SERVICE INSTRUCTION

DEFROST CONTROL FIXED TIME INTERVAL S116

JANUARY 06,2000
SI-S116

CONSOLIDATED TECHNOLOGY CORPORATION

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***** Safety *****

Heat pumps are appliances in which service, if improperly performed, may result in personal injury or damage to equipment or property. **Follow proper and workmanlike safety procedures.** Before proceeding, carefully read and understand the entire instructions, recognize each component, and understand its function. More than one design is covered by these instructions. Refer to section 2 to determine the design you have. *Most down flow units will need to be removed for sensor access.*

SECTION-1-PARTS LIST

Before you begin changing this control, first check the kit to make sure that you have the complete kit. The items should be as follows:

Item description	CTC Part No.	Qty.
Instruction Manual	SI-S116	1
Defrost Control	24015401	1
Defrost Sensor	24016207	1
Nylon Tie Strap	32015602	2
Presstite x 6"	22010106	1
Wire, Black	W1801000X2560	3
Relay, Defrost Heater	24015000	1
Screws	20025007	2

SECTION-2-UNIT DESIGN

(a) Units prior to date code 96050076 containing a standard fan relay will not need the *additional* defrost heater relay. Refer to wiring diagram on page (5).

(b) Units falling between date codes 96050076 and 98020066 containing a post purge (*delay off*) fan relay will need the defrost heater relay added. Refer to wiring diagram on page (4).

(c) Units falling after date code 98020066 refer to wiring diagram in the unit. *See figure 2*

SECTION-3-PROCEDURE

****WARNING****

MORE THAN ONE DISCONNECT MAY BE REQUIRED TO DE-ENERGIZE THE UNIT. TO PREVENT RISK OF ELECTRICAL SHOCK, OPEN *ALL* REMOTE DISCONNECTS BEFORE SERVICING THIS APPLIANCE.

NOTE: FOR UNIT DESIGNS A-B, THIS IS NOT AN IDENTICAL REPLACMENT, THEREFORE, THE WIRING WILL CHANGE FROM THE ORIGINAL.

1. Turn off all electrical power to the unit at the home's main service panel.
2. Remove the upper front panel and the control box access cover from the heat pump.
3. Remove and discard the red wire between the transformer and the old control board, designs A-B *See figure 1* page 3.
4. For unit design B requiring the additional relay, find a suitable location and mount the relay with the screws provided.
5. Reach behind the control box and cut the sensor wires that are molded into the old defrost board (2 blue and 1 white/2 red and 1 white) and pull those wires out. Disconnect the remaining leads from the old defrost control. These leads are indicated as broken lines in figure 1. Remove old control.
6. Mount the new defrost control in the exact location the old one was removed from.

7. Bring the two leads of the new defrost sensor into the control box. Connect one of the leads to the 24 volt terminal of the transformer and connect the other lead to the new defrost control at one of the terminals labeled **24VAC.**

8. Reconnect the leads disconnected in step 5 to the new control. *Note: The old control has two common terminals whereas the new control has one. The two commons must be tied together or the reversing valve common will need to be relocated.*

9. Units requiring the additional relay will wire as follows:
   a. remove the brown wire from pin # 3 of the defrost relay and move it to pin # 3 of the defrost heater relay.
   b. using one of the new wires, connect one end to pin # 1 of the defrost heater relay and the other end to the hold terminal of the new defrost control.
   c. with another new wire, place one end on pin # 3 of the defrost relay, and the other end of this wire on coil terminal (A) of the defrost heater relay.
   d. place one end of the third and final wire on coil terminal (B) of the defrost heater relay, and the other end of this wire on transformer common.

10. Refer to figure (4) for proper location of the defrost sensor according to unit model # and coil design. Secure the sensor to the U-Bend with one of the tie wraps provided. Wrap the sensor with the piece of presstite provided to prevent the sensor from being influenced by surrounding air temperatures.

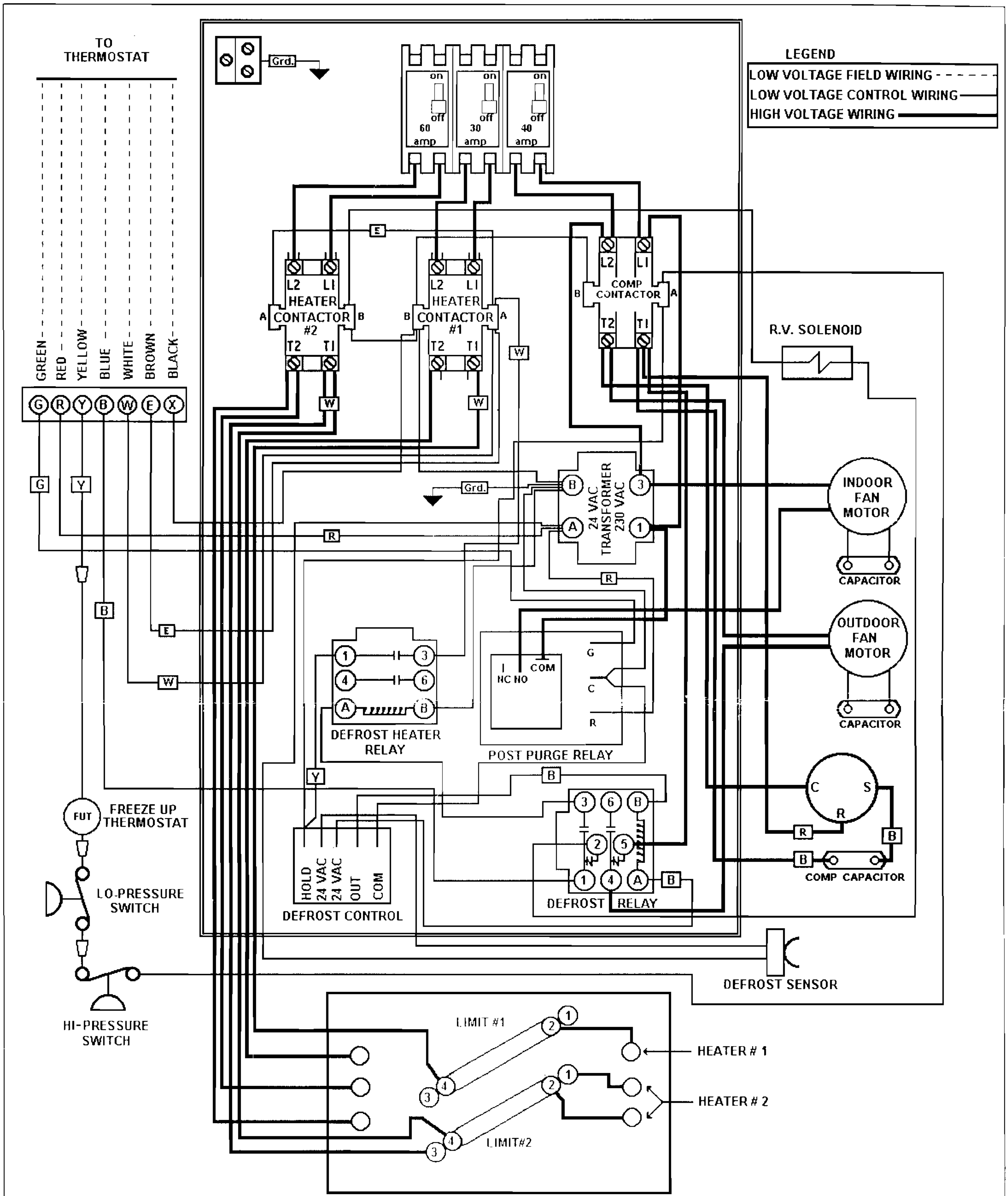
11. Check the new control's run time jumper. Recommended setting is (60) minutes.

12. Test the defrost control as follows:
    a. place a jumper from transformer 24VAC to the 24VAC terminal at the control board to simulate closed contacts.
    b. with the unit running in the heat mode, short the test pins until a click is heard, remove the short immediately. Outdoor fan should shut off, reversing valve should switch, and heater contactor(s) should engage.
    c. turn off the unit and remove the test jumper from the 24VAC terminals

13. Affix these instructions close to the unit for future reference.

14. Design A units refer to figure 3 for wire diagram.

IF YOU HAVE ANY QUESTIONS REGUARDING THESE SERVICE INSTRUCTIONS OR NEED TECHNICAL ASSISTANCE PLEASE CALL TOLL FREE 1-800-807-7066 extension 3


TO THERMOSTAT
LEGEND
LOW VOLTAGE FIELD WIRING
LOW VOLTAGE CONTROL WIRING
HIGH VOLTAGE WIRING
GREEN
RED
YELLOW
BLUE
WHITE
BROWN
BLACK
on
off
60 amp
30 amp
40 amp
Grd.
HEATER CONTACTOR #2
HEATER CONTACTOR #1
COMP CONTACTOR
R.V. SOLENOID
24 VAC TRANSFORMER 230 VAC
INDOOR FAN MOTOR
CAPACITOR
OUTDOOR FAN MOTOR
CAPACITOR
FREEZE UP THERMOSTAT
LO-PRESSURE SWITCH
HI-PRESSURE SWITCH
DEFROST HEATER RELAY
POST PURGE RELAY
DEFROST CONTROL
HOLD
24 VAC
24 VAC
OUT
COM
DEFROST RELAY
COMP CAPACITOR
DEFROST SENSOR
LIMIT #1
LIMIT#2
HEATER # 1
HEATER # 2
Figure 2

Friedrich®

INSIDER® AND VERT-I-PAK® B SERIES


SERVICE MANUAL

INVBSVC (03/02)

Table of Contents

Introduction

This service manual is designed to be used in conjunction with the installation manuals provided with each air conditioning system component. Air conditioning systems consist of **BOTH** an **evaporator** (indoor section) and a **condenser** (outdoor section) in one closed system, and a room thermostat. Electric strip heaters are also considered part of the system.

This service manual was written to assist the professional HVAC service technician to quickly and accurately diagnose and repair any malfunctions of this product.

IMPORTANT: It will be necessary for you to accurately identify the unit you are servicing, so you can be certain of a proper diagnosis and repair. (See Unit Identification.)

The information contained in this manual is intended for use by a qualified service technician who is familiar with the safety procedures required in installation and repair, and who is equipped with the proper tools and test instruments.

Installation or repairs made by unqualified persons can result in hazards subjecting the unqualified person making such repairs to the risk of injury or electrical shock which can be serious or even fatal not only to them, but also to persons being served by the equipment.

If you install or perform service on equipment, you must assume responsibility for any bodily injury or property damage which may result to you or others. Friedrich Air Conditioning Company will not be responsible for any injury or property damage arising from improper installation, service, and/or service procedures.

Model Number Identification Guide

MODEL NUMBER ------ C D H P 18 B 05 0 A

- **DESIGN SERIES**: A
- C = Standard Efficiency
- E = High Efficiency
- D = Down Flow
- U = Up Flow
- AC = Air Conditioning
- H = Heat Pump
- Series P – B

NOMINAL CAPACITY (BTUh)

18 = 18,000 22 = 22,000 24 = 24,000
25 = 25,000 29 = 29,000 35 = 35,000
36 = 36,000 48 = 48,000

VOLTAGE

B = 208/230V - 1Ph - 60 Hz Active Defrost
E = 208/230V - 1 Ph - 60 Hz Passive Defrost

FILTER TYPE

0 = Front grille w/filter CDHP models
1 = No grille, drop-in rack w/filter
2 = Left side RA duct w/o filter
3 = Front RA duct w/o filter

ELECTRIC HEATER SIZE

(Nominal KW size)
05 = 5.0 KW
10 = 10.0 KW
15 = 15.0KW

Model Number Identification Guide

MODEL NUMBER ——— V E B 24 K 10 RT A

- **ENGINEERING CODE**: A
- V = Vertical Series
- E = Cooling with or without electric heat
- H = Heat Pump

DESIGN SERIES

NOMINAL CAPACITY (BTUh)

24= 24,000 30 = 30,000 36 = 36,000
42 = 42,000 48 = 48,000 60 =60,000

VOLTAGE

K = 208/230V - 1Ph. - 60Hz.

DEFROST TYPE

RT = Active Defrost
FF = Passive Defrost

ELECTRIC HEATER SIZE

(Nominal KW size)
05 = 5.0 KW 20 = 20,000 KW
10 = 10.0 KW 25 = 25,000 KW
15 = 15.0 KW

Serial Number Identification Guide

SERIAL NUMBER 01 01 00001

PRODUCTION RUN NUMBER: 00001

Year Manufactured: 01

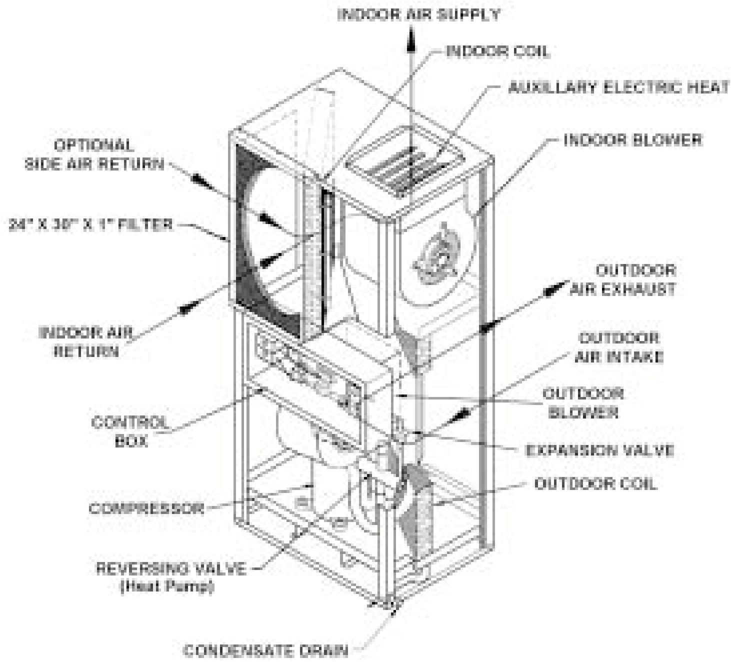
Month Manufactured: 01

01 = Jan	04 = Apr	07 = Jul	10 = Oct
02 = Feb	05 = May	08 = Aug	11 = Nov
03 = Mar	06 = Jun	09 =Sep	12 = Dec

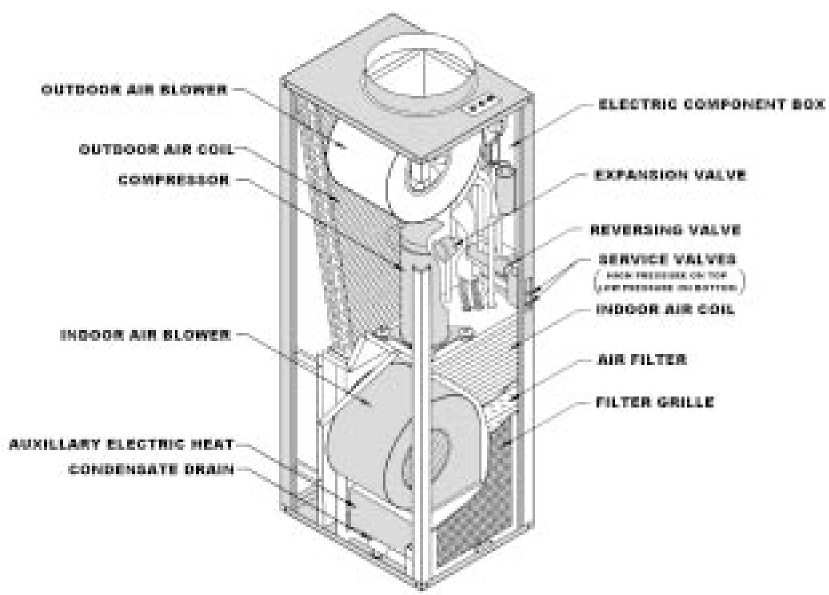
GENERAL DESCRIPTION

INSIDER and VERT-I-PAK B Series models are self-contained indoor heating and cooling systems. This means that all of the components for heating and cooling are in a single package.

INSIDER and VERT-I-PAK B Series units are manufactured as air conditioners with electric heat as well as heat pumps. These units are very similar to their heat pump counterparts with the main difference being in the control box components and the air conditioners do not have reversing valves. Basically everything else is the same. The cabinets are the same, the major components are the same, as is their general locations in the cabinet.



B-SERIES VERT-I-PAK® UPFLOW MODELS



INSIDER DOWNFLOW MODELS

REFRIGERANT SYSTEM OPERATION

A good understanding of the basic operation of the refrigeration system is essential for the service technician. Without this understanding, accurate troubleshooting of refrigeration system problems will be more difficult and time consuming, if not (in some cases) entirely impossible. The refrigeration system uses four basic principles (laws) in its operation they are as follows:

1. "Heat always flows from a warmer body to a cooler body."
2. "Heat must be added to or removed from a substance before a change in state can occur."
3. "Flow is always from a higher pressure area to a lower pressure area."
4. "The temperature at which a liquid or gas changes state is dependent upon the pressure."

The refrigeration cycle begins at the compressor. Starting the compressor creates a low pressure in the suction line which draws refrigerant gas (vapor) into the compressor. The compressor then "compresses" this refrigerant, raising its pressure and its (heat intensity) temperature.

The refrigerant leaves the compressor through the discharge line as a HOT high pressure gas (vapor). The refrigerant enters the condenser coil where it gives up some of its heat. The condenser fan moving air across the coil's finned surface facilitates the transfer of heat from the refrigerant to the relatively cooler outdoor air.

When a sufficient quantity of heat has been removed from the refrigerant gas (vapor), the refrigerant will "condense" (i.e. change to a liquid). Once the refrigerant has been condensed (changed) to a liquid it is cooled even further by the air that continues to flow across the condenser coil.

The system design determines at exactly what point (in the condenser) the change of state (i.e. gas to a liquid) takes place. In all cases, however, the refrigerant must be totally condensed (changed) to a liquid before leaving the condenser coil.

The refrigerant leaves the condenser coil through the liquid line as a WARM high pressure liquid. It next will pass through the refrigerant drier (if so equipped). It is the function of the drier to trap any moisture present in the system, contaminants, and LARGE particulate matter.

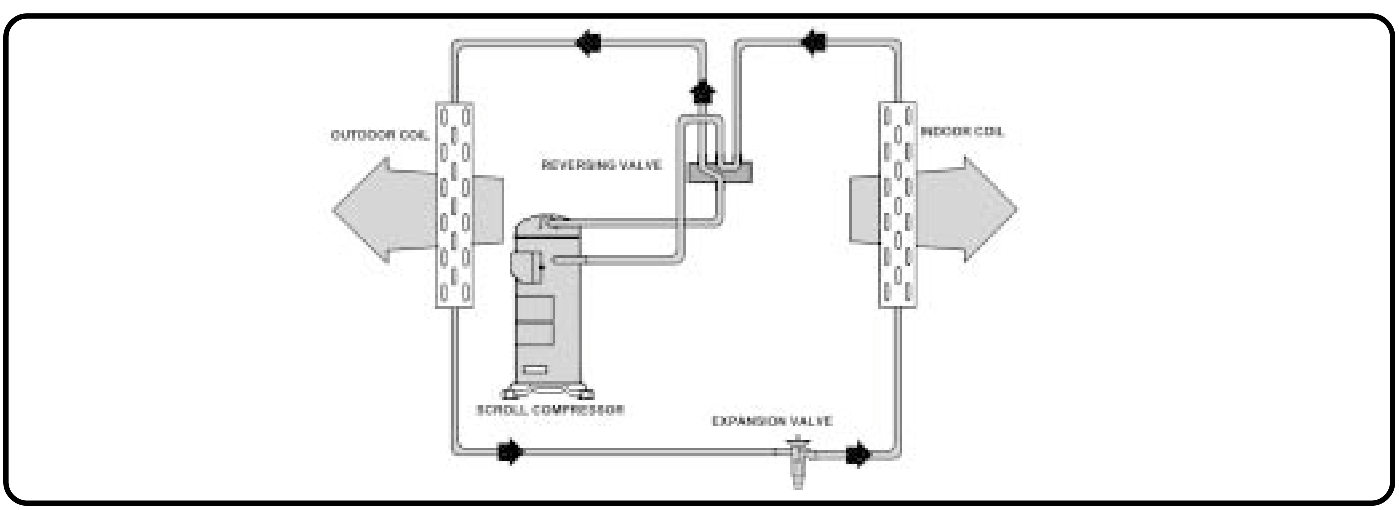
The liquid refrigerant next enters the metering device. The metering device is a TXV. The purpose of the metering device is to "meter" (i.e. control or measure) the quantity of refrigerant entering the evaporator coil.

Since the evaporator coil is under a lower pressure (due to the suction created by the compressor) than the liquid line, the liquid refrigerant leaves the metering device entering the evaporator coil. As it enters the evaporator coil, a larger area and lower pressure allows the refrigerant to expand and lower its temperature (heat intensity.) This expansion is often referred to as "boiling." Since the units blower is moving indoor air across the finned surface of the evaporator coil, the expanding refrigerant absorbs some of that heat. This results in a lowering of the indoor air temperature, hence the "cooling" effect.

The expansion and absorbing of heat cause the liquid refrigerant to evaporate (i.e. change to a gas). Once the refrigerant has been evaporated, it is heated even further by the air that continues to flow across the evaporator coil.

The particular system design determines at exactly what point (in the evaporator) the change of state (i.e. liquid to gas) takes place. In all cases, the refrigerant must be totally evaporated (changed) to a gas before leaving the evaporator coil.

The low pressure (suction) created by the compressor causes the refrigerant to leave the evaporator through the suction line as a COOL low pressure vapor. The refrigerant then returns to the compressor, where the cycle is repeated.



SEQUENCE OF OPERATION

Air Circulation

When the thermostat is set with the FAN switch set to ON and the SYSTEM switch is set to OFF, the heat pump is in air circulation mode. While the thermostat is set this way a 24 volt signal is on the "G" thermostat terminal, energizing the blower control, turning on the indoor-air blower. The blower will run continuously until the setting is changed.

Cooling

When thermostat is set for cooling mode (SYSTEM switch set to COOL and FAN switch set to AUTO) a rise in room temperature will make a 24-volt signal on the "G" thermostat terminal to the post purge control turning on the indoor air blower. It also causes a 24-volt signal on the "Y" thermostat conductor to the high and low pressure switches energizing the compressor contactor turning on the compressor and outdoor air blower.

A drop in room temperature will break the 24-volt signal on the "Y" thermostat terminal de-energizing the compressor contactor turning off the compressor and outdoor air blower. It also causes the loss of the 24-volt signal on the "G" thermostat terminal starting the timer of the post purge control (60-second delay) to turn off the indoor air blower.

Heating

With the thermostat set to heating mode (SYSTEM switch set to HEAT and FAN switch set to AUTO) a drop in the room temperature will make a 24-volt signal on the "G" thermostat terminal to the post purge control turning on the indoor air blower. It also makes a 24-volt signal on the "Y" thermostat terminal through the high-pressure switch and low pressure switch energizing the compressor contactor turning on the compressor and outdoor air blower. The reversing valve solenoid coil will be energized through the "B" terminal when the thermostat is set to the heat position.

A further drop in the room temperature will make a 24-volt signal through the "W" thermostat terminal energizing the electric heat contactor, bringing on the auxiliary electric heat.

A rise in the room temperature will break the 24-volt signal on the "W" thermostat terminal de-energizing the electric heat contactor, turning off the auxiliary electric heat.

A further rise in room temperature will break the 24-volt signal on the "G" thermostat conductor starting the timer of the post purge control (60 second delay) to turn off the indoor-air blower. It also causes the loss of the 24-volt signal on the "Y" thermostat conductor de-energizing the compressor contactor turning off the compressor and outdoor air blower.

Defrost

During normal operation in the heating mode, frost & ice may build up on the outdoor coil. This frost & ice must be removed periodically for the unit to operate properly. The INSIDER & VERT-I-PAK units employ either an *active* or a *passive* defrost method to accomplish this. To identify which method your unit employs, Check the Model Number Identification Guides located at the beginning of this manual.
Active Defrost
An *active* defrost cycle is initiated by the defrost control when the combination of the selected compressor run time and an outdoor coil temperature of 33 degrees, + or – 3 degrees is reached. When this occurs:
The defrost relay is energized.

- Contacts 4 & 5 open, de-energizing the outdoor blower.
- Contacts 4 & 6 close, energizing the drain line heater, (if equipped.)
- Contacts 1 & 2 open, de-energizing the reversing valve solenoid.
- Contacts 1 & 3 close, energizing the defrost heater relay which energizes the electric heat strip/strips.

When the outdoor coil temperature reaches 53 degrees, + or – 5. 5 degrees, or 10 minutes passes, the defrost control will terminate the defrost cycle, reversing the above actions and returning the unit to normal heat pump mode operation.

Passive Defrost

A *passive* defrost cycle is initiated when the outdoor coil temperature falls to 33 degrees, + or – 3 degrees. The frost-free thermostat is responsible for determining this temperature. It not only senses the outdoor coil *refrigerant* temperature, it senses the outdoor entering *air* temperature as well. When this occurs:

- The frost-free thermostat closes, energizing the frost free relay coil.
- Contacts 4 & 5 open, de-energizing the reversing valve solenoid.
- Contacts 1 & 2 open, de-energizing the compressor contactor coil.
- Contacts 1 & 3 close, energizing the electric heater contactor coil when the room thermostat calls for heat.

When the room thermostat calls for heating, the unit will now supply heat only by means of the electric strip heaters. The compressor will remain locked out until the outdoor coil temperature rises to 53 degrees, + or –5. 5 degrees. When the above temperature is reached, the frost-free thermostat opens, reversing the above actions and returning the unit to normal heat pump mode operation.

Emergency Heat

The EM HEAT setting provides for the use of the electric auxiliary heat in the event of a malfunction of the heat pump system.

NOTE: For economical reasons, the EM HEAT mode should only be used when necessary.

With the thermostat set on EM HEAT or EMER, and the FAN switch set on AUTO, a drop in room temperature causes the upper mercury switch to make a 24-volt signal on the "G" thermostat conductor, energizing the indoor blower post purge control, and turning on the indoor air blower. It also causes a 24-volt signal on the "W" thermostat terminal energizing the electric heat contactor (s) turning on the electric heat.

A rise in room temperature causes the upper mercury switch to break the 24-volt signal on the "G" thermostat conductor starting the timer of the post purge control (60-second delay) to turn off the indoor air blower. It also causes the loss of the 24-volt signal on the "W" thermostat terminal de-energizing the electric heat contactor (s) turning off the electric heat.

Electrical Supply

WARNING: **Electrical shock hazard.**

Turn OFF electric power at fuse box or service panel before making any electrical connections and ensure a proper ground connection is made before connecting line voltage. Failure to do so can result in property damage personal injury and/or death.

Supply Circuit

The system cannot be expected to operate correctly unless the system is properly connected (wired) to an adequately sized single branch circuit. Check the installation manual and/or technical data for your particular unit and/or strip heaters to determine if the circuit is adequately sized.

Supply voltage

To insure proper operation, supply voltage to the system should be within five (5) percent (plus or minus) of listed rating plate voltage. Supply voltage to the unit should be a nominal 208/230 volts. It must be between 197 volts and 253 volts. Supply voltage to the unit should be checked WITH THE UNIT IN OPERATION. Voltage readings outside the specified range can be expected to cause operating problems. Their cause MUST be investigated and corrected.

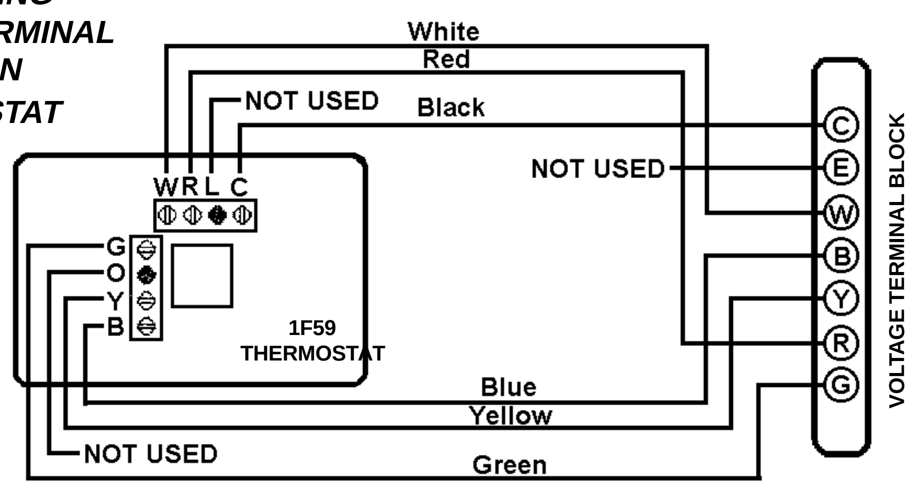
Control (Low) Voltage

To insure proper system operation the transformer secondary output must be maintained at a nominal 24 volts. The control (low) voltage transformer is equipped with multiple primary voltage taps. Connecting the primary, (supply) wire to the tap (i.e., 208 and 240 volts) that most closely matches the MEASURED supply voltage will insure proper transformer secondary output is maintained.

Electrical Ground

Grounding of the electrical supply to ALL UNITS IS REQUIRED for safety reasons.

CONTROL WIRING
LOW VOLTAGE TERMINAL DESIGNATION
1F59 THERMOSTAT



Terminals O, L, and E are not used.

Room Thermostats

Room thermostats are available from several different manufacturers in a wide variety of styles. They range from the very simple bimetallic type to the complex electronic set-back type. In all cases, no matter how simple or complex, they are simply a switch (or series of switches) designed to turn equipment (or components) "ON" or "OFF" at the desired conditions.

An improperly operating, or poorly located room thermostat can be the source of perceived equipment problems. A careful check of the thermostat and wiring must be made to insure that it is not the source of problems.

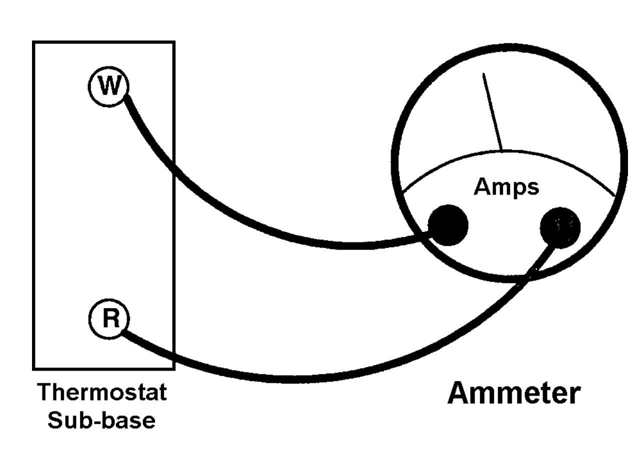
Location

The thermostat should not be mounted where it may be affected by drafts, discharge air from registers (hot or cold), or heat radiated from the sun or appliances.

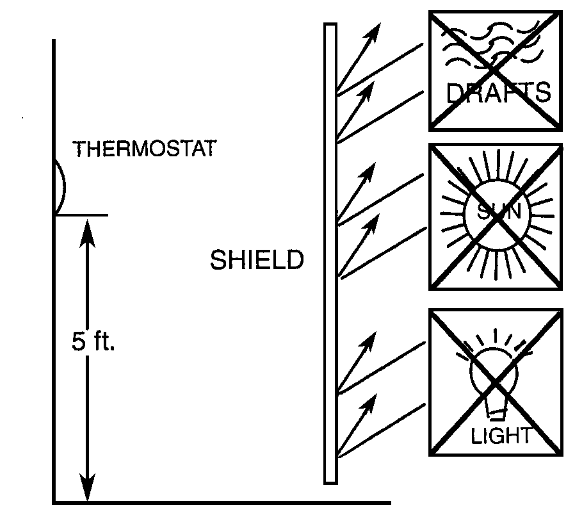
The thermostat should be located about 5 Ft. above the floor in an area of average temperature, with good air circulation. Close proximity to the return air grille is the best choice.

Mercury bulb type thermostats MUST be level to control temperature accurately to the desired set-point. Electronic digital type thermostats SHOULD be level for aesthetics.

Measuring Current Draw



Thermostat Location



Heat Anticipators

Heat anticipators are small resistance heaters (wired in SERIES with the "W" circuit) and built into most electromechanical thermostats. Their purpose is to prevent wide swings in room temperature during system operation in the HEATING mode. Since they are wired in series, the "W" circuit will open if one burns out preventing heat operation.

The heat anticipator provides a small amount of heat to the thermostat causing it to cycle (turn off) the heat source just prior to reaching the set point of the thermostat. This prevents exceeding the set point.

In order to accomplish this, the heat output from the anticipator must be the same regardless of the current flowing through it. Consequently, some thermostats have an adjustment to compensate for varying current draw in the thermostat circuits.

The proper setting of heat anticipators then is important to insure proper temperature control and customer satisfaction. A Heat anticipator that is set too low will cause the heat source to cycle prematurely possibly never reaching set point. A heat anticipator that is set too high will cause the heat source to cycle too late over shooting the set point.

Setting the Heat Anticipator

The best method to obtain the required setting for the heat anticipator, is to measure the actual current draw in the control circuit ("W") using a low range (0-2.0 Amps) Ammeter. After measuring the current draw, simply set heat anticipator to match that value.

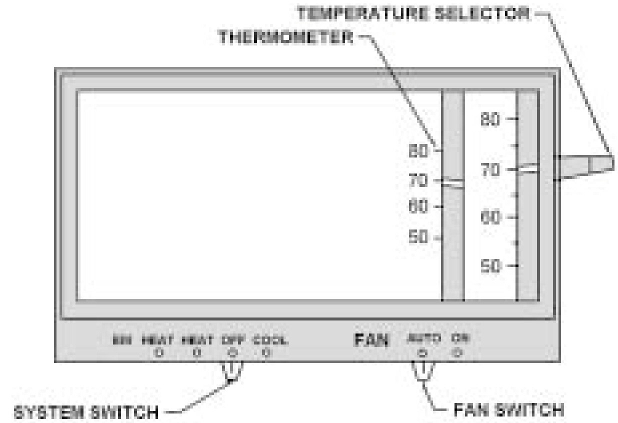
If a low range ammeter is not available, a "Clamp-on" type ammeter may be used as follows:

1. Wrap EXACTLY ten (10) turns of wire around the jaws of a clamp-on type ammeter.

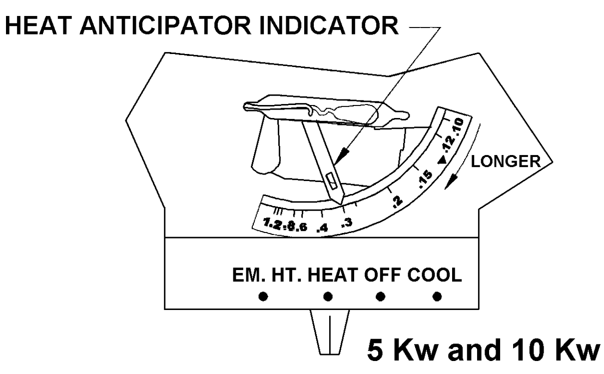
2. Connect one end of the wire to the "W" terminal of the thermostat subbase, and the other to the "R" terminal.

3. Turn the power on, and wait approximately one minute, then read meter.

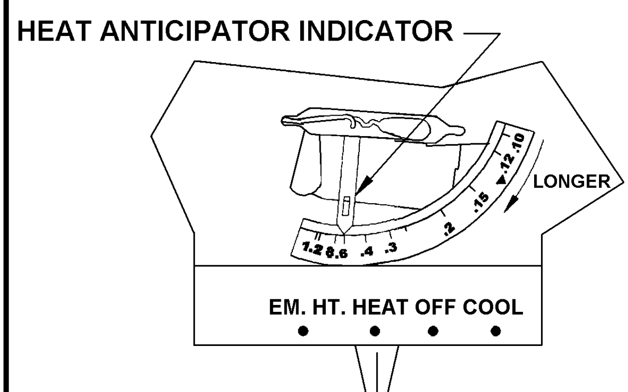
4. Divide the meter reading by 10 to obtain the correct anticipator setting. If an ammeter is not available, set the heat anticipator as shown below.



The Honeywell T841A was the primary thermostat provided and used with the INSIDER heat pump prior to January 1999. The T841A is a heat pump thermostat with one stage of cooling and two stages of heat. This thermostat has two mercury bulbs making accurate leveling a requirement for proper operation.

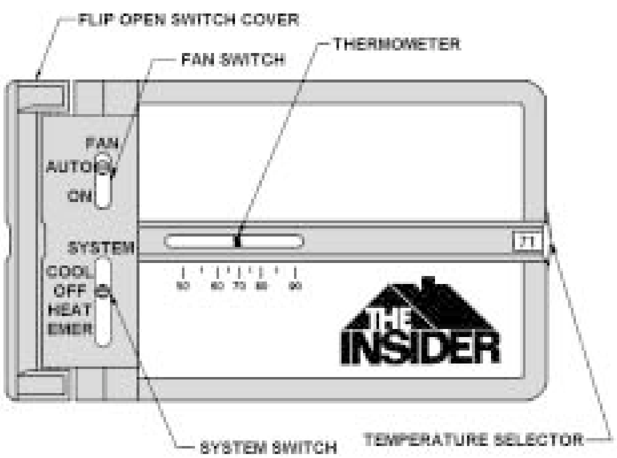


The Anticipation Setting for the 5 and 10 Kw is 0.3



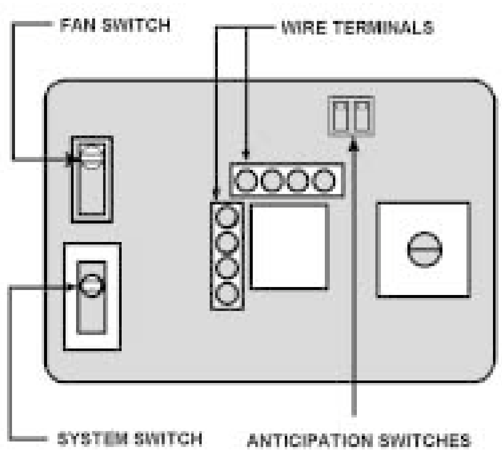
The Anticipation Setting for the 15 KW is 0.6.

In April 2000, the White Rogers 1F59-13 became the primary thermostat provided and used with the INSIDER and VERT-I-PAK B Series heat pump. The 1F59-13 is an electronic heat pump thermostat providing control without mercury bulbs. The electronic digital type thermostat should be leveled for aesthetics.

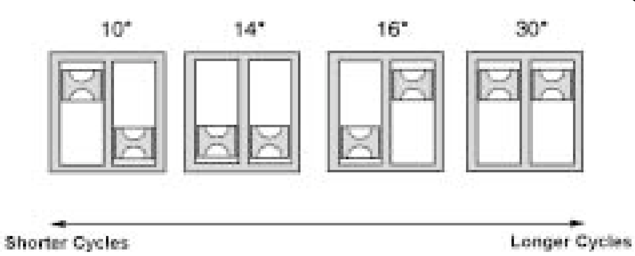


White Rodgers 1F59-13

The White Rodgers thermostat has switches that control the anticipation setting. The following illustrations and tables show the location of the switches and setting information.



Terminal and Switch Location



Anticipation Selection Switch Settings

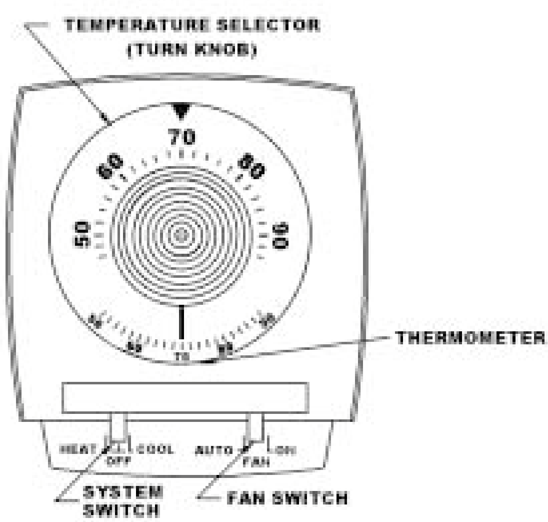
Table 1 – First Stage Heat and Cool

Anticipation Reference Number	Approx. Temperature Differential
10	0.8°F
14	1.1°F
16	1.3°F
30	2.4°F

Table 2 – Second Stage and Emergency Heat

Anticipation Reference Number	Approx. Temperature Differential
10	0.3°F
14	1.4°0F
16	1.5°F
30	2.9°F

The CM260 is a basic heat-cool thermostat with a set of mechanical contacts operated by a bimetal coil. Accurate leveling is not a requirement for proper operation of this thermostat. The thermostat controls are described below.



Robert Shaw CM 260

CAUTION: Recheck the wiring to be certain proper terminals are connected before applying power. Improper wiring or installation may damage the thermostat.

Electric Strip Heaters

Electric heat strips use electrical resistance to produce heat. They normally use coils of nichrome wire to provide the resistance. When electrical current flows through the coils, the resistance of the coil produces a specific amount of heat. Proper airflow across strip heaters is essential to insure proper operation, and life expectancy. During operation, the elements will produce a dull orange glow. Insufficient airflow will cause elements to overheat (producing a very bright orange glow) and cycle on limit switch, or possibly fail.

Heaters are available in several sizes (wattage). Normally, heaters larger then 10 KW (10 kilowatts) are divided into increments with one or two increments (i.e. 5 or 10 KW) controlled by a single relay which energizes a contactor.

Strip heaters may be checked using one of several methods. During operation ("Calling for Heat"), a clamp-on ammeter may be used to check the current draw of each individual increment to verify its operation. At 240 Volts (nominal), a current draw of approximately 20 Amps should be indicated for each 5 KW. If no current draw is indicated, the heater is not operating. This may be due to defective relay or contactor, an open (broken) element, tripped (open) breaker, etc. These conditions then, may be checked (with the power "OFF") using an ohmmeter. They may also be checked (being very careful) with the power "ON" by using a voltmeter.

All component parts of strip heater assemblies are field replaceable. If the entire heater package is removed for servicing, (i.e. component replacement), extreme care should be used when reinstalling the heater package that all wiring is properly connected.

Indoor Blower – Air Flow

INSIDER and VERT-I-PAK B-Series units use a single-speed permanent split capacitor motor direct drive. Different size (HP) motors and/or different diameter blower wheels are used in different models to obtain the required airflow.

Blower Wheel Inspection

Visually inspect the blower wheel for the accumulation of dirt or lint since they can cause reduced airflow. Clean the blower wheel of these accumulations. If accumulation cannot be removed, it will be necessary to remove the blower assembly from the unit for proper wheel cleaning.

Cooling

A nominal 400 (350-450 allowable) CFM per ton of airflow is required to insure proper system operation, capacity, and efficiency. Factory blower motors should provide the proper airflow for the size (cooling capacity) of the unit when connected to a properly sized duct system.

External Static Pressure

External Static Pressure can best be defined as the pressure difference (drop) between the Positive Pressure (discharge) and the Negative Pressure (intake) sides of the blower. External Static Pressure is developed by the blower as a result of resistance to airflow (Friction) in the air distribution system EXTERNAL to the INSIDER / VERT-I-PAK B Series cabinet.

Resistance applied externally to the INSIDER and VERT-I-PAK B Series (i.e. duct work, coils, filters, etc.) on either the supply or return side of the system causes an INCREASE in External Static Pressure accompanied by a REDUCTION in airflow.

External Static Pressure is affected by two (2) factors.

1. Resistance to Airflow as already explained.
2. Blower Speed. Changing to a higher or lower blower speed will raise or lower the External Static Pressure accordingly.

These affects must be understood and taken into consideration when checking External Static Pressure/Airflow to insure that the system is operating within design conditions.

Operating a system with insufficient or excessive airflow can cause a variety of different operating problems. Among these are reduced capacity, freezing evaporator coils, premature compressor and/or heating component failures. etc.

System airflow should always be verified upon completion of a new installation, or before a change-out, compressor replacement, or in the case of heat strip failure to insure that the failure was not caused by improper airflow.

Checking External Static Pressure

The airflow through the unit can be determined by measuring the external static pressure of the system, and consulting the blower performance data for the specific INSIDER and VERT-I-PAK B Series unit.

1. Set up to measure external static pressure at the supply and return air.
2. Drill holes in the supply duct for pressure taps, pilot tubes or other accurate pressure sensing devices.
3. Connect these taps to a level inclined manometer or Magnehelic gauges.
4. Ensure the coil and filter are clean, and that all the registers are open.
5. Determine the external static pressure with the blower operating.

6. Refer to the Air Flow Data for your system to find the actual airflow.
7. If the actual airflow is either too high or too low, check the ductwork and make appropriate changes

EXAMPLE: Airflow requirements are calculated as follows:

1 ½ TON SYSTEM (18,000 Btu)
Operating to full capacity @ 230 volts with dry coil
measured external static pressure .20
Air Flow = 500 CFM

It is also important to remember that when dealing with INSIDER and VERT-I-PAK B Series units that the measured External Static Pressure increases as the resistance is added externally to the cabinet. Example: duct work, dirty filters, grilles.

Checking Approximate Airflow

If an inclined manometer or Magnehelic gauge is not available to check the External Static Pressure, or the blower performance data is unavailable for your unit, approximate air flow call be calculated by measuring the temperature rise, then using the following criteria.

Electric Heat Strips

The approximate CFM actually being delivered can be calculated by using the following formula:

$$\frac{\text{KILOWATTS X 3413}}{\text{Temp Rise X 1.08}}$$

DO NOT simply use the Kilowatt Rating of the heater (i.e. 5.0, 10.0, 15.0 etc.) as this will result in a less-than-correct airflow calculation. Kilowatts may be calculated by multiplying the measured voltage to the unit (heater) times the measured current draw of all heaters (ONLY) in operation to obtain watts. Kilowatts are than obtained by dividing by 1000.

EXAMPLE: Measured voltage to unit (heaters) is 230 volts. Measured Current Draw of strip heaters is 20.0 amps.

230 X 20.0 = 4600
4600/1000 = 4.6 Kilowatts
4.6 x 3413 = 15700

Supply Air	95°F
Return Air	<u>75°F</u>
Temperature Rise	20°

20 X 1.08 = 21.6

$$\frac{15700}{21.6} = 727 \text{ CFM}$$

Condenser Fan Motors

The INSIDER / VERT-I-PAK B Series units use a single speed permanent split capacitor motor direct drive. Different size HP motors and/ or wheels are used on different models to obtain the required heat transfer.

Capacitors

Many motor capacitors are internally fused. Shorting the terminals will blow the fuse, ruining the capacitor. A 20,000 ohm 2 watt resistor can be used to discharge capacitors safely. Remove wires from capacitor and place resistor across terminals.

Capacitor Check With Capacitor Analyzer

The capacitor analyzer will show whether the capacitor is "open" or "shorted." It will tell whether the capacitor is within its microfarads rating and it will show whether the capacitor is operating at the proper power-factor percentage. The instrument will automatically discharge the capacitor when the test switch is released.

WARNING

HAZARD OF SHOCK AND ELECTROCUTION. A CAPACITOR CAN HOLD A CHARGE FOR LONG PERIODS OF TIME. A SERVICE TECHNICIAN WHO TOUCHES THESE TERMINALS CAN BE INJURED. NEVER DISCHARGE THE CAPACITOR BY SHORTING ACROSS THE TERMINALS WITH A SCREWDRIVER.

Capacitor Connections

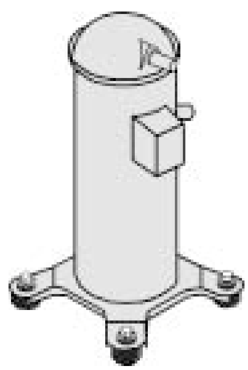
The starting winding of a motor can be damaged by a shorted and grounded running capacitor. This damage usually can be avoided by proper connection of the running capacitor terminals. From the supply line on a typical 230 volt circuit, a 115 volt potential exists from the "R" terminal to ground through a possible short in the capacitor. However, from the "S" or start terminal, a much higher potential, possibly as high as 400 volts, exists because of the counter EMF generated in the start winding. Therefore, the possibility of capacitor failure is much greater when the identified terminal is connected to the "S" or start terminal. The identified terminal should always be connected to the supply line, or "R" terminal, never to the "S" terminal.

When connected properly, a shorted or grounded running-capacitor will result in a direct short to ground from the "R" terminal and will blow the line fuse. The motor protector will protect the main winding from excessive temperature.

Compressors

The type of compressor used is the SCROLL compressor. The Scroll compressor may easily be distinguished from a a reciprocating compressor by its relatively tall, and relatively small diameter round case. Although the methods of testing and/or checkout of both types of compressors is essentially the same, the Scroll compressor differs from the reciprocating type compressor in several ways.

First, the Scroll compressor uses a pair of Scrolls (one stationary, one "orbiting") to compress and pump refrigerant through the system, instead of the piston and valve arrangement found in a reciprocating compressor. This design makes the Scroll compressor able to tolerate a certain amount of liquid refrigerant better than a reciprocating compressor. Consequently, crankcase heaters are not normally required on most scroll equipped models.



Scroll Compressor

Operating Noise Level

The operating noise characteristics of a scroll compressor also differ considerably from that of a reciprocating compressor. If you are unfamiliar with the operating noise characteristics of a scroll compressor, you should be absolutely certain that there is a problem with the compressor prior to replacing it. For example, a scroll compressor which is running in reverse rotation (see anti-cycle timer section on page 15) will apparently make an excessive amount of noise.

Compressor Contactor

The compressor contactor is a "Normally Open" Double Pole (Relay) which when energized closes to complete the line voltage circuit to the compressor and outdoor fan motor.

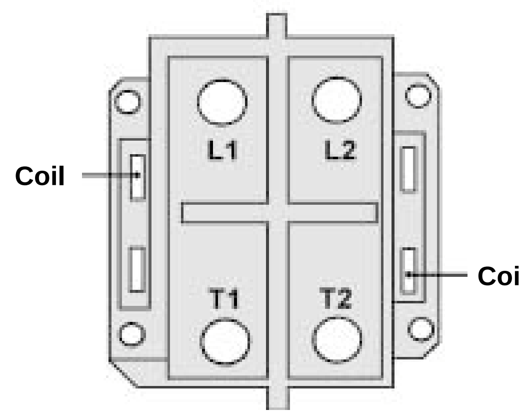
Electrical Shock Hazard.

Disconnect power at fuse box or service panel before performing any service on the unit.

Failure to follow this warning can result in property damage, personal injury, and/or death.

The contactor coil is energized on a call for COOLING AND HEATING from the room thermostat. If the contactor is not being energized (Pulled-In) it may be checked as follows:

A check across the two (2) coil terminals of the contactor should indicate 24 Volts during a call for COOLING and HEATING. If 24 volts IS indicated, and the contactor does not pull-In, the contactor is faulty (either a bad coil or mechanically stuck).

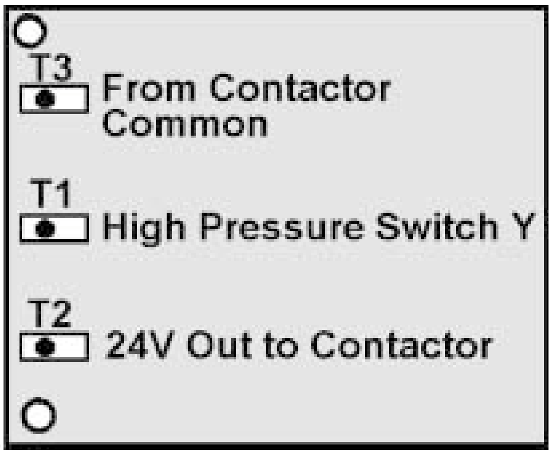


Typical Double Pole Contactor

If 24 volts is NOT indicated, check any optional controls (i.e. High Pressure or Low Pressure Switches) which may be wired in series with the compressor contactor. Next check across "Y" and "C" of the units Low voltage (Control) circuit during a call for COOLING or HEATING. This should also indicate 24 volts. If not, there may be problems with the thermostat, control wiring, or the Low (control) voltage transformer.

Problems with the transformer can quickly be ruled out by jumpering between "R" & "G" of the units low (control) voltage circuit (or switching the FAN switch on the thermostat subbase from AUTO to "ON.")

Once the transformer has been determined to be good, a jumper placed between "R" and "Y" of the INDOOR units low (control) voltage circuit should cause the contactor coil to be energized. If so, the problem is in the thermostat or thermostat wiring. If not, the problem is in the wiring between the Low (Control) voltage terminal block and the contactor.



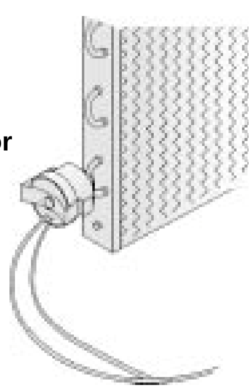
Anti-cycle Timer

Anti-cycle Timer (Scroll Compressor Models)

Some older models are equipped with an electronic Anti-Cycle timer. This timer is required to prevent the possibility of the scroll compressor running in reverse rotation due to a momentary power interruption. The anti-cycle timer is essentially a "delay on break" timer which prevents the compressor contactor from reenergizing for a period of 5 minutes if the power to it is interrupted. This delay provides sufficient time for the compressor to come to a complete stop before being reenergized, preventing the compressor from starting in reverse rotation. If defective, however, it will not complete the circuit to the compressor contactor. The anti-cycle timer is not used on new INSIDER / Vert-Pak "B" units. The IF59-13 thermostat has a built in anti cycle feature.

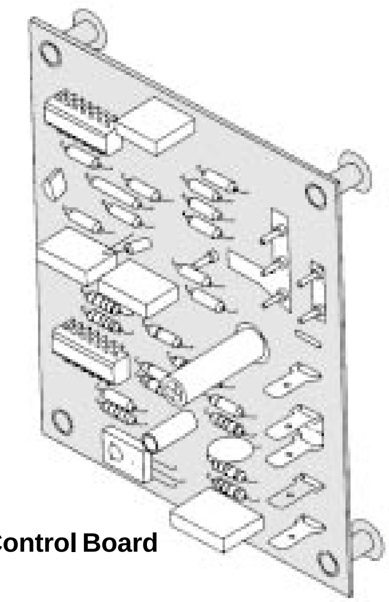
Defrost

Typical Defrost Sensor



When operating the heat pump in 1st Stage Heating, refrigerant flow (discharge gas) is being directed (by the reversing valve) to the INDOOR coil, making **it** the **CONDENSER.** Consequently, the **OUTDOOR** coil is then acting as the **EVAPORATOR**.

Operating an evaporator coil in low outdoor ambient temperatures (such as would be present when heating is required) will cause the EVAPORATOR (outdoor coil) to develop frost. Left unchecked, the frost would continue to build to the point of totally blocking the coil, severely reducing heat transfer, and consequently; the heating capacity of the unit.



Typical Defrost Control Board

To insure that this does not happen, some means of "Defrosting" the unit is required. All INSIDER and VERT-I-PAK B units use either an active defrost or passive defrost design. Check the Model Number Guide to identify which design you are working with.

Defrost Control Operation (Active Defrost)

An Electromechanical Defrost (Coil Temperature) Sensor is used with all of the various defrost controls. This sensor is a "Normally Open" switch wired in series with either the "R" terminal or the "C" terminal.

The sensor closes when (coil) temperature conditions have been met. When closed, the sensor completes a circuit to components within the control (board) itself which then begins "Accumulating" (keeping track of) compressor run time. Consequently, if the sensor NEVER closes, the unit will NEVER Defrost.

Defrost intervals (frequency) are field selectable (30, 60, or 90 Minutes). The frequency may be changed by moving (positioning) the jumper (or shunt) to a different terminal., i.e. 30 minutes, 60 minutes, and 90 minutes. Defrost intervals should be set to the LONGEST interval that will still allow the coil to completely defrost during one defrost cycle.

With the desired defrost interval selected, the control will initiate a defrost cycle whenever it "ACCUMULATES" this amount of compressor run time. The defrost (coil temp.) sensor MUST remain closed during this accumulation Period. If the defrost sensor opens at any time during the accumulation period (such as may happen during an "OFF" cycle in mild weather), the "ACCUMULATED" time will be lost (i.e. counter is reset to zero).

An automatic defrost capability is provided in the system that will defrost the outdoor air coil when needed. The defrost cycle is controlled by an ICM-300 time-temperature control. (As described on Page 7, Defrost.)

After the selected compressor run time is accumulated and a coil temperature of 33° ± 3° degrees F is reached, the Defrost Control initiates a defrost cycle by energizing the Defrost Relay.

The normally closed Defrost Relay contacts 4-5 open turning off the outdoor blower motor.

Relay contacts 1-2 open de-energizing the Reversing Valve Solenoid.

The normally open Defrost Relay contacts 1-3 close, energizing the Defrost Heater Relay, turning on the electric heat.

After 10 minutes or a rise in coil temperature to 55 degrees F, the defrost cycle will terminate.

When the defrost cycle is terminated the above actions are reversed.

The control will then begin accumulating time when (if) the sensor closes during the next run ("ON") cycle.

Once initiated, a defrost cycle may be terminated one of two (2) different ways.

1. The first, or "Normal" termination is based on coil temperature. When the defrost sensor reaches its opening temperature (indicating a fully defrosted coil) it will open, deselecting the circuits that caused the unit to change over into the defrost mode of operation.

   This causes the second stage heat to be deenergized, the outdoor fan to be reenergized, and the reversing valve to shift back into the HEATING position.

2. The second type of termination for a defrost is a "TIMED" (forced) termination. In the event that the defrost sensor DOES NOT open within 10 minutes the control will terminate the defrost cycle and return to normal 1st stage heating operation.

   Some of the reasons which might cause the sensor NOT to open during a normal defrost cycle are, defrost interval set TOO LONG, refrigerant circuit problems (i.e. under charge, restriction, etc.) or a sensor which is mechanically stuck closed.

Testing Defrost Mode Of Operation (Active Defrost

The basic procedure for testing ALL of the defrost controls used in this series is nearly identical, with relatively few variations/exceptions (as noted).

As previously stated, the defrost (Coil Temperature) sensor MUST be closed BEFORE ANY UNIT can initiate a defrost cycle. A closed defrost sensor can be simulated by "jumpering" across the defrost sensor.

The exact terminal identification(s) and/or locations the defrost (coil temp.) sensor is wired across may vary. Check the wiring diagram for your particular unit to determine WHERE to place the jumper.

Once the defrost sensor is closed the "Timing" function of the board will begin, (Temperature first, THEN time) and a defrost cycle will be initiated when the selected interval time (i.e. 30, 60, or 90 minutes) has been reached.

Since it is undesirable to wait this amount of time to check control operation an "ACCELERATOR" has been designed into these controls to significantly reduce the defrost interval time FOR TESTING PURPOSES ONLY.

Controls are equipped with a pair of terminals identified as "TEST" (or TST) which when "jumpered" will accelerate the selected defrost interval time.

The method of jumpering the test pins varies slightly however, based on the particular control.

With the TEST ("TST") pins jumpered, (and if the defrost sensor remains closed) the unit will go into the Defrost mode of operation every 7, 14, or 21 seconds (depending upon interval selected and/or type of (control). The unit will then remain in defrost until the accelerated "TIMED" (forced) termination period (2-3 seconds depending upon control) is reached as long as the "jumper" remains in place, and the defrost sensor remains closed (or jumped, out). EXTENDED OPERATION IN THIS MODE IS NOT RECOMMENDED.

During defrost the reversing valve solenoid will be deenergized, the outdoor fan motor will be de energized and indoor supplemental (second stage) heat will normally be energized. The identification of the terminal (on the control board) used to accomplish these function varies, however, with the particular control.

By referring to the wiring diagram for your particular unit you should be able to determine where (what terminal to check to verify if the control is performing the necessary switching functions. If the control performs the necessary switching functions, the problem is NOT in the defrost control, it is EXTERNAL to the control.

An electromechanical defrost (coil temperature) sensor is used on ALL units. This sensor is a "NORMALLY OPEN" electrical switch wired in series with the defrost control board. Depending upon the particular model and/or control used, it may be wired in series with either the "R" circuit or the "C" circuit to the board.

The sensor CLOSES when its temperature drops below a predetermined level, completing the circuit to the defrost board to begin "ACCUMULATING" compressor run time. The sensor OPENS during defrost at another predetermined level to TERMINATE the defrost cycle. The sensor can also OPEN during an "OFF" cycle in warmer outdoor ambient conditions, which will RESET (zero out) any time that has been accumulated on the defrost control board.

If the defrost sensor does NOT open and close, it must be replaced. (The sensor is designed to close at 33° ± 3° degrees F and open at 53°F ± 5°.) When replacing the defrost sensor BE ABSOLUTELY CERTAIN to reinstall the replacement sensor in the EXACT LOCATION of the removed sensor. Failure to do so may create problems with improper defrosting of the unit.

Passive Defrost

Units, which employ the Passive method for defrosting the outdoor coil, depend upon the rising of the temperature of the outdoor coil to do so. No heat is supplied by the unit to remove the frost & ice.

When the frost-free thermostat senses a temperature of 33 degrees, + or – 3 degrees, the compressor is locked-out. The outdoor fan continues to run, allowing outdoor air to help speed the defrosting process. Keep in mind, however that the colder the outdoor temperature is, the longer it will take for frost and ice to melt from the outdoor coil.

When the frost-free thermostat senses a rise in the temperature of the outdoor coil to 53 degrees, + or – 5. 5 degrees, the passive defrost cycle is complete. The compressor will now be able to run to provide heat to the space.

Testing Defrost Operation (Passive Defrost)

The Frost-Free Thermostat is mounted to the outdoor coil. It is a saddle type sensor, using a snap-type strap to secure it to a return bend on the outdoor coil. The thermostat switch contacts are normally open, and will close on a fall in temperature.

Two leads are permanently connected to the thermostat. One lead connects to the coil of the frost-free relay. On earlier model units, the other lead connects to "R" on the low voltage transformer. Later model units have this lead connected to terminal # 4 on the frost-free relay.

Disconnect power to the unit. Keep in mind that more that one disconnect may be required. Install a jumper between the two leads of the frost-free thermostat. Restore power to the unit.

The compressor should be locked-out. The electric strip heaters should be energized if; the room thermostat is calling for heating. Cycle the room thermostat to insure that the electric strip heaters do come on and off with the action of the thermostat. The compressor should not run during this test. When complete, disconnect power to the unit and remove the jumper.

If you encounter a unit where frost or ice is present on the outdoor coil and the compressor is still running, perform this simple test. Should the compressor lockout with the jumper installed, replace the frost-free thermostat.

High Pressure Switch

INSIDER and VERT-I-PAK B Series units are equipped with a high-pressure switch. The purpose of the high-pressure switch is to prevent damage to the compressor, which may occur as a result of operating under high discharge pressure conditions. Some possible causes of high discharge include condenser fan motor failure, excessive refrigerant charge, air and non-condensables in refrigerant circuit, etc.

The high-pressure switch is a "Normally closed" pressure operated switch (automatic reset) wired in series with the compressor contactor. The switch will remain closed, completing the circuit to the compressor contactor until the discharge pressure rises above (a nominal) 450 +/- 10 psig. At this point the switch will open, breaking the circuit to the compressor contactor. The switch then will remain open until the pressure drops to (a nominal) 300 +/- 20 psig, at which time it will close again, (auto reset) completing the circuit to the compressor contactor.

Low Pressure Switch

The low-pressure switch is a "Normally Open" pressure operated switch (Automatic Reset) wired in series with the compressor contactor. The switch closes at (a Nominal) 15 +/- 5 psig of pressure in the refrigerant system completing the circuit to the compressor contactor. The switch will remain closed until the system pressure drops below (a Nominal) 3 psig, at which time it will open, breaking the circuit to the compressor contactor.

Compressor Checks

Locked Rotor Voltage (L.R.V.) Test

Locked rotor voltage (L.R.V.) is the actual voltage available at the compressor under a stalled condition.

Single Phase Connections

Disconnect power from unit. Using a voltmeter, attach one lead of the meter to the run "R" terminal on the compressor and the other lead to the common "C" terminal of the compressor. Restore power to unit.

CAUTION
Make sure that the ends of the lead do not touch the compressor shell since this will cause a short circuit.

Determine L.R.V.

Start the compressor with the voltmeter attached; then stop the unit. Attempt to restart the compressor within a couple of seconds and immediately read the voltage on the meter. The compressor under these conditions will not start and will usually kick out on overload within a few seconds since the pressures in the system will not have had time to equalize. Voltage should be at or above minimum voltage of 197 VAC, as specified on the rating plate. If less than minimum, check for cause of inadequate power supply; i.e., incorrect wire size, loose electrical connections, etc. The compressor time delay relay will have to be bypassed for this test. Do not leave the time delay bypassed when the test is completed.

Amperage (L.R.V.) Test

The running amperage of the compressor is the most important of these readings. A running amperage higher than that indicated in the performance data indicates that a problem exists mechanically or electrically.

Single Phase Running and L.R.A. Test

NOTE: Consult the specification and performance section for running amperage. The L.R.A. can also be found on the rating plate.

Select the proper amperage scale and clamp the meter probe around the wire to the "C" terminal of the compressor.

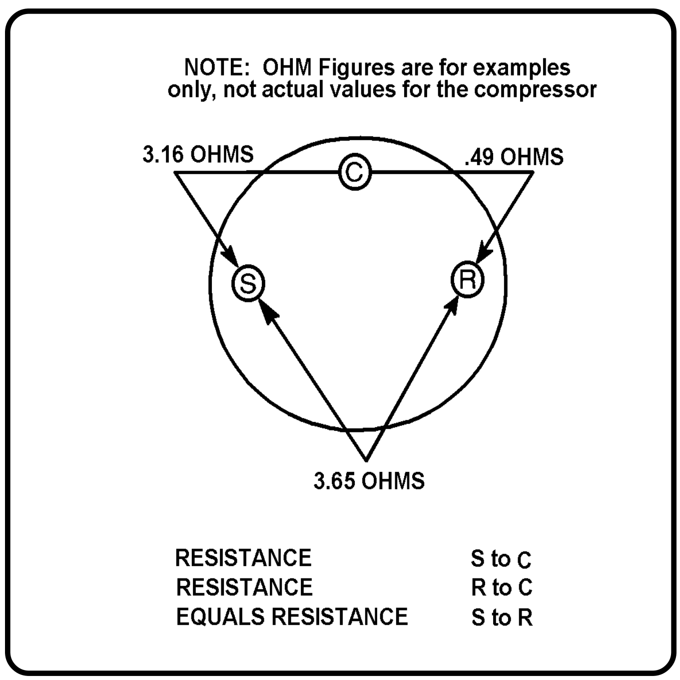
Turn on the unit and read the running amperage on the meter. If the compressor does not start, the reading will indicate the locked rotor amperage (L.R.A.).

Internal Overload

The compressor is equipped with an internal overload which senses both motor amperage and winding temperature. High motor temperature or amperage heats the overload causing it to open, breaking the common circuit within the compressor. Heat generated within the compressor shell, usually due to recycling of the motor, is slow to dissipate. It may take anywhere from a few minutes to several hours for the overload to reset.

Checking the Internal Overload

A reading of infinity (∞) between any two terminals MAY indicate an open winding. If, however, a reading of infinity (∞) is obtained between C & R and C & S, accompanied by a resistance reading between S & R, an open internal overload is indicated. Should you obtain this indication, allow the compressor to cool (May take up to 24 hours) then recheck before condemning the compressor. If an open internal overload is indicated, the source of its opening must be determined and corrected. Failure to do so will cause repeat problems with an open overload and/or premature compressor failure. Some possible causes of an open internal overload include insufficient refrigerant charge, restriction in the refrigerant circuit, and excessive current draw.



Single Phase Resistance Test

Remove the leads from the compressor terminals and set the ohmmeter on the lowest scale (R x 1).

Touch the leads of the ohmmeter from terminals common to start ("C" to "S"). Next, touch the leads of the ohmmeter from terminals common to run ("C" to "R").

Add values "C" to "S" and "C" to "R" together and check resistance from start to run terminals ("S" to "R"). Resistance "S" to "R" should equal the total of "C" to "S" and "C" to "R." In a single phase PSC compressor motor, the highest value will be from the start to the run connections ("S" to "R"). The next highest resistance is from the start to the common connections ("S" to "C"). The lowest resistance is from the run to common. ("C" to "R".) Before replacing a compressor, check to be sure it is defective.

Check the complete electrical system to the compressor and compressor internal electrical system, check to be certain that compressor is not out on internal overload.

Complete evaluation of the system must be made whenever you suspect the compressor is defective. If the compressor has been operating for sometime, a careful examination must be made to determine why the compressor failed.

Recommended procedure for compressor replacement

NOTE: Be sure power source is off, then disconnect all wiring from the compressor.

1. Be certain to perform all necessary electrical and refrigeration tests to be sure the compressor is actually defective before replacing.
2. Recover all refrigerant from the system. **PROPER HANDLING OF RECOVERED REFRIGERANT ACCORDING TO EPA REGULATIONS IS REQUIRED.** Do not use gauge manifold for this purpose if there has been a burnout. You will contaminate your manifold and hoses.
3. After all refrigerant has been recovered, disconnect suction and discharge lines from the compressor and remove compressor. Be certain to have both suction and discharge access tubes open to atmosphere.
4. Carefully pour a small amount of oil from the suction stub of the defective compressor into a clean container.
5. Using an acid test kit (one shot or conventional kit), test the oil for acid content according to the instructions with the kit.
6. If any evidence of a burnout is found, no matter how slight, the system will need to be cleaned up following proper procedures.
7. Install the replacement compressor.
8. Pressurize with a combination of R-22 and nitrogen and leak test all connections with an electronic or Halide leak detector. Recover refrigerant and repair any leaks found. Repeat Step 8 to insure no more leaks are present.
9. Evacuate the system with a good vacuum pump capable of a final vacuum of 300 microns or less. The system should be evacuated through both liquid line and suction line gauge ports. While the unit is being evacuated, seal all openings on the defective compressor. Compressor manufacturers will void warranties on units received not properly sealed. Do not distort the manufacturers tube connections.
10. Recharge the system with the correct amount of refrigerant. The proper refrigerant charge will be found on the unit rating plate. The use of an accurate measuring device, such as a charging cylinder, electronic scales or similar device is necessary.

Expansion Valves

INSIDER and VERT-I-PAK /B Series Systems use a balance port thermostatic expansion valve for the metering device. The expansion valve is designed to maintain a constant Superheat in the coil it is controlling regardless of loading conditions.

It accomplishes this by OPENING (allowing more refrigerant flow to the coil) or CLOSING (allowing less refrigerant to flow to the coil). The extent to which the valve opens or closes is based on the temperature sensed by the temperature sensing bulb. ThIs that the sensing bulb MUST be in good contact with the suction line to insure proper operation. Expansion valves used in the evaporator coils of INSIDER/ VERT-I-PAK B Series units are NONADJUSTABLE expansion valves. Their Superheat setting CANNOT be changed. When replacing expansion valves, a factory authorized TXV must be used.

Refrigerant Charging

Proper refrigerant charge is essential to proper unit operation. Operating a unit with an improper refrigerant charge will result in reduced performance (capacity) and/or efficiency. Accordingly, the use of proper charging methods during servicing will insure that the unit is functioning as designed and that its compressor will not be damaged.

Method Of Charging

The acceptable method for charging INSIDER / VERT-I-PAK B Series is the Weighed in Charge Method. The weighed in charge method is applicable to all units. It is the preferred method to use, as it is the most accurate. The weighed in method should always be used whenever a charge is removed from a unit such as for a leak repair, compressor replacement, or when there is no refrigerant charge left in the unit.

INSIDER and VERT-I-PAK B Series units are equipped with a low-pressure switch (some older units did not include a low-pressure switch) connected to the units suction line or suction service valve. The purpose of this switch is to prevent damage to the compressor caused by operating with insufficient suction pressure. Low suction pressure may be caused by insufficient refrigerant charge, refrigerant restriction, low airflow etc. Operating the unit with insufficient suction pressure can cause a variety of problems within the unit. Among these are overheating of the compressor windings, the freezing of the evaporator coil.

To charge by this method, requires the following steps:

1. Recover Refrigerant in accordance with EPA regulations.
2. Make necessary repairs to system.
3. Evacuate system to 300 microns or less.
4. Weigh in refrigerant with the property quantity of R-22 refrigerant.
5. Start unit, and verify performance.

Because INSIDER®/VERT-I-PAK®/B Series units have expansion valves (TVX), the subcooling method is an acceptable method for charging.

Subcooling Method

The Subcooling method is applicable to units equipped with THERMOSTATIC EXPANSION VALVE controlled evaporators. Charging by the subcooling method is accomplished with the unit RUNNING. It requires the use of ACCURATE refrigeration gauges, electronic dry bulb thermometer, and a pressure/temperature chart (if your refrigeration gauges do not have temperature conversion scales on their face).

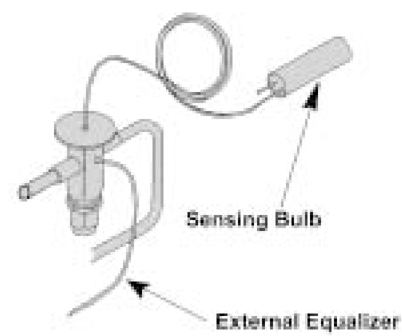
The Subcooling method can be used when a partial charge remains in the unit and it is not desirable to remove the entire charge. To charge by the Subcooling method the requires the following steps:

1. Connect refrigerant gauges to service access ports, start unit and allow to run for several minutes until system pressures stabilize.
2. While waiting for pressures to stabilize, measure Outdoor Dry Bulb temperature, (must be between 65°F and 115°F).
3. Measure (and record) liquid line temperature as close to condenser coil OUTLET as practical.
4. Using the R-22 temperature conversion scale on the High Side gauge (if so equipped) or a pressure/temperature chart, convert liquid pressure to (saturation) temperature.
5. Subtract measured liquid temperature from the converted (saturation) temperature; the result is Subcooling.
6. Compare calculated subcooling with allowable range (8°F to 12°F) of subcooling.
7. If calculated subcooling is HIGHER than the allowable range, gradually REMOVE (recover) refrigerant (vapor) from suction side of system.

   Recheck Subcooling periodically (while removing refrigerant), and discontinue removing refrigerant when allowable range has been reached.

8. If calculated Subcooling is LOWER than the allowable range, gradually ADD refrigerant (vapor) to the suction side of system.

The TXV is not adjustable. If allowable subcooling cannot be obtained by adding or removing refrigerant, the TXV is suspect.



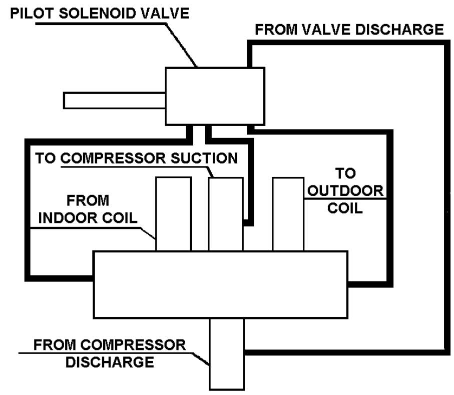
Non Adjustable TXV

Reversing Valve Description/Operation

The Reversing Valve controls the direction of refrigerant flow to the indoor and outdoor coils. It consists of a pressure-operated main valve, and a pilot valve actuated by a solenoid plunger. The solenoid is energized during the heating cycle only. The reversing valve used in INSIDER® / VERT-I-PAK® B Series systems are 2-position, 4-way valves. The single tube on one side of the main valve body is the high-pressure inlet to the valve from the compressor. The center tube on the opposite side is connected to the Low pressure (suction) side of the system. The other two are connected to the indoor and outdoor coils. Small capillary tubes connect each end of the main valve cylinder to the "A" and "B" ports of the pilot valve. A third capillary is a common return line from these ports to the suction tube on the main valve body. Four-way reversing valves also have a capillary tube from the compressor discharge tube to the pilot valve.

The piston assembly in the main valve can only be shifted by the pressure differential between the high and low sides of the system. The pilot section of the valve opens and closes ports for the small capillary tubes to the main valve to cause it to shift.

NOTE: System operating pressures must be near normal before valve can shift.



4-WAY REVERSING VALVE

Electrical Circuit and Coil

(Reversing valve coil is energized in the heating cycle only).

1. Set controls for heating; valve should shift.
2. Check for line voltage at the defrost relay, terminal #2 and the common terminal post purge relay. If line voltage is not present check the power supply.

Testing Coil

1. Turn off high voltage electrical power to unit.
2. Unplug the electrical leads from the reversing valve coil.
3. Check for electrical continuity through the coil. If you do not have continuity replace the coil.
4. Check from each lead of coil to the copper liquid line as it leaves the unit or the ground lug. There should be no continuity between either of the coil leads and ground; if there is, coil is grounded and must be replaced.
5. If coil tests okay, reconnect the electrical leads.
6. Make sure coil has been assembled correctly.

Checking Reversing Valve

NOTE: You must have normal operating pressures before the reversing valve can shift.

Check for proper refrigerant charge. Sluggish or sticky reversing valves can sometimes be remedied by reversing the valve several time with the airflow restricted to increase system pressure.

To raise head pressure during the cooling season the airflow through the outdoor coil can be restricted. During heating the indoor air can be restricted by blocking the return air. Dented or damaged valve body or capillary tubes can prevent the main slide in the valve body from shifting.

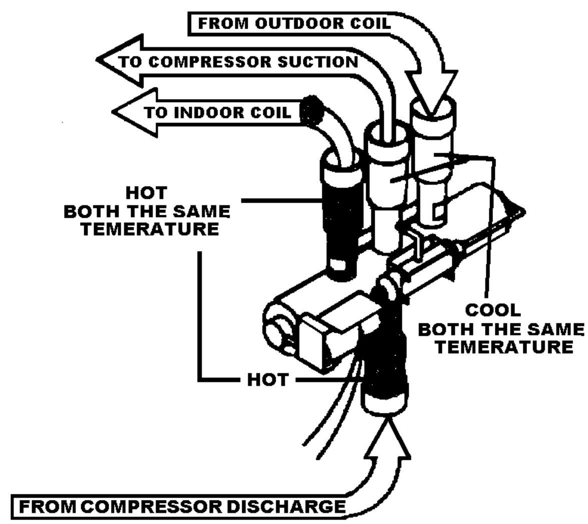
If you determine this is the problem, replace the reversing valve.

CAUTION

Never energize the coil when it is removed from the valve as a coil burnout will result.

Procedure For Changing Reversing Valve:

1. Recover refrigerant from system. PROPER HANDLING OF RECOVERED REFRIGERANT ACCORDING TO EPA REGULATIONS IS REQUIRED.
2. Remove solenoid coil from reversing valve. If coil is to be reused, protect from heat while changing valve.
3. Unbraze all lines from reversing valve.
4. Clean all excess braze from all tubing so that they will slip into fittings on new valve.
5. Remove solenoid coil from new valve.



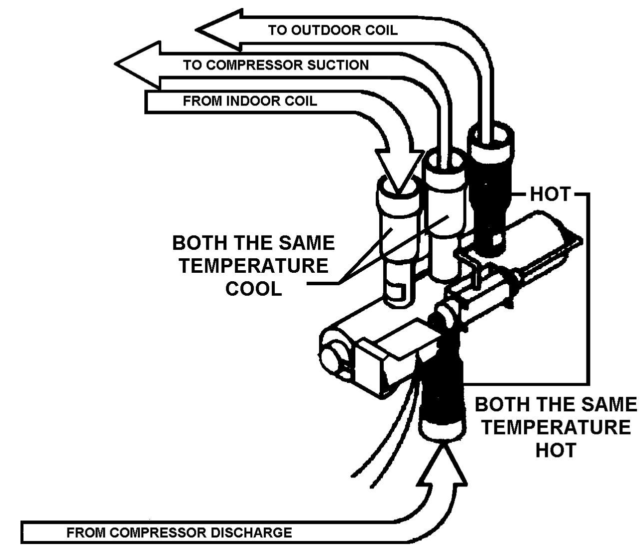
REVERSING VALVE IN HEATING MODE

6. Protect new valve body from heat while brazing with plastic heat sink (ThermoTrap) or wrap valve body with wet rag.

7. Fit all lines into new valve and braze lines into new valve.

8. Pressurize system with a combination of R-22 and nitrogen and check for leaks, using a suitable leak detector. Recover refrigerant per EPA guidelines.

9. Once the system is leak free, install solenoid coil on new valve and charge the sealed system by weighing in the proper amount and type of refrigerant as shown on rating plate. You can also charge the system using the subcooling method as explained on Page 20.



REVERSING VALVE IN COOLING MODE

THE INSIDER®

INSIDER CHASSIS SPECIFICATIONS

MODEL	CDHP18	CDHP25	CDHP29	CDHP35	CDHB42	CDHB48
PERFORMANCE DATA:						
Cooling Capacity (Btu/h)	18,000	25,0000	30,000	34,000	43,000	48,000
Heating Capacity (Btu/h)	18,000	25,000	27,400	32,400	40,000	47,000
SEER	10.0	10.0	10.0	9.7	9.8	9.7
Outdoor Blower (CFM)	1,200	1,200	1,590	1,590	1,900	1,900
Outdoor Blower (HP)	1/3	1/3	1/2	1/2	3/4	3/4
Outdoor Blower (ESP)	.15	.15	.15	.15	.25	.25
Indoor Blower (CFM)	650	850	900	1050	1400	1400
Indoor Blower (HP)	1/6	1/4	1/4	1/3	1/2	1/2
Indoor Blower (ESP)	.20	.20	.20	.20	.50	.50
Heater Size (KW)	5 or 10	5 or 10	10 or 15	10 or 15	10 or 15	15 or 20
High Temp. COP	3.3	3.2	2.8	2.9	2.0	2.0
Low Temp. COP	2.1	2.0	1.8	1.9	2.0	2.0
ELECTRICAL DATA:						
Voltage/Hertz/Phase	208-230/60/1	208-230/60/1	208-230/60/1	208-230/60/1	208-230/60/1	208-230/60/1
Minimum Ampacity - Heat Pump Only	13.8	17.3	23.4	27.9	33	40.5
Minimum Ampacity - 10 KW Aux. Heat	52.0	52.0	52.0	52.0	52.0	52.0
Minimum Ampacity - 15 KW Aux. Heat	N/A	N/A	26.0/52.0	26.0/52.0	26.0/52.0	26.0/52.0
Power Connection	Hard Wired	Hard Wired	Hard Wired	Hard Wired	Hard Wired	Hard Wired
PHYSICAL DATA:						
Unit Width (In.)	20	20	20	20	30	30
Unit Depth (In.)	25	25	25	25	28	28
Unit Height (In.)	69 1/2	69 1/2	69 1/2	69 1/2	71	71
Shipping Weight (Lbs.)	320	320	330	340	380	400

Rated in accordance with ARI standard 240 and Department of Energy test standards. Ratings are net values based on 230 volt operation. Auxiliary electric resistance heat is not included. Ratings are based on:

Cooling Standard: 80°F db, 67°F wb indoor entering air temperature95°F db air entering the outdoor coil.
Hi-Temp Heating Standard: 70°F db indoor entering air temperature47°F db, 43°F wb air entering the outdoor coil.
Lo-Temp Heating Standard: 70°F db indoor entering air temperature17°F db, 15°F wb air entering the outdoor coil.

For 208-230/60/1 units the maximum operating voltage is 253, the minimum operating voltage is 197.

Models CDHP18 and CHDP25 are available with 5KW or 10KW auxiliary electric resistance heat. Models CDHP29, CDHP35 and CDHP42 are available with either 10KW or 15 KW auxiliary electric resistance heat. Model CDHB48 is available with either 15KW or 20 KW auxiliary electric resistance heat. 5KW and 10 KW heat systems use one (1) circuit breaker, 15KW and 20 KW heat systems use two (2) circuit breakers.

Due to continuing research in new energy saving technology, specifications are subject to change without notice.

B-SERIES CHASSIS SPECIFICATIONS

MODELS:	V(E,H)B18K05	V(E,H)B18K10	V(E,H)B24K05	V(E,H)B24K10	V(E,H)B30K10	V(E,H)B30K15	V(E,H)B36K10	V(E,H)B36K15
COOLING DATA:								
Cooling Cap.	17000	17000	22000	22000	30000	30000	35000	35000
Cooling Power (W)	1700	1700	2200	2200	2900	2900	3500	3500
SEER	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Cooling SHR	0.78	0.78	0.75	0.75	0.70	0.70	0.70	0.70
ELECTRICAL HEAT DATA:								
Heater Size (KW)	5.0	10.0	5.0	10.0	10.0	15.0	10.0	15.0
Heating Cap. (Btu/h)	17050	34100	17050	34100	34100	51150	34100	51150
Heating Power (W)	5000	10000	5000	10000	10000	15000	10000	15000
Heating Current (A)	20.8	41.6	20.8	41.6	41.6	62.4	41.6	62.4
HEAT PUMP DATA:								
Heating Cap. (Btu/h)	17000	17000	22000	22000	30000	30000	34000	34000
Heating Power (W)	1650	1650	2000	2000	2600	2600	3300	3300
Heating Current (A)	7.3	7.3	9.3	9.3	12.0	12.0	15.0	15.0
COP	3.0	3.0	3.2	3.2	3.2	3.2	3.0	3.0
ELECTRICAL DATA:								
Voltage (V)	230/208	230/208	230/208	230/208	230/208	230/208	230/208	230/208
LRA - Comp. (A)	42.5	42.5	56.0	56.0	72.5	72.5	88.0	88.0
Min. Ckt. Amps (A)	(14)26	(14)52	(16.7)26	(16.7)52	(22.8)52	(22.8)26,52	(27.9)52	(27.9)26,52
Power Connection	Hard Wire	Hard Wire	Hard Wire	Hard Wire	Hard Wire	Hard Wire	Hard Wire	Hard Wire
PHYSICAL DATA:								
Unit Width (in.)	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Unit Depth (in.)	21.00	21.00	21.00	21.00	21.00	21.00	12.00	12.00
Unit Height (in.)	68.00	68.00	68.00	68.00	68.00	68.00	68.00	68.00
Shipping Weight (lbs.)	320	320	320	320	330	330	340	340
AIRFLOW DATA:								
Indoor CFM	640	640	800	800	1000	1000	1050	1050
Fresh Air CFM	65	65	65	65	65	65	65	65
Indoor Motor	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3
Indoor Motor Amps	1.0	1.0	1.0	1.0	1.8	1.8	2.5	2.5
Outdoor Motor	1/3	1/3	1/3	1/3	1/3	1/3	1/2	1/2
Outdoor Motor Amps	1.4	1.4	1.4	1.4	2.2	2.2	3.0	3.0

MODELS:	V(E,H)B42K10	V(E,H)B42K15	V(E,H)B48K15	V(E,H)B48K20	V(E,H)B60K20	V(E,H)B60K25
COOLING DATA:						
Cooling Cap.	43000	43000	48000	48000	58000	58000
Cooling Power (W)	4500	4500	5300	5300	6450	6450
SEER	9.8	9.8	9.7	9.7	9.8	9.8
Cooling SHR	0.72	0.72	0.69	0.69	0.72	0.72
ELECTRICAL HEAT DATA:						
Heater Size (KW)	10.0	15.0	15.0	20.0	20.0	25.0
Heating Cap. (Btu/h)	34100	51150	51150	68200	68200	85250
Heating Power (W)	10000	15000	15000	20000	20000	25000
Heating Current (A)	41.6	62.4	62.4	83.2	83.4	104.2
HEAT PUMP DATA:						
Heating Cap. (Btu/h)	40000	40000	47000	47000	59000	59000
Heating Power (W)	4000	4000	4800	4800	5636	5636
Heating Current (A)	19.0	19.0	22.0	22.0	25.0	25.0
COP	3.0	3.0	3.0	3.0	3.0	3.0
ELECTRICAL DATA:						
Voltage (V)	230/208	230/208	230/208	230/208	230/208	230/208
LRA - Comp. (A)	104.0	104.0	129.0	129.0	169.0	169.0
Min. Ckt. Amps (A)	(33)52	(33)26,52	(40.5)26,52	(40.5)52,52	(49) 52, 52	(49) 26, 52, 52
Power Connection	Hard Wire	Hard Wire	Hard Wire	Hard Wire	Hard Wire	Hard Wire
PHYSICAL DATA:						
Unit Width (in.)	38.00	38.00	38.00	38.00	45.00	45.00
Unit Depth (in.)	28.00	28.00	28.00	28.00	30.50	30.50
Unit Height (in.)	68.00	68.00	68.00	68.00	77.00	77.00
Shipping Weight (lbs.)	440	440	460	460	540	540
AIRFLOW DATA:						
Indoor CFM	1400	1400	1400	1400	1800	1800
Fresh Air CFM	70	70	70	70	70	70
Indoor Motor	1/2	1/2	1/2	1/2	1/2	1/2
Indoor Motor Amps	3.0	3.0	3.0	3.0	3.1	3.1
Outdoor Motor	3/4	3/4	3/4	3/4	1/3 (2)	1/3 (2)
Outdoor Motor Amps	4.7	4.7	4.7	4.7	5.0	5.0

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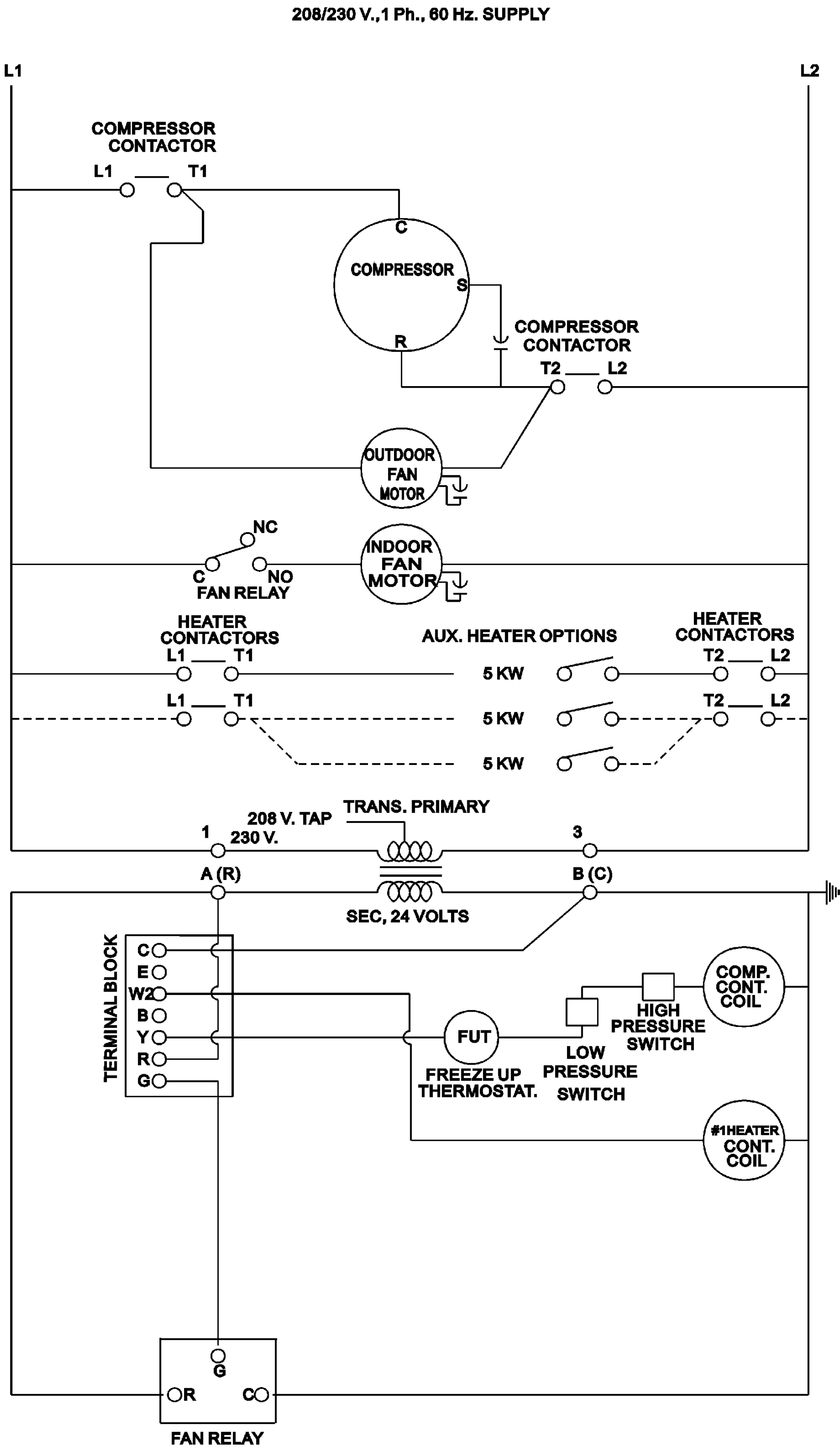
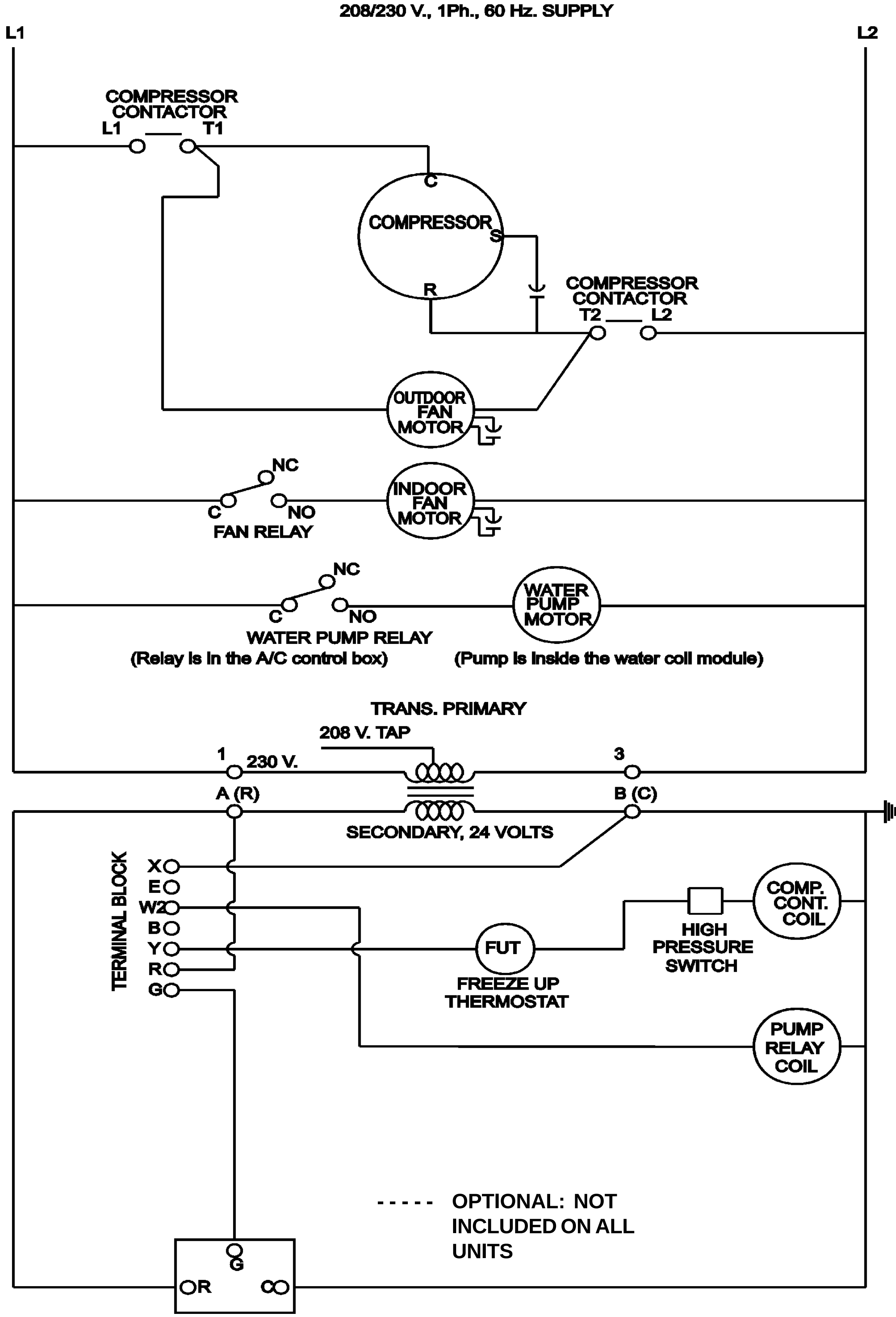
Wiring Diagram Index

Wiring Diagram: All Standard Air Conditioners With Electric Heat

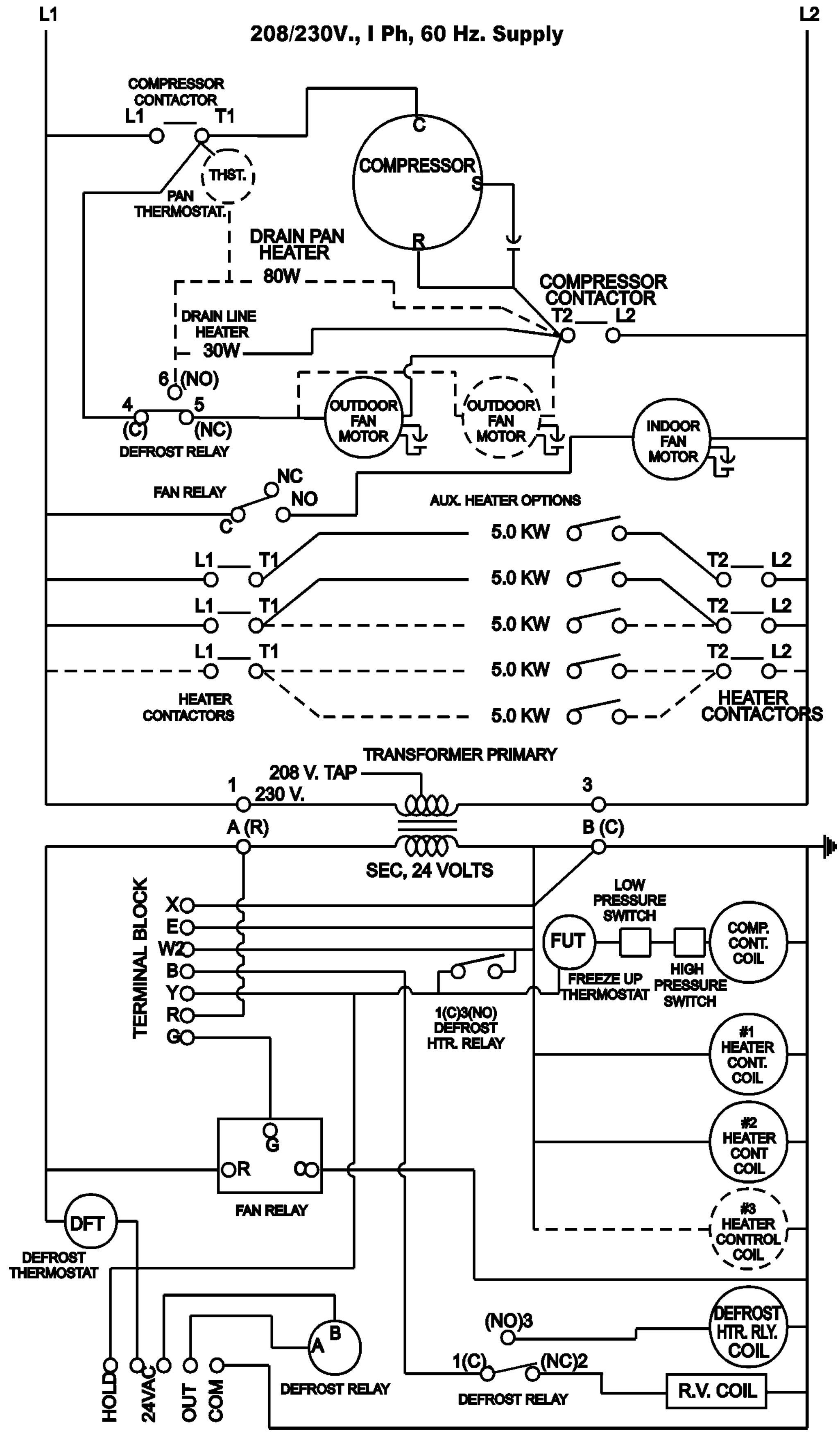


- - - - - OPTIONAL: NOT INCLUDED ON ALL UNITS

Wiring Diagram: Air Conditioner With Water Coil

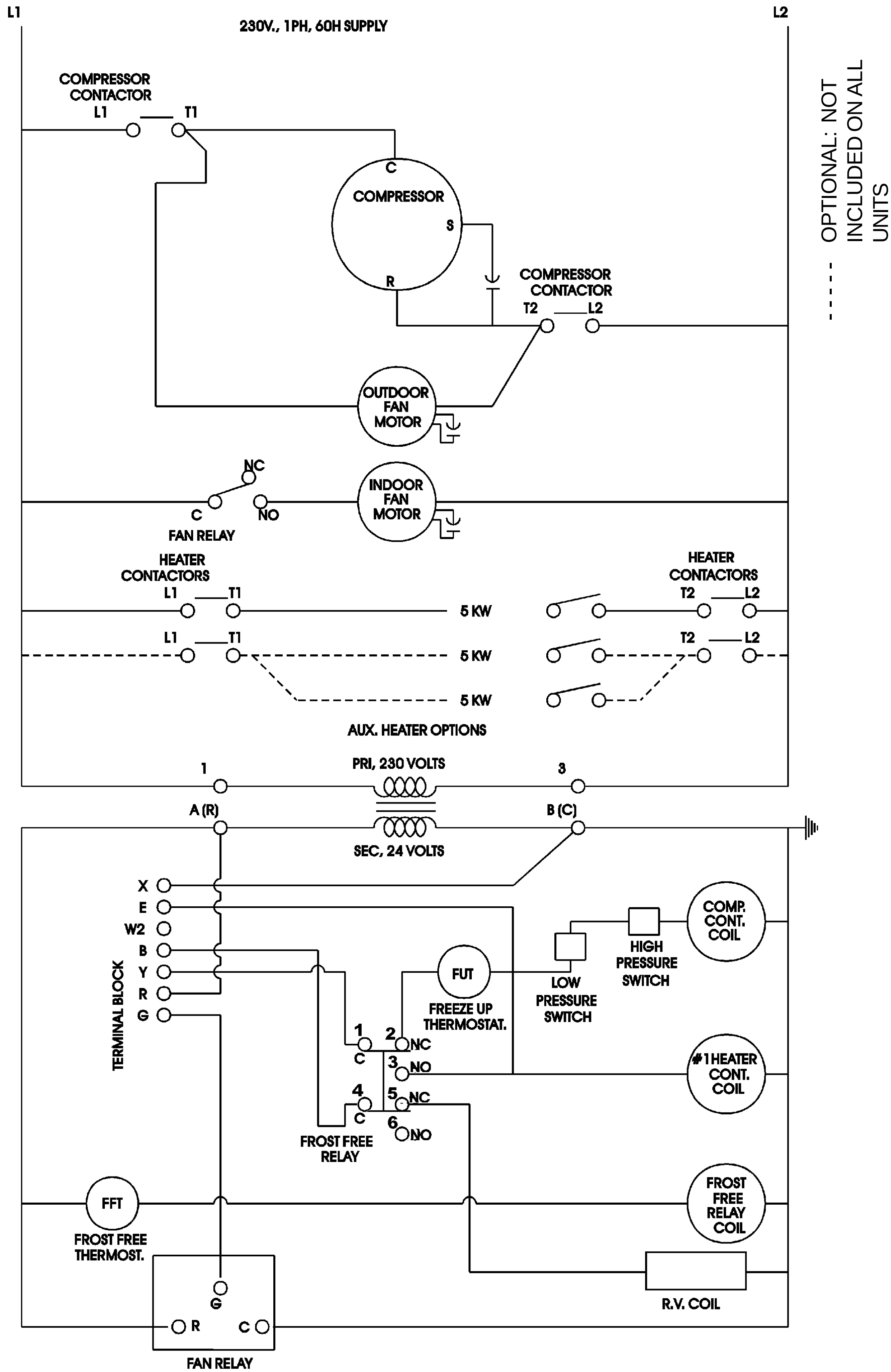


Wiring Diagram: All Standard Heat Pumps

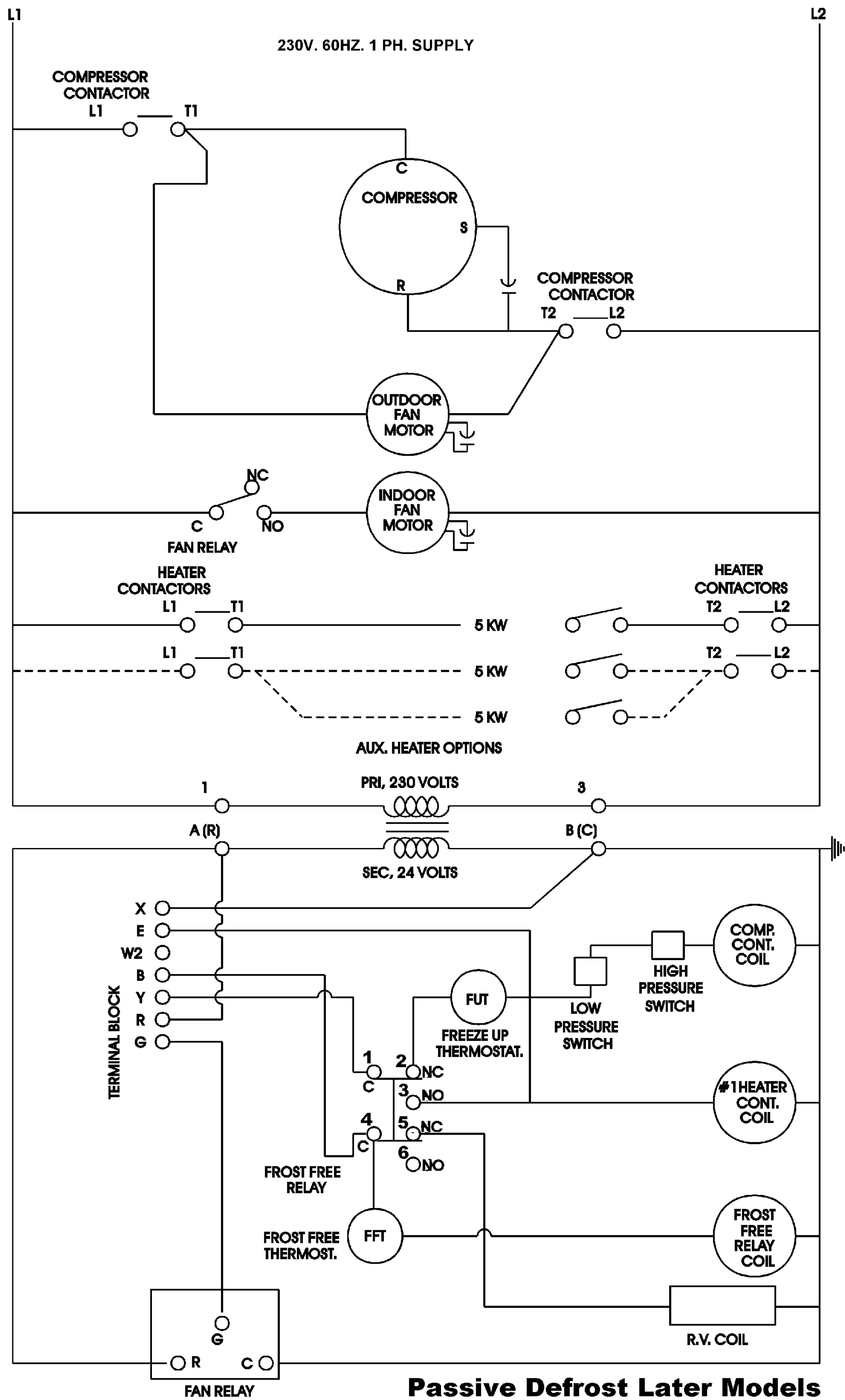


- - - - - OPTIONAL: NOT INCLUDED ON ALL UNITS

Wiring Diagram: Frost Free Heat Pumps (Passive Defrost) Early Models

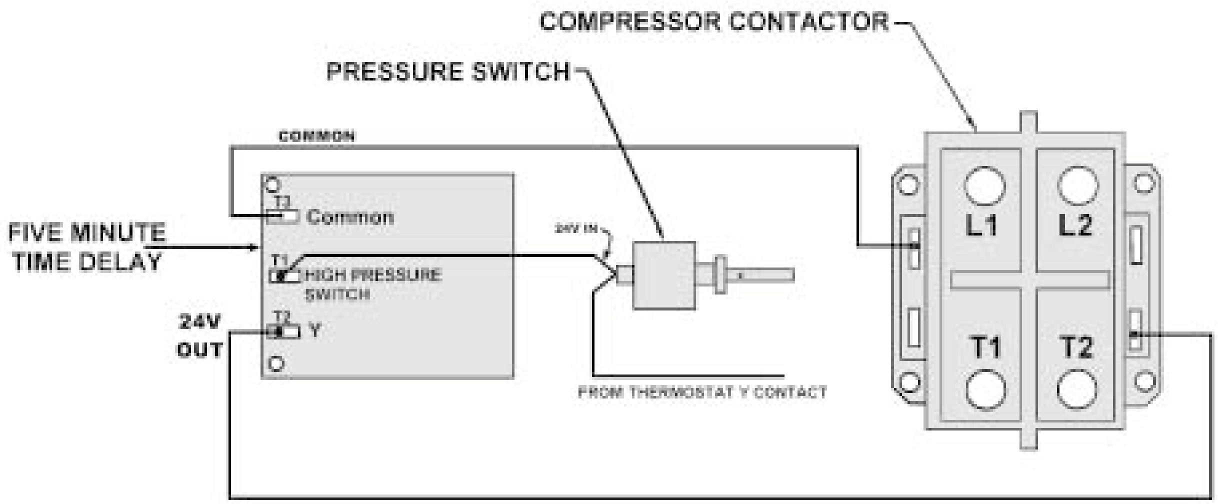


Wiring Diagram: Frost Free Heat Pumps (Passive Defrost) Later Models

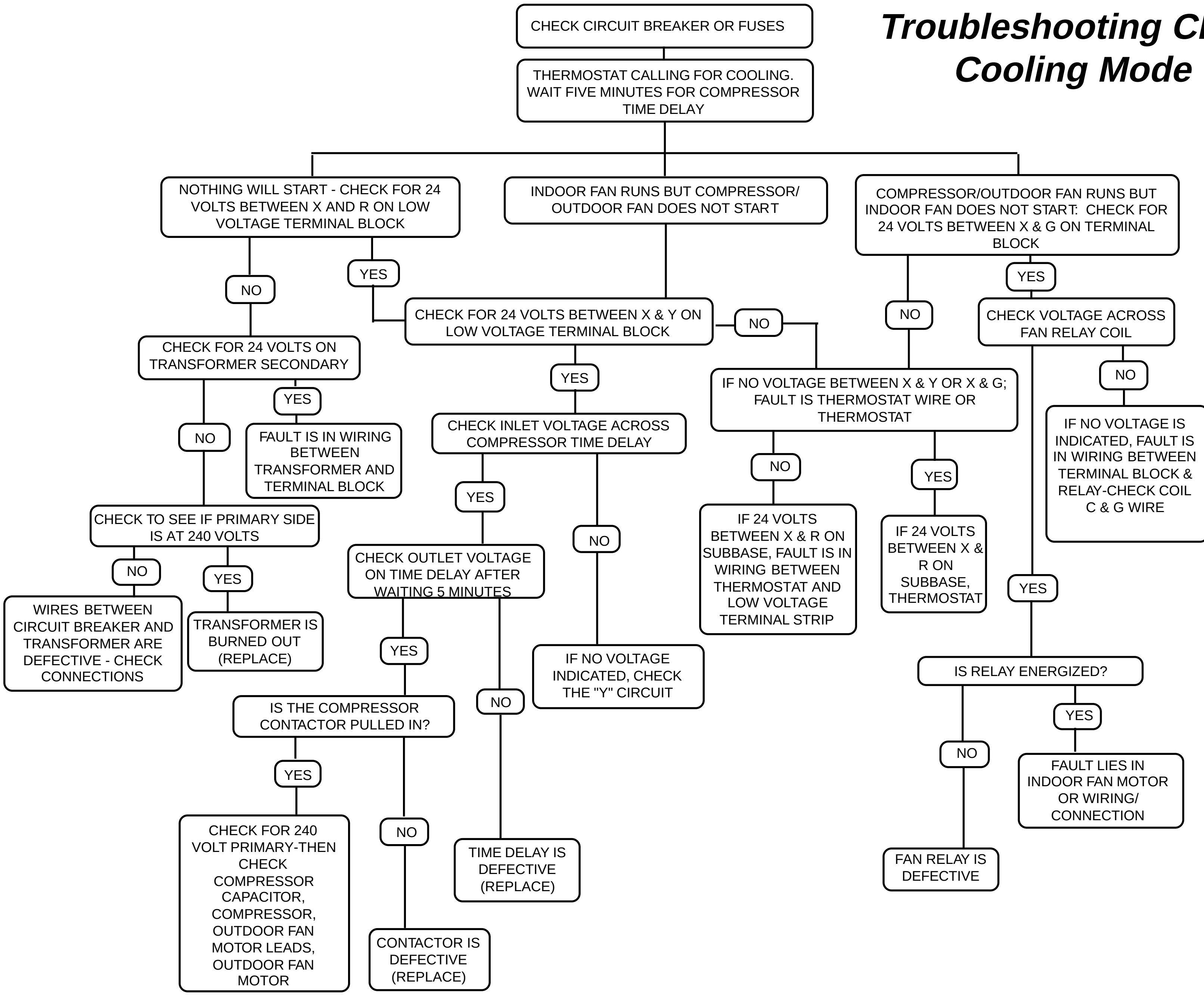


Passive Defrost Later Models

Wiring Diagram: Time Delay Relay

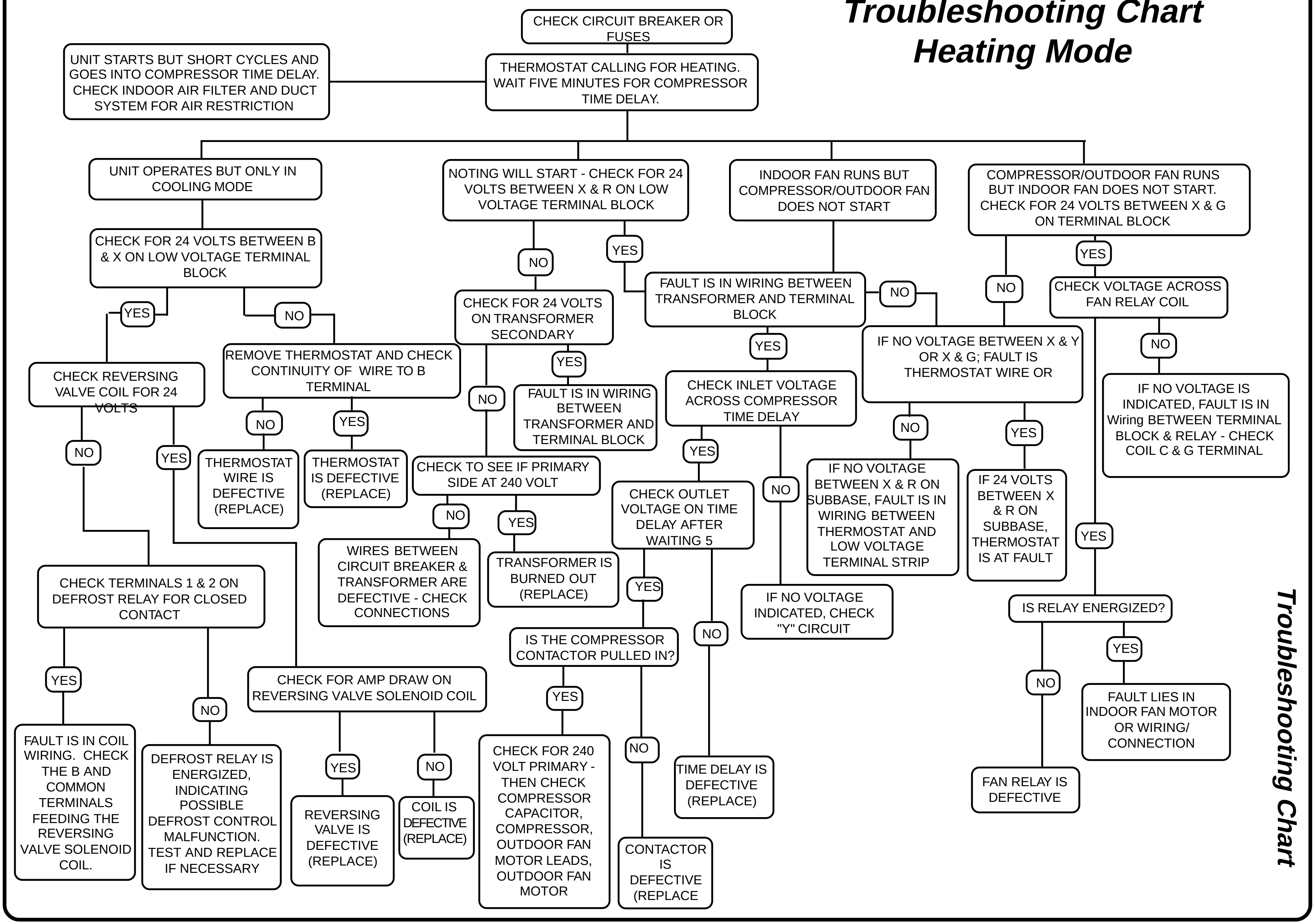


Troubleshooting Chart Cooling Mode

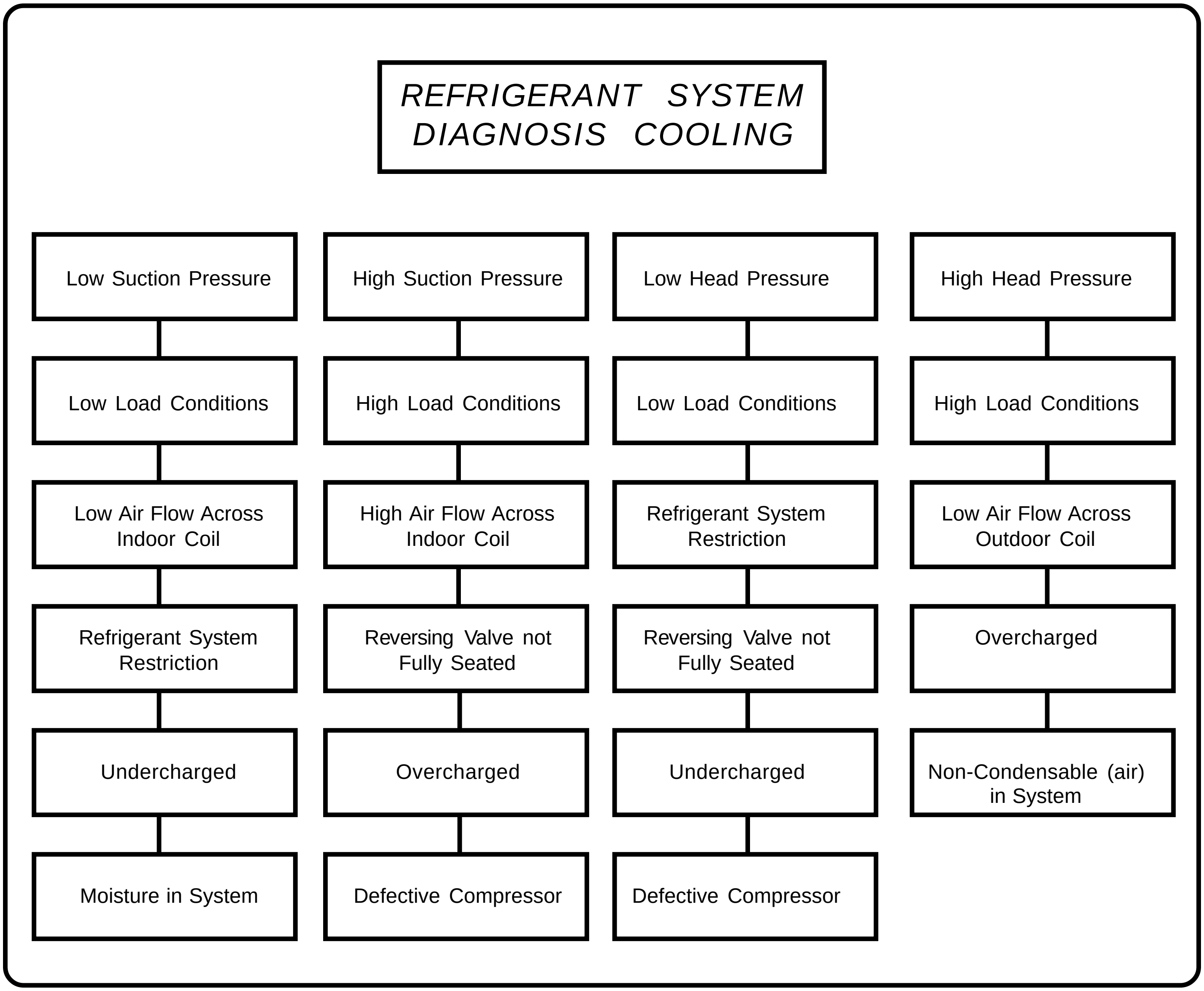


Troubleshooting Chart Cooling Mode

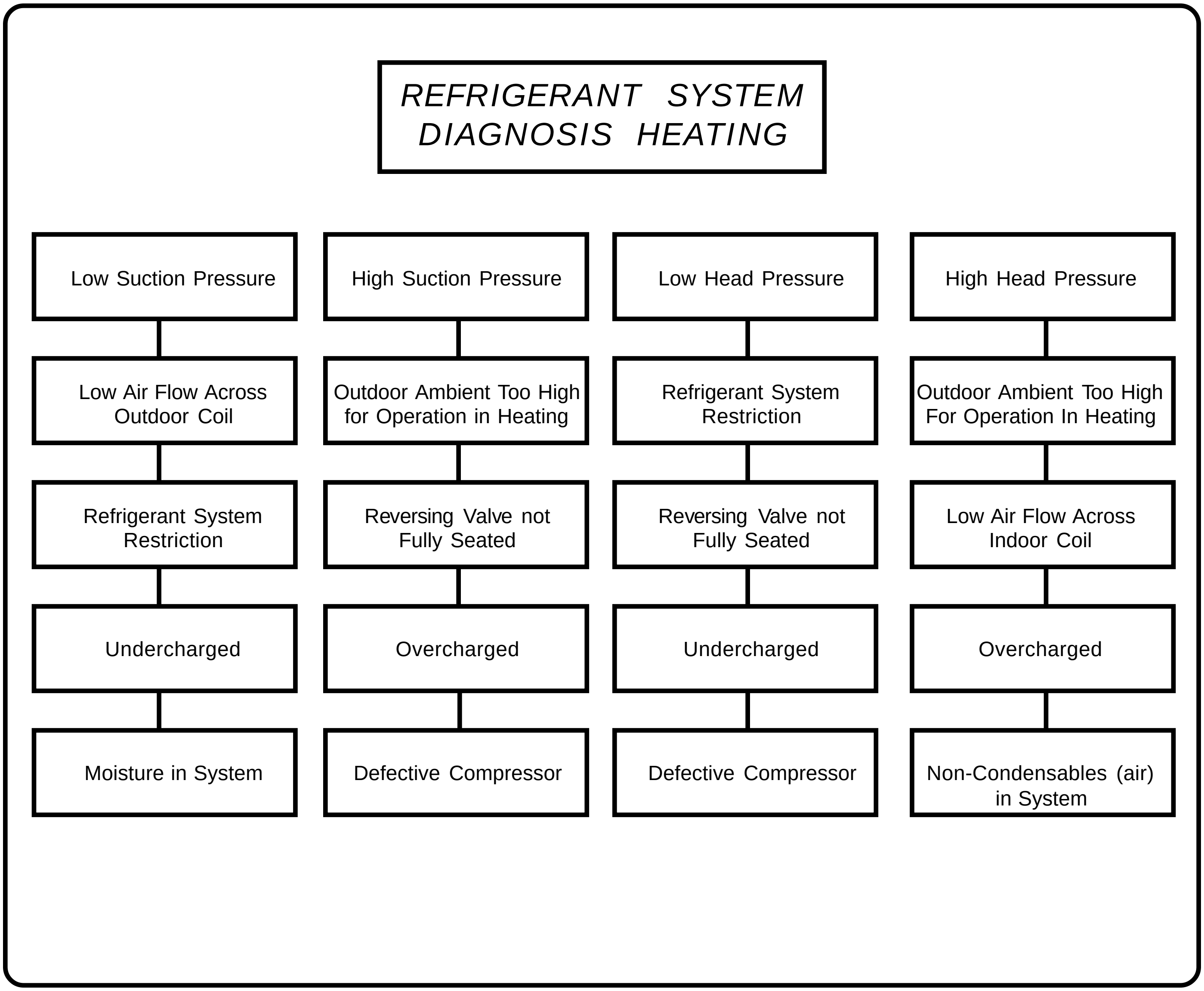
Troubleshooting Chart
Heating Mode



Troubleshooting Chart — Cooling



Troubleshooting Chart — Heating



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