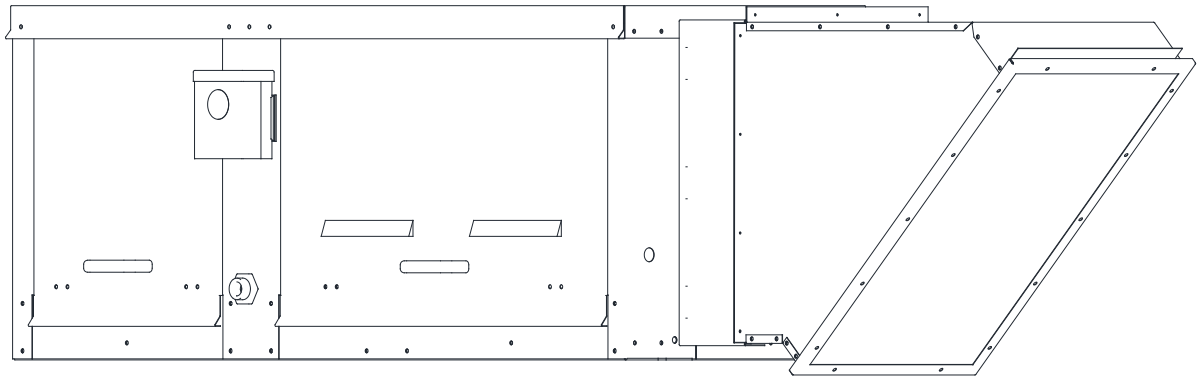
Compact Direct Fired Heaters

Installation, Operation, and Maintenance Manual



FOR YOUR SAFETY

IF YOU SMELL GAS: OPEN WINDOWS, DO NOT TOUCH ELECTRICAL SWITCHES, EXTINGUISH ANY OPEN FLAMES, IMMEDIATELY CALL YOUR GAS SUPPLIER.

FOR YOUR SAFETY

THE USE AND STORAGE OF GASOLINE OR OTHER FLAMMABLE VAPORS AND LIQUIDS IN OPEN CONTAINERS IN THE VICINITY OF THIS APPLIANCE IS HAZARDOUS.

RECEIVING AND INSPECTION

Upon receiving unit, check for any interior and exterior damage. If damage is found, report it immediately to the carrier. Check that all accessory items are accounted for and are not damaged.

WARNING!!

Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death. Read the installation, operating and maintenance instructions thoroughly before installing or servicing this equipment. ALWAYS disconnect power and gas prior to working on heater.

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

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WARRANTY

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

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

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

INSTALLATION

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

Mechanical

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

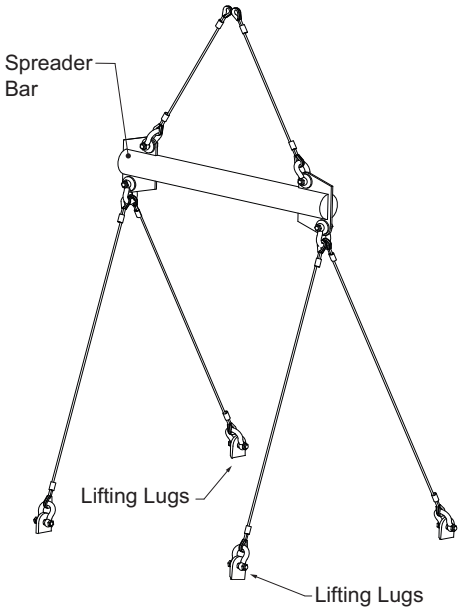
Clearance

The top, back, and front surfaces of this heater may not be installed less than 6" from combustible materials. The heater base may be installed on combustible surfaces. Allow 24" minimum service clearance on both sides of this heater.

Site Preparation

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

Figure 1 - Spreader Bar

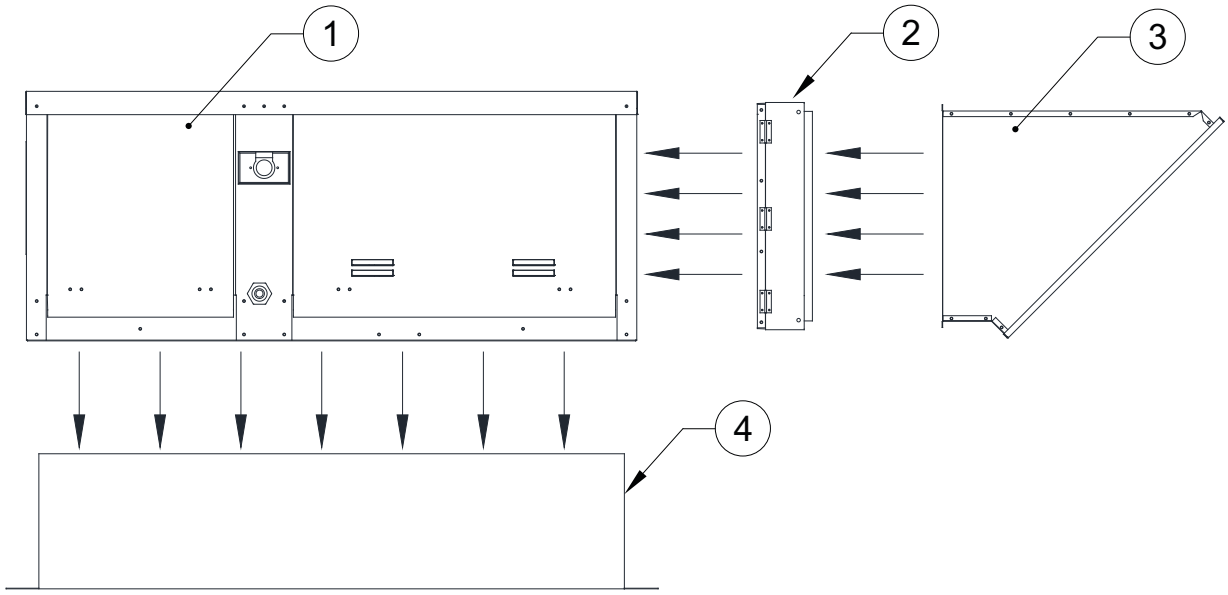


Intake Assembly

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

1. Apply silicone or weather-proof gasket on the backside of the flanges of the intake hood or V-bank intake.
2. Secure the flanges of the intake hood to the unit with the supplied sheet metal screws.
3. Use caulk on the outside of the screws to prevent water leaks.

Figure 2 - Intake and Curb Assembly



1. Blower/Motor Access Door
2. Filtered Intake
3. Screened Intake
4. Curb

Curb and Ductwork

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

- **Table 1** shows the minimum fan outlet duct sizes and straight lengths required for optimal fan performance.
- Do not use the unit to support ductwork in any way. This may cause damage to the unit.
- **Follow SMACNA standards and manufacturer's requirements for the duct runs.** Fans designed for rooftop installation should be installed on a prefabricated or factory-built roof curb.
- Follow curb manufacturer’s instructions for proper curb installation.
- The unit should be installed on a curb and/or rail that meets local code height requirements.
- Make sure the duct connection and fan outlet are properly aligned and sealed.
- Secure fan to curb through vertical portion of the ventilator base assembly flange. Use a minimum of eight (8) lug screws, anchor bolts, or other suitable fasteners (not furnished). Shims may be required depending upon curb installation and roofing material.
- Verify all fasteners are secure. **Figure 3** and **Figure 4** show different mechanical installations.
- Adequate building relief shall be provided so as not to over pressurize the building when the heating system is operating at its rated capacity. This can be accomplished by taking into account, through standard engineering methods, the structure’s designed infiltration rate; by providing properly-sized relief openings; or by interlocking a powered exhaust system; or by a combination of these methods.
- Heaters installed with intake ductwork must be purged to replace at least four air changes of the volume of the intake duct.
- If the failure or malfunction of this heater creates a hazard to other fuel-burning equipment in the building (e.g., when the heater is providing makeup air to a boiler room), the unit is to be interlocked to open inlet air dampers or other such devices.
- On outdoor installations, it is recommended that the discharge duct be insulated to prevent condensation during the “OFF” cycle in cold weather.
- Flexible connectors should be used on all ductwork connections. Vibration isolators are optional and can be supplied in the loose parts package.
- Units that are installed in airplane hangars should be installed in accordance with the Standard for Aircraft Hangars, ANSI/NFPA 409. Units that are to be installed in public garages should be installed in accordance with the Standard for Parking Structures, ANSI/NFPA 88A, or the Standard for Repair Garages, ANSI/NFPA 88B, and with CAN/CGA B149 Installation Codes.

Table 1 - Required Supply Ductwork

Duct Size	Straight Duct Length
12” x 12”	36”

Roof Mount Installation

Note: Refer to submittal drawings for specific unit dimensions.

Figure 3 - Roof Mount Installation Details

1. Discharge Opening
2. Curb Outer Wall
3. Flex Conduit for Field Wiring
4. Screened Intake
5. Filter Access Door
6. Service Disconnect Switch
7. 1/2” NPT Pipe
8. Blower/Motor Access Door
9. Control Drop
10. Motor Drop

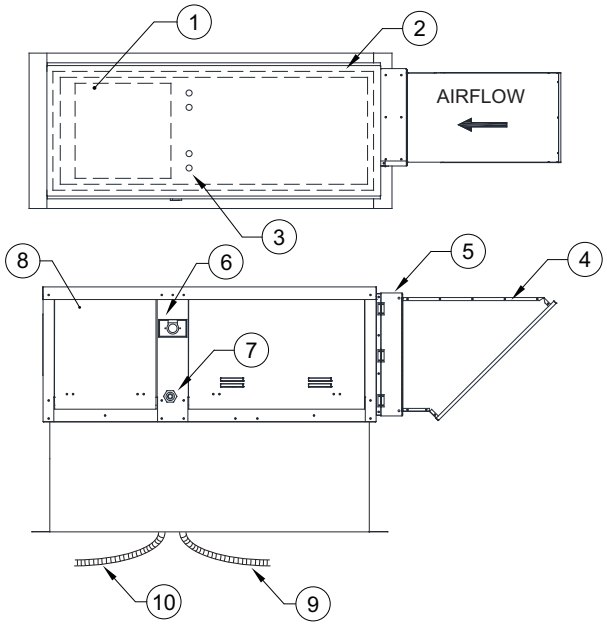
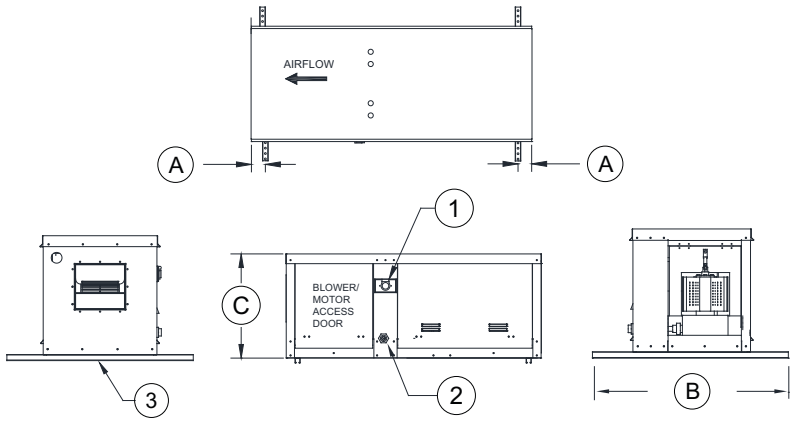


Figure 4 - Indoor Inline

1. Service Disconnect Switch
2. 1/2” NPT Pipe
3. Optional Unistrut Base for Hanging

A. 1” Spacing from Unistrut to edge of unit
B. 36” Unistrut
C. Unit Height



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.

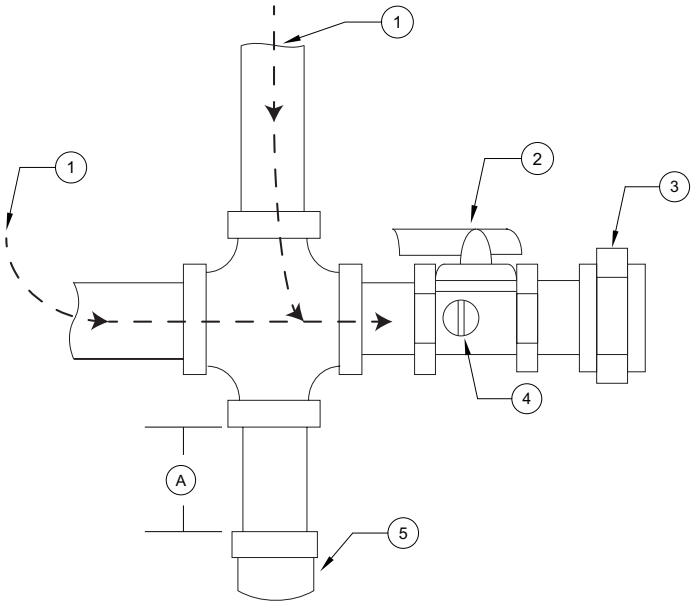
WARNING: INLET GAS PRESSURE MUST NOT EXCEED PRESSURE INDICATED ON NAMEPLATE. SEE UNIT NAMEPLATE FOR PROPER GAS SUPPLY PRESSURE AND GAS TYPE.

1. Always **disconnect power** before working on or near a heater. Lock and tag the disconnect switch or breaker to prevent accidental power-up.
2. 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.
3. The incoming pipe near the heater should be sized to match the connection on the outside of the unit. Unit inlet sizes are shown in **Table 2**. The unit requires a steady supply of gas at all times, avoid multiple taps in the gas supply line.
4. Install a ground joint union with brass seat and a manual shut-off valve external to the unit casing. Install shut-off valve adjacent to the unit for emergency shut-off and easy servicing of controls. Refer to **Figure 5**.
5. Provide a sediment trap, as shown in **Figure 5**, before each unit and where low spots in the pipeline cannot be avoided.
6. Clean out the gas line to remove debris before making connections. Purge gas line to remove air before attempting to start unit. Purging air from gas lines should be performed as described in ANSI Z223.1-latest edition "National Fuel Gas Code," or in Canada as described in CAN/CGA-B149.
7. All field gas piping must be pressure/leak tested before 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 1/2 psi.
8. This unit requires the gas pressure to be within the unit's minimum and maximum gas pressure ratings. If the pressure is greater than the maximum, the internal valve components will be damaged. If the pressure is below the minimum, the heater will not perform to specifications. Refer to **Table 3 on page 10**.

Table 2 - Gas Connection Sizes

Unit Size	Gas Pipe Size (NPT)
76	1/2"

Figure 5 - Gas Connection Diagram



1. Gas Supply Line Connection
2. Manual Gas Shut-off Valve
3. Ground Joint Union with Brass Seat
4. Plugged 1/8” NPT Test Gauge Connection
5. Sediment Trap

A. Minimum Depth = 3”

Table 3 - Gas Pressure

Gas Pressure Type	Gas Pressure
Natural/LP	5 - 14 Inches WC Maximum

NOTICE

Refer to the heater’s rating plate for determining gas supply pressures and requirements.

ELECTRICAL

WARNING!!

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

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

Electrical wiring (**Table 4**) and connections must be made in accordance with local ordinances and the National Electric Code, ANSI/NFPA 70. Verify the voltage and phase of the power supply, and the wire amperage capacity is in accordance with the unit nameplate. For additional safety information, refer to AMCA publication 410-96, *Recommended Safety Practices for Users and Installers of Industrial and Commercial Fans.*

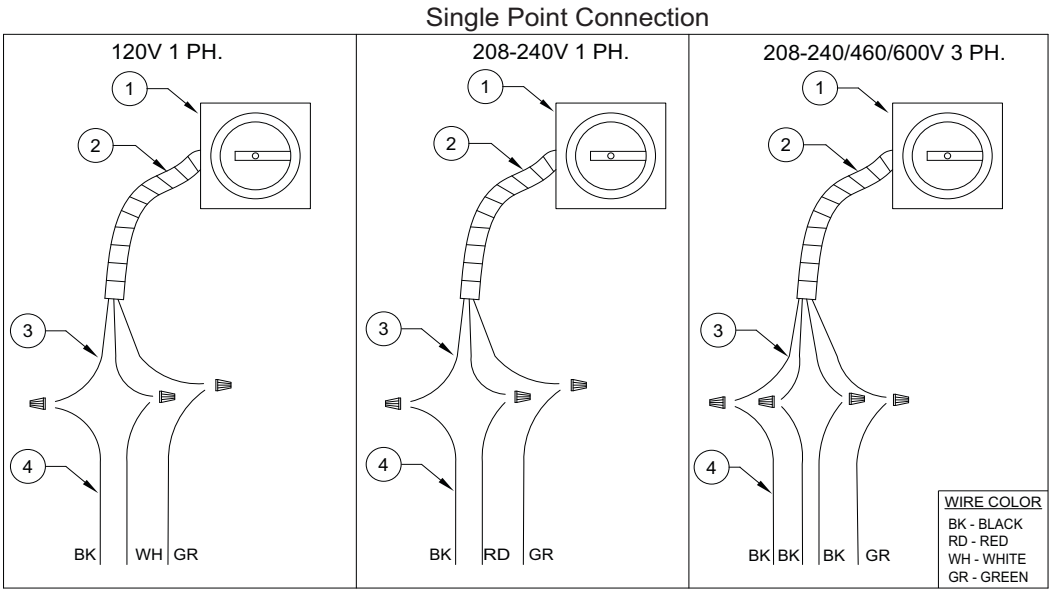
1. **Always disconnect power before working on or near this equipment. Lock and tag the disconnect switch and/or breaker to prevent accidental power-up**.
2. An electrical drop containing the line voltage power wiring is shipped with every unit. The electrical drop should be brought through one of the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

Table 4 - 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

Fan to Building Wiring Connection

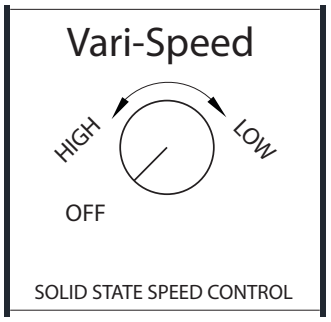
Figure 6 - Wiring Connection Details



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

Permanent Split Capacitor (PSC) Motor Speed Control

Figure 7 - PSC Motor Speed Control



Some single-phase direct-drive fans contain speed controls that regulate the amount of voltage going to the motor. Specific PSC motors must be used in conjunction with speed controls. The speed control has a knob (**Figure 7**) with an off position along with high to low range. At high speed, the speed control allows all of the line voltage to pass directly to the motor.

A minimum speed adjustment is provided to allow independent control of the minimum speed setting. Minimum speed adjustment ensures the motor runs with sufficient torque to prevent stalling. To adjust this:

1. Motor must be in actual operating conditions to achieve proper speed adjustment. Motor will not slow down unless proper load is applied.
2. Turn main control knob to lowest speed position.
3. Locate and adjust minimum speed setting. This can be found under the speed control faceplate. Use a small screwdriver to adjust. Rotate clockwise to decrease minimum speed; counter-clockwise to increase minimum speed.
4. Motor will now operate from this preset minimum speed to full speed.

The lowest minimum voltage that may be applied to these motors is 65V AC. Running lower voltages to the motor can cause premature failure and overheating problems.

Electronically Commutated Motor (ECM) Speed Control

An Electrically Commutated Motor (ECM) with speed control allows for an accurate manual adjustment of the fan's speed. The benefits of using an EC motor is exceptional efficiency, performance, and motor life.

External PWM Signal

The fan unit will be shipped with power wiring and communication wiring fed to an internal junction box. The fan is shipped with Shielded Twisted Pair (STP) wire which is used to wire to a remote PWM signal. Red wire is used to go to the positive PWM signal, black wire is used to go to the negative PWM signal. Reference schematics for all wiring connections. STP is connected to the communication wiring of the motor using wire nuts in the junction box. If a preset length of STP is provided, it will be connected to the junction box from the factory. Run the STP through any available knockout in the fan base.

Unit Mount Controller

The RTC speed controller features a 4 digit LED display with a five button interface. All parameters can be accessed through the user menu. The percent of run speed can be changed by using the **Up** and **Down** buttons followed by pressing **Enter** (middle button) to save changes. Every **ten seconds** the display will toggle between current percentage of run speed and current RPMs. The flow index has a range of **0-100%** and is typically linear with motor RPM.

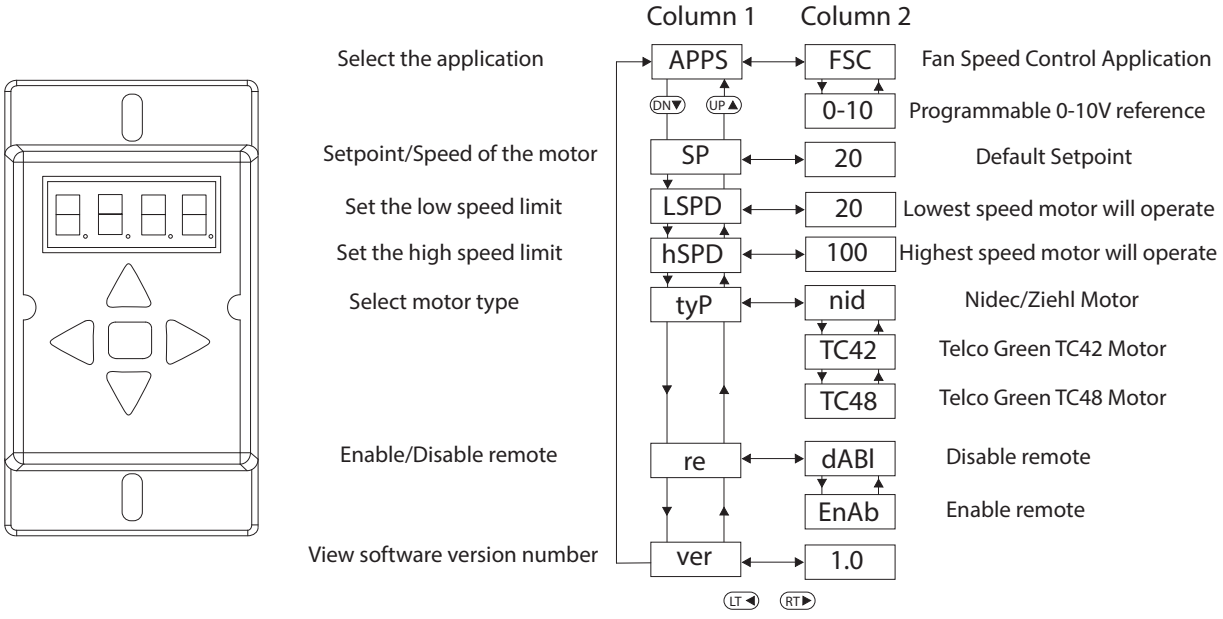
If the remote function (re) is enabled, the speed is controlled through a **0-10V** input. **0V = 0%** and **10V = 100%**, unless overridden by the low speed and high speed limits.

The speed controller requires a **24V AC** input and can locally turn the motor on and off. The motor RPM range is fully adjustable between the minimum and maximum setpoints, see LSPD and HSPD on the programming display. For more information, see the RTC control operating manual.

For all motors except 16Z, 18Z, 20Z, 22Z, 25Z, 28Z: If "oFF" is being displayed, and the speed is set above 300 RPM, the ECM is not receiving RPM feedback. Check that the ECM is wired correctly. Check that the motor "tyP" in the settings matches the motor manufacturer. 16Z, 18Z, 20Z, 22Z, 25Z, 28Z do not send RPM feedback.

NOTE: A Variable Frequency Drive (VFD) is required to adjust the speed control of a non-electrically commutated 3-phase direct-drive motor.

Figure 8 - RTC Speed Controller and Menu



Motor Speed Controller (MSC) Installation

The Motor Speed Controller (MSC) is a versatile device able to output various signal types to many different Electrically Commutated Motors (ECMs). The MSC signal output types can be selected under the 'Motor Type' section of the MSC menu. The MSC may be installed in a fan, remotely in a kitchen space, or in a mechanical room. While this device can be mounted remotely and powered using 24V, it may also be mounted with the fan where it will be exposed to higher voltages. If installed in the fan, the electrical installation must be carried out according to the appropriate regulations (e.g., cable cross-sections, circuit breaker, protective earth [PE] connection). National and local codes must be followed during the installation process.

The MSC board may be powered through a 120VAC/24VAC CLASS 2 transformer, 120V AC/24V DC CLASS 2 power supply, or through MODBUS connections.

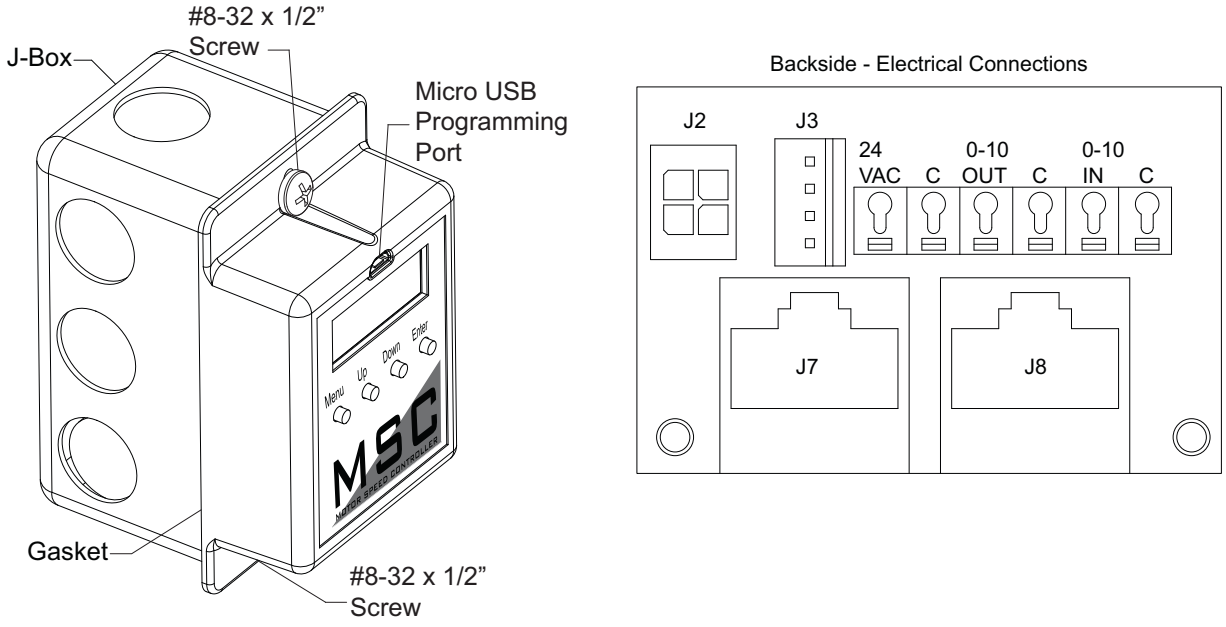
The MSC contains static sensitive components. Therefore, you must handle with care to avoid damage to these components. All operations concerning installation, commissioning, and maintenance must be carried out by qualified, skilled personnel who are familiar with the installation, assembly, commissioning, and operation of the electronic board and the application for which it is being used.

Ensure proper handling and avoid excessive mechanical stress. Do not bend any components when handling or installing component. **Do not touch any electronic components or contacts**.

Precautions must be adhered to during installation, testing, servicing, and repairing of this board. Component damage may result if proper procedures are not followed.

Do not install the MSC where it is subjected to adverse environmental conditions such as combustibles, oils, hazardous vapors, corrosive chemicals, excessive dust, moisture, direct sunlight, or extreme temperatures. When removing or installing the MSC to the j-box, verify the gasket is present. All electrical connections for the MSC are located on the backside of the controller. Refer to **Figure 9** for details on installation and electrical connections. When the micro USB programming port is not in use, place the weather-seal plug into the port location.

Figure 9 - Installation/Electrical Connections



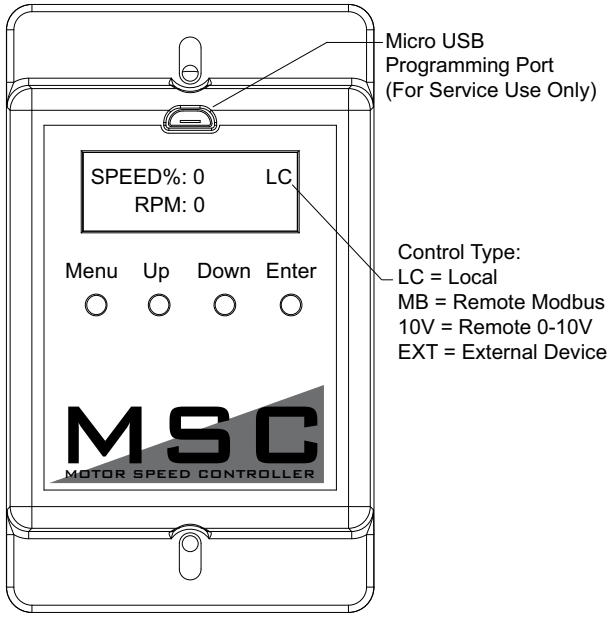
MSC Controls Overview

There are four buttons to navigate through the menu screens, refer to **Figure 10**.

Press the **MENU** button to access menu settings/parameters, pressing **MENU** will also back out of the current menu screen. To scroll through menus, use **UP** and **DOWN** buttons. Press the **ENTER** button to change setting/parameter selection.

To enter password, press MENU, then press **ENTER** when “Board Config” is displayed. Use **UP** and **DOWN** to scroll through numbers, press **ENTER** to advance to the next numerical setting. To save changes, press **MENU** until the screen displays “SAVE CHANGES? [ENTER] TO SAVE.” Press the ENTER button to save changes.

Figure 10 - MSC Front Detail View



MSC Menu

Board Config - Password (default is 0225)

- **Motor Type** - User may change motor type between Nidec, Telco 42, Telco 48, Ziehl, 0-10V, Other.
- **Control Type** - This setting adjusts how the fan will be controlled.
  - **Local** - The fan will be controlled by the MSC.
  - **Remote Modbus** - The fan will be controlled by another master board through the MSC. A connection between the 0-10V Out to 0-10V In must be made for start command.
  - **Remote 0-10V** - The fan will be controlled by an external 0-10V signal.
- **Speed Settings** - Provides access to speed and voltage settings.
  - **Low Speed** - Adjustable speed from 20% up to high speed setting, or 0-10V. Setting cannot go above High Speed parameter.
  - **High Speed** - Adjustable speed from 100% down to low speed setting, or 10-0V. Setting cannot go below Low Speed parameter.
  - **Set Speed%** - Adjustable speed range is dependent on Low Speed and High Speed settings. This controls the output of the motor.
  - **Voltage Range** - Only available when Motor Type “OTHER” is selected. Default setting is 24V. 5V, and 10V are also available.

- **Modbus #** - Adjustable Modbus ID. Exhaust Fan range 11-18, Supply Fan range 21 or 22. **A VFD and MSC cannot use the same Modbus #**.
- **Options**
  - **Feedback Fault** - If set to ENABLED, the MSC will monitor RPM feedback. If the MSC does not receive data for 30 seconds or 70% of the expected RPM, this fault will be displayed. **Ziehl motors do not provide feedback.**
  - **2 Speed** - The 0-10V output cannot be used when the 2 Speed or Manual Speed options are On, or if the "Control Type" is set to Modbus. When the 0-10V OUT and 0-10V IN terminals are **not** jumped together, the fan will operate at low speed. When 0-10V OUT and 0-10V IN terminals are jumped together, the fan will operate at high speed.
  - **Analog Speed** - The user may enable/disable the option, and calibrate a potentiometer for proper operation that is connected between the 0-10V OUT and 0-10V IN terminals. When enabled, you must calibrate the potentiometer. Follow the MSC's on-screen instructions. The speed will be adjustable between 0V (low speed) to 10V (high speed).
  - **Input Threshold** - When control type is set to Remote 0-10V, an input threshold will be created for motor control. Refer to **Figure 11 on page 18** for threshold examples.
    - **Zero Operation** - The user may select how the motor will operate when the 0-10V input is at 0V. The options will be Off or Low Speed (default).
    - **Threshold** - Increasing the threshold value will allow for the device to hold its voltage/RPM output while the input is between the 0 - threshold value.
- **Restore Settings** - Provides access to restore factory settings, and test & balance settings.
  - **Factory Settings** - This will reset all values back to factory settings.
  - **T & B Settings** - This will reset all values back to last saved test & balance settings.
- **Change Password** - Users may update the password setting to their own. Password 0225 will also be stored for backup. Both passwords will allow users to enter "Board Config" settings.

Software Version - Displays the current software version installed on the board.

Faults - This provides access to "Fault History," "Fault Totals," and "Clear Faults."

- **Fault History** - Displays fault history and board reboots in chronological order. Possible displayed faults are:
  - **No Faults** - There are no active faults with the system.
  - **Feedback Fault** - Only displayed for motors with feedback capabilities.
  - **Reboot** - Any time the fan goes from OFF to ON, this "fault" will be logged. This fault will only display in "Fault History."
  - **Modbus** - Issue with Modbus communication between the MSC and master board.
  - **Variable Device Fault** - When "Analog Speed" is selected and a potentiometer is connected, if the voltage drops below 1V, this fault will be displayed.
- **Fault Totals** - Displays amount of faults for Modbus, Feedback, Var Device, Reboot, and Total Faults.
- **Clear Faults** - Users may clear all faults from the board.

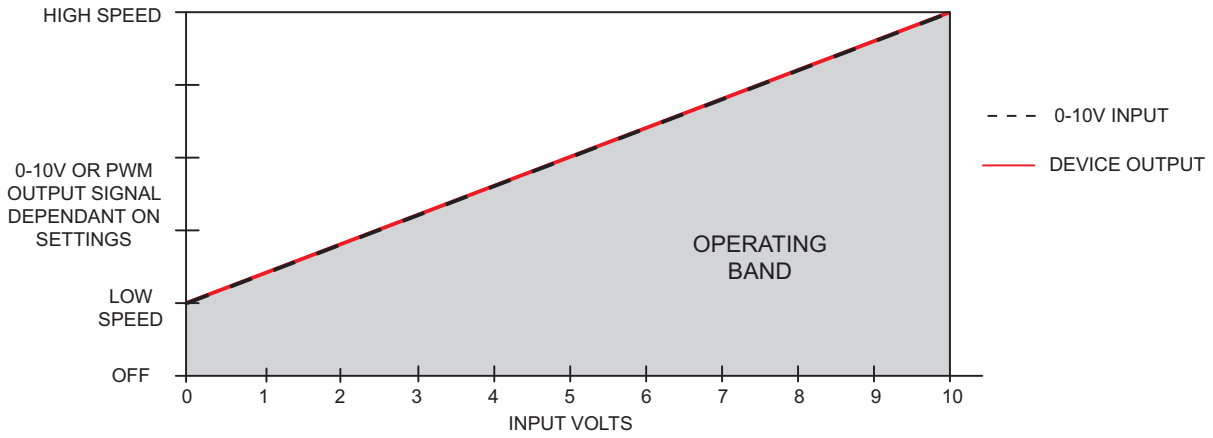
Service - This provides access to service settings. Password: 1234

- **Save T & B** - After the test & balance process has been completed, save adjustments under this menu.
- **IO Status** - Provides access to information about the inputs and outputs of the MSC board.
  - **V In** - Displays the incoming voltage (0-10V) to the MSC.
  - **V Out** - Displays the output voltage (0-10V) to the motor.
  - **RPM** - Displays motor RPM feedback. **Ziehl motors do not provide feedback.**
  - **PWM V** - Displays equivalent voltage reading of the PWM output to the motor.
  - **Speed%** - Displays PWM percentage output value to the motor.

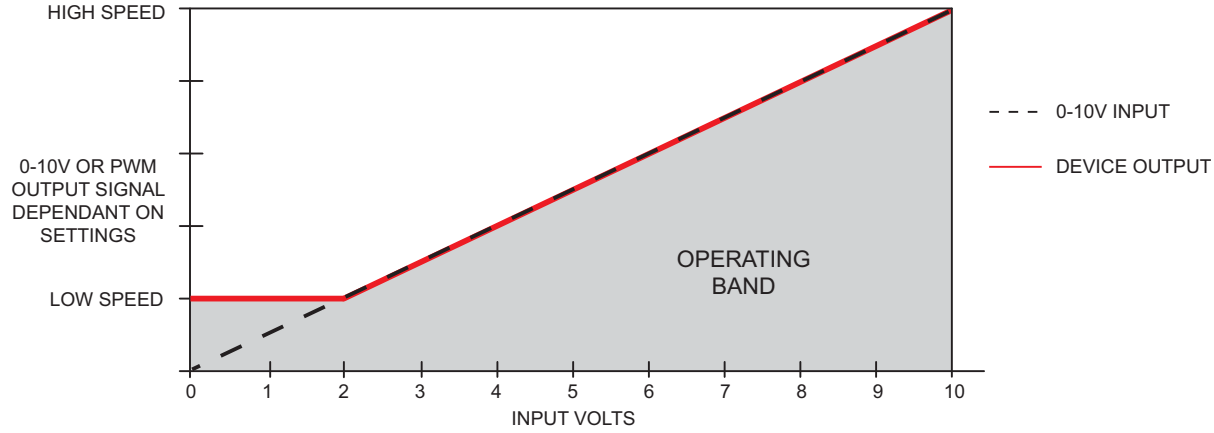
Input Threshold

Figure 11 - Input Threshold Examples

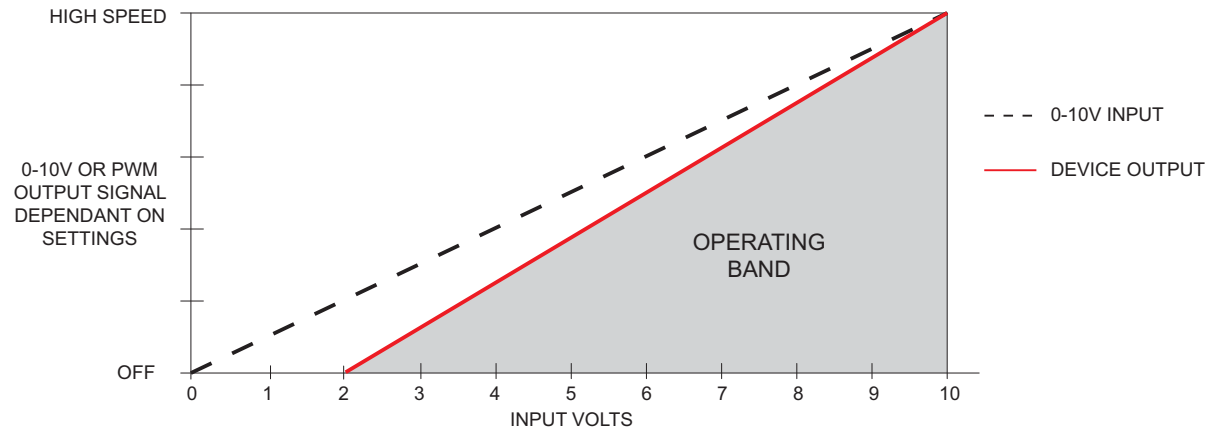
Factory Default: Zero operation set to low speed, threshold set to 0V.



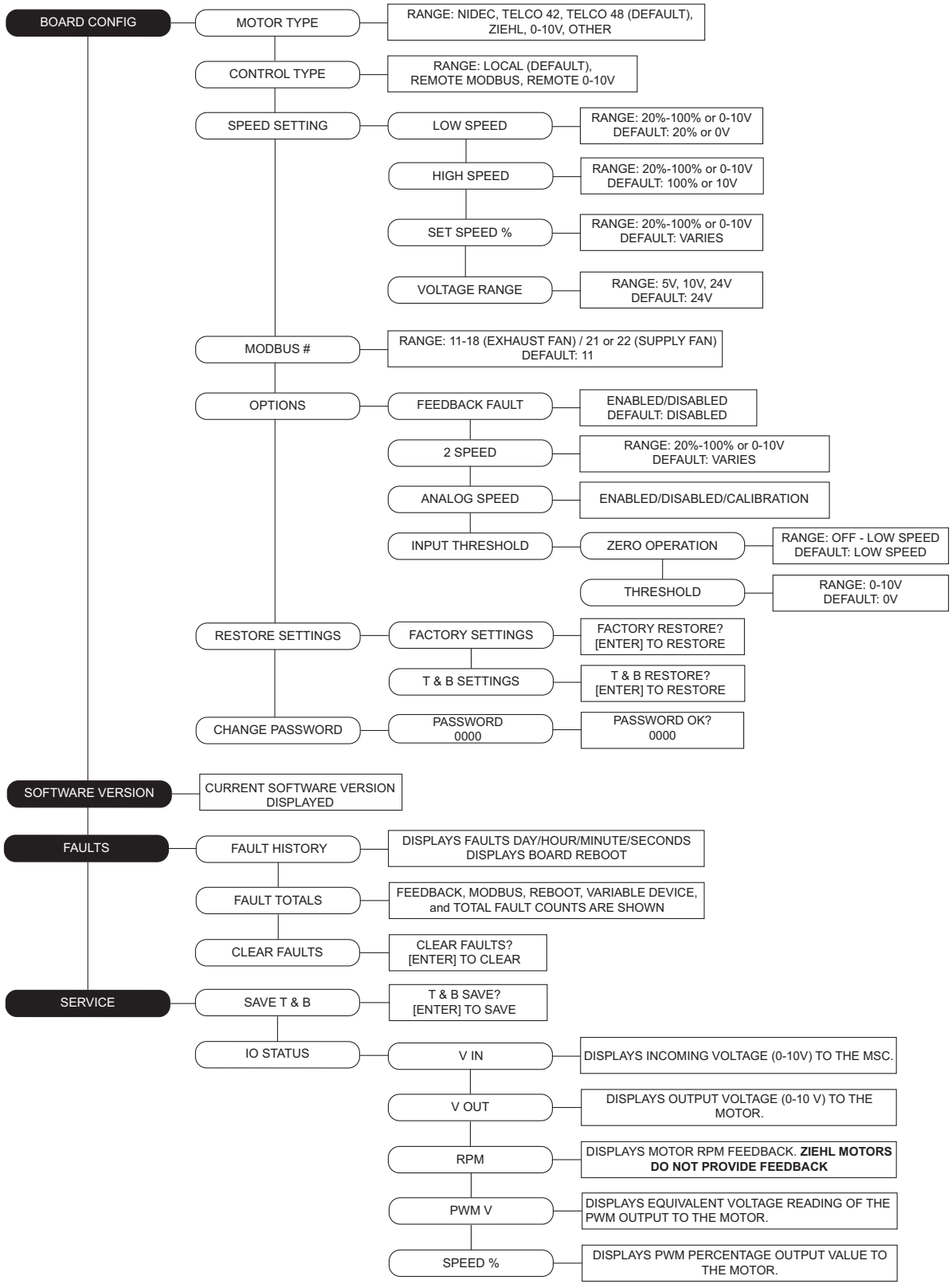
Zero operation set to low speed, threshold set to 2V.



Zero operation set to off, threshold set to 2V.



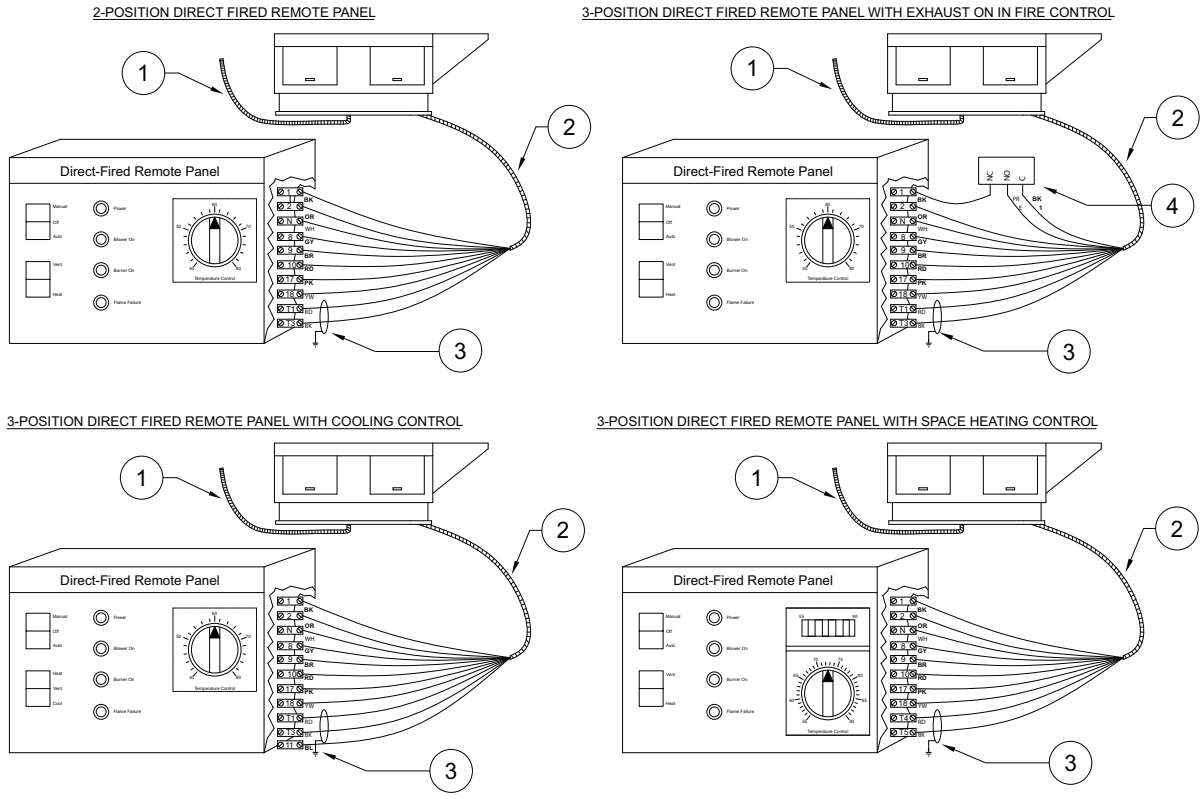
MSC Menu Tree



Remote Control Panel

On units shipped with the optional remote control panel, an electrical drop containing the panel wiring is provided with the heater. There is a terminal strip inside the remote panel that matches the terminals in the heater unit. The remote panel should be wired as shown in **Figure 12**. Wiring may vary by unit, refer to electrical schematics that were provided with your unit.

Figure 12 - Typical Remote Control Panel Wiring



1. Motor Connection
2. Control Connection
3. Shielded Cable
4. Fire System Micro-switch

Motorized Intake Damper

On units shipped with the optional motorized intake damper, a power transformer is supplied with the unit if the main incoming voltage is greater than 120V. The damper motor is automatically energized when the main disconnect switch is in the ON position. No external wiring to the damper motor is required.

Electric Cabinet Heater

On units shipped with an optional electric cabinet heater, ensure that the heater is wired to a separate 120V, 15 amp input, the thermostat sensing bulb is mounted correctly in the control vestibule where the heater is located, and the thermostat set to 0 Degrees Fahrenheit.

Variable Frequency Drive (VFD)

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

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

Table 5 - VFD Installation Check List

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

Variable Frequency Drive (VFD) Installation

Input AC Power

- Circuit breakers feeding the VFDs are recommended to be thermal-magnetic and fast-acting. They should be sized based on the VFD amperage and according to **Table 6 on page 24**. Refer to the installation schematic for exact breaker sizing.
- Every VFD should receive power from its own breaker. If multiple VFDs are to be combined on the same breaker, each drive should have its own protection measure (fuses or miniature circuit breaker) downstream from the breaker.
- Input AC line wires should be routed in conduit from the breaker panel to the drives. AC input power to multiple VFDs can be run in a single conduit if needed. **Do not combine input and output power cables in the same conduit.**
- The VFD should be grounded on the terminal marked PE. A separate insulated ground wire must be provided to each VFD from the electrical panel. This will reduce the noise being radiated in other equipment.

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

VFD Output Power

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

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

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

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

VFD Programming

Programming

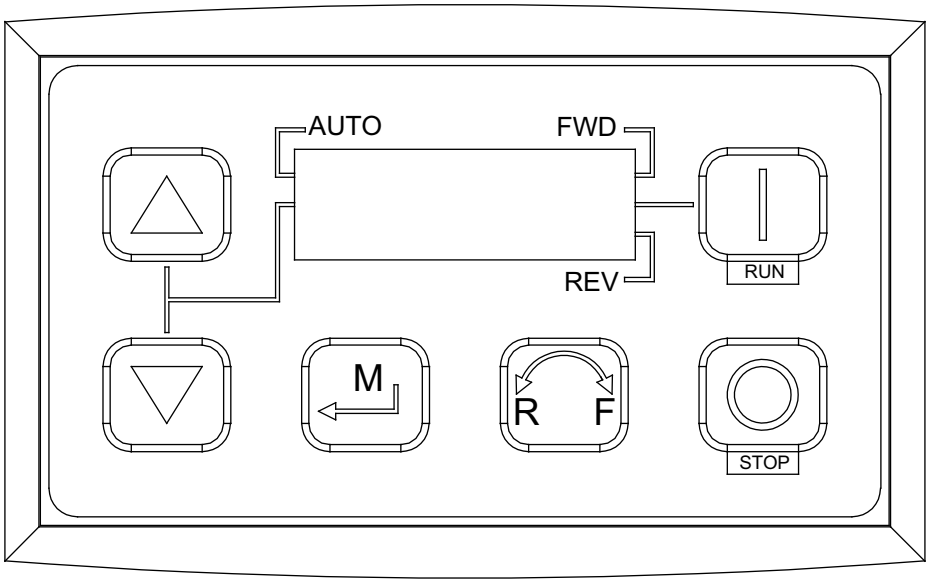
1. The Drive should be programmed for the proper motor voltage. P107 is set to 0 (Low) if motor voltage is 120V AC, 208V AC or 400V AC. P107 is set to 1 (High) if the motor voltage is 230V AC, 480V AC, or 575V AC.
2. The Drive should be programmed for the proper motor overload value. P108 is calculated as Motor FLA x 100 / Drive Output Rating (available in **Table 6 on page 24**).

To enter the PROGRAM mode to access the parameters:

1. Use the buttons on the VFD screen (**Figure 13**) to adjust VFD settings. Press the Mode (M) button. This will activate the password prompt (PASS).
2. Use the Up and Down buttons to scroll to the password value (the factory default password is “0225”) and press the Mode (M) button. Once the correct password is entered, the display will read “P100”, which indicates that the PROGRAM mode has been accessed at the beginning of the parameter menu.
3. Use the Up and Down buttons to scroll to the desired parameter number.
4. Once the desired parameter is found, press the Mode (M) button to display the present parameter setting. The parameter value will begin blinking, indicating that the present parameter setting is being displayed. The value of the parameter can be changed by using the Up and Down buttons.
5. Pressing the Mode (M) button will store the new setting and exit the PROGRAM mode. To change another parameter, press the Mode (M) button again to re-enter the PROGRAM mode. If the Mode button is pressed within 1 minute of exiting the PROGRAM mode, the password is not required to access the parameters. After one minute, the password must be re-entered to access the parameters again.

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

Figure 13 - VFD Screen



ACTECH SMV VFD

Table 6 - Cross Reference

HP	Part Number	Volts	1Ø Input	3Ø Input	Input Amps 1Ø 120V AC	Input Amps 1Ø 240V AC	Output Amps	Breaker 1Ø 120V AC	Breaker 1Ø 240V AC
0.5	ESV371N01SXB	120/240V	X	-	9.2	4.6	2.4	15	15
1	ESV751N01SXB	120/240V	X	-	16.6	8.3	4.2	25	15
1.5	ESV112N01SXB	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	ESV371N02YXB	240V	X	X	5.1	2.9	2.4	15	15
1	ESV751N02YXB	240V	X	X	8.8	5	4.2	15	15
1.5	ESV112N02YXB	240V	X	X	12	6.9	6	20	15
2	ESV152N02YXB	240V	X	X	13.3	8.1	7	25	15
3	ESV222N02YXB	240V	X	X	17.1	10.8	9.6	30	20
5	ESV402N02TXB	240V	-	X	-	18.6	16.5	-	30
7.5	ESV552N02TXB	240V	-	X	-	26	23	-	40
10	ESV752N02TXB	240V	-	X	-	33	29	-	50
15	ESV113N02TXB	240V	-	X	-	48	42	-	80
20	ESV153N02TXB	240V	-	X	-	59	54	-	90
1	ESV751N04TXB	480V	-	X	-	2.5	2.1	-	15
1.5	ESV112N04TXB	480V	-	X	-	3.6	3	-	15
2	ESV152N04TXB	480V	-	X	-	4.1	3.5	-	15
3	ESV222N04TXB	480V	-	X	-	5.4	4.8	-	15
5	ESV402N04TXB	480V	-	X	-	9.3	8.2	-	15
7.5	ESV552N04TXB	480V	-	X	-	12.4	11	-	20
10	ESV752N04TXB	480V	-	X	-	15.8	14	-	25
15	ESV113N04TXB	480V	-	X	-	24	21	-	40
20	ESV153N04TXB	480V	-	X	-	31	27	-	50
25	ESV183N04TXB	480V	-	X	-	38	34	-	70
30	ESV223N04TXB	480V	-	X	-	45	40	-	80
40	ESV303N04TXB	480V	-	X	-	59	52	-	100
50	ESV373N04TXB	480V	-	X	-	74	65	-	125
60	ESV453N04TXB	480V	-	X	-	87	77	-	150
1	ESV751N06TXB	600V	-	X	-	2	1.7	-	15
2	ESV152N06TXB	600V	-	X	-	3.2	2.7	-	15
3	ESV222N06TXB	600V	-	X	-	4.4	3.9	-	15
5	ESV402N06TXB	600V	-	X	-	6.8	6.1	-	15
7.5	ESV552N06TXB	600V	-	X	-	10.2	9	-	20
10	ESV752N06TXB	600V	-	X	-	12.4	11	-	20
15	ESV113N06TXB	600V	-	X	-	19.7	17	-	30
20	ESV153N06TXB	600V	-	X	-	25	22	-	40
25	ESV183N06TXB	600V	-	X	-	31	27	-	50
30	ESV223N06TXB	600V	-	X	-	36	32	-	60
40	ESV303N06TXB	600V	-	X	-	47	41	-	70
50	ESV373N06TXB	600V	-	X	-	59	52	-	90
60	ESV453N06TXB	600V	-	X	-	71	62	-	110

START-UP OPERATION

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

Special Tools Required: Standard Hand Tools, AC Voltage Meter, Tachometer, Amperage Meter, Manometer, Differential Pressure Gauge

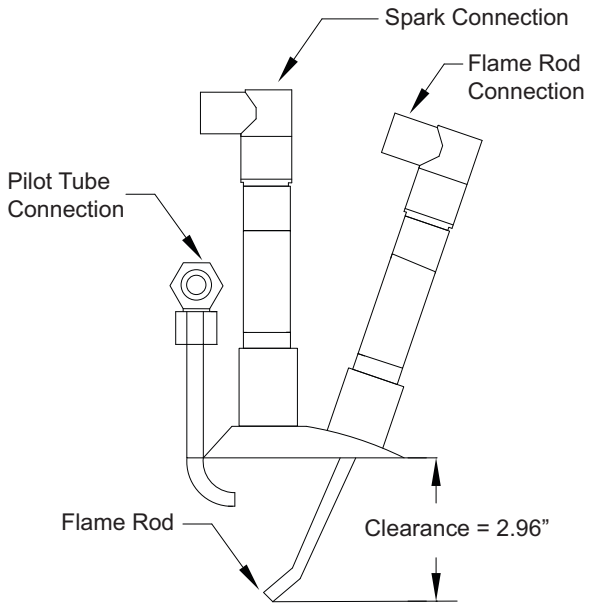
Start-up Procedure

1. Check all electrical connections are secure and tight.
2. Check pulley alignment and belt tension. Refer to **"Pulley Alignment/Proper Belt Tension" on page 30**.
3. Inspect the condition of the intake damper and damper linkage, if applicable.
4. Remove intake filters if not already installed, inspect the air stream for obstructions. Install intake filters.
5. Compare the supplied **motor voltage** with the fan's nameplate voltage. If this does not match, correct the problem.
6. Place the external disconnect to the **ON** position to start the unit. Immediately place the disconnect switch off. **Check the rotation of the fan** with the directional arrow on the blower scroll. Reversed rotation will result in poor air performance, motor overloading and possible burnout. For units equipped with a single-phase motor, check the motor wiring diagram to change rotation. For 3-phase motors, any two power leads can be interchanged to reverse motor direction.
7. When the fan is started, observe the operation and check for any unusual noises.
8. Place the external disconnect switch back to the **ON** position. The system should be in full operation with all ducts attached. Measure the system airflow. The motor sheave (pulley) is variable pitch and allows for an increase or decrease of the fan RPM. If an adjustment is needed, refer to **"Pulley Adjustment" on page 29**. Refer to **"Pulley Combination Chart" on page 28** for adjustment specifications.
9. Once the proper airflow is achieved, measure and record the fan speed with a reliable tachometer. **Caution - Excessive speed will result in motor overloading or bearing failure. Do not set fan RPMs higher than specified in the maximum RPM chart.** Refer to **"Troubleshooting" on page 37** for more information.
10. Measure and record the **voltage** and **amperage** to the motor. Compare with the motor's nameplate to determine if the motor is operating under safe load conditions. Once the RPM of the ventilator has been properly set, disconnect power. Re-check belt tension and pulley alignment, refer to **"Pulley Alignment/Proper Belt Tension" on page 30**.

Pilot Adjustment

1. Restart the fan and check the gas supply pressure at the inlet gas gauge upstream of all electronic valves. The inlet pressure should be **5-14 inches wc**. If the inlet pressure is too high, install an additional pressure regulator external to the unit.
2. Open the field-installed manual gas shut-off valve and the manual main gas valve on the combination gas control valve.
3. Close the ball valve located inside the cabinet.
4. Call for heat with the intake air thermostat (turn set-point to temperature above outside air) and allow the pilot to light. If the pilot does not light, purge the pilot line. If air purging is required, disconnect the pilot line at the outlet of the pilot valve.
5. Check the **pilot flame voltage** at the Flame Safety Control interface test jacks. A weak pilot flame can be caused by low gas pressure, or a dirty pilot orifice.
6. To adjust the pilot flame, remove the cap from the pilot adjustment screw on the combination gas valve. Increase the pilot gas flow by turning the screw counter-clockwise. Decrease the pilot gas flow by turning the screw clockwise. The pilot DC voltage should read **12V DC minimum and should typically be 15V DC**.
7. Once the pilot has been established, open the main manual gas shut-off valve downstream of the electronic valves. Check to make sure that the main gas valve opens, and gas flows to the burner.

Figure 14 - Pilot Assembly



Main Burner Adjustment

1. Once the pilot has been properly established, the manifold gas pressure or temperature rise should be adjusted to nameplate or design specifications. The gas pressure regulator is adjusted at the factory for average gas conditions. It is important that the gas supplied to the burner is in accordance with the input rating on the rating plate. **See "Gas Pressure" on page 10.**
2. Create a high fire call for heat. This should be done with the blower on and all gas controls on. High fire can be achieved by removing the wire at terminal #4 (remove wires #2 and #4 for Maxitrol 44 systems) from the Maxitrol 14 amplifier.
3. The manifold pressure should be checked at the pressure gauge downstream of the modulating valve. **Figure 16** indicates the proper manifold pressure for the desired amount of BTUs per foot of burner. For natural gas systems, the high fire manifold pressure should not exceed **5 inches wc**. For propane gas, the high fire manifold pressure should not exceed **2.5 inches wc**. Another method of checking high fire is to measure the temperature rise of the unit. The temperature rise should be set to design specifications and typically is minimum 70°F.
4. Every unit has a specific design manifold gas pressure based on CFM and temperature rise. Refer to the unit's nameplate for the design manifold gas pressure.
5. Remove the cap from the combination gas valve for regulator adjustment.
6. Use the regulator pressure adjusting screw to adjust the high fire manifold pressure to design temperature rise (**5 inches wc** maximum for natural gas and **2.5 inches wc** maximum for propane gas). High fire should be set to generate the design temperature rise. If the high fire screw is at the end of its adjustment and more pressure is needed, then adjust the main building gas pressure regulator spring (located external to the unit) to achieve the proper manifold pressure. Turning the regulator screw clockwise will increase pressure and counter-clockwise will decrease pressure.
7. Reconnect the wire on the Maxitrol 14 amplifier at terminal #4 (wires #2 and #4 for Maxitrol 44).
8. The low fire manifold pressure must now be set. Low fire can be achieved by removing the wire at terminal #5 from the Maxitrol 14 amplifier (remove #8 for Maxitrol 44).
9. Locate the bypass screw (under the cap of the valve - location #1), refer to **Figure 15**.
10. Adjust the low fire manifold pressure until there is a very thin flame along the entire length of the burner. No dark spots should be seen in the burner. The burner may be observed through the view-port located on the external wall of the heater. Replace the cap to the valve. Make sure all wiring and gas components are connected and operational.
11. A final gas leak check shall be performed to verify the gas-tightness of the heater's components and piping under normal operating conditions. This can be done by measuring the gas pressure at the 1/4" gas plug just downstream of the modulating valve.

Figure 15 - High Fire/Low Fire Bypass Screw Setting

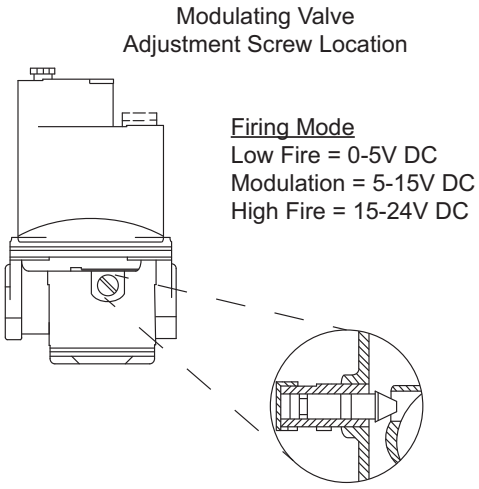
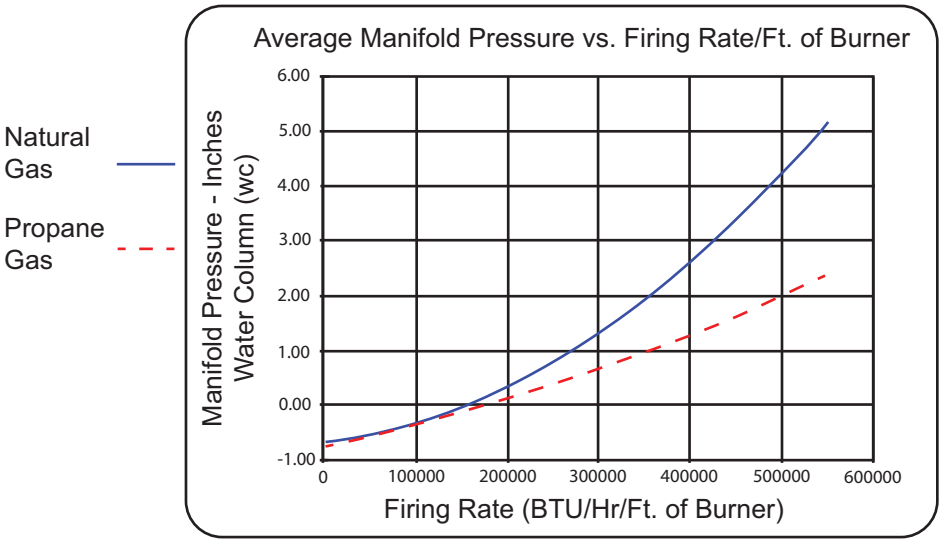


Figure 16 - Pressure vs. Firing Rate



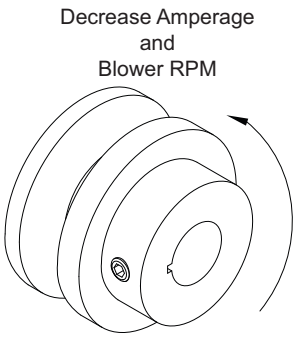
Final Start-up Procedure

1. With the air and burner systems in full operation and all ducts attached, measure the system airflow. The motor sheave (pulley) is variable pitch and allows for an increase or decrease of the fan RPM. If an adjustment is needed, refer to **"Pulley Adjustment" on page 29**.
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 RPM higher than specified in the maximum RPM chart.** See the troubleshooting guide for more information.
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. Once the rpm of the wheel has been properly set, disconnect power and recheck belt tension and pulley alignment, refer to **Figure 18**.

Pulley Adjustment

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

Figure 17 - Adjustable Pulley



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

Table 7 - Maximum RPM and HP Chart

Blower Size	Maximum RPM	Maximum HP
7”	2400	2

Pulley Alignment/Proper Belt Tension

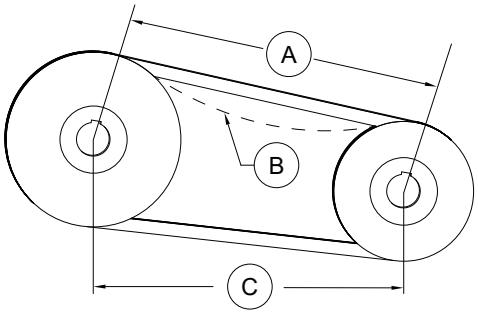
1. Belts tend to stretch and settle into pulleys after an initial start-up sequence. **Do not tension belts by changing the setting of the motor pulley**, this will change the fan speed and may damage the motor.
   - To re-tension belts, turn OFF power to the fan motor.
   - Loosen the fasteners that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

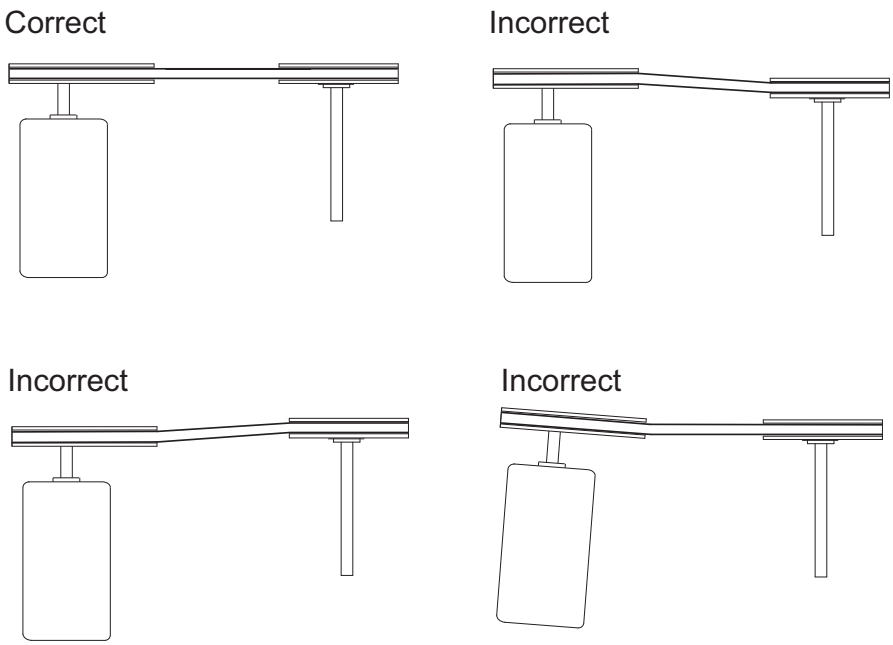
Belt tension examples:

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

Figure 18 - Pulley Alignment/Belt Tension

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





Pulley Combination Chart

Table 8 - 7” Blower Pulley Chart

Motor RPM **1725**

1/3 to 1-1/2 HP AX BELTS		**MOTOR PULLEY 1VP50**	**Dd1 3.4**	**Dd2 4.4**	**Pd1 3.6**	**Pd2 4.6**							
BLOWER PULLEY	DATUM DIAMETER	PITCH DIAMETER	Open			TURNS ON MOTOR PULLEY							Closed
			5	4 1/2	4	3 1/2	3	2 1/2	2	1 1/2	1	1/2	0
AK32H	3	3.2	1941	1995	2048	2102	2156	2210	2264	2318	2372	2426	2480

1/3 to 1-1/2 HP AX BELTS		**MOTOR PULLEY 1VL44**	**Dd1 2.8**	**Dd2 3.8**	**Pd1 3**	**Pd2 4**							
BLOWER PULLEY	DATUM DIAMETER	PITCH DIAMETER	Open			TURNS ON MOTOR PULLEY							Closed
			5	4 1/2	4	3 1/2	3	2 1/2	2	11/2	1	1/2	0
AK32H	3	3.2	1617	1671	1725	1779	1833	1887	1941	1995	2048	2102	2156

1/3 to 2 HP AX BELTS		**MOTOR PULLEY 1VL40**	**Dd1 2.4**	**Dd2 3.4**	**Pd1 2.6**	**Pd2 3.6**							
BLOWER PULLEY	DATUM DIAMETER	PITCH DIAMETER	Open			TURNS ON MOTOR PULLEY							Closed
			5	4 1/2	4	3 1/2	3	2 1/2	2	1 1/2	1	1/2	0
AK66	6.2	6.4	701	728	755	782	809	836	863	889	916	943	970
AK54	5	5.2	863	896	929	962	995	1028	1062	1095	1128	1161	1194
AK46	4.2	4.4	1019	1059	1098	1137	1176	1215	1255	1294	1333	1372	1411
AK39	3.5	3.7	1212	1259	1305	1352	1399	1445	1492	1539	1585	1632	1678
AK32	3	3.2	1402	1455	1509	1563	1617	1671	1725	1779	1833	1887	1941

Sequence of Operation

To better understand the heater, it is easier to break the unit out into smaller individual systems. There are two main systems, a make-up air fan, and a heater. The make-up air fan consists of a blower and motor. The heater may be further broken down into two control systems, the Flame Safety Control (FSC) and the Modulating Gas System (MGS). The burner mixes air with the gas (Natural or LP), which heats the air.

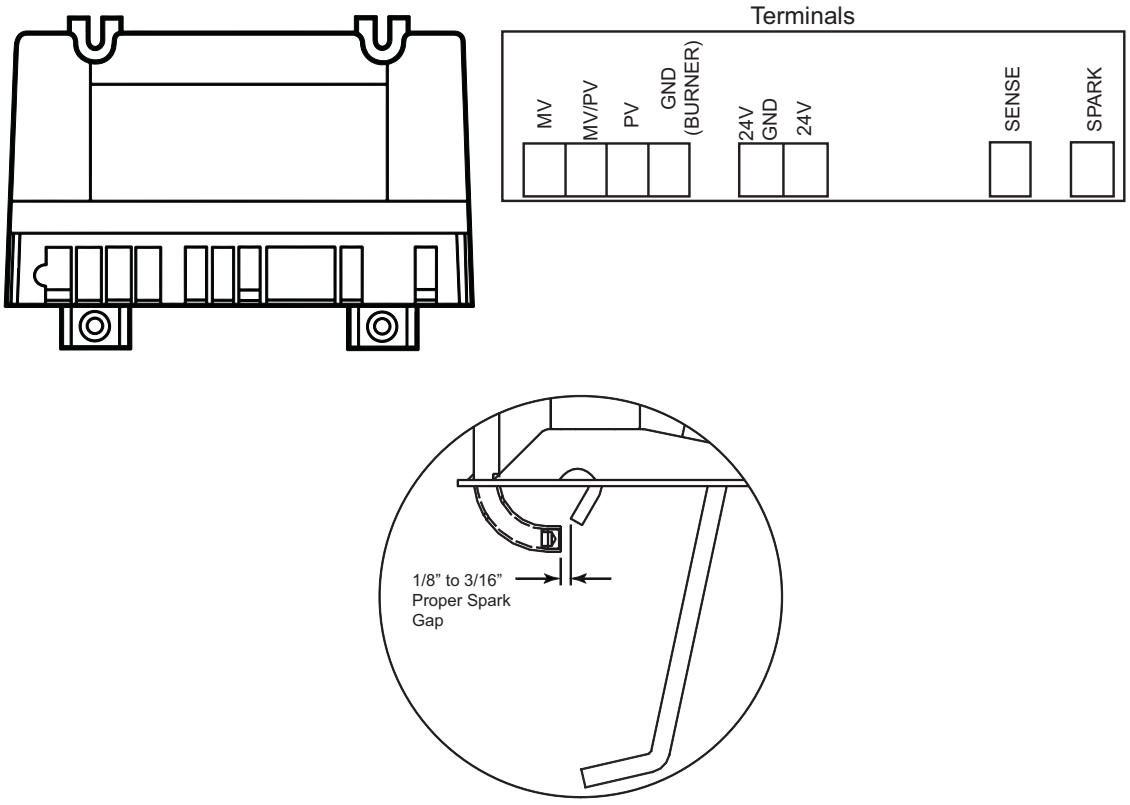
Flame Safety Control

The first system to understand is the Flame Safety Controller. The FSC is there ***only*** to monitor the flame, **NOT** to control the temperature. The FSC uses a flame rectification sensor mounted on the pilot assembly to detect the presence of flame in the burner.

The FSC also works with the airflow sensor, which relays if there is proper airflow through the unit (not *just* any airflow, but *proper* airflow). Proper airflow occurs when there is a **.15" w.c. to .80" w.c. differential pressure drop across the burner**. The FSC controls the opening of the redundant solenoid gas valves and the operation of the spark igniter to initiate a pilot flame upon start-up.

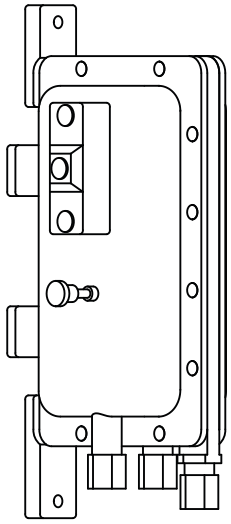
Upon a call for heat, there is a 15 second Pilot Trial For Ignition (PTFI). During PTFI, the FSC opens the pilot gas valve and allows gas to flow to the pilot assembly. At the same moment, the spark igniter is started, causing the spark to ignite the pilot gas. When the flame rod sensor detects the flame it powers the modulating gas system. This is the normal operating mode. The FSC continues to monitor the flame and airflow. Once this occurs, the unit is in a main flame cycle and thus powers the main gas valve and the modulating gas system. This is the normal operating mode. The FSC continues to monitor the flame and airflow. If the flame fails to light after 15 seconds of sparking, the FSC goes in to lock-out mode. Anytime this occurs, the problem must be diagnosed and corrected to avoid future lockouts after resetting. To begin troubleshooting, or to reset the FSC, shut down power to the heater and restart the heater. This will clear the alarm from the flame safety.

Figure 19 - Flame Safety Controller



Air Flow Switch

Figure 20 - Air Flow Switch

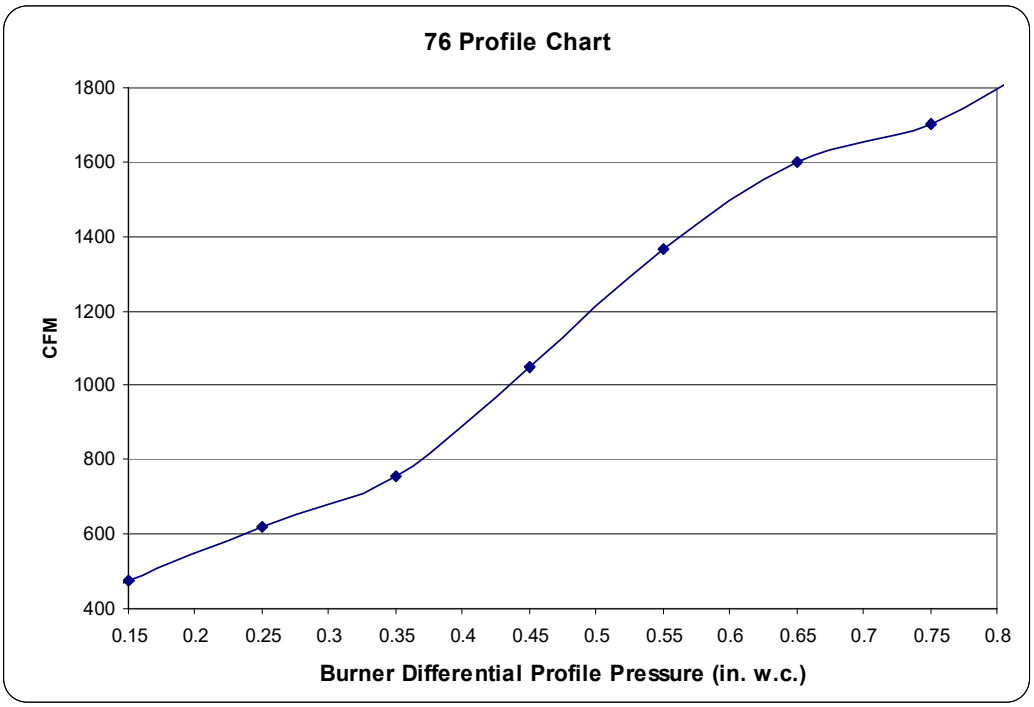


There are both high and low **airflow switches** contained within one housing (**Figure 20**) measuring the pressure drop across the burner. This is to ensure that there is proper airflow **(.15 inches wc to .80 inches wc**) across the burner and proper combustion at all times. Both switches are wired in series and have single pole double throw (one common contact, one normally open contact, and one normally closed contact) switches that are 'switched' by air pressure.

There are two airflow tubes in the heater, located near the burner and profile plate assembly (profile plates surround the burner and control air into the burner section). In the case of clogged filters, blocked intake, excessive duct static pressure, or a broken belt, the correct burner differential pressure may not be achieved, not allowing the low airflow switch to close. The high airflow switch protects against profile plate failures that cause excessive airflow through the burner. In the event that the pressure drop across the burner is not in the range of the airflow switch, gas flow to the burner is stopped by the Flame Safety Control.

The graph in **Figure 21** illustrates the approximate CFM going through the unit vs. the differential pressure measured by the airflow switch. Simply measure the differential profile pressure drop at the airflow tubes in the unit and match that value up to the matching unit curve below. This will show the CFMs traveling through the burner and will indicate proper airflow or airflow problems (too much or not enough). **If the pressure drop is outside of the .15" to .80" range, the blower RPM should be adjusted to fix airflow**.

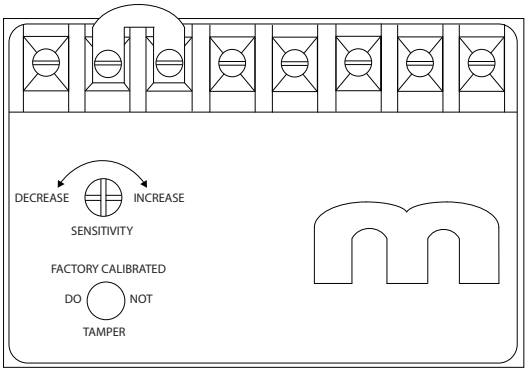
Figure 21 - CFM Charts



Modulating Gas System

The second system, the **modulating gas system,** consists of a temperature selector dial, a discharge air sensor, an amplifier, and a modulating gas valve. The two types of modulating gas systems used are the Maxitrol 14 or RTC Solutions controls and the Maxitrol 44 series. The Maxitrol 14/RTC utilizes a discharge air sensor and modulates the Maxitrol gas valve to provide discharge air to match the selected temperature on the temperature selector. The Maxitrol 44 utilizes a room temperature sensor to control room temperature as well as a discharge air sensor in order to control the discharge air temperature. The modulating gas valve controls the amount of gas flow to the burner based on the temperature rise needed. When the modulating gas valve is all the way open and achieving the maximum BTUs and temperature rise of the unit, it is called “high fire”.

Figure 22 - Maxitrol 14 Amplifier

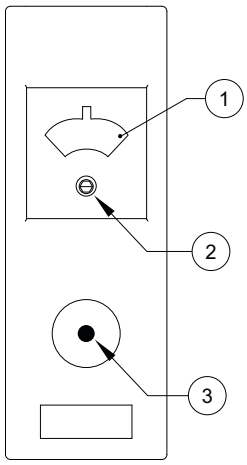


High Temperature Limit

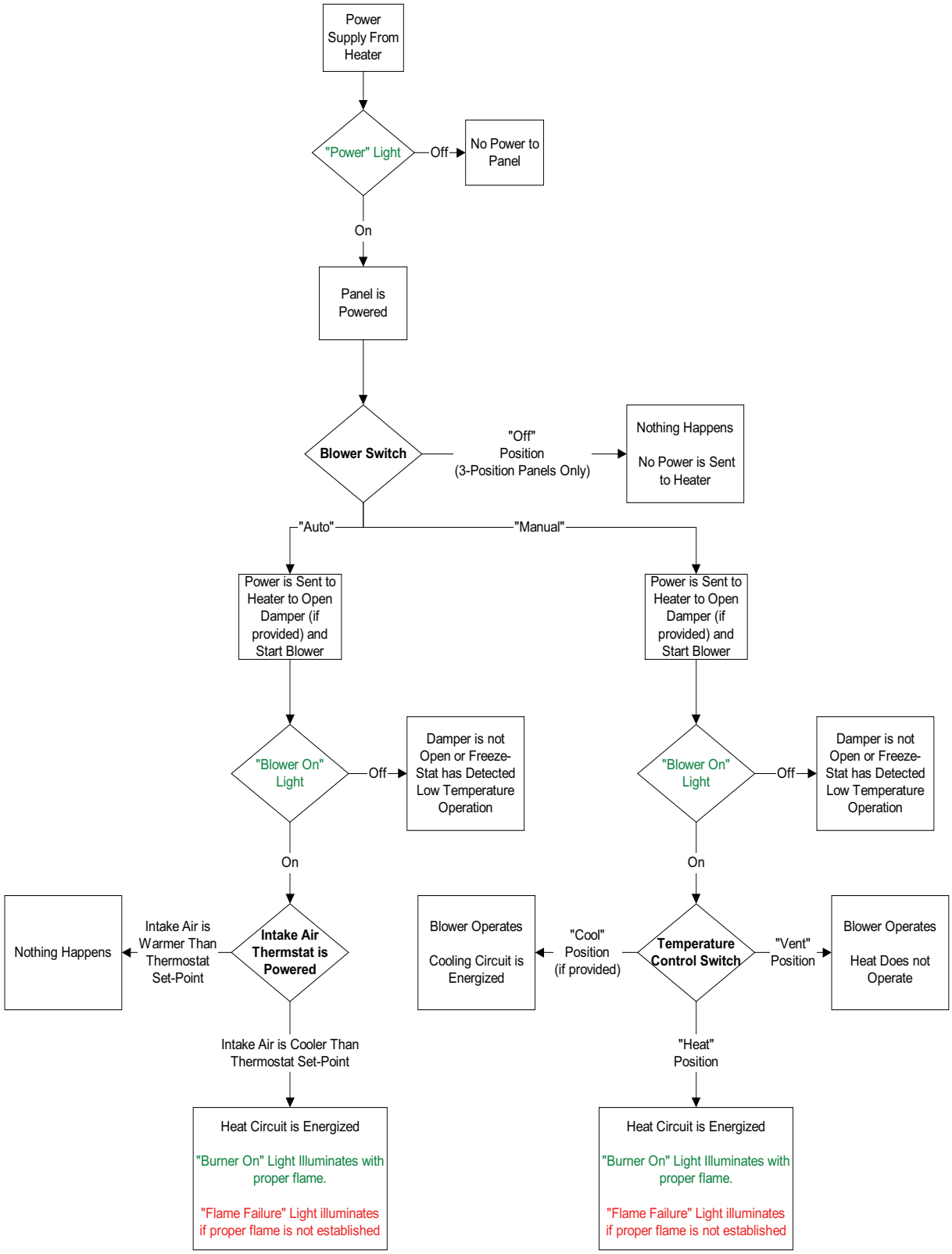
One of the backup safety devices is the **high temperature limit** switch. This switch is a mechanical thermostat that measures the temperature inside the unit downstream of the burner. If the factory-set temperature of **180°F** is exceeded, it will signal the FSC to turn off the burner. This requires a manual reset of the high temperature limit. This ensures that the discharge does not exceed 185°F.

Figure 23 - High Temperature Limit Control

1. Temperature Setting
2. Adjustment Screw
3. Manual Reset Button



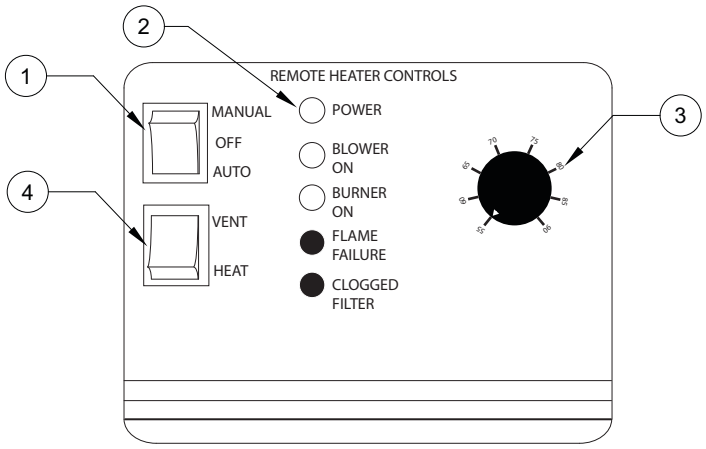
Optional Remote Panel Circuit



Remote Panel Option

The remote panel is a device used to control the operation of the heater from a remote location. This unit is available in both a “2 Position” and “3 Position” configuration, and with or without a cooling output. It also will accommodate both discharge and space heating configurations. It is important to understand the following remote panel controls and uses:

Figure 24 - Remote Heater Controls



1. **Manual/Off/Auto Switch** - Used to control blower operation and tempering mode of unit. The **AUTO** position allows the unit to “decide”, through the use of the intake air thermostat, whether or not heating is needed. The **MANUAL** position allows the user to control whether or not heat is needed. The **OFF** position will turn the blower off when a “3 Position” remote panel is ordered. The **OFF** position will disable all temperature controls when a “2 Position” remote panel is ordered and fan power is then controlled by the pre-wire package only.
2. **Lights** - Displays the current status of unit features. The light definitions are as follows:

   POWER - Illuminated when there is power to the remote panel.

   BLOWER ON - Illuminated when the blower motor is powered.

   BURNER ON - Illuminates after pilot flame has established and main valve is powered.

   FLAME FAILURE - Illuminated when the Flame Safety Control is in alarm mode.

   CLOGGED FILTER – (Optional) Illuminated when the intake filters are dirty.
3. **Temperature Control** - Controls the discharge temperature of a standard unit. The temperature dial is replaced with a Maxitrol Selectrastat in space heating applications and is used to control the space temperature.
4. **Heat/Vent Switch** - This switch is powered when the Manual/Off/Auto switch is in the **MANUAL** position. It is used to control the tempering mode of the unit. The **VENT** position will prevent the burner from operating and the heater will deliver untempered air. The **HEAT** position will force the burner on and the unit will heat the incoming air. This switch becomes a Heat/Vent/Cool switch when the cooling interlock is ordered. This option provides a 120V cooling output from the remote panel.

Troubleshooting

The following table lists causes and corrective actions for possible problems with the fan units. Review this list prior to consulting manufacturer. The following table lists causes and corrective actions for possible problems with the fan units. Review this list before consulting manufacturer.

Airflow Troubleshooting Chart

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

Burner Troubleshooting

Table 9 - Burner Troubleshooting Chart

Problem	Potential Cause	Corrective Action
Pilot Does Not Light/Stay Lit	Main gas is off	Open main gas valve.
	Air in gas line	Purge gas line.
	Dirt in pilot orifice	Clean orifice with compressed air.
	Gas pressure out of range	Adjust to proper gas pressure.
	Pilot valve is off	Turn pilot valve on.
	Leak at pilot orifice	Tighten pilot orifice.
	Excessive drafts	Redirect draft away from unit.
	Safety device has cut power	Check limits and airflow sensor.
	Dirty flame sensor	Clean flame sensor.
	No call for heat	Adjust heat setpoint.
	No spark at igniter	Check wiring, sensor, and ignition controller. Check spark gap, refer to **Figure 19 on page 32**.
Main Burner Does Not Light (Pilot is lit)	Defective valve	Replace combination valve.
	Loose valve wiring	Check wiring to valve.
	Defective flame rod	Replace flame rod.
	Shut off valve closed	Open shut off valve.
	Defective flame safety controller	Replace flame safety controller.
	Pilot fails as main gas valve opens, and main gas flows.	Plug the first burner port next to the pilot gas tube with burner cement.
Not Enough Heat	Main gas pressure too low	Increase main gas pressure - do not exceed 14 inches wc inlet pressure(5-14” wc).
	Too much airflow	Decrease airflow if possible.
	Burner undersized	Check design conditions.
	Gas controls not wired properly	Check wiring.
	Heat setpoint too low	Increase heat setpoint.
	Thermostat malfunction	Check Wiring. Replace Thermostat.
	Unit locked into low fire	Check wiring.
Too much heat	Defective modulating gas valve	Check/replace modulating valve.
	Heat setpoint too high	Decrease heat setpoint.
	Unit locked into high fire	Check wiring.
	Thermostat malfunction	Check Wiring. Replace Thermostat.

Remote Panel Troubleshooting Chart

Table 10 - Troubleshooting Chart

Light Indication	Condition	Possible Cause
No Lights	Power not available to remote panel	Incorrect voltage to unit.
		Main disconnect switch in “OFF” position.
		Circuit breaker tripped.
		Faulty main transformer.
Power Light Only	Proper unit - Off operation	No correction required.
	No power to motor starter	Manual/Off/Auto switch in “Off” position (3 position remote panels only).
		Improper damper function.
		Low temperature thermostat timed out (optional).
Power Light and Blower On Light	Proper ventilation operation	No correction required.
	No power to flame safety controller	Manual/Off/Auto switch in “Off” position (2 position remote panels only).
		Heat/vent switch in “Vent” position.
		Gas pressure switch tripped (option).
		High temperature limit thermostat tripped
		Manual/Off/Auto switch in “Auto” position and intake air thermostat not satisfied.
	Improper Airflow	Excessive airflow.
		Faulty airflow switch.
		Issue with air probes and/or tubing
		Broken belt.
		Dirty air filters. Replace as needed.
Power Light, Blower On Light, and Burner On Light	Proper heating operation	No correction required.

MSC Troubleshooting

Fault	Problem	Potential Cause	Corrective Action
Feedback Fault	Feedback Fault on MSC Display	Disconnected/faulty wiring	Secure connections to fan. If faulty wiring is found, repair or replace as required.
		No feedback for 30 seconds	Check parameters
		Less than 70% of RPM	Check duct/fan for obstructions.
Modbus	Modbus fault on MSC Display	Faulty Cat 5 connection/cable	Find and replace faulty cable
		ECPM03 does not recognize device	Verify Modbus # on device is set correctly.
Variable Device Fault	Motor not responding to changes made on variable device (potentiometer)	Defective potentiometer	Replace potentiometer
		Faulty wiring to motor	Find and replace faulty wiring.
Motor not responding	Motor not functioning as expected	2-Speed switch not working	Check switch and wiring.
		Wiring to motor defective	Find and replace faulty wiring.
		Check for other faults on MSC display	If no other faults are present, motor maybe defective.

TURN OFF POWER TO THE MOTOR WHILE PROGRAMMING THIS DEVICE.

- If the device has a potentiometer or a 2-Speed switch, a jumper wire can be placed in between the 10V In and 10V Out terminals to rule out a defective device. This will cause the motor to go to HIGH SPEED.
- The IO STATUS menu can be used to verify the inputs and outputs of the device are functioning as expected.
- The FAULT HISTORY menu can be used to keep track of faults while working on the device.

MAINTENANCE

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

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

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

General Maintenance

1. Fan inlet and approaches to ventilator should be kept clean and free from any obstruction.
2. All fasteners and electrical connections should be checked for tightness each time maintenance checks are performed before restarting unit.
3. These units require very little attention when moving clean air. Occasionally oil and dust may accumulate, causing imbalance. If the fan is installed in a corrosive or dirty atmosphere, periodically inspect and clean the wheel, inlet, and other moving parts to ensure smooth and safe operation.
4. Motors are normally permanently lubricated. **Caution: Use care when touching the exterior of an operating motor. Components may be hot enough to burn or cause injury.**
5. If bearings require lubrication, very little is needed. A general rule is one-half pump from a grease gun for 1/2” to 1-7/16” shaft diameters and one full pump for 1-11/16” and large diameter shafts for every 1500 to 3000 hours of operation. A lithium-based grease should be used. Bearings should be rotated as they are lubricated to evenly distribute the grease, either by hand or via extended grease lines. Do not attempt to grease bearings from inside the enclosure while the motor is energized. **Caution: Bearings are sealed, over-greasing can cause damage to the bearings. Do not grease until grease comes out of seals. Only add the appropriate amount of grease.**

2 Weeks After Start-up

1. Belt tension should be checked after the first 2 weeks of fan operation. **See “Pulley Alignment/ Proper Belt Tension” on page 30.**
2. All fasteners should be checked for tightness each time maintenance checks are performed before restarting unit.

Every 3 Months

1. Belt tension should be checked quarterly. **See “Pulley Alignment/Proper Belt Tension” on page 30.** Over-tightening will cause excessive bearing wear and noise. Too little tension will cause slippage at start-up and uneven wear.
2. Filters need to be cleaned and/or replaced quarterly, and more often in severe conditions. Washable filters can be washed in warm soapy water. When re-installing filters, be sure to install with the **airflow in the correct direction** as indicated on the filter.

Yearly

1. Inspect bearings for wear and deterioration. Replace if necessary.
2. Inspect belt wear and replace torn or worn belts.
3. Inspect bolts and set screws for tightness. Tighten as necessary.
4. Inspect motor for cleanliness. Clean exterior surfaces only. Remove dust and grease from the motor housing to ensure proper motor cooling. Remove dirt from the wheel and housing to prevent imbalance and damage.
5. Check for gas leak and repair if present.
6. Clean flame sensor by rubbing with steel wool to remove any rust build-up.
7. Inspect burner assembly. Refer to **“Burner Maintenance” on page 42**.

Table 11 - Filter Quantity Chart

Intake	16” x 20”
76	1

Burner Maintenance

1. Verify the unit is off.
2. Inspect the pilot assembly, refer to **“Pilot Assembly” on page 26**. Replace if required.
3. Inspect the burner plates.
4. Clean the burner plates. Make sure the baffles are secure and attached to the burner.
5. Clean burner with wire brush and make sure the burner ports are free of debris. Refer to **Table 12** for drill size(s) to clear ports. Wipe the burner with a clean rag.
6. After cleaning the system, turn the system. Visually inspect the flame.

Table 12 - Burner Orifice Drill Size

Orifice	Drill Size
Gas Port	1/8”
Air Port	42

Re-Setting of the Unit

If the flame safety control is locked out (alarm light on), reset the unit by:

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

Emergency Shutdown of Unit

To shutdown 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.

Notes

Start-Up and Maintenance Documentation

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

Job Information

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

Heater Information

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

Name Plate and Unit Information		**Field Measure Information**	
Model Number		Motor Voltage	
Serial Number		Motor Amperage**	
Hardware Rev.		RPM	
Software Rev.		Burner Differential Pressure	Inches WC
Motor Volts		Pilot Flame Signal	VDC
Motor Hertz		Low Fire Flame Signal	VDC
Motor Phase		High Fire Flame Signal	VDC
Motor FLA		High Fire Inlet Gas Pressure	Inches WC
Motor HP		Low Fire Manifold Gas Pressure	Inches WC
Blower Pulley		High Fire Manifold Gas Pressure	Inches WC
Motor Pulley		Thermostat Set Point	
Belt Number		Gas Type	
Min. Btu/Hr			
Max. Btu/Hr			
Gas Type			

Temperature Control	Discharge	
	Space	
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