Service and Troubleshooting

GPCM3 Cooling/*PHM3 Heat Pump & *PHM5 15.2 SEER(2) Heat Pump Multi Position Package Unit with R-410A

Pride and workmanship go into every product to provide our customers with quality products. It is possible, however, that during its lifetime a product may require service. Products should be serviced only by a qualified service technician who is familiar with the safety procedures required in the repair and who is equipped with the proper tools, parts, testing instruments and the appropriate service manual. **REVIEW ALL SERVICE INFORMATION IN THE APPROPRIATE SERVICE MANUAL BEFORE BEGINNING REPAIRS.**

WARNING

ONLY PERSONNEL THAT HAVE BEEN TRAINED TO INSTALL, ADJUST, SERVICE, MAINTENANCE OR REPAIR (HEREINAFTER, "SERVICE") THE EQUIPMENT SPECIFIED IN THIS MANUAL SHOULD SERVICE THE EQUIPMENT. THE MANUFACTURER WILL NOT BE RESPONSIBLE FOR ANY INJURY OR PROPERTY DAMAGE ARISING FROM IMPROPER SERVICE OR SERVICE PROCEDURES. IF YOU SERVICE THIS UNIT, YOU ASSUME RESPONSIBILITY FOR ANY INJURY OR PROPERTY DAMAGE WHICH MAY RESULT. IN ADDITION, IN JURISDICTIONS THAT REQUIRE ONE OR MORE LICENSES TO SERVICE THE EQUIPMENT SPECIFIED IN THIS MANUAL, ONLY LICENSED PERSONNEL SHOULD SERVICE THE EQUIPMENT. IMPROPER INSTALLATION, ADJUSTMENT, SERVICING, MAINTENANCE OR REPAIR OF THE EQUIPMENT SPECIFIED IN THIS MANUAL, OR ATTEMPTING TO INSTALL, ADJUST, SERVICE OR REPAIR THE EQUIPMENT SPECIFIED IN THIS MANUAL WITHOUT PROPER TRAINING MAY RESULT IN PRODUCT DAMAGE, PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

WARNING

DO NOT BYPASS SAFETY DEVICES

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IMPORTANT INFORMATION

IMPORTANT NOTICES

RECOGNIZE SAFETY SYMBOLS, WORDS AND LABELS

WARNING

TO PREVENT THE RISK OF PROPERTY DAMAGE, PERSONAL INJURY, OR DEATH, DO NOT STORE COMBUSTIBLE MATERIALS OR USE GASOLINE OR OTHER FLAMMABLE LIQUIDS OR VAPORS IN THE VICINITY OF THIS APPLIANCE.

WARNING

HIGH VOLTAGE
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING THIS UNIT. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

WARNING

THIS UNIT SHOULD NOT BE CONNECTED TO, OR USED IN CONJUNCTION WITH, ANY DEVICES THAT ARE NOT DESIGN CERTIFIED FOR USE WITH THIS UNIT OR HAVE NOT BEEN TESTED AND APPROVED BY THE MANUFACTURER. SERIOUS PROPERTY DAMAGE OR PERSONAL INJURY, REDUCED UNIT PERFORMANCE AND/OR HAZARDOUS CONDITIONS MAY RESULT FROM THE USE OF DEVICES THAT HAVE NOT BEEN APPROVED OR CERTIFIED BY THE MANUFACTURER.

SAFE REFRIGERANT HANDLING

While these items will not cover every conceivable situation, they should serve as a useful guide.

WARNING

Refrigerants are heavier than air. They can "push out" the oxygen in your lungs or in any enclosed space. To avoid possible difficulty in breathing or death:

- Never purge refrigerant into an enclosed room or space. By law, all refrigerant must be reclaimed.
- If an indoor leak is suspected, thoroughly ventilate the area before beginning work.
- Liquid refrigerant can be very cold. To avoid possible frostbite or blindness, avoid contact with refrigerant and wear gloves and goggles. If liquid refrigerant does contact your skin or eyes, seek medical help immediately.
- Always follow EPA regulations. Never burn refrigerant, as poisonous gas will be produced.

WARNING

To avoid possible injury, explosion or death, practice safe handling of refrigerants.

WARNING

The compressor POE oil for R-410A units is extremely susceptible to moisture absorption and could cause compressor failure. Do not leave system open to atmosphere any longer than necessary for installation.

WARNING

To avoid possible explosion:

- Never apply flame or steam to a refrigerant cylinder. If you must heat a cylinder for faster charging, partially immerse it in warm water.
- Never fill a cylinder more than 80% full of liquid refrigerant.
- Never add anything other than R-22 to an R-22 cylinder or R-410A to an R-410A cylinder. The service equipment used must be listed or certified for the type of refrigerant used.
- Store cylinders in a cool, dry place. Never use a cylinder as a platform or a roller.

WARNING

To avoid possible explosion, use only returnable (not disposable) service cylinders when removing refrigerant from a system.

- Ensure the cylinder is free of damage which could lead to a leak or explosion.
- Ensure the hydrostatic test date does not exceed 5 years.
- Ensure the pressure rating meets or exceeds 400 lbs.

When in doubt, do not use cylinder.

OUTSIDE THE U.S., **call 1-713-861-2500**.
(Not a technical assistance line for dealers.) Your telephone company will bill you for the call.

PRODUCT IDENTIFICATION

NOMENCLATURE

The model number is used for positive identification of component parts used in manufacturing. Please use this number when requesting service or parts information.

G	P	C	M	3	24	4	1	A	A
1	2	3	4	5	6,7	8	9	10	11

Brand
G Goodman® brand

Product Category
P Packaged Unit

Unit Type
C Air Conditioner
H Heat Pump

Airflow
H Horizontal
M Multi-Position

Efficiency
3 13.4 SEER2

Nominal Capacity

24	2 Tons	36	3 Tons	48	4 Tons
30	2½ Tons	42	3½ Tons	60	5 Tons

Refrigerant
4 R-410A

Electrical
1 208/230 V, 1 Phase, 60 Hz

Major Revision
A

Minor Revision
A

PRODUCT IDENTIFICATION NOMENCLATURE

The model number is used for positive identification of component parts used in manufacturing. Please use this number when requesting service or parts information.

A	P	H	M	3	24	4	1	A	A
1	2	3	4	5	6,7	8	9	10	11

Brand
A - Amana® Brand

Product Category
P - Packaged Unit

Unit Type
C Air Conditioner
H Heat Pump

Airflow
H Horizontal
M Multi-Position

Efficiency
3 13.4 SEER2
5 15.2 SEER2

Minor Revision
A

Major Revision
A

Electrical
1 - 208/230V 1 phase, 60 Hz

Refrigerant
4 - R-410A

Nominal Capacity
24 - 2.0 tons
30 - 2.5 tons
36 - 3.0 tons
42 - 3.5 tons
48 - 4.0 tons
60 - 5.0 tons

G	P	H	M	3	36	4	1	A	A
1	2	3	4	5	6,7	8	9	10	11

Brand
G - Goodman® Brand

Product Category
P - Packaged Unit

Unit Type
C - Air Conditioner
H - Heat Pump

Airflow
H - Horizontal
M - Multi-Position

Efficiency
3 - 13.4 SEER2
5 - 15.2 SEER2

Minor Revision
A

Major Revision
A

Electrical
1 - 208/230V single-phase, 60 Hz

Refrigerant
4 - R-410A

Nominal Capacity
24 - 2 tons
30 - 2½ tons
36 - 3 tons
42 - 3½ tons
48 - 4 tons
60 - 5 tons

PRODUCT IDENTIFICATION

Single Phase Multiposition Cooling	
Model #	**Description**
APC14[24-60]M41AA	Amana® Brand Package Cooling 14 SEER R410A Multiposition cooling units. Initial release of single phase models.
GPC14[24-60]M41AA	Goodman® Brand Package Cooling 14 SEER R410A Multiposition cooling units. Initial release of sinlge phase models.
APC14[24-60]M41AB	Amana® Brand Package Cooling 14 SEER R410A Multiposition cooling units. Release of models with access box removed.
GPC14[24-60]M41AB	Goodman® Brand Package Cooling 14 SEER R410A Multiposition cooling units. Release of models with access box removed.
GPC1430M41BA	Goodman® Brand Package Cooling 14 SEER R410A Multiposition cooling units. Release of models with Rechi compressor.
GPC1436M41BA	Goodman® Brand Package Cooling 14 SEER R410A Multiposition cooling units. Release of models with Rechi compressor.
GPCM3[24-60]41AA	Goodman® Brand Package Cooling 13.4 SEER(2) R410A Multiposition cooling units. Initial release of models meeting DOE 2023 Regulatory Requirements.

Single Phase Multiposition Heat Pump	
Model #	**Description**
APH14[24-60]M41AA	Amana® Brand Package Heat Pump 14 SEER R410A Multiposition heating/cooling units. Initial release of single phase models.
GPH14[24-60]M41AA	Goodman® Brand Package Heat Pump 14 SEER R410A Multiposition heating/cooling units. Initial release of sinlge phase models.
APH14[24-60]M41AB	Amana® Brand Package Heat Pump 14 SEER R410A Multiposition heating/cooling units. Release of models with access box removed.
GPH14[24-60]M41AB	Goodman® Brand Package Heat Pump 14 SEER R410A Multiposition heating/cooling units. Release of models with access box removed.
A/GPHM3[24-60]41AA	Amana® Brand/Godman® Brand Package Heat Pump up to 13.4 SEER(2) R410A Multiposition heating/cooling units. Initial release of models meeting DOE 2023 Regulatory Requirements

PRODUCT IDENTIFICATION

Single Phase Multiposition Heat Pump	
Model #	**Description**
APH16[24-48]M41AA	Amana® Brand Package Heat Pump up to 16 SEER R410A Multiposition heating/ cooling units. Initial release of single phase models.
GPH16[24-48]M41AA	Goodman® Brand Package Heat Pump up to 16 SEER R410A Multiposition heating/ cooling units. Initial release of single phase models.
APH16[24-48]M41AB	Amana® Brand Package Heat Pump up to 16 SEER R410A Multiposition heating/ cooling units. Release of models with access box removed.
GPH16[24-48]M41AB	Goodman® Brand Package Heat Pump up to 16 SEER R410A Multiposition heating/ cooling units. Release of models with access box removed.
APH1660M41AA	Amana® Brand Package Heat Pump up to 16 SEER R410A Multiposition heating/ cooling units. Converting light commercial 6 ton unit to 5 ton residential gas pack and heat pump units.
GPH1660M41AA	Goodman® Brand Package Heat Pump up to 16 SEER R410A Multiposition heating/ cooling units. Converting light commercial 6 ton unit to 5 ton residential gas pack and heat pump units.
APH1660M41BA	Amana® Brand Package Heat Pump up to 16 SEER R410A Multiposition heating/ cooling units. Release of 5 Ton single phase models with new chassis design.
GPH1660M41BA	Goodman® Brand Package Heat Pump up to 16 SEER R410A Multiposition heating/ cooling units. Release of 5 Ton single phase models with new chassis design.
A/GPHM5[24-60]41AA	Amana® Brand/Godman® Brand Package Heat Pump up to 15.2 SEER(2) R410A Multiposition units. Initial release of models meeting DOE 2023 Regulatory Requirements

SYSTEM OPERATION

Cooling

The refrigerant used in the system is R-410A. It is a clear, colorless, non-toxic and non-irritating liquid. R-410A is a 50:50 blend of R-32 and R-125. The boiling point at atmospheric pressure is -62.9°F.

A few of the important principles that make the refrigeration cycle possible are: heat always flows from a warmer to a cooler body. Under lower pressure, a refrigerant will absorb heat and vaporize at a low temperature. The vapors may be drawn off and condensed at a higher pressure and temperature to be used again.

The indoor evaporator coil functions to cool and dehumidify the air conditioned spaces through the evaporative process taking place within the coil tubes.

NOTE: The pressures and temperatures shown in the refrigerant cycle illustrations on the following pages are for demonstration purposes only. Actual temperatures and pressures are to be obtained from the "Expanded Performance Chart".

Liquid refrigerant at condensing pressure and temperatures, (270 psig and 122°F), leaves the outdoor condensing coil through the drier and is metered into the indoor coil through the metering device. As the cool, low pressure, saturated refrigerant enters the tubes of the indoor coil, a portion of the liquid immediately vaporizes. It continues to soak up heat and vaporizes as it proceeds through the coil, cooling the indoor coil down to about 48°F.

Heat is continually being transferred to the cool fins and tubes of the indoor evaporator coil by the warm system air. This warming process causes the refrigerant to boil. The heat removed from the air is carried off by the vapor.

As the vapor passes through the last tubes of the coil, it becomes superheated. That is, it absorbs more heat than is necessary to vaporize it. This is assurance that only dry gas will reach the compressor. Liquid reaching the compressor can weaken or break compressor valves.

The compressor increases the pressure of the gas, thus adding more heat, and discharges hot, high pressure super-heated gas into the outdoor condenser coil.

In the condenser coil, the hot refrigerant gas, being warmer than the outdoor air, first loses its superheat by heat transferred from the gas through the tubes and fins of the coil. The refrigerant now becomes saturated, part liquid, part vapor and then continues to give up heat until it condenses to a liquid alone. Once the vapor is fully liquefied, it continues to give up heat which subcools the liquid, and it is ready to repeat the cycle.

Cooling Cycle

Cooling Only Models

When the contacts of the room thermostat close, making terminals R to Y and R to G, the low voltage circuit to the contactor is completed starting the compressor and outdoor fan motor. The EEM indoor blower motor is energized at the cool speed when the compressor contactor energizes.

When the thermostat is satisfied, breaking the circuit between R to Y and R to G, the compressor and outdoor fan motor will stop. The indoor blower will stop after the fan off delay.

If the room thermostat fan selector switch should be set to the “on” position then the indoor blower would run continuous rather than cycling with the compressor.

Heat Pump Models

Any time the room thermostat is switched to cool, the O terminal is energized. This energizes the 24 volt coil on the reversing valve and switches it to the cooling position.

When the contacts of the room thermostat close, this closes the circuit from R to Y and R to G in the unit.

This energizes the compressor contactor and will energize the indoor blower on models equipped with the EEM motor.

When the thermostat is satisfied, it opens its contacts breaking the low voltage circuit causing the compressor contactor to open and indoor fan to stop after the programmed 60 second off delay on units with the EEM motor.

If the room thermostat fan selector switch should be set to the “on” position then the indoor blower would run continuous rather than cycling with the compressor.

Heating Cycle

Cooling Only Units

NOTE: The following only applies if the cooling only unit has an approved electric heat kit installed for heating. If auxiliary electric heaters should be used, they may be controlled by outdoor thermostats (OT18-60A or OT/EHR18-60A).

GPCM3 EEM Equipped Model Units

With the thermostat set to the heat position and a call for heat, R to W will be energized. This will energize the electric heat contactor(s)/sequencer(s) and the EEM indoor blower motor. When the normally open contacts of the heat contactor(s)/sequencer(s) close, this will energize the electric resistance heat.

SYSTEM OPERATION

Single-Stage Heat Pump Units

On a call for first stage heat, the contacts of the room thermostat close. This energizes terminals R to Y and R to G, the low voltage circuit to the contactor is completed starting the compressor and outdoor fan motor. This also energizes the indoor blower on models equipped with the EEM motor.

When the thermostat is satisfied, breaking the circuit between R to Y and R to G, the compressor and outdoor fan motor will stop. The indoor blower will stop after the programmed 60 second off delay on models equipped with the EEM motor.

Two-Stage Heat Pump Units

On a call for first stage heat, the contacts of the room thermostat close. This energizes terminals R to Y1 and R to G, the low voltage circuit to the contactor is completed starting the compressor and outdoor fan motor. This also energizes the indoor blower motor.

When the thermostat is satisfied, breaking the circuit between R to Y1 and R to G, the compressor and outdoor fan motor will stop. The indoor blower will stop after the programmed off delay.

During first stage operation the stat calls for second stage heat. This energizes terminals R to Y2. This powers voltage to the compressor solenoid allowing the compressor to shift to full capacity. When the thermostat is satisfied, breaking the circuit between R to Y1, R to Y2 and R to G, the compressor and outdoor fan motor will stop. The indoor blower will stop after the programmed off delay on the motor.

When auxiliary electric heaters are used the Aux stage heating contacts in the room thermostat close, which would be wired to W1 at the unit low voltage connections, this would energize the coil(s) of the electric heat contactor(s)/sequencer(s). Contacts within the contactor(s)/ Sequencer(s) will close, bringing on the electric resistance heaters. If auxilary electric heaters should be used, the may be controlled by outdoor thermostats (OT18-60A or OT/EHR18-60A).

Emergency Heat Mode (Heat Pumps)

NOTE: The following only applies if the unit has an approved electric heat kit installed for auxiliary heating.

A/GPHM3 EEM Equipped Models Only:

With the thermostat set to the emergency heat position and a call for 2nd stage heat, R to W1 will be energized. This will energize the electric heat contactor(s)/sequencer(s) and the EEM motor. The electric heat will be energized through the normally open contacts of the electric heat contactor(s)/sequencer(s). The indoor blower will be energized through W from the thermostat.

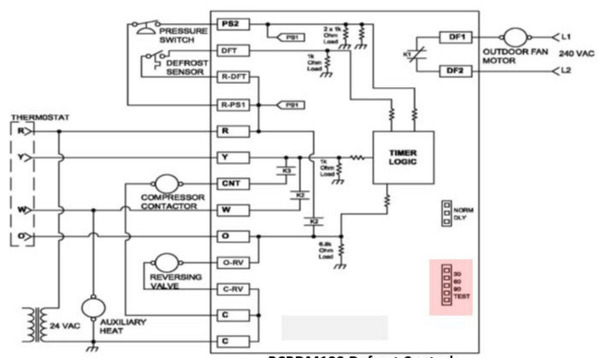
DEFROST CYCLE

Package Heat Pumps

The defrosting of the outdoor coil is jointly controlled by the defrost control board and the defrost thermostat.

Solid State Defrost Control

During operation the power to the circuit board is controlled by a temperature sensor, which is clamped to a feeder tube entering the outdoor coil. Defrost timing periods of 30, 60, or 90 minutes may be selected by setting the circuit board jumper to 30, 60, or 90 respectively. Accumulation of time for the timing period selected starts when the sensor closes (approximately 30° F), and when the room thermostat calls for heat. At the end of the timing period, the unit's defrost cycle will be initiated provided the sensor remains closed. When the sensor opens (approximately 60° F), the defrost cycle is terminated and the timing period is reset. If the defrost cycle is not terminated due to the sensor temperature, a twelve minute override interrupts the unit's defrost period.



PCBDM133 Defrost Control

FAN OPERATION

Continuous Fan Mode

GPCM3 & A/GPHM3 EEM Equipped Models Only:

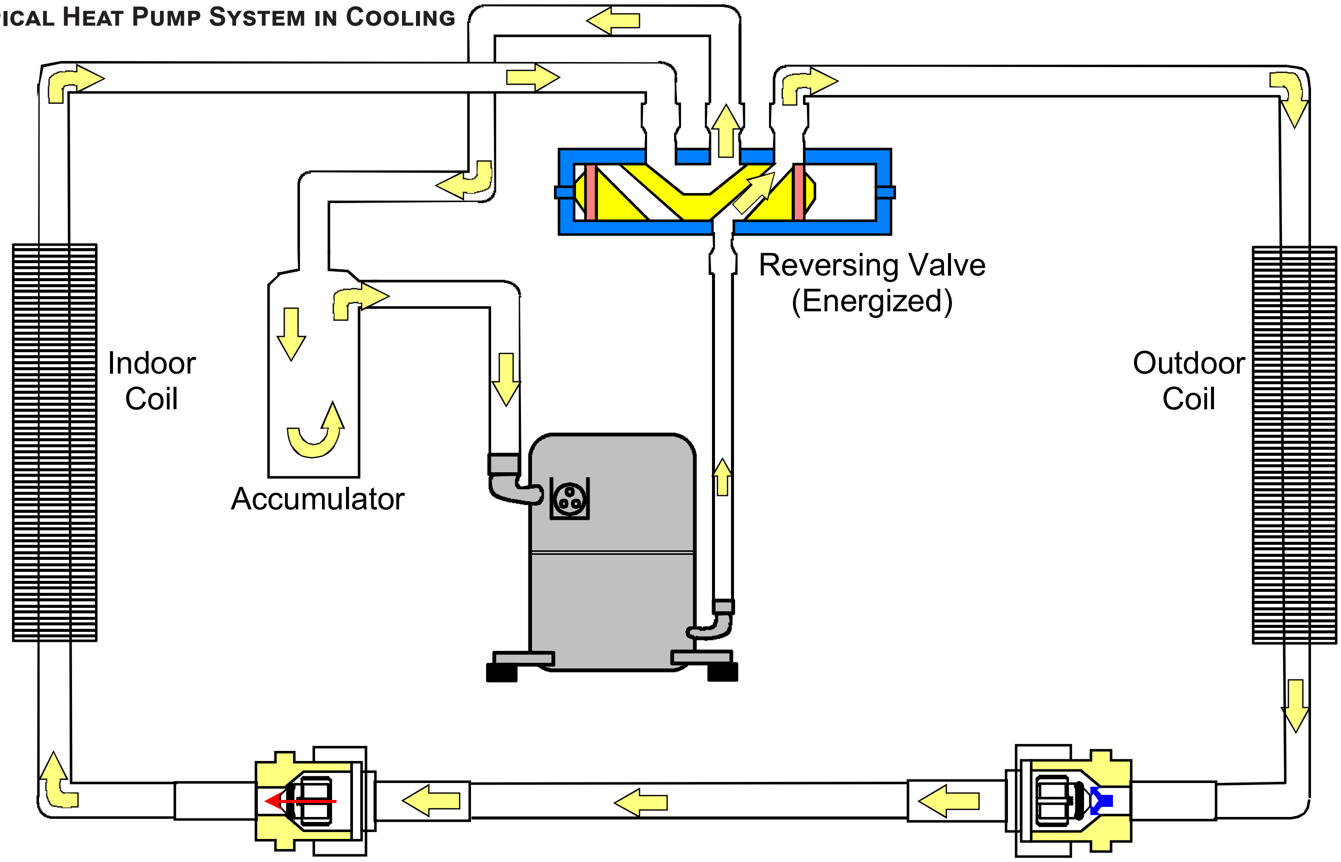
If the thermostat calls for continuous fan, the indoor blower will be energized from the G terminal of the thermostat to the EEM blower motor.

If a call for heat or cool occurs during a continuous fan call, the EEM motor will always recognize the call for the highest speed and ignore the lower speed call.

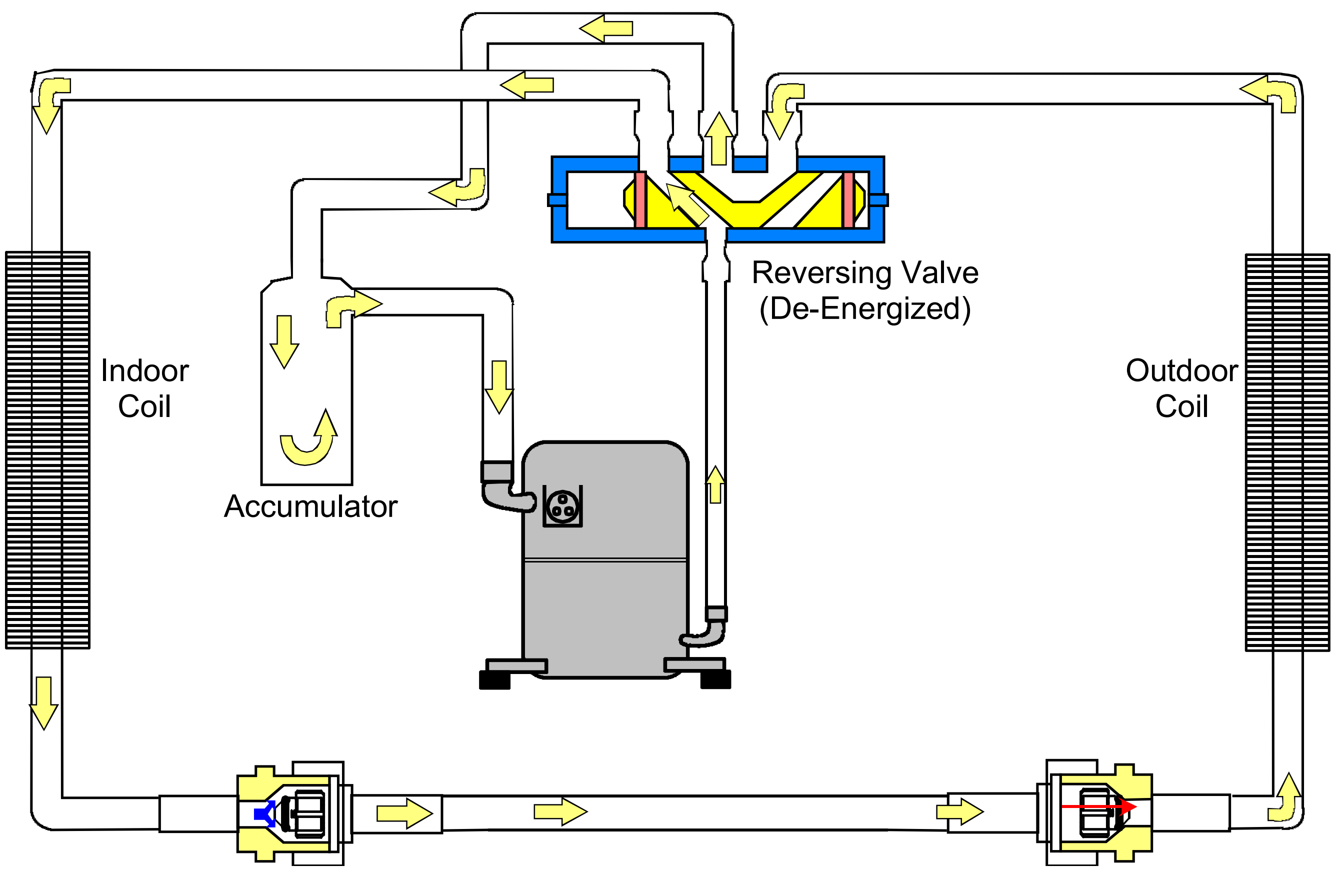
If the thermostat is not calling for heat or cool, and the fan switch on the thermostat is returned to the automatic position, the fan will stop after the programmed 60 second off delay on units with the EEM motor.

SYSTEM OPERATION

Typical Heat Pump System in Cooling



Typical Heat Pump System in Heating



SCHEDULED MAINTENANCE

Package gas units require regularly scheduled maintenance to preserve high performance standards, prolong the service life of the equipment, and lessen the chances of costly failure.

In many instances the owner may be able to perform some of the maintenance; however, the advantage of a service contract, which places all maintenance in the hands of a trained serviceman, should be pointed out to the owner.

WARNING
HIGH VOLTAGE! **DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.**

ONCE A MONTH

1. Inspect the return filters of the evaporator unit and clean or change if necessary. **NOTE:** Depending on operation conditions, it may be necessary to clean or replace the filters more often. If permanent type filters are used, they should be washed with warm water and dried.
2. When operating on the cooling cycle, inspect the condensate line piping from the evaporator coil. Make sure the piping is clear for proper condensate flow.

ONCE A YEAR

QUALIFIED SERVICE PERSONNEL ONLY

1. Clean the indoor and outdoor coils.
2. Clean the cabinet inside and out.
3. Motors are permanently lubricated and do not require oiling. TO AVOID PREMATURE MOTOR FAILURE, DO NOT OIL.
4. Manually rotate the outdoor fan and indoor blower to be sure they run freely.
5. Inspect the control panel wiring, compressor connections, and all other component wiring to be sure all connections are tight. Inspect wire insulation to be certain that it is good.
6. Check the contacts of the compressor contactor. If they are burned or pitted, replace the contactor.
7. Using a halide or electronic leak detector, check all piping and etc. for refrigerant leaks.

TEST EQUIPMENT

Proper test equipment for accurate diagnosis is as essential as regular hand tools.

The following is a must for every service technician and service shop:

1. Thermocouple type temperature meter - measure dry bulb temperature.
2. Sling psychrometer - measure relative humidity and wet bulb temperature.
3. Volt-Ohm Meter - testing continuity, capacitors, motor windings and voltage.
4. Accurate Leak Detector - testing for refrigerant leaks.
5. High Vacuum Pump - evacuation.
6. Electric Vacuum Gauge, Manifold Gauges and high vacuum hoses - to measure and obtain proper vacuum.
7. Accurate Charging Cylinder or Electronic Scale - measure proper refrigerant charge.
8. Inclined Manometer - measure static pressure and pressure drop across coils.

Other recording type instruments can be essential in solving abnormal problems, however, in many instances they may be rented from local sources.

Proper equipment promotes faster, more efficient service, and accurate repairs with less call backs.

SERVICING

Checking Voltage

WARNING

High Voltage!
Disconnect all power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.

Unit Voltage		
Rated Voltage	**Min. Supply Voltage**	**Max. Supply Voltage**
208/230V	197	253

1. Remove doors, control panel cover, etc. from unit being tested.

With power ON:

WARNING

Line voltage now present.

2. Using a voltmeter, measure the voltage across terminals L1 and L2 of the contactor.
3. No reading - indicates open wiring, open fuse(s) no power or etc. from unit to fused disconnect service. Repair as needed.
4. If incoming voltage is within the range listed in the chart below, energize the unit.
5. Using a voltmeter, measure the voltage with the unit starting and operating to determine if voltage is within the range listed in the chart below.
6. If the voltage falls below the minimum voltage, check the line wire size. Long runs of undersized wire can cause low voltage. If the wire size is adequate, notify the local power company regarding either low or high voltage.

Checking Wiring

WARNING

High Voltage!
Disconnect all power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.

1. Check wiring visually for signs of overheating, damaged insulation and loose connections.
2. Use an ohmmeter to check continuity of any suspected open wires.
3. If any wires must be replaced, replace with comparable gauge and insulation thickness.

Checking Thermostat and Wiring

Branch Circuit Ampacity	15	20	25	30	35	40	45	50
SUPPLY WIRE LENGTH - FEET								
200	6	4	4	4	3	3	2	2
150	8	6	6	4	4	4	3	3
100	10	8	8	6	6	6	4	4
50	14	12	10	10	8	8	6	6

Wiring Table

Thermostat Wiring: The maximum wire length for 18 AWG thermostat wire is 100 feet.

GPCM3 Thermostat Wiring	
Terminal	**Thermostat**
Red	R (24V)
Green	G (fan)
Yellow	Y (Cool)
White	W1 (Heat, Aux Heat Stage 1)*
Brown	W2 (Heat, Aux Heat Stage 2)*
Blue	C (Common)
*Optional field installed heat connections	

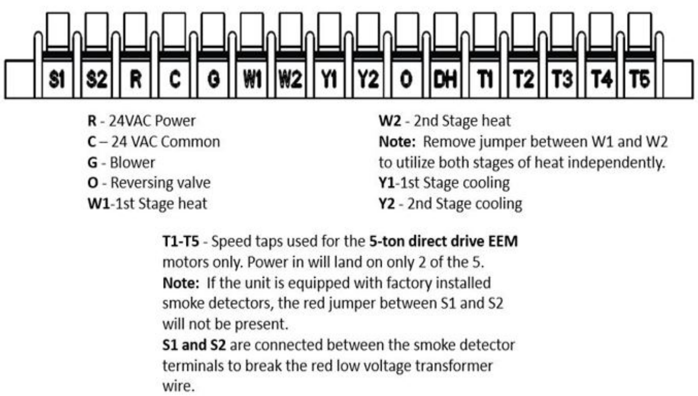
*PHM3 Thermostat Wiring	
Terminal	**Thermostat**
Red	R (24V)
Green	G (fan)
Orange	O (Rev. Valve)
White	W1 (Heat, Aux Heat Stage 1)*
Brown	W2 (Heat, Aux Heat Stage 2)*
Yellow	Y (Compressor)
Blue	C (24V Common)
*Optional field installed heat connections	
Thermostats must be set to energize “G” during cooling. This is default on most thermostats.	

SERVICING

*PHM5[24-48]41 Thermostat Wiring	
Terminal	**Thermostat**
Red	R (24V)
Green	G (fan)
Orange	O (Rev. Valve)
White	W1 (Heat, Aux Heat Stage 1)*
Brown	W2 (Heat, Aux Heat Stage 2)*
Purple	Y1 (Compressor Stage 1)
Yellow	Y2 (Compressor Stage 2)
Blue	C (24V Common)
*Optional field installed heat connections	
Thermostats must be set to energize "G" during cooling. This is default on most thermostats.	

NOTE: &PHM5[60]41 models have a low voltage terminal block for thermostat connections.

***PHM5[60]41 Low Voltage Terminal Block Wiring**



WARNING

LINE VOLTAGE NOW PRESENT.

With power ON, thermostat calling for cooling:

1. Use a voltmeter to verify 24 volts present at thermostat wires C and R.
2. If no voltage present, check transformer and transformer wiring. If 24 volts present, proceed to step 3.
3. Use a voltmeter to check for 24 volts at thermostat wires C and Y.
4. No voltage indicates trouble in the thermostat, wiring or external transformer source.
5. Check the continuity of the thermostat and wiring. Repair or replace as necessary.

Indoor Blower Motor

With power ON:

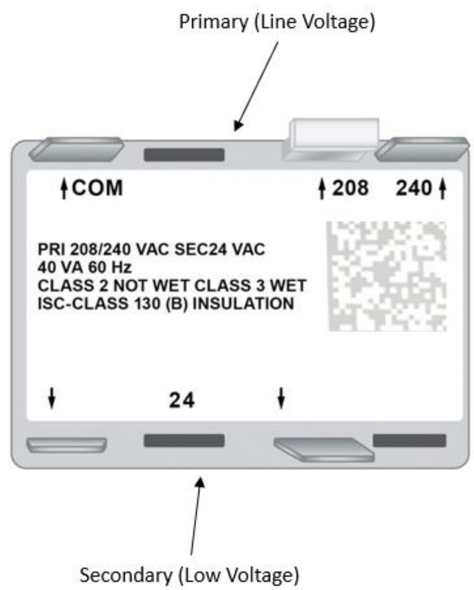
WARNING

LINE VOLTAGE NOW PRESENT.

1. Use a voltmeter to verify 24 volts present at thermostat wires C and R.
2. If no voltage present, check transformer and transformer wiring. If 24 volts present, proceed to step 3.
3. Set fan selector switch at thermostat to "ON" position.
4. With voltmeter, check for 24 volts at wires C and G.
5. No voltage, indicates the trouble is in the thermostat or wiring.
6. Check the continuity of the thermostat and wiring. Repair or replace as necessary.

Checking Transformer and Control Circuit

A step-down transformer (208/240 volt primary to 24 volt secondary) is provided with each package unit. This allows ample capacity for use with resistance heaters.



WARNING

HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

1. Remove control panel cover, or etc., to gain access to transformer.

With power ON:

SERVICING

⚠ WARNING

Line voltage now present.

2. Using a voltmeter, check voltage across secondary voltage side of transformer (R to C).
3. No voltage indicates faulty transformer, bad wiring, or bad splices.
4. Check transformer primary voltage at incoming line voltage connections and/or splices.
5. If line voltage is present at the primary voltage side of the transformer and 24 volts is not present on the secondary side, then the transformer is inoperative. Replace.

Checking Contactor and/or Relays

The compressor contactor and other relay holding coils are wired into the low or line voltage circuits. When the control circuit is energized, the coil pulls in the normally open contacts or opens the normally closed contacts. When the coil is de-energized, springs return the contacts to their normal position.

⚠ WARNING

High Voltage!
Disconnect all power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.

1. Remove the leads from the holding coil.
2. Using an ohmmeter, test across the coil terminals.

If the coil does not test continuous, replace the relay or contactor.

Checking Contactor Contacts

⚠ WARNING

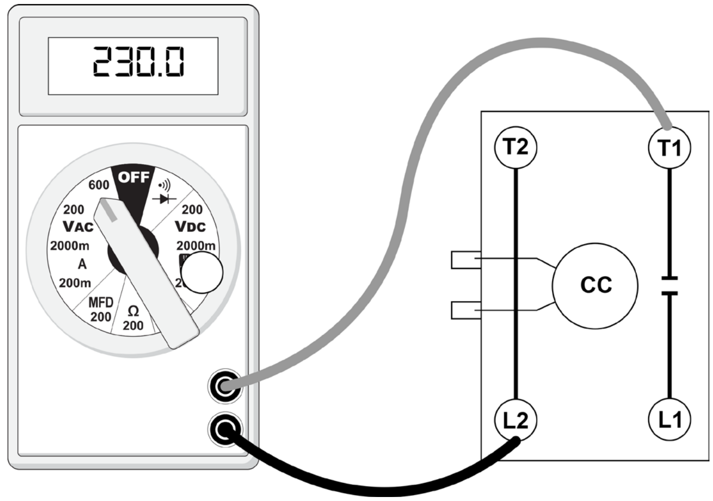
High Voltage!
Disconnect all power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.

Single Phase

1. Disconnect the wire leads from the terminal (T) side of the contactor.
2. With power ON, energize the contactor.

⚠ WARNING

Line voltage now present.



Testing Compressor Contactor (Single Phase)

3. Using a voltmeter, test across terminals.
   A. L1 - L2 - No voltage. Check breaker or fuses on main power supply. If voltage present, proceed to step B.
   B. T1 to T2 - Meter should read the same as L1 to L2 in step A. If voltage readings are not the same as step A, replace contactor.

Checking Low Pressure Control

(Heat Pump Models)

The low pressure control senses the pressure in the suction line and will open its contacts on a drop in pressure. The low pressure control will automatically reset itself with a rise in pressure.

The low pressure control is designed to cut-out (open) at approximately 22 PSIG. It will automatically cut-in (close) at approximately 50 PSIG.

Test for continuity using a VOM and if not as above, replace the control.

Checking High Pressure Control

⚠ WARNING

High Voltage!
Disconnect all power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.

The high pressure control capillary senses the pressure in the liquid or discharge line. If abnormally high condensing pressures develop, the contacts of the control open, breaking the control circuit before the compressor motor overloads. This control is automatically reset.

1. Using an ohmmeter, check across terminals of high pressure control, with wire removed. If not continuous, the contacts are open.
2. Attach a gauge to the dill valve port on the base valve.

With power ON:

> **WARNING**
>
> **LINE VOLTAGE NOW PRESENT.**

3. Start the system and place a piece of cardboard in front of the condenser coil, raising the condensing pressure.
4. Check pressure at which the high pressure control cuts-out.

If it cuts-out at 660 PSIG ± 10 PSIG, it is operating normally (See causes for high head pressure in Service Problem Analysis Guide). If it cuts out below this pressure range, replace the control. The control should reset at 420 PSIG ± 25 PSIG.

Checking Internal Overload

The Internal Overload prevents the compressor windings from overheating. Reacts to both current and temperature Cuts out **302°F**. Cuts in between **146** and **176°F**

1. Using an ohmmeter, test continuity between terminals, If either winding test continuous, Internal overload open.
2. Allow time for the compressor to cool, and overload to close and retest.

Checking Capacitor

Capacitor, Run

A run capacitor is wired across the auxiliary and main windings of a single phase permanent split capacitor motor. The capacitors primary function is to reduce the line current while greatly improving the torque characteristics of a motor. This is accomplished by using the 90° phase relationship between the capacitor current and voltage in conjunction with the motor windings so that the motor will give two phase operation when connected to a single phase circuit. The capacitor also reduces the line current to the motor by improving the power factor.

Capacitor, Start

Scroll Compressor Models

Hard start components are not required on Scroll compressor equipped units due to a non-replaceable check valve located in the discharge line of the compressor. However hard start kits are available and may improve low voltage starting characteristics.

This check valve closes off high side pressure to the compressor after shut down allowing equalization through the scroll flanks. Equalization requires only about one or two seconds during which time the compressor may turn backwards.

Your unit comes with a 180-second anti-short cycle to prevent the compressor from starting and running backwards.

Models Equipped With A Hard Start Device

A start capacitor is wired in parallel with the run capacitor to increase the starting torque. The start capacitor is of the electrolytic type, rather than metallized polypropylene as used in the run capacitor.

A switching device must be wired in series with the capacitor to remove it from the electrical circuit after the compressor starts to run. Not removing the start capacitor will overheat the capacitor and burn out the compressor windings.

These capacitors have a 15,000 ohm, 2 watt resistor wired across its terminals. The object of the resistor is to discharge the capacitor under certain operating conditions, rather than having it discharge across the closing of the contacts within the switching device such as the Start Relay, and to reduce the chance of shock to the servicer. See the Servicing Section for specific information concerning capacitors.

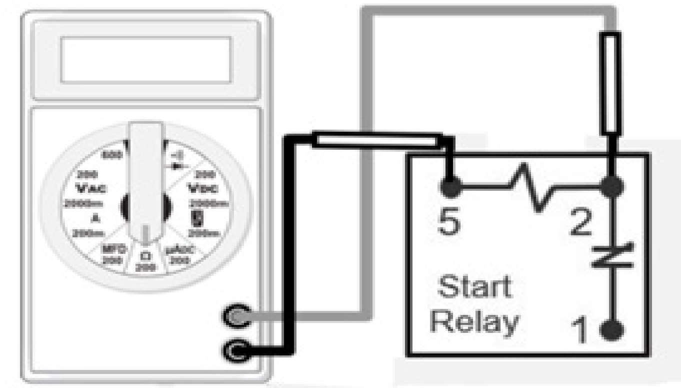
Relay, Start

A potential or voltage type relay is used to take the start capacitor out of the circuit once the motor comes up to speed. This type of relay is position sensitive. The normally closed contacts are wired in series with the start capacitor and the relay holding coil is wired parallel with the start winding. As the motor starts and comes up to speed, the increase in voltage across the start winding will energize the start relay holding coil and open the contacts to the start capacitor.

Testing Start Relay Kits
Testing Coil Relay

1. Disconnect power to unit
2. Disconnect all wiring
3. Measure the resistance of the coil between terminals 2 & 5
4. If the coil reads open or shorted, replace the relay

SERVICING



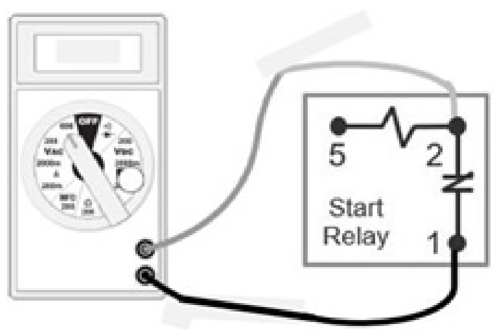
Testing Start Relay Coil Resistance

Testing Contacts Resistance

1. Disconnect power to unit
2. Disconnect all wiring to the start relay
3. Measure the resistance of the contacts between terminals 1 & 2
4. If the contacts read open, replace the relay

Testing Contacts Voltage

1. With power on, provide a call for cool to energize the compressor
2. With the compressor running, use a voltmeter to measure the voltage between terminals 1 & 2
3. voltage reading of zero indicates that the relay's contacts are stuck, replace the relay



Testing Start Relay Contacts

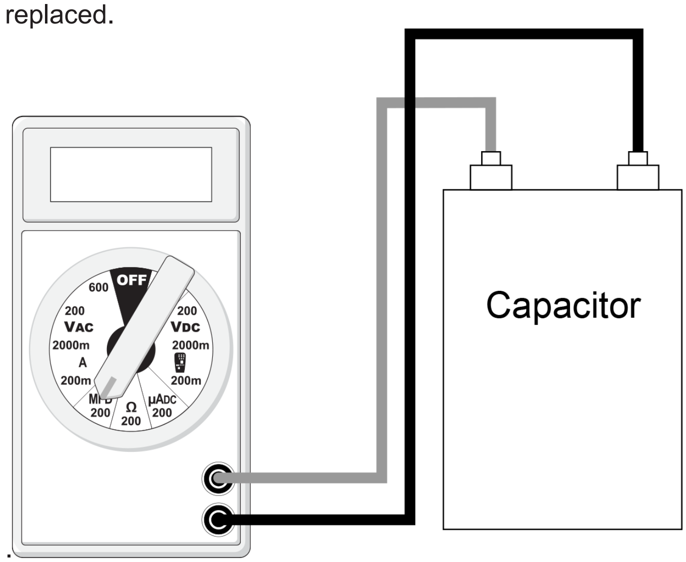
Two quick ways to test a capacitor are a resistance and a capacitance check.

Capacitance Check (MFD)

> **WARNING**
>
> **Discharge capacitor through a 20 to 30 OHM resistor before handling.**

1. Turn Power off to Unit
2. Discharge capacitor through a 20Ω - 30Ω resistor
3. Remove wires from capacitor
4. Use multi-meter check micro-farads (MFD) of the capacitor.
5. Place leads from C – HERM
6. Place leads from C – FAN
7. Compare to capacitor rating label.

If the reading is within the tolerance listed on rating label the capacitor is good.
If the reading is lower, the capacitor is bad and must be replaced.



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Testing Capacitance

Checking Fan And Blower Motor Windings (PSC Motors)

The auto reset fan motor overload is designed to protect the motor against high temperature and high amperage conditions by breaking the common circuit within the motor, similar to the compressor internal overload. However, heat generated within the motor is faster to dissipate than the compressor, allow at least 45 minutes for the overload to reset, then retest.

> **WARNING**
>
> **High Voltage!**
> **Disconnect all power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.**

1. Remove the motor leads from its respective connection points and capacitor (if applicable).
2. Check the continuity between each of the motor leads.
3. Touch one probe of the ohmmeter to the motor frame (ground) and the other probe in turn to each lead.

If the windings do not test continuous or a reading is obtained from lead to ground, replace the motor.

SERVICING

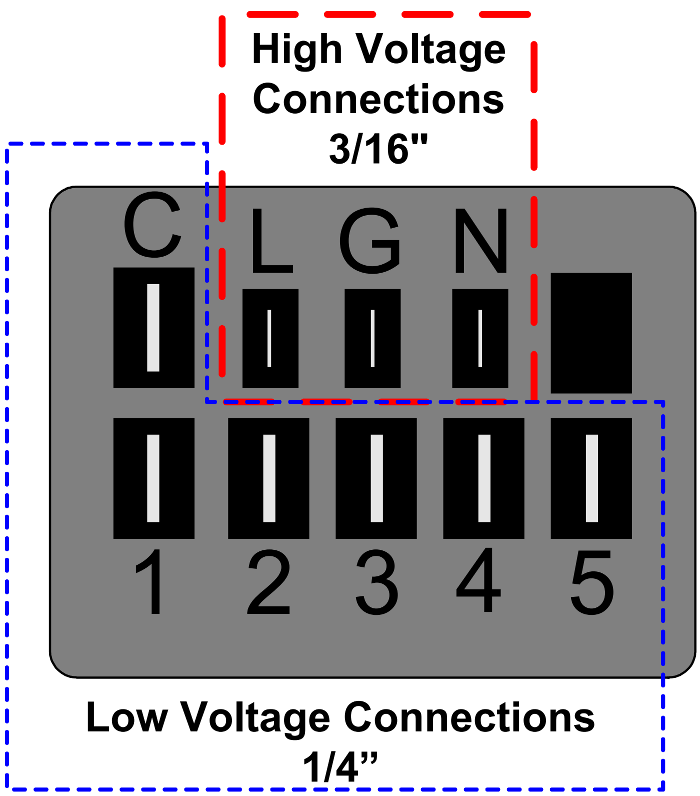
Checking EEM Motors

The EEM Motor is a one piece, fully encapsulated, 3 phase brushless DC (single phase AC input) motor with ball bearing construction. The EEM features an integral control module.

NOTE: The GE TECMate will not operate the currently used EEM motor.

1. Using a voltmeter, check for 230 volts to the motor connections L and N. If 230 volts is present, proceed to step 2. If 230 volts is not present, check the line voltage circuit to the motor.
2. Using a voltmeter, check for 24 volts from terminal C to either terminal 1, 2, 3, 4 or 5, depending on which tap is being used, at the motor. If voltage is present, proceed to step 3. If no voltage, check 24 volt circuit to motor.
3. If voltage was present in steps 1 and 2, the motor has failed and will need to be replaced.

NOTE: When replacing motor, ensure the belly band is between the vents on the motor and the wiring has the proper drip loop to prevent condensate from entering the motor.



EEM Motor Connections

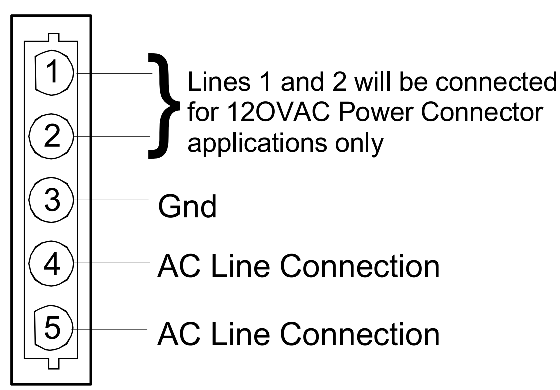
Checking ECM Motors

An ECM is an *Electronically Commutated Motor* which offers many significant advantages over PSC motors. The ECM has near zero rotor loss, synchronous machine operation, variable speed, low noise, and programmable air flow. Because of the sophisticated electronics within the ECM motor, some technicians are intimated by the ECM motor; however, these fears are unfounded. GE/ Regal Beloit offers two ECM motor testers, and with a VOM meter, one can easily perform basic troubleshooting on ECM motors. An ECM motor requires power (line voltage) and a signal (24 volts) to operate. The ECM motor stator contains permanent magnet. As a result, the shaft feels “rough” when turned by hand. This is a characteristic of the motor, not an indication of defective bearings.

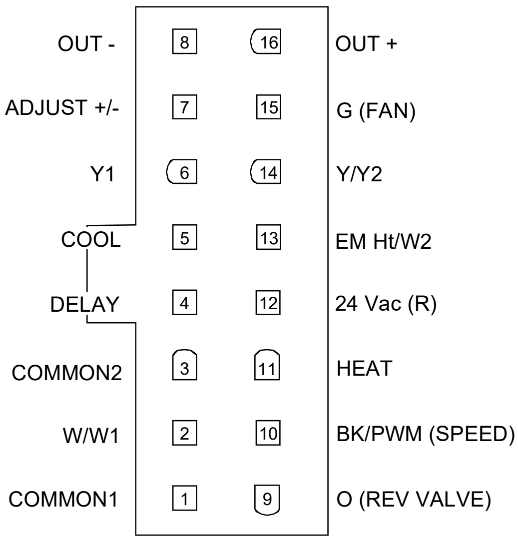
WARNING

Line voltage now present.

1. Disconnect the 5-pin connector from the motor.
2. Using a volt meter, check for line voltage at terminals #4 & #5 at the power connector. If no voltage is present:
3. Check the unit for incoming power.
4. Check the control board.
5. If line voltage is present, reinsert the 5-pin connector and remove the 16-pin connector.
6. Check for signal (24 volts) at the transformer.
7. Check for signal (24 volts) from the thermostat to the “G” terminal at the 16-pin connector.
8. Using an ohmmeter, check for continuity from the #1 & #3 (common pins) to the transformer neutral or “C” thermostat terminal. If you do not have continuity, the motor may function erratically. Trace the common circuits, locate and repair the open neutral.
9. Set the thermostat to “Fan-On”. Using a voltmeter, check for 24 volts between pin # 15 (G) and common.
10. Disconnect power to compressor. Set thermostat to call for cooling. Using a voltmeter, check for 24 volts at pin # 6 and or #14.
11. Set the thermostat to a call for heating. Using a voltmeter, check for 24 volts at pin #2 and/or #11.



SERVICING



16-PIN ECM HARNESS CONNECTOR

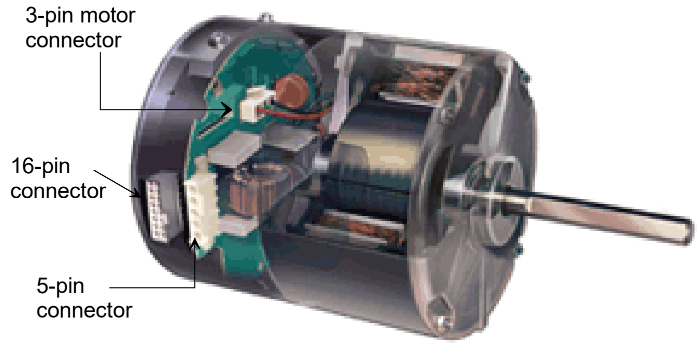
If you do not read voltage and continuity as described, the problem is in the control or interface board, but not the motor. If you register voltage as described, the ECM power head is defective and must be replaced.

Checking ECM Motor Windings

WARNING

High Voltage!
Disconnect all power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.

1. Disconnect the 5-pin and the 16-pin connectors from the ECM power head.
2. Remove the 2 screws securing the ECM power head and separate it from the motor.
3. Disconnect the 3-pin motor connector from the power head and lay it aside.
4. Using an ohmmeter, check the motor windings for continuity to ground (pins to motor shell). If the ohmmeter indicates continuity to ground, the motor is defective and must be replaced.
5. Using an ohmmeter, check the windings for continuity (pin to pin). If no continuity is indicated, the thermal limit (over load) device may be open. Allow motor to cool and retest.



Checking Compressor

WARNING

Hermetic compressor electrical terminal venting can be dangerous. When insulating material which supports a hermetic compressor or electrical terminal suddenly disintegrates due to physical abuse or as a result of an electrical short between the terminal and the compressor housing, the terminal may be expelled, venting the vapor and liquid contents of the compressor housing and system.

If the compressor terminal PROTECTIVE COVER and gasket (if required) are not properly in place and secured, there is a remote possibility if a terminal vents, that the vaporous and liquid discharge can be ignited, spouting flames several feet, causing potentially severe or fatal injury to anyone in its path.

This discharge can be ignited external to the compressor if the terminal cover is not properly in place and if the discharge impinges on a sufficient heat source.

Ignition of the discharge can also occur at the venting terminal or inside the compressor, if there is sufficient contaminant air present in the system and an electrical arc occurs as the terminal vents.

Ignition cannot occur at the venting terminal without the presence of contaminant air, and cannot occur externally from the venting terminal without the presence of an external ignition source.

Therefore, proper evacuation of a hermetic system is essential at the time of manufacture and during servicing. To reduce the possibility of external ignition, all open flame, electrical power, and other heat sources should be extinguished or turned off prior to servicing a system.

If the following test indicates shorted, grounded or open windings, see procedure for the next steps to be taken.

Resistance Test

Each compressor is equipped with an internal overload.

The line break internal overload senses both motor amperage and winding temperature. High motor temperature or amperage heats the disc causing it to open, breaking the common circuit within the compressor on single phase units.

Heat generated within the compressor shell, usually due to recycling of the motor, high amperage or insufficient gas to cool the motor, is slow to dissipate. Allow at least three to four hours for it to cool and reset, then retest.

WARNING

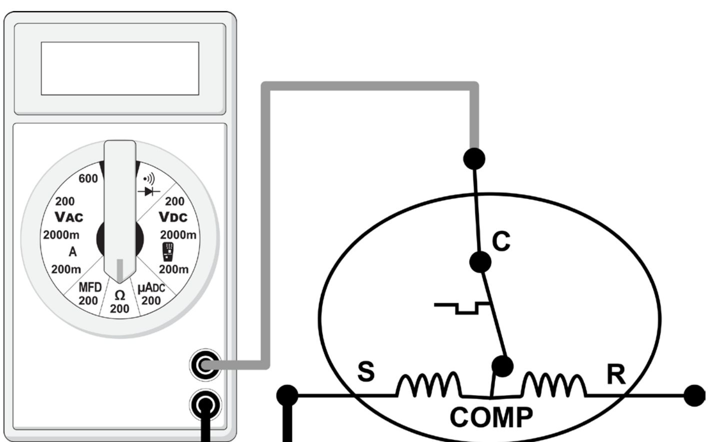
HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

1. Remove the leads from the compressor terminals.

WARNING

SEE WARNINGS BEFORE REMOVING COMPRESSOR TERMINAL COVER.

2. Using an ohmmeter, test continuity between terminals S-R, C-R, and C-S.



TESTING COMPRESSOR WINDINGS

If either winding does not test continuous, replace the compressor.

NOTE: If an open compressor is indicated, allow ample time for the internal overload to reset before replacing compressor.

GROUND TEST

If fuse, circuit breaker, ground fault protective device, etc. has tripped, this is a strong indication that an electrical problem exists and must be found and corrected. The circuit protective device rating must be checked and its maximum rating should coincide with that marked on the equipment nameplate.

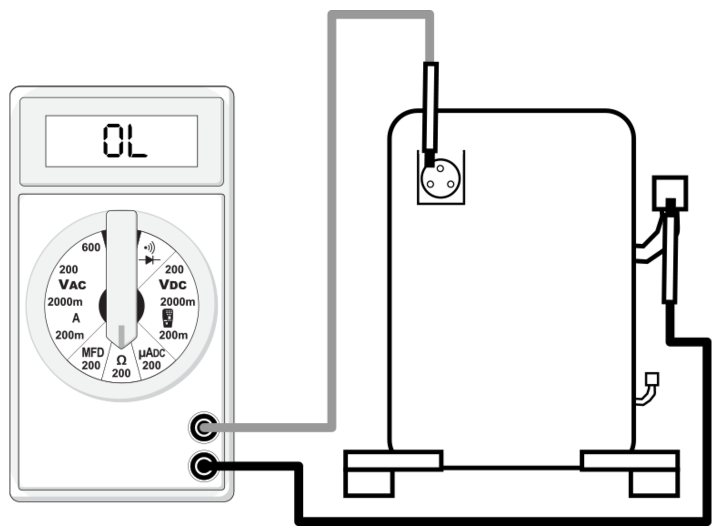
With the terminal protective cover in place, it is acceptable to replace the fuse or reset the circuit breaker **ONE TIME ONLY** to see if it was just a nuisance opening. If it opens again, **DO NOT** continue to reset.

Disconnect all power to unit, making sure that all power legs are open.

1. Carefully remove the compressor terminal protective cover and inspect for loose leads or insulation breaks in the lead wires.
2. Disconnect the three leads going to the compressor terminals at the compressor or nearest point to the compressor.
3. Check for a ground separately between each of the three terminals and ground (such as an unpainted tube on the compressor). If there is any reading of continuity to ground on the meter, the compressor should be considered defective.
4. If ground is indicated, replace the compressor.

WARNING

DAMAGE CAN OCCUR TO THE GLASS EMBEDDED TERMINALS IF THE LEADS ARE NOT PROPERLY REMOVED. THIS CAN RESULT IN TERMINAL AND HOT OIL DISCHARGING.



COMPRESSOR GROUND TEST

UNLOADER TEST PROCEDURE (2 STAGE COMPRESSORS ONLY)

A nominal 24-volt direct current coil activates the compressor internal unloader solenoid. The input control circuit voltage must be 18 to 28 volt ac. (remove) The coil power requirement is 5 VA. The external electrical connection is made with a molded plug assembly. This plug contains a full wave rectifier to supply direct current to the unloader coil. The measured DC voltage at the connectors in the plug should be 15 to 27 volt dc.

SERVICING

Unloader Test Procedure

If it is suspected that the unloader is not working, the following methods may be used to verify operation.

1. Operate the system and measure compressor amperage. Cycle the unloader ON and OFF at 10 second intervals. The compressor amperage should increase when switching from part-load to full-load and decrease when switching from full-load to part-load. The percent change depends on the operating conditions and voltage, but should be at least 25 percent.
2. If step one does not give the expected results, shut unit off. Apply 18 to 28 volt ac to the unloader molded plug leads and listen for a click as the solenoid pulls in. Remove power and listen for another click as the unloader returns to its original position.
3. If clicks can't be heard, shut off power to the unit and remove the control circuit molded plug from the compressor and measure the unloader coil resistance (connections on the compressor). The solenoid coil should have continuity and not be grounded or have infinite resistance. If the coil resistance is infinite, zero, or grounded, the compressor must be replaced.
4. Next check the molded plug.
   A. Voltage check: Apply control voltage to the plug wires (18 to 28 volt ac). The measured dc voltage at the female connectors in the plug should be around 15 to 27 vdc.
   B. Resistance check: Measure the resistance from the end of one molded plug lead to either of the two female connectors in the plug. One of the connectors should read close to zero ohms while the other should read infinity. Repeat with other wire. The same female connector as before should read zero while the other connector again reads infinity. Reverse polarity on the ohmmeter leads and repeat. The female connector that read infinity previously should now read close to zero ohms.
   C. Replace plug if either of these test methods doesn't show the desired results.

Operation Test

If the voltage, capacitor, overload and motor winding test fail to show the cause for failure:

> **WARNING**
>
> **High Voltage!**
> **Disconnect all power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.**

1. Remove unit wiring from disconnect switch and wire a test cord to the disconnect switch.

NOTE: The wire size of the test cord must equal the line wire size and the fuse must be of the proper size and type.

2. With the protective terminal cover in place, use the three leads to the compressor terminals that were disconnected at the nearest point to the compressor and connect the common, start and run clips to the respective leads.
3. Connect good capacitors of the right MFD and voltage rating into the circuit as shown.
4. With power ON, close the switch.

> **WARNING**
>
> **Line voltage now present.**

A. If the compressor starts and continues to run, the cause for failure is somewhere else in the system.
B. If the compressor fails to start - replace.

Locked Rotor Test

If fuse, circuit breaker, ground fault protective device, etc. has tripped, this is a strong indication that an electrical problem exists and must be found and corrected. The circuit protective device rating must be checked and its maximum rating should coincide with that marked on the equipment nameplate.

Before checking for locked rotor, the compressor terminals should be checked for open windings (see Resistance Test) and the run capacitor and start capacitor (if used) should be checked thoroughly (see Checking Capacitor).

With power ON:

> **WARNING**
>
> **Line voltage now present.**

1. Check the serial data plate for the compressor locked rotor amps (LRA) rating.
2. Using an ampmeter, measure the amperage reading for the run and common wires to the compressor. Since the compressor motor overload will likely trip soon after drawing locked rotor amps, this measurement should be taken as soon as the compressor starts.
3. If the amperage reading roughly equals the compressor LRA rating and all other checks have been completed, locked rotor amps has been verified.

SERVICING

Testing crankcase heater

NOTE: Not all compressors use crankcase heaters.

The crankcase heater must be energized a minimum of four (4) hours before the condensing unit is operated.

Crankcase heaters are used to prevent migration or accumulation of refrigerant in the compressor crankcase during the off cycles and prevents liquid slugging or oil pumping on start up.

A crankcase heater will not prevent compressor damage due to a floodback or over charge condition.

⚠ WARNING

Disconnect ALL power before servicing.

1. Disconnect the heater lead in wires.
2. Using an ohmmeter, check heater continuity - should test continuous. If not, replace.

Checking Crankcase Heater Thermostat

NOTE: Not all models with crankcase heaters will have a crankcase heater thermostat.

1. Install a thermocouple type temperature test lead on the discharge line adjacent to the crankcase heater thermostat.
2. Check the temperature at which the control closes its contacts by lowering the temperature of the control. The crankcase heater thermostat should close at 67°F ± 5°F.
3. Check the temperature at which the control opens its contacts by raising the temperature of the control. The crankcase heater thermostat should open at 85°F ± 5°F.
4. If not as above, replace control.

Checking Reversing Valve And Solenoid

Reversing valve used in heat pumps could potentially leak internally. Discharge gases can leak into the suction inside the valve. Compound gages will give the same symptoms as bad compressor valves or broken scroll flanks. The temperature between true suction and the suction line after the valve should not be greater than 4 degrees. Note: The center tube is always the suction line and should be cold.

Troubleshooting the Reversing Valve for Electrical Failure

1. Place unit into the cooling mode. Test for 24 volts at the solenoid. If there is no voltage present at coil, check the control voltage.
2. If voltage is present, loosen the nut on the top of the coil. Remove the coil, there should be slight resistance.
3. If the slight resistance is felt, remove the coil. As you remove the coil listen carefully, an audible click should be detected. The clicking is due to the movement of the pilot valve plunger. The absence of a clicking sound indicates the plunger is stuck.

Troubleshooting Mechanical Failures on a Reversing Valve by Pressure

1. Troubleshooting the reversing valve can be done by pressure and touch.
2. Raise the head pressure. In the cooling mode block the fan exhaust. Once head pressure has been raised, cycle between cooling and heating and see if the piston can be freed.

Troubleshooting Mechanical Failures on a Reversing Valve byTemperature

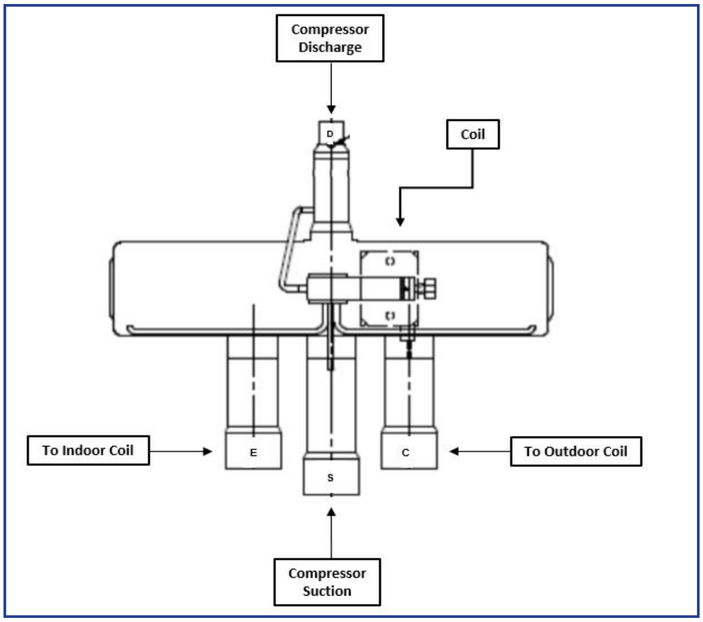
1. When operating properly the valve contains refrigerant gases at certain temperatures.
2. The discharge line should be the same temperature after the valves discharge line.
3. The true suction should be the same as the suction line after the valve. If there is a 4-degree difference, valve is leaking

When stuck in the mid-position, part of the discharge gas from the compressor is directed back to the suction side, resulting in excessively high suction pressure. An increase in the suction line temperature through the reversing valve can also be measured. Check operation of the valve by starting the system and switching the operation from COOLING to HEATING cycle.

If the valve fails to change its position, test the voltage (24V) at the valve coil terminals, while the system is on the COOLING cycle.

If voltage is registered at the coil, tap the valve body lightly while switching the system from HEATING to COOLING, etc. If this fails to cause the valve to switch positions, remove the coil connector cap and test the continuity of the reversing valve solenoid coil. If the coil does not test continuous - replace it. If the coil test continuous and 24 volts is present at the coil terminals, the valve is inoperative - replace it.

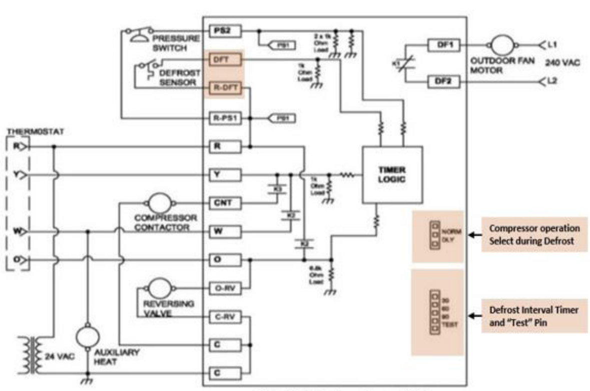
SERVICING



Testing Defrost Control

NOTE: PCBDM133 defrost control has a three (3) minute compressor off cycle delay.

NOTE: The PCBDM133 defrost control is shipped from the factory with the compressor delay option selected. This will de-energize the compressor contactor for 30 seconds on defrost initiation and defrost termination. If the jumper is set to Normal, the compressor will continue to run during defrost initiation and defrost termination. The control will also ignore the low pressure switch connected to R-PS1 and PS2 for 5 minutes upon defrost initiation and 5 minutes after defrost termination.



PCBDM133 Defrost Control PCB

To check the defrost control for proper sequencing, proceed as follows: With power ON; unit not running.

1. Jumper defrost thermostat by placing a jumper wire across the terminals "DFT" and "R"/" R-DFT" at defrost control board.
2. Remove jumper from timer pins and jump across test pins on defrost control board. **NOTE: Do not use screwdriver or field supplied jumper to test the control.**
3. Set thermostat to call for heating. System should go into defrost within 21 seconds.
4. Immediately remove jumper from test pins.
5. Using VOM check for voltage across terminals "C & O". Meter should read 24 volts.
6. Using VOM check for voltage across fan terminals DF1 and DF2 on the board. You should read line voltage (208-230 VAC) indicating the relay is open in the defrost mode.
7. Using VOM check for voltage across "W"/"W2" & "C" terminals on the board. You should read 24 volts.
8. If not as above, replace control board.
9. Set thermostat to off position and disconnect power. Remove jumper from defrost thermostat and replace timer jumper to the desired defrost time.

NOTE: Remove jumper across defrost thermostat before returning system to service.

Testing Defrost Thermostat

1. Install a thermocouple type temperature test lead on the tube adjacent to the defrost control. Insulate the lead point of contact.
2. Check the temperature at which the control closes its contacts by lowering the temperature of the control. The defrost control should close at approximately 30°F.
3. Check the temperature at which the control opens its contacts by raising the temperature of the control. The defrost control should open at approximately 60°F.
4. If not as above, replace control.

Checking Heater Limit Control(s)

(Optional Electric Heaters)

Each individual heater element is protected with an automatic rest limit control connected in series with each element to prevent overheating of components in case of low airflow. This limit control will open its circuit at approximately 150°F. to 160°F and close at approximately 110°F.

⚠ WARNING
Disconnect ALL power before servicing.

1. Remove the wiring from the control terminals.
2. Using an ohmmeter test for continuity across the normally closed contacts. No reading indicates the control is open - replace if necessary. Make sure the limits are cool before testing.

IF FOUND OPEN - REPLACE - DO NOT WIRE AROUND.

Checking Heater Elements

Optional electric heaters may be added, in the quantities shown in the spec sheet for each model unit, to provide electric resistance heating. Under no condition shall more heaters than the quantity shown be installed.

SERVICING

⚠ WARNING

HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

1. Disassemble and remove the heating element(s).
2. Visually inspect the heater assembly for any breaks in the wire or broken insulators.
3. Using an ohmmeter, test the element for continuity - no reading indicates the element is open. Replace as necessary.

REFRIGERATION REPAIR PRACTICE

⚠ DANGER

ALWAYS REMOVE THE REFRIGERANT CHARGE IN A PROPER MANNER BEFORE APPLYING HEAT TO THE SYSTEM.

These models use the FasTest Access Fitting System, with a saddle that is either soldered to the suction and liquid lines or is fastened with a locking nut to the access fitting box (core) and then screwed into the saddle. **Do not remove the core from the saddle until the refrigerant charge has been removed. Failure to do so could result in property damage or personal injury.**

When installing a new core or reinstalling the core after removal, it is very important to note that before inserting the core into the saddle, the core and saddle must be free of debris and the "O" Ring **must** have a thin coating of refrigerant oil applied to it. The oil is to prevent the "O" Ring from being deformed when the core is tightened completely. The core should be torqued to 8 ft. lb.

When repairing the refrigeration system:
1. Never open a system that is under vacuum. Air and moisture will be drawn in.
2. Plug or cap all openings.
3. Remove all burrs and clean the brazing surfaces of the tubing with sand cloth or paper. Brazing materials do not flow well on oxidized or oily surfaces.
4. Clean the inside of all new tubing to remove oils and pipe chips.
5. When brazing, sweep the tubing with dry nitrogen to prevent the formation of oxides on the inside surfaces.
6. Complete any repair by replacing the liquid line drier in the system, evacuate and charge.

At any time the system has been open for repair, the factory installed liquid line filter drier must be replaced.

BRAZING MATERIALS

Copper to Copper Joints - Sil-Fos used without flux (alloy of 15% silver, 80% copper, and 5% phosphorous). Recommended heat 1400°F.

Copper to Steel Joints - Silver Solder used without a flux (alloy of 30% silver, 38% copper, 32% zinc). Recommended heat - 1200°F.

STANDING PRESSURE TEST (RECOMMENDED BEFORE SYSTEM EVACUATION)

⚠ WARNING

TO AVOID THE RISK OF FIRE OR EXPLOSION, NEVER USE OXYGEN, HIGH PRESSURE AIR OR FLAMMABLE GASES FOR LEAK TESTING OF A REFRIGERATION SYSTEM.

⚠ WARNING

TO AVOID POSSIBLE EXPLOSION, THE LINE FROM THE NITROGEN CYLINDER MUST INCLUDE A PRESSURE REGULATOR AND A PRESSURE RELIEF VALVE. THE PRESSURE RELIEF VALVE MUST BE SET TO OPEN AT NO MORE THAN 450 PSIG.

Using dry nitrogen, pressurize the system to 450 PSIG. Allow the pressure to stabilize and hold for 15 minutes (minimum). If the pressure does not drop below 450 PSIG, the system is considered leak free. Proceed to system evacuation using the Deep Vacuum Method. If after 15 minutes the pressure drops below 450 PSIG, follow the procedure outlined below to identify system leaks. Repeat the Standing Pressure Test.

LEAK TESTING (NITROGEN OR NITROGEN-TRACED)

⚠ WARNING

TO AVOID THE RISK OF FIRE OR EXPLOSION, NEVER USE OXYGEN, HIGH PRESSURE AIR OR FLAMMABLE GASES FOR LEAK TESTING OF A REFRIGERATION SYSTEM.

⚠ WARNING

TO AVOID POSSIBLE EXPLOSION, THE LINE FROM THE NITROGEN CYLINDER MUST INCLUDE A PRESSURE REGULATOR AND A PRESSURE RELIEF VALVE. THE PRESSURE RELIEF VALVE MUST BE SET TO OPEN AT NO MORE THAN 450 PSIG.

Leak test the system using dry nitrogen and soapy water to identify leaks. If you prefer to use an electronic leak detector, charge the system to 10 PSIG with the appropriate system refrigerant (See Serial Data Plate for refrigerant identification). Using dry nitrogen, finish charging the system to 450 PSIG. Apply the leak detector to all suspect areas. When leaks are discovered, repair the leaks, and repeat the pressure test. If leaks have been eliminated proceed to system evacuation.

SERVICING

System Evacuation

Condensing unit liquid and suction valves are closed to contain the charge within the unit. The unit is shipped with the valve stems closed and caps installed. Do not open valves until the system is evacuated.

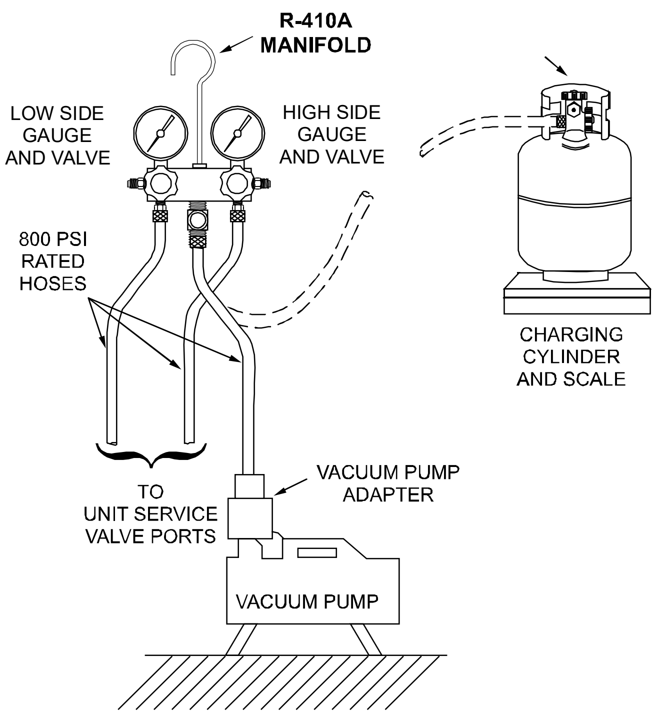
WARNING

REFRIGERANT UNDER PRESSURE!
FAILURE TO FOLLOW PROPER PROCEDURES MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

NOTE: Scroll compressors should never be used to evacuate or pump down a heat pump or air conditioning system.

CAUTION

PROLONGED OPERATION AT SUCTION PRESSURES LESS THAN 20 PSIG FOR MORE THAN 5 SECONDS WILL RESULT IN OVERHEATING OF THE SCROLLS AND PERMANENT DAMAGE TO THE SCROLL TIPS, DRIVE BEARINGS AND INTERNAL SEAL.



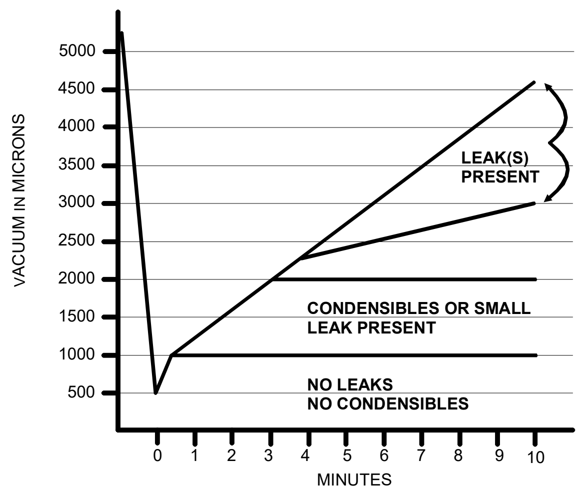
Evacuation

Deep Vacuum Method (Recommended)

The Deep Vacuum Method requires a vacuum pump rated for 500 microns or less. This method is an effective and efficient way of assuring the system is free of non-condensable air and moisture. As an alternative, the Triple Evacuation Method is detailed in the Service Manual for this product model.

It is recommended to remove the Schrader Cores from the service valves using a core-removal tool to expedite the evacuation procedure.

1. Connect the vacuum pump, micron gauge, and vacuum rated hoses to both service valves. Evacuation must use both service valves to eliminate system mechanical seals.
2. Evacuate the system to less than 500 microns.
3. Isolate the pump from the system and hold vacuum for 10 minutes (minimum). Typically, pressure will rise slowly during this period. If the pressure rises to less than 1000 microns and remains steady, the system is considered leak-free; proceed to system charging and startup.
4. If pressure rises above 1000 microns but holds steady below 2000 microns, non-condensable air or moisture may remain or small leak is present. Return to step 2: If the same result is achieved, check for leaks and repair. Repeat the evacuation procedure.
5. If pressure rises above 2000 microns, a leak is present. Check for leaks and repair. Repeat the evacuation procedure.



Triple Evacuation Method (Alternate)

1. Evacuate the system to 4000 microns and hold for 15 minutes. Break the vacuum with dry nitrogen, bring the system pressure to 2-3 PSIG, and hold for 20 minutes. Release the nitrogen,
2. Evacuate to 1500 microns and hold for 20 minutes. Break the vacuum with dry nitrogen again, bring the system pressure back to 2-3 PSIG, and hold for 20 minutes.
3. Evacuate the system to 500 microns and hold for 60 minutes.
4. If the pressure rises to 1000 microns or less and remains steady the system is considered leak free; proceed to start-up.

Charging

WARNING

REFRIGERANT UNDER PRESSURE!
- **DO NOT OVERCHARGE SYSTEM WITH REFRIGERANT.**
- **DO NOT OPERATE UNIT IN A VACUUM OR AT NEGATIVE PRESSURE.**

FAILURE TO FOLLOW PROPER PROCEDURES MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

SERVICING

⚠ CAUTION

Only use refrigerant certified to AHRI standards. Used refrigerant may cause compressor damage. Goodman is not responsible for damage or the need for repairs resulting from the use of unapproved refrigerant types or used or recycled refrigerant. Most portable machines cannot clean used refrigerant to meet AHRI standards.

Charge the system with the exact amount of refrigerant.

See unit nameplate for the correct refrigerant charge amount.

NOTE: An inaccurately charged system will cause future problems.

1. Using a charging scale, weigh in the refrigerant charge amount listed on unit nameplate.
2. After the system will take all it will take, close the valve on the high side of the charging manifold.
3. Start the system and charge the balance of the refrigerant through the low side.

NOTE: R410A should be drawn out of the storage container or drum in liquid form due to its fractionation properties, but should be "Flashed" to its gas state before entering the system. There are commercially available restriction devices that fit into the system charging hose set to accomplish this. DO NOT charge liquid R410A into the compressor.

4. With the system still running, close the valve on the charging cylinder. At this time, you may still have some liquid refrigerant in the charging cylinder hose and will definitely have liquid in the liquid hose. Reseat the liquid line core. Slowly open the high side manifold valve and transfer the liquid refrigerant from the liquid line hose and charging cylinder hose into the suction service valve port. CAREFUL: Watch so that liquid refrigerant does not enter the compressor.

NOTE: Even though the compressor section of a Scroll compressor is more tolerant of liquid refrigerant, continued floodback or flooded start conditions may wash oil from the bearing surfaces causing premature bearing failure.

Checking Compressor Efficiency

The reason for compressor inefficiency is broken or damaged scroll flanks on Scroll compressors, reducing the ability of the compressor to pump refrigerant vapor.

The condition of the scroll flanks is checked in the following manner.

1. Attach gauges to the high and low side of the system.
2. Start the system and run a "Cooling Performance Test.

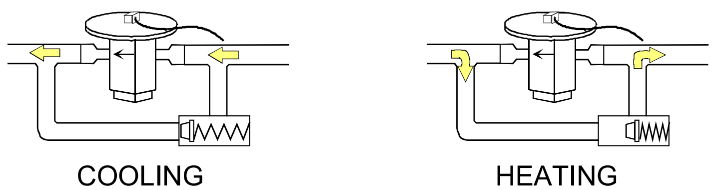
If the test shows:

A. Below normal high side pressure.
B. Above normal low side pressure.
C. Low temperature difference across coil.
D. Low amp draw at compressor.

And the charge is correct. The compressor is faulty - replace the compressor.

Thermostatic Expansion Valve

The expansion valve is designed to control the rate of liquid refrigerant flow into an evaporator coil in exact proportion to the rate of evaporation of the refrigerant in the coil. The amount of refrigerant entering the coil is regulated since the valve responds to temperature of the refrigerant gas leaving the coil (feeler bulb contact) and the pressure of the refrigerant in the coil. This regulation of the flow prevents the return of liquid refrigerant to the compressor.
The illustration below shows typical heatpump TXV/check valve operation in the heating and cooling modes.



TXV Valves

Some TXV valves contain an internal check valve thus eliminating the need for an external check valve and bypass loop. The three forces which govern the operation of the valve are: (1) the pressure created in the power assembly by the feeler bulb, (2) evaporator pressure, and (3) the equivalent pressure of the superheat spring in the valve.

0% bleed type expansion valves are used on indoor and outdoor coils. The 0% bleed valve will not allow the system pressures (High and Low side) to equalize during the shut down period. The valve will shut off completely at approximately 100 PSIG.

30% bleed valves used on some other models will continue to allow some equalization even though the valve has shut-off completely because of the bleed holes within the valve. This type of valve should not be used as a replacement for a 0% bleed valve, due to the resulting drop in performance.

The bulb must be securely fastened with two straps to a clean straight section of the suction line. Application of the bulb to a horizontal run of line is preferred. If a vertical installation cannot be avoided, the bulb must be mounted so that the capillary tubing comes out at the top.

THE VALVES PROVIDED ARE DESIGNED TO MEET THE SPECIFICATION REQUIREMENTS FOR OPTIMUM PRODUCT OPERATION. NO ADJUSTMENTS NEEDED. NOTE: DO NOT USE SUBSTITUTES.

Pressure vs. Temperature Chart

R-410A

PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F
12	-37.7	114.0	37.8	216.0	74.3	318.0	100.2	420.0	120.7	522.0	137.6
14	-34.7	116.0	38.7	218.0	74.9	320.0	100.7	422.0	121.0	524.0	137.9
16	-32.0	118.0	39.5	220.0	75.5	322.0	101.1	424.0	121.4	526.0	138.3
18	-29.4	120.0	40.5	222.0	76.1	324.0	101.6	426.0	121.7	528.0	138.6
20	-36.9	122.0	41.3	224.0	76.7	326.0	102.0	428.0	122.1	530.0	138.9
22	-24.5	124.0	42.2	226.0	77.2	328.0	102.4	430.0	122.5	532.0	139.2
24	-22.2	126.0	43.0	228.0	77.8	330.0	102.9	432.0	122.8	534.0	139.5
26	-20.0	128.0	43.8	230.0	78.4	332.0	103.3	434.0	123.2	536.0	139.8
28	-17.9	130.0	44.7	232.0	78.9	334.0	103.7	436.0	123.5	538.0	140.1
30	-15.8	132.0	45.5	234.0	79.5	336.0	104.2	438.0	123.9	540.0	140.4
32	-13.8	134.0	46.3	236.0	80.0	338.0	104.6	440.0	124.2	544.0	141.0
34	-11.9	136.0	47.1	238.0	80.6	340.0	105.1	442.0	124.6	548.0	141.6
36	-10.1	138.0	47.9	240.0	81.1	342.0	105.4	444.0	124.9	552.0	142.1
38	-8.3	140.0	48.7	242.0	81.6	344.0	105.8	446.0	125.3	556.0	142.7
40	-6.5	142.0	49.5	244.0	82.2	346.0	106.3	448.0	125.6	560.0	143.3
42	-4.5	144.0	50.3	246.0	82.7	348.0	106.6	450.0	126.0	564.0	143.9
44	-3.2	146.0	51.1	248.0	83.3	350.0	107.1	452.0	126.3	568.0	144.5
46	-1.6	148.0	51.8	250.0	83.8	352.0	107.5	454.0	126.6	572.0	145.0
48	0.0	150.0	52.5	252.0	84.3	354.0	107.9	456.0	127.0	576.0	145.6
50	1.5	152.0	53.3	254.0	84.8	356.0	108.3	458.0	127.3	580.0	146.2
52	3.0	154.0	54.0	256.0	85.4	358.0	108.8	460.0	127.7	584.0	146.7
54	4.5	156.0	54.8	258.0	85.9	360.0	109.2	462.0	128.0	588.0	147.3
56	5.9	158.0	55.5	260.0	86.4	362.0	109.6	464.0	128.3	592.0	147.9
58	7.3	160.0	56.2	262.0	86.9	364.0	110.0	466.0	128.7	596.0	148.4
60	8.6	162.0	57.0	264.0	87.4	366.0	110.4	468.0	129.0	600.0	149.0
62	10.0	164.0	57.7	266.0	87.9	368.0	110.8	470.0	129.3	604.0	149.5
64	11.3	166.0	58.4	268.0	88.4	370.0	111.2	472.0	129.7	608.0	150.1
66	12.6	168.0	59.0	270.0	88.9	372.0	111.6	474.0	130.0	612.0	150.6
68	13.8	170.0	59.8	272.0	89.4	374.0	112.0	476.0	130.3	616.0	151.2
70	15.1	172.0	60.5	274.0	89.9	376.0	112.4	478.0	130.7	620.0	151.7
72	16.3	174.0	61.1	276.0	90.4	378.0	112.6	480.0	131.0	624.0	152.3
74	17.5	176.0	61.8	278.0	90.9	380.0	113.1	482.0	131.3	628.0	152.8
76	18.7	178.0	62.5	280.0	91.4	382.0	113.5	484.0	131.6	632.0	153.4
78	19.8	180.0	63.1	282.0	91.9	384.0	113.9	486.0	132.0	636.0	153.9
80	21.0	182.0	63.8	284.0	92.4	386.0	114.3	488.0	132.3	640.0	154.5
82	22.1	184.0	64.5	286.0	92.8	388.0	114.7	490.0	132.6	644.0	155.0
84	23.2	186.0	65.1	288.0	93.3	390.0	115.0	492.0	132.9	648.0	155.5
86	24.3	188.0	65.8	290.0	93.8	392.0	115.5	494.0	133.3	652.0	156.1
88	25.4	190.0	66.4	292.0	94.3	394.0	115.8	496.0	133.6	656.0	156.6
90	26.4	192.0	67.0	294.0	94.8	396.0	116.2	498.0	133.9	660.0	157.1
92	27.4	194.0	67.7	296.0	95.2	398.0	116.6	500.0	134.0	664.0	157.7
94	28.5	196.0	68.3	298.0	95.7	400.0	117.0	502.0	134.5	668.0	158.2
96	29.5	198.0	68.9	300.0	96.2	402.0	117.3	504.0	134.8	672.0	158.7
98	30.5	200.0	69.5	302.0	96.6	404.0	117.7	506.0	135.2	676.0	159.2
100	31.2	202.0	70.1	304.0	97.1	406.0	118.1	508.0	135.5	680.0	159.8
102	32.2	204.0	70.7	306.0	97.5	408.0	118.5	510.0	135.8	684.0	160.3
104	33.2	206.0	71.4	308.0	98.0	410.0	118.8	512.0	136.1	688.0	160.8
106	34.1	208.0	72.0	310.0	98.4	412.0	119.2	514.0	136.4	692.0	161.3
108	35.1	210.0	72.6	312.0	98.9	414.0	119.6	516.0	136.7	696.0	161.8
110	35.5	212.0	73.2	314.0	99.3	416.0	119.9	518.0	137.0		
112	36.9	214.0	73.8	316.0	99.7	418.0	120.3	520.0	137.3		

*Based on ALLIED SIGNAL Data

REQUIRED LIQUID LINE TEMPERATURE						
LIQUID PRESSURE AT SERVICE VALVE (PSIG)	REQUIRED SUBCOOLING TEMPERATURE (°F)					
	8	10	12	14	16	18
189	58	56	54	52	50	48
195	60	58	56	54	52	50
202	62	60	58	56	54	52
208	64	62	60	58	56	54
215	66	64	62	60	58	56
222	68	66	64	62	60	58
229	70	68	66	64	62	60
236	72	70	68	66	64	62
243	74	72	70	68	66	64
251	76	74	72	70	68	66
259	78	76	74	72	70	68
266	80	78	76	74	72	70
274	82	80	78	76	74	72
283	84	82	80	78	76	74
291	86	84	82	80	78	76
299	88	86	84	82	80	78
308	90	88	86	84	82	80
317	92	90	88	86	84	82
326	94	92	90	88	86	84
335	96	94	92	90	88	86
345	98	96	94	92	90	88
354	100	98	96	94	92	90
364	102	100	98	96	94	92
374	104	102	100	98	96	94
384	106	104	102	100	98	96
395	108	106	104	102	100	98
406	110	108	106	104	102	100
416	112	110	108	106	104	102
427	114	112	110	108	106	104
439	116	114	112	110	108	106
450	118	116	114	112	110	108
462	120	118	116	114	112	110
474	122	120	118	116	114	112
486	124	122	120	118	116	114
499	126	124	122	120	118	116
511	128	126	124	122	120	118

SERVICING

Overfeeding

Overfeeding by the expansion valve results in high suction pressure, cold suction line, and possible liquid slugging of the compressor.

If these symptoms are observed:

1. Check for an overcharged unit by referring to the cooling performance charts in the servicing section.
2. Check the operation of the power element in the valve as explained in Checking Expansion Valve Operation.
3. Check for restricted or plugged equalizer tube.

Underfeeding

Underfeeding by the expansion valve results in low system capacity and low suction pressures.

If these symptoms are observed:

1. Check for a restricted liquid line or drier. A restriction will be indicated by a temperature drop across the drier.
2. Check the operation of the power element of the valve as described in Checking Expansion Valve Operation.

Refrigerant Charge Check

Units with Fixed Orifice Devices

After completing airflow measurements and adjustments the unit's refrigerant charge must be checked. All package units with fixed orifice devices are charged using the super heat method at the compressor suction line.

After superheat is verified, it is recommended to check unit sub-cooling at the condenser coil liquid line out.

Superheat

Before checking the superheat or replacing the valve, perform all the procedures outlined under Air Flow, Refrigerant Charge, Expansion Valve - Overfeeding, Underfeeding. These are the most common causes for evaporator malfunction.

Checking Superheat

Refrigerant gas is considered superheated when its temperature is higher than the saturation temperature corresponding to its pressure. The degree of superheat equals the degrees of temperature increase above the saturation temperature at existing pressure.
Procedure:

CAUTION

To prevent personal injury, carefully connect and disconnect manifold gauge hoses. Escaping liquid refrigerant can cause burns. Do not vent refrigerant to atmosphere. Recover during system repair or final unit disposal.

1. Run system at least 15 -20 minutes to allow pressure to stabilize.
2. Install a low side pressure gauge on the suction line access fitting.
3. Temporarily install thermometer on suction (large) line near compressor with adequate contact and insulate for best possible reading.
4. Record the gauge pressure corresponding temperature and the temperature of the suction line.
5. Refer to the superheat table for proper system superheat. Add charge to lower superheat recover charge to raise superheat.

Ambient Condenser Inlet Temp (°F Drybulb)	Return Air Temp. (°F Drybulb)				
	65	70	75	80	85
100	-	-	-	10	10
95	-	-	10	10	10
90	-	-	12	15	18
85	-	10	13	17	20
80	-	10	15	21	26
75	10	13	17	25	29
70	10	17	20	28	32
65	13	19	26	32	35
60	17	25	30	33	37

EXAMPLE:

A. Suction Pressure = 143
B. Corresponding Temp. °F. = 50
C. Thermometer on Suction Line = 61°F.

To obtain the degrees temperature of superheat, subtract 50.0 from 61.0°F.
The difference is 11° Superheat. The 11° Superheat would fall in the ± range of allowable superheat.

Superheat Formula = Suct. Line Temp. - Sat. Suct. Temp.

Units with TXV Devices

All package units with TXV devices are charged using the SUBCOOLING method at the liquid line. After subcooling is checked it is recommended to check unit superheat at the evaporator coil suction line.

Checking Subcooling

Refrigerant liquid is considered subcooled when its temperature is lower than the saturation temperature corresponding to its pressure. The degree of subcooling equals the degrees of temperature decrease below the saturation temperature at the existing pressure.
Procedure:

1. Attach an accurate thermometer or preferably a thermocouple type temperature tester to the liquid line close to the pressure switch.
2. Install a high side pressure gauge on the liquid access fitting.
3. Record the gauge pressure and the temperature of the line.

4. The difference between the thermometer reading and pressure to temperature conversion is the amount of subcooling.

Subcooling Formula = Sat. Liquid Temp. - Liquid Line Temp.

EXAMPLE:

A. Liquid Line Pressure = 417
B. Corresponding Temp. °F. = 120°
C. Thermometer on Liquid line = 109°F.

To obtain the amount of subcooling subtract 109°F from 120°F.
The difference is 11° subcooling. See the specification sheet or technical information manual for the design subcooling range for your unit.
See R410A Pressure vs. Temperature Chart

Expansion Valve (TXV) System Two Speed Application

Run the unit on high stage cooling for 15-20 minutes until refrigerant pressures stabilize. Check charge with unit on high stage.

Follow Checking Subcooling Instructions.

NOTE: THE TXV PROVIDED IS DESIGNED TO MEET THE SPECIFICATION REQUIREMENTS FOR OPTIMUM PRODUCT OPERATION. **"NO ADJUSTMENTS NEEDED TO TXV"**

SATURATED LIQUID PRESSURE TEMPERATURE CHART	
Liquid Pressure	**Saturated Liquid Temperature °F**
PSIG	**R-410A**
200	70
210	73
220	76
225	78
235	80
245	83
255	85
265	88
275	90
285	92
295	95
305	97
325	101
355	108
375	112
405	118

Heat Pump - Heating Cycle

The proper method of charging a heat pump in the heat mode is by weighing the charge according to the total charge listed on the rating plate.

Checking expansion valve operation

1. Remove the remote bulb of the expansion valve from the suction line.
2. Start the system and cool the bulb in a container of ice water, closing the valve. As you cool the bulb, the suction pressure should fall and the suction temperature will rise.
3. Next warm the bulb in your hand. As you warm the bulb, the suction pressure should rise and the suction temperature will fall.
4. If a temperature or pressure change is noticed, the expansion valve is operating. If no change is noticed, the valve is restricted, the power element is faulty, or the equalizer tube is plugged.
5. Capture the charge, replace the valve and drier and evacuate.

Fixed Orifice Restriction Devices

The fixed orifice restriction device (flowrator) used in conjunction with the indoor coil is a predetermined bore (I.D.).

It is designed to control the rate of liquid refrigerant flow into an evaporator coil.

The amount of refrigerant that flows through the fixed orifice restriction device is regulated by the pressure difference between the high and low sides of the system.

In the cooling cycle when the outdoor air temperature rises, the high side condensing pressure rises. At the same time, the cooling load on the indoor coil increases, causing the low side pressure to rise, but at a slower rate.

Since the high side pressure rises faster when the temperature increases, more refrigerant flows to the evaporator, increasing the cooling capacity of the system.

When the outdoor temperature falls, the reverse takes place. The condensing pressure falls, and the cooling loads on the indoor coil decreases, causing less refrigerant flow.

If a restriction should become evident, proceed as follows:

1. Recover refrigerant charge.
2. Remove the orifice assembly and clean or replace.
3. Replace liquid line drier, evacuate and recharge.

Checking Equalization Time

During the "OFF" cycle, the high side pressure bleeds to the low side through the fixed orifice restriction device. Check equalization time as follows:

1. Attach a gauge manifold to the suction and liquid line access fittings.
2. Start the system and allow the pressures to stabilize.

SERVICING

3. Stop the system and check the time it takes for the high and low pressure gauge readings to equalize.

If it takes more than seven (7) minutes to equalize, the restriction device is inoperative. Replace, install a liquid line drier, evacuate and recharge.

Checking Restricted Liquid Line

When the system is operating, the liquid line is warm to the touch. If the liquid line is restricted, a definite temperature drop will be noticed at the point of restriction. In severe cases, frost will form at the restriction and extend down the line in the direction of the flow.

Discharge and suction pressures will be low, giving the appearance of an undercharged unit. However, the unit will have normal to high subcooling.

Locate the restriction, replace the restricted part, replace drier, evacuate and recharge.

Refrigerant Overcharge

An overcharge of refrigerant is normally indicated by excessively high head pressure and/or liquid return to the compressor.

If high head pressure is not indicated, an overcharge or a system containing non-condensables could be the problem. If overcharging is indicated:

1. Start the system.
2. Remove small quantities of gas from the suction line dill valve until the head pressure is reduced to normal.
3. Observe the system while running a cooling performance test, if a shortage of refrigerant is indicated, then the system contains non-condensables.

Non-Condensables

Check for non-condensables:

1. Shut down the system and allow the pressures to equalize for a minimum of 15 minutes.
2. Take a pressure reading.
3. Compare this pressure to the temperature of the coldest coil since this is where most of the refrigerant will be. If the pressure indicates a higher temperature than that of the coil temperature, non-condensables are present.

To remove the non-condensables:

1. Remove the refrigerant charge.
2. Replace and/or install liquid line drier.
3. Evacuate and recharge.

Air Conditioning Diagnostic Chart

Issue	Discharge Pressure	Suction Pressure	(Orifice) Superheat	(TXV) Subcooling	Temperature Split
Liquid Line Restriction	↓	↓	↑	↑	↓
System Undercharge	↓	↓	↑	↓	↓
System Overcharge	↑	↑	↓	↑	↓
Non Condensible	↑	↑	↑	↑	↓
Low Indoor Airflow	↓	↓	↓	↑	↑
Inefficient Compressor	↓	↑	↑	↓	↓

Heat Pump Diagnostic Chart

Issue	Discharge Pressure	Suction Pressure	(Orifice) Superheat	(TXV) Subcooling	Temperature Split
Liquid Line Restriction	↑	↓	↑	↑	↓
System Undercharge	↓	↓	↑	↓	↓
Leaking Reversing Valve	↓	↑	Normal	↓	↓
Low Indoor Airflow	↑	↑	Normal	Normal	↑
Inefficient Compressor	↓	↑	Normal	↓	↓

NOTE: Superheat and Subcooling is determined by the system metering device.

Compressor Burnout

When a compressor burns out, high temperature develops causing the refrigerant, oil and motor insulation to decompose forming acids and sludge.

If a compressor is suspected of being burned-out, attach a refrigerant hose to the liquid line dill valve and properly remove and dispose of the refrigerant.

NOTICE

Violation of EPA regulations may result in fines or other penalties.

Now determine if a burn out has actually occurred. Confirm by analyzing an oil sample using a Sporlan Acid Test Kit, AK-3 or its equivalent.

Remove the compressor and obtain an oil sample from the suction stub. If the oil is not acidic, either a burnout has not occurred or the burnout is so mild that a complete clean-up is not necessary.

If acid level is unacceptable, the system must be cleaned by using the clean-up drier method.

CAUTION

Do not allow the sludge or oil to contact the skin. Severe burns may result.

SERVICING

NOTE: The Flushing Method using R-11 refrigerant is no longer approved by Goodman® Manufacturing Company, L.P.

Suction Line Drier Clean-Up Method

The POE oils used with R410A refrigerant is an excellent solvent. In the case of a burnout, the POE oils will remove any burnout residue left in the system. If not captured by the refrigerant filter, they will collect in the compressor or other system components, causing a failure of the replacement compressor and/or spread contaminants throughout the system, damaging additional components.

The suction line filter drier should be installed as close to the compressor suction fitting as possible. The filter must be accessible and be rechecked for a pressure drop after the system has operated for a time. It may be necessary to use new tubing and form as required.

NOTE: At least twelve (12) inches of the suction line immediately out of the compressor stub must be discarded due to burned residue and contaminates.

1. Remove compressor discharge line strainer.
2. Remove the liquid line drier and expansion valve.
3. Purge all remaining components with dry nitrogen or carbon dioxide until clean.
4. Install new components including liquid line drier.
5. Braze all joints, leak test, evacuate, and recharge system.
6. Start up the unit and record the pressure drop across the drier.
7. Continue to run the system for a minimum of twelve (12) hours and recheck the pressure drop across the drier. Pressure drop should not exceed 6 PSIG.
8. Continue to run the system for several days, repeatedly checking pressure drop across the suction line drier. If the pressure drop never exceeds the 6 PSIG, the drier has trapped the contaminants. Remove the suction line drier from the system.
9. If the pressure drop becomes greater, then it must be replaced and steps 5 through 9 repeated until it does not exceed 6 PSIG.

NOTICE: Regardless, the cause for burnout must be determined and corrected before the new compressor is started.

Reversing Valve Replacement

Remove the refrigerant charge from the system.

When brazing a reversing valve into the system, it is of extreme importance that the temperature of the valve **does not exceed 250°F** at any time.

Wrap the reversing valve with a large rag saturated with water. "Re-wet" the rag and thoroughly cool the valve after each brazing operation of the four joints involved. The wet rag around the reversing valve will eliminate conduction of heat to the valve body when brazing the line connection.

The use of a wet rag sometimes can be a nuisance. There are commercial grades of heat absorbing paste that may be substituted.

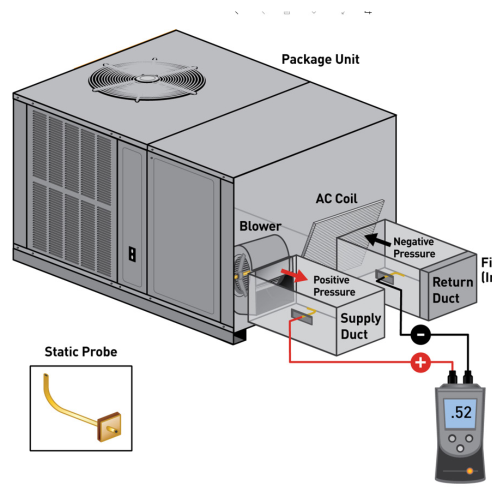
After the valve has been installed, leak test, evacuate and recharge.

Checking External Static Pressure

The minimum and maximum allowable duct static pressure is found in the Technical Information Manual.

Too great of an external static pressure will result in insufficient air that can cause icing of the coil, whereas too much air can cause poor humidity control, and condensate to be pulled off the evaporator coil causing condensate leakage. Too much air can cause motor overloading and in many cases this constitutes a poorly designed system. To determine proper air movement, proceed as follows:

1. Using a manometer measure the static pressure of the return duct at the inlet of the unit, (Negative Pressure).



Total External Static

2. Measure the static pressure of the supply duct, (Positive Pressure).
3. Add the two readings together.

NOTE: Both readings may be taken simultaneously and read directly on the manometer as shown in the illustration above, if so desired.

4. Consult proper table for quantity of air.

If the external static pressure exceeds the minimum or maximum allowable statics, check for closed dampers, dirty filters, undersized or poorly laid out ductwork.

SERVICING

Adjusting Airflow

EEM Motor

The blower motor speed for the EEM motor is controlled by three 24V low voltage leads: green, yellow, and white. The green lead sets the speed for fan-only mode. The yellow lead sets the speed for cooling and heat pump heating mode (if applicable).

EEM Motor Speed Adjustment

The white lead sets the speed for electric heat mode (emergency heat and second stage heat, if applicable). The leads are factory connected as follows: Green to T1, Yellow to T2, and White to T3. T1 is the low speed setting and is dedicated to fan-only mode. T2 is medium speed cooling and T3 is medium speed heating. T4 is high speed cooling and T5 is high speed heating. To adjust the blower speed, move the yellow and/or white wires to T4 and T5.

NOTE: If more than one lead is energized at the same time, the motor will use the higher speed setting.

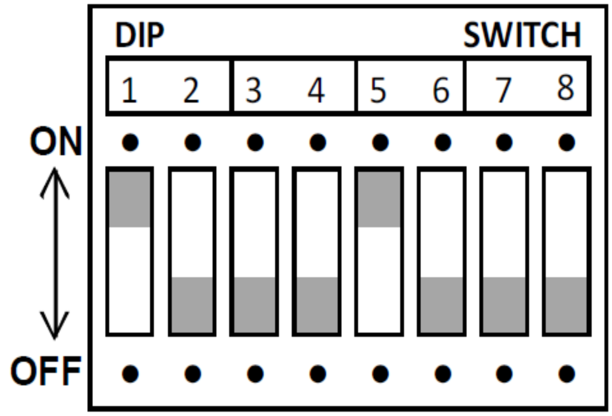
ECM Motor Speed Adjustment

Each ECM blower motor has been preprogrammed for operation at 4 distinct air flow levels when operating in Cooling/Heat Pump mode or Electric Heat mode. These 4 distinct levels may also be adjusted slightly lower or higher if desired. The adjustment between levels and the trim adjustments are made by changing the dip switch(s) either to an "OFF" or "ON" position. See Blower Performance Data tables in installation manual.

DIP Switch Functions

The ECM motor has an electronic control that contains eight (8) 2-position dip switches. The function of these dip switches is shown in Table below.

For APHH5[24-36]41 models, dip switch 4 must be set to ON. Dip switch 4 must be set to OFF for the two-stage compressor models APHH5[42-60]41. Dip switch 4 ON energizes Y1 signal to the ECM motor anytime Y/Y2 is energized. The indoor motor will not operate properly if switch is not set correctly for the correct model.



Factory DIP Switch Settings

Switches	Function
1, 2	Heating Speeds
3	Unused
4	OFF for Two-Stage
5, 6	Cooling Speeds
7, 8	Airflow Adjust

DIP Switch Functions

GPCM3[24-60]41** BLOWER PERFORMANCE

Horizontal Flow

Model	Motor Tap	Compressor stage	Volts		E.S.P. (In. of H_2O)							
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
GPCM32441**	T1	Single stage	230	CFM	580	505	445	390	320	-	-	-
				Watts	36	46	54	60	65	-	-	-
	T2/T3	Single stage	230	CFM	1133	1081	1026	970	911	839	748	679
				Watts	146	154	161	168	176	185	192	197
	T4/T5	Single stage	230	CFM	1230	1190	1140	1095	1040	990	920	850
				Watts	202	212	220	233	235	243	249	262
GPCM33041**	T1	Single stage	230	CFM	-	550	475	415	340	270	-	-
				Watts	-	50	59	66	74	77	-	-
	T2/T3	Single stage	230	CFM	1271	1222	1176	1129	1081	1026	962	889
				Watts	202	210	219	227	234	242	250	257
	T4/T5	Single stage	230	CFM	1345	1305	1260	1220	1180	1125	1080	975
				Watts	258	273	272	283	292	298	306	310
GPCM33641**	T1	Single stage	230	CFM	1070	1030	980	935	870	775	720	665
				Watts	145	161	165	173	181	190	198	202
	T2/T3	Single stage	230	CFM	1468	1427	1385	1337	1293	1243	1189	1137
				Watts	288	296	304	310	318	325	333	340
	T4/T5	Single stage	230	CFM	1505	1465	1420	1385	1335	1300	1250	1205
				Watts	359	371	384	383	393	398	406	416
GPCM34241**	T1	Single stage	230	CFM	1035	995	945	895	845	790	695	630
				Watts	132	144	152	157	168	176	183	189
	T2/T3	Single stage	230	CFM	1575	1526	1481	1438	1393	1352	1306	1253
				Watts	301	310	321	332	342	350	361	369
	T4/T5	Single stage	230	CFM	1698	1654	1604	1558	1513	1467	1421	1370
				Watts	370	381	386	396	405	413	421	429
GPCM34841**	T1	Single stage	230	CFM	1355	1300	1250	1210	1155	1110	1045	965
				Watts	212	228	230	246	248	261	273	282
	T2/T3	Single stage	230	CFM	1844	1803	1763	1725	1682	1639	1593	1546
				Watts	438	447	457	468	477	484	491	498
	T4/T5	Single stage	230	CFM	1895	1855	1805	1770	1730	1685	1640	1600
				Watts	558	558	578	584	590	594	602	612
GPCM36041**	T1	Single stage	230	CFM	1360	1300	1260	1215	1175	1125	1085	1030
				Watts	213	221	233	244	255	264	273	293
	T2/T3	Single stage	230	CFM	1959	1920	1884	1847	1806	1768	1724	1680
				Watts	515	526	541	554	564	572	581	589
	T4/T5	Single stage	230	CFM	2000	1960	1925	1875	1835	1800	1760	1725
				Watts	642	651	660	651	672	683	691	699

GPCM3[24-60]41** BLOWER PERFORMANCE												
Down flow												
Model	Motor Tap	Compressor stage	Volts	E.S.P. (In. of H_2O)								
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
GPCM32441**	T1	Single stage	230	CFM	545	475	418	367	301	-	-	-
				Watts	37	47	55	62	67	-	-	-
	T2/T3	Single stage	230	CFM	1065	1016	964	912	856	788	703	638
				Watts	150	158	165	172	181	189	197	202
	T4/T5	Single stage	230	CFM	1156	1119	1072	1029	978	931	865	799
				Watts	207	217	226	239	241	249	255	269
GPCM33041**	T1	Single stage	230	CFM	-	517	447	390	320	254	-	-
				Watts	-	51	60	68	76	79	-	-
	T2/T3	Single stage	230	CFM	1195	1148	1106	1061	1016	964	905	836
				Watts	207	215	224	233	240	248	256	264
	T4/T5	Single stage	230	CFM	1264	1227	1184	1147	1109	1058	1015	917
				Watts	264	280	279	290	299	305	314	318
GPCM33641**	T1	Single stage	230	CFM	1006	968	921	879	818	729	677	625
				Watts	149	165	169	177	186	195	203	207
	T2/T3	Single stage	230	CFM	1380	1342	1302	1257	1215	1168	1118	1068
				Watts	295	304	312	318	326	333	341	348
	T4/T5	Single stage	230	CFM	1415	1377	1335	1302	1255	1222	1175	1133
				Watts	368	380	394	393	403	408	416	426
GPCM34241**	T1	Single stage	230	CFM	973	935	888	841	794	743	653	592
				Watts	135	148	156	161	172	180	188	194
	T2/T3	Single stage	230	CFM	1480	1434	1392	1351	1310	1271	1228	1178
				Watts	309	318	329	340	350	359	370	378
	T4/T5	Single stage	230	CFM	1596	1554	1508	1465	1423	1379	1336	1288
				Watts	379	390	395	406	415	424	432	439
GPCM34841**	T1	Single stage	230	CFM	1274	1222	1175	1137	1086	1043	982	907
				Watts	217	234	236	252	254	268	280	289
	T2/T3	Single stage	230	CFM	1733	1695	1658	1622	1581	1541	1497	1453
				Watts	449	459	469	480	489	497	504	510
	T4/T5	Single stage	230	CFM	1781	1744	1697	1664	1626	1584	1542	1504
				Watts	572	572	592	599	605	609	617	627
GPCM36041**	T1	Single stage	230	CFM	1278	1222	1184	1142	1105	1058	1020	968
				Watts	218	227	239	250	261	271	280	300
	T2/T3	Single stage	230	CFM	1841	1805	1771	1736	1698	1661	1620	1579
				Watts	528	539	554	568	578	587	596	603
	T4/T5	Single stage	230	CFM	1880	1842	1810	1763	1725	1692	1654	1622
				Watts	658	667	677	667	689	700	708	716

*PHM3[24-60]41** BLOWER PERFORMANCE

Horizontal Flow												
Model	Motor Tap	Compressor stage	Volts	E.S.P. (In. of H_2O)								
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
*PHM32441**	T1	Single stage	230	CFM	847	792	728	638	-	-	-	-
				Watts	76	84	94	102	-	-	-	-
	T2/T3	Single stage	230	CFM	1114	1068	1017	964	901	829	751	667
				Watts	138	147	155	164	173	181	188	194
	T4/T5	Single stage	230	CFM	1371	1316	1281	1240	1186	1133	1072	1000
				Watts	235	243	252	261	266	275	284	293
*PHM33041**	T1	Single stage	230	CFM	877	821	758	674	596	531	481	-
				Watts	84	92	99	110	118	125	130	-
	T2/T3	Single stage	230	CFM	1347	1295	1243	1190	1134	1079	1010	938
				Watts	228	236	245	252	259	266	275	283
	T4/T5	Single stage	230	CFM	1463	1419	1376	1329	1282	1235	1183	1126
				Watts	284	294	302	309	317	325	333	340
*PHM33641**	T1	Single stage	230	CFM	850	795	726	640	559	-	-	-
				Watts	76	85	93	103	110	-	-	-
	T2/T3	Single stage	230	CFM	1438	1393	1354	1304	1258	1209	1154	1089
				Watts	271	280	291	296	305	312	320	329
	T4/T5	Single stage	230	CFM	1604	1560	1507	1468	1415	1364	1321	1276
				Watts	396	402	408	424	426	433	444	454
*PHM34241**	T1	Single stage	230	CFM	1003	937	887	837	773	699	631	574
				Watts	100	106	116	129	142	154	162	171
	T2/T3	Single stage	230	CFM	1534	1492	1453	1410	1372	1330	1287	1236
				Watts	257	269	279	290	301	311	322	334
	T4/T5	Single stage	230	CFM	1799	1754	1712	1672	1630	1582	1534	1482
				Watts	419	430	442	453	462	469	475	481
*PHM34841**	T1	Single stage	230	CFM	1177	1123	1077	1031	972	-	-	-
				Watts	142	151	162	173	185	-	-	-
	T2/T3	Single stage	230	CFM	1825	1785	1748	1713	1674	1610	1609	1544
				Watts	439	448	460	470	480	488	489	498
	T4/T5	Single stage	230	CFM	1984	1947	1975	1864	1823	1781	1741	1694
				Watts	567	578	590	596	603	610	618	623
*PHM36041**	T1	Low stage	230	CFM	1488	1448	1410	1371	1336	1293	1254	1204
				Watts	270	279	290	305	318	330	343	356
	T2/T3	High stage	230	CFM	2029	1991	1956	1920	1876	1829	1801	1766
				Watts	616	622	631	638	648	656	671	682
	T4/T5	High stage	230	CFM	2199	2161	2126	2090	2056	2018	1982	1949
				Watts	801	809	817	828	838	851	858	873

*PHM3[24-60]41** BLOWER PERFORMANCE

Down flow												
Model	Motor Tap	Compressor stage	Volts	E.S.P. (In. of H_2O)								
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
*PHM32441**	T1	Single stage	230	CFM	828	767	680	574	-	-	-	-
				Watts	75	85	95	104	-	-	-	-
	T2/T3	Single stage	230	CFM	1085	1019	960	888	813	713	657	601
				Watts	136	144	152	162	173	180	185	191
	T4/T5	Single stage	230	CFM	1355	1300	1254	1201	1147	1084	1007	899
				Watts	244	253	260	268	276	285	294	303
*PHM33041**	T1	Single stage	230	CFM	859	797	719	619	552	497	437	-
				Watts	83	92	101	111	118	122	127	-
	T2/T3	Single stage	230	CFM	1302	1257	1198	1148	1089	1023	936	844
				Watts	220	228	238	246	254	263	273	282
	T4/T5	Single stage	230	CFM	1439	1396	1341	1294	1246	1185	1119	1047
				Watts	288	297	305	313	322	330	339	347
*PHM33641**	T1	Single stage	230	CFM	825	762	686	577	523	-	-	-
				Watts	77	87	97	105	111	-	-	-
	T2/T3	Single stage	230	CFM	1436	1389	1338	1289	1241	1186	1122	1053
				Watts	281	290	298	307	315	325	334	343
	T4/T5	Single stage	230	CFM	1595	1555	1506	1462	1415	1370	1319	1260
				Watts	382	391	399	408	418	426	435	444
*PHM34241**	T1	Single stage	230	CFM	981	918	850	761	687	613	553	488
				Watts	100	113	126	138	153	161	171	179
	T2/T3	Single stage	230	CFM	1490	1433	1371	1318	1260	1197	1121	1023
				Watts	258	273	285	297	309	323	335	347
	T4/T5	Single stage	230	CFM	1786	1728	1678	1629	1577	1517	1453	1385
				Watts	419	432	445	457	468	474	482	490
*PHM34841**	T1	Single stage	230	CFM	1168	1101	1045	979	913	-	-	-
				Watts	144	155	168	182	197	-	-	-
	T2/T3	Single stage	230	CFM	1829	1771	1720	1670	1613	1556	1493	1426
				Watts	440	452	465	478	486	494	501	510
	T4/T5	Single stage	230	CFM	2004	1949	1892	1837	1782	1728	1674	1616
				Watts	564	577	587	594	603	612	620	628
*PHM36041**	T1	Low stage	230	CFM	1399	1361	1326	1289	1256	1215	1179	1132
				Watts	277	286	298	312	326	338	351	365
	T2/T3	High stage	230	CFM	1907	1872	1839	1804	1763	1719	1692	1660
				Watts	632	638	646	654	664	672	688	699
	T4/T5	High stage	230	CFM	2067	2031	1999	1964	1932	1897	1863	1832
				Watts	821	829	838	849	859	872	880	895

APHM5 Blower Performance Data

APHM52441

Cooling / HP Speed	Adjust Tap	CFM*	Electric Heat	Adjust Tap	CFM*
D	Minus	630	D	Minus	630
	Normal	700		Normal	700
	Plus	770		Plus	770
C	Minus	743	C	Minus	743
	Normal	825		Normal	825
	Plus	908		Plus	908
B	Minus**	855	B	Minus**	855
	Normal	950		Normal	950
	Plus	1,045		Plus	1,045
A	Minus	945	A	Minus	945
	Normal	1,050		Normal	1,050
	Plus	1,155		Plus	1,155

* - @ 0.1 - 0.8 ESP

** - Factory Default

APHM53041

Cooling / HP Speed	Adjust Tap	CFM*	Electric Heat	Adjust Tap	CFM*
D	Minus	720	D	Minus	720
	Normal	800		Normal	800
	Plus	880		Plus	880
C	Minus	900	C	Minus	900
	Normal	1,000		Normal	1,000
	Plus	1,100		Plus	1,100
B	Minus	990	B	Minus	990
	Normal**	1,100		Normal**	1,100
	Plus	1,210		Plus	1,210
A	Minus	1,125	A	Minus	1,125
	Normal	1,250		Normal	1,250
	Plus	1,375		Plus	1,375

* - @ 0.1 - 0.8 ESP

** - Factory Default

APHM53641

Cooling / HP Speed	Adjust Tap	CFM*	Electric Heat	Adjust Tap	CFM*
D	Minus	720	D	Minus	720
	Normal	800		Normal	800
	Plus	880		Plus	880
C	Minus	900	C	Minus	900
	Normal	1,000		Normal	1,000
	Plus	1,100		Plus	1,100
B	Minus	990	B	Minus	990
	Normal**	1,100		Normal**	1,100
	Plus**	1,210		Plus**	1,210
A	Minus	1,125	A	Minus	1,125
	Normal	1,250		Normal	1,250
	Plus	1,375		Plus	1,375

* - @ 0.1 - 0.8 ESP

** - Factory Default

APHM54241

Cooling / HP Speed	Adjust Tap	CFM*	Electric Heat	Adjust Tap	CFM*
D	Minus	1,103	D	Minus	1,103
	Normal	1,225		Normal	1,225
	Plus**	1,348		Plus**	1,348
C	Minus**	1,260	C	Minus**	1,260
	Normal	1,400		Normal	1,400
	Plus	1,540		Plus	1,540
B	Minus	1,530	B	Minus	1,530
	Normal	1,700		Normal	1,700
	Plus	1,870		Plus	1,870
A	Minus	1,620	A	Minus	1,620
	Normal	1,800		Normal	1,800
	Plus	1,980		Plus	1,980

* - @ 0.1 - 0.8 ESP

** - Factory Default

APHM54841

Cooling / HP Speed	Adjust Tap	CFM*	Electric Heat	Adjust Tap	CFM*
D	Minus	1,103	D	Minus	1,103
	Normal	1,225		Normal	1,225
	Plus	1,348		Plus	1,348
C	Minus	1,260	C	Minus	1,260
	Normal	1,400		Normal	1,400
	Plus	1,540		Plus	1,540
B	Minus	1,530	B	Minus	1,530
	Normal	1,700		Normal	1,700
	Plus	1,870		Plus	1,870
A	Minus**	1,620	A	Minus**	1,620
	Normal	1,800		Normal	1,800
	Plus	1,980		Plus	1,980

* - @ 0.1 - 0.8 ESP

** - Factory Default

GPHM5[24-48]41** BLOWER PERFORMANCE

Horizontal Flow												
Model	Motor Tap	Compressor stage	Volts	E.S.P. (In. of H_2O)								
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
GPHM52441**	T1	Low stage	230	CFM	726	662	576	486	415	346	284	248
				Watts	56	64	73	79	84	89	93	97
	T2/T3	High stage	230	CFM	1151	1099	1047	993	936	865	775	704
				Watts	157	164	173	180	188	196	204	209
	T4/T5	High stage	230	CFM	1347	1315	1256	1194	1152	1096	1051	972
				Watts	239	256	265	271	282	286	293	297
GPHM53041**	T1	Low stage	230	CFM	866	805	743	666	578	508	435	359
				Watts	83	91	98	106	112	119	124	128
	T2/T3	High stage	230	CFM	1321	1276	1232	1170	1116	1065	1007	948
				Watts	232	240	249	255	262	269	276	283
	T4/T5	High stage	230	CFM	1440	1418	1364	1307	1265	1219	1168	1094
				Watts	290	306	312	321	326	332	348	353
GPHM53641**	T1	Low stage	230	CFM	981	929	866	791	717	642	566	492
				Watts	89	97	105	113	121	128	134	140
	T2/T3	High stage	230	CFM	1507	1465	1425	1377	1329	1275	1216	1154
				Watts	260	271	281	289	295	303	310	317
	T4/T5	High stage	230	CFM	1604	1560	1507	1468	1415	1364	1321	1276
				Watts	396	402	408	424	426	423	444	454
GPHM54241**	T1	Low stage	230	CFM	1215	1162	1114	1073	1027	976	910	822
				Watts	153	162	173	184	196	210	224	236
	T2/T3	High stage	230	CFM	1563	1521	1479	1435	1387	1346	1305	1247
				Watts	286	297	307	317	328	339	350	359
	T4/T5	High stage	230	CFM	1775	1718	1673	1643	1588	1532	1482	1431
				Watts	416	424	430	454	458	466	478	488
GPHM54841**	T1	Low stage	230	CFM	1271	1231	1186	1140	1094	1041	986	915
				Watts	169	181	190	201	211	223	234	249
	T2/T3	High stage	230	CFM	1863	1819	1780	1740	1697	1655	1606	1562
				Watts	456	466	476	487	496	504	510	516
	T4/T5	High stage	230	CFM	2012	1965	1912	1871	1809	1770	1741	1691
				Watts	578	593	599	606	610	627	626	634

GPHM5[24-48]41** BLOWER PERFORMANCE

Down flow												
Model	Motor Tap	Compressor stage	Volts	E.S.P. (In. of H_2O)								
					0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
GPHM52441**	T1	Low stage	230	CFM	683	622	542	457	390	326	267	233
				Watts	58	66	75	81	86	91	96	100
	T2/T3	High stage	230	CFM	1082	1033	984	933	880	813	729	662
				Watts	160	168	177	185	193	201	209	214
	T4/T5	High stage	230	CFM	1266	1236	1181	1122	1083	1030	988	914
				Watts	245	262	272	278	289	293	300	304
GPHM53041**	T1	Low stage	230	CFM	814	757	699	626	543	478	408	338
				Watts	85	93	101	108	115	122	128	132
	T2/T3	High stage	230	CFM	1242	1200	1158	1100	1049	1001	946	891
				Watts	238	246	255	261	268	276	283	290
	T4/T5	High stage	230	CFM	1354	1333	1282	1229	1189	1146	1098	1028
				Watts	297	314	320	329	334	340	357	362
GPHM53641**	T1	Low stage	230	CFM	922	873	814	743	674	604	532	462
				Watts	91	100	108	116	124	131	138	143
	T2/T3	High stage	230	CFM	1416	1377	1339	1294	1249	1198	1143	1085
				Watts	267	277	288	296	302	311	318	325
	T4/T5	High stage	230	CFM	1508	1466	1417	1380	1330	1282	1242	1199
				Watts	406	412	418	435	437	434	455	465
GPHM54241**	T1	Low stage	230	CFM	1142	1092	1047	1009	965	917	856	773
				Watts	157	166	177	189	201	215	229	242
	T2/T3	High stage	230	CFM	1469	1430	1390	1349	1303	1266	1227	1172
				Watts	293	305	315	325	336	347	359	368
	T4/T5	High stage	230	CFM	1669	1615	1573	1544	1493	1440	1393	1345
				Watts	426	435	441	465	469	478	490	500
GPHM54841**	T1	Low stage	230	CFM	1195	1157	1114	1072	1028	979	927	860
				Watts	173	186	195	206	216	228	240	255
	T2/T3	High stage	230	CFM	1751	1710	1673	1635	1595	1556	1509	1468
				Watts	467	477	488	499	508	516	523	529
	T4/T5	High stage	230	CFM	1891	1847	1797	1759	1700	1664	1637	1590
				Watts	592	608	614	621	625	643	642	650

SERVICING

APHM56041				
Horizontal Flow				
Speed Tap	**External Static Pressure (ESP), in w.c.**	**SCFM**	**RPM**	**BHP**
T1	0.2	1372	665	0.20
	0.4	1259	734	0.23
	0.6	1133	813	0.25
	0.8	1016	888	0.27
T2	0.2	2176	878	0.69
	0.4	2080	939	0.74
	0.6	1973	1000	0.79
	0.8	1887	1048	0.83
T3	0.2	2176	878	0.69
	0.4	2080	939	0.74
	0.6	1973	1000	0.79
	0.8	1887	1048	0.83
T4	0.2	2234	960	0.86
	0.4	2162	1003	0.9
	0.6	2101	1042	0.83
	0.8	2053	1073	0.96
T5	0.2	2300	982	0.93
	0.4	2222	1025	0.98
	0.6	2170	1061	1.01
	0.8	2120	1095	1.04

APHM56041				
Downflow				
Speed Tap	**External Static Pressure (ESP), in w.c.**	**SCFM**	**RPM**	**BHP**
T1	0.2	1372	665	0.20
	0.4	1259	734	0.23
	0.6	1133	813	0.25
	0.8	1016	888	0.27
T2	0.2	2176	878	0.69
	0.4	2080	939	0.74
	0.6	1973	1000	0.79
	0.8	1887	1048	0.83
T3	0.2	2176	878	0.69
	0.4	2080	939	0.74
	0.6	1973	1000	0.79
	0.8	1887	1048	0.83
T4	0.2	2234	960	0.86
	0.4	2162	1003	0.9
	0.6	2101	1042	0.83
	0.8	2053	1073	0.96
T5	0.2	2300	982	0.93
	0.4	2222	1025	0.98
	0.6	2170	1061	1.01
	0.8	2120	1095	1.04

5 Ton Heat Pump

Standard Static Drive
Model: APHM56041

Horizontal Flow

Speed Tap	External Static Pressure (ESP), in w.c.	SCFM	RPM	BHP
T1	0.2	1372	665	0.20
	0.4	1259	734	0.23
	0.6	1133	813	0.25
	0.8	1016	888	0.27
T2	0.2	2176	878	0.69
	0.4	2080	939	0.74
	0.6	1973	1000	0.79
	0.8	1887	1048	0.83
T3	0.2	2176	878	0.69
	0.4	2080	939	0.74
	0.6	1973	1000	0.79
	0.8	1887	1048	0.83
T4	0.2	2234	960	0.86
	0.4	2162	1003	0.9
	0.6	2101	1042	0.83
	0.8	2053	1073	0.96
T5	0.2	2300	982	0.93
	0.4	2222	1025	0.98
	0.6	2170	1061	1.01
	0.8	2120	1095	1.04

Downflow

Speed Tap	External Static Pressure (ESP), in w.c.	SCFM	RPM	BHP
T1	0.2	1380	664	0.20
	0.4	1262	735	0.23
	0.6	1132	811	0.25
	0.8	1006	884	0.27
T2	0.2	2145	902	0.71
	0.4	2056	952	0.75
	0.6	1967	1003	0.79
	0.8	1890	1051	0.83
T3	0.2	2145	902	0.71
	0.4	2056	952	0.75
	0.6	1976	1003	0.79
	0.8	1890	1051	0.83
T4	0.2	2293	950	0.85
	0.4	2195	995	0.89
	0.6	2112	1042	0.93
	0.8	2034	1088	0.97
T5	0.2	2364	971	0.92
	0.4	2274	1019	0.97
	0.6	2190	1063	1.01
	0.8	2113	1110	1.06

Shaded area indicates air flow below 1500 SCFM (300 SCFM/ton) that is not recommended for High Stage cooling or heating.

5 TON HEAT PUMP

Standard Static Drive
Model: GPHM56041

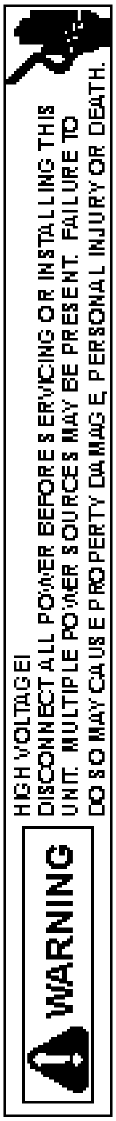
Horizontal Flow					Down Flow				
Speed Tap	External Static Pressure (ESP), in w.c.	SCFM	RPM	BHP	Speed Tap	External Static Pressure (ESP), in w.c.	SCFM	RPM	BHP
T1	0.2	1372	665	0.20	T1	0.2	1380	664	0.20
	0.4	1259	734	0.23		0.4	1262	735	0.23
	0.6	1133	813	0.25		0.6	1132	811	0.25
	0.8	1016	888	0.27		0.8	1006	884	0.27
T2	0.2	2176	878	0.69	T2	0.2	2145	902	0.71
	0.4	2080	939	0.74		0.4	2056	952	0.75
	0.6	1973	1000	0.79		0.6	1967	1003	0.79
	0.8	1887	1048	0.83		0.8	1890	1051	0.83
T3	0.2	2176	878	0.69	T3	0.2	2145	902	0.71
	0.4	2080	939	0.74		0.4	2056	952	0.75
	0.6	1973	1000	0.79		0.6	1967	1003	0.79
	0.8	1887	1048	0.83		0.8	1890	1051	0.83
T4	0.2	2234	960	0.86	T4	0.2	2293	950	0.85
	0.4	2162	1003	0.9		0.4	2195	995	0.89
	0.6	2101	1042	0.83		0.6	2112	1042	0.93
	0.8	2053	1073	0.96		0.8	2034	1088	0.97
T5	0.2	2300	982	0.93	T5	0.2	2364	971	0.92
	0.4	2222	1025	0.98		0.4	2274	1019	0.97
	0.6	2170	1061	1.01		0.6	2190	1063	1.01
	0.8	2120	1095	1.04		0.8	2113	1110	1.06

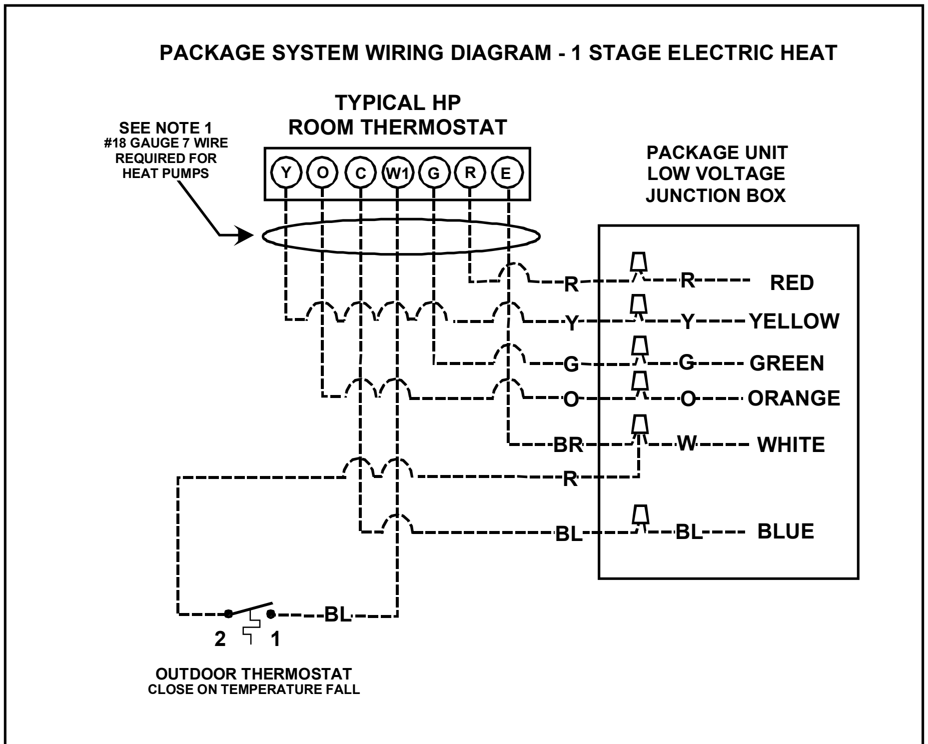
Shaded area indicates air flow below 1500 SCFM (300 SCFM/ton) that is not recommended for High Stage cooling or heating

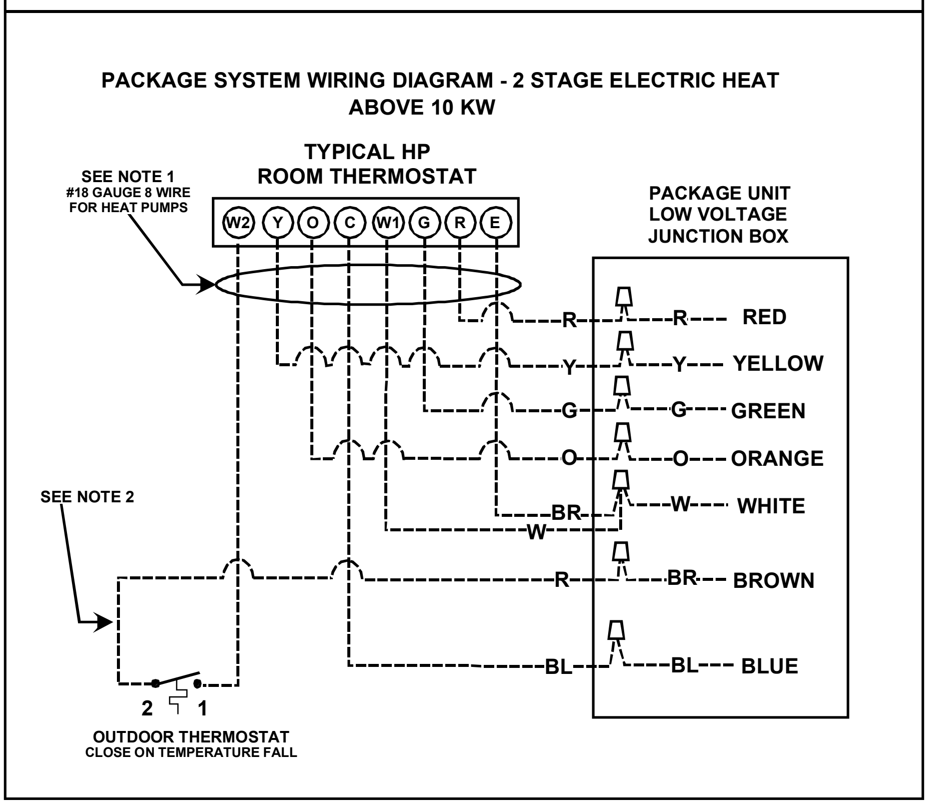
TROUBLESHOOTING

SYMPTOM	POSSIBLE CAUSE	REMEDY
High head - low suction	a. Restriction in liquid line or TXV not functioning	a. Remove or replace with proper size TXV.
High head - high or normal suction	a. In Cooling: Dirty condenser coil In Heating: Dirty filter, Dirty indoor coil b. Overcharged c. In Cooling: Condenser fan not running c. In Heating: Indoor blower not running	a. Clean coil b. Correct System charge c. Repair or Replace
Low head - high suction	a. Incorrect TXV. b. Defective compressor valves c. TXV not functioning properly d. Incorrect TXV setting	a. Replace with correct TXV b. Replace compressor c. Check for debris in TXV or deformed TXV. Remove debris or replace TXV. d. Check Super Heat
Unit will not run	a. Power off or loose electrical connection b. Thermostat out of calibration set too high c. Defective contactor d. Blown fuses or tripped breaker e. Transformer defective f. High or low pressure control open (Optional) g. Compressor overload contacts open	a. Check for unit voltage at contactor in unit b. Reset c. Check for 24 volts at contactor coil replace if contacts are open d. Replace fuse or reset breaker e. Check wiring - replace transformer f. Check high pressure control or check unit charge High pressure control opens at 610 psig Low pressure control opens at 22 psig g. Replace compressor NOTE: Wait at least 2 hours for overload to reset
Condenser fan runs, compressor doesn't	a. Loose connection b. Compressor stuck, grounded or open winding open internal overload c. Low voltage connection d. Capacitor weak, open, or shorted	a. Check for unit voltage at compressor check & tighten all connections b. Wait at least 2 hours for overload to reset If still open, replace the compressor. c. At compressor terminals, voltage must be within 10 % of nameplate volts when unit is operating d. Check capacitor. If defective, replace.
Low suction - cool compressor Iced evaporator coil	a. In Cooling: Low indoor airflow In Heating: Dirty outdoor coil, defective defrost thermostat, defective defrost control board, outdoor fan not running, low refrigerant charge. b. Low airflow c. Low refrigerant charge d. Operating unit in cooling mode below 65°F outdoor temperature	a. Increase speed of blower or reduce restriction - replace air filters b. Check - should be approximately 400 CFM per ton, dirty air filters, all duct outlets open c. Properly charge unit d. Install or check low ambient control, should be open below 65°F outdoor temperature
Compressor short cycles	a. Defective overload protector b. Unit cycling on low pressure control c. High pressure switch cuts out	a. Replace - check for correct voltage b. Check refrigerant charge and / or airflow c. Check airflow (indoor & outdoor), check expansion device
Registers sweat	a. Low airflow	a. Increase speed of blower or reduce restriction replace air filters
High suction pressure	a. Excessive load b. Defective compressor c. Reversing valve not seating properly.	a. Recheck load calculation b. Replace c. Replace
Insufficient cooling	a. Improperly sized unit b. Improper airflow c. Incorrect refrigerant charge. d. Incorrect voltage	a. Recalculate load b. Check - should be approximately 400 CFM per ton c. Charge per procedure attached to unit service panel d. At compressor terminals, voltage must be within 10% of nameplate volts when unit is operating

WIRING DIAGRAMS







NOTES:

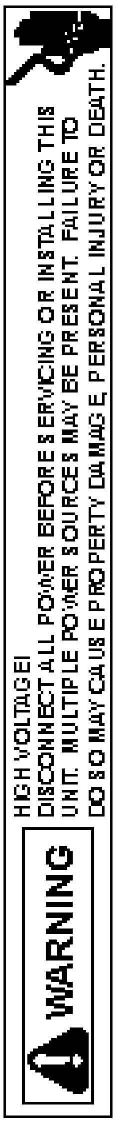
1) "O" and "E" used on heat pumps only.
2) Connect wire from terminal #1 on outdoor thermostat to the white wire on package units if single stage indoor thermostat is used.

Color Codes
R - Red
Y - Yellow
BL - Blue
BR - Brown
O - Orange
W - White
G - Green

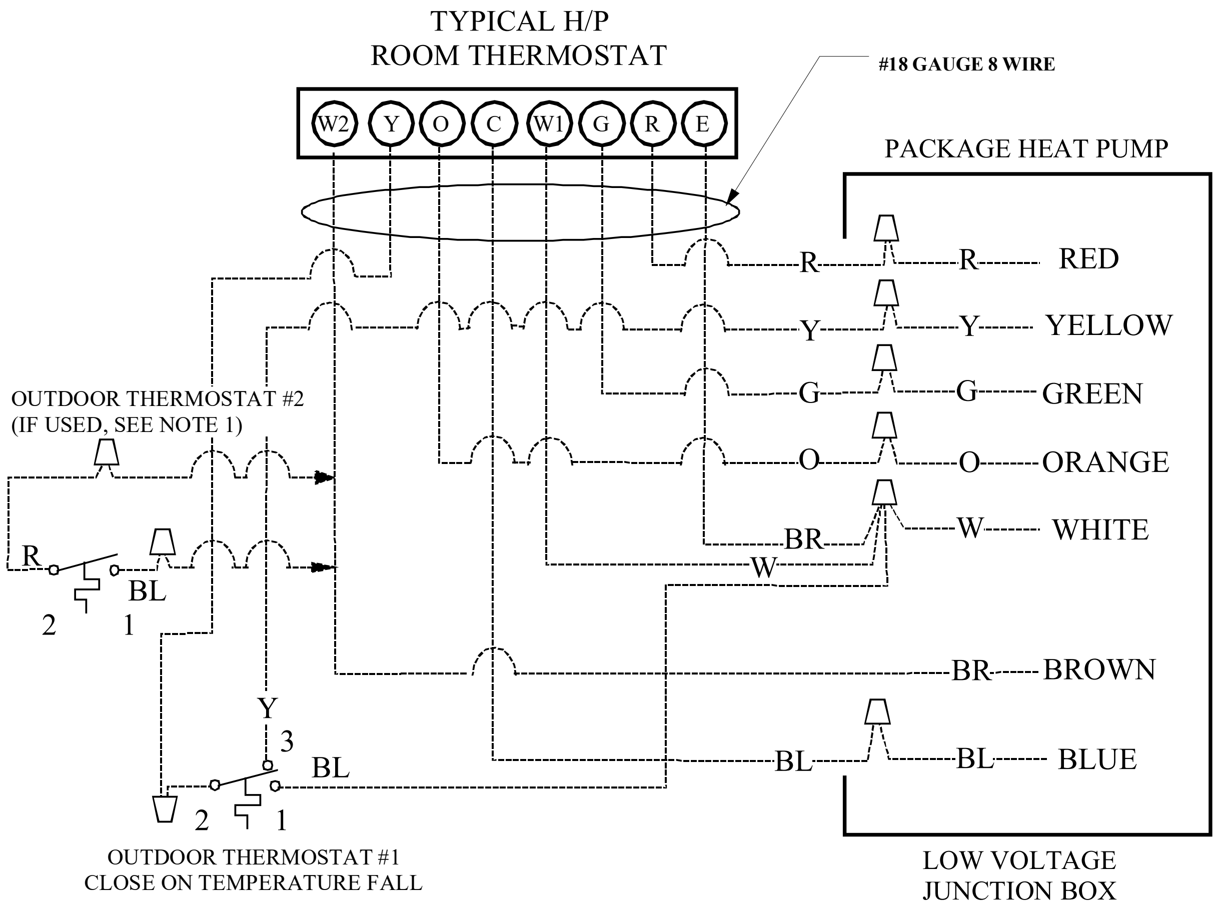
OT18-60A Outdoor Thermostat

Wiring is subject to change. Always refer to the wiring diagram on the unit for the most up-to-date wiring.

WIRING DIAGRAMS



PACKAGE SYSTEM WIRING DIAGRAM - HEAT PUMPS ONLY!
TWO-STAGE ELECTRIC HEAT ABOVE 10 kW



For outdoor temperatures below 0° F with 50% or higher relative humidity, set outdoor thermostat at 0° F

NOTE 1: OT18 #2 CAN BE CONNECTED BETWEEN W2 OF THERMOSTAT AND BROWN WIRE IF DESIRED.

COLOR CODES
R --RED
Y --YELLOW
BL-BLUE
BR-BROWN
O --ORANGE
W -WHITE
G --GREEN

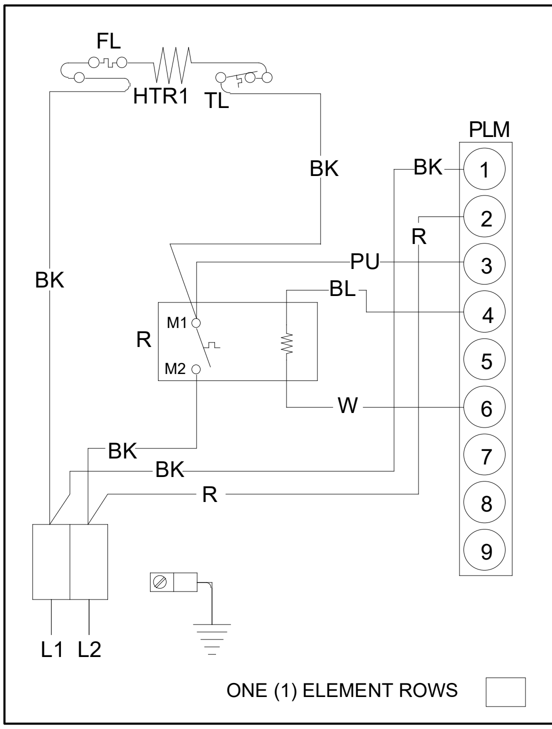
OT18-60A Outdoor Thermostat

Wiring is subject to change. Always refer to the wiring diagram on the unit for the most up-to-date wiring.

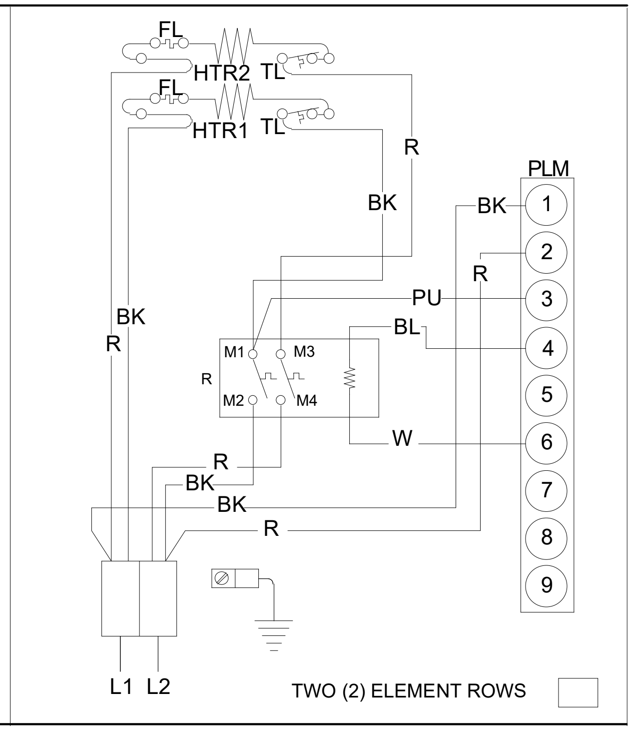
WIRING DIAGRAMS

WARNING

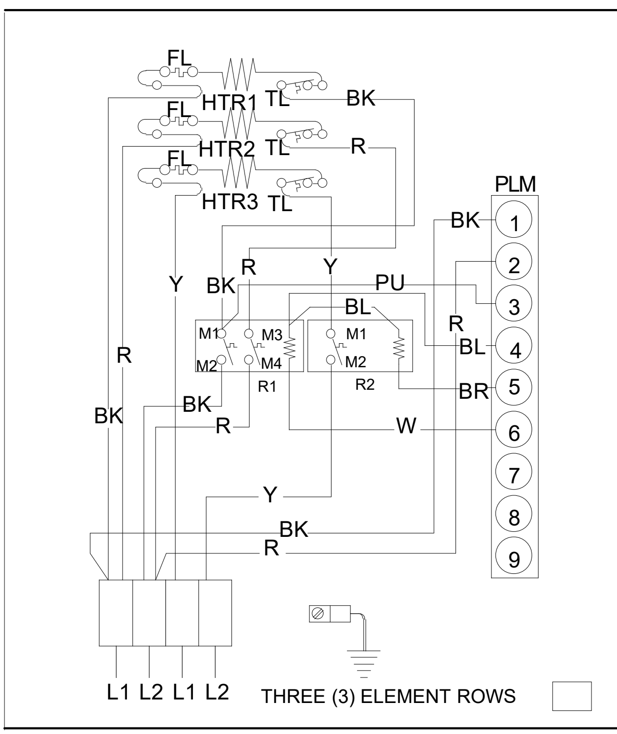
HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING THIS UNIT. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.



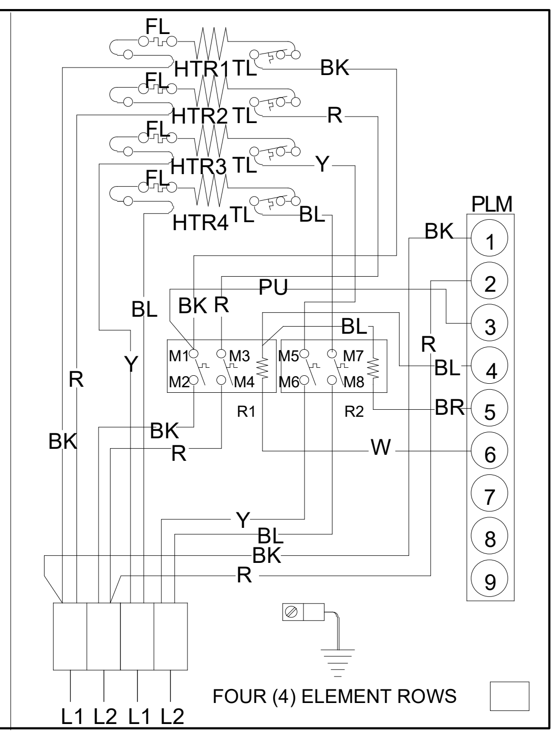
5 KW



10 KW



15 KW

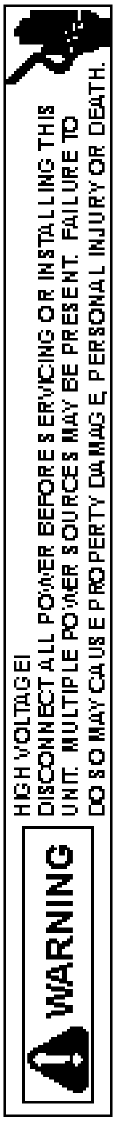


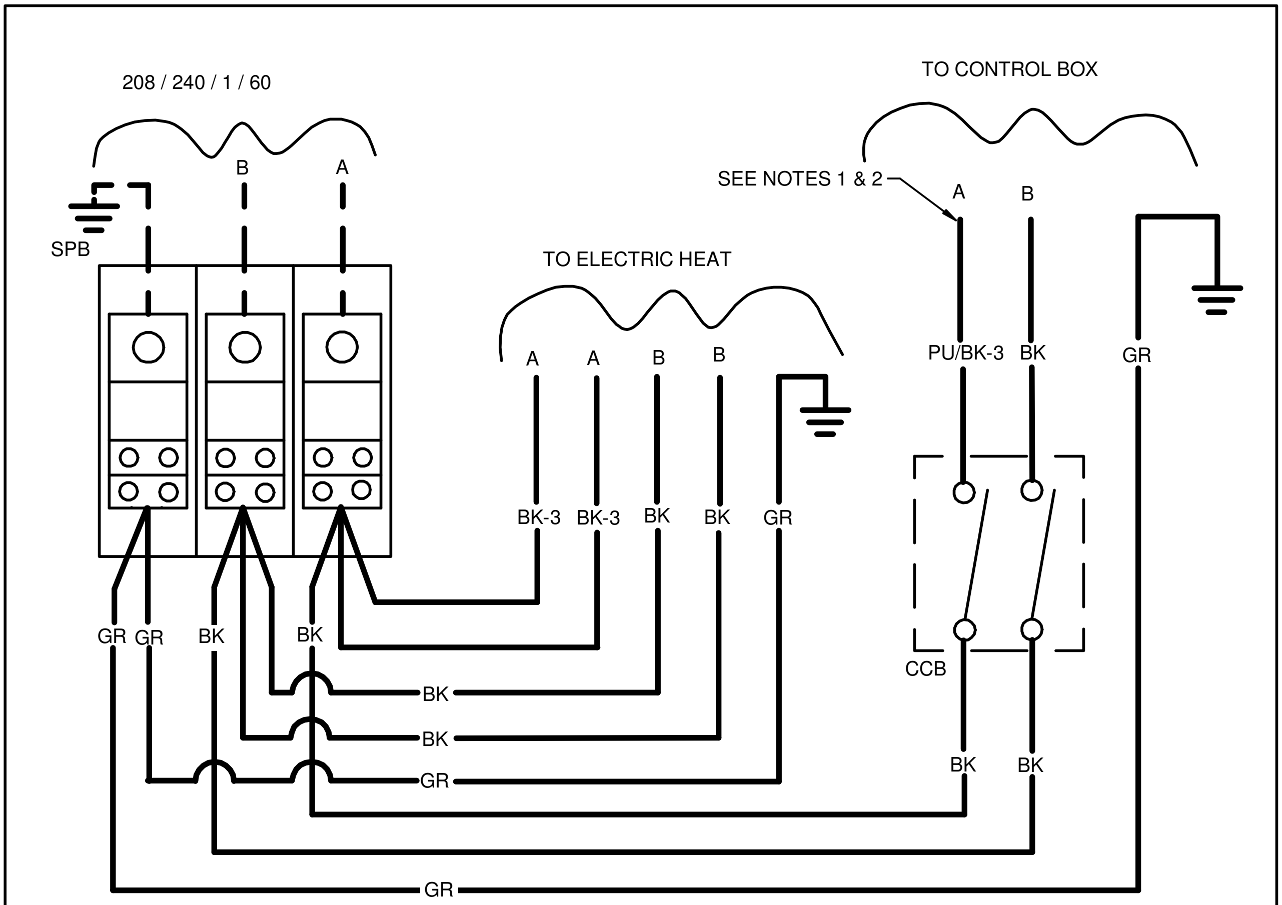
20 KW

Single Phase HKP / HKR** Heat Kit**

Wiring is subject to change. Always refer to the wiring diagram on the unit for the most up-to-date wiring.

WIRING DIAGRAMS





NOTES:
1. FOR APC & GPC UNITS: A = L1 / B = L2
   FOR APH & GPH UNITS: A = L2 / B = L1
2. 45, 40, 35, & 30 AMP BREAKERS WILL HAVE A PURPLE WIRE. 50 AND 60 AMP BREAKERS WILL HAVE BLACK WIRE LABELED WITH A #3

COMPONENT LEGEND

CCB - COMPRESSOR CIRCUIT BREAKER
SPB - SINGLE POINT BLOCK

WIRING CODE

FACTORY WIRING
HIGH VOLTAGE ————
OPTIONAL HIGH VOLTAGE —-—-—
FIELD WIRING
HIGH VOLTAGE — — —

COLOR CODE

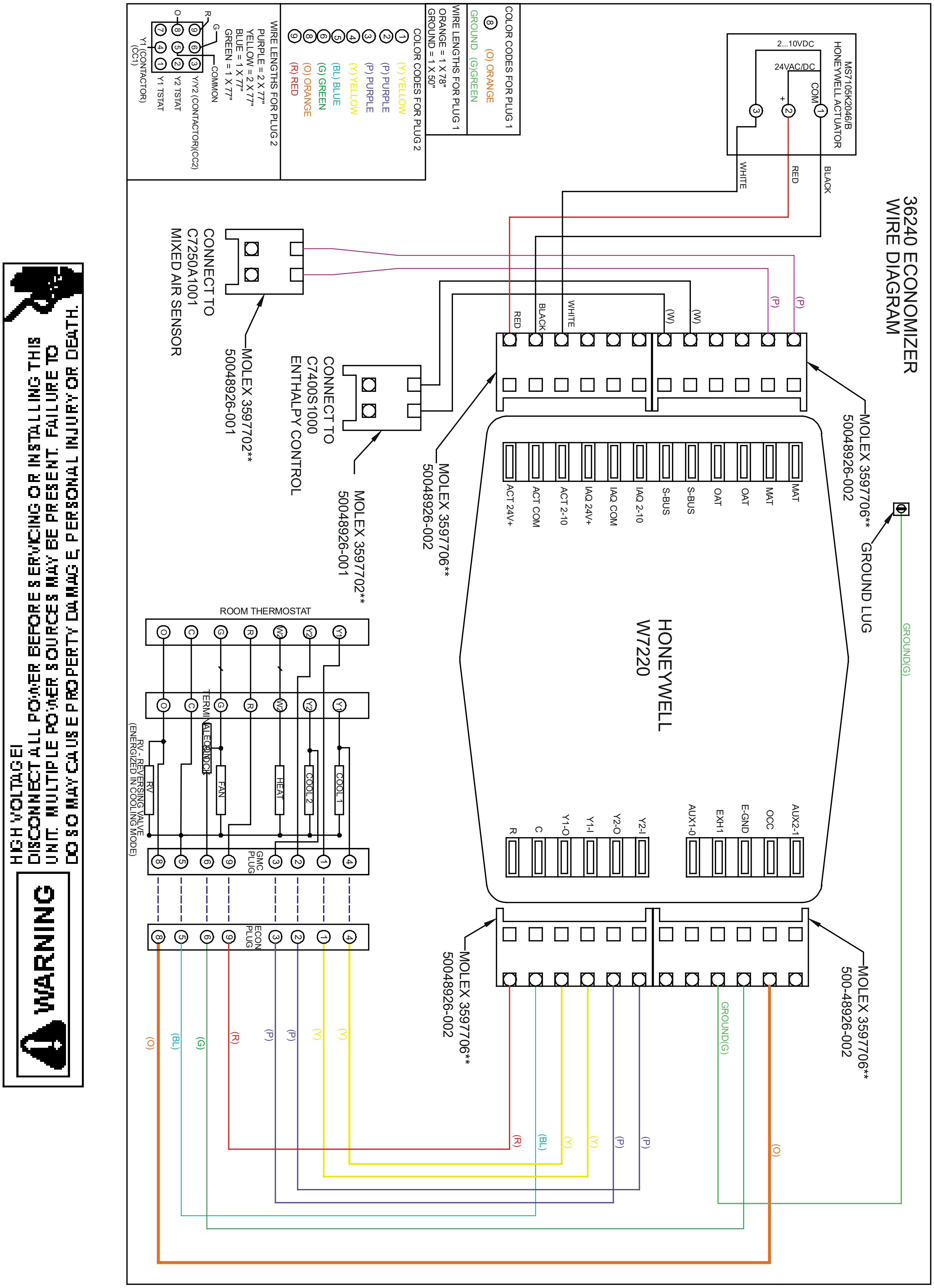
BK --------------- BLACK
GR---------------- GREEN
BR --------------- BROWN
PU --------------- PURPLE
WH -------------- WHITE
YL --------------- YELLOW

0140G02544-B

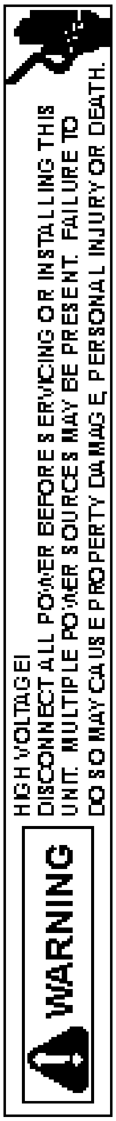
Wiring is subject to change. Always refer to the wiring diagram on the unit for the most up-to-date wiring.

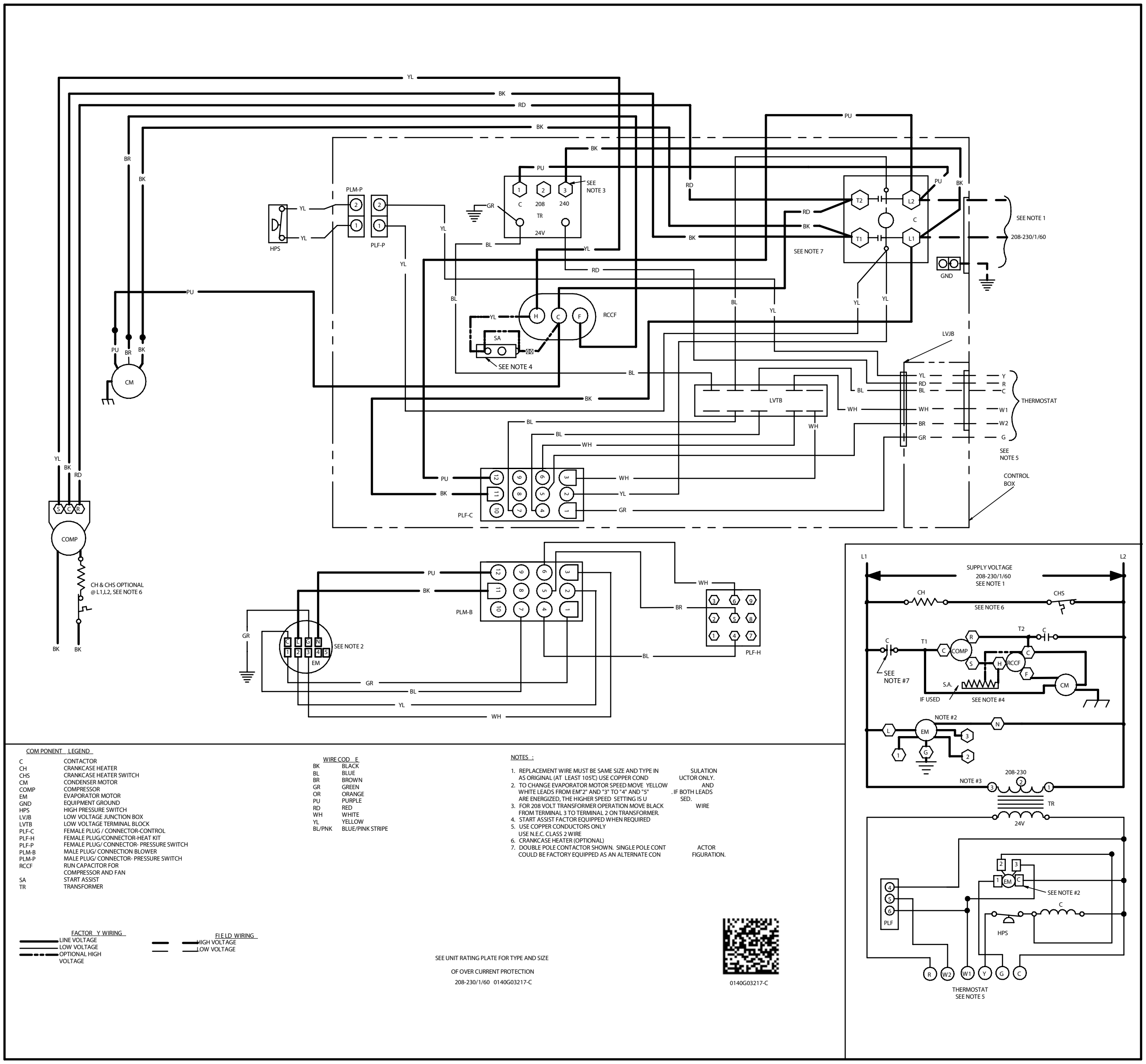
WIRING DIAGRAMS

Economizer



Wiring is subject to change. Always refer to the wiring diagram on the unit for the most up-to-date wiring.





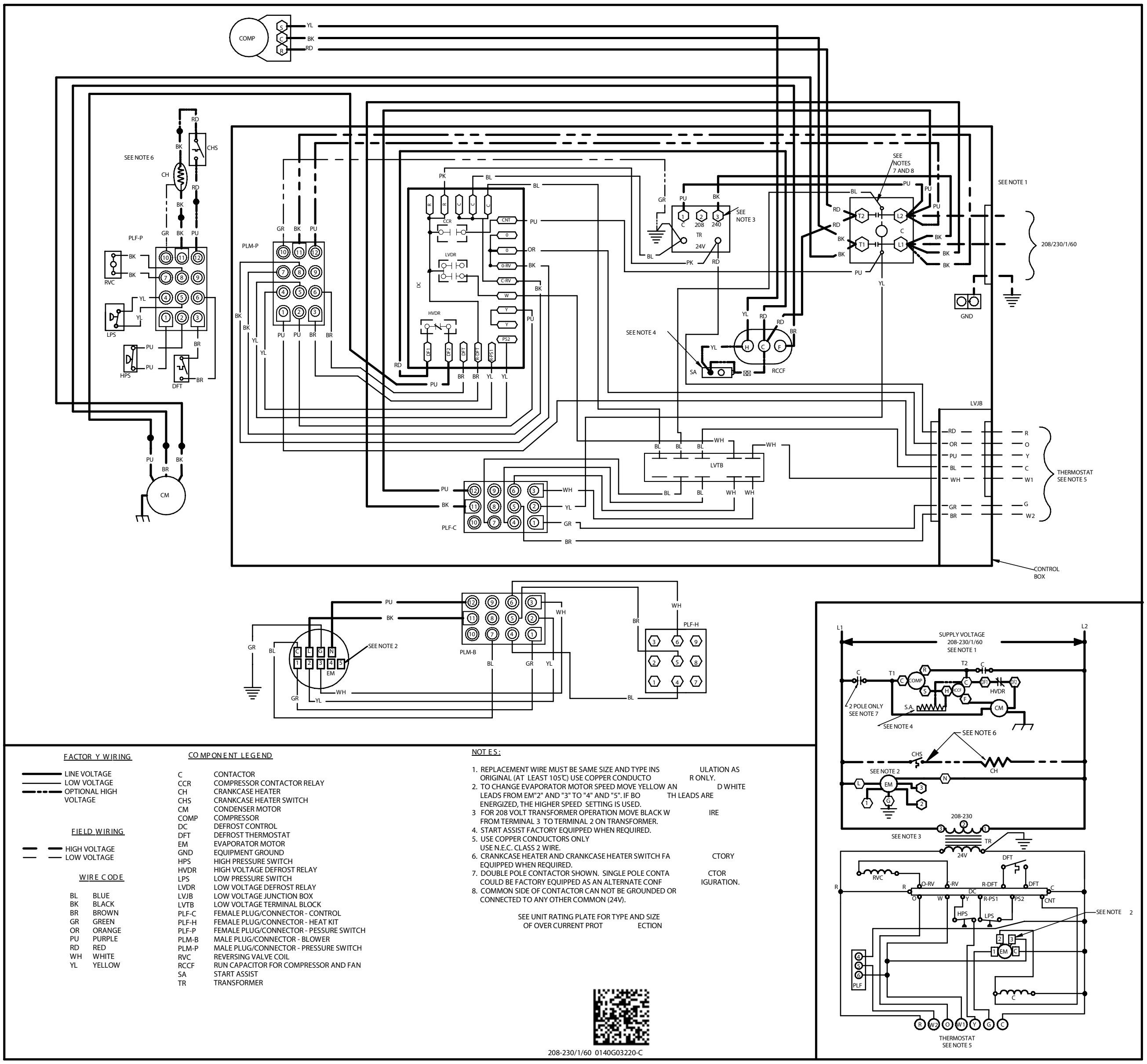
Wiring is subject to change. Always refer to the wiring diagram on the unit for the most up-to-date wiring.

WIRING DIAGRAMS

A/GPHM3[24-48]M41A*

WARNING

HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING THIS UNIT. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.



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WARNING

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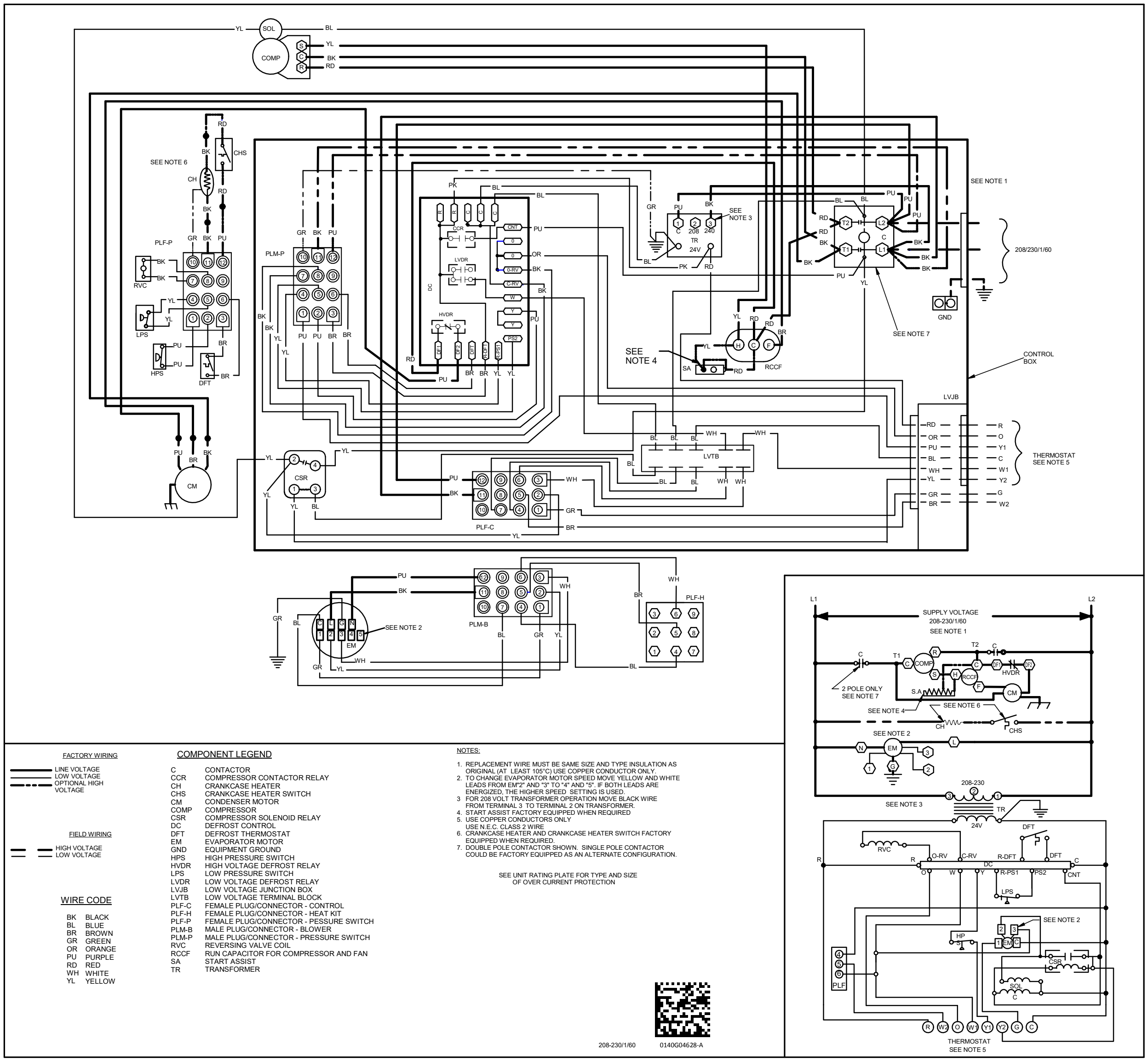
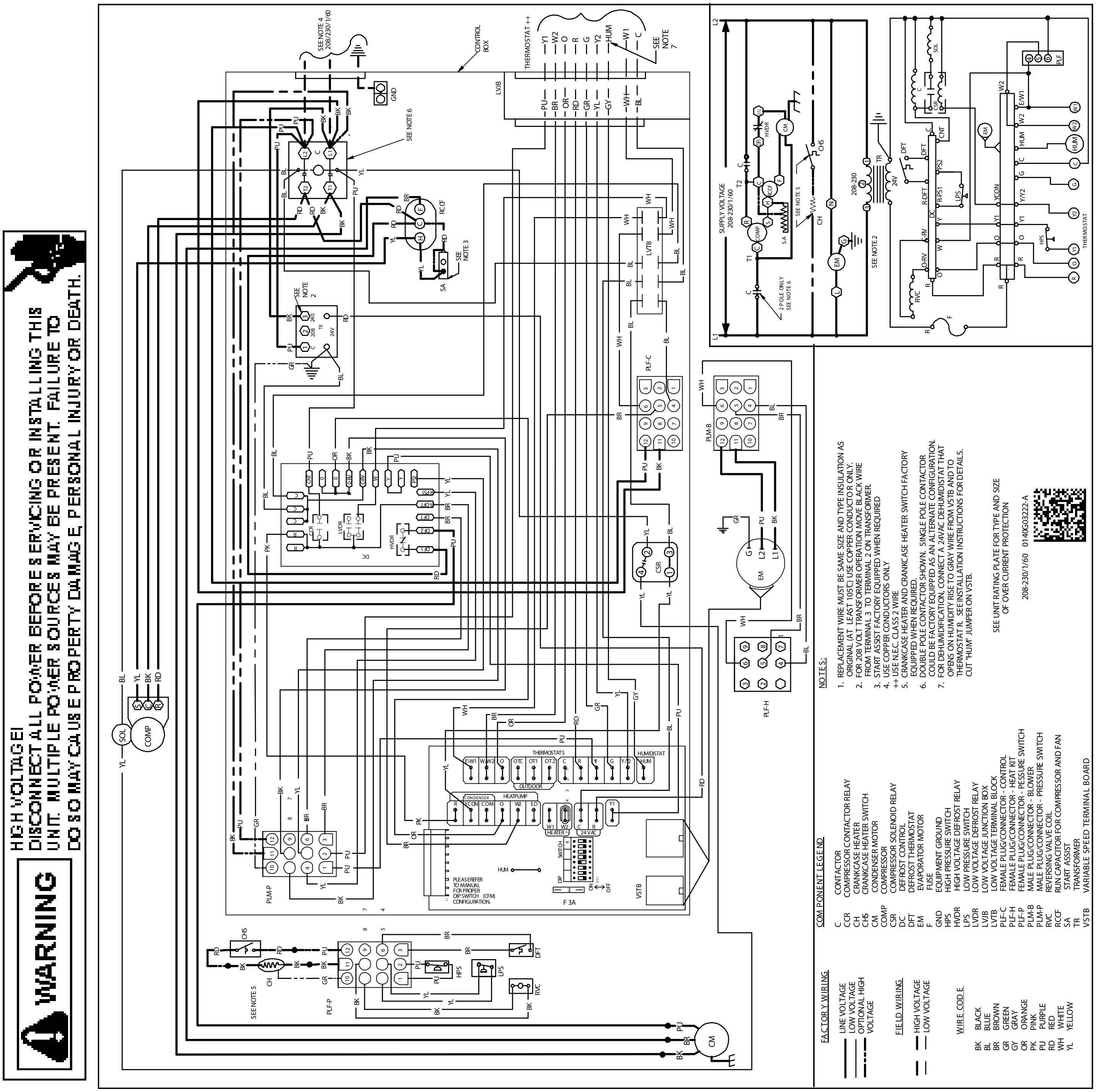


Wiring is subject to change. Always refer to the wiring diagram on the unit for the most up-to-date wiring.

WIRING DIAGRAMS

APHM5[24-48]M41A*



Wiring is subject to change. Always refer to the wiring diagram on the unit for the most up-to-date wiring.

WARNING

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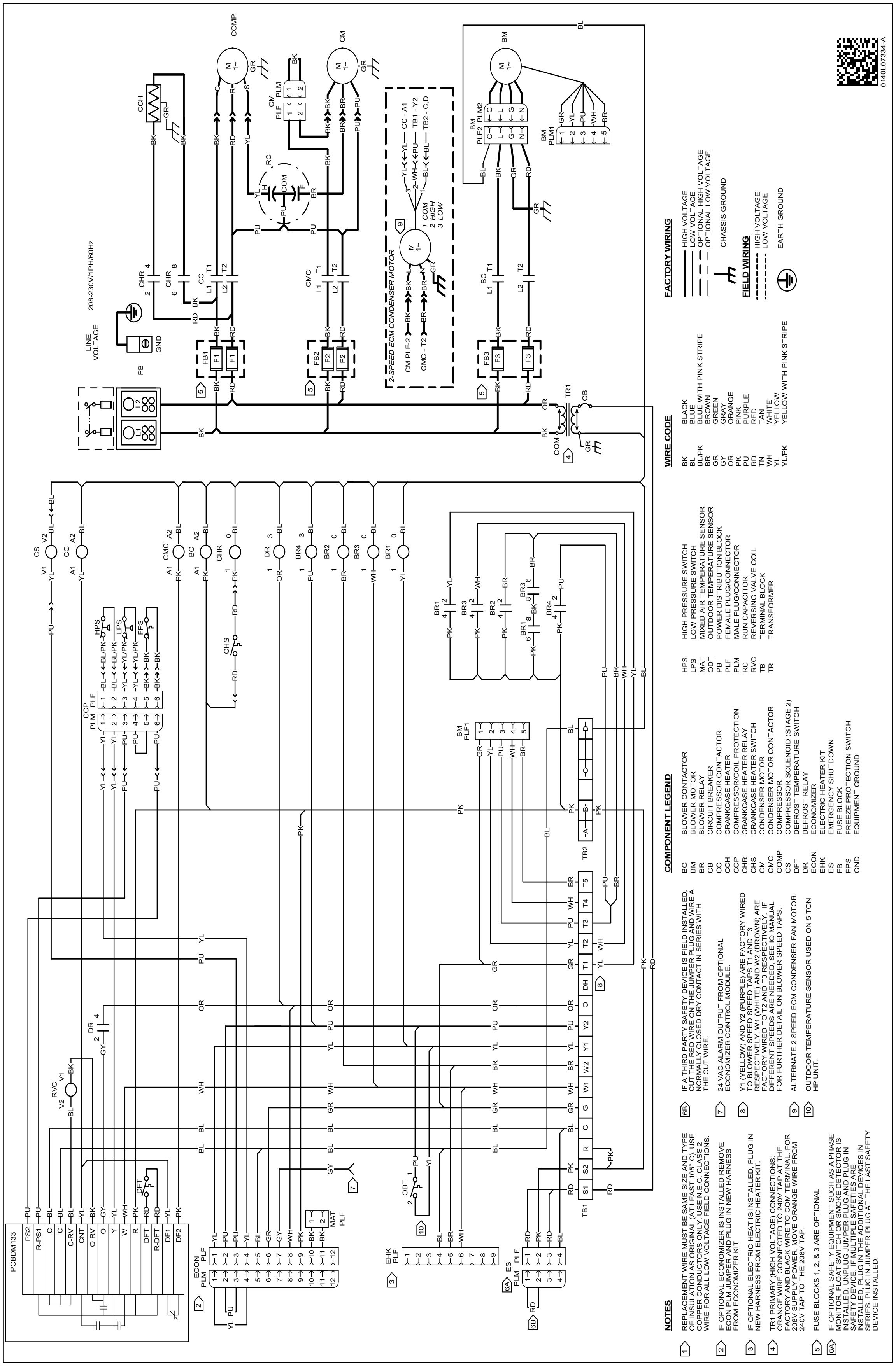

Wiring is subject to change. Always refer to the wiring diagram on the unit for the most up-to-date wiring.

WARNING

HIGH VOLTAGE!
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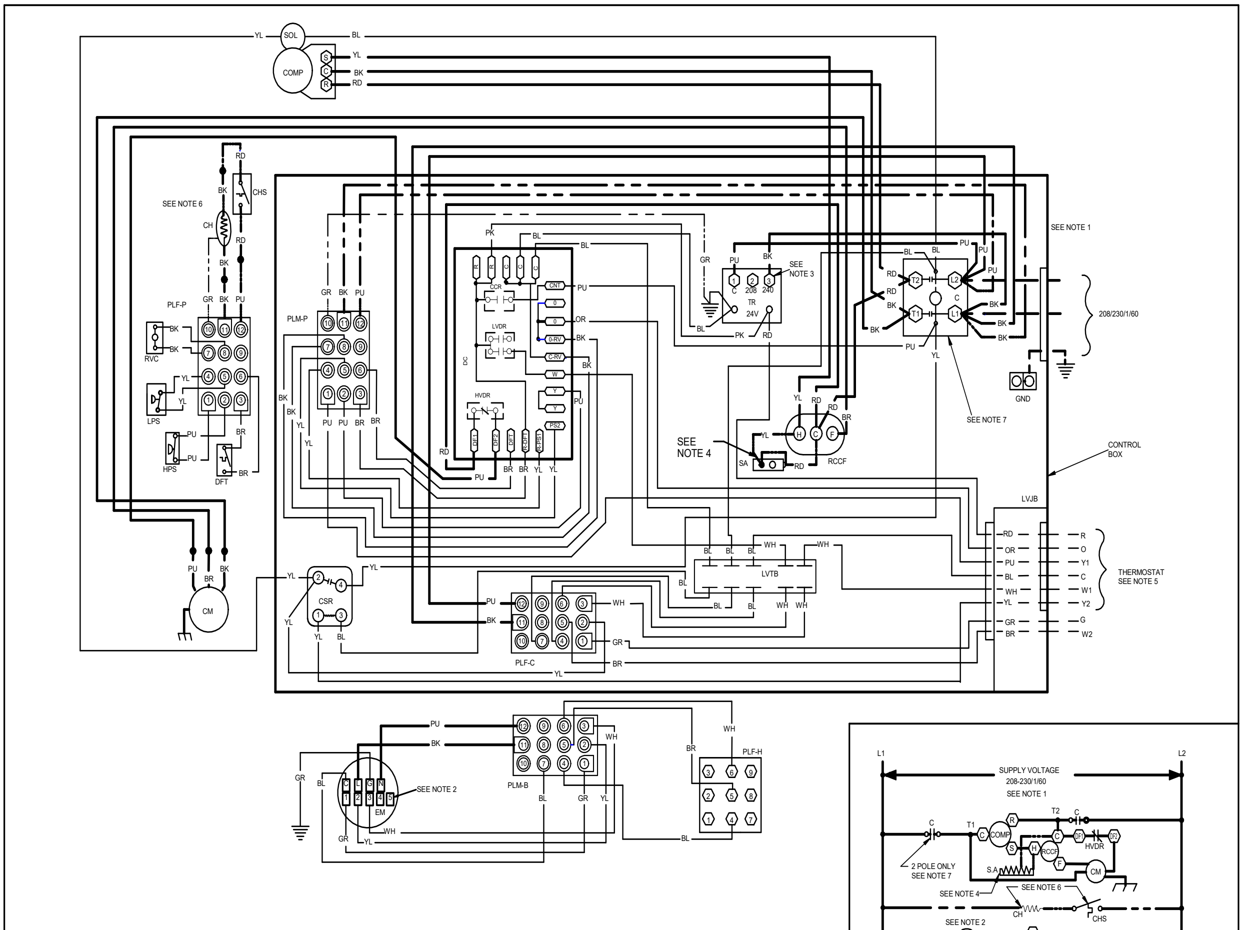

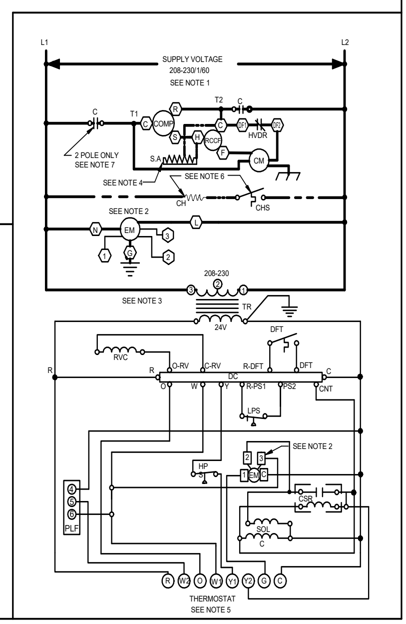

FACTORY WIRING

LINE VOLTAGE
LOW VOLTAGE
OPTIONAL HIGH VOLTAGE

FIELD WIRING

HIGH VOLTAGE
LOW VOLTAGE

WIRE CODE

BK	BLACK
BL	BLUE
BR	BROWN
GR	GREEN
OR	ORANGE
PU	PURPLE
RD	RED
WH	WHITE
YL	YELLOW

COMPONENT LEGEND

C	CONTACTOR
CCR	COMPRESSOR CONTACTOR RELAY
CH	CRANKCASE HEATER
CHS	CRANKCASE HEATER SWITCH
CM	CONDENSER MOTOR
COMP	COMPRESSOR
CSR	COMPRESSOR SOLENOID RELAY
DC	DEFROST CONTROL
DFT	DEFROST THERMOSTAT
EM	EVAPORATOR MOTOR
GND	EQUIPMENT GROUND
HPS	HIGH PRESSURE SWITCH
HVDR	HIGH VOLTAGE DEFROST RELAY
LPS	LOW PRESSURE SWITCH
LVDR	LOW VOLTAGE DEFROST RELAY
LVJB	LOW VOLTAGE JUNCTION BOX
LVTB	LOW VOLTAGE TERMINAL BLOCK
PLF-C	FEMALE PLUG/CONNECTOR - CONTROL
PLF-H	FEMALE PLUG/CONNECTOR - HEAT KIT
PLF-P	FEMALE PLUG/CONNECTOR - PESSURE SWITCH
PLM-B	MALE PLUG/CONNECTOR - BLOWER
PLM-P	MALE PLUG/CONNECTOR - PRESSURE SWITCH
RVC	REVERSING VALVE COIL
RCCF	RUN CAPACITOR FOR COMPRESSOR AND FAN
SA	START ASSIST
TR	TRANSFORMER

NOTES:

1. REPLACEMENT WIRE MUST BE SAME SIZE AND TYPE INSULATION AS ORIGINAL (AT LEAST 105°C) USE COPPER CONDUCTOR ONLY.
2. TO CHANGE EVAPORATOR MOTOR SPEED MOVE YELLOW AND WHITE LEADS FROM EM"2" AND "3" TO "4" AND "5". IF BOTH LEADS ARE ENERGIZED, THE HIGHER SPEED SETTING IS USED.
3. FOR 208 VOLT TRANSFORMER OPERATION MOVE BLACK WIRE FROM TERMINAL 3 TO TERMINAL 2 ON TRANSFORMER.
4. START ASSIST FACTORY EQUIPPED WHEN REQUIRED
5. USE COPPER CONDUCTORS ONLY
   USE N.E.C. CLASS 2 WIRE
6. CRANKCASE HEATER AND CRANKCASE HEATER SWITCH FACTORY EQUIPPED WHEN REQUIRED.
7. DOUBLE POLE CONTACTOR SHOWN. SINGLE POLE CONTACTOR COULD BE FACTORY EQUIPPED AS AN ALTERNATE CONFIGURATION.

SEE UNIT RATING PLATE FOR TYPE AND SIZE OF OVER CURRENT PROTECTION

208-230/1/60 0140G04628-A

Wiring is subject to change. Always refer to the wiring diagram on the unit for the most up-to-date wiring.

CUSTOMER FEEDBACK
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