T-336 Manual

OPERATION AND SERVICE

for

DC12174 & DC12175

Large Split System EM17 with CM5 or KR4

Electronic Thermostat or EnviroMATE

T-336

REV. 06/2012

Mobile Climate Control

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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 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 safety glasses.

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

No work should be performed on the system until all circuit breakers and start-stop switches are placed in the OFF position, and power supply 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

Beware of unannounced starting of the evaporator and condenser fans, and compressor clutch. Do not open the unit cover before turning power off.

Be sure power is turned off before working on motors, controllers, solenoid valves and electrical controls. Tag circuit breaker and power supply to prevent accidental energizing of circuit.

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 unit, disconnect all wire harness connectors from the modules in the control box. Do not remove wire harness from the modules unless you are grounded to the unit frame with a static-safe wrist strap.

In case of electrical fire, open circuit switch and extinguish with CO_2 (never use water).

SAFETY SUMMARY

SPECIFIC WARNINGS AND CAUTIONS

WARNING

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

WARNING

Read the entire procedure before beginning work. Park the coach on a level surface, with parking brake applied. Turn main electrical disconnect switch to the off position.

WARNING

Do not use a nitrogen cylinder without a pressure regulator.

WARNING

Do not use oxygen in or near a refrigeration system as an explosion may occur.

WARNING

The filter-drier may contain liquid refrigerant. Slowly loosen the flare nuts to avoid refrigerant contact with exposed skin or eyes.

WARNING

Extreme care must be taken to ensure that all the refrigerant has been removed from the compressor crankcase or the resultant pressure will forcibly discharge compressor oil.

WARNING

Beware of rotating fan blades and unannounced starting of fans or compressor.

CAUTION

To avoid the entrance of air, never evacuate an open drive compressor below 500 microns.

CAUTION

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

SECTION 1

DESCRIPTION

1.1 INTRODUCTION

This manual contains Operating Instructions, Service Instructions and Electrical Data for the Model DC12175 and DC12174 Air Conditioning equipment furnished by Mobile Climate Control as shown in Table 1-1. Additional support manuals are referenced in Table 1-2.

The Model DC12175 system consists of a CM-5 condensing unit, an EM-17 evaporator section and a rear engine compartment mounted 05G compressor.

The Model DC12174 system consists of a KR-4 rooftop condensing unit, an EM-17 evaporator section and a rear engine compartment mounted 05G compressor.

NOTE

An optional 05K compressor can be used in place of the 05G in lighter duty applications.

To complete the systems, the air conditioning equipment interfaces with electrical cabling, refrigerant piping, duct work and other components furnished by the bus manufacturer.

Information on the compressor(s) is provided in separately bound manuals.

The drivers control may be equipped with either a single HIGH-OFF-LOW switch and A/C Stop Light, or a digital MCC EnviroMATE controller. The manual switch application requires the switch to be placed in the desired fan speed postion to start temperature control. Operation of the system is controlled automatically by an electronic thermostat which maintains the vehicles interior temperature at the desired set point. Some systems may be configured to override the high speed selection to low speed once interior temperature approaches set point. The A/C Stop Light will be liuminated if the system is shut down on a safety.

The systems utilizing the EnviroMATE controller can be controlled by pushing the I/O button to energize the system. More information on the EnviroMate can be found in section 2.5.

Description of the system components are provided in the following sub paragraphs and illustrated in Figure 1-1 .

1.1.1 Evaporator Section (EM-17)

The evaporator system includes the evaporator coil, fan and motor assemblies, a thermostatic expansion valve and condensate drain line connections. Also included with the evaporator assembly for manual controls are UPS1, 2 & 3, CFS 1 & 2. The enviroMATE controlled units are equipped with transducers mounted at the compressor, that control the system by continuously monitoring system pressures. Both systems are equipped with a Liquid Line solenoid (LLS) and Condenser fan speed resistor.

The thermostatic expansion valve meters the flow of refrigerant entering the evaporator coil. The evaporator coil provides heat transfer surface for transferring heat from air circulating over the coil to refrigerant circulating inside the tubes; thus providing cooling. The optional heating coils provide heat transfer surface for transferring heat from engine coolant water circulating inside the tubes to air circulating over the outside surface of the tubes; thus providing heating. The fans circulate the air over the coils. The air filters remove dirt particles from the air before it passes over the coils.

1.1.2 Condensing Section

The condensing section includes the condenser coil (s), fan and motor assemblies, filter-drier, receiver (with sight glass and moisture indicator), discharge line check valve, discharge line connection, service valves, fusible plug and an ambient temperature sensor or thermistor.

The discharge check valve is a spring loaded, normally closed valve that opens with the flow of refrigerant from the compressor. When the compressor clutch is disengaged, the discharge check valve will close, preventing the flow of high pressure liquid from the condenser back into the compressor.

The condenser coil provides heat transfer surface for condensing refrigerant gas at a high temperature and pressure into a liquid at high temperature and pressure. The condenser fans circulate ambient air across the outside of the condenser tubes at a temperature lower than the refrigerant circulating inside the tubes; this results in condensation of the refrigerant into a liquid.

The receiver collects and stores the liquid refrigerant. The receiver is fitted with liquid level sight glass to enable determination of refrigerant liquid level and moisture content. The receiver is also fitted with a fusible plug which protects the system from unsafe high pressure conditions. The filter-drier removes moisture and debris from the liquid refrigerant before it enters the thermostatic expansion valve. The service valves enable isolation of the filter-drier for service. The ambient temperature sensor or thermistor, opens in low ambient conditions to prevent A/C operation

1.1.3 Compressor Assembly

The compressor assembly includes the refrigerant compressor, clutch assembly, suction and discharge service valves, high pressure switch, low pressure switch, suction and discharge servicing (charging) ports and electric solenoid unloaders. Units equipped with the EnviroMATE Controller include pressure transducers on the compressor assembly.

The compressor raises the pressure and temperature of the refrigerant and forces it into the condenser. The clutch assembly provides a means to disengage the compressor operation from the bus engine. The suction and discharge service valves enable servicing of the compressor. Suction and discharge servicing (charging) ports mounted on the service valves enable connection of charging hoses for servicing of the compressor, as well as other parts of the refrigerant circuit. The high pressure switch contacts open on a pressure rise to shut down the system when abnormally high refrigerant pressures occur. The electric unloaders provide a means of controlling compressor capacity, which enables control of temperature inside the bus.

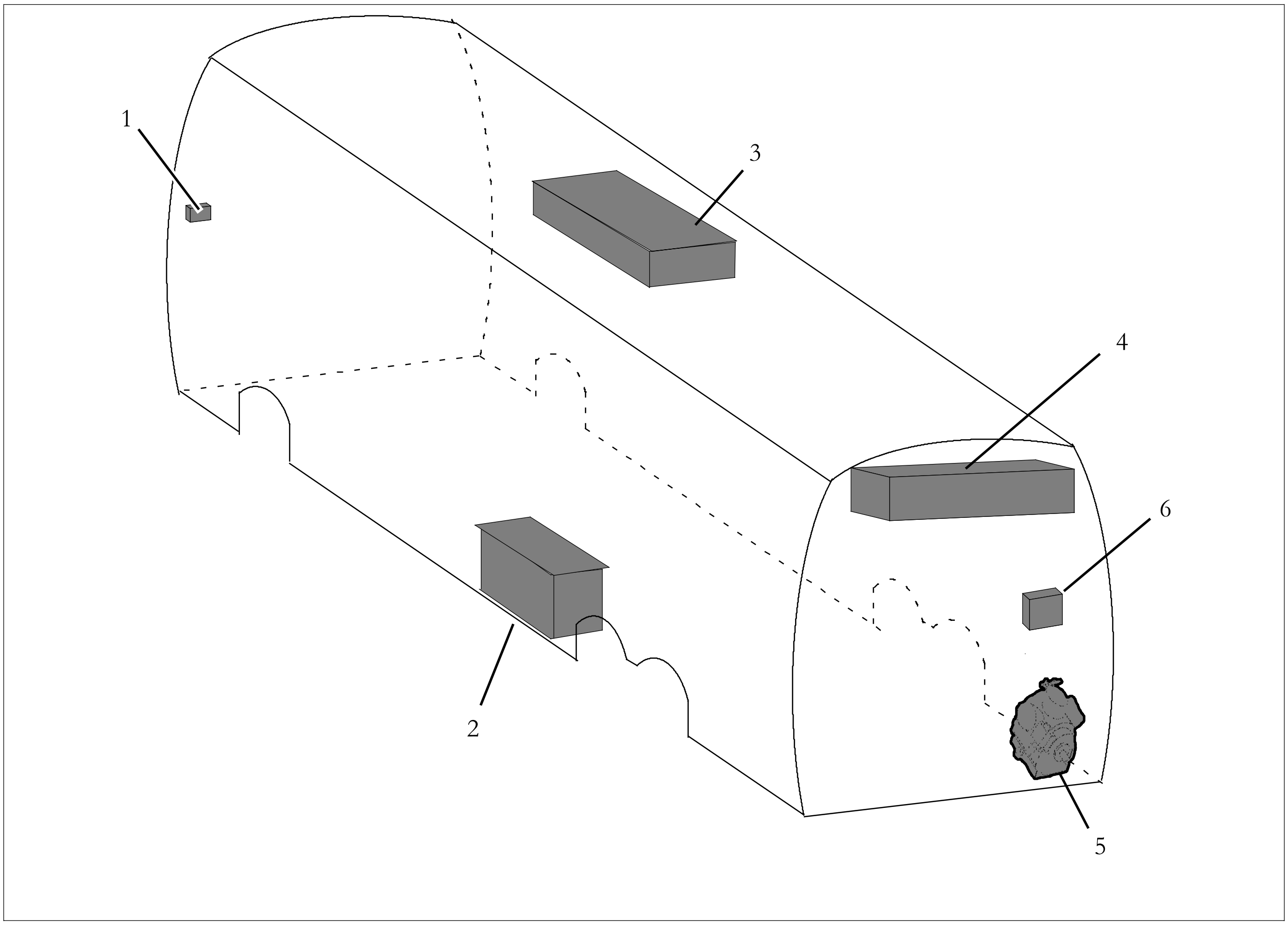


Figure 1-1 Coach Cutaway View

1 Drivers Control
2 CM-5 Condenser (DC12175)
3 KR-4 Rooftop Condenser (DC12174)
4 EM-17 Evaporator Assembly
5 Compressor Assembly
6 Control Box (TBB)

Table 1-1 Model

MODEL	VDC	CONTROLLER	COMPRESSOR.	CONDENSOR	EVAPORATOR
DC12174	24	Electronic or EnviroMATE	05G	KR-4	EM-17 Single Loop
DC12175	24	Electronic	05G	CM-5	EM-17 Single Loop

Table 1-2 Additional Support Manuals

MANUAL/FORM NUMBER	EQUIPMENT COVERED	TYPE OF MANUAL
T-299PL	Split Systems Gen 4/5	Parts List

1.2 REFRIGERANT SYSTEM COMPONENT SPECIFICATIONS

a. Refrigeration Charge

Approximate R134a refrigerant charge will be between 14 and 19 pounds, dependent upon condenser type and placement.

b. Compressors

Model: 05G
No. of Cylinder: 6
Weight (Dry): 145 lbs. (66 kg) including clutch

Model: 05K
No. of Cylinder: 4
Weight (Dry): 108 lbs. (49 kg) including clutch

c. 05G Compressor - Electric Unloader Pressure Switches UPS1, UPS2 and UPS3 for Electronic T-Sta models (See Table 1-3)

NOTE

Refer to 05g or 05K Operation and Service manuals for additional technical data, including approved oils and oil capacity.

d. Thermostatic Expansion Valve

Superheat Setting: 10°F (5.6°C)
MOP Setting: 65.0 ±4 psig

e. Condenser Fan Switches (Electronic T-Stat)

CFS1

Closes for 4 (DC12174) or 5 (DC12175) fan operation: 100 ±10 psig
Opens for 2 fan operation: 80 ±15 psig

CFS2

Closes for high speed: 275 ±10 psig
Opens for Low Speed: 220 ±15 psig

f. Low Ambient Switch (LATH) (Electronic T-Stat)

Opens at: 50 ±3_F *(7.2_C)*
Closes at: 60 ±3_F *(12.8_C)*

Table 1-3 Unloader Pressure Switch Settings (Electronic T-Stat R-134a)

UNLOADER PRESSURE SWITCH - Contacts Open/Close Settings [psig (*kg/cm2*)]					
UPS1		UPS2		UPS3	
Load Up (Opens)	Unload (Closes)	Load Up (Opens)	Unload (Closes)	Load Up (Opens)	Unload (Closes)
34 ±3 *(2.5 ± 0.21)*	26 ±2 *(1.8 ± 0.14)*	31 ±2 *(2.2 ± 0.14)*	23 ±2 *(1.6 ± 0.14)*	250 ±15 *(19 ± 1.1)*	320 ±10 *(19 ± 1.1)*

NOTE

On unit models utilizing the EnviroMATE Controller, compressor unloaders are controlled by the pressure transducers located on the compressor. See Section 2.5 for more information on the EnviroMATE operation.

1.3 SYSTEM OPERATING CONTROLS AND COMPONENTS (Electronic Thermostat)

1.3.1 Electronic Thermostat (TH)

The system is equipped with an electronic thermostat which operates in combination with a separate relay board (See Figure 1-2 & Figure 1-3) to control the operation of the system.

The setpoint is adjusted by manually turning the control box mounted potentiometer towards "COOLER" or "WARMER".

The thermostat's temperature sensor monitors the vehicles interior temperature at the return air section of the evaporator and controls the operating function of the system to maintain the desired vehicle interior temperature.

1.3.2 Manual Switches

A/C Mode Switch (ACMS)

The drivers control is equipped with a single HIGH-OFF-LOW switch. The switch is placed in the desired fan speed position to start temperature control.

1.3.3 Pressure Switches

Condenser Fan Switches (CFS)

The condenser fan switches are located in the evaporator section. Switch CFS 1 controls the number of fans in operation while switch CFR2 controls fan speed.

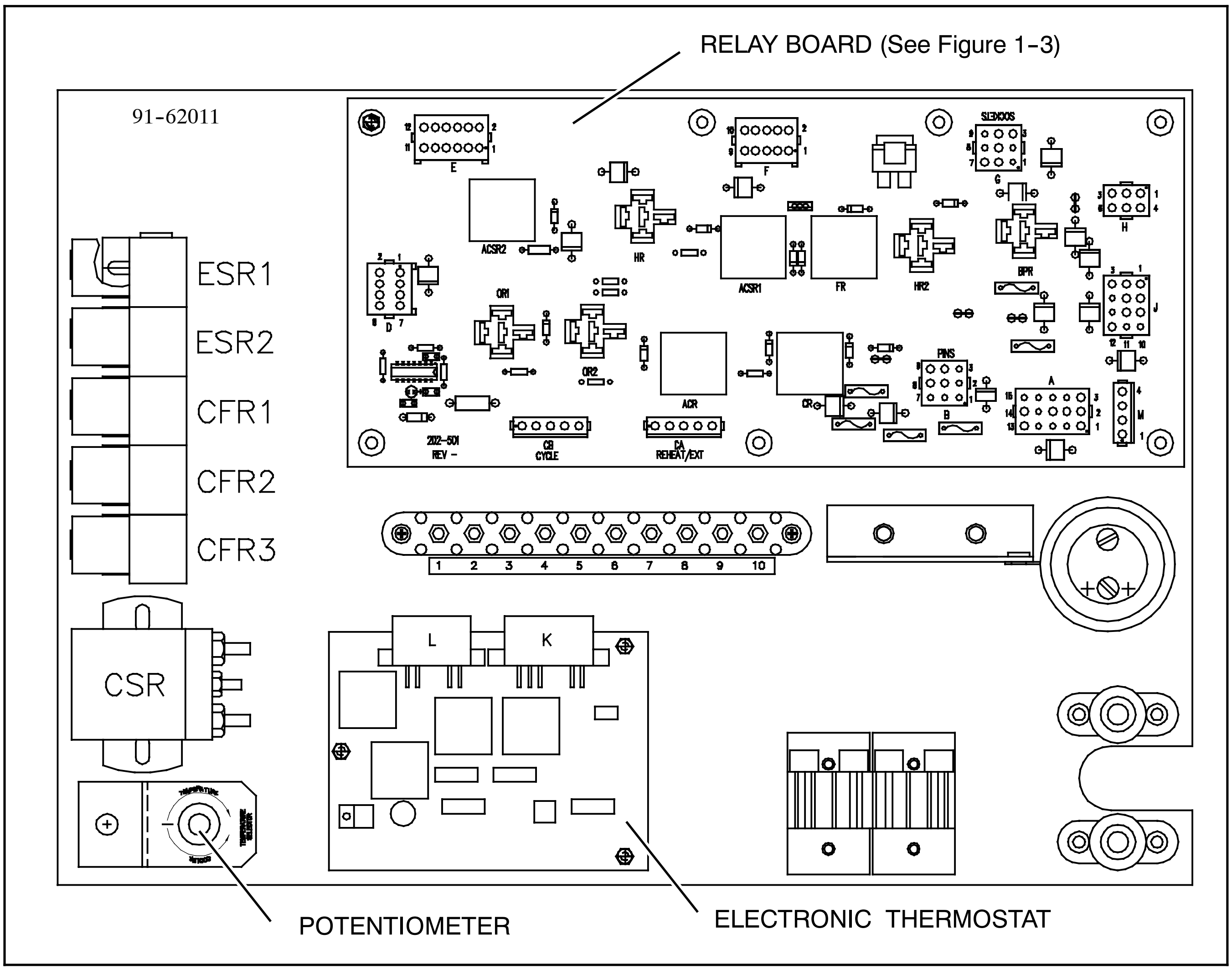


Figure 1-2 Panel Assembly, Control Box, Electronic T-Stat

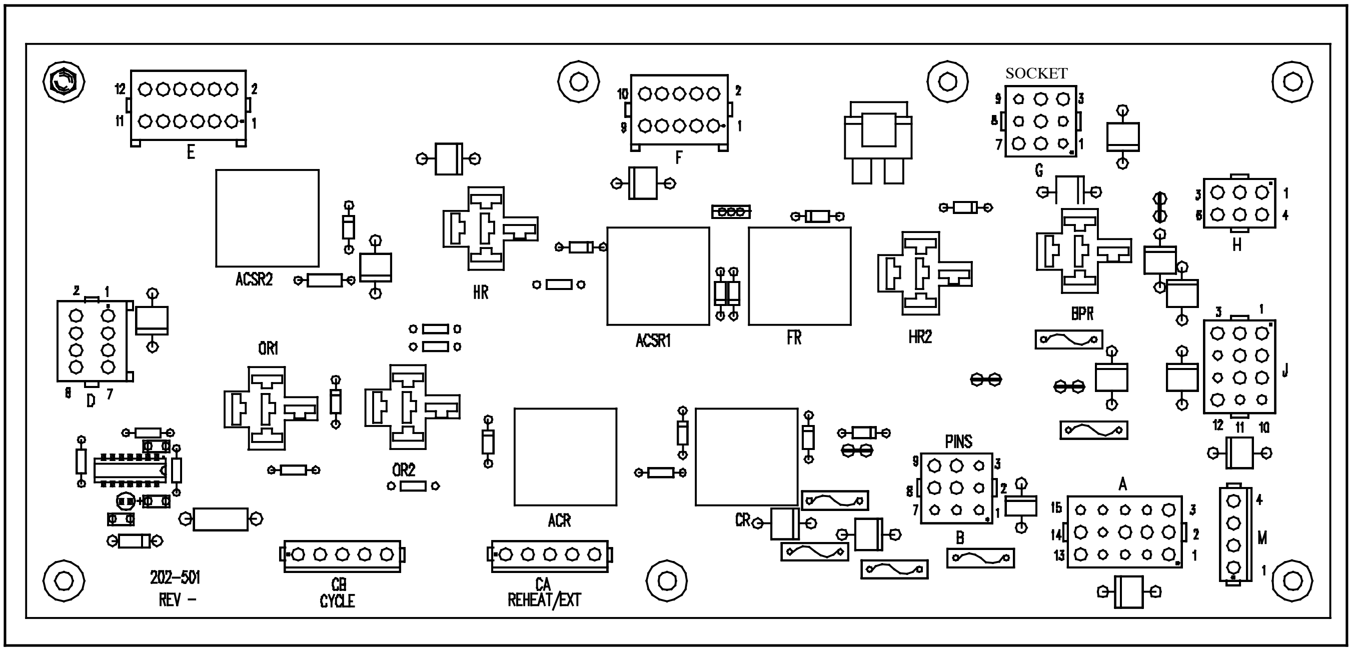


Figure 1-3 Relay Board, Electronic T-Stat

1.4 SYSTEM OPERATING CONTROLS AND COMPONENTS (EnviroMATE)

1.4.1 EnviroMATE Controller

The system is equipped with a digital EnviroMATE controller which operates in combination with a separate relay panel (See Figure 1-4) to control the operation of the system.

The setpoint is adjusted by pressing the UP or DOWN arrow keys to desired temperature.

The return air sensor monitors the vehicles interior temperature at the return air section of the evaporator and controls the operating function of the system to maintain the desired vehicle interior temperature.

The pressure transducers monitor system pressures and control components for system capacity control and safety.

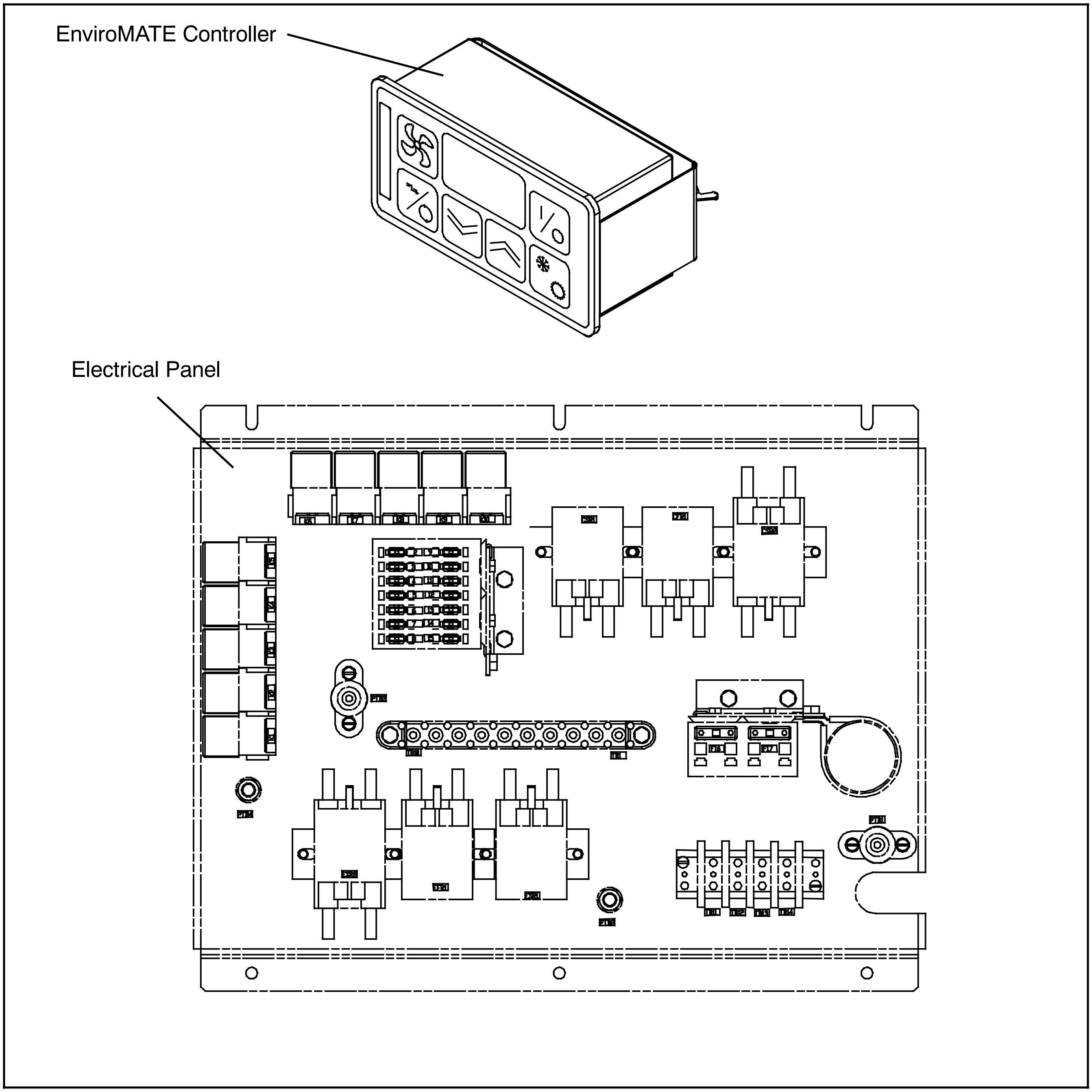


Figure 1-4 Panel Assembly, Control Box, EnviroMATE

1.5 SAFETY DEVICES

System components are protected from damage caused by unsafe operating conditions with safety devices listed in Table 1-4.

During A/C mode, operation will automatically stop if the High Pressure Switch (HPS) or Low Pressure Switch (LPS) contacts open due to an unsafe operating condition. Opening the High Pressure Switch (HPS) or Low Pressure Switch (LPS) contacts de-energizes the A/C compressor clutch. The A/C Stop Light will also illuminate indicating that an unsafe operating condition has occurred. The unit will then operate in VENT Mode.

The system circuits are protected independently against high current draw with fuses. Refer to the schematic diagram in Section 5 for fuse locations.

When a safety device opens and causes the unit operation to stop, place the climate control switch to off position before resolving the problem. The safety device may need to be replaced before restarting the unit.

The ambient temperature sensor located in the condenser section measures the condenser inlet air temperature. When the temperature has fallen below the cut out set point the compressor is locked out until the temperature rises above the cut in setting. The set point will be to cut out at 50°F ± 3° and cut in at 60°F ± 3°. This setting protects the compressor from damage caused by operation in low ambient conditions.

Table 1-4 Safety Devices (Electronic T-Stat Models)

UNSAFE CONDITION	SAFETY DEVICE	DEVICE SETTING
Excessive current draw by system	Main Power Fuse	Opens at 150 amps
Excessive current draw by the control circuit	Fuse 2 & 4	Opens at 15 amps
Excessive current draw by the clutch coil or fault circuit	Fuse 5	Opens at 15 amps
Excessive current draw by any condenser motors no. 1 thru 4 (DC12174) or 5 (DC12175)	Fuses 6 thru 10	Opens at 15 amps
Excessive current draw by the ACMS or control circuit	Fuse 11	Opens at 15 amps
Excessive current draw by evaporator motor no. 1.	Fuse 12	Opens at 40 amps
Excessive current draw by evaporator motor no. 2.	Fuse 13	Opens at 40 amps
Excessive current draw by the condenser unit	Fuse 14	Opens at 60 amps
High system pressure	High Pressure Switch (HPS) Automatic Reset	Opens at 360 ± 10 psig (23.81 ± 0.68bar Closes at 285± 10 psig (13.61 ± 0.68bar)
Low system pressure	Low Pressure Switch (LPS) Automatic Reset	Opens at 6 ± 3 psig(0.41 ± 0.20 bar Closes at 25 ± 5 psig(1.7 ± 0.20 bar)

Table 1-5 Safety Devices (EnviroMATE Models)

UNSAFE CONDITION	SAFETY DEVICE	DEVICE SETTING
Excessive current draw by system	Fuse 1	Opens at 150 amps
Excessive current draw by the condenser control circuit	Fuses 2 & 3	Opens at 5 amps
Excessive current draw by the clutch coil or fault circuit	Fuse 4	Opens at 5 amps
Excessive current draw by Evaporator control circuit	Fuses 5 & 6	Opens at 5 amps
Excessive current draw by the Unloaders 1 & 2	Fuses 7 & 8	Opens at 5 amps
Excessive current draw by evaporator motor no. 1.	Fuse 16	Opens at 40 amps
Excessive current draw by evaporator motor no. 2.	Fuse 17	Opens at 40 amps
Excessive current draw by the condenser motor 1	Fuse 11	Opens at 15 amps
Excessive current draw by the condenser motor 2	Fuse 12	Opens at 15 amps
Excessive current draw by the condenser motor 3	Fuse 13	Opens at 15 amps
Excessive current draw by the condenser motor 4	Fuse 14	Opens at 15 amps
Excessive current draw by the Heat solenoid valve	Fuse 9	Opens at 5 amps
Excessive current draw by the Boost pump	Fuse 10	Opens at 15 amps
Excessive current draw by the OEM ignition circuit to alternator	Fuse 15	Opens at 20 amps
Excessive current draw (noise suppression) to Enviormate controller	Fuse 18	Opens at 3 amps
Excessive current draw (noise suppression) to Enviormate controller	Fuse 19	Opens at 2 amps
High system pressure	High Pressure Switch (HPS) Automatic Reset	Opens at 360 ± 10 psig (23.81 ±0.68bar Closes at 285± 10 psig (13.61 ±0.68bar)
Low system pressure	Low Pressure Switch (LPS) Automatic Reset	Opens at 6 ± 3 psig(0.41 ±0.20 bar Closes at 25 ± 5 psig(1.7 ±0.20 bar)

1.6 ELECTRICAL SPECIFICATIONS - EVAPORATOR (EM-17) MOTOR

Permanent Magnet Motor

Bearing Lubrication: Factory Lubricated
(additional grease not required)

Horsepower: 0.75
Full Load Amps (FLA): 27 amps
Operating Speed: 1800 rpm
Voltage: 24 vdc

1.7 ELECTRICAL SPECIFICATIONS - CONDENSER (CM-5) FAN MOTORS

Permanent Magnet Motor

Bearing Lubrication: Factory Lubricated
(additional grease not required)

Horsepower: 0.8 hp
Full Load Amps (FLA): 21/32 amps
Operating Speed: 1600/1800 rpm
Voltage: 24 vdc

1.7.1 CONDENSER FAN MOTOR KR-4

Permanent Magnet Motor

Bearing Lubrication: Factory Lubricated
(additional grease not required)

Horsepower: 0.8 hp
Full Load Amps (FLA): 21/32 amps
Operating Speed: 1600/1800 rpm
Voltage: 24 vdc

1.8 ELECTRICAL SPECIFICATIONS SENSORS

a. Temperature Sensors

Input Range: 52.6 to 158°F (47 to 70°C)
Output: NTC 10K ohms at 77°F (25°C)

1.9 AIR CONDITIONING REFRIGERATION CYCLE

When air conditioning (cooling) is selected by the thermostat, the unit operates as a vapor compression system using R-134a as the refrigerant (See Figure 1-5 OR Figure 1-6). The main components of the system are the reciprocating compressor, air-cooled condenser coils, receiver, filter-drier, thermostatic expansion valve, liquid line solenoid valve and evaporator coils.

The compressor raises the pressure and the temperature of the refrigerant and forces it through the discharge check valve 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 condense, thus liquid refrigerant leaves the condenser and flows to the receiver.

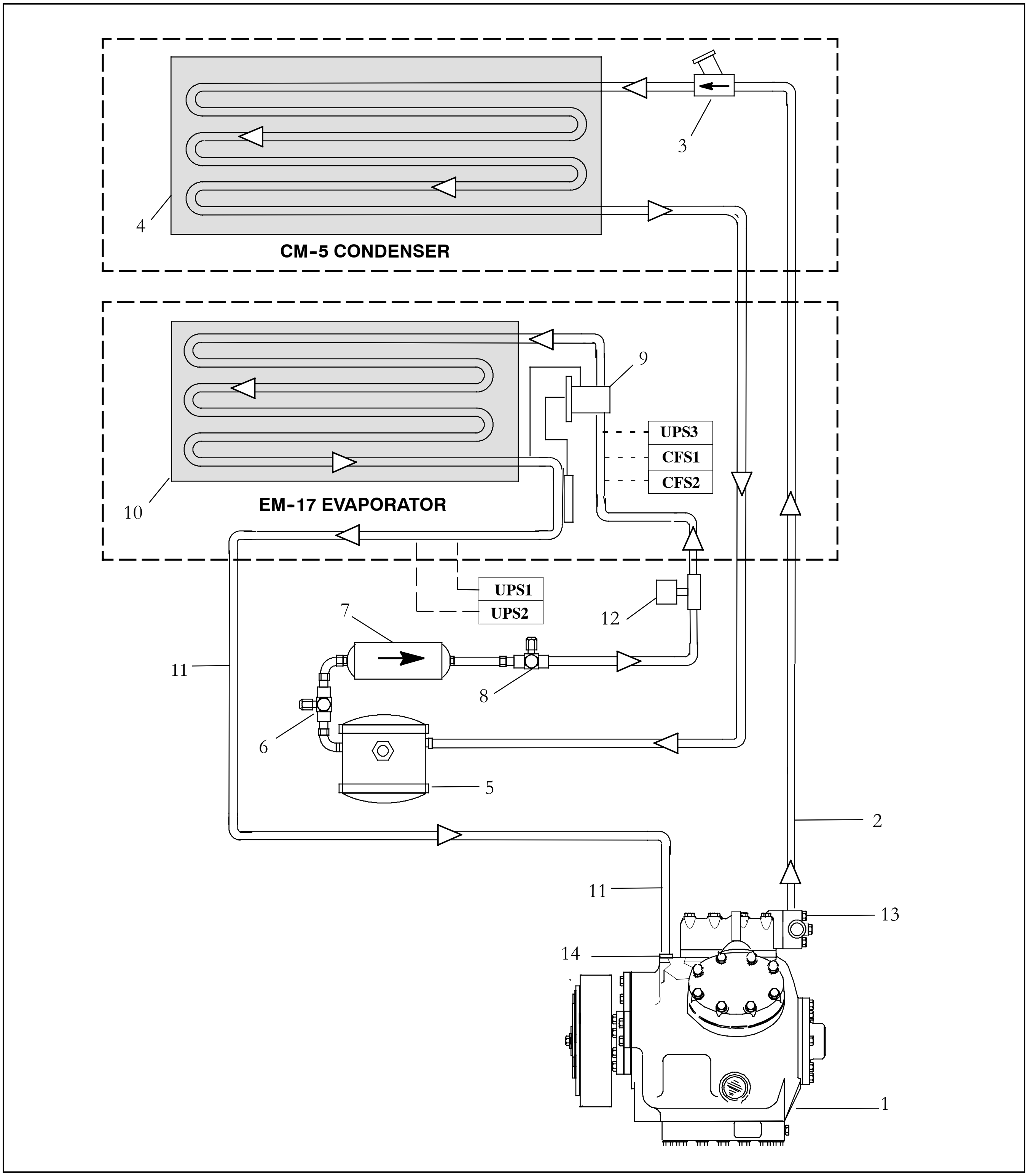
The receiver serves as a liquid refrigerant reservoir so that a constant supply of liquid is available to the evaporator as needed, and acts as a storage space when pumping down the system.

The refrigerant leaves the receiver and flows through the filter-drier where an absorbent keeps the refrigerant clean and dry. The liquid line may be equipped with a sight glass to observe the refrigerant for restricted flow and the correct charge level.

From the filter-drier, the liquid refrigerant then flows through the liquid line solenoid valve towards the thermostatic expansion valve. For the CM-5 condenser this flow is a direct path. For the KR-4 condenser, the refrigerant also passes through a subcooling circuit in the leaving condenser. The thermal expansion valve reduces pressure and temperature of the liquid and meters the flow of liquid (saturated mix) refrigerant to the evaporator to obtain maximum use of the evaporator heat transfer surface.

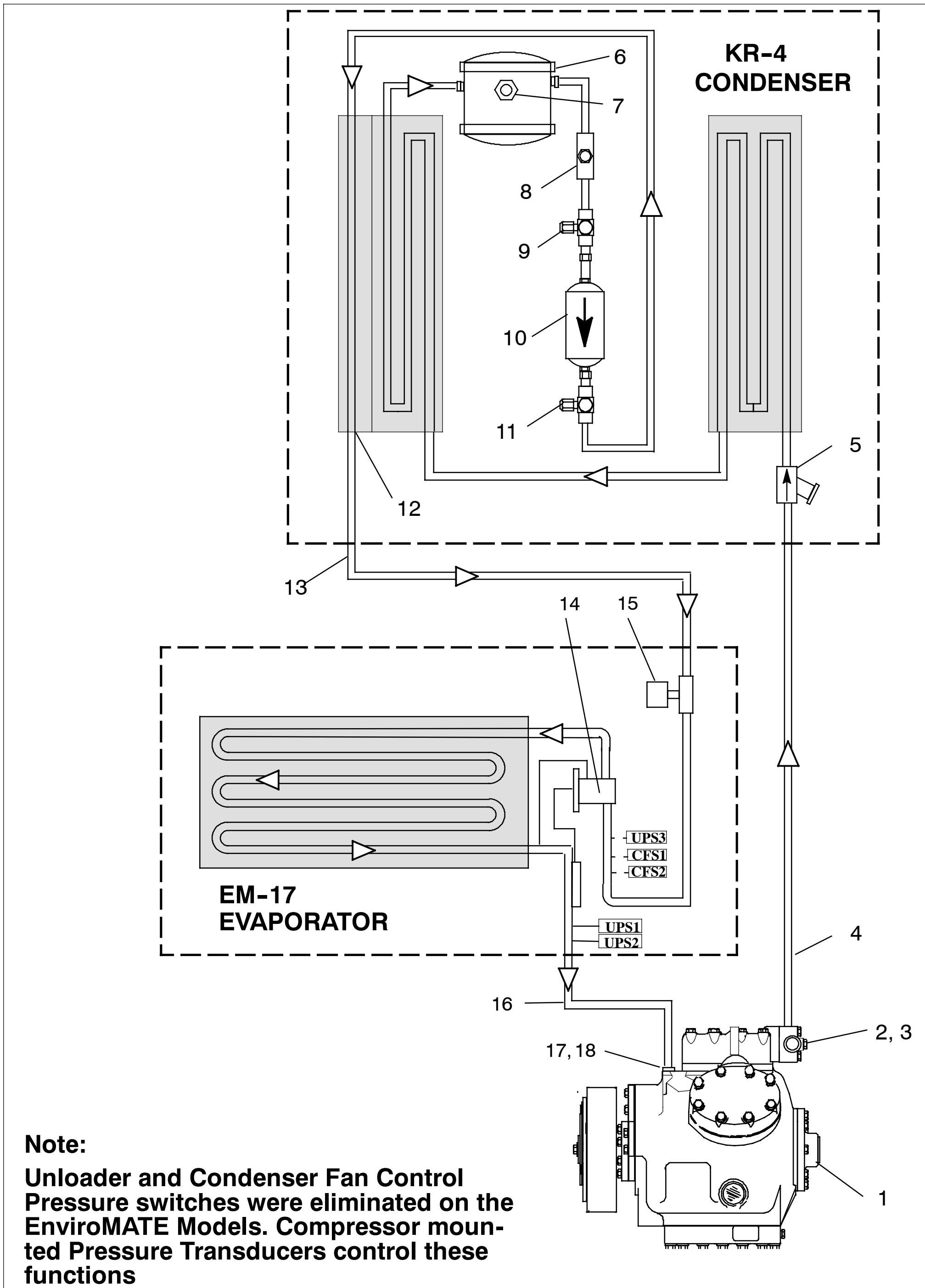
The low pressure, low temperature liquid (saturated mix) that flows into the evaporator tubes is colder than the air that is circulated over the evaporator tubes by the evaporator fans. Heat transfer is established from the evaporator air (flowing over the tubes) to the refrigerant (flowing inside the tubes). The evaporator tubes have aluminum fins to increase heat transfer from the air to the refrigerant; therefore the cooler air is circulated to the interior of the vehicle. Liquid line solenoid valve closes during shutdown to prevent refrigerant migration to the compressor.

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 passes through the suction line and returns to the compressor where the cycle repeats.



1	Compressor	8	Filter-Drier Outlet Valve
2	Discharge Line	9	Thermostatic Expansion Valve
3	Discharge Line Check Valve	10	Evaporator Coil
4	Condenser Coil	11	Suction Line
5	Receiver	12	Liquid Line Solenoid Valve (LSV)
6	Filter-Drier Inlet Valve	13	Discharge Service Port
7	Filter-Drier	14	Suction Service Port

Figure 1-5 Refrigerant Flow Diagram (DC12175)



Note:

Unloader and Condenser Fan Control Pressure switches were eliminated on the EnviroMATE Models. Compressor mounted Pressure Transducers control these functions

1. Compressor
2. Discharge Service Port
3. High Pressure Switch
4. Discharge Line
5. Discharge Check Valve
6. Receiver
7. Fusible Plug
8. Sight Galss
9. Filter Drier Inlet Valve
10. Filter Drier
11. Filter Drier Outlet Valve
12. Subcooler
13. Liquid Line
14. Liquid Line Solenoid Valve (LSV)
15. Thermostatic Expansion Valve
16. Suction Line
17. Suction Service Port
18. Low Pressure Switch

Figure 1-6 Refrigerant Flow Diagram DC12174

SECTION 2

OPERATION

2.1 STARTING ANDSTOPPING INSTRUCTIONS (Electronic T-Stat Contorller)

2.1.1 Starting

A Start the vehicle engine. The evaporator (interior) fans will start as soon as power is available from the vehicle electrical system.

B The drivers control is equipped with a single HIGH-OFF-LOW switch. The switch is placed in the desired fan speed position to start temperature control. Operation of the system is controlled automatically by an electronic thermostat which maintains the vehicles interior temperature at the desired set point.

2.1.2 Stopping

NOTE

It is good practice to turn off the air conditioning system before stopping the vehicle engine.

Placing the A/C Mode Switch in the OFF position will stop the system operation.

2.2 PRE-TRIP-INSPECTION

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

A Listen for abnormal noises in compressor or fan motors.

B Check compressor oil level. Refer to paragraph 4.15.3

C Check refrigerant charge. Refer to paragraph 4.7.1

2.3 UNIT OPERATION

The unit has a temperature controlling Electronic Thermostat (TH), which in combination with a separate relay board, will control the vehicle's interior temperature in a clutch cycle mode.

The unit control circuits and components operate on 24 VDC supplied by the vehicle battery or alternator.

2.3.1 Temperature Control

Temperature is controlled by maintaining the temperature of the air measured at the return air grille. Modes of operation include: Cooling and Vent.

2.3.2 Cooling Mode

Cooling is accomplished by energizing the compressor and condenser fans and opening the liquid line solenoid valve. Once interior temperature reaches the desired set point, the thermostat will de-energize the compressor clutch and allow the system to operate in the vent mode until further cooling is required.

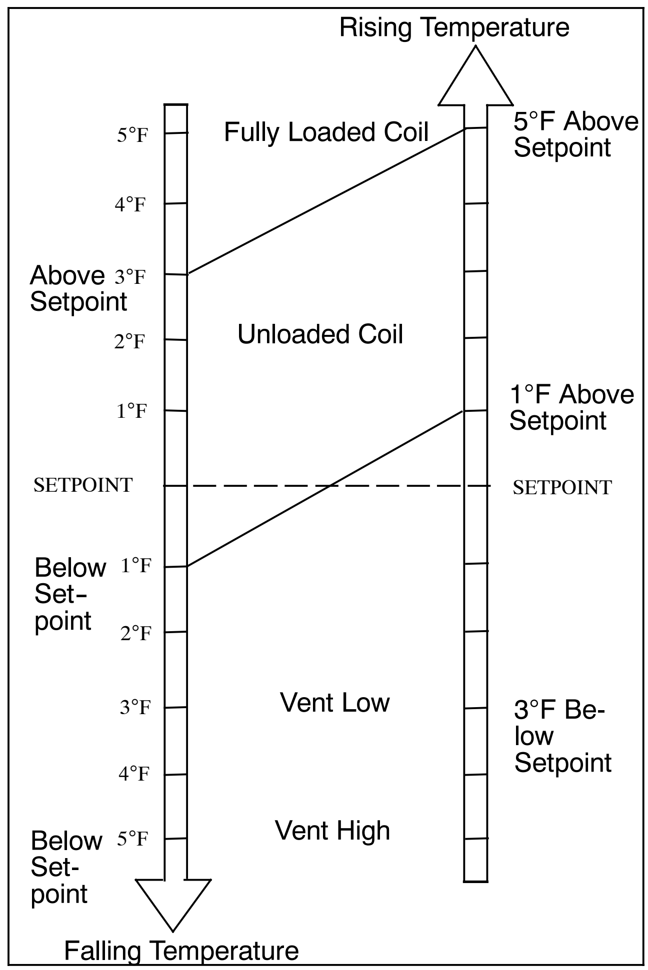


Figure 2-1 Thermostat Control Sequence

2.3.3 Vent Mode

In the vent mode the evaporator fans are operated to circulate air in the bus interior.

2.3.4 Compressor Unloader Control

When operating in cooling, the unloaders are used to reduce system capacity as return air temperature approaches set point. Operation of the unloaders balances system capacity with the load and thereby prevents overshoot from set point.

Relay Board mounted unloader outputs control the capacity of the compressor by energizing or de-energizing unloader solenoid valves. The model 05K has two banks of two cylinders each while the model 05G compressor has three banks of two cylinders each. Energizing a valve de-activates a bank of cylinders. The 05K right cylinder bank (looking at the pump end) and the outboard cylinder banks of the 05G are equipped with unloader valves (UV1 and, for the 05G, UV2), each controlling two cylinders; this allows the 05K to be operated with two or four cylinders and the 05G to be operated with two, four or six cylinders.

A Temperature Control

The unloaders operate as follows for temperature control:

1 Compressor Unloader UV1. When return air temperature falls to less than 2°F (1.1°C) above set point unloader UV1 is energized. If temperature rises to greater than 3°F (1.7°C) above set point, UV1 will be de-energized to place the compressor at 100% capacity.

2 Compressor Unloader UV2. When return air temperature falls to less than 1°F (0.6°C) above set point unloader UV2 is energized. If temperature rises to greater than 2°F (1.1°C) above set point, UV2 will be de-energized to place the compressor at 66% capacity.

B Suction Pressure

The unloaders are used to control suction pressure and thereby prevent coil frosting:

1 Compressor Unloader UV1. When the suction pressure decreases below 26 psig (1.77 bar), unloader UV1 is energized unloading a cylinder bank (two cylinders); this output will remain energized until the pressure increases to above 34 psig (2.31 bar).

2 Compressor Unloader UV2. When suction pressure decreases below 23 psig (1.56 bar) unloader UV2 is energized unloading the second compressor cylinder bank; this output will remain energized until the pressure increases to above 31 psig (2.11 bar).

C Discharge Pressure

Discharge pressure is also controlled by the unloaders:

1 Compressor Unloader UV2. When the discharge pressure increases above 320 psig, unloader UV2 is energized; this output will remain energized until the pressure decreases below 250 psig.

2.3.5 Condenser Fan Control

The condenser fans are energized when the compressor clutch output is energized. The fans are started in low speed and will remain in low speed until the discharge pressure increases to 275 psig (R-134a). The fans will remain in high speed until discharge pressure decreases below 220 psig (R-134a).

2.3.6 Compressor Clutch Control

A belt driven electric clutch is employed to transmit engine power to the air conditioning compressor. De-energizing the clutch electric coil disengages the clutch and removes power from the compressor. The clutch will be engaged when in cooling and disengaged when the system is off, vent, or during high and low pressure conditions.

The clutch coil is prevented from engagement when the ambient temperature is below ambient lockout setpoint.

The clutch coil will be de-energized if the discharge pressure rises to the cutout setting of the compressor mounted high pressure switch. The clutch coil will energize when the discharge pressure falls to the reset point of the compressor mounted high pressure switch.

2.3.7 Liquid Line Solenoid Control

The liquid line solenoid is energized (open) when the compressor clutch is energized and de-energized (closed) when the clutch is not.

2.4 SEQUENCE OF OPERATION

Operation begins when the A/C mode switch (ACMS) is placed in the HIGH or LOW position. This provides:

- a signal the vehicle to apply 24V power from the vehicle alternator to the ALT+ terminal (Refer to wiring schematic, Section 5.)
- energizes the power relay (PWRR) to provide power to the speed contacts of the ACMS, power to energize the A/C relay (ACR) and power to the thermostat.

If the ACMS is in the LOW speed position, power flows through evaporator fan motor EM1, the evaporator speed relay ESR1 normally closed contacts and evaporator fan motor EM2 to energize the fans in series (low speed).

If the ACMS is in the HIGH position, ESR1 & ESR2 are both energized. With these relays energized, power flows through EM1 and the ESR1 normally open contact (now closed) direct to ground and through the ESR2 evaporator fan relay contact (now closed) and EM2 direct to ground, placing both fans in high speed.

With the evaporator fans in operation, the system is in the VENT mode.

Before the system can enter the COOL mode, the high pressure switch (HPS) and low pressure switch (LPS) must be closed. With these switches closed, the fault relay (FR) is energized. Energizing FR closes a set of normally open contacts to allow a potential circuit to the clutch (CL) and opens a set of normally closed contacts to the AC stop relays ACR1 & ACR2 and STOP light. Also, the ambient temperature must be sufficiently high enough to close the low ambient temperature thermostat (LATH).

If the thermostat is calling for cooling, power flows through the normally open ACR contacts (previously closed) and LATH (or jumper) and the following sequence occurs:

- If condenser fan speed switch CFS2 is closed, the condenser speed relay (CSR) is energized and power for the fans flows through its normally open contact (now closed) to place the fans in high speed. If condenser fan speed switch CFS2 is open, CSR is de-energized and power for the fans flows through a resistor (RES) to place the fans in low speed.
- condenser fan relay CFR1 is energized. Energizing CFR1 provides power to two condenser fan motors (CF)
- if CFS1 is closed, relays CFR2 & CFR3 are energized. Energizing CFR2 & CFR3 provides power to two (DC12174) or three (DC12175) additional condenser fan motors
- the liquid line solenooid valve (LLS) is energized
- the clutch relay (CR) is energized. Energizing relay CR closes a set of contacts to energize the compressor clutch.

The system is now operating in the COOL mode. The thermostat will open and close (energizing and de-energizing) the compressor, condenser fans and LLS as required to maintain desired temperature.

Once the temperature approaches set point, the thermostat will call for the system to unload. With the thermostat calling for unloading, unloader valve UV1 is energized. Energizing UV1 energizes one bank of compressor cylinder unloading. UV1 may also be energized if compressor suction pressure rises to the closing point of unloader pressure switch UPS1.

If discharge pressure rises to the set point of UPS3 or suction pressure falls to the set point of UPS2 unloader valve UV2 is energized. Energizing UV2 energizes one (or one additional) bank of compressor cylinder unloading.

If either HPS or LPS open, relay FR is de-energized. De-energizing FR opens a set of contacts to de-energize the compressor clutch and closes a set of contacts to energize A/C stop relays ACSR1 & ACSR2. Energizing ACSR2 energizes the AC STOP light and sets up a holding circuit while energizing ACSR1 opens an additional set of contacts in the compressor clutch power line. The holding circuit will not be broken until power is removed by placing the ACMS or main vehicle power switch in the OFF position.

2.5 STARTING ANDSTOPPING INSTRUCTIONS (EnviroMATE Contorller)

2.5.1 EnviroMATE Controller

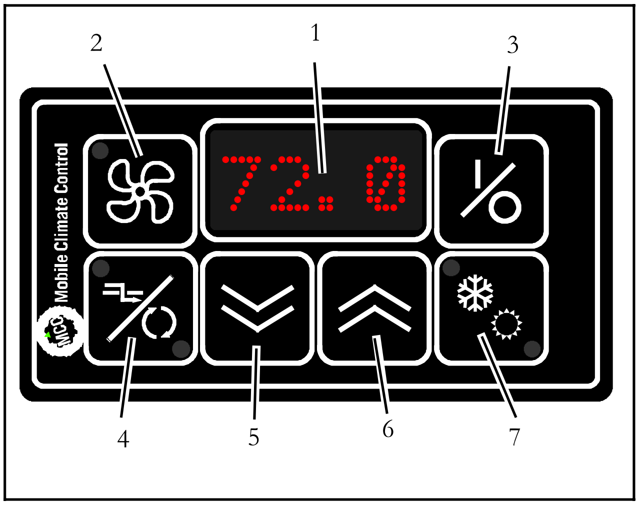


Figure 2-2 EnviroMATE Control Panel

1 Display
2 Vent Key
3 On/Off Key
4 Fresh Air Damper Key
5 Decrease Selection Key
6 Increase Selection Key
7 Auto/Off Key (Cool vs. Heat Indicators)

The Control Panel consist of the main CPU and keypad to control the air conditioning system operation. It is equipped with a numerical display to view operation status, fan speed and temperatures.

The Controller is designed to automatically operate system components to maintain desired temperature set point.

NOTE

Controller parameters are factory set, and cannot be modified without factory authorization. If necessary, contact MCC's Technical Service Hot Line for assistance (800-450-2211) .

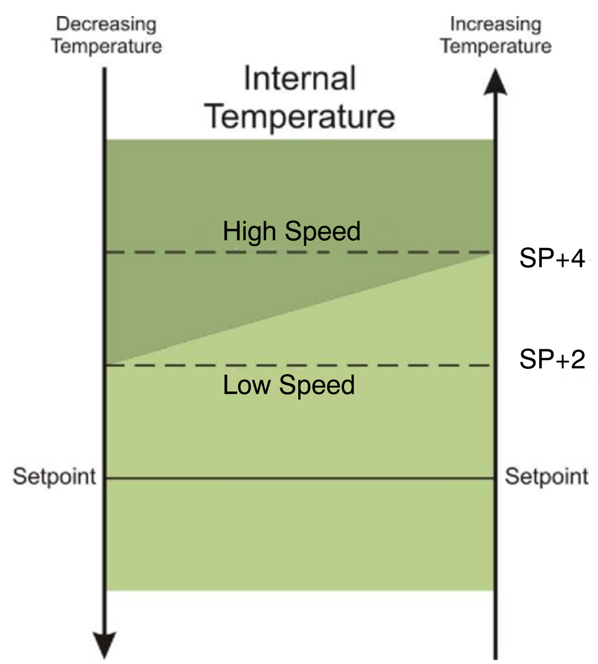
2.5.2 Controller Operation

Once the EnviroMATE controller is powered, the system can be turned On or Off using the On/Off key (Item 3 in Figure 2-2). When the display is powered On, the controller will go through self test mode, and then the current set point will be displayed. The controller has 3 operating modes, Auto, Indoor Fan only and Off. To adjust the temperature set point up or down, use the Increase/Decrease selection keys (Items 5 and 6 in Figure 2-2). Temperature set point can be set from 64°F to 82°F (17.8°C to 27.8°C)

The controller is equipped with two temperature sensors to monitor the evaporator return air temperature, and the outside air temperature. To view the return air temperature, press and hold the Increase Selection Key for 3 seconds (Item 6 in Figure 2-2) . To view the outside air temperature, press and hold the Decrease Selection Key (Item 5 in Figure 2-2).

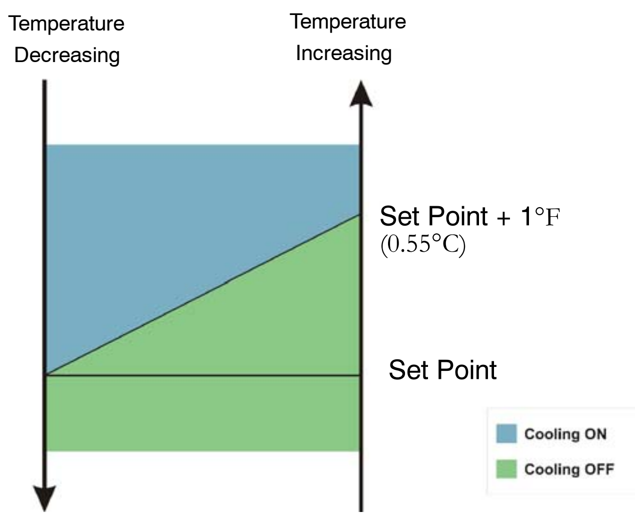
2.5.3 Evaporator Fan Operation

Evaporator fan speeds are controlled automatically according to the chart shown below. There are 2 fan speeds controlled by relays mounted to an auxiliary electrical panel.



2.5.4 Cooling Mode

When Cooling Mode is selected, the controller will check the Outside Air temperature. If the Outside Air temperature is below 45°F (7.2°C), the compressor function will be disabled. If Outside Air temperature is above 45°F (7.2°C), and the Return Air temperature is above the set point, the compressor will be energized by providing an output voltage from **Pin 6** of controller to enable cooling . The chart below shows the temperature control of the compressor operation.



The controller will constantly monitor the low and high pressure switches to protect system components by monitoring voltage on **Pin 13** of controller from the compressor clutch relay output.. If the freeze up thermostat, or low pressure switch circuit opens, the controller will de-energize the compressor clutch relay, and the condenser fan relay for a minimum time of 1 minute, or until the open circuit closes. If the high pressure switch circuit opens, the controller will de-energize the compressor clutch relay, and the condenser fan relay will remain energized to lower system pressure. The compressor relay will remain open for a minimum time of 1 minute, or until high pressure switch circuit closes.

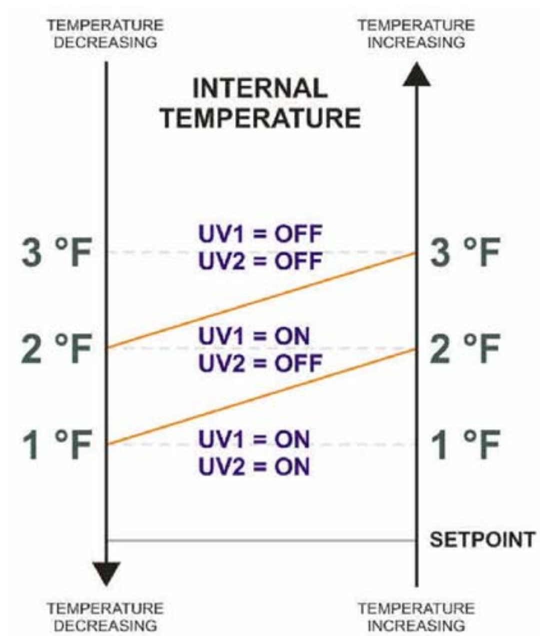
If a low or high pressure condition occurs, an alarm will be generated and **HA** shown on the display. If either condition occurs 3 times within 30 minutes, the cooling circuit will be disabled until controller power is cycled and an alarm **LC** is shown on the display. Evaporator fans will remain energized to provide ventilation.

2.5.5 Compressor Capacity Control , Unloaders

The model 05G compressor has three banks of two cylinders each. Energizing a valve de-activates a bank of cylinders. The outboard cylinder banks of the 05G are equipped with unloader valves (UV1 and UV2), each controlling two cylinders; this allows the 05G to be operated with two, four or six cylinders. Unloading sequence can be done according to temperature, or pressures.

A) Temperature

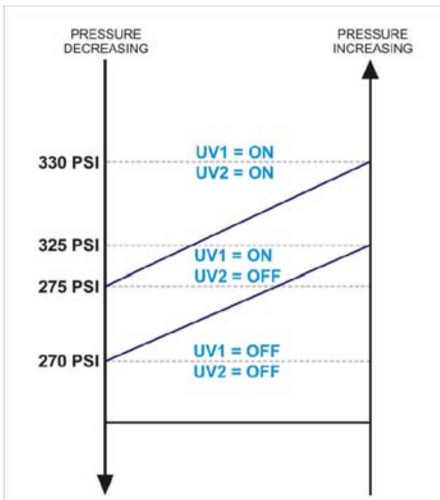
Below is a chart showing how capacity control of the compressor is performed by loading and unloading the electric unloaders.



B) Pressures

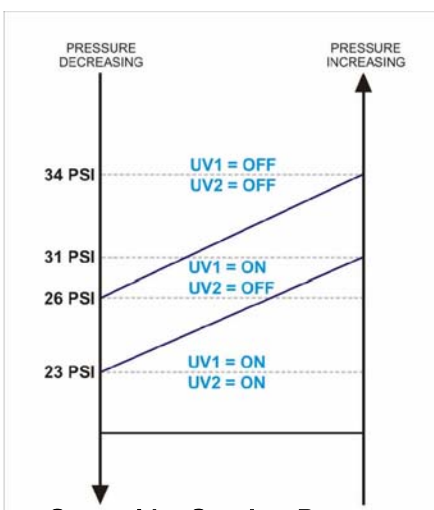
Below are a charts showing how capacity control of the compressor is performed by loading and unloading the electric unloaders according to discharge or suction pressures.

If system discharge pressures rise too high, the compressor will unload to keep system pressures in a safe range.



Control by Discharge Pressure

If system suction pressures fall too low, the compressor will unload to keep system pressures high enough to avoid a potential of the evaporator coil icing.



Control by Suction Pressure

2.5.6 Heating Mode (If equipped)

The EnviroMATE Controller has the ability to control output to a heat control valve and boost pump (OEM supplied), to supply heat provided by the engine coolant system. Heat is selected automatically by the controller according to selected set point. If the interior temperature is more than 1°F below set point, the controller will open a coolant heat valve to allow engine coolant flow to the heater coil until temperature rises to set point.

2.5.7 Sensors

The EnviroMATE Controller constantly monitors the Return Air (Controller **Pins 15 & 11**) and Outside Air sensors (Controller **Pins 3 & 7**). In the event the sensor or related wiring causes an Open or Shorted condition, the controller will default that particular sensor value to 72°F (22.2°C). An alarm will be generated and either **F1** or **F2** will be shown on the display screen.

2.5.8 Voltage

The EnviroMATE Controller monitors the voltages being supplied by the OEM by fused circuits on **Pins 1 & 9** at the controller. In the event of a low voltage (below 10 VDC), or an alternator failure, the system will be disabled, and an alarm **bL** or **AL** will be shown on the display.

2.5.9 Schematics

Typical system schematic for an EnviroMATE single loop system can be found in Section 5, Figure 5-3.

2.5.10 Alarm Descriptions

FAILURE	DESCRIPTION
HA	Pressure switch failure
F1	Internal temperature sensor failure
F2	External temperature sensor failure
bL	Battery lower 10 VDC failure
AL	Alternator failure
LC	3 Pressure switch failures (HA) in 30 min.
Pd	Discharge pressure failure
Ps	Suction pressure failure

Figure 2-1 EnviroMATE Alarms (Single Zone)

2.5.11 Stopping

NOTE

It is good practice to turn off the air conditioning system before stopping the vehicle engine.

Pressing the I/O Key will stop the system operation.

2.6 PRE-TRIP-INSPECTION

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

A Listen for abnormal noises in compressor or fan motors.

B Check compressor oil level (Refer to section 4.15.3).

C Check refrigerant charge (Refer to section 4.7.1)

2.6.1 Condenser Fan Control

The condenser fans are energized when the compressor clutch output is energized. The fans are started in low speed and will remain in low speed until the discharge pressure increases to 190 psig (R-134a). The fans will remain in high speed until discharge pressure decreases below 135 psig (R-134a). Once the minimum run time has been satisfied, if the discharge pressure remains below 86 psig (R-134a) for a period of 1 minute, the condenser and clutch will be de-energized and an alarm LP will be generated.

2.6.2 Compressor Clutch Control

A belt driven electric clutch is employed to transmit engine power to the air conditioning compressor. De-energizing the clutch electric coil disengages the clutch and removes power from the compressor. The clutch will be engaged when in cooling and disengaged when the system is off, vent, or during high and low pressure conditions.

The clutch coil is prevented from engagement when the ambient temperature is below ambient lockout setpoint.

The clutch coil will be de-energized if the discharge pressure rises to the cutout setting of the compressor mounted high pressure switch. The clutch coil will energize when the discharge pressure falls to the reset point of the compressor mounted high pressure switch.

2.6.3 Liquid Line Solenoid Control

The liquid line solenoid is energized (open) when the compressor clutch is energized and de-energized (closed) when the clutch is not.

SECTION 3

TROUBLESHOOTING

Table 3-1 General System Troubleshooting Procedures

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.1 System Will Not Cool		
Compressor will not run	V-Belt loose or defective Clutch coil defective Clutch malfunction Compressor malfunction	Check Check/Replace Check/Replace See Table 1-2
Electrical malfunction	Coach power source defective Circuit Breaker/safety device open	Check/Repair Check/Reset
3.2 System Runs But Has Insufficient Cooling		
Compressor	V-Belt loose or defective Compressor valves defective	Check See Table 1-2
Refrigeration system	Abnormal pressures No or restricted evaporator air flow Expansion valve malfunction Restricted refrigerant flow Low refrigerant charge Service valves partially closed Safety device open Liquid solenoid valve stuck closed	3.3 3.6 3.7 4.11 4.7 Open 1.5 Check
Restricted air flow	No evaporator air flow or restriction	3.6
Heating system	Heat valve stuck open	3.8
3.3 Abnormal Pressures		
High discharge pressure	Refrigerant overcharge Noncondensable in system Condenser motor failure Condenser coil dirty	4.7.1 Check Check Clean
Low discharge pressure	Compressor valve(s) worn or broken Low refrigerant charge	See Table 1-2 4.7
High suction pressure	Compressor valve(s) worn or broken	See Table 1-2
Low suction pressure	Suction service valve partially closed Filter-drier inlet valve partially closed Filter-drier partially plugged Low refrigerant charge Expansion valve malfunction Restricted air flow	Open Check/Open 4.11 4.7 3.7 3.6
Suction and discharge pressures tend to equalize when system is operating	Compressor valve defective	See Table 1-2
3.4 Abnormal Noise Or Vibrations		
Compressor	Loose mounting hardware Worn bearings Worn or broken valves Liquid slugging Insufficient oil Clutch loose, rubbing or is defective V-belt cracked, worn or loose Dirt or debris on fan blades	Check/Tighten See Table 1-2 See Table 1-2 3.7 4.15.3 Check Check/Adjust Clean

Table 3-1 General System Troubleshooting Procedures - Continued

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.4 Abnormal Noise Or Vibrations - Continued		
Condenser or evaporator fans	Loose mounting hardware Defective bearings Blade interference Blade missing or broken	Check/Tighten Replace Check Check/Replace
3.5 Control System Malfunction		
Will not control	Sensor or Relay(s) defective	Check
3.6 No Evaporator Air Flow Or Restricted Air Flow		
Air flow through coil blocked	Coil frosted over Dirty coil Dirty filter	Defrost coil Clean Clean/Replace
No or partial evaporator air flow	Motor(s) defective Motor brushes defective Evaporator fan loose or defective Fan damaged Return air filter dirty Icing of coil Fan relay(s) defective Safety device open Fan rotation incorrect	Repair/Replace Replace Repair/Replace Repair/Replace Clean/Replace Clean/Defrost Check/Replace 1.5 Check
3.7 Expansion Valve Malfunction		
Low suction pressure with high superheat	Low refrigerant charge Wax, oil or dirt plugging valve orifice Ice formation at valve seat Power assembly failure Loss of bulb charge Broken capillary tube	4.7 Check 4.6 Replace Replace 4.13.2
Low superheat and liquid slugging in the compressor	Bulb is loose or not installed. Superheat setting too low Ice or other foreign material holding valve open	4.13.2 4.13.2
Side to side temperature difference (Warm Coil)	Wax, oil or dirt plugging valve orifice Ice formation at valve seat Power assembly failure Loss of bulb charge Broken capillary	Check 4.6 Replace Replace 4.13
3.8 Heating Malfunction		
Insufficient heating	Dirty or plugged heater core Coolant solenoid valve(s) malfunctioning or plugged Low coolant level Strainer(s) plugged Hand valve(s) closed Water pumps defective Auxiliary Heater malfunctioning.	Clean Check/Replace Check Clean Open Repair/Replace Repair/Replace
No Heating	Coolant solenoid valve(s) malfunctioning or plugged Controller malfunction Pump(s) malfunctioning Safety device open	Check/Replace Replace Repair/Replace 1.5
Continuous Heating	Coolant solenoid valve stuck open	Replace

SECTION 4

SERVICE

WARNING

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

WARNING

Beware of rotating fan blades and unannounced starting of fans or compressor.

WARNING

Read the entire procedure before beginning work. Park the vehicle on a level surface, with parking brake applied. Turn main electrical disconnect switch to the off position.

NOTE

To avoid damage to the earth's ozone layer, use a refrigerant recovery system whenever removing refrigerant. When working with refrigerants you must comply with all local government environmental laws.

4.1 MAINTENANCE SCHEDULE

SYSTEM		SYSTEM	REFERENCE SECTION
ON	OFF		
a. Weekly Maintenance			
X		Pre-trip Inspection - after starting	2.2
	X	Check tension and condition of V-belt	None
b. Monthly Inspection			
	X	Perform daily inspection	See above
	X	Check condenser, evaporator coils and return air filters for cleanliness	None
	X	Check refrigerant hoses and compressor shaft seal for leaks	4.5
X		Feel filter-drier for excessive temperature drop across drier	4.11
c. Annual Inspection and Maintenance			
	X	Perform weekly inspection and maintenance	See above
	X	Clean evaporator drain pans and hoses	None
	X	Check wire harnesses for chafing and loose terminals	Replace/Tighten
	X	Check fan motor bearings	None
	X	Check compressor mounting bolts for tightness	None
	X	Check fan motor brushes	None
	X	Check and drain shaft seal reservoir, (05G Manual) If Applicable	62–11052 –Sec..3

4.2 SUCTION AND DISCHARGE SERVICE VALVES

The suction and discharge service valves (Figure 4-1) are provided with a double seat and a gauge port, which allows servicing of the compressor and refrigerant lines.

Turning the valve stem counterclockwise (all the way out) will *backseat* the valve to open the line to the compressor and close off the gauge port. In normal operation, the valve is backseated to allow full flow through the valve. The valve should always be backseated before removing the gauge port cap.

Turning the valve stem clockwise (all the way forward) will *frontseat* the valve to isolate the compressor line and open the gauge port.

To measure suction or discharge pressure, midseat the valve by opening the valve clockwise 1/4 to 1/2 turn. With the valve stem midway between frontseated and backseated positions, the suction or discharge gauge port is open to both the compressor and the line.

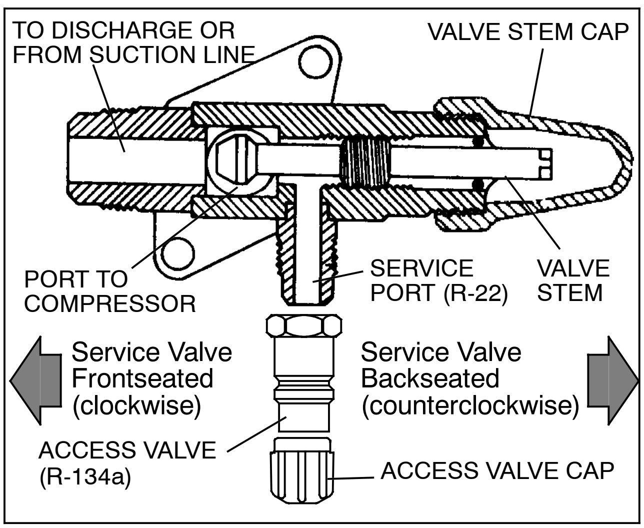


Figure 4-1 Suction or Discharge Service Valve

4.3 INSTALLING/ REMOVING MANIFOLD GAUGE SET

A manifold gauge set (Figure 4-2) can be used to determine system operating pressures, add charge, equalize or evacuate the system.

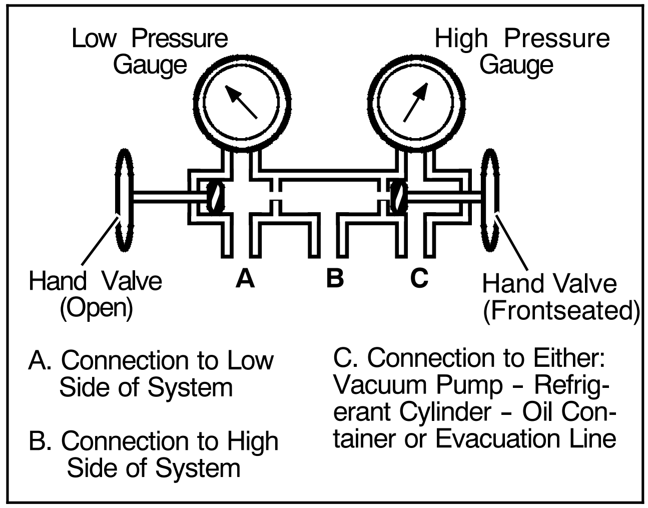


Figure 4-2 Manifold Gauge Set

When the suction pressure hand valve is front seated (turned all the way in), the suction (low) pressure can be read. When the discharge pressure hand valve is frontseated, discharge (high) pressure can be read. When both valves are open (turned counterclockwise), high pressure vapor will flow into the low side. When only the low pressure valve is open, the system can be charged or evacuated. To install a manifold gauge set, do the following (refer to Figure 4-4, Figure 4-5 or Figure 4-6 as applicable).

A R-134a manifold gauge/hose set with self-sealing hoses is required for service of models covered within this manual. To perform service using the manifold gauge/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. Back seat (turn counterclockwise) both field service couplers (see Figure 4-3) and midseat both hand valves.
3. Connect the yellow hose to a vacuum pump and an R-134a cylinder.
4. Evacuate to 10 inches of vacuum and then charge with R-134a to a slightly positive pressure of 1.0 psig.
5. Front seat both manifold gauge set hand valves and disconnect from cylinder. The gauge set is now ready for use.

b. Connecting Manifold Gauge/Hose Set

To connect the manifold gauge/hose set for reading pressures, do the following:

1. Remove service valve stem cap and check to make sure it is backseated. Remove access valve cap.
2. Connect the field service coupler (see Figure 4-3) to the access valve.
3. Turn the field service coupling knob clockwise, which will open the system to the gauge set.
4. Read system pressures.
5. Repeat the procedure to connect the other side of the gauge set.

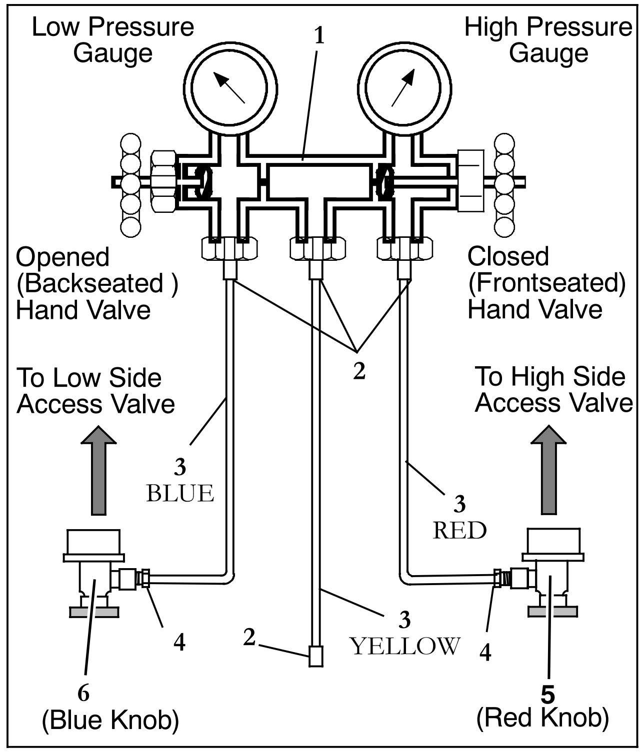
c. Removing the Manifold Gauge Set

1. While the compressor is still ON, backseat the high side service valve.
2. Midseat both hand valves on the manifold gauge set and allow the pressure in the manifold gauge set to be drawn down to low side pressure. This returns any liquid that may be in the high side hose to the system.

CAUTION

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

3. Backseat the low side service valve. Backseat both field service couplers and frontseat both manifold set hand valves. Remove the couplers from the access valves.
4. Install both service valve stem caps and access valve caps (finger-tight only).



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 Coupler
6. Low Side Field Service Coupler

Figure 4-3 Manifold Gauge Set (R-134a)

4.4 PUMPING THE SYSTEM DOWN OR REMOVING THE REFRIGERANT CHARGE

NOTE

To avoid damage to the earth's ozone layer, use a refrigerant recovery system whenever removing refrigerant.

4.4.1 System Pump Down For Low Side Repair

To service or replace the filter-drier, thermostatic expansion valve, suction line or liquid line solenoid valve, pump the refrigerant to the condenser and receiver as follows:

a. Install manifold gauge set to the filter-drier inlet service valve. Refer to Figure 4-4.

b. Frontseat the filter-drier inlet service valve by turning clockwise. Install a jumper on the compressor mounted low pressure switch. Unplug the suction transducer (if applicable).

c. Start the system and run in cooling. Stop the unit when suction reaches a slight vacuum (1-2 “/hg).

d. Frontseat the compressor suction service valve to trap refrigerant in the high side of the system between the compressor suction service valve and the filter-drier inlet valve. Wait 5 minutes to verify that system remains in a vacuum. If system pressure rises above a vacuum, open the compressor suction service valve and repeat steps c and d until the system remains in a vacuum.

e. Service or replace necessary components.

f. Leak check connections and replace filter-drier. Refer to paragraph 4.11.

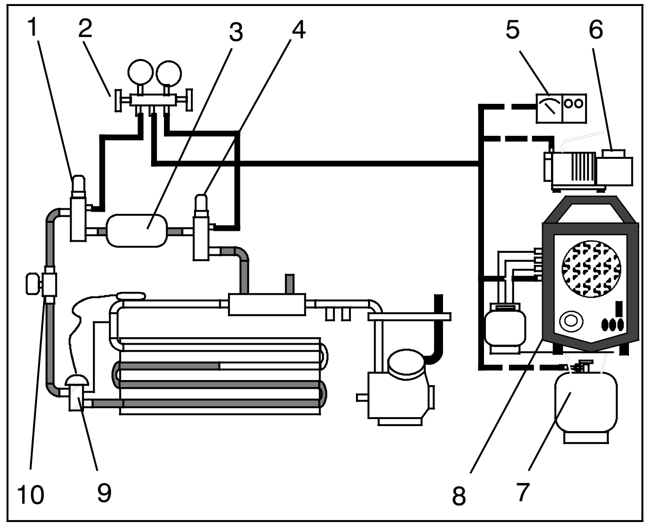
g. Energize the Liquid Line Solenoid Valve (LSV) using an external power source (24 VDC).

h. Using refrigerant hoses designed for vacuum service, evacuate and dehydrate the low side of the system by connecting a vacuum pump to the center connection of manifold gauge set. Evacuate system to 500 microns. Close off pump valve, isolate vacuum gauge and stop pump. Wait 5 minutes to verify that vacuum holds.

i. Recharge low side with R-134a to 20 to 30 PSIG by admitting vapor from the refrigerant cylinder.

j. Remove the low pressure switch jumper. Re-connect the suction transducer (if applicable).

k. Open service valves and check refrigerant level. Refer to paragraph 4.7.1.



1. Filter-Drier Outlet Service Valve
2. Manifold Gauge Set
3. Filter-Drier
4. Filter-Drier Inlet Service Valve
5. Thermistor Vacuum Gauge
6. Vacuum Pump
7. Refrigerant Cylinder
8. Reclaimer
9. Thermostatic Expansion Valve
10. Liquid Solenoid Valve

Figure 4-4 Low Side Pump Down Connections

4.4.2 Refrigerant Removal From An Inoperative Compressor.

To remove the refrigerant from a compressor that is not operational, do the following:

a. Attach a manifold gauge set as shown in Figure 4-5 and isolate the compressor by front seating the suction and discharge valves.

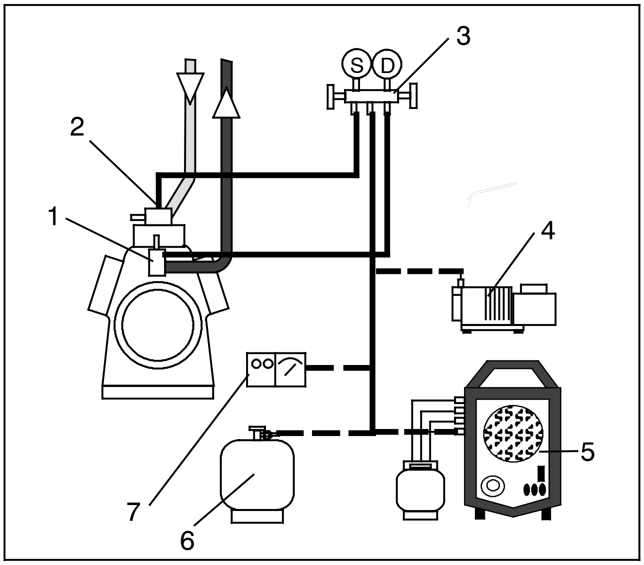
b. Recover refrigerant with a refrigerant reclaimer. If the discharge service valve port is not accessible, it will be necessary to recover refrigerant through the suction service valve port only.

c. Service or replace components as required and leak check the compressor.

d. Using refrigerant hoses designed for vacuum service, connect a vacuum pump to center connection of manifold gauge set. Evacuate compressor to 500 microns. Close off pump valve, isolate vacuum gauge and stop pump. Wait 5 minutes to verify that vacuum holds.

e. Once vacuum is maintained, recharge low side with R-134a to 20 - 30 psig by admitting vapor from the refrigerant cylinder. Backseat compressor service valves and disconnect manifold gauge set.

f. Check refrigerant level. Refer to paragraph 4.7.1.



1. Discharge Service Valve and Port
2. Suction Service Valve and Port
3. Manifold Gauge Set
4. Vacuum Pump
5. Reclaimer
6. Refrigerant Cylinder
7. Thermistor Vacuum Gauge

Figure 4-5 Compressor Service Connections

4.4.3 Pump Down An Operable Compressor For Repair

To service an operable compressor, pump the refrigerant into the condenser coil and receiver as follows:

a. Install manifold gauge set. Refer to Figure 4-5.

b. Frontseat the compressor suction service valve by turning clockwise.

c. Install a jumper on the compressor mounted low pressure switch. Unplug the suction pressure transducer (if applicable). Start the unit and run in cooling until 10 ”/hg (25.4 cm/hg) of vacuum is reached. Shut the system down and tag out system power source.

d. Frontseat the compressor discharge service valve and wait 5 minutes to verify that vacuum is maintained. If the pressure rises above vacuum, open the compressor discharge service valve and repeat steps c and d until a vacuum is maintained.

e. Service or replace components as required and leak check the compressor.

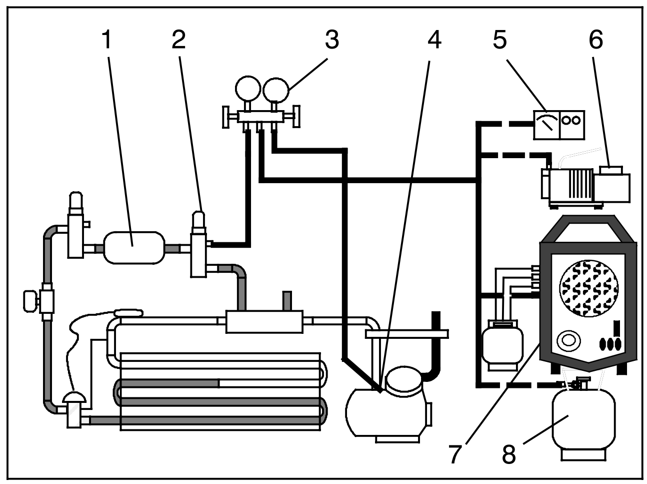
CAUTION

To avoid the entrance of air, never evacuate an open drive compressor below 500 microns.

f. Using refrigerant hoses designed for vacuum service, connect a vacuum pump to the center connection of the manifold gauge set. Evacuate compressor to 500 microns. Close off pump valve, isolate vacuum gauge and stop pump. Wait 5 minutes to verify that vacuum holds.

g. Once vacuum is maintained, re-connect low pressure switch. Re-connect the suction pressure transducer (if applicable). Backseat compressor service valves and disconnect manifold gauge set.

h. Check refrigerant level. Refer to paragraph 4.7.1.



1. Filter-Drier
2. Filter-Drier Inlet Service Valve
3 Manifold Gauge Set
4. Suction Service Valve and Port
5. Thermistor Vacuum Gauge
6. Vacuum Pump
7. Reclaimer
8. Refrigerant Cylinder

Figure 4-6 System Charge Removal Connections

4.4.4. Removing Entire System Charge

To remove the entire refrigerant charge, do the following:

a. Connect a manifold gauge set to the system as shown in Figure 4-6.

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

c. Recover refrigerant in accordance with reclaimer manufacturers instructions.

4.5 REFRIGERANT LEAK CHECK

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:

NOTE

It is emphasized that only the correct refrigerant should be used to pressurize the system. Use of any other refrigerant will contaminate the system, and require additional evacuation.

a. Ensure the service valves are open and power the liquid line service valve from an external source.

b. If system is without refrigerant, charge system with refrigerant vapor to build up pressure to approximately 30 PSIG (R-134a).

c. Add sufficient nitrogen to raise system pressure to 150 to 200 psig (10.21 to 13.61 bar).

d. Check for leaks. The recommended procedure for finding leaks in a system is with an electronic leak detector. Testing joints with soap suds is satisfactory and may be necessary under conditions when an electronic leak detector will not function correctly.

e. Remove test gas and replace filter-drier.

f. Evacuate and dehydrate the system. Refer to paragraph 4.6.

g. Charge the unit. Refer to paragraph 4.7.

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 4.6.4) should take place after a minor system repair (replacement of a solenoid valve or a filter drier).

4.6.2 Preparation

NOTE

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

CAUTION

Never evacuate an open drive compressor below 500 microns.

a. Evacuate and dehydrate only after pressure leak test. Refer to paragraph4.5.

b. Essential tools to properly evacuate and dehydrate any system include a good vacuum pump with a minimum of 6 cfm (10.2 m^3/hr) volume displacement, and a good vacuum indicator (MCC P/N 07-00414-00).

c. Keep the ambient temperature above 60°F (15.6°C) to speed evaporation of moisture. If ambient temperature is lower than 60°F (15.6°C), ice may form before moisture removal is complete.

4.6.3 Procedure for Evacuation and Dehydrating System (Triple Evacuation)

a. Remove refrigerant using a refrigerant recovery system. Refer to paragraph 4.4.4.

b. The recommended method is connecting lines (refrigerant hoses designed for vacuum service) as shown in Figure 4-7.

c. Make sure vacuum pump valve is open.

d. Start 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.

g. Purge the nitrogen from the system.

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

i. Start vacuum pump and open all valves. Dehydrate unit to 500 microns Hg vacuum.

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

k. Charge system. Refer to paragraph 4.7.2.

4.6.4 Procedure for Evacuation and Dehydrating System (One Time Evacuation)

a. Remove refrigerant using a refrigerant recovery system. Refer to paragraph 4.4.4.

b. The recommended method is connecting lines (refrigerant hoses designed for vacuum service) as shown in Figure 4-7.

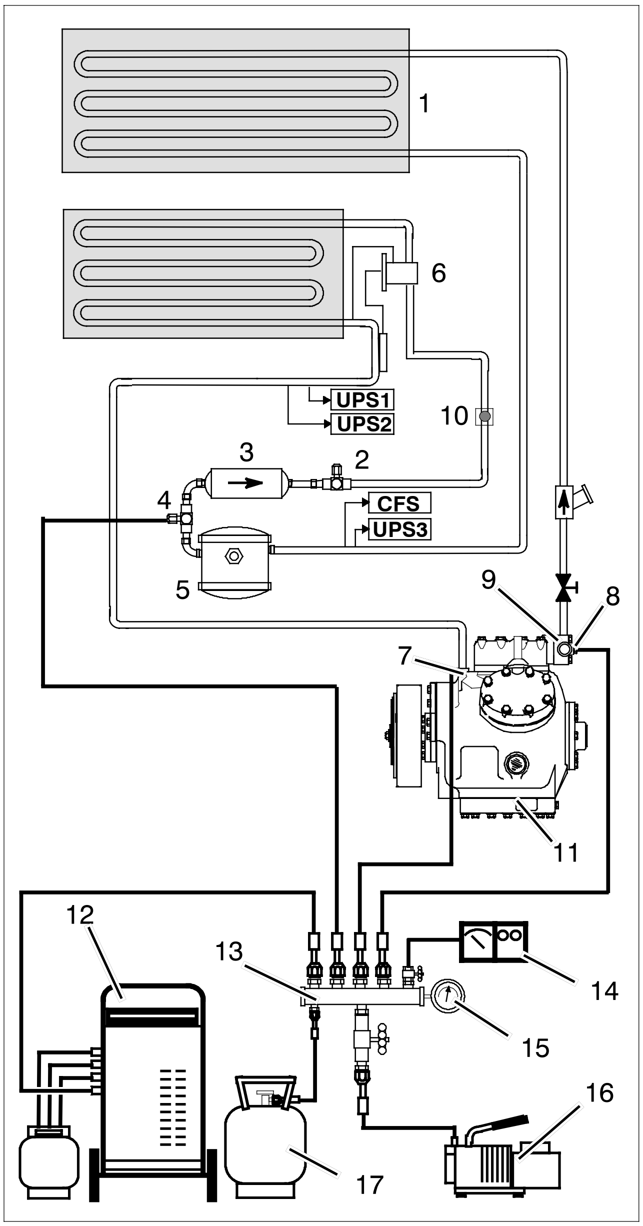
c. Make sure vacuum pump valve is open.

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

e. Evacuate unit until vacuum gauge indicates 500 microns Hg vacuum.

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

g. Charge system. Refer to paragraph 4.7.2.



1 Condenser Coil
2 Filter-Drier Outlet Service Valve
3 Filter – Drier
4 Filter – Drier Inlet Service Valve
5 Receiver
6 Thermostatic Expansion Valve
7 Suction Service Valve & Service Port
8 Discharge Service Port
9 Discharge Service Valve
10 Liquid Line Solenoid Valve
11 Compressor
12 Reclaimer
13 Vacuum Manifold
14 Thermister Vacuum Gauge
15 Compound Gauge
16 Vacuum Pump
17 Refrigerant Cylinder

Figure 4-7 Vacuum Pump Connections

4.7 ADDING REFRIGERANT TO SYSTEM

4.7.1 Checking Refrigerant Charge

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

a. Coach engine operating at high idle.

b. Compressor operating fully loaded (six cylinder) in cool mode for 15 minutes.

c. Compressor discharge (head) pressure to 150 PSIG (R-134a). It may be necessary to block condenser air flow to raise discharge pressure.

d. Under the above fully loaded conditions, the system is properly charged when the refrigerant liquid level is at 1/2 to 3/4 of the receiver sight glass (bottom glass if receiver is equipped with 2 glasses). If it is not at the proper level, add or remove refrigerant to bring it to the proper level.

4.7.2 Adding Full Charge

a. Install manifold gauge set at the compressor suction service valve and filter-drier inlet service valve. See figure Figure 4-6.

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

c. Place appropriate refrigerant cylinder on scales. Prepare to charge liquid refrigerant by connect charging hose from container to center connection on gauge manifold . Purge air from hoses.

d. Note weight of refrigerant and cylinder.

e. Open cylinder valve, backseat discharge valve on gauge manifold and allow liquid refrigerant to flow into the high side of the system

f. When correct charge has been added, close cylinder valve and frontseat manifold discharge valve. At this point, the high side of the system has been charged but the low side is still in a vacuum because the liquid line solenoid is normally closed.

g. Prepare the cylinder as required to allow vapor charging. Backseat the manifold suction valve and charge vapor to build 30 PSIG (R-134a) pressure on the manifold suction gauge. Close cylinder valve and frontseat suction manifold set.

h. Check charge level in accordance with the procedures of paragraph 4.7.1.

4.7.3 Adding Partial Charge

a. Install manifold gauge set at the compressor suction service valve and filter-drier inlet service valve. See Figure 4-6.

b. Place appropriate refrigerant cylinder on scale. Prepare to charge vapor refrigerant by connecting charging hose from container to center connection on gauge manifold. Purge air from hoses.

c. Run the unit in the cool mode as described in section 4.7.1. With the suction service valve midseated, open the refrigerant cylinder valve and add vapor charge until the refrigerant level appears in the liquid line sight glass. Under the above conditions, the system is properly charged when the refrigerant liquid level is at 1/2 sight glass. If it is not at the proper level, add or remove refrigerant to bring it to the proper level.

d. Backseat the suction service valve. Close the vapor valve on the refrigerant drum and note weight. Remove the manifold gauge set and replace all valve caps.

4.8 CHECKING FOR NONCONDENSIBLES

To check for noncondensibles, proceed as follows:

a. Stabilize system to equalize pressure between the suction and discharge side of the system.

b. Check temperature at the condenser and receiver.

c. Check pressure at the filter-drier inlet service valve.

d. Check saturation pressure as it corresponds to the condenser/receiver temperature using the Temperature-Pressure Chart, Table 4-3.

e. If gauge reading is 3 psig *(0.20 bar)* or more than the saturation pressure in step d, noncondensibles are present.

f. Remove refrigerant using a refrigerant recovery system.

g. Evacuate and dehydrate the system. Refer to paragraph 4.6.3.

h. Charge the unit. Refer to paragraph 4.7.2.

4.9 CHECKING AND REPLACING HIGH OR LOW PRESSURE SWITCH

WARNING

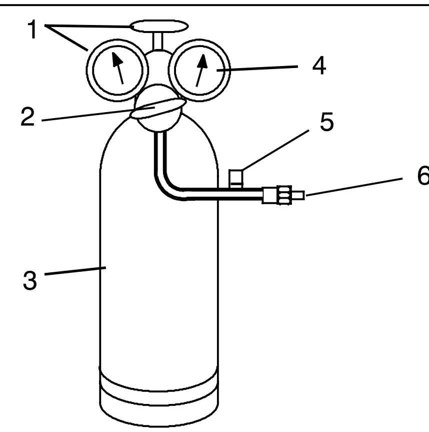
Do not use a nitrogen cylinder without a pressure regulator

WARNING

Do not use oxygen in or near a refrigeration system as an explosion may occur.

a. Disconnect wiring and remove switch from unit. All units are equipped with a schrader valve at the pressure switch connections.

b. Connect switch to a cylinder of dry nitrogen. See Figure 4-8.



1. Cylinder Valve and Gauge
2. Pressure Regulator
3. Nitrogen Cylinder
4. Pressure Gauge (0 to 400 psig = 0 to 27.22 bar)
5. Bleed-Off Valve
6. 1/4 inch Connection

Figure 4-8 Checking High Pressure Switch

c. Connect an ohmmeter across switch terminals.

d. Set nitrogen pressure regulator higher than the upper switch setting. (refer to paragraph 1.2).

e. For a high pressure switch, close cylinder valve and open bleed-off valve. Open cylinder valve and slowly close bleed-off valve. The switch should open, (no continuity) within required cut out tolerance. Close cylinder valve and release pressure through the bleed-off valve. As pressure drops, switch should close, (continuity) within required cut in tolerance.

f. For a low pressure switch, close cylinder valve and bleed-off valve. Open cylinder valve to bring pressure above the cutout setting. Close the cylinder valve and slowly open bleed-off valve. The switch should open, (no continuity) within required cut out tolerance. Open cylinder valve and increase pressure by closing the bleed-off valve. As pressure increases, switch should close, (continuity) within required cut in tolerance.

g. Replace or re-install switch (as required) and reconnect wiring.

4.10 REMOVING TOP COVER (KR-4 CONDENSER)

The KR-4 condenser cover assembly is of one piece construction. To remove the cover from the condenser assembly do the following:

a. Twist all (10) of the 1/4 Turn cam locks counterclockwise (see Figure 4-9).

b. Using two people, grasp the condenser cover section under the bottom edge and lift up evenly from both sides.

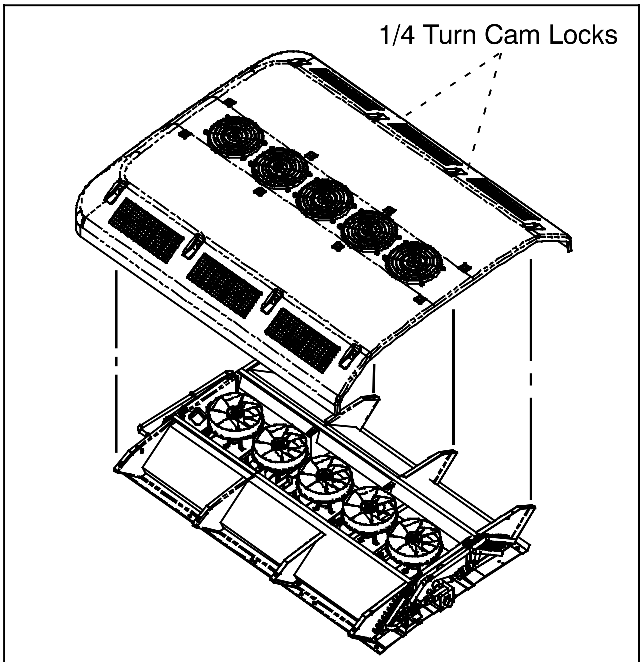
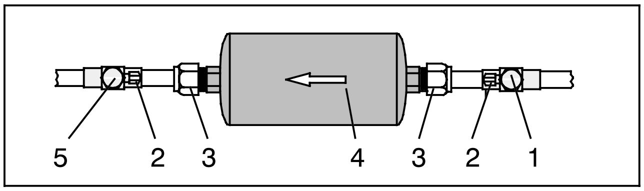


Figure 4-9 Condenser Cover Removal

4.11 FILTER-DRIER

4.11.1 To Check Filter-Drier

The filter-drier (see Figure 4-10) must be changed if the drier is partially restricted or service has been performed on the refrigerant system. Check for a restriction by feeling the inlet and outlet lines of the filter-drier. If the outlet side feels cooler than the inlet side, then the filter-drier should be changed



1. Filter-Drier Inlet Service Valve
2. Valve Service Port
3. Flare Nut
4. Filter-Drier
5. Filter-Drier Outlet Service Valve

Figure 4-10 Filter-Drier Removal

4.11.2 To Replace Filter-Drier

a. Perform a low side pump down. Refer to paragraph 4.4.1, (steps a. to c.)

b. Turn the driver's A/C switch to “OFF” position.

c. Frontseat the filter-drier outlet service valve and place a new filter-drier near the unit for immediate installation.

d. Remove two screws securing the filter-drier clamp. Remove the filter-drier clamp.

WARNING

The filter-drier may contain liquid refrigerant. Slowly loosen the flare nuts to avoid refrigerant contact with exposed skin or eyes.

e. Using two open end wrenches, slowly crack open the flare nuts on each side of the filter-drier. Remove the filter-drier.

f. Remove seal caps from the new filter-drier. Apply a light coat of compressor oil to the flares.

g. Assemble the new filter-drier to lines ensuring that the arrow on the body of the filter-drier points in the direction of the refrigerant flow (refrigerant flows from the receiver to the evaporator). Finger tighten nuts.

h. Tighten filter-drier nuts using two open end wrenches.

i. Evacuate the filter-drier and lines by connecting a vacuum pump as shown in Figure 4-4. Evacuate to 500 microns.

j. Backseat (fully close) both service valve ports and replace valve caps.

k. Test filter-drier for leaks.

l. Check refrigerant level.

4.12 SERVICING THE LIQUID LINE SOLENOID VALVE

The Liquid line solenoid valve (Figure 4-11) requires no maintenance unless a malfunction to the internal parts or coil occurs. This may be caused by foreign material such as: dirt, scale, or sludge in the refrigeration system, or improper voltage to the coil.

There are only three possible valve malfunctions: coil burnout, failure to open, or failure to close.

Coil burnout may be caused by the following:

1 Improper voltage.

2 Continuous over-voltage, more than 10% or under-voltage of more than 15%.

3 Incomplete magnet circuit due to the omission of the coil housing or plunger.

4 Mechanical interface with movement of plunger which may be caused by a deformed enclosing tube.

Failure to open may be caused by the following:

1 Coil burned out or an open circuit to coil connections.

2 Improper voltage.

3 Defective plunger or deformed valve body assembly.

Failure to close may be caused by the following:

1 Defective plunger or deformed valve body assembly.

2 Foreign material in the valve.

4.12.1 Coil Replacement

a. It is not necessary to remove the refrigerant charge from the system.

b. Place main battery disconnect switch in OFF position and lock.

c. Disconnect wire leads to coil.

d. Remove coil retaining clip and nameplate.

e. Lift burned-out coil from enclosing tube and replace.

f. Connect wire leads and test operation

4.12.2 Internal Part Replacement

a. Perform a low side pump down. Refer to paragraph 4.4.1 .

b. Carefully loosen enclosing tube assembly and ensure no pressure remains within the valve. Disassemble valve and replace defective parts.

c. Assemble valve and leak check.

d. Evacuate low side and re-open system.

4.12.3 Replace Entire Valve

a. Perform a low side pump down. Refer to paragraph 4.4.1. Remove coil and plunger assembly and un-braze valve from lines.

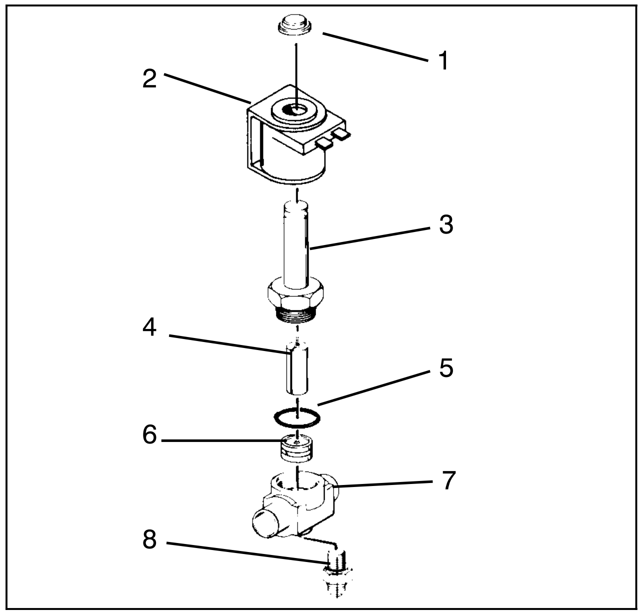
b. Remove valve assembly from bracket.

c. Disassemble new valve, to protect internal parts, and solder to lines.

d. Assemble and leak check valve.

e. Evacuate low side and re-open system.

f. Connect wire leads and test operation.

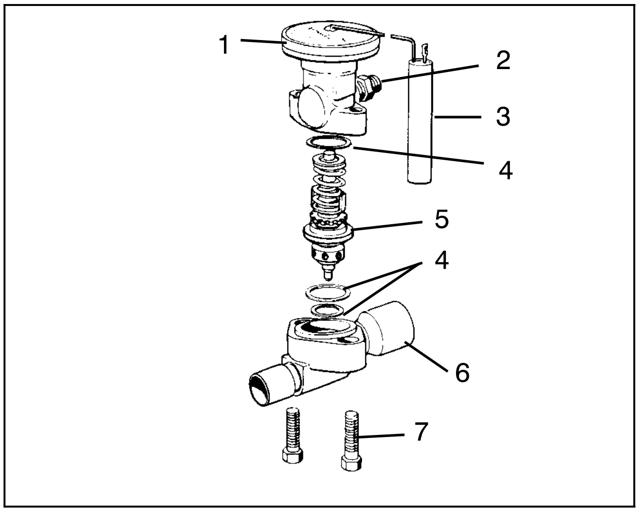


1. Snap Cap
2. Coil Assembly
3. Enclosing Tube Assembly
4. Plunger Assembly
5. Gasket
6. Piston Assembly
7. Body
8. Bracket Adapter

Figure 4-11 Liquid Line Solenoid Valve

4.13 THERMOSTATIC EXPANSION VALVE

The thermostatic expansion valve (Figure 4-11) is an automatic device which maintains constant superheat of the refrigerant gas leaving the evaporator regardless of suction pressure. The valve functions are: (a) automatic control of refrigerant flow to match the evaporator load and (b) prevention of liquid refrigerant entering the compressor. Unless the valve is defective, it seldom requires any maintenance.



1. Power Head Assembly
2. Equalizer Connection
3. Bulb
4. Gasket
5. Cage Assembly
6. Body Flange
7. Cap screw

Figure 4-12 Thermostatic Expansion Valve

4.13.1 Valve Replacement

a. Pump down low side of the unit. Refer to paragraph 4.4.1.

b. Remove insulation from expansion valve and bulb. See Figure 4-12 and Figure 4-13.

c. Loosen retaining straps holding bulb to suction line and detach bulb from the suction line.

d. Loosen flare nuts on equalizer line and disconnect equalizer line from the expansion valve.

e. Remove capscrews and lift off power head and cage assemblies and gaskets.

f. Check, clean and remove any foreign material from the valve body, valve seat and mating surfaces. If required, replace valve body.

NOTE

R-134a valves are non-adjustable.

g. Using new gaskets, install new cage and power head assemblies.

h. Fasten equalizer line to the expansion valve.

i. Leak check the new valve and evacuate and dehydrate low side. Refer to paragraph 4.4.1.

j. The thermal bulb is installed below the center of the suction line (four or eight o'clock position). This area must be clean to ensure positive bulb contact. Strap thermal bulb to suction line. Ensure that retaining straps are tight and renew insulation.

k. If required, add vapor refrigerant to bring low side pressure to 20 to 30 PSIG (R-134a). Open filter-drier inlet service valve and compressor service valves.

l. Run the coach for approximately 30 minutes on fast idle.

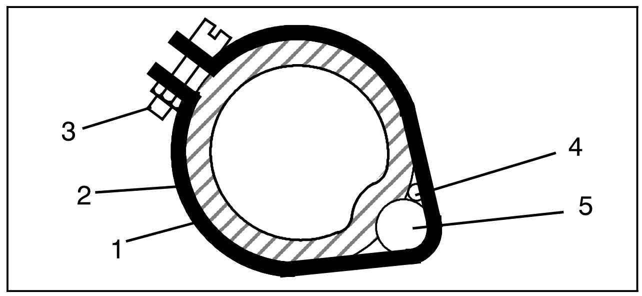
m.Check refrigerant level. Refer to paragraph 4.7.1.

n. Check superheat. Refer to paragraph 4.13.2.

4.13.2 Superheat Measurement

NOTE

All readings must be taken from the TXV bulb location and out of the direct air stream.



1. Suction Line (section view)
2. TXV Bulb Clamp
3. Nut & Bolt (clamp)
4. Thermocouple
5. TXV Bulb (Shown in the 4'clock position)

Figure 4-13 Thermostatic Expansion Valve Bulb and Thermocouple

a. Remove Presstite insulation from expansion valve bulb and suction line.

b. Loosen one TXV bulb clamp and make sure area under clamp is clean.

c. Place temperature thermocouple in contact with the suction tube and parallel to the TXV bulb, and then secure loosened clamp making sure both bulb and thermocouple are firmly secured to suction line. See Figure 4-13. Reinstall insulation around the bulb.

d. Connect an accurate low pressure gauge to the low pressure port (Figure 1-6).

e. Start bus and run on fast idle until unit has stabilized, about 20 to 30 minutes.

NOTE

When conducting this test, the suction pressure must be at least 6 psig *(0.41 bar)* below the expansion valve maximum operating pressure (MOP). Refer to Section 1.2 for MOP.

f. From the temperature/pressure chart (Table 4-3), determine the saturation temperature corresponding to the evaporator outlet pressure.

g. Note the temperature of the suction gas at the expansion valve bulb. Subtract the saturation temperature from this temperature. The difference is the superheat of the suction gas.

h. The superheat may cycle from a low to high reading. Monitor the superheat taking readings every 3-5 minutes for a total of 5-6 readings. Calculate the superheats, add the readings and divide by the number of readings taken to determine average superheat. Refer to Section 1.2 for superheat setting.

i. If superheat is not within tolerance, replace the valve.

4.14 REPLACING RETURN AIR FILTERS

The return air filters are located behind the return air grill, inside the vehicle.

The filters should be checked for cleanliness periodically depending on operating conditions. A dirty filter will restrict air flow over the evaporator coil which may cause insufficient cooling or heating and possible frost buildup on the coil. To remove the filters, do the following.

a. Place main battery disconnect switch in OFF position and lock.

b. Remove the return air grille.

c. Loosen filter retaining hardware and remove the filter from the grille.

d. Reverse procedure to install new filters.

4.15 COMPRESSOR MAINTENANCE

4.15.1 Removing the Compressor

If compressor is inoperative and the unit still has refrigerant pressure, isolate the compressor and remove the refrigerant. Refer to paragraph 4.4.2. If compressor is operative, perform a pump down. Refer to paragraph 4.4.3.

a. Place main battery disconnect switch in OFF position and lock.

b. Tag and disconnect wiring to the high pressure and low pressure switch, unloaders and clutch.

c. Remove tension on drive belts, remove drive belts.

d. Loosen bolts at suction and discharge service valve flanges and break seal to be sure pressure is released. Remove bolts.

e. Remove four bolts holding compressor to base

f. Attach sling or other device to the compressor and remove compressor from the coach through the rear access door.

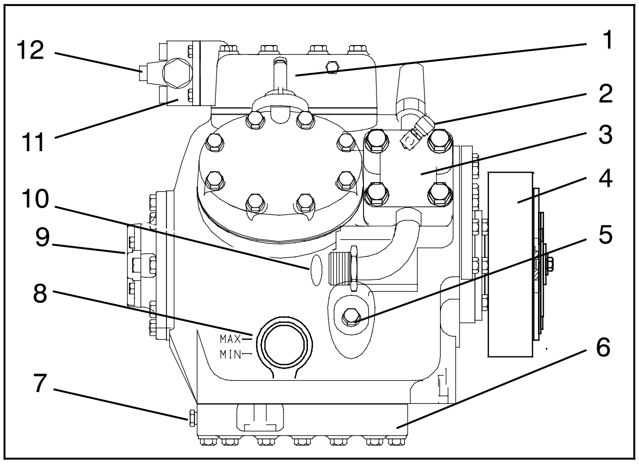
NOTES

1 Service replacement compressors are sold without service valves. Valve pads are installed in their place. The optional unloaders are not supplied, as the cylinder heads are shipped with plugs. Customer should retain the original unloader valves for use on the replacement compressor.

2 The piston plug that is removed from the replacement compressor head must be installed in the failed compressor if returning for warranty or core credit.

3 Do not interchange allen-head capscrews that mount the piston plug and unloader, they are not interchangeable.

4 Check oil level in service replacement compressor. Refer to paragraph 4.15.3.



1. Electric Unloader Valve
2. Suction Service Valve Charging Port
3. Suction Service Valve
4. Clutch
5. Oil Fill Plug
6. Bottom Plate
7. Oil Drain Plug
8. Oil Level Sight Glass
9. Oil Pump
10. O-ring
11. Discharge Service Valve
12. Service Port

Figure 4-14 Compressor

g. Remove the three socket head capscrews from the cylinder head(s) that have unloader valves installed. See Figure 4-15. Remove the unloader valve and bypass piston assembly, keeping the same capscrews with the assembly. The original unloader valve must be transferred to the replacement compressor. The plug arrangement removed from the replacement is installed in the original compressor as a seal. If piston is stuck, it may be extracted by threading a socket head capscrew into top of piston. A small Teflon seat ring at the bottom of the bypass piston plug must be removed.

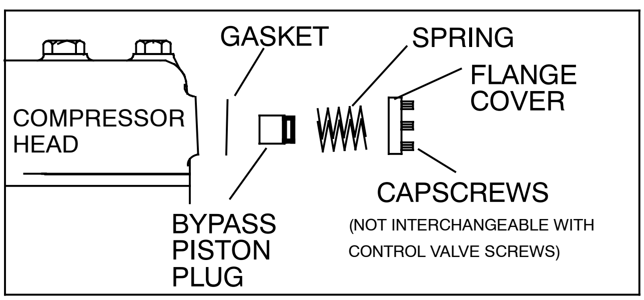


Figure 4-15 Removing Bypass Piston Plug

h. Remove the pressure switches and install on replacement compressor after checking switch operation. Refer to paragraph 4.9.

i. Remove clutch assemble and retain original clutch key. Install on replacement compressor.

j. Install compressor in unit by performing the removal steps in reverse. It is recommended that new locknuts be used when replacing compressor. Install new gaskets on service valves and tighten bolts uniformly (55 to 80 ft-lbs suction and 20 to 30 ft-lbs discharge service valves).

k. Leak check connections and replace filter-drier. Refer to paragraph 4.11.

l. Using refrigerant hoses designed for vacuum service, connect a vacuum pump (see Figure 4-5) and evacuate compressor to 500 microns. Front seat both manifold valves to isolate the pump.

m. Open compressor service valves.

n. Start unit and check refrigerant level. Refer to paragraph 4.7.1.

o. Check compressor oil level. Refer to paragraph 4.15.3. Add or remove oil if necessary.

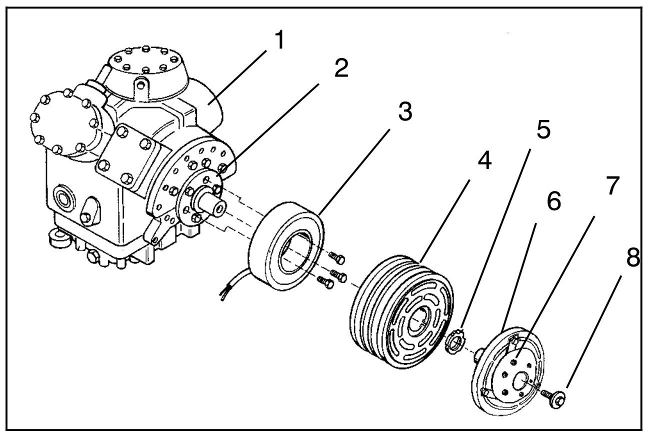
p. Check compressor unloader operation. Refer to paragraph 4.15.4

q. Backseat compressor service valves.

r. Remove manifold gauge set. Refer to section 4.3.

4.15.2 Transferring Compressor Clutch

To remove a clutch (see Figure 4-16) from a compressor and install on a replacement compressor, do the following:



1. Compressor
2. Seal Cover
3. Coil
4. Rotor
5. Rotor Nut
6. Armature
7 Spacer Nuts
8. Retaining Capscrew, Lockwasher, 3/8 Washer

Figure 4-16 Compressor Clutch

a. Place main battery disconnect switch in OFF position and lock.

b. Tag and disconnect wiring to the clutch.

c. Remove tension on drive belts, remove drive belts.

d. Remove the armature as a complete assembly by removing the retaining capscrew, lockwasher, and special 3/8 washer from the compressor crankshaft. Use special tool (MCC P/N 07-00240-01) to prevent crankshaft rotation.

e. Install a 7/8-14 x 4" (MCC P/N 07-00381-00) capscrew into the center hole of the armature assembly and use it as a jacking bolt to remove the armature. Use tool (MCC P/N 07-00240-01) as in step a. to prevent crankshaft rotation.

f. Using special tool (MCC P/N 07-00242-01), remove the rotor nut and rotor. Retain original key.

g. Noting the position of the wire, remove the three bolts holding the coil to the compressor.

h. Remove every other bolt from the seal cover of the new compressor in the same manner as the original compressor. Mount the coil assembly with the wire in the same orientation as it was mounted on the original compressor. Tighten the mounting bolts to 45-50 ft/lbs (5.53-6.92 mkg).

i. Mount the rotor on the shaft. Seat the rotor to the hub, using the rotor nut. Be sure pulley turns freely without binding. Tighten rotor nut by first noting torque necessary to start the nut on the hub and then adding 50 ft/lbs of torque.

j. Install armature on shaft using original key and tighten mounting bolt to 20 ft/lbs (2.8 mkg).

k. Perform a check of the air gap between the inside face of the armature and the mating face of the rotor. The air gap should be measured with a minimum of 50 psig (3.4 bar) in the crankcase. A preliminary check may be performed before the crankcase is pressurized but a final check must be performed before the clutch is operated. The gap should be between 0.030 and 0.060 inch (7.62 to 15.24 mm). If required, remove the six armature spacer nuts and spacer. Add or remove shims to adjust gap. Reinstall spacer nuts and tighten to 7-8 ft/lbs (1.0 to 1,1 mkg).

l.Reconnect wiring and test clutch operation.

4.15.3 Compressor Oil Level

To check, and correct (if required) the compressor oil level, do the following:

a. Operate the coach for at least one-half hour at fast idle speed, with the temperature controls at the coolest setting, and the compressor fully loaded. It may be necessary to pre-heat the coach and/or operate the system in the reheat mode to keep the compressor fully loaded throughout this procedure

b. Ensure the system is fully charged (refer to paragraph 4.7.1) and the compressor crankcase is warm to the touch after fifteen minutes of operation.

c. Shut off the system and immediately record the oil level in the compressor sight glass. See Figure 4-14. If the compressor is not level, an average between the sight glass levels will have to be made to determine level.

d. The correct oil level for this application should be between the bottom and 1/2 of the oil level sightglass. See Figure 4-14. If the oil level is correct, release the coach into service. If the level is above the 1/2 sightglass maximum, proceed to step e. If the level is below the 1/2 sightglass maximum proceed to step f.

e. To remove oil and bring the level to the 1/2 sightglass maximum, do the following:

1. With the system off, connect a manifold gauge set to the compressor suction and discharge service valves. Front seat the service valves to isolate the compressor from the system (See Figure 4-5) and reclaim the refrigerant to below atmospheric pressure. Shut off the reclaimer and verify the pressure does not rise. If the pressure rises, continue reclaiming until the pressure remains below atmospheric.

⚠ WARNING

Extreme care must be taken to ensure that all the refrigerant has been removed from the compressor crankcase or the resultant pressure will forcibly discharge compressor oil.

2. Drain or pump out compressor oil until the level is brought to the proper level.
3. Evacuate the compressor to 500 microns. Backseat the compressor service valves and repeat the oil level check procedure.

f. To add oil to the compressor, do the following:

1. With the system off, connect a manifold gauge set to the compressor suction and discharge service valves. Front seat both service valves to isolate the compressor from the system (See Figure 4-5) and reclaim the refrigerant to below atmospheric pressure. Shut off the reclaimer and verify the pressure does not rise. If the pressure rises, continue reclaiming until the pressure remains below atmospheric.
2. Add oil to compressor crankcase slowly, through the oil fill plug opening (see Figure 4-14) to bring level to mid range of allowed levels.
3. Evacuate compressor to 500 microns. Backseat compressor suction and discharge valves, start system and recheck oil level.
4. Remove manifold gauge set.

4.15.4 Compressor Electric Unloader Operation

To check unloader operation do the following:

a. Install a manifold gauge set (Refer to Figure 4-6).

b. Start the unit and allow it to stabilize in High Speed Cool.

c. Insure that the unloaders are de-energized. Compressor is fully loaded, 6 cylinder operation.

d. Slowly front-seat the suction service valve. The suction pressure will begin to fall.

e. Watch the suction gauge on the manifold gauge set. When the suction pressure gauge “jumps” 3 to 5 psi (0.2 to 0.4 bar) note the pressure at which the gauge jumped in the chart below. Unloader solenoid coil #1 has been energized and the compressor is now in 4 cylinder operation.

f. Continue to slowly front-seat the suction service valve and watch the suction gauge. When the suction pressure gauge “jumps” (3 to 5 psi- 0.2 to 0.4 bar) note the pressure at which the gauge jumped in the chart below. Unloader solenoid coil #2 has been energized and the compressor is now in 2 cylinder operation.

g. Slowly back-seat the suction service valve. The suction pressure will begin to rise.

h. Watch the suction gauge on the manifold gauge set. When the suction pressure gauge “jumps” (3 to 5 psi- 0.2 to 0.4 bar) note the pressure at which the gauge jumped in the chart below. Unloader solenoid coil #2 has been de-energized and the compressor is now in 4 cylinder operation.

i. Continue to slowly back-seat the suction service valve and watch the suction gauge. When the suction pressure gauge “jumps” 3 to 5 psi (0.2 to 0.4 bar) note the pressure at which the gauge jumped in the chart below. Unloader solenoid coil #1 has been de-energized and the compressor is now in 6 cylinder operation.

j. Compare these values to the one in your service manual (Table 1-3).

PRESSURE READING	COIL ENERGIZED UNLOADED	COIL DE-ENERGIZED LOADED
UNLOADER #1		
UNLOADER #2		

Approximate Unloader Coil Resistance:

12VDC Coil = 10.2 Ohms

24VDC Coil = 40.0 Ohms

4.16 TEMPERATURE SENSOR CHECKOUT

a. An accurate ohmmeter must be used to check resistance values shown in Table 4-1.

b. Due to variations and inaccuracies in ohmmeters, thermometers or other test equipment, a reading within two percent of the chart value would be considered acceptable. If a sensor is bad, the resistance value would usually be much higher or lower than the value given in Table 4-1.

c. At least one sensor lead must be disconnected from the controller before any reading can be taken. Not doing so will result in a false reading. Two preferred methods of determining the actual test temperature at the sensor are an ice bath at 32°F (0°C) and/or a calibrated digital temperature meter.

Table 4-1 Temperature Sensor Resistance

Temperature		Resistance In Ohms
°F	°C	
-20	-28.9	165,300
-10	-23.3	117,800
0	-17.8	85,500
10	-12.2	62,400
20	- 6.7	46,300
30	- 1.1	34,500
32	0	32,700
40	4.4	26,200
50	10.0	19,900
60	15.6	15,300
70	21.1	11,900
77	25	10,000
80	26.7	9,300
90	32.2	7,300
100	37.8	5,800
110	43.3	4,700
120	48.9	3,800

4.17 REPLACING SENSORS

a. Place main battery disconnect switch in OFF position and lock.

b. Tag and disconnect wiring from defective sensor.

c. Remove and replace defective sensor. Sensor connections are fitted with Schreader valves to facilitate replacement.

d. Connect wiring to replacement sensor.

e. Checkout replacement sensor. Refer to section 4.16.

f. Repair or replace any defective component(s), as required.

4.18 ELECTRIC COMPRESSOR UNLOADERS

The electric unloaders are activated by an electromagnetic coil, which is energized by a pressure switch or pressure transducer monitoring refrigerant pressure. (See Figure 4-17)

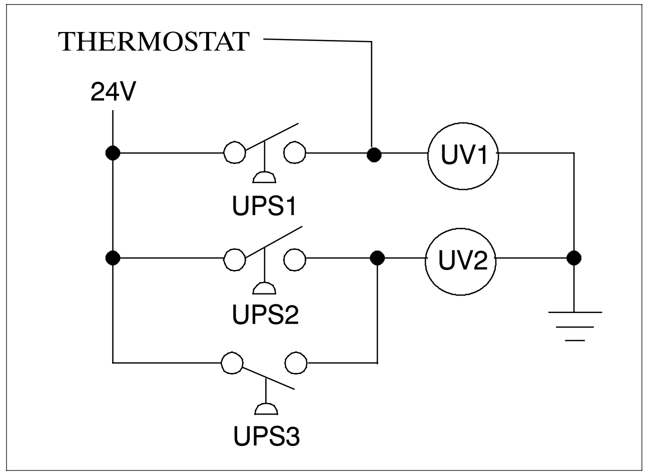


Figure 4-17 Electric Unloader Schematic

Pressure switches UPS1 and UPS2 are installed in the suction return line to the compressor. Each switch monitors suction pressure and operates one unloader by controlling the voltage applied to the unloader coil. When suction pressure falls to the setpoint of the pressure switch, the switch contacts close applying control voltage to energize the unloader coil, which unloads two of the compressor cylinders each.

Pressure switch UPS3 is installed in the liquid line to the receiver. The switch monitors refrigerant liquid line pressure and operates unloader coil UL2 by controlling voltage applied to the coil. When refrigerant liquid pressure rises to the setpoint of the pressure switch, the switch contacts close applying control voltage to energize unloader coil UL2, which unloads one of the compressor cylinder banks.

Pressure switch (UPS1, UPS2 and UPS3) settings are given in Table 1-3.

Unloader operation on an EnviroMATE controlled system is accomplished through the pressure transducers and controller software.

4.19 PRESSURE TRANSDUCER CHECKOUT (EnviroMATE)

NOTE

System must be operating to check transducers.

a. With the system running use the driver display and manifold gauges to check suction and/or discharge pressure(s) simultaneously.

b. Determine with the gages whether one or both pressure readouts are correct. If one is correct, exchange the pressure transducer locations. If the problem moves with the transducer replace the faulty transducer.

c. If the driver display read out disagrees with both values shown on the manifold gauges proceed to step d.

CAUTION

Use care when checking/manipulating wires/plugs attached to the Logic Board. Damage to the board or wiring harness can occur.

d. Verify that the wiring to the transducer(s) is in good condition.

e. Use a digital volt-ohmmeter to measure voltage across the transducer connector corresponding to terminals A & B. See Figure 4-18. The reading should be 5.0 VDC.

f. Use a digital volt-ohmmeter to measure wire continuity between the connector positions corresponding to C and ENV14 (Suction) or C and ENV16 (Discharge).

g. Use a digital volt-ohmmeter measure voltage across the transducer at terminals A & C. See Figure 4-18. Compare to values in Table 4-2. A reading within two percent of the values in the table would be considered good.

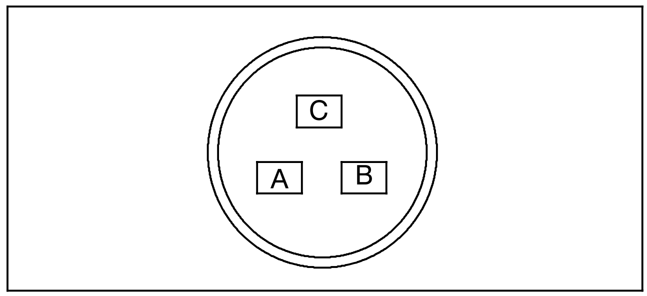


Figure 4-18 Transducer Terminal Location

Table 4-2. Pressure Transducer Voltage

"/hg	Voltage	Psig	Voltage	Psig	Voltage	Psig	Voltage	Psig	Voltage	Psig	Voltage
20"	0.369	40	0.858	95	1.397	150	1.936	205	2.475	260	3.014
10"	0.417	45	0.907	100	1.446	155	1.985	210	2.524	265	3.063
Psig	**Voltage**	50	0.956	105	1.495	160	2.034	215	2.573	270	3.112
0	0.466	55	1.007	110	1.544	165	2.083	220	2.622	275	3.161
5	0.515	60	1.054	115	1.593	170	2.132	225	2.671	280	3.210
10	0.564	65	1.103	120	1.642	175	2.181	230	2.720	285	3.259
15	0.614	70	1.152	125	1.691	180	2.230	235	2.769	290	3.308
20	0.663	75	1.204	130	1.740	185	2.279	240	2.818	295	3.357
25	0.712	80	1.250	135	1.789	190	2.328	245	2.867	300	2.406
30	0.761	85	1.299	140	1.838	195	2.377	250	2.916	305	3.455
35	0.810	90	1.348	145	1.887	200	2.426	255	2.965	310	3.504

Table 4-3 R-134a Temperature - Pressure Chart

Temperature		Vacuum		
°F	°C	"/hg	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

Temperature		Pressure		
°F	°C	Psig	Kg/cm2	Bar
-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

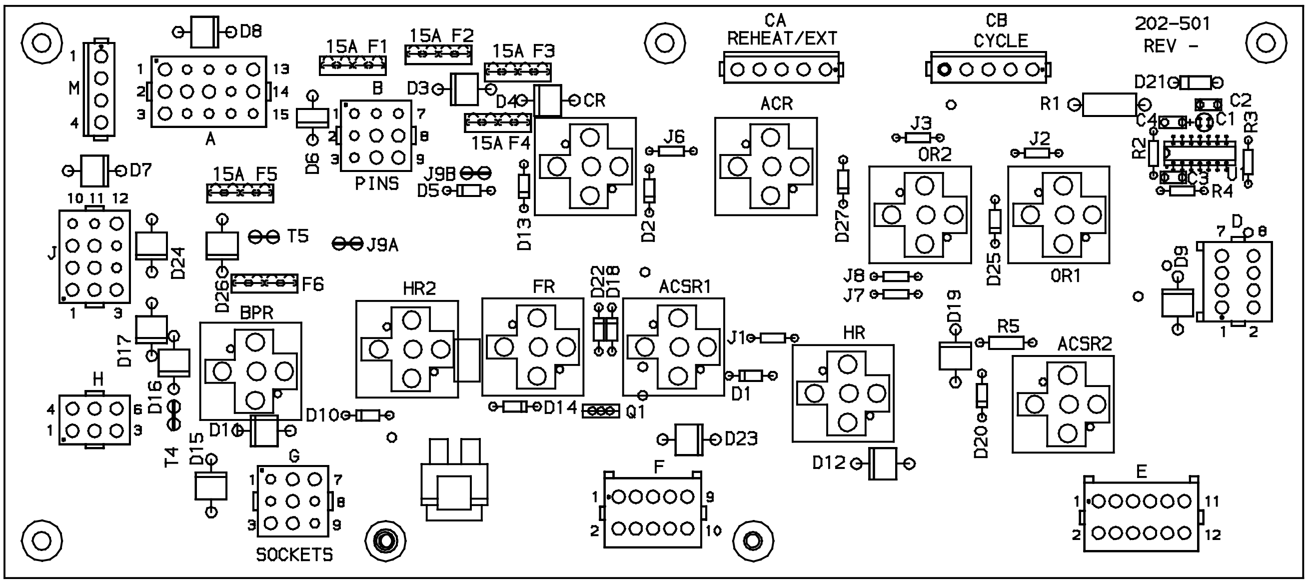
Temperature		Pressure		
°F	°C	Psig	Kg/cm2	Bar
28	-2	24.5	1.72	1.69
30	-1	26.1	1.84	1.80
32	0	27.8	1.95	1.92
34	1	29.6	2.08	2.04
36	2	31.3	2.20	2.16
38	3	33.2	2.33	2.29
40	4	35.1	2.47	2.42
45	7	40.1	2.82	2.76
50	10	45.5	3.20	3.14
55	13	51.2	3.60	3.53
60	16	57.4	4.04	3.96
65	18	64.1	4.51	4.42
70	21	71.1	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

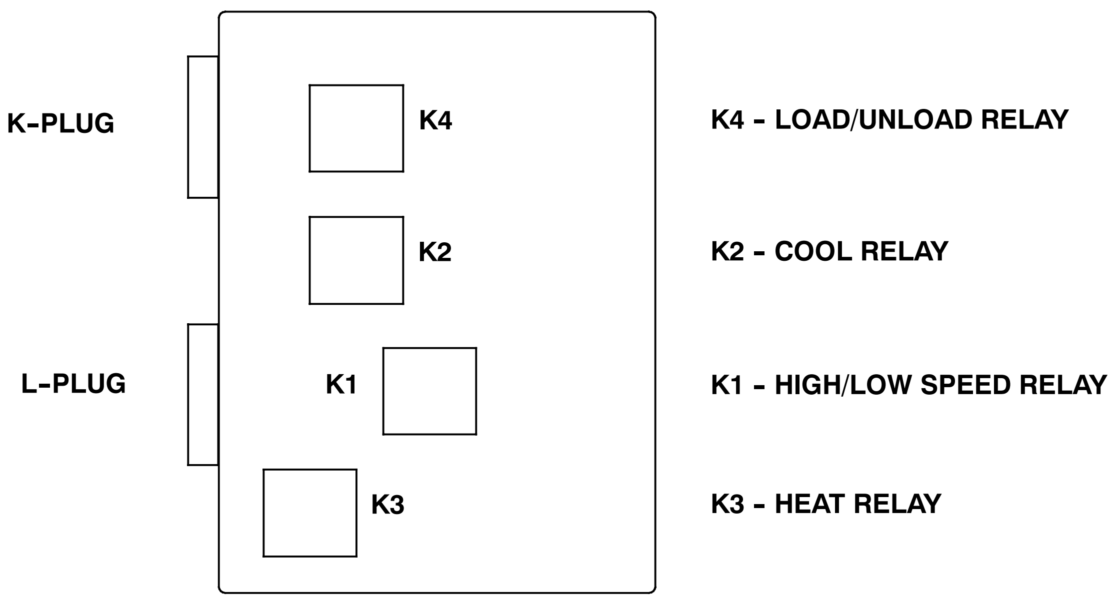
ELECTRICAL

5-1 INTRODUCTION

This section contains electrical wiring schematics covering the models listed in Table 1-1. The schematics shown in this section provides information for all system models and optional configurations. The EM-17 evaporators are fitted with 2 blower/motor assemblies. The CM-5 Skirt-Mounted Condenser has 5 fan/motor assemblies and the KR-4 Rooftop Condenser has 4 fan/motor assemblies.



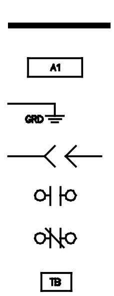
RELAY BOARD (RB)



ELECTRONIC THERMOSTAT (TH)

Figure 5-1 Electrical Control Panel Relay Board (RB) & Electronic Thermostat (TH) Outline Views.

SYMBOL	DESCRIPTION
ACMS	A/C MODE SWITCH
ACR	A/C RELAY
ACSL	A/C STOP LIGHT
ACSR1	A/C STOP RELAY #1 (TIME DELAYED)
ACSR2	A/C STOP RELAY #2 (TIME DELAYED)
ALT	ALTERNATOR
CFR1 – CFR3	CONDENSER FAN RELAY
CFS1 – CFS2	CONDENSER FAN SPEED SWITCH
CL	CLUTCH
CF1 – CF5	CONDENSER FAN MOTORS
CR	CLUTCH RELAY
CSR	CONDENSER SPEED RELAY
D1 – D30	DIODES
EM1	EVAPORATOR FAN MOTOR #1
EM#2	EVAPORATOR FAN MOTOR #2
ESR – ESR2	EVAPORATOR SPEED RELAY
FR	FAULT RELAY
F2, F4 – F11	FUSE – 15 AMP
F12 & F13	FUSE – 40 AMP
F14	FUSE – 60 AMP
HPS	HIGH PRESSURE SWITCH
LATH	LOW AMBIENT THERMOSTAT
LPS	LOW PRESSURE SWITCH
LLS	LIQUID LINE SOLENOID
PWRR	POWER RELAY
RES	RESISTOR
TB1, TB2 ...	TERMINAL STRIP POSITIONS
TS	THERMOSTAT
UPS1	UNLOADER PRESSURE SWITCH #1
UPS2	UNLOADER PRESSURE SWITCH #2
UPS3	UNLOADER PRESSURE SWITCH #3
UV1	UNLOADER VALVE #1
UV2	UNLOADER VALVE #2



INDICATES RELAY BOARD TRACE

INDICATES PLUG LOCATION ON RELAY BOARD

INDICATES A WIRE GROUND

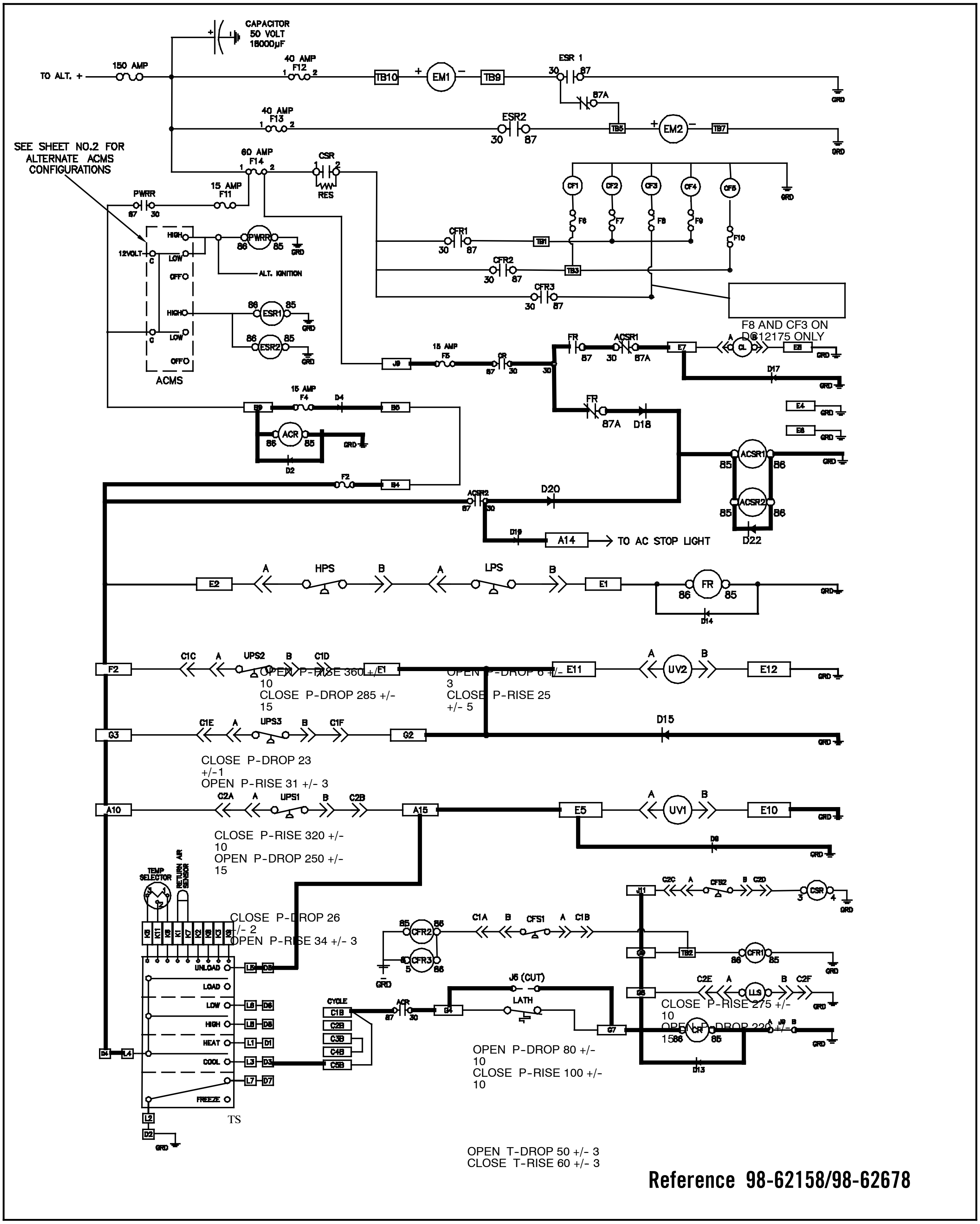
INDICATES A CONNECTOR (WEATHER PACK)

INDICATES A NORMALLY OPEN CONTACT

INDICATES A NORMALLY CLOSED CONTACT

INDICATES TERMINAL STRIP

Figure 5-2 Schematic (Electronic T-Stat)
(Sheet 1 of 3)



Reference 98-62158/98-62678

Figure 5-2 Schematic (Electronic T-Stat)
(Sheet 2 of 3)

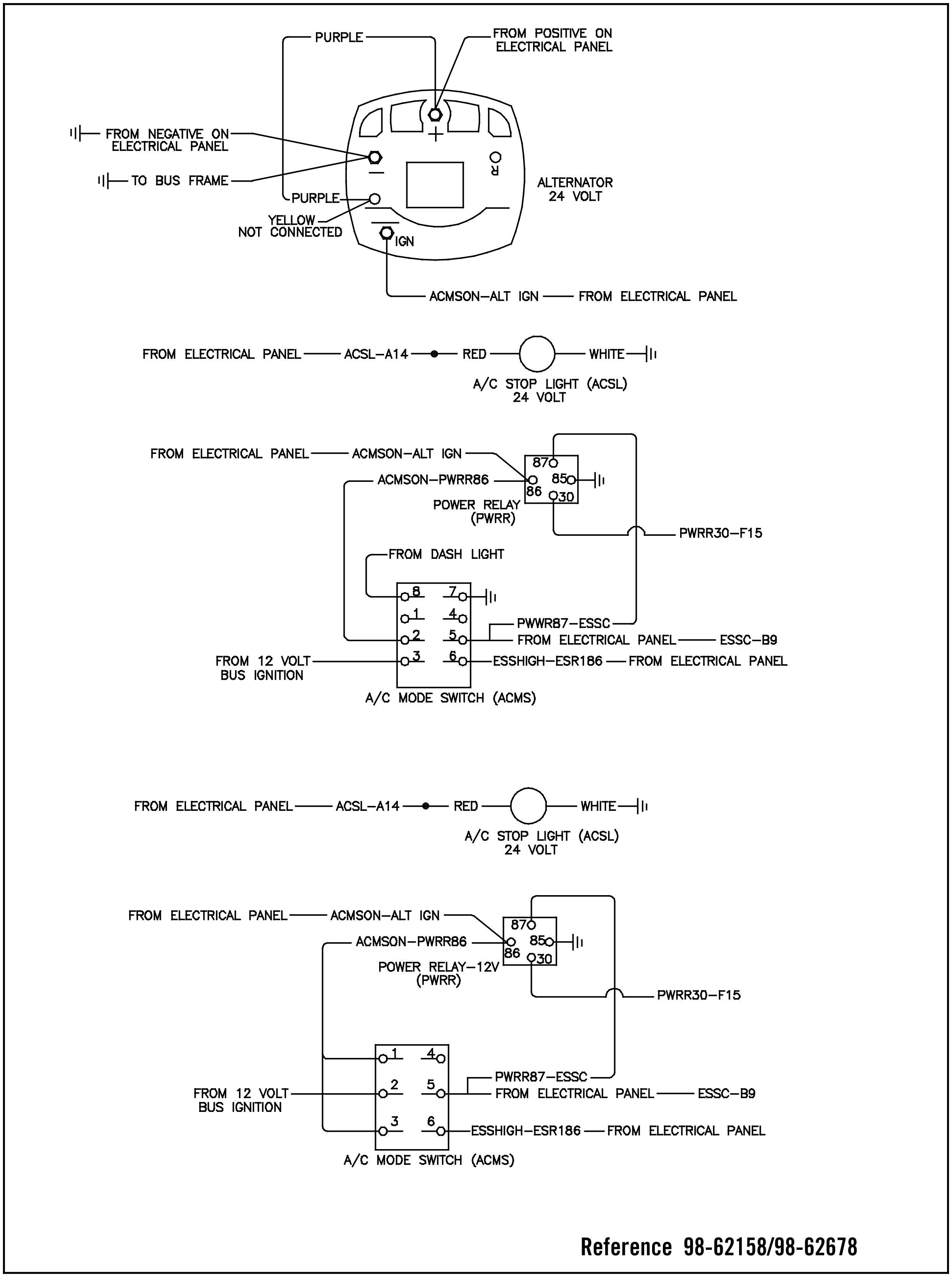
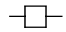
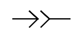
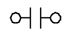
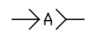
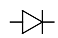
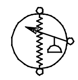
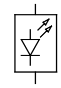
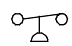
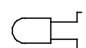
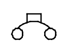
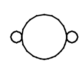
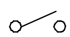
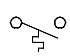
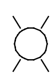
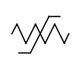
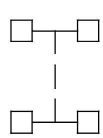


Figure 5-2 Schematic (Electronic T-Stat)
(Sheet 3 of 3)

LEGEND

SYMBOL	DESCRIPTION	
ATS	AMBIENT TEMPERATURE SENSOR	
CFR1	CONDENSER FAN RELAY 1	
CAP	CAPACITOR	
CM1	CONDENSER MOTOR 1	
CM2	CONDENSER MOTOR 2	
CM3	CONDENSER MOTOR 3	
CM4	CONDENSER MOTOR 4	
CSR1	COND MOTOR LOW SPEED RELAY	
CSR2	COND MOTOR HIGH SPEED RELAY	
D1	CFR1	
D2	CSR1	
D3	CSR2	
D4	EFR1	
D5	ESR1	
D6	ESR2	
DPT	DISCHARGE PRESSURE TRANSDUCER	
EFR1	EVAP FAN RELAY 1	
EM1	EVAP MOTOR 1	
EM2	EVAP MOTOR 2	
ESR1	EVAP SPEED RELAY 1 (LOW SPEED)	
ESR2	EVAP SPEED RELAY 2 (HIGH SPEED)	
F1	FUSE, MAIN POWER (PTB1)	
F2	FUSE, COND FAN (LOW SPEED)	
F3	FUSE, COND FAN (HIGH SPEED)	
F4	FUSE, COMPRESSOR CLUTCH	
F5	FUSE, EVAP LOW SPEED	
F6	FUSE, EVAP HIGH SPEED	
F7	FUSE, UNLOADER 1	
F8	FUSE, UNLOADER 2	
F9	FUSE, HEAT	
F10	FUSE, WATER PUMP	
F11	FUSE, CM1	
F12	FUSE, CM2	
F13	FUSE, CM3	
F14	FUSE, CM4	
F15	FUSE, ALTERNATOR	
F16	FUSE, EFR1–EM1	
F17	FUSE, ESR2–EM2	
F18	FUSE, TB1 TO ENVIROMATE	
F19	FUSE, TB5 TO ENVIROMATE	
K1	ENERGIZES COND LOW SPEED	
K2	ENERGIZES COND HIGH SPEED	
K3	ENERGIZES COMPRESSOR CLUTCH	
K4	ENERGIZES EVAP LOW SPEED	
K5	ENERGIZES EVAP HIGH SPEED	
K6	ENERGIZES UNLOADER 1	
K7	ENERGIZES UNLOADER 2	
K8	HEAT	
K9	WATER PUMP	
K10	IGNITION	
PTB1	POWER BLOCK 1 POSITIVE	SINGLE POLE STUD
PTB2	POWER BLOCK 2 NEGATIVE	
PTB3	POWER BLOCK 3 POSITIVE	
PTB4	POWER BLOCK 4 NEGATIVE	
TB1	TERMINAL BLOCK (TERMINAL 1)	10 POLE TERMINAL BLOCK
TB2	TERMINAL BLOCK (TERMINAL 2)	
TB4	TERMINAL BLOCK (TERMINAL 4)	
TB5	TERMINAL BLOCK (TERMINAL 5)	
TB6	TERMINAL BLOCK (TERMINAL 6)	
TB7	TERMINAL BLOCK (TERMINAL 7)	
TB8	TERMINAL BLOCK (TERMINAL 8)	
TB9	TERMINAL BLOCK (TERMINAL 9)	
TB10	TERMINAL BLOCK (TERMINAL 10)	
TB11	TERMINAL BLOCK (TERMINAL 11)	4 POLE TERMINAL BLOCK
TB12	TERMINAL BLOCK (TERMINAL 12)	
TB13	TERMINAL BLOCK (TERMINAL 13)	
TB14	TERMINAL BLOCK (TERMINAL 14)	
ENV1	ENVIROMATE 1	
ENV3	ENVIROMATE 3	
ENV4	ENVIROMATE 4	
ENV7	ENVIROMATE 7	
ENV9	ENVIROMATE 9	
ENV10	ENVIROMATE 10	
ENV11	ENVIROMATE 11	
ENV12	ENVIROMATE 12	
ENV15	ENVIROMATE 15	
ENV16	ENVIROMATE 16	
ENV18	ENVIROMATE 18	
ENV19	ENVIROMATE 19	
ENV20	ENVIROMATE 20	
ENV21	ENVIROMATE 21	
ENV22	ENVIROMATE 22	
ENV23	ENVIROMATE 23	
ENV24	ENVIROMATE 24	

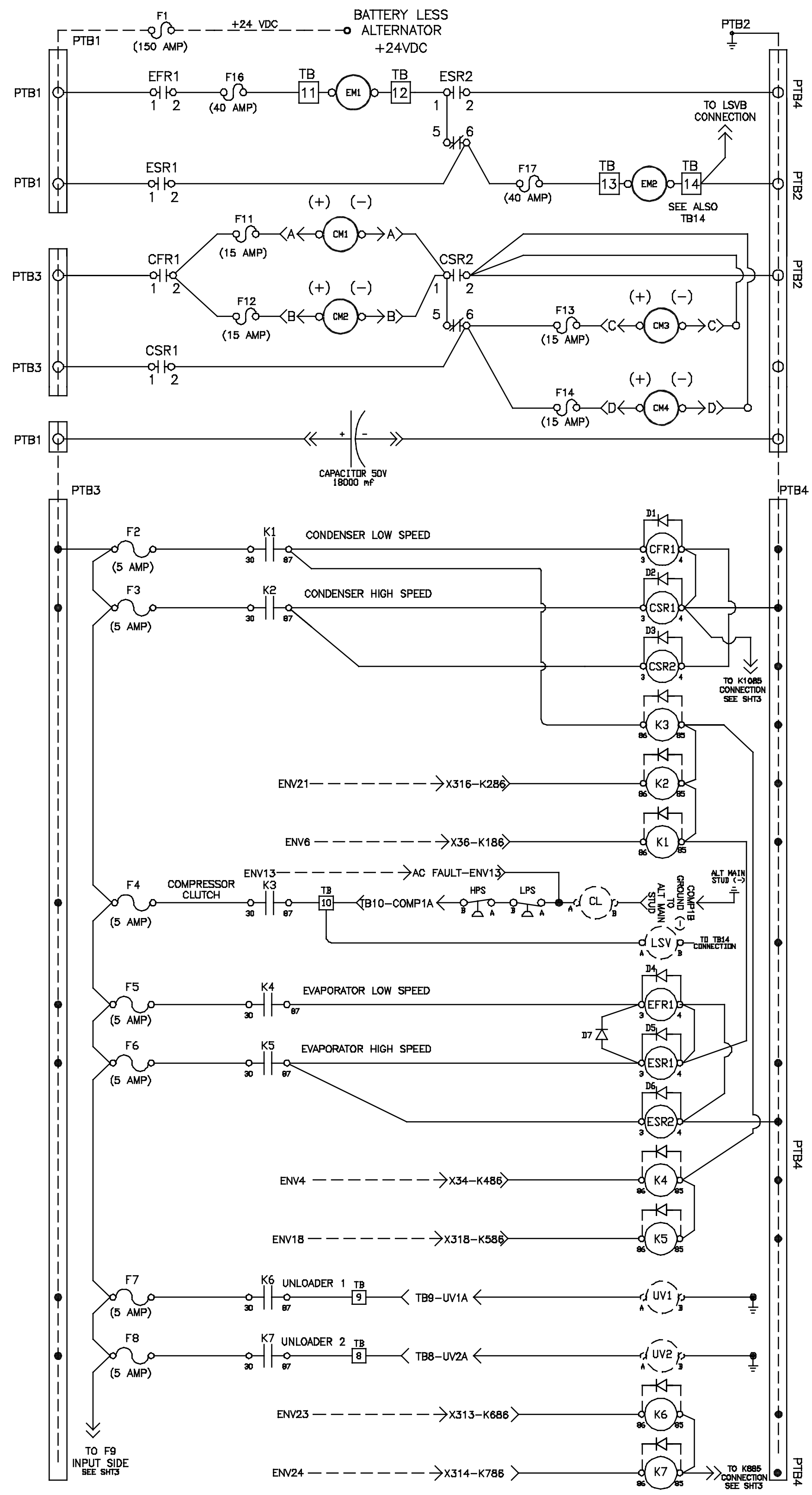
SYMBOLS

	INDICATES CONNECTOR TERMINAL
	INDICATES GROUND
	INDICATES A WIRE
	INDICATES A WIRE (OEM SUPPLIED)
	INDICATES GROUND STUD CONNECTION
	INDICATES POWER STUD
	INDICATES A CONNECTOR
	INDICATES A NORMALLY OPEN CONTACT
	INDICATES A CONNECTOR WITH PIN LOCATION
	INDICATES DIODE
	INDICATES FUSE
	INDICATES PRESSURE SENSOR
	INDICATES LED ASSEMBLY
	INDICATES PRESSURE SWITCH NC
	INDICATES TEMPERATURE SENSOR
	INDICATES MANUAL RESET BREAKER
	INDICATES RELAY COIL
	INDICATES SWITCH N/O
	INDICATES TEMPERATURE SWITCH NO
	INDICATES LAMP
	INDICATES POLY SWITCH
	INDICATES RIBBON CABLE

Schematic 98-63239 Rev. B (Sheet 1)

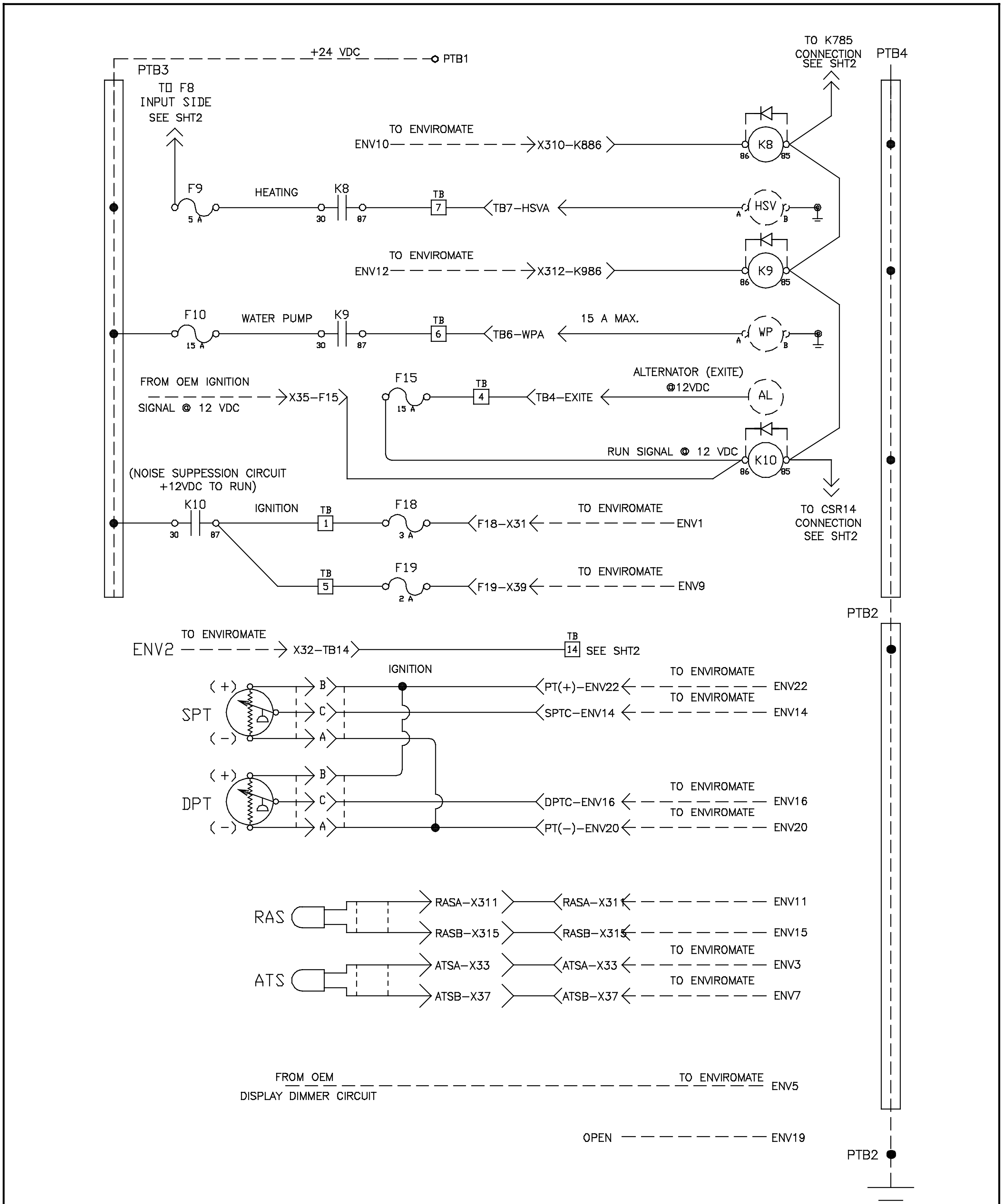
Figure 5-3 Schematic (EnviroMATE)

POWER CIRCUIT



Schematic 98-63239 Rev. B (Sheet 2)

Figure 5-3 Schematic (EnviroMATE)



Schematic 98-63239 Rev. B (Sheet 3)

Figure 5-3 Schematic (EnviroMATE)

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