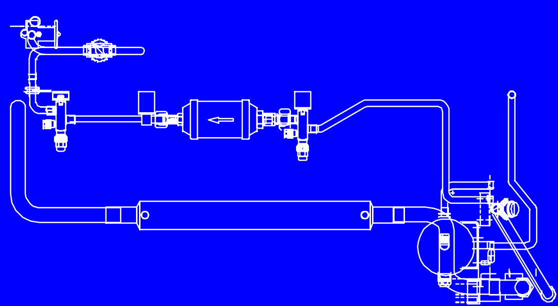
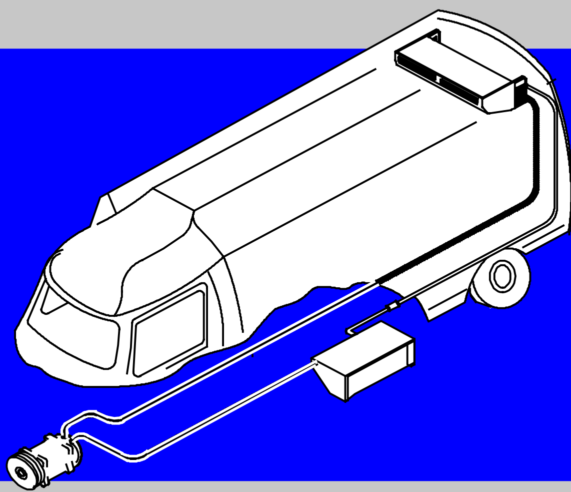
Carrier

Transport Air Conditioning





OPERATION & SERVICE
for
SPLIT SYSTEMS

Generation 4 & 5

T-299 Rev C Change 06/10

Carrier
TRANSICOLD

OPERATION AND SERVICE MANUAL

BUS
AIR CONDITIONING
EQUIPMENT

SPLIT-SYSTEMS
Generation 4 & 5

SAFETY SUMMARY

GENERAL SAFETY NOTICES

The following general safety notices supplement the specific warnings and cautions appearing elsewhere in this manual. They are recommended precautions that must be understood and applied during operation, service, and maintenance of the equipment covered herein. The general safety notices are presented in the following three sections labeled: First Aid, Operating Precautions and Maintenance Precautions. A listing of the specific warnings and cautions appearing elsewhere in the manual follows the general safety notices.

FIRST AID

An injury, no matter how slight, should never go unattended. Always obtain first aid or medical attention immediately.

OPERATING PRECAUTIONS

Always wear protective eye wear (safety glasses or goggles).

Keep hands, clothing and tools clear of the evaporator and condenser fans.

No work should be performed on the system unless battery power is disconnected.

Always work in pairs. Never work on the equipment alone.

In case of severe vibration or unusual noise, stop the system and investigate.

MAINTENANCE PRECAUTIONS

Familiarize yourself with the proper operation of any service equipment you will be using (voltmeter, amp probe, manifold gauges, etc.). Always read the owner's manual that is enclosed with the equipment

Always follow the manufacturers instructions for your recovery/recycling equipment. Failure to do so could cause personal injury or damage to your equipment. Never perform any maintenance or service on your equipment before consulting with authorized service personnel. Always unplug unit before attempting any maintenance. Removing internal fittings and filters can release pressurized refrigerant. Slowly release pressure and always wear appropriate safety wear.

Avoid breathing any refrigerant vapor, lubricant vapor, or mist. Exposure to these, particularly PAG oil mist, may irritate your eyes, nose, or throat.

Always use a DOT (Department of Transportation) approved cylinder for storing used and recycled refrigerant. Approved cylinders will be stamped DOT 4BW or DOT 4BA. Carrier recommends a MACS (Mobile Air Conditioning Society) certification in Recovery/Recycling to gain more information on handling and using refrigerants.

Never attempt to apply heat or open flame to a refrigerant cylinder. High temperatures can raise the cylinder pressure to dangerous levels. Carrier recommends using a heat blanket to increase the internal temperature of the refrigerant cylinder, greatly increasing the transfer of refrigerant to the bus air conditioning system.

Never use compressed air (shop-air) to leak-test or pressure test a R134a system. Under certain conditions, pressurized mixtures of R134a and air can be combustible. In addition, shop air will inject moisture into the system.

Always use mineral oil to lubricate "O" Rings, hoses, and fittings on R134a systems. PAG oils will absorb moisture and become very acidic and corrosive. Mineral oil will not absorb moisture and thus prevent corrosion. Always wear gloves when working with PAG and Ester lubricants to prevent irritation to your skin. R134a lubricants can also damage vehicles paint, plastic parts, engine drive belts and coolant hoses.

Beware of unannounced starting of the evaporator and condenser fans. Do not remove the evaporator cover or condenser fan guards without disconnecting the vehicle battery cable.

Be sure power is turned off before working on motors, controllers, and electrical control switches. Tag system controls and vehicle battery to prevent accidental energizing of the system.

Do not bypass any electrical safety devices, e.g. bridging an overload, or using any sort of jumper wires. Problems with the system should be diagnosed, and any necessary repairs performed, by qualified service personnel.

When performing any arc welding on the vehicle, disconnect the vehicle battery.

In case of electrical fire, extinguish with CO_2 (never use water). Disconnect vehicle battery power if possible.

SPECIFIC WARNINGS

WARNING

Beware of unannounced starting of the evaporator and condenser fans. The unit may cycle the fans and compressor unexpectedly as control requirements dictate.

WARNING

Be sure to observe warnings listed in the safety summary in the front of this manual before performing maintenance on the air conditioning system

WARNING

Never use air for leak testing. It has been determined that pressurized, air-rich mixtures of refrigerants and air can undergo combustion when exposed to an ignition source.

WARNING

Do not use a nitrogen cylinder without a pressure regulator. Do not use oxygen in or near a refrigeration system or as an explosion may occur.

WARNING

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

WARNING

There may be liquid refrigerant trapped behind the block valve. Slowly loosen the fitting and avoid contact with exposed skin or eyes.

WARNING

The filter-drier may contain liquid refrigerant. Slowly open the fitting nuts and avoid contact with exposed skin or eyes.

CAUTION

Unless there was a catastrophic failure, such as a blown or ruptured refrigerant hose, additional oil may not be needed.

CAUTION

Use only the exact oil specified by the compressor manufacturer. Use of oil other than that specified will void the compressor warranty.

TABLE OF CONTENTS

TABLE OF CONTENTS - Continued:

LIST OF ILLUSTRATIONS

Figure **Page**

LIST OF TABLES

SECTION 1

DESCRIPTION

1.1 INTRODUCTION

This manual contains Operating, Service, and Maintenance Instructions for Gen 4 and Gen 5 Split System Air Conditioning and Heating equipment furnished by Carrier Transport Air Conditioning. Additional support manuals are listed in Table 1-1.

A Split System normally includes an Evaporator(s), a Condenser(s) a Compressor(s) and interconnecting refrigerant hoses, fittings, and electrical harnesses and controls. A listing of the evaporator and condenser models, along with specific data for each, is provided in the component data that follows.

Specific systems may vary, this manual does not cover all combinations, variations, and applications, it does set up standards from which processes can be measured. Contact Carrier Transport Air Conditioning Technical Service Hot-Line for additional assistance (800-450-2211).

1.2 WHAT IS AIR CONDITIONING

Air Conditioning is the cooling, heating, dehumidification, and filtration of the air located within the passenger compartment of a vehicle.

1.3 MODEL AND SERIAL NUMBER TAGS

In order to identify the air conditioning components you have, you will need to know the model number and serial number. All Carrier Transport Air Conditioning evaporators, condensers and compressors have a model/serial number tag or PID decal located on the assembly. See Figure 1-1 for all skirt mounted condenser data tag locations, Figure 1-2 for GEN 4 evaporator data tag location, Figure 1-3 for GEN 5 evaporator data tag locations, Figure 1-4 & Figure 1-5 for In-Wall data tag locations, Figure 1-7 for KR-2 & KR-3 PID locations and Figure 1-6 for the CM-7 & CM-11 rooftop condensers data tag location. The CM-7 and CM-11 rooftop condensers are no longer available from Carrier TAC.

NOTE

The EM-9 evaporator data tag is located on the side of the evaporator assembly, not between the blower assemblies (See Figure 1-2).

Knowing these locations and the information on the data tags will aid you in identifying the correct service procedures.

1.3.1 PID Data Tag (Decal)

All KR2, KR3 & KR4 Rooftop Condensers have PID Decals instead of the standard Model/Serail tag. These tags will list the following:

a. System Model No. (Example - 68KR4-101-2)

b. Serial No.

c. P.I.D. (Example - KR4C00032)

d. Refrigerant (Example - R134a)

e. Voltage (Example - 13.5 VDC)

f. Amps (Example - 25A)

g. Unit Weight (Example - 186 lbs.)

Table 1-1 Additional Support Manuals

MANUAL NUMBER	EQUIPMENT COVERED	TYPE OF MANUAL
T-299PL	Split Systems	Parts List
T-311	Split Systems	Installation Procedures
62-50455	Basic Refrigeration	Service Training
62-50468	Transport Refrigeration	Service Training
62-03213	Service Tools	Service Tools

Figure 1-1 Condenser Model CM2/3 - Serial Number Location

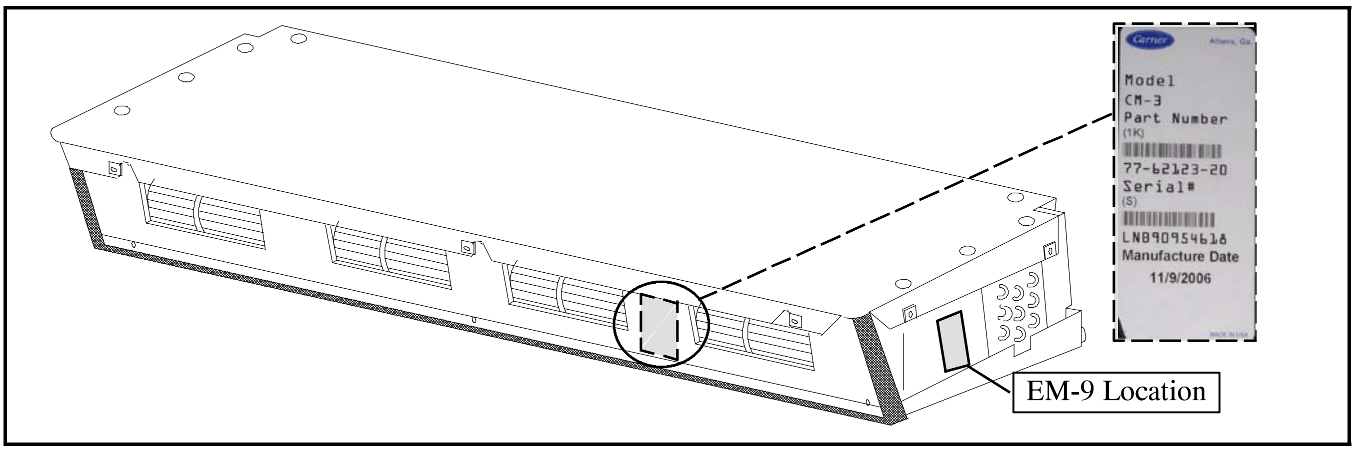


Figure 1-2 GEN 4 Evaporator Model - Serial Number Location

Figure 1-3 GEN 5 Evaporator Model (All) - Serial Number Location

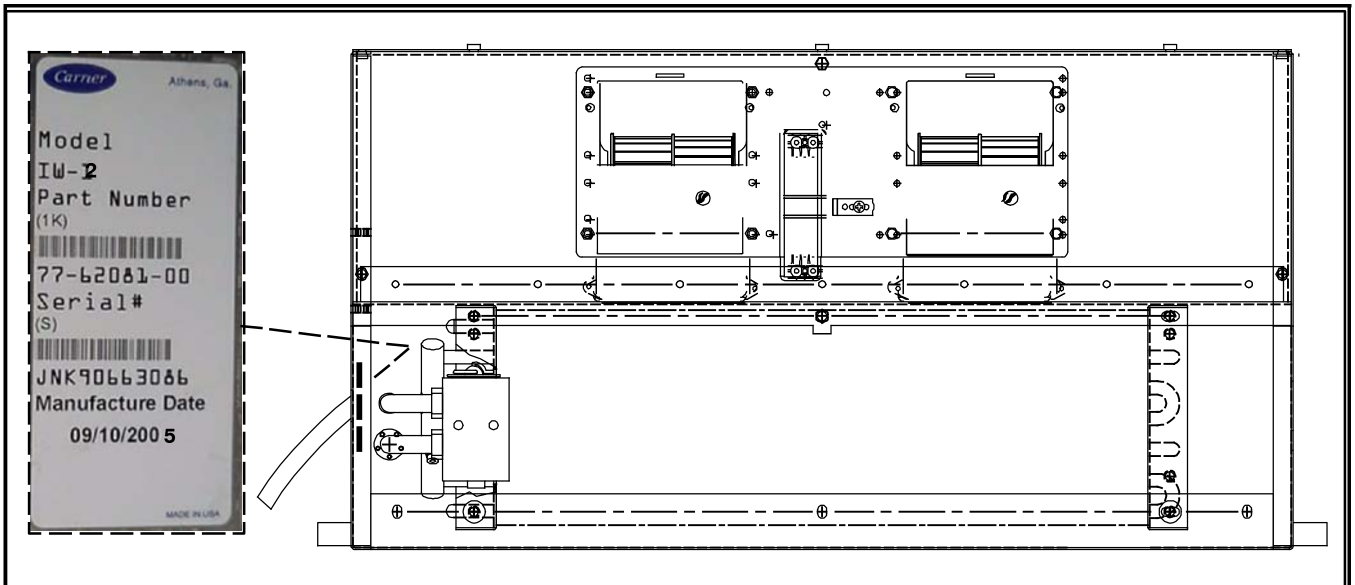


Figure 1-4 GEN 4, IW-2 & IW-7 - Serial Number Location

Figure 1-5 GEN 4, IW-1 - Serial Number Location

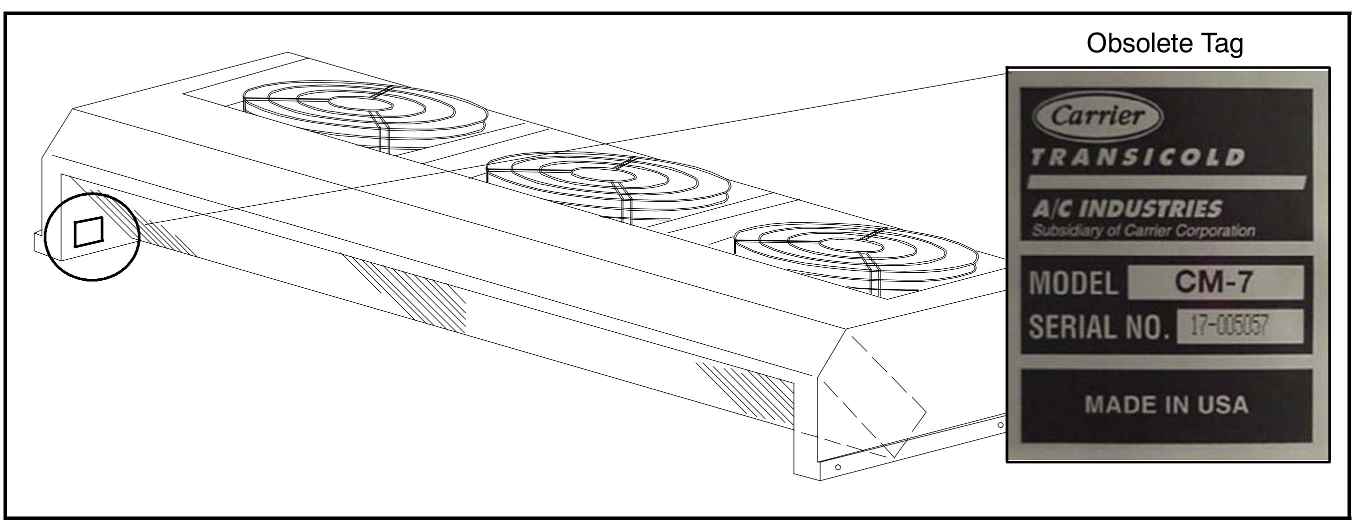


Figure 1-6 CM-7/11 Rooftop Condensers (No Longer Offered) - Serial Number Location

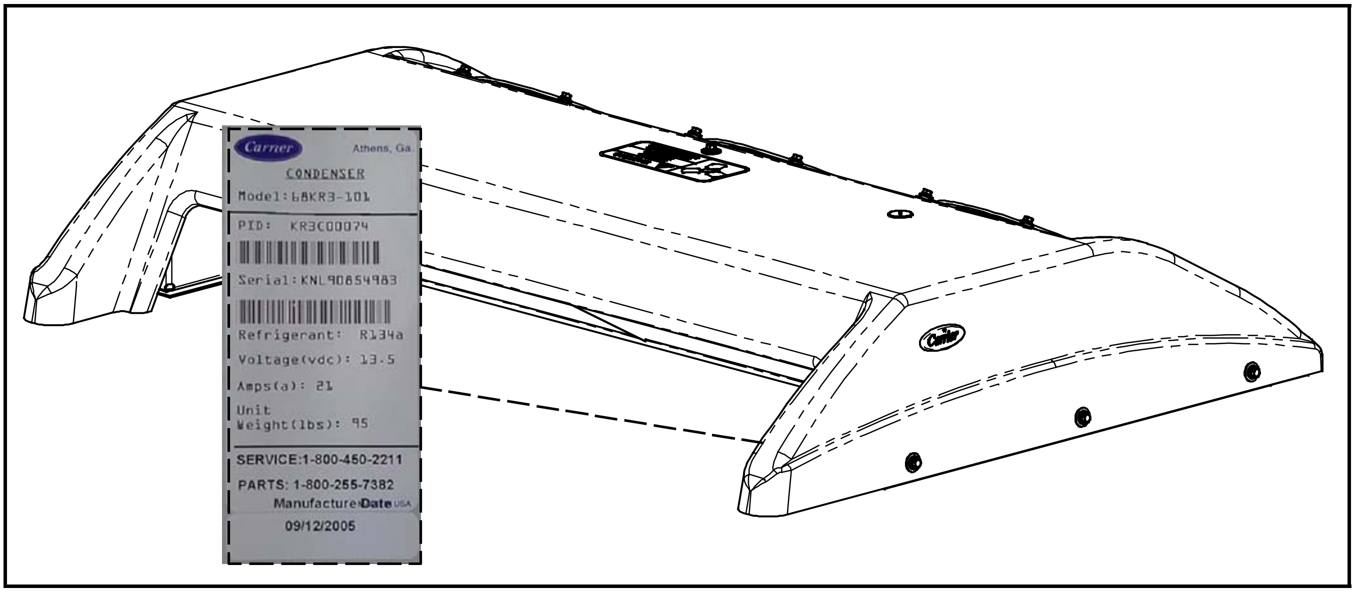


Figure 1-7 KR-2/KR-3 Rooftop Condensers - Serial Number/PID Location

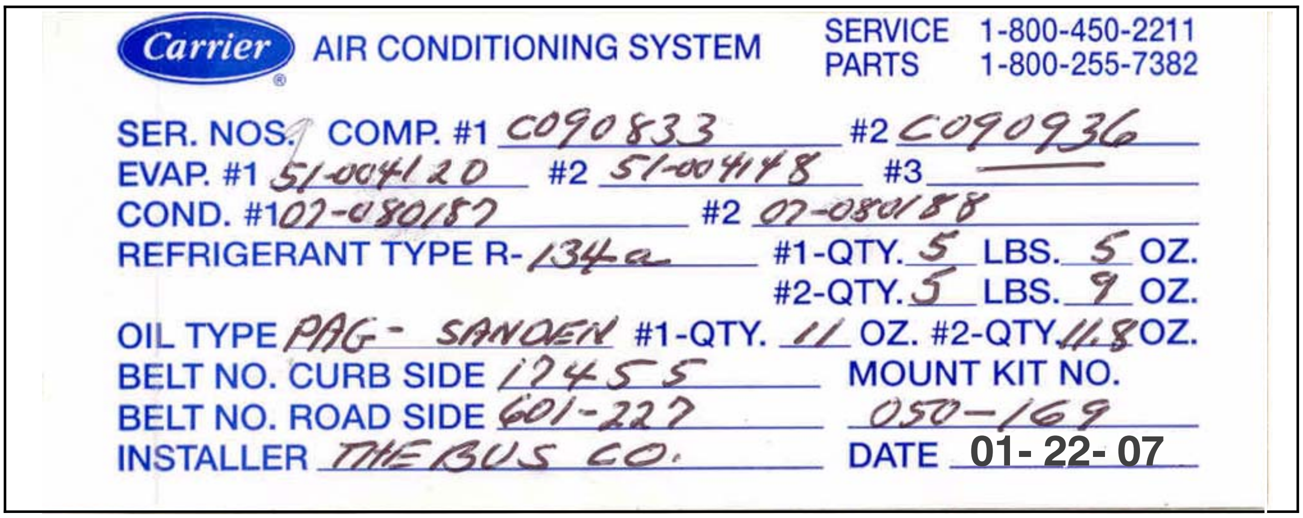


Figure 1-8 System Requirements Label

1.4 SYSTEM REQUIREMENTS LABEL

The system requirements label is conveniently located within the vehicle's engine compartment. This label, when properly completed by the installer, will give the servicing technician the refrigerant and oil charge(s), evaporator(s), condenser(s), and compressor(s) serial numbers, the drive belt(s) number, mount kit number, the date of installation and the installer (See Figure 1-8).

1.5 SYSTEM DESIGNATIONS

Tie-In System - Is a Carrier evaporator and condenser connected to an existing OEM compressor and dash evaporator. The OEM radiator condenser is normally removed.

NOTE

You may encounter installations where the OEM radiator style condenser is used as the Tie-In condenser. Call Carrier Transport Air Conditioning Technical Service Hot-Line (800-450-2211) for assistance, as this is not a recommended Carrier Transport Air Conditioning application.

Max System - A Carrier system installed along with an existing OEM system. The systems operate independent of each other.

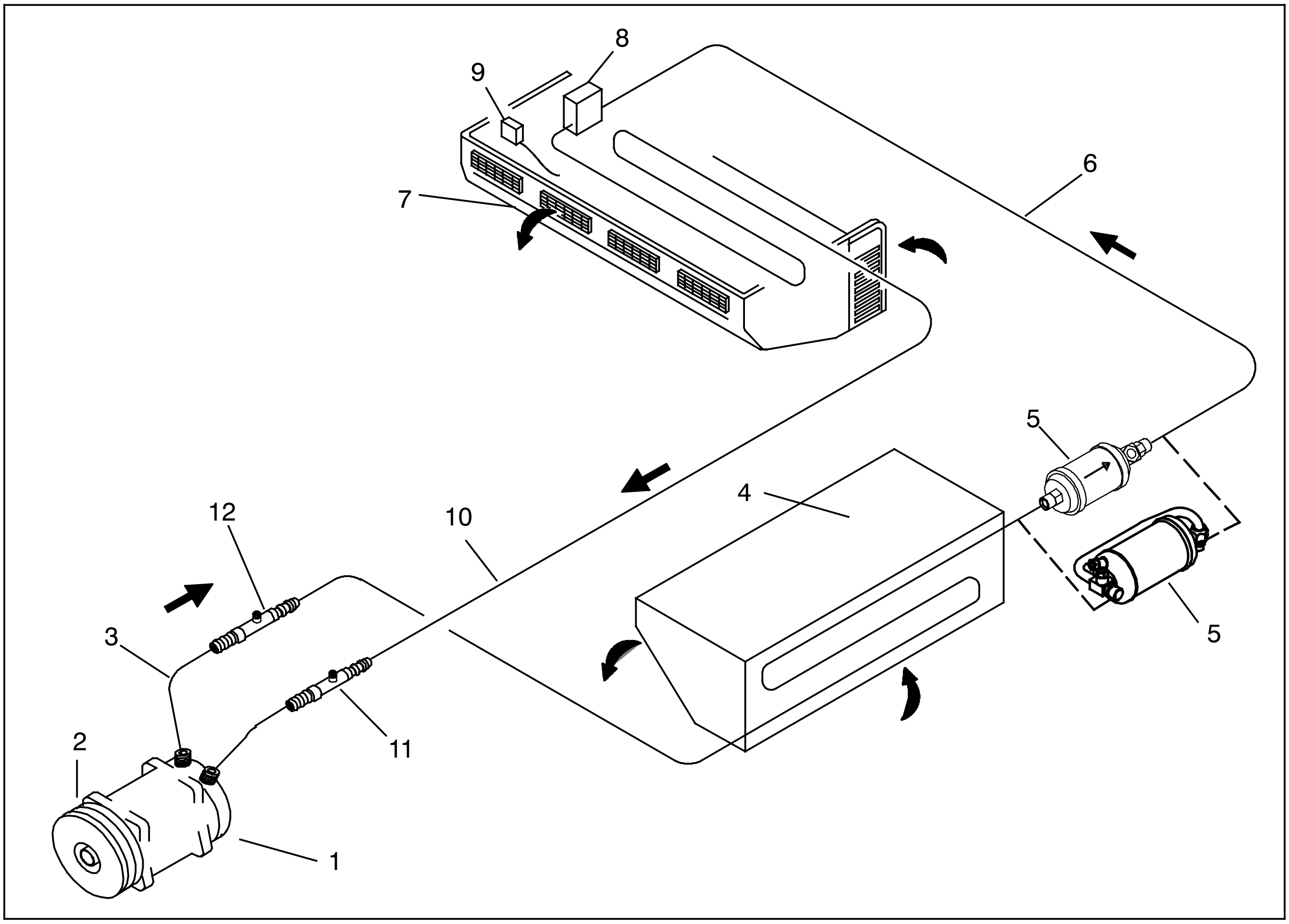
Stand-Alone (Standard) System - All Carrier components installed on a vehicle. These can be either single or dual compressor systems.

IW (In-Wall) System - A Carrier evaporator installed in the front and/or rear of the vehicle. This type evaporator is installed between the inside & outside walls of the vehicle.

1.6 SYSTEM COMPONENTS

Return Air Thermostat/Sensor - The system may be supplied with a thermostat or thermistor Both of these devices are temperature sensitive components which when activated, signals the Electro-Magnetic Clutch to engage/disengage. The return air thermostat is normally located in the drivers control panel while the return air thermister is normally located in the evaporator assembly.

Electro-Magnetic clutch - The Electro-Magnetic clutch controls the operation of the compressor. When engaged, the compressor circulates refrigerant and provides cooling (See Figure 1-9).



1	Compressor	7	Evaporator
2	Electro-Magnetic Clutch	8	Block Valve (TXV)
3	Discharge Line	9	Freezestat-(Coil freeze-up thermostat)
4	Condenser	10	Suction Line
5	Filter-Dryer or Receiver-Drier	11	Suction Access Valve
6	Liquid Line	12	Discharge Access Valve

Figure 1-9 Component Location Diagram

Compressor - The compressor is a belt driven, high-pressure pump, which circulates the refrigerant through the evaporator and condenser . The operation of the compressor is controlled by the Electro-Magnetic clutch.

Condenser - The condenser is normally located in the skirt or on the roof of the vehicle. Its primary function is to reject heat, which was transferred to the refrigerant by the evaporator from the passenger compartment of the vehicle.

Filter-Dryer - The filter-dryer removes moisture and particulate matter from the refrigerant.

Receiver-Dryer - The receiver-dryer removes moisture and particulate matter from the refrigerant. The receiver-drier also stores a small amount of liquid refrigerant.

Expansion/Block Valve - Meters the refrigerant flow into the evaporator coil. The majority of the Gen 4 (Excel) and all Gen 5 systems use a nonadjustable block valve with an 8° F superheat setting, which is preset at the factory. If you feel there is a problem with the block valve, do not attempt to adjust the valve, replace it.

NOTE

In the event you encounter a Gen 1, Gen 2, or Gen 3 system with an externally equalized expansion valve and/or a system with refrigerant R12, contact Carrier's Technical Service Hot Line (800-450-2211) for assistance.

Evaporator - The evaporator is located in the interior of the vehicle. Its primary function is to transfer heat contained in the passenger compartment air, into the refrigerant, which is circulated by the compressor, through the evaporator coil. During this process the air is also filtered and dehumidified.

Resistor - Resistors are used to control the speeds of the permanent magnet evaporator blower motors.

Pressure Switches - The systems use high and low pressure switches wired in series to control the power circuit of the compressor clutch relay. If either pressure switch opens, interrupting the circuit to the clutch relay, the operation of the compressor will stop. When conditions return to normal the switch will automatically reset and the compressor will resume operating. The switches are non-adjustable.

Freeze-Up Thermostat - Carrier Transport Air Conditioning systems use a freeze thermostat (freezestat) wired in series with the system pressure switches to control the operation of the compressor clutch. Freeze-up thermostats are used to prevent ice from forming on the evaporator coil, which is an indication that liquid refrigerat is getting back to the compressor.

Refrigerant - A refrigerant is a material that is used to move heat from the passenger compartment to the outside air. It is a substance that gives up heat by condensing at high temperature and pressures and absorbs heat by evaporating at low temperatures and pressures. The heat transfer properties exhibited when refrigerant changes state is the foundation of the refrigerant cycle. Most Carrier TAC systems use R134a.

1.7 REFRIGERATION SYSTEM COMPONENT SPECIFICATIONS

a. EXPANSION/BLOCK VALVE:

Superheat Setting: 8° F

b. PRESSURE SWITCHES:

High Pressure Switch: Normally closed, open on pressure rise.
Cut-out at 400 psig - Cut-in at 300 psig.(±5%)

Low Pressure Switch: Normally closed, open on pressure drop.
Cut-in at 25 psig. - Cut-out at 10 psig (±5%)

c. FREEZE-UP THERMOSTAT:

GEN 4 Series Freeze-Up Thermostat: Cut-out at 26° F, ±1.5° F. Cut-in at 34° F, ±1.5° F. Pre-set at factory (Adjustable). Turn counterclockwise to end - then 1/4 turn clockwise for original factory setting.

GEN 5 Series Freeze-Up Thermostat: Cut-out at 30.5° F, ±1.5° F. Cut-in at 45° F, ±1.5° F. Pre-set at the factory (Non-adjustable).

d. RETURN AIR THERMOSTAT/SENSOR

Return Air Thermostat: Adjustable range from 55° F to 85° F. Normal remote (drivers location) setting is 55° F with a ±5° F differential.

Return Air Sensor (Total Control): Temperature range 60° F to 80° F.

e. EVAPORATOR MOTORS

Gen 4 Series: Double shafted 12 VDC (13.5 VDC Nominal), permanent magnet, motor/blower assemblies.

Full Load Amps: Refer to Table 3-1
Volts DC Maximum: 15.1 VDC
Volts DC Minimum: 10.8 VDC
RPM: 2600 @ zero static

Gen 5 Series: Single shafted 12 VDC continuous duty motors.

Full Load Amps: 30 Amps @ 2900 RPM @ 12.5 VDC
Locked Rotor Amps: 80 Amps
Volts DC Maximum: 16 VDC
Volts DC Minimum: 4 VDC

f. CONDENSER MOTORS

Rooftop:

CM-7 and CM-11: Single shafted 12 VDC (12.5 Nominal) continuous duty motors (barrel type) to be used with Rooftop Condensers.

Full Load Amps: 30 Amps @ 2900 RPM @ 12.5 VDC
Locked Rotor Amps: 80 Amps
Volts DC Maximum: 16 VDC
Volts DC Minimum: 4 VDC

KR-2 and KR-3: Fan-Motor Assembly. Single shafted 12 VDC (12.5 Nominal) continuous duty motors.

Full Load Amps: 7 Amps @ 2100 RPM @ 12.5 VDC
Locked Rotor Amps: 40 Amps
Volts DC Maximum: 13.5 VDC
Volts DC Minimum: 5 VDC

KR-4: Single shafted, permanent magnet, 12 VDC (12.5 Nominal) continuous duty, single speed motors.

Full Load Amps: 7 Amps @ 1900 RPM @ 12.5 VDC
Locked Rotor Amps: 30 Amps
Volts DC Maximum: 16 VDC
Volts DC Minimum: 4 VDC

Skirt Mounted: Permanent magnetic**,** single speed motor (12VDC nominal) and fan combination (pancake style) 5 blades.

Full Load Amps: 7 Amps @ 2100 RPM @ 12.5 VDC
Locked Rotor Amps: 40 Amps @ 13.5VDC
Volts DC Maximum: 13.5 VDC
Volts DC Minimum: 5 VDC

Skirt Mounted ("Vector" Fan): Permanent magnetic, single speed motor (12VDC nominal) and fan combination (pancake style) 10 blades.

Full Load Amps: 6.8 Amps @ 2350 RPM @ 12.5 VDC
Locked Rotor Amps: 25.4 Amps @ 13.5VDC
Volts DC Maximum: 13.5 VDC
Volts DC Minimum: 5 VDC

g. COMPRESSORS

Carrier Transport Air Conditioning uses a variety of compressors properly sized and suited for split system applications. Their cubic inch displacement (c.i.d.) ranges from a 10 cubic inch TM-16 to the 19.1 cubic inch TM-31. Applications include rear and front engine mounted. Compressor Clutch coils typically draw 2 to 3 Amps. A compressor must always be replaced with a compressor of the same style and capacity.

1.8 COOLING CYCLE

The unit operates as a vapor compression system using R-134a as the refrigerant (see Figure 1-10). The compressor raises the pressure and the temperature of the refrigerant vapor and forces it thru the discharge lines into the condenser tubes. The condenser fan circulates surrounding air (which is at a temperature lower than the refrigerant) over the outside of the condenser tubes. Heat transfer is established from the refrigerant (inside the tubes) to the condenser air (flowing over the tubes). The condenser tubes have fins designed to improve the transfer of heat from the refrigerant gas to the air; this removal of heat causes the refrigerant to liquefy, thus liquid refrigerant leaves the condenser and flows to the filter-drier. The filter-drier contains an absorbent that keeps the refrigerant clean and dry.

NOTE

The new style micro-channel condensers are fitted with receiver-driers instead of filter-driers. The receiver-drier performs the same function as a filter-drier and it also stores liquid refrigerant.

From the filter-drier/receiver-drier, the liquid refrigerant then flows to the block type expansion valve. The expansion valve reduces pressure and temperature of the liquid and meters the flow of liquid refrigerant to the evaporator to obtain maximum use of the evaporator heat transfer surface.

The low pressure, low temperature liquid that flows into the evaporator tubes is colder than the air that is circulated over the evaporator tubes by the evaporator fans. Heat transfer is established from the evaporator air (flowing over the tubes) to the refrigerant (flowing inside the tubes). The evaporator tubes have fins to increase heat transfer from the air to the refrigerant; therefore the cooler air is circulated to the interior of the vehicle.

The transfer of heat from the air to the low temperature liquid refrigerant in the evaporator causes the liquid to vaporize. This low temperature, low pressure vapor refrigerant then continues through the suction line and returns to the compressor where the cycle repeats.

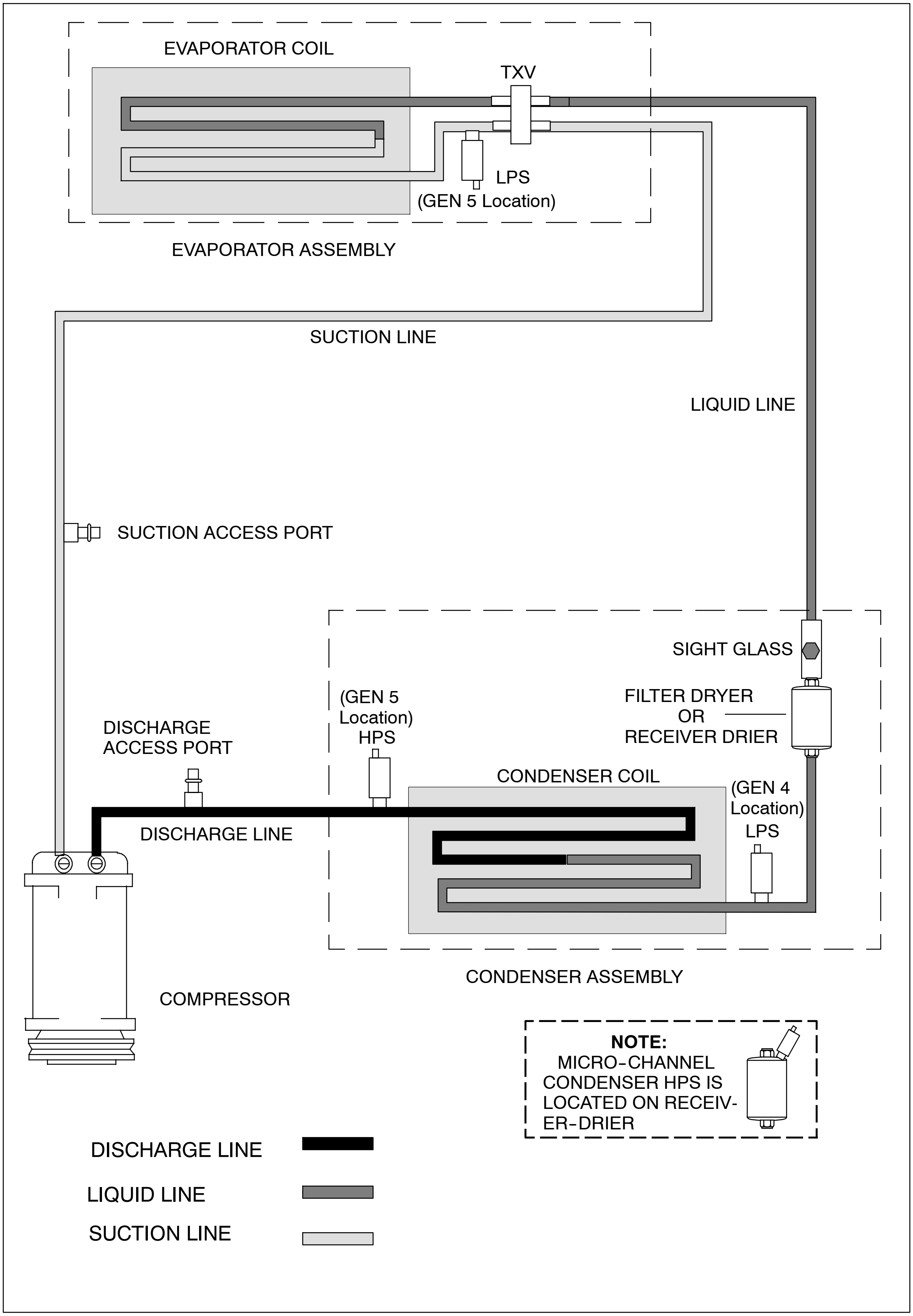


Figure 1-10 Air Conditioning Refrigerant Flow Diagram – Small Split System

1.9 HEATING CYCLE (If Applicable)

The optional heating circuit component furnished by Carrier Transport Air Conditioning is the side or rear mounted evaporator heater core. Components furnished by the vehicle manufacturer include coolant (glycol solution), pumps, and a hot water shut-off valve (See Figure 1-11).

Engine coolant is circulated through the heating circuit by the engine and/or auxiliary water pump. When the heat valve is opened, engine coolant flows through the heater coil. Heat is transferred from the glycol flowing in the tubes to the air flowing over the tubes. The heater tubes have aluminum fins to increase heat transfer from the glycol to the air.

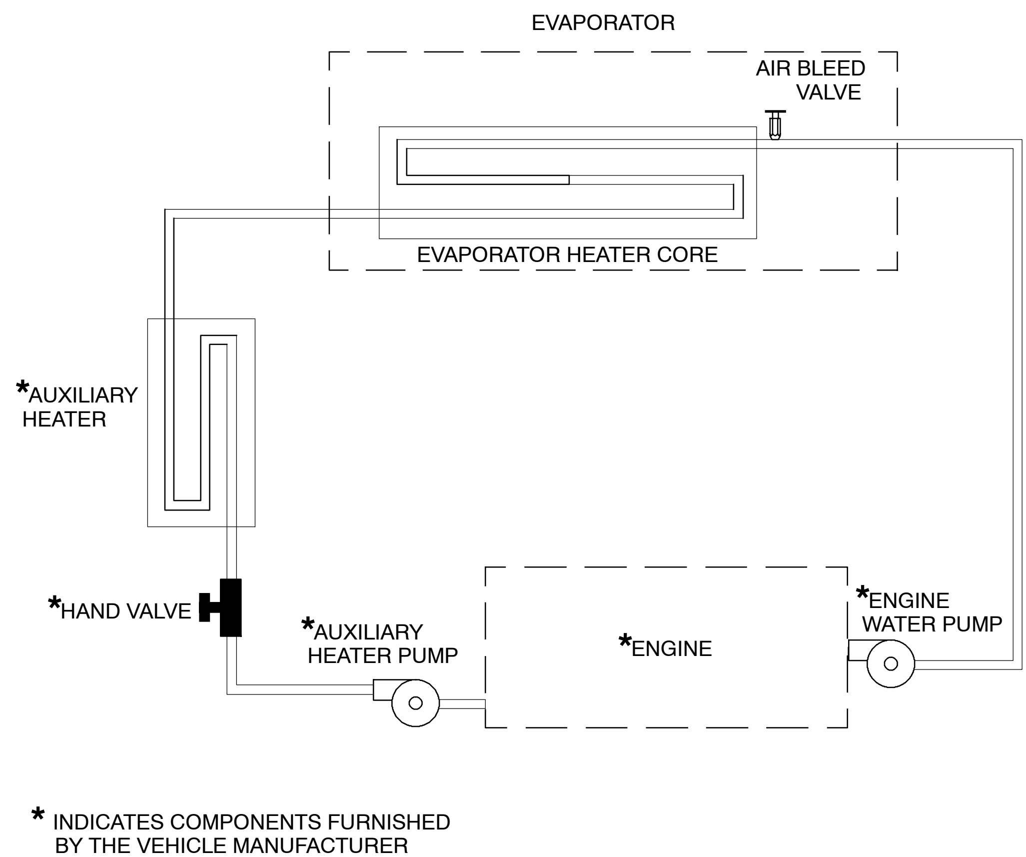


Figure 1-11 Heating System Flow Diagram (Typical)

SECTION 2

OPERATION

2.1 OPERATING INSTRUCTIONS

Before attempting to operate the system, power must be available from the vehicle battery. If the engine is not running, start the engine.

The system may be supplied with Manual Controls (see Figure 2-1 & Figure 2-3) or the Carrier Transport Air Conditioning Total Control (see Figure 2-5).

Refer to the Sections 2.2 & 2.3 for manual control operating instructions or Section 2.5 for Total Control operating instructions.

2.2 MANUAL CONTROLS

Carrier Transport Air Conditioning systems are manually operated by a Drivers Control Panel (See Figure 2-1) wired into an Electrical Control Panel (See Figure 2-2).

2.2.1 Driver's Control Panel

The Drivers Control Panel (See Figure 2-1), consists of an evaporator fan speed switch (three speed or variable) and an adjustable thermostat. The drivers control panel is normally located within easy reach of the driver. On larger bus applications there could be two (2) separate air conditioning system driver control panels. One for each system.

There will be some applications where the switch mounting plate, thermostat and fan speed switch are mounted in the drivers area without the control panel housing.

On some applications the vehicle manufacturer (OEM) will supply different type controls for the air conditioning system. Refer to OEM technical manual for operating instructions.

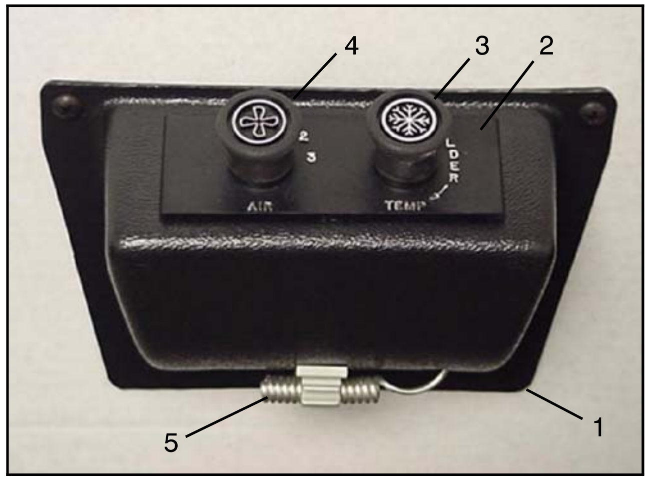
2.2.2 Fan Speed Switch (three speed or variable)

Three Speed – The standard fan speed switch has four settings, Off (0), Low (1), Medium (2), and High (3) speed operation. This switch controls the operation of the system and the evaporator blower(s) by energizing the appropriate circuits and relays located on the electrical control panel. See Figure 2-2.

Variable Speed – Certain applications may be fitted with a variable speed control switch instead of the standard three speed switch. This switch controls the speed of the evaporator motors by varying the supply voltage.

2.2.3 Thermostat Control

The thermostat controls the temperature within the passenger compartment by switching system components on and off.

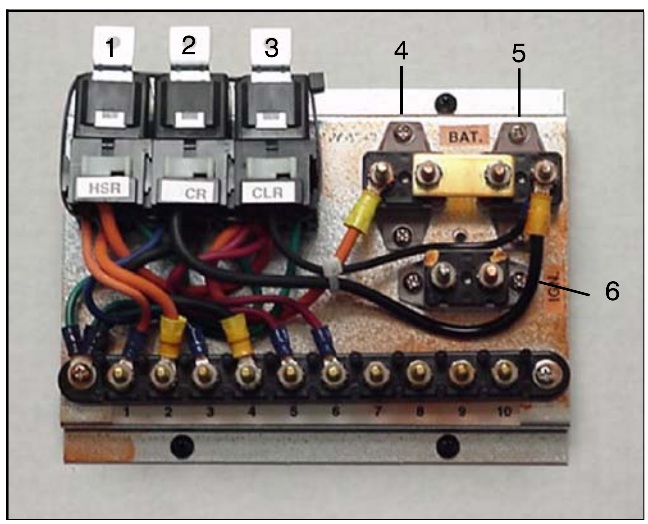


1 Control Panel Housing
2 Nameplate (Switch Mounting)
3 Thermostat Control Switch
4 Fan Speed Switch (3 Speed or Variable)
5 Ambient Air Sensor (Thermostat)

Figure 2-1 Drivers Control Panel

2.2.4 Electrical Control Panel

The electrical control panel contains relays and circuit breakers used for system control.



1 High Speed Relay
2 Condenser Relay
3 Compressor Clutch Relay
4 Circuit Breaker (HSR)
5 Circuit Breaker (CR)
6 Circuit Breaker (Ignition)

Figure 2-2 Electrical Panel (Typical)

2.3 FLORIDA CONTROL (TEMPCON)

This controller is normally used in school buses located within the state of Florida, but not limited to that area (See Figure 2-3). This controller is wired to an electrical control board.

The controller consists of:

a. ON/OFF Switch

b. Fan Speed Switch

c. Potentiometer

d. In-Line Fuse (Behind Controller)

2.3.1 ON/OFF Function

Power is supplied to the controller, through an in-line fuse (see Figure 2-4) from a 12 VDC ignition source originating from the vehicle. The controller will not operate until the ignition switch is activated.

Move the ON/OFF switch to the ON position. A green light will illuminate indicating that the controller has power. At the same time the evaporator fans will operate in either Low, Medium or High speed, depending on the Fan Speed switch position.

2.3.2 Fan Speed Switch - 3 Speed

The evaporator fan speeds can be adjusted by pushing the rocker switch to the desired position:

a. H = High Speed

b. M = Medium Speed

c. L = Low Speed

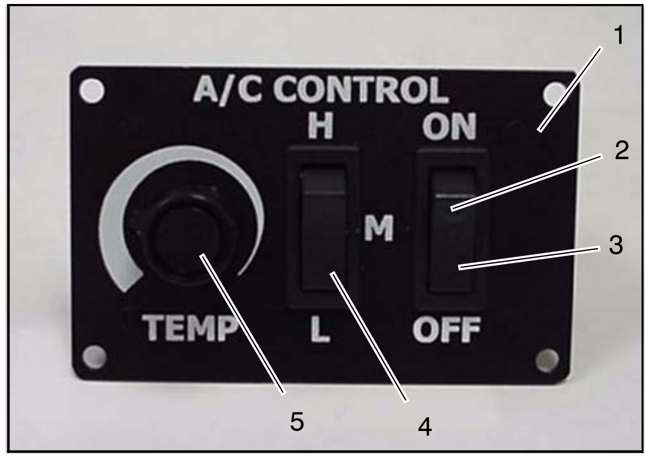
When the evaporator fan speed switch is positioned at the desired speed, a signal is sent to the corresponding fan speed relay located on the electrical circuit board.

2.3.3 Adjusting Set Point (Interior Temperature Adjustment)

The potentiometer switch has an operating range between 60 and 85 degrees F. (+/- 1 degree F.).

Rotate the potentiometer switch knob to the right (clockwise) for maximum cooling.

Rotate the potentiometer switch knob to the left (counterclockwise) for less cooling.



1 Face Plate
2 Green Light)
3 Rocker Switch, 2 Position, ON/OFF
4 Rocker Switch, 3 Position, LOW-MED-HIGH
5 Temperature Switch (Potentiometer)

Figure 2-3 Switch Assembly (TEMPCON)

2.4 IN-LINE FUSE (FLORIDA CONTROL)

The controller is protected by a 3 Amp ATO in-line fuse (Figure 2-4). To replace the fuse do the following:

a. Make sure ignition power is off.

b. Grasp fuse cover at finger grips and lift off cover.

c. Remove fuse and check if fuse is defective.

d. Replace if needed.

e. Push fuse cover back on to in-line holder.

f. Restore ignition power and place ON/OFF switch to ON.

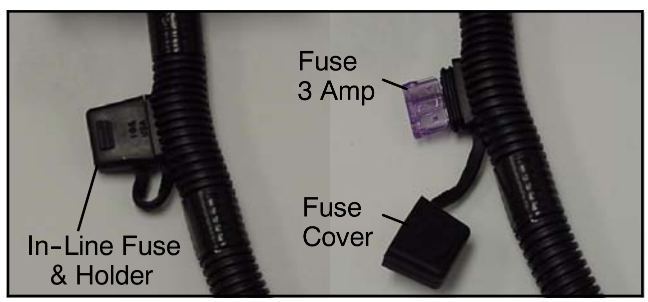
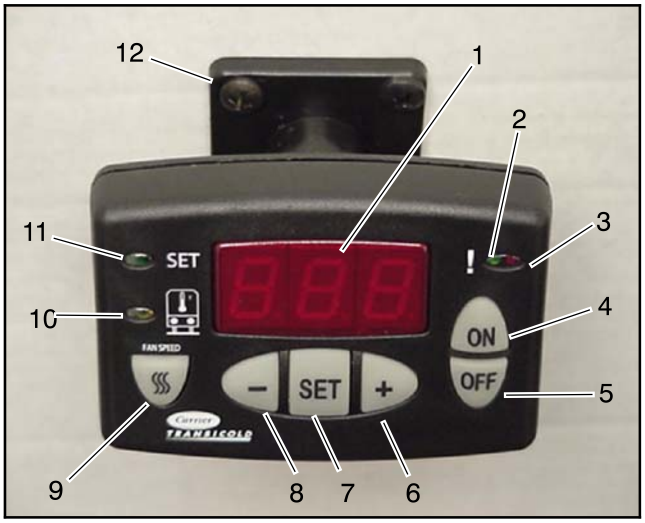


Figure 2-4 In-Line Fuse & Holder (3 Amp)

2.5 TOTAL CONTROL

The Total Control system consists of a Key Pad Display (See Figure 2-5) wired to an Electrical Control Panel (See Figure 2-7). Refer to Figure 2-5 for the following operating functions.



1 Display
2 Green LED, Cool Mode
3 Red LED, Heat Mode
Red LED, Flash, Alarm
4 ON Button
5 OFF Button
6 Increase Selection
7 SET Button
8 Decrease Selection
9 Fan Speed Button
10 Green LED, Inside Temperature
11 Green LED, Set Point
12 Total Control Mounting Assembly

Figure 2-5 Total Control Key Pad/Display

1 ON/OFF Button

Press the ON or OFF button to turn the system on or off. The display will show the temperature set point.

2 Return Air Temperature

If SET key is pressed the display will show return air (inside) temperature. With the inside temperature displayed, the green led on the left side of the display (which has the symbol of a bus with a thermal sensor) will be illuminated. If no key is pressed the display will go back to show set point after 30 seconds.

3 Adjusting Set Point

To adjust the set point, press the SET button.

The green SET led will illuminate on the left side of the display.

Press the + or – keys to bring the desired set point into the display.

If the set point is below the inside temperature, the cooling will come on. This will be characterized by a green led on the right side at the top of the display.

If the set point is above the inside temperature, heat will come on.This will be characterized by a red led on the right side at the top of the display.

4 Adjusting Fan Speed

Press the FAN SPEED button. The present setting (1 to 10) will show in the display.

Press the + or – button to adjust the fan speed. The number 10 represents the highest speed and the number 1 represents the lowest speed.

5 Alarms

With the alarm led flashing, the alarm code may be displayed by pressing the SET button. Refer Table 3-5 for system alarm code descriptions.

2.5.1 Total Control Operation

1 Control Stages

Temperature control will be regulated using 3 stages based on the return air temperature.

Cool

Null

Heat

When started, if the return air temperature sensor senses the temperature higher than the set point, the system will run cooling. When the return air temperature decreases to lower than the set point, cooling stage will stop and system will be in the null mode.

When started, if the return air temperature is lower than the set point, the system will run heating (refer to paragraph 2.8.5). When the return air temperature increases to higher than the set point, heating stage will stop and system will be in null mode.

In the null mode, if return air temperature increases to be out of the null band, system will run heating. If return air temperature decreases to be out of the null mode, system will run heating. The center of the null band is the set point and the width of the null band is controlled by microprocessor parameter P01.

For example, if the null band is 4 F and set point is 72° F, system will run cooling if temperature is higher than 72 + 2 = 74. System will run heating if temperature is lower than 72 – 2 = 70.

When in parameter, if no key is pressed for 5 seconds, the display will go back to default mode showing temperature set point.

2 Modification Of Null Band Parameter P01

Press and hold + and – key simultaneously for 5 seconds to access parameters programming mode.

P01 shows up on the display screen for 1 second and the current value of P01 will be shown. While viewing the current value, press + or – key to change the value of the parameter.

3 Null Band

The null differential can take the values of 2, 4, or 6° F, default to 2° F. See Figure 2-6

4 Set Point Range

The valid set point is from 60° F to 80° F.

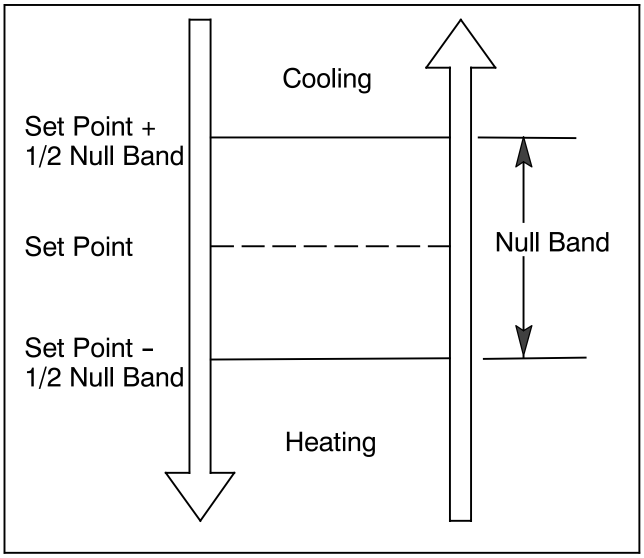


Figure 2-6 Null Band

2.6 GEN 4 – WITH TOTAL CONTROL, UNIT OPERATING INSTRUCTIONS

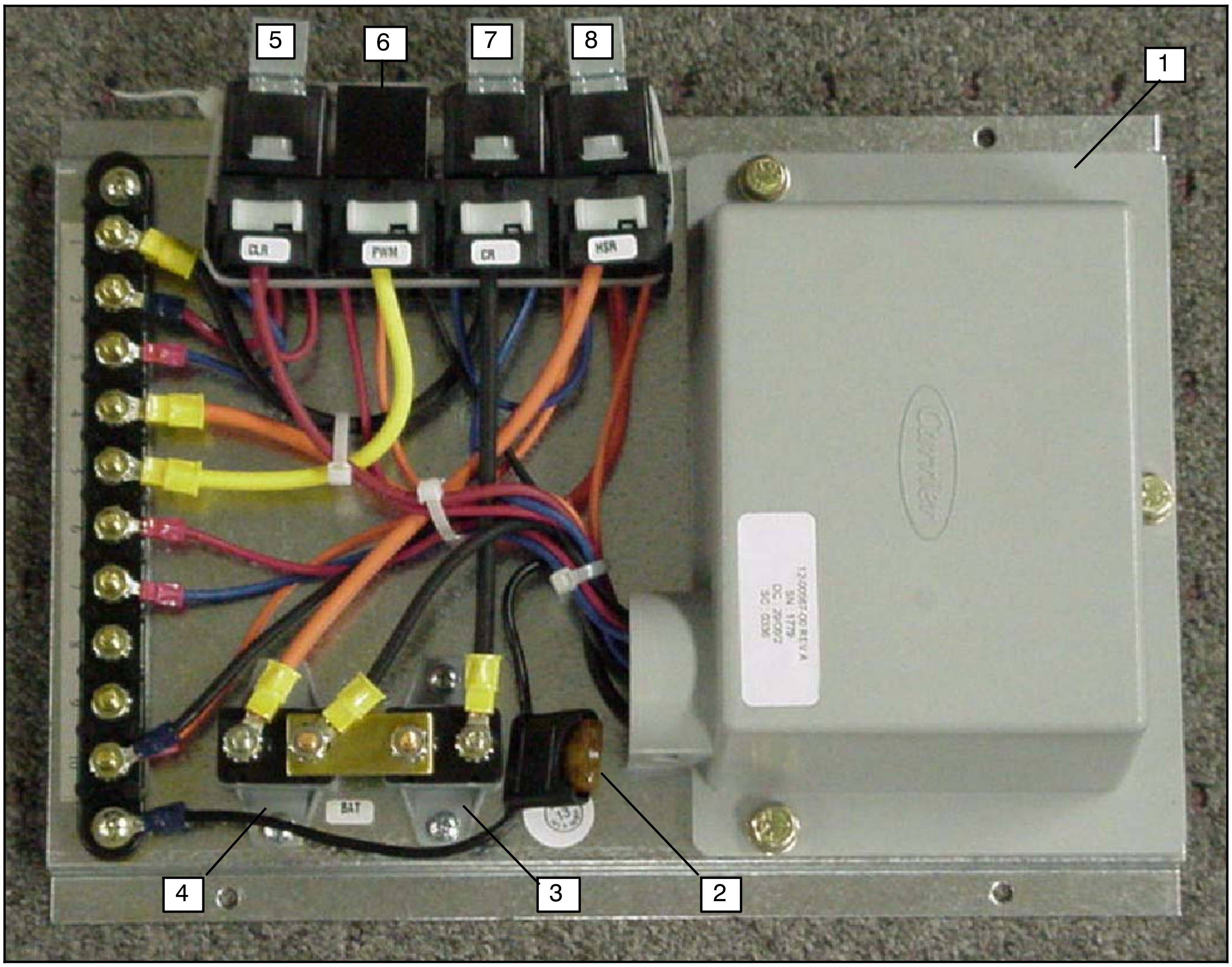
The controller is configured to operate with the GEN 5 unit by default. To operate as a GEN 4 unit controller, the following changes need to be made thru the controller. The operation of the controller is similar between the GEN 4 unit and the GEN 5 unit except the GEN 4 unit has only three speeds.

a. Modification Of Parameter P01

Press and hold + or – keys simultaneously for 5 seconds to access parameters programing mode.

P01 shows up on the display screen for 1 second and the current value of P01 will be shown. While viewing the current value, press + to change the value of the parameter P01 =1.

When in parameter, if no key is pressed for 5 seconds, the display will go back to default mode showing temperature set point.



1	Logic Module (Speed Control)	5	Clutch relay
2	Fuse (5 Amp	6	Relay Filter – PWM (Pulse Width Modulation)
3	Circuit Breaker (Condenser)	7	Condenser Relay
4	Circuit Breaker (High Speed)	8	High Speed Relay

Figure 2-7 Total Control Electrical Control Panel (Typical)

b. Fan Speed Selection

Press the Fan Speed button.

Press the + or - button to toggle between HIGH, MEDIUM, and LOW speeds.

NOTE: Other operating functions like setting the temperature, checking inside temperature, and alarm codes are similar between both Generation (GEN 4/ GEN 5) of units.

2.7 PRE-TRIP INSPECTION

After starting system operation, allow system to stabilize for ten to fifteen minutes and check for the following:

1 Listen for abnormal noises from the vehicle engine, evaporator and condenser areas.

2 Ensure evaporator and condenser fans are operating.

3 Water dripping from the evaporator or air ducts.

4 Reduced airflow. This is normally caused by dirty or clogged evaporator filters.

2.8 SEQUENCE OF OPERATION

Three types of control circuit are provided for split system equipment. They consist of the three position switch type, adjustable fan speed type and the Total Control type. Typical operating sequence descriptions for the various types are provided in the following subparagraphs.

2.8.1 Three Position Switch Operation

With Power to the ignition circuit breaker (see Figure 5-3) and battery circuit breaker the fan speed switch is placed in the LOW, MEDIUM or HIGH position to start the system. In the LOW and MEDIUM positions, power flows from the ignition circuit breaker through the fan speed switch and terminal board (TB) terminal 8 or 7 and the evaporator fan resistor to start the evaporator fans.

In the HIGH position, power flows through TB-1 to energize the high speed relay (HSR). HSR closes it's normally open contacts to provide power from the high speed fan circuit breaker through TB-2 and the evaporator fan resistor to start the evaporator fans.

Power also flows from the fan speed switch common terminal through the thermostat to TB-3. From TB-3 power flows to energize the condenser relay (CR) which closes it's normally open contacts to provide power from the battery circuit breaker through TB-4 to start the condenser fans (CM).

Power also flows from TB-3 through the low pressure switch (LP), high pressure switch (HP) and TB-5 to energize the clutch relay (CLR). Energizing CLR closes it's normally open contacts to provide power from the battery circuit breaker through TB-6 and energize the clutch. Energizing the clutch starts the compressor.

The operating sequence of a Tie-In system or a system with multiple evaporators, condensers or compressors is similar to the preceding description. Refer to Figure 5-4 for a typical Tie-In system schematic or Figure 5-5 for a multiple component schematic.

2.8.2 Variable Speed Control Operation

With Power to the ignition circuit breaker and battery circuit breakers (see Figure 5-6) the fan speed switch is brought to the desired speed position to start the system. Bringing the fan speed switch to the desired speed position closes the fan speed switch contacts to supply power to the input terminal of the thermostat and through the terminal board terminal TB-1 to energize the high speed relay (HSR) and optional hour meter. Energizing HSR closes a set of normally open contacts to supply power to the electronic speed control.

Power also flows through the fan speed switch potentiometer to provide a signal through TB-9 to the electronic speed control ADJ terminal. With this signal present, the electronic speed control will provide power to energize the evaporator blower at the desired speed.

With the thermostat calling for cooling, power flows from the thermostat output terminal, through TB-10, the Freeze-up thermostat and low pressure switch (optional location) to TB-3.

From TB-3, power flows to energize the condenser relay (CR). Energizing CR closes it's normally open contacts to provide power from the battery circuit breaker through TB-4 to start the condenser fans (CM).

Power also flows from TB-4 through the low pressure switch (LP - optional location), high pressure switch (HP) and TB-5 to energize the clutch relay (CLR). Energizing CLR closes it's normally open contacts to provide power from the battery circuit breaker through TB-6 and energize the clutch. Energizing the clutch starts the compressor.

2.8.3 Total Control - Gen 5 Operation

With Power to the battery circuit breakers (see Figure 5-7) the Total Control Key Pad ON button is pressed to start the system. The microprocessor will perform a voltage check (10 seconds) and then proceed to the start-up sequence. With voltage within the specified range, the microprocessor will provide power from the CFM+ terminal to energize the condenser relay (CR). Energizing CR closes it's normally open contacts to supply power from the battery circuit breaker through terminal board terminal TB-1 to start the condenser fan motors.

Two seconds after starting the condenser fans, the microprocessor will provide power from the CL terminal through TB-3, the low pressure switch (LP - optional location) and high pressure switch (HP) to energize the clutch. Energizing the clutch starts the compressor.

Two seconds after starting the compressor, the microprocessor will provide power from terminal EFM+ to energize the high speed relay (HSR). Energizing HSR closes a set of normally open contacts to supply power through TB-4 to the electronic speed control. At the same time, the microprocessor will provide power from terminal BPV+ to energize the pulse width modulation relay (PWM). Energizing PWM closes a set of normally open contacts to allow regulated voltage from microprocessor terminal BPV- , through TB-5 to the electronic speed control adjustment (ADJ) terminal. The voltage output will begin at the lowest setting and then ramp up to the voltage required in accordance with the speed selection made at the Total Control Key Pad.

If at any time during operation the circuit from microprocessor terminal BPT+ back to terminal BPT- is opened by the freeze-up thermostat or low pressure switch (LP - optional location) the compressor clutch will be de-energized. Once the circuit is re-established, the clutch will be re-energized after a one minute delay.

When the system is installed as a tie-in system, power is supplied by the vehicle controls to the microprocessor ignition terminal (NEIM) when operation of the compressor is required by the in-dash defroster. With power to the NEIM terminal, the compressor clutch is energized.

2.8.4 Total Control - Gen 4 Operation

With Power to the battery circuit breakers (see Figure 5-9) the Total Control Key Pad ON button is pressed to start the system. The microprocessor will perform a voltage check (10 seconds) and then proceed to the start-up sequence. With voltage within the specified range, the microprocessor will provide power from the CFM+ terminal to energize the condenser relay (CR). Energizing CR closes it's normally open contacts to supply power from the battery circuit breaker through terminal board terminal TB-1 to start the condenser fan motors.

Two seconds after starting the condenser fans, the microprocessor will provide power from the CL terminal through TB-3, the low pressure switch (LP - optional location) high pressure switch (HP) and TB-2 to energize the clutch. Energizing the clutch starts the compressor.

Two seconds after starting the compressor, the microprocessor will start the evaporator fans in accordance with the speed selection made at the Total Control Key Pad.

If low speed is selected, the microprocessor will provide power from terminal EFM+ to energize the low speed relay (LSR). Energizing LSR closes it's normally open contacts to provide power from the battery circuit breaker through TB-8 to the low speed resistor connection. It may be noted that the high speed relay (HSR) is also energized at this time. However, power is not available to the contacts of this relay so no action will result.

If medium speed is selected, the microprocessor will provide power from terminal BPV to energize the medium speed relay (MSR). Energizing MSR closes it's normally open contacts to provide power from the battery circuit breaker through TB-5 to the medium speed resistor connection. It may be noted that power is also supplied to the high speed relay (HSR) at this time. However, the relay coil is not energized so no action will result.

If high speed is selected, the microprocessor will provide power from terminal EFM+ and BPV to energize the low speed relay (LSR), medium speed relay (MSR and high speed relay (HSR). Energizing all three relays closes contacts to provide the required path from the battery circuit breaker through MSR, TB-5, HSR and TB-4 to the high speed resistor connection. Although all of the resistor connections are actually powered, powering of the high speed connection will bring the motors to high speed operation.

If at any time during operation the circuit from microprocessor terminal BPT+ back to terminal BPT- is opened by the freeze-up thermostat or low pressure switch (LP - optional location) the compressor clutch will be de-energized. Once the circuit is re-established, the clutch will be re-energized after a one minute delay.

When the system is installed as a tie-in system, power is supplied by the vehicle controls to the microprocessor ignition terminal (NEIM) when operation of the compressor is required by the in-dash defroster. With power to the NEIM terminal, the compressor clutch is energized.

On multiple compressor or multiple condenser systems, operation is similar to the preceding description except the second compressor is controlled from microprocessor terminal HP2+. Refer to Figure 5-8 for typical schematic diagram.

2.8.5 Heat Option

When heat option is incorporated with the Total Control system, the heater valve will be controlled by the HGS2 terminal on the microprocessor.

SECTION 3
TROUBLESHOOTING

3.1 INSUFFICIENT OR NO COOLING

3.1.1 Preliminary Checks

Make certain that the evaporator filters are not clogged with dirt. Check to make certain that all vehicle body openings are air tight. Check the adjustment and condition of the compressor drive belt (s); adjust or replace as necessary. Refer to Section 4, paragraph 4.12 for complete drive belt installation and maintenance procedures.

3.1.2 Checking System Air Output

If the evaporator air flow appears less than normal, check the evaporator filter and coil for dirt and obstructions. Clean where necessary. Check the blower assembly for proper operation. Current draw will vary as to evaporator, speed setting and voltage. See Table 3-1, Table 3-2 or Table 3-3 for approximate evaporator current draw. If the current drawn by the motor is not to specifications, replace the motor.

3.1.3 Check The Sight Glass For Bubbles

If the preceding steps do not remedy the problem, check the sight glass for bubbles. Run the vehicle engine at high idle (approximately 1200 RPM) while maintaining a minimum discharge pressure of 150 psig. The thermostatic switch should be positioned for maximum cooling.

Bubbles in the sight glass indicate an undercharge of refrigerant and/or a restriction in the liquid line. If the charge is low, check the system for leaks; repair if necessary and charge the system with the proper amount of refrigerant.

NOTE

Under certain ambient conditions a few bubbles may appear in the sight glass. Refer to Section 4, Table 4-5 to determine if system has correct charge.

No bubbles in the sight glass will indicate either a full charge or a complete loss of refrigerant. To determine if there is refrigerant in the system, run the vehicle engine at high idle (approximately 1200 RPM) with the thermostatic switch positioned for maximum cooling. Allow system to stabilize, then shut system down while observing the sight glass. If bubbles begin to appear, the system has a refrigerant charge. If no bubbles appear, system is without refrigerant.

A restriction in the liquid line can be found by feeling the liquid line. Any portion that is cold to the touch or that frosts up is restricting the refrigerant flow.

Table 3-1 Evaporator Current Draw (GEN 4)

MODEL	VOLTAGE	SPEED SETTING AND AMP DRAW (COLOR)			
		LOW – (Red)	MED. – (Yellow)	HIGH – (Orange)	HIGH PERF. – (Black)
EM–1	12.5 VDC	8.6 Amp	14.4 Amp	18.5 Amp	30 Amp
	13.5 VDC	10 Amp	15 Amp	19.4 Amp	32 Amp
	24.5 VDC	7.8 Amp	10.7Amp	12.7 Amp	16 Amp
EM–2	12.5 VDC	5.0 Amp	8.0 Amp	10 Amp	17 Amp
	13.5 VDC	6.0 Amp	9.0 Amp	12 Amp	20 Amp
	25 VDC	4.5 Amp	6.0 Amp	6.5 Amp	9 Amp
EM–3	12.5 VDC	11 Amp	22 Amp	28 Amp	47 Amp
	13.5 VDC	12 Amp	25 Amp	30 Amp	52 Amp
	24.5 VDC	6.0 Amp	14 Amp	17 Amp	21 Amp
EM–6	12.5 VDC	4.6 Amp	7.5Amp	9.4 Amp	16 Amp
	13.5 VDC	5.1 Amp	8.4 Amp	10.6 Amp	19.3 Amp
	24.5 VDC	4.0 Amp	6.0 Amp	7.0 Amp	9.0 Amp
EM–9	12.5 VDC	8.1 Amp	15 Amp	32 Amp	37.1 Amp
	13.5 VDC	10.3 Amp	18 Amp	33.2 Amp	37.4 Amp
EM–14	12.5 VDC	7.0 Amp	10 Amp	21 Amp	Not Applicable
	13.5 VDC	8.0 Amp	11 Amp	23 Amp	Not Applicable
	24.5 VDC	4.0 Amp	6.0 Amp	10 Amp	Not Applicable
IW–1	12.5 VDC	7.7 Amp	11.5 Amp	24 Amp	–
IW–2	12.5 VDC	–	–	21 Amp	–
IW–7	12.5 VDC	–	–	15 Amp	–
IW–14	12.5 VDC	7.0 Amp	–	18 Amp	–

Table 3-2 Evaporator Current Draw (GEN 5)

MODEL	VOLTAGE	SPEED SETTING (3) AND AMP DRAW		
		LOW – AMP	MEDIUM – AMP	HIGH – AMP
EM-1	13.5 VDC	9.7 Amp	17.9 Amp	29.5 Amp
	24.5 VDC			
EM-2	13.5 VDC	8.8 Amp	13.3 Amp	24.3 Amp
	24.5 VDC			
EM-3	13.5 VDC	16 Amp	32.2 Amp	46 Amp
	24.5 VDC			
EM-7	13.5 VDC	7 Amp	11.5 Amp	15.9 Amp
	24.5 VDC			

MODEL	VOLTAGE	VARIABLE SPEED CONTROL – AMP DRAW
		HIGH SPEED – MAX
EM-1	12.5 VDC	Fully Loaded 29.5 Amp
	13.5 VDC	Fully Loaded 30.1 Amp
	24.5 VDC	Fully Loaded 16 Amp
EM-2	12.5 VDC	Fully Loaded 23 Amp
	13.5 VDC	Fully Loaded 24.3 Amp
	24.5 VDC	Fully Loaded 12 Amp
EM-3	12.5 VDC	Fully Loaded 46 Amp
	13.5 VDC	Fully Loaded 46 Amp
	24.5 VDC	Fully Loaded 24 Amp
EM-7	12.5 VDC	Fully Loaded 15 Amp
	13.5 VDC	Fully Loaded 15.9 Amp
	24.5 VDC	Fully Loaded 10 Amp

Table 3-3 Condenser Current Draw (GEN 5)

MODEL	VOLTAGE	AMP DRAW
CM-2	13.5 VDC	14.5 Amp
CM-2 With **Vector Fans**	13.5 VDC	13.5 Amp
CM-3	13.5 VDC	22.5 Amp
CM-3 With **Vector Fans**	13.5 VDC	20.5 Amp
CM-14	13.5 VDC	27.8 Amp
KR-2	13.5 VDC 25 VDC	14.0 Amp 10.0 Amp
KR-3	13.5 VDC 25 VDC	21.0 Amp 16.0 AMp
KR-4	13.5 VDC 25 VDC	44.0 Amps 22.0 Amps

Note: Condenser Amp Draw Increases As Static Pressure Increases

3.1.4 Compressor Amp Draw

Split System Compressor clutch coils typically draw 2 to 3 Amps.

Table 3-4 GENERAL SYSTEM TROUBLESHOOTING PROCEDURES

INDICATION/ TROUBLE	POSSIBLE CAUSES
3.2 SYSTEM WILL NOT COOL	
Compressor will not run	Drive-Belt loose or defective Clutch coil defective Clutch malfunction Low refrigerant charge Compressor malfunction
Electrical Malfunction	Circuit Breaker Open Relay Defective
3.3 SYSTEM RUNS BUT HAS INSUFFICIENT COOLING	
Compressor	Drive-Belt loose or defective Compressor defective
Refrigeration system	Abnormal pressures No or restricted evaporator air flow Expansion valve malfunction Restricted refrigerant flow Low refrigerant charge
3.4 ABNORMAL PRESSURES	
High discharge pressure	Refrigerant overcharge Noncondensables in system Condenser motor(s) failure Dirty Condenser coil Skirt-Mounted Condenser recirculating hot air from under bus.
Low discharge pressure	Compressor defective Low refrigerant charge
High suction pressure	Compressor defective
Low suction pressure	Filter–drier or Receiver–Drier partially plugged Low refrigerant charge Expansion valve malfunction Restricted air flow
Suction and discharge pressures equal or near equal	Compressor valves defective
3.5 ABNORMAL NOISES, VIBRATIONS OR CONDITIONS	
Compressor - Engine area	Compressor or compressor mounting loose Liquid slugging Insufficient oil Excessive oil Clutch loose, rubbing or defective Dirt or debris on vehicle fan blades Drive belt cracked, worn or loose
Evaporator area	Evaporator blower assembly broken or loose Blower wheel loose or out of alignment Blade interference
Condenser area	Broken or missing fan blade Condenser assembly loose Fan assembly loose

Table 3-4 GENERAL SYSTEM TROUBLESHOOTING PROCEDURES – Continued

3.6 NO EVAPORATOR AIR FLOW OR RESTRICTED AIR FLOW	
Air flow through coil blocked	Coil frosted over Dirty coil Dirty filter assembly
No or partial evaporator air flow	Motor running in reverse Motor(s) defective Evaporator fan loose or defective Fan damaged Dirty filter Icing of coil Fan speed relay(s) defective Fan rotation incorrect
3.7 EXPANSION VALVE MALFUNCTION	
Low suction pressure	Low refrigerant charge Ice formation or dirt at block valve orifice
3.8 CONTROL SYSTEM MALFUNCTION	
Will not operate/control	Circuit breaker or relay defective Fan speed switch defective Thermostat defective Microprocessor controller malfunction (Total Control)
3.9 NO OR INSUFFICIENT HEATING	
Insufficient heating	Dirty or plugged heater core Coolant heat valve(s) malfunctioning or plugged Low coolant level Hand valve(s) partially closed Water pump defective Auxiliary Heater malfunctioning.
No Heating	Hand valve(s) closed Coolant heat valve(s) malfunctioning or plugged Pump(s) malfunctioning
Continuous Heating	Hand valve(s) defective Coolant heat valve(s) malfunctioning Debries under heat valve diaphragm

Table 3-5 TROUBLESHOOTING ALARM CODES (TOTAL CONTROL)			
ALARM CODE	**TITLE**	**CAUSE**	**REMEDY**
AL 13	Return air sensor.	Open circuit or short circuit on the return air sensor connection.	Check connections on RAS + and RAS – on the control board. Make sure the Red terminal is connected to RAS + and Black terminal is connected to RAS – on the control board.
AL 15	Set point out of range	Wrong set point is saved on the controller.	Controller will correct this problem automatically.
AL 17	Not Used		
AL 21	Low Voltage	Controller senses battery voltage is less than 10 volts.	Check battery voltage.
AL 27	Compressor 1 pressure alarm	Open or short circuit in the clutch related circuit (CLHR on the control board) such as: High pressure switch open circuit. Low pressure switch open circuit, if the low pressure switch is in series with the high pressure switch in the condenser. Wire from controller CLHR to terminal 3 on the electrical panel terminal board is open. Wire from terminal 3 to condenser is open, short to ground or short to battery. Wire from terminal 2 to clutch is open, short to ground or short to battery. Wire from clutch to ground is open. Clutch coil open or short circuit.	Turn off the controller by pressing OFF button. Measure the resistance between terminal 3 and terminal 2 on the electrical panel. The reading should be less than 1 OHM. This is to check the pressure switch circuit. If the resistance is too high, look for open circuit on the high pressure or low pressure switches. Measure the resistance between terminal 2 to ground. The readings should be about 6 OHM. This is to check the clutch coil. If readings are low, look for a open circuit in the clutch coil. Check with power on: Connect voltmeter to terminal 3 and ground. Press the ON button on the controller and wait for 10 seconds. If you see 12 VDC appear for about 1second and disappears, the circuit from CLHR on control board to terminal 3 is good but circuit from terminal 3 to clutch is open. Connect voltmeter to terminal 2 and ground. Turn on controller by pressing the ON button. Wait for about 10 seconds. If you see 12 VDC appear for 1 second and disappear, the circuit from CLHR on control to terminal 2 is good but the circuit from terminal 2 to clutch is open. If the 12 VDC does not appear, then the pressure switch circuit is open. Follow the procedure mentioned above for tracing the pressure switch circuit.
AL 41	Compressor 2 pressure alarm	Open circuit on compressor 2 high pressure circuit.	If the second compressor is used follow the procedure for Alarm 27. If the second compressor is not used, there should be a jumper wire between HP2 + and HP – on the control board inputs.
AL 43	Condenser fan relay malfunction	Short circuit between CFM + and CFM – on the control board.	Check condenser fan relay CR and its related circuit.
AL 44	Evaporator fan relay malfunction	Short circuit between EFM + and EFM – on the control board.	Check evaporator fan relay HSR and the related circuits.
AL 45	Clutch Relay malfunction	Malfunction is detected on the CLR output.	
AL 46	EFS Control malfunction	Malfunction is detected on the EFS output.	

Table 3-5 TROUBLESHOOTING ALARM CODES (TOTAL CONTROL) Cont::			
AL 47	Not Used		
AL 48	Heating Valve malfunction	Malfunction is detected on the HV output.	

NOTE

If the controller calls for cooling (green led is on), the condenser and evaporator fans are running, but the compressor is OFF without any alarm code, this indicates one of the following has occured:

1. The freezestat is open. The compressor is disabled when the freezestat is open and will be enabled when the freezestat is closed.
2. The low pressure switch, also present in the evaporator (GEN 5 units) which is in series with the freezestat is open.
3. The compressor is disabled by minimum off time. When the compressor is turned OFF by temperature control, freezestat, low or high pressure switches, it will remain OFF for a minute (60 seconds) before it is re-energized. This protects the compressor clutch from short cycling.

SECTION 4

SERVICE

WARNING

Beware of unannounced starting of the evaporator and condenser fans. The unit may cycle the fans and compressor unexpectedly as control requirements dictate.

WARNING

Be sure to observe warnings listed in the safety summary in the front of this manual before performing maintenance on the air conditioning system

4.1 PREVENTATIVE MAINTENANCE SCHEDULE

SYSTEM		OPERATION
ON	OFF	
a. Daily Maintenance		
X	X	Pre–trip inspection – after starting. (Refer to paragraph 2.7)
	X	Check tension and condition of drive belts. (Refer to paragraph 4.12)
b. Weekly Maintenance		
	X	Perform daily inspection
	X	Check condenser, evaporator coils and return air filters for cleanliness
c. Monthly Maintenance		
	X	Perform weekly inspection
	X	Clean or replace Evaporator return air filters
	X	Inspect Condenser coil fins – Clean when necessary
	X	Inspect refrigerant hoses and fitting connections. (Refer to paragraph 4.10)
	X	Inspect electrical harness and connections
X		Check battery voltage – System operates efficiently at 13.5 volts
d. Quarterly Inspection		
	X	Inspect Evaporator(s) coil fins (heater coil if installed) Clean if needed.
X		Check blower operation.
X		Check current draw and voltage of system components including fan motors. (Repair or replace any component showing more than 0.2 volt drop). (Refer to Table 3-1, Table 3-2, or Table 3-3)
	X	Check that all compressor mounting brackets and hardware are tight. Tighten and torque to proper specifications. (Refer to paragraph 4.11)
X	X	Check hose and harness under vehicle for proper support and protection
	X	Check Evaporator drain lines.
e. Semi–Annual Inspection and Maintenance		
X		Check system pressures. (Refer to Table 4-5)
		Check refrigerant in sight glass.
X		Check element in the the sight glass. (Green is dry – Yellow is wet)
	X	Inspect condenser fan blades.
	X	Open bus heater valves (In winter).
	X	Close bus heater valves (In spring).
	X	Remove or install optional condenser winter guard kit.
f. Annual Inspection and Maintenance		
	X	Inspect electrical panel and terminals. Clean if needed with a high-grade cleaner specifically formulated for this purpose.
	X	Tighten all electrical connections at terminal boards and at the battery. (Refer to Par. 4.11)
		Inspect Evaporator drain pan. (Clean if needed)
	X	Check pressure switch operation.
X		Check evaporator roof mounting and sealing.
	X	Check condenser mounting, fan guards, and screen/grill.

4.2 MAINTENANCE PROCEDURES

The following air conditioning service equipment is required in order to properly perform the maintenance procedures.

1.. **Manifold Gauge Set** CTD P/N 07-00294-00 Provides access to and monitors pressures within the system. Manifold gauge sets are available in different configurations and styles. 3-way or 4-way, liquid filled gauges, with or without a sight glass, 3 hoses or 4 hoses, 1/4 inch or 3/8 inch manifold connections, etc. Familiarize yourself with the proper operation of your manifold gauge set before attempting any service.

2.. **R134a Low Side (Suction) Coupler** CTD P/N 07-00307-04 - Connects the air conditioning system Suction Access Port to the Manifold Gauge Set.

3.. **R134a High Side (Discharge) Coupler** CTD P/N 07-00307-05 - Connects the air conditioning system Discharge Access Port to the Manifold Gauge Set.

4.. **Vacuum Pump - 2 Stage (5 CFM Minimum)** CTD P/N 07-00176-11 - Removes moisture and air from the air conditioning system in order to obtain required micron level.

5.. **Micron Gauge**, **Digital** CTD P/N 07-00414-00 Monitors the evacuation process in units of microns. Micron gauges can be either digital (electronic) or analog.

6.. **Recovery/Recycle Machine (R134a)** CTD P/N MVS-115-F-L-CT (115VDC), MVS-240-F-L-CT (240 VDC) - Recovers and recycles R134a refrigerant that is present within the air conditioning system.

7.. **Refrigerant Scale** CTD P/N 07-00315-00 - Accurately weighs the transfer of refrigerant into the air-conditioning system.

8.. **Refrigerant Cylinder** - Storage tank for R134a.

9.. **Heat Blanket** - Used to increase internal temperature of the refrigerant cylinder, greatly increasing the transfer of refrigerant to the air conditioning system.

10.. **Oil Injector** - Used to add additional amounts of oil to a closed system.

4.3 INSTALLING MANIFOLD GAUGES

The manifold gauge set (see Figure 4-1) is used to determine system operating pressures, add refrigerant charge, and to equalize or evacuate the system.

When the suction pressure hand valve is frontseated (turned all the way in), the suction (low) pressure can be checked. When the discharge pressure hand valve is frontseated, the discharge (high) pressure can be checked. When both valves are open (turned counter-clockwise all the way out), high pressure vapor will flow into the low side. When the suction pressure valve is open and the discharge pressure valve shut, the system can be charged.

A R-134a manifold gauge/hose set with self-sealing hoses is required for service of the models covered within this manual. The manifold gauge/hose set is available from Carrier Transicold. (Carrier Transicold P/N 07-00294-00, which includes items 1 through 6, Figure 4-1 .) To perform service using the manifold gage/hose set, do the following:

a. Preparing Manifold Gauge/Hose Set For Use

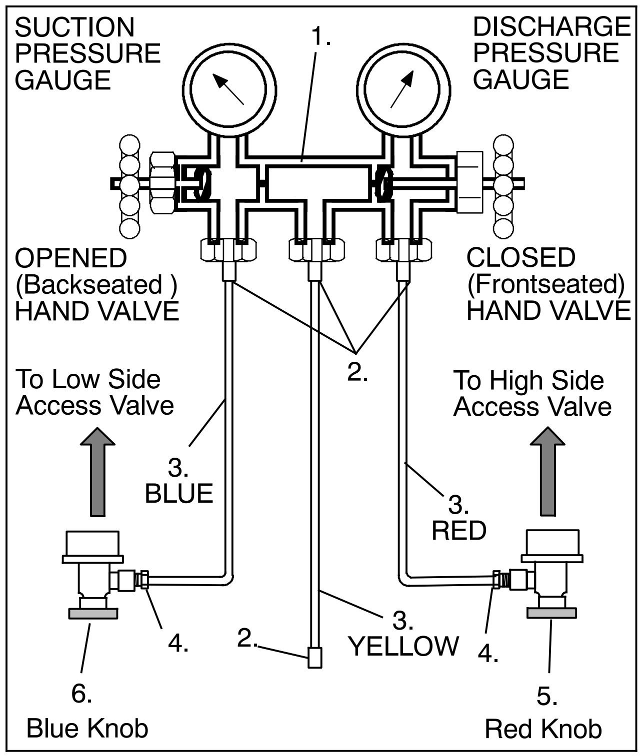
1.. If the manifold gauge/hose set is new or was exposed to the atmosphere it will need to be evacuated to remove contaminants and air as follows:

2.. Backseat (turn counterclockwise)both field service couplings (see Figure 4-1) and midseat both hand valves.

3.. Connect the yellow hose to a recovery machine, vacuum pump or refrigerant 134a cylinder. Depending on tools available and service to be performed.

4.. Evacuate to 10 inches of vacuum and then charge with R-134a to a slightly positive pressure of 0.1 kg/cm@ (1.0 psig).

5.. Front seat both manifold gauge set valves and disconnect from cylinder. The gauge set is now ready for use.

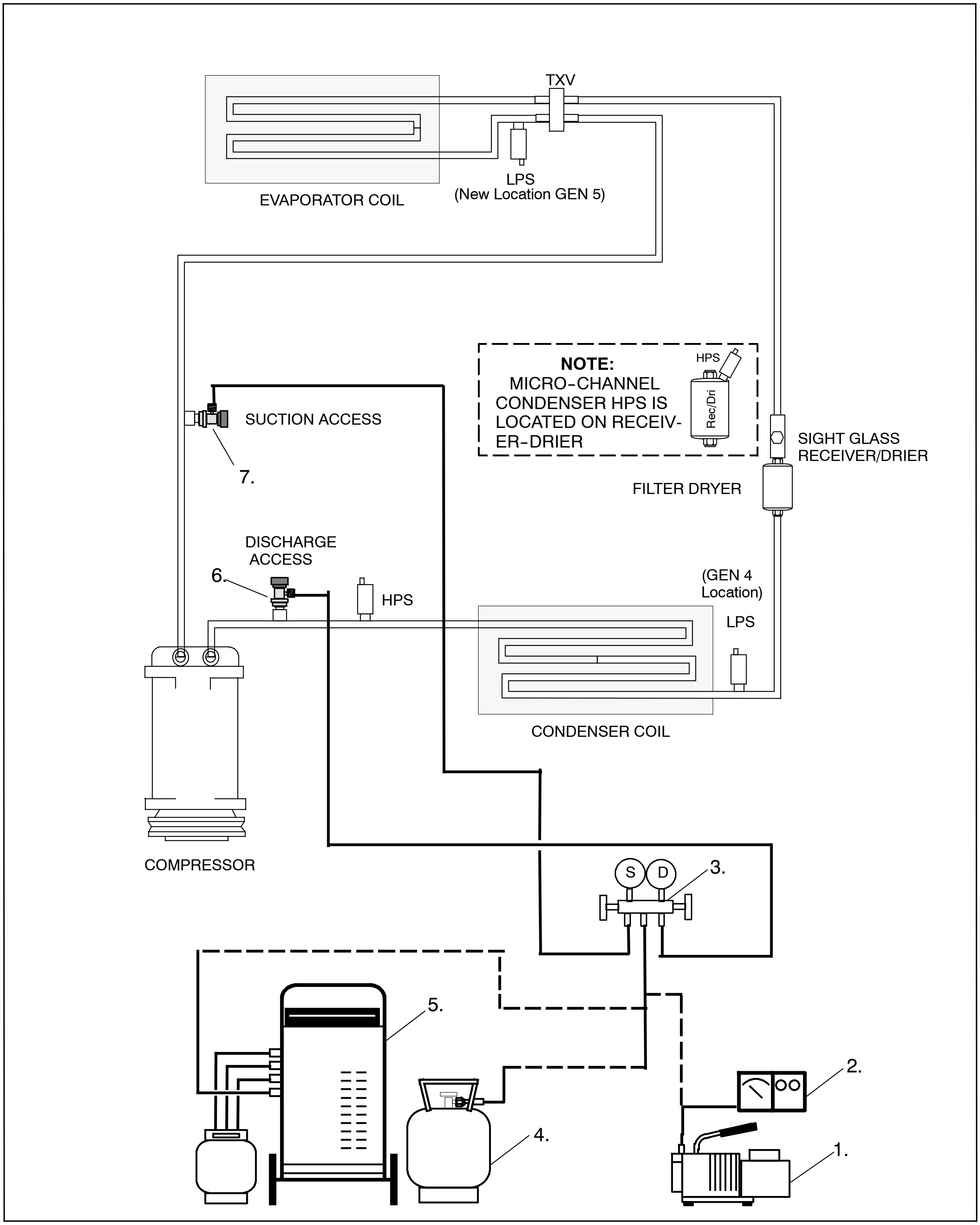


1.. Manifold Gauge Set
2.. Hose Fitting (0.5-16 Acme)
3.. Refrigeration and/or Evacuation Hose
. (SAE J2196/R-134a)
4.. Hose Fitting w/O-ring (M14 x 1.5)
5.. High Side Field Service Coupling
6.. Low Side Field Service Coupling

Figure 4-1 Manifold Gauge Set

b. Connecting Manifold Gauge/Hose Set

To connect the manifold gauge set, (See Figure 4-2) do the following.



1. Vacuum Pump
2. Micron Gauge
3. Manifold Gauge Set
4. Refrigerant Cylinder
5. Recovery/Recycle Machine
6. R134a High (Discharge) Side Coupler
7. R134a Low (Suction) Side Coupler

Figure 4-2 Refrigerant Service Connections (Split Systems)

1.. Connect the high side field service coupling (see Figure 4-1) to the discharge line service valve port.

2.. Turn the high side field service coupling knob (red) clockwise, which will open the high side of the system to the gauge set.

3.. Connect the low side field service coupling to the suction service valve port.

4.. Turn the low side field service coupling knob (blue) clockwise, which will open the low side of the system to the gauge set.

WARNING

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

c. Removing the Manifold Gauge Set

1. Backseat (turn counterclockwise) the high side (discharge) field service coupling (red knob).

2.. Midseat both hand valves on the manifold gauge set and allow the pressure in the manifold gauge set to be drawn down to suction pressure. This returns any liquid that may be in the high side hose to the system.

3.. Backseat the low side (suction) field service coupling (red knob) and frontseat (clockwise) both manifold gauge set valves. Remove the couplings from the service ports.

4.. Install both service port caps (finger-tight only).

4.4 REFRIGERANT RECOVERY

To remove the entire refrigerant charge, do the following:

a. Connect a manifold gauge set to the system as shown in Figure 4-2.

b. Connect a reclaimer to the center manifold gauge set connection.

c. Recover refrigerant in accordance with reclaimer manufacturers instructions.

4.5 REFRIGERANT LEAK CHECKING

A refrigerant leak check should always be performed after the system has been opened to replace or repair a component.

To check for leaks in the refrigeration system, perform the following procedure:

WARNING

Never use air for leak testing. It has been determined that pressurized, air-rich mixtures of refrigerants and air can undergo combustion when exposed to an ignition source.

Note

Larger split systems may be equipped with service valves and a liquid line solenoid. Ensure these service valves are open and power the liquid line service valve from an external source.

a. If the system is without refrigerant, charge the system with refrigerant vapor to build up pressure to approximately 30 PSIG (R134a).

b. Add sufficient nitrogen to raise system pressure to150/200 psig. (10.21/13.61 bar).

c. Check for leaks. The recommended procedure for finding leaks in a system is with a R-134a electronic leak detector. Testing joints with soapsuds is satisfactory and may be necessary under conditions where when an electronic leak detector will not function properly, such as with large leaks.

d. Remove test gas and replace filter-drier.

e. Evacuate and dehydrate the unit. (Refer to paragraph 4.6.)

f. Charge the unit. (Refer to paragraph 4.8).

4.6 EVACUATION AND DEHYDRATION

4.6.1 General

The presence of moisture in a refrigeration system can have many undesirable effects. The most common are copper plating, acid sludge formation, “freezing-up” of metering devices by free water, and formation of acids, resulting in metal corrosion. A triple evacuation (Refer to paragraph 4.6.3) should be performed after a major system repair (compressor, evaporator, or condenser replacement). A one time evacuation (Refer to paragraph) should take place after a minor system repair, such as a filter-drier replacement.

4.6.2 Preparation

NOTE

Using a compound gauge for determination of vacuum level is not recommended because of its inherent inaccuracy.

a. Evacuate and dehydrate only after pressure leak test. (Refer to paragraph 4.5 .)

b. Essential tools to properly evacuate and dehydrate any system include a vacuum pump (6 cfm volume displacement - (CTD P/N 07-00176-11) and an electronic vacuum (micron) gauge (CTD P/N 07-00414-00).

c. Keep the ambient temperature above 60° F (15.6° C) to speed evaporation of moisture. If the ambient temperature is lower than 60° F (15.6° C), ice may form before moisture removal is complete. Heat lamps or alternate sources of heat may be used to raise the system temperature.

4.6.3 Procedure For Evacuation and Dehydrating System (Triple Evacuation)

a. Remove all refrigerant using a refrigerant recovery system (Refer to paragraph)

b. The recommended method is connecting lines (3/8" refrigerant hoses designed for vacuum service) as shown in Figure 4-2.

c. Make sure vacuum pump valve is open.

d. Start the vacuum pump. Slowly open valves halfway and then open vacuum gauge valve.

e. Evacuate unit until vacuum gauge indicates 2000 microns (Hg vacuum). Close gauge valve, vacuum pump valve, and stop vacuum pump.

f. Break the vacuum with nitrogen. Raise system pressure to approximately 2 psig (0.14 bar).

g. Purge the nitrogen from the system.

h. Repeat steps d. thru f. one time.

i. Start vacuum pumpand open all valves. Dehydrate system to 500 microns (Hg vacuum).

j. Close off pump valve, and stop pump. Wait 5 minutes to see if vacuum holds.

k. Charge system. Refer to paragraph 4.8.

4.7 PROCEDURE FOR EVACUATION AND DEHYDRATING SYSTEM (ONE TIME EVACUATION)

a. Remove all refrigerant using a refrigerant recovery (reclaimer) system (Refer to paragraph 4.4)

b. The recommended method is connecting lines (3/8" refrigerant hoses designed for vacuum service) as shown in Figure 4-2.

c. Make sure vacuum pump valve is open.

d. Start the vacuum pump. Slowly open valves halfway and then open vacuum gauge valve.

e. Evacuate unit until vacuum gauge indicates 500 microns (Hg vacuum). Close gauge valve, vacuum pump valve, and stop vacuum pump.

f. Close off pump valve, and stop pump. Wait 5 minutes to see if vacuum holds.

g. Charge system. Refer to paragraph 4.8.

4.8 ADDING REFRIGERANT TO A SYSTEM

4.8.1 Checking Refrigerant Charge

The following conditions must be met to accurately check the refrigerant charge.

a. Bus engine operating at high idle.

b. Air conditioning system operating in high cool 10 to 15 minutes.

c. Compressor discharge (head) pressure a minimum of 150 psig with R134a. It may be necessary to block condenser air flow to raise discharge pressure.

d. On the large split systems that are equiped with a liquid line receiver, the system is properly charged when the refrigerant level is at 1/2 to 3/4 of the receiver sight glass. If it is not at the proper level, add or remove refrigerant to bring it ro the proper level.

e. On the smaller split systems refer to Table 4-5 to determine if correct charge has been obtained.

4.8.2 Adding Full Charge

a. Install manifold gauge set at the suction and discharge service valves. See Figure 4-2.

b. Evacuate and dehydrate system. (Refer to paragraph 4.6).

c. Place R134a refrigerant cylinder on scales.

d. Calculate the approximate refrigerant charge using either Table 4-1 or NO TAG. Open the liquid valve on refrigerant cylinder. Open the discharge line service port coupler and allow refrigerant to flow into the unit until the correct weight of refrigerant has been added as indicated by scales.

e. Backseat discharge service coupler (to close off gauge port). Close liquid valve on cylinder.

f. Start unit in cooling mode. Run approximately 10 minutes and check the refrigerant charge. (Refer to paragraph 4.8.1)

4.8.3 Adding Partial Charge

a. Examine the unit refrigerant system for any evidence of leaks. Repair as necessary. (Refer to paragraph 4.5.)

b. Maintain the conditions outlined in paragraph 4.8.2.

c. Connect charging line between suction service port and cylinder of refrigerant R-134a. Open VAPOR valve.

d. Slowly add charge as required. Refer to Table 4-5.

4.9 COMPRESSOR(S)

If the compressor(s) is inoperative and the system still has refrigerant pressure, recover the refrigerant with an approved recovery/recycle machine before attempting repair and/or replacement of the compressor.

Always ensure the replacement compressor has the correct amount of oil as specified by the manufacturer.

Approximate oil charges:

A-6 - - - 10 Fluid Ounces

TM-16 - - 6.08 Fluid Ounces (180CC)

TM-21 - - 8 Fluid Ounces

TM-31 - 16.9 Fluid Ounces

⚠ CAUTION

Unless there was a catastrophic failure, such as a blown or ruptured refrigerant hose, additional oil may not be needed.

Refer to the specific compressor manufacturer's service manual for proper maintenance and handling procedures for the compressor installed on your vehicle.

NOTE

Carrier Transport A/C does not recommend chemical flushing of the refrigeration system. If required, flushing is to be performed using the system refrigerant.

Table 4-1 Split System Refrigerant And Oil Charging Table – Thru GEN 4

Evaporator Up to GEN V	Condenser All Series	Recommended R134a Charge	Recommended Oil Charge*
EM–1, EM–2, or EM–9	CM–2	5.00 Pounds	10.0 Ounces
EM–1, EM–2, or EM–9	CM–11	5.25 Pounds	10.5 Ounces
EM–6	CM–2	4.00 Pounds	8.0 Ounces
EM–6	CM–11	4.25 Pounds	8.5 Ounces
EM–1, EM–2, or EM–9	CM–3	5.50 Pounds	11.0 Ounces
EM–1, EM–2, or EM–9	CM–7	6.50 Pounds	13.0 Ounces
EM–3	(2) CM–2	4.25 Pounds Each	8.5 Ounces Each
EM–3	(2) CM–11	4.25 Pounds Each	8.5 Ounces Each
EM–3	(2) CM–3	5.50 Pounds Each	11.0 Ounces Each
EM–3	(2) CM–7	6.25 Pounds Each	12.5 Ounces Each
EM–14	CM–2	3.50 Pounds	7.0 Ounces
EM–14	CM–11	3.75 Pounds	7.5 Ounces
EM–17	CM–5	19.0 Pounds	Consult Factory
EM–17	KR–4	13.0 Pounds	Consult Factory

Table 4-2 SPLIT SYSTEM REFRIGERANT AND OIL CHARGING TABLE (GEN–5)

Evaporator GEN 5	Condenser All Series	Recommended R134a Charge	Recommended Oil Charge*
GEN 5 - EM-1	CM-2 or CM-4	4.75 Pounds	9.5 Ounces
GEN 5 - EM-1	CM-11	5.00 Pounds	10.0 Ounces
GEN 5 - EM-1	CM-3	5.25 Pounds	10.5 Ounces
GEN 5 - EM-1	CM-7	6.25 Pounds	12.5 Ounces
GEN 5 - EM-7	CM-2 or CM-4	4.00 Pounds	8.0 Ounces
GEN 5 - EM-7	CM-11	4.25 Pounds	8.5 Ounces
GEN 5 - EM-2	CM-2 or CM-4	4.50 Pounds	9.0 Ounces
GEN 5 - EM-2	CM-11	4.75 Pounds	9.5 Ounces
GEN 5 - EM-2	CM-3	5.00 Pounds	10.0 Ounces
GEN 5 - EM-2	CM-7	6.00 Pounds	12.0 Ounces

Table 4-3 SPLIT–SYSTEM GEN–5 WITH MICRO–CHANNEL CONDENSER

Evaporator	Condenser Micro–Channel	Recommended R134a Charge	Recommended Oil Charge
EM–1, EM–9, IW–1	CM–2	3.25 Pounds	6.5 Ounces
EM–1, EM–9, IW–1	CM–3	3.75 Pounds	7.5 Ounces
EM–2, IW–2	CM–2	3.00 Pounds	6.0 Ounces
EM–2, IW–2	CM–3	3.50 Pounds	7.0 Ounces
EM–7, IW–14	CM–2	2.75 Pounds	5.0 Ounces
EM–7, IW–14	CM–3	3.00 Pounds	6.0 Ounces
EM–3 (dual loop)	(2) CM–3	4.50 Pounds (each)	9.0 Ounces (each)

NOTE

Micro–Channel Style Condensers (See Figure 4-1) will require 1–1/2 to 2 lbs less charge than standard condenser assemblies.

NOTE

The information contained within Table 4-3 may change. Refer to document number 62–11317 for the latest revisions to the GEN–5 Micro Channel charging chart.

Figure 4-1 Micro-Channel Style Condenser Assembly

The data listed in Table 4-1 trough Table 4-3 is based on a 20 foot liquid line. Increase the charge by 0.5 pound for each additional 10 feet of liquid line.

After determining the *approximate charge* using the above tables, refer to “System Performance Chart” (Table 4-5) to determine if the correct charge has been obtained.

4.9.1 . Evaporator Tie-In

When an after market in-dash evaporator is added to a standard system the refrigerant charge will increase by approximately 1 pound.

If attempting to use a CM-2 condenser with a tie-in call Carrier Transport Air conditioning technical support for an application review.

NOTE

The above chart is based on a 20 foot liquid line. Increase the charge by 0.5 pound for each additional 10 feet of liquid line.

When an after market evaporator or in-dash evaporator is added to a standard system the refrigerant charge will increase by approximately 1 pound.

If attempting to use a CM-2 condenser with a tie-in call Carrier Transport Air conditioning technical support for an application review.

Table 4-4 Compressor Oil Type & Part Numbers

Manufacturer	Oil Type	CTAC Part Number
Seltec - Valeo - ICE - Zexel - Sanden	PAG	46-50006-00
Alma (A-6)	PAG	46-50004-00
05G & 05K Bus & 06D	POE	46-50008-00

CAUTION

Use only the exact oil specified by Carrier Transicold. Use of oil other than that specified will void the compressor warranty.

Table 4-5 CARRIER TRANSPORT AIR CONDITIONING SYSTEM PERFORMANCE CHART

Determine the approximate refrigerant charge using Table 4-1, Table 4-2 or Table 4-3 .

Use the following table to determine if the correct charge has been obtained.

Table			Procedure	Your Entry	Example
Pressure	**Refrigerant Temp.**		**1.** Connect Manifold Gauge Set To Air Conditioning System	NONE	NONE
PSIG	R–12	R134a			
(A)	(B)	(C)			
95	87	85	**2.** Measure outside (ambient) air temperature. Enter here ----------->	_____Degrees F	100 Degrees F
100	90	88			
105	93	90			
110	96	93			
115	99	96			
120	102	98	**3.** Add 40 degrees F to the outside (ambient) air temperature ---> **(SEE NOTE BELOW)**	40 Degrees F _____Degrees F	40 Degrees F = 140 Degrees F
125	104	100			
130	107	103			
135	109	105			
140	112	107			
145	114	109	**4.** Find closest refrigerant temperature in Table (B or C) and enter here ---->	_____Degrees F	139 Degrees F
150	117	112			
155	119	114			
160	121	116			
165	123	118			
170	126	120	**5**. Going across the Table, find the corresponding pressure (A) -->	(D)=______ PSI	225 PSI
175	128	122			
180	130	123			
185	132	125			
190	134	127			
195	136	129	**6.** If the Discharge Pressure (High Side) on gaugers (With compressor engaged, engine speed 1200 RPM, and system operating) is : Greater than (D) – Reduce refrigerant by 4 ounce increments. Less than (D) – Add refrigerant Wait 10 minutes for system to stabilize before taking new readings	***	***
200	138	131			
205	140	132			
210	142	134			
215	143	136			
220	145	137			
225	147	139			
235	150	142			
245	154	145			
255	157	148			
265	160	151			
275	163	153			

NOTE

If using the Micro-Channel type Condenser assembly, add 37 degrees in step 3 instead of 40 degrees. This is due to the approximately 10 psi lower discharge pressure that will be experienced with this type application.

Table 4-6 STANDARD TORQUE REQUIREMENTS

SIZE	TUBE O.D. *	FLARE	O-RING		THREAD **
			STEEL TUBING	ALUM. TUBING	
4	1/4 inch (.250)	11-13 ft./lbs.	30-35 ft./lbs.	5-7 ft./lbs.	7/16
5	3/8 inch (.375)	15-17 ft./lbs.	30-35 ft./lbs.	8-10 ft./lbs	9/16
6	3/8 inch (.375)	18-20 ft./lbs.	30-35 ft./lbs.	11-13 ft./lbs	5/8
8	1/2 inch (.500)	36-39 ft./lbs.	30-35 ft./lbs.	15-20 ft./lbs	3/4
10	5/8 inch (.625)	52-57 ft./lbs.	30-35 ft./lbs.	21-27 ft./lbs	7/8
12	3/4 inch (.750)	71-79 ft./lbs.	30-35 ft./lbs.	28-33 ft./lbs	1-1/16
* The tube O.D. is measured at the point it passes through the nut. ** Thread pitch may vary.					

4.10 TORQUE SPECIFICATIONS - REFRIGERANT FITTINGS

All refrigerant hose fitting connections must be torqued to the specifications listed in Table 4-6.

NOTE

No matter what type of lubricant (oil) used in the system, always use mineral oil to lubricate the O-Rings and fittings. PAG oils will absorb moisture and become very acidic and corrosive. Mineral oil absorbs moisture at a much lower rate than PAG oils.

4.11 TORQUE SPECIFICATIONS - BOLTS

The torque values listed in Table 4-7 and Table 4-8 are are based on the use of lubricated threads.

Table 4-7 Metric Torque Specs

Bolt Size Dia. mm	Torque (Ft-Lb Cast Iron Grade 8.8	Torque (Ft-Lb Cast Iron Grade 10.9	Torque (Ft-Lb Cast Iron Grade 12.9
6	7	9	9
7	10	13	18
8	18	23	27
10	30	45	50
12	55	75	95
14	85	120	145
16	130	175	210

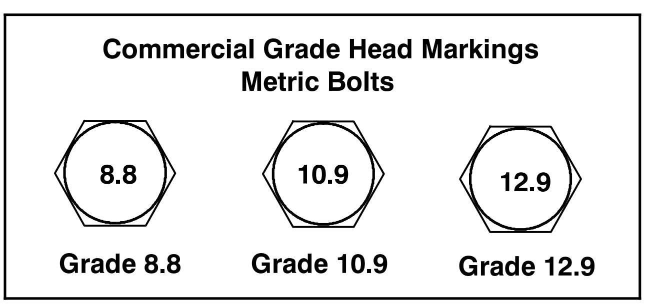


Figure 4-3 Metric Bolt Markings

Table 4-8 U.S. Torque Specs

Bolt Size Dia. mm	Torque (Ft-Lb) Cast Iron Grade 2	Torque (Ft-Lb Cast Iron Grade 5	Torque (Ft-Lb Cast Iron Grade 8
1/4-20	5	7	11
5/16-18	10	15	22
3/8-16	18	30	40
7/16-14	30	45	65
7/16-20	32	50	70
1/2-13	45	70	95
1/2-20	50	75	110
5/8-11	82	135	190
5/8-18	93	155	215

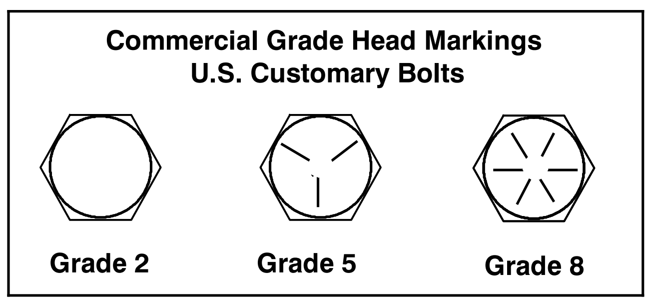


Figure 4-4 U.S. Bolt Markings

4.11.1 Electrical Control Panel - Torque Values

Torque values for all Split-System electrical panels are as follows.

1. Torque value for wire connections at the plastic circuit breakers are: **24 In-Lbs max.**
2. Plastic Breaker mounting screw torque is:**15 In-Lbs.**
3. Torque value for wire connections at the plastic terminal strip are: **25 In-Lbs max.**
4. Terminal Strip mounting screws are: **25 In-Lbs max.**

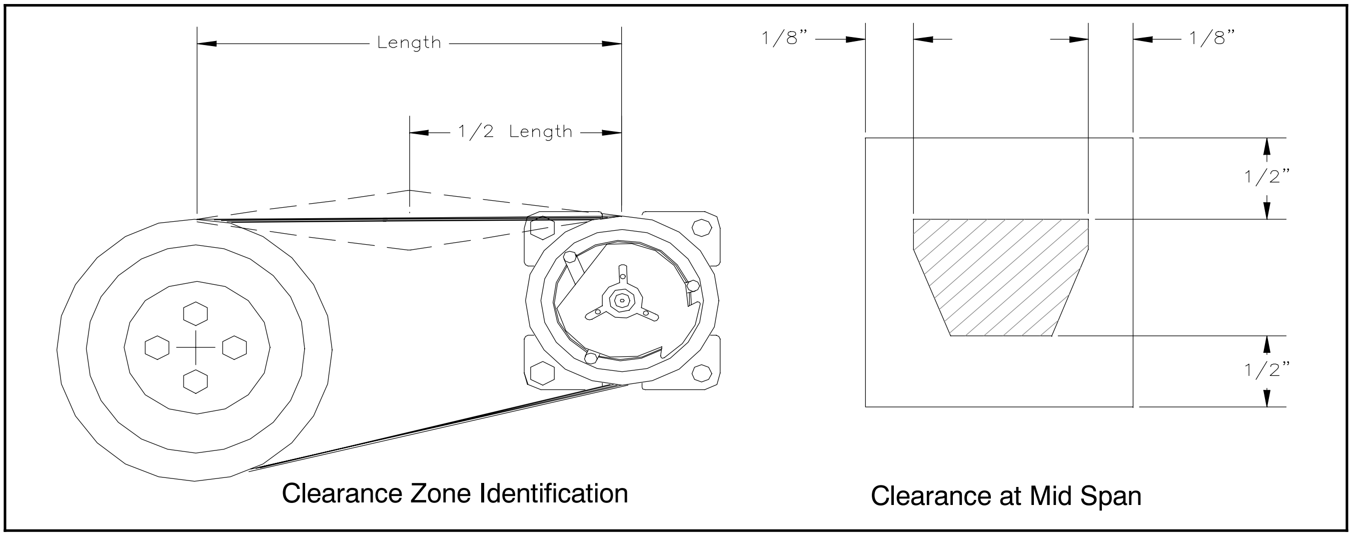


Figure 4-5 Belt Clearance Requirements

4.12 DRIVE BELT INSTALLATION

4.12.1 Introduction

There are several factors that have major effects on compressor and alternator drive belt(s) life expectancy and reliability. Belt alignment and proper tension being the most critical and controllable by the installer and end-user. Improper alignment and/or tension will cause premature failure of drive belts, driven components as well as a possible safety issue. When improperly installed and/or maintained, drive belts can cause significant damage to equipment. The following are the biggest factors that effect belt life and system dependability.

A. Belt Alignment
B. Belt Tension
  1. Over Tensioned
  2. Under Tensioned
C. Belt Clearance
D. Temperature-Heat
E. Fluids
F. Maintenance Procedures

4.12.2 Belt Clearance

A certain belt clearance needs to be maintained for belt span vibration when installing compressors and alternator belts. Figure 4-5 shows the recommended guidelines for clearance. Due to the large number of variables, actual testing is required to determine whether the clearances are acceptable.

4.12.3 Pulley Alignment

Correct belt alignment is essential for alternator and compressor belt life. The centerline of all pulleys related to compressor or alternator drive must be within 1/3 degree of true center. Refer to Figure 4-6 for approximate measurements, and keep in mind, these are maximum values. You should try to attain perfect alignment whenever possible to maximize component and belt life.

Maximum allowable run-out for Poly "V" belts is 1/8 inch.

Maximum allowable run-out for Standard "V" belts is 1/4 inch.

Alignment methods are illustrated in Figure 4-6 and Figure 4-7. A high quality straight edge is a necessity, your eye is not an acceptable method of determining proper belt alignment. All mounting brackets should allow for minor belt centerline adjustments.

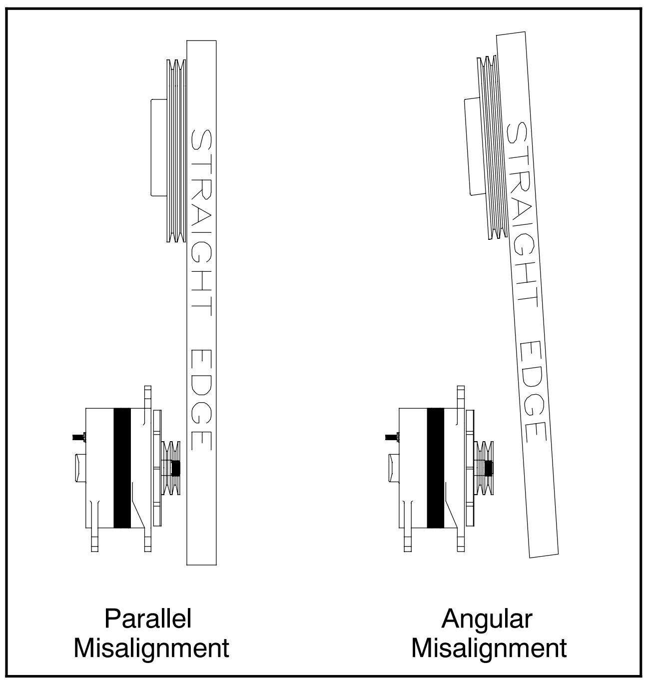


Figure 4-6 Belt Misalignment

Parallel adjustment is designed into a mount for final alignment during the installation process. Parallel misalignment is corrected by moving the driven pulley (alternator or compressor) into alignment with the drive pulley. This can be done using several methods. Spacing the component forward or rearward by adding or removing spacers is the most popular method used to achieve proper alignment. Other methods such as sliding the component forward or rearwards using slide plates and/or slots in the main weldment are also used.

Angular misalignment is often caused by tolerances in several pieces, such as hardware to mounting holes and plates to components. Angular misalignment is corrected by loosening the mounting hardware, adjusting the compressor/alternator to the proper angle and retightening the mounting hardware.

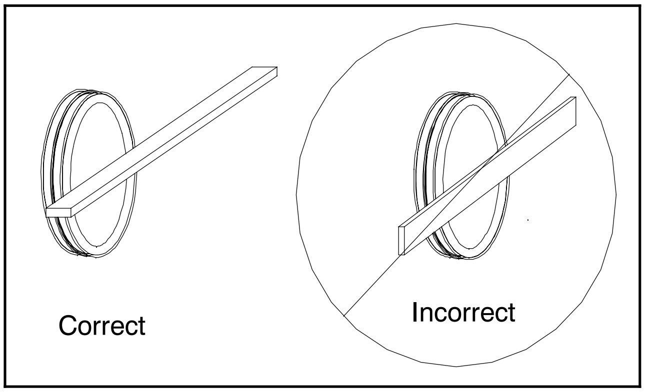


Figure 4-7 Straight-Edge Application

Proper use of a straight edge is illustrated in Figure 4-7 . Never use a straight edge on the wide/flat side, as they are not accurate. The thin edge is a straight surface and the only accurate surface. The straight edge must be flush across the face of the pulley. Then, to measure the alignment, lower the other end down to the driven pulley(s). Adjustments are made based on results of the aforementioned. Note that the pulley rim width must be considered when making the aforementioned measurements.

The next step is to lay the straight edge flush across the face of the driven pulley. This is the best way to determine angular misalignment. Again, adjust as required. You should repeat this step for all pulleys until acceptable alignment is achieved. Note the drive pulley is the primary guide for alignment. Do not use idlers as a guide for proper component belt alignment as bearing play could give you false readings.

4.12.4 Drive Belt Tension Guidelines

Proper belt tension is essential for not only belt life, but also the alternator and compressor life as well. Heat is a major enemy of compressors and alternators that can cause unnecessary stress and greatly reduce component life.

Listed in Table 4-9 are the examples specific to belt tension concerns:

A. Under tension would promote belt slippage causing excessive heat. Heat equals premature alternator and/or compressor failure.

B. Over tension could cause premature bearing failure and excessive wear on drive and driven components.

Proper belt tension is obtained by referring to Table 4-9. Find the belt used and where applied (compressor or alternator drive, Single ”V” or Ploy ”V” 4-8 ribs).

Notice that new belt tension is higher than in-service or re-tension amount. All new belts require a run-in period. During this period, a new belt will stretch more in a 10 hour run time than the entire life of the belt. So it is important to recheck belt tension after run-in or re-tension new belts if less than re-tension amount prescribed above. You should check belt tension with the belt ”hot.” However, the belt must be allowed to cool before re-tensioning. Drives which incorporate automatic tensioners do not require a run-in period or re-tensioning.

4.12.5 Measuring Methods for Belt Tension

There are several methods and tools available for determining belt tension. The industry’s acceptable method would be to use a belt tension gauge as manufactured by Burroughs or approved equal. There are also several models available than can be used. Please follow manufacturer guidelines regarding gauge selection operation and calibration requirements. You must get the correct tension gauge for your specific belt type(s).

4.13 RETURN AIR FILTER

NOTE

Never operate the evaporator without the return-air filter properly installed.

The evaporator return air filter(s) should be checked for cleanliness periodically(refer to table 4.1) and always with regard to operating conditions. A system operating on unpaved dusty roads will need a stricter maintenance schedule than a bus operating consistently on paved roads. A dirty air filter will restrict the air flow over the evaporator coil. This could cause insufficient cooling or heating and possible frost build-up on the coil. The GEN 4 series return air filters are secured to the rear of the evaporator coil assembly, while the GEN 5 series return air filters are located under the evaporator cover assembly.

Table 4-9 Belt Tension Guide

Drive	Belt Top Width	New Belt Lbs. Tension	Re-Tension Lbs. Tension	Re-Tension Threshold
Alternator	All	110	90	70
Compressor	All	130	105	80
Poly-Rib Belt & Serpentine Drive	6 or More Ribs	145	105	90

4.13.1 GEN 4 (EXCEL) Series

Replace the GEN 4 series return air filter(s) as follows:

a. Remove the evaporator return air grill.

b. Remove the return air filter from behind the coil assembly.

c. With the return air filter(s) and return air grill removed, it is advisable to check the evaporator coil. If the coil is dirty proceed with cleaning the coil.

d. Clean or replace the return air filter(s).

e. Replace evaporator return air grill.

4.13.2 GEN 5 Series

Replace the GEN 5 series return air filter(s) as follows:

a. Insert a 3mm Allen wrench into the 1/4 turn receptacle stud.

b. Turn counterclockwise opening the filter channel.

c. Slide filter out of the evaporator grill. (In some applications, needle-nosed pliers may be needed in order to grip the filter assembly).

d. Clean or replace the return air filter(s) as required.

e. Close the filter channel and lock the 1/4 turn stud into place by turning clockwise with 3mm Allen wrench.

4.14 EVAPORATOR BLOWER AND/OR MOTOR ASSEMBLY

4.14.1 GEN 4 Series

Replace the blower motor assembly as follows:

a. Disconnect bus battery.

b. Pop-off the snap cap covers and remove all screws holding the cover to the unit assembly. Remove the evaporator cover.

c. Remove drain hoses from drain pan assembly.

d. Remove hardware securing drain pan to the evaporator assembly (4 places).

e. Supporting the blower motor assembly, remove the hardware that secures the blower motor assembly to the evaporator. (4 places).

f. Unplug the motor from the evaporator wiring harness.

g. Replace as necessary.

h. Reinstall blower motor assembly reversing steps a. thru f.

i. Check blower motor assembly operation.

4.14.2 GEN 5 Series

Replace the blower wheel and/or motor as follows:

a. Disconnect bus battery.

b. Pop-off the snap cap covers and remove all screws holding the cover to the unit assembly. Remove the evaporator cover

c. Disconnect the red and black wire from the terminal block.

d. Using a 1/8 inch (EM-1 only) or 3/32 inch (EM-2/3/7) Allen handle loosen the set screw securing the motor shaft to the blower wheel. The set screw can be accessed through a notched fin in the blower wheel.

e. Remove hardware (4 places) securing the motor strap to the top panel.

f. Remove motor strap and motor gasket from motor assembly.

g. Slide motor assembly shaft out of blower wheel.

h. Pull blower wheel assembly from bearing cup.

i. Replace motor and/or blower wheel if necessary.

j. Carefully place blower wheel assembly into the bearing cup.

k. Insert motor shaft into the blower wheel hub.

l. Align blower wheel set screw to flat spot on motor shaft and tighten.

m. Continue to reassemble by reversing steps a. thru f.

n. Check motor and blower wheel operation.

4.15 RESISTORS

4.15.1 GEN 4 Series (Excel)

Low, Medium, High, and High Performance speeds (for ducted systems) on the GEN 4 series of evaporators are controlled by the speed selection switch located on the drivers control panel. High (orange wire) or High Performance ducted (black wire) speed is determined at time of installation. See Figure 2-2 for wire connections and Section 5 Electrical for appropriate wiring diagram. Every GEN 4 series evaporator blower motor assembly has a speed control resistor. See Figure 4-8 for wire color connections (speed control) and Ohm's between prongs.

Total resistance rating of the 4-prong resistor is 1.8 Ohm with a ±5% tolerance rating. Total wattage is 115.

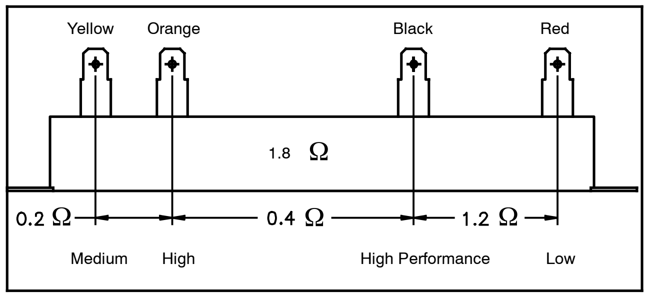


Figure 4-8 GEN 4 Series Resistor Assembly

4.15.2 GEN 5 Series

GEN 5 evaporator motor speeds can be controlled by the driver three ways:

1. Standard GEN 4 type operation using the 3 speed switch and resistors.
2. Variable speed switch control.
3. Electronic Total Control.

Refer to Section 2, paragraph NO TAG GEN 5 Operating Instructions and Section 5, Electrical, for the appropriate GEN 4/5 wiring diagram.

NOTE

If evaporator fan motor is only functioning in 1 or 2 of the 3 speeds, the resistor is bad, not the fan motor.

4.16 CONDENSER FAN ASSEMBLY

Condenser fan assemblies for GEN 4 and GEN 5 are identical in function and fit. Replace a condenser fan assembly as follows:

a. Disconnect bus battery.

b. While supporting both parts, remove hardware (4 places) securing the fan guard and condenser fan assembly to the condenser venturi.

c. Un-plug fan assembly from condenser harness.

d. Repair or replace as necessary.

e. Reassemble by reversing steps a. thru c.

f. Check condenser fan assembly operation.

4.17 REPLACING THERMOSTATIC BLOCK VALVE

The Thermostatic Block Valve is an automatic device which regulates the flow of refrigerant into the evaporator coil. Properly operating it will also prevent liquid refrigerant from returning to the compressor. If the valve is defective, it must be replaced.

a. Disconnect bus battery.

b. Recover refrigerant from air conditioning system.

c. Pop-off the snap cap covers and remove all screws holding the cover to the unit assembly. Remove the evaporator cover .

d. Remove no-drip insulating tape from block valve and fitting connections.

e. Carefully loosen fittings connected to the block valve.

WARNING

There may be liquid refrigerant trapped behind the block valve. Slowly loosen the fitting and avoid contact with exposed skin or eyes.

f. Remove and replace block valve, lubricating the fittings with mineral oil before torquing to required specifications (Refer to paragraph 4.10).

NOTE

Do not attempt to adjust the replacement block valve. Valves are preset at the factory.

g. Insulate block valve with no-drip insulating tape.

h. Leak check and evacuate per paragraphs 4.5 & 4.6.

i. Charge system with the recovered refrigerant.

j. Check operation of the system. Adjust refrigerant charge as needed.

4.18 CHECKING AND REPLACING HIGH PRESSURE SWITCH

4.18.1 Replacing High or Low Pressure Switch

a. The high and low pressure switches are equipped with schrader valve to allow removal and installation without pumping the unit down.

b. Disconnect wiring from defective switch.

c. Install new cutout switch after verifying switch settings. (Refer to paragraph 4.18.2)

4.18.2 Checking High Pressure Switch

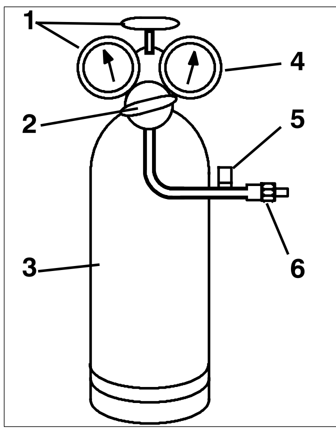
WARNING

Do not use a nitrogen cylinder without a pressure regulator. Do not use oxygen in or near a refrigeration system or as an explosion may occur.

a. Remove switch from unit. All units are equipped with schrader valves at the high and low pressure switch connections.

b. Connect an ohmmeter across switch terminals. If the switch is good, the ohmmeter will indicate no resistance, indicating that the contacts are closed.

c. Connect switch to a cylinder of dry nitrogen. (See
Figure 4-9.



1. Cylinder Valve and Gauge
2. Pressure Regulator
3. Nitrogen Cylinder
4. Pressure Gauge (0 to 400 psig = 0 to 36 kg/cm@)
5. Bleed-Off Valve
6. 1/4 inch Connection

Figure 4-9. Checking High Pressure Switch

d. Set nitrogen pressure regulator higher than cutout point on switch being tested.(Refer to paragraph 1.7)

e. Open cylinder valve. Slowly open the regulator valve to increase the pressure until it reaches cutout point. The switch should open, which is indicated by an infinite reading on an ohmmeter (no continuity).

f. Close cylinder valve and release pressure through the bleed-off valve. As pressure drops to cut-in point, the switch contacts should close, indicating no resistance (continuity) on the ohmmeter.

g. Replace switch if it does not function as outlined above.

4.19 MOISTURE INDICATOR (SYSTEM)

There are two types of moisture indicators presently in use with Carrier Transport A/C systems.

1. **Green/Yellow** (Previous Configuration)

Green = Dry System   Yellow = Wet System

2. **Blue/Pink** (Current Configuration)

Blue = Dry   Pink = Wet

4.20 FILTER-DRIER OR RECEIVER-DRIER

Carrier Transport A/C condensers are supplier with either a filter-drier or a receiver-drier.

NOTE

All microchannel condenser assemblies are equiped with a receiver-drier with an integral high pressure switch. All other condensers are equiped with filter driers.

If a pressure drop across the Filter-Drier (see Figure 4-10) or Receiver-Drier (see Figure 4-11) is indicated or the moisture-indicator shows an abnormal (wet) condition, the Filter-Drier or Receiver-Drier must be changed.

a. Check for a restricted filter by touching the filter drier or receiver-drier on inlet and outlet connections. If there is a noticeable temperature difference the filter is probably restricted and should be replaced.

b. Recover refrigerant, refer to paragraph 4.4.

c. Place a new filter-drier or receiver-drier near the unit for immediate installation.

d. Using two open end wrenches, slowly crack open and remove the liquid line O-ring fittings on each side of the filter-drier.

WARNING

The filter-drier or receiver-drier may contain liquid refrigerant. Slowly open the fitting nuts and avoid contact with exposed skin or eyes.

e. Loosen the hose clamp(s) securing the filter drier or receiver-drier to the condenser assembly.

f. Remove the filter-drier or receiver drier. Transfer high pressure switch if required.

g. Remove seal caps from the new filter-drier or receiver-drier. Apply a light coat of mineral oil to the fittings and O'rings.

h. Assemble the new filter-drier or receiver-drier to the liquid lines ensuring that the arrow on the body of the filter-drier or receiver-drier points in the direction of the refrigerant flow (liquid refrigerant flows from the condenser to the evaporator). Finger tighten the liquid line fittings.

i. Tighten filter-drier or receiver-drier O-ring fittings using two open end wrenches. Refer to paragraph 4.10 for torque specifications.

j. Evacuate system to 500 microns by connecting a vacuum pump as shown in Figure 4-2.

k. Charge system according to paragraph 4.8.2.

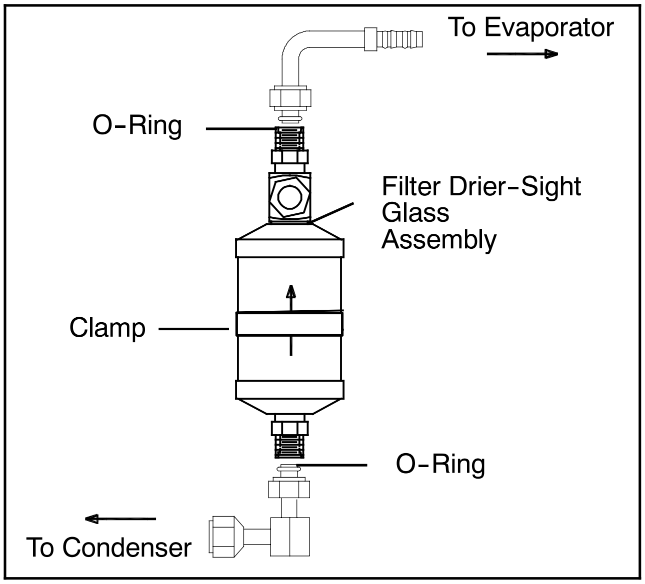


Figure 4-10 Filter Drier

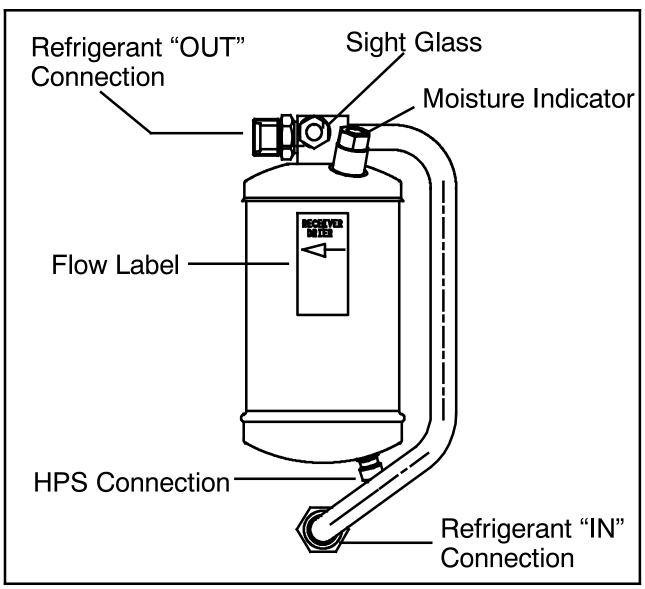


Figure 4-11 Receiver-Drier

Table 4-10 R-134a Temperature - Pressure Chart

Temperature		Vacuum		
°F	°C	PSIG	Kg/cm2	Bar
−40	−40	14.6	37.08	0.49
−35	−37	12.3	31.25	0.42
−30	−34	9.7	24.64	0.33
−25	−32	6.7	17.00	0.23
−20	−29	3.5	8.89	0.12
−18	−28	2.1	5.33	0.07
−16	−27	0.6	1.52	0.02
−14	−26	0.4	0.03	0.03
−12	−24	1.2	0.08	0.08
−10	−23	2.0	0.14	0.14
−8	−22	2.9	0.20	0.20
−6	−21	3.7	0.26	0.26
−4	−20	4.6	0.32	0.32
−2	−19	5.6	0.39	0.39
0	−18	6.5	0.46	0.45
2	−17	7.6	0.53	0.52
4	−16	8.6	0.60	0.59
6	−14	9.7	0.68	0.67
8	−13	10.8	0.76	0.74
10	−12	12.0	0.84	0.83
12	−11	13.2	0.93	0.91
14	−10	14.5	1.02	1.00
16	−9	15.8	1.11	1.09
18	−8	17.1	1.20	1.18
20	−7	18.5	1.30	1.28
22	−6	19.9	1.40	1.37
24	−4	21.4	1.50	1.48
26	−3	22.9	1.61	1.58

Temperature		Pressure		
°F	°C	Psig	Kg/cm2	Bar
28	−2	24.5	1.72	1.69
30	−1	26.1	1.84	1.80
32	0	27.8	1.95	1.92
34	1	29.6	2.08	2.04
36	2	31.3	2.20	2.16
38	3	33.2	2.33	2.29
40	4	35.1	2.47	2.42
45	7	40.1	2.82	2.76
50	10	45.5	3.20	3.14
55	13	51.2	3.60	3.53
60	16	57.4	4.04	3.96
65	18	64.1	4.51	4.42
70	21	71.1	5.00	4.90
75	24	78.7	5.53	5.43
80	27	86.7	6.10	5.98
85	29	95.3	6.70	6.57
90	32	104.3	7.33	7.19
95	35	114.0	8.01	7.86
100	38	124.2	8.73	8.56
105	41	135.0	9.49	9.31
110	43	146.4	10.29	10.09
115	46	158.4	11.14	10.92
120	49	171.2	12.04	11.80
125	52	184.6	12.98	12.73
130	54	198.7	13.97	13.70
135	57	213.6	15.02	14.73
140	60	229.2	16.11	15.80
145	63	245.6	17.27	16.93
150	66	262.9	18.48	18.13
155	68	281.1	19.76	19.37

SECTION 5
ELECTRICAL SCHEMATIC DIAGRAMS

5.1 INTRODUCTION

This section contains Electrical Schematics covering the GEN 4 and GEN 5 systems. Figure 5-3 shows a GEN 4 EM-1 Evaporator with a CM-2/3 Condenser, Figure 5-4 shows a GEN 4 Series EM-1 Evaporator with a CM-2/3 Condenser tied into an OEM compressor, Figure 5-5 shows a GEN 4 EM-3 evaporator with (2) CM-3 condensers, Figure 5-6 shows a (typical) GEN V evaporator with variable speed controls, Figure 5-7 shows a (typical) GEN 5 system with Total Control, Figure 5-8 shows a GEN 4 EM-3 with Total Control, and Figure 5-9 shows a (typical) GEN 4 evaporator (s) with Total Control. Contact your Carrier Transport Air Conditioning Field Service representative or call Carrier's technical hot line at 800-450-2211 for a copy of the schematic for your specific model and/or series.

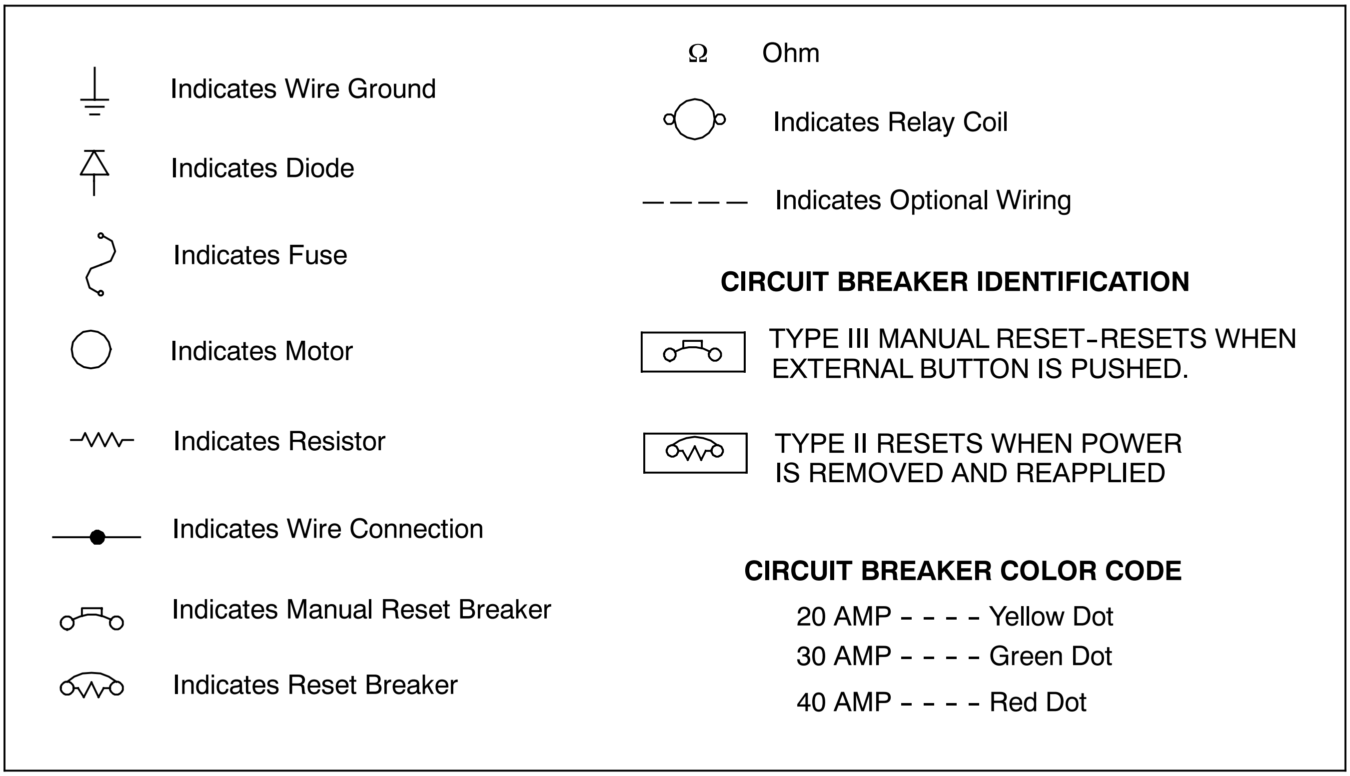


Figure 5-1 Electrical Schematic Diagram - Symbols

LEGEND			
ADJ	Adjusting	GRD	Ground
ALT	Alternator	HGS1	Compressor #2 Relay
AMP	Ampere	HGS2	Heat Valve
AUX	Load	HP	High Pressure Switch
BAT	Battery	HP1	For Grounding of Low Pressure & Frozen Coil Switch For Comp. #1
BP	Low Pressure & Frozen Coil Switch For Compressor #2	HP2	For Grounding of Low Pressure & Frozen Coil Switch For Comp. #2
BPT	Low pressure & Frozen Coil Switch For Compressor #2	HSR	High Speed Relay
BPV	Fan Speed PWM Signal Output	IGN	Ignition Circuit
CFM	Condenser Fan Motor	LP	Low Pressure Switch
CL	Clutch	LSR	Low Speed Relay
CLR	Clutch Relay	M	Motor
CLR2	Clutch Relay #2	MSR	Medium Speed Relay
CM	Condenser Motor	NEIM	(IGN) Tie-In (OEM)
CR	Condenser Relay	OEM	Original Equipment Manufacturer
EFM	Evaporator Fan Motor	PWM	Pulse Width Modulation
EM	Evaporator Module	RAS	Return Air Sensor
G 4	Generation 4 (Excel) Series		
G 5	Generation 5 Series		

Figure 5-2 Legend – Electrical Schematic Diagrams

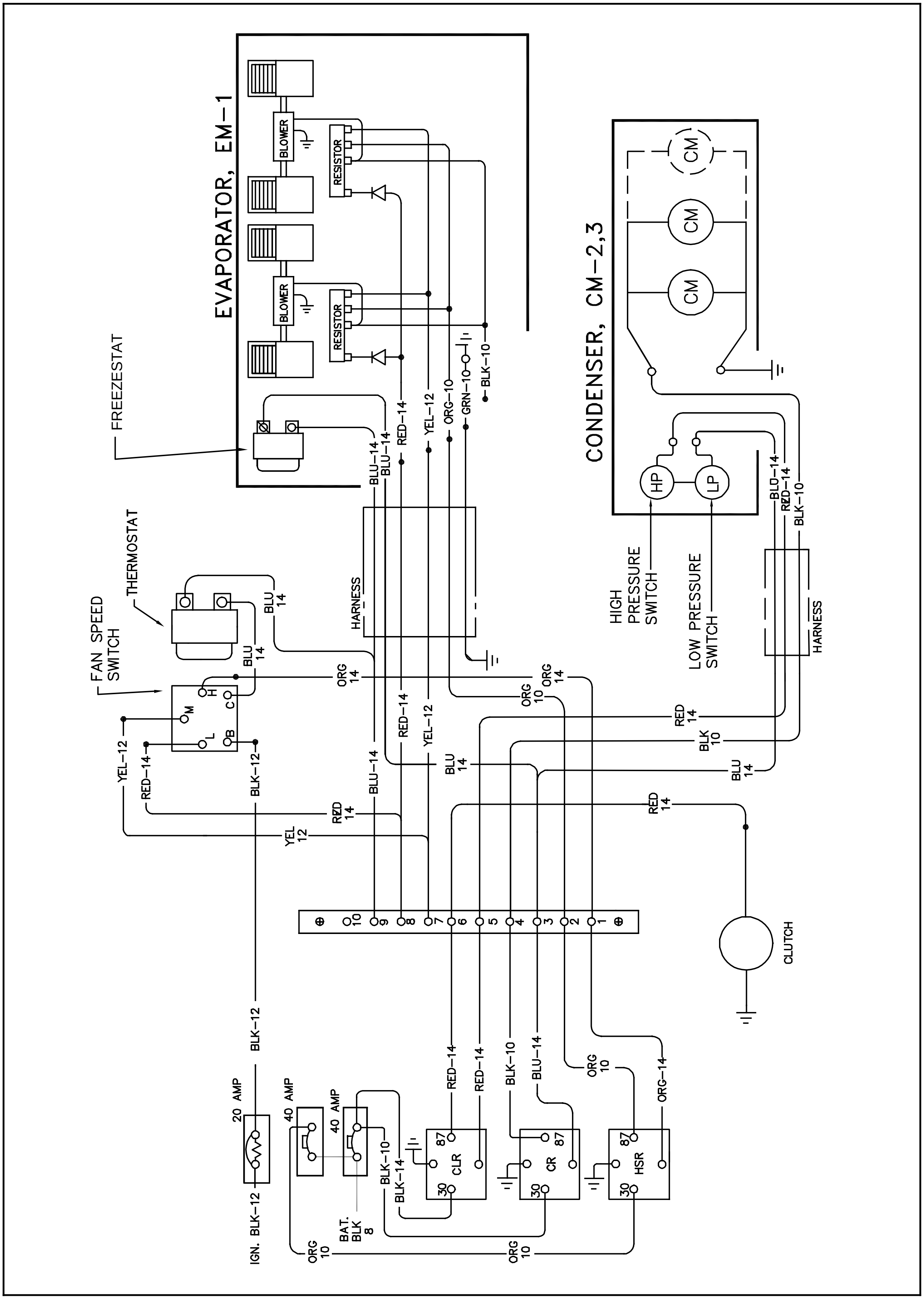


Figure 5-3 GEN 4 System Schematic - EM-1 With CM-2/3

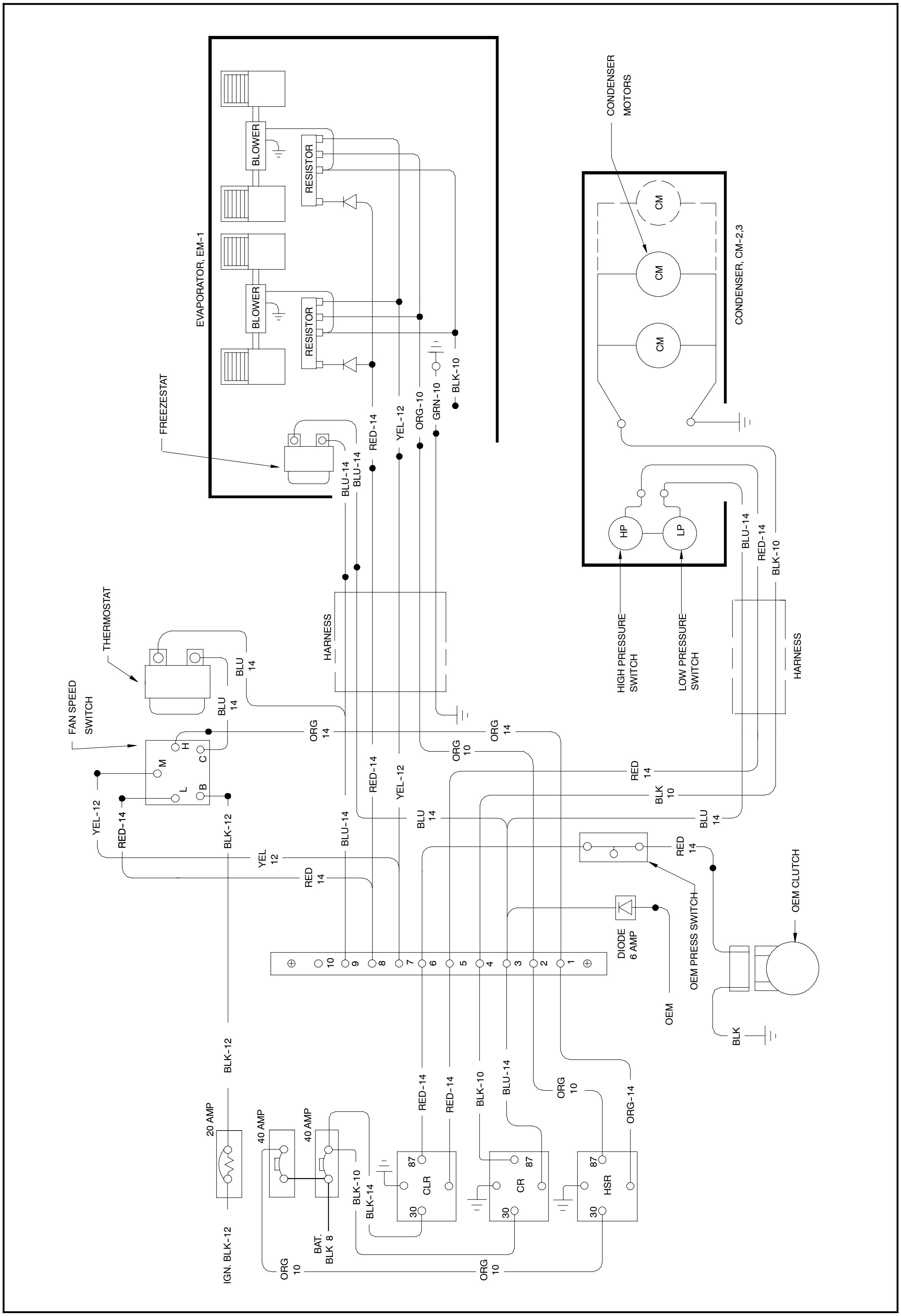


Figure 5-4 GEN 4 System Schematic - EM-1 With CM-2/3 - Tie-In

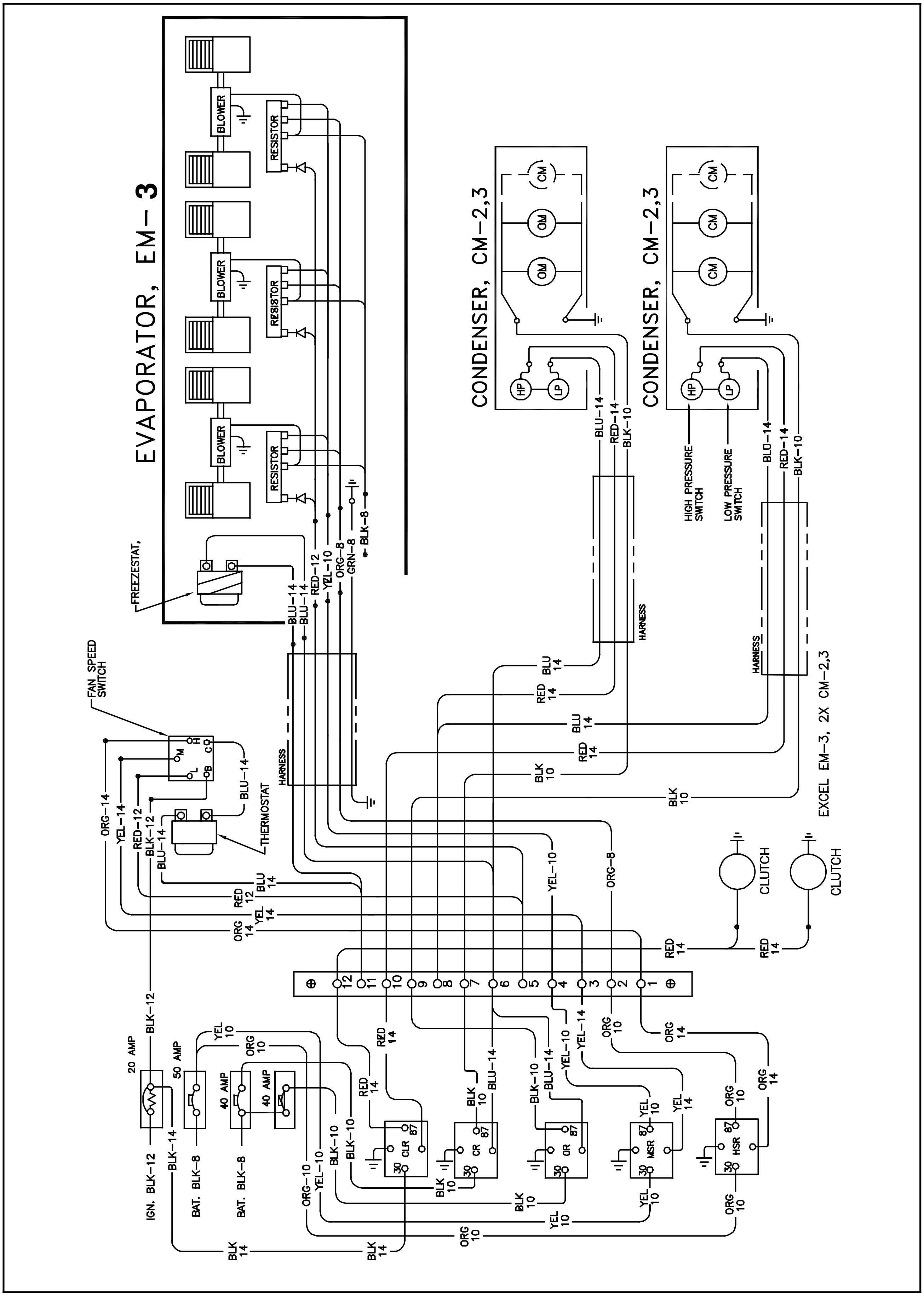


Figure 5-5 GEN 4 System Schematic - EM-3 With (2) CM-3 Condensers & (2) Compressors

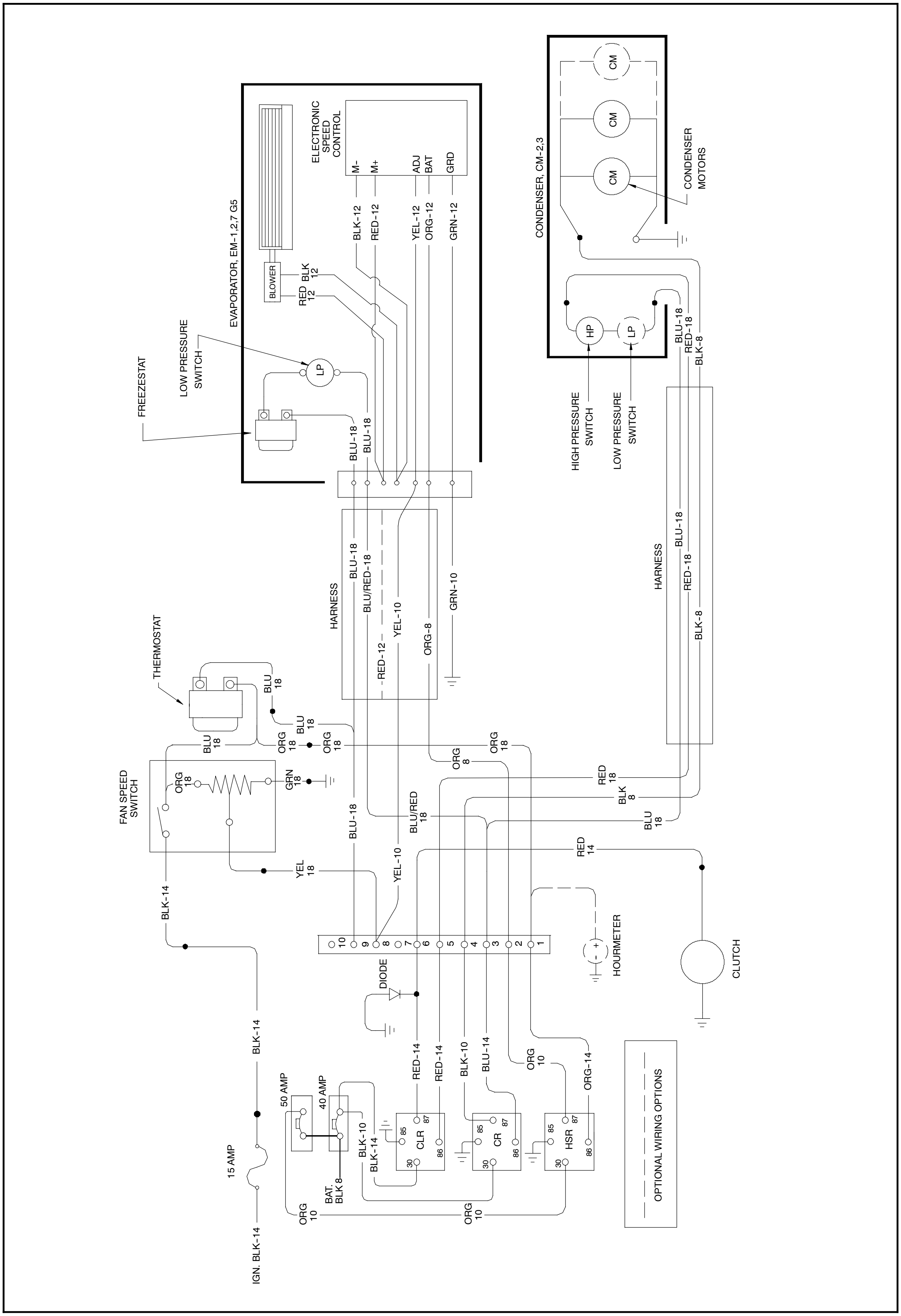


Figure 5-6 GEN 5 Evaporator (With Variable Speed Control) Schematic

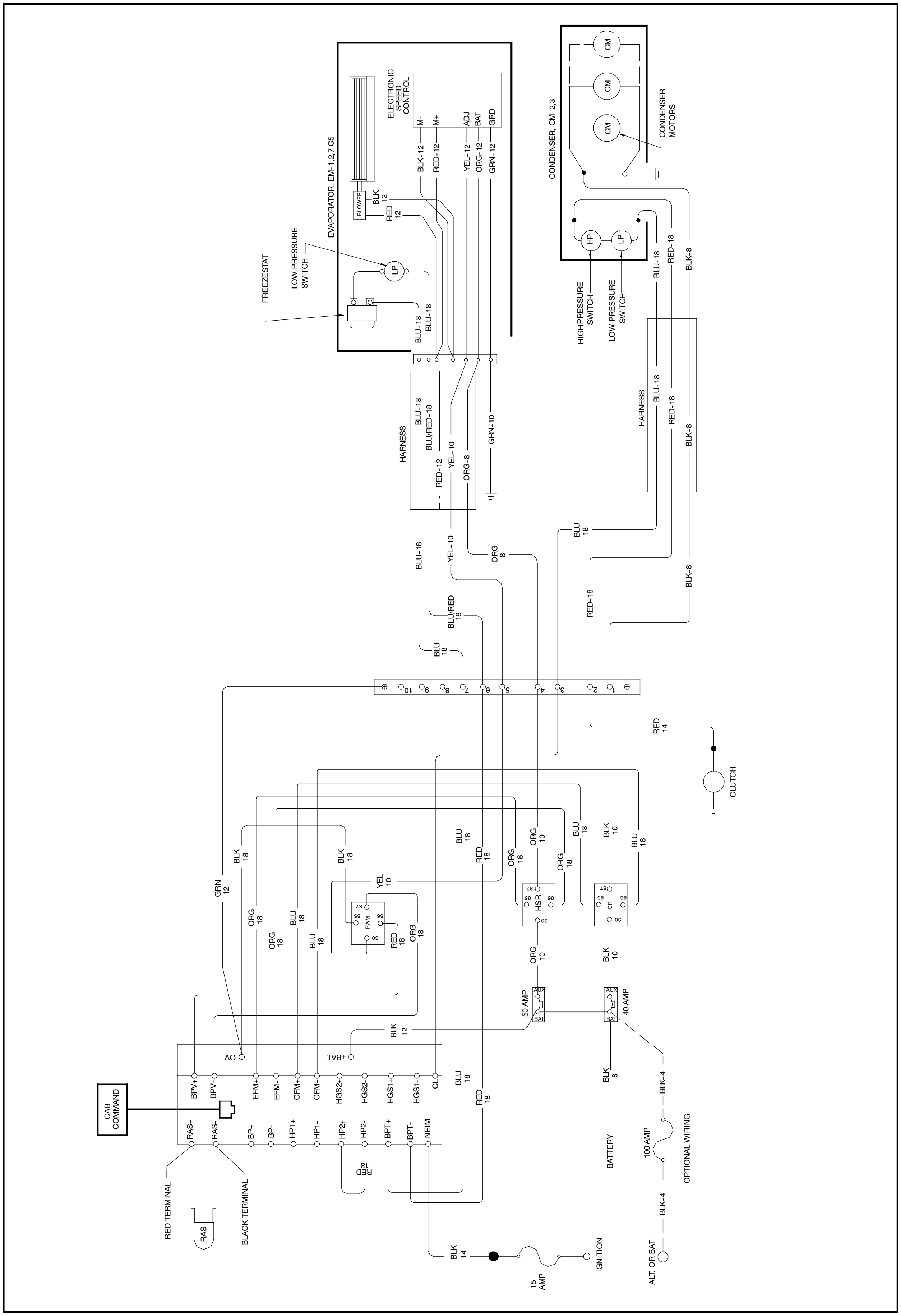


Figure 5-7 GEN 5 System Schematic With Total Control

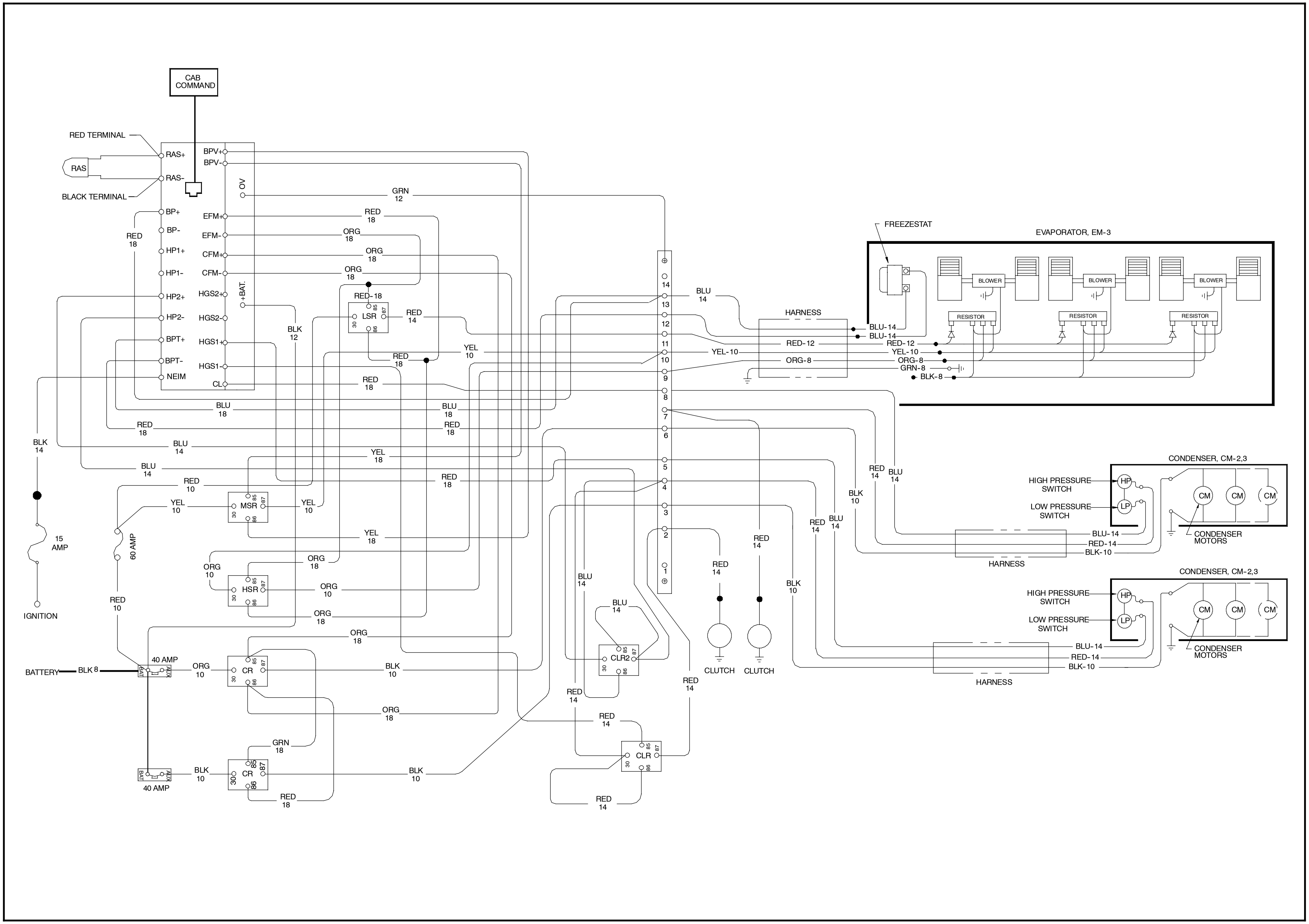


Figure 5-8 GEN 4 EM-3 With (2) CM-3 With Total Control - System Schematic

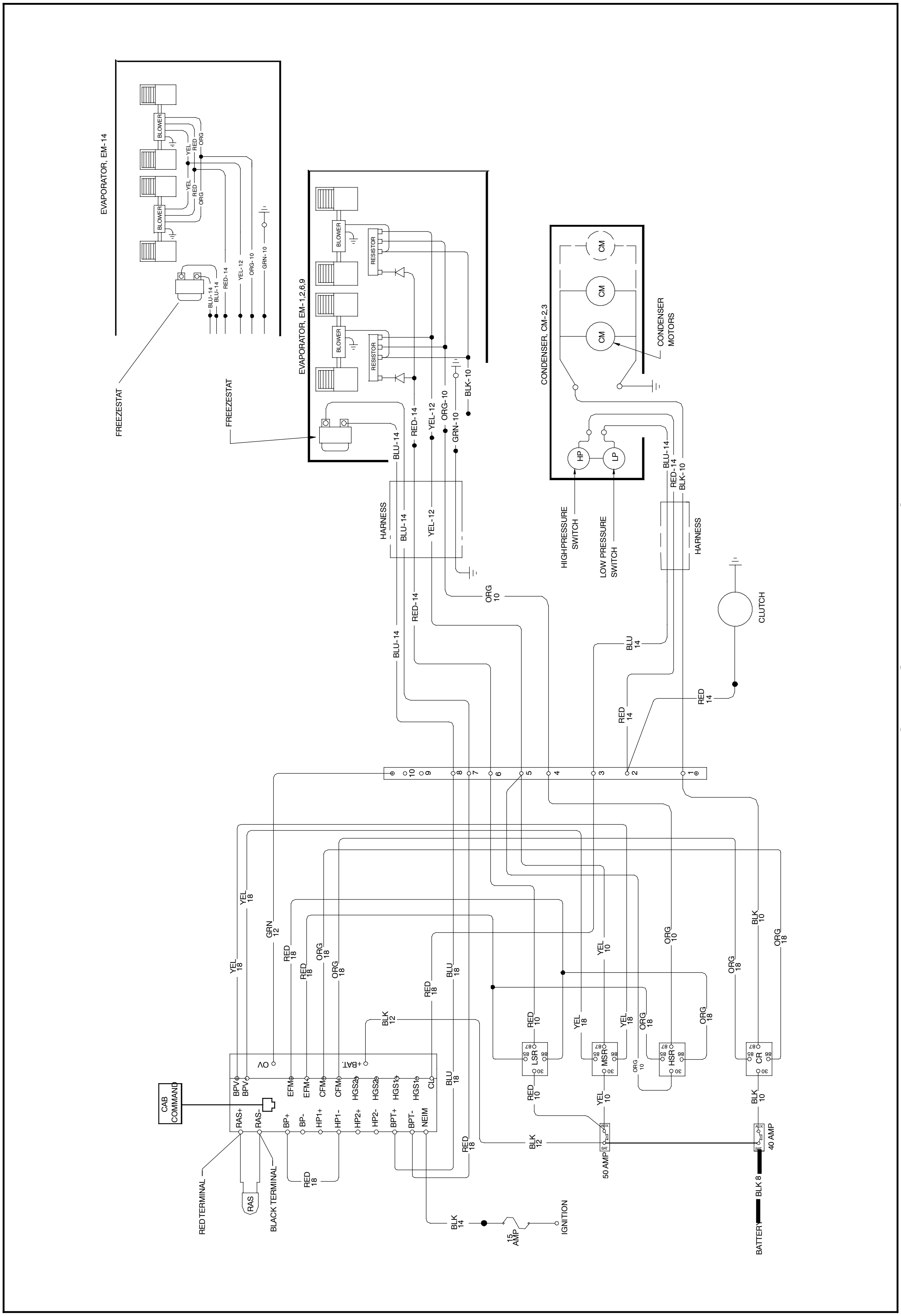


Figure 5-9 GEN 4 Series With Total Control

INDEX

INDEX

S

T

V

Carrier Transport Air Conditioning
50 Grumbacher Road
York PA 17406 USA
Tel: 1-800-673-2431
Fax: 1-717-764-0401

Carrier
A United Technologies Company
Carrier Transicold Division,
Carrier Corporation
Transport Air Conditioning Group
P.O. Box 4805
Syracuse, N.Y. 13221 U.S A

www.carrier.transicold.com

Carrier TRANSICOLD