Setpoint for longer than a minute, compressors will be disabled for 10 minutes.
2. If after the 10 minutes, the Suction Pressure is still below setpoint, then after one additional minute:
 - A Low Suction Pressure Alarm will be activated and the Status LEDs will blink a code indicating this alarm.
 - The compressors will be locked out until power is cycled.
3. If after the initial 10 minute disable period, the pressure has risen above setpoint, restart compressors and resume testing for a Low Suction Pressure condition.

Water Source Heat Pump Safety Monitoring

4. If compressors run then run for 2 hours without falling below the Low Suction Temperature Setpoint, then all counters and timers are cleared.
 5. If another Low Suction condition occurs within that 2 hour period:
 - A Low Suction Pressure Alarm will be activated and the Status LEDs will blink a code indicating this alarm.
 - The compressors will be locked out until power is cycled.
 6. If multiple compressors are enabled to come back on simultaneously, a 2 second start-up delay is implemented to avoid a power surge.
- 1b. If the Leaving Water Temperature remains below setpoint after a 1 minute stage off delay:
 - The 1st compressor will stage off.
 - A Low Leaving Water Temperature Alarm will activate and LEDs will blink the code-indicating failure.
 - Compressor 1 and 2 will be locked out until the Leaving Water Temperature is 12° above setpoint.
 2. If the Leaving Water Temperature falls below the Low Leaving Water Setpoint with only 1 compressor on:
 - The 1st compressor will stage off.
 - A Low Leaving Water Temperature Alarm will activate and LEDs will blink the code-indicating failure.
 - Compressor 1 will be locked out until the Leaving Water Temperature is 12° above setpoint.

Unsafe Suction Pressure Detection

If the Suction Pressure falls below the Unsafe Suction Pressure Setpoint for 5 seconds:

- Compressors will be locked out immediately.
- Power will need to be cycled to restart the unit.

Low Leaving Water Temperature

NOTE: This safety is only monitored in the Heat Mode.

- 1a. If the Leaving Water Temperature falls below the Low Leaving Water Temperature Setpoint with 2 compressors on:
 - The 2nd compressor will stage off.
 - A Low Leaving Water Temperature Alarm will activate and LEDs will blink the code-indicating failure.
 - Compressor 2 will be locked out until the Leaving Water Temperature is 6° above setpoint.

SEQUENCE OF OPERATIONS

Head Pressure Control and Alarms

Head Pressure Control

The VCB-X EM1 Expansion Module can monitor a Head Pressure Transducer(s) and control a Condenser Fan(s) or a Condenser Water Valve(s) to maintain a Head Pressure Setpoint. The VCB-X Controller can be configured for an Air Cooled Condenser (default) or for a Water Cooled Condenser.

If there are two head pressure transducers being monitored to control one condenser fan/valve, then control will be based on the highest of the two transducer readings. For this operation, one condenser relay should be configured.

If there are two head pressure transducers being monitored to control two condenser fans/valves, then each transducer will control its respective condenser fan/valve. For this operation, two condenser relays should be configured.

A Condenser Relay is commanded on when the first compressor is enabled (except if the unit is in Heat Pump Defrost Mode). On an Air Cooled Unit, the Condenser Fan will be controlled with 0-10 VDC output signal or a PWM output signal. Both outputs operate simultaneously. On a Water Cooled Unit, the Condenser Water Valve will be controlled with a 2-10 VDC output signal.

When the Condenser Signal first activates, it maintains at 50% for 30 seconds on an Air Cooled Unit and at 75% for 3 minutes on a Water Cooled Unit.

In the Cooling Mode, the Condenser Signal will modulate to maintain the Cooling Head Pressure Setpoint. For an Air Cooled Unit, the signal can modulate between 15% and 100%. For a Water Cooled Unit, the signal can modulate between 25% and 100%. If the Head Pressure exceeds 550 PSIG, the condenser control signal will immediately go to 100% and a High Head Pressure Alarm will be generated. The alarm will be deactivated when the Head Pressure drops below 540 PSIG.

In the Dehumidification Mode, the Condenser Output Signal controls to the Reheat Head Pressure Setpoint. High Head Pressure conditions produce the same effects as in the Cooling Mode.

In Heat Pump Heating Mode, the Condenser Output Signal will be 100%. In the Defrost Mode the signal will be 0%. There is no Defrost required in a Water Cooled Unit.

If no Head Pressure Sensor is detected, the Condenser Output Signal will be maintained at 100%. When the unit is off, the Condenser Output Signal will be 0%.

Temperature Protection

Temperature Protection is activated when the Supply Air Temperature (SAT) rises above the High Cutoff Temperature (immediate) or drops below the Low Cutoff Temperature (for 10 minutes). In either case, an alarm will be created. Both cutoff setpoints are user-adjustable. This mode shuts off the unit (with a 3 minute fan off delay) until the mode is cancelled.

This mode is cancelled when the SAT drops 5 degrees below the High Cutoff Temperature Setpoint or rises 5 degrees above the Low Temp Cutoff Temperature Setpoint or when the unit changes back into Occupied Operation.

Outdoor Air Lockouts

The compressors are disabled during Cooling Mode when the Outdoor Air Temperature is below the Compressor Cooling Lockout Setpoint.

Mechanical heating is disabled when the Outdoor Air Temperature is above the Heating Lockout Setpoint.

For Air to Air Heat Pumps, the compressors are disabled during Heating Mode when the Outdoor Air Temperature is below the Compressor Heating Lockout Setpoint.

System Broadcasts

You can configure the VCB-X Controller to broadcast Building Pressure, Outdoor Air Temperature, and Outdoor Air Humidity to any other VCB-X Controller that does not have one or more of these sensor(s).

Alarm Detection and Reporting

The VCB-X Controller continuously performs self diagnostics during normal operation to determine if any operating failures have occurred.

These failures (alarms) can be reported to a Touch Screen System Manager, a Hand Held Modular Service Tool, or to a computer running Prism 2 software.

Diagnostic LEDs on the VCB-X controller will generate “blink codes” for certain alarm conditions.

The following are the available alarm designations for the VCB-X Controller:

- Bad SAT Sensor
- Bad OAT Sensor
- Bad Space Sensor
- Missing Main Exp Board
- Missing Co2 Sensor
- Bad Compressor Discharge Sensor
- Missing Suction Pressure Sensor
- Missing Outdoor Airflow Sensor
- Missing Exhaust Airflow Sensor

Missing Supply Air Airflow Sensor
 Missing Return Air Airflow Sensor
 Missing MHGRV-X Board
 Missing MODGAS-X Board
 Missing 12RLY Board
 Mech Cooling Failure
 Mech Heating Failure
 Fan Proving Alarm
 Dirty Filter Alarm
 Emergency Shutdown
 High Supply Air Temperature Cutoff
 Low Supply Air Temperature Cutoff
 High Control Temp
 Low Control Temp
 Digital Compressor Cutoff
 Digital Compressor Lockout

Sensor Failure Alarms

Supply Air Temperature Sensor Failure Alarm

The Supply Air Temperature Sensor Failure Alarm is generated when the controller detects an open or short circuit on the Supply Air Temperature Sensor input. Once the alarm is generated, the unit will be completely shut down. If a sensor is properly detected after the unit has alarmed, the alarm will be cleared and the unit will restart operations.

Space Temperature Sensor Failure Alarm

If the Space Sensor is configured as the Controlling Sensor (Mode Enable Sensor) or as the Reset Sensor, and if the controller detects an open or short circuit on the Space Sensor input, then a Space Temperature Sensor Failure Alarm is generated. If the Space Sensor is configured as the Controlling Sensor and the Failure Alarm is generated, the unit will shut down. If the Space Sensor is only configured as a Reset Sensor and the Failure Alarm is generated, the Space Temperature will default to a value half way between the Heating and Cooling Mode Enable Setpoints, and the unit will continue to run.

Outdoor Air Temperature Sensor Failure Alarm

The Outdoor Air Temperature Sensor Failure Alarm is generated when the controller detects an open or short circuit on the Outdoor Air Temperature Sensor input. When this occurs, the Outdoor Air reading will be artificially set to the half point between the Cooling and Heating Lockout Setpoints. This will allow the cooling and the heating to continue operating.

CO₂ Sensor Failure Alarm

This alarm is generated if the controller is configured to have a CO₂ sensor, but does not detect it. IAQ Mode is disabled when this occurs. If a sensor is properly detected after the unit has alarmed, the alarm will be cleared and the unit will be return to CO₂ control.

Compressor Discharge Sensor Failure Alarm

This alarm is generated if the unit is configured to have a digital scroll compressor, but the Digital Compressor Discharge Temperature Sensor is not detected or if shorted.

Suction Pressure Sensor Failure Alarm

If the controller detects the Suction Pressure Sensor is missing, this alarm is generated and the unit will shut down. If the sensor is properly detected after the unit has alarmed, the alarm will be cleared and the unit will restart.

Airflow Alarms

Outdoor Airflow Sensor Alarm
 Supply Airflow Sensor Alarm
 Return Airflow Sensor Alarm
 Exhaust Airflow Sensor Alarm

If the controller is configured to have any of the above air flow sensors, but the controller does not detect that the sensor is connected, then the applicable alarm will occur. If the sensor is properly detected after the unit has alarmed, the alarm will be cleared.

Missing Expansion Module Alarm

Main Expansion Missing
 EM2 Expansion Missing
 Reheat Board Missing
 ModGas Board Missing
 12 Relay Board Missing
 Preheat-X Controller Missing

If the controller is configured to have any of the above Expansion Boards (Modules), but the controller does not detect that board, then the applicable alarm will occur. If the board is properly detected after the unit has alarmed, the alarm will be cleared.

Mechanical Failure Alarms

Mechanical Cooling Failure

The Mechanical Cooling Failure Alarm is generated if the Supply Air Temperature fails to drop 5 degrees (within a user-adjustable time period) from the temperature the supply air was at when the cooling was activated. The alarm will be cleared when the Supply Air Temperature drops the 5 degrees and sets the failure timer back to zero. This alarm does not apply for Modulating Cooling.

Mechanical Heating Failure

The Mechanical Heating Failure Alarm is generated if the Supply Air Temperature fails to rise 5 degrees (within a user-adjustable time period) from the temperature the supply air was at when the heating was activated. The alarm will be cleared when the Supply Air Temperature rises the 5 degrees and sets the failure timer back to zero. This alarm does not apply for Modulating Heating.

SEQUENCE OF OPERATIONS

Alarms

Proof of Flow Interlock Alarm

A Proof of Flow switch (by others) provides a 24 VAC wet contact closure when the Supply Fan is operating. If this contact opens while the fan is being called to run, all heating and cooling is disabled, the Outdoor Air Damper closes, and a Fan Proving Alarm is generated. Fan Proving needs to be configured for this alarm to occur.

Dirty Filter Alarm

A differential pressure switch (by others) is used to provide a 24 VAC wet contact closure to indicate a dirty filter status. A Dirty Filter Alarm is then generated. Dirty Filter needs to be configured for this alarm to occur.

Emergency Shutdown Alarm

A 24 VAC wet contact input is available to be used when a N.C. Smoke Detector, Firestat, or other shutdown condition occurs. If this contact opens, it will initiate shutdown of the VCB-X and will generate an alarm condition. This contact closure does not produce an instantaneous shutdown. Emergency Shutdown needs to be configured for this alarm to occur.

Failure Mode Alarms

High and Low Supply Temp Alarm

These alarms are activated when the Supply Air Temperature (SAT) rises above the High Cutoff Temperature Setpoint (immediate) or drops below the Low Cutoff Temperature Setpoint (for 10 minutes). Both cutoff setpoints are user-adjustable. This mode shuts off the unit (with a 3 minute fan off delay) until the mode is cancelled.

This mode is cancelled when the SAT drops 5 degrees below the High Cutoff Temperature Setpoint or rises 5 degrees above the Low Temp Cutoff Temperature Setpoint, or when the unit changes back into Occupied Operation.

On non-MUA units, if the Supply Air Temperature falls 5° below the Low Supply Air Temperature Cutoff, the Outdoor Air Damper will fully close in an attempt to the Supply Air Temperature up before the 10 minute cutoff occurs.

High and Low Control Temp Failure

When the Controlling Sensor Temperature rises above the Cooling Mode Enable Setpoint plus the Control Mode High Alarm Offset setpoint, the controller will generate a High Control Temp Failure Alarm.

When the Controlling Sensor Temperature drops below the Heating Mode Enable Setpoint minus the Control Mode Low Alarm Offset setpoint, the controller will generate a Low Control Temp Failure Alarm.

Both offset setpoints are user-adjustable.

Digital Compressor Cutoff Alarm

If the digital compressor discharge temperature rises above 268°F (131.11°C) or the sensor is shorted (which will read a temperature of 300°F (148.88°C)), this alarm will be generated.

The alarm is removed when the compressor discharge temperature drops below 250°F (121.11°C). Once the compressor is shut off, it remains off for 30 minutes.

Digital Compressor Lockout Alarm

If a total of 5 Digital Compressor High Temperature Cutoffs have occurred within four hours, the VCB-X Controller will lock out the digital compressor and this alarm will be generated. The ALERT LED will continually flash 6 times to signal the lockout. The lockout can only be reset by cycling the 24VAC power off and on to the controller.

If the unit runs for 60 minutes without a digital compressor discharge temperature alarm, then the counter is reset to zero.

High Head Pressure Alarm

If the Head Pressure exceeds an acceptable limit, this alarm will be generated. The alarm will be cleared if the Head Pressure falls back within acceptable limits.

WSHP Proof of Flow Alarm

On a Water Source Heat Pump unit, if water flow is not proven within a certain time limit, this alarm will be generated. This alarm condition will disable the compressor(s) or prevent activation of compressor(s).

Low Suction Pressure Alarm

On a Water Source Heat Pump unit, if the Suction Pressure falls below the Low Suction Pressure Setpoint, this alarm will be generated. This alarm condition will disable the compressor(s) or prevent activation of compressor(s).

Unsafe Suction Pressure Alarm

On a Water Source Heat Pump unit, if the Suction Pressure falls below the Unsafe Suction Pressure Setpoint, this alarm will be generated. This alarm condition will disable the compressor(s) or prevent activation of compressor(s).

WSHP Low Leaving Water Temperature Alarm

On a Water Source Heat Pump unit, if the Leaving Water Temperature falls below the Low Leaving Water Temperature Setpoint while in the Heating Mode, this alarm will be generated. This alarm condition will disable the compressor(s) or prevent activation of compressor(s).

Title 24 Economizer Alarms

Economizer Temperature Sensor Failure

Outside Air or Supply Air Temperature Sensor is shorted or missing.

Economizer Not Economizing When it Should

Economizer is enabled but not following the desired Economizer position commanded.

Economizer Is Economizing When It Should Not

Economizer is not enabled but the feedback signal indicates a position more open than the minimum.

Economizer Damper Not Modulating

Economizer is enabled but not within 10% of desired position within 150 seconds.

Economizer Excess Outdoor Air Filter

Economizer feedback is lost or Economizer is not following commanded position.

Relay Outputs

There are 5 relay outputs that are configurable for the VCB-X Controller (Relay #1 is reserved for the Supply Fan and is not configurable). See Table 5 for descriptions of the configuration options.

Trend Logging

The VCB-X Controller continuously maintains an Internal Trend Log in memory which records a fixed set of values at a user-defined interval.

120 log positions (timed retrievals) are available on the controller. Once these positions are full, the controller begins overwriting the oldest data.

Values can be retrieved using the Prism 2 graphical front-end software program. With Prism 2 running continuously, values can be saved to the computer hard drive at regular intervals to keep from losing data.

The following are the fixed items that can be logged:

Date
 Time
 Mode of Op (Occupied / Override / Unoccupied)
 HVAC Mode
 Space Temperature
 Indoor Humidity
 Active Cooling Mode Setpoint
 Active Heating Mode Setpoint
 Supply Air Temperature
 Supply Air Temperature Setpoint
 Digital Compressor Discharge Temperature
 Return Air Temperature
 Leaving Water Temperature
 Outdoor Air Temperature
 Outdoor Air Humidity
 Outdoor Air Dewpoint
 IAQ Mode Active (0=No, 1=Yes)
 CO₂
 Head Pressure 1 Status
 Head Pressure 2 Status
 Head Pressure Setpoint
 Condenser Fan 1 Status
 Condenser Fan 2 Status
 Outdoor Air CFM
 Supply Air CFM
 Return Air CFM
 Exhaust CFM
 Building Pressure
 Building Pressure Relief VFD Signal
 Duct Static Pressure
 Main Fan Speed VFD Signal
 Economizer Signal Percentage
 Economizer Position
 Modulating Cool Signal - (Digital Compressor)
 Modulating Heat Signal
 Reheat Signal
 MODGAS Valve Position
 Suction Pressure
 Coil Temperature
 Coil Temperature Setpoint
 Binary Inputs (1=Emergency, 2=Proof of Flow,
 4=Dirty Filter, 8=Defrost, 16=Hood On,
 32=Remote Occupied, 64=Water POF)
 Main Fan Status
 Relay Outputs Status

LED Diagnostics

Using VCB-X LEDs To Verify Operation

The VCB-X Controller is equipped with LEDs that can be used to verify operation and perform troubleshooting. There are LEDs for communication, operation modes, and diagnostic codes. The VCB-X Controller has 23 LEDs—11 used for operation & status, and 6 used for relays, 2 used for Digital Compressor operation, and 4 used for binary inputs. See **Figure 42** for the LED locations. The LEDs associated with these inputs and outputs allow you to see what is active without using a voltmeter. The LEDs and their uses are as follows:

① Operation LEDs - Factory Troubleshooting

POWER - This green LED will light up to indicate that 24 VAC 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.

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

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

② Diagnostic LEDs

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

STATUS 1 - This red LED is a diagnostic blink code LED. It will light up and blink out diagnostic codes. STATUS 1 LED also represents the tens column in the address blink code. See **Table 6** for Status Blink Code code descriptions. The blink code descriptions are also located on the Controller's front cover.

STATUS 2 - This red LED is a diagnostic blink code LED. It will light up and blink out diagnostic codes. STATUS 2 LED also represents the ones column in the address blink code. See **Table 6** for Status Blink Code code descriptions. The blink code descriptions are also located on the Controller's front cover.

③ Communication LEDs

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

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

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

④ Compressor LEDs

ALERT - This red LED will light up and blink a code to indicate why the digital scroll compressor is not working properly.

UNLOAD - This green LED will light up and blink continuously when the digital scroll compressor is in cooling mode.

⑤ Relay LEDs

RLY1 - This green LED will light up when the Supply Fan is enabled and will stay lit as long as the Supply Fan is active.

RLY2 - This green LED will light up when Relay 2 is enabled and will stay lit as long as Relay 2 is active.

RLY3 - This green LED will light up when Relay 3 is enabled and will stay lit as long as Relay 3 is active.

RLY4 - This green LED will light up when Relay 4 is enabled and will stay lit as long as Relay 4 is active.

RLY5 - This green LED will light up when Relay 5 is enabled and will stay lit as long as Relay 5 is active.

RLY6 - This green LED will light up when Relay 6 is enabled and will stay lit as long as Relay 6 is active.

⑥ Binary Input LEDs

BIN1 - This green LED will light up when the Emergency Shutdown contact is closed.

BIN2 - This green LED will light up when the Proof of Flow switch is closed.

BIN3 - This green LED will light up when the Dirty Filter switch is closed.

BIN4 - This green LED will light up when the Defrost Coil Temperature switch is closed.

VCB-X EM1 Expansion Module LEDs

The VCB-X EM1 Expansion Module is equipped with 4 LEDs that can be used as very powerful troubleshooting tools. See **Figure 42** for LED locations. The LEDs and their uses are as follows:

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

ALARM - If the module does not receive communications for more than 1 minute, this LED will light up, the relays will turn off, and the Analog Outputs will go to 0 VDC.

STAT - If the software is running, this LED should blink at a rate of 1 blink per second.

COMM - Every time the module receives a valid E-BUS request from the VCB-X Controller, this LED will blink on and then off, signifying that it received a valid request and responded.

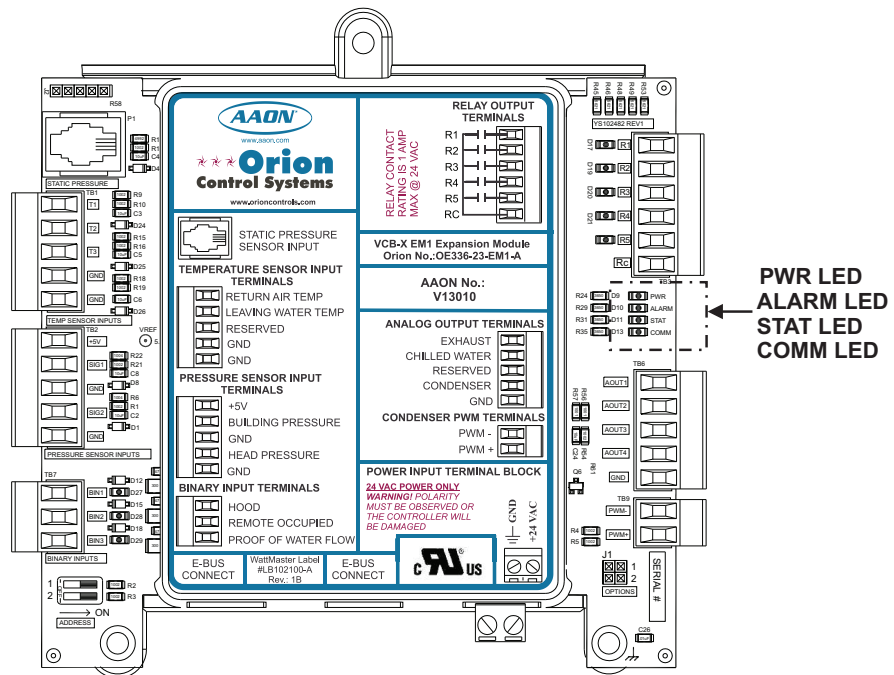
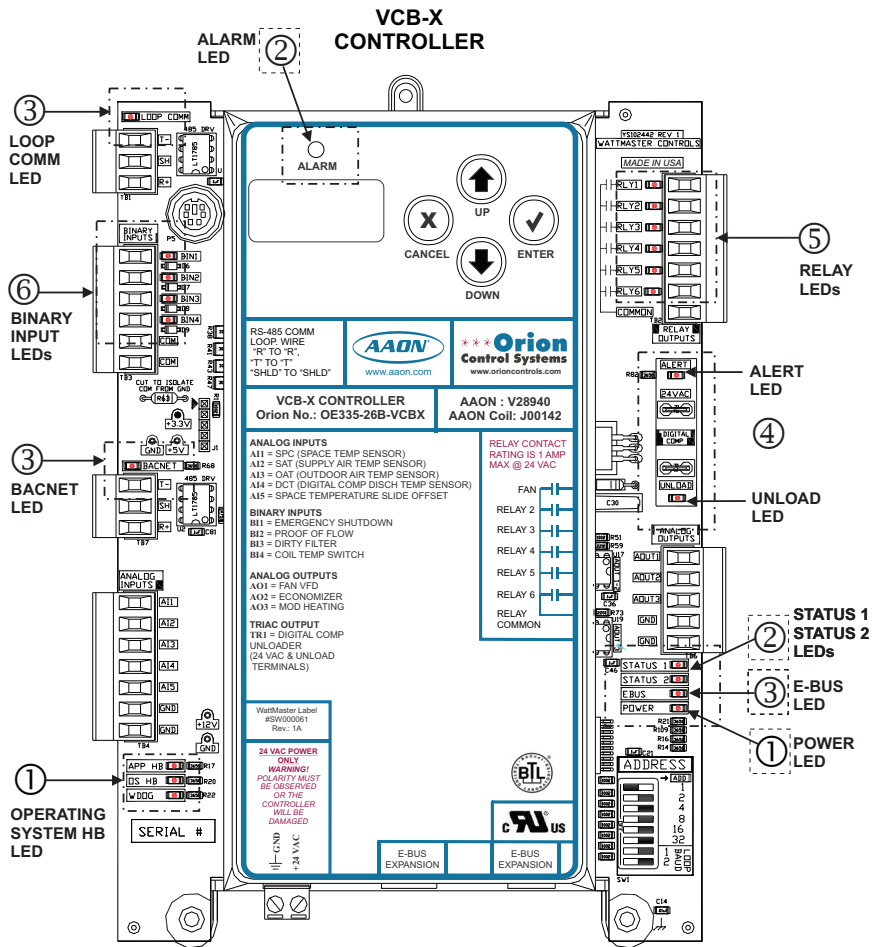


Figure 42: VCB-X Controller & VCB-X EM1 Expansion Module LED Locations

LED Diagnostics

Diagnostic LED Operation

POWER LED Operation

When the VCB-X Controller is 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.

Diagnostic LED Operation

When power is first applied, the STATUS 1 and STATUS 2 LEDs will be off for 1 second. At this time, both LEDs will blink to indicate the setting of the address switch and then will extinguish for 5 seconds. Verify that the address switch setting is correct by counting the number of blinks.

If the address switch is not correct, first remove the communication loop terminal plug from the controller and then from the power terminal plug. Set the address dip switches correctly. See **Figure 41** for correct address switch setting instructions. After you are sure the address switch setting is correct, first reconnect the power connection and then reconnect the communication loop connection to the controller.

NOTE: You must always cycle power to the Controller being addressed after changing address switch settings in order for the changes to take effect.

Reapply power to the controller and observe the blink code to verify the address is set correctly. If the STATUS 1 and STATUS 2 LEDs now blink the correct address, your controller is addressed correctly. If they don't light up at all, the controller is not operating correctly and could be defective. Once the controller is done blinking the address, the LEDs will blink a code every 10 seconds to indicate controller status. If all of these tests are made and the controller still doesn't operate, please contact WattMaster Controls Technical Support at 866-918-1100.

The Blink Code Descriptions in **Table 6** cover multiple alarm conditions. You will need to use one of the Orion Interface Tools to determine the specific alarm condition. See the Alarm descriptions on pages 66 through 68 for further details.

Digital Compressor LED Operation

UNLOAD LED

Any time there is a signal going to the Digital Compressor Unloader Solenoid Valve the Unload LED will be on.

ALERT LED

The ALERT LED will blink the alarm codes for the digital compressor. See **Table 7**.

Blink Code Description	STATUS 1 LED Blinks	STATUS 2 LED Blinks
NORMAL OPERATION	0	1
SUPPLY AIR SENSOR FAILURE	1	2
OUTDOOR AIR SENSOR FAILURE	2	2
SPACE SENSOR FAILURE	3	2
MISSING EXPANSION MODULE*	4	2
CO2 SENSOR FAILURE	6	2
AIRFLOW SENSOR FAILURE*	7	2
MECHANICAL COOLING FAILURE	1	3
MECHANICAL HEATING FAILURE	2	3
FAN PROVING FAILURE	3	3
DIRTY FILTER ALARM	4	3
EMERGENCY SHUTDOWN	5	3
ECONOMIZER TITLE 24 ALARM	6	3
LOW SUPPLY TEMP ALARM	1	4
HIGH SUPPLY TEMP ALARM	2	4
CONTROL TEMP HI ALARM	3	4
CONTROL TEMP LOW ALARM	4	4
HIGH HEAD PRESSURE	5	4
WATER PROOF FAILURE	6	4
SUCTION PRESSURE ALARM*	7	4
LOW LEAVING WATER TEMP	8	4
PUSH BUTTON OVERRIDE	1	5
OUTPUT FORCE ACTIVE	0	6
* MISSING EXP. MODULE – INCLUDES MULTIPLE MODULES		
AIRFLOW SENSOR FAILURE – INCLUDES MULTIPLE AIRFLOW SENSORS		
SUCTION PRESSURE ALARM – INCLUDES SUCTION PRESSURE SENSOR FAILURE ALARM, LOW SUCTION PRESSURE ALARM, AND UNSAFE SUCTION PRESSURE ALARM		

Table 6: Diagnostic LED Blink Code Interpretation

Blink Code Description	ALERT LED Blinks
NORMAL OPERATION	0
MISSING DISCHARGE SENSOR	1
HIGH TEMPERATURE CUTOFF TIMEOUT PERIOD (30 MINUTES)	3
HIGH DISCHARGE TEMPERATURE CUTOFF	4
COMPRESSOR LOCKED OUT	6

Table 7: ALERT LED Blink Code Interpretation

System Configuration Options

The VCB-X Controller can be used as a Stand-Alone System (one VCB-X Controller only), connected together on an Interconnected System (multiple VCB-X Controllers only) or connected together on a Network System (multiple VCB-X Controllers, VAV/Zone Controllers, or Add-On Controllers) to form a complete Controls System that can be programmed and monitored with one or more of the available Operator Interfaces.

Operator Interfaces

The Operator Interfaces are designed to provide for programming and monitoring of VCB-X Controller(s) and/or any VAV/Zone or Add-on Controller(s) connected to your System. See **Figure 43**. The available Operator Interfaces are as follows:

- Modular Service Tool SD (OE391-12)
- Modular System Manager SD (OE392-12)
- System Manager Touch Screen II (OE392-10)
- Personal Computer with Prism 2 Computer Front End Software Installed and CommLink 5

You can use any one of these interfaces or all of them on the same VCB-X Control System.

Stand-Alone System

The Stand-Alone System is used when you have a single VCB-X Controller only. Programming and status monitoring are accomplished by selecting and installing one or more of the Operator Interfaces.

See **Figure 44** for a Typical Stand-Alone System Layout diagram.

Interconnected System

The Interconnected System is used when you have multiple VCB-X Controllers on your job. With this system, you simply connect the controllers together using WattMaster communications wire or 18-gauge, 2-conductor twisted pair with shield wire (Belden #82760 or equivalent). This allows for all controllers that are connected on the communications loop to be programmed and monitored from one or more of the available Operator Interfaces connected on the communications loop.

See **Figure 45** for a Typical Interconnected System Layout diagram.

Networked System

If you have 1 to 59 VCB-X Controllers that require information sharing, simply connect the controllers together using WattMaster communications wire or 18-gauge, 2-conductor twisted pair with shield wire (Belden #82760 or equivalent). The Networked Single Loop System requires that either a MiniLink PD communication interface and/or CommLink communication interface are purchased and wired into the communications loop in a similar manner to the VCB-X Controllers.

The Networked Multiple Loop system is used when you have more than 59 VCB-X Controllers and/or are using multiple VCB-X Controllers that are connected to VAV/Zone controllers. These groups of controllers are broken up into multiple “Local Loops” that connect to each other via the “Network Loop.” Each individual MiniLink PD handles its specific local loop’s communications requirements. The CommLink communications interface handles all the communications between the individual MiniLink PDs to form the network loop. Up to 60 local loops can be connected together with this configuration. This provides the capability for over 3500 controllers to be networked together.

See **Figure 46** for a Typical Networked System Layout diagram.

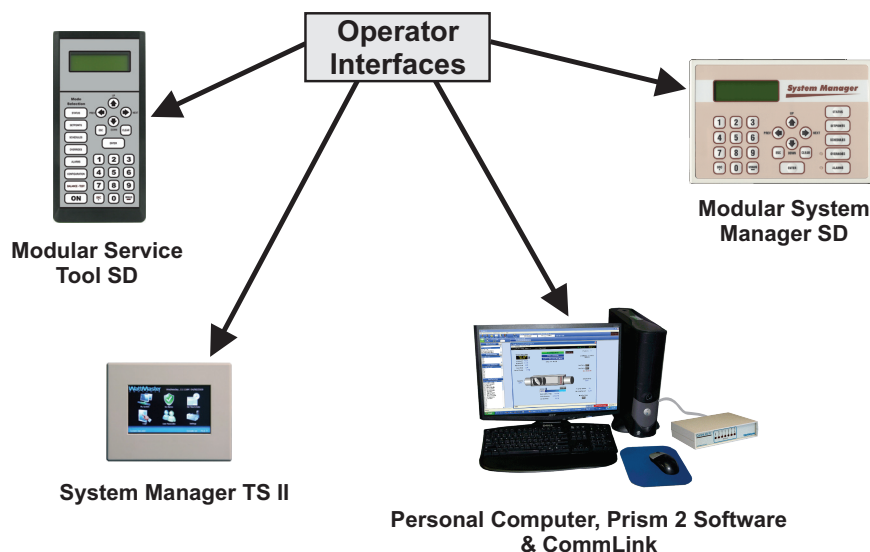


Figure 43: Available Operator Interfaces

Stand-Alone System Layout

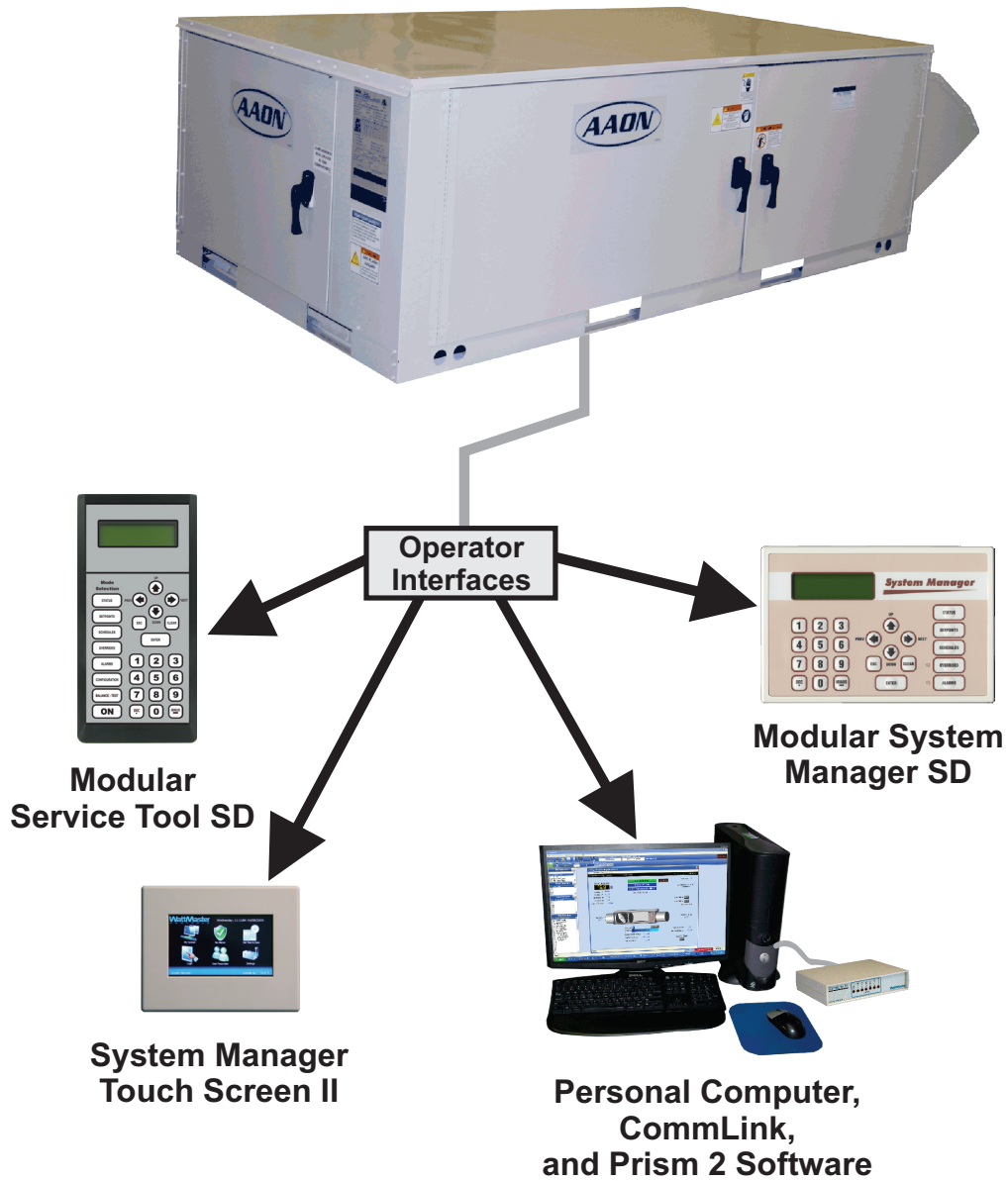


Figure 44: Typical Stand-Alone System Layout

Interconnected System Layout

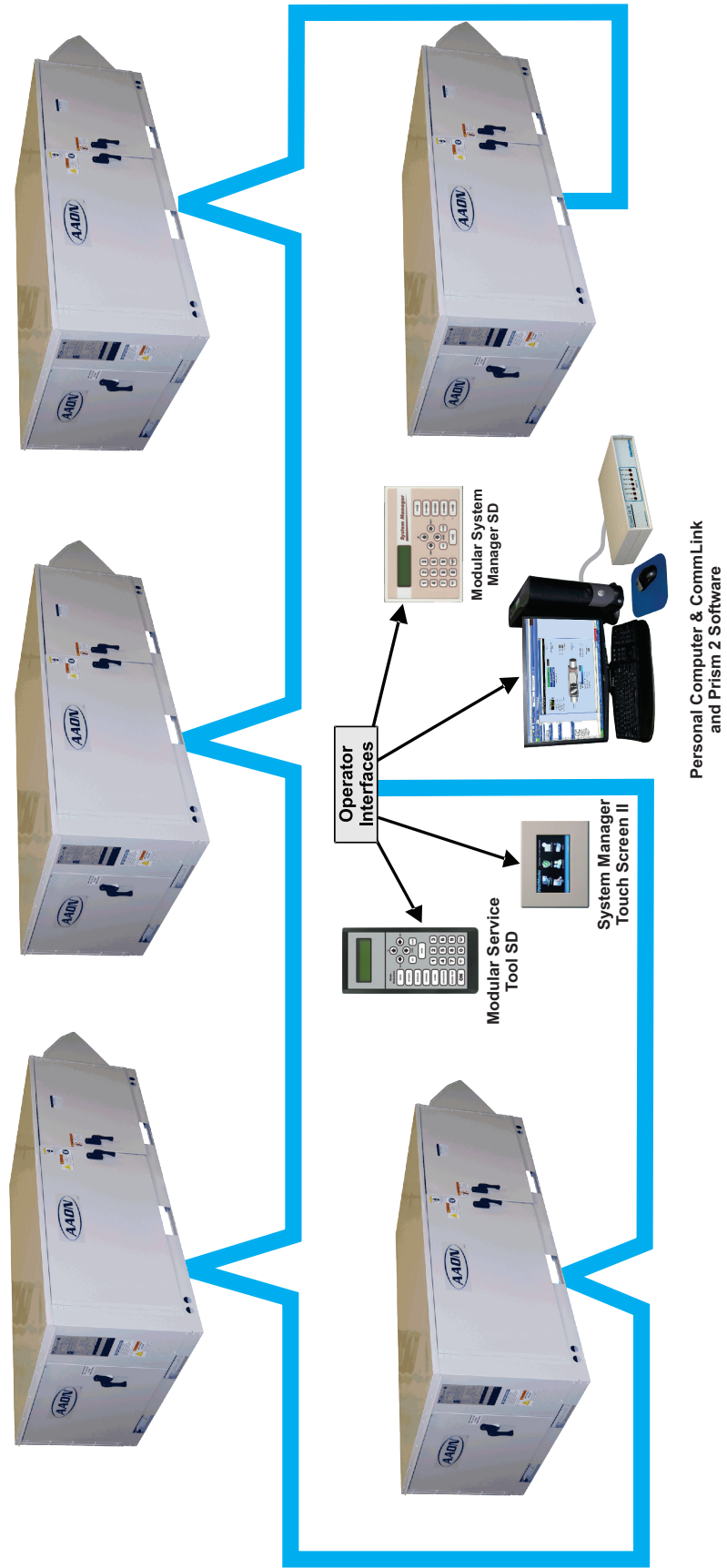


Figure 45: Typical Interconnected System Layout

Networked System Layout

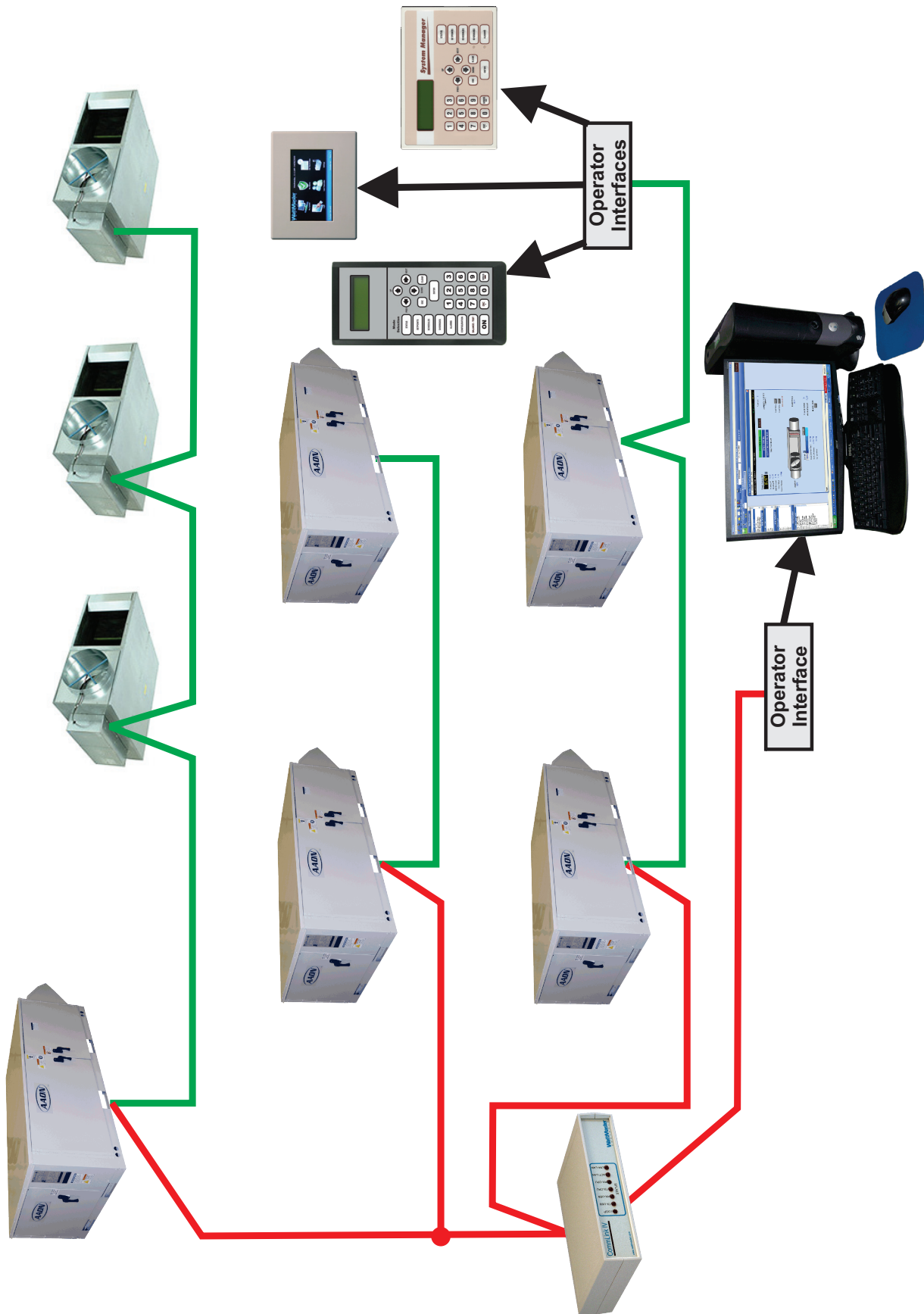


Figure 46: Typical Networked System Layout

Temperature Sensor Testing

Space, Supply Air, Outdoor Air or Return Air 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 tables. Please follow the notes and instructions that appear after the chart when checking sensors.

Temperature – Resistance – Voltage for Type III 10 K Ohm Thermistor Sensors			
Temp (°F)	Temp (°C)	Resistance (Ohms)	Voltage @ Input (VDC)
-10	-23.33	93333	4.51
-5	-20.55	80531	4.45
0	-17.77	69822	4.37
5	-15	60552	4.29
10	-12.22	52500	4.2
15	-9.44	45902	4.1
20	-6.66	40147	4.002
25	-3.88	35165	3.891
30	-1.11	30805	3.773
35	1.66	27140	3.651
40	4.44	23874	3.522
45	7.22	21094	3.39
50	10	18655	3.252
52	11.11	17799	3.199
54	12.22	16956	3.143
56	13.33	16164	3.087
58	14.44	15385	3.029
60	15.55	14681	2.972
62	16.66	14014	2.916
64	17.77	13382	2.861
66	18.88	12758	2.802
68	20	12191	2.746
69	20.55	11906	2.717
70	21.11	11652	2.691
71	21.66	11379	2.661
72	22.22	11136	2.635
73	22.77	10878	2.605

Table 8: Temperature/Resistance for Type III 10K Ohm Thermistor Sensors

Temperature – Resistance – Voltage for Type III 10 K Ohm Thermistor Sensors			
Temp (°F)	Temp (°C)	Resistance (Ohms)	Voltage @ Input (VDC)
74	23.33	10625	2.576
75	23.88	10398	2.549
76	24.44	10158	2.52
77	25	10000	2.5
78	25.55	9711	2.464
80	26.66	9302	2.41
82	27.77	8893	2.354
84	28.88	8514	2.3
86	30	8153	2.246
88	31.11	7805	2.192
90	32.22	7472	2.139
95	35	6716	2.009
100	37.77	6047	1.884
105	40.55	5453	1.765
110	43.33	4923	1.65
115	46.11	4449	1.54
120	48.88	4030	1.436
125	51.66	3656	1.339
130	54.44	3317	1.246
135	57.22	3015	1.159
140	60	2743	1.077
145	62.77	2502	1.001
150	65.55	2288	0.931

Table 8, cont.: Temperature/Resistance for Type III 10K Ohm Thermistor Sensors

Thermistor Sensor Testing Instructions

Use the resistance column to check the thermistor sensor while disconnected from the controllers (not powered).

Use the voltage column to check sensors while connected to powered controllers. Read voltage with meter set on DC volts. Place the “-” (minus) lead on GND terminal and the “+” (plus) lead on the sensor input terminal being investigated.

If the voltage is above 4.88 VDC, then the sensor or wiring is “open.” If the voltage is less than 0.05 VDC, then the sensor or wiring is shorted.

Copeland® Discharge Thermistor Temperature Sensor Testing

Copeland® Discharge Thermistor 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 that appear after the chart when checking sensors.

Discharge Thermistor Temperature/ Resistance			
Temp (°F)	Temp (°C)	Resistance (K Ohms)	Voltage @ Input (VDC)
-40	-40	2889.60	4.98
-31	-35	2087.22	4.97
-22	-30	1522.20	4.96
-13	-25	1121.44	4.95
-4	-20	834.72	4.94
5	-15	627.28	4.92
14	-10	475.74	4.89
23	-5	363.99	4.86
32	0	280.82	4.82
41	5	218.41	4.77
50	10	171.17	4.72
59	15	135.14	4.65
68	20	107.44	4.57
77	25	86.00	4.47
86	30	69.28	4.36
95	35	56.16	4.24
104	40	45.81	4.10
113	45	37.58	3.94
122	50	30.99	3.77
131	55	25.68	3.59
140	60	21.40	3.40
149	65	17.91	3.20
158	70	15.07	3.00
167	75	12.73	2.80
176	80	10.79	2.59
185	85	9.20	2.39

Table 9: Discharge Thermistor Temperature/
Resistance

Discharge Thermistor Temperature/ Resistance			
Temp (°F)	Temp (°C)	Resistance (K Ohms)	Voltage @ Input (VDC)
194	90	7.87	2.19
203	95	6.77	2.01
212	100	5.85	1.84
221	105	5.09	1.68
230	110	4.45	1.53
239	115	3.87	1.39
248	120	3.35	1.25
257	125	2.92	1.12
266	130	2.58	1.02
275	135	2.28	0.92
284	140	2.02	0.83
293	145	1.80	0.76
302	150	1.59	0.68
311	155	1.39	0.61
320	160	1.25	0.55
329	165	1.12	0.50
338	170	1.01	0.45
347	175	0.92	0.42
356	180	0.83	0.38

Table 9, cont.: Discharge Thermistor Temperature/
Resistance

Thermistor Sensor Testing Instructions

Use the resistance column to check the thermistor sensor while disconnected from the controllers (not powered).

Use the voltage column to check sensors while connected to powered controllers. Read voltage with meter set on DC volts. Place the “-” (minus) lead on GND terminal and the “+” (plus) lead on the sensor input terminal being investigated.

If the voltage is above 4.98 VDC, then the sensor or wiring is “open.” If the voltage is less than 0.38 VDC, then the sensor or wiring is shorted.

OE271 & OE258-01 Pressure Sensor Testing

OE271 Pressure Sensor Testing

The table below is used to troubleshoot the OE271 Duct Static Pressure Sensors.

OE271 Duct Static Pressure Sensor			
Pressure @ Sensor (" W.C.)	Voltage @ Input (VDC)	Pressure @ Sensor (" W.C.)	Voltage @ Input (VDC)
0.00	0.25	2.60	2.33
0.10	0.33	2.70	2.41
0.20	0.41	2.80	2.49
0.30	0.49	2.90	2.57
0.40	0.57	3.00	2.65
0.50	0.65	3.10	2.73
0.60	0.73	3.20	2.81
0.70	0.81	3.30	2.89
0.80	0.89	3.40	2.97
0.90	0.97	3.50	3.05
1.00	1.05	3.60	3.13
1.10	1.13	3.70	3.21
1.20	1.21	3.80	3.29
1.30	1.29	3.90	3.37
1.40	1.37	4.00	3.45
1.50	1.45	4.10	3.53
1.60	1.53	4.20	3.61
1.70	1.61	4.30	3.69
1.80	1.69	4.40	3.77
1.90	1.77	4.50	3.85
2.00	1.85	4.60	3.93
2.10	1.93	4.70	4.01
2.20	2.01	4.80	4.09
2.30	2.09	4.90	4.17
2.40	2.17	5.00	4.25
2.50	2.25		

Table 10: Duct Static Pressure/Voltage for OE271 Duct Static Pressure Sensors

OE271 Pressure Sensor Testing Instructions

Use the voltage column to check the Duct Static Pressure Sensor while connected to powered controllers. Read voltage with meter set on DC volts. Place the “-” (minus) lead on the GND terminal and the “+” (plus) lead on the 0-5 pin terminal on (TP) with the jumper removed. Be sure to replace the jumper after checking.

OE258-01 Pressure Sensor Testing

The table below is used to troubleshoot the OE258-01 Building Pressure Sensors.

OE258-01 Building Pressure Sensor			
Pressure @ Sensor (" W.C.)	Voltage @ Input (VDC)	Pressure @ Sensor (" W.C.)	Voltage @ Input (VDC)
-0.25	0.00	0.01	2.60
-0.24	0.10	0.02	2.70
-0.23	0.20	0.03	2.80
-0.22	0.30	0.04	2.90
-0.21	0.40	0.05	3.00
-0.20	0.50	0.06	3.10
-0.19	0.60	0.07	3.20
-0.18	0.70	0.08	3.30
-0.17	0.80	0.09	3.40
-0.16	0.90	0.10	3.50
-0.15	1.00	0.11	3.60
-0.14	1.10	0.12	3.70
-0.13	1.20	0.13	3.80
-0.12	1.30	0.14	3.90
-0.11	1.40	0.15	4.00
-0.10	1.50	0.16	4.10
-0.09	1.60	0.17	4.20
-0.08	1.70	0.18	4.30
-0.07	1.80	0.19	4.40
-0.06	1.90	0.20	4.50
-0.05	2.00	0.21	4.60
-0.04	2.10	0.22	4.70
-0.03	2.20	0.23	4.80
-0.02	2.30	0.24	4.90
-0.01	2.40	0.25	5.00
0.00	2.50		

Table 11: Building Static Pressure/Voltage for OE258-01 Building Pressure Sensors

OE258-01 Building Pressure Sensor Testing Instructions

Use the voltage column to check the Building Static Pressure Sensor while connected to a powered expansion module. Read voltage with meter set on DC volts. Place the “-” (minus) lead on terminal labeled GND and the “+” lead on terminal SIG1 on the VCB-X Expansion Module.

OE275-01 Suction Pressure Transducer Testing

OE275-01 Suction Pressure Transducer Testing for R410A Refrigerant

The Evaporator Coil Temperature is calculated by converting the Suction Pressure to Temperature. The Suction Pressure is obtained by using the OE275-01 Suction Pressure Transducer, which is connected into the Suction Line of the Compressor.

Use the voltage column to check the Suction Pressure Transducer while connected to the VCB-X Expansion Module. The VCB-X and the VCB-X Expansion Module must be powered for this test. Read voltage with a meter set on DC volts. Place the positive lead from the meter on the PR OUT terminal located on the VCB-X Expansion Module terminal block. Place the negative lead from the meter on the ground (GND) terminal located adjacent to the PR OUT terminal on the VCB-X Expansion Module terminal block. Use a refrigerant gauge set and/or an accurate electronic thermometer to measure the temperature or suction line pressure near where the Suction Pressure Transducer is connected to the suction line. Measure the Voltage at the terminals PR OUT and GND terminals and compare it to the appropriate chart depending on the refrigerant you are using. If the temperature/voltage or pressure/voltage readings do not align closely with the chart, your Suction Pressure Transducer is probably defective and will need to be replaced.

See the OE275-01 Suction Pressure Transducer, Pressure, Temperature, and Voltage Chart for R410A Refrigerant testing (**Table 12**). The charts show a temperature range from 20°F to 80°F. For troubleshooting purposes, the DC Voltage readings are also listed with their corresponding temperatures and pressures.

OE275-01 Suction Pressure Transducer Coil Pressure – Temperature – Voltage Chart for R410A Refrigerant					
Temperature °F	Pressure PSI	Signal DC Volts	Temperature °F	Pressure PSI	Signal DC Volts
21.19	80.94	1.8	59.03	168.10	3.2
24.49	87.16	1.9	61.17	174.32	3.3
27.80	93.39	2.0	63.19	180.55	3.4
30.99	99.62	2.1	65.21	186.78	3.5
33.89	105.84	2.2	67.23	193.00	3.6
36.80	112.07	2.3	69.24	199.23	3.7
39.71	118.29	2.4	71.15	205.46	3.8
42.30	124.52	2.5	72.95	211.68	3.9
44.85	130.75	2.6	74.76	217.91	4.0
47.39	136.97	2.7	76.57	224.14	4.1
49.94	143.2	2.8	78.37	230.36	4.2
52.23	149.42	2.9	80.18	236.59	4.3
54.50	155.65	3.0			
56.76	161.88	3.1			

Table 12: Coil Pressure/Voltage/Temp for OE275-01 Suction Pressure Transducers - R410A Refrigerant

Head Pressure Transducer Troubleshooting

Head Pressure Transducer Troubleshooting

If you suspect there is a problem related to head pressure transducer measurements, reference **Table 13** below.

Head Pressure Transducer Chart			
Voltage	Pressure	Voltage	Pressure
0.5	0	2.6	350
0.6	17	2.7	367
0.7	33	2.8	384
0.8	50	2.9	400
0.9	67	3.0	417
1.0	83	3.1	434
1.1	100	3.2	450
1.2	117	3.3	467
1.3	133	3.4	484
1.4	150	3.5	500
1.5	167	3.6	517
1.6	183	3.7	534
1.7	200	3.8	550
1.8	217	3.9	567
1.9	233	4.0	584
2.0	250	4.1	600
2.1	267	4.2	617
2.2	283	4.3	634
2.3	300	4.4	650
2.4	317	4.5	667
2.5	334		

Table 13: Head Pressure Transducer Chart

APPENDIX B - LCD SCREENS

Navigation Keys

LCD Display Screen & Navigation Keys

The LCD display screens and buttons allow you to view status and alarms, enable force modes, and make BACnet® configuration changes. See **Figure 47** and refer to **Table 13** for descriptions.

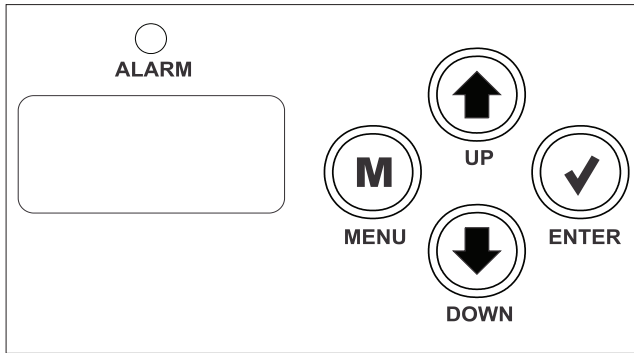


Figure 47: LCD Display and Navigation Keys





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

Table 14: Navigation Key Functions

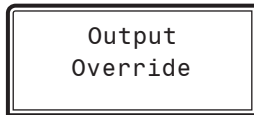
Main Screens Map and Settings Screens

Main Screens Map

Refer to the following map when navigating through the LCD Main Screens. The first screen is an initialization screen. To scroll through the rest of the screens, press the **<MENU>** button.

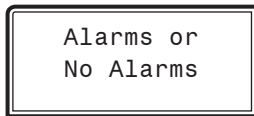


Press to go to Output Override Screens.



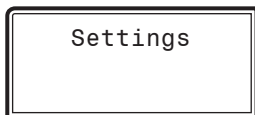
Press to scroll through the Output Override Screens.

Press to go to the Alarm Screens.



Press to scroll through the Alarm Screens.

Press to go to the Settings Screens.



Press to scroll through the Settings Screens.

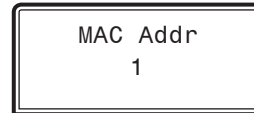
Press to go to the Status Screens.



Press to scroll through Status Screens.

Settings Screens

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



BACnet® - CURRENT MAC ADDRESS

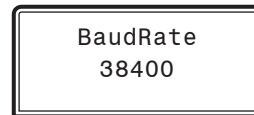
Valid range is 0 to 254. Default is 1.



BACnet® - CURRENT DEVICE ID

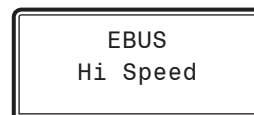
A Device ID of up to 7 digits can be entered.

The left and right arrow keys move the cursor between the digit fields. Once the cursor is under a field, use the up and down arrow keys to select a number between 0 and 9.



BACnet® - CURRENT BAUD RATE

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



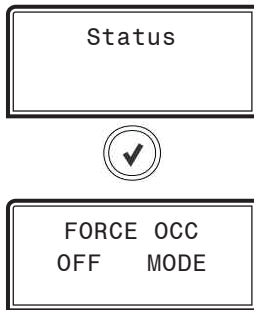
E-BUS COMMUNICATIONS

Hi Speed or Lo Speed. Default is Hi Speed.

Status Screens

Status Screens

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



MODE

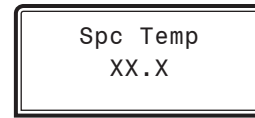
This screen displays the current mode of operation of the VCB-X Controller. The mode options are:

LINE 1

- UNOCCUPY (Unoccupied)
- OCCUPIED
- OVERRIDE
- HOL UNOC (Holiday Unoccupied)
- HOL OCC (Holiday Occupied)
- FRC OCC (Force Occupied)
- FRC UNOC (Force Unoccupied)
- REM OCC (Remote Occupied)
- ZONE HEAT
- ZONE COOL
- ZONE OVR (Zone Override)

LINE 2

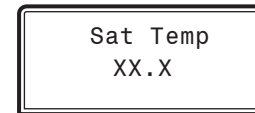
- OFF MODE
- VENT MODE
- COOL MODE
- HEAT MODE
- VENT RH
- COOL RH
- HEAT RH
- WARMUP
- DEFROST
- PURGE



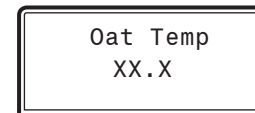
SPACE TEMPERATURE
40°F to 200°F or 5°C to 93°C.



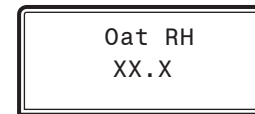
SPACE HUMIDITY



SUPPLY AIR TEMPERATURE
40°F to 200°F or 5°C to 93°C.



OUTDOOR AIR TEMPERATURE
40°F to 200°F or 5°C to 93°C.



OUTDOOR AIR TEMPERATURE HUMIDITY

Alarm Screens

If there are no Alarms, the Alarm Screen will display “No Alarms.” If there are alarms present, the screen will display, “Alarms.” You must press **<ENTER>** to scroll through the alarms. For alarm definitions and troubleshooting, see **pages 74-77**.



Alarms

The screen will display the alarms as follows:

No Alarms

SAT SENSOR	See Supply Air Temperature Sensor Failure Alarm, page 75.
OAT SENSOR	See Outdoor Air Temperature Sensor Failure Alarm, page 75.
SPC SENSOR	See Space Temperature Sensor Failure Alarm, page 75.
MAIN EXP MISSING	See Missing Expansion Module Alarm, page 75.
SUCTION SENSOR	See Low Suction Pressure Sensor Alarm, page 76.
CO2 SENSOR	See CO ₂ Sensor Failure Alarm, page 75.
COMP DISCHG	See Compressor Discharge Sensor Failure Alarm, page 75.
OAT CFM SENSOR	See Airflow Alarms, page 75.
EX CFM SENSOR	See Airflow Alarms, page 75.
SA CFM SENSOR	See Airflow Alarms, page 75.
RA CFM SENSOR	See Airflow Alarms, page 75.
REHEAT ALARM	See Missing Expansion Module Alarm - Reheat Board Missing, page 75.
MODGAS ALARM	See Missing Expansion Module Alarm - MODGAS Board Missing, page 75.
RLY EXP ALARM	See Missing Expansion Module Alarm, page 75.

COOLING FAILURE	See Mechanical Cooling Failure Alarm, page 75.
HEATING FAILURE	See Mechanical Heating Failure Alarm, page 75.
FAN POF FAILURE	See Proof of Flow Interlock Alarm, page 76.
DIRTY FILTER	See Dirty Filter Alarm, page 76.
EMERG SHUTDOWN	See Emergency Shutdown Alarm, page 76.
HI SAT ALARM	See High and Low Supply Temp Alarm, page 76.
LO SAT ALARM	See High and Low Supply Temp Alarm, page 76.
CONTROL TEMP HI	See High and Low Control Temp Failure, page 76.
CONTROL TEMP LO	See High and Low Control Temp Failure, page 76.
DIGITAL CUTOFF	See Digital Compressor Cutoff Alarm, page 76.
DIGITAL LOCKOUT	See Digital Compressor Lockout Alarm, page 76.
HIGH HEAD PRESSURE	See High Head Pressure Alarm, page 76.
NO WATER FLOW	See WSHP Proof of Flow Alarm, page 76.
LOW SUCTION	See Low Suction Pressure Alarm, page 76.
UNSAFE SUCTION	See Unsafe Suction Pressure Alarm, page 76.
LOW WATER TEMP	See WSHP Low Leaving Water Temperature Alarm, page 76.
ECONO TITLE 24	See Title 24 Economizer Alarms, pages 76-77.
????? ALARMS	This screen should never display. But if it does, it means the controller doesn't know what the alarm is.

Output Override Screens

Output Override Screens

Refer to the following map when navigating through the Output Override Screens. From the *Output Override Screen*, press **<ENTER>**.

Output
Override



Relay #1-6
ON, OFF, AUTO

VCB-X CONTROLLER RELAYS 1-6

Press the **<UP>** button to change the value.
Default is **AUTO**.



Unloader
ON, OFF, AUTO

Press the **<UP>** button to change the value.
Default is **AUTO**.



ExpRly 1-5
ON, OFF, AUTO

VCB-X EM1 EXPANSION RELAYS 1-5

Press the **<UP>** button to change the value.
Default is **AUTO**.



Fan VFD
-1.0, 0.0-10.0
vdc

SUPPLY FAN VFD

0.0 to 10.0 = Active Force Mode.
Press the **<UP>** and **<DOWN>** buttons to
increase and decrease the value.
Default is **-1.0 = AUTO**.



Econo
-1.0, 0.0-10.0
vdc

ECONOMIZER VFD

0.0 to 10.0 = Active Force Mode.
Press the **<UP>** and **<DOWN>** buttons to
increase and decrease the value.
Default is **-1.0 = AUTO**.



Heating
-1.0, 0.0-10.0
vdc

MODULATING HEATING

0.0 to 10.0 = Active Force Mode.
Press the **<UP>** and **<DOWN>** buttons to
increase and decrease the value.
Default is **-1.0 = AUTO**.



Condense
-1.0, 0.0-10.0
vdc

MODULATING CONDENSER

0.0 to 10.0 = Active Force Mode.
Press the **<UP>** and **<DOWN>** buttons to
increase and decrease the value.
Default is **-1.0 = AUTO**.



Cooling
-1.0, 0.0-10.0
vdc

MODULATING COOLING

0.0 to 10.0 = Active Force Mode.
Press the **<UP>** and **<DOWN>** buttons to
increase and decrease the value.
Default is **-1.0 = AUTO**.

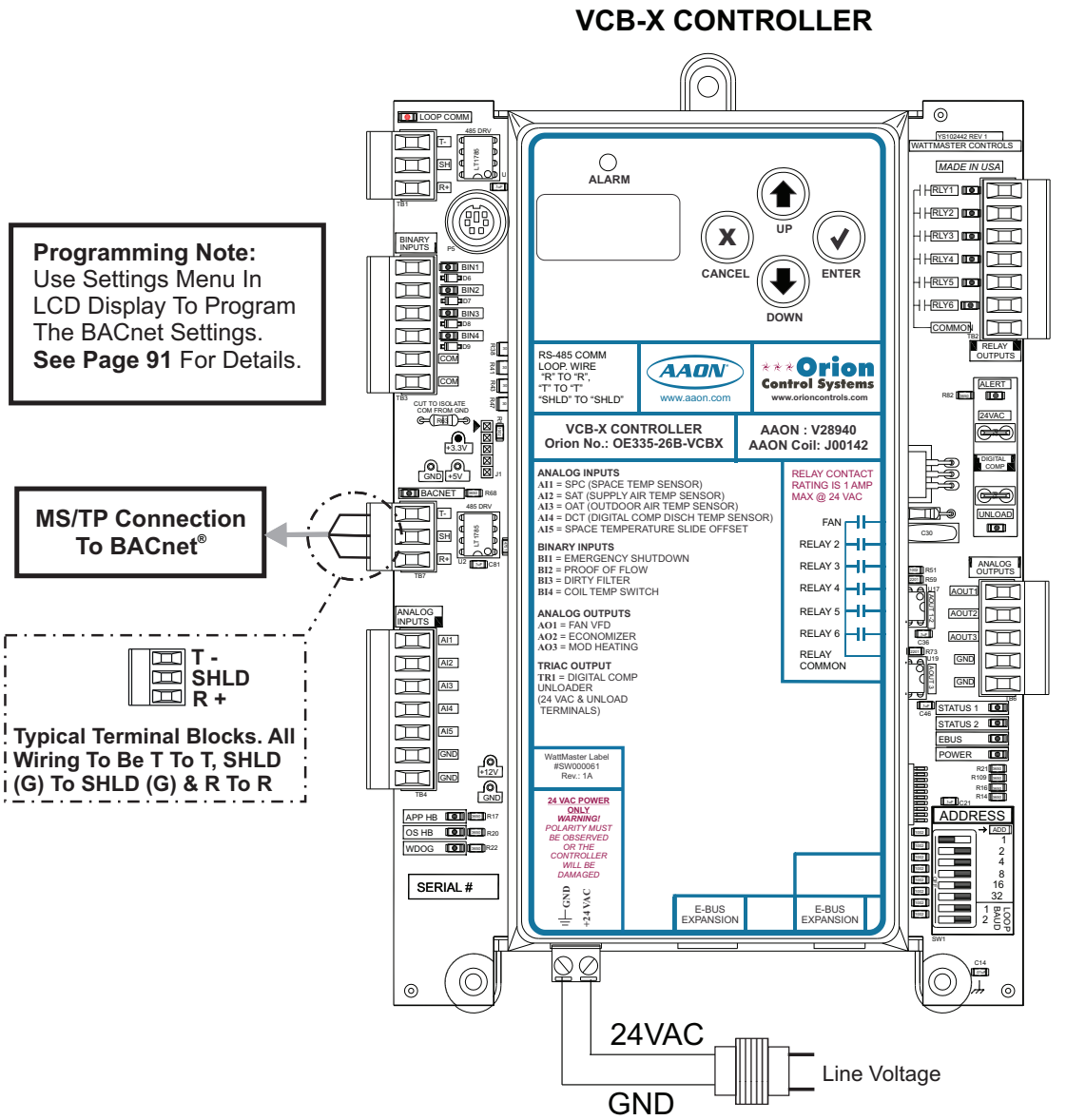


Exhaust
-1.0, 0.0-10.0
vdc

EXHAUST FAN

0.0 to 10.0 = Active Force Mode.
Press the **<UP>** and **<DOWN>** buttons to
increase and decrease the value.
Default is **-1.0 = AUTO**.

VCB-X BACnet® Connection To MS/TP Network



Programming Note:
Use Settings Menu In LCD Display To Program The BACnet Settings. See Page 91 For Details.

MS/TP Connection To BACnet®

Typical Terminal Blocks. All Wiring To Be T To T, SHLD (G) To SHLD (G) & R To R

T - SHLD R +

Wiring Notes:

- 1.) All wiring to be in accordance with local and national electrical codes and specifications.
- 2.) All communication wiring to be 18 gauge minimum, 2 conductor twisted pair with shield. Use Belden #82760 or equivalent.

Size Transformer For Correct Total Load. VCB-X Controller = 8 VA

Figure 48: VCB-X BACnet Connection to MS/TP Network

VCB-X BACnet® Parameters

NOTE: Objects labeled AI and BI are read-only. Objects labeled AV are read/writeable. You cannot write directly to Sensor Inputs.

NOTE: When a new setpoint is received from BACnet, it is maintained and used in temporary memory until the unit reaches midnight. It is then stored in permanent memory and will become the new default setpoint even if power is cycled. Therefore, if power is cycled prior to reaching midnight, the setpoint will not have been stored in permanent memory.

BACnet® Properties for the VCB-X Controller			
Parameter	Object	Description	Limits
Application Software Version	AI: 1	Current version of the software in the unit.	
Control Mode	AI:2	Configured unit application.	See Control Mode Bits on page 104.
Control Status	AI: 3	Current Occupied/Unoccupied Status.	See Control Status Bits on page 104.
HVAC Mode	AI: 4	Current operational status.	See HVAC Mode Bits on page 104.
Control Temperature	AI: 5	Current value of the Control Temperature Sensor.	
Space Temperature	AI:6	Current value of the Space Temperature Sensor.	
Supply Air Temperature	AI:7	Current value of the Supply Air Temperature sensor.	
Coil Temperature	AI: 8	Current Coil Temperature value.	
Discharge Temperature	AI:9	Current value of the Digital Compressor Discharge Air Temperature Sensor.	
Outdoor Air Temperature	AI: 10	Current value of the Outdoor Temperature Sensor.	
Return Air Temperature	AI: 11	Current value of the Return Temperature Sensor.	
Leaving Water Temperature	AI:12	Current value of the Leaving Water Temperature Sensor.	

BACnet® Properties for the VCB-X Controller			
Parameter	Object	Description	Limits
Outdoor Air Wetbulb Temperature	AI:13	Current calculated Outdoor Wetbulb Temperature.	
Outdoor Air Dewpoint Temperature	AI:14	Current Calculated Outdoor Air Dewpoint Temperature.	
Indoor Air Humidity	AI: 15	Current value of the Indoor Humidity Sensor.	
Outdoor Air Humidity	AI:16	Current value of the Outdoor Humidity Sensor.	
Duct Static Pressure	AI:17	Current Duct Static Pressure.	
Building Pressure	AI:18	Current value of the Building Pressure Sensor.	
Suction Pressure	AI: 19	Current Suction Pressure Value.	
Head Pressure 1	AI:20	Current Value of the Head Pressure 1 Reading.	
CO ₂	AI:21	Current Indoor CO ₂ Level.	
Outdoor Airflow	AI: 22	Current Outdoor Airflow Measurement.	
Exhaust Airflow	AI:23	Current Exhaust Airflow Measurement	
Supply Airflow	AI:24	Current Supply Airflow Measurement.	
Return Airflow	AI:25	Current Return Airflow Measurement.	
Cooling Setpoint	AI:26	Occupied Cooling Mode Enable Setpoint Mirror. Adjusted by Slide Adjust and Night Offsets.	
Heating Setpoint	AI: 27	Occupied Heating Mode Enable Setpoint Mirror. Adjusted by Slide Adjust and Night Offsets.	
Supply Air Setpoint	AI: 28	Current SAT Cooling or Heating Setpoint if there is no reset source; Current calculated SAT setpoint with Reset Source.	
Coil Temperature Setpoint	AI:29	This is the current calculated Coil Suction Temperature target during Dehumidification Mode.	
Head Pressure Setpoint	AI:30	Current Head Pressure Setpoint.	

VCB-X BACnet® Parameters

BACnet® Properties for the VCB-X Controller			
Parameter	Object	Description	Limits
Indoor Humidity Setpoint	AI:31	This reflects the value set as the Low Indoor Humidity Reset Limit, which initiates Dehumidification on indoor controlled (non MUA) units.	
Economizer Position	AI: 32	Current signal percentage to the Economizer Damper.	
Fan VFD Signal	AI:33	Current Supply Fan VFD Signal.	
Modulating Heating Position	AI: 34	Current percentage of the Modulating Heating signal (Hot Water or SCR heat).	
Modulating Cooling Position	AI: 35	Current percentage of the Modulating Cooling Signal (Chilled Water or Digital Compressor).	
Building Pressure Exhaust Control Signal	AI: 36	Current Relief VFD Fan/ Damper Signal.	
Reheat Valve Position	AI:37	Current position of MHGRV Modulating Hot Gas Reheat Valve.	
Modulating Gas Valve Position	AI:38	Current position of MODGAS Modulating Gas Valve Control.	
Condenser 1 Control Signal	AI:39	Condenser 1 Fan / Water Valve Signal Status.	
Alarm Status	AI: 40	Indicates an alarm condition.	See Alarm Status Bits on page 104.
Return Bypass Damper	AI: 41	Position of Return Bypass Damper.	
Return Air Damper	AI: 42	Position of Return Air Damper if using Return Air Bypass Control.	
Superheat #1 Temperature	AI: 43	Not Used.	
Superheat #2 Temperature	AI: 44	Not Used.	
Expansion Valve #1 Position	AI: 45	Not Used.	
Expansion Valve #2 Position	AI: 46	Not Used.	
Return Air Humidity	AI: 47	Return Air Humidity Reading.	
Sensor Slide Adjust Effect	AI: 48	Amount Of Current Sensor Slide Offset	
Title 24 Economizer Feedback	AI: 49	Current position of feedback from Economizer actuator.	

BACnet® Properties for the VCB-X Controller			
Parameter	Object	Description	Limits
Head Pressure 2	AI: 50	Current Value of the Head Pressure 2 Reading.	
Condenser 2 Control Signal	AI: 51	Condenser 2 Fan/Water Valve Signal.	
Occupied Cooling Setpoint	AV: 1	If the control temperature rises one degree above this setpoint, the control will activate the cooling demand. If the control sensor is the Supply Air Sensor, then the cooling demand is always active.	1 110
Occupied Heating Setpoint	AV: 2	If the control temperature drops one degree below this setpoint, the control will activate the heating demand. If the control sensor is the Supply Air Sensor, then there is no heating demand.	1 110
Hood On Outdoor Air Cooling Setpoint	AV:3	This is the Cooling Mode Enable Setpoint used in Hood On Mode operation, Supply Air Tempering, and during Vent Mode of Space Control of High Percentage Outside Air.	1 110
Hood On Outdoor Air Heating Setpoint	AV:4	This is the Heating Mode Enable Setpoint used in Hood On Mode operation, Supply Air Tempering, and during Vent Mode of Space Control of High Percentage Outside Air.	1 110
Unoccupied Cooling Offset	AV:5	During the Unoccupied Mode of Operation, this Setpoint offsets the Occupied Cooling Setpoint up by this user-adjustable amount. If you do not want Cooling to operate during the Unoccupied Mode, use the default setting of 30°F for this setpoint.	0 30
Unoccupied Heating Offset	AV:6	During the Unoccupied Mode of Operation, this Setpoint offsets the Occupied Heating Setpoint down by this user-adjustable amount. If you do not want Heating to operate during the Unoccupied Mode, use the default setting of 30°F for this setpoint.	0 30
Mode Select Deadband	AV:7	This value is added to and subtracted from the HVAC Mode Setpoints to create a control deadband range.	0 10

VCB-X BACnet® Parameters

BACnet® Properties for the VCB-X Controller				
Parameter	Object	Description	Limits	
Max Coil Setpoint Reset Limit	AV:8	This is the highest that the Coil Temperature will be reset to during Space Humidity Reset of the Coil Suction Temperature Setpoint. If no coil temperature reset is required, this value should be set the same as the Min Coil Setpoint Reset Limit.	35	70
Min Coil Setpoint Reset Limit	AV:9	This is the lowest that the Coil Temperature will be reset to during Space Humidity Reset of the Coil Suction Temperature Setpoint. If no coil temperature reset is required, this value should be set the same as the Max Coil Setpoint Reset Limit.	35	70
Supply Air Cooling Setpoint	AV:10	Supply Air Cooling Setpoint. If Supply Air Reset is configured this is the Low SAT Cooling Reset Value.	30	80
Supply Air Heating Setpoint	AV:11	Supply Air Heating Setpoint. If Supply Air Reset is configured this is the Low SAT Heating Reset Value.	40	240
Max SAT Cooling Setpoint Reset Limit	AV: 12	If Supply Air Reset is configured this is the High SAT Cooling Reset Value.	0	100
Max SAT Heating Setpoint Reset Limit	AV: 13	If Supply Air Reset is configured this is the High SAT Heating Reset Value.	0	250
Supply Air Cooling Staging Window	AV: 14	In Cooling Mode, if the Supply Air Temperature drops below the Active Supply Air Cooling Setpoint minus this Staging Window, a Cooling Stage will be deactivated after its Minimum Run Time.	1	30
Supply Air Heating Staging Window	AV: 15	In Heating Mode, if the Supply Air Temperature rises above the Active Supply Air Heating Setpoint plus this Staging Window, a Heating Stage will be deactivated after its Minimum Run Time.	1	50

BACnet® Properties for the VCB-X Controller				
Parameter	Object	Description	Limits	
Morning Warm-Up Target Temperature	AV:16	If Morning Warm-Up is configured, upon entering the occupied mode, the Warm-up Mode will be activated if the return air temperature falls one degree below this setpoint.	50	90
Mechanical Cooling Outdoor Air Lockout	AV:17	The VCB-X will Lockout Mechanical Cooling when the Outdoor Air Temperature is below this Setpoint.	-30	100
Mechanical Heating Outdoor Air Lockout	AV:18	The VCB-X will Lockout Mechanical Heating when the Outdoor Air Temperature is above this Setpoint.	-30	150
Low Supply Air Temperature Cutoff	AV:19	Cooling will be disabled if the Supply Air Temperature falls below this value. See sequence for more details.	0	100
High Supply Air Temperature Cutoff	AV:20	Heating will be disabled if the Supply Air Temperature rises above this value. See sequence for more details.	0	250
Outdoor Air Dewpoint Setpoint	AV:21	On an MUA unit, if the OA dewpoint rises above this setpoint, Dehumidification is initiated.	35	80
Economizer Enable Setpoint	AV:22	The economizer is enabled if the outdoor drybulb, dewpoint, or wetbulb temperature falls below this setpoint.	-30	80
Heat Wheel Defrost Enable Setpoint	AV:23	The unit will go into Heat Wheel Defrost if the Outdoor Air is below this setpoint.	0	50
Preheat Setpoint	AV:24	If the Supply Fan is energized this is the temperature at which the Preheat Relay or the PREHEAT-X Controller will activate. Operates only in the Occupied Mode.	-30	70
Space Sensor Calibration Offset	AV:25	If the Space Temperature Sensor is reading incorrectly, you can use this option to enter an offset temperature to adjust the Sensor's Temperature.	-100	100
Supply Air Sensor Calibration Offset	AV:26	If the Supply Air Temperature Sensor is reading incorrectly, you can use this option to enter an offset temperature to adjust the Sensor's Temperature.	-100	100

VCB-X BACnet® Parameters

BACnet® Properties for the VCB-X Controller				
Parameter	Object	Description	Limits	
Return Air Sensor Calibration Offset	AV: 27	If the Return Temperature Sensor is reading incorrectly, you can use this option to enter an offset temperature to adjust the Sensor's Temperature.	-100	100
Outdoor Air Sensor Calibration Offset	AV: 28	If the Outdoor Temperature Sensor is reading incorrectly, you can use this option to enter an offset temperature to adjust the Sensor's Temperature.	-100	100
Coil Temperature Calibration Offset	AV:29	If the Coil Temperature value is reading incorrectly, you can use this option to enter an offset temperature to adjust the Coil Temperature Value.	-100	100
Leaving Water Sensor Calibration Offset	AV:30	If the Leaving Water Temperature Sensor is reading incorrectly, you can use this option to enter an offset temperature to adjust the Sensor's Temperature.	-100	100
CO2 Sensor Calibration Offset	AV:31	If the CO ₂ Sensor is reading incorrectly, you can use this option to enter an offset value to adjust the Sensor's CO ₂ reading.	-500	500
Low Ambient Protection Setpoint	AV:32	Temperature at which the Low Ambient Relay will activate in the Occupied or Unoccupied Mode.	-30	70
SAT Cool Setpoint Reset Source Low Limit	AV: 33	If doing Supply Air Setpoint Reset, this is the Low Reset Source value in Cooling that will correspond to the Supply Air Cool High Reset Setpoint.	-30	150
SAT Cool Setpoint Reset Source High Limit	AV: 34	If doing Supply Air Setpoint Reset, this is the High Reset Source value in Cooling that will correspond to the Supply Air Cooling Setpoint (Low Reset).	1	150
SAT Heat Setpoint Reset Source Low Limit	AV: 35	If doing Supply Air Setpoint Reset, this is the Low Reset Source value in Heating that will correspond to the Supply Air Heating High Reset Setpoint.	-30	150
SAT Heat Setpoint Reset Source High Limit	AV: 36	If doing Supply Air Setpoint Reset, this is the High Reset Source value in Heating that will correspond to the Supply Air Heating Setpoint (Low Reset).	1	150

BACnet® Properties for the VCB-X Controller				
Parameter	Object	Description	Limits	
Control Temperature High Alarm Offset	AV:37	If the temperature of the controlling sensor rises above the Occupied Cooling Setpoint by this value, a High Control Temp Alarm will occur. Only applies if configured for Space or Return Air Temp Control, or as Single Zone VAV.	0	50
Control Temperature Low Alarm Offset	AV:38	If the temperature of the controlling sensor falls below the Occupied Heating Setpoint by this value, a Low Control Temp Alarm will occur. Only applies if configured for Space or Return Air Temp Control, or as Single Zone VAV.	0	50
Heat Pump Compressor Heat Lockout	AV:39	Compressor Heat will be locked out below this setpoint.	-30	100
Minimum Main Fan VFD in Cooling Mode	AV:40	In Single Zone VAV configuration, this is the fan speed at which the VFD will start when Cooling is initiated. In a VAV configuration this is the lowest fan speed allowed in the Cooling Mode. In CAV and MUA configurations this should be set to 100%.	0	100
Minimum Main Fan VFD in Heating Mode	AV:41	In Single Zone VAV configuration, this is the fan speed at which the VFD will start when Heating is initiated. In a VAV configuration this is the lowest fan speed allowed in the Heating Mode. In CAV and MUA configurations this should be set to 100%.	0	100
Minimum Main Fan VFD in Vent Mode	AV:42	Speed at which the VFD will operate in the Vent Mode in Single Zone VAV.	0	100
Maximum Economizer in Heating Mode	AV:43	Max position the Economizer Damper can open in the Heating Mode. Takes priority over Max Position in High CO ₂ .	0	100
Minimum Economizer Position	AV:44	The minimum position of the Outdoor Air damper in the Occupied Mode. This can be reset upwards based on indoor CO ₂ levels.	0	100

VCB-X BACnet® Parameters

BACnet® Properties for the VCB-X Controller				
Parameter	Object	Description	Limits	
Maximum Economizer CO2 Reset Limit	AV:45	The maximum value the Economizer Minimum Position can be reset up to during CO2 override.	0	100
Maximum Main Fan VFD in Heat Mode	AV:46	In Single Zone VAV configuration, this is the max fan speed the VFD can modulate up to in Heat Mode.	0	100
Heat Pump Defrost Minimum Interval	AV:47	The interval that must be met between Defrost Modes.	0 Min.	120 Min
Heat Pump Adaptive Defrost Increment	AV:48	Value added to or subtracted from the Defrost Interval depending on how long the unit remains in defrost. See sequence for details.	0	30
CO ₂ Minimum Setpoint	AV:49	This is the threshold CO ₂ level at which the Economizer Min Damper Position Setpoint will begin to be reset higher.	0	2000
CO ₂ Maximum Setpoint	AV:50	This is the CO ₂ level at which the Economizer Min Damper Position will be reset to the Economizer Max Position in High CO ₂ . In between the Min and Max CO ₂ levels the Economizer Min Damper Position will be proportionally reset between the configured Min Damper Position and the Max Position in High CO ₂ .	0	2000
Indoor Humidity Setpoint Low Reset Limit	AV: 51	On indoor controlled (non MUA) units, this is the Humidity setpoint that initiates Dehumidification. During Coil Temp Reset, this is the lowest Space RH value that corresponds to the High Coil Temp Setpoint.	0	100
Indoor Humidity Setpoint High Reset Limit	AV:52	During Coil Temp Reset, this is the highest Space RH value that corresponds to the Low Coil Temp Setpoint.	0	100
Duct Static Pressure Setpoint	AV:53	Current Static Pressure Setpoint.	.10	3.0

BACnet® Properties for the VCB-X Controller				
Parameter	Object	Description	Limits	
Duct Static Pressure Control Deadband	AV:54	Value above and below the Duct Static Pressure Setpoint where no control change occurs.	.01	.5
Building Pressure Control Setpoint	AV:55	Building Pressure Setpoint.	-20	.20
Building Pressure Control Deadband	AV:56	Value above and below the Building Pressure Setpoint where no control change occurs.	.01	.1
Head Pressure Setpoint in Cooling Mode	AV:57	This is the Head Pressure Setpoint the unit will control to in the Cooling Mode.	240 PSI	420 PSI
Head Pressure Setpoint in Reheat Mode	AV:58	This is the Head Pressure Setpoint the unit will control to in the Dehumidification Reheat Mode.	240 PSI	420 PSI
Minimum Outdoor Air CFM	AV:59	Minimum Outdoor Airflow CFM Setpoint	.10K	200K
Outdoor Air CFM Proportional Window	AV:60	Controls rate of change for damper signal. As OA CFM moves further from setpoint within this window, the damper makes a larger change.	10	9999
SZ VAV Fan Speed Integral	AV:61	The Integral Constant for Single Zone VAV Fan Control.	0	10
Schedule Force	AV: 62	0 = Auto (uses controller's schedule) 1 = Forced Occupied 2 = Forced Unoccupied	0	2
HVAC Mode Override	AV: 63	Overrides normal controller operation in order to force the unit into this desired mode. Configuring for "Auto" will restore normal unit control of the mode of operation.	0=Auto 1=Vent 2=Cool 3=Heat 4=Vent Dehum. 5=Cool Dehum. 6=Heat Dehum.	
Fan VFD Override	AV: 64	Override to force the VFD to this percentage speed. Configuring "Auto" will restore normal unit control of the VFD speed.	0% 100%	Auto=65535

VCB-X BACnet® Parameters

BACnet® Properties for the VCB-X Controller				
Parameter	Object	Description	Limits	
Outdoor Air Damper Override	AV: 65	Overrides all other Outdoor Air Damper position commands so as to maintain this fixed position. Configuring for "Auto" will restore normal unit control of the Outdoor Air Damper/Economizer operation.	0%	100%
			Auto=65535	
Warm-Up Supply Air Temperature Setpoint	AV: 66	Heating will be controlled to this Supply Air Setpoint during Warm-Up.	40	240
Cool-Down Supply Air Temperature Setpoint	AV: 67	Cooling will be controlled to this Supply Air Setpoint during Cool-Down.	30	80
Minimum Condenser Position	AV: 69	If using Head Pressure control and have the EM1 Expansion Module installed and configured, this is the minimum condenser signal percentage.	0	100
Maximum Condenser Position	AV: 70	If using Head Pressure control and have the EM1 Expansion Module installed and configured, this is the maximum condenser signal percentage.	0	100
Preheat Cooling Setpoint	AV: 71	If the Preheater is enabled, and the unit is in the Cooling Mode, this setpoint will be sent to the Preheat-X Controller to control Leaving Air Temperature.	35	90
Preheat Heating Setpoint	AV: 72	If the Preheater is enabled, and the unit is in the Heating Mode, this setpoint will be sent to the Preheat-X Controller to control Leaving Air Temperature.	35	90
Preheat Venting Setpoint	AV: 73	If the Preheater is enabled, and the unit is in the Vent Mode, this setpoint will be sent to the Preheat-X Controller to control Leaving Air Temperature.	35	90
Push-Button Override Duration	AV: 74	The Push-Button Override Duration Setpoint allows you to adjust the amount of time the Override will remain in effect when the Override Button is pressed.	0	8
Cooling Enabled Status	BI: 1	Status that indicates Mechanical Cooling is enabled based on the Cooling Lockout.		

BACnet® Properties for the VCB-X Controller			
Parameter	Object	Description	Limits
Heating Enabled Status	BI: 2	Status that indicates that Mechanical Heating is enabled based on the Heating Lockout.	
Economizer Enabled Status	BI: 3	Status that indicates the Economizer is enabled based on the Economizer Enable Setpoint.	
Reheat Enabled Status	BI:4	Modulating Hotgas Reheat Enabled.	
Emergency Heat Enabled Status	BI:5	Shows the Emergency Heat is enabled based on the Compressor Heating Lockout.	
Bad Supply Air Sensor	BI: 6	Alarm that indicates a failure of the Supply Air Sensor.	
Reserved For Bad RAT Sensor	BI: 7	Not Currently Used.	
Bad Outdoor Air Sensor	BI: 8	Failure of the Outdoor Air Temperature Sensor.	
Bad Space Temp Sensor	BI: 9	Failure of the Space Temperature Sensor. If Space is the controlling sensor, the unit will shut down.	
Missing EM1 Expansion Module	BI: 10	EM1 Module is configured but not detected.	
Bad Coil Pressure Sensor	BI: 11	Failure of the Coil Pressure Sensor. Will shut unit down.	
Bad CO2 Sensor	BI: 12	Failure of the CO2 Sensor.	
Bad Discharge Sensor	BI: 13	Failure of the Digital Compressor Discharge Temperature Sensor.	
Bad Outdoor Airflow Sensor	BI: 14	An Outdoor Airflow Sensor is configured, but not detected.	
Bad Exhaust Airflow Sensor	BI: 15	An Exhaust Airflow Sensor is configured, but not detected.	
Bad Supply Airflow Sensor	BI: 16	A Supply Airflow Sensor is configured, but not detected.	
Bad Return Airflow Sensor	BI: 17	A Return Airflow Sensor is configured, but not detected.	
Bad or Missing Reheat Board	BI: 18	The MHGR board is configured but not detected.	

VCB-X BACnet® Parameters

BACnet® Properties for the VCB-X Controller			
Parameter	Object	Description	Limits
Bad or Missing MODGAS Board	BI: 19	The MODGAS board is configured but not detected.	
Bad or Missing 12 Relay Expansion Board.	BI: 20	The 12 Relay Expansion Board is configured but not detected.	
Mechanical Cooling Alarm	BI: 21	Compressor Relays are enabled but the Supply Air Temperature has not fallen 5°F w/in a user-adjustable time period. This does not apply for Modulating Cooling.	
Mechanical Heating Alarm	BI: 22	Heating Mode has been initiated but the Supply Air Temperature has not risen 5°F w/ in a user-adjustable time period. This does not apply for Modulating Heating.	
Fan Proving Alarm	BI: 23	Alarm that indicates an Air-flow failure from the Main Fan. Heating and Cooling will be disabled.	
Dirty Filter Alarm	BI: 24	Alarm that indicates the filters are dirty.	
Emergency Shutdown Alarm	BI: 25	Alarm that indicates that Emergency Shutdown has been activated. Will shut the unit down.	
High Supply Temp Cutoff Alarm	BI: 26	The Supply Air has risen above the Hi SAT Cutoff Setpoint. Heating stages begin to deactivate and the fan continues to run.	
Low Supply Temp Cutoff Alarm	BI: 27	The Supply Air has fallen below the Low SAT Cutoff Setpoint and cooling stages will begin to deactivate. If the unit is in Economizer, Vent, or Heating Mode the Supply Fan will shut off.	
High Control Mode Alarm	BI: 28	Occurs when the Controlling Sensor Temperature rises above the Cooling Mode Enable Setpoint plus the Control Mode High Alarm Offset. Applies only to Space or Return Air Temperature controlled units.	

BACnet® Properties for the VCB-X Controller			
Parameter	Object	Description	Limits
Low Control Mode Alarm	BI: 29	Occurs when the Controlling Sensor Temperature falls below the Heating Mode Enable Setpoint minus the Control Mode Low Alarm Offset. Applies only to Space or Return Air Temperature controlled units.	
Digital Compressor Cutoff Alarm	BI: 30	Occurs if the digital compressor discharge temperature rises above 268°F or the sensor is shorted. The compressor is disabled.	
Digital Compressor Lockout Alarm	BI: 31	Occurs if five Digital Compressor Cutoffs occur within four hours. The compressor will be locked out.	
High Head Pressure Alarm	BI: 32	Occurs if the Head Pressure exceeds the acceptable limit.	
Loop Water Proof of Flow Alarm	BI: 33	On a WSHP unit, occurs if water flow is not proven within a certain time limit. Compressors disabled or prevented from activating.	
Low Suction Pressure Alarm	BI: 34	On a WSHP unit, occurs if the Suction Pressure falls below the Low Suction Pressure Setpoint. Compressors disabled or prevented from activating.	
Unsafe Suction Pressure Alarm	BI: 35	On a WSHP unit, occurs if the Suction Pressure falls below the Unsafe Suction Pressure Setpoint. Compressors disabled or prevented from activating.	
Low Leaving Water Temperature Alarm	BI: 36	On a WSHP unit, occurs if the Leaving Water Temperature falls below the Low Leaving Water Temperature Setpoint while in the Heating Mode. Compressors disabled or prevented from activating.	
On Board Relay 1 Main Fan	BI: 37	Current status of Relay 1 on VCB-X Main Board.	
On Board Relay 2	BI: 38	Current status of Relay 2 on VCB-X Main Board.	
On Board Relay 3	BI: 39	Current status of Relay 3 on VCB-X Main Board.	

VCB-X BACnet® Parameters

BACnet® Properties for the VCB-X Controller			
Parameter	Object	Description	Limits
On Board Relay 4	BI: 40	Current status of Relay 4 on VCB-X Main Board.	
On Board Relay 5	BI: 41	Current status of Relay 5 on VCB-X Main Board.	
On Board Relay 6	BI: 42	Current status of Relay 6 on VCB-X Main Board.	
Expansion Module Relay 1	BI:43	Current status of Relay 1 on the EM1 Expansion Module.	
Expansion Module Relay 2	BI:44	Current status of Relay 2 on the EM1 Expansion Module.	
Expansion Module Relay 3	BI:45	Current status of Relay 3 on the EM1 Expansion Module.	
Expansion Module Relay 4	BI:46	Current status of Relay 4 on the EM1 Expansion Module.	
Expansion Module Relay 5	BI:47	Current status of Relay 5 on the EM1 Expansion Module.	
12 Relay Expansion Module Relay 1	BI:48	Current status of Relay 1 on the 12 Relay Expansion Module.	
12 Relay Expansion Module Relay 2	BI:49	Current status of Relay 2 on the 12 Relay Expansion Module.	
12 Relay Expansion Module Relay 3	BI:50	Current status of Relay 3 on the 12 Relay Expansion Module.	
12 Relay Expansion Module Relay 4	BI:51	Current status of Relay 4 on the 12 Relay Expansion Module.	
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12 Relay Expansion Module Relay 6	BI:53	Current status of Relay 6 on the 12 Relay Expansion Module.	
12 Relay Expansion Module Relay 7	BI:54	Current status of Relay 7 on the 12 Relay Expansion Module.	
12 Relay Expansion Module Relay 8	BI:55	Current status of Relay 8 on the 12 Relay Expansion Module.	
12 Relay Expansion Module Relay 9	BI:56	Current status of Relay 9 on the 12 Relay Expansion Module.	

BACnet® Properties for the VCB-X Controller			
Parameter	Object	Description	Limits
12 Relay Expansion Module Relay 10	BI:57	Current status of Relay 10 on the 12 Relay Expansion Module.	
12 Relay Expansion Module Relay 11	BI:58	Current status of Relay 11 on the 12 Relay Expansion Module.	
12 Relay Expansion Module Relay 12	BI:59	Current status of Relay 12 on the 12 Relay Expansion Module.	
Reheat Expansion Board FAN Relay	BI:60	Current status of Reheat Board Relay 1.	
Reheat Expansion Board COMP Relay	BI:61	Current status of Reheat Board Relay 2.	
Reheat Expansion Board VALVE Relay	BI:62	Current status of Reheat Board Relay 3.	
Reheat Expansion Board AUX Relay	BI:63	Current status of Reheat Board Relay 4.	
MODGAS-X Controller Fan Relay	BI:64	Current Status of the Fan Relay on the MODGAS-X Controller.	
MODGAS-X Controller Low Speed Relay	BI:65	Current Status of the Low Speed Relay on the MODGAS-X Controller.	
MODGAS-X Controller AUX 1 Relay	BI:66	Current Status of the AUX 1 Relay on the MODGAS-X Controller.	
MODGAS-X Controller AUX 2 Relay	BI:67	Current Status of the AUX 2 Relay on the MODGAS-X Controller.	
Title 24 Sensor Alarm	BI:68	Outside Air or Supply Air Temperature Sensor is shorted or missing.	
Title 24 Not Economizing When It Should	BI:69	Economizer is enabled but not following the desired Economizer position commanded.	
Title 24 Economizing When It Should Not	BI:70	Economizer is not enabled but the feedback signal indicates a position more open than the minimum.	
Title 24 Damper Failure	BI:71	Economizer is enabled but not within 10% of desired position within 150 seconds.	
Title 24 Excess Outdoor Air	BI:72	Economizer feedback is lost or Economizer is not following commanded position.	

VCB-X BACnet® Parameters**VCB-X BACnet® Property Identifier:****BACNETPropertyIdentifier :****VcbxControlModeBits ::= ENUMERATED {**

Constant Volume Mode	(1),
Supply Air Cooling Only	(2),
Outdoor Temperature Control	(3),
Single Zone VAV	(4),
Supply Air Tempering	(5),
Space Temperature Control w/ High OA Content	(6),
}	

VcbxControlStatusBits ::= ENUMERATED {

Unoccupied	(0)
Occupied	(1),
Override Mode	(2),
Holiday Unoccupied	(3),
Holiday Occupied	(4),
Forced Occupied	(5),
Forced Unoccupied	(6),
Remote Contact Occupied	(7),
Zone Heat Demand (Not applicable on BACnet system)	(8),
Zone Cool Demand (Not applicable on BACnet system)	(9),
Zone Override (Not applicable on BACnet system)	(10),
Hot Water Lockout (May only be available on custom code)	(11)
}	

VcbxHVACModeStatusBits ::= ENUMERATED {

Off	(0),
Vent Mode	(1),
Cooling Mode	(2),
Heating Mode	(3),
Vent RH Mode	(4),
Cooling RH Mode	(5),
Heating RH Mode	(6),
Warm Up Mode	(7),
Defrost Mode	(8),
Purge Mode	(9),
Cool Down Mode	(10),

Remote Cooling Mode	(11),
Remote Heating Mode	(12),
Remote Vent Dehum	(13),
Remote Cool Dehum	(14),
Remote Heat Dehum	(15)
}	

VcbxAlarmStatusBits ::= BIT STRING {

Bad Supply Air Sensor	(0),
Bad Return Air Sensor	(1),
Bad Outside Air Sensor	(2),
Bad Space Sensor	(3),
Missing EM1 Module	(4),
Bad Coil Temp Sensor	(5),
Bad Co2 Sensor	(6),
Bad Discharge Sensor	(7),
Bad OA CFM Sensor	(8),
Bad Exhaust CFM Sensor	(9),
Bad Supply CFM Sensor	(10),
Bad Return CFM Sensor	(11),
Bad or Missing Reheat Module	(12),
Bad or Missing ModGas Module	(13),
Bad or Missing 12 Relay Expansion Module	(14)
Mechanical Cooling Failure	(15),
Mechanical Heating Failure	(16),
Fan Proving Alarm	(17),
Dirty Filter Alarm	(18),
Emergency Shutdown Alarm	(19)
High Supply Air Temp Cutoff	(20),
Low Supply Air Temp Cutoff	(21),
High Control Mode Signal Alarm	(22),
Low Control Mode Signal Alarm	(23),
Digital Compressor Cutoff Alarm	(24),
Digital Compressor Lockout Alarm	(25),
High Head Pressure	(26)
Loop Water Proof of Flow Alarm	(27)
Low Suction Pressure Alarm	(28)
Unsafe Suction Pressure Alarm	(29)
Low Leaving Water Temperature Alarm	(30)
}	



BACnet® Protocol Implementation Conformance Statement

Vendor		Listing Status
WattMaster Controls, Inc. 8500 NW River Park Drive, Suite 108A Parkville, MO 64152 USA		Listed Product
Test Requirements	BACnet® Protocol Revision	Date Tested
Requirements as of December 2011	Revision 12 (135-2010)	April 2013

Product Name	Model Number	Software Version
VCB-X Controller	OE335-26B-VCBX	2.13

BACnet® Standardized Device Profile (Annex L)
BACnet Application Specific Controller (B-ASC)

BIBBs Supported		
Data Sharing	ReadProperty-B	DS-RP-B
	ReadPropertyMultiple-B	DS-RPM-B
	WriteProperty-B	DS-WP-B

Device and Network Management	Dynamic Device Binding-B	DM-DDB-B
	Dynamic Object Binding-B	DM-DOB-B
	DeviceCommunication Control-B	DM-DCC-B

Object Type Support		
Device	Analog Input	Analog Value
Binary Input	Binary Value	
Device does not support CreateObject, DeleteObject, and there are no Proprietary Properties.		

Data Link Layer Options	
Media	Options
MS/TP Master	9600,19200, 38400, 57600, 76800

Character Set Support
ANSI X3.4

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