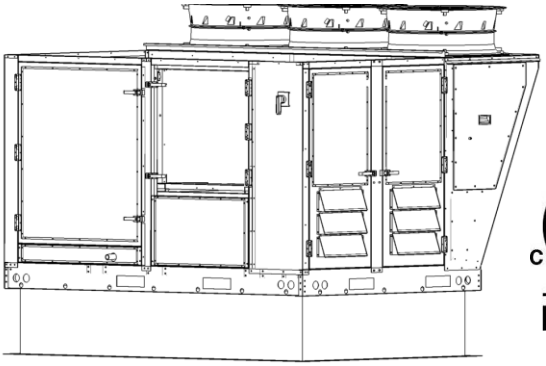
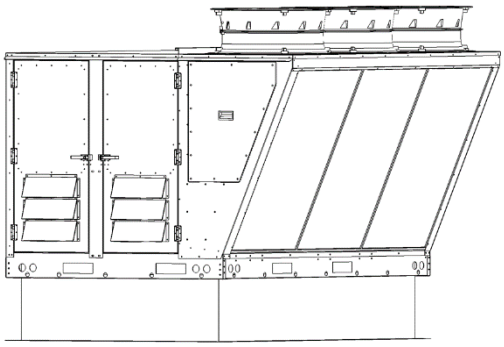
Packaged Rooftop Unit – DOAS RTU Series

Installation, Operation, and Maintenance Manual





WARNING!!

FIRE OR EXPLOSION HAZARD

- **Failure to follow safety warnings exactly could result in serious injury, death or property damage.**
- **Be sure to read and understand the installation, operation and service instructions in this manual.**
- **Improper installation, adjustment, alteration, service or maintenance can cause serious injury, death or property damage**
- **Read the installation, operating and maintenance instructions thoroughly before installing or servicing this equipment. ALWAYS disconnect power and gas prior to working on unit.**

FOR YOUR SAFETY

Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

WHAT TO DO IF YOU SMELL GAS:

- **Do not try to light any appliance.**
- **Do not touch any electrical switch; do not use any phone in your building.**
- **Leave the building immediately.**
- **Immediately call your gas supplier from a phone remote from the building. Follow the gas supplier's instructions.**
- **If you cannot reach your gas supplier, call the fire department.**

Installation and service must be performed by a qualified installer, service agency or the gas supplier.

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. Turn the blower wheel by hand to verify free rotation and check the damper (if supplied) for free operation.

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.

A0026936
November 2018 Rev 9

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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 5 years from date of shipment. Furnace heat exchangers have a standard 10 year pro-rated manufacturer-backed warranty. 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 or neglected, or not maintained per the MANUFACTURER'S maintenance instructions.
4. The equipment is not operated within its published capacity.
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 5 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, register this product by filling out the Start-up and Maintenance Document. Fax the form to 1-919-554-9374 or call 1-866-784-6900 for email information.

Pro-Rated Furnace Warranty

Subject to all terms stated herein, the MANUFACTURER warrants to BUYER the stainless steel heat exchanger to be free from defects in material and workmanship under normal use and service for 10 years from the date of manufacture, and warranty is limited to replacement of the heat exchanger only, at a percentage (%) of the current replacement part price in accordance with the following:

Table 1- Furnace Warranty

Year Number	% of Heat Exchanger Price Covered
1	100%
2	90%
3	80%
4	70%
5	60%
6	50%
7	40%
8	30%
9	20%
10	10%

Compressor Warranty

Subject to all terms stated herein, the MANUFACTURER warrants to BUYER the refrigeration compressor to be free from defects in material and workmanship under normal use and service for 5 years from the date of manufacture, and warranty is limited to replacement of the compressor only.

CERTIFICATIONS

Listings and Standards

This unit is ETL-listed to the following standards:

- Standard for Safety Heating and Cooling Equipment ANSI/UL 1995, CSA 22.2 no. 236
- American National Standard/CSA Standard for Gas Unit Heaters and Gas-Fired Duct Furnaces ANSI Z83.8-2013, CSA 2.6-2013

This unit has been tested in accordance with the following standards:

- ANSI/AHRI Standard 340/360 – 2007
- ANSI/ASHRAE Standard 37 2009

INSTALLATION

It is imperative that this unit is installed and operated with the designed airflow, gas, 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

Inspection on Arrival

1. Inspect unit on delivery.
2. Photograph any visible damage.
3. Report any damage to the delivery carrier.
4. Request a written inspection report from the Claims Inspector to substantiate claim.
5. File a claim with the delivery carrier.
6. Check unit's rating plate to verify proper electric and fuel type to meet job requirements.
7. Compare unit received with description of product ordered.

Unit Location - Site Preparation

- Do not locate any gas-fired equipment near corrosive or explosive vapors such as chlorinated or acid vapors.
- Avoid overhead power lines, or other utility access points to prevent accidental contact or damage.
- Provide clearance around the installation site to safely rig and lift the equipment into its final position onto adequate supports. Refer to the manufacturer's estimated weights.
- Consider general service and installation space when locating the unit.
- Locate the unit close to the space it will serve to reduce long and twisted duct runs.
- Do not allow the air intake to face prevailing winds. The air flow switch may trip in high winds.
- Situate the 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 inlet must be located in accordance with the applicable building code provisions for ventilation air.
- The unit must have adequate structural support or the equipment or building could be damaged.
- Do not alter or otherwise restrict combustion or ventilation openings.

IMPORTANT

For gas units, to prevent premature heat exchanger failure, do not locate any gas fired unit in areas where chlorinated, halogenated, or acid vapors are present in the atmosphere.

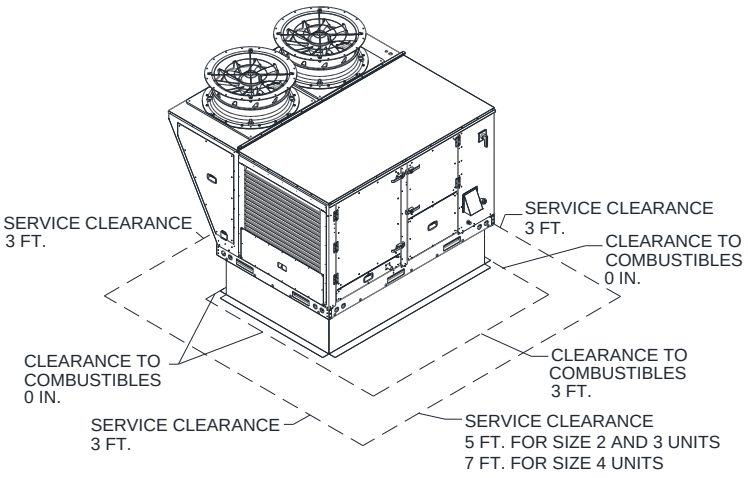
CLEARANCE TO COMBUSTIBLE MATERIALS

This equipment may be installed with clearances from the equipment to combustible material not less than 0 in. from the top, bottom, condenser side, front and back. The flue side must be installed 3 feet from combustible materials.

SERVICE CLEARANCE

For service accessibility and performance, this unit must have at least 3 feet of clearance on the intake, supply and condensing coil sides. At least 5 feet of clearance is required on the coil and blower access side of size 2 and 3 units. This may be reduced to 3 feet if drain pan removal is not required. At least 7 feet of clearance is required on the coil and blower access side on size 4 units, this cannot be reduced. Clearance above condenser fans should be at least 10 feet.

Figure 1 - Unit Clearance



Note: The 5 foot service clearance on the coil and supply fan access side can be reduced to 3 feet if drain pan removal is not required on size 2 and 3 units.

Rigging

WARNING!!

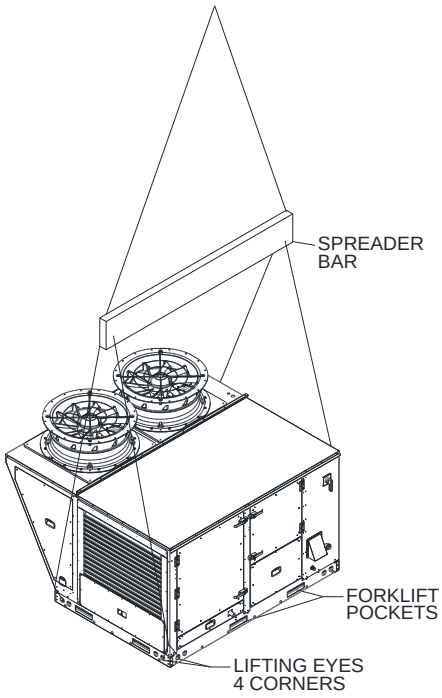
Ensure that all the lifting equipment used is properly rated for the weight of the unit being lifted. Each of the cables (chains or slings), hooks, and shackles used to lift the unit must be capable of supporting the entire weight of the unit. Lifting cables (chains or slings) may not be of the same length. Adjust as necessary for even unit lift. Other lifting arrangements could cause equipment or property damage. Failure to follow instructions above or properly lift unit could result in unit dropping and possibly crushing operator/ technician which could result in death or serious injury.

Spreader bars must be used and should extend past the edges of the equipment to avoid damage to the casing. Not using spreader bars may cause damage to the unit casing.

WARNING: DO NOT LIFT UNIT BY THE INTAKE LOUVER, OR DOOR OPENINGS – USE ALL LIFTING POINTS PROVIDED WITH A SPREADER BAR OR SLINGS UNDER THE UNIT – USE CARE NOT TO DAMAGE COILS, SWITCHES OR PROTRUDING SHEET METAL COMPONENTS.

- Units are supplied with four lifting eyes on the bottom corners of the structural rails.
- Always use spreader bars to prevent damage to the unit casing.
- Test lift unit approximately **2 feet** to verify proper center of gravity lift point. To avoid dropping unit, re-position lifting point if unit is not level. Failure to properly lift unit could result in unit dropping and possibly crushing operator/technician which could result in death or serious injury and possible equipment or property-only damage.

Figure 2 – Rigging
(Size 2 Unit Shown)



Curb and Ductwork

This unit was specified for a specific CFM and static pressure. The ductwork attached to this unit will significantly affect the airflow performance. Flexible ductwork and square elbows should not be used. Also, transitions and turns in ductwork near the fan outlet will cause system effect and will drastically increase the static pressure and reduce airflow. **Table 2** and **Table 3** detail the minimum fan outlet duct sizes required for optimal fan performance.

Table 2 - Recommended Supply Ductwork Sizes Down Discharge

Unit Size	Down Discharge Duct Size (IN)	Down Return Duct Size (IN)	Side Return Duct Size (IN)	Straight Duct Length*
2	20.25 x 20	36 x 9	36.25 x 11.25	54”
3	39 x 21.5	45.5 x 13.5	45.5 x 10.75	78”
4	39.75 x 31	74 x 12.25	76.5 x 16.25	96”

Table 3 - Recommended Supply Ductwork Sizes Side Discharge

Unit Size	Side Discharge Duct Size (IN)	Down Return Duct Size (IN)	Side Return Duct Size (IN)	Straight Duct Length*
2	20 x 14	36 x 9	36.25 x 11.25	48”
3	25 x 14	45.5 x 13.5	45.5 x 10.75	54”
4	34 x 21.25	74 x 12.25	76.5 x 16.25	78”

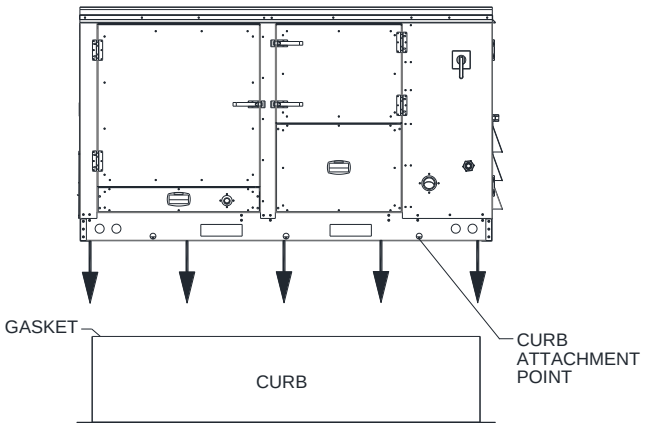
***Minimum straight discharge duct length required before fitting/transition.**

WARNING!!

Failure to properly size ductwork may cause system effects and reduce the performance of the equipment.

- **Follow SMACNA guides and manufacturer’s requirements for the remaining duct run.** Units designed for rooftop installation should be installed on a prefabricated or factory built roof curb. Follow curb manufacturer’s instructions for proper curb installation.
- **Do not use unit to support ductwork in any way. This may cause damage to the unit.**
- If installed in a geographical area where snow accumulates, the unit should be installed on a curb and/or rail elevated not less than **12 inches** above any surface. Verify installation meets local code height requirements.
- Verify duct connection and unit supply outlet are properly aligned and sealed. Use gasket between the curb and unit. See **Figure 3**.
- The curb and unit must be leveled or the unit may leak or be damaged. Use shims if necessary to level the unit. Shims may be required depending upon curb installation and roofing material.
- Secure unit to curb through vertical portion of the base assembly rails (shown below) using a minimum of twenty four **(24) lug screws**, anchor bolts, or other suitable fasteners (not furnished). See **Figure 3**.
- Check all fasteners for tightness.

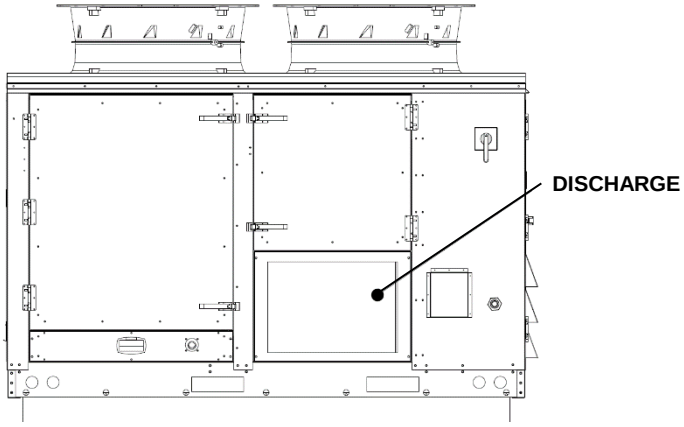
Figure 3 - Curb



Side Discharge Duct Install, see **Figure 4:**

- Mount ductwork to the lip of the side discharge opening.
- Use self-tapping screws to secure ductwork.
- Verify the ductwork is clear for opening the top access panel door.

Figure 4 - Side Discharge



Side Return Duct/Access Panel Install, see **Figure 5**:

- Install gasket material around the upper and side edges.
- Install ductwork using self-tapping screws.
- Use caulk/sealant around the upper and side edges.
- Do not use caulk/sealant on the lower edge. Use only self-tapping screws to mount ductwork.

Figure 5 - Gasket/Sealant for Side Return Duct or Access Panel

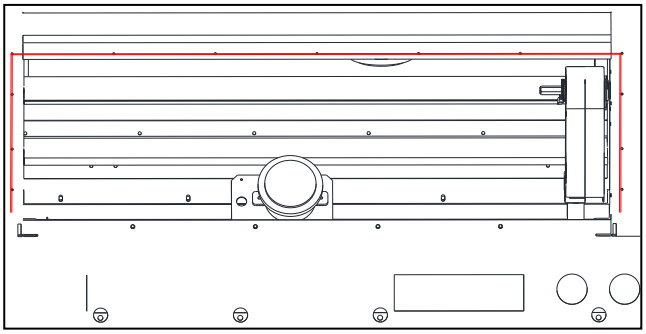


Table 4 – Duct Hanger Curb Dimensions

Ref.	Size 2	Size 3	Size 4
A	12 1/4	16 5/8	15 1/2
B	33 3/8	48 1/8	60 1/4
C	55 1/2	71 5/8	93 3/4
D	1 3/4	NA	NA
E	39 1/2	48 3/8	NA
F	7 3/8	2 3/4	29 3/8
G	29 1/8	43 1/2	70 3/4

Figure 6 – Duct Hanger Dimensions

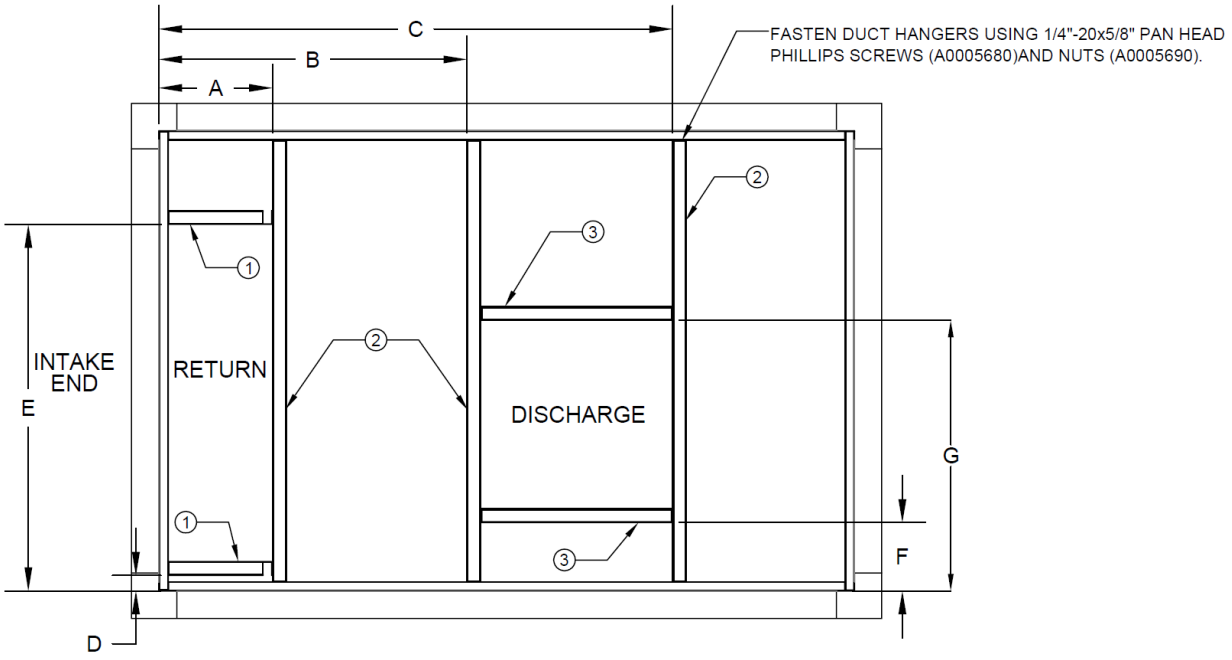


Figure 7 – Duct Hanger Assembled

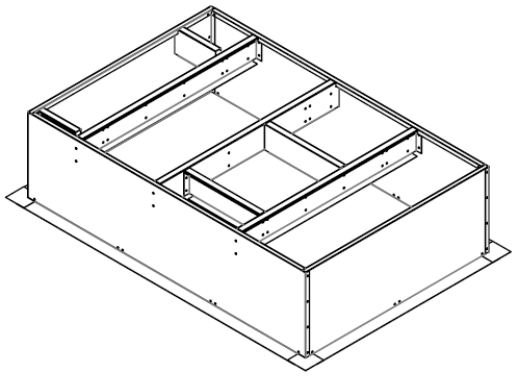


Table 5 – Duct Hanger Bill of Materials

Ref.	Size 2	Size 3	Size 4
1	RTU2DHR Quantity x 2	RTU3DHR Quantity x 1	NA
2	RTU2DHL Quantity x 3	RTU3DHL Quantity x 3	RTU4DHL Quantity x 3
3	RTU2DHD Quantity x 2	RTU3DHD Quantity x 2	RTU4DHD Quantity x 2

ROOFTOP UNIT DOWN DISCHARGE DOWN RETURN

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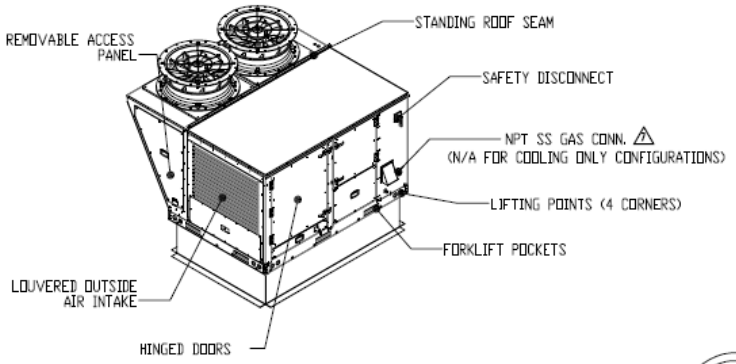

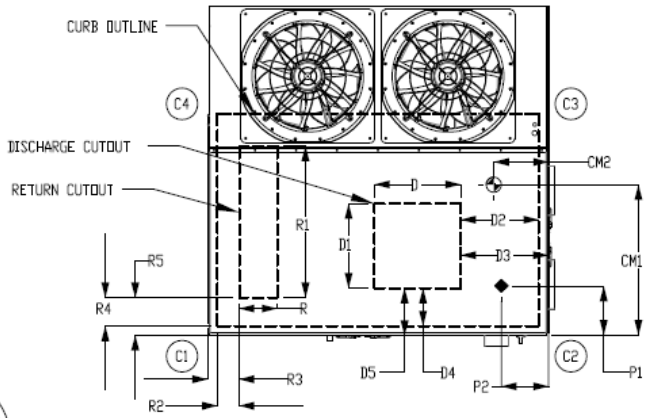

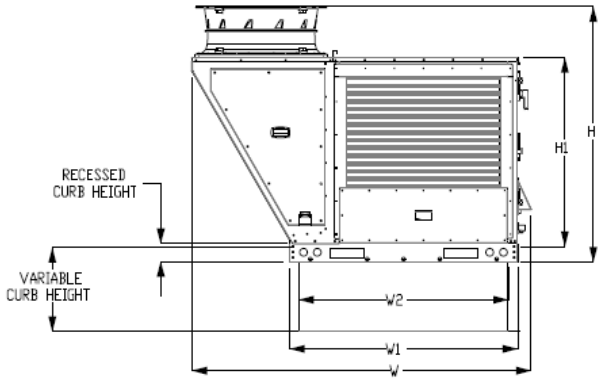

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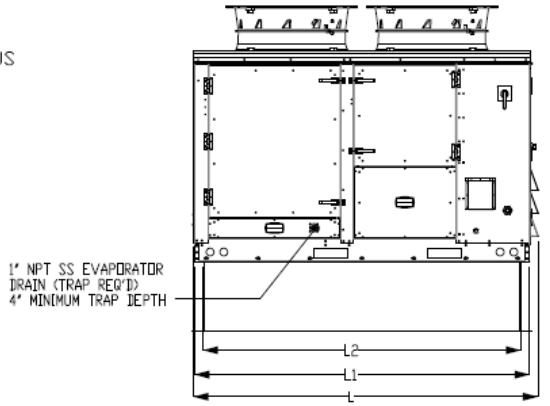


NOTES:
1. ROOF OPENING MUST BE 2" SMALLER THAN CURB DIMENSIONS IN BOTH DIRECTIONS
2. DO NOT OBSTRUCT OUTSIDE AIR INLET, OUTSIDE AIR COIL OR OUTSIDE AIR FAN
3. FLOOR MOUNT ISOLATORS LOCATED 1" FROM END OF BASE IN EITHER DIRECTION. ACCOUNT FOR AN ADDITIONAL 5" FOR ISOLATOR HEIGHT
4. QUANTITIES SUBJECT TO CHANGE DEPENDING ON FILTER TYPES
5. ONLY APPLICABLE FOR INDIRECT HEAT OR ELECTRIC HEAT CONFIGURATIONS
6. SUBTRACT 100 LBS. FOR COOLING ONLY CONFIGURATIONS
7. 3/4" NPT SS GAS CONN. FOR 50-200 MBH FURNACES
   1" NPT SS GAS CONN. FOR 300-500 MBH FURNACES

RTU INFORMATION*

UNIT SIZE	NOMINAL TONNAGE	INTAKE FILTERS	SUPPLY FILTERS 4	FURNACE CAPACITY (MBH) 5	ELECTRIC CAPACITY (KW) 5	APPROXIMATE WEIGHT (LBS) 6	CENTER OF MASS		CORNER WEIGHTS (LBS)				ENTERING POWER	
							CM1	CM2	C1	C2	C3	C4	P1	P2
2	8	25 X 20 X 2 (2)	16 X 20 (8)	50 - 200	15 - 60	1650	32	36	441	537	369	303	5 1/4	7 1/4
3	15, 20	16 X 25 X 2 (4)	25 X 20 (8)	150 - 500	15 - 100	2500	37 1/4	44	472	572	798	658	5 1/2	7 1/2

RTU DIMENSIONS*

UNIT SIZE	UNIT LENGTH (L)	OUTSIDE BASE LENGTH (L1)	INSIDE BASE LENGTH (L2)	UNIT HEIGHT (H)	MOUNTED HEIGHT (H1)	UNIT WIDTH (W)	BASE WIDTH (W1)	INSIDE BASE WIDTH (W2)	RECESSED CURB HEIGHT	DISCHARGE DIMENSIONS						RETURN DIMENSIONS						CURB SIZE
										D	D1	D2	D3	D4	D5	R	R1	R2	R3	R4	R5	
2	81 3/4	79 3/4	75 3/4	60	45	80 3/4	54	49 3/4	3 1/2	20 1/2	20	19 3/4	22	9	12	9	36	3 1/4	5 1/2	3 1/4	6 1/2	75 x 49 1/2
3	99	96 3/4	91 3/4	68 1/4	52 3/4	89 3/4	65 1/4	60	4 1/4	21 1/2	39	20	23 1/4	4 1/4	8	13 1/2	45 1/2	3 1/2	6 1/4	2 1/2	6 1/4	91 x 59 1/2

*ALL DIMENSIONS IN INCHES UNLESS OTHERWISE SPECIFIED

Figure 8 – Typical Submittal Drawing

Furnace Condensation Drain

In some applications, condensation can form in the flue collection box, especially when furnaces are located downstream of cooling coils or operate in a high efficiency range. In the event that condensation occurs in the flue collection box, there are fittings in the bottom of the flue collection box to drain condensation out of the box. The burner in the unit is provided with a condensation drain assembly located underneath this fitting for the condensation to collect. The drain will need to be connected to field piping to properly handle the condensation.

Consult your local code as to the proper drainage regulations of the condensation. A heated drain option is available to prevent the internal drain piping from freezing. If drains are field piped, ensure that the field piping is piped in a fashion to prevent the condensation from freezing. Do not plug the holes under any circumstance as it will cause the burners to overflow.

The standard efficiency furnace drain is piped to the exterior of the unit via 5/16 inch silicone tubing. A 1/4 inch female NPT fitting is provided external to the unit to allow for field piping if required. If piping is added to the unit, freeze protection should be added to prevent damage to the field installed piping.

The high efficiency furnace is fitted with a condensation float switch assembly, located in the bottom main cabinet, from the factory. A condensation drain must be field piped through the base of the unit using 3/4 inch PVC schedule 80 smooth fittings per the above requirements. A 2 inch deep trap must be field installed downstream of the unit to ensure adequate flow.

Note: Seal <u>ALL</u> base penetrations with appropriate filler (caulk or all-purpose putty) to prevent water from entering the space.

Figure 9 - Standard Efficiency Drain

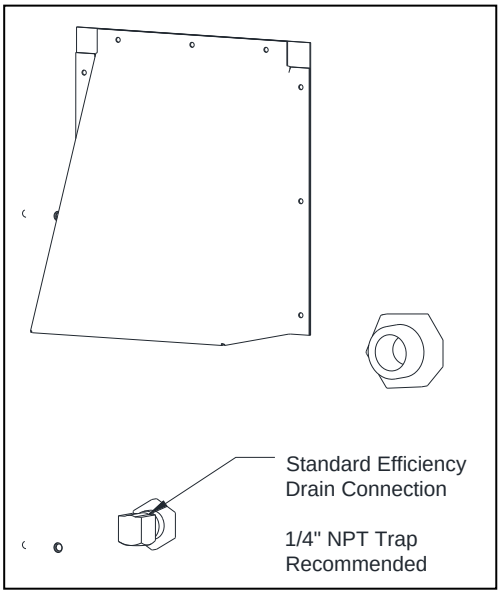
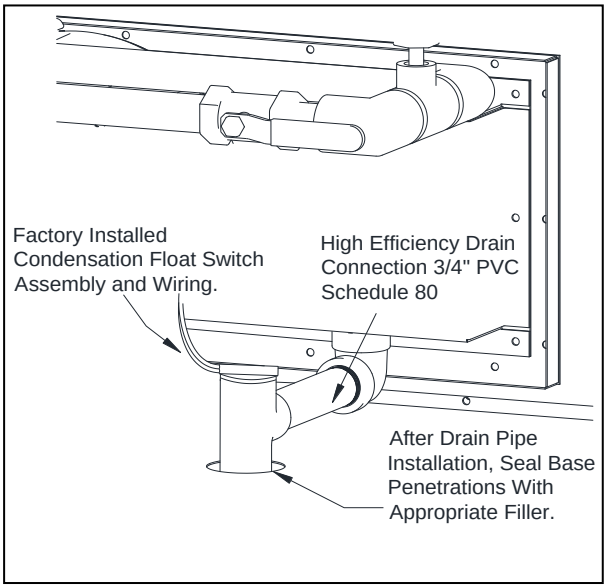


Figure 10 - High Efficiency Drain



To test the factory installed condensation float switch assembly:

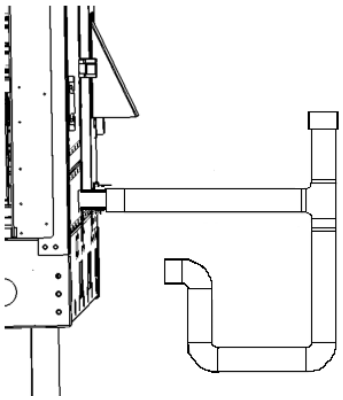
- Turn the unit on, start the heating system. If the heating system does not run, verify the condensation float switch assembly wiring is correct.
- Remove the condensation float switch from the assembly. Lift the switching arm with a screwdriver. The heating system should shut off immediately. If not, check that the condensation float switch assembly's wiring connections are secure and tight. Re-check the float switch for correct operation.

Cooling Coil Trap

There is a field plumbing connection that is required for the DX/cooling coil. This connection is for the drain pan located under the DX/cooling coil. Also, it is recommended that all plumbing connections be sealed with Teflon tape or pipe dope.

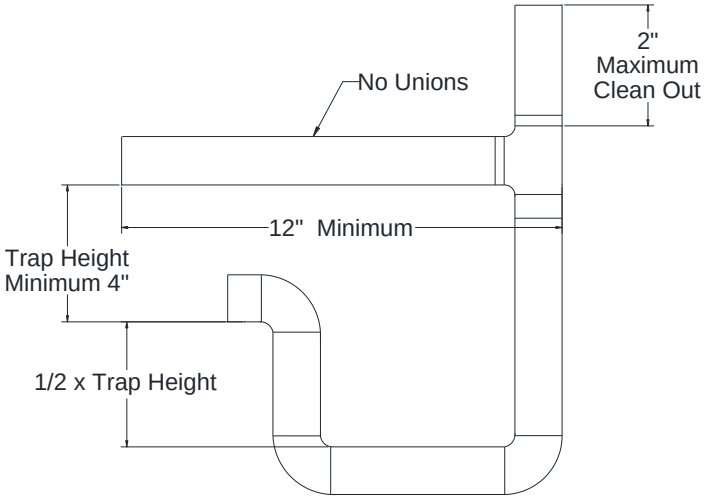
Only 1” diameter PVC Pipe and low profile couplings should be used. Additionally, the top horizontal length on the P-Trap should be a minimum of 12”. No unions should be used. Add a clean out as shown in the picture below. Keep the cleanout as low as possible to avoid interference with opening the door. The P-Trap drain should be attached to the end of the drain pipe on the side of the unit. The trap is important for two reasons. First, it can be piped to drain in the most convenient area. Second, it keeps air from being drawn through the drain hole in the side of the pan, impeding drainage.

Figure 11 - Coil Trap



1) Use only low profile couplings
2) Add clean out as shown

Figure 12 - Typical Cooling Coil Drain Trap



Gas

Installation of gas piping must conform with local building codes, or in the absence of local codes, to the National Fuel Gas Code, ANSI Z223.1 (NFPA 54) – latest edition. In Canada, installation must be in accordance with CAN/CGA-B149.1 for natural gas units and CAN/CGA-B149.2 for propane units.

WARNING: INLET GAS PRESSURE MUST NOT EXCEED 14 IN. W.C. SEE UNIT RATING PLATE FOR PROPER GAS SUPPLY PRESSURE AND GAS TYPE.

- Always **disconnect power** before working on or near a heater. Lock and tag the disconnect switch or breaker to prevent accidental power up.
- Piping to the unit should conform to local and national requirements for type and volume of gas handled, and pressure drop allowed in the line. Refer to the Gas Engineer's Handbook for gas line capacities.
- The incoming pipe near the heater should be sized to match the connection on the outside of the unit. Unit inlet size is **3/4" or 1" NPT, refer to job specific sheet**. Avoid multiple taps in the gas supply so the unit has a steady supply of gas at all times.
- Install a ground joint union with brass seat and a manual shut-off valve external to the unit casing, as shown in **Figure 14**, adjacent to the unit for emergency shut-off and easy servicing of controls.
- Provide a drip leg (sediment trap), as shown in **Figure 14**, before each unit and where low spots in the pipe line cannot be avoided.
- A minimum 1/8" NPT plugged tapping, accessible for test gauge connection, must be installed immediately upstream of the gas supply connection to the appliance.
- Clean out the gas line to remove debris before making connections. Purge line to remove air before attempting to start unit. Purging of air from gas lines should be performed as described in ANSI Z223.1-latest edition "National Fuel Gas Code", or in Canada in CAN/CGA-B149.
- All field gas piping must be pressure/leak tested prior to unit operation. Use a non-corrosive bubble forming solution or equivalent for leak testing. The heater and its individual shut-off valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of ½ psi. The heater must be isolated from the gas supply piping system by closing its individual manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than ½ psi.
- This unit requires a constant **7 in. w.c. minimum natural gas supply, (LP should be 11 in. w.c. minimum)** when the unit is operating at maximum gas flow. If the gas supply exceeds **14 in. w.c.** it will damage the internal valve components, and if it is below **7 in. w.c.**, the heater may not perform to specifications.

Figure 14 – Field Gas Connection Diagram

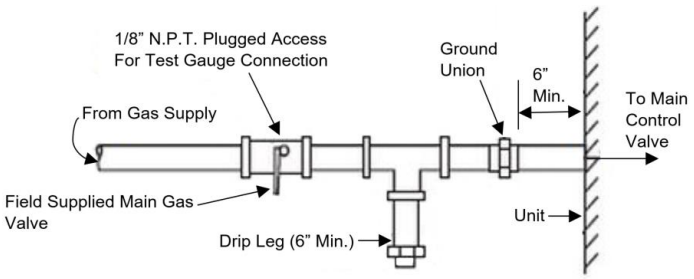
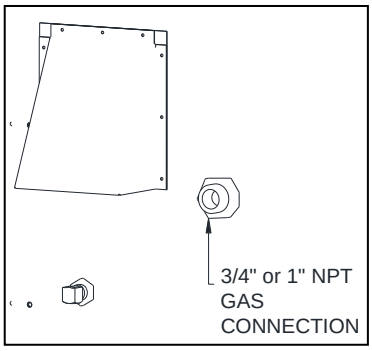


Figure 13 – Gas Connection



NOTICE

Refer to the heater rating plate for determining the minimum gas supply pressure for obtaining the maximum gas capacity for which this heater is specified.

Table 6 - Gas Pressure

Gas Pressure Type	Gas Pressure
Inlet Pressure – Natural Gas	**7 – 14 in. w.c.**
Inlet Pressure – Propane (LP)	**11 – 14 in. w.c.**
Max. Manifold Pressure – Natural Gas	**3.5 in. w.c.** maximum
Max. Manifold Pressure – Propane (LP)	**10 in. w.c.** maximum
Min. Manifold Pressure – Natural Gas	**0.15 in. w.c.** minimum
Min. Manifold Pressure – Propane (LP)	**0.75 in. w.c.** minimum

High Altitude and Gas Type Orifice Sizing

The burner orifices should be sized per the table below depending on fuel type, furnace size and altitude. Standard orifice sizes are for sea level. The unit should either be ordered with the altitude specific orifices or the parts should be ordered through the manufacturer. Refer to main gas valve documentation for instructions to convert gas valve spring from Natural to LP and vice versa.

Table 7- High Altitude Charts

Natural Gas High Altitude Conversion								
Size 3			Size 2 and 3				Size 2 and 3	
High Altitude for 500,000 BTU			High Altitude for 300,000 to 50,000 BTU				High Altitude for 400,000 BTU	
Altitude	Input Rate	Drill Size	Input Rate	Input Rate	Input Rate	Drill Size	Input Rate	Drill Size
0 - 1999ft	500000	#33	300,000	200,000	150,000	#3/32	400000	#41
2000-2999ft	479998	#35	288000	192000	144000	2.35mm	384000	#42
3000-3999ft	460797	#35	276480	184320	138240	2.3mm	368640	2.35mm
4000-4999ft	442364	#36	265421	176947	132710	#43	353894	2.3mm
5000-5999ft	424668	#36	254804	169869	127402	2.25mm	339739	#43
6000-6999ft	407680	#37	244612	163075	122306	#44	326149	2.25mm
7000-7999ft	391372	#38	234827	156552	117414	2.15mm	313103	#44
8000-8999ft	375716	#38	225434	150290	112717	#46	300579	#45
9000-10000ft	360686	#40	216417	144278	108209	#47	288556	#46

Note: 50,000 – 100,000 BTU High Efficiency Natural Gas furnaces use 2.3mm Drill Size at 0 – 3999 ft.

Natural Gas High Altitude Conversion							
Size 4			Size 4				
High Altitude for 600,000 BTU			High Altitude for 500,000 to 200,000 BTU				
Altitude	Input Rate	Drill Size	Input Rate	Input Rate	Input Rate	Input Rate	Drill Size
0 - 1999ft	600000	3.4mm	500000	400000	300,000	200,000	3.3mm
2000-2999ft	576000	#30	479998	384000	288000	192000	#30
3000-3999ft	552960	#30	460797	368640	276480	184320	#31
4000-4999ft	530482	#30	442364	353894	265421	176947	#31
5000-5999ft	509608	#30	424668	339739	254804	169869	#31
6000-6999ft	489224	#30	407680	326149	244612	163075	#31
7000-7999ft	469654	#31	391372	313103	234827	156552	#32
8000-8999ft	450868	#31	375716	300579	225434	150290	#32
9000-10000ft	432834	#32	360686	288556	216417	144278	#33

LP Gas High Altitude Conversion								
Size 3			Size 2 and 3				Size 2 and 3	
High Altitude for 500,000 BTU			High Altitude for 300,000 to 50,000 BTU				High Altitude for 400,000 BTU	
Altitude	Input Rate	Drill Size	Input Rate	Input Rate	Input Rate	Drill Size	Input Rate	Drill Size
0 - 1999ft	500000	1/16”	300,000	200,000	150,000	#54	400000	1.45mm
2000-2999ft	479998	#53	288000	192000	144000	#54	384000	#54
3000-3999ft	460797	#54	276480	184320	138240	#55	368640	#54
4000-4999ft	442364	#54	265421	176947	132710	#55	353894	#54
5000-5999ft	424668	#54	254804	169869	127402	#55	339739	#54
6000-6999ft	407680	#54	244612	163075	122306	#55	326149	#55
7000-7999ft	391372	#54	234827	156552	117414	#56	313103	#55
8000-8999ft	375716	#55	225434	150290	112717	#56	300579	#55
9000-10000ft	360686	#55	216417	144278	108209	#57	288556	#56

LP Gas High Altitude Conversion							
Size 4							
High Altitude for 600,000 BTU			High Altitude for 500,000 to 200,000 BTU				
Altitude	Input Rate	Drill Size	Input Rate	Input Rate	Input Rate	Input Rate	Drill Size
0 - 1999ft	600000	#45	500000	400000	300,000	200,000	#45
2000-2999ft	576000	#46	479998	384000	288000	192000	#46
3000-3999ft	552960	#47	460797	368640	276480	184320	#47
4000-4999ft	530482	#47	442364	353894	265421	176947	#47
5000-5999ft	509608	#47	424668	339739	254804	169869	#47
6000-6999ft	489224	#48	407680	326149	244612	163075	#48
7000-7999ft	469654	#48	391372	313103	234827	156552	#48
8000-8999ft	450868	#49	375716	300579	225434	150290	#49
9000-10000ft	432834	#49	360686	288556	216417	144278	#49

Table 8 - Orifice Part Numbers and Quantity Charts

Orifice Part Numbers					
Size	**Part#**	**AX#**	**Size**	**Part#**	**AX#**
#30	BG100-30	A0029277	#49	BG100-49	A0029283
#31	BG100-31	A0029278	#50	BG100-50	A0029284
#32	BG100-32	A0029279	#53	BG100-53	A0030724
#33	BG100-33	A0029280	#54	BG100-54	A0023048
#35	BG100-35	A0029281	#55	BG100-55	A0023049
#36	BG100-36	A0030719	#56	BG100-56	A0023057
#37	BG100-37	A0030721	#57	BG100-57	A0028803
#38	BG100-38	A0030722	1/16”	BG100-116	A0030725
#40	BG100-40	A0030723	1.45mm	BG101-16	A0023052
#41	BG100-41	A0023045	2.15mm	BG101-21	A0023055
#42	BG100-42	A0023050	2.25mm	BG101-20	A0023054
#43	BG100-43	A0023047	2.3mm	BG101-05	A0023051
#44	BG100-44	A0023046	2.35mm	BG101-19	A0023053
#45	BG100-45	A0028800	3.3mm	BG101-08	A0029285
#46	BG100-46	A0028801	3.4mm	BG101-09	A0030726
#47	BG100-47	A0028802	#3/32	BG100-3/32	A0023044
#48	BG100-48	A0029282			

Orifice Qty. Per Furnace			
Size 2 and 3	**Qty**	**Size 4**	**Qty**
50,000 BTU	2	N/A	-
75,000 BTU	3	N/A	-
100,000 BTU	4	N/A	-
150,000 BTU	6	N/A	-
200,000 BTU	8	200,000 BTU	4
300,000 BTU	12	300,000 BTU	6
400,000 BTU	15	400,000 BTU	8
500,000 BTU	15	500,000 BTU	10
N/A	-	600,000 BTU	11

LP Conversion Kit for RTU Series

LP/Natural Gas conversion kits are used to convert from one gas type to another in the field. This kit is used on all RTUs and the part numbers below should be used on furnace sizes listed.
Kits contain:

- Main Safety Gas Valve Regulator Spring
- Furnace orifices clearly indicated with orifice size

This unit is configured for the gas type listed on the nameplate. To convert gases, you must replace the following parts listed in the table below. The size specific parts include the orifice conversion parts and the combination gas valve spring(s). These parts are available by contacting the **Parts & Service Department at (866) 784-6900**. All field gas piping must be pressure/leak tested prior to unit operation. Use a non-corrosive bubble forming solution or equivalent for leak testing. The equipment and its individual shut-off valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of 1/2 psi. The equipment must be isolated from the gas supply piping system by closing its individual manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 psi. This must be performed on an annual basis.

Table 9 - Gas Conversion Kit Part Numbers

Size 2 and 3 Units							
Furnace Size	**50 MBH**	**100 MBH**	**150 MBH**	**200 MBH**	**300 MBH**	**400 MBH**	**500 MBH**
Natural Gas	NAT-HMG50	NAT-HMG100	NAT-HMG150	NAT-HMG200	NAT-HMG300	NAT-HMG400	NAT-HMA500
LP Gas	LP-HMG50	LP-HMG100	LP-HMG150	LP-HMG200	LP-HMG300	LP-HMG400	LP-HMA500
Modulating Valve	E50						E60

Size 4 Units					
Furnace Size	**200 MBH**	**300 MBH**	**400 MBH**	**500 MBH**	**600 MBH**
Natural Gas	NAT-HMA200	NAT-HMA300	NAT-HMA400	NAT-HMA500	NAT-HMA600
LP Gas	LP-HMA200	LP-HMA300	LP-HMA400	LP-HMA500	LP-HMA600
Modulating Valve	E50			E60	

Pre-Conversion Unit Check-Out

The following procedure is intended as a guide to aid in determining that the appliance is properly installed and is in a safe condition for continuing use. It should be recognized that generalized test procedures cannot anticipate all situations. Accordingly, in some cases, deviation from this procedure may be necessary to determine safe operation of the equipment:

- This procedure should be performed prior to any attempt at modification of the appliance or the installation.
- If it is determined there is a condition which could result in unsafe operation, the appliance should be shut off and the owner advised of the unsafe condition.

The following steps should be followed in making the safety inspection:

1. Conduct a gas leakage test of the appliance piping and control system downstream of the shut-off valve in the supply line to the appliance.
2. Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restrictions, leakage or corrosion or other deficiencies which could cause an unsafe condition.
3. Shut off all gas to the appliance and shut off any other fuel-burning appliance within the same room. Use the shut-off valve in the supply line to each appliance.
4. Inspect burners and cross-overs for blockage and corrosion.
5. Inspect heat exchangers for cracks, openings or excessive corrosion.
6. Insofar as is practical, close all windows and all doors between the space in which the appliance is located and other spaces of the building. Turn on any exhaust fans, so they will operate at maximum speed. If after completing steps 6 through 10, it is believed sufficient combustion air is not available, refer to the section covering air for combustion, venting and ventilation of *Natural Gas and Propane Installation Code*, *CSA B149.1,* or *National Fuel Gas Code*, *ANSI Z223.1/NFPA 54,* for guidance.
7. Place the appliance in operation following the lighting instructions. Adjust thermostat so the appliance will operate continuously. Other fuel-burning appliances shall be placed in operation.
8. Determine that the pilot is burning properly and that the main burner ignition is satisfactory by interrupting and re-establishing the electrical supply to the appliance in any convenient manner.
    a. Visually determine that main burner gas is burning properly, i.e. no floating, lifting or flashback. Adjust the primary air shutter(s) as required.
    b. If appliance is equipped with high- and low-flame control, or flame modulation, check for proper main burner operation at low flame.
9. Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use a draft gauge, the flame of a match, or candle.
10. Return doors, windows, exhaust fans, and all other fuel-burning appliances to their previous conditions of use.
11. Check both limit control and fan control for proper operation. Limit control operation can be checked by temporarily disconnecting the electrical supply to the supply motor and determining that the limit control acts to shut off the main burner gas.

Gas Conversion Instructions

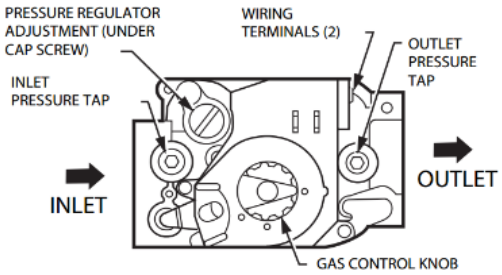
WARNING

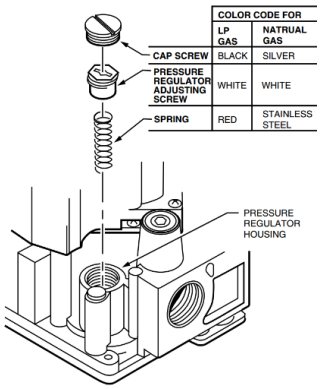
This conversion kit shall be installed by a qualified service agency in accordance with the manufacturer's instructions and all applicable codes and requirements of the authority having jurisdiction. If the information in these instructions is not followed exactly, a fire, explosion or production of carbon monoxide may result causing property damage, personal injury or loss of life. The qualified service agency performing this work assumes the responsibility for the proper conversion of the appliance with this kit.

To convert gas types, the following procedure should be followed:

1. Before proceeding with the conversion shut off all gas supply to the unit using the manual shut off valve.
2. Disconnect or shut off all electrical power to the unit, and turn the thermostat to lowest temperature setting.
3. Remove screws holding manifold pipe assembly to burner assembly.
4. Loosen and remove Natural Gas Orifices, remove from manifold.
5. Install propane gas orifices provided with kit. Verify orifice sizes are correct.
6. Open Gas Valve Regulator conversion kit and follow instructions provided for conversion of gas valve regulator. **Be sure to apply label provided in kit indicating that valve has been converted. The spring tension is different for LP and Natural Gas. This is the main component difference.**
7. Secure manifold assembly to burner assembly. Be sure that all orifices are aligned with opening on each burner.
8. Turn on gas supply at manual shut off valve.
9. Leak check union fitting and connection at gas valve using a soap solution.
10. Turn power to the unit "On".
11. Initiate a heating cycle. Check inlet and manifold gas pressures.
12. A label is included in this kit to attach to the manifold indicating this assembly has been converted to LP gas.
13. Attach label to manifold where it is readily visible when this assembly is accessed for service.
14. Verifying proper sequence of operation for appliance after conversion is completed.
15. Verifying proper gas inlet supply pressure and information on maximum and minimum supply pressures.

Figure 15 – On/Off Gas Valve





Electrical

Disconnect power before installing or servicing unit. High voltage electrical input is needed for this equipment. This work should be performed by a qualified electrician.

Before connecting power to the unit, read and understand this entire section of this document. As-built wiring diagrams are furnished with each fan by the factory, and are attached to the door of the unit.

When installed, the appliance must be electrically grounded in accordance with local codes, or in the absence of local codes, with the National Electrical Code, ANSI/NFPA 70, and/or the Canadian Electrical Code, CSA C22.1, if an external electrical source is utilized. Be sure the voltage and phase of the power supply and the wire amperage capacity is in accordance with the unit nameplate.

Table 10 - 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

- Always disconnect power before working on or near a unit. Lock and tag the disconnect switch or breaker to prevent accidental power up.
- The main electrical feed should be brought through one of the conduit openings located in the base of the unit, within the perimeter of the curb. **DO NOT RUN WIRING WITHIN THE SUPPLY OR RETURN DUCT.** See **Figure 16**.
- A dedicated branch circuit should supply the unit with short circuit protection according to the National Electric Code.
- Make certain that the power source is compatible with the requirements of your equipment. The unit nameplate identifies the proper phase and voltage of the equipment.
- Units shipped with an optional remote HMI panel have separate wiring requirements. It is important to run the main electrical wires in a separate conduit from the remote control HMI wiring. The HMI wiring is Cat 5 and must be separate from power cable. Maximum distance on any low voltage wire is 1000 feet.
- Before connecting the unit to the building power source, verify power line wiring is de-energized.
- Secure the power cables to prevent contact with sharp objects.
- Do not kink power cable and never allow the cable to come in contact with oil, grease, hot surfaces or chemicals.
- Before powering up the unit, check fan wheel for free rotation and make sure that the interior of the heater is free of loose debris or shipping materials.
- If any of the original wire supplied with the appliance needs replaced, it must be replaced with wiring material having a temperature rating of at least 149°F and be type TW wire or equivalent.
- **Seal <u>ALL</u> base penetrations with appropriate filler (caulk or all-purpose putty) to prevent water from entering the space. See Figure 16**.

WARNING: LOW VOLTAGE WIRES SHOULD NEVER BE RUN TOGETHER WITH HIGH VOLTAGE WIRES.

Building to Unit Power Wiring Connection

Figure 16 - Conduit Termination (Size 3 Unit Shown)

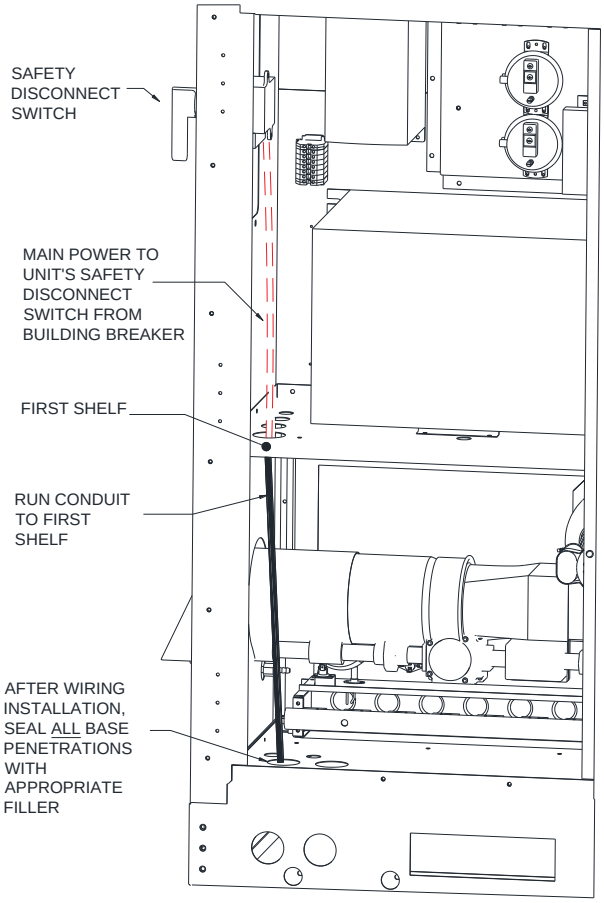
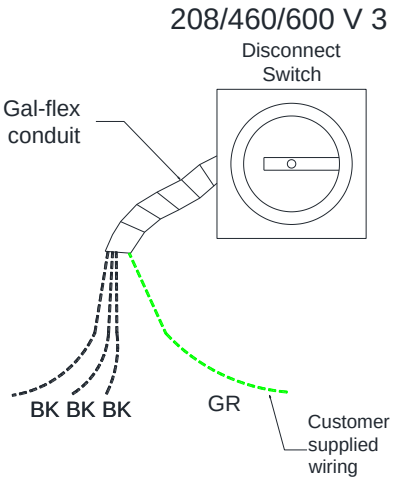


Figure 17 - Disconnect Switch Unit Wiring

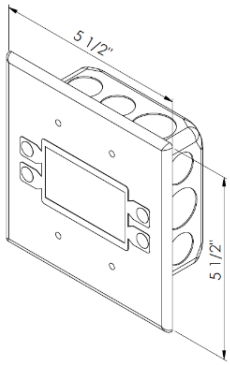


Site Preparation – Controls

- Consider general service and installation space when locating the remote temperature control.
- Locate the control as close to the space/fan that it will serve to reduce long, unnecessary wire runs.
- Install thermostats in locations that will produce a good representation of the air being moved by the fan in the space. Avoid thermostat installations in direct sunlight, near HVAC supplies, or abnormal temperature airstreams.

Remote Room Sensor/HMI (Human Machine Interface) Installation

Figure 18 – HMI Mounted to Junction Box

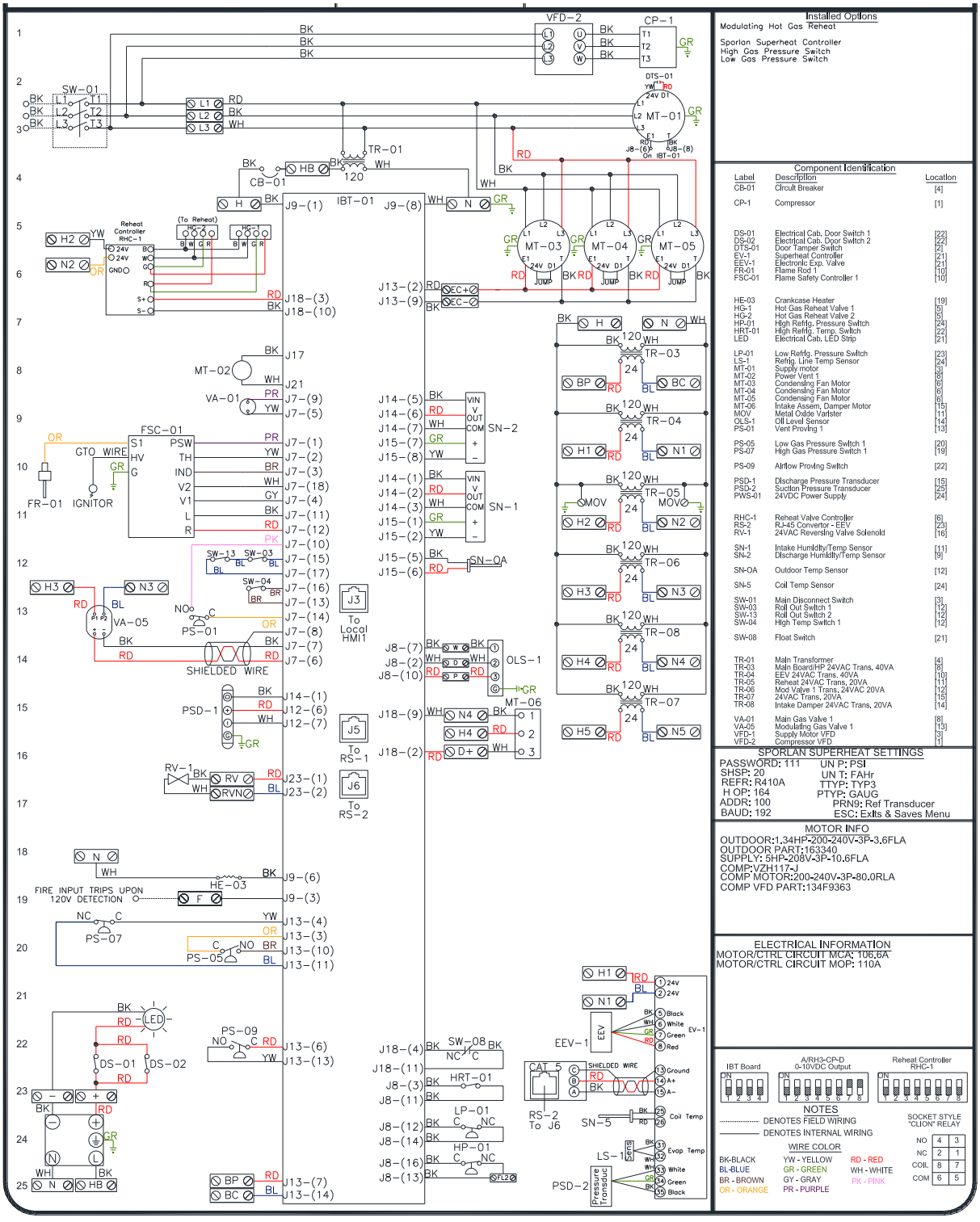


Do not install the room sensor on the ceiling.

In some instances, smart controls, remote room sensors and remote HMI faceplates may be ordered and shipped separately. These components will be used to measure temperature and assist in controlling the unit. These components should be installed in a safe location, free of influence from external heat sources and should be indicative of the average room temperature away from heat producing appliances. Remote room sensors and HMIs can be installed directly to industry standard junction boxes, either surface mounted or recessed mounted. HMIs have a built-in temperature sensor, which is typically used to help control the automatic function of the unit. The HMI can also be configured to manually control the unit from a remote location. They can be configured to not use the internal temperature sensor. In this configuration, the sensor in the HMI is ignored in automatic operation. Multiple HMIs can be connected to one unit for temperature averaging. Control modes will be discussed in later sections of this manual.

Typical Wiring Schematic

Figure 19 – Schematic



Supply Fan Variable Frequency Drive (VFD) Installation Instructions

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 and according to the table below. Refer to the installation schematic for exact breaker sizing.
- Each VFD should be fed by 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 run 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 to the ground terminal internal to the VFD. 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 THE OUTPUT TERMINALS (U, V, W) OF THE VFD. 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 run in a **separate** conduit away from control wiring and incoming AC power wiring 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(s) output power cables in the same conduit.
- Load reactors: If the distance between the VFD and the motor is greater than the distances specified below, a load reactor should be used between the VFD and the motor. The output reactor should be sized accordingly and installed within 10 feet of the output of the VFD.
    - 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.
- 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.
- No contactor should be installed 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 switch should only be operated when the drive is in a STOP state.

Supply Fan VFD Programming

Programming

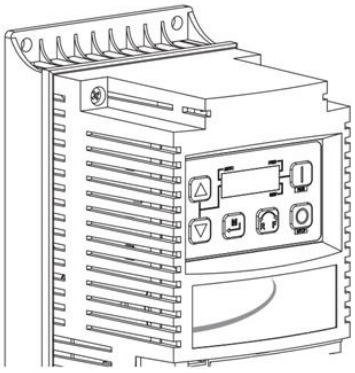
1. The drive should be programmed for the proper motor voltage.
    - P107 is set to 0 (Low) if motor voltage is **120V AC**, **208V AC** or **400V AC**.
    - P107 is set to 1 (High) if motor voltage is **230V AC**, **480V AC** or **575V AC**.
2. The drive should be programmed for the proper motor overload value. P108 is calculated as Motor FLA x 100 / Drive Output Rating (available in **Table 11**).

To enter the PROGRAM mode to access the parameters:

1. 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 also exit the PROGRAM mode. To change another parameter, press the **Mode (M)** button again to re-enter the PROGRAM mode. If the **Mode (M)** 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 in order to access the parameters again.

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

Figure 20 - Supply VFD



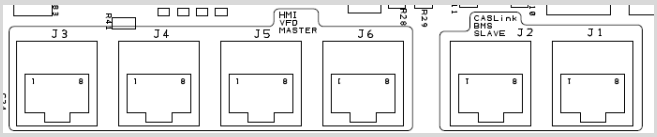
ACTECH SMV VFD

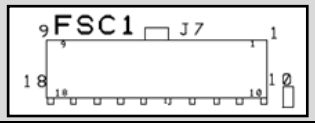
Table 11 - Cross-Reference Table

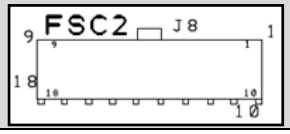
HP	Part Number	Volts	1Ø Input	3Ø Input	Input Amps 1Ø 120V AC	Input Amps 1Ø 240V AC	Output Amps	Breaker 1Ø 120V AC	Breaker 1Ø 240V AC
0.33	ESV251N01SXB571	120/240V	X		6.8	3.4	1.7	15	15
0.5	ESV371N01SXB571	120/240V	X		9.2	4.6	2.4	15	15
1	ESV751N01SXB571	120/240V	X		16.6	8.3	4.2	25	15
1.5	ESV112N01SXB571	120/240V	X		20	10	6	30	20

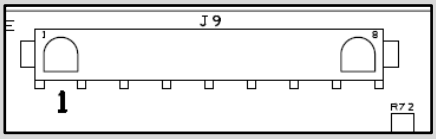
HP	Part Number	Volts	1Ø Input	3Ø Input	Input Amps 1Ø	Input Amps 3Ø	Output Amps	Breaker 1Ø	Breaker 3Ø
0.5	ESV371N02YXB571	240V	X	X	5.1	2.9	2.4	15	15
1	ESV751N02YXB571	240V	X	X	8.8	5	4.2	15	15
1.5	ESV112N02YXB571	240V	X	X	12	6.9	6	20	15
2	ESV152N02YXB571	240V	X	X	13.3	8.1	7	25	15
3	ESV222N02YXB571	240V	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
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

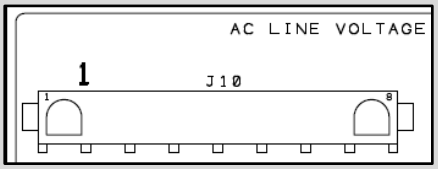
IBT Board Electrical Connections

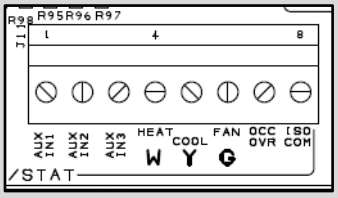
RJ45 Connectors	
J1 Auxiliary slave port J2 Programming port (service only) J3 connects to HMI	J4 connects to VFD controller J5 connects to Cat 5 converter for Compressor Frequency Drive J6 connects to Superheat Controller

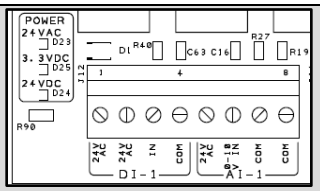
Connector J7 contains inputs and outputs for the Flame Safety Controller (FSC), gas components or electric heater	
Pin 1 - **24V AC** output to pressure switch input (PSW) on FSC or Electric Heater (option) Pin 2 - **24V AC** output to thermostat input (TH/W) on FSC Pin 3 - detects **24V AC** presence from IND on FSC or High Efficiency (HE) furnace relay (**RE-B**) Pin 4 - **24V AC** output to valve power (V1) on FSC Pin 5 - **24V AC** output to main gas valve Pin 6 - **0-10V DC** (+) to modulating gas valve or Electric Heater (option) Pin 7 - **0-10V DC** (–) to modulating gas valve or Electric Heater (option) Pin 8 - modulating gas valve shield Pin 9 - ground to main gas valve	Pin 10 - detects **24V AC** presence from vent proving switch or Electric Heater (option) Pin 11 - **24V AC** output (L1) on FSC Pin 12 - **24V AC** supply power (R) on FSC Pin 13 - **24V AC** out to high limit switch Pin 14 - **24V AC** out to vent proving switch Pin 15 - detects **24V AC** presence from roll out switch Pin 16 - detects **24V AC** presence from high limit switch Pin 17 - **24V AC** out to roll out switch Pin 18 - valve ground (V2) on FSC/High Efficiency (HE) furnace relay (**RE-B**)

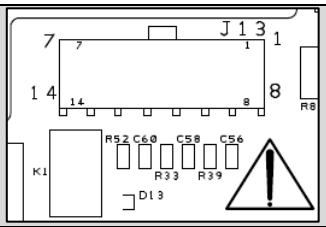
Connector J8 contains inputs and outputs for cooling, and compressor components	
Pin 1 - N/A Pin 2 - oil level sensor output Pin 3 - high return temperature sensor input Pin 4 - condensation switch input Pin 5 - N/A Pin 6 - Output supply motor Pin 7 - oil level sensor ground Pin 8 - Ground supply motor Pin 9 - N/A	Pin 10 - oil level sensor input Pin 11 - **24V AC** output high return temperature sensor Pin 12 - **24V AC** supply out to low pressure switch Pin 13 - **24V AC** out to high pressure switch Pin 14 - detects **24V AC** presence from low pressure switch Pin 15 - N/A Pin 16 - detects **24V AC** presence from high pressure switch Pin 17 - N/A Pin 18 - N/A

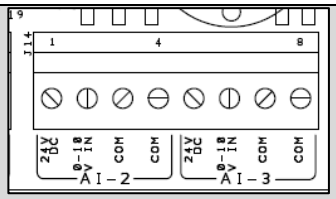
Connector J9 contains **120V AC** connections	
Pin 1 - **120V AC** input Pin 2 - tied to Pin 1 internally to the board Pin 3 - detects **120V AC** presence for fire condition Pin 4 - N/A	Pin 5 - N/A Pin 6 - **120V AC** out to crankcase heater Pin 7 - **120V AC** out to enclosure heater/heated drain Pin 8 - **120V AC** neutral

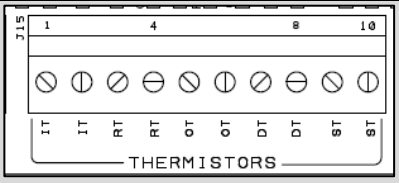
Connector J10 contains **120V AC** connections	
Pin 1 - N/A Pin 2 - N/A Pin 3 - N/A Pin 4 - N/A	Pin 5 - N/A Pin 6 - N/A Pin 7 - **120V AC** out to exhaust starter coil (field wired) Pin 8 - N/A

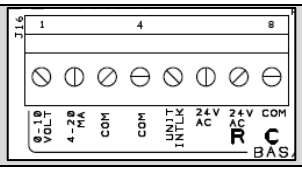
Connector J11 contains low voltage screw terminal connections	
Pin 1 - is an auxillary input Pin 2 - is an auxiliary input Pin 3 - is an auxiliary input Pin 4 - Analog Control/DDC heat select input	Pin 5 - Analog Control cool select input Pin 6 - Analog Control call for supply motor input Pin 7 - Analog Control occupied override input Pin 8 - Analog Control isolated common

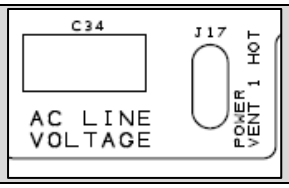
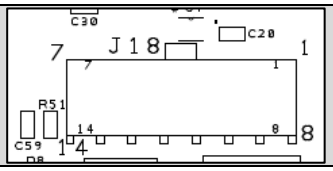
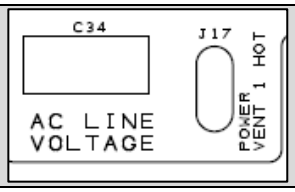
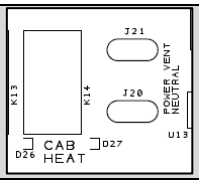
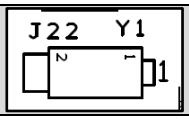
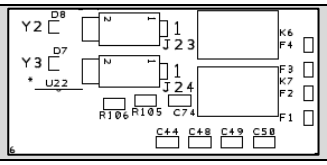
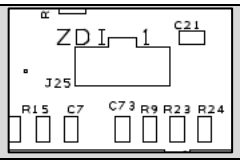
Connector J12 contains low voltage sensor screw terminal connection	
Pin 1 - smoke detector **24V AC** out Pin 2 - smoke detector **24V AC** out Pin 3 - smoke detector input Pin 4 - smoke detector **24V AC** common	Pin 5 - **24V AC** out Pin 6 - Pressure transducer **0-10V DC** input Pin 7 - Pressure transducer **0-10V DC** common Pin 8 - **24V AC** common

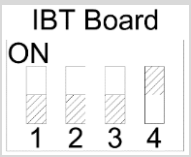
Connector J13 contains low voltage connections	
Pin 1 - **24V DC** (+) for **4-20mA** current sensor Pin 2 - PWM (+) out for EC motor Pin 3 - **24V AC** out for low gas pressure switch Pin 4 - **24V AC** out for high gas pressure switch Pin 5 - **24V AC** out for clogged filter switch Pin 6 - **24V AC** out for air flow switch Pin 7 - **24V AC** for board power	Pin 8 - **24V DC** (-) for **4-20mA** current sensor Pin 9 - PWM (–) out for EC motor Pin 10 - detects **24V AC** for low gas pressure switch Pin 11 - detects **24V AC** for high gas pressure switch Pin 12 - detects **24V AC** for clogged filter switch Pin 13 - detects **24V AC** for air flow switch Pin 14 - Ground

Connector J14 contains screw terminal connections for relative humidity sensors	
Pin 1 - **24V DC** (+) to humidity sensor or discharge pressure transducer Pin 2 - **0-10V DC** input from humidity sensor Pin 3 - **0-10V DC** common from humidity sensor Pin 4 - **24V DC** common to humidity sensor	Pin 5 - **24V DC** + to humidity sensor Pin 6 - **0-10V DC** input from humidity sensor Pin 7 - **0-10V DC** common from humidity sensor Pin 8 - **24V DC** common to humidity sensor

Connector J15 contains screw terminal connections for 10k temperature thermistors only	
Pins 1 and 2 - for intake sensor or intake humidity sensor Pins 3 and 4 - for return sensor or space humidity sensor Pins 5 and 6 - for outdoor sensor	Pins 7 and 8 - for discharge sensor or discharge humidity sensor Pins 9 and 10 - for space temperature sensor

Connector J16 contains low voltage screw terminal connections for BAS/DDC/Space	
Pin 1 - **0-10V DC** input Pin 2 - **4-20mA** input Pin 3 - analog input common Pin 4 - shield	Pin 5 - aux in for unit interlock Pin 6 - **24V AC** out Pin 7 - **24V AC** out Pin 8 - common

Connector J17 triac output for power vent 2	
Connector J18 contains low voltage connections	
Pin 1 **- 24V DC** (+) spare output Pin 2 - **0-10V DC** (+) for modulating damper Pin 3 - **0-10V DC** (+) reheat control Pin 4 - DX/condensation float switch output Pin 5 - **24V AC** out spare unit interlock Pin 6 - unused connection Pin 7 - unused connection	Pin 8 - **24V DC** (–) spare output Pin 9 - **0-10V DC** (–) for modulating damper Pin 10 - **0-10V DC** (–) reheat control Pin 11 - DX/condensation float switch input Pin 12 - **24V AC** common spare unit interlock Pin 13 - unused connection Pin 14 - unused connection
Connector J19 triac output for second power vent 2	
Connector J20 triac neutral for second power vent	
Connector J21 triac neutral for first power vent	
Connector J22 – N/A	
Connector J23 (Y2) contains **24V AC** outputs for reversing valve (heat pump)	
Connector J24 (Y3) N/A	
Connector J25 factory programming only, Zilog ZDI microcontroller debug/programming interface	
Pin 1 - **3.3V DC** Pin 2 - reset Pin 3 - Gnd	Pin 4 - DBG input Pin 5 - Gnd Pin 6 - NC

DIP Switches – Located by Connector J16	
DIP switch 1, 2, 3 are shown in the “OFF” position. DIP switch 4 will be defaulted in the “ON” position. Shaded area represents switch position.	

Optional Components

AC Interlock

On units equipped with the optional AC interlock, **24V AC** power from a roof top unit should be field wired to screw terminal J11-(5) on the IBT board. **24V AC** common from a rooftop unit should be field wired to terminal block J11-(8) on the IBT board. When these terminals are powered, heat will be locked out on the RTU.

Burner Interlock

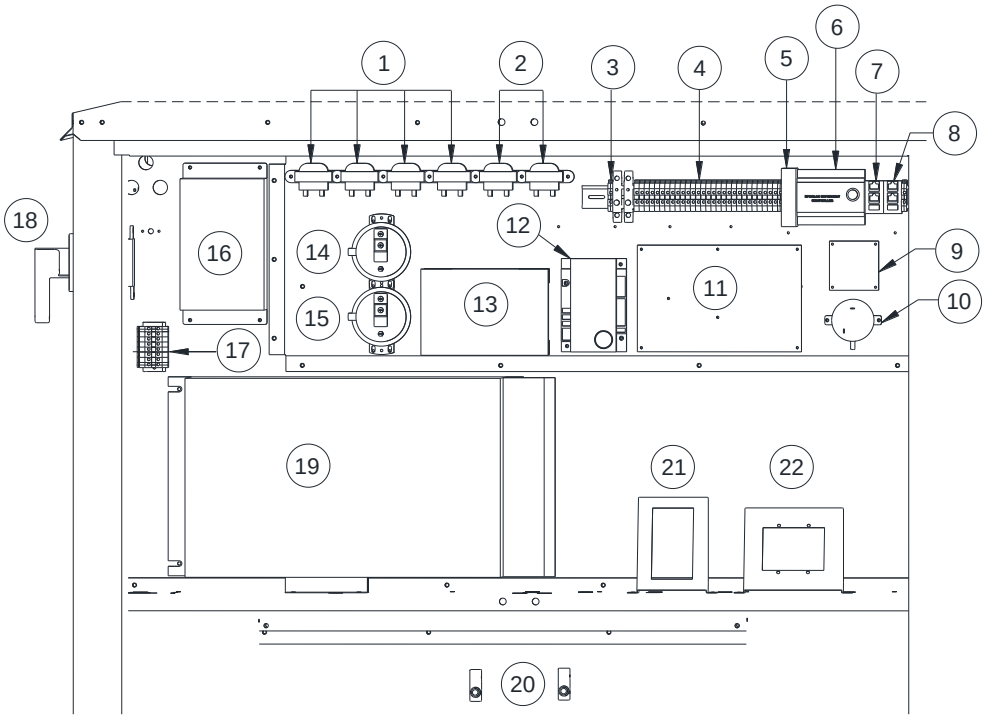
On units equipped with the optional burner interlock, **24V AC** power from a roof top unit should be field wired to screw terminal J11-(4) on the IBT board. **24V AC** common from a rooftop unit should be field wired to terminal block J11-(8) on the IBT board. When these terminals are powered, cooling will be locked out on the RTU.

Electric Cabinet Heater

Units can be shipped with an optional **120V** electric cabinet heater powered from the IBT board. There is a temperature sensor built onto the IBT board that will regulate when the cabinet heater activates.

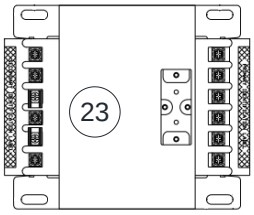
Component Location

Figure 21- Typical Main Cabinet



1. **20VA 120V to 24V Transformer (TR-05/TR-06/TR-07/TR-08)** – Reheat (TR-05), Intake damper (TR-06), Mod valve 1 (TR-07), Oil level sensor (TR-08). Will vary by application.
2. **40VA 120V to 24V Transformer (TR-03/TR-04)** – Main board (TR-03), Electronic Expansion Valve (EEV)/Oil solenoid (TR-04). Will vary by application.
3. **Circuit Breaker (CB-01)** – Protects electrical components from high current spikes.
4. **Terminal Strip** – Central location to terminate control wiring. Should be used for troubleshooting.
5. **24V DC Power Supply (PWS-01)** – Converts input voltage of **100-240V AC** to an output voltage of **24V DC**.
6. **Superheat Controller (EV-1)** – The superheat controller is designed to monitor and control the EEV pressure and temperature settings.
7. **RJ45 Converter** – Communication port for a Cat 5 cable that allows components to connect to other components. Depending on options the RED/BLACK/WHITE wires may connect to the EV controller, and/or the VFD compressor drive.
8. **RJ45 Converter** – Communication port for a Cat 5 cable that allows components to connect to other components.
9. **Reheat Valve Controller (RHC-1)** – Receives a **4-20 milliamp** or **0-10 volt DC** analog input signal. The reheat board provides a control signal to the hot gas reheat valve(s).
10. **Induced Draft Air Sensor (PS-01)** – Is a safety device located near the draft inducer motor that will prevent operation of the furnace if correct venting air pressures are not detected.
11. **IBT Board** - Controls the **0-10V DC** signal to modulating furnace controls, modulating gas valve, and **24V AC** signals to staged furnace controls.
12. **Flame Safety Control (FSC-01)** – Initiates and monitors flame. Equipped with non-adjustable time settings for pre-purge, inter-purge, and post-purge of the exhaust flue and control cabinet.
13. **Main Transformer (TR-01)** – Converts unit voltage to **120V** for unit controls.
14. **Air Flow Switch (PS-09)** – Normally open, adjustable airflow switch. Senses supply air flow for the unit to start.
15. **Clogged Filter Switch (PS-10)** – Senses whether the filters at the intake to the main supply motor are free of dirt and contaminant. This is an optional component.
16. **VFD Controller (VFD1)** – Used to protect supply motor, and to control the speed of the motor to vary airflow across unit.
17. **Distribution Block** – Distributes power to condensing components.
18. **Disconnect Switch (SW-01)** – Controls all electrical power to entire unit.
19. **Compressor Drive Frequency Converter (VFD-02)** – Operates the compressor.
20. **Door Switches (DS-01/DS-02)** – These switches operate the LED lights inside the cabinet.
21. **Compressor Local Control Panel (LCP)** – Used to navigate the compressor's VFD controls.
22. **HMI Panel** - IBT board interface. The 4 buttons are used to navigate through the menu screens.
23. **Convenience Outlet Transformer (TR-09)** – **2000VA** transformer used for the convenience outlet. Voltage inputs 208/230/480.

Figure 22 - Outlet Transformer



Not shown: **Convenience Outlet Circuit Breaker (CB-02)** – Protects transformer **TR-09** from high current spikes. Located next to **CB-01.**

Figure 23 – Typical Refrigerant Access Panel
Heat Pump with Reheat shown

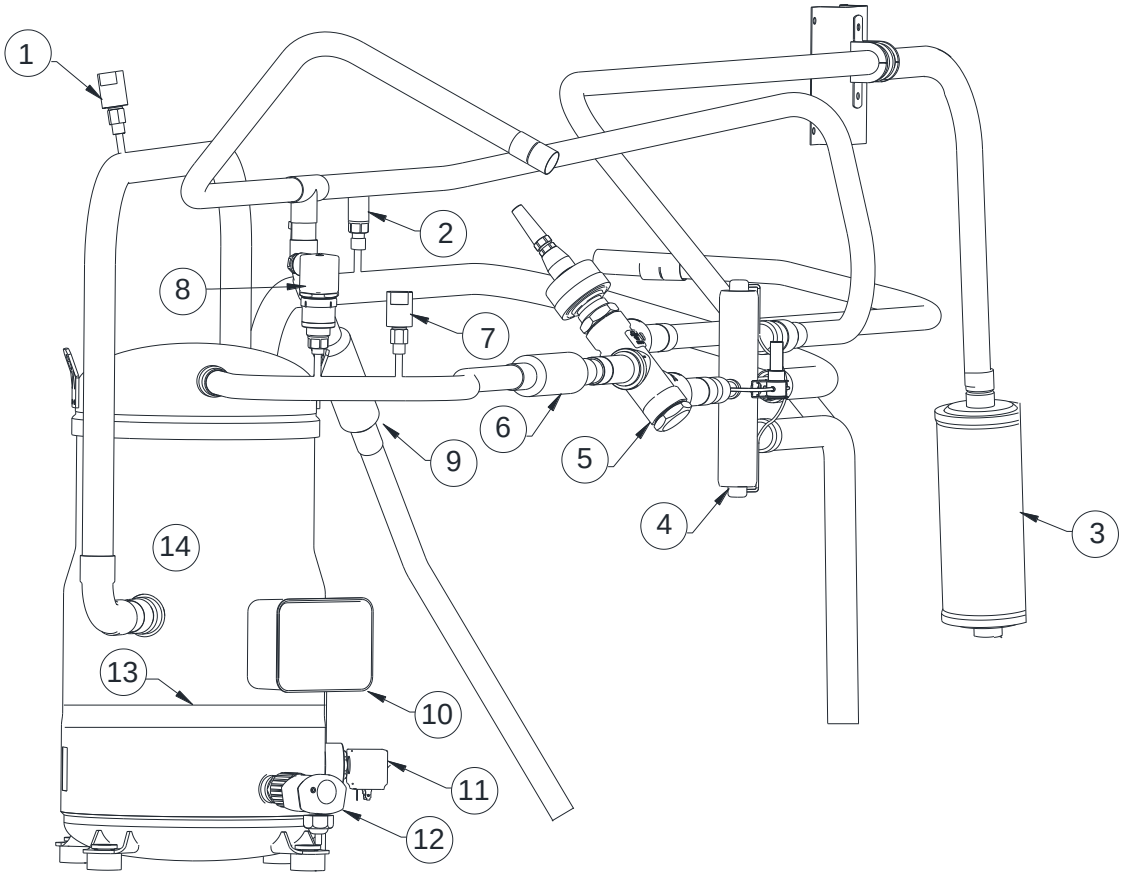
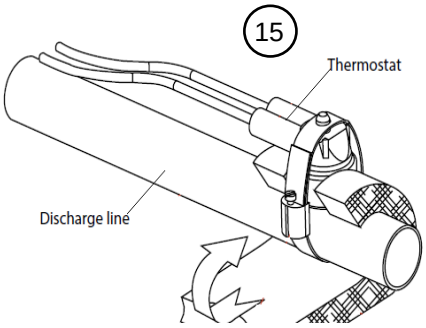


Figure 24 – HRT-01

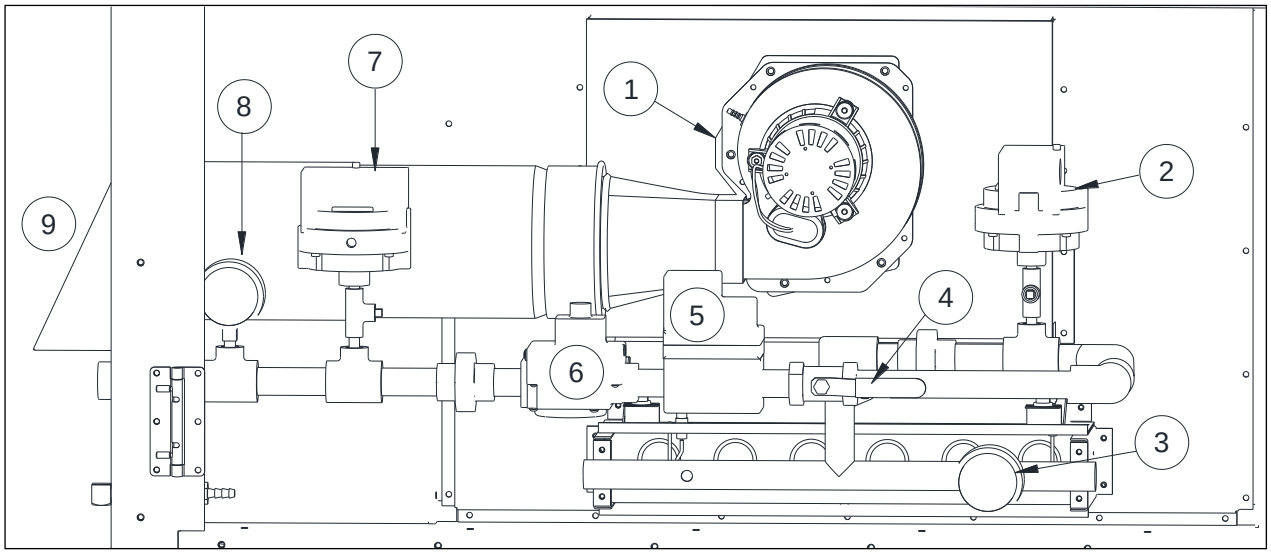


1. **Low Refrigerant Pressure Switch (LP-01)** – Detects refrigerant pressure on the low pressure side of the system. If the pressure drops below the preset value, the compressor will shut down. This sensor has an automatic reset.
2. **Suction (Low Pressure) Transducer (PSD-2)** – Pressure transducer that monitors the low side of the refrigeration system. Superheat Controller (EV-1) monitors for readings.
3. **Filter/Drier –** Absorbs water and filters system contaminants.
4. **Reversing Valve (RV-1) –** A valve used for heat pump applications that changes the flow of refrigerant. By changing the flow of refrigerant, the heat pump cycle is changed from cooling to heating or heating to cooling.
5. **Hot Gas Reheat Valve(s)** – Valve(s) will modulate the supply of refrigerant to the outdoor (condensing) coil and to the reheat coil. Units with a single reheat valve, HG-1 will be a three-way valve. Units that use dual reheat valves, not shown, will have HG-1 in-line to the reheat coil inlet and HG-2 in-line to the outdoor (condensing) coil inlet.
6. **Discharge Check Valve** – Restricts liquid migration back to compressor during off cycles.
7. **High Refrigerant Pressure Switch (HP-01)** – If the pressure rises above the preset value, the compressor will shut down.
8. **Discharge (High) Pressure Transducer (PSD-01)** – Pressure transducer that monitors the high side of the refrigeration system.
9. **Reheat Coil Check Valve** – Restricts refrigerant flow to the reheat coil when reheat is not active.
10. **Compressor Power Termination** – Power connection from Compressor Drive Frequency Converter.
11. **Oil Return Solenoid Valve (OS-1)** – Allows oil to be distributed throughout the scroll set when activated. Not applicable to VZH-044 compressors.
12. **Oil Level Sensor (OLS-1)** – Monitors the oil level in the compressor. If the oil level is low, the unit will shut down. Not applicable to VZH028/035/044 compressors.
13. **Crankcase Heater (HE-03)** – A heating cable used to boil off liquid refrigerant within the crank of the compressor.
14. **Compressor** – Circulates refrigerant throughout the system.
15. **High Refrigerant Temperature Switch (HRT-01)** – This safety switch opens at dangerously high compressor discharge temperatures. For heat pump applications only.

Not Shown**:**

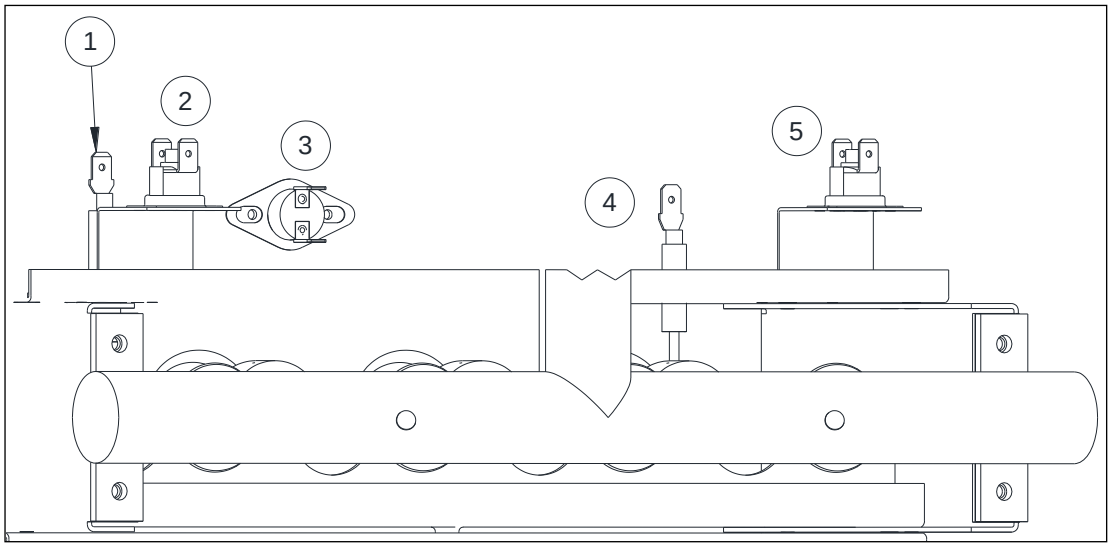
- **High Pressure Port –** High pressure gauge connection port.
- **Low Pressure Port** – Low pressure gauge connection port.
- **Refrigerant Line Temperature Sensor (LS-1)** – Monitors the low side (suction) temperature.
- **Accumulator** – The accumulator prevents liquid flood back to the compressor. Used in heat pump and certain cooling applications.

Figure 25 - Typical Main Cabinet Standard Gas Furnace



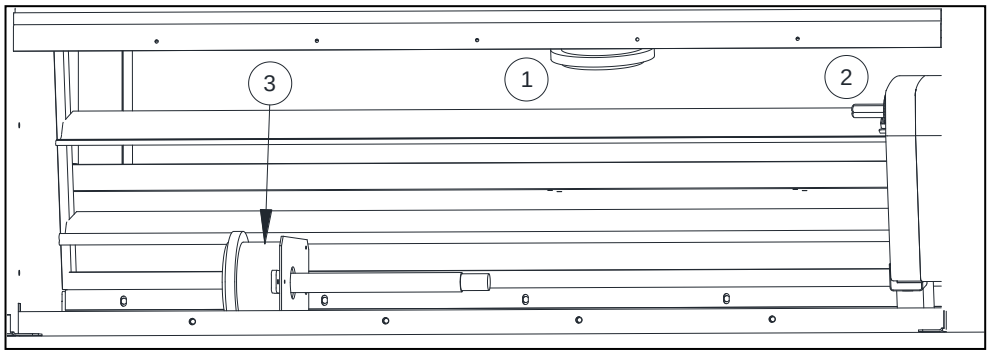
1. **Power Vent Motor (MT-02)** – An assembly used to exhaust flue gases.
2. **High Pressure Gas Switch (PS-07)** – Monitors pressure and shuts down heating when pressures rise above the desired setpoint. This is an optional component.
3. **Manifold Gas Pressure Gauge - 0-10" w.c.** – Manifold gas pressure gauge.
4. **Manual Gas Shut Off Valve** – Allows gas flow to burner to be shut off to leak test gas train.
5. **Modulating Gas Valve (VA-01)** – Controls the amount of gas to the furnace to meet desired discharge/space temperature.
6. **ON/OFF Gas Valve (VA-01)** – On/Off gas valve with built in regulator and manual shut off switch.
7. **Low Pressure Gas Switch (PS-05)** – Monitors pressure and shuts down heating when pressures drops below the desired setpoint. This is an optional component.
8. **Inlet Gas Pressure Gauge** - **0-35" w.c.** – Inlet gas pressure gauge.
9. For standard furnaces a stainless steel type B vent will be used. For High Efficiency (HE) furnace a PVC vent will be used. See Furnace Condensation Drain (page 12).

Figure 26 – Typical Burner Cabinet



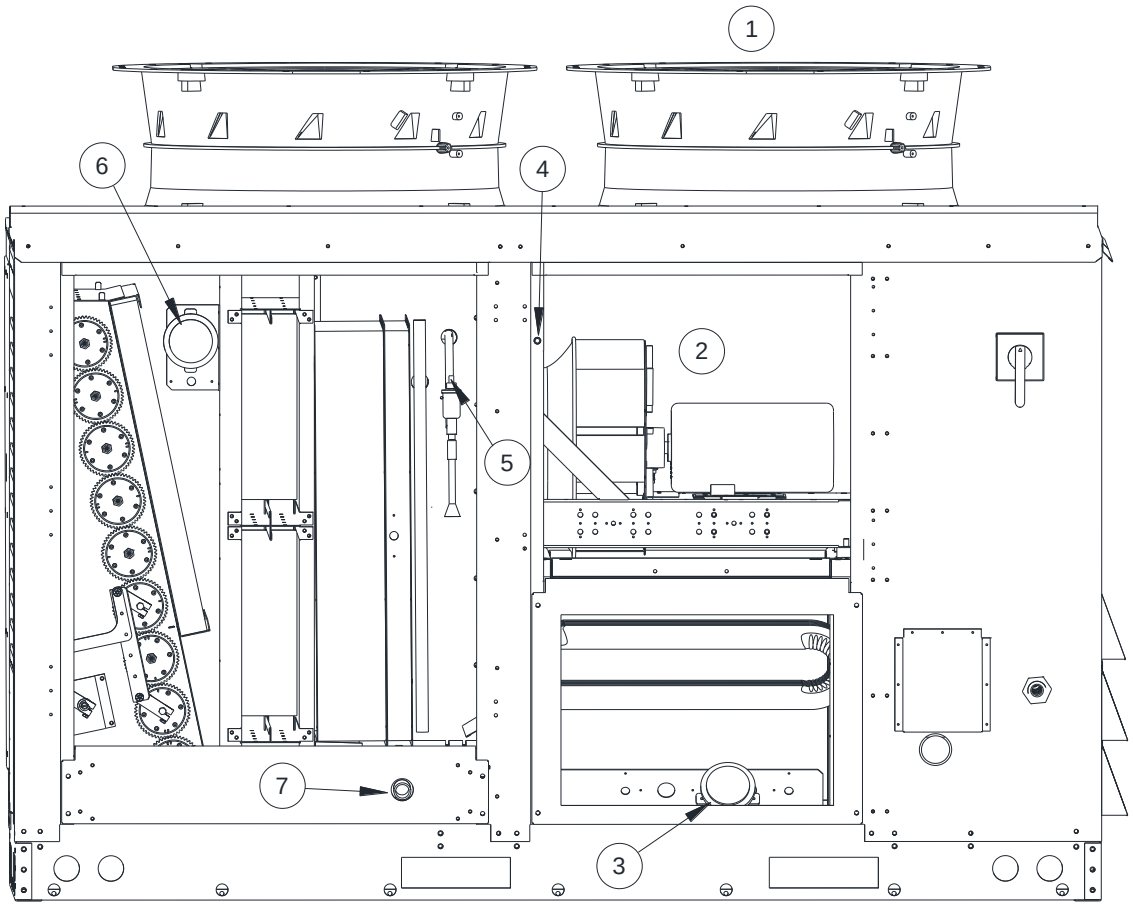
1. **Ignitor** – Powered by Flame Safety Control to initiate light-off.
2. **Rollout Switch 1 (SW-03)** – Normally closed temperature activated switch. Mounted on bracket at the firing tube. Senses flame roll-out in the event of a blocked tube, low airflow, or low gas pressure. If flame-rollout is present, the switch de-energizes heater circuit on the furnace. Must be manually reset by pressing small button on top of the switch.
3. **High Temperature Switch (SW-04)** – Normally closed high temperature switch. De-energizes the heater circuit on furnace if temperature exceeds mechanical set-point. Automatic recycling.
4. **Flame Rod (FR-01)** – Continuously senses for the presence of flame in heating mode after ignition has commenced. This sensor is wired to the Flame Safety Control (FSC-1).
5. **Rollout Switch 2 (SW-13)** – Normally closed temperature activated switch. Mounted on bracket at the firing tube. Senses flame roll-out in the event of a blocked tube, low airflow, or low gas pressure. If flame-rollout is present, the switch de-energizes heater circuit on the furnace. Must be manually reset by pressing small button on top of the switch.

Figure 27 – Typical Damper Access Panel



1. **Outdoor Temperature Sensor (SN-OA)** – Monitors the outdoor temperature. Located behind outside air intake louvers.
2. **Intake Damper Assembly Motor (MT-06)** – Provides control of the outside/return air damper assembly.
3. **Return Temperature and/or Humidity Sensor (SN-4)** – Monitors the return air temperature and/or humidity.

Figure 28 - Typical Blower and Air Intake Access Doors/Panel



1. **Condensing Fan Motor (MT-03, MT-04, MT-05)** – Pulls air across the outdoor coil.
2. **Supply Motor (MT-01)** – Located behind door. Main supply air motor.
3. **Discharge Temperature Sensor or Discharge Humidity/Temperature (SN-2)** – Monitors discharge air temperature or humidity/temperature.
4. **Door Tamper Switch (DTS-01)** – When the blower door is open, the switch will de-activate the supply motor.
5. **Electronic Expansion Valve (EEV-1)** – Controls the flow of refrigerant to maintain a desired superheat value.
6. **Intake Temperature or Intake Humidity/Temperature Sensor (IT-1)** – Monitors intake air humidity/temperature.
7. **Float Switch (SW-08)** – Monitors the water level from condensation in the drain pan.

   Not Shown: **Coil Temperature Sensor (SN-5)** – Monitors the dew point temperature of the air before the reheat coil.

Electric Heater Option

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

The three black wires from the electric heater will need to be field wired to the disconnect switch.

Figure 29 – Typical Electric Heater Wiring

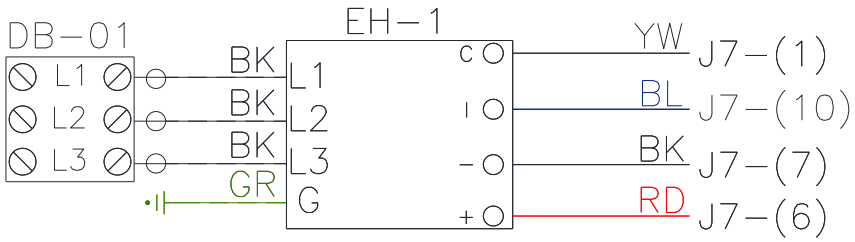
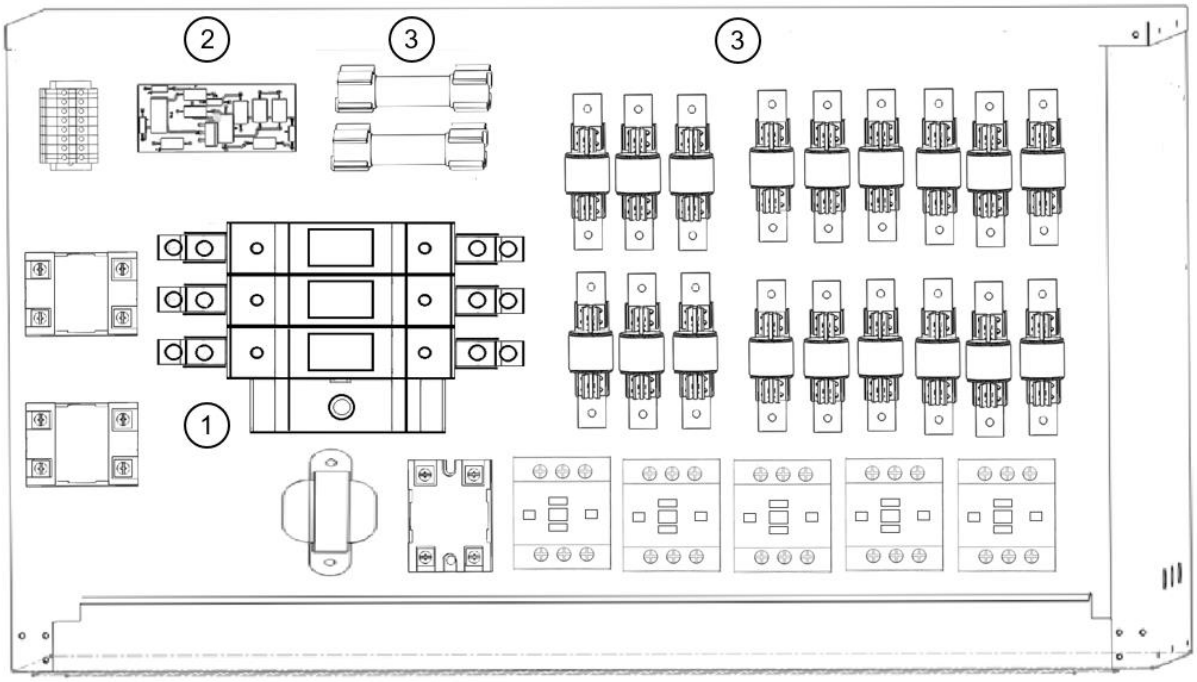


Figure 30 - Electric Heater Option



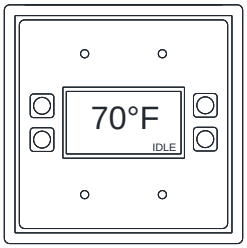
1. **Disconnect Switch** – Interrupts power to the electric coil.
2. **Stage Controller** – Controls multiple heating stages in a pre-determined sequence. Works in conjunction with a proportional thermostat (not shown). A sensor is mounted in the blower housing for discharge control. The set-point is mounted remotely for either space control or discharge control.
3. **Fuse** – Provides overcurrent protection.

OPERATION

HMI Configuration

General Overview
The HMI allows the user to change parameters and options. You can use the HMI to view operating information regarding sensors, temperatures, pressures, and fault history.

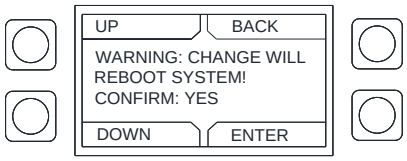
Figure 31 - HMI



There are four buttons to navigate through the HMI screen.
Note: Buttons change functions during certain options and tests. Verify the screen and buttons throughout the menu display.

The user can access the HMI configuration screen by pressing the top two buttons simultaneously. To exit this screen, simply press 'BACK' button. When setting certain options or functions, pressing 'BACK' button multiple times will bring up the reboot screen. The user may select 'YES' to save changes, 'NO' to return to factory settings, or 'CANCEL' to return to the main menu.

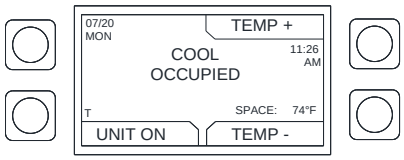
Figure 32 - HMI Reboot



The HMI menu system is explained under Menu Descriptions (page 38). The menu system is illustrated under Menu Tree (page 46). The HMI allows full access to every configurable parameter. The parameters are factory configured to the specific application. Parameters may need to be modified to fine tune automatic operation after the original setup.

HMI Notification Letters
The HMI will display notification letters when the unit is in a specific status.

Figure 33 - HMI Home Screen

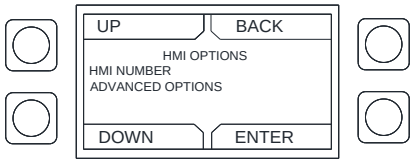


- When the blower is in a delay, a "B" will be displayed.
- When the unit is in dehumidification mode, a "D" will be displayed.
- When the compressor is in an oil boost, an "O" will be displayed.
- When the unit loses a call for cooling or heating (heat pump) during the compressor's "Min ON" or "Min OFF" time, a "T" will be displayed.
- An "E" will be displayed anytime the economizer function is active.

HMI Options Screen

To set the HMI number or to adjust the screen contrast, press the bottom two buttons simultaneously on the HMI faceplate. Use the UP and Down buttons to select the parameter that will be adjusted. Press Enter to select the highlighted parameter.

Figure 34 - HMI Options Screen



Setting the HMI number configures the Modbus address for that HMI.

To change the contrast, select "Advanced Options". 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.

Scheduling

To set a schedule on the HMI, you must first enable scheduling.

Factory Settings > Occupied Scheduling > On

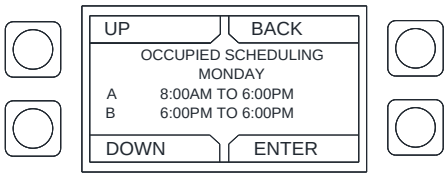
Set your sensor temperature setpoints for occupied, and unoccupied schedules.

User Settings > Temp Setpoints > (Varies)

Once scheduling is enabled, and the temperature setpoints are configured, you may enter your schedule days and times.

User Settings > Scheduling

Figure 35 - Schedule Screen



Schedule A default:

- Monday – Friday 8:00AM to 6:00PM
- Saturday and Sunday 12:00AM to 12:00AM

Schedule B default:

- Monday – Friday 6:00PM to 6:00PM
- Saturday and Sunday 12:00AM to 12:00AM

To adjust the settings press **ENTER** to highlight the parameter.

- The first parameter to be highlighted will be the day. Press **UP** or **DOWN** to select the day you want to set an occupied time schedule for.
- 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 day, time, and desired temperature settings.
When in the UNOCCUPIED setting, the system will run at the unoccupied temperature setting.

Menu Descriptions

This section will explain the different menus, settings, and options available in the HMI. Reference the Menu Tree (page 46) for navigating through the HMI screens.

MENU

User settings: Allows the user to change or set certain temperature and configurations on the unit. Any changes within this menu do not require a reboot to take effect.

Factory settings: Requires a password to enter this menu (1 1 1 1). These will be set job specific from the plant. Any changes within this menu require a reboot to take effect. Upon exiting factory settings, if anything has been altered, the board will reboot itself.

Service: Requires a password to enter this menu (1 2 3 4). Allows a certified technician to monitor the unit, and test components in the system.

USER SETTINGS

Temp Setpoints – Some or all of these may not be available based on settings. If scheduling is enabled, there will be occupied and unoccupied values for each setpoint. The user will be allowed to check or adjust the setpoints for:

- Heating
  - Intake Heat
  - Space Heat
  - Discharge Heat
  - Min Discharge Heat
  - Max Discharge Heat
- Cooling
  - Intake Cool
  - Space Cool
  - Discharge Cool
  - Min Discharge Cool
  - Max Discharge Cool
- Humidity Ctrl
  - Intake Rel Hum
  - Space Rel Hum
  - Discharge Rel Hum
- Options
  - Room Override
  - Intake Firestat
  - Discharge Firestat
  - Discharge Freezestat
  - Discharge Overheat
  - Cabinet Heat
  - Drain Heat
  - Economizer Temp Band
  - Economizer Temp
  - Economizer Enth Band
  - Economizer RH

Occupied Scheduling – This menu will only show when the scheduling option is set to On. Each day contains the option for two occupied time periods. If the time is scrolled past 11:59 pm it will display UNOCC.

Copy Schedule – 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.

Supply VFD Frequency – Enabled when the supply fan is controlled by a VFD. The range of this menu is limited by the min and max frequency setpoints under factory settings. When occupied scheduling is set to On, occupied and unoccupied settings are available.

Supply PWM Rate – Enabled when “Blower Control” is set to ECM. This will be used to control the speed of the EC motor. The PWM signal will be sent directly to the EC motor. When occupied scheduling is set to On, occupied and unoccupied settings are available.

Compressor Freq – Allows user to set a desired frequency between 0-200Hz. This is available when the compressor control is set to manual.

HMI Dimming Timer - Configurable time until HMI will dim, 10 seconds - 60 seconds.

Man Cond Speed Heat – Enabled when heat pump condensing fan mode is set to manual, you may select the % the fans will operate at. Default is 100%. The range setting is 0-100%.

Man Cond Speed Cool – Enabled when cooling condensing fan mode is set to manual, you may select the % the fans will operate at. Default is 100%. The range setting is 0-100%.

Outdoor Air % – Enabled when the outdoor air is set to percentage or scheduled control. Limited by min and max outdoor air percentages located under factory settings.

Outdoor Air Voltage – Enabled when outdoor air is set to manual. Controls the damper position via a 0-10V signal, limited by min and max settings located under factory settings.

Active Faults – Contains the current faults on the board.

Fault History – Will show time stamped history of the last 20 faults, most recent fault showing first.

Reset Lockouts – Resets lock out faults.

FACTORY SETTINGS

Note: Password to enter factory menu is 1 1 1 1.

Temperature Control –The IBT board monitors temperature control components. There are five options for controlling the output of the unit in heat/cool tempering mode. These options are Discharge/Space/Analog Control/Direct Digital Control (DDC)/None, see Sequence of Operation (page 60). The unit can be set to "Activate Based On" one of the following temperature readings: Intake/Space/Both/Either/Stat (field installed thermostat). These settings can be altered for occupied and unoccupied preferences.

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

- **Heating Type** – Selectable range: Indirect Fired, Heat Pump, Electric, Indirect and HP, Elec & HP, Elec or HP, or None.
- **Space Heat Hyst** – Space tempering sensor must go this amount of degrees above the setpoint before heating will turn off. Default is 1°F.
- **Intake Heat Hyst** – Intake tempering sensor must go this amount of degrees above the setpoint before heating will turn off. Default is 3°F.
- **BAS Input Source** – This lets the board know what signal (volts or milliamps) to expect from the analog control system.
- **Gas Heat Config**:
  - **Number of Heat Stages** – Default is set to 0 for units without gas heat. If the unit is equipped with gas heat, select 1.
  - **PWM Powervent Ctrl** – On/Off operation of the power vent motor when equipped with a high efficiency (400HE) burner.
  - **Condensation Float** – Monitors the water level from condensation in the drain pan. Default is Off, select On if switch is installed on the unit. Required on high efficiency furnaces.
- **Heat Pump Config**:
  - **Cond Fan Config**
    - **Condensing Fan Mode** – The condensing fans can operate from one of the following modes: Outside Temperature Differential or Manual.
    - **Outside Temp Diff** – If the outside temperature differential is selected, the default temperature is set at 15°F.
    - **Cond Fan Min** – The minimum rate the condensing fans will operate. Range 0-100%. Default is 15%.
  - **Defrost Config**
    - **Defrost Mode** – This allows for the unit to defrost the outdoor coil in the case of freezing ambient conditions. User may set defrost method to Off/Timer/PressTemp.
    - **Defrost Time Off** – If the timer option is selected, the time off default is 15 minutes.
    - **Defrost Time On** – Minutes between defrost cycles if in timer or temperature mode. Default time is 5 minutes.
    - **Min Suction PS** – If the pressure/temperature defrost setting is selected, the suction pressure default is set to 40 psi.
    - **Min Suction Temp** – If the pressure/temperature defrost setting is selected, the suction temperature default is 5°F.
  - **Comp Max Freq** – Limits the maximum run speed of the compressor.
  - **Superheat** – Superheat monitors what state the refrigerant is in as it leaves the evaporator coil. The superheat default setting is 20°F.
  - **Min Outdoor Run Temp** – The heat pump will shut off at the set temperature. The default temperature setting is 45°F.
- **Cabinet Diff (Differential)** – This is the differential for the cabinet heater. The outdoor air temp must reach this many degrees above the activation setpoint to turn off.
- **Freezestat Timer** – The discharge temp must stay below the freezestat setpoint for this amount of time before the unit will lock out on freeze stat.

FACTORY SETTINGS

Note: Password to enter factory menu is 1 1 1 1.

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

- **Cond Fan Config**:
  - **Condensing Fan Mode** – The condensing fans can operate from one of the following modes: Outside temperature difference or manual.
  - **Outside Temp Diff** – If the outside temperature difference is selected, the default temperature is set at 20°F difference.
  - **Cond Fan Min** – The minimum rate the condensing fans will operate. Default is 15%.
- **Comp Max Freq** – Limits the maximum run speed of the compressor.
- **Min Intake Cool Temp** – Cooling will not activate when intake temperature is below this setpoint. Default is 50°F.
- **Min Outdoor Air (OA) Cool Temp** – Cooling will not activate when outdoor air temperature is below this setpoint. Default is 50°F.
- **Space Cool Hyst** – Space tempering sensor must change this amount of degrees below the setpoint before cooling will turn off. Default is 1°F.
- **Intake Cool Hyst** – Intake tempering sensor must change this amount of degrees below the setpoint before cooling will turn off. Default is 3°F.
- **Reheat Config**:
  - **Reheat/Dehumidify** – DP/RH, DP, RH, Off selection. When DP/RH is selected, software will monitor both dew point and relative humidity for reheat activation. When only DP is selected, software will monitor dew point for reheat activation. When only RH is selected, software will monitor relative humidity for reheat activation. When Off is selected, reheat will not be active.
  - **Space Dew Point Diff** – Reheat will be active if the cooling mode is set to SPACE and the inside coil temperature is less than the intake dew point minus the Space Dew Point Diff. Default is 2°F.
  - **Dschrg Dew Point Diff** – Reheat will be active if the cooling mode is set to DISCHARGE and the inside coil temperature is less than the intake dew point minus the Dschrg Dew Point Diff. Default is 2°F.
  - **Intake Reheat Hyst** – Intake RH/DP must go above the intake RH/DP setpoint plus intake reheat hyst before reheat will turn off.
  - **Space Reheat Hyst** – Space RH/DP must go above the intake RH/DP setpoint plus intake reheat hyst before reheat will turn off.
  - **Reheat Dew Point Adj** – This value determines what dew point the unit will cool to prior to reheating. If the reheat dew point adjust is set to 5°F, and the reheat setpoints' dew point is set to 50°F, the unit will cool the air to 45°F before reheating.
- **Superheat** – Superheat monitors what state the refrigerant is in as it leaves the evaporator coil. The superheat default setting is 20°F.
- **Overheat Timer** – When in cooling mode, if the discharge temperature exceeds the setpoint for 10 minutes (default), the cooling system and the blower will shut down. The unit will wait the "Comp Min Off Time" for the compressor, then re-attempt to cool again. If the overheat stat fails again, everything will shut down and display the fault "Overheat Stat Failure".

Compressor Config – Allows the user to change or adjust compressor settings.

- **Compressor Model** – Allows user to select compressor model.
- **Compressor Control** – Allows the user to turn the compressor on between manual or auto control.
- **Oil Sensor** – On/Off option. Default is On. Required for VZH088 (15T), VZH117 (20T) and VZH170 (30T) compressors. If an oil sensor is present, leave option set to ON.
- **Oil Boost Time –** Allows user to set boost option for VZH 044, 035 and 028 compressors. Settings are OFF or 1-120 minutes. Default is 60 minutes.
- **Comp Min On Time** – The amount of minutes the compressor must stay on. Default is 10 minutes.
- **Comp Min Off Time** – The amount of minutes the compressor will stay off after being active. Default is 10 minutes.
- **Pumpdown Sequence** – On/Off selection used for compressor protection in an off cycle. Prior to beginning the pumpdown sequence, an oil boost will run to return oil back to the compressor before shutting down.

FACTORY SETTINGS

Note: Password to enter factory menu is 1 1 1 1.

Occupied Scheduling – This menu is where scheduling may be turned On or Off. Default is Off.
Occupancy Override – Allows the user to override the current occupied settings. This is an On/Off option. Default is On.

Unit Options

- **Board Config**
  - **Board Address** – Modbus address of the IBT board.
  - **Startup Timer** – Time upon power up where the board will sit idle.
  - **Celsius/Fahrenheit –** Allows the user to set temperature range. Changing between the two will reset all setpoints.
  - **# Of HMIs –** Number of HMIs connected to the IBT board. Must always be at least one.
  - **HMI Dimming –** This is an On/Off menu. Default is set to Off. If set to On, a "HMI Dimming Timer" option will be available under "User Settings".
  - **Screensaver –** This is an On/Off menu. Default is set to On. If set to Off, the home screen will not time out to the screensaver.
  - **HMI Averaging –** If there are multiple space HMIs connected, this menu allows you to select which will be included in the space temperature averaging. If a thermistor is connected into the ST screw terminals, it will automatically be averaged into any HMIs included.
- **Blower Config**
  - **Blower Control** – Prewire, VFD Manual, VFD Jog, VFD 0-10V, ECM, ECM 0-10V.
    - **Prewire** – This option should be selected when the RTU is used in conjunction with a DCV package.
    - **VFD Manual** – HMI selectable VFD frequency.
    - **VFD Jog** – For use with VFD using photohelic control. Uses the aux pins to control the VFD. Powering "Aux 1" will speed the fan up, powering "Aux 2" will slow the fan down. When neither "Aux 1" nor "Aux 2" are 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.
    - **Electronically Controlled Motor (ECM)** – HMI selectable supply fan 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.
  - **Blower Mode** – If the "Occupied Scheduling" is set to On, the menu screen for the blower mode will allow you to choose ON/AUTO/OFF for Occupied or Unoccupied. If the "Occupied Scheduling" is set to Off, the menu screen for the blower mode will allow you to choose MANUAL/AUTO/OFF. In blower auto mode, the blower will only run when it gets a call for heating/cooling. In blower 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, powering the unit interlock pin will cause the blower to run.
  - **Blower Start Delay** – On/Off selection. Enabling this menu will run the furnace before starting the blower. A "B" will be present in the lower left corner when the unit is in a blower START/STOP DELAY.
  - **Blower Stop Delay** – On/Off selection. Enabling this menu will stop the furnace, and allow the blower to run until timer expires. A "B" will be present in the lower left corner when the unit is in a blower START/STOP DELAY.
  - **Blower Delay Time** – A delayed time setting for the start or stop of the supply fan.
  - **Blower Preset Speed** – This allows the user to set blower preset option On or Off.
  - **Supply VFD Direction** – Sends a command to the VFD to run in forward or reverse.

FACTORY SETTINGS

Note: Password to enter factory menu is 1 1 1 1.

Unit Options

- **Blower Config continued:**
  - **Fan Speed Presets** – Uses aux pins to control VFD, see **Table 12**.
  - **Occ Fan Presets** – Presets 0-6
  - **Unocc Fan Presets** – Presets 0-6

Table 12 - Fan Speed Presets

Preset	AUX 1	AUX 2	AUX 3	HZ
Speed 0	X			40
Speed 1		X		50
Speed 2	X	X		0
Speed 3			X	60
Speed 4	X		X	0
Speed 5		X	X	0
Speed 6	X	X	X	0

- **Purge Config**
  - **Purge Button** – On/Off selection. When the purge button is pressed, the damper will open to max outdoor air and turn on the exhaust contactor, if enabled.
  - **Purge Time** – This is setting is adjustable from 1 – 120 minutes, default is 15 minutes. This is the amount of time that the unit will run the purge process, if the user does not stop the purge manually.
  - **VFD Purge Speed** – Default is 60 Hz. Adjustable between VFD Min and Max frequency. This is the speed the blower will run during the purge cycle.
  - **ECM Purge Speed** – Adjustable between PWM Min and Max frequency. This is the speed the blower will run during the purge cycle.
- **Monitoring Sensors** – On/Off selection for possible options.
  - **Smoke Detector**
  - **Filter Monitor**
  - **Intake Firestat**
  - **Discharge Firestat**
  - **Freezestat**
  - **Overheat**
  - **Low Gas Switch**
  - **High Gas Switch**
- **Outdoor Air Config**
  - **Outdoor Air** – Off, Manual, 2 Position, Schedule, Outdoor Air %, 100% OA, Analog Control.
  - **Outdoor Air Deadband** – If the temperature difference between the outdoor and return sensor is less than or equal to this setpoint, the IBT board will not attempt to adjust the output voltage until it matches the outdoor air percentage setpoint. This setting only takes effect when either outdoor air % or schedule is selected.
  - **Min Outdoor Air %** – Minimum allowed outdoor air percentage.
  - **Max Outdoor Air %** – Maximum allowed outdoor air percentage.
  - **Min Outdoor Air** – Minimum allowed outdoor air voltage range.
  - **Max Outdoor Air** – Maximum allowed outdoor air voltage range.
  - **Return As Space** – On/Off selection. Setting this to on will not require a space sensor or HMI. It will use the return air thermistor (RT) in place of the space sensor.
  - **Economizer** – See Economizer (page 68).
    - **Economizer Type** – Off, Fixed Dry Bulb, Diff (Differential) Dry Bulb, Fixed Enthalpy, Diff Enthalpy.
    - **Disable Cooling** – When the economizer is using an outside air % greater than this setting, mechanical cooling will be disabled.

FACTORY SETTINGS

Note: Password to enter factory menu is 1 1 1 1.

- **Room Override** – On, Off option. If set to On, the unit will use the Room Override SP rather than Discharge SP. This setting will only have an effect when the heat tempering mode is set to Discharge and "Activate Based On" is not set to "Intake" only.
  - **DISCHARGE (heat) tempering set to activate on SPACE temperature:** When the space temperature has reached its heating set point, the unit will use the Room Override SP instead of Discharge SP to heat the space.
  - **DISCHARGE (heat) tempering set to activate on BOTH (Intake and Space temperature):** When the intake and space temperature has reached its heating set point, the unit will use the Room Override SP instead of Discharge SP to heat the space.
  - **DISCHARGE (heat) tempering set to activate on Either (Intake or Space temperature):** When the intake or space temperature has reached its heating set point, the unit will use the Room Override SP instead of Discharge SP to heat the space.
- **Exhaust Cntctr (Contactor)** – This allows the user to assign a contactor for an interlocked exhaust fan. There is an occupied and unoccupied setting for this.
  - 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 air flow.
- **Exhaust On Smoke** – Input that when enabled, if it receives a **120V** signal from a fire system, will shut down the supply fan and enable the exhaust contactor.
- **Cab and Drn (Drain) Heaters** – This allows the user to enable the cabinet and drain heater, if applicable.
- **Crankcase Heater** – This allows the user to enable the crankcase heater, if applicable.
- **Powered Exhaust** – On, Off option. This allows the user to enable the powered exhaust option. When set to On, the user can set activation based on outdoor air percentage or outdoor air voltage. Dependent on outdoor air configuration, refer to Outdoor Air Configuration on **page 62**, this will limit the adjustable range. Outdoor air percentage range is 0-100%. Outdoor air voltage range is 0-10V.

Occpd Ovrd (Occupancy Override) Duration – Length of override timer. If override is active, it can be manually stopped by pressing the end override button on the HMI. The default setting is 1 hour, but can be adjusted up to 16 hours.

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

Protected Params (DO NOT CHANGE THESE PARAMETERS)

SERVICE SETTINGS

Note: Password to enter service menu is 1 2 3 4.

Temperatures – User can monitor various temperature values.

Sensor Offsets:

- Dschrg Disp Offset – Displays offset for discharge temp. This can be used if actual discharge temperature is measured differently from what is being displayed.
- Space Disp Offset – Displays offset for space temperature. This can be used if actual space temperature is measured differently from what is being displayed.
- Dschrg RH Offset – Displays offset for discharge humidity. This can be used if actual discharge humidity is measured differently from what is being displayed.
- Space RH Offset – Displays offset for space humidity. This can be used if actual space humidity is measured differently from what is being displayed.

Inputs

- Open/Closed Status – Menu to view the open/closed status of all inputs.
- Voltages – Voltage Inputs, Analog Control, Air quality, Outdoor Air Damper, Discharge RH, Space RH and Outdoor RH.
- Refridge Diag – This allows the user to monitor refrigerant components, pressures and temperatures.
- Supply VFD – Live parameter feedback from the supply VFD.
- Compressor VFD – Live parameter feedback from the compressor VFD.

Outputs - Board output equipment status.

Test Menu - To stop any test, hit the abort button on the HMI.

- Test Fans – All, Supply, Exhaust.
- Test Gas Heat – Contains high and low fire tests.
- Test Cooling/HP – Test cooling or heat pump system. Also monitor cooling system specifications.
- Test Analog Heating – This test will simulate a voltage input from a BMS system. The test will begin at **0 volts**. The up and down buttons allow for modulation of input.
- Test Analog Cooling – This test will simulate a voltage input from a BMS system. The test will begin at **0 volts**. The up and down buttons allow for modulation of input.
- Evacuation Mode – Only to be used when working on the cooling system. All refrigeration valves in the circuit will be open during evacuation.
- Test Options
  - **Cabinet Heater** – Beginning this test will turn the cabinet heater on.
  - **Drain Heater** – Beginning this test will turn the drain heater on.
  - **Outdoor Air** – 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.

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.

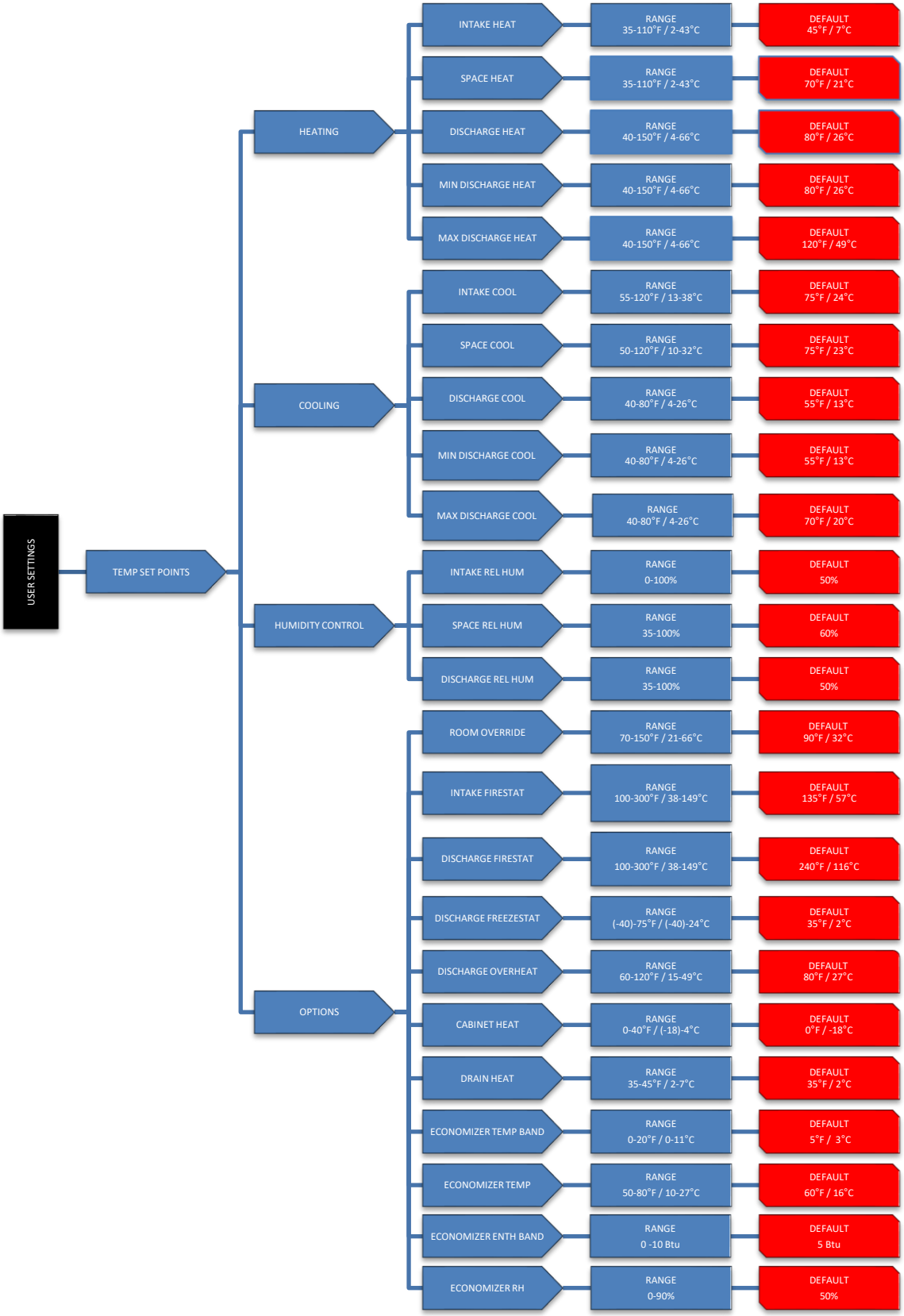
Set Clock – Set day and time.

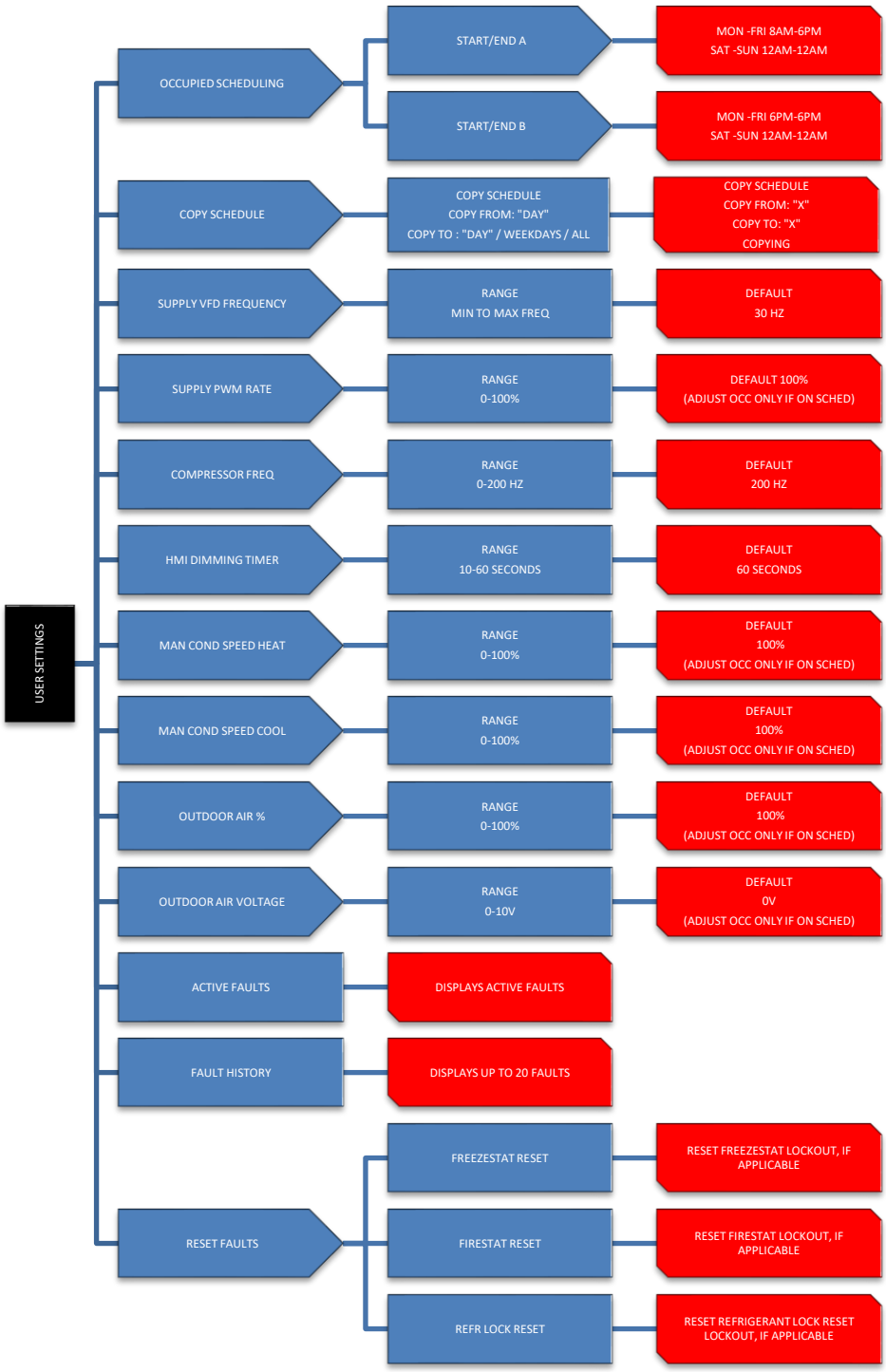
Time Zone – This allows the user to set their time zone.

Factory Reset – Will reset board to factory commissioned settings.

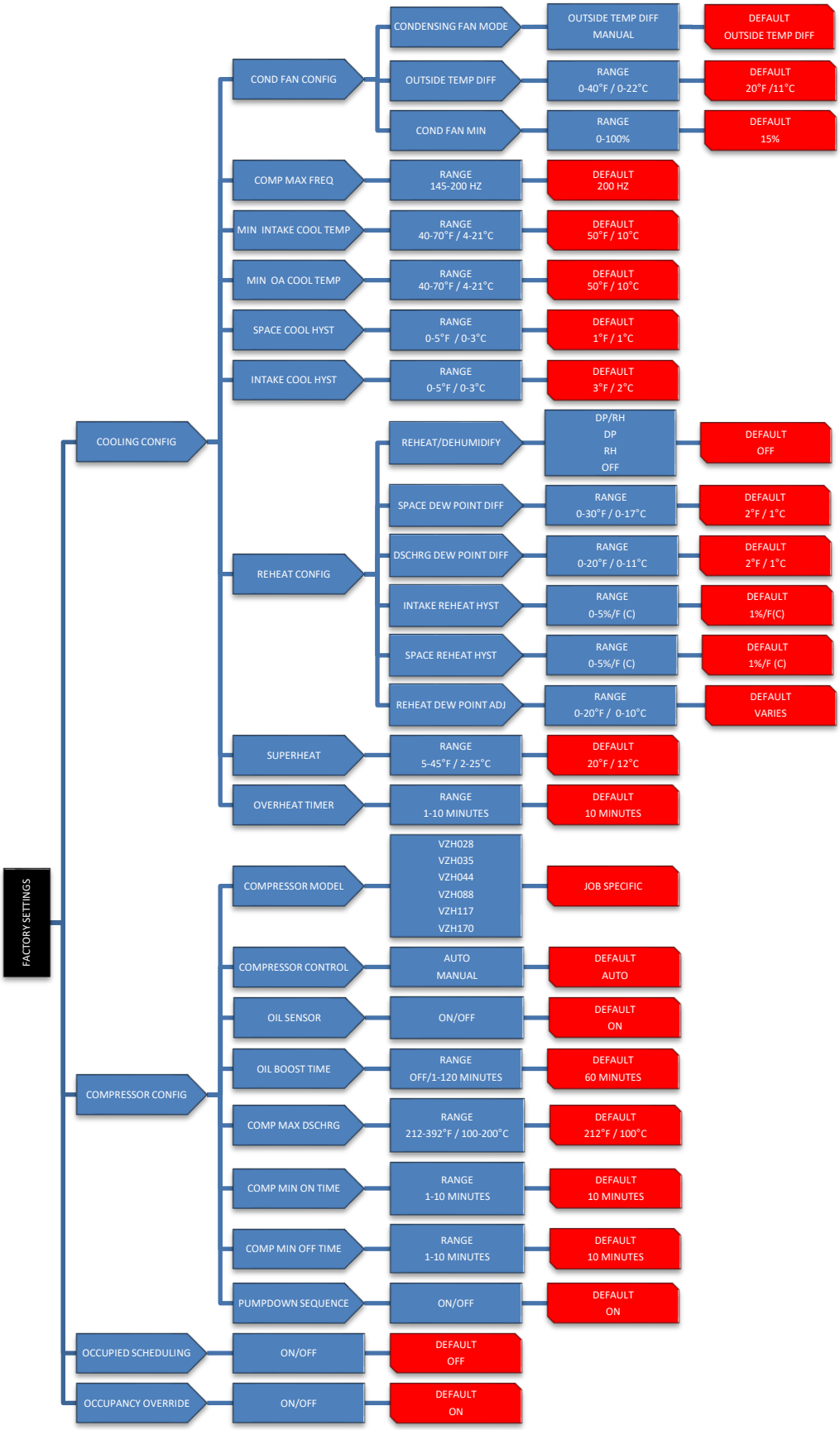
Update Factory Defaults – This allows the original factory default settings to be overridden. When confirming the updated settings, these settings will now be used when “Factory Reset” is needed.

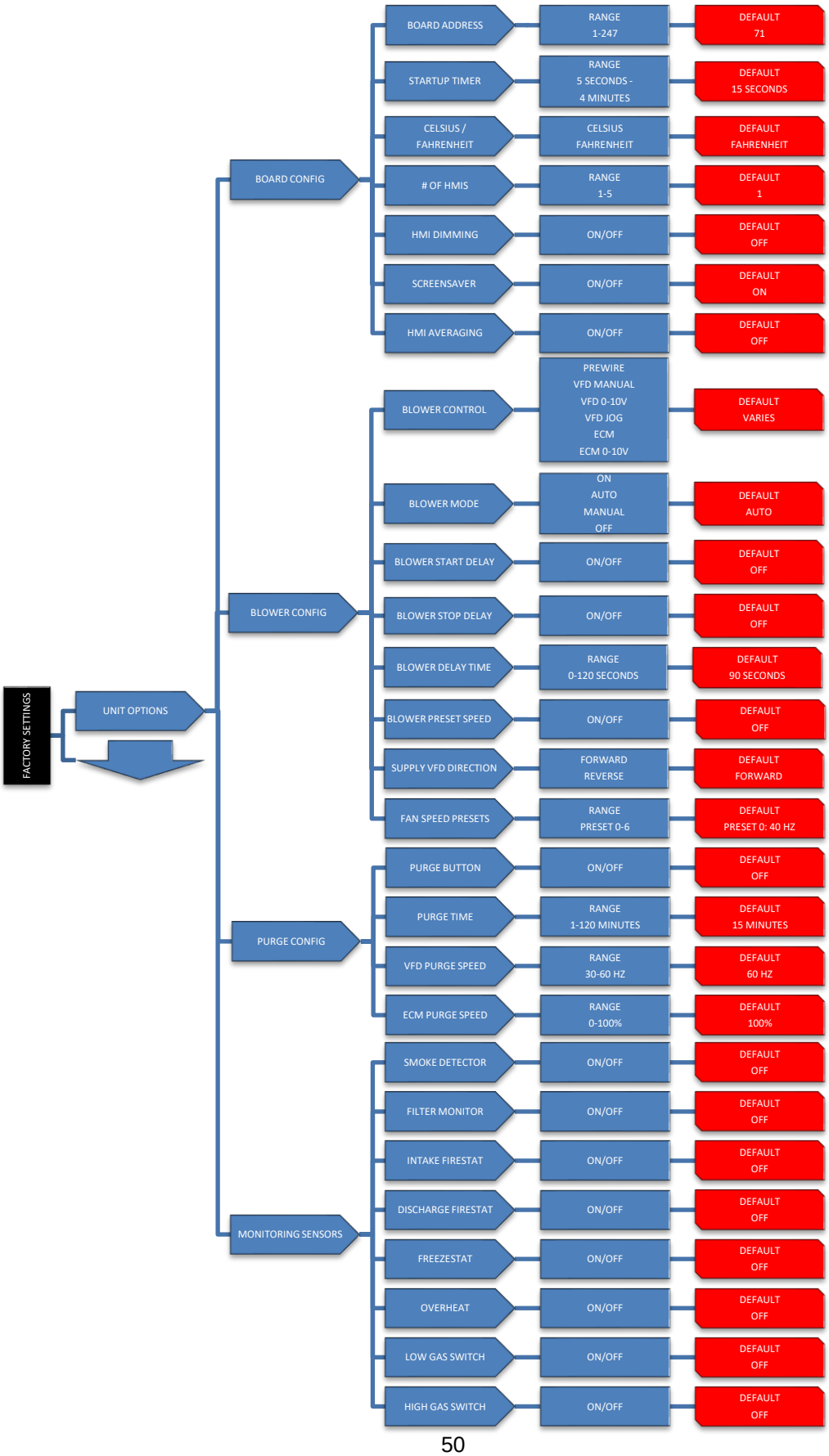
Menu Tree


USER SETTINGS
TEMP SET POINTS
HEATING
INTAKE HEAT
RANGE 35-110°F / 2-43°C
DEFAULT 45°F / 7°C
SPACE HEAT
RANGE 35-110°F / 2-43°C
DEFAULT 70°F / 21°C
DISCHARGE HEAT
RANGE 40-150°F / 4-66°C
DEFAULT 80°F / 26°C
MIN DISCHARGE HEAT
RANGE 40-150°F / 4-66°C
DEFAULT 80°F / 26°C
MAX DISCHARGE HEAT
RANGE 40-150°F / 4-66°C
DEFAULT 120°F / 49°C
COOLING
INTAKE COOL
RANGE 55-120°F / 13-38°C
DEFAULT 75°F / 24°C
SPACE COOL
RANGE 50-120°F / 10-32°C
DEFAULT 75°F / 23°C
DISCHARGE COOL
RANGE 40-80°F / 4-26°C
DEFAULT 55°F / 13°C
MIN DISCHARGE COOL
RANGE 40-80°F / 4-26°C
DEFAULT 55°F / 13°C
MAX DISCHARGE COOL
RANGE 40-80°F / 4-26°C
DEFAULT 70°F / 20°C
HUMIDITY CONTROL
INTAKE REL HUM
RANGE 0-100%
DEFAULT 50%
SPACE REL HUM
RANGE 35-100%
DEFAULT 60%
DISCHARGE REL HUM
RANGE 35-100%
DEFAULT 50%
OPTIONS
ROOM OVERRIDE
RANGE 70-150°F / 21-66°C
DEFAULT 90°F / 32°C
INTAKE FIRESTAT
RANGE 100-300°F / 38-149°C
DEFAULT 135°F / 57°C
DISCHARGE FIRESTAT
RANGE 100-300°F / 38-149°C
DEFAULT 240°F / 116°C
DISCHARGE FREEZESTAT
RANGE (-40)-75°F / (-40)-24°C
DEFAULT 35°F / 2°C
DISCHARGE OVERHEAT
RANGE 60-120°F / 15-49°C
DEFAULT 80°F / 27°C
CABINET HEAT
RANGE 0-40°F / (-18)-4°C
DEFAULT 0°F / -18°C
DRAIN HEAT
RANGE 35-45°F / 2-7°C
DEFAULT 35°F / 2°C
ECONOMIZER TEMP BAND
RANGE 0-20°F / 0-11°C
DEFAULT 5°F / 3°C
ECONOMIZER TEMP
RANGE 50-80°F / 10-27°C
DEFAULT 60°F / 16°C
ECONOMIZER ENTH BAND
RANGE 0 -10 Btu
DEFAULT 5 Btu
ECONOMIZER RH
RANGE 0-90%
DEFAULT 50%

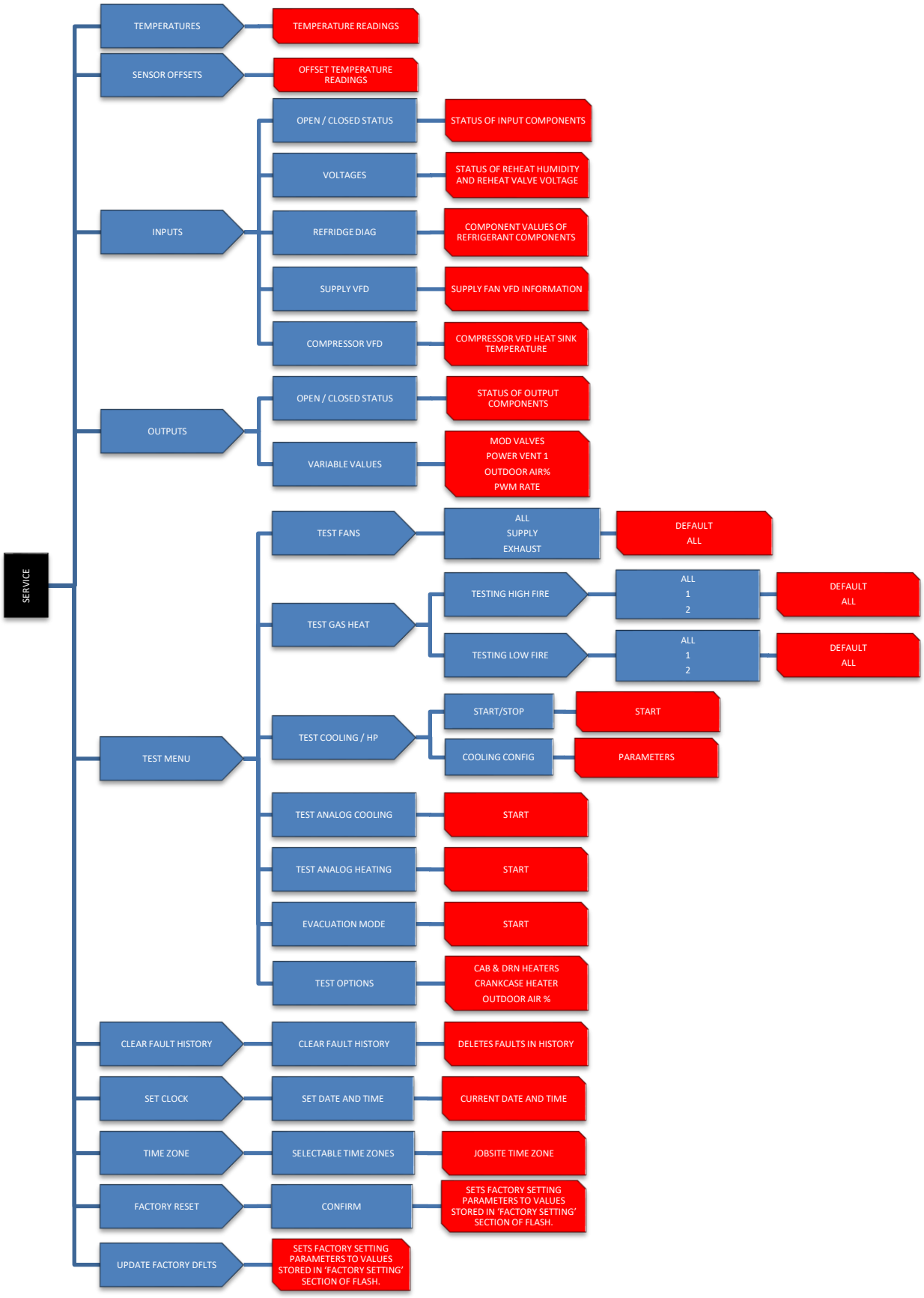

USER SETTINGS
OCCUPIED SCHEDULING
START/END A
MON -FRI 8AM-6PM
SAT -SUN 12AM-12AM
START/END B
MON -FRI 6PM-6PM
SAT -SUN 12AM-12AM
COPY SCHEDULE
COPY SCHEDULE
COPY FROM: "DAY"
COPY TO : "DAY" / WEEKDAYS / ALL
COPY SCHEDULE
COPY FROM: "X"
COPY TO: "X"
COPYING
SUPPLY VFD FREQUENCY
RANGE
MIN TO MAX FREQ
DEFAULT
30 HZ
SUPPLY PWM RATE
RANGE
0-100%
DEFAULT 100%
(ADJUST OCC ONLY IF ON SCHED)
COMPRESSOR FREQ
RANGE
0-200 HZ
DEFAULT
200 HZ
HMI DIMMING TIMER
RANGE
10-60 SECONDS
DEFAULT
60 SECONDS
MAN COND SPEED HEAT
RANGE
0-100%
DEFAULT
100%
(ADJUST OCC ONLY IF ON SCHED)
MAN COND SPEED COOL
RANGE
0-100%
DEFAULT
100%
(ADJUST OCC ONLY IF ON SCHED)
OUTDOOR AIR %
RANGE
0-100%
DEFAULT
100%
(ADJUST OCC ONLY IF ON SCHED)
OUTDOOR AIR VOLTAGE
RANGE
0-10V
DEFAULT
0V
(ADJUST OCC ONLY IF ON SCHED)
ACTIVE FAULTS
DISPLAYS ACTIVE FAULTS
FAULT HISTORY
DISPLAYS UP TO 20 FAULTS
RESET FAULTS
FREEZESTAT RESET
RESET FREEZESTAT LOCKOUT, IF APPLICABLE
FIRESTAT RESET
RESET FIRESTAT LOCKOUT, IF APPLICABLE
REFR LOCK RESET
RESET REFRIGERANT LOCK RESET LOCKOUT, IF APPLICABLE


FACTORY SETTINGS
TEMPERATURE CONTROL
HEAT TEMPERING MODE
DISCHARGE
SPACE
ANALOG CONTROL
DDC
NONE
JOB SPECIFIC
COOL TEMPERING MODE
DISCHARGE
SPACE
ANALOG CONTROL
DDC
NONE
JOB SPECIFIC
ACTIVATE BASED ON
INTAKE
SPACE
BOTH
EITHER
STAT
DEFAULT
EITHER
HEATING CONFIG
HEATING TYPE
INDIRECT FIRED
HEAT PUMP
ELECTRIC
INDIRECT & HP
ELEC & HP
ELEC OR HP
NONE
JOB SPECIFIC
SPACE HEAT HYST
RANGE
0-5°F / 0-1°C
DEFAULT
1°F / 1°C
INTAKE HEAT HYST
RANGE
0-5°F / 0-2°C
DEFAULT
3°F / 2°C
BAS INPUT SOURCE
0-10VDC
2-10VDC
0-20mA
4-20mA
JOB SPECIFIC
GAS HEAT CONFIG
OF HEAT STAGES
RANGE
0-1
IF UNIT HAS A HEAT OPTION, DEFAULT IS 1. IF UNIT DOES NOT HAVE A HEAT OPTION DEFAULT IS 0.
PWM POWERVENT CTRL
ON/OFF
DEFAULT
OFF
CONDENSATION FLOAT
ON/OFF
DEFAULT
OFF
HEAT PUMP CONFIG
COND FAN CONFIG
CONDENSING FAN MODE
OUTSIDE TEMP DIFF
MANUAL
DEFAULT
OUTSIDE TEMP DIFF
OUTSIDE TEMP DIFF
RANGE
0-40°F / 0-22°C
DEFAULT
15°F / 3°C
COND FAN MIN
RANGE
0-100%
DEFAULT
15%
DEFROST CONFIG
DEFROST MODE
OFF
TIMER
PRESS/TEMP
DEFAULT
OFF
DEFROST TIME OFF
RANGE
0-100 MINUTES
DEFAULT
15 MINUTES
DEFROST TIME ON
RANGE
5-100 MINUTES
DEFAULT
5 MINUTES
MIN SUCTION PS
RANGE
30-80 PSI
DEFAULT
40 PSI
MIN SUCTION TEMP
RANGE
(-20)-40°F / (-29)-4°C
DEFAULT
5°F / -15°C
COMP MAX FREQ
RANGE
145-200 HZ
DEFAULT
200 HZ
SUPERHEAT
RANGE
5-45°F / 2-25°C
DEFAULT
20°F / 12°C
MIN OUTDOOR RUN TEMP
RANGE
0-70°F / (-18)-21°C
DEFAULT
45°F / 7°C
CABINET DIFF
RANGE
1-4°F / 1-3°C
DEFAULT
1°F / 1°C
FREEZESTAT TIMER
RANGE
1-10 MINUTES
DEFAULT
10 MINUTES


FACTORY SETTINGS
COOLING CONFIG
COND FAN CONFIG
CONDENSING FAN MODE
OUTSIDE TEMP DIFF
MANUAL
DEFAULT
OUTSIDE TEMP DIFF
OUTSIDE TEMP DIFF
RANGE
0-40°F / 0-22°C
DEFAULT
20°F /11°C
COND FAN MIN
RANGE
0-100%
DEFAULT
15%
COMP MAX FREQ
RANGE
145-200 HZ
DEFAULT
200 HZ
MIN INTAKE COOL TEMP
RANGE
40-70°F / 4-21°C
DEFAULT
50°F / 10°C
MIN OA COOL TEMP
RANGE
40-70°F / 4-21°C
DEFAULT
50°F / 10°C
SPACE COOL HYST
RANGE
0-5°F / 0-3°C
DEFAULT
1°F / 1°C
INTAKE COOL HYST
RANGE
0-5°F / 0-3°C
DEFAULT
3°F / 2°C
REHEAT CONFIG
REHEAT/DEHUMIDIFY
DP/RH
DP
RH
OFF
DEFAULT
OFF
SPACE DEW POINT DIFF
RANGE
0-30°F / 0-17°C
DEFAULT
2°F / 1°C
DSCHRG DEW POINT DIFF
RANGE
0-20°F / 0-11°C
DEFAULT
2°F / 1°C
INTAKE REHEAT HYST
RANGE
0-5%/F (C)
DEFAULT
1%/F(C)
SPACE REHEAT HYST
RANGE
0-5%/F (C)
DEFAULT
1%/F (C)
REHEAT DEW POINT ADJ
RANGE
0-20°F / 0-10°C
DEFAULT
VARIES
SUPERHEAT
RANGE
5-45°F / 2-25°C
DEFAULT
20°F / 12°C
OVERHEAT TIMER
RANGE
1-10 MINUTES
DEFAULT
10 MINUTES
COMPRESSOR CONFIG
COMPRESSOR MODEL
VZH028
VZH035
VZH044
VZH088
VZH117
VZH170
JOB SPECIFIC
COMPRESSOR CONTROL
AUTO
MANUAL
DEFAULT
AUTO
OIL SENSOR
ON/OFF
DEFAULT
ON
OIL BOOST TIME
RANGE
OFF/1-120 MINUTES
DEFAULT
60 MINUTES
COMP MAX DSCHRG
RANGE
212-392°F / 100-200°C
DEFAULT
212°F / 100°C
COMP MIN ON TIME
RANGE
1-10 MINUTES
DEFAULT
10 MINUTES
COMP MIN OFF TIME
RANGE
1-10 MINUTES
DEFAULT
10 MINUTES
PUMPDOWN SEQUENCE
ON/OFF
DEFAULT
ON
OCCUPIED SCHEDULING
ON/OFF
DEFAULT
OFF
OCCUPANCY OVERRIDE
ON/OFF
DEFAULT
ON


FACTORY SETTINGS
UNIT OPTIONS
BOARD CONFIG
BOARD ADDRESS
RANGE 1-247
DEFAULT 71
STARTUP TIMER
RANGE 5 SECONDS - 4 MINUTES
DEFAULT 15 SECONDS
CELSIUS / FAHRENHEIT
CELSIUS FAHRENHEIT
DEFAULT FAHRENHEIT
OF HMIS
RANGE 1-5
DEFAULT 1
HMI DIMMING
ON/OFF
DEFAULT OFF
SCREENSAVER
ON/OFF
DEFAULT ON
HMI AVERAGING
ON/OFF
DEFAULT OFF
BLOWER CONFIG
BLOWER CONTROL
PREWIRE
VFD MANUAL
VFD 0-10V
VFD JOG
ECM
ECM 0-10V
DEFAULT VARIES
BLOWER MODE
ON
AUTO
MANUAL
OFF
DEFAULT AUTO
BLOWER START DELAY
ON/OFF
DEFAULT OFF
BLOWER STOP DELAY
ON/OFF
DEFAULT OFF
BLOWER DELAY TIME
RANGE 0-120 SECONDS
DEFAULT 90 SECONDS
BLOWER PRESET SPEED
ON/OFF
DEFAULT OFF
SUPPLY VFD DIRECTION
FORWARD
REVERSE
DEFAULT FORWARD
FAN SPEED PRESETS
RANGE PRESET 0-6
DEFAULT PRESET 0: 40 HZ
PURGE CONFIG
PURGE BUTTON
ON/OFF
DEFAULT OFF
PURGE TIME
RANGE 1-120 MINUTES
DEFAULT 15 MINUTES
VFD PURGE SPEED
RANGE 30-60 HZ
DEFAULT 60 HZ
ECM PURGE SPEED
RANGE 0-100%
DEFAULT 100%
MONITORING SENSORS
SMOKE DETECTOR
ON/OFF
DEFAULT OFF
FILTER MONITOR
ON/OFF
DEFAULT OFF
INTAKE FIRESTAT
ON/OFF
DEFAULT OFF
DISCHARGE FIRESTAT
ON/OFF
DEFAULT OFF
FREEZESTAT
ON/OFF
DEFAULT OFF
OVERHEAT
ON/OFF
DEFAULT OFF
LOW GAS SWITCH
ON/OFF
DEFAULT OFF
HIGH GAS SWITCH
ON/OFF
DEFAULT OFF


FACTORY SETTINGS
UNIT OPTIONS
OUTDOOR AIR CONFIG
OUTDOOR AIR CTRL
OFF
MANUAL
2 POSITION
SCHEDULE
OUTDOOR AIR %
100% OA
ANALOG CONTROL
DEFAULT
OFF
OUTDOOR AIR DEADBAND
RANGE
0-10°F / 0-6°C
DEFAULT
5°F / 3°C
RETURN AS SPACE
ON/OFF
DEFAULT
OFF
MIN OUTDOOR AIR %
RANGE
0 - MAX OUTDOOR AIR %
DEFAULT
0%
MAX OUTDOOR AIR %
RANGE
0 - MIN OUTDOOR AIR %
DEFAULT
100%
MIN OUTDOOR AIR
RANGE
0V - MAX OUTDOOR AIR V
DEFAULT
0V
MAX OUTDOOR AIR
RANGE
MIN OUTDOOR AIR - 10V
DEFAULT
10V
ECONOMIZER
ECONOMIZER TYPE
OFF
FIXED DRY BULB
DIFF DRY BULB
FIXED ENTHALPY
DIFF ENTHALPY
DEFAULT
OFF
DISABLE COOLING
0-100%
DEFAULT
0%
ROOM OVERRIDE
ON/OFF
DEFAULT
OFF
EXHAUST CNTCTR
NONE
BEFORE AIRFLOW
AFTER AIRFLOW
DEFAULT
NONE
EXHAUST ON SMOKE
ON/OFF
DEFAULT
OFF
CAB & DRN HEATERS
ON/OFF
DEFAULT
OFF
CRANKCASE HEATER
ON/OFF
DEFAULT
ON
POWERED EXHAUST
POWERED EXHAUST
ON/OFF
DEPENDENT ON FACTORY SETTINGS
MIN OA POSITION
0-100% or 0-10V
DEFAULT
RANGE DEPENDENT ON OA CONFIG
OCCPD OVRD DURATION
RANGE
0-16 HOURS
DEFAULT
1 HOUR
LIMIT SP ADJUST
RANGE
0-100°F/ 0-55°C
DEFAULT
5°F / 3°C
PROTECTED PARAMS
PID
CONFIG
PID DIAGNOSTICS
PID HEATING
PID INFORMATION
PID COOLING
PID INFORMATION
PID
COMPRESSOR
PID INFORMATION
PID REHEAT
PID INFORMATION
PID COND FAN
PID INFORMATION


SERVICE
TEMPERATURES
TEMPERATURE READINGS
SENSOR OFFSETS
OFFSET TEMPERATURE READINGS
INPUTS
OPEN / CLOSED STATUS
STATUS OF INPUT COMPONENTS
VOLTAGES
STATUS OF REHEAT HUMIDITY AND REHEAT VALVE VOLTAGE
REFRIDGE DIAG
COMPONENT VALUES OF REFRIGERANT COMPONENTS
SUPPLY VFD
SUPPLY FAN VFD INFORMATION
COMPRESSOR VFD
COMPRESSOR VFD HEAT SINK TEMPERATURE
OUTPUTS
OPEN / CLOSED STATUS
STATUS OF OUTPUT COMPONENTS
VARIABLE VALUES
MOD VALVES
POWER VENT 1
OUTDOOR AIR%
PWM RATE
TEST MENU
TEST FANS
ALL
SUPPLY
EXHAUST
DEFAULT
ALL
TEST GAS HEAT
TESTING HIGH FIRE
ALL
1
2
DEFAULT
ALL
TESTING LOW FIRE
ALL
1
2
DEFAULT
ALL
TEST COOLING / HP
START/STOP
START
COOLING CONFIG
PARAMETERS
TEST ANALOG COOLING
START
TEST ANALOG HEATING
START
EVACUATION MODE
START
TEST OPTIONS
CAB & DRN HEATERS
CRANKCASE HEATER
OUTDOOR AIR %
CLEAR FAULT HISTORY
CLEAR FAULT HISTORY
DELETES FAULTS IN HISTORY
SET CLOCK
SET DATE AND TIME
CURRENT DATE AND TIME
TIME ZONE
SELECTABLE TIME ZONES
JOBSITE TIME ZONE
FACTORY RESET
CONFIRM
SETS FACTORY SETTING PARAMETERS TO VALUES STORED IN 'FACTORY SETTING' SECTION OF FLASH.
UPDATE FACTORY DFLTS
SETS FACTORY SETTING PARAMETERS TO VALUES STORED IN 'FACTORY SETTING' SECTION OF FLASH.

Start-up

Prior to starting up or operating this unit, check all fasteners for tightness. In particular, check the set screw in the wheel hub. With power and gas OFF or prior to connecting ventilator to power, turn the fan wheel by hand to be sure it is not striking the inlet or any obstacles. Re-center if necessary.

WARNING: GLOVES AND SAFTEY GLASSES MUST BE WORN WHEN SERVICING REFRIGERATION EQUIPMENT.

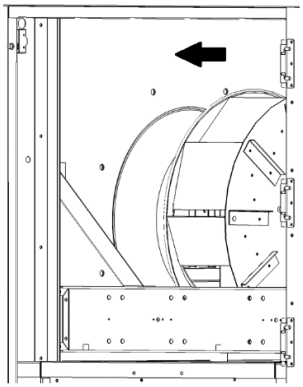
Special Tools Required

- AC Voltage Meter
- Tachometer
- Standard Hand Tools
- Refrigeration Gauge Set
- Amperage Meter
- Differential Pressure Gauge
- Thermometer

Start-up Procedure Cooling

1. Check that all electrical connections are secure and tight.
2. Inspect the condition of the intake damper.
3. Inspect the air-stream for obstructions. Install necessary filters.
4. Verify all drains are connected, and routed in the proper positions. For high efficiency furnaces, verify the condensate drain is connected. See Furnace Condensation Drain (page 12).
5. Compare the supplied **motor voltage** with the fan's nameplate motor voltage. If this does not match, correct the problem.
6. Check the rotation of the wheel motor. Verify the wheel is moving in the direction of the directional arrow. Incorrect rotation will result in poor air performance, motor overloading, and possible damage to the motor. If the motor rotation is incorrect, adjust using the HMI panel.
   - Factory Settings > Unit Options > Blower Config > Supply VFD Direction > Forward.
7. When the fan is started, observe the operation and check for any unusual noises.
8. Connect a refrigerant gauge set to the system. See Connecting Manifold Gauge Set (page 81). Verify the high side and low side pressure readings are equal at the initial connection.
9. Monitor the surface temperature with a thermometer.
10. Start and run the unit for approximately 20 minutes.
11. Monitor the manifold gauge, surface temperature, subcool, and Superheat Controller (EV-1):
    - Use the Pressure Temperature Chart (page 95) to convert the pressure gauge readings to temperature.
    - The subcool reading should be approximately **14-16°F**.
    - The EV-1 controller reading should be approximatley **20°F**.

Figure 36 - Direction of rotation



Start-up Procedure Heating

Furnace Start-Up Summary

1. Open the field installed manual gas shut-off valve, and ensure the On/Off gas control valve knob is set to 'On'.
2. Check the inlets to all of the firing tubes on the furnace and ensure that they are all clear of foreign debris. Verify that the tubes line up properly with each nozzle of the gas manifold.
3. Start the unit and check the gas supply pressure at the inlet gas gauge, this gauge is upstream of all electronic gas valves. The inlet pressure should be **7 in. - 14 in. w.c. on natural gas or 11 in. – 14 in. w.c. on propane gas**. If the inlet pressure is too high, install an additional pressure regulator external to the unit.

Table 13 – Modulating Valve DIP Switch Settings

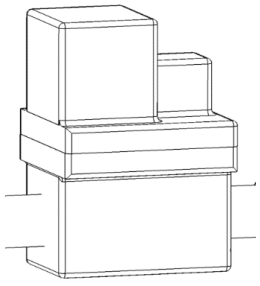
DIP Switch Position Table			
Control Signal	SW1 Signal	SW2 Offset	SW3 Characteristic
0-10V	OFF	OFF	OFF
2-10V	OFF	ON	OFF
0-20 mA	ON	OFF	OFF
4-20 mA	ON	ON	OFF

4. Verify DIP switches are set correctly on the modulating valve. Factory setting for DIP switches is Off.
5. A final gas leak check shall be performed to verify the gas-tightness of the heater's components and piping under normal operating conditions.
6. At any point during high/low fire burner adjustment, check the characteristics of the flames in every firing tube of the furnace. Non-existence of flame or a lazy flame can be caused by no gas pressure, low gas pressure, a dirty nozzle orifice, or clogged section of exhaust flue.
7. When testing is complete replace all caps, and covers removed during the adjustment procedure.

High Fire Burner Adjustment

1. Set the unit into high fire mode. This is achieved by configuring high fire by going into the HMI Configuration menu (page 37). **Service>test menu>test gas heat>run high fire test**.
2. After it has been verified that the furnace(s) are lighting off properly, the manifold gas pressure should be adjusted to jobsite conditions. The gas pressure regulator (integral to the On/Off gas control valve, see **Figure 15**) is adjusted at the factory for average gas conditions. It is important that the gas supplied to the furnace is in accordance with the input rating on the rating plate. Once the gas pressure is verified, continue to step 3.
3. If the unit is set up for analog control, continue with high fire using the method above or send the unit a constant 10V DC or 20mA signal. See **Table 13**.
    - Remove the cover on the modulating valve. Read the manifold gas pressure gauge (0-10 in. w.c.) located directly on the gas manifold. The pressure should read **3.5 in. w.c.** for natural gas / **10 in. w.c.** for propane. If the pressure is incorrect, adjust the pressure.
    - To adjust the pressure, press button #1 until the LED lights solid red. Release the button. The valve is now in high fire setting mode.
    - Buttons #1 and #2 are used to set desired high fire setting. Press once to step or hold to auto step.

Figure 37 - Modulating Valve

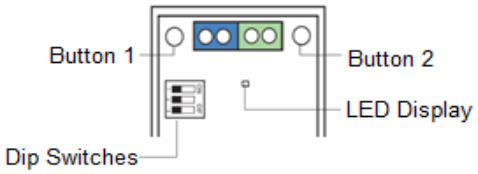


- Button #1 = increases flow
- Button #2 = decreases flow

To save the high fire setting, simultaneously hold buttons #1 and #2 until the LED turns off.

4. If the proper (**in. w.c**.) gas pressure cannot be achieved by adjusting the modulating gas valve, and it has been verified that the inlet gas pressure is within the acceptable range of **7 in. - 14 in. w.c. on natural gas and 11 in. – 14 in. w.c. on propane gas**, adjust the regulator on the On/Off gas control valve. Use a screwdriver to **turn the inner adjustment screw clockwise to increase the gas pressure,** see **Figure 15**.

Figure 38 - Modulating Valve Controls



Low-Fire Burner Adjustment

1. Lock the unit into low fire mode. This is achieved by configuring low fire by going into the HMI Configuration menu (page 37). **Service>test menu>test gas heat>run low fire test**.
2. Press and hold button #2 on the modulating valve until the LED light blinks red. Release the button. The valve is now in low fire setting mode.
3. Press button #1 to increase flow or press button #2 to decrease flow.
   - The desired pressure reading for natural gas is **0.15 in. w.c.** If this cannot be obtained, set the low fire pressure as low as possible.
   - The pressure reading for propane gas should be **0.75 in. w.c.**
4. Save the low fire setting by simultaneously holding down buttons #1 and #2 until the blinking LED turns off. Press the abort button on the HMI to exit low fire mode.

Final Start-Up Procedure

1. With the air and burner systems in full operation and all ductwork attached, measure the system airflow.
2. 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**.
3. Measure and record the **voltage** and **amperage** to the motor and compare with the motor nameplate to determine if the motor is operating under safe load condition.
4. Check for any obstructions, tools, or hardware that may cause damage when unit is in full operation.
5. Make sure all access panels are in place, and secure.

Compressor and Compressor Drive

Compressor VZH 044/035/028

Oil return management – Insufficient lubrication can be the result of oil depositing itself in pipes and bends. Return management helps oil deposits to return to the crankcase by:

- Increasing velocity for short periods at regular time intervals.
- By ensuring adequate oil return when velocity is too low.

When the system has been running low on oil at a low rpm (less than 50 Rotations Per Second (RPS) for 19 minutes, the internal lubrication algorithm in the drive will accelerate the compressor. The compressor will accelerate to 70 rps for 60 seconds. This will make sure there is sufficient lubrication of the compressor's moving parts. When "Hands On" mode is selected the oil return management will not be active, even if the parameter is set to be on. If the compressor does run below 50 rps for 19 minutes, an error will occur and the compressor will shut down.

Timed oil boost – Returns oil from the system to the compressor for a defined time period. To set the oil boost configuration, go to Factory Settings > Compressor Config > Oil Boost Time. The user can set this to be OFF or configure a time setting that ranges between 1-120 minutes. Default is set to 60 minutes. When the system is in an oil boost, the boost will last for 1 minute and an "O" will be displayed on the HMI.

Oil level –When the compressor is running, and in a stabilized condition, the oil level should be visible in the sight glass window, see **Figure 39**. The presence of small bubbles and foam indicates there could be a large concentration of refrigerant in the oil, or there may be liquid returning to the compressor.

If the oil level is low, add oil as necessary when the compressor is idle. Use PVE oil from new containers. **DO NOT CONTAMINATE THE OIL**. Connect an oil hand pump to the Schrader valve connection on the compressor. Add oil until the level fills 50-75% of the sight glass after the unit has been of for at least 5 minutes, see **Figure 39**.

Figure 39 - VZH 044 Compressor

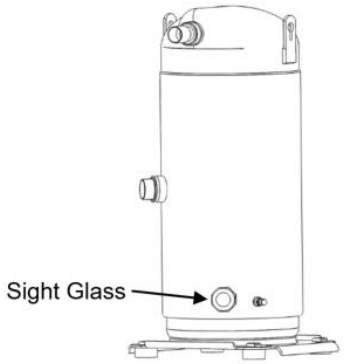
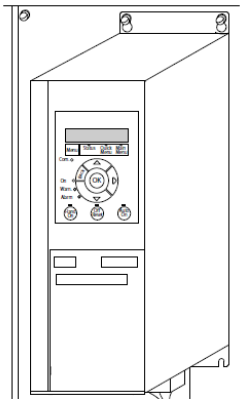


Figure 40 - CDS 803 Compressor Drive

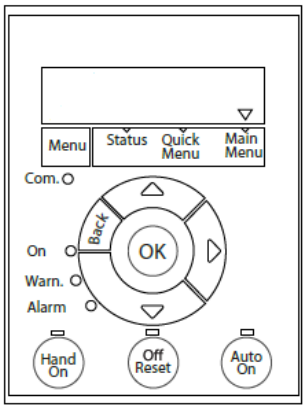


CDS803 Compressor Drive Quick Menu Navigation

The parameter setting for the compressor drive is factory set, and should not be adjusted unless specified by a service representative. If replacing the compressor drive, verify the settings match the compressor drive parameter settings. If settings need to be programmed, proceed with the following:

- Press “Menu” to enter the “Quick Menu”.
- Press [▼] to select “Compressor Function”.
- Press “OK” to enter parameter screen.
- Press “OK” to enter edit the parameter. Use [▲] [▼] to adjust the parameter to the factory settings. Press “OK” to set parameter.
- Use the VFD schematics to locate the parameters that will need to be adjusted.

Figure 41 – CDS 803 Panel



CDS803 Compressor Drive Main Menu Navigation

“Main Menu” is used for access to and programming of all parameters. The Main Menu parameters can be accessed readily by using the password. See VFD schematic for password.
For most Compressor Drive applications it is not necessary to access the Main Menu parameters but instead the Quick Menu provides the simplest and quickest access to the typical required parameters.

The Main Menu accesses all parameters.

- Press [Menu] until indicator in display is placed above “Main Menu”.
- Press [▲] [▼] to browse through the parameter groups.
- Press “OK” to select a parameter group.
- Press [▲] [▼] to browse through the parameters in the specific group.
- Press “OK” to select the parameter.
- Press [▲] [▼] to set/change the parameter value.

Press “Back” to go back one level.

Note: Contact Factory Service Department if more information is needed.

Rotations Per Second (RPS) conversion to Hertz: 1rps x 2 = Hz
Example: 15rps = 30 Hz

Compressor VZH 088/117/170

Oil return management - Insufficient lubrication can be the result of oil depositing itself in pipes and bends. Return management helps oil deposits to return to the crankcase by:

- Increasing velocity for short periods at regular time intervals.
- By ensuring adequate oil return when velocity is too low.

When oil return management is enabled, the frequency converter performs an oil boost when the compressor is below 3000 RPM. The oil boost will happen every 60 minutes for 30 seconds when the compressor speed is below 3000 RPM.

Oil boost – This function is controlled by the Variable Frequency Drive converter (VFD-02) to return oil from the system to the compressor when oil balance cannot be reached or maintained in a defined time period.

Oil solenoid – The compressor VFD-02 controls the oil solenoid, which will then actuate the valve. This solenoid valve set up helps optimize the oil circulation, and improve efficiency of the compressor at all running speeds. Control parameters are factory preset, but are accessible on the parameter list as read only values.

Oil level sensor – This sensor is an optical sensor that monitors the compressor's internal oil level. The sensor will send a signal to the VFD controller, a warning will be displayed on the HMI if a low oil level condition exists. If the oil level is low the system will enter a secondary oil boost. If the oil level is still low after this boost cycle the system will shut down and display a fault.

If the oil level is low, add oil as necessary when the compressor is idle. Use POE oil from new containers. **DO NOT CONTAMINATE THE OIL.** Connect an oil hand pump to the Schrader valve connection on the compressor. Carefully add oil until the oil level sensor is satisfied after the compressor has been off for at least 5 minutes. Repeat until the oil level sensor is satisfied for at least 30 minutes of unit operation.

Figure 42 - VZH 088/117/170 Compressor

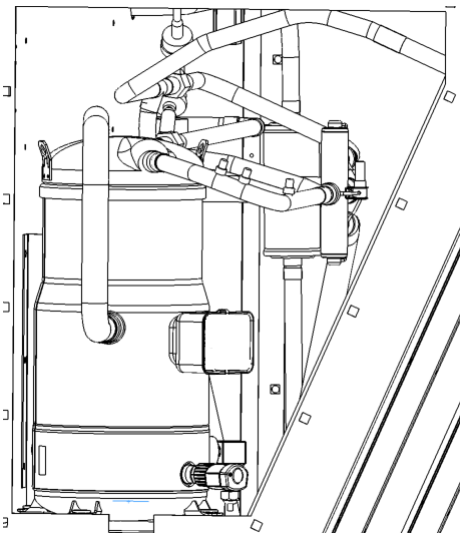
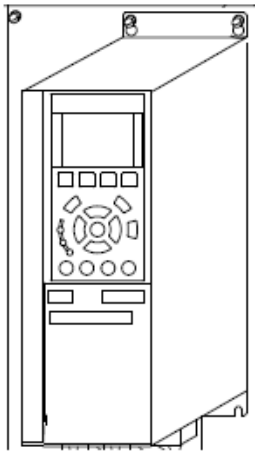


Figure 43 - CDS 302/303 Compressor Drive



CDS302/303 Compressor Drive Quick Menu navigation

The parameter setting for the compressor drive is factory set, and should not be adjusted unless specified by a service representative. If replacing the compressor drive, verify the settings match the compressor drive parameter settings. If settings need to be programmed, proceed with the following:

- Press ‘Quick Menus’.
- Press the down arrow to select ‘Compressor Functions’.
- Press ‘OK’ to enter the parameter screen.
- Use the arrow key pad to select parameters. Press ‘OK’ to enter the parameter screen.
- Press ‘OK’ to enter edit the parameter. Use the arrows key pad to adjust the parameter to the factory settings. Press ‘OK’ to set parameter.
- Use the VFD schematics to locate the parameters that will need to be adjusted.

CDS302/303 Compressor Drive Main Menu

In the Main menu mode, the parameters are divided into groups. Use the navigation keys for selecting a parameter group.

After selecting a parameter group, select a parameter with the navigation keys. The middle section on the display shows the parameter number, and name.

The procedure for changing data is the same in both the Quick menu and the Main menu mode.
Press “OK” to change the selected parameter. The procedure for changing data depends on whether the selected parameter represents a numerical data value or a text value.

Some of the parameters cannot be changed from the LCP. These parameters are defined by the compressor choice made in 1-13 Compressor Selection. The parameters come up as “Read only”.

Note: Contact Factory Service Department if more information is needed.

Rotations Per Second (RPS) conversion to Hertz: 1rps x 2 = Hz
Example: 15rps = 30 Hz

Figure 44 – LCD Menu

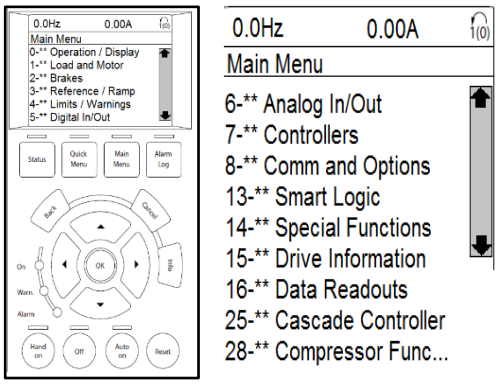
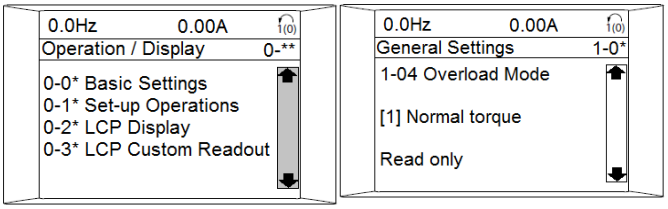


Figure 45 – Setting Screen



Sequence of Operation

Operation Summary – Gas Heating

- When there is a call for heat, the main blower is turned “On” and the airflow switch is proven.
- The Flame Safety Controller (FSC-1) sends **120V AC** power to the line input of the power vent blower.
- Power vent blower is controlled by pin J17 on the control board. This varies a signal to the power vent blower motor to initiate a **1 min** pre-purge at high speed.
- **24V AC** signal runs through the safety circuit (Power Vent Airflow Switch/High Temperature Limit/Flame Roll-out Switch) and into FSC-1.
- FSC-1 initiates Trial for Ignition by sending a signal to the spark igniter to light the furnace and **24V AC** power to the On/Off gas valve and a signal to the HMI that it is sparking. This opens the On/Off gas valve and triggers the start of the **17 seconds** from the HMI to the power vent blower, and modulating valve.
- Flame is sensed by FSC-1’s remote flame sensor at the firing tube of furnace.
- HMI’s **17 second** high-fire off-delay time sequence runs out, and a variable voltage is sent to the power vent blower motor.
- The control board continues to modulate the heat output of the unit by adjusting the **0-10V DC** signal to the modulating gas valve.

There are different options for controlling the temperature output of these units. These include Discharge Temperature Control, Space Temperature Control, Analog Control, and Direct Digital Control (DDC).

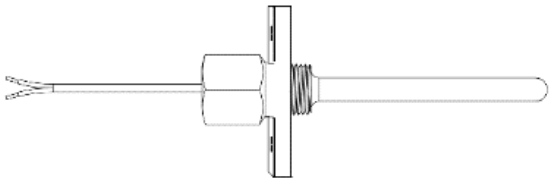
Discharge Control: When used in discharge control, the IBT board receives a call to heat from the intake sensor, the IBT board will modulate the discharge temperature until it hits the desired setpoint. The user can choose whether discharge heating is activated based off of intake temperature, space temperature, either, both or stat.

Space Control: When the space control option has been selected, there may be an HMI (that contains an internal temperature sensor) or a space thermistor. The user can choose whether the space heating is activated based off of intake temperature, space temperature, either, both or stat.

Analog Control/Direct Digital Control (DDC): A **0-10V DC** or **0-20mA** signal is sent to the IBT board from the building control system to regulate the heating output of the unit.

In all cases, the IBT board controls the amount of gas to the burner based on the signal from the temperature control components. When the modulating gas valve is all the way open, achieving the maximum BTUs and temperature rise of the unit, the unit is in high fire.

Figure 46 - Temp Sensor



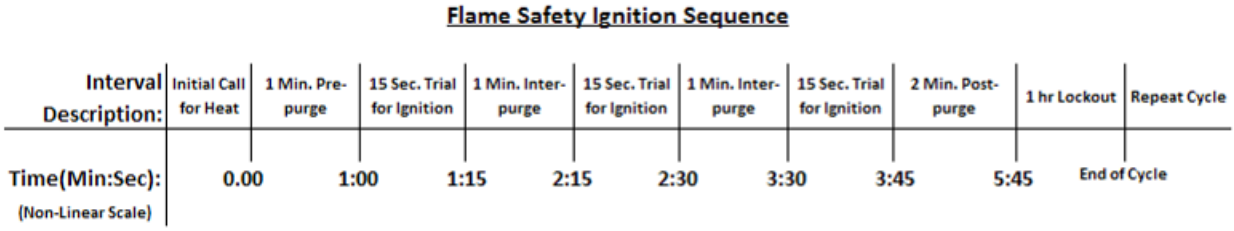
Flame Safety Control (FSC)

The Flame Safety Control (FSC) is present ***only*** to monitor the flame, NOT to control temperature.

The FSC uses a sensor mounted at the intake of the upper-most firing tube of the furnace to sense the existence of a flame. The FSC controls the opening of the solenoid gas valve, and the operation of the spark igniter to initiate a flame upon start-up. When there is a call for heat, the LED on the FSC is energized indicating that the unit has power. Then, there is a one minute pre-purge. The power vent blower on the furnace is sent to high speed to exhaust any gas in the Heat-exchanger/Control Cabinet that may be present prior to trial for ignition. As soon as the pre-purge has initiated, the FSC checks that airflow is sensed by the power vent airflow switch and that the High Limit and Roll-out switches are not tripped.

Upon successful sensing of induced power vent airflow, continuity of temperature limit and roll-out switches, the FSC initiates a **15 second** ignition sequence. During this ignition sequence, the FSC opens the On/Off gas valve and allows gas to pass through to the gas manifold. At the same moment, the spark igniter begins to spark, causing the electrode on the burner to ignite the gas. This results in a flame at the lowest firing tube of the furnace which immediately ignites the flow of gas in each succeeding firing tube moving vertically until the entire furnace is lit. When the sensor detects the flame at the intake of the upper-most firing tube the FSC continues to power the On/Off gas valve until there is a loss of flame presence. This is the normal operating mode.

Figure 47 - Ignition Sequence



Modulating Stage Sequence

The modulating stage operates differently than other On/Off staged furnaces. Instead of being “On” or “Off”, the gas flow to this furnace is modulated up and down to account for varying calls for heat during the unit’s operating period. In addition, the speed of its power vent blower is varied as the gas flow changes in order to maintain constant combustion efficiency over the entire firing range.

The modulating furnace power vent blower is controlled by an onboard speed controller, located on the IBT control board. Voltage to the motor is based on a **0-10V DC** signal. The Output voltage (True RMS) to the motor varies non-linearly between **120V AC** @ **10V DC** for high fire and **81.6V AC** @ **0V DC** for low fire.

IBT Board and High Fire Start

The IBT board compares a difference between two sensor values, and setpoints; or compares a **0-10V DC** or **0-20 mA** signal from an analog control to the modulating furnace. The signal is linearized such that input voltage is directly proportional to amount of gas being delivered to the modulating valve.

In order to ensure proper light-off in all conditions, the IBT board contains software that forces the modulating furnace to light at high fire when that furnace’s main gas valve is first opened. There is a built in timer that allows it to send a constant **10V DC** signal to the modulating gas valve, and power vent blower speed controller. This will force the furnace into high fire for a period of **17 seconds** after the initial spark is sent by the FSC. After this forced high-fire light-off period has expired, the modulating furnace’s power vent blower and modulating gas valve will receive a modulating signal from the IBT board.

Re-Circulating Control Options

The ratio of outdoor to indoor air in the discharge supply air can be adjusted through the IBT board output. The board will output a **0-10V DC** signal to command the position of the damper. There are a number of options for controlling the position of this damper. Use the HMI panel to change options:

FACTORY SETTINGS > UNIT OPTIONS > OUTDOOR AIR CONFIG> OUTDOOR AIR CTRL

Powered Exhaust

The powered exhaust fan is located by the intake damper assembly and is designed to prevent the building from over pressurizing. When there is excessive static in the building's return ductwork, the powered exhaust fan will assist exhausting air directly outdoors to balance the building's internal pressure. The powered exhaust fan will actuate depending on the outdoor air configuration's settings and supply fan activation.

Outdoor Air Configuration

When Outdoor Air % or Schedule is selected, "Outdoor Air Deadband" will be active. This setting checks the delta T between outdoor and return air. If the difference between these two temperatures is less than or equal to the dead band setting (default setting is 5 degrees), the IBT board will not alter its output to the damper assembly.

- **Off**

Outdoor air control from the control board will not output a signal. May be used when damper is controlled by a photohelic gauge or a Building Management System (BMS).

- **Manual**

The fresh air dampers can be manually controlled from the HMI panel corresponding to a 0-10V DC output signal from the control board. This output voltage signal can be manually adjusted. This will allow the user to manually set the dampers to match the building ventilation requirements.

- **2 Position**

The fresh air dampers can be controlled by a two position switch (a field supplied switching device) to select closed position or 100% open. The control board sends out a constant 10V DC signal to the actuator. The field supplied switch will break or make the signal from the control board to the outdoor air damper. When the switch is used to disconnect power (open the circuit), or if a power failure occurs, or if the control board is shutoff, the return air damper will open by spring return. If using a two position switch, connect in series to the control board at connection A+ and D+.

- **Schedule**

When schedule is selected, the outdoor to return air ratio will change based on the schedule. There are separate occupied and unoccupied outdoor air percentage settings. The unit will maintain the appropriate outdoor air percentage based on the schedule settings using the logic of the Outdoor Air % mode. Use the HMI panel to change the percentage.

- **Outdoor Air %**

The dampers can be controlled from the HMI to position the dampers from 0% to 100% fresh air. The IBT board utilizes an internal algorithm to alter its **0-10V** output to the damper assembly in order to maintain an exact outdoor air percentage.

- **100% OA**

If this damper control is chosen, anytime the blower is running the damper will be fully open. The board logic will send 10 volts to open the damper. When there is no call for the blower, the board logic will send 0 volts to close the damper.

- **Analog Control**

When this is set to ON, the damper will modulate linearly between the min and max OA voltage for both occupied and unoccupied modes.

Static Pressure Control (Photohelic)

The dampers can be controlled by a building static pressure control. The controller will sense the difference between pressure inside the building and pressure outside the building. The sensor (A306 outdoor sensor) senses the pressure difference, and will position the dampers to maintain the pressure setting on the controller. The controller has two setpoints and an indicator. The two setpoints are a minimum desired static pressure point, and a maximum static pressure point.

The actual building static pressure will be shown by a visual indicator between these two settings. The controller will modulate the dampers to maintain a static pressure between these setpoints.

When building static pressure is below the minimum setting, the damper motor will proportionally open the fresh air damper and close the return air damper until static increases above the minimum setting. At this point, the damper motor will stop and hold this proportion.

If the building static continues to climb and goes above maximum setting, the damper motor will reverse proportion, closing the fresh air damper and opening the return air damper until static drops below maximum setting.

During the “OFF” or “Night” cycle of the unit, an internal switching circuit will close the return air damper.

See additional wiring and installation information on the static pressure controller and A306 outdoor sensor.

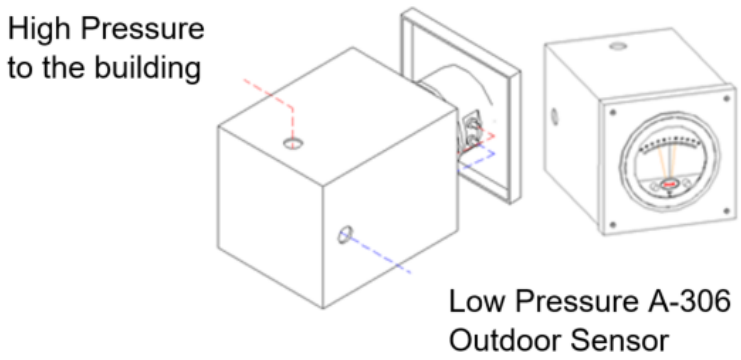
Static Pressure Controller Installation Instructions

Avoid locating the front of the static pressure controller in sun light or other areas with high ambient light or corrosive levels. Bright light shining on the photocells can cause false actuation of the load relays.

The static pressure controller should be zeroed out before attaching the low and high pressure hoses. The zero adjustment is located between the minimum and maximum dials.

Using the supplied rubber tubing the high side of the static pressure controller should be plumbed to the inside of the building. The low side of the static pressure controller should be plumbed to the A306 outdoor sensor. See the A306 installation instructions.

Figure 48 - Static Pressure Controller



A306 Outdoor Sensor

Use the installation instructions shipped with the A306 outdoor sensor.

Figure 49 - Exploded View

PART #	DESCRIPTION
1	(2) NO. 10-32 X 1/2" MACHINE SCREW
3	(4) NO. 10-32 NUT
4	(2) NO. 10-32 X 1 3/4" MACHINE SCREW
028	ANTENA CLAMP
029	MOUNTING BRACKET
163	PICK UP BODY
164	STATIC PRESSURE PLATES
165	"O" RING SEAL
168	HOLE PLUG
290	TUBING 50 FT

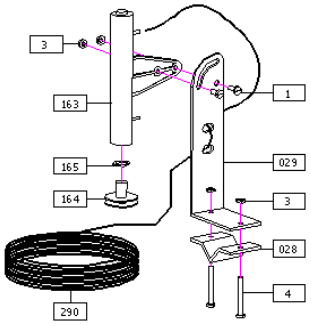
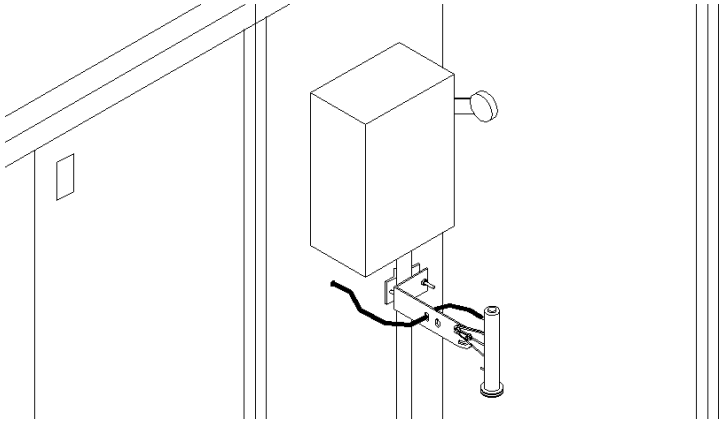


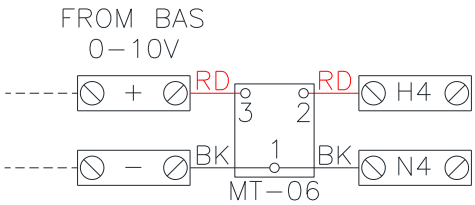
Figure 50 – Outdoor Sensor Installed



Building Signal Damper Control

When this option is ordered, the supply and return dampers will modulate based on a 0-10V DC signal from the Building Automation System.

Figure 51 – BAS Wiring

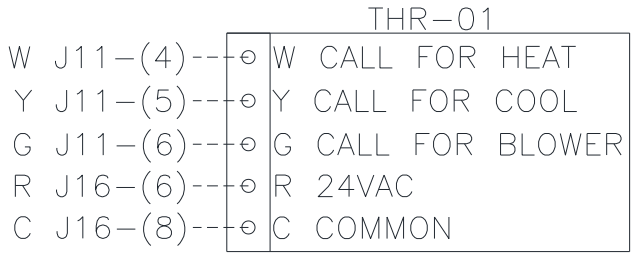


Programmable Thermostat

The programmable thermostat can be set off of the discharge sensor setpoint. This allows the unit to modulate for the programmed space setpoint. An example would be, if the discharge setpoint is set for 65°F, and the space calls for heat/cooling cycle, the unit will modulate to meet the discharge setpoint.

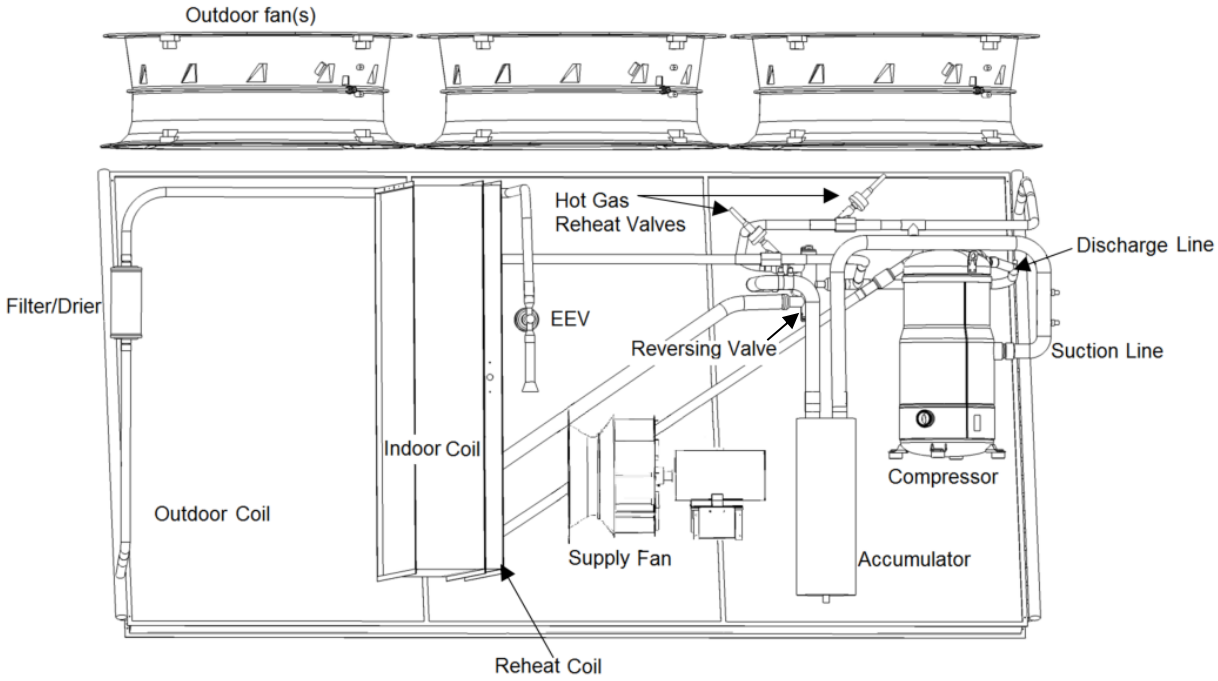
The thermostat can also work off of blower mode. This setting will look at the intake air temperature. The unit will modulate to avoid bringing in too hot or too cold of air into the space.

Figure 52 – Thermostat Wiring



Heating, Cooling, Defrost, and Reheat

Figure 53 – Heat Pump with Reheat Option



Note: Example shown is only one of many configurations

Air velocity should be maintained between 200 and 550 fpm through the indoor coil.

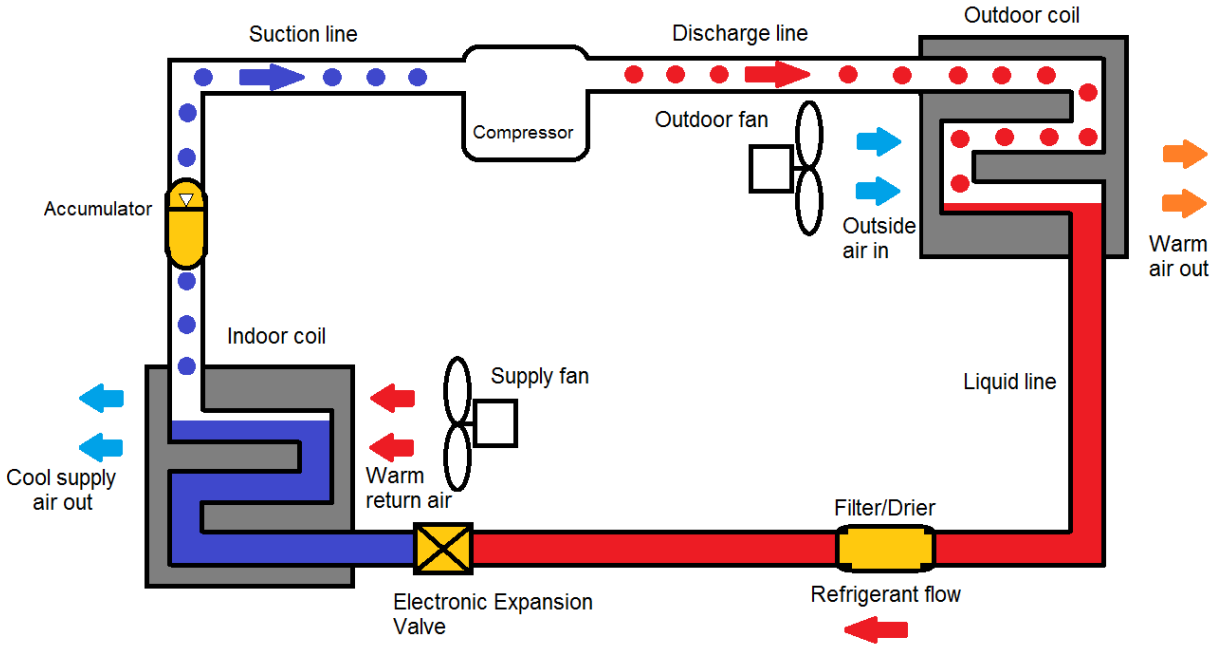
Heating cycle (heat pump)

- In heating mode, the outdoor coil acts as the evaporator coil. When the thermostat calls for a heating sequence, the reversing valve is automatically powered. The compressor and outdoor fan start. The heating system is now in operation. Once the thermostat is satisfied, the system will shut down.
- The compressor pumps out high-pressure refrigerant vapor. The vapor leaves the compressor, and then through the energized reversing valve.
- The refrigerant then flows through the indoor coil. Supply air removes heat from the refrigerant vapor, warming the indoor air and heating the building. When enough heat is removed, the vapor condenses into a high-pressure liquid. The liquid temperature is slightly warmer than indoor air temperature. The liquid refrigerant then passes through an Electronic Expansion Valve (EEV), reducing its pressure and temperature, then passes through a filter/drier. The filter/drier adsorbs water and filters system contaminants.
- As the cool, low pressure liquid refrigerant enters the outdoor coil, it expands and absorbs heat from the outdoor air passing over the finned surface. Heat from the outdoor air causes the low pressure liquid to evaporate into a cool vapor.
- The cold refrigerant vapor passes through the outdoor vapor line to the reversing valve. The reversing valve directs refrigerant into the accumulator. The accumulator holds a liquid refrigerant and oil mixture, and controls flow back to the compressor. The liquid refrigerant and oil mixture are metered back to the compressor through a small orifice near the bottom of the accumulator.
- The refrigerant vapor passes through the suction line to the intake of the compressor. The cycle then repeats.

Cooling cycle

- When the cooling sequence is initiated, the compressor and outdoor fan start. The cooling system is now in operation. Once the thermostat is satisfied, the system will shut down.
- The compressor pumps out high-pressure refrigerant vapor (discharge line). The vapor leaves the compressor. If the unit is a heat pump the vapor will pass through the de-energized reversing valve.
- The vapor flows through the discharge line to the outdoor coil. Air from the outdoor fan removes heat from the refrigerant vapor. When enough heat is removed, the vapor condenses into a high pressure liquid. The liquid temperature is slightly warmer than ambient air temperature. This warm, high-pressure liquid leaves the outdoor coil and flows through the copper refrigerant line. The liquid passes through a filter/drier. The filter/drier adsorbs water, and filters system contaminants.
- At the end of the line, the refrigerant passes through an Electronic Expansion Valve (EEV), reducing its pressure and temperature.
- As the liquid, under reduced pressure, enters the indoor coil, it expands and absorbs heat from the indoor air passing over the finned surface. Heat from the indoor air, causes the low-pressure liquid to evaporate, and cools the indoor air. The refrigerant is now a cool vapor.
- Some units may have an accumulator or a heat pump installed (not shown). Refrigerant vapor passes through the insulated vapor line. If the unit is a heat pump, a reversing valve will direct refrigerant into the accumulator. The accumulator controls liquid refrigerant and refrigerant oil flow back to the compressor. Refrigerant vapor passes through the suction line to the compressor. The cycle then repeats.

Figure 54 - Cooling Cycle



Note: An accumulator will be present in heat pump and certain cooling applications.

Defrost cycle (heat pump)

- In heating mode, the outdoor (condensing) coil acts as the evaporator coil. Moisture from the outside air condenses on the outside coil, and normally runs off. During the colder part of the heating season, this moisture freezes. This frozen moisture blocks air movement through the coil. A defrost cycle needs to be run to remove the frost.
- The defrost control detects the buildup of ice on the outdoor coil. The reversing valve will direct hot gas from the compressor to the outdoor coil. This starts the defrost process.
- The outdoor fan stops to prevent cold air being passed onto the outdoor coil while hot refrigerant is in the outdoor coil.
- When the defrost control has detected the ice has melted, the defrost mode will end. The reversing valve shifts to the heating position. Hot refrigerant gas is then sent to the indoor coil. The outdoor fan operates, and the unit is now in normal heating mode.

Reheat cycle (cooling only)

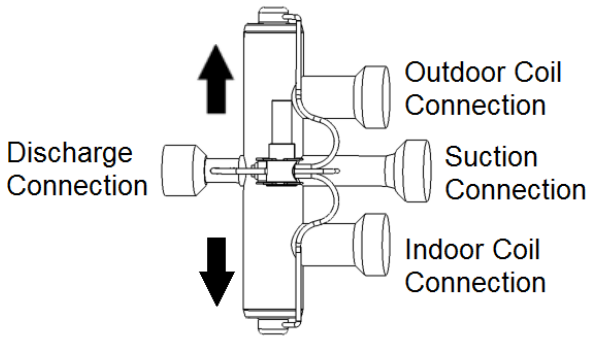
- During the reheat cycle, a portion of the hot gas from the compressor enters the reheat coil, and then is fed into the discharge line to the outdoor coil.
- The air is cooled and dehumidified as it flows across the indoor coil. It is then reheated by the reheat coil to lower the relative humidity.

Reversing valve for heating/cooling (heat pump)

When the unit is set up to run as a heat pump, the reversing valve is activated before the compressor starts. The reversing valve will de-energize if there is a call for cooling.

- When the internal valve is de-energized (down) the unit will be in cooling mode.
- When the internal valve is energized (up) the unit will be in heating mode.

Figure 55 – Reversing Valve



Economizer

Economizer Type

Economizer type sets the type of economizer logic that will be used. This feature will control the economizer using a **0-10V DC** signal output on the IBT board. The table below shows option selections and definitions.

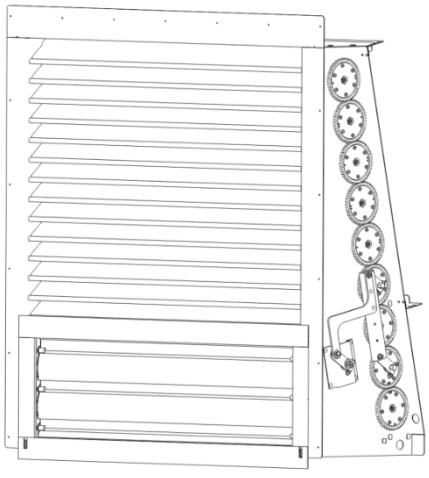
Use the HMI to select Economizer type. Go to Factory Settings > Unit Options > Outdoor Air Config > Economizer.

Option	Definition
Fixed Dry Bulb	The economizer will modulate open if the outdoor air temperature is less than the economizer temperature setpoint. The modulation occurs from the current damper position to fully open over a specific temperature range (determined by the economizer temperature band value).
Differential Dry Bulb	The economizer will modulate open if the outdoor air temperature is less than the return air temperature. The modulation occurs from the current damper position to fully open over a specific temperature range (determined by the economizer temperature band value).
Fixed Enthalpy	The economizer will modulate open if the outdoor air enthalpy is less than the economizer enthalpy setpoint, which is calculated from the economizer temperature and humidity setpoints. The modulation occurs from the current damper position to fully open over a specific enthalpy range (determined by the economizer enthalpy band value).
Differential Enthalpy	The economizer will modulate open if the outdoor air enthalpy is less than the return air enthalpy and the outdoor air temperature is less than the economizer temperature setpoint. The modulation occurs from the current damper position to fully open over a specific enthalpy range (determined by the economizer enthalpy band value).

Disable Cooling

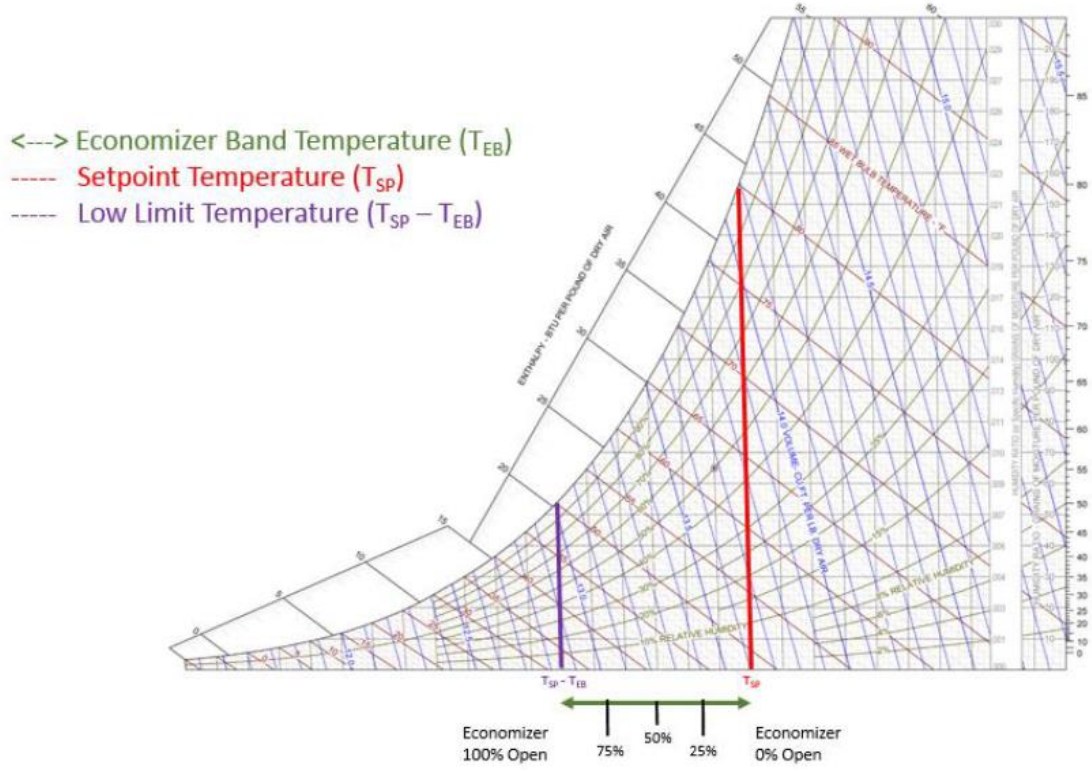
This allows the user to set the Outdoor Air (OA) percentage when the mechanical cooling will disable. View **Psychrometric Chart** (page 69) for economizer operation and logic.

Figure 56 – Damper Assembly

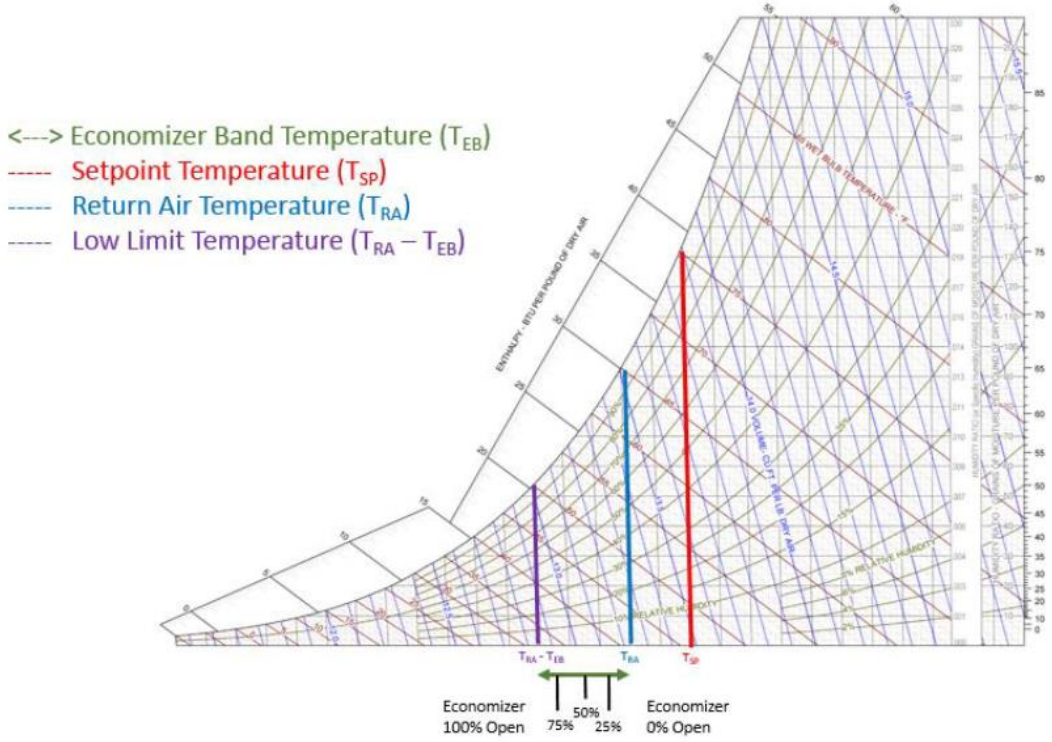


Psychrometric Chart

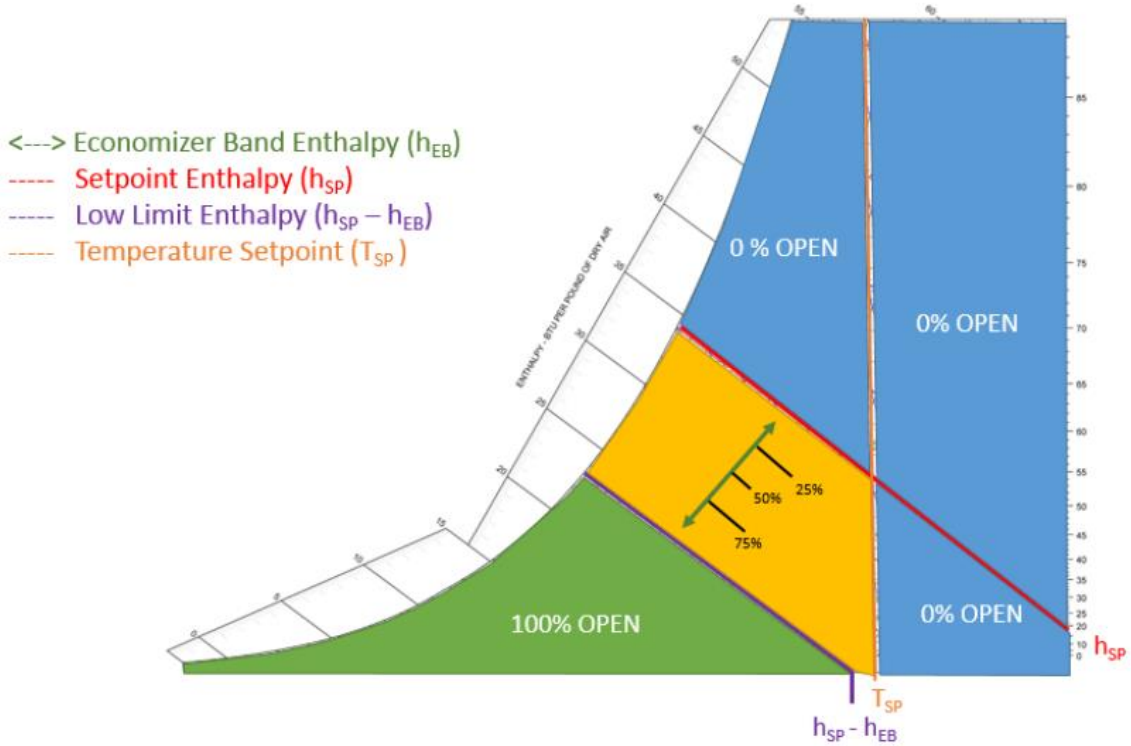
Fixed Dry Bulb Economizer



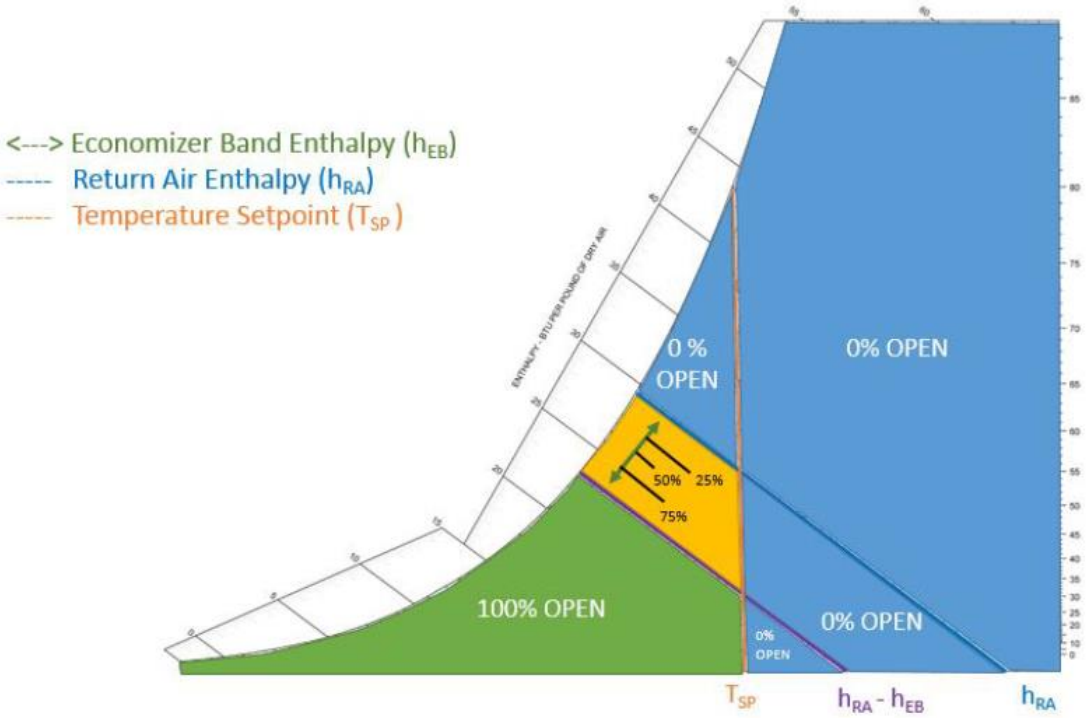
Differential Dry Bulb Economizer



Fixed Enthalpy Economizer



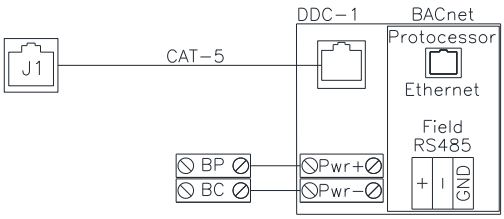
Differential Enthalpy Economizer



Network

Note: The board will reboot when altering factory settings.

Figure 57 – BACNET Wiring Reference



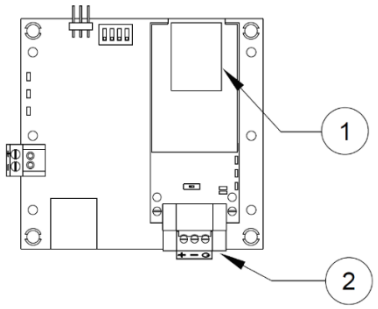
BACNET

BACNET IP or BACNET MS/TP 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 to the right.

The Protocessor is pre-configured 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.

1. Field Ethernet Connection for BACNET IP
2. Field RS485 Connection for BACNET MS/TP

Figure 58 – BACNET Connections



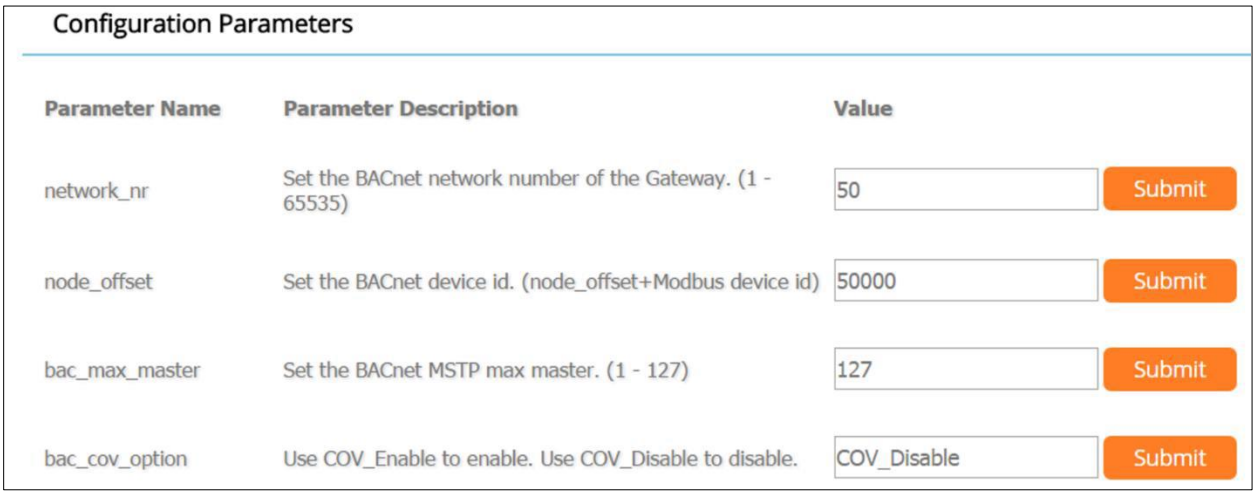
Changing Device Instance, MAC Address, Baud Rate

Some applications may require that the Protocessor have a specific Device Instance, the default device instance is 50,000. To change the Device Instance, you must access the Web Configurator by connecting a computer to the Ethernet port of the Protocessor. The computer used must be assigned a static IP address of 192.168.1.xxx and a subnet mask of 255.255.255.0.

To access the Web Configurator, type the IP address of the Protocessor in the URL of any web browser. The default IP address of the Protocessor is 192.168.1.24. The window shown in **Figure 59** should appear.

The MAC address and Baud Rate, used by BACNET MTSP, are editable. The MAC address default is 127 and the Baud Rate default is 38400.

Figure 59 - Configuration Parameters Page



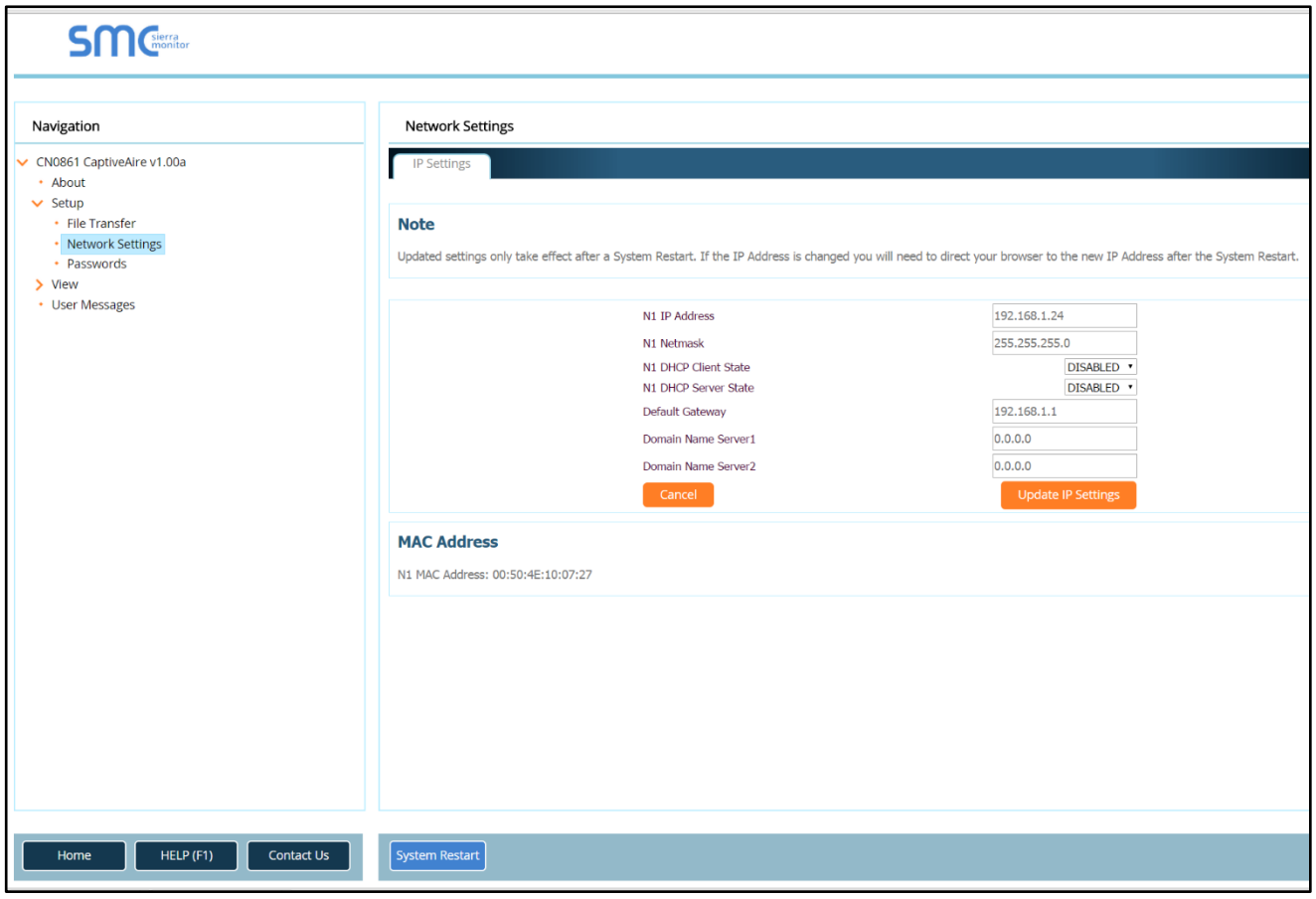
If any changes are made, **click on the submit button for each individual change.** Each individual change will require the system to restart.

Changing the IP Address

Some BACNET IP applications may require changing the IP address of the Protocessor. In order to change the IP address, go to the internal server by typing the default IP address of the Protocessor, 192.168.1.24, in the URL field of any web browser. The computer used must have a static IP address of 192.168.1.xxx. The window shown in **Figure 60** appears. Click on the “Diagnostics and Debugging” button on the lower right corner.

Click on “Setup” from the left hand side menu and select “Network Settings.” The window shown in **Figure 60** will appear. You can now modify the IP address to whatever is required in the application. Once the IP address has been modified, click on “Update IP Settings.”

Figure 60 – Network Settings Page

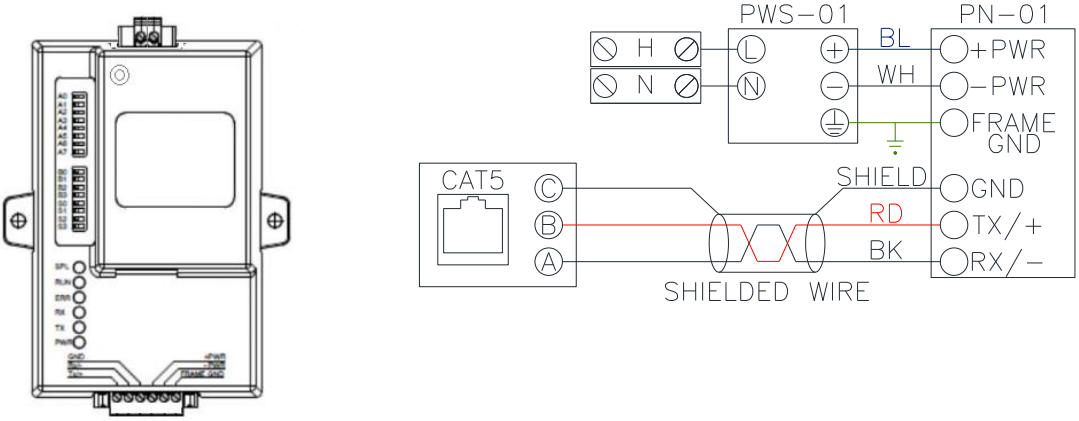


After you have updated the IP settings, you will be prompted to restart the system. You can do so by clicking on the “System Restart” button at the bottom of the screen. Any time after this, you will have to type the new IP address of the Protocessor on the URL to gain access to the Web Configurator.

LonWorks

LonWorks compatibility 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. Field connections to the Building Management System is shown.

Figure 61 – LonWorks Adapter and Wiring Reference



DDC Control Points

Full Control Points:

BACNET OBJECT NAME	BACNET OBJECT ID	BACNET DATA TYPE	LON SNVT NAME	SNVT TYPE	FUNCTION	DEFAULT	RANGE	DESCRIPTION
HeatCommand	1	Binary Value	nviHeat	SNVT_count	Monitor/Control	0	0-1	OFF(0) / ON(1)
CoolCommand	2	Binary Value	nviCool	SNVT_count	Monitor/Control	0	0-1	OFF(0) / ON(1)
FanCommand	3	Binary Value	nviBlower	SNVT_count	Monitor/Control	0	0-1	OFF(0) / ON(1)
AnalogHeatCool	4	Binary Value	nviModHeatCool	SNVT_count	Monitor/Control	0	0-1000	Analog Control Signal for Heating and Cooling

- 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 is to use space and/or intake temperatures along with unit setpoints.
- 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.

For factory settings and temperature set points BACNET and LON points are displayed on to the BMS as raw values. The BMS must scale these points when reading and/or writing based on the point description. For example, temperature sensor values must be divided by 10 after they are read. Likewise, when writing to a set point, the intended value must be multiplied by 10 before being sent to the controller.

Factory Settings:

BACNET OBJECT NAME	BACNET OBJECT ID	BACNET DATA TYPE	LON SNVT NAME	SNVT TYPE	FUNCTION	DEFAULT	RANGE	DESCRIPTION
VFDminFreqOccupied	5	Analog Value	nviVFDminFreqOc	SNVT_count	Monitor/Control	0	0-MaxVFDFreq	Freq(Hz)*10
VFDmaxFreqOccupied	6	Analog Value	nviVFDmaxFreqOc	SNVT_count	Monitor/Control	80	MinVFDFreq-800	Freq(Hz)*10
minOAOcc	7	Analog Value	nviminOAOcc	SNVT_count	Monitor/Control	0	0-Max Outdoor Air %	Minimum Percentage of Outdoor Air
maxOAOcc	8	Analog Value	nvimaxOAOcc	SNVT_count	Monitor/Control	100	Min Outdoor Air %-100	Maximum Percentage of Outdoor Air
minOAUnocc	9	Analog Value	nviminOAUnoc	SNVT_count	Monitor/Control	0%	0-Max %	Percentage of outdoor air
maxOAUnocc	10	Analog Value	nvimaxOAUnoc	SNVT_count	Monitor/Control	100%	Min-100%	Percentage of outdoor air
minSupplyPWMOcc	11	Analog Value	nviminSupPWMOc	SNVT_count	Monitor/Control	0	0-Max PWM	ECM Minimum Speed
maxSupplyPWMOcc	12	Analog Value	nvimaxSupPWMOc	SNVT_count	Monitor/Control	100	Min PWM-100	ECM Maximum Speed
AllowSchedule	13	Binary Value	nviAllowSched	SNVT_count	Monitor/Control	0	0-1	Disabled (0) / Enabled (1)
CoolLowTempThreshold	14	Analog Value	nviCoolLowTemp	SNVT_count	Monitor/Control	550°F 130°C	400-700°F 40-210°C	Temperature*10
VFDminFreqUnocc	15	Analog Value	nviVFDminFrqUnc	SNVT_count	Monitor/Control	30Hz	0-VFD Max	Freq (Hz) *10
VFDmaxFreqUnocc	16	Analog Value	nviVFDmaxFrqUnc	SNVT_count	Monitor/Control	60Hz	VFD Min-800	Freq (Hz) *10
minSupplyPWMUnocc	17	Analog Value	nviminSupPWMUnc	SNVT_count	Monitor/Control	0%	0-Max PWM	Motor speed %
maxSupplyPWMUnocc	18	Analog Value	nvimaxSupPWMUnc	SNVT_count	Monitor/Control	100%	Min PWM - 100	Motor speed %

- Writing to any of these registers will trigger a system reboot. 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.

Temperature Setpoints:

BACNET OBJECT NAME	BACNET OBJECT ID	BACNET DATA TYPE	LON SNVT NAME	SNVT TYPE	FUNCTION	DEFAULT	RANGE	DESCRIPTION
IntakeHeatOcc	19	Analog Value	nviIntakeHeatOc	SNVT_count	Monitor/Control	450°F 70°C	350-1100°F 20-430°C	Temperature*10
SpaceHeatOcc	20	Analog Value	nviSpaceHeatOc	SNVT_count	Monitor/Control	700°F 210°C	350-1100°F 20-430°C	Temperature*10
MinDischargeHeatOcc	21	Analog Value	nviminDisHeatOc	SNVT_count	Monitor/Control	800°F 260°C	400°F-DischHeatOccSP 40°C-DischHeatOccSP	Temperature*10
DischargeHeatOcc	22	Analog Value	nviDisHeatOc	SNVT_count	Monitor/Control	800°F 210°C	MinDischHeatSP- MaxDischHeatOccSP	Temperature*10
MaxDischargeHeatOcc	23	Analog Value	nvimaxDisHeatOc	SNVT_count	Monitor/Control	1200°F 490°C	DischHeatOccSP-1500°F DischHeatOccSP-660°C	Temperature*10
IntakeCoolOcc	24	Analog Value	nviIntakeCoolOc	SNVT_count	Monitor/Control	750°F 290°C	550-1200°F 130-500°C	Temperature*10
minDischargeCoolOcc	25	Analog Value	nviminDisCoolOc	SNVT_count	Monitor/Control	500°F 100°C	400°F-DischCooltOccSP 40°C-DischCoolOccSP	Temperature*10
DischargeCoolOcc	26	Analog Value	nviDisCoolOc	SNVT_count	Monitor/Control	550°F 120°C	MinDischCoolSP- MaxDischCoolOccSP	Temperature*10
maxDischargeCoolOcc	27	Analog Value	nvimaxDisCoolOc	SNVT_count	Monitor/Control	700°F 200°C	MinDischCoolSP-800°F MinDischCoolSP-260°C	Temperature*10
SpaceCoolOcc	28	Analog Value	nviSpaceCoolOc	SNVT_count	Monitor/Control	750°F 230°C	500-1200°F 100-320°C	Temperature*10
IntakeCoolRHOcc	29	Analog Value	nviInCoolRHOc	SNVT_count	Monitor/Control	50%	0-100%	Percentage
DischargeCoolRHOcc	30	Analog Value	nviDisCoolRHOc	SNVT_count	Monitor/Control	50%	0-100%	Percentage
SpaceCoolRHOcc	31	Analog Value	nviSpaceCoolRHOc	SNVT_count	Monitor/Control	60%	0-100%	Percentage
IntakeHeatUnocc	32	Analog Value	nviInHeatUnc	SNVT_count	Monitor/Control	450°F 70°C	350-1100°F 20-430°C	Temperature*10
SpaceHeatUnocc	33	Analog Value	nviSpaceHeatUnc	SNVT_count	Monitor/Control	700°F 210°C	350-1100°F 20-430°C	Temperature*10
MinDischargeHeatUnocc	34	Analog Value	nviMinDisHeatUnc	SNVT_count	Monitor/Control	800°F 260°C	400°F-DischHeatOccSP 40°C-DischHeatOccSP	Temperature*10
DischargeHeatUnocc	35	Analog Value	nviDisHeatUnc	SNVT_count	Monitor/Control	800°F 210°C	MinDischHeatSP- MaxDischHeatOccSP	Temperature*10
MaxDischargeHeatUnocc	36	Analog Value	nviMaxDisHeatUnc	SNVT_count	Monitor/Control	1200°F 490°C	DischHeatOccSP-1500°F DischHeatOccSP-660°C	Temperature*10
IntakeCoolUnocc	37	Analog Value	nviInCoolUnc	SNVT_count	Monitor/Control	750°F 290°C	550-1200°F 130-500°C	Temperature*10
minDischargeCoolUnocc	38	Analog Value	nviminDisCoolUnc	SNVT_count	Monitor/Control	500°F 100°C	400°F-DischCooltOccSP 40°C-DischCoolOccSP	Temperature*10
DischargeCoolUnocc	39	Analog Value	nviDisCoolUnc	SNVT_count	Monitor/Control	550°F 120°C	MinDischCoolSP- MaxDischCoolOccSP	Temperature*10
maxDischargeCoolUnocc	40	Analog Value	nvimaxDisCoolUnc	SNVT_count	Monitor/Control	700°F 200°C	MinDischCoolSP-800°F MinDischCoolSP-260°C	Temperature*10
SpaceCoolUnocc	41	Analog Value	nviSpaceCoolUnc	SNVT_count	Monitor/Control	750°F 230°C	500-1200°F 100-320°C	Temperature*10
IntakeCoolRHUnocc	42	Analog Value	nviInCoolRHUnc	SNVT_count	Monitor/Control	50%	0-100%	Percentage
DischargeCoolRHUnocc	43	Analog Value	nviDisCoolRHUnc	SNVT_count	Monitor/Control	50%	0-100%	Percentage
SpaceCoolRHUnocc	44	Analog Value	nviSpacCoolRHUnc	SNVT_count	Monitor/Control	60%	0-100%	Percentage
intakeFirestatSP	45	Analog Value	nviInFirestatSP	SNVT_count	Monitor/Control	1350°F 570°C	1000-3000°F 380-1490°C	Temperature*10
dischargeFirestatSP	46	Analog Value	nviDisFirestatSP	SNVT_count	Monitor/Control	2400°F 1160°C	1000-3000°F 380-1490°C	Temperature*10
cabHeatSP	47	Analog Value	nvicabHeatSP	SNVT_count	Monitor/Control	0°F -180°C	0-400°F (-180)-40°C	Temperature*10
freezestatSetpoint	48	Analog Value	nvifreezestatSP	SNVT_count	Monitor/Control	350°F 20°C	(-400)-750°F (-400)-24°C	Temperature*10
drainHeatSP	49	Analog Value	nvidrainHeatSP	SNVT_count	Monitor/Control	350°F 20°C	350-450°F 20-70°C	Temperature*10
roomOverrideSP	50	Analog Value	nviRmOverrideSP	SNVT_count	Monitor/Control	900°F 320°C	750-1500°F 210-660°C	Temperature*10
economizerBandSP	51	Analog Value	nvieconBandSP	SNVT_count	Monitor/Control	50°F 30°C	0-200°F 0-110°C	Temperature*10
economizerSP	52	Analog Value	nvieconomizerSP	SNVT_count	Monitor/Control	600°F 160°C	500-800°F 100-270°C	Temperature*10
econoEnthalpyBandSP	53	Analog Value	nvieconEntBandSP	SNVT_count	Monitor/Control	5 Btu/lb	0 - 10 Btu/lb	-
econoRelHumSP	54	Analog Value	nvieconoRelHumSP	SNVT_count	Monitor/Control	50%	0 - 90%	Percentage
overheatSP	55	Analog Value	nvioverheatSP	SNVT_count	Monitor/Control	800°F 270°C	600-1200°F 150-490°C	Temperature*10

- The preferred method for DDC control is through setpoint manipulation. Use the setpoints 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.

On-Board Scheduling:

BACNET OBJECT NAME	BACNET OBJECT ID	BACNET DATA TYPE	LON SNVT NAME	SNVT TYPE	FUNCTION	DEFAULT	RANGE	DESCRIPTION
MondayStartA	56	Analog Value	nviMondayStartA	SNVT_count	Monitor/Control	480	0 - A end, 1440	480 = 8AM
MondayEndA	57	Analog Value	nviMondayEndA	SNVT_count	Monitor/Control	1080	A start - B start, 1440	1080 = 6PM
TuesdayStartA	58	Analog Value	nviTuesStartA	SNVT_count	Monitor/Control	480	0 - A end, 1440	480 = 8AM
TuesdayEndA	59	Analog Value	nviTuesEndA	SNVT_count	Monitor/Control	1080	A start - B start, 1440	1080 = 6PM
WednesdayStartA	60	Analog Value	nviWedStartA	SNVT_count	Monitor/Control	480	0 - A end, 1440	480 = 8AM
WednesdayEndA	61	Analog Value	nviWedEndA	SNVT_count	Monitor/Control	1080	A start - B start, 1440	1080 = 6PM
ThursdayStartA	62	Analog Value	nviThursStartA	SNVT_count	Monitor/Control	480	0 - A end, 1440	480 = 8AM
ThursdayEndA	63	Analog Value	nviThursEndA	SNVT_count	Monitor/Control	1080	A start - B start, 1440	1080 = 6PM
FridayStartA	64	Analog Value	nviFridayStartA	SNVT_count	Monitor/Control	480	0 - A end, 1440	480 = 8AM
FridayEndA	65	Analog Value	nviFridayEndA	SNVT_count	Monitor/Control	1080	A start - B start, 1440	1080 = 6PM
SaturdayStartA	66	Analog Value	nviSaturdStartA	SNVT_count	Monitor/Control	1440	0 - A end, 1440	1440 is a special value meaning that there is no scheduling for that set.
SaturdayEndA	67	Analog Value	nviSaturdEndA	SNVT_count	Monitor/Control	1440	A start - B start, 1440	
SundayStartA	68	Analog Value	nviSundayStartA	SNVT_count	Monitor/Control	1440	0 - A end, 1440	
SundayEndA	69	Analog Value	nviSundayEndA	SNVT_count	Monitor/Control	1440	A start - B start, 1440	
MondayStartB	70	Analog Value	nviMondayStartB	SNVT_count	Monitor/Control	1440	A end - B end, 1440	
MondayEndB	71	Analog Value	nviMondayEndB	SNVT_count	Monitor/Control	1440	B start – 1439, 1440	
TuesdayStartAB	72	Analog Value	nviTuesStartAB	SNVT_count	Monitor/Control	1440	A end - B end, 1440	
TuesdayEndB	73	Analog Value	nviTuesEndB	SNVT_count	Monitor/Control	1440	B start – 1439, 1440	
WednesdayStartB	74	Analog Value	nviWedStartB	SNVT_count	Monitor/Control	1440	A end - B end, 1440	
WednesdayEndB	75	Analog Value	nviWedEndB	SNVT_count	Monitor/Control	1440	B start – 1439, 1440	
ThursdayStartB	76	Analog Value	nviThursStartB	SNVT_count	Monitor/Control	1440	A end - B end, 1440	
ThursdayEndB	77	Analog Value	nviThursEndB	SNVT_count	Monitor/Control	1440	B start – 1439, 1440	
FridayStartB	78	Analog Value	nviFridayStartB	SNVT_count	Monitor/Control	1440	A end - B end, 1440	
FridayEndB	79	Analog Value	nviFridayEndB	SNVT_count	Monitor/Control	1440	B start – 1439, 1440	
SaturdayStartB	80	Analog Value	nviSaturdStartB	SNVT_count	Monitor/Control	1440	A end - B end, 1440	
SaturdayEndB	81	Analog Value	nviSaturdEndB	SNVT_count	Monitor/Control	1440	B start – 1439, 1440	
SundayStartB	82	Analog Value	nviSundayStartB	SNVT_count	Monitor/Control	1440	A end - B end, 1440	
SundayEndB	83	Analog Value	nviSundayEndB	SNVT_count	Monitor/Control	1440	B start – 1439, 1440	

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.

- 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).

A Start	A End	B Start	B End	Time:
480	720	1020	1320	8am-12pm, 5pm – 10pm
480	720	1440	1440	8am-12pm, B is not used
1440	1440	1440	1440	No scheduling set

Runtime Settings and Indicators:

BACNET OBJECT NAME	BACNET OBJECT ID	BACNET DATA TYPE	LON SNVT NAME	SNVT TYPE	FUNCTION	DEFAULT	RANGE	DESCRIPTION
SupplyVFDFrequencyOcc	84	Analog Value	nviSupVFDFreqOc	SNVT_count	Monitor/Control	Set By Plant	VFD Min Freq-VFD Max Freq	Occupied VFD Hz*10
SupplyPWMOcc	85	Analog Value	nviSupPWMOc	SNVT_count	Monitor/Control	Set By Plant	Min PWM-Max PWM	Running PWM Rate
OApercentUnocc	86	Analog Value	nviOApercentUnc	SNVT_count	Monitor/Control	0	Min Outdoor Air %- Max Outdoor Air %	Percentage of Outdoor Air Unoccupied
OApercentOcc	87	Analog Value	nviOApercentOc	SNVT_count	Monitor/Control	100	Min Outdoor Air %- Max Outdoor Air %	Percentage of Outdoor Air Occupied
OutdoorAirVoltsOcc	88	Analog Value	nviOAVoltsOc	SNVT_count	Monitor/Control	0	0-1000	Volts*100
DDCOccupiedOverride	89	Binary Value	nviDDCOccOvrrd	SNVT_count	Monitor/Control	0	0-1	Override Off(0) – Override On(1)
SupplyVFDFrequencyUnocc	90	Analog Value	nviSupVFDFreqUnc	SNVT_count	Monitor/Control	Set By Plant	VFD Min Freq-VFD Max Freq	Unoccupied VFD Hz*10
SupplyPWMUnocc	91	Analog Value	nviSupPWMUnc	SNVT_count	Monitor/Control	Set By Plant	Min PWM-Max PWM	Unoccupied VFD Hz*10
OutdoorAirVoltsUnocc	92	Analog Value	nviOAVoltsUnc	SNVT_count	Monitor/Control	0	0-1000	Volts*100

Sensor Values and Alerts:

BACNET OBJECT NAME	BACNET OBJECT ID	BACNET DATA TYPE	LON SNVT NAME	SNVT TYPE	FUNCTION	DEFAULT	RANGE	DESCRIPTION
AlertCode1	93	Analog Input	nvoAlertCode1	SNVT_count	Monitor	-	0-126	See DDC Faults page 80
AlertCode2	94	Analog Input	nvoAlertCode2	SNVT_count	Monitor	-	0-126	See DDC Faults page 80
AlertCode3	95	Analog Input	nvoAlertCode3	SNVT_count	Monitor	-	0-126	See DDC Faults page 80
AlertCode4	96	Analog Input	nvoAlertCode4	SNVT_count	Monitor	-	0-126	See DDC Faults page 80
AlertCode5	97	Analog Input	nvoAlertCode5	SNVT_count	Monitor	-	0-126	See DDC Faults page 80
AlertCode6	98	Analog Input	nvoAlertCode6	SNVT_count	Monitor	-	0-126	See DDC Faults page 80
OutsideTemp	99	Analog Input	nvoOutsideTemp	SNVT_count	Monitor	-	(-64)-302°F (-53)-150°C	Temperature*10
ReturnTemp	100	Analog Input	nvoReturnTemp	SNVT_count	Monitor	-	(-64)-302°F (-53)-150°C	Temperature*10
DischargeTemp	101	Analog Input	nvoDischargeTemp	SNVT_count	Monitor	-	(-64)-302°F (-53)-150°C	Temperature*10
IntakeTemp	102	Analog Input	nvoIntakeTemp	SNVT_count	Monitor	-	(-64)-302°F (-53)-150°C	Temperature*10
SpaceTemp	103	Analog Input	nvoSpaceTemp	SNVT_count	Monitor	-	(-64)-302°F (-53)-150°C	Temperature*10
EvapCoilTemp	104	Analog Input	nvoEvapCoilTemp	SNVT_count	Monitor	-	-	Temperature*10
HMI1Temp	105	Analog Input	nvoHMI1Temp	SNVT_count	Monitor	-	(-40)-257°F (-40)-125°C	Temperature*10
HMI2Temp	106	Analog Input	nvoHMI2Temp	SNVT_count	Monitor	-	(-40)-257°F (-40)-125°C	Temperature*10
HMI3Temp	107	Analog Input	nvoHMI3Temp	SNVT_count	Monitor	-	(-40)-257°F (-40)-125°C	Temperature*10
HMI4Temp	108	Analog Input	nvoHMI4Temp	SNVT_count	Monitor	-	(-40)-257°F (-40)-125°C	Temperature*10
HMI5Temp	109	Analog Input	nvoHMI5Temp	SNVT_count	Monitor	-	(-40)-257°F (-40)-125°C	Temperature*10
IntakeHumiditySensor1	110	Analog Input	nvoInRHSensor1	SNVT_count	Monitor	-	-	0-100% *10
HumiditySensor2	111	Analog Input	nvoRHSensor2	SNVT_count	Monitor	-	-	0-100% *10
UnitStatus	112	Analog Input	nvoUnitStatus	SNVT_count	Monitor	-	0-6	See table notes
SupplyVFDFrequency	113	Analog Input	nvoSupVFDFreq	SNVT_count	Monitor	-	-	VFD Hz*10
SupplyVFDCurrent	114	Analog Input	nvoSupVFDCurrent	SNVT_count	Monitor	-	-	Amps*10
SupplyVFDPower	115	Analog Input	nvoSupVFDPower	SNVT_count	Monitor	-	-	kW*100
PWMtoCondenserFans	116	Analog Input	nvoPWMCond	SNVT_count	Monitor	-		0-100%
CompressorVFDCurrent	117	Analog Input	nvoCompCurrent	SNVT_count	Monitor	-		Amps*100
CompressorVFDPower	118	Analog Input	nvoCompPower	SNVT_count	Monitor	-		kW*100
CompressorVFDFrequency	119	Analog Input	nvoCompFreq	SNVT_count	Monitor	-		Hz*10
ModulatingGasOut1	120	Analog Input	nvoMGasOut1	SNVT_count	Monitor	-	-	Service Parameter Readings
OutdoorAirMode	121	Analog Input	nvoOAMode	SNVT_count	Monitor	-	-	See table notes
OutAirVoltsOut	122	Analog Input	nvoOAVoltsOut	SNVT_count	Monitor	-	-	Service Parameter Readings
ReheatVoltsOut	123	Analog Input	nvoReheatVoltOut	SNVT_count	Monitor	-	-	Service Parameter Readings
OccupancyStatus	124	Analog Input	nvoOccStatus	SNVT_count	Monitor	-	0-6	See table notes
SuperHeatValue	125	Analog Input	nvoSuperHeat	SNVT_count	Monitor	-	-	Temperature*10
SuctionPressure	126	Analog Input	nvoSuctionPress	SNVT_count	Monitor	-	-	Pressure*10
SuctionEvapTemp	127	Analog Input	nvoSuctionEvapT	SNVT_count	Monitor	-	-	Temperature*10
SuctionLineTemp	128	Analog Input	nvoSuctionLineT	SNVT_count	Monitor	-	-	Temperature*10
EEVPosition	129	Analog Input	nvoEEVPosition	SNVT_count	Monitor	-	0-1000	0-100%*10
HeatTemperingModeOcc	130	Analog Input	nvoHeatModeOc	SNVT_count	Monitor	-	-	Tempering Mode value to use for heating depending on occupied state.
ActivateBasedONOcc	131	Analog Input	nvoActivateONOc	SNVT_count	Monitor	-	-	Activated Based On value for occupied
CoolTemperingModeOcc	132	Analog Input	nvoCoolModeOc	SNVT_count	Monitor	-	See table notes below	Tempering Mode value to use for cooling depending on occupied state.
HeatTemperingModeUnocc	133	Analog Input	nvoHeatModeUnc	SNVT_count	Monitor	-	See table notes below	Tempering Mode value to use for heating depending on unoccupied state.
ActivateBasedONUnocc	134	Analog Input	nvoActivateONUnc	SNVT_count	Monitor	-	See table notes below	Activated Based On value for unoccupied
CoolTemperingModeUnocc	135	Analog Input	nvoCoolModeUnc	SNVT_count	Monitor	-	See table notes below	Tempering Mode value to use for cooling depending on unoccupied state.
BlowerModeOcc	136	Analog Input	nvoBlowerModeOc	SNVT_count	Monitor	-	See table notes below	Blower mode value based on occupied state
BlowerModeUnocc	137	Analog Input	nvoBlowerModeUnc	SNVT_count	Monitor	-	See table notes below	Blower mode value based on unoccupied state

- For Alert Codes 1-6 see DDC Faults (page 80).
- Unit Status: 0 = Idle, 1 = Heating, 2 = Cooling, 3 = Blower Only, 4-6 = Lockout
- OA Mode: 0 = Off, 1 = Manual, 2 = 2 Position, 3 = Schedule, 4 = Outside Air, 5 = 100% OA, 6 = Analog
- Occupancy Status: 0 = Unoccupied, 1 = Occupied by Schedule, 2 = Occupied by Hardware Input Override, 4 = Occupied by DDC Override, 8 = Occupied by HMI Override, 16 = Scheduling disabled (occupied set points are in effect)

Sensor Values and Alerts (continued)

- 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 = Discharge, 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 = Discharge, 1 = Space, 2 = BAS, 3 = DDC
- Blower Mode Occ: 0 = Interlock, 1= Auto, 2= ON
- Blower Mode Unocc: 0 = Interlock, 1= Auto, 2= ON

DDC Faults

Refer to Troubleshooting section starting on page 85 for more information.

Code	Description
0	No Fault
1	Fire
2	Smoke
3	Gas PS High
4	Gas PS Low
5	Exhaust Overload
6	Supply Overload
7	VFD571 IGBT Temp
8	VFD571 Output
9	VFD571 Ground
10	VFD571 Temp
11	VFD571 Flying Start
12	VFD571 High DC Bus
13	VFD571 Low DC Bus
14	VFD571 Overload
15	VFD571 OEM
16	VFD571 Illegal Setup
17	VFD571 Dynamic Break
18	VFD571 Phase Lost
19	VFD571 External
20	VFD571 Control
21	VFD571 Start
22	VFD571 Incompat Param Set
23	VFD571 EPM HW
24	VFD571 Internal 1
25	VFD571 Internal 2
26	VFD571 Internal 3
27	VFD571 Internal 4
28	VFD571 Internal 5
29	VFD571 Internal 6
30	VFD571 Internal 7
31	VFD571 Internal 8
32	VFD571 Personality
33	VFD571 Internal 10
34	VFD571 Remote Keypad Lost
35	VFD571 Assertion Level
36	VFD571 Internal 11
37	VFD571 Internal 12
38	VFD571 Internal 13
39	VFD571 Internal 14
40	VFD571 Comm Module
41	VFD571 Network
42	VFD571 Network 1
43	VFD571 Network 2

Code	Description
44	VFD571 Network 3
45	VFD571 Network 4
46	VFD571 Network 5
47	VFD571 Network 6
48	VFD571 Network 7
49	VFD571 Network 8
50	VFD571 Network 9
51	Return Sensor Missing
52	Return Sensor Broken
53	Outside Sensor Missing
54	Outside Sensor Broken
55	Intake Sensor Missing
56	Intake Sensor Broken
57	Discharge Sensor Missing
58	Discharge Sensor Broken
59	Coil Sensor Missing
60	Coil Sensor Broken
61	HMI Temp Sensor
62	RTC 1 Temp Sensor
63	N/A
64	No Supply Air Proving
65	FSC1 High Temp
66	FSC1 Rollout
67	FSC1 Vent Proving
68	Refridge PS Low
69	Refridge PS High
70	Refridge Discharge Temp
71	Oil Low
72	Envelope Cond Temp High
73	Envelope Cond Temp Low
74	Envelope Evap Temp High
75	Envelope Cond Temp Low
76	Envelope Angle
77	N/A
78	Max Head Pressure
79	Freezestat Lockout
80	Firestat Lockout
81	Overheat Lockout
82	Alarm1 Bit1
83	Alarm1 Bit2
84	Alarm1 Bit3
85	Alarm1 Bit4
86	Alarm1 Bit5
87	Alarm1 Bit6

Code	Description
88	Alarm1 Bit8
89	Alarm1 Bit9
90	Alarm1 Bit10
91	Alarm1 Bit11
92	Alarm1 Bit12
93	Alarm1 Bit13
94	Alarm1 Bit14
95	Alarm1 Bit17
96	Alarm1 Bit19
97	Alarm1 Bit20
98	Alarm1 Bit21
99	Alarm1 Bit23
100	Alarm1 Bit24
101	Alarm1 Bit29
102	Alarm1 Bit30
103	Alarm2 Bit10
104	Alarm2 Bit11
105	Alarm2 Bit25
106	Suction PS
107	Temp Sens
108	N/A
109	N/A
110	DX/Condensation Float Detect
111	Modbus Sysinfo Comm
112	Master ROM CRC
113	Clogged Filters
114	Superheat Ctrl Comm
115	Compressor Comm
116	Furnace Float Detect
117	Electric Heater Fault
118	Space RH Sensor
119	Intake RH Sensor
120	Discharge RH Sensor
121	HMI 1 Revision Wrong
122	HMI 2 Revision Wrong
123	HMI 3 Revision Wrong
124	HMI 4 Revision Wrong
125	HMI 5 Revision Wrong
126	Compressor VFD Off
127	Space Sensor Missing
128	Space Sensor Broken
129	Supply VFD Modbus Comm
130	HMI Modbus Comm
131	Min Low PS Limit

WARNING: Technicians must be certified by an EPA-approved training and certification program to service any HVAC equipment, regardless of the refrigerant.

SERVICE INFORMATION

Basic service

Note: Always wear gloves and eye protection when working with refrigerant.
Note: Purge lines before connecting to service ports.

Monitoring the A/C system using the HMI

The HMI is capable of monitoring the A/C temperature and pressure readings through the service function menu. Go to *SERVICE > INPUTS > REFRIDGE DIAG*

The Refridge Diag menu will display the following:

- Discharge Pressure (DSCHRG PS)
- Discharge Condensing Temperature (DCH CON TMP)
- Suction Pressure (SUCTION PS)
- Suction Saturation Temperature (SUC SAT TMP)
- Suction Line Temp (SUC LIN TMP)
- Superheat Temperature
- EEV Position Percentage
- Compressor Hertz
- PWM Rate Percentage
- Oil Voltage - Yes/No

Monitoring the A/C system with a Gauge Set

1. Close the high side hand valve (red) and low side hand valve (blue).
2. Connect the manifold service hoses:
   - Red service hose to the high side service port, see **Figure 62**.
   - Blue service hose to the low side service port, see **Figure 62**.
   - Make sure the yellow service hose is capped off if it is not connected to a refrigerant tank, recovery tank or vacuum pump.
3. Connect a standard pressure gauge set to the service port located on the leaving side of the outdoor coil, see **Figure 66**.
4. Start the system.
5. If the service hoses have a manual turn valve, open the valve. Monitor the following:
   - The low side and high side gauges.
   - The Superheat Controller (EV-1) reading should be 20°F.
6. Determine subcool using the Pressure Temperature Chart (page 95). Compressor must be running at 100% and condenser fan temperature must be 110°F. Subcool should be approximately 14-16°F. (**Note: subcool readings will vary based on ambient and condensing fan temperatures**).
7. Determining the readings:
   A. If the readings are correct, close the gauge set and shut down the system. See Removing manifold gauge set (page 83).
   B. If the readings are incorrect, follow the Troubleshooting Charts (page 85) to locate and repair the problem.

Recovering refrigerant from the system

1. Purge all hoses of non-condensables.
2. Connect the manifold service hoses:
   - Red service hose to the high side service port, see **Figure 62**.
   - Blue service hose to the low side service port, see **Figure 62**.
   - Connect the yellow service hose to the inlet port of the recovery machine, see **Figure 65**.
   - Connect a hose from the discharge port of the recovery machine to the recovery tank, see **Figure 65**.
3. Place the system in 'Evacuation Mode' and ensure the compressor does not run. Use the HMI Service > Test Menu > Evacuation Mode.
4. Open the connected valve on the recovery tank.
5. Turn the recovery unit on.
6. Open the low side and high side hand valves.
7. Monitor the gauge set until all refrigerant has been recovered and the system is under a proper vacuum.

Pressure Testing

When repairs have been completed, use dry nitrogen to verify there are no leaks in the system. Connect the dry nitrogen tank to the high and low service ports, ensuring the entire system will be pressurized. Pressurize the system to 350-400 PSI. Use soap bubbles or some other liquid leak solvent to check for leaks. Check the system for approximately 15 minutes.

- If there are leaks, evacuate the nitrogen from the system. Repair as necessary.
- If there are no leaks, evacuate the nitrogen from the system, see Evacuating the system.

Evacuating the system

1. Connect the manifold service hoses:
   - Red service hose to the high side service port, see **Figure 62**.
   - Blue service hose to the low side service port, see **Figure 62**.
   - Connect the yellow service hose to the vacuum pump, see **Figure 64.**
2. Connect a micron gauge to the service port located on the leaving side of the outdoor coil, see **Figure 66**.
3. Place the system in 'Evacuation Mode' and ensure the compressor does not run. Use the HMI Service > Test Menu > Evacuation Mode.
4. Open the high side hand valve (red) and low side hand valve (blue). Start the vacuum pump.
5. Pump the system down until the micron gauge reads 500 microns.
6. Close off the valve to the vacuum pump. Turn the pump off.
7. Monitor the micron gauge for twenty minutes. Make sure it does not rise above 1000 microns.
   A. If the reading goes above 1000 microns in less than twenty minutes, there is a leak or moisture in the system. Determine the issue and repair.
   B. If the reading stays below 1000 microns, close all valves on the manifold gauge set.
8. Charge the system. See Charging an empty system (page 83).

Note: To prevent trapping liquid refrigerant in the manifold gauge set be sure the gauge set is brought to suction pressure before disconnecting.

Charging an empty system

1. Connect the manifold service hoses:
   - Red service hose to the high side service port, see **Figure 62**.
   - Blue service hose to the low side service port, see **Figure 62**.
   - Connect the yellow hose to refrigerant source, see **Figure 63**.
2. Connect a temperature clamp near the service port located on the leaving side of the outdoor coil, see **Figure 66**.
3. Place the system in 'Evacuation Mode' and ensure the compressor does not run. Use the HMI Service > Test Menu > Evacuation Mode.
4. Open the valve on the refrigerant source.
5. Open the low side hand valve (blue) on the manifold set.
6. Prior to starting the compressor, add at least 50% of the charge on the label from the refrigerant cylinder to the system. Abort 'Evacuation Mode'.
7. Verify the unit is in an idle state (it should not be in cooling, heating, reheat, or blower only modes). Occupied scheduling must be disabled. Turn on the cooling system through the service test menu. Set the compressor to run at maximum speed (200Hz) and verify reheat voltage is set to 0V. Adjust condensing fans so that the condensing coil maintains a 110°F condensing temperature.
8. Continue charging the system until the following conditions are met:
   - Determine subcool using the Pressure Temperature Chart (page 95). Compressor must be running at 100% and condenser fan temperature must be 110°F. Subcool should be approximately 14-16°F. (**Note: subcool readings will vary based on ambient and condensing fan temperatures**).
   - The Superheat Controller (EV-1) reading should be 20°F.
9. Close the low side hand valve (blue). Monitor the gauge set, and determine the system is operating properly.

Charging system low on refrigerant

1. To add refrigerant with system running, open the low side hand valve (blue).
2. Start the unit. Verify the unit is in an idle state (it should not be in cooling, heating, reheat, or blower only modes). Occupied scheduling must be disabled. Turn on the cooling system through the service test menu. Set the compressor to run at maximum speed (200Hz) and verify reheat voltage is set to 0V. Adjust condensing fans so that the condensing coil maintains a 110°F condensing temperature.
3. Monitor the system until the following conditions are met:
   - Determine subcool using the Pressure Temperature Chart (page 95). Compressor must be running at 100% and condenser fan temperature must be 110°F. Subcool should be approximately 14-16°F. (**Note: subcool readings will vary based on ambient and condensing fan temperatures**).
   - The Superheat Controller (EV-1) reading should be 20°F.

Removing Manifold Gauge Set

1. Make sure the hand valves are closed.
2. Make sure the refrigerant source is closed / the vacuum pump is not running.
3. Disconnect the high side hose and low side hose from the service valve ports.
4. Install the service port caps. Tighten by hand.

Figure 62 – Connecting Gauges to Service Ports

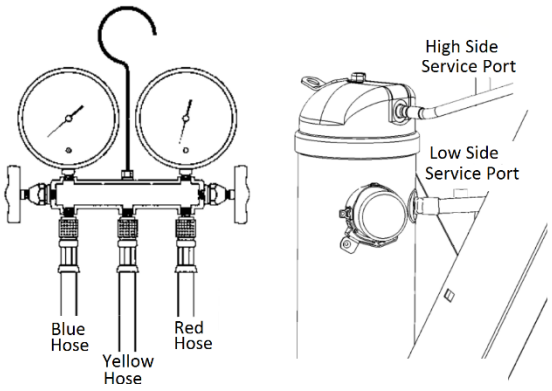


Figure 63 – Refrigerant Cylinder

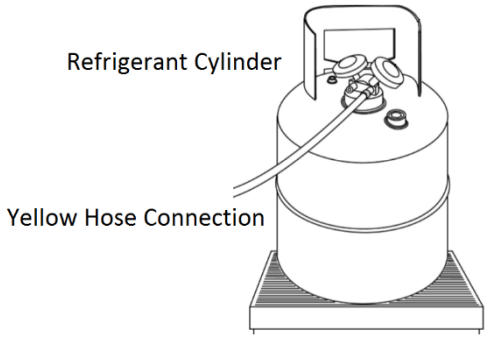


Figure 64 – Vacuum Pump

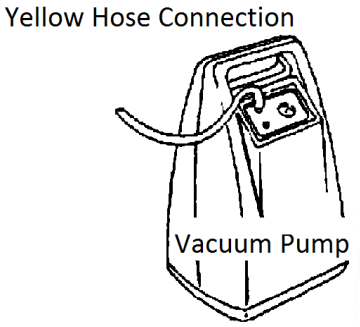


Figure 65 – Recovery Machine

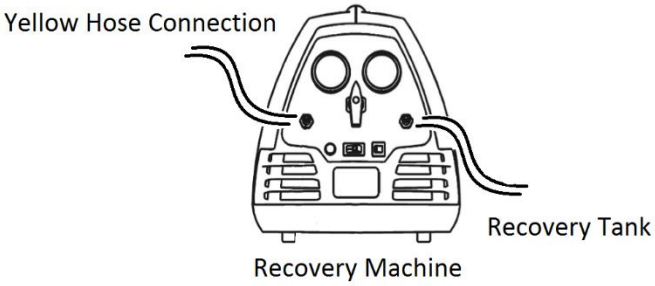
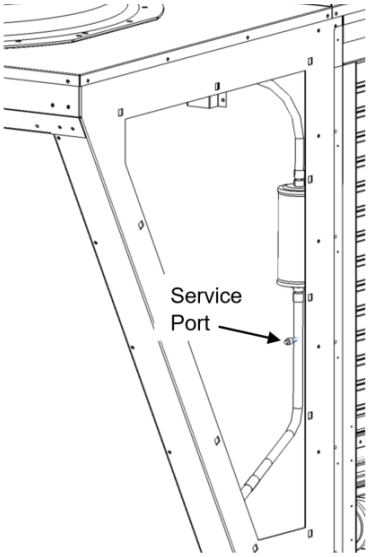


Figure 66 – Auxiliary Service Port



Troubleshooting

The following tables and information list possible causes and corrective actions for possible problems. Review this section prior to consulting technical support.

System Troubleshooting Chart

Problem	Potential Cause	Corrective Action
Unit will not start	Power failure	-Check voltage to the unit. -Check the disconnect switch. -Check the circuit breaker. -Check the hot, neutral, and ground wires.
Unit ON – HMI OFF	Power issue	-Check connector J13 is properly connected. -Check wiring to the HMI, and to connector J13. -Make sure the circuit breaker (CB-01) is turned ON.
System runs continuously – poor cooling/heating heat pump mode	Shortage of refrigerant	Test for leaks. Add refrigerant.
	Restricted discharge line	Repair or replace as needed.
	Dirty or clogged filters	Inspect filter. Clean or replace.
	Dirty indoor coil	Inspect coil. Clean the coil.
	Not enough air flow across indoor coil	Check blower speed, duct static pressure, filters.
	Compressor	Verify the compressor modulates from MIN to MAX frequency.
	Electronic Expansion Valve (EEV)	-Verify Superheat Controller (EV-1) “PoSn” reading is 0% when not in heating or cooling -Check the correct EEV is installed. -See Electronic Expansion Valve (EEV-1) (page 106)
System runs – blows cold air in heat pump mode	Compressor	Verify the compressor modulates from MIN to MAX frequency.
	Incorrect refrigerant charge	Check Superheat and Subcooling (page 95)
	Non-condensable in system	-Recover the charge, evacuate the system. -Recharge the system.
	Faulty reversing valve	Test the reversing valve.
	Defrost control	Test the defrost control.
System runs – blows cold air in gas heat mode	Gas supply issue	See Furnace Troubleshooting Chart (page 94)
	Faulty gas train components	
System runs – blows cold air in electric heat mode	Improper wiring	Check electrical wiring
	Electric disconnect switch	Check electric heater disconnect switch.
	Fuse in electric heater panel	Check fuses. Replace if needed.
	Air flow switch	See Air Flow Switch (page 96)

Fault Codes

Fault	Description	Corrective Action
Fire	There is an input from the fire detector.	-Check for short circuits in the wire. -Replace fire detector.
Smoke (optional)	There is an input from the smoke detector.	-Verify the smoke detector is set up properly. -Check for short circuits in the wire. -Replace smoke detector.
Gas PS High (optional)	The board is receiving an input on the gas pressure high terminal.	-Adjust regulator or add regulator. -Repair shorted wiring. -Replace switch. -See High Gas Pressure switch (page 101)
Gas PS Low (optional)	The board lost input on the Gas Pressure Low terminal. There should be an input when gas pressure is at the proper level.	-Low gas pressure switch. -Repair broken or loose wiring connections. -Replace switch. -See Low Gas Pressure switch (page 101)
Exhaust Overload	Motor overload has tripped.	-Check motor for debris or bad bearings. -Check motor wiring connections. -Check overload reset button. -Check wiring to the contactor. -Check overload amperage setting.
Supply Overload	Motor overload has tripped.	-Check motor for debris or bad bearings. -Check motor wiring connections. -Check overload reset button. -Check wiring to the contactor. -Check overload amperage setting.
Stat Missing (Return, Outside, Intake, Discharge, Space, Coil)	If the temperature sensor signal being sensed is too low, a missing fault will be active.	-Install, and wire sensor. -Check for faulty wiring, see Temperature Sensor (page 100)
Stat Broken (Return, Outside, Intake, Discharge, Space, Coil)	If the temperature sensor signal being sensed is too high, a broken fault will be active.	-Install, and wire sensor. -Check for faulty wiring, see Temperature Sensor (page 100)
Space HMI Missing	One of the HMIs in the system is not connected properly or one of the settings is not properly set.	-Verify that the “# of HMIs” is set correctly. -Verify there is no damage to the HMI(s). -Verify loose or damaged wiring to HMI(s). -If space temperature is being utilized, make sure “HMI Averaging” is set to ‘On’ for all space HMIs.
RTC 1 Temp Sensor	Real Time Clock (RTC) temperature sensor located on IBT board.	-Verify there is no damage to the IBT board, or wiring to the IBT board.
Air Flow	Signal was not received from air switch when supply blower was running.	-Make sure the supply fan runs. -Check air flow switch wiring. -Check supply fan rotation. See Start-up Procedure Cooling (page 53) -Check damper operation. -See Air Flow Switch (page 96)

Fault	Description	Corrective Action
FSC1 High Temp	The Flame Sensor Controller (FSC) continually and safely monitors, analyze, and controls the proper operation of the gas burner and inducer motor.	-Check connector J7 on the IBT board. Make sure the connection is secure. -High limit switch failed open. There should be continuity.
FSC1 Rollout	If flame-rollout is present, the switch de-energizes heater circuit on individual furnace. Must be manually reset by pressing small button on the switch.	-Check wiring to the switches. -Reset the switch. -Rollout switch failed open. There should be continuity. -Check for a blocked tube, low airflow, or low gas pressure.
FSC Vent Proving	The FSC verifies that airflow is sensed by the induced draft air sensor.	-Kinked/blocked/damaged hose. -Poor venting. -Blockage in vent system. -Check bleed hole in proving switch. -Clogged condensation drain. -Power vent motor. -Failed vent proving switch. -See Vent Proving switch (page 102)
Min Low Pressure Limit	The suction pressure for the compressor is below the minimum threshold in software.	-Follow possible checks for “Refrigerant low PS”.
Refrigerant Low PS	If the system is operating at a low pressure and temperature range, the system can become inoperable.	-Verify low pressure switch operation. -Low Refrigerant. Monitor the A/C system (page 81) -Possible leak. -Low or blocked air flow. -Plugged indoor (evaporator) coil. -Electronic Expansion Valve (EEV) issue.
Refrigerant High PS	If the system is operating at a high pressure and temperature range, the system can become inoperable.	-Verify high pressure switch operation. -Faulty condensing fan motor. -Outside coil plugged. -Inadequate airflow across coil. -Blockage in the system. Monitor the A/C system (page 81)
Refrigerant DSCHRG Temp (Heat Pump)	Discharge temperature is out of range.	-Follow possible checks for “Refrigerant High PS”.
Oil Sensor	The oil level sensor monitors the compressor’s internal oil level. See Compressor VZH 088/117/170	-Low oil level, if sight glass is available, check level. -Oil depositing itself in pipes. Increase compressor velocity for short periods of time. -Check Superheat and Subcooling (page 95) -Check oil level sensor wiring. -Check transformer TR-08. -Oil level sensor failure, see Oil Level Sensor (page 102)
Envelope Cond Temp High	Indoor and outdoor coil operating temperatures are too high.	-Follow possible checks for “Refrigerant High PS”. -See Superheat and Subcooling (page 95)
Envelope Cond Temp Low	Indoor and outdoor coil operating temperatures are too low.	-Follow possible checks for “Refrigerant Low PS”. -See Superheat and Subcooling (page 95)

Fault	Description	Corrective Action
Envelope Angle	Indoor and outdoor coil operating temperatures are out of range.	-Follow possible checks for “Refrigerant low PS” and “Refrigerant high PS”. -See Superheat and Subcooling (page 95)
Max Head Pressure	The max head pressure for the compressor is too high.	-Monitor the A/C system (page 81) -Check the air flow.
Freezestat lockout (optional)	The discharge temperature was too low for a long period of time.	-Check gas pressure. -Check for proper burner firing. -Use the HMI to reset.
Overheat Stat lockout (optional)	The discharge temperature was too high for a long period of time.	-Check cooling system. -Use the HMI to reset.
Firestat lockout (optional)	Intake or discharge temperatures exceeded the firestat setpoint.	-Use the HMI to reset. -Check for bad regulators, or modulating valves.
Suction PS	The Superheat Controller (EV-1) has detected a pressure sensor failure.	-Verify suction pressure transducer is operating correctly and wired properly.
Temp Sens	The Superheat Controller (EV-1) has detected a temperature sensor failure.	-Verify suction line temp sensor is operating correctly and wired properly. -Check EEV
DX/Condensation Float Detect	Input signal from the drain pan float switch.	-Make sure the pan drain is clear and water is draining. -Check for shorted wires. -Replace float switch.
Modbus System Communication	Software mismatch.	Verify P410 (Modbus Address) is 21 on VFD.
Master ROM CRC	Software mismatch.	Contact technical support.
Clogged Filters (optional)	Input from filter airflow switch.	-Clean or replace filters. -See Clogged Filter Switch (page 96)
Superheat Ctrl Comm	Communication Error.	-Check Modbus programming on EV-1. -Check wiring for EV-1 controller.
Compressor Comm	Communication Error.	-Check wiring from Compressor VFD to compressor.
Furnace Float	Input signal from the furnace condensation float switch is active.	-See Furnace Condensation Drain (page 12) -Verify pipe connections are not clogged. -Verify the pipes are draining. -Check for shorted wires. -Replace float switch.
Electric Heater Fault	Voltage input is lost while the electric heater is active.	-Check electric heater wiring to board connector J7 pin 10. -Verify all other wiring is connected properly. -Check Fuse(s).
RH Sensor (Space, Intake, Discharge)	One of the Relative Humidity (RH) sensors is not working.	See Humidity Temperature Sensor (page 99)
HMI “x” Revision Wrong	Software mismatch	Contact technical support to flash the appropriate software.
HMI Config Error	HMI is not connected or HMI is assigned incorrectly	Install HMI or change HMI address using bottom 2 buttons on HMI. See HMI Options Screen (page 37)
Compressor VFD Off	Compressor controller is set in the Off or Hand On position.	Verify that the compressor controller is set to the Auto On position.
DF Faults	DF faults are communicated from the compressor drive to the HMI.	See Compressor Drive VFD Troubleshooting Chart (page 89)

Compressor Drive VFD Troubleshooting Chart

For LCP and settings information see Compressor and Compressor Drive section (page 56)

Warning/Alarm	Description	Corrective Action
Earth Fault	There is current from the output phases to ground (earth) in the cables, or the motor.	-Check the cables from the converter to the compressor. -Check for continuity from the compressor terminals to ground There should be no continuity.
Control Word Timeout	There is no communication to the frequency converter. Only active if setting 8-04 is NOT set to [0] OFF.	-Verify wiring, and connections are correct. -Check cable connections to the converter. -Increase the Control Word Timeout time setting 8-03. -Check the communication components.
Over Current	This fault can be caused by shock loading, or quick acceleration with high inertia load.	-Make sure the unit is OFF. Verify the motor shaft can be turned. -Check the motor size matches the frequency converter. -Check parameters 1-20 to 1-25 for correct set up.
Torque Limit	The torque has exceeded the value in setting 4-16 or 4-17.	-Check for excessive current draw on the motor. -If the motor torque limit is exceeded during ramp up, extend ramp up time. -If the generator torque limit is exceeded during ramp down, extend ramp down time. -If torque limit occurs while running, increase the torque limit. Verify the system operation can operate safely at a higher torque.
Inverter Overload	The converter is about to cutout because of an overload. The thermal protection issues a warning at 98%, and an alarm at 100%. This converter cannot be reset until the counter is at 90%.	-Compare current output from LCP to the converter's rated current. -Compare the output shown from the LCP with measured motor current. -Verify the drive load on the LCP. Monitor the value. The counter will increase when running above the continuous current rating. The counter will decrease when running below the continuous current rating.
DC Under Volt	If the intermediate circuit voltage drops below the under voltage limit, the frequency converter checks if a **24V DC** backup supply is connected. If no **24V DC** backup supply is connected, the converter trips after a fixed time delay. The time delay varies with unit size.	-Check that the supply voltage matches the frequency converter voltage. -Perform input voltage test.

Warning/Alarm	Description	Corrective Action
DC Over Volt	If the intermediate circuit voltage exceeds the limit, the converter trips after a time.	-Connect a brake resistor. -Extend the ramp time. -Change the ramp type. -Activate the functions in 2-10 Brake Function. -Increase 14-26 Trip Delay at Inverter Fault. -If the alarm/warning occurs during a power sag the solution is to use kinetic back-up (14-10 Mains Failure).
Short Circuit	There is short-circuiting in the motor or motor wiring.	Remove power to the frequency converter and repair the short circuit.
Mains Phase Loss	A phase is missing on the supply side, or the mains voltage imbalance is too high. This message also appears for a fault in the input rectifier on the frequency converter. Options are programmed at parameter 14-12.	-Check the supply voltage and supply currents to the frequency converter. -See Compressor drive check (page 98)
U Phase Loss	The “U” output terminal signal is lost.	See Compressor drive check (page 98)
V Phase Loss	The “V” output terminal signal is lost.	See Compressor drive check (page 98)
W Phase Loss	The “W” output terminal signal is lost.	See Compressor drive check (page 98)
24V Supply Low	The **24V DC** is measured on the control card. The external **24V DC** backup power supply may be overloaded	-Check wiring. -Check backup supply.
Mains Fail	This warning/alarm is only active if the supply voltage to the frequency converter is lost and parameter 14-10 is NOT set to [0] No Function.	Check the fuses to the frequency converter and mains power supply to the unit.
Safe Stop	Loss of the **24V DC** signal on terminal 37 has caused the filter to trip.	Apply **24V DC** to terminal 37 and reset the filter.
Start Fail	The speed has not been able to exceed parameter 1-77 during start within the allowed time.	Motor may be locked.
Speed Limit	When the speed is not within the specified range in parameters 4-11 and 4-13, the converter shows a warning. When the speed is below the specified limit in parameter 1-86 (except when starting or stopping) the frequency converter will trip.	This alarm is reset automatically, and the compressor restarts automatically.
Current Limit	The current is higher than the value in 4-18 Current Limit. Ensure that the motor data in parameters 1-20 to 1-25 are set correctly. Possibly increase the current limit. Be sure that the system can operate safely at a higher limit.	-Make sure that motor data in parameters 1-20 to 1-25 are set correctly. -Possibly increase the current limit. Be sure that the system can operate safely at a higher limit.

Compressor Troubleshooting Chart

Problem	Potential Cause	Corrective Action
Compressor will not start	Shorted or broken wires	Use a multi-meter to check the compressor wiring harness for an open or short circuit.
	Locked rotor	Check continuity of the compressor. Replace if failed.
	Low voltage	Test voltage.
	Internal failure	If no other failure is present, there is an internal failure. Replace the compressor.
Compressor runs intermittently	Shorted or broken wires	Check the compressor wiring harness for an open or short circuit.
	Loose connections	Secure connections.
	Shorted or grounded compressor	Check for continuity from the compressor terminals to ground. There should be no continuity.
	Overcharge of refrigerant	Recover part of the refrigerant.
	Dirty outdoor coil	Clean the outdoor coil.
	Incorrect thermostat location	Relocate thermostat.
	Electronic Expansion Valve (EEV)	Verify the correct expansion valve is installed.
	Hot Gas Reheat Valve / Reheat controller	See Hot Gas Reheat Valve / Reheat Controller (page 106)
	Faulty reversing valve	Test the reversing valve.
	Defrost control	Test the defrost control.
Compressor cycles on overload	Shortage of refrigerant	Test for leak. Recharge.
	Restricted discharge line	Repair or replace as needed.
	Non-condensables in system	Recover the charge, evacuate the system. Recharge the system.
	Recirculation of condensing air	Remove air flow obstruction.
	Electronic Expansion Valve (EEV)	Make sure the expansion valve is operating properly.
Compressor making abnormal noise.	Overcharge of refrigerant	Recover part of the refrigerant.
	Loose hardware	Tighten the mounting bolts.
	Internal failure	If no other failure is present, replace the compressor.
	Liquid in compressor head	Check Superheat Setting (page 95) and EEV position
Low suction pressure	Low charge	Check Superheat and Subcooling (page 95)
	Restricted discharge line, drier, or reversing valve	Repair as needed.
Low discharge pressure	Low charge	Check Superheat and Subcooling (page 95)
	Restricted discharge line, drier, or reversing valve, hot gas reheat valve	Repair as needed.
Compressor oil issues	Low oil	-If sight glass is available, check oil level. Add oil. -If there is an oil level sensor. See Oil Level Sensor (page 102)
	Imbalance of refrigerant	Check Superheat and Subcooling (page 95)
	Compressor running too slow for a long period of time	Adjust compressor speed.

Superheat Controller Troubleshooting

Problem	Potential Cause
Will not power up	-Wiring terminal for power at transformer and controller. -Supply voltage.
Superheat below setpoint	-Pressure transducer range (correct transducer set up in controller; 0-300 or 0-500) -Pressure transducer type. -Temperature sensor type (correct sensor set up, 2K or 3K) -Temperature sensor wiring (make sure wiring is correct) -Foam insulation on pipe and sensor.
Superheat above setpoint	-Liquid condition entering expansion valve. -Pressure transducer range (correct transducer set up in controller; 0-300 or 0-500) -Temperature sensor type (correct sensor set up in controller; 2K or 3K. -Electronic Expansion Valve (EEV) (correct valve set up in controller; 1596, 2500 steps, etc.) -EEV sizing (if EEV position in controller is at 100% when symptom exists, the EEV may be undersized) -Heat exchanger sizing. -Improper system refrigerant charge. -Oil return (oil logging in heat exchanger) -Liquid line filter (clogging or excessive pressure drop) -Hot Gas Reheat Valve / Reheat Controller.
No Superheat	-Wiring terminals (power) at transformer and controller. -Improper system refrigerant charge. -Pressure transducer range (correct transducer set up in controller; 0-300 or 0-500, etc.) -Pressure transducer type (correct transducer set up in controller; gauge/sealed vs absolute) -Temperature sensor type (correct sensor set up in controller; 2K or 3K -Temperature sensor wiring (make sure sensor locations are not mismatched) -Foam insulation on piping and sensors.
Superheat unstable	-Wiring terminals (power) at transformer and controller. -Wiring terminals (sensors) at controller. -Sensor locations. -Sensor operation. -Proper heat exchanger flow direction. -Stability of head pressure control valves (upstream of EEV) -Stability of suction pressure control valves (downstream of EEV) -Stability of rack controller (verify compressors are not short cycling)
No Communication	-Wiring at controller and master communication board. -Addresses of controllers.
Communication errors	-Wiring terminals at controller and master communication board. -Proper network wire grounding. -Termination resistors. -Network parameters in controller and master communication board. -Third-party controllers on Control network.
Setpoints not saved	-ESC must be set within 60 seconds of changes being made.
PSAL – Pressure sensor failure alarm	Pump-down (open terminals 19 & 20) and close EEV.
tSAL - Suction temp sensor failure alarm	Pump-down (open terminals 19 & 20) and close EEV.
LSHA – Low superheat alarm	If superheat is 2 degree or less, EEV will close more aggressively.
HSHA – High superheat alarm	No system response.

Airflow Troubleshooting Chart

Problem	Potential Cause	Corrective Action
Fan Inoperative	Blown fuse or open circuit breaker	Replace fuse or reset circuit breaker and check amps.
	Disconnect switch in “Off” position	Turn to “On” position.
	Door switch	-Verify door is closed properly. -Check door switch wiring and switch.
	Motor wired incorrectly	Check motor wiring to wiring diagram located on fan motor.
	Motor starter overloaded	Reset starter and check amps.
	HMI set to “Blower Off”	Set HMI to “Blower On”.
Motor Overload	Fan rotating in the wrong direction	Be sure fan is rotating in the direction shown on rotation label.
	Fan speed is too high	Reduce fan RPM.
	Motor wired incorrectly	-Check motor wiring to wiring diagram located on fan motor. -Check the fan wiring. -Check fan rotation using the HMI.
	Overload in starter set too low	Set overload to motor FLA value.
	Motor HP too low	Determine if HP is sufficient for job.
	Duct static pressure lower than design	Reduce fan RPM.
Insufficient Airflow	Fan rotating in the wrong direction	-Be sure fan is rotating in the direction shown on rotation label. -Check the fan wiring. -Check fan rotation using the HMI.
	Poor outlet conditions	There should be a straight clear duct at the outlet.
	Intake damper not fully open	Inspect damper linkage and replace damper motor if needed.
	Duct static pressure higher than design	Improve ductwork to eliminate or reduce duct losses.
	Fan speed too low	Increase fan RPM. Do not overload motor.
	Indoor coil dirty or frozen	Clean Indoor Coil and filters.
	Supply grills or registers closed	Open and adjust.
	Dirty or clogged filters	Clean and/or replace.
Excessive Airflow	Fan speed to high	Reduce fan RPM.
	Filters not installed	Install filters.
	Duct static pressure lower than design	Reduce fan RPM.
Excessive Vibration and Noise	Fan speed is too high	Reduce fan RPM.
	Damaged or unbalanced wheel	Replace wheel.
	Fan is operating in the unstable region of the fan curve	Refer to performance curve for fan.
	Bearings need lubrication or replacement	Lubricate or replace.

Furnace Troubleshooting Chart

Problem	Potential Cause	Corrective Action
Furnace Does Not Light/Stay Lit	Main gas is off	Open main gas valve.
	Air in gas line	Purge gas line.
	Dirt in burner orifices	Clean orifices with compressed air.
	Gas pressure out of range	Adjust to proper gas pressure.
	ON/OFF gas valve is off	Turn ON/OFF gas valve on.
	Spark igniter rod out of position	Relocate spark igniter rod to proper area.
	Excessive drafts	Re-direct draft away from unit.
	Safety device has cut power	Check limits. Check Air flow switch (page 96)
	Dirty flame sensor	Clean flame sensor.
	Thermostat not calling for heat	Change heating set-points to call for heat.
	No spark at igniter	See Flame Safety Control check (page 104)
	Defective valve	See Gas valve / Modulating gas valve check (page 103)
	Loose valve wiring	See Gas valve / Modulating gas valve check (page 103)
	Defective flame sensor	Replace flame sensor.
	Shut off valve closed	Open shut off valve.
	Defective flame safety controller	See Flame Safety Control check (page 104)
	Unit cycling on high limit	Increase airflow through furnace. Check gas pressure.
Not Enough Heat	Main gas pressure too low	Increase main gas pressure – do not exceed **14 in. w.c**. inlet pressure.
	Unit locked into low fire	Check wring or modulating valve settings. See High-fire and Low-fire burner adjustment (page 54)
	Too much airflow	Decrease airflow if possible.
	Furnace undersized	Check design conditions.
	Gas controls not wired properly	See Gas valve / Modulating gas valve check (page 103)
	Thermostat setting too low	Increase thermostat setting.
	Thermostat malfunction	Check thermostat.
Too Much Heat	Defective modulating gas valve	Check/replace modulating valve.
	Thermostat setting too high	Decrease thermostat setting.
	Unit locked into high fire	Check modulation valve settings. See High-fire and Low-fire burner adjustment (page 54)
	Thermostat wired incorrectly	Check thermostat wiring.
	Too much primary air	Reduce primary air.
	Manifold pressure set too high	Reduce manifold pressure.
Lifting Flames or Flashback	Dirty orifice	Check and clean orifice.
	Orifice too large	Check orifice size.
	Insufficient primary air	Increase primary air.
Yellow Tipping Flames	Misaligned orifice	Check manifold alignment.
	Insufficient primary air	Increase primary air.
	Orifice too large	Check orifice size.
Floating Flames or Flame Rollout	Manifold pressure too high	Decrease manifold pressure.
	Blocked vent	Check venting system.
	Misaligned orifice	Check manifold alignment.

Superheat and Subcooling

Table 14 - R410A Pressure Temperature Chart

Temperature (°F)	Refrigerant Pressure	Temperature (°F)	Refrigerant Pressure
-45	7.7	55	156.6
-40	10.8	60	170.7
-35	14.1	65	185.8
-30	17.8	70	201.8
-25	21.9	75	218.7
-20	26.3	80	236.5
-15	31.2	85	255.4
-10	36.5	90	275.4
-5	42.2	95	296.4
0	48.2	100	318.6
5	55	105	341.9
10	62.3	110	366.4
15	70.2	115	392.3
20	78.7	120	419.4
25	87.8	125	447.9
30	97.5	130	447.9
35	107.9	135	509.4
40	118.9	140	542.5
45	130.7	145	577.3
50	143.3	150	613.9

When determining superheat, convert the low side pressure gauge (suction line) to the appropriate temperature. Subtract the converted temperature from the suction line surface temperature. There should be approximately a **20°F** difference. Superheat monitors what state the refrigerant is when it leaves the evaporator coil. High superheat indicates the refrigerant has picked up more heat than designed. Low superheat indicates the refrigerant has not picked up enough heat, and can cause flooding in the compressor. If superheat is incorrect, verify subcool first before making changes to the system.

When determining subcool, convert the high side pressure gauge (condensing coil liquid line) to the appropriate temperature. Subtract the converted temperature from the liquid line surface temperature. There should be approximately a **14-16°F** difference. Subcooling monitors what state the refrigerant is when it leaves the condensing coil. High subcooling means the condenser is flooded. Low subcooling means the condenser is starving.

- If the superheat is high and the subcool is low under normal operating conditions, the system may be low on charge. Determine the cause of low refrigerant, and repair as necessary. See Charging system low on refrigerant (page 83).
- If the superheat is low and the subcool is high under normal operating conditions, the system may be overcharged. See Recovering refrigerant from the system (page 82).
- If the superheat is high and the subcool is high under normal operating conditions, there could be a blockage in the coil, or line set.

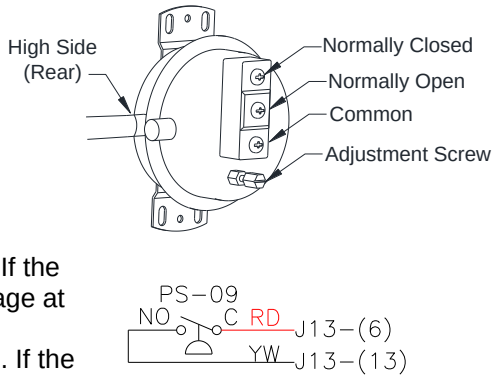
Note: Ambient temperatures may affect subcooling.

Component Check/Testing

Air flow switch (PS-09)

1. Verify the vent tube is connected to the high side port for standard supply fans. Verify the vent tube is connected to the low side port for high efficiency supply fans. When the supply fan starts, the pressure will close the switch and allow the supply fan to run. A fault will occur if the switch does not close.
2. If the “Air Flow” fault is active:
   - Check the rotation of the supply fan.
   - Verify the electrical connections are secure and tight. Verify vent tube is not pinched or damaged.
   - When the unit is powered ON and the supply fan is running:
     There should be **24-28V AC** at connector J13 pin 6 to ground. If the voltage reading is incorrect, check the wiring harness and voltage at the circuit board.
     There should be **24-28V AC** at connector J13 pin 13 to ground. If the voltage reading is incorrect, check the adjustment of the switch.

Figure 67 - Air Flow Switch and Wiring Reference



Air Flow Switch Field Adjustment

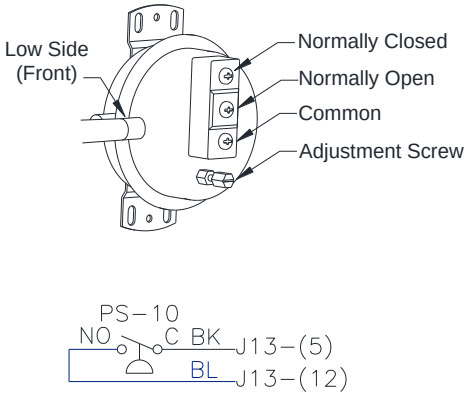
Follow these steps if performing a part replacement, or to calibrate the switch.

- Install the switch. Install the vent tube to the correct port.
- Install the electrical connections. Power the unit ON. Monitor the HMI screen.
- Turn the adjustment screw counter-clockwise until the screw can no longer turn. Turn the adjustment screw clockwise in one turn increments (waiting 3 seconds per adjustment) until the “Air Flow” fault is active. Turn the adjustment screw two full turns counter-clockwise.

Clogged filter switch (PS-10)

1. The vent tube should be connected to the low side port. A fault will occur when the switch senses a negative pressure.
2. If the “Clogged Filters” fault is active:
   - Check the filters. If the filters are clogged or damaged, replace as needed. Check for any other obstructions in the unit.
   - Verify the electrical connections are secure and tight. Verify vent tube is not pinched or damaged.
   - When the unit is powered ON:
     There should be **24-28V AC** at connector J13 pin 5 to ground. If the voltage reading is incorrect, check the wiring harness and voltage at the circuit board.
     There should be **0V AC** at connector J13 pin 12 to ground. If there is voltage at pin 12, check the adjustment of the switch.

Figure 68 - Clogged Filter Switch and Wiring Reference



Clogged Filter Switch Field Adjustment

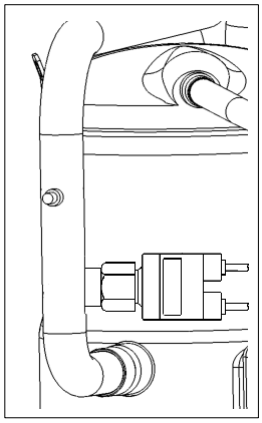
Follow these steps if performing a part replacement, or to calibrate the switch.

- Install the switch. Install the vent tube on the low side port.
- Install the electrical connections. Power the unit ON. Set dampers to 100% open for outdoor air. Monitor the HMI screen.
- Use a screwdriver to turn the adjustment screw clockwise until it is completely seated in the switch. Use material suitable to block 50-75% of the intake from the outside of the unit.
- Turn the adjustment screw counter-clockwise in one turn increments (waiting 3 seconds per adjustment) until the “Clogged Filters” fault is active. Turn the adjustment screw a 1/4 to 1/2 turn clockwise until the fault is no longer active.

Low refrigeration pressure switch (LP-01)

1. For the low pressure switch, insert a back probe tool at connector J8 pin 12 and J8 pin 14. Power the unit ON. Check for voltage at the following pins:
   - J8 pin 12 to ground. There should be **24-28V AC**.
   - J8 pin 14 to ground. There should be **24-28V AC**.
     A. If the voltage is incorrect, continue to the next step.
     B. If the voltage is correct, the system may need to be charged. Monitor the A/C system (page 81).
2. Check the electrical circuit. Power the unit OFF. Check for continuity in the wiring harness.
   - J8 pin 12 to J8 pin 14. There should be continuity.
   - J8 pin 12 to ground. There should be no continuity.
   - J8 pin 14 to ground. There should be no continuity.
     A. If any of the continuity readings are incorrect, verify the wiring is not damaged. If no damage is found, replace the low pressure switch.
     B. If all of the continuity readings are correct, there may be an issue with transformer (TR-03).

Figure 69 - Low Refrigeration Pressure Switch and Wiring Reference

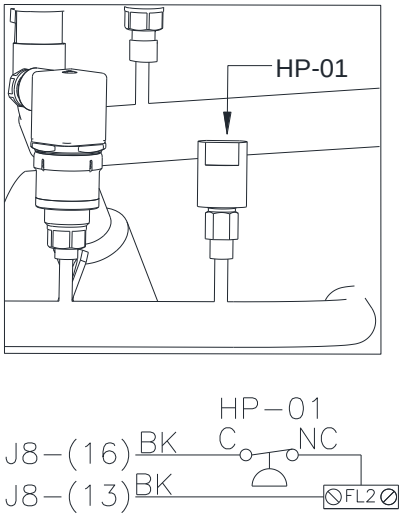


High refrigeration pressure switch (HP-01)

1. If a high pressure switch failure occurred, manually reset the switch.
2. For the high pressure switch insert a back probe tool at connector J8 pin 13 and J8 pin 16. Power the unit ON. Check for voltage at the following pins:
   - J8 pin 13 to ground. There should be **24-28V AC**.
   - J8 pin 16 to ground. There should be **24-28V AC**.
     A. If the voltage is incorrect, continue to the next step.
     B. If the voltage is correct, the system may be overcharged. Monitor the A/C system (page 81).
3. Check the electrical circuit. Power the unit OFF. Check for continuity in the wiring harness.
   - J8 pin 13 to J8-pin 16. There should be continuity.
   - J8 pin 13 to ground. There should be no continuity.
   - J8 pin 16 to ground. There should be no continuity.

A. If any of the continuity readings are incorrect, verify the wiring is not damaged. If no damage is found, replace the high pressure switch.
B. If all of the continuity readings are correct, there may be an issue with transformer (TR-03).

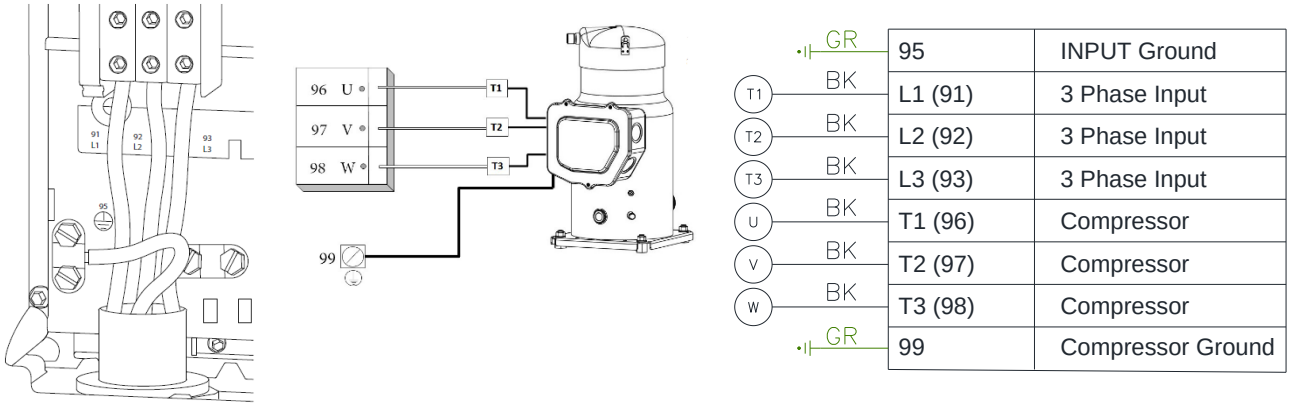
Figure 70 - High Refrigeration Pressure Switch and Wiring Reference



Compressor Drive Input/Output (VFD-02)

1. Power the unit OFF. Verify there is no damage to the wiring. Make sure all connections are secure, and connected. Verify wiring connections to the schematic.
2. Make sure the unit is OFF. Check for open or short circuits in the wiring harness.
3. Power the unit ON. Check for voltage at the following terminals:
   - Terminal L1 to ground. Verify reading to nameplate voltage.
   - Terminal L2 to ground. Verify reading to nameplate voltage.
   - Terminal L3 to ground. Verify reading to nameplate voltage.
   - Terminal T1/U to ground. Voltage will vary with compressor speed.
   - Terminal T2/V to ground. Voltage will vary with compressor speed.
   - Terminal T3/W to ground. Voltage will vary with compressor speed.

Figure 71 - Compressor Drive and Wiring Reference



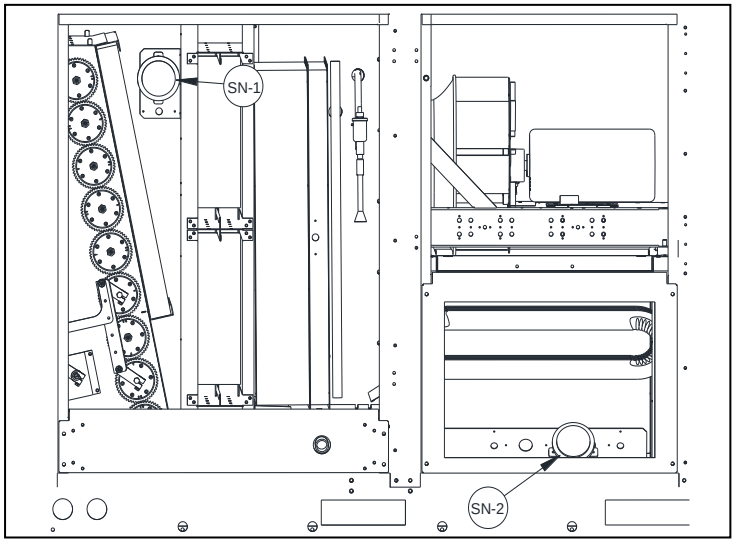
95	INPUT Ground
L1 (91)	3 Phase Input
L2 (92)	3 Phase Input
L3 (93)	3 Phase Input
T1 (96)	Compressor
T2 (97)	Compressor
T3 (98)	Compressor
99	Compressor Ground

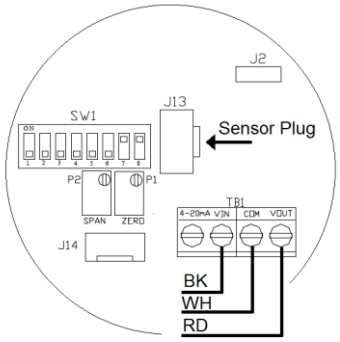
Intake (IT-1)/Discharge (SN-2) Humidity/Temperature sensor. Field wired Space Humidity/Temperature sensor (SN-3)

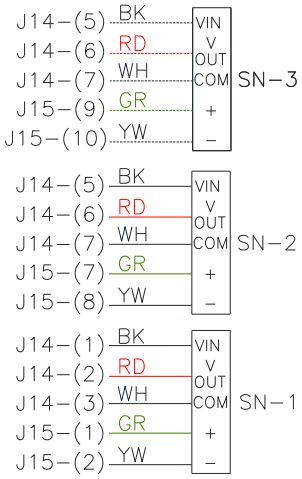
Check the following:

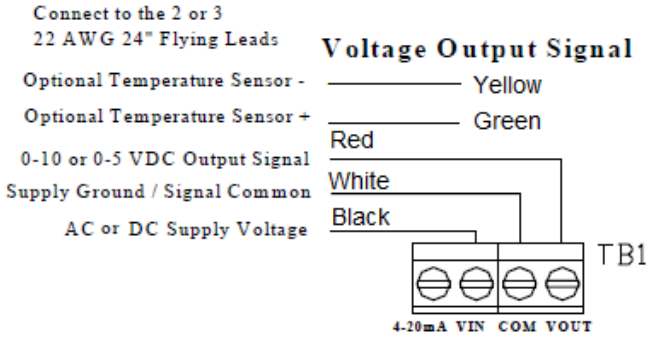
1. Verify the wiring is connected properly to the terminal block.
2. Verify the DIP switches are set properly. Make sure switch 7 and 8 are ON.
3. Check the wiring is connected properly at the switch.
4. Make sure all the connections are clean, and that there is no condensation on the RH sensor circuit board.

Figure 72 - Humidity/Temperature Sensors and Wiring Reference









Temperature sensor

Outdoor (SN-OA)/Intake (IT-1)/Discharge (SN-2)/Space (SN-3)/Return (SN-4)

1. Make sure the unit is OFF.
2. Make sure the wires are connected properly.
3. Measure the resistance of the temperature sensor.
   - IT-1 – J15 pin 1 to pin 2
   - SN-2 – J15 pin 7 to pin 8
   - SN-3 – J15 pin 9 to pin 10
   - SN-4 – J15 pin 3 to pin 4
   - SN-OA – J15 pin 5 to pin 6

Use the temperature/ohm chart to determine your readings.

A. If there is **0 ohms** the sensor or wires are shorted.

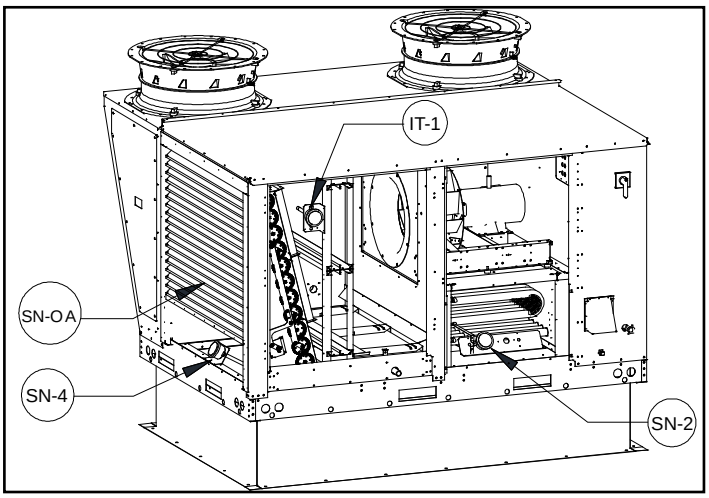
B. If there is **infinite (OL) ohms** the sensor or wires are open.

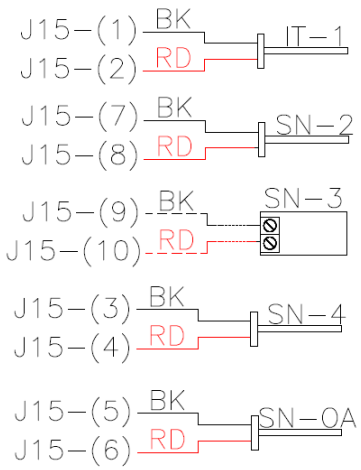
If the sensor or wiring has failed, replace the sensor.

Table 15 – Sensor Ohm Reading

Temperature	Ohm 10k
-20	165k
-10	117k
0	85k
10	62k
20	46k
30	34k
40	26k
50	19k
60	15k
70	11k
80	9k
90	7k
100	5k

Figure 73 - Temperature Sensors and Wiring Reference





Note: SN-OA is located behind the damper assembly.

Low Gas Pressure switch (PS-05)

1. Turn the unit ON. Verify the inlet pressure gauge is reading the correct pressure.
   - Natural gas - **7 in. w.c. – 14 in. w.c**.
   - Propane - **11 in. w.c. – 14 in. w.c.**

   Note: If the reading is incorrect, contact the gas supply company.
2. Reset the lever on the switch. Gas pressure must be higher in the chamber for the reset latch to be set properly. If the reset did not work, continue with the next step.
3. Remove the cover. Make sure the wiring is set up for Normally Open (N.O.) contact.
4. Check for voltage:
   - Back probe connector J13 pin 3 to ground. There should be **24-28V AC**.
   - Back probe connector J13 pin 10 to ground. There should be **0V AC**.

A. If the voltage reading is incorrect, check the wiring for an open or short circuit. If the wiring is correct, the switch has failed. Replace the switch

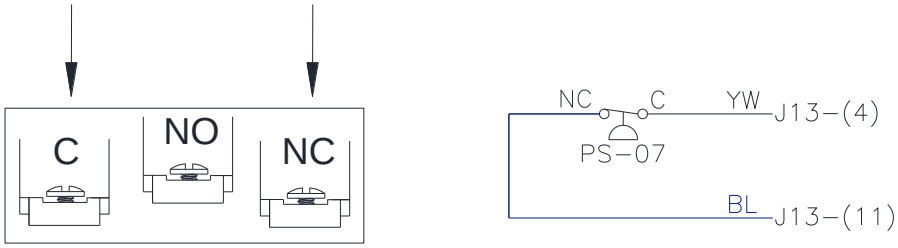
B. If the voltage reading is correct, and the switch reset corrected the fault, there may have been an intermittent fault.

Figure 74 - Low Gas Pressure and Wiring Reference

High Gas Pressure switch (PS-07)

1. Turn the unit ON. Reset the lever on the switch. Gas pressure must be lower in the chamber for the reset latch to be set properly.
2. Remove the cover. Make sure the wiring is set up for Normally Closed (N.C.) contact.
3. Verify the ON/OFF gas valve, and modulating valve are set properly. See Start-up Procedure Heating (page 54).
4. Check for voltage:
   - Back probe connector J13 pin 4 to ground. There should be **24-28V AC**.
   - Back probe connector J13 pin 11 to ground. There should be **24-28V AC**.
     A. If the voltage reading is incorrect, check the wiring for an open or short circuit. If the wiring is correct, the switch has failed. Replace the switch
     B. If the voltage reading is correct, and the switch reset corrected the fault, there may have been an intermittent fault.

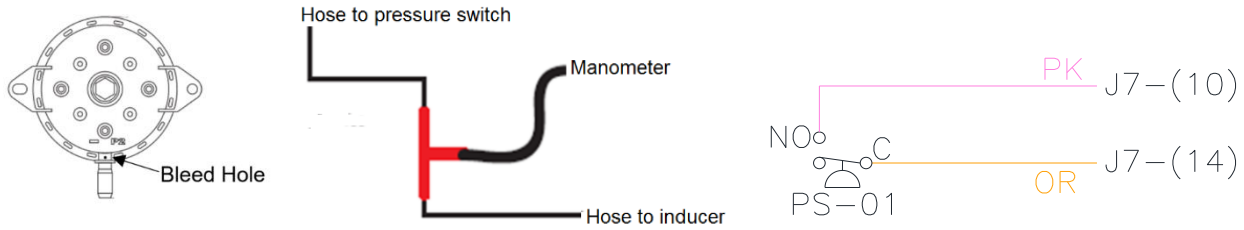
Figure 75 - High Gas Pressure and Wiring Reference



Vent Proving switch (PS-01)

1. Make sure the wiring is connected properly.
2. Verify the vent tubing is routed correctly, and the tube is not pinched or clogged.
3. Make sure the bleed hole is not clogged. The bleed hole reduces condensation build up in the switch and tubing.
4. Make sure the unit is OFF. Check the switch. Remove the electrical connections. Check for continuity between pin “C” to pin “NO”. There should be no continuity.
   A. If there is continuity, the switch has failed. Replace the switch.
   B. If there is no continuity, re-connect the electrical connections. Continue to the next step.
5. Connect a manometer between the pressure switch and hose. Turn the unit ON. Monitor the manometer. Verify the value (**w.c.**) on the switch is correct.
   A. If the reading is below the value, there is an issue with the vacuum. See
   B. If the reading is above the value, continue to the next step.
6. With the unit ON. Check for voltage:
   - Back probe connector J7 pin 14 to ground. There should be **24-28V AC**.
   - Back probe connector J7 pin 10 to ground. There should be **24-28V AC**.
   A. If the voltage reading is incorrect, check the wiring for an open or short circuit. If the wiring check is good, the switch has failed. Replace the switch.
   B. If the voltage reading is correct, there may have been an intermittent fault.

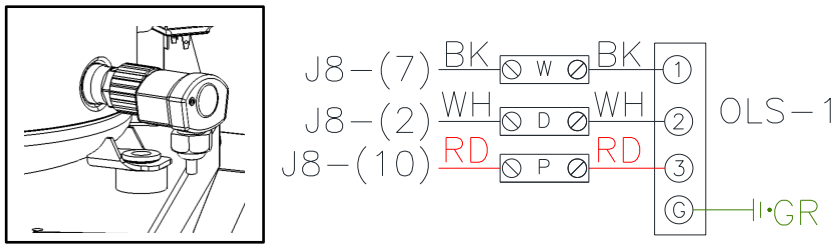
Figure 76 - Vent Proving Switch and Wiring Reference



Oil Level Sensor (OLS-1) – Used on compressor models VZH088/117/170

1. Make sure the compressor is not running. Remove the oil level sensor from the compressor.
2. Turn the unit ON, make sure the compressor is OFF by pressing OFF on the LCP panel.
3. Check for voltage:
   - Back probe connector J8 pin 10 to ground. There should be **26V AC** without a mirror in front of the sensor.
   - Back probe connector J8 pin 10 to ground. There should be **0V AC** with a mirror in front of the sensor.
   A. If the voltage reading is incorrect, check the wiring for an open or short circuit. Check transformer TR-08. If the wiring, and transformer check are good, the sensor may have failed.
   B. If the voltage reading is correct, verify the oil management function is working properly. Add oil if needed. See Compressor VZH 088/117/170 (page 58).

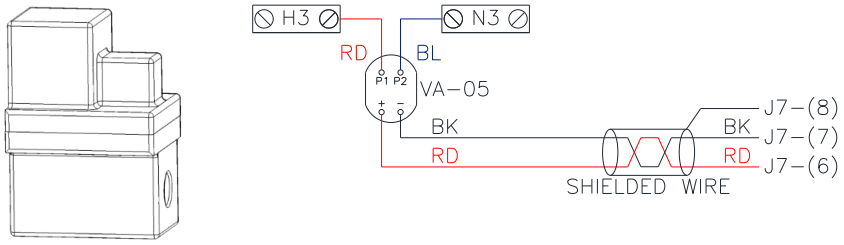
Figure 77 - Oil Level Sensor and Wiring Reference



Modulating Gas Valve (VA-05)

1. Make sure the wiring is connected properly. Check the wiring using a multi-meter for open or short circuits.
   - Terminal 1 – Signal (**+**) to J7 pin 6
   - Terminal 2 – Signal (**-**) to J7 pin 7
   - Terminal 3 – Power **24V DC** (**+**) to H4
   - Terminal 4 – Power (**-**) to N4
     A. If any damaged wiring is found, repair or replace.
     B. If any open or short circuits are found, repair or replace.
     C. If any wiring is connected incorrectly, correct the wiring.
     Note: The wiring connection is polarity sensitive.
2. Make sure the DIP switches are all in the OFF position (factory setting). This will set the valve to receive a **0-10V DC** signal. If the unit is set up for an analog control system, see **Table 13**.
3. Make sure the valve has been adjusted properly. See High-fire and Low-fire burner adjustment (page 54).
4. If the unit has been running, restart the unit. Check for voltage:
   - Connector J7 pin 6 to ground. There should be **10V DC**. The voltage reading will drop after the unit has been running.
   - Check for voltage between H4 to N4 on the terminal block. There should be **24-28V AC**. This voltage reading will be constant.
     A. If the voltage reading is incorrect, check voltage to the IBT control board.
     B. If the voltage reading is correct, there may be an issue with the modulating valve.

Figure 78 - Modulating Gas Valve and Wiring Reference

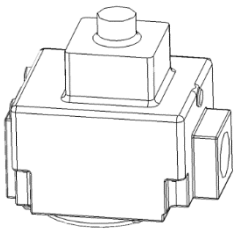


Main (On/Off) Gas Valve (VA-01)

Units that use 500MBH and larger furnaces are equipped with two shutoff valves internal to a single body.

1. Make sure the wiring is connected properly.
2. Make sure the gas valve is ON.
3. Turn the unit ON. Check for voltage. Check for voltage across the pins on the gas valve. There should be **24-28V AC**.
   A. If the voltage reading is incorrect, check the wiring for an open or short circuit.
   B. If the voltage reading is correct, the gas valve may be faulty.

Figure 79 - Main Gas Valve



Flame Safety Control (FSC-01)

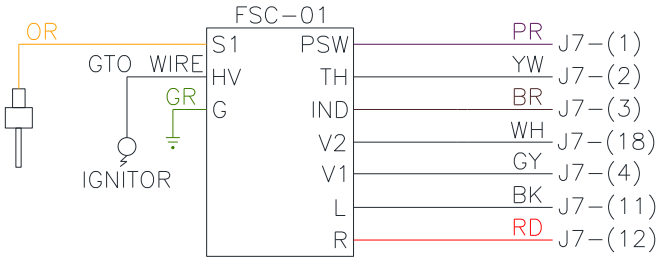
1. Make sure the wiring is connected properly.
2. Turn the unit ON. Use the HMI to set the unit in test mode.
   - Service > Test Menu > Test Heating > Run Low Fire Test > Stages All
   - Refer to the operation of sequence for the Flame Safety Control (page 61).

Determine the symptom below:

Symptom	Action
Control does not start	-Check wiring -Check for a **24V AC** transformer failure -Check circuit breaker -Check LED light
Thermostat ON – no spark	-Check wiring to thermostat input (TH) -Faulty thermostat -Check LED light
Blower ON – no Trial For Ignition (TFI) after purge delay	-Check wiring -Check for flame fault -Air Flow fault, see Air Flow Switch (page 96) -Check connection at PSW terminal -Faulty Control (Check voltage between L1 and IND. There should be **24V AC**)
Valve ON – no spark during TFI	-Check wiring -Shorted ignitor electrode -Check cable to ignitor
Spark ON – valve OFF	-Check wiring -Valve coil open -Check voltage at V1
Flame during TFI – no flame sensed after TFI	-Check flame rod position -Check cable to flame rod -Poor ground connection at burner -Poor flame

3. Turn the unit ON. If the LED is blinking, verify the fault:
   - Steady ON = Internal controller failure
   - 1 flash = Airflow fault
   - 2 flashes = Flame without call for heat
   - 3 flashes = Ignition lock out

Figure 80 - FSC Wiring Reference



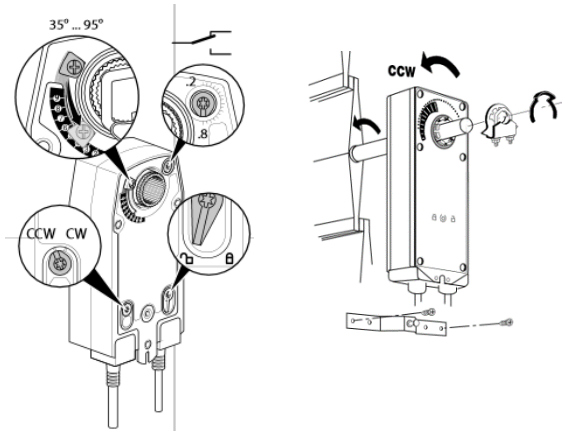
Intake Damper Motor Assembly (MT-06)

1. Make sure the wiring is correct.
2. Check the wiring for open or short circuits.
3. Verify the positive signal from J18 pin 2 is connected to the assembly at pin 3.
4. Verify the negative signal from J18 pin 9 is connected to the assembly at pin 1.
5. Test the damper rotation. Turn the unit ON. Use the HMI to monitor the movement of the damper.
   - User Settings > Outdoor Air Voltage > 10V (default)
   - Adjust the voltage setting, and monitor the damper movement.
     A. If the damper movement and voltage reading is correct, test is complete.
     B. If the damper movement and voltage reading is incorrect, continue to the next step.
6. Check transformer TR-06.
     A. If there is an issue with the transformer or wiring, repair or replace.
     B. If the transformer check is good, check for mechanical failures.

Field installation/adjustment

1. Rotate the damper shaft to its fail-safe position (closed). Mount the actuator with the counterclockwise "CCW" out.
2. If the universal clamp is not on the correct side of the actuator, move it to the correct side.
3. Slide the actuator onto the shaft. Position the clamp so that the pointer of the tab is at the top of the rotation.
4. Lock the clamp to the actuator using the retaining clip.
5. Tighten the nuts on the V-bolt. Torque to **6-8 ft-lb**.
6. Secure to strap.
7. Make sure the rotation is set correctly.
   Y = 0 set to CCW.
8. Test the spring return damper rotation.
   - You can use the crank handle to test manually.
   - Turn the unit ON. Use the HMI to monitor the movement of the damper.
   - Service > Test Menu > Test Misc > Outdoor Air
   - Adjust the voltage setting, and monitor the damper movement.
     - **0V – Outdoor air dampers closed**
     - **10V – Outdoor air dampers open**
     A. If the damper operates properly, the installation is correct.
     B. If the damper operates incorrectly, adjust as required. If adjustment cannot be made, check the wiring is correct. Verify to the unit's wiring schematics.

Figure 81 - Intake Damper Motor Assembly

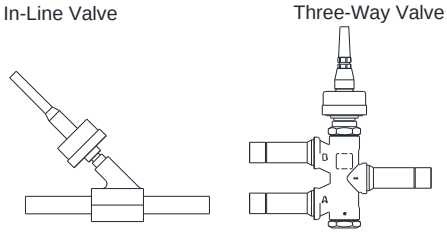


Hot Gas Reheat Valve (HG-1/HG-2)

Units with a single reheat valve, HG-1 will be a three-way valve. Units that use dual reheat valves will have HG-1 in-line to the reheat coil inlet and HG-2 in-line to the outdoor (condensing) coil inlet.

Power the unit OFF. Verify there is no damage to the wiring. Make sure all connections are secure, and connected. Verify wiring connections to the schematic. Check the G wire and R wire connections to the Reheat Controller (RHC) between reheat valve.

Figure 82 - Hot Gas Reheat

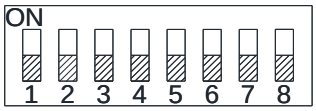


Reheat Controller (RHC-1)

1. Power the unit OFF. Verify there is no damage to the wiring. Make sure all connections are secure, and connected. Verify wiring connections to the schematic.
2. Verify all DIP switches are set to OFF.

   Note: If in-line reheat valves are used on size 2 units, DIP switch 2 should be set to "ON".
3. Power the unit ON. Verify there is **24V AC** at terminals H2 and N2.

Figure 83 – IB-G Universal Reheat Controller

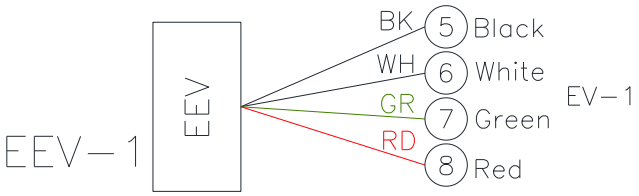


Electronic Expansion Valve (EEV-1)

The Electronic Expansion Valve (EEV-1) wiring is connected to the Superheat Controller (EV-1).

1. Power the unit OFF. Verify there is no damage to the wiring. Make sure all connections are secure, and connected. Verify wiring connections to the schematic.
2. Disconnect electronic expansion valve wiring from the superheat controller.
3. Use a multi-meter to measure the resistance in the electronic expansion valve harness from:
   - The black wire to white wire. There should be **90-100 ohms.**
   - The red wire to green wire. There should be **90-100 ohms.**
   - The white wire to ground. There should be infinite resistance (open circuit).
   - The black wire to ground. There should be infinite resistance (open circuit).
   - The red wire to ground. There should be infinite resistance (open circuit).
   - The green wire to ground. There should be infinite resistance (open circuit).
     A. If the readings are incorrect, there may be an issue with the electronic expansion valve. Replace EEV if necessary.
     B. If the readings are correct and there are no issues with the electronic expansion valve, there may be an issue with the superheat controller.

Figure 84 - EEV Wiring Reference



Power Vent (MT-02)

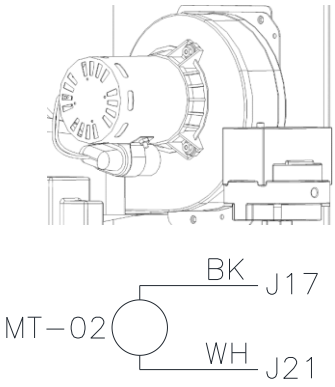
1. If the blower motor is not operating properly, power the unit OFF.
2. Verify there is no damage to the vent proving switch or vent tube. See **Figure 76**.
3. Verify there is no damage to the wiring, blower motor or capacitor. Make sure all connections are secure, and connected. Verify wiring connections to the schematic. If damage is found, replace the damaged component(s).
4. Check the blower motor electrical circuit.

For standard furnaces:

Disconnect the wiring connections from pin J17 and pin J21. Power the unit ON. Check for voltage from pin J17 to pin J21 on the board. There should be **115-120V AC.**

A. If the voltage reading is incorrect, verify there is **120V AC** to the circuit board.
B. If the voltage reading is correct, check the motor's capacitor. If the capacitor is OK, there may be an issue with the power vent motor.

Figure 85 – Standard Power Vent and Wiring Reference

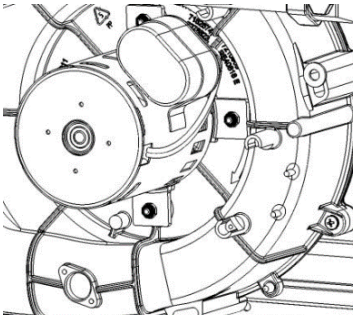


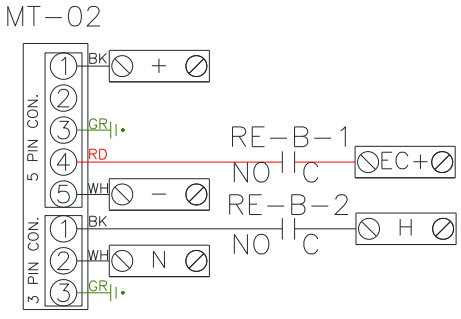
For 400HE (High Efficiency) Furnaces:

1. Power the unit OFF. Check the ground circuit on the five pin connector. Check the ground circuit on the three pin connector. If there is an issue with the ground circuit, repair the circuit. If there is not an issue with the ground circuit, power the unit ON.
2. With the unit powered ON, check the following:
   - Check for **24V DC** between the (**+**) and (**-**) terminals. If the voltage reading is incorrect, check the **24V DC** power supply.
   - Check the PWM signal from the **EC+** to ground. The voltage reading should vary. If the voltage reading is incorrect, verify connections to the circuit board.
   - Check for **120V AC** between the **H** and **N** terminals. If the voltage reading is incorrect, check the circuit breaker and the main transformer (TR-01).
   - Check the **24V AC** HE Furnace Relay (RE-B). When the relay is actuated, check the following:
     - Black wire terminal to ground. There should be **120V AC**.
     - Red wire terminal to ground. The voltage will vary.

   A. If the voltage reading is incorrect, the relay may have failed.
   B. If the voltage reading and all other checks are within specifications, there may be an issue with the power vent motor.

Figure 86 – High Efficiency Power Vent and Wiring Reference





MAINTENANCE

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

Record any maintenance or service performed on this unit in the documentation section located at the end of this manual.

WARNING: DO NOT ATTEMPT MAINTENANCE ON THIS EQUIPMENT UNTIL THE ELECTRICAL SUPPLY HAS BEEN COMPLETELY DISCONNECTED AND THE MAIN GAS SUPPLY VALVE HAS BEEN TURNED OFF.

General Maintenance

- Fan inlet and approaches to ventilator and coils should be kept clean and free from any obstruction. Clean both the indoor and outdoor coils regularly to maintain unit efficiency.
- Motors are normally permanently lubricated. Check bearings periodically. If they have grease fittings lubricate each season. Use caution when lubricating bearings, wipe the fittings clean, the unit should be rotated by hand while lubricating. **Caution: Use care when touching the exterior of an operating motor. Motors normally run hot and may be hot enough to be painful or cause injury.**
- All fasteners should be checked for tightness each time maintenance checks are preformed prior to restarting unit.
- Fans 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.
- Before each heating season, verify that the drain on the bottom of each common flue box of every furnace in the unit is clear.

Every 3 months

Filters need to be cleaned and/or replaced quarterly, and more often in severe conditions. Washable filters, located in the intake louver can be washed in warm soapy water. When re-installing filters, be sure to install with the same size and rated filter and with **airflow in the correct direction** as indicated on the filter.

Table 16 - Louvered Intake Filter Quantity Chart (Washable)

Unit Housing Size	16” x 25” x 2”	20” x 20” x 2”	20” x 25” x 2”
Size 2	x	x	2
Size 3	4	x	x
Size 4	x	8	x

Table 17 - Internal Filter Quantity Chart (Throw Away)

Unit Housing Size	16” x 20” x 2”	20” x 20” x 2”	20” x 25” x 2”
Size 2	4	x	x
Size 3	x	x	4
Size 4	x	12	x

Note: Quantity subject to change based on filter options. Optional 4” thick filters available upon request.

Heating Season

- Verify that the drain on the bottom of the flue box in the unit is clear.
- Inspect bolts and set screws for tightness. Tighten as necessary.
- Inspect the wiring on the unit and replace components where necessary.
- Inspect motor for cleanliness. Clean exterior surfaces only. Remove dust and grease from the motor housing to ensure proper motor cooling. Remove dirt and grease from the wheel and housing to prevent imbalance and damage.
- The heat exchanger should be checked for cracks. The heat exchanger should be replaced immediately if cracks are detected. With a soft cloth, remove any built up dirt or oil on the exterior surface of the heat exchanger.
- Inspect the combustion blower motor for cleanliness. Clean exterior surfaces of the combustion blower motor only. Removing excess dust and grease guarantees proper motor cooling.
- Before each heating season, examine the burner and gas orifices. Inspect burner ports for foreign debris. Check the heat exchanger, and spark igniter for cleanliness. Use a wire brush to remove any soot, dirt, or grease from the burner or orifices.

Re-Setting of the Furnace Unit

If the flame safety control is locked out (Spark igniter fails or no gas supply), reset the unit by:

1. Turn OFF Power to the unit.
2. Turn Power to the unit back ON.

Emergency shutdown of unit

To shut down the unit in the event of an emergency do the following:

1. Turn power OFF to the unit from main building disconnect.
2. Turn the external disconnect switch to the OFF position.
3. CLOSE the inlet gas valve located on the heater.

Prolonged shutdown of the unit

For prolonged shutdown the following steps should be done:

1. Turn the external disconnect switch to the OFF position.
2. CLOSE the inlet gas valve located on the heater.

To re-start the unit the following steps should be done:

1. Turn the external disconnect switch to the ON position.
2. OPEN the inlet gas valve located on the heater.

Cooling Season

- Before each cooling season, verify that the drain on the bottom indoor coil drain pan is clear. Inspect bolts and set screws for tightness. Tighten as necessary.
- Inspect the wiring on the unit and replace components where necessary.
- Inspect motor for cleanliness. Clean exterior surfaces only. Remove dust and grease from the motor housing to ensure proper motor cooling. Remove dirt and grease from the wheel and housing to prevent imbalance and damage.
- Inspect the indoor and outdoor coil for dirt and bent fins. Clean or replace as necessary.
- Check the outdoor fans for proper rotation and operation. Clean all debris from fan guards.
- Inspect all return air and fresh air dampers and linkage to ensure free operations. Lubricate where necessary.
- With the unit running, check and record the ambient temperature, superheat, compressor suction and discharge pressures. Record this data on the back of this manual.

  Note: Do NOT release refrigerant to the atmosphere! If adding or removing refrigerant is required, the service technician must comply with all federal, state and local laws.

Maintenance Quick Reference Chart

Component	Maintenance	Interval
Filters	Clean or replaced	Every 3 months
Damper assembly	Inspect and clean louvers and gutters	Every 3 months
Drain pans	Clean, and clear of obstruction	Every heating/cooling season
Bolts, and screws	Inspect bolts, and screws. Verify all hardware is secure, and tight	Every heating/cooling season
Wiring, and electrical	Inspect all wiring, and electrical components	Every heating/cooling season
Blower motor	Inspect motor for cleanliness, and proper rotation	Every heating/cooling season
Heat Exchanger	Inspect for cracks or damage	Every heating season
Power vent motor	Inspect motor for cleanliness	Every heating season
Burner and gas orifices	Inspect for cleanliness	Every heating season
Indoor/Outdoor coil	Check for damage fins, and cleanliness of the coil	Every cooling season
Outdoor fans	Check for proper rotation, operation, and cleanliness	Every cooling season
Damper assembly	Inspect the linkage, and movement	Every cooling season
Unit operation	Verify the unit pressures, see Basic service (page 81)	Every cooling season

Start-Up and Maintenance Documentation

START-UP AND MEASUREMENTS SHOULD BE PERFORMED AFTER THE SYSTEM HAS BEEN AIR BALANCED AND WITH THE COOLING ON (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	
MUA Serial Number	
Unit Voltage	
Unit Hertz	
Unit Phase	
Unit FLA	
Unit Supply HP	
Gas Type	
Min. Btu/Hr	
Max. Btu/Hr	
Measured Temp Rise	°F

Field Measured Information		
Motor Voltage		
Motor Amperage**		
MUA Blower RPM		
Ambient Wet Bulb Temp		°F
Ambient Dry Bulb Temp		°F
COND 1 Suction Pressure		PSI
COND 1 Suction Temperature		°F
COND 1 Liquid Pressure		PSI
COND 1 Liquid Temperature		°F
COND 1 Subcooling		°F
COND 1 Superheat		°F
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.

Maintenance Record

Date	Service Performed

Factory Service Department
Phone: 1-866-784-6900
Fax: 1-919-554-9374