Residential Air Handlers Before 2023

Field Reference Guide

September 2023

Johnson Controls

Table of Contents

Introduction	3
Safety	8
Component Familiarization	14
Installation	32
Start-up	56
Inputs & Operation	64
Troubleshooting	73
Appendix	95

01

Introduction

Available Models

Ducted Systems air handlers are available in two configurations: single piece and modular. Each of these configurations can be ordered with a PSC (before 2021), Standard ECM, or communications-capable variable speed ECM blower motor.

"Flex" air handlers and coils are shipped without a factory installed metering device. An R-22(older models) or R- 410A TXV or orifice is field installed to meet your refrigerant choice. All kits are bolt-on and require no brazing to install. "FMID" coils contain a factory installed TXV.

Single Piece Air Handler

Single Piece Air Handlers – AP, AE, AVC, AVV

Four variations of multi-position single piece air handlers are available. The AP series contains a direct drive PSC blower motor, the AE series contains a direct drive Standard ECM blower motor, and the AVC series is communications-capable and contains a direct drive variable speed ECM blower motor. The AVV model contains a factory-installed electronic expansion valve (EEV) for matching with a Unitary Products variable capacity outdoor unit and a direct drive variable speed ECM blower motor.

Modular Air Handlers – MP, ME, MVC

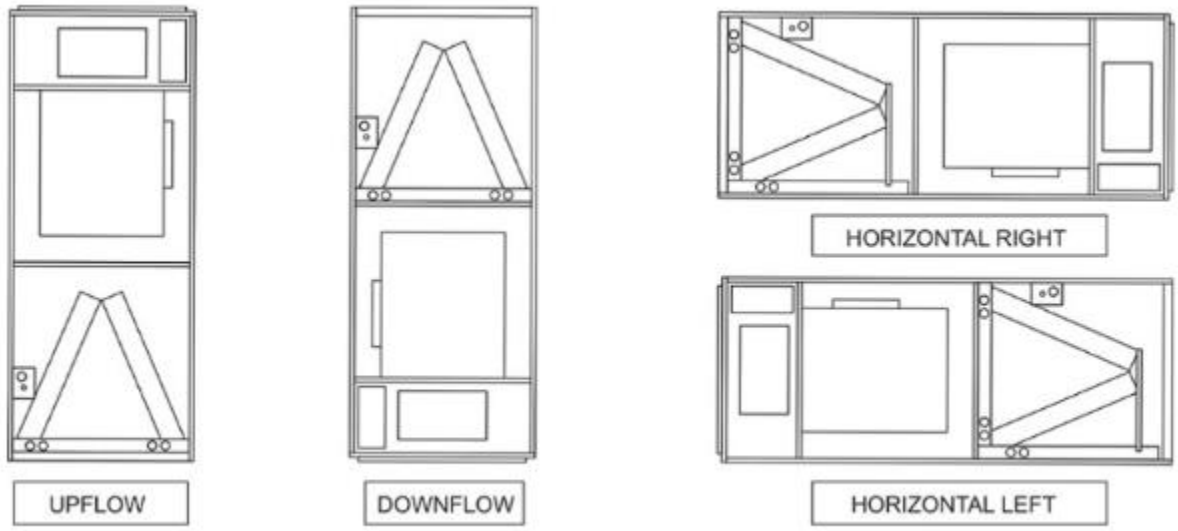
Modular air handlers are multi-position and are available in models MP (PSC), ME (Standard ECM), and MVC (communications-capable variable speed ECM).

The primary benefit of the modular air handler design is that the separated air handler and coil components allow for applications where a single piece air handler will not fit. This is convenient in attic applications where a small access door or a limited turn radius requires the use of a shorter, more maneuverable model.

Modular Air Handler

Features

Multiple Positions



Upflow / Downflow / Horizontal Application

All single piece (AP, AE, AVC, AVV) and modular (MP, ME, MVC) air handlers can be applied in upflow, downflow, horizontal right or horizontal left configurations. Upflow and horizontal right are the standard configuration. Single-piece air handler installation in downflow and horizontal configuration requires field conversion as described in the Installation Manual. Modular air handlers (blower only, no coil) do not require conversion, although the cased coils require modification for installation on the horizontal right configuration as noted below.

Coils

Cooling and heat pump coils are designed to be installed with Unitary Products modular air handlers, and to be matched with Unitary Products cooling and heat pump outdoor units. CF series coils are fully cased and are for upflow and downflow applications. They are available in Flex (no metering device) and FMID (TXV metering device included) versions. The CM series coils are fully cased and are installable in all positions (upflow, downflow, horizontal left, horizontal right). Horizontal Right CM application requires field conversion. They are available in Flex (no metering device) and FMID (TXV metering device included) versions. CU series coils are uncased and are available as flex coils only.

The CF/CM/CU MaxAlloyTM coils are all-aluminum in construction. Appropriate considerations for aluminum coils must be adhered to during cleaning, installation, and service.

Thermostatic Expansion Valve

Thermostatic expansion valves (TXV) provide the increased refrigerant control required for high efficiency systems. Flex coils do not include a factory installed metering device but allow for field installation of the metering device. TXVs are factory installed on FMID coils.

Electronic Expansion Valve

Electronic expansion valves (EEV) are factory installed on AVV air handlers.

Insulated Cabinet

A single piece insulation design with no external screws reduces thermal transmission paths to prevent sweating. Foil faced insulation provides ease of cleaning.

Durable Finish Inside and Out

A G30 galvanized steel case provides a coated edge that resists corrosion and rust creep. All internal coil sheet metal parts, except for the coil header plate, are made of G90 pre-painted steel. Coil header plates are not painted due to the brazing process during production. The coil header plates are treated after the brazing process with a corrosion resistant spray to reduce the probability of rust.

Case Depth

These models have 20.5" casing which provides ease of attic access and tight applications.

Thermal Plastic Drain Pan

Positive slope for drainage reduces potential for mold or contaminates.

Factory Sealed

Achieves 2% or less total airflow leakage rate at duct leakage test conditions in positive and negative pressure for system airflow verification.

Enhanced Filter Rack

All models have integrated internal filter racks provided for use with 1" thick standard size filters.

Accessories

A full line of matching accessories is available for use with the blower and coils to provide application flexibility.

Electric Heaters

6HK models shown under electrical data include sequential operation and temperature dual-limit switches for safe, efficient operation. Service disconnects are provided where shown.

Bottom Rack Filter Kit

The filter frame accessory allows installation of an external air handler filter in an upflow application, a downflow application, or a horizontal application.

Combustible Floor Base Accessory

If an electric heat accessory rated for greater than zero clearance to combustible surfaces is installed in the downflow operating positions on a combustible floor, one of the following combustible floor base accessory models is required: S1-1FB1917, S1-1FB1921, S1-1FB1924.

Breaker Moisture Seal Accessory

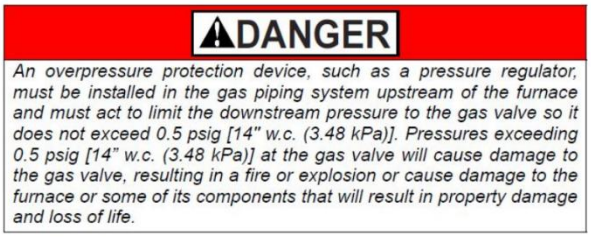
A clear circuit breaker moisture barrier seals the breakers from humidity and dust. The flexibility of the clear cover allows circuit breakers to be turned ON or OFF without removing the cover. The cover firmly attaches to the access panel around the circuit breakers with double-backed adhesive tape. To ensure that moisture or dust does not contaminate circuit breakers, an S1-02435672000 Circuit Breaker Cover Seal may be ordered.

02

Safety

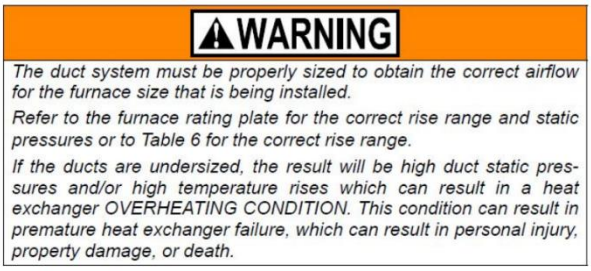
Safety Symbols

Reminder – use this manual in conjunction with the technical literature for each product. This manual Does Not Supersede the Installation Manual and Technical Guide provided with the equipment. Always read and follow all instructions before installing equipment. Understand and pay particular attention to the signal words **DANGER**, **WARNING** or **CAUTION**.



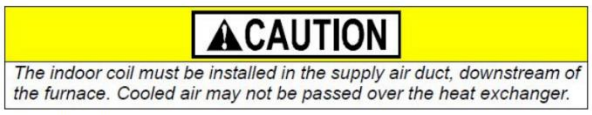
Sample Danger Label

DANGER indicates an imminently hazardous situation which could result in death or serious injury.



Sample Warning Label

WARNING indicates a potentially hazardous situation which could result in death or serious injury.



Sample Caution Label

CAUTION indicates a potentially hazardous situation, which, if not avoided, may result in minor or moderate injury. It is also used to alert against unsafe practices and hazards involving only property damage.

Safety Specific Rules

Follow these specific safety rules for a safe application:

- Air conditioning systems utilizing gas heating can only use natural gas or propane (LP) gasses as an approved fuel. LP applications require installation of the appropriate LP conversion kit. Refer to the unit rating plate or Installation Manual for information on proper inlet and manifold pressures.
- Install air conditioning systems only in locations and positions as specified in the Installation Manual.
- Provide adequate clearances for service, combustion, and ventilation air to the unit. The recommended clearances are specified in the Installation Manual.
- Test for gas leaks as specified in the Installation Manual.
- Only connect the equipment to a duct system which has an external static pressure within the allowable range as specified in the Installation Manual.
- These unites are not to be used for temporary heating or cooling of buildings or structures under construction. Improper installation will shorten equipment life, reduce product efficiency, and void the warranty.
- Always install the systems to operate within the equipment's intended temperature and operating ranges.
- The size of the unit should be based on an acceptable and approved heat load calculation for the structure being conditioned.

Safety Requirements

Follow these safety requirements for a safe application:

- All equipment should be installed in accordance with all national and local building/safety codes and requirements, local plumbing or wastewater codes, and other applicable codes. In the absence of local codes, install in accordance with the most recent National Electrical Code, National Fuel Gas Code and/or Natural Gas and Propane Installation Code (latest editions). Furnaces have been certified to the latest edition of standard ANSI and CSA standards.
- Only approved heat accessories shall be installed on these air conditioning units local.
- Refer to the unit rating plate for the equipment model number, and refer to the Installation Manual for proper air plenum dimensions.
- Provide clearances from combustible materials as listed under Clearances to Combustibles in the Installation Manual and the equipment rating plate.
- Provide clearances for servicing ensuring that service access is allowed for both the burners and indoor fan motor.
- Provides clearances for servicing.
- Failure to carefully read and follow all instructions in this manual and the equipment Installation Manual can result in equipment malfunction, death, personal injury and/or property damage.
- Check the rating plate and power supply to be sure that the electrical characteristics match. All commercial 15 through 25-ton units distributed in North America use nominal 208/230 volts AC, nominal 460 volts AC, or nominal 575 volts AC 3 Phase, 60-Hertz power supply. DO NOT CONNECT THIS APPLIANCE TO A POWER SUPPLY OR A VOLTAGE OTHER THAN THE RANGE SPECIFIED ON THE UNIT DATA TAG.
- The equipment shall be installed so the access panels are readily available, and the electrical components are protected from water infiltration.
- Installing and servicing HVAC equipment can be hazardous due to the electrical and mechanical components. Only trained and qualified personnel should install, repair, or service HVAC equipment. When working on equipment, observe precautions in the manuals and on the labels attached to the unit and other safety precautions that may apply.
- The Installation manual covers minimum requirements needed to conform to existing national standards and safety codes. In some instances, these instructions exceed certain local codes and ordinances. These instructions are required as a minimum for safe installation and operation.

General Awareness

Safety is ALWAYS the primary concern for everyone. On the job injuries can be significantly reduced when proper guidelines are followed. Always be aware of all company, local, state and/or OSHA (Occupational Safety and Health Administration) regulations.

Jobsite Safety

Keeping the job site clean of trash, extra tools and equipment will significantly reduce the chance for injuries. Since each job is unique and has its own hazards, all new workers to the area should be made aware of the location of hire and first-aid equipment, fire escape routes, and other dangers.

Hazardous Materials

Many different chemicals and compounds are used in the service and installation of HVAC systems. Please read the directions and use caution along with PPDs whenever handling these materials. Read and understand the MSDS for all materials used.

Confined Spaces

Never enter or work in a confined space without taking the appropriate precautions. Have someone available outside the space ready to assist or summon help if necessary. Even spaces that seem relatively safe can quickly become hazardous if a pipe were to break and fill the space with refrigerant, steam, poisonous fumes or other gasses. Welding or brazing in a confined space is especially hazardous.

Pressure

High pressures have always been part of the HVAC profession. Wear the proper personal protective devices including safety glasses and gloves. Proper hose ratings and manifolds are required for high-pressure refrigerants.

Electrical Safety

Jewelry should be removed prior to any electrical work being performed. Ensure that the equipment disconnect switch removes the primary power source prior to taking resistance readings or disconnecting any wires or connections. Removal of system power should be verified with the voltage function of a multimeter. All electrical safety guidelines should be always followed. Only trained, qualified technicians should perform electrical maintenance, installation, inspections and troubleshooting of electrical equipment.

Electrocution occurs when a current as low as 6 to 200mA flows through the heart, disrupting its normal operation and causing death. Electrical shock is an injury that occurs because of exposure to an electrical current. Inspect all extension cords and power tools regularly. Fuses and circuit breakers are designed to protect equipment, not people. For personal electrical protection, GFCI or Ground Fault Circuit Interrupters are highly recommended.

Lock-Out Tag-Out

OSHA Standards cover the servicing and maintenance of machines and equipment, in which unexpected energizing or startup of the machines or equipment, or release of stored energy, could cause injury to employees.

These standards establish minimum requirements for the control of such hazardous energy. To ensure safety, put a lock that is tagged with the technician’s name on the electrical disconnect or breaker of the equipment or circuit which is being serviced.

Be aware of others who may be working on the same circuit or other circuits served by the same electrical panel. The technician should also be aware that other technicians may not have used the proper Lock-Out, Tag-Out procedures.

Fire Safety & Burns

While brazing, keep the area clear of combustible material or use a heat shield to help reduce risk of fire.

Check equipment regularly and never try to modify or repair regulators.

While servicing the refrigeration circuit, improper use of equipment and tools can result in serious burns that are associated with refrigerants. This may include frostbite, which is a deep tissue injury. Proper personal protection devices must be in use when servicing the refrigeration system.

Personal Safety

Personal safety always includes remaining aware of the surroundings, using properly maintained tools, and correct use of items designed for personal protection.

Personal Protection Devices (PPD)

- Hard Hat: Hard hats must be worn when there is a danger of head injury.
- Safety Glasses: Eye protection should be worn at all times while on a job site.
- Gloves: Assist in the prevention of serious injury to the hands from serious cuts as well as injuries from high-pressure gasses such as refrigerants. Rubber gloves can protect the technician's hands from chemicals when inspected and worn properly.
- Safety Shoes: Work shoes with steel toes for foot protection. There are also electrical safety shoes that can aid in protecting the technician against electrical shock and/or electrocution. At a minimum, leather work shoes with rubber soles are required.
- Respirator: Used in a confined space where the air can be dissipated by refrigerant which can cause asphyxiation.
- Safety Harness: Used when working above grade level. Ladders must be tied down. Ensure that PPDs provide the intended protection. They should be inspected regularly, used properly and never altered or modified in any way.

Clothing

Rotating and moving components pose a serious risk. Loose fitting clothing and ties should not be worn when servicing rotating equipment. If any clothing becomes entangled in moving parts, serious injury or death is a likely result.

Jewelry

Serious injury or death can result if jewelry contacts an energized circuit or is caught in moving parts. Leave jewelry at home or in your service bag or service vehicle.

Lifting

To avoid back injuries, always adhere to proper lifting techniques. Be aware of personal limitations and seek help with items that are too heavy to safely lift. A back support belt may provide additional protection.

03

Component Familiarization

Coils

The cooling and heat pump coils are to be installed with Ducted Systems air handlers and matched with Ducted Systems outdoor units. Flex coils are shipped without a factory installed metering device, and an R-22 or R-410A TXV is installed in the field for the refrigerant type desired. FMID coils contain a factory mounted TXV, which is to be matched to the outdoor unit.

The CF/CM/CU MaxAlloy™ coils are all-aluminum in construction. Appropriate considerations for aluminum coils must be adhered to during cleaning, installation, and service.

Air Handler Coil

Note
The coil connection should not be open to the air for more than 5 minutes to prevent moisture and contaminants from entering the system. If the coil cannot be brazed into the refrigeration system in that time, the ends should be temporarily sealed or plugged.

Full-Cased Multi-Position Coils (CM)

The CM multi-position coils may be used for up flow, downflow, and horizontal left or right applications. Coil cabinets are insulated with 3/4" foil face insulation to prevent sweating.

CM coils are supplied ready to be installed in a horizontal left position. Horizontal right installation requires field conversion. Be sure to follow the instructions in the Installation Manual concerning conversion.

Full-Cased Upflow/Counterflow Coils (CF)

The fully cased coils (CF) may be used for either upflow or downflow applications. These coils cannot be used in horizontal applications.

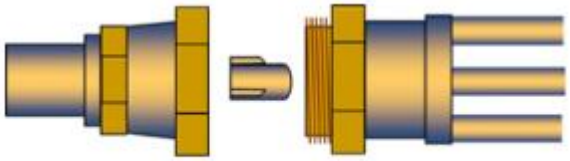
Metering Devices

The metering device, refrigerant type, and valve size applied to the coil in the single piece air handler can be identified by the model nomenclature. If the model number nomenclature identifies the coil as a flex coil design, the coil requires a field-installed metering device.

Fixed Orifice

The fixed orifice is generally sized to match the capacity of the outdoor unit but check approved system matchups to ensure the proper fixed orifice is selected for the application.

Use the Tabular Data Sheet to properly match the evaporator, condenser, and orifice to achieve the rated efficiency and system capacity. The Tabular Data Sheet will also list the additional charge required for the matched equipment.



Fixed Orifice

Systems using fixed orifice metering devices must be charged either by weight or superheat. The superheat readings must fall within the values listed in the Installation Manual, Tech Guide, or those provided on the unit data plate.

Thermostatic Expansion Valve (TXV)

Split systems using TXV metering devices are charged by the subcooling method. The TXV is designed to maintain a relatively constant superheat within the evaporator coil.

TXV Operating Forces

The TXV has three operating forces that control the flow of refrigerant through the system in order to maintain suction superheat at the evaporator outlet: one opening force and two closing forces.

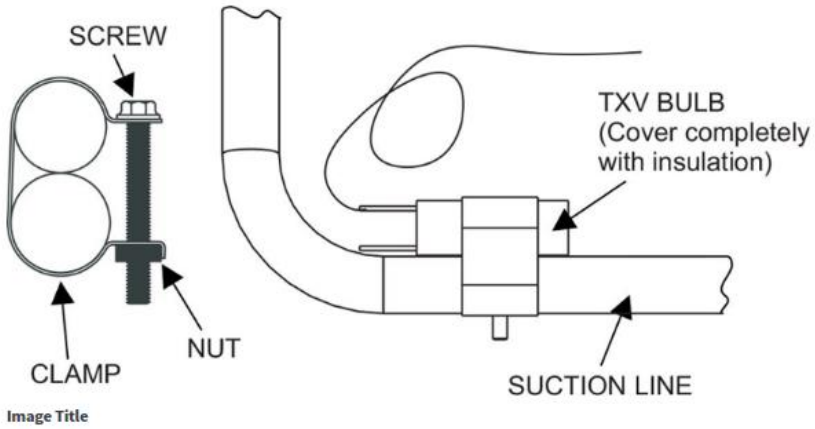


Image Title

1. Sensing Bulb Pressure (Opening):

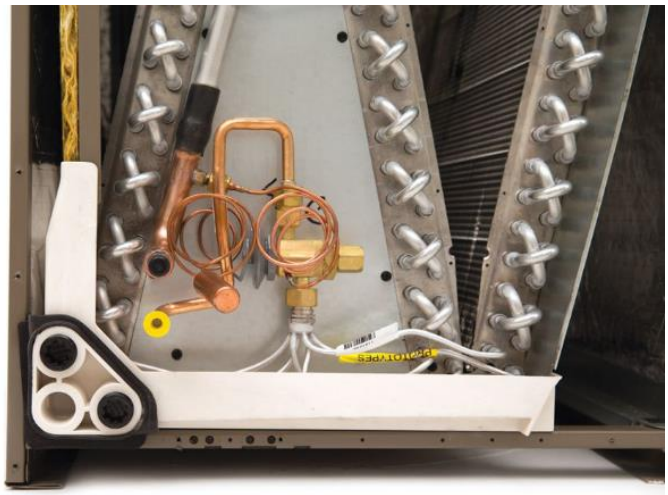
The sensing bulb is the "opening force" of the TXV. It is located at the outlet of the coil, on the suction line, downstream of the header. It is mounted to the top of the suction line and measures the temperature of the suction line.
As the load increases on the coil, the superheat and the suction line temperature increases. The sensing bulb pressure increases as the suction line temperature increases. When the sensing bulb pressure increases, pressure is exerted on the TXV diaphragm. This opens the valve and allows more refrigerant to flow into the evaporator.

2. Spring Pressure (Closing):

The spring pressure is one of the "closing forces" on the TXV. The TXV assemblies on these units have a factory-adjusted (non-adjustable) spring. It is located in the body of the valve and exerts pressure on a set of pushrods which are in direct contact with the diaphragm within the powerhead assembly. The pressure of the spring and the refrigerant pressure within the coil opposes the sensing bulb pressure.

3) Evaporator Pressure (Closing)

Evaporator pressure is another "closing force" on the TXV. The external equalizer line is a small capillary line that is attached to the top of the suction line at the outlet of the coil and downstream of the sensing bulb. This line allows coil pressure to be applied on the diaphragm. The pressure of the coil, in addition to the spring pressure, opposes the sensing bulb pressure.



Coil with TXV

Note
The coil connections should not be open to the air for more than 5 minutes to prevent moisture and contaminants from entering the system. If the coil cannot be brazed into the refrigeration systems in that time, the ends should be temporarily sealed or plugged.

Note
For models that have a factory installed TXV, take caution not to apply high temperatures to the TXV assembly or equalizer line while brazing.

Electronic Expansion Valve (EEV)

The AVV air handler features a factory-installed electronic expansion valve (EEV) for matching with a variable capacity air conditioner or heat pump. Variable capacity heat pumps feature a second EEV located in the outdoor unit.

The 500-step valve is driven by a 12 VDC stepper motor from the EEV control. A stepper motor is a small motor that can move the rotor in very small increments or steps. The valve needle serves as the rotor. Threaded on one end into a "nut" type component, the needle moves slightly. The result is a more precise refrigerant control than that offered by conventional expansion valves. Successful EEV operation requires three components: the transducer, the thermistor, and the controller. The controller receives values from the transducer and thermistor. Algorithms in the controller process the input values to determine necessary output to the EEV.

Electronic Expansion Valve

Valve Body and Motor Stator

Valve Body

Valve Body

The valve body consists of two basic components - the metering needle and motor rotor.

Motor Stator

The motor stator slips over the valve body and is held in place by a retaining clip that snaps over the liquid inlet.

Select the ";" symbols to learn more about each element of the EEV.

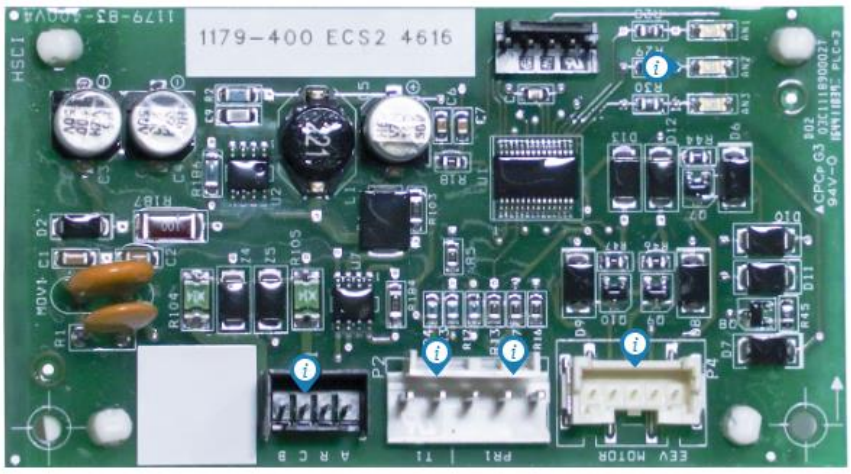
Motor Stator

Electronic Expansion Valve

EEV Control

The EEV control is shown below. In addition to the connection points, the control features three (3) LEDs that provide visual information to the technician.

- Yellow LED-EEV closing.
- Green LED - EEV opening.
- Red LED - Power and diagnostics



Indoor EEV Control

EEV Homing

The EEV is homed to establish the valve position. After homing, the valve is driven to mid-position (250 steps) if no compressor call exists. If there is a demand for compressor operation, the control transitions to Start Up Mode.

EEV Start Up

When the call for compressor is activated, the valve enters the Startup Mode. In this mode, the EEV is homed (fully closed) followed by driving to the fully open position for 15 seconds. The valve is then driven to the position it was in at the end of the previous cycle as stored in the controller memory. This position is held for the first 60 seconds of compressor operation (>900RPM) unless one of the following conditions exist:

- Superheat is below setpoint.
- A fault retries and compressor speed has been active > 30 seconds.

If communication is lost, such as might occur in Repair Mode, the EEV is still functional. System operation is confirmed when suction pressure drops below 175psi. The EEV returns to the last position stored for 60 seconds, after which the EEV controls superheat at 6°F. If the suction pressure rises above 209psig, the control assumes the system is in heating mode and opens the valve fully.

EEV Shutdown

Once the demand for compressor operation is terminated, the EEV enters Shutdown Mode. In this mode, the control will store the valve position and remain in its current position until the next compressor call.

Defrost

During defrost operation, the outdoor EEV is driven fully open (bypass).

Floodback Prevention

Should superheat drop below 1°F, the controller closes the valve until superheat rises above 1°F.

Indoor EEV Control LEDs

There are three LEDs on the indoor EEV controller. The green LED illuminates when the valve is being driven open. The yellow LED indicates the valve is being closed. It is normal for these LED to flash momentarily as the valve is often driven in incremental steps. The LEDs are OFF if the valve is not being driven. The red LED is illuminated when power is applied.

- The green LED illuminates when the valve is being driven open
- The yellow LED indicates the valve is being closed
- The red LED is illuminated solid on when power is applied and there are no faults
    - The red LED, when flashing, provides diagnostic information.
    - Additional information is available in the Residential Variable Capacity Air Conditioning & Heat Pumps Field Reference Guide.

Blower Motor (PSC Models)

AP and MP Models

The AP (single piece) and MP (modular) air handlers contain a PSC blower motor. A blower speed is selectable and connected from the COM terminal of the control board relay to the desired blower speed on the motor terminal block. The selected speed must deliver the required airflow based on system cooling capacity. Total system external static pressure (ESP) is measured and used with the blower performance charts provided in the Installation Manual to determine the CFM delivery.

To achieve the desired airflow, connect the motor wires to the corresponding motor speed tap receptacle located on the motor housing. Model-specific motor wiring details are in the unit Installation Manual and on the wiring label. More information is also available in the Start Up section of this Guide.

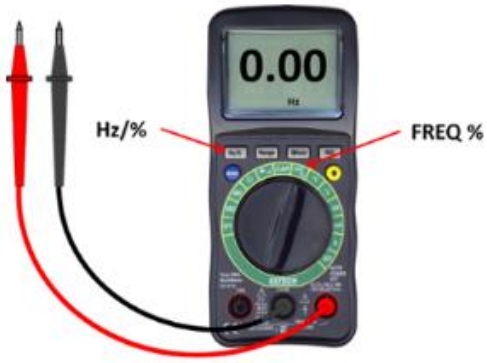
PSC Blower

Blower Motor (Variable Speed ECM Models)

AVC/AVV/MVC Models

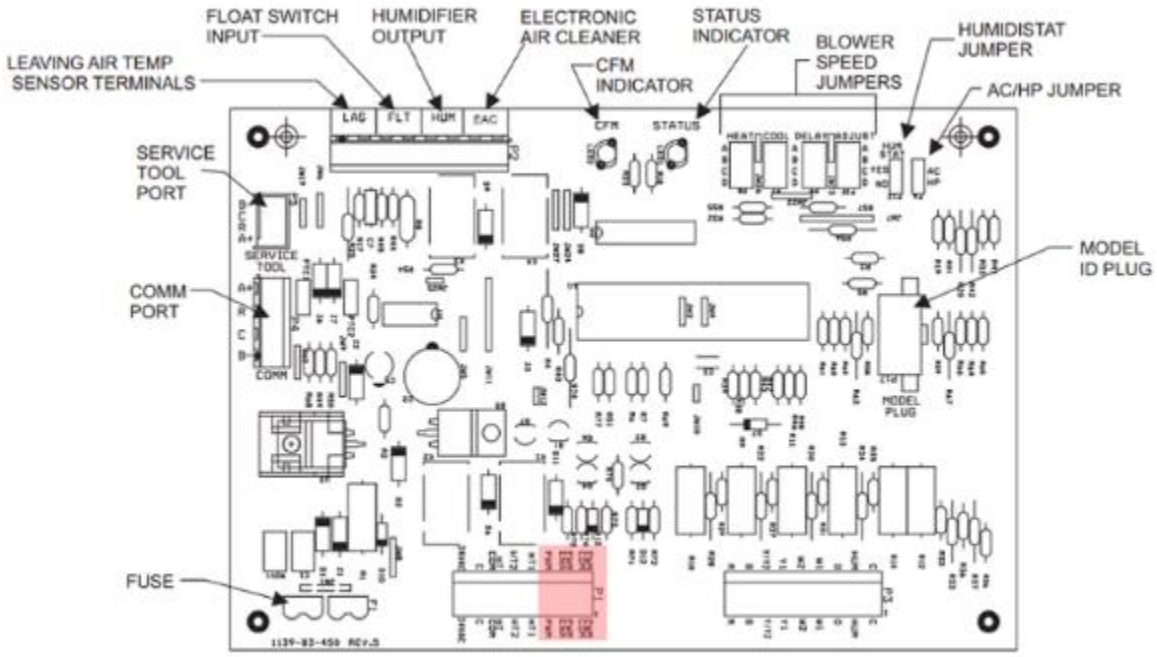
Variable speed Electrically Commutated Motors (ECM) blower motors are selected for applications that demand higher electrical efficiency and reduced operational sound levels. The variable speed ECM motor speed is controlled by a pulse width modulation (PWM) signal from the control and is measurable with a multimeter with "duty cycle" measurement capability.

A PWM signal is a fixed period waveform in which the "on-time" is described as a percent of the total run time. The information is communicated FREQ % to the motor by the control board in "percent duty cycle". The PWM signal is a 20VDC square wave with duty cycles measurable between 2% and 98% in 1% increments. This is measurable between the PWM and PWM COM terminals P1 pins 3 and 1. The meter is set to Freq% with the meter probes placed on P1 pins 3 and 1.



Multimeter with PWM (Duty Cycle) Measurement

P1 pin 2 (PWM ENA) is a 24-volt signal that places the blower in operational mode. The command from PWM (pin 3) determines the commanded motor speed. The Field Reference Guide Extras provide a list of expected PWM values based on system mode.

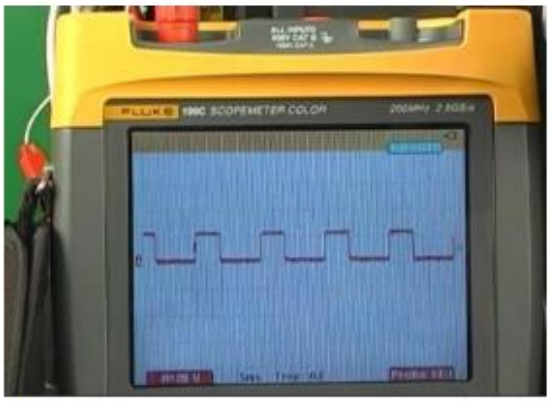


System Control Board: PWM Measurement Location

When the PWM / duty cycle is measured with a scope meter, the waveform is visibly modified as airflow requirements change, with the bottom of the waveform (0) representing de-energization, and the top of the waveform (1) representing energization.

As PWM / duty cycle values increase, the square wave segments increase in size. As the value approaches 100%, the pulse width carries across the full length of the energized (1) portion of the waveform.

The variable speed ECM motor will attempt to deliver the commanded airflow under adverse conditions including restricted air filters or increased static resistance due to closed registers or slightly undersized ductwork. Attempts to overcome restrictions will result in greater electrical consumption and operational sound. In all cases, the system must be designed for .5" w.c. or less total external static pressure. Air handlers are designed to provide their rated airflow at up to .5" w.c. Total external static pressure exceeding this value will negatively impact system performance.



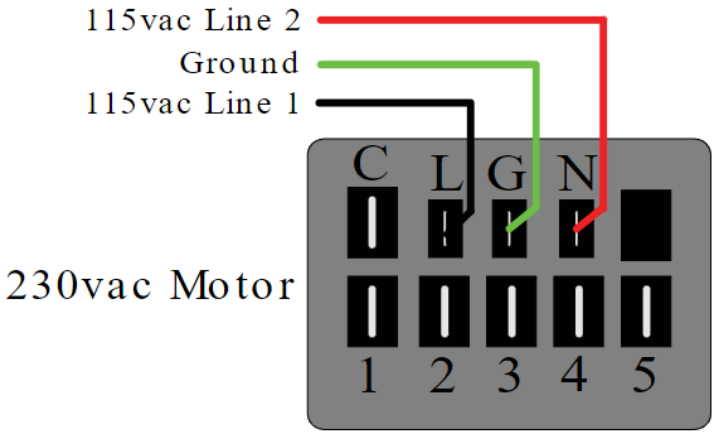
PWM Waveform on Scopemeter

Blower Motor (Standard ECM Models)

AE/ME Models

The Standard ECM uses less energy (watts) than the PSC motor both at rated speed and constant fan mode while producing greater airflow. The standard ECM operates with 208/230 AC line voltage. The allowable voltage range is 196-264 volts AC.

The Standard ECM motor is designed to provide constant torque. If the static pressure changes, the motor will only maintain the factory programmed torque. This should not be confused with constant airflow. Even though the Standard ECM can maintain torque, if static pressure increases, airflow will decrease. This is like the PSC motor characteristics. However, airflow will not decrease as dramatically as with a PSC motor since torque is being maintained.



Standard ECM Wiring

The Standard ECM motor has a 10-pin connector for line and control voltage connections. The line voltage terminals are labeled "L", "G" and "N". The "L" terminal is line 1, and the "N" terminal is line 2 for 230 volts AC. The "G" terminal is the ground terminal. A reading of 230 volts AC is measured between the "L" and "N" terminals.

The control terminals are labeled "C", "1", "2", "3", "4" and "5". The terminal labeled "C" is common for the 24 volts AC control voltage, while terminals labeled "1" through "5" are pre-programmed torque settings representing blower speed. The pins receive 24-volt AC input signals from the control board to engage the proper fan torque for the application and mode of operation.

If the motor is wired improperly, the control module and/or the motor module may be permanently damaged.
The speed of the motor must be adjusted within the minimum and maximum limits approved for the evaporator coil, electric heat, and outdoor unit. The settings and blower capacities are provided in the air flow data tables listed in the unit Installation Manual. More information is also available in the Start Up section of this Guide.

To adjust the motor speeds for heating and cooling modes, the 24-volt AC motor wire is connected to the appropriate motor speed tap. Standard ECM models use black wire for heating speed and red for cooling/continuous fan speed. Consult the unit wiring diagram for confirmation as required.

Multi-Tap Transformer

The multi-tap transformer is prewired for 240-volt AC operation. If the supply voltage is 208 volts AC, the push-on connector located at the 240-volt tap must be moved to the 208-volt tap. There are no changes required to the COM or 24-volt AC connections.

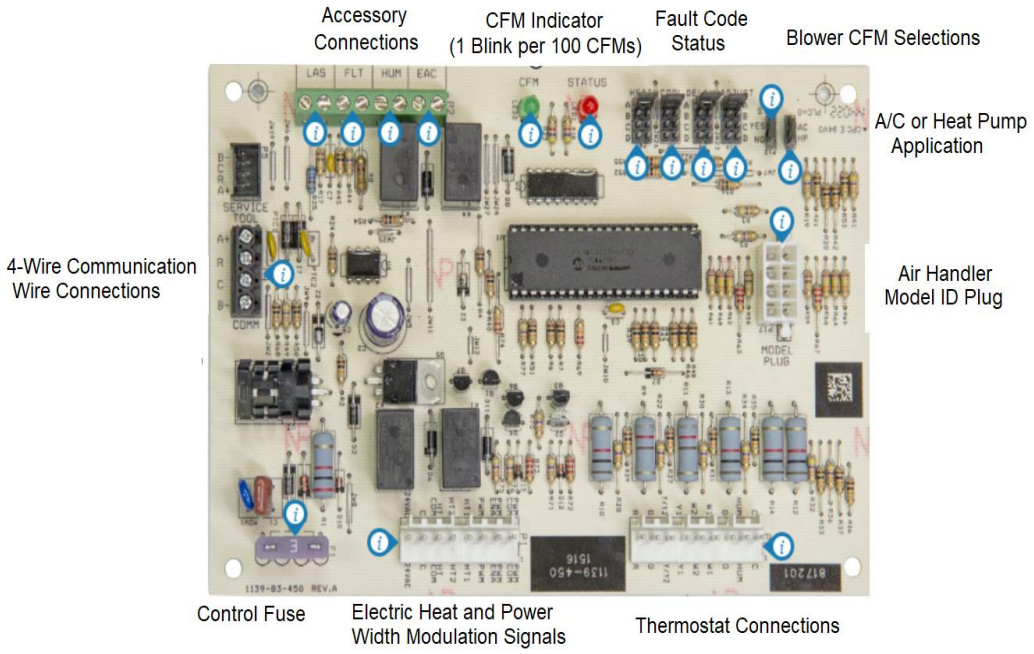
If the transformer is not wired correctly, damage to the equipment will occur. Identify the voltage being supplied to the primary side of the transformer from the electrical panel or disconnect. Ensure that the transformer is properly wired to the primary voltage taps.

Multi-Tap Transformer

AVC/AVV/MVC Control Board

AVC/AVV/MVC (Variable Speed ECM)

This section details the inputs and outputs of the AVC/AVV/MVC control board.



The table shows the temperature/resistance conversion for the Leaving Air Temperature sensor. If the sensor is replaced, an exact replacement part must be used.

Note
If the air handler is being installed with a communicating thermostat, the P 9-pin connector must be removed from the control board. Wiring for specific applications can be found in the Appendix of the Installation Manual.

Temperature	Resistance	Temperature	Resistance
30°F	34545	95°F	6531
35°F	29986	100°F	5827
40°F	26092	105°F	5208
45°F	22758	110°F	4663
50°F	19896	115°F	4182
55°F	17434	120°F	3757
60°F	15310	125°F	3381
65°F	13474	130°F	3047
70°F	11883	135°F	2750
75°F	10501	140°F	2487
80°F	9299	145°F	2251
85°F	8250	150°F	2041
90°F	7334	155°F	1854

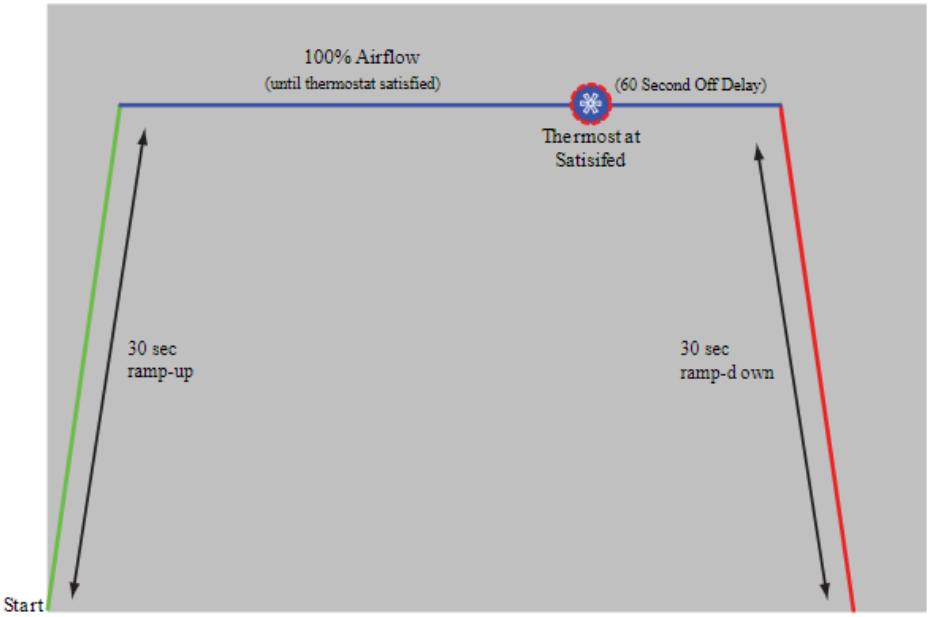
Humidity Control with Communicating Thermostat

An external humidistat built into the communicating thermostat controls both humidification and de-humidification. When humidity is below the set point, the communicating thermostat energizes the P2 HUM terminals. When humidity is above the set point, the communicating thermostat will reduce airflow by 15% to remove moisture. The communication control ignores the status of the humidistat selection jumper.

The control governs dehumidification during cooling using the reduced blower speeds. A selection jumper is provided on the control to distinguish between an open humidistat (called for de- humidification) and a non-connected humidistat. If the jumper is not connected to either terminal, the control responds as if no humidistat is connected.

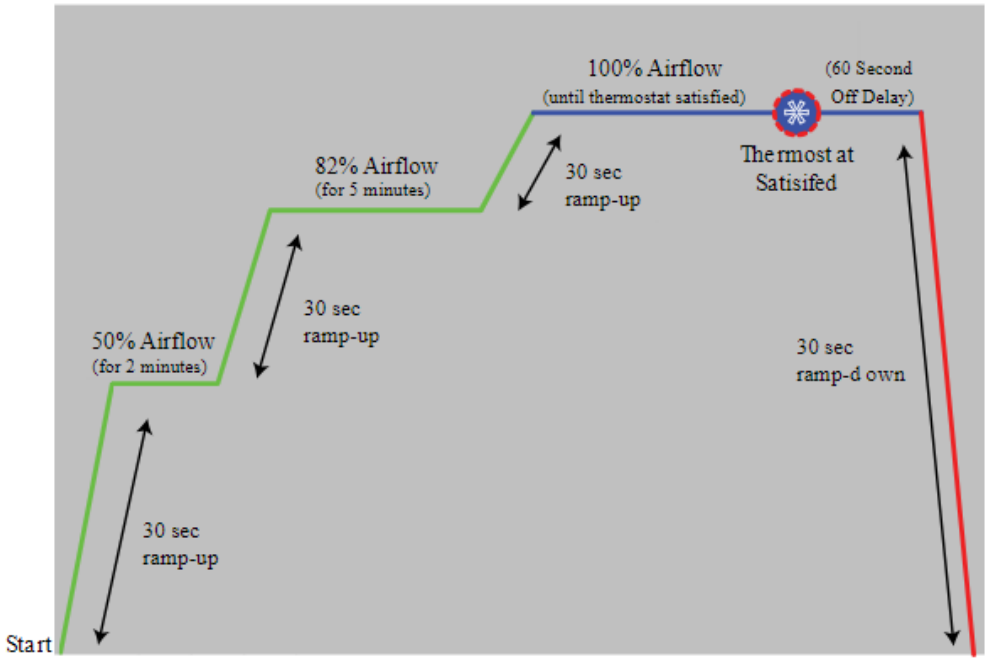
Delay Jumper Details

Tap A is the default profile. It provides a 30-second ramp-up from zero airflow to full capacity and a 30- second ramp-down from full capacity back to zero airflow. The motor will take 30 seconds to ramp from one speed to the other.



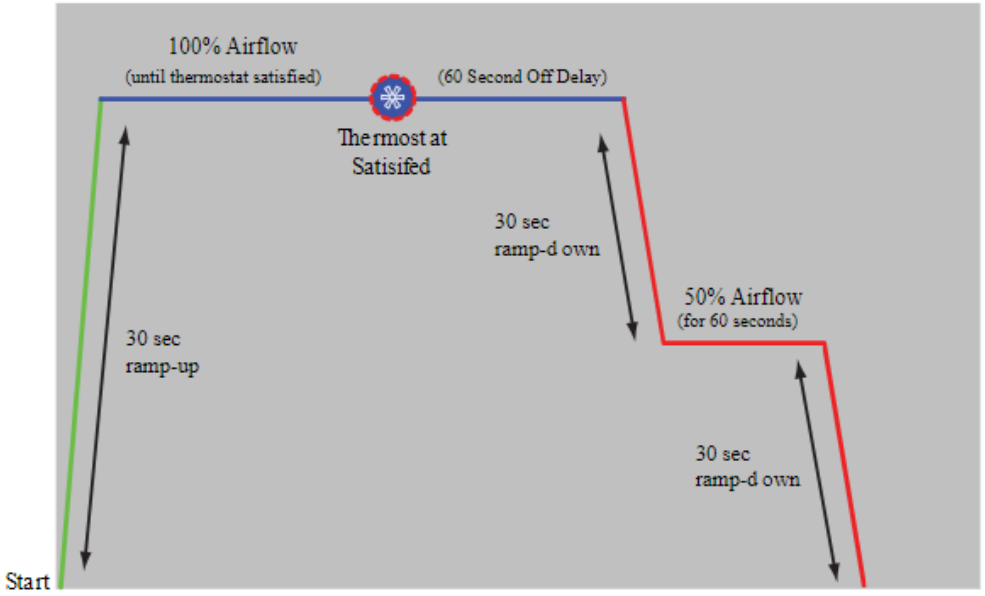
Delay Tap A Profile

Tap B is the humid profile. This profile is best suited for installations where the humidity is frequently very high during cooling season. On a "call for cooling", the blower will ramp up to 50% of full capacity and will stay there for two minutes, then will ramp up to 82% of full capacity and will stay there for five minutes, and then will ramp up to full capacity, where it will stay until the wall thermostat is satisfied.



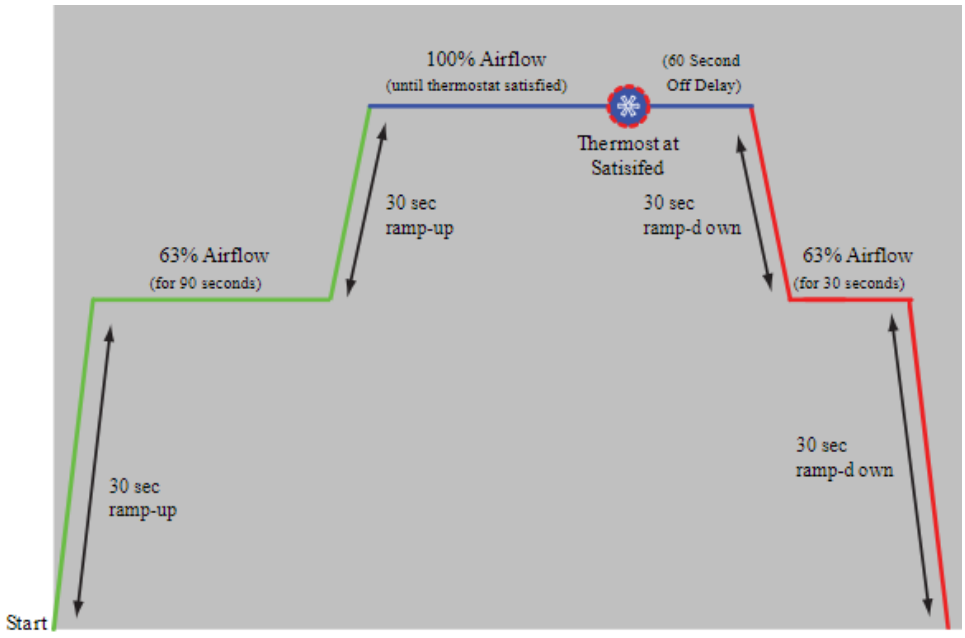
Delay Tap B Profile

Tap C is the dry profile. This profile is best suited where excessive humidity is not generally a problem, where the summer months are usually dry. On a "call for cooling" the motor will ramp up to full capacity and stay there until the thermostat is satisfied. At the end of the cooling cycle, the blower will ramp down to 50% of full capacity where it will stay for 60 seconds, and then ramp down to zero.



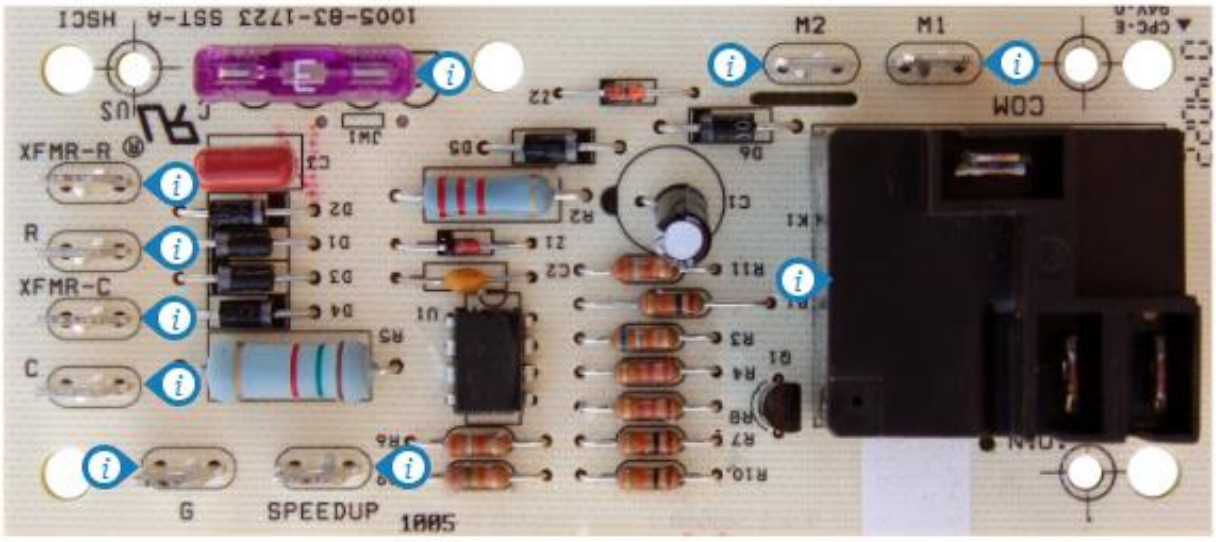
Delay Tap C Profile

Tap D is the normal profile, best suited for most areas where neither excessive humidity nor extremely dry conditions are the norm.



Delay Tap D Profile

AP/MP (PSC Model) Control Board



PSC Model Air Handler Control Board

Electric Heat

Electric heat applications include:

- Standalone electric heat
- Air conditioning with electric heat
- Heat pump with supplemental electric heat

Each one of the air handler models are approved for use with specific electric heat accessories. The air handler Installation Manual and name plate provide potential application combinations, electrical data, and limitations. Aftermarket heat kits may not be used. Use only the heat kits UL approved and specified in the appropriate Technical Guide.

6HK Heat Kits

Follow the 6HK Installation Manual to ensure proper application and installation. Always follow the latest instructions available in the Equipment Catalog on Solutions Navigator.

Air Filters

Equipment should never be operated without field supplied air filters. A 1” filter access rack is provided. Standard 1” permanent washable or throw-away filters may be used.

04

Installation

Introduction

Proper installation and start up enables equipment to operate at peak efficiency and provides the end user with the comfort and efficiency expected from the system.

This section DOES NOT REPLACE THE INSTALLATION MANUAL for the specific air handler model. This guide is designed to be a companion to the model-specific Installation Manual. Be sure to THOROUGHLY READ the instructions provided by the air handler.

For specific start up details, see Section 5, Start Up.

Do not use air handler for temporary heat. Air handlers are not to be used as temporary heat. Materials used in the construction process greatly reduce air handler efficiency and operational life. Drywall dust, varnishes, paints, and sawdust rob the end user of their investment in their comfort system.

Inspection

When an air handler is received, it should be inspected for damage during transit. If damage is evident, the extent of the damage should be noted on the carrier's freight bill. Also, before installation, the unit should be checked for screws, bolts, or wiring connections which may have loosened in transit. There are no shipping or spacer brackets that require removal.

Recommended Minimum Clearances

Ample clearances should be provided to permit easy access to the unit. The following minimum clearances are recommended:

- Refrigerant piping and connections – minimum 12” recommended.
- Maintenance and servicing access – minimum 36” from the front of the unit, recommended for blower motor/coil replacement.
- Condensate drain lines routed to clear filter and panel access.
- Filter removal – minimum 36” recommended.
- The duct work and plenum connected to this unit are designed for zero clearance to combustible materials.
- A combustible floor base accessory is available for downflow applications of this equipment, if required by local code.

Air Handler Location

The air handler shall be located using the following guidelines:

- Select a location with adequate structural support, space for service access, clearance for air return and supply duct connections.
- Using hanging brackets to wall mount the air handler is not recommended.
- Normal operating sound levels may be objectionable if the air handler is placed directly over sound sensitive rooms such as bedrooms and study areas.
- Select a location that will permit installation of condensate line to an open drain or outdoors allowing condensate to drain away from structure when matched with an air conditioning or heat pump unit.

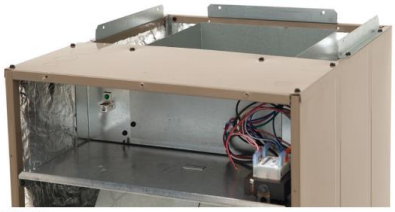
Note
The primary and secondary drain line must be trapped to allow proper drainage of condensate. If the secondary drain line is not used, it must be capped. Additionally, the secondary drain line must be piped to a location that will allow for visual inspection.

- When an evaporator coil is installed in an attic, above a finished ceiling, or any area that may be damaged by leaking water, an auxiliary drain pan must be provided under the air handler as is specified by most local building codes.
- A proper electrical supply must be available.

Note
In severe high humidity, high temperature indoor unit environments, an accessory insulation blanket is available to supplement the standard cabinet insulation. Insulate using the appropriate insulation kit or seal completely with adequate fiberglass insulation with an exterior vapor barrier.

Ductwork Installation

To properly design the ductwork for the building, refer to the ASHRAE Fundamentals Handbook chapter on “Duct Design”, or ACCA Manual ‘D’. It is imperative that the duct system is designed properly per these methods. As with all residential equipment, the air handlers are designed to deliver their rated airflow up to 0.5” w.c. total external static pressure. Higher external static values can cause problems with system performance and customer comfort. This may include:



Duct Flanges

- Inadequate airflow to the conditioned space.
- Inadequate cooling performance, including evaporator coil frosting/freezing in the cooling mode, leading to liquid refrigerant getting back to the compressor and eventual compressor failure.
- Customer complaints about noisy operation. If whistling is heard in and around the air handler area during blower operation, it is likely that there is an airflow restriction, which may include an undersized duct system.
- Temperature rise outside of the allowable range on the electric heat accessory, causing undue stress on the heating elements, limit trips or melting of the fusible links.
- Increased energy consumption due to fan operation conditions.

For more information on locating problems in Air Distribution, see Chapter 5 Start Up. Included is a discussion on measuring external static pressure (ESP)in the duct system.

Air Handler Configurations

All air handlers may be installed in upflow, downflow, horizontal right, and horizontal left. The air handlers, as shipped from the factory, are configured differently depending upon the model type. Horizontal right applications always require field conversion. For information about conversion of air handlers to another configuration, see the Installation Manual for the model specified.

Horizontal Suspension

Air handler units can be installed in a suspended horizontal position. It is recommended that horizontally suspended units are supported from the bottom with angle steel support brackets and threaded rods. For more information and suspension support locations, see the Installation Manual for the model specified.

Suspension Kits

A suspension kit is available for FFP, FRP, FFV, MA, MX, and MV model air handlers. These suspension kits are designed for upflow applications only. For installation of these accessory kits, refer to the Installation Manual provided with the suspension kit.

Refrigerant Line Connections

When preparing to make refrigerant line connections, relieve the pressure from the coil by removing the plugs. The coil is pressurized with an inert gas during the manufacturing process. The technician must braze the coil into the system within two minutes after removing the plugs to prevent moisture and contaminants from entering the system. If the coil is going to be open for more than two minutes, replace the plugs in the copper tubing.

During the brazing process, temperatures exceed 800 degrees Fahrenheit. At these temperatures, oxidation forms inside of the copper tubing if a dry nitrogen purge is not used during brazing to displace oxygen. If oxidation forms, it is released in the refrigerant flowing through the system during normal operation, and can accumulate in the filter drier, metering device, or reversing valve, causing improper operation and component failure.

Oxidized Fitting

Silfos-5

Use heat sinks to prevent heat damage to the coil and metering device. Wrap a wet rag around smaller components to provide protection during brazing. Use the heat shield provided in the customer packet to protect property and equipment, including the structure, painted panels, data plates and aluminum fins. Keep an approved fire extinguisher present during all brazing operations.

Prior to brazing, remove the grommets where tubes exit the cabinet to prevent burning. Braze joints using a phosphorous copper allow material, such as Silfos-5, or an equivalent brazing alloy with at least 5% silver content. Do not use soft solder. After brazing, re-attach the grommets to the lines to prevent air leakage. Lines should be sound isolated by using appropriate hangers or strapping.

Note
Route the refrigerant lines to the coil so that they will not obstruct service access to the coil, air handling system, or filter.

Indoor Vapor (Suction) Thermistor

Care must be taken not to overheat the indoor coil vapor (suction) line thermistor during brazing. The thermistor will not withstand exposure to extreme heat.

Note
Research has proven that applying wet rags on the vapor (suction) line before commencing the brazing process is sufficient to prevent thermistor overheating.

Electronic Expansion Valve (AVV)

The indoor Electronic Expansion Valve is shipped in a closed position to prevent damage to the valve during transit. The valve MUST be driven open to permit the flow of nitrogen during brazing. There are two methods of opening the valve – power the valve open or manually opening the valve.

During installation, the EEV control harness must be connected to furnace or air handler control with the equipment powered up to drive the EEV open. Powering the indoor unit provides low voltage power to the EEV control. The control will first home the valve followed by driving the valve to mid-position. A small quantity of nitrogen can then flow through the coil during brazing.

EVV Manual Tool

Available in mid-2017 from Source 1, this tool allows technicians to manually operate the EEV. When the EEV motor is removed, this tool slips over the valve body. The technician then rotates the tool in the desired direction. Magnets in the tool cause the EEV rotor to turn. When available, the part number will be S1-02649686000.

Pressure Testing

The lineset and indoor coil are pressurized up to 250 psig with dry nitrogen and leak tested with a bubble type leak detector. Do not use refrigerant to purge or leak test the system. Do not exceed the rated test pressure located on the indoor coil data plate when pressure testing the systems. Nitrogen charge can be released into the atmosphere.

Evacuation

The vapor line, indoor coil, and liquid line must be evacuated to 500 microns or less. This ensures that moisture and non-condensables are evacuated from the system.

R-410A Considerations

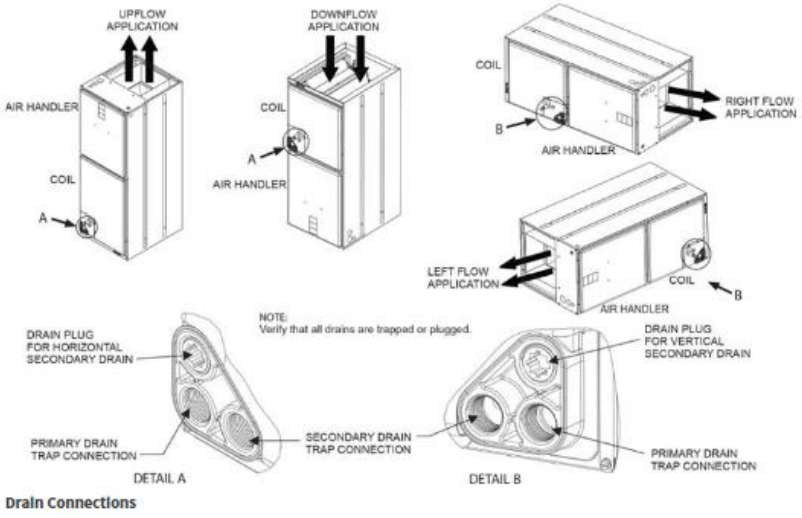
R-410A having POE oil with much greater hygroscopic properties, utilizing all the necessary tools and following all of the installation procedures to ensure proper equipment operation is a must.

Condensate Drain

The drain line must be routed so that it does not interfere with accessibility to the coil, air handling system, or filter. It should not be exposed to freezing temperatures. Primary and secondary drain connections must be made with the unused secondary drain connection plugged with the provided cap.

The drain pan connections a ¾" PVC, copper, or steel pipe fittings. Since the drains are not subject to any pressure, it is not necessary to use Schedule 40 PVC pipe for drain lines unless required by local codes.

The evaporator drain line must be trapped at least three inches and pitched away from the coil drain pan. Drain lines must be no smaller than the coil drain connection.



Drain Connections

If an open drain is not available, identify the local building code requirements for drainage before installing a condensate drain. A plugged drain can cause property damage; therefore, properly size the condensate drain and seal the fittings and connections with an approved sealing compound. All threaded drain connections should be hand-tightened, with no more than 1/16 of a turn past hand tight. Take care when applying sealing compounds to the drain pan connection. Excessive sealant and tightening of the drain pan connection can result in pan failure. After installation, prime the trap with water.

Line Power Connections

Power may be brought into the unit through the supply air end of the unit (top when unit is vertical) or the left side panel. Use the knockout appropriate to the unit's orientation in each installation to bring the conduit from the disconnect. The power supply wiring leads should be terminated at the electrical control box. Refer to tables in the Installation Manual to determine wire size. To minimize air leakage, seal around the wiring entry point at the outside of the unit.

Control Wiring

Air handlers can be connected to the wall thermostat and outdoor unit using either conventional low voltage thermostat wiring when a standard thermostat is used or four wire digital communications wiring when a Residential Communicating Control is used. Residential Communicating Controls may only be used on communication-capable air handlers. This includes the AVC and MVC models.

Non-Communicating (AP/AE/MP/ME)

Select a thermostat that is compatible with the system's modes of operation. Provide control wiring to the appropriate control boards and terminal strips as indicated on the electrical wiring diagrams. All control wiring should be a minimum of 18-gauge wire. Install the field supplied thermostat following the Installation Manual that accompanies the thermostat, and the electrical wiring diagrams shipped with the equipment.

With the thermostat and the electrical disconnects set to the "OFF" position and locked-out, connect the thermostat wiring to the terminal strip, as indicated in the Installation Manual. Electronic thermostats may require a common wire between the transformer's 24 volts AC secondary side and the "C" terminal. The digital display and electronics within the thermostat are powered by the transformer at the "R" and "C" terminals of the thermostat.

Communicating (AVC/MVC)

The control wiring for the Communicating System links the components and continually communicates commands, operating conditions, and other data over a four-wire connection.

To operate in full communications (COMM) mode, a communicating air handler must be installed with a matching touch screen communicating wall thermostat and an outdoor air conditioner or heat pump with fully communicating controls.

A non-communicating outdoor unit may be used with a communicating air handler and thermostat. When an outdoor communicating control board is added, the system allows full communication between the air handler and thermostat with limited exchange of commands to the outdoor unit. Fault and operating conditions are not transmitted in this application. When conventional 24-volt wiring is connected to the outdoor unit, the system allows full communication between the air handler thermostat, but no digital communication with the outdoor unit.

Electronic Air Cleaner (EAC)

The AVC/MVC models contain EAC terminals on the unit control board to energize a 24-volt relay during blower operation.

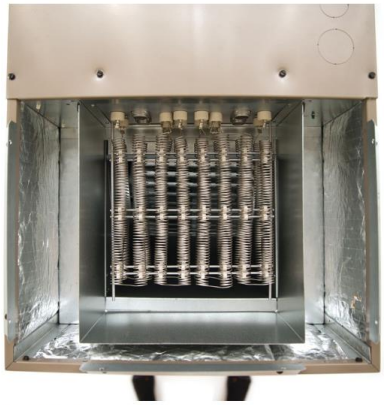
Humidifier (HUM)

The AVC/AVV/MVC models contain HUM terminals to energize a 24-volt relay to energize the humidifier as needed to maintain the desired humidity level.

6HK Electric Heat Kit Installation

Only apply electric heat kits that are specifically approved by Johnson Controls Ducted Systems for a particular model. Follow all required safety guidelines and required installation details as supplied in the instructions provided with the heat kit. Follow the 6HK Installation Manual to ensure proper application and installation. Always follow the most up-to-date instructions which are always available in the Equipment Catalog on Solution Navigator.

Electric Heat Kit Installation



Electric Heat Kit Installed

05

Start-up

Online Ducted Systems Residential Start-up Form

The online form is for use with all Ducted Systems residential products. The form allows savings for later completion. Completed form data is sent to your inox for archive purposes.

Prior to start-up, all the installation procedures outlined in the indoor and outdoor equipment Installation Manuals must be completed. This includes proper installation of the indoor unit, outdoor unit, thermostat, electrical wiring and accessory kits.

Required Tools

The following tools are required to properly set up air handlers:

- A thermometer or portable, digital thermometer to verify the supply and return air temperatures. For best accuracy, use thermocouple-type thermometers and probes.
- Magnehelic gauge
- Digital multimeter with Duty Cycle/PWM capability
- 1/4” nut driver
- Phillips head screwdriver

Cooling Blower Speed (PSC and Standard ECM Blower Models)

The cooling blower speed is selected based on the requirements of the application. If the airflow is set too high for the application, proper dehumidification of the return air will not occur, and the desired temperature drop across the evaporator coil will not be obtained. If the airflow is set too low, frost and ice may form on the evaporator coil, leading to eventual refrigerant floodback to the compressor. For the best possible comfort and equipment longevity, the system external static pressure (ESP) is measured and used with the provided blower charts to determine the best speed to use for the application.

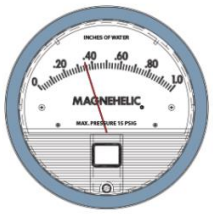
For optimum performance, 400 CFM per ton of air conditioning is used. For example, a 3-ton system should have 1200 CFM of air moving through the evaporator coil.

To determine the total external static pressure, both the supply and return static pressures are measured.

When establishing airflow for cooling mode, create a call for cooling. If outdoor conditions are too cold for outdoor unit operation, de-energize the outdoor unit disconnect switch.

Details

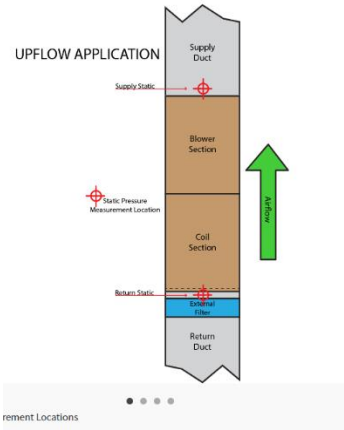
To measure the supply static pressure, connect the Magnehelic gauge, incline manometer, or digital manometer in the locations shown below. The blower performance charts provided with the air handlers indicate blower performance with filter in place. If an external filter is not used, ensure that the internal 1” filter is clean.



Magnehelic© Gauge

The total external static pressure is determined either by taking the supply and return static pressures individually and adding them, or simply by using two probes and noting the reading on the gauge.

Scroll through the images below for various configurations.



When the total external static pressure has been determined, apply the total static pressure to the blower performance chart for the air handler model being serviced. The CFM delivered is where the ESP reading intersects with the blower speed being used. Remember that 400 CFM per ton is the target value. If required, change the blower speed to get as close as possible to 400 CFM per ton.

After a blower speed change, re-check the total ESP and consult the blower performance chart to verify CFM.

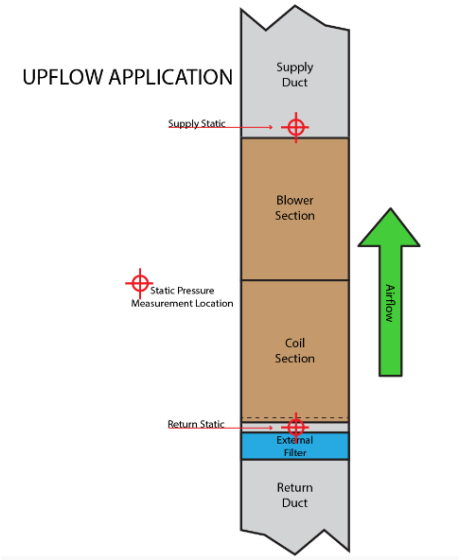
Speed tap adjustments are made at the motor terminal block with PSC and Standard ECM motors. PSC blower models use a single speed for cooling and heating operation. Standard ECM blow models have separate blower speeds for cooling and heating operation.

AVC/AVV/MVC Airflow and Comfort Setting Selections for ECM Motors

The airflow and comfort setting selection must be set properly at the time of installation and start-up for proper system operation.

Note
Incorrect airflow and comfort settings result in decreased system efficiency and performance.

The AVC, AVV, and MVC model air handlers are designed to deliver a constant airflow (CFM) even when external static pressure (ESP) in the duct system exceeds the recommended 0.5” w.c. value. Therefore, if too many supply registers are closed, a filter becomes clogged, or there is a restriction in the duct, the motor will automatically operate at a higher speed and torque to compensate for the higher ESP. This results in a higher operating sound level and reduced electrical efficiency.



Variable speed ECMs automatically adjust to provide constant CFM from 0.0” to 0.6” w.c. static pressure. From 0.6” to 1.0” w.c. static pressure, CFM is reduced by 2% per 0.1” w.c. increase in external static pressure. Operation within duct systems with greater than 1.0” w.c. external static pressure is not recommended as this results in excessive operational sound and electrical consumption as the blower speed is maximized to overcome the additional restriction.

The blower performance charts provided with the air handlers indicate blower performance with filter in place. If an external filter is not used, ensure that the internal 1” filter is clean.

Cooling Airflow (COOL and ADJ)

The airflow delivered by the air handler during cooling operation is adjusted to match the cooling capacity of the outdoor condensing unit. This is done by moving the “COOL” and “ADJ” jumpers on the control board.

The “COOL” jumper has four positions which will deliver sufficient airflow in cooling mode for the cooling capacities shown in the air handler Installation Manual. The “ADJ” jumper has three positions which can be used to make further adjustments to the cooling blower airflow. See the air handler Installation Manual for further information.

Delay

The DELAY tap affects the blower ramping times and selection is determined by the type of climate the equipment resides in. The selections are described in Chapter 3 of this field reference guide.

When a Residential Communicating Control System is utilized with a communication-ready air handler, the HEAT, DELAY, COOL and ADJ soft jumpers can be adjusted from the COMM thermostat display.

Heat Pump Airflow

The heat pump airflow setting is the same as the cooling airflow setting required. However, the MODE jumper must be set to the HP position for proper operation of the “O” terminal.

Electric Heat Airflow

On variable speed ECM models, the blower speed required for electric heat is different than cooling. Refer to the Installation Manual for the minimum required airflow for the electric heater installed. Find the desired airflow in the Electric Heat Airflow table in the Installation Manual and set the “HEAT” jumper on the control as indicated. As shown below, minimum blower speeds are specified for use with 6HK heat kits. Consult the manual for the model-specific instruction.

TABLE 4: Electrical Heat: Minimum Fan Speed

Heater Kit Models[1,2,3]	Nom. kW @240V	Air Handler Models									
		18B	24B	30B	36B	36C	42C	48C	48D	60C	60D
6HK(0,1)6500206	2.4kW	Med Lo (#2)	Med Lo (#2)	Med Lo (#2)	Med Lo (#2)	Med Lo (#2)	Med Lo (#2)	Med Lo (#2)	Med Lo (#2)	Med Lo (#2)	Med Lo (#2)
6HK(0,1)6500506	4.8kW	Med Lo (#2)	Med (#3)	Med (#3)	Med Lo (#2)	Med (#3)	Med Lo (#2)	Med Lo (#2)	Med Lo (#2)	Med Lo (#2)	Med Lo (#2)
6HK(0,1)6500806	7.7kW	Med (#3)	Med Hi (#4)	Med Hi (#4)	Med Lo (#2)	Med Hi (#4)	Med (#3)	Med Lo (#2)	Med Lo (#2)	Med Lo (#2)	Med Lo (#2)
6HK(0,1)6501006 6HK36501025	9.6kW	Med (#3)	Med Hi (#4)	Med Hi (#4)	Med Lo (#2)	Med Hi (#4)	Med (#3)	Med Lo (#2)	Med Lo (#2)	Med Lo (#2)	Med Lo (#2)
6HK(1,2)6501306	12.5kW	–	Med Hi (#4)	Med Hi (#4)	Med (#3)	Med Hi (#4)	Med (#3)	Med Lo (#2)	Med Lo (#2)	Med Lo (#2)	Med Lo (#2)
6HK(1,2)6501506 6HK36501525	14.4kW	–	–	Med Hi (#4)	Med Hi (#4)	Med Hi (#4)	Hi (#5)	Med (#3)	Med (#3)	Med Lo (#2)	Med Lo (#2)
6HK(1,2)6501806 6HK36501825	17.3kW	–	–	–	Med Hi (#4)	Med Hi (#4)	Hi (#5)	Med (#3)	Med Hi (#4)	Med (#3)	Med (#3)
6HK(1,2)6502006 6HK46502025	19.2kW	–	–	–	Med Hi (#4)	Hi (#5)	Hi (#5)	Med Hi (#4)	Hi (#5)	Med Hi (#4)	Med Hi (#4)
6HK(1,2)6502506 6HK46502525	24kW	–	–	–	–	–	–	–	Hi (#5)	–	Med Hi (#4)

Minimum Heat Speeds for Electric Heat Application

In all installations, the temperature rise in the heating mode must not exceed the values on the rating plate during all modes. If the temperature rise exceeds the allowable range, a higher blower speed will reduce the temperature rise. If the blower is on the highest speed with a temperature rise still out of range, it is likely that the duct system and/or filters are too restrictive. The system’s external static pressure must be verified to determine the location of the problem. Inadequate duct systems with excessive external static pressure must be corrected to ensure proper equipment operation, longevity, and customer comfort.

Note

Do not change the ADJUST tap position for heating CFM selection. The COOL and ADJUST taps are for heat pump, cooling and “Fan ON” modes only.

Fan Only Airflow

When the connection is made from “R” to “G”, the “Fan ON” mode is activated. In this module, the blowers deliver either 100% of the selected COOL and ADJUST CFM jumper settings for full capacity cooling operation or a reduced airflow as described for the AVC, AVV, and MVC air handlers. This setting cannot be field adjusted.

Refrigerant Charge Verification

Following airflow setup, the system refrigerant charge must be verified. Systems with a TXV metering device must be verified with the subcooling method. Fixed orifice metering device applications must be verified with the superheat method. Variable capacity systems utilize charge verification mode on the outdoor unit technician interface to confirm system charge. Consult the outdoor unit Installation Instructions for specific details on system charge requirements and expected values.

06

Inputs & Operation

Introduction

A complete understanding of air handler operation is critical to success as a service technician. This chapter provides insight on the heating mode (electric and heat pump), cooling mode, and continuous fan operation of the Ducted Systems air handlers.

General Operation Description

Standby Mode

When there is no demand from the thermostat for fan operation, the control is considered to be in Standby Mode. In this mode, it de-energizes all outputs until action is initiated by a thermostat call. In Standby, it continually monitors all thermostat inputs.

Blower Motor Control

When there is a thermostat demand for Fan Operation (G), after a 7 second delay, the control energizes the blower relay. When the thermostat demand for Fan Operation is removed the control continues to energize the blower relay for 60 seconds and then return to Standby Mode.

Faults

Control Fault: If the control detects a fault on the control board (including a fault within the microprocessor), it immediately de-energizes all outputs, ignores all inputs, and enters a 1-hour Hard Lockout. The control resets itself after 1 hour to clear the fault.

Power Up Operation: When power is first applied to the control, all outputs are turned off and all timers are reset. The control performs an initial self-check routine before entering Standby Mode.

Hard Lockout: If the control detects a fault on the control board (including a fault within the microprocessor), it will immediately de-energize all outputs, ignores all inputs, and enters a 1-hour Hard Lockout. If possible, the control shall reset itself after 1- hour to clear the fault.

Power Integration: If power to the control is interrupted for less than 20 milliseconds, the control resumes operation at the same point in the timing cycle that the interruption began but may not go to any other mode of operation. Power interruptions greater than 100 milliseconds may reset the control as a power-up sequence. Power interruptions less than 100 milliseconds do not affect timings. Power interruptions of any duration do not directly cause lockout.

Operational Detail: Variable Speed Models

Powerup Operation

When power is first applied to the control, all outputs are turned off and all timers are reset.

Standby Mode

When there is no demand from the thermostat for heating, cooling, or fan operation, the control is considered in Standby Mode. In this mode, it de-energizes all outputs and flashes the “heartbeat” status code on the STATUS LED until action is initiated by a thermostat call. In Standby, it continually monitors all thermostat inputs, LAS temperature, and the float switch.

Normal Cooling Mode

During normal cooling mode the control energizes the ECM blower. When the demand for cooling has been satisfied, the control runs the blower for an off delay.

Compressor Heating Mode

During Normal Compressor Heating mode, the control causes the following to occur:

- Energize ECM blower
- Energize HUM_OUT contacts

When the demand for compressor heating has been satisfied, the control runs the blower for a 30 second off-delay.

Electric Heating Mode

During Normal Electric Heating Mode, the control causes all of the following to occur:

- Energize ECM blower
- Energize HUM_OUT contacts
- Energize Heat Kit outputs

If the thermostat is sending a demand for first stage electric heat (W1), the control immediately energizes the first stage heat output. If the thermostat is sending a demand for second stage electric heat (W2), the control immediately energizes the second stage heat output. If the thermostat is sending a demand for third stage electric heat, the control energizes the first and second stage heat output. During this condition, the control does not implement any delays between energizing the first stage heat output and the second stage heat output.

When the thermostat demand reduces the number of stages, the control immediately de-energizes the highest heat stage currently energized. Heat relay outputs are unaffected by any Heat Pump demand (heating or cooling mode).

Fan Only Mode

During Normal Fan Only operation, the control energizes the ECM blower.

Humidity Control – Conventional Wiring

An external humidistat controls de-humidification during cooling only. When humidity is below the set point, the humidistat applies 24VAC to the HUM input. When humidity is above the set point, the humidistat will be open. A selection jumper is provided on the control to distinguish between an open humidistat (calling for de-humidification) and a non-connected humidistat.

The HUM enable jumper has 2 positions. “YES” enables de-humidification during cooling. “NO” disables de-humidification logic and energizes the HUM input terminal.

If the jumper is not connected to either terminal, the control responds as if no humidistat is connected. The control operates the fan at normal cooling speeds. The control energizes the HUM_OUT terminals any time there is a conventional wiring call for Heat Pump or Electric Heating.

Humidity Control with Communicating Thermostat

An external humidistat built into the communicating thermostat controls both humidification and de-humidification. The control initiates de-humidification during cooling using reduced blower speeds.

Blower Motor Control

The control determines the proper fan speed based upon thermostat demand, model ID, and the position of the ADJUST, HEAT, COOL, and DELAY jumpers. The control provides the ECM motor with a PWM signal which corresponds to the thermostat demand, model ID and tap adjustment settings.

The DELAY jumper setting does not affect the blower-off delay during any W thermostat call. The DELAY jumper setting only affects operation with compressor-only operation (heating and cooling).

The only conventional 24 Volt AC signal provided to the motor is a “G” signal which is used by the ECM motor to enable it to run in PWM mode. The commanded CFM value at various PWM values is listed in the Extras section of this Field Reference Guide.

MP/ME (PSC)

Thermostat Input	Result	Action
G	Applied	Fan ON
	Removed	Fan OFF
G & Y1	Applied	Fan ON
	Removed	Fan 60 second delay OFF
G & Y/Y2	Applied	Fan ON
	Removed	Fan 60 second delay OFF
G & Y1 or Y/Y2 (with 0)	Applied	Fan ON
	Removed	Fan 60 second delay OFF
W1 (with or without G)	Applied	Fan ON HT1 relay energized
	Removed	HT1 relay OFF Fan 10 second delay OFF
W2 (with or without G)	Applied	Fan ON HT1 relay energized HT2 relay energized after 10 second delay
	Removed	HT2 relay OFF HT1 relay OFF after ½ second delay Fan 10 second delay OFF
W1 & W2 (with or without G)	Applied	Fan ON HT1 relay energized HT2 relay energized after 10 second delay HT3 relay energized after 10 second delay
	Removed	HT3 relay OFF HT2 relay OFF after ½ second delay HT1 relay OFF after ½ second delay Fan 10 second delay OFF
G & Y/Y2 or Y1 (without O)	Applied	Fan ON
	Removed	Fan 30 second delay OFF
G & Y/Y2 or Y1 & W1 (without O)	Applied	Fan ON HT1 relay energized
	Removed	HT1 relay OFF Fan 10 second delay OFF
G & Y/Y2 or Y1 & W2 (without O)	Applied	Fan ON HT1 relay energized HT2 relay energized after 10 second delay
	Removed	HT2 relay OFF HT1 relay OFF after ½ second delay Fan 10 second delay OFF
G & Y/Y2 or Y1 & W1 & W2 (without O)	Applied	Fan ON HT1 relay energized HT2 relay energized after 10 second delay HT3 relay energized after 10 second delay
	Removed	HT3 relay OFF HT2 relay OFF after ½ second delay HT1 relay OFF after ½ second delay Fan 10 second delay OFF

Heat Output Staging

Heat output staging depends on the capacity of the electric heat kit installed. The following table provides heat kit capacity with output stages based on the different inputs.

1Ø 4HK Heat Acc. Nominal KW	KW Staging per Input		
	W1 Only	W2 Only	W1 & W2
2.5	2.5	2.5	2.5
5	5	5	5
7.5	3.75	7.5	7.5
10	5	10	10
15	5	10	15
18	4.5	9	18
20	5	10	20
25	5	15	25

“W1” without “W2” calls for one stage of electric heat. “W2” without “W1” calls for two stages of electric heat. “W1” and “W2” together call for three stages of electric heat.

If the HEAT/NO HEAT jumper is in the “HEAT” position, the control will energize the first stage heat output whenever there is a demand for electric heat (W1, W2, or W1and W2). A call for second stage heat will energize the additional stage after a 10 second delay. With a “W1” and “W2” call, another 10 second delay will commence before the third stage is energized.

When the thermostat demand reduces the number of stages, the control de-energizes the highest heat stage, followed by the next highest heat stage every ½ second until heat output matches thermostat demand.

Heat delay outputs are unaffected by any Heat Pump demand (heating or cooling mode).

AE and ME (Standard ECM)

Thermostat Input	Action	Result
G	Applied	Fan ON
	Removed	Fan OFF
G &Y1	Applied	Fan ON
	Removed	Fan OFF
G & Y/Y2	Applied	Fan ON
	Removed	Fan OFF
G & Y1 or Y/Y2 (without O)	Applied	Fan ON
	Removed	Fan OFF
W1 (with or without G)	Applied	Fan ON
		HT1 relay energized
	Removed	HT1 relay OFF
		Fan OFF
W2 (with or without G)	Applied	Fan ON
		HT1 relay energized
		HT2 relay energized after 10 second delay
	Removed	HT2 relay OFF
		HT1 relay OFF after ½ second delay
		Fan OFF
W1 & W2 (with or without G)	Applied	Fan ON
		HT1 relay energized
		HT2 relay energized after 10 second delay
		HT3 relay energized after 10 second delay
	Removed	HT3 relay OFF
		HT2 relay OFF after ½ second delay
		HT1 relay OFF after ½ second delay
		Fan 30 second delay OFF
G & Y/Y2 or Y1 (without O)	Applied	Fan ON
	Removed	Fan OFF
G & Y/Y2 or Y1 or W1 (without O)	Applied	Fan ON
		HT1 relay energized
	Removed	HT1 relay OFF
		Fan OFF
G & Y/Y2 or Y1 & W2 (without O)	Applied	Fan ON
		HT1 relay energized
		HT2 relay energized after 10 second delay
	Removed	HT2 relay OFF
		HT1 relay OFF after ½ second delay
		Fan OFF
G & Y/Y2 or Y1 & W1 & W2 (without O)	Applied	Fan ON
		HT1 relay energized
		HT2 relay energized after 10 second delay
		HT3 relay energized after 10 second delay
	Removed	HT3 relay OFF
		HT2 relay OFF after ½ second delay
		HT1 relay OFF after ½ second delay
		Fan OFF

AVC/AVV/MVC (Variable Speed ECM)

Thermostat Input	Action	Result			
G	Applied	Fan ON			
		Fan Jumper	"H"	"M"	"L"
	Removed	Fan OFF			
G & Y1	Applied	Fan ON			
	Removed	Fan 30 second delay OFF			
G & Y/Y2	Applied	Fan ON			
	Removed	Fan 30 second delay OFF			
G & Y1 or Y/Y2 (with O)	Applied	Fan ON			
	Removed	Fan 60 second delay OFF			
W1 (with or without G)	Applied	Fan ON			
		HT1 relay energized			
	Removed	HT1 relay OFF			
		Fan 30 second delay OFF			
W2 (with or without G)	Applied	Fan ON			
		HT1 relay energized			
		HT2 relay energized after 10 second delay			
	Removed	HT2 relay OFF			
		HT1 relay OFF after ½ second delay			
		Fan 30 second delay OFF			
W1 & W2 (with or without G)	Applied	Fan ON			
		HT1 relay energized			
		HT2 relay energized after 10 second delay			
		HT3 relay energized after 10 second delay			
	Removed	HT3 relay OFF			
		HT2 relay OFF after ½ second delay			
		HT1 relay OFF after ½ second delay			
		Fan 30 second delay OFF			
G & Y/Y2 or Y1 (without O)	Applied	Fan ON			
	Removed	Fan 30 second delay OFF			
G & Y/Y2 or Y1 & W1 (without O)	Applied	Fan ON			
		HT1 relay energized			
	Removed	HT1 relay OFF			
		Fan 30 second delay OFF			
G & Y/Y2 or Y1 & W2 (without O)	Applied	Fan ON			
		HT1 relay energized			
		HT2 relay energized after 10 second delay			
	Removed	HT2 relay OFF			
		HT1 relay OFF after ½ second delay			
		Fan 30 second delay OFF			
G & Y/Y2 or Y1 & W1 & W2 (without O)	Applied	Fan ON			
		HT1 relay energized			
		HT2 relay energized after 10 second delay			
		HT3 relay energized after 10 second delay			
	Removed	HT3 relay OFF			
		HT2 relay OFF after ½ second delay			
		HT1 relay OFF after ½ second delay			
		Fan 30 second delay OFF			

07

Troubleshooting

Introduction

This chapter provides common troubleshooting techniques. It is the responsibility of the technician to become familiar with the equipment being serviced and utilize the appropriate troubleshooting techniques.

Flash Codes

Many control boards installed in air handlers have flash codes to assist in troubleshooting the system.

AVC/AVV/MVC

Fault or Status Condition	LED1 (RED) Flash Code
Status	
No power to control	OFF
Normal operation	2s ON/2s OFF
Control in test mode	Rapid Flash
Control failure	ON
Limit Faults	
Limit switch currently open (not in lockout)	1
Multiple limit openings with no call for heat	2
Multiple limit openings during one call for heat	3
Single long duration limit opening	4
Multiple long duration limit openings	5
Fan failure	6
Wiring Related Faults	
Simultaneous call for heating and cooling	7
Internal Control Faults	
Control recovered from internal event	9

Command CFM Flashes

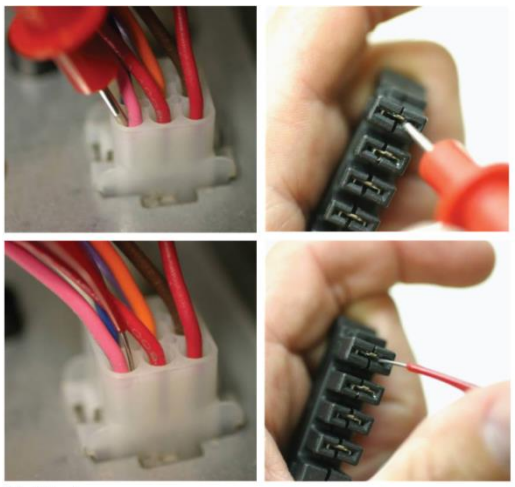
The number of flashes on the unit control board indicates the amount of CFM (in hundreds) that the control board is requesting. The number of flashes on the green LED represents 100 cubic feet per minute of air flow for each flash.

Example:
12 flashes indicate 1200 CFM
8 flashes indicate 800 CFM

It does not indicate actual air flow if the air handler is operating beyond its external static limitations. The commanded CFM may also be measured with a multimeter capable of measuring duty cycle. Measurements can be taken between PWM and PWM COM on the control board. The commanded CFM values corresponding to PWM are in the Appendix of this field reference guide. 24 volts AC should also be measured between PWM ENA (enable) and 24- volt common.

Test Lead Selection

Standard meter test leads are typically larger than the terminals or sockets on the plug connections being checked for voltage. Use thinner test pins to prevent the terminals from being damaged. Below is an example of a standard meter lead test pin (top) and a thinner one (bottom). These test pins are also available in 90-degree angles for tight areas. These types of leads are available from most meter manufacturers.



Meter Test Leads

Motor Troubleshooting

PSC (Permanent Split Capacitance) Motor

The motor contains a start winding, run winding, and run capacitor wired between the start and run windings. It relies on the frequency of the supplied voltage, the number of poles the motor contains and the load on the motor.

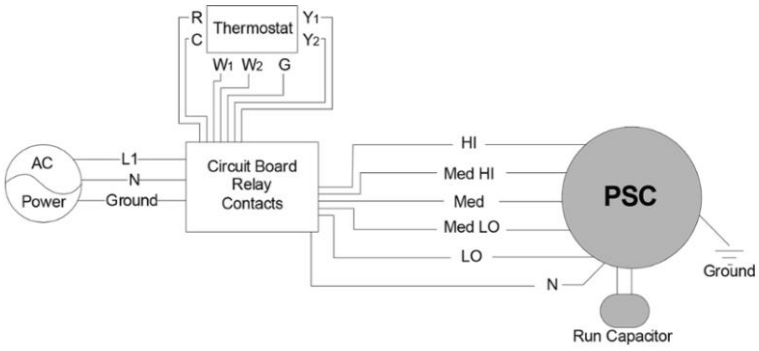
A PSC motor can only run at the rated rpm to make the designed airflow if the static pressure is also at the design rating. Without the ability to add power and increase the speed of the motor, it moves less air when static pressure increases.

A thorough understanding of troubleshooting run capacitors is required when servicing the PSC motor. Improper troubleshooting of these motors and capacitors has resulted in numerous situations where the motor is identified as the problem component when the capacitor was the true fault.

Before using a multi-meter or capacitor analyzer to evaluate the run capacitor, the capacitor must be discharged using a bleed resistor. The bleed resistor should be a 20,000-ohm 2-watt resistor. Do not use a screwdriver to bleed the capacitor as this can cause damage to the component.

Capacitor Analyzer

Open: Open capacitors will have an infinite reading between the terminals on the capacitor.
Shorted: Shorted capacitors will have a reading of zero ohms of resistance between the terminals of the capacitor.
Grounded: Any measurable resistance from the capacitor terminals to the shell of the capacitor indicates a grounded capacitor.



PSC Motor Operation

Standard ECM Motor

There is one connection block on the Standard ECM motor with two rows of terminals and two different size terminals used.

The power inputs (high voltage) to the motor connect through the 3/16” terminals on the following terminals:
(L) – Line 1
(G) – Ground
(N) Neutral or Line 2

The line voltage is present at these terminals whenever the system is powered regardless of the thermostat demand. The control inputs (low voltage) to the motor connect through the ¼” terminals. Terminal C is used for common and terminals 1-5 are used to select airflow settings programmed into the motor.

Communication to the Standard ECM motor is the low-voltage 24 volts AC provided to taps 1 through 5. The purpose of this voltage is to communicate to the motor only, not to operate it. The 24 volts AC provided to each tap is a communication signal used to select five different torque values. The motor’s control board uses this signal to determine which torque value it should deliver and then uses the line voltage (high voltage that is continuously connected) to operate the motor according to that program.

Each motor has a unique program. The tap settings must never be changed to adjust airflow without checking the air flow charts for the system installed.

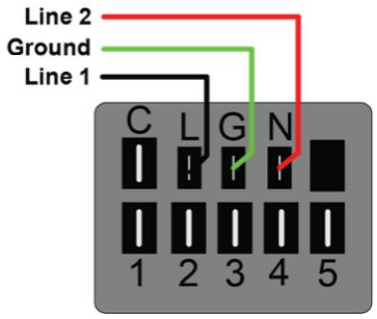
Standard ECM Connections

The high voltage connections contain the three terminals labeled “L”, “G” and “N” and the low voltage connections contain one terminal labeled “C” for the 24 volts AC common and the five torque settings labeled terminals “1” through “5” as discussed in Section 3.

The high voltage plus is used when troubleshooting the low voltage input to the motor, since the 24 volts AC common terminal “C” is in this plug.

The plug design prevents improper connection. The high voltage plus has a full blank tab on the opposite end from the “C” terminal. This prevents it from being installed on the low voltage terminals.

Both the high and low voltage plugs, if equipped, have tabs on the bottom. When the high voltage plus is installed properly, the low voltage plug can only be installed with its tab down, or opposite from the high voltage plug. This properly orients the low voltage terminals 1-5.



208/240 VAC Inputs (L, G, N) Speed Taps (1-5)

Servicing the Standard ECM Motor

Service Basics

The Installation Manual, diagrams and wiring schematics must be consulted for proper set up, wiring, operation, and all troubleshooting. Checking all system limits and safeties before troubleshooting the motor is important.

Troubleshooting this motor is simple if the following information is known:

1. Which tap(s) have programs and what are their purposes (heating airflow, cooling airflow, continuous fan airflow)?
2. Where on the controls or circuit board do the line voltage and control voltage come from?
3. What is the sequence of operation, and when is the control voltage sent to the motor from each thermostat demand?

Troubleshooting the voltage at the Standard ECM motor comes down to two factors:

1. Line voltage (208/240 volts AC) must be present with or without a demand for heating, cooling or continuous fan. Make sure proper line voltage is present between the “L” and “N” terminals as shown for the specific model being serviced.
    a. If there is no high voltage present at the motor, the voltage is present between the “L” and “N” terminals as shown for the specific model being serviced.
    b. Line voltage must be present at the motor with or without a demand from the thermostat. The allowable voltage variance is between 196-264 volts AC on the 230 AC models.
2. 24 volts AC low (control) voltage at the appropriate tap, with the appropriate thermostat demand call. Control voltage is present between terminals 1-5 and the “C” terminal (as shown in the Low Voltage Control Inputs image above), depending on which terminal is receiving control voltage.
    a. If there is no low (control) voltage present at the motor, the voltage loss must be traced back towards the wiring and controls. It may be necessary to confirm there is a proper thermostat demand.

The allowable voltage variance can be as much as +/-1-% of the nominal 24 volts AC. If this voltage is present below this range, confirm that the control voltage is present at the unit transformer, and at the thermostat low voltage connections on the unit control board.

- If high voltage is present at the motor, the low (control) voltage is present on a programmed tap, and the motor is operating, then the airflow issues, such as high or low temperature rise, tripping main limit, freezing coils, or compressor overload tripping, must be addressed as an airflow issue first.

The Standard ECM is not a contact CFM motor. Airflow will decrease if static pressure rises too high in the system. All obvious airflow restrictions such as closed or blocked registers, grilles, dampers, blower wheel and dirty filters or evaporator coils must be corrected. The external static pressure (ESP) must be evaluated, and any airflow restrictions corrected.

Probable causes of high static pressure are:

- Blocked, crushed, or dented ductwork
- Undersized ductwork
- Closed or blocked supply registers or return grilles
- Dirty filters
- Dirty indoor coil

If the high voltage and the low (control) voltage are present at the appropriate electrical connections, but the motor will not operate, the motor must be replaced. A direct replacement motor from the manufacturer for the same model and size unit is required.

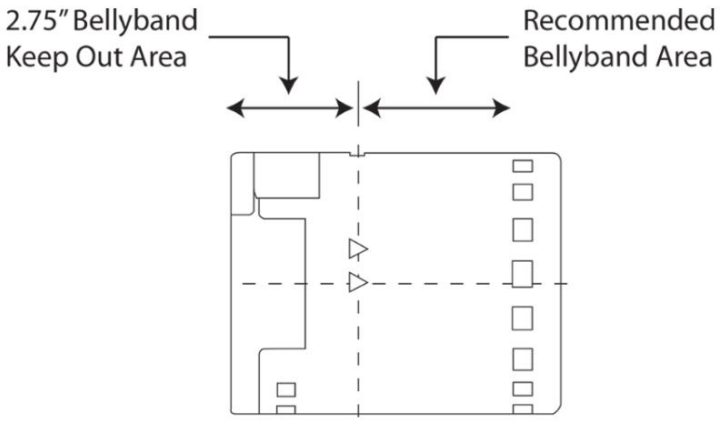
Replacing the Standard ECM Motor

The Standard ECM motor is a one piece motor that is replaced as a whole and is not field repairable.

The Standard ECM motor must have a direct replacement for the specific model unit it came from. When using a bellyband for mounting, the band should not be located in the area identified below as the “Keep Out Area”.

The wheel key must be tightened on the flat side of the motor shaft with the blower wheel centered in the housing.

If the wheel sits too close to the motor when centered or if the wheel cannot be centered because it hits the motor, the motor must be adjusted in the bellyband. The blower/motor assembly must be re-installed into the HVAC system.



Bellyband Keep-Out Area

All wires and plugs must be reconnected to the motor confirming connection to proper terminals per demand.

A drip-loop must be formed so water cannot enter the motor by draining down the cables. Condensate or droplets can accumulate in the harness and may find their way into the motor.

Final Installation Checks – ECM and Standard ECM Motors

Perform a visual inspection of all wiring and connections, especially those removed while servicing.

The system is setup as following:

- Reconnect the AC power to the HVAC system.
- Verify that the motor control module is working properly.
- Plug and seal all leaks in the return ducts and equipment cabinet, using approved methods. Verify that the system is operating quietly and smoothly in all modes (heating, cooling, and continuous fan) and all stages (if applicable)
- Return the thermostat setting to the customer's preference.

If this is a repeat failure, check the following:

- Moisture
- Question whether the area is subject to excessive amounts of lightning strikes; if so, the use of additional transient protection may be helpful.

Tech Tips

- Line voltage must be within +/-10% of the value indicated on the equipment rating plate.
- A true-RMS meter is not required to check input voltage to this motor. Any standard AC voltmeter, analog or digital, will work if it can read voltage up to at least 500 volts AC.
- If the polarity is reversed on the 115 volts AC connection, the motor may still run, but this must be corrected.

Variable Speed ECM Motor

Troubleshooting the ECM motor is not just an off or off solution. The following four problems will prevent the motor from running:

1. There is no input power to the motor controller (high voltage input).
2. There is improper or no communication to the motor controller (low voltage inputs). This problem could be in the interface board or the low voltage connector.
3. The motor control has failed.
4. The motor module has failed.

A significant percentage of ECM field returns are "No Problem Found". Do not simply assume the motor has failed because it is not running.

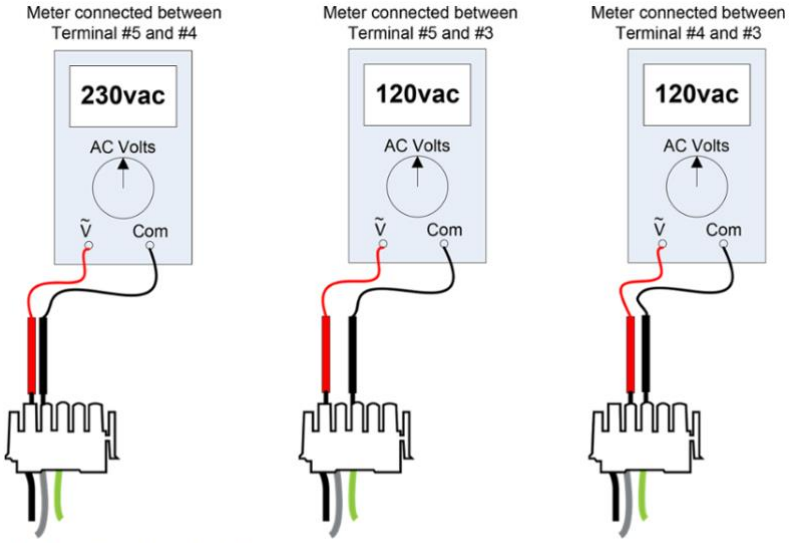
Measure the input power (high voltage) to the motor controller by following these steps:

1. Disconnect the power from the system.
2. Disconnect the 5-pin (high voltage) connector.
3. Restore the power to the system.
4. Check for proper input power.

ECM 5-Pin Plug Connector

When the main power is restored, take a power measurement at the 5-pin connector as shown below:

5 Pin Connector



Motor Test 230 Volts AC and 120 Volts AC

Reconnecting the Plug

After all the input high voltage power connections are confirmed or corrected, turn the power off and reconnect the plug to the motor control. The plug connector is keyed and must be reconnected properly. Do not force the plug in the wrong direction or it will cause permanent damage to the motor. Fully insert the plug to prevent arcing or vibration, which may cause the connection to be broken. When the plug is fully inserted, it will slide gently, all the way in until clicks are heard on both sides.

Motor Grounding

It is especially important to have a properly grounded connection from the connector to the main ground when using ECM motors. This will ensure proper operation and safety. Disconnect the power to the system before checking the resistance. Evaluate the continuity between the two connections with an ohm meter. The resistance reading must be zero between the two connections. If any other readings are indicated, correct the problem immediately. Although the motor may run despite not being properly grounded, this is a safety concern that must be corrected.

Troubleshooting the AVC and MVC Model Air Handler ECM Motors

This section provides the information needed to troubleshoot the ECM motors installed on the AVC, AVV, MVC air handlers with communication-capable control boards.

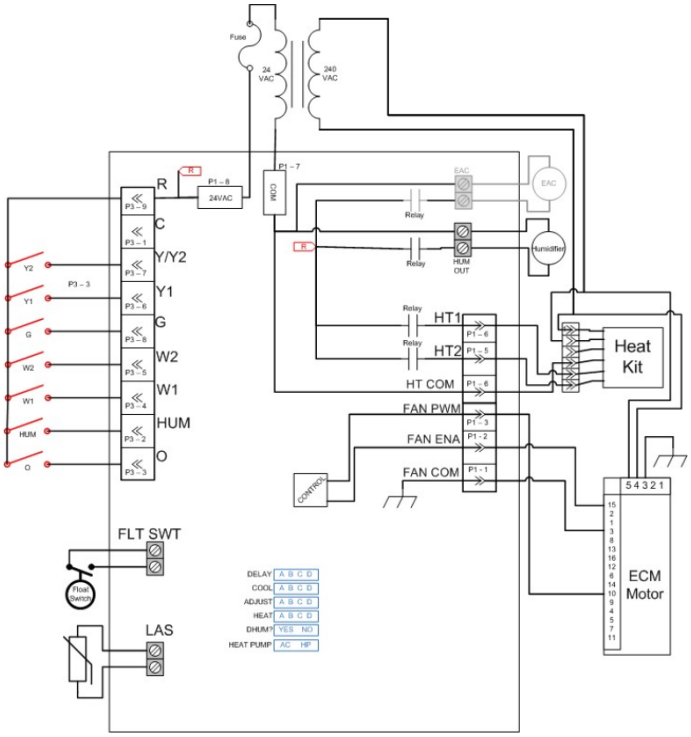
1. Determine the mode of operation present at the thermostat.
2. A line voltage (208/230 volts AC) measurement must be taken to verify that proper voltage is present. The required line voltage as indicated in the table below must be measured between pins 4 and 5 of the 5-pin line voltage connector.
    a. If line voltage is not present, the technician must ensure that the door switch is closed, and the electrical connections are properly secured.
    b. If line voltage is present and the motor is not rotating, then advance to step 3.

The 208/230-volt AC line voltage limitations are as follows:

Voltage	Voltage Range
208/230 volts AC	187-253 volts AC

3. A PWM (Pulse Width Modulation) measurement must be taken between PWM and PWM COM on the air handler control board to identify that there is proper communication issued from the control board to the motor. Use the chart in the Extras to identify the proper PWM signal present for the application.

Note the three connections on the 16-pin motor plug connector: Pin 15 (Fan PWM), Pin 3 (Fan COM-NOT tied to 24-volt AC Common) and FAN ENA (24-volt signal to enable blower operation).



Electrical Connections with Variable Speed ECM Blower

Replacing the Variable Speed ECM Control Module

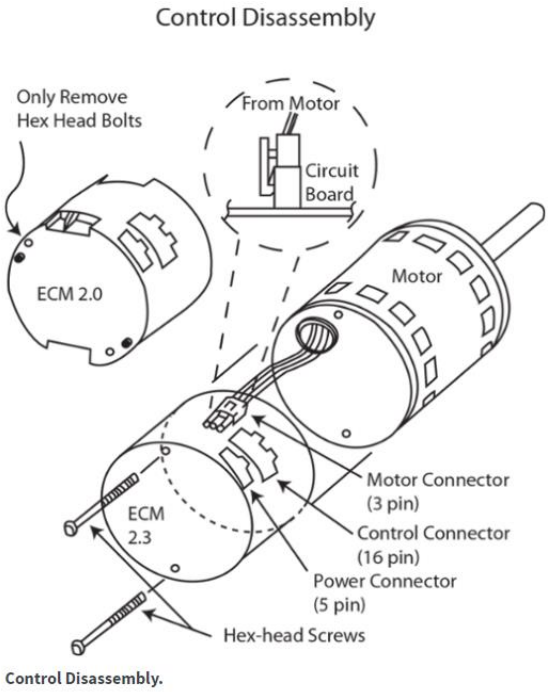
1. Lock-out and tag-out the electrical disconnect, and ensure the motor is de-energized for 5 minutes.

Note
Disconnect AC power from the HVAC system and wait 5 minutes before opening the motor to avoid electrical shock from the motor's capacitors.

2. Unplug the 5-pin connector and the 16-pin connector from the motor control.
3. Remove the blower assembly from the HVAC system.
4. Remove the two (2) hex-head screws from the back of the control. Support the module to prevent the internal wires from breaking.
5. Unplug the 3-pin connector from inside of the control module by squeezing the latch and gently pulling on the connector.
6. Ensure the motor module is not damaged by performing the "Module Tests" below.

Variable Speed ECM Motor Control Disassembly Review

Step 1: Unplug the 16-pin connector and the 5-pin connector from the motor control.
Step 2: Remove the blower assembly from the HVAC system.
Step 3: Remove the two (2) hex-head screws from the back of the control.
Step 4: Unplug the 3-pin connector from inside the control by squeezing the latch and gently pulling on the connector.



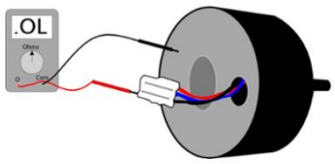
Control Disassembly.

Variable Speed ECM Motor Module Tests

These tests are no different than taking resistance readings on a 3-phase compressor motor. Confirm that the windings are not shorted to ground, and that the resistance is equal when tested phase-to-phase.

Test A: Measure the resistance between each of the three motor leads to the unpainted part of the end shield (winding to ground resistance). Typically, a good motor will read infinite ohms to the ground on all leads. A grounded motor would read a measurable resistance from any one of the motor leads to ground. For this test, the meter is set to the highest ohms scale unless it is auto-ranging, and Meg-ohm meters should not be used for this test.

Good Reading

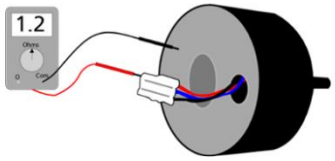


Good Motor Reading (Test A)

If the motor has a resistance of less than 100k ohms between any one motor lead to ground, the motor must be replaced with an exact replacement.

If the resistance is greater than 100k ohms, then perform Test B.

Failed Reading



Failed Motor Reading (Test A)

Test B: Measure the motor phase-to-phase resistance by checking these combinations of the 3-pin motor connector with an ohmmeter. For this test, either end of the connector may be used as Lead 1, the center lead as Lead 2, and the opposite end as Lead 3.

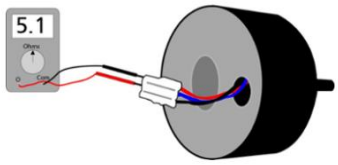
- Resistance between Lead 1 and Lead 2
- Resistance between Lead 1 and Lead 3
- Resistance between Lead 2 and Lead 3

The values for each lead-to-lead resistance reading must be measured with the meter set to the highest ohms scale unless it is auto-ranging.

The resistance across any two leads must be less than 20 ohms. All resistance readings measured between either two of the three leads must be no greater than +/-10% of each other. If any of the three resistance measurements are greater than 10% from the other readings, the motor module must be replaced with an exact replacement.

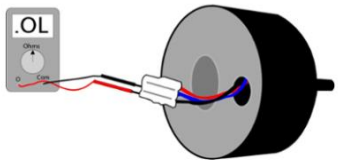
The motor must pass both tests to be good. If the motor passes both tests, the motor control must be replaced (control module) only. If the motor fails either test, it must be replaced.

Good Reading



Good Motor Reading (Test B)

Failed Reading



Failed Motor Reading (Test B)

When replacing a failed motor or reinstalling the existing motor, make sure that the bellyband is not covering any vents and is not installed on the motor control. The motor module does not have a specific orientation; however, the motor control does. The three wire plus must be oriented properly, allowing the plug to reach the motor control. This must be aligned properly prior to tightening the bellyband.

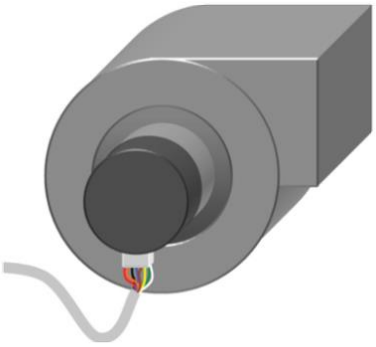
Always make sure to tighten the wheel key on the flat side of the motor shaft with the blower wheel centered in the housing. If the wheel sits too close to the motor when centered or cannot be centered because it hits the motor, the motor must be adjusted in the bellyband.

Attaching the New Control Module

The 3-pin connector is inserted into the new control module. A slight click will be heard when inserted properly.

The 16-pin connector and the 5-pin connector must be plugged back into the motor. The keyed connectors must be inserted properly and securely until they click. The blower/motor assembly must be re-installed into the HVAC system.

A drip-loop must be formed so that water cannot enter the motor by draining down the cables. Condensate or droplets can accumulate in the harness and may eventually travel into the motor.



Drip Loop Cable

ECM Motor Failure Footnotes

All repair parts for ECM motors must be obtained as a specific match to the existing motor or control module. Even if the new part looks like a direct replacement, all literature that comes with the new part must be read. There may be a small but important change in mounting, programming, or wiring that could make the difference between a long-term repair and a callback.

Frozen Evaporator Coil

Many “no cooling” calls come from a neglected air filter or other causes of restricted airflow. As airflow is reduced, the temperature of the evaporator coil during cooling operation decreases below the freezing point of water and the moisture in the return air will freeze on the coil surface.

If left running long enough in this condition, the evaporator coil will become a block of ice. As a result, minimal heat transfer will occur between the return air and the refrigerant within the coil. The liquid refrigerant entering the evaporator coil cannot boil to a vapor and will pass into the suction side of the compressor. If liquid refrigerant flows back to the compressor, the compressor may fail.

To prevent such an occurrence, customers must be advised to replace filters regularly and refrain from closing off rooms not in use. Closing off registers or rooms does not save operational costs. Rather, it increases static pressure in the system and the possibility of liquid refrigerant floodback. The technician should take the time to explain to the customer that the equipment will continue to run until the conditioned space reaches the desired thermostat setting, regardless of if the unused rooms are open or closed. When airflow is properly set up and the customer is educated in regard to his/her role in system upkeep, “no cooling” calls due to airflow restrictions are avoided.

The appearance of frost can also indicate low system refrigerant charge or a restriction. If frost appears on or immediately downstream of a specific component in the refrigeration system, (such as the filter drier or metering device), there is most likely a restriction within that component. A low system refrigerant charge causes a portion of the evaporator coil to drop below 32 degrees F during cooling operation. This causes the moisture in the return air to freeze on the surface of the coil.

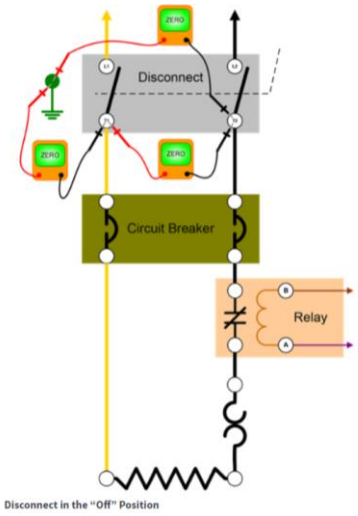
If a frozen evaporator coil is encountered during cooling operation, allow the coil to completely defrost. When the coil has defrosted, proper airflow must be verified. Review the methods covered in the external static pressure (ESP) section. Then, the refrigerant charge may be verified. If the system has a low system refrigerant charge, the system must be leak checked. Any leaks present must be repaired prior to attempting to adjust the system refrigerant charge.

Heat Kit Troubleshooting

High voltage troubleshooting is uncomplicated on residential air handler heat kits since the circuitry is limited to disconnect, circuit breaker, relay, thermal overloads, heat elements and associated wiring.

Many troubleshooting procedures require that power remain on the unit for valid readings. The technician must be attentive to his/her personal safety when working on a unit that is energized.

Other procedures for maintenance, service and repair require that the unit power be disengaged. To prevent electrical shock, the technician should ensure line voltage is fully disengaged any time that the disconnect handle is placed in the "off" position.



Disconnect in the "Off" Position

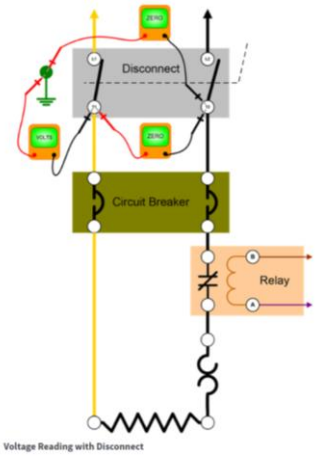
With a trusted AC voltmeter, make the following readings from the outgoing side (unit side) of the disconnect:

- T1 to T2
- T1 to cabinet ground
- T2 to cabinet ground

As illustrated, all readings should be zero volts with the disconnect in the "off" position to ensure that line voltage is disengaged.

If any of the following readings from the outgoing side (unit side) of the disconnect show voltage, there is risk of electrical shock to the technician since line voltage is still present to the unit:

- T1 to T2
- T1 to cabinet ground
- T2 to cabinet ground



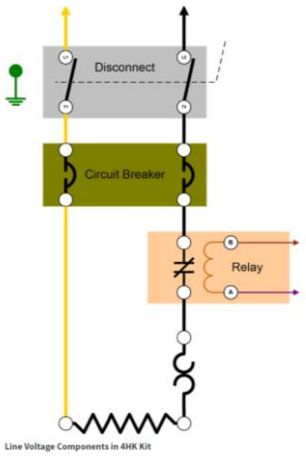
Voltage Reading with Disconnect

The example illustrated shows all readings to be zero except for T1 to cabinet ground. This is an indication that, even though the disconnect handle is in the “off” position, the L1 to T1 knife-blade of the disconnect has not disengaged line voltage to the unit.

The power to the unit must be shut off from the main power-panel if the disconnect will not fully disengage line voltage. A qualified electrician should then replace the failed disconnect.

A systematic approach to line voltage component electrical troubleshooting will provide the greatest diagnostic accuracy. The following method requires that the equipment be powered. The technician must exercise care and caution to avoid electrical shock and other personal safety hazards.

The accompanying diagram is a simplified version representing the line voltage components in a standard 4HK heat kit.



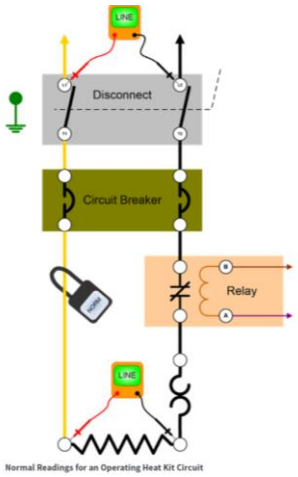
From the top, the items diagrammed are:

- Up arrows represent the connection to the power panel.
- A field-mounted power disconnect switch (gray rectangle)
- A circuit breaker (olive rectangle)
- A heat relay (tan rectangle)
- A thermal overload.
- An electric heat element (resistive load).

Electrical troubleshooting of the line voltage components uses:

- Voltage readings of the line voltage circuit.
- Amperage readings of the line voltage circuit.
- Confirmation that the 24-volt relay is complete and enabled.

The technician’s understanding of normal readings and recognition of abnormal readings is key to heat kit electrical troubleshooting.



Normal Readings for an Operating Heat Kit Circuit

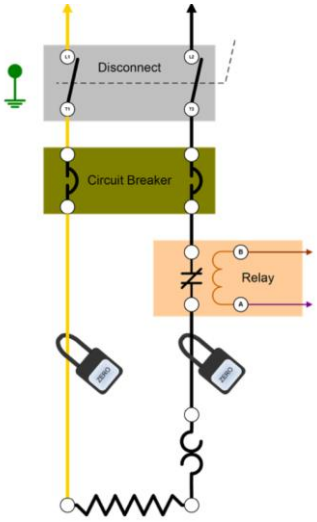
The illustration shows normal readings for an operating heat kit circuit:

- The presence of 24 volts, and normal current draw (typically 1 amp or less) at the relay will confirm the 24-volt circuit is complete and enabled.
- The current draw of the heat strip is normal.

Line voltage is read throughout the circuit between the two “legs”:

- Leg 1 (yellow) to Leg 2 (black).

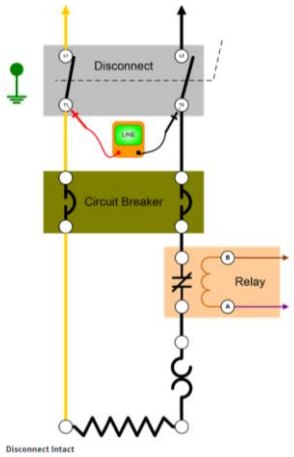
The following diagrams and descriptions discuss troubleshooting methods used to identify various problem conditions. While each condition is discussed in isolation, there may be multiple problems existing on a circuit at the same time.



When beginning the electrical troubleshooting process, the amp draw of the individual heating element(s) must be determined. Then read the current draw of one “leg” of the voltage circuit. This reading indicates the type of problem and the urgency and care needed for troubleshooting.

If the current reads normal, the line voltage circuit is complete, and the heat element should be operating. The table below provides expected current readings depending on the capacity of the heat strip and voltage applied. Consider that these readings are dependent on precise measurement and voltage. If the voltage applied varies from 208-, 230- or 240-volts AC, the measurement will also show variations.

Heat Strip (KW)	Applied Voltage		
	208 volts AC	230 volts AC	240 volts AC
2.5	9.0	10.0	10.4
3.75	13.5	14.9	15.6
4.3	15.5	17.1	17.9
4.4	15.9	17.5	18.3
4.8	17.3	19.2	20



If the current draw reads zero, the line voltage circuit is currently open. The open circuit may be temporary if the thermal overload tripped due to overheating. In this case, the open circuit may be a secondary result of another condition. However, during periods with zero current draw there is little chance of further damage to the line voltage circuit or equipment.

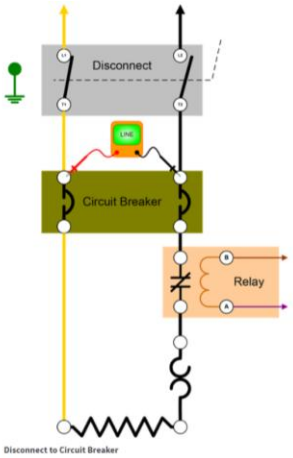
Next is confirmation that the disconnect is intact. Line voltage should be read from the outgoing lugs of the disconnect:

- T1 to T2

If the line voltage is complete at the incoming lugs of the disconnect but is not complete at the outgoing lugs of the on-positioned disconnect, then the connections of the disconnect are faulty.

In most cases where the disconnect is faulty, a qualified electrician will need to be consulted for repairs.

Next is confirmation that the disconnect to circuit breaker and connections are intact.



Disconnect to Circuit Breaker

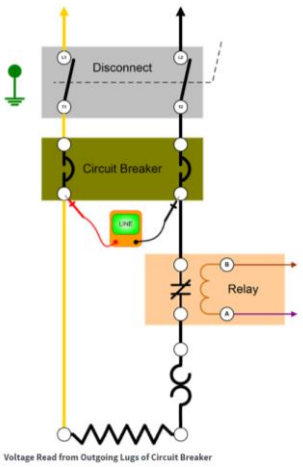
Line voltage should be read from the incoming lugs of the circuit breaker:

- Leg 1 (yellow) to Leg 2 (black)

If these readings are not present, further troubleshooting procedures are required. If the line voltage is complete at the outgoing lugs of the disconnect but is not complete at the incoming lugs of the circuit breaker, then the connections or wiring between the disconnect and circuit breaker are faulty.

Often when these readings are found there will be visible discoloration or damage to the connections or wiring terminals. Typically, the component damage originates with loose connections.

Next is confirmation that there are no blown circuits, and that all circuit breaker connections are intact.



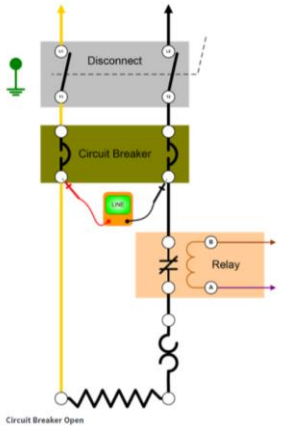
Voltage Read from Outgoing Lugs of Circuit Breaker

Line voltage should be read from the outgoing lugs of the circuit breaker:

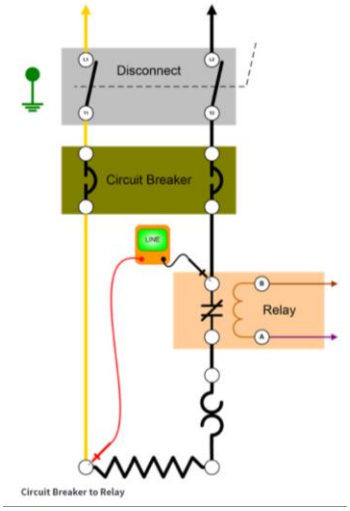
- Leg 1 (yellow) to Leg 2 (black)

If the line voltage is complete at the incoming legs of the circuit breaker but is not complete at the outgoing lugs of the circuit breaker, then a high current situation has tripped the circuit breaker of the connections of the circuit breaker are faulty.

If this occurs, reset the circuit breaker, and monitor the current draw of the heat strip to determine if a fault is causing high current draw.



Next is confirmation that the circuit breaker to relay wiring and connections are intact.



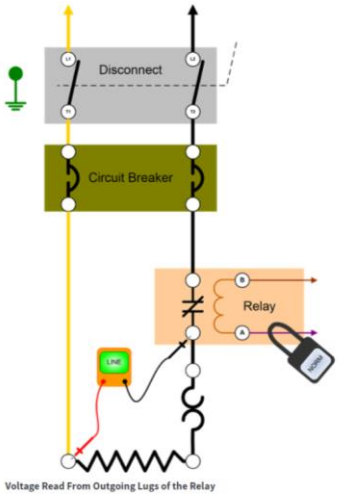
Line voltage should be read from the incoming lugs of the relay:

- L1 to L2

If the line voltage is complete at the outgoing lugs of the circuit breaker but is not complete at the incoming lugs of the relay, then the connections or wiring between the circuit breaker and contactor are faulty.

Often when these readings are found there will be visible discoloration or damage to the connections or wiring terminations. Typically, the component damage originates with loose connections.

Next is confirmation that the relay is energized, and its contacts are engaged.



Line voltage should be read from the outgoing lugs of the relay:

- L1 to L2

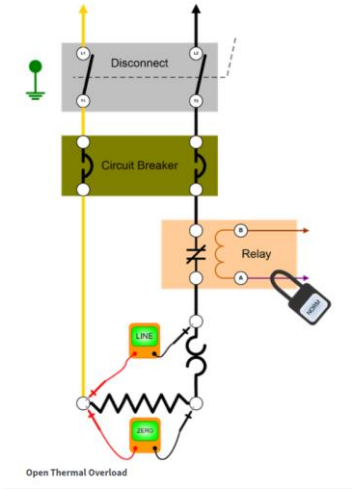
If the line voltage is complete at the incoming lugs of the relay but is not complete at the outgoing lugs of the relay, and the relay is confirmed to be energized, then the relay is faulty.

Inspect the faulty relay for indications of mechanical binding such as water damage or corrosion. Typically, these problems can be prevented. Inspection of the faulty relay can reveal if the failure was due to excessively low control circuit voltage, such as overheating damage.

If inspection indicates that the faulty relay has evidence of excessive current draw, then particular attention should be paid to the current draw through the relay after the fault has been corrected.

When power is restored after repairs are made, overall current draw of the unit should be monitored to determine if a unit fault is causing high current draw (amp-meter segment of the illustration).

Next is confirmation that the thermal overload is intact and closed.



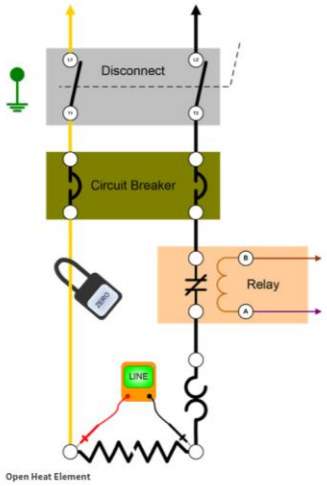
Line voltage should be read from the terminals:

Leg 1 (yellow) to Leg 2 (black) prior to the thermal overload.

If these readings are present, take a voltage reading across the heat element lugs.

If line voltage is not present between the heat element lugs, as in Figure 7-25, then the thermal overload is open.

The final voltage reading confirms that the wiring and connections to the heat element are intact.



Line voltage should be read from the terminals of the heat element:

Leg 1 (yellow) to Leg 2 (black)

If these readings are not present, then the heat element is open and must be replaced.

If the line voltage is complete at the outgoing lugs of the lay, but is not complete at the heat element lugs, check the connections and wiring.

08

Appendix

Blower PWM AVC/AVV/MVC Variable Speed Air Handlers

The control determines the proper fan speed based upon thermostat demand, Model ID, and the position of the ADJUST, HEAT, COOL, and DELAY jumpers. The control provides the ECM motor with a PWM signal which corresponds to the thermostat demand, model ID, and tap adjustment settings.

The DELAY jumper setting does not affect the blower off delay during any W thermostat call. The DELAY jumper setting only affects operation with compressor only operation (heating and cooling).
The only conventional 24VAC signal provided to the motor is a "PWM ENA" signal which is used by the ECM motor to enable it to run in PWM mode. The proper PWM value for each model, thermostat demand, and tap adjustment settings are listed in the charts that follow.

AVC/AVV/MVC Blower PWM

Hi Cooling Mode

PWM Summary Sheet																					
ENERGIZE							COOL	ADJUST	HEAT	DELAY	PWM										
G	Y1	Y/Y2	O	W1	W2	HUM					AVC1 8B	AVC2 4B / MVC0 8B	AVC3 0B	AVC3 6B / MVC1 2B	AVC3 6C	AVC4 2C	AVC4 8C / MVC1 6C	AVC4 8D	AVC6 0C	AVC6 0D / MVC2 0D	MVC1 4D
CFM TABLES/TARGETS FOR FAN ONLY (Kfan = 63% of CFM TARGET FOR HI COOLING)																					
X						X	A	A	X	X	39	46	54	51	47	54	53	46	57	55	57
X						X	A	B	X	X	43	52	60	57	52	61	58	51	65	61	64
X						X	A	C	X	X	34	40	48	45	42	49	46	40	49	51	50
X						X	B	A	X	X	33	36	49	47	43	48	45	39	51	48	49
X						X	B	B	X	X	36	41	54	53	48	54	51	44	60	54	55
X						X	B	C	X	X	29	31	44	41	38	43	39	34	44	45	44
X						X	C	A	X	X	26	35	42	43	40	46	38	32	44	41	47
X						X	C	B	X	X	29	39	46	48	44	51	42	36	51	46	53
X						X	C	C	X	X	22	30	37	37	35	41	32	28	37	38	42
X						X	D	A	X	X	21	25	35	34	32	39	29	25	35	37	40
X						X	D	B	X	X	24	29	39	38	36	43	33	29	42	42	44
X						X	D	C	X	X	17	21	30	28	28	35	24	22	30	34	36
X							A	A	X	X	39	46	54	51	47	54	53	46	57	55	57
X							A	B	X	X	43	52	60	57	52	61	58	51	65	61	64
X							A	C	X	X	34	40	48	45	42	49	46	40	49	51	50
X							B	A	X	X	33	36	49	47	43	48	45	39	51	48	49
X							B	B	X	X	36	41	54	53	48	54	51	44	60	54	55
X							B	C	X	X	29	31	44	41	38	43	39	34	44	45	44
X							C	A	X	X	26	35	42	43	40	46	38	32	44	41	47
X							C	B	X	X	29	39	46	48	44	51	42	36	51	46	53
X							C	C	X	X	22	30	37	37	35	41	32	28	37	38	42
X							D	A	X	X	21	25	35	34	32	39	29	25	35	37	40
X							D	B	X	X	24	29	39	38	36	43	33	29	42	42	44
X							D	C	X	X	17	21	30	28	28	35	24	22	30	34	36

Full Compressor Heating/Cooling

PWM Summary Sheet																						
ENERGIZE							COOL	ADJUST	HEAT	DELAY	PWM											
G	Y1	Y/Y2	O	W1	W2	HUM					AV C18B	AV C28B / MV C08B	AV C30B	AV C36B / MV C12B	AV C36C	AV C42C	AV C48C / MV C16C	AV C48D	AV C60C	AV C60D / MV C20D	MV C14D	
CFM TABLES/TARGETS FOR FULL COMPRESSOR HEATING																						
X	X	X				X	A	A	X	A	58	75	86	80	72	98	85	78	93	88	100	
X	X	X				X	B	A	X	A	49	57	75	73	66	78	74	67	84	75	84	
X	X	X				X	C	A	X	A	40	55	63	66	60	74	63	56	71	63	79	
X	X	X				X	D	A	X	A	34	41	53	54	49	61	52	46	59	58	64	
ADJUST MULTIPLIERS OF CFM TARGETS FOR FULL HP (ADJUST B=115%, C=90%)																						
X	X	X				X	A	B	X	A	65	91	100	93	84	100	95	87	100	100	100	
X	X	X				X	A	C	X	A	51	64	73	70	63	79	75	69	80	80	85	
X	X	X				X	B	B	X	A	55	65	88	83	75	93	82	75	99	86	98	
X	X	X				X	B	C	X	A	44	49	66	64	58	68	66	59	72	70	72	
X	X	X				X	C	B	X	A	45	63	70	75	68	86	70	63	83	71	92	
X	X	X				X	C	C	X	A	36	48	56	59	53	65	56	49	62	59	69	
X	X	X				X	D	B	X	A	38	46	59	60	55	68	58	51	68	65	73	
X	X	X				X	D	C	X	A	30	35	47	47	44	54	46	40	51	54	56	
CFM TABLES/TARGETS FOR FULL COMPRESSOR HEATING																						
X	X	X					A	A	X	A	58	75	86	80	72	98	85	78	93	88	100	
X	X	X					B	A	X	A	49	57	75	73	66	78	74	67	84	75	84	
X	X	X					C	A	X	A	40	55	63	66	60	74	63	56	71	63	79	
X	X	X					D	A	X	A	34	41	53	54	49	61	52	46	59	58	64	
ADJUST MULTIPLIERS OF CFM TARGETS FOR FULL HP (ADJUST B=115%, C=90%)																						
X	X	X					A	B	X	A	65	91	100	93	84	100	95	87	100	100	100	
X	X	X					A	C	X	A	51	64	73	70	63	79	75	69	80	80	85	
X	X	X					B	B	X	A	55	65	88	83	75	93	82	75	99	86	98	
X	X	X					B	C	X	A	44	49	66	64	58	68	66	59	72	70	72	
X	X	X					C	B	X	A	45	63	70	75	68	86	70	63	83	71	92	
X	X	X					C	C	X	A	36	48	56	59	53	65	56	49	62	59	69	
X	X	X					D	B	X	A	38	46	59	60	55	68	58	51	68	65	73	
X	X	X					D	C	X	A	30	35	47	47	44	54	46	40	51	54	56	
MULTIPLIER FOR COOLING OPERATION ("O" PRESENT) SHOULD BE THE SAME AS TARGET FOR FULL HP																						
X	X	X	X			X	A	A	X	A	58	75	86	80	72	98	85	78	93	88	100	
X	X	X	X			X	A	B	X	A	65	91	100	93	84	100	95	87	100	100	100	
X	X	X	X			X	A	C	X	A	51	64	73	70	63	79	75	69	80	80	85	
X	X	X	X			X	B	A	X	A	49	57	75	73	66	78	74	67	84	75	84	
X	X	X	X			X	B	B	X	A	55	65	88	83	75	93	82	75	99	86	98	
X	X	X	X			X	B	C	X	A	44	49	66	64	58	68	66	59	72	70	72	
X	X	X	X			X	C	A	X	A	40	55	63	66	60	74	63	56	71	63	79	
X	X	X	X			X	C	B	X	A	45	63	70	75	68	86	70	63	83	71	92	
X	X	X	X			X	C	C	X	A	36	48	56	59	53	65	56	49	62	59	69	
X	X	X	X			X	D	A	X	A	34	41	53	54	49	61	52	46	59	58	64	
X	X	X	X			X	D	B	X	A	38	46	59	60	55	68	58	51	68	65	73	
X	X	X	X			X	D	C	X	A	30	35	47	47	44	54	46	40	51	54	56	

Hi Humidity

PWM Summary Sheet																						
ENERGIZE							COOL	ADJUST	HEAT	DELAY	PWM											
G	Y1	Y/Y2	O	W1	W2	HUM					AVC18B	AVC24B/MVC08B	AVC30B	AVC36B/MVC12B	AVC36C	AVC42C	AVC48C/MVC16C	AVC48D	AVC60C	AVC60D/MVC20D	MVC14D
MULTIPLIER FOR HI HUMIDITY (BK = OFF) Khum = 85% OF CFM TARGET FOR LO COOLING																						
X	X		X				A	A	X	A	34	34	48	45	42	48	46	39	49	48	49
X	X		X				A	B	X	A	38	39	53	50	46	54	51	44	57	54	55
X	X		X				A	C	X	A	30	30	43	39	37	43	40	34	42	45	44
X	X		X				B	A	X	A	29	26	44	41	38	42	39	33	45	43	43
X	X		X				B	B	X	A	32	30	48	46	43	47	44	37	52	48	48
X	X		X				B	C	X	A	25	22	39	36	34	38	33	29	38	39	39
X	X		X				C	A	X	A	22	25	37	37	35	41	31	27	37	36	42
X	X		X				C	B	X	A	25	29	41	42	39	45	36	31	44	40	47
X	X		X				C	C	X	A	18	21	32	32	30	36	26	23	32	33	38
X	X		X				D	A	X	A	17	17	30	28	28	34	23	21	30	32	36
X	X		X				D	B	X	A	21	20	35	33	31	38	27	24	36	36	39
X	X		X				D	C	X	A	13	14	26	23	23	30	17	18	24	29	32

W1/W2/AUX

PWM Summary Sheet																					
ENERGIZE							COOL	ADJUST	HEAT	DELAY	PWM										
G	Y1	Y/Y2	O	W1	W2	HUM					AVC18B	AVC24B / MVC08B	AVC30B	AVC36B / MVC12B	AVC36C	AVC42C	AVC48C / MVC16C	AVC48D	AVC60C	AVC60D / MVC20D	MVC14D
W1 HEATING TABLE VALUES																					
X				X		X	X	X	A	X	69	85	71	68	69	74	63	54	64	55	67
X				X		X	X	X	B	X	60	82	65	63	60	70	60	48	62	51	64
X				X		X	X	X	C	X	55	59	63	51	56	64	55	46	59	49	60
X				X		X	X	X	D	X	36	47	50	49	42	55	52	34	54	46	57
W1 HEATING TABLE VALUES																					
X				X			X	X	A	X	69	85	71	68	69	74	63	54	64	55	67
X				X			X	X	B	X	60	82	65	63	60	70	60	48	62	51	64
X				X			X	X	C	X	55	59	63	51	56	64	55	46	59	49	60
X				X			X	X	D	X	36	47	50	49	42	55	52	34	54	46	57
W2 HEATING TABLE VALUES																					
X					X	X	X	X	A	X	69	91	90	82	91	100	88	81	99	90	100
X					X	X	X	X	B	X	60	82	81	76	69	90	82	78	94	87	91
X					X	X	X	X	C	X	55	59	63	63	56	70	73	63	82	75	73
X					X	X	X	X	D	X	36	47	50	49	42	55	60	52	71	66	57
W2 HEATING TABLE VALUES																					
X					X		X	X	A	X	69	91	90	82	91	100	88	81	99	90	100
X					X		X	X	B	X	60	82	81	76	69	90	82	78	94	87	91
X					X		X	X	C	X	55	59	63	63	56	70	73	63	82	75	73
X					X		X	X	D	X	36	47	50	49	42	55	60	52	71	66	57
SECOND STAGE OR AUX HEAT (SAME AS W2 HEATING)																					
X				X	X	X	X	X	A	X	69	91	90	82	91	100	88	81	99	90	100
X				X	X	X	X	X	B	X	60	82	81	76	69	90	82	78	94	87	91
X				X	X	X	X	X	C	X	55	59	63	63	56	70	73	63	82	75	73
X				X	X	X	X	X	D	X	36	47	50	49	42	55	60	52	71	66	57
SECOND STAGE OR AUX HEAT (SAME AS W2 HEATING)																					
X				X	X		X	X	A	X	69	91	90	82	91	100	88	81	99	90	100
X				X	X		X	X	B	X	60	82	81	76	69	90	82	78	94	87	91
X				X	X		X	X	C	X	55	59	63	63	56	70	73	63	82	75	73
X				X	X		X	X	D	X	36	47	50	49	42	55	60	52	71	66	57

Defrost/AUX

PWM Summary Sheet																						
ENERGIZE							COOL	ADJUST	HEAT	DELAY	PWM											
G	Y1	Y/Y2	O	W1	W2	HUM					AVC18B	AVC24B/MVC08B	AVC30B	AVC36B/MVC12B	AVC36C	AVC42C	AVC48C/MVC16C	AVC48D	AVC60C	AVC60D/MVC20D	MVC14D
DEFROST OR AUX HEAT (GREATER OF FULL COMPRESSOR OR W2 SPEED)																						
X	X	X		X	X	X	A	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X		X	X	X	A	B	A	X	69	91	100	93	91	100	95	87	100	100	100
X	X	X		X	X	X	A	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X		X	X	X	B	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X		X	X	X	B	B	A	X	69	91	90	83	91	100	88	81	99	90	100
X	X	X		X	X	X	B	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X		X	X	X	C	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X		X	X	X	C	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X		X	X	X	C	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X		X	X	X	D	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X		X	X	X	D	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X		X	X	X	D	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X		X	X	X	A	A	B	X	60	82	86	80	72	98	85	78	94	88	100
X	X	X		X	X	X	A	B	B	X	65	91	100	93	84	100	95	87	100	100	100
X	X	X		X	X	X	A	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X		X	X	X	B	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X		X	X	X	B	B	B	X	60	82	88	83	75	93	82	78	99	87	98
X	X	X		X	X	X	B	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X		X	X	X	C	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X		X	X	X	C	B	B	X	60	82	81	76	69	90	82	78	94	87	92
X	X	X		X	X	X	C	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X		X	X	X	D	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X		X	X	X	D	B	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X		X	X	X	D	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X		X	X	X	A	A	C	X	58	75	86	80	72	98	85	78	93	88	100
X	X	X		X	X	X	A	B	C	X	65	91	100	93	84	100	95	87	100	100	100
X	X	X		X	X	X	A	C	C	X	55	64	73	70	63	79	75	69	82	80	85
X	X	X		X	X	X	B	A	C	X	55	59	75	73	66	78	74	67	84	75	84
X	X	X		X	X	X	B	B	C	X	55	65	88	83	75	93	82	75	99	86	98
X	X	X		X	X	X	B	C	C	X	55	59	66	64	58	70	73	63	82	75	73
X	X	X		X	X	X	C	A	C	X	55	59	63	66	60	74	73	63	82	75	79
X	X	X		X	X	X	C	B	C	X	55	63	70	75	68	86	73	63	83	75	92
X	X	X		X	X	X	C	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X	X		X	X	X	D	A	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X	X		X	X	X	D	B	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X	X		X	X	X	D	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X	X		X	X	X	A	A	D	X	58	75	86	80	72	98	85	78	93	88	100
X	X	X		X	X	X	A	B	D	X	65	91	100	93	84	100	95	87	100	100	100
X	X	X		X	X	X	A	C	D	X	51	64	73	70	63	79	75	69	80	80	85
X	X	X		X	X	X	B	A	D	X	49	57	75	73	66	78	74	67	84	75	84
X	X	X		X	X	X	B	B	D	X	55	65	88	83	75	93	82	75	99	86	98
X	X	X		X	X	X	B	C	D	X	44	49	66	64	58	68	66	59	72	70	72
X	X	X		X	X	X	C	A	D	X	40	55	63	66	60	74	63	56	71	66	79
X	X	X		X	X	X	C	B	D	X	45	63	70	75	68	86	70	63	83	71	92
X	X	X		X	X	X	C	C	D	X	36	48	56	59	53	65	60	52	71	66	69
X	X	X		X	X	X	D	A	D	X	36	47	53	54	49	61	60	52	71	66	64
X	X	X		X	X	X	D	B	D	X	38	47	59	60	55	68	60	52	71	66	73
X	X	X		X	X	X	D	C	D	X	36	47	50	49	44	55	60	52	71	66	57

DEFROST OR AUX HEAT (GREATER OF FULL COMPRESSOR OR W2 SPEED)																					
X	X	X		X	X		A	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X		X	X		A	B	A	X	69	91	100	93	91	100	95	87	100	100	100
X	X	X		X	X		A	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X		X	X		B	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X		X	X		B	B	A	X	69	91	90	83	91	100	88	81	99	90	100
X	X	X		X	X		B	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X		X	X		C	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X		X	X		C	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X		X	X		C	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X		X	X		D	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X		X	X		D	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X		X	X		D	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X		X	X		A	A	B	X	60	82	86	80	72	98	85	78	94	88	100
X	X	X		X	X		A	B	B	X	65	91	100	93	84	100	95	87	100	100	100
X	X	X		X	X		A	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X		X	X		B	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X		X	X		B	B	B	X	60	82	88	83	75	93	82	78	99	87	98
X	X	X		X	X		B	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X		X	X		C	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X		X	X		C	B	B	X	60	82	81	76	69	90	82	78	94	87	92
X	X	X		X	X		C	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X		X	X		D	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X		X	X		D	B	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X		X	X		D	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X		X	X		A	A	C	X	58	75	86	80	72	98	85	78	93	88	100
X	X	X		X	X		A	B	C	X	65	91	100	93	84	100	95	87	100	100	100
X	X	X		X	X		A	C	C	X	55	64	73	70	63	79	75	69	82	80	85
X	X	X		X	X		B	A	C	X	55	59	75	73	66	78	74	67	84	75	84
X	X	X		X	X		B	B	C	X	55	65	88	83	75	93	82	75	99	86	98
X	X	X		X	X		B	C	C	X	55	59	66	64	58	70	73	63	82	75	73
X	X	X		X	X		C	A	C	X	55	59	63	66	60	74	73	63	82	75	79
X	X	X		X	X		C	B	C	X	55	63	70	75	68	86	73	63	83	75	92
X	X	X		X	X		C	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X	X		X	X		D	A	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X	X		X	X		D	B	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X	X		X	X		D	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X	X		X	X		A	A	D	X	58	75	86	80	72	98	85	78	93	88	100
X	X	X		X	X		A	B	D	X	65	91	100	93	84	100	95	87	100	100	100
X	X	X		X	X		A	C	D	X	51	64	73	70	63	79	75	69	80	80	85
X	X	X		X	X		B	A	D	X	49	57	75	73	66	78	74	67	84	75	84
X	X	X		X	X		B	B	D	X	55	65	88	83	75	93	82	75	99	86	98
X	X	X		X	X		B	C	D	X	44	49	66	64	58	68	66	59	72	70	72
X	X	X		X	X		C	A	D	X	40	55	63	66	60	74	63	56	71	66	79
X	X	X		X	X		C	B	D	X	45	63	70	75	68	86	70	63	83	71	92
X	X	X		X	X		C	C	D	X	36	48	56	59	53	65	60	52	71	66	69
X	X	X		X	X		D	A	D	X	36	47	53	54	49	61	60	52	71	66	64

PWM Summary Sheet																							
ENERGIZE							COOL	ADJUST	HEAT	DELAY	PWM												
G	Y1	Y/Y2	O	W1	W2	HUM					AVC18B	AVC24B / MVC08B	AVC30B	AVC36B / MVC12B	AVC36C	AVC42C	AVC48C / MVC16C	AVC48D	AVC60C	AVC60D / MVC20D	MVC14D
X	X	X		X	X		D	B	D	X	38	47	59	60	55	68	60	52	71	66	73
X	X	X		X	X		D	C	D	X	36	47	50	49	44	55	60	52	71	66	57
DEFROST OR AUX HEAT (GREATER OF FULL COMPRESSOR OR W2 SPEED)																							
X	X	X			X	X	A	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X			X	X	A	B	A	X	69	91	100	93	91	100	95	87	100	100	100
X	X	X			X	X	A	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X			X	X	B	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X			X	X	B	B	A	X	69	91	90	83	91	100	88	81	99	90	100
X	X	X			X	X	B	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X			X	X	C	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X			X	X	C	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X			X	X	C	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X			X	X	D	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X			X	X	D	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X			X	X	D	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X			X	X	A	A	B	X	60	82	86	80	72	98	85	78	94	88	100
X	X	X			X	X	A	B	B	X	65	91	100	93	84	100	95	87	100	100	100
X	X	X			X	X	A	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X			X	X	B	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X			X	X	B	B	B	X	60	82	88	83	75	93	82	78	99	87	98
X	X	X			X	X	B	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X			X	X	C	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X			X	X	C	B	B	X	60	82	81	76	69	90	82	78	94	87	92
X	X	X			X	X	C	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X			X	X	D	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X			X	X	D	B	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X			X	X	D	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X			X	X	A	A	C	X	58	75	86	80	72	98	85	78	93	88	100
X	X	X			X	X	A	B	C	X	65	91	100	93	84	100	95	87	100	100	100
X	X	X			X	X	A	C	C	X	55	64	73	70	63	79	75	69	82	80	85
X	X	X			X	X	B	A	C	X	55	59	75	73	66	78	74	67	84	75	84
X	X	X			X	X	B	B	C	X	55	65	88	83	75	93	82	75	99	86	98
X	X	X			X	X	B	C	C	X	55	59	66	64	58	70	73	63	82	75	73
X	X	X			X	X	C	A	C	X	55	59	63	66	60	74	73	63	82	75	79
X	X	X			X	X	C	B	C	X	55	63	70	75	68	86	73	63	83	75	92
X	X	X			X	X	C	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X	X			X	X	D	A	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X	X			X	X	D	B	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X	X			X	X	D	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X	X			X	X	A	A	D	X	58	75	86	80	72	98	85	78	93	88	100
X	X	X			X	X	A	B	D	X	65	91	100	93	84	100	95	87	100	100	100
X	X	X			X	X	A	C	D	X	51	64	73	70	63	79	75	69	80	80	85
X	X	X			X	X	B	A	D	X	49	57	75	73	66	78	74	67	84	75	84
X	X	X			X	X	B	B	D	X	55	65	88	83	75	93	82	75	99	86	98
X	X	X			X	X	B	C	D	X	44	49	66	64	58	68	66	59	72	70	72
X	X	X			X	X	C	A	D	X	40	55	63	66	60	74	63	56	71	66	79
X	X	X			X	X	C	B	D	X	45	63	70	75	68	86	70	63	83	71	92
X	X	X			X	X	C	C	D	X	36	48	56	59	53	65	60	52	71	66	69
X	X	X			X	X	D	A	D	X	36	47	53	54	49	61	60	52	71	66	64
X	X	X			X	X	D	B	D	X	38	47	59	60	55	68	60	52	71	66	73
X	X	X			X	X	D	C	D	X	36	47	50	49	44	55	60	52	71	66	57

DEFROST OR AUX HEAT (GREATER OF FULL COMPRESSOR OR W2 SPEED)																					
X	X	X			X		A	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X			X		A	B	A	X	69	91	100	93	91	100	95	87	100	100	100
X	X	X			X		A	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X			X		B	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X			X		B	B	A	X	69	91	90	83	91	100	88	81	99	90	100
X	X	X			X		B	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X			X		C	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X			X		C	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X			X		C	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X			X		D	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X			X		D	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X			X		D	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X	X			X		A	A	B	X	60	82	86	80	72	98	85	78	94	88	100
X	X	X			X		A	B	B	X	65	91	100	93	84	100	95	87	100	100	100
X	X	X			X		A	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X			X		B	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X			X		B	B	B	X	60	82	88	83	75	93	82	78	99	87	98
X	X	X			X		B	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X			X		C	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X			X		C	B	B	X	60	82	81	76	69	90	82	78	94	87	92
X	X	X			X		C	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X			X		D	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X			X		D	B	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X			X		D	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X	X			X		A	A	C	X	58	75	86	80	72	98	85	78	93	88	100
X	X	X			X		A	B	C	X	65	91	100	93	84	100	95	87	100	100	100
X	X	X			X		A	C	C	X	55	64	73	70	63	79	75	69	82	80	85
X	X	X			X		B	A	C	X	55	59	75	73	66	78	74	67	84	75	84
X	X	X			X		B	B	C	X	55	65	88	83	75	93	82	75	99	86	98
X	X	X			X		B	C	C	X	55	59	66	64	58	70	73	63	82	75	73
X	X	X			X		C	A	C	X	55	59	63	66	60	74	73	63	82	75	79
X	X	X			X		C	B	C	X	55	63	70	75	68	86	73	63	83	75	92
X	X	X			X		C	C	C	X	55	59	63	63	56	70	73	63	82	75	73

PWM Summary Sheet																						
ENERGIZE								COOL	ADJUST	HEAT	DELAY	PWM										
G	Y1	Y/Y2	O	W1	W2	HUM					AVC18B	AVC24B/MVC08B	AVC30B	AVC36B/MVC12B	AVC36C	AVC42C	AVC48C/MVC16C	AVC48D	AVC60C	AVC60D/MVC20D	MVC14D
X	X	X			X		D	A	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X	X			X		D	B	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X	X			X		D	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X	X			X		A	A	D	X	58	75	86	80	72	98	85	78	93	88	100
X	X	X			X		A	B	D	X	65	91	100	93	84	100	95	87	100	100	100
X	X	X			X		A	C	D	X	51	64	73	70	63	79	75	69	80	80	85
X	X	X			X		B	A	D	X	49	57	75	73	66	78	74	67	84	75	84
X	X	X			X		B	B	D	X	55	65	88	83	75	93	82	75	99	86	98
X	X	X			X		B	C	D	X	44	49	66	64	58	68	66	59	72	70	72
X	X	X			X		C	A	D	X	40	55	63	66	60	74	63	56	71	66	79
X	X	X			X		C	B	D	X	45	63	70	75	68	86	70	63	83	71	92
X	X	X			X		C	C	D	X	36	48	56	59	53	65	60	52	71	66	69
X	X	X			X		D	A	D	X	36	47	53	54	49	61	60	52	71	66	64
X	X	X			X		D	B	D	X	38	47	59	60	55	68	60	52	71	66	73
X	X	X			X		D	C	D	X	36	47	50	49	44	55	60	52	71	66	57

PWM Summary Sheet																							
ENERGIZE							COOL	ADJUST	HEAT	DELAY	PWM												
G	Y1	Y/Y2	O	W1	W2	HUM					AVC18B	AVC24B / MVC08B	AVC30B	AVC36B / MVC12B	AVC36C	AVC42C	AVC48C / MVC16C	AVC48D	AVC60C	AVC60D / MVC20D	MVC14D
DEFROST OR AUX HEAT (GREATER OF FULL COMPRESSOR OR W2 SPEED)																							
X		X		X	X	X	A	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X		X	X	X	A	B	A	X	69	91	100	93	91	100	95	87	100	100	100
X		X		X	X	X	A	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X		X	X	X	B	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X		X	X	X	B	B	A	X	69	91	90	83	91	100	88	81	99	90	100
X		X		X	X	X	B	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X		X	X	X	C	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X		X	X	X	C	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X		X	X	X	C	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X		X	X	X	D	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X		X	X	X	D	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X		X	X	X	D	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X		X	X	X	A	A	B	X	60	82	86	80	72	98	85	78	94	88	100
X		X		X	X	X	A	B	B	X	65	91	100	93	84	100	95	87	100	100	100
X		X		X	X	X	A	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X		X		X	X	X	B	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X		X		X	X	X	B	B	B	X	60	82	88	83	75	93	82	78	99	87	98
X		X		X	X	X	B	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X		X		X	X	X	C	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X		X		X	X	X	C	B	B	X	60	82	81	76	69	90	82	78	94	87	92
X		X		X	X	X	C	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X		X		X	X	X	D	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X		X		X	X	X	D	B	B	X	60	82	81	76	69	90	82	78	94	87	91
X		X		X	X	X	D	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X		X		X	X	X	A	A	C	X	58	75	86	80	72	98	85	78	93	88	100
X		X		X	X	X	A	B	C	X	65	91	100	93	84	100	95	87	100	100	100
X		X		X	X	X	A	C	C	X	55	64	73	70	63	79	75	69	82	80	85
X		X		X	X	X	B	A	C	X	55	59	75	73	66	78	74	67	84	75	84
X		X		X	X	X	B	B	C	X	55	65	88	83	75	93	82	75	99	86	98
X		X		X	X	X	B	C	C	X	55	59	66	64	58	70	73	63	82	75	73
X		X		X	X	X	C	A	C	X	55	59	63	66	60	74	73	63	82	75	79
X		X		X	X	X	C	B	C	X	55	63	70	75	68	86	73	63	83	75	92
X		X		X	X	X	C	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X		X		X	X	X	D	A	C	X	55	59	63	63	56	70	73	63	82	75	73
X		X		X	X	X	D	B	C	X	55	59	63	63	56	70	73	63	82	75	73
X		X		X	X	X	D	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X		X		X	X	X	A	A	D	X	58	75	86	80	72	98	85	78	93	88	100
X		X		X	X	X	A	B	D	X	65	91	100	93	84	100	95	87	100	100	100
X		X		X	X	X	A	C	D	X	51	64	73	70	63	79	75	69	80	80	85
X		X		X	X	X	B	A	D	X	49	57	75	73	66	78	74	67	84	75	84
X		X		X	X	X	B	B	D	X	55	65	88	83	75	93	82	75	99	86	98
X		X		X	X	X	B	C	D	X	44	49	66	64	58	68	66	59	72	70	72
X		X		X	X	X	C	A	D	X	40	55	63	66	60	74	63	56	71	66	79
X		X		X	X	X	C	B	D	X	45	63	70	75	68	86	70	63	83	71	92
X		X		X	X	X	C	C	D	X	36	48	56	59	53	65	60	52	71	66	69
X		X		X	X	X	D	A	D	X	36	47	53	54	49	61	60	52	71	66	64
X		X		X	X	X	D	B	D	X	38	47	59	60	55	68	60	52	71	66	73
X		X		X	X	X	D	C	D	X	36	47	50	49	44	55	60	52	71	66	57

PWM Summary Sheet																								
ENERGIZE							COOL	ADJUST	HEAT	DELAY	PWM													
G	Y1	Y/Y2	O	W1	W2	HUM					AVC18B	AVC24B / MVC08B	AVC30B	AVC36B / MVC12B	AVC36C	AVC42C	AVC48C / MVC16C	AVC48D	AVC60C	AVC60D / MVC20D	MVC14D
DEFROST OR AUX HEAT (GREATER OF FULL COMPRESSOR OR W2 SPEED)																								
X		X		X	X		A	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X		X	X		A	B	A	X	69	91	100	93	91	100	95	87	100	100	100
X		X		X	X		A	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X		X	X		B	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X		X	X		B	B	A	X	69	91	90	83	91	100	88	81	99	90	100
X		X		X	X		B	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X		X	X		C	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X		X	X		C	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X		X	X		C	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X		X	X		D	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X		X	X		D	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X		X	X		D	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X		X	X		A	A	B	X	60	82	86	80	72	98	85	78	94	88	100
X		X		X	X		A	B	B	X	65	91	100	93	84	100	95	87	100	100	100
X		X		X	X		A	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X		X		X	X		B	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X		X		X	X		B	B	B	X	60	82	88	83	75	93	82	78	99	87	98
X		X		X	X		B	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X		X		X	X		C	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X		X		X	X		C	B	B	X	60	82	81	76	69	90	82	78	94	87	92
X		X		X	X		C	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X		X		X	X		D	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X		X		X	X		D	B	B	X	60	82	81	76	69	90	82	78	94	87	91
X		X		X	X		D	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X		X		X	X		A	A	C	X	58	75	86	80	72	98	85	78	93	88	100
X		X		X	X		A	B	C	X	65	91	100	93	84	100	95	87	100	100	100
X		X		X	X		A	C	C	X	55	64	73	70	63	79	75	69	82	80	85
X		X		X	X		B	A	C	X	55	59	75	73	66	78	74	67	84	75	84
X		X		X	X		B	B	C	X	55	65	88	83	75	93	82	75	99	86	98
X		X		X	X		B	C	C	X	55	59	66	64	58	70	73	63	82	75	73
X		X		X	X		C	A	C	X	55	59	63	66	60	74	73	63	82	75	79
X		X		X	X		C	B	C	X	55	63	70	75	68	86	73	63	83	75	92
X		X		X	X		C	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X		X		X	X		D	A	C	X	55	59	63	63	56	70	73	63	82	75	73
X		X		X	X		D	B	C	X	55	59	63	63	56	70	73	63	82	75	73
X		X		X	X		D	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X		X		X	X		A	A	D	X	58	75	86	80	72	98	85	78	93	88	100
X		X		X	X		A	B	D	X	65	91	100	93	84	100	95	87	100	100	100
X		X		X	X		A	C	D	X	51	64	73	70	63	79	75	69	80	80	85
X		X		X	X		B	A	D	X	49	57	75	73	66	78	74	67	84	75	84
X		X		X	X		B	B	D	X	55	65	88	83	75	93	82	75	99	86	98
X		X		X	X		B	C	D	X	44	49	66	64	58	68	66	59	72	70	72
X		X		X	X		C	A	D	X	40	55	63	66	60	74	63	56	71	66	79
X		X		X	X		C	B	D	X	45	63	70	75	68	86	70	63	83	71	92
X		X		X	X		C	C	D	X	36	48	56	59	53	65	60	52	71	66	69
X		X		X	X		D	A	D	X	36	47	53	54	49	61	60	52	71	66	64
X		X		X	X		D	B	D	X	38	47	59	60	55	68	60	52	71	66	73
X		X		X	X		D	C	D	X	36	47	50	49	44	55	60	52	71	66	57
DEFROST OR AUX HEAT (GREATER OF FULL COMPRESSOR OR W2 SPEED)																								
X		X			X	X	A	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X			X	X	A	B	A	X	69	91	100	93	91	100	95	87	100	100	100
X		X			X	X	A	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X			X	X	B	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X			X	X	B	B	A	X	69	91	90	83	91	100	88	81	99	90	100
X		X			X	X	B	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X			X	X	C	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X		X			X	X	C	B	A	X	69	91	90	82	91	100	88	81	99	90	100

PWM Summary Sheet																								
ENERGIZE							COOL	ADJUST	HEAT	DELAY	PWM													
G	Y1	Y/Y2	O	W1	W2	HUM					AVC18B	AVC24B/MVC08B	AVC30B	AVC36B/MVC12B	AVC36C	AVC42C	AVC48C/MVC16C	AVC48D	AVC60C	AVC60D/MVC20D	MVC14D			
X		X			X	X	C	C	A	X	69	91	90	82	91	100	88	81	99	90	100			
X		X			X	X	D	A	A	X	69	91	90	82	91	100	88	81	99	90	100			
X		X			X	X	D	B	A	X	69	91	90	82	91	100	88	81	99	90	100			
X		X			X	X	D	C	A	X	69	91	90	82	91	100	88	81	99	90	100			
X		X			X	X	A	A	B	X	60	82	86	80	72	98	85	78	94	88	100			
X		X			X	X	A	B	B	X	65	91	100	93	84	100	95	87	100	100	100			
X		X			X	X	A	C	B	X	60	82	81	76	69	90	82	78	94	87	91			
X		X			X	X	B	A	B	X	60	82	81	76	69	90	82	78	94	87	91			
X		X			X	X	B	B	B	X	60	82	88	83	75	93	82	78	99	87	98			
X		X			X	X	B	C	B	X	60	82	81	76	69	90	82	78	94	87	91			
X		X			X	X	C	A	B	X	60	82	81	76	69	90	82	78	94	87	91			
X		X			X	X	C	B	B	X	60	82	81	76	69	90	82	78	94	87	92			
X		X			X	X	C	C	B	X	60	82	81	76	69	90	82	78	94	87	91			
X		X			X	X	D	A	B	X	60	82	81	76	69	90	82	78	94	87	91			
X		X			X	X	D	B	B	X	60	82	81	76	69	90	82	78	94	87	91			
X		X			X	X	D	C	B	X	60	82	81	76	69	90	82	78	94	87	91			
X		X			X	X	A	A	C	X	58	75	86	80	72	98	85	78	93	88	100			
X		X			X	X	A	B	C	X	65	91	100	93	84	100	95	87	100	100	100			
X		X			X	X	A	C	C	X	55	64	73	70	63	79	75	69	82	80	85			
X		X			X	X	B	A	C	X	55	59	75	73	66	78	74	67	84	75	84			
X		X			X	X	B	B	C	X	55	65	88	83	75	93	82	75	99	86	98			
X		X			X	X	B	C	C	X	55	59	66	64	58	70	73	63	82	75	73			
X		X			X	X	C	A	C	X	55	59	63	66	60	74	73	63	82	75	79			
X		X			X	X	C	B	C	X	55	63	70	75	68	86	73	63	83	75	92			
X		X			X	X	C	C	C	X	55	59	63	63	56	70	73	63	82	75	73			
X		X			X	X	D	A	C	X	55	59	63	63	56	70	73	63	82	75	73			
X		X			X	X	D	B	C	X	55	59	63	63	56	70	73	63	82	75	73			
X		X			X	X	D	C	C	X	55	59	63	63	56	70	73	63	82	75	73			
X		X			X	X	A	A	D	X	58	75	86	80	72	98	85	78	93	88	100			
X		X			X	X	A	B	D	X	65	91	100	93	84	100	95	87	100	100	100			
X		X			X	X	A	C	D	X	51	64	73	70	63	79	75	69	80	80	85			
X		X			X	X	B	A	D	X	49	57	75	73	66	78	74	67	84	75	84			
X		X			X	X	B	B	D	X	55	65	88	83	75	93	82	75	99	86	98			
X		X			X	X	B	C	D	X	44	49	66	64	58	68	66	59	72	70	72			
X		X			X	X	C	A	D	X	40	55	63	66	60	74	63	56	71	66	79			
X		X			X	X	C	B	D	X	45	63	70	75	68	86	70	63	83	71	92			
X		X			X	X	C	C	D	X	36	48	56	59	53	65	60	52	71	66	69			
X		X			X	X	D	A	D	X	36	47	53	54	49	61	60	52	71	66	64			
X		X			X	X	D	B	D	X	38	47	59	60	55	68	60	52	71	66	73			
X		X			X	X	D	C	D	X	36	47	50	49	44	55	60	52	71	66	57			
DEFROST OR AUX HEAT (GREATER OF FULL COMPRESSOR OR W2 SPEED)																								
X		X			X		A	A	A	X	69	91	90	82	91	100	88	81	99	90	100			
X		X			X		A	B	A	X	69	91	100	93	91	100	95	87	100	100	100			
X		X			X		A	C	A	X	69	91	90	82	91	100	88	81	99	90	100			
X		X			X		B	A	A	X	69	91	90	82	91	100	88	81	99	90	100			
X		X			X		B	B	A	X	69	91	90	83	91	100	88	81	99	90	100			
X		X			X		B	C	A	X	69	91	90	82	91	100	88	81	99	90	100			
X		X			X		C	A	A	X	69	91	90	82	91	100	88	81	99	90	100			
X		X			X		C	B	A	X	69	91	90	82	91	100	88	81	99	90	100			
X		X			X		C	C	A	X	69	91	90	82	91	100	88	81	99	90	100			
X		X			X		D	A	A	X	69	91	90	82	91	100	88	81	99	90	100			
X		X			X		D	B	A	X	69	91	90	82	91	100	88	81	99	90	100			
X		X			X		D	C	A	X	69	91	90	82	91	100	88	81	99	90	100			
X		X			X		A	A	B	X	60	82	86	80	72	98	85	78	94	88	100			
X		X			X		A	B	B	X	65	91	100	93	84	100	95	87	100	100	100			
X		X			X		A	C	B	X	60	82	81	76	69	90	82	78	94	87	91			
X		X			X		B	A	B	X	60	82	81	76	69	90	82	78	94	87	91			
X		X			X		B	B	B	X	60	82	88	83	75	93	82	78	99	87	98			

PWM Summary Sheet																						
ENERGIZE							COOL	ADJUST	HEAT	DELAY	PWM											
G	Y1	Y/Y2	O	W1	W2	HUM					AVC18B	AVC24B / MVC08B	AVC30B	AVC36B / MVC12B	AVC36C	AVC42C	AVC48C / MVC16C	AVC48D	AVC60C	AVC60D / MVC20D	MVC14D
X		X			X		B	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X		X			X		C	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X		X			X		C	B	B	X	60	82	81	76	69	90	82	78	94	87	92
X		X			X		C	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X		X			X		D	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X		X			X		D	B	B	X	60	82	81	76	69	90	82	78	94	87	91
X		X			X		D	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X		X			X		A	A	C	X	58	75	86	80	72	98	85	78	93	88	100
X		X			X		A	B	C	X	65	91	100	93	84	100	95	87	100	100	100
X		X			X		A	C	C	X	55	64	73	70	63	79	75	69	82	80	85
X		X			X		B	A	C	X	55	59	75	73	66	78	74	67	84	75	84
X		X			X		B	B	C	X	55	65	88	83	75	93	82	75	99	86	98
X		X			X		B	C	C	X	55	59	66	64	58	70	73	63	82	75	73
X		X			X		C	A	C	X	55	59	63	66	60	74	73	63	82	75	79
X		X			X		C	B	C	X	55	63	70	75	68	86	73	63	83	75	92
X		X			X		C	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X		X			X		D	A	C	X	55	59	63	63	56	70	73	63	82	75	73
X		X			X		D	B	C	X	55	59	63	63	56	70	73	63	82	75	73
X		X			X		D	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X		X			X		A	A	D	X	58	75	86	80	72	98	85	78	93	88	100
X		X			X		A	B	D	X	65	91	100	93	84	100	95	87	100	100	100
X		X			X		A	C	D	X	51	64	73	70	63	79	75	69	80	80	85
X		X			X		B	A	D	X	49	57	75	73	66	78	74	67	84	75	84
X		X			X		B	B	D	X	55	65	88	83	75	93	82	75	99	86	98
X		X			X		B	C	D	X	44	49	66	64	58	68	66	59	72	70	72
X		X			X		C	A	D	X	40	55	63	66	60	74	63	56	71	66	79
X		X			X		C	B	D	X	45	63	70	75	68	86	70	63	83	71	92
X		X			X		C	C	D	X	36	48	56	59	53	65	60	52	71	66	69
X		X			X		D	A	D	X	36	47	53	54	49	61	60	52	71	66	64
X		X			X		D	B	D	X	38	47	59	60	55	68	60	52	71	66	73
X		X			X		D	C	D	X	36	47	50	49	44	55	60	52	71	66	57

Reduced Airflow with AUX or Below LTCO

PWM Summary Sheet																						
ENERGIZE							COOL	ADJUST	HEAT	DELAY	PWM											
G	Y1	Y/Y2	O	W1	W2	HUM					AVC18B	AVC24B/MVC08B	AVC30B	AVC36B/MVC12B	AVC36C	AVC42C	AVC48C/MVC16C	AVC48D	AVC60C	AVC60D/MVC20D	MVC14D
REDUCED AIRFLOW W/ AUX HEAT OR BELOW LTCO (GREATER OF LOW COMPRESSOR OR W2 SPEED)																						
X	X			X	X	X	A	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X	X	A	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X	X	A	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X	X	B	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X	X	B	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X	X	B	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X	X	C	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X	X	C	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X	X	C	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X	X	D	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X	X	D	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X	X	D	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X	X	A	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X	X	A	B	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X	X	A	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X	X	B	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X	X	B	B	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X	X	B	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X	X	C	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X	X	C	B	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X	X	C	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X	X	D	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X	X	D	B	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X	X	D	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X	X	A	A	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X	X	A	B	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X	X	A	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X	X	B	A	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X	X	B	B	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X	X	B	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X	X	C	A	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X	X	C	B	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X	X	C	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X	X	D	A	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X	X	D	B	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X	X	D	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X	X	A	A	D	X	40	47	55	53	48	56	60	52	71	66	58
X	X			X	X	X	A	B	D	X	44	47	61	59	54	63	60	53	71	66	66
X	X			X	X	X	A	C	D	X	36	47	50	49	43	55	60	52	71	66	57
X	X			X	X	X	B	A	D	X	36	47	50	49	45	55	60	52	71	66	57
X	X			X	X	X	B	B	D	X	37	47	56	54	50	55	60	52	71	66	57
X	X			X	X	X	B	C	D	X	36	47	50	49	42	55	60	52	71	66	57
X	X			X	X	X	C	A	D	X	36	47	50	49	42	55	60	52	71	66	57
X	X			X	X	X	C	B	D	X	36	47	50	49	45	55	60	52	71	66	57
X	X			X	X	X	C	C	D	X	36	47	50	49	42	55	60	52	71	66	57
X	X			X	X	X	D	A	D	X	36	47	50	49	42	55	60	52	71	66	57
X	X			X	X	X	D	B	D	X	36	47	50	49	42	55	60	52	71	66	57
X	X			X	X	X	D	C	D	X	36	47	50	49	42	55	60	52	71	66	57

PWM Summary Sheet																								
ENERGIZE								COOL	ADJUST	HEAT	DELAY	PWM												
G	Y1	Y/Y2	O	W1	W2	HUM						AVC18B	AVC24B / MVC08B	AVC30B	AVC36B / MVC12B	AVC36C	AVC42C	AVC48C / MVC16C	AVC48D	AVC60C	AVC60D / MVC20D	MVC14D
REDUCED AIRFLOW W/ AUX HEAT OR BELOW LTCO (GREATER OF LOW COMPRESSOR OR W2 SPEED)																								
X	X			X	X		A	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X		A	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X		A	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X		B	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X		B	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X		B	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X		C	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X		C	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X		C	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X		D	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X		D	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X		D	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X			X	X		A	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X		A	B	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X		A	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X		B	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X		B	B	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X		B	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X		C	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X		C	B	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X		C	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X		D	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X		D	B	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X		D	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X			X	X		A	A	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X		A	B	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X		A	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X		B	A	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X		B	B	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X		B	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X		C	A	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X		C	B	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X		C	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X		D	A	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X		D	B	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X		D	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X			X	X		A	A	D	X	40	47	55	53	48	56	60	52	71	66	58
X	X			X	X		A	B	D	X	44	47	61	59	54	63	60	53	71	66	66
X	X			X	X		A	C	D	X	36	47	50	49	43	55	60	52	71	66	57
X	X			X	X		B	A	D	X	36	47	50	49	45	55	60	52	71	66	57
X	X			X	X		B	B	D	X	37	47	56	54	50	55	60	52	71	66	57
X	X			X	X		B	C	D	X	36	47	50	49	42	55	60	52	71	66	57
X	X			X	X		C	A	D	X	36	47	50	49	42	55	60	52	71	66	57
X	X			X	X		C	B	D	X	36	47	50	49	45	55	60	52	71	66	57
X	X			X	X		C	C	D	X	36	47	50	49	42	55	60	52	71	66	57
X	X			X	X		D	A	D	X	36	47	50	49	42	55	60	52	71	66	57
X	X			X	X		D	B	D	X	36	47	50	49	42	55	60	52	71	66	57
X	X			X	X		D	C	D	X	36	47	50	49	42	55	60	52	71	66	57

PWM Summary Sheet																							
ENERGIZE							COOL	ADJUST	HEAT	DELAY	PWM												
G	Y1	Y/Y2	O	W1	W2	HUM					AVC18B	AVC24B / MVC08B	AVC30B	AVC36B / MVC12B	AVC36C	AVC42C	AVC48C / MVC16C	AVC48D	AVC60C	AVC60D / MVC20D	MVC14D
REDUCED AIRFLOW W/ AUX HEAT OR BELOW LTCO (GREATER OF LOW COMPRESSOR OR W2 SPEED)																							
X	X				X	X	A	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X	X	A	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X	X	A	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X	X	B	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X	X	B	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X	X	B	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X	X	C	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X	X	C	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X	X	C	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X	X	D	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X	X	D	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X	X	D	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X	X	A	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X				X	X	A	B	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X				X	X	A	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X				X	X	B	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X				X	X	B	B	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X				X	X	B	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X				X	X	C	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X				X	X	C	B	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X				X	X	C	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X				X	X	D	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X				X	X	D	B	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X				X	X	D	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X				X	X	A	A	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X				X	X	A	B	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X				X	X	A	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X				X	X	B	A	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X				X	X	B	B	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X				X	X	B	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X				X	X	C	A	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X				X	X	C	B	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X				X	X	C	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X				X	X	D	A	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X				X	X	D	B	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X				X	X	D	C	C	X	55	59	63	63	56	70	73	63	82	75	73
X	X				X	X	A	A	D	X	40	47	55	53	48	56	60	52	71	66	58
X	X				X	X	A	B	D	X	44	47	61	59	54	63	60	53	71	66	66
X	X				X	X	A	C	D	X	36	47	50	49	43	55	60	52	71	66	57
X	X				X	X	B	A	D	X	36	47	50	49	45	55	60	52	71	66	57
X	X				X	X	B	B	D	X	37	47	56	54	50	55	60	52	71	66	57
X	X				X	X	B	C	D	X	36	47	50	49	42	55	60	52	71	66	57
X	X				X	X	C	A	D	X	36	47	50	49	42	55	60	52	71	66	57
X	X				X	X	C	B	D	X	36	47	50	49	45	55	60	52	71	66	57
X	X				X	X	C	C	D	X	36	47	50	49	42	55	60	52	71	66	57
X	X				X	X	D	A	D	X	36	47	50	49	42	55	60	52	71	66	57
X	X				X	X	D	B	D	X	36	47	50	49	42	55	60	52	71	66	57
X	X				X	X	D	C	D	X	36	47	50	49	42	55	60	52	71	66	57

PWM Summary Sheet																						
ENERGIZE							COOL	ADJUST	HEAT	DELAY	PWM											
G	Y1	Y/Y2	O	W1	W2	HUM					AVC18B	AVC24B / MVC08B	AVC30B	AVC36B / MVC12B	AVC36C	AVC42C	AVC48C / MVC16C	AVC48D	AVC60C	AVC60D / MVC20D	MVC14D
REDUCED AIRFLOW W/ AUX HEAT OR BELOW LTCO (GREATER OF LOW COMPRESSOR OR W2 SPEED)																						
X	X				X		A	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X		A	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X		A	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X		B	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X		B	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X		B	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X		C	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X		C	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X		C	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X		D	A	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X		D	B	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X		D	C	A	X	69	91	90	82	91	100	88	81	99	90	100
X	X				X		A	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X				X		A	B	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X				X		A	C	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X				X		B	A	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X				X		B	B	B	X	60	82	81	76	69	90	82	78	94	87	91
X	X				X		B	C	B	X	60	82	81	76	69	90	82	78	94	87	91

PWM Summary Sheet																						
ENERGIZE								COOL	ADJUST	HEAT	DELAY	PWM										
G	Y1	Y/Y2	O	W1	W2	HUM						AVC18B	AVC24B/MVC08B	AVC30B	AVC36B/MVC12B	AVC36C	AVC42C	AVC48C/MVC16C	AVC48D	AVC60C	AVC60D/MVC20D	MVC14D
REDUCED AIRFLOW W/ AUX HEAT OR BELOW LTCO (GREATER OF LOW COMPRESSOR OR W1 SPEED)																						
X	X			X		X	A	A	A	X	69	85	71	68	69	74	63	54	64	56	67
X	X			X		X	A	B	A	X	69	85	71	68	69	74	63	54	68	63	67
X	X			X		X	A	C	A	X	69	85	71	68	69	74	63	54	64	55	67
X	X			X		X	B	A	A	X	69	85	71	68	69	74	63	54	64	55	67
X	X			X		X	B	B	A	X	69	85	71	68	69	74	63	54	64	56	67
X	X			X		X	B	C	A	X	69	85	71	68	69	74	63	54	64	55	67
X	X			X		X	C	A	A	X	69	85	71	68	69	74	63	54	64	55	67
X	X			X		X	C	B	A	X	69	85	71	68	69	74	63	54	64	55	67
X	X			X		X	C	C	A	X	69	85	71	68	69	74	63	54	64	55	67
X	X			X		X	D	A	A	X	69	85	71	68	69	74	63	54	64	55	67
X	X			X		X	D	B	A	X	69	85	71	68	69	74	63	54	64	55	67
X	X			X		X	D	C	A	X	69	85	71	68	69	74	63	54	64	55	67
X	X			X		X	A	A	B	X	60	82	65	63	60	70	60	48	62	56	64
X	X			X		X	A	B	B	X	60	82	65	63	60	70	60	53	68	63	66
X	X			X		X	A	C	B	X	60	82	65	63	60	70	60	48	62	52	64
X	X			X		X	B	A	B	X	60	82	65	63	60	70	60	48	62	51	64
X	X			X		X	B	B	B	X	60	82	65	63	60	70	60	48	62	56	64
X	X			X		X	B	C	B	X	60	82	65	63	60	70	60	48	62	51	64
X	X			X		X	C	A	B	X	60	82	65	63	60	70	60	48	62	51	64
X	X			X		X	C	B	B	X	60	82	65	63	60	70	60	48	62	51	64
X	X			X		X	C	C	B	X	60	82	65	63	60	70	60	48	62	51	64
X	X			X		X	D	A	B	X	60	82	65	63	60	70	60	48	62	51	64
X	X			X		X	D	B	B	X	60	82	65	63	60	70	60	48	62	51	64
X	X			X		X	D	C	B	X	60	82	65	63	60	70	60	48	62	51	64
X	X			X		X	A	A	C	X	55	59	63	53	56	64	55	48	59	56	60
X	X			X		X	A	B	C	X	55	59	63	59	56	64	60	53	68	63	66
X	X			X		X	A	C	C	X	55	59	63	51	56	64	55	46	59	52	60
X	X			X		X	B	A	C	X	55	59	63	51	56	64	55	46	59	50	60
X	X			X		X	B	B	C	X	55	59	63	54	56	64	55	46	62	56	60
X	X			X		X	B	C	C	X	55	59	63	51	56	64	55	46	59	49	60
X	X			X		X	C	A	C	X	55	59	63	51	56	64	55	46	59	49	60
X	X			X		X	C	B	C	X	55	59	63	51	56	64	55	46	59	49	60
X	X			X		X	C	C	C	X	55	59	63	51	56	64	55	46	59	49	60
X	X			X		X	D	A	C	X	55	59	63	51	56	64	55	46	59	49	60
X	X			X		X	D	B	C	X	55	59	63	51	56	64	55	46	59	49	60
X	X			X		X	D	C	C	X	55	59	63	51	56	64	55	46	59	49	60
X	X			X		X	A	A	D	X	40	47	55	53	48	56	54	48	58	56	58
X	X			X		X	A	B	D	X	44	47	61	59	54	63	60	53	68	63	66
X	X			X		X	A	C	D	X	36	47	50	49	43	55	52	42	54	52	57
X	X			X		X	B	A	D	X	36	47	50	49	45	55	52	41	54	50	57
X	X			X		X	B	B	D	X	37	47	56	54	50	55	52	46	62	56	57
X	X			X		X	B	C	D	X	36	47	50	49	42	55	52	35	54	46	57
X	X			X		X	C	A	D	X	36	47	50	49	42	55	52	34	54	46	57
X	X			X		X	C	B	D	X	36	47	50	49	45	55	52	38	54	47	57
X	X			X		X	C	C	D	X	36	47	50	49	42	55	52	34	54	46	57
X	X			X		X	D	A	D	X	36	47	50	49	42	55	52	34	54	46	57
X	X			X		X	D	B	D	X	36	47	50	49	42	55	52	34	54	46	57
X	X			X		X	D	C	D	X	36	47	50	49	42	55	52	34	54	46	57

REDUCED AIRFLOW W/ AUX HEAT OR BELOW LTCO (GREATER OF LOW COMPRESSOR OR W1 SPEED)																					
X	X			X			A	A	A	X	69	85	71	68	69	74	63	54	64	56	67
X	X			X			A	B	A	X	69	85	71	68	69	74	63	54	68	63	67
X	X			X			A	C	A	X	69	85	71	68	69	74	63	54	64	55	67
X	X			X			B	A	A	X	69	85	71	68	69	74	63	54	64	55	67
X	X			X			B	B	A	X	69	85	71	68	69	74	63	54	64	56	67
X	X			X			B	C	A	X	69	85	71	68	69	74	63	54	64	55	67
X	X			X			C	A	A	X	69	85	71	68	69	74	63	54	64	55	67
X	X			X			C	B	A	X	69	85	71	68	69	74	63	54	64	55	67
X	X			X			C	C	A	X	69	85	71	68	69	74	63	54	64	55	67
X	X			X			D	A	A	X	69	85	71	68	69	74	63	54	64	55	67
X	X			X			D	B	A	X	69	85	71	68	69	74	63	54	64	55	67
X	X			X			D	C	A	X	69	85	71	68	69	74	63	54	64	55	67
X	X			X			A	A	B	X	60	82	65	63	60	70	60	48	62	56	64
X	X			X			A	B	B	X	60	82	65	63	60	70	60	53	68	63	66
X	X			X			A	C	B	X	60	82	65	63	60	70	60	48	62	52	64
X	X			X			B	A	B	X	60	82	65	63	60	70	60	48	62	51	64
X	X			X			B	B	B	X	60	82	65	63	60	70	60	48	62	56	64
X	X			X			B	C	B	X	60	82	65	63	60	70	60	48	62	51	64
X	X			X			C	A	B	X	60	82	65	63	60	70	60	48	62	51	64
X	X			X			C	B	B	X	60	82	65	63	60	70	60	48	62	51	64
X	X			X			C	C	B	X	60	82	65	63	60	70	60	48	62	51	64
X	X			X			D	A	B	X	60	82	65	63	60	70	60	48	62	51	64
X	X			X			D	B	B	X	60	82	65	63	60	70	60	48	62	51	64
X	X			X			D	C	B	X	60	82	65	63	60	70	60	48	62	51	64
X	X			X			A	A	C	X	55	59	63	53	56	64	55	48	59	56	60
X	X			X			A	B	C	X	55	59	63	59	56	64	60	53	68	63	66
X	X			X			A	C	C	X	55	59	63	51	56	64	55	46	59	52	60
X	X			X			B	A	C	X	55	59	63	51	56	64	55	46	59	50	60
X	X			X			B	B	C	X	55	59	63	54	56	64	55	46	62	56	60
X	X			X			B	C	C	X	55	59	63	51	56	64	55	46	59	49	60
X	X			X			C	A	C	X	55	59	63	51	56	64	55	46	59	49	60
X	X			X			C	B	C	X	55	59	63	51	56	64	55	46	59	49	60
X	X			X			C	C	C	X	55	59	63	51	56	64	55	46	59	49	60
X	X			X			D	A	C	X	55	59	63	51	56	64	55	46	59	49	60
X	X			X			D	B	C	X	55	59	63	51	56	64	55	46	59	49	60
X	X			X			D	C	C	X	55	59	63	51	56	64	55	46	59	49	60
X	X			X			A	A	D	X	40	47	55	53	48	56	54	48	58	56	58
X	X			X			A	B	D	X	44	47	61	59	54	63	60	53	68	63	66
X	X			X			A	C	D	X	36	47	50	49	43	55	52	42	54	52	57
X	X			X			B	A	D	X	36	47	50	49	45	55	52	41	54	50	57
X	X			X			B	B	D	X	37	47	56	54	50	55	52	46	62	56	57
X	X			X			B	C	D	X	36	47	50	49	42	55	52	35	54	46	57
X	X			X			C	A	D	X	36	47	50	49	42	55	52	34	54	46	57
X	X			X			C	B	D	X	36	47	50	49	45	55	52	38	54	47	57
X	X			X			C	C	D	X	36	47	50	49	42	55	52	34	54	46	57
X	X			X			D	A	D	X	36	47	50	49	42	55	52	34	54	46	57
X	X			X			D	B	D	X	36	47	50	49	42	55	52	34	54	46	57
X	X			X			D	C	D	X	36	47	50	49	42	55	52	34	54	46	57

Defrost or AUX Heat Full Comp or W1 Heating

PWM Summary Sheet																						
ENERGIZE							COOL	ADJUST	HEAT	DELAY	PWM											
G	Y1	Y/Y2	O	W1	W2	HUM					AVC18B	AVC24B / MVC08B	AVC30B	AVC36B / MVC12B	AVC36C	AVC42C	AVC48C / MVC16C	AVC48D	AVC60C	AVC60D / MVC20D	MVC14D
DEFROST OR AUX HEAT (GREATER OF FULL COMPRESSOR OR W1 HEATING)																						
X	X	X		X		X	A	A	A	X	69	85	86	80	72	98	85	78	93	88	100
X	X	X		X		X	A	B	A	X	69	91	100	93	84	100	95	87	100	100	100
X	X	X		X		X	A	C	A	X	69	85	73	70	69	79	75	69	80	80	85
X	X	X		X		X	B	A	A	X	69	85	75	73	69	78	74	67	84	75	84
X	X	X		X		X	B	B	A	X	69	85	88	83	75	93	82	75	99	86	98
X	X	X		X		X	B	C	A	X	69	85	71	68	69	74	66	59	72	70	72
X	X	X		X		X	C	A	A	X	69	85	71	68	69	74	63	56	71	63	79
X	X	X		X		X	C	B	A	X	69	85	71	75	69	86	70	63	83	71	92
X	X	X		X		X	C	C	A	X	69	85	71	68	69	74	63	54	64	59	69
X	X	X		X		X	D	A	A	X	69	85	71	68	69	74	63	54	64	58	67
X	X	X		X		X	D	B	A	X	69	85	71	68	69	74	63	54	68	65	73
X	X	X		X		X	D	C	A	X	69	85	71	68	69	74	63	54	64	55	67
X	X	X		X		X	A	A	B	X	60	82	86	80	72	98	85	78	93	88	100
X	X	X		X		X	A	B	B	X	65	91	100	93	84	100	95	87	100	100	100
X	X	X		X		X	A	C	B	X	60	82	73	70	63	79	75	69	80	80	85
X	X	X		X		X	B	A	B	X	60	82	75	73	66	78	74	67	84	75	84
X	X	X		X		X	B	B	B	X	60	82	88	83	75	93	82	75	99	86	98
X	X	X		X		X	B	C	B	X	60	82	66	64	60	70	66	59	72	70	72
X	X	X		X		X	C	A	B	X	60	82	65	66	60	74	63	56	71	63	79
X	X	X		X		X	C	B	B	X	60	82	70	75	68	86	70	63	83	71	92
X	X	X		X		X	C	C	B	X	60	82	65	63	60	70	60	49	62	59	69
X	X	X		X		X	D	A	B	X	60	82	65	63	60	70	60	48	62	58	64
X	X	X		X		X	D	B	B	X	60	82	65	63	60	70	60	51	68	65	73
X	X	X		X		X	D	C	B	X	60	82	65	63	60	70	60	48	62	54	64
X	X	X		X		X	A	A	C	X	58	75	86	80	72	98	85	78	93	88	100
X	X	X		X		X	A	B	C	X	65	91	100	93	84	100	95	87	100	100	100
X	X	X		X		X	A	C	C	X	55	64	73	70	63	79	75	69	80	80	85
X	X	X		X		X	B	A	C	X	55	59	75	73	66	78	74	67	84	75	84
X	X	X		X		X	B	B	C	X	55	65	88	83	75	93	82	75	99	86	98
X	X	X		X		X	B	C	C	X	55	59	66	64	58	68	66	59	72	70	72
X	X	X		X		X	C	A	C	X	55	59	63	66	60	74	63	56	71	63	79
X	X	X		X		X	C	B	C	X	55	63	70	75	68	86	70	63	83	71	92
X	X	X		X		X	C	C	C	X	55	59	63	59	56	65	56	49	62	59	69
X	X	X		X		X	D	A	C	X	55	59	63	54	56	64	55	46	59	58	64
X	X	X		X		X	D	B	C	X	55	59	63	60	56	68	58	51	68	65	73
X	X	X		X		X	D	C	C	X	55	59	63	51	56	64	55	46	59	54	60
X	X	X		X		X	A	A	D	X	58	75	86	80	72	98	85	78	93	88	100
X	X	X		X		X	A	B	D	X	65	91	100	93	84	100	95	87	100	100	100
X	X	X		X		X	A	C	D	X	51	64	73	70	63	79	75	69	80	80	85
X	X	X		X		X	B	A	D	X	49	57	75	73	66	78	74	67	84	75	84
X	X	X		X		X	B	B	D	X	55	65	88	83	75	93	82	75	99	86	98
X	X	X		X		X	B	C	D	X	44	49	66	64	58	68	66	59	72	70	72
X	X	X		X		X	C	A	D	X	40	55	63	66	60	74	63	56	71	63	79
X	X	X		X		X	C	B	D	X	45	63	70	75	68	86	70	63	83	71	92
X	X	X		X		X	C	C	D	X	36	48	56	59	53	65	56	49	62	59	69
X	X	X		X		X	D	A	D	X	36	47	53	54	49	61	52	46	59	58	64
X	X	X		X		X	D	B	D	X	38	47	59	60	55	68	58	51	68	65	73
X	X	X		X		X	D	C	D	X	36	47	50	49	44	55	52	40	54	54	57

DEFROST OR AUX HEAT (GREATER OF FULL COMPRESSOR OR W1 HEATING)																				
X	X	X		X			A	A	A	X	69	85	86	80	72	98	85	78	93	88	100
X	X	X		X			A	B	A	X	69	91	100	93	84	100	95	87	100	100	100
X	X	X		X			A	C	A	X	69	85	73	70	69	79	75	69	80	80	85
X	X	X		X			B	A	A	X	69	85	75	73	69	78	74	67	84	75	84
X	X	X		X			B	B	A	X	69	85	88	83	75	93	82	75	99	86	98
X	X	X		X			B	C	A	X	69	85	71	68	69	74	66	59	72	70	72
X	X	X		X			C	A	A	X	69	85	71	68	69	74	63	56	71	63	79
X	X	X		X			C	B	A	X	69	85	71	75	69	86	70	63	83	71	92
X	X	X		X			C	C	A	X	69	85	71	68	69	74	63	54	64	59	69
X	X	X		X			D	A	A	X	69	85	71	68	69	74	63	54	64	58	67
X	X	X		X			D	B	A	X	69	85	71	68	69	74	63	54	68	65	73
X	X	X		X			D	C	A	X	69	85	71	68	69	74	63	54	64	55	67
X	X	X		X			A	A	B	X	60	82	86	80	72	98	85	78	93	88	100
X	X	X		X			A	B	B	X	65	91	100	93	84	100	95	87	100	100	100
X	X	X		X			A	C	B	X	60	82	73	70	63	79	75	69	80	80	85
X	X	X		X			B	A	B	X	60	82	75	73	66	78	74	67	84	75	84
X	X	X		X			B	B	B	X	60	82	88	83	75	93	82	75	99	86	98
X	X	X		X			B	C	B	X	60	82	66	64	60	70	66	59	72	70	72
X	X	X		X			C	A	B	X	60	82	65	66	60	74	63	56	71	63	79
X	X	X		X			C	B	B	X	60	82	70	75	68	86	70	63	83	71	92
X	X	X		X			C	C	B	X	60	82	65	63	60	70	60	49	62	59	69
X	X	X		X			D	A	B	X	60	82	65	63	60	70	60	48	62	58	64
X	X	X		X			D	B	B	X	60	82	65	63	60	70	60	51	68	65	73
X	X	X		X			D	C	B	X	60	82	65	63	60	70	60	48	62	54	64
X	X	X		X			A	A	C	X	58	75	86	80	72	98	85	78	93	88	100
X	X	X		X			A	B	C	X	65	91	100	93	84	100	95	87	100	100	100
X	X	X		X			A	C	C	X	55	64	73	70	63	79	75	69	80	80	85
X	X	X		X			B	A	C	X	55	59	75	73	66	78	74	67	84	75	84
X	X	X		X			B	B	C	X	55	65	88	83	75	93	82	75	99	86	98
X	X	X		X			B	C	C	X	55	59	66	64	58	68	66	59	72	70	72
X	X	X		X			C	A	C	X	55	59	63	66	60	74	63	56	71	63	79
X	X	X		X			C	B	C	X	55	63	70	75	68	86	70	63	83	71	92
X	X	X		X			C	C	C	X	55	59	63	59	56	65	56	49	62	59	69
X	X	X		X			D	A	C	X	55	59	63	54	56	64	55	46	59	58	64
X	X	X		X			D	B	C	X	55	59	63	60	56	68	58	51	68	65	73
X	X	X		X			D	C	C	X	55	59	63	51	56	64	55	46	59	54	60
X	X	X		X			A	A	D	X	58	75	86	80	72	98	85	78	93	88	100
X	X	X		X			A	B	D	X	65	91	100	93	84	100	95	87	100	100	100
X	X	X		X			A	C	D	X	51	64	73	70	63	79	75	69	80	80	85
X	X	X		X			B	A	D	X	49	57	75	73	66	78	74	67	84	75	84
X	X	X		X			B	B	D	X	55	65	88	83	75	93	82	75	99	86	98
X	X	X		X			B	C	D	X	44	49	66	64	58	68	66	59	72	70	72
X	X	X		X			C	A	D	X	40	55	63	66	60	74	63	56	71	63	79
X	X	X		X			C	B	D	X	45	63	70	75	68	86	70	63	83	71	92
X	X	X		X			C	C	D	X	36	48	56	59	53	65	56	49	62	59	69
X	X	X		X			D	A	D	X	36	47	53	54	49	61	52	46	59	58	64
X	X	X		X			D	B	D	X	38	47	59	60	55	68	58	51	68	65	73
X	X	X		X			D	C	D	X	36	47	50	49	44	55	52	40	54	54	57

PWM Summary Sheet																						
ENERGIZE							COOL	ADJUST	HEAT	DELAY	PWM											
G	Y1	Y/Y2	O	W1	W2	HUM					AVC18B	AVC24B / MVC08B	AVC30B	AVC36B / MVC12B	AVC36C	AVC42C	AVC48C / MVC16C	AVC48D	AVC60C	AVC60D / MVC20D	MVC14D
DEFROST OR AUX HEAT (GREATER OF FULL COMPRESSOR OR W1 HEATING)																						
X		X		X		X	A	A	A	X	69	85	86	80	72	98	85	78	93	88	100
X		X		X		X	A	B	A	X	69	91	100	93	84	100	95	87	100	100	100
X		X		X		X	A	C	A	X	69	85	73	70	69	79	75	69	80	80	85
X		X		X		X	B	A	A	X	69	85	75	73	69	78	74	67	84	75	84
X		X		X		X	B	B	A	X	69	85	88	83	75	93	82	75	99	86	98
X		X		X		X	B	C	A	X	69	85	71	68	69	74	66	59	72	70	72
X		X		X		X	C	A	A	X	69	85	71	68	69	74	63	56	71	63	79
X		X		X		X	C	B	A	X	69	85	71	75	69	86	70	63	83	71	92
X		X		X		X	C	C	A	X	69	85	71	68	69	74	63	54	64	59	69
X		X		X		X	D	A	A	X	69	85	71	68	69	74	63	54	64	58	67
X		X		X		X	D	B	A	X	69	85	71	68	69	74	63	54	68	65	73
X		X		X		X	D	C	A	X	69	85	71	68	69	74	63	54	64	55	67
X		X		X		X	A	A	B	X	60	82	86	80	72	98	85	78	93	88	100
X		X		X		X	A	B	B	X	65	91	100	93	84	100	95	87	100	100	100
X		X		X		X	A	C	B	X	60	82	73	70	63	79	75	69	80	80	85
X		X		X		X	B	A	B	X	60	82	75	73	66	78	74	67	84	75	84
X		X		X		X	B	B	B	X	60	82	88	83	75	93	82	75	99	86	98
X		X		X		X	B	C	B	X	60	82	66	64	60	70	66	59	72	70	72
X		X		X		X	C	A	B	X	60	82	65	66	60	74	63	56	71	63	79
X		X		X		X	C	B	B	X	60	82	70	75	68	86	70	63	83	71	92
X		X		X		X	C	C	B	X	60	82	65	63	60	70	60	49	62	59	69
X		X		X		X	D	A	B	X	60	82	65	63	60	70	60	48	62	58	64
X		X		X		X	D	B	B	X	60	82	65	63	60	70	60	51	68	65	73
X		X		X		X	D	C	B	X	60	82	65	63	60	70	60	48	62	54	64
X		X		X		X	A	A	C	X	58	75	86	80	72	98	85	78	93	88	100
X		X		X		X	A	B	C	X	65	91	100	93	84	100	95	87	100	100	100
X		X		X		X	A	C	C	X	55	64	73	70	63	79	75	69	80	80	85
X		X		X		X	B	A	C	X	55	59	75	73	66	78	74	67	84	75	84
X		X		X		X	B	B	C	X	55	65	88	83	75	93	82	75	99	86	98
X		X		X		X	B	C	C	X	55	59	66	64	58	68	66	59	72	70	72
X		X		X		X	C	A	C	X	55	59	63	66	60	74	63	56	71	63	79
X		X		X		X	C	B	C	X	55	63	70	75	68	86	70	63	83	71	92
X		X		X		X	C	C	C	X	55	59	63	59	56	65	56	49	62	59	69
X		X		X		X	D	A	C	X	55	59	63	54	56	64	55	46	59	58	64
X		X		X		X	D	B	C	X	55	59	63	60	56	68	58	51	68	65	73
X		X		X		X	D	C	C	X	55	59	63	51	56	64	55	46	59	54	60
X		X		X		X	A	A	D	X	58	75	86	80	72	98	85	78	93	88	100
X		X		X		X	A	B	D	X	65	91	100	93	84	100	95	87	100	100	100
X		X		X		X	A	C	D	X	51	64	73	70	63	79	75	69	80	80	85
X		X		X		X	B	A	D	X	49	57	75	73	66	78	74	67	84	75	84
X		X		X		X	B	B	D	X	55	65	88	83	75	93	82	75	99	86	98
X		X		X		X	B	C	D	X	44	49	66	64	58	68	66	59	72	70	72
X		X		X		X	C	A	D	X	40	55	63	66	60	74	63	56	71	63	79
X		X		X		X	C	B	D	X	45	63	70	75	68	86	70	63	83	71	92
X		X		X		X	C	C	D	X	36	48	56	59	53	65	56	49	62	59	69
X		X		X		X	D	A	D	X	36	47	53	54	49	61	52	46	59	58	64
X		X		X		X	D	B	D	X	38	47	59	60	55	68	58	51	68	65	73
X		X		X		X	D	C	D	X	36	47	50	49	44	55	52	40	54	54	57

PWM Summary Sheet																							
ENERGIZE							COOL	ADJUST	HEAT	DELAY	PWM												
G	Y1	Y/Y2	O	W1	W2	HUM					AVC18B	AVC24B/MVC08B	AVC30B	AVC36B/MVC12B	AVC36C	AVC42C	AVC48C/MVC16C	AVC48D	AVC60C	AVC60D/MVC20D	MVC14D
DEFROST OR AUX HEAT (GREATER OF FULL COMPRESSOR OR W1 HEATING)																							
X		X		X			A	A	A	X	69	85	86	80	72	98	85	78	93	88	100
X		X		X			A	B	A	X	69	91	100	93	84	100	95	87	100	100	100
X		X		X			A	C	A	X	69	85	73	70	69	79	75	69	80	80	85
X		X		X			B	A	A	X	69	85	75	73	69	78	74	67	84	75	84
X		X		X			B	B	A	X	69	85	88	83	75	93	82	75	99	86	98
X		X		X			B	C	A	X	69	85	71	68	69	74	66	59	72	70	72
X		X		X			C	A	A	X	69	85	71	68	69	74	63	56	71	63	79
X		X		X			C	B	A	X	69	85	71	75	69	86	70	63	83	71	92
X		X		X			C	C	A	X	69	85	71	68	69	74	63	54	64	59	69
X		X		X			D	A	A	X	69	85	71	68	69	74	63	54	64	58	67
X		X		X			D	B	A	X	69	85	71	68	69	74	63	54	68	65	73
X		X		X			D	C	A	X	69	85	71	68	69	74	63	54	64	55	67
X		X		X			A	A	B	X	60	82	86	80	72	98	85	78	93	88	100
X		X		X			A	B	B	X	65	91	100	93	84	100	95	87	100	100	100
X		X		X			A	C	B	X	60	82	73	70	63	79	75	69	80	80	85
X		X		X			B	A	B	X	60	82	75	73	66	78	74	67	84	75	84
X		X		X			B	B	B	X	60	82	88	83	75	93	82	75	99	86	98
X		X		X			B	C	B	X	60	82	66	64	60	70	66	59	72	70	72
X		X		X			C	A	B	X	60	82	65	66	60	74	63	56	71	63	79
X		X		X			C	B	B	X	60	82	70	75	68	86	70	63	83	71	92
X		X		X			C	C	B	X	60	82	65	63	60	70	60	49	62	59	69
X		X		X			D	A	B	X	60	82	65	63	60	70	60	48	62	58	64
X		X		X			D	B	B	X	60	82	65	63	60	70	60	51	68	65	73
X		X		X			D	C	B	X	60	82	65	63	60	70	60	48	62	54	64
X		X		X			A	A	C	X	58	75	86	80	72	98	85	78	93	88	100
X		X		X			A	B	C	X	65	91	100	93	84	100	95	87	100	100	100
X		X		X			A	C	C	X	55	64	73	70	63	79	75	69	80	80	85
X		X		X			B	A	C	X	55	59	75	73	66	78	74	67	84	75	84
X		X		X			B	B	C	X	55	65	88	83	75	93	82	75	99	86	98
X		X		X			B	C	C	X	55	59	66	64	58	68	66	59	72	70	72
X		X		X			C	A	C	X	55	59	63	66	60	74	63	56	71	63	79
X		X		X			C	B	C	X	55	63	70	75	68	86	70	63	83	71	92
X		X		X			C	C	C	X	55	59	63	59	56	65	56	49	62	59	69
X		X		X			D	A	C	X	55	59	63	54	56	64	55	46	59	58	64
X		X		X			D	B	C	X	55	59	63	60	56	68	58	51	68	65	73
X		X		X			D	C	C	X	55	59	63	51	56	64	55	46	59	54	60
X		X		X			A	A	D	X	58	75	86	80	72	98	85	78	93	88	100
X		X		X			A	B	D	X	65	91	100	93	84	100	95	87	100	100	100
X		X		X			A	C	D	X	51	64	73	70	63	79	75	69	80	80	85
X		X		X			B	A	D	X	49	57	75	73	66	78	74	67	84	75	84
X		X		X			B	B	D	X	55	65	88	83	75	93	82	75	99	86	98
X		X		X			B	C	D	X	44	49	66	64	58	68	66	59	72	70	72
X		X		X			C	A	D	X	40	55	63	66	60	74	63	56	71	63	79
X		X		X			C	B	D	X	45	63	70	75	68	86	70	63	83	71	92
X		X		X			C	C	D	X	36	48	56	59	53	65	56	49	62	59	69
X		X		X			D	A	D	X	36	47	53	54	49	61	52	46	59	58	64
X		X		X			D	B	D	X	38	47	59	60	55	68	58	51	68	65	73
X		X		X			D	C	D	X	36	47	50	49	44	55	52	40	54	54	57

