



OPERATION AND SERVICE for

MODEL 68RF353-100 & 101

T-308

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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. 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 and condenser fans.

No work should be performed on the unit 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 unit and investigate.

MAINTENANCE PRECAUTIONS

Beware of unannounced starting of the evaporator and condenser fans. 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 CO₂ (never use water).

SPECIFIC WARNINGS AND CAUTIONS



WARNING

The Filter-drier May Contain Liquid Refrigerant. Slowly Loosen The Connecting Nuts And Avoid Contact With Exposed Skin Or Eyes.



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



SPECIFIC WARNINGS AND CAUTIONS - Continued:



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

Battery disconnect should be off.



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.



CAUTION

Do not under any circumstances attempt to service the microprocessor. Should a problem develop with the microprocessor, replace it.



CAUTION

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



CAUTION

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



SECTION 1

DESCRIPTION

1.1 INTRODUCTION

This manual contains Operating Instructions, Service Instructions and Electrical Data for the Model 68RF353 Air Conditioning and Heating equipment furnished by Mobile Climate Control as shown in Table 1-1, Table 1-2 and Table 1-3. Additional support manuals are referenced in Table 1-4.

The Mobile Climate Control model 68RF series units are of lightweight frame construction, designed to be installed on the vehicle roof.

Model 68RF353 systems consists of a condensing section, evaporator section and an engine compartment mounted compressor. To complete the system, the air conditioning and heating equipment interfaces with electrical cabling, refrigerant piping, engine coolant piping (for heating), duct work and other components furnished by the bus manufacturer. See Figure 1-1.

Operation of the units is controlled automatically by a microprocessor based Micromax Controller which maintains the vehicle's interior temperature at the desired set point.

1.2 CONFIGURATION IDENTIFICATION

Unit identification information is provided on a plate located inside the condenser and evaporator sections. The plate provides the unit model number, the unit serial number and the unit parts identification number (PID). The model number identifies the overall unit configuration while the PID provides information on specific optional equipment and differences in detailed parts.

The following paragraph provides descriptions of the options provided. A tabular listing of unit model numbers and PID numbers, used to assist the reader in identifying the equipment supplied is provided in Table 1-1, Table 1-2 and Table 1-3.

1.3 OPTION DESCRIPTION

Various options may be factory or field equipped to the base unit. These options are listed in the tables and described in the following subparagraphs.

1.3.1 Condenser Cover (Skins)

The condenser section may be fitted with one of three different cover assemblies dependent upon the

curvature of the bus roof. The cover assemblies available are the Standard, Standard "China" and 180 inch radius cover.

1.3.2 Condenser/Evaporator Electrical Kit

The 68RF353 systems are available with either 24 Volt permanent magnet motors or 24 Volt brushless motors.

1.3.3 Condenser Refrigeration Kit

The 100 Series condensers are all fitted with the same Refrigerant Kit. The 101 Series units may be fitted with one of three different kits. The 101 Series Kit include: condensers fitted with service valves and a check valve, condensers with no service valves and fitted with a check valve and condensers fitted with service valves and no check valve.

1.3.4 Evaporator Frame Kit

The evaporator may be fitted with one of ten different base assemblies, depending if 100 (4 assemblies) or 101 series (6 assemblies) and whether the condenser is located in the front or rear. The assemblies allow fitting of different air exchange equipment, ESS Air Coolers and Spoiler Brackets.

1.3.5 Evaporator Cover (Skins)

The evaporator section may be fitted with one of seven different cover assemblies. A standard cover, a standard "China" cover, a 180 inch radius cover, an evaporator only with grey end caps, an evaporator only with safety option or an evaporator only with safety option and grey.

1.3.6 Evaporator Refrigeration Kit

The evaporator units are assembled to allow orientation of the connections for different mounting arrangements and may be supplied with various piping layouts for specific applications, including the ESS Air Cooler and Heat Only application.

1.3.7 Air Exchange/Controller

The unit may be fitted with either an air exchange assembly or an air exchange blankoff plate. Air exchange assemblies may be of the 0 & 20% opening, 0 & 100 % opening or customer preset type.

The customer preset air exchange uses a special controller.

There is also the heat only multiplex and the 05G Micromax kit.



Table 1-1 Option Legend

OPTION	DESCRIPTION
1	Standard Cover
2	180 Inch Radius Cover
3	Standard Cover (China)
1	24 Volt With PM Motors
2	24 Volt Brushless Motors
1	100 Series Units
2	Fitted With Service Valves And Check Valve
3	With No Service Valves, Fitted With Check Valve
4	Fitted With Service Valves And No Check Valve
1	100 Series - 20% Air Exchange Or Blank-Off
2	100 Series - 100% Air Exchange
3	100 Series - Customer Preset - 100% Fresh Air
4	100 Series - Customer Preset - 20% Fresh Air
5	101 Series - 100% Fresh Air
6	101 Series - 100% Fresh With ESS Modified
7	101 Series - 100% Fresh With Spoiler Brackets
8	101 Series - 20% Fresh With Spoiler Brackets - Condenser Rear (CR)
9	101 Series - 20% Fresh With Spoiler Brackets - Condenser Front (CF)
10	101 Series - 20% Fresh Air

1	Standard Cover
2	Standard Cover (China)
3	180 Inch Radius Cover
4	Standard Cover - Evaporator Only - With End Cap
5	Standard Cover - Evaporator Only - With End Cap - Grey
6	Standard Cover - Evaporator Only - Safety
7	Standard Cover - Evaporator Only - Safety - Grey
1	24 Volt With PM Motors
2	24 Volt Brushless Motors
OPTION	DESCRIPTION
1	100 Series - Curb Side With Heat
2	100 Series - Road Side With Heat
3	100 Series - Curb Side With Heat
4	100 Series - Curb Side With Heat
5	100 Series - Road Side With Heat
6	101 Series - C. Rear With Heat
7	101 Series - C. Front With Heat
8	101 Series - C. Front Without Heat
9	101 Series - C. Front With Heat - ESS Module
10	101 Series - C. Rear With Heat Only - Evaporator Only
11	101 Series - C. Front With Heat Only - Evaporator Only
1	None
2	0 & 20%
3	Customer Preset
4	0% TO 100% (101 Series)
1	05G Micromax Belimo
2	Micromax With GR60 Relay Board
3	Heat Only - Multiplex
4	05G Micromax Belimo - No Transducers
3	Heat Only - Multiplex C. Front
4	05G Micromax Can +/-



Table 1-2 Option Table - 100 Series

MODEL 68RF353	PID Condenser RF353C	PID Evaporator RF353E	Condenser Skins Kit	Condenser Electrical Kit	Condenser Refrigeration Kit	Evaporator Frame	Evaporator Electrical Kit	Evaporator Refrigeration Kit	Air Exchange Kit	Controller Kit
-100	N/A	N/A	1	1	1	1	1	1	1	1
-100-1	N/A	N/A	1	1	1	1	1	1	2	1
-100-2	00006	00007	1	1	1	2	1	2	3	1
-100-3	00008	00009	1	1	1	1	1	2	2	1
-100-4	00010	00011	1	1	1	1	1	2	1	1
-100-5	00012	00013	1	1	1	2	1	3	3	1
-100-6	00014	00015	1	1	1	1	1	3	2	1
-100-7	00016	00017	1	1	1	1	1	3	1	1
-100-8	00018	00019	1	1	1	2	1	1	3	1
-100-9	00020	00021	1	1	1	4	1	5	4	1
-100-10	00022	00023	1	1	1	1	1	2	1	1
-100-11	00024	00025	1	1	1	2	1	3	3	1
-100-12	00026	00027	1	1	1	4	1	4	2	1
-100-13	00028	00029	1	1	1	1	1	3	1	1
-100-14	00038	00039	1	1	1	3	1	4	4	1

Table 1-3 Option Table - 101 Series

MODEL 68RF353	PID Condenser RF353C	PID Evaporator RF353E	Condenser Skins Kit	Condenser Electrical Kit	Condenser Refrigeration Kit	Evaporator Frame	Evaporator Electrical Kit	Evaporator Refrigeration Kit	Air Exchange Kit	Controller Kit
-101	00053	00054	3	1	3	5	2	1	7	1
-101-1	00054	00056	3	1	3	5	2	1	6	1
-101-2	00057	00058	3	1	2	5	2	1	6	1
-101-3	00059	00060	3	1	3	5	3	1	7	1
-101-4	00067	00068	3	1	3	5	2	1	8	1
-101-5	00069	00070	3	1	3	5	2	1	7	2
-101-6	00071	00072	3	1	4	5	2	1	6	1
-101-7	00097	00098	3	1	4	6	2	1	9	1
-101-8	00113	00114	3	2	4	5	2	2	6	6
-101-9	00115	00116	3	2	4	6	2	2	9	1
-101-10	-	00117	-	-	-	7	4	1	10	1
-101-11	-	00118	-	-	-	7	4	2	10	1
-101-12	-	00119	-	-	-	8	5	2	10	3
-101-13	-	00120	-	-	-	9	6	2	11	4
-101-14	-	00121	-	-	-	9	6	2	11	5

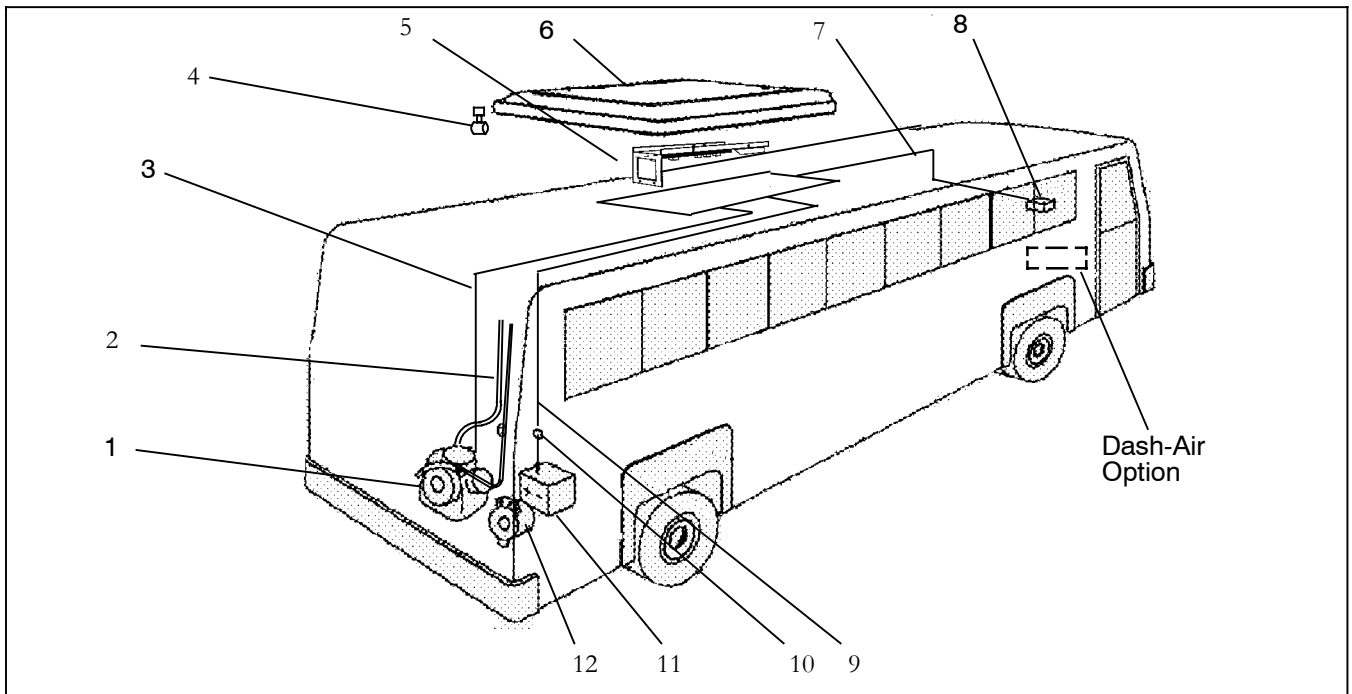


Table 1-3 Option Table - 101 Series (Continued)

MODEL 68RF353	PID Condenser RF353C	PID Evaporator RF353E	Condenser Skins Kit	Condenser Electrical Kit	Condenser Refrigeration Kit	Evaporator Frame	Evaporator Electrical Kit	Evaporator Refrigeration Kit	Air Exchange Kit	Controller Kit
-101-15	-	00122	-	-	-	9	7	2	11	4
-101-16	-	00123	-	-	-	9	7	2	11	5
-101-17	00116	00124	3	2	4	5	2	2	6	1

Table 1-4 Additional Support Manuals

MANUAL/FORM NUMBER	EQUIPMENT COVERED	TYPE OF MANUAL
T-304PL	68RF353	Parts List
62-10699	Micromate	Diagnostic Tool (Card)



- | | |
|-----------------------------------|-------------------|
| 1. Compressor | 7. Main Harness |
| 2. Refrigerant Lines | 8. Driver Control |
| 3. Compressor Harness | 9. Power Harness |
| 4. Liquid Line Solenoid | 10. Power Relay |
| 5. Electronics Boards | 11. Battery |
| 6. RF353 (Rooftop) See Figure 1-2 | 12. Alternator |

Figure 1-1 System Component Identification

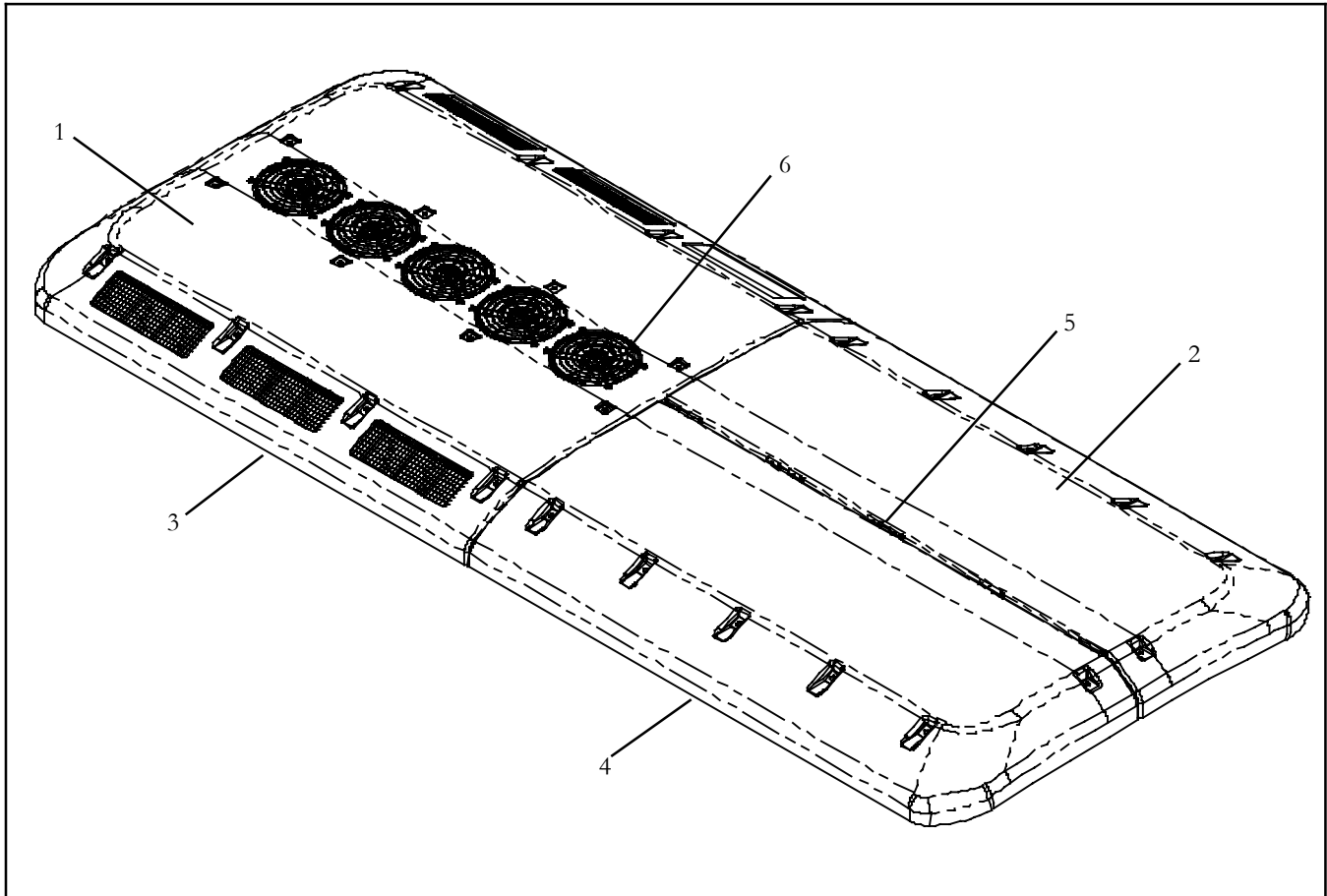


1.4 GENERAL DESCRIPTION

1.4.1 Rooftop Unit

The Rooftop unit (see Figure 1-2) is comprised of the condensing section, evaporator section,

Micromax electronics, and the Fresh Air System. All components are accessible by lifting the condenser and evaporator top covers. Descriptions of the systems are provided in the following sub paragraphs.



- | | |
|---------------------------------------|--|
| 1. Top Cover, Condenser | 4. Evaporator Section (See Figure 1-4) |
| 2. Top Cover, Evaporator | 5. Hinge, Evaporator Cover |
| 3. Condenser Section (See Figure 1-3) | 6. Condenser Fan Grille |

Figure 1-2 Rooftop Unit Components

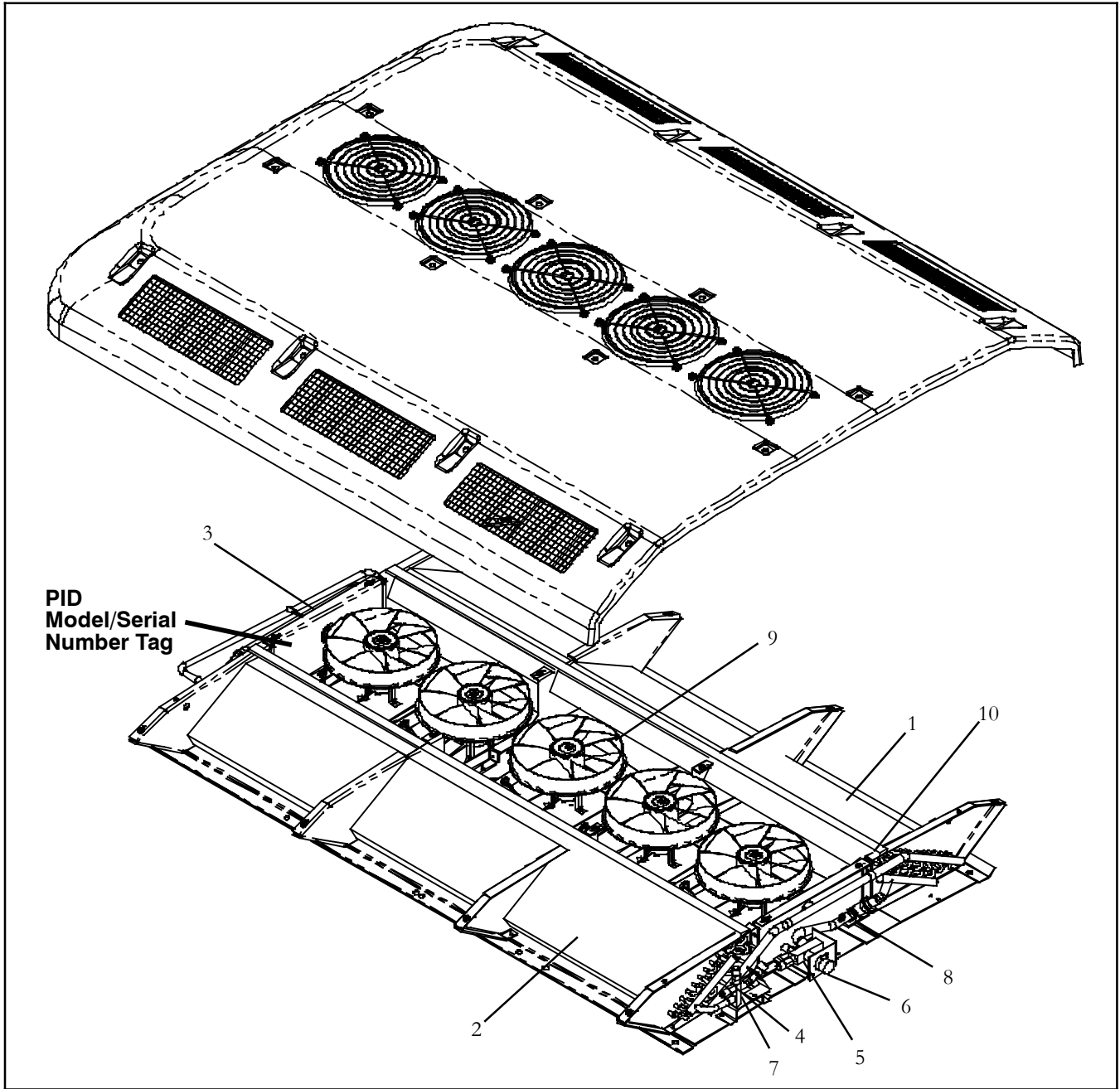
1.4.2 Condensing Section

The condensing section (Figure 1-3) includes the cover, left and right condenser coils, five fan and motor assemblies, receiver, check valve, service valves and an ambient temperature sensor..

The condenser coils provide 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 refrigerant circulating inside the tubes; this results in condensation of the refrigerant into a liquid.

The receiver collects and stores liquid refrigerant. The receiver is also fitted with a fusible plug which protects the system from unsafe high pressure conditions. An ambient temperature sensor measures ambient temperature and sends an electrical signal to the controller.

A check valve is located in the discharge line. 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.



- | | |
|------------------------------|-------------------------------------|
| 1. Coil Assembly Left | 6. Discharge Line. |
| 2. Coil Assembly Right | 7. Liquid Line |
| 3. Receiver | 8. Check Valve |
| 4. Service Valve (Liquid) | 9. Condenser Fan and Motor Assembly |
| 5. Service Valve (Discharge) | 10. Ambient Temperature Sender |

Figure 1-3 Condensing Section Components

1.4.3 Evaporator Section

The evaporator section (Figure 1-4) includes the evaporator coils, six blower and motor assemblies, evaporator coil assemblies, heater coil assemblies, filter drier, a thermostatic expansion valve, liquid line

solenoid, service valves and condensate drain connections.

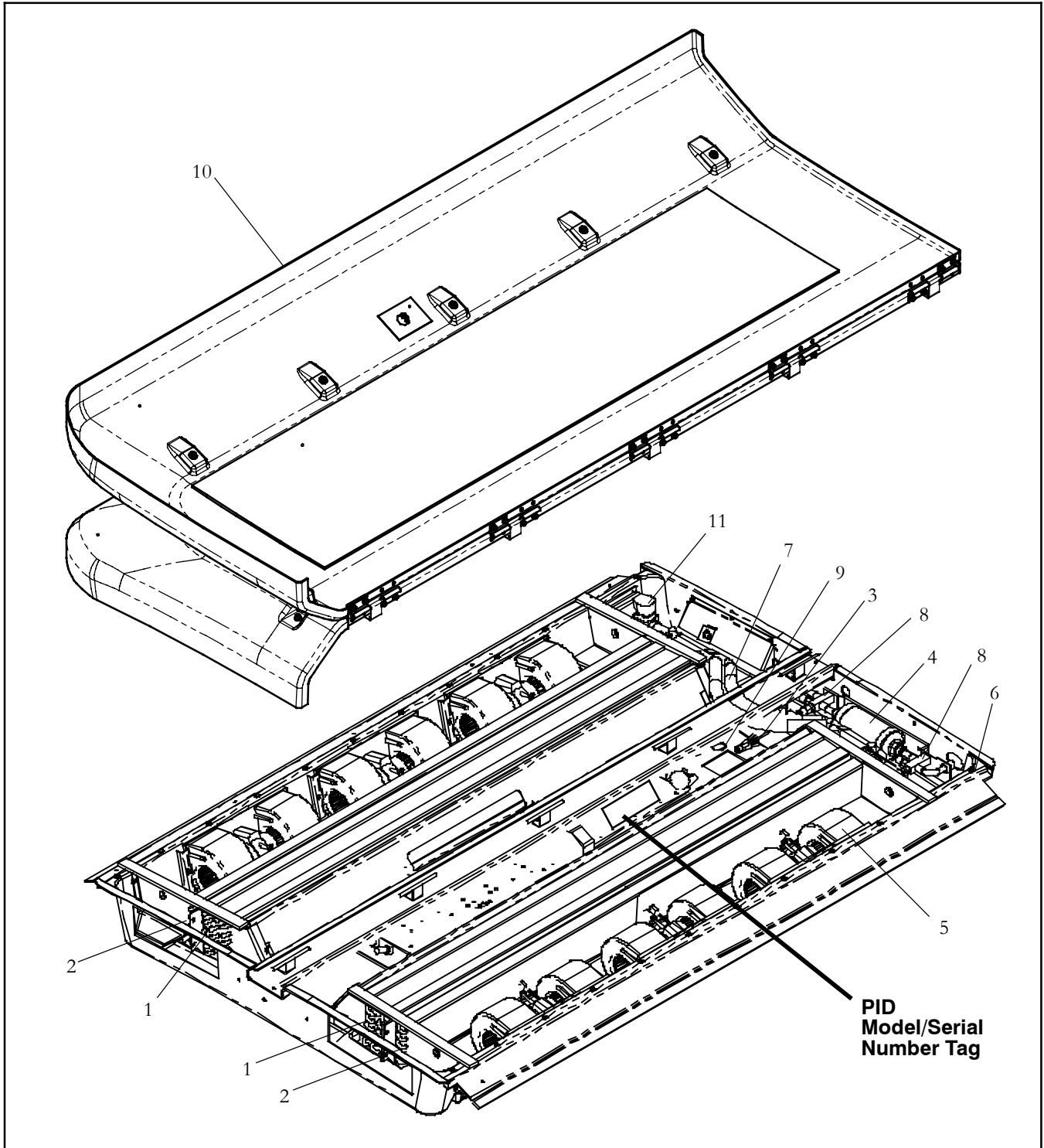
The evaporator coils provide heat transfer surface for transferring heat from air circulating over the outside coil area to the refrigerant circulating inside the tubes; thus providing cooling. The heating coils



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. The filter-drier removes moisture and debris from the liquid refrigerant before it enters the thermostatic expansion valve in the evaporator assembly. Service valves enable isolation of the filter-drier for service. The thermostatic expansion valve meters flow of

refrigerant entering the evaporator coils. The liquid line solenoid valve closes when system is shut down to prevent flooding of the evaporator coils with liquid refrigerant.

A heat valve controls the flow of engine coolant water to the heating coils upon receipt of a signal from the controller. The condensate drain connections provide a means for connecting tubing for disposing of condensate collected on the evaporator coils during cooling operation.



- 1. Evaporator Coil Assembly
- 2. Heat Coil
- 3. Expansion Valve
- 4. Filter Drier
- 5. Blower & Motor Assembly
- 6. Suction Line

- 7. Heating Lines
- 8. Service Valve
- 9. Liquid Line Solenoid
- 10. Cover
- 11. Heat Valve

PID
Model/Serial
Number Tag

Figure 1-4 Evaporator Section Components



1.4.4 Compressor Assembly

The compressor assembly is mounted in the engine compartment (see Figure 1-1) and 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.

The compressor raises the pressure and temperature of the refrigerant and forces it into the condenser tubes. The clutch assembly provides a means of belt driving the compressor by 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. For more detailed information on the 05G compressor, refer to the Operation and Service Manual number 62-02756.

1.4.5 Fresh Air System

The Fresh Air System consists of a damper and damper operator. The damper operator may be controlled by the driver, if a switch is provided. In the automatic mode, it is controlled by the Micromax to open and close the damper to allow addition of fresh air into the air entering the evaporator coil. For additional information on air flow, refer to paragraph 1.9.

1.4.6 System Operating Controls And Components

The system is operated by a Mobile Climate Control Micromax microprocessor controller which consist of a relay board (Figure 1-9), logic board (Figure 1-8), and manual operator switches. The manual operating switches are located on the drivers control and may consist of a single OEM supplied ON/OFF switch, additional OEM supplied switches or a Mobile Climate Control supplied Micromate control panel (Figure 1-11). The logic board regulates the operational cycles of the system by energizing or de-energizing relays on the relay board in response to deviations in interior temperature. Modes of operation include Cooling, Heat and Vent. On systems fitted with only an ON/OFF switch and on systems with the Micromate set in the AUTO mode, the logic board will cycle the system between

the operating modes as required to maintain desired set point temperature.

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

In the heat mode the heat valve is opened to allow a flow of engine coolant through the heat coils of the evaporator coil. The evaporator fans operate to circulate air over the evaporator coil in the same manner as the vent mode.

In the cooling mode the compressor is energized while the evaporator and condenser fans are operated to provide refrigeration as required. The compressor is fitted with cylinder unloaders to match compressor capacity to the bus requirements. Once interior temperature reaches the desired set point, the system may operate in the clutch cycle or reheat mode. A controller programmed for clutch cycle will de-energize the compressor clutch and allow the system to operate in the vent mode until further cooling is required. A controller programmed for reheat will maintain compressor operation and open the heat valve to allow reheating of the return air. In the reheat mode interior temperature is maintained at the desired set point while additional dehumidification takes place.

Controls may also be provided to allow manual operation of the evaporator fans in low or high speed and manual control of the fresh air damper in the open or closed position.

1.5 REFRIGERATION SYSTEM COMPONENT SPECIFICATIONS

a. Refrigerant Charge

R-134a 17 Lb (7.7 kg)

b. Compressor

UNIT MODEL	RF353
Compressor	05G
No of Cylinders	6
Weight - Dry W/Clutch	145 lbs (65.77 kg)
Oil Charge	5.5 pints (2.6 liters)

Oil Level:

Level in sight glass between Min.-Max marks on compressor crankcase (curbside)

Approved Compressor Oils - R-134a:

Castrol: Icematic SW68C

Mobil: EAL Arctic 68

ICI: Emkarate RL68H

c. Thermostatic Expansion Valve:

Superheat Setting: 12 ± 3°F (5 to 8°C)

MOP Setting: 53.9 ± 4 psig (3.67 ± 0.27 bar)



d. High Pressure Switch (HPS):

Opens at: 350 ± 10 psig (23.81 ± 0.68bar)
Closes at: 250 ± 10 psig (13.61 ± 0.68bar)

e. Low Pressure Switch (LPS)

Opens at: 6 ± 3psig (0.41 ± 0.20 bar)
Closes at: 25 ± 3 psig (1.7 ± 0.20 bar)

f. Water Temperature Switch (WTS)

Bus manufacturer supplied - suggested close on temperature rise at 105°F (41°C).

1.6 ELECTRICAL SPECIFICATIONS - MOTORS

a. Evaporator Fan Motor

Evaporator Motor	Permanent Magnet 24 VDC
Horsepower (kW)	1/8 (.09)
Full Load Amps (FLA)	9.5
Operating Speed High/ Low (RPM)	2900/1700
Bearing Lubrication	Factory Lubricated (additional grease not required)

b. Condenser Fan Motor

Condenser Motor	Permanent Magnet 24 VDC
Horsepower (kW)	1/8 (.09)
Full Load Amps (FLA)	3
Operating Speed (RPM)	1900
Bearing Lubrication	Factory Lubricated (additional grease not required)

1.7 ELECTRICAL SPECIFICATIONS - SENSORS AND TRANSDUCERS

a. Suction and Discharge Pressure Transducer

Supply Voltage: 4.5 to 5.5 vdc (5 vdc nominal)
Supply current: 8 mA maximum
Output Range: 8K ohms minimum
Input Range: -6.7 to 450 psig (-0.46 to 30.62 bar)
Output Current: -1.5 mA minimum to 1.5 mA maximum
Output Voltage: vdc = 0.0098 x psig + 0.4659

b. Temperature Sensors

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

1.8 SAFETY DEVICES

System components are protected from damage caused by unsafe operating conditions with safety

devices. Safety devices with Mobile Climate Control supplied equipment include high pressure switch (HPS), low pressure switch (LPS), circuit breakers and fuses.

a. Pressure Switches

High Pressure Switch (HPS)

During the A/C mode, compressor operation will automatically stop if the HPS switch contacts open due to an unsafe operating condition. Opening HPS contacts de-energizes, through the controller, the compressor clutch shutting down the compressor. The high pressure switch (HPS) is installed in the center head of the compressor.

Low Pressure Switch (LPS)

The low pressure switch is installed in the compressor and opens on a pressure drop to shut down the system when a low pressure condition occurs. In addition, if the microprocessor monitors a pressure less than 10 psig (0.68 bar) by the suction pressure transducer mounted in the evaporator section, the system will be shut down for at least one minute.

b. Fuses and Circuit Breakers

The system is protected against high current by an OEM supplied 150 amp fuse. Independent 15 amp fuses protect each evaporator blower motor assembly, 5 amp fuses protect each relay board output, 10 amp fuses protect ignition circuit output, while 20 amp fuses protect each condenser motor.

c. Ambient Lockout

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 points will be programmed to cut out at 45°F (7.2°C) and cut in at 50°F (10°C). This setting protects the compressor from damage caused by operation at low pressures.

d. Heat Lockout

When the the engine water temperature has fallen below the cut out set point, hot water is locked out until the temperature rises above the cut in setting. The set point will be programmed to cut in at 105°F (41°C).

1.9 AIR FLOW

The paths for ambient air through the condenser and coach air through the evaporator are illustrated in .

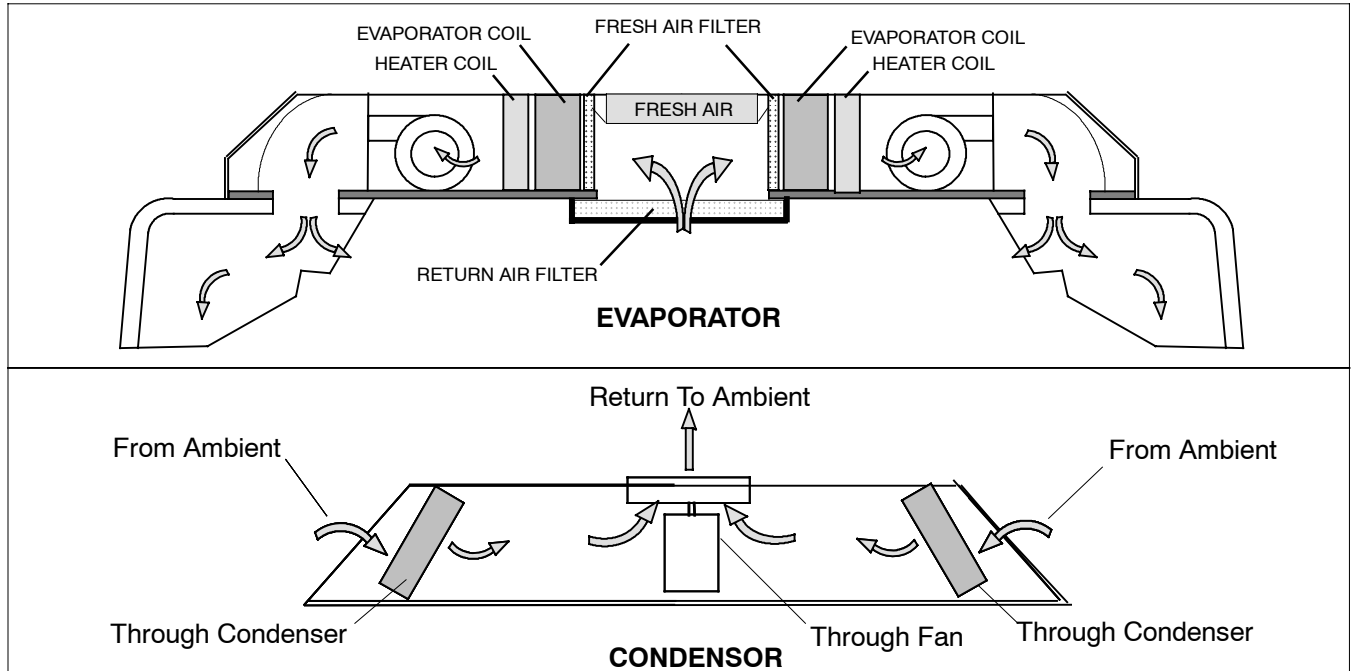


Figure 1-5 System Air Flow



1.10 AIR CONDITIONING REFRIGERATION CYCLE

When air conditioning (cooling) is selected by the controller, the unit operates as a vapor compression system using R-134a as the refrigerant (See 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 into the condenser tubes. The condenser fan circulates surrounding air (which is at a temperature lower than the refrigerant) over the outside of the condenser tubes. Heat transfer is established from the refrigerant (inside the tubes) to the condenser air (flowing over the tubes). The condenser tubes have fins designed to improve the transfer of heat from the refrigerant gas to the air; this removal of heat causes the refrigerant to liquefy, thus liquid refrigerant leaves the condenser and flows to the receiver.

The receiver serves as a liquid refrigerant reservoir so that a constant supply of liquid is available to the evaporators as needed, and acts as a storage space when pumping down the system. The liquid line is equipped with a sight glass to observe the refrigerant for restricted flow and the correct charge level.

The refrigerant leaves the receiver and passes through a sub-cooler, then to a filter-drier where an absorbent keeps the refrigerant clean and dry.

From the filter-drier, the liquid refrigerant then flows through the liquid line solenoid valve to the thermostatic expansion valve. The thermal expansion valve reduces pressure and temperature of the liquid and meters the flow of liquid refrigerant to

the evaporator to obtain maximum use of the evaporator heat transfer surface.

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

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.

1.11 HEATING CYCLE

Heating circuit (See Figure 1-6) components furnished by Mobile Climate Control include the heater coils and a solenoid operated heat valve. Components furnished by the bus manufacturer include auxiliary heater and boost water pump. The controller automatically controls the heat valve during the heating and reheat modes to maintain required temperatures inside the bus. Engine coolant (glycol solution) is circulated through the heating circuit by the engine and an auxiliary boost water pump. When the heat valve solenoid is energized, the valve will open to allow engine coolant to flow through the heater coil. The valve is normally closed so that if a failure occurs, the system will be able to cool.

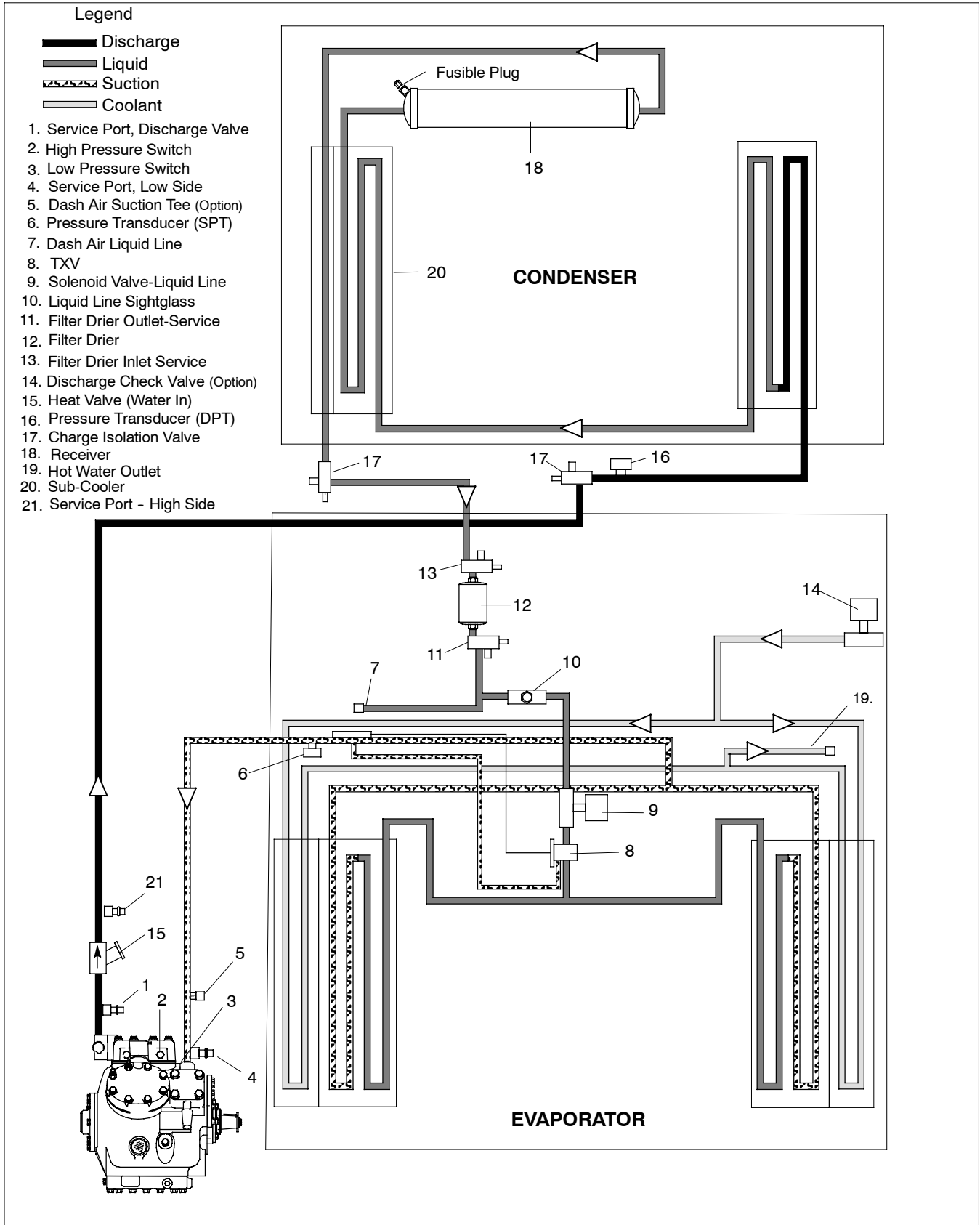


Figure 1-6 Refrigerant Flow Diagram

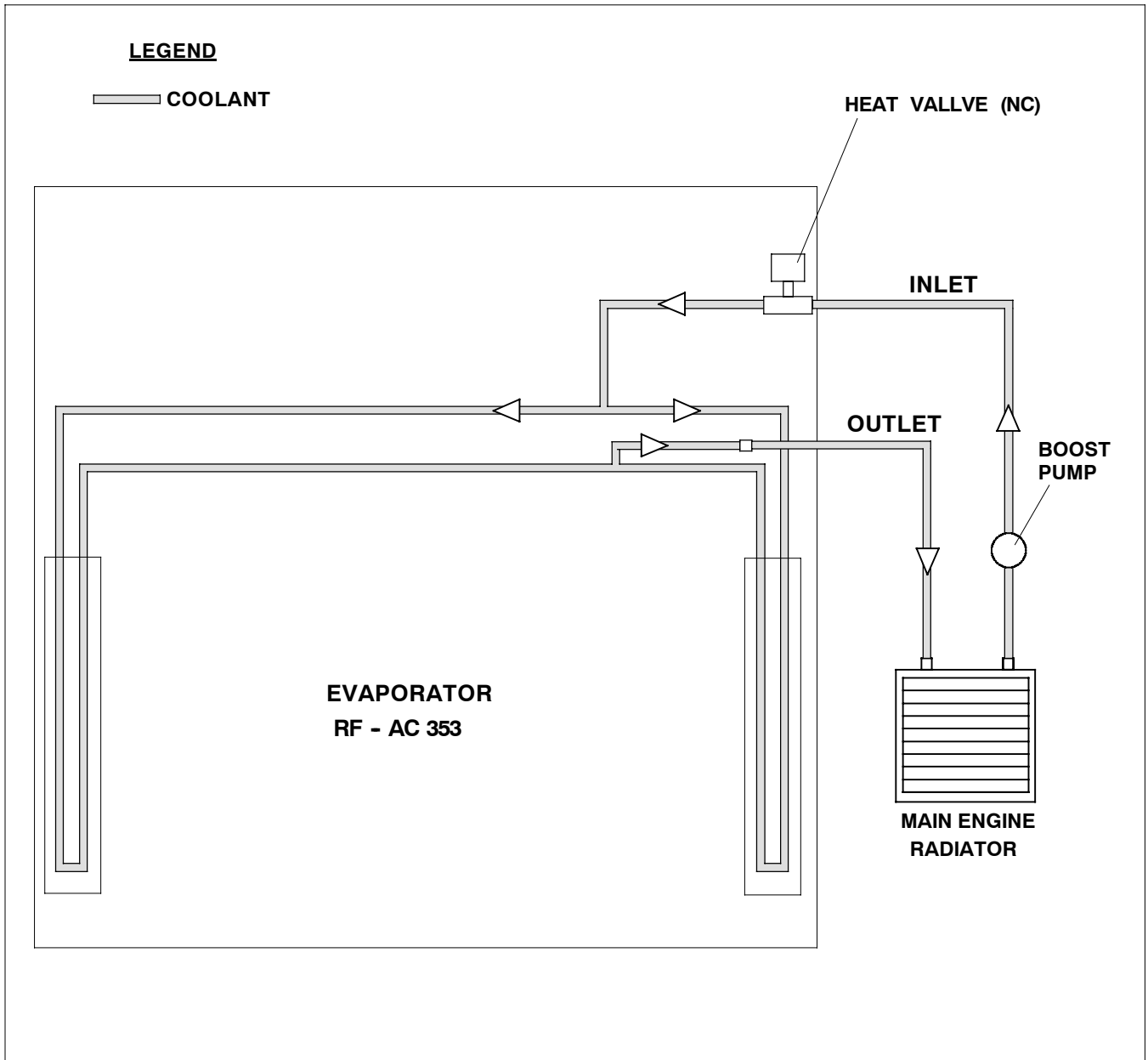
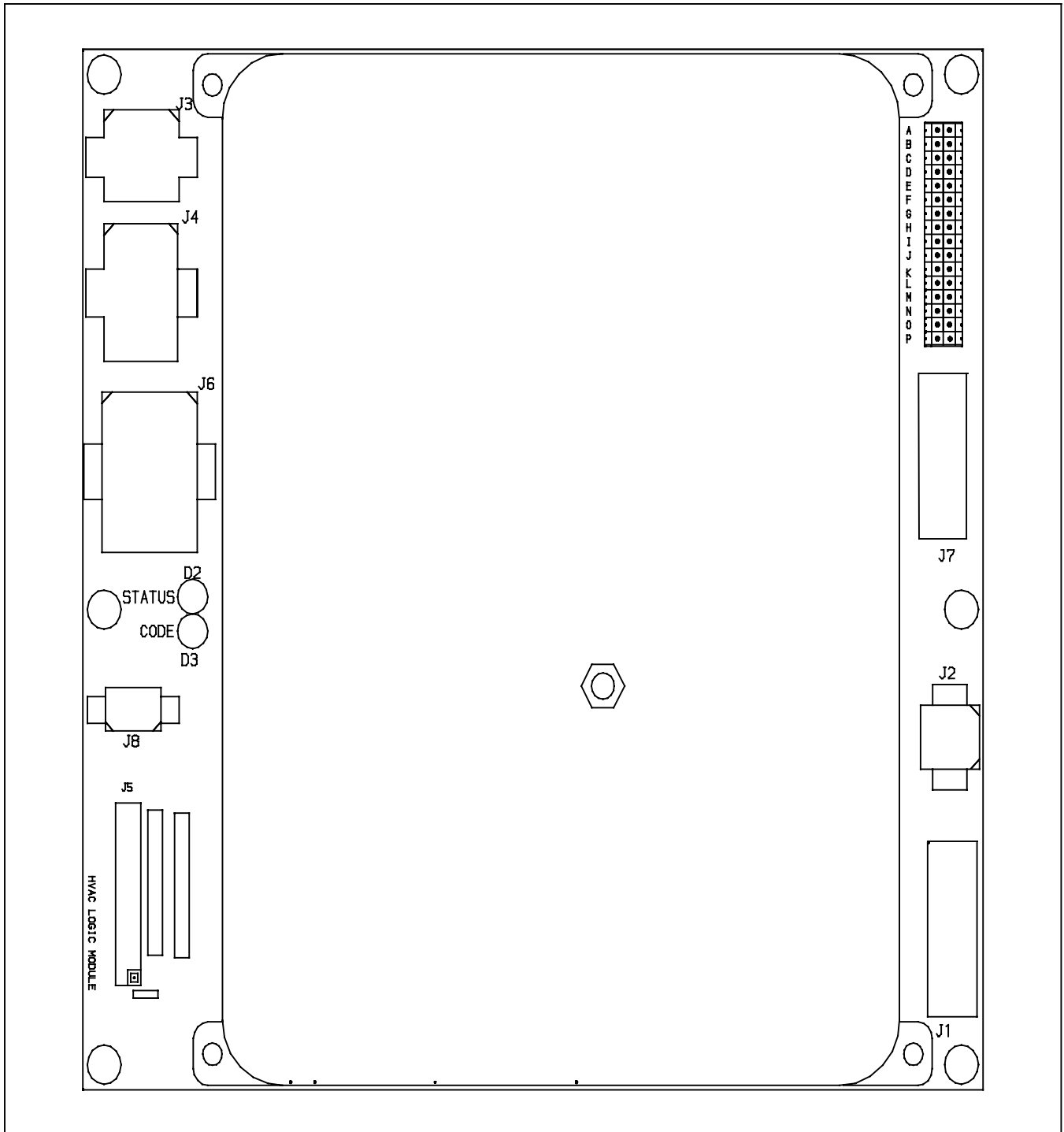


Figure 1-7 Heat Flow Diagram



1.12 LOGIC BOARD



- | | | | |
|----|--|-----|--|
| J1 | Logic board power in. | J7 | Diagnostics interface (RS232, DB9). |
| J2 | Micromate Display interface. | D2 | Blinks once per second in normal operation.
On steady to indicate alarms detected. |
| J3 | Manual control inputs. | D3 | Off In normal operation, blinks out alarm
codes (2 digits each) when alarms detected. |
| J4 | Interlock Inputs
(WTS, low side pressure switch etc.) | A-P | Configuration Jumpers |
| J5 | Relay board interface. | | |
| J6 | Sensor inputs (Thermistors, etc.). | | |

Figure 1-8 Logic Board

1.13 RELAY BOARD, 24VDC

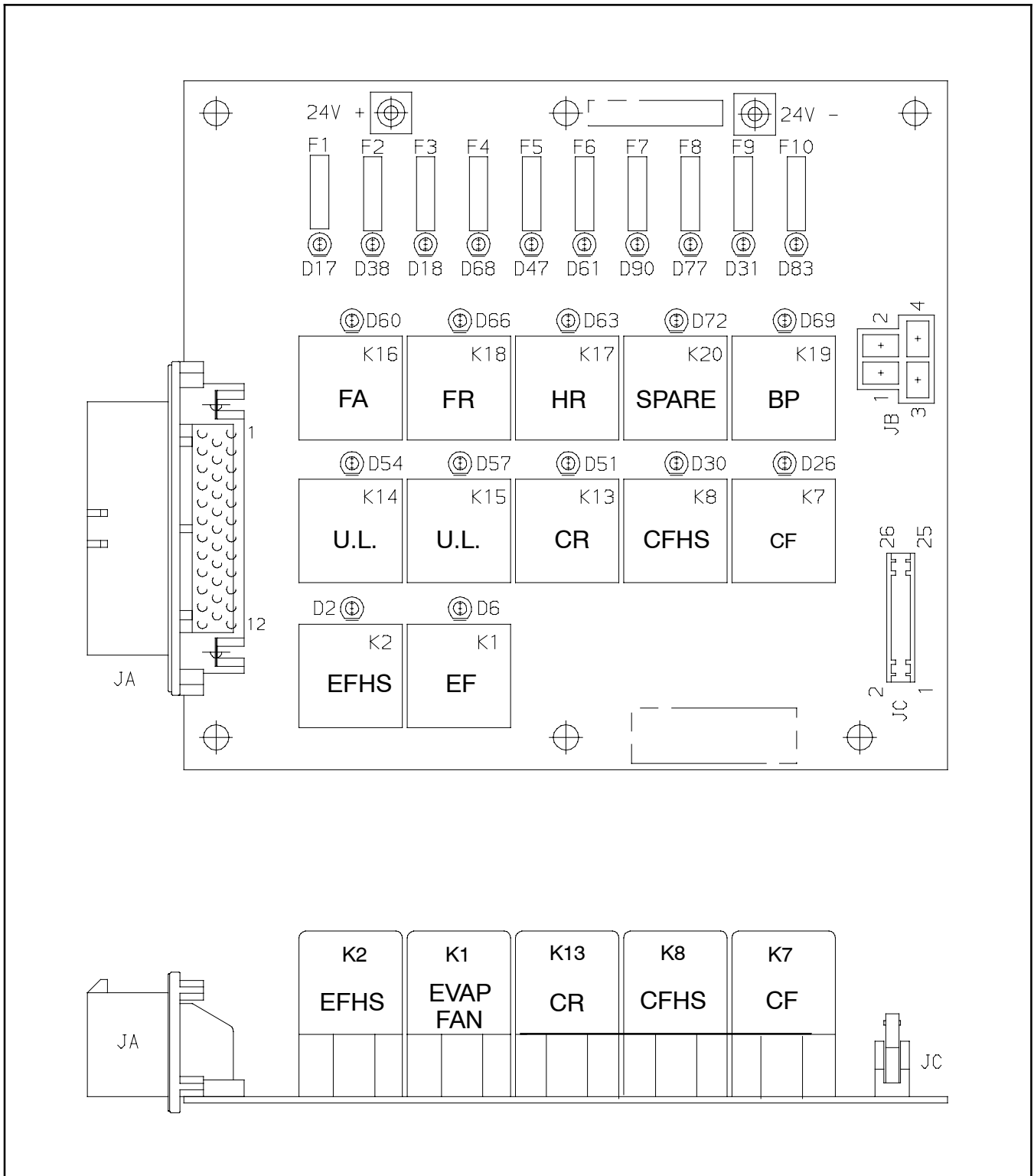


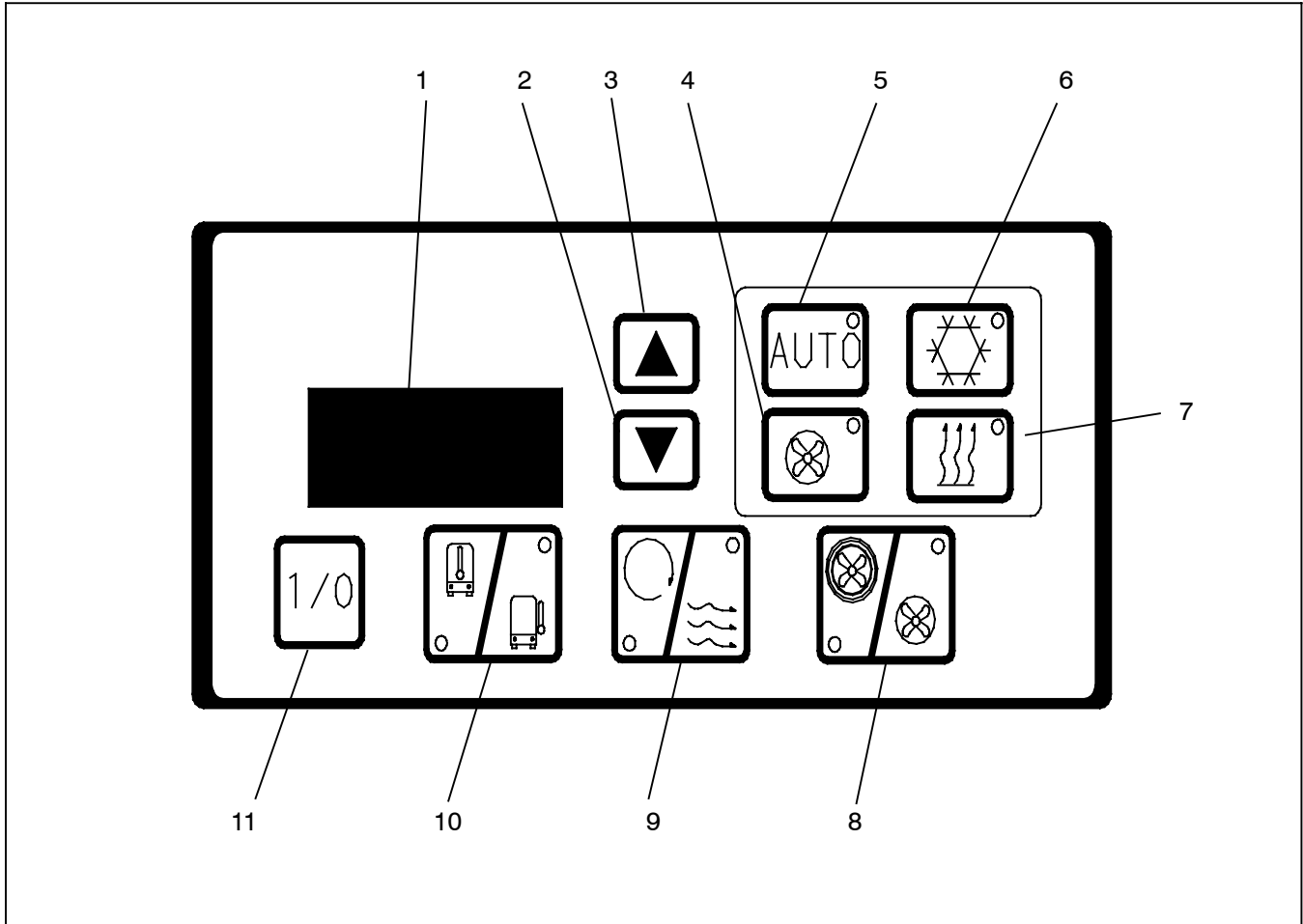
Figure 1-9 Relay Board, 24VDC



RELAY BOARD 12-00486-00	DEFINITION
POWER STUD +	24V+
POWER STUD -	COMMON
JA-1	K17, HEATER RELAY (N.O.)
JA-2	FAULT LIGHT SOURCE
JA-3	K7, COND FAN ON RELAY (N.O.)
JA-4	COND FAN JUMPER
JA-5	K15, UNLOADER 2 RELAY (N.O.)
JA-6	EVAPORATOR FAN JUMPER
JA-7	K1, EVAP FAN ON RELAY (N.O.)
JA-8	K18, FAULT LIGHT RELAY (N.O.)
JA-9	COMMON FOR RELAY COIL
JA-10	+24V SOURCE FOR FAULT LIGHT
JA-11	+24V SOURCE FOR EVAP FAN JUMPER
JA-12	+24V SOURCE FOR COND FAN JUMPER
JA-13	K20, SPARE RELAY (N.O.)
JA-14	K16, FRESH AIR RELAY (N.O.)
JA-15	K8, COND FAN HIGH SPEED RELAY (N.O.)
JA-16	K14, UNLOADER 1 RELAY (N.O.)
JA-17	K13, CLUTCH RELAY (N.O.)
JA-18	K2, EVAP FAN HIGH SPEED RELAY (N.O.)
JA-19	COMMON FOR HIGH PRESSURE SWITCH
JA-20	K8, COND FAN HIGH SPEED RELAY (N.C.)
JA-21	
JA-22	CIRCUIT BREAKER FAULT INPUT
JA-23	K2, EVAP FAN HIGH SPEED RELAY (N.C.)
JA-24	COMMON FOR HEATER RELAY
JA-25	COMMON FOR FAULT LIGHT RELAY
JA-26	COMMON FOR EVAP FAN ON RELAY
JA-27	COMMON FOR COND FAN ON RELAY
JA-28	COMMON FOR COND FAN HIGH SPEED RELAY
JA-29	COMMON FOR SPARE RELAY
JA-30	COMMON FOR FRESH AIR RELAY
JA-31	COMMON FOR UNLOADER 1 RELAY
JA-32	COMMON FOR UNLOADER 2 RELAY
JA-33	COMMON FOR CLUTCH RELAY
JA-34	COMMON FOR EVAP FAN HIGH SPEED RELAY
JA-35	
JB-1	BOOST PUMP SOURCE
JB-2	+24V SOURCE FOR BOOST PUMP
JB-3	BOOST PUMP OUT
JB-4	COMMON FOR BOOST PUMP
JC-1	+24V
JC-2	K21, EVAP FAN HIGH SPEED RELAY
JC-3	K22, EVAP FAN ON RELAY
JC-4	K23, COND FAN HIGH SPEED RELAY
JC-5	K24, COND FAN ON RELAY
JC-6	K13, CLUTCH RELAY
JC-7	K14, UNLOADER 1 RELAY
JC-8	K15, UNLOADER 2 RELAY
JC-9	K16, FRESH AIR RELAY
JC-10	HEATER RELAY
JC-11	K18, FAULT RELAY
JC-12	K19, BOOST PUMP RELAY
JC-13	K20, SPARE
JC-14	EVAP MOTOR OVERLOAD INPUT
JC-15	COND MOTOR OVERLOAD INPUT
JC-16	HIGH PRESSURE SWITCH STATUS INPUT
JC-17	BREAKER FAULT INPUT
JC-18	COMMON
JC-19	COMMON
JC-20	COMMON
JC-21	COMMON
JC-22	COND FAN BREAKER FAULT INPUT
JC-23	
JC-24	
JC-25	
JC-26	

Figure 1-10 Relay Board, 24VDC - Definition

1.14 CONTROL PANEL (Diagnostic Module)



- | | |
|-------------------------------------|---|
| 1. Display | 7. HEAT (Only) Button |
| 2. DOWN Button - decrease selection | 8. FAN SPEED Button |
| 3. UP Button - increase selection | 9. FRESH AIR Button |
| 4. VENT (Only) Button | 10. TEMPERATURE (Inside / Outside) Button |
| 5. AUTO Button (Automatic Control) | 11. ON/OFF Button |
| 6. COOLING (Only) Button | |

Figure 1-11 Micromate Control Panel



SECTION 2

OPERATION

2.1 STARTING, STOPPING AND OPERATING INSTRUCTIONS

2.1.1 Power to Logic Board

Before starting, electrical power must be available from the bus power supply. The system components receive power from two sources:

- a. 24 vdc power for the microprocessor electronics is supplied through the bus ignition system.
- b. 24 vdc, 125 amp, power from a fuse in the battery compartment supplies power for the, clutch, compressor unloader solenoids, evaporator and condenser assemblies; this power is controlled by the Logic Board.

2.1.2 Starting

- a. If the engine is not running, start the engine.

b. OEM SUPPLIED SWITCHES

Actual start sequence depends on the operating controls supplied. If only an ON/OFF switch is supplied, place the switch in the ON position to start the system in the automatic mode. If additional OEM switches are supplied, refer to the following Micromate control description for operating instructions.

c. MICROMATE CONTROL PANEL

It is suggested the system be started in the automatic mode.

1. The Micromate Control Panel Display (see Figure 1-11) may be programmed to display the set point temperature or return air temperature. To determine which display temperature is programmed, press the TEMPERATURE button so that the OUT SIDE AIR indicator is illuminated. If the controller cycles back to the INSIDE AIR indicator, than the controller is programmed to display return air temperature. If the controller does not automatically cycle back to the return air indicator, than the controller is programmed to display set point temperature.
2. To start the system, press the I/O button to illuminate the indicator light and signal the Logic Board to perform start up. Ensure the AUTO button indicator is illuminated. If not, press the AUTO button to place the system in the automatic mode. After the pre-trip inspection is com-

pleted, the switches may be set in accordance with the desired control modes.

3. If cooling only, heating only or ventilation only is desired, press the corresponding button (refer to Figure 1-11) to illuminate the indicator light and place the system in that mode of operation.
4. If low or high speed evaporator fan speed is desired, press the FAN SPEED button to illuminate the indicator light and bring speed to the desired level.
5. To open or close the fresh air damper, press the FRESH AIR button to illuminate the indicator light and bring the damper to the desired position.
6. To read interior or exterior temperature, press the TEMPERATURE button to illuminate the indicator light and bring the display to the desired temperature reading. After a short delay, the display will return to the default set point or return air temperature reading.
7. Setpoint may be changed by pressing the UP or DOWN arrow button. The UP button will increase the setpoint temperature and the DOWN button will decrease the setpoint temperature.
8. For Micromate instructions refer to paragraph 2.4.

2.1.3 Self-Test and Diagnostics (Check for Errors and/or Alarms)

Self-test of the main Logic Board electrical circuit is automatically initiated when the system is powered up. If there is an error in the circuit, an alarm will be indicated by flashing LED's on the Logic Board. If a Micromate is connected to the Logic Board, the error code can also be read on the display. If there are no errors in the circuit, system will operate normally and flash the status LED at a one second interval. During normal operation, the Logic Board monitors system operating parameters for out of tolerance conditions. If an out of tolerance condition occurs, ALARM will be indicated through the code LED or on the Micromate display. Refer to Section 3 for definition of system errors and alarms and general troubleshooting procedures.

2.1.4 Stopping

Placing the ON/OFF switch in the OFF position or pressing the Micromate ON/OFF button 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 4.15.4)
- c. Check refrigerant charge. (Refer to paragraph 4.8.1)
- d. Ensure that self-test has been successfully performed and that there are no errors or alarms indicated. (Refer to paragraph 2.1.3.)

2.3 MODES OF OPERATION

The system is operated by a Mobile Climate Control

Micromax microprocessor controller which consists of a logic board (Figure 1-8), relay board (Figure 1-9), and manual operator switches. The logic board regulates operational cycles of the system by energizing or de-energizing Relay Board relays in response to deviations in interior temperature. Modes of operation include Cooling, Heat and Vent. Refer to Figure 2-1 and the following paragraphs for a description of each mode.

Figure 2-1 shows the Logic Board actions at various temperature deviations from setpoint. On rising temperature, changes occur when the temperature rises above Logic Board setpoints, On falling temperature, changes occur when temperatures falls below Logic Board set point. The system will operate in these modes unless pressures override the Logic Board settings.

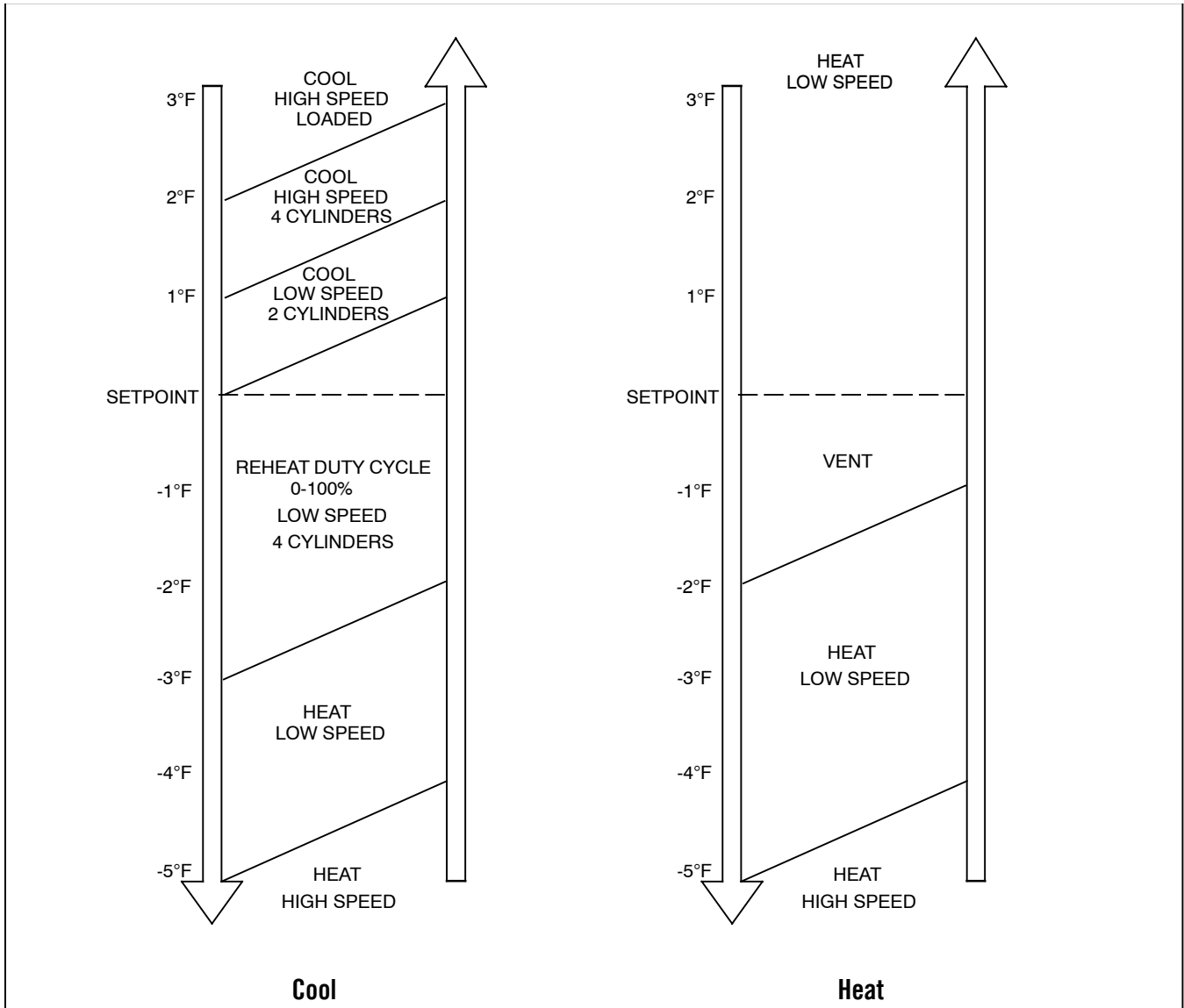


Figure 2-1 Capacity Control Diagram (Factory Settings)

2.3.1 Temperature Control

Temperature is controlled by maintaining the return air temperature measured at the return air grille.

2.3.2 Cooling Mode

Cooling is accomplished by energizing the compressor and condenser fans, opening the liquid line solenoid valve and closing the heating valve. Once interior temperature reaches the desired set point, the system may operate in the clutch cycle or reheat mode. Selection of clutch cycle or reheat is factory programmed in accordance with the bus purchase specification.

A controller programmed for clutch cycle will de-energize the compressor clutch and allow the

system to operate in the vent mode until further cooling is required.

A controller programmed for reheat will maintain compressor operation and cycle the heat valve to allow reheating of the return air. In the reheat mode interior temperature is maintained at the desired set point while additional dehumidification takes place.



2.3.3 Heating Mode

In the heat mode the liquid line solenoid is closed and the compressor and condenser fans are shut down. The heat valve is opened to allow a flow of engine coolant through the heat coils. The evaporator fans speed is varied as required to circulate air over the evaporator coil based on the temperature difference from setpoint.

Operation in the heating mode is controlled by the water temperature switch (WTS). The WTS is located on the engine block of the vehicle and is provided by the OEM. It senses the engine coolant temperature and reverses its contacts on temperature rise at 105°F. The switch prevents the circulation of cooler air throughout the vehicle as the engine comes up to temperature.

2.3.4 Boost Pump (Optional)

When the unit is in heat mode, and a boost pump is supplied by the coach manufacturer, the boost pump relay is energized, providing 24 VDC to activate the boost pump.

2.3.5 Vent Mode

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

2.3.6 Fresh Air System

The fresh air damper is opened allowing entrance of ambient air to mix with return air entering the evaporator coil. The damper is operated by the controller to open when return air temperature is within +/-5°F (+/-2.8°C) of set point.

2.3.7 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.

Whenever the compressor is started, the unloaders are energized for thirty seconds to reduce starting torque. After thirty seconds, unloaders may be de-energized. Any subsequent changes between energizing and de-energizing the unloaders for temperature control must be staged with a thirty second delay. Once an unloader is energized for pressure control, it remains energized for two seconds to prevent short cycling. Only one unloader may change state at a time when staging is required. Operating parameters for temperature control, suction pressure control and discharge pressure control are as follows.

a. Temperature Control

The unloaders are also used to control system capacity by controlling compressor capacity.

- 1 Compressor Unloader UV1 Relay. 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, UV-1 will be de-energized to place the compressor at 100% capacity.
- 2 Compressor Unloader UV2 Relay. 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, UV-2 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 Relay. 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 Relay. 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 UV1 Relay. When the discharge pressure increases above 275 psig (18.71 bar), unloader UV1 is energized; this output will remain energized until the pressure decreases be-



low 220 psig (14.97 bar). Staging is ignored during discharge pressure override.

- 2 **Compressor Unloader UV2 Relay.** When the discharge pressure increases above 285 psig (19.39 bar), unloader UV2 is energized; this output will remain energized until the pressure decreases below 225 psig (15.31 bar).

2.3.8 Evaporator Fan Speed Selection

Temperature control is the primary method of determining the fan speed selection. Table 2-1 indicates relay operational status for the various fan motor states while Figure 2-1 provides Logic Board speed selections at various deviations from set point..

Table 2-1 Evaporator Fan Speed Relay Operation

STAT E	HIGH SPEED RELAYS	EVAP FAN RELAY
Off	Off	Off
Low	Off	On
High	On	On

2.3.9 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). The fans will also be activated if a high pressure alarm has been activated and operation has not been locked out (refer to Table 3-2).

2.3.10 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, in heating, 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.

The clutch coil will be de-energized if the suction pressure decreases below 10 psig (R-134a).

2.3.11 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.



2.3.12 Alarm Description

Alarm descriptions and troubleshooting procedures are provided in section 3.

2.3.13 Hour Meters

Hour meter readings are available in the parameter code list of the Micromate. The hour meters record the compressor run time and the total time the evaporator fans are on. The maximum hours is 999,999. Refer to paragraph 2.4.2 for instructions on reading parameter codes.

2.4 MICROPROCESSOR DIAGNOSTICS

The Micromate allows the user to interface with the microprocessor based control. This allows system parameters, alarms and settings to be viewed and modified.

2.4.1 Diagnostic Panel Installation

If the system is not fitted with a Micromate control panel, diagnosis may be performed by installing a panel (MCC Part Number 12-00391-03) and 10 foot harness (MCC Part Number 22-62032-02). To install the panel do the following:

- a. Turn the A/C main power switch (located in the drivers area) to OFF.
- b. Connect the Micromate to the Logic Board Micromate connector J2. (See Figure 1-8).
- c. Unplug the logic board connector J3.
- d. Turn the A/C main power switch back to the ON position.
- e. Activate the system by pressing the 1/0 key on the Micromate panel.

NOTE

Be sure to remove the panel and harness and to reconnect J3 when testing is completed or the system will fail to operate on OEM controls.

NOTE

When modifying the setpoint temperature for diagnostic purposes, be sure to reset the setpoint when testing is complete.

2.4.2 Diagnostic Mode

Diagnostic mode can be entered by pressing the up and down arrow keys simultaneously for 5 seconds. Diagnostic mode allows alarms and system

parameters to be viewed. If there are any alarms stored, the most recent alarm will be shown. To view additional alarm information, refer to section 3. Press the up and down arrow keys to view parameters.

2.4.3 System Parameters

NOTE

- 1 This procedure should be performed by an HVAC technician who has been trained on MCC Model RM or RF system design. Control configuration is preset by the manufacturer and resetting of the parameters should not be required. It is recommended that Mobile Climate Control service be contacted before any control configuration is changed. MCC cannot be responsible for failures or damage resulting from unauthorized changes.
- 2 If a replacement Logic Module is installed, it is necessary to match the configuration jumpers (see Figure 1-8) to the original board. Refer to paragraph 4.19.

Pressing the up/down arrow keys will allow the user to scroll up or down through the parameters. If no key is pressed for 30 seconds this mode is exited and the display will revert back to the default display. Pressing the on/off key any time will exit this mode and the display will again indicate the default. The parameters are shown in Table 2-3. When scrolling through the parameters, the current parameter will be displayed for two seconds. After two seconds, the display will show the data for the current parameter. When the last parameter is reached, the list will wrap back to P1.

2.4.4 Test Mode

With the system in normal operation, the controller may be placed in the test mode, by doing the following:

- a. Enter the diagnostic mode by pressing the up and down arrow keys simultaneously for 5 seconds. Enter the test mode by pressing the COOL key five times.
- b. In the test mode, the display will read “T##” where “##” indicated the test number that is currently running.
- c. The initial indication will be “T00”. This indicates the controller is in the test mode and all relays are



de-energized. Press the arrow keys to scroll through and perform each test. When the highest test number is reached, the display will increment back to the lowest test number. A listing of tests is

provided in Table 2-2.
d. To terminate testing, press the I/O key.

Table 2-2 Controller Test List

TEST	OUTPUT	STATE	TEST	OUTPUT	STATE
T00	All Relays De-Energized	Off	T07	Unloader Valve 2	On
T01	Evaporator Fans High Speed	On	T08	Fresh Air Damper	On
T02	Evaporator Fans Low Speed	On	T09	Heat Valve	On
T03	Condenser Fans High Speed	On	T10	Fault Light	On
T04	Condenser Fans Low Speed	On	T11	Boost Pump	On
T05	Compressor Clutch & LLS	On	T12	Spare, Motor Fault Or Floor Blower Circuit	On
T06	Unloader Valve 1	On			



Table 2-3 Parameter Codes

Code	Code Name	Description
P1	Return Air Temperature	This value is the temperature measured by the return air sensor. If the sensor is shorted it will display <i>CL</i> . If it is open circuited it will display <i>OP</i> .
P2	Coil Temperature	This value is the coil temperature measured by the evaporator temperature sensor. If the sensor is shorted it will display <i>CL</i> . If it is open circuited it will display <i>OP</i> .
P3	Ambient Temperature	This value is the outside temperature measured by the ambient temperature sensor. If the sensor is shorted it will display <i>CL</i> . If it is open circuited it will display <i>OP</i> .
P4	Suction Line Temperature	Not used.
P5	Suction Pressure	This value is the suction pressure measured by the suction pressure transducer. If the sensor is shorted it will display <i>CL</i> . If it is open circuited it will display <i>OP</i> .
P6	Discharge Pressure	This value is the discharge pressure measured by the discharge pressure transducer. If the sensor is shorted it will display “CL” and if it is open circuited it will display “OP”.
P7	Superheat	Not used.
P8	Analog Set Point Temperature	Not used.
P9	A/C Control Window #1	This is the number of degrees F above setpoint at which the unloaders will be both energized. This value can be modified between 0 and 10 degrees F. The default value is 1 degree F.
P10	A/C Control Window #2	This is the number of degrees F above AC control window one at which the first unloader will be energized. This value can be modified between 0 and 10 degrees F. The default value is 1 degree F.
P11	A/C Control Window #3	This is the number of degrees F above AC control window two at which the evaporator fan speed will be set to low. This value can be modified between 0 and 10 degrees F. The default value is 1 degree F.
P12	Heat Control Window	This is the number of degrees F below setpoint before the heat valve is energized. This value can be modified between 0 and 10 degrees F. The default value is 2 degree F for heat and 4 degrees F for reheat.
P13	Compressor Safety Off Delay	This number is the minimum time in minutes that the compressor must be off after a high or low pressure alarm before it can be restarted. This value can be modified between one and five minutes. The default value is 1.
P14	Fan Delay	This is the minimum time (in seconds) that the fans must run at a particular speed before changing to another speed. This value can be modified between one and 60 seconds. The default value is two seconds.
P15	Unloader/Heat Valve Delay	This is the minimum time (in seconds) that the heat valve must be in a particular state (open /closed) before changing to another state. This value can be modified between 1 and 60 seconds. The default value is 2 seconds.
P16	Compressor High Pressure Switch	This is the current state of the compressor high pressure switch input. “CL” will be displayed if it is closed and “OP” will be displayed if it is open.
P17	Condenser Fan Speed Switch	Not Used
P18	Maximum Setpoint	This is the maximum value that the operator will be allowed to set the setpoint temperature. The value can be modified in degrees with the up and down keys to a value between 605F and 805F.
P19	Minimum Setpoint	This is the minimum value that the operator will be allowed to set the setpoint temperature. The value can be modified in degrees with the up and down keys to a value between 605F and 805F.



Table 2-3 Parameter Codes - Continued

Code	Code Name	Description
P20	Compressor Hours High	This is the number of hours of operation that the compressor has run with the clutch energized in thousands
P21	Compressor Hours Low	This is the number of hours of operation that the compressor has run with the clutch energized in hundreds, tens and ones.
P22	Evaporator Hours High	This is the number (in thousands) of hours of operation with the evaporator fans energized.
P23	Evaporator Hours Low	This is the number (in hundreds, tens and ones) of hours of operation with the evaporator fans energized.
P24	Maintenance 1 Hour High	This is the value of compressor hours high (P20) at which maintenance alarm #1 will be activated. This value can be modified by the up and down arrow keys. If both high and low values are zero the alarm is disabled.
P25	Maintenance 1 Hour Low	This is the value of compressor hours low (P21) at which maintenance alarm #1 will be activated. This value can be modified by the up and down arrow keys. If both high and low values are zero the alarm is disabled.
P26	Maintenance 2 Hours High	This is the value of evaporator fan hours high (P22) at which maintenance alarm #2 will be activated. This value can be modified by the up and down arrow keys. If both high and low values are zero the alarm is disabled.
P27	Maintenance 2 Hours Low	This is the value of evaporator fan hours low (P23) at which maintenance alarm #2 will be activated. This value can be modified by the up and down arrow keys. If both high and low values are zero the alarm is disabled.
P28	Freeze Alarm Setting	This is the value at which the freeze alarm will be activated. The default value is 325F. This value can be modified between 205F and 405F in one degree increments by using the arrow keys
P29	Relay Module Voltage	This is the voltage being supplied to the relay module.
P30	Main Board Software Version	This is the software version of the logic board.
P31	Display Software Version	This is the software version of the display module.
P32	Ki	Not used.
P33	Kp	Not used.
P34	Heat Set Point Offset	This value is the offset that can be used to change the points at which the unit switches between heat and vent in the heat mode. A positive value will raise the critical temperatures (winter use) and a negative value will decrease the critical temperatures (summer use).
P35	Default Display Temperature	This value determines what temperature driver's display will show as a default. When the value is OFF, set-point temperature is displayed. When the value is ON, return air temperature is displayed. This option is only available in logic module software revisions 1.9 and newer, and drivers display software revision 1.3 and newer. Otherwise P35 will not be active and set-point temperature will only be displayed as default.



Table 2-3 Parameter Codes - Continued

Code	Code Name	Description
P37	Seasonal Operation	This is a binary (ON or OFF) parameter for seasonal operation. When it is turn ON, the control will run automatic mode, and the Cool and Heat Mode input (J3-3 and J3-4) will determine the temperature set point. When Cool Mode input J3-3 is energized, there will be no offset for the set point. When Heat Mode input J3-4 is energized, the temperature set point will be offset by the value of P34.
P38	Evaporator Fan Operation in Heat Mode	This is a binary (ON or OFF) parameter. When set to the OFF position, the evaporator blowers will operate according to the values set for Auto Mode. When set to ON, the evaporator blowers will operate in low speed in Heat Mode.
P39	Compressor Minimum On time	When parameter is set to OFF, the minimum compressor on time will be 5 minutes. When set to ON, the minimum compressor on time will be 1 minute.
P40	Enable Hidden Alarm	This value determines if alarms A33 and A34 are displayed. When the value is OFF, alarms A33 and A34 will not be displayed. When the value is ON, alarms A33 and A34 will be displayed.
P41	Fresh Air Damper	Not used.
P42	Defrost Operation	This value determines if the defrost switch will override the Micromate controller. If the parameter is ON the defrost switch will initiate unit defrost whenever it senses a need for defrosting (the Micromate display will shut off in defrost). If the parameter is OFF the Micromate display will continue to operate and override the defrost switch.



SECTION 3 TROUBLESHOOTING

CAUTION

Do not under any circumstances attempt to service the microprocessor. should a problem develop with the microprocessor, replace it.

3.1 SELF DIAGNOSTICS

A self test is performed by the Micromax Logic Board each time the board is powered up. Errors, if any, will be indicated and the unit will not be allowed to start. The error codes can be read by counting the number of times that the Logic Board STATUS and CODE LED's (see Figure 1-8) flash simultaneously. The Micromate display will indicate errors with the code ER-#, where "ER" is the error prefix and # is the error number.

3.2 DIAGNOSTIC PANEL INSTALLATION

If the system is not fitted with a Micromate control panel, diagnosis may be performed by installing a panel (MCC Part Number 62-00391-03) and harness (MCC Part Number 62-62032-01). To install the panel, refer to section 2.4.1.

3.3 SYSTEM ALARMS

3.3.1 Alarm Codes

The Micromax Logic Board continuously monitors system parameters and will generate an ALARM if a parameter exceeds preset limits. Alarms are indicated and the controller will respond in accordance with the information provided in Table 3-2. The alarm codes can be read by counting the number of times that the Logic Board CODE LED (see Figure 1-8) flashes. Each alarm code is a two digit number. The first set of flashes is the first digit and (after a slight pause) the second set of flashes is the second digit.

The Micromate Display will indicate alarms with the code A-## or i-##, where "A" is an active alarm prefix, "i" is an inactive alarm prefix and ## is the error number. If no alarms are present, the display will show "---". To access the alarm codes, press the

UP and DOWN arrow keys at the same time and hold for three seconds. If multiple alarms are present the user can scroll through each alarm by pressing the AUTO key. When the end of the alarm list is reached the display will show "---". Press VENT to scroll backward from the latest alarm to the earliest alarm in the queue. When using the VENT key to scroll back, only the alarm code will be shown, the alarm time will not be shown. If the AUTO key is held down for five seconds while "---" is displayed, all inactive alarms are cleared. A listing of alarm codes is provided in Table 3-2.

3.3.2 Activation

When alarms are detected, they are placed in an alarm queue in the order at which they initiated unless the alarm is already present. Each alarm recorded will also capture an evaporator hour meter reading corresponding to the activation time. If the AUTO key is pressed while an alarm is displayed, the activation time capture will be shown.

3.3.3 Alarm Queue

The alarm queue consist of 10 alarm locations. When the alarm queue is full the Logic Board will take the required action, but the alarm will not be recorded. When this situation occurs, an "Alarm Queue Full" alarm will be generated. When the alarms are viewed this will be the first alarm to be shown.

3.3.4 Alarm Clear

The user may clear inactive alarms using the Micromate keypad. Refer to paragraph 3.3.1.

3.4 TROUBLESHOOTING

General procedures for system troubleshooting are provided in Table 3-3



Table 3-1 Error Codes

CODE	NAME	DESCRIPTION
ER 1	Data Memory	Logic board data memory failure.
ER 2	Program Memory	Logic board program memory failure.
ER 3	A/D	A/D and multiplexer failure.
ER 4	Communication Failure	Failure in communication between the logic board and MDST.
ER 5	Program Memory	Display program memory failure.

Table 3-2 Alarm Codes

ALARM NO.	TITLE	CAUSE	REMEDY	CONTROLLER RESPONSE
A11	Coil Freeze	Coil temperature is less than 32°F and the compressor is operating.	Check causes of coil freezing. (Refer to section 3.4.6)	An alarm will be generated and the system will shut-down. The evaporator fans will remain running while the compressor is off.
A12	High Voltage	The battery voltage is greater than 32 volts.	Check, repair or replace alternator.	The system is shut down until the voltage returns to normal levels.
A13	Low Voltage	The battery voltage is less than 17 volts.	Check, repair or replace wiring or alternator.	The system is shut down until the voltage returns to normal levels.
A14	Return Air Probe Failure	Return air temperature sensor failure or wiring defective.	Ensure all connectors are plugged in. Check sensor resistance or wiring. Refer to paragraph 4.14. Replace sensor or repair wiring.	All outputs except the evaporator fans will be de-energized.
A15	Suction Pressure Transducer Failure	Suction pressure transducer failure or wiring defective.	Ensure all connectors are plugged in. Check sensor voltage or wiring. Replace sensor or repair wiring.	Both unloaders are energized.
A16	Discharge Pressure Transducer Failure	Discharge pressure transducer failure or wiring defective.	Ensure all connectors are plugged in. Check sensor voltage or wiring. Replace sensor or repair wiring.	One unloader is energized.
A17	Low Pressure Shutdown	Low suction pressure switch open or wiring defective.	Check cause of low suction pressure. (Refer to section 3.4.3)	The clutch is de-energized for the minimum off time. The evaporator fans will remain running during this period. After the compressor cycles off three times in 30 minutes all outputs will be de-energized and the system is locked out until the power is cycled or the alarm is reset.



Table 3-2 Alarm Codes - Continued

ALARM NO	TITLE	CAUSE	REMEDY	CONTROLLER RESPONSE
A21	High Discharge Pressure	High discharge pressure switch open or wiring defective.	Check discharge pressure transducer reading, wiring or cause of high discharge pressure. (Refer to section 3.4.3)	The clutch is de-energized for the minimum off time. The condenser and evaporator fans will remain running during this period. After the compressor cycles off three times in 30 minutes all outputs will be de-energized and the system is locked out until the power is cycled or the alarm is reset.
A22	Breaker Trip Alarm	A breaker on the relay board has tripped or a fan relay has failed.	Check breakers for tripped device. Repair short and reset breaker.	Alarm will be generated.
A23	Evaporator Fan Overload	Evaporator fan overload jumper is open.	Ensure connector is plugged in or repair wiring.	Alarm will be generated.
A24	Condenser Fan Overload	Condenser fan overload jumper is open.	Ensure connector is plugged in or repair wiring.	Alarm will be generated.
A25	Motor Failure	A brushless motor has not reached full operating speed or a motor failure.	Replace motor, or correct pressure shutdown.	Alarm displayed and the motor fail output is energized.
A26	Not used			
A31	Maintenance Alarm 1	The compressor hour meter is greater than the value in Maintenance Hour Meter 1.	Perform scheduled maintenance and reset the maintenance hour meter.	Alarm will be generated.
A32	Maintenance Alarm 2	The evaporator hour meter is greater than the value in Maintenance Hour Meter 2.	Perform scheduled maintenance and re-set the maintenance hour meter.	Alarm will be generated.
A99	Alarm Queue Full	All locations of the alarm queue are currently full and no more alarms can be saved.	Record and clear alarm queue.	Alarm will be generated.



Table 3-3 General System Troubleshooting Procedures

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.4.1 System Will Not Cool		
Compressor will not run	Active system alarm V-Belt loose or defective Clutch coil defective Clutch malfunction Compressor malfunction	3.3 Check Check/Replace Check/Replace See Table 1-4
Electrical malfunction	Coach power source defective Circuit Breaker/safety device open	Check/Repair Check/Reset
3.4.2 System Runs But Has Insufficient Cooling		
Compressor	V-Belt loose or defective Compressor valves defective	Check See Table 1-4
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	3.4.3 3.4.6 3.4.7 4.11 4.8 Open 1.8 Check
Restricted air flow	No evaporator air flow or restriction	3.4.6
Heating system	Heat valve stuck open	3.4.8
3.4.3 Abnormal Pressures		
High discharge pressure	Discharge transducer failure Refrigerant overcharge Noncondensable in system Condenser motor failure Condenser coil dirty	Replace 4.8.1 Check Check Clean
Low discharge pressure	Discharge transducer failure Compressor valve(s) worn or broken Low refrigerant charge	See Note. See Table 1-4 4.8
High suction pressure	Compressor valve(s) worn or broken	See Table 1-4
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 Suction transducer failure	Open Check/Open 4.11 4.8 3.4.7 3.4.6 Replace
Suction and discharge pressures tend to equalize when system is operating	Compressor valve defective	See Table 1-4
3.4.4 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 1-4 See Table 1-4 3.4.7 4.15.4 Check Check/Adjust Clean



Table 3-3 General System Troubleshooting Procedures - Continued

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.4.4 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
3.4.5 Control System Malfunction		
Will not control	Sensor or transducer defective Relay(s) defective Microprocessor controller malfunction Logic Board J3 connector unplugged	4.17 or 4.18 Check Check
3.4.6 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 1.8 Check
3.4.7 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	4.8 Check 4.7 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 4.7 Replace Replace 4.13
3.4.8 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 1.8
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**

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.

NOTE

Following completion of all maintenance or service activities, the alarm queue should be cleared of any original alarms and any alarms generated during service. Refer to paragraph 3.3.1

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. Daily Maintenance			
X	X	Pre-trip Inspection - after starting Check tension and condition of V-belt	2.2 None
b. Weekly Inspection			
X	X X X	Perform daily inspection Check condenser, evaporator coils and air filters for cleanliness Check refrigerant hoses and compressor shaft seal for leaks Feel filter-drier for excessive temperature drop across drier	See above Figure 1-5 4.6 4.11
c. Monthly Inspection and Maintenance			
	X X X X X X	Perform weekly inspection and maintenance Clean evaporator drain pans and hoses Check wire harnesses for chafing and loose terminals Check fan motor bearings Check compressor mounting bolts for tightness Check fan motor brushes	See above None Replace/Tighten None None None



4.2 OPENING TOP COVER (EVAPORATOR)

To open either side of the evaporator assembly cover do the following: (See Figure 4-1.)

- a. Twist all 6 of the 1/4 Turn cam locks counter-clockwise.
- b. Grasp the cover section under the bottom edge and lift up.
- c. Locate metal rod (prop) secured behind the evaporator motor assemblies.
- d. Lift end of metal rod (prop) and place in plate on cover assembly.

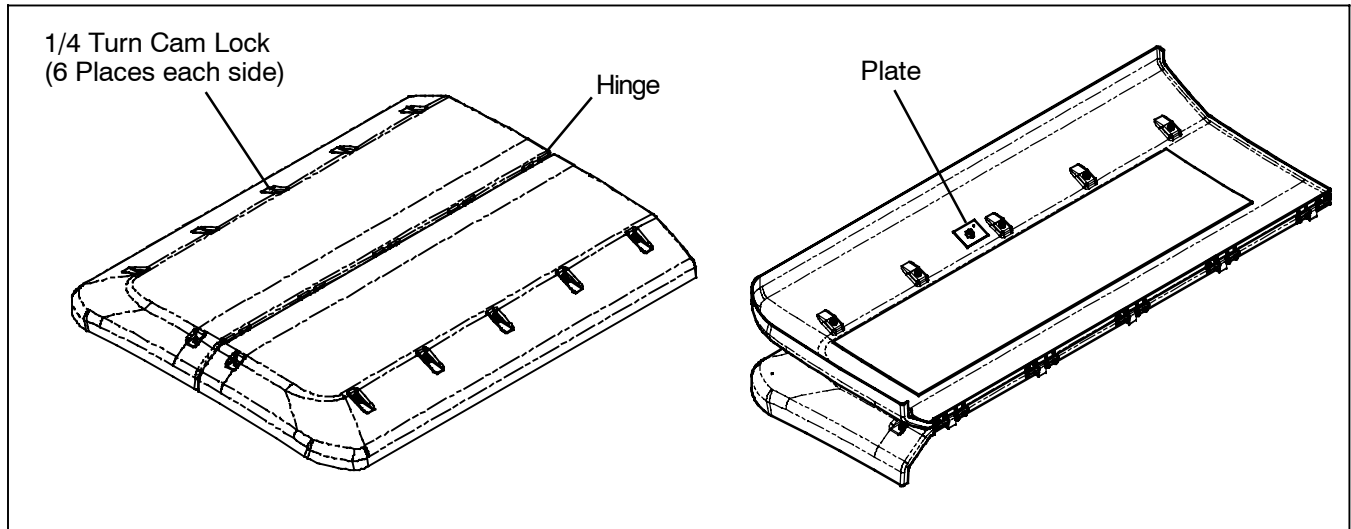


Figure 4-1 Opening Top Cover (Evaporator)

4.3 REMOVING TOP COVER (CONDENSER)

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

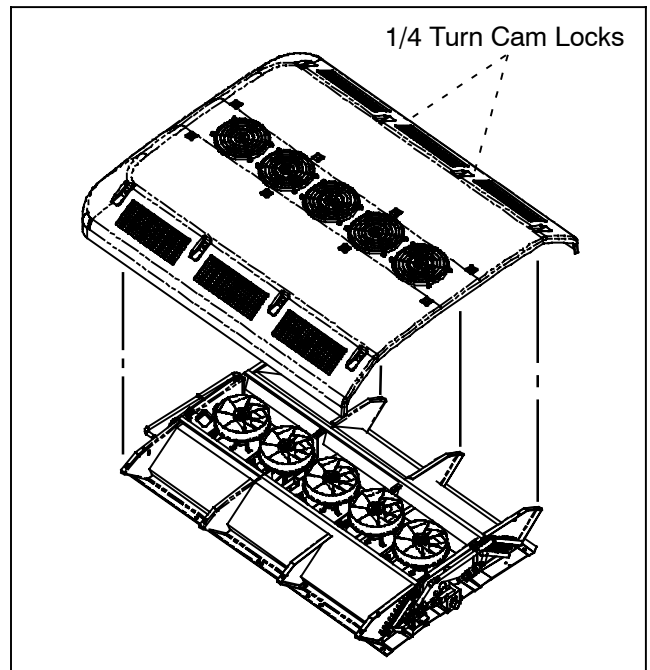


Figure 4-2 Condenser Cover Removal



4.4 SUCTION AND DISCHARGE SERVICE VALVES

The suction and discharge service valves (Figure 4-3) 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.

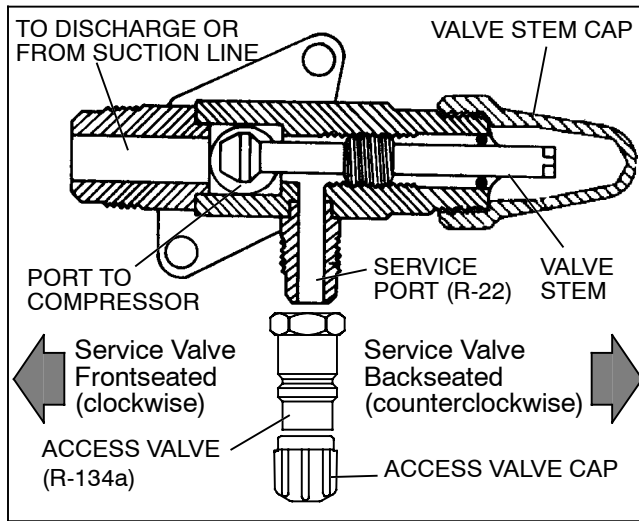


Figure 4-3 Suction or Discharge Service Valve

4.4.1 Installing R-134a Manifold Gauge Set

A R-134a manifold gauge/hose set with self-sealing hoses is required for service of models covered within this manual. The manifold gauge/hose set is available from Mobile Climate Control. (Mobile Climate Control P/N 07-00294-00, which includes items 1 through 6, Figure 4-4). 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 4-4) 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 4-4) 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.

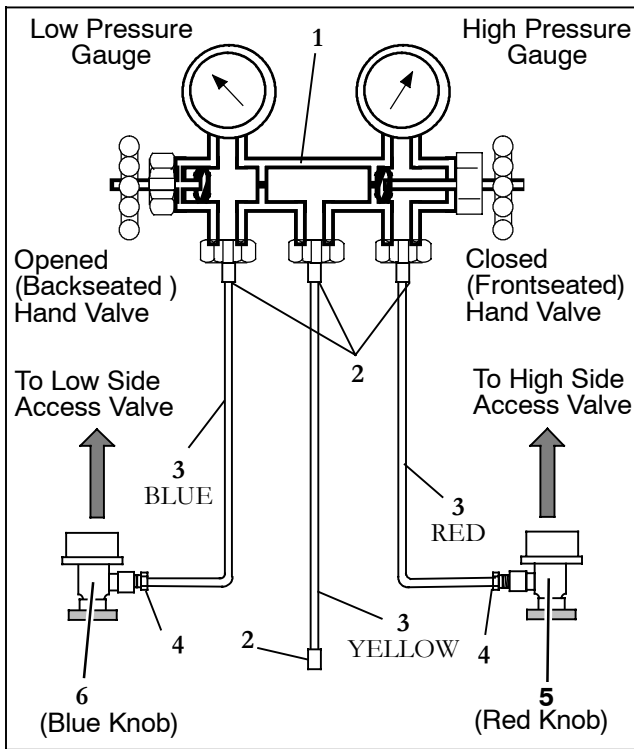


To prevent trapping liquid refrigerant in the manifold gauge set be sure set is brought to suction pressure before disconnecting.

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

4.5 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.

4.5.1 System Pump Down For Low Side Repair

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

- a. Install manifold gauge set to compressor suction & discharge service ports (items 21 & 22). Refer to Figure 4-5.
- b. Frontseat the filter-drier inlet service valve (13) by turning clockwise. Disconnect suction pressure transducer (6), install a jumper on the compressor mounted low pressure switch (3).
- c. Start the system and run in cooling. Stop the unit when suction reaches 2 psig (0.14 Bar).
- d. Frontseat the compressor suction service valve (21) 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 at approximately 2 psig (0.14 Bar). If system pressure rises above 2 psig (0.14 Bar), open the compressor suction service valve and repeat steps c and d until the system remains at 2 psig (0.14 Bar).
- e. Service or replace necessary components.
- f. Leak check connections and replace filter-drier (12). Refer to paragraph 4.11.
- g. Energize the Liquid Line Solenoid Valve (LSV) (9) 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 (29) and vacuum gauge valve (28) and stop pump. Wait 5 minutes to verify that vacuum holds.
- i. Open suction service valve (21) and inlet filter drier valve (13).
- j. Disconnect external 24 VDC to liquid solenoid valve (9).
- k. Run and check refrigerant level. Refer to paragraph 4.8.1.

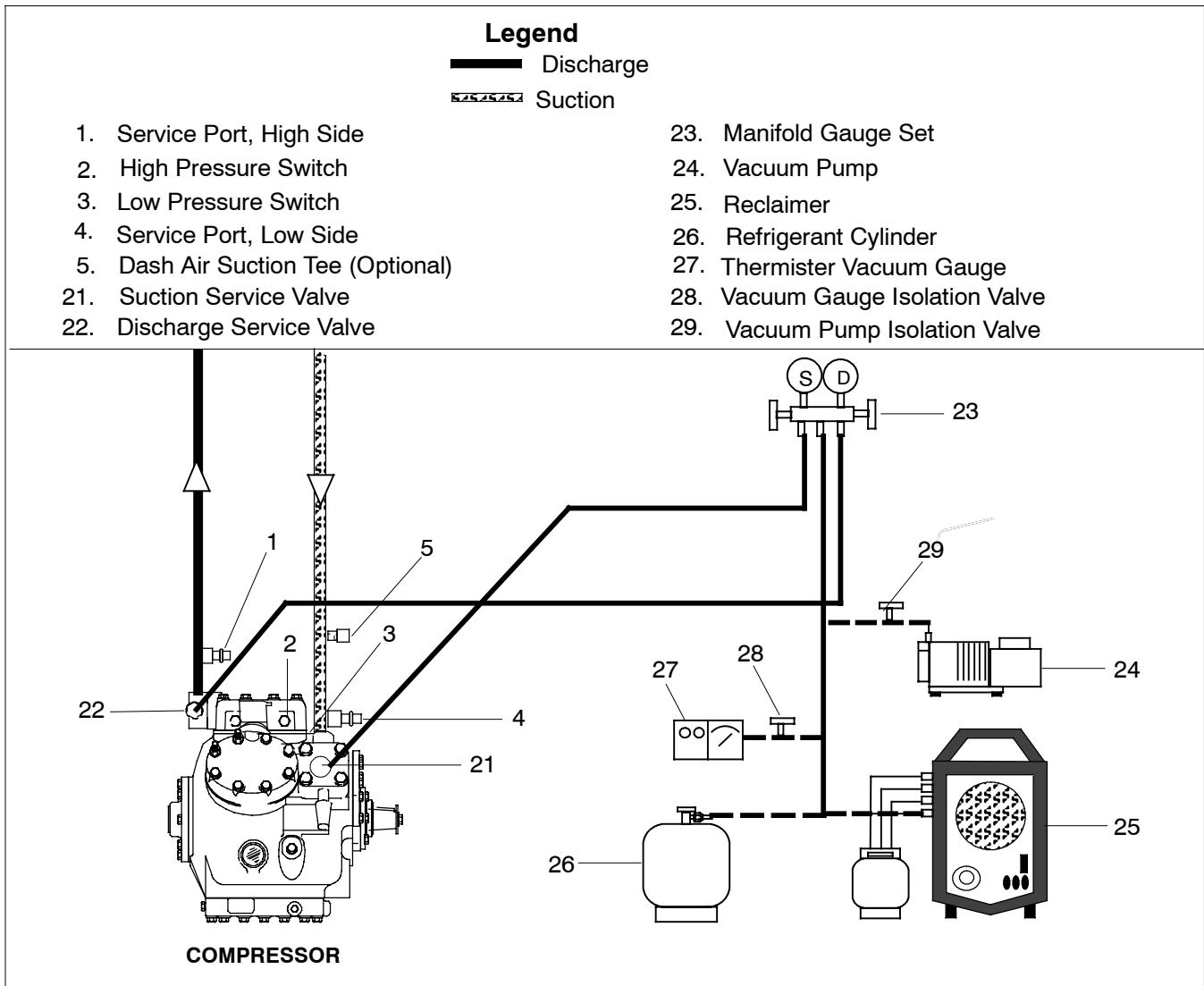


Figure 4-5 Low Side Pump Down Connections

4.5.2 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 (items 21 & 22).
- 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 (29) and vacuum gauge valve (28), and stop pump. Wait 5 minutes to verify that vacuum holds.
- e. Once vacuum is maintained, backseat compressor service valves and disconnect manifold gauge set.
- f. Check refrigerant level. Refer to paragraph 4.8.1. It may be necessary to clear any alarms that have been generated.



4.5.3 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 (21) by turning clockwise.
- c. Install a jumper on the compressor mounted low pressure switch. 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.

NOTE

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 (28), isolate vacuum gauge valve (29) and stop pump. Wait 5 minutes to verify that vacuum holds.
- g. Once vacuum is maintained, re-connect low pressure switch. Backseat compressor service valves and disconnect manifold gauge set.
- h. Check refrigerant level. Refer to paragraph 4.8.1. It may be necessary to clear any alarms that have been generated.

4.5.4. 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 4-5.

- b. Connect a reclaimer to the center manifold gauge set connection.
- c. Energize the Liquid Line Solenoid Valve (LSV) (9) using an external power source (24 VDC).
- d. Recover refrigerant in accordance with reclaimer manufacturers instructions.

4.6 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 4.7.
- g. Charge the unit. Refer to paragraph 4.8.
- h. Ensure that a Logic Board self-test has been performed and that there are no errors or alarms indicated. (Refer to paragraph 2.1.3.)



4.7 EVACUATION AND DEHYDRATION

4.7.1 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 4.7.4) should be performed after a major system repair (compressor, evaporator, or condenser replacement). A one time evacuation (Refer to paragraph 4.7.3) should take place after a minor system repair (replacement of a solenoid valve or a filter drier).

4.7.2 Preparation

NOTE

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

- Evacuate and dehydrate only after pressure leak test. Refer to paragraph 4.6.
- Essential tools to properly evacuate and dehydrate any system include a good vacuum pump with a minimum of 6 cfm (10.2 m³/hr) volume displacement, (MCC P/N 07-00176-11), and a good vacuum indicator (MCC P/N 07-00414-00).
- 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.

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

- Remove refrigerant using a refrigerant recovery system. Refer to paragraph 4.5.4.
- The recommended method is connecting lines (refrigerant hoses designed for vacuum service) as shown in Figure 4-5.
- Energize the Liquid Line Solenoid Valve (LSV) (9) using an external power source (24 VDC).
- Start vacuum pump. Slowly open valves halfway and then open vacuum gauge valve (items 28 & 29).
- Evacuate unit until vacuum gauge indicates 500 microns Hg vacuum.
- Close off pump valve (28 & 29), and stop pump. Wait five minutes to see if vacuum holds.

- Remove external 24 VDC from Liquid Line Solenoid.

- Charge system. Refer to paragraph 4.8.2.

4.7.4 Procedure for Evacuation and Dehydrating System (Triple Evacuation)

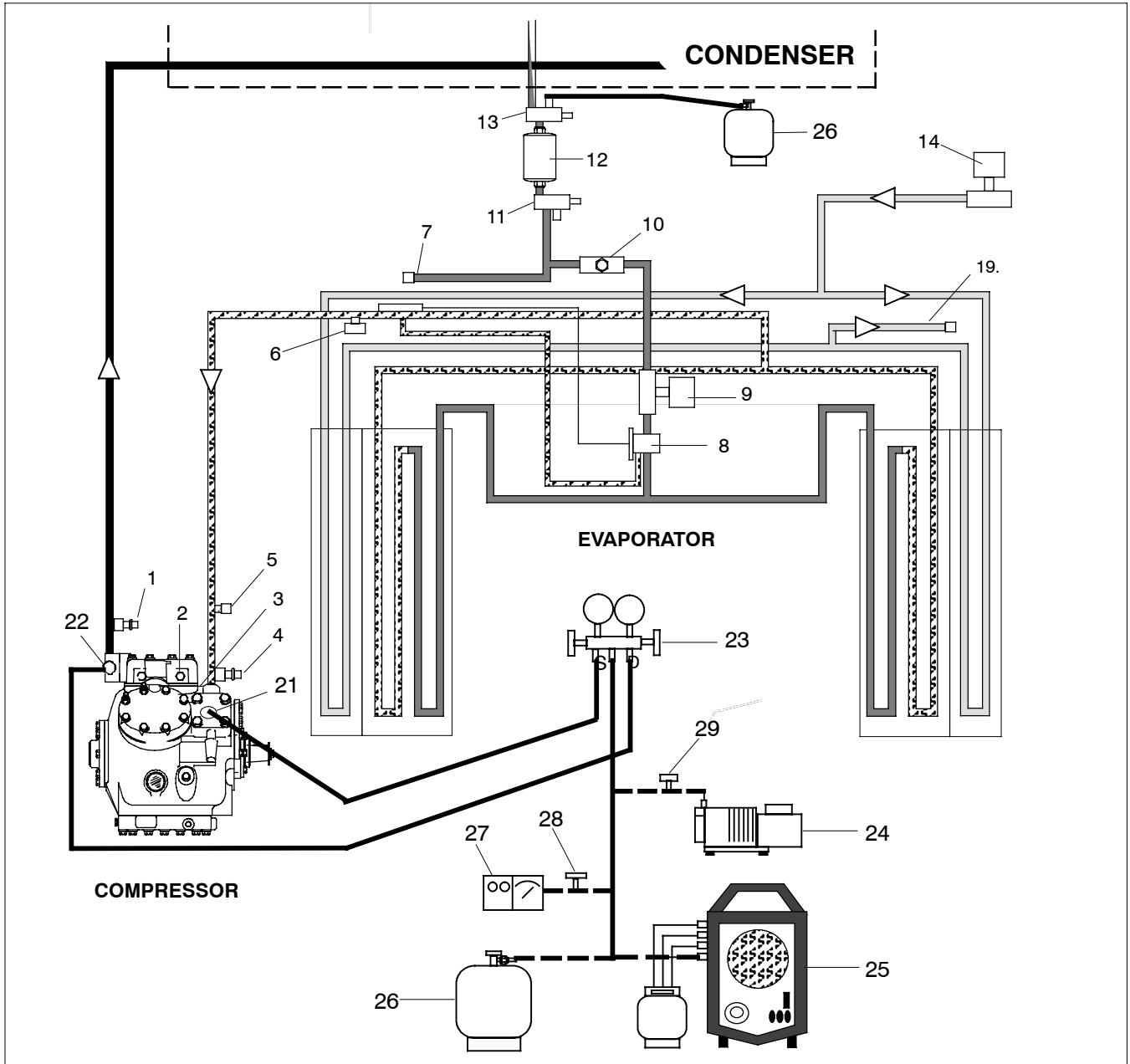
- Remove refrigerant using a refrigerant recovery system. Refer to paragraph 4.5.4.
- The recommended method is connecting lines (refrigerant hoses designed for vacuum service) as shown in Figure 4-5.
- Energize the Liquid Line Solenoid Valve (LSV) (9) using an external power source (24 VDC).
- Start vacuum pump. Slowly open valves halfway and then open vacuum gauge valve.
- Evacuate unit until vacuum gauge indicates 2000 microns Hg vacuum. Close gauge valve, vacuum pump valve, and stop vacuum pump.
- Break the vacuum with nitrogen. Raise system pressure to approximately 2 psig.
- Purge the nitrogen from the system.
- Repeat steps d. thru g. one time.
- Start vacuum pump and open all valves. Dehydrate unit to 500 microns Hg vacuum.
- Close off pump valve (29), and stop pump. Wait five minutes to see if vacuum holds.
- Remove external 24 VDC from Liquid Line Solenoid.
- Charge system. Refer to paragraph 4.8.2.

4.8 ADDING REFRIGERANT TO SYSTEM

4.8.1 Checking Refrigerant Charge

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

- Coach engine operating at high idle.
- Unit operating fully loaded (six cylinder) in cool mode for 15 minutes.
- Compressor discharge (head) pressure to 150 PSIG (R-134a). It may be necessary to block condenser air flow to raise discharge pressure.
- Under the above conditions, the system is properly charged when the liquid line sight glass has little or no bubbles. Add or remove refrigerant to bring it to clear the sight glass.



Legend

———— Discharge

- - - - - Suction

- 1. Service Port, High Side
- 2. High Pressure Switch
- 3. Low Pressure Switch
- 4. Service Port, Low Side
- 5. Dash Air Suction Tee (Optional)
- 6. Pressure Transducer (SPT)
- 7. Dash Air Liquid Line

- 8. TXV
- 9. Solenoid Valve-Liquid Line
- 10. Liquid Line Sightglass
- 11. Filter Drier Outlet-Service
- 12. Filter Drier
- 13. Filter Drier Inlet Service

- 14.
- 19. Hot Water Outlet
- 21. Suction Service Valve
- 22. Discharge Service Valve
- 23. Manifold Gauge Set
- 24. Vacuum Pump
- 25. Reclaimer
- 26. Refrigerant Cylinder
- 27. Thermister Vacuum Gauge
- 28. Vacuum Gauge Isolation Valve
- 29. Vacuum Pump Isolation Valve

Figure 4-6 Compressor Service Connections



4.8.2 Adding Full Charge

- a. Install manifold gauge set at the compressor suction and discharge service valve ports. See figure Figure 4-6.
- b. Evacuate and dehydrate system. Refer to paragraph 4.7.

NOTE

Evacuation can be performed at the compressor but liquid charging can only be done at the filter drier king valve on the bus roof (See Figure 4-6, Item 26).

- c. Place appropriate refrigerant cylinder on scales. Prepare to charge liquid refrigerant by connect charging hose from refrigerant container to inlet valve of filter drier (13). Purge air from hoses.
- d. Energize the Liquid Line Solenoid Valve (LLSV) (9) using an external power source (24 VDC).
- e. Note weight of refrigerant and cylinder.
- f. Open cylinder valve and purge hose at filter drier inlet valve (13).
- g. Midseat filter drier inlet valve to allow liquid refrigerant to flow into the high side.
- h. When correct charge has been added, refer to paragraph 1.5, close cylinder valve.
- i. Remove 24 VDC from Liquid Line Solenoid .
- j. Backseat filter drier inlet valve.
- k. Check charge level in accordance with the procedures of paragraph 4.8.1.

4.8.3 Adding Partial Charge

- a. Install manifold gauge set at the compressor suction service valve and filter-drier inlet service valve. See Figure 4-5.
- 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 4.8.1. With the suction service valve mid-seated, open the refrigerant cylinder valve and add vapor charge until the refrigerant level appears in the liquid line sight glass.

- 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.

4.9 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 4-4.
- 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 4.7.4.
- h. Charge the unit. Refer to paragraph 4.8.2.

4.10 CHECKING AND REPLACING HIGH OR LOW PRESSURE SWITCH



WARNING

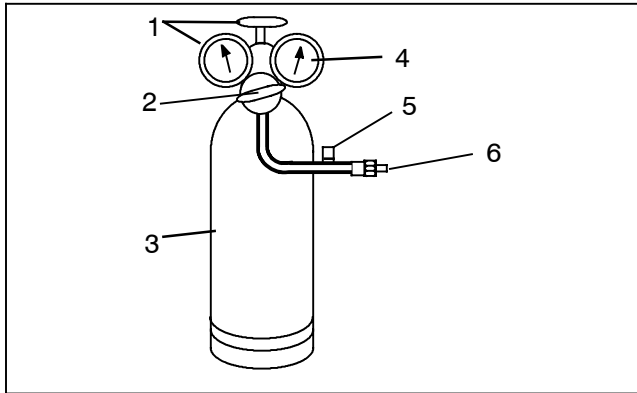
Do not use a nitrogen cylinder without a pressure regulator



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 4-7.



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

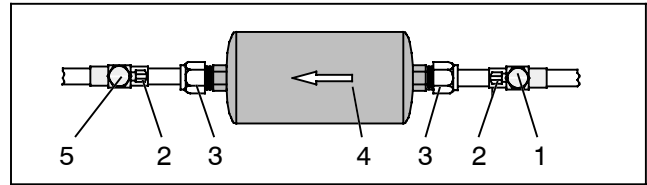
Figure 4-7 Checking High Pressure Switch

- c. Connect an ohmmeter across switch terminals.
- d. Set nitrogen pressure regulator higher than the upper switch setting. (refer to paragraph 1.5.)
- 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 re-connect wiring.

4.11 FILTER-DRIER

4.11.1 To Check Filter-Drier

The filter-drier (see Figure 4-8) 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 | 4. Filter-Drier |
| 2. Valve Service Port | 5. Filter-Drier Outlet Service Valve |
| 3. Flare Nut | |

Figure 4-8 Filter-Drier Removal

4.11.2 To Replace Filter-Drier

- a. Perform a low side pump down. Refer to paragraph 4.5.1, (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 flare nuts.
- h. Tighten filter-drier flare nuts using two open end wrenches.
- i. Evacuate the filter-drier and lines by connecting a vacuum pump as shown in Figure 4-5. 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 4-9) 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

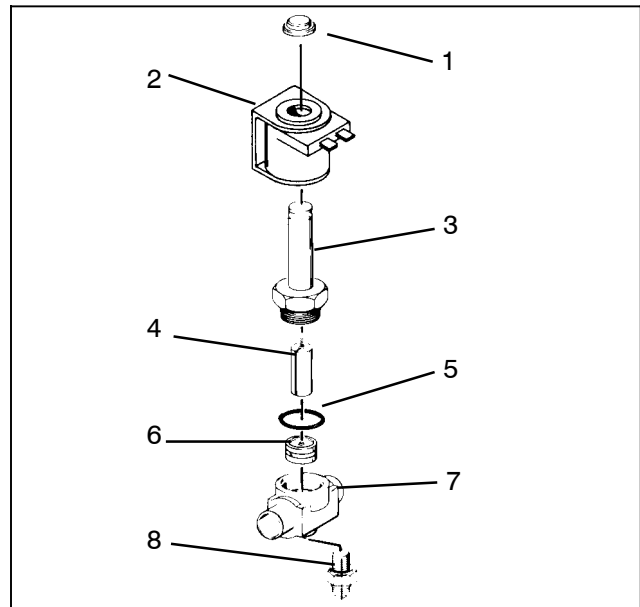
4.12.2 Internal Part Replacement

- a. Perform a low side pump down. Refer to paragraph 4.5.1 .
- 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 4.5.1. 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.

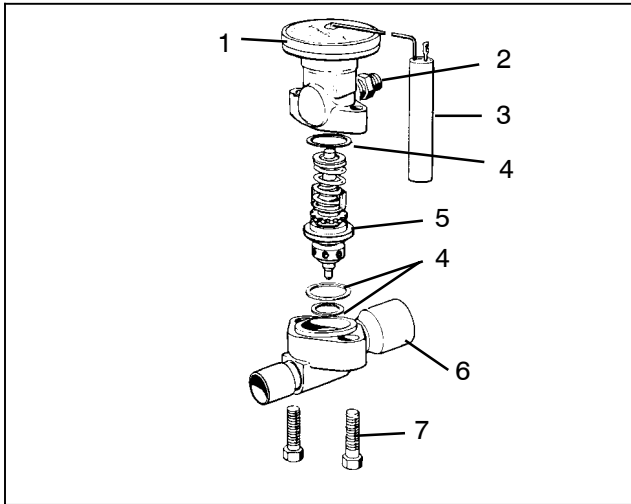


- | | |
|----------------------------|--------------------|
| 1. Snap Cap | 5. Gasket |
| 2. Coil Assembly | 6. Piston Assembly |
| 3. Enclosing Tube Assembly | 7. Body |
| 4. Plunger Assembly | 8. Bracket Adapter |

Figure 4-9 Liquid Line Solenoid Valve

4.13 THERMOSTATIC EXPANSION VALVE

The thermostatic expansion valve (Figure 4-9) 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 | 4. Gasket |
| 2. Equalizer Connection | 5. Cage Assembly |
| 3. Bulb | 6. Body Flange |
| | 7. Cap screw |

Figure 4-10 Thermostatic Expansion Valve

4.13.1 Valve Replacement

- Pump down low side of the unit. Refer to paragraph 4.5.1.
- Remove insulation from expansion valve and bulb. See Figure 4-10 and Figure 4-11.
- Loosen retaining straps holding bulb to suction line and detach bulb from the suction line.
- Loosen flare nuts on equalizer line and disconnect equalizer line from the expansion valve.
- Remove capscrews and lift off power head and cage assemblies and gaskets.
- 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.

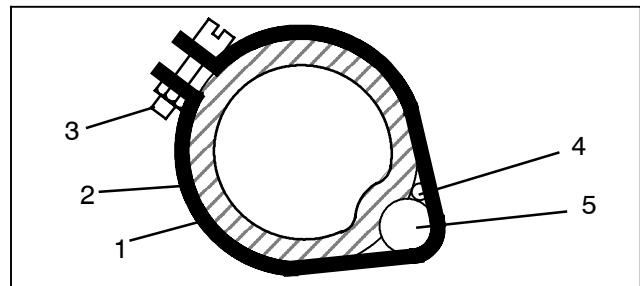
- Using new gaskets, install new cage and power head assemblies.
- Fasten equalizer line to the expansion valve.
- Leak check the new valve and evacuate and dehydrate low side. Refer to paragraph 4.5.1.

- 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.
- 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.
- Run the coach for approximately 30 minutes on fast idle.
- Check refrigerant level. Refer to paragraph 4.8.1.
- 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) | 4. Thermocouple |
| 2. TXV Bulb Clamp | 5. TXV Bulb (Shown in the 4'clock position) |
| 3. Nut & Bolt (clamp) | |

Figure 4-11 Thermostatic Expansion Valve Bulb and Thermocouple

- Remove Presstite insulation from expansion valve bulb and suction line.
- Loosen one TXV bulb clamp and make sure area under clamp is clean.
- 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 4-11. Reinstall insulation around the bulb.
- Connect an accurate low pressure gauge to the low pressure port (Figure 1-6).
- 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 paragraph 1.5 for MOP.

- f. From the temperature/pressure chart (Table 4-4), 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 paragraph 1.5 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

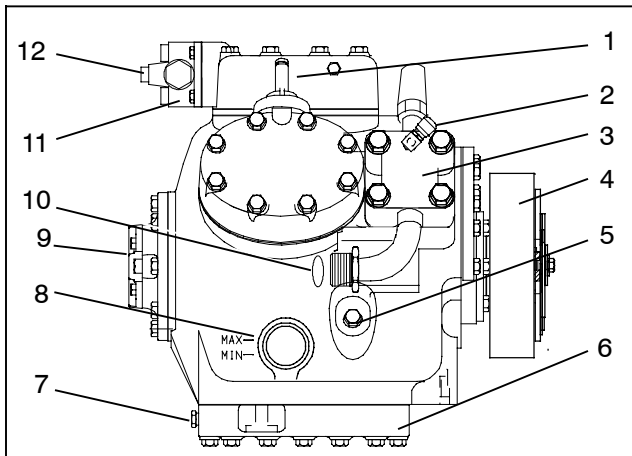
4.15.1 Removing the Compressor

If compressor is inoperative and the unit still has refrigerant pressure, isolate the compressor and remove the refrigerant. Refer to paragraph 4.5.2. If compressor is operative, perform a pump down. Refer to paragraph 4.5.3.

- 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 paragraphs 1.5 and 4.15.4.



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

Figure 4-12 Compressor

g. Remove the three socket head capscrews from the cylinder head(s) that have unloader valves installed. See Figure 4-13. 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.

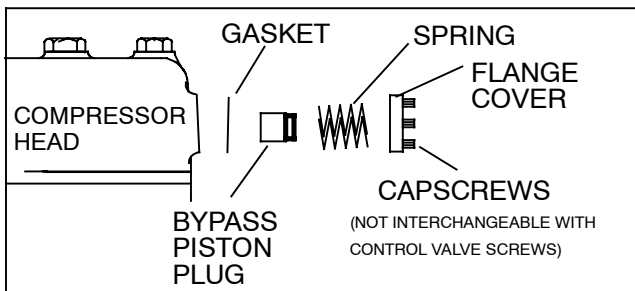


Figure 4-13 Removing Bypass Piston Plug

h. Remove the pressure switches and install on replacement compressor after checking switch operation. Refer to paragraph 4.10.

- 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 4-6) 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 4.8.1.
- o. Check compressor oil level. Refer to paragraph 4.15.4. Add or remove oil if necessary.
- p. Check compressor unloader operation. Refer to paragraph 4.15.5
- q. Backseat compressor service valves.
- r. Remove manifold gauge set. Refer to paragraph 4.4.1.

4.15.2 Transferring Compressor Clutch

To remove a clutch (see Figure 4-14) from a compressor and install on a replacement compressor, do the following:

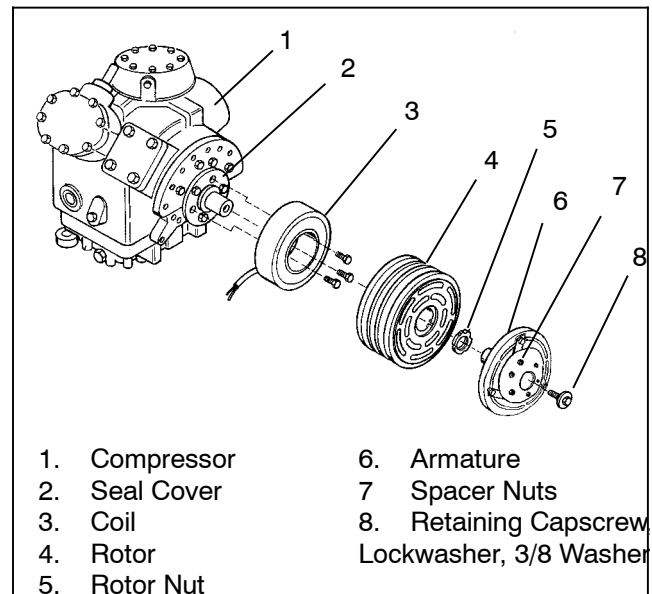


Figure 4-14 Compressor Clutch

- 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 Shimless Compressor Clutch

As of February 4, 2008 all 05G and 05K compressor clutches supplied by MCC and built by Warner Electric will have an upgraded armature plate installed. This new armature plate will eliminate the need for separate shims previously installed on the armature. The shim pack has been replaced by three

adjusting screws installed on the spring plate of the armature. Armature to rotor clearance will stay the same (.030"-.060") but the procedure to adjust will be different from original shim style clutch. Clutch assemblies are interchangeable. The clearance is factory set on each clutch, but should the need arise to adjust the clutch gap the following procedure should be followed.

Three Point Clutch Adjustment Procedure

- a. Confirm the clutch electrical circuit can not be energized while you are working on clutch.



Battery disconnect should be off.

- b. With a .045" feeler gauge check the clearance at the three set screws and determine what adjustment needs to be made. Clearance is to be .045" +-.015".
- c. With a 1/8" hex socket wrench and a 7/16" box wrench to hold the locking nut, back off the three set screws until they do not contact the armature plate.
- d. Turn the set screws CW until they just make contact with the armature plate. Adjust clockwise one and one half turns after contact. One and one half turns equals approximately .040".
- e. Measure the initial clearance after the one and one half turns CW and adjust for a clearance between .030" and .060". All three set screw locations should be very close in clearance dimensions.
- f. When clearance is set lock the adjusting screws with the nuts torqued to 7 foot pounds. You will need to hold the hex socket adjusting screw while torquing the lock nut.

NOTE

Setting clearance is done with 30 psig in the compressor due to the crankshaft movement when charged. If there is not 30 psig in the compressor when the clearance is set the clearance should be set on the lower end of the tolerance to allow for crankshaft movement when charged. Check clearance again after compressor is pressurized.

- g. Reconnect battery wiring and test clutch operation.



4.15.4 Compressor Oil Level

To check, and if required correct, 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 4.8.1) 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 4-12. 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 sight-glass. See Figure 4-12. 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.



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.

- e. To remove oil and bring the level to the 1/2 sight-glass 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 4-6) and reclaim the refrigerant to below atmospheric pressure. Shut off the reclaim and verify the pressure does not rise. If the pressure rises, continue reclaiming until the pressure remains below atmospheric.
 2. Drain or pump out compressor oil until the level is brought to the proper level.

3. Evacuate the compressor to 500 microns. Back-seat 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 4-6) and reclaim the refrigerant to below atmospheric pressure. Shut off the reclaim 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 4-12) 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.

4.15.5 Checking Unloader Operation

To check unloader operation do the following:

- a. Install a manifold gauge set as shown in Figure 4-6. Ensure both manifold valves are frontseated and center connection is tight on blank fitting.
- b. Midseat compressor suction service valve.
- c. Disconnect the suction pressure transducer Figure 1-6. This will force the controller to energize the unloader(s).
- d. Start the bus and run in cooling, lower set point if required to ensure system remains in full speed cooling.
- e. Locate the unloader connector at the compressor. Observe manifold suction gauge while unplugging the connector. Pressure should decrease 3 to 5 psi (0.2 to 0.4 bar) when the unloader is unplugged and increase the same amount as the plug is reconnected. Repeat test for second unloader if fitted.
- f. If pressures do not react as described, check unloader coil or repair unloader mechanism as required.
- g. When testing is complete, reconnect transducer and unloader connectors and remove manifold gauge set.
- h. Disconnection of the suction pressure transducer will cause an "A15" alarm. Once the transducer is reconnected, the alarm will go to inactive and can then be cleared.



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 PRESSURE TRANSDUCER CHECKOUT

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 gauges 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 4-15. 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 J6-23 (Suction) or C and J6-20 (discharge). See Figure 4-15.
- g. Use a digital volt-ohmmeter to measure voltage across the transducer at terminals A & C. See Figure 4-15. Compare to values in Table 4-1. A reading within two percent of the values in the table would be considered good.

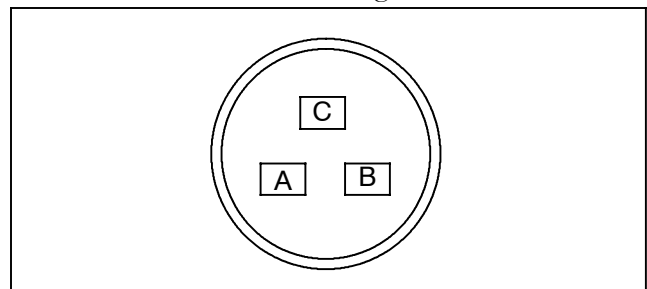


Figure 4-15 Transducer Terminal Location



4.18 REPLACING SENSORS AND TRANSDUCERS

- a. Place main battery disconnect switch in OFF position and lock.
- b. Tag and disconnect wiring from defective sensor or transducer.
- c. Remove and replace defective sensor or transducer.
- d. Connect wiring to replacement sensor or transducer.
- e. Checkout replacement sensor or transducer. Refer to section 4.16 or 4.17 as applicable.
- f. Repair or replace any defective component(s), as required.

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



4.19 LOGIC BOARD REPLACEMENT

Control configuration is preset by the manufacturer and resetting of the parameters is not advised. If a replacement Logic Board is installed, it is necessary to match the configuration jumpers (See Figure 1-9) to the original board. Table 4-3 provides a list of jumper functions. MCC is not responsible for failures or damage resulting from unauthorized changes.

Table 4-3 Logic Board Configuration

Configuration	Description
A	High Reheat - When this configuration is removed, the unit will default to high speed in reheat mode and in the low speed cool band. If not removed, heat/reheat will default to low speed.
B*	High Vent - When this configuration is removed, the unit will default to high speed in vent mode. If not removed vent mode will default to low speed.
C*	Dry Heat - When this configuration is removed, the unit will run on 100% reheat instead of heat.
D	Reheat/Cycle - When the reheat cycle configuration is removed, the unit is in reheat mode. The default configuration is cycle clutch mode.
E	Transducers - When the transducer configuration is removed, transducers will assume to be present.
F*	Refrigerant R-22/R-134a - When the refrigerant configuration is removed, the refrigerant is set for R-22. The default refrigerant is R-134a.
G	Unit Type - Rearmount unit enabled with "G" removed and "H" installed.
H	Unit Type - With "H" removed and "G" installed, roof top unit will be enabled.
I	Factory - Reserved for the manufacturer.
J*	Invert H ₂ O - When this configuration is removed, the logic for the water temperature switch will be inverted.
K	Voltage - When this configuration is removed, the voltage selection will be changed from 12 to 24 vdc.
L	Factory - Reserved for the manufacturer.
M*	Psig/Bars - When this configuration is removed, the display will indicate pressures in <i>bars</i> . When not removed, the display will indicate pressures in <i>psig</i> .
N	°C/°F - When this configuration is removed, the display will show temperatures in °F. When not removed the display will show temperatures in °C.
O*	PI Reheat - When this configuration is removed, reheat mode will use the PI algorithm to vary the duty cycle of the heat valve. If it is not removed, the heat valve will be on constantly.
P*	Low Ambient Lockout - When this configuration is removed, the compressor clutch will disengage at 25°F. With this configuration in place, the compressor will disengage at 45°F.

NOTE: * Designates N.J.T. Jumpers



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

Temperature		Vacuum		
°F	°C	“/hg	Kg/cm ²	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/cm ²	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/cm ²	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 includes electrical wiring schematics covering the models listed in Table 1-2. The schematic shown in this section provides information for all unit models and optional configurations. The model 68RF353 units are fitted with 6 evaporator blower/motor assemblies and 5 condenser fan/motor assemblies. Heat only units are supplied with an evaporator section only. For applications with OEM supplied operating switches, the switches are wired to Logic Board connector J3 as shown. For units with a Micromate as the operators control, there is no wiring to the Logic Board J3 connector, instead the Micromate is hard wired to the Logic Board connector J2. When the Micromate is used for service or diagnostic purposes, it is wired in the same manner as shown for drivers panel, refer to section 2.4.1.


























LEGEND	SYMBOL	DESCRIPTION
REF: 98-62696 Rev. D	ACMS	AIR CONDITIONING MANUAL SWITCH
	ATS	AMBIENT TEMPERATURE SENSOR
	BPS	BOOST PUMP SIGNAL
	CB	CIRCUIT BREAKER
	CFR1	CONDENSER FAN RELAY 1
	CL	COMPRESSOR CLUTCH
	CM1	COND MOTOR 1
	CM2	COND MOTOR 2
	CM3	COND MOTOR 3
	CM4	COND MOTOR 4
	CM5	COND MOTOR 5
	CSR	COND SPEED RELAY ON (HIGH SPEED) (NOT USED)
	D2	RELAY K2 OUTPUT ACTIVE
	D6	RELAY K1 OUTPUT ACTIVE
	D17	FUSE 1 OPEN (FRESH AIR DAMPER)
	D18	FUSE 3 OPEN (EVAPORATOR FAN)
	D26	RELAY K7 OUTPUT ACTIVE
	D30	RELAY K8 OUTPUT ACTIVE
	D31	FUSE 9 OPEN (CONDENSER FAN)
	D38	FUSE 2 OPEN (UNLOADER #1)
	D47	FUSE 5 OPEN (UNLOADER #2)
	D51	A/C CLUTCH & LSV OUTPUT ACTIVE
	D54	UNLOADER #1 OUTPUT ACTIVE
	D57	UNLOADER #2 OUTPUT ACTIVE
	D60	FRESH AIR OUTPUT ACTIVE
	D61	FUSE 6 OPEN (HEAT VALVE)
	D63	HEAT VALVE OUTPUT ACTIVE
	D66	FAULT OUTPUT ACTIVE
	D68	FUSE 4 OPEN (FAULT LIGHT)
	D69	CIRCULATION PUMP OUTPUT ACTIVE
	D72	DRIVER LSV ACTIVE OR FLOOR BLOWER ACTIVE
	D77	FUSE 8 OPEN (SPARE)
	D83	FUSE 10 OPEN (CIRCULATION PUMP)
	D90	FUSE 7 OPEN (COMPRESSOR CLUTCH)
	DPT	DISCHARGE PRESSURE TRANSDUCER
	EFR1	EVAPORATOR FAN RELAY 1 ON
	EM1	EVAP MOTOR 1
	EM2	EVAP MOTOR 2
	EM3	EVAP MOTOR 3
	EM4	EVAP MOTOR 4
	EM5	EVAP MOTOR 5
	EM6	EVAP MOTOR 6
	ESR1	EVAPORATOR SPEED RELAY 1 ON (HIGH SPEED)
	ESR2	EVAPORATOR SPEED RELAY 2 (LOW)
	FAA	FRESH AIR ACTUATOR
	FAR	FRESH AIR RELAY
	F1	FUSE 1, FAR
	F2	FUSE 2, UV1
	F3	FUSE 3, EVAPORATOR FAN
	F4	FUSE 4, FAULT LIGHT
	F5	FUSE 5, UV2
	F6	FUSE 6, HEAT VALVE
	F7	FUSE 7, COMPRESSOR CLUTCH
	F8	FUSE 8, FLOOR BLOWER/ SPARE
	F9	FUSE 9, CONDENSER FAN
	F10	FUSE 10, BOOSTER PUMP
	F11	FUSE 11, EM1
	F12	FUSE 12, EM2
	F13	FUSE 13, EM3
	F14	FUSE 14, EM4
	F15	FUSE 15, EM5
	F16	FUSE 16, EM6
	F17	FUSE 17, CM1
	F18	FUSE 18, CM2
	F19	FUSE 19, CM3
	F20	FUSE 20, CM4
	F21	FUSE 21, CM5
	F22	FUSE 22, POWER IN LOGIC BOARD (J1)
	HPS	HIGH PRESSURE SWITCH
	HSV	HEAT SOLENOID VALVE
	K1	ENERGIZES EVAP RELAY EFR1
	K2	ENERGIZES EFR LOW SPEED
	K7	ENERGIZES CFR1
	K8	ENERGIZES CSR (NOT USED)
	K13	CLUTCH RELAY
	K14	UV1 RELAY
	K15	UV2 RELAY
	K16	FRESH AIR RELAY (FAR)
	K17	HEAT RELAY
	K18	FAULT RELAY
	K19	BOOST RELAY
	K20	FLOOR HEAT RELAY
	LSV	LIQUID SOLENOID VALVE
	LPS	LOW PRESSURE SWITCH
	PR	POWER RELAY (ON)
	PTB1	POWER TERMINAL BLOCK 1 (POS)
	PTB2	POWER TERMINAL BLOCK 2 (NEG)
	RAS	RETURN AIR SENSOR
	SPT	SUCTION PRESSURE TRANSDUCER
	TB1	TERMINAL BLOCK (TERMINAL 1)
	TB2	TERMINAL BLOCK (TERMINAL 2)
	TB4	TERMINAL BLOCK (TERMINAL 4)
	UV1	UNLOADER VALVE 1
	UV2	UNLOADER VALVE 2
	WTS	WATER TEMPERATURE SWITCH

Figure 5-1 Legend

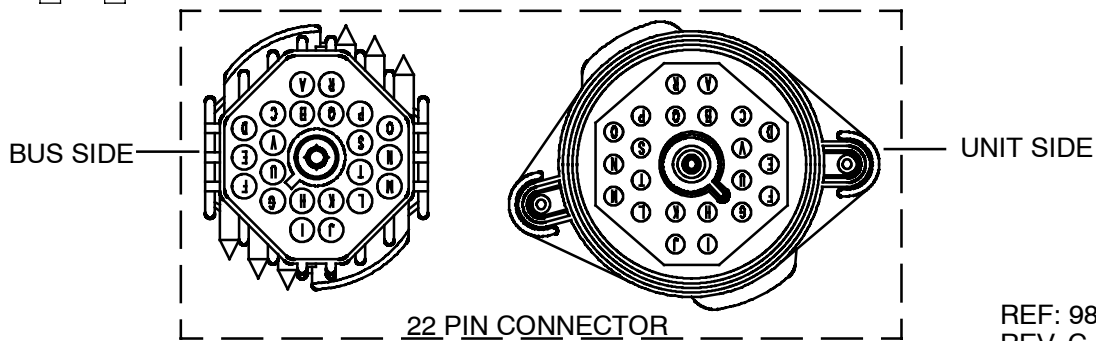
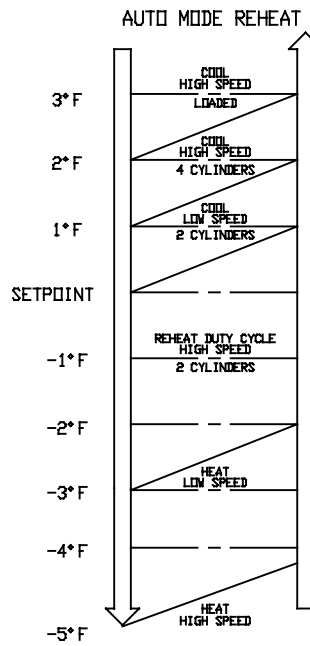


SYMBOLS

-  INDICATES CONNECTOR TERMINAL
-  INDICATES GROUND
-  INDICATES A WIRE
-  INDICATES A WIRE <DEM 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 N/O
-  INDICATES LAMP
-  INDICATES POLY SWITCH
-  INDICATES RIBBON CABLE
-  INDICATES RIBBON CABLE

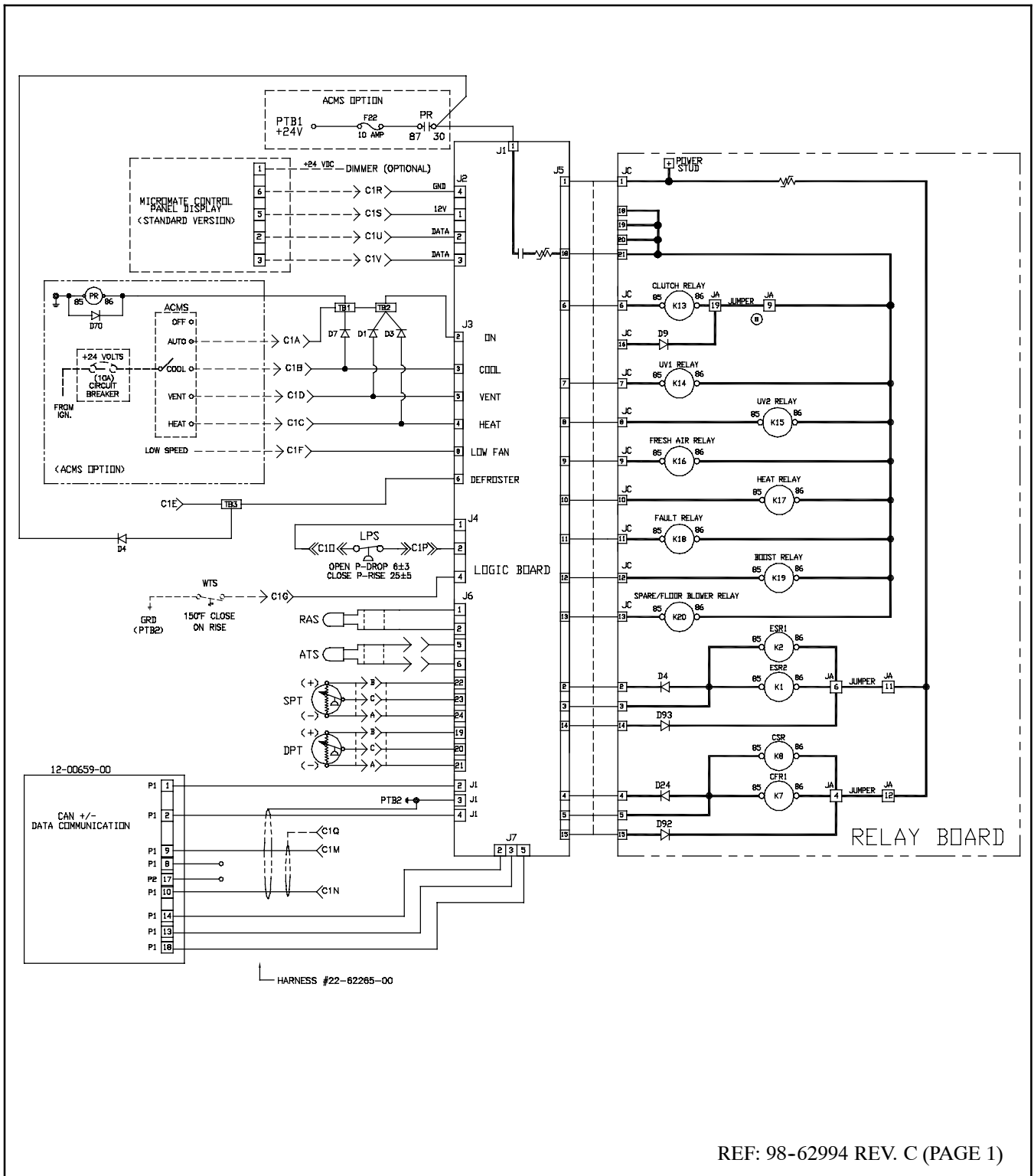
LOGIC BOARD JUMPER CONFIGURATION

JUMPER	REMOVED	INSTALLED
A	X	
B		X
C		X
D	X	
E	X	
F		X
G	X	
H	X	
I	X	
J		X
K	X	
L	X	
M		X
N	X	
O		X
P		X



REF: 98-62994
REV. C

Figure 5-2 Symbols & Logic (NJT)



REF: 98-62994 REV. C (PAGE 1)

Figure 5-3 Relay Circuit (NJT)

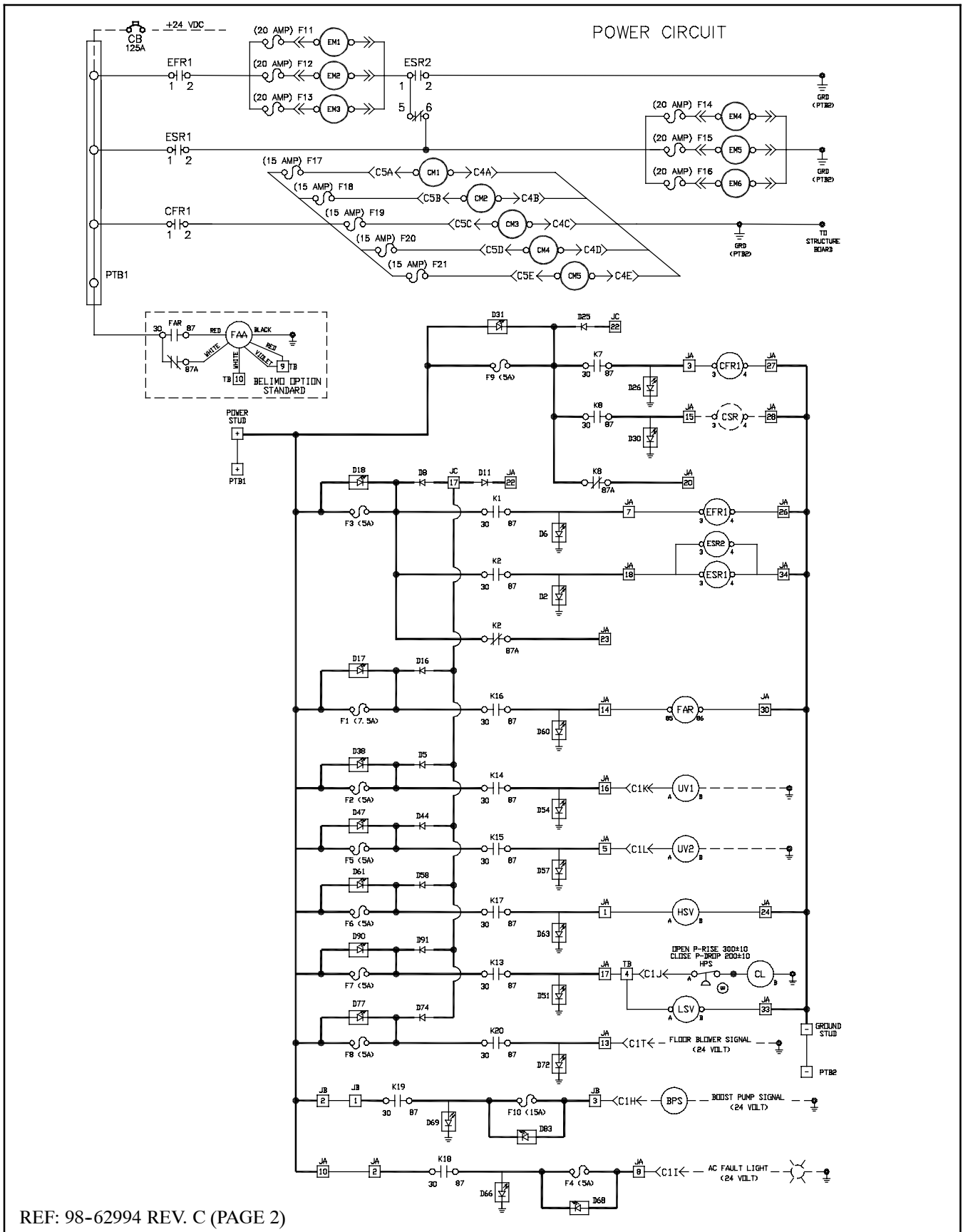
























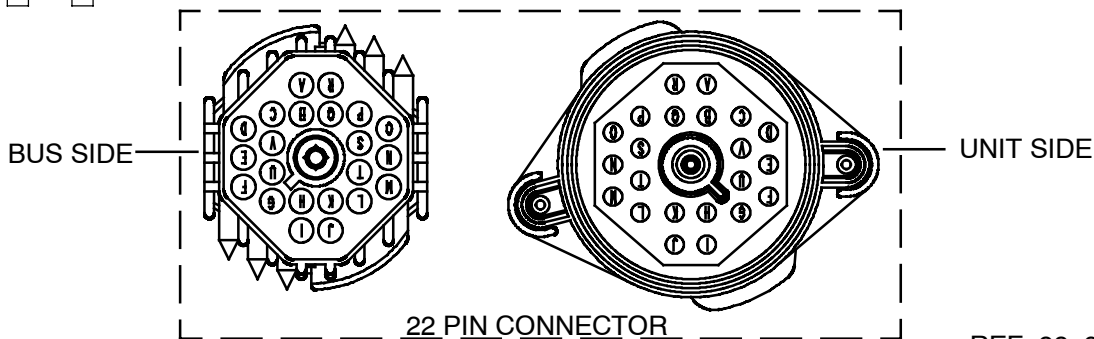
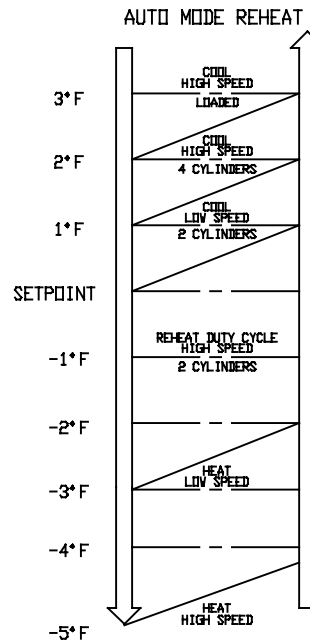
Figure 5-4 Power Circuit (NJT)



-  INDICATES CONNECTOR TERMINAL
-  INDICATES GROUND
-  INDICATES A WIRE
-  INDICATES A WIRE (DEM 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 N/D
-  INDICATES LAMP
-  INDICATES POLY SWITCH
-  INDICATES RIBBON CABLE

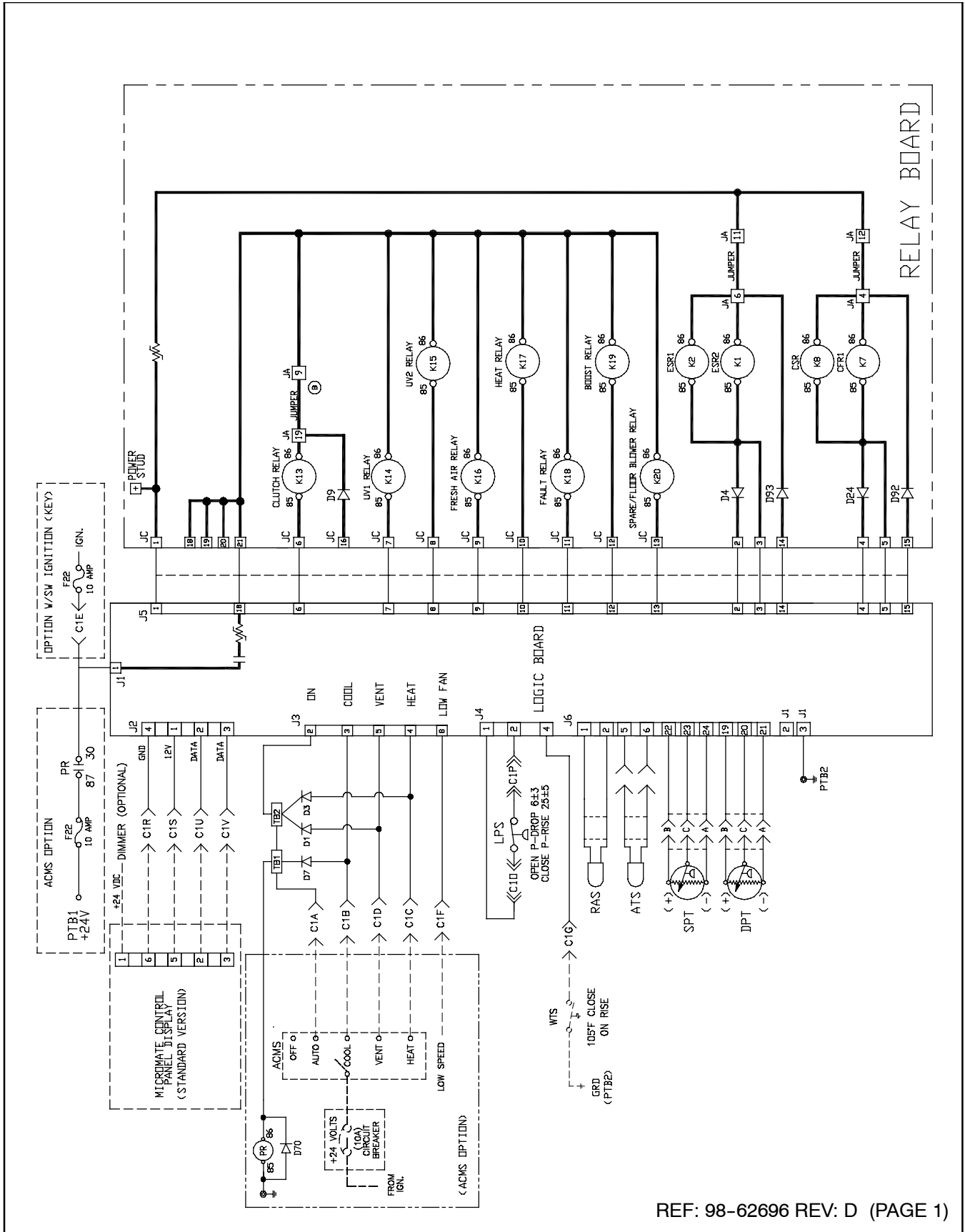
LOGIC BOARD JUMPER CONFIGURATION

JUMPER	REMOVED	INSTALLED
A	X	
B		X
C		X
D	X	
E	X	
F		X
G		X
H		X
I	X	
J		X
K	X	
L	X	
M		X
N	X	
O		X
P		X



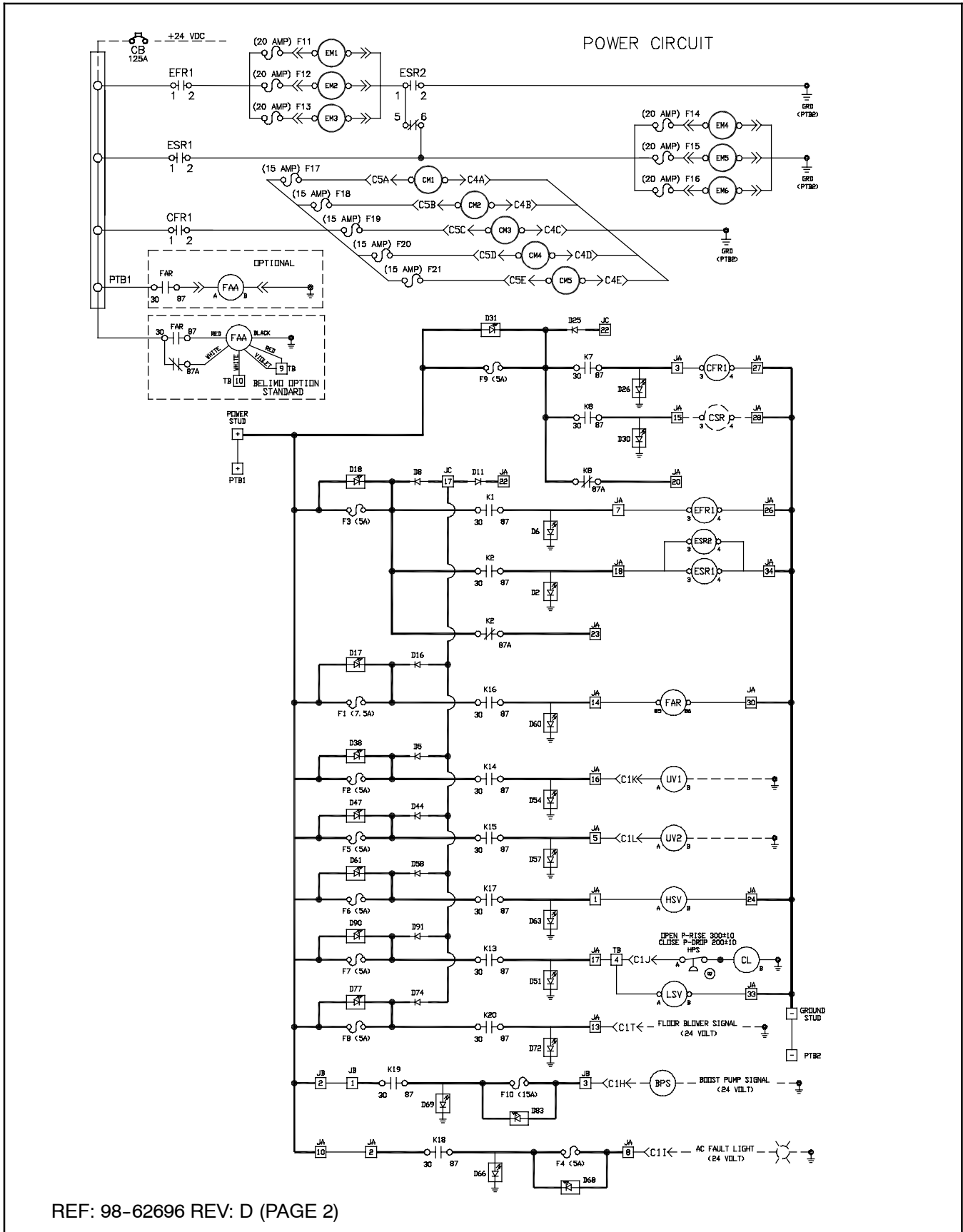
REF: 98-62696
REV. D

Figure 5-5 Symbols & Logic (BC TRANSIT)



REF: 98-62696 REV: D (PAGE 1)

Figure 5-6 Relay Circuit (BC TRANSIT)






















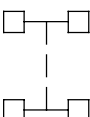


REF: 98-62696 REV: D (PAGE 2)

Figure 5-7 Power Circuit (BC TRANSIT)

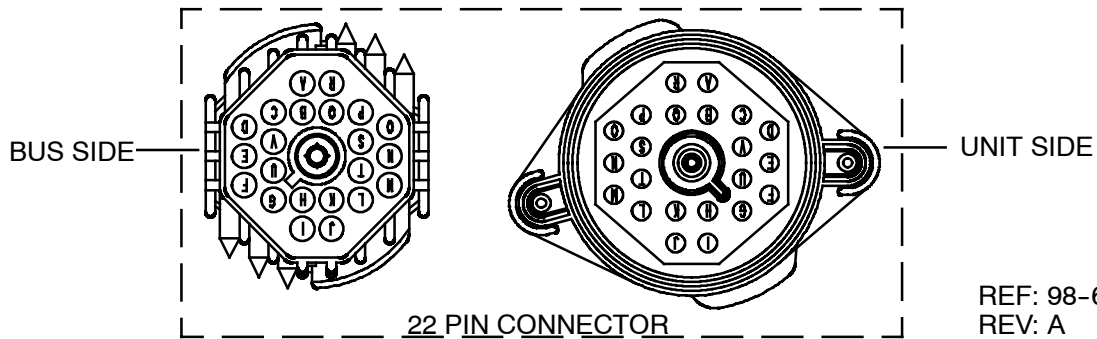
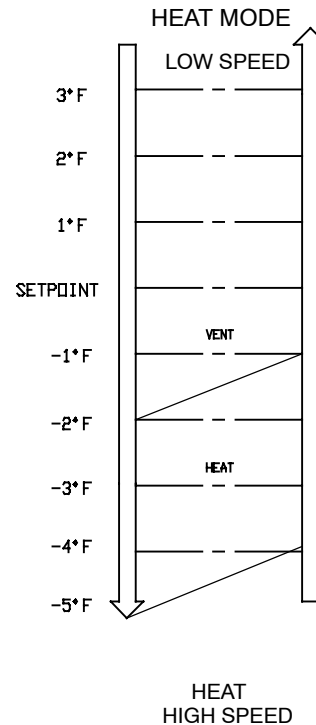


SYMBOLS & LOGIC (HEAT ONLY)

-  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

LOGIC BOARD JUMPER CONFIGURATION

JUMPER	REMOVED	INSTALLED
A	X	
B		X
C		X
D	X	
E		X
F		X
G		X
H		X
I	X	
J		X
K	X	
L	X	
M		X
N	X	
O		X
P		X



REF: 98-62883
REV: A

Figure 5-8 Symbols & Logic (Heat Only)



98-62883 REV: A

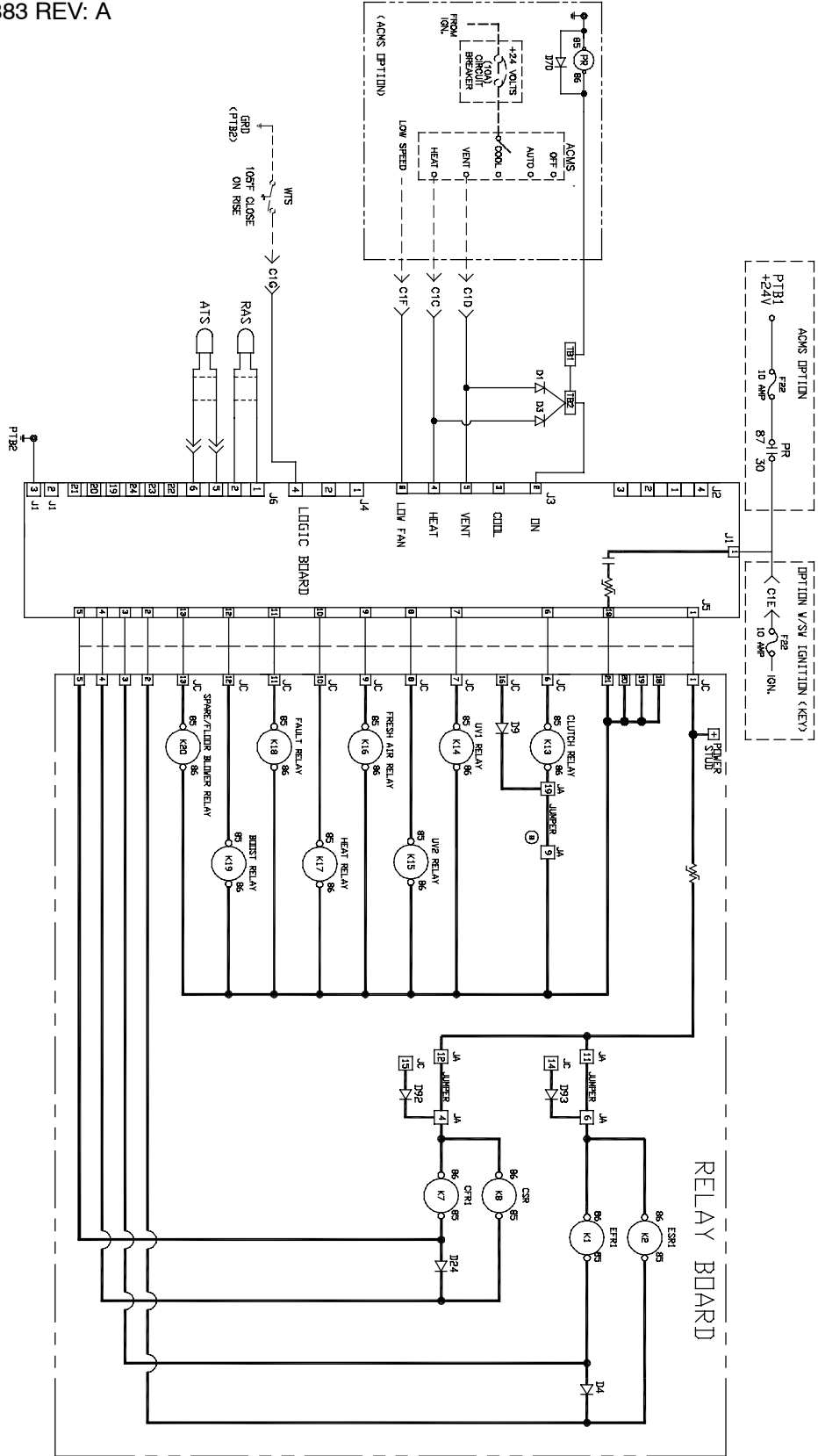
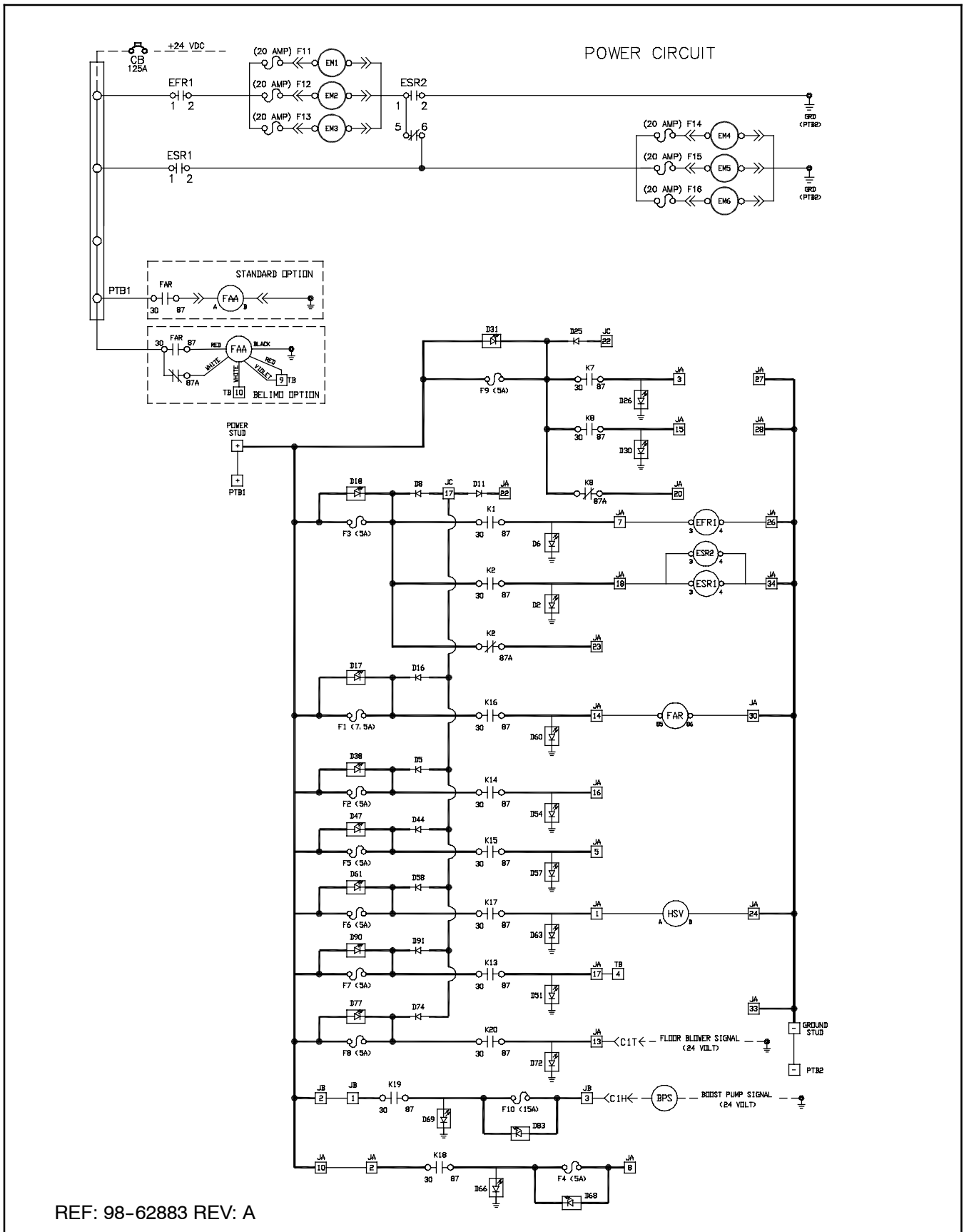


Figure 5-9 Relay Circuit (Heat Only)



REF: 98-62883 REV: A

Figure 5-10 Power Circuit (Heat Only)



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