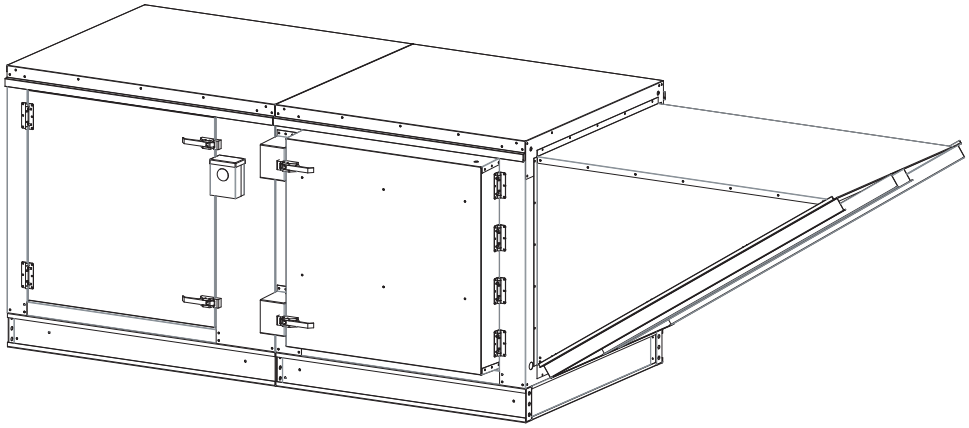
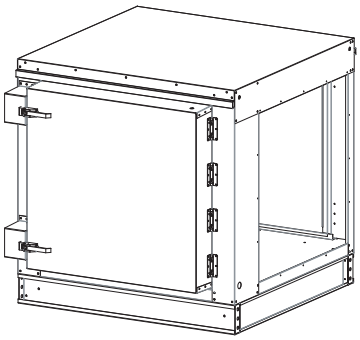
MUA Controls

Standard and Modular Electric Heater and Inserts

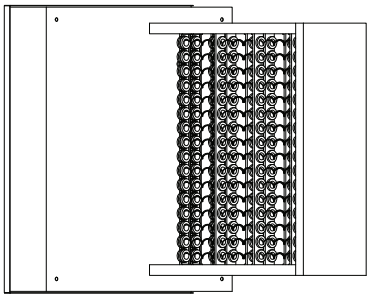
Installation, Operation, and Maintenance Manual



Modular Electric Heater



Electric Heat Module



Electric Insert

RECEIVING AND INSPECTION

Upon receiving unit, check for any interior and exterior damage, and if found, report it immediately to the carrier. Also check that all accessory items are accounted for and are damage free.

WARNING!!

Installation of this equipment should only be performed by a qualified professional who has read and understands these instructions and is familiar with proper safety precautions. Improper installation poses serious risk of injury due to electric shock and other potential hazards. Read this manual thoroughly before installing or servicing this equipment. ALWAYS disconnect power prior to working on equipment.

Save these instructions. This document is the property of the owner of this equipment and is required for future maintenance. Leave this document with the owner when installation or service is complete.

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WARRANTY

This equipment is warranted to be free from defects in materials and workmanship, under normal use and service, for a period of 2-years from date of shipment. This warranty shall not apply if:

1. The equipment is not installed by a qualified installer per the MANUFACTURER'S installation instructions shipped with the product.
2. The equipment is not installed in accordance with Federal, State, and Local codes and regulations.
3. The equipment is misused, neglected, or not maintained per the MANUFACTURER'S maintenance instructions.
4. The equipment is not installed and operated within the limitations set forth in this manual.
5. The invoice is not paid within the terms of the sales agreement.

The MANUFACTURER shall not be liable for incidental and consequential losses and damages potentially attributable to malfunctioning equipment. Should any part of the equipment prove to be defective in material or workmanship within the 2-year warranty period, upon examination by the MANUFACTURER, such part will be repaired or replaced by MANUFACTURER at no charge. The BUYER shall pay all labor costs incurred in connection with such repair or replacement. Equipment shall not be returned without MANUFACTURER'S prior authorization, and all returned equipment shall be shipped by the BUYER, freight prepaid to a destination determined by the MANUFACTURER.

NOTE: To receive warranty coverage for this product, copy and print out the "Start-Up and Maintenance Documentation" on page 60. Fill in all required details. Fax the page to 1-919-516-8710 or call 1-866-784-6900 for email information.

Patents

This product may be covered by one or more of the following patent number(s): (United States) 6629523, or other U.S. and foreign patents pending.

INSTALLATION

It is imperative that this unit is installed and operated with the designed airflow and electrical supply in accordance with this manual. If there are any questions about any items, please call the service department at **1-866-784-6900** for warranty and technical support issues.

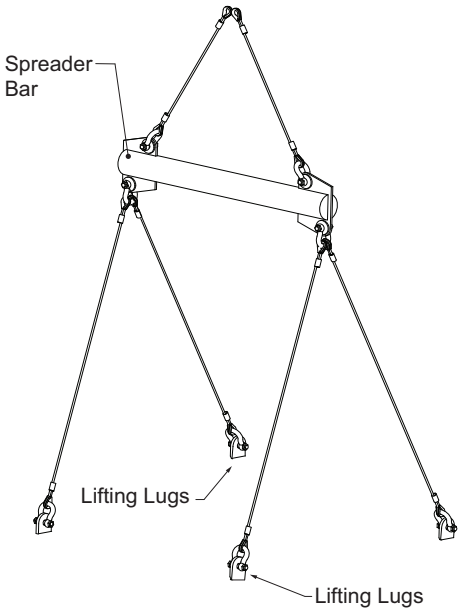
Mechanical

WARNING: DO NOT RAISE UNIT BY THE INTAKE HOOD, BLOWER, MOTOR SHAFT, OR BEARINGS. USE ALL LIFTING LUGS PROVIDED WITH A SPREADER BAR OR SLING UNDER THE UNIT.

Site Preparation

1. Provide clearance around installation site to safely rig and lift equipment into its final position (**Figure 1**). Supports must adequately support equipment. Refer to manufacturer's estimated weights.
2. Locate unit close to the space it will serve to reduce long, twisted duct runs.
3. Consider general service and installation space when locating unit.
4. Do not allow air intake to face prevailing winds. Support unit above ground or at roof level high enough to prevent precipitation from being drawn into its inlet. The inlet must also be located at least 10 feet away from any exhaust vents. The fan inlet shall be located in accordance with the applicable building code provisions for ventilation air.

Figure 1 - Spreader Bar



Service Clearance

Refer to **Table 1** for unit size clearance specifications. This will allow for enough clearance in the front, back, and sides of the unit for servicing and maintenance of the unit.

Table 1 - Clearance Chart

Unit Size	Clearance
1	24”
2	36”
3	42”
4	48”
5	54”

Common Electric Heater Calculations

Conversion:
1 KW = 3413

Load Requirement:
KW = (CFM x Temperature Rise) / 3160

Line Current (1 Phase):
Amperage = (KW x 1000) / Volts

Applied vs Rated KW Factors

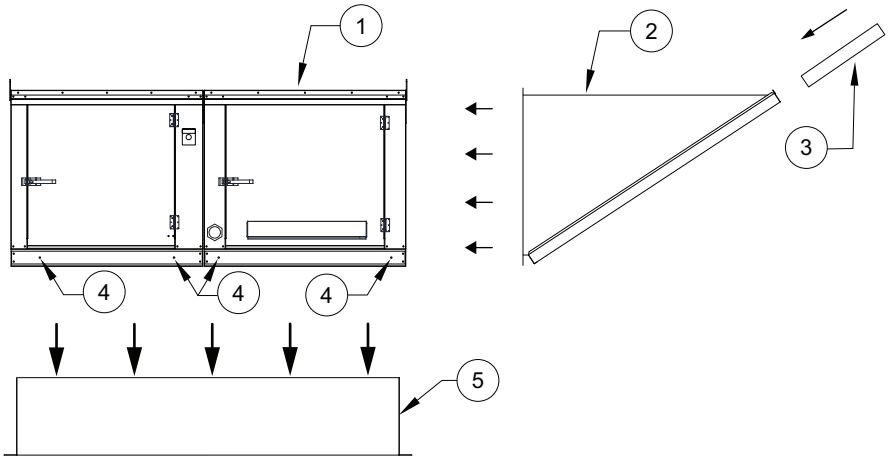
Rated Voltage	Applied Voltage							
	200	208	220	230	240	440	460	480
208	.92	1.00	1.12	1.22	1.33	-	-	-
460	-	-	-	-	-	.91	1.00	1.09
480	-	-	-	-	-	.84	.92	1.00

Intake Assembly

Intakes and curbs (**Figure 2**) are shipped on a separate skid. Upon unit arrival, perform the following steps to assemble the intake to the unit.

1. Apply silicone or weather-proof gasket on the backside of the flanges of the intake hood or V-bank intake.
2. Secure the flanges of the intake hood to the unit with the supplied sheet metal screws.
3. Use caulk on the outside of the screws to prevent water leaks.
4. If the unit is a modular unit with a V-bank or evaporative cooler section, the V-bank or evaporative cooler will bolt to the heater with the bolts provided.
5. Slide the filters down the filter track.

Figure 2 - Intake and Curb Assembly



1. Unit
2. Intake Housing
3. Intake Filter(s)
4. Unit to Curb hardware mounting location
5. Curb

Curb and Ductwork

This fan was specified for a specific CFM and static pressure. The ductwork attached to this unit will significantly affect airflow performance. When using rectangular ductwork, elbows must be radius throat, radius back with turning vanes. Flexible ductwork and square elbows should not be used. Any transitions and/or turns in the ductwork near the fan outlet will cause system effect. System effect will drastically increase the static pressure and reduce airflow.

- **Table 2** displays the minimum fan outlet duct sizes and straight lengths required for optimal fan performance.
- Do not use the unit to support ductwork in any way. This may cause damage to the unit.
- **Follow SMACNA guides and manufacturer's requirements for the remaining duct run.** Fans designed for rooftop installation should be installed on a prefabricated or factory-built roof curb.
- Follow curb manufacturer’s instructions for proper curb installation.
- The unit should be installed on a curb and/or rail that meets local code height requirements.
- Make sure the duct connection and fan outlet are properly aligned and sealed.
- Secure fan to curb through vertical portion of the ventilator base assembly flange. Use a minimum of eight (8) lug screws, anchor bolts, or other suitable fasteners (not furnished). Shims may be required depending upon curb installation and roofing material.
- Verify all fasteners are secure. **Figure 3** through **Figure 5** show different mechanical installations.

Table 2 - Required Supply Ductwork

Blower Size (Inches)	Discharge	Duct Size	Straight Duct Length*
10	Side	14” x 14”	48”
	Down		
15D, 16Z, 18Z	Side	20” x 20”	72”
	Down	14” x 14”	48”
12	Side	16” x 16”	54”
	Down		
15	Side	20” x 20”	72”
	Down		
20D, 20Z, 22Z	Side	26” x 26”	108”
	Down	20” x 20”	72”
18	Side	24” x 24”	86”
	Down		
24D, 25Z	Side	30” x 30”	108”
	Down	24” x 24”	86”
20	Side	26” x 26”	108”
	Down		
30D, 28Z	Side	32” x 32”	168”
	Down	26” x 26”	108”
25	Side	32” x 32”	168”
	Down		
36D	Side	36” x 36”	189”
	Down	32” x 32”	168”

WARNING: ELECTRIC HEATERS HAVE TWO POWER INPUTS. THE EXTERNAL DISCONNECT INTERRUPTS POWER TO THE MOTOR AND CONTROLS ONLY. THE ELECTRIC COIL POWER IS INTERRUPTED BY THE DISCONNECT SWITCH ON THE ELECTRIC COIL DOOR.

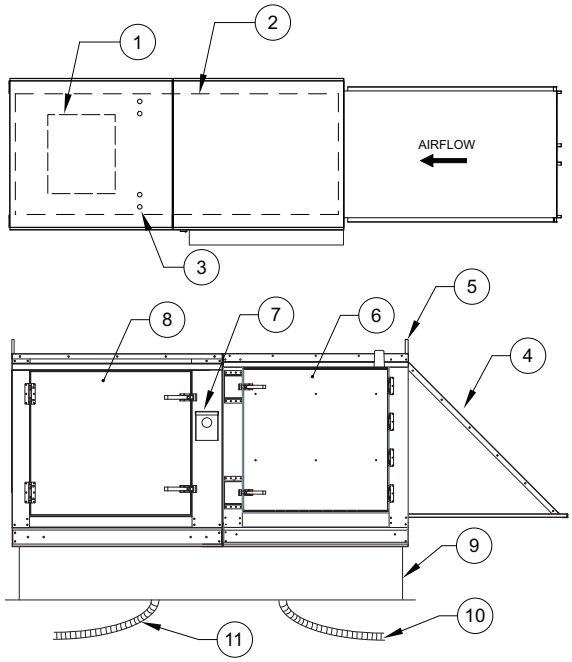
Roof Mount Installation

Note: Refer to submittal drawings for specific unit dimensions.

Figure 3 - Roof Mount Details

1. Discharge Opening
2. Curb Outer Wall
3. Flex Conduit for Field Wiring
4. Intake Housing
5. Lifting Lugs
6. Electric Heat Module
7. Service Disconnect Switch
8. Blower/Motor Access Door
9. Curb with Support Legs or Rail (20” High)
10. Control Drop
11. Motor Drop

Max. Roof Opening 2” Smaller than Curb Outside Dimension.

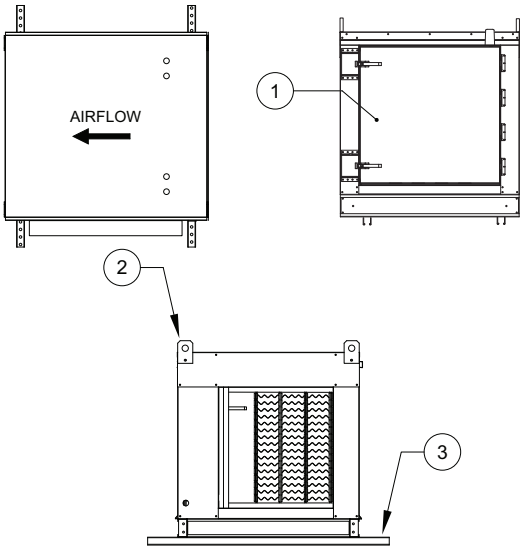


Duct Mount Installation

Note: Refer to submittal drawings for specific unit dimensions.

Figure 4 - Duct Mount Details

1. Control/Coil Access Door
2. Lifting Lugs
3. Optional Uni-Strut Base



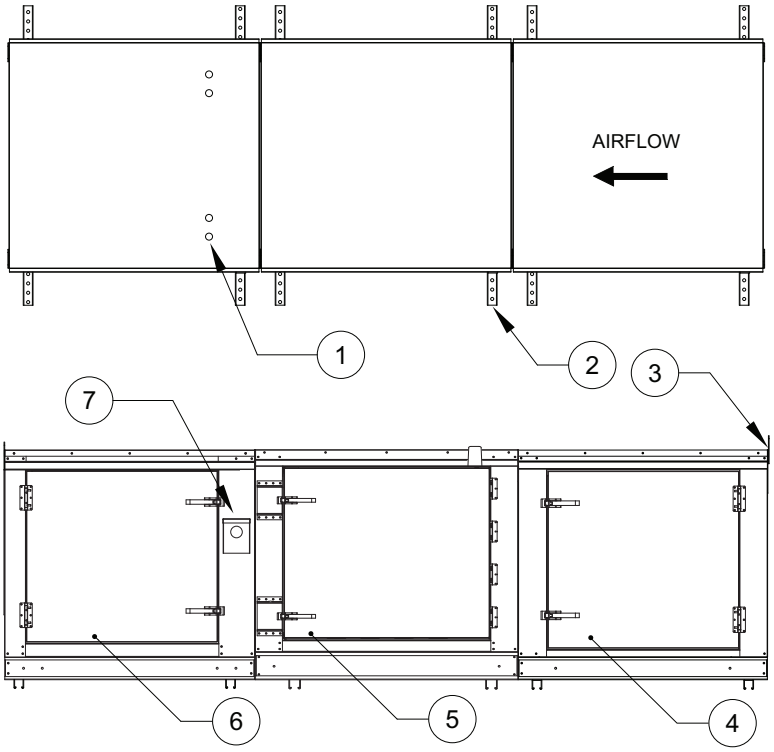
WARNING: ELECTRIC HEATERS HAVE TWO POWER INPUTS. THE EXTERNAL DISCONNECT INTERRUPTS POWER TO THE MOTOR AND CONTROLS ONLY. THE ELECTRIC COIL POWER IS INTERRUPTED BY THE DISCONNECT SWITCH ON THE ELECTRIC COIL DOOR.

Indoor (Inline) Installation

Note: Refer to submittal drawings for specific unit dimensions.

Figure 5 - Indoor Installation Details

1. Flex Conduit for Field Wiring
2. Optional Uni-Strut Base
3. Lifting Lugs
4. Filter Access Door
5. Electric Heat Module
6. Blower/Motor Access Door
7. Service Disconnect Switch

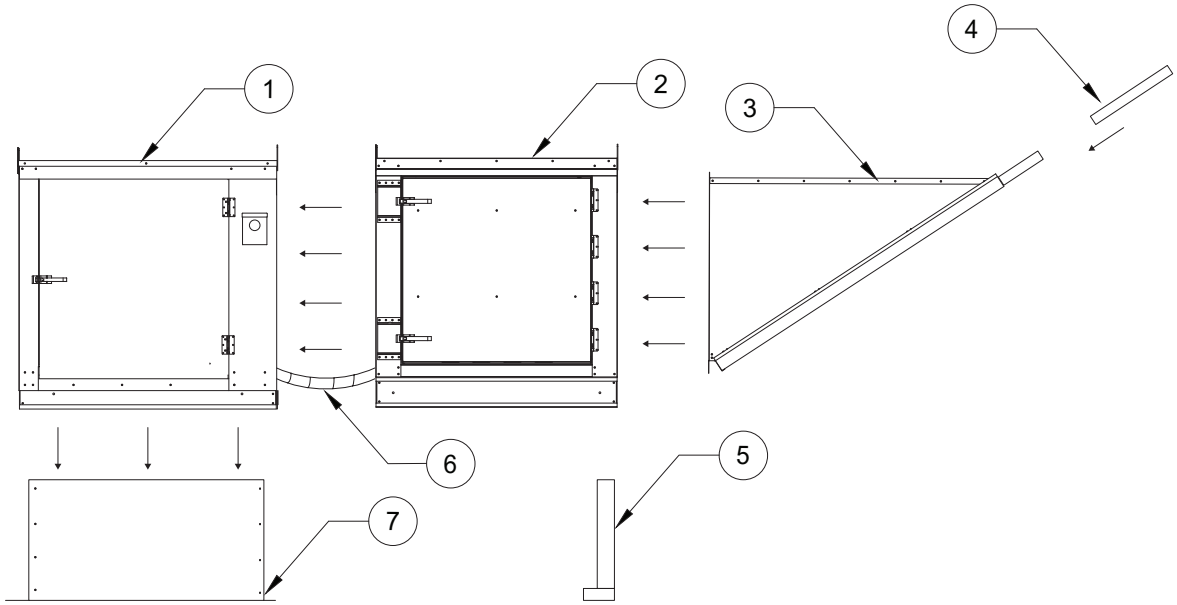


Heat Module Add-On Installation

Modular heat units (**Figure 6**) that are ordered to provide heat onto an existing blower only application require field mechanical and wiring installation.

1. Remove existing intake housing and lifting lugs from the blower section intake side.
2. Attach heat module to blower intake using the provided sheet metal screws and bolts. Tighten screws and bolts to compress the gasket between the heat module and the blower module.
3. Support and level the end of the heat module (opposite end of the blower) with the provided equipment legs/rails.
4. Attach the intake housing to the intake side of the heater module.
5. Drill a hole in the discharge of the blower large enough to insert the discharge control sensor (if provided). Install the sensor through the hole.
6. Wire the sensor and coil as indicated on the supplied wiring schematic. Route all wiring through metal conduit.
7. After the add-on installation is complete, refer to **“Unit Start-up Procedure” on page 43**.

Figure 6 - Heat Module



1. Blower
2. Electric Heat Module
3. Intake Housing
4. Filters
5. Equipment Legs
6. Conduit
7. Curb

Electrical

WARNING!
Disconnect power before installing or servicing unit. High voltage electrical input is needed for this equipment. A qualified electrician should perform this work.

Before connecting power to the heater, read and understand the entire section of this document. As-built wiring diagrams are furnished with each unit by the factory and are attached to the control module's door or provided with paperwork packet.

Electrical wiring and connections must be made in accordance with local ordinances and the National Electric Code, ANSI/NFPA 70. Verify the voltage and phase of the power supply. Confirm the wire amperage capacity is in accordance with the unit nameplate. For additional safety information, refer to AMCA publication 410-96, *Recommended Safety Practices for Users and Installers of Industrial and Commercial Fans.*

1. **Always disconnect power before working on or near this equipment. Lock and tag the disconnect switch and/or breaker to prevent accidental power-up**.
2. An electrical drop containing the line voltage power wiring is shipped with every unit. The electrical drop should be brought through one of the conduit openings located in the base of the unit (**Figure 3**), run through the curb, and connected to a junction box inside the building.
3. A dedicated branch circuit should supply the motor circuit with short circuit protection according to the National Electric Code. This dedicated branch should run to the junction box. Every branch circuit should include a properly sized ground connection.
4. A **separate power source should supply the electric coil power**. Power from the building breaker should be wired directly to the coil disconnect. This should be done using wire of the proper gauge as indicated in **Table 3**. **A hole must be drilled in the fan enclosure to properly run the electric coil power**.
5. Verify that the power source is compatible with the requirements of your equipment. The nameplate identifies the **proper phase and voltage** of the equipment.
6. Units shipped with a remote HMI will require a second drop through the base of the unit. It is important to route the motor wires in a separate conduit from the HMI wiring. Refer to **Figure 3**.
7. Before connecting the unit to the building's power source, verify that the power source wiring is de-energized. Refer to schematics.
8. Secure the power cable to prevent contact with sharp objects. Verify ground connection is secure.
9. Do not kink power cable and never allow the cable to encounter oil, grease, hot surfaces, or chemicals.
10. Before powering up the unit, make sure that the fan rotates freely. Make sure that the interior of the unit is free of loose debris or shipping materials.
11. If any of the original wire supplied with the unit must be replaced, it must be replaced with type THHN wire or equivalent.

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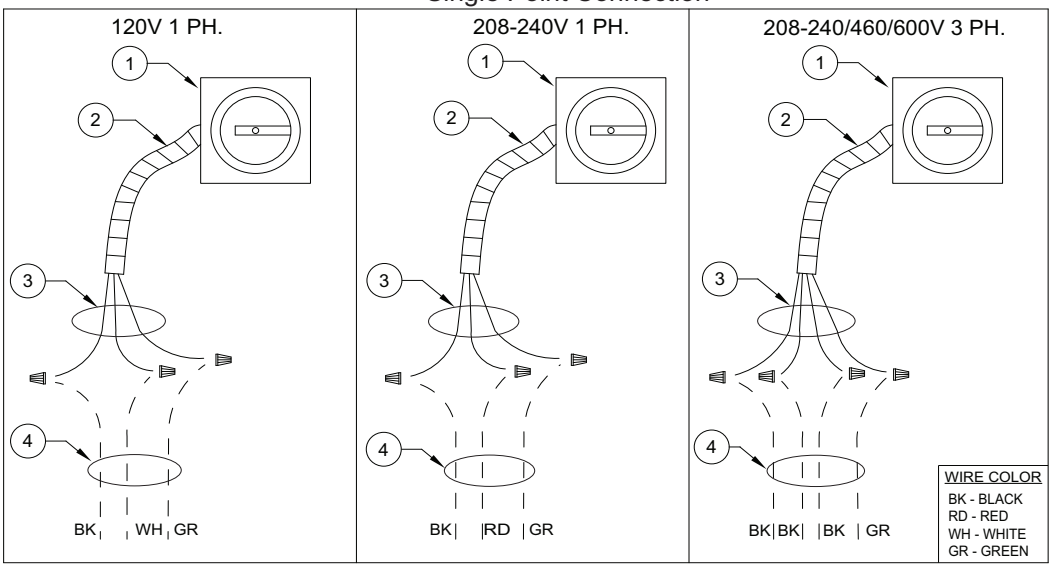
Table 3 - Copper Wire Ampacity

Wire Size AWG	Maximum Amps
14	15
12	20
10	30
8	50
6	65
4	85
3	100
2	115
1	130
1/0	150
2/0	175
3/0	200
4/0	230
250	255
300	285
350	310
400	335
500	380
600	420

Fan to Building Wiring Connection

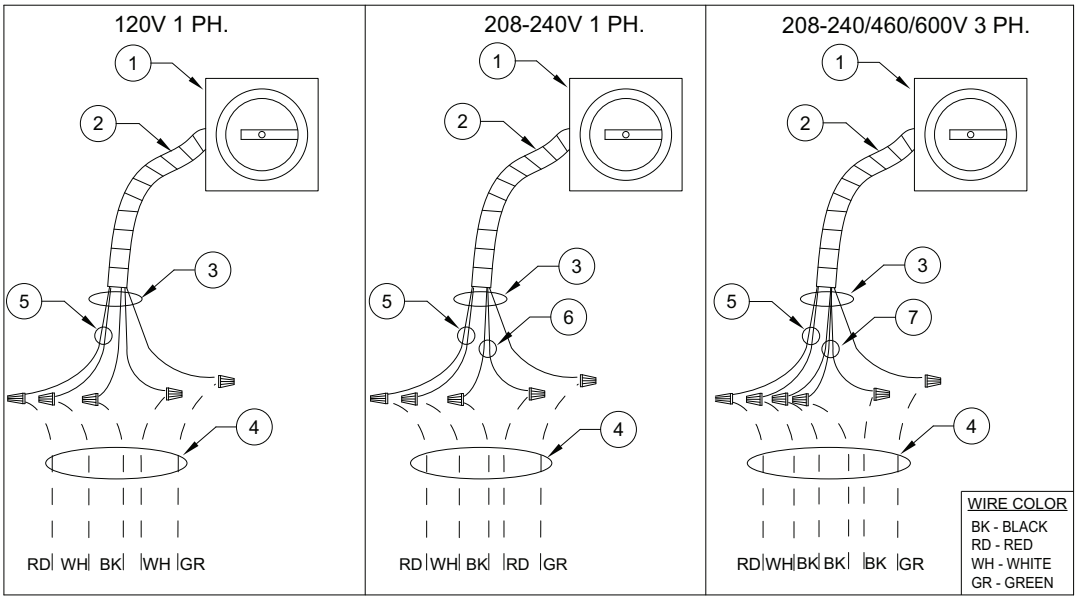
Figure 7 - Wiring Connection Details

Single Point Connection



1. Disconnect Switch
2. Galflex Conduit (In Unit)
3. Factory Wiring
4. Field Supplied Wiring - From building power or pre-wired control panel.

120V Optional

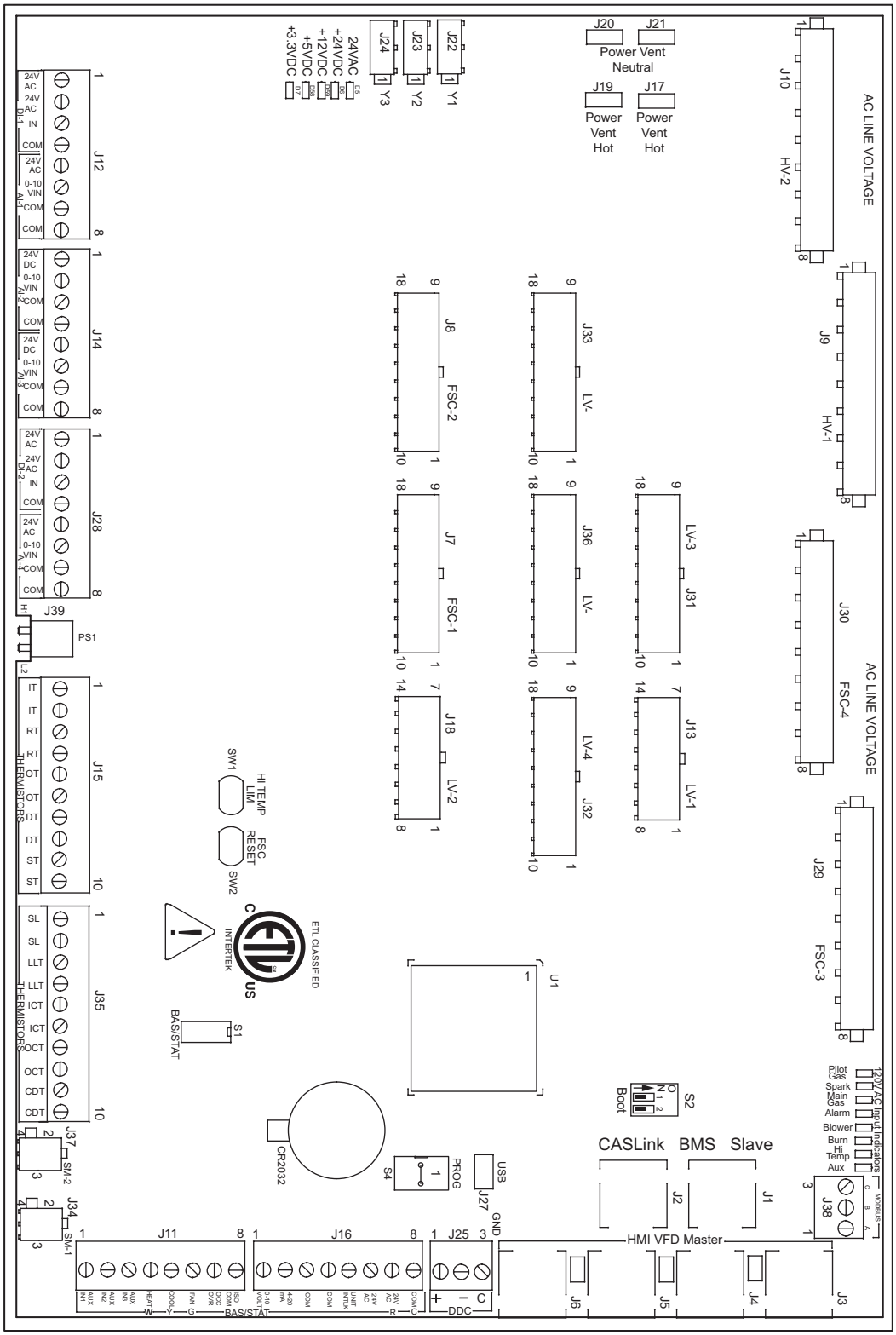


1. Disconnect Switch
2. Galflex Conduit (In Unit)
3. Factory Wiring
4. Field Supplied Wiring - From building power or pre-wired control panel.
5. 120V Single Phase Standing Power
6. 208-240 Single Phase
7. Three Phase

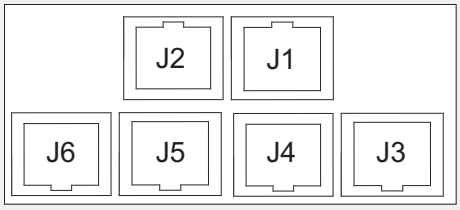
Make-up Air (MUA) Board Connectors

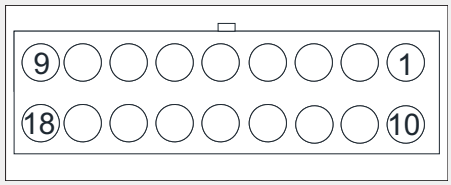
The Make-up Air (MUA) Board (**Figure 8**) is located in the main control cabinet.

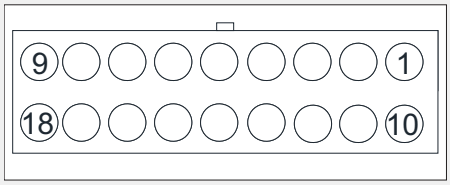
Figure 8 - Make-up Air Board

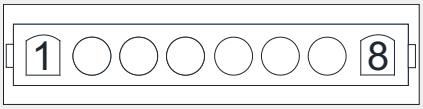


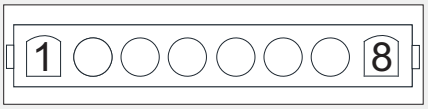
Note: Some connections may not be used dependent on system configurations

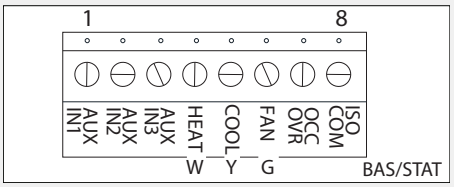
RJ45 connectors. **Connector J1** and **J2** are associated with BMS. **Connector J3** through **J6** are interchangeable and may be used to connect to an HMI or VFD.	
J1 - CASLink/Slave **J2** - CASLink/Slave **J3** - HMI/VFD/Master	**J4** - HMI/VFD/Master **J5** - HMI/VFD/Master **J6** - HMI/VFD/Master

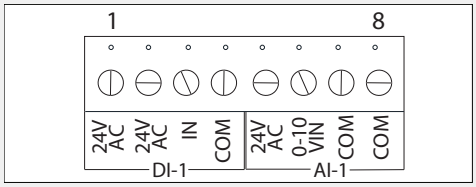
Connector J7 - FSC-1	
Pin 1 - Electric Heat Dry Contact **Pin 2** through **Pin 9** - N/A	**Pin 10** - Electric Heat Dry Contact

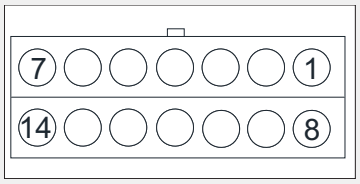
Connector J8 - N/A	

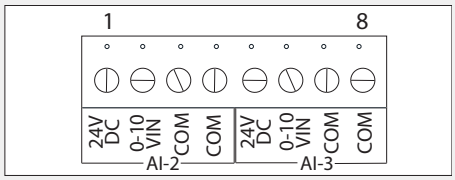
Connector J9 contains 120V AC connections	
Pin 1 - 120VAC Main Input **Pin 2** - 120VAC Input from Discharge Damper End Switch **Pin 3** - 120VAC Input from Fire Micro-Switch **Pin 4** - 120VAC Output to Intake/Discharge Damper Actuator	**Pin 5** - 120VAC Input from Intake Damper End Switch **Pin 6** - N/A **Pin 7** - 120VAC Output to Cabinet Heater **Pin 8** - 120VAC Neutral

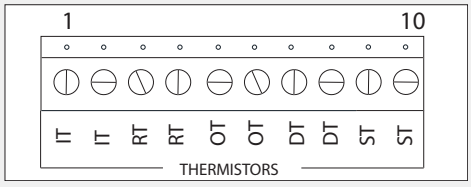
Connector J10 contains 120V AC connections	
Pin 1 - 120VAC Input from Evap Cooler Pressure Switch **Pin 2** - 120VAC Input from Evap Cooler Float Switch **Pin 3** - 120VAC Output to Evap Cooler Water Solenoid **Pin 4** - 120VAC Output to Evap Cooler 3-way Drain Valve	**Pin 5** - 120VAC Input from Supply Overload **Pin 6** - 120VAC Output to Supply Starter Coil **Pin 7** - 120VAC Output to Exhaust Starter Coil **Pin 8** - 120VAC Input from Exhaust Overload

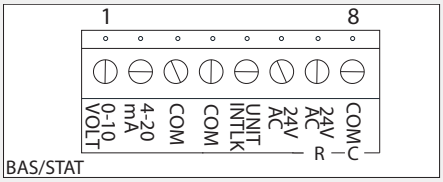
Connector J11 contains low voltage screw terminal connections	
Pin 1 - 24VAC Auxiliary Input **Pin 2** - 24VAC Auxiliary Input **Pin 3** - 24VAC Auxiliary Input **Pin 4** - 24VAC Call for Heat Input/Burner Interlock	**Pin 5** - 24VAC Call for Cooling Input/AC Interlock **Pin 6** - 24VAC Call for Blower Input **Pin 7** - 24VAC Occupied Override Input **Pin 8** - 24VAC Isolated Common

Connector J12 contains low voltage screw terminal connections	
Pin 1 - 24VAC Output to Smoke Detector **Pin 2** - 24VAC Output to Smoke Detector **Pin 3** - 24VAC Digital Input from Smoke Detector **Pin 4** - 24VAC Common to Smoke Detector	**Pin 5** - 24VAC Output to Air Quality Sensor **Pin 6** - 0-10V Analog Input from Air Quality Sensor **Pin 7** - 24VAC Common to Air Quality Sensor **Pin 8** - 24VAC Common to Air Quality Sensor

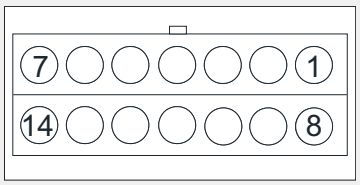
Connector J13 contains low voltage connections	
Pin 1 - N/A **Pin 2** - PWM + Output for Supply ECM **Pin 3** - N/A **Pin 4** - N/A **Pin 5** - 24VAC Output for Clogged Filter Switch **Pin 6** - 24VAC Output for Low Airflow **Pin 7** - 24VAC Input for Board Power	**Pin 8** - N/A **Pin 9** - PWM Output for Supply ECM **Pin 10** - N/A **Pin 11** - N/A **Pin 12** - 24VAC Input from Clogged Filter Switch **Pin 13** - 24VAC Input from Low Air Pressure Switch **Pin 14** - 24VAC for Board Power

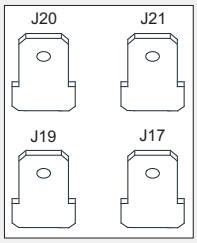
Connector J14 contains screw terminal connections	
Pin 1 - 24VAC Output to Humidity Sensor **Pin 2** - 0-10VDC Analog Input from Humidity Sensor **Pin 3** - 24VAC Common to Humidity Sensor **Pin 4** - 24VAC Common to Humidity Sensor	**Pin 5** - 24VAC Output to Humidity Sensor **Pin 6** - 0-10VDC Analog Input VFD/Humidity Sensor **Pin 7** - 24VAC Common VFD/Humidity Sensor **Pin 8** - 24VAC Common to Humidity Sensor

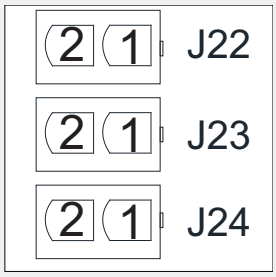
Connector J15 contains low voltage connections	
Pin 1 - Intake Temperature Thermistor Input **Pin 2** - Intake Temperature Thermistor Input **Pin 3** - Return Temperature Thermistor Input **Pin 4** - Return Temperature Thermistor Input **Pin 5** - Outdoor Temperature Thermistor Input	**Pin 6** - Outdoor Temperature Thermistor Input **Pin 7** - Discharge Temperature Thermistor Input **Pin 8** - Discharge Temperature Thermistor Input **Pin 9** - Space Temperature Thermistor Input **Pin 10** - Space Temperature Thermistor Input

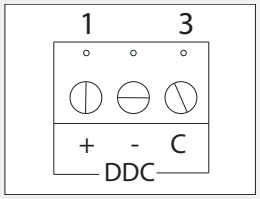
Connector J16 contains low voltage screw terminal connections	
Pin 1 - 0-10VDC Analog Input for Heat Modulation **Pin 2** - 4-20 mA Analog Input for Heat Modulation **Pin 3** - 24VAC Common **Pin 4** - 24VAC Common	**Pin 5** - 24VAC Unit Interlock Input **Pin 6** - 24VAC Output (Stat) **Pin 7** - 24VAC Output (R) **Pin 8** - 24VAC Common

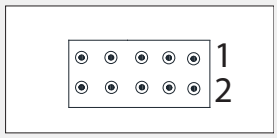
NOTE: Connector J17 is grouped with connectors J-19 through J-21

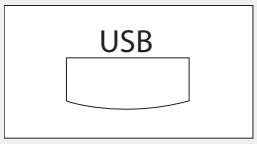
Connector J18 contains low voltage connections	
Pin 1 - 24VDC + Output **Pin 2** - 0-10VDC Analog Output for Mixing Box Actuator **Pin 3** - N/A **Pin 4** - 24VAC Output for DX Float Switch **Pin 5** - 24VAC Output for Door Interlock **Pin 6** - 24VAC Warm Liquid Bypass Output **Pin 7** - 24VAC for Damper Actuator	**Pin 8** - 24VDC - Common **Pin 9** - Common for Mixing Box Actuator **Pin 10** - N/A **Pin 11** - 24VAC Input from DX Float Switch **Pin 12** - 24VAC Input from Door Interlock **Pin 13** - 24VAC Warm Liquid Bypass Output Common **Pin 14** - 24VAC for Damper Actuator

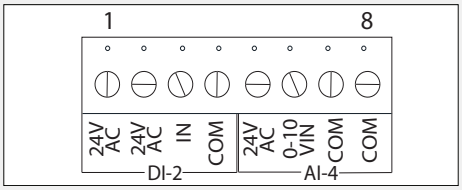
Connector J17 - N/A **Connector J19** - N/A **Connector J20** - N/A **Connector J21** - N/A	

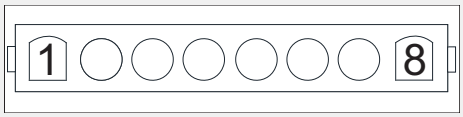
Connector J22 (Y1) Condenser 1 **Connector J23** (Y2) Condenser 2 **Connector J24** (Y3) Condenser 3	
J22 Pin 1 - 24VAC Output to Condenser 1 **J22 Pin 2** - 24VAC Common to Condenser 1 **J23 Pin 1** - 24VAC Output to Condenser 2	**J23 Pin 2** - 24VAC Common to Condenser 2 **J24 Pin 1** - 24VAC Output to Condenser 3 **J24 Pin 2** - 24VAC Common to Condenser 3

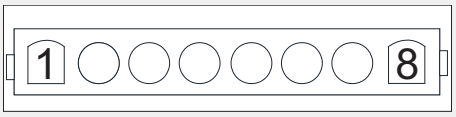
Connector J25 contains low voltage screw terminal connections for DDC Communications Isolated	
Pin 1 - RS-485 + **Pin 2** - RS-485 -	**Pin 3** - RS-485 Common

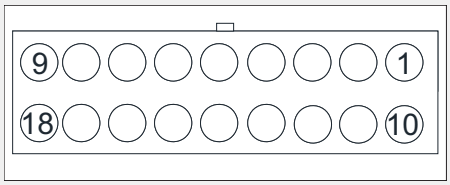
Connector J26 Programming Port	

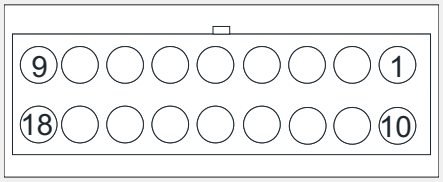
Connector J27 USB Programming Port	

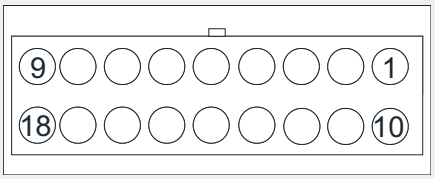
Connector J28 contains low voltage screw terminal connections	
Pin 1 - 24VAC Start Command for 3rd-Party VFD **Pin 2** - 24VAC Output **Pin 3** - 24VAC Trouble Input **Pin 4** - 24VAC Common for 3rd-Party VFD	**Pin 5** - 24VAC Constant Output **Pin 6** - 0-10VDC Analog Input VFD Speed Reference **Pin 7** - 24VAC Common **Pin 8** - 24VAC Common

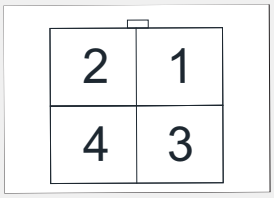
Connector J29 contains 120V AC connections	
Pin 1 - N/A **Pin 2** - N/A **Pin 3** - 120VAC High Temp Limit Input **Pin 4** - 120VAC Output to FSC (6)	**Pin 5** - 120VAC Output to FSC (7) **Pin 6** - N/A **Pin 7** - N/A **Pin 8** - 120VAC Neutral

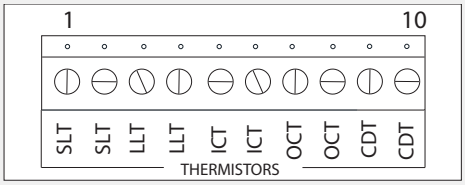
Connector J30 - N/A	

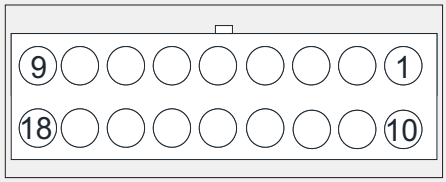
Connector J31 - Contains inputs and outputs for components	
Pin 1 - 24VDC + Output to Main Air Flow Pressure Sensor **Pin 2** - 0-10VDC Analog Input from Main Air Flow Pressure Sensor **Pin 3** - 24VDC/0-10VDC Common Main Air Flow Pressure Sensor **Pin 4** - N/A **Pin 5** - N/A **Pin 6** - N/A **Pin 7** - N/A **Pin 8** - N/A **Pin 9** - N/A	**Pin 10** - N/A **Pin 11** - N/A **Pin 12** - N/A **Pin 13** - 24VDC + output to Clogged Filter Pressure Sensor **Pin 14** - 0-10VDC Analog Input from Clogged Filter Pressure Sensor **Pin 15** - 24VDC/0-10VDC Common from Clogged Filter Pressure Sensor **Pin 16** - 24VDC + Output for Analog or Static Pressure Control for Blower/Damper **Pin 17** - 0-10VDC Analog Input for Analog or Static Pressure Control for Blower/Damper **Pin 18** - 24VDC/0-10VDC Common for Analog or Static Pressure Control for Blower/Damper

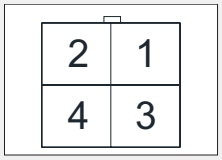
Connector J32 contains inputs and outputs for components	
Pin 1 - N/A **Pin 2** - N/A **Pin 3** - N/A **Pin 4** - N/A **Pin 5** - 24VAC Output To CO Alarm **Pin 6** - N/A **Pin 7** - N/A **Pin 8** - 0-10VDC Out for VFD **Pin 9** - N/A	**Pin 10** - N/A **Pin 11** - N/A **Pin 12** - N/A **Pin 13** - N/A **Pin 14** - 24VAC From CO Alarm **Pin 15** - N/A **Pin 16** - N/A **Pin 17** - 0-10VDC Common for VFD **Pin 18** - N/A

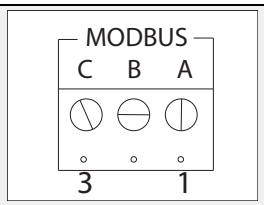
Connector J33 contains inputs and outputs for components	
Pin 1 through 8 - N/A **Pin 9** - 0-10VDC Analog Input for CFM	**Pin 10 through 17** - N/A **Pin 18** - 0-10VDC Common for CFM

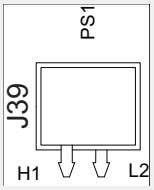
Connector J34 - N/A	

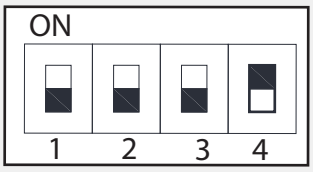
Connector J35 N/A	

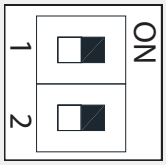
Connector J36 N/A	

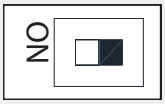
Connector J37 N/A	

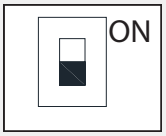
Connector J38 Modbus	
Pin 1 (A) - Modbus (-) **Pin 2 (B)** - Modbus (+)	**Pin 3 (C)** - Modbus Ground

Connector J39 Onboard Airflow Switch	
H1 - High Side	**L2** - Low Side

Dip Switch S1	
Switch 1, 2, 3 always OFF. Switch 4 Always ON. If Switch 4 is OFF, BAS terminals disabled.	

Dip Switch S2	
Programming - Service Only	

Dip Switch S3	
End of line termination	

Dip Switch S4	
Programming - Service Only	

HMI and Remote Room Sensor Installation

Remote HMI faceplates (**Figure 9**), remote room sensors (**Figure 10**), and smart controls may be ordered and shipped separately. These components measure temperature and assist in controlling the unit. These components should be installed in a safe location, free of influence from external heat sources. Install sensors in areas indicative of the average room temperature. Keep sensor away from heat-producing appliances. HMIs and remote room sensors can be installed directly to industry-standard junction boxes, either surface mounted or recessed mounted. HMIs have a built-in temperature/relative humidity (RH) sensor, which is typically used to help control the automatic function of the unit.

The HMI can also be configured to control the unit from a remote location manually. They can be configured not to use the internal temperature/relative humidity sensor. In this configuration, the sensor in the HMI is ignored in automatic operation. Multiple HMIs can be connected to one unit for temperature and R/H averaging. All combination temperature/humidity HMIs will use a vented standoff. Mount the static pressure tube close to the HMI to obtain proper room conditions.

A max of 4 additional HMIs can be daisy-chained together. Place an End-of-Line (EOL) device in the last HMI connected.

Figure 9 - HMI with Standoff

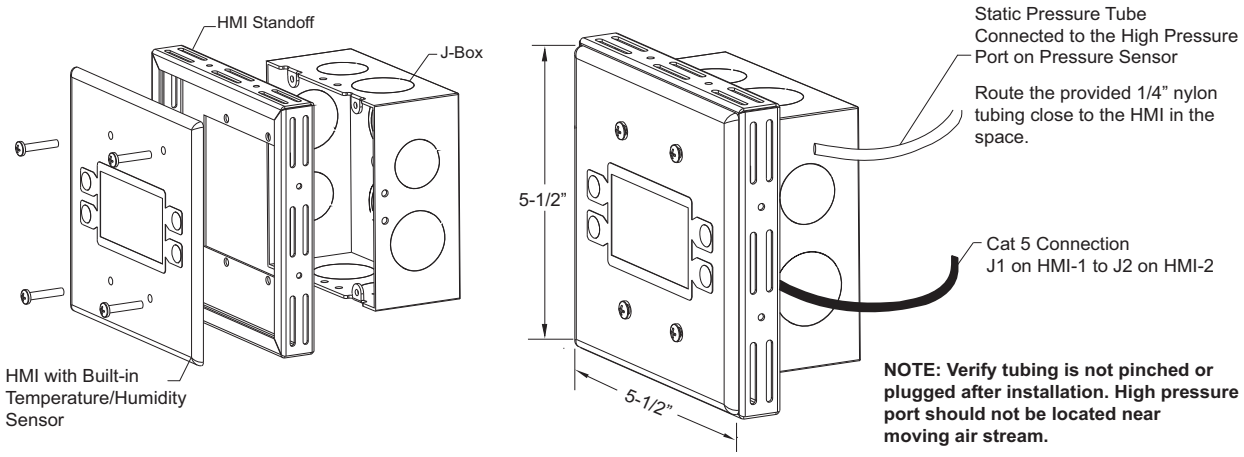
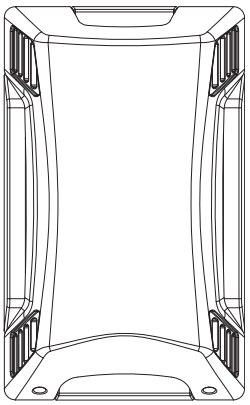


Figure 10 - Remote Room Sensor



The room temperature sensor is a 10K ohm thermistor. The sensor provides constant room temperature to the controller. It should be installed on a wall somewhere in the room, but not directly in the HVAC diffuser’s path or close to heat-producing appliances so that the reading is not affected by heat.

Room sensors are not required for proper control operation, but still can be configured as remote sensors or averaging sensors.

Do not install the room sensor on the ceiling.

OPERATION

Accessing Menu Configurations

General Overview

The HMI allows the user to change parameters and options. The user may use the HMI to view operating information regarding sensors, temperatures, pressures, and fault history on the HMI screen (**Figure 11**).

There are four buttons to navigate through the HMI screens.

NOTE: Buttons change functions during certain options and tests. Verify the screen and buttons throughout the menu display.

Figure 11 - HMI Screen

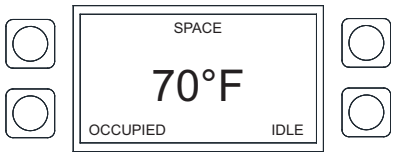
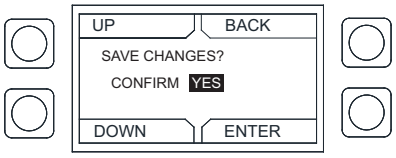


Figure 12 - Save Screen



The user can access the Top Menu HMI configurations by pressing the top two buttons simultaneously. To exit this screen, simply press the 'BACK' button. When setting certain options or functions, pressing the 'BACK' button multiple times will bring up the save screen (**Figure 12**). The user may select 'YES' to save the changes, select 'NO' to return to factory settings, or select 'CANCEL.' When selecting 'CANCEL,' any changes made will not be saved, and the screen will return to the top menu.

The HMI menu system allows full access to every configurable parameter in the HMI. The parameters are factory configured to the specific application. Parameters may need to be modified to fine-tune automatic operation after the original setup.

Remote (HMI) Control Panel

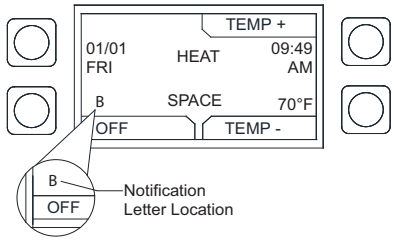
On units shipped with a space HMI, a Cat 5 cable will need to be run from J4, J5, or J6 (refer to schematics) on the main MUA Board to J2 on the HMI. If additional space HMIs have been added, they can be daisy-chained from the first HMI. In the event there is a slave MUA board, HMIs can also be powered from J1 or J2 of the slave board. An end of line resistor should be added to the last HMI in the chain.

HMI Notification Letters

The HMI will display notification letters (**Figure 13**) when the unit is in a specific status.

- B = Blower Start or Blower Stop Delay Active
- C = Condenser Min On or Min Off Timer Active. Displayed when any of the condensers are in a Min On/Off Time.
- D = Min or Max Discharge Temp Reached.
- R = OA Reset.
- Δ = Dynamic SP Applied.

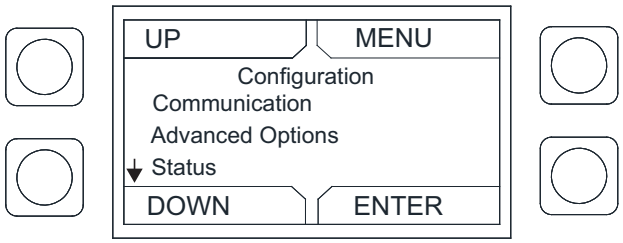
Figure 13 - Notification Letters



HMI Configuration Menu

To enter the configuration menu (**Figure 14**), press the bottom two buttons simultaneously on the HMI faceplate. In this menu screen, you may adjust Communication and Advanced Options, check Status, and About information.

Figure 14 - Configuration Menu



Communication

Under the communication menu, the user may adjust the following settings:

- **Modbus Address** - Default is 55 for the first HMI. For every additional HMI, increase the address by one. For example, if a second HMI is used, the Modbus Address should be 56. For a third HMI, the Modbus Address should be 57.
- **Baud** - The baud rate address is 115200.
- **Parity** - Do not adjust this setting. The default setting should always be set to ‘EVEN.’

Advanced Options

Under advanced options, the user may adjust the following settings:

- **Contrast** - The user may adjust the setting from 0 to 10. Setting the contrast to 0 is the lowest setting available, and 10 is the highest contrast setting available. The factory default contrast setting is 5.
- **Audio Enable** - User may set the audio to off.
- **Dimming Enable** - Default is set to Off. If set to On, the ‘HMI Dimming Timer’ option will be available.
- **Set Time** - The user may adjust dimming setting from 10-60 seconds. The default time is 30 seconds.

Status

User may monitor board temperature status, Uptime (how long the board has been active since last restart), HW RH (HMI hardware humidity sensor), HW Temp (HMI hardware temperature sensor).

About

User may view SCADA HMI Software Version, Modbus Address (assigned to HMI), Baud (115200).

Scheduling

To set a schedule on the HMI (**Figure 15**), you must first enable scheduling: **Factory Settings > Occupancy Config > Scheduling > On**

Set your sensor temperature set points for occupied and unoccupied schedules: **User Settings > Temp Set Points > (Varies)**

Once scheduling is enabled and the temperature set points are configured, you may enter your scheduled days and times: **User Settings > Scheduling**

Schedule A Default

- Monday - Friday
  8:00AM to 6:00PM
- Saturday and Sunday
  Unocc

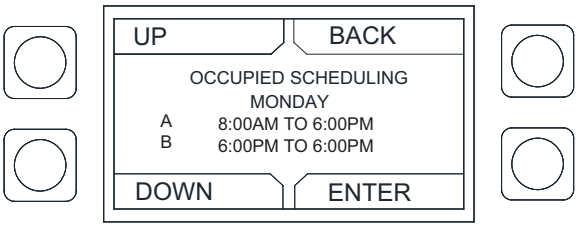
Schedule B Default

- Monday - Friday
  Unocc
- Saturday and Sunday
  Unocc

Schedule C Default

- Monday - Friday
  Unocc
- Saturday and Sunday
  Unocc

Figure 15 - Scheduling Screen



To adjust the settings, highlight the parameter and press **ENTER**.

- The first parameter to be highlighted will be the day. Press **UP** or **DOWN** to select the day an occupied time schedule is required.
- Press **ENTER** to continue to set a start time. Press **UP** or **DOWN** to set start time.
- Press **ENTER** to set an end time. Press **UP** or **DOWN** to set end time.

The system will run between these days, time, and desired temperature settings. When in the UNOCCUPIED setting, the system will run at the unoccupied temperature settings.

Menu Descriptions

User settings: Allows the user to change or set certain temperatures and configurations on the unit.

Factory settings: Requires a password (1111) to enter this menu. Factory settings are job-specific and configured from the plant. Any changes to the factory settings will require the user to save the updated changes.

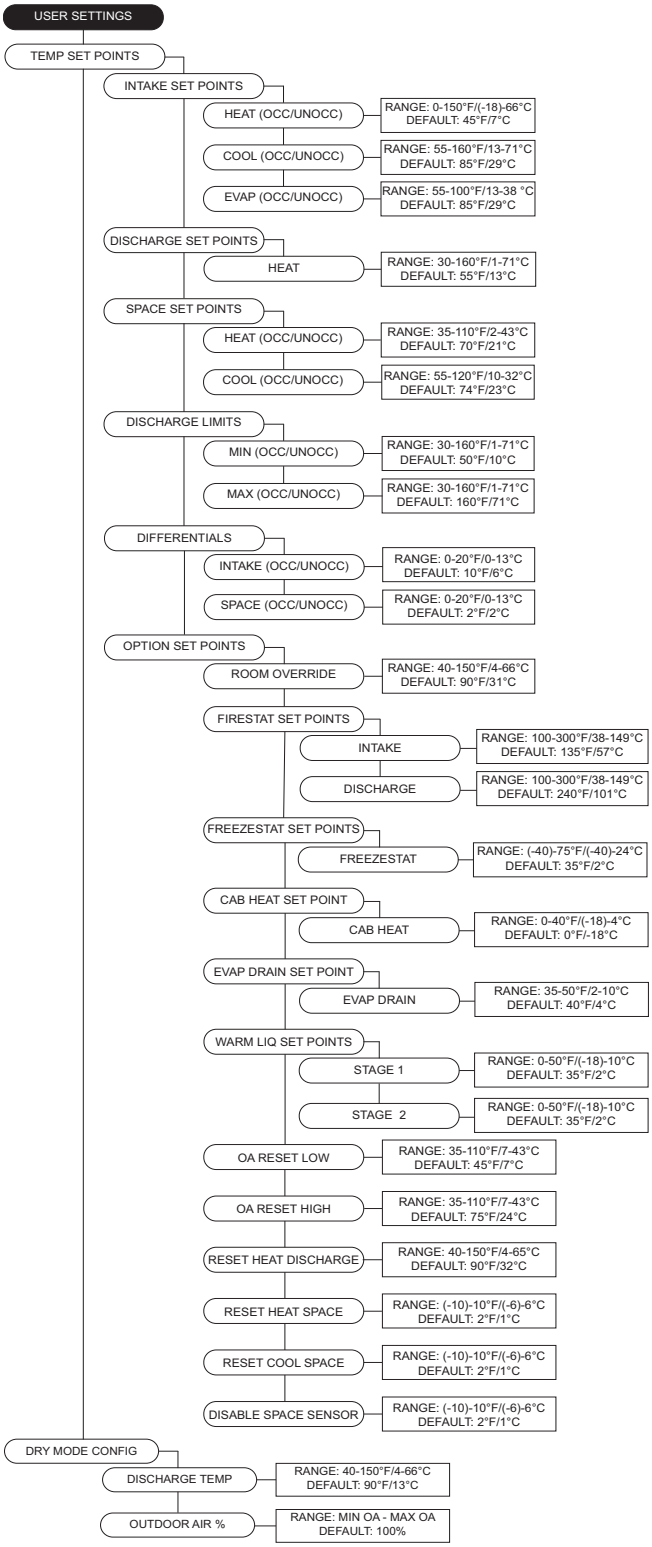
Service: Requires a password (1234) to enter this menu. Allows a certified technician to monitor the unit and test components in the system.

User Settings

Temp Set Points - Some or all of these set points may not be available based on settings. If scheduling is enabled, there will be occupied and unoccupied values for each set point. The user will be allowed to check or adjust the set points/limits.

- **Intake Set Points** - User adjustable set points for intake activation.
  - **Heat** - Activate Based On must be set to Intake, Both, Either, or Stat.
  - **Cool** - Activate Based On must be set to Intake, Both, Either, or Stat. Cooling type set to DX or both.
  - **Evap** - Activate Based On must be set to Intake, Both, Either, or Stat. Cooling type set to Evap or both.
- **Discharge Set Points** - User adjustable set points for heat discharge activation.
  - **Heat** - Tempering mode must be set to discharge.
- **Space Set Points** - User adjustable set points for heat, and cool space activation.
  - **Heat** - Activate Based On must be set to Space, Both, or Either.
  - **Cool** - Activate Based On must be set to Space, Both, Either, or Stat. Cooling type set to DX, Evap or both.
- **Discharge Limits** - User adjustable set points for discharge limits.
  - **Min** - Cannot be greater than maximum discharge heat set point.
  - **Max** - Cannot be less than minimum discharge heat set point
- **Differentials** - User adjustable space heat and cool differential set points.
  - **Intake** - Activate Based On must be set to Intake. Cool tempering mode set to Intake.
  - **Space** - Activate Based On must be set to Space. Cool tempering mode set to Space.
- **Option Set Points** - Adjustable set points for options that are enabled to “ON” in Factory Settings.
  - Room Override, Firestat Set Points, Freezestat Set Points, Cab Heat Set Point, Evap Drain Set Point, Warm Liq Set Points, OA Reset Low, OA Reset High, Reset Heat Discharge, Reset Heat Space, Reset Cool Space.
  - **Disable Space Sensor** - Use this option when a space sensor is broken/missing. When enabled, the unit will temper based on discharge.

Dry Mode Config - View or adjust dry mode setpoints/limits when the option is enabled.



Scheduling - Active when the scheduling is set to On.

- **Scheduling Times** - Each day contains the option for three occupied time periods. Settings cannot overlap.
- **Schedule Copy** - This will allow the user to copy an existing schedule from one day of the week to individual days in the week, to Week Days, or All.

Fan Speed - Enabled when the supply fan is controlled by a VFD or ECM. The range of this menu is limited by the min and max setpoints under factory settings. When the fan is set to VFD, the settings will be displayed in Hertz. When the fan is set to ECM, the PWM percentage will be displayed. When occupied scheduling is set to On, occupied and unoccupied settings are available.

Clogged Filter SP - Displayed when “Filter Mon” is set to sensor in **Factory Settings > Unit Options > Monitoring Sensors**. This adjustable SP will display a fault on the HMI when the reading is below SP for five minutes.

Mixing Box Setting - Mixing box will allow outdoor air in vs. return air. 0V out is equal to 100% OA and 0% RA.

Pressure Config - Settings vary based on **Factory Settings > Unit Options > Pressure Config**.

- **Blower PS SP** - Adjustable blower pressure set points.
- **OA PS SP** - Adjustable OA pressure set points.

Single Zone VAV - When single zone VAV is enabled to the blower, damper, or both, depending on settings, will modulate linearly between min and max discharge.

- **Blower Speed Heat** - Blower to modulate with the min discharge temp, min blower speed. Max discharge, max blower speed. Scaled linearly between min/ max discharge to min/max blower speed.
- **Damper Pos Heat** - Damper to modulate with the min discharge temp, min damper position. Max discharge, max damper speed. Scaled linearly between min/max discharge to min/max damper position.
- **Blower Speed Cool** - Blower speed will change depending on how many cooling stages are active. Evap counts as 1st stage of cooling.
- **Damper Pos Cool** - Damper position will change depending on how many cooling stages are active. Evap counts as 1st stage of cooling.

Active Faults - Contains the current faults on the board.

Fault History - Displays time-stamped history of the last 20 faults. The most recent fault will show first.

Reset Lockouts - Reset lockout faults.

Dynamic SP Diff - Temperature differential for dynamic SP.

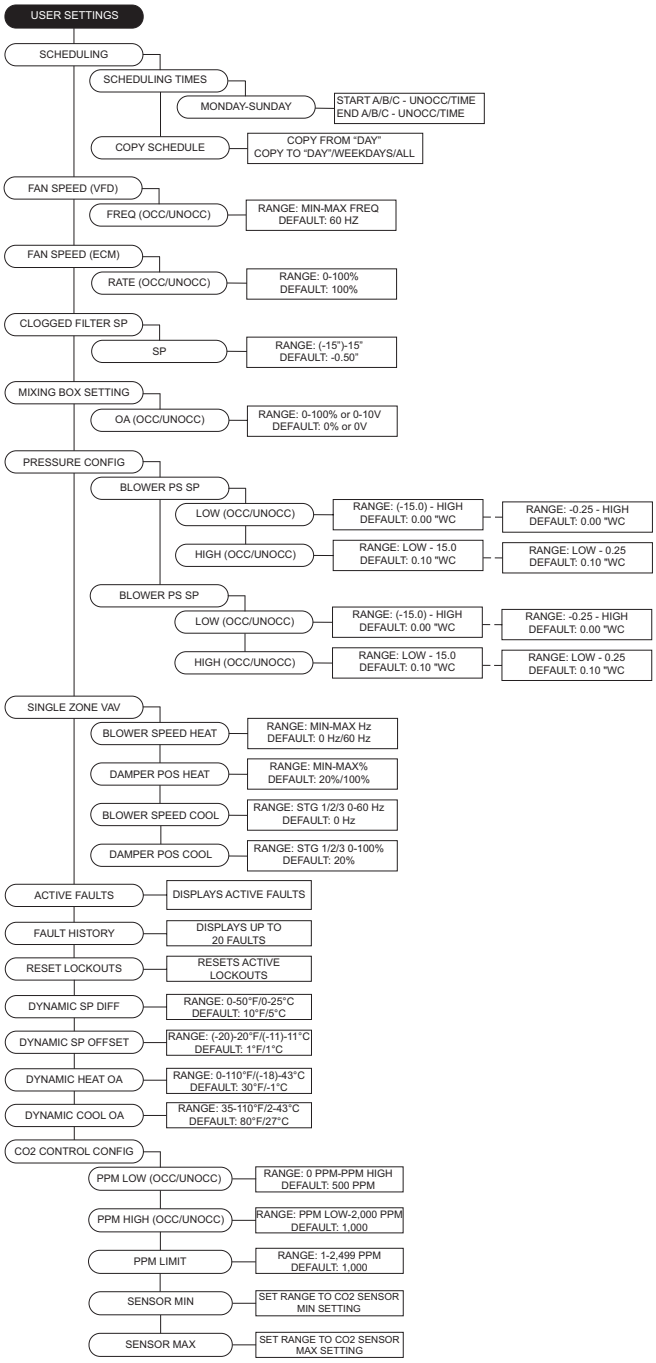
Dynamic SP Offset - Temperature change per differential.

Dynamic Heat OA - Outdoor air dynamic heat setpoint.

Dynamic Cool OA - Outdoor air dynamic cool setpoint.

CO2 Control Config - CO2 Parts Per Million (PPM) setpoints and sensor settings.

- **PPM Low/High** - CO2 Parts Per Million (PPM) threshold setpoints for the space, used in CO2 Override.
- **PPM Limit** - CO2 Parts Per Million (PPM) threshold limit set points.
- **Sensor Min/Max** - Set minimum and maximum range setting for CO2 sensor.



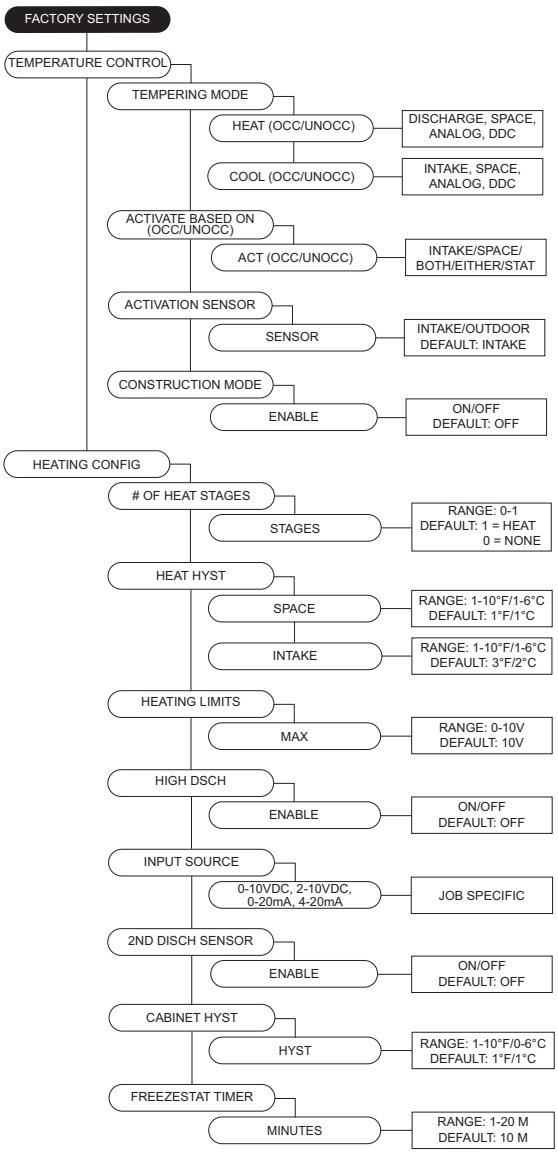
Factory Settings **Factory Menu Password = 1111.**

Temperature Control - The MUA board monitors temperature control setpoints and components.

- **Tempering Mode** - The options for controlling the output of the tempering mode in heat/cool (if equipped). Available options are Intake/Discharge/Space/Analog Control/Direct Digital Control (DDC).
- **Activate Based On** - Select how the unit will activate based on temperature readings: Intake/Space/Both/Either/Stat (field installed thermostat). These settings can be altered for occupied and unoccupied preferences.
- **Activation Sensor** - Allows selection of intake or outdoor sensor for unit to activate.
- **Construction Mode** - Configurable option for units used in construction settings.

Heating Config - Allows the user to set various heating configurations.

- **# of Heat Stages** - Default is set to 0 for units without gas heat. If the unit is equipped with gas heat, select 1.
- **Heat Hyst** - Intake or Space tempering sensor must go this amount of degrees above the setpoint before heating turns off.
- **Heating Limits** - Maximum voltage setting for electric heater.
- **High Disch** - When enabled On, the heat max discharge limit allowed will be increased.
- **Input Source** - This lets the board know what signal (volts or milliamps) to expect from the analog control system. **Only valid for analog tempering mode.**
- **2nd Disch Sensor** - On/Off selection. When an additional thermistor is added, the two thermistor readings will be averaged together. Default Off.
- **HTL Blower Off** - The blower will shut off when the high temperature limit trips.
- **Cabinet Hyst** - The cabinet temp must reach this many degrees above the activation setpoint to turn off.
- **Freezestat Timer** - If the discharge temperature is below the freezestat setpoint for half the duration of the freezestat timer, the heat will shut off momentarily. If the freezestat trips for a second time, the heat will shut down immediately. Reset the lockout manually on the HMI.

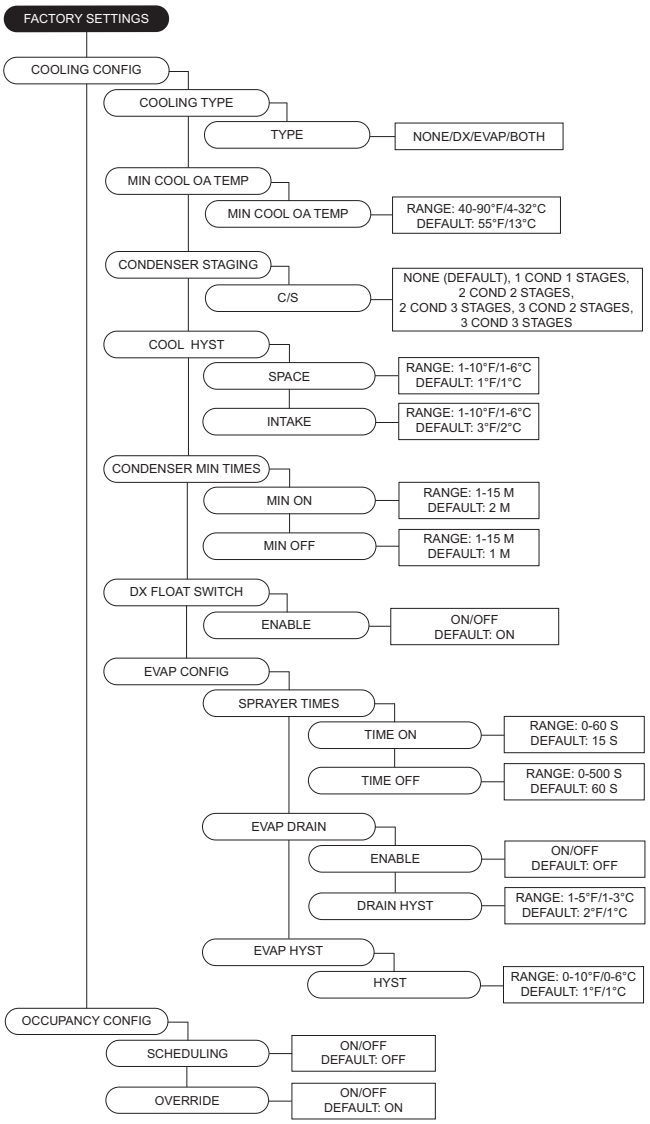


Cooling Config - Allows the user to set various cooling configurations.

- **Cooling Type** - Selections are None, DX, Evap, Both. If “None” is selected, all cooling options under user settings are hidden.
- **Min Cool OA Temp** - When the space temperature is calling for cooling, and the outdoor air temperature is below the setpoint, the unit will shut the condensers off. The blower will start and use outdoor air to cool the space.
- **Condenser Staging** - Selections None, 1, 2, or 3 condensers. Within the 2 and 3 condenser selection, there is another sub-menu that allows for 2 or 3 stages. For 2 condenser units, 3 stages should only be selected when the condensers are of unequal tonnages.
- **Cool Hyst** - Intake or Space tempering sensor must fall this many degrees below the setpoint for cooling turns off.
- **Condenser Min Times** - Minimum time each condensing stage must remain on after becoming activated. This is to prevent stage cycling. **A “C” will be present in the lower-left corner of the home screen when any of the condensers are in a MIN ON/OFF TIME.**
- **DX Float Switch** - Enables DX float switch option.
- **Evap Config**
  - **Sprayer Times**
    - **Time On** - Time the evaporative cooler will spray in the cycle.
    - **Time Off** - Time the evaporative cooler will be idle in the cycle.
  - **Evap Drain** - Units that use evap drain should be set to On.
    - **Drain Hyst** - Temperature differential setting before the drain shuts off.
  - **Evap Hyst** - Temperature differential before the evap cooling shuts off.

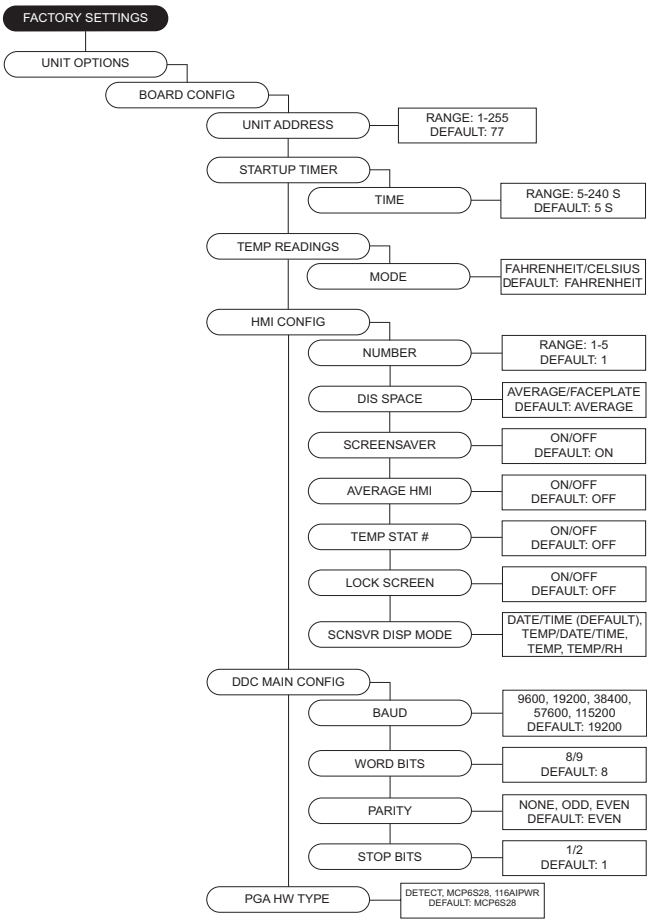
Occupancy Config - Allows access to setting scheduling and/or override On or Off.

- **Scheduling** - This menu is where the scheduling can be turned On or Off. Default is Off.
- **Override** - This menu is where the occupancy override can be turned On or Off.



Unit Options - Allows user access to various options included with the unit.

- **Board Config**
  - **Unit Address** - Modbus address of the MUA Board.
  - **Startup Timer** - Time upon power-up where the board will sit idle.
  - **Temp Readings** - Allows user to set temperature readings between Fahrenheit or Celsius. Changing between the two will reset all setpoints.
  - **HMI Config** - Allows access to adjust HMI settings and options.
    - **Number** - Set the number of HMIs connected to the MUA board.
    - **Dis Space** - Select display space temperature option. Faceplate will display the room's current temperature. Average will display an average of all faceplates, excluding HMI in the unit, and all wired space sensor readings.
    - **Screensaver** - Default is set to On. If set to Off, the home screen will not time out to the screensaver.
    - **Average HMI** - If there are multiple space HMIs connected, this menu allows you to select which will be included in the space temperature and relative humidity averaging. If a thermistor or relative humidity sensor is connected into the ST screw terminals, it will automatically be averaged into any HMIs included. When in Space Tempering Mode, a minimum of one HMI must have Average HMI set to On, or a separate remote sensor must be used that is wired back to the MUA board.
    - **Temp Stat #** - On/Off option to turn on temperature averaging for wired HMI thermistors.
    - **Lock Screen** - If the option is set to On, a password (9999) will be required when; screensaver option is enabled or if any button functions are not pressed for 5 minutes.
    - **Scnsvr Disp** - Displays date, time, and/or temperature when screensaver is active.
- **DDC Main Config**
  - **Baud** - The baud rate of the Modbus communications.
  - **Word Bits** - The amount of data bits over Modbus communications.
  - **Parity** - The parity selection for Modbus communications.
  - **Stop Bits** - The stop bits selection for Modbus communications.
- **PGA HW Type** - (DO NOT CHANGE SETTINGS)



NOTE: When Average HMI is set to more than 1, each HMI will have an averaging On/Off setting.

- **Blower Config** (refer to **Table 4** for aux pin settings)
  - **Blower Control** - Allows user to select between 120V Contactor, VFD Manual, VFD Jog, VFD 0-10V, ECM, ECM 0-10V, ECM Pressure, ECP.
    - **120V Contactor** - 120V output on the MUA board to energize the coil of a contactor. This option should be selected when the MUA is used in conjunction with a DCV package.
    - **VFD Manual** - HMI selectable VFD frequency.
    - **VFD Jog** - For use with VFDs using photohelic control. Aux pins are used to control the VFD. Powering aux 1 will speed the fan up, powering aux 2 will slow the fan down. When aux 1 or aux 2 are not powered, the VFD will hold current speed.
    - **VFD 0-10V** - For use when an external 0-10V signal is being provided to control the speed of the VFD. The VFD output from this input will be based on the VFD min and max freq set under protected params in factory settings. 0 Volts will equal VFD min, 10V will equal VFD max, and all voltages in between will be scaled linearly. This option will utilize 0-10V J14-(6) and 0-10V common J14-(7) screw terminals, and will require field wiring.
    - **VFD Pressure** - For use with VFDs that use a pressure transducer (0-10V output).
    - **Electronically Commutated Motor (ECM)** - HMI selectable PWM rate.
    - **ECM 0-10V** - For use when an external 0-10V signal is being provided to modulate the ECM supply output between min and max speed.
    - **ECM Pressure** - For use with ECMs that use a pressure transducer (0-10V output).
  - **Blower Mode**:
    - If “Occ” is set to On, the menu screen for the blower mode will allow you to choose ON/AUTO OFF for Occupied or Unoccupied.
    - If “Occ” is set to Off, the menu screen for the blower mode will allow you to choose MANUAL/AUTO/ INTERLOCK. In blower auto mode, the blower will only run when it gets a call for heating/cooling.
    - In blower manual/on mode, the blower will run as long as the fan button is enabled regardless of whether the unit is heating/cooling. In blower off mode, closing contacts J16-5 (unit intlk) and J16-6 (24V AC) will cause the blower to run.
  - **Blower Presets** - User may set blower preset option On/Off.
  - **Post Purge Config** - When enabled, this option will run the blower for the set time after heating has shut down.
  - **Door Interlock** - When enabled, if the door is open, the supply fan will shut down immediately.
  - **Fan Proving Config** - To set fan proving, the Exhaust Contactor must be set to Before Airflow or After Airflow. When enabled, the user may set the number of contactors used. Contactor 1 = Aux 2. Contactor 2 = Aux 3.

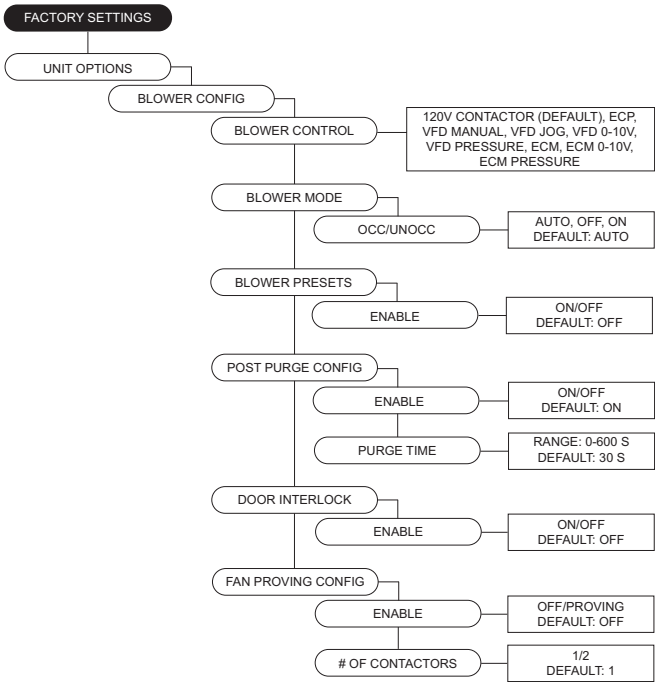


Table 4 outlines the aux pins on Connector J11 for preset settings associated with fan speed and damper position found in **Factory Settings > Unit Options**.

Table 4 - Aux Presets

Presets	Aux 1	Aux 2	Aux 3
Normal Operation (Selected Blower Mode)			
Fan Speed/Damper Position 1	X		
Fan Speed/Damper Position 2		X	
Fan Speed/Damper Position 3	X	X	
Fan Speed/Damper Position 4			X
Fan Speed/Damper Position 5	X		X
Fan Speed/Damper Position 6		X	X
Fan Speed/Damper Position 7	X	X	X

- **VFD Direction** - Sends a command to the VFD to run in forward or reverse.
- **VFD Freq Limits** - Min to Max range settings for fan speed.
- **VFD Volt Limits** - Min to Max range settings for third party VFDs.
- **PWM Rate Limits** - Range Min to Max settings for fan speed.
- **Occ Fan Presets** - After the blower has started, the blower setting will use the aux pins to drive the preset occupied value.
- **Unocc Fan Presets** - After the blower has started, the blower setting will use the aux pins to drive the preset unoccupied value.

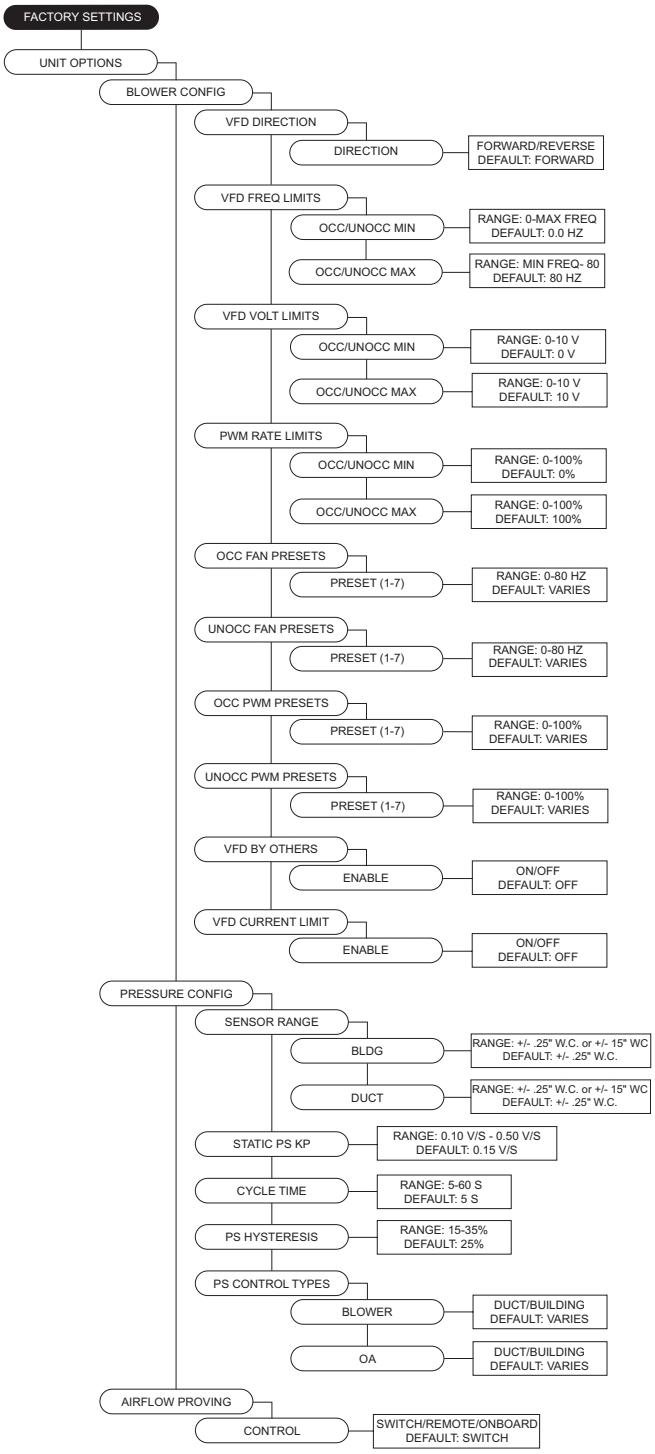
- Fan Preset Default: 1 = 40Hz, 2 = 50Hz, 3 = 0Hz, 4 = 60Hz, 5 = 0Hz, 6 = 0Hz, 7 = 0Hz.

- **Occ PWM Presets** - After the blower has started, the blower setting will use the aux pins to drive the preset unoccupied value.
- **Unocc PWM Presets** - Allows user to set unoccupied preset blower speed value.

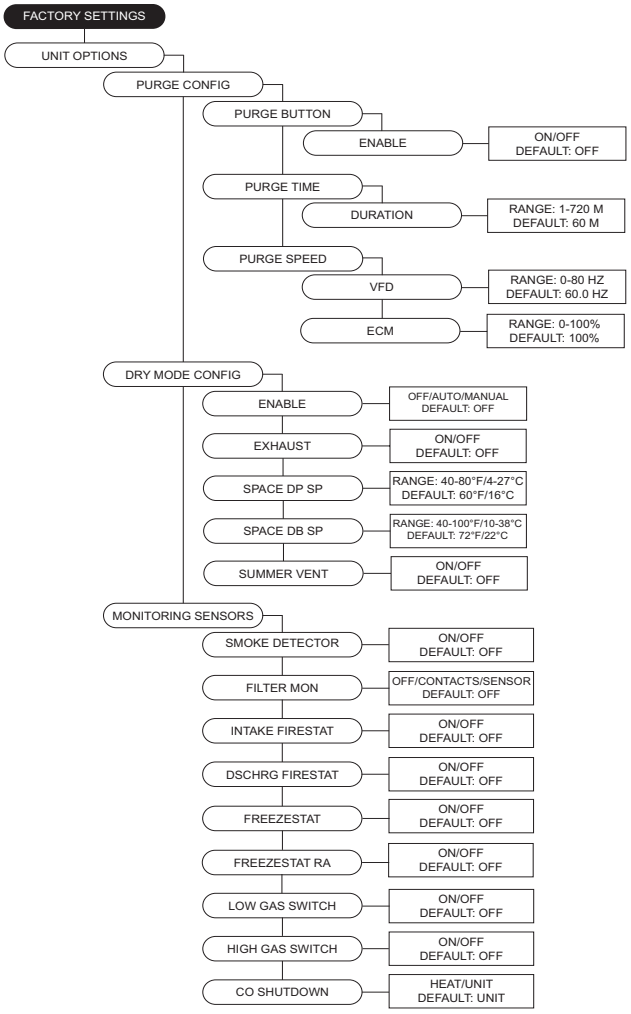
- PWM Preset Default: 1 = 80%, 2 = 90%, 3 = 0%, 4 = 100%, 5 = 0%, 6 = 0%, 7 = 0%.

- **VFD By Others** - This option will be used when a factory provided Modbus control VFD is not utilized. A start command, as well as a 0-10 V output will be provided to the VFD.
- **VFD Current Limit** - This limits the max current to the VFD.

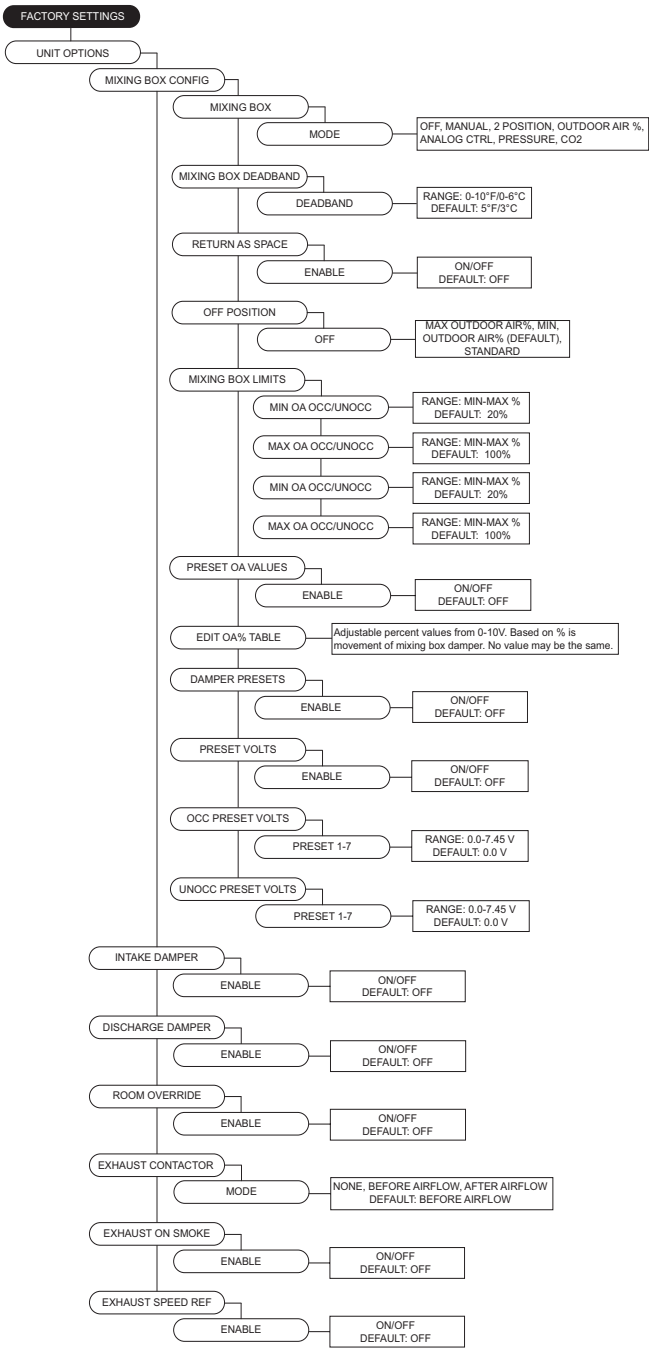
- **Pressure Config**
  - **Sensor Range** - Menu is available when any blower pressure or mixing box pressure option is selected.
  - **Static PS KP** - Proportionally constant value for static pressure measured in V/sec.
  - **Cycle Time** - Cycle time is the time between two consecutive readings.
  - **PS Hysteresis** - Percentage band between high and low static set points. This will reduce cycling of blower or damper. Increase this value if the blower speed or damper does not settle into a set point.
  - **PS Control Types** - Pressure control may be set to monitor Building or Duct pressure.
- **Airflow Proving** - Unit may be set to prove by an external airflow switch, remote 0-10 V input signal, or from the onboard switch (connector J39).



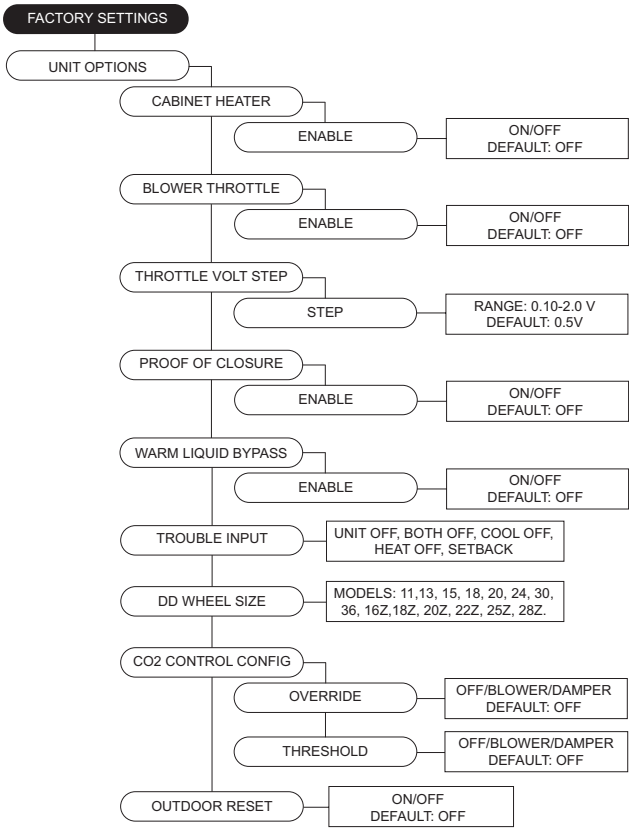
- **Purge Config**
  - **Purge Button** - When the purge button is pressed, the damper will open to max outdoor air and turn on the exhaust contactor, if enabled. Purge Button must be enabled for Dry Mode use.
  - **Purge Time** - This is the amount of time that the unit will run the purge process if the user does not stop the purge manually.
  - **Purge Speed** - Adjustable between VFD or ECM. Min and Max frequency the fan will run during the purge cycle.
  - **Dry Mode Config** - When this option is active (automatically or through manual button press), dry mode will run when:
    - Space Dew Point rises above Space DP set point (SP). Dry mode only.
    - In addition, if Summer Vent is ON, Space Dry Bulb rises above Space Dry Bulb SP and space enthalpy is greater than outside air enthalpy.
    - The unit will go to Dry Mode Discharge when there is a call for heat.
    - Space dew point is the average of the Space RH input with any additional HMI inputs.
    - If OA dew point < Space dew point, the mixing box should go to outdoor air set point. This should override any other mixing box functionality.
    - If OA dew point > Space dew point, the mixing box should go to min OA%.
    - Purge should run until the purge timer expires or the user cancels the purge.
      - **Exhaust** - Enables/disables exhaust contactor during dry mode.
      - **Space DP SP** - Dew point threshold for automatic dry mode activation.
      - **Space DB SP** - Dry bulb threshold for automatic dry mode activation.
      - **Summer Vent** - Dew point activation will enhance with enthalpy activation when set to On.
- **Monitoring Sensors** - Smoke Detector, Filter Mon, Intake Firestat, Discharge Firestat, Freezestat, Freezestat RA, Low Gas Switch, High Gas Switch, CO Shutdown.



- **Mixing Box Config**
  - **Mixing Box** - Off, Manual, 2 Position, Outdoor Air %, Analog Control, Pressure, CO2.
  - **Mixing Box Deadband** - If the temperature difference between the outdoor and return sensor is less than or equal to this set point, the MUA board will not attempt to adjust the output voltage until it matches the outdoor air percentage set point. This setting only takes effect when either outdoor air % or schedule is selected.
  - **Return As Space** - Setting this to On will not require a space sensor or HMI. This setting will use the return air thermistor (RT) in place of the space sensor.
  - **Off Position** - Allows user to select how the dampers will be positioned when the supply fan is off. Standard (default), Max Outdoor Air %, or Min Outdoor Air %.
  - **Mixing Box Limits** - Minimum and maximum settings for mixing box. Percentage or voltage based on mixing box selection.
  - **Preset OA Values** - On/Off option. If set to On, the voltage values equivalent to air percentage.
  - **Edit OA% Table** - User may edit voltages for the equivalent to outdoor air percent table.
  - **Damper Presets** - This allows the user to set damper preset option On or Off.
  - **Preset Volts** - Uses aux pins to control damper actuator.
  - **Occ/Unocc Preset Volts** - When scheduling is On, Occ Preset Volts and Unocc Preset Volts with be available.
- **Intake Damper** - User can adjust intake damper to be On or Off.
- **Discharge Damper** - User can adjust discharge damper to be On or Off.
- **Room Override** - Uses room override SP rather than Discharge SP. This setting will only have an effect when the heat tempering mode setting is discharge and activate based on is not set to intake.
- **Exhaust Contactor** - This allows the user to assign a contactor for an interlocked exhaust fan. There are occupied and unoccupied settings.
  - **None**
  - **Before airflow** - Exhaust fan will start before the airflow proving switch has been activated.
  - **After airflow** - Exhaust fan will start after the airflow proving switch has proved there is airflow.
- **Exhaust On Smoke** - When the input is enabled, if it receives a 24VAC signal from a fire system, this will shut down the supply fan and enable the exhaust contactor. The 24VAC signal must originate from the MUA Board.
- **Exhaust Speed Ref** - When enabled On, the exhaust speed will match supply blower VFD.



- **Cabinet Heater** - This allows the user to enable the cabinet heater, if applicable. If enabled, the temperature sensor on MUA board controls the cabinet heater. When this option is enabled, to adjust set points, go to **User Settings > Temp Set Points > Option Set Points > Cab Heat Set Points**.
- **Blower Throttle** - The throttle function is to maintain profile pressure across the burner.
- **Throttle Volt Step** - Increases/decreases fan speed when a third party VFD is used.
- **Proof of Closure** - For gas valves that contain a proof of closure switch, the user may set this option On. Before heating occurs, a 24V AC input must be present at connector J32 pin 12.
- **Warm Liquid Bypass** - Prevents freezing of condensing coil in low ambient temperatures.
- **Trouble Input** - While connector J28 pin 3 receives 24 volts, the unit will act based on one of the following settings:
  - **Unit Off** - Shuts down blower (heating/cooling will also shutdown). Timers will be bypassed.
  - **Both Off** - Turn off/lockout heating and cooling. Bypass min on/off timers.
  - **Heat Off** - Turns off/lockout heating.
  - **Cool Off** - Turns off/lockout cooling. Bypass min on/off timers.
  - **Set Back** - Forces unit to unoccupied state.
- **DD Wheel Size** - Direct drive wheel size selection. The wheel size selection will be utilized for CFM monitoring. Dual blower models will have a ‘2’ assigned after the wheel size model number.
- **CO2 Control Config** - Monitors CO2 and will adjust blower speed/damper position depending on CO2 set point.
  - **Override** - The unit will try to maintain space CO2 Parts Per Million (PPM) levels based on min/max threshold set points set by the user. The unit will modulate the blower/damper linearly between their corresponding min/max settings.
  - **Threshold** - CO2 Parts Per Million (PPM) maximum threshold set points for the space. When the space CO2 PPM reading exceeds the threshold setting, the blower/damper will go to their max setting.
- **Outdoor Reset** - Allows access to setting option On/Off. Below are scenarios for Outdoor Reset functionality.
  - Discharge Heat Tempering: If outside air is below OA Reset Low set point, heat will discharge to Reset Heat Discharge setting.
  - Space Heat Tempering: If outside air is below OA Reset Low set point, the space set point will adjust to Reset Heat Space setting.
  - Intake Cool Tempering: If outside air is above OA Reset High set point, cooling will go to max staging. If both evap and dx are present, unit will run all.
  - Intake Space Cool Tempering: If outside air is below OA Reset Low set point, the space set point will adjust to Reset Cool Space setting.



- **Dynamic Set Point** - below are scenarios for dynamic functionality. For heating, every multiple of the Dynamic Set Point Differential would multiply the effect of the Dynamic Offset setting.
  - When heating: If the measured outside air temperature is below the Dynamic Heat OA set point minus the differential set point, the space or discharge set point will increase/decrease by the offset setting.
  - When cooling: If the measured outside air temperature is above the Dynamic Cool OA set point minus the differential set point, the space or discharge set point will increase/decrease by the offset setting.
- **Extra Cooling Input** - When the DX cooling stage is set to 2 or greater, the cooling input will utilize all stages of cooling.
- **Single Zone VAV** - When Mode is set to blower, damper, or both, adjustable set points can be found in "User Settings."
  - **Invert** - Normal operation, the blower/damper will go to max settings. Inverse operation, the blower/damper will go to min settings.

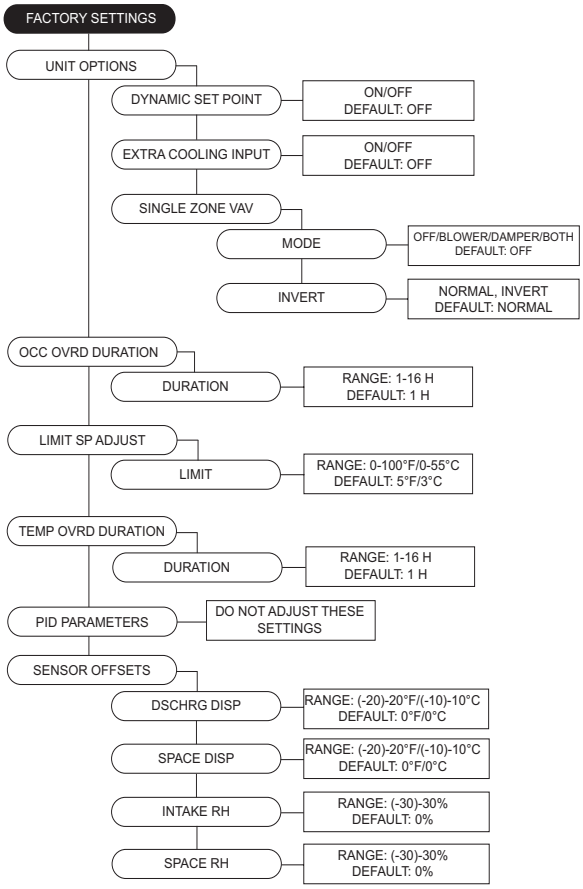
Occ Ovrd Duration - Length of override timer. If override is active, it can be manually stopped by pressing the end override button on the HMI.

Limit SP Adjust - This allows the user to change the current temperature set point through the home screen. The range adjustment is 0-100 degrees. Default is 5°F. When the set point is set to 0°F, the adjustment buttons (+/-) will not be visible.

Temp Ovrd Duration - Length of temperature override timer.

PID Parameters - (DO NOT CHANGE THESE PARAMETERS)

Sensor Offsets - Offset adjustment for Discharge, Space, and Intake sensor parameter settings.



Service Settings **Service Menu Password = 1234.**

Temperatures - Monitor various temperature values.

Relative Humidity - Current humidity readings per HMI.

Open/Closed Status - Open/closed status of all inputs.

Variable Values - Monitor variable input/output values.

VFD Status - Monitor VFD parameters.

High Temp Limit - Displays the high temp limit.

Airflow Limits - Displays the high/low airflow limits.

Mixing Box Values - Monitor mixing box values.

Test Menu - When in a testing state, you must set the 'State' back to OFF to cancel the test.

- **Test Fans** - All, Supply, Exhaust.
- **Test Heating** - Contains high/low fire tests for stages. If "Heating Config" is set to 0, then "No Heat Stage Set" will display. Allows blower and damper modulation.
  - In test mode, the high limit setting will be based on intake temp + max temp rise + 10 degrees or the unit's high limit setting, whichever is higher.
  - If mixing box is On, set to 0V or 100% OA.
  - Exiting test mode should reset the PID.
- **Test Cooling** - Test cooling or heat pump system. Also, monitors cooling system specifications. Allows blower and damper modulation.
- **Test High Temp Limit** - Test menu allows user to set limit to simulate a high temp fault.

NOTE: Heating/Cooling parameters are displayed below State selection

- **Test Options**
  - **Test Cabinet Heater** - Activates the cabinet heater on.
  - **Test Drain Heater** - Activates the drain heater on.
  - **Test Mixing Box** - Beginning this test will create an output to the outdoor air control. The test will begin at 0 volts. The up and down buttons allow for modulation of the output.
  - **Test Freezestat** - Access to adjust set points to verify freezestat operation in various types of ambient conditions.

Clear Fault History - This will clear the entire fault history. If there is an active fault when cleared, that fault will show up until it is fixed.

Set Clock - Adjustment for Day and Time settings.

Factory Reset - Will reset to the last time the unit was commissioned or an update factory defaults was set.

Update Factory Defaults (DFLTS) - This allows the original factory default settings to be overridden. When confirming the updated settings, these settings will now be used when "Factory Reset" is used.

Calibrate Onboard PS - Calibrates onboard pressure sensor. Must disconnect all pressure tubes before calibration.

Calibrate Mixing Box - Calibration process to update factory default values to building site conditions.

Reset MB To Defaults - Resets mixing box to defaults.

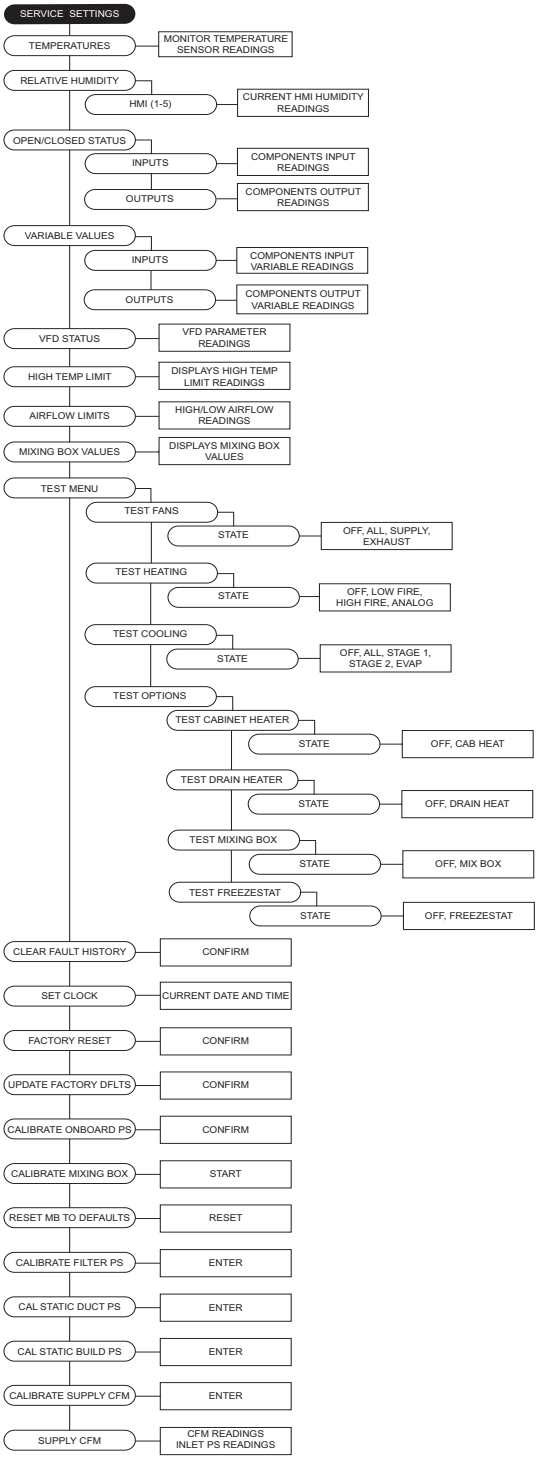
Calibrate Filter PS - Calibrates clogged filter pressure. Must disconnect all pressure tubes before calibration.

Cal Static Duct PS - Calibrates static duct pressure sensor. Must disconnect all pressure tubes before calibration.

Cal Static Build PS - Calibrates static building pressure sensor. Must disconnect all pressure tubes prior to calibration.

Calibrate Supply CFM - Calibrates pressure differential in the venturi to calculate approximate fan CFM. Must disconnect all pressure tubes prior to calibration.

Supply CFM - Displays measured CFM readings. This readout is only valid for units with direct-drive wheels.



Electronically Commutated Motor Speed Control

Electrically Commutated Motors (ECM) with speed control allow for accurate adjustments of fan speed. The benefit of EC motors is exceptional efficiency, performance, and motor life.

External PWM Signal

The fan unit will be shipped with power wiring and communication wiring fed to an internal junction box. The fan is shipped with Shielded Twisted Pair (STP) wire, which is used for wiring to a remote PWM signal. Red wire is used to go to the positive PWM signal, and black wire is used to go to the negative PWM signal.

Reference schematics for all wiring connections. STP is connected to the communication wiring of the motor using wire nuts in the junction box. If a preset length of STP is provided, it will be connected to the junction box from the factory. Run the STP through any available knockout in the fan base.

Motorized Intake Damper

On units shipped with the optional motorized intake damper, a power transformer is supplied with the unit if the main incoming voltage is greater than 120V. **No external wiring to the damper motor is required.**

Variable Frequency Drive (VFD)

WARNING!
- Before installing the VFD drive, ensure the input power supply to the drive is OFF.
- The power supply and motor wiring of the VFD must be completed by a qualified electrician.
- The VFD is factory programmed, only change if replaced or ordered separately.

Consult the VFD manual and all documentation shipped with the unit for proper installation and wiring of the VFD. The VFD has been programmed by the factory with ordered specific parameters. Use **Table 5** as a guide during installation.

Table 5 - VFD Installation Check List

Check Off	Description
	The installation environment conforms to the VFD manual.
	The drive is mounted securely.
	Space around the drive meets the drive's specification for cooling.
	The motor and driven equipment are ready to start.
	The drive is properly grounded.
	The input power voltage matches the drive's nominal input voltage.
	The input power connections at L1, L2, and L3 are connected and tight. Verify correct size crimp fitting is used.
	The input power protection is installed.
	The motor's power connection at U, V, and W are connected and tight. Verify correct size crimp fitting is used.
	The input, motor, and control wiring are run in separate conduit runs.
	The control wiring is connected and tight.
	NO tools or foreign objects (such as drill shavings) are in the drive.
	NO alternative power source for the motor (such as a bypass connection) is connected - NO voltage is applied to the output of the drive.

VFD Installation

Input AC Power

- Circuit breakers feeding the VFDs are recommended to be thermal-magnetic and fast-acting. They should be sized based on the VFD amperage. Refer to **“ACTECH SMV VFD” on page 42**. See installation schematic for exact breaker sizing.
- Every VFD should receive power from its own breaker. If multiple VFDs are to be combined on the same breaker, each drive should have its own protection measure (fuses or miniature circuit breaker) downstream from the breaker.
- Input AC line wires should be routed in conduit from the breaker panel to the drives. AC input power to multiple VFDs can be run in a single conduit if needed. **Do not combine input and output power cables in the same conduit.**
- The VFD should be grounded on the terminal marked PE. A separate insulated ground wire must be provided to each VFD from the electrical panel. This will reduce the noise being radiated in other equipment.

ATTENTION: Do not connect incoming AC power to output terminals U, V, W. Severe damage to the drive will result. Input power must always be wired to the input L terminal connections (L1, L2, L3).

VFD Output Power

- Motor wires from each VFD to its respective motor MUST be routed in a **separate steel** conduit away from control wiring and incoming AC power wiring. This is to avoid noise and crosstalk between drives. An insulated ground must be run from each VFD to its respective motor. Do not run different fan output power cables in the same conduit.
- VFD mounted in ECP: A load reactor should be used and sized accordingly when the distance between the VFD and motor is greater than specified below. The load reactor should be installed within 10 feet of the VFD output:

  208/230V - Load reactor should be used when distance exceeds 250 feet.
  460/480V - Load reactor should be used when distance exceeds 50 feet.
  575/600V - Load reactor should be used when distance exceeds 25 feet.
- VFD mounted in fan: The load reactor should be sized accordingly when the VFD is mounted in the fan.

  208/230V - Load reactor is optional but recommended for 15 HP and above motors.
  460/480V - Load reactor is optional but recommended for 7.5 HP and above motors.
  575/600V - Load reactors are required for all HP motors.
- If the distance between the VFD and the motor is extremely long, up to 1000 FT, a dV/dT filter should be used, and the VFD should be increased by 1 HP or to the next size VFD. The dV/dT filter should be sized accordingly and installed within 10 feet of the output of the VFD.

  208/230V – dV/dT filter should be used when distance exceeds 400 feet.
  460/480V – dV/dT filter should be used when distance exceeds 250 feet.
  575/600V – dV/dT filter should be used when distance exceeds 150 feet.
- Do not install a contactor between the drive and the motor. Operating such a device while the drive is running can potentially cause damage to the power components of the drive.
- When a disconnect switch is installed between the drive and motor, the disconnect should only be operated when the drive is in a STOP state.

VFD Programming

Programming

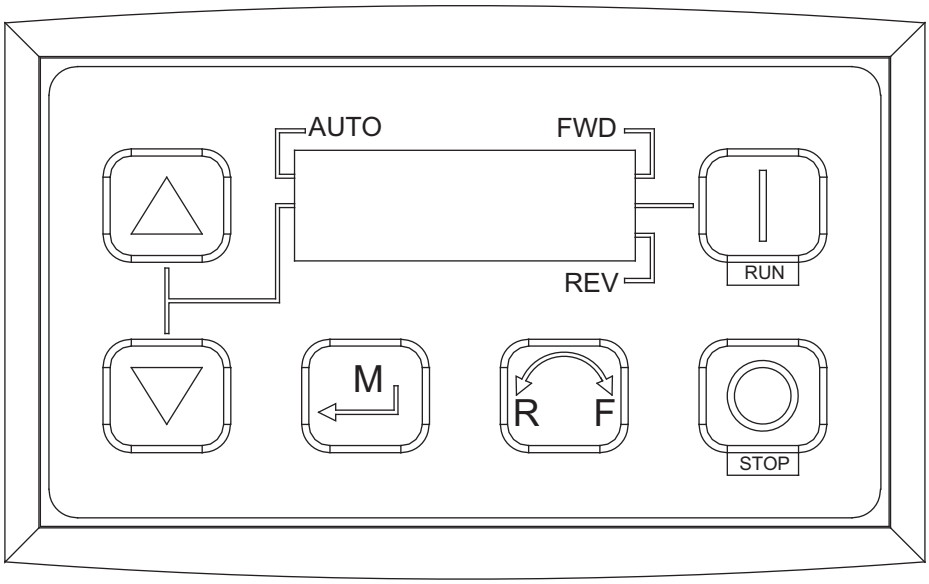
1. The Drive should be programmed for the proper motor voltage. P107 is set to 0 (Low) if motor voltage is 120V AC, 208V AC or 400V AC. P107 is set to 1 (High) if the motor voltage is 230V AC, 480V AC, or 575V AC.
2. The Drive should be programmed for the proper motor overload value. P108 is calculated as Motor FLA x 100 / Drive Output Rating (refer to **“ACTECH SMV VFD” on page 42**).

To enter the PROGRAM mode to access the parameters:

1. Use the buttons on the VFD screen (**Figure 16**) to adjust VFD settings. Press the Mode (M) button. This will activate the password prompt (PASS).
2. Use the Up and Down buttons to scroll to the password value (the factory default password is “0225”) and press the Mode (M) button. Once the correct password is entered, the display will read “P100”, which indicates that the PROGRAM mode has been accessed at the beginning of the parameter menu.
3. Use the Up and Down buttons to scroll to the desired parameter number.
4. Once the desired parameter is found, press the Mode (M) button to display the present parameter setting. The parameter value will begin blinking, indicating that the present parameter setting is being displayed. The value of the parameter can be changed by using the Up and Down buttons.
5. Pressing the Mode (M) button will store the new setting and exit the PROGRAM mode. To change another parameter, press the Mode (M) button again to re-enter the PROGRAM mode. If the Mode button is pressed within 1 minute of exiting the PROGRAM mode, the password is not required to access the parameters. After one minute, the password must be re-entered to access the parameters again.

P500 parameter provides a history of the last 8 faults on the drive. It can be accessed without entering PROGRAM mode.

Figure 16 - VFD Screen



NOTE: When a parameter is changed in the drive, the drive should be de-energized. Wait for the display to go completely dark. Once the display is completely dark, the drive can be re-energized.

ACTECH SMV VFD

Table 6 - Cross-Reference

HP	Part Number	Volts	1Ø Input	3Ø Input	Input Amps 1Ø 120V AC	Input Amps 1Ø 240V AC	Output Amps	Breaker 1Ø 120V AC	Breaker 1Ø 240V AC
0.5	ESV371N01SXB571	120/240V	X	-	9.2	4.6	2.4	15	15
1	ESV751N01SXB571	120/240V	X	-	16.6	8.3	4.2	25	15
1.5	ESV112N01SXB571	120/240V	X	-	20	10	6	30	20

HP	Part Number	Volts	1Ø Input	3Ø Input	Input Amps 1Ø	Input Amps 3Ø	Output Amps	Breaker 1Ø	Breaker 3Ø
0.5	ESV371N02YXB571	240V	X	X	5.1	2.9	2.4	15	15
1	ESV751N02YXB571	240V	X	X	8.8	5	4.2	15	15
1.5	ESV112N02YXB571	240V	X	X	12	6.9	6	20	15
2	ESV152N02YXB571	240V	X	X	13.3	8.1	7	25	15
3	ESV222N02YXB571	240V	X	X	17.1	10.8	9.6	30	20
5	ESV402N02TXB571	240V	-	X	-	18.6	16.5	-	30
7.5	ESV552N02TXB571	240V	-	X	-	26	23	-	40
10	ESV752N02TXB571	240V	-	X	-	33	29	-	50
15	ESV113N02TXB571	240V	-	X	-	48	42	-	80
20	ESV153N02TXB571	240V	-	X	-	59	54	-	90
1	ESV751N04TXB571	480V	-	X	-	2.5	2.1	-	15
1.5	ESV112N04TXB571	480V	-	X	-	3.6	3	-	15
2	ESV152N04TXB571	480V	-	X	-	4.1	3.5	-	15
3	ESV222N04TXB571	480V	-	X	-	5.4	4.8	-	15
5	ESV402N04TXB571	480V	-	X	-	9.3	8.2	-	15
7.5	ESV552N04TXB571	480V	-	X	-	12.4	11	-	20
10	ESV752N04TXB571	480V	-	X	-	15.8	14	-	25
15	ESV113N04TXB571	480V	-	X	-	24	21	-	40
20	ESV153N04TXB571	480V	-	X	-	31	27	-	50
25	ESV183N04TXB571	480V	-	X	-	38	34	-	70
30	ESV223N04TXB571	480V	-	X	-	45	40	-	80
40	ESV303N04TXB571	480V	-	X	-	59	52	-	100
50	ESV373N04TXB571	480V	-	X	-	74	65	-	125
60	ESV453N04TXB571	480V	-	X	-	87	77	-	150
1	ESV751N06TXB571	600V	-	X	-	2	1.7	-	15
2	ESV152N06TXB571	600V	-	X	-	3.2	2.7	-	15
3	ESV222N06TXB571	600V	-	X	-	4.4	3.9	-	15
5	ESV402N06TXB571	600V	-	X	-	6.8	6.1	-	15
7.5	ESV552N06TXB571	600V	-	X	-	10.2	9	-	20
10	ESV752N06TXB571	600V	-	X	-	12.4	11	-	20
15	ESV113N06TXB571	600V	-	X	-	19.7	17	-	30
20	ESV153N06TXB571	600V	-	X	-	25	22	-	40
25	ESV183N06TXB571	600V	-	X	-	31	27	-	50
30	ESV223N06TXB571	600V	-	X	-	36	32	-	60
40	ESV303N06TXB571	600V	-	X	-	47	41	-	70
50	ESV373N06TXB571	600V	-	X	-	59	52	-	90
60	ESV453N06TXB571	600V	-	X	-	71	62	-	110

START-UP OPERATION

Before starting up or operating the unit, verify all fasteners are secure and tight. Check the set screw in the wheel hub, bearings, and the fan sheaves (pulleys). With power **OFF** to the unit or before connecting the unit to power, turn the fan wheel by hand. Verify it is not striking the inlet or any obstructions. If necessary, re-center.

Special Tools Required: Standard Hand Tools, AC Voltage Meter, Tachometer

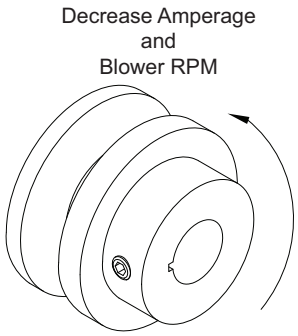
Unit Start-up Procedure

1. Check all electrical connections are secure and tight.
2. Check pulley alignment and belt tension. Refer to **“Pulley Alignment/Proper Belt Tension” on page 45**.
3. Inspect the condition of the intake damper and damper linkage, if applicable.
4. Remove intake filters if not already installed, inspect the air stream for obstructions. Install intake filters.
5. Compare the supplied **motor voltage** with the fan’s nameplate voltage. If this does not match, correct the problem. Compare the supplied **coil voltage** with the coil’s nameplate voltage. If this does not match, correct the problem. If this does match, turn the coil disconnect to the **ON** position.
6. Place the external disconnect to the **ON** position to start the unit. Immediately place the disconnect switch off. **Check the rotation of the fan** with the directional arrow on the blower scroll. Reversed rotation will result in poor air performance, motor overloading and possible burnout. For units equipped with a single-phase motor, check the motor wiring diagram to change rotation. For 3-phase motors, any two power leads can be interchanged to reverse motor direction.
7. When the fan is started, observe the operation and check for any unusual noises.
8. Place the external disconnect switch back to the **ON** position. The system should be in full operation with all ducts attached. Measure the system airflow. The motor sheave (pulley) is variable pitch and allows for an increase or decrease of the fan RPM. If an adjustment is needed, refer to **“Pulley Adjustment” on page 44**. Refer to **“Pulley Combination Chart” on page 46** for adjustment specifications.
9. Once the proper airflow is achieved, measure and record the fan speed with a reliable tachometer. **Caution - Excessive speed will result in motor overloading or bearing failure. Do not set fan RPMs higher than specified in the maximum RPM chart**. Refer to **“TROUBLESHOOTING” on page 56** for more information.
10. Measure and record the **voltage** and **amperage** to the motor. Compare with the motor’s nameplate to determine if the motor is operating under safe load conditions.
11. Once the RPM of the ventilator has been properly set, disconnect power. Re-check belt tension and pulley alignment, refer to **“Pulley Alignment/Proper Belt Tension” on page 45**.

Pulley Adjustment

The adjustable motor pulley is factory set for the RPM specified (**Table 7**). Speed can be increased by closing or decreased by opening the adjustable motor sheave. Two groove variable pitch pulleys must be adjusted to an equal number of turns open or closed. Any increase in speed represents a substantial increase in horsepower required by the unit. Motor amperage should always be checked to avoid serious damage to the motor when the speed is varied. Always torque set screws according to the torque specifications shown in **Figure 17**.

Figure 17 - Adjustable Pulley



Setscrew Thread Size	Torque (in-lbs)
No. 10 (bushing)	32
1/4” (bushing)	72
5/16”	130

Table 7 - Maximum RPM and HP Chart

Belt Drive		
Blower Size	**Max. RPM**	**Max. HP**
10”	1800	2
12”	1500	3
15”	1400	5
18”	1200	5
20”	1000	10
25”	900	20

Direct Drive		
Blower Size	**Max. RPM**	**Max. HP**
15D	1800	2
20D	1500	3
24D	1400	5
30D	1200	5
36D	1000	10
16Z	2400	4
18Z	3200	5
20Z	2300	5
22Z	1900	5
25Z	1800	8
28Z	1400	7

Pulley Alignment/Proper Belt Tension

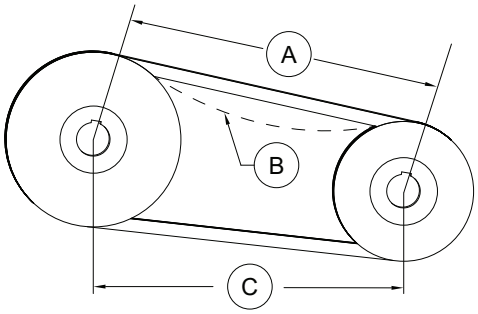
1. Belts tend to stretch and settle into pulleys after an initial start-up sequence. **Do not tension belts by changing the setting of the motor pulley**, this will change the fan speed and may damage the motor.
   - To re-tension belts, turn OFF power to the fan motor.
   - Loosen all fasteners that hold the blower motor plate to the blower housing.
   - Rotate the motor to the left or right to adjust the belt tension. Belt tension should be adjusted to allow 1/64” of deflection per inch of belt span. Use extreme care when adjusting V-belts as not to misalign pulleys. Any misalignment will cause a sharp reduction in belt life and produce squeaky noises. Over-tightening will cause excessive belt and bearing wear as well as noise. Too little tension will cause slippage at start-up and uneven wear.
   - **Whenever belts are removed or installed, never force belts over pulleys without loosening motor first to relieve belt tension.** When replacing belts, use the same type as supplied by the manufacturer. On units shipped with double groove pulleys, matched belts should always be used.
2. All fasteners should be checked for tightness each time maintenance checks are performed before restarting unit.

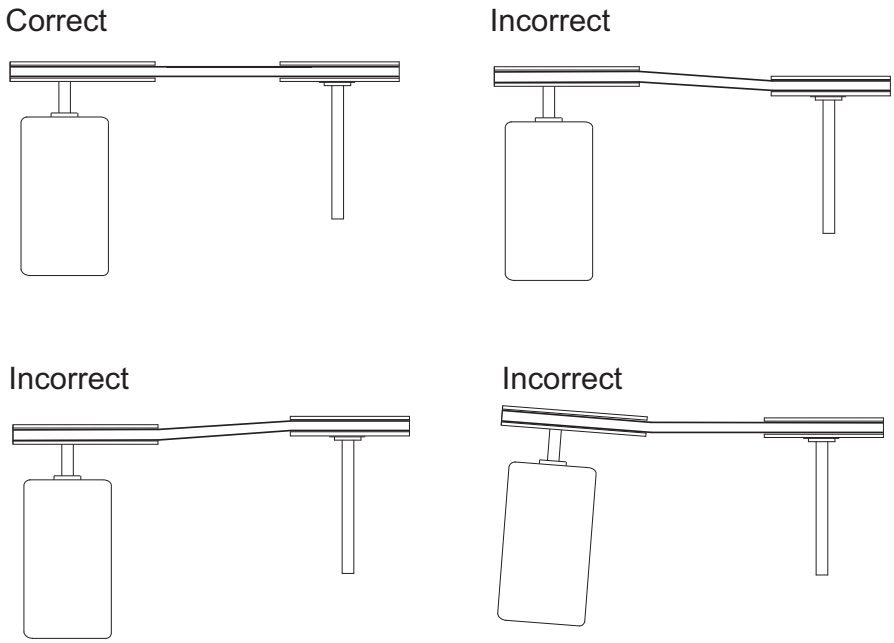
Belt tension examples:

- Belt span 12” = 3/16” deflection
- Belt span 32” = 1/2” deflection

Figure 18 - Pulley Alignment/Belt Tension

A. Belt Span Length
B. Deflection
C. Center Distance





Pulley Combination Chart

10 - 20 IN. BLOWER**

Motor RPM		1725													
1/3 to 1-1/2 HP		MOTOR PULLEY	Dd1	Dd2	Pd1	Pd2									
AX BELTS		1VL34	1.9	2.9	2	3									
			Open				TURNS ON MOTOR PULLEY						Closed		
BLOWER PULLEY	DATUM DIAMETER	PITCH DIAMETER	5	4 1/2	4	3 1/2	3	2 1/2	2	1 1/2	1	1/2	0		
AK114	11	11.2	308	323	339	354	370	385	400	416	431	447	462		
1/3 to 2 HP		MOTOR PULLEY	Dd1	Dd2	Pd1	Pd2									
AX BELTS		1VL40	2.4	3.4	2.6	3.6									
			Open				TURNS ON MOTOR PULLEY						Closed		
BLOWER PULLEY	DATUM DIAMETER	PITCH DIAMETER	5	4 1/2	4	3 1/2	3	2 1/2	2	1 1/2	1	1/2	0		
AK114	11	11.2	400	416	431	447	462	477	493	508	524	539	554		
AK94	9	9.2	488	506	525	544	563	581	600	619	638	656	675		
AK79	7.5	7.7	582	605	627	650	672	694	717	739	762	784	806		
AK66	6.2	6.4	701	728	755	782	809	836	863	889	916	943	970		
AK54	5	5.2	863	896	929	962	995	1028	1062	1095	1128	1161	1194		
AK46	4.2	4.4	1019	1059	1098	1137	1176	1215	1255	1294	1333	1372	1411		
AK39	3.5	3.7	1212	1259	1305	1352	1399	1445	1492	1539	1585	1632	1678		
AK32	3	3.2	1402	1455	1509	1563	1617	1671	1725	1779	1833	1887	1941		
3 to 5 HP		MOTOR PULLEY	Dd1	Dd2	Pd1	Pd2									
BX BELTS		2VP42	2.9	3.9	3	4									
			Open				TURNS ON MOTOR PULLEY								Closed
BLOWER PULLEY	DATUM DIAMETER	PITCH DIAMETER	6	5 1/2	5	4 1/2	4	3 1/2	3	2 1/2	2	1 1/2	1	1/2	0
2BK160H	15.4	15.7	330	339	348	357	366	375	385	394	403	412	421	430	439
2BK140H	13.4	13.7	378	388	399	409	420	430	441	451	462	472	483	493	504
2BK120H	11.4	11.7	442	455	467	479	491	504	516	528	541	553	565	577	590
2BK110H	10.4	10.7	484	497	511	524	537	551	564	578	591	605	618	631	645
2BK100H	9.4	9.7	534	548	563	578	593	608	622	637	652	667	682	697	711
2BK90H	8.4	8.7	595	611	628	644	661	677	694	710	727	744	760	777	793
2BK80H	7.4	7.7	672	691	709	728	747	765	784	803	821	840	859	877	896
2BK70H	6.4	6.7	772	794	815	837	858	880	901	923	944	965	987	1008	1030
2BK60H	5.4	5.7	908	933	958	984	1009	1034	1059	1084	1110	1135	1160	1185	1211
2BK55H	4.9	5.2	995	1023	1050	1078	1106	1133	1161	1189	1216	1244	1272	1299	1327
2BK50H	4.4	4.7	1101	1132	1162	1193	1223	1254	1285	1315	1346	1376	1407	1438	1468
7-1/2 to 10 HP		MOTOR PULLEY	Dd1	Dd2	Pd1	Pd2									
BX BELTS		2VP60	4.3	5.5	4.7	5.9									
			Open				TURNS ON MOTOR PULLEY								Closed
BLOWER PULLEY	DATUM DIAMETER	PITCH DIAMETER	6	5 1/2	5	4 1/2	4	3 1/2	3	2 1/2	2	1 1/2	1	1/2	0
2BK160H	15.4	15.7	516	527	538	549	560	571	582	593	604	615	626	637	648
2BK140H	13.4	13.7	592	604	617	630	642	655	667	680	693	705	718	730	743
2BK120H	11.4	11.7	693	708	722	737	752	767	781	796	811	826	840	855	870
2BK110H	10.4	10.7	758	774	790	806	822	838	854	871	887	903	919	935	951
2BK100H	9.4	9.7	836	854	871	889	907	925	943	960	978	996	1014	1031	1049
2BK90H	8.4	8.7	932	952	972	991	1011	1031	1051	1071	1091	1110	1130	1150	1170
2BK80H	7.4	7.7	1053	1075	1098	1120	1143	1165	1187	1210	1232	1255	1277	1299	1322

25 IN. BLOWER

3 to 5 HP		MOTOR PULLEY	Dd1	Dd2	Pd1	Pd2									
BX BELTS		2VP42	2.9	3.9	3	4									
			Open				TURNS ON MOTOR PULLEY								Closed
BLOWER PULLEY	DATUM DIAMETER	PITCH DIAMETER	6	5 1/2	5	4 1/2	4	3 1/2	3	2 1/2	2	1 1/2	1	1/2	0
2B5V278	27.8	28.1	184	189	194	200	205	210	215	220	225	230	235	240	246
2B5V250	25	25.3	205	210	216	222	227	233	239	244	250	256	261	267	273
2B5V234	23.4	23.7	218	224	230	237	243	249	255	261	267	273	279	285	291
2B5V200	20	20.3	255	262	269	276	283	290	297	304	312	319	326	333	340
2B5V184	18.4	18.7	277	284	292	300	307	315	323	331	338	346	354	361	369
2B5V160	16	16.3	317	326	335	344	353	362	370	379	388	397	406	414	423
2B5V154	15.4	15.7	330	339	348	357	366	375	385	394	403	412	421	430	439
2B5V136	12.6	12.9	401	412	423	435	446	457	468	479	490	501	513	524	535
2B5V124	12.4	12.7	407	419	430	441	453	464	475	487	498	509	521	532	543
2B5V110	11	11.3	458	471	483	496	509	522	534	547	560	572	585	598	611
7-1/2 to 10 HP		MOTOR PULLEY	Dd1	Dd2	Pd1	Pd2									
BX BELTS		2VP60	4.3	5.5	4.7	5.9									
			Open				TURNS ON MOTOR PULLEY								Closed
BLOWER PULLEY	DATUM DIAMETER	PITCH DIAMETER	6	5 1/2	5	4 1/2	4	3 1/2	3	2 1/2	2	1 1/2	1	1/2	0
2B5V278	27.8	28.1	289	295	301	307	313	319	325	331	338	344	350	356	362
2B5V250	25	25.3	320	327	334	341	348	355	361	368	375	382	389	395	402
2B5V234	23.4	23.7	342	349	357	364	371	378	386	393	400	408	415	422	429
2B5V200	20	20.3	399	408	416	425	433	442	450	459	467	476	484	493	501
2B5V184	18.4	18.7	434	443	452	461	470	480	489	498	507	517	526	535	544
2B5V160	16	16.3	497	508	519	529	540	550	561	571	582	593	603	614	624
2B5V154	15.4	15.7	516	527	538	549	560	571	582	593	604	615	626	637	648
2B5V136	12.6	12.9	628	642	655	669	682	695	709	722	735	749	762	776	789
2B5V124	12.4	12.7	638	652	666	679	693	706	720	733	747	761	774	788	801
2B5V110	11	11.3	717	733	748	763	779	794	809	824	840	855	870	885	901
15 to 20 HP		MOTOR PULLEY	Dd1	Dd2	Pd1	Pd2									
BX BELTS		2VP75	5.8	7	6.2	7.4									
			Open				TURNS ON MOTOR PULLEY								Closed
BLOWER PULLEY	DATUM DIAMETER	PITCH DIAMETER	6	5 1/2	5	4 1/2	4	3 1/2	3	2 1/2	2	1 1/2	1	1/2	0
2B5V278	27.8	28.1	381	387	393	399	405	411	417	424	430	436	442	448	454
2B5V250	25	25.3	423	430	436	443	450	457	464	470	477	484	491	498	505
2B5V234	23.4	23.7	451	459	466	473	480	488	495	502	509	517	524	531	539
2B5V200	20	20.3	527	535	544	552	561	569	578	586	595	603	612	620	629
2B5V184	18.4	18.7	572	581	590	600	609	618	627	636	646	655	664	673	683
2B5V160	16	16.3	656	667	677	688	698	709	720	730	741	751	762	773	783
2B5V154	15.4	15.7	681	692	703	714	725	736	747	758	769	780	791	802	813
2B5V136	12.6	12.9	829	842	856	869	883	896	909	923	936	949	963	976	990

** 2HP Motors on 20 IN Blowers use 2VP42 Pulleys

Silicon Controlled Rectifier (SCR) Electrical Control

The electric coils on the heater are controlled using Silicon Controlled Rectifier (SCR) controls. SCR is a time proportioning type controller that modulates the heater and supplies the exact amount of power to match heating demand of the system.

During modulation (proportional) control of the heater, an electric signal (0-10V DC) from a proportional sensor is transmitted to the stage controller. The sensor, which may be either a duct type for fresh make-up air or a room sensor thermostat for zone heating. The stage controller activates the modulating stage(s) of the electric heater. The heater is electronically controlled to provide 0 to 100% of its capacity to heat the space.

Depending on the space sensor demand, the heater is pulsed in different proportions of ON time and OFF time to match the heating demand. A modulation control can maintain an accurate room or discharge temperature without the typical variations of the ON/OFF method.

An example of proportional control would be when the heater element is operating at 10% of its capacity, 10% ON and 90% OFF.

Heaters that use more than one modulating stage use an ON/OFF control for supplemental stages.

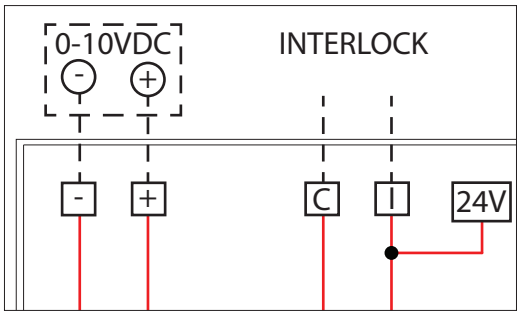
SCR Electrical Circuit Check

Components and electrical wiring will vary depending on heater model and insert. Refer to schematics provided with unit for appropriate electrical wiring checks.

- Verify the automatic and manual cutout switches are in their closed position.
- Verify electrical wiring and component connections are secure and tight.
- Check for air flow, and air flow switch operation. If the switch is not closed during operation, verify the tube is properly installed.
- Verify the control setting is set to 0-10V DC on the stage control board.
- Check for 0-10V DC between (-) to (+) connections.
- When there is a call for heat, verify there is 24V AC between interlock connection “I” and common connection “C”.
- When the unit is operating at 50% demand, the green LED should blink. If the light is not blinking, there may be an issue with the stage control board.
- Check for 24V AC at control fuse (labeled CF on heater schematics).
- Check SSR output terminals. There should be 0V DC when the demand is 0% and 24V DC when the demand is 100%. If the voltage readings are incorrect, there may be an issue with the stage control board.
- If the heater is equipped with multiple heating stages, verify operation of contacts. When the heating unit is at 100% demand, there should be 24V AC present at the corresponding contactor coil. The contacts should be closed.

If any components or wiring are found defective during these checks, repair or replace as required.

Figure 19 - Typical Heater Insert Wiring



Network

NOTE: The board will reboot when altering certain factory settings.

Communication Module (Optional)

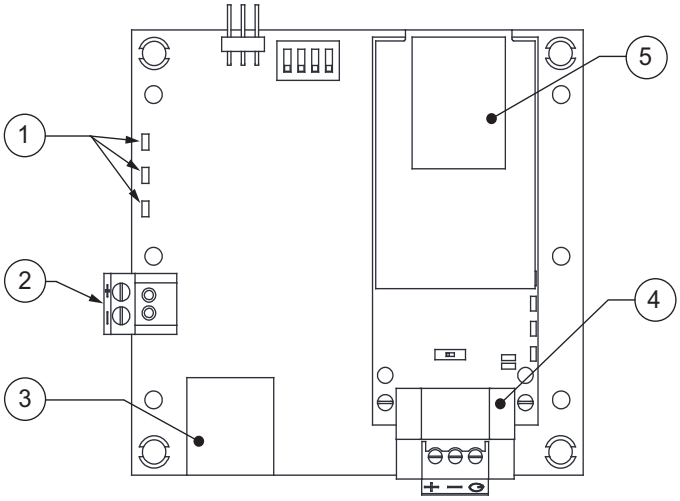
The Communication Module, PN: **SCADA**, is included in all CASlink equipped panels. It obtains operational data from various connected components. This communication wiring is either RS-485 shielded twisted pair wiring or RJ45 Cat 5 Ethernet wiring.

BACnet

BACnet IP or BACnet MS/TP (**Figure 20**) compatibility can be implemented with this package through a Protocessor, which is a BTL listed embedded Gateway configured to give a Building Management System access to monitor and/or control a list of BACnet objects. The Protocessor is mounted and factory pre-wired inside the Electrical Control Panel (ECP). Field connections to the Building Management System (BMS) are shown on wiring schematics.

The Protocessor is preconfigured at the factory to use the field protocol of the Building Management System in the specific jobsite. BACnet objects can only be accessed through the specified port and protocol.

Figure 20 - BACnet

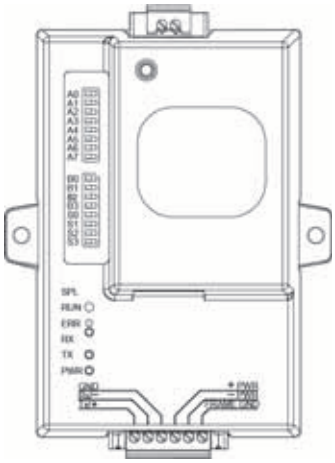


1. Status LEDs
   - Green - Data Out
   - Yellow - Data In
   - Red - Power On
2. Power Supply 24V AC/DC
3. Cat 5 Cable to MUA Board.
4. Field RS485 Connection for BACnet MS/TP
5. Field Ethernet Connection for BACnet IP

LonWorks

LonWorks compatibility (**Figure 21**) can be implemented on control packages through the ProtoNode, a LonMark certified external Gateway configured to give a Building Management System access to monitor and/or control a list of Network Variables. The ProtoNode is mounted and factory pre-wired inside the Electrical Control Panel. Refer to schematics connections to the Building Management System are shown.

Figure 21 - LonWorks



Commissioning on a LonWorks Network

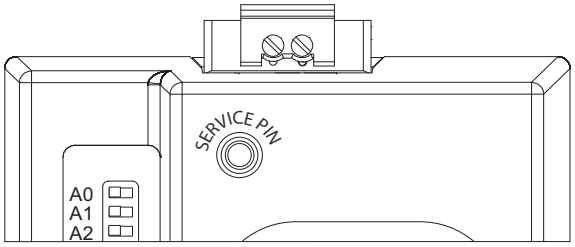
During the commissioning process by the LonWorks administrator (using a LonWorks Network Management Tool), the user will be prompted to hit the Service Pin in the ProtoNode. This pin is located in the front face, and it can be pressed by inserting a small screwdriver and tilting it towards the LonWorks Port. Refer to **Figure 22** for location of the “Service Pin.”

If an XIF file is required, it can be obtained by following these steps:

1. Set your computer’s static IP address to 192.168.1.xxx with a subnet mask of 255.255.255.0.
2. Run a Cat 5 connection from the ProtoNode’s Ethernet port to your computer.
3. On any web browser’s URL field, type 192.168.1.24/fserver.xif.

The web browser should automatically download the fserver.xif file or let you save it on your computer. Save it as fserver.xif.

Figure 22 - LonWorks Service Pin



NOTE: Insert Small Screwdriver. Tilt Toward LonWorks Port To Activate Service Pin.

DDC Control Points

Refer to **page 54** for DDC Notes - 1-5.

Name	ID	Object Type	Lon SVNT Name	Function	Modbus	Description
DDCHeatCommand (1)	1	Binary Value (BV)	nviDDCHeat/nvoDDCHeat	Read/Write	10000	Heating command, requires heat tempering mode = DDC
DDCCoolCommand1 (1)	2	BV	nviDDCCool1/nvoDDCCool1	Read/Write	10001	Cooling stage 1 command, requires cool tempering mode = DDC
DDCCoolCommand2 (1)	3	BV	nviDDCCool2/nvoDDCCool2	Read/Write	10002	Cooling stage 2 command, requires cool tempering mode = DDC
DDCCoolCommand3 (1)	4	BV	nviDDCCool3/nvoDDCCool3	Read/Write	10003	Cooling stage 3 command, requires cool tempering mode = DDC
DDCBlowerCommand (1)	5	BV	nviDDCBlow/nvoDDCBlow	Read/Write	10004	Blower command, requires both heat and cool tempering modes = DDC
DDCHeatModulation (1)	6	Analog Value (AV)	nviDDCModHeat/nvoDDCModHeat	Read/Write	10005	Heat modulation signal, 0-10V. 0V = low fire and 10V = high fire. Requires heat tempering mode = DDC
DDCOccupiedOverride (4)	7	BV	nviDDCOccOvrrd/nvoDDCOccOvrrd	Read/Write	10006	Occupied override command, requires SchedulingEnabled = ON (1)
SchedulingEnabled (4)	8	BV	nviSchedEnabled/nvoSchedEnabled	Read/Write	15016	Enable scheduling
HeatTemperModeOcc (2)	9	AV	nviHeatModeOcc/nvoHeatModeOcc	Read/Write	15055	Heat tempering mode during occupied time
HeatTemperModeUnocc (2)	10	AV	nviHeatModeUnocc/nvoHeatModeUnocc	Read/Write	15056	Heat tempering mode during unoccupied time
CoolTemperModeOcc (2)	11	AV	nviCoolModeOcc/nvoCoolModeOcc	Read/Write	15057	Cool tempering mode during occupied time
CoolTemperModeUnocc (2)	12	AV	nviCoolModeUnocc/nvoCoolModeUnocc	Read/Write	15058	Cool tempering mode during unoccupied time
ActivateOnOcc (2)	13	AV	nviActOnOcc/nvoActOnOcc	Read/Write	15059	"Activate based on" during occupied time
ActivateOnUnocc (2)	14	AV	nviActOnUnoc/nvoActOnUnoc	Read/Write	15060	"Activate based on" during unoccupied time
SpaceHeatHyst (2)	15	AV	nviSpaceHeatHyst/nvoSpaceHeatHyst	Read/Write	15064	Space Heating Hysteresis
IntakeHeatHyst (2)	16	AV	nviInHeatHyst/nvoInHeatHyst	Read/Write	15065	Intake Heating Hysteresis
SpaceCoolHyst (2)	17	AV	nviSpaceCoolHyst/nvoSpaceCoolHyst	Read/Write	15072	Space Cooling Hysteresis
IntakeCoolHyst (2)	18	AV	nviInCoolHyst/nvoInCoolHyst	Read/Write	15073	Intake Cooling Hysteresis
EvapHyst (2)	19	AV	nviEvapHyst/nvoEvapHyst	Read/Write	15074	Evap Cooling Hysteresis
BlowerModeOcc (2)	20	AV	nviBlowModeOcc/nvoBlowModeOcc	Read/Write	15081	Blower mode during occupied times
BlowerModeUnocc (2)	21	AV	nviBlowModeUnoc/nvoBlowModeUnoc	Read/Write	15082	Blower mode during unoccupied times
MixingBoxMode (2)	22	AV	nviMixingBoxMode/nvoMixingBoxMode	Read/Write	15096	Mixing box mode
MixingBoxMinOAPercentOcc (2)	23	AV	nviMBMinOAPerOcc/nvoMBMinOAPOcc	Read/Write	15099	Min occupied outdoor air percent when mixing box mode = outdoor air percent
MixingBoxMinOAPercentUnocc (2)	24	AV	nviMBMinOAPerUn/nvoMBMinOAPUnoc	Read/Write	15100	Min unoccupied outdoor air percent when mixing box mode = outdoor air percent
MixingBoxMaxOAPercentOcc (2)	25	AV	nviMBMaxOAPerOcc/nvoMBMaxOAPOcc	Read/Write	15101	Max occupied outdoor air percent when mixing box mode = outdoor air percent
MixingBoxMaxOAPercentUnocc (2)	26	AV	nviMBMaxOAPerUn/nvoMBMaxOAPUnoc	Read/Write	15102	Max unoccupied outdoor air percent when mixing box mode = outdoor air percent
MixingBoxMinVoltsOcc (2)	27	AV	nviMBMinVoltsOcc/nvoMBMinOAVOcc	Read/Write	15156	Min occupied mixing box voltage when mixing box mode = manual
MixingBoxMinVoltsUnocc (2)	28	AV	nviMBMinVoltsUn/nvoMBMinOAVUnoc	Read/Write	15157	Min unoccupied mixing box voltage when mixing box mode = manual
MixingBoxMaxVoltsOcc (2)	29	AV	nviMBMaxVoltsOcc/nvoMBMaxOAVOcc	Read/Write	15158	Max occupied mixing box voltage when mixing box mode = manual
MixingBoxMaxVoltsUnocc (2)	30	AV	nviMBMaxVoltsUn/nvoMBMaxOAVUnoc	Read/Write	15159	Max unoccupied mixing box voltage when mixing box mode = manual
BlowerVFDMinFreqOcc (2)	31	AV	nviVFDMinFreqOcc/nvoVFDMinFreqOcc	Read/Write	15085	Min blower VFD Frequency when occupied
BlowerVFDMinFreqUnocc (2)	32	AV	nviVFDMinFUnocc/nvoVFDMinFUnocc	Read/Write	15086	Min blower VFD Frequency when unoccupied
BlowerVFDMaxFreqOcc (2)	33	AV	nviVFDMaxFreqOcc/nvoVFDMaxFreqOcc	Read/Write	15087	Max blower VFD Frequency when occupied
BlowerVFDMaxFreqUnocc (2)	34	AV	nviVFDMaxFUnocc/nvoVFDMaxFUnocc	Read/Write	15088	Max blower VFD Frequency when unoccupied
BlowerPWMMinOcc (2)	35	AV	nviPWMMinOcc/nvoPWMMinOcc	Read/Write	15089	Min blower ECM speed when occupied
BlowerPWMMinUnocc (2)	36	AV	nviPWMMinUnocc/nvoPWMMinUnocc	Read/Write	15090	Min blower ECM speed when unoccupied
BlowerPWMMaxOcc (2)	37	AV	nviPWMMaxOcc/nvoPWMMaxOcc	Read/Write	15091	Max blower ECM speed when occupied
BlowerPWMMaxUnocc (2)	38	AV	nviPWMMaxUnocc/nvoPWMMaxUnocc	Read/Write	15092	Max blower ECM speed when unoccupied
IntakeHeatOccSP (3)	39	AV	nviInHeatOccSP/nvoInHeatOccSP	Read/Write	16000	Intake Heating Occupied Setpoint
IntakeHeatUnoccSP (3)	40	AV	nviInHeatUnocSP/nvoInHeatUnocSP	Read/Write	16001	Intake Heating Unoccupied Setpoint
SpaceHeatOccSP (3)	41	AV	nviSpHeatOccSP/nvoSpHeatOccSP	Read/Write	16002	Space Heating Occupied Setpoint

Name	ID	Object Type	Lon SVNT Name	Function	Modbus	Description
SpaceHeatUnoccSP (3)	42	AV	nviSpHeatUnocSP/nvoSpHeatUnocSP	Read/Write	16003	Space Heating Unoccupied Setpoint
MinDischargeHeatOccSP (3)	43	AV	nviMinDHeatOccSP/nvoMinDHeatOccSP	Read/Write	16004	Min Discharge Heating when occupied, relevant only if heat tempering mode = space
MinDischargeHeatUnoccSP (3)	44	AV	nviMinDHeatUnoSP/nvoMinDHeatUnoSP	Read/Write	16005	Min Discharge Heating when unoccupied, relevant only if heat tempering mode = space
DischargeHeatOccSP (3)	45	AV	nviDisHeatOccSP/nvoDisHeatOccSP	Read/Write	16006	Discharge heating setpoint when occupied, requires heat tempering mode = discharge
DischargeHeatUnoccSP (3)	46	AV	nviDisHeatUnocSP/nvoDisHeatUnocSP	Read/Write	16007	Discharge heating setpoint when unoccupied, requires heat tempering mode = discharge
MaxDischargeHeatOccSP (3)	47	AV	nviMaxDHeatOccSP/nvoMaxDHeatOccSP	Read/Write	16008	Max Discharge Heating when occupied, relevant only if heat tempering mode = space
MaxDischargeHeatUnoccSP (3)	48	AV	nviMaxDHeatUnoSP/nvoMaxDHeatUnoSP	Read/Write	16009	Max Discharge Heating when unoccupied, relevant only if heat tempering mode = space
IntakeCoolOccSP (3)	49	AV	nviInCoolOccSP/nvoInCoolOccSP	Read/Write	16010	Intake Cooling Occupied Setpoint
IntakeCoolUnoccSP (3)	50	AV	nviInCoolUnocSP/nvoInCoolUnocSP	Read/Write	16011	Intake Cooling Unoccupied Setpoint
SpaceCoolOccSP (3)	51	AV	nviSpCoolOccSP/nvoSpCoolOccSP	Read/Write	16012	Space Cooling Occupied Setpoint
SpaceCoolUnoccSP (3)	52	AV	nviSpCoolUnocSP/nvoSpCoolUnocSP	Read/Write	16013	Space Cooling Unoccupied Setpoint
IntakeCoolStagingDiffOcc (3)	53	AV	nviInCoolStDifOc/nvoInCoolStDifOc	Read/Write	16020	Intake Cooling Stage Differential Setpoint when occupied
IntakeCoolStagingDiffUnocc (3)	54	AV	nviInCoolStDifUn/nvoInCoolStDifUn	Read/Write	16021	Intake Cooling Stage Differential Setpoint when unoccupied
SpaceCoolStagingDiffOcc (3)	55	AV	nviSpCoolStDifOc/nvoSpCoolStDifOc	Read/Write	16022	Space Cooling Stage Differential Setpoint when occupied
SpaceCoolStagingDiffUnocc (3)	56	AV	nviSpCoolStDifUn/nvoSpCoolStDifUn	Read/Write	16023	Space Cooling Stage Differential Setpoint when unoccupied
RoomOverrideOccSP (3)	57	AV	nviRoomOvOccSP/nvoRoomOvOccSP	Read/Write	16024	Room Override Occupied Setpoint
RoomOverrideUnoccSP (3)	58	AV	nviRoomOvUnocSP/nvoRoomOvUnocSP	Read/Write	16025	Room Override Unoccupied Setpoint
OAEvapCoolOccSP (3)	59	AV	nviOAEvaCoolOCSP/nvoOAEvaCoolOCSP	Read/Write	16026	Outdoor air evap cooling occupied setpoint
OAEvapCoolUnoccSP (3)	60	AV	nviOAEvaCoolUnSP/nvoOAEvaCoolUnSP	Read/Write	16027	Outdoor air evap cooling unoccupied setpoint
ScheduleSundayAStart (4)	61	AV	nviSundayAStart/nvoSundayAStart	Read/Write	16037	Daily schedule start/end time in minutes
ScheduleSundayAEnd (4)	62	AV	nviSundayAEnd/nvoSundayAEnd	Read/Write	16038	Daily schedule start/end time in minutes
ScheduleSundayBStart (4)	63	AV	nviSundayBStart/nvoSundayBStart	Read/Write	16039	Daily schedule start/end time in minutes
ScheduleSundayBEnd (4)	64	AV	nviSundayBEnd/nvoSundayBEnd	Read/Write	16040	Daily schedule start/end time in minutes
ScheduleSundayCStart (4)	65	AV	nviSundayCStart/nvoSundayCStart	Read/Write	16041	Daily schedule start/end time in minutes
ScheduleSundayCEnd (4)	66	AV	nviSundayCEnd/nvoSundayCEnd	Read/Write	16042	Daily schedule start/end time in minutes
ScheduleMondayAStart (4)	67	AV	nviMondayAStart/nvoMondayAStart	Read/Write	16043	Daily schedule start/end time in minutes
ScheduleMondayAEnd (4)	68	AV	nviMondayAEnd/nvoMondayAEnd	Read/Write	16044	Daily schedule start/end time in minutes
ScheduleMondayBStart (4)	69	AV	nviMondayBStart/nvoMondayBStart	Read/Write	16045	Daily schedule start/end time in minutes
ScheduleMondayBEnd (4)	70	AV	nviMondayBEnd/nvoMondayBEnd	Read/Write	16046	Daily schedule start/end time in minutes
ScheduleMondayCStart (4)	71	AV	nviMondayCStart/nvoMondayCStart	Read/Write	16047	Daily schedule start/end time in minutes
ScheduleMondayCEnd (4)	72	AV	nviMondayCEnd/nvoMondayCEnd	Read/Write	16048	Daily schedule start/end time in minutes
ScheduleTuesdayAStart (4)	73	AV	nviTuesdayAStart/nvoTuesdayAStart	Read/Write	16049	Daily schedule start/end time in minutes
ScheduleTuesdayAEnd (4)	74	AV	nviTuesdayAEnd/nvoTuesdayAEnd	Read/Write	16050	Daily schedule start/end time in minutes
ScheduleTuesdayBStart (4)	75	AV	nviTuesdayBStart/nvoTuesdayBStart	Read/Write	16051	Daily schedule start/end time in minutes
ScheduleTuesdayBEnd (4)	76	AV	nviTuesdayBEnd/nvoTuesdayBEnd	Read/Write	16052	Daily schedule start/end time in minutes
ScheduleTuesdayCStart (4)	77	AV	nviTuesdayCStart/nvoTuesdayCStart	Read/Write	16053	Daily schedule start/end time in minutes
ScheduleTuesdayCEnd (4)	78	AV	nviTuesdayCEnd/nvoTuesdayCEnd	Read/Write	16054	Daily schedule start/end time in minutes
ScheduleWednesdayAStart (4)	79	AV	nviWedAStart/nvoWedAStart	Read/Write	16055	Daily schedule start/end time in minutes
ScheduleWednesdayAEnd (4)	80	AV	nviWedAEnd/nvoWedAEnd	Read/Write	16056	Daily schedule start/end time in minutes
ScheduleWednesdayBStart (4)	81	AV	nviWedBStart/nvoWedBStart	Read/Write	16057	Daily schedule start/end time in minutes
ScheduleWednesdayBEnd (4)	82	AV	nviWedBEnd/nvoWedBEnd	Read/Write	16058	Daily schedule start/end time in minutes
ScheduleWednesdayCStart (4)	83	AV	nviWedCStart/nvoWedCStart	Read/Write	16059	Daily schedule start/end time in minutes
ScheduleWednesdayCEnd (4)	84	AV	nviWedCEnd/nvoWedCEnd	Read/Write	16060	Daily schedule start/end time in minutes
ScheduleThursdayAStart (4)	85	AV	nviThursAStart/nvoThursAStart	Read/Write	16061	Daily schedule start/end time in minutes
ScheduleThursdayAEnd (4)	86	AV	nviThursAEnd/nvoThursAEnd	Read/Write	16062	Daily schedule start/end time in minutes
ScheduleThursdayBStart (4)	87	AV	nviThursBStart/nvoThursBStart	Read/Write	16063	Daily schedule start/end time in minutes
ScheduleThursdayBEnd (4)	88	AV	nviThursBEnd/nvoThursBEnd	Read/Write	16064	Daily schedule start/end time in minutes
ScheduleThursdayCStart (4)	89	AV	nviThursCStart/nvoThursCStart	Read/Write	16065	Daily schedule start/end time in minutes
ScheduleThursdayCEnd (4)	90	AV	nviThursCEnd/nvoThursCEnd	Read/Write	16066	Daily schedule start/end time in minutes

Name	ID	Object Type	Lon SVNT Name	Function	Modbus	Description
ScheduleFridayAStart (4)	91	AV	nviFridayAStart/nvoFridayAStart	Read/Write	16067	Daily schedule start/end time in minutes
ScheduleFridayAEnd (4)	92	AV	nviFridayAEnd/nvoFridayAEnd	Read/Write	16068	Daily schedule start/end time in minutes
ScheduleFridayBStart (4)	93	AV	nviFridayBStart/nvoFridayBStart	Read/Write	16069	Daily schedule start/end time in minutes
ScheduleFridayBEnd	94	AV	nviFridayBEnd/nvoFridayBEnd	Read/Write	16070	Daily schedule start/end time in minutes
ScheduleFridayCStart (4)	95	AV	nviFridayCStart/nvoFridayCStart	Read/Write	16071	Daily schedule start/end time in minutes
ScheduleFridayCEnd (4)	96	AV	nviFridayCEnd/nvoFridayCEnd	Read/Write	16072	Daily schedule start/end time in minutes
ScheduleSaturdayAStart (4)	97	AV	nviSatAStart/nvoSatAStart	Read/Write	16073	Daily schedule start/end time in minutes
ScheduleSaturdayAEnd (4)	98	AV	nviSatAEnd/nvoSatAEnd	Read/Write	16074	Daily schedule start/end time in minutes
ScheduleSaturdayBStart (4)	99	AV	nviSatBStart/nvoSatBStart	Read/Write	16075	Daily schedule start/end time in minutes
ScheduleSaturdayBEnd (4)	100	AV	nviSatBEnd/nvoSatBEnd	Read/Write	16076	Daily schedule start/end time in minutes
ScheduleSaturdayCStart (4)	101	AV	nviSatCStart/nvoSatCStart	Read/Write	16077	Daily schedule start/end time in minutes
ScheduleSaturdayCEnd (4)	102	AV	nviSatCEnd/nvoSatCEnd	Read/Write	16078	Daily schedule start/end time in minutes
BlowerManualFreqOcc (2)	103	AV	nviBlowManFreqOc/nvoBlowManFreqOc	Read/Write	16079	VFD frequency when occupied, requires blower control = VFD manual
BlowerManualFreqUnocc (2)	104	AV	nviBlowManFreqUn/nvoBlowManFreqUn	Read/Write	16080	VFD frequency when unoccupied, requires blower control = VFD manual
BlowerManualPwmRateOcc (2)	105	AV	nviBlowManPwmOc/nvoBlowManPwmOc	Read/Write	16081	ECM speed when occupied, requires blower control = ECM manual
BlowerManualPwmRateUnocc (2)	106	AV	nviBlowManPwmUn/nvoBlowManPwmUn	Read/Write	16082	ECM speed when unoccupied, requires blower control = ECM manual
MixingBoxManualOAOcc (2)	107	AV	nviMixBoxManOAOc/nvoMixBoxManOAOc	Read/Write	16084	Mixing Box Outdoor Air Percent during occupied times, requires mixing box mode = outdoor air percent
MixingBoxManualOAUnocc (2)	108	AV	nviMixBoxManOAUn/nvoMixBoxManOAUn	Read/Write	16085	Mixing Box Outdoor Air Percent during unoccupied times, requires mixing box mode = outdoor air percent
MixingBoxManualVoltsOcc (2)	109	AV	nviMixBoxManVOc/nvoMixBoxManVOc	Read/Write	16093	Mixing Box damper voltage during occupied times, requires mixing box mode = manual
MixingBoxManualVoltsUnocc (2)	110	AV	nviMixBoxManVUn/nvoMixBoxManVUn	Read/Write	16094	Mixing Box damper voltage during unoccupied times, requires mixing box mode = manual
DryModeDischTempSpOcc (3)	111	AV	nviDryDischTSpOc/nvoDryDischTSpOc	Read/Write	16101	Dry mode discharge temperature setpoint when occupied
DryModeDischTempSpUnocc (3)	112	AV	nviDryDischTSpUn/nvoDryDischTSpUn	Read/Write	16102	Dry mode discharge temperature setpoint when unoccupied
DryModeDewPointSP	113	AV	nviDryDewSp/nvoDryDewSp	Read/Write	15249	Dry mode dew point setpoint
DryModeOAPercent	114	AV	nviDryOAPer/nviDryOAPer	Read/Write	16122	Dry mode outdoor air percentage
StaticPressureLowOcc (2)	115	AV	nviStatPLowOcc/nviStatPLowOcc	Read/Write	16095	Static Pressure Low setpoint when occupied
StaticPressureLowUnocc (2)	116	AV	nviStatPLowUnoc/nviStatPLowUnoc	Read/Write	16096	Static Pressure Low setpoint when unoccupied
StaticPressureHighOcc (2)	117	AV	nviStatPHighOcc/nviStatPHighOcc	Read/Write	16097	Static Pressure High setpoint when occupied
StaticPressureHighUnocc (2)	118	AV	nviStatPHighUnoc/nviStatPHighUnoc	Read/Write	16098	Static Pressure High setpoint when unoccupied
OutdoorStatTemp (5)	119	AI	nvoOutdoorTemp	Read Only	9057	Outdoor temperature
ReturnStatTemp (5)	120	AI	nvoReturnTemp	Read Only	9058	Return temperature
DischargeStatTemp (5)	121	AI	nvoDischargeTemp	Read Only	9059	Discharge temperature
IntakeStatTemp (5)	122	AI	nvoIntakeTemp	Read Only	9060	Intake temperature
SpaceStatTemp (5)	123	AI	nvoSpaceTemp	Read Only	9061	Space temperature (thermistor)
Hmi0Temp (5)	124	AI	nvoHmi0Temp	Read Only	9063	Unit HMI temperature
Hmi1Temp (5)	125	AI	nvoHmi1Temp	Read Only	9064	Remote HMI 1 temperature
Hmi2Temp (5)	126	AI	nvoHmi2Temp	Read Only	9065	Remote HMI 2 temperature
Hmi3Temp (5)	127	AI	nvoHmi3Temp	Read Only	9066	Remote HMI 3 temperature
Hmi4Temp (5)	128	AI	nvoHmi4Temp	Read Only	9067	Remote HMI 4 temperature
IntakeRh (5)	129	AI	nvoIntakeRh	Read Only	9078	Intake relative humidity
SpaceRh (5)	130	AI	nvoSpaceRh	Read Only	9079	Space relative humidity
AdjustableDamperPosition (2)	131	AI	nvoDampPosition	Read Only	9085	Mixing Box Damper signal
Hmi0Rh (5)	132	AI	nvoHmi0Rh	Read Only	9097	Unit HMI relative humidity
Hmi1Rh (5)	133	AI	nvoHmi1Rh	Read Only	9098	Remote HMI 1 relative humidity
Hmi2Rh (5)	134	AI	nvoHmi2Rh	Read Only	9099	Remote HMI 2 relative humidity
Hmi3Rh (5)	135	AI	nvoHmi3Rh	Read Only	9100	Remote HMI 3 relative humidity
Hmi4Rh (5)	136	AI	nvoHmi4Rh	Read Only	9101	Remote HMI 4 relative humidity
ActiveFault0Id (5)	137	AI	nvoActiveFault0	Read Only	30501	Active Fault Code (see fault code table)

Name	ID	Object Type	Lon SVNT Name	Function	Modbus	Description
ActiveFault1Id (5)	138	AI	nvoActiveFault1	Read Only	30502	Active Fault Code (see fault code table)
ActiveFault2Id (5)	139	AI	nvoActiveFault2	Read Only	30503	Active Fault Code (see fault code table)
ActiveFault3Id (5)	140	AI	nvoActiveFault3	Read Only	30504	Active Fault Code (see fault code table)
ActiveFault4Id (5)	141	AI	nvoActiveFault4	Read Only	30505	Active Fault Code (see fault code table)
ActiveFault5Id (5)	142	AI	nvoActiveFault5	Read Only	30506	Active Fault Code (see fault code table)
CurrentHvacState (5)	143	AI	nvoCurrentState	Read Only	2083	HVAC State (Idle = 0, Blower = 1, Heating = 2, Cooling = 3)
OccupiedbySchedule (4)	144	AI	nvoOccbySchedule	Read Only	2125	Occupied due to the schedule
OccupiedbyInput (5)	145	AI	nvoOccbyInput	Read Only	2132	Occupied due to hardware input
OccupiedbyDDC (5)	146	AI	nvoOccbyDDC	Read Only	2133	Occupied due to DDC command
OccupiedbyHMIOverride (5)	147	AI	nvoOccbyHMI	Read Only	2134	Occupied due to HMI command
CurrentOccupiedStatus (5)	148	AI	nvoOccStatus	Read Only	2140	Occupancy status, occupied = 1, unoccupied = 0
CalculatedAverageSpaceTemp (5)	149	AI	nvoAvgSpaceTemp	Read Only	2144	Average space temperature
BlowerVFDFrequency (5)	150	AI	nvoBlowVFDFreq	Read Only	2146	Blower VFD frequency
BlowerVFDCurrent (5)	151	AI	nvoBlowVFDAmps	Read Only	2150	Blower VFD current
BlowerVFDPower (5)	152	AI	nvoBlowVFDPower	Read Only	2152	Blower VFD power
CalculatedAverageRh (5)	153	AI	nvoAvgRh	Read Only	2190	Average space relative humidity
GasValveOutput (5)	154	AI	nvoGasOutput	Read Only	1045	Controller output to the modulating gas valve. 0% = Low Fire, 100% = High Fire
CFMReading (5)	155	AI	nvoCFMReading	Read Only	2207	Fan CFM Reading
StaticPressure (5)	156	AI	nvoStaticPress	Read Only	2224	Static Pressure

DDC Notes

(1) Full Control Points

- Use only if Heating and/or Cooling tempering mode has been set to “DDC” through the unit’s HMI.
- Setting the Heating and Cooling modes to “DDC” disables temperature based activation of these functions. The preferred heating and cooling activation method are to use space and/or intake temperatures along with unit set points.
- Heating and Cooling cannot be called for at the same time.
- The Fan Control point will only work if the heating or cooling mode is set to DDC.

(2) Factory Setting Points

- Avoid writing to these on a regular basis.
- The Allow Schedule point tells the unit whether scheduling is allowed or not. It is **NOT** an occupancy command.
- Unit Status: 0 = Idle, 1 = Blower, 2 = Heating, 3 = Cooling
- OA Mode: 0 = Off, 1 = Manual, 2 = 2 Position, 3 = OA Percent, 4 = Analog Ctrl, 5 = PS, 6 = 100% OA, 7 = Modes
- Occupancy Status: 0 = OFF, 1 = ON
- Heat Tempering Mode Occ: 0 = Discharge, 1 = Space, 2 = BAS, 3 = DDC
- Activate Based ON Occ: 0 = Intake, 1 = Space, 2 = Both, 3 = Either, 4 = Stat
- Cool Tempering Mode Occ: 0 = Intake, 1 = Space, 2 = BAS, 3 = DDC
- Heat Tempering Mode Unocc: 0 = Discharge, 1 = Space, 2 = BAS, 3 = DDC
- Activate Based ON Unocc: 0 = Intake, 1 = Space, 2 = Both, 3 = Either, 4 = Stat
- Cool Tempering Mode Unocc: 0 = Intake, 1 = Space, 2 = BAS, 3 = DDC
- Blower Mode Occ: 0 = Auto, 1 = OFF, 2 = ON
- Blower Mode Unocc: 0 = Auto, 1 = OFF, 2 = ON

(3) Temperature Set Points

- The preferred method for DDC control is through set point manipulation. Use the set points shown above along with the “DDC Occupied Override” point in the Runtime settings section to control the blower and to determine when to heat or cool.
- Temperatures can be in degrees F or degrees C, depending on the “Temp Units” point in the factory settings.

(4) On-Board Scheduling

- Values are based on minutes in a day. 1439 minutes = 11:59 PM, 0 = 12:00AM.
- The end value of the A set or B set must be greater than or equal to the start value in that set (A start <= A end, B start <= B end).
- The B set must be greater than the A set and cannot overlap it (A end <= B start).
- The value 1440 is a special value meaning that there is no scheduling for that set. Both the start and end value of a set must have the value for it to be valid. If the A set has this value, the B set must also have this value (no scheduling for the entire day).

NOTE: The preferred method for a BMS to control occupancy is through the “DDC Occupied Override” binary point. The “On-Board Schedule” points should all be set to unoccupied (1440) if the “DDC Occupied Override” is used.

(5) Sensor Values and Alerts

- For Alert Codes 0-5, refer to **“DDC Fault List” on page 55**.

DDC Fault List

Fault Number	Fault Description
0	None
1	FireDetect
2	SmokeDetect
3	SupplyOverload
4	ExhaustOverload
5	MasterRomCrc
6	AuxRomCrc
7	FlameProving
8	IntakeFirestat
9	DischargeFirestat
10	Freezestat
12	HighTempLimit
13	FireEyeAlarm
14	GasHighPs
15	GasLowPs
16	AuxGasHighPs
17	AuxGasLowPs
18	CoAlarm
19	EvapWaterPs
20	EvapFloat
21	DxFloat
22	FurnaceFloat
23	BlowerVfdMbComm
24	DoorInterlock
26	MuaToAuxMbComm
27	IntakeDamperEnd
28	DischargeDamperEnd
29	BlowerAirProving
30	CloggedFilter
31	MissingSensorIntake
32	BrokenSensorIntake
33	MissingSensorDischarge
34	BrokenSensorDischarge
35	MissingSensorSpace
36	BrokenSensorSpace
37	MissingSensorOutsideAir
38	BrokenSensorOutsideAir
39	MissingSensorReturn

Fault Number	Fault Description
40	BrokenSensorReturn
49	RtcTempSensor
50	AuxRtcTempSensor
51	Hmi0TempInvalid
52	Hmi1TempInvalid
53	Hmi2TempInvalid
54	Hmi3TempInvalid
55	Hmi4TempInvalid
56	ProofOfClosure
57	LowFlameVoltage
58	SpPressureLowLimit
59	SpPressureHighLimit
86	SpaceRh
87	IntakeRh
88	DischargeRh
92	HmiMbComm0
93	HmiMbComm1
94	HmiMbComm2
95	HmiMbComm3
96	HmiMbComm4
121	Co2ShutdownRequired
122	Co2Override
127	Vfd571IgbtTemp
128	Vfd571Output
129	Vfd571Ground
130	Vfd571Temp
131	Vfd571FlyingStart
132	Vfd571HighDcBus
133	Vfd571LowDcBus
134	Vfd571Overload
135	Vfd571Oem
136	Vfd571IllegalSetup
137	Vfd571DynamicBrake
138	Vfd571PhaseLost
139	Vfd571External
140	Vfd571Control
141	Vfd571Start
142	Vfd571IncompatParamSet

Fault Number	Fault Description
143	Vfd571EpmHw
144	Vfd571Internal1
145	Vfd571Internal2
146	Vfd571Internal3
147	Vfd571Internal4
148	Vfd571Internal5
149	Vfd571Internal6
150	Vfd571Internal7
151	Vfd571Internal8
152	Vfd571Personality
153	Vfd571Internal10
154	Vfd571RemoteKeypadLost
155	Vfd571AssertionLevel
156	Vfd571Internal11
157	Vfd571Internal12
158	Vfd571Internal13
159	Vfd571Internal14
160	Vfd571CommModuleFail
161	Vfd571Network
162	Vfd571Network1
163	Vfd571Network2
164	Vfd571Network3
165	Vfd571Network4
166	Vfd571Network5
167	Vfd571Network6
168	Vfd571Network7
169	Vfd571Network8
170	Vfd571Network9
171	ReturnRh
173	OutsideRh
174	Co2Threshold
175	ErvDoorInterlock
176	ExternalInterlockActive
182	ExhFanContactor1Prv
183	ExhFanContactor2Prv

TROUBLESHOOTING

The troubleshooting section lists causes and corrective actions for possible problems with the equipment. Review this section prior to consulting the manufacturer.

Airflow Troubleshooting Chart

Problem	Potential Cause	Corrective Action
Fan Inoperative	Blown fuse/Open circuit breaker	Check amperage.
		Check fuse, replace if needed.
		Check circuit breaker.
	Disconnect switch in “OFF” position	Place switch to the “ON” position.
	Incorrect wiring to motor	Inspect motor wiring. Verify connections with wiring diagram located on fan motor.
	Broken fan belt	Replace belt.
	Motor starter overloaded	Check amperage.
		Reset starter.
Motor Overload	Incorrect fan rotation	Verify that the fan is rotating in the direction shown on rotation label.
	Fan speed is too high	Reduce fan RPM.
	Incorrect wiring to motor	Inspect motor wiring. Verify connections with wiring diagram located on fan motor.
	Overload in starter set too low	Set overload to motor’s FLA value.
	Motor HP too low	Determine if HP is sufficient for job.
	Duct static pressure lower than design	Reduce fan RPM.
Insufficient Airflow	Incorrect fan rotation	Verify that the fan is rotating in the direction shown on rotation label.
	Poor outlet conditions	Check duct and connections. There should be a straight duct connection to the outlet.
	Intake damper not fully open	Inspect damper linkage. If the linkage is damaged, replace damper motor.
	Duct static pressure higher than design	Check ductwork. Adjust/resize to eliminate or reduce duct losses.
	Blower speed too low	Increase fan RPM. Do not overload motor.
	Supply grills or registers closed	Open/Adjust.
	Dirty/clogged filters	Clean filters. Replace filters if they cannot be cleaned or are damaged.
	Belt slippage	Adjust belt tension.
Excessive Airflow	Blower speed too high	Reduce fan RPM.
	Filters not installed	Install filters.
	Duct static pressure lower than design	Reduce fan RPM.
Excessive Vibration and Noise	Damaged/Unbalanced wheel	Replace wheel.
	Misaligned pulleys	Align pulleys.
	Fan is operating in unstable region of fan curve	Refer to performance curve for fan.
	Bearings need lubrication/Damaged bearing	Lubricate bearings, replace if damaged.
	Fan speed is too high	Reduce fan RPM.
	Dirty/oily belt(s)	Clean belt(s).
	Belt(s) too loose	Adjust, replace if necessary.
	Worn belt(s)	Replace belt(s).

Problem	Potential Cause	Corrective Action
Insufficient Heating	Blown fuse(s)	Inspect fuses. Replace if needed.
	Thermostat settings too low	Increase thermostat setting.
	Excessive Airflow	Reduce fan RPM.
	Insufficient coil power	Check incoming voltage and amperage with all coil stages on and compare to nameplate values.
No Heat	Blown fuse(s)	Inspect fuses. Replace if needed.
	Airflow switch not energized	Increase fan RPM (Sensing tube should be curved toward air flow)
	Hi-limit activation	Insufficient airflow. Increase fan RPM.
	Improper coil wiring	Inspect coil power wiring.

MAINTENANCE

To guarantee trouble-free operation of this heater, the manufacturer suggests following these guidelines. Most problems associated with fan failures are directly related to poor service and maintenance.

Please record any maintenance or service performed on this fan in the documentation section located at the end of this manual.

WARNING: ELECTRIC HEATERS HAVE TWO POWER INPUTS. DO NOT ATTEMPT MAINTENANCE ON THE HEATER UNTIL BOTH THE MOTOR AND COIL ELECTRICAL SUPPLY HAVE BEEN COMPLETELY DISCONNECTED.

General Maintenance

1. Fan inlet and approaches to ventilator should be kept clean and free from any obstruction.
2. All fasteners and electrical connections should be checked for tightness each time maintenance checks are performed before restarting unit.
3. These units require very little attention when moving clean air. Occasionally oil and dust may accumulate, causing imbalance. If the fan is installed in a corrosive or dirty atmosphere, periodically inspect and clean the wheel, inlet, and other moving parts to ensure smooth and safe operation.
4. Motors are normally permanently lubricated. **Caution: Use care when touching the exterior of an operating motor. Components may be hot enough to burn or cause injury.**
5. The electric coil should be kept free of dirt and foreign matter that may cause uneven air patterns. Hot spots on the coil can shorten the life of the coil.

2 Weeks After Start-up

1. Belt tension should be checked after the first 2 weeks of fan operation. **See “Pulley Alignment/ Proper Belt Tension” on page 45.**
2. All fasteners should be checked for tightness each time maintenance checks are performed before restarting unit.
3. Inspect the electric coil. All elements should be in the proper location and clean. If an element is missing or broken, replace coil immediately.

Every 3 Months

1. Belt tension should be checked quarterly. **See “Pulley Alignment/Proper Belt Tension” on page 45.** Over-tightening will cause excessive bearing wear and noise. Too little tension will cause slippage at start-up and uneven wear.
2. Filters need to be cleaned and/or replaced quarterly, and more often in severe conditions. Washable filters can be washed in warm soapy water. When re-installing filters, be sure to install with the **airflow in the correct direction** as indicated on the filter.
3. Inspect the electric coil. All elements should be in the proper location and clean. If an element is missing or broken, replace coil immediately.

Yearly

1. Inspect bearings for wear and deterioration. Replace if necessary.
2. Inspect belt wear and replace torn or worn belts.
3. Inspect bolts and set screws for tightness. Tighten as necessary.
4. Inspect motor for cleanliness. Clean exterior surfaces only. Remove dust and grease from the motor housing to ensure proper motor cooling. Remove dirt from the wheel and housing to prevent imbalance and damage.
5. Inspect the electric coil. All elements should be in the proper location and clean. If an element is missing or broken, replace coil immediately.

Unit Filters

Table 8 - Filter Quantity Chart

Intake	16” x 20”	20” x 25”
Size 1 Standard Sloped	2	-
Size 2 Standard Sloped	-	2
Size 1 Modular Sloped	3	-
Size 2 Modular Sloped	-	3
Size 3 Modular Sloped	6	-
Size 4 Modular Sloped	10	-
Size 5 Modular Sloped	-	8
Size 1 V-Bank	-	3
Size 2 V-Bank	8	-
Size 3 V-Bank	-	8
Size 4 V-Bank	15	-
Size 5 V-Bank	-	12
Size 1 Inline	1	-
Size 2 Inline	-	1
Size 3 Inline	-	2

Start-Up and Maintenance Documentation

START-UP AND MEASUREMENTS SHOULD BE PERFORMED AFTER THE SYSTEM HAS BEEN AIR BALANCED (Warranty will be void without completion of this form)

Job Information

Job Name	
Address	
City	
State	
Zip	
Phone Number	
Fax Number	
Contact	
Purchase Date	

Service Company	
Address	
City	
State	
Zip	
Phone Number	
Fax Number	
Contact	
Start-up Date	

Unit Information

Refer to the start-up procedure in this manual to complete this section.

Name Plate and Unit Information	
Model Number	
Serial Number	
Coil Voltage	
Coil Hertz	
Coil Phase	
Coil FLA	
Motor HP	
Motor Volts	
Motor Hertz	
Motor Phase	
Motor FLA	
# of Steps	
Blower Pulley	
Motor Pulley	
Belt Number	

Field Measured Information	
Coil Voltage	
Coil Amperage	
Motor Voltage	
Motor Amperage**	
RPM	
Thermostat Setpoint	
Temperature Control	Discharge:
	Space:
# of Operating Steps	

Airflow Direction	Correct	
	Incorrect	

**If measured amps exceed the FLA rating on the nameplate, fan RPM must be reduced to decrease the measured amps below the nameplate FLA rating.

CLEANING & MAINTENANCE RECORD

Date	Service Performed